VSGENVIROMATION
A ZELLER COMPANY
1000 UNIVERSITY AVENUE
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ROCHESTER, NEW YORK 14607
585.244.0450 :T
585.254.0982 :F

LETTER OF TRANSMITTAL

Date	Job No
May 5, 2014	121222
Attention: Jason Greene	
Re: Onondaga County Harbor Brook Operations and Maintenance Manual Rev B	

To: JJ Lane Construction
200 Terminal Road East
Liverpool, NY 13088

From Bob Newby

We are sending you:

Copies	Date	NO#	Description
	May 5, 2014		
7	Hardcopies		Operation and Maintenance Manual
1	Electronic		Operation and Maintenance Manual

Remarks

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OPERATION AND MAINTENANCE MANUAL (Rev B)

Project: Onondaga County
Harbor Brook CSO

Customer: JJ Lane Construction
200 Terminal Road East
Liverpool, NY 13088

WORK ORDER NUMBER	121222	
	DATE	INIT'L
RELEASED FOR APPROVAL	11-15-13	RN
APPROVED AS SUBMITTED		
APPROVED AS NOTED		
CORRECT AND RE-SUBMIT		
COMMENTS: Please return one (1) approved or marked-up copy for release to manufacture or correction.		

VSGENVIROMATION
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SUITE 800
ROCHESTER, NEW YORK 14607
585.244.0450: T
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May 05, 2014

JJ Lane Construction
200 Terminal Road East
Liverpool, NY 13088

Subject: Onondaga County, Harbor Brook CSO

In response to the CHA Engineering comments regarding Shop Drawing Processing Form, dated 11-07-13. VSG Enviromation offers the following clarifications and comments.

Item	Comment	VSGEnviromation Response
1	Provide description of operation (theory of operations)	Confirmed; Section 1, Theory of Operation, has been added to the O&M manual.
2	Include schematic site plan identifying the location of various equipment.	Site plans are not in the scope of VSG deliverables for this project.
3	Provide summary of how level and flow equipment "as programmed".	Confirmed; Section 2, the latest revision of the PLC program has been added to the O&M manual.

Please forward this to the engineers for review and feel free to call with any questions or concerns.

Best regards,

Bob Newby

Bob Newby
VP VSGEnviromation
Zeller Corporation
585.254.8840

Project: Onondaga County
Harbor Brook CSO

Customer: JJ Lane Construction
200 Terminal Road East
Liverpool, NY 13088

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SECTION 1
Theory of Operation

Harbor Brook CSO 018 Constructed Wetlands Treatment System

Theory of Operation

Series Configuration:

Flow enters cell #1, is dosed to cell #2 and discharged to cell #3.

LT 101 in FDS #11: This transducer measures water elevation in cell #1. The actuated gate "open" time is determined by the water elevation in Cell #1. Once the water elevation in cell #1 reaches 397.7, dosing will start. "Open" times for the actuated valve shall conform to the attached.

LT 102 in FDS #13; this transducer measures the flow exiting cell #2. The actuated gate will not be allowed to open to dose cell #2 unless the elevation of water at LT 102 is 393.75 or lower.

Parallel Configuration:

Flow enters cell # 1, 2 & 3 independently by opening and manually closing various slide gates. There is no dosing of cell #2 under this configuration. LT 101 & LT 102 are not required for this configuration.

Series + Parallel Configuration:

Under this configuration water will fill cell #1 and spill to cell #3 via the 12" discharge pipe to FDS #7. Water will only exit the 12" pipe outlet until the water elevation in Cell #1 drains down to 398.35. Water will fill cell #1 above the 12" outlet; dosing of cell #2 will not occur until the water level in cell #1 rises above 398.50 and recedes back below 398.35.

LT 101 in FDS #11: This transducer measures water elevation in cell #1. The actuated gate "open" time is determined by the water elevation in Cell #1. "Open times shall conform to the attached. Dosing of cell #2 will not occur under this configuration until the water level in cell #1 rises above 398.50 and recedes back to elevation 398.35.

LT 102 in FDS #13; this transducer measures the flow exiting cell #2**.** The actuated gate will not be allowed to open to dose cell #2 unless the elevation of water at LT 102 is 393.75 or lower.

Flow Meters

FT 105 in MH # 19: This meter records the flow discharging to Harbor Brook.

FT 107 in MH 5A: This meter records the flow bypassing the wetland treatment system.

Both flow meters shall communicate with the Onondaga County Metropolitan Wastewater Treatment Plant Control Room via a Compactlogix with Ethernet system.

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  - **STRING**
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  - **AB:1769_DO8:C:0**
  - **AB:1769_DO8:I:0**
  - **AB:1769_DO8:O:0**
  - **AB:1769_IF4:C:0**
  - **AB:1769_IF4:I:0**

Trends

I/O Configuration

- **1769 Bus**
  - **[0] 1769-L30ER HARBOR_BROOK_CSO**
  - **[1] 1769-IA8I/A DI_SLOT1**

- **Ethernet**
  - **1769-L30ER HARBOR_BROOK_CSO**

Name	Value	Data Type	Scope
AlwaysOffBit	0	BOOL	HARBOR_BROOK_CSO
Constant	No		
External Access:	Read/Write		
*AlwaysOffBit - MainProgram/MainRoutine - *1(OTE), 1(XIC), 1(XIO)*			
AlwaysOnBit	1	BOOL	HARBOR_BROOK_CSO
Constant	No		
External Access:	Read/Write		
*AlwaysOnBit - MainProgram/MainRoutine - *0(OTE), 0(XIC), 0(XIO)*			
Comm_TM		TIMER	HARBOR_BROOK_CSO
Constant	No		
External Access:	Read/Write		
*Comm_TM - MainProgram/Communication - *10(TON)*			
Comm_TM.DN	1	BOOL	
Comm_TM.DN - MainProgram/Communication - 11(XIC), 5(XIC)			
Comm_TM2		TIMER	HARBOR_BROOK_CSO
Constant	No		
External Access:	Read/Write		
*Comm_TM2 - MainProgram/Communication - *11(TON)*			
Comm_TM2.DN	0	BOOL	
Comm_TM2.DN - MainProgram/Communication - 10(XIO)			
CommToMainPLC		DINT[10]	HARBOR_BROOK_CSO
Constant	No		
External Access:	Read/Write		
CommToMainPLC[0]	39820	DINT	
*CommToMainPLC[0] - MainProgram/Communication - *0(CPT)*			
CommToMainPLC[1]	39367	DINT	
*CommToMainPLC[1] - MainProgram/Communication - *1(CPT)*			
CommToMainPLC[2]	-500	DINT	
*CommToMainPLC[2] - MainProgram/Communication - *2(CPT)*			
CommToMainPLC[3]	-500	DINT	
*CommToMainPLC[3] - MainProgram/Communication - *3(CPT)*			
CommToMainPLC[4]	-500	DINT	
*CommToMainPLC[4] - MainProgram/Communication - *4(CPT)*			
CommToMainPLC[9].0	1	BOOL	
*CommToMainPLC[9].0 - MainProgram/Communication - *5(OTE)*			
CommToMainPLC[9].1	0	BOOL	
*CommToMainPLC[9].1 - MainProgram/Communication - *6(OTE)*			
CommToMainPLC[9].2	0	BOOL	
*CommToMainPLC[9].2 - MainProgram/Communication - *7(OTE)*			
CommToMainPLC[9].3	1	BOOL	
*CommToMainPLC[9].3 - MainProgram/Communication - *8(OTE)*			
CommToMainPLC[9].4	0	BOOL	
*CommToMainPLC[9].4 - MainProgram/Communication - *9(OTE)*			
DoseDurationForSeriesSequenceTM		TIMER	HARBOR_BROOK_CSO
Constant	No		
External Access:	Read/Write		
*DoseDurationForSeriesSequenceTM - MainProgram/Series_Seq - *2(TON)*			
DoseDurationForSeriesSequenceTM.PRE	2280000	DINT	
*DoseDurationForSeriesSequenceTM.PRE - MainProgram/Series_Seq - *1(MOV)*			
DoseDurationForSeriesSequenceTM.TT	1	BOOL	
DoseDurationForSeriesSequenceTM.TT - MainProgram/Outputs - 0(XIC), 1(XIO)			
DoseDurationForSeriesSequenceTM.DN	0	BOOL	

DoseDurationForSeriesSequenceTM (Continued)
DoseDurationForSeriesSequenceTM.DN - MainProgram/Series_Seq - 3(XIC)

DoseDurationForSerParSequenceTM TIMER HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*DoseDurationForSerParSequenceTM - MainProgram/SerPar_Seq - *3(TON)*
DoseDurationForSerParSequenceTM.PRE 0 DINT
*DoseDurationForSerParSequenceTM.PRE - MainProgram/SerPar_Seq - *2(MOV)*
DoseDurationForSerParSequenceTM.TT 0 BOOL
DoseDurationForSerParSequenceTM.TT - MainProgram/Outputs - 0(XIC), 1(XIO)
DoseDurationForSerParSequenceTM.DN 0 BOOL
DoseDurationForSerParSequenceTM.DN - MainProgram/SerPar_Seq - 4(XIC)

FlowControlValveCloseCmd 0 BOOL HARBOR_BROOK_CSO
AliasFor: Local:2:O.Data.1
Base Tag: Local:2:O.Data.1
Constant No
External Access: Read/Write
*FlowControlValveCloseCmd - MainProgram/Outputs - *1(OTE)*

FlowControlValveClosed 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
FlowControlValveClosed - MainProgram/Communication - 7(XIC)
*FlowControlValveClosed - MainProgram/Inputs - *1(OTE)*

FlowControlValveClosed_In 0 BOOL HARBOR_BROOK_CSO
AliasFor: Local:1:I.Data.1
Base Tag: Local:1:I.Data.1
Constant No
External Access: Read/Write
FlowControlValveClosed_In - MainProgram/Inputs - 0(XIO), 1(XIC)

FLowControlValveClosedTM TIMER HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*FLowControlValveClosedTM - MainProgram/Inputs - *1(TON)*
FLowControlValveClosedTM.DN 0 BOOL
FLowControlValveClosedTM.DN - MainProgram/Inputs - 1(XIC)

FlowControlValveOpenCmd 1 BOOL HARBOR_BROOK_CSO
AliasFor: Local:2:O.Data.0
Base Tag: Local:2:O.Data.0
Constant No
External Access: Read/Write
*FlowControlValveOpenCmd - MainProgram/Outputs - *0(OTE)*

FlowControlValveOpened 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
FlowControlValveOpened - MainProgram/Communication - 6(XIC)
*FlowControlValveOpened - MainProgram/Inputs - *0(OTE)*

FlowControlValveOpened_In 0 BOOL HARBOR_BROOK_CSO
AliasFor: Local:1:I.Data.0
Base Tag: Local:1:I.Data.0
Constant No

FlowControlValveOpened_In (Continued)
External Access: Read/Write
FlowControlValveOpened_In - MainProgram/Inputs - 0(XIC), 1(XIO)

FLowControlValveOpenedTM TIMER HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*FLowControlValveOpenedTM - MainProgram/Inputs - *0(TON)*
FLowControlValveOpenedTM.DN
0 BOOL
FLowControlValveOpenedTM.DN - MainProgram/Inputs - 0(XIC)

FlowPositionSelectorSeries 1 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
FlowPositionSelectorSeries - MainProgram/Communication - 8(XIC)
*FlowPositionSelectorSeries - MainProgram/Inputs - *3(OTE)*
FlowPositionSelectorSeries - MainProgram/Series_Seq - 0(XIC)

FlowPositionSelectorSeries_In 1 BOOL HARBOR_BROOK_CSO
AliasFor: Local:1:I.Data.3
Base Tag: Local:1:I.Data.3
Constant No
External Access: Read/Write
FlowPositionSelectorSeries_In - MainProgram/Inputs - 2(XIO), 3(XIC)

FlowPositionSelectorSeriesTM TIMER HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*FlowPositionSelectorSeriesTM - MainProgram/Inputs - *3(TON)*
FlowPositionSelectorSeriesTM.DN
1 BOOL
FlowPositionSelectorSeriesTM.DN - MainProgram/Inputs - 3(XIC)

FlowPositionSelectorSerPar 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
FlowPositionSelectorSerPar - MainProgram/Communication - 9(XIC)
*FlowPositionSelectorSerPar - MainProgram/Inputs - *2(OTE)*
FlowPositionSelectorSerPar - MainProgram/SerPar_Seq - 0(XIC), 1(XIC)

FlowPositionSelectorSerPar_In 0 BOOL HARBOR_BROOK_CSO
AliasFor: Local:1:I.Data.2
Base Tag: Local:1:I.Data.2
Constant No
External Access: Read/Write
FlowPositionSelectorSerPar_In - MainProgram/Inputs - 2(XIC), 3(XIO)

FlowPositionSelectorSerParTM TIMER HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*FlowPositionSelectorSerParTM - MainProgram/Inputs - *2(TON)*
FlowPositionSelectorSerParTM.DN
0 BOOL
FlowPositionSelectorSerParTM.DN - MainProgram/Inputs - 2(XIC)

FT_105 -5.0 REAL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*FT_105 - MainProgram/Analog_Inputs - *2-E1(OREF,FT_105), 2-C1(SCL,SCL_03.Out)*
FT_105 - MainProgram/Communication - 2(CPT)

FT_105_Raw -500 INT HARBOR_BROOK_CSO
Flow Tranmitter FT105 Raw Input
AliasFor: Local:4:I.Ch0Data
Base Tag: Local:4:I.Ch0Data
Constant No
External Access: Read/Write
FT_105_Raw - MainProgram/Analog_Inputs - 2-B1(IREF,FT_105_Raw), 2-C1(SCL,SCL_03.In)

FT_106 -5.0 REAL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*FT_106 - MainProgram/Analog_Inputs - *2-E2(OREF,FT_106), 2-C2(SCL,SCL_04.Out)*
FT_106 - MainProgram/Communication - 3(CPT)

FT_106_Raw -500 INT HARBOR_BROOK_CSO
Flow Tranmitter FT106 Raw Input
AliasFor: Local:4:I.Ch1Data
Base Tag: Local:4:I.Ch1Data
Constant No
External Access: Read/Write
FT_106_Raw - MainProgram/Analog_Inputs - 2-B2(IREF,FT_106_Raw), 2-C2(SCL,SCL_04.In)

FT_107 -5.0 REAL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*FT_107 - MainProgram/Analog_Inputs - *2-E3(OREF,FT_107), 2-C3(SCL,SCL_05.Out)*
FT_107 - MainProgram/Communication - 4(CPT)

FT_107_Raw -500 INT HARBOR_BROOK_CSO
Flow Tranmitter FT107 Raw Input
AliasFor: Local:4:I.Ch2Data
Base Tag: Local:4:I.Ch2Data
Constant No
External Access: Read/Write
FT_107_Raw - MainProgram/Analog_Inputs - 2-B3(IREF,FT_107_Raw), 2-C3(SCL,SCL_05.In)

Local:1:I AB:1769_DI8:I:0 HARBOR_BROOK_CSO
External Access: Read/Write
Local:1:I.Data.0 0 BOOL
FlowControlValveOpened_In - MainProgram/Inputs - 0(XIC), 1(XIO)
Local:1:I.Data.1 0 BOOL
FlowControlValveClosed_In - MainProgram/Inputs - 0(XIO), 1(XIC)
Local:1:I.Data.2 0 BOOL
FlowPositionSelectorSerPar_In - MainProgram/Inputs - 2(XIC), 3(XIO)
Local:1:I.Data.3 1 BOOL
FlowPositionSelectorSeries_In - MainProgram/Inputs - 2(XIO), 3(XIC)

Local:2:O AB:1769_DO8:O:0 HARBOR_BROOK_CSO
External Access: Read/Write
Local:2:O.Data.0 1 BOOL
*FlowControlValveOpenCmd - MainProgram/Outputs - *0(OTE)*
Local:2:O.Data.1 0 BOOL
*FlowControlValveCloseCmd - MainProgram/Outputs - *1(OTE)*

Local:3:I AB:1769_IF4:I:0 HARBOR_BROOK_CSO
External Access: Read/Write
Local:3:I.Ch0Data 2196 INT
LT_101_Raw - MainProgram/Analog_Inputs - 1-A1(IREF,LT_101_Raw), 1-C1(SCL,SCL_01.In)
Local:3:I.Ch1Data 129 INT
LT_102_Raw - MainProgram/Analog_Inputs - 1-A2(IREF,LT_102_Raw), 1-C2(SCL,SCL_02.In)

Local:4:I AB:1769_IF4:I:0 HARBOR_BROOK_CSO

Local:4:I (Continued)
External Access: Read/Write
Local:4:I.Ch0Data -500 INT
FT_105_Raw - MainProgram/Analog_Inputs - 2-B1(IREF,FT_105_Raw), 2-C1(SCL,SCL_03.In)
Local:4:I.Ch1Data -500 INT
FT_106_Raw - MainProgram/Analog_Inputs - 2-B2(IREF,FT_106_Raw), 2-C2(SCL,SCL_04.In)
Local:4:I.Ch2Data -500 INT
FT_107_Raw - MainProgram/Analog_Inputs - 2-B3(IREF,FT_107_Raw), 2-C3(SCL,SCL_05.In)

LT_101 398.1987 REAL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*LT_101 - MainProgram/Analog_Inputs - *1-D1(OREF,LT_101), 1-C1(SCL,SCL_01.Out)*
LT_101 - MainProgram/Communication - 0(CPT)
LT_101 - MainProgram/Series_Seq - 0(GEQ), 1(GEQ), 1(LES)
LT_101 - MainProgram/SerPar_Seq - 0(GEQ), 1(LES), 2(GEQ), 2(LES)

LT_101_Raw 2196 INT HARBOR_BROOK_CSO
Level Tranmitter LT101 Raw Input
AliasFor: Local:3:I.Ch0Data
Base Tag: Local:3:I.Ch0Data
Constant No
External Access: Read/Write
LT_101_Raw - MainProgram/Analog_Inputs - 1-A1(IREF,LT_101_Raw), 1-C1(SCL,SCL_01.In)

LT_102 393.6703 REAL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*LT_102 - MainProgram/Analog_Inputs - *1-D2(OREF,LT_102), 1-C2(SCL,SCL_02.Out)*
LT_102 - MainProgram/Communication - 1(CPT)
LT_102 - MainProgram/Series_Seq - 0(LES), 1(LES)
LT_102 - MainProgram/SerPar_Seq - 0(LES), 2(LES)

LT_102_Raw 129 INT HARBOR_BROOK_CSO
Level Tranmitter LT102 Raw Input
AliasFor: Local:3:I.Ch1Data
Base Tag: Local:3:I.Ch1Data
Constant No
External Access: Read/Write
LT_102_Raw - MainProgram/Analog_Inputs - 1-A2(IREF,LT_102_Raw), 1-C2(SCL,SCL_02.In)

SCL_01 SCALE MainProgram
Constant No
External Access: Read/Write
*SCL_01 - MainProgram/Analog_Inputs - *1-A1(IREF,0), *1-A1(IREF,10000), *1-A1(IREF,395.3), *1-A1(IREF,408.5), *1-A1(IREF,LT_101_Raw), *1-A2(IREF,1), *1-C1(SCL,SCL_01), *1-D1(OREF,LT_101)*

SCL_02 SCALE MainProgram
Constant No
External Access: Read/Write
*SCL_02 - MainProgram/Analog_Inputs - *1-A2(IREF,0), *1-A2(IREF,10000), *1-A2(IREF,406.7), *1-A2(IREF,LT_102_Raw), *1-A3(IREF,1), *1-A3(IREF,393.5), *1-C2(SCL,SCL_02), *1-D2(OREF,LT_102)*

SCL_03 SCALE MainProgram
Constant No
External Access: Read/Write
*SCL_03 - MainProgram/Analog_Inputs - *2-B1(IREF,-5), *2-B1(IREF,0), *2-B1(IREF,10000), *2-B1(IREF,20), *2-B1(IREF,FT_105_Raw), *2-B2(IREF,1), *2-C1(SCL,SCL_03), *2-E1(OREF,FT_105)*

SCL_04 SCALE MainProgram
Constant No
External Access: Read/Write

SCL_04 (Continued)
*SCL_04 - MainProgram/Analog_Inputs - *2-B2(IREF,-5), *2-B2(IREF,0), *2-B2(IREF,10000), *2-B2(IREF,20), *2-B2(IREF,FT_106_Raw), *2-B3(IREF,1), *2-C2(SCL,SCL_04), *2-E2(OREF,FT_106)*

SCL_05 SCALE MainProgram
Constant No
External Access: Read/Write
*SCL_05 - MainProgram/Analog_Inputs - *2-B3(IREF,-5), *2-B3(IREF,0), *2-B3(IREF,10000), *2-B3(IREF,20), *2-B3(IREF,FT_107_Raw), *2-B4(IREF,1), *2-C3(SCL,SCL_05), *2-E3(OREF,FT_107)*

SerialSequenceBeginDosing 1 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SerialSequenceBeginDosing - MainProgram/Series_Seq - *2(OTE), 2(XIC)*

SerialSequencePresetStored 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SerialSequencePresetStored - MainProgram/Series_Seq - *1(OTE), 2(XIC)*

SeriesSequenceActive 1 BOOL MainProgram
Constant No
External Access: Read/Write
*SeriesSequenceActive - MainProgram/Series_Seq - *0(OTE), 0(XIC), 2(XIC), 3(XIC)*

SeriesSequenceActive_ONS 1 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SeriesSequenceActive_ONS - MainProgram/Series_Seq - *0(ONS)*

SeriesSequenceActiveOneShot 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SeriesSequenceActiveOneShot - MainProgram/Series_Seq - *0(OTE), 1(XIC)*

SeriesSequenceComplete 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SeriesSequenceComplete - MainProgram/Series_Seq - *3(OTE), 0(XIO), 4(XIC)*

SeriesSequenceCooldownTM TIMER HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SeriesSequenceCooldownTM - MainProgram/Series_Seq - *4(TON)*
SeriesSequenceCooldownTM.TT 0 BOOL
SeriesSequenceCooldownTM.TT - MainProgram/Series_Seq - 0(XIO), 4(XIC)
SeriesSequenceCooldownTM.DN 0 BOOL
SeriesSequenceCooldownTM.DN - MainProgram/Series_Seq - 4(XIO)

SerParSequenceActive 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SerParSequenceActive - MainProgram/SerPar_Seq - *1(OTE), 1(XIC), 3(XIC), 4(XIC)*

SerParSequenceActive_ONS 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SerParSequenceActive_ONS - MainProgram/SerPar_Seq - *1(ONS)*

SerParSequenceActiveOneShot 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write

SerParSequenceActiveOneShot (Continued)
*SerParSequenceActiveOneShot - MainProgram/SerPar_Seq - *1(OTE), 2(XIC)*

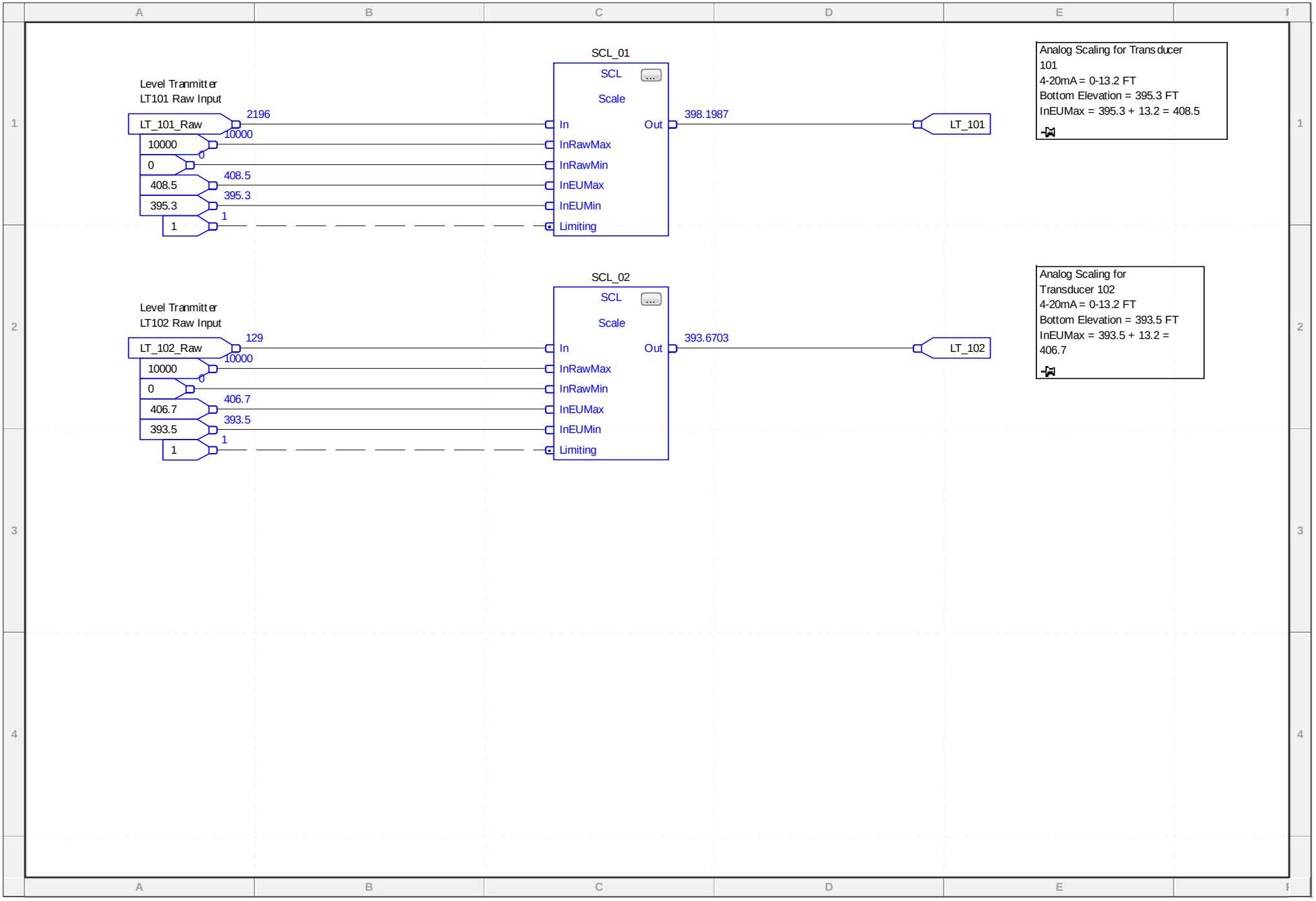
SerParSequenceBeginDosing 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SerParSequenceBeginDosing - MainProgram/SerPar_Seq - *3(OTE), 3(XIC)*

SerParSequenceComplete 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SerParSequenceComplete - MainProgram/SerPar_Seq - *4(OTE), 0(XIO), 1(XIO), 5(XIC)*

SerParSequenceCooldownTM TIMER HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SerParSequenceCooldownTM - MainProgram/SerPar_Seq - *5(TON)*
SerParSequenceCooldownTM.TT 0 BOOL
SerParSequenceCooldownTM.TT - MainProgram/SerPar_Seq - 0(XIO), 5(XIC)
SerParSequenceCooldownTM.DN
0 BOOL
SerParSequenceCooldownTM.DN - MainProgram/SerPar_Seq - 5(XIO)

SerParSequenceLevelOverStartSetpoint
0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SerParSequenceLevelOverStartSetpoint - MainProgram/SerPar_Seq - *0(OTE), 0(XIC), 1(XIC)*

SerParSequencePresetStored 0 BOOL HARBOR_BROOK_CSO
Constant No
External Access: Read/Write
*SerParSequencePresetStored - MainProgram/SerPar_Seq - *2(OTE), 3(XIC)*


SCL_01
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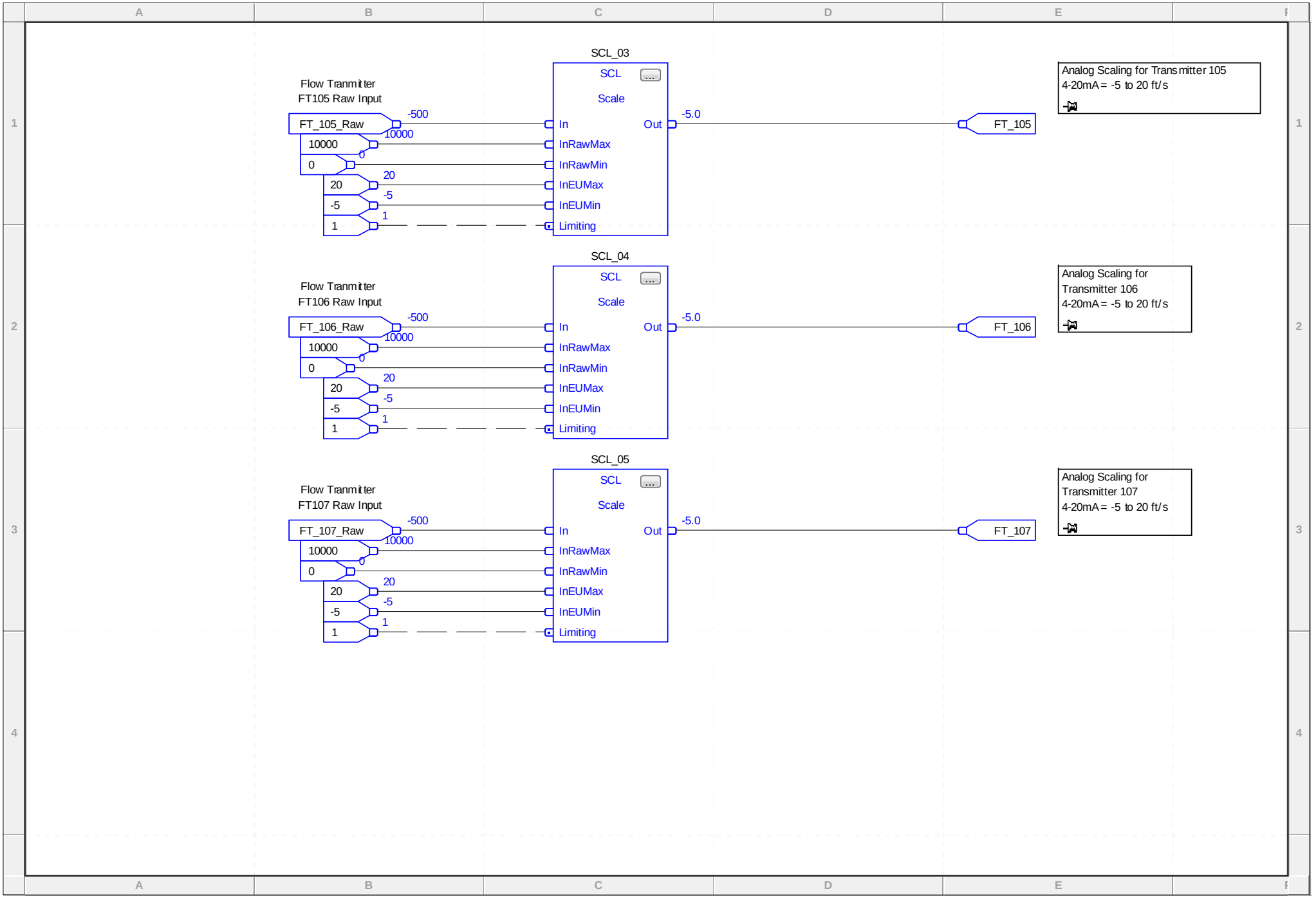
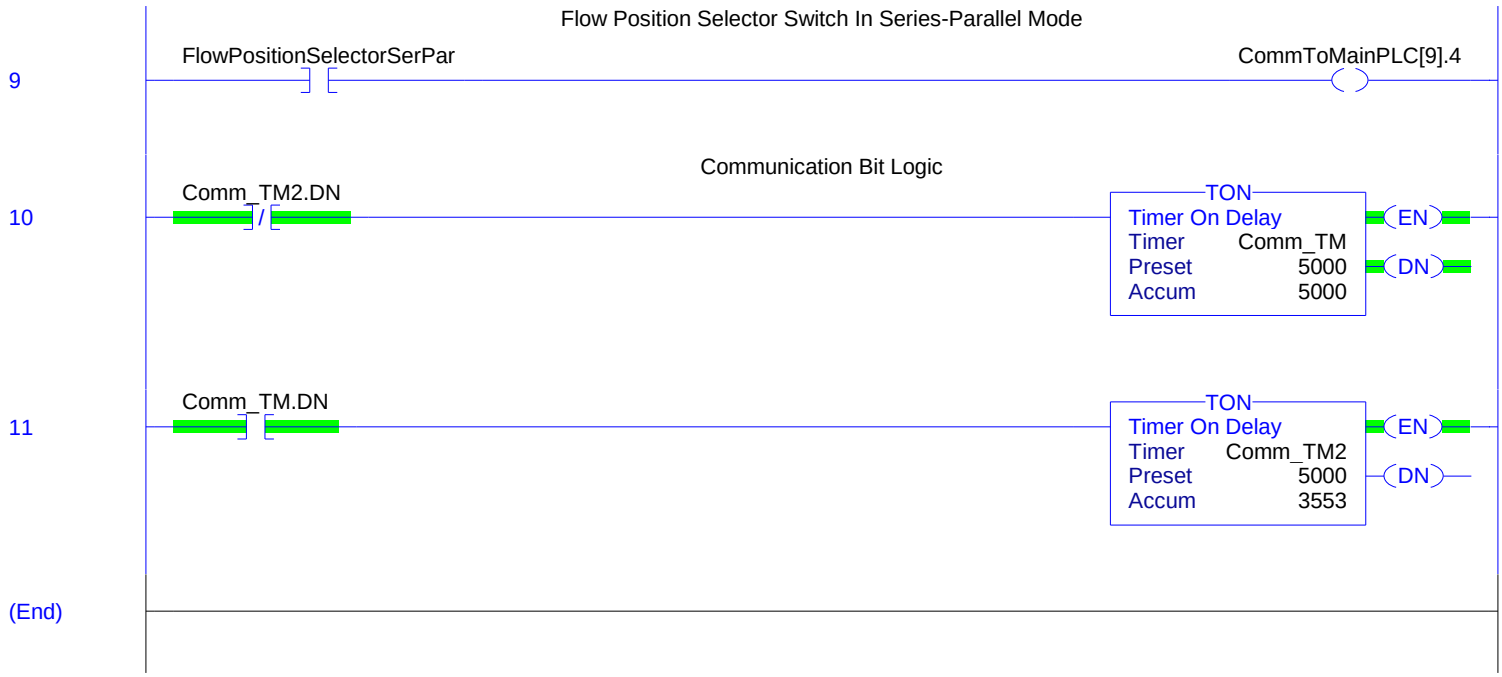
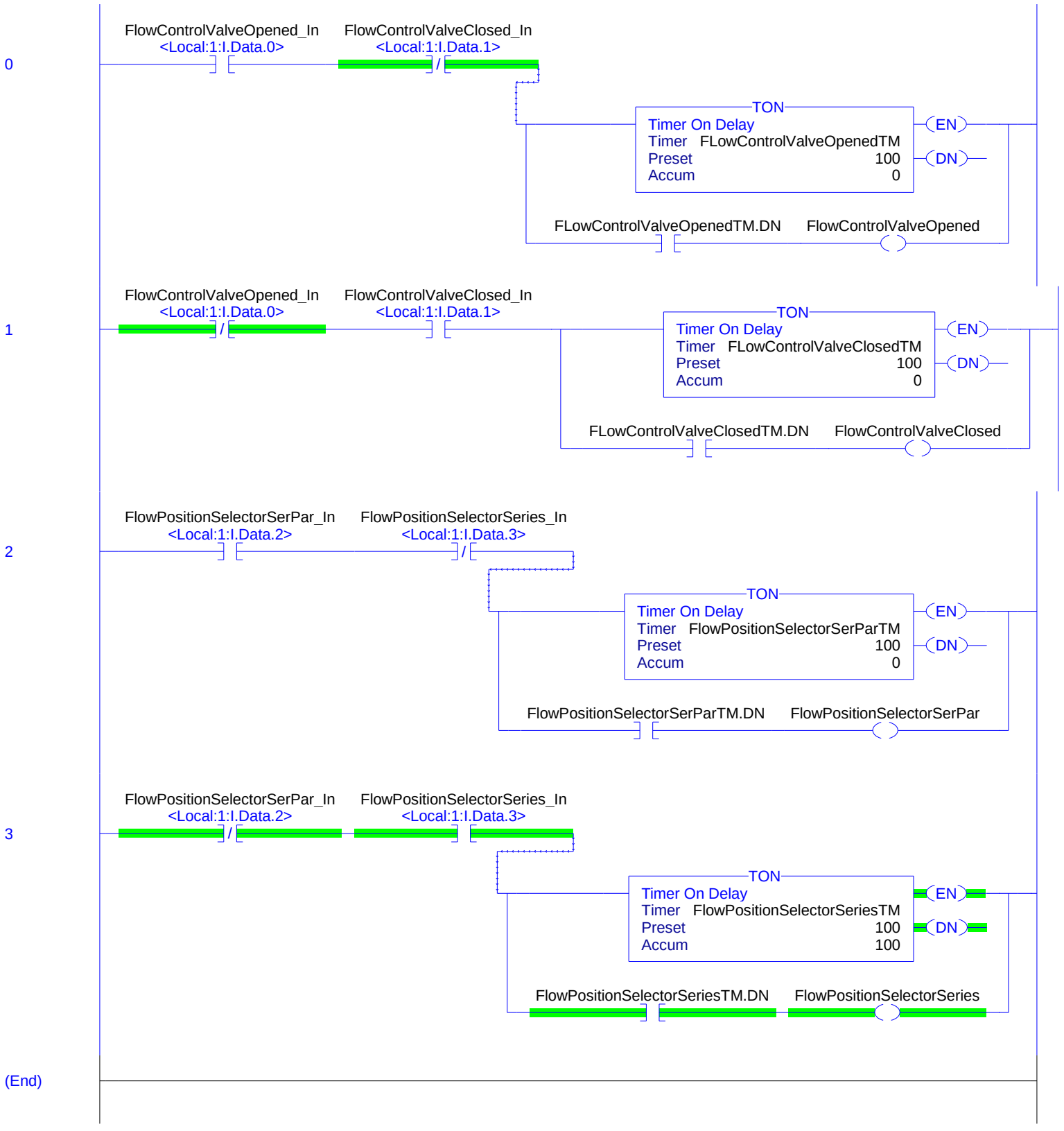
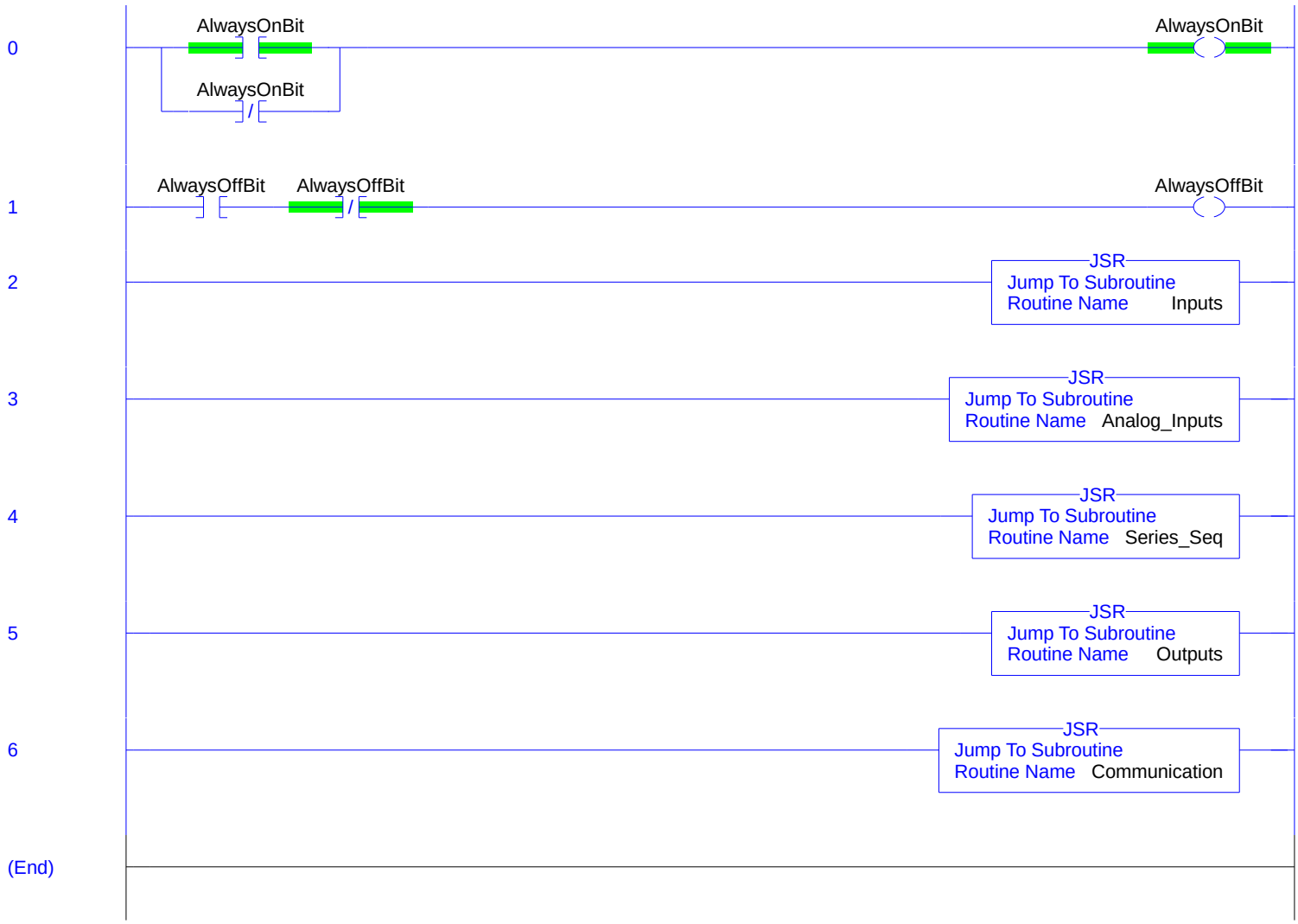
LT_102
Analog Scaling for
Transducer 102
4-20mA = 0-13.2 FT
Bottom Elevation = 393.5 FT
InEUMax = 393.5 + 13.2 =
406.7

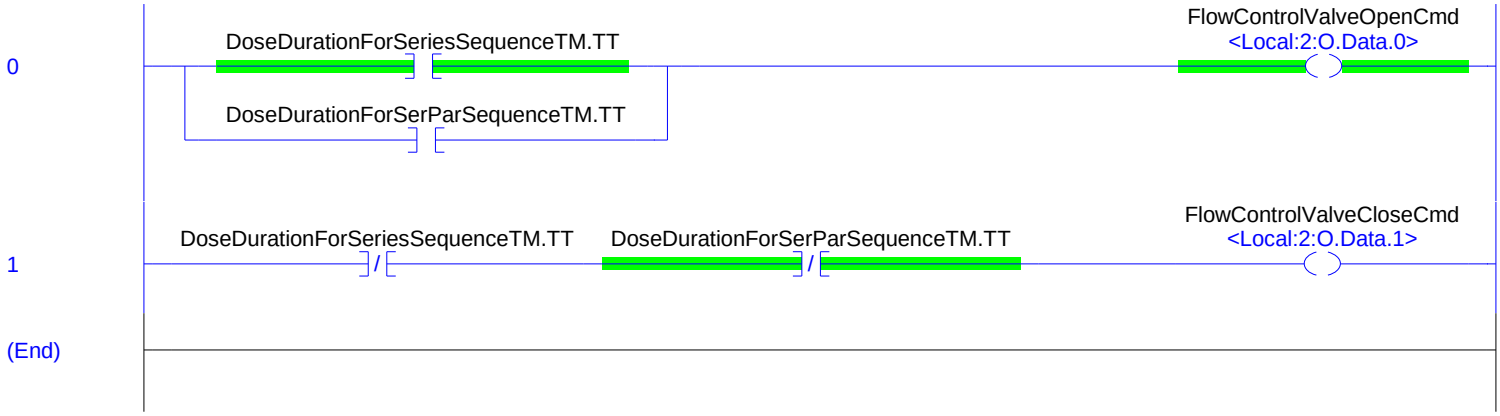

SCL_03
SCL
Scale
Flow Tranmitter
FT105 Raw Input
FT_105_Raw
-500
10000
0
20
-5
1
In
InRawMax
InRawMin
InEUMax
InEUMin
Limiting
Out
-5.0
FT_105
Analog Scaling for Transmitter 105
4-20mA = -5 to 20 ft/s
SCL_04
Flow Tranmitter
FT106 Raw Input
FT_106_Raw
FT_106
Analog Scaling for
Transmitter 106
4-20mA = -5 to 20 ft/s
SCL_05
Flow Tranmitter
FT107 Raw Input
FT_107_Raw
FT_107
Analog Scaling for
Transmitter 107
4-20mA = -5 to 20 ft/s

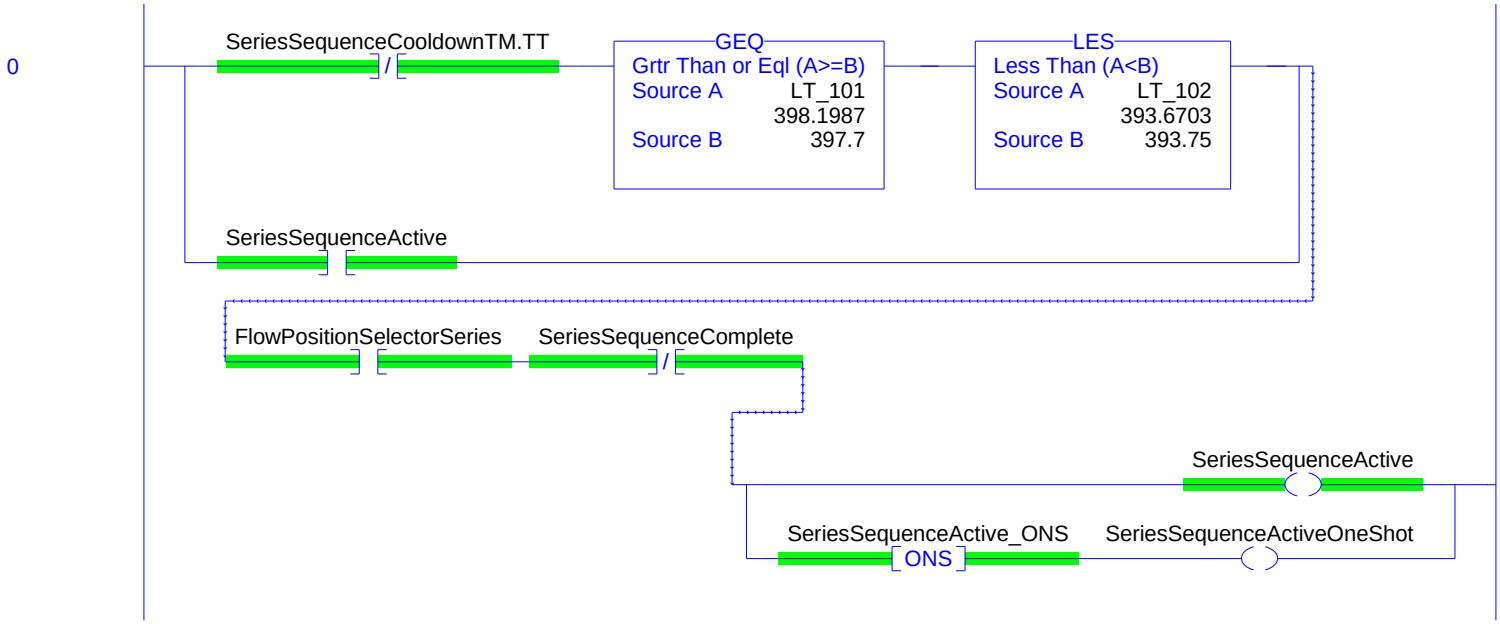

LT 101 Level * 100
0
CPT
Compute
Dest CommToMainPLC[0]
39820
Expression LT_101*100
LT 102 Level * 100
1
CPT
Compute
Dest CommToMainPLC[1]
39367
Expression LT_102*100
FT 105 Flow * 100
2
CPT
Compute
Dest CommToMainPLC[2]
-500
Expression FT_105*100
FT 106 Flow * 100
3
CPT
Compute
Dest CommToMainPLC[3]
-500
Expression FT_106*100
FT 107 Flow * 100
4
CPT
Compute
Dest CommToMainPLC[4]
-500
Expression FT_107*100
Communication Bit. Chnages State Every 5 Seconds
Comm_TM.DN
5
CommToMainPLC[9].0
Flow Control Valve Opened
FlowControlValveOpened
6
CommToMainPLC[9].1
Flow Control Valve Closed
FlowControlValveClosed
7
CommToMainPLC[9].2
Flow Position Selector Switch In Series Mode
FlowPositionSelectorSeries
8
CommToMainPLC[9].3


Flow Position Selector Switch In Series-Parallel Mode
FlowPositionSelectorSerPar
CommToMainPLC[9].4
9
Communication Bit Logic
Comm_TM2.DN
10
TON
Timer On Delay
Timer Comm_TM
Preset 5000
Accum 5000
EN
DN
Comm_TM.DN
11
TON
Timer On Delay
Timer Comm_TM2
Preset 5000
Accum 3553
EN
DN
(End)


0
FlowControlValveOpened_In
<Local:1:I.Data.0>
FlowControlValveClosed_In
<Local:1:I.Data.1>
TON
Timer On Delay
Timer FLowControlValveOpenedTM
Preset 100
Accum 0
EN
DN
FLowControlValveOpenedTM.DN
FlowControlValveOpened
1
FlowControlValveOpened_In
<Local:1:I.Data.0>
FlowControlValveClosed_In
<Local:1:I.Data.1>
TON
Timer On Delay
Timer FLowControlValveClosedTM
Preset 100
Accum 0
EN
DN
FLowControlValveClosedTM.DN
FlowControlValveClosed
2
FlowPositionSelectorSerPar_In
<Local:1:I.Data.2>
FlowPositionSelectorSeries_In
<Local:1:I.Data.3>
TON
Timer On Delay
Timer FlowPositionSelectorSerParTM
Preset 100
Accum 0
EN
DN
FlowPositionSelectorSerParTM.DN
FlowPositionSelectorSerPar
3
FlowPositionSelectorSerPar_In
<Local:1:I.Data.2>
FlowPositionSelectorSeries_In
<Local:1:I.Data.3>
TON
Timer On Delay
Timer FlowPositionSelectorSeriesTM
Preset 100
Accum 100
EN
DN
FlowPositionSelectorSeriesTM.DN
FlowPositionSelectorSeries
(End)

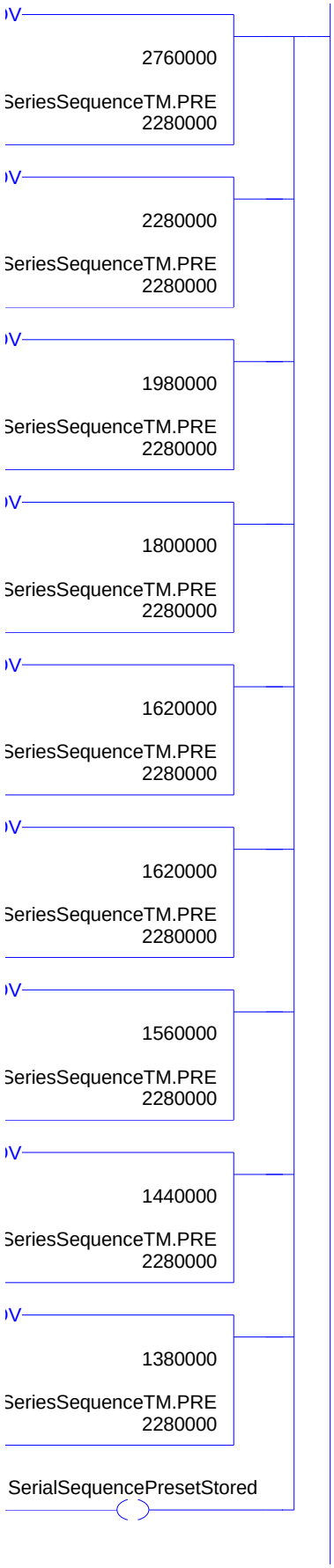

0
AlwaysOnBit
AlwaysOnBit
AlwaysOnBit
1
AlwaysOffBit
AlwaysOffBit
AlwaysOffBit
2
JSR
Jump To Subroutine
Routine Name Inputs
3
JSR
Jump To Subroutine
Routine Name Analog_Inputs
4
JSR
Jump To Subroutine
Routine Name Series_Seq
5
JSR
Jump To Subroutine
Routine Name Outputs
6
JSR
Jump To Subroutine
Routine Name Communication
(End)

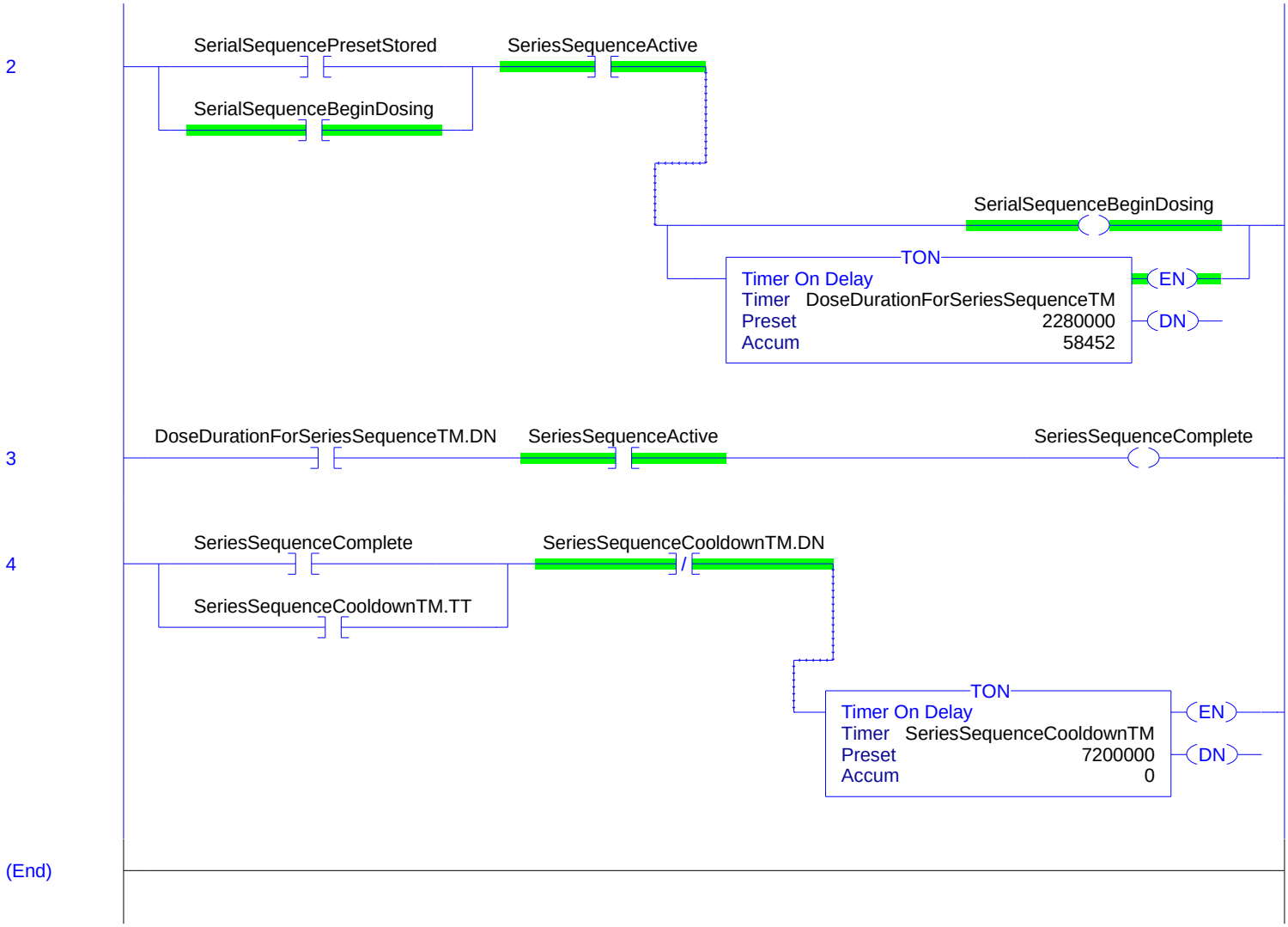

0
DoseDurationForSeriesSequenceTM.TT
DoseDurationForSerParSequenceTM.TT
FlowControlValveOpenCmd
<Local:2:O.Data.0>
1
DoseDurationForSeriesSequenceTM.TT
DoseDurationForSerParSequenceTM.TT
FlowControlValveCloseCmd
<Local:2:O.Data.1>
(End)

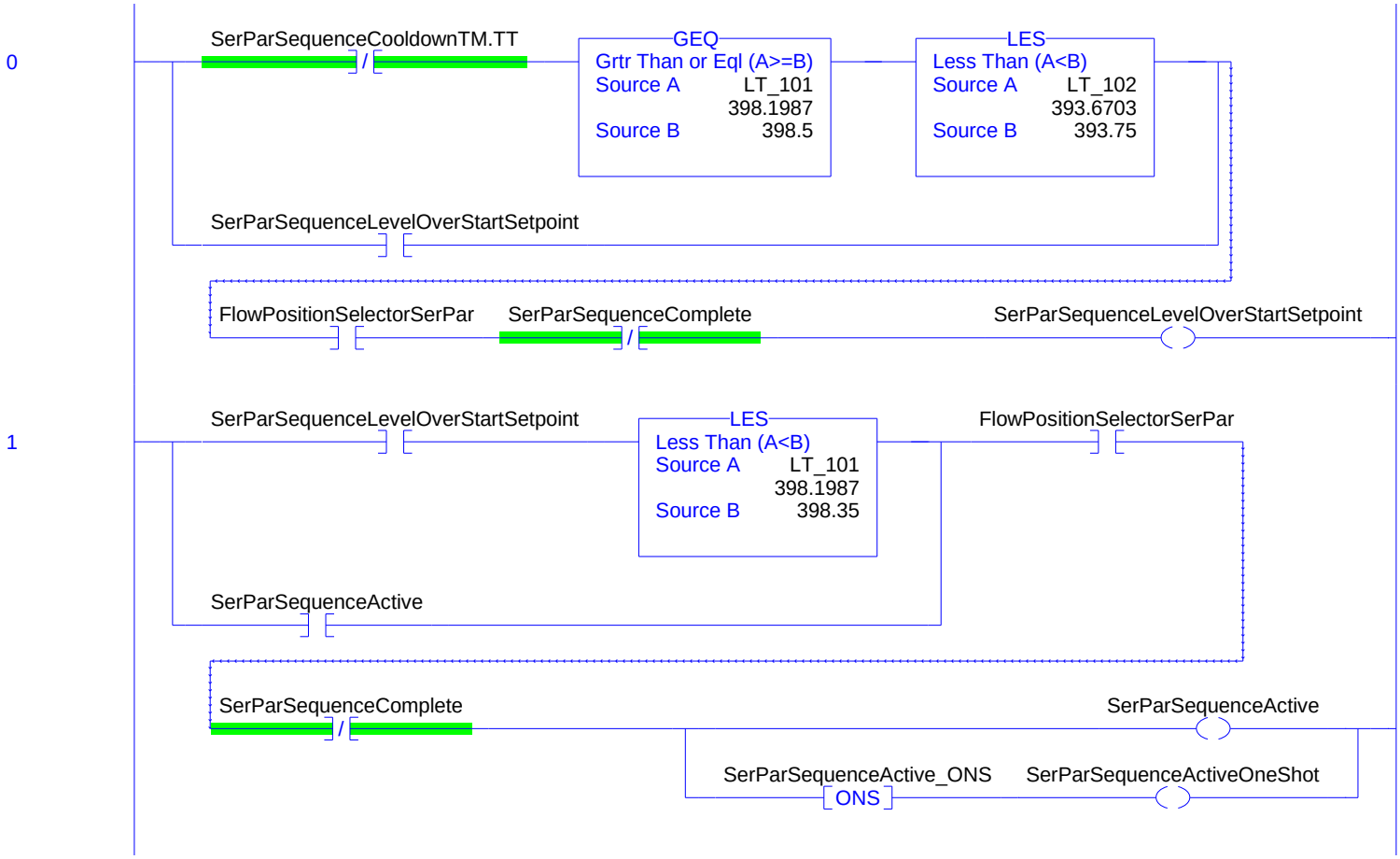

0
SeriesSequenceCooldownTM.TT
/
GEQ
Grtr Than or Eql (A>=B)
Source A
LT_101
398.1987
Source B
397.7
LES
Less Than (A<B)
Source A
LT_102
393.6703
Source B
393.75
SeriesSequenceActive
FlowPositionSelectorSeries
SeriesSequenceComplete
/
SeriesSequenceActive
SeriesSequenceActive_ONS
ONS
SeriesSequenceActiveOneShot

1


SeriesSequenceActiveOneShot
LES
Less Than (A<B)
Source A LT_102 393.6703
Source B 398.1
M
Move
Source
Dest DoseDurationFc
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 398.1
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 398.5
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 398.5
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 398.9
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 398.9
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 399.2
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 399.2
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 399.6
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 399.6
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 400.0
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 400.0
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 400.4
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 400.4

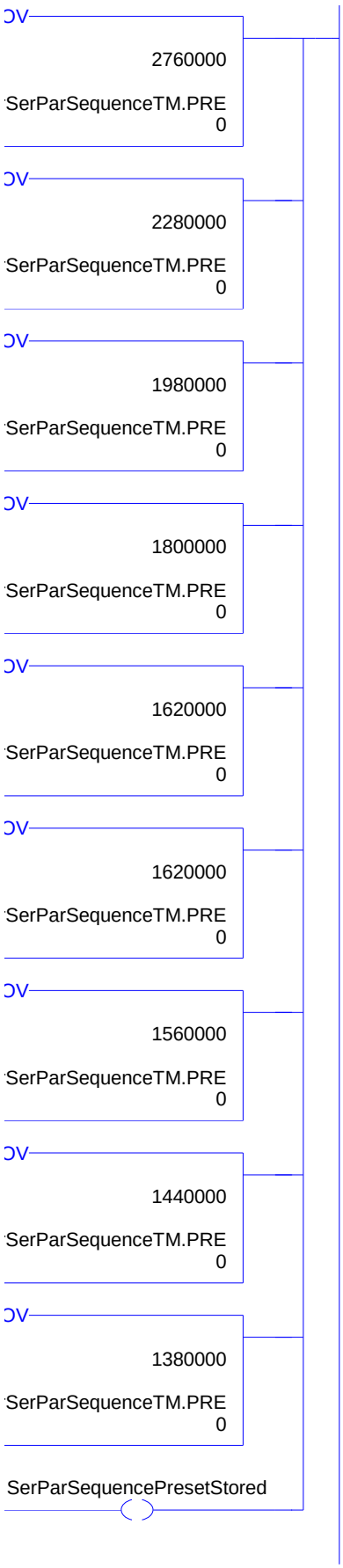

IV
2760000
SeriesSequenceTM.PRE
2280000
IV
2280000
SeriesSequenceTM.PRE
2280000
IV
1980000
SeriesSequenceTM.PRE
2280000
IV
1800000
SeriesSequenceTM.PRE
2280000
IV
1620000
SeriesSequenceTM.PRE
2280000
IV
1620000
SeriesSequenceTM.PRE
2280000
IV
1560000
SeriesSequenceTM.PRE
2280000
IV
1440000
SeriesSequenceTM.PRE
2280000
IV
1380000
SeriesSequenceTM.PRE
2280000
SerialSequencePresetStored


2
SerialSequencePresetStored
SeriesSequenceActive
SerialSequenceBeginDosing
SerialSequenceBeginDosing
TON
Timer On Delay
Timer DoseDurationForSeriesSequenceTM
Preset 2280000
Accum 58452
EN
DN
3
DoseDurationForSeriesSequenceTM.DN
SeriesSequenceActive
SeriesSequenceComplete
4
SeriesSequenceComplete
SeriesSequenceCooldownTM.DN
SeriesSequenceCooldownTM.TT
TON
Timer On Delay
Timer SeriesSequenceCooldownTM
Preset 7200000
Accum 0
EN
DN
(End)


0
SerParSequenceCooldownTM.TT
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 398.5
LES
Less Than (A<B)
Source A LT_102 393.6703
Source B 393.75
SerParSequenceLevelOverStartSetpoint
FlowPositionSelectorSerPar
SerParSequenceComplete
SerParSequenceLevelOverStartSetpoint
1
SerParSequenceLevelOverStartSetpoint
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 398.35
FlowPositionSelectorSerPar
SerParSequenceActive
SerParSequenceComplete
SerParSequenceActive
SerParSequenceActive_ONS
ONS
SerParSequenceActiveOneShot

2


SerParSequenceActiveOneShot
LES
Less Than (A<B)
Source A LT_102 393.6703
Source B 398.1
Move
Source
Dest DoseDurationF
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 398.1
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 398.5
Move
Source
Dest DoseDurationF
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 398.5
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 398.9
Move
Source
Dest DoseDurationF
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 398.9
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 399.2
Move
Source
Dest DoseDurationF
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 399.2
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 399.6
Move
Source
Dest DoseDurationF
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 399.6
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 400.0
Move
Source
Dest DoseDurationF
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 400.0
LES
Less Than (A<B)
Source A LT_101 398.1987
Source B 400.4
Move
Source
Dest DoseDurationF
GEQ
Grtr Than or Eql (A>=B)
Source A LT_101 398.1987
Source B 400.4
Move
Source
Dest DoseDurationF


OV
2760000
SerParSequenceTM.PRE
0
OV
2280000
SerParSequenceTM.PRE
0
OV
1980000
SerParSequenceTM.PRE
0
OV
1800000
SerParSequenceTM.PRE
0
OV
1620000
SerParSequenceTM.PRE
0
OV
1620000
SerParSequenceTM.PRE
0
OV
1560000
SerParSequenceTM.PRE
0
OV
1440000
SerParSequenceTM.PRE
0
OV
1380000
SerParSequenceTM.PRE
0
SerParSequencePresetStored


3
SerParSequencePresetStored
SerParSequenceActive
SerParSequenceBeginDosing
SerParSequenceBeginDosing
TON
Timer On Delay
Timer DoseDurationForSerParSequenceTM
Preset 0
Accum 0
EN
DN
4
DoseDurationForSerParSequenceTM.DN
SerParSequenceActive
SerParSequenceComplete
5
SerParSequenceComplete
SerParSequenceCooldownTM.DN
/
SerParSequenceCooldownTM.TT
TON
Timer On Delay
Timer SerParSequenceCooldownTM
Preset 7200000
Accum 0
EN
DN
(End)

1769 Bus : Local Modules

Local: [0] 1769-L30ER HARBOR_BROOK_CSO

Type:	1769-L30ER CompactLogix™ 5370 Controller	Parent:	Local
Vendor:	Allen-Bradley	Vendor ID:	1
Slot:	0	Electronic Keying:	Disabled
Revision:	20.12	Status:	Standby
Module Fault:	Offline	Inhibit Flag	Off

Local: [1] 1769-IA8I/A DI_SLOT1

Type:	1769-IA8I/A 8 Point Isolated 120V AC Input	Parent:	Local
Vendor:	Allen-Bradley	Vendor ID:	1
Slot:	1	Electronic Keying:	Compatible Keying
Revision:	3.1	Status:	Standby
Module Fault:	Offline	Inhibit Flag	Off
Use Unicast:	n/a		

Local: [2] 1769-OW8I/B DO_SLOT2

Type:	1769-OW8I/B 8 Point Isolated AC/DC Relay Output	Parent:	Local
Vendor:	Allen-Bradley	Vendor ID:	1
Slot:	2	Electronic Keying:	Compatible Keying
Revision:	3.1	Status:	Standby
Module Fault:	Offline	Inhibit Flag	Off
Use Unicast:	n/a		

Module Defined Configuration Tag	Value	Data Type
Local:2:C		AB:1769_DO8:C:0
.Config	2#0000_0000_0000_0000	INT
.ProgToFaultEn	0	BOOL
.ProgMode	2#0000_0000	SINT
.ProgValue	2#0000_0000	SINT
.FaultMode	2#0000_0000	SINT
.FaultValue	2#0000_0000	SINT

Local: [3] 1769-IF4/B AI_SLOT3

Type:	1769-IF4/B 4 Channel Current/Voltage Analog Input	Parent:	Local
Vendor:	Allen-Bradley	Vendor ID:	1
Slot:	3	Electronic Keying:	Compatible Keying
Revision:	3.1	Status:	Standby
Module Fault:	Offline	Inhibit Flag	Off
Use Unicast:	n/a		

Module Defined Configuration Tag	Value	Data Type
Local:3:C		AB:1769_IF4:C:0
.Ch0Config	2#1011_0011_0000_0000	INT
.Ch0Filter_0	0	BOOL
.Ch0Filter_1	0	BOOL
.Ch0Filter_2	0	BOOL

.Ch0Filter_3	0	BOOL
.Ch0Range_8	1	BOOL
.Ch0Range_9	1	BOOL
.Ch0Range_10	0	BOOL
.Ch0Range_11	0	BOOL
	1	BOOL
.Ch0DataFormat_12		
	1	BOOL
.Ch0DataFormat_13		
	0	BOOL
.Ch0DataFormat_14		
.Ch0En	1	BOOL
.Ch1Config	2#1011_0011_0000_0000	INT
.Ch1Filter_0	0	BOOL
.Ch1Filter_1	0	BOOL
.Ch1Filter_2	0	BOOL
.Ch1Filter_3	0	BOOL
.Ch1Range_8	1	BOOL
.Ch1Range_9	1	BOOL
.Ch1Range_10	0	BOOL
.Ch1Range_11	0	BOOL
	1	BOOL
.Ch1DataFormat_12		
	1	BOOL
.Ch1DataFormat_13		
	0	BOOL
.Ch1DataFormat_14		
.Ch1En	1	BOOL
.Ch2Config	2#1011_0011_0000_0000	INT
.Ch2Filter_0	0	BOOL
.Ch2Filter_1	0	BOOL
.Ch2Filter_2	0	BOOL
.Ch2Filter_3	0	BOOL
.Ch2Range_8	1	BOOL
.Ch2Range_9	1	BOOL
.Ch2Range_10	0	BOOL
.Ch2Range_11	0	BOOL
	1	BOOL
.Ch2DataFormat_12		
	1	BOOL
.Ch2DataFormat_13		
	0	BOOL
.Ch2DataFormat_14		
.Ch2En	1	BOOL
.Ch3Config	2#1011_0011_0000_0000	INT
.Ch3Filter_0	0	BOOL
.Ch3Filter_1	0	BOOL
.Ch3Filter_2	0	BOOL
.Ch3Filter_3	0	BOOL
.Ch3Range_8	1	BOOL
.Ch3Range_9	1	BOOL
.Ch3Range_10	0	BOOL
.Ch3Range_11	0	BOOL
	1	BOOL
.Ch3DataFormat_12		
	1	BOOL
.Ch3DataFormat_13		
	0	BOOL
.Ch3DataFormat_14		

.Ch3En	1	BOOL	

Local: [4] 1769-IF4/B AI_SLOT4

Type:	1769-IF4/B 4 Channel Current/Voltage Analog Input	Parent:	Local
Vendor:	Allen-Bradley	Vendor ID:	1
Slot:	4	Electronic Keying:	Compatible Keying
Revision:	3.1	Status:	Standby
Module Fault:	Offline	Inhibit Flag	Off
Use Unicast:	n/a		

Module Defined Configuration Tag	Value	Data Type
Local:4:C		AB:1769_IF4:C:0
.Ch0Config	2#1011_0011_0000_0000	INT
.Ch0Filter_0	0	BOOL
.Ch0Filter_1	0	BOOL
.Ch0Filter_2	0	BOOL
.Ch0Filter_3	0	BOOL
.Ch0Range_8	1	BOOL
.Ch0Range_9	1	BOOL
.Ch0Range_10	0	BOOL
.Ch0Range_11	0	BOOL
	1	BOOL
.Ch0DataFormat_12		
	1	BOOL
.Ch0DataFormat_13		
	0	BOOL
.Ch0DataFormat_14		
.Ch0En	1	BOOL
.Ch1Config	2#1011_0011_0000_0000	INT
.Ch1Filter_0	0	BOOL
.Ch1Filter_1	0	BOOL
.Ch1Filter_2	0	BOOL
.Ch1Filter_3	0	BOOL
.Ch1Range_8	1	BOOL
.Ch1Range_9	1	BOOL
.Ch1Range_10	0	BOOL
.Ch1Range_11	0	BOOL
	1	BOOL
.Ch1DataFormat_12		
	1	BOOL
.Ch1DataFormat_13		
	0	BOOL
.Ch1DataFormat_14		
.Ch1En	1	BOOL
.Ch2Config	2#1011_0011_0000_0000	INT
.Ch2Filter_0	0	BOOL
.Ch2Filter_1	0	BOOL
.Ch2Filter_2	0	BOOL
.Ch2Filter_3	0	BOOL
.Ch2Range_8	1	BOOL
.Ch2Range_9	1	BOOL
.Ch2Range_10	0	BOOL
.Ch2Range_11	0	BOOL
	1	BOOL
.Ch2DataFormat_12		

	1	BOOL
.Ch2DataFormat_13		
	0	BOOL
.Ch2DataFormat_14		
.Ch2En	1	BOOL
.Ch3Config	2#1011_0011_0000_0000	INT
.Ch3Filter_0	0	BOOL
.Ch3Filter_1	0	BOOL
.Ch3Filter_2	0	BOOL
.Ch3Filter_3	0	BOOL
.Ch3Range_8	1	BOOL
.Ch3Range_9	1	BOOL
.Ch3Range_10	0	BOOL
.Ch3Range_11	0	BOOL
	1	BOOL
.Ch3DataFormat_12		
	1	BOOL
.Ch3DataFormat_13		
	0	BOOL
.Ch3DataFormat_14		
.Ch3En	1	BOOL

SECTION 3
Bill of Material

ZELLERCORPORATION
THE RIGHT SOLUTION FOR YOU

BOM Number:	**121222 - BOM**	**Revision:**	**C**
Approval Date:	**May 5, 2014**	**Approval ER/ECN:**	**ECN-121222-0004**
Prepared By:	**Bill Schlinger**		

Item	Device ID	Item Description	Manufacturer	Manufacturer Part No.	PLC-B Panel	Software	Instruments
Zeller							
1	ENCLOSURE	WM 30X30X10 304 S/S, #4 BRUSHED	Rittal Corporation	WM303010N4	1		
2	ENCLOSURE	Stainless Steel Enclosure Wall Mount Bracket Kit For Rittal WM Enclosures, (KitOF 4)	Rittal Corporation	2433000	1		
3	ENCLOSURE	DEAD FRONT KIT F/WM 30"HX30"W, RAL7035	Rittal Corporation	8018665	1		
4	ENCLOSURE	Door Padlock Kit for Rittal AE and WM Enclosures with Cam-Lock Locks	Rittal Corporation	2493000	2		
5	CB-102	QOU Circuit Breaker, 1-Pole, DIN Rail Mount, 20A, 120/240 Vac, 10 KAIC	Square D	QOU120	1		
6	CBL-206	CAT-5E Ethernet Cable, 3 Feet, Black, Un-Shielded	L-com	TRD815BLK-3	1		
7	CR-352, 355	Relay, 4PDT, 6 Amp, Rectangular, Plug-In, 14 Pin, 120VAC Lighted Coil	Square D	RXM4AB2F7	2		
8	CR-352, 355	Relay Socket-14 Pole-300vac-10 Amp-Blade Base-For RXM relays-DIN Rail Mount-Separate Terminals	Square D	RXZE2S114M	2		
9	ESW-133	Ethernet Switch, 4 RJ45, 1 SC	Moxa	EDS-208-M-SC	1		
10	FPP	Fiber-Optic Patch Panel Housing, 1 Slot, 12 Fiber, 6.3Hx5.5Wx2D", CCH Panels Separate	Corning Cable Systems	SPH-01P	1		
11	FPP	Fiber-Optic Connector Housing Panel, 62.5um, 6 SC Duplex MultiMode Connectors, 12 Fiber	Corning Cable Systems	CCH-CP12-91	1		
12	FPP	Fiber Optic Patch Cable, SC to SC, Dual Fiber, 2 Meter, Multi-Mode, 62.5-125	L-com	FODSC-02	1		
13	FU-102, 120, 127	Fuse, 4 Amp, 125 Vac, Time Delay, Glass, 1/4" x 1-1/4"	Ferraz Shawmut	GDL4	3		
14	FU-131	250V 1/4A 1-1/4X1/4 Sm Fuse	Ferraz Shawmut	GDL1/4	1		
15	FU-124, 125	Fuse, 1 Amp, 125 Vac, Time Delay, Glass, 1/4" x 1-1/4"	Ferraz Shawmut	GDL1	3		
16	FU-103	Fuse, 5 Amp, 125 Vac, Time Delay, Glass, 1/4" x 1-1/4"	Ferraz Shawmut	GDL5	1		
17	FUSEBLOCK FOR ABOVE FUSES	UK6.3-HESI, Fuse Terminal Block, 1 Pole, 10 Amp, 250 Vac, for 1/4" x 1-1/4" Fuses	Phoenix Contact	3004171	8		
18	GND-104	Equipment Ground Bar Assembly, 12 Position, 100 Amp	Square D	PK12GTA	1		
19	HTR-102	ENCLOSURE HEATER 50W 110-240V	Rittal Corporation	3105340	1		
20	ISB-401, 405	MACX-MCR-EX-SL-RPSSI, Intrinsically Safe Barrier for One Analog Signal, 24 Vdc Powered	Phoenix Contact	2865340	2		
21	ISB ENCLOSURE	VJ Enclosure	Vynckier	VJ606W	1		
22	ISB ENCLOSURE	VJ Steel Mounting Plate	Vynckier	MP606S	1		
23	PLC-120	Compactlogix 1 MB Mem Ct	Allen Bradley	1769-L30ER	1		
24	PLC-120	AB - Power Supply, 85-265 Vac, 5 Vdc, 2 Amp, 24 Vdc, 0.8 Amp	Allen Bradley	1769-PA2	1		
25	PLC-120	Digital Input Module, 8 Point, 120 Vac, Isolated	Allen Bradley	1769-IA8I	1		
26	PLC-120	AB- Compactligix AC/DC Relay Output Module	Allen Bradley	1769-OW8I	1		
27	PLC-120	AB Analog Input Module, 4 Channel	Allen Bradley	1769-IF4	2		
28	PLC-120	AB - End Cap, For Right Side of 1769 I/O Modules	Allen Bradley	1769-ECR	1		
29	PLC-120	AB - RSLOGIX 500 STANDARD SOFTWARE EN	Allen Bradley	9324-RL0300ENE		1	
30	PWS-127	TRIO-PS1AC24DC2.5, Power Supply, 24 vdc, 2.5 Amp, 100-230 vac input	Phoenix Contact	2866268	1		
31	RECP-108	Single 3-Wire Receptacle, 125 vac, 15 Amp, DIN Rail Mount	Phoenix Contact	2963860	1		

ZELLERCORPORATION
THE RIGHT SOLUTION FOR YOU

BOM Number:	**121222 - BOM**	**Revision:**	**C**
Approval Date:	**May 5, 2014**	**Approval ER/ECN:**	**ECN-121222-0004**
Prepared By:	**Bill Schlinger**		

Item	Device ID	Item Description	Manufacturer	Manufacturer Part No.	PLC-B Panel	Software	Instruments
32	SS-306	Selector Switch, 22mm, 2 Position, Maintained, Black, 1NC 1NO	Square D	XB4BD25	1		
33	TAS-102	Thermostat 32-140F Norm Closed, for Heating Applications, 15Amp, 120V/10A, 250V	Hammond Manufacturing	SKT011409NC	1		
34	TERMINALS	UT 2.5 Universal Terminal Block, 20 Amp, 600 volt, AWG: 26 - 12,	Phoenix Contact	3044076	25		
35	TERMINALS	UT 2.5-PE Universal Ground Terminal Block, 20 Amp, 600 volt, AWG: 26 - 12	Phoenix Contact	3044092	2		
36	TERMINALS	E/NS 35 N End bracket, width: 9.5 mm, color: gray	Phoenix Contact	0800886	13		
37	TERMINALS	ATP-UT, Partition Plate for UT Terminal block	Phoenix Contact	3047167	6		
38	TERMINALS	FBS 2-5 Plug-in bridge for UT2.5 Terminals in the center, 2-pos., color: Red	Phoenix Contact	3030161	1		
39	TERMINALS	FBS 3-5 Plug-in bridge for UT2.5 Terminals in the center, 3-pos., color: Red	Phoenix Contact	3030174	2		
40	TVSS-104	PT2PE/S120AC/FM, Surge Suppressor, 120 VAC, 20 Amp Plug Module and Base	Phoenix Contact	2856812	1		
41	UPS-111	APC Power Saving Back-UPS Pro 1500	American Power Conversion	BR1500G	1		
42	UPS-111	Cord-Set, 3 Wire Power Cord to Flying Leads, 9 Ft, 14 AWG, BLK-WHT-GRN	Belden	B17629	1		
		Instruments					
43	FT-105, FT-106, FT-107	Model 2150 Flow Module	Teledyne Isco	2150			1
44	FT-105, FT-106, FT-107	2108 Analog Output Module for Teledyne Open Channel Flow Meter	Teledyne Isco	682000010			1
45	FT-105, FT-106	2100 to 2180 CRTL Cable, 550 Ft	Teledyne Isco	605314461			1
46	FT-107	2100 to 2180 CRTL Cable, 50 Ft	Teledyne Isco	602004219			1
47	LT-101, LT-102	Level Transducer, Submersible Water Pilot	Endress + Hauser	FMX21-CE221FGJ20A+P0PS			2

SECTION 4
Control Panel Cutsheets

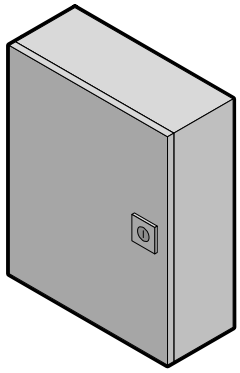
WM Wallmount Enclosures

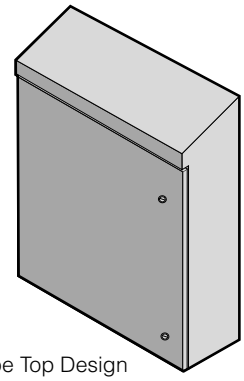
Configuration:
One-piece welded cold-rolled steel body
Left-hand hinged door (the carbon steel single door configuration is reversible)
Single door enclosures less than 20” in height have one 1/4 turn latch with screwdriver insert
Single door enclosures 20 - 40” in height have two 1/4-turn latches with screwdriver inserts
Single door enclosures greater than or equal to 42” in height have a 3-point latching L-handle
Double door and disconnect enclosures have a 3-point latching L-handle
Wallmounting holes (carbon steel versions); blind riv-nuts (stainless steel versions)
Foamed-in-place gasket
Zinc-plated mounting panel included
Slope Top enclosures have a 20° sloped roof that overhangs the door

Material:
Housing and door (carbon steel):
Dip-coat primed, powder-coated
RAL 7035 light gray
- 12”H x 12”W - 24”H x 20”W, 16 ga (1.5 mm) body and door
- 24”H x 24”W - 36”H x 24”W, 16 ga (1.5 mm) body and 14 ga (2.0 mm) door
- 36”H x 30”W - 60”H x 36”W, 14 ga (2.0 mm) body and door

Housing and door (stainless steel):
Stainless Steel, #4 Brushed Finish

Protection Ratings:
-Single door, disconnect and slope top enclosures
UL/cUL Type 1, 3R, 12, 4 (4X stainless steel)
-Double door enclosures
UL/cUL Type 1, 12
UL File Number E170282





Slope Top Design

Understanding the Part Number:

WM S 12 12 06 N C

- **WM** — **Product Type**
- **S** — **Slope Top Version**
- **12** — **Height**
- **12** — **Width**
- **06** — **Depth**
- **N** — **Disconnect**: N = Non-disconnect, X = Disconnect
- **C** — **Material**: C = Carbon Steel, 4 = Stainless Steel 304, 6 = Stainless Steel 316L

WM Wallmount Enclosures—Carbon Steel

Part No.	Description	Door(s)	H (in)	H (mm)	W (in)	W (mm)	D (in)	D (mm)	Mounting Panel (included)*	Panel H (in)	Panel H (mm)	Panel W (in)	Panel W (mm)
WM121206NC	WM 12x12x6 Carbon Steel	1	12	300	12	300	6	150	**WMMP1212**	11	275	10	254
WM161206NC	WM 16x12x6 Carbon Steel	1	16	400	12	300	6	150	**WMMP1612**	15	375	10	254
WM161606NC	WM 16x16x6 Carbon Steel	1	16	400	16	400	6	150	**WMMP1616**	15	375	14	354
WM162006NC	WM 16x20x6 Carbon Steel	1	16	400	20	500	6	150	**WMMP1620**	15	375	18	449
WM201606NC	WM 20x16x6 Carbon Steel	1	20	500	16	400	6	150	**WMMP2016**	19	475	14	354
WM202006NC	WM 20x20x6 Carbon Steel	1	20	500	20	500	6	150	**WMMP2020**	19	475	18	449
WM241606NC	WM 24x16x6 Carbon Steel	1	24	600	16	400	6	150	**WMMP2416**	22	570	14	354
WM242006NC	WM 24x20x6 Carbon Steel	1	24	600	20	500	6	150	**WMMP2420**	22	570	18	449
WM242406NC	WM 24x24x6 Carbon Steel	1	24	600	24	600	6	150	**WMMP2424**	22	570	22	549
WM302406NC	WM 30x24x6 Carbon Steel	1	30	760	24	600	6	150	**WMMP3024**	29	730	22	549
WM161208NC	WM 16x12x8 Carbon Steel	1	16	400	12	300	8	210	**WMMP1612**	15	375	10	254
WM161608NC	WM 16x16x8 Carbon Steel	1	16	400	16	400	8	210	**WMMP1616**	15	375	14	354
WM162008NC	WM 16x20x8 Carbon Steel	1	16	400	20	500	8	210	**WMMP1620**	15	375	18	449
WM201608NC	WM 20x16x8 Carbon Steel	1	20	500	16	400	8	210	**WMMP2016**	19	475	14	354
WM202008NC	WM 20x20x8 Carbon Steel	1	20	500	20	500	8	210	**WMMP2020**	19	475	18	449
WM202408NC	WM 20x24x8 Carbon Steel	1	20	500	24	600	8	210	**WMMP2024**	19	475	22	549
WM241608NC	WM 24x16x8 Carbon Steel	1	24	600	16	400	8	210	**WMMP2416**	22	570	14	354
WM242008NC	WM 24x20x8 Carbon Steel	1	24	600	20	500	8	210	**WMMP2420**	22	570	18	449
WM242408NC	WM 24x24x8 Carbon Steel	1	24	600	24	600	8	210	**WMMP2424**	22	570	22	570
WM243008NC	WM 24x30x8 Carbon Steel	1	24	600	30	760	8	210	**WMMP2430**	22	570	28	704
WM244208NC	WM 24x42x8 Carbon Steel	2	24	600	42	1050	8	210	**WMMP2442**	22	550	39	1000

*See page 14 for additional mounting panel options

WM Wallmount Enclosures

WM Wallmount Enclosures—Carbon Steel Disconnect

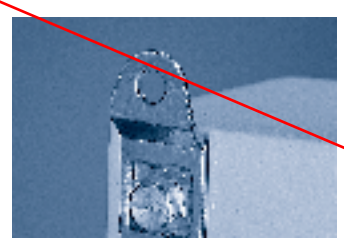
Part No.	Description	Door(s)	H (in)	H (mm)	W (in)	W (mm)	D (in)	D (mm)	Mounting Panel (included)*	Panel H (in)	Panel H (mm)	Panel W (in)	Panel W (mm)
WM202208XC	WM20x22x8	1	20	500	22	550	8	210	**WMMP2020**	19	470	18	449
WM242208XC	WM 24x22x8 Carbon Steel	1	24	600	22	550	8	210	**WMMP2422**	22	570	18	449
WM242608XC	WM 24x26x8 Carbon Steel	1	24	600	26	650	8	210	**WMMP2426**	22	570	22	549
WM302608XC	WM 30x26x8 Carbon Steel	1	30	760	26	650	8	210	**WMMP3026**	29	730	22	549
WM363208XC	WM 36x32x8 Carbon Steel	1	36	900	31	825	8	210	**WMMP3630**	34	870	28	704
WM363210XC	WM 36x32x10 Carbon Steel	1	36	900	32	825	10	250	**WMMP3630**	34	870	28	704
WM603810XC	WM 60x38x10 Carbon Steel	1	60	1500	38	975	10	250	**WMMP6036**	57	1455	33	840
WM302612XC	WM 30x26x12 Carbon Steel	1	30	760	26	650	12	30	**WMMP3026**	29	730	22	549
WM363212XC	WM 36x32x12 Carbon Steel	1	36	900	32	825	12	300	**WMMP3630**	34	870	29	730
WM423212XC	WM 42x32x12 Carbon Steel	1	42	1050	32	825	12	300	**WMMP4230**	40	1020	29	730
WM423812XC	WM 42x38x12 Carbon Steel	1	42	1050	38	975	12	300	**WMMP4236**	40	1020	33	840
WM483812XC	WM 48x38x12 Carbon Steel	1	48	1200	38	975	12	300	**WMMP4836**	45	1155	33	840
WM603812XC	WM 60x38x12 Carbon Steel	1	60	1500	38	976	12	300	**WMMP6036**	57	1455	33	840
WM483816XC	WM 48x38x16 Carbon Steel	1	48	1200	38	975	16	400	**WMMP4836**	45	1155	33	840
WM603816XC	WM 60x38x16 Carbon Steel	1	60	1500	38	975	16	400	**WMMP6036**	57	1455	33	840

*See page 14 for additional mounting panel options

WM Wallmount Enclosures—Type 304 Stainless Steel

Part No.	Description	Door(s)	H (in)	H (mm)	W (in)	W (mm)	D (in)	D (mm)	Mounting Panel (included)*	Panel H (in)	Panel H (mm)	Panel W (in)	Panel W (mm)
WM121206N4	WM 12x12x6 Type 304	1	12	300	12	300	6	150	**WMMP1212**	11	275	10	254
WM161206N4	WM 16x12x6 Type 304	1	16	400	12	300	6	150	**WMMP1612**	15	375	10	254
WM161606N4	WM 16x16x6 Type 304	1	16	400	16	400	6	150	**WMMP1616**	15	375	14	354
WM201606N4	WM 20x16x6 Type 304	1	20	500	16	400	6	150	**WMMP2016**	19	475	14	354
WM202006N4	WM 20x20x6 Type 304	1	20	500	20	500	6	150	**WMMP2020**	19	475	18	449
WM161208N4	WM 16x12x8 Type 304	1	16	400	12	300	8	210	**WMMP1612**	15	375	10	254
WM201608N4	WM 20x16x8 Type 304	1	20	500	16	400	8	210	**WMMP2016**	19	475	14	354
WM202008N4	WM 20x20x8 Type 304	1	20	500	20	500	8	210	**WMMP2020**	19	470	18	449
WM241608N4	WM 24x16x8 Type 304	1	24	600	16	400	8	210	**WMMP2416**	22	570	14	354
WM242008N4	WM 24x20x8 Type 304	1	24	600	20	500	8	210	**WMMP2420**	22	570	18	449
WM242408N4	WM 24x24x8 Type 304	1	24	600	24	600	8	210	**WMMP2424**	22	570	22	549
WM302408N4	WM 30x24x8 Type 304	1	30	760	24	600	8	210	**WMMP3024**	29	730	22	549
WM303008N4	WM 30x30x8 Type 304	1	30	760	30	760	8	210	**WMMP3030**	29	730	28	704
WM362408N4	WM 36x24x8 Type 304	1	36	900	24	600	8	210	**WMMP3624**	34	870	22	549
WM363008N4	WM 36x30x8 Type 304	1	36	900	30	760	8	210	**WMMP3630**	34	870	28	704
WM242010N4	WM 24x20x10 Type 304	1	24	600	20	500	10	250	**WMMP2420**	22	570	18	449
WM303010N4	WM 30x30x10 Type 304	1	30	760	30	760	10	250	**WMMP3030**	29	730	28	704
WM483610N4	WM 48x36x10 Type 304	1	48	1200	36	900	10	250	**WMMP4836**	45	1155	33	840
WM242412N4	WM 24x24x12 Type 304	1	24	600	24	600	12	300	**WMMP2424**	23	570	22	549
WM302412N4	WM 30x24x12 Type 304	1	30	760	24	600	12	300	**WMMP3024**	29	730	22	549
WM363012N4	WM 36x30x12 Type 304	1	36	900	30	760	12	300	**WMMP3630**	34	870	28	704
WM363612N4	WM 36x36x12 Type 304	1	36	900	36	900	12	300	**WMMP3636**	34	870	33	840
WM423612N4	WM 42x36x12 Type 304	1	42	1050	36	900	12	300	**WMMP4236**	40	1020	33	840
WM483612N4	WM 48x36x12 Type 304	1	48	1200	36	900	12	300	**WMMP4836**	45	1155	33	840
WM603612N4	WM 60x36x12 Type 304	1	60	1500	36	900	12	300	**WMMP6036**	57	1455	33	840
WM363016N4	WM 36x30x16 Type 304	1	36	900	30	760	16	400	**WMMP3630**	34	870	28	704
WM483616N4	WM 48x36x16 Type 304	1	48	1200	36	900	16	400	**WMMP4836**	46	1155	33	840
WM603616N4	WM 60x36x16 Type 304	1	60	1500	36	900	16	400	**WMMP6036**	57	1455	33	840

*See page 14 for additional mounting panel options



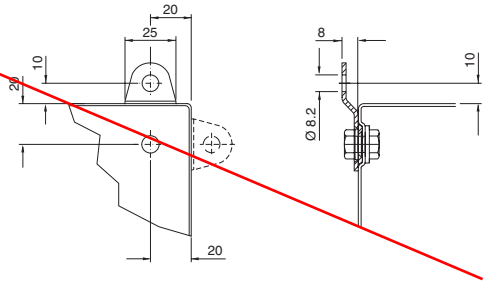
Wallmounting bracket

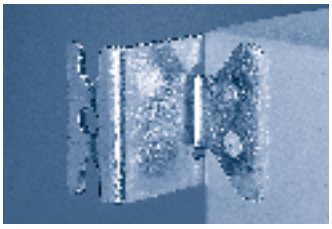
For the attachment of KL, EB, BG and EL enclosures as well as DK and FM wallmounted distributors.

Configuration:
Assembly hardware for mounting on the enclosure.

Note:
For hygiene reasons, and to ensure the protection category, the stainless steel enclosures do not have any drilled holes for the wallmounting brackets.

Material	Wall distance inches (mm)	PU	Part No. KL
Brass nickel-plated	0.3 (8)	4.000	**1580.000**
Sheet steel zinc-plated, passivated	0.3 (8)	4.000	**1590.000**
Type 304 stainless steel	0.3 (8)	4.000	**1594.000**





Wallmounting bracket

For the attachment of KL, EB, AE, CM

Configuration:
Assembly hardware for mounting on the enclosure.

Note:
For hygiene reasons, and to ensure the protection category, the stainless steel enclosures do not have any drilled holes for the wallmounting brackets.

RittalXpress

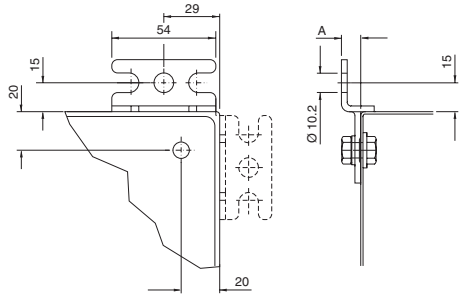
AE Carbon Steel, Stainless Steel

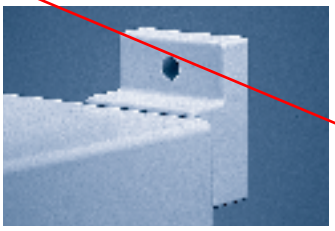
WM Carbon Steel, Stainless Steel

Material	Wall distance (A) inches (mm)	PU	Part No. SZ
Sheet steel zinc-plated, passivated	1.6 (40)	1	**2503.000** [1]
		4	**2503.200**
	0.4 (10)	1	**2508.000** [1]
		4	**2508.200**
Type 304 stainless steel	0.4 (10)	4	**2433.000**

1) Without assembly hardware.

Black cells indicate Rittal Xpress product.





Wallmounting bracket

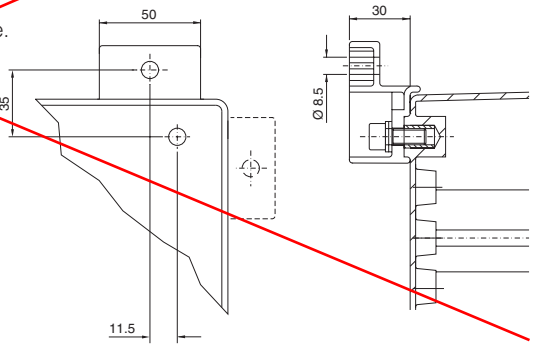
For KS
For attachment to the wall, only possible from the outside of the enclosure.

Material:
Fiberglass-reinforced polyamide1)

Configuration:
Assembly hardware for mounting on the enclosure.

Color	PU	Part No. KS/KE
Similar to RAL 7035 (light gray)	4	**1483.010**

1) With graphite additive for Ex applications



Door variants

Trim frame

for TS

To conceal the TS 8 front frame in enclosures without a door. Can be combined with large swing frames. Possible application areas include:
– Studio technology
– Electronic configuration

Material:
Carbon steel

Color:
RAL 7035

Configuration:
Assembly parts

For enclosures		Part No.
Height inches (mm)	Width inches (mm)	
79 (2000)	24 (600)	**7824.130**
79 (2000)	32 (800)	**7824.132**

Note:
The trim frame conceals the side system punchings in the inner mounting level.
The TS punched sections with mounting flange 0.9" x 2.9" (23 x 73 mm) may be used for installation (see page 653).

Interior door

with mounting frame for AE IP 69K

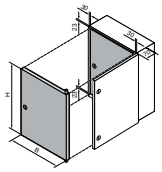
For the installation of control and display components. Mounting frame, depth-adjustable for a distance between the outer surface and the inside of the outer door of 1.4" to 3.3" (35 to 85 mm), 3.1" (80 mm) with 1101.010/.110.

Material: Carbon steel, 16 ga (1.5 mm)

Color: RAL 7035

Configuration:
– Mounting frame
– Door with cam lock and screwdriver insert
– Assembly parts

For AE enclosure	H inches (mm)	W (B) inches (mm)	Part No.
1101.010/.110	10 (260)	6 (160)	**1101.910**
1101.020/.120	13 (330)	13 (330)	**1101.920**
1101.030/.130	23 (580)	13 (330)	**1101.930**
1101.040/.140	23 (580)	23 (580)	**1101.940**



Dead front kits

for WM

Provides a UL 1 safety barrier and mounting surface towards the front of WM wallmount enclosures. Easy installation and can be retrofitted to existing enclosures.

Material:
Carbon Steel, RAL 7035 (light grey)

Configuration:
Mounting brackets, panel, and hardware

Enclosure Height inches (mm)	Enclosure Width inches (mm)	Part No. Carbon Steel
12 (305)	12 (305)	**DFK1212C**
16 (406)	12 (305)	**DFK1612C**
16 (406)	16 (406)	**DFK1616C**
16 (406)	20 (508)	**DFK1620C**
20 (508)	16 (406)	**DFK2016C**
20 (508)	20 (508)	**DFK2020C**
20 (508)	24 (610)	**DFK2024C**
24 (610)	16 (406)	**DFK2416C**
24 (610)	20 (508)	**DFK2420C**
24 (610)	24 (610)	**DFK2424C**
24 (610)	30 (762)	**DFK2430C**
30 (762)	20 (508)	**DFK3020C**
30 (762)	24 (610)	**DFK3024C**
30 (762)	30 (762)	**DFK3030C**
36 (914)	24 (610)	**DFK3624C**
36 (914)	30 (762)	**DFK3630C**
36 (914)	36 (914)	**DFK3636C**
42 (1067)	30 (762)	**DFK4230C**
42 (1067)	36 (914)	**DFK4236C**
48 (1219)	36 (914)	**DFK4836C**
60 (1524)	36 (914)	**DFK6036C**

8018665

Lock systems

Lock cylinder insert

Design	B	C
		
	With lock no. 3524 E[1)]	With lock no. 3524 E[1)]
Material	Die-cast zinc	Die-cast zinc
Part No.	**2571.000**	**2525.000**

[1)] With 2 keys

Semi-cylinder lock

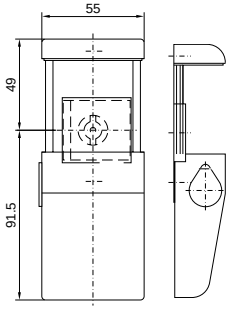
for compact enclosures AE/WM

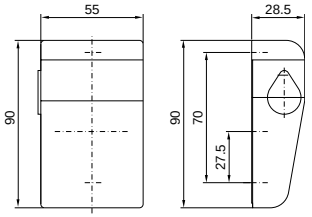
For retro-fitting to single-door enclosures with cam lock. The cover plate is locked by semi-cylinders with a total length of 40/45 mm (to DIN 18 252). An additional cover protects the cylinder against dirt. The protection category of the enclosure is not impaired. Supplied without semi-cylinder.

Surface finish	Part No.
RAL 7035	**2534.100**
Nickel-plated (matte)	**2534.500**

Material:
Die-cast zinc

Accessories:
Semi-cylinder, see page 602





Lock cover

For padlocks or multiple locks

For retrospective mounting on all compact enclosures AE/WM, of carbon steel and with cam lock.

Packs of	Part No.
1	**2493.000**

Material:
Die-cast zinc

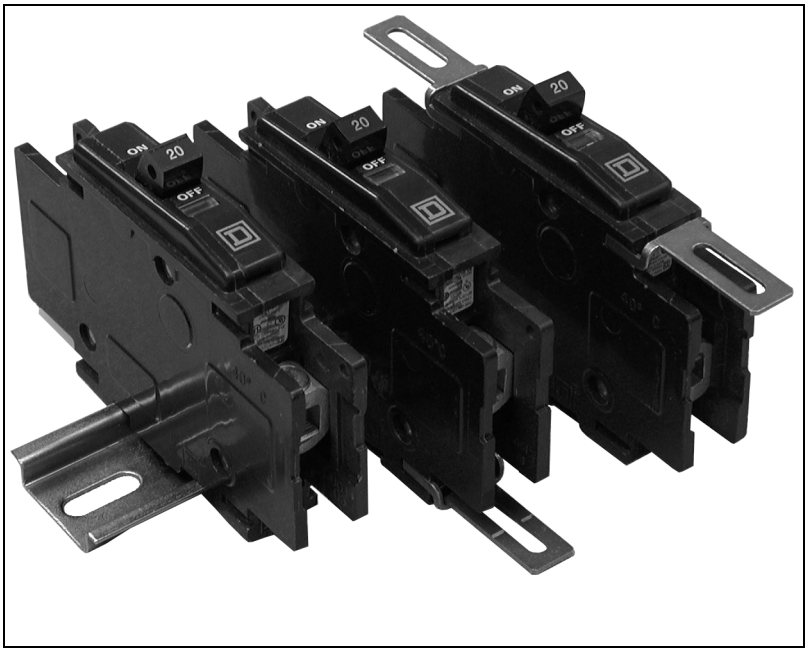
Surface finish:
Nickel-plated

QOU Miniature Circuit Breakers and Switches

Unit Mount (Cable-in/Cable-out)

Class 720

Catalog
September
2005



CONTENTS

APPLICATION INFORMATION

QOU Miniature Circuit Breaker Types

Miniature molded case circuit breakers are intended for use in residential and commercial applications. They are tested and listed according to UL Standard 489 and CSA Standard C22.2 No. 5-02 for molded case circuit breakers and enclosures.

QOU miniature circuit breakers are unit-mount (lug/lug) thermal-magnetic circuit breakers which:

- Provide a means to manually open a circuit.
- Automatically open a circuit under overload or short circuit conditions.
- Feature common tripping of all poles.
- Have a Visi-Trip® trip indicator.
- Can be flush-, surface-, or DIN rail-mounted.
- Has lugs at both ends (cable-in/cable-out construction)
- Operate in any position.
- Are fully tested, UL Listed, and CSA certified for reverse connection without restrictive line/load markings.

Non-automatic Switches

QOU non-automatic switches are intended for use as disconnect devices only. UL Standard 489 requires switches to be protected by a thermal-magnetic circuit breaker (or fuse) of equivalent rating. QOU switches are UL Listed for use on circuits capable of delivering not more than 10,000 amperes when protected by an equivalent rated circuit breaker or fuse. QOU switches contain no automatic tripping mechanisms and do not provide overcurrent protection.

Description

QOU miniature circuit breakers and switches are available for surface-, flush-, or DIN rail mounted applications in one-, two-, and three-pole constructions. QOU miniature circuit breakers are used for overcurrent protection and switching on both ac and dc electrical systems. QOU circuit breakers and switches measure 0.75 in. (19 mm) wide per pole. Two- and three-pole circuit breakers are both equipped with an internal crossbar for common tripping of all poles. QOU switches are available in one-pole, 60 ampere and two- and three-pole, 60, 100 and 125 ampere construction.

Cases for QOU miniature circuit breakers and switches are constructed of a glass-reinforced insulating material that provides high dielectric strength. Current carrying components are isolated from the handle. The handle position indicates whether the circuit breaker is off, on or tripped.

Applications

One-pole QOU miniature circuit breakers rated 120/240 Vac are UL Listed for use on 120/240 Vac single-phase, three-wire or 208Y/120 Vac three-phase, four-wire electrical systems.

Two-pole QOU circuit breakers rated 120/240 Vac are UL Listed for use on 120/240 Vac single-phase, three-wire or 208Y/120 Vac three-phase, four-wire electrical systems. They cannot be used on 240 Vac delta systems. Use QOU-H two-pole circuit breakers rated 240 Vac on 240 Vac delta and 240 Vac single-phase, two wire systems.

Three-pole QOU circuit breakers rated 240 Vac are UL Listed for use on any system where the maximum phase-to-phase or phase-to-ground voltage is 240 Vac or less.

For application information on other systems, contact your local field office

Table 1: Selection Data

Rating	Catalog Number						Terminal Lug Wire Size (AWG)
	One-Pole		Two-Pole			Three-Pole	
	120/240 Vac		120/240 Vac	240 Vac	120/240 Vac	240 Vac	
	10K AIR	22K AIR	10 K AIR		22K AIR	10K AIR	
10 A	QOU110	—	QOU210	—		QOU310	
15 A	QOU115*	QOU115VH	QOU215*	QOU215H*	QOU215VH	QOU315*	
15 A	QOU115HM*†	—	—	—		—	
20A	QOU120*	QOU120VH	QOU220*	QOU220H*	QOU220VH	QOU320*	
20 A	QOU120HM*†	—	—	—		—	
25 A	QOU125*	QOU125VH	QOU225*	QOU225H*	QOU225VH	QOU325*	1—#14–#2
30 A	QOU130*	QOU130VH	QOU230*	QOU230H*	QOU230VH	QOU330*	Cu or Al
35 A	QOU135*	QOU135VH	QOU235*	—	QOU235VH	QOU335*	
40 A	QOU140*	QOU140VH	QOU240*	—	QOU240VH	QOU340*	
45 A	QOU145*	QOU145VH	QOU245*	—	QOU245VH	QOU345*	
50 A	QOU150*	QOU150VH	QOU250*	—	QOU250VH	QOU350*	
60 A	QOU160*	QOU160VH	QOU260*	—	QOU260VH	QOU360*	
70 A	QOU170*	—	QOU270*	—	—	QOU370‡	
80 A	QOU180‡	—	QOU280‡	—	—	QOU380‡	
90 A	QOU190‡	—	QOU290‡	—	—	QOU390‡	1—#12–#2/0
100 A	QOU1100‡	—	QOU2100‡	—	—	QOU3100‡	Cu or Al
125 A	—	—	QOU2125‡	—	—	—	
Switch—60 Amperes Max.—240 Vac				QOU200		QOU300	1—#14–#2
Switch—100 Amperes Max.—240 Vac				QOU2000‡		QOU3000‡	1—#12–#2/0
Switch—125 Amperes Max.—240 Vac				QOU20001‡		QOU30001‡	

* UL Listed as HACR type for use with heating, air conditioning and refrigeration equipment containing motor-group combinations and marked for use with HACR type circuit breakers.

† High-magnetic trip circuit breakers. Recommended for applications where high initial inrush current can occur and for individual dimmer applications.

‡ Available as Series 1 with forward box lugs only. (No optional terminations)

Tripping Mechanisms

A tripping mechanism is an assembly within the circuit breaker molded case that causes the circuit breaker to open automatically under sustained overload or short circuit conditions.

The tripping mechanisms in two- and three-pole circuit breakers operate such that an overcurrent on any pole of the circuit breaker will cause all poles of the circuit breaker to open simultaneously. Thermal and magnetic factory calibration (with current) is performed on each pole of every Square D circuit breaker.

These mechanisms operate to trip the circuit breaker:

- Thermal trip
- Magnetic trip
- Optional shunt trip accessory (see Accessories, page 12)

The sensing system is an integral part of a thermal-magnetic circuit breaker. The sensing system continually monitors current flowing through the circuit breaker. It detects abnormal current conditions and, depending on the magnitude of the current, initiates an inverse-time or an instantaneous tripping response. This action causes the tripping mechanism to open the circuit breaker contacts and interrupt current flow. The speed of the tripping process must be controllable and inversely matched to the severity of the overcurrent. QOU miniature circuit breakers have an over-center toggle mechanism for quick-make, quick-break action with positive handle indication. The handle assumes a position between ON (I) and OFF (O) when the circuit breaker has tripped.

Thermal Trip

The thermal trip element of a circuit breaker is a root-mean-squared (rms) current sensing device. The thermal element, or bimetal, is constructed from metals with dissimilar rates of expansion bonded together. The thermal element responds to overloads by reacting to the heat generated both by the current flowing through the circuit breaker and by the heat contribution from ambient conditions. The bending force of the bimetal causes the circuit breaker to trip (see Figure 1). The deflection of the bimetal is predictable as a function of current and time. This is the inverse time tripping characteristic of the thermal element, i.e., the tripping time decreases as the magnitude of the current increases.

Square D calibrates the thermal elements and they are not field-adjustable. The thermal trip elements are calibrated for 40° C (104° F) ambient temperature, per UL Standard 489 and CSA Standard C22.2 No. 5-02.

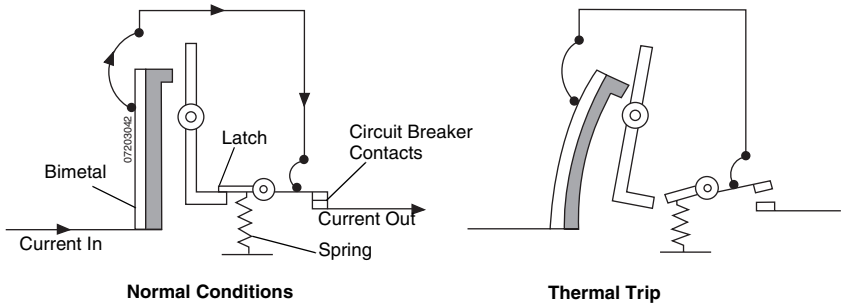


Figure 1: Thermal Tripping

Magnetic Trip

The magnetic (instantaneous) trip element uses an electromagnetic assembly to trip the circuit breaker instantaneously (with no intentional delay) at or above a predetermined current value. During a short circuit of sufficient magnitude, the high-level current passing through the conductor rapidly increases the magnetic field of the electromagnet that attracts the armature. As the armature is drawn toward the electromagnet, it initiates an unlatching action and opens the circuit breaker contact (see Figure 2).

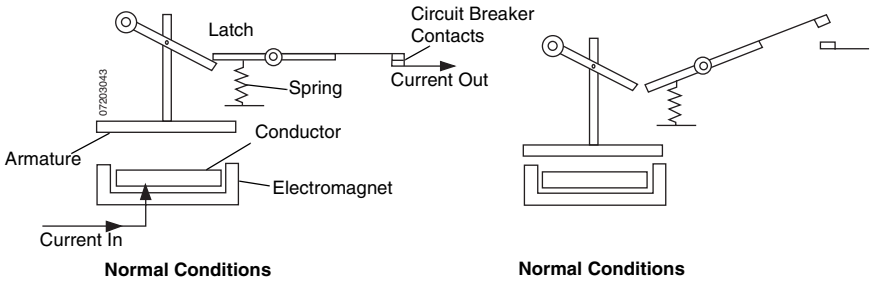


Figure 2: Magnetic Tripping

Trip Indicator

When the QOU miniature circuit breaker is tripped, the handle assumes a position between ON (I) and OFF (O) and the red Visi-Trip® indicator (A) appears in a window in the circuit breaker case. Reset the circuit breaker and Visi-Trip indicator by pushing the handle to OFF and then to ON.

Line and Load Connections

QOU miniature circuit breakers are supplied with two types of lug configuration as standard, depending on the continuous current rating:

- 10–70 ampere one- and two-pole; reversible lugs
- 10–60 ampere three-pole; reversible lugs
- Other ampere ratings; forward lugs only

The box-type lugs supplied on QOU miniature circuit breakers are UL Listed and CSA certified to accept solid or stranded, aluminum or copper conductors These lugs are UL Listed to be used with wire rated at 140° F, 167° F and 194° F (60° C, 75° C and 90° C), sized according to the NEC 176° F (75° C) temperature rating. See the Accessories section for more information on terminations.

Optional terminations, such as quick connectors, are also available. See the Accessories section for more information on terminations.

Ring-tongue terminals can be factory ordered using the following catalog number designations:

- QOU_ _ _3100 (ring-tongue terminal wired from front)
- QOUR_ _ _5283 (ring-tongue terminal wired from rear)

Mounting Provisions

QOU miniature circuit breakers are supplied with mounting brackets for both line and load side support. Mounting brackets are field installable and can be attached to the front or back of the circuit breaker molded case. See the Accessories section for more information on mounting brackets. Tapped mounting feet can be ordered using the catalog number designation QOU_ _ _3100.

All QOU miniature circuit breakers also come equipped with slots in the molded case for DIN rail mounting.

These miniature circuit breakers are designed for use with a standard 35 mm DIN mounting rail (DIN/EU 50 022, 0.30 x 1.38 in. [7.5 mm x 35 mm]).

Standards

Square D brand QOU miniature circuit breakers are manufactured and tested according to the following standards:

- UL Standard 489 (File E84967)
- NEMA Standard AB1
- Canadian Standards Association CSA C22.2 No. 5-02
- IEC 60947-2
- CE

Square D brand QOU non-automatic switches comply with:

- UL Standard 489
- Canadian Standards Association CSA C22.2 No. 5-02

NOTE: Circuit breakers are to be applied by guidelines detailed in the NEC and other applicable electrical codes.

Catalog Numbers

Square D brand circuit breakers are ordered by a catalog number that includes the circuit breaker family, description, number of poles, amperage rating and suffix.

Table 2: Catalog Numbers

Typical Catalog Number:

	QO	U	2	30	H	2100
QO Miniature Circuit Breaker Family						
Description						
U – Unit Mounted (Lugs on Both Ends)						
No. of Poles						
1 – 1-pole						
~~2 – 2-pole~~						
~~3 – 3-pole~~						
Ampere Rating						
10–125 Ampere Rating						
00 = 60 A, 000 = 100 A, and 0001 - 125 A QOU Switch						
Rating						
~~1- and 2-pole~~		2-pole		3-pole		
No Letter-Standard 120/240 Vac Rating		VH - 22,000 AIR		No Letter - 240 Vac Rating		
VH - 22,000 AIR		H-240 Vac Rating		VH - 22,000 AIR		
Suffix						
~~XXX (i.e., 2100) - Indicates Factory-installed Accessory (See page 12)~~						

Ratings for QOU Miniature Circuit Breakers

When designing an electrical distribution system, overcurrent protective devices are generally selected based on performance requirements. Factors influencing this selection include system voltage, continuous current, interrupting rating and frequency.

QOU circuit breakers are selected by their ratings. A circuit breaker's rating must meet or exceed the parameters of the electrical system on which they are used.

Voltage Rating

A circuit breaker can be rated for alternating current (ac) or direct current (dc) or both. The established voltage rating of a circuit breaker is based on design parameters such as clearance of current carrying parts and dielectric withstand tests both through air and over surfaces. Voltage ratings indicate the maximum voltage for the electrical system on which the circuit breaker can be applied.

The circuit breaker must have a voltage rating greater than or equal to the system voltage. When a circuit breaker clears an overcurrent, it does so in two steps: First, the current sensing system identifies the overcurrent and releases the tripping mechanism. This results in a parting of the contacts. Then the circuit breaker must extinguish the voltage arc across the contacts. If the circuit breaker has the correct voltage rating, it can efficiently extinguish this voltage arc. QOU miniature circuit breakers are rated in the following UL 489 voltages, as shown in Table 3:

- 120/240 Vac
- 240 Vac
- 48 Vdc
- 60 Vdc
- 277 Vac for QYU, UL 1077 recognized supplementary protector only (not a branch circuit breaker)

Interrupting Rating

The interrupting rating of a circuit breaker is the highest current at rated voltage that the circuit breaker is intended to interrupt under standard test conditions. Circuit breakers must be chosen with interrupting ratings equal to or greater than the maximum available short-circuit current at the point where the circuit breaker is applied in the system (See Table 3).

Table 3: Interrupting Rating

Circuit Breaker Type	No. of Poles	Ampere Rating	UL Listed Interrupting Rating—RMS Sym. Amperes				
			AC Volts			DC Volts[1]	
			120/240	240	277	48	60
QOU	1	10–30	NA	NA	5 kA		
		10–70	10 kA	NA	NA	5 kA	NA
		80–100	10 kA	NA	NA	NA	5 kA
	2	10–70	10 kA	NA	NA	5 kA	NA
		80–125	10 kA	NA	NA	NA	5 kA
	3	10–70	NA	10 kA	NA	5 kA	NA
		80–100	NA	10 kA	NA	NA	5 kA
QOU-H	2	15–30	NA	10 kA	NA	5 kA	NA
QOU-VH	2	15–60	22 kA	NA	NA	5 kA	NA

NA = Not Applicable

[1] DC ratings do not apply to circuit breakers rated for 10 A

Continuous Current Rating

The continuous current rating of a circuit breaker is defined by the National Electrical Manufacturers Association (NEMA) as: “The maximum direct current or rms current, in amperes, at rated frequency which a device or assembly will carry continuously without exceeding the specified limits of observable temperature rise.” Sometimes referred to as the ampere rating or handle rating of the circuit breaker, the continuous current rating relates to the system current flow under normal conditions.

UL Standard 489 states that circuit breakers must carry 100% of their continuous current rating indefinitely (without tripping) at 104° F (40° C) in free air. QOU circuit breakers should be applied, per the NEC, to carry 80% of their continuous current ratings in the intended enclosure. The continuous current rating is indicated on the handle of each circuit breaker. See Table 1.

Switching Duty

The switching duty (SWD) listing applies only to 15 A and 20 A circuit breakers rated at 277 Vac or less. The circuit breakers are subjected to specified temperature rise tests at predetermined periods during the endurance operations.

UL HACR Type

HACR is an acronym that designates circuit breakers certified to be used on heating, air conditioning, and refrigeration loads. The 9th edition of UL489 eliminated special testing requirements for HACR certification, and the 2005 NEC eliminated the requirement for special HACR marking. HACR marking is no longer necessary for circuit breakers used in these applications in states and localities where the 2005 NEC has been adopted.

QOU circuit breakers will continue to carry the HACR marking to meet the rquirements of previous NEC Sections 430 and 440 in areas where the 2005 NEC has not yet been adopted. In older versions of the NEC, Article 430-53(c) required that each circuit breaker must be of the inverse time type, and be approved for group installation. The 2005 NEC eliminated the group installation clause of this article.

The following QOU miniature circuit breakers will continue to carry the HACR label:

- 10–100 A, one-pole
- 10–125 A, two-pole
- 10–100 A, three-pole

High Magnetic

QOU-HM circuit breakers are recommended for area lighting (athletic fields, parking lots, outdoor signs, etc.) when using lamps of inherent high inrush current or individual dimmer applications, or other applications where high inrush current exceeds standard tripping conditions. These circuit breakers are available in 15 A and 20 A only.

QOU-HM circuit breakers are manufactured with the magnetic trip point calibrated at a much higher level than standard QOU circuit breakers. Table 4 lists the magnetic trip levels to which high-magnetic circuit breakers are calibrated:

Table 4: QOU-HM Circuit Breaker Magnetic Trip Levels

QOU-HM Circuit Breakers	Max. Full-Cycle Magnetic Hold Level	
15 A	21–35 x In	315–525 A
20 A	16–26 x In	322–537 A

Ambient Temperature Rating

To meet the requirements of UL 489 and the Canadian Standards Association, thermal-magnetic circuit breakers are designed, built and calibrated for use on 50/60 Hz ac systems in a 104° F (40° C) ambient temperature. Time/current characteristic trip curves are drawn from actual test data that meets UL 489 testing requirements.

The ambient temperature is the temperature of the air surrounding the circuit breaker. Thermal-magnetic circuit breakers are temperature-sensitive devices, and their rated continuous current carrying capacity is based on a UL specified 104° F (40° C) calibration temperature. The ambient temperature can affect the performance characteristics of the circuit breaker. Thus, when applying a circuit breaker at temperatures other than 104° F (40° C), it is necessary to determine the circuit breaker's actual current carrying capacity under this condition. Further, it may be necessary to rerate the circuit breaker to compensate for these ambient conditions. See Figure 3:

Thermal-magnetic circuit breakers use bimetal strips that bend in response to temperature changes. Current flowing through the circuit breaker creates most of the heat that causes the tripping action. The ambient temperature surrounding the circuit breaker either adds to or subtracts from this available heat. Conductors are sized using the ampacity rerating factors shown on the bottom of NEC Table 310-16 when designing systems for ambient temperatures other than 40° C.

Rerating of Thermal-magnetic Circuit Breakers for Ambient Conditions

Square D thermal-magnetic circuit breakers are to be applied in ambient temperatures within the range of 14° F to 140° F (-10° C to 60° C). Use the following rerating guidelines:

- Ambient Temperatures Between 77° F and 104° F (25° C and 40° C):
  - — No rerating is necessary.
- Ambient Temperatures Between 14° F and 75° F (-10° C and 24° C):
  - — Thermal-magnetic circuit breakers operating within this ambient temperature range will carry more than their continuous current rating without tripping. Conductor and equipment damage can result if they are not in the same low ambient environment as the circuit breaker.
  - — Nuisance tripping will not be a problem. However, if closer protection of the equipment and conductor is required, the increased current carrying capacity of the circuit breaker at the lower ambient temperature should be taken into consideration.
- Ambient Temperatures Between 106° F and 140° F (41° C and 60° C):
  - — Thermal-magnetic circuit breakers operating within this ambient temperature range will carry less than their continuous current rating and must be carefully selected to prevent nuisance tripping.

To determine the continuous current carrying capacity of a thermal-magnetic circuit breaker at an ambient temperature other than 104° F (40° C), perform the following steps:

1. Choose the ambient rerating curve in Figure 3 for the specific amperage rating of the circuit breaker you wish to apply. Note that the curve crosses the 104° F (40° C) ambient temperature line at the circuit breaker's rated continuous current carrying capacity (Circuit Breaker Handle Rating on the curve).
2. Follow this curve to the appropriate ambient temperature.
3. Read the adjusted continuous current carrying capacity at this point (on the left axis).
4. Add in any other applicable factors, such as continuous loading, per the NEC requirement.

Figure 3: Ambient Rerating of QOU Circuit Breaker

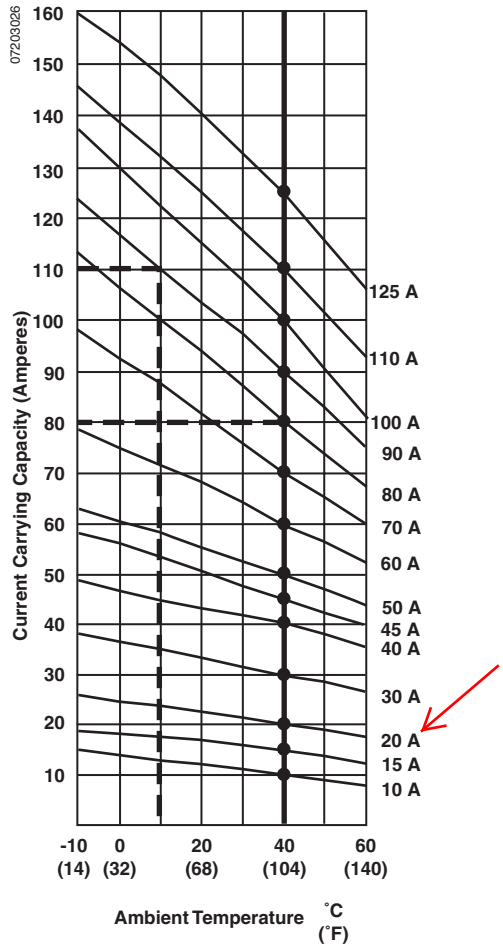
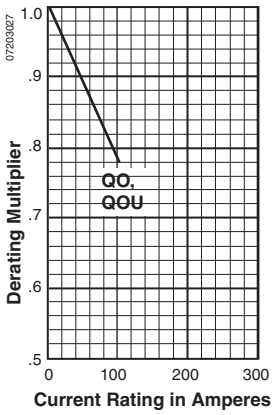


Figure 4: Frequency Rerating of QOU Circuit Breaker at 400 Hz



For example, Figure 3 shows the ambient rerating curves for QOU miniature circuit breakers. What is the continuous current capacity of a 80 A circuit breaker applied at 104° F (40° C)? A 90 A circuit breaker at 50° F (10° C)?

By finding 40° C on the horizontal axis and reading up to the 80 A curve, you find that the circuit breaker will carry 80 A, which is its rated current carrying capacity. If the circuit breaker will be used on a continuous load (defined as three hours or more), Section 210-20(a) of the 2005 NEC requires that loading not exceed 80% of the rating. Here, 80 A x .80 = 64 A.

Locate 50° F (10° C) on the horizontal axis and move straight up to the 90 A curve. The circuit breaker will carry 110 A. Again, if the circuit is used on a continuous load, it must be applied at 80% of its rating. In this example the equation is 110 A x .80 = 88 A.

As explained in Section 210-20(a) of the NEC:

> "Where a branch circuit supplies continuous loads or any combination of continuous and noncontinuous loads, the rating of the overcurrent device shall not be less than the noncontinuous load plus 125 percent of the continuous load.
>
> "Exception: Where the assembly, including the overcurrent devices protecting the branch circuit(s), is listed for operation at 100 percent of its rating, the ampere rating of the overcurrent device shall be permitted to be not less than the sum of the continuous load plus the noncontinuous load."

Frequency Rating

The standard-rated frequency for circuit breakers is 60 Hz, but Square D circuit breakers can be applied on 50 Hz systems without thermal or magnetic rerating. Other frequencies can affect the thermal, magnetic and short-circuit tripping characteristics of circuit breakers.

Applying thermal-magnetic circuit breakers at frequencies above 50/60 Hz requires special consideration of the effects of high frequency on circuit breaker tripping characteristics. Thermal and magnetic operations must be treated separately.

Thermal Tripping Performance at High Frequency

At frequencies below 60 Hz, the thermal rerating of thermal-magnetic circuit breakers is negligible. However, at frequencies above 60 Hz, thermal rerating is required. High-frequency operation causes abnormal heat rise in the current-carrying parts because of the skin effect.

One of the most common high-frequency applications is at 400 Hz. Figure 4 indicates the thermal rerating multiplier to be used with each circuit breaker family when applied on 400 Hz systems.

When applying a 100 A QOU circuit breaker on a 400 Hz system, the circuit breaker's current carrying capacity is as follows:

- Non-continuous Loads (less than three hours): Using Figure 4, the QOU circuit breaker may be applied at .78 of rating, or 78 A.
- Continuous Loads (three hours of more): NEC Article 210-20(a) requires that standard circuit breaker loading does not exceed 80% of the circuit breaker's rating when used for continuous loads. Therefore, the current-carrying capacity of a 100 A QOU circuit breaker operating under continuous load at 400 Hz would be 100 A x .78 x .80 = 62 A.

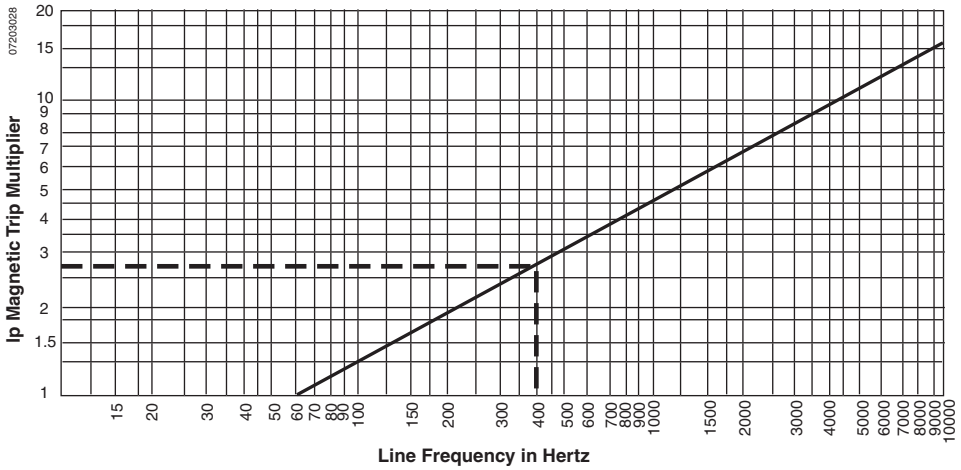
Interrupting Rating (AIR) at 400 Hz.

At frequencies above 60 Hz, the interrupting rating of thermal-magnetic circuit breakers is less than the 60 Hz interrupting rating. Unless specifically marked for use of 400 Hz systems, the interrupting rating of Square D circuit breakers is reduced to 1/10th of the 60 Hz interrupting rating.

Magnetic Tripping Performance

At frequencies above 60 Hz more current is necessary to magnetically trip a circuit breaker than at 60 Hz. Fig. 3 shows the multipliers of 60 Hz current that it takes to instantaneously trip a circuit breaker when applied at various frequencies. For example, at 60 Hz, it takes 700 A or more to magnetically trip a 100 A QOU circuit breaker per trip curve 730-7 (page 26). At 400 Hz, it takes 1820 A (2.6 multiplier) or more to magnetically trip the same circuit breaker.

Figure 5: 60 Hz Current Multiplier



ACCESSORIES

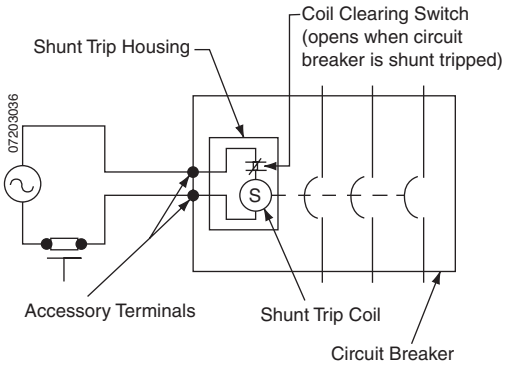
Factory-installed Accessories

QOU circuit breakers and QYU supplementary protectors can be supplied with electrical accessories factory-installed. Available factory-installed accessories are shown in Table 5 below. Each QOU circuit breaker or QYU supplementary protector can be equipped with only one (1) factory-installed electrical accessory from the table below. These devices cannot be added, modified or removed once assembled. All electrical accessories occupy one additional pole space, 3/4 in. (19.05 mm). The proper suffix number must be added to the circuit breaker catalog number to order an accessory.

Table 5: Factory-installed Accessories

Accessory	Description	Volts, 50/60 Hz	Coil Burden, VA	Catalog Suffix
Shunt Trip	Used for tripping the circuit breaker electrically using a remote control source. Includes coil clearing contact.	12 ac/dc 24 ac/dc	60 168	1042
		120 Vac 208 Vac 240 Vac	72 228 288	1021
Auxiliary Switch “A” Contact	One contact only; opens when circuit breaker is OFF or tripped; 5 A max. at 120 Vac, 50/60 Hz			1200
Auxiliary Switch “B” Contact	One contact only; closed when circuit breaker is OFF or tripped; 5 A max. at 120 Vac, 50/60 Hz			1201
Alarm Switch	One contact only; closed when circuit breaker is tripped; open when circuit breaker is ON or OFF; 5 A max. at 120 Vac, 50/60 Hz			2100
Ring-tongue Terminal	Factory-installed ring tongue terminal, 10-32 screw, for 1-, 2-, and 3-pole QOU 10–60 A			5283
Wire Binding Screw	Hex drive 5/32 in. wire binding screw for QOU			5280
Mounting Foot	Tapped mounting foot for QOU, 1- and 2-pole 10–70 A, 3-pole 10–60 A			3100

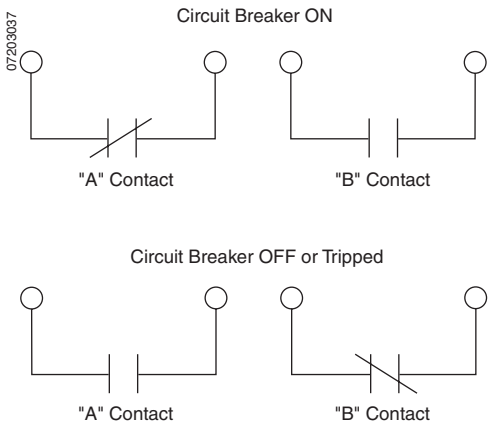
Figure 6: Shunt Trip Accessory



Shunt Trip

The shunt trip accessory is used to trip the circuit breaker from a remote location by using a trip coil energized from a separate electrical source. When energized by a push button or other pilot device, the shunt trip causes the circuit breaker to trip. The handle moves to the tripped position and the Visi-Trip indicator appears. The trip coil has a coil clearing contact to break the coil circuit when the circuit breaker trips. Shunt trips operate at 75% or more of rated voltage. See the wiring diagram in Figure 6.

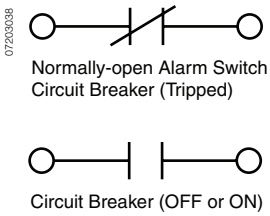
Figure 7: Auxiliary Switch Accessory



Auxiliary Switch

The auxiliary switch accessory monitors the circuit breaker contact status and provides a remote signal indicating whether the circuit breaker contacts are open or closed. When the circuit breaker is OFF or tripped, the auxiliary switch with an “A” contact is open and the auxiliary switch with a “B” contact is closed. When the circuit breaker is on, the auxiliary switch with an “A” contact is closed and the auxiliary switch with a “B” contact is open. See the wiring diagram in Figure 7.

Figure 8: Alarm Switch Accessory



Alarm Switch

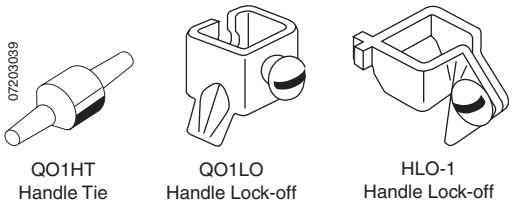
The alarm switch accessory monitors the circuit breaker trip status and is used to provide a remote warning signal indicating that the circuit breaker has tripped. This signal can be a horn, pilot light, or some other indicator. The contact on the standard alarm switch is open when the circuit breaker is in the off or on position and is closed when the circuit breaker is in the tripped position.

Alarm switches are actuated when the circuit breaker has tripped as a result of an overload, short circuit or shunt trip operation. See the wiring diagram in Figure 8.

Field-installed Accessories

Table 6: Field-installed Accessories

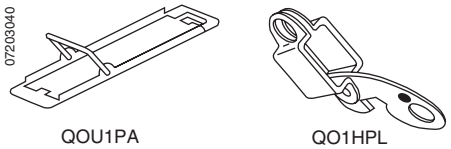
Accessory	Description	Catalog Number
Handle Tie	Ties two 1-pole circuit breakers together.	QO1HT
	Ties three 1-pole circuit breakers together; includes lock-off for California Title 24.	QO3HT
Handle Lock-off (Clamp)	Clamp for holding QOU single-pole handle in ON or OFF position.	QO1LO
	Attaches to 1-, 2-, or 3-pole circuit breaker handles.	HLO1
Handle Padlock Attachment	For padlocking 1-pole circuit breaker in “OFF” or “ON” position. Attaches to circuit breaker escutcheon—Fixed	QOU1PA
	For padlocking 2- and 3-pole circuit breaker in “OFF” or “ON” position. Attaches to circuit breaker escutcheon—Fixed	QOU1PL
	For padlocking 1-pole circuit breaker in “OFF” position only	QOU1PAFLA
	For padlocking 2- and 3-pole circuit breaker in “OFF” position only (1- and 2-pole 10–70 A, 3-pole 10–60 A)	QOU2PAFLA
	One-pole circuit breakers. Attaches to circuit breaker handle—Removable	QOHPL
	Two-and 3-pole circuit breakers. Attaches to circuit breaker handle—Removable	QO1HPL
Mechanical Interlock	Interlocks two 2-pole or one 2-pole and one 1-pole QOU circuit breakers	QO2DTILA
Mechanical Interlock with Retaining Kit	For interlocking two adjacent back-fed circuit breakers in dual power supply applications. Interlocks two 2-pole or one 2-pole and one 1-pole QOU circuit breakers.	QO2DTIM
Mounting Feet	For mounting 1-, 2-, or 3-pole circuit breakers (Two mounting feet required per circuit breaker)	QOUMF1
		QOUMF2
		QOUMF3
	Tapped mounting foot for QOU, 1- and 2-pole 10–70 A, 3-pole 10–60 A (Two mounting feet required per pole)	QOUMFS1
Quick Connectors	For forward or reverse wiring of 60 A maximum circuit breakers	QOUFR
	For end connection wiring of 60 A maximum circuit breakers	QOUEC
Finger Safe Cover	For 10–70 A 1- and 2-pole 10–60 A 3-pole circuit breakers (Two covers required per pole)	QOULFSC1
	For 80–100 A 1-, 2-, and 3-pole circuit breakers (Two covers required per pole)	QOUHFSC1
Jumper Bars for 2-pole Low Ampere QOUs	4-pole jumper bar with front wiring, base, cover, and screw	QOU14100JBAF
	4-pole jumper bar with wiring, base, cover, and screw to left	QOU14100JBAL
	4-pole jumper bar with wiring, base, cover, and screw to right	QOU14100JBAR
	4-pole, 100 A jumper bar base with front wiring	QOU14100BAFB
	4-pole, 100 A jumper bar base with left-side wiring	QOU14100BALB
	4-pole, 100 A jumper bar base with right-side wiring	QOU14100BARB
	4-pole jumper bar cover	QOU14100CAB
	Mounting screw for jumper bar cover	QOUQCMSB
	6-pole jumper bar with front wiring, base, cover, and screw	QOU16150JBAF
	6-pole, 150 A jumper bar base with front wiring	QOU16150BAFB
	6-pole, 150 A jumper bar base with left-side wiring	QOU16150BALB
	6-pole, 150 A jumper bar base with right-side wiring	QOU16150BARB
	6-pole jumper bar cover	QOU16150CAB
Cover Plates	For one 2-pole circuit breaker	QOUCP2
	For one 3-pole circuit breaker	QOUCP3
	For two 2-pole circuit breakers	QOUCP4
	For three 2-pole circuit breakers	QOUCP6
Rainproof Cover	Vertical cover for 2- and 3-pole circuit breakers	BCV
	Horizontal cover for 2-pole circuit breakers	BCH
Ring Tongue Terminal Adapter	For ring tongue terminal wiring of 60 A maximum circuit breakers	QOURT



QO1HT
Handle Tie

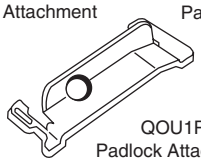
QO1LO
Handle Lock-off

HLO-1
Handle Lock-off

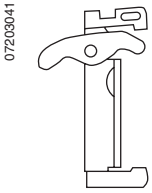


QOU1PA
Padlock Attachment

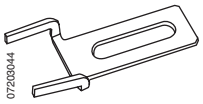
QO1HPL
Padlock Attachment



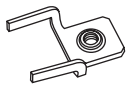
QOU1PL
Padlock Attachment



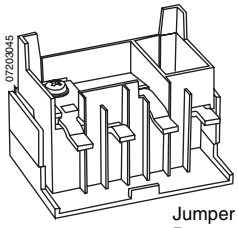
QOU2DTILA
Mechanical Interlock Attachment



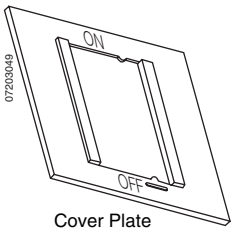
QOUMF1
Mounting Foot



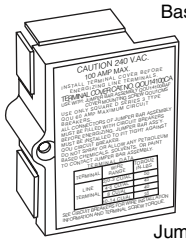
suffix -3100 or QOUMFSI
Tapped Mounting Foot



Jumper Bar
Base



Cover Plate



Jumper Bar
Cover

Handle Tie

The handle tie accessory converts any adjacent 1-pole QOU circuit breaker to one independent-trip multi-pole circuit breaker.

Handle Lock-off

The handle lock-off accessories fasten the handle in the on or off position. The mechanism will still be able to trip and open the contacts even if the handle is held on. The handle lock-off cannot be padlocked.

Handle Padlock Attachment

The handle padlock attachments allow padlocking the circuit breaker handles in the on or off position. The mechanism will still be able to trip and open the contacts even if the handle is held on.

Mechanical Interlock Attachment

The mechanical interlock attachment locks the handles of two adjacent circuit breakers to prevent both circuit breakers from being on at the same time. Both circuit breakers may be switched to the off position with the mechanical interlock in place. The mechanism will still be able to trip and open the contacts even if the handle is held on.

Mounting Feet

Mounting feet are available to mount 1-, 2-, and 3-pole circuit breakers. Two brackets (two kits) are required to mount each circuit breaker.

Tapped Mounting Feet

Tapped versions of the mounting feet are available to mount 1-, 2-, and 3-pole circuit breakers. Two brackets (one kit) are required to mount each circuit breaker.

Jumper Bars

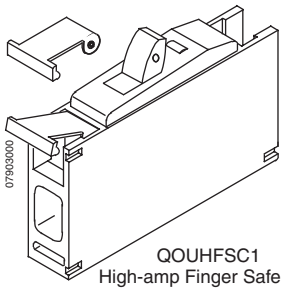
For added wiring convenience, jumper bars are available for common connections to two 2-pole or three 2-pole 60 A maximum QOU circuit breakers. Jumper bars are available with front, left-side, or right-side wiring bases and covers.

Cover Plates

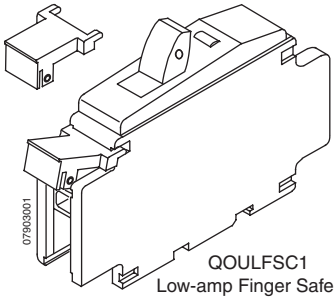
Cover plates are available to fit one 2-pole, one 3-pole, two 2-pole, or three 2-pole circuit breakers. The cover plates fasten to the escutcheon and provide 1 in. (25.4 mm) per pole finish trim to cover the circuit breaker.

Finger Safe Covers

Finger safe covers are installed over the top of the terminal connections to prevent accidental contact with energized parts. Two covers are required per pole of each circuit breaker.

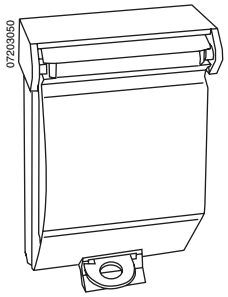


QOUHFSC1
High-amp Finger Safe Cover

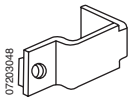


QOULFSC1
Low-amp Finger Safe Cover

Rainproof Covers



Ring-tongue Terminal Adapter



Rainproof Covers

Rainproof covers plates are available for vertical mounted 2- and 3-pole circuit breakers and horizontal mounted 2-pole circuit breakers.

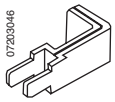
Ring-tongue Terminal Adapters

Ring-tongue terminal adapters are available for ring tongue terminal wiring of 60 A maximum circuit breakers.

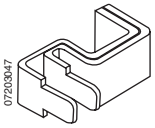
Reversible Lugs

For added wiring convenience, QOUR 10–70 A 1- and 2-pole, and 10–60 A 3-pole QOUR circuit breakers have reversible lugs. Removing the wire binding screw allows the captive lug body to be rotated and the wire binding screw reinstalled. This permits the circuit breaker to be flush mounted and then conveniently wired from the back.

Forward or Reverse Quick Connector



End Quick Connector



Quick Connectors

In addition to the reversible lugs previously described, 10–70 A 1- and 2-pole, and 10–60 A 3-pole A QOU circuit breakers have optional field installable quick connectors.

Quick connectors provide a convenient way to attach two wires using two standard, 0.25 in. insulated quick connectors per terminal (30 A maximum per connector). Quick connectors are not furnished with the circuit breakers, but are commercially available. Connectors suitable for wire sizes up to AWG #10 can be selected for use with these circuit breakers.

Table 7: Optional Terminations

Type	Wiring Method	Quantity	Catalog Number
Field-installed Quick Connectors	Forward or Reverse	1	QOUFR
Field-installed Quick Connectors	End Connection	1	QOUEC
Factory-installed Quick Connectors	One each end of QOU for end connection	—	QOUQ prefix

Available only on 10–60 ampere circuit breakers.

UL REQUIREMENTS

A UL label on the QOU miniature circuit breaker indicates that the circuit breaker meets the requirements of UL Standard 489 for molded case circuit breakers.

Underwriters Laboratories Inc. (UL), the Canadian Standards Association (CSA), the National Electrical Manufacturers Association (NEMA), and the National Electrical Code (NEC) all define a circuit breaker as “a device designed to open and close a circuit by non-automatic means and to open the circuit automatically at a predetermined overcurrent without damage to itself when properly applied within its rating.”

A molded case circuit breaker is one “that is assembled as an integral unit in a supportive and enclosing housing of insulated material.”

A UL label also means the production procedure is monitored by UL inspectors for continuing conformance to UL performance requirements. These requirements are based on sound engineering principles, research, records of test and field experience, and information gathered from users and inspection authorities.

UL 489 and CSA 22.2 #5-02 Test Procedures

Limited Available Fault Current Tests

UL and CSA require a series of tests on a single set of sample circuit breakers for compliance with UL Standard 489. The tests for thermal-magnetic circuit breakers are described below and conducted in the order presented.

Since QOU switches are derivatives of QOU miniature circuit breakers,they do not have to go through an overload test. They have to complete a withstand test (paragraph 11.1.7).

200% Thermal Calibration

Each pole of the circuit breaker must trip within a specified time limit when carrying 200% of its ampere rating.

135% Thermal Calibration

With all poles connected in series, the circuit breaker must trip within a specified time limit when carrying 135% of its ampere rating.

Overload

The circuit breaker is operated making and breaking 600% of its ampere rating, but not less than 150 A. For circuit breakers through 100 A, the number of 600% operations is 35 manual open and close and 15 manual close and automatic open. For 125 A circuit breakers, the number of operations is 50 manual open and close.

Temperature Rise

While carrying 100% of rated current at a 104° F (40° C) ambient temperature and mounted in open air, the circuit breaker is checked for temperature rise on a wiring terminal. The temperature rise must not exceed a 122° F (50° C) rise above ambient temperature and must be within specified limits.

Endurance

The circuit breaker must successfully complete the number of switching operations shown in the table below. One switching operation includes a motion to turn the circuit breaker on and a motion to turn the circuit breaker off.

Table 8: QOU Circuit Breaker Switching Operations

Amperes	Full Load Operations	No Load Operations
0–100 A	6000	4000
125 A	4000	4000

Calibration Retest

Both the 200% and 135% thermal calibration tests are repeated.

Short Circuit

For circuit breakers rated 240 V, two short-circuit tests per pole and one test with all poles connected in series are performed. For example, a three-pole circuit breaker receives seven short-circuit tests. For circuit breakers rated 120/240 V, three tests are made with all poles connected in series. The circuit breaker is connected to the test circuit using wire correctly sized for the rating of the circuit breaker. The line leads are not more than 4 ft. (1.22 m) in length and the load leads are not more than 10 in. (25.4 cm) in length.

NOTE: Successful testing requires that the current be interrupted while maintaining the integrity of all conductors and connections.

Trip Out

The 200% thermal calibration test is repeated following the short-circuit tests.

Dielectric

The circuit breaker must withstand, for one minute, twice its rated voltage plus 1000 V:

- Between line and load terminals with the circuit breaker open, that is, with the circuit breaker either tripped or off.
- Between terminals of opposite polarity with the circuit breaker open.
- Between live parts and the overall enclosure with the circuit breaker both open and closed.

No conditioning of the circuit breaker can take place during or between tests. There also can be no failure of functional parts at the conclusion of the sequences.

High Available Fault Current Tests

After qualifying a set of circuit breakers to the standard tests, a manufacturer can have additional circuit breaker samples tested on higher than standard available fault currents.

The following performance requirements apply:

200% Thermal Calibration

Each pole of the circuit breaker must trip within a specified time limit when carrying 200% of its continuous current rating.

Short Circuit

With the load side terminals connected by 10 in. (25.4 cm) lengths of specified wire, the circuit breaker is exposed to a short-circuit current. After successful interruption, the circuit breaker is reset and closed again on the short circuit. An additional short-circuit bus-connected test is required for frame sizes or construction groups below 100 A.

Trip Out

Each pole of the circuit breaker must trip within a specified time limit when carrying 250% of its continuous current rating.

Dielectric Withstand

The circuit breaker is subjected to twice its rated voltage, but not less than 900 V.

CIRCUIT BREAKER TRIPPING CHARACTERISTICS (TRIP CURVES)

The tripping characteristics of thermal-magnetic circuit breakers are represented by a characteristic tripping curve that plots tripping time versus current level. See page 20. The curve shows the amount of time required for a circuit breaker to trip for overcurrent through the entire tripping range of the circuit breaker. Manufacturing tolerances result in a curve that is a band bound by minimum and maximum values of total clearing time. Total clearing time is the sum of the sensing time, unlatching time, mechanical operating time, and arcing time of the circuit breaker. For currents in excess of 135 percent of the circuit breaker rating at ambient temperature (40°C/104°F), the circuit breaker will automatically open the circuit within limits specified by the band.

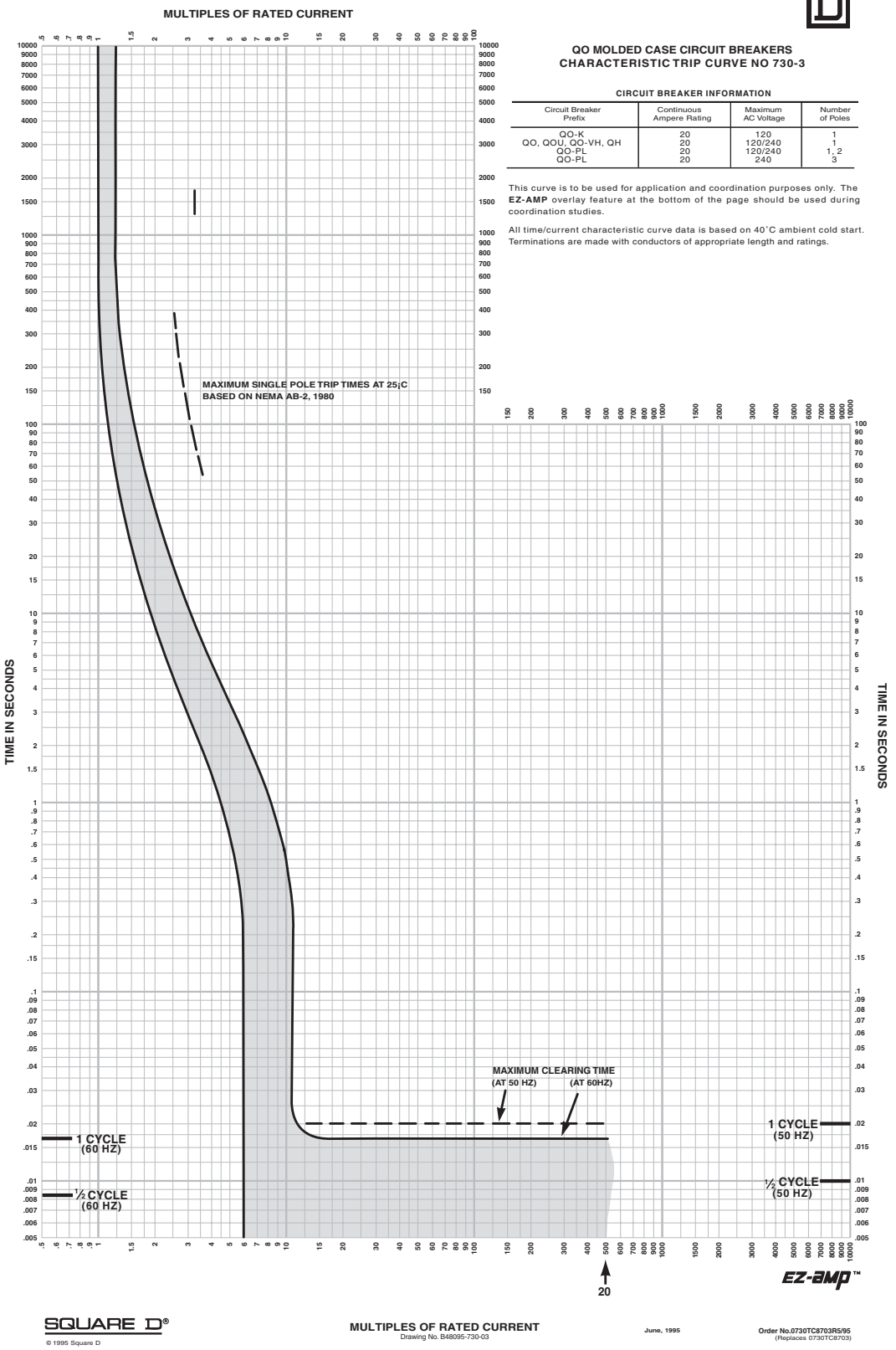
Thermal Tripping Characteristics

The upper left portion of the characteristic tripping curve displays the thermal response of the circuit breaker. On overcurrent levels, up to the instantaneous tripping level, thermal tripping occurs when the bimetal in the circuit breaker responds to the heat associated with the overcurrent. The bimetal deflects, unlatching the mechanism and mechanically causing the circuit breaker to trip and open the circuit. The larger the overcurrent, the faster the circuit breaker operates to open the circuit (inverse time).

Magnetic (Instantaneous) Tripping Characteristics

The lower right portion of the characteristic tripping curve displays the magnetic (instantaneous) tripping response of the circuit breaker. This takes place when overcurrents of sufficient magnitude operate the magnetic tripping mechanism. Magnetic tripping occurs with no intentional delay.

Curve 730-3



QO MOLDED CASE CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO 730-3

CIRCUIT BREAKER INFORMATION

Circuit Breaker Prefix	Continuous Ampere Rating	Maximum AC Voltage	Number of Poles
QO-K	20	120	1
QO, QOU, QO-VH, QH	20	120/240	1
QO-PL	20	120/240	1, 2
QO-PL	20	240	3

This curve is to be used for application and coordination purposes only. The **EZ-AMP** overlay feature at the bottom of the page should be used during coordination studies.

All time/current characteristic curve data is based on 40˚C ambient cold start. Terminations are made with conductors of appropriate length and ratings.

SQUARE D®

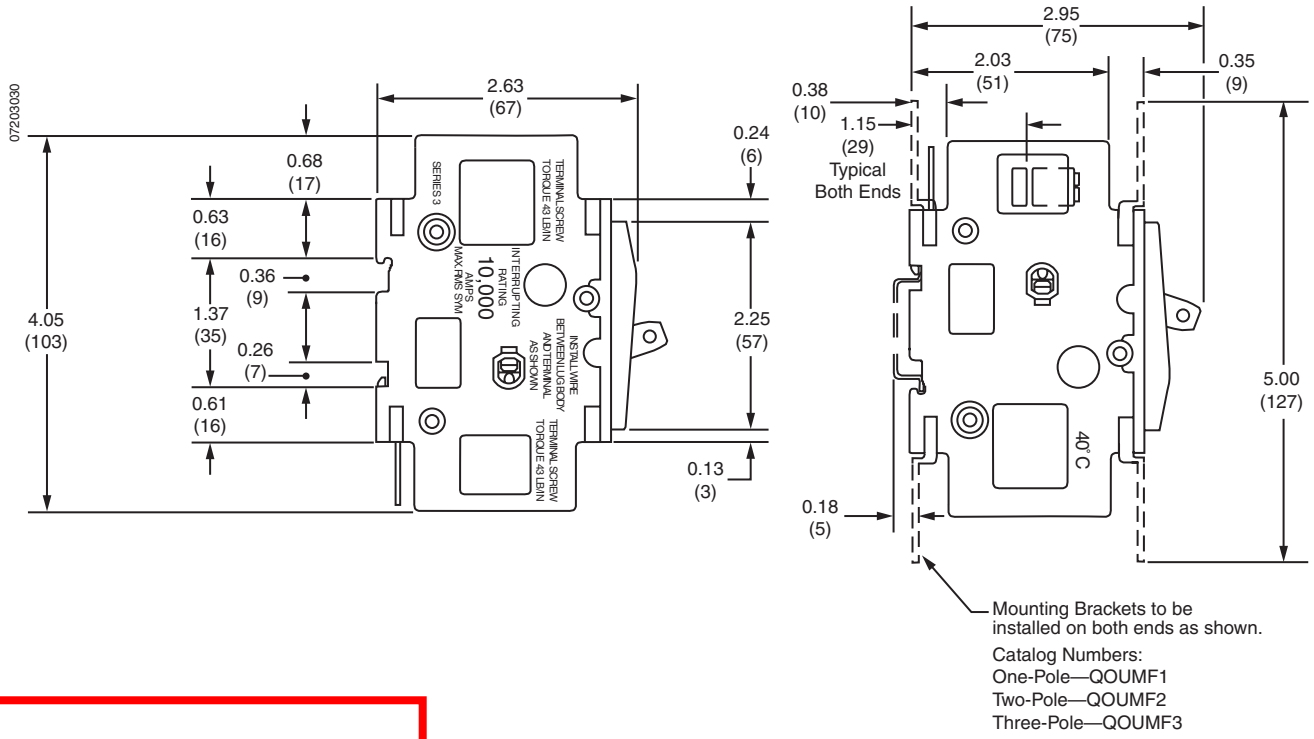
MULTIPLES OF RATED CURRENT
Drawing No. B48095-730-03

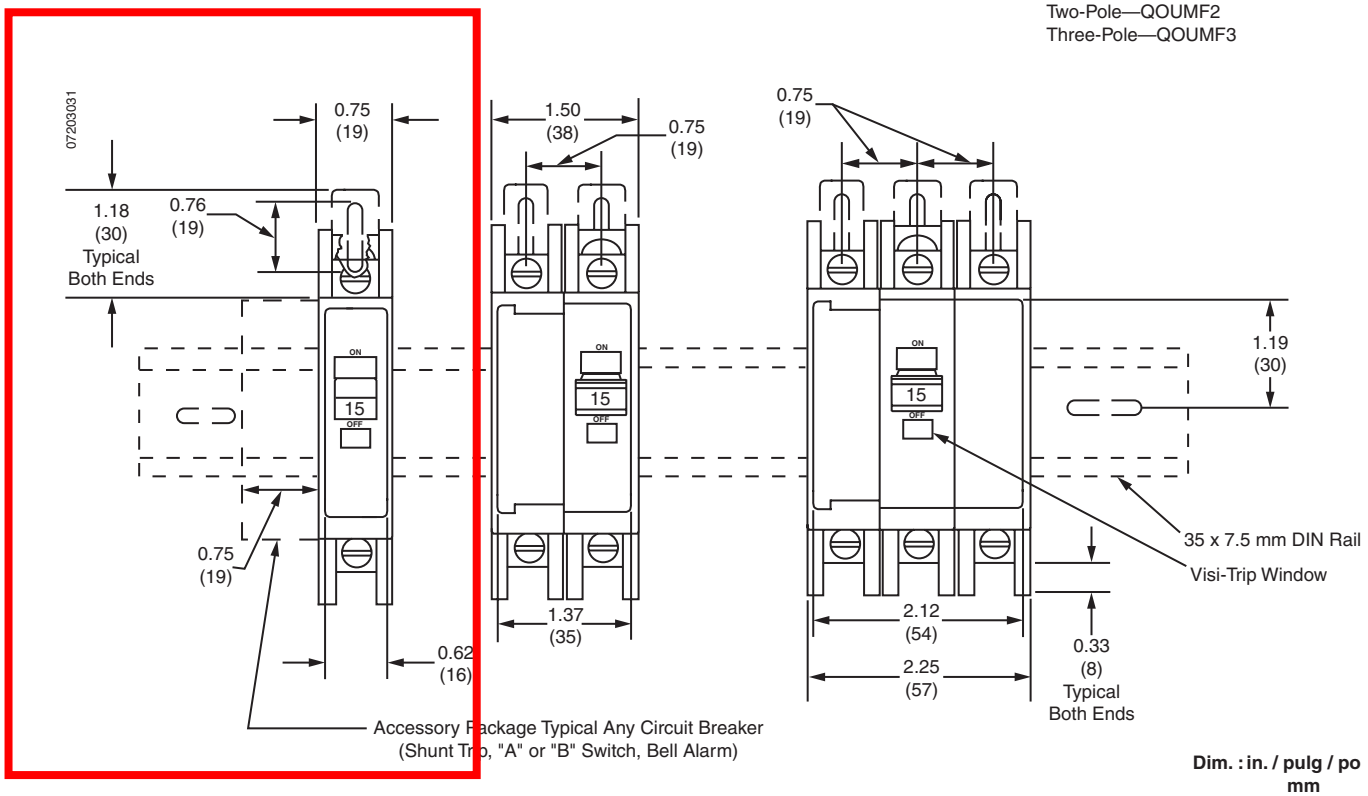
June, 1995

Order No.0730TC8703RS/95
(Replaces 0730TC8703)

DIMENSIONS

1 & 2 pole 10A - 70A and 3 pole 10A -60A QOU Circuit Breakers

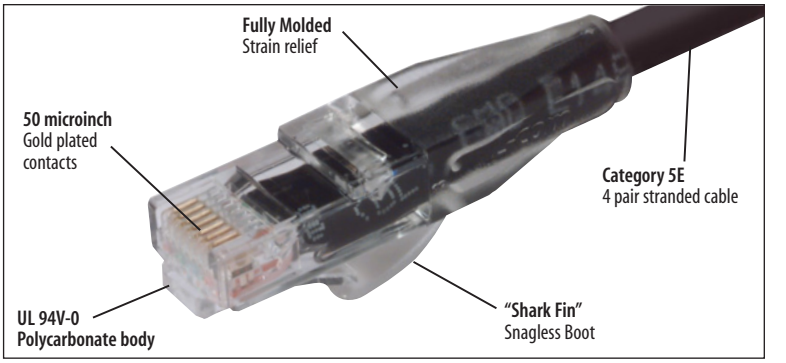




Dim. : in. / pulg / po
mm

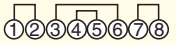
Premium Category 5E RJ45 Molded Ethernet Patch Cords

Designed for today's high-density patch panels, these unique Category 5E molded patch cables feature an easy to depress "shark fin" snagless mold boot that makes connecting cables easier. The clear boot also allows the color of each cable to be easily seen to each port for easy cable identification. Each cable is tested for Category 5E performance to ensure maximum speed out of the network. Contact us today for your patch cable needs!



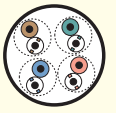
Category 5E Patch Cords

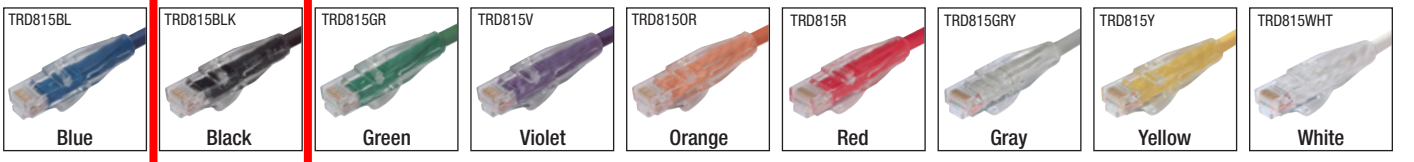
EIA568



Twisted Pair Pinning: 1 & 2, 3 & 6, 4 & 5, 7 & 8.

Category 5E 4 Pair Stranded Cable





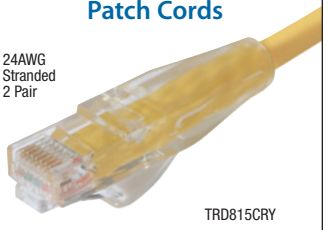
BL	BLK	GR	V	OR	R	GRY	Y	WHT

Ordering is easy, add the desired color code to the part number. Ex: TRD815BL-3

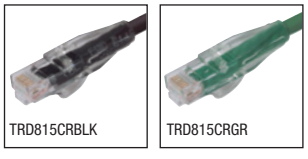
Item #	Description	Length	1-9	10-24	25-99	100-249	250-499
TRD815 __ -3	Category 5E Patch Cable, RJ45 / RJ45	3.0 ft					
TRD815 __ -5	Category 5E Patch Cable, RJ45 / RJ45	5.0 ft					
TRD815 __ -7	Category 5E Patch Cable, RJ45 / RJ45	7.0 ft					
TRD815 __ -10	Category 5E Patch Cable, RJ45 / RJ45	10.0 ft					
TRD815 __ -14	Category 5E Patch Cable, RJ45 / RJ45	14.0 ft					
TRD815 __ -25	Category 5E Patch Cable, RJ45 / RJ45	25.0 ft					
TRD815 __ -50	Category 5E Patch Cable, RJ45 / RJ45	50.0 ft					
TRD815 __ -75	Category 5E Patch Cable, RJ45 / RJ45	75.0 ft					
TRD815 __ -100	Category 5E Patch Cable, RJ45 / RJ45	100.0 ft					

10/100Base-T Crossover Patch Cords

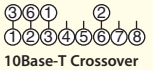
24AWG Stranded 2 Pair



TRD815CRY



10/100Base-T Crossover Patch Cords



10Base-T Crossover

Tip *Network Cable Performance Testing*

Testing of cable assemblies is often an overlooked issue when it comes to Ethernet patch cables. A cable that uses category 5E components may not really be category 5E compliant. Economy grade cables are typically only tested for continuity whereas a certified patch cable is checked against the actual standard for performance criteria. Your level of requirement many not need a certified cable so if you are not sure give us a call and let us help you to choose the perfect cable for your installation.

Item #	Description	Color	1-9	10-24	25-99	100-249	250-499

Premium Category 5E RJ45 Molded Crossover Ethernet Patch Cords

Also designed for today's high-density patch panels, these unique Category 5E molded patch cables feature an easy to depress "shark fin" snagless mold boot that makes connecting cables effortless. The clear boot also allows the color of each cable to be easily seen up to each port for easy cable identification. Each cable is crossover wired (EIA568A/B) for usage as either uplink connections or for direct connecting of two computers. Contact us today for all your patch cable needs!

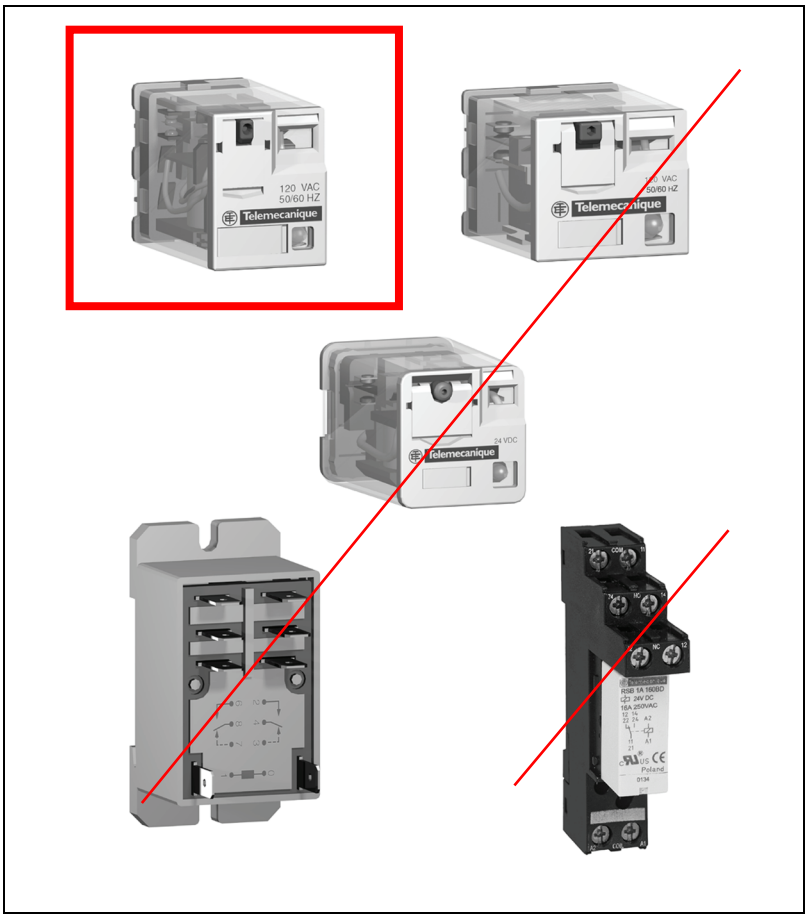
TRD815CRBLK-3	10/100Base-T Crossover Cable, 3.0 ft	Black
TRD815CRBLK-7	10/100Base-T Crossover Cable, 7.0 ft	Black
TRD815CRBLK-10	10/100Base-T Crossover Cable, 10.0 ft	Black
TRD815CRBLK-15	10/100Base-T Crossover Cable, 15.0 ft	Black
TRD815CRGR-3	10/100Base-T Crossover Cable, 3.0 ft	Green
TRD815CRGR-7	10/100Base-T Crossover Cable, 7.0 ft	Green
TRD815CRGR-10	10/100Base-T Crossover Cable, 10.0 ft	Green
TRD815CRGR-15	10/100Base-T Crossover Cable, 15.0 ft	Green
TRD815CRBL-3	10/100Base-T Crossover Cable, 3.0 ft	Blue
TRD815CRBL-7	10/100Base-T Crossover Cable, 7.0 ft	Blue
TRD815CRBL-10	10/100Base-T Crossover Cable, 10.0 ft	Blue
TRD815CRBL-15	10/100Base-T Crossover Cable, 15.0 ft	Blue
TRD815CRR-3	10/100Base-T Crossover Cable, 3.0 ft	Red
TRD815CRR-7	10/100Base-T Crossover Cable, 7.0 ft	Red
TRD815CRR-10	10/100Base-T Crossover Cable, 10.0 ft	Red
TRD815CRR-15	10/100Base-T Crossover Cable, 15.0 ft	Red
TRD815CRY-3	10/100Base-T Crossover Cable, 3.0 ft	Yellow
TRD815CRY-7	10/100Base-T Crossover Cable, 7.0 ft	Yellow
TRD815CRY-10	10/100Base-T Crossover Cable, 10.0 ft	Yellow
TRD815CRY-15	10/100Base-T Crossover Cable, 15.0 ft	Yellow

Zelio® Plug-In Relays
RXM, RPM, RUM, RPF, RSB

Class 8501

Catalog
8501CT0601R1/08

08



CONTENTS

a brand of Schneider Electric

Telemecanique

RXM●AB2F7

RXM Miniature Relays (page 4)

2 pole relays; 12 A, 1/2 hp (IEC rating = 12 A)
3 pole relays; 10 A, 1/3 hp (IEC rating = 10 A)
4 pole relays; 8 A, 1/3 hp (IEC rating = 6 A)
4 pole relays; 3 A (low level), 1/16 hp (IEC rating = 3 A)

- Mechanical “relay status” indicator on all relays
- Pilot light option available
- Manual operator optional for all relays
- Built-in marking area

RPM32F7

RPM Miniature Power Relays (page 13)

1 pole relays; 15 A, 1/2 hp (IEC rating = 15 A)
2 pole relays; 15 A, 1/2 hp (IEC rating = 15 A)
3 pole relays; 15 A, 1/2 hp (IEC rating = 15 A)
4 pole relays; 15 A, 1/2 hp (IEC rating = 15 A)

- Mechanical “relay status” indicator on all relays
- Pilot light option available
- Manual operator optional for all relays
- Built-in marking area

RUM●●AB2B7

RUM Universal Relays (page 21)

2 pole relays; 8-pin, tube type; 16 A, 1/3 hp (IEC rating = 10 A)
3 pole relays; 11-pin, tube type; 16 A, 1/3 hp (IEC rating = 10 A)
2 pole relays; 8 blade type; 16 A, 1/3 hp (IEC rating = 10 A)
3 pole relays; 11 blade type; 16 A, 1/3 hp (IEC rating = 10 A)

- Mechanical “relay status” indicator on all relays
- Pilot light option available
- Manual operator optional for all relays
- Built-in marking area


RPF2B●●

RPF Power Relays (page 30)

Two Form C contacts; 30 A
Two Normally Open contacts; 30 A

- DIN track mountable
- Can be mounted directly to a panel

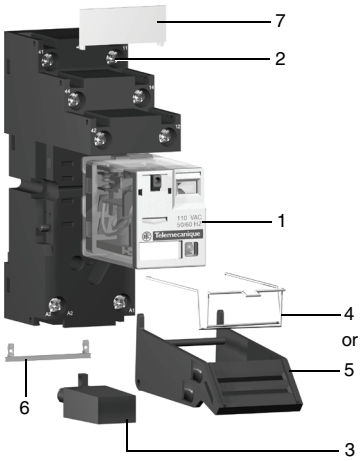

RSB1A160BD
+ RSZE1S48M

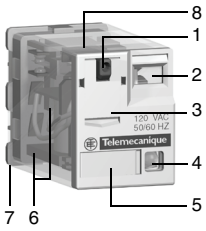
RSB Interface Relays (page 33)

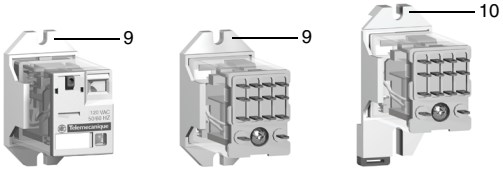
Two Form C contacts; 8 A
One Form C contact; 12 A
One Form C contact; 16 A

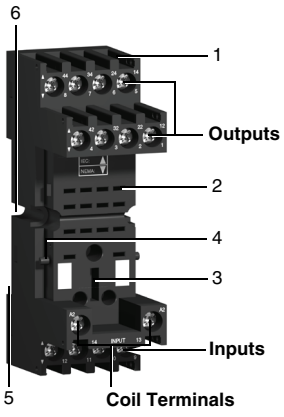
General Technical Information (page 38)

Relay contact types
Utilization categories
Protection categories
Protection modules









Product Description

The RXM miniature relay range consists of:

1. 12 A relays with DPDT contacts, 10 A relays with 3PDT contacts, 6 A relays with 4PDT contacts, and 3 A “low level” relays with 4PDT contacts. All of these relays have the same dimensions.
2. Sockets with mixed or separate contact terminals.
3. Protection modules (diode, RC circuit or varistor). All these modules are common to all sockets.
4. A metal hold-down clip for all sockets.
5. A plastic hold-down clip for all sockets.
6. A 2-pole bus jumper that can be used on sockets with separate contact terminals to simplify wiring when creating a jumper between the coil terminals.
7. Clip-in markers for all the sockets except RXZ E2M114.

Relay Description

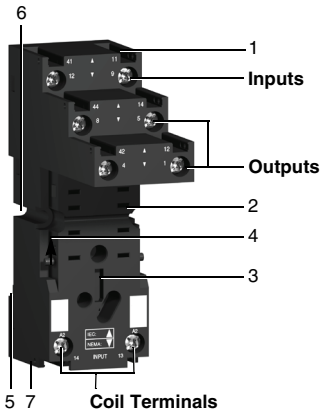
1. Spring return push button for testing the contacts (green: DC, red: AC).
2. Mechanical “relay status” indicator.
3. Optional removable lock-down door and push button, enabling forced maintaining of the contacts for test or maintenance purposes. During operation, this lock-down door must always be in the closed position.
4. Bipolar LED (depending on version) indicating the relay status.
5. Removable marker for relay identification.
6. Four notches for DIN rail mounting adapter or panel mounting adapter.
7. Eight, eleven, or fourteen pins.
8. Area by which the product can be easily gripped.
9. Mounting adapter enabling direct mounting of the relay on a panel.
10. Mounting adapter enabling direct mounting of the relay on a DIN rail.

Socket Description

Sockets with Mixed Contact Terminals

1. Connection by screw clamp terminals or box lug connector.
2. Fourteen female contacts for the relay pins.
3. Location for protection modules.
4. Locking components for plastic and metal hold-down clips.
5. Locating slot for mounting on DIN rail.
6. Two or four mounting holes for panel mounting.

NOTE: The inputs are mixed with the relay coil terminals, with the outputs being located on the opposite side of the socket.



Sockets with Separate Contact Terminals

1. Box lug connector.
2. Eight, eleven, or fourteen female contacts for the relay pins.
3. Location for protection modules.
4. Locking components for plastic and metal hold-down clips.
5. Locating slot for mounting on DIN rail.
6. Two mounting holes for panel mounting.
7. Location for bus jumpers (see mounting on sockets on page 11).

NOTE: The inputs and outputs are separated from the relay coil terminals.

General characteristics

Conforming to standards		IEC/EN 61810-1 (iss. 2), UL 508, CSA C22-2 n° 14
Product certifications		cULus File E164862 CCN NLDX, NLDX7; cURus File E164862 CCN NLDX2, NLDX8; CSA pending; CE; RoHS compliant
Ambient air temperature around the device	Storage	-40—185 °F (-40—85 °C)
	Operation	-40—131 °F (-40—55 °C)
Vibration resistance	Conforming to IEC/EN 60068-2-6	> 6 gn (10–50 Hz)
Degree of protection	Conforming to IEC/EN 60529	IP 40
Shock resistance conforming to IEC/EN 60068-2-27	Opening	10 gn
	Closing	5 gn
Protection category (see page 38)		RT I
Mounting position		Any

Insulation characteristics

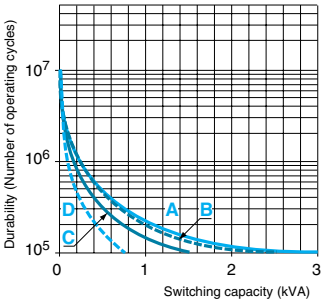
Rated insulation voltage (Ui)		250 V (IEC), 300 V (UL, CSA)
Rated impulse withstand voltage (Uimp)		3.6 kV (1.2/50 µs)
Dielectric strength (rms voltage)	Between coil and contact	2,500 Vac
	Between poles	2,500 Vac
	Between contacts	1,500 Vac

Contact characteristics

Relay type			**RXM2AB●●●**	**RXM3AB●●●**	**RXM4AB●●●**	**RXM4GB●●●**
Number and type of contacts (see page 12)			DPDT	3PDT	4PDT	4PDT
Contact materials			AgNi			AgAu–Bifurcated
Conventional thermal current (Ith)	For ambient temperature ≤ 131 °F (55 °C)		12 A	10 A	6 A	3 A
Rated operational current	Conforming to IEC in utilization category AC-1	N.O.	12 A	10 A	6 A	2 A
		N.C.	6 A	5 A	3 A	1 A
	Conforming to UL Resistive @277 Vac, hp @120 Vac		12 A, 1/2 hp	10 A, 1/3 hp	8 A, 1/3 hp	3 A, 1/16 hp
Maximum operating rate In operating cycles/hour	No load		18,000			
	Under load		1,200			
Switching voltage	Maximum		250 Vac/Vdc			
Switching capacity	Minimum		10 mA on 17 V			2 mA on 5 V
	Maximum		3,000 VA	2,500 VA	1,500 VA	750 VA
Utilization coefficient			20%			
Mechanical durability in millions of operating cycles			10			
Electrical durability in millions of operating cycles	Resistive load		0.1			

Electrical durability of contacts

Resistive load AC



A=RXM2AB●●● B=RXM3AB●●● C=RXM4AB●●● D=RXM4GB●●●

Coil characteristics

Average consumption		AC	1.2 VA
		DC	0.9 W
Drop-out voltage threshold		AC	⩾ 0.15 Uc
		DC	⩾ 0.1 Uc
Operating time (response time)	Between coil energization and making of the N.O. contact	AC	20 ms
		DC	20 ms
	Between coil de-energization and making of the N.C. contact	AC	20 ms
		DC	20 ms

Coil voltage Uc			**12 V**	**24 V**	**48 V**	**110 V**	**120 V**	**125 V**	**220 V**	**230 V**	**240 V**
Relay coil voltage codes			**JD**	**BD**	**ED**	**FD**	**—**	**GD**	**MD**	**—**	**—**
DC	Average resistance at 68 °F (20 °C) ± 10%		160 Ω	650 Ω	2,600 Ω	11,000 Ω	—	11,000 Ω	14,000 Ω	—	—
	Operating voltage limits	Min.	9.6 V	19.2 V	38.4 V	88 V	—	100 V	176 V	—	—
		Max.	13.2 V	26.4 V	52.8 V	121 V	—	138 V	242 V	—	—
Relay coil voltage codes			**—**	**B7**	**E7**	**—**	**F7**	**—**	**M7**	**P7**	**U7**
AC	Average resistance at 68 °F (20 °C) ± 15%		—	180 Ω	770 Ω	—	4,430 Ω	—	15,000 Ω	15,000 Ω	15,500 Ω
	Operating voltage limits	Min.	—	19.2 V	38.4 V	—	96 V	—	176 V	184 V	192 V
		Max.	—	26.4 V	52.8 V	—	132 V	—	242 V	253 V	264 V

Socket characteristics

Socket type		**RXZE2S108M**	**RXZE2S111M**	**RXZE2S114M**	**RXZE2M114**	**RXZE2M114M**
Relay types used		**RXM2●●●●●**	**RXM3●●●●●**	**RXM4●●●●●**	**RXM2●●●●●**[1] **RXM4●●●●●**	**RXM2●●●●●**[1] **RXM4●●●●●**
Product certifications		cURus File E172326 CCN SWIV2, SWIV8; CSA (pending); CE; RoHS compliant				
Conventional thermal current (Ith)		12 A	10 A			
Degree of protection	Conforming to IEC/EN 60529	IP 20				
Connection	Solid wire without cable end	1 conductor: AWG 20–12 (0.5–2.5 mm^2) 2 conductors: AWG 20–14 (0.5–1.5 mm^2)				
	Flexible wire with cable end	1 conductor: AWG 24–14 (0.2–2.5 mm^2) 2 conductors: AWG 24–16 (0.2–1.5 mm^2)				
	Flexible wire without cable end	1 conductor: AWG 24–14 (0.2–2.5 mm^2) 2 conductors: AWG 24–16 (0.2–1.5 mm^2)				
Maximum tightening torque		5.3 lbf-in (0.6 N●m) (M3 screw)				
Contact terminal arrangement		Separate			Mixed	
Bus jumper Ith: 5 A		Yes			No	

[1] When mounting relay RXM2●●●●● on socket RXZE2M●●●●, the thermal current must not exceed 10 A.

RXM●AB2F7

Miniature relays with lockable test button, without LED (sold in lots of 10)

	Number and type of contacts - Thermal current (Ith)								
	DPDT - 12 A			3PDT - 10 A			4PDT - 6 A		
Coil Voltage	Catalog Number	Weight		Catalog Number	Weight		Catalog Number	Weight	
		lb.	kg		lb.	kg		lb.	kg
12 Vdc	**RXM2AB1JD**	0.082	0.037	**RXM3AB1JD**	0.084	0.038	**RXM4AB1JD**	0.080	0.036
24 Vdc	**RXM2AB1BD**	0.082	0.037	**RXM3AB1BD**	0.084	0.038	**RXM4AB1BD**	0.080	0.036
48 Vdc	**RXM2AB1ED**	0.082	0.037	**RXM3AB1ED**	0.084	0.038	**RXM4AB1ED**	0.080	0.036
110 Vdc	**RXM2AB1FD**	0.082	0.037	**RXM3AB1FD**	0.084	0.038	**RXM4AB1FD**	0.080	0.036
220 Vdc	—	—	—	—	—	—	**RXM4AB1MD**	0.080	0.036
24 Vac	**RXM2AB1B7**	0.082	0.037	**RXM3AB1B7**	0.084	0.038	**RXM4AB1B7**	0.080	0.036
48 Vac	**RXM2AB1E7**	0.082	0.037	**RXM3AB1E7**	0.084	0.038	**RXM4AB1E7**	0.080	0.036
120 Vac	**RXM2AB1F7**	0.082	0.037	**RXM3AB1F7**	0.084	0.038	**RXM4AB1F7**	0.080	0.036
230 Vac	**RXM2AB1P7**	0.082	0.037	**RXM3AB1P7**	0.084	0.038	**RXM4AB1P7**	0.080	0.036
240 Vac	—	—	—	—	—	—	**RXM4AB1U7**	0.080	0.036
Miniature relays with lockable test button, with LED (sold in lots of 10)									
12 Vdc	**RXM2AB2JD**	0.082	0.037	**RXM3AB2JD**	0.084	0.038	**RXM4AB2JD**	0.080	0.036
24 Vdc	**RXM2AB2BD**	0.082	0.037	**RXM3AB2BD**	0.084	0.038	**RXM4AB2BD**	0.080	0.036
48 Vdc	**RXM2AB2ED**	0.082	0.037	**RXM3AB2ED**	0.084	0.038	**RXM4AB2ED**	0.080	0.036
110 Vdc	**RXM2AB2FD**	0.082	0.037	**RXM3AB2FD**	0.084	0.038	**RXM4AB2FD**	0.080	0.036
125 Vdc	—	—	—	—	—	—	**RXM4AB2GD**	0.080	0.036
24 Vac	**RXM2AB2B7**	0.082	0.037	**RXM3AB2B7**	0.084	0.038	**RXM4AB2B7**	0.080	0.036
48 Vac	**RXM2AB2E7**	0.082	0.037	**RXM3AB2E7**	0.084	0.038	**RXM4AB2E7**	0.080	0.036
120 Vac	**RXM2AB2F7**	0.082	0.037	**RXM3AB2F7**	0.084	0.038	**RXM4AB2F7**	0.080	0.036
230 Vac	**RXM2AB2P7**	0.082	0.037	**RXM3AB2P7**	0.084	0.038	**RXM4AB2P7**	0.080	0.036

RXM4GB2F7

Miniature relays with low level contacts, without LED (sold in lots of 10)

Number and type of contacts - Thermal current (Ith)			
4PDT - 3 A			
Coil Voltage	Catalog Number	Weight	
		lb.	kg
12 Vdc	**RXM4GB1JD**	0.080	0.036
24 Vdc	**RXM4GB1BD**	0.080	0.036
48 Vdc	**RXM4GB1ED**	0.080	0.036
110 Vdc	**RXM4GB1FD**	0.080	0.036
24 Vac	**RXM4GB1B7**	0.080	0.036
48 Vac	**RXM4GB1E7**	0.080	0.036
120 Vac	**RXM4GB1F7**	0.080	0.036
230 Vac	**RXM4GB1P7**	0.080	0.036

Miniature relays with low level contacts, with LED (sold in lots of 10)

Number and type of contacts - Thermal current (Ith)			
4PDT - 3 A			
Coil Voltage	Catalog Number	Weight	
		lb.	kg
12 Vdc	**RXM4GB2JD**	0.080	0.036
24 Vdc	**RXM4GB2BD**	0.080	0.036
48 Vdc	**RXM4GB2ED**	0.080	0.036
110 Vdc	**RXM4GB2FD**	0.080	0.036
24 Vac	**RXM4GB2B7**	0.080	0.036
48 Vac	**RXM4GB2E7**	0.080	0.036
120 Vac	**RXM4GB2F7**	0.080	0.036
230 Vac	**RXM4GB2P7**	0.080	0.036
240 Vac	**RXM4GB2U7**	0.080	0.036

RXZ E2M114M with relay RXM4AB2P7TQ

Miniature relays with lockable test button, without LED (sold in lots of 100)

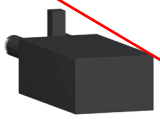
Coil Voltage	Number and type of contacts - Thermal current (Ith)					
	DPDT - 12 A			4PDT - 6 A		
	Catalog Number	Weight		Catalog Number	Weight	
		lb.	kg		lb.	kg
12 Vdc	—	—	—	**RXM4AB1JDTQ**	0.080	0.036
24 Vdc	**RXM2AB1BDTQ**	0.082	0.037	**RXM4AB1BDTQ**	0.080	0.036
48 Vdc	—	—	—	**RXM4AB1EDTQ**	0.080	0.036
110 Vdc	—	—	—	**RXM4AB1FDTQ**	0.080	0.036
220 Vdc	—	—	—	**RXM4AB1MDTQ**	0.080	0.036
24 Vac	**RXM2AB1B7TQ**	0.082	0.037	**RXM4AB1B7TQ**	0.080	0.036
48 Vac	—	—	—	**RXM4AB1E7TQ**	0.080	0.036
120 Vac	**RXM2AB1F7TQ**	0.082	0.037	**RXM4AB1F7TQ**	0.080	0.036
230 Vac	**RXM2AB1P7TQ**	0.082	0.037	**RXM4AB1P7TQ**	0.080	0.036
Miniature relays with LED (sold in lots of 100)						
24 Vdc	—	—	—	**RXM4AB2BDTQ**	0.080	0.036
24 Vac	**RXM2AB2B7TQ**	0.082	0.037	**RXM4AB2B7TQ**	0.080	0.036
230 Vac	**RXM2AB2P7TQ**	0.082	0.037	**RXM4AB2P7TQ**	0.080	0.036

RXZ E2S114M with relay RXM4AB2F7TQ

Sockets (sold in lots of 10)

Contact terminal arrangement	Connection	Relay type	Catalog Number	Weight	
				lb.	kg
Mixed	Screw clamp terminals	RXM2●●●● [1] RXM4●●●●	**RXZE2M114** [2]	0.11	0.048
	Box lug connector	RXM2●●●● [1] RXM4●●●●	**RXZE2M114M** [2]	0.12	0.056
Separate	Box lug connector	RXM2●●●●	**RXZE2S108M** [3]	0.13	0.058
		RXM3●●●●	**RXZE2S111M** [2]	0.15	0.066
		RXM4●●●●	**RXZE2S114M** [2]	0.15	0.070

[1] When mounting relay RXM2●●●●● on socket RXZE2M●●●●, the thermal current must not exceed 10 A.
[2] Thermal current Ith: 10 A
[3] Thermal current Ith: 12 A



RXM 041●●7

Protection modules (sold in lots of 20)

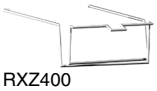
Description	Voltage	For use with	Catalog Number	Weight	
				oz.	g
Diode	6–250 Vdc	All sockets	**RXM040W**	0.11	3.0
RC circuit	24–60 Vac	All sockets	**RXM041BN7**	0.35	10.0
	110–240 Vac	All sockets	**RXM041FU7**	0.35	10.0
Varistor	6–24 Vac/Vdc	All sockets	**RXM021RB**	1.06	30.0
	24–60 Vac/Vdc	All sockets	**RXM021BN**	1.06	30.0
	110–240 Vac/Vdc	All sockets	**RXM021FP**	1.06	30.0

REXL4●●

Timing relays

Description	For use with	Catalog Number	Weight	
			lb.	kg
2 timed DPDT contacts (function A—On-delay)	Sockets RXZ E●●●●●	**REXL2●●** [4]	0.09	0.042
4 timed 4PDT contacts (function A—On-delay)		**REXL4●●** [4]	0.09	0.042

[4] Please refer to the *Zelio® Time - Timers* catalog (9050CT0001R2/05).



RXZ400

Accessories (sold in lots of 10)

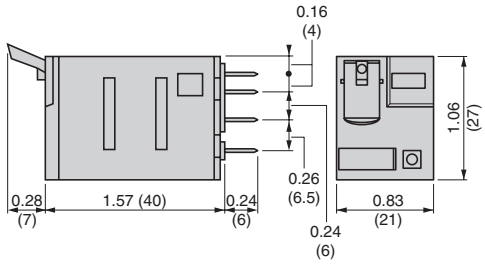
Description	For use with	Catalog Number	Weight	
			oz.	g
Metal hold-down clip	All sockets	**RXZ400**	0.04	1.0
Plastic hold-down clip	All sockets	**RXZR335**	0.18	5.0
Bus jumper, 2-pole (Ith: 5 A)	All sockets with separate contacts	**RXZS2**	0.18	5.0
Mounting adapter for DIN rail [5]	All relays	**RXZE2DA**	0.14	4.0
Mounting adapter for mounting directly to a panel	All relays	**RXZE2FA**	0.07	2.0
Clip-in markers	All relays (sheet of 108 markers)	**RXZL520**	2.82	80.0
	All sockets except RXZE2M114	**RXZL420**	0.04	1.0

[5] Test button becomes inaccessible.

Relays

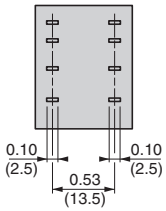
RXM●●●●●●

Common view

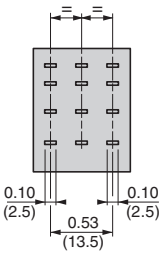


RXM2

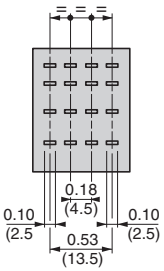
Pin side view



RXM3



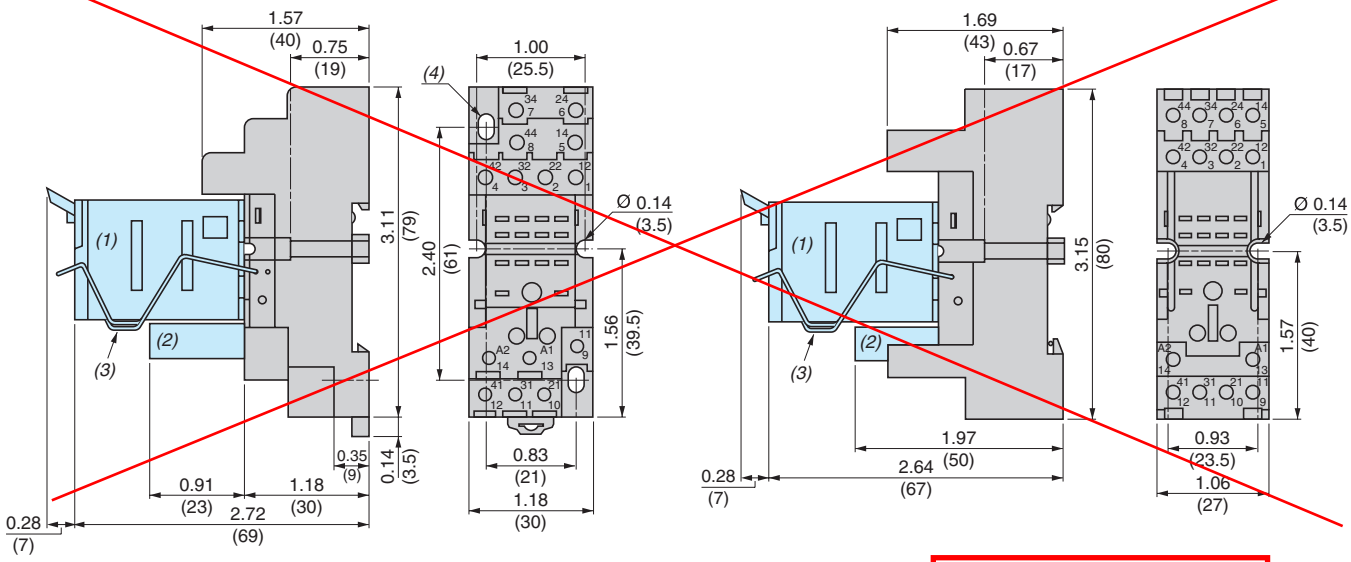
RXM4



Sockets

RXZE2M114

RXZE2M114M



RXZE2S●●●●

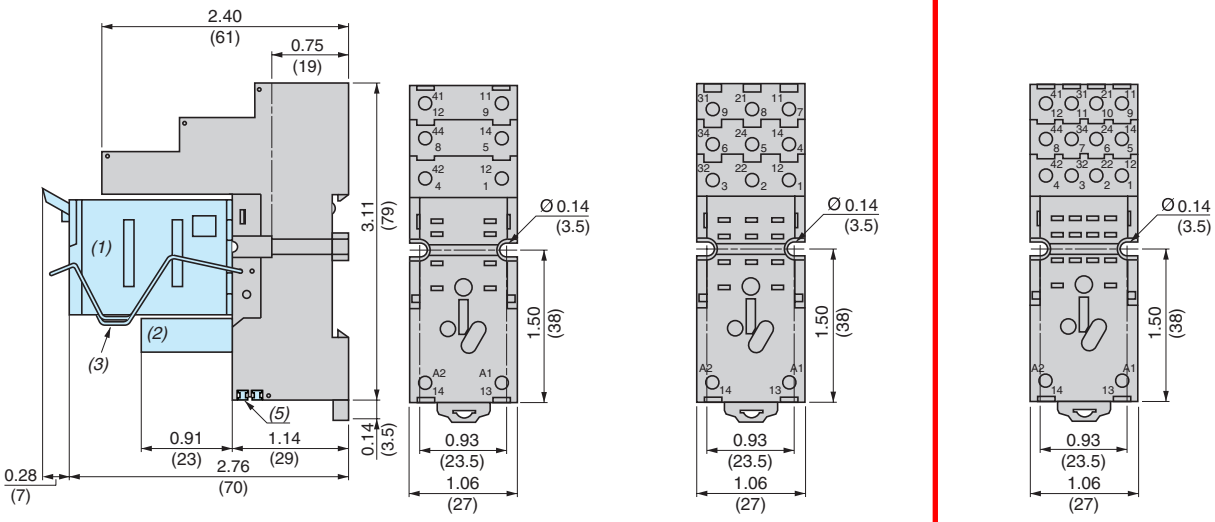
Common side view

RXZE2S108M

Pin side view

RXZE2S111M

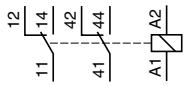
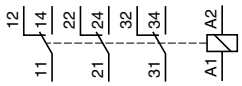
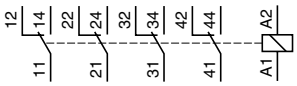
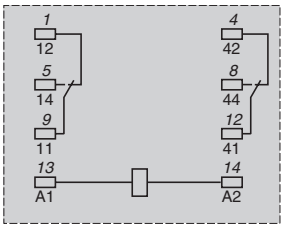
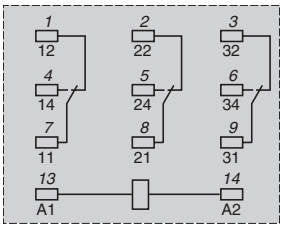
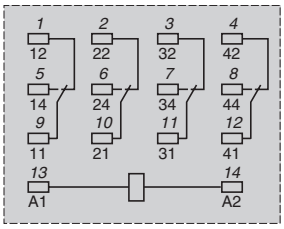
RXZE2S114M



(1) Relays
(2) Add-on protection module
(3) Hold-down clip
(4) 2 elongated holes Ø 0.14 x 0.26 (3.5 x 6.5)
(5) 2 bus jumpers

Dimensions = Inches / (mm)

Miniature relays

RXM2●●●●●	RXM3●●●●●	RXM4●●●●●
		
		

Numbers shown in *italics* correspond to NEMA marking. Viewed from pin end.

EDS-205/208 Series

5 and 8-port entry-level unmanaged Ethernet switches

- 10/100BaseT(X) (RJ45 connector), 100BaseFX (multi-mode, SC/ST connectors)
- IEEE802.3/802.3u/802.3x support
- Broadcast storm protection
- DIN-Rail mounting ability
- -10 to 60°C operating temperature range

Introduction

The EDS-205/208 series of industrial Ethernet switches are entry-level industrial 5 and 8-port Ethernet switches that support IEEE 802.3/802.3u/802.3x with 10/100M, full/half-duplex, MDI/MDIX auto-sensing RJ45 ports. The EDS-205/208 switches are rated to operate at temperatures ranging from -10 to 60°C, and are rugged enough for any harsh industrial environment. The switches can be easily installed on a DIN-Rail as well as in distribution boxes. The DIN-Rail mounting capability, wide operating temperature, and the the IP30 housing with LED indicators make the plug-and-play EDS-205/208 switches easy to use and reliable.

Specifications

Technology

Standards:
IEEE 802.3 for 10BaseT
IEEE 802.3u for 100BaseT(X) and 100BaseFX
IEEE 802.3x for Flow Control
Processing Type: Store and Forward
Flow Control: IEEE 802.3x flow control, back pressure flow control

Switch Properties

MAC Table Size: 1 K
Packet Buffer Size: 512 Kbit

Interface

Fiber Ports: 100BaseFX ports (SC/ST connector, multi-mode)
RJ45 Ports: 10/100BaseT(X) auto negotiation speed, Full/Half duplex mode, and auto MDI/MDI-X connection
LED Indicators: Power, 10/100M (TP port), 100M (fiber port)

Optical Fiber

	100BaseFX	
	Multi-mode	Single-mode
Wavelength	1300 nm	1310 nm
Max. TX	-10 dBm	0 dBm
Min. TX	-20 dBm	-5 dBm
RX Sensitivity	-32 dBm	-34 dBm
Link Budget	12 dB	29 dB
Typical Distance	5 km [a] 4 km [b]	40 km [c]
Saturation	-6 dBm	-3 dBm

a. 50/125 µm, 800 MHz*km fiber optic cable
b. 62.5/125 µm, 500 MHz*km fiber optic cable
c. 9/125 µm single-mode fiber optic cable

Power Requirements

Input Voltage:
EDS-205: 12 to 48 VDC, 18 to 30 VAC (47 to 63 Hz)
EDS-208 series: 12 to 45 VDC, 18 to 30 VAC (47 to 63 Hz)
Input Current:
EDS-205: 0.12 A @ 24 V
EDS-208: 0.14 A @ 24 V
EDS-208-M: 0.23 A @ 24 V
Overload Current Protection: 1.1 A
Connection: 1 removable 3-contact terminal block
Reverse Polarity Protection: Present

Physical Characteristics

Housing: Plastic, IP30 protection
Dimensions:
EDS-205: 24.9 x 100 x 86.5 mm (0.98 x 3.94 x 3.41 in)
EDS-208: 40 x 100 x 86.5 mm (1.57 x 3.94 x 3.41 in)
Weight:
EDS-205: 135 g
EDS-208: 170 g
Installation: DIN-Rail mounting

Environmental Limits

Operating Temperature: -10 to 60°C (14 to 140°F)
Storage Temperature: -40 to 85°C (-40 to 185°F)
Ambient Relative Humidity: 5 to 95% (non-condensing)

Standards and Certifications

Safety:
EDS-205: UL 508, EN 60950-1
EDS-208: UL 508, UL 60950-1, EN 60950-1
EMI: FCC Part 15 Subpart B Class A, EN 55022 Class A
EMS:
EN 61000-4-2 (ESD) Level 2, EN 61000-4-3 (RS) Level 3,
EN 61000-4-4 (EFT) Level 3, EN 61000-4-5 (Surge) Level 3,
EN 61000-4-6 (CS) (EDS-205: Level 3; EDS-208: Level 2),
EN 61000-4-8, EN 61000-4-11
Shock: IEC 60068-2-27
Freefall: IEC 60068-2-32
Vibration: IEC 60068-2-6
Note: Please check Moxa's website for the most up-to-date certification status.

MTBF (mean time between failures)

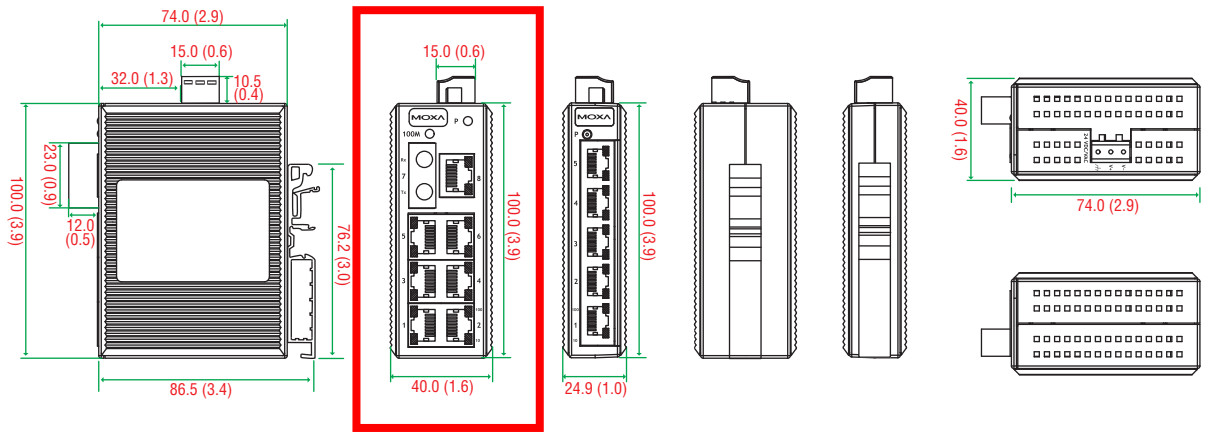
Time:
EDS-205: 768,000 hrs
EDS-208: 368,000 hrs
Database:
EDS-205: Telcordia (Bellcore), GB
EDS-208: MIL-HDBK-217F, GB 25°C

Warranty

Warranty Period: 5 years
Details: See www.moxa.com/warranty

Dimensions

Unit: mm (inch)



Side View | Front Views | Rear Views | Top & Bottom Views

Ordering Information

Available Models	Port Interface			Housing Material	Power Range
Standard Temperature (-10 to 60°C)	10/100BaseT(X)	100BaseFX			
		Multi-mode, SC Connector	Multi-mode, ST Connector		
EDS-205	5	–	–	Plastic	12 to 48 VDC
EDS-208	8	–	–	Plastic	12 to 45 VDC
EDS-208-M-SC	7	1	–	Plastic	12 to 45 VDC
EDS-208-M-ST	7	–	1	Plastic	12 to 45 VDC

Optional Accessories (can be purchased separately)

DR-4524/75-24/120-24: 45/75/120 W DIN-Rail 24 VDC power supplies
MDR-40-24/60-24: 40/60 W DIN-Rail 24 VDC power supplies, -20 to 70°C operating temperature
RK-4U: 4U-high 19" rack mounting kit

Package Checklist

- EDS-205 or EDS-208 switch
- Hardware installation guide (printed)
- Warranty card

Single-Panel Housing (SPH-01P)

A LANscape® Solutions Product

Applications

- Indoor wall-mount installations
- Telecommunications rooms, closets and enclosures, small spaces
- DOT Traffic Control cabinets and industrial PLC cabinets
- 12-fiber interconnect and splicing

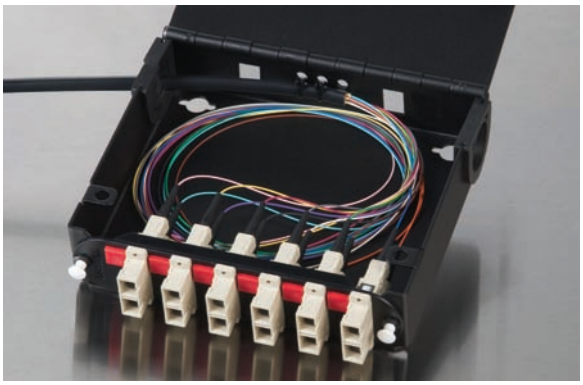
Description

The Corning Cable Systems Single-Panel Housing (SPH-01P) is a cost-effective housing for storage, protection and termination of optical fiber cables.

Accepting standard LANscape® Solutions CCH Connector Panels, the housing offers protection for the fiber cable and connectors in the physical plant. This compact unit is ideal for use in locations such as building entrance terminals, wiring closets, open office and other controlled environments where space is a premium.

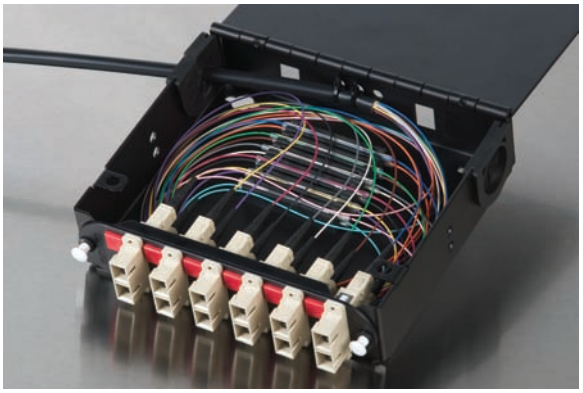
Features / Benefits

- Accepts one CCH connector panel
- Accepts Plug & Play™ Universal Systems Clip
- Includes a 6-slot, 0.4-in splice holder accommodating up to 12 heat-shrink splices
- Can be used for splice management, cross-connect or both for up to 12 fibers
- 1.5-in projection from the wall minimizes space requirements – Corning Cable Systems smallest offering (2.0-in including plungers)
- Excellent for interconnect and cross-connect functions
- Provided top and bottom cable entry grommets allow for midspan access and environmental sealing
- Cost effective for customer premises or remote locations
- Durable black metal housing



Single-Panel Housing with UniCam® SC Duplex Connectors | Photo LAN671

Single-Panel Housing with SC Duplex Adapters | Photo LAN670



Single-Panel Housing with SC Duplex Connector Pigtails Spliced onto FREEDM® One Cable | Photo LAN672

CORNING
LANscape® Solutions

Single-Panel Housing (SPH-01P)

A LANscape® Solutions Product

Specifications

Part Number	Dimensions (H x W x D)	Shipping Weight
SPH-01P	16 x 14 x 5 cm (6.3 x 5.5 x 2.0 in)	0.5 kg (1.1 lb)

Ordering Information

Part Number	Description
SPH-01P	Single-Panel, Wall-Mount Housing accommodating one CCH connector panel; also includes a 6-slot, 0.4-in splice holder and can be used for splice management, cross-connect, or both up to 12 fibers. CCH panels ordered separately.
Accessories	
SPH-01P-BKT	Ledge-Mount Bracket used to mount to the top of a ledge
CCH-CP12-E4	CCH Panel with 12 fiber, LC duplex adapters for laser-optimized multimode 50 µm fiber*

**Many other CCH panel configurations also available.*

CORNING

LANscape® Solutions

Corning Cable Systems LLC • PO Box 489 • Hickory, NC 28603-0489 USA
800-743-2675 • FAX: 828-901-5973 • International: +1-828-901-5000 • www.corning.com/cablesystems

Closet Connector Housing Panels (CCH-CP)

A LANscape® Solutions Product

Corning
Cable Systems

Applications

- The panels are used with field-installable connectors or in applications where the preconnectorized cables are routed directly from the equipment to the piece of interconnect hardware

- Provides an efficient way to securely mate two or more connectors

Description

Closet Connector Housing Panels are offered in 6-, 8-, 12-, 16- and 24-fiber panels for use with the LANscape® Solutions hardware products. The panels are used with field-installable connectors or in applications where the preconnectorized cables are routed directly from the equipment to the interconnect hardware.

The panels are available with a variety of industry-standard adapter types. In most applications, the Closet Connector Housing Panels are designed for applications where specified labeling and connector identification are required. This is accomplished by the use of colored icons with different symbols molded into the icon.

Features / Benefits

- Designed to accommodate all industry-standard adapter types

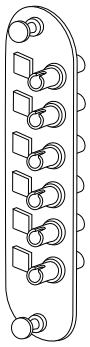
- Unique color-coded connector labeling system

- Universal approach is used; one panel size fits in all standard LANscape Solutions hardware

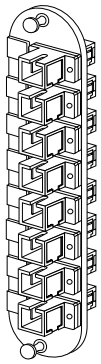
- Available in 6-, 8- and 12-fiber count options in most adapter styles; 16- and 24-fiber count options available in MT-RJ and LC duplex styles

- Also available for copper jacks

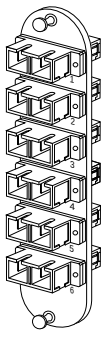
Closet Connector Housing Panels | Photo LAN215



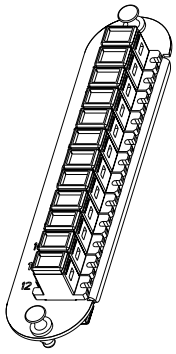
6-Fiber ST Compatible Connector Panel (CCH-CP06-25T)
| Drawing CPC-220/5/14



8-Fiber SC Simplex Panel (CCH-CP08-56)
| Drawing CPC-220/5/13



12-Fiber SC Duplex Panel (CCH-CP12-91)
| Drawing CPC-220/5/12



24-Fiber MT-RJ Connector Panel (CCH-CP24-97)
| Drawing CPC-220/5/15

CORNING
Discovering Beyond Imagination

Ordering Information *(continued)*

Part Number	Description
8-Fiber Closet Connector Housing Panels	
MT-RJ Adapter	
CCH-CP08-97	CCH Connector Panel with four MT-RJ adapters, multimode 62.5 µm
CCH-CP08-98	CCH Connector Panel with four MT-RJ adapters, single-mode
CCH-CP08-G1	CCH Connector Panel with four MT-RJ, standard 50 µm multimode, composite housing
CCH-CP08-E1	CCH Connector Panel with four MT-RJ, Xcelerate Plus™ Solutions laser-optimized 50 µm multimode, composite housing
FC Adapter	
CCH-CP08-11	CCH Connector Panel with eight FC, single-mode adapters with metal inserts, metal housings
CCH-CP08-21	CCH Connector Panel with eight FC, angle polish, single-mode adapters with metal inserts, metal housings
12-Fiber Closet Connector Housing Panels	
SC Adapter (Duplex)	
CCH-CP12-59	CCH Connector Panel with six 568SC (SC duplex) adapters, single-mode, ceramic insert, composite housing
CCH-CP12-91	CCH Connector Panel with six 568SC (SC duplex) adapters, multimode 62.5 µm, composite insert, composite housing
CCH-CP12-G7	CCH Connector Panel with six SC duplex, standard 50 µm multimode, ceramic insert, composite housing
CCH-CP12-E7	CCH Connector Panel with six SC duplex, Xcelerate Plus Solutions laser-optimized 50 µm multimode, ceramic insert, composite housing
LC Adapter (Duplex)	
CCH-CP12-A7	CCH Connector Panel with six LC duplex adapters, multimode 62.5 µm, metal insert, composite housing
CCH-CP12-A8	CCH Connector Panel with six LC duplex adapters, multimode 62.5 µm, ceramic insert, composite housing
CCH-CP12-A9	CCH Connector Panel with six LC duplex adapters, single-mode, ceramic insert, composite housing
CCH-CP12-D3	CCH Connector Panel with six LC duplex, standard 50 µm multimode, ceramic insert, composite housing
CCH-CP12-E4	CCH Connector Panel with six LC duplex, Xcelerate Plus Solutions laser-optimized 50 µm multimode, ceramic insert, composite housing
SC Adapter (Simplex)	
CCH-CP12-3C	CCH Connector Panel with 12 SC simplex, single-mode adapters with ceramic insert, composite housing
CCH-CP12-6C	CCH Connector Panel with 12 SC simplex, angle polish, single-mode adapters with ceramic insert, composite housing
CCH-CP12-56	CCH Connector Panel with 12 SC simplex adapters, multimode 62.5 µm, composite insert, composite housing
CCH-CP12-G6	CCH Connector Panel with 12 SC, standard 50 µm multimode
CCH-CP12-E6	CCH Connector Panel with 12 SC, Xcelerate Plus Solutions laser-optimized 50 µm multimode

CONNECTOR LEGEND


ST Connector

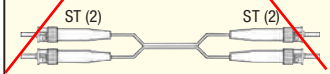

SC Connector


FC Connector


Clipped LC Connector

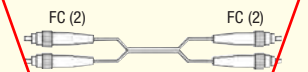

MT-RJ Connector

FODSTC-XX
• Dual ST Connectors



FODSC-XX
• Dual SC Connectors

FODFC-XX
• Dual FC Connectors

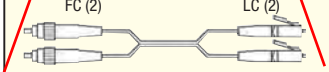


FODLC-CL-XX
• Dual LC Clipped Connectors

FODMTRJ-XX
• MT-RJ Connectors
• Dual Fiber / Single Jacket

FODMTRJP-XX
• MT-RJ Connectors
• One Connector has Pins

FODFC-LC-XX
• Dual FC and Dual LC Connectors



Item #	Description	1-9	10-24	25-99	100-249	250-499

62.5/125

L-com's multimode fiber optic patch cords and adapter cords utilize OFNR Riser Rated jackets. All cables are 100% optically tested and utilize a PC polish. Custom lengths and other connector types are available. All cable measurements are in meters. 1m = 3.28 ft.

RoHS Dual ST to Dual ST Duplex Patch Cord, Multimode Fiber with OFNR Jacket

FODSTC-01	MM Fiber Cable, Dual ST / Dual ST, 1.0m
FODSTC-02	MM Fiber Cable, Dual ST / Dual ST, 2.0m
FODSTC-03	MM Fiber Cable, Dual ST / Dual ST, 3.0m
FODSTC-04	MM Fiber Cable, Dual ST / Dual ST, 4.0m
FODSTC-05	MM Fiber Cable, Dual ST / Dual ST, 5.0m
FODSTC-10	MM Fiber Cable, Dual ST / Dual ST, 10.0m
FODSTC-15	MM Fiber Cable, Dual ST / Dual ST, 15.0m
FODSTC-20	MM Fiber Cable, Dual ST / Dual ST, 20.0m
FODSTC-25	MM Fiber Cable, Dual ST / Dual ST, 25.0m
FODSTC-30	MM Fiber Cable, Dual ST / Dual ST, 30.0m
FODSTC-35	MM Fiber Cable, Dual ST / Dual ST, 35.0m
FODSTC-40	MM Fiber Cable, Dual ST / Dual ST, 40.0m
FODSTC-45	MM Fiber Cable, Dual ST / Dual ST, 45.0m

RoHS Dual SC to Dual SC Duplex Patch Cord, Multimode Fiber with OFNR Jacket

FODSC-01	MM Fiber Cable, Dual SC / Dual SC, 1.0m
FODSC-02	MM Fiber Cable, Dual SC / Dual SC, 2.0m
FODSC-03	MM Fiber Cable, Dual SC / Dual SC, 3.0m
FODSC-04	MM Fiber Cable, Dual SC / Dual SC, 4.0m
FODSC-05	MM Fiber Cable, Dual SC / Dual SC, 5.0m
FODSC-10	MM Fiber Cable, Dual SC / Dual SC, 10.0m
FODSC-15	MM Fiber Cable, Dual SC / Dual SC, 15.0m
FODSC-20	MM Fiber Cable, Dual SC / Dual SC, 20.0m
FODSC-25	MM Fiber Cable, Dual SC / Dual SC, 25.0m
FODSC-30	MM Fiber Cable, Dual SC / Dual SC, 30.0m
FODSC-35	MM Fiber Cable, Dual SC / Dual SC, 35.0m
FODSC-40	MM Fiber Cable, Dual SC / Dual SC, 40.0m
FODSC-45	MM Fiber Cable, Dual SC / Dual SC, 45.0m

RoHS Dual FC to Dual FC Duplex Patch Cord, Multimode Fiber with OFNR Jacket

FODFC-01	MM Fiber Cable, Dual FC / Dual FC, 1.0m
FODFC-02	MM Fiber Cable, Dual FC / Dual FC, 2.0m
FODFC-03	MM Fiber Cable, Dual FC / Dual FC, 3.0m
FODFC-04	MM Fiber Cable, Dual FC / Dual FC, 4.0m
FODFC-05	MM Fiber Cable, Dual FC / Dual FC, 5.0m

RoHS Dual LC to Dual LC Clipped Duplex Patch Cord, Multimode Fiber with OFNR Jacket

FODLC-CL-01	MM Fiber Cable, Dual Clipped LC / Dual Clipped LC, 1.0m
FODLC-CL-02	MM Fiber Cable, Dual Clipped LC / Dual Clipped LC, 2.0m
FODLC-CL-03	MM Fiber Cable, Dual Clipped LC / Dual Clipped LC, 3.0m
FODLC-CL-04	MM Fiber Cable, Dual Clipped LC / Dual Clipped LC, 4.0m
FODLC-CL-05	MM Fiber Cable, Dual Clipped LC / Dual Clipped LC, 5.0m
FODLC-CL-10	MM Fiber Cable, Dual Clipped LC / Dual Clipped LC, 10.0m

RoHS MT-RJ to MT-RJ Duplex Patch Cord - Multimode Fiber with OFNR Jacket

Note: These MT-RJ connectors do not utilize alignment pins.

FODMTRJ-01	MM Fiber Cable, MT-RJ / MT-RJ, 1.0m
FODMTRJ-02	MM Fiber Cable, MT-RJ / MT-RJ, 2.0m
FODMTRJ-03	MM Fiber Cable, MT-RJ / MT-RJ, 3.0m
FODMTRJ-04	MM Fiber Cable, MT-RJ / MT-RJ, 4.0m
FODMTRJ-05	MM Fiber Cable, MT-RJ / MT-RJ, 5.0m

RoHS MT-RJ to MT-RJ Duplex Patch Cord with Pins - Multimode Fiber with OFNR Jacket

Note: One MT-RJ connector features alignment pins.

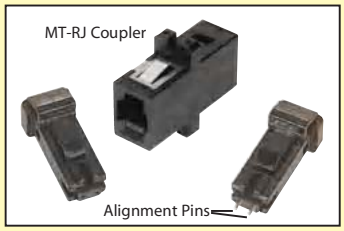
FODMTRJP-01	MM Fiber Cable, MT-RJ / MT-RJ, 1.0m
FODMTRJP-02	MM Fiber Cable, MT-RJ / MT-RJ, 2.0m
FODMTRJP-03	MM Fiber Cable, MT-RJ / MT-RJ, 3.0m
FODMTRJP-04	MM Fiber Cable, MT-RJ / MT-RJ, 4.0m
FODMTRJP-05	MM Fiber Cable, MT-RJ / MT-RJ, 5.0m

RoHS Dual FC to Dual LC Duplex Adapter Cord, Multimode Fiber with OFNR Jacket

FODFC-LC-01	MM Fiber Cable, Dual FC / Dual LC, 1.0m
FODFC-LC-02	MM Fiber Cable, Dual FC / Dual LC, 2.0m
FODFC-LC-03	MM Fiber Cable, Dual FC / Dual LC, 3.0m
FODFC-LC-04	MM Fiber Cable, Dual FC / Dual LC, 4.0m
FODFC-LC-05	MM Fiber Cable, Dual FC / Dual LC, 5.0m

Tip *What is the MT-RJ connector? How does it work?*

The MT-RJ is one of the newly emerging *Small Form Factor* connectors that are becoming commonplace in the networking industry. The MT-RJ utilizes two fibers and integrates them into a single design that looks similar to a Black RJ45 modular connector. Alignment is completed through the use of two pins that mate with the connector. Transceiver jacks found on NICs and equipment typically have the pins built into them. Users need to be careful that one connector has alignment pins when mating two MT-RJ cables through a coupler.



Time-Lag Glass Tube Fuse Series

GDL

GDL-V

GDL

UL Listed	200mA~10A
CSA Certified	200mA~10A
MITI	1A~10A

GDL-V (With Pig-Tail)

UL Listed	200mA~8A
CSA Certified	200mA~8A
MITI	1A~8A

Rated Current	1 In	1.35 In	2 In	
	MIN	MAX	MIN	MAX
10mA~3A	4 Hrs.	1 hr	5 sec	120 Sec
3.15A~30A	4 Hrs.	1 hr	12 sec	120 Sec

10mA~10A: 10,000 amperes at 125V AC
10mA~1A: 35 amperes at 250V AC
1.2A~3.5A: 100 amperes at 250V AC
3.75A~10A: 200 amperes at 250V AC

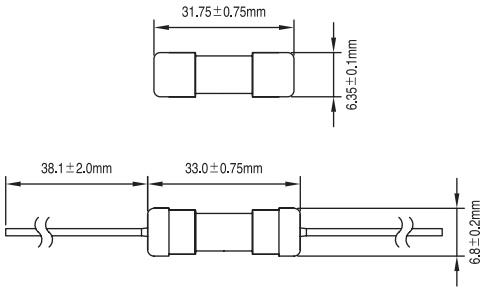
-55°C to +125°C

Materials

Glass body / Nickel Plated Brass Caps
Lead Wire:
Diameter Ø0.8 mm 12A and less.
Diameter Ø1.0 mm for rating above 13A to 19A.
Diameter Ø1.2 mm for rating above 20A.

Packaging

In Bulk:
GDL - 500 pcs ; GDL-V - 250 pcs per box



Cartridge Catalog Number	Axial Lead Catalog Number	Ampere Rating [In]	Voltage Rating (V)	Nominal Resistance Cold Ohms	Nominal Melting I^2t A^2 Sec
GDL1/100	GDL-V1/100	10 mA		*	*
2/100	-V2/100	20 mA		*	*
3/100	-V3/100	30 mA		*	*
1/32	-V1/32	32 mA		*	*
4/100	-V4/100	40 mA		*	*
5/100	-V5/100	50 mA		*	*
1/16	-V1/16	63 mA		*	*
7/100	-V7/100	70 mA		*	*
8/100	-V8/100	80 mA		*	*
1/10	-V1/10	100 mA		15.669	0.02000
1/8	-V1/8	125 mA		10.596	0.03125
15/100	-V15/100	150 mA		8.4090	0.05625
16/100	-V16/100	160 mA		7.6250	0.06400
175/1000	-V175/1000	175 mA		6.9250	0.07656
18/100	-V18/100	180 mA		5.9110	0.08790
2/10	-V2/10	200 mA		16.920	0.14000
1/4	-V1/4	250 mA		10.225	0.18750
3/10	-V3/10	300 mA		8.3170	0.31500
315/1000	-V315/1000	315 mA		8.0000	0.34720
35/100	-V35/100	350 mA		5.5000	0.42870
3/8	-V3/8	375 mA		4.3110	0.49210
4/10	-V4/10	400 mA		4.2090	0.80000
1/2	-V1/2	500 mA		2.4090	1.75000
6/10	-V6/10	600 mA		1.7740	2.88000
63/100	-V63/100	630 mA		1.6000	3.96900
7/10	-V7/10	700 mA		1.3400	4.90000
8/10	-V8/10	800 mA		1.0100	5.76000
1	-V1	1 A		0.6940	6.50000
1-2/10	-V1-2/10	1.2 A		0.4540	10.0800
1-1/4	-V1-1/4	1.25 A	250V	0.4300	11.7180
1-1/2	-V1-1/2	1.5 A		0.2800	22.5000
1-6/10	-V1-6/10	1.6 A		0.3380	25.6000
1-3/4	-V1-3/4	1.75 A		0.2900	33.6880
1-8/10	-V1-8/10	1.8 A		0.2630	35.6400
2	-V2	2 A		0.2250	48.0000
2-1/4	-V2-1/4	2.25 A		0.1910	60.7500
2-1/2	-V2-1/2	2.5 A		0.1610	81.2500
2-8/10	-V2-8/10	2.8 A		0.1080	117.600
3	-V3	3 A		0.0952	135.000
3-15/100	-V3-15/100	3.15 A		0.0856	148.830
3-2/10	-V3-2/10	3.2 A		0.0689	153.600
3-1/2	-V3-1/2	3.5 A		0.0650	183.750
4	-V4	4 A		0.0546	240.000
5	-V5	5 A		0.0422	375.000
6	-V6	6 A		0.0141	540.000
6-3/10	-V6-3/10	6.3 A		0.0135	585.930
6-1/2	-V6-1/2	6.5 A		0.0121	760.500
7	-V7	7 A		0.0116	882.000
7-1/2	-V7-1/2	7.5 A		0.0108	1012.50
8	-V8	8 A		0.0093	1280.00
10	-V10	10 A		0.0072	2500.00
12	-V12	12 A		0.0053	4320.00
13	-V13	13 A		0.0049	5070.00
15	-V15	15 A		0.0041	6750.00
16	-V16	16 A		0.0037	7680.00
18	-V18	18 A		0.0033	9720.00
20	-V20	20 A		0.0031	12000.0
25	-V25	25 A		0.0024	18750.0
30	-V30	30 A		0.0019	27000.0

*Please contact the manufacturer.

Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation at http://www.download.phoenixcontact.com. The General Terms and Conditions of Use apply to Internet downloads.

Extract from the online catalog

Fuse terminal block for cartridge fuse insert, cross section: 0.5 - 16 mm², AWG: 26 - 8, width: 10.2 mm, color: black

Order No.	3004171
Ord designation	UK 6,3-HESI
EAN	4017918090685
Pack	50 Pcs.
Customs tariff	85363010
Weight/Piece	0,03418 KG
Catalog page information	Page 267 (CL-2005)

Product notes

WEEE/RoHS-compliant since: 01/01/2003

IMPORTANT : This date is valid for Customers in Germany only. Date Format is MM/DD/YYYY.Please contact your local in-country Phoenix Contact location or designated business partner for a Logistics Compliant date in your area.In order to guarantee delivery of RoHS-Compliant product, please purchase Phoenix Contact parts from authorized Phoenix Contact representatives and distributors.

General

Number of levels	1
Number of connections	2
Color	black
Insulating material	PA
Inflammability class acc. to UL 94	V2

Dimensions

Width	10.2 mm
Length	79 mm
Height NS 35/7,5	60.5 mm
Height NS 35/15	68 mm
Height NS 32	65 mm

Technical data

Fuse	G / 6,3 x 32
Fuse type	Glass
Rated surge voltage	6 kV
Contamination class	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC / EN
Nominal current I_N	10 A
Nominal voltage U_N	800 V

Connection data

Conductor cross section solid min.	0.5 mm^2
Conductor cross section solid max.	16 mm^2
Conductor cross section stranded min.	0.5 mm^2
Conductor cross section stranded max.	16 mm^2
Conductor cross section AWG/kcmil min.	20
Conductor cross section AWG/kcmil max	6
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.5 mm^2
Conductor cross section stranded, with ferrule without plastic sleeve max.	10 mm^2
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.5 mm^2
Conductor cross section stranded, with ferrule with plastic sleeve max.	10 mm^2
2 conductors with same cross section, solid min.	0.5 mm^2
2 conductors with same cross section, solid max.	4 mm^2
2 conductors with same cross section, stranded min.	0.5 mm^2
2 conductors with same cross section, stranded max.	4 mm^2
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.5 mm^2
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	4 mm^2
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm^2

2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	6 mm^2
Cross section with insertion bridge, solid max.	10 mm^2
Cross section with insertion bridge, stranded max.	10 mm^2
Type of connection	Screw connection
Stripping length	12 mm
Screw thread	M 4
Tightening torque, min	1.2 Nm

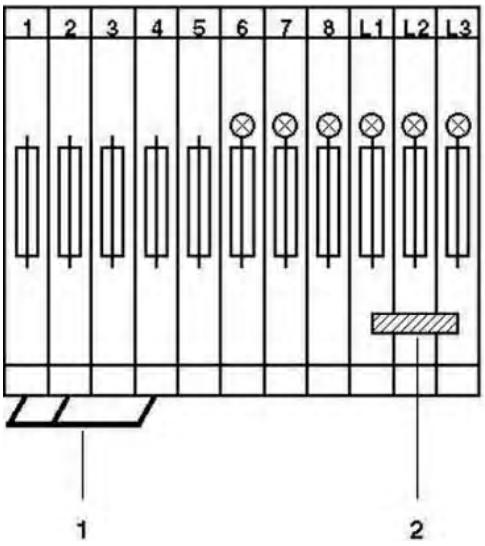
Certificates / Approvals

Certificate logos

CSA	
Nominal voltage U_N	600 V
Nominal current I_N	25 A
AWG/kcmil	26-8
UL	
Nominal voltage U_N	600 V
Nominal current I_N	10 A
AWG/kcmil	26-8

Drawings

Circuit diagram



1 = fixed bridge

2 = insertion bridge

Accessories

Item	Designation	Description
Assembly		
3022218	CLIPFIX 35	Snap-on end bracket, for 35 mm NS 35/7.5 or NS 35/15 mounting rail, can be fitted with Zack strip ZB 8 and ZB 8/27, terminal strip marker KLM 2 and KLM, width: 9.5 mm, color: gray
1201442	E/UK	End clamp, for supporting the electronic base. If mounted vertically, 2 end clamps are required in each case
1201028	NS 32 AL UNPERF 2000MM	G rail 32 mm (NS 32)
1201280	NS 32 CU/120QMM UNPERF 2000MM	G-profile DIN rail, deep-drawn, material: Copper, unperforated, height 15 mm, width 32 mm, length 2 m
1201358	NS 32 CU/35QMM UNPERF 2000MM	G-profile DIN rail, material: Copper, unperforated, height 15 mm, width 32 mm, length 2 m
1201002	NS 32 PERF 2000MM	G-profile DIN rail, material: Steel, perforated, height 15 mm, width 32 mm, length 2 m
1201015	NS 32 UNPERF 2000MM	G-profile DIN rail, material: Steel, unperforated, height 15 mm, width 32 mm, length 2 m
0801762	NS 35/ 7,5 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, height 7.5 mm, width 35 mm, length: 2 m
0801733	NS 35/ 7,5 PERF 2000MM	DIN rail, material: Steel, perforated, height 7.5 mm, width 35 mm, length: 2 m
0801681	NS 35/ 7,5 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1201756	NS 35/15 AL UNPERF 2000MM	DIN rail, deep-drawn, high profile, unperforated, 1.5 mm thick, material: Aluminum, height 15 mm, width 35 mm, length 2 m
1201895	NS 35/15 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, 1.5 mm thick, height 15 mm, width 35 mm, length: 2 m
1201730	NS 35/15 PERF 2000MM	DIN rail, material: Steel, perforated, height 15 mm, width 35 mm, length: 2 m
1201714	NS 35/15 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 15 mm, width 35 mm, length: 2 m
1201798	NS 35/15-2,3 UNPERF 2000MM	DIN rail, material: Steel, unperforated, 2.3 mm thick, height 15 mm, width 35 mm, length: 2 m
3004207	VS	Connection pin, for coupling disconnect knives, in plastic, 1 m long
Bridges		
0203153	EB 2-10	Insertion bridge, 2-pos., fully insulated
0203137	EB 10-10	Insertion bridge, 10-pos., divisible, fully insulated
Marking		
1007248	SBS10:UNBEDRUCKT	Marker cards, unprinted, for individual labeling with the M-PEN, 250-section, perforated, white plastic
1050525	ZB10:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements
Tools		
1205066	SZS 1,0X4,0	Screwdriver, bladed, matches all screw terminal blocks with 10 mm² and 16 mm² connection cross section, blade: 1.0 x 4.0 mm

Product Data Sheet

PK12GTA
Load Center Ground Bar Assembly

SQUARE D
by Schneider Electric

[redacted] [redacted]

Availability **Stock Item: This item is normally stocked in our distribution facility.**

Technical Characteristics

Application	Load Centers
Circuit Breaker Type	PK
Marketing Trade Name	QO and Homeline

Shipping and Ordering

Category	00102 - Load Centers, Accessories, Type QO
Discount Schedule	DE3A
GTIN	00785901026402
Package Quantity	10
Weight	0.14 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	US

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

Generated: 01/05/2011 08:52:09

Schneider Electric

Instruction Bulletin	Boletín de instrucciones	Directives d'utilisation

Series Serie Série 0	Replaces Reemplaza Remplace 40271-658-04 09/2001

40271-658-05
09/2005
Lexington, KY, USA
40559-084-50/51

PK12GTA

Equipment Grounding Bar Kit

~~Accesorio de la barra de tierra de~~ protección

Kit de barre de m.à.l.t. de l'appareil

Retain for future use. / Conservar para uso futuro. / À conserver pour usage ultérieur.

Contents

1 Grounding Bar
2 Mounting Screws
1 Equipment Grounding Label

Contenido

1 barra de puesta a tierra
2 tornillos de montaje
1 etiqueta de puesta a tierra del equipo

Contenu

1 barre de m.à.l.t.
2 vis de montage
1 étiquette de m.à.l.t. de l'appareil

Installation

Instalación

Installation

⚠ DANGER / PELIGRO / DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must be only installed and serviced by qualified electrical personnel.
- Turn off all power supplying the equipment where this kit will be installed before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

PELIGRO DE DESCARGA ELÉCTRICA, EXPLOSIÓN O DESTELLO POR ARQUEO

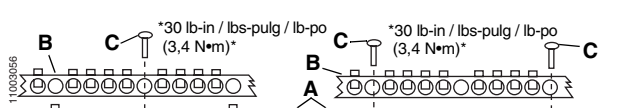
- Utilice equipo de protección personal (EPP) apropiado y siga las prácticas de seguridad eléctrica establecidas por su Compañía, consulte la norma NFPA 70E.
- Solamente el personal eléctrico especializado deberá instalar y prestar servicio de mantenimiento a este equipo.
- Desenergice el equipo donde será instalado este accesorio antes de realizar cualquier trabajo en él equipo.
- Siempre utilice un dispositivo detector de tensión nominal adecuado para confirmar la desenergización del equipo.
- Vuelva a colocar todos los dispositivos, las puertas y las cubiertas antes de volver a energizar el equipo.

El incumplimiento de estas instrucciones podrá causar la muerte o lesiones serias.

RISQUE D'ÉLECTROCUTION, D'EXPLOSION OU D'ÉCLAIR D'ARC

- Portez un équipement de protection personnel (ÉPP) approprié et observez les méthodes de travail électrique sécuritaire. Voir NFPA 70E.
- Seul un personnel qualifié doit effectuer l'installation et l'entretien de cet appareil.
- Coupez l'alimentation de l'appareil sur lequel ce kit doit être installé avant d'y travailler.
- Utilisez toujours un dispositif de détection de tension à valeur nominale appropriée pour s'assurer que l'alimentation est coupée.
- Replacez tous les dispositifs, les portes et les couvercles avant de mettre l'appareil sous tension.

Si ces directives ne sont pas respectées, cela entraînera la mort ou des blessures graves.



*After overcoming starting torque / Una vez realizado el apriete inicial / Après le serrage de départ

1. Mount grounding bar to back of enclosure (A):
   — If one mounting hole and two nubs are provided, mount grounding bar (B) with two outer mounting holes over nubs and one mounting screw (C) through center mounting hole.
   — If two mounting holes are provided, mount grounding bar (B) with two mounting screws (C).

   NOTE: If no mounting holes are provided use #26 drill bit to drill two 0.147 in. (3.7 mm) diameter mounting holes using grounding bar as a drilling template.
2. Apply equipment grounding label to enclosure beside grounding bar.
3. Install wiring to grounding bar. See equipment grounding label for binding screw torque.

1. Instale la barra de puesta a tierra del equipo en la parte posterior del gabinete (A):
   — Si viene provisto con un agujero de montaje y dos muescas, instale la barra (B) con dos agujeros de montaje sobre las muescas e inserte un tornillo de montaje (C) por el agujero intermedio.
   — Si viene provisto con dos agujeros de montaje, instale la barra (B) utilizando dos tornillos de montaje (C).

   NOTA: Si no vienen con agujeros de montaje, utilice un taladro con una broca del no. 26 para perforar dos agujeros de 3,7 mm (0,147 pulg) de diámetro utilizando la barra de puesta a tierra del equipo como plantilla de perforación.
2. Adhiera la etiqueta de puesta a tierra del equipo al gabinete junto a la barra de tierra.
3. Instale los cables en la barra de puesta a tierra. Consulte la etiqueta de puesta a tierra del equipo para conocer los valores de par de apriete de los tornillos de sujeción.

1. Monter la barre de m.à.l.t. à l'arrière du coffret(A) :
   — Si un trou de montage et deux bossages sont fournis, monter la barre (B) avec les deux trous de montage extérieurs sur les bossages et une vis de montage (C) passant par le trou de montage central.
   — Si deux trous de montage sont fournis, monter la barre (B) à l'aide de deux vis de montage (C).

   REMARQUE : Si aucun trou de montage n'a été fourni, utiliser une mèche n° 26 pour percer deux trous de montage d'un diamètre de 3,7 mm (0,147 po) en se servant de la barre de m.à.l.t. de l'appareil comme gabarit de perçage.
2. Placer l'étiquette de m.à.l.t. de l'appareil sur le coffret, à côté de la barre de m.à.l.t.
3. Installer le câblage sur la barre de m.à.l.t. Consulter l'étiquette de m.à.l.t. de l'appareil pour connaître le couple de serrage des vis de fixation.

Made in Canada | **Hecho en Canadá** | **Fabriqué aux Canada**

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

Solamente el personal especializado deberá instalar, hacer funcionar y prestar servicios de mantenimiento al equipo eléctrico. Schneider Electric no asume responsabilidad alguna por las consecuencias emergentes de la utilización de este material.

Seul un personnel qualifié doit effectuer l'installation, l'utilisation, l'entretien et la maintenance du matériel électrique. Schneider Electric n'assume aucune responsabilité des conséquences éventuelles découlant de l'utilisation de cette documentation.

Schneider Electric USA
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Lexington, KY 40511 USA
1-888-778-2733
www.us.SquareD.com

40271-658-05

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Catalog 33
North American Edition 2012

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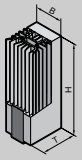
ENCLOSURES | POWER DISTRIBUTION | CLIMATE CONTROL | IT INFRASTRUCTURE | SOFTWARE & SERVICES

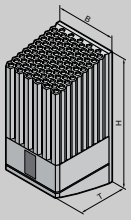
FRIEDHELM LOH GROUP

Climate control accessories Page 471 **Software & services** Page 511

Configuration:
- PTC heater
- Quick-connection terminal
- Assembly parts

Note:
- For precise temperature control inside the enclosure, we recommend the enclosure internal thermostat 3110.000 or the digital thermostat 3114.200 with display (see accessories).
- In order to prevent condensation on assemblies, hygrostat 3118.000 (see accessories) is recommended to regulate heating.
- In larger enclosures, even heat distribution is best achieved by installing several low-output heaters.
- The installation of heaters is generally advisable, in order to prevent condensation.

1 

2 

1 Without fan, continuous thermal output 10 – 150 W

Part No.		**3105.310**	**3105.320**	**3105.330**	**3105.340**	**3105.350**	**3105.360**	**3105.370**	
Dimensions inches (mm)	W (B) H D (T)	5 (120) 2 (45) 2 (46)	5 (120) 2 (45) 2 (46)	6 (155) 3 (64) 2 (56)	6 (155) 3 (64) 2 (56)	9 (230) 3 (64) 2 (56)	6 (165) 4 (90) 3 (75)	7 (180) 4 (90) 3 (75)	
Rated operating voltage V, Hz		110 – 240 V, 50/60 Hz							
Continuous thermal output at T_u = 50° F (10° C) BTU (W)		**27 – 34 (8 – 10)**	**61 – 68 (18 – 20)**	**78 – 102 (23 – 30)**	**167 – 171 (49 – 50)**	**215 – 256 (63 – 75)**	**293 – 341 (86 – 100)**	**444 – 512 (130 – 150)**	
Pre-fuse T		2 A		4A					

Accessories	PU		Page
Encl. internal thermostat	1	3110.000	476
Hygrostat	1	3118.000	476
Digital temp. display/thermostat	1	3114.200	475

Special voltages available on request. We reserve the right to make technical modifications.

2 With fan, continuous thermal output 250 – 800 W

Part No.		**3105.410**	**3105.380**	**3105.420**	**3105.390**	**3105.430**	**3105.400**	
Dimensions inches (mm)	W (B) H D (T)	8 (200) 4 (103) 4 (103)						
Rated operating voltage V, Hz		110 V, 50/60 Hz	230 V, 50/60 Hz	110 V, 50/60 Hz	230 V, 50/60 Hz	110 V, 50/60 Hz	230 V, 50/60 Hz	
Continuous thermal output at T_u = 50°F (10°C) BTU (W)		**853 (250)[1)]**		**1365 (400)[1)]**		**2730 (800)[1)]**		
Pre-fuse T		4 A		6 A		10 A	6 A	

Accessories	PU		Page
Encl. internal thermostat	1	3110.000	476
Hygrostat	1	3118.000	476
Digital temp. display/thermostat	1	3114.200	475

[1)] Thermal output with fan.
Special voltages available on request. We reserve the right to make technical modifications.

Extract from the online catalog

MACX MCR-EX-SL-RPSSI-I

Order No.: 2865340

http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2865340

Ex-i repeater power supply and input isolation amplifier, HART. Sends fed or active 0/4-20 mA signals from the Ex area to a load (active or passive) to the safe area. Electrical 3-way isolation, SIL 2 in accordance with IEC 61508.

SIL 2

Product notes

WEEE/RoHS-compliant since: 03/10/2008

http://www.download.phoenixcontact.com
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Commercial data	
GTIN (EAN)	4046356160353
sales group	H720
Pack	1 pcs.
Customs tariff	85437090
Weight/Piece	0.1605 KG
Catalog page information	Page 432 (IF-2009)

Technical data

Measuring input

Current input signal	0 mA ... 20 mA
	4 mA ... 20 mA
Transmitter supply voltage	> 16 V (at 20 mA)

Measurement output	
Signal output	Current output
Current output signal	0 mA ... 20 mA (active)
	4 mA ... 20 mA (active)
	0 mA ... 20 mA (passive, ext.Source voltage 14...26 V)
	4 mA ... 20 mA (passive, ext.Source voltage 14...26 V)
Load/output load current output	< 600 Ω

Power supply	
Nominal supply voltage	24 V DC
Range of supply voltages	19.2 V DC ... 30 V DC
Max. current consumption	< 60 mA (for 24 V DC)
Power consumption	< 1.1 W (At 24 V DC / 20 mA)

Connection data	
Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	2.5 mm²
Conductor cross section stranded min.	0.2 mm²
Conductor cross section stranded max.	2.5 mm²
Conductor cross section AWG/kcmil min.	24
Conductor cross section AWG/kcmil max	14
Stripping length	8 mm
Screw thread	M3
Type of connection	Screw connection
Tightening torque, min	0.5 Nm
Tightening torque max	0.6 Nm

General data	
No. of channels	1
Transmission error, max.	< 0.1 % (of end value)
Transmission error, typical	< 0.05 % (of end value)
Maximum temperature coefficient	< 0.01 %/K
Ambient temperature (operation)	-20 °C ... 60 °C (Any mounting position)
Ambient temperature (storage/transport)	-40 °C ... 80 °C
Permissible humidity (operation)	10 % ... 95 % (no condensation)
Step response (10-90%)	< 600 µs (For jump 4 mA ... 20 mA)
Status display	Green LED (supply voltage)

Width	12.5 mm
Height	99 mm
Depth	114.5 mm
Inflammability class acc. to UL 94	V0
Housing material	PA 66-FR
Color	green
Conformity	CE-compliant, additionally EN 61326
ATEX	II (1) GD [Ex ia] IIC
	Ex II 3 (1GD) G Ex nA [ia] IIC T4
IECEx	[Ex ia] IIC; Ex nA[ia] IIC T4
UL, USA / Canada	UL applied for
Functional safety (SIL)	SIL 2 according to EN 61508

Data communication (bypass)

HART function	Yes
Protocols supported	HART

Safety characteristic data

Integrity requirement	for IEC 61508 - Low demand
Equipment type	Type A
Safety integrity level (SIL)	Up to 2
SFF	90.7 %
λ_{SU}	4.867×10^{-7} (486.7 FIT)
λ_{SD}	0
λ_{DU}	5×10^{-8} (50 FIT)
λ_{DD}	0
Wahrscheinlichkeit eines gefahrbringenden Ausfalls pro Anforderung (PFD_{AVG})	$2{,}19 \times 10^{-4}$ (1Jahr)
	$8{,}76 \times 10^{-4}$ (Jahre)
	$1{,}1 \times 10^{-3}$ (5 Jahre)
DC	(DC_S = 0%, DC_D = 0%)
Integrity requirement	for IEC 61508 - High demand
Equipment type	Type A
Safety integrity level (SIL)	Up to 2
SFF	90.7 %
λ_{SU}	4.867×10^{-7} (486.7 FIT)

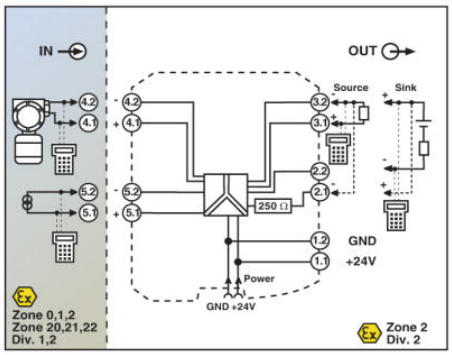
λ_{SD}	0
λ_{DU}	5 x 10^{-8} (50 FIT)
λ_{DD}	0
PFH	4,99 x 10^{-8}
DC	(DC_S = 0%, DC_D = 0%)

Certificates / Approvals

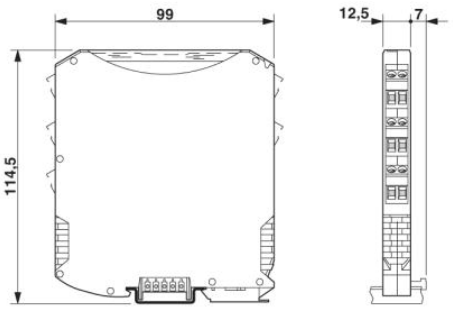
Certification	CUL Listed, UL Listed
Certification Ex:	IECEx
Certifications applied for:	UL-EX LIS

Diagrams/Drawings

Block diagram



Dimensioned drawing



vynckier
ENCLOSURE SYSTEMS INC.
Vynckier Enclosure Systems, 271 McCarty, Houston, TX 77029
Phone:(713) 374-7850 • Toll Free:(888) 837-1114 • Fax:(800) 444-1261 • www.EnclosuresOnline.com

VJ Series Non-Metallic Enclosures

Global Approvals

VJ/RVJ Series - NEMA Rated Enclosures

Features

VJ: Seven sizes ranging from inside dimensions of 6” x 6” to 18” x 16”.

RVJ: Five sizes ranging from inside dimensions of 10” x 8” to 18” x 16”.

Enclosures are maintenance free and corrosion resistant.

Bases and covers are made from hot compression molded halogen free, self extinguishing fiberglass reinforced polyester that can withstand continuous temperatures from -58°F to 302°F (-50°C to 150°C) and momentary exposure to temperatures up to 392°F (200°C).

All enclosures can be easily modified to customer specifications.

Gaskets are made from continuously poured polyurethane foam.

Molded on mounting flanges and ribbed cover corners provide extra strength.

Applications

VJ and RVJ enclosures are designed for use as electrical junction boxes in highly corrosive environments. Examples include:

Chemical processing plants, oil refineries, marine installations, waste water treatment plants, electroplating plants, food processing plants, and agricultural environments to name a few.

Enclosures are highly suitable as both indoor and outdoor instrument housings. Window enclosures provide easy visual inspection of interior components.

Accessories

Front panels
Back panels
Window Kits
Venting options

Standards

IEC 439-1
IEC 529 - Rated IP66-11
EN 50298
CSA Certified per C22.2 No. 94
CE Marking

Global Approvals

UL Listed Types:
3, 3R, 4, 4X, 12 & 13 per UL 508
CSA Listed Types:
3, 3R, 4, 4X, 12 & 13
AS Australian Standards 3131-1991
EExell, INTEX 84.102.378 U
LLOYD’s Register of Shipping
BASEEFA
KEMA - Netherlands
CEBEC - Belgium
RoHS

The ***“Platinum Plus”*** light grey color is cleaner, cooler and more asthetically pleasing. Now users can enjoy the physical benefits of better heat reflection and better UV resistance due to the lighter color.

Custom colors also available, please contact factory for more information

VJ Series Non-Metallic Enclosures

Vynckier VJ Series

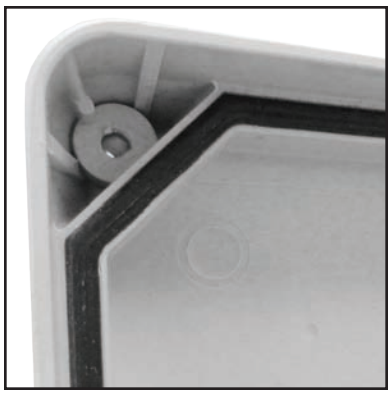
Product Number	Outside Dimensions (mm) H	W	D	Inside Dimensions (mm) H	W	D	Weight lbs. (kg)
VJ606	7.31 (186)	7.31 (186)	4.96 (126)	6.00 (152)	6.00 (152)	4.21 (106)	2.8 (1.27)
VJ806	9.30 (236)	7.31 (186)	4.96 (126)	8.00 (203)	6.00 (152)	4.21 (106)	3.8 (1.72)
VJ1008	11.31 (287)	9.30 (236)	5.43 (138)	10.00 (254)	8.00 (203)	4.69 (119)	4.8 (2.17)
VJ1210	13.30 (338)	11.31 (287)	5.58 (142)	12.00 (305)	10.00 (254)	4.84 (123)	6.3 (2.85)
VJ1412	15.32 (389)	13.30 (338)	6.70 (170)	14.00 (356)	12.00 (305)	5.82 (148)	8.6 (3.90)
VJ1614	17.31 (440)	15.32 (389)	6.70 (170)	16.00 (406)	14.00 (356)	5.82 (148)	10.6 (4.80)
VJ1816	19.31 (490)	17.31 (440)	9.58 (243)	18.00 (457)	16.00 (406)	8.69 (221)	14.0 (6.34)

Options and Configurations:

Prefix	*Suffix*
(VJ) Standard Opaque Cover	(W) Corner Screws
(RVJ) Raised Opaque Cover	(HW) Piano Hinge with Corner Screws
(CVJ) Transparent Cover	(NHW) Non-metallic Hinges with Corner Screws
(VJB) Bonded Window	(HWPL*) Piano Hinge with Padlockable Latches
(RVJB) Raised Bonded Window	(NHWPL*) Non-metallic Hinges with Padlockable latches
(VJG) Gasketed Window	(HWLL*) Piano Hinge with Twist Latches
	(NHWLL*) Non-metallic Hinges with Twist latches

Mushroom Head Cover

Ribbed Cover Corners



Molded Mounting Flanges

Vynckier Enclosure Systems, 271 McCarty, Houston, TX 77029
Phone: (713) 374-7850 • Toll Free: (888) 837-1114 • Fax: (800) 444-1261 • www.EnclosuresOnline.com

CompactLogix™ 5370 L3 Programmable Automation Controllers

1769-L30ER, -L30ERM, -L30ER-NSE, -L33ER, -L33ERM, -L36ERM

Allen-Bradley

Features and Benefits

The CompactLogix 5370 L3 controllers deliver scalable, affordable control ideal for applications from small stand-alone equipment to high performance indexing tables, process skids, case packers and erectors, and packaging.

Machine builders and end users can take advantage of the cost-saving features of these controllers:

- Support for Integrated Motion on EtherNet/IP
- Support for Device Level Ring (DLR) network topologies
- Built-in energy storage eliminates the need for lithium batteries
- Support reuse of existing 1769 I/O
- Removable 1GB secure digital (SD) card improves data integrity
- Flexible memory options up to 3MB
- Added features for hazardous environments (NSE version)
- Support for Kinematics eliminates the need for additional robot controllers and software
- Open socket capability allows support for Modbus TCP as well as devices such as printers, barcode readers and servers

Reduce cost and time to market with CompactLogix 5370 L3 Programmable Automation Controllers.

Expanding on the scalability of the Logix family of controllers, the CompactLogix 5370 L3 programmable automation controllers (PAC) are designed to meet the growing need for a higher performance controller in a compact and affordable package.

As part of the Integrated Architecture system, the CompactLogix 5370 L3 controllers use the same programming software, network protocol, and information capabilities as all Logix controllers, providing a common development environment for all control disciplines.

Integrated Motion on EtherNet/IP

The CompactLogix 5370 L3 controller provides a strong motion solution for customers looking for performance and cost competitiveness.

- Supports up to 16 axes of integrated motion
- Together with the Kinetix 350, offers cost-effective, scalable motion solution

Network Capabilities

With dual Ethernet ports and an integrated Ethernet switch, these controllers now support Device Level Ring (DLR) network topologies, simplifying integration of components in your control system and reducing system cost:

- Provides resiliency from loss of one network connection
- Allows replacement of devices one at a time without stopping production
- Reduces the number of Ethernet switches in the control system

Features for Hazardous Environments

The No Stored Energy (NSE) version of the CompactLogix 5370 L3 offers additional features for hazardous environments found in industries such as mining and oil and gas.

- Allows safe transport of controller in and out of mining areas
- Powered down controller has less than 200uJ of residual energy stored in each component
- No consequences of arc or spark to cause an explosion in gaseous environment

LISTEN. THINK. SOLVE.®

CompactLogix 5370 L3 Controller Product Specifications

	1769-L30ER	1769-L30ERM	1769-L30ER-NSE	1769-L33ER	1769-L33ERM	1769-L36ERM
User memory	1 MB	1 MB	1 MB	2 MB	2 MB	3 MB
Controller tasks	32 tasks	32 tasks	32 tasks	32 tasks	32 tasks	32 tasks
Programs per task	100 tasks	100 tasks	100 tasks	100 tasks	100 tasks	100 tasks
Integrated Motion	--	4 axis CIP motion position loop axis	--	--	8 axis CIP motion position loop axis	16 axis CIP motion position loop axis
Package Size	55mm wide x 118mm high x 105mm deep					
Certifications	cULH (Class I Division 2), KCC / UL (UL 508), ULH (Class I & II, Division 2 and Class III, Divisions 1 & 2) / ATEX, CE, C-Tick / Marine and GOST certifications in 2012					
Local Expansion Modules	8	8	8	16	16	30
Local Expansion I/O Points	128	128	128	256	256	480
Communication Module Additions	DeviceNet with 1769-SDN or 3rd party					
Flash Memory Card	Industrially rated and certified Secure Digital (SD) memory card (1 and 2 GB options); all controllers shipped with 1 GB card					
Servo Drives (Position Loop CIP)	--	4	--	--	8	16
Ethernet I/O IP nodes	16	16	16	32	32	64
Virtual axes	100	100	100	100	100	100
Feedback only, torque, velocity, Vhz (max CIP motion drives)	--	16	--	--	32	64
Axes/ms	--	2	--	--	2	2
Kinematics support	--	yes	--	--	yes	yes
Software / Firmware	RSLogix 5000 V20 and RSLinx Classic V2.58 Firmware v20.1x or later					

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

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Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 1769-PP010A-EN-E – November 2011

Installation Instructions

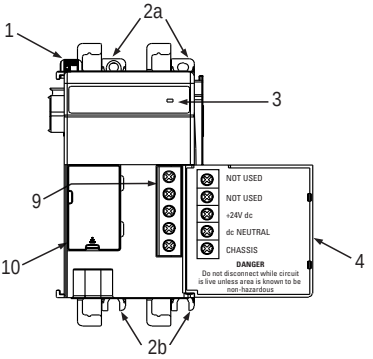
Compact™ Expansion Power Supplies

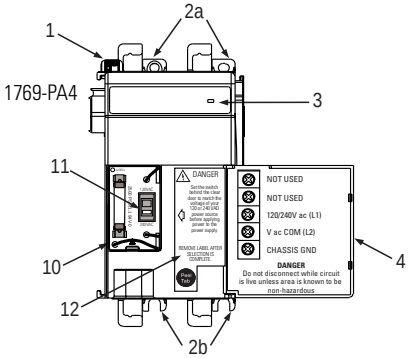
(Cat. No. 1769-PA2, -PB2, -PA4, -PB4)

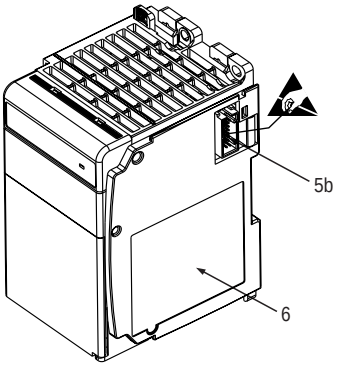
Inside

Publication 1769-IN028A-EN-P

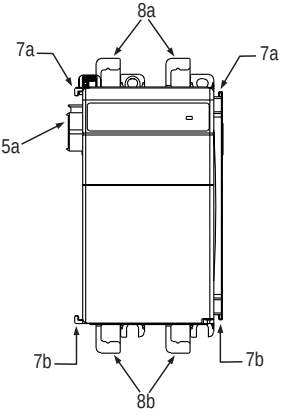
Power Supply Description







Item	Description
1	bus lever (with locking function)
2a	upper panel mounting tabs
2b	lower panel mounting tabs
3	green power LED
4	power supply door with terminal identification label
5a	movable bus connector with female pins
5b	stationary bus connector with male pins
6	nameplate label
7a	upper tongue-and-groove slots
7b	lower tongue-and-groove slots
8a	upper DIN rail latches
8b	lower DIN rail latches
9	terminal block with finger-safe cover
10	fuse housing cover for replaceable fuse
11	120V ac or 240V ac line input power selector switch (PA4 only)
12	selector switch label (PA4 only)

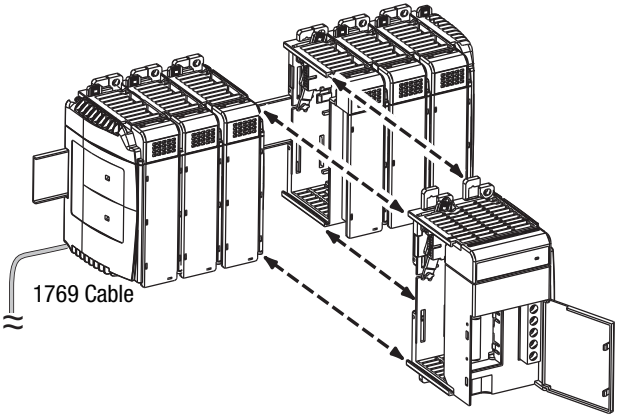


DIN Rail Mounting

The power supply can be mounted using the following DIN rails: 35 x 7.5 mm (EN 50 022 - 35 x 7.5) or 35 x 15 mm (EN 50 022 - 35 x 15).

Before mounting a power supply or module on a DIN rail, close the DIN rail latches. Press the DIN rail mounting area of the module against the DIN rail. The latches will momentarily open and lock into place.

The following illustration shows a power supply being attached to the I/O modules in a DIN rail mounted Compact I/O system.



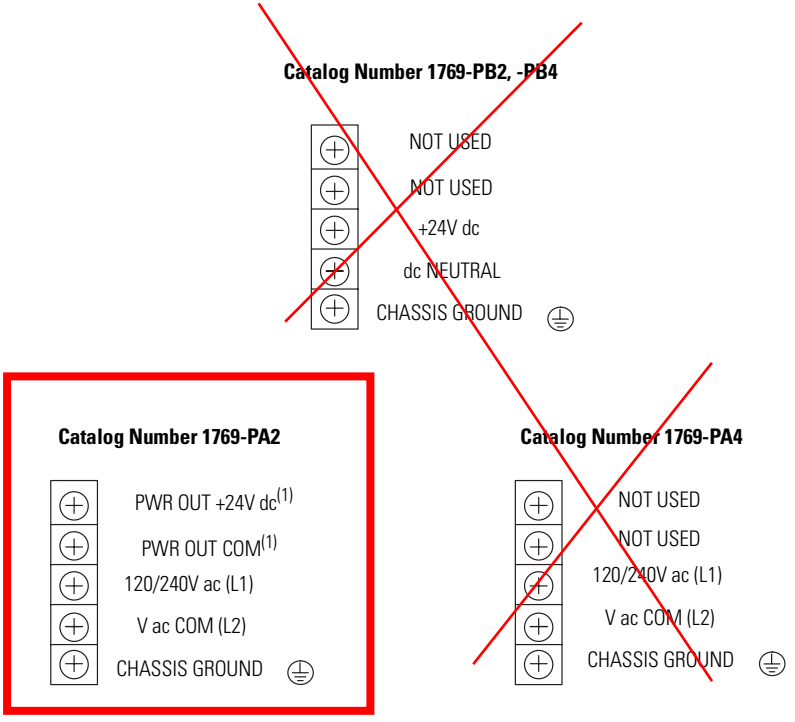
System Power Budget Calculation and Considerations

The following *example* is provided to illustrate system power budget validation using 1769 power supplies. The table on the following page accounts for the amount of 5V dc and 24V dc current consumed by a 1769-ADN DeviceNet adapter (if used), 1769 Compact I/O modules and user supplied equipment (24V dc sensors).

3. Connect incoming power to the power supply terminals as indicated below.

ATTENTION

Turn off incoming power before connecting or disconnecting wires. Failure to do so could cause injury to personnel and/or damage to equipment.



(1) 24V dc user power for sensors or other special 24V dc I/O devices

Specifications

Specification	1769-PA2	1769-PB2	1769-PA4	1769-PB4
Dimensions	118 mm (height) x 87 mm (depth) x 70 mm (width) height including mounting tabs is 138 mm 4.65 in. (height) x 3.43 in (depth) x 2.76 in (width) height including mounting tabs is 5.43 in.			
Approximate Shipping Weight (with carton)	525g (1.16 lbs.)	525g (1.16 lbs.)	630g (1.39 lbs.)	630g (1.39 lbs.)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)			
Operating Temperature	0°C to +60°C (32°F to +140°F)			
Operating Humidity	5% to 95% non-condensing			
Power Supply Distance Rating	8 (Up to eight I/O modules can be connected on either side of the power supply for a maximum of 16 modules.) (1)			
Operating Altitude	2000 meters (6561 feet)			
Vibration(2)	Operating: 10 to 500 Hz, 5G, 0.030 in. peak-to-peak			
Shock(3)	Operating: 30G panel mounted (20G DIN rail mounted) Non-Operating: 40G panel mounted (30G DIN rail mounted)			
Agency Certification	C-UL certified (under CSA C22.2 No. 142) UL 508 listed CE compliant for all applicable directives			
Hazardous Environment Class	Class I, Division 2, Hazardous Location, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No. 213)			
Radiated and Conducted Emissions	EN50081-2 Class A			
Electrical /EMC:	*The power supply has passed testing at the following levels:*			
ESD Immunity (IEC1000-4-2)	4 kV contact, 8 kV air, 8 kV indirect			
Radiated Immunity (IEC1000-4-3)	10 V/m, 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier			
Fast Transient Burst (IEC1000-4-4)	2 kV, 5 kHz			
Surge Immunity (IEC1000-4-5)	4 kV common mode, 2 kV differential mode(4)	500 V common mode, 500 V differential mode	4 kV common mode, 2 kV differential mode	500 V common mode, 500 V differential mode
Conducted Immunity (IEC1000-4-6)	10V, 0.15 to 80 MHz(5)			

(1) When configuring your system using a MicroLogix 1500 controller, only one expansion cable, one expansion power supply and a total of eight I/O modules may be used in a maximum of two banks of I/O modules. The expansion power supply cannot be directly connected to the MicroLogix 1500 controller.

(2) If a relay module (e.g.1769-OW8) is used in the system, operating vibration is 2G.

(3) If a relay module is used in the system, operating shock is 7.5G panel mounted (5G DIN rail mounted).

(4) 24V user test voltage is 500 V common mode, 500 V differential mode.

(5) Conducted Immunity frequency range may be 150 kHz to 30 MHz if the Radiated Immunity frequency range is 30 MHz to 1000 MHz.

Specifications (continued)

Specification	1769-PA2	1769-PB2	1769-PA4	1769-PB4
Nominal Supply Voltage	120/240V ac (no jumpers)	24V dc	120/240V ac selector switch	24V dc
Voltage Range	85 to 265V ac (wide range; no jumper or DIP switch required) 47 to 63 Hz	19.2 to 31.2V dc	85 to 132V ac or 170 to 265 (switch selectable) 47 to 63 Hz	19.2 to 31.2V dc
Maximum Line Requirement	100 VA at 120V ac 130 VA at 240V ac	50 VA at 24V dc	200 VA at 120V ac 240 VA at 240V ac	100 VA at 24V dc
Green Input Power Available Diagnostic LED	ON (+5 and +24V dc current available from power supply) OFF (No input power; Power-fail enabled, Overvoltage Exceeded/Protection Enabled)			
Maximum Inrush	25A at 132V ac 10Ω source impedance 40A at 265V ac 10Ω source impedance	30A at 31.2V dc	25A at 132V ac, 10Ω source impedance 40A at 265V ac, 10Ω source impedance	30A
Line Loss Ride Through	10 ms (minimum) to 10s (maximum)		5 ms (minimum) to 10s (maximum)	
Output Bus Current Capacity (0°C to +55°C)	2A at 5V dc 0.8A at 24V dc	2A at 5V dc 0.8A at 24V dc	4A at 5V dc 2A at 24V dc	4A at 5V dc 2A at 24V dc
Output Bus Current Capacity (55°C to +60°C)	Refer to the Temperature Derating graphs on pages 25 through 30.			
Minimum Load Current	0 mA at 5V dc; 0 mA at 24V dc			
24V dc User Power Capacity (0°C to +55°C)	250 mA(1)	NA		
24V dc User Power Capacity (>+55°C to +60°C)	200 mA(1)	NA		
+24V dc User Voltage Range	20.4V dc to 26.4V dc	NA		
Short Circuit Protection	Front Access Fuse (Replacement part number: Wickmann 19195-3.15A, Wickmann 19343-1.6A, or Wickmann 19181-4A)	Front Access Fuse (Replacement part number: Wickmann 19193-6.3A)	Front Access Fuse (Replacement part number: Wickmann 19195-3.15A or Wickmann 19181-4A)	Front Access Fuse (Replacement part number: Wickmann 19193-6.3A)

(1) Refer to the Temperature Derating graphs on pages 25 through 30.

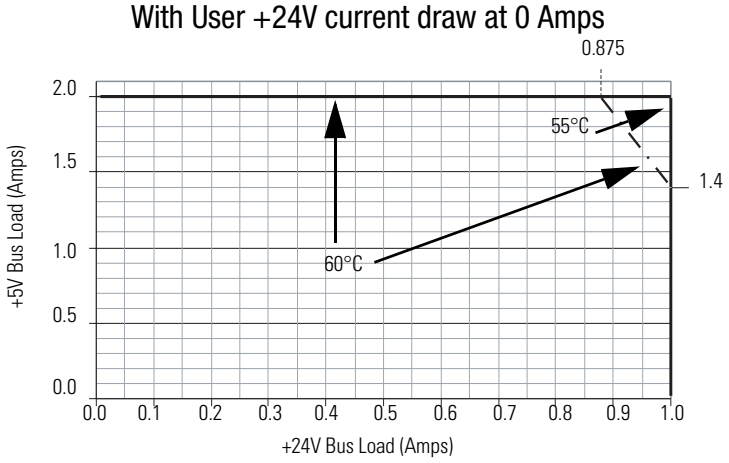
Specifications table continued on next page.

Specification	1769-PA2	1769-PB2	1769-PA4	1769-PB4
+5V 1769 Bus Overvoltage Protection	Yes			
+24V 1769 Bus Overvoltage Protection	Yes			
Isolation Voltage (Input Power to 1769 Bus)	Verified by one of the following dielectric tests:			
	1836V ac for 1s or 2596V dc for 1s	1200V ac for 1s or 1697V dc for 1s	1836V ac for 1s or 2596V dc for 1s	1200V ac for 1s or 1697V dc for 1s
	265V Working Voltage (IEC Class 1 - grounding required)	75V Working Voltage (IEC Class 1 - grounding required)	265V Working Voltage (IEC Class 1 - grounding required)	75V Working Voltage (IEC Class 1 - grounding required)

(1) Refer to the Temperature Derating graphs on pages 25 through 30.

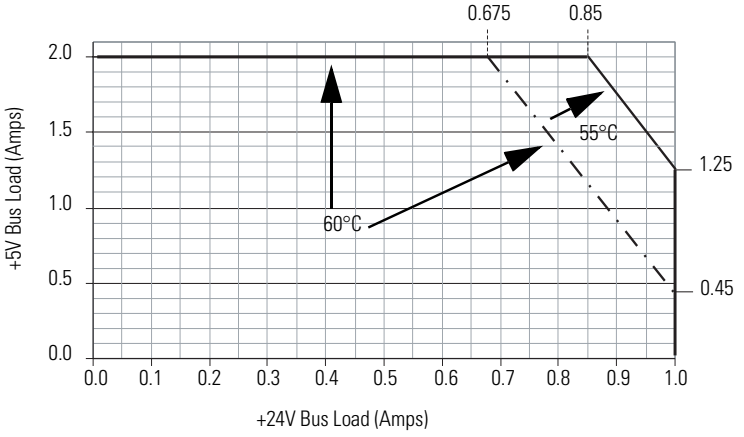
Temperature Derating

1769-PA2 Output Derating

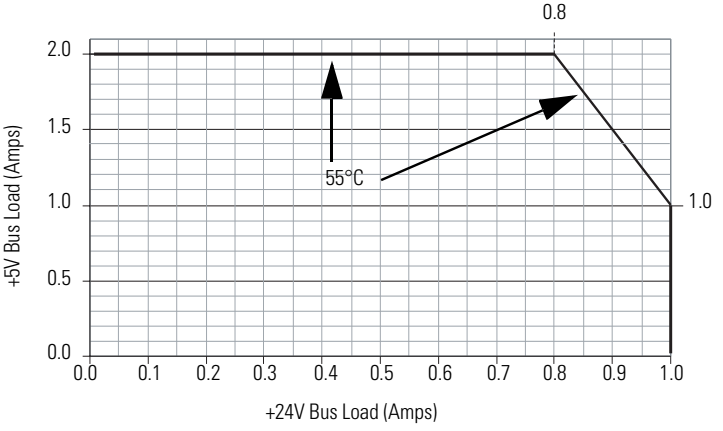


1769-PA2 Output Derating (continued)

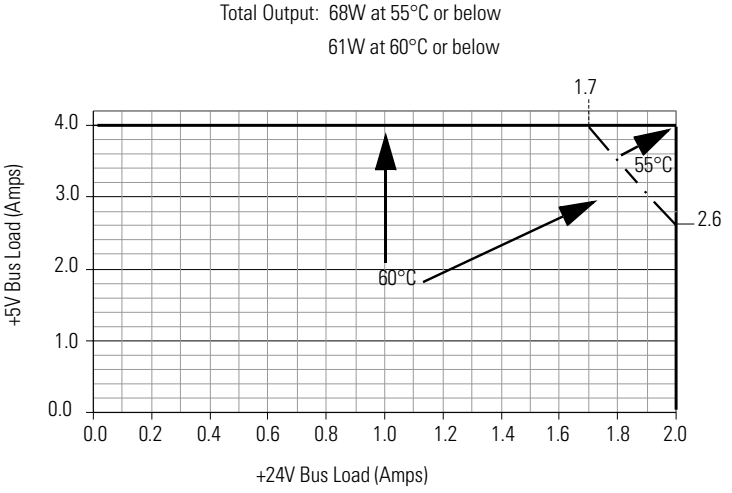
With User +24V current draw at 0.2 Amps



With User +24V current draw at 0.25 Amps

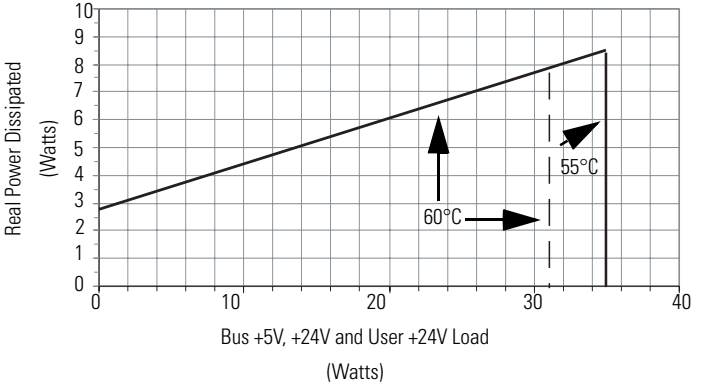


1769-PB4 Output Derating

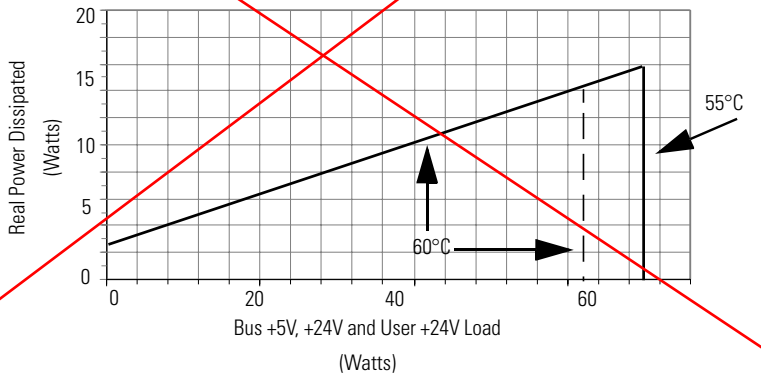


Power Dissipation

1769-PA2 Real Power Dissipation



1769-PB4 Real Power Dissipation



Compatibility with MicroLogix 1500

To use the 1769 expansion I/O power supply with the MicroLogix 1500 processor, the processor (catalog number 1764-LSP or 1764-LRP) must be Series A, Revision C, FRN 3 or higher. You can check the firmware revision by looking at:

- Status file bit S:59 (Operating System Firmware Revision Number)
- The processor nameplate

If your processor is at an older revision, you must upgrade the operating system. On the internet, go to **http://www.abmicrologix.com** to download the firmware upgrade.

Compact™ Individually Isolated 120V ac Input Module

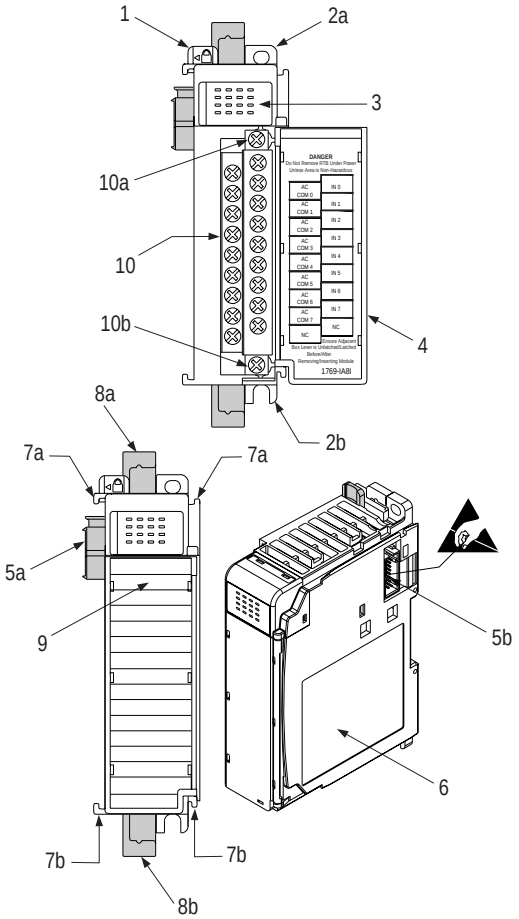
(Catalog Number 1769-IA8I)

Installation Instructions

Inside

Publication 1769-IN012B-EN-P

Module Description



Item	Description
1	bus lever (with locking function)
2a	upper panel mounting tab
2b	lower panel mounting tab
3	I/O diagnostic LEDs
4	module door with terminal identification label
5a	movable bus connector with female pins
5b	stationary bus connector with male pins
6	nameplate label
7a	upper tongue-and-groove slots
7b	lower tongue-and-groove slots
8a	upper DIN rail latch
8b	lower DIN rail latch
9	write-on label (user ID tag)
10	removable terminal block (RTB) with finger-safe cover
10a	RTB upper retaining screw
10b	RTB lower retaining screw

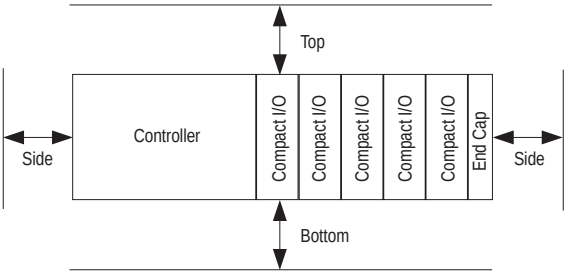
IMPORTANT: A 1769-ECR or 1769-ECL right or left end cap must be used to terminate the end of the serial communication bus.

Mounting Expansion I/O

ATTENTION: During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the module. Debris that falls into the module could cause damage on power up.

Minimum Spacing

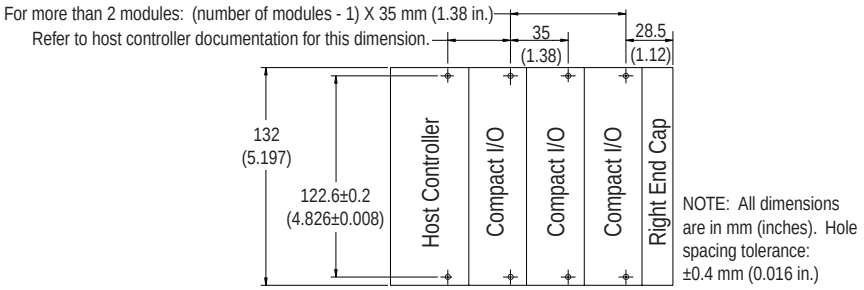
Maintain spacing from enclosure walls, wireways, adjacent equipment, etc. Allow 50 mm (2 in.) of space on all sides for adequate ventilation, as shown:



Panel Mounting

Mount the module to a panel using two screws per module. Use M4 or #8 panhead screws. Mounting screws are required on every module.

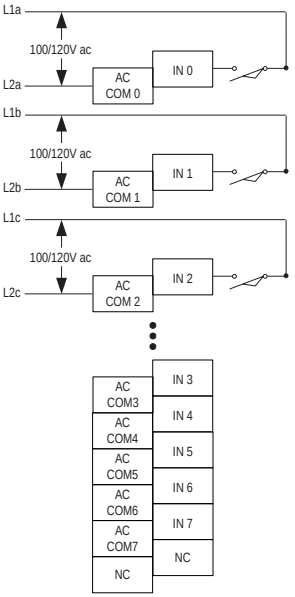
Panel Mounting Using the Dimensional Template



Input Wiring

Basic wiring[1] of input devices to the 1769-IA8I is shown below.

ATTENTION: Be careful when stripping wires. Wire fragments that fall into a module could cause damage at power up. Once wiring is complete, ensure the module is free of all metal fragments.



A removable, write-on label is provided with the module. Remove the label from the door, mark the identification of each terminal with permanent ink, and slide the label back into the door. Your markings (ID tag) will be visible when the module door is closed.

1. A current limiting resistor can be used to limit inrush current; however, the operating characteristics of the ac input circuit will be affected. If a 6.8K Ω resistor is placed in series with the input, the inrush current is reduced to 35 mA. In this configuration the minimum on-state voltage increases to 92V ac.

   Before adding the resistor in a hazardous environment, be sure to consider the operating temperature of the resistor and the temperature limits of the environment. The operating temperature of the resistor must remain below the temperature limit of the environment.

Specifications

General Specifications

Specification	Value
Dimensions	118 mm (height) x 87 mm (depth) x 35 mm (width) height including mounting tabs is 138 mm 4.65 in. (height) x 3.43 in (depth) x 1.38 in (width) height including mounting tabs is 5.43 in.
Approximate Shipping Weight (with carton)	270g (0.60 lbs.)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Operating Temperature	0°C to +60°C (32°F to +140°F)
Operating Humidity	5% to 95% non-condensing
Operating Altitude	2000 meters (6561 feet)
Vibration	Operating: 10 to 500 Hz, 5G, 0.030 inches maximum peak-to-peak Relay Operation: 2G
Shock	Operating: 30G panel mounted (20G DIN rail mounted) Relay Operation: 7.5G panel mounted (5G DIN rail mounted) Non-Operating: 40G panel mounted (30G DIN rail mounted)
Agency Certification	• C-UL certified (under CSA C22.2 No. 142) • UL 508 listed • CE compliant for all applicable directives
Hazardous Environment Class	Class I, Division 2, Hazardous Location, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No. 213)
Radiated and Conducted Emissions	EN50081-2 Class A
Electrical /EMC:	*The module has passed testing at the following levels:*
• ESD Immunity (IEC1000-4-2)	• 4kV contact, 8 kV air, 4 kV indirect
• Radiated Immunity (IEC1000-4-3)	• 10 V/m, 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier
• Fast Transient Burst (IEC1000-4-4)	• 2 kV, 5 kHz
• Surge Immunity (IEC1000-4-5)	• 2 kV common mode, 1 kV differential mode
• Conducted Immunity (IEC1000-4-6)	• 10V, 0.15 to 80 MHz[1]

1. Conducted Immunity frequency range may be 150 kHz to 30 MHz if the Radiated Immunity frequency range is 30 MHz to 1000 MHz.

Input Specifications

Specification	1769-IA8I
Voltage Category	100/120V ac
Operating Voltage Range	79V ac to 132V ac at 47 Hz to 63 Hz
Number of Inputs	8
Isolated Groups	8 individually isolated inputs
Bus Current Draw (max.)	90 mA at 5V dc (0.45W)
Heat Dissipation	1.81 Total Watts *(The Watts per point, plus the minimum Watts, with all points energized.)*
Signal Delay (max.)	On Delay: 20.0 ms Off Delay: 20.0 ms
Off-State Voltage (max.)	20V ac
Off-State Current (max.)	2.5 mA
On-State Voltage (min.)	79V ac
On-State Current	5.0 mA at 79V ac (min.) 12 mA at 120V ac (nominal)
Inrush Current (max.)[1]	250 mA
Nominal Impedance	12K Ω at 50 Hz 10K Ω at 60 Hz
IEC Input Compatibility	Type 1+
Power Supply Distance Rating	8 (The module may not be more than 8 modules away from the power supply or controller.)
Input Point to Bus Isolation	Verified by one of the following dielectric tests: 1517V ac for 1 sec. or 2145V dc for 1 sec. 132V ac working voltage (IEC Class 2 reinforced insulation)
Isolated Groups	8: Each point is individually isolated from the other.
Group to Group Isolation	Verified by one of the following dielectric tests: 1517V ac for 1 sec. or 2145V dc for 1 sec. 132V ac working voltage (IEC Class 2 reinforced insulation)
Vendor I.D. Code	1
Product Type Code	7
Product Code	81

1. A current limiting resistor can be used to limit inrush current; however, the operating characteristics of the ac input circuit will be affected. If a 6.8K Ω (2.5W minimum) resistor is placed in series with the input, the inrush current is reduced to 35 mA. In this configuration the minimum on-state voltage increases to 92V ac.
   Before adding the resistor in a hazardous environment, be sure to consider the operating temperature of the resistor and the temperature limits of the environment. The operating temperature of the resistor must remain below the temperature limit of the environment.

Installation Instructions

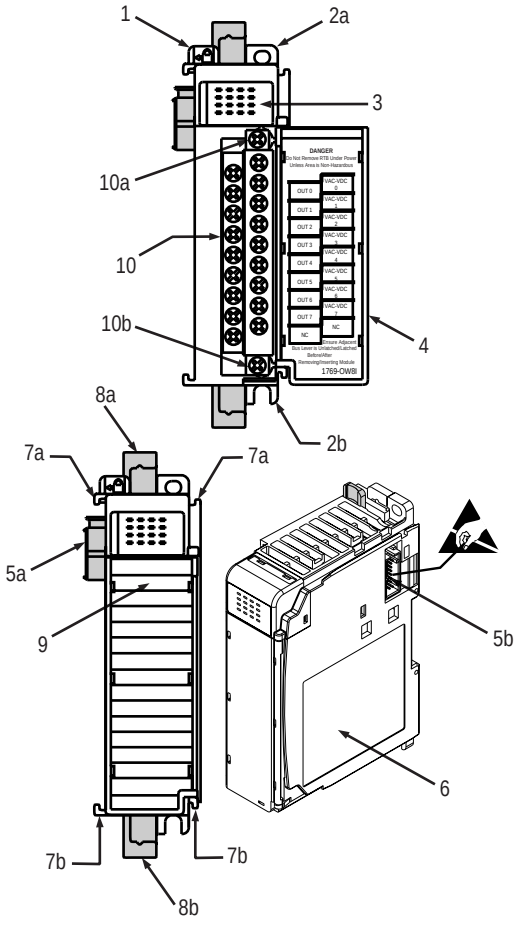
Compact™ Individually Isolated AC/DC Relay Output Module

(Catalog Number 1769-OW8I, Series B)

Inside

Publication 1769-IN053A-EN-P - April 2001

Module Description



Item	Description
1	bus lever (with locking function)
2a	upper panel mounting tab
2b	lower panel mounting tab
3	I/O diagnostic LEDs
4	module door with terminal identification label
5a	movable bus connector with female pins
5b	stationary bus connector with male pins
6	nameplate label
7a	upper tongue-and-groove slots
7b	lower tongue-and-groove slots
8a	upper DIN rail latch
8b	lower DIN rail latch
9	write-on label (user ID tag)
10	removable terminal block (RTB) with finger-safe cover
10a	RTB upper retaining screw
10b	RTB lower retaining screw

6. To allow communication between the controller and module, move the bus lever fully to the left (4) until it clicks. Ensure it locks firmly into the bus locking tab.

ATTENTION

When attaching I/O modules, it is very important that the bus connectors are securely locked together to ensure proper electrical connection.

7. Attach an end cap terminator (5) to the last module in the system by using the tongue-and-groove slots as before.

8. Lock the end cap bus terminator (6).

IMPORTANT A 1769-ECR or 1769-ECL right or left end cap must be used to terminate the end of the serial communication bus.

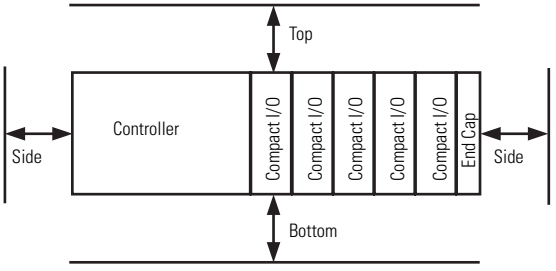
Mounting Expansion I/O

ATTENTION

During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the module. Debris that falls into the module could cause damage on power up.

Minimum Spacing

Maintain spacing from enclosure walls, wireways, adjacent equipment, etc. Allow 50 mm (2 in.) of space on all sides for adequate ventilation, as shown:



Field Wiring Connections

Grounding the Module

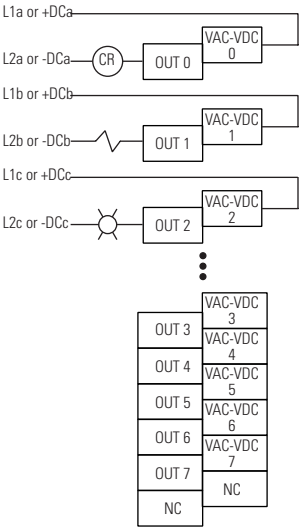
This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the module's mounting tabs or DIN rail (if used), are not required unless the mounting surface cannot be grounded. Refer to *Industrial Automation Wiring and Grounding Guidelines*, Allen-Bradley publication 1770-4.1, for additional information.

Output Wiring

Basic wiring(1) of output devices to the 1769-OW8I is shown below.

ATTENTION

Be careful when stripping wires. Wire fragments that fall into a module could cause damage at power up. Once wiring is complete, ensure the module is free of all metal fragments.



(1) **Surge Suppression** - Connecting surge suppressors across your external inductive load will extend the life of the relay contacts. For additional details, refer to Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley publication 1770-4.1.

2. Route the wire under the terminal pressure plate. You can use the bare wire or a spade lug. The terminals will accept a 6.35 mm (0.25 in.) spade lug.

TIP

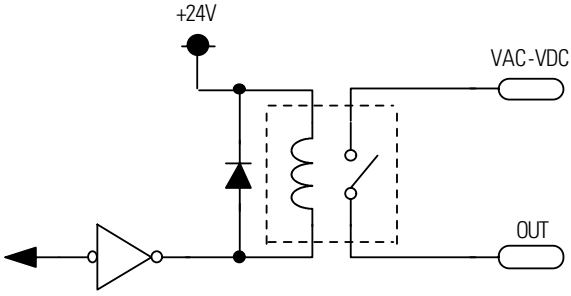
The terminal screws are non-captive. Therefore, it is possible to use a ring lug [maximum 1/4 inch o.d. with a 0.139 inch minimum i.d. (M3.5)] with the module.

3. Tighten the terminal screw making sure the pressure plate secures the wire. Recommended torque when tightening terminal screws is 0.68 Nm (6 in-lbs).

TIP

If you need to remove the finger-safe cover, insert a screwdriver into one of the square, wiring holes and gently pry the cover off. If you wire the terminal block with the finger-safe cover removed, you will not be able to put it back on the terminal block because the wires will be in the way.

Simplified Output Circuit Diagram



Wire Size and Terminal Screw Torque

Each terminal accepts up to two wires with the following restrictions:

Wire Type		Wire Size	Terminal Screw Torque	Retaining Screw Torque
Solid	Cu-90°C (194°F)	#14 to #22 AWG	0.68 Nm (6 in-lbs)	0.46 Nm (4.1 in-lbs)
Stranded	Cu-90°C (194°F)	#16 to #22 AWG	0.68 Nm (6 in-lbs)	0.46 Nm (4.1 in-lbs)

Specifications

General Specifications

Specification	Value
Dimensions	118 mm (height) x 87 mm (depth) x 35 mm (width) height including mounting tabs is 138 mm 4.65 in. (height) x 3.43 in (depth) x 1.38 in (width) height including mounting tabs is 5.43 in.
Approximate Shipping Weight (with carton)	290g (0.64 lbs.)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Operating Temperature	0°C to +60°C (32°F to +140°F)
Operating Humidity	5% to 95% non-condensing
Operating Altitude	2000 meters (6561 feet)(1)
Vibration	Operating: 10 to 500 Hz, 5G, 0.030 inches maximum peak-to-peak Relay Operation: 2G
Shock	Operating: 30G panel mounted (20G DIN rail mounted) Relay Operation: 7.5G panel mounted (5G DIN rail mounted) Non-Operating: 40G panel mounted (30G DIN rail mounted)
Agency Certification	• C-UL certified (under CSA C22.2 No. 142) • UL 508 listed • CE and C-Tick compliant for all applicable directives
Hazardous Environment Class	Class I, Division 2, Hazardous Location, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No. 213)
Radiated and Conducted Emissions	EN50081-2 Class A
Electrical /EMC:	*The module has passed testing at the following levels:*
ESD Immunity (IEC61000-4-2)	• 4kV contact, 8kV air, 4kV indirect
Radiated Immunity (IEC61000-4-3)	• 10 V/m, 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier
Fast Transient Burst (IEC61000-4-4)	• 2 kV, 5 kHz
Surge Immunity (IEC61000-4-5)	• 2 kV common mode, 1 kV differential mode
Conducted Immunity (IEC61000-4-6)	• 10V, 0.15 to 80 MHz(2)

(1) For operation above 2000 meters, consult the factory.
(2) Conducted Immunity frequency range may be 150 kHz to 30 MHz if the Radiated Immunity frequency range is 30 MHz to 1000 MHz.

Output Specifications

Specification	1769-OW8I
Voltage Category	AC/DC normally open relay
Operating Voltage Range	5 to 265V ac 5 to 125V dc
Number of Outputs	8
Isolated Groups	8 individually isolated outputs
Bus Current Draw (max.)	125 mA at 5V dc (0.625W) 100 mA at 24V dc (2.4W)
Heat Dissipation	2.83 Total Watts *(The Watts per point, plus the minimum Watts, with all points energized.)*
Signal Delay (max.) – resistive load	turn-on = 10 ms turn-off = 10 ms
Off-State Leakage (max.)	0 mA
On-State Current (min.)	10 mA at 5V dc
Continuous Current per Point (max.)	2.5A (Also see "Relay Contact Ratings" on page 16.)
Continuous Current per Common (max.)	2.5A
Continuous Current per Module (max.)	16A
Power Supply Distance Rating	8 (The module may not be more than 8 modules away from the power supply.)
Output Point to Bus Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 sec. or 2596V dc for 1 sec. 265V ac working voltage (IEC Class 2 reinforced insulation)
Isolated Groups	8: Each point individually isolated from the other.
Group to Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 sec. or 2596V dc for 1 sec. 265V ac working voltage (basic insulation) 150V ac working voltage (IEC Class 2 reinforced insulation)
Vendor I.D. Code	1
Product Type Code	7
Product Code	87

Relay Contact Ratings

Volts (max.)	Continuous Amps per Point (max.)	Amperes[1]		Voltamperes		NEMA ICS 2-125
		Make	Break	Make	Break	
240V ac	2.5A	7.5A	0.75A	1800 VA	180 VA	C300
120V ac		15A	1.5A			
125V dc	1.0A	0.22A[2]		28 VA		R150
24V dc	2.0A	1.2A[2]		28 VA		—

(1) **Surge Suppression** - Connecting surge suppressors across your external inductive load will extend the life of the relay contacts. For additional details, refer to Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley publication 1770-4.1.

(2) For dc voltage applications, the make/break ampere rating for relay contacts can be determined by dividing 28 VA by the applied dc voltage. For example, 28 VA/48V dc = 0.58A. For dc voltage applications less than 48V, the make/break ratings for relay contacts cannot exceed 2A.

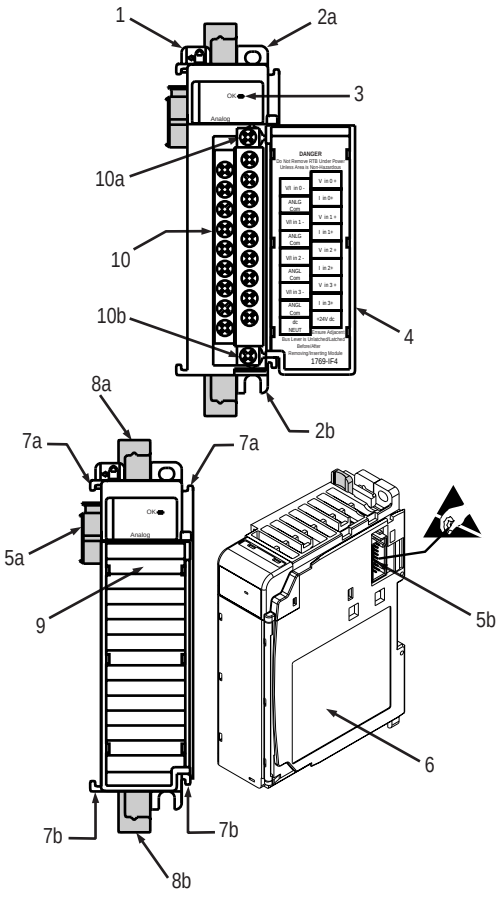
Installation Instructions

Compact™ 1769-IF4 (Series B or Later) Analog Input Module

Inside

Publication 1769-IN048A-EN-P

Module Description



Item	Description
1	bus lever (with locking function)
2a	upper panel mounting tab
2b	lower panel mounting tab
3	module status LED
4	module door with terminal identification label
5a	movable bus connector with female pins
5b	stationary bus connector with male pins
6	nameplate label
7a	upper tongue-and-groove slots
7b	lower tongue-and-groove slots
8a	upper DIN rail latch
8b	lower DIN rail latch
9	write-on label (user ID tag)
10	removable terminal block (RTB) with finger-safe cover
10a	RTB upper retaining screw
10b	RTB lower retaining screw

Module Installation

Compact I/O is suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution degree 2[1]) and to circuits not exceeding Over Voltage Category II[2] (IEC 60664-1).[3]

Prevent Electrostatic Discharge

ATTENTION

Electrostatic discharge can damage integrated circuits or semiconductors if you touch bus connector pins or the terminal block. Follow these guidelines when you handle the module:

- Touch a grounded object to discharge static potential.
- Wear an approved wrist-strap grounding device.
- Do not touch the bus connector or connector pins.
- Do not touch circuit components inside the module.
- If available, use a static-safe work station.
- When not in use, keep the module in its static-shield box.

(1) Pollution Degree 2 is an environment where, normally, only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.

(2) Over Voltage Category II is the load level section of the electrical distribution system. At this level transient voltages are controlled and do not exceed the impulse voltage capability of the product's insulation.

(3) Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commission (IEC) designations.

Remove Power

ATTENTION

Remove power before removing or inserting this module. When you remove or insert a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

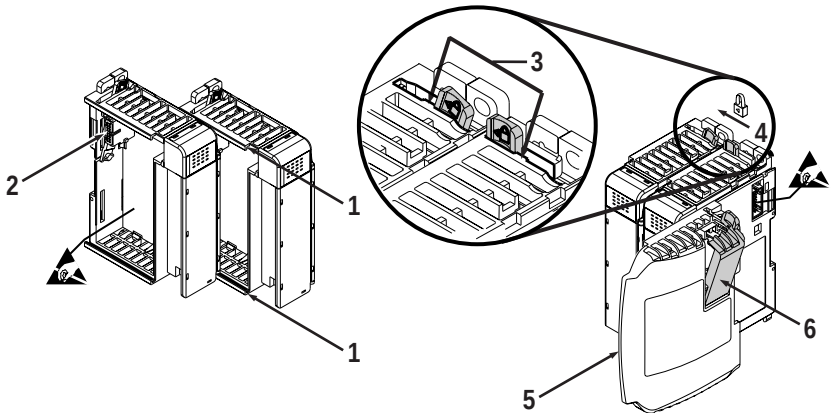
- sending an erroneous signal to your system's field devices, causing unintended machine motion
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

System Assembly

The module can be attached to the controller or an adjacent I/O module *before* or *after* mounting. For mounting instructions, see "Panel Mounting" on page 6, or "DIN Rail Mounting" on page 7. To work with a system that is already mounted, see "Replacing a Single Module within a System" on page 8.

The following procedure shows you how to assemble the Compact I/O system.



1. Disconnect power.

2. Check that the bus lever of the module to be installed is in the unlocked (fully right) position.

3. Use the upper and lower tongue-and-groove slots (1) to secure the modules together (or to a controller).

4. Move the module back along the tongue-and-groove slots until the bus connectors (2) line up with each other.

5. Push the bus lever back slightly to clear the positioning tab (3). Use your fingers or a small screwdriver.

6. To allow communication between the controller and module, move the bus lever fully to the left (4) until it clicks. Ensure it is locked firmly in place.

ATTENTION

When attaching I/O modules, it is very important that the bus connectors are securely locked together to ensure proper electrical connection.

7. Attach an end cap terminator (5) to the last module in the system by using the tongue-and-groove slots as before.

8. Lock the end cap bus terminator (6).

IMPORTANT A 1769-ECR or 1769-ECL right or left end cap must be used to terminate the end of the communication bus.

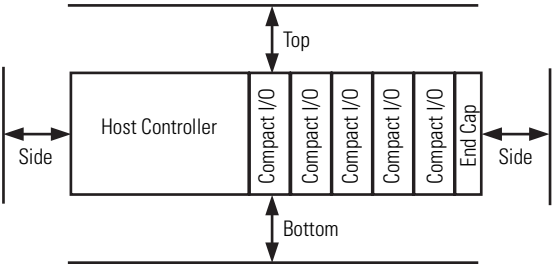
Mounting Expansion I/O

ATTENTION

During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the module. Debris that falls into the module could cause damage on power up.

Minimum Spacing

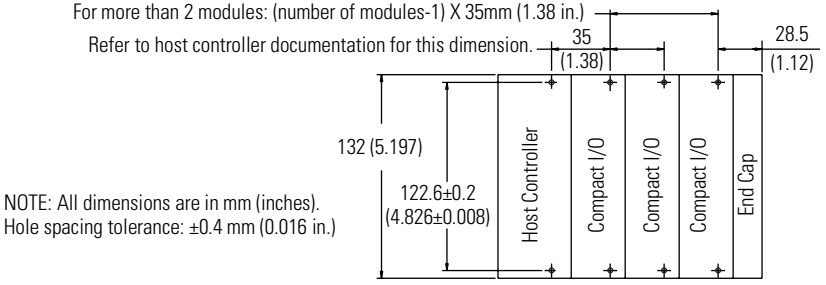
Maintain spacing from enclosure walls, wireways, adjacent equipment, etc. Allow 50 mm (2 in.) of space on all sides for adequate ventilation, as shown:



Panel Mounting

Mount the module to a panel using two screws per module. Use M4 or #8 panhead screws. Mounting screws are required on every module.

Panel Mounting Using the Dimensional Template



NOTE: All dimensions are in mm (inches).
Hole spacing tolerance: ±0.4 mm (0.016 in.)

Panel Mounting Procedure Using Modules as a Template

The following procedure allows you to use the assembled modules as a template for drilling holes in the panel. If you have sophisticated panel mounting equipment, you can use the dimensional template provided on page 6. Due to module mounting hole tolerance, it is important to follow these procedures:

1. On a clean work surface, assemble no more than three modules.

2. Using the assembled modules as a template, carefully mark the center of all module-mounting holes on the panel.

3. Return the assembled modules to the clean work surface, including any previously mounted modules.

4. Drill and tap the mounting holes for the recommended M4 or #8 screw.

5. Place the modules back on the panel and check for proper hole alignment.

6. Attach the modules to the panel using the mounting screws.

NOTE If mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time during drilling and tapping of the next group.

7. Repeat steps 1 to 6 for any remaining modules.

DIN Rail Mounting

The module can be mounted using the following DIN rails: 35 x 7.5 mm (EN 50 022 - 35 x 7.5) or 35 x 15 mm (EN 50 022 - 35 x 15).

Before mounting the module on a DIN rail, close the DIN rail latches. Press the DIN rail mounting area of the module against the DIN rail. The latches will momentarily open and lock into place.

Replacing a Single Module within a System

The module can be replaced while the system is mounted to a panel (or DIN rail). Follow these steps in order:

1. Remove power. See important note on page 4.
2. On the module to be removed, remove the upper and lower mounting screws from the module (or open the DIN latches using a flat-blade or phillips-style screwdriver).
3. Move the bus lever to the right to disconnect (unlock) the bus.
4. On the right-side adjacent module, move its bus lever to the right (unlock) to disconnect it from the module to be removed.
5. Gently slide the disconnected module forward. If you feel excessive resistance, check that the module has been disconnected from the bus and that both mounting screws have been removed (or DIN latches opened).

NOTE It may be necessary to rock the module slightly from front to back to remove it, or, in a panel-mounted system, to loosen the screws of adjacent modules.

6. Before installing the replacement module, be sure that the bus lever on the module to be installed, and on the right-side adjacent module are in the unlocked (fully right) position.
7. Slide the replacement module into the open slot.
8. Connect the modules together by locking (fully left) the bus levers on the replacement module and the right-side adjacent module.
9. Replace the mounting screws (or snap the module onto the DIN rail).

Module Spare/Replacement Parts

- Terminal block, catalog number 1769-RTBN18 (1 per kit)
- Door Labels, catalog number 1769-RL2 Series B (2 per kit)
- Door, catalog number 1769-RD (2 per kit)

Field Wiring Connections

Grounding the Module

This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the module's mounting tabs or DIN rail (if used), are not required unless the mounting surface cannot be grounded. Refer to *Industrial Automation Wiring and Grounding Guidelines*, Allen-Bradley publication 1770-4.1, for additional information.

System Wiring Guidelines

Consider the following when wiring your system:

- All module commons (ANLG COM) are connected in the analog module. The analog common (ANLG COM) is not connected to earth ground inside the module.
- Do not use the analog module's NC terminals as connection points.
- Channels are not isolated from each other.
- Use Belden™ 8761, or equivalent, shielded wire.
- Under normal conditions, the drain wire and shield junction must be connected to earth ground via a panel or DIN rail mounting screw at the analog I/O module end. Keep the shield connection to ground as short as possible.(1)
- To ensure optimum accuracy, limit overall cable impedance by keeping your cable as short as possible. Locate the I/O system as close to your sensors or actuators as your application will permit.
- If multiple power supplies are used with analog inputs, the power supply commons must be connected.

(1) In environments where high-frequency noise may be present, it may be necessary to directly ground cable shields to earth at the module end and via a 0.1µF capacitor at the sensor end.

- The 1769-IF4 module does not provide loop power for analog inputs. Use a power supply that matches the input transmitter specifications.
- Differential analog inputs are more immune to noise than single-ended analog inputs.
- Voltages on Vin+, V/Iin-, and Iin+ of the 1769-IF4 module must be within ±10V dc of analog common.

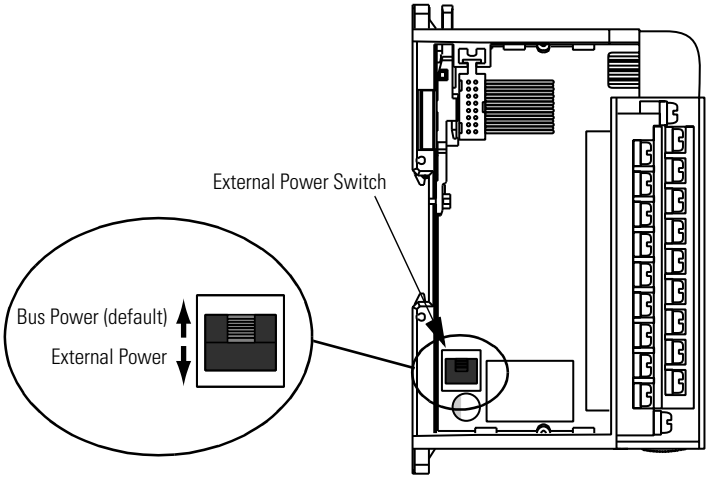
ATTENTION

Be careful when stripping wires. Wire fragments that fall into a module could cause damage at power up. Once wiring is complete, ensure the module is free of all metal fragments.

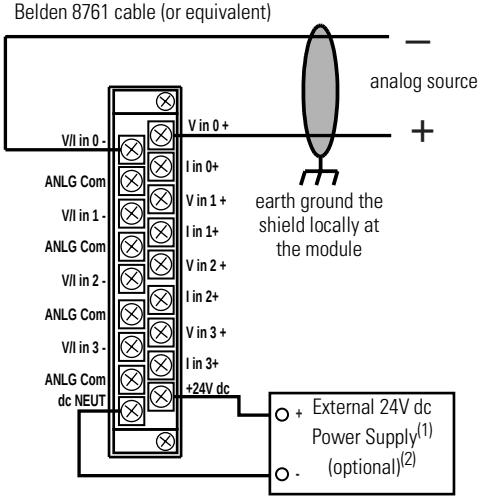
External Power Switch

The 1769-IF4 (Series B or later) has an external 24V dc power switch which gives you the option of using an external power supply. The switch is located in on the lower left portion of the module's circuit board, as shown below. With this switch in the up position (default), 24V dc power is drawn from the 1769 system power supply via the 1769 I/O bus. In the down position, 24V dc power is drawn from the external power supply.

Wire the external power supply to the module via the module's terminal block. The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 60 mA minimum.



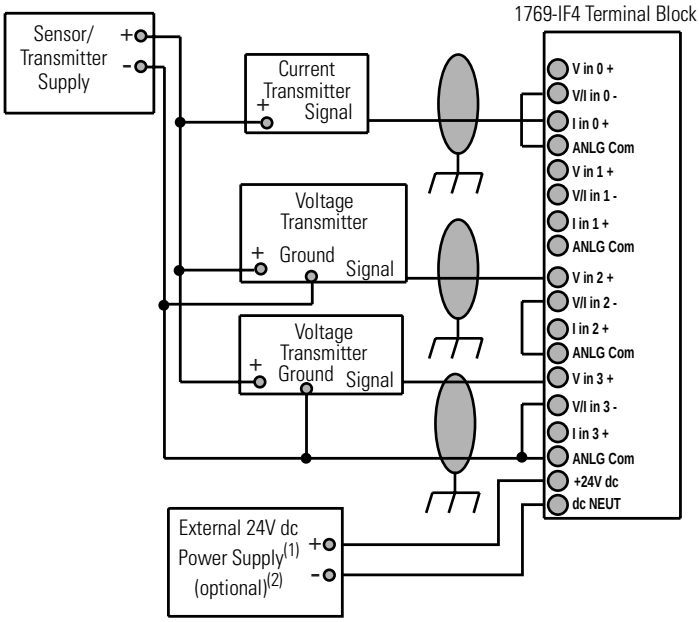
Wiring Differential Inputs



(1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 60 mA minimum.

(2) Series B and later modules provide this option.

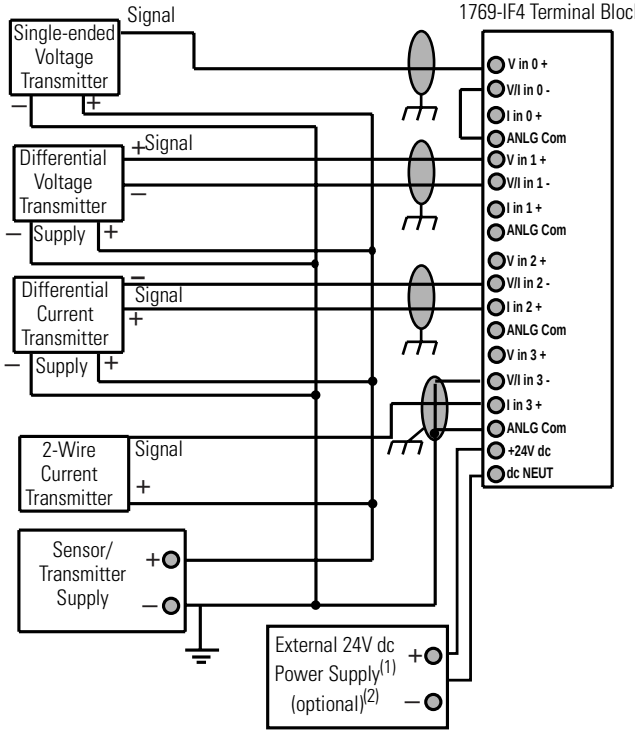
Wiring Single-Ended Sensor/Transmitter Types



(1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 60 mA minimum.

(2) Series B and later modules provide this option.

Wiring Mixed Transmitter Types

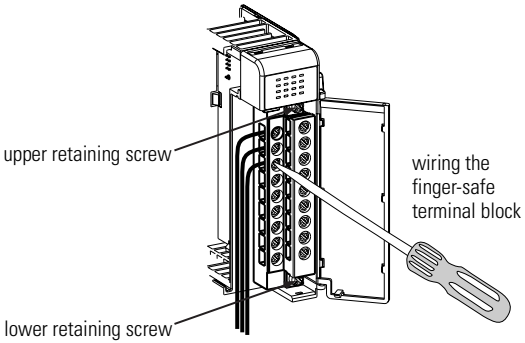


(1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 60 mA minimum.

(2) Series B and later modules provide this option.

Labeling the Terminals

A removable, write-on label is provided with the module. Remove the label from the door, mark the identification of each terminal with permanent ink, and slide the label back into the door. Your markings (ID tag) will be visible when the module door is closed.



Removing the Finger-Safe Terminal Block

To remove the terminal block, loosen the upper and lower retaining screws. The terminal block will back away from the module as you remove the screws. When replacing the terminal block, torque the retaining screws to 0.46 Nm (4.1 in-lbs).

Wiring the Finger-Safe Terminal Block

When wiring the terminal block, keep the finger-safe cover in place.

1. Loosen the terminal screws to be wired.

2. Route the wire under the terminal pressure plate. You can use the bare wire or a spade lug. The terminals will accept a 6.35 mm (0.25 in.) spade lug.

NOTE The terminal screws are non-captive. Therefore, it is possible to use a ring lug [maximum 1/4 inch o.d. with a 0.139 inch minimum i.d. (M3.5)] with the module.

3. Tighten the terminal screw making sure the pressure plate secures the wire. Recommended torque when tightening terminal screws is 0.68 Nm (6 in-lbs).

NOTE If you need to remove the finger-safe cover, insert a screw driver into one of the square wiring holes and gently pry the cover off. If you wire the terminal block with the finger-safe cover removed, you will not be able to put it back on the terminal block because the wires will be in the way.

Wire Size and Terminal Screw Torque

Each terminal accepts up to two wires with the following restrictions:

Wire Type		Wire Size	Terminal Screw Torque	Retaining Screw Torque
Solid	Cu-90°C (194°F)	#14 to #22 AWG	0.68 Nm (6 in-lbs)	0.46 Nm (4.1 in-lbs)
Stranded	Cu-90°C (194°F)	#16 to #22 AWG	0.68 Nm (6 in-lbs)	0.46 Nm (4.1 in-lbs)

I/O Memory Mapping

Input Data File

For each input module, slot x, words 0-3 in the input data file contain the analog values of the inputs.

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	SGN	Analog Input Data Channel 0														
1	SGN	Analog Input Data Channel 1														
2	SGN	Analog Input Data Channel 2														
3	SGN	Analog Input Data Channel 3														
4	Not Used												S3	S2	S1	S0
5	U0	O0	U1	O1	U2	O2	U3	O3	Set to 0							

The bits are defined as follows:

- SGN = Sign bit in two's complement format
- Sx = General status bit for channels 0 through 3. This bit is set (1) when an error (over- or under-range) exists for that channel.
- Ux = Under-range flag bits for channels 0 through 3. These bits can be used in the control program for error detection.
- Ox = Over-range flag bits for channels 0 through 3. These bits can be used in the control program for error detection.

Configuration Data File

The manipulation of the bits from this file is normally done with programming software (e.g. RSLogix 500, RSNetworx for DeviceNet, etc.) during initial configuration of the system. In that case, graphical screens are provided by the programmer to simplify configuration. However, some systems, like the 1769-ADN DeviceNet Adapter, also allow the bits to be altered as part of the control program, using communication rungs. In that case, it is necessary to understand the bit arrangement. Refer to the *Compact™ Analog I/O User Manual*, publication number 1769-UM002A-EN-P for additional details.

Words 0 to 3 of the configuration file allow you to change the parameters of each channel independently. For example, word 0 corresponds to channel 0.

Define	To Select	Make these bit settings												
		15	14	13	12	11	10	9	8	4-7	3	2	1	0
Input Filter Selection/ -3 dB Frequency	60 Hz/15.7 Hz									Not Used	0	0	0	0
	50 Hz/13.1 Hz										0	0	0	1
	Not Used										0	0	1	0
	250 Hz/65.5 Hz										0	0	1	1
	500 Hz/131Hz										0	1	0	0
	Spare(1)													
Input Type/ Range	-10 to +10V dc					0	0	0	0					
	0 to 5V dc					0	0	0	1					
	0 to 10V dc					0	0	1	0					
	4 to 20 mA					0	0	1	1					
	1 to 5V dc					0	1	0	0					
	0 to 20 mA					0	1	0	1					
	Spare(1)													
Input Data Format	Raw/Proportional Data		0	0	0									
	Engineering Units		0	0	1									
	Scaled-for-PID		0	1	0									
	Percent Range		0	1	1									
	Spare(1)													
Enable Channel	Enabled	1												
	Disabled	0												

(1) An attempt to write any non-valid (spare) bit configuration into any selection field results in a module configuration error.

Specifications

General Specifications

Specification	Value
Dimensions	118 mm (height) x 87 mm (depth) x 35 mm (width) height including mounting tabs is 138 mm 4.65 in. (height) x 3.43 in (depth) x 1.38 in (width) height including mounting tabs is 5.43 in.
Approximate Shipping Weight (with carton)	300g (0.65 lbs.)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Operating Temperature	0°C to +60°C (32°F to +140°F)
Operating Humidity	5% to 95% non-condensing
Operating Altitude	2000 meters (6561 feet)
Vibration	Operating: 10 to 500 Hz, 5G, 0.030 in. peak-to-peak Relay Operation: 2G
Shock	Operating: 30G, 11 ms panel mounted (20G, 11 ms DIN rail mounted) Relay Operation: 7.5G panel mounted (5G DIN rail mounted) Non-Operating: 40G panel mounted (30G DIN rail mounted)
Agency Certification	• C-UL certified (under CSA C22.2 No. 142) • UL 508 listed • CE compliant for all applicable directives
Hazardous Environment Class	Class I, Division 2, Hazardous Location, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No. 213)
Radiated and Conducted Emissions	EN50081-2 Class A
Electrical /EMC:	*The module has passed testing at the following levels:*
• ESD Immunity (IEC1000-4-2)	• 4 kV contact, 8 kV air, 4 kV indirect
• Radiated Immunity (IEC1000-4-3)	• 10 V/m , 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier
• Fast Transient Burst (IEC1000-4-4)	• 2 kV, 5kHz
• Surge Immunity (IEC1000-4-5)	• 1 kV galvanic gun
• Conducted Immunity (IEC1000-4-6)	• 10 V, 0.15 to 80MHz(1)

(1) Conducted Immunity frequency range may be 150 kHz to 30 MHz if the Radiated Immunity frequency range is 30 MHz to 1000 MHz.

Input Specifications

Specification	1769-IF4 (Series B or later)
Analog Normal Operating Ranges(1)	Voltage: ± 10V dc, 0 to 10V dc, 0 to 5V dc, 1 to 5V dc Current: 0 to 20 mA, 4 to 20 mA
Full Scale Analog Ranges(1)	Voltage: ± 10.5V dc, -0.5 to 10.5V dc, -0.5 to 5.25V dc, 0.5 to 5.25V dc Current: 0 to 21 mA, 3.2 to 21 mA
Number of Inputs	4 differential or single-ended
Bus Current Draw (max.)	120 mA at 5V dc 60 mA at 24V dc(6)
Heat Dissipation	2.52 Total Watts (The Watts per point, plus the minimum Watts, with all points energized.)
Converter Type	Delta Sigma
Response Speed per Channel	Input filter and configuration dependent. See your user's manual.
Resolution (max.)(2)	14 bits (unipolar) 14 bits plus sign (bipolar)
Rated Working Voltage(3)	30V ac/30V dc
Common Mode Voltage Range(4)	±10V dc maximum per channel
Common Mode Rejection	greater than 60 dB at 50 and 60 Hz with the 50 or 60 Hz filter selected, respectively.
Normal Mode Rejection Ratio	-50 dB at 50 and 60 Hz with the 50 or 60 Hz filter selected, respectively.
Input Impedance	Voltage Terminal: 220K Ω (typical) Current Terminal: 250 Ω
Overall Accuracy(5)	Voltage Terminal: ±0.2% full scale at 25°C Current Terminal: ±0.35% full scale at 25°C

(1) The over- or under-range flag will come on when the normal operating range (over/under) is exceeded. The module will continue to convert the analog input up to the maximum full scale range. The flag automatically resets when within the normal operating range.

(2) Resolution is dependent upon your filter selection. The maximum resolution is achieved with either the 50 or 60 Hz filter selected. For resolution with other filter selections, refer to the user manual, publication 1769-UM002A-EN-P.

(3) Rated working voltage is the maximum continuous voltage that can be applied at the input terminal, including the input signal and the value that floats above ground potential (for example, 10V dc input signal and 20V dc potential above ground).

(4) For proper operation, both the plus and minus input terminals must be within ±10V dc of analog common.

(5) Includes offset, gain, non-linearity and repeatability error terms.

(6) If the optional 24V dc Class 2 power supply is used, the 24V dc current draw from the bus is 0 mA.

Specification	1769-IF4 (Series B or later)
Accuracy Drift with Temperature	Voltage Terminal: ±0.003% per °C Current Terminal: ±0.0045% per °C
Optional 24V dc Class 2 Power Supply Voltage Range	20.4 V to 26.4 V dc(3)
Calibration	The module performs autocalibration on channel enable and on a configuration change between channels.
Non-linearity (in percent full scale)	±0.03%
Repeatability(1)	±0.03%
Module Error over Full Temperature Range (0 to +60°C [+32°F to +140°F])	Voltage: ±0.3% Current: ±0.5%
Input Channel Configuration	via configuration software screen or the user program (by writing a unique bit pattern into the module's configuration file). Refer to your controller's user manual to determine if user program configuration is supported.
Module OK LED	On: module has power, has passed internal diagnostics, and is communicating over the bus. Off: Any of the above is not true.
Channel Diagnostics	Over- or under-range by bit reporting
Maximum Overload at Input Terminals(2)	Voltage Terminal: ±30V dc continuous, 0.1 mA Current Terminal: ±32 mA continuous, ±7.6 V dc
System Power Supply Distance Rating	8 (The module may not be more than 8 modules away from the system power supply.)
Recommended Cable	Belden™ 8761 (shielded)
Input Group to Bus Isolation	500V ac or 710V dc for 1 minute (qualification test) 30V ac/30V dc working voltage (IEC Class 2 reinforced insulation)
Vendor I.D. Code	1
Product Type Code	10
Product Code	35

(1) Repeatability is the ability of the input module to register the same reading in successive measurements for the same input signal.

(2) Damage may occur to the input circuit if this value is exceeded.

(3) Failure to use a Class 2 power supply without regulation within these limits could result in improper module operation.

Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following ATTENTION statement applies to use in hazardous locations.

WARNING

EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
- Do not connect or disconnect components unless power has been switched off or the area is known to be non-hazardous.
- This product must be installed in an enclosure.
- All wiring must comply with N.E.C. article 501-4(b).

Environnements dangereux

Cet équipement est conçu pour être utilisé dans des environnements de Classe 1, Division 2, Groupes A, B, C, D ou non dangereux. La mise en garde suivante s'applique à une utilisation dans des environnements dangereux.

MISE EN GARDE

DANGER D'EXPLOSION

- La substitution de composants peut rendre cet équipement impropre à une utilisation en environnement de Classe 1, Division 2.
- Ne pas remplacer de composants ou déconnecter l'équipement sans s'être assuré que l'alimentation est coupée et que l'environnement est classé non dangereux.
- Ne pas connecter ou déconnecter des composants sans s'être assuré que l'alimentation est coupée ou que l'environnement est classé non dangereux.
- Ce produit doit être installé dans une armoire.

For More Information

For	Refer to this Document	Pub. No.
A more detailed description of how to install and use your Compact I/O with MicroLogix 1500 programmable controller.	MicroLogix 1500 Programmable Controllers User Manual	1764-UM001A-US-P
Detailed information on installing, programming, and troubleshooting your Compact Analog I/O modules.	Compact I/O Analog Modules User Manual	1769-UM002A-EN-P
A detailed description of how to install and use your Compact I/O with the 1769-ADN DeviceNet Adapter.	1769-ADN DeviceNet Adapter User Manual	1769-UM001A-US-P
An overview of the MicroLogix 1500 system, including Compact I/O.	MicroLogix 1500 Programmable Controller with Compact I/O for Expansion	1764-SO001B-EN-P
More information on proper wiring and grounding techniques.	Industrial Automation Wiring and Grounding Guidelines	1770-4.1

If you would like a manual, you can:

- download a free electronic version from the internet: **www.ab.com/micrologix** or **www.theautomationbookstore.com**
- purchase a printed manual by:
  - contacting your local distributor or Rockwell Automation representative
  - visiting **www.theautomationbookstore.com** and placing your order
  - calling 1.800.963.9548 (USA/Canada) or 001.330.725.1574 (Outside USA/Canada)

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Asia Pacific Headquarters, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Rockwell Automation

Publication 1769-IN048A-EN-P - December 2000 PN 40072-103-01(A)
Supersedes Publication 1769-IN0016A-EN-P - June 2000

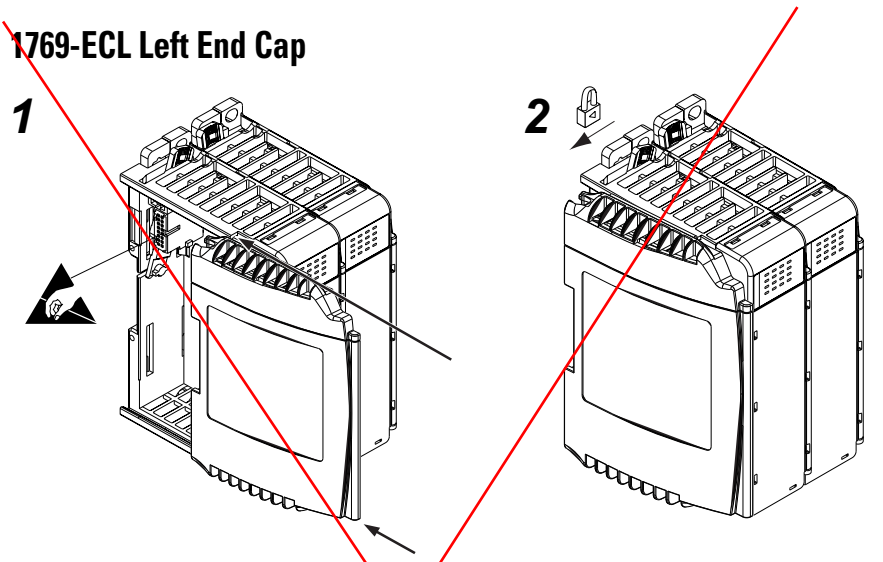
Compact I/O End Caps/Terminators

Catalog Numbers 1769-ECL 1769-ECR

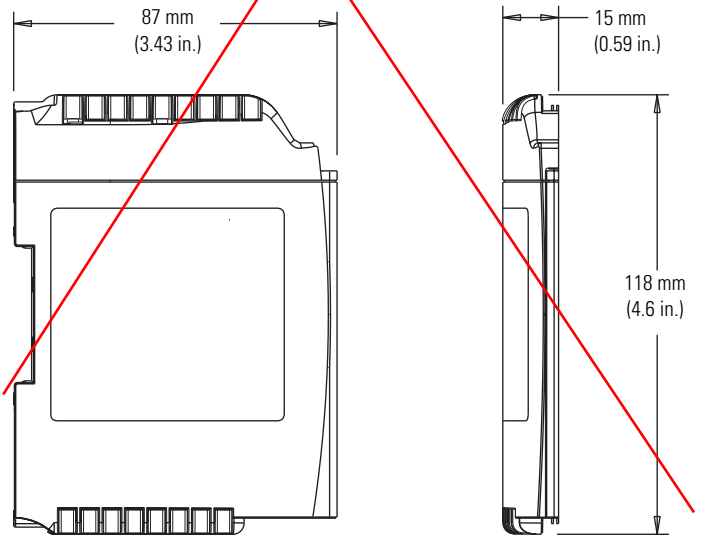
About the End Caps/Terminators

The 1769 controllers, such as the 1769-L32E, require end caps. A 1769-ECR right end cap or 1769-ECL left end cap terminates the end of the communication bus. Use this guide to install either end cap.

1769-ECL Left End Cap

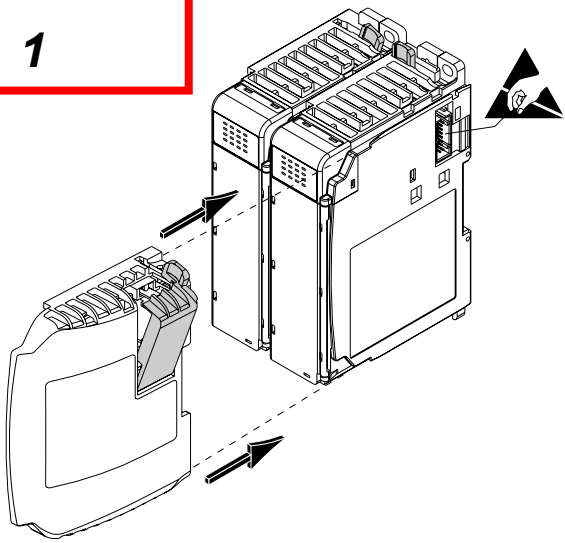


1769-ECL Dimensions

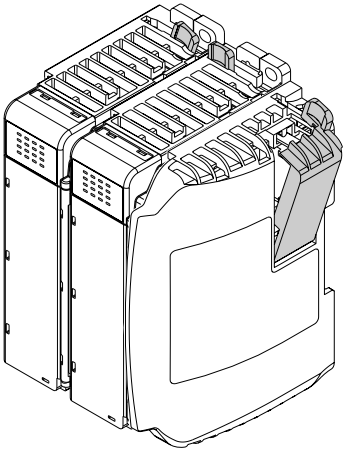


1769-ECR Right End Cap

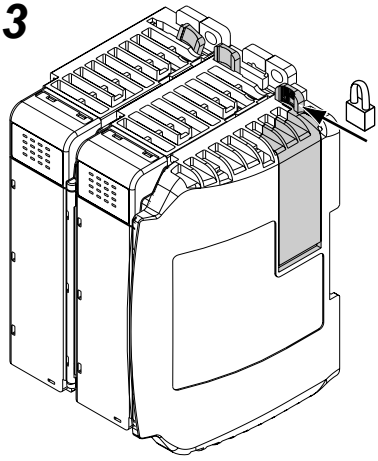
1



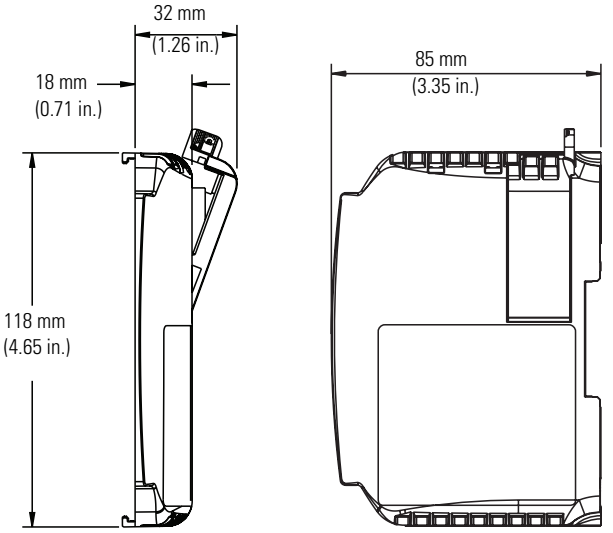
2



3



1769-ECR Dimensions



Specifications

1769-ECL, 1769-ECR - Technical Specifications

Attribute	1769-ECL	1769-ECR
Bus current draw, max	5 mA at 5V DC	
Operating altitude	2000 m (6562 ft)	
North American temp code	T3C	
IEC temp code	N/A	T4
Shipping weight, approx	130 g (0.286 lb)	
Enclosure type rating	None (open style)	

1769-ECL, 1769-ECR - Environmental Specifications

Attribute	1769-ECL	1769-ECR
Operating temperature IEC 60068-2-1 (Test Ad, Operating Cold) IEC 60068-2-2 (Test Bd, Operating Dry Heat) IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)	
Nonoperating temperature IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold) IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat) IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)	
Relative humidity	5…95% noncondensing	
Vibration IEC 60068-2-6 (Test Fc, Operating)	5 g @ 10…500 Hz	
Operating shock IEC 60068-2-27 (Test Ea, Unpackaged Shock)	DIN rail mount: 20 g; Panel mount: 30 g	
Nonoperating shock IEC 60068-2-27 (Test Ea, Unpackaged Shock)	DIN rail mount: 30 g; Panel mount: 40 g	

1769-ECL, 1769-ECR - Environmental Specifications

Attribute	1769-ECL	1769-ECR
Emissions CISPR 11	Group 1, Class A	
ESD immunity IEC 61000-4-2	8 kV air discharges	
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50%Pulse 100% AM at 900 MHz	

1769-ECL, 1769-ECR - Certifications[1]

Certifications[2]	1769-ECL	1769-ECR
c-UL-us	UL Listed for Class I, Division 2 Group A, B, C, D Hazardous Locations, certified for U.S. and Canada. See UL File E10314	
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions	
C-Tick	Australian Radio Communications Act, compliant with: • AS/NZS CISPR 11; Industrial Emissions	
Ex	N/A	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection “n” (II 3 G Ex nA IIC T4 X) • EN 60079-0; General Requirements (Zone 2)

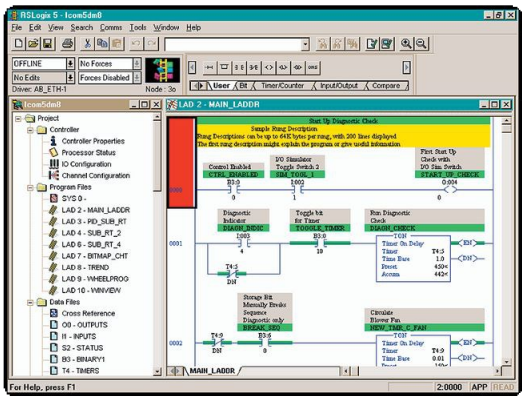
(1) When product is marked.

(2) See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

Software

RSLogix 500 Software

The RSLogix family of ladder logic programming packages helps you maximize performance, save project development time, and improve productivity. This family of products has been developed to operate on Microsoft Windows operating systems. Supporting the Allen-Bradley SLC 500 and MicroLogix families of processors, RSLogix 500 was the first PLC programming software to offer unbeatable productivity with an industry-leading user interface. RSLogix 5 supports the Allen- Bradley PLC-5 family of programmable controllers. RSLogix 5000 provides support for the Logix5000 Highly Integrated Motion functionality. RSLogix offers reliable communications, powerful functionality, and superior diagnostics.



RSLogix 500 Selection

Cat. No.	Description
9324-RL0100ENE	RSLogix 500 Starter Edition Programming Software for SLC 500 and MicroLogix controller families. (CD-ROM)
9324-RL0300ENE	RSLogix 500 Standard Edition Programming Software for SLC 500 and MicroLogix controller families. (CD-ROM)
9324-RL0700NXENE	RSLogix 500 Professional Edition. CD-ROM also includes RSLogix Emulate 500, RSNetWorx for DeviceNet and RSNetWorx for ControlNet.

Extract from the online catalog

Primary switched-mode power supply unit, 1-phase, output: 24 V DC / 2.5 A

Order No.	2866268
Ord designation	TRIO-PS/1AC/24DC/2.5
EAN	4046356046626
Pack	1 Pcs.
Customs tariff	85044081
Weight/Piece	0,6671 KG
Catalog page information	Page 318 (NTK-2006)

Technical data

Product description

Input data

Nominal input voltage	100 V AC ... 240 V AC
AC input voltage range	85 V AC ... 264 V AC (derating < 90 V AC: 2.5% per Kelvin)
AC frequency range	45 Hz ... 65 Hz
Current consumption	0.95 A (120 V AC)
Current consumption	0.5 A (230 V AC)
Nominal power consumption	48 W
Inrush surge current	2s)
Power failure bypass	> 20 ms (115 V AC)
Power failure bypass	> 100 ms (230 V AC)
Input fuse	2A (träge, intern)
Recommended backup fuse	6 A
Recommended backup fuse	10 A
Recommended backup fuse	16 A (characteristic B)
Power factor (cos phi)	0.72
Name of protection	Transient surge protection
Protective circuit/component	Varistor

Output data

Nominal output voltage	24 V DC ±1%
Setting range of the output voltage	22.5 V DC ... 29.5 V DC
Output current	2.5 A (0°C ... 55°C)
Connection in parallel	Yes, for redundancy and increased capacity
Connection in series	No
Max. capacitive load	Unlimited
Current limitation	Approx. 5 A (for short circuit)
Control deviation	< 1 % (change in load, static 10% ... 90%)
Control deviation	< 2 % (change in load, dynamic 10% ... 90%)
Control deviation	< 0.1 % (change in input voltage ±10%)
Residual ripple	PP
Peak switching voltages nominal load	PP
Maximum power dissipation idling	0.9 W
Power loss nominal load max.	11 W

General data

Width	32 mm
Height	130 mm
Depth	115 mm
Weight	0.5 kg
Operating voltage display	LED green
Efficiency	> 85 %
Insulation voltage input/output	4 kV AC (Typprüfung)
Insulation voltage input/output	2 kV AC (routine test)
Degree of protection	IP20
Class of protection	I, with PE connection
MTBF	> 500 000 h in acc. with IEC 61709 (SN 29500)
Ambient temperature (operation)	-25 °C ... 70 °C (> 55° C derating)
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Max. permissible relative humidity (operation)	95 % (at 25°C, no condensation)

Installation position	Horizontal DIN rail NS 35, EN 60715
Assembly instructions	Can be aligned: Horizontal 0 cm, vertical 5 cm
Electromagnetic compatibility	Conformance with EMC directive 89/336/EEC
Immunity to interference	EN 61000-6-2
Standard – Electrical equipment of machines	EN 60204
Standard – Safety transformers for switched-mode power supply units	EN 61558-2-17
Standard - Electrical safety	EN 60950/VDE 0805 (SELV)
Standard - Electrical safety	EN 61558-2-17
Standard - Electrical safety	UL/C-UL recognized UL 60950
Standard – Industrial regulation devices	UL/C-UL Listed UL 508
Standard – Electronic equipment for use in electrical power installations and their assembly into electrical power installations	EN 50178/VDE 0160 (PELV)
Standard – Safety extra-low voltage	EN 60950 (SELV)
Standard – Safety extra-low voltage	EN 60204 (PELV)
Standard - Safe isolation	DIN VDE 0100-410
Standard - Safe isolation	DIN VDE 0106-1010
Standard – Protection against electric shock	DIN 57100-410
Standard – Protection against shock currents, basic requirements for protective separation in electrical equipment	DIN VDE 0106-101
Standard – Limitation of mains harmonic currents	EN 61000-3-2

Connection data, input

Type of connection	Screw connection
Conductor cross section solid min.	0.2 mm^2
Conductor cross section solid max.	2.5 mm^2
Conductor cross section stranded min.	0.2 mm^2
Conductor cross section stranded max.	2.5 mm^2
Conductor cross section AWG/kcmil min.	24
Conductor cross section AWG/kcmil max	14
Stripping length	9 mm
Screw thread	M2,5

Connection data, output

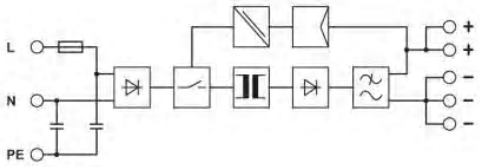
Type of connection	Screw connection
Conductor cross section solid min.	0.2 mm^2
Conductor cross section solid max.	2.5 mm^2
Conductor cross section stranded min.	0.2 mm^2
Conductor cross section stranded max.	2.5 mm^2
Conductor cross section AWG/kcmil min.	24
Conductor cross section AWG/kcmil max	14
Stripping length	9 mm

Signaling

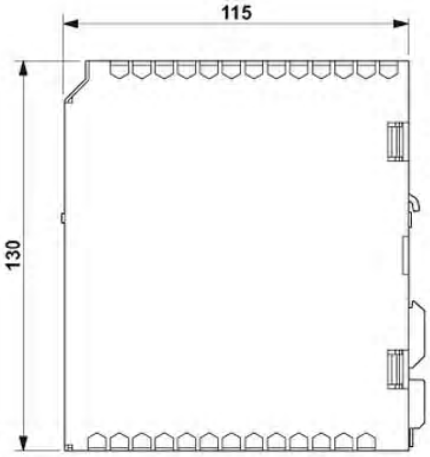
Status display	"DC OK" LED green
Note on status display	U_{OUT} > 21.5 V: LED lights up

Drawings

Block diagram



Dimensioned drawing



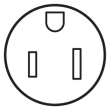
Extract from the online catalog

SD-US/SC/LA/GY

Order No.: 2963860

http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2963860

Rail-mountable socket, with light indicator, housing color: gray, with screw connection, national version: USA, housing width 45 mm



Commercial data	
EAN	4017918859138
Pack	10 Pcs.
Customs tariff	85366990
Weight/Piece	0.07641 KG
Catalog page information	Page 513 (IF-2007)

Product notes

WEEE/RoHS-compliant since: 07/20/2006

http://www.download.phoenixcontact.com
Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

Technical data

General data

Nominal voltage U_N	125 V AC
Nominal current I_N	15 A AC
Status display	Glow lamp or LED with preresistor
Material of contact	CuZn37
For country-specific use in	USA
Color	gray

Insulating material	PA
Ambient temperature (operation)	-20 °C ... 60 °C
Ambient temperature (storage/transport)	-20 °C ... 60 °C
Standards/regulations	IEC 83
	DIN 49440-1
	UL 498
Length	75 mm
Width	45 mm
Height	70.5 mm

Connection data

Conductor cross section solid min.	0.2 mm^2
Conductor cross section solid max.	4 mm^2
Conductor cross section stranded min.	0.2 mm^2
Conductor cross section stranded max.	2.5 mm^2
Conductor cross section AWG/kcmil min.	30
Conductor cross section AWG/kcmil max	12
Type of connection	Screw connection
Stripping length	8 mm
Screw thread	M 3

Certificates / Approvals

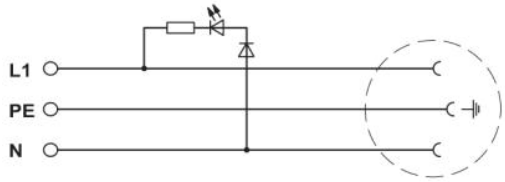
Approval logo

requested approbations

Certification	CUL Listed, GOST, UL Listed

Drawings

Circuit diagram



Control and signalling units Ø 22

Harmony® style 4
Pushbuttons and switches with chromium plated metal bezel
Complete units, XB4 B


550275

XB4 BT845


550276

XB4 BS9445


550277

XB4 BS542


814108

XB4 BD33


814109

XB4 BJ33


814110

XB4 BG33

Emergency stop mushroom head pushbuttons, Ø 40 (red) (screw clamp terminal connections)

Shape of head	Type of push	Type of contact N/O	Type of contact N/C	Reference	Weight kg
	Trigger action Push-pull	1	1	**XB4 BT845** (ZB4 BZ105 + ZB4 BT84)	0.136
	Trigger action Turn to release	1	1	**XB4 BS8445** (ZB4 BZ105 + ZB4 BS844)	0.130
		–	2	**XB4 BS8444** (ZB4 BZ104 + ZB4 BS844)	0.130
		1	2	**XB4 BS84441** (ZB4 BZ141 + ZB4 BS844)	0.140
	Trigger action Key release (Key n° 455)	1	1	**XB4 BS9445** (ZB4 BZ105 + ZB4 BS944)	0.170
	Push-pull	–	1	**XB4 BT42** (ZB4 BZ102 + ZB4 BT4)	0.125
	Turn to release	–	1	**XB4 BS542** (ZB4 BZ102 + ZB4 BS54)	0.118
	Key release (key n° 455)	–	1	**XB4 BS142** (ZB4 BZ102 + ZB4 BS14)	0.133

Selector switches and key switches (screw clamp terminal connections)

Shape of head	Type of operator	Type of contact N/O	Type of contact N/C	Number and type of positions *(1)*	Reference	Weight kg
	Standard handle, black	1	–	2 - stay put	**XB4 BD21** (ZB4 BZ101 + ZB4 BD2)	0.095
		1	1	2 - stay puts	**XB4 BD25** (ZB4 BZ105 + ZB4 BD2)	0.105
		2	–	3 - stay put	**XB4 BD33** (ZB4 BZ103 + ZB4 BD3)	0.105
				3 - spring return to centre	**XB4 BD53** (ZB4 BZ103 + ZB4 BD5)	0.105
	Long handle, black	1	–	2 - stay put	**XB4 BJ21** (ZB4 BZ101 + ZB4 BJ2)	0.096
		2	–	3 - stay put	**XB4 BJ33** (ZB4 BZ103 + ZB4 BJ3)	0.105
				3 - spring return to centre	**XB4 BJ53** (ZB4 BZ103 + ZB4 BJ5)	0.105
	Key (n° 455)	1	–	2 - stay put	**XB4 BG21** (ZB4 BZ101 + ZB4 BG2)	0.117
					XB4 BG41 (ZB4 BZ101 + ZB4 BG4)	0.117
				2 - spring return to left	**XB4 BG61** (ZB4 BZ101 + ZB4 BG6)	0.117
		2	–	3 - stay put	**XB4 BG03** (ZB4 BZ103 + ZB4 BG0)	0.127
					XB4 BG33 (ZB4 BZ103 + ZB4 BG3)	0.127

(1) The symbol ⚷ indicates key withdrawal position(s).

Control and signalling units Ø 22

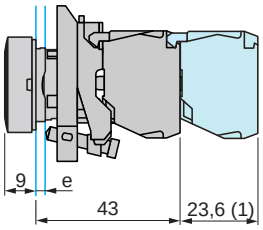
Harmony® style 4

Pushbuttons, switches and pilot lights with chromium plated metal bezel

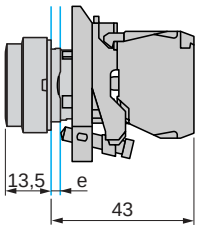
Complete units, XB4 B : contact functions

Pushbuttons, spring return

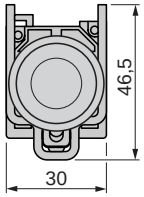
XB4 BA●●



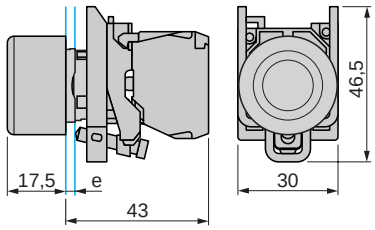
XB4 BL●●



Common face view

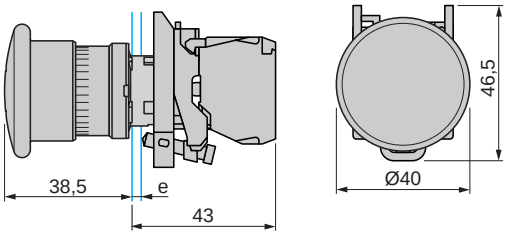


XB4 BP●●



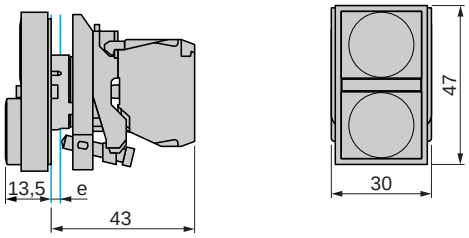
Mushroom head pushbuttons, spring return

XB4 BC21



Double-headed pushbuttons, spring return

XB4 BL●45, BL●4C5

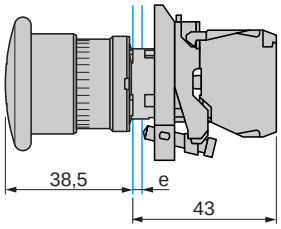


e: panel thickness: 1 to 6 mm

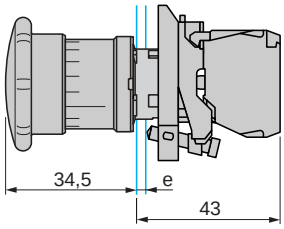
(1) Additional row of contacts or double contact.

Emergency stop mushroom head pushbuttons

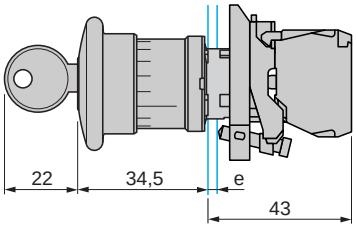
XB4 BT42, BT845



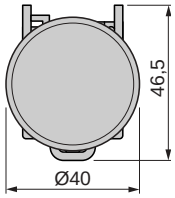
XB4 BS542, BS8441, BS8444, BS8445



XB4 BS142, BS9445



Common face view

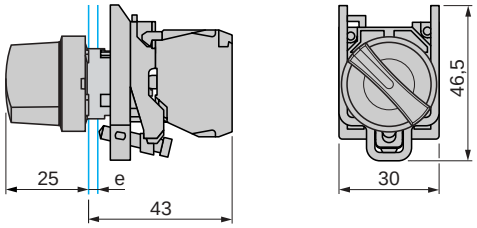


e: panel thickness: 1 to 6 mm

Selector switches

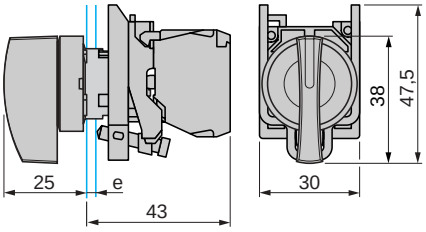
Standard handle operator

XB4 BD



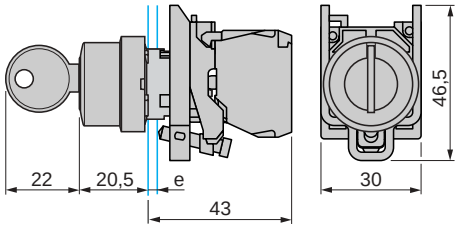
Long handle operator

XB4 BJ



Key switches

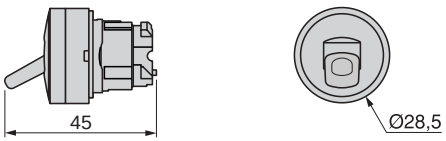
XB4 BG



e: panel thickness: 1 to 6 mm

Heads for toggle switches

ZB4 BD●8



General :
pages 36022/2 to 36024/5

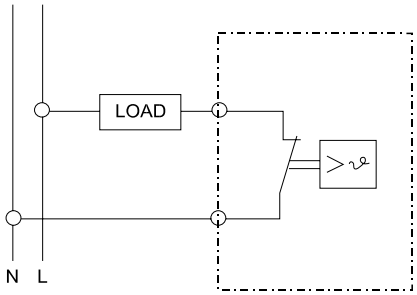
Characteristics :
pages 36001/2 to 36001/5

References:
pages 36002/2 to 36009/3

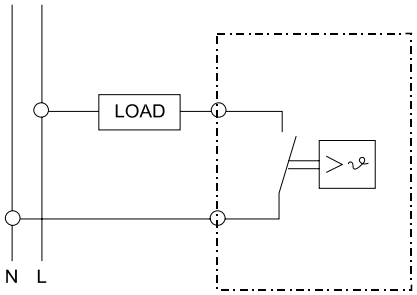
Thermostat

- Designed to provide air temperature control and monitoring in cabinets.
- Thermostat NC (Normally Closed) for the control of heaters and heater fans.
- Thermostat NO (Normally Open) for the control of cooling units, or for switching signal transmitters in case of overheating.
- Available in Fahrenheit or Celsius.

Sensor Element:	Thermostatic bi-metal
Switching difference (hysteresis):	±4°F (±3°K)
Adjustment Range:	30-140°F
Connection:	2 pole terminal for AWG 14 (2.5mm²)
Mounting:	Easily installed by clip mounting on 35 mm or 38 mm DIN rails (included)
Housing:	Flame retardant plastic UL94VO
Color:	Gray (SB)
Protection:	IP20
Approval:	UL Recognized Component , cUL Recognized Component, CE, CSA Listed



NC - Normally Closed (Red)
Used in conjunction with heaters. Contact opens when rising temperatures reach the set point temperature shutting heater off.



NO - Normally Open (Blue)
Used in conjunction with fans. Contact closes when rising temperatures reach the set point temperature turning fan on.

Part No.	Scale	Contact Type	Dimensions Height x Width x Depth	Switching Capacity	Ship Wt. lbs.
SKT011409NC	°F	Normally Closed	2.4 x 1.6 x 1.4	15 A (1) AC 120 V, 10 A (1) AC 250 V	1
SKT011409NC-C	°C	Normally Closed	2.4 x 1.3 x 1.4	15 A (1) AC 120 V, 10 A (1) AC 250 V	1
SKT011419NO	°F	Normally Open	2.4 x 1.6 x 1.4	15 A (1) AC 120 V, 10 A (1) AC 250 V	1
SKT011419NO-C	°C	Normally Open	2.4 x 1.3 x 1.4	15 A (1) AC 120 V, 10 A (1) AC 250 V	1

Technical references and DXF downloads available at www.hammfg.com
All dimensions in inches unless specified otherwise

Canada: 519.822.2960 or 905.456.3770 USA: 716.630.7030

Extract from the online catalog

Universal terminal block with screw connection, cross section: 0.14 - 2.5 mm², AWG: 26 - 12, width: 5.2 mm, color: gray

Order No.	3044076
Ord designation	UT 2,5
EAN	4017918960377
Pack	50 Pcs.
Customs tariff	85369010
Weight/Piece	0,008397 KG
Catalog page information	Page 12 (NTK-2005)

Product notes

WEEE/RoHS-compliant since: 01/01/2003

IMPORTANT : This date is valid for Customers in Germany only. Date Format is MM/DD/YYYY.Please contact your local in-country Phoenix Contact location or designated business partner for a Logistics Compliant date in your area.In order to guarantee delivery of RoHS-Compliant product, please purchase Phoenix Contact parts from authorized Phoenix Contact representatives and distributors.

Technical data

General	
Number of levels	1
Number of connections	2
Color	gray
Insulating material	PA
Inflammability class acc. to UL 94	V0
Dimensions	
Width	5.2 mm
Length	46.9 mm
Height NS 35/7,5	47.5 mm
Height NS 35/15	55 mm
Technical data	
Maximum load current	32 A (with 4 mm^2 conductor cross section)
Rated surge voltage	8 kV
Contamination class	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC / EN
Nominal current I_N	24 A
Nominal voltage U_N	1000 V
Open side panel	ja
Connection data	
Conductor cross section solid min.	0.14 mm^2
Conductor cross section solid max.	4 mm^2
Conductor cross section stranded min.	0.14 mm^2
Conductor cross section stranded max.	2.5 mm^2
Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	12
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.25 mm^2
Conductor cross section stranded, with ferrule without plastic sleeve max.	2.5 mm^2
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.25 mm^2
Conductor cross section stranded, with ferrule with plastic sleeve max.	2.5 mm^2
2 conductors with same cross section, solid min.	0.14 mm^2
2 conductors with same cross section, solid max.	1.5 mm^2
2 conductors with same cross section, stranded min.	0.14 mm^2
2 conductors with same cross section, stranded max.	1.5 mm^2
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm^2
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	1.5 mm^2

2 conductors with same cross section, stranded, ferrules 0.25 mm^2 without plastic sleeve, min.	
2 conductors with same cross section, stranded, ferrules 1.5 mm^2 without plastic sleeve, max.	
Type of connection	Screw connection
Stripping length	9 mm
Internal cylindrical gage	A3
Screw thread	M 3
Tightening torque, min	0.6 Nm

Certificates / Approvals

Certificate logos

c UL us

CSA	
Nominal voltage U_N	600 V
Nominal current I_N	20 A
AWG/kcmil	26-12
CUL	
Nominal voltage U_N	600 V
Nominal current I_N	20 A
AWG/kcmil	26-12
UL	
Nominal voltage U_N	600 V
Nominal current I_N	20 A
AWG/kcmil	26-12

Accessories

Item	Designation	Description
Assembly		
3047167	ATP-UT	Partition plate, for visual and electrical separation of terminal groups, width: 2 mm, color: gray
3047028	D-UT 2,5/10	Cover, for terminal block UT and UT...-PE, width 2.2 mm, color: Gray
0801762	NS 35/ 7,5 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1207640	NS 35/ 7,5 PERF 755MM	NS 35 DIN rail, height 7.5 mm, length 755 mm
1207653	NS 35/ 7,5 PERF 955MM	NS35 DIN rail, height 7.5 mm, length 955 mm
1207666	NS 35/ 7,5 PERF 1155MM	NS 35 DIN rail, height 7.5 mm, length 1155 mm
0801733	NS 35/ 7,5 PERF 2000MM	DIN rail, material: Steel, perforated, height 7.5 mm, width 35 mm, length: 2 m
0801681	NS 35/ 7,5 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1201756	NS 35/15 AL UNPERF 2000MM	DIN rail, deep-drawn, high profile, unperforated, 1.5 mm thick, material: Aluminum, height 15 mm, width 35 mm, length 2 m
1201895	NS 35/15 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, 1.5 mm thick, height 15 mm, width 35 mm, length: 2 m
1207679	NS 35/15 PERF 755MM	NS 35 DIN rail, height 15 mm, length 755 mm
1207682	NS 35/15 PERF 955MM	NS 35 DIN rail, height 15 mm, length 955 mm
1207695	NS 35/15 PERF 1155MM	NS 35 DIN rail, height 15 mm, length 1155 mm
1201730	NS 35/15 PERF 2000MM	DIN rail, material: Steel, perforated, height 15 mm, width 35 mm, length: 2 m
1201714	NS 35/15 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 15 mm, width 35 mm, length: 2 m
1201798	NS 35/15-2,3 UNPERF 2000MM	DIN rail, material: Steel, unperforated, 2.3 mm thick, height 15 mm, width 35 mm, length: 2 m
Bridges		
3030161	FBS 2-5	Plug-in bridge for cross-connections in the terminal center, 2-pos., color: Red
3030174	FBS 3-5	Plug-in bridge for cross-connections in the terminal center, 3-pos., color: Red
3030187	FBS 4-5	Plug-in bridge for cross-connections in the terminal center, 4-pos., color: Red
3030190	FBS 5-5	Plug-in bridge for cross-connections in the terminal center, 5-pos., color: Red
3030213	FBS 10-5	Plug-in bridge for cross-connections in the terminal center, 10-pos., color: Red
3030226	FBS 20-5	Plug-in bridge for cross-connections in the terminal center, 20-pos., color: Red
3038930	FBS 50-5	Plug-in bridge for cross-connections in the terminal center, 50-pos., color: Red
Marking		
0811228	X-PEN 0,35	Marker pen without ink cartridge, for manual labeling of markers, labeling extremely wipe-proof, line thickness 0.35 mm

Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation at http://www.download.phoenixcontact.com. The General Terms and Conditions of Use apply to Internet downloads.

Extract from the online catalog

Universal terminal block with screw connection, cross section: 0.14 - 2.5 mm², AWG: 26 - 12, width: 5.2 mm, color: green-yellow

Order No.	3044092
Ord designation	UT 2,5-PE
EAN	4017918960360
Pack	50 Pcs.
Customs tariff	85369010
Weight/Piece	0.012156 KG
Catalog page information	Page 32 (CL-2007)

Product notes

WEEE/RoHS-compliant since:	01/01/2003

IMPORTANT : This date is valid for Customers in Germany only. Date Format is MM/DD/YYYY.Please contact your local in-country Phoenix Contact location or designated business partner for a Logistics Compliant date in your area.In order to guarantee delivery of RoHS-Compliant product, please purchase Phoenix Contact parts from authorized Phoenix Contact representatives and distributors.

General

Number of levels	1
Number of connections	2
Color	green-yellow
Insulating material	PA
Inflammability class acc. to UL 94	V0

Dimensions

Width	5.2 mm
Length	47.7 mm
Height NS 35/7,5	47.5 mm
Height NS 35/15	55 mm

Technical data

Rated surge voltage	8 kV
Contamination class	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-2
Open side panel	ja

Connection data

Conductor cross section solid min.	0.14 mm^2
Conductor cross section solid max.	4 mm^2
Conductor cross section stranded min.	0.14 mm^2
Conductor cross section stranded max.	4 mm^2
Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	12
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.25 mm^2
Conductor cross section stranded, with ferrule without plastic sleeve max.	2.5 mm^2
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.25 mm^2
Conductor cross section stranded, with ferrule with plastic sleeve max.	2.5 mm^2
2 conductors with same cross section, solid min.	0.14 mm^2
2 conductors with same cross section, solid max.	1.5 mm^2
2 conductors with same cross section, stranded min.	0.14 mm^2
2 conductors with same cross section, stranded max.	1.5 mm^2
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm^2
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	1.5 mm^2
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.25 mm^2
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	1.5 mm^2
Type of connection	Screw connection
Stripping length	9 mm
Internal cylindrical gage	A3

Certificates / Approvals

Certificate logos

CSA	
AWG/kcmil	26-12
CUL	
AWG/kcmil	26-12
UL	
AWG/kcmil	26-12

Extract from the online catalog

End bracket, width: 9.5 mm, color: gray

Order No.	0800886
Ord designation	E/NS 35 N
EAN	4017918129309
Pack	50 Pcs.
Customs tariff	39269098
Weight/Piece	0,014872 KG
Catalog page information	Page 443 (CL-2005)

Product notes

WEEE/RoHS-compliant since:	02/01/2005

IMPORTANT : This date is valid for Customers in Germany only. Date Format is MM/DD/YYYY.Please contact your local in-country Phoenix Contact location or designated business partner for a Logistics Compliant date in your area.In order to guarantee delivery of RoHS-Compliant product, please purchase Phoenix Contact parts from authorized Phoenix Contact representatives and distributors.

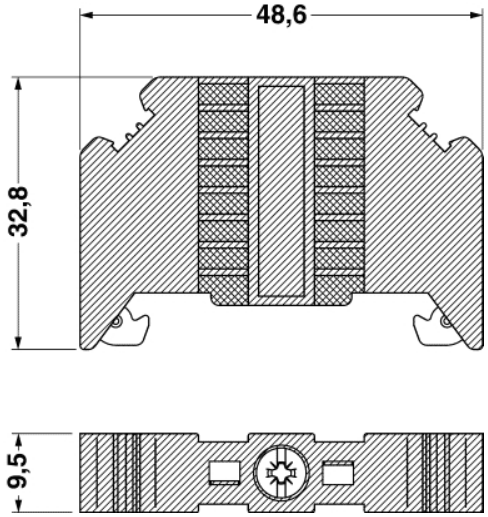
Technical data

General data

Length	48.6 mm
Width	9.5 mm
Material	PA
Color	gray
Inflammability class acc. to UL 94	V2

Drawings

Dimensioned drawing



Accessories

Item	Designation	Description
Assembly		
0801762	NS 35/ 7,5 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, height 7.5 mm, width 35 mm, length: 2 m
0801733	NS 35/ 7,5 PERF 2000MM	DIN rail, material: Steel, perforated, height 7.5 mm, width 35 mm, length: 2 m
0801681	NS 35/ 7,5 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1201756	NS 35/15 AL UNPERF 2000MM	DIN rail, deep-drawn, high profile, unperforated, 1.5 mm thick, material: Aluminum, height 15 mm, width 35 mm, length 2 m
1201895	NS 35/15 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, 1.5 mm thick, height 15 mm, width 35 mm, length: 2 m
1201730	NS 35/15 PERF 2000MM	DIN rail, material: Steel, perforated, height 15 mm, width 35 mm, length: 2 m
1201714	NS 35/15 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 15 mm, width 35 mm, length: 2 m
1201798	NS 35/15-2,3 UNPERF 2000MM	DIN rail, material: Steel, unperforated, 2.3 mm thick, height 15 mm, width 35 mm, length: 2 m
Marking		
1007235	SBS 8:UNBEDRUCKT	Marker cards for modular terminal blocks, color: white
1050512	ZB 8:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements

Extract from the online catalog

Partition plate, for visual and electrical separation of terminal groups, width: 2 mm, color: gray

Order No.	3047167
Ord designation	ATP-UT
EAN	4017918962159
Pack	50 Pcs.
Customs tariff	85472000
Weight/Piece	0.004895 KG
Catalog page information	Page 26 (CL-2007)

Product notes

WEEE/RoHS-compliant since:	01/01/2003

IMPORTANT : This date is valid for Customers in Germany only. Date Format is MM/DD/YYYY.Please contact your local in-country Phoenix Contact location or designated business partner for a Logistics Compliant date in your area.In order to guarantee delivery of RoHS-Compliant product, please purchase Phoenix Contact parts from authorized Phoenix Contact representatives and distributors.

Extract from the online catalog

Plug-in bridge for cross-connections in the terminal center, 2-pos., color: Red

Order No.	3030161
Ord designation	FBS 2-5
EAN	4017918188511
Pack	50 Pcs.
Customs tariff	85369010
Weight/Piece	0,001746 KG
Catalog page information	Page 12 (NTK-2005)

Product notes

WEEE/RoHS-compliant since: IMPORTANT : This date is valid for Customers in Germany only. Date Format is DD/MM/YYYY. Please contact your local in-country Phoenix Contact location or designated business partner for a Logistics Compliant date in your area. In order to guarantee delivery of RoHS-Compliant product, please purchase Phoenix Contact parts from authorized Phoenix Contact representatives and distributors.	01/01/2003

Extract from the online catalog

FBS 3-5

Order No.: 3030174

http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3030174

Plug-in bridge for cross-connections in the terminal center, 3-pos., color: Red

Commercial data	
EAN	4017918188528
Pack	50 Pcs.
Customs tariff	85389099
Weight/Piece	0.00262 KG
Catalog page information	Page 26 (CL-2007)

Product notes

WEEE/RoHS-compliant since: 01/01/2003

http://www.download.phoenixcontact.com
Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

Extract from the online catalog

PT 2-PE/S-120AC/FM

Order No.: 2856812

The figure shows the PT 2-PE/S-230AC/FM version

http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2856812

DIN rail module with pluggable surge protection type 3 for terminal equipment, fault signaling and remote indication contact. Design: 120 V AC

Product notes

WEEE/RoHS-compliant since: 06/23/2006

http://www.download.phoenixcontact.com
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Commercial data	
EAN	4017918952952
Pack	1 pcs.
Customs tariff	85363010
Weight/Piece	0.0807 KG
Catalog page information	Page 46 (TT-2009)

Technical data

Standards

Housing material	PA
Inflammability class acc. to UL 94	V0
Color	black

Standards for air and creepage distances	DIN VDE 0110-1
	IEC 60664-1: 1992-10
	DIN VDE 0675-6
	IEC 61643-1
Surge voltage category	III
Pollution degree	2
Degree of protection	IP20
Design	DIN rail module, two-section, divisible
Mounting type	DIN rail 35 mm
Ambient temperature (operation)	-40 °C ... 85 °C
Arrester can be tested with CHECKMASTER from software version:	From SW rev. 1.00
Direction of action	1L-N & N-PE
Width	17.70 mm
Height	65.50 mm
Length	90.00 mm
Pitch unit	1 Div.

Protective circuit

IEC category	III
EN type	T3
Nominal voltage U_N	120 V AC
Arrester rated voltage U_C	150 V AC
Nominal frequency f_N	50 Hz
	60 Hz
Nominal current I_N	26 A (≤ 30°C)
Operating effective current I_C at U_C	≤ 1.1 mA
Discharge current to PE at U_C	≤ 1.5 µA
Nominal discharge surge current I_n (8/20) µs	2.5 kA
Max. discharge surge current Imax (8/20) µs	10 kA
Combined surge U_{OC}	6 kV
Protection level U_P (L-N)	≤ 620 V
Protection level U_P (L-PE)	≤ 850 V
Protection level U_P (N-PE)	≤ 850 V
Response time tA (L-N)	≤ 25 ns
Response time tA (L-PE)	≤ 100 ns

Max. required back-up fuse	25 A (gL/C)
Message surge protection faulty	Optical, remote indicator contact

Non-heating apparatus connection, power supply

Type of connection	Screw connection
Connection type IN	Screw terminal blocks
Connection type OUT	Screw terminal blocks
Screw thread	M3
Tightening torque, min	0.8 Nm
Stripping length	8 mm
Conductor cross section stranded min.	0.2 mm²
Conductor cross section stranded max.	2.5 mm²
Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	4 mm²
Conductor cross section AWG/kcmil min.	24
Conductor cross section AWG/kcmil max	12

Remote indicator contact

Connection name	Remote fault indicator contact
Switching function	N/C contact
Type of connection	Screw connection
Screw thread	M3
Tightening torque, min	0.8 Nm
Stripping length	8 mm
Conductor cross section stranded min.	0.2 mm²
Conductor cross section stranded max.	2.5 mm²
Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	4 mm²
Conductor cross section AWG/kcmil min.	24
Conductor cross section AWG/kcmil max	12
Maximum operating voltage $U_{max.}$ AC	250 V
Maximum operating voltage U_{max} DC	50 V
Max. operating current I_{max}	3 A AC/DC

Connection, protective circuit

Standards/regulations	IEC 61643-1

	DIN EN 61643-11/A11
	E DIN VDE 0675-6/A1
	E DIN VDE 0675-6/A2
	UL 1449
	NF C61-740

Certificates / Approvals

Certification	CB, CCA, CSA, CUL, GOST, KEMA, OEVE, UL

Accessories

Item	Designation	Description
Marking		
1050004	ZB 5 :UNBEDRUCKT	Zack strip, unprinted, 10-section, for individual labeling with M-PEN, ZB-T or CMS system, pack is sufficient for 100 terminal blocks, for a terminal width of 5.2 mm, color: White
2715212	ZB 5,8,LGS:FORTL.ZAHLEN	Zack marker strip, 10-section, printed horizontally: with consecutive numbers, 1-10, 11-20 etc. up to 991-1000, color: white
1050305	ZB 5,8:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements
2715209	ZB 5,8:UNBEDRUCKT	Zack strip, unprinted, strips with 10 labels for individual labeling with M-PEN or CMS system, for terminal block width: 5.8 mm, color: White
1050017	ZB 5,LGS:FORTL.ZAHLEN	Zack strip, 10-section, printed horizontally: with the numbers, 1-10, 11-20 etc. up to 991-1000, color: white
1050415	ZB 5,LGS:L1-N,PE	Zack strip, printed horizontally, strips with 10 labels, L1, L2, L3, N, PE, L1, L2, L3, N, PE, color: white
1050295	ZB 5:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements

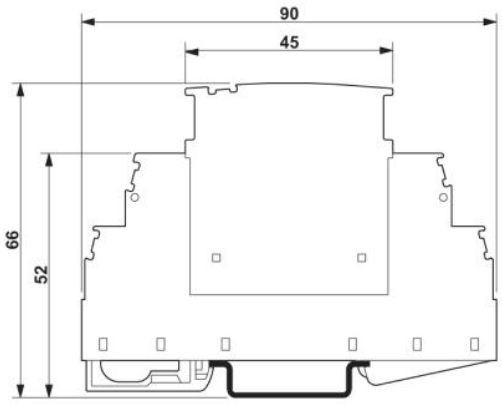
Additional products

Item	Designation	Description
Assembly		
2839295	SSA 3-6	shield fast connections for conductor diameter 3 - 6 mm. Potential connection cable: 200 mm, black

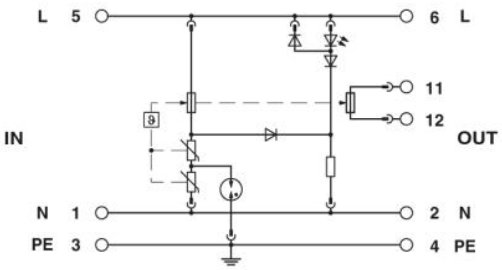
2839512	SSA 5-10	Shield fast connection for conductor diameters 5 - 10 mm. Potential connection cable: 200 mm, black

Diagrams/Drawings

Dimensioned drawing



Circuit diagram



APC Back-UPS® Pro 1300/1500

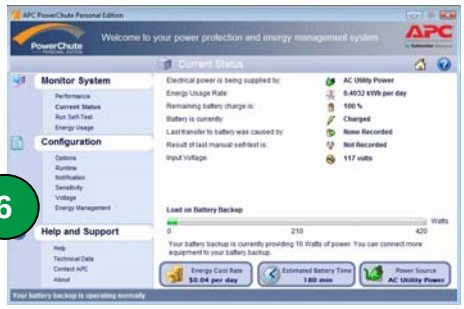
Power-Saving, high performance power protection for office computers

The Back-UPS Pro provides abundant battery backup power, so you can work through medium and extended length power outages. It safeguards your equipment against damaging surges and spikes that travel along utility and data lines. The Back-UPS Pro also features automatic voltage regulation (AVR), which instantly adjusts high and low voltages to safe levels, so you can work indefinitely during brownouts and overvoltages.

The Back-UPS Pro also includes unique “green” features, like power-saving outlets that automatically turn off idle peripherals. A high efficiency charging system and “AVR Bypass” also reduce power consumption. With the rest of the Back-UPS Pro’s standard features, this is the perfect unit to protect your productivity from the constant threat of bad power and lost data.

Product Features:

1. **LCD (Liquid Crystal Display)** gives the status of over 20 different utility and battery backup conditions.
2. **Automatic Voltage Regulation (AVR)** instantly corrects voltage fluctuations so you can work indefinitely through brownouts and overvoltages.
3. **5 “Battery Backup & Surge Protected” Outlets** keep a CPU, monitor and other critical devices running when the power goes out or fluctuates outside safe levels. (Includes one power-saving “*Controlled*” outlet).
4. **5 “Surge Only” Outlets** protect printers, faxes or other equipment without reducing battery capacity. (Includes three power-saving “*Controlled*” outlets).
5. **Data Line Surge Protection** guards against surges and spikes traveling over Ethernet or coax cable lines.
6. **PowerChute Software** lets you use your computer to access additional power protection and management features:
   - Preserves your work, shuts down system during outages
   - Restarts your system, minimizing work disruptions
   - Enables customization of your Back-UPS settings
   - Monitors and displays power and battery status
7. **Push Button Circuit Breaker** enables quick recovery from overloads.
8. **3 Yr Warranty**, $150,000 Equipment Protection Policy, free technical support and data recovery services.
9. **Automatic Diagnostic Testing** ensures your unit is ready when you need it.
10. **External Battery Pack Compatibility** allows you to dramatically increase your run time. (BR1500G only)



by Schneider Electric

Back-UPS Pro 1300 & 1500 Specifications

Model Number	BR1300G	BR1500G
Output		
Output Capacity	1300 VA / 780 Watts	1500 VA / 865 Watts
Output Volt., Freq. (on utility)	120V, 50 or 60 Hz, +/- 3Hz (auto sensing)	120V, 50 or 60 Hz, +/- 3Hz (auto sensing)
Output Volt., Freq. (on battery)	115V +/-8%, 50 or 60Hz +/-1Hz (auto sensing)	115V +/-8%, 50 or 60Hz +/-1Hz (auto sensing)
Output Connections	10 total NEMA 5-15R outlets: 5 battery & surge (incl. 1 *Master* & 1 *Controlled)* 5 surge protection only (incl. 3 *Controlled* outlets)	10 total NEMA 5-15R outlets: 5 battery & surge (incl. 1 *Master* & 1 *Controlled*) 5 surge protection only (incl. 3 *Controlled* outlets)
Waveform Type	Stepped Approximation to Sine Wave	Stepped Approximation to Sine Wave
Input		
Input Voltage, Frequency	120V, 50 or 60 Hz, +/- 3 Hz	120V, 50 or 60 Hz, +/- 3 Hz
Input Connection	6 ft cord with NEMA 5-15 plug	6 ft cord with NEMA 5-15 plug
Surge Protection		
AC Power Surge Protection	All outlets	All outlets
Data Line Surge Protection	Network: 10/100/1000 Base-T (gigabit) Ethernet Coax cable (CATV, SATV, modem, A/V)	Network: 10/100/1000 Base-T (gigabit) Ethernet Coax cable (CATV, SATV, modem, A/V)
Physical		
Unit Dimensions (H x W x D)	11.9 x 4.4 x 15.0“ (30.2 x 11.2 x 38.1 cm)	11.9 x 4.4 x 15.0“ (30.2 x 11.2 x 38.1 cm)
Unit Weight	28.3 lbs (12.9 kg)	29.4 lbs (13.4 kg)
Shipping Dims. (H x W x D)	15.0 x 9.25 x 19.0“ (38.1 x 22.9 x 48.3 cm)	15.0 x 9.25 x 19.0“ (38.1 x 22.9 x 48.3 cm)
Shipping Weight	30.8 lbs (14.0 kg)	31.9 lbs (14.5 kg)
Color	Black	Black
UPC Code	731304268765	731304268772
Battery		
Battery Type	Sealed, lead-acid, maintenance-free	Sealed, lead-acid, maintenance-free
Extended run battery pack compatibility	No	Yes p/n: BR24BPG
Management		
Alarms	Visual (LCD) and audible alarms	Visual (LCD) and audible alarms
Auto-Shutdown Software	PowerChute Personal Edition (via USB and serial interface)	PowerChute Personal Edition (via USB and serial interface)
Safety		
Certification/Approvals	FCC Part 15 Class B, NOM, TUV, UL1778	FCC Part 15 Class B, NOM, TUV, UL1778

APC *by Schneider Electric*
132 Fairgrounds Rd
West Kingston, RI 02892
Tel: 800-800-4272
www.apc.com

APC by Schneider Electric

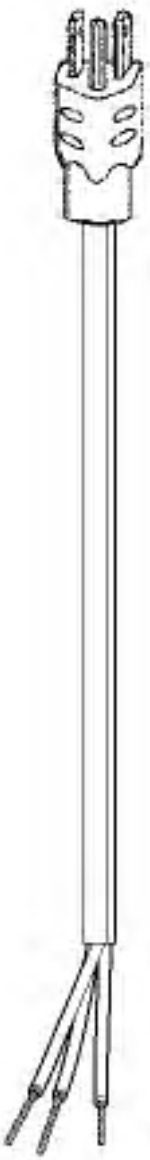
Back

Selected Cable: 17629

End View	Plug	Cord	Connector	End View
				
5-15P	173	SJ	2"STRIP	NONE

Part Number	**17629**
NSN	6150-01-062-1147; 6930-01-055-8726
Category	3 conductor rubber original equipment cords
Shielding	unshielded
Jacket Color	black
Length Feet	9'
Length Meters	2.74
Temperature Rating	60 C°C
Packaging Units Per Carton	B-10,S-5
Color Coding	North America
AWG Stranding	14 (41x30)
Nominal OD Inch	0.38
Nominal OD millimeter	9.65
Rating	1875 Watts 15A-125V
Notes	See 17635 for 15ft version

Cord View



Approvals

SECTION 5
Instrument Cutsheets

Isco Product Data

Isco 2150 Area Velocity Flow Module

The 2150 Flow Module uses continuous wave Doppler technology to measure mean velocity. The sensor transmits a continuous ultrasonic wave, then measures the frequency shift of returned echoes reflected by air bubbles or particles in the flow.

The 2150's "smart" area velocity probe is built on digital electronics, so the analog level is digitized in the sensor itself to overcome electromagnetic interference. The probe is also factory-calibrated for 10-foot (3 meter) span at different temperatures. This built-in calibration eliminates drift in the level signal, providing long-term level stability that reduces recalibration frequency and completely eliminates span recalibration.

In field use, the 2150 is typically powered either by two alkaline, or Isco Rechargeable Lead-acid batteries, within a 2191 Battery Module. Highly efficient power management extends battery life up to 15 months at 15-minute data storage intervals. Other power options (including solar) are available.

Applications

- Portable and permanent-site AV flow monitoring for inflow and infiltration, capacity assessment, sewer overflow, and other sewer studies.
- Measuring shallow flows in small pipes. Our low-profile area velocity sensor minimizes flow stream obstruction and senses velocity in flows down to 1 inch (25 mm) in depth.

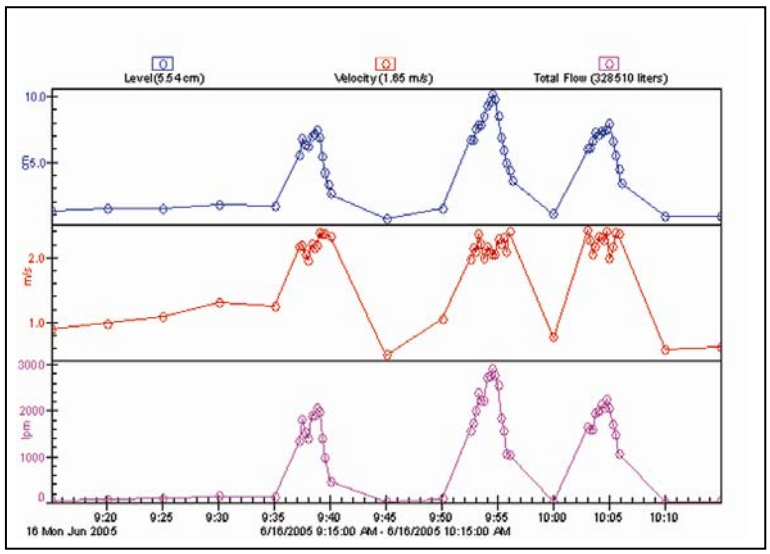
Standard Features

- Rugged, submersible enclosure meets NEMA 4X, 6P (IP68) environmental specs.
- Chemically resistant epoxy-encapsulated sensor withstands abuse, resists oil and grease fouling, and eliminates the need for frequent cleaning.
- Replaceable high-capacity internal desiccant cartridge and hydrophobic filter protect sensor reference from water entry and internal moisture.
- Pressure transducer vent system automatically compensates for atmospheric pressure changes to maintain accuracy.
- The quick-connect sensor can be easily removed and interchanged in the field without requiring recalibration.
- Up to four 2100 Series flow modules can be networked by stacking and/or extension cables.

Above left: Additional modules can be added for redundant or multi-stream measuring (Isco 2110 Ultrasonic Module shown). Right: Optional mounting rings provide quick, secure sensor installation in round pipes from 6 to 80 inches (150 to 2000 mm).

Software Features

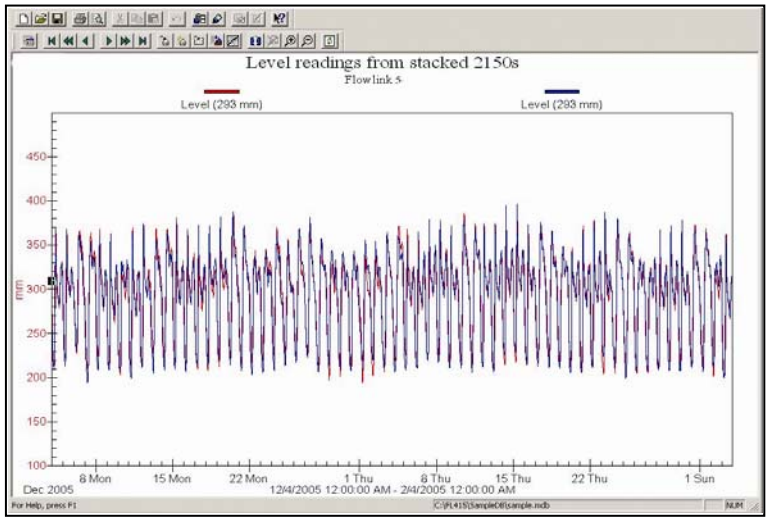
- Secure data storage. All data are continuously stored in flash memory to protect against loss in case of power failure
- Easy to upgrade. New operating software can be downloaded into non-volatile flash memory, without affecting stored program and data.
- Records and stores input voltage and temperature data.
- Variable rate data storage lets you change the data storage interval when programmed conditions occur. This feature assures maximum information about an exceptional event – such as an overflow – while conserving power and data capacity during normal conditions.
- 38,400 bps communication provides speedy setup and data retrieval.



Variable rate data storage

The 2150 flow module has the ability to automatically switch data storage rates based on varying conditions.

In the example at left, the 5-minute data storage rate automatically changed to 30 seconds when the flow rose above a programmed level.



Level stability

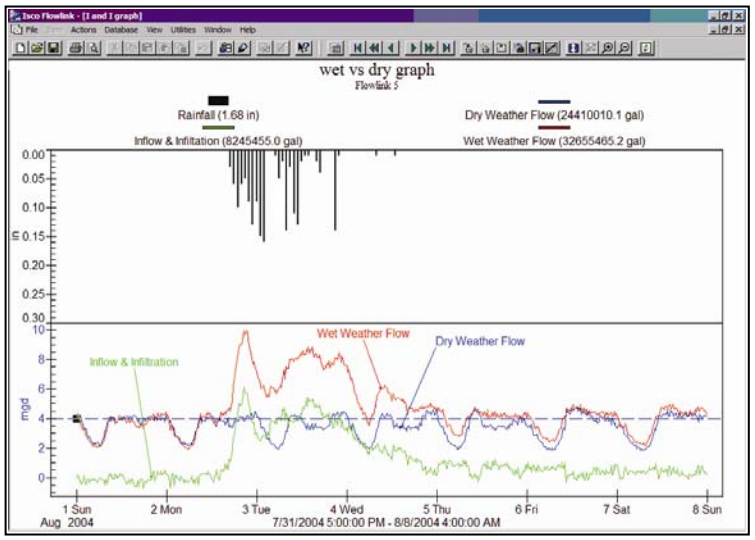
Frequent multipoint level recalibration is a requirement with other area velocity flow meters. Isco's exclusive "smart" sensor design in the area velocity probe yields exceptionally low drift in the level signal.

The 2150's factory-calibrated 3-meter span totally eliminates the need for cumbersome span recalibration in the field.

In the example at left, two area velocity probes were installed at the same site. The level readings from both sensors track closely without any drift, over an 8-week period.

Flowlink® Data Analysis

Isco Flowlink® Software is a powerful tool for analyzing flow and water quality data. It provides site setup, data retrieval, and comprehensive data analysis, as well as advanced reporting and graphing. See separate datasheets for details on Flowlink and Flowlink Pro software.



The Flowlink screen shown above gives a comparison of dry and wet weather flows, plus rainfall typical of an inflow & infiltration study

Information Delivery

Isco 2100 Series Flow Modules offer a wide variety of communication and retrieval options, to minimize the need for expensive on-site visits and confined space entry. These include:

Isco 2103 Land-line Modem Module
Reliable two-way dial-up communication between down-hole 2100 Flow Modules and your desktop computer, equipped with Isco Flowlink Software. A dial-out feature enables the system to transmit a text message alarm to your digital cell phone or pager.

Isco 2103c Cellular Modem Module
All the features of the 2103 Modem with the convenience of cell phone access. And the 2103c can automatically send data via the Internet to a designated server running Flowlink Pro software, using economical 1xRTT packet-switched data transmission.

Isco 2108 Analog Output Module
Provides current outputs for use with Isco 2100 Series Area Velocity and Ultrasonic Flow Modules. It allows easy interface with SCADA/DCS or other secondary instrument systems.

Modbus
2100 Series Flow Modules provide digital RS 232 Modbus output that can be used to interface with external communication modules, SCADA systems, or other devices.

On-site Data Retrieval

Isco Flowlink Software
Download and process data on-site. Enjoy unmatched data management capability, advanced data editing and analysis, powerful reporting and presentation choices, and a variety of downloading and data handling options.

Isco 2101 Field Wizard
A durable, weatherproof module for on-site data retrieval. Don't risk damage to your fragile notebook PC. The 2101 Field Wizard provides on-site display of current readings, information about stored data, diagnostics, and more.

Interrogate all 2100 Series Flow Modules in the stack at one time, and store more than 14 days' data from up to 20 modules!

Isco 2102 Communication Module
Connect with your Isco 2100 Series Flow Modules from the safety and convenience of your vehicle.

Digital spread-spectrum radio signals enable "drive-up" data retrieval, system configuration, and level calibration, with minimum power consumption. "Plug and Play" setup – no interfacing needed.

Specifications

2150 Flow Module	
Size (HxWxD):	2.9 x 11.3 x 7.5 in (74 x 287 x 191 mm)
Weight:	2.0 lb (0.9 kg)
Materials of construction:	High-impact polystyrene, stainless steel
Enclosure (self-certified):	NEMA 4X, 6P (IP68)
Temperature Range:	-40° to 140° F (-40° to 60° C) operating and storage
Power Required:	12 VDC nominal (7.0 to 16.6 VDC), 100 mA typical, 1 mA standby
Power Source:	Typically, an Isco 2191 Battery Module, containing 2 alkaline or 2 rechargeable lead-acid batteries. (Other power options are available; ask for details.)
Typical Battery Life:	Using 15-minute data storage interval Energizer® Model 529 alkaline - 15 months Isco rechargeable lead-acid - 2.5 months
Program Memory:	Non-volatile programmable flash; can be updated using PC without opening enclosure; retains user program after updating.
Built-in Conversions	
Flow Rate Conversions:	Up to 2 independent level-to-area conversions and/or level-to-flow rate conversions.
Level-to-Area Conversions:	Channel Shapes - round, U-shaped, rectangular, trapezoidal, elliptical, with silt correction; Data Points - Up to 50 level-area points.
Level-to-Flow Conversions:	Most common weirs and flumes; Manning Formula; Data Points (up to 50 level-flow points); 2-term polynomial equation
Total Flow Calculations:	Up to 2 independent, net, positive or negative, based on either flow rate conversion
Data Handling and Communications	
Data Storage:	Non-volatile flash; retains stored data during program updates. Capacity 395,000 bytes (up to 79,000 readings, equal to over 270 days of level and velocity readings at 15-minute intervals, plus total flow and input voltage readings at 24-hour intervals)
Data Types:	Level, velocity, flow rate 1, flow rate 2, total flow 1, total flow 2, input voltage, temperature
Storage Mode:	Rollover; 5 bytes per reading.
Storage Interval:	15 or 30 seconds; 1, 2, 5, 15, or 30 minutes; or 1, 2, 4, 12, or 24 hours Storage rate variable based on level, velocity, flow rate, total flow, or input voltage
Data Retrieval:	Serial connection to PC or optional 2101 Field Wizard module; optional modules for spread spectrum radio; land-line or cellular modem; 1xRTT. Modbus and 4-20 mA analog available.
Software:	Isco Flowlink for setup, data retrieval, editing, analysis, and reporting
Multi-module networking:	Up to four 2100 Series Flow Modules, stacked and/or remotely connected. Max distance between modules 3300 ft (1000 m).
Serial Communication Speed:	38,400 bps

2150 Area Velocity Sensor	
Size (HxWxD):	0.75 x 1.3 x 6.0 in (19 x 33 x 152 mm)
Cable (Length x Diameter):	25 ft x 0.37 in (7.6 m x 9 mm) standard. Custom lengths available on request.
Weight (including cable):	2.2 lbs (1 kg)
Materials of construction:	Sensor - Epoxy, chlorinated polyvinyl chloride (CPVC), stainless steel Cable - Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC)
Operating Temperature:	32° to 140° F (0° to 60° C)
Level Measurement:	Method - Submerged pressure transducer mounted in the flow stream Transducer Type - Differential linear integrated circuit pressure transducer Range (standard) 0.033 to 10 ft (0.010 to 3.05 m); (optional) up to 30 ft (9.15 m). Maximum Allowable Level 34 ft (10.5 m) Accuracy ±0.01 ft from 0.033 to 10 ft, (±0.003 m from 0.01 to 3.05 m,) Long-Term Stability ±0.023 ft/yr (±0.007 m/yr) Compensated Range 32° to 122°F (0° to 50°C)
Velocity Measurement:	Method - Doppler ultrasonic, frequency 500 kHz Typical Minimum Depth 0.08 ft (25 mm) Range -5 to +20 ft/s (-1.5 to +6.1 m/s) Accuracy (in water with uniform velocity profile, speed of sound = 4850 ft/s, for indicated velocity range) ±0.1 ft/s from -5 to 5 ft/s (±0.03 m/s from -1.5 to +1.5 m/s) ±2% of reading from 5 to 20 ft/s (1.5 to 6.1 m/s)
Temperature Measurement:	Accuracy ±3.6° F (±2° C)

2191 Battery Module	
Size (HxWxD):	6.0 x 9.6 x 7.6 in (152 x 244 x 193 mm)
Weight (without batteries):	3.2 lb (1.4 kg)
Materials of construction:	High-impact polystyrene, stainless steel
Enclosure (self certified):	NEMA 4X, 6P, (IP68)
Batteries:	Two 6-volt Energizer Model 529* alkaline (25 Ahrs capacity) or Isco Rechargeable Lead-acid (5 Ahrs capacity) recommended. *Note – Energizer 529 ER does not give specified life.

2150 Ordering Information

Contact your Teledyne Isco representative for complete ordering details and information on other 2100 Series Modules.

Description	Part No.
2150 with AV sensor, 2191 Battery Module, and Handle	68-2050-002
2150 Module with AV sensor (only)	68-2050-001
Isco Flowlink® 5 Software	68-2540-200
Energizer® Model 529 Alkaline Lantern Battery (2 required)	340-2006-02
Isco Rechargeable Lead-acid Battery (2 required)	60-2004-041
Charger for Lead-acid Batteries (holds 2 batteries)	60-2004-049

Teledyne Isco, Inc.

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USA and Canada: (800) 228-4373
Fax: (402) 465-3022
E-Mail: iscoinfo@teledyne.com
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Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

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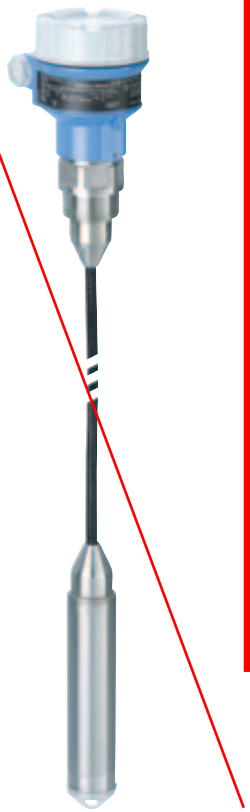
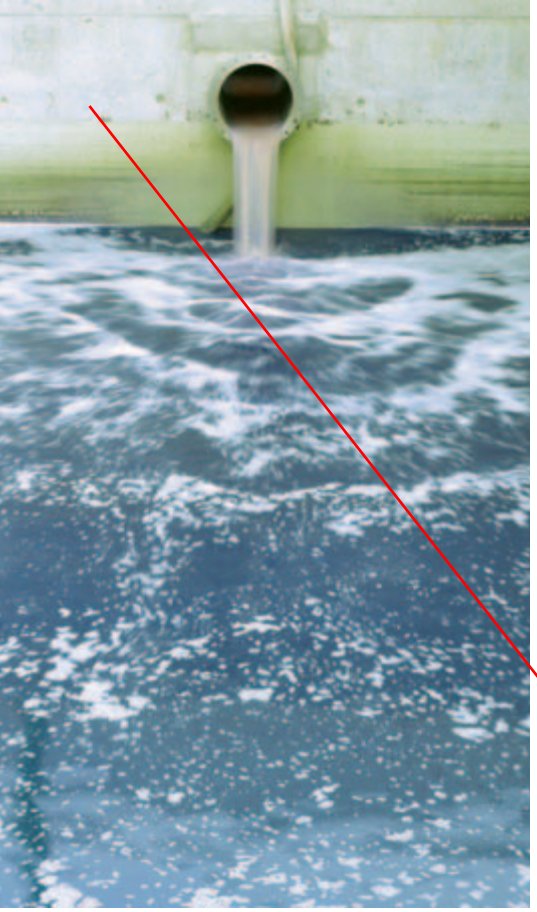
Deltapilot M and Waterpilot



Endress+Hauser

People for Process Automation



Competence in the environmental industry

Consistent process safety, a high degree of plant availability and economic efficiency are important aspects when equipping any measuring point.

Endress+Hauser assumes this task as the leading instrumentation manufacturer. Providing solutions in the areas of upkeep strategies, maintenance services through to consultation and engineering Endress+Hauser is the partner in all measurement and control technology issues.

Deltapilot M and Waterpilot control reliably levels in all areas of drinking water abstraction and treatment as well as sewerage and wastewater purification.

Deltapilot M

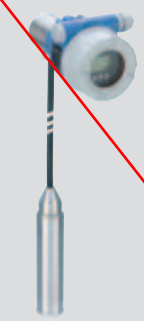
Deltapilot M solves perfectly any basic application requiring condensate resistance, flexibility and the highest degree of reproducibility. The compactness of the hydrostatic level instrument permits its integration in almost any installation condition.

- Contite measuring cell: watertight, resistant to climatic changes and long-term stable
- Compact rod/cable versions for installation from the top
- Minimum temperature influences
- Easy setting at the instrument, without any tools

Technical data
- Measuring ranges 100mbar…10bar (1.45…145psi)
- Accuracy 0.2% of the span (0.1% optional)
- Process temperature -10…+100°C/-14…+212°F (+135°C/275°F for 30min.)

Output
4…20mA HART®, PROFIBUS® PA, FOUNDATION™ fieldbus

Certificates / approvals
Ex ia, ATEX, FM, CSA, IEC Ex, NEPSI, TIIS and WHG as well as Triple Approval (ATEX, FM and CSA)



FMB53

FMB51

FMB52

ATEX FM APPROVED TIIS WHG

Calibration

Apart from an outstanding quality in serial production, correct calibration forms the basis of any measuring device. The in-house calibration laboratory of Endress+Hauser is DKD-accredited and has been responsible for the calibration and delivery of instruments according to respective standards for more than 15 years.

Waterpilot

Level measurement in deep wells is a typical application for Waterpilot which involves instruments approved for drinking water with a robust ceramic sensor and integrated temperature measurement, combined to a diameter of only 22mm/0.87". A robust design for applications in wastewater and sludges and a version free of metal for long-term stable operation in salt water are also available.

- Highest degree of accuracy and long-term stability
- Robust housing with an extremely small probe diameter
- Materials compatible with drinking water
- Extensive measuring point accessories

Technical data
- Measuring ranges 100mbar…20bar/1.45…290psi
- Accuracy up to 0.1% of the span
- Process temperature -10…+70°C/-14…+158°F

Output
- 4…20mA analog or 4…20mA HART®
- Integrated temperature sensor Pt100

Certificates / approvals
ATEX, FM, CSA, GL, ABS, certified for drinking water, NSF

FMX21/FMX167

ATEX FM APPROVED CSA GL ABS NSF

Endress+Hauser is one of the internationally leading providers of instrumentation with a complete range of products and services. Our global sales and service network as well as 19 production sites in Europe, Asia and the US guarantee a constant and close dialogue with our customers. This dialogue promotes an important goal of Endress+Hauser – the sustaining support of the competitiveness of our customers through the highest quality, safety and efficiency standards. Innovative and state-of-the-art technologies enable us to extend the application limits in measuring, control and automation technology and to offer safe and efficient solutions – for your benefit as a user. At the same time, we ensure that our processes are compatible with the environment to save energy and resources.

All of this assures you that you may also rely on us tomorrow – on us, the “People for Process Automation“.

12.06/I.I.

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People for Process Automation

SECTION 6
Instrument Manuals

2150 Area Velocity Flow Module and Sensor

Installation and Operation Guide

"The Future of Flow!"™

TELEDYNE ISCO
A Teledyne Technologies Company

Part #60-2003-092 of Assembly #60-2004-038

Revision BB, March 9, 2011

Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Teledyne Isco recommends that you read this manual completely before placing the equipment in service.

Although Teledyne Isco designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If the problem persists, call or e-mail the Teledyne Isco Technical Service Department for assistance. Simple difficulties can often be diagnosed over the phone.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by the Customer Service Department, including the use of the **Return Authorization Number** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

Teledyne Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

Teledyne Isco is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.

Contact Information

Customer Service

Phone:	(800) 228-4373	(USA, Canada, Mexico)
	(402) 464-0231	(Outside North America)
Fax:	(402) 465-3022	
Email:	IscoCSR@teledyne.com	

Technical Support

Phone:	(800) 775-2965	(Analytical)
	(866) 298-6174	(Samplers and Flow Meters)
Email:	IscoService@teledyne.com	
Return equipment to:	4700 Superior Street, Lincoln, NE 68504-1398	

Other Correspondence

Mail to:	P.O. Box 82531, Lincoln, NE 68501-2531
Email:	IscoInfo@teledyne.com
Web site:	www.isco.com

Revised March 17, 2009

Radio Interference Statement

FCC

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which the user will be required to correct the interference at his own expense.

Canada

This ISM apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Ce générateur de fréquence radio ISM respecte toutes les exigences du Règlement sur le materiel brouilleur du Canada.

Caution

Changes or modifications not expressly approved by the party responsible for compliance (Isco, Inc.) could void your authority to operate the equipment.

This equipment should be installed and operated using Isco's cables, such as the Flowlink Communication Cable or the optional Module-to-module Cable. Isco cables are listed in Appendix B, *Accessories*.

General Warnings

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood. While specific hazards may vary according to location and application, take heed in the following general warnings.

This product is often installed in confined spaces. Some examples of confined spaces are manholes, pipelines, digesters, and storage tanks. These spaces may become hazardous environments that can prove fatal for those unprepared. These spaces are governed governed by OSHA 1910.146 and require a permit before entering.

Hazard Severity Levels

This manual applies *Hazard Severity Levels* to the safety alerts, These three levels are described in the sample alerts below.

⚠ CAUTION

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

⚠ WARNING

Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.

⚠ DANGER

DANGER – limited to the most extreme situations to identify an imminent hazard, which if not avoided, will result in death or serious injury.

Hazard Symbols

The equipment and this manual use symbols used to warn of hazards. The symbols are explained below.

Hazard Symbols	
Warnings and Cautions	
	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
	The lightning flash and arrowhead within the triangle is a warning sign alerting you of "dangerous voltage" inside the product.
Symboles de sécurité	
	Ce symbole signale l'existence d'instructions importantes relatives au produit dans ce manuel.
	Ce symbole signale la présence d'un danger d'électocution.
Warnungen und Vorsichtshinweise	
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
	Der gepfeilte Blitz im Dreieck ist ein Warnzeichen, das Sei vor "gefährlichen Spannungen" im Inneren des Produkts warnt.
Advertencias y Precauciones	
	Esta señal le advierte sobre la importancia de las instrucciones del manual que acompañan a este producto.
	Esta señal alerta sobre la presencia de alto voltaje en el interior del producto.

2150 Area Velocity Flow Module

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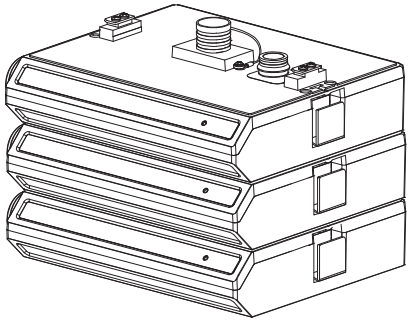
2150 Area Velocity Flow Module

Section 1 Introduction

1.1 Product Description



A 3-module site

The 2150 Area Velocity Module is part of Isco's 2100 Series system. The 2100 Series system measures parameters of open channel flow streams.

The 2100 Series system is designed to be modular so that you can expand the system to meet your data collection needs. By stacking the 2100 Series modules, a single site can measure multiple flow channels, collect redundant data, or add other available measurement capabilities. A site can include remote measurement points, as distant as 3300 feet, by connecting modules with cables. Even with several remote modules configured as a site, you can still retrieve all of the measurement data from a single connection.

The 2100 Series System is paired with Isco's *Flowlink* software. With this software application, you can quickly set up modules, retrieve measurement data, manage the sites and analyze the data.

The module's data storage memory is quite flexible, able to store the measurements in intervals from 15 seconds to 24 hours. The modules can also be configured for variable rate data storage. Variable rates allow you to store data at a different interval when a programmed condition occurs.

The module's program and collected data are stored in *flash* memory for security. Flash memory retains data without the concern of power failures or aging backup batteries. Its capacity is more than sufficient for many applications. The data storage memory can hold approximately 79,000 readings – the equivalent of nine months of level and velocity data when stored at fifteen minute intervals. The flash memory also stores sensor calibration information. A separate flash memory device inside the module stores the operating firmware.

The rugged 2100 series components are rated NEMA 4X, 6P (IP68). The permanently sealed enclosures are designed to meet the environmental demands of many sewer flow monitoring applications. All connections between modules, sensors, and communication cables "lock" in place. Each locking mechanism strongly secures the components and ensures a watertight seal.

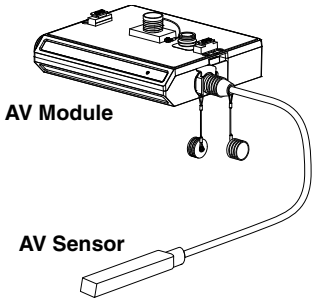
The flow information from a 2150 can be used to pace an Isco 3700, GLS, or 6700 Series sampler. The connection is made using a 2100 Series Sampler Interface Cable (Isco part #68-2000-014). A flow pulse is sent out every 100 gallons or 500 liters of flow, depending on how the 2150 is configured.

1.2 Applications

Typical applications for the 2150 Module include:

- Portable and permanent on-site flow monitoring for inflow and infiltration (I&I), capacity assessment, combined sewer overflow (CSO), and other sewer studies
- Storm Water Runoff Monitoring
- Shallow flow measurement in small pipes.

1.3 2150 System Overview

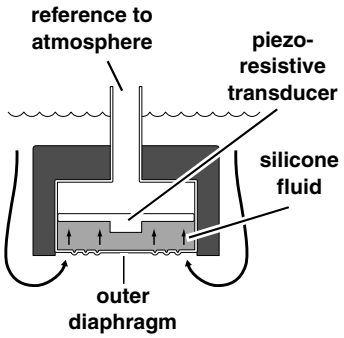


The 2150 measures liquid level and average stream velocity, and calculates the flow rate and total flow. The liquid level and velocity measurements are read from an attached AV Sensor that is placed in the flow stream. Flow rate calculations are performed internally using the measured parameters from the AV Sensor. Additionally, the AV Module can measure its input voltage – a service feature.

The 2150 is designed to provide durable operation with only a minimal amount of routine maintenance, all of which may be performed in the field. Typically, the AV Module and its AV Sensor will only require that you keep the stream free from excessive debris, and replace or recharge spent desiccant and batteries.

Sections 1.3.1 through 1.3.6 describe the module and sensor in greater detail.

1.3.1 Level

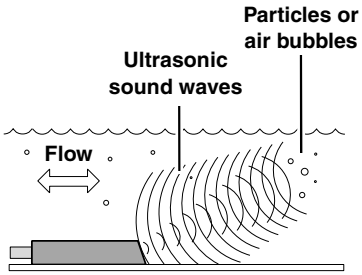


The AV Sensor's internal differential pressure transducer measures the liquid level. The transducer is a small piezo-resistive chip that detects the difference of the pressures felt on the inner and outer face.

The stainless steel outer diaphragm is exposed to the flow stream through the ports under the AV Sensor. The pressure felt on the outer diaphragm is transferred to the outer face of the transducer through a silicone fluid medium. The outer diaphragm and fluid isolate the sensitive transducer from direct exposure to the stream. The inner face of the transducer is exposed, or referenced, to the atmosphere through the internal vent tube that runs the full length of the AV Sensor's cable.

The difference between the pressures exerted on the transducer is the hydrostatic pressure. Hydrostatic pressure is proportional to the level of the stream. The analog representation of the hydrostatic pressure is digitized and sent to the AV Module as an RS-485 half-duplex signal.

1.3.2 Velocity



The AV Sensor measures average velocity by using ultrasonic sound waves and the Doppler effect. The Doppler effect states that the frequency of a sound wave (or other wave) passed from one body to another is relative to both their motions. As the two approach each other, the frequency increases; as they move apart, the frequency decreases.

The AV Sensor contains a pair of ultrasonic transducers. One transducer transmits the ultrasonic sound wave. As the transmitted wave travels through the stream, particles and bubbles carried by the stream reflect the sound wave back towards the AV Sensor. The second transducer receives the reflected wave.

Circuits internal to the module compare the frequencies of the sound waves and extract the difference. An increase or decrease in the frequency of the reflected wave indicates forward or reverse flow. The degree of change is proportional to the velocity of the flow stream.

1.3.3 Flow Rate

Using measurements from the AV Sensor, the AV Module can calculate the flow rate. The AV Module supports many different flow rate conversion methods:

- Area Velocity
- Data Points
- Manning Formula
- Two-term Polynomial Equations
- Flumes
- Weirs

Often the Model 2150 Area Velocity Flow Module is chosen for applications where a primary device is not available, nor is it practical to install a primary device. Therefore, area velocity is usually the conversion method of choice.

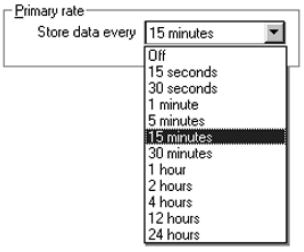
The AV Module is capable of calculating and storing any two conversion methods simultaneously. This feature is useful when it is necessary to validate a flow conversion method. For example, the flow rate at a new site programmed for area velocity conversion can be directly compared to the flow rate calculated using a Manning formula.

1.3.4 Total Flow

The AV Module can calculate and report the total flow. You can set up the module to monitor *net, positive,* or *negative* total flow from either of the calculated flow rates.

1.3.5 Data Storage

Through Flowlink, you configure which type of data is logged and the storage rate. For each measurement, the *Data Storage Setup* window lets you turn the primary rate off, or select a rate from 15 seconds to once every 24 hours. If the primary rate is turned off, the AV Module will not store the measurement (unless a secondary rate is selected). However, the AV Module will still take readings if that measurement type is necessary for a calculation.



Secondary rates are used to log data at a different rate when a user-defined condition exists. For example, a secondary rate can be used to increase the level and velocity data storage rate when level is greater than or equal to a point of interest. Secondary rates give you the best resolution of data, but only when it is needed. Until the condition is met, the module will conserve power and memory by storing the data at the primary storage rate. Like the primary rate, you can turn the secondary rate off, or select a storage rate of 15 seconds to every 24 hours.

Time Resolution

The time resolution of each measurement is one second. That is, readings are taken at the same time as the time stamp, not collected and averaged over a period of time before the stamp.

Rollover Memory

Whether the measurements are stored at the primary or secondary rate, they are stored in a *rollover* type of memory. When full, the module overwrites the oldest data with the newest readings.

1.3.6 Input Voltage

The AV Module measures the input voltage so that it can be reported to the user. Input Voltage measurements are useful when estimating the remaining battery life and determining when the system must be serviced. You can log the Input Voltage readings in data storage to chart power consumption.

2191 Battery Module

The Battery Module uses two 6 volt lantern batteries to supply 12VDC to Model 2100 system modules.

The Battery Module's only role is to supply DC power, yet it still supports communications between other modules. The upper and lower connectors pass along communications between modules attached above and below.

You can stack Battery Modules to increase the power available to a module or a stack of modules.

1.4 Component Identification

The components of the 2150 Module, area velocity sensor, and 2191 Battery Module are shown in Figures 1-2 through 1-3. Items referenced in the figures are briefly discussed in the tables below.

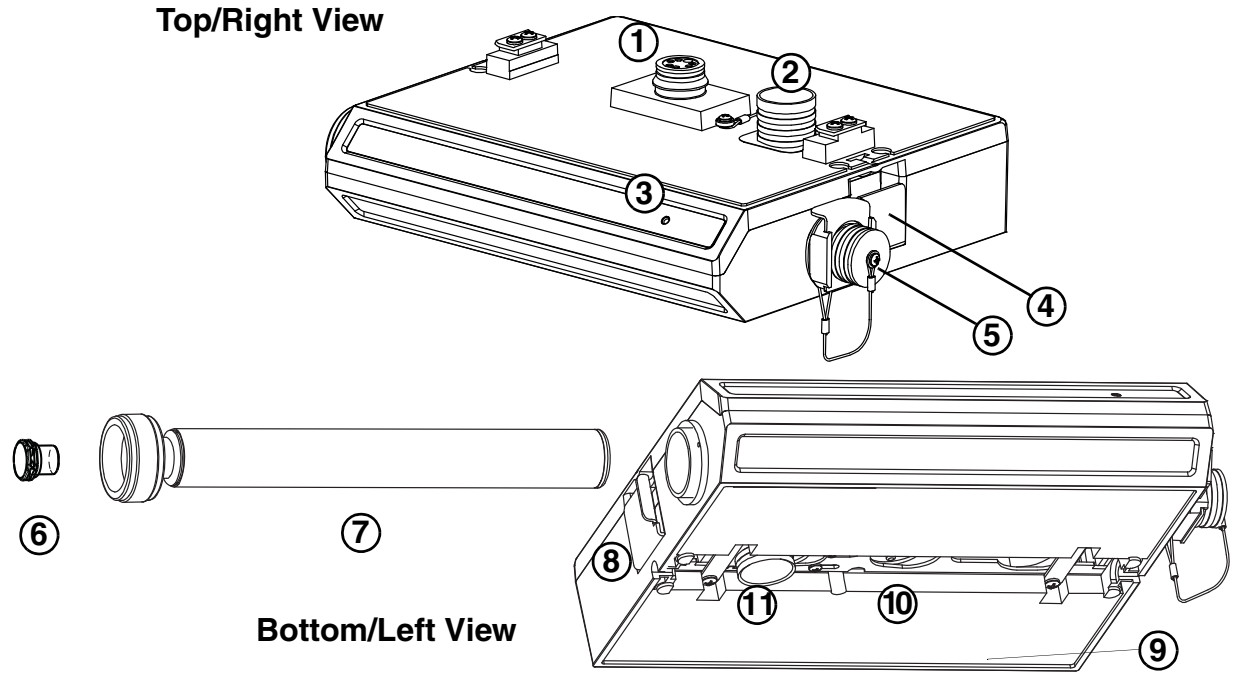


Figure 1-1 Controls, connectors, and indicators – 2150 Flow Module

Table 1-1 Controls, connectors, and indicators – 2150 Flow Module

Item No.	Name	Description
1	Communication Connector	Upper communication port. The connection transfers data and 12 VDC power to other modules. The port is also used to connect to a PC running Flowlink software.
2	Connector Caps	Insert into unused communication connectors to terminate the network and protect them from moisture damage. When communication connectors are in use, the caps must be stowed as shown in Figure 1-1 to protect the terminating components inside the caps.
3	Communication Indicator	Illuminates when the module is active. With Flowlink, a user can turn on this light-emitting diode (LED) to identify the module at a multiple-module site.
4	Latch Release	Push in to release the module from a stack.
5	Sensor Receptacle	Port used to attach the AV Sensor. Insert the protective cap when not in use.
6	Hydrophobic Filter	Prevents moisture from entering the case and reference line.
7	Desiccant Cartridge	Container holding desiccant that dries the reference air.
8	Latch	Push in to lock the module in a stack.
9	Serial Number Label	On back of unit - lists product ID and unit serial numbers.
10	Communication Connector	Lower communication port. The connector transfers data and 12 VDC power to other modules.
11	Connector Plug	Insert into the interface connector when the connector is not in use to protect it from damage.

1.4.1 Battery Module

Figures 1-2 and 1-3 identify key components of the model 2191 Battery Module.

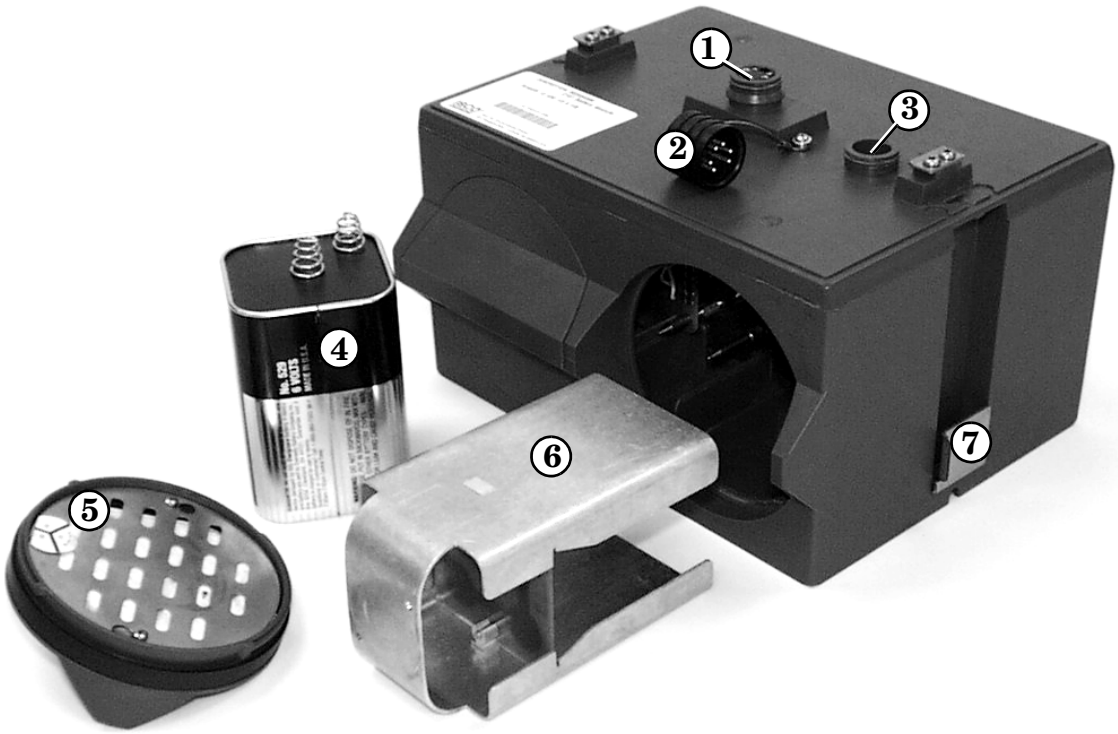


Figure 1-2 Battery Module components, top view

Table 1-2 Battery Module Components - Top View

Item No.	Description
1	Communication Connector
2	Connector Cap
3	Connector Cap Holder
4	Lantern Battery (Alkaline shown)
5	Door
6	Battery Carrier
7	Latch Release

Figure 1-3 Battery Module components, bottom view

Table 1-3 Battery Module Components - Bottom View

Item No. Fig. 1-3	Description
1	Communication connector
2	Connector plug
3	Connector plug holder
4	Latch

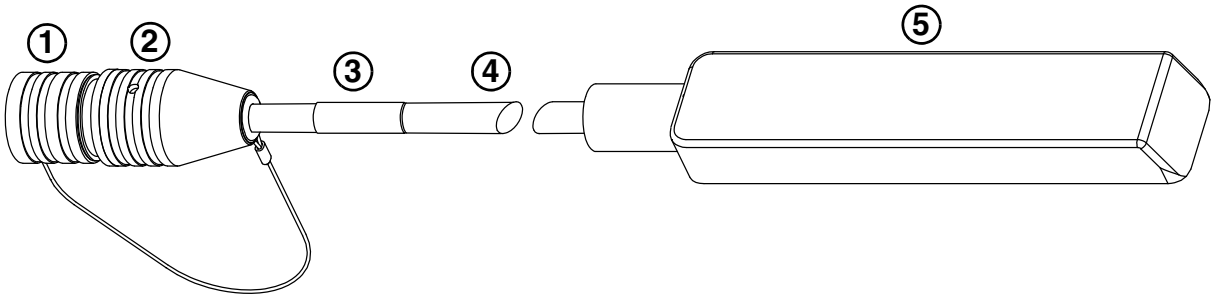


Figure 1-4 2150 Area Velocity Sensor Parts

Table 1-4 2150 Area Velocity Sensor Parts and Descriptions

Item No. Fig. 1-4	Name	Description
1	Connector Cap	Protects the connector. When the connector is not in use, this cap must be in place to prevent damage to the connector pins and reference air tubing.
2	Connector	Attaches to the sensor receptacle on the 2150.
3	Serial Number Label	Lists product ID and unit serial numbers.
4	Cable	394 in (10 m) cable containing the reference air tubing and conductors to transfer level data, velocity data, and AV Sensor power.
5	Sensor Body	The sensor body is placed in the flow stream to measure level and velocity.

1.5 Latches

Latches must be operated to stack and unstack the modules. Take a moment to familiarize yourself with operating the latches. The latch is operated by pushing on one of the sides — the right side to unlock, and the left side to lock. Both latches are flush to the module's sides in the locked position.

⚠ CAUTION

The latch can be damaged by applying too much force. Never press on both sides at the same time. Do not force the latch if it is obstructed. While some degree of pressure must be applied to slide the latch, the ends of the latches should never bend more than 1/8".

Figure 1-5 shows how to unlock the latch. You must unlock the latch to place the module on top of a stack. Otherwise, the latch is normally locked. Locate the latch release on the right side of the module. Push in to slide the latch toward the left of the module.

Module stacking is described in more detail in Section %%.

Figure 1-5 Unlocking the Latch

☑ Note

Latches will "click" when they are fully locked and unlocked.

1.6 Communication Connectors

When a communication connector is not in use, the connector should always be capped (Figures 1-6 and 1-8). The cap will seal the connector to prevent corrosion, prevent moisture from entering the unit, and improve communications.

When a communication connector is in use, store the cap on the holder next to the connector (Figures 1-7 and 1-9). The communication connector will be sealed by its mating connector.

⚠ CAUTION

Caps **PUSH ON** and **PULL OFF**. Do not rotate the caps to remove them from the connectors.

☑ *Note*

For modules to correctly stack and lock together, protective caps between the modules must be stored on the holders. Section 1.9 shows how to store the caps so that you can stack the modules.

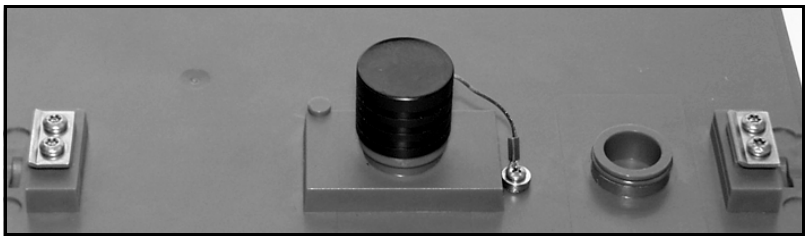


Figure 1-6 Flow Module - Upper connector, capped

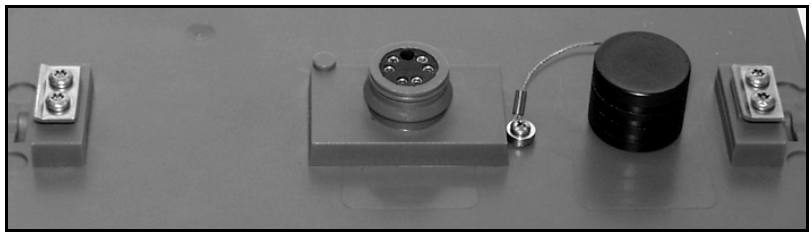


Figure 1-7 Flow Module - Upper connector, uncapped

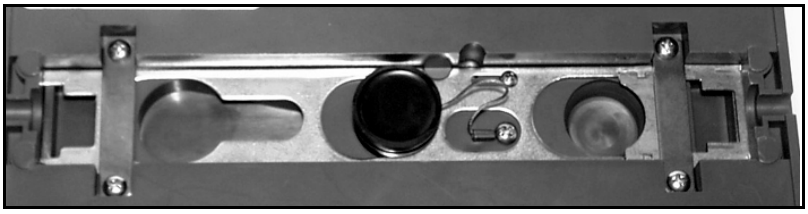


Figure 1-8 Flow Module - Lower connector, plugged

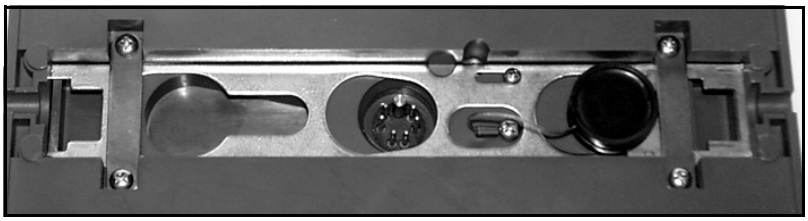


Figure 1-9 Flow Module - Lower connector, unplugged

1.7 Connecting the Sensor

To connect the Area Velocity Sensor to the 2150 Flow Module, follow steps in Figures 1-10 and 1-11.

1. Prepare the 2150's sensor connector by removing the cap. To do so, push down on the Sensor Release and pull out the cap.
2. Prepare the sensor cable's connector by removing the cap.

Figure 1-10 Flow Module - preparing the sensor connectors

1. Align the pins on the sensor cable with those in the sensor receptacle.
2. Push the sensor connector into the receptacle until the sensor release clicks.
3. To be certain that the connectors are locked, lightly pull on the cable connector; the cable should be held in place by the sensor release clip.
4. Push the protective caps on the module and sensor together.

Figure 1-11 Flow Module - connecting the sensor

1.8 Installing the Batteries

The Battery Module requires two lantern batteries. The figures below show a 6 VDC alkaline battery. Rechargeable 6 VDC lead-acid batteries are also available for the module.

To install the batteries, follow the instructions in Figures 1-12 through 1-15.

Load the Lantern Battery into the Carrier.

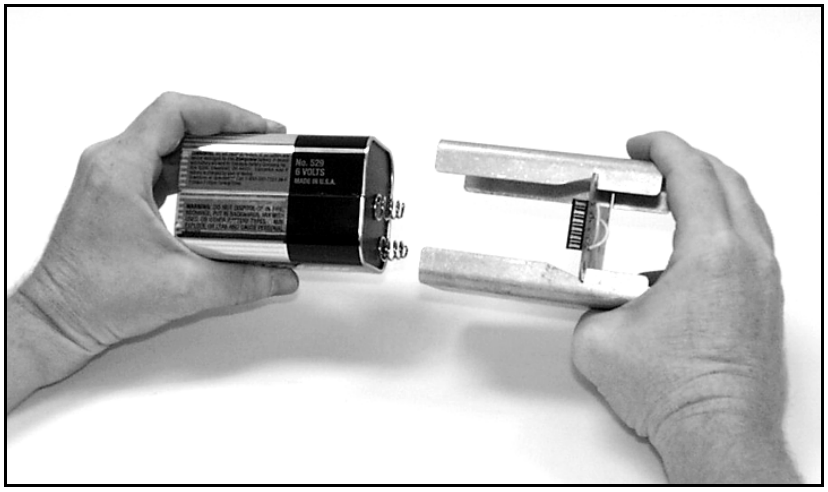


Figure 1-12 Insert Battery in carrier

Insert the carrier and battery into the module. Note the position of the carrier's connector; it must be aligned toward the center of the module.

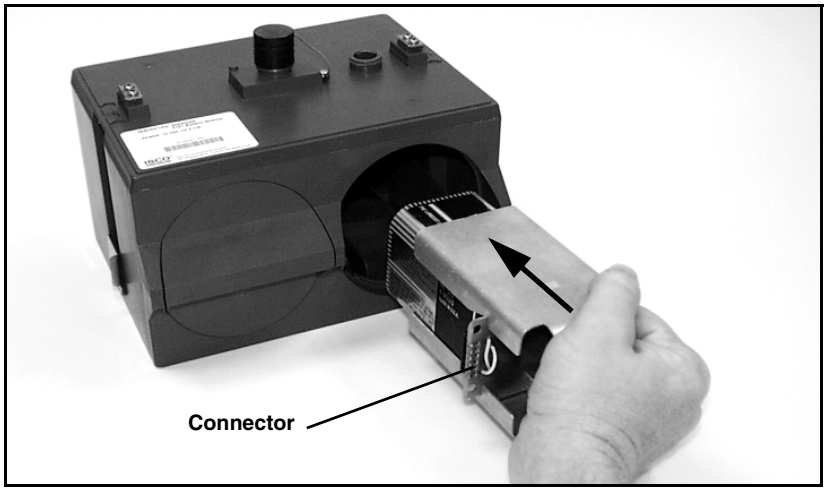


Figure 1-13 Battery Module - inserting carrier

While holding the door in your right hand, align the marks and insert the door.

Figure 1-14 Battery Module - aligning the door

Rotate the door 1/4 turn clockwise.

Repeat Steps 1-12 through 1-15 to install the second battery.

Figure 1-15 Battery Module - closing the door

1.9 Stacking Modules

To stack a 2150 Flow Module on a 2191 Battery Module, follow the instructions in Figures 1-16 through 1-22.

Unlock the latch to release the connector plug.

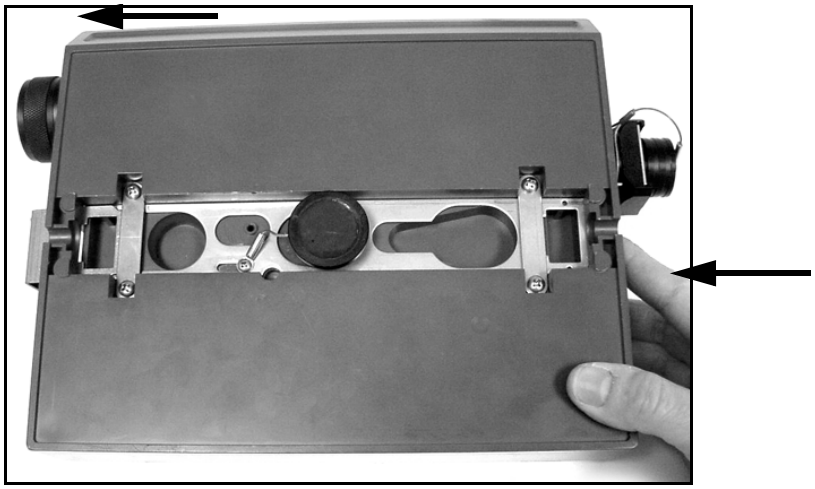


Figure 1-16 Flow Module - Unlocking the latch

Pull the plug out of the connector.

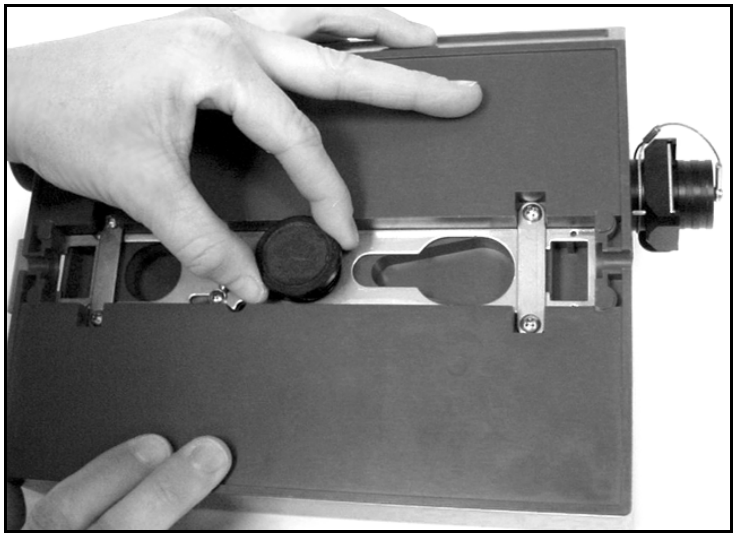


Figure 1-17 Flow Module - Unplugging the connector

Push the plug into the holder.

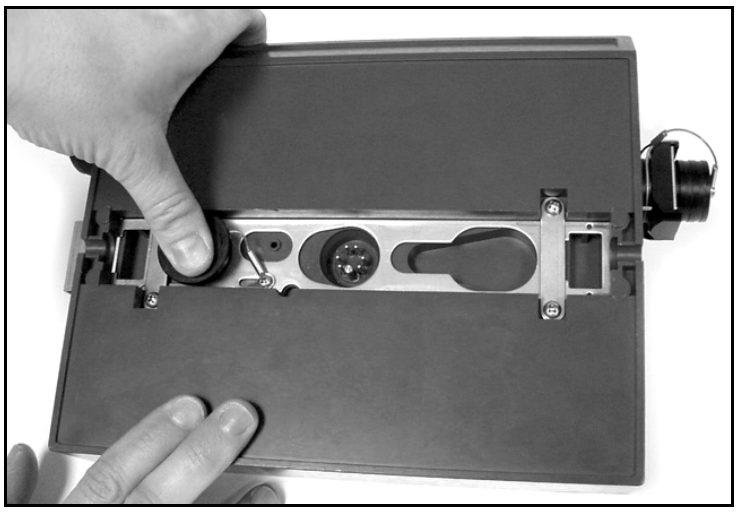


Figure 1-18 Flow Module - Pushing plug into holder

On the Battery Module, uncap the connector. Store the cap on the holder.

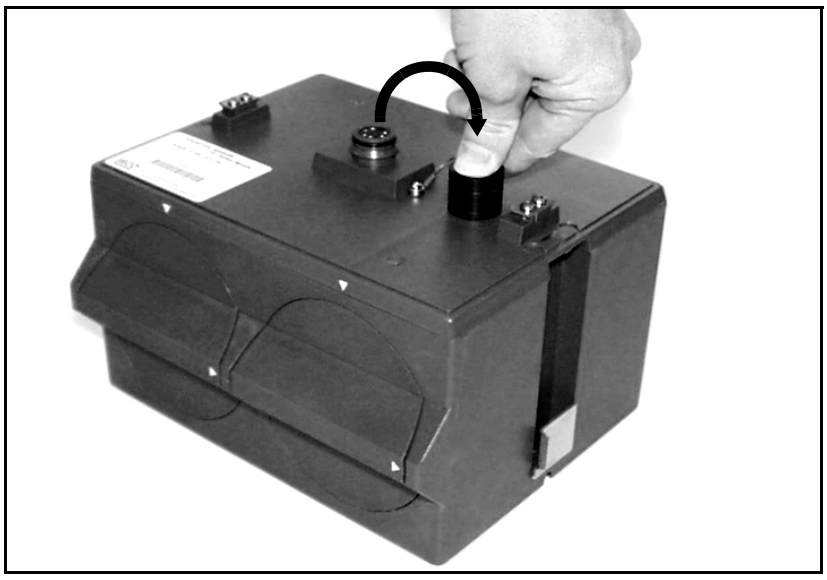


Figure 1-19 Battery Module - uncapping the connector

Place the handle on the Battery Module. The handle must rest towards the back of the module, otherwise its movement will be obstructed by the sensor cable, desiccant cartridge, and latches.

Figure 1-20 Battery Module - inserting the handle

Align the modules and gently press the 2150 module down onto the 2191 module.

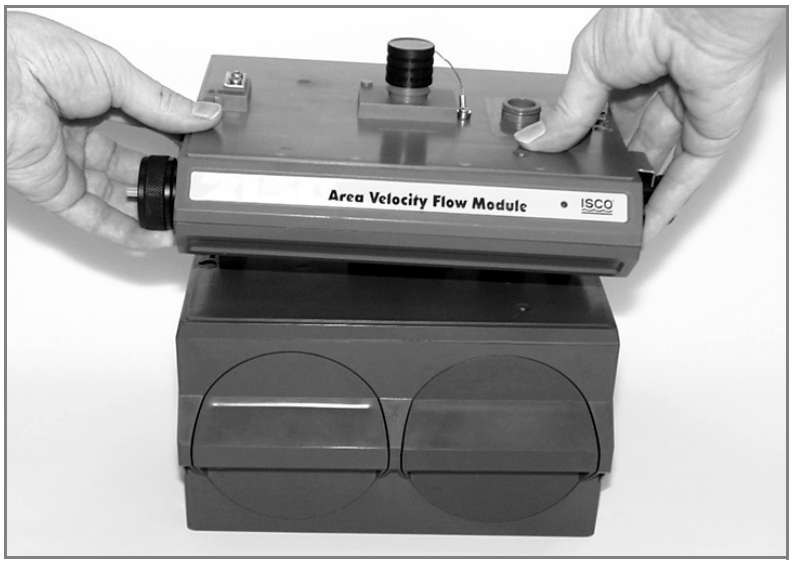


Figure 1-21 Aligning the modules

Locate the latch extending from the left side of the 2150 module. Push in to slide the latch toward the right of the module.

Figure 1-22 Locking the modules

1.10 Technical Specifications

The following tables provide technical information about the 2150 Module and its related components.

- Table 1-5 lists the technical specifications of the 2150 Area Velocity Flow Module
- Table 1-6 lists the technical specifications of the 2150 Area Velocity Sensor
- Table 1-7 lists the technical specifications of the 2191 Battery Module
- Figure 1-23 and Table 1-8 lists information about the 2150 Module's communication connector.

Table 1-5 Specifications – 2150 Area Velocity Flow Module

Size (H×W×D)	2.9 × 11.3 × 7.5 in.	7.4 × 28.7 × 19.1 cm
Weight	2.0 lbs	0.9 kg
Material	High-impact polystyrene, stainless steel	
Enclosure (self-certified)	NEMA 4X, 6P	IP 68
Power	7 to 26 VDC, 100 mA typical at 12 VDC, 1 mA standby **Note** Earlier versions of the 2150, as well as some other system components including cables, have lower voltage limits and cannot be connected in systems powered by more than 16.6 VDC. Refer to Section 2.2.2 for complete information.	

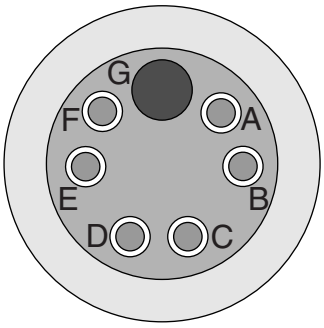
Table 1-5 Specifications – 2150 Area Velocity Flow Module (Continued)			
Typical Battery Life (one module)	Data Storage Interval	Alkaline Batteries	Lead-Acid Batteries
	15 minutes	15 months	2.5 months
	5 minutes	8 months	1.5 months
	1 minute	2 months	11 days
Program Memory	Non-volatile, programmable flash; can be updated using PC without opening enclosure; retains user program after updating		
Number of Modules	Up to 4, field interchangeable		
Maximum Distance between Remote Modules	3300 ft	1000 m	
Wiring between Modules	Twisted pair for communication, pair for power, gauge dependent on distance		
Flow Rate Conversions	Up to 2 independent level-to-area and/or level-to-flow rate conversions		
Level-to-Area Conversions			
Channel Shapes	Round, U-shaped, rectangular, trapezoidal, elliptical, with silt correction		
Data Points	Up to 50 level-area points		
Level-to-Flow Rate Conversions			
Weirs	V-notch, rectangular, Cipolletti, Isco Flow Metering Inserts, Thel-Mar		
Flumes	Parshall, Palmer-Bowlus, Leopold-Lagco, trapezoidal, H, HS, HL		
Manning Formula	Round, U-shaped, rectangular, trapezoidal		
Data Points	Up to 50 level-flow rate points		
Equation	2-term polynomial		
Total Flow Calculations	Up to 2 independent, net, positive or negative, based on either flow rate conversion		
Data Storage Memory	Non-volatile flash; retains stored data during program updates		
Capacity	395,000 bytes (up to 79,000 readings, equal to over 270 days of level and velocity readings at 15 minute intervals, plus total flow and input voltage readings at 24 hour intervals)		
Data Types	Level, velocity, flow rate 1, flow rate 2, total flow 1, total flow 2, input voltage		
Storage Mode	Rollover with variable rate data storage based on level, velocity, flow rate 1, flow rate 2, total flow 1, total flow 2, or input voltage		
Storage Interval	15 or 30 seconds; 1, 2, 5, 15 or 30 minutes; or 1, 2, 4, 12 or 24 hours		
Bytes per reading	5		
Setup and Data Retrieval	Serial connection to computer with Isco Flowlink for Windows software		
Baud Rate	38,400		
Temperature Range	-40° to 140°F	-40° to 60°C operating & storage	

Table 1-6 Specifications – 2150 Area Velocity Sensor		
Size (H×W×D)	0.75 × 1.31 × 6.00 in.	1.9 × 3.3 × 15.2 cm
Cable Length	394 in.	10 m
Cable Diameter	0.37 in.	0.9 cm
Weight *(including cable)*	2.1 lbs	0.95 kg
Level Measurement		
Method	Submerged pressure transducer mounted in the flow stream	
Transducer Type	Differential linear integrated circuit pressure transducer	
Range[1]	0.033 to 10 ft. (optionally) up to 30 ft.	0.010 to 3.05 m 9.15m
Maximum Submersible Depth	34 ft.	10.5 m
Accuracy[2]	± .010 ft.	± 0.003 m
Typical Long Term Stability	± 0.023 ft./yr	± 0.007m/yr
Compensated Temperature Range	32 - 122°F	0 - 50°C
Velocity Measurement		
Method	Doppler Ultrasonic	
Frequency	500 kHz	
Transmission Angle	20° from horizontal	
Typical Minimum Depth for Velocity Measurement	0.08 ft.	25 mm
Range	-5 to +20 ft./s	-1.5 to +6.1 m/s
Accuracy[3]	Velocity -5 to +5 ft./s (-1.5 to +1.5 m/s) 5 to 20 ft./s (1.5 to 6.1 m/s)	Error ±0.1 ft./s (±0.03 m/s) ±2% of reading
Operating Temperature	32° to 160°F	0° to 71°C
Temperature Measurement Accuracy	± 3.6°F	± 2 °C
Materials		
Sensor	Epoxy, chlorinated polyvinyl chloride (CPVC), stainless steel	
Cable	Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC)	

Notes:

1. Actual vertical distance between the area velocity sensor and the liquid surface
2. Maximum error within compensated temperature range (per degree of change from calibration temperature)
3. In water with a uniform velocity profile and a speed of sound of 4850 ft./s (1480 m/s)

Table 1-7 Specifications – 2191 Battery Module		
Size (H×W×D)	6.0 × 9.6 × 7.6 in.	15.2 × 24.4 × 19.3 cm
Weight *(without batteries)*	3.2 lbs.	1.4 kg
Materials	ABS plastic, stainless steel	
Enclosure *(self-certified)*	NEMA 4X, 6P	IP68
Batteries	6V alkaline lantern or lead-acid lantern, quantity 2	
Capacity		
Alkaline Lantern Batteries	25 Ahrs	
Lead-acid Lantern Batteries	5 Ahrs	



Communications Port
(upper connector shown)

Figure 1-23 2150 Module Connector Pins

Table 1-8 AV Module Connector Pins		
Pin	**Name**	**Description**
A	LONA	Neuron differential transceiver Data A
B	LONB	Neuron differential transceiver Data B
C	VIN+	Positive power supply voltage input (+12 VDC nominal)
D	VIN–	Negative power supply voltage input (0 VDC nominal)
E	RCVUP	PC data receiver RS-232 level input
F	XMTUP	PC data transmit RS-232 level output
G	Key	Aligns connector pins

2150 Area Velocity Flow Module

Section 2 Preparation and Installation

2.1 Unpacking Instructions

When the system arrives, inspect the outside packing for any damage. Then carefully inspect the contents for damage. If there is damage, contact the delivery company and Teledyne Isco (or its agent) immediately.

⚠ WARNING

If there is any evidence that any items may have been damaged in shipping, do not attempt to install the unit. Please contact Teledyne Isco (or its agent) for assistance.

When you unpack the system, check the items against the packing list. If any parts are missing, contact the delivery company and Teledyne Isco's Customer Service Department. When you report missing part(s), please indicate them by part number. In addition to the main packing list, there may be other packing lists for various sub-components.

It is recommended that you retain the shipping cartons as they can be used to ship the unit in the event that it is necessary to transport the system.

Please complete the registration card and return it to:

Teledyne Isco, Inc.
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

Phone:(800) 228-4373
Outside USA & Canada call:
(402) 464-0231

FAX: (402) 465-3022

E-mail:IscoInfo@teledyne.com

2.2 Safety

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood.

2.2.1 Site Conditions

The 2100 Series components are often installed in confined spaces. Some examples of confined spaces include manholes, pipelines, digesters, and storage tanks. These spaces may become hazardous environments that can prove fatal for those unprepared. These spaces are governed by OSHA 1910.146 and require a permit before entering.

⚠ WARNING

The installation and use of this product may subject you to hazardous working conditions that can cause you serious or fatal injuries. Take any necessary precautions before entering a worksite. Install and operate this product in accordance with all applicable safety and health regulations, and local ordinances.

2.2.2 System Power

2150 modules currently sold can be powered by 7 to 26 volts. Earlier units, as well as some other 2100 system components, are limited to a maximum of 16.6 volts (12 volts typical). The voltage specification is printed on the serial tag located on the back of the module (refer to Figure 2-1).

Table 2-1 lists the maximum voltages for all Isco 2100 instrumentation. Regardless of the capabilities of other components, **never** attempt to connect a module or cable to a system using a power source that exceeds its stated operating range.

Table 2-1 Voltage Specifications for 2100 System Components

Module or Cable	Earlier Voltage Range	Current Voltage Range	Date of Change
2150	7-16.6 VDC	7-26 VDC	March 2005
2110	7-16.6 VDC		N/A
2101			
2103			
2102	10.2-16.6 VDC		
2108	7-26 VDC		
2105			
RS-232 DB9 Cable (part #60-2004-046)	7-16.6 VDC	7-26 VDC	January 2009
RS-232 USB Cable (part #60-2004-507)	7-26 VDC		N/A
Sampler Interface Cable (part #60-2004-260)	12VDC		N/A (Cable is powered from sampler.)

Figure 2-1 Identifying the 2150 voltage specification

The module crown connector on the earlier RS-232 DB9 digital communication cable (part #60-2004-046) is unmarked. The connector on the 26-volt cable has a serial tag specifying the higher voltage (refer to Figure 2-2).

Lower Voltage DB9 Cable

Higher Voltage DB9 Cable

Figure 2-2 Identifying the voltage specification on the DB9 cable

⚠ WARNING

Injury and/or equipment damage can result from connecting modules or cables to a power source exceeding the specified operating voltage range. Check labeling on all modules and cables for voltage ranges.

☑ *Note*

All connected system components should share a common supply ground.

2.3 Preparing for Installation

2.3.1 Locating the Site

The 2150 Flow Module is designed to measure flow in open channels with or without a primary device. A primary device is a hydraulic structure, such as a weir or a flume that modifies a channel so there is a known relationship between the liquid level and the flow rate. Although the 2150 supports flow rate conversion in channels with a primary device, its level and velocity measurement capabilities are best suited for channels *without* a primary device.

> ☑ ***Note***
>
> Primary devices limit the usefulness of the AV Sensor's readings. In most cases, levels and velocities near these structures do not represent what normally occurs in the channel. If you must use area velocity flow conversion, or if your interest is the stream's velocity, do not install the AV Sensor near a primary device. Move the AV Sensor away to where the flow is unaffected by the primary device.

2.3.2 Channels Without a Primary Device

When the AV Sensor is installed without a primary device, find a section of channel with a minimum of disturbances to the flow. Avoid areas with elbows, outfalls, inverts, junctions, etc. that create turbulence near the AV Sensor. The AV Sensor should be located away from these disturbances to a point where the flow has stabilized. For best results, install the AV Sensor where the flow is most uniform. Uniform flow is a condition where the water surface is parallel to the bottom of the channel.

2.3.3 Channels With a Primary Device

If the AV Sensor is installed in a primary device, its location depends on the type of primary device. Most primary devices have a specific place for the head (level) measurement sensor. For more details about the location of the head measuring point, refer to the *Isco Open Channel Flow Measurement Handbook*, or to information provided by the manufacturer of the primary device.

> ☑ ***Note***
>
> When you install the AV Sensor for use within a primary device, a Level-to-Flow conversion method should be used. (See Programming, Section 3.)

2.3.4 AV Module and AV Sensor Mounting Considerations

Ideal sites are easily accessible for service and data collection, while still providing protection for the 2100 Series devices. The 2100 Series devices are rated NEMA 4X, 6P, and constructed of materials that can withstand harsh environments. However, continual exposure to UV light, or periodic submersion should be avoided to extend the life of the components.

Typically, the AV Module is suspended inside a manhole. Suspending the AV Module near the opening will protect it from the elements, minimize the chance of submersion, and allow it to be easily retrieved without entering the manhole.

The AV Sensor should be installed within 25 feet (7.6 m) of the AV Module. Distances greater than 25 feet require custom length cables. Call the factory or your representative.

2.4 Installation Procedures

2.4.1 Install Battery Module Batteries

The Battery Module requires two 6V lantern-type batteries. The following batteries may be used in the Battery Module:

- commercially available 6VDC alkaline lantern batteries (Isco P/N 340-2006-02)
- rechargeable 6VDC lead-acid battery in a lantern-style case. This 5.0 ampere-hour battery can be ordered from Isco (P/N 60-2004-041).

To install batteries (refer to Figure 2-3):

1. Remove the battery door. To remove the door, turn it ¼ turn counter-clockwise and pull it from the Battery Module.
2. Pull the lantern battery carrier out of the Battery Module.
3. Remove the old battery from the carrier.
4. Insert a fresh battery in the carrier. Slide in the battery so that the springs contact the plate inside the carrier.
5. Align the connectors and insert the battery carrier into the Battery Module.
6. Check the humidity indicator disk inside the door. (See section 2.4.2.)
7. Replace the door.

Repeat steps 1 through 7 to install the second battery.

☑ *Note*

The batteries should always be replaced as a pair. Never mix old and new batteries.

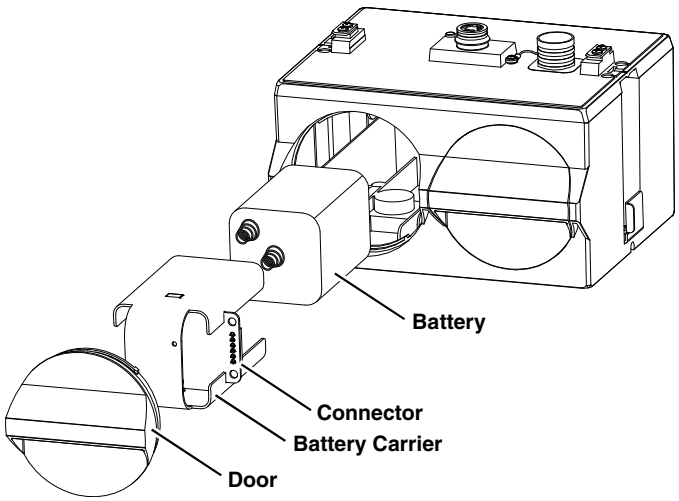
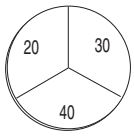


Figure 2-3 Installing a Battery

2.4.2 Inspect the Desiccant – Battery Module



A humidity indicator is mounted inside each battery cap on the Battery Module. The humidity indicators have regions that display 20, 30, and 40 percent humidity levels. Ideally each region should be completely blue. As the desiccant becomes saturated, the humidity levels will increase and the regions turn pink. When the 40 percent region turns pink, the Battery Module is no longer adequately protected and the desiccant must be replaced. Refer to section 5.4 for replacement instructions.

2.4.3 Inspect the Desiccant – AV Module

A desiccant cartridge is inserted into the side of the AV Module. The cartridge is filled with silica gel beads that will indicate when they are saturated. When dry, the beads are yellow or blue. As the desiccant becomes saturated, the humidity levels will increase and the beads turn green or pink. If the entire length of the desiccant cartridge turns green or pink, the reference air is no longer adequately protected and the desiccant must be replaced. Refer to section 5.4 for replacement instructions.

⚠ CAUTION

Operating the AV Module and sensor with saturated desiccant can cause many problems such as drifting level readings and permanent damage. It is important that the equipment is serviced often enough to prevent the entire desiccant cartridge from becoming saturated.

2.4.4 Connecting the Modules

The 2100 Series System is modular; you build the system by connecting modules together. The instructions in this section describe how to connect an AV Module to a Battery Module in its most basic configuration — by stacking the two modules. Either module may be stacked on the other, but you may find it more

convenient if you place the Battery Module at the bottom of the stack. This keeps the heavier items lower in the stack making it easier to transport or store.

Other modules may be attached to this stack to increase the site's functions. You can add many modules to the stack as long as each module uses a unique module name (Section 3.2.1), and as long as you observe the power requirements of the extra modules.

Connection options

Keep in mind that stacking is not the only way to connect modules. The modules may be placed in remote locations and still operate as a single site. If you would like to use remote modules for your application, please consult with the factory or your representative to realize the full potential of your system.

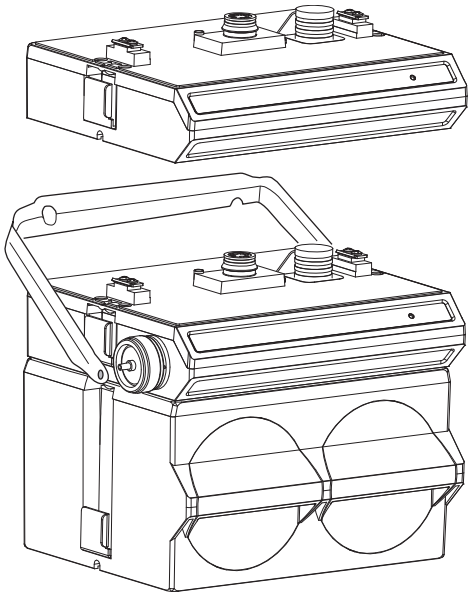


Figure 2-4 Assembling a system (shown: 2 flow modules with 1 battery module)

Connecting the Modules

To connect the AV and Battery modules, refer to the following instructions and Figure 2-4.

1. On the top of the Battery Module, remove the cap and stow it on the holder. This exposes the communication connector on the Battery Module.
2. Prepare the Battery Module's communication connector:
   a. Inspect the connector. It should be clean and dry. Damaged O-rings must be replaced. Spare O-rings (Isco P/N 202-1006-69) are supplied in the maintenance kit (60-2099-001).
   b. Spray the O-ring's sealing surface with a *silicone* lubricant.

☑ Note

Do not use petroleum-based lubricants. Petroleum-based lubricants will cause the O-ring to swell and eventually deteriorate. Aerosol silicone lubricant sprays often use petroleum based propellants. If you are using an aerosol spray, allow a few minutes for the propellant to evaporate before proceeding.

3. Place the carrying handle on the Battery Module. (If you are stacking several modules, it is recommended that you position the handle between the top two modules.)
4. Unlock the AV Module's latch by pressing in on the latch release (right side).
5. Underneath the AV Module, remove the cap from the lower communication connector and stow it in the holder.
6. Lock the latch. Locking the latch correctly seats and aligns the lower cap in its holder.
7. Position the AV Module over the Battery Module. Align the connectors and lower the AV Module onto the Battery Module.
8. Unlock the AV Module's latch by pressing in on the latch release (right side).
9. Firmly press the modules together and lock the AV Module's latch (left side).

The Communications indicator will blink during the start-up routine to indicate the AV Module is operating.

☑ Note

Unused communication ports on the top and bottom of the stack must be capped. The connector caps terminate the communication lines and protect the pins.

2.4.5 Installing the modules

The modules should be secured at the site. This prevents damage caused by accidental falls and from being swept away if the channel is flooded. In manholes, the modules are often secured to a ladder rung, or suspended from a spreader bar. Teledyne Isco's Customer Service Department or your local representative can assist you with installation options.

As you complete the installation, the following should be checked before leaving the site unattended:

1. The modules should be positioned where they will be protected from submersion. Should the modules become submerged, level readings may drift and the hydrophobic filter will seal to protect the reference air line. If the possibility of *short-term* submersion cannot be avoided, you can prevent the drifting level readings and damage to the hydrophobic filter. Attach a length of $^{1}/_{8}$ inch I.D. tubing (Isco P/N 60-2003-104) to the hydrophobic filter. Route the other end of the tubing to a dry location.

☑ Note

To protect the AV Module and sensor, the hydrophobic filter seals off the reference air line when it is exposed to excessive moisture. When sealed, the filter prevents irreparable damage, yet may cause the level readings to drift. This single-use filter must be replaced once it becomes sealed. See Section 5.6.1 for more information.

⚠ CAUTION

Long-term submersion (several hours or more), may permanently damage the modules and sensors.

2. Ensure that all of the protective caps are in place. Unused upper and lower communication connections must be capped. The caps prevent damage and terminate the communication lines. Caps for any communication connectors that are in use should be properly stowed. Like the module and sensor connections, the protective caps and their O-rings should be cleaned and coated with a silicone lubricant. Damaged O-rings must be replaced (Isco P/N 202-1006-69).
3. Carefully route cables. Protect them from traffic in the area. Avoid leaving excess AV Sensor cable in the flow stream where it may collect debris.

2.4.6 Connecting the AV Sensor

The AV Sensor cable attaches to sensor receptacle on the AV Module.

To connect the AV Sensor (refer to Figure 2-5):

1. Remove the protective caps:
   a. On the AV Module, push down on the sensor release while pulling the protective cap from the receptacle.
   b. On the AV Sensor cable, pull the cap from the end of its connector.
2. Prepare the AV Sensor connector:
   a. Inspect the connector. It should be clean and dry. Damaged O-rings must be replaced. Spare O-rings (Isco P/N 202-1006-69) are supplied in the maintenance kit (60-2059-001).
   b. Spray the O-ring's sealing surface with a *silicone* lubricant.

☑ Note

Do not use petroleum-based lubricants. Petroleum-based lubricants will cause the O-ring to swell and eventually deteriorate. Aerosol silicone lubricant sprays often use petroleum based propellants. If you are using an aerosol spray, allow a few minutes for the propellant to evaporate before proceeding.

3. Align and insert the connector. The sensor release will "click" when the sensor connector is fully seated.
4. Connect the two caps together.

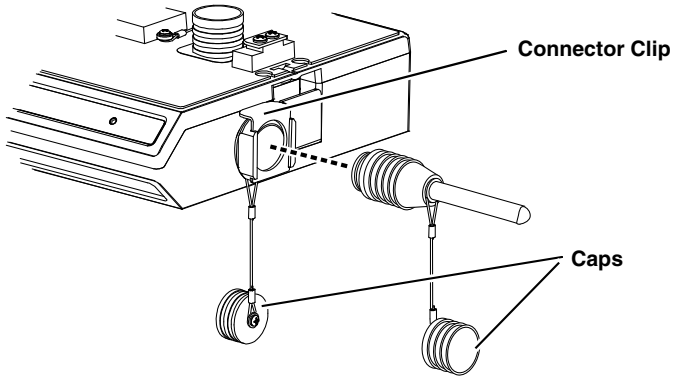
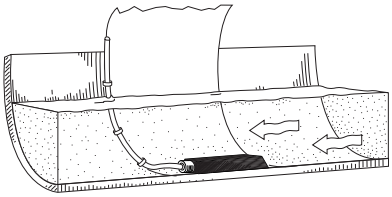


Figure 2-5 Connecting the AV Sensor

2.4.7 Installing the AV Sensor

See Section 2.6 for a summary of sensor mounting options for round pipe installations. Sensor installation is discussed in detail in *Isco's Mounting Rings Instruction Manual*. The manual explains how to mount the low profile AV Sensor in flow streams using spring rings, scissors rings, a street level installation tool, and mounting plates.

Several factors concerning the AV Sensor's installation may affect your system's performance. Please review the following to understand how to obtain the best results:



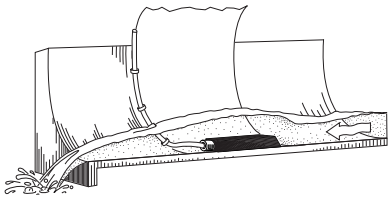
Ideal Conditions - Uniform Flow

Uniform flow - The AV Sensor provides the best results in flow streams with uniform flow. An example of uniform flow is shown in the margin.

Avoid poor channel conditions - Poor channel conditions may cause incorrect or erratic readings. Areas to avoid are:

- outfalls or channel intersections
- flow streams at very low levels with high flow rates
- turbulence
- channel sections that are apt to collect debris or silt
- depths that consistently run below 1 inch (25 mm).

Install the AV Sensor in streams where the liquid covers the sensor. The AV Sensor can detect levels above approximately 0.033 feet (0.4 inch or 1.0 cm) and typically can measure velocities in streams as low as 0.08 ft (1 inch or 25 mm). Streams that run consistently below 1 inch are not a good application for the 2150 Module and AV Sensor.



Poor Conditions

The example in the margin shows a few of these poor conditions. The outfall is drawing down the liquid level and the AV Sensor is disturbing the flow. In this example, the AV Sensor should be moved forward to avoid the drawdown near the outfall.

Offsets - You can install the AV Sensor above the bottom of the flow stream or along the side of the channel, as long as it will be continually submerged. The AV Module can be calibrated to measure level with the AV Sensor at nearly any depth. The AV Sensor cannot, of course, measure a liquid level that falls below its position in the flow stream. Installing the AV Sensor above the bottom has several advantages:

- It avoids heavy concentrations of silt, sand, or other solids.
- It aids installation in narrow or hard-to-reach locations.
- It maximizes level resolution over a specific level range.
- It can avoid obstructions in the flow stream.

When the AV Sensor is installed above the bottom of the channel, a *Zero Level Offset* must be entered in the program settings.

Liquid properties - Velocity measurements depend on the presence of some particles in the stream such as suspended solids or air bubbles. If the stream lacks particles it may be necessary to aerate the water upstream from the sensor.

Handle with care - Abusive handling will damage the AV Sensor. Although the AV Sensor will survive normal handling and installation, treat the sensor with reasonable care. The internal components cannot be repaired.

Protect the cable - There is a vent tube inside the cable that must remain open. Do not kink the cable or overtighten the plastic ties while securing the cable.

Secure the cable - Teledyne Isco recommends that you secure the cable in place. Tying off the cable can often prevent lost equipment if excessive flow dislodges the sensor and its mounting.

2.4.8 Program the Module

After you have installed the AV Sensor in the flow stream, the flow stream properties must be defined. To do this, connect to the AV Module with *Flowlink for Windows* software and define the stream properties in the AV Module's program settings. These ensure that the system correctly reads the liquid level and converts the measured level to flow rate.

☑ *Note*

The 2100 System requires Flowlink 4.1or later. Earlier versions do not support 2100 System instruments.

Referring to Section 3, define the following properties:

- **Level** – Enter a liquid level measurement to calibrate the level readings from the AV Sensor (3.3.1).
- **Zero Level Offset** – If the AV Sensor is not installed in the bottom-center of the channel, an offset distance must be entered (3.3.2).
- **Set Flow Rate to zero if no velocity data checkbox** - Determines how the AV Module reports flow rates if stream velocity data is not available (3.3.3).

- **Prevent velocity signal interference** – When more than one sensor is measuring the same section of channel, the ultrasonic sound waves can interfere with each other. AV Modules can be synchronized to prevent velocity signal interference (3.3.4).
- **Flow Conversion** – The AV Module can store flow rate readings. To correctly convert the measured level and velocity readings to a flow rate, the flow conversion method and channel properties should be defined (3.3.5).
- **Silt Level** – *(Area Velocity Flow Conversion Only)* The AV Module can compensate for a build up of silt around the AV Sensor (3.3.6).

These six settings should be considered a minimum requirement. Other settings, such as *Data Storage Rates*, *Site Name*, and *Module Names*, also may be set using Flowlink. Section 3 describes how you can modify these other settings.

2.4.9 Basic Installation Checklist

As a review, the following steps may be used as a guide to install a 2150 Module at a basic site. In this example, a basic site is a single AV Module and AV Sensor, and a Battery Module. Your steps may differ if you have selected an alternative power source, or if you are installing additional modules.

1. Prepare the Battery Module.
   a. Install batteries (Section 2.4.1).
   b. Inspect desiccant (2.4.2).
2. Inspect AV Module desiccant (2.4.3).
3. Assemble the system.
   a. Connect the modules (2.4.4).
   b. Attach the AV Sensor cable to the AV Module (2.4.6).
4. Install the AV Sensor in the flow stream. Refer to *Isco Mounting Rings Instruction Manual* (2.4.7).
5. Connect to the site with *Flowlink for Windows* software (2.4.8).
   a. Create the site by Quick Connecting to the modules.
   b. Set up the site and module settings.
   c. Calibrate the level measurement.
6. Disconnect from the site and replace all protective caps.
7. Mount or suspend the modules (2.4.5).

2.5 Site Example

Figure 2-6 illustrates a visit to a round-pipe site that uses several optional components. Key items are explained below:

The computer running **Flowlink** communicates with the modules. With Flowlink, you can name the site, set up its operation, and adjust the level measurement. To assist with servicing, Flowlink also will display input power voltage (an indication of remaining battery life) and collect diagnostic reports.

A **communication cable** connects the computer and site. The cable supports the data transfers between the two.

> ☑ ***Note***
>
> Earlier versions of the 2150, as well as some other system components including cables, have lower voltage limits and cannot be connected in systems powered by more than 16.6 VDC. Refer to Section 2.2.2 for complete information.

A **spreader bar** is used to suspend the modules in a manhole. Spreader bars are adjustable to fit openings from 22.5 to 48 inches (60 to 120 cm).

The **2150 Area Velocity and Battery Modules** measure and store the stream data.

The **Street Level Installation Ring Release Strap** is tied to a rung inside the manhole. When it is necessary to retrieve the AV Sensor and mounting ring, pulling on the strap releases the ring from the pipe so you can lift it from the manhole.

The **AV Sensor cable** is routed carefully without kinks or sharp bends. Any excess cable is kept out of the channel to prevent debris from collecting.

The **Street Level Installation Ring** was set in place using Isco's Street level Installation Tool. The tool is an adjustable, multi-section pole that allows you to insert the ring and AV Sensor into a round pipe without entering the manhole.

The **AV Sensor** is positioned in the flow stream to measure liquid level and velocity.

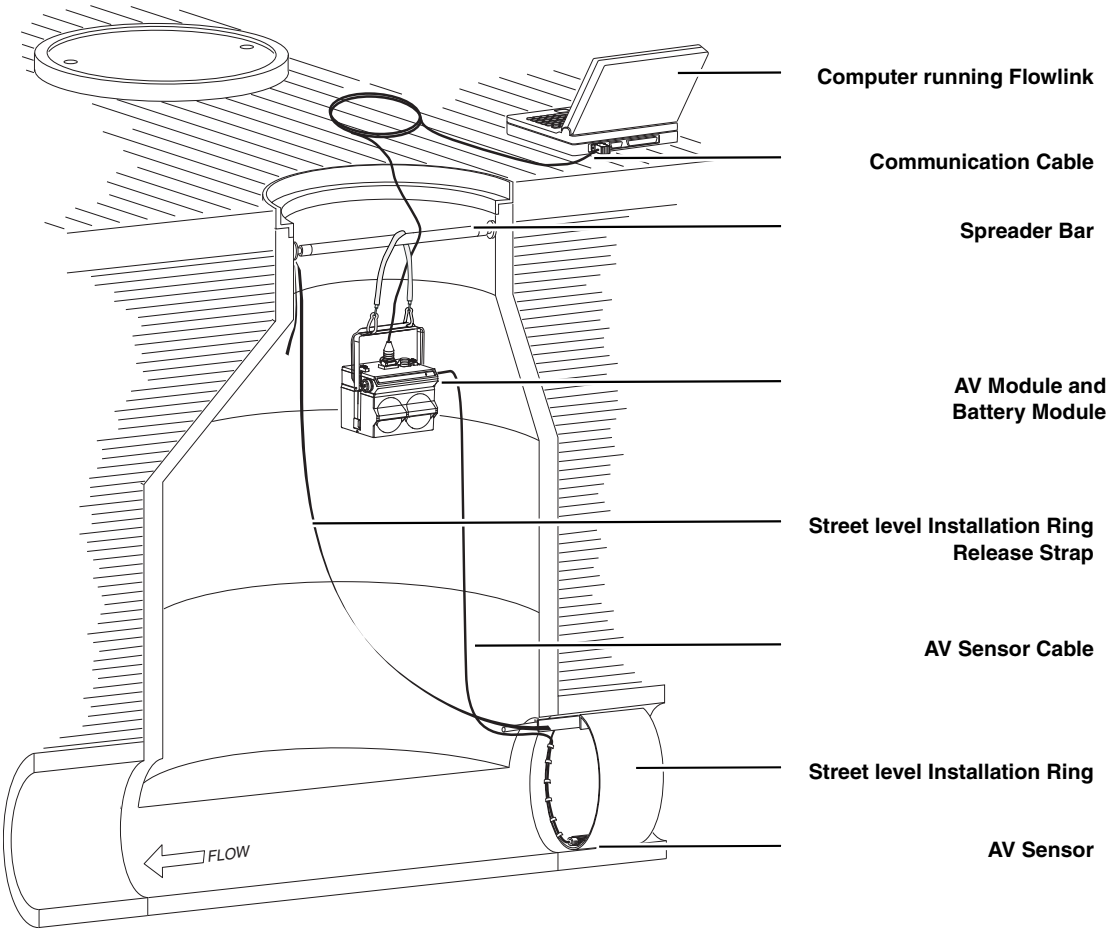


Figure 2-6 Typical Round-pipe Installation

2.6 Mounting Rings

Consult your Isco Mounting Rings Installation and Operation Guide for detailed hardware information.

The following sections describe sensor installation using the two options available for mounting the AV sensor in pipes or round-bottomed flow streams. For pipes up to 15" (38 cm) in diameter, **stainless steel self-expanding mounting rings** (**Spring Rings**) are available. For pipes larger than 15" in diameter, Teledyne Isco offers the **Scissors Rings (Universal Mounting Rings)**. Area velocity sensors can also be installed using primary measuring devices.

2.6.1 Spring Rings

To install a spring ring, compress the ring, slip it inside the pipe, and then allow it to spring out to contact the inside diameter of the pipe. The inherent outward spring force of the ring firmly secures it in place. A typical self-expanding mounting ring (with a probe mounted on it) is shown in Figure 2-7.

These mounting rings are available for use in pipes with inside diameters of 15.2 cm (6"), 20.3 cm (8"), 25.4 cm (10"), 30.5 cm (12"), and 38.1 cm (15"). The Isco part numbers for the various size mounting rings available are listed in Appendix B. These part numbers include not only the ring, but also the miscellaneous hardware necessary to mount the sensor on the ring.

⚠ CAUTION

Always wear leather gloves when handling the rings (either type). The metal is finished, but there is still a possibility of cutting your hands on the edges.

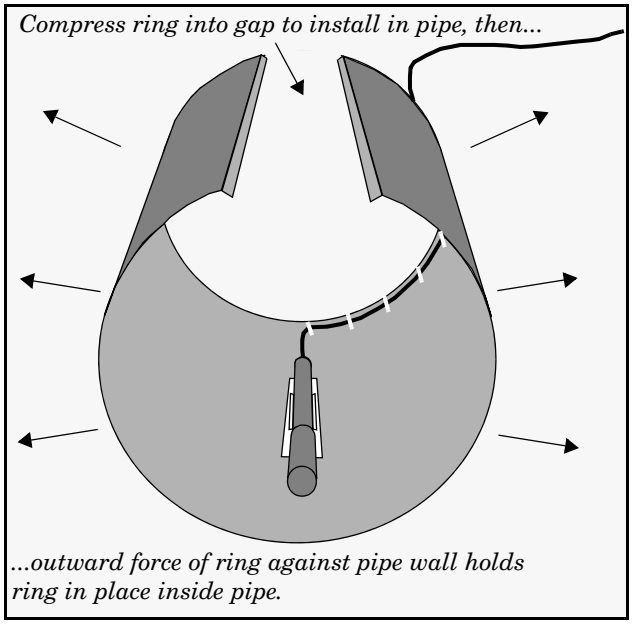


Figure 2-7 Sensor Installed on a Spring Ring

Attaching the Sensor to the Ring

Attach the AV sensor to the ring either by using two 4-40 countersink screws or by snapping the optional probe carrier to the ring. This second method of attaching the sensor allows for easy removal in case service is needed later.

⚠ CAUTION

Make sure the slots on the AV sensor carrier are completely pressed into the tabs on the ring. This is particularly important where there is any possibility of reverse flows, or where flows are of high velocity. If the AV sensor is not fully pressed into the mounting ring tabs, it might come loose in the stream, and could possibly be damaged or lost.

Make sure the sensor cable is securely fastened along the back (downstream) edge of the ring. Otherwise, the sensor may provide **inaccurate level readings** under conditions of high velocity.

To complete the sensor-spring ring assembly procedure, attach the sensor cable to the downstream edge of the ring. Follow the cable routing shown in Figure 2-7. Other routing directions may affect measurement accuracy. The cable can actually create a stilling well downstream from the sensor, causing the level to read low. Use the self-locking plastic ties supplied with the ring. Install the ring in the pipe by compressing it. Press inward on both sides and slide the ring into the pipe.

Route the sensor cable out of the stream and secure it in position by placing the ties through the holes in the mounting ring and then locking them around the cable, as shown in figure 2-7.

⚠ CAUTION

Do not overtighten the plastic cable ties; they should be tightened just enough to secure the cable in place, without greatly indenting the cable. Overtightening the plastic ties may collapse the reference tube in the cable, blocking it.

The spring ring may need anchoring. Under conditions of high velocity (greater than 1.5 meters per second or 5 feet per second), the ring may not have sufficient outward spring force to maintain a tight fit inside the pipe. The ring may start to lift off the bottom of the pipe, or may even be carried downstream.

This problem is more prevalent in the larger diameter pipes and in pipes with smooth inside surfaces, such as plastic pipes. If any of these conditions are present, or if movement of the mounting ring is detected or suspected, you must anchor the ring in place. You can do this by setting screws through the ring into the pipe, or by other appropriate means. If there is a problem with the smaller diameter rings, it may be sufficient to simply increase the outward spring force of the ring by bending it into a less round configuration.

2.6.2 Scissors Mounting Ring

For pipes larger than 15" in diameter, Teledyne Isco offers the adjustable Scissors Ring (also known as the Universal Mounting Ring). This device consists of two or more metal strips that lock together with tabs to form a single assembly. There is a base section where the sensors are mounted, two or more extension sections (usually), and a scissors section at the top that expands the entire assembly and tightens it inside the pipe. The scissors section contains a long bolt that increases the length of the section as it is tightened.

The assembled scissors rings fit pipe diameters from 16" to 80". Secure the unit in place by tightening the scissors mechanism with a 5/8" socket wrench or other suitable tool. Ring sections are .040" thick half-hard 301 stainless steel sheet. All other parts are also stainless steel, except for the plastic cable ties in the hardware kit.

Each extension, 1, 2, 3, and 4, adds 9.0", 21.5", 31.5", or 41.5", respectively, to the circumference of the ring. Used alone, the base section fits a pipe that is approximately 16" to 19" in diameter. The 9.0" (smallest) extensions can be used to take up or remove slack, to bring the scissors mechanism into a position where it can be effectively tightened.

> ☑ ***Note***
>
> The hardware kit includes flat head bolts and nuts.Teledyne Isco strongly recommends bolting the assembled scissors ring together before installation, using the holes provided for that purpose. Bolting the tongue sections together can greatly increase safety and prevent the assembly from being torn apart.

Do not overtighten the mechanism. It is designed to flex somewhat to provide a positive lock, once moderately tightened.

For installations in larger channels and/or high flow, extensions 2, 3, and 4 have slots for attaching the ring to the channel wall using appropriate anchoring hardware.

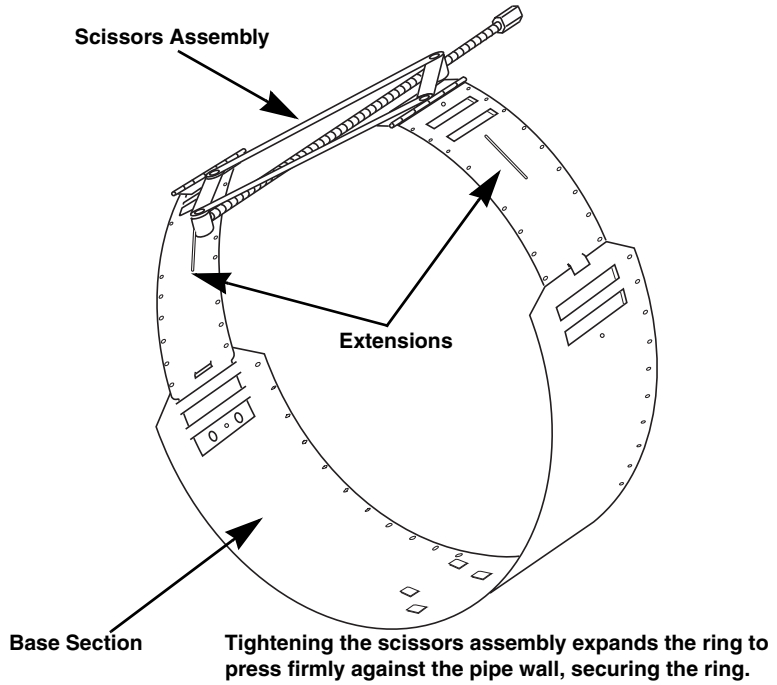


Figure 2-8 Scissors Ring adjustment

To prevent debris from catching on the probe cable, it is important to attach the cable to the mounting ring so it offers as little resistance to the flow as possible. Attach the sensor cable to the downstream edge of the ring, using the self-locking plastic ties supplied with the ring. Place the ties through the holes in the mounting ring and then lock them around the cable.

⚠ CAUTION

Do not overtighten the plastic cable ties; they should be tightened just enough to secure the cable in place, without greatly indenting the cable. Overtightening the plastic ties may collapse the reference tube in the cable, blocking it.

2.6.3 Completing the AV Sensor Installation

The AV sensor installation is finished by securing any excess sensor cable using cable clamps or other means.

The reference tube inside the cable can be restricted or blocked if the cable is kinked, sharply bent, coiled, or otherwise pinched. The sensor cable should be handled and mounted with care. Also, if there is any appreciable distance between the point where the sensor cable leaves the mounting apparatus and the location of the flow meter, *be sure* to attach the cable to the flow stream wall to prevent it from vibrating, moving around, tangling, or possibly collecting debris.

⚠ CAUTION

Under no circumstances should you leave any extra length of sensor cable dangling freely in the flow stream where it could trap debris or become tangled.

Use gloves and eye protection when assembling and installing the rings in a pipe. Though deburred, the edges of the stainless steel can cut if improperly handled. *Please read the information in the Isco Mounting Rings Manual on how best to install this device.*

Observe general safety procedures when entering any manhole. See “General Safety Procedures” in the back of this manual for more information on general hazards and necessary precautions.

2150 Area Velocity Flow Module

Section 3 Programming

3.1 Section Overview

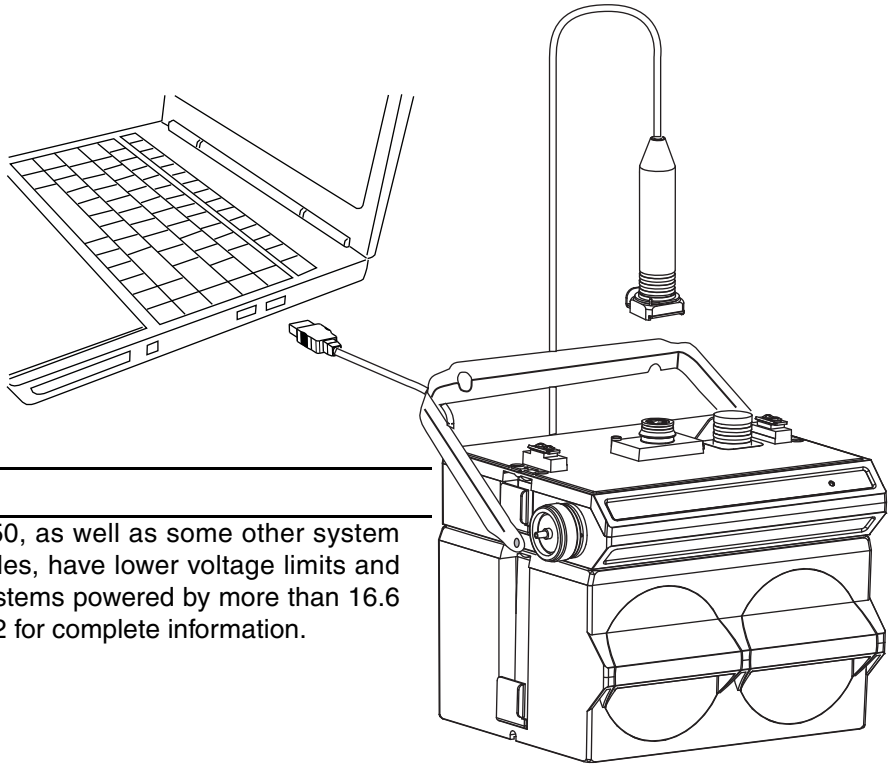
This section describes how to set up the operation of a 2150 Module using Isco's Flowlink for Windows software.

Flowlink Help

Detailed Flowlink instructions are beyond the scope of this manual. Flowlink's operating instructions are available in a Windows Help format. You can access the help topics for an active window by clicking on its *Help* button or by pressing F1 on your computer's keyboard. You can also access Help topics from a Contents and Index window (HELP>CONTENTS AND INDEX from the Flowlink menu).

3.2 Flowlink Connections

Make the necessary wiring connections to allow your computer to communicate with the site. Figure 3-1 shows a connection using Isco's *RS232 Communication Cable*, Isco part #60-2004-507.



☑ Note

Earlier versions of the 2150, as well as some other system components including cables, have lower voltage limits and cannot be connected in systems powered by more than 16.6 VDC. Refer to Section 2.2.2 for complete information.

Figure 3-1 Flowlink connections

An easy way to begin Flowlink communications with the site is to *Quick Connect*. As a default Flowlink setting, the Quick Connect dialog box opens when you start Flowlink. Click on the large *2100 Instruments* button to connect. Flowlink will read the 2100 system information and try to match it with an existing site in the open database. If Flowlink cannot find a match for the connected site, it creates a new site in the database.

3.2.1 Communication Resolution

During the connection process, Flowlink checks the stability of the site's communications. If communication is found to be unstable, Flowlink presents the *Communication Resolution* window.

There are two common causes of unstable communications. One cause is a Module Name conflict, which may occur when two or more modules at a site use the same module name. The second cause is a Site Name conflict, which occurs when a module added to the site indicates that it belongs to a different site.

The Communications Resolution window lets you choose how the modules should be reconfigured and which Site Name should be retained. To resolve the communications, select the sites and modules that should be reconfigured and click the OK button. Be aware that reconfiguring a module removes the Site Name, Module Name, program settings, *and any stored data*. The module is then restarted with the stable Site's Name, a default Module Name, and default program settings, and the data storage is ready to accept new data.

3.3 Program Settings

While connected, Flowlink displays the *Site View* window. This window contains all of the program settings that control the site's operation. The settings are grouped, or categorized, using five tabs: Measurements, Site Info, Modules, Data Storage, and a variable tab used to set up the various measurement types.

Essential Settings

Some program settings are essential to the operation of an AV Module and its attached AV Sensor. Five program settings should always be verified when you are setting up a new site:

- **Level** – Enter a liquid level measurement to calibrate the level readings from the AV Sensor (3.3.1).
- **Zero Level Offset** – If the AV Sensor is not installed in the bottom-center of the channel, the distance the AV Sensor is offset must be entered (3.3.2).
- **Set Flow Rate to zero if no velocity data checkbox** - Determines how the AV Module reports flow rates if stream velocity data is not available (3.3.3).
- **Flow Conversion** – The AV Module can calculate flow rate readings. To correctly convert the measured level and velocity readings to a flow rate, the flow conversion method and channel properties should be defined (3.3.5).
- **Silt Level** – The AV Module can compensate for a build up of silt around the sensor (3.3.6).

These five program settings directly affect the data collection. Incorrect settings may introduce errors in the measured data, many of which may prove to be difficult to correct afterwards.

Data Storage Settings

You should also check the Data Storage Rates while you are reviewing the program settings. You can view the storage rates on the Data Storage tab to ensure that pertinent types of data are being stored, and that the rates will provide a sufficient amount of data for your application. Refer to section 3.3.7 for instructions on how to modify the data storage rates.

General Settings

Once the site's communication has been resolved, the Site and Module Names may be changed to help you better manage the sites and data collection. Giving sites descriptive names such as "12th and Main Streets" can help you easily recognize the measurement locations, instead of generic terms such as "Site 1." Site and Module Names are discussed in sections 3.3.8 and 3.3.9.

Changing a Setting

After modifying a setting as described in sections 3.3.1 through 3.3.9, click on the APPLY button (or press F9 on your keyboard). Flowlink sends the change to the module and updates the site's settings in its Flowlink database.

3.3.1 Level

A measurement of the actual liquid depth should be taken to calibrate the level readings. The value of this measured depth should be entered on the *Level* measurement tab in Flowlink.

> ☑ ***Note***
>
> Before calibrating the level, allow a newly installed AV Sensor to stabilize under the stream conditions. If the sensor undergoes wide temperature variations between its storage and operating environments, it may take several minutes to stabilize.

Measurement Location

The location of your measurements can affect the flow conversion results. An understanding of how the AV Sensor measures level and velocity will help you determine where the measurements should be taken.

The AV Sensor transmits an ultrasonic sound wave. It propagates from the front of the sensor in a cone-shaped pattern. From within this cone, the AV Sensor measures the stream velocity. Therefore, your level measurement should be taken from a point inside the cone. Since this cone cannot be seen, a general rule is to measure in front of the sensor along the channel centerline at a distance equal to the liquid depth. For example, if the stream is one foot deep, take the level and channel dimension measurements one foot upstream from the sensor. If the flow at this point is turbulent, consider relocating the sensor.

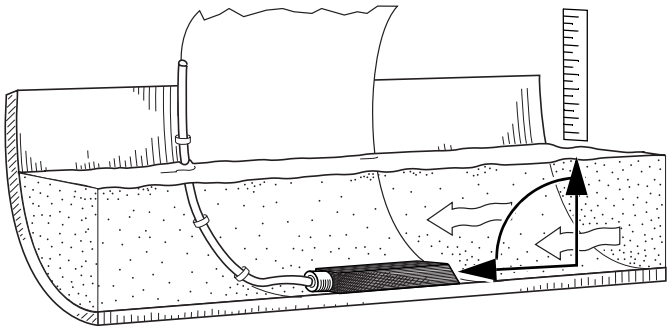
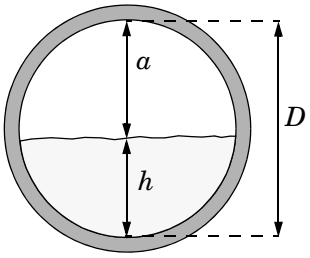


Figure 3-2 Preferred Measurement Location

Do not measure the level and channel dimensions right at the sensor, as the sensor and the mounting ring may cause a slight "jump" or localized rise in the level. At very low levels and high velocities, this jump in the liquid surface may become quite significant.

In round pipes you can measure the level without disturbing the stream surface. This method is preferred. Refer to the diagram to the left. First measure the inside diameter of the pipe (*D*). Then measure the airspace (*a*) from the liquid surface to the peak of the inside diameter. Average this measurement if the surface is not calm. The level measurement you enter (*h*) is calculated by subtracting the distance above the liquid (*d*) from the diameter (*D*).



Level (h) = D – a

If difficult channel conditions keep you from making the measurements as described above, another site should be considered. If this is impossible, you may opt for an alternative level calibration method. The method described below will often yield better results than entering a "best estimate" of the liquid level, but results within the listed performance specifications *may be compromised*.

Alternative Level Calibration

1. Fill a bucket with 6 to 12 inches (15 to 30 cm) of water.
2. Place the AV Sensor upside-down in the bucket of water to allow any air bubbles trapped under the sensor to escape.
3. After a few minutes, place the AV Sensor right-side up at the bottom of the bucket.
4. With the AV Sensor flat against the bottom of the bucket, measure the distance from the bottom surface of the bucket to the liquid surface. Enter the distance on the *Level* measurement tab in Flowlink.

3.3.2 Zero Level Offset

AV Sensors are sometimes offset in the channel to avoid heavy concentrations of silt, or to maximize the level resolution over a specific range. When the AV Sensor is offset, an offset distance must be entered on the *Velocity* measurement tab in Flowlink.

Refer to Figure **3-3**. Enter a value for the vertical distance the sensor is installed above the true zero level of the stream. For example, if the sensor is mounted on the side of the pipe two inches higher than the true zero level (the bottom center of the pipe), the Zero Level Offset is two inches. If the sensor is mounted at the bottom of the channel, enter zero.

> **Note**
>
> Do not confuse the circumferential distance between true zero and the location of the AV Sensor with the vertical distance (height). If you install the AV Sensor at the true zero level of the pipe or channel, you would enter "0" for the offset (ignoring the thickness of the mounting ring).

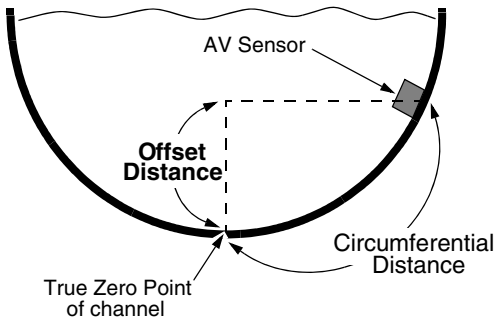


Figure 3-3 Zero Level Offset Measurement

3.3.3 No Velocity Data and Flow Rates

Occasionally velocity readings are lost because either a flow stream does not contain enough reflective particles, or the sensor is covered with silt. These lost velocity readings are logged as a "No Data Code." If the AV Module is set up to use area velocity flow conversion, it is then unable to calculate the flow rate. You can control how the Flow Rate readings will be reported during these conditions with the "Set flow rate to zero if no velocity data" checkbox, found on Flowlink's *Velocity* measurement tab.

- Checked, the AV Module stores the flow rate as 0.0 when velocity data is not available.
- Unchecked, the AV Module will use last valid velocity measurement in the flow rate calculation.

> **Note**
>
> Measuring velocity becomes extremely difficult at low liquid levels. When the level falls below one inch, the module no longer measures the velocity. Instead, velocity is interpolated based on measurements that occurred between one and seven inches of liquid.

3.3.4 Prevent Velocity Signal Interference

If the AV Sensors of a multiple module site are placed near each other it is important that each sensor receives its own transmitted signal. To prevent this sort of interference, you can synchronize the modules so that only one module may take a velocity measurement at any given moment.

To synchronize the velocity measurements of a multiple module site, check the *Prevent interference* box found on the *Velocity* measurement tab. You may leave this box unchecked for single module sites or multiple module sites measuring velocities of separate channels.

3.3.5 Flow Conversion

The AV Module is capable of determining flow rates using either area velocity conversion or level-to-flow rate conversion. Table **3-1** lists the available flow conversion methods.

The AV Module is capable of calculating and storing any two conversion methods simultaneously. Flow conversions are defined on the *Flow Rate* and *Flow Rate 2* measurement tabs in Flowlink. To do this, select the *Conversion Type* that matches your application, then enter the required parameters in the fields to the right of the selected conversion type.

Table 3-1 Flow Conversion Methods

Conversion Type		Device, Formula, or Table	Size or Parameters
Area Velocity	**Channel Shape**	Area × Velocity	Round Pipe, U-Channel, Rectangular, Trapezoidal, Elliptical
	Level-to-area Data Points	User-developed Table	3 to 50 data points
Level to Flow	**Weir**	V-Notch Weir	22.5, 30, 45, 60, 90, 120 degrees
		Rectangular Weir with end contractions	Crest Length
		Rectangular Weir without end contractions	Crest Length
		Thel-Mar	6, 8, 10, 12-14, 15-16 inches
		Cipoletti Weir	Crest Length
	Flume	Parshall Flume	1, 2, 3, 6, 9 inches 1, 1.5, 2, 3, 4, 5, 6, 8, 10, 12 feet
		Palmer-Bowlus Flume	4, 6, 8, 10, 12, 15, 18, 21, 24, 27, 30, 48 inches
		Leopold-Lagco	4, 6, 8, 10, 12, 15, 18, 21, 24, 30 inches
		“HS” Flume	0.4, 0.6, 0.8, 1.0 feet
		“H” Flume	0.5, 0.75, 1, 1.5, 2, 2.5, 3, 4.5 feet
		“HL” Flume	4.0 feet
		Trapezoidal Flume	Large 60-degree V Extra Large 60-degree V 2-inch, 45-degree WSC 12-inch, 45-degree SRCRC
	Flow Metering Insert	V-notch	6, 8, 10, 12 inches
		Round Orifice	6, 8, 10, 12 inches
	Manning Formula	Round Pipe	Slope, Roughness, Diameter
		U-Channel Pipe	Slope, Roughness, Width
		Rectangular Pipe	Slope, Roughness, Width
		Trapezoidal	Slope, Roughness, Bottom Width, Top Width
	Equation	Flow = 0.00*(Head^0.00) + 0.00*(Head^0.00)	
	Level-to-Flow Rate Data Points	User-developed tables for level-to-flow rate	3 to 50 data points

If the selected flow conversion requires channel dimensions, actual channel measurements should be taken. Channel measurements are preferred over nominal values. Significant errors may be introduced if your measurements are inaccurate. The example below illustrates the importance of accurate measurements.

Example:

Nominal Pipe Diameter:	10 inches
Actual Pipe Diameter:	10.25 inches
Level Measured Near Outfall:	2.75 inches
Correct Level Measurement:	3 inches

During programming, you enter 10 inches for the round pipe diameter - from the pipe manufacturer's specification. You also enter the 2.75 inch level measurement taken behind the sensor near an outfall. Although each setting has only a 0.25 inch error, the cumulative flow measurement error may exceed 14%!

Refer to the discussion on *measurement location* in section 3.3.1, and Figure 3-2 to determine where to measure the channel dimensions.

3.3.6 Silt Level

Silting in the flow stream will alter your channel dimensions, affecting the flow rate conversion. To compensate for a buildup of silt, a *Silt Level* value can be entered on the *Flow Rate* measurement tab in Flowlink. Silt level compensation is only available when using Area Velocity flow conversion.

3.3.7 Data Storage Rates

The data storage function of an AV Module can record level, velocity, flow rate, total flow, and input voltage readings. The interval at which the AV Module stores the readings is called the *Data Storage Rate*. The AV Module is shipped with default storage rates of 15 minutes for the level, velocity, and flow rate, and 1 hour for total flow and input voltage readings.

You can modify the data storage rates to log readings at a faster or slower rate. Keep in mind that although the AV Module can store data as fast as 1 reading every 15 seconds, faster storage rates will shorten battery life, increase memory usage, and lengthen *Retrieve Data* (interrogation) times.

You can also create conditional data storage rates. The AV Module can log data at a secondary rate when user-defined conditions have been met. For example, an AV Module can store level readings at a primary rate of 15 minutes, and a secondary rate of 1 minute when the level reading is greater than or equal to 1 foot. Secondary rates allow you to collect detailed data when defined events of interest occur, while reducing power and memory consumption when detailed readings are not needed.

To modify the Data Storage Rates, first click on the *Set Up Data Storage…* button on a measurement tab. Then enter the Primary and Secondary Rate settings on the *Data Storage Setup* window. Repeat this for each measurement type.

3.3.8 Site Name

The modules are shipped with default names so that they can immediately begin to communicate with Flowlink. You can change the site name to a more descriptive name on the *Site Info* tab in Flowlink. Keep in mind that the name must be unique among the other site names in the open Flowlink database.

Site names can be up to 20 characters long. Any character may be used in the name except:

/	forward slash	\	back slash
:	colon	*	asterisk
?	question mark	“	double-quote
<	left angle bracket	>	right angle bracket
|	bar	&	ampersand

3.3.9 Module Name

The modules are shipped with default names so that they can immediately begin to communicate with Flowlink. You can change a Module Name to a more descriptive name on the *Devices* tab in Flowlink. Keep in mind that the name must be unique among the other module names connected at that site.

To help you match up a single module in a stack with its module name in Flowlink, the Devices tab includes an *Identify* button. To identify a module, highlight the Module Name, then click the Identify button. The module will turn on its front-panel light so that you can identify which module at the site corresponds with the highlighted Module Name.

Module names can be up to 20 characters long. Any character may be used in the name, except for those noted in *Site Name*, Section 3.3.8.

2150 Area Velocity Flow Module

Section 4 Modbus Protocol

Sections 4.1 through 4.5 give an overview of the basic capabilities and operation of Modbus protocol as it applies to Isco 2100 Series flow modules.

For a Glossary of Terms and Common Acronyms, see sections 4.4 and 4.5.

For Modbus technical specifications, turn to section 4.6.

4.1 Introduction

Modbus is a simple command/response mechanism to read from and write to specific memory locations called *registers*. A register is a holding place for a piece of digital information within the equipment. There are three standard protocols for Modbus: Modbus RTU, Modbus TCP/IP, and Modbus ASCII. The Isco 2100 Series devices use Modbus ASCII protocol, the method discussed in this manual. Modbus ASCII has more liberal communication timing requirements. Modbus communication for the Isco 2100 Series provides a standard protocol that can be used to retrieve real-time data from a single module or stack of modules at a site, or multiple sites, over a wide area. The data can be sent to a central computer for display, data collection, or process control.

Modbus implementation is independent of Flowlink and cannot alter the Flowlink-programmed configuration of the module. Modbus cannot be used to retrieve historical data from a module's memory.

Due to the wide variety of configurations that can be made with Modbus, it is impossible to cover every usable application. This section will discuss the overall capabilities and operation of Modbus.

4.2 Operation

There are many standard, third party Modbus drivers and OPC servers that may be used to link a remote Modbus device, such as a 2100 Series module, to SCADA or process control software, such as Wonderware™ or Intellution™. The OPC server communicates with the remote instrumentation and accesses registers. The definition of what information is contained and where (the register number, or address) is decided by the manufacturer (Teledyne Isco).

In a 2100 module, the registers hold, but are not limited to, the current real-time value of the meter's level, velocity, flow, input voltage, temperature, and total flow readings, stored in specified register locations. A list of the 2100 register addresses, and what parameters are held where, is available in section 4.6.

By accessing these registers you can obtain the current value of whatever parameter you desire. The reading(s) can then be displayed or stored wherever you designate as a destination; for example, a process control computer.

> **☑ Note**
>
> Level, flow, velocity, and temperature data is stored in metric units only.

Not all registers are limited to read-only data storage. You can also use some registers for control purposes. For example, by writing a "1" value to register 24 ("Identify Module" register), you will tell a 2100 module to light the LED on the front of the module.

4.2.1 Establishing Communication

There are several different communications protocols supported in the 2100 series that require auto-baud rate detection. Because of this, each time a modbus connection is made, the module uses a polling mechanism to repeatedly send a command until a response is received. It may take up to 20 command retries before the module has identified the baud rate and a response is received.

4.2.2 Module Addressing

When connecting to a site via a Modbus OPC server, you use a dedicated line of communication to that module or stack from the OPC server, which can be a dedicated communications cable (direct connection) or a dedicated phone number (modem).

When you are using a direct connection, you are dedicating a specified COM port on the computer, and that COM port determines the site to which you are connecting.

When you are using a modem, the dedicated line is defined by the site's phone number.

If you connect more than one 2100 Series module at a site, the Modbus OPC server, while using the shared communication line for all of the modules within the network, must have some way to differentiate between the modules. When sending a command to a specific module, the command has an address field. This allows the server software to talk to, as well as control, the specified module, while ignoring other modules in the same stack or site.

Each module capable of Modbus Protocol communication will automatically create its own specific ASCII address within the site, using:

- The model numbers of the modules
- The user-defined module names

4.3 Configurations

A variety of configurations can be made with Modbus, either through direct connection or through a modem.

In the example shown in Figure 4-1, you are direct-connecting a server PC to two individual 2100 sites through Modbus, using the COM ports on the OPC Server, which are directly connected to the remote sites.

Connection to the module is made through the RS-232 communication port on the top of the module.

> **Note**
>
> For low power operation, we recommend connecting the module(s) to the computer using the straight-through cable (Isco part number 60-5314-529), which consumes less power, instead of our standard interrogation cable.

In Figure 4-1, the OPC Server PC must have two COM ports. Modbus requires one COM port each, for direct connection of each 2150.

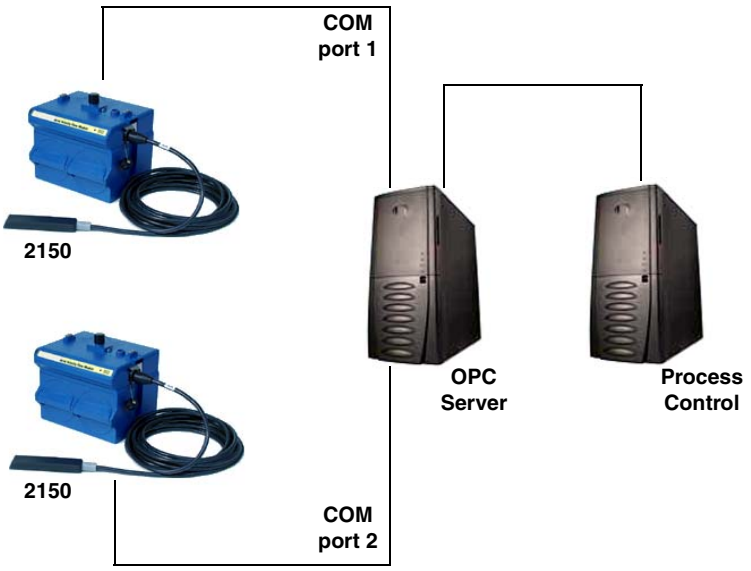


Figure 4-1 Configuration example

The operation sequence for the example above can be summarized in the following steps:

2150:

1. 2150s take readings from probes.
2. 2150s store readings (level, velocity, flow rate, etc.) in their specified registers.

Process Control:

3. The user requests data through Process Control.
4. Process Control asks the OPC server to gather information.

5. OPC connects to the 2150 stack through the cable (direct connection), takes register data from the specified 2150, and populates the OPC server's holding index.
6. Process Control takes data from the OPC server's holding index and gives data to the user.

Note that Process Control can be either manual or automated in this example, and that the OPC server and Process Control may be located physically on the same computer.

4.4 Glossary of Terms

ASCII – Short for American Standard Code for Information Interchange, ASCII is a code that represents English characters with numbers. Most computers represent text with ASCII code, making it possible for one computer or device to share data with another.

2100 modules support Modbus ASCII protocol.

Dedicated Line – A telecommunications path reserved for communication between two specified points and not shared among multiple points.

Modbus Protocol – Modbus Protocol is a messaging structure used to establish master-slave/client server communications between intelligent devices. Modbus is a simple command/response mechanism to read from and write to registers.

OPC – OPC (OLE for Process Control) means open connectivity via open (free for use) standards. It is a series of software standards specifications that fill a need in automation (like printer drivers did for Windows), acting as a translator for data transmission and process control.

The specification defines a standard set of objects, interfaces, and methods for use in process control and manufacturing automation applications to facilitate interoperability. There are hundreds of OPC Data Access servers and clients.

Registers – Registers are locations in memory that have specific data stored for retrieval or are used for control functions. A register is a holding place for a piece of digital information within the equipment. The definition of what is contained and where (the registry number, or address) is decided by the manufacturer (in this case Teledyne Isco).

SCADA – SCADA (Supervisory Control And Data Acquisition) is a computer system for gathering and analyzing real-time data. SCADA systems are used to monitor and control plant operation, or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining, and transportation.

The SCADA system transfers the information (for example, where a leak has occurred in a pipeline), back to a central site, alerting the home station of the leak, performing necessary analysis and control (such as determining if the leak is critical), and displaying the information in a logical and organized manner.

SCADA systems can be relatively simple, such as one that monitors the environmental conditions of a small office building, or very complex, such as a system that monitors all the activity in a nuclear power plant or a municipal water system.

4.5 Common Acronyms

ASCII – American Standard Code for Information Interchange

DCS – Distributed Control Systems

MTU – Master Terminal Unit

OPC – Object Linking and Embedding (OLE) for Process Control

PLC – Programmable Logic Controller

RTU – Remote Terminal Unit

SCADA – Supervisory Control And Data Acquisition

TCP/IP – Transmission Control Protocol/Internet Protocol

4.6 Register Specifications

All numbers in the Modbus registers are stored most significant byte first. If the polling device has a byte ordering of least significant byte first (an Intel-based PC, for example), the bytes will need to be reversed after they are received.

The Modbus ASCII address is used to index the data by modules.

Modbus ASCII address 1 contains information related to the site. The first register contains a 16-bit integer count of the number of modules that have data to report. The maximum number of modules that can be supported is 4.

Modbus ASCII addresses 2 through the number of the module in the stack (N) minus 1 contain data from the individual modules.

The Modbus ASCII addresses will be sorted by the model number, and then by module name, which is entered by the user through Flowlink. This allows the user to control the ordering of the addresses and easily predict what data will be in specific registers.

Every measured parameter has a corresponding status and measurement time that are updated with each measurement.

The maximum number of supported measurements from all modules in the system is 28.

The Modbus registers are assigned within 30 seconds after the 2100 module is powered up. To conserve power for the users who do not use Modbus communications, no Modbus registers will be updated with sensor readings until a Modbus master communicates with the 2100 module.

The register definitions for the Site Information device (Modbus ASCII address 1) are in Table 4-1 below:

Table 4-1 Modbus ASCII Address 1 Register Definitions

Register Number(s)	Name	Data type	Units	Read/Write
1	Number of module (N) (1-4)	16 bit integer	None	Read
2-20	Site name	38-byte string	None	Read

The register definitions for the individual modules (Modbus ASCII addresses 2+ (N-1)) are in Table 4-2 below:

Table 4-2 Modbus ASCII Address 2+(N-1) Register Definitions

Register Number(s)	Name	Data Type	Units	Read/Write
1-4	Model number	8-byte string	None	Read
5-23	Module name	38-byte string	None	Read
24[a]	Identify module	16 bit integer	None	Read/Write
25[b]	Take reading flag	16 bit integer	None	Read/Write
26[c]	Update interval	16 bit integer	Seconds	Read/Write
27[d]	Active flag 1	16 bit field	None	Read
28	Active flag 2	16 bit field	None	Read
29	Active flag 3	16 bit field	None	Read
30	Active flag 4	16 bit field	None	Read
40,41	Level	4-byte float	Meters	Read
42	Level status code[e]	16-bit integer		Read
43-48	Level time record	Time[f]		Read
55,56	Velocity	4-byte float	Meters/second	Read
57	Velocity status code	16-bit integer		Read
58-63	Velocity time record	Time		Read
70,71	Flow	4-byte float	Cubic Meters/sec	Read
72	Flow status code	16-bit integer		Read
73-78	Flow time record	Time		Read
85,86	Flow 1	4-byte float	Cubic Meters/sec	Read
87	Flow 1 status code	16-bit integer		Read
88-93	Flow 1 time record	Time		Read
100,101	Volume	4-byte float	Cubic Meters	Read
102	Volume status code	16-bit integer		Read
103-108	Volume time record	Time		Read
115,116	Volume 1	4-byte float	Cubic Meters	Read

Table 4-2 Modbus ASCII Address 2+(N-1) Register Definitions (Continued)

Register Number(s)	Name	Data Type	Units	Read/Write
117	Volume 1 status code	16-bit integer		Read
118-123	Volume 1 time record	Time		Read
130,131	Voltage	4-byte float	Volts	Read
132	Voltage status code	16-bit integer		Read
133-138	Voltage time record	Time		Read
145,146	Temperature	4-byte float	Degrees Celsius	Read
147	Temperature status code	16-bit integer		Read
148-153	Temperature time record	Time		Read
160,161	Internal Temp	4-byte float	Degrees Celsius	Read
162	Internal Temp status code	16-bit integer		Read
163-168	Internal Temp time record	Time		Read
175,176	Analog channel 1	4-byte float	0-100 percent	Read
177	Analog channel 1 status code	16-bit integer		Read
178-183	Analog channel 1 time record	Time		Read
190,191	Analog channel 2	4-byte float	0-100 percent	Read
192	Analog channel 2 status code	16-bit integer		Read
193-198	Analog channel 2 time Record	Time		Read
205,206	Analog channel 3	4-byte float	0-100 percent	Read
207	Analog channel 3 status code	16-bit integer		Read
208-213	Analog channel 3 time record	Time		Read
220,221	Analog channel 4	4-byte float	0-100 percent	Read
222	Analog channel 4 status code	16-bit integer		Read
223-228	Analog channel 4 time record	Time		Read
235,236	Analog channel 5	4-byte float	0-100 percent	Read
237	Analog channel 5 status code	16-bit integer		Read
238-243	Analog channel 5 time record	Time		Read
250,251	Analog channel 6	4-byte float	0-100 percent	Read
252	Analog channel 6 status code	16-bit integer		Read
253-258	Analog channel 6 time record	Time		Read
265,266	Analog channel 7	4-byte float	0-100 percent	Read
267	Analog channel 7 status code	16-bit integer		Read
268-273	Analog channel 7 time record	Time		Read
280,281	Analog channel 8	4-byte float	0-100 percent	Read
282	Analog channel 8 status code	16-bit integer		Read
283-288	Analog channel 8 time record	Time		Read

a. A write to the Identify module register will cause the module to perform the identify operation which may be a steady LED for a few seconds or a beep in the Field Wizard.

b. Setting the Take Reading flag to 1 will cause the module to update the registers with current data readings. It will be set to zero when the readings have all been updated. This may be used to initiate readings and poll for when they are ready to be read. It may take up to 50 seconds to update all the readings, depending upon the flow conditions. Setting the Take Reading flag to 2 causes an automatic, 15 second update of readings when a Modbus master is polling the 2100.

c. The Update Interval specifies an interval in seconds that the registers are automatically updated. It defaults to zero, which indicates that no automatic updating will occur.

d. The Active Flag (1-4) bit fields specify what fields/registers are active in the list. This provides support for a maximum of 64 fields. For example, if bit 0 of register 27 is set, the Level (registers 40,41) is active. If bit 1 of register 27 is set, then the Velocity (registers 55,56) is active. If bit 0 of register 28 is set, the Analog channel 7 (registers 265,266) is active.

e. A non-zero status code indicates a measurement problem.

f. Time is represented in a series of registers: Order is from lowest address to highest - Seconds (0-59), Minutes (0-59), Hours (0-23), Days (1-31), Month (1-12) and Year (1977-2099).

Table 4-3 2100 Measurement Parameters by Model Number*

2103, 2103c/g, 2105, 2105c/g	2108	2110	2150, 2151, 2151P
Voltage	Analog channel 1	Level	Level
	Analog channel 2	Flow	Velocity
	Analog channel 3	Volume	Flow
		Voltage	Flow 1
		Temperature	Volume
			Volume 1
			Voltage
			Temperature

*Single module only; does not include any additional connected devices. Subject to change.

2150 Area Velocity Flow Module

Section 5 Maintenance

5.1 Maintenance Overview

This section explains the maintenance requirements of the 2150 Module and its AV Sensor.

The 2100 Series system is designed to perform reliably in adverse conditions with a minimal amount of routine service requirements. To keep your system working properly, the following should be checked at regular intervals:

- Battery power (section 5.3)
- Desiccant (section 5.4)
- Channel conditions (section 5.5)

Maintenance intervals are affected by many variables. The number of modules powered by a Battery Module and the Data Storage Rate will affect the battery life. Humidity levels obviously affect the service life of the desiccant, and the amount of debris in the stream can drastically alter the channel conditions.

As a guide, a basic system installed in an environment with moderate humidity levels and an AV Sensor installed in a channel relatively free from debris and silt, the maintenance interval should not exceed three months. A basic system is defined as:

- a single AV Module and AV Sensor,
- powered by a fresh pair of alkaline lantern batteries,
- recording readings at the default intervals of 15 minutes.

Experience is often the best tool to use when establishing minimum maintenance intervals for your system. Until you have gained an understanding of the AV Module's operation under differing environmental conditions, a weekly maintenance interval is recommended.

5.2 Maintenance Kits

Teledyne Isco, Inc.
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

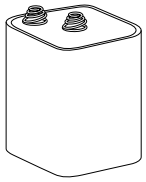
Phone: (800) 228-4373
(402) 464-0231
FAX: (402) 465-3022

E-mail:
IscoInfo@teledyne.com

Many of the parts called out in the *Installation* and *Maintenance* sections of this manual are available in maintenance kits. Kit number 60-2059-001, which supports the AV Module, contains O-rings for the connectors and desiccant cartridge, a hydrophobic filter, and a one-pound container of indicating silica gel desiccant. Kit number 60-2099-001, which supports the Battery Module, contains O-rings for the connectors, gaskets for the battery doors, humidity indicators, and bags of desiccant. You can order the kits by calling Teledyne Isco's Customer Service Department.

5.3 Batteries

Input voltage can be monitored while you are connected to the AV Module with Flowlink. The AV Module also can record Input Voltage readings to closely track the power consumption. Keep in mind that battery discharge rates vary widely depending on the configuration of your system and its operating environment. Batteries should be replaced according to the instructions in section 2.4.1.

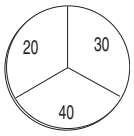


Lantern Battery

The batteries should be replaced with:

- new 6V alkaline lantern batteries (Isco P/N 340-2006-02), *or*
- fully-charged lead-acid batteries (Isco P/N 60-2004-041).

5.4 Desiccant



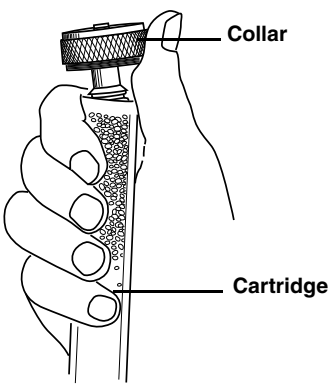
Battery Module
Humidity Indicator

The 2100 System devices use desiccant to protect the internal components from moisture damage. In the AV Module, a desiccant cartridge is used to dry the reference air for the sensor. This prevents moisture from plugging the reference line, which would cause the sensor to report erroneous level readings. The cartridge is filled with indicating silica gel that is yellow or blue when dry. As the desiccant becomes saturated, the color changes from blue to pink, or from yellow to green. Replace the desiccant before the entire length of the cartridge turns pink or green.

The Battery Module uses desiccant bags to keep the interior of the case dry. The bags are located inside the battery caps. Attached to the inside face of each cap is a humidity indicator. Humidity indicators have regions that display 20, 30, and 40 percent humidity levels. Ideally, each region should be completely blue. As the desiccant becomes saturated, the humidity levels will increase and the regions turn pink. When the 40 percent region begins to turn pink, the components are no longer adequately protected and the desiccant must be replaced.

5.4.1 Replacing the Desiccant: AV Module

The desiccant is contained in a cartridge located on the left side of the AV Module. To remove the cartridge, unscrew the collar and slide the cartridge out of the AV Module. The clear tube reveals the silica gel desiccant inside.



To replace the silica gel desiccant:

1. Hold the cartridge upright with the collar at the top.
2. As shown in the margin, push the collar off the cartridge.
3. Empty the saturated silica gel beads or granules.
4. Fill the tube with new (Isco P/N 099-0011-03) or reactivated (see section 5.4.3) silica gel desiccant.
5. Press the collar onto the tube.
6. Slide the cartridge into the AV Module. Tighten the collar to seal the cartridge in place.

5.4.2 Replacing the Desiccant: Battery Module

A bag of desiccant is located inside each of the battery caps behind a retaining plate. To replace the desiccant:

1. Loosen the two mounting screws that secure the metal retaining plate.
2. Rotate the retaining plate until it is free from the mounting screws.
3. Remove the spent desiccant bag from the cap and replace it with a new (Isco P/N 099-0002-33) or reactivated (see section 5.4.3) bag.
4. Replace the retaining plate and secure it with the screws.

5.4.3 Reactivating the Desiccant

Silica gel beads/granules and bags of desiccant can be reactivated.

⚠ CAUTION

Desiccant may produce irritating fumes when heated. Observe the following precautions:

- Use a vented oven in a well-ventilated room.
- Do not remain in the room while the regeneration is taking place.
- Use the recommended temperature. Avoid heating the desiccant at higher than recommended temperatures.

There have been reports of irritating fumes coming from the desiccant during reactivation. While our attempts to duplicate the problem have been unsuccessful, we still urge you to use caution. Material Safety Data Sheets are in the back of this manual.

The desiccant's ability to remove moisture may lessen with each saturation/reactivation cycle, resulting in a need for more frequent service. After several cycles, the desiccant may no longer be effective as it saturates too quickly. At this point, replace the desiccant.

Silica gel

To reactivate the silica gel desiccant, pour the spent desiccant into a heat resistant container. Never heat the cartridge assembly; it will melt. Heat the silica gel in a *vented convection oven* at 212° to 350°F (100° to 175°C) for two to three hours, or until the blue or yellow color returns. Allow the desiccant to cool and store it in an airtight container until ready for use.

Desiccant bags

Bagged desiccant will often include reactivation or recharging instructions on the bag's labeling. Always follow the instructions printed on the bag. If the instructions are not available, the bags may be heated in a *vented convection oven* at 245°F (120°C) for sixteen hours.

5.5 Channel Conditions

Because the sensor body offers a streamlined profile to the flow, solid materials rarely collect on the sensor. However, clear the channel upstream and downstream from the sensor periodically. This maintains the hydrostatic conditions on which the level-to-area conversion is based.

5.6 Other Maintenance

Other maintenance may be performed on the AV Module and sensor "as-needed." Sections 5.6.1 through 5.6.3 describe these activities.

5.6.1 Hydrophobic Filter

If the 2150 is in a humid location or submerged, a hydrophobic filter prevents water from entering the desiccant cartridge and reference line. Any amount of water will plug the filter and it must be rinsed with clean water and allowed to dry, or replaced so that the reference line can be reliably ventilated. *Drifting level readings are often an indication that the hydrophobic filter may be plugged*.

209-0093-93

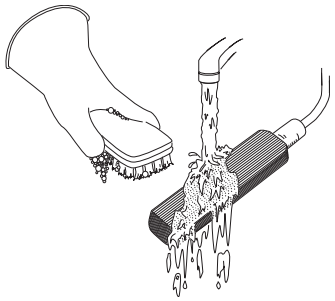
Remove the hydrophobic filter with a 5/8" or 16mm socket. Gently screw in the replacement filter (Isco part #209-0093-93).

If the hydrophobic filter frequently requires replacement, consider relocating the modules so that they are better protected.

5.6.2 Cleaning

The AV Module case may be cleaned with mild detergent and warm water. Before cleaning the module, ensure that all protective connector caps are in place.

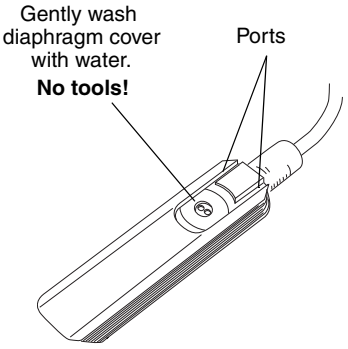
The cable and outer surfaces of the AV Sensor may also be cleaned with mild detergent and warm water.



If the flow stream carries a great deal of debris, beware of organic materials that may collect beneath the AV Sensor. This material swells as it becomes saturated with water and may exert pressure on the outer diaphragm. This can damage the transducer and permanently disable the AV Sensor. Keeping the ports clean not only prevents damage, but assures you that the AV Sensor will respond to the hydrostatic pressure above instead of the pressure created by swollen material.

If the ports become blocked:

1. Remove the sensor from its mounting ring, plate, or carrier.
2. Scrape any accumulated solids off the exterior of the sensor. Use a brush and flowing water.
3. Remove debris that has accumulated in the ports.
4. The outer diaphragm is behind the small round cover on the bottom of the sensor. It should be visible through the two small openings at the center of the cover. Gently flush the cover and holes with water to remove debris.



⚠ CAUTION

Avoid using tools near the cover openings. The transducer is extremely sensitive to pressure applied to its exposed surface. Direct or indirect contact with the outer diaphragm may permanently damage the AV Sensor.

5.6.3 Sensor Cable Inspection

Erroneous level or velocity readings may not always indicate a fault inside the AV Sensor body. A damaged cable can affect the operation of the sensor, particularly if the reference air tube inside the cable is collapsed or blocked. Damaged cables cannot be spliced or repaired.

If the AV Sensor cable is damaged, you must replace the entire assembly, as the sensor body and cable are a factory-sealed unit. Keep the connector clean and dry and install the cable so that it is not at risk of damage resulting from other activity taking place in the area. The connector can be replaced in some instances, depending on the condition of the cable.

In temporary installations, do not leave cables lying around where they may be stepped on or run over by heavy equipment. Do not leave extra cable loose in the flow stream where it can trap debris.

In permanent installations, cables repeatedly subjected to abuse will fail and should be installed in conduit for protection. The conduit must be large enough to pass the connector through, as you cannot remove or replace it.

5.7 How to Obtain Service

The internal components of the AV Module are not user-serviceable. The case is completely sealed to protect the internal components. To repair the unit, the case must be broken open and replaced. If you think your module requires repair, contact Teledyne Isco's Technical Service Department.

Teledyne Isco, Inc.
Technical Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: (800) 228-4373
(402) 464-0231
FAX: (402) 465-3085

E-mail:
IscoService@teledyne.com

The pressure transducer, the ultrasonic transducers, cable connections, and the electronic components of the AV Sensor are encapsulated in plastic resin and are not user-serviceable. If any part of the AV Sensor fails, it must be replaced.

Corresponding with a Teledyne Isco Technical Service Representative can often resolve the problem without the need to return the item. If the difficulty cannot be resolved you will be issued a Return Authorization Number (RAN) and information on returning it to the factory.

5.7.1 Diagnostics

As a troubleshooting aid, many module functions can generate a diagnostic file. With the assistance of a Teledyne Isco Technical Service Representative, the diagnostic files can often be used to isolate a problem.

To view a diagnostic file, connect to the site with Flowlink. View the measurement tab of the suspect function and click on the *Diagnostics...* button. The module then generates the file and sends it to Flowlink where it is displayed as a text report.

Flowlink can also collect all of the diagnostic files while retrieving data. The last available diagnostic files are always kept in Flowlink's database where they can be viewed "off-line" at a later time. To enable Flowlink to automatically collect all diagnostic files while retrieving the data, open the *Utilities>Options* from the menu and check the *Retrieve data gets text reports* box on the 2100 tab.

2150 Area Velocity Flow Module

Appendix A Replacement Parts

A.1 Replacement Parts Diagrams and Listings

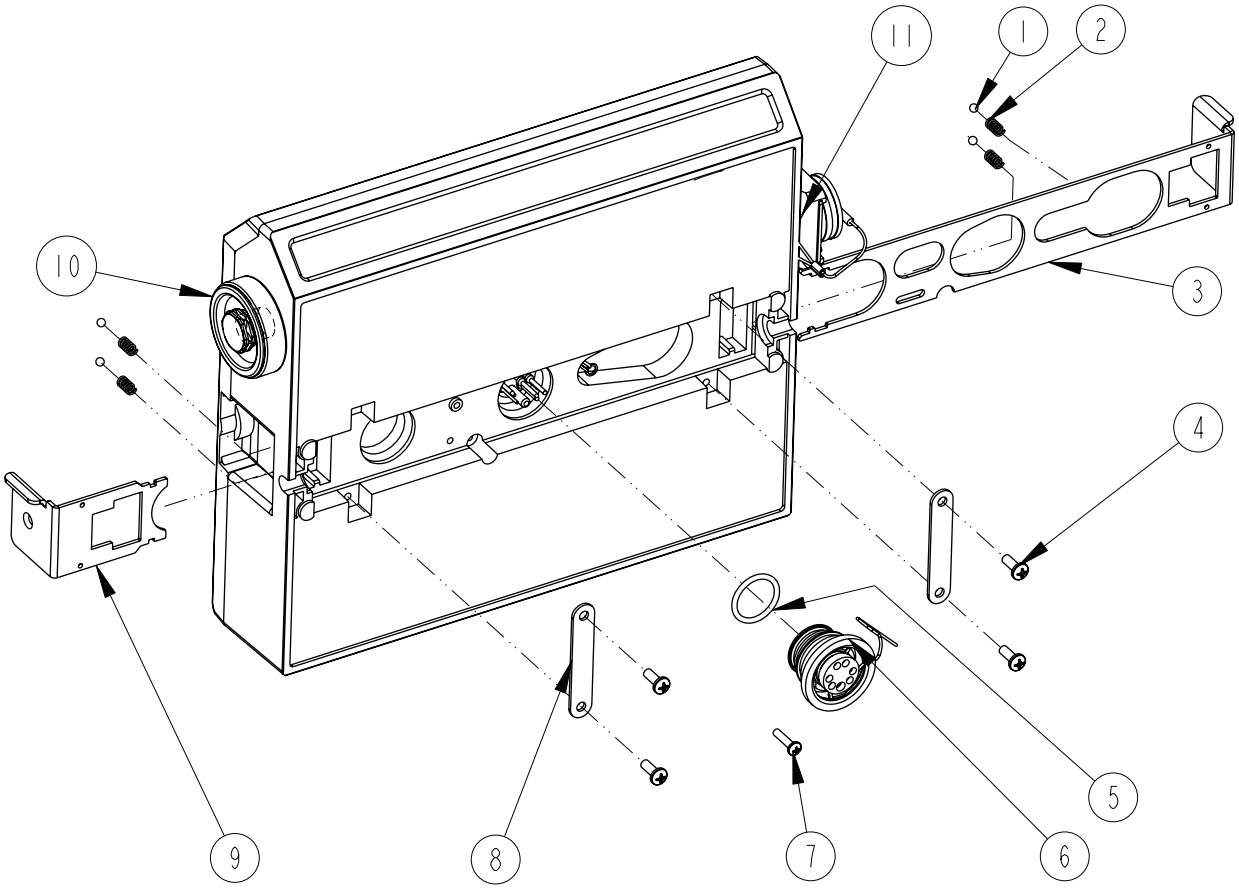
Replacement parts are called out in illustrations in this section. Reference the call-outs in the accompanying tables to determine the part number for the item.

Replacement parts can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco, Inc.
Customer Service Department
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: (800) 228-4373
(402) 464-0231
FAX: (402) 465-3022

E-mail: IscoInfo@teledyne.com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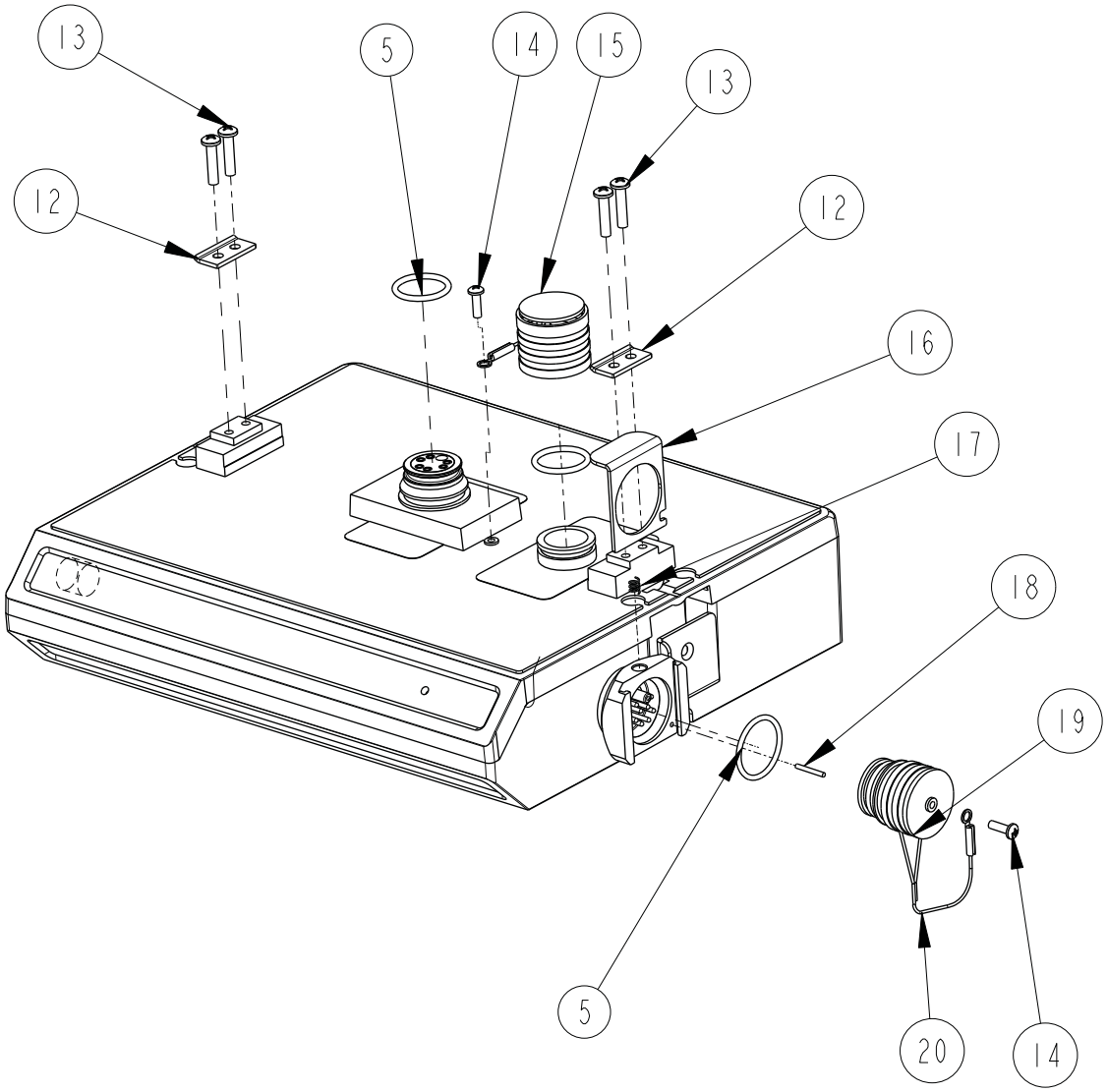
SHEET 1 OF 5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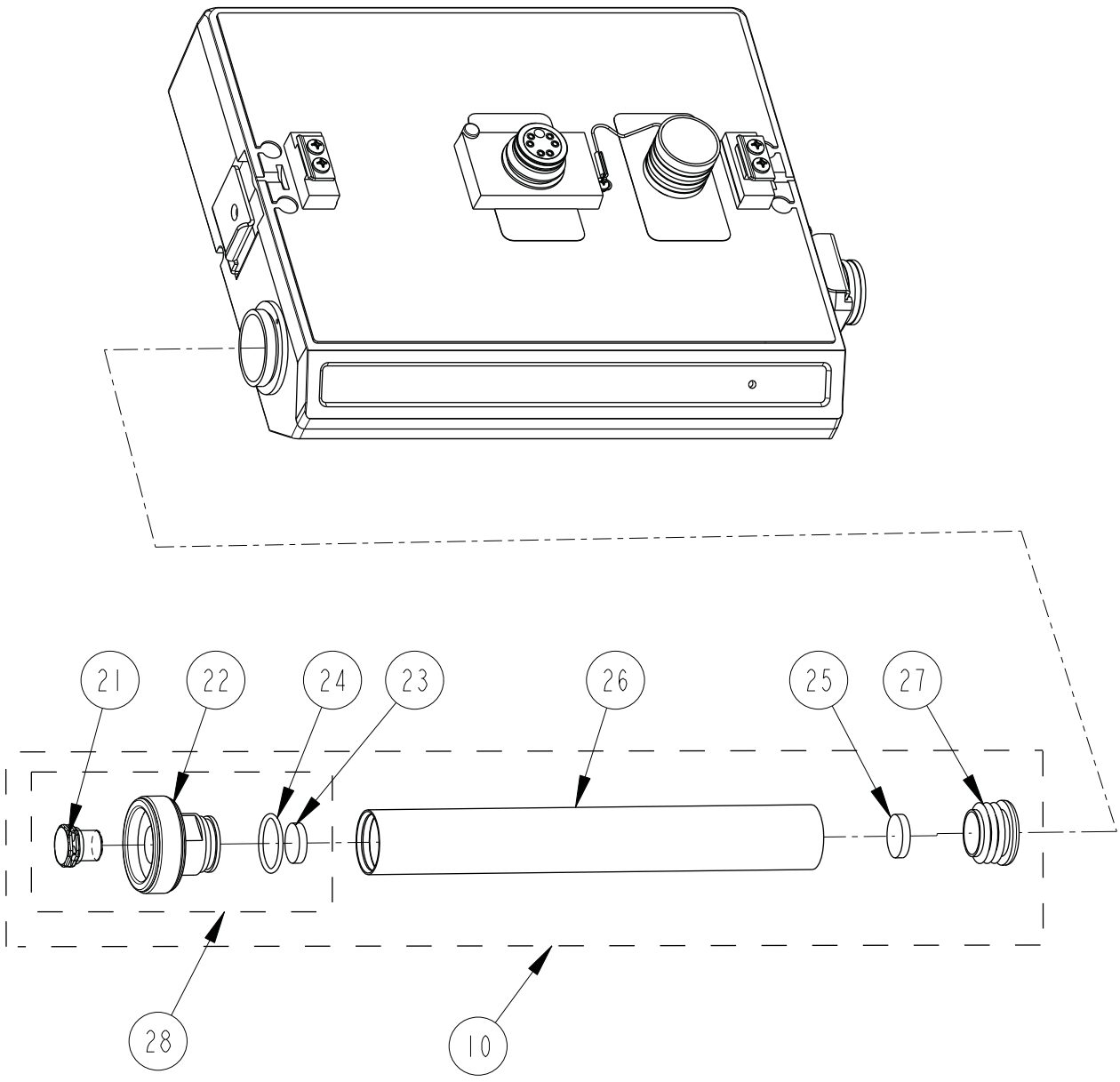
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602003112

REPLACEMENT PARTS LIST

SHEET: 4 OF 5

TELEDYNE ISCO, INC.

REV: E | DATE: 022008

ITEM NO.	PART NUMBER	DESCRIPTION
1	201900102	BALL .125 DIAMETER 316 SST
2	203011602	COMPRESSION SPRING, .022 DIAMETER WIRE, .31 FREE LENGTH
3	692003190	LARGE LATCH
4	231311206	SCREW, SELF TAP #6 X 3/8, PAN HEAD, PHILLIPS, SST
5	202100669	O RING,.669 ID,.079 CROSS SECTION, BUNA-N RUBBER
6	602004013	PLUG ASSEMBLY FEMALE CONNECTOR (includes item 5)
7	231611108	SCREW, SELF TAP, #4 X 1/2, PAN HEAD PHILLIPS, SST
8	602003022	LATCH HOLD
9	692003189	SMALL LATCH
10	602004016	DESICCANT ASSEMBLY (includes items 21 thru 27)
11	602004033	PLUG ASSEMBLY, FEMALE PROBE (includes items 5, 14, 19, and 20)
12	602003019	NODE CLIP
13	231514920	SCREW, SELF TAP, 6-19 X 5/8 TORX, PAN HEAD, SST
14	231310140	SCREW, SELF TAP, #4 X 3/8, PAN HEAD PHILLIPS, SST
15	602004012	CAP ASSEMBLY, MALE CONNECTOR
16	602003018	CONNECTOR CLIP
17	203011105	COMPRESSION SPRING, .026 DIAMETER WIRE, .31 FREE LENGTH
18	236410408	PIN, SPRING, 1/16 X 1/2 LONG SST
19	602003076	PLUG, FEMALE PROBE
20	692003172	CABLE, FEMALE PROBE PLUG
21	209009393	SCREW IN FILTER
22	602004265	DESICCANT CAP ASSEMBLY
23	692203300	FRIT, .620 DIA.
24	202500017	O-RING, .676 ID, .070 CROSS SECTION, BUNA-N RUBBER
25	692203301	FRIT, .670 DIA.
26	602003046	DESICCANT TUBE

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.

602003112

REPLACEMENT PARTS LIST

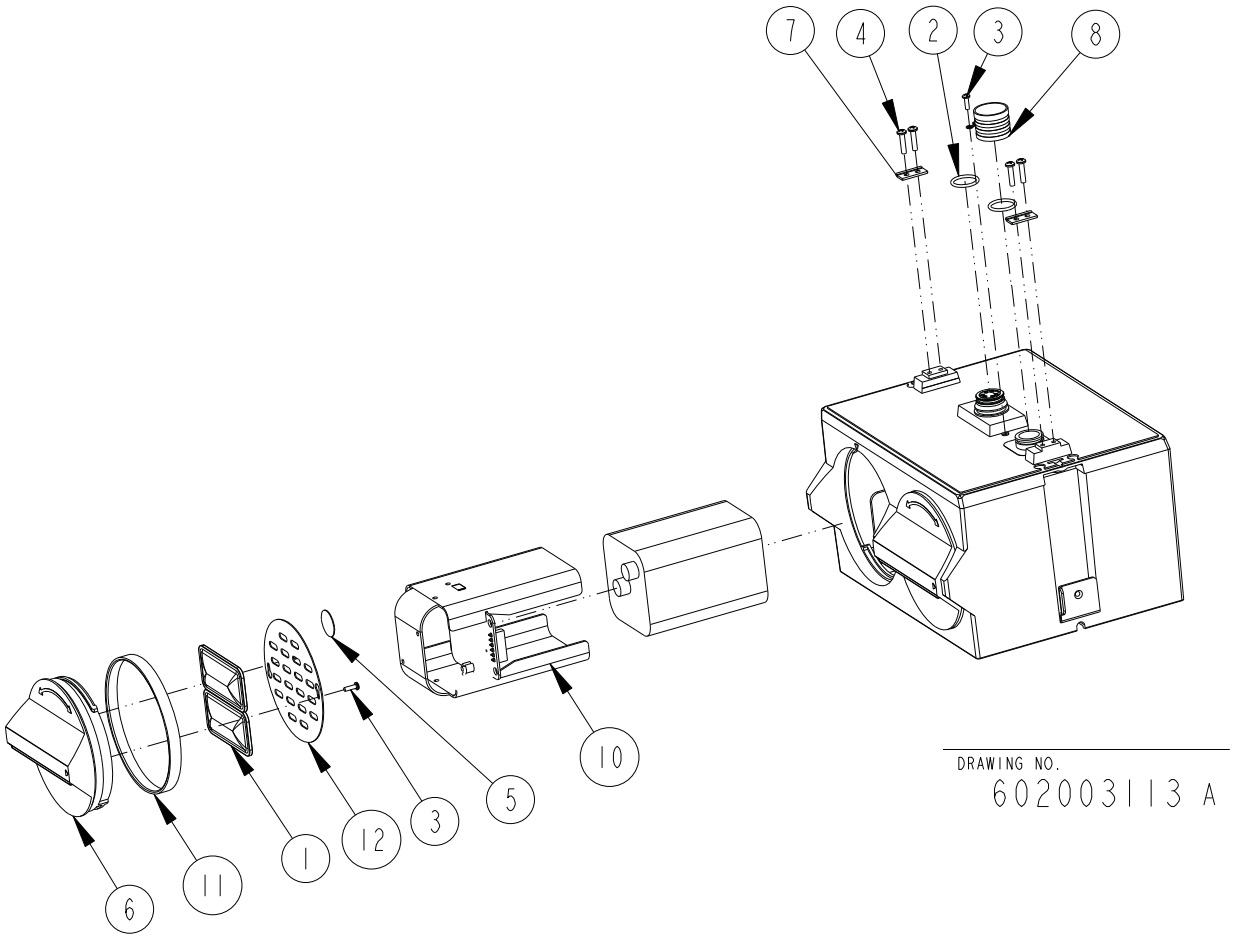
SHEET: 5 OF 5

TELEDYNE ISCO, INC.

REV: E | DATE: 022008

ITEM NO.	PART NUMBER	DESCRIPTION
27	602003074	CAP PLUG MODIFICATION, DESICCANT
28	602004270	GORE DESICCANT CAP

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.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602003113

REPLACEMENT PARTS LIST

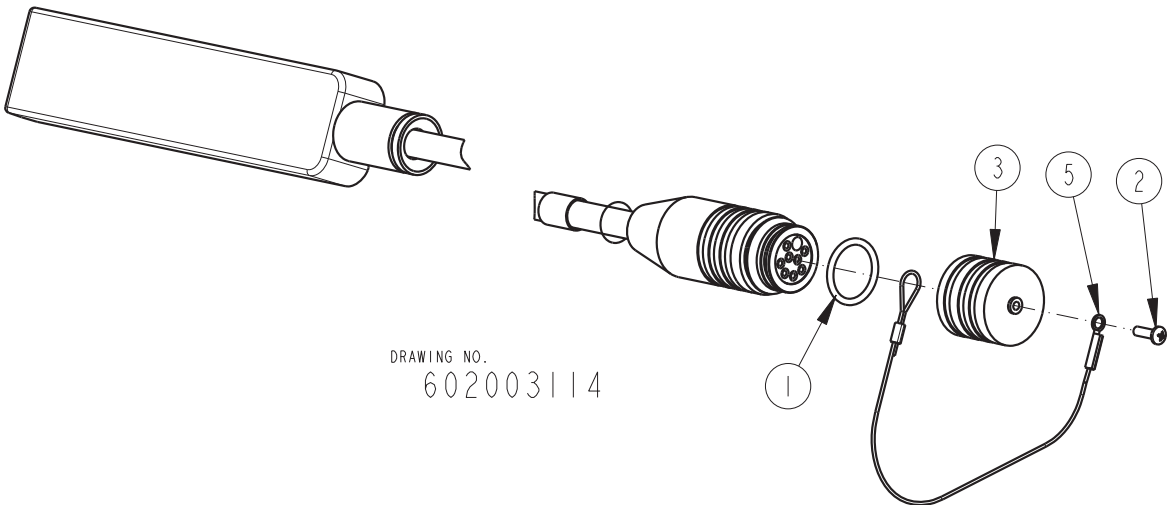
SHEET: 2 OF 2

TELEDYNE ISCO, INC.

REV: A | DATE: 06200

ITEM NO.	PART NUMBER	DESCRIPTION
1	099000201	DESICCANT BAG 16.5 GRAM
2	202100669	O RING, .669 ID, .079 CROSS SECTION, BUNA-N RUBBER
3	231310140	SCREW, SELF TAP, #4 X 3/8, PAN HEAD, PHILLIPS, SST
4	231514920	SCREW, SELF TAP 6-19 X 5/8, TORX, PAN HEAD, SST
5	490001300	HUMIDITY INDICATOR CARD
6	602003014	CAP BATTERY NODE
7	602003019	NODE CLIP
8	602004012	CAP ASSEMBLY, MALE CONNECTOR
9	602004017	BATTERY CAP ASSEMBLY (Includes 1, 3, 5, 6, 11, & 12)
10	602004030	BATTERY HOLDER ASSEMBLY
11	692003017	BATTERY CAP GASKET
12	692003067	BATTERY CAP PLATE
3	Refer to 2150/2110 module for a listing of parts associated with latch and lower communication port cap.	

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.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REPLACEMENT PARTS LIST

SHEET: 2 OF 2

Isco, Inc.

REV: | DATE: 03294

ITEM NO.	PART NUMBER	DESCRIPTION
1	202100669	O RING, .669 ID, .079 CROSS SECTION, BUNA-N RUBBER
2	231310140	SCREW, SELF TAP, #4 X 3/8, PAN HEAD, PHILLIPS, SST
3	602003075	CAP, MALE PROBE
4	602004034	CAP ASSEMBLY, MALE PROBE (Includes items 2, 3, & 5)
5	692003174	CABLE, MALE PROBE CAP

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.

2150 Area Velocity Flow Module

Appendix B Accessories

B.1 How to Order

Accessories can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco, Inc.
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: (800) 228-4373
(402) 464-0231
FAX: (402) 465-3022

E-mail: IscoInfo@teledyne.com

B.2 General Accessories

2150 A/V Sensor	60-2004-135
Tubing, Reference Air Extension, 10 ft.	60-2003-104
Alkaline Lantern Battery	340-2006-02
Rechargeable 6V Lead-acid Lantern Battery	60-2004-041
Charging Adapter for 6V Lead-acid Lantern Battery	60-2004-040
Power adaptor cable for Isco batteries and power packs, 2 ft standard, CE-rated	69-2004-451
RS232 Communication Cable	60-2004-046
USB Communication Cable	60-2004-507
2100 Module to Module Extension Cable	60-2004-056
Sampler Interface Cable	60-2004-260
2108 Analog Output Module	68-2000-010
Flowlink for Windows Software	CALL
ProHanger *bracket for 18–20 inch (45–50 cm) manhole*	209-9006-01
ProHanger *bracket for 20–22 inch (50–56 cm) manhole*	209-9006-02
Spreader Bar *adjusts from 22.5 to 48 inches (57 to 122 cm)*	60-3004-110
Instruction Manual	60-2004-038
Isco Open Channel Flow Measurement Handbook	60-3003-041

B.3 Maintenance Kits

AV Module Maintenance Kit	60-2059-001
Battery Module Maintenance Kit	60-2099-001

B.4 AV Sensor Mounting Accessories

The 2150 Area Velocity Sensor can be installed using Isco's installation systems listed below. A Low Profile Carrier is optional when attaching the AV Sensor to any system listed below.

Low Profile Carrier *(attaches the 2150 AV sensor to a standard-size ring or plate)* 60-3204-029

Standard Spring Rings *(Each ring includes plastic ties to fasten the cable and a manual)*

- 6" Dia 68-3200-007
- 8" Dia 68-3200-008
- 10" Dia 68-3200-009
- 12" Dia 68-3200-010
- 15" Dia 68-3200-011

Standard Scissors Rings *(Each scissors ring includes a base section, scissors mechanism, extensions, plastic ties, and a manual)*

- 16-24" Pipe. 68-3000-042
- 26-38" Pipe. 68-3000-043
- 38-44" Pipe. 68-3000-044
- 44-48" Pipe. 68-3000-045
- 60" Pipe 68-3000-046
- 72" Pipe 68-3000-047
- 16-60" Pipe. 68-3000-048

Base Section *(with plastic ties and manual)* 60-3004-169

Street Level Installation System

- Multi-section Pole *(Includes manual. To complete your system, you must also order a Street Level Mounting Ring)* 60-3204-012
- Street Level Mounting Ring for 6" dia. pipe 60-3204-014
- Street Level Mounting Ring for 8" dia. pipe 60-3204-015
- Street Level Mounting Ring for 10" dia. pipe 60-3204-016
- Street Level Mounting Ring for 12" dia. pipe 60-3204-017
- Street Level Mounting Ring for 15" dia. pipe 60-3204-018

Sensor Mounting Plate *(With plastic ties & instructions)* . . 68-3000-051

2150 Area Velocity Flow Module

Appendix C Material Safety Data Sheets

C.1 Overview

This appendix to the manual provides Material Safety Data Sheets for the desiccant used by the 2150 Area Velocity Module and 2191 Battery Module.

Teledyne Isco cannot guarantee the accuracy of the data. Specific questions regarding the use and handling of the products should be directed to the manufacturer listed on the MSDS.

101 Christine Drive
Belen, New Mexico 87002
Phone: (505) 864-6691
Fax: (505) 861-2355

SÜD-CHEMIE
Performance Packaging

ISO 9002

MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

SECTION I -- PRODUCT IDENTIFICATION

Trade Name and Synonyms:	Silica Gel, Synthetic Amorphous Silica, Silicon, Dioxide
Chemical Family:	Synthetic Amorphous Silica
Formula:	$SiO_2.x\ H_2O$

SECTION II -- HAZARDOUS INGREDIENTS

Components in the Solid Mixture

COMPONENT	CAS No	%	ACGIH/TLV (PPM)	OSHA-(PEL)
Amorphous Silica	63231-67-4	>99	PEL - 20 (RESPIRABLE), TLV – 5	LIMIT – NONE, HAZARD - IRRITANT ˝

Synthetic amorphous silica is not to be confused with crystalline silica such as quartz, cristobalite or tridymite or with diatomaceous earth or other naturally occurring forms of amorphous silica that frequently contain crystalline forms.

This product is in granular form and packed in bags for use as a desiccant. Therefore, no exposure to the product is anticipated under normal use of this product. Avoid inhaling desiccant dust.

SECTION III -- PHYSICAL DATA

Appearance and Odor:	White granules; odorless.
Melting Point:	>1600 Deg C; >2900 Deg F
Solubility in Water:	Insoluble.
Bulk Density:	>40 lbs./cu. ft.
Percent Volatile by Weight @ 1750 Deg F:	<10%.

101 Christine Drive
Belen, New Mexico 87002
Phone: (505) 864-6691
Fax: (505) 861-2355

SÜD-CHEMIE
Performance Packaging

ISO 9002

MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

SECTION IV -- FIRE EXPLOSION DATA

Fire and Explosion Hazard - Negligible fire and explosion hazard when exposed to heat or flame by reaction with incompatible substances.

Flash Point - Nonflammable.

Firefighting Media - Dry chemical, water spray, or foam. For larger fires, use water spray fog or foam.

Firefighting - Nonflammable solids, liquids, or gases: Cool containers that are exposed to flames with water from the side until well after fire is out. For massive fire in enclosed area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of the tank due to fire.

SECTION V -- HEALTH HAZARD DATA

Health hazards may arise from inhalation, ingestion, and/or contact with the skin and/or eyes. Ingestion may result in damage to throat and esophagus and/or gastrointestinal disorders. Inhalation may cause burning to the upper respiratory tract and/or temporary or permanent lung damage. Prolonged or repeated contact with the skin, in absence of proper hygiene, may cause dryness, irritation, and/or dermatitis. Contact with eye tissue may result in irritation, burns, or conjunctivitis.

First Aid (Inhalation) - Remove to fresh air immediately. If breathing has stopped, give artificial respiration. Keep affected person warm and at rest. Get medical attention immediately.

First Aid (Ingestion) - If large amounts have been ingested, give emetics to cause vomiting. Stomach siphon may be applied as well. Milk and fatty acids should be avoided. Get medical attention immediately.

First Aid (Eyes) - Wash eyes immediately and carefully for 30 minutes with running water.

101 Christine Drive
Belen, New Mexico 87002
Phone: (505) 864-6691
Fax: (505) 861-2355

SÜD-CHEMIE
Performance Packaging

ISO 9002

MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

NOTE TO PHYSICIAN: This product is a desiccant and generates heat as it adsorbs water. The used product can contain material of hazardous nature. Identify that material and treat accordingly.

SECTION VI -- REACTIVITY DATA

Reactivity - Silica gel is stable under normal temperatures and pressures in sealed containers. Moisture can cause a rise in temperature which may result in a burn.

SECTION VII --SPILL OR LEAK PROCEDURES

Notify safety personnel of spills or leaks. Clean-up personnel need protection against inhalation of dusts or fumes. Eye protection is required. Vacuuming and/or wet methods of cleanup are preferred. Place in appropriate containers for disposal, keeping airborne particulates at a minimum.

SECTION VIII -- SPECIAL PROTECTION INFORMATION

Respiratory Protection - Provide a NIOSH/MSHA jointly approved respirator in the absence of proper environmental control. Contact your safety equipment supplier for proper mask type.

Ventilation - Provide general and/or local exhaust ventilation to keep exposures below the TLV. Ventilation used must be designed to prevent spots of dust accumulation or recycling of dusts.

Protective Clothing - Wear protective clothing, including long sleeves and gloves, to prevent repeated or prolonged skin contact.

Eye Protection - Chemical splash goggles designed in compliance with OSHA regulations are recommended. Consult your safety equipment supplier.

101 Christine Drive
Belen, New Mexico 87002
Phone: (505) 864-6691
Fax: (505) 861-2355

SÜD-CHEMIE
Performance Packaging

ISO 9002

MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

SECTION IX -- SPECIAL PRECAUTIONS

Avoid breathing dust and prolonged contact with skin. Silica gel dust causes eye irritation and breathing dust may be harmful.

* No Information Available

HMIS (Hazardous Materials Identification System) for this product is as follows:

Health Hazard	0
Flammability	0
Reactivity	0
Personal Protection	HMIS assigns choice of personal protective equipment to the customer, as the raw material supplier is unfamiliar with the condition of use.

Material Safety Data Sheet

Indicating Silica Gel

Identity (Trade Name as Used on Label)

Manufacturer : MULTISORB TECHNOLOGIES, INC. (formerly Multiform Desiccants, Inc.)	MSDS Number* : M75
Address: 325 Harlem Road Buffalo, NY 14224	CAS Number* :
Phone Number (For Information): 716/824-8900	Date Prepared: July 6, 2000
Emergency Phone Number: 716/824-8900	Prepared By* : G.E. McKedy

Section 1 - Material Identification and Information

Components - Chemical Name & Common Names (Hazardous Components 1% or greater; Carcinogens 0.1% or greater)	%*	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Silica Gel SiO_2	98.0	6mg/m^3 (total dust)	10mg/m^3 (total dust)	
Cobalt Chloride	>2.0	0.05mg/m^3 (TWA cobalt metal dust & fume)	.05mg/m^3 (Cobalt, TWA)	
Non-Hazardous Ingredients				
TOTAL	100			

Section 2 - Physical/Chemical Characteristics

Boiling Point	N/A	Specific Gravity (H_20 = 1)	2.1
Vapor Pressure (mm Hg and Temperature	N/A	Melting Point	N/A
Vapor Density (Air =1)	N/A	Evaporation Rate (_____=1)	N/A
Solubility in Water	Insoluble, but will adsorb moisture.	Water Reactive	Not reactive, but will adsorb moisture.
Appearance and Odor	Purple crystals, no odor.		

Section 3 - Fire and Explosion Hazard Data

Flash Point and Methods Used	N/A	Auto-Ignition Temperature	N/A	Flammability Limits in Air % by Volume	N/A	LEL	UEL
Extinguisher Media	Dry chemical, carbon dioxide and foam can be used.						
Special Fire Fighting Procedures	Water will generate heat due to the silica gel which will adsorb water and liberate heat.						
Unusual Fire and Explosion Hazards	When exposed to water, the silica gel can get hot enough to reach the boiling point of water. Flooding with water will reduce the temperature to safe limits.						

Section 4 - Reactivity Hazard Data

STABILITY ☐**Stable** ☐**Unstable**	Conditions To Avoid	Moisture and high humidity environments.
Incompatibility (Materials to Avoid)	Water.	
Hazardous Decomposition Products	Carbon dioxide, carbon monoxide, water	
HAZARDOUS POLYMERIZATION ☐May Occur	Conditions To Avoid	None.

*Optional

Section 5 - Health Hazard Data

PRIMARY ROUTES OF ENTRY	☐Inhalation ☐Skin Absorption	☐Ingestion ☐Not Hazardous	**CARCINOGEN LISTED IN**	☐NTP ☐IARC Monograph	☐OSHA ☐Not Listed
HEALTH HAZARDS	Acute	May cause eye, skin and mucous membrane irritation.			
	Chronic	Prolonged inhalation may cause lung damage.			
Signs and Symptoms of Exposure	Drying and irritation.				
Medical Conditions Generally Aggravated by Exposure	Asthma.				
EMERGENCY FIRST AID PROCEDURES - Seek medical assistance for further treatment, observation and support if necessary.					
Eye Contact	Flush with water for at least 15 minutes.				
Skin Contact	Wash affected area with soap and water.				
Inhalation	Remove affected person to fresh air.				
Ingestion	Drink at least 2 glasses of water.				

Section 6 - Control and Protective Measures

Respiratory Protection (Specify Type)	Use NIOSH approved dust mask or respirator.		
Protective Gloves	Light cotton gloves.	Eye Protection	Safety glasses.
VENTILATION TO BE USED	☐ Local Exhaust	☐Mechanical (General)	☐Special
	☐Other (Specify)		
Other Protective Clothing and Equipment	None.		
Hygienic Work Practices	Avoid raising dust. Avoid contact with skin, eyes and clothing.		

Section 7 - Precautions for Safe Handling and Use/Leak Procedures

Steps to be Taken if Material Is Spilled Or Released	Sweep or vacuum up and place the spilled material in a waste disposal container. Avoid raising dust.
Waste Disposal Methods	Dispose in an approved landfill according to federal, state and local regulations.
Precautions to be Taken In Handling and Storage	Cover promptly to avoid blowing dust. Wash after handling.
Other Precautions and/or Special Hazards	Keep in sealed containers away from moisture. The silica gel will readily adsorb moisture.

*Optional Indicating Silica Gel

MULTISORB
Multisorb Technologies Inc.

MATERIAL SAFETY DATA SHEET

Effective Date March 8, 2005
MSDS Number M163

Section 1 – Product and Company Information

Product Name: **Silica gel, indicating, yellow**

Product Use: Desiccant, absorbent
Grades: Silica gel, indicating
Synonyms: Amorphous silica gel, SiO_2, silicon dioxide (amorphous)

Company; Multisorb Technologies, Inc.
Street Address: 325 Harlem Road
City, State, Zip, Country: Buffalo, NY 14224-1893 USA

Telephone Number: (716) 824 8900 [USA] Monday - Friday (8:00 - 5:00 EDT)
Fax Number: (716) 824 4091 [USA]
Website / E-Mail : multisorb.com

Section 2 – Composition / Information on Ingredients

Component Name	CAS Number	% by Weight
Synthetic amorphous silica gel (SiO_2)	112926-00-8	100
Phenolphthalein	77-09-08	100 ppm

While this material is not classified, this MSDS contains valuable information critical to the safe handling and proper use of this product. This MSDS should be retained and available for employees and other users of this product.

Section 3 – Hazard Identification

Emergency Overview: A yellow bead or granular material that poses little or no immediate hazard. This material is not combustible.

Potential Health Effects:

Eyes: Dust and or product may cause eye discomfort and irritation seen as tearing and reddening.

Skin: The product dust may cause drying of the skin. Silica gel may get hot enough to burn skin when it adsorbs moisture rapidly. Use an excess of water to cool the silica gel.

Ingestion: Material is not toxic and will pass through the body normally.

Inhalation: Slight irritation is possible but none is expected.

Medical Effects Generally Aggravated by Exposure: Respiratory ailments.

Chronic Effects/Carcinogenity: May cause eye, skin and mucous membrane irritation and drying.

Section 8 – Exposure Controls/Personal Protection

Engineering Controls: Use exhaust ventilation to keep the airborne concentrations below the exposure limits.

Respiratory Protection: Use NIOSH approved respirator when the air quality levels exceed the TLV's.

Skin Protection: Light gloves will protect against abrasion and drying of the skin.

Eye Protection: Safety glasses.

Component Name	Exposure Limits		
	OSHA PEL	ACGIH TLV	Other Recommended Limits
Silica gel	TWA 20 mppcf (80 mg / m^3 % SiO_2)	TWA 10 mg / m^3	NIOSH REL TWA 6 mg / m^3 IDLH 3000 mg / m^3
Phenolphthalein	Not Applicable	Not Applicable	Not Applicable

Section 9 – Physical and Chemical Properties

Appearance: Yellow beads or granules

Odor: None

Physical State: Solid bead

PH: Not applicable

Vapor Pressure: Not applicable

Vapor Density: Not applicable

Boiling Point: 4046° F (2230° C)

Melting Point: 3110° F (1710° C)

Solubility: Insoluble in water

Specific Gravity: 2.1

Section 10 – Stability and Reactivity

Stability: Stable

Conditions to avoid: Moisture and high humidity environments.

Incompatibility: Water, fluorine, oxygen difluoride, chlorine trifluoride

Hazardous Decomposition Products: None

Hazardous Polymerization: Will not occur

Section 8 – Exposure Controls/Personal Protection

Engineering Controls: Use exhaust ventilation to keep the airborne concentrations below the exposure limits.

Respiratory Protection: Use NIOSH approved respirator when the air quality levels exceed the TLV's.

Skin Protection: Light gloves will protect against abrasion and drying of the skin.

Eye Protection: Safety glasses.

Component Name	Exposure Limits		
	OSHA PEL	**ACGIH TLV**	**Other Recommended Limits**
Silica gel	TWA 20 mppcf (80 mg / m^3 % SiO_2)	TWA 10 mg / m^3	NIOSH REL TWA 6 mg / m^3 IDLH 3000 mg / m^3
Phenolphthalein	Not Applicable	Not Applicable	Not Applicable

Section 9 – Physical and Chemical Properties

Appearance: Yellow beads or granules

Odor: None

Physical State: Solid bead

PH: Not applicable

Vapor Pressure: Not applicable

Vapor Density: Not applicable

Boiling Point: 4046° F (2230° C)

Melting Point: 3110° F (1710° C)

Solubility: Insoluble in water

Specific Gravity: 2.1

Section 10 – Stability and Reactivity

Stability: Stable

Conditions to avoid: Moisture and high humidity environments.

Incompatibility: Water, fluorine, oxygen difluoride, chlorine trifluoride

Hazardous Decomposition Products: None

Hazardous Polymerization: Will not occur

Section 11 – Toxicological Information

This product and its components are not listed on the NTP or OSHA Carcinogen lists.

Animal Toxicology Tests for DOT Hazard classification
(Tests Conducted on finely ground silica gel)

1 - hour LC_{50} (rat) > 2 mg / l
48 - hour oral LD_{50} (rat) est. > 31,600 mg / kg
48 - hour dermal LD_{50} (rabbit) est. > 2,000 mg / kg
Considered an ocular irritant

Human Toxicology Silica gel is a synthetic amorphous silica not to be confused with crystalline silica. Epidemiological studies indicate low potential for adverse health effects. In the activated form, silica gel acts as a desiccant and can cause a drying irritation of the mucous membranes and skin in cases of severe exposure. Multisorb Technologies Inc. knows of no medical conditions that are abnormally aggravated by exposure to silica gel. The primary route of entry is inhalation of dust.

Section 12 – Ecological Information

Not known to have any adverse effect on the aquatic environment. Silica gel is insoluble and non-toxic.

Section 13 – Disposal Information

Disposal Information If this product as supplied becomes a waste, it does not meet the criteria of a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Materials of a hazardous nature that contact the product during normal use may be retained on the product. The user of the product must identify the hazards associated with the retained material in order to assess the waste disposal options. Dispose according to federal, state and local regulations.

Section 14 – Transportation Information

U.S. Department of Transportation Shipping Name: Not classified as a hazardous material. Not regulated.

Section 15 – Regulatory Information (Not meant to be all inclusive - selected regulations represented)

TSCA Listed: Yes

DSL/NDSL (Canadian) Listed: Yes

OSHA: TWA 20 mppcf (80 mg / m^3 % SiO_2) for Silica gel

NIOSH: REL TWA 6 mg / m^3 IDLH 3,000 mg / m^3 for silica gel
Animal tests conducted in 1976 - 1978. 18 month exposure at 15 mg / m^3 showed silica deposition in respiratory macrophages and lymph nodes, minimum lung impairment, no silicosis.

ACGIH: TLV - 10 mg / m^3 for Silica gel

DOT: Not classified as a hazardous material.

Section 16 – Other Information

HMIS – Hazardous Materials Identification System

HMIS Rating	
Health	0
Flammability	0
Reactivity	0

0 - minimal hazard, 1 - slight hazard, 2 - moderate hazard, 3 - serious hazard, 4 - severe hazard

This MSDS was prepared by: George E. Mckedy
Senior Applications Development Specialist
Multisorb Technologies, Inc.

This data and recommendations presented in this data sheet concerning the use of our product and the materials contained therein are believed to be correct but does not purport to be all inclusive and shall be used only as a guide. However, the customer should determine the suitability of such materials for his purpose before adopting them on a commercial scale. Since the use of our products is beyond our control, no guarantee, expressed or implied, is made and no responsibility assumed for the use of this material or the results to be obtained therefrom. Information on this form is furnished for the purpose of compliance with Government Health and Safety Regulations and shall not be used for any other purposes. Moreover, the recommendations contained in this data sheet are not to be construed as a license to operate under, or a recommendation to infringe, any existing patents, nor should they be confused with state, municipal or insurance requirements, or with national safety codes.

2150 Area Velocity Flow Module

Appendix D Safety Information

D.1 Safety Considerations

In field installations of Teledyne Isco wastewater samplers and associated equipment, the safety of the personnel involved should be the foremost consideration. The following sections provide safety procedures for working in and around manholes and sewers. the first section offers general safety advice. The second section deals with the special problem of hazardous gases found in sewers.

The 2150 has not been approved for use in hazardous locations as defined by the National Electrical Code.

D.2 Practical Safety Precautions

The following procedures are those used by Black & Veatch, a respected consulting firm, and are published here by permission.

Field personnel must keep safety uppermost in their minds at all times. When working above ground, rules of common sense and safety prevail. However, when entering manholes, strict safety procedures must be observed. Failure to do so could jeopardize not only your own life, but also the lives of other crew members.

D.2.1 Hazards

There are many hazards connected with entering manholes. Some of the most common hazards are:

Adverse Atmosphere – The manhole may contain flammable or poisonous gases or the atmosphere may be deficient in oxygen. orced ventilation may be necessary.

Deteriorated Rungs – Manhole steps may be corroded and not strong enough to support a man. It may be difficult to inspect the rungs because of poor lighting.

Traffic – Whenever manholes are located in the traveled way, barricades and warning devices are essential to direct traffic away from an open manhole.

Falling Objects – Items placed near the manhole opening may fall and injure a worker in the manhole.

Sharp Edges – Sharp edges of items in or near a manhole may cause cuts or bruises.

Lifting Injuries – Unless proper tools are used to remove manhole covers, back injuries or injuries to hands or feet may result.

D.2.2 Planning

Advance planning should include arrangements for test equipment, tools, ventilating equipment, protective clothing, traffic warning devices, ladders, safety harness, and adequate

number of personnel. Hasty actions may result in serious injuries. Time spent in the manhole should be kept to a minimum.

D.2.3 Adverse Atmospheres

[Refer to Table D-1, Hazardous Gases, at the end of this appendix.] Before workers enter a manhole, tests should be made for explosive atmosphere, presence of hydrogen sulfide, and oxygen deficiency. Combustible or toxic vapors may be heavier than air, so the tests on the atmosphere must be run at least 3/4 of the way down the manhole.

Whenever adverse atmosphere is encountered, forced ventilation must be used to create safe conditions. After the ventilating equipment has been operated for a few minutes, the atmosphere in the manhole should be retested before anyone enters the manhole.

When explosive conditions are encountered, the ventilating blower should be placed upwind to prevent igniting any gas that is emerging from the opening. When a gasoline engine blower is used, it must be located so that exhaust fumes cannot enter the manhole.

If testing equipment is not available, the manhole should be assumed to contain an unsafe atmosphere and forced ventilation must be provided. It should never be assumed that a manhole is safe just because there is no odor or the manhole has been entered previously.

D.2.4 Entering Manholes

Since the top of the manhole is usually flush with the surrounding surface, there may not be anything for the person who is entering the manhole to grab on to steady himself. Persons who are entering manholes should not be permitted to carry anything in their hands as they enter the manhole, to ensure that their hands will be free to hold on or grab if they slip. A good method for entering a manhole is to sit on the surface facing the manhole steps or ladder, with the feet in the hole and the arms straddling the opening for support. As the body slides forward and downward, the feet can engage a rung, and the back can rest against the opposite side of the opening. If there is any doubt about the soundness of the manhole steps, a portable ladder should be used.

A person should never enter a manhole unless he is wearing personal safety equipment, including a safety harness and a hard hat. Two persons should be stationed at the surface continuously while anyone is working inside a manhole, to lift him out if he is overcome or injured. One man cannot lift an unconscious man out of a manhole. The persons stationed at the surface should also function as guards to keep people and vehicles away from the manhole opening. To avoid a serious injury, a person should not be lifted out of a manhole by his arm unless it is a dire emergency.

When more than one person must enter a manhole, the first person should reach the bottom and step off the ladder before the next one starts down. When two men climb at the same time, the upper one can cause the lower one to fall by slipping or stepping on his fingers.

D.2.5 Traffic Protection

In addition to traffic cones, markers, warning signs, and barricades, a vehicle or a heavy piece of equipment should be placed between the working area and oncoming traffic. Flashing warning signals should be used to alert drivers and pedestrians. Orange safety vests should be worn by personnel stationed at the surface when the manhole is located in a vehicular traffic area.

D.2.6 Falling Objects

All loose items should be kept away from the manhole opening. This applies to hand tools as well as stones, gravel and other objects.

D.2.7 Removing the Covers

Manhole covers should be removed with a properly designed hook. Use of a pick ax, screwdriver, or small pry bar may result in injury. A suitable tool can be made from $^{3}/_{4}$-inch round or hex stock. Two inches of one end should be bent at a right angle and the other end should be formed into a D-handle wide enough to accommodate both hands. Even with this tool, care must be exercised to prevent the cover from being dropped on the toes. The 2-inch projection should be inserted into one of the holes in the cover, the handle grasped with both hands, and the cover lifted by straightening the legs which have been slightly bent at the knees.

D.2.8 Other Precautions

Other precautions which should be taken when entering a manhole are:

- Wear a hard hat.
- Wear coveralls or removable outer garment that can be readily removed when the work is completed.
- Wear boots or nonsparking safety shoes.
- Wear rubberized or waterproof gloves.
- Wear a safety harness with a stout rope attached.
- Do not smoke.
- Avoid touching yourself above the collar until you have cleaned your hands.

D.2.9 Emergencies

Every member of the crew should be instructed on procedures to be followed in cases of an emergency. It is the duty of each crew chief to have a list of emergency phone numbers, including the nearest hospital and ambulance service, police precinct, fire station, and rescue or general emergency number.

D.2.10 Field Equipment

The following equipment will be available for use:

Blowers	Gloves	Traffic cones
Breathing apparatus	Hard Hats	Coveralls
Harnesses	First aid kits	Manhole irons
Emergency flashers	Pick axes	Flashlights
Rain slickers	Mirrors	Ropes

Gas detectors Safety vests Gas masks
Waders”

D.3 Lethal Atmospheres in Sewers

The following is an article written by Dr. Richard D. Pomeroy, and published in the October 1980 issue of ***Deeds & Data*** of the WPCF. Dr. Pomeroy is particularly well known for his studies, over a period of nearly 50 years, in the field of the control of hydrogen sulfide and other odors in sewers and treatment plants. He has personally worked in a great many functioning sewers. In the earlier years he did so, he admits, with little knowledge of the grave hazards to which he exposed himself.

It is gratifying that the subject of hazards to people working in sewers is receiving much more attention than in past years, and good safety procedures are prescribed in various publications on this subject. It is essential that people know and use correct procedures.

It is less important to know just what the hazardous components of sewer atmospheres are, as safety precautions should in general be broadly applicable, but there should be a reasonable understanding of this subject. It is disturbing to see statements in print that do not reflect true conditions.

One of the most common errors is the assumption that people have died from a lack of oxygen. The human body is able to function very well with substantially reduced oxygen concentrations. No one worries about going to Santa Fe, New Mexico, (elev. 2,100 meters), where the partial pressure of oxygen is equal to 16.2% (a normal atmosphere is about 21%) oxygen. When first going there, a person may experience a little ‘shortness of breath’ following exercise. People in good health are not afraid to drive over the high passes in the Rocky Mountains. At Loveland Pass, oxygen pressure is 13.2% of a normal atmosphere. At the top of Mt. Whitney, oxygen is equal to 12.2%t. Many hikers go there, and to higher peaks as well. After adequate acclimation, they may climb to the top of Mt. Everest, where oxygen is equal to only 6.7%.

The lowest oxygen concentrations that I have observed in a sewer atmosphere was 13 percent. It was in a sealed chamber, near sea level, upstream from an inverted siphon on a metropolitan trunk. A man would be foolish to enter the chamber. Without ventilation, he might die, but not from lack of oxygen.

It seems unlikely that anyone has ever died in a sewer from suffocation, that is, a lack of oxygen. Deaths have often been attributed to ‘asphyxiation.’ This is a word which, according to the dictionary, is used to mean death from an atmosphere that does not support life. The word has sometimes been misinterpreted as meaning suffocation, which is only one kind of asphyxiation.

In nearly all cases of death in sewers, the real killer is hydrogen sulfide. It is important that this fact be recognized. Many cities diligently test for explosive gases, which is very important, and they may measure the oxygen concentration which usually is

unimportant, but they rarely measure H_2S. Death has occurred where it is unlikely that there was any measurable reduction in the oxygen concentration. Waste water containing 2 mg per liter of dissolved sulfide, and at a pH of 7.0, can produce, in a chamber with high turbulence, a concentration of 300 PPM H_2S, in the air. This is considered to be a lethal concentration. Many people have died from H_2S, not only in sewers and industries, but also from swamps and from hot springs. In one resort area, at least five persons died from H_2S poisoning before the people were ready to admit that H_2S is not a therapeutic agent. Hardly a year passes in the U.S. without a sewer fatality from H_2S as well as deaths elsewhere in the world.

The presence of H_2S in a sewer atmosphere is easily determined. A bellows-and-ampoule type of tester is very satisfactory for the purpose, even though it is only crudely quantitative. When using a tester of this type, do not bring the air to the ampoule by way of a tube, as this may change the H_2S concentration. Hang the ampoule in the air to be tested, with a suction tube to the bulb or bellows.

Lead acetate paper is very useful as a qualitative indicator. It cannot be used to estimate the amount of sulfide, but it will quickly turn black in an atmosphere containing only a tenth of a lethal concentration.

Electrodes or other similar electrical indicating devices for H_2S in air have been marketed. Some of them are known to be unreliable, and we know of none that have proved dependable. Do not use one unless you check it at frequent intervals against air containing known H_2S concentrations. A supposed safety device that is unreliable is worse than none at all.

Remember that the nose fails, too, when it comes to sensing dangerous concentrations of H_2S.

Various other toxic gases have been mentioned in some publications. It is unlikely that any person has been asphyxiated in a sewer by any of those other gases, except possibly chlorine. The vapor of gasoline and other hydrocarbons is sometimes present in amounts that could cause dTeledyne Iscomfort and illness, but under that condition, the explosion hazard would be far more serious. The explosimeter tests, as well as the sense of smell, would warn of the danger. Pipelines in chemical plants might contain any number of harmful vapors. They, too, are sensed by smell and explosimeter tests if they get into the public sewer. Such occurrences are rare.

The attempt to instill a sense of urgency about real hazards is diluted if a man is told to give attention to a long list of things that in fact are irrelevant.

Be very careful to avoid high H_2S concentrations, flammable atmospheres, and hazards of physical injuries. Remember that much H_2S may be released by the stirring up of sludge in the bottom of a structure. Obey your senses in respect to irritating gases, such as chlorine (unconsciousness comes suddenly from breathing too much). Be cautious about strange odors. Do not

determine percent oxygen in the air. There is a danger that the result will influence a man's thinking about the seriousness of the real hazards. Most important, use ample ventilation, and do not enter a potentially hazardous structure except in a good safety harness with two men at the top who can lift you out."

D.4 Hazardous Gases

The following table contains information on the properties of hazardous gases.

Table D-1 Hazardous Gases

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Ammonia	NH_3	Irritant and poisonous. Colorless with characteristic odor.	0.60	Causes throat and eye irritation at 0.05%, coughing at 0.17%. Short exposure at 0.5% to 1% fatal.	300 to 500	85	16 25	Near top. Concentrates in closed upper spaces	Sewers, chemical feed rooms.	Detectable odor at low concentrations
Benzene	C_6H_6	Irritant, colorless anesthetic	2.77	Slight symptoms after several hours exposure at 0.16% to 0.32%. 2% rapidly fatal.	3,000 to 5,000	25	1.3 7.1	At bottom.	Industrial wastes, varnish, solvents.	Combustible gas indicator
Carbon Bisulfide	CS_2	Nearly odorless when pure, colorless, anesthetic. Poisonous.	2.64	Very poisonous, irritating, vomiting, convulsions, psychic disturbance.	—	15	1.3 44.0	At bottom	An insecticide	Combustible gas indicator
Carbon Dioxide	CO_2	Asphyxiant, Colorless, odorless. When breathed in large quantities, may cause acid taste. Non-flammable. Not generally present in dangerous amounts unless an oxygen deficiency exists.	1.53	Cannot be endured at 10% more than a few minutes, even if subject is at rest and oxygen content is normal. Acts on respiratory nerves.	40,000 to 60,000	5,000	— —	At bottom; when heated may stratify at points above bottom.	Products of combustion, sewer gas, sludge. Also issues from carbonaceous strata.	Oxygen deficiency indicator
Carbon Monoxide	CO	Chemical asphyxiant. Colorless, odorless, tasteless. Flammable. Poisonous.	0.97	Combines with hemoglobin of blood. Unconsciousness in 30 min. at 0.2% to 0.25%. Fatal in 4 hours at 0.1%. Headache in few hours at 0.02%.	400	50	12.5 74.0	Near top, especially if present with illuminating gas.	Manufactured gas, flue gas, products of combustion, motor exhausts. Fires of almost any kind.	CO ampoules.
Carbon Tetra-Chloride	CCl_4	Heavy, ethereal odor.	5.3	Intestinal upset, loss of consciousness, possible renal damage, respiratory failure.	1,000 to 1,500	100	— —	At bottom.	Industrial wastes, solvent, cleaning	Detectable odor at low concentrations.

Table D-1 Hazardous Gases (Continued)

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Chlorine	Cl_2	Irritant. Yellow-green color. Choking odor detectable in very low concentrations. Non-flammable.	2.49	Irritates respiratory tract. Kills most animals in a very short time at 0.1%.	4	1	— —	At bottom.	Chlorine cylinder and feed line leaks.	Detectable odor at low concentrations.
Formaldehyde	CH_2O	Colorless, pungent suffocating odor.	1.07	Irritating to the nose.	—	10	7.0 73.0	Near bottom.	Incomplete combustion of organics. Common air pollutant, fungicide.	Detectable odor.
Gasoline	C_5H_{12} to C_9H_{20}	Volatile solvent. Colorless. Odor noticeable at 0.03%. Flammable.	3.0 to 4.0	Anesthetic effects when inhaled. Rapidly fatal at 2.4%. Dangerous for short exposure at 1.1 to 2.2%.	4,000 to 7,000	1,000	1.3 6.0	At bottom.	Service stations, garages, storage tanks, houses.	1. Combustible gas indicator. 2. Oxygen deficiency indicator.**
Hydrogen	H_2	Simple asphyxiant. Colorless, odorless, tasteless. Flammable	0.07	Acts mechanically to deprive tissues of oxygen. Does not support life.	—	—	4.0 74.0	At top.	Manufactured gas, sludge digestion tank gas, electrolysis of water. Rarely from rock strata.	Combustible gas indicator.
Hydrogen Cyanide	HCN	Faint odor of bitter almonds. Colorless gas	0.93	Slight symptoms appear upon exposure to 0.002% to 0.004%. 0.3% rapidly fatal.	—	10	6.0 40.0	Near top.	Insecticide and rodenticide.	Detector tube
Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air = 1	Physiological Effect*	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air.) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Hydrogen Sulfide	H_2S	Irritant and poisonous volatile compound. Rotten egg odor in small concentrations. Exposure for 2 to 15 min. at 0.01% impairs sense of smell. Odor not evident at high concentrations. Colorless. Flammable.	1.19	Impairs sense of smell, rapidly as concentration increases. Death in few minutes at 0.2%. Exposure to 0.07 to 0.1% rapidly causes acute poisoning. Paralyzes respiratory center.	200 to 300	20	4.3 45.0	Near bottom, but may be above bottom if air is heated and highly humid.	Coal gas, petroleum, sewer gas. Fumes from blasting under some conditions. Sludge gas.	1. H_2S Ampoule. 2. 5% by weight lead acetate solution.
Methane	CH_4	Simple asphyxiant. Colorless, odorless, tasteless, flammable.	0.55	Acts mechanically to deprive tissues of oxygen. Does not support life.	Probably no limit, provided oxygen percentage is sufficient for life.	—	5.0 15.0	At top, increasing to certain depth.	Natural gas, sludge gas, manufactured gas, sewer gas. Strata of sedimentary origin. In swamps or marshes.	1. Combustible gas indicator 2. Oxygen deficiency indicator.

Table D-1 Hazardous Gases (Continued)

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Nitrogen	N_2	Simple asphyxiant. Colorless, tasteless. Non-flammable. Principal constituent of air. (about 79%).	0.97	Physiologically inert.	—	—	— —	Near top, but may be found near bottom.	Sewer gas. sludge gas. Also issues from some rock strata.	Oxygen deficiency indicator.
Nitrogen Oxides	NO N_2O NO_2	Colorless Colorless, sweet odor. Reddish-brown. Irritating odor. Deadly poison	1.04 1.53 1.58	60 to 150 ppm cause irritation and coughing. Asphyxiant. 100 ppm dangerous. 200 ppm fatal.	50	10	— —	Near bottom.	Industrial wastes. Common air pollutant.	NO_2 detector tube.
Oxygen	O_2	Colorless, odorless, tasteless. Supports combustion.	1.11	Normal air contains 20.8% of O_2. Man can tolerate down to 12%. Minimum safe 8 hour exposure, 14 to 16%. Below 10%, dangerous to life. Below 5 to 7% probably fatal.	—	—	— —	Variable at different levels.	Oxygen depletion from poor ventilation and absorption, or chemical consumption of oxygen.	Oxygen deficiency indicator.
Ozone	O_3	Irritant and poisonous. Strong electrical odor. Strong oxidizer. Colorless. At 1 ppm, strong sulfur-like odor.	1.66	Max. naturally occurring level is 0.04 ppm. 0.05 ppm causes irritation of eyes and nose. 1 to 10 ppm causes headache, nausea; can cause coma. Symptoms similar to radiation damage.	0.08	0.04	— —	Near bottom.	Where ozone is used for disinfection.	Detectable odor at 0.015 ppm.
Sludge Gas	—***	Mostly a simple asphyxiant. May be practically odorless, tasteless.	Variable	Will not support life.	No data. Would vary widely with composition.		5.3 19.3	Near top of structure.	From digestion of sludge.	See components.
Sulfur Dioxide	SO_2	Colorless, pungent odor. Suffocating, corrosive, poisonous, non-flammable.	2.26	Inflammation of the eyes. 400 to 500 ppm immediately fatal.	50 to 100	10	— —	At bottom, can combine with water to form sulfurous acid.	Industrial waste, combustion, common air pollutant.	Detectable taste and odor at low concentration.
Toluene	C_5H_{12} to C_9H_{20}	Colorless, benzene-like odor.	3.14	At 200-500 ppm, headache, nausea, bad taste, lassitude.	200	100	1.27 7.0	At bottom.	Solvent.	Combustible gas indicator.
Turpentine	$C_{10}H_{16}$	Colorless, Characteristic odor.	4.84	Eye irritation. Headache, dizziness, nausea, irritation of the kidneys.	—	100		At bottom.	Solvent, used in paint.	1. Detectable odor at low concentrations. 2.Combustible gas indicator.
Xylene	C_8H_{10}	Colorless, flammable	3.66	Narcotic in high concentrations. less toxic than benzene.	—	100	1.1 7.0	At bottom.	Solvent	Combustible gas indicator.

Table D-1 Hazardous Gases (Continued)

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing

* Percentages shown represent volume of gas in air.

** For concentration over 0.3%.

***Mostly methane and carbon dioxide with small amounts of hydrogen, nitrogen, hydrogen sulfide, and oxygen; occasionally traces of carbon monoxide.

产品中有毒有害物质或元素的名称及含量

Name and amount of Hazardous Substances or Elements in the product

部件名称 Component Name	有毒有害物质或元素 Hazardous Substances or Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二联苯 (PBDE)
线路板 Circuit Boards	X	O	O	O	O	O

产品中有毒有害物质或元素的名称及含量：Name and amount of Hazardous Substances or Elements in the product

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在ST/ 标准规定的限量要求以下。

O: Represent the concentration of the hazardous substance in this component's any homogeneous pieces is lower than the ST/ standard limitation.

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出ST/ 标准规定的限量要求。

(企业可在此处，根据实际情况对上表中打"X" 的技术原因进行进一步说明。)

X: Represent the concentration of the hazardous substance in this component's at least one homogeneous piece is higher than the ST/ standard limitation.

(Manufacturer may give technical reasons to the "X"marks)

环保使用期由经验确定。

The Environmentally Friendly Use Period (EFUP) was determined through experience.

生产日期被编码在系列号码中。前三位数字为生产年(207 代表 2007 年) 。随后的一个字母代表月份：A 为一月，B 为二月，等等。

The date of Manufacture is in code within the serial number. The first three numbers are the year of manufacture (207 is year 2007) followed by a letter for the month. "A" is January, "B" is February and so on.

产品中有毒有害物质或元素的名称及含量

Name and amount of Hazardous Substances or Elements in the product

部件名称 Component Name	有毒有害物质或元素 Hazardous Substances or Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二联苯 (PBDE)
线路板 Circuit Boards	X	O	O	O	O	O
外部电缆 External Cables	O	O	O	O	X	O

产品中有毒有害物质或元素的名称及含量：Name and amount of Hazardous Substances or Elements in the product

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在ST/ 标准规定的限量要求以下。

O: Represent the concentration of the hazardous substance in this component's any homogeneous pieces is lower than the ST/ standard limitation.

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出ST/ 标准规定的限量要求。

(企业可在此处，根据实际情况对上表中打"X" 的技术原因进行进一步说明。)

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The date of Manufacture is in code within the serial number. The first three numbers are the year of manufacture (207 is year 2007) followed by a letter for the month. "A" is January, "B" is February and so on.

DECLARATION OF CONFORMITY

ISM1-A

Application of Council Directive:	89/336/EEC – The EMC Directive 73/23/EEC – The Low Voltage Directive
Manufacturer's Name:	Teledyne Isco, Inc.
Manufacturer's Address:	4700 Superior, Lincoln, Nebraska 68504 USA Mailing Address: P.O. Box 82531, Lincoln, NE 68501
Equipment Type/Environment:	Laboratory Equipment for Light Industrial/Commercial Environments
Trade Name/Model No:	2150 Area Velocity Flow Module and Sensor
Year of Issue:	2001
Standards to which Conformity is Declared:	EN 61326-1998 EMC Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use EN 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

Standard	Description	Severity Applied	Performance Criteria
EN61000-4-2	Electrostatic Discharge	Level 2 - 4kV contact discharge Level 3 - 8kV air discharge	B B
EN61000-4-3	Radiated RF Immunity	80 MHz to 1000MHz 80% AM at 1kHz Level 1 – 10V/m	*B
EN61000-4-4	Electrical Fast Transient	Level 1 – 1kV on I/O lines	B
EN61000-4-5	Surge on I/O Lines	1kV common mode, 0.5KV differential mode	B
EN61000-4-6	Conducted RF on I/O lines	150 kHz to 80 MHz, 3V rms, 80% modulated	B
CISPR11/ EN 55011	RF Emissions	Group 1, Class A Industrial, Scientific, and Medical Equipment	

* Standard requires performance criteria A, however, tests show some degradation of performance due to RF at 10V/m, in that flow rates are affected beyond the tolerances published in the instrument's specifications.

We, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of July 1, 2001.

William Foster
USA Representative

TELEDYNE ISCO
A Teledyne Technologies Company

William Foster
Director of Engineering
Teledyne Isco, Inc.
4700 Superior Street
Lincoln, Nebraska 68504

Phone: (402) 464-0231
Fax: (402) 464-4543

60-2002-155
Rev A

DECLARATION OF CONFORMITY

ISM1-A

Application of Council Directive:	89/336/EEC – The EMC Directive 73/23/EEC – The Low Voltage Directive
Manufacturer's Name:	Teledyne Isco, Inc.
Manufacturer's Address:	4700 Superior, Lincoln, Nebraska 68504 USA Mailing Address: P.O. Box 82531, Lincoln, NE 68501
Equipment Type/Environment:	Laboratory Equipment for Light Industrial/Commercial Environments
Trade Name/Model No:	2191 Battery Module
Year of Issue:	2001
Standards to which Conformity is Declared:	EN 61326-1998 EMC Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use EN 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use.

Standard	Description	Severity Applied	Performance Criteria
EN61000-4-2	Electrostatic Discharge	Level 2 - 4kV contact discharge Level 3 - 8kV air discharge	B B
EN61000-4-3	Radiated RF Immunity	80 MHz to 1000MHz 80% AM at 1kHz Level 1 – 10V/m	B
EN61000-4-4	Electrical Fast Transient	Level 1 – 1kV on I/O lines	B
EN61000-4-5	Surge on I/O Lines	1kV common mode, 0.5KV differential mode	B
EN61000-4-6	Conducted RF on I/O lines	150 kHz to 80 MHz, 3V rms, 80% modulated	B
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60-2002-158
Rev A

Teledyne Isco One Year Limited Warranty*

Factory Service for Teledyne Isco Flow Meters, Waste Water Samplers, and Syringe Pumps

This warranty exclusively covers Teledyne Isco instruments, providing a one-year limited warranty covering parts and labor.

Any instrument that fails during the warranty period due to faulty parts or workmanship will be repaired at the factory at no charge to the customer. Teledyne Isco's exclusive liability is limited to repair or replacement of defective instruments. Teledyne Isco is not liable for consequential damages.

Teledyne Isco will pay surface transportation charges both ways within the 48 contiguous United States if the instrument proves to be defective within 30 days of shipment. Throughout the remainder of the warranty period, the customer will pay to return the instrument to Teledyne Isco, and Teledyne isco will pay surface transportation to return the repaired instrument to the customer. Teledyne Isco will not pay air freight or customer's packing and crating charges. This warranty does not cover loss, damage, or defects resulting from transportation between the customer's facility and the repair facility.

The warranty for any instrument is the one in effect on date of shipment. The warranty period begins on the shipping date, unless Teledyne Isco agrees in writing to a different date.

Excluded from this warranty are normal wear; expendable items such as charts, ribbon, lamps, tubing, and glassware; fittings and wetted parts of valves; and damage due to corrosion, misuse, accident, or lack of proper maintenance. This warranty does not cover products not sold under the Teledyne Isco trademark or for which any other warranty is specifically stated.

No item may be returned for warranty service without a return authorization number issued by Teledyne Isco.

This warranty is expressly in lieu of all other warranties and obligations and Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

The warrantor is Teledyne Isco, Inc. 4700 Superior, Lincoln, NE 68504, U.S.A.

*** This warranty applies to the USA and countries where Teledyne Isco Inc. does not have an authorized dealer. Customers in countries outside the USA, where Teledyne Isco has an authorized dealer, should contact their Teledyne Isco dealer for warranty service.**

Before returning any instrument for repair, please call, fax, or e-mail the Teledyne Isco Service Department for instructions. Many problems can often be diagnosed and corrected over the phone, or by e-mail, without returning the instrument to the factory.

Instruments needing factory repair should be packed carefully, and shipped to the attention of the service department. Small, non-fragile items can be sent by insured parcel post. **PLEASE BE SURE TO ENCLOSE A NOTE EXPLAINING THE PROBLEM.**

Shipping Address:	Teledyne Isco, Inc. - Attention Repair Service 4700 Superior Street Lincoln, NE 68504 USA
Mailing Address:	Teledyne Isco, Inc. PO Box 82531 Lincoln, NE 68501 USA
Phone:	Repair service: (800) 775-2965 (lab instruments) (866) 298-6174 (samplers & flow meters) Sales & General Information: (800) 228-4373 (USA & Canada)
Fax:	(402) 465-3001
Email:	IscoService@teledyne.com

March 8, 2011 P/N 60-1002-040 Rev E

TELEDYNE ISCO
A Teledyne Technologies Company

Technical Information
Waterpilot FMX21

Hydrostatic level measurement
Compact device for level measurement in fresh water, wastewater and saltwater, communication via HART

Reliable and robust level probe with ceramic measuring cell

Application

The Waterpilot FMX21 is a pressure sensor for hydrostatic level measurement. Endress+Hauser offers three different versions of the FMX21 sensor:
- FMX21 with a stainless steel housing, outer diameter of 22 mm (0.87 in): Standard version suitable for drinking water applications and for use in bore holes and wells with small diameters.
- FMX21 with a stainless steel housing, outer diameter of 42 mm (1.65 in): Heavy duty version, easy clean flush-mounted process diaphragm. Ideally suited for wastewater and sewage treatment plants.
- FMX21 with a plastic insulation, outer diameter of 29 mm (1.14 in): Corrosion resistant version generally for use in saltwater, particularly for ship ballast water tanks.

Your benefits

- High resistance to overload and aggressive media
- High-precision, robust ceramic measuring cell with long-term stability
- Climate proofed sensor thanks to completely potted electronics and 2-filter pressure compensation system
- 4 to 20 mA with superimposed HART 6.0 output signal
- Simultaneous measurement of level and temperature with optionally integrated Pt100 temperature sensor
- Accuracy
  - Reference accuracy ±0.2 %
  - PLATINUM version ±0.1 %
- Automatic density compensation to increase accuracy
- Usage in drinking water: KTW, NSF, ACS
- Approvals: ATEX, FM, CSA
- Marine certificate: GL, ABS, LR, BV, DNV
- Extensive range of accessories provides complete measuring point solutions

Endress+Hauser
People for Process Automation

Table of contents

Document information

Document conventions

Safety symbols

Symbol	Meaning
 A0011189-DE	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in seriousor fatal injury.
 A0011190-DE	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in seriousor fatal injury.
 A0011191-DE	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minoror medium injury.
 A0011192-DE	**NOTICE!** This symbol contains information on procedures and other facts which do not result in per-sonalinjury.

Electrical symbols

Symbol	Meaning
A0018335	**Direct current** A terminal to which DC voltage is applied or through which direct current flows.
A0018336	**Alternating currrent** A terminal to which alternating voltage is applied or through which alternating current flows.
 A0018337	**Direct current and alternating current** ▪ A terminal to which alternating voltage or DC voltage is applied. ▪ A terminal through which alternating current or direct current flows.
 A0018338	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system..
 A0018339	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.
 A0011201	**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of praxis.

Symbols for certain types of information

Symbol	Meaning
 A0011193	**Tip** Indicates additional information.
 A0015484	**Reference to page** Refers to the corresponding page number.

Symbols in graphics

Symbol	Meaning
1, 2, 3, 4, ...	Item numbers
A, **B**, **C**, **D**, ...	Views

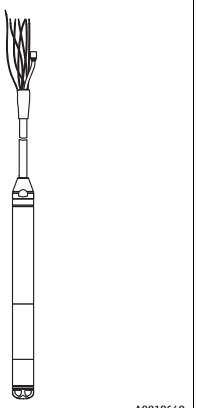
 A0011187	**Hazardous area** Indicates a hazardous area.
 A0011188	Safe area (non-hazardous area) Indicates a non-hazardous location.

Symbols at the device

Symbol	Meaning
	**Connecting cable immunity to temperature change** Indicates that the connecting cables must be able to withstand temperatures of at least 85 °C (185 °F).

Function and system design

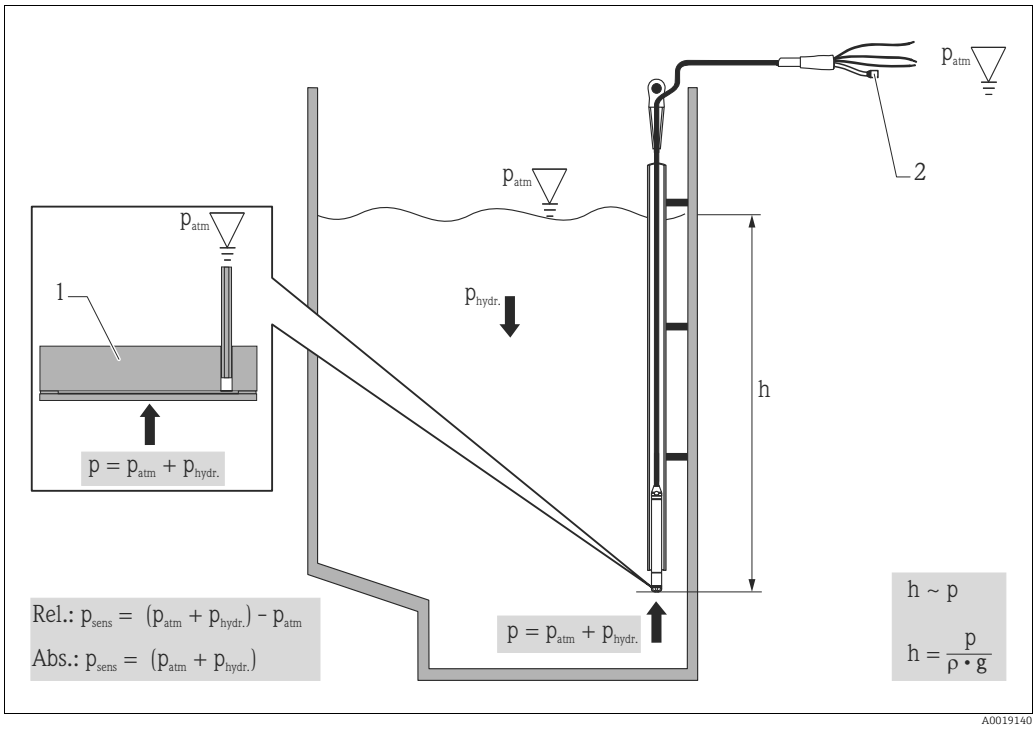
Device selection

Waterpilot FMX21	 A0018640	 A0018641	 A0018642
Field of application	Hydrostatic level measurement in deep wells e.g. drinking water	Hydrostatic level measurement in wastewater	Hydrostatic level measurement in saltwater
	NOTICE **The Waterpilot is not suitable for use in biogas plants since the gases can diffuse through the elastomers (seals, extension cable).** ▸ For applications with biogas Endress+Hauser offers the level transmitter Deltapilot.		
Process connection	▪ Mounting clamp ▪ Extension cable mounting screw with G 1½" A or NPT 1½" thread		
Outer diameter	22 mm (0.87 in)	42 mm (1.65 in)	max. 29 mm (1.14 in)
Extension cable	PE, PUR, FEP (→ 📄 25)		
Seals	▪ FKM Viton ▪ EPDM [1]	FKM Viton	▪ FKM Viton ▪ EPDM [1]
Measuring ranges	▪ Gauge pressure: from 0 to 0.1 bar to 0 to 20 bar (0 to 1.5 psi to 0 to 300 psi) ▪ Absolute pressure: from 0 to 2 bar to 0 to 20 bar (0 to 30 psi to 0 to 300 psi)		▪ Gauge pressure: from 0 to 0.1 bar to 0 to 4 bar (0 to 1.5 psi bis 0 to 60 psi) ▪ Absolute pressure: from 0 to 2 bar to 0 to 4 bar (0 to 1.5 psi bis 0 to 60 psi)
	▪ Customer-specific measuring ranges; factory-calibrated ▪ The following output units can be configured: %, mbar, bar, kPa, MPa, mmH_2O, mH_2O, inH_2O, ftH_2O, psi and numerous level units.		
Overload	Up to 40 bar (600 psi)		Up to 25 bar (375 psi)
Process temperature range	−10 to +70 °C (+14 to +158 °F)		0 to +50 °C (+32 to +122 °F)
Reference accuracy	▪ ±0.2 % of the set span ▪ Optional: ±0.1 % of set span (PLATINUM version)		
Supply voltage	10.5 to 35 V DC, Ex: 10.5 to 30 V DC		
Output	4 to 20 mA (invertible) with superimposed digital communication protocol HART 6.0, 2-wire		
Options	Drinking water approval	—	
	▪ Large selection of approvals, including ATEX, FM, CSA ▪ Broad range of accessories ▪ Integrated Pt100 temperature sensor and TMT182 temperature head transmitter (4 to 20 mA HART) ▪ Marine certificate		
Specialties	▪ High-precision, robust ceramic measuring cell with long-term stability ▪ Automatic density compensation ▪ Customer specific cable marking ▪ Absolute pressure measuring cell		

1) Recommended for drinking water applications and not for use in hazardous areas.

Measuring principle

The ceramic measuring cell is a dry measuring cell, i.e. pressure acts directly on the robust ceramic process isolating diaphragm of the Waterpilot FMX21.
Any changes in the air pressure are routed through the extension cable, via a pressure compensation tube, to the rear of the ceramic process isolating diaphragm and compensated for. A pressure-dependent change in capacitance caused by the movement of the process isolating diaphragm is measured at the electrodes of the ceramic carrier. The electronics then convert this into a signal which is proportional to the pressure and is linear to the level of the medium.



1 *Ceramic measuring cell*
2 *Pressure compensation tube*

h *Level height*
p *Total pressure = atmospheric pressure + hydrostatic pressure*
ρ *Density of the medium*
g *Gravitational acceleration*
$p_{hydr.}$ *Hydrostatic pressure*
p_{atm} *Atmospheric pressure*
p_{sens} *Pressure displayed on the sensor*

Temperature measurement with optional Pt100 resistance thermometer [1)]

Endress+Hauser also offers the Waterpilot FMX21 with an optional 4-wire Pt100 resistance thermometer to measure level and temperature simultaneously (→ 30). The Pt100 belongs to Accuracy Class B in accordance with DIN EN 60751.

Temperature measurement with optional Pt100 and TMT182 temperature head transmitter [1)]

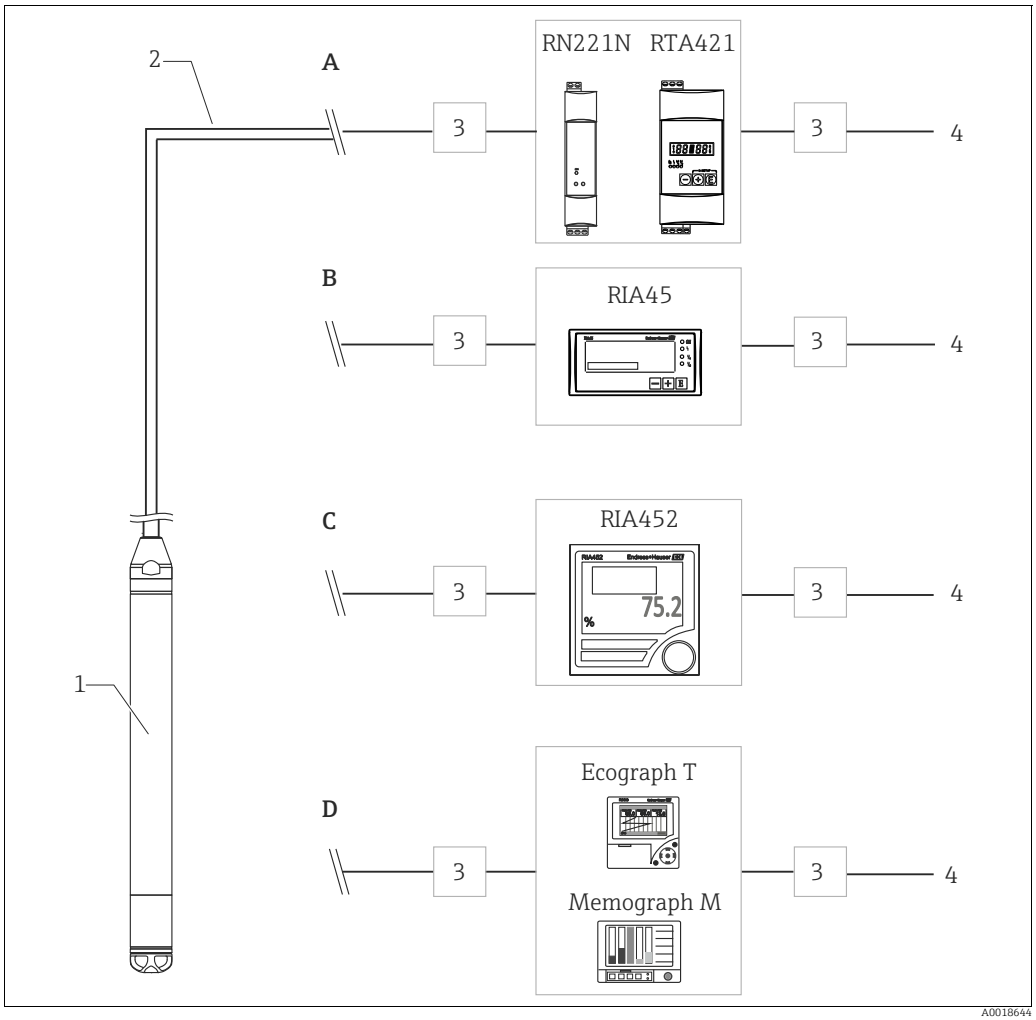
Endress+Hauser also offers the TMT182 temperature head transmitter with the HART protocol to convert the temperature signal to an analog, scalable 4 to 20 mA output signal superimposed with HART 6.0.
See also: "Density compensation with Pt100 temperature sensor" (→ 9); "Ordering information" (→ 28); "Accessories" (→ 30) and Technical Information TI00078R.

1) Not for use in hazardous areas.

Measuring system

As standard, the complete measuring system consists of a Waterpilot FMX21 and a transmitter power supply unit with a supply voltage of 10.5 to 30 V DC (hazardous areas) or 10.5 to 35 V DC (non-hazardous areas).

Possible measuring point solutions with a transmitter and evaluation units from Endress+Hauser:



Application examples

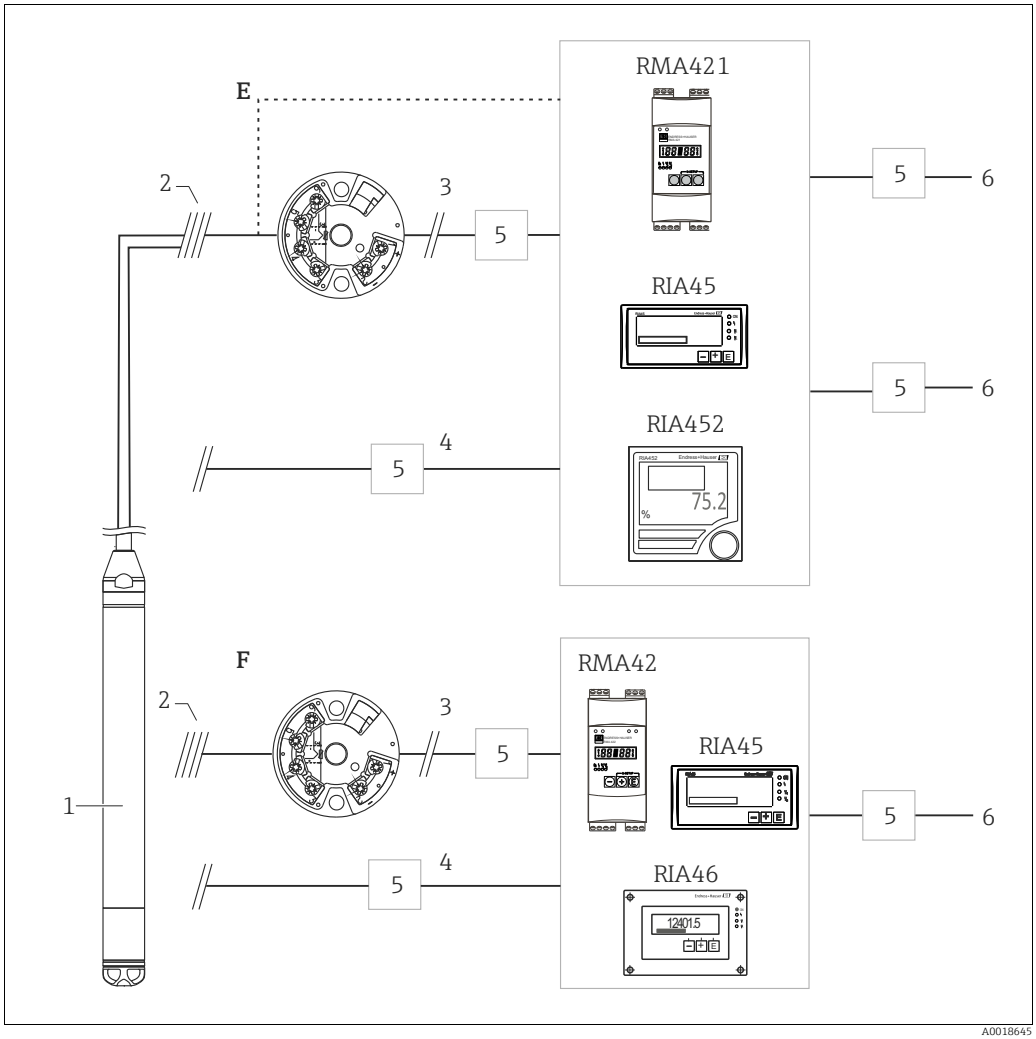
1 Waterpilot FMX21 HART
2 4 to 20 mA HART
3 Overvoltage protection (OP), e.g. HAW from Endress+Hauser (not for use in hazardous areas)
- OP on the sensor side for field installation: HAW569; for top-hat rail/DINrail: HAW562/intrinsically safe HAW562Z
- OP on the supply side for top-hat rail/DINrail: HAW561 (115/230 V) and HAW561K (24/48 V AC/DC)
The overvoltage protection selected must be appropriate for the supply voltage.
4 Power supply

A Simple cost-effective measuring point solution: Power supply of Waterpilot in hazardous and non-hazardous areas using RN221N active barrier. Power supply and additional control of two consumers, e.g. pumps, via limit switch RTA421 with onsite display.

B Evaluation unit RIA45 (for panel mounting) provides a power supply system, an onsite display and two switch outputs.

C If several pumps are used, the pump service life can be prolonged by alternate switching. With alternating pump control, the pump which was out of service for the longest period of time is switched on. The evaluation unit RIA452 (for panel mounting) provides this option in additional to several other functions.

D State-of-the-art recording technology with graphic display recorders from Endress+Hauser, such as Ecograph T, Memograph M, or paper recorders such as Alphalog for documenting, monitoring, visualizing and archiving purposes.



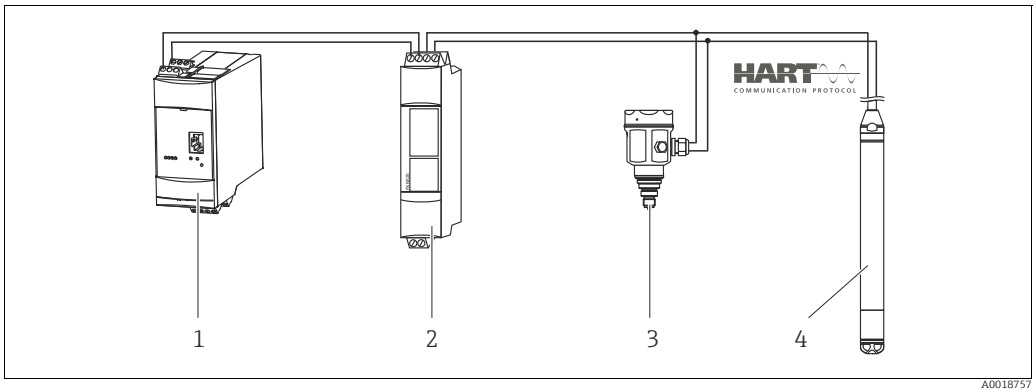
Application examples with Pt100

1 *Waterpilot FMX21 HART*
2 *Connection for integrated Pt100 temperature sensor in the FMX21*
3 *4 to 20 mA HART (Temperature)*
4 *4 to 20 mA HART (Level)*
5 *Overvoltage protection (OP), e.g. HAW from Endress+Hauser (not for use in hazardous areas)*
- OP on the sensor side for field installation: HAW569; for top-hat rail/DINrail: HAW562/intrinsically safe HAW562Z
- OP on the supply side for top-hat rail/DINrail: HAW561 (115/230 V) and HAW561K (24/48 V AC/DC)
The overvoltage protection selected must be appropriate for the supply voltage.
6 *Power supply*

E If you want to measure, display and evaluate the temperature as well as the level, e.g. to monitor temperature in fresh water to detect temperature limits for germ formation, you have the following options:
The optional TMT182 temperature head transmitter can convert the Pt100 signal to a 4 to 20 mA HART signal and transfer it to any common evaluation unit. The RMA421, RIA45 and RIA452 evaluation units also offer a direct input for the Pt100 signal.

F If you want to record and evaluate the level and temperature measured value with one device, use the RMA42, RIA45 and RIA46 evaluation units with two inputs. It is even possible to mathematically link the input signals with this unit. These evaluation units are not HART-compatible.

Level measurement with absolute pressure probe and external pressure signal



1 Fieldgate FXA520
2 Multidrop-Connector FXN520
3 Cerabar
4 Waterpilot FMX21

It is advisable to use an absolute pressure probe for applications in which condensation can occur. In the case of level measurement with an absolute pressure probe, the measured value is affected by fluctuations in the ambient pressure. To correct the resulting measured error, you can connect an external absolute pressure sensor (e.g. Cerabar) to the HART signal cable, switch the waterpilot to the burst mode and the Cerabar to operate in mode "Electr. Delta P".
The external absolute pressure sensor then calculates the difference between the two pressure signals and can thus determine the level precisely. Only one level measured value can be corrected in this way.

If using intrinsically safe devices, strict compliance with the rules for interconnecting intrinsically safe circuits as stipulated in IEC60079-14 (proof of intrinsic safety) is mandatory.

Density compensation with Pt100 temperature sensor

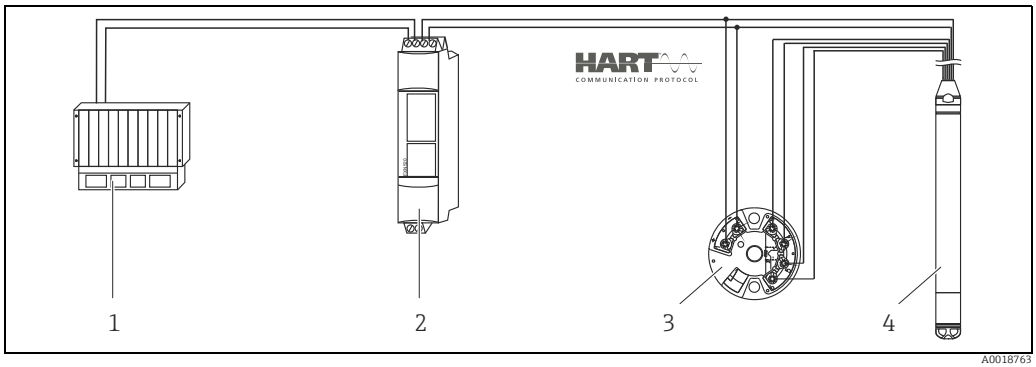
The Waterpilot FMX21 can correct measured errors that result from fluctuations in the density of the water caused by temperature. Users can choose from the following options:

Use the internally measured sensor temperature of the FMX21

The internally measured sensor temperature is calculated in the Waterpilot FMX21 for density compensation. The level signal is thus corrected according to the density characteristic line of the water.

Use the optional internal temperature sensor for density compensation in a suitable HART master (e.g. PLC)

The Waterpilot FMX21 is available with an optional Pt100 temperature sensor. Endress+Hauser additionally offers the TMT182 temperature head transmitter to convert the Pt100 signal to a 4 to 20 mA HART signal.
The temperature and pressure signals are transmitted to the HART master (e.g. PLC) where a corrected level value can be generated using a stored linearization table or the density function (of a chosen medium).

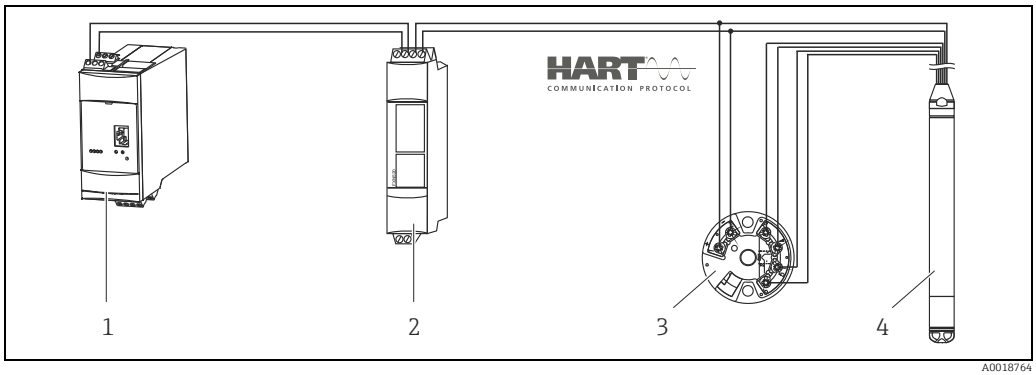


1 HART Master, e.g. PLC (programmable logic controller)
2 FXN520 Multidrop-Connector
3 TMT182 Temperature head transmitter
4 Waterpilot FMX21

Use an external temperature signal which is transmitted to the FMX21 via HART burst mode

The Waterpilot FMX21 is available with an optional Pt100 temperature sensor. In this case, the signal of the Pt100 is analyzed using a HART-compliant (at least HART 5.0) temperature transmitter that supports BURST mode. The temperature signal can thus be transmitted to the FMX21. The FMX21 uses this signal for the density correction of the level signal.

The TMT182 temperature head transmitter is not suitable for this configuration.



1 Fieldgate FXA520
2 Multidrop-Connector FXN520
3 TMT182 Temperature head transmitter
4 Waterpilot FMX21

Without additional compensation due to the anomaly of water, errors of up to 4 % may occur at a temperature of +70 °C (+158 °F), for example. With density compensation, this error can be decreased to 0.5% in the entire temperature range from 0 to +70 °C (+32 to +158 °F).

For further information please refer to the appropriate Technical documentation:
- TI00078R: TMT182 temperature head transmitter (4 to 20 mA/HART)
- TI00369F: FXA520 Fieldgate
- TI00400F: FXN520 multidrop connector

Communication protocol	4 to 20 mA HART with communication protocol
System integration	The device can be fitted with a tag name, "Ordering information", feature 895 "Marking" version "Z1" (→ 28).

Input

Measured variable

FMX21 + Pt100 (optional)

- Hydrostatic pressure of a liquid
- Pt100: temperature

TMT182 temperature head transmitter (optional)

Temperature

Measuring range

- Customer-specific measuring ranges or factory calibration
- Temperature measurement from −10 to +70 °C (+14 to +158 °F) with Pt100 (optional)

Sensor measuring range [bar (psi)]	Smallest span that can be calibrated [1] [bar (psi)]	Vacuum resistance [bar_{abs} (psi_{abs})]	Version in the order code [2]
Gauge pressure			
0.1 (1.5)	0.01 (0.15)	0.3 (4.5)	1C
0.2 (3.0)	0.02 (0.3)	0.3 (4.5)	1D
0.4 (6.0)	0.04 (1.0)	0	1F
0.6 (9.0)	0.06 (1.0)	0	1G
1.0 (15.0)	0.1 (1.5)	0	1H
2.0 (30.0)	0.2 (3.0)	0	1K
4.0 (60.0)	0.4 (6.0)	0	1M
10.0 (150) [3]	1.0 (15)	0	1P
20.0 (300) [3]	2.0 (30)	0	1Q
Absolute pressure			
2.0 (30.0)	0.2 (3.0)	0	2K
4.0 (60.0)	0.4 (6.0)	0	2M
10.0 (150) [3]	1.0 (15)	0	2P
20.0 (300) [3]	2.0 (30)	0	2Q

1) Recommended Turn down: Max 100:1
Factory calibration Turn down: Max 20:1, higher on request.

2) Ordering information (→ 28)

3) These measuring ranges are not offered for the probe version with plastic insulation, outer diameter 29 mm (1.14 in) .

Input signal

FMX21 + Pt100 (optional)

- Change in capacitance
- Pt100: change in resistance

TMT182 temperature head transmitter (optional)

Pt100 resistance signal, 4-wire

Output

Output signal

FMX21 + Pt100 (optional)

- 4 to 20 mA with overlying digital HART 6.0 communication protocol, 2-wire for hydrostatic pressure measured value
- Pt100: Temperature-dependent resistance values

TMT182 temperature head transmitter (optional)

4 to 20 mA with overlying digital HART 5.0 communication protocol for temperature measured value, 2-wire

Signal range

3.8 to 20.5 mA

Signal on alarm

FMX21 + Pt100 (optional)

4 to 20 mA HART
Options:
- Max. alarm (factory setting 22mA): can be set from 21 to 23 mA
- Hold measured value: last measured value is held
- Min. alarm: 3.6 mA

TMT182 temperature head transmitter (optional)

Options:
- Max. alarm ≥ 21.0 mA
- Min. alarm ≤ 3.6 mA

Load

FMX21

$$R_{Lmax} \leq \frac{U - 10.5\ V}{23\ mA} - 2 \cdot 0.09\ \frac{\Omega}{m} \cdot L - R_{add}$$

A0018753-EN

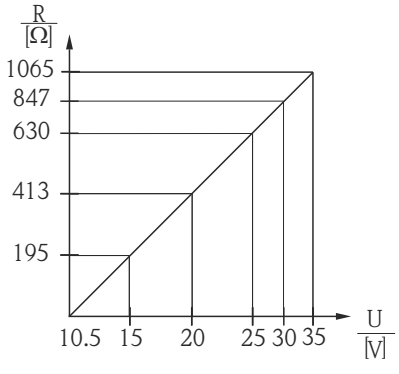
TMT182 temperature head transmitter (optional)

$$R_{Lmax} \leq \frac{U - 11.5\ V}{0.023\ A} - R_{add}$$

A0018754-EN

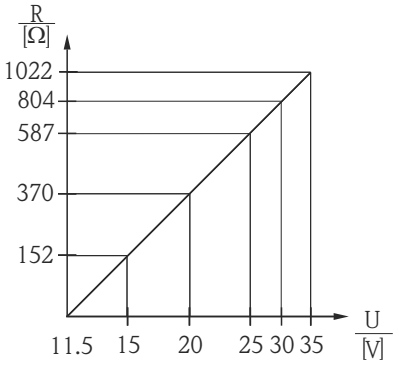
R_{Lmax} = *Max. load resistance [Ω]*
R_{add} = *Additional resistances such as resistance of evaluation unit and/or display unit, cable resistance [Ω]*
U = *Supply voltage [V]*
l = *Simple length of extension cable [m], (cable resistance per wire ≤ 0.09 Ω/m)*

When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings (XA).



A0018765

FMX21 load chart for estimating the load resistance. Additional resistances, such as the resistance of the extension cable, have to be subtracted from the value calculated as shown in the equation.



A0018766

Temperature head transmitter TMT182 load chart for estimating the load resistance. Additional resistances have to be subtracted from the value calculated as shown in the equation.

When operating using a HART handheld terminal or a PC with an operating program, a minimum communication resistance of 250 Ω has to be taken into account.

Damping

- Continuously 0 to 999 s via HART handheld terminal or PC with operating program
- Factory setting: 2 s

Power supply

When using the measuring device in hazardous areas, installation must comply with the applicable national standards and regulations and the Safety Instructions (XAs) and the Installation or Control Drawings (ZDs). All explosion-protection data are given in a separate documentation which is available upon request. This documentation is provided with the devices as standard (→ 32).

Supply voltage

FMX21 + Pt100 (optional)	TMT182 temperature head transmitter (optional)
▪ 10.5 to 35 V (non-hazardous area) ▪ 10.5 to 30 V (hazardous area)	11.5 to 35 V DC

Power consumption

FMX21 + Pt100 (optional)	TMT182 temperature head transmitter (optional)
▪ ≤ 0.805 W at 35 V DC (non-hazardous area) ▪ ≤ 0.690 W at 30 V DC (hazardous area)	≤ 0.805 W at 35 V DC

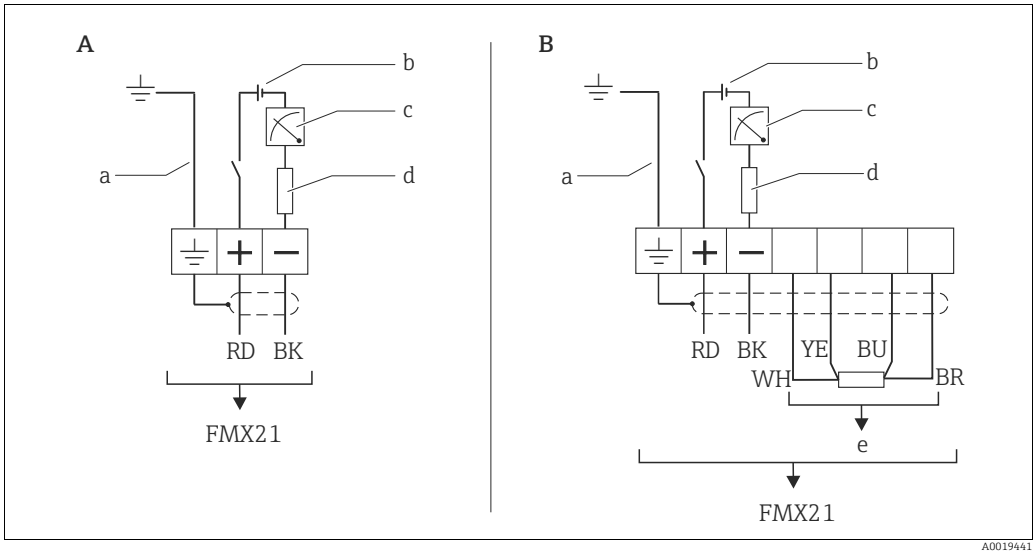
Current consumption

FMX21 + Pt100 (optional)	TMT182 temperature head transmitter (optional)
▪ Max. current consumption: ≤ 23 mA Min. current consumption: ≥ 3.6 mA ▪ Pt100: ≤ 0.6 mA	▪ Max. current consumption: ≤ 23 mA Min. current consumption: ≥ 3.5 mA ▪ Pt100 via temperature head transmitter: ≤ 0.6 mA

Measuring unit electrical connection

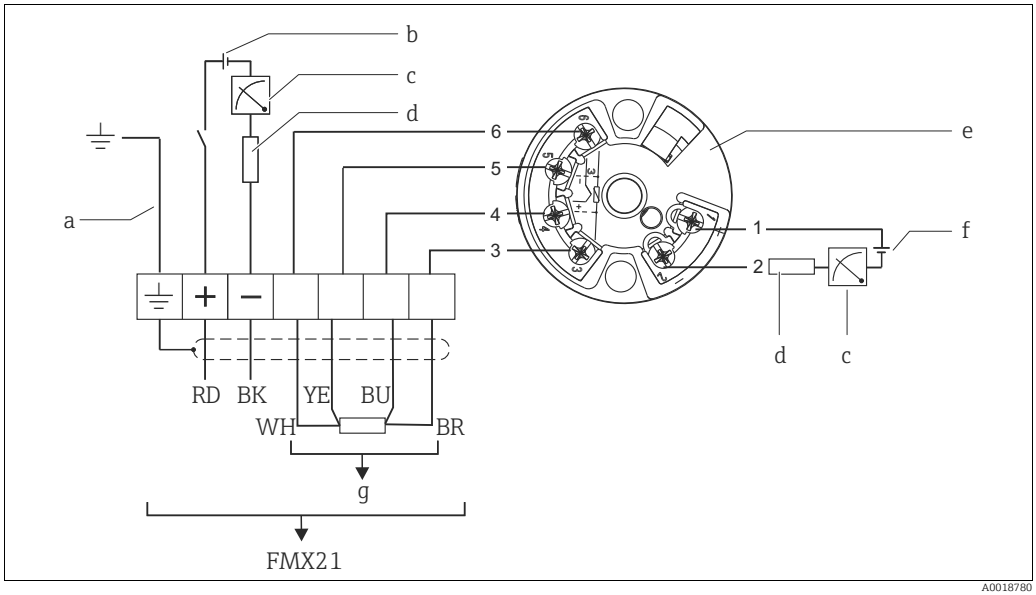
- Reverse polarity protection is integrated in the Waterpilot FMX21 and in the TMT182 temperature head transmitter. Changing the polarities will not damage the devices.
- The cable must end in a dry room or a suitable terminal box. The terminal box (IP66/IP67) with a GORE-TEX® filter from Endress+Hauser is suitable for outdoor installations. The terminal box can be ordered as an accessory using the order code for FMX21 version "PS" for feature 620 (→ 28).

The electrical connection is made with the corresponding wires of the probe cable and with the optional use of the terminal box (Commubox FXA) or an active barrier (e.g. RN221N).



A *Waterpilot FMX21*
B *Waterpilot FMX21 with Pt100 [1]; Version "NB" for feature 610 "Accessories" in the order code (→ 28)*

a Not for FMX21 with an outer diameter of 29 mm (1.14 in)
b 10.5 to 30 V DC (Ex), 10.5 to 35 V DC
c 4 to 20 mA
d Resistance (R_L)
e Pt100



Waterpilot FMX21 with Pt100 and TMT182 temperature head transmitter (4 to 20 mA) [1]
versions "NB" und "PT", feature 610 and 620 in the order code (→ 28)

a Not for FMX21 with an outer diameter of 29 mm (1.14 in)
b 10.5 to 35 V DC
c 4 to 20 mA
d Resistance (R_L)
e TMT182 temperature head transmitter (4 to 20 mA)
f 11.5 to 35 V DC
g Pt100

[1] Not for use in hazardous areas.

Wire colors
RD = red, BK = black, WH = white, YE = yellow, BU = blue, BR = brown

Connection classification as per IEC 61010-1:

- Overvoltage category 1
- Pollution degree 1

Connection data in the hazardous area

4 to 20 mA	Ex ia IIC T4 to T6
Ui	30 V DC
Ii	133 mA
Pi	1.0 W
Ci	10.3 nF (sensor); 180 pF/m (cable)
Li	0 µH (sensor); 1 µH/m (cable)
Ta	−10 °C (+14 °F) ≤ Ta ≤ +70 °C (+158 °F) for T4; −10 °C (+14 °F) ≤ Ta ≤ +40 °C (+104 °F) for T6

Cable specifications

FMX21 + Pt100 (optional)

- Commercially available instrument cable
- Terminal, terminal box: 0.08 to 2.5 mm^2 (28 to 14 AWG)
- If the Pt100 signal is directly connected to a display and/or evaluation unit, Endress+Hauser recommends using a shielded cable.

TMT182 temperature head transmitter (optional)

- Commercially available instrument cable
- Terminal, terminal box: 0.08 to 2.5 mm^2 (28 to 14 AWG)
- Transmitter connection: max. 1.75 mm^2 (15 AWG)

Residual ripple

FMX21 + Pt100 (optional)

No impact on the 4 to 20 mA signal to ±5 % residual ripple within the permitted voltage range (according to HART Hardware Specification HCF_SPEC-54 (DIN IEC 60381-1))

TMT182 temperature head transmitter (optional)

$U_{ss} \geq 3$ V at U ≥ 13 V, $f_{max.}$ = 1 kHz

Performance characteristics

Reference operating conditions

FMX21 + Pt100 (optional)

- As per IEC 60770
- Ambient temperature T_A = constant, in range: +21 to +33 °C (+70 °F to +91 °F)
- Humidity φ = constant, in range: 20 to 80 % RH
- Ambient pressure p_A = constant, in range: 860 to 1060 mbar (13 to 16 psi)
- Position of the measuring cell = constant, in range, vertical: ±1°
- Supply voltage constant: 21 V DC to 27 V DC
- Load with HART: 250 Ω
- Pt100: DIN EN 60770 T_A = 25 °C (77 °F)

TMT182 temperature head transmitter (optional)

Calibration temperature 25 °C (77 °F) ±5 K

Reference accuracy

FMX21 + Pt100 (optional)

The reference accuracy comprises the non-linearity after limit point configuration, hysteresis and non-repeatability in accordance with IEC 60770.

- Setting ±0.2 %
  - to TD 5:1: < 0.2 % of the set span
  - from TD 5:1 to TD 10:1 ±(0.02 x TD+0.1)

PLATINUM version:
- Setting ±0.1 % (optional)
  - to TD 5:1: < 0.1 % of the set span
  - from TD 5:1 to TD 10:1 ±(0.02 x TD)
- Class B to DIN EN 60751
  - Pt100: max. ±1 K

TMT182 temperature head transmitter (optional)

- ±0.2 K
- With Pt100: max. ±0.9 K

Resolution

Current output: 1 µA

Read cycle
HART commands: 2 to 3 per second on average

Long-term stability

FMX21 + Pt100 (optional)

- ≤ 0.1 % of URL/year
- ≤ 0.25 % of URL/5 years

TMT182 temperature head transmitter (optional)

≤ 0.1 K per year

Influence of medium temperature

- Thermal change in the zero output and the output span
  0 to +30 °C (+32 to +86 °F): <(0.15 + 0.15 x TD)%
  −10 to +70 °C (+14 to +158 °F): <(0.4 + 0.4 x TD)%
- Temperature coefficient (T_K) of the zero output and output span
  −10 to +70 °C (+14 to +158 °F): 0.1 % / 10 K URL

Warm-up period

FMX21 + Pt100 (optional)

- FMX21: < 6 s
- Pt100: 20 ms

TMT182 temperature head transmitter (optional)

4 s

Step response time

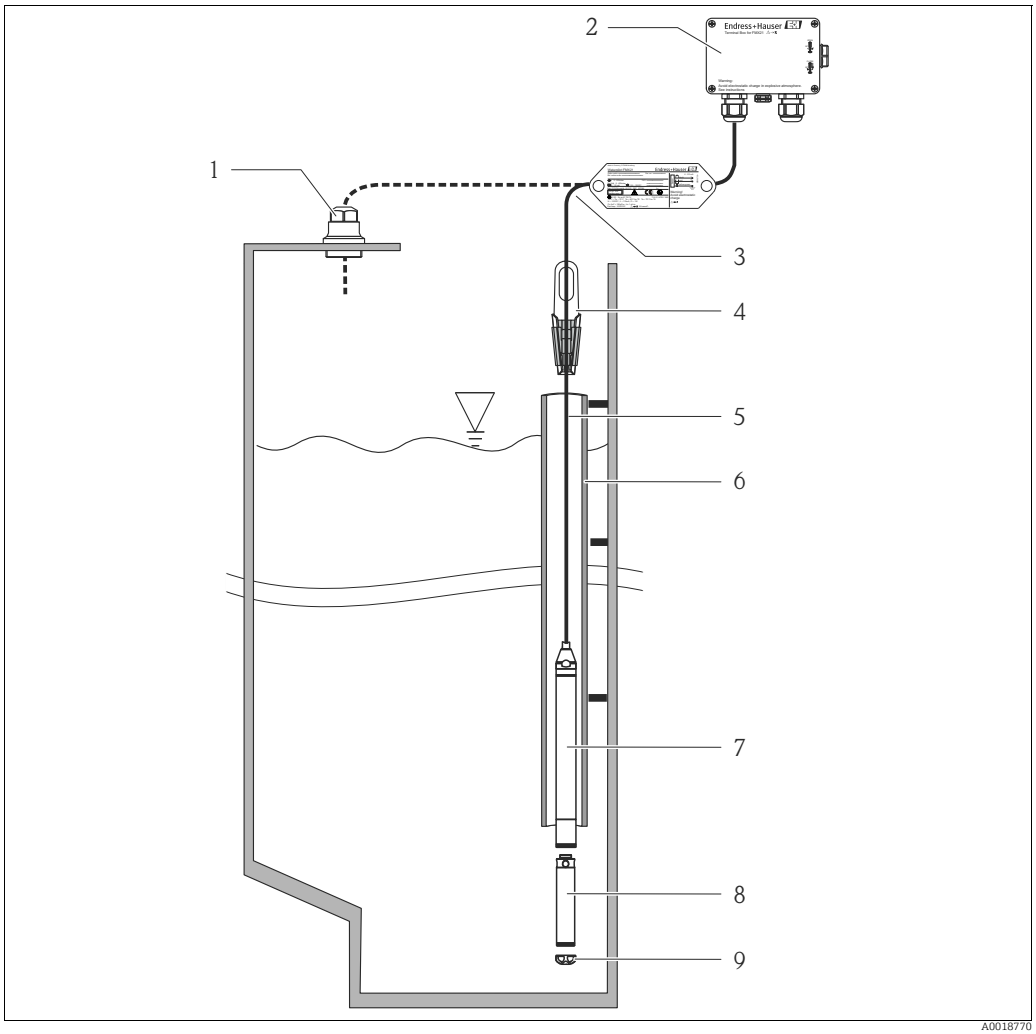
FMX21 + Pt100 (optional)

- FMX21: 400 ms (T90 time), 500 ms (T99 time)
- Pt100: 160 s (T90 time), 300 s (T99 time)

—

Installation

Installation instructions



Installation examples, here illustrated with FMX21 with an outer diameter of 22 mm (0.87 in)

1 *Extension cable mounting screw can be ordered via order code or as an accessory (→ 28)*
2 *Terminal box can be ordered via order code or as an accessory (→ 28)*
3 *Extension cable bending radius > 120 mm (4.72 in)*
4 *Mounting clamp can be ordered via order code or as an accessory (→ 28)*
5 *Extension cable, length (→ 25)*
6 *Guide pipe*
7 *Waterpilot FMX21*
8 *Additional weight can be ordered as an accessory for FMX21 with an outer diameter of 22 mm (0.87 in) and 29 mm (1.14 in)*
9 *Protection cap*

Additional installation instruction

- Sideways movement of the level probe can result in measuring errors. For this reason, install the probe at a point free from flow and turbulence, or use a guide tube. The internal diameter of the guide tube should be at least 1 mm (0.04 in) bigger than the outer diameter of the selected FMX21.
- The device is provided with a protection cap to prevent mechanical damage to the measuring cell.
- The cable must end in a dry room or a suitable terminal box. The terminal box from Endress+Hauser provides optimum humidity and climatic protection and is suitable for outdoor installation (→ 30).
- Rod length tolerances: < 5 m (16 ft): ±17.5 mm (0.69 in); > 5 m (16 ft): ±0.2 % (→ 31)
- If the cable is shortened, the filter at the pressure compensation tube has to be reattached. Endress+Hauser offers a cable shortening kit for this purpose → 28 ff; (SD00552P/00/A6).
- Endress+Hauser recommends using twisted, shielded cables.
- Note for ship building applications: Measures for limitation of the propagation of fire along cable bundles are required (fire stops).

Environment

Ambient temperature range

FMX21 + Pt100 (optional)

- With outer diameter of 22 mm (0.87 in) and 42 mm (1.65 in):
  −10 to +70 °C (+14 to +158 °F)
  (= medium temperature)
- With outer diameter of 29 mm (1.14 in):
  0 to +50 °C (+32 to +122 °F)
  (= medium temperature)

Cable
(fixed installation)
- PE: −30 to +70 °C (−22 to +158 °F)
- FEP: −40 to +70 °C (−40 to +158 °F)
- PUR: −40 to +70 °C (−40 to +158 °F)

Terminal box

−40 to +80 °C (−40 to +176 °F)

TMT182 temperature head transmitter (optional)

−40 to +85 °C (−40 to +185 °F)

Storage temperature range

FMX21 + Pt100 (optional)

−40 to +80 °C (−40 to +176 °F)

Cable
(fixed installation)
- PE: −30 to +70 °C (−22 to +158 °F)
- FEP: −30 to +80 °C (−22 to +176 °F)
- PUR: −40 to +80 °C (−40 to +176 °F)

Terminal box

−40 to +80 °C (−40 to +176 °F)

TMT182 temperature head transmitter (optional)

−40 to +100 °C (−40 to +212 °F)

Degree of protection

FMX21 + Pt100 (optional)

IP68, permanently hermetically sealed at 20 bar (290 psi)(~200 m H_2O)

Terminal box (optional)

IP66, IP67

TMT182 temperature head transmitter (optional)

IP00, condensation permitted

Geometric height according to IEC61010-1 Ed.3

Up to 2 000 m (6 600 ft) above MSL.

Electromagnetic compatibility (EMC)

FMX21 + Pt100 (optional)

- EMC in accordance with all the relevant requirements of the EN 61326 series. Details are provided in the Declaration of Conformity.
- Maximum deviation < 0.5 % of the span.

TMT182 temperature head transmitter (optional)

EMC in accordance with all the relevant requirements of the EN 61326 series. Details are provided in the Declaration of Conformity.

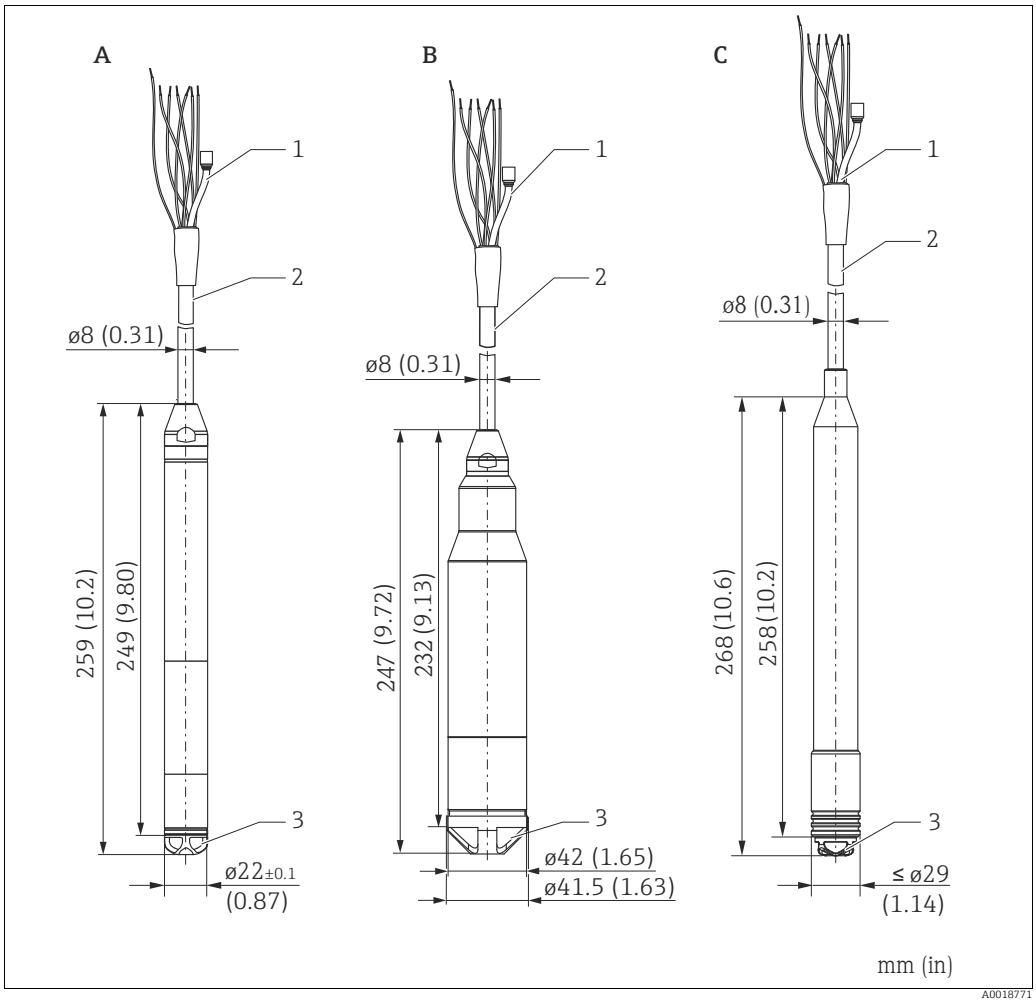
Overvoltage protection	**FMX21 + Pt100 (optional)** ▪ Integrated overvoltage protection to EN 61000-4-5 (500 V symmetrical/1000 V asymmetrical) ▪ Install overvoltage protection ≥ 1.0 kV, external if necessary	**TMT182 temperature head transmitter (optional)** Install overvoltage protection, external if necessary.

Process

Medium temperature range	**FMX21 + Pt100 (optional)** ▪ With outer diameter of 22 mm (0.87 in) and 42 mm (1.65 in): −10 to +70 °C (+14 to +158 °F) ▪ With outer diameter of 29 mm (1.14 in): 0 to +50 °C (+32 to +122 °F)	**TMT182 temperature head transmitter (optional)** —
Medium temperature limits	**FMX21 + Pt100 (optional)** ▪ With outer diameter of 22 mm (0.87 in) and 42 mm (1.65 in): −20 to +70 °C (−4 to +158 °F) In hazardous areas incl. CSA GP, the medium temperature limit is at −10 to +70 °C (+14 to +158 °F). ▪ With outer diameter of 29 mm (1.14 in): 0 to +50 °C (+32 to +122 °F) The FMX21 can be operated in this temperature range. The specification can then be exceeded, e.g. measuring accuracy.	—

Mechanical construction

Dimensions of the level probe

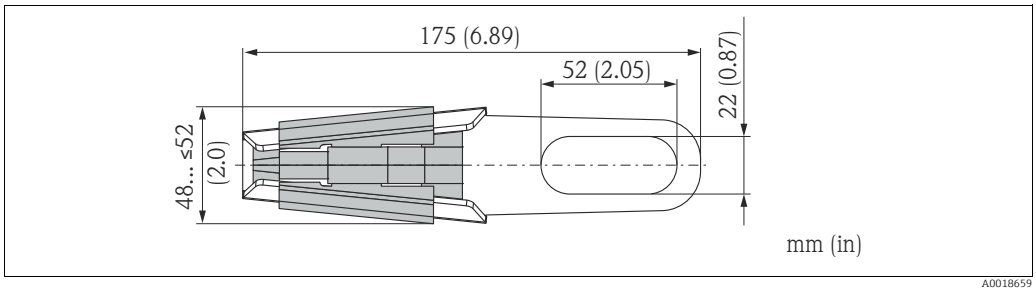


Versions of the FMX21

A *In the order code: feature 45 "Probe tube", version "1" or "Accessories" (→ 28)*
B *In the order code: feature 45 "Probe tube", version "2" (→ 28)*
C *In the order code: feature 45 "Probe tube", version "5" (→ 28)*

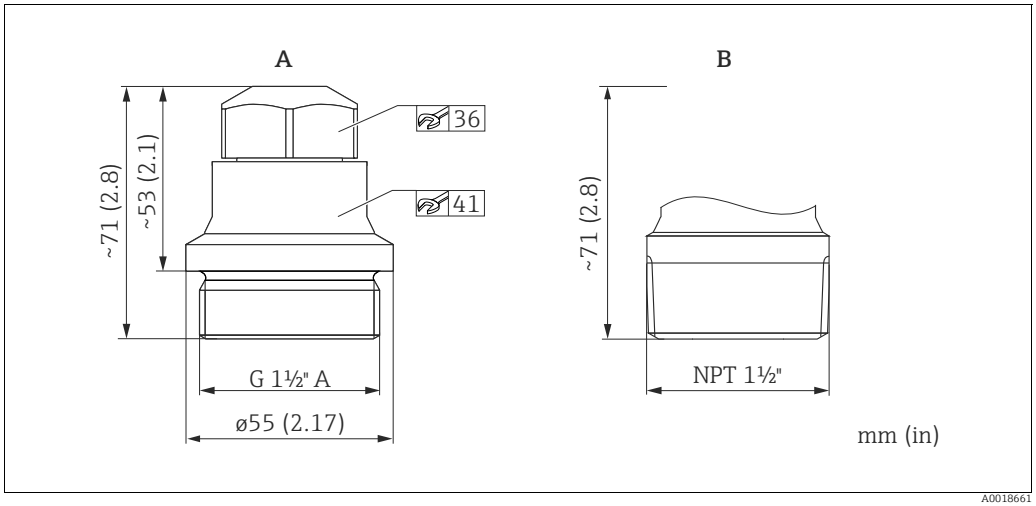
1 Pressure compensation tube
2 Extension cable ((Length, see → 25)
3 Protection cap

Dimensions of the mounting clamp



In the order code: feature 620 "Accessories", version "PO" (→ 28)

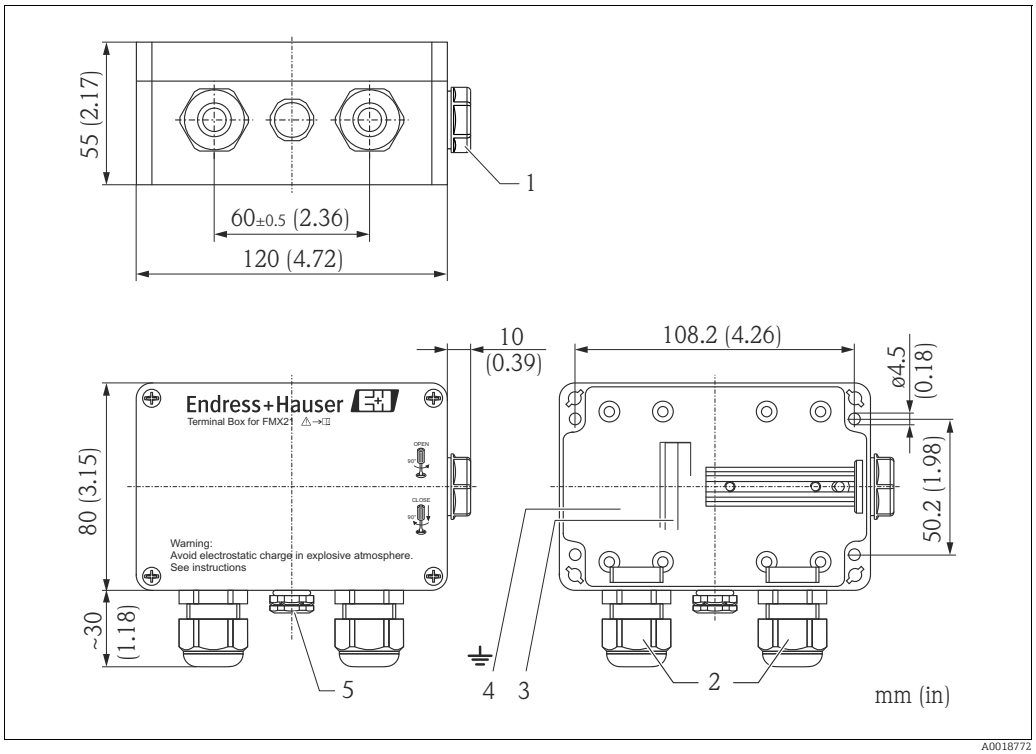
Dimensions of the extension cable mounting screws



A *G 1½" A, in the order code: feature 620 "Accessories", version "PQ" (→ 28)*
B *NPT 1½", in the order code: feature 620 "Accessories", version "PR" for (→ 28)*

Application in unpressurized containers only.

Dimensions of the IP66, IP67 terminal boxes with filters



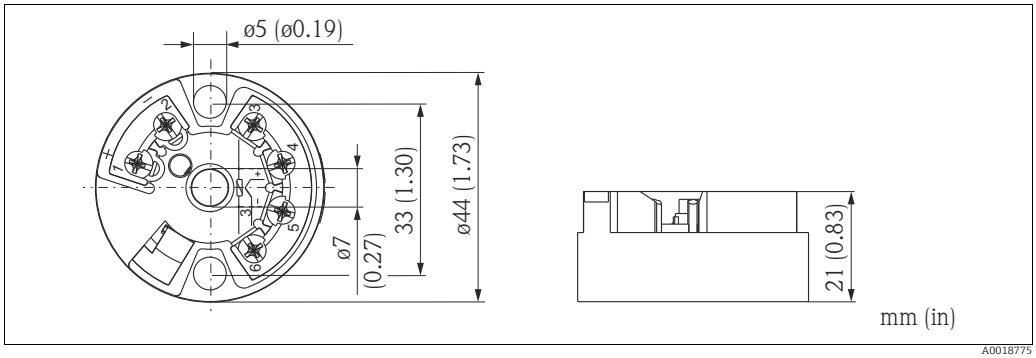
In the order code: feature 620, version "PS" or "PT" (→ 28)

1 *Dummy plug M20x1.5*
2 *Cable gland M20x1.5*
3 *4 to 20 mA; terminals for 0.08 to 2.5 mm² (28 to 14 AWG)*
4 *Ground connection; terminals for 0.08 to 2.5 mm² (28 to 14 AWG)*
5 *GORE-TEX® filter*

If ordered together with FMX21 but without the optional TMT182 temperatur transmitter, the terminal box is incl. a 4-terminal strip.

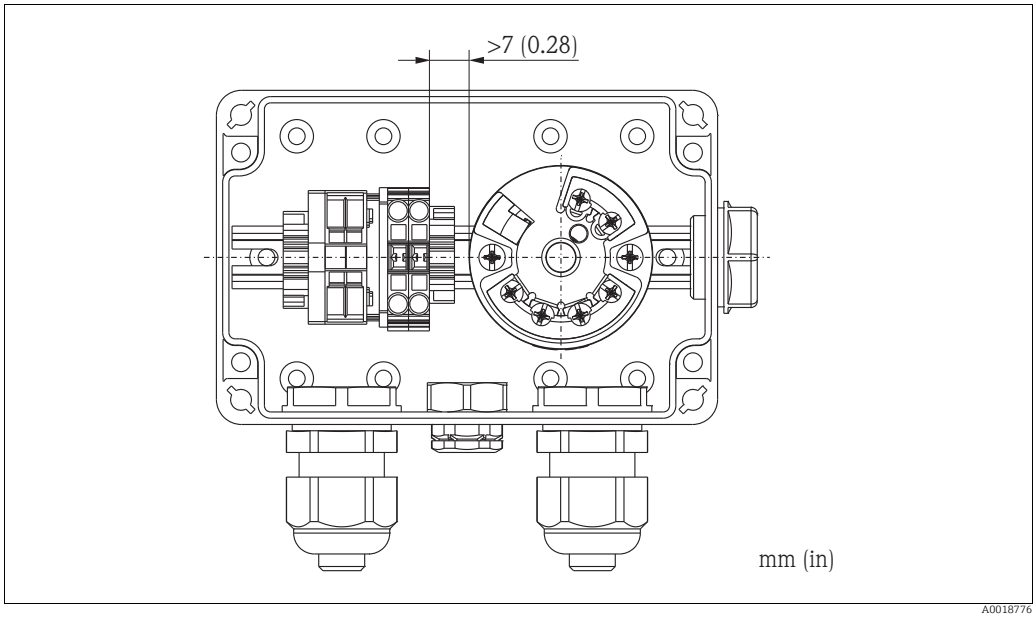
The 4-terminal strip is not intended for use in hazardous areas incl. CSA GP.

Dimensions of the TMT182 temperature head transmitter



In the order code: feature 620 "Accessories", version "PT" for (→ 28)

Terminal box with integrated TMT182 temperature head transmitter (4 to 20 mA HART)

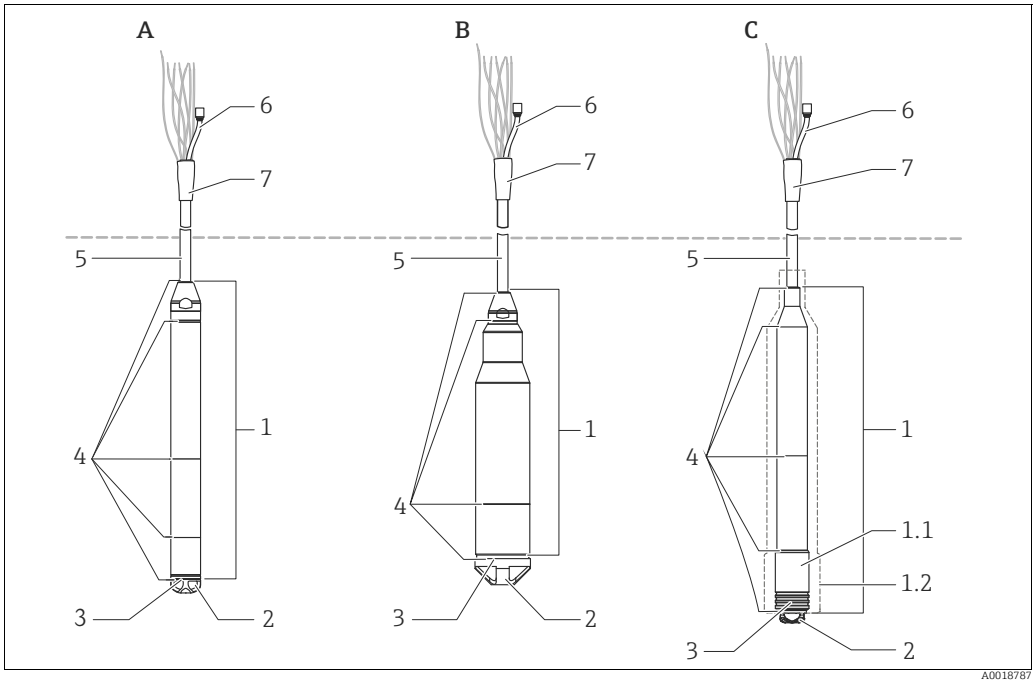


A distance of > 7 mm (> 0.28 in mm) must be maintained between the terminal strip and the TMT182 temperature head transmitter.

Weight

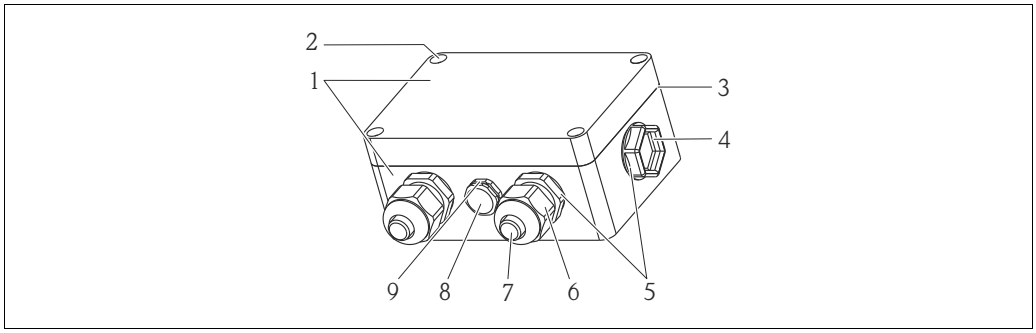
Component part		Weight
Level probe, outer diameter 22 mm (0.87 in)		344 g (12.133 oz)
Level probe, outer diameter 42 mm (1.65 in)		1376 g (48.532 oz)
Level probe, outer diameter 29 mm (1.14 in)		394 g (13.896 oz)
Extension cable	▪ PE ▪ PUR ▪ FEP	▪ 52 g/m (0.035 lbs/1 ft) ▪ 60 g/m (0.040 lbs/1 ft) ▪ 108 g/m (0.072 lbs/1 ft
Mounting clamp		170 g (5.996 oz)
Extension cable mounting screw G 1½" A		770 g (27.158 oz
Extension cable mounting screw NPT 1½"		724 g (25.535 oz)
Terminal box		235 g (8.288 oz)
Temperature head transmitter TMT182		40 g (1.411 oz)
Additional weight		300 g (10.581 oz)
Testing adapter		39 g (1.376 oz)

Material



Material in contact with process		
Position number	**Component part**	**Material**
1	**A**: Level probe, outer diameter 22 mm (0.87 in) **B**: Level probe, outer diameter 42 mm (1.65 in) **C**: Level probe, outer diameter max. 29 mm (1.14 in)	316L (1.4404/1.4435)
1.1	Sensor sleeve	PPS (polyphenylene sulfide)
1.2	Heat-shrink sleeve	Polyolefin and hot-melt adhesive
	The heat-shrink sleeve at the level probe acts as an insulation. It prevents electrical contact between the probe and the tank. Electrochemical corrosion is thus avoided.	
2	Protection cap ▪ **A** and **C**: with outer diameter 22 mm (0.87 in) and 29 mm (1.14 in) ▪ **B**: with outer diameter 42 mm (1.65 in)	▪ PPO (Polyphenylenoxid) ▪ PFA (Perfluoralkoxy)
3	Process ceramic	Al_2O_3 (aluminum oxide ceramic)
4	Seal	EPDM or FKM Viton
5	Extension cable insulation For more information → 25	Either: ▪ PE-LD (low-density polyethylene) ▪ FEP (fluorinated ethylene propylene) ▪ PUR (polyurethane)
Material not in contact with process		
6	Pressure compensation tube	PA
7	Heat-shrink sleeve	Polyolefin

Terminal box (not in contact with process)



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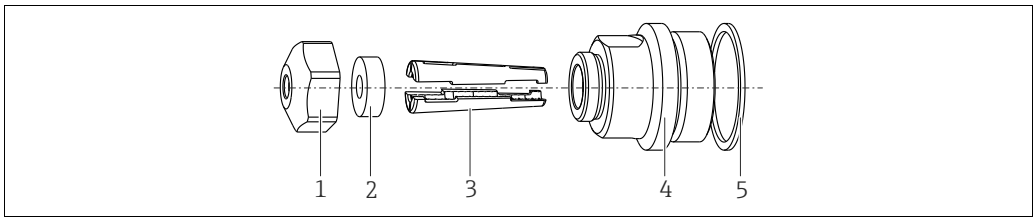
Position number	Component part	Material
1	Housing	PC
2	Mounting screws (4 x)	A2
3	Seal	CR (Chloropren-Unvulcanized rubber)
4	Dummy plug M20x1.5	PBT-GF30
5	Cable gland M20x1.5	PE-HD
6		PA6
7		PA6-GF30
8	Pressure compensation tube	PA6-GF10, ePTFE
9	Pressure compensation tube O-ring	Silicone (VMQ)

Cable mounting screw (not in contact with process)



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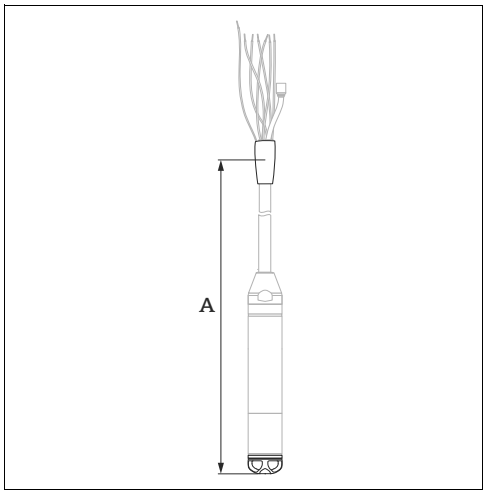
Position number	Component part	Material
1	Cover cable gland	304 (1.4301)
2	Seal	NBR
3	Klemmhülsen	PA66-GF35
4	Anschlussstück cable gland G 1½" A, NPT 1½"	304 (1.4301)
5	Seal → only for G 1½" A	EPDM

Extension cable

PE	PUR	FEP
▪ Abrasion-resistant extension cable with Dynema strain-relief members ▪ Shielded with aluminum-coated film ▪ Insulated with polyethylene (PE), black ▪ Copper wires, twisted ▪ Pressure compensation tube with Teflon filter	▪ Abrasion-resistant extension cable with Dynema strain-relief members ▪ Shielded with aluminum-coated film ▪ Insulated with polyurethane (PUR), black ▪ Copper wires, twisted ▪ Pressure compensation tube with Teflon filter	▪ Abrasion-resistant extension cable ▪ Shielded with galvanized steel wire netting ▪ Insulated with fluorinated ethylene propylene (FEP), black ▪ Copper wires, twisted ▪ Pressure compensation tube with Teflon filter

Cable length



A Cable length

- Please refer also to "Load" (→ 12).
- Cable lengths that can be ordered
  - Customer-specific length in meters or feet (→ 28, "Ordering information")
  - Limited cable length when performing installation with freely suspended device with extension cable mounting screw or mounting clamp, as well as for hazardous areas: max. 300 m (984 ft).

When using the measuring device in hazardous areas, installation must comply with the applicable national standards and regulations and the Safety Instructions (XAs) or the Installation or Control Drawings (ZDs) "Documentation"

Cross-section

- Total outer diameter: 8.0 mm (0.31 in) ±0.25 mm (±0.01 in)
- FMX21: 3 x 0.227 mm^2 (3 x 26 AWG) + pressure compensation tube with Teflon filter
- FMX21 with Pt100 (optional): 7 x 0.227 mm^2 (7x 26 AWG) + pressure compensation tube with Teflon filter
- Pressure compensation tube with Teflon filter:
  outer diameter 2.5 mm (0.1 in), internal diameter 1.5 mm (0.06 in)

Cable resistance

per wire: ≤ 0.09 Ω/m

Further technical data

- Minimum bending radius: 120 mm (4.72 in)
- Tensile strength: max. 950 N (213.56 lbf)
- Cable extraction force (= necessary tensile force to extract the cable from the level probe):
  - PE, FEP: typical ≥ 400 N (89.92 lbf), PUR: typical ≥ 150 N (33.72 lbf)
  - for use in hazardous areas: ≥ 100 N (73,75 lbf)
- Resistance to UV light
- PE: Usage in drinking water

Terminals

- Three terminals as standard in the terminal box
- 4-terminal strip can be ordered as an accessory, Order No: 52008938
  Conductor cross-section 0.08 to 2.5 mm^2 (28 to 14 AWG)

The 4-terminal strip is not intended for use in hazardous areas incl. CSA GP.

Operability

FieldCare

FieldCare is Endress+Hauser's plant asset management tool based on FDT technology. You can use FieldCare to configure all Endress+Hauser devices as well as third-party devices which support the FDT standard.

FieldCare supports the following functions:
- Configuration of transmitters in offline and online mode
- Loading and saving device data (upload/download)
- Documentation of the measuring point

Connection options:
- Via Commubox FXA195 and the USB port of a computer
- Via Fieldgate FXA520

For further information and free download of FieldCare see → www.endress.com → Download → Search: FieldCare

Field Xpert SFX

Field Xpert is an industrial PDA with integrated 3.5" touchscreen from Endress+Hauser based on Windows Mobile. It communicates via wireless with the optional VIATOR® Bluetooth® modem connected to a HART device point-to-point or wireless via WiFi and Endress+Hauser's Fieldgate FXA520. Field Xpert also works as a stand-alone device for asset management applications. For details refer to BA00060S/00/EN.

Certificates and approvals

CE mark

The device meets the legal requirements of the applicable EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

Ex approval

- ATEX
- CSA C/US
- FM
- IEC
- NEPSI
- INMETRO

- The approvals to apply only for Waterpilot FMX21 without Pt100 and without TMT182.
- Waterpilot FMX21 is only available for use in hazardous areas with the FKM Viton seal.
- All explosion protection data are given in separate documentation which is available upon request. The Ex documentation is supplied as standard with all devices approved for use in explosion hazardous areas (→ 32).

Drinking water approval

For FMX21 with outer diameter 22 mm (0.87 in)
- KTW certificate
- NSF 61 approval
- ACS approval

Marine certificate

- GL (Germanischer Lloyd)
- ABS (American Bureau of Shipping)
- LR (Lloyds Register)
- BV (Bureau Veritas)
- DNV (Det Norske Veritas)

Standards and guidelines

The European standards and guidelines that have been applied are listed in the associated EC Declarations of Conformity. In addition, the following standards were also applied for the Waterpilot FMX21:

- DIN EN 60770 (IEC 60770):
  Transmitters for use in industrial process control systems
  Part 1: Methods for performance evaluation
- DIN 16086:
  Electrical pressure measuring instruments,
  pressure sensors, pressure transmitters,
  pressure measuring instruments, concepts, specifications on data sheets
- EN 61326:
  Electrical equipment for measurement, control and laboratory use – EMC requirements
- EN 61010-1 (IEC 61010-1):
  Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC 60529:
  Degrees of protection provided by enclosures

Ordering information

FMX21

You can enter the versions for the specific feature in the following table. The versions entered make up the complete order code. Options which are mutually exclusive are not marked.

10	**Approval:**									
	AA	Non-hazardous area								
	BE	ATEX II 2 G Ex ia IIC T6								
	BD	ATEX II 3 G Ex nA IIC T6								
	FE	FM IS, Cl. I Division 1, Groups A – D, AEx ia, zone 1								
	CE	CSA C/US IS Cl. I Division 1, Groups A – D, Ex ia, zone 1								
	CD	CSA General Purpose								
	IC	IEC Ex ia IIC T6 Gb								
	MA	INMETRO Ex ia IIC T6								
	NA	NEPSI Ex ia IIC T6								
20		**Output:**								
		2	4-20 mA HART							
45			**Probe tube:**							
			1	Outer diameter d = 22 mm, AISI 316L						
			2	Outer diameter d = 42 mm, flush-mounted, AISI 316L						
			5	Outer diameter d = 29 mm, AISI 316L, PPS/polyolefin for saltwater applications						
70				**Sensor range:**						
				Measuring range						
				1C	100 mbar/10 kPa/1.5 psi gauge, 1 m H_2O/3 ft H_2O/40 in H_2O					
				1D	200 mbar/20 kPa/3 psi gauge, 2 m H_2O/6 ft H_2O/80 in H_2O					
				1F	400 mbar/40 kPa/6 psi gauge, 4 m H_2O/13 ft H_2O/160 in H_2O					
				1G	600 mbar/60 kPa/9 psi gauge, 6 m H_2O/20 ft H_2O/240 in H_2O					
				1H	1 bar/100 kPa/15 psi gauge, 10 m H_2O/33 ft H_2O/400 in H_2O					
				1K	2 bar/200 kPa/30 psi gauge, 20 m H_2O/67 ft H_2O/800 in H_2O					
				1M	4 bar/400 kPa/60 psi gauge, 40 m H_2O/133 ft H_2O/1600 in H_2O					
				1P	10 bar/1 MPa/150 psi gauge, 100 m H_2O/333 ft H_2O/4000 in H_2O					
				1Q	20 bar/2 MPa/300 psi gauge, 200 m H_2O/667 ft H_2O/8000 in H_2O					
				2K	2 bar/200 kPa/30 psi absolute, 20 m H_2O/67 ft H_2O/800 in H_2O					
				2M	4 bar/400 kPa/60 psi absolute, 40 m H_2O/133 ft H_2O/1600 in H_2O					
				2P	10 bar/1 MPa/150 psi absolute, 100 m H_2O/333 ft H_2O/4000 in H_2O					
				2Q	20 bar/2 MPa/300 psi absolute, 200 m H_2O/667 ft H_2O/8000 in H_2O					
80						**Reference accuracy:**				
						D	Platinum			
						G	Standard			
90							**Calibration, unit:**			
							A	Sensor range; %		
							B	Sensor range; mbar/bar		
							C	Sensor range; kPa/MPa		
							D	Sensor range; mm/mH_2O		
							E	Sensor range; in H_2O/ft H_2O		
							F	Sensor range; psi		
							J	Customized pressure; see additional specification		
							K	Customized level; see additional specification		
FMX21-										Order code

→ Ordering information for continued on next page

FMX21 (continued)

100		**Probe connection:**
	10	10 m cable, shortable, PE
	11	20 m cable, shortable, PE
	15	..... m cable, shortable, PE
	20	30 ft cable, shortable, PE
	21	60 ft cable, shortable, PE
	25	..... ft cable, shortable, PE
	30	10 m cable, shortable, FEP
	31	20 m cable, shortable, FEP
	35	..... m cable, shortable, FEP
	40	30 ft cable, shortable, FEP
	41	60 ft cable, shortable, FEP
	45	..... ft cable, shortable, FEP
	50	10 m cable, shortable, PUR
	51	20 m cable, shortable, PUR
	55	..... m cable, shortable, PUR
	60	30 ft cable, shortable, PUR
	61	60 ft cable, shortable, PUR
	65	..... ft cable, shortable, PUR
190		**Seal:**
	A	FKM Viton
	H	EPDM
FMX21-		Order code

Additional ordering information (optional)

550		**Calibration**
	F1	Works calib. certificate 5-point
570		**Service**
	IA	Adjusted min alarm current
	IB	Adjusted HART Burst Mode PV
	IR	... m cable marking>installation
	IS	... ft cable marking>installation
	I9	Special version
590		**Additional approval**
	LE	GL Marine certificate
	LF	ABS Marine certificate
	LG	LR Marine certificate
	LH	BV Marine certificate
	LI	DNV Marine certificate
	LQ	KTW potable water approval
	LR	NSF potable water approval
	LS	ACS potable water approval
610		**Accessories mounted**
	NB	Temperature sensor Pt100, 4-wire
620		**Accessories enclosed**
	PO	Suspension clamp, 316L
	PQ	Cable mounting screw G1½", 304
	PR	Cable mounting screw NPT1½", 304
	PS	Terminal box IP66/67
	PT	Temperature head transmitter TMT182, 2-wire, 4-20 mA, –20 to 80 °C
	PU	Additional weight, 316L
	PV	Adapter, function test
	PW	Shortening kit, extension cable
895		**Marking**
	Z1	Tagging (TAG)
FMX21-		Order code

Accessories

Mounting clamp

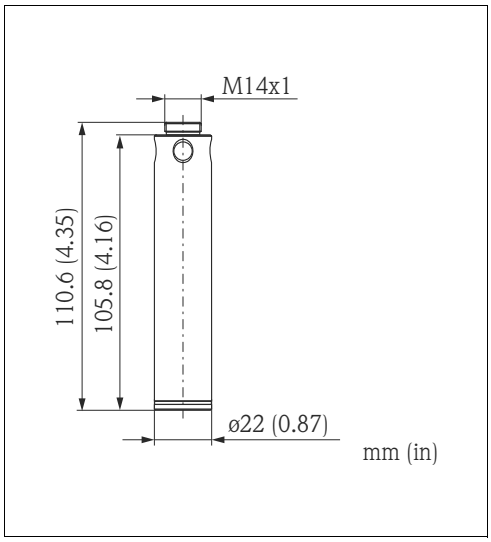
- Endress+Hauser offers a mounting clamp for easy FMX21 mounting (→ 20).
- Material: 316L (1.4404) and fiberglass reinforced PA (polyamide)
- Order number 52006151, "Ordering information" (→ 28)

Terminal box

- IP66/IP67 terminal boxes with GORE-TEX® filter incl. 3 integrated terminals.
  The terminal box is also suitable for installing a TMT182 temperature head transmitter or for four additional terminals (Order No. 52008938) → 21, "Ordering information" (→ 28).

The terminal box is not intended for the FMX21 with Ex nA explosion protection in the hazardous area. When using the terminal box in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.

Additional weight



For FMX21 with outer diameter of 22 mm (0.87 in) or 29 mm (1.14 in)

- Endress+Hauser offers additional weights to prevent sideways movement that results in measuring errors, or to make it easier to lower the device in a guide tube.
  You can screw several weights together. The weights are attached directly to the FMX21. For FMX21 with an outer diameter of 29 mm (1.14 in) a maximum of 5 weights may be attached. In combination with the Ex nA approval, for FMX21 with an outer diameter of 29 mm (1.14 in) a maximum of 1 additional weight may be attached.
- Material: 316L (1.4435)
- Weight: 300 g (10.581 oz)
- Order number 52006153, "Ordering information" (→ 28)

TMT182 temperature head transmitter (4 to 20 mA HART)

- 2-wire temperature head transmitter, configured for a measuring range from −20 to +80 °C (-4 to +158 °F). This setting offers a temperature range of 100 K which can be easily mapped. Please note that the Pt100 resistance thermometer is designed for a temperature range from −10 to +70 °C (−14 to +176 °F) → 22.
- Order number: 51001023, Ordering information (→ 28)

The TMT182 temperature head transmitter is not intended for use in hazardous areas incl. CSA GP.

Extension cable mounting screw

Endress+Hauser offers extension cable mounting screws to ease FMX21 mounting and to seal the measuring aperture (→ 21).

- Order number for extension cable mounting screw:
  - 52008264 (G 1½" A)
  - 52009311 (NPT 1½")
- Material (→ 23)

Terminals

- Four terminals in strip for terminal box, suitable for wire cross-section: 0.08 to 2.5 mm² (28 to 14 AWG)
- Order number: 52008938

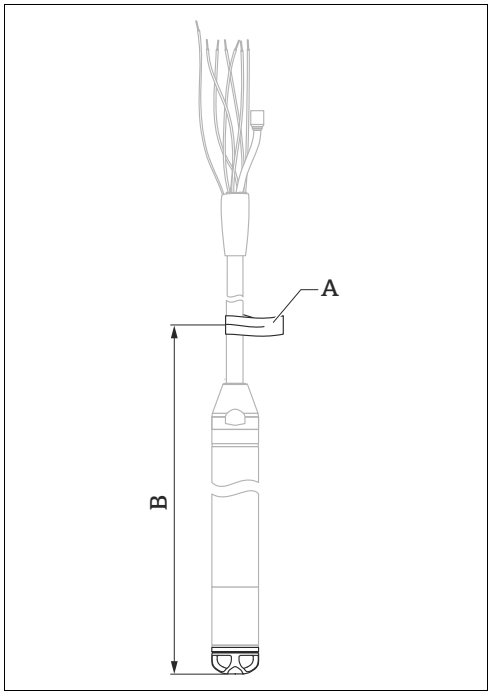
The 4-terminal strip is not intended for use in hazardous areas incl. CSA GP.

Cable shortening kit

- The cable shortening kit is used to easily and professionally shorten a cable.
- Order Number: 71222671, "Ordering information" and the documentation SD00552P/00/A6 (→ 28)

The cable shortening kit is not intended for the FMX21 with FM/CSA approval.

Cable marking



A Cable marking
B Cable marking tolerance

- To make installation easier, Endress+Hauser offers a mark on the extension cable for a customer-specific length, see also → 28, "Ordering information".
- Cable marking tolerance (distance to the lower end of the cable probe):
  Cable length < 5 m (16 ft): ±17.5 mm (0.69 in)
  Cable length > 5 m (16 ft): ±0,2 %
- Material: PET, Adhesive: acrylic
- Immunity to temperature change:
  −30 to +100 °C (-22 to +212 °F)

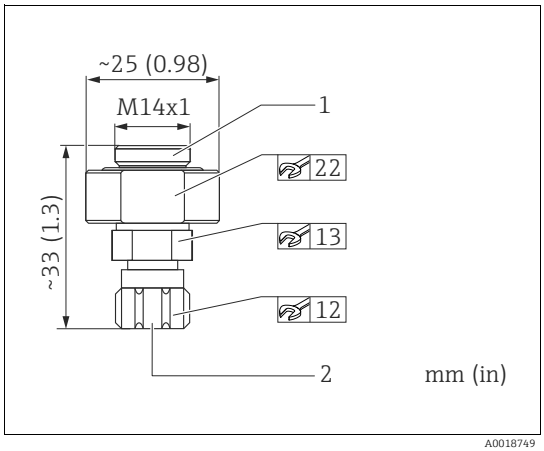
NOTICE

The mark is for installation purposes only.

- ▸ It must be thoroughly removed without trace in the case of devices with drinking water approval. The extension cable must not be damaged in the process

Not for use in hazardous areas.

Testing adapter



1 FMX21 level probe connection
2 Compressed air hose connection, internal diameter of quick coupling piece 4 mm (0.16 in)

For FMX21 with outer diameter of 22 mm (0.87 in) and 29 mm (1.14 in)

- Endress+Hauser offers a testing adapter to ease function-testing of the level probes.
- Observe the maximum pressure for the compressed air hose and the maximum overload for the level probe (→ 11).
- Maximum pressure of the quick coupling piece supplied: 10 bar (145 psi)
- Adapter material: 304 (1.4301)
- Quick coupling piece material: anodized aluminum
- Adapter weight: 39 g (1.376 oz)
- Order number 52011868 (→ 28)

Documentation

The following document types are also available in the Download Area of the Endress+Hauser website: www.endress.com → Download

Field of activities

- Pressure measurement: FA00004P/00/EN
- Recording technology: FA00014R/09/EN
- System components: FA00016K/09/EN

Technical Information

- Waterpilot FMX167 with 4 to 20 mA analog output: TI00351P/00/EN
- Deltapilot M: TI00437P/00/EN
- Temperature head transmitter iTEMP HART TMT182: TI00078R/09/EN

Operating Instructions

- Waterpilot FMX21: BA00380P/00/EN
- Cable shortening kit: SD00552P/00/A6
- Field Xpert: BA01211S/04/EN

Safety instructions

Safety Instructions (XA) are supplied with the device depending on the approval. These instructions are anintegral part of the Operating Instructions.

Approval	Feature in Order code	Types of protection	Category	Documentation
ATEX	BD	Ex ia IIC	II 2 G	XA00454P
ATEX	BE	Ex nA IIC	II 3 G	XA00485P
IECEx	IC	Ex ia IIC	n/a	XA00455P
CSA C/US	CE	Ex ia IIC	n/a	ZD232P (960008976)
FM	FE	AEx ia IIC	n/a	ZD231P (960008975)
NEPSI	NA	Ex ia IIC	n/a	XA00456P
INMETRO	MA	Ex ia IIC	n/a	XA01066P

The nameplate provides information on the Safety Instructions (XA) that are relevant for the device.

Drinking water approval

- SD00289P/00/A3 (NSF)
- SD00319P/00/A3 (KTW)
- SD00320P/00/A3 (ACS)

Patents

This product is protected by at least one of the following patents. Further patents are pending.

- US 6,427,129 B1 ≙ EP 0 892 249 B1
- US 6,703,943 A1
- DE 203 13 744.2 U1

Configuration data sheet

Level

The following configuration data sheet has to be filled in and included with the order if the option "K: customized level" has been selected in feature "090: Calibration; unit" in the product structure.

Pressure Engineering Unit

❑ mbar	❑ mmH_2O	❑ mmHg	❑ hPa
❑ bar	❑ mH_2O		❑ kPa
	❑ ftH_2O		❑ MPa
❑ psi	❑ inH_2O	❑ kgf/cm^2	

Output Unit (Scaled unit)

Mass	Length	Volume	Volume	Percent
❑ kg	❑ m	❑ l	❑ gal	❑ %
❑ t	❑ dm	❑ hl	❑ Igal	
❑ lb	❑ cm			
	❑ mm	❑ m^3		
		❑ ft^3		
	❑ ft	❑ in^3		
	❑ inch			

Empty calibration [a]:
low pressure value (empty) _____ [pres.eng.unit]

Empty calibration [a]:
low level value (empty) _____ [scaled unit]

Full calibration [b]:
high pressure value (full) _____ [pres.eng.unit]

Full calibration [b]:
high level value (full) _____ [scaled unit]

Damping

Damping: _____ sec

Pressure

The following configuration data sheet has to be filled in and included with the order if the option "J: customized pressure" has been selected in feature "090: Calibration; unit" in the product structure.

Pressure Engineering Unit

❑ mbar	❑ mmH_2O	❑ mmHg	❑ Pa
❑ bar	❑ mH_2O		❑ kPa
	❑ ftH_2O		❑ MPa
❑ psi	❑ inH_2O	❑ kgf/cm^2	

Calibration Range / Output

Low range value (LRV) _____ [pressure engineering unit]
Upper range value (URV): _____ [pressure engineering unit]

Damping

Damping: _____ sec

www.addresses.endress.com

Endress+Hauser

People for Process Automation

SECTION 7
Drawings

SECTION 8
Warranty & Service Information

ZELLER
Automation, Control & Energy
A KAMAN COMPANY
1000 University Avenue
Rochester, NY 14607
Phone: 585-254-8840
Fax: 585-254-4805

JJ Lane Construction

200 Terminal Road East

Liverpool, NY 13088

Attn: Mr. Greene

Project # 121222 – OCWEP Harbor Brook CSO 18

CUSTOMER PO# 1087.007

This letter is to confirm that KIT Zeller will warranty the equipment we supplied covered under our scope of work for 12 months from the date of commissioning. The warranty period will commence on 06/16/14 when the system will be commissioned, commissioning to be witnessed and approved by the customer (JJ Lane Construction). This warranty period will (with the exception of human negligence or acts of extreme nature such as lightning, floods or high winds) provide for the repair of any and all defects of workmanship, as well as repair or replacement of any defective or failed components.

Please feel free to contact KIT Zeller with any questions or comments regarding this letter.

Regards,

John Finter
KIT - Zeller
Construction Manager
1000 University Avenue
Rochester, NY 14607

ZELLER
Automation, Control & Energy
A KAMAN COMPANY
1000 University Avenue
Rochester, NY 14607
Phone: 585-254-8840
Fax: 585-254-4805

Project # 121222

Reference County of Onondaga Harbor Brook CSO 18

Service Contact Information:

Zeller Corporation
1000 University Avenue
Rochester, NY 14607

Service Department Manager:

Darlene Toole
585-719-2931

Main Office:
585-254-8840
800-295-8696

ONONDAGA COUNTY
HARBOR BROOK CSO

REVISED AUGUST 2015 AS – BUILT CONDITIONS

FILENAME	SH	DWGDESC
12122–PLCB–SCH–00	0	INDEX and GENERAL INFORMATION
12122–PLCB–SCH–01	1	POWER and CONTROL SCHEMATIC
12122–PLCB–SCH–02	2	NETWORK DIAGRAM
12122–PLCB–SCH–03	3	DIGITAL INPUTS/OUTPUTS
12122–PLCB–SCH–04	4	ANALOG INPUT
12122–PLCB–SCH–05	5	SPARE
12122–PLCB–SCH–06	6	INTERFACE RELAYS
121222–PLCB–SCH–07–10	7	EXTERIOR LAYOUT
121222–PLCB–SCH–07–10	8	CUTOUT DIMENSIONS
121222–PLCB–SCH–07–10	9	SUBPLATE DIMENSIONS
121222–PLCB–SCH–07–10	10	TERMINAL BLOCKS

TAGS	QTY	MFG	DESCRIPTION
FU–125	1	MERSEN	G FUSE, U.S. SIZE 6.3x32mm, 1 A, 250V AC, TIME DELAY, GLASS TUBE
FU–102 FU–120 FU–127	3	MERSEN	G FUSE, U.S. SIZE 6.3x32mm, 4 A, 250V AC, TIME DELAY, GLASS TUBE
FU–131	1	MERSEN	G FUSE, U.S. SIZE 6.3x32mm, 0.25 A, 250V AC, FAST ACTING, GLASS TUBE
FU–108	1	MERSEN	G FUSE, U.S. SIZE 6.3x32mm, 5 A, 250V AC, FAST ACTING, GLASS TUBE

DEVICE ID	POWER (W)
PWS–127	4
PLC–120	70
ND–114	30
TOTAL	104 Watts
RUN TIME	66 MINS

PHONE 585–244–0450
FAX 585–254–4115
VSGENVIROMATION
A ZELLER COMPANY

LOWER HARBOR BROOK CSO

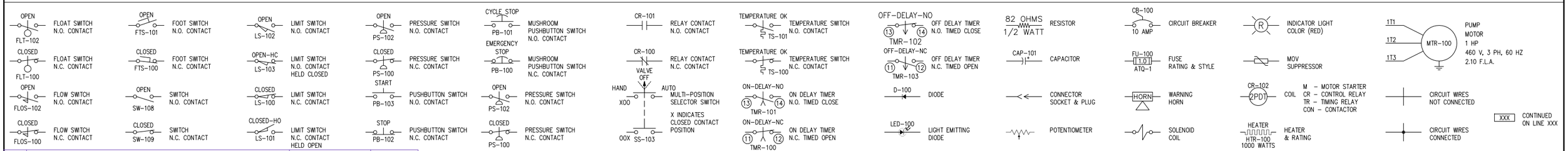
JOB No. 121222 SERIAL No. 121222–001

CONTROL CABINET	CONTROL CABINET " PLC–B"
POWER FEED	120VAC, 20A, 1PH, 60Hz,
DISCONNECT SW.	20A
FULL LOAD AMPS	1.4
LARGEST MOTOR FLA	N/A
CONTROL VOLTAGE	120VAC
CONTROL XFMR.	N/A
INTERRUPTING CAPACITY	5 K.A.I.C.

NOTES:
1. 230 OR 460 VAC POWER WIRING IS:
   TYPE "MTW"; WIRE SIZE AS SHOWN ON THE SCHEMATIC.
   PHASE–A – BLACK
   PHASE–B – BLACK
   PHASE–C – BLACK
2. AC CONTROL WIRING IS 16 AWG MINIMUM, TYPE "MTW", COLORS AS FOLLOWS:
   120 VAC POWER – RED
   120 VAC NEUTRAL – WHITE
   FOREIGN VOLTAGES – ORANGE
   GROUND – GREEN or GREEN/YELLOW
3. DC CONTROL WIRING IS 16 AWG MINIMUM, TYPE "MTW", COLORS AS FOLLOWS:
   DC CONTROL HOT – BLUE
   DC CONTROL COMMON – BLUE/WHITE
4. ANALOG SIGNAL WIRING IS SHIELDED TWISTED PAIR, 20 AWG MINIMUM.
5. POWER WIRING FOR DC DRIVES IS 14 AWG MINIMUM, , TYPE "MTW"
   DC MOTOR ARMATURE – BROWN
   DC MOTOR FIELD – PURPLE
6. ———— THIN LINES DENOTE PANEL WIRING
7. – – – – – – – – DOTTED LINES DENOTE FIELD WIRING
8. ⊘TB3 DENOTES CONTROL PANEL TERMINAL AND TERMINAL STRIP NUMBER
9. □ TB4 DENOTES FIELD TERMINAL AND TERMINAL STRIP NUMBER
10. * DENOTES EXISTING FIELD DEVICE
11. PANEL DEVICE IDENTIFICATION NAMETAGS ARE ADHESIVE BACKED BRADY LABELS, WHITE LABELS WITH BLACK LETTERING.
12. ENGRAVED LAMICOID NAMETAGS ARE ADHESIVE BACKED, WHITE LABELS WITH BLACK LETTERING.
13. LINE REFERENCING:
    THREE DIGIT
    1st DIGIT – SHEET NUMBER
    2nd & 3rd DIGITS – LINE REFERENCE
    EXAMPLE – 150, SHEET 1, LINE 50

    FOUR DIGIT
    1st & 2nd DIGITS – SHEET NUMBER
    3rd & 4th DIGITS – LINE REFERENCE
    EXAMPLE – 2150, SHEET 21, LINE 50

ELECTRICAL SYMBOLS



REV:	DESCRIPTION:	DOC. CONTROL No:	DATE:
F	AS BUILT CONDITIONS	ECN–121222–0006	08–2015
E	FIELD UPDATE ADD ETHERNET SWITCH, DELETE RADKIT	ECN–121222–0005	05–05–14
D	RECORD DRAWINGS	ECN–121222–0004	09–13–13
C	AS–BUILT DRAWINGS	ECN–121222–0003	06–21–13
B	REVISED PER ENGINEER REVIEW	EC–121222–0002	04–24–13
A	ORGINAL ISSUE	ECN–121222–0001	04–01–13

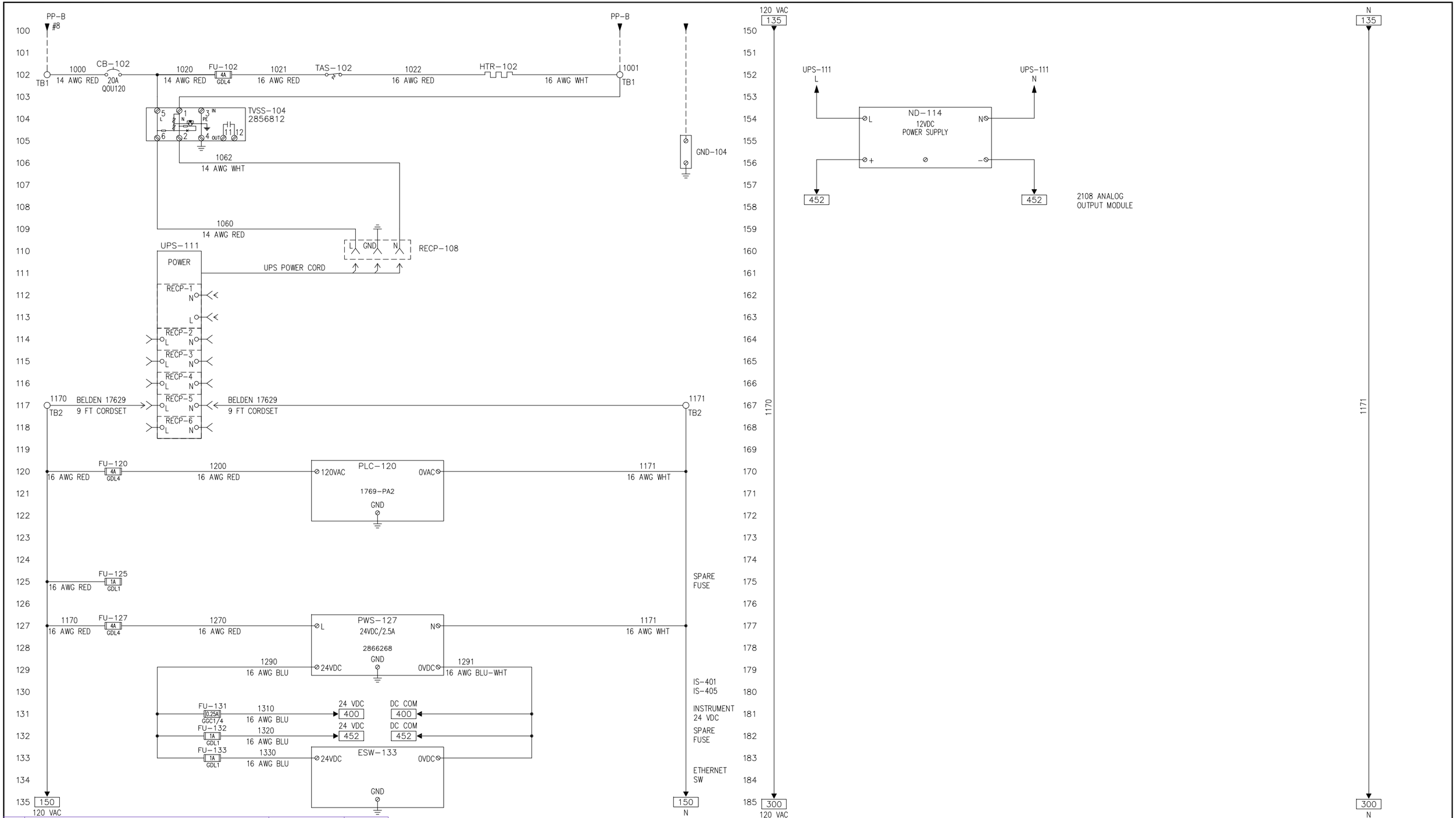
DESIGNED ON: AUTOCAD ELECTRICAL 2012 DWG LAST SAVED ON: 05–05–2014 7:53a

VSGENVIROMATION
A ZELLER COMPANY
1000 UNIVERSITY AVENUE
SUITE 800
ROCHESTER, NY 14607
TEL.: 585–244–0450
FAX: 585–254–0982

CUSTOMER: JJ LANE CONSTRUCTION
STREET: 200 TERMINAL ROAD EAST
CITY / STATE: LIVERPOOL, NY 13088

ONONDAGA COUNTY
HARBOR BROOK CSO
PLC B
INDEX and GENERAL INFORMATION

DRAWN BY: RJY	DRAWN DATE: 04–01–13	MODEL–PART NUMBER: UL 698A LISTED CABINET
CHECKED BY: DL	CHECKED DATE: 4–11–13	DRAWING NUMBER: 121222–PLCB–SCH
FILE REFERENCE: 121222–PLCB–SCH–00E		SCALE: N/A / PAGE: 0 / REVISION: F
SERIAL/PROJECT NUMBER: 121222–001	PAGES: 0 OF 11	



REV:	DESCRIPTION:	DOC. CONTROL No:	DATE:
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TEL.: 585-244-0450
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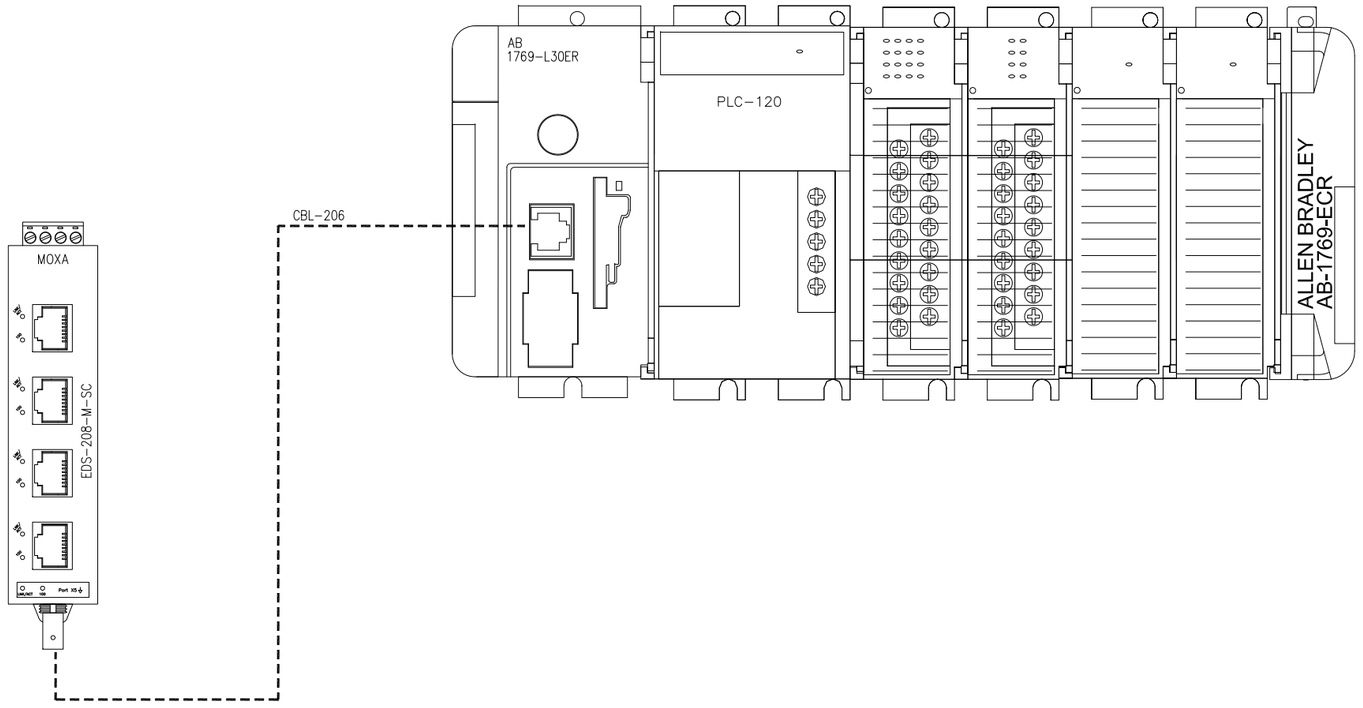
CUSTOMER: JJ LANE CONSTRUCTION
STREET: 200 TERMINAL ROAD EAST
CITY / STATE: LIVERPOOL, NY 13088
ONONDAGA COUNTY
HARBOR BROOK CSO
PLC B
POWER and CONTROL SCHEMATIC

DRAWN BY: RJY	DRAWN DATE: 04-01-13	MODEL-PART NUMBER: UL 698A LISTED CABINET	
CHECKED BY: DL	CHECKED DATE: 4-11-13	DRAWING NUMBER: 121222-PLCB-SCH	
FILE REFERENCE: 121222-PLCB-SCH-01E		SCALE: N/A	PAGE: 1
SERIAL/PROJECT NUMBER: 121222-001	PAGES: 1 OF 11		REVISION: F



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E	FIELD UPDATE ADD ETHERNET SWITCH, DELETE RADKIT	ECN-121222-0005	05-05-14
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B	REVISED PER ENGINEER REVIEW	EC-121222-0002	04-24-13
A	ORGINAL ISSUE	ECN-121222-0001	04-01-13

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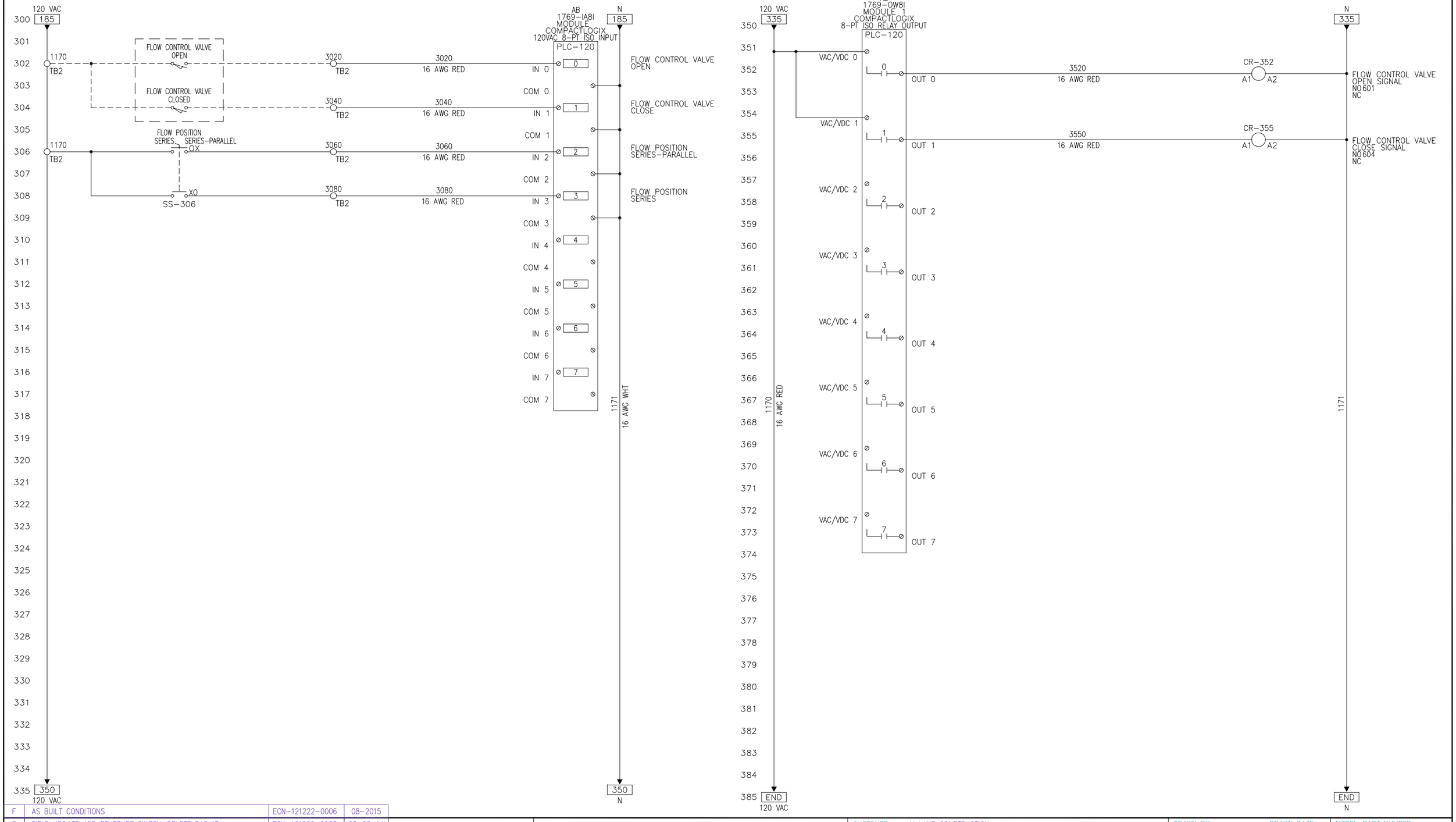
ROCHESTER, NY 14607
TEL.: 585-244-0450
FAX: 585-254-0982

CUSTOMER: JJ LANE CONSTRUCTION
STREET: 200 TERMINAL ROAD EAST
CITY / STATE: LIVERPOOL, NY 13088
ONONDAGA COUNTY
HARBOR BROOK CSO
PLC B
NETWORK DIAGRAM

DRAWN BY: RJY	DRAWN DATE: 04-01-13	MODEL-PART NUMBER: UL 698A LISTED CABINET	
CHECKED BY: DL	CHECKED DATE: 4-11-13	DRAWING NUMBER: 121222-PLCB-SCH	
FILE REFERENCE: 121222-PLCB-SCH-02E		SCALE: N/A	PAGE: 2
SERIAL/PROJECT NUMBER: 121222-001	PAGES: 2 OF 11		REVISION: F



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A	ORGINAL ISSUE	ECN–121222–0001	04–01–13

DESIGNED ON: AUTOCAD ELECTRICAL 2012 | DWG LAST SAVED ON: 05–05–2014 7:53a

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CUSTOMER: JJ LANE CONSTRUCTION
STREET: 200 TERMINAL ROAD EAST
CITY / STATE: LIVERPOOL, NY 13088
ONONDAGA COUNTY
HARBOR BROOK CSO
PLC B
DIGITAL INPUTS

DRAWN BY: RJY	DRAWN DATE: 04–01–13	MODEL–PART NUMBER: UL 698A LISTED CABINET	
CHECKED BY: DL	CHECKED DATE: 4–11–13	DRAWING NUMBER: 121222–PLCB–SCH	
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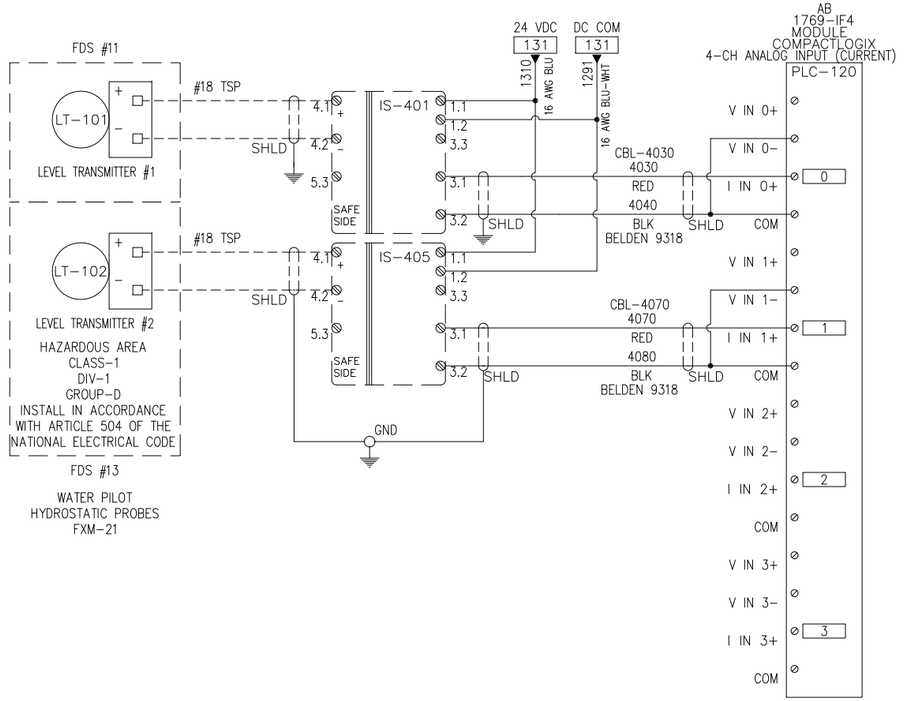
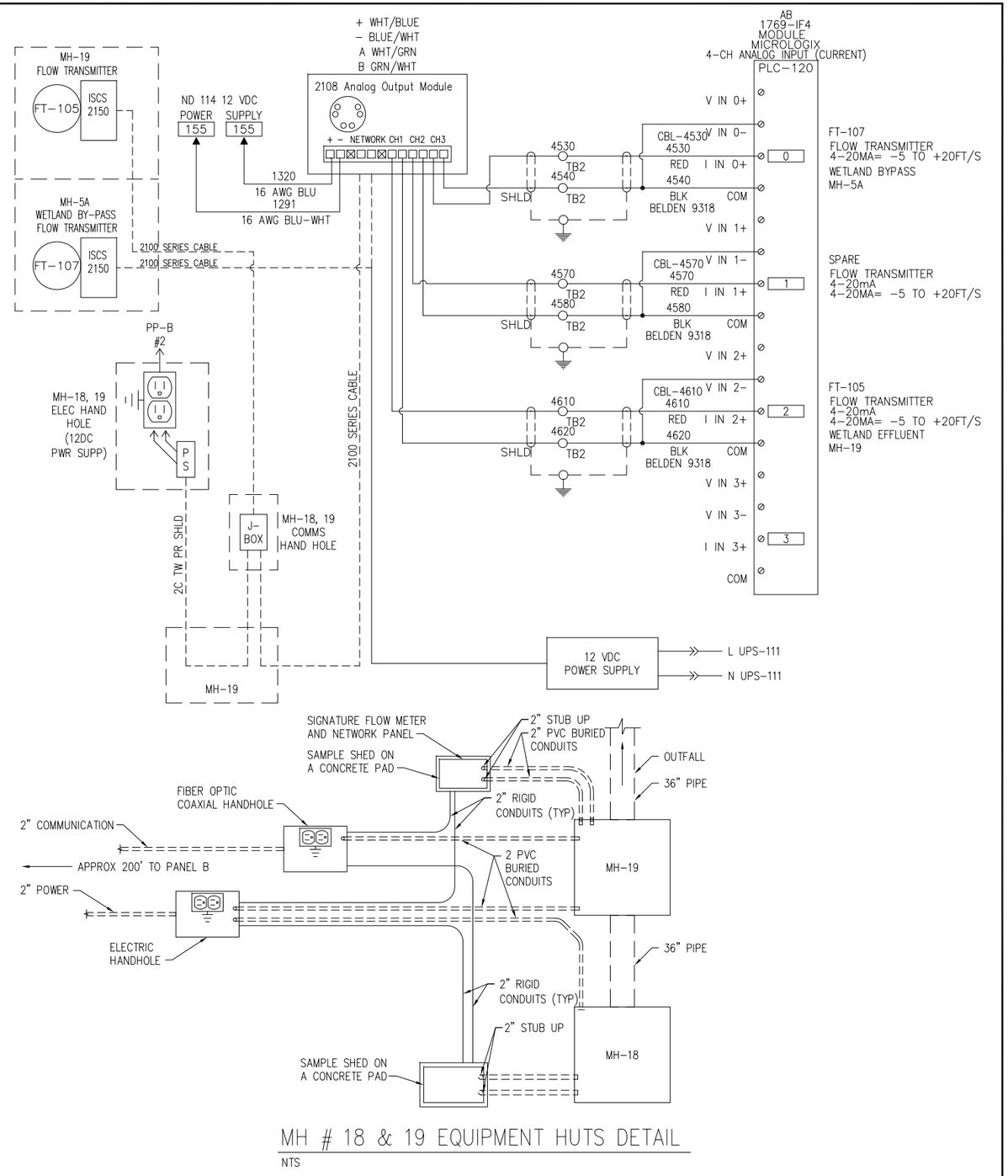
SERIAL/PROJECT NUMBER: 121222–001	PAGES: 3 OF 11		REVISION: F





MH # 18 & 19 EQUIPMENT HUTS DETAIL

NTS

REV:	DESCRIPTION:	DOC. CONTROL No:	DATE:
F	AS BUILT CONDITIONS	ECN-121222-0006	08-2015
E	FIELD UPDATE ADD ETHERNET SWITCH, DELETE RADKIT	ECN-121222-0005	05-05-14
D	RECORD DRAWINGS	ECN-121222-0004	09-13-13
C	AS-BUILT DRAWINGS	ECN-121222-0003	06-21-13
B	REVISED PER ENGINEER REVIEW	EC-121222-0002	04-24-13
A	ORGINAL ISSUE	ECN-121222-0001	04-01-13

DESIGNED ON: AUTOCAD ELECTRICAL 2012 | DWG LAST SAVED ON: 05-05-2014 7:53a

VSGENVIROMATION
A ZELLER COMPANY
1000 UNIVERSITY AVENUE
SUITE 800
ROCHESTER, NY 14607
TEL.: 585-244-0450
FAX: 585-254-0982

CUSTOMER: JJ LANE CONSTRUCTION
STREET: 200 TERMINAL ROAD EAST
CITY / STATE: LIVERPOOL, NY 13088
ONONDAGA COUNTY
HARBOR BROOK CSO
PLC B
ANALOG INPUT

DRAWN BY: RJY	DRAWN DATE: 04-01-13	MODEL-PART NUMBER: UL 698A LISTED CABINET	
CHECKED BY: DL	CHECKED DATE: 4-11-13	DRAWING NUMBER: 121222-PLCB-SCH	
FILE REFERENCE: 121222-PLCB-SCH-04E		SCALE: N/A	PAGE: 4
SERIAL/PROJECT NUMBER: 121222-001	PAGES: 4 OF 11		REVISION: F

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REV:	DESCRIPTION:	DOC. CONTROL No:	DATE:
F	AS BUILT CONDITIONS	ECN-121222-0006	08-2015
E	FIELD UPDATE ADD ETHERNET SWITCH, DELETE RADKIT	ECN-121222-0005	05-05-14
D	RECORD DRAWINGS	ECN-121222-0004	09-13-13
C	AS-BUILT DRAWINGS	ECN-121222-0003	06-21-13
B	REVISED PER ENGINEER REVIEW	EC-121222-0002	04-24-13
A	ORGINAL ISSUE	ECN-121222-0001	04-01-13

DESIGNED ON: AUTOCAD ELECTRICAL 2012 | DWG LAST SAVED ON: 05-05-2014 7:53a

VSGENVIROMATION
A ZELLER COMPANY
1000 UNIVERSITY AVENUE
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ROCHESTER, NY 14607
TEL.: 585-244-0450
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CUSTOMER: JJ LANE CONSTRUCTION
STREET: 200 TERMINAL ROAD EAST
CITY / STATE: LIVERPOOL, NY 13088
ONONDAGA COUNTY
HARBOR BROOK CSO
PLC B

DRAWN BY: RJY	DRAWN DATE: 04-01-13	MODEL-PART NUMBER: UL 698A LISTED CABINET	
CHECKED BY: DL	CHECKED DATE: 4-11-13	DRAWING NUMBER: 121222-PLCB-SCH	
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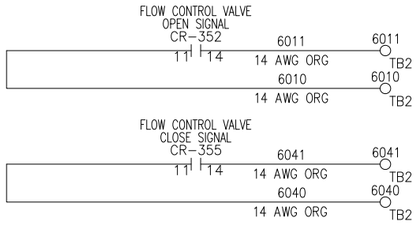
SERIAL/PROJECT NUMBER: 121222-001	PAGES: 5 OF 11		REVISION: F



REV:	DESCRIPTION:	DOC. CONTROL No:	DATE:
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A	ORGINAL ISSUE	ECN-121222-0001	04-01-13

DESIGNED ON: AUTOCAD ELECTRICAL 2012 | DWG LAST SAVED ON: 05-05-2014 7:53a

VSGENVIROMATION
A ZELLER COMPANY
1000 UNIVERSITY AVENUE
SUITE 800
ROCHESTER, NY 14607
TEL.: 585-244-0450
FAX: 585-254-0982

CUSTOMER: JJ LANE CONSTRUCTION
STREET: 200 TERMINAL ROAD EAST
CITY / STATE: LIVERPOOL, NY 13088
ONONDAGA COUNTY
HARBOR BROOK CSO
PLC B
INTERFACE RELAYS

DRAWN BY: RJY	DRAWN DATE: 04-01-13	MODEL-PART NUMBER: UL 698A LISTED CABINET	
CHECKED BY: DL	CHECKED DATE: 4-11-13	DRAWING NUMBER: 121222-PLCB-SCH	
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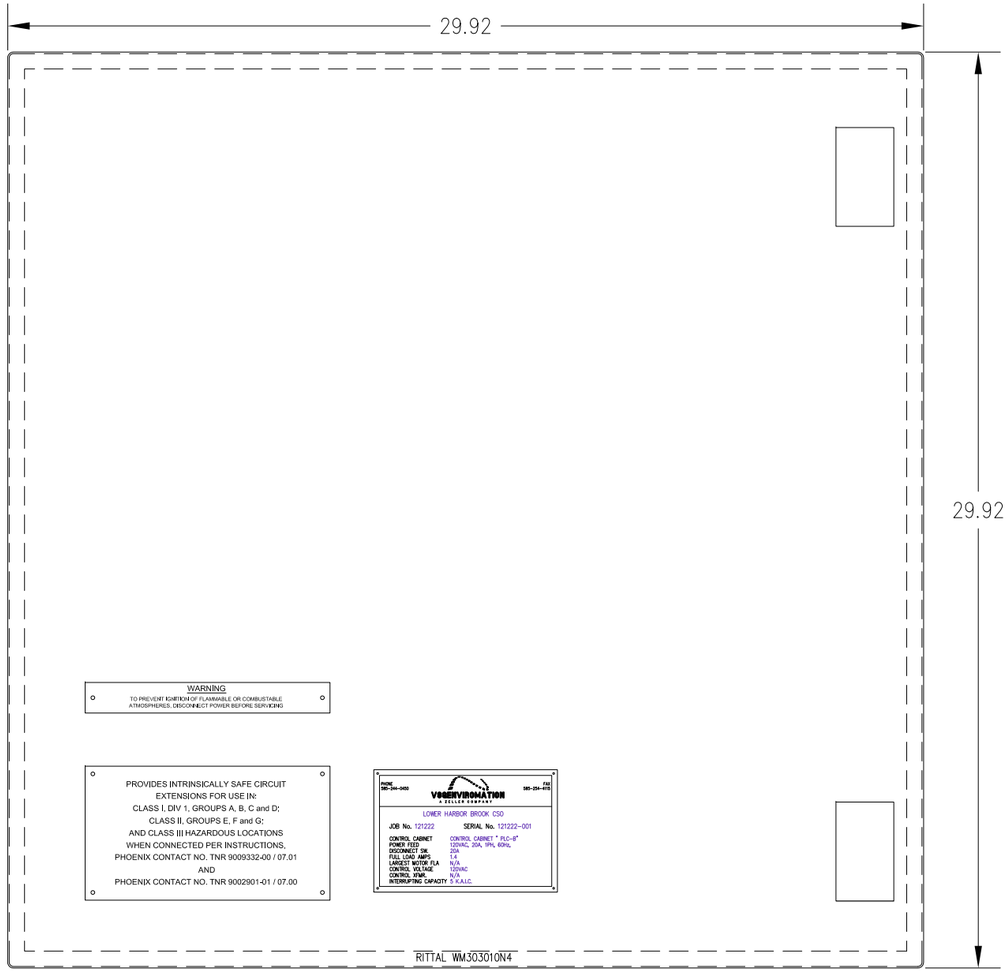
SERIAL/PROJECT NUMBER: 121222-001	PAGES: 6 OF 11		REVISION: F



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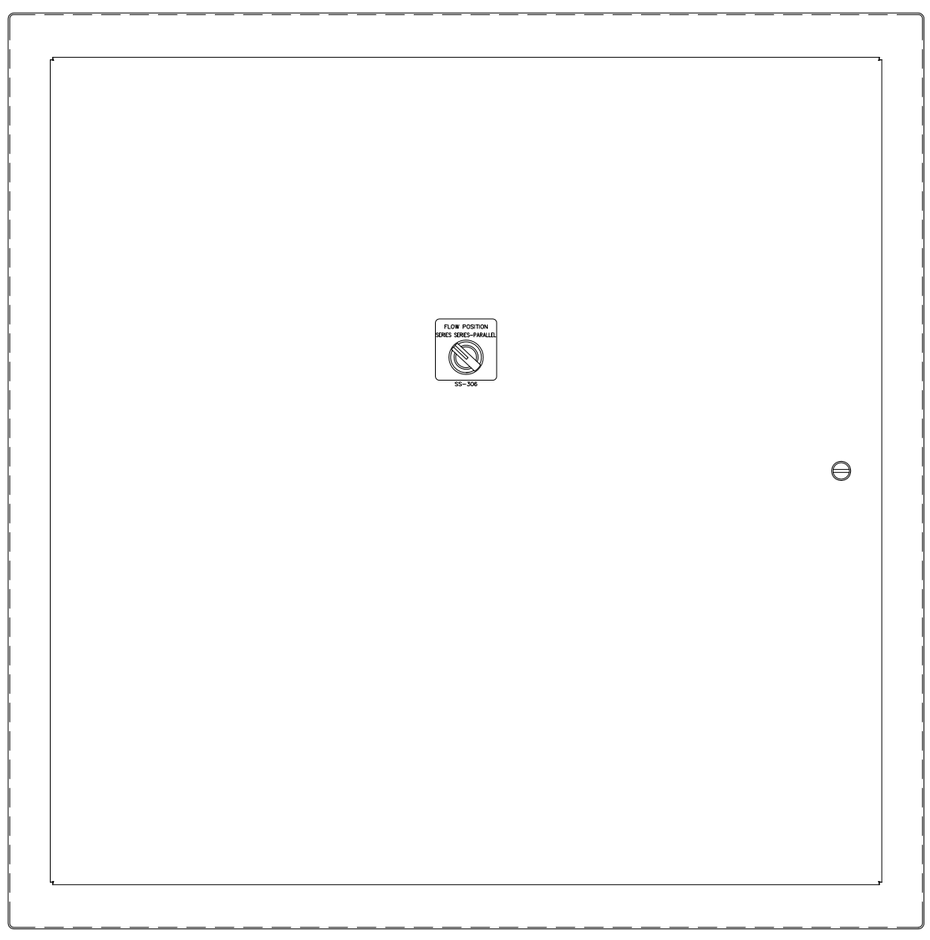

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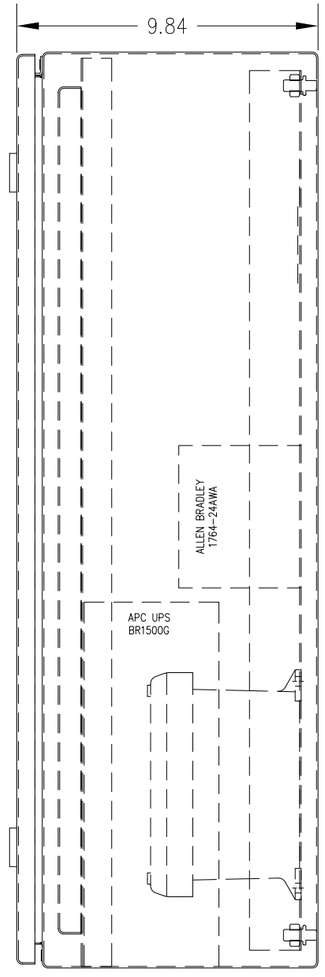

EXTERIOR RIGHT SIDE VIEW

REV:	DESCRIPTION:	DOC. CONTROL No:	DATE:
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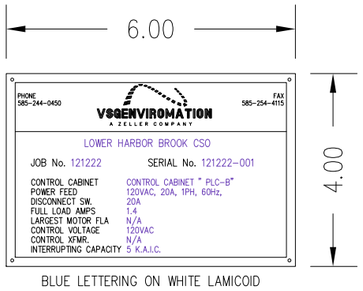
A	ORGINAL ISSUE	ECN-121222-0001	04-01-13

DESIGNED ON: AUTOCAD ELECTRICAL 2012 — DWG LAST SAVED ON: 05-05-2014 7:53a

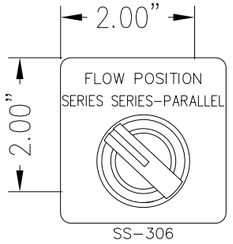
VSGENVIROMATION
A ZELLER COMPANY
1000 UNIVERSITY AVENUE
SUITE 800
ROCHESTER, NY 14607
TEL.: 585-244-0450
FAX: 585-254-0982

CUSTOMER: JJ LANE CONSTRUCTION
STREET: 200 TERMINAL ROAD EAST
CITY / STATE: LIVERPOOL, NY 13088
ONONDAGA COUNTY
HARBOR BROOK CSO
PLC B
EXTERIOR VIEW

DRAWN BY: RJY	DRAWN DATE: 04-01-13	MODEL-PART NUMBER: UL 698A LISTED CABINET	
CHECKED BY: DL	CHECKED DATE: 4-11-13	DRAWING NUMBER: 121222-PLCB-SCH	
FILE REFERENCE: 121222-PLCB-SCH-07E-10E		SCALE: N/A	PAGE: 7
SERIAL/PROJECT NUMBER: 121222-001	PAGES: 7 OF 11		REVISION: F



BLUE LETTERING ON WHITE LAMICOID



SS-306

22mm
1/8" BLACK TEXT
ON WHITE

1" X 5-1/2"
Yellow with Black Letters
3/16" & 1/8" Font
Adhesive Backed

WARNING
TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTIBLE ATMOSPHERES, DISCONNECT POWER BEFORE SERVICING

1-1/4" X 1-3/4"
Black with White Letters
7/64" Font
Adhesive Backed

TRANSDUCER FIELD WIRING AREA
INTRINSICALLY SAFE FIELD WIRING TERMINALS

7/8" X 2-3/4"
Black with White Letters
3/32" X 7/64" Font
Adhesive Backed

WARNING
SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY

8.00"

WARNING
TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTABLE ATMOSPHERES, DISCONNECT POWER BEFORE SERVICING

1.00"

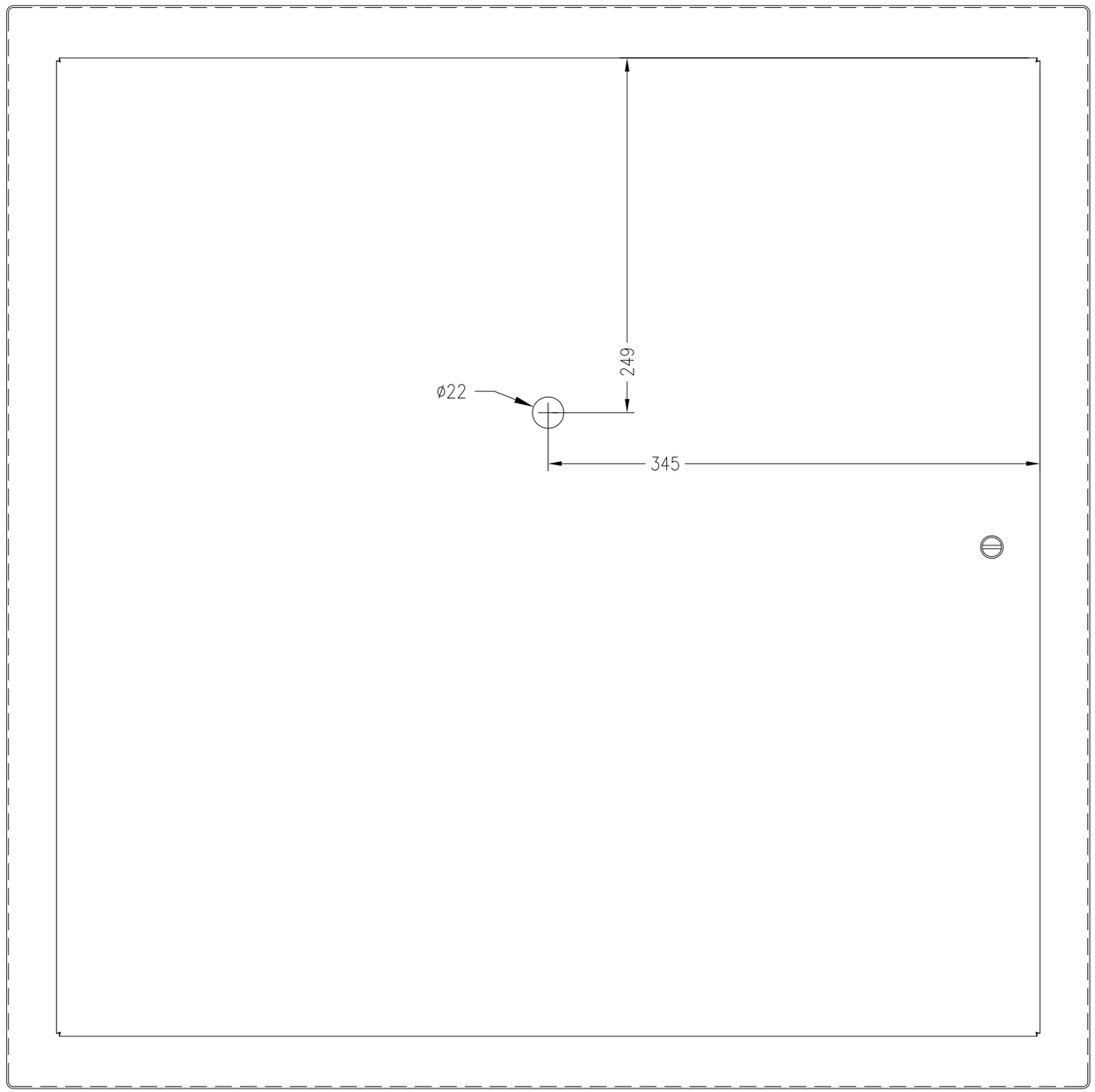
1" X 8" Yellow with Black Letters 3/16" & 1/8" Font Drilled

8.00"

PROVIDES INTRINSICALLY SAFE CIRCUIT
EXTENSIONS FOR USE IN:
CLASS I, DIV 1, GROUPS A, B, C and D;
CLASS II, GROUPS E, F and G;
AND CLASS III HAZARDOUS LOCATIONS
WHEN CONNECTED PER INSTRUCTIONS,
PHOENIX CONTACT NO. TNR 9009332-00 / 07.01
AND
PHOENIX CONTACT NO. TNR 9002901-01 / 07.00

4.38"

3-3/4" X 8" Black with White Letters 3/16" Font Drilled



DEAD FRONT

REV:	DESCRIPTION:	DOC. CONTROL No:	DATE:
F	AS BUILT CONDITIONS	ECN-121222-0006	08-2015
E	FIELD UPDATE ADD ETHERNET SWITCH, DELETE RADKIT	ECN-121222-0005	05-05-14
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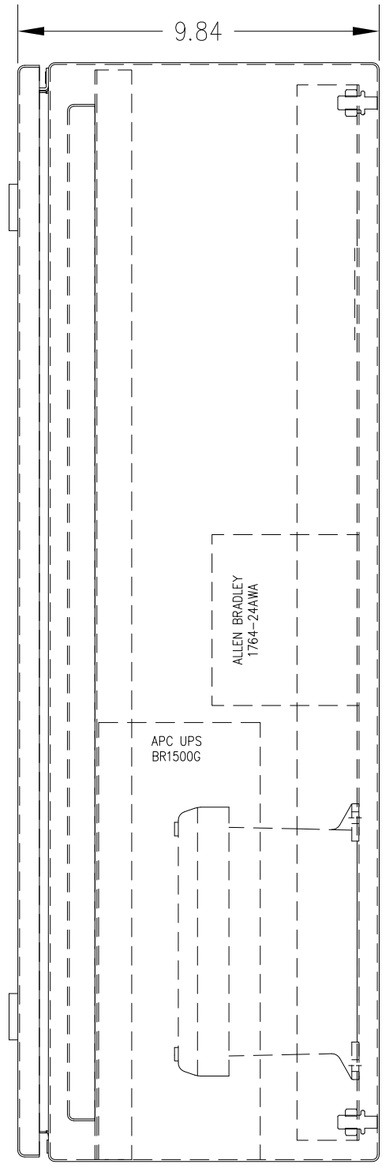
DESIGNED ON: AUTOCAD ELECTRICAL 2012 | DWG LAST SAVED ON: 05-05-2014 7:53a

VSGENVIROMATION
A ZELLER COMPANY
1000 UNIVERSITY AVENUE
SUITE 800
ROCHESTER, NY 14607
TEL.: 585-244-0450
FAX: 585-254-0982

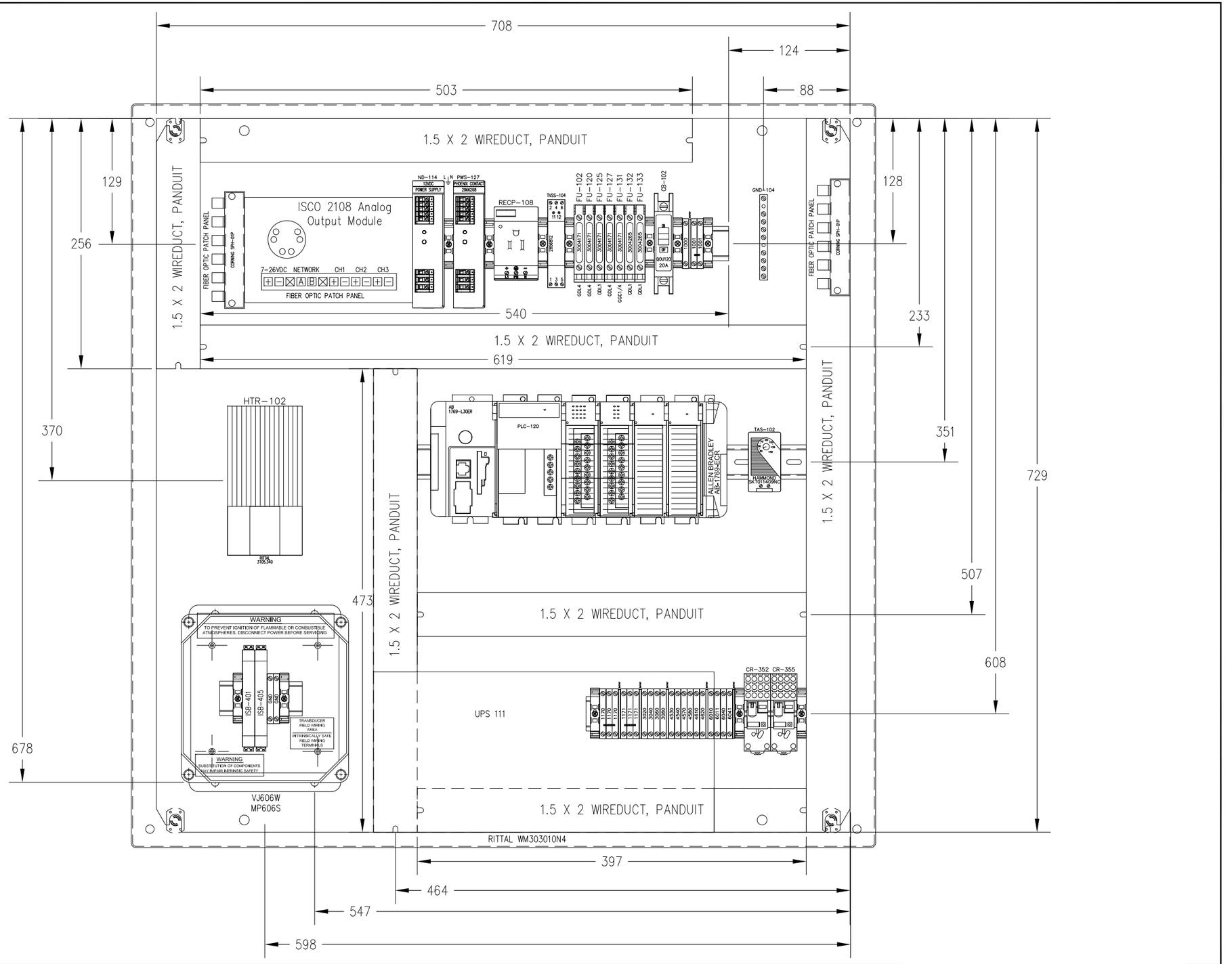
CUSTOMER: JJ LANE CONSTRUCTION
STREET: 200 TERMINAL ROAD EAST
CITY / STATE: LIVERPOOL, NY 13088
ONONDAGA COUNTY
HARBOR BROOK CSO
PLC B

DOOR CUTOUTS

DRAWN BY: RJY	DRAWN DATE: 04-01-13	MODEL-PART NUMBER: UL 698A LISTED CABINET	
CHECKED BY: DL	CHECKED DATE: 4-11-13	DRAWING NUMBER: 121222-PLCB-SCH	
FILE REFERENCE: 121222-PLCB-SCH-07E-10E		SCALE: N/A	PAGE: 8
SERIAL/PROJECT NUMBER: 121222-001	PAGES: 8 OF 11		REVISION: F



EXTERIOR RIGHT SIDE VIEW



REV:	DESCRIPTION:	DOC. CONTROL No:	DATE:
F	AS BUILT CONDITIONS	ECN-121222-0006	08-2015
E	FIELD UPDATE ADD ETHERNET SWITCH, DELETE RADKIT	ECN-121222-0005	05-05-14
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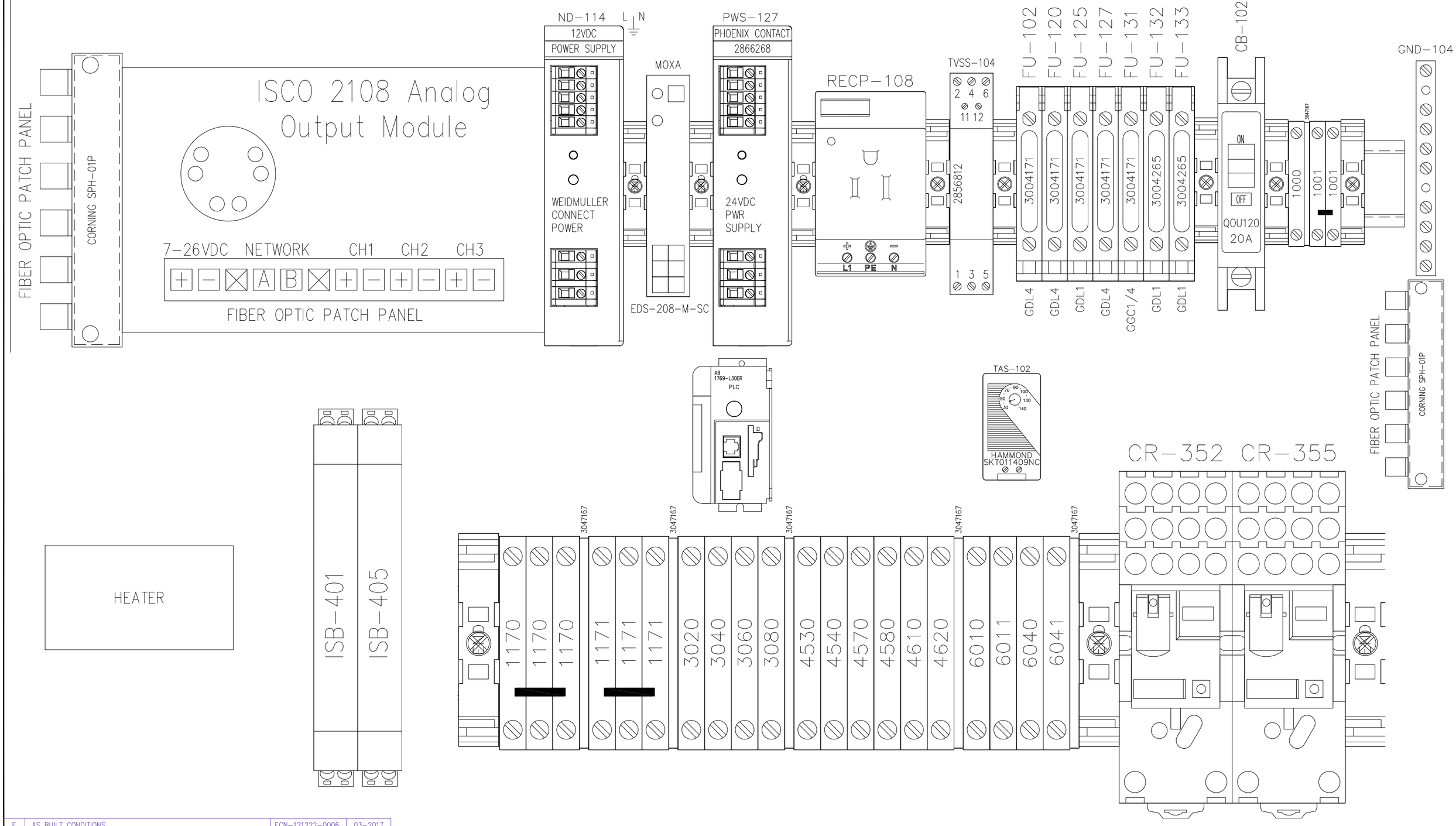
A	ORGINAL ISSUE	ECN-121222-0001	04-01-13

DESIGNED ON: AUTOCAD ELECTRICAL 2012 | DWG LAST SAVED ON: 05-05-2014 7:53a

VSGENVIROMATION
A ZELLER COMPANY
1000 UNIVERSITY AVENUE
SUITE 800
ROCHESTER, NY 14607
TEL.: 585-244-0450
FAX: 585-254-0982

CUSTOMER: JJ LANE CONSTRUCTION
STREET: 200 TERMINAL ROAD EAST
CITY / STATE: LIVERPOOL, NY 13088
ONONDAGA COUNTY
HARBOR BROOK CSO
PLC B
INTERIOR DIMENSIONS

DRAWN BY: RJY	DRAWN DATE: 04-01-13	MODEL-PART NUMBER: UL 698A LISTED CABINET	
CHECKED BY: DL	CHECKED DATE: 4-11-13	DRAWING NUMBER: 121222-PLCB-SCH	
FILE REFERENCE: 121222-PLCB-SCH-07E-10E		SCALE: N/A	PAGE: 9
SERIAL/PROJECT NUMBER: 121222-001	PAGES: 9 OF 11		REVISION: F



REV:	DESCRIPTION:	DOC. CONTROL No:	DATE:
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E	FIELD UPDATE ADD ETHERNET SWITCH, DELETE RADKIT	ECN-121222-0005	05-05-14
D	RECORD DRAWINGS	ECN-121222-0004	09-13-13
C	AS-BUILT DRAWINGS	ECN-121222-0003	06-21-13
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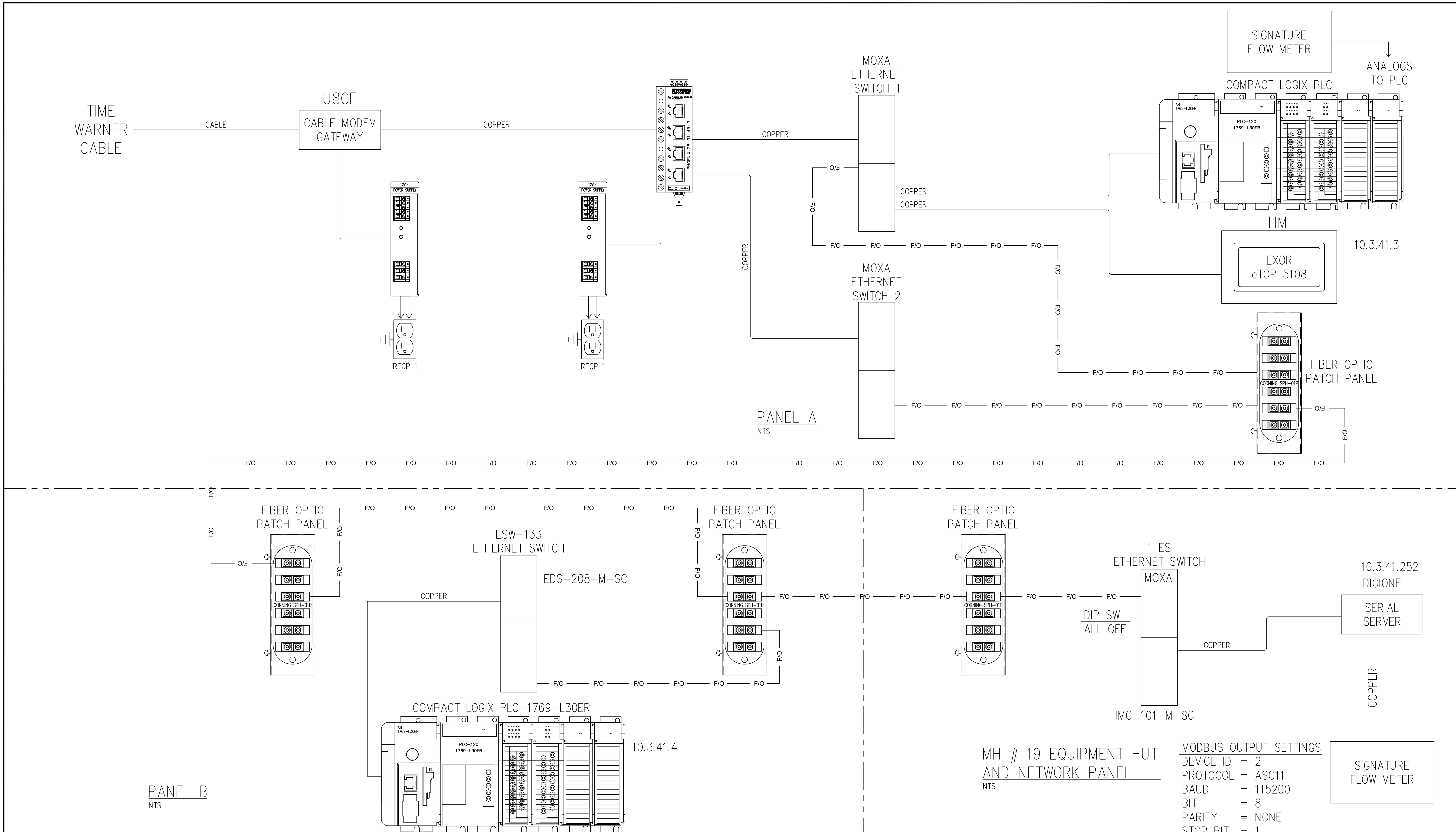
A	ORGINAL ISSUE	ECN-121222-0001	04-01-13

DESIGNED ON: AUTOCAD ELECTRICAL 2012 — DWG LAST SAVED ON: 05-05-2014 7:53a

VSGENVIROMATION
A ZELLER COMPANY
1000 UNIVERSITY AVENUE
SUITE 800
ROCHESTER, NY 14607
TEL.: 585-244-0450
FAX: 585-254-0982

CUSTOMER: JJ LANE CONSTRUCTION
STREET: 200 TERMINAL ROAD EAST
CITY / STATE: LIVERPOOL, NY 13088
ONONDAGA COUNTY
HARBOR BROOK CSO
PLC B
TERMINAL STRIPS

DRAWN BY: RJY	DRAWN DATE: 04-01-13	MODEL-PART NUMBER: UL 698A LISTED CABINET	
CHECKED BY: DL	CHECKED DATE: 4-11-13	DRAWING NUMBER: 121222-PLCB-SCH	
FILE REFERENCE: 121222-PLCB-SCH-07E-10E		SCALE: N/A	PAGE: 10
SERIAL/PROJECT NUMBER: 121222-001	PAGES: 10 OF 11		REVISION: F



REV:	DESCRIPTION:	DOC. CONTROL No:	DATE:
A	AS BUILT CONDITIONS	ENC-121222-0006	03-2017

DESIGNED ON: AUTOCAD ELECTRICAL 2012 | DWG LAST SAVED ON: 7:53a

CH2MHILL®
430 GENESEE STREET
SUITE 400
SYRACUSE NY, 13202

ONONDAGA COUNTY
HARBOR BROOK CSO
CONTROL SYSTEM
ARCHITECTURE

DRAWN BY: GH | DRAWN DATE: 08-2015
CHECKED BY: ZM | CHECKED DATE: 08-2015
FILE REFERENCE:
SERIAL/PROJECT NUMBER: | PAGES: 11 OF 11
MODEL-PART NUMBER:
DRAWING NUMBER:
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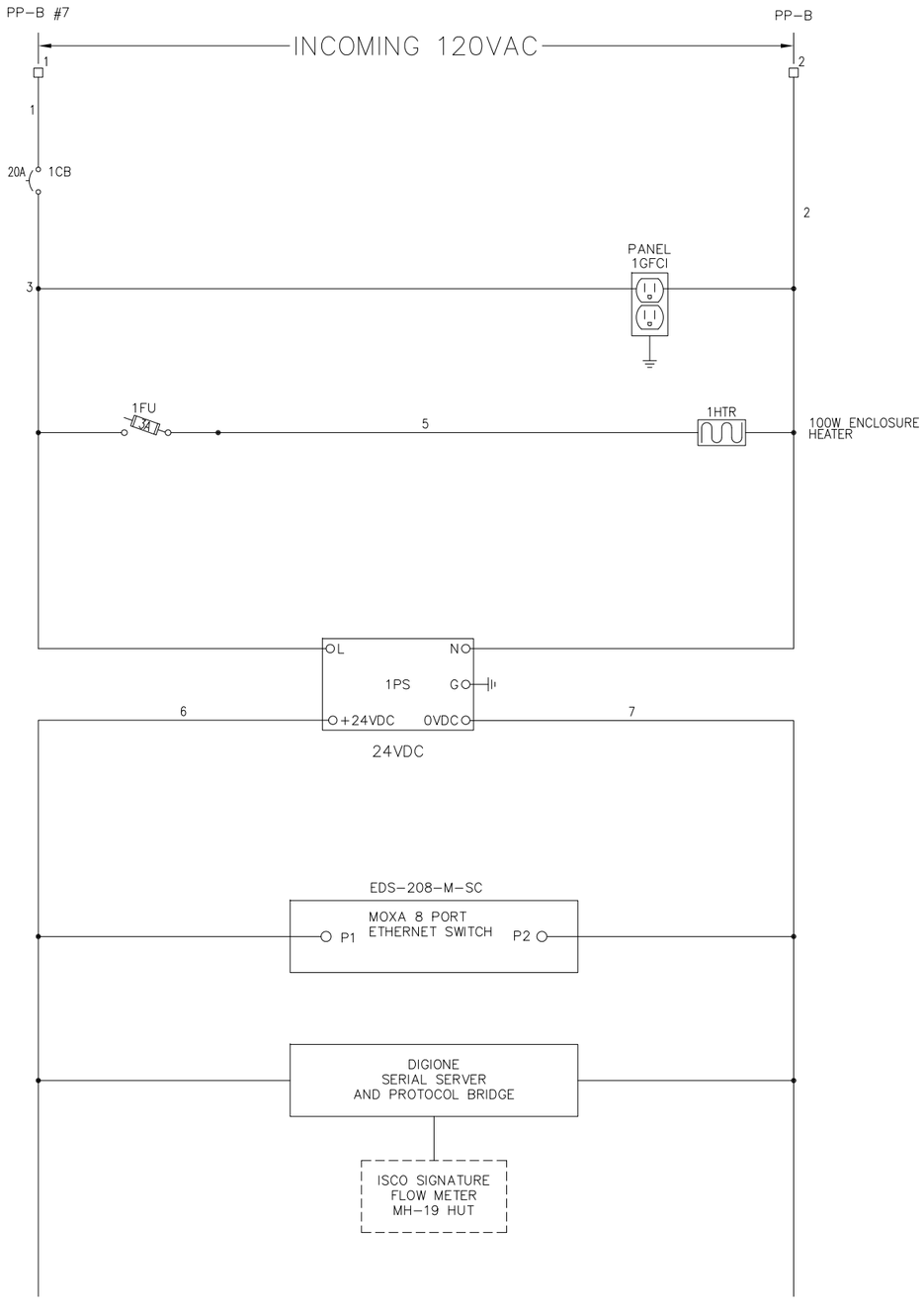

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REV.	DATE	BY	CHKD	DESCRIPTION
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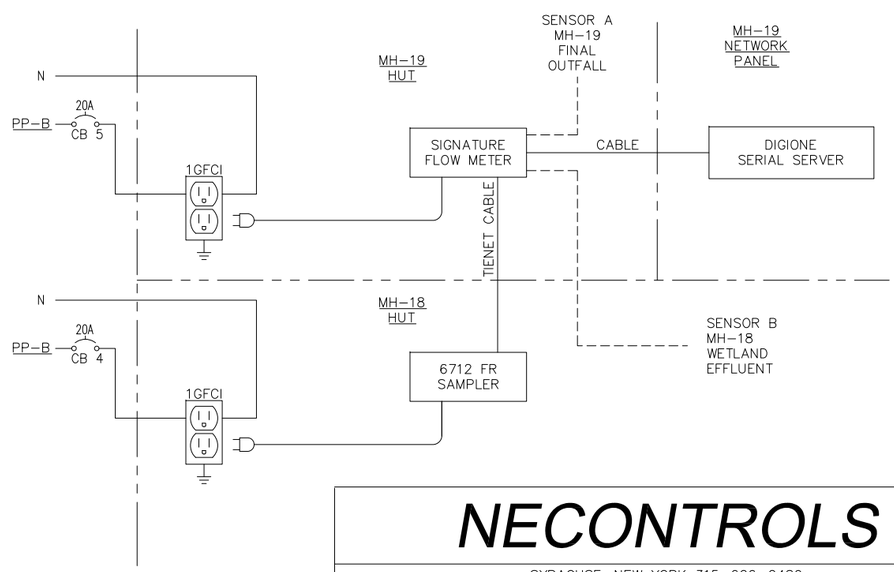
1	10/22/14	MM		AS BUILT
2	08/2015	GH	ZM	AS BUILT

CALL	NEC PART#	MAN. PART#	MANUFACTURER	QTY	DESCRIPTION
1ENCL	ENCC113	CSD20168SS	HOFFMAN	1	ENCLOSURE, 20X16X8 NEMA 4X 304
1ENCL	ENCP004	CP2016	HOFFMAN	1	SUB-PANEL, 20 X 16
1ENCL	ENCM093	CMFKSS	HOFFMAN	1	MOUNTING FOOT KIT, STAINLESS STEEL
1ENCL	ENCM186	CWHPTO	HOFFMAN	1	DOOR LATCH KIT, LOCKING
1GFCI	GFCI002	2095-I	P&S	1	GFCI, RECEPTACLE TYPE
1GFCI	ENCL082	DIH3-1-LM	RED DOT	1	ENCLOSURE, OUTLET, SINGLE GANG
1CB	CBKW120	FAZ-C20/1-NA-SP	C-H	1	CIRCUIT BREAKER, 20 AMP, 1 POLE
1HTR	HETR010	DAH1001A	HOFFMAN	1	HEATER, 100 WATT, 110 VAC, HOFFMAN DAH1001A
1FU	FHOLD001	USM1	FERRAZ	1	FUSEHOLDER, SINGLE POLE
1FU	FTRM003	TRM3	FERRAZ	1	FUSE, 3 AMP
1PS	PWRS2425	SND2.5-24-100P	SOLA	1	POWER SUPPLY, 24VDC, 2.5 AMP
1ES		EDS-208-M-SC	MOXA	1	ETHERNET SWITCH
TB	TBLK501	0115 116.07	ABB	3	TERMINAL BLOCK, GRAY, 22-10 AWG
TB	TBLK502	0118 368.16	ABB	1	END COVER, GRAY
TB	TBLK503	0206 351.16	ABB	2	END STOP
TB	TBLK505	0236 000.04	ABB	5	MARKERS, 6 X 10 TOP, RT610
TB	TBLK506	0165 809.01	ABB	2	TERMINAL BLOCK, GROUND



NE CONTROLS-SYRACUSE,NY-315-626-2480

2 PANEL TERMINAL
COMPONENT WIRING
FIELD WIRING
PANEL WIRING

NECONTROLS

SYRACUSE, NEW YORK 315-626-2480

NETWORK PANEL, MH-18 & 19
NEMA 4X 304 SS

PATRICIA		PAGE	PAGE 1 OF 2
CUST PO#: T6152F		SIZE D	25566E02 REV. 1
SCALE: N.T.S.	FILE NAME: 2556601		

REVISIONS				
REV.	DATE	BY	CHKD	DESCRIPTION
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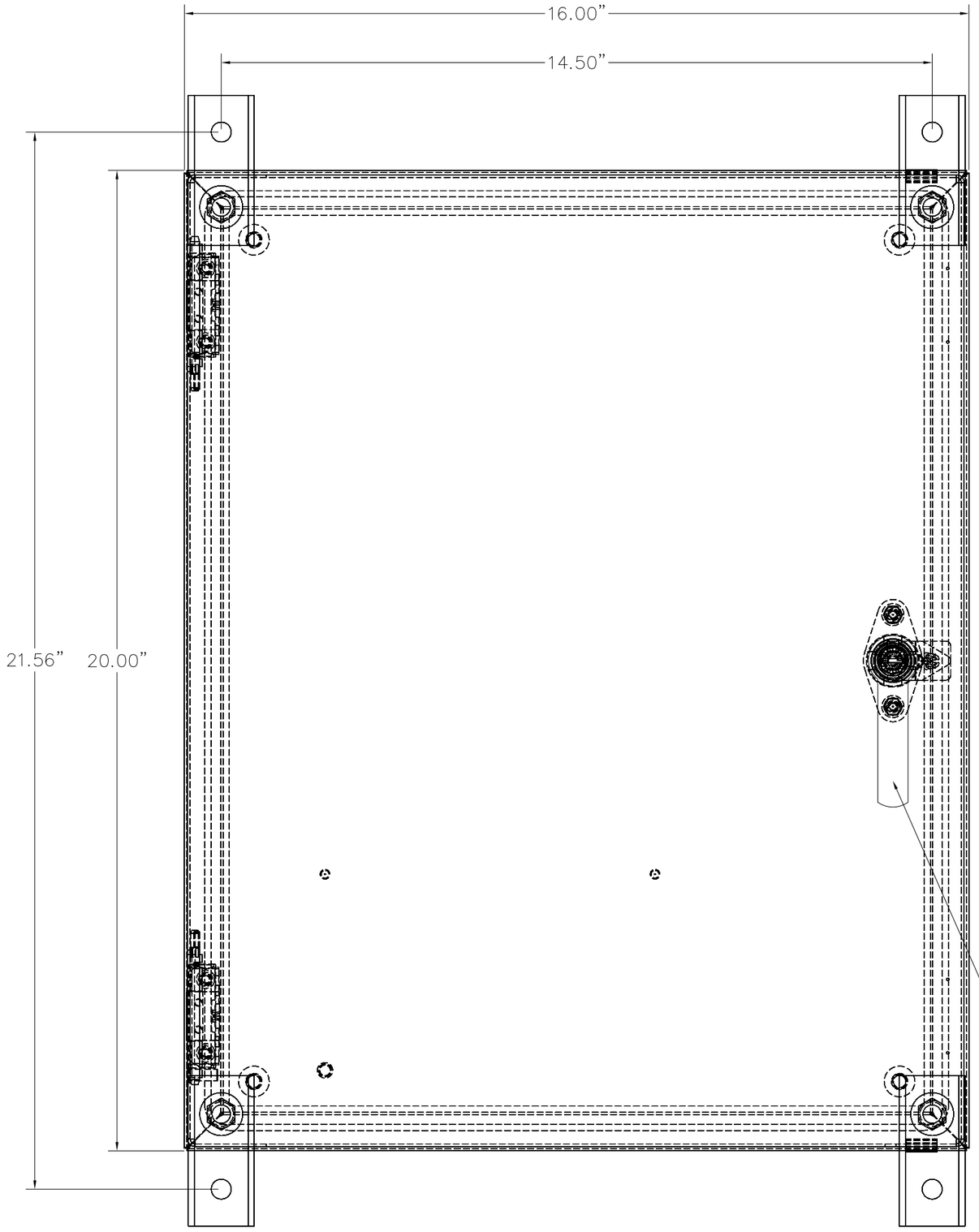
2	08/2015	GH	ZM	AS BUILT



TB DETAILS

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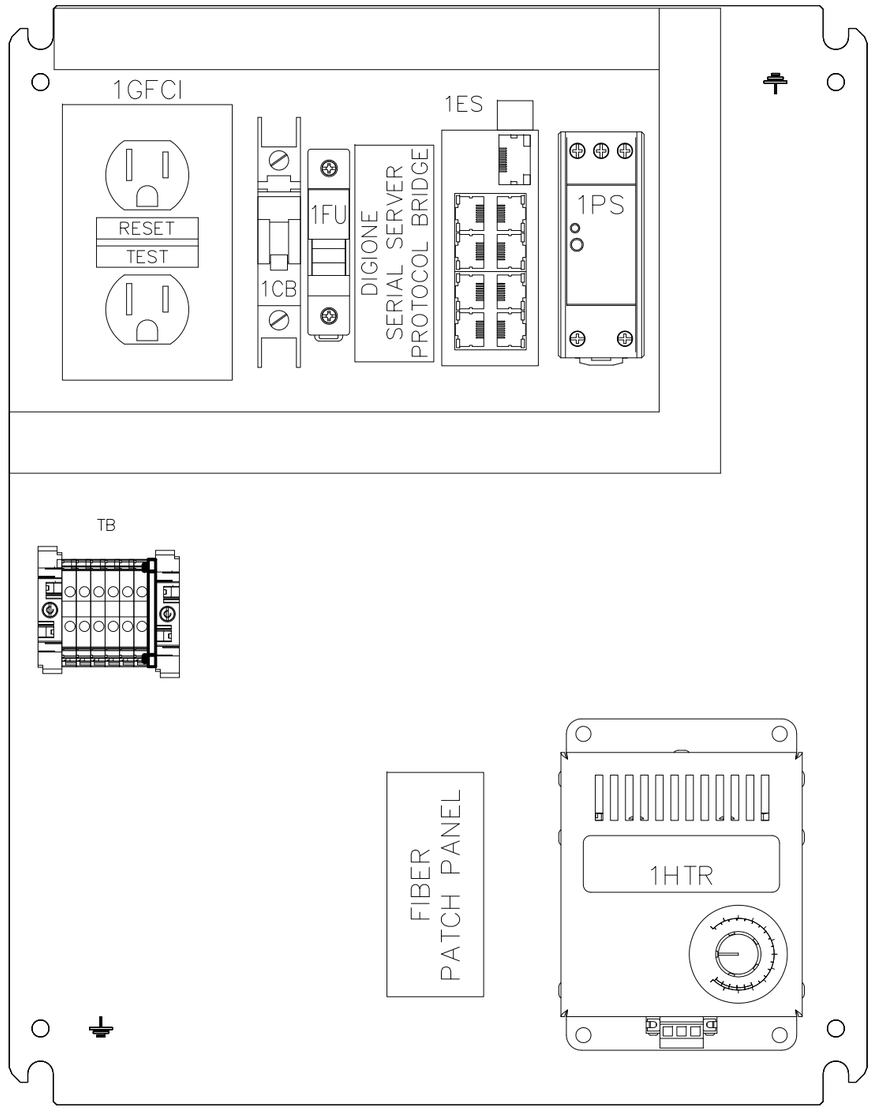

2 PANEL TERMINAL
COMPONENT WIRING
FIELD WIRING
PANEL WIRING

NE CONTROLS–SYRACUSE,NY–315–626–2480

NECONTROLS

SYRACUSE, NEW YORK 315–626–2480

NETWORK PANEL MH–19 HUT
NEMA 4X 304 SS

PATRICIA		PAGE	PAGE 2 OF 2
CUST PO#: T6152F		SIZE D	25566E02 REV. 1
SCALE: N.T.S.	FILE NAME: 2556602		