

# **Modicon Terminal Block I/O Modules Hardware Reference Guide**

890 USE 104 00 Version 2.0

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**AEG SCHNEIDER  
AUTOMATION**  
Modicon • Square D • Telemecanique

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# Preface

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This book describes Modicon Terminal Block Input/Output (TIO) modules. It provides specifications for the modules, and describes how to install them and connect them to field devices in the user application.

The book also presents guidelines for connection of the modules to a Modbus Plus or InterBus-S network. Further details about development of network applications may be found in the reference publications listed in this book.

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Modicon	984	

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# Contents

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<b>Chapter 1</b>		
<b>Modicon Terminal Block I/O Modules</b>	.....	<b>1</b>
1.1	Modicon Terminal Block I/O Modules	2
1.1.1	Planning Your TIO System	2
1.2	Reference Publications	3
1.2.1	Publications for TIO on Modbus Plus	3
1.2.2	Publications for TIO on InterBus-S	3
1.3	Modbus Plus Network Layouts	4
1.4	TIO Modules for Modbus Plus	5
1.5	InterBus-S Network Layouts	6
1.6	TIO Modules for InterBus-S	7
1.7	Environmental Specifications	8
<b>Chapter 2</b>		
<b>Installing TIO Modules</b>	.....	<b>9</b>
2.1	Setting the Modbus Plus Node Address	10
2.1.1	Applicable Modules	10
2.1.2	Setting the Modbus Plus Node Address	10
2.1.3	Network Design Options	11
2.1.4	Deterministic I/O Servicing	11
2.1.5	Multi-Function Servicing	11
2.2	Mounting on a DIN Rail or Panel	12
2.3	Selecting Connectors and Bus Bars	13
2.3.1	Availability of Connectors and Bus Bars	13
2.3.2	Spring Terminals	13
2.3.3	Screw Terminals	13
2.4	Inserting Coding Keys Into Connectors	14
2.5	Connecting to the Modbus Plus Network	15
2.6	Connecting to the InterBus-S Remote Bus	16

<b>170 BDI 342 00</b>	
<b>Modbus Plus TIO</b>	
<b>24 VDC 16 Input Module .....</b>	<b>19</b>
Field Wiring Connections .....	20
LED Indicators .....	21
Specifications .....	22
<b>170 BDO 342 00</b>	
<b>Modbus Plus TIO</b>	
<b>24 VDC 16 Output Module .....</b>	<b>23</b>
Field Wiring Connections .....	24
LED Indicators .....	25
Specifications .....	26
<b>170 BDM 342 00</b>	
<b>Modbus Plus TIO</b>	
<b>24 VDC 16 Input / 16 Output Module .....</b>	<b>27</b>
Field Wiring Connections .....	28
LED Indicators .....	29
Specifications .....	30
<b>170 BDI 542 50</b>	
<b>Modbus Plus TIO</b>	
<b>115 VAC 16 Input Module .....</b>	<b>33</b>
Field Wiring Connections .....	34
LED Indicators .....	35
Specifications .....	36
<b>170 BDO 542 50</b>	
<b>Modbus Plus TIO</b>	
<b>24 ... 230 VAC 16 Output Module .....</b>	<b>37</b>
Field Wiring Connections .....	38
LED Indicators .....	39
Specifications .....	40

<b>170 BAM 096 00</b>	
<b>InterBus–S TIO</b>	
<b>Analog Input/Output Module .....</b>	<b>41</b>
Field Wiring Connections .....	42
Register Allocation .....	48
LED Indicators .....	50
Specifications .....	51
Input Ranges and Values .....	52
Output Ranges and Values .....	53
<b>170 BDI 346 00</b>	
<b>Interbus–S TIO</b>	
<b>24 VDC 16 Input Module .....</b>	<b>55</b>
Field Wiring Connections .....	56
LED Indicators .....	57
Specifications .....	58
<b>170 BDO 346 00</b>	
<b>InterBus–S TIO</b>	
<b>24 VDC 16 Output Module .....</b>	<b>59</b>
Field Wiring Connections .....	60
LED Indicators .....	61
Specifications .....	62
<b>170 BDM 346 00</b>	
<b>InterBus–S TIO</b>	
<b>24 VDC 16 Input / 16 Output Module .....</b>	<b>63</b>
Field Wiring Connections .....	64
LED Indicators .....	65
Specifications .....	66

<b>170 BDM 346 30</b>	
<b>InterBus–S TIO</b>	
<b>24 VDC 8 Input / 24 ... 230 VAC/DC 8 Relay Output Module . . . . .</b>	<b>69</b>
Field Wiring Connections . . . . .	70
LED Indicators . . . . .	71
Specifications . . . . .	72
<b>170 BDI 356 00</b>	
<b>Interbus–S TIO</b>	
<b>24 VDC 32 Input Module . . . . .</b>	<b>75</b>
Field Wiring Connections . . . . .	76
LED Indicators . . . . .	77
Specifications . . . . .	78
<b>170 BDO 356 00</b>	
<b>InterBus–S TIO</b>	
<b>24 VDC 32 Output Module . . . . .</b>	<b>79</b>
Field Wiring Connections . . . . .	80
LED Indicators . . . . .	81
Specifications . . . . .	82
<b>170 BDI 546 50</b>	
<b>InterBus–S TIO</b>	
<b>115 VAC 16 Input Module . . . . .</b>	<b>83</b>
Field Wiring Connections . . . . .	84
LED Indicators . . . . .	85
Specifications . . . . .	86
<b>170 BDI 746 50</b>	
<b>InterBus–S TIO</b>	
<b>230 VAC 16 Input Module . . . . .</b>	<b>87</b>
Field Wiring Connections . . . . .	88
LED Indicators . . . . .	89
Specifications . . . . .	90



<b>170 BDO 946 50 InterBus-S TIO</b>	
<b>115 ... 230 VAC 16 Output Module</b> .....	<b>91</b>
Field Wiring Connections .....	92
LED Indicators .....	93
Specifications .....	94
<b>Appendix A</b>	
<b>Modbus Plus TIO Registers</b> .....	<b>95</b>
A .1 Modbus Plus TIO Module Registers .....	96
A .1.1 Data Registers .....	97
A .1.2 Configuration Register .....	98
A .1.3 Status Registers .....	99
A .2 Write Privilege to Modules .....	100
<b>Appendix B</b>	
<b>CE Compliance</b> .....	<b>101</b>
B .1 Requirements for CE Compliance .....	102
B .1.1 CE-Compliant Wiring Examples .....	102
B .2 Available Components for CE Compliance .....	103
B .2.1 Capacitive Discharge Terminal and DIN Grounding Clip .	103
B .2.2 AC Line Filters .....	103
B .3 170 BDI 542 50: Modbus Plus 115 VAC Input Module .....	104
B .4 170 BDO 542 50: Modbus Plus 24 ... 230 VAC Output Module .....	105



# Chapter 1

## Modicon Terminal Block I/O Modules

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- Modicon Terminal Block I/O Modules
- Reference Publications
- Modbus Plus Network Layouts
- TIO Modules for Modbus Plus
- InterBus-S Network Layouts
- TIO Modules for InterBus-S
- Environmental Specifications

## 1.1 Modicon Terminal Block I/O Modules

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Modicon Terminal Block Input/Output modules provide a cost-effective method for distributed control of field devices in industrial automation applications. Modules are available for controlling and monitoring a wide variety of discrete and analog input/output devices.

Terminal Block Input/Output (TIO) modules can be installed at or near field devices at remote locations in the industrial process. TIO modules are compact, occupying a minimum of mounting space at the device site.

Each TIO module connects to its field devices through local field wiring. Each module connects directly to the industrial communication network, exchanging data and status messages with the programmable controller or other controlling node in the industrial application.

### 1.1.1 Planning Your TIO System

Modicon TIO modules are available for these types of networks:

- Modicon Modbus Plus
- InterBus-S Remote Bus.

Modicon provides programmable controllers and other products that communicate with TIO modules over these networks. Modicon also provides software for the configuration and setup of the TIO modules. In addition, due to the wide acceptance of these networks in industrial applications, many third-party products are available for your use.

Contact your local Modicon product representative for information about available Modicon products for network applications.

## 1.2 Reference Publications

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### 1.2.1 Publications for TIO on Modbus Plus

Several Modicon publications are available to assist your planning for TIO module applications based on the Modbus Plus network:

**Modbus Plus Network Planning and Installation Guide (890 USE 100)**

This publication describes how to plan a Modbus Plus network application consisting of programmable controllers, host-based devices, and I/O devices. It presents guidelines for estimating the speed of message transactions in network applications. It includes worksheets for planning the network layout, and for specifying and ordering network components. The publication also defines the requirements for the installation of the network cable, taps, and other media.

**Modbus Plus I/O System Planning Guide (840 USE 104)**

This publication describes how to incorporate Modicon Distributed I/O (DIO) and Terminal Block I/O (TIO) products into Modbus Plus networks. It presents guidelines for the design of I/O networks that require deterministic timing of I/O processes, and for I/O networks that must include programmers, Man-Machine Interfaces, and other devices.

### 1.2.2 Publications for TIO on InterBus-S

Publications are available for planning InterBus-S network applications. Contact your local Modicon product representative for information about obtaining additional publications for your planning.

**InterBus-S Protocol Structure (Data Sheet 0005C)**

This publication describes the InterBus-S protocol format, network control, data movement, and overall implementation. Available from: Phoenix Contact, Inc., P.O. Box 4100, Harrisburg, PA 17111 USA.

## 1.3 Modbus Plus Network Layouts

The Modicon *Modbus Plus Planning and Installation Guide* provides details for the design and installation of Modbus Plus cable systems.

Modbus Plus nodes connect to taps along a trunk cable, as in Figure 1. Trunk cables consist of simple twisted-pair and shield wire connections.

A single segment of trunk cable supports up to 32 nodes along a cable path of up to 1500 ft (450 m). Up to three Modicon RR85 Repeaters can be used to expand the network to its maximum capacity of 64 nodes and 6000 ft (1800 m). Modicon FR85 Repeaters are also available for further expansion of the network through fibre optic links.

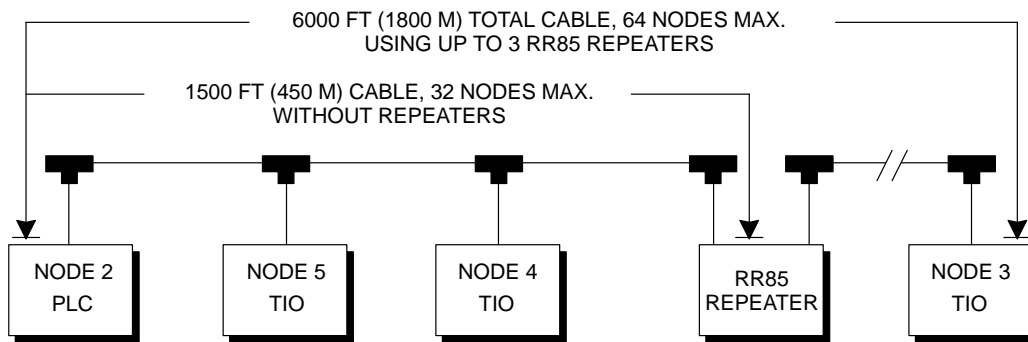


Figure 1 Modbus Plus Network Example

The user assigns a logical address to each node device by setting switches on the device. Addresses are assigned as required by the application and are not related to the physical locations of the nodes. Nodes function as peer-to-peer members of a logical ring, accessing the network by acquiring a token frame that is passed in a rotating address sequence. In Figure 1, a programmable controller is present at node address 2, with TIO modules at addresses 3 ... 5.

Networks can be designed as either a single-cable or dual-cable layout. Dual-cable layouts offer increased protection against cable faults or excessive noise bursts on either cable path, by continuing to process error-free messages on the alternate path.

Repeaters can also be applied in plant environments that have high levels of electrical interference. Repeaters at key points in the system can help to maintain an excellent signal-to-noise ratio on the network.

## 1.4 TIO Modules for Modbus Plus

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The table below summarizes the characteristics of Modicon TIO modules for Modbus Plus network applications. Modules are compliant with the IEC 1131 specification. Complete specifications are provided in the section for each module.

Part Number	Module Type	Inputs	Outputs	Operating Power
170 BDI 342 00	Discrete 16 in	15 ... 30 V dc	--	20 ... 30 V dc
170 BDO 342 00	Discrete 16 out	--	20 ... 30 V dc	20 ... 30 V dc
170 BDM 342 00	Discrete 16 in/16 out	15 ... 30 V dc	20 ... 30 V dc	20 ... 30 V dc
170 BDI 542 50	Discrete 16 in	74 ... 132 V ac	--	85 ... 264.5 V ac
170 BDO 542 50	Discrete 16 out	--	20.4 ... 253 V ac	85 ... 264.5 V ac

### Network Specifications

General specifications of Modbus Plus networks are presented in the *Modicon Modbus Plus Planning and Installation Guide*.

## 1.5 InterBus-S Network Layouts

Publications for the design and installation of InterBus-S cable systems are available from a variety of sources. Contact your Modicon product representative for information about obtaining InterBus-S publications. Here is an overview to assist your preliminary planning.

InterBus-S nodes connect to a remote bus cable, as shown in Figure 2. Nodes connect to the bus along a total cable path of up to 8 mi (13 km), with a maximum of 1300 ft (400 m) cable length between any pair of nodes. The network supports up to 256 nodes.

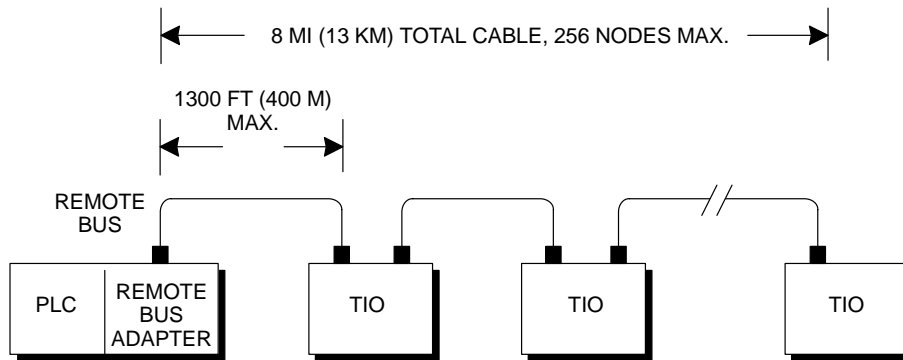


Figure 2 InterBus-S Network Example

Each type of node device is given an imbedded identifier code by the manufacturer to identify the device type to the application software. Nodes are not assigned node addresses by the user. Instead, the network functions as a logical shift register, in which the application's entire data stream originates at a master node and is transferred serially from node to node. In Figure 2, the programmable controller and its associated remote bus adapter function as the master device.

Each node regenerates the entire stream before passing it on to the next node. As each node handles the stream, it extracts the portion that is assigned to that node as input data (into the node), and adds output data (from the node) to the stream as applicable to that type of node device.

Networks can be designed using only the remote bus structure shown in Figure 2, or can employ bus adapters to extend the network to modules on a local bus. Modicon TIO modules are designed for connection only to the remote bus as shown in Figure 2.



## 1.6 TIO Modules for InterBus-S

The table below summarizes the characteristics of Modicon TIO modules for InterBus S remote bus network applications. Modules are compliant with the IEC 1131 specification. Complete specifications are provided in the section for each module.

Part Number	Module Type	Inputs	Outputs	Operating Power
170 BDI 346 00	Discrete 16 in	15 ... 30 V dc	--	20 ... 30 V dc
170 BDO 346 00	Discrete 16 out	--	20 ... 30 V dc	20 ... 30 V dc
170 BDM 346 00	Discrete 16 in/16 out	15 ... 30 V dc	20 ... 30 V dc	20 ... 30 V dc
170 BDM 346 30	Discrete 8 in/8 relay out	15 ... 30 V dc	20.4 ... 115 V dc, 20.4 ... 250 V ac	20 ... 30 V dc
170 BDI 546 50	Discrete 16 in	74 ... 132 V ac	--	85 ... 132 V ac
170 BDI 746 50	Discrete 16 in	170 ... 264.5 V ac	--	170 ... 264.5 V ac
170 BDO 946 50	Discrete 16 out	--	74 ... 253 V ac	85 ... 264.5 V ac
170 BAM 096 00	Analog 4 in/2 out	+/- 10 V dc 0 ... 10 V dc 0 ... 20 mA dc Pt 100	+/- 10 V dc 0 ... 20 mA dc	20 ... 30 V dc
170 BDI 356 00	Discrete 32 in	15 ... 30 V dc	--	20 ... 30 V dc
170 BDO 356 00	Discrete 32 out	--	20 ... 30 V dc	20 ... 30 V dc

### Network Specifications

General specifications of InterBus-S networks are as follows.

Parameter	Specifications
Number of Distributed I/O Stations	256 maximum
Remote Bus Segment Cable Length	400 m maximum
Total System Expansion	13 km maximum
Transmission Speed	500 kbits/s
Number of Input/Output Points	4096 maximum
Temperature Range, Operating	0 ... +55 °C
Humidity	75% average, 85% occasional, non-condensing
RFI Suppression	VDE 0871

## 1.7 Environmental Specifications

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All TIO modules share the following environmental specifications. Detailed specifications for individual modules are contained in the chapters for the modules.

Environmental Characteristic	Specification
Safety Class	VDE 0106, IEC 536: Class 1
Safety Type	IEC 529: IP20
Temperature Range (Operating)	EN 60721: 0 ... 60 °C
Temperature Range (Storage)	EN 60721: -40 ... +85 °C
Relative Humidity	EN 60721 Class F: 95% for 30 days per year 85% for remaining days per year 75% average per year without condensation
Atmospheric Pressure (Operating/Storage)	700 hPa (700 mbar)
Atmospheric Pressure (Transport)	230 hPa (230 mbar)
Pollutants	Maximum @ 60% relative humidity, without condensation: SO <sub>2</sub> ≤ 0.5 ml/m <sup>3</sup> IEC 68-2-42 H <sub>2</sub> S < 0.1 ml/m <sup>3</sup> IEC 68-2-43
Shock Load	EN 60068-2-27: 15 g (147 m/s <sup>2</sup> ) for 11 ms 3 shocks each direction per axis
Vibration Load	EN 60068-2-6: 0.15 mm single amplitude @ 10 ... 55 Hz 2 g (19.6 m/s <sup>2</sup> ) @ 55 Hz
Dielectric Strength	Conforms to IEC 664 (VDE 0160 5/88)

# Chapter 2

## Installing TIO Modules

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- Setting the Modbus Plus Node Address
- Mounting on a DIN Rail or Panel
- Selecting Connectors and Bus Bars
- Inserting Coding Keys Into Connectors

2

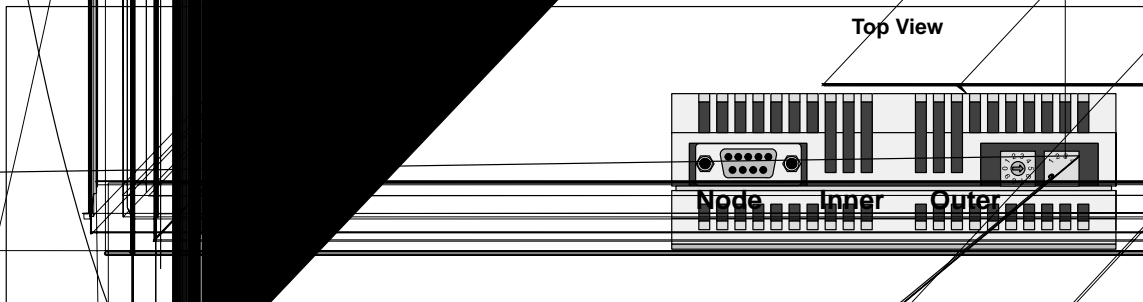
2

work.  
network,

address of 0 (zero).  
address for your application.

for the module, do not proceed  
Modbus Plus network administrator  
before proceeding. Do not connect the  
have this information.

address for the module, set the two rotary  
module to the assigned address. **Setting the Modbus Plus Node Address**



Address Switch Switch

1 ... 9 0 1 ... 9

10 ... 19 1 0 ... 9

### 10 Installing TIO Modules

890 USE 104 00

### 2.1.3 Network Design Options

You can design your network to provide deterministic timing for servicing the I/O nodes that are controlling your machine or process. You can also design it for non-deterministic timing between nodes performing a variety of functions. Your options are outlined below.

### 2.1.4 Deterministic I/O Servicing

When using Modbus Plus as an I/O network, the CPU or NOM modules must be set to the lowest addresses, followed immediately by the I/O drop addresses. For truly deterministic I/O servicing do not connect any other kinds of devices on the network. In addition, do not add or delete nodes from the network while the machine or process is running.

### 2.1.5 Multi-Function Servicing

Modbus Plus networks can be used for communication among many kinds of node devices. You should be aware of each device's requirement for access to the network. You should also be aware of the impact each device will have on the timing of your network communication, including the servicing of I/O nodes.

#### **Programmers**

Programmers may be connected to the network. However, caution must be used when adding or deleting these devices as this may cause an interruption in I/O servicing. The duration of this interruption depends greatly on the number of nodes on the network and their assigned addresses. In general, the lower the addresses on the network the shorter the interruption will be. In addition, the use of programmers may add to the token rotation time of the network. For example, Modsoft can add up to 6 milliseconds.

#### **Man Machine Interfaces (MMI)**

MMI devices typically communicate with the CPUs on a periodic polled basis, which generates network traffic that may vary over time. Therefore, to ensure proper I/O servicing, it is important to understand the worst case traffic these devices can generate. Typically an MMI adds 6 milliseconds to the token rotation time.

#### **ModConnect Devices**

Many third party devices exist which may be attached to a Modbus Plus network. To ensure proper performance, it is important that the user understands the impact these devices have on token rotation time. Please consult the appropriate Vendor's literature.

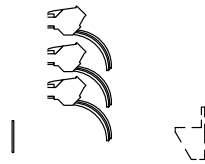
## 2.2 Mounting on a DIN Rail or Panel

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TIO modules are designed for mounting on a vertical panel surface. Mounting dimensions are as follows:

When mounting a module, take care to maintain the clearances for air circulation.

Dimensions (mm)



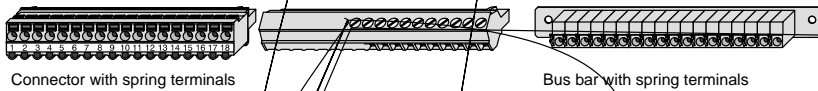
## 2.3 Selecting Connectors and Bus Bars

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### 2.3.1 Availability of Connectors and Bus Bars

Field wiring connectors and bus bars are available separately from the TIO modules. They are not shipped with the modules.

Connectors and bus bars are available in configurations with spring terminals or screw terminals. Part numbers are shown below.



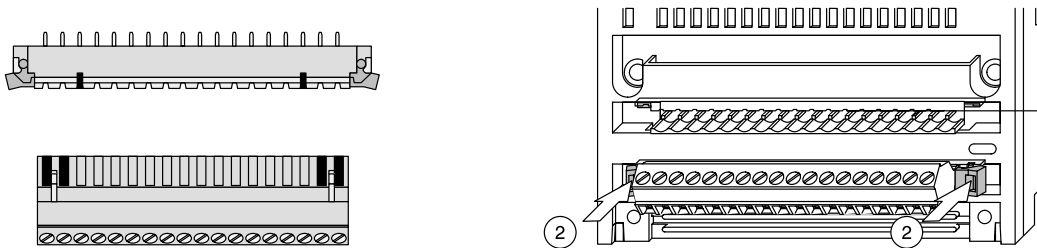
## 2.4 Inserting Coding Keys Into Connectors

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Field wiring connectors are supplied with an assortment of coding keys that allow you to customize the mounting of connectors to each module. This prevents the misconnection of field wiring to modules during installation and servicing.

Each module has a series of slots into which you can insert one or more coding keys. Each connector has a similar series of slots. When the keys are inserted into the same slot positions in both the module and the connector, the connector cannot be physically connected to the module.

By inserting coding keys into selected slots, you can ensure that each connector will mate at only one position on a specific module in your application.

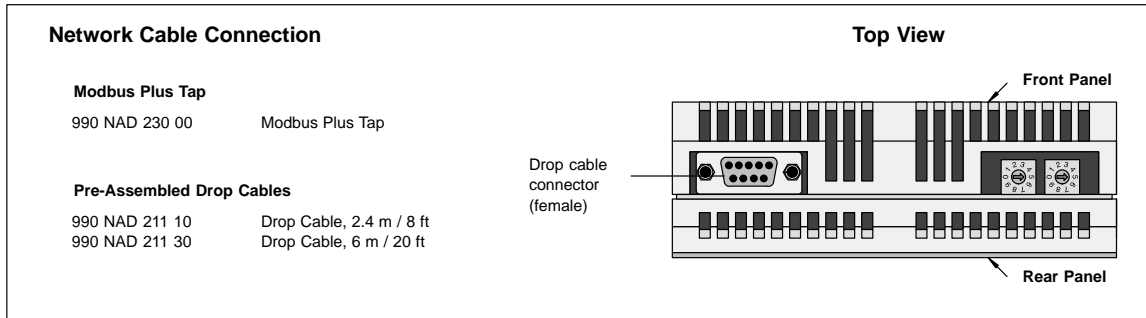




## 2.5 Connecting to the Modbus Plus Network

Modules on the Modbus Plus network will have one cable connection. This is to the drop cable from the network tap at the module site.

You should plan to provide a complete cabling diagram for your network installation, showing the cable routing path and methods of securing the cable. Your diagram should identify the drop cable at each module site.



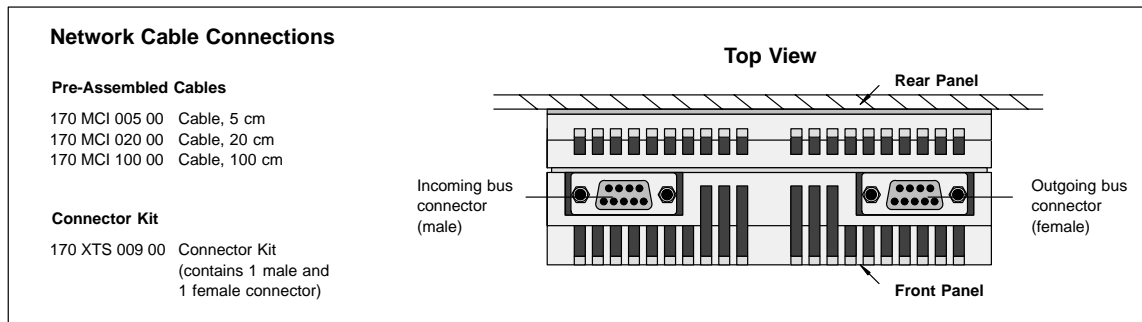
Modicon provides pre-fabricated Modbus Plus drop cables in two lengths. Each cable has a connector installed on one end for direct connection to the module. The other end has open wires for connection to the Modbus Plus network tap.

## 2.6 Connecting to the InterBus-S Remote Bus

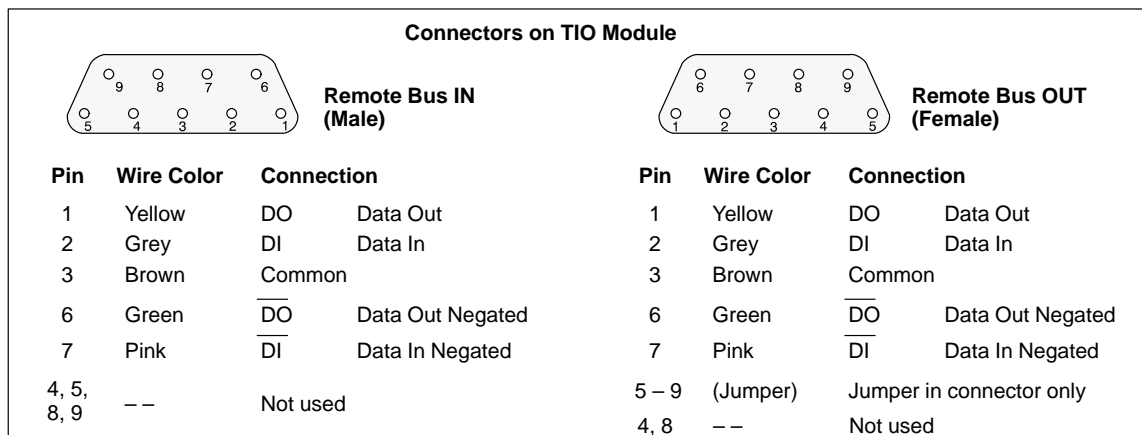
Modules at inline sites on the InterBus-S remote bus cable will have two connections. One connection is to the incoming bus cable, and the other is to the outgoing bus cable.

Modules at end sites on the network cable will have one connection. This is to the incoming bus cable only.

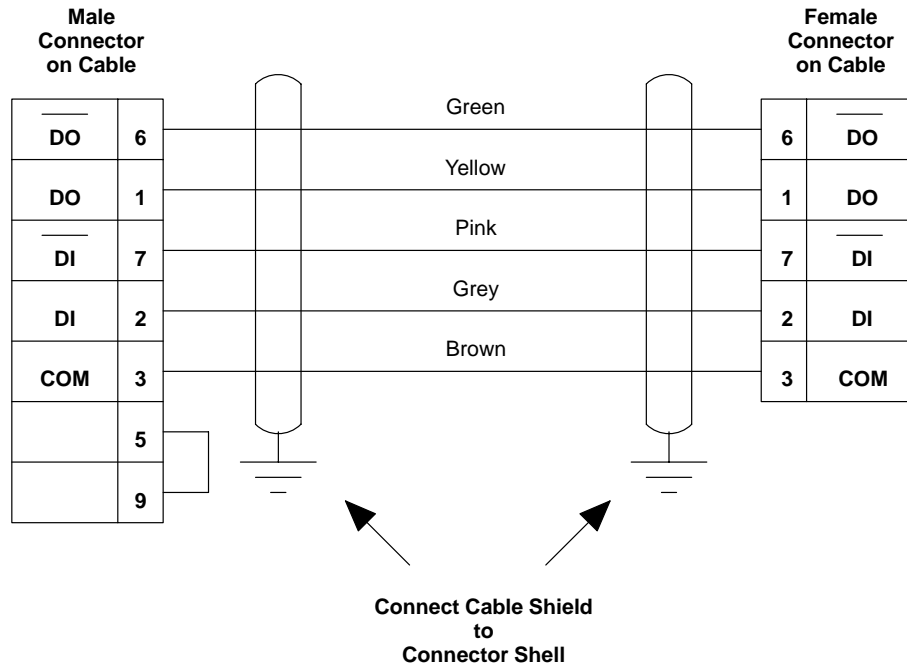
You should plan to provide a complete cabling diagram for your network installation, showing the cable routing path and methods of securing the cable. Your diagram should identify incoming and outgoing cables at each module site.



Modicon provides pre-fabricated InterBus-S cables in three lengths. Each cable has two connectors installed for direct interconnection between two modules. Modicon also provides a connector kit for installation onto user-supplied cable. The kit contains one male and one female connector. Recommended cable is: Belden 8103 or equivalent.



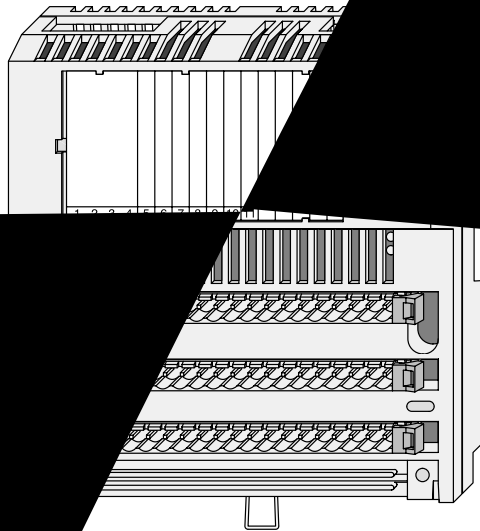
### Remote Bus Cable Fabrication





**170 BDI 342 00**  
**Modbus Plus TIO**  
**24 VDC 16 Input Module**

Module Type	16 digital
Nominal Input Voltage	24 VDC
Nominal Input Current, each point	4 mA



# Field Wiring Connections

### Connecting Operating Voltages

### Connecting Field Devices

### Common Connections

Row 2: Terminals 1 ... 18 (UB1) are connected together within the module.

Row 3: Terminals 1 ... 18 (M) are connected together within the module.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 (PE) are connected together within the external bus bar. There is no connection to the module.

### External Fuses

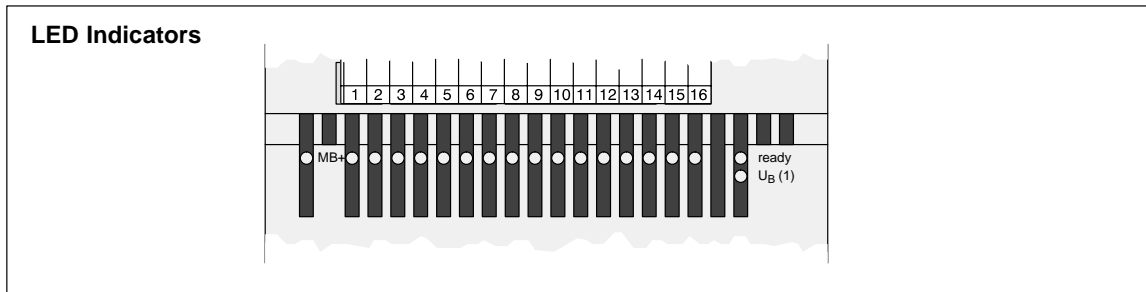
UB supply: 200 mA fast blow.

UB1 supply: Select a fuse that meets the total supply requirement of the connected devices. The maximum allowable fuse rating is: 4 A fast blow.

### Labeling of Terminals

Row	Terminal	Connection
1	1 ... 16	I1 ... I16 Input points 1 ... 16
1	17	M Voltage return
1	18	UB Module operating voltage
2	18	UB1 Voltage for field devices
3	17	M Voltage return
4	18	PE Earth ground for field devices

# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
UB(1)	green	UB1 voltage is present.
	off	UB1 voltage is not present. Check the UB1 source.
1 ... 16	green	Input 1 ... 16 is active (input voltage high level).
	off	Input 1 ... 16 is not active (input voltage low level).
MB+	6 flashes/s	This is the normal operating state for the node. It is receiving and passing the network token. All nodes on a healthy network flash this pattern.
	1 flash/s	The node is offline just after power-up or after exiting the 4 flashes/s mode. In this state, the node monitors the network and builds a table of active nodes. After being in this state for 5 s, the node attempts to go to its normal operating state, indicated by 6 flashes/s.
	2 flashes, then off for 2 s	The node detects the token being passed among the other nodes, but never receives the token. Check the network for an open circuit or defective termination.
	3 flashes, then off for 1.7 s	The node is not detecting any tokens being passed among the other nodes. It periodically claims the token but cannot find another node to which to pass it. Check the network for an open circuit or defective termination.
	4 flashes, then off for 1.4 s	The node has detected a valid message from a node using a network address identical to its own address. The node remains in this state for as long as it continues to detect the duplicate address. If the duplicate address is not detected for 5 s, the node changes to its 1 flash/s mode.
	off	The Modbus Plus network is not active.

# Specifications

The **DC Input 24 Vdc 1x16 Sink** module accepts 24 Vdc inputs and is for use with source output devices.

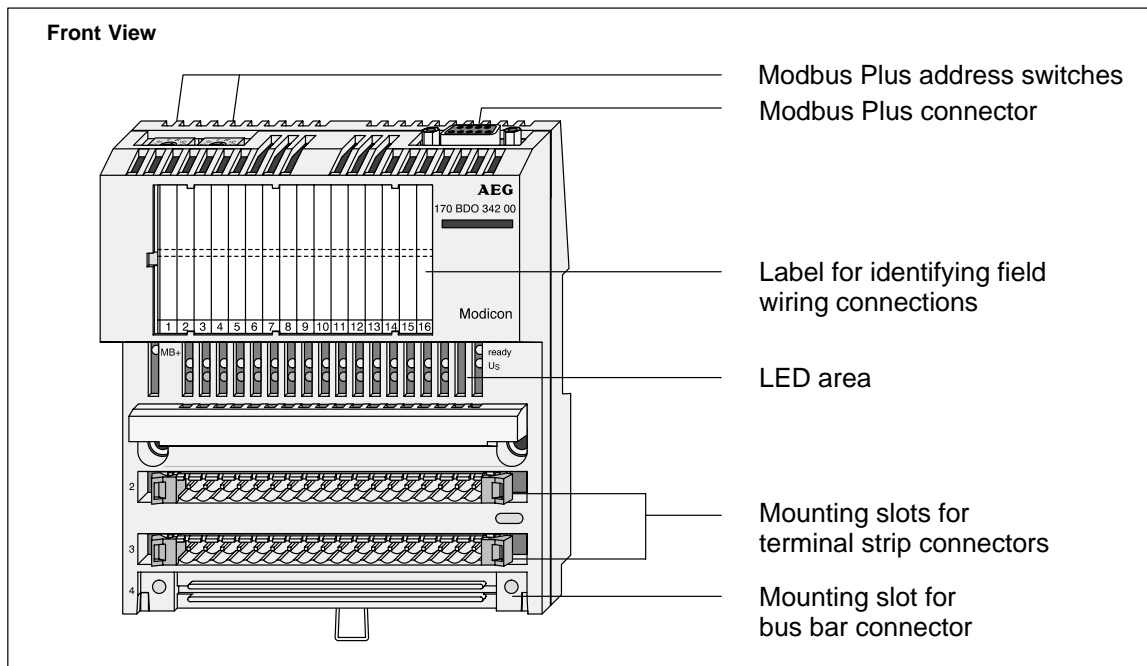
## Specifications

<b>Number of Input Points</b>	16 in one group
<b>Module Quiescent Current</b>	100 mA @ 20 ... 30 Vdc
<b>Operating Voltages and Currents</b>	
Guaranteed ON (voltage)	+15 ... +30 Vdc
Guaranteed OFF (voltage)	-3 ... +5 Vdc
Guaranteed ON (current)	2.4 mA
Guaranteed OFF (current)	0.9 mA
<b>Absolute Maximum Input</b>	
Continuous	30 Vdc
1.3 ms	56 Vdc decaying pulse
<b>Response</b>	
OFF – ON	3 ms (max)
ON – OFF	3 ms (max)
<b>Internal Resistance</b>	5.6 k
<b>Input Protection</b>	Resistor limited
<b>Isolation</b>	
Point to Point	None
Group to Bus	500 Vac rms
<b>Fault Detection</b>	None
<b>Fusing</b>	
Internal	None
External	User discretion 4A max per group



# 170 BDO 342 00 Modbus Plus TIO 24 VDC 16 Output Module

<b>Module Type</b>	16 discrete output points, in 1 group
<b>Nominal Output Voltage</b>	24 V dc
<b>Maximum Output Current, each point</b>	0.5 A



# Field Wiring Connections

### Connecting Operating Voltages

1 (Not Used)

### Connecting Field Devices

1 (Not Used)

### Common Connections

Row 3: Terminals 1 ... 18 (M) are connected together within the module.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 (PE) are connected together within the external bus bar. There is no connection to the module.

### Labeling of Terminals

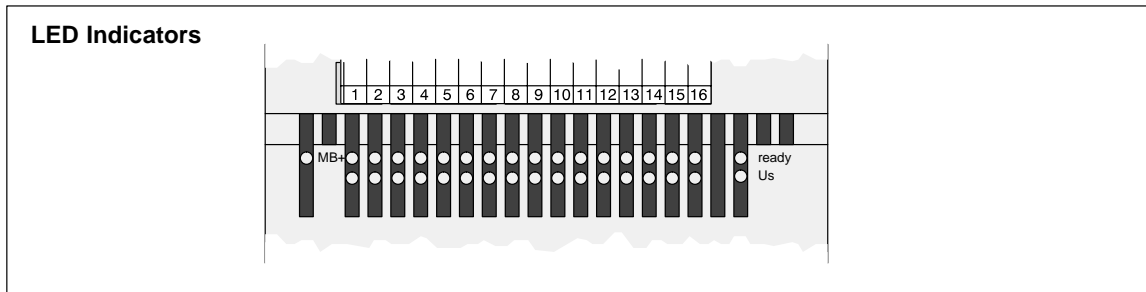
Row	Terminal	Connection
2	1 ... 16	O1 ... O16 Output points 1 ... 16
2	17	US Voltage for field devices
2	18	UB Module operating voltage
3	18	M Voltage return
4	18	PE Earth ground for field devices

### External Fuses

UB supply: 200 mA fast blow.

US supply: Select a fuse that meets the total supply requirement of the connected devices. The maximum allowable fuse rating is: 8 A fast blow.

# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
Us	green	US voltage is present.
	off	US voltage is not present. Check the US source.
1 ... 16 upper row	green	Output 1 ... 16 is active (output voltage high level).
	off	Output 1 ... 16 is not active (output voltage low level).
1 ... 16 lower row	red	Output 1 ... 16 has an error condition (overload or short circuit).
	off	Output 1 ... 16 is operating normally.
MB+	6 flashes/s	This is the normal operating state for the node. It is receiving and passing the network token. All nodes on a healthy network flash this pattern.
	1 flash/s	The node is offline just after power-up or after exiting the 4 flashes/s mode. In this state, the node monitors the network and builds a table of active nodes. After being in this state for 5 s, the node attempts to go to its normal operating state, indicated by 6 flashes/s.
	2 flashes, then off for 2 s	The node detects the token being passed among the other nodes, but never receives the token. Check the network for an open circuit or defective termination.
	3 flashes, then off for 1.7 s	The node is not detecting any tokens being passed among the other nodes. It periodically claims the token but cannot find another node to which to pass it. Check the network for an open circuit or defective termination.
	4 flashes, then off for 1.4 s	The node has detected a valid message from a node using a network address identical to its own address. The node remains in this state for as long as it continues to detect the duplicate address. If the duplicate address is not detected for 5 s, the node changes to its 1 flash/s mode.
	off	The Modbus Plus network is not active.

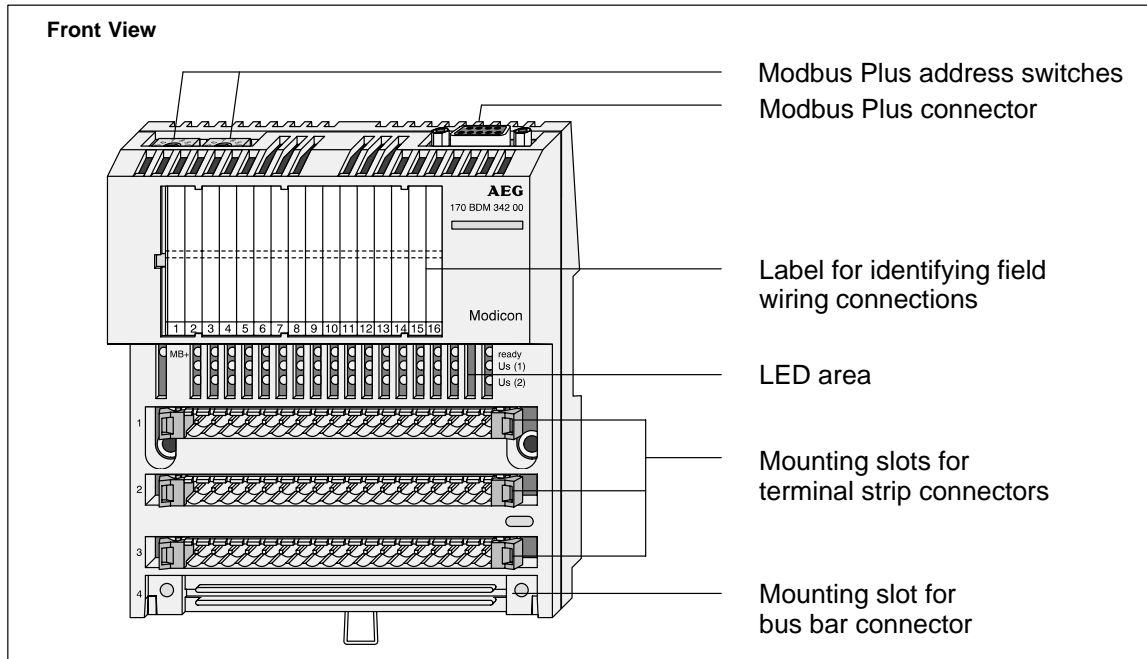
# Specifications

The **DC Output 24 Vdc 1x16** module switches 24 Vdc outputs and is for use with source output devices.

<b>Specifications</b>	
<b>Number of Output Points</b>	16 in one group
<b>Module Quiescent Current</b>	100 mA @ 20 ... 30 Vdc
<b>Voltage</b>	
Operating	20 ... 30 Vdc
Absolute (max)	56 Vdc for 1.3 ms decaying voltage pulse
ON State Drop / Point	0.5 Vdc @ 0.5 A
<b>Maximum Load Current</b>	
Each Point	0.5 A
Per Module	8 A
OFF State Leakage / Point	0.4 mA @ 30 Vdc
<b>Maximum Surge Current</b>	
Each Point	5 A @ 500 $\mu$ s duration (no more than 6 per minute)
<b>Maximum Loading</b>	
Each Point	12 W @ 100 cycles/s, resistive 12 W @ 1000 cycles/h, inductive 1.2 W @ 8 cycles/s, lamp
<b>Load Capacitance Maximum</b>	50 $\mu$ f
<b>Response Time</b>	
OFF – ON	1 ms (max)
ON – OFF	1 ms (max)
<b>Module Protection</b>	
Input Protection	Resistor limited
Output Protection	Electronically protected
<b>Isolation</b>	
Group to Bus	500 Vac rms
<b>Fault Detection</b>	
Input	None
Output	Red LED indicator for each output
<b>Fusing</b>	
Input	<b>Internal</b> – None <b>External</b> – User discretion
Output	<b>Internal</b> – None, electronically protected <b>External</b> – User discretion

# 170 BDM 342 00 Modbus Plus TIO 24 VDC 16 Input / 16 Output Module

<b>Module Type</b>	16 discrete input points, in 1 group 16 discrete output points, in 2 groups of 8 points
<b>Nominal Operating Voltage</b>	24 V dc
<b>Nominal Input Current, each point</b>	4.2 mA
<b>Maximum Output Current, each point</b>	0.5 A



# Field Wiring Connections

### Connecting Operating Voltages

**Common Connections**  
Row 3: Terminals 1 ... 18 (M) are connected together within the module.

**External Bus Bar Connections**  
Row 4, 5, and 6: Install an external 3-row bus bar at row 4, and use the bus bar terminals for UB1, M, and PE field wiring.

Use row 4 for UB1 wiring connections.  
Use row 5 for M wiring connections.  
Use row 6 for PE wiring connections.

Terminals 1 ... 18 are connected together within each bus bar.  
There are no internal connections to the module.

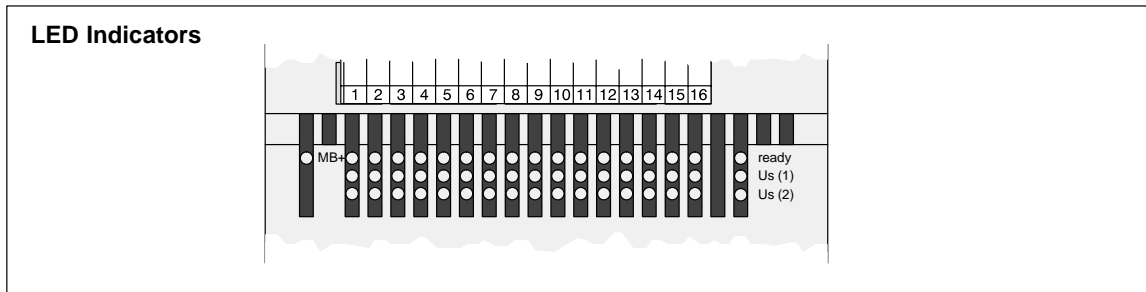
**External Fuses**  
UB supply: 200 mA fast blow.  
UB1, US1 and US2 supply: Select a fuse that meets the total supply requirement of the connected devices.  
The maximum allowable fuse rating is: 6.3 A fast blow.

### Connecting Field Devices

**Labeling of Terminals**

Row	Terminal	Connection
1	1 ... 16	I1 ... I16 Input points 1 ... 16
1	17	M Module operating voltage return
1	18	UB Module operating voltage
2	1 ... 8	O1 ... O8 Output points 1 ... 8 (group 1)
2	9 ... 16	O9 ... O16 Output points 9 ... 16 (group 2)
2	17	US1 Voltage for outputs 1 ... 8 (group 1)
2	18	US2 Voltage for outputs 9 ... 16 (group 2)
3	18	M Voltage return for field devices
4	18	UB1 Voltage for inputs 1 ... 16
5	18	M Voltage return for field devices
6	18	PE Earth ground for field devices

# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
Us(1)	green	US1 voltage is present.
	off	US1 voltage is not present. Check the US1 source.
Us(2)	green	US2 voltage is present.
	off	US2 voltage is not present. Check the US2 source.
1 ... 16 upper row	green	Input 1 ... 16 is active (input voltage high level).
	off	Input 1 ... 16 is not active (input voltage low level).
1 ... 16 center row	green	Output 1 ... 16 is active (output voltage high level).
	off	Output 1 ... 16 is not active (output voltage low level).
1 ... 16 lower row	red	Output 1 ... 16 has an error condition (overload or short circuit).
	off	Output 1 ... 16 is operating normally.
MB+	6 flashes/s	This is the normal operating state for the node. It is receiving and passing the network token. All nodes on a healthy network flash this pattern.
	1 flash/s	The node is offline just after power-up or after exiting the 4 flashes/s mode. In this state, the node monitors the network and builds a table of active nodes. After being in this state for 5 s, the node attempts to go to its normal operating state, indicated by 6 flashes/s.
	2 flashes, then off for 2 s	

# Specifications

The module's **DC Input 24 Vdc 1x16 Sink** inputs accept 24 V dc inputs for use with source output devices. The **DC Output 24 Vdc 2x8 Source** outputs switch 24 V dc for use with sink input devices.

## Specifications (General)

<b>Module Quiescent Current</b>	100 mA @ 20 ... 30 Vdc
<b>Module Protection</b>	
Input Protection	Resistor limited
Output Protection	Electronically protected
<b>Isolation (Input and Output)</b>	
Point to Point	None
Group to Group	None
Group to Bus	500 Vac rms
<b>Fault Detection</b>	
Input	None
Output	Red LED indicator for each output
<b>Fusing</b>	
Input	<b>Internal</b> – None <b>External</b> – User discretion
Output	<b>Internal</b> – None, electronically protected <b>External</b> – User discretion

## Specifications (Inputs)

<b>Number of Input Points</b>	16 in one group
<b>Operating Voltages and Currents</b>	
Guaranteed ON (voltage)	+15 ... +30 Vdc
Guaranteed OFF (voltage)	-3 ... +5 Vdc
Guaranteed ON (current)	2.4 mA
Guaranteed OFF (current)	0.9 mA
<b>Absolute Maximum Input</b>	
Continuous	30 Vdc
1.3 ms	56 Vdc decaying pulse
<b>Internal Resistance (Input)</b>	5.6 k
<b>Response (Input)</b>	
OFF – ON	3 ms max
ON – OFF	3 ms max



### Specifications (Outputs)

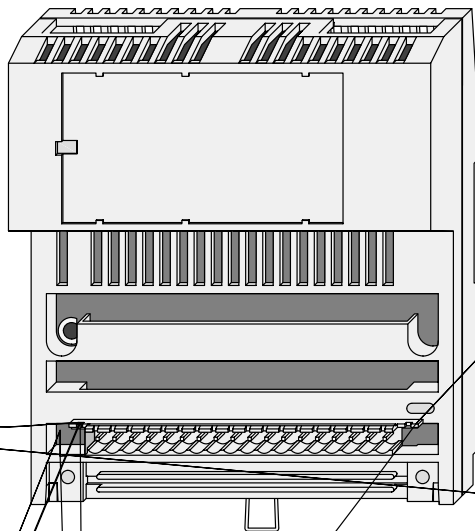
<b>Number of Output Points</b>	16 in two 8 point groups
<b>Voltage (Output)</b>	
Operating (max)	19.2 ... 30 Vdc
Absolute (max)	56 Vdc for 1.3 ms decaying voltage pulse
ON State Drop / Point	0.5 Vdc @ 0.5 A
<b>Maximum Load Current</b>	
Each Point	0.5 A
Each Group	4 A
Per Module	8 A
Off State Leakage / Point	0.4 mA @ 30 Vdc
<b>Maximum Loading</b>	
Each Point	12 W @ 100 cycles/s, resistive 12 W @ 1000 cycles/h, inductive 1.2 W @ 8 cycles/s, lamp
<b>Load Capacitance Maximum</b>	50 $\mu$ f
<b>Response (Output)</b>	
OFF – ON	1 ms max (resistive load)
ON – OFF	1 ms max (resistive load)



**170 BDI 542 50**  
**Modbus Plus TIO**  
**115 VAC 16 Input Module**

<b>Module Type</b>	16 discrete input points, in 2 groups of 8 points
<b>Nominal Input Voltage</b>	115 V ac
<b>Nominal Input Current, each point</b>	10 mA

Modbus Plus address switches



# Field Wiring Connections

### Connecting Operating Voltages

#### Common Connections

Row 2: Terminals 1 ... 8 and 17 (US1) are connected together within the module.

Row 2: Terminals 9 ... 16 and 18 (US2) are connected together within the module.

Row 3: Terminals 1 ... 8 and 17 (MS1) are connected together within the module.

Row 3: Terminals 9 ... 16 and 18 (MS2) are connected together within the module.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 (PE) are connected together within the external bus bar. There is no connection to the module.

#### External Fuses

L supply: 100 mA fast blow.

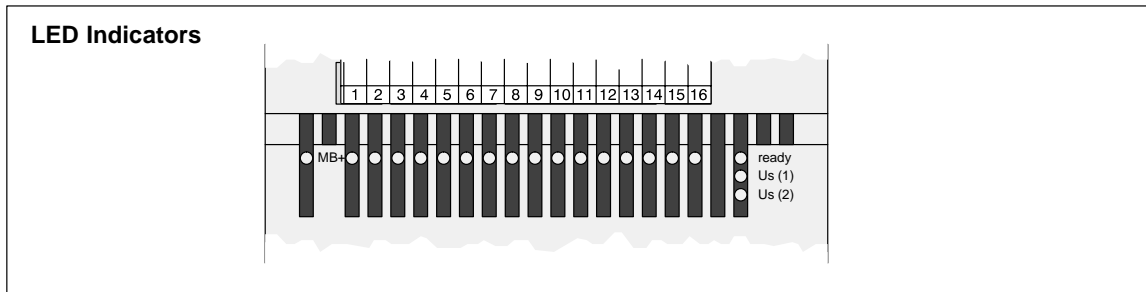
US1 and US2 supply: Select a fuse that meets the total supply requirement of the connected devices. The maximum allowable fuse rating is: 4 A fast blow.

### Connecting Field Devices

#### Labeling of Terminals

Row	Terminal	Connection
1	1 ... 8	I1 ... I8 Input points 1 ... 8 (group 1)
1	9 ... 16	I9 ... I16 Input points 9 ... 16 (group 2)
1	17	N Module operating voltage, Neutral
1	18	L Module operating voltage, Line
2	17	US1 Voltage for devices 1 ... 8 (group 1)
2	18	US2 Voltage for devices 9 ... 16 (group 2)
3	17	MS1 Voltage return for 1 ... 8 (group 1)
3	18	MS2 Voltage return for 9 ... 16 (group 2)
4	18	PE Earth ground for field devices
		Power ground

# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the L voltage source.
Us (1)	green	US1 voltage is present.
	off	US1 voltage is not present. Check the US1 source.
Us (2)	green	US2 voltage is present.
	off	US2 voltage is not present. Check the US2 source.
1 ... 16	green	Input 1 ... 16 is active (input voltage high level).
	off	Input 1 ... 16 is not active (input voltage low level).
MB+	6 flashes/s	This is the normal operating state for the node. It is receiving and passing the network token. All nodes on a healthy network flash this pattern.
	1 flash/s	The node is offline just after power-up or after exiting the 4 flashes/s mode. In this state, the node monitors the network and builds a table of active nodes. After being in this state for 5 s, the node attempts to go to its normal operating state, indicated by 6 flashes/s.
	2 flashes, then off for 2 s	The node detects the token being passed among the other nodes, but never receives the token. Check the network for an open circuit or defective termination.
	3 flashes, then off for 1.7 s	The node is not detecting any tokens being passed among the other nodes. It periodically claims the token but cannot find another node to which to pass it. Check the network for an open circuit or defective termination.
	4 flashes, then off for 1.4 s	The node has detected a valid message from a node using a network address identical to its own address. The node remains in this state for as long as it continues to detect the duplicate address. If the duplicate address is not detected for 5 s, the node changes to its 1 flash/s mode.
	off	The Modbus Plus network is not active.

# Specifications

The **AC Input 115 Vac 2x8** module accepts 115 Vac inputs.

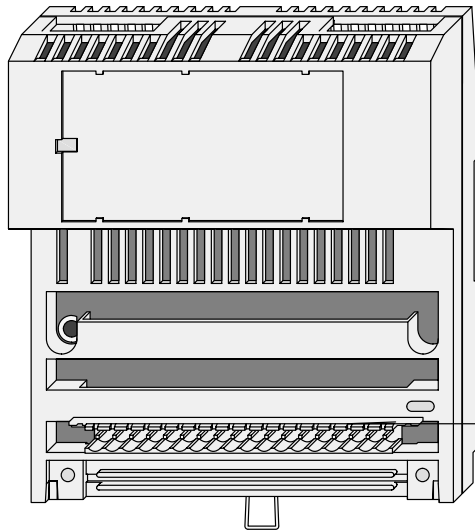
<b>Specifications</b>	
<b>Number of Input Points</b>	16 in two 8 point groups
<b>Module Quiescent Current</b>	40 mA @ 85 ... 264.5 Vac
<b>Input Voltage and Currents Ranges</b>	
Voltage	Guaranteed ON: 74 Vac Guaranteed OFF: 20 Vac
Current	Guaranteed ON: 10 mA Guaranteed OFF: 2 mA
<b>Input Frequency</b>	47 ... 63 Hz
<b>Absolute Maximum Input</b>	
Continuous	132 Vac
10 s	156 Vac
1 cycle	200 Vac
1.3 ms	276 Vac
<b>Response</b>	
OFF – ON	Min: 4.9 ms Max: 0.75 line cycle
ON – OFF	Min: 7.3 ms Max: 12.3 ms
<b>Isolation</b>	
Input to Input	All inputs in a group must be from the same phase of line input voltage
Group to Group	1780 Vac rms for 1 minute
Input to Bus	1780 Vac rms for 1 minute
<b>Fault Detection</b>	None
<b>Fusing</b>	
Internal	None
External	User discretion

**Note:** Input signals must be sinusoidal with less than 6% THD.

# 170 BDO 542 50 Modbus Plus TIO 24 ... 230 VAC 16 Output Module

<b>Module Type</b>	16 discrete output points, in 2 groups of 8 points
<b>Nominal Output Voltage</b>	24 ... 230 V ac
<b>Maximum Output Current, each point</b>	0.5 A rms

Modbus Plus address switches



# Field Wiring Connections

### Connecting Operating Voltages

Fuses (behind protective cover)

### Connecting Field Devices

### Common Connections

Row 3: Terminals 1 ... 17 (N) are connected together within the module.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 (PE) are connected together within the external bus bar. There is no connection to the module.

### Internal Fuses

L1 supply: 6.3 A 250 V fast blow, for each output group.  
Total fuses: 2.

### External Fuse

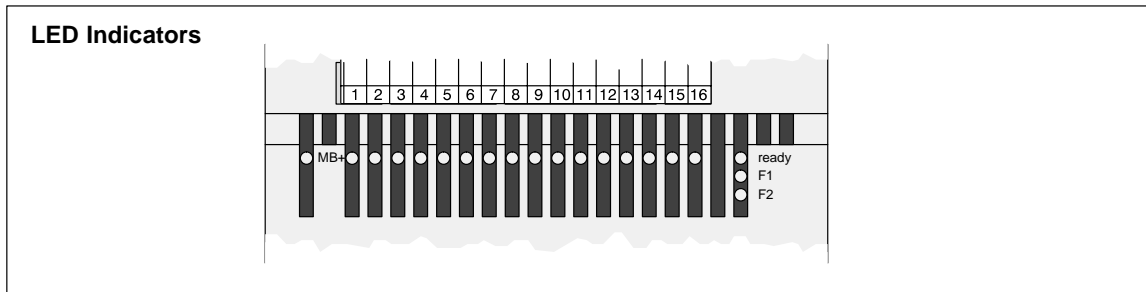
L supply: 100 mA 250 V fast blow.

### Labeling of Terminals

Row	Terminal	Connection
2	1 ... 8	O1 ... O8 Output points 1 ... 8 (group 1)
2	9 ... 16	O9 ... O16 Output points 9 ... 16 (group 2)
2	17	N Voltage for field devices, Neutral
2	18	L1 Voltage for field devices, Line
3	17	N Module operating voltage, Neutral
3	18	L Module operating voltage, Line
4	18	PE Earth ground for field devices
		Power ground



# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the L voltage source.
F1	green	Fuse F1 (group 1 outputs) is OK.
	off	Fuse F1 is not OK.
F2	green	Fuse F2 (group 2 outputs) is OK.
	off	Fuse F2 is not OK.
1 ... 16	green	Output 1 ... 16 is active (output voltage high level).
	off	Output 1 ... 16 is not active (output voltage low level).
MB+	6 flashes/s	This is the normal operating state for the node. It is receiving and passing the network token. All nodes on a healthy network flash this pattern.
	1 flash/s	The node is offline just after power-up or after exiting the 4 flashes/s mode. In this state, the node monitors the network and builds a table of active nodes. After being in this state for 5 s, the node attempts to go to its normal operating state, indicated by 6 flashes/s.
	2 flashes, then off for 2 s	The node detects the token being passed among the other nodes, but never receives the token. Check the network for an open circuit or defective termination.
	3 flashes, then off for 1.7 s	The node is not detecting any tokens being passed among the other nodes. It periodically claims the token but cannot find another node to which to pass it. Check the network for an open circuit or defective termination.
	4 flashes, then off for 1.4 s	The node has detected a valid message from a node using a network address identical to its own address. The node remains in this state for as long as it continues to detect the duplicate address. If the duplicate address is not detected for 5 s, the node changes to its 1 flash/s mode.
	off	The Modbus Plus network is not active.

# Specifications

The **AC Output 24 ... 230 Vac 2x8** module switches 24 ... 230 Vac powered loads.

## Specifications

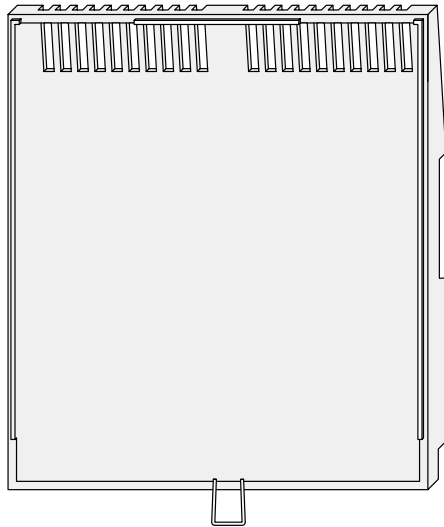
<b>Number of Output Points</b>	16 in two 8 point groups
<b>Module Quiescent Current</b>	40 mA @ 85 ... 264.5 Vac
<b>Output Voltage (rms)</b>	
Working	20.4 ... 253 Vac
Absolute Maximum	300 Vac for 10 s 400 Vac for 1 cycle
Frequency	47 ... 63 Hz
ON State Drop / Point	1.5 Vac max
<b>Minimum Load Current (rms)</b>	10 mA
<b>Maximum Load Current (rms)</b>	
Each Point	0.5 A continuous, 20.4 ... 253 Vac rms
Per Module	8 A continuous
Off State Leakage / Point (max)	3.75 mA

## Surge Current Maximum (rms)

One Cycle	15 A per point
Two Cycles	10 A per point
Three Cycles	5 A per point
<b>Applied DV / DT</b>	400 V/μs
<b>Commutative DV / DT</b>	5 V/μs
<b>Response</b>	
OFF – ON	0.50 of one line cycle max
ON – OFF	0.50 of one line cycle max
<b>Output Protection (internal)</b>	RC snubber suppression
<b>Isolation (rms)</b>	
Output to Output	300 Vac for 1 minute
Output to Bus	1780 for 1 minute
<b>Fusing</b>	
Internal	One 6.3 A 250 V fuse per group
External	User discretion

**170 BAM 096 00**  
**InterBus-S TIO**  
**Analog Input/Output Module**

<b>Module Type</b>	4 analog inputs, 2 analog outputs
<b>Nominal Input Ranges</b>	0 ... 10 V, $\pm 10$ V, 0 ... 20 mA (see Specifications)
<b>Nominal Output Ranges</b>	$\pm 10$ V, 0 ... 20 mA (see Specifications)



# Field Wiring Connections

### Connecting Operating Voltages

1 (Not used)

### Connecting Field Devices

(See wiring examples on following pages.)

### Common Connections

Row 2: Terminals 4 and 5 ( I ) are connected together within the module.

Row 2: Terminals 12 and 13 ( I ) are connected together within the module.

Rows 2 and 3: The following pairs of terminals ( I+ ) on both rows are connected within the module: 2-2, 7-7, 10-10, and 15-15.

Row 3: The following terminals ( AG ) are connected together within the module: 3, 5, 8, 11, 13, and 16.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 ( PE ) are connected together within the external bus bar. There is no connection to the module.

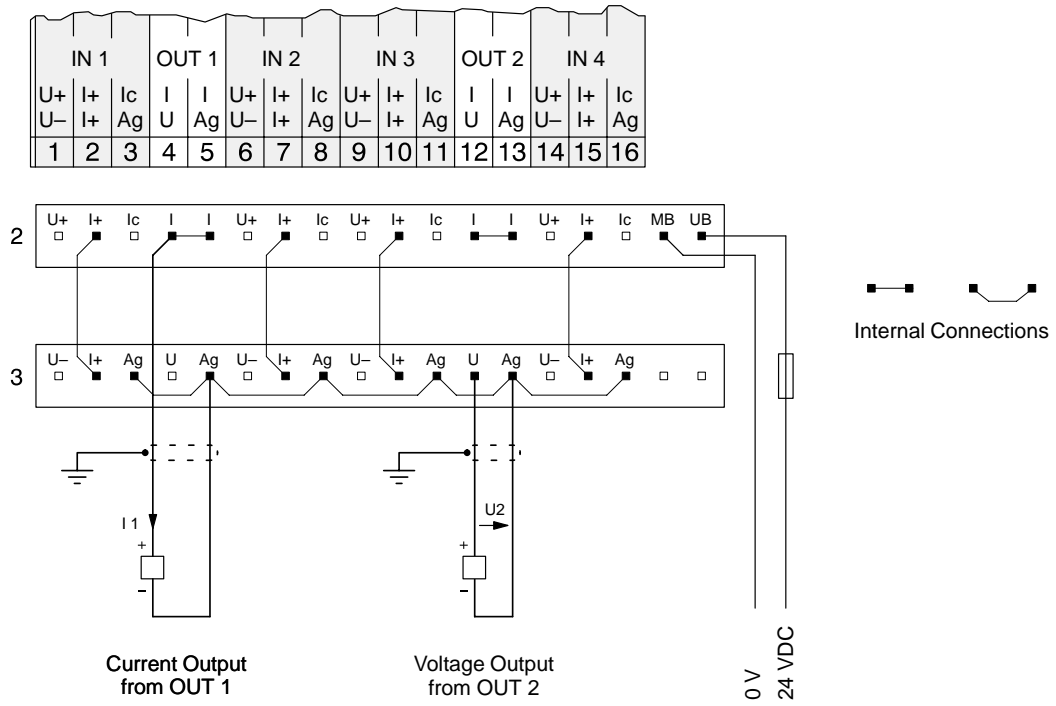
### External Fuses

UB supply: 1 A fast blow.

### Labeling of Terminals

Row	Terminal	Connection
2	1	U+ + Voltage input, sensor 1
3	1	U- - Voltage input, sensor 1
2,3	2	I+ Current input, sensor 1
2	3	IC Constant current to Pt100, sensor 1
2	4,5	I Constant current out, sensor 1
3	4	U Voltage out to sensor 1
2	6	U+ + Voltage input, sensor 2
3	6	U- - Voltage input, sensor 2
2,3	7	I+ Current input, sensor 2
2	8	IC Constant current to Pt100, sensor 2
2	9	U+ + Voltage input, sensor 3
3	9	U- - Voltage input, sensor 3
2,3	10	I+ Current input, sensor 3
2	11	IC Constant current to Pt100, sensor 3
2	14	U+ + Voltage input, sensor 4
3	14	U- - Voltage input, sensor 4
2,3	15	I+ Current input, sensor 4
2	16	IC Constant current to Pt100, sensor 4
2	17	MB Module operating voltage return
2	18	UB Module operating voltage
3	3, 5, 8, 11, 13, 16	AG Analog ground for field devices
4	18	PE Earth ground for field devices

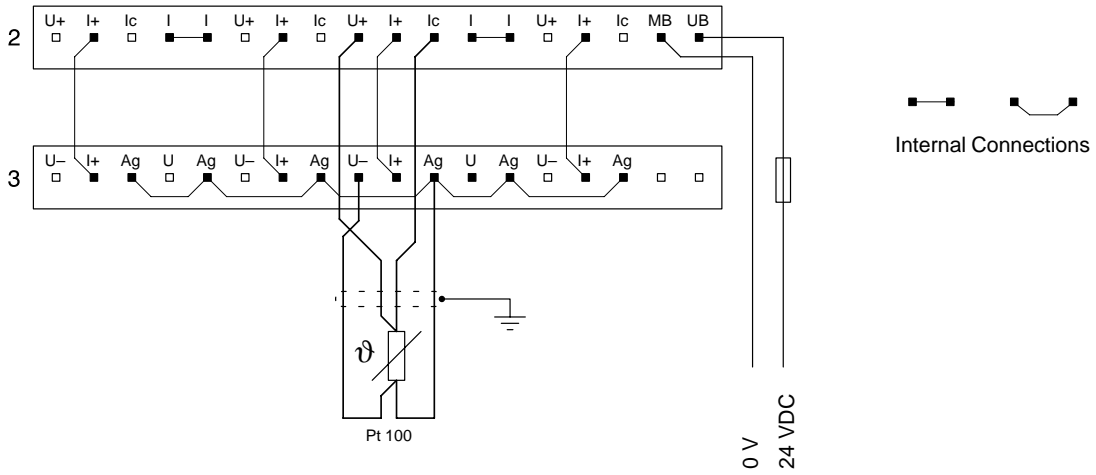
**Wiring Example: 2-Wire Current Output and Voltage Output Devices**



Ag = Analog ground  
 I = Current output to current device  
 U = Positive voltage output to voltage device

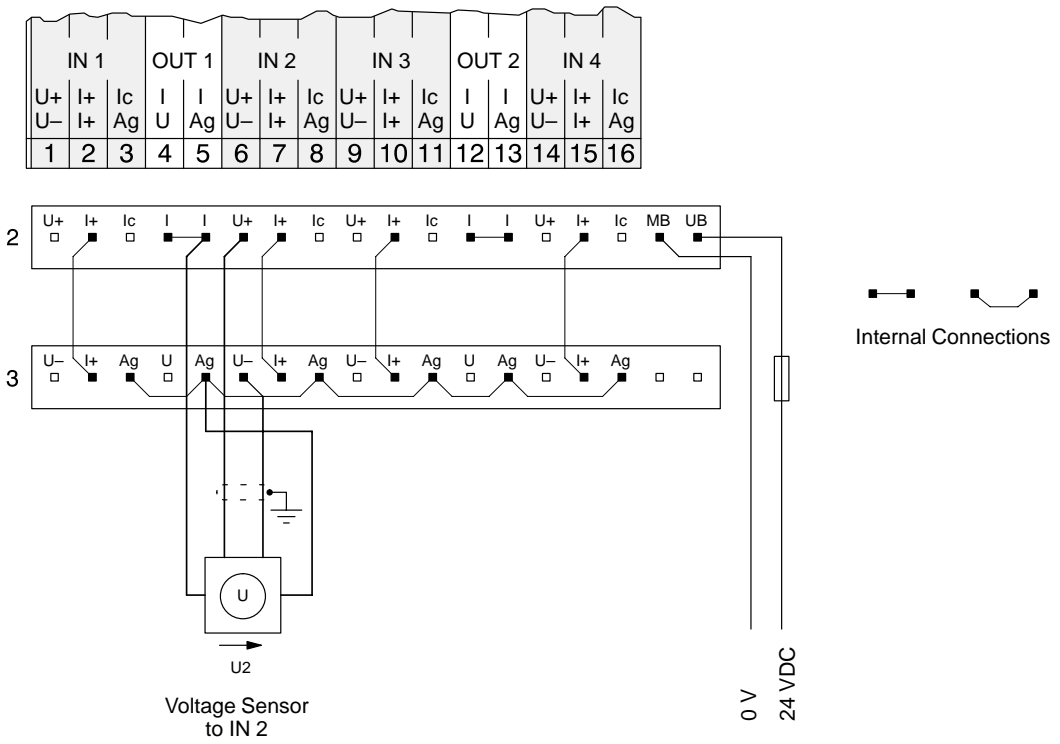
**Wiring Example: Pt100 Sensor Input**

IN 1			OUT 1		IN 2			IN 3			OUT 2		IN 4		
U+	I+	Ic	I	I	U+	I+	Ic	U+	I+	Ic	I	I	U+	I+	Ic
U-	I-	Ag	U	Ag	U-	I-	Ag	U-	I-	Ag	U	Ag	U-	I-	Ag
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16



Ag = Analog ground  
 Ic = Constant current output to Pt100  
 U+ = Positive differential voltage input from Pt100  
 U- = Negative differential voltage input from Pt100

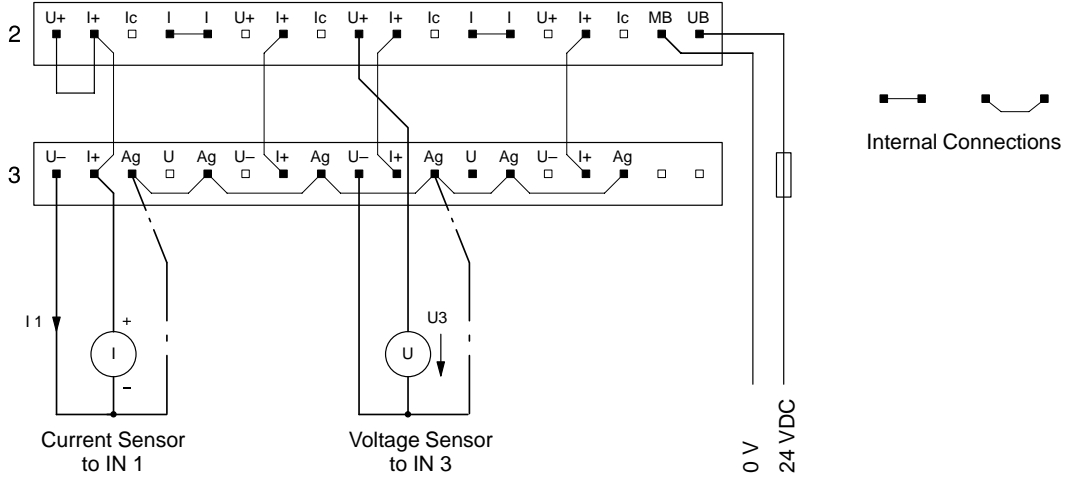
**Wiring Example: 4-Wire Sensor Input**



- Ag = Analog ground
- I = Constant current output to sensor
- U+ = Positive differential voltage input from sensor
- U- = Negative differential voltage input from sensor

**Wiring Example: 2-Wire and 3-Wire Sensor Inputs**

IN 1			OUT 1		IN 2			IN 3			OUT 2		IN 4		
U+	I+	Ic	I	I	U+	I+	Ic	U+	I+	Ic	I	I	U+	I+	Ic
U-	I+	Ag	U	Ag	U-	I+	Ag	U-	I+	Ag	U	Ag	U-	I+	Ag
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

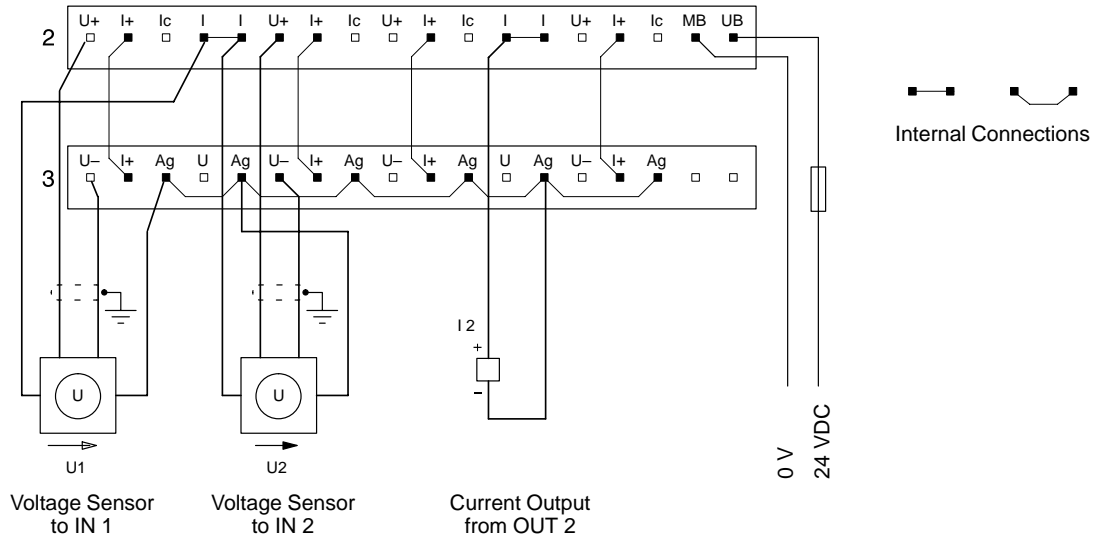


Ag = Analog ground (for 3-wire sensors only)  
 I+ = Current input from current sensor  
 U+ = Positive voltage input from voltage sensor  
 U- = Negative voltage input from voltage sensor



**Wiring Example: Combination of 3-Wire Sensor Inputs and 2-Wire Output**

IN 1			OUT 1		IN 2			IN 3			OUT 2		IN 4		
U+	I+	Ic	I	I	U+	I+	Ic	U+	I+	Ic	I	I	U+	I+	Ic
U-	I+	Ag	U	Ag	U-	I+	Ag	U-	I+	Ag	U	Ag	U-	I+	Ag
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16



- Ag = Analog ground
- I (OUT1) = Current output supply to input sensors 1 and 2
- U+ (IN1) = Positive voltage input from input sensor 1
- U- (IN1) = Negative voltage input from input sensor 1
- U+ (IN2) = Positive voltage input from input sensor 2
- U- (IN2) = Negative voltage input from input sensor 2
- I (OUT2) = Current output to output device

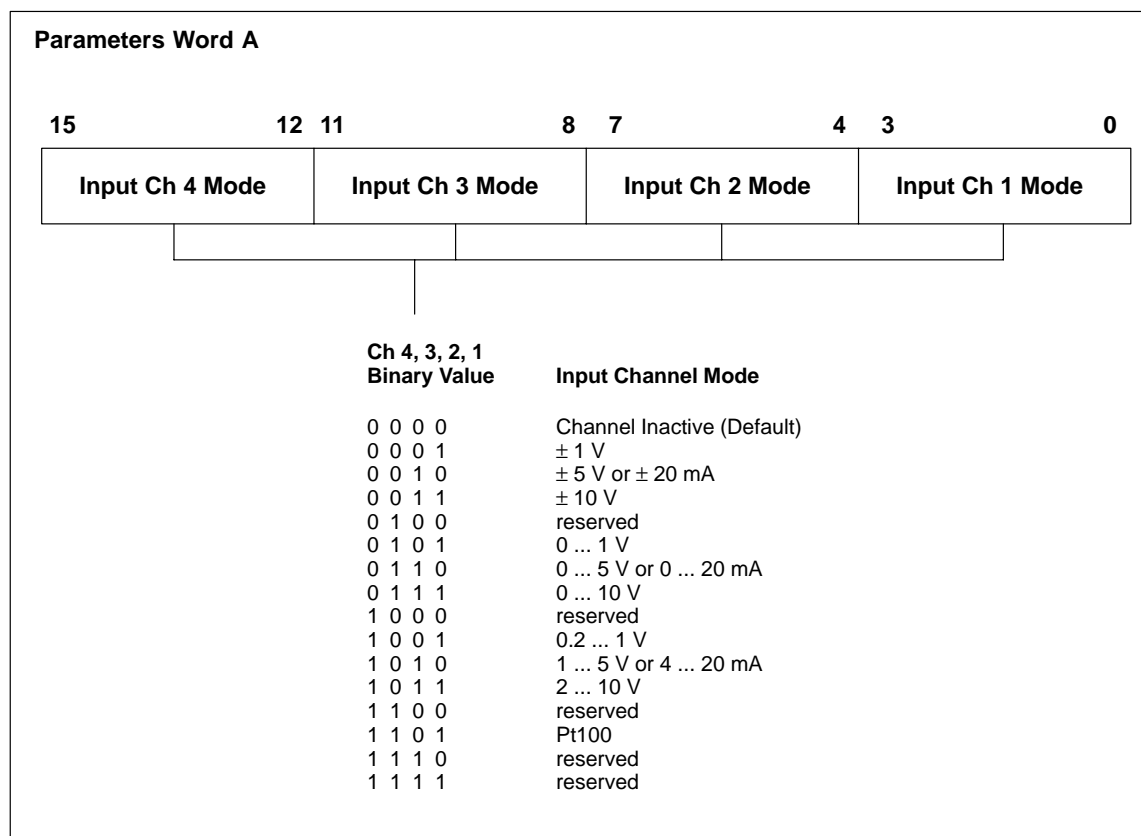
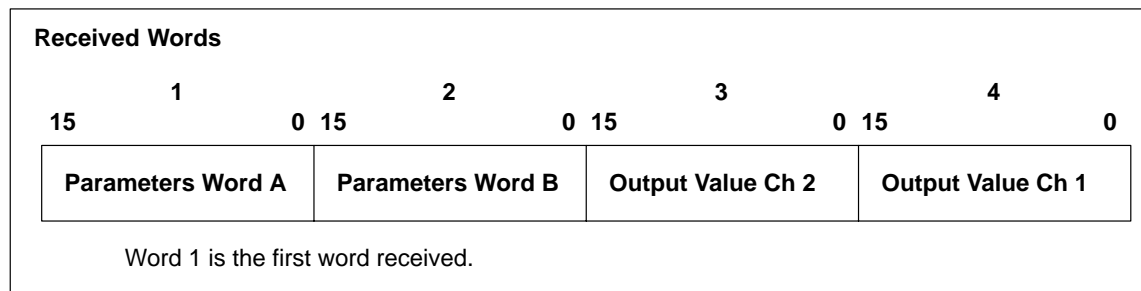
When using the I (OUT1) output to supply the voltage input sensors as in this example, the same output circuit cannot be used to drive an output device.

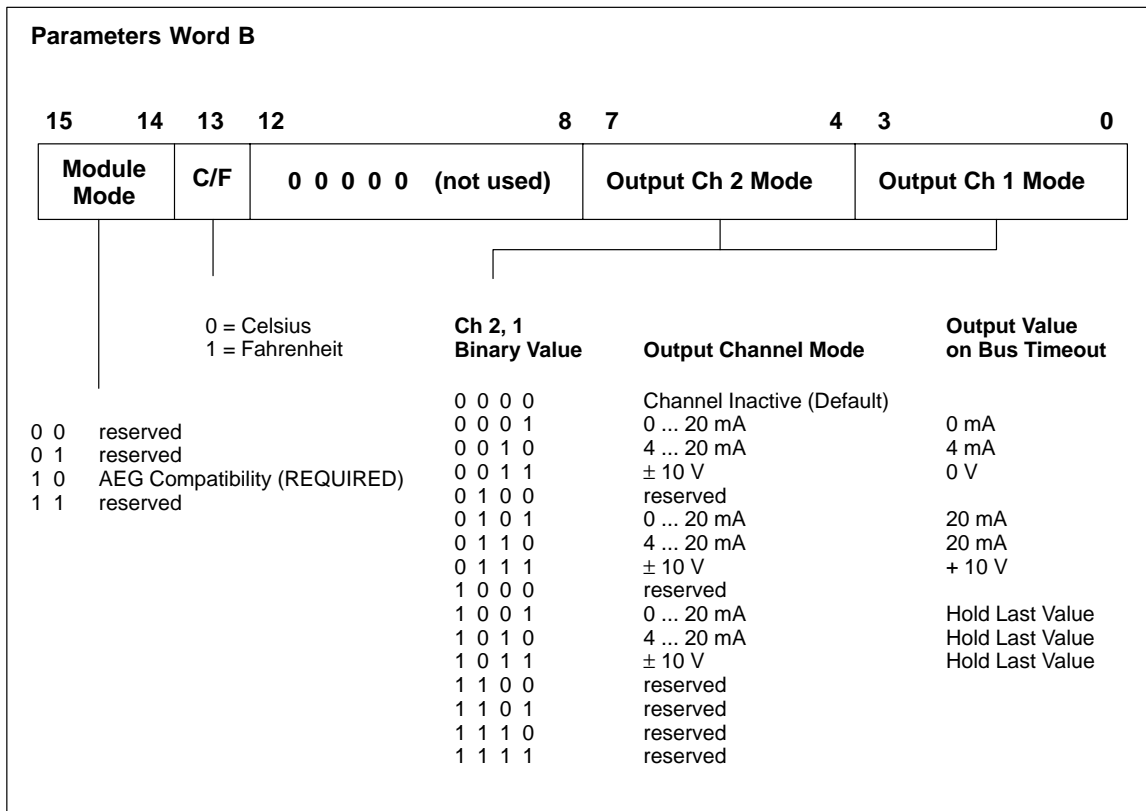
# Register Allocation

The module receives four 16-bit words from the InterBus-S network, and transmits four 16-bit words to the network.

## Received Words

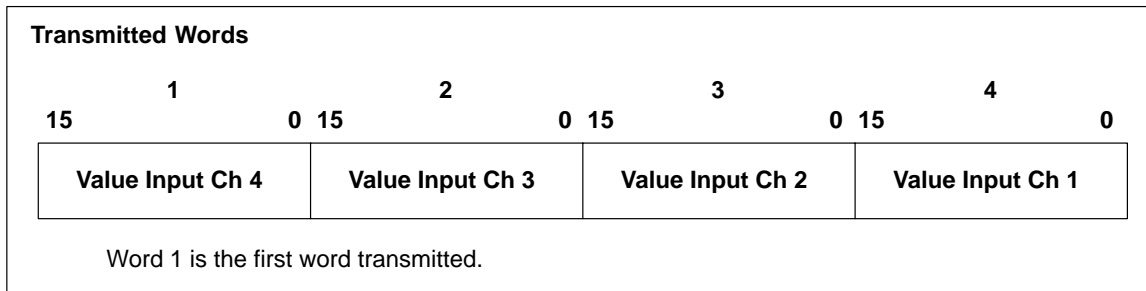
The first two received words specify control parameters for the module's input and output channels. The next two words specify the analog values for the two output channels.



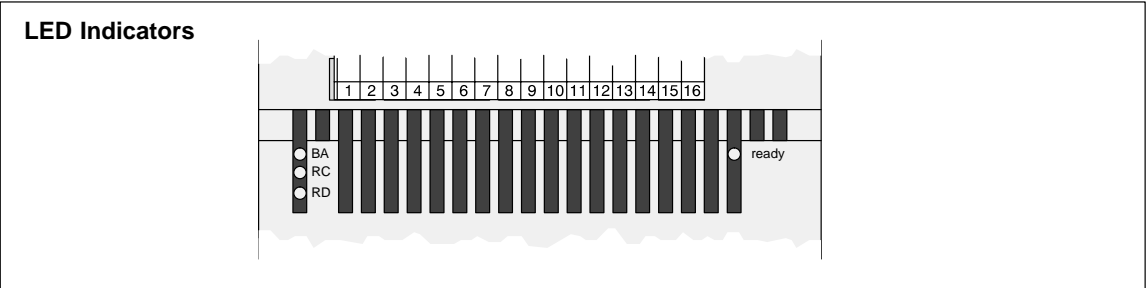


**Transmitted Words**

The four transmitted words contain the analog values for the signals received on the four input channels.



# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
BA	green	Bus Active. The module is transmitting data messages on the network.
	off	The module is not transmitting data messages on the network.
RC	green	Remote Bus Check. The module's incoming bus is connected correctly, and the bus master device is not sending a bus reset signal.
	off	The incoming bus is not connected correctly, or the bus master device is sending a bus reset signal.
RD	red	Remote Bus Disabled. The module's outgoing bus is disabled.
	off	The module's outgoing bus is enabled.

# Specifications

## General Specifications

<b>InterBus-S ID Code</b>	0433 hexadecimal
<b>Number of Channels</b>	4 input, 2 output
<b>Module Quiescent Current</b>	120 mA @ 20 ... 30 Vdc
<b>Power Dissipation</b>	6 W
<b>Isolation</b>	
Channel to Channel	None
Channel to Bus	500 Vdc
<b>Load Fault Detection</b>	None

## Input Specifications

<b>Voltage and Pt100 Input</b>	
Absolute Maximum Input	50 Vdc
Input Impedance	>20 M $\Omega$
<b>Current Input</b>	
Absolute Maximum Input	25 mA
Input Impedance	250 $\Omega$ $\pm$ 0.03%
<b>Accuracy @ 25°C (Voltage Mode)</b>	Typical: $\pm$ 0.2% of full scale Maximum: $\pm$ 0.35% of full scale
<b>Linearity</b>	$\pm$ 0.04 %
<b>Accuracy Drift w/Temperature</b>	Typical: $\pm$ 0.0025% of full scale / °C Maximum: $\pm$ 0.005% of full scale / °C
<b>Common Mode Rejection</b>	> -100 dB @ 50/60Hz
<b>Update Time</b>	270 ms for all channels (simultaneous update)
<b>Repeatability</b>	$\pm$ 3 counts

## Output Specifications

<b>Accuracy</b>	$\pm$ 0.5% of full scale @ 25 °C, $\pm$ 0.9% of full scale, 0 ... 60 °C
<b>Accuracy Drift w/Temperature</b>	
Unipolar Ranges	0.003% of full scale /°C typical 0.005% of full scale /°C max
Bipolar Ranges	0.006% of full scale /°C typical 0.013% of full scale /°C max
<b>Linearity</b>	$\pm$ 1 LSB
<b>Maximum Settling Time</b>	1 ms to $\pm$ 0.1% of the final value
<b>Update Time</b>	3 ms for all channels (simultaneous update)

## Input Ranges and Values

Input Range	Input Values (Decimal)	Conversion Factor and Resolution	Example (Value/Conversion = Input)
0 ... 1 V	0 ... + 32000	32000 / V (15 bits)	32000 / 32000 = 1 V
0 ... 5 V	0 ... + 32000	6400 / V (14 bits)	32000 / 6400 = 5 V
0 ... 10 V	0 ... + 32000	3200 / V (15 bits)	32000 / 3200 = 10 V
0.2 ... 1 V	0 ... + 32000	(40000 / V) + 0.2 (15 bits)	(32000 / 40000) + 0.2 = 1 V
1 ... 5 V	0 ... + 32000	(8000 / V) + 1 (14 bits)	(32000 / 8000) + 1 = 5 V
2 ... 10 V	0 ... + 32000	(4000 / V) + 2 (15 bits)	(32000 / 4000) + 2 = 10 V
+/- 1 V	- 32000 ... + 32000	32000 / V (15 bits)	+ 32000 / 32000 = + 1 V
+/- 5 V	- 32000 ... + 32000	6400 / V (14 bits)	+ 32000 / 6400 = + 5 V
+/- 10 V	- 32000 ... + 32000	3200 / V (15 bits)	+ 32000 / 3200 = + 10 V
0 ... 20 mA	0 ... + 32000	1600 / mA (14 bits)	32000 / 1600 = 20 mA
4 ... 20 mA	0 ... + 32000	(2000 / mA) + 4 (14 bits)	(32000 / 2000) + 4 = 20 mA
+/- 20 mA	- 32000 ... + 32000	1600 / mA (14 bits)	+32000 / 1600 = + 20 mA
Pt100 °F	- 3280 ... + 15620	10 / °F (14 bits)	+ 15620 / 10 = + 1562 °F
Pt100 °C	- 5000 ... + 21250	25 / °C (14 bits)	+ 21250 / 25 = + 850 °C

## Input Examples

0 ... 1 V	0 ... 5 V	0 ... 10 V	Value (Decimal)
- 0.004 V	- 0.02 V	- 0.04 V	- 128 (Underrange)
0 V	0 V	0 V	0
0.0005 V	0.0025 V	0.005 V	+ 16
1 V	5 V	10 V	+ 32000
1.0239 V	5.119 V	10.239 V	+ 32766 (Overrange)
0.2 ... 1 V	1 ... 5 V	2 ... 10 V	Value (Decimal)
0.1968 V	0.984 V	1.968 V	- 128 (Underrange)
0.2 V	1 V	2 V	0
0.2004 V	1.002 V	2.004 V	+ 16
1 V	5 V	10 V	+ 32000
1.019 V	5.095 V	10.19 V	+ 32766 (Overrange)
+/- 1 V	+/- 5 V	+/- 10 V	Value (Decimal)
- 1.0239 V	- 5.119 V	- 10.239 V	- 32766 (Underrange)
-1 V	- 5 V	- 10 V	- 32000
- 0.005 V	- 0.0025 V	- 0.005 V	- 16
0 V	0 V	0 V	0
0.005 V	0.0025 V	0.005 V	+ 16
1 V	5 V	10 V	+ 32000
1.0239 V	5.119 V	10.239 V	+ 32766 (Overrange)

0 ... 20 mA	4 ... 20 mA	+/- 20 mA	Value (Decimal)
...	...	-20.476 mA	- 32766 (Underrange)
...	...	- 20 mA	- 32000
...	...	- 0.01 mA	- 16
0 mA	4 mA	0 mA	0
0.01	4.008 mA	0.01 mA	+ 16
20 mA	20 mA	20 mA	+ 32000
20.476 mA	20.38 mA	20.476 mA	+ 32766 (Overrange)

Pt100 Fahrenheit	Value (Decimal)	Pt100 Celsius	Value (Decimal)
- 339 °F	- 3390 (Underrange)	- 206.6 °C	- 5165 (Underrange)
- 328 °F	- 3280	- 200 °C	- 5000
- 76 °F	- 760	- 60 °C	- 1500
- 0.1 °F	- 1	- 0.04 °C	- 1
0 °F	0	0 °C	0
0.1 °F	1	0.04 °C	+ 1
482 °F	4280	250 °C	+ 6250
1562 °F	15620	850 °C	+ 21250
1564 °F	15640 (Overrange)	851.2 °C	+ 21280 (Overrange)

## Output Ranges and Values

Output Range	Output Values (Decimal)	Conversion Factor and Resolution	Example (Value/Conversion = Output)
+/- 10 V	- 32000 ... + 32000	V / 3200 (12 bits)	+ 32000 / 32000 = + 10 V
0 ... 20 mA	0 ... + 32000	ma / 1600 (12 bits)	32000 / 1600 = 20 mA
4 ... 20 mA	0 ... + 32000	(ma / 2000) + 4 (12 bits)	(32000 / 2000) + 4 = 20 mA

## Output Examples

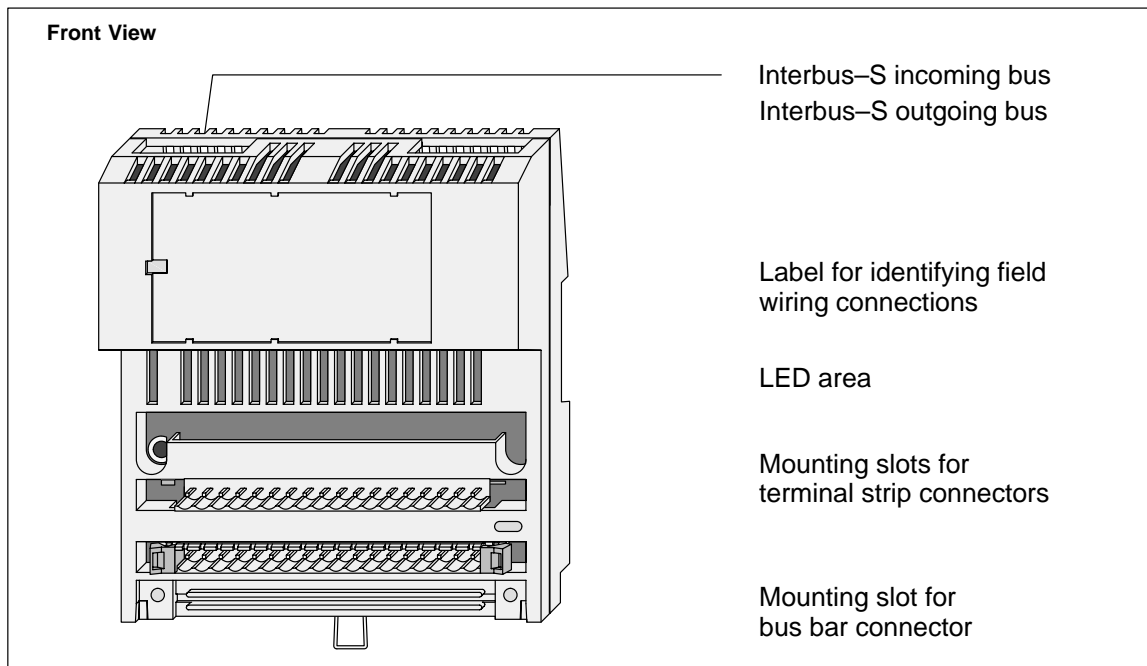
+/- 10 V	0 ... 20 mA	4 ... 20 mA	Value (Decimal)
- 10 V	...	...	- 32000
- 0.005 V	...	...	- 16
0 V	0 mA	4 mA	0
+ 0.005 V	0.01 mA	4.008 mA	+ 16
+ 10 V	20 mA	20 mA	+ 32000





# 170 BDI 346 00 Interbus-S TIO 24 VDC 16 Input Module

<b>Module Type</b>	16 discrete input points
<b>Nominal Input Voltage</b>	24 V dc
<b>Nominal Input Current, each point</b>	4.2 mA



# Field Wiring Connections

### Connecting Operating Voltages

#### Common Connections

Row 2: Terminals 1 ... 8 and 17 (UB1) are connected together within the module.

Row 2: Terminals 9 ... 16 and 18 (UB2) are connected together within the module.

Row 3: Terminals 1 ... 8 and 17 (M1) are connected together within the module.

Row 3: Terminals 9 ... 16 and 18 (M2) are connected together within the module.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 (PE) are connected together within the external bus bar. There is no connection to the module.

#### External Fuses

UB supply: 200 mA fast blow.

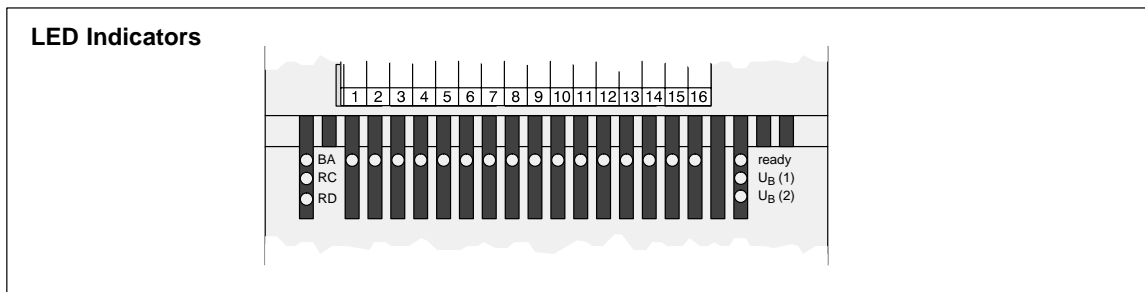
UB1 and UB2 supply: Select a fuse that meets the total supply requirement of the connected devices. The maximum allowable fuse rating is: 4 A fast blow.

### Connecting Field Devices

#### Labeling of Terminals

Row	Terminal	Connection
1	1 ... 16	I1 ... I16 Input points 1 ... 16
1	17	MB Module operating voltage return
1	18	UB Module operating voltage
2	17	UB1 Voltage for devices 1 ... 8
2	18	UB2 Voltage for devices 9 ... 16
3	17	M1 Voltage return, devices 1 ... 8
3	18	M2 Voltage return, devices 9 ... 16
4	18	PE Earth ground for field devices

# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
BA	green	Bus Active. The module is transmitting data messages on the network.
	off	The module is not transmitting data messages on the network.
RC	green	Remote Bus Check. The module's incoming bus is connected correctly, and the bus master device is not sending a bus reset signal.
	off	The incoming bus is not connected correctly, or the bus master device is sending a bus reset signal.
RD	red	Remote Bus Disabled. The module's outgoing bus is disabled.
	off	The module's outgoing bus is enabled.
UB(1)	green	UB1 voltage is present.
	off	UB1 voltage is not present. Check the UB1 source.
UB(2)	green	UB2 voltage is present.
	off	UB2 voltage is not present. Check the UB2 source.
1 ... 16	green	Input 1 ... 16 is active (input voltage high level).
	off	Input 1 ... 16 is not active (input voltage low level).

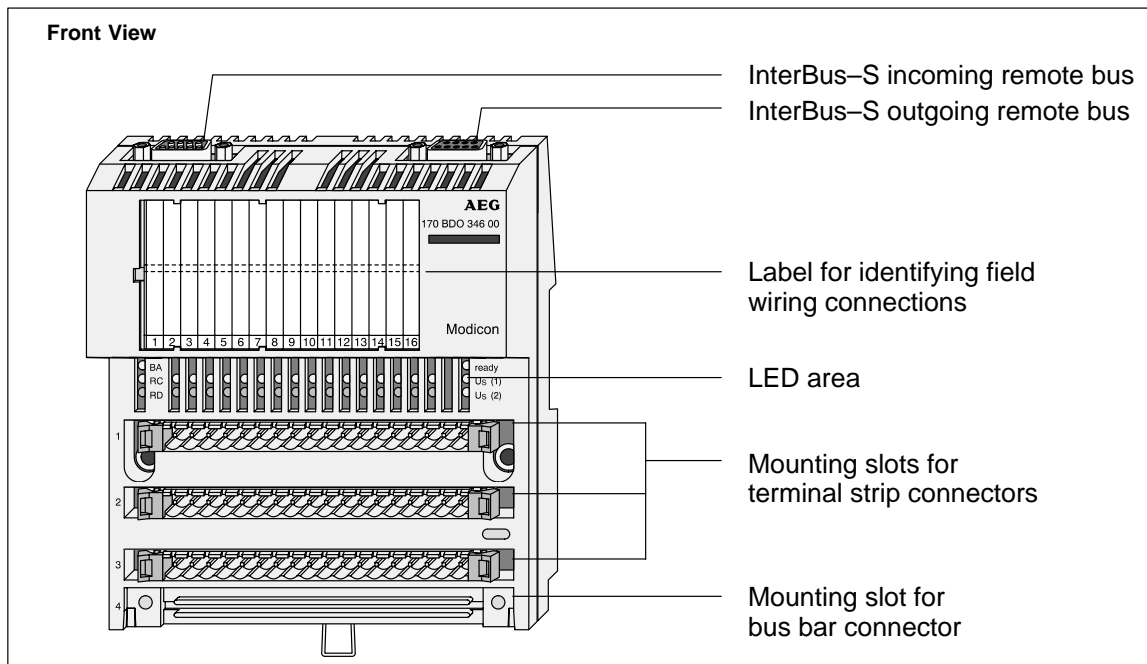
# Specifications

The **DC Input 24 Vdc 16-point Sink** module accepts 24 Vdc inputs and is for use with source output devices.

<b>Specifications</b>	
<b>InterBus-S ID Code</b>	0102 hexadecimal
<b>Number of Input Points</b>	16
<b>Module Quiescent Current</b>	100 mA @ 20 ... 30 Vdc
<b>Operating Voltages and Currents</b>	
Guaranteed ON (voltage)	+15 ... +30 Vdc
Guaranteed OFF (voltage)	-3 ... +5 Vdc
Guaranteed ON (current)	2.4 mA
Guaranteed OFF (current)	0.9 mA
<b>Absolute Maximum Input</b>	
Continuous	30 Vdc
1.3 ms	56 Vdc decaying pulse
<b>Response</b>	
OFF – ON	3 ms (max)
ON – OFF	3 ms (max)
<b>Internal Resistance</b>	5.6 k
<b>Input Protection</b>	Resistor limited
<b>Isolation</b>	
Group to Group	None
Group to Bus	500 Vac rms for 1 minute
<b>Fault Detection</b>	None
<b>Fusing</b>	
Internal	None
External	User discretion 4A max per group

# 170 BDO 346 00 InterBus-S TIO 24 VDC 16 Output Module

<b>Module Type</b>	16 discrete output points
<b>Nominal Output Voltage</b>	24 V dc
<b>Nominal Output Current, each point</b>	0.5 A



# Field Wiring Connections

### Connecting Operating Voltages

### Connecting Field Devices

### Common Connections

Row 3: Terminals 1 ... 18 (M2) are connected together within the module.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 (PE) are connected together within the external bus bar. There is no connection to the module.

### External Fuses

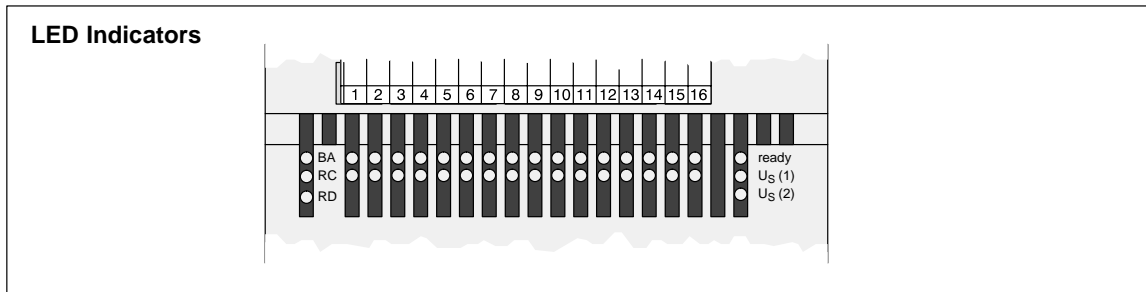
UB supply: 200 mA fast blow.

US1 and US2 supply: Select a fuse that meets the total supply requirement of the connected devices. The maximum allowable fuse rating is: 4 A fast blow.

### Labeling of Terminals

Row	Terminal	Connection
1	1 ... 16	Not used
1	17	MB Module operating voltage return
1	18	UB Module operating voltage
2	1 ... 8	O1 ... O8 Output points 1 ... 8
2	9 ... 16	O9 ... O16 Output points 9 ... 16
2	17	US1 Voltage for devices 1 ... 8
2	18	US2 Voltage for devices 9 ... 16
3	18	M2 Voltage return, devices 1 ... 16
4	18	PE Earth ground for field devices

# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
BA	green	Bus Active. The module is transmitting data messages on the network.
	off	The module is not transmitting data messages on the network.
RC	green	Remote Bus Check. The module's incoming bus is connected correctly, and the bus master device is not sending a bus reset signal.
	off	The incoming bus is not connected correctly, or the bus master device is sending a bus reset signal.
RD	red	Remote Bus Disabled. The module's outgoing bus is disabled.
	off	The module's outgoing bus is enabled.
US(1)	green	US1 voltage is present.
	off	US1 voltage is not present. Check the US1 source.
US(2)	green	US2 voltage is present.
	off	US2 voltage is not present. Check the US2 source.
1 ... 16 upper row	green	Output 1 ... 16 is active (output voltage high level).
	off	Output 1 ... 16 is not active (output voltage low level).
1 ... 16 lower row	red	Output 1 ... 16 has an error condition (overload or short circuit).
	off	Output 1 ... 16 is operating normally.

# Specifications

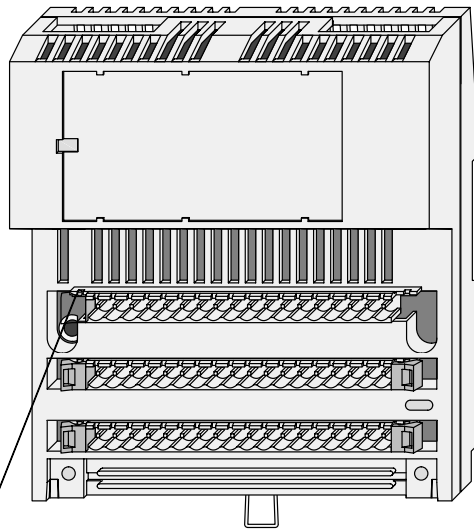
The **DC Output 24 Vdc 16-point** module switches 24 Vdc outputs and is for use with sink input devices.

<b>Specifications</b>	
<b>InterBus-S ID Code</b>	0101 hexadecimal
<b>Number of Output Points</b>	16
<b>Module Quiescent Current</b>	100 mA @ 20 ... 30 Vdc
<b>Voltage (Output)</b>	
Operating (max)	19.2 ... 30 Vdc
Absolute (max)	56 Vdc for 1.3 ms decaying voltage pulse
ON State Drop / Point	0.5 Vdc @ 0.5 A
<b>Maximum Load Current</b>	
Each Point	0.5 A
Each Group	4 A
Per Module	8 A
Off State Leakage / Point	0.4 mA @ 30 Vdc
<b>Maximum Surge Current</b>	
Each Point	5 A @ 500 $\mu$ s duration (no more than 6 per minute)
<b>Maximum Loading</b>	
Each Point	12 W @ 100 cycles/hr, resistive 12 W @ 1000 cycles/hr, inductive 1.2 W @ 10 cycles/hr, lamp
<b>Load Capacitance Maximum</b>	50 $\mu$ f
<b>Response Time</b>	
OFF – ON	1 ms (max)
ON – OFF	1 ms (max)
<b>Module Protection</b>	
Input Protection	Resistor limited
Output Protection	Electronically protected
<b>Isolation (Input and Output)</b>	
Group to Group	None
Group to Bus	500 V
<b>Fault Detection</b>	
Input	None
Output	Red LED indicator for each output
<b>Fusing</b>	
Input	<b>Internal</b> – None <b>External</b> – User discretion
Output	<b>Internal</b> – None, electronically protected <b>External</b> – User discretion



**170 BDM 346 00**  
**InterBus-S TIO**  
**24 VDC 16 Input / 16 Output Module**

<b>Module Type</b>	16 discrete input points, in 1 group 16 discrete output points, in 2 groups of 8 points
<b>Nominal Operating Voltage</b>	24 V dc
<b>Nominal Input Current, each point</b>	4.2 mA
<b>Maximum Output Current, each point</b>	0.5 A



# Field Wiring Connections

### Connecting Operating Voltages

**Common Connections**  
Row 3: Terminals 1 ... 18 (M) are connected together within the module.

**External Bus Bar Connections**  
Row 4, 5, and 6: Install an external 3-row bus bar at row 4, and use the bus bar terminals for UB1, M, and PE field wiring.

Use row 4 for UB1 wiring connections.  
Use row 5 for M wiring connections.  
Use row 6 for PE wiring connections.

Terminals 1 ... 18 are connected together within each bus bar.  
There are no internal connections to the module.

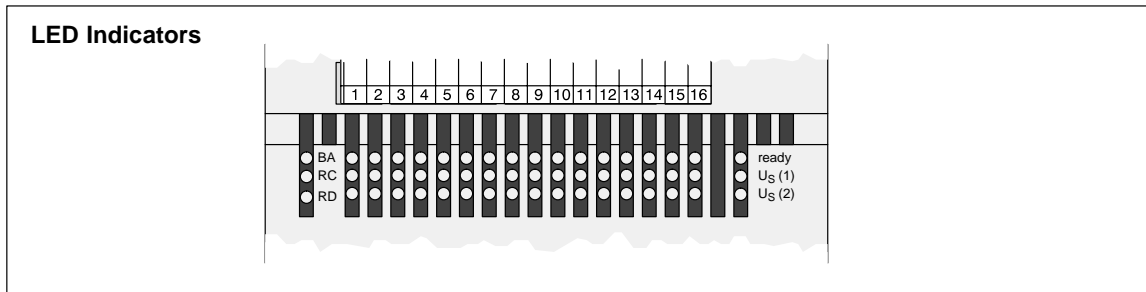
**External Fuses**  
UB supply: 200 mA fast blow.  
UB1, US1 and US2 supply: Select a fuse that meets the total supply requirement of the connected devices.  
The maximum allowable fuse rating is: 6.3 A fast blow.

### Connecting Field Devices

**Labeling of Terminals**

Row	Terminal	Connection
1	1 ... 16	I1 ... I16 Input points 1 ... 16
1	17	M Module operating voltage return
1	18	UB Module operating voltage
2	1 ... 8	O1 ... O8 Output points 1 ... 8 (group 1)
2	9 ... 16	O9 ... O16 Output points 9 ... 16 (group 2)
2	17	US1 Voltage for outputs 1 ... 8 (group 1)
2	18	US2 Voltage for outputs 9 ... 16 (group 2)
3	18	M Voltage return for field devices
4	18	UB1 Voltage for inputs 1 ... 16
5	18	M Voltage return for field devices
6	18	PE Earth ground for field devices

# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
BA	green	Bus Active. The module is transmitting data messages on the network.
	off	The module is not transmitting data messages on the network.
RC	green	Remote Bus Check. The module's incoming bus is connected correctly, and the bus master device is not sending a bus reset signal.
	off	The incoming bus is not connected correctly, or the bus master device is sending a bus reset signal.
RD	red	Remote Bus Disabled. The module's outgoing bus is disabled.
	off	The module's outgoing bus is enabled.
Us(1)	green	US1 voltage is present.
	off	US1 voltage is not present. Check the US1 source.
Us(2)	green	US2 voltage is present.
	off	US2 voltage is not present. Check the US2 source.
1 ... 16 upper row	green	Input 1 ... 16 is active (input voltage high level).
	off	Input 1 ... 16 is not active (input voltage low level).
1 ... 16 center row	green	Output 1 ... 16 is active (output voltage high level).
	off	Output 1 ... 16 is not active (output voltage low level).
1 ... 16 lower row	red	Output 1 ... 16 has an error condition (overload or short circuit).
	off	Output 1 ... 16 is operating normally.

## Specifications

The module's **DC Input 24 Vdc 1x16 Sink** inputs accept 24 V dc inputs for use with source output devices. The **DC Output 24 Vdc 2x8 Source** outputs switch 24 V dc for use with sink input devices.

### Specifications (General)

<b>InterBus-S ID Code</b>	0103 hexadecimal
<b>Module Quiescent Current</b>	100 mA @ 20 ... 30 Vdc
<b>Module Protection</b>	
Input Protection	Resistor limited
Output Protection	Electronically protected
<b>Isolation (Input and Output)</b>	
Group to Group	None
Group to Bus	500 Vac rms for 1 minute
<b>Fault Detection</b>	
Input	None
Output	Red LED indicator for each output – overcurrent and short circuit
<b>Fusing</b>	
Input	<b>Internal</b> – None <b>External</b> – User discretion
Output	<b>Internal</b> – None, electronically protected <b>External</b> – User discretion

### Specifications (Inputs)

<b>Number of Input Points</b>	16 in one group
<b>Operating Voltages and Currents</b>	
Guaranteed ON (voltage)	+15 ... +30 Vdc
Guaranteed OFF (voltage)	-3 ... +5 Vdc
Guaranteed ON (current)	2.4 mA
Guaranteed OFF (current)	0.9 mA
<b>Absolute Maximum Input</b>	
Continuous	30 Vdc
1.3 ms	56 Vdc decaying pulse
<b>Internal Resistance (Input)</b>	5.6 k
<b>Response (Input)</b>	
OFF – ON	3 ms max
ON – OFF	3 ms max

## Specifications (Outputs)

<b>Number of Output Points</b>	16 in two 8 point groups
<b>Voltage (Output)</b>	
Operating (max)	19.2 ... 30 Vdc
Absolute (max)	56 Vdc for 1.3 ms decaying voltage pulse
ON State Drop / Point	0.5 Vdc @ 0.5 A
<b>Maximum Load Current</b>	
Each Point	0.5 A
Each Group	4 A
Per Module	8 A
Off State Leakage / Point	0.4 mA @ 30 Vdc
<b>Maximum Surge Current</b>	
Each Point	5 A @ 500 $\mu$ s duration (no more than 6 per minute)
<b>Maximum Loading</b>	
Each Point	12 W @ 100 cycles/s, resistive 12 W @ 1000 cycles/h, inductive 1.2 W @ 8 cycles/s, lamp
<b>Load Capacitance Maximum</b>	50 $\mu$ f
<b>Response (Output)</b>	
OFF – ON	1 ms max (resistive load)
ON – OFF	1 ms max (resistive load)

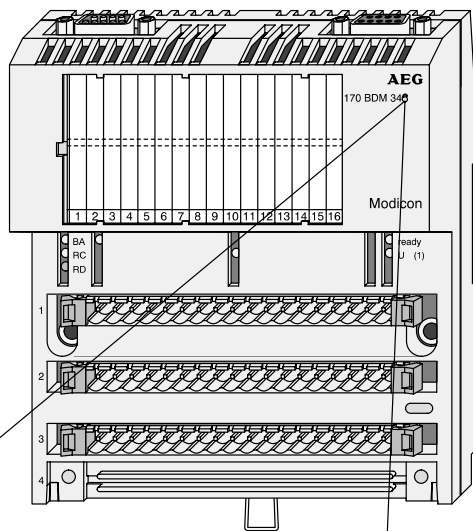


# 170 BDM 346 30

## InterBus-S TIO

### 24 VDC 8 Input / 24 ... 230 VAC/DC 8 Relay Output Module

<b>Module Type</b>	8 discrete input points, in 1 group 8 relay output points, in 2 groups of 4 points
<b>Nominal Operating Voltage</b>	24 V dc
<b>Nominal Input Current, each point</b>	4.2 mA at 24 V dc
<b>Maximum Output Current, each point</b>	2.0 A at 24 ... 230 V ac/dc



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# Field Wiring Connections

### Connecting Operating Voltages

### Connecting Field Devices

### Common Connections

Row 1 terminal 15 (M1) and Row 3 terminals 1 ... 8 are connected together within the module.

Row 1 terminal 16 (UB1) and Row 2 terminals 1 ... 8 are connected together within the module.

Row 3: Terminals 9 ... 12 and 17 (M3/N3) are connected together within the module.

Row 3: Terminals 13 ... 16 and 18 (M4/N4) are connected together within the module.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 (PE) are connected together within the external bus bar. There is no connection to the module.

### External Fuses

UB supply: 200 mA fast blow.

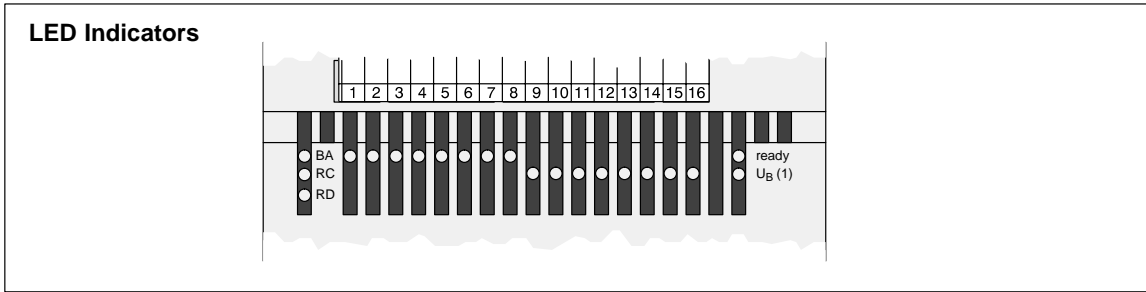
US3/L3, US4/L4 supplies: Select a fuse that meets the total supply requirement of the connected devices. The maximum allowable fuse rating is: 8 A fast blow.

### Labeling of Terminals

Row	Terminal	Connection
1	1 ... 8	I1 ... I8 Input points 1 ... 8
1	15	M1 Voltage return for input devices
1	16	UB1 Voltage for input devices
1	17	M Module operating voltage return
1	18	UB Module operating voltage
2	1 ... 8	UB1 Voltage for input devices
2	9 ... 12	O1 ... O4 Relay output points 1 ... 4
2	13 ... 16	O5 ... O8 Relay output points 5 ... 8
2	17	US3/L3 DC/AC voltage for relay outputs 1 ... 4
2	18	US4/L4 DC/AC voltage for relay outputs 5 ... 8
3	1 ... 8	M1 Voltage return for input devices
3	17	M3/L3 DC/AC voltage return for outputs 1 ... 4
3	18	M4/L4 DC/AC voltage return for outputs 5 ... 8
4	18	PE Earth ground for field devices



# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
BA	green	Bus Active. The module is transmitting data messages on the network.
	off	The module is not transmitting data messages on the network.
RC	green	Remote Bus Check. The module's incoming bus is connected correctly, and the bus master device is not sending a bus reset signal.
	off	The incoming bus is not connected correctly, or the bus master device is sending a bus reset signal.
RD	red	Remote Bus Disabled. The module's outgoing bus is disabled.
	off	The module's outgoing bus is enabled.
U <sub>B</sub> (1)	green	UB1 voltage is present.
	off	UB1 voltage is not present. Check the UB1 source.
1 ... 8 upper row	green	Input 1 ... 18 is active (input voltage high level).
	off	Input 1 ... 18 is not active (input voltage low level).
9 ... 16 lower row	green	Output 9 ... 16 is active (output voltage high level).
	off	Output 9 ... 16 is not active (output voltage low level).

# Specifications

The **DC Input 24 Vdc Sink 1x8 / Relay Output Normally Open 2x4** module provides 24 Vdc sink inputs for use with source output devices, and provides normally-open Relay contacts for devices with up to 2.0 A loads.

## Specifications (General)

<b>InterBus-S ID Code</b>	0103 hexadecimal
<b>Module Quiescent Current</b>	100 mA @ 20 ... 30 Vdc
<b>Fusing</b>	
Internal	None
External	User discretion
<b>Fault Detection</b>	None

## Specifications (Inputs)

<b>Number of Input Points</b>	8 in one group
<b>Operating Voltages and Currents</b>	
Guaranteed ON (voltage)	+15 ... +30 Vdc
Guaranteed OFF (voltage)	-3 ... +5 Vdc
Guaranteed ON (current)	2.4 mA
Guaranteed OFF (current)	0.9 mA
<b>Absolute Maximum Input</b>	
Continuous	30 Vdc
1.3 ms	56 Vdc decaying pulse
<b>Response</b>	
OFF – ON	3 ms (max)
ON – OFF	3 ms (max)
<b>Internal Resistance</b>	5.6 k
<b>Input Protection</b>	Resistor limited
<b>Isolation</b>	
Group to Group	50 Vdc
Group to Bus	500 Vdc

## Specifications (Outputs)

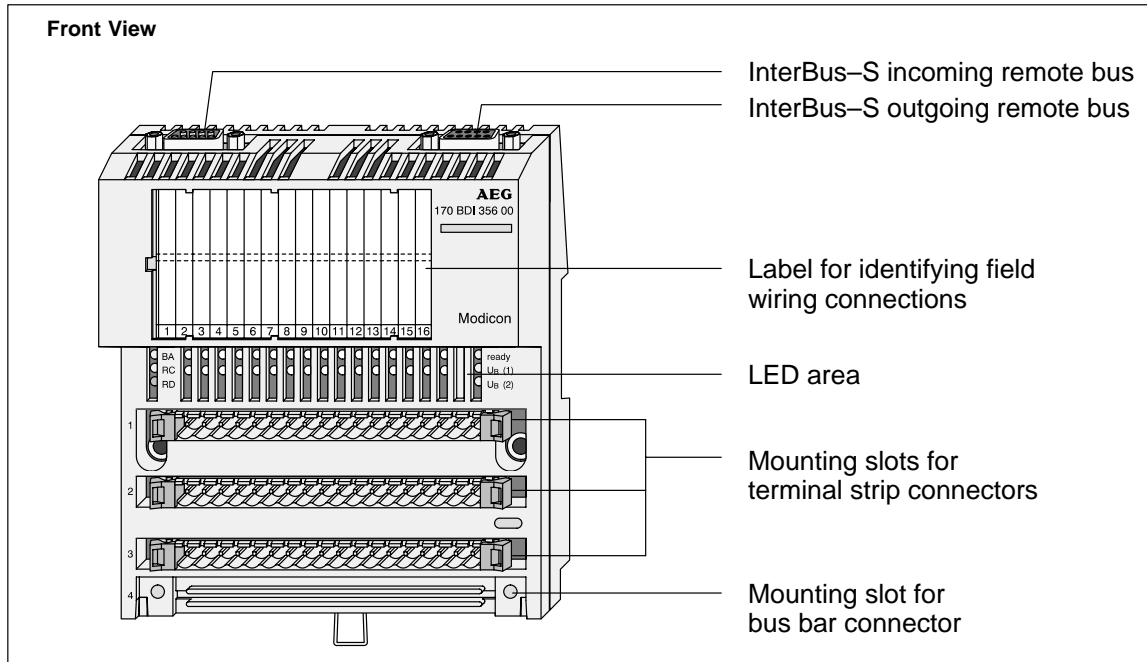
<b>Number of Output Points</b>	8 normally open relay contacts
<b>Voltage</b>	
Working	20 ... 250 Vac 5 ... 30 Vdc
<b>Maximum Load Current</b>	
Each Point	2 A max, at 250 Vac or 30 Vdc @ 60°C ambient resistive load
	1 A Tungsten lamp load
	1 A @ a power factor of 0.4
	1/8 hp @ 125/250 Vac
<b>Minimum Load Current</b>	100 mA
<b>Response</b>	
OFF – ON	10 ms max
ON – OFF	20 ms max

<b>Relay Contact Life</b>	
Mechanical Operations	10,000,000
Electrical Operations	200,000 (Resistive load @ max voltage and current)
<b>Relay Type</b>	Form A
<b>Contact Protection</b>	None
<b>Isolation</b>	
Channel to Channel	1780 Vac rms for one minute
Field to Bus	1780 Vac rms for one minute 2500 Vdc for one minute



# 170 BDI 356 00 Interbus-S TIO 24 VDC 32 Input Module

Module Type	32 discrete input points
Nominal Input Voltage	24 V dc
Nominal Input Current, each point	4.2 mA



# Field Wiring Connections

### Connecting Operating Voltages

#### Common Connections

Row 2 and 3: Row 2 terminal 17 (UB1) is connected internally to Row 3 Terminals 1 ... 16 (UB1) within the module.

#### External Bus Bar Connections

Row 4, 5, and 6: Install an external 3-row bus bar at row 4, and use the bus bar terminals for UB2, M2, and PE field wiring. Terminals 1 ... 18 are connected together within each bus bar. There are no internal connections to the module.

Use row 4 for UB2 wiring connections.  
Use row 5 for M2 wiring connections.  
Use row 6 for PE wiring connections.

#### External Fuses

UB supply: 200 mA fast blow.

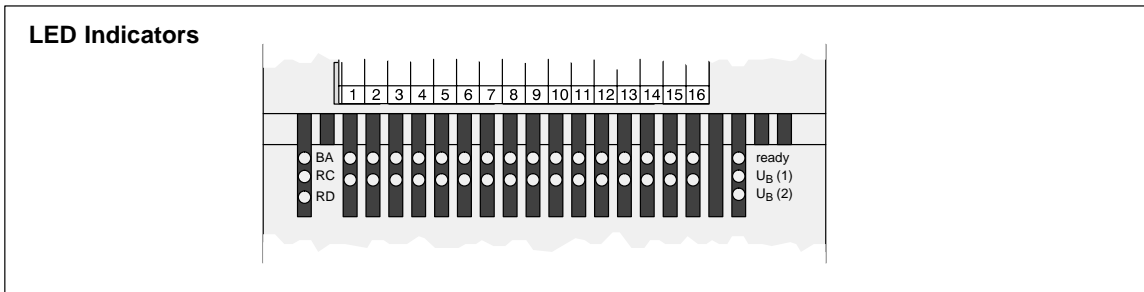
UB1 and UB2 supply: Select a fuse that meets the total supply requirement of the connected devices.  
The maximum allowable fuse rating is: 4 A fast blow.

### Connecting Field Devices

#### Labeling of Terminals

Row	Terminal	Connection
1	1 ... 16	I1 ... I16 Input points 1 ... 16
1	17	M2 Module and devices voltage return
1	18	UB Module operating voltage
2	1 ... 16	I17 ... I32 Input points 17 ... 32
2	17	UB1 Voltage for devices 1 ... 16
2	18	UB2 Voltage for devices 17 ... 32
3	17, 18	M2 Module and devices voltage return
4	1 ... 18	UB2 External bus bar — UB2 wiring
5	1 ... 18	M2 External bus bar — M2 wiring
6	1 ... 18	PE External bus bar — Earth ground

# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
BA	green	Bus Active. The module is transmitting data messages on the network.
	off	The module is not transmitting data messages on the network.
RC	green	Remote Bus Check. The module's incoming bus is connected correctly, and the bus master device is not sending a bus reset signal.
	off	The incoming bus is not connected correctly, or the bus master device is sending a bus reset signal.
RD	red	Remote Bus Disabled. The module's outgoing bus is disabled.
	off	The module's outgoing bus is enabled.
UB(1)	green	UB1 voltage is present.
	off	UB1 voltage is not present. Check the UB1 source.
UB(2)	green	UB2 voltage is present.
	off	UB2 voltage is not present. Check the UB2 source.
1 ... 16 Upper row	green	Input 1 ... 16 is active (input voltage high level).
	off	Input 1 ... 16 is not active (input voltage low level).
1 ... 16 Lower row	green	Input 17 ... 32 is active (input voltage high level).
	off	Input 17 ... 32 is not active (input voltage low level).

# Specifications

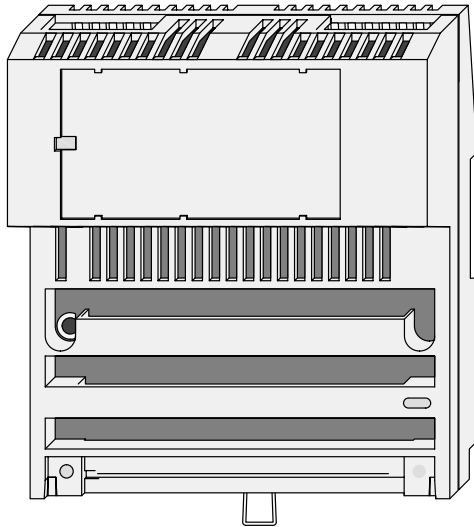
The **DC Input 24 Vdc 32-point Sink** module accepts 24 Vdc inputs and is for use with source output devices.

<b>Specifications</b>	
<b>InterBus-S ID Code</b>	0202 hexadecimal
<b>Number of Input Points</b>	32
<b>Module Quiescent Current</b>	100 mA @ 20 ... 30 Vdc
<b>Operating Voltages and Currents</b>	
Guaranteed ON (voltage)	+15 ... +30 Vdc
Guaranteed OFF (voltage)	-3 ... +5 Vdc
Guaranteed ON (current)	2.4 mA
Guaranteed OFF (current)	0.9 mA
<b>Absolute Maximum Input</b>	
Continuous	30 Vdc
1.3 ms	56 Vdc decaying pulse
<b>Response</b>	
OFF – ON	3 ms (max)
ON – OFF	3 ms (max)
<b>Internal Resistance</b>	5.6 k
<b>Input Protection</b>	Resistor limited
<b>Isolation</b>	
Group to Group	None
Group to Bus	500 Vac rms for 1 minute
<b>Fault Detection</b>	None
<b>Fusing</b>	
Internal	None
External	User discretion, 4A max



**170 BDO 356 00**  
**InterBus-S TIO**  
**24 VDC 32 Output Module**

<b>Module Type</b>	32 discrete output points, in 2 groups of 16 points
<b>Nominal Output Voltage</b>	24 V dc
<b>Nominal Output Current, each point</b>	0.5 A



# Field Wiring Connections

### Connecting Operating Voltages

### Connecting Field Devices

### Common Connections

Row 3: Terminals 1 ... 18 (M2) are connected together within the module.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 (PE) are connected together within the external bus bar. There is no connection to the module.

### Labeling of Terminals

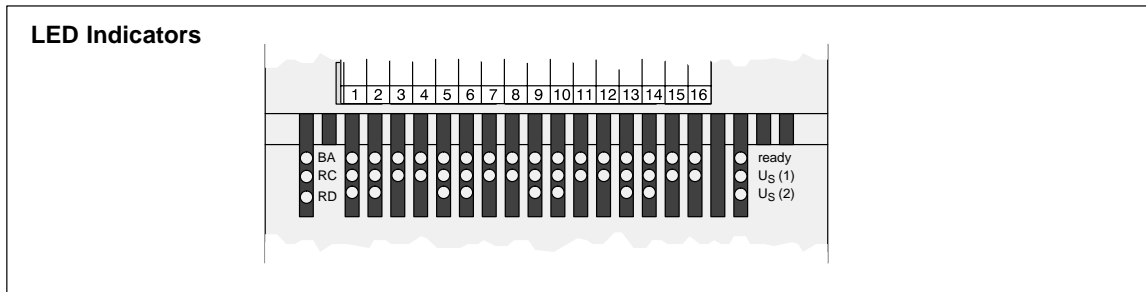
Row	Terminal	Connection
1	1 ... 16	O1 ... O16 Output points 1 ... 16 (group 1)
1	17	M Module operating voltage return
1	18	UB Module operating voltage
2	1 ... 16	O17 ... O32 Output points 17 ... 32 (group 2)
2	17	US1 Voltage for devices 1 ... 16 (group 1)
2	18	US2 Voltage for devices 17 ... 32 (group 2)
3	18	M2 Voltage return, devices 1 ... 32
4	18	PE Earth ground for field devices

### External Fuses

UB supply: 200 mA fast blow.

US1 and US2 supply: Select a fuse that meets the total supply requirement of the connected devices. The maximum allowable fuse rating is: 4 A fast blow.

# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
BA	green	Bus Active. The module is transmitting data messages on the network.
	off	The module is not transmitting data messages on the network.
RC	green	Remote Bus Check. The module's incoming bus is connected correctly, and the bus master device is not sending a bus reset signal.
	off	The incoming bus is not connected correctly, or the bus master device is sending a bus reset signal.
RD	red	Remote Bus Disabled. The module's outgoing bus is disabled.
	off	The module's outgoing bus is enabled.
US(1)	green	US1 voltage is present.
	off	US1 voltage is not present. Check the US1 source.
US(2)	green	US2 voltage is present.
	off	US2 voltage is not present. Check the US2 source.
1 ... 16 upper row	green	Terminal Row 1 Output 1 ... 16 is active (output voltage high level).
	off	Terminal Row 1 Output 1 ... 16 is not active (output voltage low level).
1 ... 16 center row	green	Terminal Row 2 Output 1 ... 16 is active (output voltage high level).
	off	Terminal Row 2 Output 1 ... 16 is not active (output voltage low level).
1, 5, 9 13 lower row	red	Error condition (overload or short circuit) in Terminal Row 1 Output Group: 1: Outputs 1 ... 4; 5: Outputs 5 ... 8; 9: Outputs 9 ... 12; 13: Outputs 13 ... 16.
	off	Terminal Row 1 Output Group is operating normally.
2, 6, 10 14 lower row	red	Error condition (overload or short circuit) in Terminal Row 2 Output Group: 1: Outputs 1 ... 4; 5: Outputs 5 ... 8; 9: Outputs 9 ... 12; 13: Outputs 13 ... 16.
	off	Terminal Row 2 Output Group is operating normally.

# Specifications

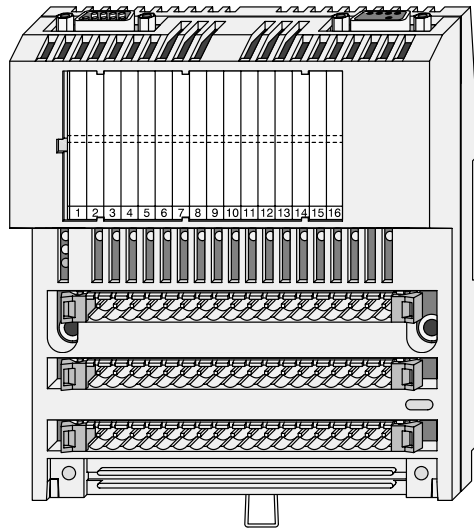
The **DC Output 24 Vdc 2x16 Source** module switches 24 Vdc powered loads and is for use with sink devices.

## Specifications

<b>InterBus-S ID Code</b>	0201 hexadecimal
<b>Number of Output Points</b>	32 in two 16 point groups
<b>Module Quiescent Current</b>	100 mA @ 20 ... 30 Vdc
<b>Output Voltage</b>	
Operating (max)	19.2 ... 30 Vdc
Absolute (max)	56 Vdc for 1.3 ms decaying voltage pulse
ON State Drop / Point	0.4 Vdc @ 0.5 A
<b>Maximum Load Current</b>	
Each Point	0.5 A
Each Group	8 A
Per Module	16 A
Off State Leakage / Point	0.4 mA @ 30 Vdc
<b>Surge Current Maximum</b>	
Each Point	5 A @ 500 $\mu$ s duration (no more than 6 per minute)
<b>Response (Resistive Loads)</b>	
OFF – ON	1 ms (max)
ON – OFF	1 ms (max)
<b>Output Protection (internal)</b>	Transient voltage suppression
<b>Maximum Loading</b>	
Each Point	12 W @ 100 cycles/s, resistive 12 W @ 1000 cycles/h, inductive 1.2 W @ 8 cycles/s, lamp
<b>Load Capacitance Maximum</b>	50 $\mu$ f
<b>Isolation</b>	
Group to Group	30 V
Output to Bus	500 V
<b>Fault Detection</b>	Red LED indicator for each output
<b>Fusing</b>	
Internal	None
External	User discretion

**170 BDI 546 50**  
**InterBus-S TIO**  
**115 VAC 16 Input Module**

<b>Module Type</b>	16 discrete input points, in 2 groups of 8 points
<b>Nominal Input Voltage</b>	115 V ac
<b>Nominal Input Current, each point</b>	10 mA



# Field Wiring Connections

### Connecting Operating Voltages

**Common Connections**

Row 2: Terminals 1 ... 8 and 17 (US1) are connected together within the module.

Row 2: Terminals 9 ... 16 and 18 (US2) are connected together within the module.

Row 3: Terminals 1 ... 8 and 17 (MS1) are connected together within the module.

Row 3: Terminals 9 ... 16 and 18 (MS2) are connected together within the module.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 (PE) are connected together within the external bus bar. There is no connection to the module.

**External Fuses**

L supply: 100 mA fast blow.

US1 and US2 supply: Select a fuse that meets the total supply requirement of the connected devices. The maximum allowable fuse rating is: 4 A fast blow.

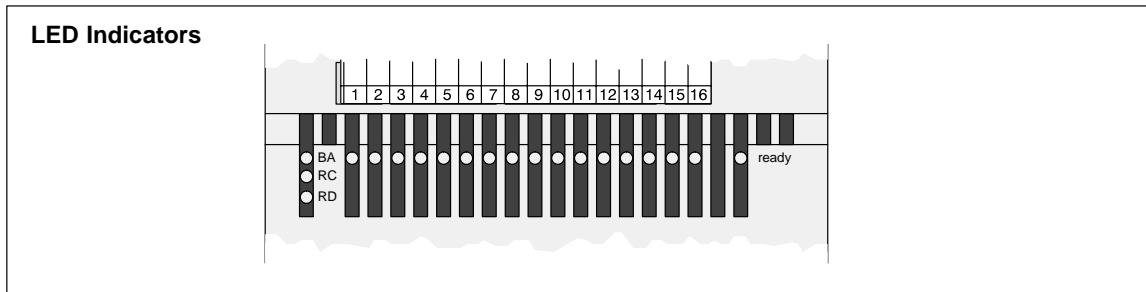
### Connecting Field Devices

**Labeling of Terminals**

Row	Terminal	Connection
1	1 ... 8	I1 ... I8 Input points 1 ... 8 (group 1)
1	9 ... 16	I9 ... I16 Input points 9 ... 16 (group 2)
1	17	N Module operating voltage, Neutral
1	18	L Module operating voltage, Line
2	17	US1 Voltage for devices 1 ... 8 (group 1)
2	18	US2 Voltage for devices 9 ... 16 (group 2)
3	17	MS1 Voltage return for 1 ... 8 (group 1)
3	18	MS2 Voltage return for 9 ... 16 (group 2)
4	18	PE Earth ground for field devices

Power ground

# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
BA	green	Bus Active. The module is transmitting data messages on the network.
	off	The module is not transmitting data messages on the network.
RC	green	Remote Bus Check. The module's incoming bus is connected correctly, and the bus master device is not sending a bus reset signal.
	off	The incoming bus is not connected correctly, or the bus master device is sending a bus reset signal.
RD	red	Remote Bus Disabled. The module's outgoing bus is disabled.
	off	The module's outgoing bus is enabled.
1 ... 16	green	Input 1 ... 16 is active (input voltage high level).
	off	Input 1 ... 16 is not active (input voltage low level).

# Specifications

The **AC Input 115 Vac 2x8** module accepts 115 Vac inputs.

<b>Specifications</b>	
<b>InterBus-S ID Code</b>	0102 hexadecimal
<b>Number of Input Points</b>	16 in two 8 point groups
<b>Module Quiescent Current</b>	40 mA @ 85 ... 264.5 Vac
<b>Input Voltage and Currents Ranges</b>	
Voltage	Guaranteed ON: 74 Vac Guaranteed OFF: 20 Vac
Current	Guaranteed ON: 10 mA Guaranteed OFF: 2 mA
<b>Input Frequency</b>	47 ... 63 Hz
<b>Absolute Maximum Input</b>	
Continuous	132 Vac
10 s	156 Vac
1 cycle	200 Vac
1.3 ms	276 Vac
<b>Response</b>	
OFF – ON	Min: 4.9 ms Max: 0.75 line cycle
ON – OFF	Min: 7.3 ms Max: 12.3 ms
<b>Isolation</b>	
Input to Input	All inputs in a group must be from the same phase of line input voltage
Group to Group	1780 Vac rms for 1 minute
Input to Bus	1780 Vac rms for 1 minute
<b>Fault Detection</b>	None
<b>Fusing</b>	
Internal	None
External	User discretion

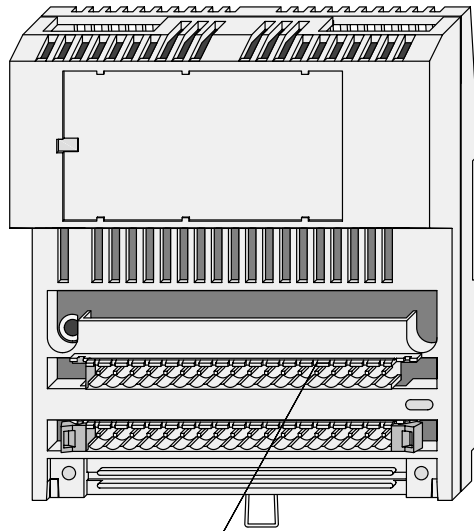


**Note:** Input signals must be sinusoidal with less than 6% THD.



**170 BDI 746 50**  
**InterBus-S TIO**  
**230 VAC 16 Input Module**

<b>Module Type</b>	16 discrete input points, in 2 groups of 8 points
<b>Nominal Input Voltage</b>	230 V ac
<b>Nominal Input Current, each point</b>	6 mA



# Field Wiring Connections

### Connecting Operating Voltages

**Common Connections**

Row 2: Terminals 1 ... 8 and 17 (US1) are connected together within the module.

Row 2: Terminals 9 ... 16 and 18 (US2) are connected together within the module.

Row 3: Terminals 1 ... 8 and 17 (MS1) are connected together within the module.

Row 3: Terminals 9 ... 16 and 18 (MS2) are connected together within the module.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 (PE) are connected together within the external bus bar. There is no connection to the module.

**External Fuses**

L supply: 100 mA fast blow.

US1 and US2 supply: Select a fuse that meets the total supply requirement of the connected devices. The maximum allowable fuse rating is: 4 A fast blow.

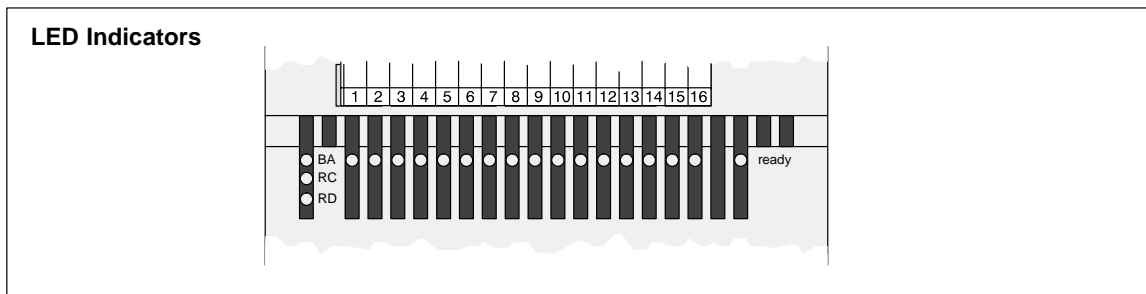
### Connecting Field Devices

**Labeling of Terminals**

Row	Terminal	Connection
1	1 ... 8	I1 ... I8 Input points 1 ... 8 (group 1)
1	9 ... 16	I9 ... I16 Input points 9 ... 16 (group 2)
1	17	N Module operating voltage, Neutral
1	18	L Module operating voltage, Line
2	17	US1 Voltage for devices 1 ... 8 (group 1)
2	18	US2 Voltage for devices 9 ... 16 (group 2)
3	17	MS1 Voltage return for 1 ... 8 (group 1)
3	18	MS2 Voltage return for 9 ... 16 (group 2)
4	18	PE Earth ground for field devices

⊕  
Power ground

# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
BA	green	Bus Active. The module is transmitting data messages on the network.
	off	The module is not transmitting data messages on the network.
RC	green	Remote Bus Check. The module's incoming bus is connected correctly, and the bus master device is not sending a bus reset signal.
	off	The incoming bus is not connected correctly, or the bus master device is sending a bus reset signal.
RD	red	Remote Bus Disabled. The module's outgoing bus is disabled.
	off	The module's outgoing bus is enabled.
1 ... 16	green	Input 1 ... 16 is active (input voltage high level).
	off	Input 1 ... 16 is not active (input voltage low level).

# Specifications

The **AC Input 230 Vac 2x8** module accepts 230 Vac inputs.

<b>Specifications</b>	
<b>InterBus-S ID Code</b>	0102 hexadecimal
<b>Number of Input Points</b>	16 in two 8 point groups
<b>Module Quiescent Current</b>	25 mA @ 170 ... 264.5 Vac
<b>Input Voltage and Currents Ranges</b>	
Voltage	Guaranteed ON: 170 Vac Guaranteed OFF: 40 Vac
Current	Guaranteed ON: 3 mA Guaranteed OFF: 2 mA
<b>Input Frequency</b>	47 ... 63 Hz
<b>Absolute Maximum Input</b>	
Continuous	264 Vac
10 s	300 Vac
1 cycle	400 Vac
<b>Response</b>	
OFF – ON	Max: 0.75 line cycle
ON – OFF	Max: 1 line cycle
<b>Isolation</b>	
Input to Input	1780 Vac rms for 1 minute
Group to Group	1780 Vac rms for 1 minute
Input to Bus	1780 Vac rms for 1 minute
<b>Fault Detection</b>	None
<b>Fusing</b>	
Internal	None
External	User discretion

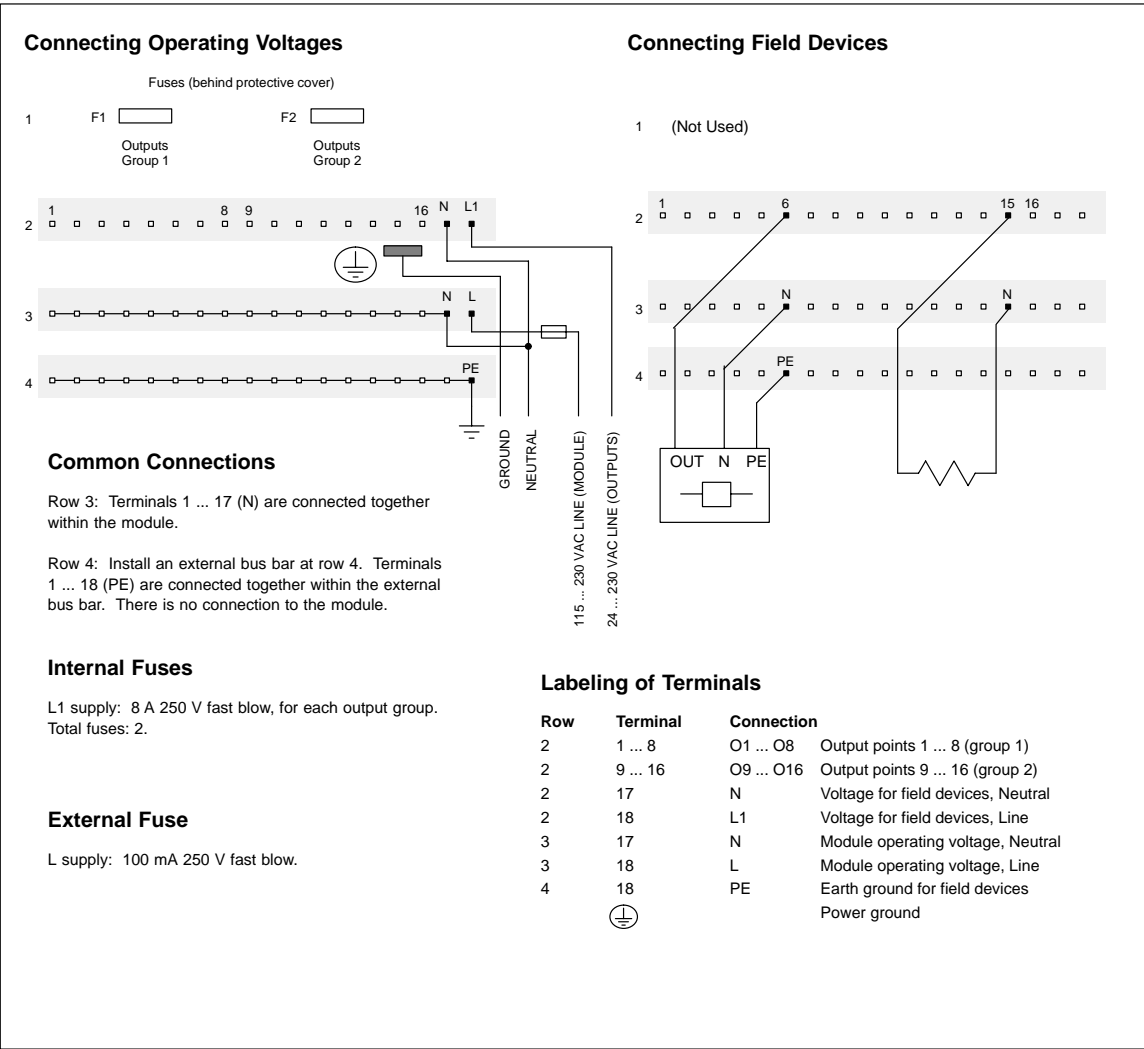


**Note:** Input signals must be sinusoidal with less than 6% THD.

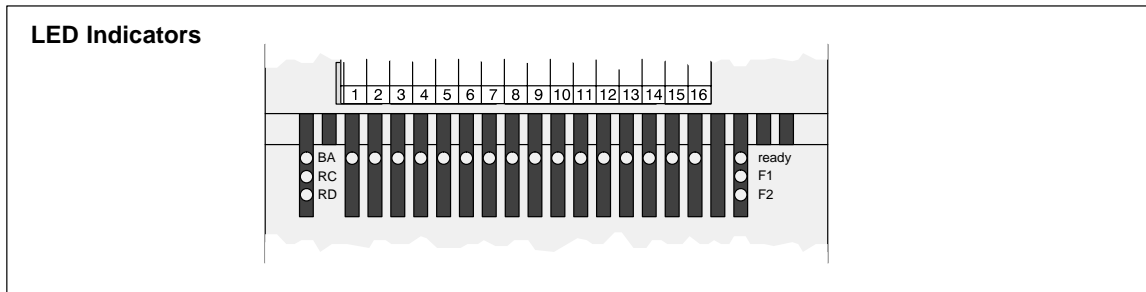
**170 BDO 946 50**  
**InterBus-S TIO**  
**115 ... 230 VAC 16 Output Module**

<b>Module Type</b>	16 discrete output points, in 2 groups of 8 points
<b>Nominal Output Voltage</b>	115 ... 230 V ac
<b>Maximum Output Current, each point</b>	0.5 A rms

# Field Wiring Connections



# LED Indicators



LED	Status	Meaning
ready	green	The module is ready to communicate on the network.
	off	The module is not ready. Check the UB voltage source.
F1	green	Fuse F1 (group 1 outputs) is OK.
	off	Fuse F1 is not OK.
F2	green	Fuse F2 (group 2 outputs) is OK.
	off	Fuse F2 is not OK.
BA	green	Bus Active. The module is transmitting data messages on the network.
	off	The module is not transmitting data messages on the network.
RC	green	Remote Bus Check. The module's incoming bus is connected correctly, and the bus master device is not sending a bus reset signal.
	off	The incoming bus is not connected correctly, or the bus master device is sending a bus reset signal.
RD	red	Remote Bus Disabled. The module's outgoing bus is disabled.
	off	The module's outgoing bus is enabled.
1 ... 16	green	Output 1 ... 16 is active (output voltage high level).
	off	Output 1 ... 16 is not active (output voltage low level).

# Specifications

The **AC Output 115 ... 230 Vac 2x8** module switches 115 ... 230 Vac powered loads.

<b>Specifications</b>	
<b>InterBus-S ID Code</b>	0101 hexadecimal
<b>Number of Output Points</b>	16 in two 8 point groups
<b>Module Quiescent Current</b>	40 mA @ 85 ... 264.5 Vac
<b>Output Voltage (rms)</b>	
Working	74 ... 253 Vac
Absolute Maximum	300 Vac for 10 s 400 Vac for 1 cycle
Frequency	47 ... 63 Hz
ON State Drop / Point	1.5 Vac max
<b>Minimum Load Current (rms)</b>	10 mA
<b>Maximum Load Current (rms)</b>	
Each Point	0.5 A continuous, 74 ... 132 Vac rms, 0.5 A continuous, 170 ... 253 Vac rms
Any Four Contiguous Points	2 A max continuous for the sum of the four points
Per Module	8 A continuous
Off State Leakage / Point (max)	3.75 mA
<b>Surge Current Maximum (rms)</b>	
	<b>Per Point</b>
One Cycle	15 A
Two Cycles	10 A
Three Cycles	5 A
<b>Applied DV / DT</b>	400 V/ $\mu$ s
<b>Commutative DV / DT</b>	5 V/ $\mu$ s
<b>Response</b>	
OFF – ON	0.50 of one line cycle max
ON – OFF	0.50 of one line cycle max
<b>Output Protection (internal)</b>	RC snubber suppression
<b>Isolation (rms)</b>	
Output to Output	300 Vac for 1 minute
Output to Bus	1780 for 1 minute
<b>Fusing</b>	
Internal	One 6.3 A 250 V fuse per group
External	User discretion



# Appendix A

## Modbus Plus TIO Registers

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- Modbus Plus TIO Module Registers
- Write Privilege to Modules

## A.1 Modbus Plus TIO Module Registers

Each Modbus Plus TIO module contains three groups of internal registers. These can be accessed through the network to transfer input or output data, to set or retrieve the module's configuration, or to monitor its status.

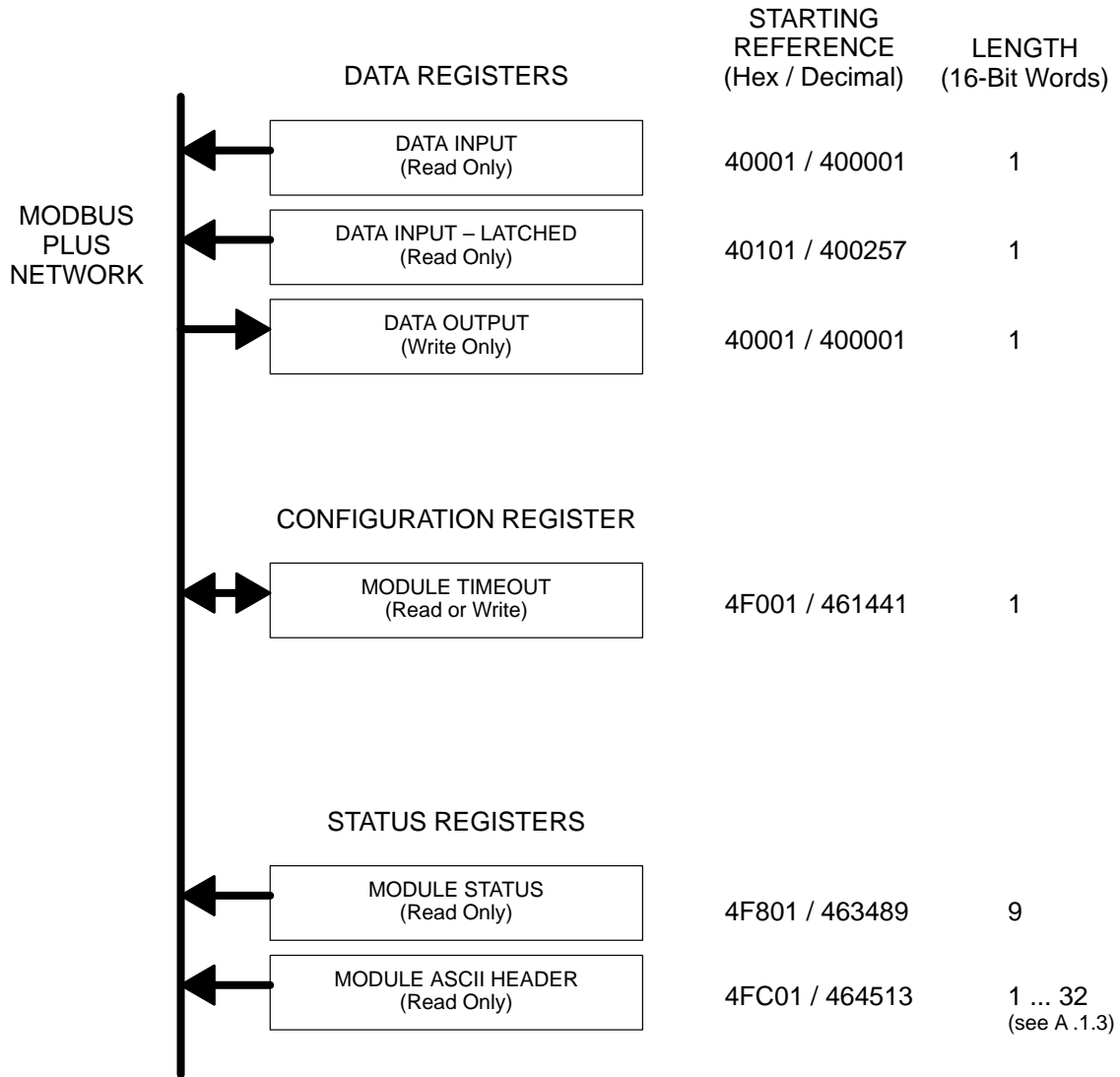


Figure 3 Modbus Plus TIO Module Registers Layout

## A.1.1 Data Registers

These registers contain the input or output data for each module.

### 40001 hex — Data Input or Output

Reference 40001 is used to address input data from field inputs, and output data to field outputs.

This reference is the only one that is accessible through Peer Cop data transfers. All other registers can be accessed using MSTR blocks.

### 40101 hex — Data Input, Latched

Reference 40101 latches inputs ON for a minimum of 500 milliseconds, if an ON input occurs with a time duration less than this. It ensures that shorter input pulses are captured and made available to the TIO application. If an input remains ON for more than this duration, the reference does not continue to latch it, but follows the input's state.

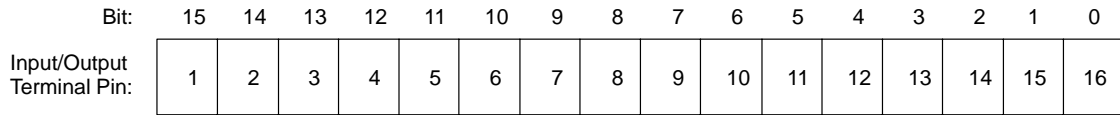


Figure 4 Input/Output Registers Bit Layout

### Quantity of Data Bytes Transferred

Each TIO module transfers the following quantities of data bytes for a read or write operation.

Part Number	Module Type	Read (Bytes)	Write (Bytes)
170 BDI 342 00	Discrete 16 in 24 V dc	2	1
170 BDO 342 00	Discrete 16 out 24 V dc	1	2
170 BDM 342 00	Discrete 16 in/16 out 24 V dc	3	2
170 BDI 542 50	Discrete 16 in 115 V ac	2	1
170 BDO 542 50	Discrete 16 out 24 ... 230 V ac	1	2

## A .1.2 Configuration Register

This register controls the holdup timeout value for output modules.

### **4F001 hex — Outputs Holdup Time**

Reference 4F001 specifies the amount of time that outputs will be held in their current state, if they are not updated by a new Modbus Plus Write command.

The timeout value is expressed in units of 10 milliseconds, with a minimum register value of 30 (300 milliseconds) and maximum value of 6000 (60 seconds). The default value is 100 (1 second).

If the module's holdup value expires before a new Write command is received, all outputs are set to logical 0 (zero).

The current contents of the register can be read using a Modbus Plus Read command.

### A.1.3 Status Registers

#### 4F801 ... 4F809 hex — Status Block

These registers provide information about the module's revision level and current operating parameters. Nine words are used to contain the module's status.

Ref (hex)	Meaning	Contents
4F801	Length of status area	9
4F802	Quantity of module input bytes	2 for input module, 1 for output module
4F803	Quantity of module output bytes	1 for input module, 2 for output module
4F804	Reserved	
4F805	Module revision number	Format: XR where: X = upper 4 bits , reserved for station management commands (always 0). R = revision number. Example: 200 hex shows revision 2.00.
4F806	ASCII header block length, words	1 ... 32
4F807	Last node address to communicate with this module	1 ... 64
4F808	Remaining write reservation time, seconds	0 ... 60
4F809	Remaining outputs holdup time, units of 10 milliseconds	30 ... 6000

#### 4FC01 ... 4FC20 hex — ASCII Header Block

These registers contain a brief ASCII text description of the module. The length of the block is 1 ... 64 bytes, as specified in word 6 of the module status block (reference 4F806). The registers can be read, but cannot be written into.

## A .2 Write Privilege to Modules

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When a node performs the initial write to a TIO module, the module will reserve further write privilege to that node for a duration of 60 seconds, before timing out. If the current node continues to write to the module within 60-second intervals, that node retains the write privilege. If the timeout is allowed to expire, any node may write to the module and the write privilege will be given to the next node that does so.

The 60-second timeout value is fixed, and is not accessible to the application. Note that the timeout process applies only to the write privilege to a module. Reading of input data or status from the module is allowed to any node.

# Appendix B

## CE Compliance

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- Requirements for CE Compliance
- Available Components for CE Compliance
- 170 BDI 542 50 -- Modbus Plus 115 VAC Input Module
- 170 BDO 542 50 -- Modbus Plus 24 ... 230 VAC Output Module

## B .1 Requirements for CE Compliance

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Certain Modicon TIO products bear the CE logo, indicating compliance with the EMC directives of the European Union. Please note, however, that EMC compliance is not determined solely by the product as shipped, but also by its employment by the user.

To ensure EMC compliance when installing these products, please observe the following measures:

- install equipment according to approved EMC practice (protective and functional earthing, connections with good conductivity);
- avoid all sources of electrical disturbance near the equipment;
- use only manufacturer-approved cable;
- observe compliant grounding of cable shielding (connections, clamps);
- use good judgment in cable routing (separate data lines from power lines to avoid electrical disturbance);
- use prescribed suppression filters and install them properly.

### B .1.1 CE-Compliant Wiring Examples

Wiring examples illustrating the connection of CE-compliant filters are provided for a typical TIO AC input and AC output module:

Part Number	Module Type
170 BDI 542 50	Discrete 16 in 115 V ac
170 BDO 542 50	Discrete 16 out 24 ... 230 V ac

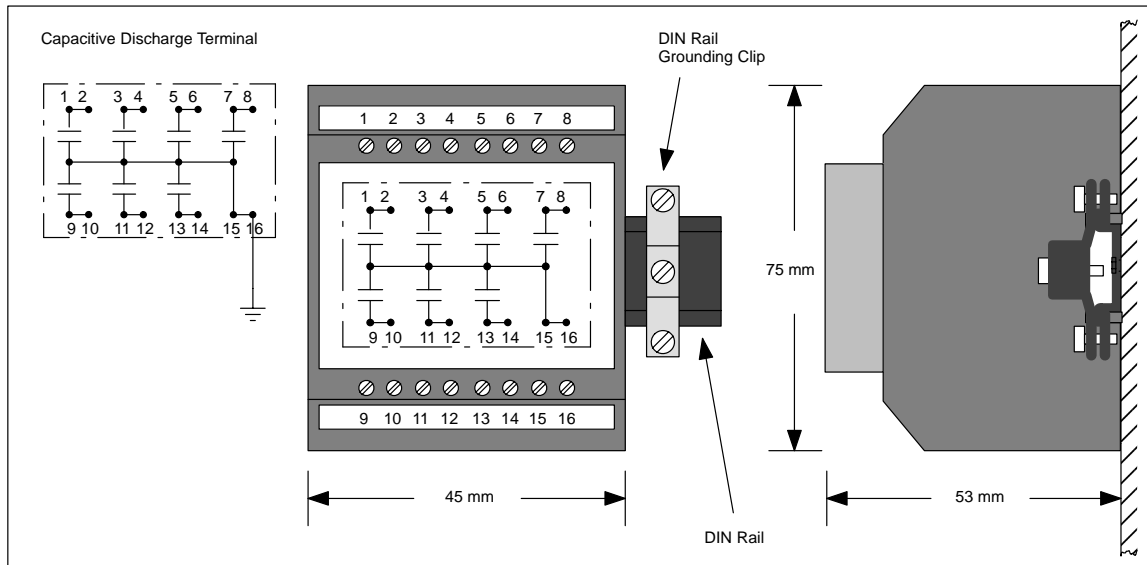


## B .2 Available Components for CE Compliance

### B .2.1 Capacitive Discharge Terminal and DIN Grounding Clip

A CE-compliant Capacitive Discharge Terminal and DIN Rail Grounding Clip are available with the following Modicon part numbers:

Part Number	Description
042244899	Capacitive Discharge Terminal, 2.2 nf
042249007	Grounding Clip, DIN Rail



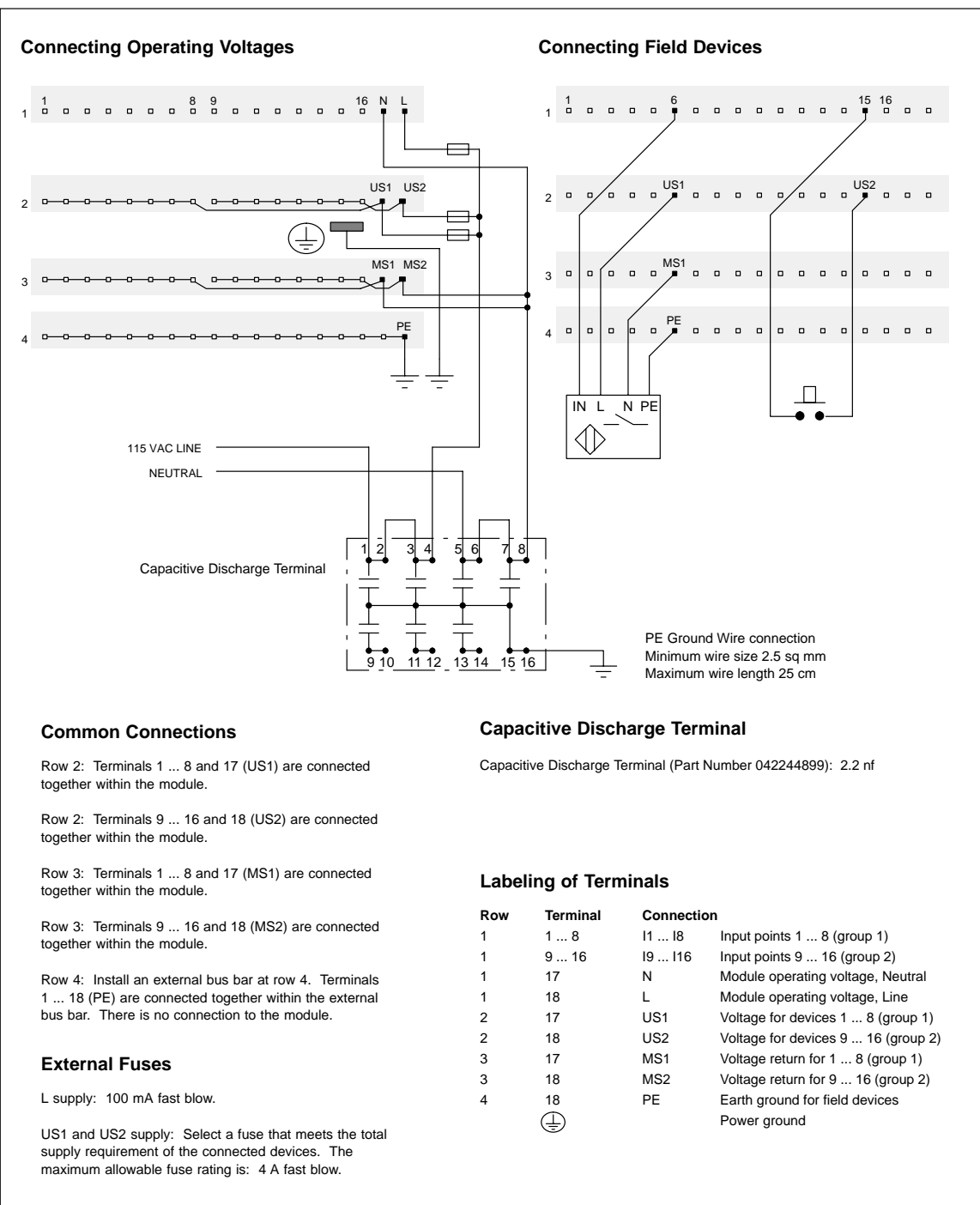
### B .2.2 AC Line Filters

CE-compliant AC Line Filters are available with a variety of wiring connections, including soldering lugs and flexible wire leads. Filters are available from the following sources:

Manufacturer: Schaffner EMC (Specify: FN-670 Series Filters)

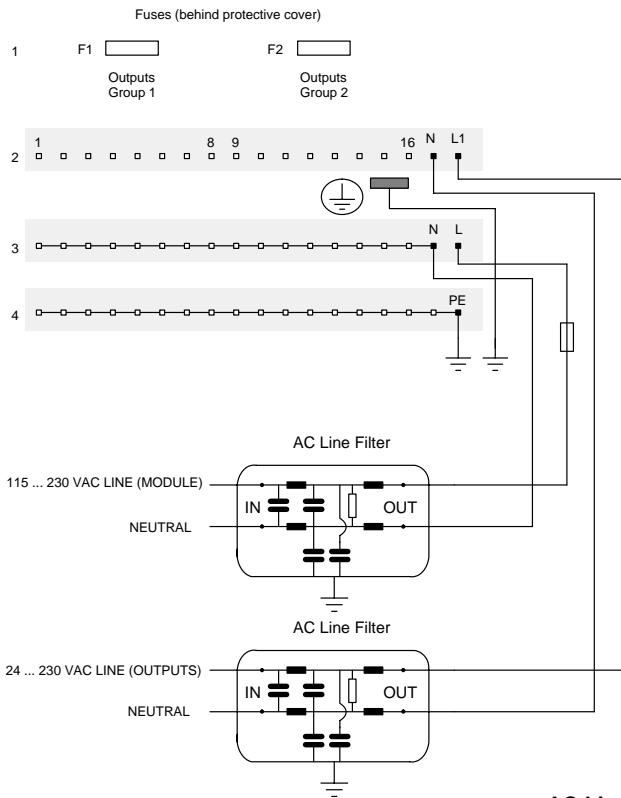
Location	Contact	Telephone	FAX
USA	Schaffner EMC Inc.	(201) 379-7778	(201) 379-1151
France	Schaffner S.A.	(13) 947 86 36	(13) 947 02 28
Germany	Schaffner Elek GmbH	(0721) 56 91 0	(0721) 56 91 10
U.K.	Schaffner EMC Ltd.	(0734) 69 71 79	(0734) 69 98 46

# B .3 170 BDI 542 50 — 115 VAC Input

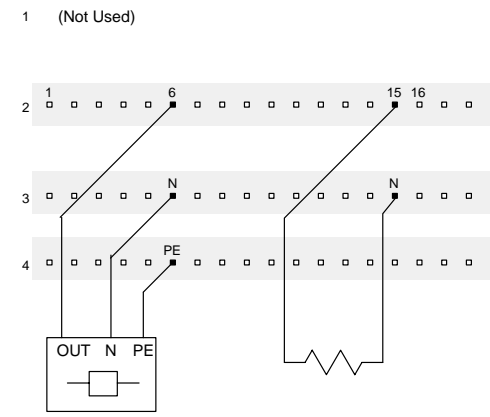


# B .4 170 BDO 542 50 — 24 ... 230 VAC Output

## Connecting Operating Voltages



## Connecting Field Devices



### Common Connections

Row 3: Terminals 1 ... 17 (N) are connected together within the module.

Row 4: Install an external bus bar at row 4. Terminals 1 ... 18 (PE) are connected together within the external bus bar. There is no connection to the module.

### Internal Fuses

L1 supply: FF 8 A 250 V fast blow, for each output group.  
Total fuses: 2.

### External Fuse

L supply: 100 mA 250 V fast blow.

### AC Line Filter

Schaffner EMC Filter Series FN670 or equivalent: 10 A 250 V.

### Labeling of Terminals

Row	Terminal	Connection
2	1 ... 8	O1 ... O8 Output points 1 ... 8 (group 1)
2	9 ... 16	O9 ... O16 Output points 9 ... 16 (group 2)
2	17	N Voltage for field devices, Neutral
2	18	L1 Voltage for field devices, Line
3	17	N Module operating voltage, Neutral
3	18	L Module operating voltage, Line
4	18	PE Earth ground for field devices
		⊕ Power ground

