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IMPORTANT! READ INSTRUCTIONS BEFORE STARTING!

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These instructions may not cover all details or variations in equipment or cover every possible situation to be met in connection with installation, operation or maintenance. Should problems arise that are not covered sufficiently in the text, the purchaser is advised to contact Bristol Babcock for further information.

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Metal enclosures and exposed metal parts of electrical instruments must be grounded in accordance with OSHA rules and regulations pertaining to "Design Safety Standards for Electrical Systems," 29 CFR, Part 1910, Subpart S, dated: April 16, 1981 (OSHA rulings are in agreement with the National Electrical Code).

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This product contains sensitive electronic components that can be damaged by exposure to an electrostatic discharge (ESD) voltage. Depending on the magnitude and duration of the ESD, this can result in erratic operation or complete failure of the equipment.

Bristol Babcock 1100 Buckingham Street, Watertown, CT 06795 Telephone (860) 945-2200

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You can easily obtain a RA number by:

A. FAX

Completing the form (GBU 13.01) and faxing it to (860) 945-3875. A BBI Repair Dept. representative will return call (or other requested method) with a RA number.

B. E-MAIL

Accessing the form (GBU 13.01) via the Bristol Babcock Web site (www.bristolbabcock.com) and sending it via E-Mail to <u>brepair@bristolbabcock.com</u>. A BBI Repair Dept. representative will return E-Mail (or other requested method) with a RA number.

C. Mail

Mail the form (GBU 13.01) to

Bristol Babcock Inc.

Repair Dept. 1100 Buckingham Street Watertown, CT 06795

A BBI Repair Dept. representative will return call (or other requested method) with a RA number.

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Calling the BBI Repair Department at (860) 945-2442. A BBI Repair Department representative will record a RA number on the form and complete Part I, then send the form to the Customer via fax (or other requested method) for Customer completion of Parts II & III.

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Bristol Babcock Inc. Repair Authorization Form

(Providing this information will permit BBI to effectively and efficiently process your return. Completion is required to receive optimal lead time. Lack of information may result in increased lead times.)

Da	nte RA #	S	H_	Line No
Sta pra •	andard Repair Practice is as follows: Variations to this is actice may be requested in the "Special Requests" section. Evaluate / Test / Verify Discrepancy Repair / Replace / etc. in accordance with this form Return to Customer	 Please be awa There is a applied to or D of path 	re of the Nor \$100 minimu the repair if a rt III below)	In warranty standard charge: in evaluation charge, which is applicable ($$ in "returned" B,C,
Pa	rt I Please complete the following information	on for single unit	o <mark>r multiple</mark> u	nit returns
Ad	ldress No(office use only)	Address No		(office use only)
Bil	ll to :	Ship to:		
Pu	rchase Order:	Contact Name:		
Ph	one: Fax:	E·	Mail:	
Pa	rt II Please complete Parts II	& III for each u	nit returned	
Mo	odel No./Part No.	Description		
Ra	nge/Calibration	S/N		
Re	ason for return : Failure Upgrade Verify	Operation	Other	
1.	Describe the conditions of the failure (Frequency/Intermitt Communication, CPU watchdog, etc.)	ent, Physical Dam	age, Environr	nental Conditions,
			(Attacl	n a separate sheet if necessary)
2.	Comm. interface used: ☐ Standalone ☐ RS-485 ☐ Ethernet	Modem (PLM (2	W or 4W) or S	SNW) Other:
3.	What is the Firmware revision?	What is the S	oftware &ver	rsion?
Pa	rt III If checking "replaced" for any question below, ch	eck an alternate o	ption if repla	acement is not available
A.	If product is within the warranty time period but is exclude to BBI's warranty clause, would you like the product:	ed due □ repair	ed 🗌 returne	d □ replaced □ scrapped?
B.	If product were found to exceed the warranty period, would you like the product:	□repaire	d 🗌 returned	i □ replaced □ scrapped?
C.	If product is deemed not repairable would you like your pr	oduct:	□ returned	l □ replaced □ scrapped?
D.	If BBI is unable to verify the discrepancy, would you like	the product:	returned	\Box replaced \Box *see below?
* (h	Continue investigating by contacting the customer to learn mass the most knowledge of the problem is:	ore about the prob	lem experien	ced? The person to contact that bhone
If v	we are unable to contact this person the backup person is:		pl	hone
Spo	ecial Requests:			

Ship prepaid to: Bristol Babcock Inc., Repair Dept., 1100 Buckingham Street, Watertown, CT 06795 Phone: 860-945-2442 Fax: 860-945-3875

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- Avoid Delays and problems in getting your system on-line
- Minimize installation, start-up and maintenance costs.
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On off-shore oil platforms, on natural gas pipelines, and maybe even at your local water company, there are Bristol Babcock instruments, controllers, and systems running year-in and year-out to provide accurate and timely data to our customers.

Getting Additional Information

In addition to the information contained in this manual, you may receive additional assistance in using this product from the following sources:

Contacting Bristol Babcock Directly

Bristol Babcock's world headquarters are located at 1100 Buckingham Street, Watertown, Connecticut 06795, U.S.A.

Our main phone numbers are:

(860) 945-2200 (860) 945-2213 (FAX)

Regular office hours are Monday through Friday, 8:00AM to 4:30PM Eastern Time, excluding holidays and scheduled factory shutdowns. During other hours, callers may leave messages using Bristol's voice mail system.

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During regular business hours, Bristol Babcock's Application Support Group can provide telephone support for your technical questions.

For technical questions about TeleFlow[™] products call (860) 945-8604.

For technical questions about ControlWave call (860) 945-2244 or (860) 945-2286.

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For technical questions regarding ACCOL products, **Open BSI Utilities**, as well as Bristol's **Enterprise Server**[®]/**Enterprise Workstation**[®] products, call (860) 945-2286.

For technical questions about Network 3000 hardware, call (860) 945-2502.

You can e-mail the Application Support Group at: bsupport@bristolbabcock.com

The Application Support Group also maintains a service area within our main web site. Technical information, as well as software updates are available in this area. To access our web site, go to: bristolbabcock.com/services/techsupport/

For assistance in interfacing Bristol Babcock hardware to radios, contact Communication Technologies in Orlando, FL at (407) 629-9463 or (407) 629-9464.

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Please call the main Bristol Babcock number (860-945-2200) if you are unsure which office covers your particular area.

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For general information about Bristol Babcock and its products, please visit our site on the World Wide Web at: **www.bristolbabcock.com**

Instruction Manual

ControlWave Ethernet Distributed (Remote) I/O Modules



Contents at a Glance:

Section 1	General Information	Ethernet I/O modules	2
Section 2	Ethernet and RS485 Wiring	Remote I/O, Ethernet I/O Expansion	3
Section 3	Configuration Tools	BB-232-SETUP and Windows Tools	4
Section 4	Discrete I/O Modules	BB-8DI2-8DO2-H, BB-16DI2-H, BB-8CNT	7
Section 5	Discrete Output Module	ВВ-16DO2-Н	10
Section 6	Discrete / Analog Modules	BB-8DI2-8AI2-H, BB-4RTD-4DI2-U	11
Section 7	Analog Input Modules	BB-16AI2-H, BB-8INS-U	13
Section 8	Analog I/O Module	BB-8AI2-4AO2-H	15
Section 9	Modbus Communications	Scheme Configuration Notes	16

Supplements & Appendices

Special Instructions for Class I, Division 2 Hazardous Locations Appendix A



CI-ControlWaveRI/O

Table Of Contents

Section 1

General Information

Overview

This manual will help you install and maintain Ethernet Remote I/O Modules and gateways. In summary, wiring for power, communications and I/O is connected to each module's base. Then, setup choices are entered using the Remote I/O Tool Kit software and the system will be ready to run. Shown below are some typical system configurations using Ethernet I/O:



Distributed Ethernet and serial I/O

General Specifications

These general specifications apply to all Ethernet I/O modules. More detailed product specifications may be found in the online help system of the Remote I/O Toolkit configuration utility.

Supply Voltage

RS485 Expansion

Ethernet Isolation Operating Temperature Storage Temperature Humidity

Protocols Supported

10 - 30 Vdc, 1.2 Watt typical per module (48 mA @ 24 Vdc - varies by module and load). Connect up to 32 Remote I/O modules using RS485

1200 Volts RMS (for 1 minute) -30 to 70 °C -40 to 85 °C 5 to 95% (non-condensing)

Open Modbus/TCP, Serial Modbus RTU & ASCII Universal

Section 2

Ethernet and RS485 Wiring

DC Power Overview

Ethernet I/O modules can be powered from the same DC source that is used to power your I/O devices. No separate power supply is required. Typically, 10 to 30 VDC power is applied to terminals 24 and 25 on the base of each module. Refer to the upcoming wiring diagram for each module for power connections.



RS485 Wiring Guidelines

The RS485 party-line consists of two wires and an isolated ground wire. It is recommended that the ground wire be connected to all stations to provide a common return. The RS485 port on all Ethernet I/O modules is isolated from its internal circuitry, local power source, and I/O wiring to improve communications reliability. It is recommended that only 32 Remote I/O modules be connected on any RS485 party-line, and that the termination jumper be installed on the last module on each end of the RS485 network. Limiting the cabling to two network arms (segments) radiating from the master controller will yield the best signal results.



Screw Torque

All the screw terminals on the base should be tightened to a maximum of 3.48 in-lbs.

Section 3	Configuration Tools
	BB-232-SETUP Remote I/O Setup Module
Operation	This setup tool is recommended to initially configure each Ethernet Remote I/O module. To use the setup module, simply unplug any Ethernet I/O module from its base and insert the setup module into the base.
	Note: Ethernet I/O "smart bases" allow hot swap of live modules an exclusive feature that makes it permissible to configure Ethernet I/O modules in live systems.
	The Ethernet I/O module configuration you created using the Remote I/O Tool Kit program will be written into permanent memory in the module's base. When the Ethernet I/O module is reinserted into its base, the module will find and upload the configuration information, instantly configure itself and begin scanning I/O.
	Once an Ethernet I/O module has been configured with an appropriate station address and IP address (Ethernet I/O only), modified configuration data can be downloaded through the Ethernet port or RS485 port into the module base.
	More information on the Remote I/O Setup Module can be found in the online help system of the Remote I/O Toolkit.
RS232 Wiring	Connect the setup module to your Windows PC using a standard BB ST-CABLE-PF RS232 cable. Only the transmit (TD), receive (RD) and common return (GND) signals are actively used. The RS232 port on this configuration tool is electrically isolated to protect your computer in the event of field wiring errors. The setup module runs on the DC power connected to terminals 17 and 18 of the module base it is plugged into. No other connections are required. (I/O wiring can be left undisturbed.)

RS232 Mode Selection

This module always communicates to the host PC at 9600 baud, with no parity and eight data bits. Be sure to select "Use Setup Module's Settings" as the communication device selection in the Remote I/O Tool Kit program.



Remote I/O Tool Kit

Ethernet I/O modules are configured using the Remote I/O Tool Kit software. Configuration parameters are written over Ethernet, RS485 or RS232 (setup module only) into permanent memory in the module's base. Refer to the Remote I/O Tool Kit help for details.

Here are the basic steps for configuring an Ethernet I/O module.

- 1. Connect DC power to the module.
- 2. Connect an Ethernet cable to the module. Use a straight-through cable if you are connecting to an Ethernet hub or switch. Use a cross-wired cable if you are connecting directly to a PC. Make sure the LNK LED on the module is on solid (not blinking).
- 3. Run the Remote I/O Tool Kit. You can use the Plug & Play Wizard to define the parameters for the module. Be sure to do the following:
 - Choose an IP address that is appropriate for your network. See the help file for details.
 - Enter in the serial number that is printed on a label on the module.
 - Choose a station (slave) number for the module. This number must be unique from other modules and the device to which you are interfacing.
 - Select the appropriate RS232 or RS485 com parameters (protocol, baud rate, etc.) to match the device to which you are interfacing.
- 4. Once you've completed the wizard, save your project file. Go to the Device menu and choose the appropriate communication device. Then go to the Operations menu and select Load. This should set the IP address in the module and then load down your other parameters.

If this load fails for some reason, here are some items to check:

- Make sure the LNK LED is on solid. If it is off or blinking then a typical cause is a bad cable, an incorrect cable, or you are plugged into the wrong port on your hub/switch.
- Try to "ping" the module. Ping is a utility that comes with your PC. Start an MSDOS prompt and type "ping" followed by the IP address of the gateway and then hit <CR>. For example, "ping 10.1.0.1" (do not type the quotes). If you get an "unknown command" error then you will need to install the TCP/IP Ethernet protocol on your computer. If you get "destination unreachable" then make sure the gateway's IP address is valid with respect to the IP address and subnet mask of your computer. If you get "request timeout" then check all the items above.
 - **Note:** Information on Ethernet networking can be found in the online help system for the Remote I/O Toolkit.
- 5. Once you establish that you can communicate with the module from the Remote I/O Tool Kit you then should attempt to communicate with your device using your ControlWave master.

Ethernet I/O LEDs	Every Ethernet I/O module has a number of LEDs. These LEDs can be useful for system diagnostics. These LEDs can be observed in the following states:
I/O Module Status LED	On, with a quick "OFF" BLINK (1.9 seconds ON, .1 seconds OFF) - The module is configured and fully operational, but has not received a valid request from the host for a time longer than the specified time out period. A communication time out has occurred.
	Full ON - The module is configured, fully operational, and has received communication from the host device before the timeout period expired. This is the desired LED indication during system operation.
	HALF BLINK (1 second ON, 1 second OFF) - The module is not adequately configured and requires a download from the Remote I/O Tool Kit program.
	Full OFF - There is no power to the module, or the status LED is being turned off intentionally by the Remote I/O Tool Kit during the module loading operation.
	Off, with a quick "ON" BLINK (1.9 seconds OFF, .1 seconds ON) - The module failed self-test at initialization. It will not attempt communication and should be replaced.
Status LED Wink Feature	The "Status" LED of an I/O module can be intentionally winked (10 blinks/ second) by the Remote I/O Tool Kit program to visually identify the module when other modules are present.
ACT / LNK LEDs	The activity (ACT) LED on an Ethernet I/O module will flicker anytime there is traffic on the Ethernet network, regardless of whom the network messages are intended for. The link (LNK) LED will be ON whenever a valid link to another Ethernet device is detected. The best troubleshooting tools for Ethernet I/O modules are the Status, ACT, and LNK

the Ethernet network, regardless of whom the network messages are intended for. The link (LNK) LED will be ON whenever a valid link to another Ethernet device is detected. The best troubleshooting tools for Ethernet I/O modules are the Status, ACT, and LNK LEDs on each module. Each Ethernet I/O Status LED indicates the health of the module and also the status of communication from the host device. You can use the Wink feature to provide continuous transmission to an Ethernet I/O. Note that an Ethernet I/O module does not send a reply in response to a Wink command.

Section 4	Discrete I/O N	lodules			
	BB-8DI2-8DO2-H BB-16DI2-H	H 8 D 16 I	iscrete Inputs and Discrete Inputs	8 Discrete Outputs	
BB-8DI2- 8DO2 Overview	This module provides one terminal for each input or output channel. All inputs may be wired as sourcing or sinking. Outputs are wired in a sourcing (power switching) configuration only. An input count feature uses analog input registers to accumulate the positive transitions of each input. More information may be found in the on-line help in the Remote I/O Tool Kit program.				
	Number of Channels Input Voltage Range Input Current @ 24Vdc Output Voltage Range Maximum Count Rate	8 discrete ir 12/24 VDC/ e 6.7 mA 10 - 30 VDC 100 Hz (600 (120,000 / m	nputs, 8 discrete outpu VAC C 0 / minute) each input ninute) mode for input	ts (BB-8DI2-8DO2 only) , plus selectable 2KHz 1 only	
Wiring and Jumpers	One wire from each sou terminal 17 (DC +). One should be bussed togethe diagram below. Set jumpe	urcing field inp wire from each er and connecte er W1 to match	but should be bussed sourcing field output a ed to terminal 18 (DC) the wiring configuratio	together and connected to nd/or or sinking field input GND). Refer to the wiring n of the inputs.	
TPO Feature	Time proportioned output value stored in an analog proportional control of he registers are assigned to t or ControlWave Designed fast as 10 mS or as slow may be configured as a T	ts pulse ON and g output registe eaters and othe the output of Pl er program. Us 7 (many minute PO or ordinary	d OFF with a duty cycler. TPO outputs are a lor r process variables. Ty ID or other control logi e the Remote I/O Tool es) as your system dyna discrete output.	e proportional to an analog ow cost way to get smooth pically, TPO analog output c in a ACCOL Workbench Kit to set pulse cycling as amics require. Each output	
I/O Registers	FunctionModDiscrete InputsX0 -Discrete OutputsY0 -TPO ValuesAY0Counter InputsAX0	<u>dule Registers</u> - X7 - Y7 0 - AY7 0 - AX7	<u>Modbus Registers</u> 10001 – 10008 00001 – 00008 40001 – 40008 30001 – 30008	2	
DC Inpu Sourcing DC Ethernet 10BaseT Duplicate Terminals 25 @ GND 24 @ DC+ RS485 to RemoteTRAK I/O 23 @ T1 21 @ 485 - 20 @ 485 + 19 @ 485 Gnd -H Base W1 (High Density Wiring	ts, Outputs GND DC+ GND DC+ GND DC+ DC+ © 17 DOUT8 © 16 DOUT7 © 15 DOUT6 © 14 DOUT3 © 11 DOUT3 © 16 DOUT3 © 16 DOUT © 15 DOUT6 © 14 DOUT3 © 16 DOUT3 © 17 DOUT3 © 17 Connect Up to 8 DC Inpu and 8 DC Outputs	dits	Equivalent DC Input Circuits DC+ Sourcing Switches DIN1 CREF DC+ Switches Sinking Switches	Equivalent DC Output Circuit (Sourcing only) DC+ Solid State Switch OND 	

BB-16DI2-H High Density Discrete Input Module BB-16DI2 This module provides sixteen input channels. Inputs may be wired as all sourcing or sinking. An input count feature uses analog input registers to accumulate the positive Overview transitions of each input. More information on this and other features may be found in the on-line help supplied with the Remote I/O Tool Kit program. **Number of Channels** 16 discrete inputs (connected to a common source) **Input Voltage Range** 12/24 VDC/VAC Input Current @ 24 VDC 6.7 mA Wiring and Positive DC or AC voltage must be applied to an input to indicate an ON condition. All channels are referenced to a common return or supply, which is connected to the negative Jumpers side (ground) or positive side (DC+) of the DC power source. One wire from each sourcing field input should be bussed together and connected to terminal 17 (DC +). One wire from each sinking field input should be bussed together and connected to terminal 18 (DC GND). Refer to the wiring diagram below. Set jumper W1 to match the wiring configuration of the inputs. I/O Registers Function Module Registers Modbus Registers **Discrete Inputs** X0 - X1510001 - 10016**Counter Inputs** AX0 - AX1530001 - 30016



	BB-8CNT		High Spee	d Counter Module	
BB-8CNT Overview	This high-speed counter module has eight isolated circuits that accept pulse inpuvariety of sources, including quadrature and incremental encoders. Count reported in 16 bit analog input registers or 32 bit long registers. The states of inputs are also reported as discrete inputs. Pulse rates up to 50 kHz are supp counters may be reset by toggling discrete output bits. Counter modes are sele the Remote I/O Tool Kit program. More information on this and other feature found in the on-line help supplied with the Remote I/O Tool Kit program.		ed circuits that accept pulse inputs from a incremental encoders. Count values are t long registers. The states of the counter e rates up to 50 kHz are supported. The ut bits. Counter modes are selected using nation on this and other features may be ote I/O Tool Kit program.		
	Number of Chann Input Voltage Ran Input Current @ 2	els nge 24 VDC	8 discrete inj 12/24 VDC/V 6.7 mA	outs, isolated /AC	
Input Wiring	Screw terminal assignments are shown below. For best noise immunity, connect input signals using twisted wire pairs. To maintain the best differential noise rejection, do not connect (-) screw terminals together at the I/O base. Positive DC voltage must be applied to an input to indicate an ON condition. Refer to the wiring diagram below.				
	Any odd-numbered even-numbered inp	input can be ut. For exampl	gated by conne, Input 2 can	ecting a gating signal to the next highest gate the counter for Input 1.	
I/O Registers	<u>Function</u> Discrete Inputs Counter Inputs Resets	<u>Module Reg</u> X0 – X7 AX0 – AX7 Y0 – Y7	<u>isters</u> or LI0 – LI7	<u>Modbus Registers</u> 10001 – 10008 30001 – 30008 35001 – 35008 00001 – 00008	
	High-speed Pulse Inputs			Proximity 18-0 17-0	
280 270	S N/C 017		Input 8	-16 -Q Load* Out	



Section 5	Discrete Outp	out Module	S
	ВВ-16DO2-Н	High I	Density Discrete Output Module
BB-16DO2 Overview	Sixteen discrete output channels valves, and other loads. Inductive outputs may optionally be configu- duty cycle proportional to an ana are controlled by a PID loop or information may be found in the program.		vide up to 1 Amp DC to motor contactors, protection is provided. Each of the sixteen me Proportioned Outputs that pulse ON at a register value. Typically these TPO outputs access algorithm in a control program. More elp supplied with the Remote I/O Tool Kit
	Number of Channels	16 discr	ete outputs connected to a common DC
	Output Voltage Range Max. Load per Output Max. Load per Module Max. Inrush Current	source 10 - 30 V 1 Amp 8 Amps 5 Amps	VDC (for 100 mS)
Wiring	A single terminal is prov DC power terminal. All to the negative side (grou	vided for each output channels are refere and) of the DC power	at channel. All outputs are powered from the need to a common return which is connected er source.
TPO Feature	Time proportioned output value stored in an analog proportional control of he registers are assigned to t or ControlWave Designer fast as 10 mS or as slow may be configured as a T	ts pulse ON and OF g output register. The eaters and other pro- the output of PID of r program. Use the v (many minutes) as PO or ordinary disc	FF with a duty cycle proportional to an analog PO outputs are a low cost way to get smooth bcess variables. Typically, TPO analog output r other control logic in a ACCOL Workbench Remote I/O Tool Kit to set pulse cycling as s your system dynamics require. Each output rrete output.
I/O Registers	FunctionModDiscrete OutputsY0 -TPO ValuesAY0	<u>dule Registers</u> – Y15 0 – AY15	<u>Modbus Registers</u> 00001 – 00016 40001 – 40016
	Sourcing DC Outputs GND Ø18 DC+ Ø17 DOUTIS Ø16 Bourts Ø16 DOUTIS Ø13 DOUTIS Ø13 DOUTIS Ø13 DOUTIS Ø13 DOUTIS Ø13 DOUTIS Ø11 DOUTIS Ø10 DOUTIS Ø10 DOUTIS Ø10 DOUTS Ø10 DOUTS Ø 5 OUTIS Ø 3 Ø485 - H DOUTIS Ø 485 - H DOUTIS Ø 485 - H DOUTIS Ø 485 Gnd OUTIS — H Base (High Density Wiring) O	DC Power Input	Equivalent DC Output Circuit (Sourcing only) DC+ Solid State Switch GND GND GND U T

Section 6	Discrete / Analog Modules					
	BB-8DI2-8AI2-H	8 Discrete Inputs and 8 4-20 mA Inputs				
BB-8DI2-8AI2 Overview	Eight 4-20 mA inputs provide 14 as all sourcing or sinking. A accumulate the positive transiti features may be found in the on-	t bit analog measurements. Discrete inputs may be wired n input count feature uses analog input registers to ons of each input. More information on this and other line help supplied with the Remote I/O Tool Kit program.				
	Number of Channels Input Range Analog Input Impedance DI Voltage Range Input Current @ 24 Vdc	 8 analog inputs (14 bit resolution), 8 discrete inputs 4 - 20 mA (analog), 12/24 Vdc/Vac (discrete) 100 ohms Note: input voltage drop = 2 volts at 20 mA 12/24 Vdc/Vac 6.7 mA 				
Wiring and Jumpers	Positive DC or AC voltage must be applied to an input to indicate an ON condition. All channels are referenced to a common return or supply, which is connected to the negative side (ground) or positive side (DC+) of the DC power source. One wire from each sourcing field input should be bussed together and connected to terminal 17 (DC +). One wire from each sinking field input should be bussed together and connected to terminal 18 (DC GND). Refer to the wiring diagram below. Set jumper W1 to match the wiring configuration of the discrete inputs. A single input terminal is provided for each analog input channel. Care must be taken to externally provide a suitable instrumentation ground for these single ended input circuits.					
Current Shunts	Precision 100 ohm current shunt current and maintain loop integ provided and may be simply inse a current overload.	s, beneath the hinged access door in the wiring base, pass rity even if the module is unplugged. A spare shunt is erted in place of any shunt that open circuits as a result of				
I/O Registers	FunctionModule RegissAnalog InputsAX0 – AX7Discrete InputsX0 – X7Counter InputsAX8 – AX15	<u>Modbus Registers</u> 30001 – 30008 10001 – 10008 30009 – 30016				
DC Inputs 4-20 mA Analog Ethernet I Duplicate Terminals 250 GND 240 DC+ 230 T2 200 485 to RemoteTRAK I/O 230 T2 200 485 - 190 485 cn 	DC Power Input GND 018 DC+ 017 AINB 016 AIN7 016 AIN7 014 AIN5 014 AI	Equivalent DC Input Circuits DC+ Sourcing Switches DINT Switches Switches CND CND Switches Switches Switches Switches				

	BB-4RTD-4DI2-U	4 RTD Inputs and 4 Discrete Inputs
BB-4RTD- 4DI2 Overview	Four RTD inputs provide 16 bit may be wired as all sourcing or sin to accumulate the positive transiti features may be found in the on-lin	high-resolution analog measurements. Discrete inputs nking. An input count feature uses analog input registers ions of each input. More information on this and other ne help supplied with the Remote I/O Tool Kit program.
	Number of Channels RTD Input Type / Range Discrete Input Range Input Current @ 24 VDC	 4 RTD inputs (16 bit resolution), 4 discrete inputs 100 ohm platinum, -200 to 850 °C 12/24 VDC/VAC 6.7 mA
Wiring and Jumpers	See the wiring diagram below for voltage applied to an input to ind common return or supply, which side (DC+) of the DC power soun bussed together and connected to input should be bussed together a wiring diagram below. Set jumpe inputs	r RTD inputs. Discrete inputs need positive DC or AC icate an ON condition. All channels are referenced to a is connected to the negative side (ground) or positive rce. One wire from each sourcing field input should be terminal 17 (DC +). One wire from each sinking field and connected to terminal 18 (DC GND). Refer to the r W1 to match the wiring configuration of the discrete
I/O Registers	FunctionModule RegisterRTD InputsAX0 – AX3Discrete InputsX0 – X3Counter InputsAX4 – AX7	<u>Modbus Registers</u> 30001 – 30004 10001 – 10004 30005 – 30008
DC Inputs, 100 Ohm RTD In Ethernet 10BoseT Duplicate Terminals 25 @ GND 24 @ Dc+ RS485 to RS485 to RemoteTRAK I/O 23 @ T2 22 @ T1 22 @ T1 22 @ T1 22 @ T4 23 @ T2 20 @ 485 - 20 @ 485 fon Bose WI Example	DC Power Input GND DC+ GND DC+ GND 10C+ GND 10C+ GN	Equivalent DC Input Circuits
назе " (High Density Wiring)	Connect Up to 4 RTD Inputs and 4 DC Inputs	Current Excite

Section 7	Analog Input Modules				
	BB-16AI2-2	H I	ligh Den	sity 4-20 mA A	nalog Input Module
BB-16Al2 Overview	Sixteen 4-20 mA information may program.	A inputs provi be found in th	de 14 bit ne on-line 1	high-resolution ar help supplied with	alog measurements. More the Remote I/O Tool Kit
	Number of Char Input Range Input Impedance	nnels e	16 (14 bi 4 - 20 mA 100 ohms	t resolution) Note: input volta	ge drop = 2 volts at 20 mA
Wiring	A single input ter externally provide	minal is provid e a suitable inst	led for each rumentation	n measurement cha n ground for these :	nnel. Care must be taken to single ended input circuits.
Current Shunts	Precision 100 ohm current shunts, beneath the hinged access door in the wiring base, past current and maintain loop integrity even if the module is unplugged. A spare shunt is provided and may be simply inserted in place of any shunt that open circuits as a result of a current overload.				oor in the wiring base, pass aplugged. A spare shunt is t open circuits as a result of
I/O Registers	<u>Function</u> Analog Inputs	<u>Module Regi</u> AX0 – AX15	<u>sters</u>	<u>Modbus Registers</u> 30001 – 30016	
4-20 m	A Analog Inputs GND ⊘18 DC+ ⊘17 AIN16 ⊘16	DC Power GND	Input DC+ L Equival	ent Circuit	
10BaseT Duplicate Terminals 25 Ø GND 24 Ø DC+	AIN15 Ø 15 AIN15 Ø 15 AIN14 Ø 14 9 AIN13 Ø 13 1 AIN12 Ø 12 2 AIN11 Ø 11 2 AIN10 Ø 10 AIN10 Ø 10 AIN10 AIN10 Ø 10 AIN10	Connect Up to 1 4-20 mA Inputs			
RS485 to RemoteTRAK I/O 23 () T2 22 () T1 21 () 485 - 20 () 485 + 19 () 485 Gnd -H Bos	AINE AINE AINE AINE		Ext. 4-20 wr. or Ir GND L 4-20	ernally Powered mA Transmitter strument Output oop Powered mA Transmitter	
(High Densi	ty Wiring)	24 VDC User Power			

	BB-8INS- U	Instrumentation Analog Input Module			
BB-8INS Overview	Eight configurable inputs provide 16 bit high-resolution analog measurements. More information may be found in the on-line help supplied with the Remote I/O Tool Kit program.				
	Number of Channels Input Range	8 (16 bit resolution) 0/4 - 20 mA, 62 mV to 10V, JKERTBCNS			
	Input Impedance (current)	100 ohms Note: input voltage drop = 2 volts at 20			
	Input Impedance (other ran	mA nges) 200K Ohms			
BB-8INS Wiring	Two input terminals are pro- isolation is provided.	ovided for each measurement channel. Channel to channel			
4-20 mA Input Jumpers	This module has a 4-20 mA match the desired input as sl the range selection in the Rer	input enable jumper for each channel. Set each jumper to hown in the diagram below. The jumper setting must match note I/O Tool Kit.			
Current Shunts	Precision 100 ohm current sh current and maintain loop in provided and may be simply a current overload.	nunts, beneath the hinged access door in the wiring base, pass ntegrity even if the module is unplugged. A spare shunt is inserted in place of any shunt that open circuits as a result of			
I/O Registers	<u>Function</u> <u>Module R</u> Analog Inputs AX0 – AX	RegistersModbus RegistersX730001 – 30008			
Instrumentat	ion Inputs $\frac{1}{100} 0.18$				
Ethernet 10BaseT	AIN8- 015	a 4-20 mA, nocouple Inputs Equivalent Circuit			
		→ → → → → → → → → → → → → → → → → → →			
	$\begin{array}{c c} AIN7 + OTS \\ \hline AIN6 - OT2 \\ \hline AIN6 + OT1 \\ \hline \end{array}$				
		or Bridge Circuit * Jumper 1 to 2 for			
		4-20 mA Range + DC Voltage			
$\begin{array}{c} \text{RemoteTRAK} \ \text{I/O} \\ 23 \text{ ()} \ \text{T2} \end{array}$		Thermocouple			
$22 \oslash T1$		Ext. Pwr. Externally Powered 4—20 mA Transmitter			
20 (2) 485 + 19 (2) 485 Gnd		Loop Powered 4—20 mA Transmitter			
U Base (Universal Wiri	ng)	r			

Section 8	Analog I/O	Modu	le		
	BB-8AI2-4AC	02-Н	Combined	d Analog Input and Output Modul	le
BB-8Al2-4AO2 Overview	This module combines eight 4-20 mA analog inputs and four 4-20 mA outputs. M information may be found in the on-line help supplied with the Remote I/O Tool program.				
	Number of Analog Inputs Input Range Input Impedance Number of Analog Outputs Output Range		 8 (14 bit resolution) 4 - 20 mA 100 ohms Note: input voltage drop = 2 volts at 20 m. 4 (16 bit resolution) 4 - 20 mA 		
Wiring	A single input terminal is provided for each input and output channel. Care must be tak to externally provide a suitable instrumentation ground for these input and output circuit				ten ts.
I/O Registers	<u>Function</u> Analog Inputs Analog Outputs	<u>Module Re</u> AX0 – AX AY0 – AY	egisters 7 3	<u>Modbus Registers</u> 30001 – 30008 40001 – 40004	



Section 9

Modbus Command Support

Modbus Communications Scheme Configuration Notes

Ethernet and RS-485 I/O Modules support the Modbus commands listed in Table 1 below (see Modbus Function Codes) as described in AEG Modicon document <u>Modicon Modbus</u> <u>Protocol Reference Guide</u> Number PI-MBUS-300 Rev. E (or higher). The modules support only the command(s) that apply to their I/O type(s).

Extensions to commands 03 and 16 provide support for long integers and floating point numbers. Two formats are supported: Daniel Extensions and Modicon Protocol.

Table 1Registers versus Function Table (ACCOL & ControlWave Non I.P.)

ControlWave Function Codes	ACCOL Function Codes	Modbus Function Codes	Modbus Registers	Description
1	1.0	01	OXXXX	Read Multiple Coil Outputs
2	2.0	02	1XXXX	Read Multiple Coil Inputs
3	3.0	03	4XXXX	Read Multiple Analog Outputs
4	4.0	04	3XXXX	Read Multiple Analog Inputs
7	5.0	07	XXXXX	Read Exception Coil ¹
5	6.0	05	OXXXX	Write Single Coil Output
6	7.0	06	4XXXX	Write Single Analog Output*
8	8.0	15	OXXXX	Write Multiple Coil Outputs
9	9.0	16	4XXXX	Write Multiple Analog Outputs**

* = For 16-bit Registers ONLY. ** = For 16-bit & 32-bit Registers. 1 = Not Supported

Note: For ControlWave use Custom Function Block if not using I.P. Note: For ControlWaves implementing I.P. use the ControlWave I/O Configurator. Note: Discrete Outputs are referred to as Coil Outputs under the Description column.

Ethernet and RS-485 I/O Modules can be configured to use Daniel Extensions or a pair of registers when responding to Modbus commands from a Modbus master device. Daniel Extension support is provided by some Modbus devices as a means of transferring 32-bit registers. These extensions are detailed in the Daniel Industries document, <u>Modbus Communications 2500 Host-Slave Com-munications</u> Number 3-9000-545 Rev. C (or higher).

Ethernet and RS-485 I/O Modules can be configured to use Daniel Extensions or a pair of registers when responding to Modbus commands from a Modbus master device. Ethernet High Speed Counter Modules do not support Daniel Extensions. The 32-bit registers in the High Speed Counter Module are read as a pair of 16-bit registers only.

Modules acting as Modbus master stations. When Daniel Extension support is disabled, Modbus data is transferred as a pair of analog registers. See the topic <u>Transfer Longs and Floats as a Pair of Analog Registers</u> in the <u>Modicon Modbus Protocol Reference Guide</u> for more information.

Daniel Extension Support

Modbus Slave Operation

Modbus Master Operation Access to different types of I/O is supported by the Modbus messaging protocol via address ranges. Table 2 provides a list of Modbus address ranges assigned to various types od I/O data. Table 3 provides a compilation of I/O Module setup information required for Modbus communications configuration.

Table 2
I/O Module Addresses & Modbus Data Addresses

Data Type	Module Address	Module Data Address
Discrete Input	0000 to 9999	10001 to 20000
Discrete Output	0000 to 9999	00001 to 10000
Analog Input	0000 to 2999	30001 to 33000
Analog Output	0000 to 2999	40001 to 43000
Short Integer Input	0000 to 1999	33001 to 35000
Long integer Input	0000 to 1999	35001 to 37000
Floating Point Input	0000 to 2999	37001 to 40000
Short Integer Output	0000 to 1999	43001 to 45000
Long Integer Output	0000 to 1999	45001 to 47000
Floating Point Output	0000 to 2999	57001 to 50000

Examples: Modbus data address 10001 equates to module DI 0. Modbus data address 30006 equates to module AI 5.

Table 3			
I/O Module Memory Map - ACCOL/ControlWave Setup			

I/O Module	I/O Type	Module Registers	Modbus Register Address	CtrlWave Function Codes	ACCOL Function Codes	Count	Address Range
8DI/8DO	DI	X0 - X7	10001 - 10008	2	2.0	1 to 8	1 to 8
	DO	Y0 - Y7	00001 - 00008	1, 5, 8	1.0, 6.0, 8.0	1 to 8	1 to 8
	TPO^2	AY0 - AY7	40001 - 40008	3, 6, 9	3.0, 7.0, 9.0	1 to 8	1 to 8
	CNT	AX0 - AX7	30001 - 30008	4	4.0	1 to 8	1 to 8
16DI	DI	X0 - X15	10001 - 10016	2	2.0	1 to 16	1 to 16
	CNT	AX0 - AX15	30001 - 30008	4	4.0	1 to 16	1 to 16
8CNT	DI	X0 - X7	10001 - 10008	2	2.0	1 to 8	1 to 8
	CNT^1	AX0 - AX7 or	30001 - 30008	4	4.0	1 to 8	1 to 8
		L10 - L17	35001 - 35008	3	3.0	1 to 8	1 to 8
	Reset	Y0 - Y7	00001 - 00008	1, 5, 8	1.0, 6.0, 8.0	1 to 8	1 to 8
16DO	DO	Y0 - Y15	00001 - 00016	1, 5, 8	1.0, 6.0, 8.0	1 to 16	1 to 16
	TPO^2	AY0 - AY15	40001 - 40016	3, 6, 9	3.0, 7.0, 9.0	1 to 16	1 to 16
8DI/8AI	AI	AX0 - AX7	30001 - 30008	4	4.0	1 to 8	1 to 8
	DI	X0 - X7	10001 - 10008	2	2.0	1 to 8	1 to 8
	CNT	AX8 - AX15	30009 - 30016	4	4.0	1 to 8	9 to 16
4RTD $/4$	RTD	AX0 - AX3	30001 - 30004	4	4.0	1 to 4	1 to 4
DI	DI	X0 - X3	10001 - 10004	2	2.0	1 to 4	1 to 4
	CNT	AX4 - AX7	30005 - 30008	4	4.0	1 to 4	5 to 8
16AI	AI	AX0 - AX15	30001 - 30016	4	4.0	1 to 16	1 to 16
8INS	AI	AX0 - AX7	30001 - 30008	4	4.0	1 to 8	1 to 8
8AI/4AO	AI	AX0 - AX7	30001 - 30008	4	4.0	1 to 8	1 to 8
	AO	AY0 - AY3	40001 - 40004	3, 6, 9	3.0, 7.0, 9.0	1 to 4	1 to 4

Note 1: Count values are reported in 16-bit AI Registers or 32-bit long registers.

Note 2: When configured as TPO, each output will pulse ON at a duty cycle proportional to an AO value stored in an AO Register.

I/O Module	I/O Type	PLC Formats (See PLC Formats – Modbus Master in the Gould Modbus/Open Modbus Interface Section of the ACCOL II Custom Protocols Manual – D4066)
8DI/8DO	DI	8VL
	DO	8VL
	TPO	8VU16
	CNT	8VU16
16DI	DI	16VL
	CNT	16VU16
8CNT	DI	8VL
	CNT AX	8VU16
	UNT L Decete	8VU32
1000	Resets	
16DO	DU TPO	
8DI/8AI		8VU16
ODI/OAI	DI	8VL
	CNT	16VU16
4RTD/4DI	RTD	4VU16
	DI	4VL
	CNT	16VU16
16AI	AI	16VU16
8INS	AI	8VU16
8AI/4AO	AI	8VU16
	AO	8VU16
DI = Discrete AO = Analog RTD = Resist INS = Instrum	Input Output ive Temper nentation A	DO = Discrete Output CNT = CounterAI = Analog Input TPO = Time Proportional Output ature DeviceI - 16-bit high-resolution measurements per channel
ACCOL II Cu Getting Starte Modicon Moc Modbus Com ControlWave	istoms Prote ed with Con ibus Protoc m. 2500 Hc Designer -	cocols Manual - BBI doc. D4066 htrolWave Designer - BBI doc. D5085 col Reference Guide - Modicon doc. PI-MBUS-300 ost-Slave Communications - Daniel Industries doc. 3-9000-545 On-line Help - Custom Function Block

Table 4 - PLC Formats Assigned to I/O Modules & I/O Types

Refer Docu

Softv Assis

ControlWave Ethernet Distributed (Remote) I/O Modules Special Instructions for Class I, Division 2 Hazardous Locations

- 1. The BBI ControlWave Ethernet Distributed (Remote) I/O Modules are listed by Underwriters Laboratories (UL) as nonincendive and is suitable for use in Class I, Division 2, Groups A, B, C and D hazardous locations or non-hazardous locations only. Read this document carefully before installing a nonincendive ControlWave Ethernet Distributed (Remote) I/O Module. In the event of a conflict between the ControlWave Ethernet Distributed (Remote) I/O Modules User Manual (CI-ControlWaveRI/O) and this document, always follow the instructions in this document.
- 2. Wiring must be performed in accordance with Class I, Division 2 wiring methods as defined in Article 501-4 (b) of the National Electrical Code, NFPA 70 for installations within the United States, or as specified in Section 18-152 of the Canadian Electrical Code for installation in Canada.
- 3. WARNING: EXPLOSION HAZARD Substitution of components may impair suitability for use in Class I, Division 2 environments.
- 4. WARNING: EXPLOSION HAZARD When situated in a hazardous location, turn off power before servicing/replacing the unit and before installing or removing I/O wiring.
- 5. WARNING: EXPLOSION HAZARD Do Not disconnect equipment unless the power has been switched off or the area is known to be nonhazardous.

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DOCUMENT NUMBER: <u>CI-ControlWaveRI/O</u> TITLE: <u>ControlWave Ethernet Distributed remote I/O Modules - Customer Instruction</u> <u>Manual</u> ISSUE DATE: <u>AUG., 2001</u>

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Customer Instruction Manual

CI-ControlWaveRI/O

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Ethernet Distributed Remote I/O Modules

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