Baldwin™-Series
Model 2300
Flow Control Drawer
User's Manual

PERMA PURE LLC
A HALMA COMPANY
8 Executive Drive ▪ P.O. Box 2105 ▪ Toms River, NJ 08754

(732) 244-0010 ▪ (800) 337-3762 ▪ fax (732) 244-8140 ▪ www.permapure.com ▪ info@permapure.com

Contents

Unpacking

Perma Pure has made every effort to ship you a high quality product that has been thoroughly inspected and tested. It has been carefully packed to ensure that it arrives at your facility in good condition. Even though every effort has been made to prevent damage during the transportation process, damage can occur by the carrier. This is out of control of Perma Pure and is the responsibility of the carrier to ensure that your equipment arrives intact and undamaged.

- Inspect outside packaging. If there is any visible damage, inform the carrier at the time of deliver. ***This inspection is important! Once the package is signed for, responsibility for any visible damage then transfers to the consignee.***

- Unpack your equipment. Visually inspect the outside of your equipment for any damage. If there is any damage, ***contact the carrier immediately***. Generally, a carrier must be notified within 24 hours of the delivery to make a hidden damage claim.

Items in the carton include:

(1) Model 2300 Flow Control Drawer

(1) User's Manual

If any of the above parts are missing or damaged, call the helpline at **(800) 337-3762 ext-145**.

Introduction

Thank you for purchasing this product from Perma Pure LLC. This manual has been assembled so that it can answer all questions regarding operation. Please keep the operators manual near the equipment for future reference. There may also be optional equipment available that was not ordered at the time of original purchase, which may be described and/or illustrated in this manual.

If you still have any questions regarding your equipment's operation, available options or technical support, please contact your purchasing dealer or contact Perma Pure directly.

Perma Pure LLC
P.O. Box 2105
8 Executive Drive
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Tel: 732-244-0010
Tel: 800-337-3762 (toll free US)
Fax: 732-244-8140
e-mail: info@permapure.com

This equipment is to be installed and operated by trained personnel, with sufficient command of the English language to clearly understand the instructions and safety warnings.

PERMA PURE LLC
A HALMA COMPANY

General description

The Baldwin™-Series Model 2300 Flow Control Drawer is used by some of the largest, most respected stack testing firms. The considerable time, money, and energy saved in collecting data and generating reports gives these companies a competitive advantage. Model 2300 is specially designed to work data logging and reporting software.

Model 2300 Features:

- Automates data collection
- Provides manual, semi-auto, and automatic performance of tests
- Computer control of sample and calibration gases
- Up to 6 gas analyzer channels
- Up to 14 cal gas channels
- Multiple flow meters: cal gas to probe, total flow to analyzers, individual analyzer channels
- Pump vacuum gauge
- Sample / cal gas pressure gauge
- Cal gas regulator

The 2300 contains Dutec® modules to receive inputs from gas analyzers, thermocouples, etc. The analog input modules can accept 0-1V, 0-10V, and 4-20mA and other types of inputs. So, it is capable of interfacing with nearly all analyzers. There are input terminals on the back of the 2300 for these analog inputs and a RS232 port on the 2300 to connect to the PC running the data logging software.

The standard configuration for Model 2300 includes four gas channels and four calibration gases. Flow meters provide visual indication and control of stack calibration gas flow, total sample flow, and individual analyzer flow. Model 2300 is operated remotely from a computer through a serial port (RS232) connection allowing easy control of sample and calibration gases.

Physical description

- Dimensions: 5U (8.75"), 19" Rack Mount, 18" depth
- Weight: 15 lbs (6.8 kg)

Specifications

Input cal-gas channels (maximum of 14)	
Sample	5-15 psig
Vacuum	0-30 in. Hg.
Calibration	5-35 psig
Output gas channels (maximum of 6)	0-2.5 lpm
Blowback	Specify 12 VDC, line voltage or dry contact
Electrical requirements	90-240 VAC, 50/60 Hz; 100 watts

Connections

(refer to Appendix A3 for back panel drawing)

1. All Sample Gas Connections are via 1/4" stainless steel bulkhead fittings.
2. All Calibration Gases are 1/4" SS Tube Quick Connects.
3. All Bulkhead Connections are labeled and follow the following functions:

Sample In --- (SAMPLE)
Sample Vacuum Sense In -------------------------------- (VACUUM)
Calibration Gas Out to Stack Filter Assembly -------- (STACK)
Analyzer #1 --- (CH1)
Analyzer #2 --- (CH2)
Analyzer #3 --- (CH3)
Analyzer #4 --- (CH4)
Analyzer #5 --- (CH5)
Analyzer #6 --- (CH6)
Calibration Gas #1-14-------------------------------------- (CG1-14)
Instrument Air Pressure Sense In ---------------------- (INSTR AIR)

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Important Safety Warnings

Please be sure to review the following basic safety procedures. These procedures represent the MINIMUM requirements to operate the equipment safely. It is the ultimate responsibility of the operator to ensure proper safety practices are utilized at the point of operation.

- **NEVER** attempt to operate this equipment in an explosive or otherwise hazardous area.
- **NEVER** exceed any specified rating for the equipment. Voltage, temperature and pressure ratings must be closely observed and not exceeded. Voltage rating of the equipment **MUST** match the rating on the data label. Please make sure that it matches before powering up the equipment.
- This equipment is **NOT** designed to be used in an explosive environment.
- This equipment is **NOT** designed to operate in a wet environment.
- **Sample gas is potentially dangerous**. A leak test is recommended at initial startup and as often as necessary to maintain a safe working environment around the equipment. The gas stream exhaust must exit away from all personnel to prevent dangerous exposure.
- **NEVER operate the equipment with any part of the enclosure unsecured**. All operated doors and covers must be in place and secured prior to operation. Electrical current may be present behind covers or doors, even if tools are not necessary to access these components.
- **NEVER** attempt service on this equipment without first disconnecting all energy sources. Repair of this equipment should only be done by properly trained personnel that are familiar with the potential risks involved with servicing of the equipment.
- **NEVER** replace fuses with types other then the sample specification of type and current. Do not bypass this or any other safety device.
- **NEVER** operate this equipment if it is visibly damaged or the possibility exists that it may have been damaged.
- The use of components that have not been purchased through an authorized Perma Pure dealer or directly from Perma Pure may compromise the safety of the operator. Additionally, use of non-authorized components may change the operating characteristics of this equipment. Any changes to the equipment, that modify its operation in any way, are dangerous, and are strictly prohibited.
- Read the entire operating manual before attempting to set up or operate the equipment.
- Please heed all warning labels that are on the equipment. They are there to remind you of possible hazardous conditions.
- Verify the integrity of any mechanical and/or electrical connections that are made to the unit.
    - Verify that the unit is connected to the proper rated power for the system
    - Verify that the unit is plumbed properly to operate effectively

Operation

A dry, filtered gas sample flows from a sample conditioning system into the Model 2300 Flow Drawer sample/calibration manifold. Here, either sample or calibration gas (for direct calibration) can be directed to the atmospheric pressure sample manifold and then on to the individual analyzer gas channels. Individual sample flow meters indicate the flow rate of each gas channel. A bypass flow meter vents excess sample gas not used by the continuous gas channels and also acts as an atmospheric vent.

The Model 2300 has a provision for system bias checks. System integrity is verified by comparison of calibration gas flow through the stack filter assembly to calibration gas flow directly to the gas analyzers. This check indicates problems such as system leakage and gas component loss.

A probe filter blowback relay contact is provided on the Flow Control Drawer to facilitate computer initiated blowback.

Functional control

The flow control drawer is controlled through the 9-pin serial port located on the back panel. A laptop or PC must be used to control the model 2300 drawer. Any suitable software which communicates to the flow drawer, using the OPTO-22 OPTOMUX serial communications protocol for remote data acquisition and control, can be connected to the flow drawer. All calibration gas (GC) functions, direct/system and blowback are available for control through the computer.

System and Direct calibration is also indicated by the local front panel LED's.

Control functions

DUTEC Module Input Digital OPTO Channel #	Sample	Blowback	Calibration Valve #	Direct Calibration	System Calibration
0			CAL VALVE 1		
1			CAL VALVE 2		
2			CAL VALVE 3		
3			CAL VALVE 4		
4			CAL VALVE 5		
5			CAL VALVE 6		
6			CAL VALVE 7		
7			CAL VALVE 8		
8					
9					
10		BLOWBACK			
11					
12					
13					
14				SYSTEM/DIRECT	

DUTEC Module Analog Input OPTO Channel #	Back Panel Terminal Strip Assignment	Analyzer
1 = 0-1 or 10VDC input	IOP module 0	O2 analyzer
2 = 0-1 or 10VDC input	IOP module 1	CO2 analyzer
3 = 0-1 or 10VDC input	IOP module 2	SO2 analyzer
4 = 0-1 or 10VDC input	IOP module 3	NOx analyzer
5 = 0-1 or 10VDC input	IOP module 4	CO analyzer
6 = 0-1 or 10VDC input	IOP module 5	THC analyzer
7 = 4-20mA input	IOP module 6	Sample Pressure Transducer
8 = 4-20mA input	IOP module 7	Pump Vacuum transducer
9 = 4-20mA input	IOP module 8	Condenser dewpoint
10 = spare		
11 = spare		
12 = spare		
13 = spare		
14 = spare		
15 = 5-60VDC output	IOP module 14	Blowback control valve
16 = 12VDC current source for 4-20mA pressure/vacuum board outputs		

***Type "K" TC input connector located inside 2300 drawer.

The Model 2300 Flow Control Drawer has the ability to switch the sample and as many as fourteen calibration gases to the analyzer rack directly or via the total sampling system. This is done through two sets of solenoid valves: the calibration gas solenoid valves (SV1-14) mounted on a common manifold at the rear of the drawer and the direct/system/AIT solenoid valves (SV10-16) located in the middle of the drawer. A block & bleed solenoid valve (SV9) which prevents the manifolds from being pressurized during sampling is also part of the direct/system/AIT solenoid valve set.

The 2300 flow control drawer has one model of operation: Computer Control (CC).

In the computer control, calibration gas solenoid valves are individually controlled by the program. The programmer can select any or all of the calibration gas solenoids. The calibration function will only take place when both a calibration gas solenoid valve and either the system solenoid valve or direct solenoid valve have been selected.

Blowback is initiated only by the computer. There is a 250V, 6 amp dry contact form C relay output provided on the back panel for blowback implementation. There is one horizontal terminal block assembly on the back panel provided for gas analyzer and other CEMS analog process signal input interface.

Computer control operation mode

Computer Control (CC) mode operation is initiated through the serial port connector. To activate a particular function, the internal Dutec OPTO channel controls 12VDC is applied to the appropriate digital output terminal for controlling the solenoids or other digital control functions as optionally installed.

Maintenance operation under computer control mode: the operator may take any or all analyzers off line for maintenance or repairs while in normal operation, that is, while under computer control. To perform maintenance or repairs on an analyzer, select Direct/System solenoid on. The system will continue to operate in its normal fashion, but the analyzer gas channels will not be active.

NOTE: If an analyzer, when taken off line is removed or should not receive calibration gas, then the particular flow meter should be turned off or the analyzer bulkhead on the back panel should be plugged.

Computer control truth table

Terminal #	2	4	1	3	5	7	9	11	13	15	6
FUNCTION											D
System/Calibration 1	*		*								D
System/Calibration 2	*			*							D
System/Calibration 3	*				*						D
System/Calibration 4	*					*					D
System/Calibration 5	*						*				D
System/Calibration 6	*							*			D
System/Calibration 7	*								*		D
System/Calibration 8	*									*	D
Direct/Calibration 1		*	*								D
Direct/Calibration 2		*		*							D
Direct/Calibration 3		*			*						D
Direct/Calibration 4		*				*					D
Direct/Calibration 5		*					*				D
Direct/Calibration 6		*						*			D
Direct/Calibration 7		*							*		D
Direct/Calibration 8		*								*	D
Blowback											*

D = Disabled

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Troubleshooting and Maintenance Guide

Symptom	Diagnostic	Fix
No LED display	Not plugged in	Plug in instrument
	Power switch is off	Turn on power
	Fuse blown	Replace fuse
	Power supply defect 12 VDC red-black	Replace power supply
	Check jumper JP1	Jumper 1-2; 3-4; 5-6
	Ribbon cable loose Defective control board	Tighten ribbon cables Replace control board
Manual Control (Local) Computer has no effect	Serial port disconnected	Remove top cover and check LED trans/receive LED indicator on the Dutec module.
Inadequate sample flow	Low sample pressure	Adjust sample pressure Cylinder to 15 psig
No system cal gas flow	No cal gas from bottle	Check cabling
	Cal gas solenoid not operating	Replace cal gas solenoid Replace control board
	Flow drawer regulator set <10psig	Set regulator to 10 psig
	Cal gas Flow meter closed	Adjust Flow meter
	Block/bleed solenoid constantly vents	Replace solenoid SV9
	System cal gas solenoid valve defective	Replace solenoid SV10
No direct cal gas flow	Direct cal gas solenoid valve defective	Replace solenoid SV11 Check cables and connector boards for good connections
Computer Control (Remote) Computer control has no effect	No Serial Communication	Remove top cover and check Dutec LED.
	Computer control wiring to terminal block is wrong	See the computer control wiring section in manual.
	Ribbon cable is loose	Check cables.
	Defective control board	Replace control board
No computer sense	Computer sense wiring to terminal block is wrong.	See computer control wiring section in manual
	Ribbon cable is loose	Check cables

Replacement parts

Part No.	Description
2FTS-021	Cal-Gas Connector
3DCB-004	Circuit Board: Display, FCD
1RYD-002	Dutec Module: Analog Input, 0 – 1 VDC
1RYD-003	Dutec Module: Analog Input, 0 – 10 VDC
1RYD-001	Dutec Module: Analog/Digital I/O Plexer
1RYD-004	Dutec Module: Digital I/O Plexer
1RYD-005	Dutec Module: Digital Output, 3 – 60 VDC, 3.5 Amps
2FIV-003	Flowmeter: 0.1 – 10 LPM w/ Valve
2FIN-002	Flowmeter: 0.1 – 10 LPM, No Valve
2FIV-005	Flowmeter: 0.2 – 2.5 LPM w/ Valve
1PSD-013	Power Supply: 100 W, 12 VDC
2GAP-006	Pressure Gauge: 2½" Dia Face

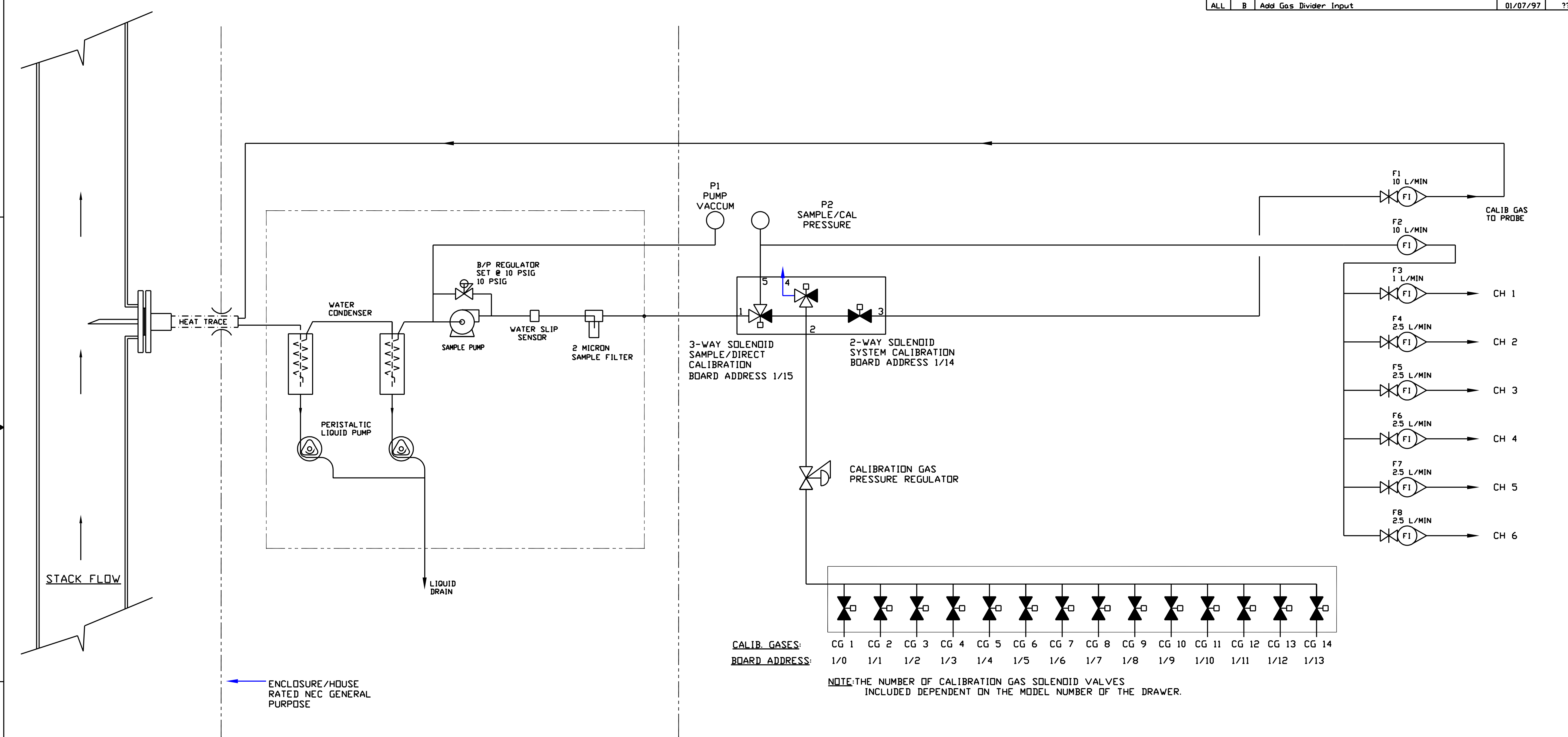
Appendix A: Flow Control Drawer Drawings

A1: Flow schematic
A2: Arrangement drawing
A3: Back panel
A4: Wiring diagram
A5: Data logging wiring diagram

REVISIONS

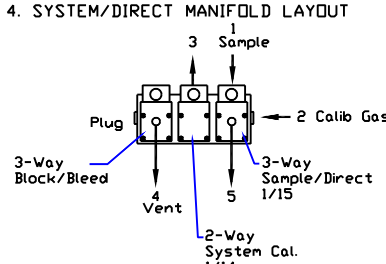
USED FOR: DESCRIPTION: Flow Control Drawer For Reference Method Testing
MODEL NUMBER: 2500

ZONE	LTR	DESCRIPTION	DATE	APPROVED
ALL	A	INITIAL	03/16/96	R. DANIEL
ALL	B	Add Gas Divider Input	01/07/97	??????



NOTES:

1. DRAWING IS FOR INFORMATION ONLY.
2. BEI IS RESPONSIBLE ONLY THOSE ITEMS MARKED WITH BEI'S MODEL NUMBER.
3. BEI IS NOT RESPONSIBLE FOR INTERCONNECTING TUBING, HEAT TRACE, WIRING OR CALIBRATION GASES.
4. SYSTEM/DIRECT MANIFOLD LAYOUT



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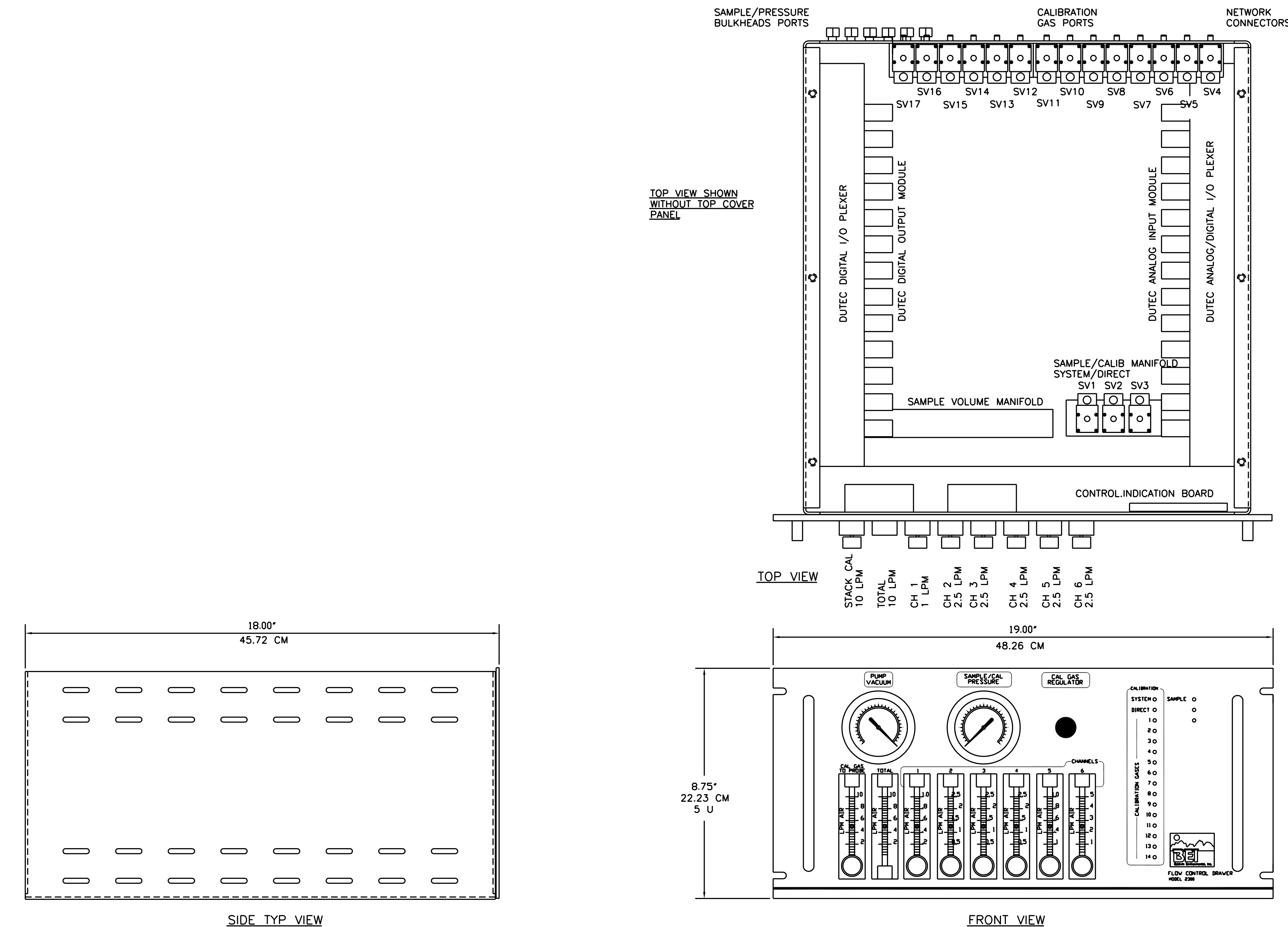
DRAWN BY: R. DANIEL	DATE: 01-16-95
APPD:	DATE:
MATERIAL	
FINISH	

DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

BALDWIN ENVIRONMENTAL, INC.

FLOW CONTROL DRAWER
P&ID

SIZE	CODE IDENT NO.	DRAWING NO:
B	24821	608370
SCALE: 1/2		SHEET 1 OF 1



NOTES:

1. ARRANGEMENT AND DIMENSIONS MAY CHANGE ACCORDING TO GOOD ENGINEERING PRACTICES

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LTR	DATE	DESCRIPTION	DWN	APVD
A	11/20/94	INITIAL SUBMITTAL	RTB	

REVISIONS

USED FOR: MODEL NUMBER: DESCRIPTION:

DRAWN BY: DATE 11-20-94

APPD DATE

MATERIAL

FINISH

DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

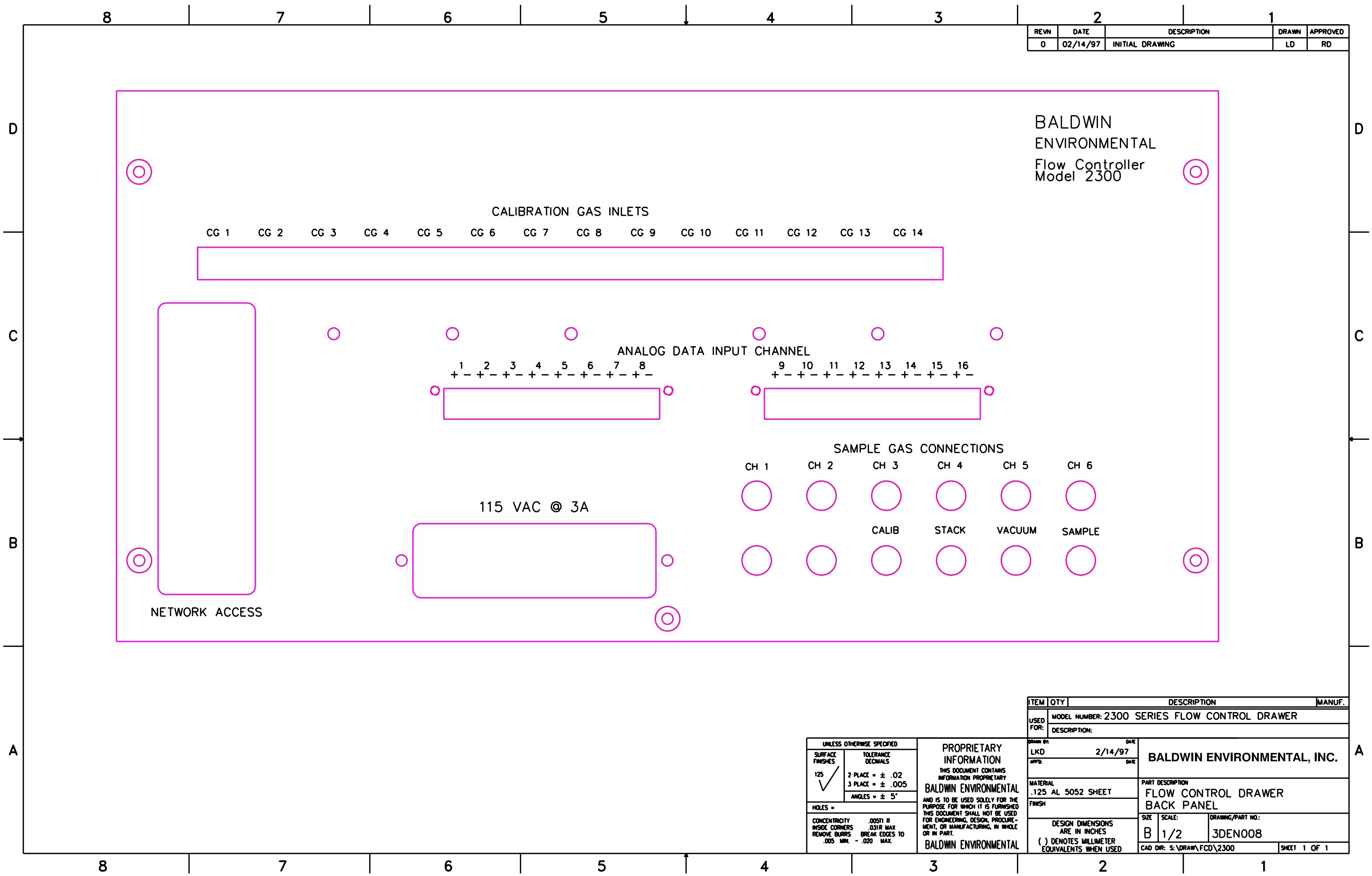
BALDWIN ENVIRONMENTAL, INC.

FLOW CONTROL DRAWER ARRANGEMENT DRAWING

SIZE	CODE IDENT NO.	DRAWING NO.
B	24821	608370B

SCALE: NONE — SHEET 1 OF 1

SIZE D — DWG. NO.


BALDWIN
ENVIRONMENTAL
Flow Controller
Model 2300
CALIBRATION GAS INLETS
CG 1 CG 2 CG 3 CG 4 CG 5 CG 6 CG 7 CG 8 CG 9 CG 10 CG 11 CG 12 CG 13 CG 14
ANALOG DATA INPUT CHANNEL
1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16
SAMPLE GAS CONNECTIONS
CH 1 CH 2 CH 3 CH 4 CH 5 CH 6
CALIB STACK VACUUM SAMPLE
115 VAC @ 3A
NETWORK ACCESS
REVN DATE DESCRIPTION DRAWN APPROVED
0 02/14/97 INITIAL DRAWING LD RD
ITEM QTY DESCRIPTION MANUF.
USED FOR: MODEL NUMBER: 2300 SERIES FLOW CONTROL DRAWER
DESCRIPTION:
UNLESS OTHERWISE SPECIFIED
SURFACE FINISHES 125
TOLERANCE DECIMALS
2 PLACE = ± .02
3 PLACE = ± .005
ANGLES = ± 5°
HOLES =
CONCENTRICITY .005TI R
INSIDE CORNERS .031R MAX
REMOVE BURRS BREAK EDGES TO .005 MIN. - .020 MAX.
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BALDWIN ENVIRONMENTAL
DRAWN BY: LKD DATE 2/14/97
APPD: DATE
MATERIAL .125 AL 5052 SHEET
FINISH
DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED
BALDWIN ENVIRONMENTAL, INC.
PART DESCRIPTION
FLOW CONTROL DRAWER
BACK PANEL
SIZE B
SCALE: 1/2
DRAWING/PART NO.: 3DEN008
CAD DIR: S:\DRAW\FCD\2300
SHEET 1 OF 1

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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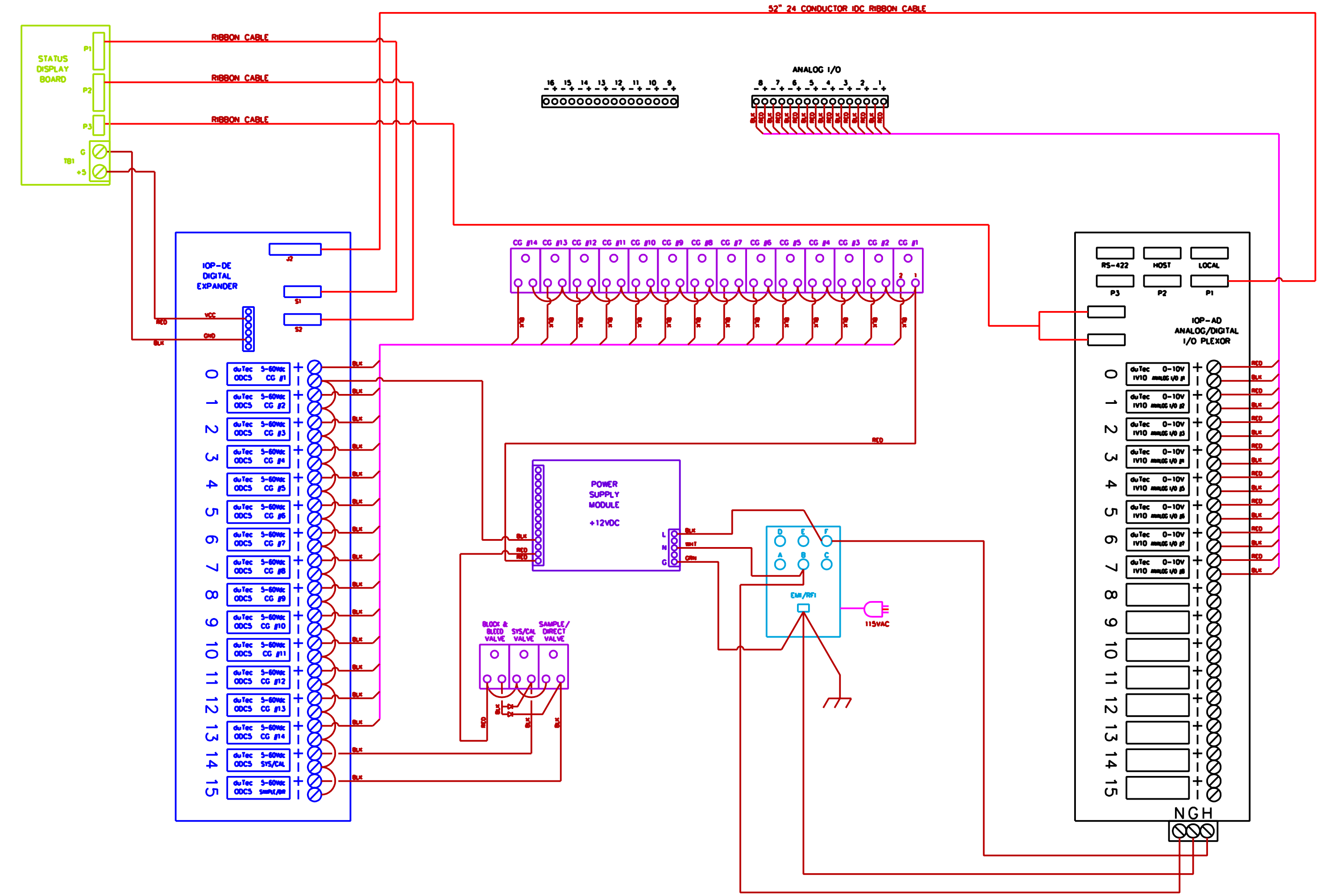

ITEM	QTY	DESCRIPTION	MANUF.

USED FOR: MODEL NUMBER: 2300 FLOW DRAWER

DESCRIPTION:

UNLESS OTHERWISE SPECIFIED

TOLERANCE DECIMALS

1 PLACE = ±.02

2 PLACE = ±.02

3 PLACE = ±.010

SURFACE FINISHES 125

ANGLES = ±5°

HOLES = +.003/-.001

BEI Baldwin Environmental, Inc.

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BALDWIN ENVIRONMENTAL

DRAWN BY: raw DATE 10/26/05

APP'D: DATE

MATERIAL

FINISH

DESIGN DIMENSIONS ARE IN INCHES

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BALDWIN ENVIRONMENTAL, INC.

PART DESCRIPTION

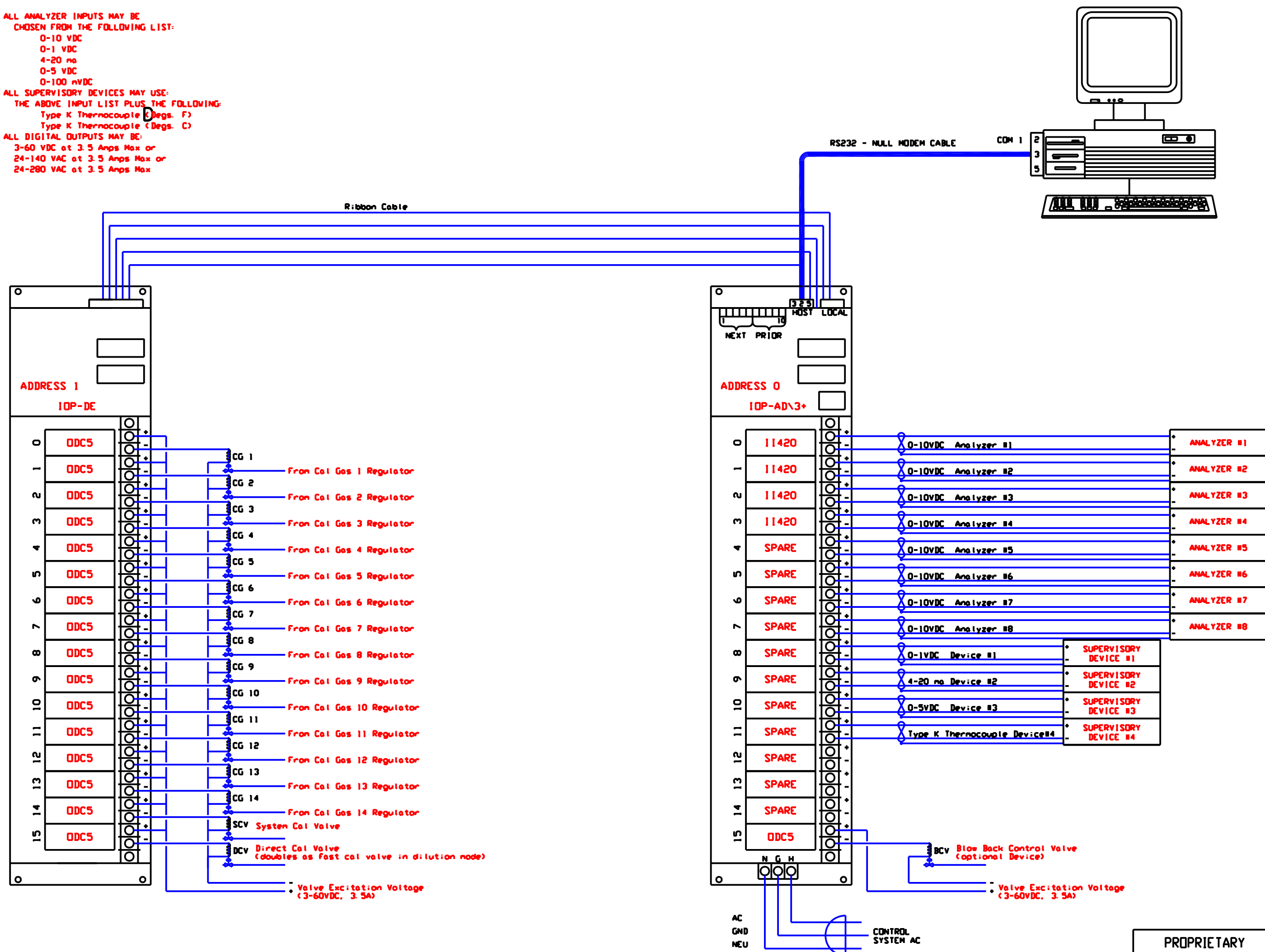
SIZE: A SCALE: NTS DRAWING/PART NO.: 2300-W-1

CAD DIR: S:\DRAW\S:\DRAW\SCH\ELECT SHEET 1 OF 1

NOTES:

1) ALL ANALYZER INPUTS MAY BE CHOSEN FROM THE FOLLOWING LIST:
   - 0-10 VDC
   - 0-1 VDC
   - 4-20 ma
   - 0-5 VDC
   - 0-100 mVDC
2) ALL SUPERVISORY DEVICES MAY USE: THE ABOVE INPUT LIST PLUS THE FOLLOWING:
   - Type K Thermocouple (Degs. F)
   - Type K Thermocouple (Degs. C)
3) ALL DIGITAL OUTPUTS MAY BE:
   - 3-60 VDC at 3.5 Amps Max or
   - 24-140 VAC at 3.5 Amps Max or
   - 24-280 VAC at 3.5 Amps Max

REVISIONS				
USED FOR: 2500	DESCRIPTION: FLOW CONTROL DRAWER FOR REFERENCE MOTHOD TESTING			
ZONE	LTR	DESCRIPTION	DATE	APPROVED
ALL	ALL	FIRST DRAFT	1-7-97	????



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DRAWN BY: C. McDONALD	DATE: 1-7-97
APPD: ????	DATE: ????
MATERIAL	
FINISH	
DESIGN DIMENSIONS ARE IN INCHES ( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED	

BALDWIN ENVIRONMENTAL, INC.

FLOW CONTROL DRAWER ELECTRICAL WIRING

SIZE	CODE IDENT NO.	DRAWING NO.
B		PARA 5_A
SCALE: NTS		SHEET 1 OF 1

Appendix B: Dutec Module

July 2004
First Revision

I/O PLEXER
Hardware
Users
Manual

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Toll Free: 800-248-1632
Fax: 419-666-4702

E-Mail: info@dutec.net
http://www.dutec.net

Notice to the User

The information contained in this manual is believed to be correct. However duTec inc. assumes no responsibility for any of the circuits described herein, conveys no license under any patent or other right and makes no representations that the circuits are free from patent infringement. duTec inc. makes no representation or warranty that such applications will be suitable the use specified without further testing or modification.

DuTec inc. general policy does not recommend the use of its products in life support applications where failure or malfunction of a component may directly threaten life or injury. It is a condition of sale that the user of duTec inc. products in life support applications assumes all risk of such use and indemnifies duTec inc. against all damage.

Warranty

duTec inc. warrants its products to be free of defects in materials and workmanship for a period of two (2) years from the shipment date. DuTec inc., at its option, will repair or replace all material found to be defective. All repair or replacement must be performed by duTec inc. personnel. Any parts determined by duTec inc. to be defective as a result of abuse, misuse or attempts to repair will be repaired at the expense of the customer. DuTec inc. will not be held liable for any consequential, incidental, or special damages.

Overview

I/OPLEXERs are a family of small, completely self-contained, industrial grade, remote data acquisition and control systems which exchange data with a Host computer via a serial communication link. Controlled by a Host, I/OPlexers are located near the sensors and actuators. The serial link eliminates the need for expensive and noise prone field wiring between sensors and actuators, and a central control room.

In applications such as remote process monitoring, factory automation, and energy management, a variety of signals must be transmitted over long distances. Instead of requiring expensive, multi-conductor, sensor wiring for each signal, cabling costs can be reduced significantly by using I/O PLEXERs and a single communications circuit. One of the most useful features of the I/O PLEXER is that in addition to gathering "raw" data, it can be instructed to perform many ranging and statistical operations on the data before it is given to the Host; thus allowing the Host to spend less time manipulating numbers and more time gathering them. Also the I/O PLEXER is able to spend more time exposed to the data which in turn allows it to base its responses to the Host on more samples of data. The I/O PLEXER may also be directed to manipulate the outputs in specific ways to produce delayed or repetitive effects.

Capacity:

Each I/O PLEXER Master unit will hold any mix of 16 analog or digital, electrically isolated input or output modules which can interface to a wide variety of sensors and actuators.

The I/O PLEXER Digital Expander, in an identical enclosure, provides an additional 16 digital I/O module positions for each master unit. Up to three Digital Expanders can be attached to each master chassis. See Page 1-8 For ordering information.

I/O PLEXER networks can service over 4000 analog and or digital I/O Lines in various Combinations.

Product Test

Every I/O PLEXER is burned-in while operating in a a network of a period of 24 hours at 70° C, prior to shipment.

Every I/O module is tested while its operating environment temperature is cycled over the specified operating range of 0° C to 60° C for a period of 24 hours. A computer record is maintained for *every* analog I/O module.

Throughput:

System response or throughput for the I/O PLEXER can be calculated using appendix B.

I/O Signal Compatibility

I/O PLEXERs use duTec I/O modules to match signal requirements exactly. With a direct interface to sensors, no external signal conditioning is required. Furthermore, all duTec modules feature total electrical isolation, both module-to-logic, and module-to-module.
Analog modules are available to measure:

- Millivolts DC to hundreds of volts AC
- Milliamps DC to amps AC
- Frequency to tens of KHz
- Temperature with all popular thermocouples and resistive temperature devices

A full range of industry standard digital modules is available for AC, DC and dry contact inputs and outputs to hundreds of volts.

Thermocouple modules provide a cold reference junction compensation. I/O PLEXER instructions provide linearized thermocouple and RTD sensor data. Engineering unit conversions are handled at the Host level.

Built-in Diagnostics:

On power-up, the unit self-tests for system faults and reports via a sequential display. Should hardware or firmware fail, an on board hardware watchdog provides safe shutdown by turning off all outputs. Normally ON modules are available for those loads that must remain ON.

Easy Setup:

The I/O PLEXER has its own power supply, no need to purchase or reserve space for an external supply. A push-button and an on board LED indicator configure unit address and baud rate. Removable terminal strips allow attachment/ removal of multiple cable sets in one step. This modularity greatly reduces troubleshooting and upgrade delays.

Protocol Compatibility

The I/O PLEXER instruction set core complies 100% with the OPTO-22 OPTOMUX serial communications protocol for remote data acquisition and control. With speak-only when spoken to protocol, which only uses ASCII printing characters, a Host transmits inquiry requests to the I/O PLEXER to determine the status of its various process inputs. Based on the reported status, the Host makes control decisions and transmits this data, as instruction messages, to the I/O PLEXER which uses the new decisions to make the proper changes to its various actuators. Both the Host and the communications link are essential elements in this data acquisition and process control scheme.

Originally, the protocol only allowed for all analog or all digital I/O chassis. Depending on application requirements, each I/O PLEXER can respond to up to five different function addresses. With their abbreviations they are:

MC	Master Unit Control function address
MD	Master Unit Control digital I/O function address
MA	Master Unit Analog I/O function address
E1	1st Expander Digital I/O function address
E2	2nd Expander Digital I/O function address
E3	3rd Expander Digital I/O functions address

It is the multiple function addressing capability of the I/O PLEXERs that allow s them to utilize, *without modification*, software developed for competitive products. Similarly I/O PLEXERs can operate simultaneously on the same network with these products.

Available I/O Functionality:

Analog Inputs

Input Value	Determines signal levels, with 12 bits resolution*
Offsets	Input values can be software offset, with 12 bits resolution, over the module's specified range.
Gain/ Slope	The amplitude of input values can be software multiplied by factors ranging from 0.25 to 4.0.
Range Limits	The occurrence of input values falling out of user defined upper or lower limits can be flagged.
Minimums	The minimum level input values can be captured.
Maximums	The maximum level input values can be captured.
Averages	Can calculate average input amplitude for 1-65,535 samples.
Temperature	Can linearize in °C, inputs from thermocouples and RTD's. Will also return temperature probe data.

Analog Outputs

Level Value	Can set output levels, as a fraction of the module's full scale range, and are specified with 12 bits resolution.
Waveforms	Analog outputs can provide square, triangular, sawtooth or ramp waveforms. Maximum and minimum amplitudes, as a fraction of the output module's full scale range, are specified with 12 bits resolution. Waveform periods are specified from 0.1 to 6,553 Sec. (109 Minutes). All waveforms are made up of at least 10 segments.

* One part in 4095

Digital Inputs

Read	Read the ON or OFF state of *all* inputs.
Pulse widths	The duration of a single pulse or total on/ off time of consecutive pulses can be resolved to the nearest 0.01 seconds for a max total of 10.9 min, or 46.6 Hrs with multiplied resolution. Positive or negative edges initiate measurements. The time scale can be multiplied by a factor of 1-256on a system wide basis.
Pulse Counting	Pulses can be counted up to a total of 65,535. To be reliably counted, pulses must have a minimum On and minimum OFF times of 1 msec. Thus the maximum counting rate for a 50% duty cycle squarewave with equal ON and OFF times for a total of 2 msec would be 500HZ.
Edge Detection	Off-to-On and On-to-Off transitions can be detected within 1 msec of their occurrence. Action is only reported each 10 msec.
Note:	The response time performance of digital input instructions can be limited by the delay in the input modules themselves which can have ON plus OFF delays of up to 40 msec.

Digital Outputs

Set outputs	Can set *individual* or *multiple* outputs ON or OFF.
Modifiers	
One Shot	Can generate ON or OFF pulse durations of up to 655.35 seconds with a resolution of 0.01 seconds. Resolution can be further multiplied by a factor of 1-256 on a system wide basis.
Delayed	Can generate delayed ON or OFF outputs of up to 655.35 seconds with a resolution of 0.01 seconds. Resolution can be further multiplied by a factor of 1-256 on a system wide basis.

Squarewave	Can generate squarewaves with programmable ON and OFF periods. On and OFF periods have a base range from 0.01 to 2.55 seconds. Resolution can be further multiplied by a factor of 1-256 on a system wide basis. Re-Triggering is available.
Pulse Generator	Can generate 1to 65,535, 50% duty cycle pulses whose equal ON and OFF periods can range from 0.01 to 2.55 Sec. Resolution can be further multiplied by a factor of 1-256 on a system wide basis.

Extended capabilities:

In addition to operating under control of a Host, option /L of the I/O PLEXER has the ability to perform local control functions without the Host. Local control functions (LCF's) can insure the continued safe operation of closed loop control should the Host or its communication link fail. In addition, the LCF's can substantially reduce Host computational load or communications traffic.

Once characterized, local control function blocks enable the I/O PLEXER to perform control tasks without the constant involvement of a Host computer. After configuration and activation via Host instructions, LCF's take data from their input port and perform computations and send the results to their outputs where they may drive output modules, or other I/O PLEXER internal functions.

Utilizing the LCF's to perform simple logic tasks such as analog comparisons, the summations, differences, sequence generating or multiple state machine operations eliminates the need for programmable controllers or special purpose circuitry. This capability allows a more effective use of the Host computer and its communication link because the LCF's handle the operation of the designated control function. In the meantime the Host is only required to monitor over-all system status and generate the system displays and reports. This is particularly valuable for systems using modems of communications.

Communications watchdogs

The I/O PLEXER can be instructed to implement alarm and fail-safe states in the event of a communication failure.

Specifications

Network Communications:

duTec supports several standards for transmitting serialized I/O data between the Host computer and the I/O PLEXERs. In addition to hardwiring, built in modem control lines allow the use of telephone, fiber optic, and radio modems at baud rates of up to 38,400.

	Maximum Distance	
Serial Link	Feet	Meters
RS-232	50	15
RS-422	5,000	1,524
RS-485	5,000	1,524
Modem	Unlimited	Unlimited

In addition to network communications, a separate local RS-232 port, with the same baud rate capabilities, provides the means for Host communications with local serial devices such as keypads, printers, or displays. Actual interaction with these devices is controlled via the Host computer in the form of character strings embedded in standard protocol instructions.

It is not possible to directly access the analog and digital I/O data from the local RS-232 Port. However this data can be obtained by the Host computer and relayed to the auxiliary device connected to the local RS-232 port. Device pinout for this port can be found on the cover plate. Data format is 8 Databits, 1-Stop and no parity.

Physical Characteristics:

Power	Standard	85-132Vac@30W (47-440Hz)
	Option E, E5	105-256 Vac @23W/ 39W (47-440Hz)
	Option /B	10-16 VDC@35W
	Option/C	18-36 Vdc @35W
Environment	Temperature	0° -60°C
	Humidity	95% non-Condensing
Package	Type	Stainless Steel
	Length	17.25 in. (44 cm)
	Width	5.0 in (12.7cm)
	Height (w/ modules)	3.5 in. (8.9cm)
	Weight	4 Pounds (1.8Kg)
Options	/L	Local Control Functions
	/3+	Expansion ports for 3 digital expanders

Ordering Information

Specify duTec products by model number:

IOP-AD	I/O PLEXER for analog and digital signals
IOP-D	I/O PLEXER for digital signals only
IOP-DE	Digital expander chassis (Master must have 3+ option)

Options are specified by a series of suffixes to the model number, preceded by a slash. For example:

IOP-AD/3+ Allows the use of up to three digital expanders on an analog capable I/O PLEXER.

IOP-D/B Specifies a digital only I/O PLEXER with a 12VDC Compatible power supply.

Available I/O Modules

Analog inputs, 12 Bit		Analog Outputs, 12 Bit	
Frequency		Voltage	
IF10K-B	Input 300Hz-10Khz	OV1	Output 0-1V, self sourcing
IF2.5K-L	Input 0-2.5Khz	Ov5	Output 0-10V, self sourcing
IF5K-L	Input 0-5Khz	Ov10	output 0-10V, self sourcing
IF10K-L	Input 0-10 KHz		
Voltage		Current	
IV25M	Input 0-25mV	01420	Output, 4-20mA Self-Sourcing
IV50M	Input 0-50mV		Into 275 Ohm Load.
IV100M	Input, 0-100mV	**Digital**	**Inputs**
IV1	Input 0-1V		
IV5	Input 0-5 V	AC	
IV5B	Input bi-polar ±5V	IAC5	Input 90-140Vac
IV10	Input 0-10V	IAC5A	Input 180-280Vac
IV10B	Input Bi-polar ±10V	DC	
IVAC	Input 28-140 Vac	IDC5D	Input 3-32 VDC fast>500Hz
IVAC-A	Input 56-280 Vac	IDC5NP	Input 10-32 Vdc, 15-32
Current			Nonpolar
II420	Input 4-20 mAdc	**Digital**	**Outputs**
IIAC5	Input 0-5Aac	AC	
Thermocouple			
ITCE	Type E 0° to 435°C	OAC5	Output 12-140 Vac, 3.5A
ITCJ	Type J 0° to 700°C	OAC5A	Output 24-280Vac, 3.5A
ITCJ-1	Type J -80° to 750°C	OAC5A5	Output 24-280Vac 3.5A NC
ITCK	Type K -100° to 924°C		
ITCK-1	Type K -110° to 1250° C	OAC5J	Output 20-280Vac, 6.0A
ITCR	Type R 0° to 960° C	DC	
ITCR-1	Type R 0° to 1760° C	ODC5	Output 5-60 Vdc, 3.5A
ITCS	Type S 0° to 1034° C	ODC5A	Output 4-200Dc, 1.0A
ITCS-1	Type S 0° to 1760°C	ODC5R	Electro-Mechanical 0.5A Relay Form A NO
ITCT	Type T -200° to 224° C	**Special**	**Purpose**
ITCT-1	Type T -120° to 400° C	IDC5S*	Dry input contact sense, built in
ITCT-2	Type T 0° to 150° C		isolated source
RTD			
ITR100	100 Ohm PT -50° to 350°C	IDC5Z*	Input±200mV, 0-10Khz
ITR100-1	100 Ohm PT 0° to 100°C		(digital)**
Type 590	Temperature Sensor	SPS-1*	Sensor power supply 18-24Vdc, 30mA
ITP590	-188.4° to 150°C	TIO1	Digital Input/output Test Module
ITP590-1	-50.0° to 150°C		with field switch and LED
* When Selecting A power supply for the		**Support**	**Products**
system, assume 25mA for standard digital		Fuses	
modules and 100mA for modules marked		FMP-06	Fuse Assy 0.062A
With an *		FMP-1	Fuse Assy, 1A
** The IDC5ZModule is used for low-level		FMP-3	Fuse Assy, 3A
signals and will pass signals at the rate of 10Khz The I/OPlexer however is limited by Communications baudrate.		FMP-5	Fuse Assy 5A

Notes:

Installation

Mounting:

In a wall mounted enclosure the I/O PLEXER can be mounted horizontally or vertically. Horizontal installation is good practice as it makes the best use of natural convection.

Figure 2-1 below shows the outline of the I/O PLEXER. Using the keyhole slots, the unit can be mounted with 2-#10 screws on 16.5" centers. Using the corner holes, the unit can be mounted with 4-#6 or #8 round head or pan head screws located on a 3.5" X 16.5" grid. Hole locations in relation to the overall dimensions are shown below. Both the I/O PLEXER and the digital expander have the same mounting dimensions.

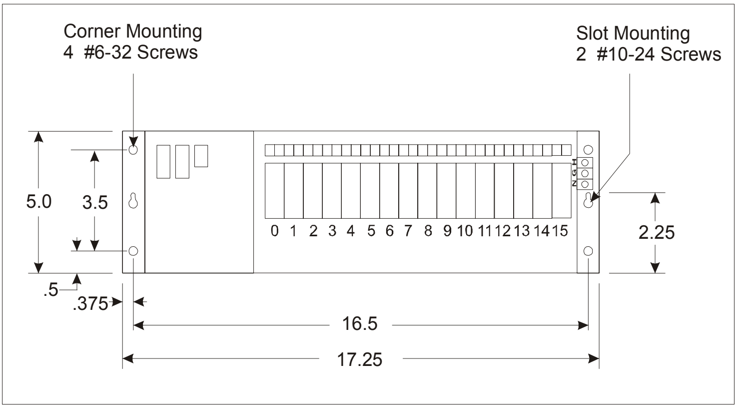


Figure 2-1 I/O Plexer footprint

Power Wiring:

Power connections are made at the 3 position terminal block located on the right end of the I/O PLEXER. No. 8 captive wire clamps accept 10-16 AWG wire or spade lugs. The terminal block cover need not be removed to install wiring.

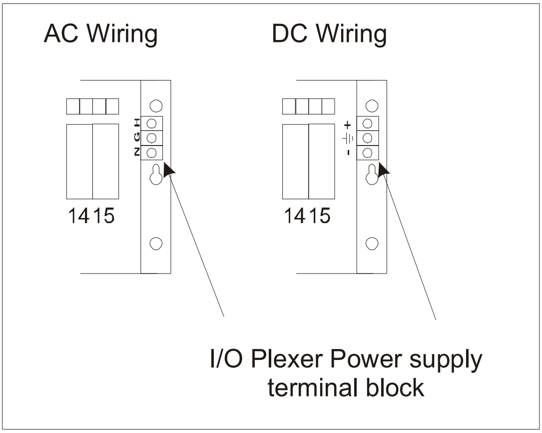


Figure 2-2 Power wiring

The center terminal block position, adjacent to the letter G on the end of the I/O module board, is chassis/ earth ground which is connected to the I/O PLEXER case.

Standard 85-132 VAC, 47-440 Hz and option /E5 105-265 VAC 47-440Hz Operation.
Following power wiring conventions(AWG)

Black wire to terminal marked H (hot)
White wire to the terminal marked N (neutral)
Green wire to the terminal marked G (chassis/ earth ground)

Option /B or /C 10-30 VDC Operation

\+ of the power source to the terminal marked H
\- of the power source to the terminal marked N
Earth Ground, where available to the terminal marked G

Digital Expander

The I/O PLEXER Digital Expander (IOP-DE) Receives its power and signals from the I/O PLEXER via the included 24 pin keyed ribbon cable (duTec part #CE-24) No other power wiring is required. See page 2-14

Designing the network

In order for the I/O PLEXER to share its data with the Host computer, it must be linked via a serial connection. This link can be hard-wired using an RS-232 link (less than 50 Ft), or an RS-422/ 485 twisted pair connection where the wire run between devices is less than 5000 Feet. In situations where distances are greater than 5000 feet or circumstances do not allow additional wire to be installed; RS-232 Radio or telephone modems may be used. In any event, the appropriate transmitter of the I/O PLEXER will be connected to a suitable receiver of the Host computer as shown in figure 2-3

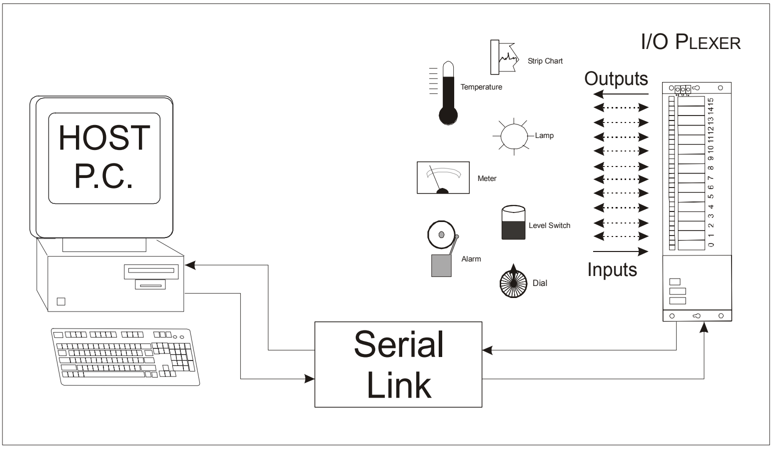


Figure 2-3 Typical installation

Multiple I/O PLEXER Master chassis can be networked together to service large numbers of I/O Points.

The serial communications link between a Host computer and a network of I/O PLEXERs can use various combinations of 3 wire shielded RS-232, dual twisted pair (plus recommended ground shield) RS-422, or single twisted pair (plus recommended ground shield) RS-485.

The Host to first I/O PLEXER can be any of the three, but because most Hosts are equipped with an RS-232 port. This is used most often providing the distance is less than 50 feet. For greater distances, up to 5000 feet, a choice must be made to either equip the Host with an RS-422 or RS-485 card, or use an external RS-232 range extender such as the duTec BaudMaster.

If the Host to first unit link is RS-232, the balance of a network, if any, *can* be a mixture of RS-422 and/or RS-485.

If the Host to first link is either RS-422 or RS-485. The balance of the network, if any, *can* be a mixture of RS-422 and/or RS-485.

For total wire runs less than 5000 feet, both RS-422 and RS-485 networks can operate in multidrop mode. In this configuration every unit attached to the Host computer is passively connected to the network. The benefit to this is that the loss of power to any unit on the network does not affect the ability of other units to respond to the Host computer. A drawback to this approach is that the total length of a multidrop segment can only be 5000 feet.

For ranges greater than 5000 feet, some or all of the I/O PLEXERs can operate in the repeat mode. In this mode, the unit plays an active roll in broadcasting the communications signals. The length of each network segment connected to a unit in the repeat mode can be up to 5000 feet. The limitation of the repeat mode is that a power failure of any single unit disables communications for all units further “downstream” from the Host.

Once the physical network media has been chosen, a decision as to which units, if any will play an *active* roll in signal transmissions. This is to say whether the unit will re-broadcast or *repeat* signals which it does not originate.

Figure 2-4 illustrates the possible networks that can be created by specifying *multidrop* or *repeat* functionality for an individual unit.

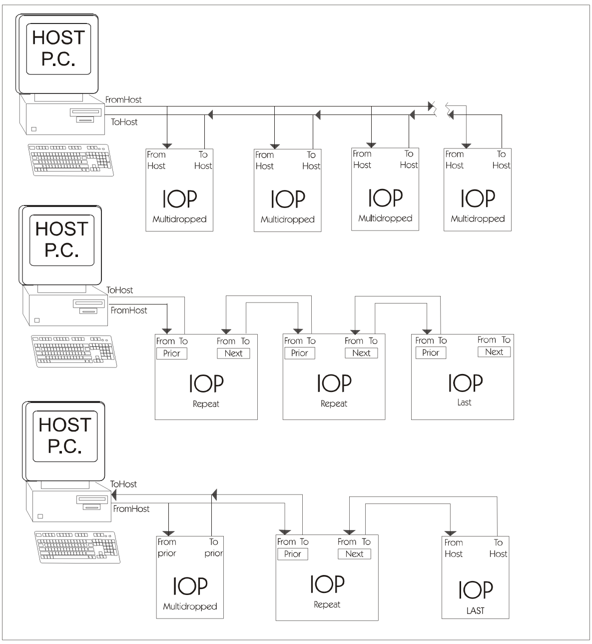


Figure 2-4 I/O Plexer Network Types

Network Type Switches

Based on the selected network configuration, each I/O PLEXER *must* be set up before communications can begin. This is done with the network switches shown below in figure 2-5.

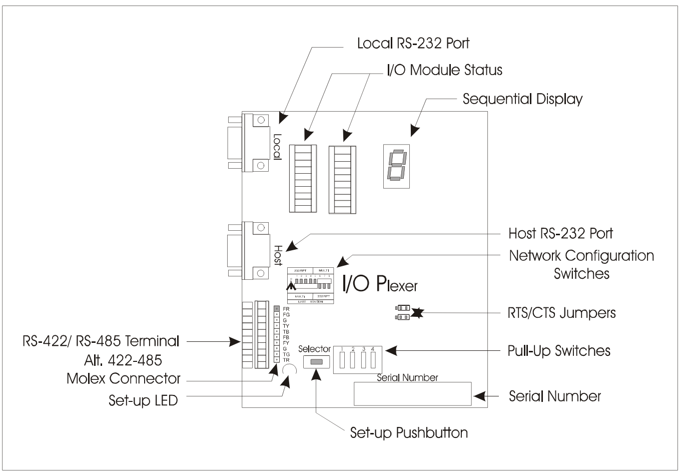
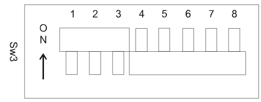
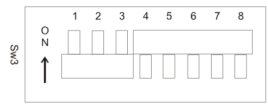
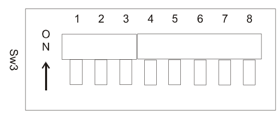


Figure 2-5 Connectors, Switches, and Indicators

The three choices for communication connections for I/O PLEXERs are:

Repeat Used in RS-422, or RS-485 networks to extend range 5000 feet between segments. Also used for RS-232 Host to first unit link if <50 feet. Sequential display reads L1	
Multidrop Used in RS-422 or RS-485 networks. Provides a total network segment range of 5000 feet. Sequential display reads L2	
Last Unit Must be used in RS-422 and RS-485 networks for the unit most distant from the Host. Sequential display reads L3	

If there is only one I/O PLEXER in a network it is designated as Last Unit.

For the network layout the sequential display indicates the letter L followed by 1, 2, or 3. As shipped I/O PLEXERs are setup as L3, Last Unit. This change is not part of the push-button sequence. The displayed value changes from L1 to L2 or L3 only after the DIP switches under the cover have been set and the unit has then undergone a power cycle.

Communications Wiring

Host to I/O PLEXER - RS-232

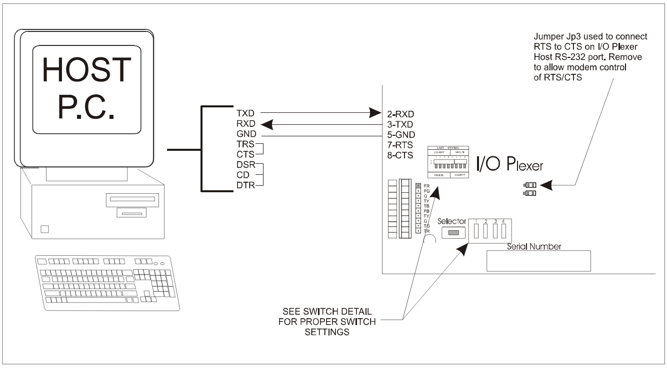


Figure 2-9 RS-232 Host to I/O Plexer wiring

Host to I/O PLEXER RS-232 communications is limited to a distance of 50 Feet. The connector for the Host cable, marked Host RS-232 (See fig. 2-5), is a 9 pin female D submin. Pin assignments for this connector may also be found on the edge of the cover.

The Host connection may be a 9 or 25 pin D submin connector depending on whether the AT or XT connection is used. A duTec cable can be used for this purpose (IOPN-AT, IOPN-XT, or IOPN-AXT).

In addition to the Host to I/O PLEXER wiring, the installer should confirm that the network type switches are set in the RS-232/ RPT positions and that both CTS/RTS jumpers are in the horizontal position as shown. The switches marked “Pull-up” in figure 2-5 should be left in the “ON” position.

2 When distances greater than 50 feet are encountered the Host must be equipped with an RS-422/ 485 device

Modem to I/O Plexer - RS-232

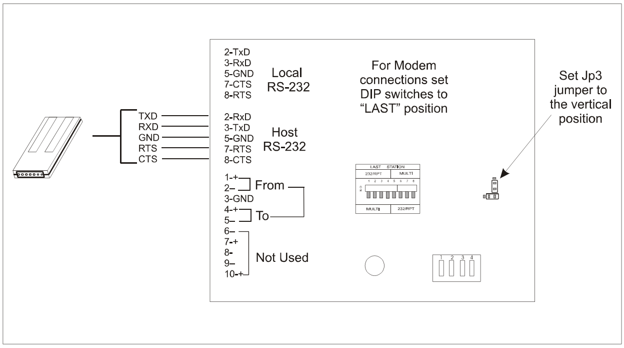


Figure 2-10 link via modem

Two handshake control lines are provided on the I/O PLEXER for interfacing to modems. They are request to send (RTS) and Clear to send (CTS). An active high RTS signal from the I/O PLEXER advises the modem that data is available. When the modem is ready to accept data, it places its CTS line active high to the I/O PLEXER thus initiating the data exchange.

In addition to the modem to I/O PLEXER wiring the installer should confirm that JP3 (RTS/CTS Jumper) is positioned as shown in figure 2-10. Jumper JP5 (RTS/CTS for the local RS-232 port), should remain in the horizontal position unless the RTS/CTS pair is needed in the device connected to the local RS-232 port. A cable for most modem applications, the IOP-RT cable, is available from duTec.

The switches marked "Pull up" in figure 2-5 should be left in the "on" position.

Note: If the modem must make use of the RTS/CTS hardware handshake, only one I/O PLEXER can be used per modem. If more than one I/O PLEXER is used at a given remote site, care should be taken that the modem does not need the RTS/CTS handshaking or external hardware will be required.

Host to I/O Plexer - RS-422

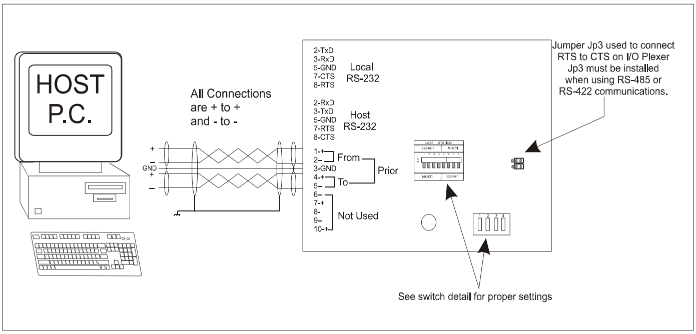


Figure 2-11 RS-422 Host to I/O Plexer wiring

The wiring figure shows two individually shielded twisted pairs of AWG 24 (such as Belden 9729) with the shields connected between unit grounds. In a perfect world with no electrical noise and equal ground potentials everywhere the ground connection is not required. Not using the ground connection can lead to costly debugging.

These connections, which require the cover to be removed, are made by placing a 1/4 inch stripped wire into the openings of the wire clamp terminal block and tightening the screw. This block is socketed for easy removal. An alternative means for network connection is to use the 10 pin male connector located behind the clamp terminal block. This connector mates with Molex shell, number 50-57-9005, and used pins, 16-02-0103.

In addition to the Host to I/O PLEXER wiring, the installer should confirm that the network type switches are set in the correct positions, multidrop, repeat, or last unit. Refer to appendix A for details concerning the switches marked "pull-up" in figure 2-5

Host to I/O Plexer- RS-485

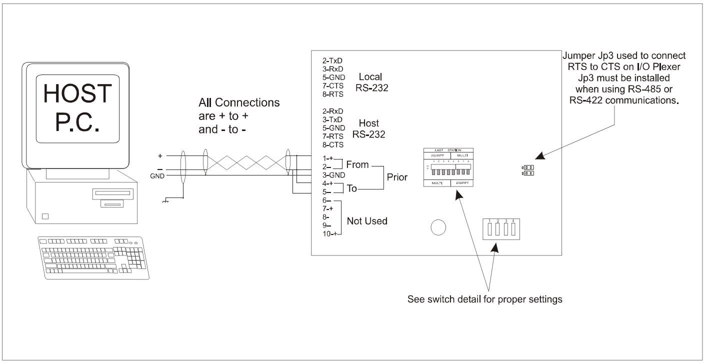


Figure 2-12 RS-485 Host to I/O Plexer wiring

The wiring figure shows one individually shielded twisted pairs of AWG 24 (such as Belden 8162) with the shields connected between unit grounds. In a perfect world with no electrical noise and equal ground potentials everywhere the ground connection is not required. Not using the ground connection can lead to costly debugging.

These connections, which require the cover to be removed, are made by placing a 1/4 inch stripped wire into the openings of the wire clamp terminal block and tightening the screw. <u>This block is socketed for easy removal</u>. An alternative means for network connection is to use the 10 pin male connector located behind the clamp terminal block. This connector mates with Molex shell, number 50-57-9005, and used pins, 16-02-0103

As shown in figure 2-12 the + terminals of to and from and the - terminals of the to and from are connected. These connections should not be made in the clamping terminal block or Molex connector alone. A combination of the two can be used, one for jumpering and the other for the incoming and outgoing connections. Another option is to use an external terminal block or leads between the clamp terminal block and Molex connectors.

In addition to the Host to I/O PLEXER wiring the installer should confirm that the network type switches are set in the correct positions, multidrop, repeat, or last unit. Refer to appendix A for details concerning the switches marked “pull up” in figure 2-5.

I/O Plexer to I/O Plexer - RS-422

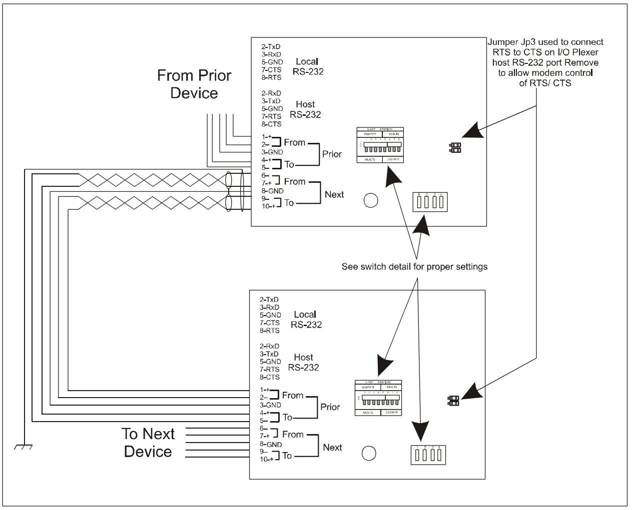


Figure 2-13 RS-422 I/O Plexer to I/O Plexer Wiring

Figure 2-13 shows two individually shielded twisted pairs of AWG 24 with an overall isolated shield (such as Belded 8162) with the internal shield connected between unit grounds. The overall isolated shield should be connected to earth ground in one place only. In a perfect wold with no electrical noise and equal ground potentials, the signal ground connection would not be required. Not connecting signal ground however, frequently leads to costly debugging.

These connections, which require the cover to be removed, are made by placing a 1/4 inch stripped wire into the openings of the wire clamp terminal block and tightening the screw. <u>This block is socketed for easy removal</u>. An alternative means for network connection is to use the 10 pin male connector located behind the clamp terminal block. This connector mates with Molex shell, number 50-57-9005, and used pins, 16-02-0103

In addition to the Host to I/O PLEXER wiring the installer should confirm that the network type switches are set in the correct positions, multidrop, repeat, or last unit. Refer to appendix A for details concerning the switches marked “pull up” in figure 2-5.

I/O Plexer to I/O plexer - RS-485

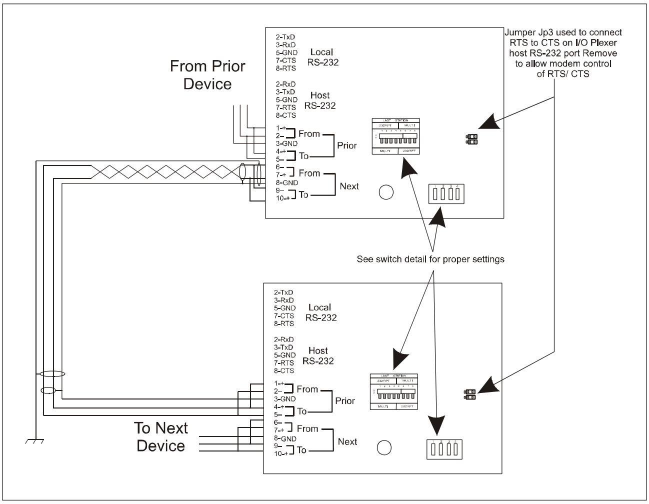


Figure 2-14 RS-485 I/O Plexer to I/O Plexer wiring

Figure 2-14 shows one individually shielded twisted pairs of AWG 24 with an overall isolated shield (such as Belded 8162) with the internal shield connected between unit grounds. The overall isolated shield should be connected to earth ground in one place only. In a perfect wold with no electrical noise and equal ground potentials, the signal ground connection would not be required. Not connecting signal ground however, frequently leads to costly debugging.

These connections, which require the cover to be removed, are made by placing a 1/4 inch stripped wire into the openings of the wire clamp terminal block and tightening the screw. This block is socketed for easy removal. An alternative means for network connection is to use the 10 pin male connector located behind the clamp terminal block. This connector mates with Molex shell, number 50-57-9005, and used pins, 16-02-0103

In addition to the Host to I/O PLEXER wiring the installer should confirm that the network type switches are set in the correct positions, multidrop, repeat, or last unit. Refer to appendix A for details concerning the switches marked “pull up” in figure 2-5.

Adding Digital Expanders:

Up to three Digital expanders may be connected to any I/O PLEXER which is equipped with a "/3+" option (see page 1-8). These chassis are attached to the main unit via a ribbon cable supplied with the Digital Expander. Normally, power is supplied through this cable. In some circumstances, however, the Digital Expander is purchased with an optional power supply. If so equipped, the installer must provide the necessary power connections as well (see page 2-2).

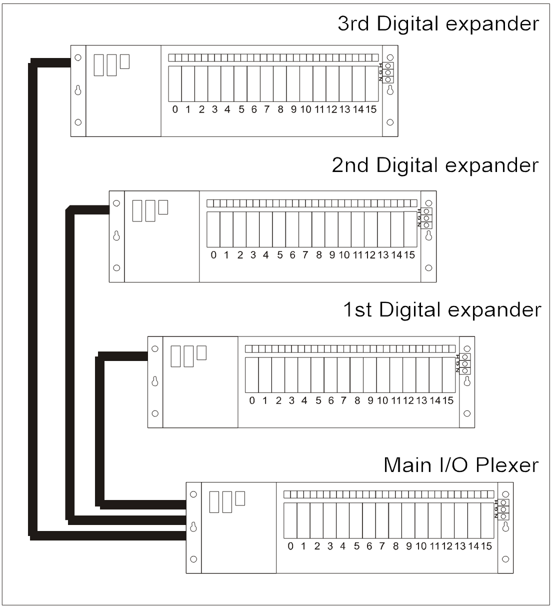


Figure 2-15 Digital Expanders

Digital expanders are configured during the main chassis' normal setup procedure (see section 3)

Module Wiring

Analog Inputs:

Modules should NEVER be installed or removed while power is applied to the I/O PLEXER.

Note: Analog modules normally run hot to the touch

Correct polarity connections are essential to proper operation of all analog inputs. Connections to terminals marked with a “+” must be more positive than the terminals marked with a “-“. Thermocouples and RTD’s are connected directly to the I/O modules with special connectors which insure correct polarity.

Module status indicators are On dimly, when wired correctly, and monitoring a valid signal. The indicator light may be On brightly, off, or flicker otherwise.

Figure 2-16, figure 2-17 and figure 2-18 show the wiring for various types of analog inputs. With the exception of thermocouples and RTD’s, connections are made via the black terminal strip. In the case of thermocouple RTD’s, connections are made directly to the module, mating connectors are included. There must be nothing connected to the screw terminals corresponding to these module positions. The source of analog inputs is external to the I/O PLEXER in most circumstances. Exceptions are those of RTD and Type 590 temperature input modules where source excitation is supplied within the module.

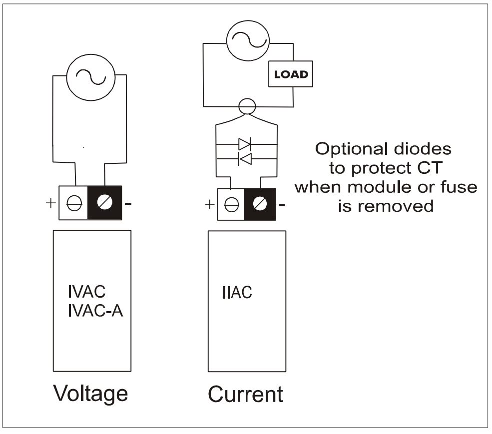


Figure 2-16 AC current and voltage wiring

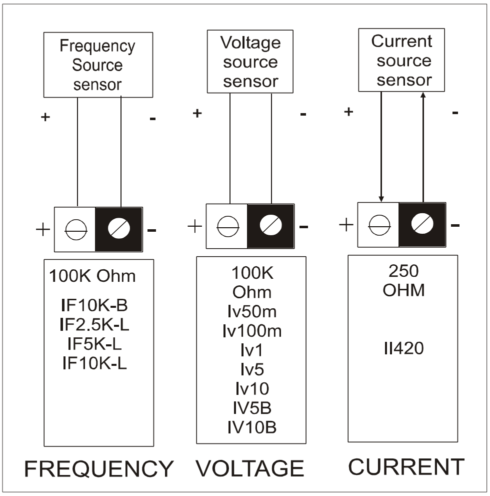
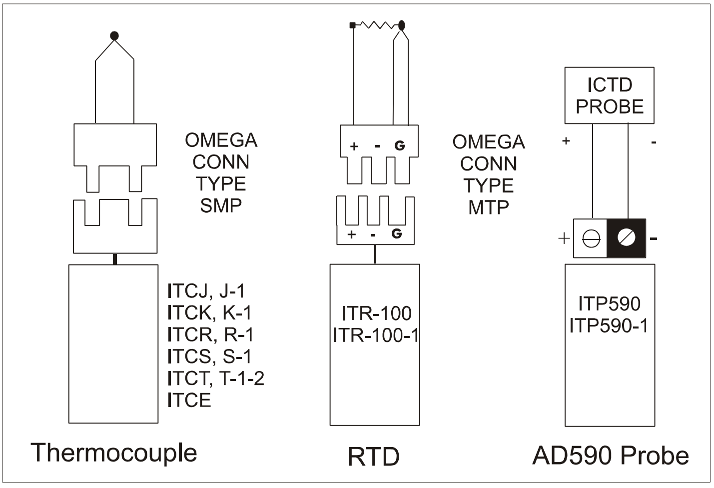


Figure 2-17 Analog Frequency, Voltage, and current input wiring



F

igure 2-18 Temperature input wiring

<u>Analog outputs:</u>

Modules should NEVER be installed or removed while power is applied to the I/O PLEXER.

Note: Analog modules normally run hot to the touch

Both voltage and current output modules provide their own isolated power output. This eliminates the need for external power supplies and insures electrical *isolation* between each output. This also makes it possible to wire voltage outputs in series to obtain larger voltage swings (consult application support).

Module status indicators blink briefly when outputs are updated. It should be noted that the status indicator only reflects the TTL data stream to the modules. This in of itself does not indicate the actual value of the output signal. Output can only truly be verified by monitoring the device to be controlled using a multimeter, oscilloscope, or employing an analog input module as a feedback tool.

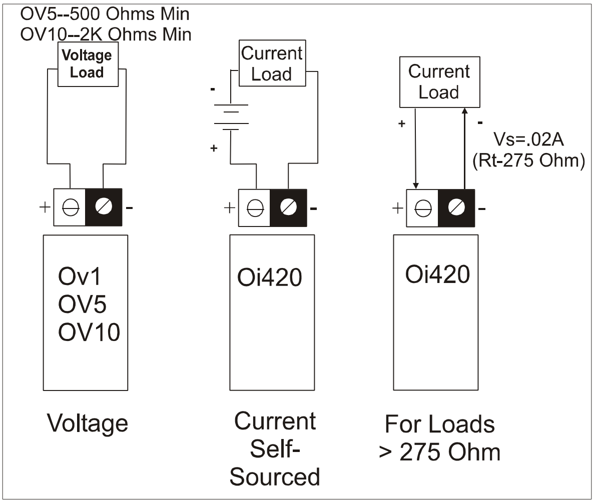


Figure 2-19 Analog Voltage and current output wiring

OI420 analog output modules will drive up to 275 ohms. If the loop resistance exceeds 275 ohms, and external power supply must be added as shown in figure 2-19. Correct polarity is essential.

Digital Inputs:

Modules should NEVER be installed or removed with power applied to the I/O PLEXER.

The source of the discrete signal to be monitored is external to the I/O PLEXER in most circumstances. The IDC5S digital input dry contact sense module is an exception. It provides its own current for sensing contact closure. Therefore, an external supply is not needed. In fact, they can be DESTROYED if an external source is connected.

The IDC5 and IDC5D input modules are polarity sensitive and operate only when the "+" terminal is more positive than the "-" terminal, Polarity does not affect the performance of the IAC5, IAC5A, or the IDC5S input modules.

Because the field sides of input modules are totally isolated from each other, like polarities can be wired common to make use of a single power supply.

The wiring and operation of digital input modules can be verified by closing individual input sensing contacts and observing the change on the nodule status indicators. They are On when the module input circuit is energized.

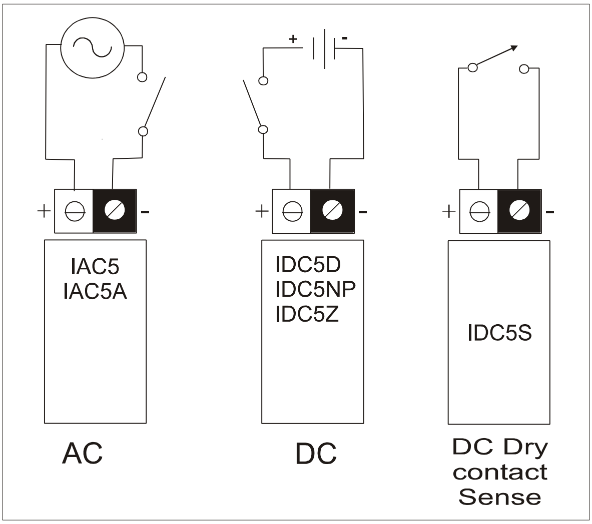


Figure 2-20 Digital Input Wiring

Digital outputs:

Modules should never be installed or removed while power is applied to the I/O PLEXER.

ODC5, ODC5A, OAC5, and OAC5A digital output modules are used to switch external power supply loads on and off.

Because they contain a protective reverse diode, the ODC5 and ODC5A output modules are polarity sensitive and operate correctly only when the “=” terminal is more positive than the “-“ terminal. A DC digital output module connected backwards conducts current through its protective diode and appears to be uncontrollable, it is. Polarity does not affect the performance of OAC5 and OAC5A digital output modules.

Because the field sides of output modules are totally isolated from each other, like polarities can be wired common to make use of a single power supply.

It should be noted that the status indicator only follows the logic instruction to the modules and does not show that the module, its fuse, or external power is present. Outputs can only be truly verified by monitoring the output with a multimeter, oscilloscope, or by employing a digital input module as a feedback tool.

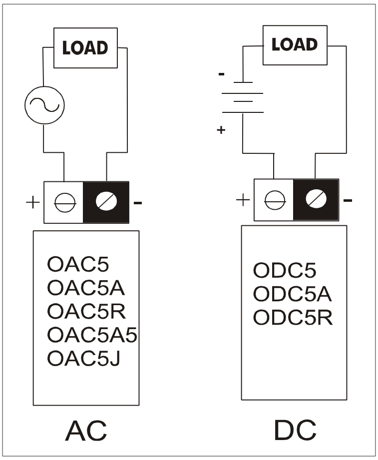


Figure 2-21 Digital output Wiring

Chassis Setup

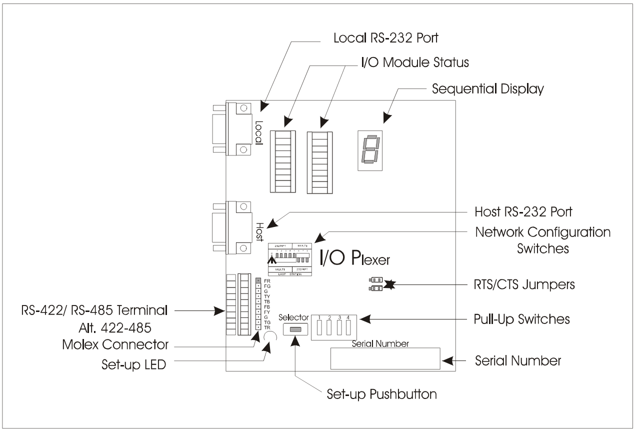


Figure 3-1 Connectors, Switches, and Indicators

During the setup phase of an I/O PLEXER system, the main chassis are given specific values for unit address, network baud rate, and protocol pass type. A momentary pushbutton and seven segment display provide access to these parameters. Figure 3-1 shows the location of these components labeled setup pushbutton and sequential display.

Function addresses:
Each Host instruction includes an address made up of two hexadecimal characters (00h to Ffh). At any I/O PLEXER network connection up to 6 different types of functions can be performed, each with its own unique system wide function address. The address for functions which are not present in a particular chassis is set equal to the master address so as not to occupy valid space. There are two I/O PLEXER addressing modes, OFFSET and VARIABLE.

Offset Mode
Units are shipped in the OFFSET mode where only the master unit control address needs to be set (with a range of 00H to 3FH). The remaining active function addresses are automatically calculated and set based on the master address.

Function	Abbrev.	Function Address	Sequential Display
Master Unit control	*MC*	00H (0)	U0=00
Master unit digital I/O	*MD*	40H (64)	U1=40
Master Unit Analog I/O***	*MA*	80H (128)	U2=80
1st Digital Expander	*D1*	C0H (192)	U3=00
2nd Digital expander	*D2*	D0H (208)	U4=d0
3rd Digital expander	*D3*	E0H (224)	U5=E0

The OFFSET addressing mode is more convenient to use as only one address setup is required for each network connection. For example changing the Master Unit Control, *MC* from 00H to 03H will automatically cause *MD*=43H, *MA*=83H, D1=C3H, D2=D3H, D3=*E3*H.

Variable Mode
In the VARIABLE mode function addresses are independent of each other and can range from 00H to FFH. For this mode, each function *MC*, *MD*, *MA*, D1, D2, and D3 must be entered. As long as addresses are not duplicated, they can take on any of the 256 possibilities. The VARIABLE mode must be used with some software packages and systems of more than 16 I/O PLEXER network connections.

The loading of selected function addresses into the I/O PLEXER is explained after the description of baud rates and protocol handshake type found on page 3-4.

*** Any function address not supported by the unit will default to the master unit control address to conserve network address usage.

Baud Rates:
Any one of the standard baud rates of 300, 600, 1200, 2400, 4800, 9600, 19200, or 38,400 can be used for the serial network communications. The sequential display indicates the letter H followed by the baud rate divided by 100. As shipped I/O PLEXERs are setup for 9600 baud; the sequential display indicates H096. Changing the baudrate is described beginning on page 3-4.

Protocol handshake types:
Two protocol handshake types are available, 2 pass and 4 pass.

2 Pass — The Host transmits an instruction to an I/O PLEXER. If the message is correctly received (IE valid address, instruction type, and correct checksum), the I/O PLEXER executes the instruction and returns the letter A and a carriage return or, where data is to be returned, the letter A followed by the data followed by a two character checksum ending with a CR.

4 Pass — The Host transmits an instruction to an I/O PLEXER. If the message is correctly received (IE valid address, but not necessarily the correct instruction type or checksum), the I/O PLEXER returns an A followed by the echo of the instruction and does not execute it. If the Host then transmits an E, the command is executed in the same manner as 2 pass. If the Host returns any other character to any unit on the network, the instruction is disregarded.

The sequential display indicates the letter P followed by 2 or 4. As shipped I/O PLEXERs are set up for 2 pass; the sequential display indicatesP2. The actual setting of the handshake protocol type into the I/O PLEXER is detailed beginning on page 3-4.

Network type switch:
The digit after the L in the sequential display represents how the network switch under the cover plate is set. See page 2-7

Note: The seven segment display will not reflect a switch position change until power has been cycled to the unit.

Modem Jumpers:
If modems are not being used, the jumpers should remain in place, as shipped, in a horizontal position (See page 2-9).

Changing setup parameters via pushbutton:

During setup, the user may need to change the unit address, serial link baud rate, and protocol pass type. The pushbutton located under the removable cover is used to change these parameters. The pushbutton causes the adjacent red LED to flash each time it is pushed. Any changed values are automatically saved in non-volatile EEPROM.

During the diagnostic test period following the application of power, the sequential display shows GoGoGo= . Flashing the pushbutton LED once when the = Appears, places the unit in setup mode. The value of each setup character can be changed, as they appear in sequence, by pressing the pushbutton. The display will continue to cycle through the setup sequence until there is a full cycle with no changes. The I/O PLEXER then stores all values in EEPROM for automatic use following each power cycle. If desired changes were not implemented correctly , line power can be recycled and setup via pushbutton procedure can be repeated as required.

Once the unit has been placed in setup mode, as described above, the value of each setup character shown below, can be changed.

U0 <u>00</u> H <u>096</u> P <u>2</u> -Only the underlined digits may be changed.

The 2 digits after U0 indicates the master unit control address; initially set for address 00H -00.

Note: In the address offset mode, only the master unit address is set, The other addresses are automatically set 40H above each other (see page 3-2).

The 3 digits after H show the baud rate (divided by 100); initially set for 1200 baud -012.

The 1 digit after P signifies the handshake protocol type; initially set for 2 pass -2

The display continues to cycle through its sequence until there is a <u>full cycle with no changes</u>. The I/O PLEXER then stores all values in EEPROM for automatic use following the next power cycle.

The unit is now in the operational mode and the sequential display cycle becomes*:

U0=00
U1=40
U2=80
U3=C0
U4=d0
U5=E0
H012
L3
P2

Address Setup via network- VARIABLE mode only

Each function address, including the master control address, of the I/O PLEXER can be set individually by using a special instruction to the current master control address of that chassis. This “set variable address” instruction should be used with caution as it will change the unit address and save them in the EEPROM (see appendix C, C). Consult the I/O PLEXER protocol manual for details.

In the event that the new addresses become lost, they will appear on the sequential display.

The pushbutton method can always be used to return to the OFFSET mode.

Hardware Error Codes:

When the I/O PLEXER is initially turned on, it goes through internal self test. If anything is not correct, the appropriate error code will flash on the sequential display. Try recycling power, if that does not resolve the error condition please call duTec Technical support at (800)- 248-1632.

* Factory default values for an IOP-AD/3+ depicted in this example

Troubleshooting:

Establishing communications is, without a doubt the most difficult process encountered when installing an I/O PLEXER system. Every component in the system plays a key roll in this function. The following steps should aid in the troubleshooting an I/O PLEXER system:

Install the unit nearest to the Host computer. Connect appropriate communications network and set the unit address and baud rate to the desired values.

At the Host computer, run a terminal emulation program such as Windows TM V3.x “Terminal” (usually found in the ACCESSORIES program group) or Windows 95 Hyper Terminal (usually found in the PROGRAMS - ACCESSORIES menu path)

Configure the terminal program for the appropriate comm-port, baudrate, 8-data bits, 1- stop bit, no parity, handshake = hardware or none. Set the terminal preferences for local echo, so that the typed characters can be seen. Set the carriage return translation (CR) to add Linefeed (CR/LF) to both the inbound and outbound transmissions. This will scroll each line sent and received rather than overwriting the previous for clarity.

Once the Host terminal software is configured; press the space bar and observe the lower left bargraph segment (marked recv.) On the first I/O PLEXER chassis.

> If this LED flashes each time the spacebar is pressed then assume that the communications link to the I/O PLEXER is O.K.
>
> If not, verify the wiring, comm port, and modem link - if any. A typical problem here is wrong com port or incorrect wiring of the Host end of the link.
>
> If the Recv. LED is on constantly the RS-422/ 485 wiring is probably backwards.

Once signal to the I/O PLEXER is verified, a valid instruction should be sent to the unit to initiate a response. Send an “Identify station type” “F” instruction (see appendix C,C) Be sure to send the entire instruction within 10 seconds as the I/O PLEXER will ignore instruction that take too long to finish. If the instruction is to a valid address for this unit and at the correct baud rate, the transmit LED should flash immediately after the carriage return of the instruction is received.

If no response is received by the Host but the trans LED flashes, check the receive wiring or the Host receiver.
Once a proper response is received at the Host, repeat the procedure for any additional I/O PLEXER to be added to the network.

When all chassis are checked out, the terminal software can be replaced with the actual Host software for this project.

MAGIC software utility:

The MAGIC software is provided as a tool to help the user become familiar with the I/O PLEXER instruction set. This program incorporates a menu driver “step by step” approach to building any instruction. Once an instruction is developed, it may be sent to the I/O PLEXER. MAGIC will then report the I/O PLEXER’s response to that instruction thus completing one Host to I/O PLEXER exchange. In transmission/ response, MAGIC will also capture groups of instructions into macros to be sent automatically. These macros can be named and stored for future use making them handy for system setup and local control functions.

The disk is located in the back of this manual. 3.5" diskettes are shipped standard.

To install this software create a directory called MAGIC and copy the contents of the diskette to that directory.

MAGIC will prompt the user for the communication port (it has been reported that Com 3 and Com 4 may not behave properly with MAGIC), of the Host computer, the baud rate, the master control address of the I/O PLEXER. Once all of this information has been entered, the user is ready to start building instructions and sending them to the I/O PLEXER.

Note: The MAGIC software has not been revised for quite some time and therefore has not been updated with some of the more recent features of the I/O PLEXER. This includes digital expanders 2 and 3.

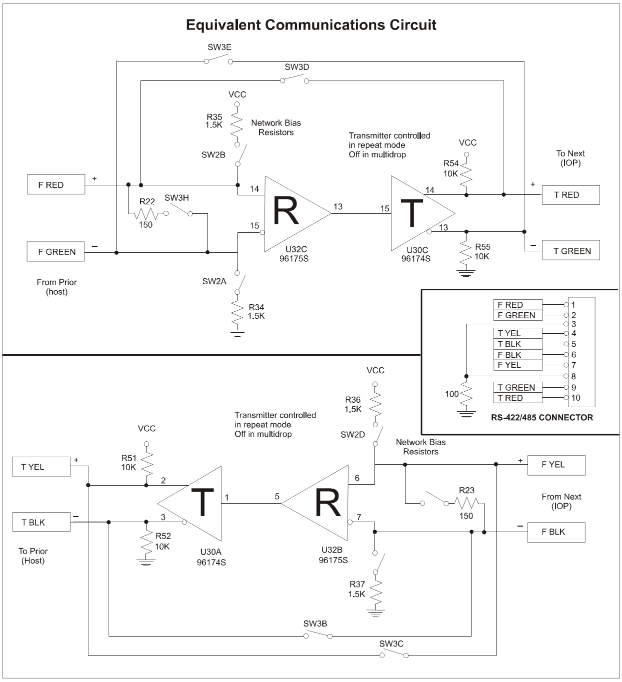


Figure A-1 Electrical Equivalent Circuit

Figure A-1 Shows the equivalent RS-232/ 422 Communications circuit for the I/O PLEXER. When switched to “Last Position” the 150 Ohm network terminator resistors are in place.

Positions A-D of SW2 allow the removal/ installation of network biasing resistors used to suppress line noise when all transmitters are at rest. These resistors should be left active on at least one but not more than eight units in a single multidrop network segment. If more than eight resistor equipped units are present, transmitter overloading may occur.

I/O Performance

The I/O PLEXER samples individual analog inputs at the constant rate of 100 samples per second. The effective sample rate per channel is determined by the total number of channels to be sampled.

Input data throughput is based on the time from the beginning of the first character of an instruction to the end of the last character of the response. The response time of the Host computer controlling input instructions will reduce the effective throughput.

Output execution throughput is based on the time from the beginning of the first character of an instruction to the time when an actual output changes. Because the instruction acknowledgment response occurs before outputs actually change state, processing time of the Host computer controlling output instructions can reduce the effective throughput.

The tables below show msec per channel and channels per second for 1 and 16 I/O channel cases.

Baud	Output (Digital J)				Input (Digital M)			
Rate	1 Ch/	IOP	16 Ch/	IOP	1 Ch/	IOP	16 Ch/	IOP
	mSec/ chan	chan/Sec	mSec/ 16 chan	chan/ Sec	mSec/ chan	chan/Sec	mSec/ 16 chan	chan/ Sec
300	501	2	501	32	379	3	379	42
600	251	4	251	64	195	5	195	82
1200	126	8	126	127	104	10	104	154
2400	64	16	64	252	58	17	58	277
4800	32	31	32	496	35	29	35	458
9600	17	60	17	962	23	43	23	682
19200	9	113	9	1816	18	56	18	902
38400	5	203	5	3261	15	67	15	1076

Baud Rate	Input (analog L)				Output (analog S)			
	1 Ch/ IOP		16 Ch/ IOP		1 Ch/ IOP		16 Ch/ IOP	
	mSec/ Chan	Chan/ Sec	mSec/ 16 Chan	Chan/ Sec	mSec/Chan	Chan/ Sec	mSec/ 16 Chan	Chan / Sec
300	639	2	2639	6	484	2	1984	8
600	323	3	1323	12	250	4	1000	16
1200	164	6	664	24	134	7	509	31
2400	85	12	335	48	75	13	263	61
4800	46	22	171	94	46	22	140	114
9600	26	39	88	181	32	32	78	204
19200	16	63	47	339	24	41	48	335
38400	11	91	27	602	21	48	32	494

The equations below can be used for determining mSec for any number of channels.

Throughput for digital I/O is independent of the number of channels.

$$DI_{Rate}=\left(\left(\frac{(15_{Characters}*10_{Bits})}{BaudRate}\right)+0.001_{mS}\right)*1000_{mS}$$

Figure B-1 Digital Input Data Time for 1-16 Channels:

$$DO_{Rate}=\left(\left(\frac{(11_{Characters}*10_{Bits})}{BaudRate}\right)+0.012_{mS}\right)*1000_{mS}$$

Figure B-2 Digital Output Execution 1-16 Channels

Throughput for analog I/O varies with the number of channels, *n*

$$AI_{Rate}=\left(\left(\frac{((15_{Characters}+(4_{Characters}*N_{Channels}))*10_{Bits})}{BaudRate}\right)+0.006_{mS}*1000_{mS}\right.$$

Figure B-3 Analog Input Data Time for *n* Channels

$$AO_{Rate}=\left(\left(\frac{((11_{Characters}+(3_{Characters}*N_{Channels}))*10_{Bits})}{BaudRate}\right)+0.017_{mS}*1000_{mS}\right.$$

Figure B-4 Analog Output Execution *n* Channels

The system throughput for systems with a mixture of analog and digital data is determined by the sum of the time for each instruction using these equations.

Instruction Format

```
>          NN         C          ( )        ( )    All instructions terminate with a carriage
return
|          |          |          |          |
|          |          |          |          |Checksum, 2 characters
|          |          |          |
|          |          |          |Variable data fields; in lower case italics
|          |          |          underlined data battery saved with option /M and eF instruction
|          |          |Instruction; 1 or 2 characters, in BOLD
|          |
|          |Address (analog, digital, etc...) in upper case ITALICS
|
```

Response format (2 pass communications protocol)

```
A          ( )        ( )        All responses terminate with a carriage return
|          |          |
|          |          |Checksum if data field present
|          |
|          |Data field depends on function and instruction type
|
|Acknowledgment of correctly received instruction
Response message N__, Returned if checksum error or other fault.
```

SETUP Instructions

Function		Instruction	Response	OPTO22 Equiv.
A	Power-up Clear	>AUA ( )	A	Yes
B	Reset	>AUB ( )	A	Yes
C	Turn-around Delay	>LUCf ( )	A	Yes
F	Identify type	>AUF ( )	Az ( )	Yes
G	Configure analog VS digital	>*MC*Gc ( )	A	Yes
G	Configure all modules	>IOGe ( )	A	Yes
H	Configure as inputs	>IOHe ( )	A	Yes
I	Configure as outputs	>IOIe ( )	A	Yes
j	Read module configuration	>Ioj ( )	Ac ( )	Yes
v	Read chassis ID	>MCv ( )	AΩ ( )	NO
Y	Read firmware version	>MCY ( )	Aβ ( )	NO
c	Set network baudrate 7	>MCch ( )	Ah ( )	NO
E	Protocol -2 Pass 7	>LUEO ( )	A	Yes
	-4 Pass 7	>LUE1 ( )	A	Yes

Watchdog

Function			Instruction	Response	OPTO22 Equiv.
m	Pos/Delay	-Digital	>DDmcn ( )	A	Yes
D	Pos/ Delay	-Analog	>MADcg ( )	A	Yes
m	Pos/ Levels	-Analog	>MAmc...1( )	A	Yes
cD	WDM Del multiplier*256		>MCeD ( )	A	NO
dD		-Disable	>McdD ( )	A	NO
cJ	WDM Del multiplier*256		>IOeD ( )	A	NO
dJ		-Disable	>IOdD ( )	A	NO
n	TRM, Timer Res Multiplier		>DDny ( )	A	Yes
cA	Address Tag	-Enable	>MCeA ( )	A	NO
dA		-Disable	>MCdA ( )	A	NO
eC	Chk sum tag	-Enable	>MCeC ( )	A	NO
dC		-Disable	>MCdC ( )	A	NO
eE	Error Msgs	-Off	>MCeE ( )	A	NO
dE		-On	>MCdE ( )	A	NO
eF	Save setup	-Enable	>MCeF ( )	A	NO
dF		-Disable	>MCdF ( )	A	NO
a	Var Add 7	-Set	>MCaMCMD MAE1E2E3 ( )	AMCMDMA E1E2E3 ( )	NO
b		-Read	>MCb ( )	AMCMDMA E1E2E3 ( )	NO

Serial I/O

N	Local Port Baud Rate		>MCNh ( )	A	NO
O	Host to Slave Msg.	123	>MCO (Msg) ()	A	NO
P	Msg for Host	-No 1	>MCP ( )	A	NO
		-Yes	>MCP ( )	A (Msg) ( )	NO
PP		-Partial	>MCPP ( )	A (Msg) ( )	NO
PA		-Control Codes	>MCPA ( )	A (Msg) ( )	NO

ANALOG INPUTS

L	Input value	-Read	>MALe ( )	A.....k( )	YES
g	Offsets	-Calculate	>MAg ( )	A.....k( )	YES
W		-Set	>MAWc...k ( )	A	YES
h		-Calc and Set	>MAhe ( )	A.....k( )	YES
X	Gain (slope)	-Calculate	>MAXe ( )	A.....k( )	YES
Y		-Set	>MAYc...k ( )	A	YES
Z		-Calc and Set	>MAZe ( )	A.....k( )	YES
N	Range limits	-Set	>MANclm ( )	A	YES
O		-Read errors	>MAO ( )	Acd( )	YES
Q		-Clear Errors	>MAQe ( )	A	YES
P		-Read and Clear	>MAPe ( )	Acd( )	YES
a	Min Values	-Read	>MAae ( )	A.....k( )	YES
b		-Clear	>MAbe ( )	A	YES
c		-Read and Clear	>MAce ( )	A.....k( )	YES

d	Max Values	-Read	>MAde ( )	A.....k( )	YES
e		-Clear	>MAee( )	A	YES
f		-Read and Clear	>MA fe( )	A.....k( )	YES
T	Averages	-Start	>MATcj( )	A	YES
I		-Complete?	>MAi( )	Ac( )	YES
U		-Read	>MAUe( )	A.....k( )	YES
o		-Read Linear °C	>MAoe( )	A.....k( )	YES
k	Set temp sensor Type		>MAkcx( )	A	YES
ℓ	Temp	-Read Linear °C	>MA ℓe( )	A.....k( )	YES

ANALOG OUTPUTS

J	Level Value	-set all same	>MAJcl( )	A	YES
K		-Read	>MAKe( )	A....l ( )	YES
S		-Set Selected	>MASc....l ( )	A	YES
V	Waveforms	-Squarewave	>MAVc4pqs( )	A	YES
	(Improved)-Triangle	-Up	>MAVc1pqs( )	A	YES
	-Dn		>MAVc5pqs( )	A	YES
	-Sawtooth	-Up	>MAvc3pqr( )	A	YES
		-Dn	>MAvc7pqr( )	A	YES
	-Ramp	-Up	>MAvc2pqr( )	A	YES
		-Dn	>MAvc6pqr( )	A	YES
	-Terminate		>MAvc0( )	A	YES

DIGITAL INPUTS

M	Read all modules		>DDM ( )	Ac ( )	Yes
eH	De-bounce -enable		>DDeHen ( )	A	No
dH	De-bounce -disable		>DDdHe ( )	A	No

Pulse Duration Measurements

a	Trig edges	-set All 4 5	>DDae ( )	A	Yes
b		-set Pos 4 5	>DDbe ( )	A	Yes
c		-set Neg 4 5	>DDce ( )	A	Yes
d		-Complete?	>DDd ( )	Ac ( )	Yes
e	Duration Ctr	-Read 5	>DDee ( )	A....n ( )	Yes
g		-Clear	>DDge ( )	A	Yes
f		-Read and Clear 5	>DDfe ( )	A....n ( )	Yes
eG	Pulse accum	-Enable	>DDeGe ( )	A	No
dG		-Disable	>DDdGe ( )	A	No
y	Pulse accum	-Enable	>DDye ( )	A	No
z		-Disable	>DDze ( )	A	No

Pulse Counting

W	Counters	-Read	>DDWe ( )	A....n ( )	Yes
Y		-Clear	>DDYe ( )	A	Yes
X		-Read and Clear	>DDXe ( )	A....n ( )	Yes
U		-Start	>DDUe ( )	A	Yes
V		-Stop	>DDVe ( )	A	Yes
T		-Start/ Stop	>DDTe ( )	A	Yes
el	Freq Counter	-Enable	>DDelen ( )	A	No
dl	Freq Counter	-Disable	>DDdle ( )	A	No

	Edge Detection					
N	Edge latch	-Set all		>DDNe ( )	A	Yes
O		-Set Off-to-On		>DDOe ( )	A	Yes
P		-Set On-to-Off		>DDPe ( )	A	Yes
Q		-Read		>DDQ ( )	Ac ( )	Yes
S		-Clear		>DDSe ( )	A	Yes
R		-Read and Clear		>DDRe ( )	Ac ( )	Yes
	Event Logging					
wA		-Set/ Reset		>DDwAe ( )	A ( )	No
wB		-Read Buffer		>DDwBe ( )	Av....w ( )	No
wC		-Clear		>DDwCe ( )	A ( )	No
	DIGITAL OUTPUTS					
J	Outputs On/ Off All Mod			>DDJe ( )	A	Yes
K	Outputs	-On		>DDKe ( )	A	Yes
L	Outputs	-Off		>DDLe ( )	A	Yes
Z	Waveforms					
	One shot	-On	5 6	>DDZeHn ( )	A	Yes
		-Off	5	>DDZeJn ( )	A	Yes
	Delayed	-On	5 6	>DDZeln ( )	A	Yes
		-Off	5	>DDZeKn ( )	A	Yes
	Squarewave		5	>DDZeLtu ( )	A	Yes
	Fast Squarewave 8-Bit		5	>DDZeMtu ( )	A	Yes
	Fast Squarewave 16-bit		5	>DDZeNtu ( )	A	No
	Terminate			>DDZeG ( )	A	Yes
h	Re-trigger time delay			>DDhe ( )	A	Yes
I	Pulses, 50% duty cycle		5	>DDictn ( )	A	Yes
k	Start Pulse	- On	5	>DDkcn ( )	A	Yes
ℓ		-Off	5	>DD ℓcn ( )	A	Yes

1 Maximum message length is 80 characters

2 Use\ to generate a CrLf within a message

3 Non-Printing ASCII characters can be transmitted using a / before the 2 hex character ASCII value.

4 Adjacent pulse durations can be accumulated by using Digital y after setting up trigger edges Digital a,b, or c.

5 Affected by setup n - TRM, Time resolution multiplier

6 Waveform action initiated by Digital J, K, or L.

7 Saved on EEPROM.

For a complete reference guide see the duTec protocol manual.

Addressing (See below for hardware setup)

Each I/O PLEXER contains up to 6 units, each with its own address; a two letter address code; a two letter address code is shown for each instruction.; These indicate which of the 6 addresses are used; they are listed below:

MC	Master unit control functions	Factory setting 00Hex *
MD	Master unit digital I/O functions	Factory setting 40Hex *
MA	Master unit analog I/O functions	Factory setting 80Hex *
E1	1st digital expander functions	Factory setting C0Hex *
E2	2nd Digital expander functions	Factory setting D0Hex *
E3	3rd digital expander functions	Factory setting E0Hex *

Some instructions have counterparts in more than one unit:

DD	-This instruction exists for *MD, E1, E2, E3*
IO	-This instruction exists for *MD, MA, E1, E2, E3*
AU	-This instruction exists for *MC, MD, MA, E1, E2, E3*
LU	-Applies to all units addressed in this I/O PLEXER, use *MC*

*See below for setup

Instruction response data fields

c,d,e Multiple position fields

Each module position maps to a digit in a 16 digit bit number.

Each digit or bit is a 1 or 0 only. This number is then converted to 4 digit numbers. Each four numbers is converted into a hex digit.

For *e* leading hex zeroes can be omitted.

Module#:	15 14 13 12	11 10 9 8	7 6 5 4	3 2 1 0
	-1st Char-	-2nd Char-	-3rd Char-	-4thChar-

Bit pattern	0000	0001	0010	0011	0100	0101	0110	0111
Hex Digit:	0	1	2	3	4	5	6	7
Bit Pattern:	1000	1001	1010	1011	1100	1101	1110	1111
Hex Digit:	8	9	10	11	12	13	14	15

In all position fields, 1's specify which positions are affected and 0's are disregarded unless they are listed below.

c,d,e

In instructions, 1's specify which positions are affected-

for setup m, analog, which outputs are set to specified values

for setup m, digital, which outputs are set to set ON

for setup G, to *IO*, which modules are configured as outputs

for setup G, to *MC*, which modules are analog

for digital a, which input durations trigger on positive edges

for digital J, which modules are to be ON

for digital N, which outputs latch ON-to-OFF

for digital T, which start counting

In instructions, 0's specify which positions are affected or-

for setup G, which modules are configured as inputs

for setup H, I which modules are not to be configured

for setup m, digital, which outputs are to be set OFF
for digital a, which input durations trigger on negative edges
for digital J, which modules are to be OFF
for digital N, which outputs latch from Off-to-ON
for digital eG, dG, which inputs have pulse-accum. enabled/ disabled
for digital eH, dH which inputs are to be de-bounce enabled/ disabled
for digital T, which inputs stop counting
In responses, 1's indicate:
for setup j, which positions are outputs
for digital d, analog I, which positions are complete
for digital M, which modules are ON
for digital Q, R, which positions have been triggered
for c of analog O,P, which positions are over limits
for d of analog O,P, which positions are under limits

ƒ Turn around delay (setup C)

For delay in mSec:	0	10	100	500
set *ƒ* to:	0	1	2	3

g Watchdog Delay (setup D) 0.2 Sec to 46.6 Hrs
convert desired delay to Sec; if <655.36, divide by 0.01 Sec; convert to hex (14H to FFFFH)
if >655.35, watchdog multiplier (setup eD) instruction must be used.; then divide desired period by 2.56 Sec. convert to hex (14H to FFFFH)

h Baud Rate local RS-232 Port (setup N) and network baud rate (setup c)

Desired baud	300	600	1200	2400	4800	9600	19,200	38,400
h value=	003	006	012	024	048	096	192	384

j Number of analog averaging samples:
For analog T convert 1-65535 samples to 4 hex digits for j

k analog input level/offset/ slope/ average -4 hex digits
for analog a,c,d,f,U,L,- convert each k to decimal; subtract 4096; divide by 4095; out of range if <0 or >1; multiply by module range for value, no input if ????.
for analog g,h - convert each k to decimal, subtract 4095; if>8 subtract 16; multiply by module range for offset.
for analog o, ℓ Convert each k to decimal, divide by 16 for °C; if >2048 °C subtract 4096. If ???? returned analog k was incorrect.
for analog W, divide desired offset by module range; if negative add 16, multiply by 4095 convert to hex.
for analog X,Z, convert each k to decimal; divide by 4096
for analog Y, multiply desired slope by 4096; convert to hex.

l,m

** With 1 start, 1 stop, 8 data bits, no parity, operates, as shipped at 300 baud. IOP local port transmits on 2, receives on 3, 5 is common.

Range limit/ Output Amplitude 3 Hex digits
for analog J,N,S; setup — divide desired level by module range, multiply by 4095; convert to hex digits for l;
for analog N high limit is l; low limit is m
for analog K Convert each l to decimal; divide by 4095; multiply by module range

n Counts/delays/ durations/ periods
for digital e,f -convert each n to decimal; multiply bu (0.01 *TRM) for time in seconds.
for digital eH, -divide desired filter period (in seconds) by (0.01*TRM); convert to 4 hex digits.
for digital eI -divide desired timebase period (in seconds) by (0.01*TRM)convert to 2 hex digits (0Ah=Hz)
for digital k,l, -Divide desired period (in seconds) by (.01*WDM) convert to 1-4 hex digits
For setup m, -divide desired watchdog delay (in seconds) by (0.01*WDM) convert 0-4 Hex digits.
for digital X,W convert each n to decimal for counts
for digital Z, -divide desired period in seconds by (0.01*TRM) convert to 1-4 hex digits

*n=0 or 1 has special case, see user manual

waveforms (Analog V) amplitude determination-Peak and Valley

p waveform peak or maximum amplitude
q waveform valley or minimum amplitude
divide desired max (for p) or min (for q) bu module range; multiply by 4095; convert to 3 hex digits

waveforms (analog V) period determination
r sawtooth period/ ramp duration
Multiply period (in seconds) by 10, convert to 4 hex digits

s squarewave and triangle wave period
Multiply period (in seconds) by 5, convert to 4 hex digits.

t squarewave On period (Digital I, ZeL, ZeM, ZeN)

u squarewave Off period (digital ZeL, ZeM, ZeN)
For Digital ZeL divide period in seconds by 2.56, convert to 2 hex digits
For digital I, ZeM divide period in seconds (by 0.01*TRM) Convert to 2 hex digits
For digital ZeN divide period (in seconds) by (0.01*TRM) Convert 4 hex digits

v The number of samples contained in response.

w Individual sample 4 hex digits representing 16 bits.

x Temperature sensor type (analog k)

--------Thermocouples--------- RTD -Sensor-

Sensor	E	J	J-1	K	K-1	R	S	T	T-1	T-2	100	100-1	590
set x to:	08H	04H	14H	05H	15H	06H	07H	08H	18H	28H	03H	13H	01H

y Timer resolution multiplier, TRM (Setup a)

The basic 0.01second resolution of ALL instructions noted with 5 are multiplied by y of setup n; default value is 1H; range is from 1H to FFH (1-255)

z response codes from Setup F identify station type.

z=:	00	01	02	03
Type=:	DD (Digital)	MA (Analog)	*MC* (Setup)	--

β Firmware version number x, yy, z

Ω Chassis ID (Type, No. of expanders, and firmware version)

COMMUNICATION PROTOCOL

There are two communications protocols, 2 pass and 4 pass, both of which use only ASCII characters; units are shipped in 2 pass the most commonly used; the instructions transmitted by the Host are identical for both protocols, they differ in their responses.

2 Pass: A correctly received instruction returns an A (and data if any) and instruction is executed; an incorrectly received message returns a response message, and the instruction is not executed.

4 Pass: A received instruction is echoed and not executed until Host returns an E (non E's cancel instruction)

CHECKSUMS:
Automatic Calculation Method

The setup eC command puts correct checksum at the end of the N02 error message; assemble instruction for which checksum is needed in usual manner, but enter XX for ( ); the N02 response message has the correct checksum tagged on.

Manual calculation method

See appendix A of the I/O PLEXER user guide.

Defeat Checksum

Enter ?? in the ( ) position of instructions; a checksum error message will *never* be returned; a *RISKY PRACTICE.*

Special Responses:

A special response negates transmitted instruction.

N00	Power has been OFF
N01	Invalid command
N02	Checksum error
N02	Checksum error *(Correct checksum)* if setup eC enabled
N03	Instruction contains >80 characters
N04	Non-Printable Characters in instruction
N05	Invalid instruction length, check data fields
N06	Communication watchdog time-out
N07	Invalid data in instruction field
N08	Invalid module (analog v.s. digital)
N09	Power has been OFF, battery backed restart OK
N10	Local control function error
N11	Local control function error
N12	Local RS-232 port buffer full

ADDRESSES/ BAUD RATE/ PROTOCOL Setup:

There are two addressing modes, Offset and Variable; units are shipped in the Offset mode where only *MC* the master unit control needs to be set and *MD*, MA, *E1*, *E2*, and *E3* are automatically set as shown below:

00H	*MC*	Master unit control functions	(display U0=*MC*)
40H	*MD*	Master unit digital I/O function	(display U1=*MD*)
80H	*MA*	Master unit analog I/O function	(display U2=*MA*)
C0H	*E1*	1st expander digital I/O functions	(display U3=*E1*)
D0H	*E2*	2nd expander digital I/O functions	(display U4=*E2*)
E0H	*E3*	3rd expander digital I/O functions	(display U5=*E3*)

in the variable mode individual addresses are independent and can range from 00H to FFH (0-255)

Setups Via pushbutton - Offset mode only

On application of power, the IOP flashes Go Go Go Go Go Flashing the pushbutton LED once while the ‘ appears, places the unit in setup mode; the IOP then flashes U 0 M C H HHH PP,

the 2 digits after U0 is the Master Unit control Hex address
the 3 digits after H is the baud rate (divided by 100)
the 1 digit after the P is the communications protocol type (2 or 4 pass)

Digit values are changed by flashing the pushbutton LED as they appear; note in this method only the *MC* value is set, *MD*, MA, and ED are automatically set 40h above each other; the display continues to cycle through until there is a full cycle with no changes and stores all values in EEPROM; the unit is now in the operational mode and the display cycle becomes:

U0 = *MC*U1= *MD*U2= MAU3= EIU4= MFHHHHLLPP

Further changes can be made by repeating the pushbutton method.

The L represents the connection type (repeat, multidrop, last-unit)

Setups Via Local RS-232 Port- Offset and Variable modes

On application of power, the IOP flashes Go Go Go= Entering Ctrl C from an RS-232 device 8, when the = appears, places the unit in setup mode RS-232 Device display shows:

(U0*MC*, U1*MD*, U2*MA*, U3*ED*, U4*MF*, HHHH,PP)

Enter only values to be changed using the *Exact* format as the display and press Enter; the RS-232 display shows the values and asks OK? (Y/N/S)

Y stores the new values in EEPROM; operational mode starts
N re-starts the process as if Ctrl C had been entered
S Generates standard offset address

Address setup via network- Variable mode only:

Instruction setup a can set all 5 addresses at one time; it is sent to the *current MC* address; its response lists the new values including the new *MC* if it was also changed; in case forgotten, *MC* is always displayed; this method stops the Offset mode; the pushbutton method can be used to return to the Offset mode.

PRECAUTIONS

Never Use:
An upper case letter O for the number (0)
An lower case letter l for the number (1)
an upper case character for a lower case one

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Appendix C: Warranty and Disclaimer

Perma Pure LLC

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