

# 360DI 6Pt I/O Board OPERATIONS MANUAL



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## SIX POINT I/O BOARD FOR 360 SYSTEM

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### 4.0 OVERVIEW

This manual describes the Six Point I/O Board (6PIO) in the *LaserHawk*<sup>®</sup> 360 system. The Six Point I/O Board option (P/N 1860-3520-01) is used as a Direct Interface feature in the *LaserHawk*<sup>®</sup> 360 where analog output and control signals are required directly from the Optical Head Assembly. The 6PIO is packaged under the Optical Head rear cover and is mounted vertically on the left side. External connections are in the Integral Junction Box. See Appendix B for Wiring Diagram connections and board location.

Many of the configuration details of the 6PIO Board are user selectable. Some parameters may be selected using the keypad and digital display of the Optical Head Assembly. Other details are configured by placement of small jumpers located on the circuit board.

### 2.0 ANALOG OUTPUT DESCRIPTION

There are two independently isolated analog outputs.

DAC 1 (Channel 1 or Out 1) is always dedicated to the Instantaneous value and carries NO calibration values. During the NORMAL mode, the analog output will track Instantaneous values. During any CALIBRATION mode, the analog output will hold the last NORMAL mode value.

DAC 2 (Channel 2 or Out 2) is always Selectable Average WITH calibration values. During the NORMAL mode, the analog output will track Selectable Average values. During any CALIBRATION mode, the analog output will track the calibration values chosen for output.

#### 2.1 Analog Output Measurement Units Selection

The DAC 1 and 2 output units may be Backscatter energy or Particulate Mass depending on user selection. The output units are software selectable using the keypad and digital display. The Measurement Unit parameter value will dictate both the LED display and the analog output units. For example, if Measurement Unit (F0 location) = 1, the LED display and analog outputs will be in terms of Backscatter and if the Measurement Unit = 3, both will display in units of Particulate Mass.

**Measurement full scale:** This is software selectable at bank FE on the optical head keypad. Typically if units selected are backscatter full scale is 100%. Particulate Mass full scale units are mg/m<sup>3</sup>, full scale number is based on test data collected. Example; If particulate testing shows your average mg/m<sup>3</sup> are 40 you may want your full scale to be 100. (See note)

**NOTE:** Banks A3-A6 on the optical head keypad can be used to setup a three point Dust Mass curve.

## **2.2 Analog Output Current Range Selection**

Two output current options are available from the 6PIO Board (either 4 – 20Ma or 0 – 20Ma). This range will apply to any measurement unit configuration selected above.

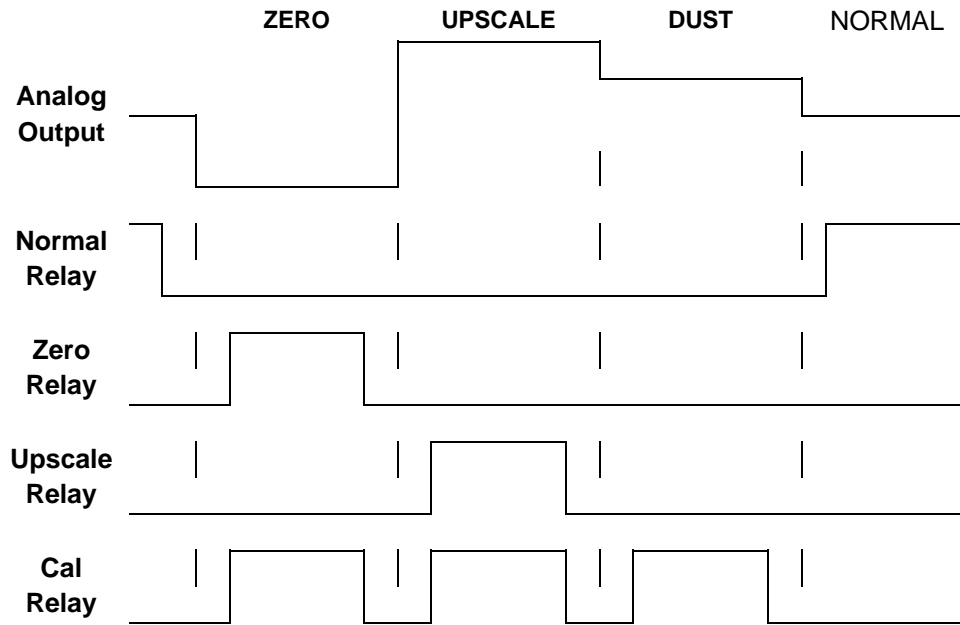
Both analog channels are configured identically and the current range selected by the placement of jumper JU9 on the 6PIO Board. Placing the removable jumper between the two *leftmost* pins of JU9 (or the “4” position) will select the 4 – 20Ma range. Placement of the jumper between the two rightmost pins of JU9 (or the “0” position) will select the 0 – 20Ma range.

## **2.3 Automatic Calibration Analog Output Sequence**

The order of the Automatic Calibration Analog Output Sequence is shown below. The duration of each is programmable in seconds.

<b>Order</b>	<b>Description</b>	<b>Duration/ Parameter #</b>	<b>Backscatter Scaling</b>	<b>Particulate Scaling</b>
1 <sup>st</sup>	ZERO Calibration	Selectable/ C7	0-100	0-9999
2 <sup>nd</sup>	UPSCALE Calibration	Selectable/ C8	0-100	0-9999
3 <sup>rd</sup>	DUST Compensation	Selectable/ CA	-5 to +5	

**Table 2-3-1  
Automatic Calibration Sequence**



**Figure 2-3-2**  
**360 Analog Output Cal Cycle Sequence**

### 3.0 DISCRETE ISOLATOR INPUTS AND JUMPER SETTINGS EFFECT ON ANALOG OUTPUTS

There are two discrete isolator inputs on the 6PIO Board. Both can be independently configured for operation from +5Vdc or Dry contacts: Jumper JU5 for isolator #1 and JU6 for isolator #2. They are also jumper configurable to perform the following functions:

- **FORCE UPSCALE:** (JU7 in position “A” and Isolator 1 engaged): The instrument goes into calibration UPSCALE mode. The calibration mechanism moves to the UPSCALE position. Normal sampling of stack data ceases. Analog output #2 follows the UPSCALE value. Analog output #1 holds the last stack value.
- **FORCE ZERO:** (JU8 in position “A” and Isolator 2 engaged): The instrument goes into calibration ZERO mode. The calibration mechanism moves to the ZERO position. Normal sampling of stack data ceases. Analog output #2 follows the ZERO value. Analog output #1 holds the last stack value read.



- **FORCE UPSCALE and FORCE ZERO:** (JU7 in position “A”, JU8 in position “A”, Isolators 1 and 2 engaged): The calibration mechanism moves to NORMAL position. Real time stack data appears on the LED readout and on analog output #1. Analog output #2 follows the DUST COMPENSATION value.
- **DUMP DUST:** (JU8 in position “C” and Isolator 2 engaged): The calibration mechanism moves to NORMAL position. Real time stack data appears on the LED readout and on analog output #1. Analog output #2 follows the DUST COMPENSATION value.
- **FORCE CALIBRATION:** (JU7 in position “C” and Isolator 1 engaged):
  1. The instrument first goes into calibration ZERO mode. The calibration mechanism moves to ZERO position. Analog output #1 holds the last stack value read. Analog output #2 follows the ZERO value.
  2. After a configurable amount of time, the instrument goes into UPSCALE mode. The calibration mechanism moves to UPSCALE position. Analog output #1 holds the last stack value read. Analog output #2 follows the UPSCALE value.
  3. After a configurable amount of time, the instrument goes into DUST COMPENSATION mode. The calibration mechanism remains in NORMAL position. Real time stack data appears on the LED readout and on analog output #1. Analog output #2 follows the DUST COMPENSATION value.
  4. After a configurable amount of time, the instrument goes into NORMAL mode. Real time stack data appears on the LED readout and on analog output #1. Analog output #2 follows the selectable average stack value.

<b>Jumper Position</b>	<b>Function</b>	<b>Available Isolator</b>
JU7 “A”	FORCE UPSCALE	ISO1
JU8 “A”	FORCE ZERO	ISO2
JU7 “C”	FORCE CALIBRATION CYCLE	ISO1
JU8 ”C”	DUMP DUST	ISO2

**Table 3-0-1**  
**Isolator Configuration Jumpers**

### **3.1 Other Jumpers That Effect Analog Outputs**

- **TEST ZERO SCALE (JU10):** This jumper is used to set both analog outputs to ZERO SCALE when placed in position “Z” (rightmost).
- **TEST FULL SCALE (JU11):** This jumper is used to set both analog outputs to FULL SCALE (20mA) when placed in the “FS” position (rightmost).
- **TEST ZERO SCALE AND TEST FULL SCALE:** When both of these jumpers (JU10 and JU11) are actuated simultaneously, both the analog outputs go to MID SCALE (12mA if the JU9 jumper is set to position “4”, 10mA if the JU9 jumper is set to position “0”).
- **JU1, JU2, JU3 and JU4:** These jumpers are used to set up internal measurement parameters for the 6PIO Board. These must remain in the positions detailed below for all 6PIO configurations.

<b>Jumper Position</b>	<b>Function</b>
JU9 “0”	Analog Outputs 0-20 mA
JU9 “4”	Analog Outputs 4-20 mA
JU10 “Z”	Test Zero Scale
JU11 “FS”	Test Full Scale
JU10 “Z” and JU11 “FS”	Test Mid Scale
JU1 & JU3 = 0	Internal Ranging (do not move)
JU2 & JU4 = 1	Internal Ranging (do not move)

**Table 3-1-1  
Output Jumper Configuration**

## **4.0 RELAY OUTPUTS**

Two relays are available. Contacts are SPDT Form C. The configuration of the relays is jumper selectable per the following table.

<b>K1 (JU12 position)</b>	<b>K2 (JU13 position)</b>	<b>Function</b>
A	A	Calibration Data on Analog Outputs
B	B	Instrument Malfunction ( <b>Not Fail-safe</b> )
C	C	Instantaneous Alarm 1 Actuated
D	D	Selectable Average Alarm 1 Actuated
E	E	UPSCALE Data on Analog Outputs
F	F	ZERO Data on Analog Outputs
G	G	Purge Failure
H	H	Excessive Dust Compensation

**Table 4-0-1  
Relay Function Configuration Jumpers**

The contacts of each relay are jumper configurable for either N.O. or N.C. operation as per the following table.

RELAY	N.O.	N.C.
K1	JU14 "A"	JU14 "B"
K2	JU15 "A"	JU15 "B"

**Table 4-0-2**  
**Relay Contact Configuration Jumpers**

## 5.0 ANALOG OUTPUT ADJUSTMENT

The output current from each channel of the 6PIO may be measured at test points located on the board. The 0 – 20 or 4 – 20mA currents may be measured using a digital voltmeter to read the voltage across a 100Ω resistor at test points TP3 and TP4 for analog channel #1 (DAC1). 2.00 VDC between TP3 and TP4 indicates a 20mA output current. 0.40 VDC corresponds to a 4mA output.

To do this, wire jumpers must be installed between pins 6 & 7 (DAC1) and pins 9 & 10 (DAC2) on TB2, located on the external interface PC board which is mounted inside the junction box. JU9 on the 6PT I/O PC Board must be in the "4" position. To adjust the 4mA output current, place jumper JU10 in the "Z" (Zero scale) position. Adjust Potentiometer R11 till .40 VDC is achieved. Put JU10 back in the "OFF" position and place JU11 in the "FS" (Full Scale) position. Adjust Potentiometer R10 till 2.00 VDC is achieved. Place JU10 back into the "Z" position. You should get a voltage of 1.2 VDC. This is the mid range scale. Return both JU10 & JU11 to there off positions.

The analog channel #2 (DAC2) output is measured between test points TP10 and TP11. Voltage readings on channel #2 are the same as channel #1.

$$2.00 \text{ VDC} = 20\text{mA}$$

$$0.40 \text{ VDC} = 4\text{mA}$$

Jumpers must be moved per DAC1 instructions. Potentiometer R23 & R22 are used for adjustment.

	TEST POINTS	ZERO ADJUST	FULL SCALE ADJUST
Channel #1 (DAC1)	TP3 – TP4	R11	R10
Channel #2 (DAC2)	TP10 – TP11	R23	R22

**Table 5-0-1**  
**Analog Output Channel Adjustment Details**

## 6.0 DATA CABLES

Two data cables are needed to interconnect the 6PIO to external devices. One is a 4 conductor #20 AWG (0.5 mm<sup>2</sup>) cable for connecting the contacts from the two relays. The other one Teledyne Monitor Labs recommends is a 6-pair #24 AWG (0.25 mm<sup>2</sup>) shielded cable for connection to the two analog outputs and two isolators. This would leave two pairs as spares or for future use. See Wiring Diagram in Appendix B for details on external connections to the 6PIO PC Board.

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## Appendix A

### Six Point I/O Board Specifications

#### SIX POINT I/O BOARD ANALOG OUTPUTS

Number	2
Isolation Type	Optical & capacitive barriers; channel to channel, channel to circuit common & earth
Minimum Isolation Voltage	500V <sub>peak</sub> *, 500VDC*
Output Type	4-20mA with live 4mA zero, OR 0-20mA w/o live zero
Maximum Load Resistance	900 ohms
Maximum Offset	±0.05% of full scale
Total Output Error	±0.30% of full scale

#### SIX POINT I/O BOARD DIGITAL INPUTS

Number	2
Modes	Isolated and Non-isolated
Isolated Mode Minimum Isolation Voltage	500V <sub>rms</sub> *
Isolated Mode Minimum Actuation Voltage	5VDC (user supplied)
Isolated Mode Maximum Actuation Voltage	24VDC (user supplied)
Isolated Mode Maximum Input Current	50mA @ 24VDC
Non-Isolated Mode Actuation Condition	Dry contact closure
Non-Isolated Mode Internal Operating Voltage	5VDC

#### SIX POINT I/O BOARD RELAY OUTPUTS

Number	2 SPST, N.O. (Single Pole Single Throw, Normally Open or Normally Closed [jumper selectable])
Minimum Isolation	500V <sub>rms</sub> *
Maximum Contact Voltage	250VAC
Maximum Contact Current	1Amp AC, 1Amp DC

\* I/O wires with respect to earth (common mode).

#### SIX POINT I/O BOARD (1860-0700) DEFAULT JUMPERS (560DI only)

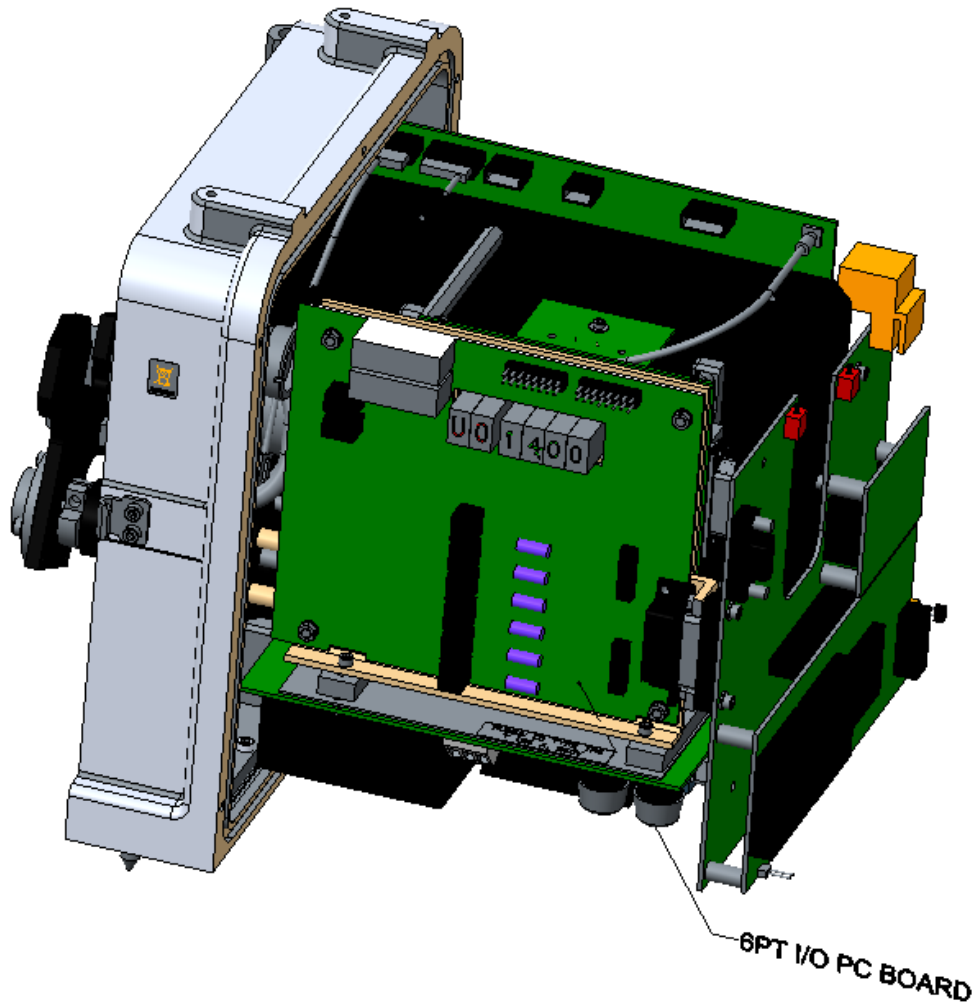
JU1	0 1	0	Hardware range for analog output #1
JU2	0 1	1	
JU3	0 1	0	Hardware range for analog output #2
JU4	0 1	1	
JU5	+5V DRY	DRY	Selects input #1 type
JU6	+5V DRY	DRY	Selects input #2 type
JU7	A (TOP=Force <sub>upscale</sub> ) B (MID=not used) C (BOTTOM=Force <sub>cal cycle</sub> )	BOTTOM	Selects input #1 function
JU8	A (TOP=Force <sub>Zero</sub> ) B (MID=not used) C (BOTTOM=Dump <sub>Dust</sub> )	TOP	Selects input #2 function
JU9	4 0	4	Software range. ma outputs
JU10	OFF ZERO	OFF	Test Zero
JU11	OFF FS	OFF	Test Full Scale
JU12	H G F E D C B A	A (Cal)	K1 relay closure condition
JU13	H G F E D C B A	B (Fault)	K2 relay closure condition
JU14	B A	A (NO)	K1 Relay operation NC/NO
JU15	B A	A (NO)	K2 Relay operation NC/NO

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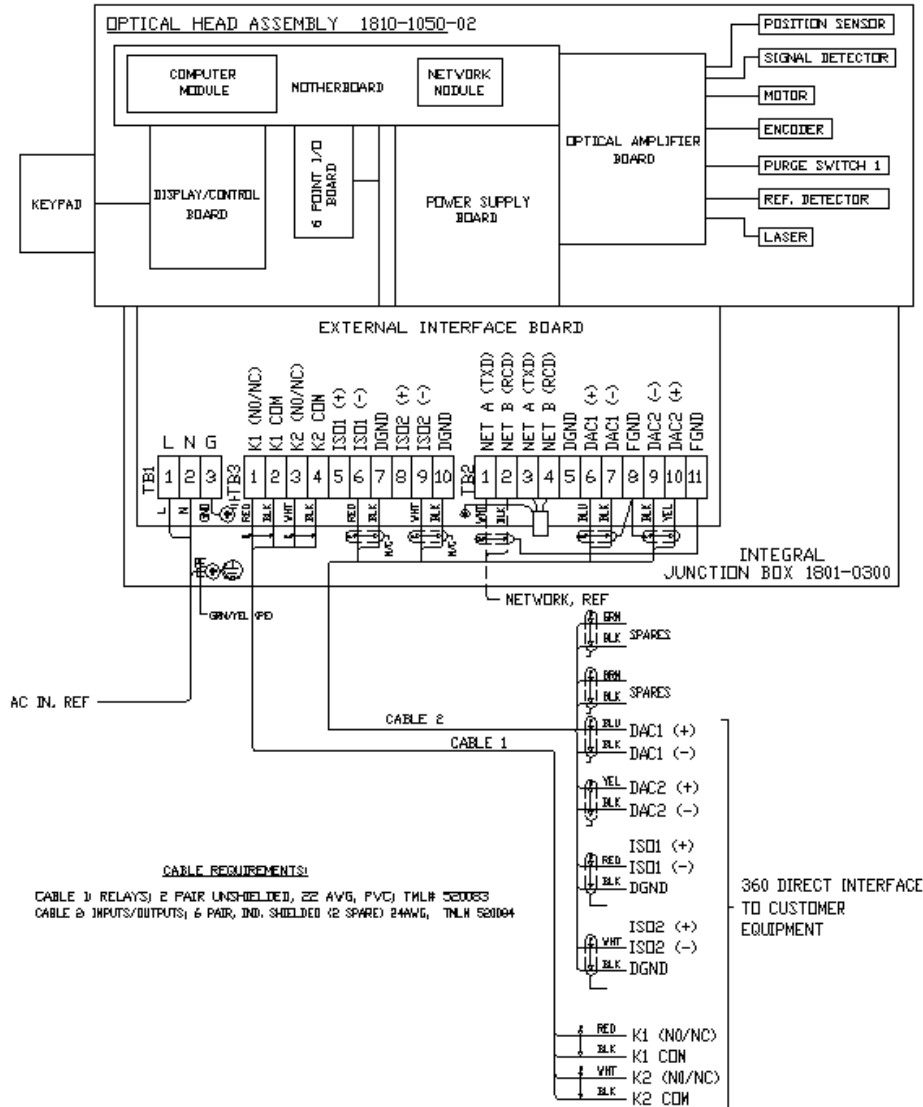
# **APPENDIX B**

## **DRAWINGS**





### 6PT I/O PC BOARD LOCATION



### 6PT I/O WIRING DIAGRAM