



# *High Sierra Electronics*

## **Model 6830/6831 SDI12 Shaft Encoder With Battery Back-up Instruction Manual 60-6831-01(C)**

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## 1.0 INTRODUCTION

### 1.1 General Description:

The Model 6830 and 6831<sup>1</sup> SDI Shaft Encoders are used to measure the rise and fall of liquid levels in various applications such as in stilling wells, evaporation pans or liquid storage tanks. The units come packaged in a weather resistant enclosure for mounting in a stilling well. They provide a maximum of 300 counts per revolution at speeds up to 1 revolution per second and will communicate with an SDI-12 DCP or Data Logger while simultaneously generating incremental pulses for conventional Data Transmitters. In addition, the Model 6831 has an LCD display which allows for on site display of the calibrated liquid level reading (See Appendix 7.5).

A backup rechargeable battery pack is included which allows continuous power while changing the system battery or troubleshooting equipment during site service.

### 1.2 Receiving, Inspection and Unpacking:

*High Sierra Electronics* products are scientific instruments. Exercise care during unpacking and installation. Remove the contents of the package carefully and compare the contents with the enclosed packing list. Should any items be missing, notify *High Sierra Electronics* Customer Service. Please have your packing list available when you call. If any of the items are received in damaged condition, immediately notify the carrier and request an inspection. You must notify the carrier within 15 days of shipment. If a claim is not made within that time period, then the carrier will not acknowledge any claim for the lost or damaged goods.

### 1.3 Specifications:

Range:	Limited by the Stilling Well
Accuracy:	±1 Increment
Sensitivity:	
Standard:	0.01 ft/ct with one foot diameter pulley (100 cts/rev)
Custom:	User specified
Input:	Shaft Position
Outputs:	SDI-12
User Selectable:	Quadrature, ACRO, or Sierra Misco format
Resolution:	300 counts per revolution max.
Shaft Mount Diameter	3/8" SS Standard, 1/2" Hub
Shaft Size:	(front) 5/16" X 2" w/ 3/4" threaded & flatted keyway (rear) 5/16" X 2" w/ flatted keyway (1/4" Shaft Wheels can be accommodated)
Maximum Shaft Speed:	1 rev/sec.
Incremental Output:	Open Drain
Incremental Pulse Width:	8.6 mS minimum.
Input Voltage:	7- 24V DC
Backup Battery Pack:	7.4V Lithium Ion 1500mA (Backup Battery will run sensor 30 days without external Battery)

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<sup>1</sup> For the remainder of this manual, the units will be referred to using the name "Model 6830" unless a feature is unique to the Model 6831, in which case "6831" will be used.

### 1.3 Specifications: (continued):

Current Consumption:	
Normal Operating:	<2 mA
Battery Pack Charging:	Maximum 200mA
Display On (6831):	30 mA
Connectors:	(2) MS-6 pin male (parallel connections)
Connections:	SDI Data (A)
	Direction (SM format only) (B)
	7-24VDC (C)
	Encoder Output B (D)
	Encoder Output A (E)
	Ground (F)
Display (6831):	LCD 2 x 16 Character
Mechanical:	Anodized Aluminum Enclosure
Shipping Weight:	3 pounds with 1 foot wheel
Dimensions:	6" Wide X 6" Deep X 5.25" High

## **2.0 INSTALLATION**

### 2.1 General:

In all cases the Model 6830 must be installed so that the pulley can rotate freely, that the beaded cable or float tape does not bind, and that the housing can not move out of adjustment due to vibration. The float and counterweights are normally supplied with either a beaded cable or float tape. The float tape can be either blank or with graduated readings (feet or meters) that requires a calibration pointer. The 6830 should be installed level so that the tape or cable does not ride off the pulley.

The Model 6830 is shipped ready for installation. If the unit is stored for more than two weeks prior to installation, the backup battery pack must be disconnected. Failure to disconnect the backup batteries will result in the failure of the backup battery pack.

To access the battery pack, remove the 8 (eight) screws that attach battery mounting bracket to the unit (See Appendix 7.5). To recharge the battery pack, connect the sensor to a 12VDC power supply and connect the battery pack cable to the header at P1 on the PCB board of the unit. After the battery pack is connected, the mounting bracket may be re-attached. The Model 6830 is now ready for installation.

### 2.2 Stilling Wells:

There should be only one float in a stilling well. When more than one float is used, the float lines may become tangled. It is important to make sure that the float lines have ample clearance. All level sites should have a staff gauge, wire weight or other level reference in place so that the Model 6830 can be properly base set.

### 2.3 Servo Manometers:

Using a pair of sprockets and a length of ladder chain, which couples the two sprockets together, the Model 6830 can be linked to a wide variety of servo mechanisms.

One sprocket is installed on the servo axle and the other is installed on the Model 6831. The shafts can also be axially lined up and coupled together directly. If this is done, the increment will depend upon the servo mechanism. Either the mechanical readout or a staff gauge is needed to base set the Model 6830 shaft encoder.

#### 2.4 SDI-12 and DCP Connections:

See Section 2.6 for connection to different types of equipment. See Appendix 7.2 and 7.3 for the pin configuration of the MS connectors for connection to the Model 3500 data Logger, the Model 3206 and 3212 ALERT transmitters and other types of DCPs.

#### 2.5 Model 6830 Setup: (See Appendix 7.1 for a full set of SDI commands)

The sensor should be powered while programming, and may be programmed using the sensor programming cable 6830-12, though if the backup battery pack is connected, no external power source is required.

##### 2.5.1 Direction of Count Increase:

Using the SDI-12 interface, the extended commands "aXCWU!" and "aXCCWU!" are used to determine the direction of rotation for the count to increase. To program a clockwise rotation use the "aXCWU!" command; for a counter-clockwise rotation use the "aXCCWU!" command. (See Section 7.1 for additional information)

Before installing the float and counterweight, turn the wheel in the direction of rotation for an upward count and verify that the output is correct. The float is installed so that as the water level rises the float turns the shaft encoder in the correct direction.

##### 2.5.2 Base Set:

Using the SDI-12 interface, extended commands "Zero" and "Write Offset" can be used to establish a base set. The zero command "aXZERO!" will force the count to equal zero at the present wheel position. Zeroing the wheel position will cause the incremental outputs to increment (decrement) from their previous value. Writing an offset the command "aXWSxxxx!" will adjust the sensor output to agree with a staff gauge or desired base elevation. This offset will not effect the incremental output. (See Section 7.1 for additional information)

To determine the offset, take the elevation above sea level of the staff gauge zero and add the reading of the water level on the staff gauge to this number. The resultant number is the offset.

##### 2.5.3 Increment Calculation:

The Model 6830 can be programmed to 1 of 3 increment size possibilities: 100, 150, and 300 counts per revolution for the incremental digital output. There are 300 increments per pulley revolution so the SDI, display and digital output must be scaled to obtain the appropriate output. Table 1 and Table 2 below illustrate typical scaling factors and the appropriate SDI commands needed for calibration of standard pulley sizes. The default *High Sierra Electronics* setting is for a 1 foot diameter pulley with an output of 100 counts per revolution. The default settings are shown in **bold** in the tables. Recalibration for other pulley diameters or other outputs may be specified on order, or changed in the shop or field.

PULLY CIRCUMFERENCE		SDI OUTPUT AND DISPLAY CALIBRATION		
		SLOPE	SLOPE COMMAND	UNITS
A	1.00 Foot	0.0033333	aXWS+.0033333!	Feet
B	1.50 Foot	0.005	aXWS+.005!	Feet
C	375 mm	0.00125	aXWS+.00125	Meters

*Table 1 Pulley Diameter and SDI Calibration*

PULLY CIRCUMFERENCE		INCREMENTAL OUTPUT CALIBRATION		MODEL 3500 DISPLAY OR BASE STATION CALIBRATION		BASE STATION
		Digital Output	SDI Command	Multiplier	Units	Range to Rollover
A	1.00 Foot	100 cts/rev	aXI100!	0.01	Feet	20.47 Feet
B	1.5 Foot	150 cts/rev	aXI150!	0.01	Feet	20.47 Feet
C	375 mm	300 cts/rev	aXI300!	0.00125	Meters	2.559 Meter
D	375 mm	100 cts/rev	aXI100!	0.00375	Meters	7.686 Meter

*Table 2 Pulley Diameter and Incremental Output Calibration<sup>2</sup>*

## 2.6 Connecting To Equipment:

### 2.6.1 Model 3500 Data Logger:

Using the SDI-12 Interface, change the Incremental Output Format to "ACRO" with the extended command "aXACRO!". For one revolution to equal one foot of change with a 0.01 foot resolution, the Incremental Digital Counts per Revolution must be set to 100 using the extended command "aXI100". (See Section 7.1 for additional information)

The 6830-13 connection cable between the Model 6830 shaft encoder and the Model 3500 Data Logger is detailed in Appendix 7.2. On the 6-pin MS connector; Increment A, Increment B and Ground are connected to the 8-conductor ribbon cable. The cover on the Model 3500 needs to be removed to connect the ribbon cable's 8-pin male plug into the circuit board.

### 2.6.2 Model 3206 Transmitter:

The Model 3206 will accept any of the shaft encoder formats (ACRO, Quadrature or Sierra Misco); the jumpers JB 1,2,3,4 on the Model 3206 logic board are set to match the output format of the Model 6830. Since the sensor is powered using pin B of the 5 pin MS connector, it is recommended that JB1 (pin B power) be disabled as shown in the table below.

<sup>2</sup> The Base Station "Range to Rollover" would not apply if the Model 6830 is connected to a Model 3500 data logger. The logger rolls over after 9999 counts and thus would accommodate a 12.498 meter range, when used with a 375 mm pulley. The calibration shown in table 2, line C would be appropriate for most applications

	ACRO	QUAD	SIERRA MISCO
JB-1	OFF	OFF	OFF
JB-2	OFF	OFF	OFF
JB-3	OFF	ON	OFF
JB-4	OFF	OFF	ON

The 6830-10 connecting cable is used to connect the Model 6830 Shaft Encoder to the Model 3206 ALERT Transmitter. The 6 pin female MS connector connects to the Model 6830. The 5 pin female MS connector connects to the digital water Level port of the Model 3206. The 3 pin female MS connector connects to the 12 VDC In Port of the Model 3206. If there is a solar panel or other charging system at the site, connect the charger to the 3 pin male connector on the cable. See Appendix 7.3 for details.

*Note: If connecting a cable other than one supplied by High Sierra Electronics, verify that there is no connection to pin B of the 5 pin rotated MS connector. If power is applied to pin B, extensive transmitter damage will ensue.*

#### 2.6.3 Connection to Model 3212, SDI Transmitter:

The Model 3212 SDI transmitter comes equipped with a 6" x 6" x 4" Enclosure with a bus strip for power, ground and SDI data connection. The 6830-11 cable shown in Appendix 7.3 should be used for this application. The sensor may be programmed using either a 6830-12 programming cable or the SDI transparent window of the Model 3212 program interface.

#### 2.6.4 Connection to Other Equipment:

The Model 6830 may be connected to a variety of data loggers and other Data Collection Platforms (DCP). Contact High Sierra Electronics customer service for help in determining the necessary cable connections.

### **3.0 MAINTENANCE**

A site should be serviced at least twice a year. At each site visit, the battery should be changed with a freshly charged battery. If solar charging, or AC charging is available at the site, the battery should be changed annually. Check to see that the display operates correctly with the battery disconnected. Change the backup battery pack if the display fails to operate with the main battery disconnected.

Check all cable and wire connections to be certain that they are secure and free of corrosion. Clean and tighten as necessary.

Although the Model 6830 Series of Shaft Encoders are essentially maintenance free instruments, *High Sierra Electronics'* recommends that the unit be periodically checked to see that it has not been moved and that it is still level. Also check to see that beaded cable/float tape, with float and counter weight is not tangled up and is free from obstructions for proper movement.

Check that the current consumption of the unit is consistent with the specifications shown in Section 1.3. If the current consumption is higher than expected, see Section 4.2 for troubleshooting tips.

Verify that the display reading is consistent with the level reading on the staff gauge or other reference indicator. Adjust as necessary. Check that the output of the sensor is being received by the DCP at the site. Follow the service recommendations for any other equipment at the site.

If the station is disabled for a prolonged period, be certain to disconnect the back-up battery pack inside the Model 6830 Shaft Encoder. Remove the right side panel on the shaft encoder and unplug the battery cable from the header at P1.

## 4.0 TROUBLESHOOTING

### 4.1 General:

It should be noted that the majority of all failures are due to bad connections. Check all connectors. In some cases just unplugging them and plugging them back in can fix the problem. In following this procedure make sure the sensor is operable; attempt to cause the sensor to fail again by wiggling the point where the cable goes into the connector. If intermittent operation results, the cable or the connector should be replaced.

For troubleshooting assistance, contact *High Sierra Electronics* Customer Service at 1 (800) 275-2080 between 8:00 a.m. and 5:00 p.m. Pacific Coast time. Assistance is also available by FAX, (530) 273-2089, or e-mail: [service@highsierraelectronics.com](mailto:service@highsierraelectronics.com).

## 5.0 RETURNS

If you need to return this product for any reason, call *High Sierra Electronics* at (530) 273-2080 between 8:00 a.m. and 4:00 p.m. Pacific Coast time. Ask for a return Authorization Number (RA#) to be assigned to your unit. Carefully pack the unit so that it will not be further damaged in shipment. Write the RA# on the outside of the box and on any paperwork enclosed with the unit. Please include a written description of the problem and any unique conditions that occurred when the unit failed.

## 6.0 WARRANTY

All *High Sierra Electronics'* manufactured products are warranted against defects in materials and workmanship for a period of three (3) years from the date of shipment. If the equipment fails due to such defects, *High Sierra Electronics* will, as its option, repair or provide a replacement for the defective part or product. In no case will *High Sierra Electronics* be liable for more than the original purchase price.

Equipment supplied by *High Sierra Electronics* and manufactured by others, carries the respective manufacturer's warranty. *High Sierra Electronics* assumes no warranty obligation, either express or implied, for equipment manufactured by others and supplied by *High Sierra Electronics*.

*THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANT ABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ALL OF WHICH IS EXPRESSLY DISCLAIMED.*



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## 7.0 APPENDIX

### 7.1 SDI-12 Commands

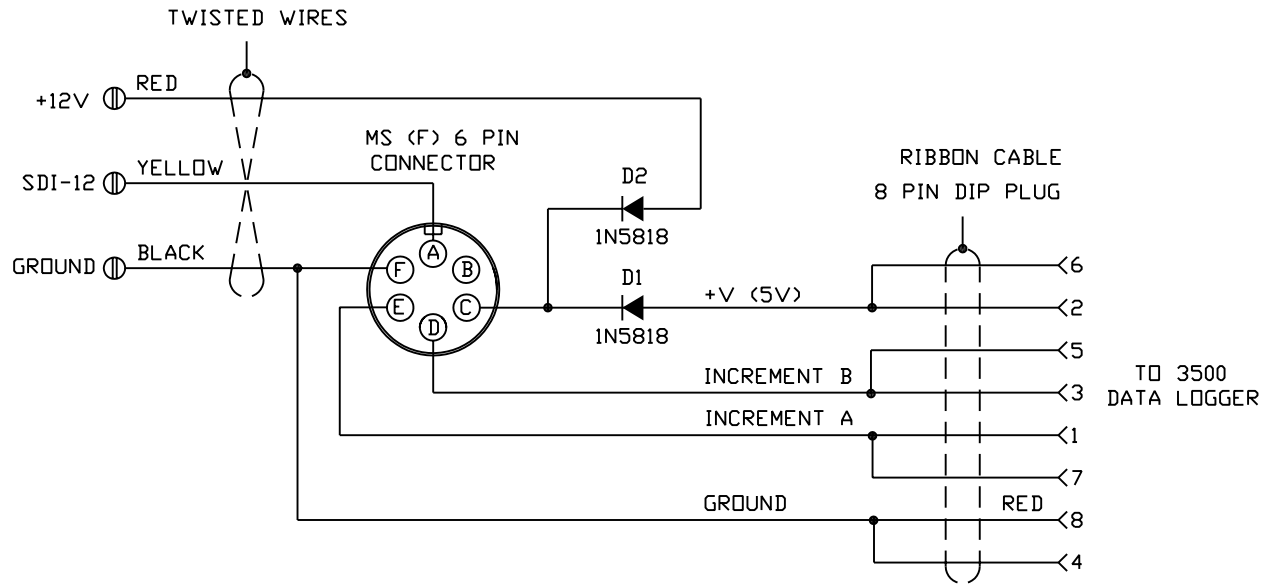
The 6830 responds to all basic SDI commands. Additional extended “X” commands are used for selecting device options. Refer to [www.sdi-12.org](http://www.sdi-12.org) for complete SDI-12 specifications. All command and response characters are in ASCII format, 1200 baud, even parity. **The small ‘a’ denotes the sensor address. The Return Data command (aD0!) is used to verify receipt of extended commands. If a second command is sent to the sensor after starting a measurement, but before the measurement is ready, the sensor will abort the measurement.**

	Command	Response
<b>Acknowledge Active:</b> Returns a response acknowledging that the sensor unit is active.	a!	a<CR><LF>
<b>Send Identification:</b> Returns SDI version, company name, sensor model #, sensor version #.	aI!	a11hisierra_6830_00 <CR><LF> ll = SDI version ccccccc = 8 character vendor ID mmmmmm = 6 character model ID vvv = 3 character sensor version
<b>Address Query:</b> Returns the address for sensor. (Note: Only one sensor may be on the buss for this query)	?!	a<CR><LF>
<b>Start Verification:</b> Returns a string that imitates a checksum.	aV! aD0!	a0001<CR><LF> a 01234<CR><LF>
<b>Change Address:</b> Changes the address of the sensor unit. Valid addresses are those in the range ‘0’ to ‘9’, ‘a’ to ‘z’, and ‘A’ to ‘Z’.	aAb!	b<CR><LF> b is the new sensor address.
<b>Start Measurement:</b> This command will initiate a measurement for the current count. The reading will be affected by the user defined slope and offset. One reading will be available in zero seconds and no service request will be issued.	aM!	a0001<CR><LF>
<b>Return Data:</b> The format of the data is determined by the previously issued command.	aD0!	axxx...xx<CR><LF> xxx..xx is the value of the wheel count (times slope plus offset)
<b>Continuous Measurement:</b> This command will return data with no additional <b>Return Data</b> command.	aR0!	axxx...xx<CR><LF> xxx..xx is the value of the wheel count (times slope plus offset)
<b>Change Direction of Rotation:</b> To program CW rotation for count increase  To program CCW rotation for count increase  Results retrieved by a return data command.  (default direction Clockwise for increase)	aXCWU!  aXCCWU!  aD0!	a0001<CR><LF>  a0001<CR><LF>  a Clockwise ->Up<CR><LF> a Counter-clockwise ->Up<CR><LF>

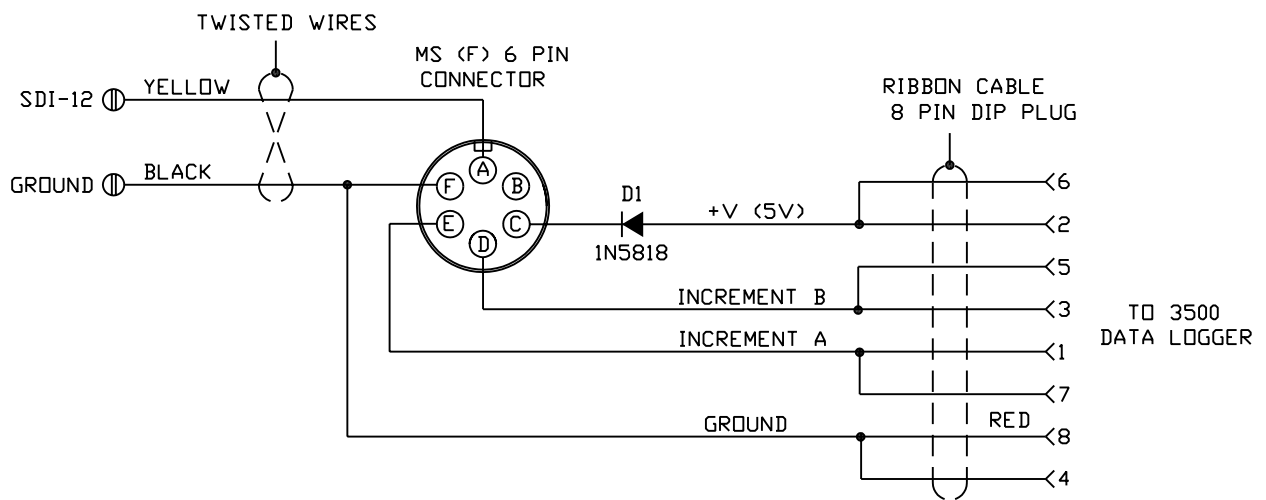



	Command	Response
<b><u>Clear Count Accumulator:</u></b> This command will "zero" the count. Results retrieved using a return data command.	aXZERO!  aD0!	a0001<CR><LF> Wheel Count = 0<CR><LF>
<b><u>Change Incremental Output Format:</u></b>  Results retrieved using a return data command. (default format Quad)	aXQUAD! aXACRO! aXMISCO!  aD0!	a0001<CR><LF>  a Quad Out<CR><LF> a ACRO Out<CR><LF> a Sierra Misco Out<CR><LF>
<b><u>Change Incremental Counts per Revolution:</u></b>  Results retrieved using a return data command. (default 100 counts per revolution)	aXI100! aXI150! aXI300!  aD0!	a0001<CR><LF>  100counts/rev<CR><LF> 150counts/rev<CR><LF> 300counts/rev<CR><LF>
<b><u>Write User Defined Slope:</u></b> Default slope value is 0.003334.  Results retrieved using a return data command.	aXWSsxxxxxx! s is the sign + or - x is the numeric value. aD0!	a0001<CR><LF>  a Slope = sxxxxxx<CR><LF>
<b><u>Write User Defined Offset:</u></b> The default value is 0.000. Results retrieved using a return data command.	aXWOsxxxxxx!  aD0!	a0001<CR><LF>  a Offset = sxxxxxx<CR><LF>
<b><u>Read User Defined Slope:</u></b> Puts the user defined slope value in the data return buffer. Results retrieved using a return data command.	aXRS!  aD0!	a0001<CR><LF>  a Slope = sxxxxxx<CR><LF>
<b><u>Read User Defined Offset:</u></b> Puts user defined offset value in the data return buffer. The data is retrieved by a return data command.	aXRO!  aD0!	a0001<CR><LF>  a Offset = sxxxxxx<CR><LF>
<b><u>Read User Defined Output Format:</u></b> Puts the value of the user defined Output Format in the data return buffer.  Results retrieved using a return data command	aXRF!  aD0! (returns one of the following responses)	a0001<CR><LF>  a Quad Out<CR><LF> a ACRO Out<CR><LF> a Sierra Misco Out<CR><LF>
<b><u>Read User Defined Direction of Rotation:</u></b> Puts the value of the user defined Direction of Rotation in the data return buffer Results retrieved using a return data command	aXRD!  aD0!	a0001<CR><LF>  a Clockwise ->Up<CR><LF> a Counter-clockwise>Up<CR><LF>
<b><u>Read User Defined Increments per Rotation:</u></b> Puts the value of the user defined Increments per Rotation in the data return buffer  Results retrieved using a return data command	aXRI!  aD0! (returns one of the following responses)	a0001<CR><LF>  a IncCounts = 100<CR><LF> a IncCounts = 150<CR><LF> a IncCounts = 300<CR><LF>

MODEL 6830 POWERED BY DCP

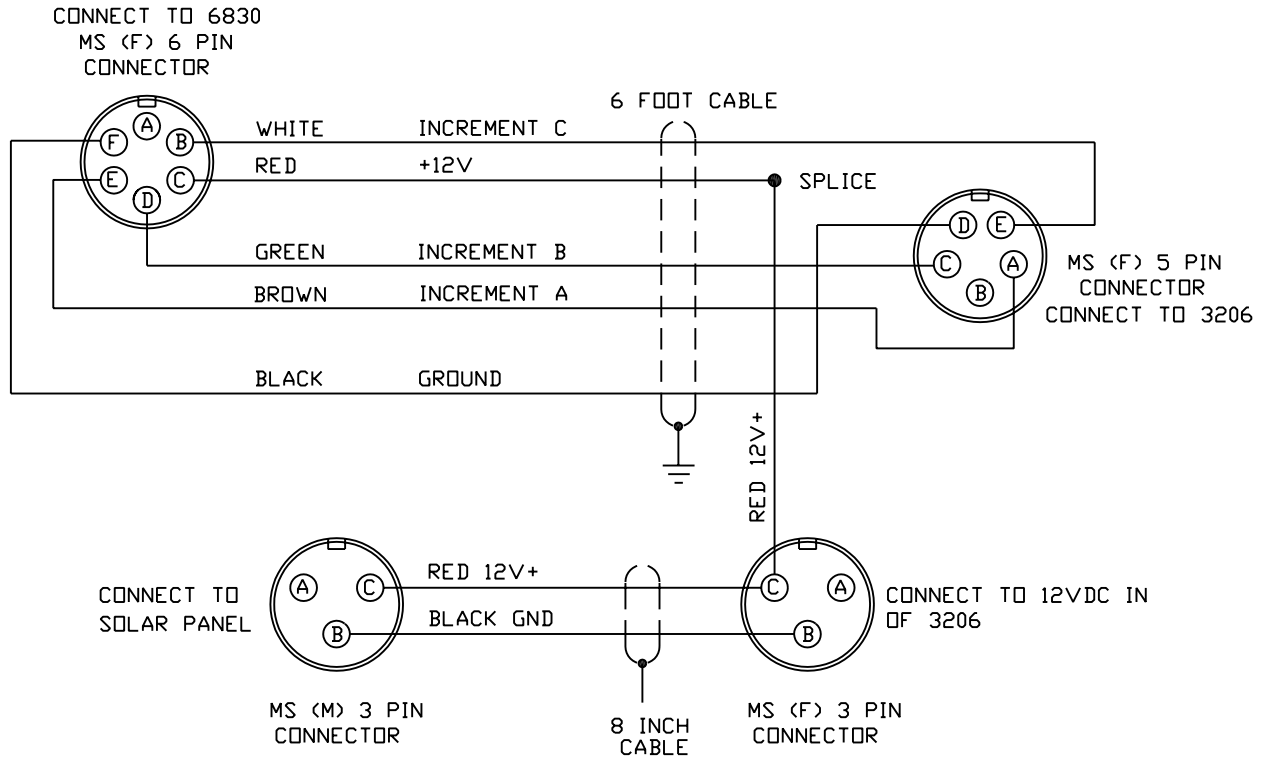


MODEL 6830 POWERED BY 3500

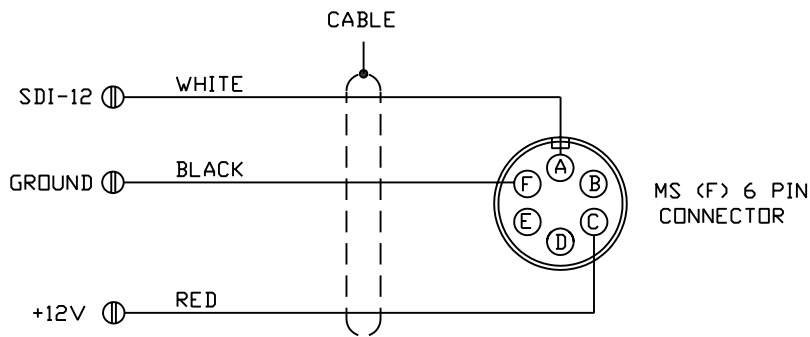



 <b>High Sierra Electronics</b> GRASS VALLEY, CALIFORNIA			
6830/6831 TO 3500 CONNECTING CABLE			
MODEL#	6830-01, 6831-01,-02	REV.:	A
DRAWN BY:	NAE	DATE:	07/02/08
SIZE:	B	APPROVED BY:	
DRAWING NO.:		61-6830-13	
SCALE:		SHT. NO.:	
		1 OF 1	

MODEL 6830-10  
CONNECTING CABLE TO MODEL 3206

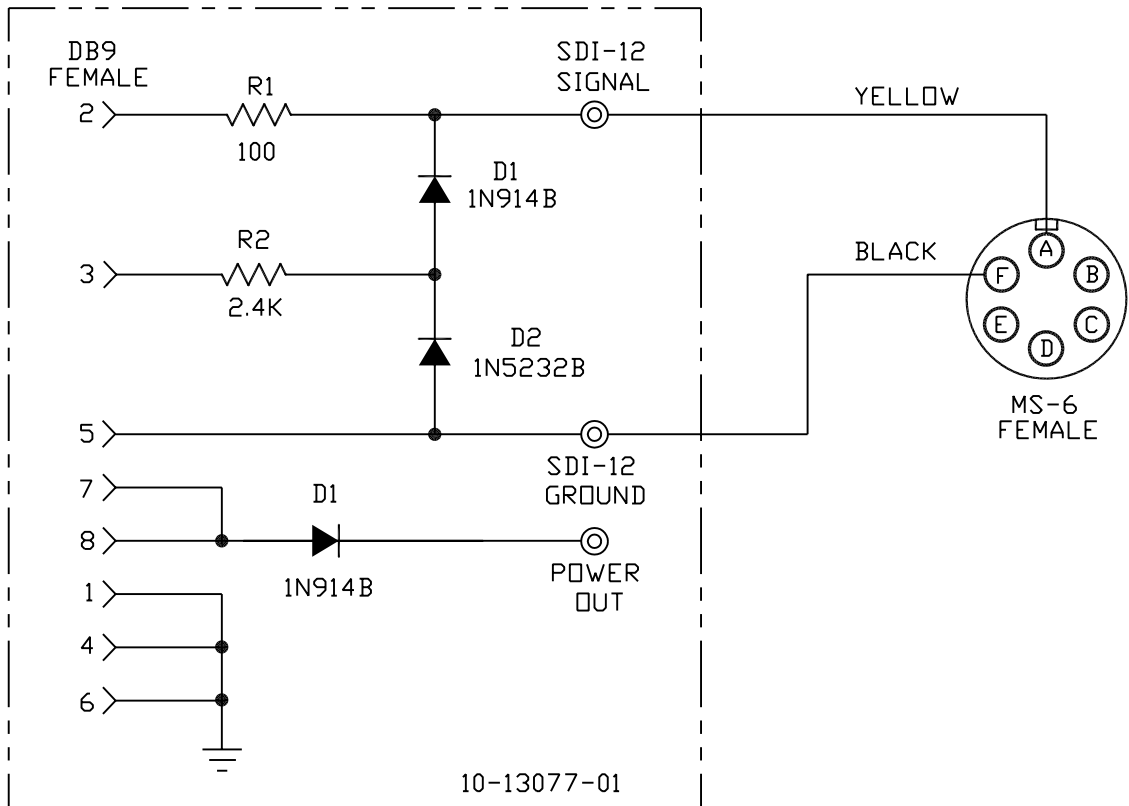


MODEL 6830-11  
CONNECTING CABLE TO MODEL 3212 SDI BUS

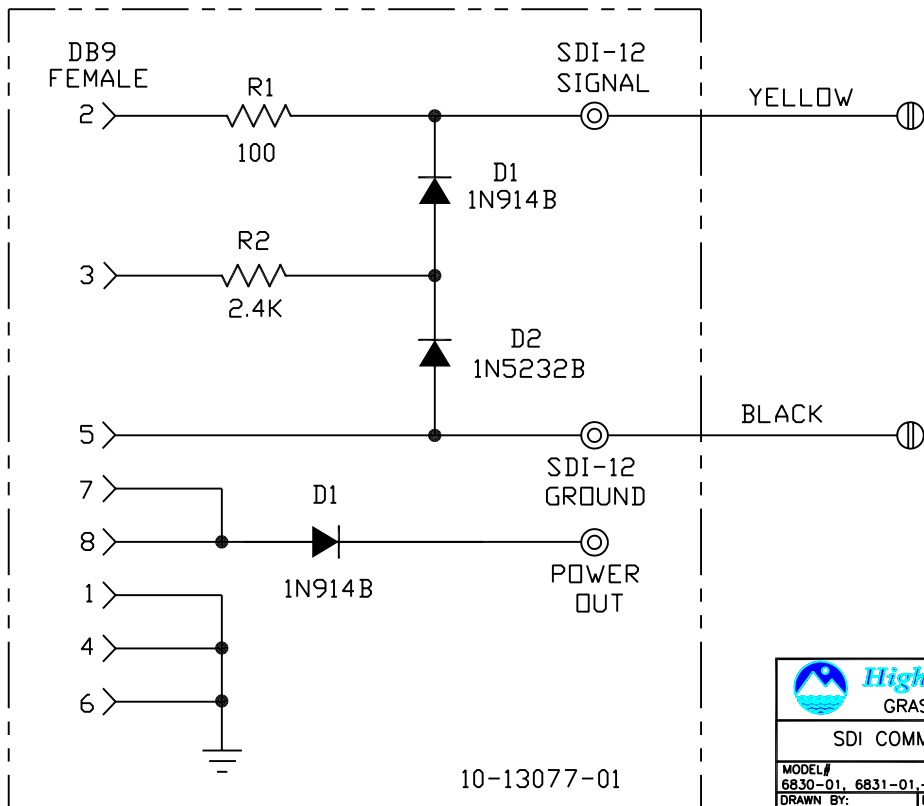


 <b>High Sierra Electronics</b> GRASS VALLEY, CALIFORNIA			
6830/6831 CONNECTING CABLES			
MODEL# 6830-01, 6831-01, -02	REV.: A	DRAWING NO.: 61-6830-11	
DRAWN BY: NAE	DATE: 07/02/08		
SIZE: B	SCALE:	APPROVED BY:	SHT. NO.: 1 OF 1

6830-12 PROGRAMMING CABLE



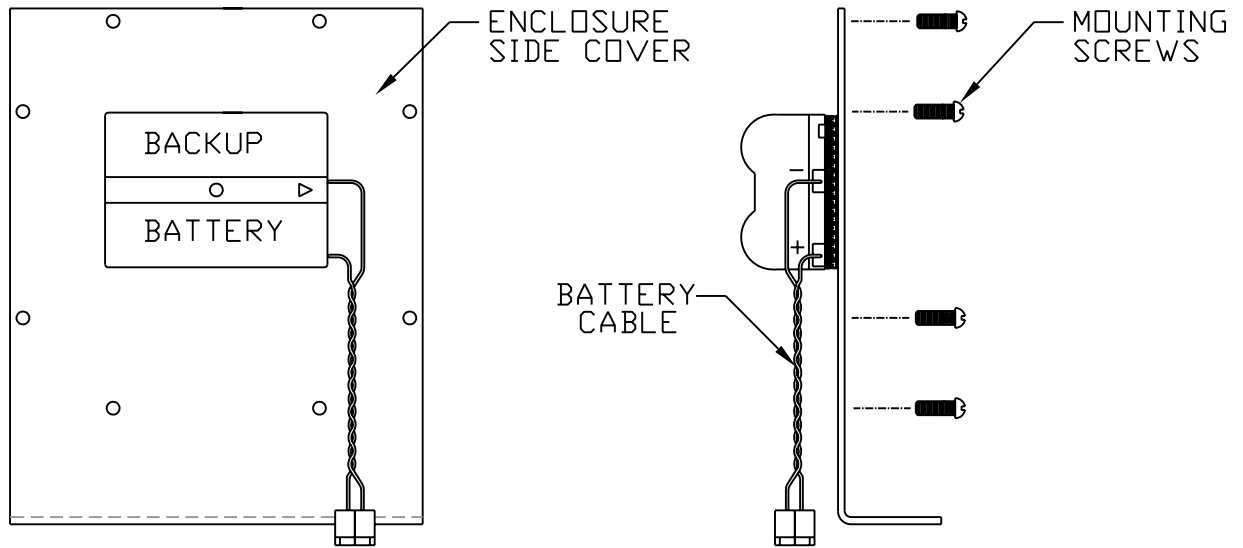
MODEL 4021 SDI-12 INTERFACE CABLE



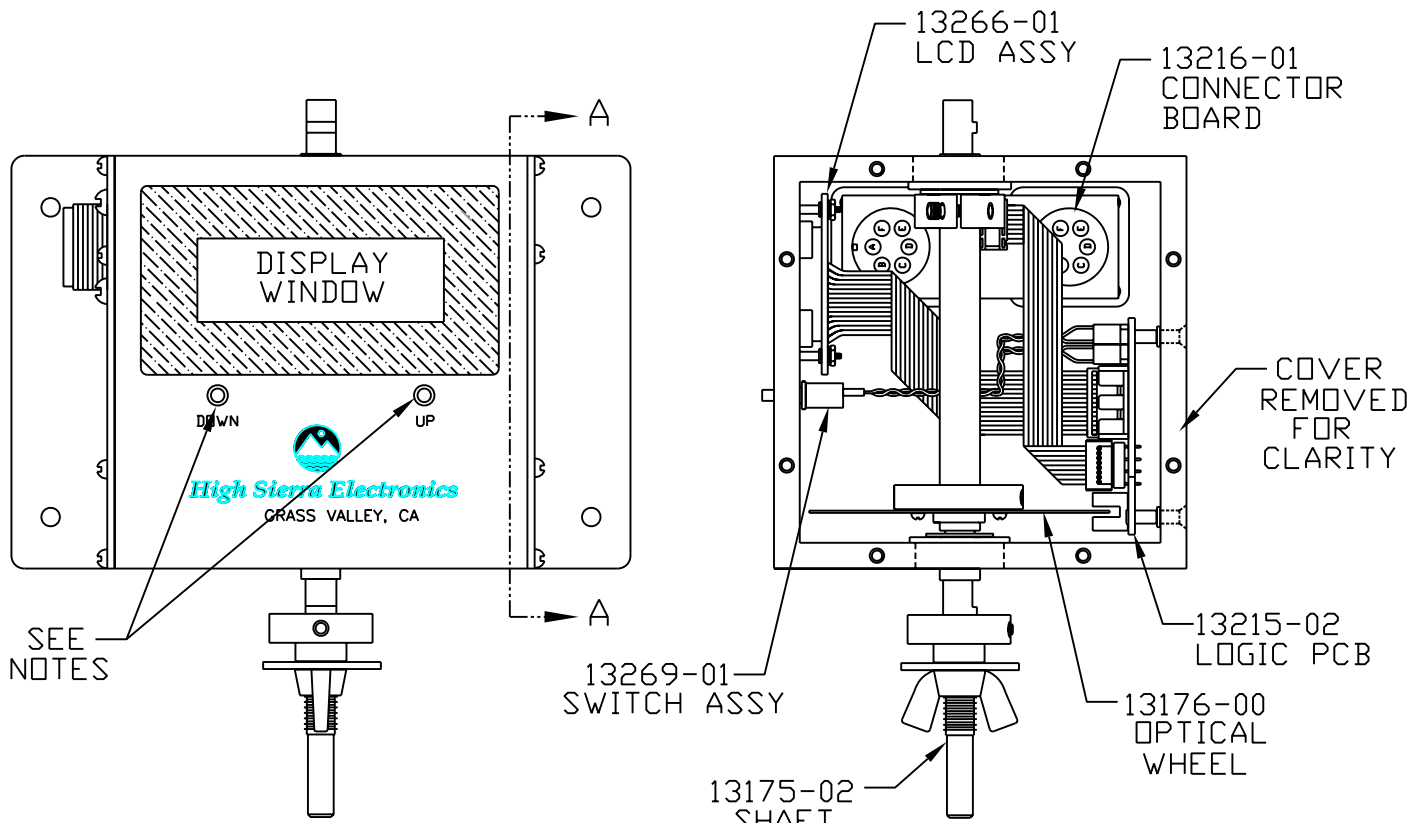
**High Sierra Electronics**  
GRASS VALLEY, CALIFORNIA

SDI COMMUNICATIONS CABLE

MODEL# 6830-01, 6831-01,-02	REV.: A	DRAWING NO.: 61-6830-12
DRAWN BY: NAE	DATE: 07/02/08	
SIZE: B	SCALE:	APPROVED BY:
		SHT. NO.: 1 OF 1




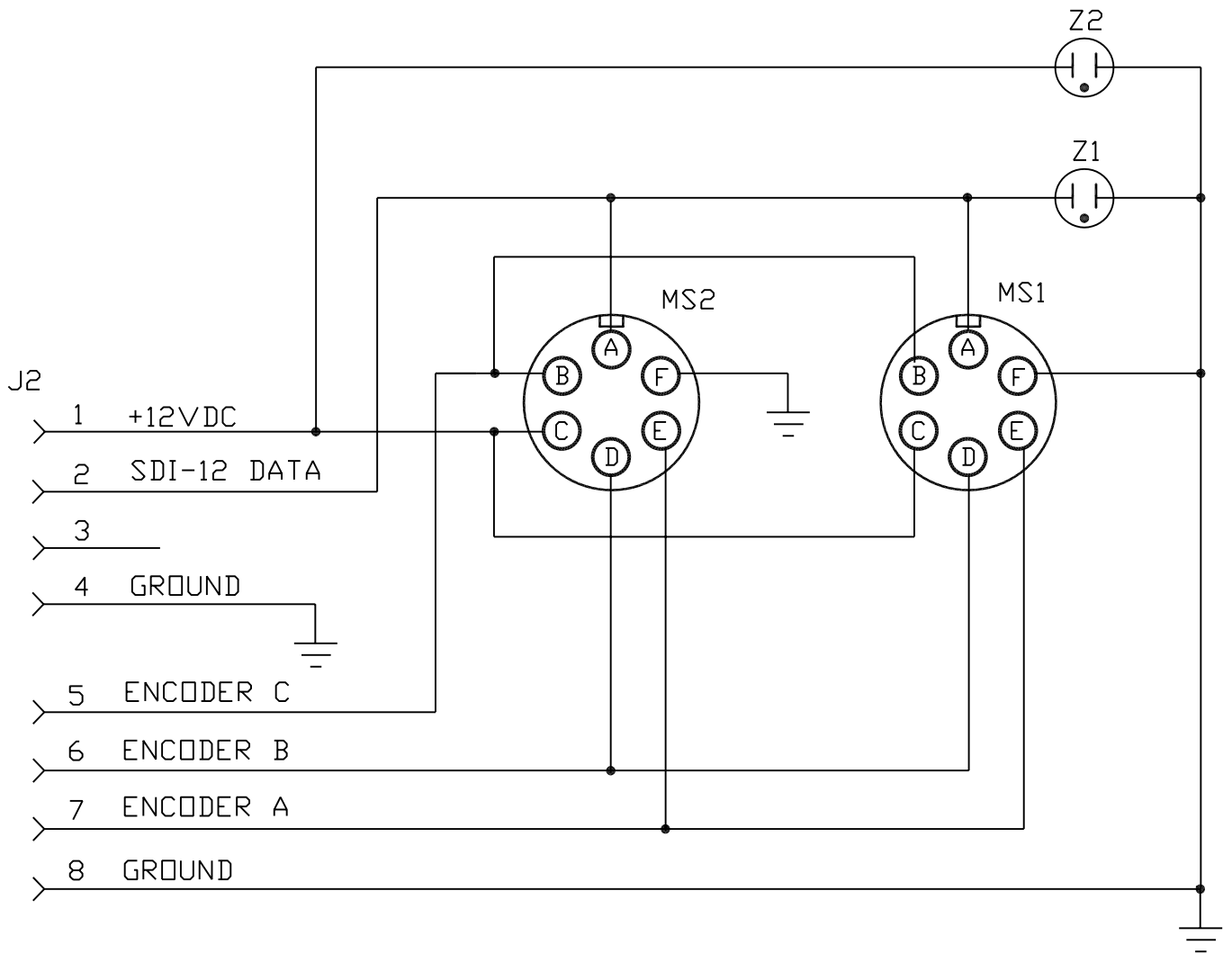
VIEW A-A (ROTATED 90°)




NOTES:

1. PRESSING EITHER BUTTON FOR 1 SECOND WILL TURN DISPLAY ON.
2. DISPLAY WILL TURN OFF AFTER TIMEOUT.
3. HOLDING BOTH BUTTONS FOR 7 SECONDS WILL ALLOW BASE SETTING OF COUNT.
4. DISPLAY WILL FLASH WHEN IN BASE SET MODE.
5. BASE SET MODE WILL RETURN TO DISPLAY MODE AFTER TIMEOUT.

 <b>High Sierra Electronics</b> GRASS VALLEY, CALIFORNIA			
TITLE: SHAFT ENCODER ASSEMBLY			
MODEL#		REV.: A	DRAWING NO.:
DRAWN BY: NAE		DATE: 01/04/10	61-6831-01
SIZE: A	SCALE: 1:1	APPROVED BY:	SHT. NO.: 1 OF 1



 <b>High Sierra Electronics</b> GRASS VALLEY, CALIFORNIA		ENCODER CONNECTOR BOARD	
		MODEL# 6830-01, 6831-01,-02	REV.: A
DRAWN BY: NAE		DATE: 01/22/08	
SIZE: B	SCALE:	APPROVED BY:	SHT. NO.: 1 OF 1

