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USER MANUAL

Accessory 53E

SSI (Synchronous Serial) Encoder Interface Board

3Ax-603360-xUxx

September 30, 2009

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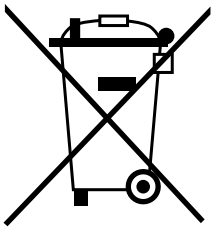
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INTRODUCTION

The Acc-53E Axis Expansion Board provides up to eight channels of SSI encoders to be read by the UMAC and Ultralite/MACRO Station controllers. The Acc-53E is part of the UMAC or MACRO Pack family of expansion cards and these accessory cards are designed to plug into an industrial 3U rack system. The information from these accessories is passed directly to either the UMAC or MACRO Station CPU via the high speed JEXP expansion bus. Other axis or feedback interface JEXP accessories include the following:

- Acc-14E Parallel feedback Inputs (absolute enc. or interferometers)
- Acc-24E2 Digital amplifier breakout w/ TTL encoder inputs or MLDT
- Acc-24E2A Analog amplifier breakout w/ TTL encoder inputs or MLDT
- Acc-24E2S Stepper amplifier breakout w/ TTL encoder inputs or MLDT
- Acc-28E 16-bit A/D converter Inputs (up to four per card)
- Acc-51E 4096 times interpolator for 1Vpp sinusoidal encoders
- Acc-53E SSI encoder interface (up to eight channels)

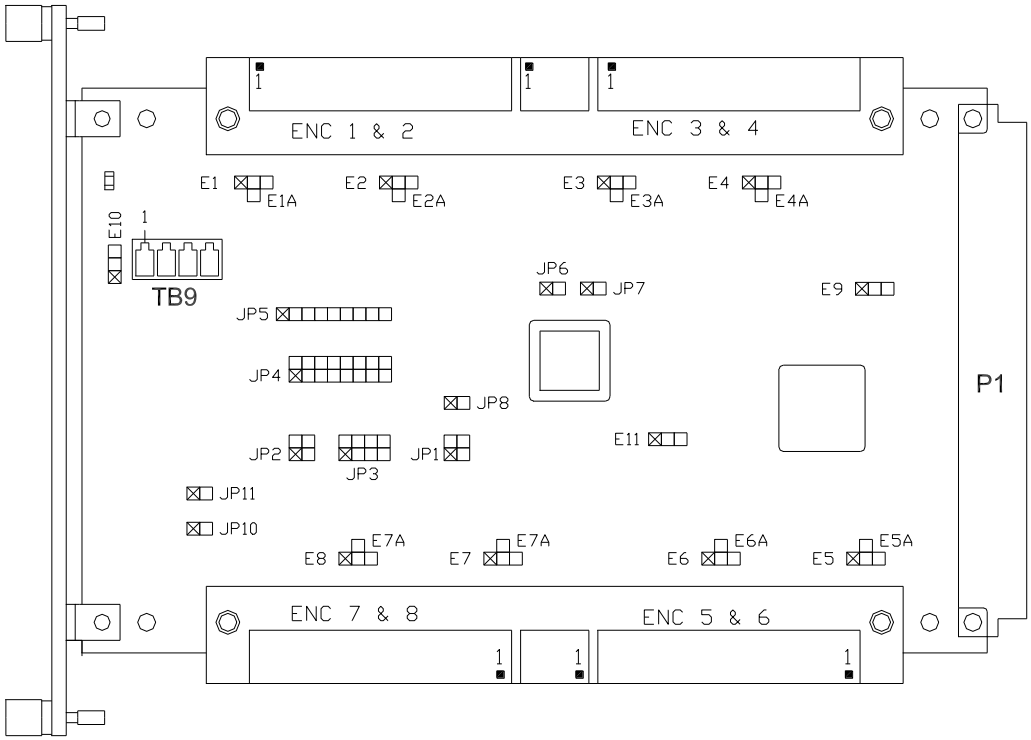
Up to four Acc-53E boards can be connected to one UMAC providing up to 32 channels of SSI encoder feedback. Because each MACRO Station CPU can service only eight channels of servo data, only one fully populated Acc-53E board can be connected to the MACRO-Station.

The Acc-53E board will take the data from the SSI encoder and process it as a binary parallel word (12 or 24 bits). This data can then processed in the UMAC or MACRO Station encoder conversion table for position and velocity feedback. With proper setup, the information can also be used to commutate brushless and AC induction motors.

Caution:

Acc-53E was designed to work with Gray Code Style SSI Encoders only. The Acc-53E takes the gray code information and converts it into a parallel binary word for absolute and ongoing position data.

BOARD LAYOUT



HARDWARE SETTINGS

The Acc-53 uses expansion port memory locations defined by the type of PMAC (3U Turbo or MACRO Station) it is directly communicating to. Typically, these memory locations are used with other Delta Tau 3U I/O accessories such as:

- Acc-9E 48 optically isolated inputs
- Acc-10E 48 optically isolated outputs, low power
- Acc-11E 24 inputs and 24 outputs, low power, all optically isolated
- Acc-12E 24 inputs and 24 outputs, high power, all optically isolated
- Acc-14E 48-bits TTL level I/O
- Acc-28E 16-bit A/D converter Inputs (up to four per card)

All of these accessories have settings which tell them where the information is to be processed at either the UMAC 3U Turbo or the MACRO Station.

3U Turbo PMAC Memory Locations	MACRO Station Memory Locations
$078C00, $079C00 $07AC00, $07BC00	$8800,$9800 $A800,$B800
$078D00, $079D00 $07AD00, $07BD00	$8840,$9840 $A840,$B840
$078E00, $079E00 $07AE00, $07EC00	$8880,$9880 $A880,$B880
$078F00, $079F00 $07AF00, $07BF00	$88C0,$98C0 $A8C0,$B8C0

The Acc-53E has a set of dip switches telling it where to write the information form the SSI encoders to. Once the information is at these locations, we can process the binary word in the encoder conversion table to use for servo loop closure. Proper setting of the dip switches ensures all of the JEXP boards used in the application do not interfere with each other.

Address Select Dip Switch S2

The Switch 2 (S2) settings will allow you to select the starting address location for the first encoder. Encoders 2 through 8 will follow in descending order from the address selected by the S2 switch. The following two tables show the dip switch settings for both the Turbo PMAC 3U and the MACRO Station.

Turbo PMAC 3U Switch Settings

Chip Select	3U Turbo PMAC Address	Dip Switch SW1 Position					
		6	5	4	3	2	1
CS10	Y:$78C00-03	Close	Close	Close	Close	Close	Close
	Y:$79C00-03	Close	Close	Close	Open	Close	Close
	Y:$7AC00-03	Close	Close	Open	Close	Close	Close
	Y:$7BC00-03	Close	Close	Open	Open	Close	Close
CS12	Y:$78D00-03	Close	Close	Close	Close	Close	Open
	Y:$79D00-03	Close	Close	Close	Open	Close	Open
	Y:$7AD00-03	Close	Close	Open	Close	Close	Open
	Y:$7BD00-03	Close	Close	Open	Open	Close	Open
CS14	Y:$78E00-03	Close	Close	Close	Close	Open	Close
	Y:$79E00-03	Close	Close	Close	Open	Open	Close
	Y:$7AE00-03	Close	Close	Open	Close	Open	Close
	Y:$7BE00-03	Close	Close	Open	Open	Open	Close
CS16	Y:$78F00-03	Close	Close	Close	Close	Open	Open
	Y:$79F00-03	Close	Close	Close	Open	Open	Open
	Y:$7AF00-03	Close	Close	Open	Close	Open	Open
	Y:$7BF00-03	Close	Close	Open	Open	Open	Open

MACRO Station Switch Settings

Chip Select	3U Turbo PMAC Address	Dip Switch SW1 Position					
		6	5	4	3	2	1
CS10	Y:$8800	Close	Close	Close	Close	Close	Close
	Y:$9800	Close	Close	Close	Open	Close	Close
	Y:$A800	Close	Close	Open	Close	Close	Close
	Y:$B800 ($FFE0*)	Close	Close	Open	Open	Close	Close
CS12	Y:$8840	Close	Close	Close	Close	Close	Open
	Y:$9840	Close	Close	Close	Open	Close	Open
	Y:$A840	Close	Close	Open	Close	Close	Open
	Y:$B840 ($FFE8*)	Close	Close	Open	Open	Close	Open
CS14	Y:$8880	Close	Close	Close	Close	Open	Close
	Y:$9880	Close	Close	Close	Open	Open	Close
	Y:$A880	Close	Close	Open	Close	Open	Close
	Y:$B880 ($FFF0*)	Close	Close	Open	Open	Open	Close
CS16	Y:$88C0	Close	Close	Close	Close	Open	Open
	Y:$98C0	Close	Close	Close	Open	Open	Open
	Y:$A8C0	Close	Close	Open	Close	Open	Open
	Y:$B8C0 ($B8C0*)	Close	Close	Open	Open	Open	Open

* Setting used for legacy systems and typically used as the address setting for Acc-9E, Acc-10E, Acc-11E, and Acc-12E IO cards.

Jumpers

Please refer to the layout diagram of Acc-53E for the location of the jumpers on the board.

E-Point Jumpers

Jumper	Config	Description	Settings	Default
E1-E8	1-2-3-4	Supply voltage to encoder	1-2 for 15V supply 2-3 for 5V supply 2-4 for Kawasaki encoder	2-3
E9	1-2-3	Turbo-PMAC/MACRO Select	Jump 1-2 for Turbo 3U CPU and MACRO CPU * Jump 2-3 for legacy MACRO CPU (before 6/00)	1-2
E11	1-2-3	Clock Select	1-2 servo clock 2-3 phase clock	2-3
* For legacy MACRO Stations (part number 602804-100 thru 602804-104)				

JP- Jumpers

Jumper	Config	Description	Settings	Default
JP1	1-2	Mode Select	1-2 XC4005 mode no jumper XC4005 mode	No jumper
JP2	1-2 3-4	Baud Rate Select	1-2 3-4 rate in in 1000K out in 500K in out 250K out out 125K	1-2 –in 3-4 -in
JP3	1-2	Not used		No jumper
JP4	1-2 (1) 3-4 (2) 5-6 (3) 7-8 (4) 9-10 (5) 11-12 (6) 13-14 (7) 15-16 (8)	Single Turn/Multi-turn Encoder Select	Jumper for Single Turn No Jumper for Multi Turn	No Jumper
JP6 JP7	1-2 1-2	EEPROM Program Jumper For factory Use	JP6 JP7 function 1-2 1-2 Normal 1-2 open disconnect open open program	JP6 1-2 JP7 1-2
JP8	1-2	Program Mode For factory use only	mal No jumper for JTAG download	1-2

Warning:

If the Minimum Read Time for the encoder based on the baud rate is less then the on time of the sample clock (based on E11), then the feedback signal will not be read properly

Data Read Limitations

The data from the SSI encoder must be read at a minimum frequency based the baud rate select jumpers. Each channel is capable of reading 24 bits of data and the data is transmitted at a rate defined by the baud rate jumpers. The data from the SSI encoder must be read during the on time of the sample clock selected by E11. The default settings for the Acc-53E use the 1000Kbaud setting and the phase clock to read the data. At this setting, the user does not have to worry about the data being read by the UMAC system when the system is at factory defaults because the minimum read time is 0.03125 msec and the phase clock is high for 0.05524 msec. The simple formula that specifies the minimum time needed to read the data is shown below:

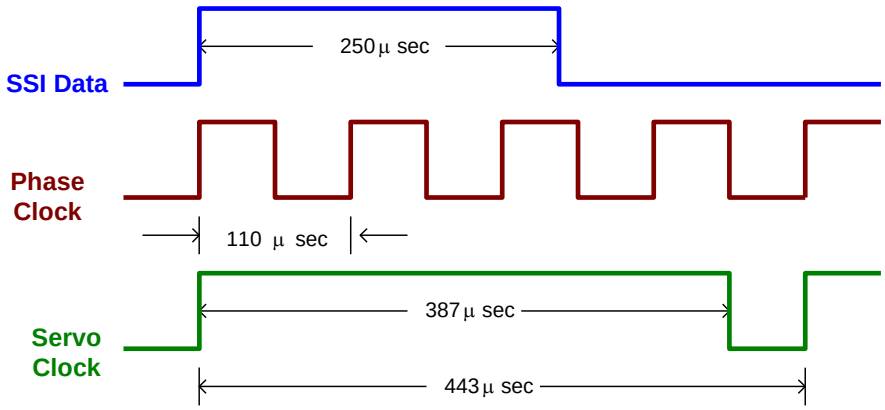
$$MinimumTime = \frac{25bits}{BaudRate} \times 1.25$$

Baud Rate	Minimum Read Time
1000K	0.03125 msec
500K	0.06250 msec
250K	0.12500 msec
125K	0.25000 msec

The default settings of servo and phase clock are listed below

Clock	Frequency	Time	Clock High Time	Clock Low Time
Phase	9.0346 KHz	0.110686 msec	0.05534 msec	0.05534 msec
Servo	2.258 KHz	0.442742 msec	0.38735 msec	0.05534 msec

Below is an example of the problem that could occur if using a SSI encoder with a Baud Rate setting 125 KHz. At this speed, the minimum read time is 0.25 msec and this is much longer than the high time of the phase clock (0.05534 msec.). A simple solution for this problem would be to set the sample jumper to the servo clock (E11 set 1-2). If the servo clock is selected as the sample clock, then the on time for the sample clock would be 0.38735 msec and this is plenty of time to sample the data. The timing diagrams for the data sampling are shown below:



If there are any questions about the timing diagrams, call the factory for assistance.

The calculations to obtain the high and low times for the servo and phase clock are shown below:

$$Phase\,Clock\,High\,Time = \frac{2}{MaxPhase(\,KHz\,)}\,m\,sec$$

$$Phase\,Clock\,Low\,Time = Phase\,Clock\,High\,Time \times \left[1 + \left(1 + 2 \times I7m01\right)\right](\,m\,sec)$$

$$Servo\,Clock\,Low\,Time = Phase\,Clock\,Low\,Time\,(msec)$$

$$Servo\,Clock\,High\,Time = Servo\,Clock\,(msec) - Phase\,Clock\,Low\,Time\,(msec)$$

The phase clock and servo clock can be calculated using the I-variables I7m00-I7m03 for the UMAC Turbo, I6800-I6803 for the Turbo Ultralites, and I992, I997, and I998 for the Ultralite cards. See the descriptions for these variables in the Software Reference manuals.

MACRO Sample Time Considerations

When the Acc-53E is used with a MACRO Station system the user must be aware of the servo and phase clock settings at the MACRO Station. Basically, the servo clock and the phase clock are set to the same settings because there are no loop closures at the MACRO CPU. The data is transferred back to the Ultralite and then the loops are closed at the Ultralite's servo clock setting. Because the servo clock and phase clock are always set to the same value at the MACRO Station, simply changing the E11 jumper to sample on the Servo clock will not fix the problem. If your system requires a slower baud rate setting (250K or 125K), then Delta Tau would recommend changing the phase clock or ring cycle time with I6800 and I6802 for the Turbo Ultralite and I992 and I998 with the non-Turbo Ultralite and lastly the user will have to change the MI992 at the MACRO CPU.

For example: If the SSI baud rate setting should be at 250K, then a sample on time of 0.125 msec is needed. For this example, the phase/ring clock is changed to 4 KHz and the servo clock to 2 KHz. This will give a sample on time of 0.125msec.

```
I6800=14744           ;sets Maxphase to 4 KHz
I6801=0               ;Phase clock set to 4KHz
I6802=1               ;Servo Clock set to 2 KHz
MS0,MI992=14744       ;sets Maxphase at MACRO Station to 4KHz
MS0,MI997=0           ;Default-Sets Phase and Ring Cycle to 4KHz
MS0,MI998=0           ;Default-Sets Servo Clock at MACRO Station to 4KHz
```

Warning:

If the Minimum Read Time for the encoder based on the baud rate is less then the on time of the sample clock (based on E11), then the feedback signal will not be read properly

Hardware Address Limitations

Some of the older UMAC IO accessories might create a hardware address limitation relative to the newer series of UMAC high-speed IO cards. The Acc-53E would be considered a newer high speed IO card. The new IO cards have four addresses per chip select (CS10, CS12, CS14, and CS16). This enables these cards to have up to 16 different addresses. The Acc-9E, Acc-10E, Acc-11E, and Acc-12E all have one address per chip select but also have the low-byte, middle-byte, and high-byte type of addressing scheme and allows for a maximum of twelve of these IO cards.

UMAC Card Types

UMAC Card	Number of Addresses	Category	Maximum # of cards	Card Type
Acc-9E, Acc-10E, Acc-11E, Acc-12E	4	General IO	12	A
Acc-65E, Acc-66E, Acc-67E, Acc-68E, Acc-14E	16	General IO	16	B
Acc-28E, Acc-36E, Acc-59E	16	ADC and DAC	16	B
Acc-53E, Acc-57E, Acc-58E	16	Feedback devices	16	B

Chip Select Addresses

Chip Select	UMAC Turbo Type A Card	MACRO Type A Card	UMAC Turbo Type B Card	MACRO Type B Card
10	$078C00	$FFE0 or $8800	$078C00, $079C00 $07AC00, $07BC00	$8800,$9800 $A800,$B800
12	$078D00	$FFE8 or $8840	$078D00, $079D00 $07AD00, $07BD00	$8840,$9840 $A840,$B840
14	$078E00	$FFF0 or $8880	$078E00, $079E00 $07AE00, $07EC00	$8880,$9880 $A880,$B880
16	$078F00	$88C0	$078F00, $079F00 $07AF00, $07BF00	$88C0,$98C0 $A8C0,$B8C0

Addressing Conflicts

When just using only the type A UMAC cards or using only the type B UMAC cards in an application, the user does not have to worry about potential addressing conflicts other than making sure the individual cards are set to the addresses as specified in the manual.

If both type A and type B UMAC cards are in a rack, be aware of the possible addressing conflicts. If using the Type A card on a particular Chip Select (CS10, CS12, CS14, or CS16), then a Type B card with the same Chip Select address cannot be used unless the Type B card is a general IO type. If the Type B card is a general IO type, then the Type B card will be the low-byte card at the Chip Select address and the Type A cards will be setup at as the middle-byte and high-byte addresses.

Type A and Type B Example 1: Acc-11E and Acc-53E

If there is an Acc-11E and Acc-53E, both cards cannot use the same Chip Select because the data from both cards will be overwritten by the other card.

The solution to this problem is to make sure that both cards are not addressed to the same chip select.

Type A and Type B Example 2: Acc-11E and Acc-65E

For this example, the two cards can share the same chip select because the Acc-65E is a general purpose IO Type B card. The only restriction in doing so is that the Acc-65E must be considered the low-byte addressed card and the Acc-11E must be jumpered to either the middle or high bytes (jumper E6A-E6H).

3U TURBO PMAC USE

To use the Acc-53 with the 3U Turbo PMAC, set up various I-Variables for the encoder conversion table and power-on position. The encoder conversion table is set up using variables I8000 through I8192. Each variable is an entry in the conversion table and its setup is described in the Turbo PMAC Software Reference Manual.

The data for from the Acc-53E is located at the base address + n where n is the encoder number –1. For example, if the base address was at $78C00:

Encoder #	Processed Data
1	Y:$78C00
2	Y:$78C01
3	Y:$78C02
4	Y:$78C03
5	Y:$78C04
6	Y:$78C05
7	Y:$78C06
8	Y:$78C07

3U Turbo PMAC Encoder Conversion Table Setup

Use the above table and S2 to select address. Once the address is selected via the S2, the corresponding address is used to read the encoder position data.

For example: On all 'closed' position, the encoder conversion table entry will be:

```
Set   I8000 =$278C00    ;Turbo location $3501 process Y:$078C000 as parallel word
      I8001 =$018000    ;Turbo location $3502 for multi-turn (24bit) encoder
Or    I8001=$00C000     ;Turbo location $3502 for single turn(12 bit) encoder
```

Refer to the Turbo PMAC Software Reference manual for this setup.

Note:

This is a two-line input for one encoder channel, so make sure the related I-Variable (Ix03, Ix04) is pointed to the address of the second line. For example, for the above set up I103 and I104 should be = $3502.

POWER ON POSITION SETUP FOR TURBO PMAC

PMAC power on absolute position is acquired by Ix10. If a multi-turn absolute SSI encoder is used, Ix10 must be set properly for power on absolute encoder data reading.

Here is an example for 24-bit multi-turn SSI encoder connected in the first channel (on PMAC address: Y:$78C00):

```
I110 = $078C00
```

Turbo-PMAC power on position requires not only Ixx10, but also Ixx95 (may also need Ixx91).

Example: (when I110 is set on above value)

```
I195 = $980000          ;for multi-turn encoder
```

Refer to the Turbo-PMAC Software Reference manual for details.

CARD IDENTIFICATION FOR TURBO PMAC

Card Identification Address

Chip select used	Data address range	Card ID address range
CS10	$78C00 - $78CFF	$78F30 - $78F33
	$79C00 - $79CFF	$79F30 - $79F33
	$7AC00 - $7ACFF	$7AF30 - $7AF33
	$7BC00 - $7BCFF	$7BF30 - $7BF33
CS12	$78D00 - $78DFF	$78F34 - $78F37
	$79D00 - $79DFF	$79F34 - $79F37
	$7AD00 - $7ADFF	$7AF34 - $7AF37
	$7BD00 - $7BDFF	$7BF34 - $7BF37
CS14	$78E00 - $78EFF	$78F38 - $78F3B
	$79E00 - $79EFF	$79F38 - $79F3B
	$7AE00 - $7AEFF	$7AF38 - $7AF3B
	$7BE00 - $7BEFF	$7BF38 - $7BF3B
CS16	$78F00 - $78F07	$78F3C - $78F3F
	$79F00 - $79F07	$79F3C - $79F3F
	$7AF00 - $7AF07	$7AF3C - $7AF3F
	$7BF00 - $7BF07	$7BF3C - $7BF3F

Card Identification Format

Base Addr. + (Bank Sel. =0)	**D4**	**D3**	**D2**	**D1**	**D0**
	Phase_Dir	Vendor ID ID:03	Vendor ID ID:02	Vendor ID ID:01	Vendor ID ID:00
	Bank Sel. =0	Vendor ID ID:13	Vendor ID ID:12	Vendor ID ID:11	Vendor ID ID:10
	Card option CO:04	Card Option CO:03	Card Option CO:02	Card Option CO:01	Card Option CO:00
	Card option CO:09	Card Option CO:08	Card Option CO:07	Card Option CO:06	Card Option CO:05
Base Addr. + (Bank Sel. =1)	Phase_Dir	Revision # CR:03	Revision # CR:02	Revision # CR:01	Revision # CR:00
	Bank Sel. = 1	Card ID CT: 03	Card ID CT: 02	Card ID CT: 01	Card ID CT: 00
	Card ID CT: 08	Card ID CT: 07	Card ID CT: 06	Card ID CT: 05	Card ID CT: 04
	Card ID CT: 13	Card ID CT: 12	Card ID CT: 11	Card ID CT: 10	Card ID CT: 09

The card identification number of all Delta Tau cards is derived from the last four digits of the PCB assembly number. For example, the SSI card assembly number is 603360. Convert the last four digits into hex number, i.e:

```
3360 = $ D20
```

This will be the card identification for SSI.

Vender identification number = 1 for Delta Tau.

Revision number for this card is 1.

Option 1: Additional four axes (makes SSI interface into 8-axis system)

ACC-53E SETUP FOR MACRO/ULTRALITE SYSTEM

If you are using the information from the Acc-53E converter for closed loop servo data, you could process the data at the encoder conversion table at the MACRO Station and have the information automatically sent to the Ultralite. The data from the Acc-53E is processed as a parallel word input at the MACRO Station and then transmitted back to the Ultralite using the traditional Servo Node. The encoder conversion table at the MACRO Station will have to be modified to process this data. From the Ultralite standpoint, nothing will need to be modified to read the position and velocity data.

Since the Acc-53E data is also absolute, the data can also be sent at the Ultralite as absolute data for correct position at power-up. This is accomplished with the proper setup of MSn,MI11x at the MACRO Station, and Ix10 at the Ultralite or Ix10 and Ix95 with the Turbo Ultralite. Regardless of the type of Ultralite, retrieving the power-on-position is the same. The information must be retrieved from MACRO Station variable MSn,MI920 for each node transfer as specified by Ix10 at the Ultralite. You do not have to set up MSn,MI920, because the MACRO Station will place the power-on position the appropriate register at power-up.

Power-On Feedback Address for PMAC2 Ultralite

Both the Ultralite and the Turbo Ultralite allow you to obtain absolute position at power up or upon request (#n$*). The Ultralite must have Ix10 set up and the Turbo Ultralite needs both Ixx10 and Ixx95 set up to enable this power on position function. For power on position reads as specified in this document MACRO firmware version 1.114 or newer is needed, the Turbo Ultralite firmware must be 1.936 or newer, and lastly the standard Ultralite users must have firmware version 1.16H or newer.

Ix10 permits an automatic read of an absolute position sensor at power-on/reset. If Ix10 is set to 0, the power-on/reset position for the motor will be considered to be 0, regardless of the type of sensor used. There are specific settings of PMAC's/PMAC2's Ix10 for each type of MACRO interface. The Compact MACRO Station has a corresponding variable I11x for each node that must be set.

Absolute Position for Ultralite

Compact MACRO Station Feedback Type (Firmware version 1.16H and above)	Ix10 (Unsigned)	Ix10 (Signed)
MACRO Station Parallel Input	$74000n	$F4000n

'n' is the MACRO node number used for Motor x: 0, 1, 4, 5, 8, 9, C(12), or D(13).

Absolute Position for Turbo Ultralite

(Ixx95=$720000 - $740000, $F20000 - $F40000)

Addresses are MACRO Node Numbers

MACRO Node Number	Ixx10 for MACRO IC 0	Ixx10 for MACRO IC 1	Ixx10 for MACRO IC 2	Ixx10 for MACRO IC 3
0	$000100	$000010	$000020	$000030
1	$000001	$000011	$000021	$000031
4	$000004	$000014	$000024	$000034
5	$000005	$000015	$000025	$000035
8	$000008	$000018	$000028	$000038
9	$000009	$000019	$000029	$000039
12	$00000C	$00001C	$00002C	$00003C
13	$00000D	$00001D	$00002D	$00003D

Compact MACRO Station Feedback Type	Ixx95 (Unsigned)	Ixx95 (Signed)
Acc-8D Opt 7 Resolver/Digital Converter	$730000	$F30000
Acc-8D Opt 9 Yaskawa Absolute Encoder Converter	$720000	$F20000
Acc-8D Opt 10 Sanyo Absolute Encoder Converter	$740000	$F40000
Acc-28B Analog/Digital Converter	$740000	$F40000
MACRO Station Option 1C/Acc-6E A/D Converter	$740000	$F40000
MACRO Station Parallel Input, MLDT, SSI	$740000	$F40000

When PMAC or PMAC2 has Ix10 set to get absolute position over MACRO, it executes a station auxiliary read command MS{node},I920 to request the absolute position from the Compact MACRO Station. The station then references its own I11x value to determine the type, format, and address of the data to be read.

MACRO Parallel Absolute Position Setup

MI111 through MI118 (MI11*x*) specify whether, where, and how absolute position is to be read on the Compact MACRO Station for a motor node (MI11*x* controls the *x*th motor node, which usually corresponds to Motor *x* on PMAC) and sent back to the Ultralite.

If MI11*x* is set to 0, no power-on reset absolute position value will be returned to PMAC. If MI11*x* is set to a value greater than 0, then when the PMAC requests the absolute position because its Ix10 and/or Ix81 values are set to obtain absolute position through MACRO (sending an auxiliary **`MS{node},MI920`** command), the Compact MACRO Station will use MI11*x* to determine how to read the absolute position, and report that position back to PMAC as an auxiliary response.

For the Acc-53E, we must take the output from the encoder conversion table (ECT) at the MACRO Station and process it as an absolute position because the information in the ECT is synchronized properly. Remember, the output from the encoder conversion table will reside in the X register. For example, if we had the following entry:

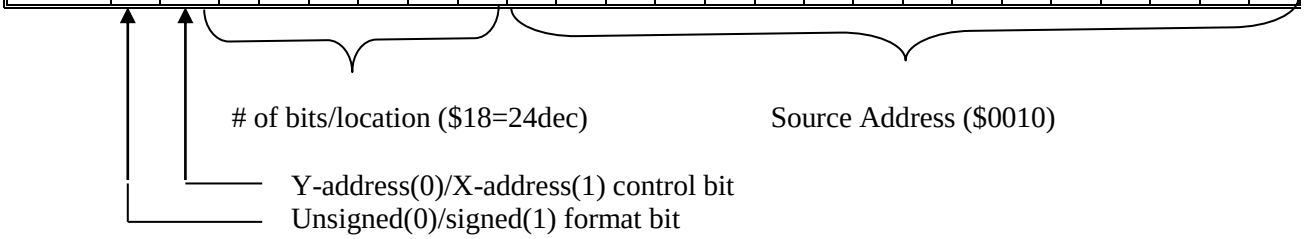
```
MS0,MI120=$208800 ($10 of ECT)
MS0,MI121=$FFFFFF ($11 of ECT)
```

The output from the ECT will reside in X:$11 and this will be the register we will obtain the absolute data from.

MI11*x* consists of two parts. The low 16 bits (last 4 hexadecimal digits) specify the address on the MACRO Station from which the absolute position information is read. The high eight bits (first two hexadecimal digits) tell the Compact MACRO Station how to interpret the data at that address (the method.

MACRO MI11x Parallel Word Example: Signed 24-bit Absolute data from Acc-53E at $0010

Hex($)		D				8				0				0				1				0		
Bit	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0



X/Y Address Bit: If bit 22 of Ix10 is 0, the PMAC looks for the parallel sensor in its Y address space. This is the standard choice, since all I/O ports map into the Y address space. If this bit is 1, PMAC looks for the parallel sensor in its X address space.

Signed/Unsigned Bit: If the most significant bit (MSB -- bit 23) of MI11x is 0, the value read from the absolute sensor is treated as an unsigned quantity. If the MSB is 1, which adds $80 to the high eight bits of MI11x, the value read from the sensor is treated as a signed, two's-complement quantity.

Summarizing the format of the variable through our example, which specifies a 24-bit parallel word at Y:$8800, treated as a signed quantity, you would write:

```
MS0,MI111=$D80010          ;read signed 24-bit absolute power on position from X:$0010
```

Example MACRO Setup:

Set jumpers appropriately for the encoder power and whether or not the SSI encoder is multi-turn or not multi-turn. The S2 settings for this example are for the CS10 ($8800) selection.

1. Set jumper E9 to 1-2, Turbo/MACRO mode.
2. Set Jumper E11 to 2-3 for phase clock
3. Set Encoder Conversion Table at the MACRO Station (MI120-MI151)

```
MS0,MI120=$208800          ;process as parallel y word  ($10 station address) for SSI #1
MS0,MI121=$FFFFFF          ;process all 24 bits ($11 station address) for SSI #1
MS0,MI122=$2088011         ;process as parallel y word  ($12 station address) for SSI #2
MS0,MI123=$FFFFFF          ;process all 24 bits ($13 station address) for SSI #2
MS0,MI124=$208802          ;process as parallel y word  ($14 station address) for SSI #3
MS0,MI125=$FFFFFF          ;process all 24 bits ($15 station address) for SSI #3
MS0,MI126=$208803          ;process as parallel y word  ($16 station address) for SSI #4
MS0,MI127=$FFFFFF          ;process all 24 bits ($17 station address) for SSI #4
MS0,MI128=$208804          ;process as parallel y word  ($18 station address) for SSI #5
MS0,MI129=$FFFFFF          ;process all 24 bits ($19 station address) for SSI #5
MS0,MI130=$208805          ;process as parallel y word  ($1A station address) for SSI #6
MS0,MI131=$FFFFFF          ;process all 24 bits ($1B station address) for SSI #6
MS0,MI132=$208806          ;process as parallel y word  ($1C station address) for SSI #7
MS0,MI133=$FFFFFF          ;process all 24 bits ($1D station address) for SSI #7
MS0,MI134=$208807          ;process as parallel y word  ($1E station address) for SSI #8
MS0,MI135=$FFFFFF          ;process all 24 bits ($1F station address) for SSI #8
```

4. Set Node Transfer Variables (MI101-MI108)

```
MS0,MI101=$11              ;processed for ECT for SSI #1
MS0,MI102=$13              ;processed for ECT for SSI #2
MS0,MI103=$15              ;processed for ECT for SSI #3
MS0,MI104=$17              ;processed for ECT for SSI #4
MS0,MI105=$19              ;processed for ECT for SSI #5
MS0,MI106=$1B              ;processed for ECT for SSI #6
MS0,MI107=$1D              ;processed for ECT for SSI #7
```

```
MS0,MI108=$1F                ;processed for ECT for SSI #8
```

5. Set Absolute Power on Read for signed (MI111-MI118)

```
MS0,M111=$D80010             ;signed power on read from ECT #1
MS0,M112=$D80012             ;signed power on read from ECT #2
MS0,M113=$D80014             ;signed power on read from ECT #3
MS0,M114=$D80016             ;signed power on read from ECT #4
MS0,M115=$D80018             ;signed power on read from ECT #5
MS0,M116=$D8001A             ;signed power on read from ECT #6
MS0,M117=$D8001C             ;signed power on read from ECT #7
MS0,M118=$D8001E             ;signed power on read from ECT #8
```

6. Set Ix10 as specified by the appropriate Ultralite

Axis	Ultralite Signed	Ultralite Unsigned	Turbo Ultralite* Node address
1	$F40000	$740000	$000100
2	$F40001	$740001	$000001
3	$F40004	$740004	$000004
4	$F40005	$740005	$000005
5	$F40008	$740008	$000008
6	$F40009	$740009	$000009
7	$F4000C	$74000C	$00000C
8	$F3000D	$73000D	$00000D

* If Turbo PMAC Ultralite, Set Ix95 for power on address and type

Axis	Turbo Ultralite Signed	Turbo Ultralite Unsigned
1	$F40000	$740000
2	$F40000	$740000
3	$F40000	$740000
4	$F40000	$740000
5	$F40000	$740000
6	$F40000	$740000
7	$F40000	$740000
8	$F40000	$740000

READING BINARY STYLE SSI ENCODERS

As stated in both this manual and the order sheet, the Acc-53E was designed to work with Grey code encoders only. The customer has a Binary style SSI encoder then Delta Tau Data Systems recommends that the customer exchange their binary SSI encoder for a gray code style SSI encoder.

If using binary style SSI encoders, write a simple grey code to Binary conversion in a PLC which takes the data from the Acc-53 and converts it to Binary. The results from this output are must be processed in a PLC0 running every servo clock cycle. Our test show that the results using this method are good but the customer should exchange the Binary encoder for a Gray Code style SSI encoder for optimum results.

Example: Convert data from Y:$78C00 from Acc-53E to Binary

PLC and a PLCC to convert the Data from Binary to Gray scale. For our example:

```
close
M90->Y:$78C00,24,u                  ; Source register from Acc-52 channel #1
M91->Y:$10f1,24,u                   ; Intermediate register
M92->Y:$10f2,24,u                   ; Final register
L90->Y:$78C00,24,s
L91->Y:$10f1,24,s
L92->Y:$10f2,24,s

open plc 0 clear
M92=M90^int(M90/2)                  ; XOR source with shifted right
close

open plcc 0 clear
L91=(L90/2-(L90/2*2-L90))&8388607   ; Shift right (div by 2, rounded neg.)
L92=L90^L91                         ; XOR source with shifted right
close
```

Position Feedback

To close the servo loop on position and velocity the encoder conversion table entry will be:

```
I8000=$2010F2           ;Turbo location $3501 process Y:$010F2 as parallel word
I8001=$18000            ;Turbo location $3502 for multi-turn (24bit) encoder
```

This is a two-line input for one encoder channel, so make sure the related I variable (Ix03, Ix04) is pointed to the address of the second line. For example, for the above set up I103 and I104 should be = $3502.

Absolute Power on Position Data

For the above set up, to set up the power on position for 24-bit multi-turn SSI encoder, connected in the first channel.

```
I110 = $10F2            ; Position register after the conversion
I195 = $980000          ; For multi-turn encoder
```

KAWASAKI ABSOLUTE ENCODER INTERFACE

The Kawasaki encoder interface is a special function for this SSI interface card, with the special ordered parts installed on the card. The corresponding changes on some of the E-points and configuration jumpers are listed as follows:

JP10,JP11 OPTO Isolation Select

Position	Default	Function
IN		Non-Opto
OUT		Opto Isolated

E1- E8

E1-E8 must be installed on position 1-2, so that the power line to the Kawasaki absolute encoder is controlled by the interface card.

E10 Power Supply Select

Position	Setting	Function
E10	1-2	Use external +12V *
	2-3	Use back-plane +15V
*A +12V @ 3 amp power has to be supplied on TB9 pin 3 (pin 4 is the return), in order to generate +8V power for this application if the card is not plugged into the 3U rack.		

J2A, J3A, J2B, J3B

These terminal blocks are the interface connector between the Kawasaki absolute encoder and the interface card. For this special application the pin-out is:

Pin#	Description	Note
1	Power output	+8V
2	Encoder (1) signal input	
3	NC	
4	NC	
5	NC	
6	Ground	
7	Power output	+8V
8	Encoder (2) signal input	
9	NC	
10	NC	
11	NC	
12	Ground	

JP2, JP4

This two-configuration jumper is not used for the Kawasaki encoder application.

Opto-Isolation

Choose to either use the opto-isolation or not. Steps and procedures are listed for both cases:

Non-Opto Isolation Option (Default)

1. Set E10 in position 2-3 to use back-plane +15V or 1-2 to use external +12V.
2. Jump JP10, JP11 (jumper block in).
3. Do not install U8.
4. Install R45 (0-ohm resister or jumper wire).

To Use Opto-Isolation Option

1. Set E10 in position 1-2.
2. Provide +12V DC at TB9 pin 3 and 4.
3. JP10, JP11 has to be open.

4. U8 (HCPL2630) has to be installed.
5. Do not install R45 – leave it open.
6. It is the user's responsibility to opto-isolate the encoder input signal line (a Acc-8D Option 6 can be used for this).

PMAC Setup

Address Select

Refer to the SSI Application manual, Section 3 for address select and encoder conversion table setup. The only difference is on the second line of encoder conversion table; set the mask equal to:

$007FFF for PMAC and PMAC 2
$00F000 for Turbo PMAC

Servo/Phase Clock

Since PMAC servo/phase clock is used to generate Kawasaki absolute encoder power control and data acquisition signal, the clock rate must be greater than 650 US. Refer to the PMAC User manual to set up the correct clock rate.

CONNECTOR PINOUTS

The terminal blocks on the Acc-53E are described as TB1 Top, TB2 Top, TB3 Top, TB1 Bottom, TB2 Bottom, TB3 Bottom, TB1 Front and TB2 Front. The top connectors have the Encoder signals for encoders 1-4, the bottom connectors have the encoder signals for encoders 5-8.

Connector TB1 Top – Encoders 1 and 2				
Pin#	**Symbol**	**Function**	**Description**	**Notes**
1	V+	+15V or +5V	Power to encoder 1	Based on E1
2	DATA +	Input	Encoder 1 +	
3	DATA -	Input	Encoder 1-	
4	CLOCK +	Output	Clock for encoder1	Based on E11
5	CLOCK -	Output	Clock for encoder1	Based on E11
6	GND	Reference	Reference to enc. power	
7	V+	+15V or +5V	Power to encoder 2	Based on E2
8	DATA +	Input	Encoder 2 +	
9	DATA -	Input	Encoder 2-	
10	CLOCK +	Output	Clock for encoder 2	Based on E11
11	CLOCK -	Output	Clock for encoder 2	Based on E11
12	GND	Reference	Reference to enc. power	

Connector TB2 Top - Encoders 3 and 4				
Pin#	**Symbol**	**Function**	**Description**	**Notes**
1	V+	+15V or +5V	Power to encoder 3	Based on E3
2	DATA +	Input	Encoder 3 +	
3	DATA -	Input	Encoder 3-	
4	CLOCK +	Output	Clock for encoder 3	Based on E11
5	CLOCK -	Output	Clock for encoder 3	Based on E11
6	GND	Reference	Reference to enc. power	
7	V+	+15V or +5V	Power to encoder 4	Based on E4
8	DATA +	Input	Encoder 4 +	
9	DATA -	Input	Encoder 4-	
10	CLOCK +	Output	Clock for encoder 4	Based on E11
11	CLOCK -	Output	Clock for encoder 4	Based on E11
12	GND	Reference	Reference to enc. power	

Connector TB1 Bottom – Encoders 5 and 6				
Pin#	**Symbol**	**Function**	**Description**	**Notes**
1	V+	+15V or +5V	Power to encoder 5	Based on E5
2	DATA +	Input	Encoder 5 +	
3	DATA -	Input	Encoder 5-	
4	CLOCK +	Output	Clock for encoder5	Based on E11
5	CLOCK -	Output	Clock for encoder5	Based on E11
6	GND	Reference	Reference to enc. Power	
7	V+	+15V or +5V	Power to encoder 6	Based on E6
8	DATA +	Input	Encoder 6 +	
9	DATA -	Input	Encoder 6-	
10	CLOCK +	Output	Clock for encoder 6	Based on E11
11	CLOCK -	Output	Clock for encoder 6	Based on E11
12	GND	Reference	Reference to enc. Power	

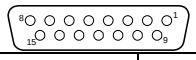
Connector TB2 Bottom – Encoders 7 and 8				
Pin#	**Symbol**	**Function**	**Description**	**Notes**
1	V+	+15V or +5V	Power to encoder 7	Based on E7
2	DATA +	Input	Encoder 7 +	
3	DATA -	Input	Encoder 7-	
4	CLOCK +	Output	Clock for encoder7	Based on E11
5	CLOCK -	Output	Clock for encoder7	Based on E11
6	GND	Reference	Reference to enc. Power	
7	V+	+15V or +5V	Power to encoder 8	Based on E8
8	DATA +	Input	Encoder 8 +	
9	DATA -	Input	Encoder 8-	
10	CLOCK +	Output	Clock for encoder 8	Based on E11
11	CLOCK -	Output	Clock for encoder 8	Based on E11
12	GND	Reference	Reference to enc. Power	

TB9 External Power Supply

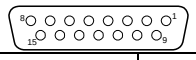
This terminal block provides a connection for user to use external DC power supply other than the DC power on the backplane.

Pin #	Signal Description	Note
1	GND	+5V Return
2	+5 V DC	Connect +5V here only when the card is not plugged into the backplane.
3	+12 V DC	For Kawasaki option only
4	12 V RETURN	For Kawasaki option only

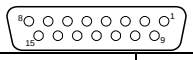
DB15 Style Connector J1 Top – Encoders 1 and 2

J1 Top Connector			Front View 	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	V+	+15V or +5V	Power to encoder 1	Based on E1
2	DATA 1-	Input	Encoder 1-	
3	CLOCK 1 -	Output	Clock for encoder1	Based on E11
4	V+	+15V or +5V	Power to encoder 2	Based on E2
5	DATA 2-	Input	Encoder 2-	
6	CLOCK 2-	Output	Clock for encoder 2	Based on E11
7	N/C	No connection		
8	N/C	No connection		
9	DATA 1+	Input	Encoder 1+	
10	CLOCK 1+	Output	Clock for encoder 1	Based on E11
11	GND	Reference	Reference to enc. Power	
12	DATA 2+	Input	Encoder 2+	
13	CLOCK 2+	Output	Clock for encoder 2	Based on E11
14	GND	Reference	Reference to enc. Power	
15	N/C	No connection		

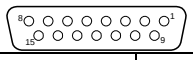
DB15 Style Connector J2 Top – Encoders 3 and 4

J2 Top Connector			Front View 	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	V+	+15V or +5V	Power to encoder 3	Based on E3
2	DATA 3-	Input	Encoder 3-	
3	CLOCK 3 -	Output	Clock for encoder 3	Based on E11
4	V+	+15V or +5V	Power to encoder 4	Based on E4
5	DATA 4-	Input	Encoder 4-	
6	CLOCK 4-	Output	Clock for encoder 4	Based on E11
7	N/C	No connection		
8	N/C	No connection		
9	DATA 3+	Input	Encoder 3+	
10	CLOCK 3+	Output	Clock for encoder 3	Based on E11
11	GND	Reference	Reference to enc. Power	
12	DATA 4+	Input	Encoder 4+	
13	CLOCK 4+	Output	Clock for encoder 4	Based on E11
14	GND	Reference	Reference to enc. Power	
15	N/C	No connection		

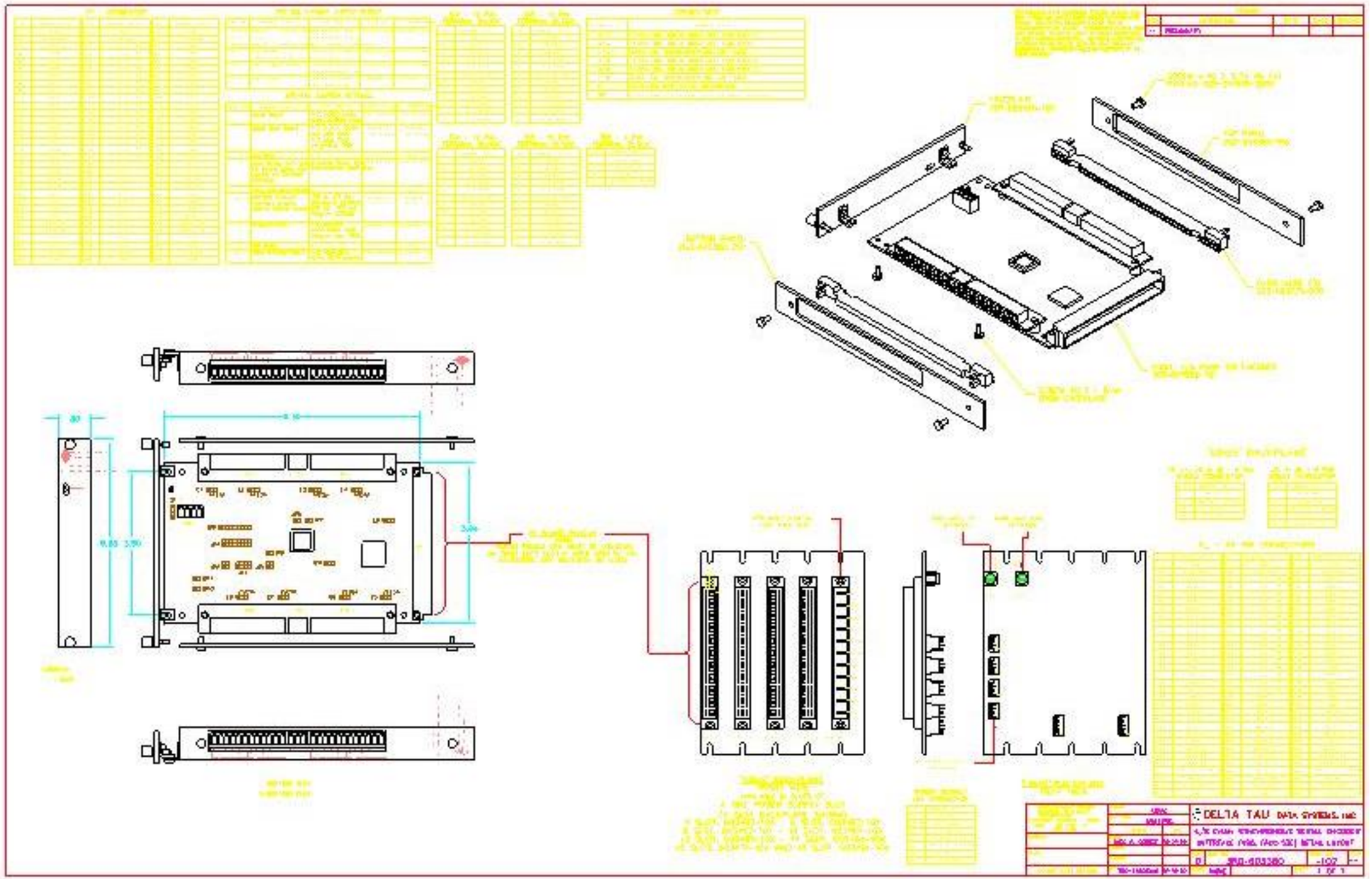
DB15 Style Connector J1 Bottom – Encoders 5 and 6

J1 Bottom Connector			Front View 	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	V+	+15V or +5V	Power to encoder 5	Based on E5
2	DATA 5-	Input	Encoder 5-	
3	CLOCK 5 -	Output	Clock for encoder5	Based on E11
4	V+	+15V or +5V	Power to encoder 6	Based on E6
5	DATA 6-	Input	Encoder 6-	
6	CLOCK 6-	Output	Clock for encoder 6	Based on E11
7	N/C	No connection		
8	N/C	No connection		
9	DATA 5+	Input	Encoder 5+	
10	CLOCK 5+	Output	Clock for encoder 5	Based on E11
11	GND	Reference	Reference to enc. Power	
12	DATA 6+	Input	Encoder 6+	
13	CLOCK 6+	Output	Clock for encoder 6	Based on E11
14	GND	Reference	Reference to enc. Power	
15	N/C	No connection		

DB15 Style Connector J2 Bottom – Encoders 7 and 8

J2 Bottom Connector			Front View 	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	V+	+15V or +5V	Power to encoder 7	Based on E7
2	DATA 7-	Input	Encoder 7-	
3	CLOCK 7 -	Output	Clock for encoder 7	Based on E11
4	V+	+15V or +5V	Power to encoder 8	Based on E8
5	DATA 8-	Input	Encoder 8-	
6	CLOCK 8-	Output	Clock for encoder 8	Based on E11
7	N/C	No connection		
8	N/C	No connection		
9	DATA 7+	Input	Encoder 7+	
10	CLOCK 7+	Output	Clock for encoder 7	Based on E11
11	GND	Reference	Reference to enc. Power	
12	DATA 8+	Input	Encoder 8+	
13	CLOCK 8+	Output	Clock for encoder 8	Based on E11
14	GND	Reference	Reference to enc. Power	
15	N/C	No connection		

SCHEMATICS



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