USER MANUAL

Accessory 8D Option 8

Sub-Count Interpolator Board

3Ax-602561-xUxx

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DELTA TAU
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21314 Lassen Street Chatsworth, CA 91311 // Tel. (818) 998-2095 Fax. (818) 998-7807 // www.deltatau.com

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Delta Tau Data Systems, Inc. Technical Support
Phone: (818) 717-5656
Fax: (818) 998-7807
Email: support@deltatau.com
Website: http://www.deltatau.com

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INTRODUCTION

Delta Tau's Accessory 8D Option 8 (Acc-8D Opt8) is a sine wave input interpolator designed to interface analog quadrature encoders to PMAC or PMAC2.

The Interpolator accepts two sinusoidal or quasi-sinusoidal inputs and provides an AquadB digital output signal and 5 bits of parallel signal to PMAC or PMAC2. This creates 128 states or 256 states per sine-wave cycle depending upon the setting of a jumper (JP26).

The Interpolator can accept either a current source or a voltage source signal from the encoder. A 1KΩ resistor is placed across the differential input for microcurrent loading. Input sensitivity is jumper selectable between ±5.7□A (±5.7mV) and ±2.3mA (±2.3V) for full-scale peak input. An Out of Range LED (D1) is provided to allow easy calibration and will indicate whether there are sensor interface problems.

For PMAC, jumper selection (E1) allows the interpolator to be selected for either channel 1 or channel 3. The index is used from the next encoder as part of the extended parallel data input. For PMAC2, the same jumper allows the interpolator to be used on either an odd or even channel. When pass-through is used, the channel selector (E1) is expected to be different for both Acc-8D Option 8 interpolators.

Pass-through allows two Acc-8D Option 8interpolators to be daisy-chained together. This reduces the number of ribbon cables that are connected to the PMAC/PMAC2.

The PMAC/PMAC2 encoder sample clock (SCLK) output is used for synchronization to the Interpolator. The Sample clock signal frequency needs to be set to a value that does not exceed 3 MHz.

When used with a sample clock frequency of 2.4576 MHz, a 1000 line sinusoidal rotary encoder will spin at a rate up to 9,180 RPM with 256,000 counts per revolution.

CONNECTORS

Refer to the layout diagram of Acc-8D Option 8 for the location of the connectors on the board. A pin definition listing for each connector is provided at the end of this manual.

J1

This is a 2-pin terminal block connector that allows the user to provide a sample clock to the Acc-8D Option 8. Usually, SCLK is obtained through connector J6 or J7.

J2

This is a 12 terminal connector that inputs data from the sinusoidal encoder into the Acc-8D Option 8.

J3

This 2-terminal connector is used for the +15Vdc power supply.

J4, J5

These are identical 14-pin header connectors that provide the parallel part of the sub-count data information back to the PMAC/PMAC2's accessory input.

On the PMAC, the accessory input is J6 on the Acc-8D accessory card. This input uses encoder and limits for channels 2 and 4.

On PMAC2, the accessory input is J1 on the Acc-8T accessory, J3 on the Acc-8E accessory, or J3 on the Acc-8F accessory.

J6, J7

These are identical 10-pin headers that have dual quadrature encoder outputs used to interface the Interpolator to the PMAC/PMAC2 accessory boards. These outputs appear as single-ended signals. They also can provide the required SCLK encoder sample clock input.

When connecting two Acc-8D Option 8s in daisy chain, there is a ribbon cable placed between them that connects to either of these connectors.

On the PMAC, these signals connect to the JXIO connector.

On the PMAC2, these signals connect to Acc-8T accessory board at J3.

J8

This 10-pin header is an HP compatible quadrature encoder output used to interface the Interpolator to PMAC/PMAC2 accessory boards. These outputs are differential signals and are used when the interpolator boards are not daisy chained.

On the PMAC, these signals connect to J1-A, J2-A, J3-A, and J4-A on the Acc-8D accessory board.

On the PMAC2, these signals connect to J1, J2 on the Acc-8E accessory and J4, J5 on the Acc-8F accessory.

When J8 is used, a sample clock must be provided at J1 or J6, J7 at pin 9.

JUMPERS

Refer to the layout diagram of Acc-8D Option 8 for the location of the jumpers on the board. A position listing for each jumper is provided at the end of this manual.

E1

This jumper allows the user to select which of two channels that this interpolator will address. When daisy-chaining two Acc-8D Option 8 boards, they must be addressed as different channels.

JP1 - JP12

These jumpers allow the user to select the input sensitivity of the SIN channel on the sinusoidal encoder at J2. Only one jumper should be inserted in this row of jumpers at any time.

Refer to the table of input sensitivities at the end of this manual.

JP13 - JP24 should be set to the same value as JP1 - JP12.

JP13 - JP24

These jumpers allow the user to select the input sensitivity of the COS channel on the sinusoidal encoder at J2. Only one jumper should be inserted in this row of jumpers at any time.

Refer to the table of input sensitivities at the end of this manual.

JP13 - JP24 should be set to the same value as JP1 - JP12.

JP25

Applies a 10k pull up resistor to the index (or HOME) flag input. Remove this jumper when using an index signal that uses a micro current output from the encoder device.

JP26

This 3-position jumper allows the user to select the resolution of the interpolator.

High resolution means that there are eight quadrature changes per sinusoidal cycle. There are 32 parallel sub-counts per quadrature change (these appear at J4 & J5) for a total of 256 sub-counts per sinusoidal cycle.

Low resolution means that there are four quadrature changes per sinusoidal cycle. There are 32 parallel sub-counts per quadrature change for a total of 128 sub-counts per sinusoidal cycle.

JP27

This jumper allows the user to connect the power supply ground from J3 to the ground signals at J4, J5, J6 and J7.

The use of this jumper defeats the opto-isolation between the encoder and PMAC.

JP28

This jumper allows the user to connect the +5Vdc from the on-board voltage regulator to the signals at J4, J5, J6 and J7. This jumper is not used except in special cases where +5Vdc is needed at J4, J5, J6 and J7. PMAC/PMAC2 provides +5Vdc at these connectors and JP28 will short power supplies together if used with the PMAC system.

The use of this jumper defeats the opto-isolation between the encoder and PMAC.

INDICATORS

Refer to the layout diagram of Acc-8D Option 8 for the location of the indicators on the board.

D1

This orange LED shows the status of the A channel quadrature output. When the encoder is operating normally, this indicator will flicker with a rate that is dependent upon the speed of the moving encoder.

D2

This red LED indicates an out-of-range condition.

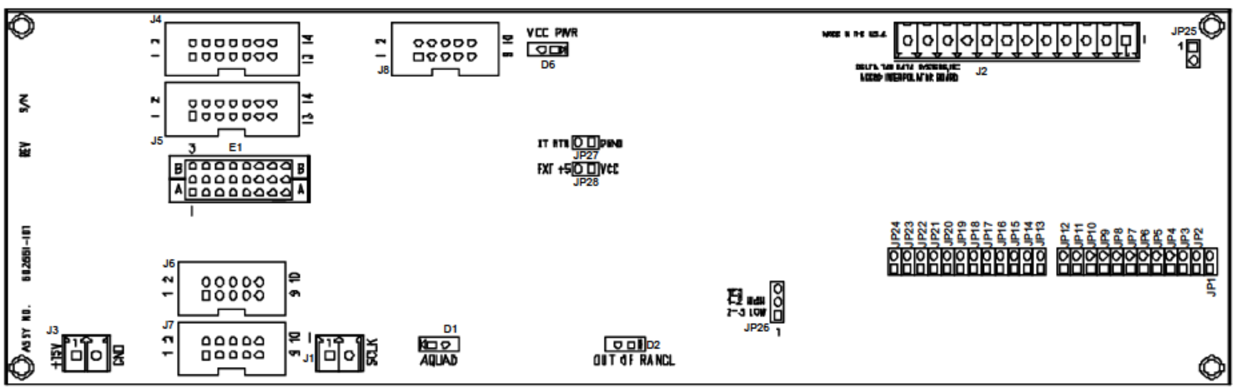
When the encoder is operating normally, this indicator will not be lit if the input attenuation jumpers (JP1 - JP24) are set correctly.

An out-of-range condition exists if the encoder is not moving and this LED is lit.

Many sinusoidal encoders have an output signal which decreases as the speed of the encoder increases. If this LED illuminates during a changing encoder input, the finite (parallel data part of) resolution may be inaccurate at the output of the interpolator. This may not be a problem if the LED extinguishes when the encoder starts to slow down.

D6

This green LED indicates input power is present at J3.



Layout Diagram Acc-8d Option 8
Connectors and Jumpers

SETTING INPUT SENSITIVITY FOR YOUR ENCODER

Since the interpolator uses two input signals that are relative to each other, there are two channels which must be adjusted for the same input sensitivity. This is done by selecting a single jumper each from JP1 to JP12, and from JP13 to JP24.

If the maximum scale output that the encoder uses is known, refer to the table at the end of this manual for jumper positions.

The Out of Range LED (D2) will illuminate if the wrong values are selected for input sensitivity. When adjusting the sensitivity of the inputs, it is possible that the LED will illuminate when the encoder is moved.

Empirical Adjustment of Input Sensitivity

By using the Out of Range LED (D2) it is possible to adjust the input attenuation for proper levels. When moving the attenuation jumpers back and forth it is important to be sure that they are in the same relative positions to each other.

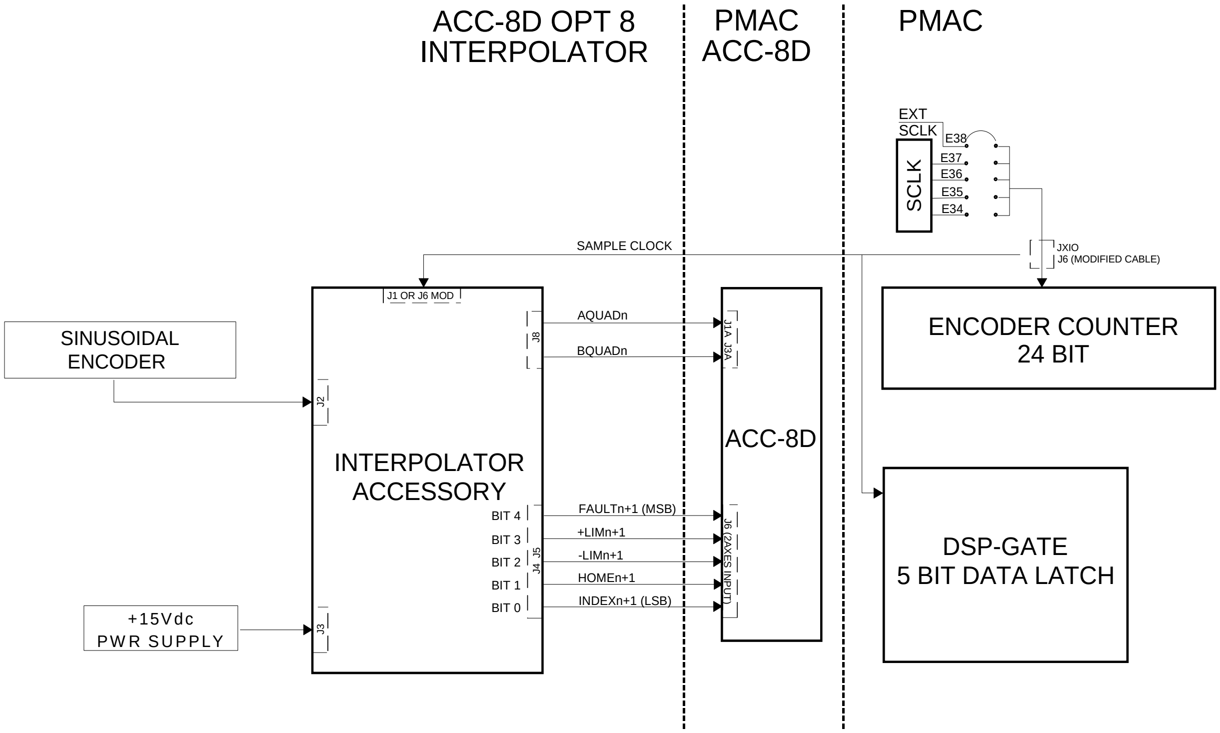
Start by placing the shorting jumpers at JP1 and JP13. If the Out of Range LED is illuminated, move the jumpers to JP2 and JP14. Continue to do this until the Out of Range LED is not illuminated. The encoder should not be moved while performing this adjustment.

Most sinusoidal encoders have an output voltage that decreases when the speed of the encoder increases. This may result in an out of range indication while the encoder is moving. If this occurs, there may be nothing wrong with the interpolator's output, except that the fractional part of the interpolation value may be inaccurate during this period. When the encoder slows down, the fractional part of the output will become accurate again. The absolute count position of the encoder is not lost should this occur.

If the Out of Range LED illuminates too easily during fast encoder moves, try setting the interpolator to low-resolution mode (JP26). There is a wider range of voltage inputs allowed at the lower resolution setting.

MAKING PMAC1 WORK WITH Acc-8D Option 8

Below is a diagram showing how the interpolator connects to a PMAC. There are three ribbon cables which should be connected between the interpolator and the PMAC Acc-8D breakout card.



Interpolator Connection to PMAC

Cables

Sample Clock (SCLK) Cable

This is a special cable that is used to synchronize the PMAC to the interpolator. Sample clock is used as an incremental time period for encoder count accumulation. This cable goes from J6 on the Acc-8D Option 8 to J6 (JXIO) on the PMAC card.

This cable is Delta Tau P/N 200-602733-100 and is 24 inches long.

Encoder Cable

This is a 10-pin ribbon cable that delivers differential encoder quadrature information to PMAC. This cable goes from J8 on the Acc-8D Option 8 to J1A or J3A on the Acc-8D.

This cable is Delta Tau P/N 200-602252-100 and is 24 inches long.

Sub-Count Interface Cable

This is a 14-pin ribbon cable that delivers the fractional part of the encoder data to PMAC. This cable goes from J4 or J5 on the Acc-8D Option 8 to J6 on the Acc-8D.

This cable is Delta Tau P/N 200-602493-0241 and is 24 inches long.

PMAC Flag Hardware Modification

On the PMAC, flag signals use opto-isolation. When parallel data is brought through those flags from the interpolator, it is important to remove the opto-couplers. Only the opto-couplers associated with interpolator flag channels need to be removed. They are replaced with DIP shunts (provided with your interpolator).

The opto-isolators at the following locations must be replaced with shunts (provided):

CH1 interpolator - U64 and U65
CH3 interpolator - U68 and U69
CH5 interpolator - U44 and U45
CH7 interpolator - U40 and U41

Setting Sample Clock (SCLK) Frequency Jumpers On PMAC

E34 - E38

Jumpers E34 through E38 establish hardware clocking rates for the encoder sample clock frequency.

For the Acc-8D Option 8 the sample clock frequency should be set to 2.4576 MHz for the maximum throughput from the interpolator.

Refer to the PMAC hardware reference for making different adjustments to these jumpers. For the interpolator, these jumpers must be changed from their default values.

Set the jumpers as follows for a 2.4576 MHz sample clock frequency:

E34A = OFF (if present)
E34 = OFF
E35 = OFF
E36 = ON
E37 = OFF
E38 = OFF

Refer to the hardware manual if using an external clock for the SCLK signal. However, do not exceed the 2.4576 MHz maximum SCLK frequency.

I-Variables for PMAC

To get the PMAC to properly process the interpolator’s data, there are several I-variables that must be set:

Encoder Decode Control I-variables

I900, I905, I910, I915, I920, I925, I930, I935 are used to establish encoder decoding. They are set for each channel in the order that they are presented above.

A value of 7 is used for CCW x4 Quadrature decode (this is default value). To reverse the decode direction, a value of 3 is used. Set the variable for 3 to select CW x4 Quadrature decode.

Encoder Filter Disable

I901, I906, I911, I916, I921, I926, I931, I936 are used to select the digital delay filter for encoder inputs. This variable introduces a small delay into the parallel extended value which is intended to reduce noise spikes for other encoder types.

The filter should be disabled for best results from the interpolator.

A value of 1 in this I-variable will disable the input filter.

Encoder Servo Feedback I-Variables

Servo feedback is established from the set of I-variable pairs for each channel that is located at Ix03 and Ix04. These values are addresses that establish an encoder reference that is used by the servo feedback algorithms to maintain a motor's position.

The following encoder table addresses are used when they are set up from the procedure that is outlined in the table below:

Processed Encoder #1	$720
Processed Encoder #3	$722
Processed Encoder #5	$724
Processed Encoder #7	$726

The encoder conversion table is a user configurable list of entries that may be assigned to different specific data processing inputs. The interpolator is assigned into the encoder conversion table as a Parallel Extension of Incremental Encoder.

As an incremental encoder, the digital quadrature input is still seen as a whole number counter. The 5-bit parallel extension is the fractional extension of the interpolator's digital quadrature count. Each bit change of the fractional data is therefore seen by PMAC as 1/32nd (0.03125) count. Since PMAC uses floating point arithmetic, a result will be accurate to 1/32 of a whole number step.

Note:

The parallel extension data is received by PMAC using the input flags of the next channel's encoder. When used with the interpolator, these inputs cannot be used for input flags. Use encoder channel 1, 3, 5, or 7 for the quadrature data for the parallel data to be received at J6 (channel 2, 4, 6, or 8) on the Acc-8D accessory card.

Note:

The AB digital quadrature inputs that are present on the even numbered channel are still available for uses such as handwheel encoder or untriggered time-base master.

PMAC Executive

The PMAC executive program is ideal for setting up the encoder conversion table. There is a list of configuration options in the Configure Encoder Table part of the executive.

1. Choose entry 1, 3, 5, or 7 as desired for the encoder configuration. It is acceptable to choose even-numbered entries in the table, but it might be less confusing in the long run if the encoder entry is assigned to the encoder channel number in the table.
2. Select Parallel Extension of Incremental Encoder as the conversion style.
3. Be sure that the correct encoder source channel number is also selected.
4. Note the address of the processed data reported in the upper-left portion of the window.
5. Download the new encoder table data to PMAC and select the View All Encoder Entries function to verify that the entries are correct.
6. When finished, close the Configure Encoder Table window and type **Save** to store the new encoder table data.

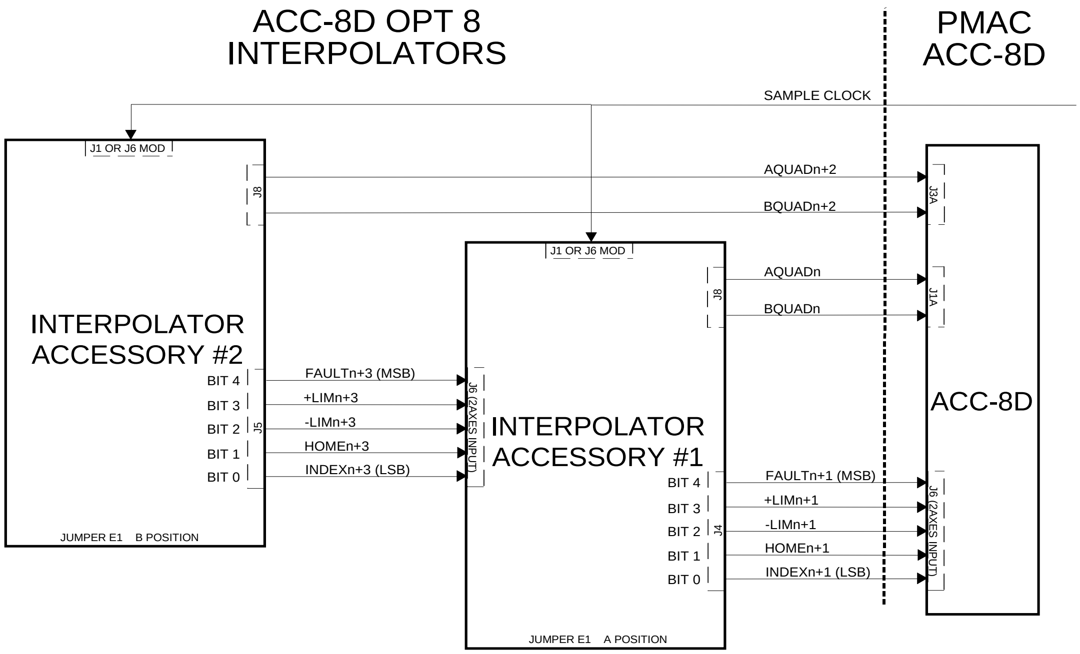
With the above process completed, notice the data from the interpolator appear in the position window (when Ix00=1).

Pass-Through

The Acc-8D Option 8 interpolator should be daisy chained to allow the PMAC to receive two channels of parallel-extended encoder information through the same connector. To facilitate this, J4 and J5 are parallel connected.

The diagram below shows how the interpolators are interconnected for pass-thru operation.

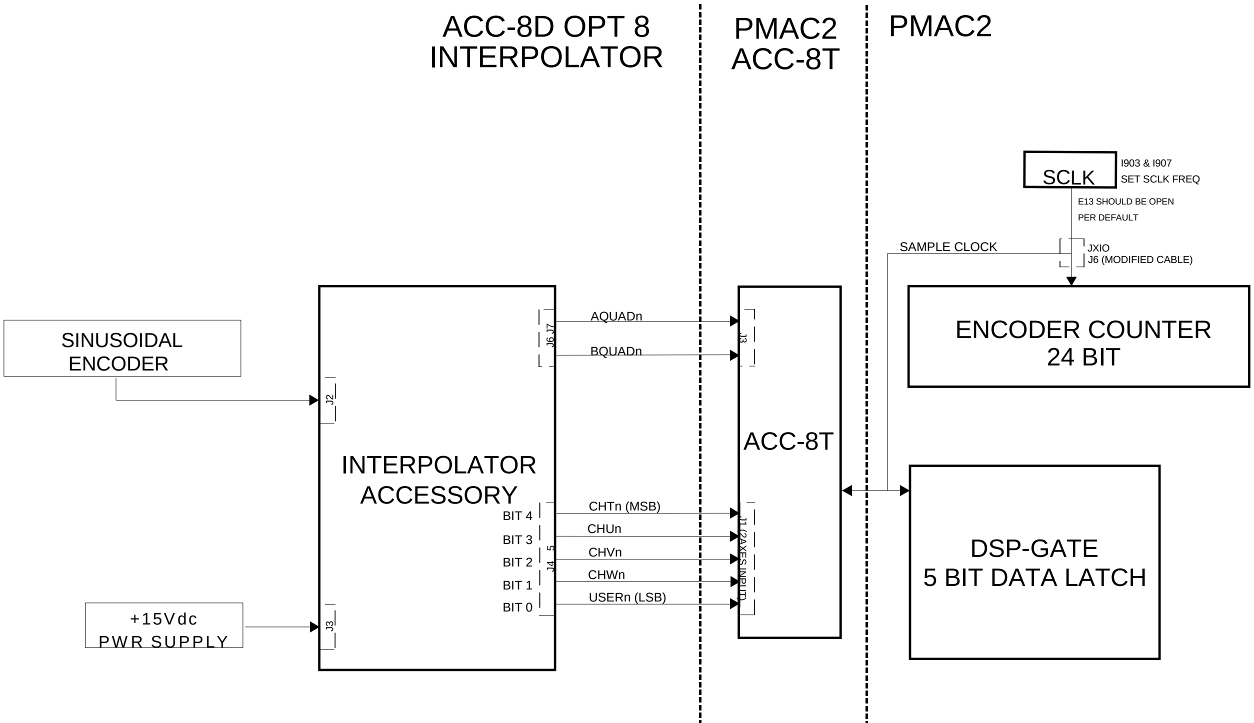
Group jumper E1 must be selected for A position on the lower channel's interpolator and E1 must be selected for "B" position on the upper channel's interpolator. It does not make a difference as to which interpolator is selected for which channel in the pass-thru configuration except that the user will want to know which encoder is assigned to which channel.



PMAC Connection Showing 2 Channels Pass-Thru

MAKING PMAC2 WORK WITH Acc-8D OPT8

Below is a diagram showing how the interpolator connects to a PMAC2. There are two ribbon cables which should be connected between the interpolator and the PMAC Acc-8D breakout card.



Interpolator Connection to PMAC2

Cables

Encoder Cable

This is a 10-pin ribbon cable that delivers differential encoder quadrature information to PMAC. This cable goes from J6 or J7 on the Acc-8D Option 8 to J3 (dual single-ended encoder input) on the Acc-8T.

This cable is Delta Tau P/N 200-602252-100 and is 24 inches long.

Sub-count Interface Cable

This is a 14-pin ribbon cable that delivers the fractional part of the encoder data to PMAC. This cable goes from J4 or J5 on the Acc-8D Option 8 to J1 (dual flag inputs) on the Acc-8T.

This cable is Delta Tau P/N 200-602493-0241 and is 24 inches long.

I-Variables for PMAC2

To get the PMAC2 to properly process the interpolator's data, several I-variables must be set:

Encoder Decode Control I-Variables

I9n0 is used to establish encoder decoding. They are set for each channel that an interpolator is connected to.

A value of 7 is used for CCW x4 Quadrature decode (this is default value). To reverse the decode direction, a value of 3 is used. Set the variable for 3 to select CW x4 Quadrature decode.

Sample Clock (SCLK) Frequency I-Variables

I903, I907

Variables I903 and I907 are PMAC2 specific variables that establish hardware clocking rates for various functions such as encoder sample clock frequency, PFM clock frequency, DAC clock frequency, and A-D converter clock frequency.

For the Acc-8D Option 8 the sample clock frequency should be set to 2.4576 MHz for the maximum throughput from the interpolator. The interpolator takes the sample clock and divides it by 2 to provide the clocking for the latches inside the interpolator.

Refer to the PMAC2 software reference for making the different adjustments to this variable. For most PMAC2 applications, this variable does not need to be changed. I903 and/or I907 must be changed to 2.4576 MHz for the interpolator to work.

I903 controls the clocking for hardware at channels 1 - 4. I907 controls the clocking for hardware at channels 5 - 8. When changing these variables for the interpolator only, set I903 and/or I907 to 2260 ($08D4).

Encoder Servo Feedback I-Variables

Servo feedback is established from the set of I-variables for each channel that is located at Ix03 and Ix04. These values are addresses that establish an encoder reference that is used by the servo feedback algorithms to maintain a motor's position.

The following encoder table addresses are used when they are set up from the procedure that is outlined in the table below:

Processed Encoder 1	$720
Processed Encoder 2	$721
Processed Encoder 3	$722
Processed Encoder 4	$723
Processed Encoder 5	$724
Processed Encoder 6	$725
Processed Encoder 7	$726
Processed Encoder 8	$727

Actually, these addresses are the default addresses used by PMAC2.

Encoder Conversion Table

The encoder conversion table is a user configurable list of entries that may be assigned to different specific data processing inputs. The interpolator is assigned into the encoder conversion table as a Parallel Extension of Incremental Encoder.

As an incremental encoder, the quadrature input is still seen as a whole number counter. The parallel data is the fractional extension of the interpolator's parallel data input. Each bit change of the parallel data is therefore seen by PMAC2 as a 1/32th (0.03125) step. Since PMAC2 uses floating point arithmetic, a calculated step distance result will be accurate to 1/32 of a whole number count.

PMAC receives the parallel extension data using the T, U, V, W, and User flags of the same channel's encoder. On the PMAC2, the parallel data is received at J1 on the Acc-8T accessory card.

PMAC Executive

The PMAC executive program is ideal for setting up the encoder conversion table. There is a list of configuration options in the Configure Encoder Table part of the executive program.

1. Choose an entry as desired for the encoder configuration. It is less confusing in the long run if the encoder entry is assigned to the encoder channel number in the table.
2. Select Parallel Extension of Incremental Encoder as the conversion style.
3. Be sure that the correct encoder source channel number is also selected.
4. Download the new encoder table data to PMAC and select the View All Encoder Entries function to verify that the entries are correct.
5. When finished, close the Configure Encoder Table window and type **Save** to store the new encoder table data.

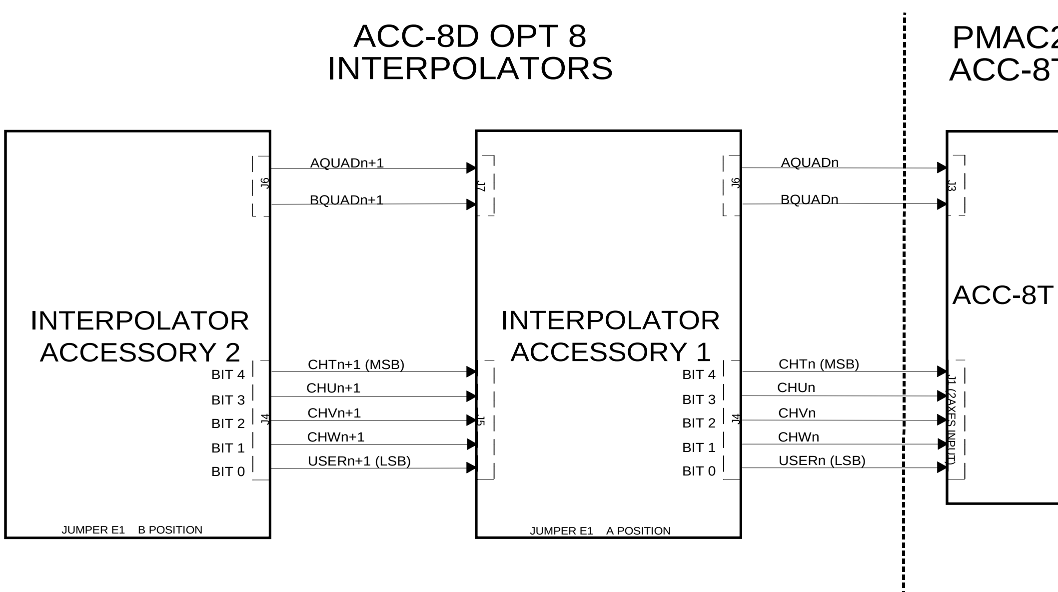
With the above process completed, notice the data from the interpolator appear in the position window (when Ix00=1).

Pass-Through

The Acc-8D Option 8 interpolator should be daisy chained to allow the PMAC2 to receive two channels of parallel-extended encoder and two channels of quadrature information through the same connectors. To facilitate this, J4 and J5 are parallel connected for the extended encoder data and J6 and J7 are parallel connected for the AQUADB data.

The diagram below shows how the interpolators are interconnected for pass-thru operation.

Group jumper E1 must be selected for A position on the lower channel's interpolator and E1 must be selected for B position on the upper channel's interpolator. It does not make a difference as to which interpolator is selected for which channel in the pass-thru configuration except that the user will want to know which encoder is assigned to which channel.



PMAC2 Connection Showing Two Channels Pass-Through

THINGS TO KNOW

1. E1 is used to select odd or even numbered channels, even if pass-thru is not used.
2. High resolution is 256 counts per encoder sinusoidal cycle. Low resolution is 128 counts per encoder sinusoidal cycle. JP26 selects resolution.
3. At high resolution, each sinusoidal cycle has eight quadrature transitions. At low resolution, each sinusoidal cycle has four quadrature transitions. There are always 32 fractional counts between quadrature transitions.
4. With either high or low resolution, the fractional part of the interpolator's output is 0.03125 (1/32 count).
5. With either high or low resolution, the maximum counts per second is the same (39,321,600 cts/sec).
6. With high resolution, the maximum sinusoidal input may be 153,600 cycles/sec. With low resolution, the maximum sinusoidal input may be 307,200 cycles/sec. This means that although the interpolator reads the same maximum counts per second at both resolutions, a sinusoidal encoder may traverse twice as fast at the lower interpolator resolution setting.
7. Jumper E13 and E14 affect the way SCLK is output on PMAC2-PC and PMAC2- Lite products only. On these products the default is that there are no jumpers installed at E13 and E14. Refer to the PMAC2 and PMAC2-Lite Hardware Reference manuals for alternate configurations.
8. Be sure to use shielded, twisted pair cabling for sinusoidal encoder wiring. The sinusoidal signals are very small and must be kept as noise free as possible. Avoid cable routing near noisy motor or driver wiring.

CONNECTOR PINOUTS

J1 Sample Clock

Pin #	Symbol	Function	Description	Notes
1	N.C.			
2	SCLK	INPUT	Sample Clock Input	

This 2-terminal block is used when a sample clock is brought to the interpolator from an external source. Since the sample clock is expected to be related to the presence of data on the outputs, it is assumed that a ground reference will be obtained through the other data connectors.

Pin 1 is not connected to anything internal and may be used to terminate a shield conductor for added cable strength.

J2 Sinusoidal Encoder Inputs

Pin #	Symbol	Function	Description	Notes
1	SIN+	Diff Input	0° Input+	⊇
2	SIN-	Diff Input	0° Input-	⊇
3	REFS	Center Ref	0° Sin Center Reference	⊇
4	GND	AGND	Shield Connection	
5	COS+	Diff Input	90° Input+	⊇
6	COS-	Diff Input	90° Input-	⊇
7	REFC	Center Ref	0° Cross Center Reference	⊇
8	GND	AGND	Shield Connection	
9	INDEX+	Diff Input	Index Input	⊄
10	INDEX-	Diff Input	Index Input	⊄
11	GND	AGND	Common	
12	+5Vdc	Supply	+5Vdc Power	500mA Max

[illegible] Sinusoidal encoder inputs are terminated with a 1kΩ resistor. For single-ended inputs, connect pin #2 to pin #3 (SIN- to REFS) and connect pin #6 to pin#7 (COS- to REFC).

[illegible] Index inputs are applied to a differential comparator circuit. When used in single-ended operation, insert JP25 (10kΩ pull up) and use index-. Index- is an active-low input.

he user's connector is a Phoenix MCVW2.5/12-ST-5.08 (Delta Tau P/N 016-0P0012-00P).

J3 Power Supply

Pin #	Symbol	Function	Description	Notes
1	+15Vdc		+12Vdc - +15Vdc Input	
2	RET		Power Supply Common	

The user's connector is a Phoenix MVSTBW2.5/2-ST-5.08 (Delta Tau P/N 016-0P0002-00P).

J4, J5 Dual Channel Sub-Count Encoder Output and Loop-Through

Pin #	Symbol	Function	Description	Notes
1	CHT1+	Output	Bit 4 (MSB) Channel 1 Output	
2	N.C.			
3	CHU1+	Output	Bit3 Channel1 Output	
4	CHV1+	Output	Bit2 Channel 1 Output	
5	CHW1+	Output	Bit1 Channel 1 Output	
6	USER1	Output	Bit0 (LSB) Channel 1 Output	
7	CHT2+	Output	Bit4 (MSB) Channel 2 Output	
8	N.C.			
9	CHU2+	Output	Bit3 Channel 2 Output	
10	CHV2+	Output	Bit2 Channel 2 Output	
11	CHW1+	Output	Bit1 Channel 2 Output	
12	USER2	Output	Bit0 (LSB) Channel 2 Output	
13	EXT_RET	GND	Power Supply Common	⊇
14	EXT_+5V	+5Vdc	External +5Vdc	⊇

⊇ Optical isolation is used on the interpolator board. External power supply inputs are needed here for power on the PMAC side of opto-couplers.

Connectors J4 and J5 are connected in parallel to each other. Jumper E1 is used to select whether each interpolator provides outputs to channel 1 or channel 2. Placing a header cable from J4 or J5 between two interpolator boards accommodates this loop-through.

The user's connector is a 14-pin box header.

J6, J7 Dual Channel Encoder Output And Loop-Through

Pin #	Symbol	Function	Description	Notes
1	CHA1+	Output	Encoder #1 Channel A	
2	CHB1+	Output	Encoder #1 Channel B	
3	CHC1+	Output	Encoder #1 Index	
4	CHA2+	Output	Encoder #2 Channel A	
5	CHB2+	Output	Encoder #2 Channel B	
6	CHC2+	Output	Encoder #2 Index	
7	GND		External GND	⊇
8	GND		External GND	⊇
9	SCLK	Input	Sample Clock	
10	CLOCK	N.C.	J6 to J7 Looped Through	

Optical isolation is used on the interpolator board. External power supply grounds are part of the PMAC side of opto-couplers.

Connectors J6 and J7 are connected in parallel to each other. Jumper E1 is used to select whether each interpolator provides outputs to channel 1 or channel 2. This loop-thru is accommodated by placing a header cable from J6 or J7 between two interpolator boards.

The user's connector is a 10-pin box header.

J8 Differential Single Channel Encoder Output

Pin #	Symbol	Function	Description	Notes
1	CHA+	Output	Encoder Channel A+	
2	ENC +5V		External +5Vdc	
3	ENC RET		External +5V Return	
4	CHA-	Output	Encoder Channel A-	
5	CHB-	Output	Encoder Channel B-	
6	ENC RET		External +5V Return	
7	N.C.			
8	CHB+	Output	Encoder Channel B+	
9	ENC +5V	Input	External +5Vdc	
10	CHC+	Output	Encoder Index+	⊇
The encoder index signal (Channel C) is provided as a single-ended signal only.				

The user's connector is a 10-pin box header.

INPUT SENSITIVITY JUMPERS

Input Max Scale Voltage	Input Max Scale Current	Sin Jumper	Cos Jumper
5.7mV	5.7uA	JP1	JP13
11.4mV	11.4uA	JP2	JP14
17.1mV	17.1uA	JP3	JP15
28.6mV	28.6uA	JP4	JP16
51.7mV	51.7uA	JP5	JP17
62.7mV	62.7uA	JP6	JP18
91.2mV	91.2uA	JP7	JP19
147.7mV	147.7uA	JP8	JP20
297mV	297uA	JP9	JP21
576mV	576uA	JP10	JP22
1.146V	1.146mA	JP11	JP23
2.298V	2.298mA	JP12	JP24
Note: The values that are used in the table above were derived by calculation. Always match the SIN and COS row jumpers.			

JUMPERS

Nomenclature	Physical Layout	Description	Default
E1	A - B	Position A selects channel #1 outputs. Position B selects channel #2 outputs.	Position A
JP1 - JP12	1 - 2	Select any 1jumper position to establish input attenuation for SIN inputs.	JP11
JP13 - JP24	1 - 2	Select any 1 jumper position to establish input attenuation for COS inputs.	JP23
JP25	1 - 2	Insert jumper to provide 10kΩ pull up for Index when used as single-ended input.	Open
JP26	1 - 2 - 3	1 - 2 selects high resolution (256 counts per sinusoidal cycle). 2 - 3 selects low resolution (128 counts per sinusoidal cycle).	1 - 2
JP27	1 - 2	Connects user-supplied power GND to ext power ground (defeats opto-isolation).	Open
JP28	1 - 2	Connects internal user regulated +5Vdc to ext. +5Vdc (defeats opto-isolation).	Open

APPENDIX A

Sinusoidal Encoder Calculations

When used with PMAC and PMAC2, the sample clock is set to 2.4576 MHz. The sample clock is divided internally inside the Acc-8D Option 8 by 2 to yield an actual clock of 1.2288 MHz. For the interpolator set at high resolution, the number of sinusoidal cycles will be 1.2288 MHz/8 which yields 153,600 cycles/sec. For low resolution, the maximum number of sinusoidal cycles will be 1.2288 MHz/4 which yields 307,200 cycles/sec.

When the cycles/sec values above are multiplied by the number of counts per sinusoidal cycle, the results are the same number for both high and low resolution:

153,600 cycle/sec * 256 cnt/cycle = 39,321,600 cnt/sec (high res. maximum rate)
307,200 cycle/sec * 128 cnt/cycle = 39,321,600 cnt/sec (low res. maximum rate)

Consider the speed at which a sinusoidal encoder will feed data to the interpolator, the maximum rate at which the sinusoidal cycles may occur must not be exceeded for the system.

The number of lines per revolution on a rotary encoder will determine the maximum rate of speed for the system. On a linear encoder, the line pitch determines the maximum sine wave cycles per second that the system can accommodate. If speed is desired in the system design, try reducing the number of lines per revolution on the rotary encoder or decrease the line pitch on the linear scale.

The examples below show typical calculations for sinusoidal rotary and linear scale encoders:

Sinusoidal Rotary Encoder Calculation Example

A 1000 line sinusoidal rotary encoder is to be used on a motor. The interpolator is to be used at high resolution:

1. Ensure that the maximum speed of the encoder will not exceed the interpolator's input rate.
   Interpolator maximum sine input = 153,600 cycles/sec.
   Divide by 1000 (encoder lines/rev) = (153,600 cycles/sec) / (1000 cycles/rev) = 153 rev/sec
   Motor max rpm = 153 rev/sec * 60 sec/min = 9,180 RPM
2. Calculate the number of steps per revolution:
   Interpolator's counts per sinusoidal cycle = 256
   Multiply by 1000 (encoder lines/rev) = 256 cnts/cycle * 1000 cycles/rev = 256,000 cnt/rev

Sinusoidal Linear Scale Calculation Example

A linear sinusoidal scale is used that has a 4µm line pitch (0.000004 meter sine wave cycle).

Ensure that the maximum speed of the encoder will not exceed the interpolator's input rate.

1. @ High Resolution (JP26 set at 1-2):
   Interpolator maximum sine input = 153,600 cycles/sec.
   Divide by 4 µm (encoder meter/cycle) = (153,600 cycle/sec) / (4 µm/cycle) = 38.4 m/sec
   a. Each fractional (1/32th) step yields:
      Number of steps per sine cycle = 256 steps/cycle.
      Scale pitch = 4µm/cycle.
      Divide pitch by number of steps = (4µm/cycle) / (256 steps/cycle) = 0.0156µm/step.
   b. To program motor 1 for 1µm steps:
      Determine number of steps for 1µm:
      1µm/4µm/cycle = 0.25cycle.
      (256 steps/cycle) * (.25 cycle) = 64 steps.
      Assign motor 1 for 1µm steps:

Motor 1 -> 64X

2. @ Low Resolution (JP26 set at 2-3):
   Interpolator maximum sine input = 307,200 cycles/sec.
   Divide by 4 µm (encoder meter/cycle) = (307,200 cycle/sec) / (4 µm/cycle) = 76.8 m/sec
   a. Each fractional (1/32th) step yields:
      Number of steps per sine cycle = 128 steps/cycle.
      Scale pitch = 4µm/cycle.
      Divide pitch by number of steps = (4µm/cycle) / (128 steps/cycle) = 0.03125µm/step.
   b. To program motor #1 for 1µm steps:
      Determine number of steps for 1µm:
      1µm/4µm/cycle = 0.25cycle.
      (128 steps/cycle) * (.25 cycle) = 32 steps.
      Assign motor #1 for 1µm steps:
      #1 -> 32X