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USER MANUAL

Accessory 28E

16 Bit Analog-To-Digital Converter Board

3Ax-603404-xUxx

November 14, 2007

CE

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REVISION HISTORY				
REV.	**DESCRIPTION**	**DATE**	**CHG**	**APPVD**
1	ADDED CE DECLARATION	06/07/06	CP	S. FIERO
2	ADDED ORDERING OPTIONS P.1; NEW LAYOUTS PP 5-6; SCHEMATIC P. 28	11/14/07	CP	S. MILICI

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INTRODUCTION

Delta Tau's Accessory 28E (Acc-28E) is a 2 or 4 (Option 1) channel analog to digital converter interface board designed to provide a means for precision voltage measurement as an input to the UMAC Turbo or UMAC MACRO systems. This accessory uses four (or two) 16-bit analog to digital converters to provide voltage measurements accurate to ±2 bits.

Jumpers allow each A-D converter to be selected for bipolar or unipolar convert modes. When selected for bipolar mode, differential inputs allow the user to apply input voltages to ±10 volts (20V p-p). When selected for unipolar mode, the user can apply input voltages from 0V to +10V (the negative input must be grounded).

Voltage references are provided for ratiometric style input control. The VREF output is provided for equipment that uses a scaled input for accurate tracking. The +5Vdc and -5Vdc supply taps are less precise, and are provided to allow the user to bias potentiometers without the need for an external power supply.

Input nulling trimmers are provided to allow for precise adjustment of input signals. Opto-couplers are used to isolate the Acc-28E's circuitry from the PMAC.

Acc-28E will be located in Delta Tau's 3U rack. The backplane provides all the power needed (±15Vdc, +5Vdc) for the Acc-28E. However, a terminal block associated with some jumpers on the card also allows the user to connect external ±15Vdc if they chose to do so.

Ordering Options

This card has the following ordering options:

OPT-1 - Additional 2 on-board 16-bit A/D converters

OPT-DBX - 2 or 4 Channel High Resolution 16-bit A/D Converter Board with D-Sub Connectors

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SPECIFICATIONS

Environmental Specifications

Description	Specification	Notes
Operating Temperature	0°C to 45°C,	
Storage Temperature	-25°C to 70°C	
Humidity	10% to 95 % non-condensing	

Physical Specifications

Description	Specification	Notes
Dimensions	Length: 16.256 cm (6.4 in.) Height: 10 cm (3.94 in.) Width: 2.03 cm (0.8 in.)	
Weight w/o Option 1A	194 g	Front , Top, and Bottom plates included
Terminal Block Connectors	FRONT-MC1,5/10-ST3,81	Terminal Blocks from Phoenix Contact. UL-94V0
DB Option Connectors	DB9 Female	UL-94V0
The width is the width of the front plate. The length and height are the dimensions of the PCB.		

Electrical Specifications

Description	Specification	Notes
ACC-28E Power Requirements	5V @ 0.05A (±10%) +15V @ 0.1A (±10%) -15V @ 0.06A (±10%)	

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EMC and Safety

Item	Description
CE Mark	`Full Compliance`
EMC	EN55011 Class A Group 1 EN61000-3-2 Class A EN61000-3-3 EN61000-4-2 EN61000-4-3 EN61000-4-4 EN61000-4-5 EN61000-4-6 EN61000-4-11
Safety	EN 61010-1
Flammability Class	UL 94V-0

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ACC-28E HARDWARE DESCRIPTION

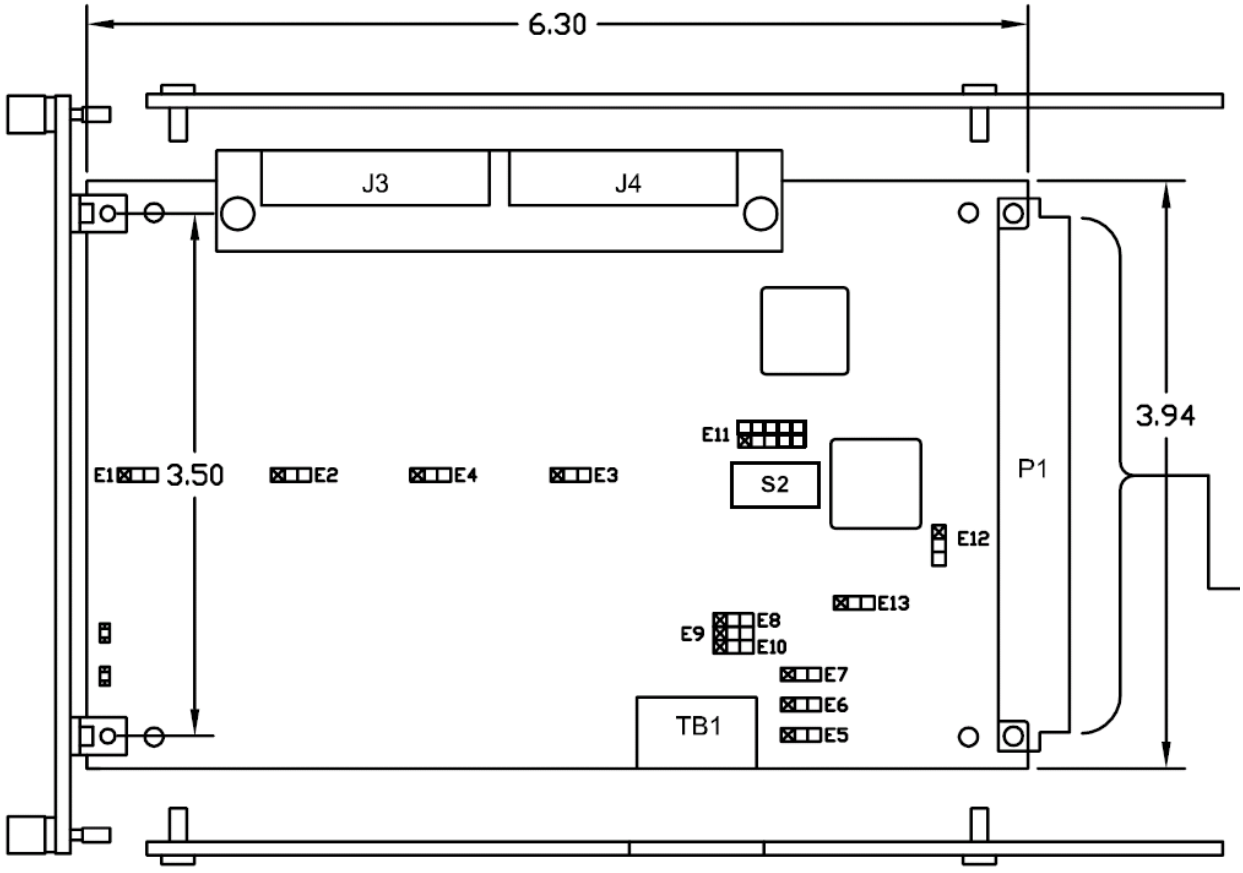
The Acc-28E uses expansion port memory locations defined by the type of PMAC (3U Turbo or MACRO Station) it is directly connected to. These memory locations are typically used with other Delta Tau 3U I/O accessories such as:

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 PMAC 3U Turbo or the MACRO Station.

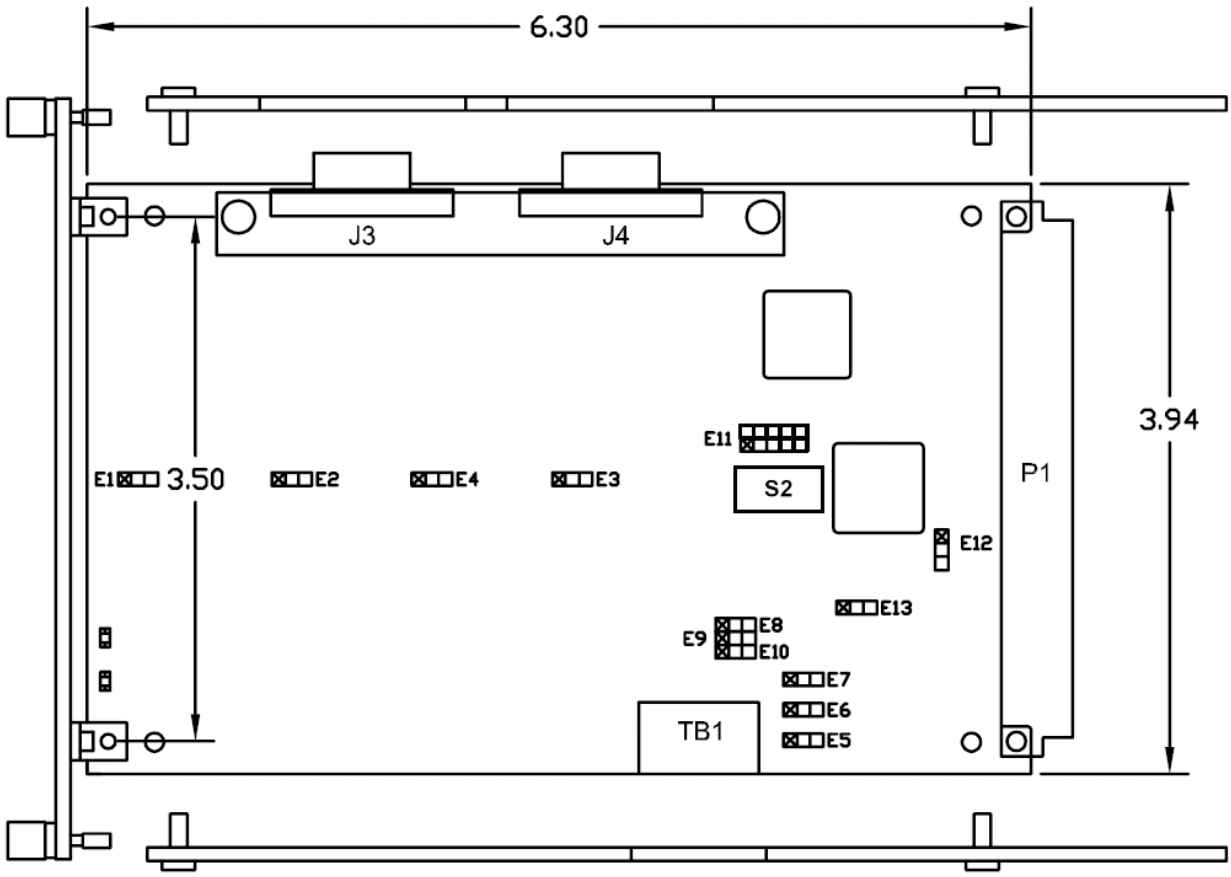
The Acc-28E has a set of dip switches telling it where to write the information from the A/D converters. Proper setting of the dip switches ensures all of the JEXP boards used in the application do not interfere with each other.

Layout Diagrams



Layout – Terminal Block Option

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Layout - DB Connector Option

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Address Select Dip Switch S2

The switch two (S2) settings will allow the user 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	CLOSE	CLOSE	OPEN	OPEN	OPEN	OPEN

The default setting is the All Closed position.

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JUMPERS

Refer to the layout diagram of Acc-28E for the location of the jumpers on the board.

E1, E2, E3, E4 - Unipolar/Bipolar Convert

These jumpers allow the user to select the method of A-D conversion for each channel. Position 1-2 allows unipolar conversions which return an unsigned value of 0 to 65535 for input voltages ranging from 0 to 10 volts (approx). Position 2-3 allows bipolar conversions which return an unsigned value of 0 to 65535 for input voltages ranging from –10V to +10 volts (20V pk-pk).

E5, E6, E7 – External Power Supply and Analog Ground

These jumpers allow the user to chose between the external DC power supply and its ground or 3U rack backplane DC power for the A/D converter.

E8, E9, E10

Used by factory to download Xilinx program. The jumpers will be installed in the right position when it is shipped, user should not change or move them.

E11

Spare, not used.

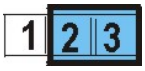
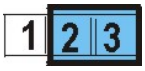
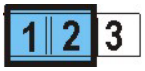
E12

This jumper is used to choose either a UMAC Turbo, UMAC MACRO station, or a legacy Macro Station.

E13

This jumper is used to determine which clock to synchronize with for the A/D conversion.

Jumpers Table

E Point	Pin Layout	Description	Default
E1, E2, E3, E4		Jumper pin 1 to 2 for Unipolar convert. Jumper pin 2 to 3 for Bipolar convert. E1 - Channel #1 E2 - Channel #2 E4 - Channel #3 E3 - Channel #4	2 to 3
E5		Jumper pin 1 to 2 to connect to the external power supply common to the user supplied AGND. Jumper pin 2 to 3 to use 3U backplane AGND	2 to 3
E6		Jumper pin 1 to 2 to use external +15V. Jumper pin 2 to 3 to use 3U rack backplane +15V.	2 to 3
E7		Jumper pin 1 to 2 to use external -15V. Jumper pin 2 to 3 to use 3U rack backplane -15V.	2 to 3
E8, E9, E10		Jumper pin 1 to 2 to connect Xilinx loader cable. Jumper pin 2 to 3 to use EEPROM.	2 to 3
E12		Jump 1-2 for Turbo 3U CPU and MACRO CPU * Jump 2-3 for legacy MACRO CPU (before 6/00)	1-2
E13		Jumper pin 1 to 2 to use servo clock to start the A/D conversion. Jumper pin 2 to 3 to use phase clock to start the A/D conversion.	1 to 2
* For legacy MACRO Stations (part number 602804-100 thru 602804-104)			

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INPUT OFFSET NULLING

Input nulling is performed at Delta Tau with the A-D inputs shorted together using Bipolar conversion. If the user's equipment has output offsets, it is possible to adjust the VR1, VR2, VR3, and VR4 to zero the inputs.

The input voltage adjustment swing is limited to approximately 60mV.

To adjust nulling, be sure that temperature has stabilized on the Acc-28E by powering it for about 20 minutes then apply zeroed inputs. Adjust VR1 for channel #1, VR2 for channel #2, VR3 for Channel 3, and VR4 for Channel 4 for the desired readings on the A-D.

When selcted for Bipolar conversion, a 0Vdc input should read a number around 32,768 on the A-D input. When selected for Unipolar conversion, the input should be adjusted to 00.

Hardware Address Limitations

Some of the older UMAC I/O accessories might create a hardware address limitation relative to the newer series of UMAC high-speed I/O cards. The Acc-28E would be considered a newer high speed I/O card. The new I/O 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 I/O 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 I/O	12	**A**
Acc-65E, Acc-66E Acc-67E, Acc-68E Acc-14E	16	General I/O	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.

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If the user has both type A and type B UMAC cards in their rack, they should be aware of the possible addressing conflicts. If the customer is using the Type A card on a particular Chip Select (CS10, CS12, CS14, or CS16) then they cannot use a Type B card with the same Chip Select address 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-28E

If the user has an Acc-11E and Acc-28E, the user cannot allow both cards to 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 user could allow the two cards to 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).

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ACC-28E SETUP FOR UMAC-TURBO

The data from the Acc-28E is copied automatically into Turbo PMAC Expansion Port I/O resisters. The location of the data transfer is specified by the jumper settings for the chip select (CS10 for example). The Acc-28E operates by converting data and transmitting it to a parallel 16 bits (higher 16-bits on PMAC bus-D0 D15) words to the PMAC. Four chip selects can be chosen to receive the data. These chip selects can be accessed directly by selection of M-Variables. There are subtle addressing differences between each channel. PMAC references are shown as follows:

PMAC A-D Registers and Address

Mxxx->Y:$78C00,8,16,U	1st A-D channel	
Mxxx->Y:$78C01,8,16,U	2nd A-D channel	If CS10 is selected
Mxxx->Y:$78C02,8,16,U	3rd A-D channel	and SW1:3-6 are closed
Mxxx->Y:$78C03,8,16,U	4th A-D channel	
Mxxx->Y:$78D00,8,16,U	1st A-D channel	
Mxxx->Y:$78D01,8,16,U	2nd A-D channel	If CS12 is selected
Mxxx->Y:$78D02,8,16,U	3rd A-D channel	and SW1:3-6 are closed
Mxxx->Y:$78D03,8,16,U	4th A-D channel	
Mxxx->Y:$78E00,8,16,U	1st A-D channel	
Mxxx->Y:$78E01,8,16,U	2nd A-D channel	If CS14 is selected
Mxxx->Y:$78E02,8,16,U	3rd A-D channel	and SW1:3-6 are closed
Mxxx->Y:$78E03,8,16,U	4th A-D channel	
Mxxx->Y:$78F00,8,16,U	1st A-D channel	
Mxxx->Y:$78F01,8,16,U	2nd A-D channel	If CS16 is selected
Mxxx->Y:$78F02,8,16,U	3rd A-D channel	and SW1:3-6 are closed
Mxxx->Y:$78F03,8,16,U	4th A-D channel	

Using M-Variables to Access A/D Data

On PMAC, M-Variables are ideal for passing the A-D values into programs. An example of a program that displays the value of A-D input 1 on an LCD display (Acc-12) follows:

```
OPEN PLC1
CLEAR
DISPLAY 0,"A-D VALUE IS -      "    ; DISPLAY HEADER.
WHILE (0<1)                      ; CREATE LOOP.
               DISPLAY 14, 5.0, M105            ; DISPLAY A-D DATA.
ENDWHILE
CLOSE
```

Acc-28E with Encoder Conversion Table for UMAC-Turbo

The encoder conversion table can be modified with either PMAC's Executive Program Encoder Conversion Table dialog box or the on-line commands in the Executive terminal mode.

The Encoder conversion table is used when motor position is desired from A-D inputs. Refer to the PMAC Software User manual for Encoder conversion table uses and applications.

Unsigned Analog Conversion

The A-D converters on the Acc-28E return unsigned data to Turbo PMAC.

If bit 19 of the analog conversion setup word is set to 1 ($18xxxx for normal analog) then PMAC treats the A/D number in the high 16 bits of the source word (left-justified of 24 bits) as an unsigned number in the range of 0 to 65535.

A typical setup word for this type of feedback is **$1F8C00**, which provides for a non-filtered unsigned left-justified conversion of the data word fed by A-D 1 of the Acc-28E connected to Turbo PMAC. For details, refer to the Turbo PMAC manual.

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ACC-28E SETUP FOR MACRO/ULTRALITE SYSTEM

The data from the Acc-28E can be sent back to the Ultralite using three different methods: Data Transfer through the MACRO I/O Nodes, Encoder conversion data through the Servo Data Nodes, and lastly, using the MACRO I-variables MI198 and MI199. The last method can be used to quickly test the hardware.

MACRO Station I/O Transfer

Typically, the MACRO station will have up to eight axis nodes (0, 1, 4, 5, 8, 9, 12, 13) and up to six I/O transfer nodes (2, 3, 6, 7, 10, 11). The PMAC2 Ultralite and the MACRO Station enable the user to transfer 72 bits per I/O node. For a multi Master system, 432 bits (6×72) of data may be transferred for each Master (Ultralite) in the ring. If only one Master is used in the ring, node 14 could be used for I/O transfer giving us 504 bits (7×72) of I/O transfer data.

MACRO Station I/O Node Transfer Addresses

Node	Node 24-bit Transfer Addresses	Node 16-bit (upper 16 bits) Transfer Addresses
2	X:$C0A0	X:$C0A1, X:$C0A2, X:$C0A3
3	X:$C0A4	X:$C0A5, X:$C0A6, X:$C0A7
6	X:$C0A8	X:$C0A9, X:$C0AA, X:$C0AB
7	X:$C0B0	X:$C0B1, X:$C0B2, X:$C0B3
10	X:$C0B4	X:$C0B5, X:$C0B6, X:$C0B7
11	X:$C0B8	X:$C0B9, X:$C0BA, X:$C0BB

PMAC2 Ultralite I/O Node Addresses

Node	Node 24-bit Transfer Addresses	Node 16-bit (upper 16 bits) Transfer Addresses
2	X:$C0A0	X:$C0A1, X:$C0A2, X:$C0A3
3	X:$C0A4	X:$C0A5, X:$C0A6, X:$C0A7
6	X:$C0A8	X:$C0A9, X:$C0AA, X:$C0AB
7	X:$C0B0	X:$C0B1, X:$C0B2, X:$C0B3
10	X:$C0B4	X:$C0B5, X:$C0B6, X:$C0B7
11	X:$C0B8	X:$C0B9, X:$C0BA, X:$C0BB

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Turbo PMAC2 Ultralite I/O Node Addresses

MACRO IC Node	User Node	Node 24-bit Transfer Addresses	Node 16-bit (upper 16 bits) Transfer Addresses
(IC0) 2	2	X:$078420	X:$078421, X:$078422, X:$078423
(IC0) 3	3	X:$078424	X:$078425, X:$078426, X:$078427
(IC0) 6	6	X:$078428	X:$078429, X:$07842A, X:$07842B
(IC0) 7	7	X:$07842C	X:$07842D, X:$07842E, X:$07842F
(IC0) 10	10	X:$078430	X:$078431, X:$078432, X:$078433
(IC0) 11	11	X:$078434	X:$078435, X:$078436, X:$078437
(IC1) 2	18	X:$079420	X:$079421, X:$079422, X:$079423
(IC1) 3	19	X:$079424	X:$079425, X:$079426, X:$079427
(IC1) 6	22	X:$079428	X:$079429, X:$07942A, X:$07942B
(IC1) 7	23	X:$07942C	X:$07942D, X:$07942E, X:$07942F
(IC1) 10	26	X:$079430	X:$079431, X:$079432, X:$079433
(IC1) 11	27	X:$079434	X:$079435, X:$079436, X:$079437
(IC2) 2	34	X:$078420	X:$07A421, X:$07A422, X:$07A423
(IC2) 3	35	X:$07A424	X:$07A425, X:$07A426, X:$07A427
(IC2) 6	38	X:$07A428	X:$07A429, X:$07A42A, X:$07A42B
(IC2) 7	39	X:$07A42C	X:$07A42D, X:$07A42E, X:$07A42F
(IC2) 10	42	X:$07A430	X:$07A431, X:$07A432, X:$07A433
(IC2) 11	43	X:$07A434	X:$07A435, X:$07A436, X:$07A437
(IC3) 2	50	X:$07B420	X:$07B421, X:$07B422, X:$07B423
(IC3) 3	51	X:$07B424	X:$07B425, X:$07B426, X:$07B427
(IC3) 6	54	X:$07B428	X:$07B429, X:$07B42A, X:$07B42B
(IC3) 7	55	X:$07B42C	X:$07B42D, X:$07B42E, X:$07B42F
(IC3) 10	58	X:$07B430	X:$07B431, X:$07B432, X:$07B433
(IC3) 11	59	X:$07B434	X:$07B435, X:$07B436, X:$07B437

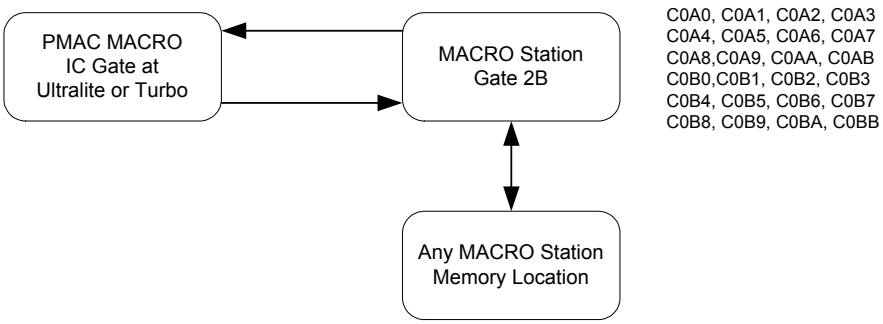
If the user wanted to read the inputs from the MACRO Station of the first 24-bit I/O node address of node 2 (X:$C0A0), then he/she could point an M-variable to the Ultralite or TURBO Ultralite I/O node registers to monitor the inputs.

```
M980->X:$C0A0,0,24            ;Ultralite node2 address
M1980->X:$078420,0,24         ;Turbo Ultralite node 2 address
```

These M-variable definitions (M980 or M1980) could then be used to monitor the inputs for either the Ultralite or Turbo Ultralite respectively.

MACRO Data Transfer via the I/O Nodes

The MACRO Station allows the user to transfer data back to the Ultralite from any MACRO station memory location. This function is useful to read the 16-bit A/D converters, transferring data from either Gate1B or Gate 2B which are not transferred automatically, or any other location for verification or troubleshooting purposes.



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The data transfer process uses MI20 and MI21-MI68 to enable this function. Since the I/O nodes are used, MI975, MI19, and the Ultralite I/O node activation I-variables must also be set to appropriate values.

MI20 controls which of 48 possible data transfer operations are performed at the data transfer period set by MI19. MI20 is a 48-bit value; each bit controls whether the data transfer specified by one of the variables MI21 through MI68 is performed.

Hex	0	0	0	0	0	0	0	0	0	0	0	F

```
MI20 = $1    ;transfer MI21
MI20 = $3    ;transfer MI21 and MI22
MI20 = $F    ;transfer MI21, MI22, MI23, and MI24
```

MI21 through **MI68** are 48-bit addresses describing the transfer of data from the desired memory location to the MACRO Station I/O node location. This transfer can be done on a bit by bit basis, but typically, this data transfer process is done as a 24-bit transfer. MI20 tells the MACRO Station how many of these data transfers will take place for a given period.

Hex Digit #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Contents	From Register Format Code		From Register Address				To Register Format Code		To Register Address			

The first 24 bits (6 hex digits) specify the address of the register on the Compact MACRO Station from which the data is to be copied; the second 24 bits (6 hex digits) specify the address on the Compact MACRO Station to which the data is to be copied. In each set of six hex digits, the last four hex digits specify the actual address. The first 2 digits (8 bits) specify what portion of the address is to be used.

The following table shows the 2-digit hex format and the portions of the address that each one selects.

Code	**X or Y**	**Bit Width**	**Bit Range**	**Notes**
$40	Y	8	0-7	
$48	Y	8	8-15	
$50	Y	8	16-23	
$54	Y	12	0-11	Lower 12-bit ADC Registers
$60	Y	12	12-23	Upper 12-bit ADC Registers
$64	Y	16	0-15	
$6C	Y	16	8-23	16-bit MACRO Servo Node Registers
$78	Y	24	0-23	24-bit MACRO Servo Node Registers
$B0	X	8	0-7	
$B8	X	8	8-15	
$C0	X	8	16-23	
$C4	X	12	0-11	
$D0	X	12	12-23	
$D4	X	16	0-15	
$DC	X	16	8-23	16-bit MACRO I/O Node Registers
$E8	X	24	0-23	24-bit MACRO I/O Node Registers

Example: Transfer the upper 16-bits of Y:$8800 to the upper sixteen bits of X:$C0A1 of the MACRO Station

```
MS0,MI21=$6C88000DCC0A1
```

Example: Transfer ADC1, ADC2, ADC3, and ADC4 to Ultralite using MACRO Data Transfer. (Assume MACRO Station 0). The S2 switch setting is set to the CS10 ($8800) selection.

Since the ADC data is 16-bit data, the most efficient method of transfer is through the MACRO 16-bit data registers from nodes 2 and 3.

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MACRO Station Setup

MACRO Commands	Notes
MS0,MI19=$4	Transfer data once every four phase clocks (servo default)
MS0,MI975=$C	Activate first I/O nodes 2 and 3 at Station
MS0,MI20=$F	Transfer MI21, MI22, MI23, and MI24
MS0,MI21=$6C8800DCC0A1	Copies upper 16-bits data from Station address Y:$8800 to X:$C0A1 (node2)
MS0,MI22=$6C8801DCC0A2	Copies upper 16-bits data from Station address Y:$8801 to X:$C0A2 (node2)
MS0,MI23=$6C8802DCC0A3	Copies upper 16-bits data from Station address Y:$8802 to X:$C0A3 (node2)
MS0,MI24=$6C8803DCC0A5	Copies upper 16-bits data from Station address Y:$8803 to X:$C0A5 (node3)
MSSAVE0	Save these changes to the MACRO Station
MS$$$0	Reset the MACRO Station for changes to take affect

Ultralite Setup

Ultralite (8 Axis)	Turbo Ultralite (8-Axis)	Description
I996=$0FB33F	I6841=$0FB33F	Enable nodes 0,1,2,3,4,5,8,9,12, and 13 at Ultralite
M980->X:$C0A1,8,16	M980->X:$78421,8,16	ADC 1, 1st 16 bit word node2
M981->X:$C0A2,8,16	M981->X:$78422,8,16	ADC 2, 2nd 16 bit word node 2
M982->X:$C0A3,8,16	M982->X:$78423,8,16	ADC 3, 3rd 16 bit word node 2
M983->X:$C0A5,8,16	M983->X:$78425,8,16	IO word 4, 1st 16 bit word node 3

Now the M-Variables can be used in the PLC or motion programs for data acquisition purposes. If the servo nodes are being used by encoders for feedback at the MACRO Station, the information from the I/O nodes can also be used in the encoder conversion table at the Ultralite for closed loop servo data.

Using MACRO Station Encoder Conversion Table for Data Transfer

If using the information from the A/D converter for closed loop servo data, 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 ADCs is processed as an ADC-style input and can be processed as unsigned data.

Voltage	ADC Converted Data	Hardware Mode
0V to 10V	0 to 65535 ADC bits	Unipolar
-10V to 10V	0 to 65535 ADC bits	Bipolar

Since the A/D converted 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 Ix93 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. The user does not have to setup MSn, MI920 because the MACRO Station will place the power-on position into that register at power-up.

Acc-28 Style A/D Entries ($1x, $5x): The A/D feedback entries read from the high 16 bits of the specified address and shift the data right three bits so that the least significant bit of the processed result in bit 5. Unlike the parallel feedback methods, this method will not roll over and extend the result.

The $1x method processes the information directly, essentially a copying with shift. The $5x integrates the input value as it copies and shifts it. That is, it reads the input value, shifts it right three bits, adds the bias term in the second line, and adds this value to the previous processed result.

Presently, the only A/D accessory of this format that can interface to the Compact MACRO Station is the Acc-28B or Acc-28E, which provides an unsigned value, so $18 and $58 should be used.

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Power-On Feedback Address for PMAC2 Ultralite

Both the Ultralite and the Turbo Ultralite allow the user to obtain absolute position at power up or upon request (**#n$***). The Ultralite must have Ix10 setup and the Turbo Ultralite needs both Ixx10 and Ixx95 setup 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 or 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)
Acc-8D Opt 7 Resolver/Digital Converter	$73000n	$F3000n
Acc-8D Opt 9 Yaskawa Absolute Encoder Converter	$72000n	$F2000n
Acc-8D Opt 10 Sanyo Absolute Encoder Converter	$74000n	$F4000n
Acc-28B Analog/Digital Converter	$74000n	$F4000n
MACRO Station Option 1C/Acc-6E A/D Converter	$74000n	$F4000n
MACRO Station Parallel Input	$74000n	$F4000n
MACRO Station MLDT 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	$740000	$F40000
MACRO Station MLDT Input	$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.

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The station then references its own I11x value to determine the type, format, and address of the data to be read. The data is returned to PMAC or PMAC2 with up to 42 bits of data, sign extended to 46 bits. Bit 48 is a Ready/Busy handshake bit and Bit 47 is a pass/fail status bit. If Bit 47 is set, the upper 24 bits of the 48 bits returned are a fail word and are stored in X:$0798 of the PMAC or PMAC2.

Example: Configure ADC1, ADC2, ADC3, and ADC4 for unsigned feedback. Since this information is absolute, also setup the appropriate variables at both the MACRO Station and Ultralite. For this example the SW1 settings are set for CS10 ($8800).

(A) Set Encoder Conversion Table at the MACRO Station (MI120-MI151)

```
MS0,MI120=$188800              ;process as ADC ($10 station address) for ADC #1
MS0,MI121=$188801              ;process as ADC ($11 station address) for ADC #2
MS0,MI122=$188802              ;process as ADC ($12 station address) for ADC #3
MS0,MI123=$188803              ;process as ADC ($13 station address) for ADC #4
```

(B) Set Node Transfer Variables (MI101-MI108)

```
MS0,MI101=$10                  ;processed for ECT for ADC #1 (default)
MS0,MI102=$11                  ;processed for ECT for ADC #2 (default)
MS0,MI103=$12                  ;processed for ECT for ADC #3 (default)
MS0,MI104=$13                  ;processed for ECT for ADC #4 (default)
```

(C) Set Absolute Power on Read (MI111-MI118)

```
MS0,M111=$318800               ;unsigned power on read from ECT #1
MS0,M112=$318801               ;unsigned power on read from ECT #2
MS0,M113=$318802               ;unsigned power on read from ECT #3
MS0,M114=$318803               ;unsigned power on read from ECT #4
```

(G) Set Ix10 as specified by the appropriate Ultralite

Axis	Ultralite Unsigned	Turbo Ultralite Node Address
1	$740000	$000100
2	$740001	$000001
3	$740004	$000004
4	$740005	$000005

(H) If Turbo PMAC Ultralite, Set Ix95 for power-on type

Axis	Turbo Ultralite Unsigned
1	$740000
2	$740000
3	$740000
4	$740000

Using MI198 and MI199 to Verify the Acc-28E ADCs

The MACRO I-Variables MI198 and MI199 can be used to look at any MACRO Station memory location. This can be useful especially when trying to test the hardware at the MACRO Station. MI198 contains the register we want to read, and we can read the information in MI198 by querying MI199.

MSn, MI198 is a 24 bit register where the lower 16 bits have the address and the upper 8 bits contain the number of bits and tell us whether its is an X or Y memory address.

MSn, MI199 will respond back with the value in MS0,MI198.

Example: Read Using MI198 and MI199. The Acc-28E has S2 switch settings for CS10 ($9800) Selection.

```
MS0,MI198=$6C9800              ;For ADC1
MS0,MI199                      ;Request Data
$000000004B78                  ;Response 19320 ADC bits
MS0,MI198=$6C9801              ;For ADC2
MS0,MI199                      ;Request Data
$00000000B46A                  ;Response 46186 ADC bits
```


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CONNECTOR PINOUTS

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J3: A-D Converter Input (Axes 1 and 2)

(With Terminal Block)

Pin	Symbol	Function	Description	Notes
1	ADC1+	Input	A-D Converter Channel 1+	
2	ADC1-	Input	A-D Converter Channel 1-	
3	AGND	GND.	Shield	❶
4	ADC2+	Input	A-D Converter Channel 2+	
5	ADC2-	Input	A-D Converter Channel 2-	
6	AGND	GND.	Shield	❶
7	VREF	Output	4.096Vdc precision reference	❷
8	AGND	GND.		❶
9	+5Vdc	Output	+5V reference output	❸
10	-5Vdc	Output	-5V reference output	❸

This 10 pin terminal block contains the inputs for Channel 1 and Channel 2. Reference outputs of ±5Vdc, 4.096Vdc (VREF) and RET (AGND) are provided on this connector.

❶ The shields are internally connected to the ground plane inside the Acc-28E. Normally, shields are connected at one end of the wire only (this eliminates possible system ground loops). In addition, the Pin 8 AGND line is connected to the internal ground plane.

❷ This is a buffered tap from the A-D precision reference. External hardware that uses this signal reference typically will scale it for a full-scale A-D voltage input.

❸ +5Vdc and -5Vdc are a less precise A-D reference. When used with an A-D input in the unipolar mode, it is possible to get approximately full-scale inputs. This requires the -5Vdc to be connected to the ADCx- input (ideal for metering potentiometers).

J4: A-D Converter (Axes 3 and 4)

(With Terminal Block and Options 1)

Pin	Symbol	Function	Description	Notes
1	ADC3+	Input	A-D Converter Channel 3+	
2	ADC3-	Input	A-D Converter Channel 3-	
3	AGND	Gnd.	Shield	❶
4	ADC4+	Input	A-D Converter Channel 4+	
5	ADC4-	Input	A-D Converter Channel 4-	
6	AGND	Gnd.	Shield	❶
7	VREF	Output	4.096Vdc precision reference	❷
8	AGND	Gnd.		❶
9	+5Vdc	Output	+5V reference output	❸
10	-5Vdc	Output	-5V reference output	❸

This 10 pin terminal block contains the inputs for Channel 3 and Channel 4. Reference outputs of ±5Vdc, 4.096Vdc (VREF) and RET (AGND) are provided on this connector.

❶ The shields are internally connected to the ground plane inside the Acc-28E. Normally, shields are connected at one end of the wire only (this eliminates possible system ground loops). In addition, the Pin 8 AGND line is connected to the internal ground plane.

❷ This is a buffered tap from the A-D precision reference. External hardware that uses this signal reference typically will scale it for a full-scale A-D voltage input.

❸ +5Vdc AND -5Vdc are a less precise A-D reference. When used with an A-D input in the unipolar mode, it is possible to get approximately full-scale inputs. This requires the -5Vdc to be connected to the ADCx- input (ideal for metering potentiometers).

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Acc-28E DB9 Connection

J3A – ADC Inputs 1 and 2

Pin	Symbol	Function	Description	Notes
1	-5Vdc	Output	-5V reference output	❸
2	VREF	Output	4.096Vdc precision reference	❷
3	ADC2-	Input	A-D Conv. Channel 2-	
4	AGND	Gnd.	Shield	❶
5	ADC1+	Input	A-D Conv. Channel 1+	
6	+5Vdc	Output	+5V reference output	❸
7	AGND	Gnd.	Shield	❶
8	ADC2+	Input	A-D Conv. Channel 2+	
9	ADC1-	Input	A-D Conv. Channel 1-	

J4A – ADC Inputs 3 and 4

(With option 1 only)

Pin	Symbol	Function	Description	Notes
1	-5Vdc	Output	-5V reference output	❸
2	VREF	Output	4.096Vdc precision reference	❷
3	ADC4-	Input	A-D Conv. Channel 4-	
4	AGND	Gnd.	Shield	❶
5	ADC3+	Input	A-D Conv. Channel 3+	
6	+5Vdc	Output	+5V reference output	❸
7	AGND	Gnd.	Shield	❶
8	ADC4+	Input	A-D Conv. Channel 4+	
9	ADC3-	Input	A-D Conv. Channel 3-	

The DB9 shell on the Acc-28E is connected to the UMAC chassis ground

❶ The shields are internally connected to the ground plane inside the Acc-28E. Shields normally are connected at one end of the wire only (this eliminates possible system ground loops).

❷ This is a buffered tap from the A-D precision reference. External hardware that uses this signal reference typically will scale it for a full-scale A-D voltage input.

❸ +5Vdc AND -5Vdc are a less precise A-D reference. When used with an A-D input in the unipolar mode, it is possible to get approximately full scale inputs. This requires the -5Vdc to be connected to the ADCx- input (ideal for metering potentiometers).

TB1: Power Supply Input

Pin	Symbol	Function	Description	Notes
1	AGND	Common	Power supply return	
2	N.C.		Not connected	
3	+15Vdc	Input	+15V power input	❶
4	-15Vdc	Input	-15V power input	❷

❶ +15Vdc requires a 200mA supply current. However, if the supply or reference taps at P1, TB1, or TB2 are used, the current requirement may be greater.
❷ -15Vdc requires 70mA supply current. However, if the supply taps at P1, TB1, or TB2 are used, the current requirement may be greater.

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CARD IDENTIFICATION

Card ID Address

Card identification can be read from the following 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 ID Format

Card identification can be read from the following address:

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 Acc-28E card assembly number is 603404. Convert the last four digits into hex number, i.e. 3404 = $ D4C.

- This will be the card identification for Acc-28E.
- Vender identification number = 1 for Delta Tau.
- Revision number for this card is 1.
- Option 1: Additional two axes (makes Acc-28E into 4-axis system)

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DECLARATION OF CONFORMITY

Application of Council Directive: 89/336/EEC, 72/23/EEC

Manufacturers Name: Delta Tau Data Systems, Inc.

Manufacturers Address: 21314 Lassen Street
Chatsworth, CA 91311
USA

We, Delta Tau Data Systems, Inc. hereby declare that the product
Product Name: Accessory 28E
Model Number: 603404
And all of its options conforms to the following standards:

EN61326: 1997	Electrical equipment for measurement, control, and laboratory use- EMC requirements
EN55011: 1998	Limits and methods of measurements of radio disturbance characteristics of information technology equipment
EN61010-1	Electrical equipment for measurement, control, and laboratory use- Safety requirements
EN61000-3-2 :1995 A14:1998	Limits for harmonic current emissions. Criteria A
EN61000-3-3: 1995	Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16A. Criteria B.
EN61000-4-2:1995 A1: 1998	Electro Static Discharge immunity test. Criteria B
EN61000-4-3: 1995 A1: 1998	Radiated, radio-frequency, electromagnetic field immunity test. Criteria A
EN61000-4-4: 1995	Electrical fast transients/burst immunity test. Criteria B
EN61000-4-5: 1995	Surge Test. Criteria B
EN61000-4-6: 1996	Conducted immunity test. Criteria A
EN61000-4-11: 1994	Voltage dips test. Criteria B and C

Date Issued: 11 May 2006
Place Issued: Chatsworth, California USA

Yolande Cano
Quality Assurance Manager

Mark of Compliance

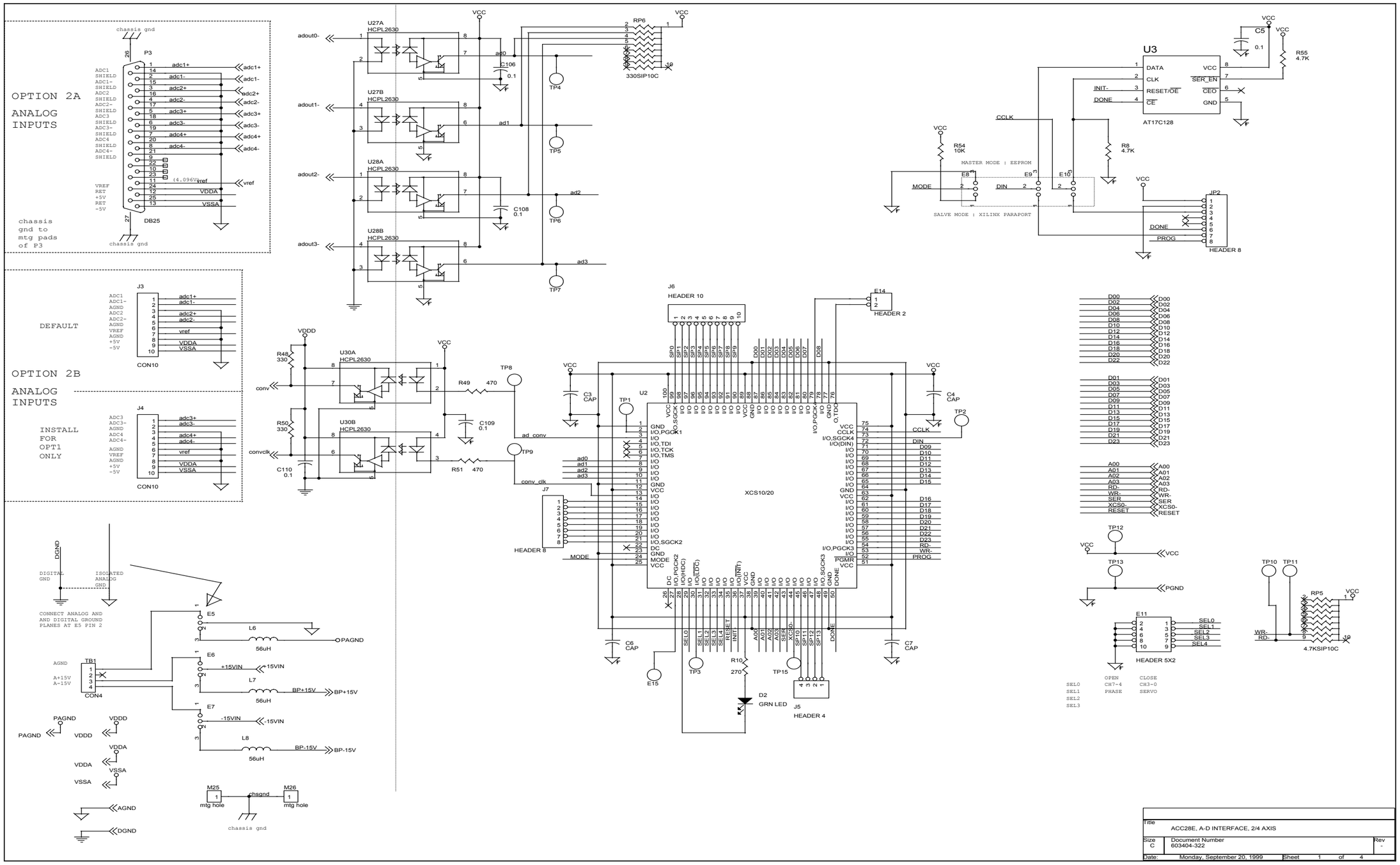
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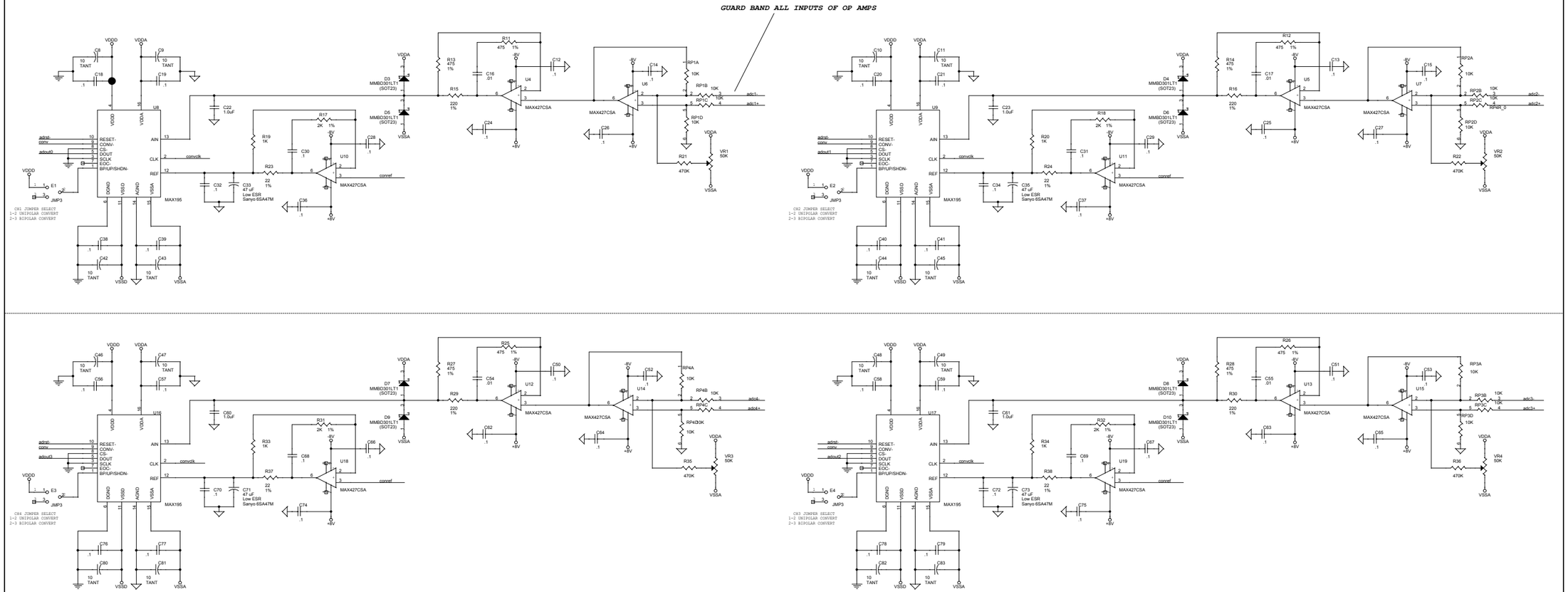
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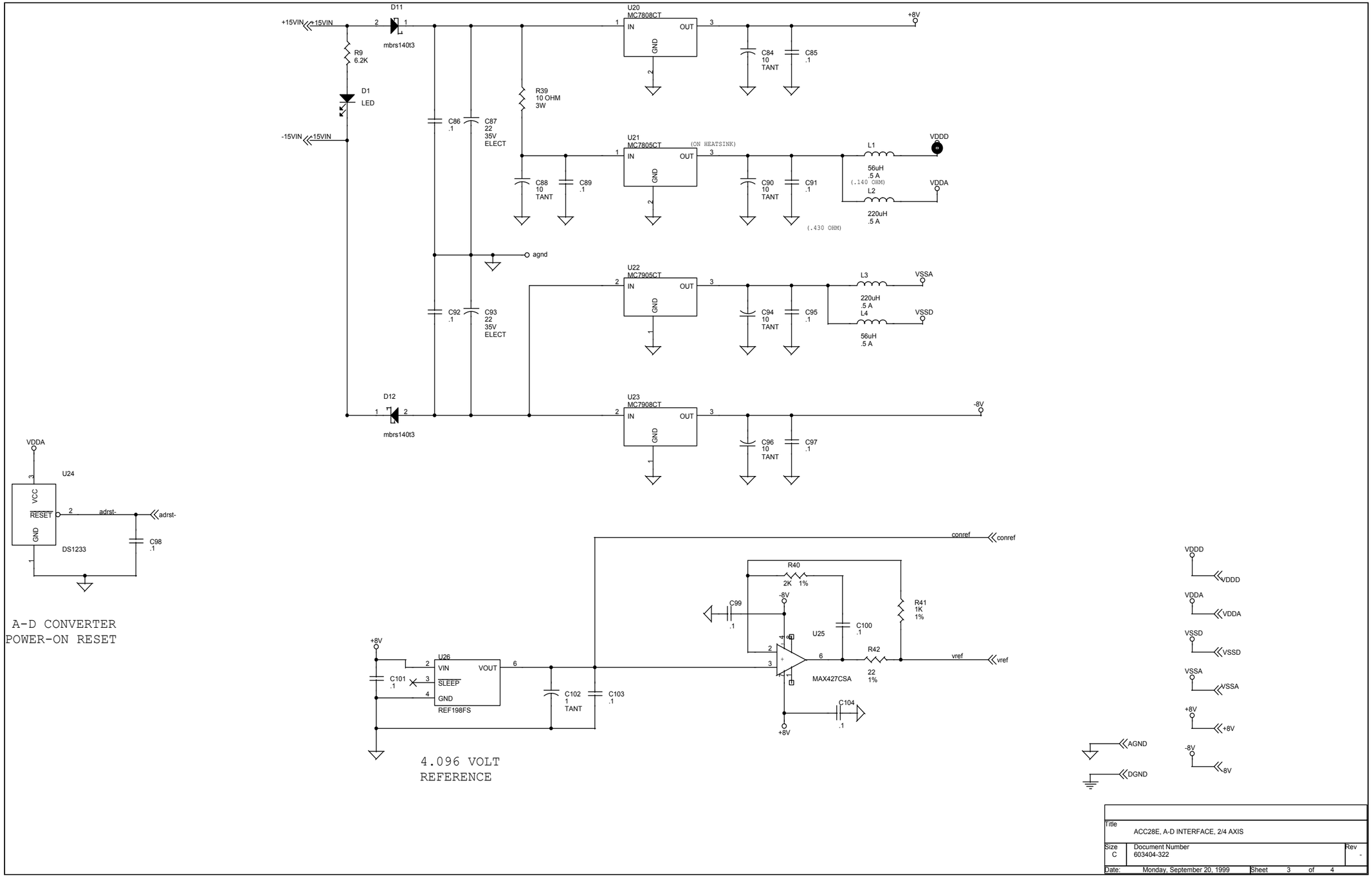
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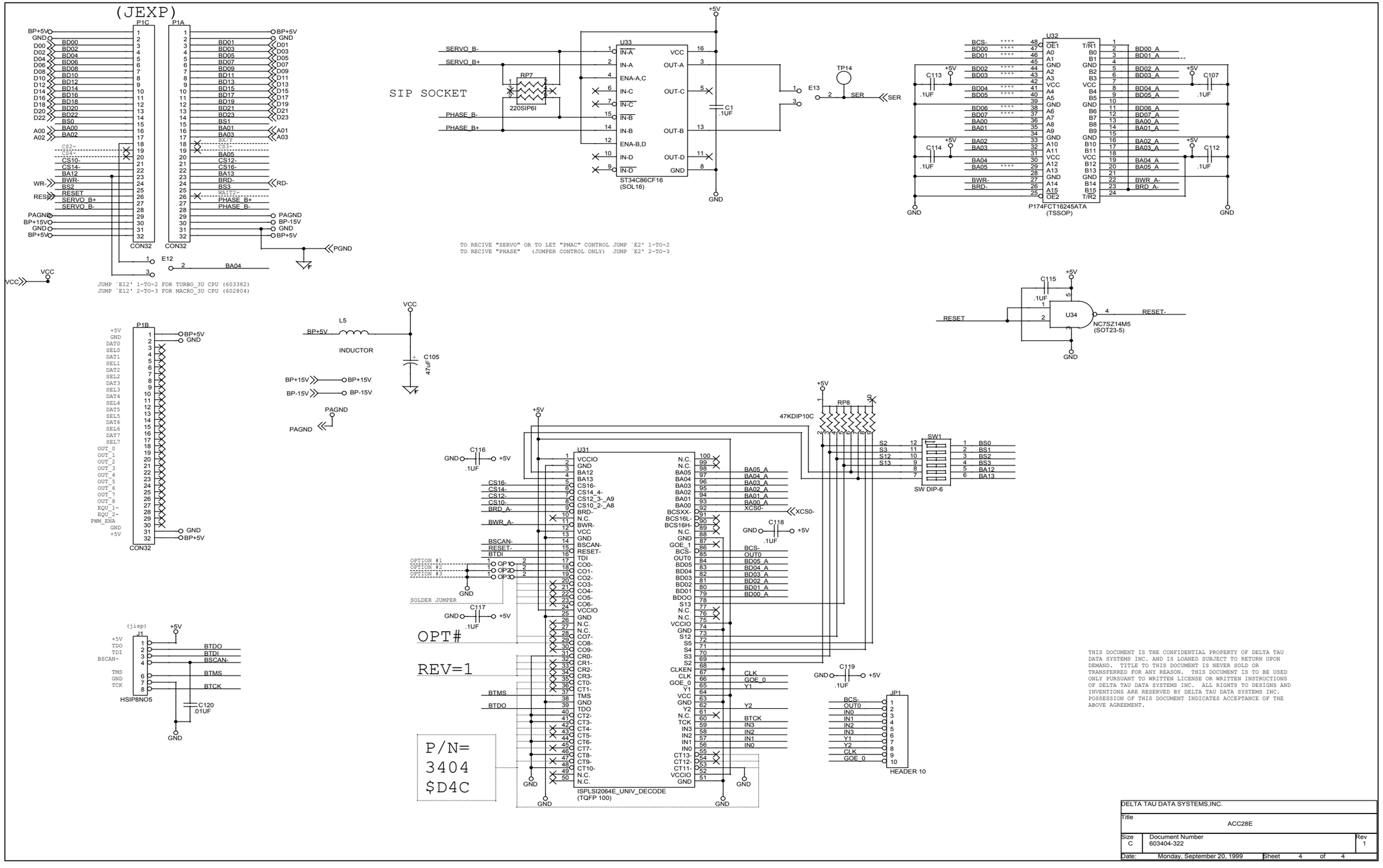
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