DP-770 SERIES
DIGITAL VOLTMETER

Operator's Manual

OMEGA ENGINEERING, INC.
An OMEGA Group Company

TABLE OF CONTENTS

DP 770 SERIES

SECTION 1

General

The Series 770 is a general purpose microprocessor based digital panel voltmeter with 4096 count resolution and selectable digital filtering with up to 1.6 seconds of averaging for the display and two millisecond response time for the four limits, peak detect and valley detect. It features display of peak reading, display of valley reading, span selection, display of span selection, deciaml point selection, auto tare, display of tare, zero adjust, and remote TTL inputs on some functions. Optional outputs and inputs include RS232C, RS422, baud rate selection, and analog output. All contained in a compact aluminum panel mount case with bright LED readouts. See attached drawings for electrical specifications, switch locations, and mechanical dimensions

Analog input:

The analog input is a high impedance differential amplifier with internal gain selection for low temperature drift. Analog to digital conversion is done with a highly accurater successive approximation A/D converter chip.

MODEL	INPUT
771	0-2VDC
772	0-5VDC
773	0-10VDC
775	4-20ma
776	0-200mVDC
777	0-200VDC

Tare switch:

The tare switch is a multifunction switch, each function depends on how long the switch is pressed. When the tare switch is pressed the display will show the stored tare value, after about 2 seconds the display will flash, if the switch is released actual displaying will resume. If the switch is not released, a new tare value will be entered, the display will now show the new tare value. If the switch is released actual displaying will resume, The new tare value is stored in a non-volatile memory and is retained during power failure.

Zero tare switch:

The zero tare switch makes the tare value zero.

SECTION 2

Connector identification: For connector diagrams see section 8

AC POWER INPUT (TB1):

Screw terminal strip.
Looking Left to Right from rear, top up.

Left: Cable shield or earth ground.
Center left: AC power input.
Center right: AC power input.
Right: Cable shield or earth ground.

Power requirements: 110 volts AC, 50-400 Hz., 8 watts max.

DC POWER INPUT (TB1):

Left : Positive DC power input.
Center left: no connection.
Center right: no connection.
Right: DC power return.

Analog Input (J2)(See figures A through F page 3A)

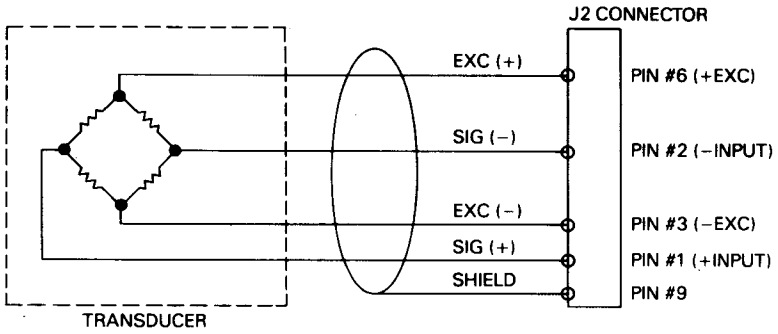
Connector type: DB-9S

Pin 1 + Signal
Pin 2 - Signal (Must be either referenced to pin 8 or tied to pin 3)
Pin 3 Optional analog output return.
Pin 4 No connection.
Pin 5 Optional analog output.
Pin 6 +15VDC at 50mA (+10VDC @120mA, DP776 only)
Pin 7 No connection
Pin 8 -15VDC at 50mA (no connection, DP776 only)
Pin 9 Cable shield

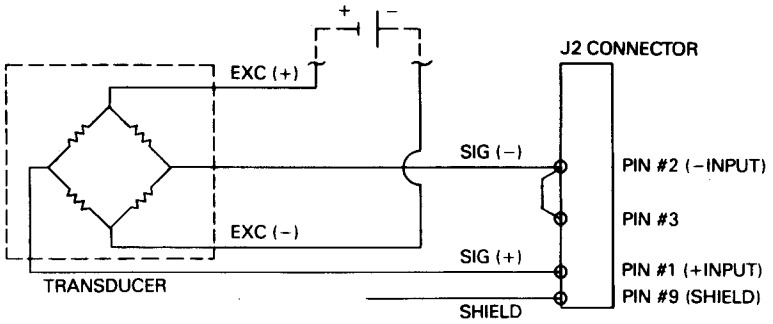
Data outputs (J1):

Connector type: DB-25S

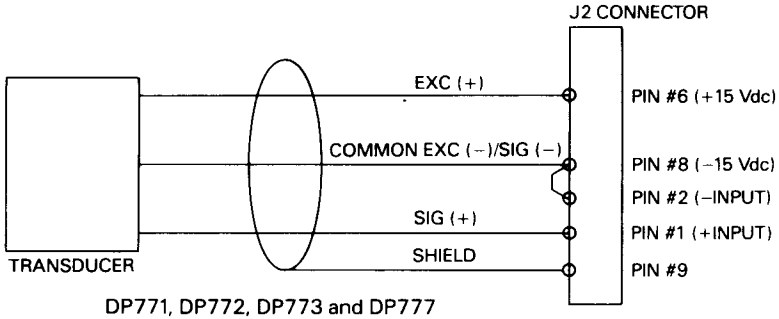
Pin 1	Logic Ground		
Pin 2	Transmit Data	RS232C -	Transmit Data High RS422
Pin 3	Receive Data	RS232C -	Receive Data Low RS422
Pin 4	Ready to Send	RS232C -	Ready to Send High RS422
Pin 5	Clear to Send	RS232C -	Clear to Send Low RS422
Pin 6	Logic Ground		
Pin 7	Signal Ground	RS232C	
Pin 8	Remote Input #1 Tare		
Pin 9	Remote Input #2 Zero Tare		
Pin 10	Remote Input #6 Valley Reading Reset		
Pin 11	Remote Input #3 Peak Reading		



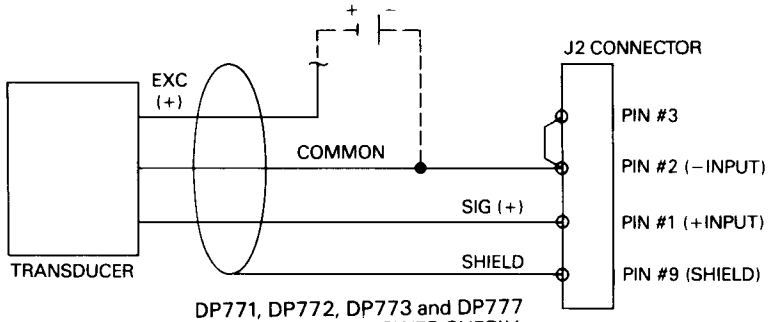
DP776 USING INTERNAL 10 VDC EXCITATION



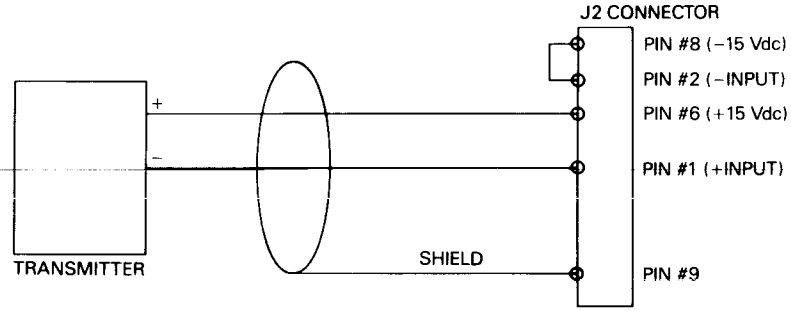
DP776 WITH EXTERNAL POWER SUPPLY



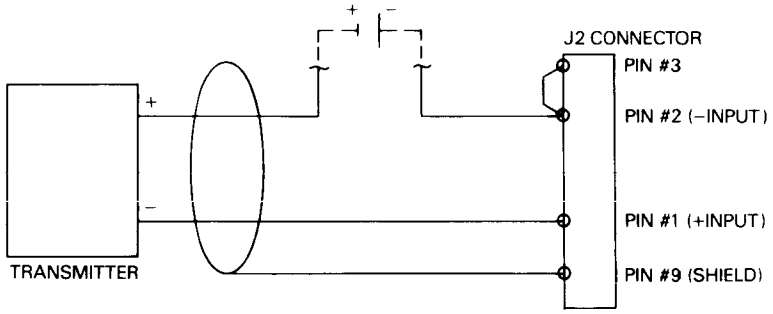
DP771, DP772, DP773 and DP777
USING INTERNAL 30 VDC SUPPLY
(If using 15 Vdc power, tie pin #3 to Common, not pin #8)



DP771, DP772, DP773 and DP777
WITH EXTERNAL POWER SUPPLY



DP775 USING INTERNAL 30 VDC EXCITATION
(If using internal 15 Vdc supply, tie pin #2 to pin #3, not pin #8)



DP775 WITH EXTERNAL POWER SUPPLY

Pin 12 Limit 4 output
Pin 13 Remote Input #4 Peak Reading Reset
Pin 14 Transmit Data Low RS422
Pin 15 Receive Data High RS422
Pin 16 Request to Send Low RS422
Pin 17 Clear to Send High RS422
Pin 18 Logic Ground
Pin 19 Logic Ground
Pin 20 Limit 1 output
Pin 21 Limit 3 output
Pin 22 Logic Ground
Pin 23 +5VDC at 30mA regulated
Pin 24 Remote Input #5 Valley Reading
Pin 25 Limit 2 output

SECTION 3

PROGRAMMING LIMITS, DIGITAL FILTER, SPAN, DECIMAL POINT, AND SERIAL INTERFACE OPTIONS:

All parameters are programmed after putting the unit into the set up mode which is accomplished by first toggling and holding the setup switch to the left, and then depressing the function switch. The display will now show ".1." which indicates the unit is ready to set up limit number one.

3.1 LIMIT PROGRAMMING:

After getting the unit into the setup mode the number ".1." will show for approximately two seconds and then the display will show the number that is presently stored in memory as limit number one. The ones unit digit on the limit will be flashing which indicates it is the digit ready to be programmed. To increment this digit momentarily depress the tare button and the digit will increment once each time the tare button is depressed. After programming the digit depress the zero tare button and the next digit to the left will flash indicating it is ready to be programmed. Program this digit in the same manner as the first and then proceed to the remainder of the digits. After programming the 5 digits press zero tare button. The sixth digit will display "1" or blank: to change, press tare after sixth digit, press zero tare. Unit will display (-) sign or blank; to change, press tare.

After programming limit number 1 momentarily depress the function switch and the number ".2." will come up on the display indicating limit number 2 is ready to be programmed. After about two seconds ".2." will disappear and the number stored in memory as limit number 2 will be displayed with one digit flashing. Program limit number 2 in the same fashion as limit number 1.

Limit number 3 and 4 are accessed and set up the same way as limit number 1 and 2.

To exit the set up mode at any time depress the function switch and hold until the display goes blank (about two seconds).

3.2 PEAK THRESHOLD SETUP:

After the 4 limits are programmed the peak threshold which is a limit in which the peak must exceed before the peak comparisons will be performed and the display will start showing the peak number. The peak threshold setup will be indicated by the number ".0." showing on the display for about two seconds, and then the peak threshold numbers. Number selection is done the same was as the limits.

3.3 DIGITAL FILTER SETUP:

After the limits are programmed momentarily depress the function switch and the unit will display a one digit number which is the number of A/D conversions that are averaged for the limits, peak and valley comparisons. The time of one A/D conversion is two milliseconds so if the filter number is set at 01 the comparisons will be every two milliseconds if the filter number is set at 02 then the comparison will be the average of two conversion or four milliseconds.This number can be incremented up to a maximum of 08 using the tare switch. When making a change on the digital filter the limits and peak threshold must be re checked. The sampling rate for max, min, and alarms (2ms to 16ms/62.5 to 500hz)=A/D conversion(2ms/sample) X digital filter(no of samples 1 to 8).

3.4 DISPLAY DIGITAL FILTER SETUP:

After the digital filter is programmed momentarily depress the function switch and the display will display a three digit number which is the number of A/D conversions x DIGITAL FILTER NUMBER that are averaged for the display. The time of one A/D conversion is two millisecond so if the digital filter number is set at 02 and the display filter is set at 10 the display will be the average of 20 conversions and updated every 40 milliseconds. This number can be incremented up to a maximum of 100 using the tare switch or down using the zero tare switch. This setting does not affect the response time of the peak detect, valley detect, or the four limit set point detect times which are fixed by the digital filter number. The display update rate (2 to 1600ms/.625 to 500hz) = A/D conversion (2ms/sample) X digital filter (1 to 8) X display filter (1 to 100).

3.5 SPAN SET UP:

After setting up digital filter momentarily depress the function switch and the display will show the current span selected with a digit flashing which indicates that digit is ready to be programmed. Increment this digit to the number desired by depressing the tare switch. The digit will increment once each time the tare switch is depressed. After programming that digit depress the zero tare switch and the next digit to the left will flash indicating that digit is ready to program. Increment this digit using the tare switch then proceed to the remainder of the digits which are programmed in the same manner.

$$\text{Span Value} = \frac{\text{Positive input meter span}}{\text{Transducer output span}} \times \text{Full scale display (ignore decimal pts)}$$

Example A: DP776 with 300 PSI transducer with 100mV output. End user wants to display .1 PSI increments, therefore full scale display is 300.0 PSI.

$$\text{Span Value} = \frac{200\text{mV}}{100\text{mV}} \times 3000 \text{ (Ignore decimal point)} = 6000$$

Example B: DP773 with 200 PSI transducer with 1-11 Vdc output. End user wants to display .1 PSI, therefore full scale display is 200.0 PSI.

$$\text{Span Value} = \frac{10\text{ Vdc}}{(11-1)\text{ Vdc}} \times 2000 \text{ (Ignore decimal point)} = 2000$$

Example C: DP775 with 300 PSI transmitter with 4-20 mA output. End user wants to display PSI increments, therefore full scale display is 300 PSI.

$$\text{Span Value} = \frac{(20-4)\text{mA}}{(20-4)\text{mA}} \times 300 = 300$$

3.6 DECIMAL POINT SELECTION:

After setting the span the next selection is decimal point location. The decimal point may be selected to appear in any position or off. To move the decimal point, press the tare button and the decimal point will rotate one position to the left. This

setting has no bearing on the scaling or the reading. To exit the set up mode depress the function switch until the display blanks.

3.7 Optional RS232/RS422 setup: After setting the decimal point momentarily depress the function switch and if either of these options are installed the display will show the current unit address programmed which may be incremented with the tare switch and decremented with the zero tare switch. Momentarily depress the function switch and the unit will display the baud rate presently programmed which may be incremented using the tare button. If the function switch is again depressed the unit will go back to the set up for the limits. To exit the set up mode depress the function switch until the display blanks (approximately two seconds). All setup parameters are stored in nonvolatile memory and will be maintained during loss of power.

SECTION 4

4.1 Peak reading

Displaying of the peak reading is accomplished by pressing and holding the function switch (the display will then blank) and then pressing the tare switch, the peak reading (highest positive value) will be displayed for approximately 2 seconds, the display will then start to flash, if the tare switch is not released the peak reading will be reset to zero. When the tare switch is released the display will blank until the function switch is released. The peak reading is compared after each conversion, approximately two millisecond.

4.2 Valley Reading:

Display of the Valley Reading is accomplished by pressing and holding the function switch (the display will then blank) and then pressing the zero tare switch, the valley reading (highest negative value) will be displayed for approximately 2 seconds, the display will then start to flash, if the zero tare check switch is not released the valley reading will be reset to zero. When the zero tare switch is released the display will blank until the function switch is released. The valley reading is compared after each conversion, approximately two millisecond.

4.3 Remote Inputs:

Located on connector J1 are six remote inputs which can control the display. These are Low Power TTL compatible inputs or switch closures to logic ground, 0 volts minimum to 5 volts maximum and must be present a minimum of 20 milliseconds,

Input #1 Tare: Remote tare when held low will set a new tare

value, same as pressing the tare switch except does not display the tare value.

Input #2 Zero Tare: Remote zero tare when held low will zero the tare value, same as pressing the zero tare switch except does not display the tare value.

Input #3 Peak Reading: Remote peak reading when held low will display the current peak reading. May be tied low (logic ground) for continuous peak reading display. Once the unit has detected a peak, ie, the input drops, the display will lock up and display that number until it is reset. When in the Peak Reading mode all limits will latch up when the limit is reached. In the normal display mode the limit will track the display.

Input #4 Peak Reading Reset: Remote peak reading reset when held low will reset the peak reading to the current actual reading.

Input #5 Valley Reading: Remote valley reading when held low will display the current valley reading. May be tied low (logic ground) for continuous valley reading display. Once the unit has detected a valley the display will lock up and display that number until the unit is reset.

Input #6 Valley Reading Reset: Remote valley reading reset when held low will reset the valley reading to the current actual reading.

SECTION 5

Analog Output:

If the analog outpput option is installed the output will track the normal display reading with the tare subtracted. The output will swing 0 to +/-10 volts at the full scale reading of 4095 counts, which is 2.44 millivolts per count of the A/D. The output will drive a 10 K ohm load.

SECTION 6

Serial Input/Output:

If the serial input/output option is installed it allows the Series 770 to communicate with a remote computer or terminal. Two standard signal levels are available, RS232C or RS422. Almost all functions available from the front switches can be duplicated by the host computer. Listed below are all commands, with a full description following. RS232 connections should be made using

null modem (cross-over) cable to connect to computer port.

AD Address Disable
AE Address Enable
AT Auto Tare
AU Abort Update
CU Continuous Update
RD Read Display
RP Read Peak
RS Read Span
RT Read Tare
RV Read Valley
S1 Set Limit 1
S2 Set Limit 2
S3 Set Limit 3
S4 Set Limit 4
SP Set Peak
SV Set Valley
V1 Verify Limit 1
V2 Verify Limit 2
V3 Verify Limit 3
V4 Verify Limit 4
ZT Zero Tare

The serial data is transmitted as ASCII characters, using the selected baud rate, each word or character is made up of eight data bits, one stop bit and no parity bit. The format of data transmitted depends on the command, and is expected to be transmitted or receive left most character first and terminated with a carriage return (c.r.) when an additional number is required leading zeros or place holders may be omitted. Plus sign is optional but must proceed the number. Received numbers will have the decimal point ignored. Transmitted numbers will have a decimal point to conform to the display format. In the command descriptions below the command string will be shown within brackets ([]), the sign if required will be shown as a lower case (s), and the number as upper case (X). Each command will be executed when received and only once except for display data which may be enabled to continuously update until disabled.

Address Disable: [ADXXc.r],[ADc.r.]

Address disable is a command used with the RS422 serial interface when several units will be in parallel on the serial buss, or with RS232C, to disable the unit. This command allows the unit specified by the address number XX to be turned off or disabled. The address must be in the range of 1 to 99. If no number is supplied all units on the serial buss will be turned off or disabled. If the unit is disable by unit address number the unit will respond with [BYEc.r.].

Address Enable: [AEXXc.r.]

Address enable is a command used with the RS422 serial

interface when several units will be in parallel on the serial buss, or with RS232C, to enable the unit. This command allows the unit specified by the address number XX to be turned on or enabled, the address must be in the range of 1 to 99. When enable the unit will respond with [HELLOc.r.].

Abort Update: [AUc.r.]

Abort update is a command that will turn off the unit from continuous update of display data. The unit will respond with [OKc.r.].

Auto Tare: [ATc.r]

Auto tare is a command which will tare the unit. See tare switch description. The unit will respond with [OKc.r.]. Note: See ZT command.

Continuous Update: [CUc.r.]

Continuous update is a command that will put the unit in a mode where it will send the last requested display data continuously until disabled by either an AU or AD command. An example would be [RVc.r.][CUc.r.] where the unit will now send the valley reading after each conversion. The unit will respond with [OKc.r.].

Read Display: [RDc.r.]

Read display is a command that will return the normal display reading, (display mode when not in Peak, Valley, Span check, ect.) The returned data format will be [sXXX.XXXc.r.] where (s) is the sign if minus, (X) is the number, and (.) is the decimal point if in the display.

Read Peak: [RPc.r.]

Read peak is a command that will return the peak display reading. The returned data format will be [sXXX.XXXc.r.] where (s) is the sign if minus, (x) is the number, and (.) is the decimal point is in the display.

Read Span: [RSc.r.]

Read span is a command that will return the current span selection. See Span Switch. The return data format will be [XX.XXXc.r.] where (X) is the number and (.) is the decimal point if in the display.

Read Tare: [RTc.r.]

Read tare is a command that will return the current tare value. The return data format will be [sXXX.XXXc.r.] where (s) is

the sign if minus, (X) is the number, and (.) is the decimal point if in the display.

Read Valley: [RVc.r.]

Read Valley is a command that will return the valley display reading. The returned data format will be [sXXX.XXXc.r.] where (s) is the sign if minus, (X) is the number, and (.) is the decimal point if in the display.

Set Limit: [S#XXXXXc.r.]

Set limit is a command that will set the value of one of the four limits. "S" is the command. "#" is the limit number from 1 to 4. "X" is the numeric value from 1 to 19999. X may be preceeded by a "+" or a "-". The + is optional.

Set Peak: [SPc.r.]

Set peak is a command that will set the current peak value to zero. The unit will respond with [OKc.r.].

Set Valley: [SVc.r.]

Set valley is a command that will set the current valley value to zero. The unit will respond with [OKc.r.].

Verify Count: [VXc.r.]

Reads the limit back. V is the command. "X" is the limit number.

Zero Tare: [ZTc.r.]

Zero tare is a command that will set the current tare value to zero (0) and will store the new value in the non-volatile memory. See Tare Switch. The unit will respond with [OKc.r.].

Serial Interface connections:

TXD (Transmit Data):

Transmit data is an output signal where the unit will transmit its serial data.

RXD (Receive Data):

Receive data is an input signal where the unit will receive its serial data.

RTS (Ready To Send):

Ready to send is an output signal where the unit requests permission from the host to send data, or the unit is ready to send data.

CLS (Clear To Send):

Clear to send is an input signal which must be high to allow the unit to send data. If not used it must be tied high.

SECTION 7

SCALING THE METER (Allow 20 min warm up time)

1. Depress zero tare switch.
2. Apply zero volts (4mA for DP775) across signal (+) and (-).
3. Adjust zero calibrate to zero display.
4. Connect transducer.
5. Simulate low input on transducer. Low input for most pressure transducers will be zero pressure and for most load cells it will be zero load. With low load input applied to transducer low output will come from transducer.

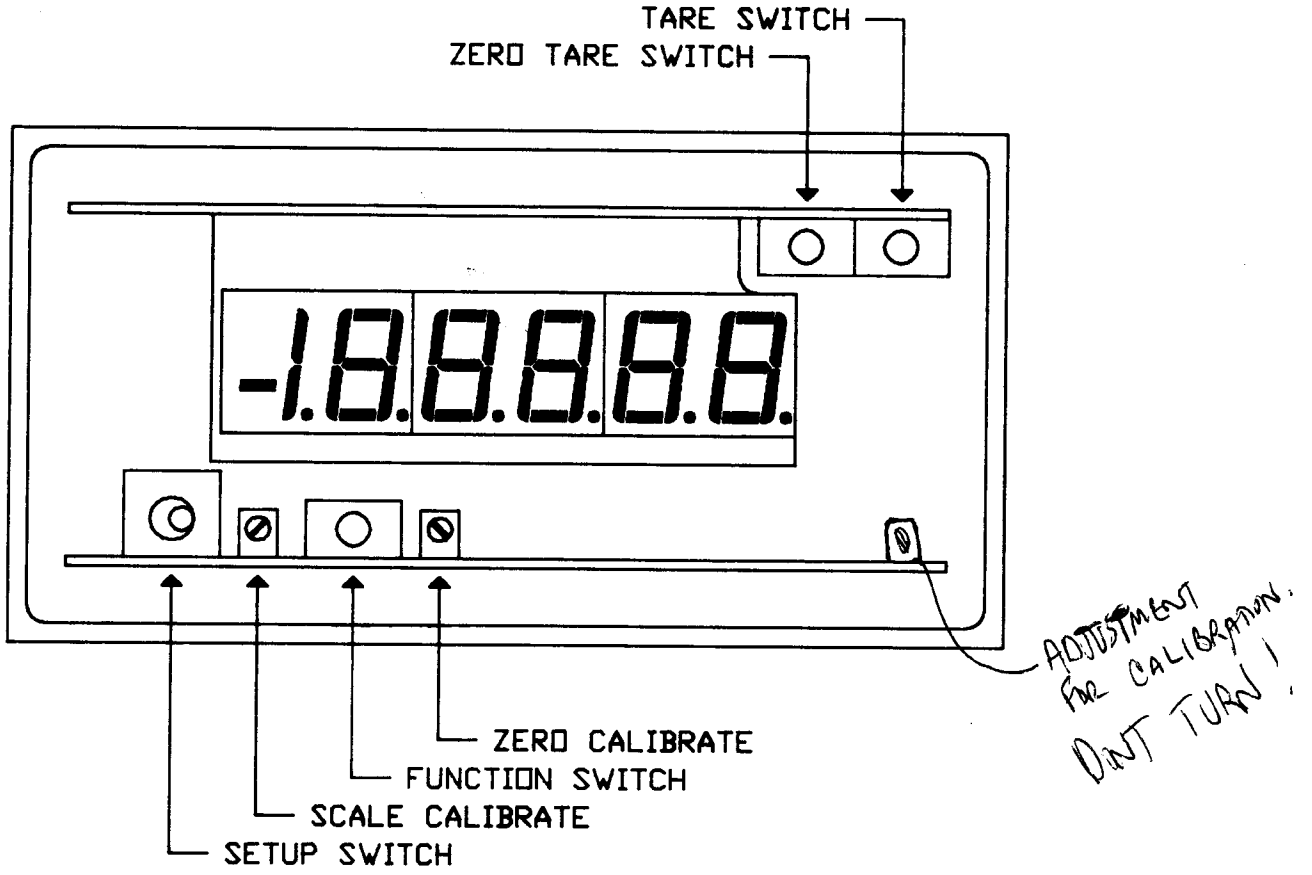
   A: Most millivolt output transducers at no load give approximately zero mV output. Adjust zero calibrate to zero display, (because zero calibrate is slight adjustment if you cannot zero display with zero calibrate use tare button.

   B: Most voltage ouput transducers (1-6Vdc, 1-5Vdc, and 1-11Vdc are common) at no load give 1 volt output. Use tare to zero display. (For slight zero adjustments use zero calibrate potentiometer).

   C: Most transmitters are 4-20mA output. At zero load the output is approximately 4mA. Use tare to zero display. (For slight adjustments use zero calibrate potentiometer).

6. Select appropriate span in setup mode as outlined on page 3.

7. Meter is now scaled. If you want to check the span with a calibrated know load or simulate transducer output with a voltage, current, or millivolt source, use the full scale adjustment screw to tweak in correct display.



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	APPROVED L Klusman
DRAWING NUMBER 89-0005-20	DATE NOV 6, 1987
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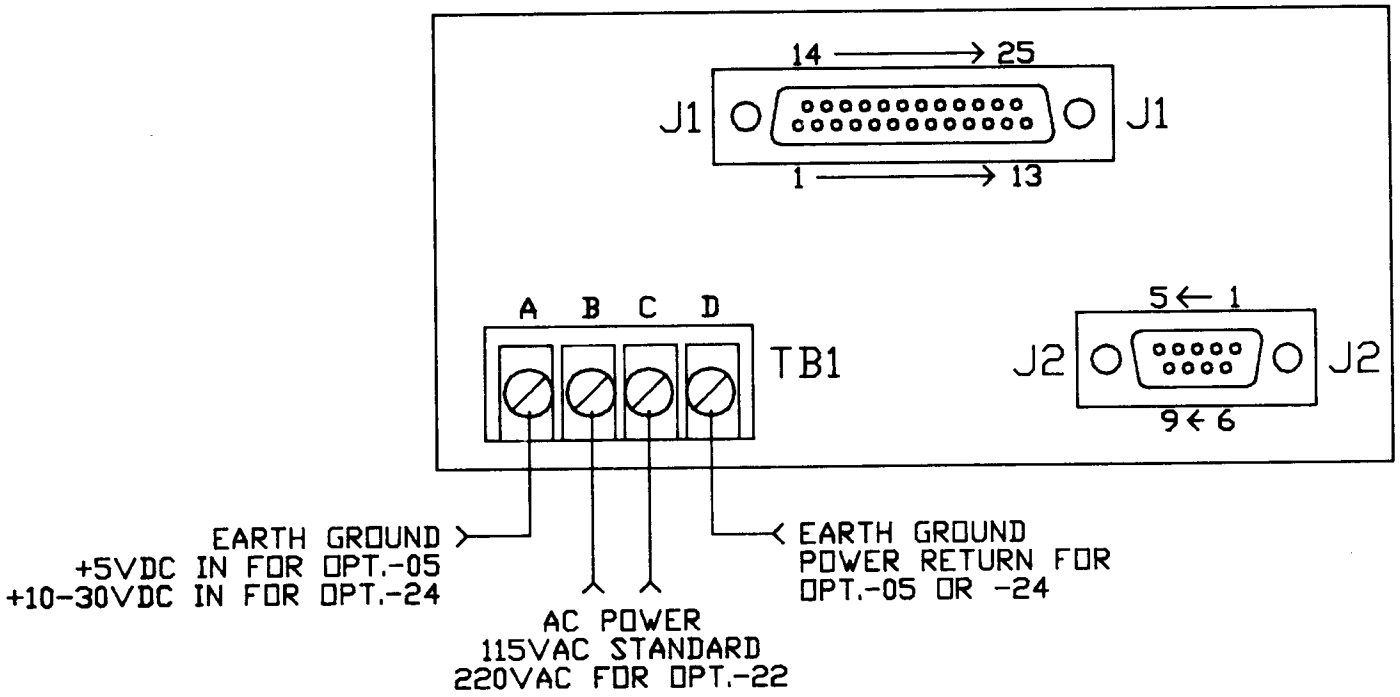
	CHANGED BY:



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	APPROVED L Klueman
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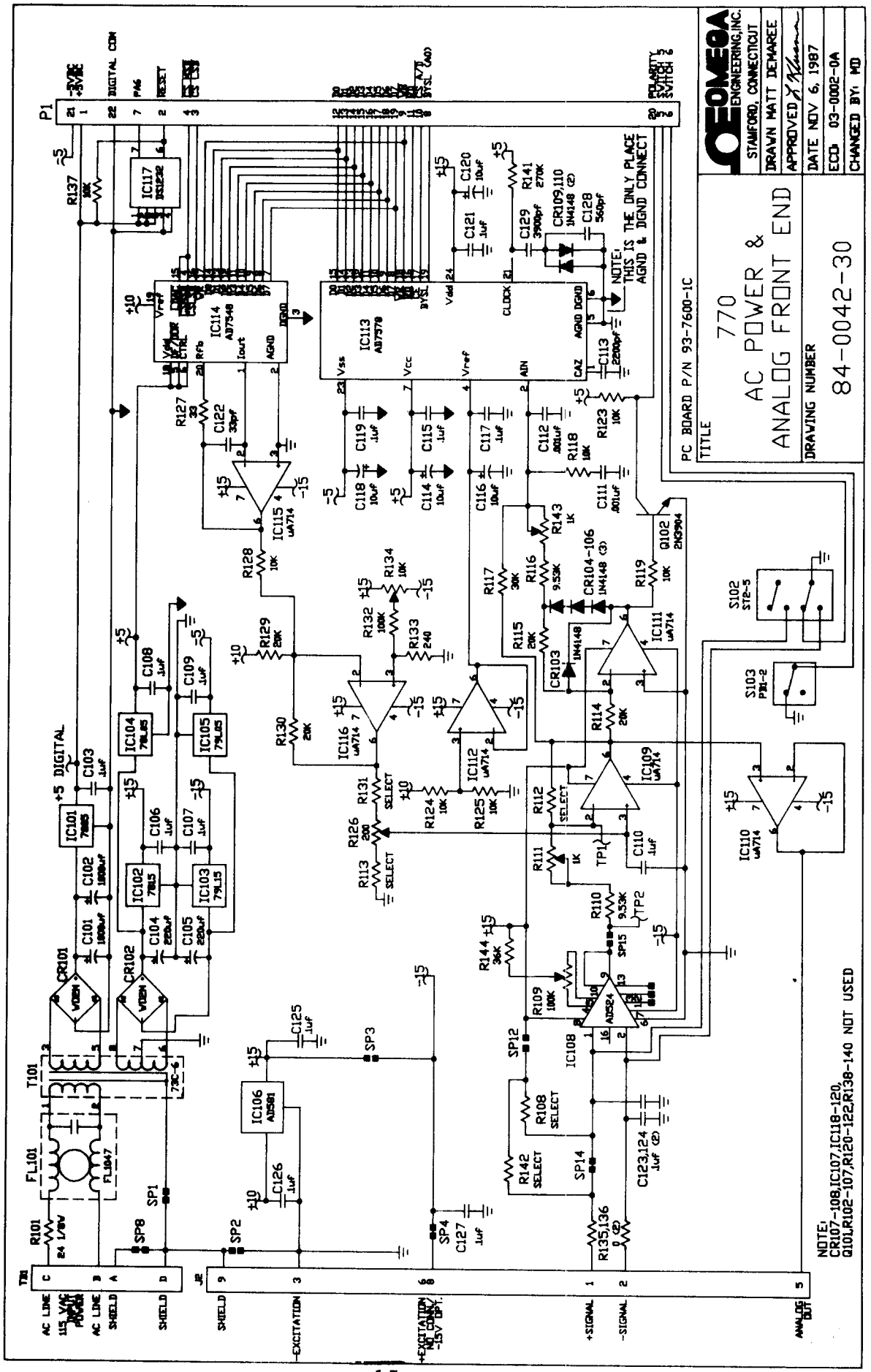
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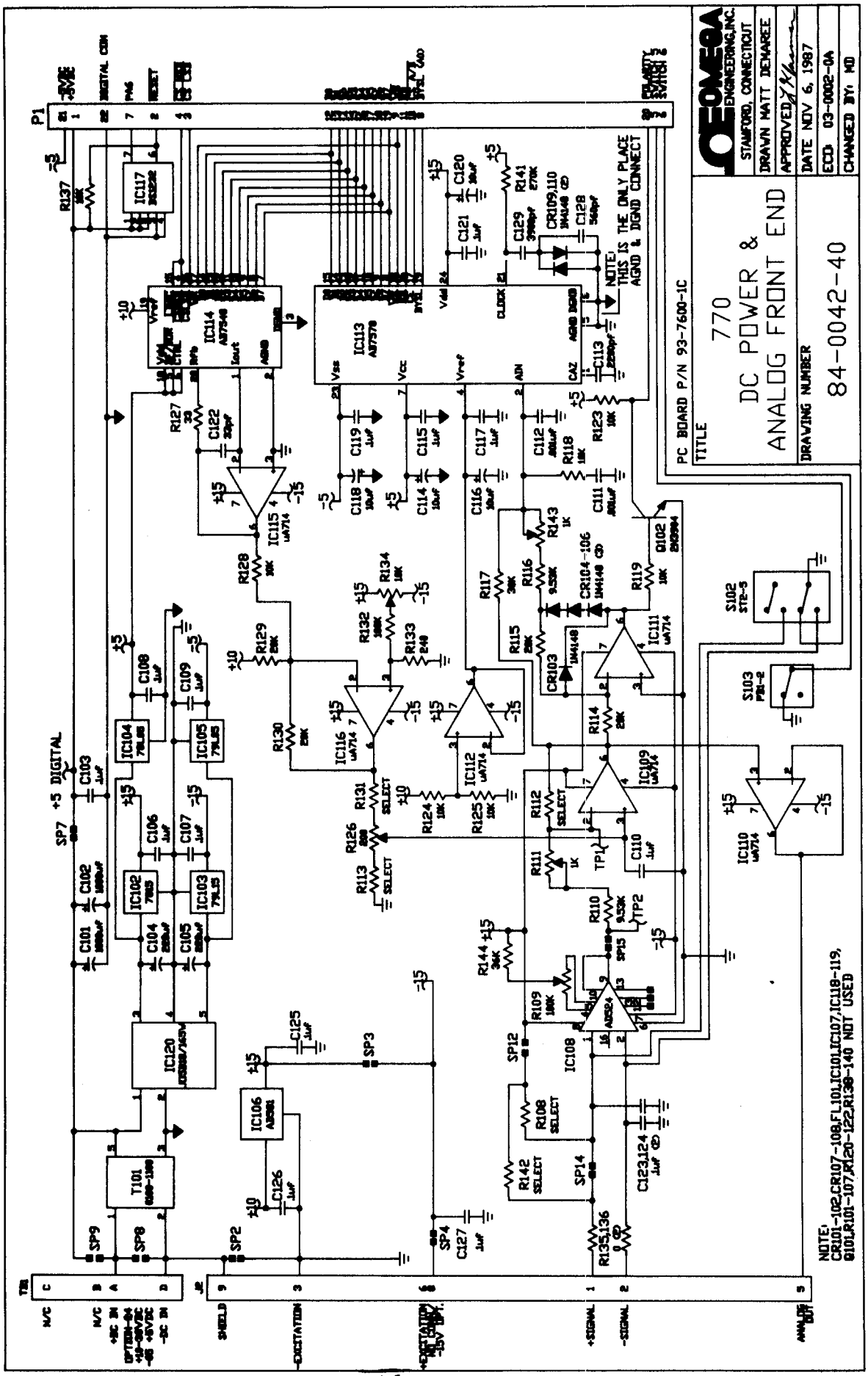
STAMFORD, CONNECTICUT
DRAWN MATT DEMAREE
APPROVED
DATE NOV 6, 1987
ECO# 03-0002-0A
CHANGED BY: MD
PC BOARD P/N 93-7600-1C
TITLE
770
AC POWER &
ANALOG FRONT END
DRAWING NUMBER
84-0042-30
NOTE! THIS IS THE ONLY PLACE AGND & DGND CONNECT
NOTE!
CR107-108,IC107,IC118-120,
Q101,R102-107,R120-122,R138-140 NOT USED
+5 DIGITAL
AC LINE
SHIELD
EXCITATION
+SIGNAL
-SIGNAL
ANALOG OUT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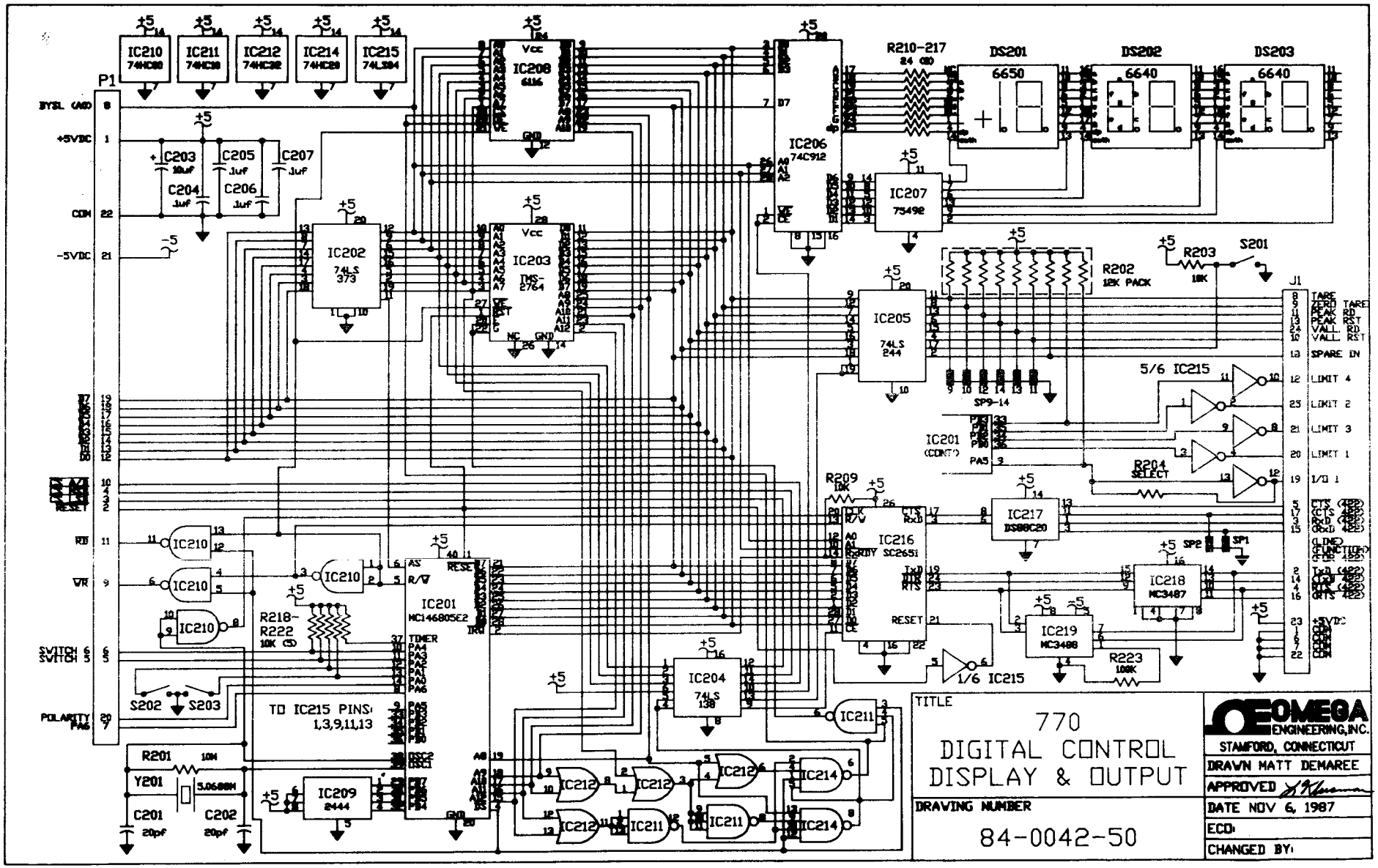
STAMFORD, CONNECTICUT
DRAWN MATT DEMAREE
APPROVED
DATE NOV 6, 1987
ECO# 03-0002-0A
CHANGED BY: MD
PC BOARD P/N 93-7600-1C
TITLE
770
DC POWER &
ANALOG FRONT END
DRAWING NUMBER
84-0042-40
NOTE: THIS IS THE ONLY PLACE AGND & DGND CONNECT
NOTE: CR101-102,CR107-108,FL101,IC101,IC107,IC118-119, R101,R101-107,R120-122,R139-140 NOT USED
+5 DIGITAL
SHIELD
EXCITATION
+EXCITATION
-EXCITATION
+SIGNAL
-SIGNAL
ANALOG OUT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IC212 74HC32
IC214 74HC20
IC215 74LS04
IC208 6116
IC206 74C912
IC207 75492
R210-217
DS201 6650
DS202 6640
DS203 6640
IC202 74LS 373
IC203 TMS-2764
IC205 74LS 244
R202 12K PACK
R203 10K
S201
J1
TARE
ZERO TARE
PEAK RD
PEAK RST
VALL RD
VALL RST
SPARE IN
LIMIT 4
LIMIT 2
LIMIT 3
LIMIT 1
I/O 1
CTS
RxD
+5VDC
5/6 IC215
SP9-14
IC201 (CONT)
R204 SELECT
R209 10K
IC216 SC2651
IC217 DS8C20
IC218 MC3487
IC219 MC3486
SP2
SP1
1/6 IC215
R223 100K
IC201 MC146805E2
R218-R222 10K (5)
TO IC215 PINS 1,3,9,11,13
S202
S203
IC204 74LS 138
IC209 2444
R201 10M
Y201 5.0688M
C201 20pf
C202 20pf
C203 10uf
C204 .1uf
C205 .1uf
C206 .1uf
C207 .1uf
TITLE
770
DIGITAL CONTROL
DISPLAY & OUTPUT
DRAWING NUMBER
84-0042-50
OMEGA ENGINEERING, INC.
STAMFORD, CONNECTICUT
DRAWN MATT DEMAREE
APPROVED
DATE NOV 6, 1987
ECO:
CHANGED BY:

SECTION 10

SPECIFICATIONS

ACCURACY:	±0.05% of reading ±2 counts of A/D at 25 degrees C
TEMPERATURE COEFFICIENT:	25 ppm/degrees C
RESOLUTION OF A/D:	12 bits
INPUT IMPEDANCE:	1000 Mohm (777, 776, and 772) <250 ohm 775 5 Mohm (777)
INPUT BIAS CURRENT:	±50 NA
NORMAL MODE REJECTION:	70dB
COMMON MODE REJECTION:	70dB
ROLLOVER ERROR:	±3 counts of A/D
SAMPLE RATE:	Adjustable from 62.5 to 500 samples per second for min., max., and limits.
DISPLAY AVERAGING:	Adjustable from 1 to 100 samples
I/O METHOD:	Two subminiature "D" connectors supplied for strain gage hookup RS232/RS422 interface, alarms, remote min./max. display and reset, remote tare and reset.
OUTPUTS:	4 high alarms (5VDC at 24mA) no deadband.
DISPLAY:	5 1/2 digits .56" red LED with polarity.
POWER:	115VAC 50-400Hz, 8 watts maximum. Input power via screw terminals.
INPUT FILTER:	2.5 KHz single pole passive filter.
OPERATING TEMPERATURE:	0 to 50 degrees C
CONSTRUCTION:	All aluminum case
DIMENSIONS:	2.7"H x 5.18"W x 6.75"d; 2.45" X 5.06"W cutout