INTRODUCTION

The Series 2XXC Digital Panel Meters are all based on the 200C voltmeter. This voltmeter has an accuracy of ± .01 % of reading, ± 2 counts @ 25°C. The meter has a high input impedance of 1,000Megohms at ± 5Volts DC input and a typical bias current of ± 50p Amps DC. It features external convert/ hold operation, internal solderless-jumper selection of scaling to almost any desired input, front panel Zero and Fine Scale adjust, internally/externally programmable decimal points, and 4 or 4½ digit display, with option for a dead zero to make it 5½ digits. With other options, it features: True RMS AC volts input to 50K Hertz, AC or DC amps input, DC analog output to ± 10 Volts or 2 wire 4-20mA transmitter, true TTL compatible BCD outputs, and an output latch to hold BCD data without interrupting front panel operation. The case is made of sturdy light weight aluminum, finished in textured black paint. The display is large .56" red LED's (optional green and sunlight readable LED's available) on a dark background for easy reading up to 30 feet or more.

Series 240C and 250C Voltmeter Controller:

The voltmeter controller consists of a choice of a single crossover limit (240C) or dual high and low limits (250C). It includes front panel limit(s) set by thumbwheel switches, optional polarity control by thumbwheels, crossover indicator or high and low indicators, High/(In)/Low TTL outputs and Form C relay closure(s) to drive loads to 5 Amps at 28 Volts DC at the crossover or limits. Ranges can be factory set up to 750 Volts or down to 50 millivolts.

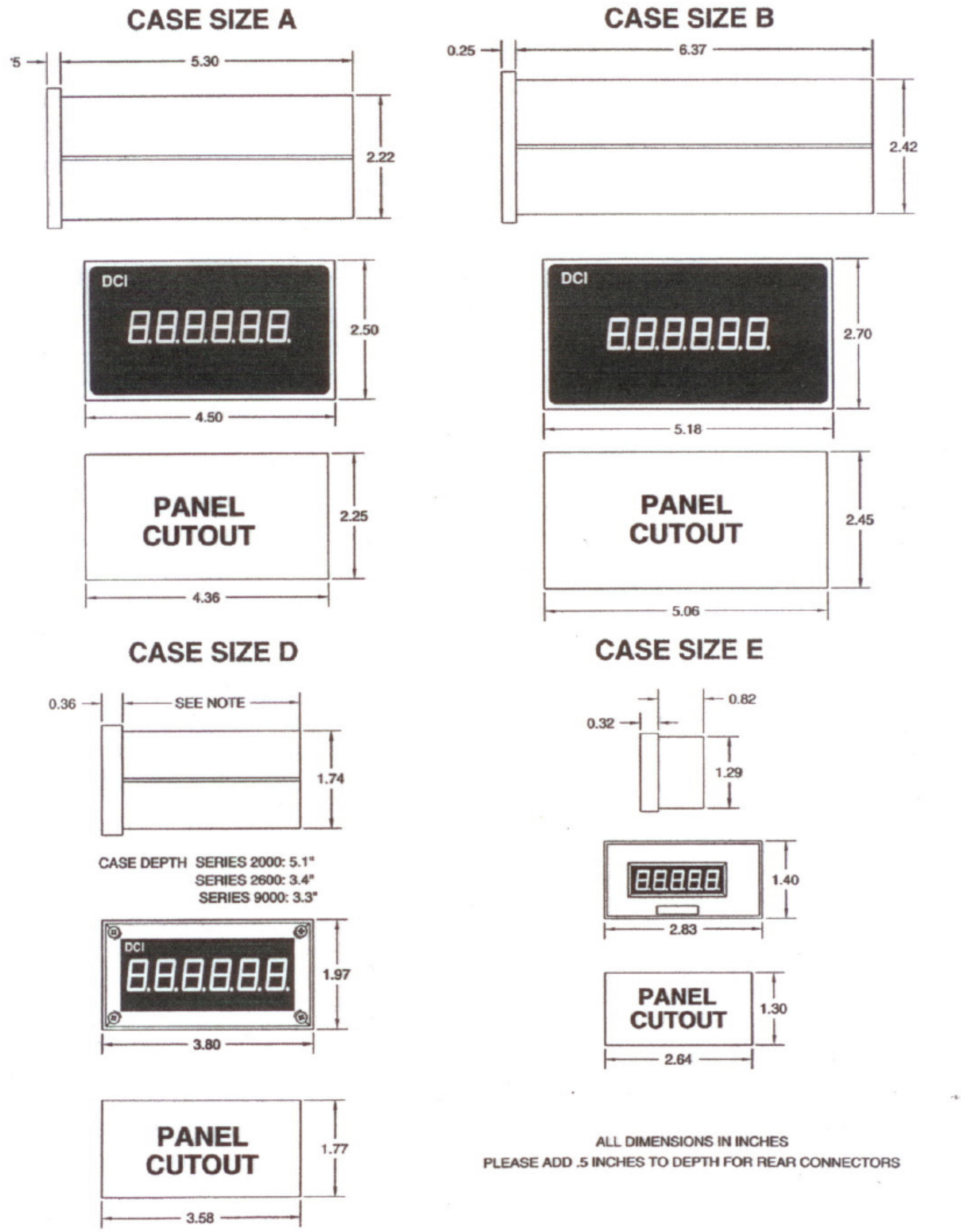
Series 210C and 220C Ohmmeter Controller:

The ohmmeter controller consists of the same crossover limit (210C) or high and low limits (220C) as the 240C and 250C, with an accuracy of ± .05% of reading, ± 2 counts @ 25°C. It includes the same High/(In)/Low TTL outputs, Form C relay closure(s) as well as most of the features and options of the basic voltmeter. The ohmmeter controller's range can be factory set from 2Ω to 2MΩ ohms, and can be configured in 2 wire hookup or 4 wire hookup for lower ohms ranges.

Series 230C Strain Gage Readout/Controller:

The strain gage readout/controller consists of the same crossover limits (231 C) or high and low limits (232C) as the 240C and 250C, and is also available with no limits (230C) like the 200C. It has an accuracy of ± .03% of reading, ± 2 counts @ 25°C. It includes the same High/(In)/Low TTL outputs and Form C relay closure(s) as well as most of the features and options of the basic voltmeter. The strain gage features selections of +5, 10, 15 or 20 Volts excitation, and optional -15 Volts excitation.

DIMENSIONS



ALL DIMENSIONS IN INCHES
PLEASE ADD .5 INCHES TO DEPTH FOR REAR CONNECTORS

REAR PANEL CONNECTORS PIN OUT AND DESCRIPTION

TB1 Connector

Pin	TB1 Connector
W	Analog input (LO)
Y	Power supply input (Power in on DC models)
Z	Power supply input (Power return on DC models)

J1 Connector

	Pin	Pin	
Analog Output	1	A	Excitation Output
Analog Ground	2	B	-15VDC Out/Optional EOC Pulse
D.P. XXX.X	3	C	D.P. XX.XX
BCD Output Latch	4	D	External Convert/Hold
Tri-State Control	5	E	BCD Bit 1 Digit 5
BCD Bit 1 Digit 4	6	F	Polarity out
BCD Bit 8 Digit 4	7	H	Over-range out
BCD Bit 4 Digit 4	8	J	BCD Bit 1 Digit 3
BCD Bit 2 Digit 4	9	K	BCD Bit 8 Digit 3
BCD Bit 1 Digit 2	10	L	BCD Bit 4 Digit 3
BCD Bit 8 Digit 2	11	M	BCD Bit 2 Digit 3
BCD Bit 4 Digit 2	12	N	BCD Bit 1 Digit 1
BCD Bit 2 Digit 2	13	P	BCD Bit 8 Digit 1
Digital Common	14	R	BCD Bit 4 Digit 1
Digital + 5VDC	15	S	BCD Bit 2 Digit 1

J2 Connector

	Pin	Pin	
"HI" Logic Output	1	A	No Connection
"LO" logic Output	2	B	No Connection
"IN" Logic Output	3	C	No Connection
NC Contact LO Relay	4	D	No Connection
NO Contact LO Relay	5	E	No Connection
C Contact LO Relay	6	F	No Connection
NC Contact HI Relay	7	H	NO Connection
NO Contact HI Relay	8	J	No Connection
C Contact HI Relay	9	K	No Connection
No Connection	10	l	No Connection
No Connection	11	M	No Connection
No Connection	12	N	No Connection
No Connection	13	P	No Connection
Digital Common	14	R	No Connection
Digital + 5VDC	15	S	No Connection
Opt 10, RS232 Rec.	16	T	No Connection
Opt 10, RS232 Com.	17	U	No Connection
Opt 10, RS232 Trns.	18	V	No Connection
Opt 10, Setup	19	W	No Connection
Relay latch	20	X	No Connection
Opt 10, Request Data	21	Y	No Connection
No Connection	22	Z	No Connection

Note: J2 is not installed on all models. Connections 14-19 & 21 on J2 are valid only for models with option -10. To program the first and second decimal points from the rear, tie pin 3 or C of J1 to Digital + 5VDC, pin 15 of J1. To program decimal points internally, jumper solder pad 3, 4, 5, or 6 on the bottom of the PC board. These pads are located near the display hang down board (see the "Adjustments Locators" section).

200C, 240C, 250C
SETUP AND OPERATIONS

Do not apply power until the unit is completely installed.
Power input lines are to be connected to pins Y and Z of TB1 on the rear of the unit. For units with DC input power options, power in is on TB1-Y and return is on TB1-Z.

Analog input HI is attached to TB1-X and LO to TB1-W.

Any other desired or used input or outputs are connected to J1 and J2 (J2 not included on 204C and 205C) as shown in the Rear Panel Connectors Pin Out and Description page of this manual (page 8).

On applicable units, the limit(s) must be set. Note that the high limit output does not switch until the value of the display reading is more positive than the value of the limit setting; and the low limit output does not switch until the value of the display reading is more negative than the value of the limit setting. I.E. On a unit with high and low limits set at high limit = + 16965 and low limit = -4238; the following table would be true of the logic output condition.

Display Reading	Hi, In, or Low Condition
0000	In
+16965	In
+ 16966	Hi
- 4238	In
- 4239	Low

Note that it is invalid to set the low limit greater than the high limit on dual limit units. On single limit units, the single limit operates like the high limit.

Now with power applied, the unit should begin operation (unless convert/hold is held low, in which case it must be released to begin operation). If unit does not appear to come on, check power supply lines for correct power applied. Check rear panel connectors for correct installation and orientation. Try operating unit without J1 and J2 to determine if something may be wired wrong. If all attempts fail, contact DCI (see front cover).

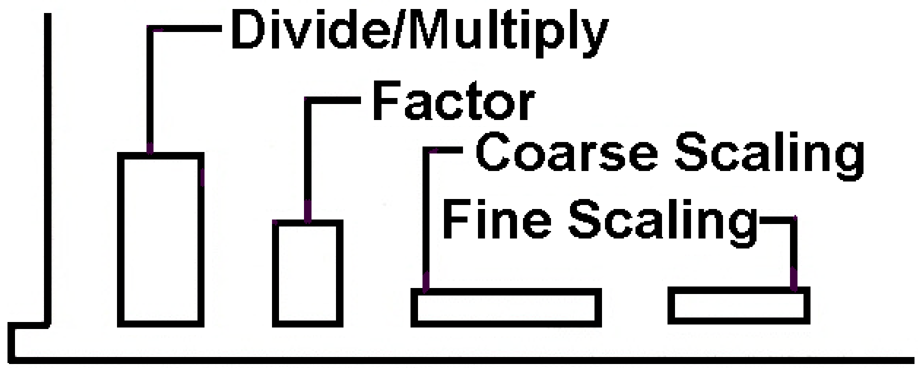
Note that the unit may require 20 to 30 minutes of warm up time to completely stabilize and give fully accurate readings.

Once unit is running in a system, fine adjustments may be made to the zero and scale via two pots located in the upper right corner behind the lens.

If more coarse adjustment is needed, see the field adjustments section to follow.

FIELD ADJUSTMENTS

In adjusting the input of the 200C, there will be 4 sets of jumpers used. The jumpers are located in the back corner of the board next to the Terminal Block and will be referred to as follows:



The page immediately following this Field Adjustments section is a field adjustments calculation page. It is recommended that this page be copied and used to keep track of the adjustment calculations and results. If there are any analog output options installed, the results of the input calibration will be needed to setup these options.

For use in equations and calculations, the desired full scale input voltage will be referred to as "S", and the display reading, disregarding any decimal point, at voltage "S" will be referred to as "D". Following are the equations to setup the 200C. The boxes along the right hand side are an example to follow. In the example, the customer wants the display to read 36.00 for an input voltage of 4.6 volts. Note that D will be <u>3600</u> and not 36.00.

Using "D" & "5", solve the following equation:

> (20,000/D) * S = Scale Volts ("SV")

D=3600 & S=4.6
(20,000/3600) *4.6 = 25. 56Volts

Now using "SV", determine from the
following table, whether to Multiply or Divide, and by what Factor ("F").

If SV is between	Div/Mult		Factor
100 to 750V	**Divide**	**by**	**100**
10 to 99.99V	**Divide**	**by**	**10**
1 to 9.999V	**Multiply**	**by**	**1**
. 1 to .9999V	**Multiply**	**by**	**10**
.05 to .09999V	**Multiply**	**by**	**100**

SV = 25.56 Volts
Div/Mult = Divide
Factor = 10

Set the Divide/Multiply jumper (3 pair jumper) and the Factor jumper on the board according to the previous calculation and table.

Now solve one of the following equations according to whether the Divide/Multiply jumper is in the Dividing or Multiplying position.

If Dividing, solve this equation:

Div/Mult = Divide
10/25.56V=0.3912

> **F/SV = Scaling ("SC")**

If Multiplying, solve this equation:

> **1/(F * SV) = Scaling ("SC ••)**

The resultant of this equation must be less than or equal to 1. If not, then recheck calculations since this may indicate an error.

The next step is to round off the scaling to two decimal places, second place even.

i.e. 0.2633 → 0.26 0.6700 → 0.68

$\boxed{0.3912 \rightarrow 0.40}$

Set the first digit into the Coarse Scaling jumper:
i.e. CS = .2 CS = .6

$\boxed{CS=.4}$

Set the second digit into the Fine Scaling jumper:
i.e. FS = .06 FS = .08

$\boxed{FS= .00}$

Attach the inputs to a voltage standard set to 0.0000 volts or short the input leads together and adjust the zero pot located at the front of the board for a display reading of zero (the pot closer to the display is zero).

Now input the desired full scale voltage either from a voltage standard or from a known source and adjust the scaling pot located at the front of the board for the desired full scale input display reading (the pot closer to the edge of the board is scaling). If the pot doesn't quite make the adjustment, it may be necessary to move the Fine Scale jumper up or down one position. Note that moving up from .08 to .00 on the Fine Scaling requires moving the Coarse Scaling up one count; and that moving down from .00 to .08 on the Fine Scaling requires moving the Coarse Scaling down one count.

It may be necessary to recheck and repeat the previous two steps (zero and scale adjustment) more than once to obtain optimum calibration.

CALCULATIONS

Full Scale input voltage?........................ | |

Display reading at "S"? ………………….. | |

> (20,000/D) *S = Scale Volts "SV"

? (20,000/______) *______=.................. | |"

Divide or Multiply? ……………………….. | | ="D/M"

Factor? .... | | ="F"

If "D/M" = D
> F/SV = Scaling "SC"

? _________/________=………………… .. | | ="SC"

If "DIM" = M
> 1/(F * SV) = Scaling "SC" I OR~

? 1/(________/_________)=……………… | | ="SC"

Coarse Scaling?.................................... | | ="CS"

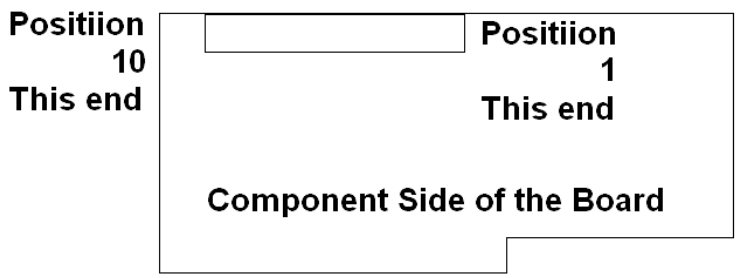
Fine Scaling?... | | ="FS"

This area is for calculating.

This area reserved for analog output options calculations.

OPTION-08ADJUSTMENT
(4-20 milliamps OUTPUT)

The 4-20 milliamps option board has an adjustment range of from 200 counts to 20,000 counts of display change is equal to 4-20 milliamps output. The zero is also adjustable over a wide range so that 4 milliamps output doesn't necessarily have to relate to a 0 volt input, although the 20 milliamps output will represent the more positive input voltage. On the 4-20 milliamps output option board, there is a jumper which is numbered as follows:



Using the variables and values from the input adjustment, solve one of the following equations for "P" to determine the option board jumper Position:

If Dividing the input, solve this equation:
> (1.6 * F)/(S * SC * 2) = P

If Multiplying the input, solve this equation:
> 1.6/(F * S * SC * 2) = P

Set the jumper on the 4-20 milliamps output option board as follows:

If P is between:	**Set jumper in position'**
0-9	**1**
10-19	**2**
20-29	**3**
30-39	**4**
40-49	**5**
50-59	**6**
60-69	**7**
70-79	**8**
80-89	**9**
90-99	**10**

With a zero volt input to the meter, (or the voltage at which 4 milliamps output is desired), adjust the output offset pot (on the output option board, the pot which is closer to the main board) for an output of 4 milliamps out (the load being driven

must be less than 500Ω).
Now with the full scale volts input, adjust the output full scale pot (on the output option board, the pot which is further from the main board) for 20 milliamps out.
This process of adjusting offset and scale may have to be repeated more than once to obtain optimum calibration. Fine tuning adjustments may be made through the lens, (see the "Adjustments Locators" section).

OPTION-09 ADJUSTMENT (ANALOG OUTPUT)

The analog output option board has an adjustment range of from 200 counts to 20,000 counts of display change equals 0 to 10 volts out. The zero is also adjustable over a wide range so that a 0 volt input doesn't necessarily have to generate a 0 volt output, although the +10 volts output will still represent the more positive input voltage.

For use in the following equations, the desired output voltage at full scale input voltage "S", will be referred to as "W" and the output voltage at 0 volts input will be referred to as "Z". Using the variables and values from the input adjustment, solve one of the following equations for "P" to determine the analog output option board jumper Position:

If you are Dividing the input:

> ((W - Z) * F)/(S * SC * 2) = P

If you are Multiplying the input:

> (W - Z)/(S * F * SC * 2) = P

Now set the jumper position on the analog output option board as follows:

If P is between:	Set jumper in position:
0-19	1
20-39	2
40-59	3
60-79	4
80-99	5

Apply a zero volt input to the meter and adjust the analog output zero pot (on the output option board, the pot which is closer to the main board) for the desired output voltage “Z".

Now apply the full scale input voltage to the meter and adjust the analog output scaling pot (on the output option board, the pot which is further from the main board) for the desired output voltage "W".

This process of adjusting zero and scale may have to be repeated more than once to obtain optimum calibration. Fine tuning adjustments may be made through the lens, (see the" Adjustments Locators" section).

OPTION-16 ADJUSTMENT
(4-20 milliamps INPUT)

The adjustment of the 4-20 milliamps input will depend upon the value of the dropping resistor used. This will be the value of R301 on standard units, or R502 on differential units and will always be less than 100Ω.

In the following equation, the value of the dropping resistor will be referred to as "R". Calculate the following equation to determine "S" for use in the setup procedure.

> 0.016 * R = S

Now using the value of "S", setup the Factor, Divide/Multiply, Coarse Scale, and Fine Scale jumpers according to the Field Adjustments section found on pages 10-12; however, do not attempt to power up and calibrate the unit at this point. One additional component, R225, must be calculated and installed. In the following equation, "R" is again the value of the dropping resistor. Calculate the following equation using the values from the setup. The resultant, R225, will be in KΩ's.

> (SC + .5) * (120,000/D) = R225 (in KΩ's)

Use a high tolerance resistor, 1 % or better, as close as possible to the calculated value of R225. Install R225 in it's slot located immediately behind the adjustment pots at the front of the board.

Apply power and attach the inputs to a 4 milliamps current source. Adjust the display for a reading of zero using the zero pot located at the front of the unit (the pot closer to the display is the zero pot). If the display doesn't quite adjust to zero, it may be necessary to go to a slightly higher or lower resistor value for R225. If the display is still reading positive, decrease R225's value, and if the display is too negative, increase R225's value.

Now input a 20 milliamps current source, and adjust the display for the desired full scale reading using the scaling pot located at the front of the unit (the pot closer to the edge of the board is the scaling pot). If the pot doesn't quite make the adjustment, it may be necessary to move the Fine Scale jumper up or down one position. Note that moving up from .08 to .00 on the Fine Scaling requires moving the Coarse Scaling up one count; and that moving down from .00 to .08 on the Fine Scaling requires moving the Coarse Scaling down one count.

It may be necessary to recheck and repeat the previous two steps (zero and scale adjustment) more than once to obtain optimum calibration.

OPTION-17 ADJUSTMENT
(True RMS AC INPUT)

Adjustment of this option will follow the Field Adjustments procedure for the 200C, 240C, & 250C, which is covered on pages 10-12. There are only two exceptions to this procedure. The first exception is the substitution of the following table for the Divide/Multiply & Factor table on page 4.

If SV is between	Div/Mult		Facto
700 to 2000	**Divide**	**by**	**1000**
70 to 700	**Divide**	**by**	**100**
7 to 70	**Divide**	**by**	**10**
.7 to 7	**Multiply**	**by**	**1**
.07 to .7	**Multiply**	**by**	**10**
.05 to .07	**Multiply**	**by**	**100**

Note that any references to voltages will be to the RMS AC voltage and <u>not</u> the peak voltage. To convert peak-to-peak AC voltage to RMS, divide Vp-p by 2.828.

i.e. 326Vp-p = 326/2.828 Vrms = 115Vrms

The second exception is to the board jumpers (1,10,100,1000); the factors all divide by ten. When a factor 100 is called for by the equations and tables, the <u>1000</u> jumper position must be used. If a factor of 10 is called for, the <u>100</u> jumper position must be used; and when a factor of 1 is called for, the <u>10</u> jumper position must be used. If a factor of 1000 is called for by the equation and table the <u>1</u> jumper position must be used. Take note that this change is only to the physical placement of the jumper and does not change any of the equations or tables.

210C/220C
SETUP AND OPERATIONS

Do not apply power until unit is completely installed.
Power input lines are to be connected to pins Y and Z of TB1 on the rear of the unit. For units with DC input power options, power in is on TB1-Y and return is on TB1-Z.

Sense leads attach to TB1-X and TB1-W.

On units with 2 wire hookup, only the 2 sense leads are required to measure resistance. On units with 4 wire hookup, the excitation comes from connector J1 pins" A" and "2". Always connect the excitation leads to the load <u>before</u> connecting the sense leads, and disconnect the excitation leads after disconnecting the sense leads from the load. With a 4 wire hookup, connect the TB1-X lead and the J1-A lead to one side of the load and the TB1-W lead and the J1-2 lead to the other side.
Any other desired or used input or outputs are connected to J1 and J2 as shown in the Rear Panel Connectors Pin Out and Description page of this manual (page 8).

On applicable units, the limit(s) must be set. Note that the high limit output does not switch until the value of the display reading is <u>more positive</u> than the value of the limit setting; and the low limit output does not switch until the value of the display reading is <u>more negative</u> than the value of the limit setting. I.E. On a unit with high and low limits set at high limit = + 16965 and low limit = -4238; the follow table would be true of the logic output condition.

<u>Display Reading</u>	<u>Hi, In, or Low Condition</u>
0000	In
+16965	In
+16966	Hi

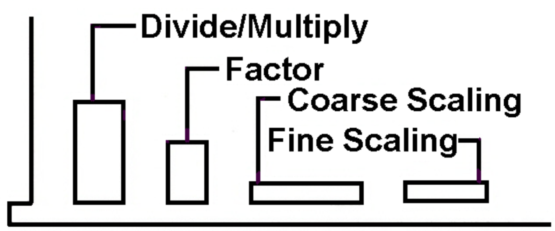
-4238	In
-4239	Low

Note that it is invalid to set the low limit greater than the high limit on dual limit units. On single limit units, the single limit acts like the high limit.

Now with power applied, the unit should begin operation (unless convert/hold is held low, in which case it must be released to begin operation). If unit does not appear to come on, check power supply lines for correct power applied. Check rear panel connectors for correct installation and orientation. Try operating unit without J1 and J2 to determine if something may be wired wrong (four wire units cannot actually measure without J1 connected, but they should still display somewhere around 0000). If all attempts fail, contact DCI (see front cover).
The unit may require 20 to 30 minutes of warm up time to completely stabilize and give fully accurate readings.
Once unit is running in a system, fine adjustments may be made to the zero and scale via two pots located in the upper right corner behind the lens. If more coarse adjustment is needed, see the field adjustments section to follow.

FIELD ADJUSTMENTS

In adjusting the input of the 210C or 220C, there will be 4 sets of jumpers used. The jumpers are located in the back corner of the board next to the Terminal Block and will be referred to as follows:



The page immediately following this Field Adjustments section is a field adjustments calculation page. It is recommended that this page be copied and used to keep track of the adjustments calculations and results. If there are any analog output options installed, the results of the input calibration will be needed to setup these options.

If your unit has the 4 wire hookup, you will need to use the set of four jumpers (1,10,100,& 1000) and the coarse zero pot on the input option board located next to the Coarse Scaling jumper.

For use in equations and calculations, the desired full scale resistance will be referred to as "R", and the display reading, disregarding any decimal points, at "R" will be referred to as "D". Following are the equations to setup the 210C or 220C. The boxes along the right hand side are an example to follow. In the example, the customer wants the display to read 36.00 for an input resistance of 5.2KΩ. Note that D equals 3.600, not 36.00.

Using "R" & "D", solve the following equation:

> (20,000/D) * R = Scale Resistance ("SR")

D = 3600 & R = 5.2KΩ
(20,000/3600 * 5200 = 28,889Ω

In the 210C or 220C the Divide/Multiply jumper will always be in the divide position. Now from the following table, determine the Factor setting and the input Option board Jumper position (if applicable). Note that an asterik "*" indicates that a four wire input is required.

If SR is between:	**Factor**	**Input Opt. Jumper 9 ("OJ"):**
1MΩ to 9.999MΩ	**1000**	**1**
100KΩ to 999.9KΩ	**100**	**1**
10KΩ to 99.99KΩ	**10**	**1**
1KΩ to 9.999KΩ	**1**	**1**
100Ω to 999.9Ω	**1**	***10**
10Ω to 99.99Ω	**1**	***10**

SR = 28,889Ω
Factor = 10, Opt.Jumper =1

Set the Divide/Multiply jumper in Divide, set the Factor jumper on the main board according to the results of the previous equation and table, and if applicable, set the input Option Jumper.
Now solve the following equation to determine the scaling:

> (F * 1000)/(SR * OJ) = SC

1(10*1000)/(28,889*1) = .3462

The resultant of this equation must be less than or equal to 1. If not, then recheck calculations since this may indicate an error.
The next step is to round off the scaling to two decimal places, second place even.

i.e. $\boxed{0.3462 \rightarrow 0.34}$ $\quad$ $0.2633 \rightarrow 0.26$ $\quad$ $0.6700 \rightarrow 0.68$

Set the first digit into the Coarse Scaling jumper:

i.e. $\boxed{CS=.3}$ $\quad$ CS = .2 $\quad$ CS = .6

Set the second digit into the Fine Scaling jumper:

i.e. $\boxed{FS = .04}$ $\quad$ FS = .06 $\quad$ FS = .08

Tie all of the inputs together, all four leads on a four wire unit and adjust the zero pot located at the front of the unit for a display reading of zero (the pot closer to the display is zero). If the zero pot will not adjust far enough to zero the display, turn the pot to the middle of its adjustment span (ten turns from either end of its adjustment span), and adjust the zero pot located on the Input Option Board for a reading of approximately zero. Now adjust the front zero pot, (the one on the main board), for a true zero reading.

Now apply the desired full scale resistance and adjust the scaling pot located at the front of the unit for the desired full scale input display reading (the pot closer to the edge of the board is scaling). If the pot doesn't quite make the adjustment, it may be necessary to move the Fine Scale jumper up or down one position. Note that moving up from .08 to .00 requires moving the Coarse Scale up one count; and that moving down from .00 to .08 requires moving the Coarse Scale down one count.

It may be necessary to recheck and repeat the previous two steps (zero and scale adjustment) more than once to obtain optimum calibration.

CALCULATIONS

Full Scale input resistance? .... [ ] = "R"

Display reading at "R"?............................ [ ] ="D"

> (20,000/D) *R = Scale Resistance "SR"

? (20,000/________) * _____________= …… [ ] ="SR"

Set Divide/Multiply in Divide Factor? …….. [ ] ="F"

If Input Option Jumper used
Input Option Jumper Value?...................... [ ] ="OJ"

> (F * 1000)/(SR * OJ) = Scaling "SC"

? (_____ *1000)/(_______ * _______) = [ ] ="SC"

Coarse Scaling? …………………………… [ ] ="CS"

Fine Scaling? ……………………………… [ ]

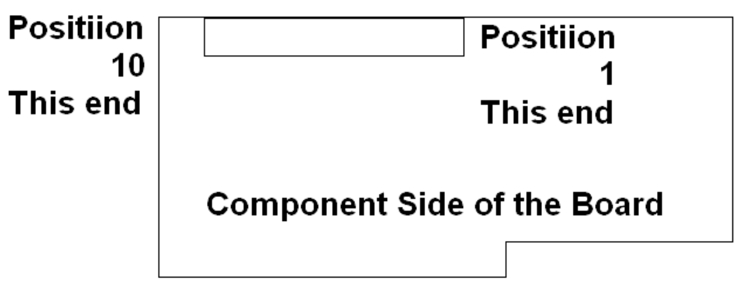
="FS"

This area is for calculating.

This area reserved for analog output options calculations.

OPTION-08 ADJUSTMENT
(4-20 milliamps OUTPUT)

The 4-20 milliamps option board has an adjustment range of from 200 counts to 20,000 counts of display change is equal to 4-20 milliamps output. The zero is also adjustable over a wide range so that 4 milliamps output doesn't necessarily have to relate to a 0Ω resistance, although the 20 milliamps output will represent the largest applied resistance. On the 4-20 milliamps output option board, there is a jumper which will be used in scaling; that jumper is numbered as follows:



Using the variables and values from the input adjustment, solve the following equation for "P" to determine the option board jumper Position:

> (1600 * F) / (R * SC * 2) = P

Set the jumper on the 4-20 milliamps output option board as follows:

If P is between:	**Set jumper in position:**
0-9	**1**
10-19	**2**
20-29	**3**
30-39	**4**
40-49	**5**

50-59	6
60-69	7
70-79	8
80-89	9
9-99	10

Short the input leads (and excitation leads on 4 wire units) together (or attach the resistance at which 4 milliamps output is desired), and adjust the output offset pot (on the output option board, the pot which is closer to the main board) for an output of 4 milliamps output (the load being driven must be less than 500Ω).
Now with the full scale resistance, attached, adjust the output full scale pot (on the output option board, the pot which is further from the main board) for 20 milliamps out.

This process of adjusting offset and scale may have to be repeated more than once to obtain optimum calibration. Fine tuning adjustments may be made through the lens, (see the "Adjustments Locators" section).

OPTION-09 ADJUSTMENT (ANALOG OUTPUT)

The analog output option board has an adjustment range of from 200 counts to 20,000 counts of display change equals 0 to + 10 volts output. The zero is also adjustable over a wide range so that a 0Ω applied resistance doesn't necessarily have to generate to a 0 volt output, although the + 10 volts output will still represent the larger applied resistance.

For use in the following equations, the desired output voltage at full scale applied resistance "R", will be referred to as "W" and the output voltage at 0Ω applied resistance will be referred to as "Z". Using the variables and values from the input adjustment, solve the following equation for "P" to determine the analog output option board jumper Position:

> ((W - Z) * F * 1000)/(R * SC * 2) = P

Now set the jumper position on the analog output option board as follows:

If P is between	Set jumper in position:
0-19	1
20-39	2
40-59	3
60-79	4
80-99	5

-Short the input leads (and excitation leads on 4 wire units) together and adjust the output offset pot (on the output option board, the pot which is closer to the main board) for the desired output voltage "Z".

Now with the full scale resistance attached, adjust the output full scale pot (on the output option board, the pot which is further from the main board) for the desired full scale output voltage "W".

This process of adjusting offset and scale may have to be repeated more than once to obtain optimum calibration. Fine tuning adjustments may be made through the lens, (see the" Adjustments locators" section).

230C, 231C, 232C
SETUP AND OPERATIONS

Do not apply power until the unit is completely installed.
Power input lines are to be connected to pins Y and Z of TB1 on the rear of the unit. For units with DC power options, power in, is on TB1-Y and return is on TB1-Z.

To connect the sense lines to the strain gage connect HI to TB1-X and LO to TB1-W. The strain gage excitation source is from J 1 pin A and excitation return is on J 1 pin 2.

Any other desired or used input or outputs are connected to J1 and J2 as shown in the Rear Panel Connectors Pin Out and Description page of this manual (page 8).

On applicable units, the limit(s) must be set. Note that the high limit output does not switch until the value of the display reading is <u>more positive</u> than the value of the limit setting; and the low limit output does not switch until the value of the display reading is <u>more negative</u> than the value of the limit setting. I.E. On a unit with high and low limits set at high limit = + 16965 and low limit = -4238; the follow table would be true of the logic output condition.

Display Reading	Hi, In, or Low Condition
0000	In
+16965	In
+16966	Hi
-4238	In
-4239	Low

Note that it is invalid to set the low limit <u>greater</u> than the high limit on dual limit units. On single limit units, the single limit acts like the high limit.

Now with power applied, the unit should begin operation (unless convert/hold is held low, in which case it must be released to begin operation). If unit does not appear to come on, check power supply lines for correct power applied. Check rear panel connectors for correct installation and orientation. Try operating unit without J1 and J2 to determine if something may be wired wrong (four wire units cannot actually measure without J1 connected, but they should still display somewhere around 0000). If all attempts fail, contact DCI (see front cover).

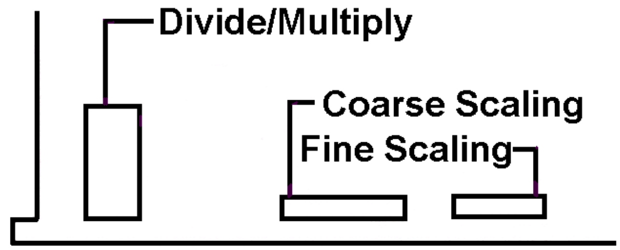
The unit may require 20 to 30 minutes of warm up time to completely stabilize and give fully accurate readings.

Once unit is running in a system, fine adjustments may be made to the zero and scale via two pots located in the upper right corner behind the lens.

If more coarse adjustment is needed, see the field adjustments section to follow.

FIELD ADJUSTMENTS

In adjusting the input of the 230C, there will be 3 sets of jumpers used. The jumpers are located in the back corner of the board next to the Terminal Block and will be referred to as follows:



The page immediately following this Field Adjustments section is a field adjustments calculation page. It is recommended that this page be copied and used to keep track of the adjustments calculations and results. If there are any analog output options installed, the results of the input calibration will be needed to setup these options.

You will need to use the set of four jumpers (1,10,100,& 1000) and the coarse zero pot located on the input option board which is located next to the Coarse Scaling jumper.

For use in equations and calculations, the desired full scale voltage will be referred to as "5", and the display reading at "5", disregarding any decimal points, will be referred to as "D". Following are the equations to setup the 230C. The boxes along the right hand side are an example to follow. In the example, the customer wants the display to read 36.00 for an input voltage of 62 millivolts. Note that D equals <u>3600</u>, not 36.00.

Using “S" & “D”, solve the following equation:

D = 3600 & S = 62mV (20,000/3600) * 62mV = 344.44mV

(20,000/D) * S = Scale Voltage (“SV”)

For this option, the Divide/Multiply jumper will always be in the divide position. Now from the following table, determine the Input Option Board Jumper setting and the input option board jumper position.

If SV is between:	**Input Option Board Jumper “OJ”:**
1V to 9.999V	**1**
100mV to 999.9mV	**10**
10mV to 99.99mV	**100**
5mV to 9.999mV	**1000**

SV = 344.4mV Option Jumper = 10

Set the Divide/Multiply jumper in Divide, set the Option Jumper on the option board according to the results of the previous equation and table.

Now solve the following equation to determine the scaling:

> **1/(SV * OJ) = SC** | 1/(344.4mV * 10) = .2904

The resultant of this equation must be less than or equal to 1. If not, then recheck calculations since this indicates an error.

The next step is to round off the scaling to two decimal places, second place even.

i.e. | **0.2904 → 0.30** | **0.2633 → 0.26** | **0.6700 → 0.68**

Set the first digit Into the Coarse Scaling jumpers:

i.e. | CS = .3 | CS = .2 | CS = .6

Set the second digit into the Fine Scaling jumpers:

i.e. | CS = .00 | FS = .06 | FS = .08

In adjusting the analog output option board, if using a voltage standard, the low input pin TB1-W must be tied to the analog common pin J1-2. If using a strain bridge, excitation supply is on pin J1-A and return is on pin J1-2.

Attach the sense leads to the voltage standard or strain bridge, whichever is being used. With a zero volt input to the meter, (or no load on the strain bridge), adjust the zero pot at the front of the unit for a display reading of zero (the pot closer to the display is zero). If the zero pot will not adjust far enough to zero the display, turn the pot to the middle of its adjustment span (ten turns from either end of its adjustment span), and adjust the zero pot located on the Input Option Board for a reading of approximately zero. Now adjust the front zero pot, (the one on the main board), for a true zero reading.

Now input the desired full scale voltage, (or apply a known load to the strain bridge), and adjust the scaling pot located at the front of the unit for the desired full scale display reading (the pot closer to the edge of the board is scaling). If the pot doesn't quite make the adjustment, it may be necessary to move the Fine Scale jumper up or down one position. Note that moving up from .08 to .00 requires moving the Coarse Scale up one count; and that moving down from .00 to .08 requires moving the Coarse Scale down one count.

It may be necessary to recheck and repeat the previous two steps (zero and scale adjustment) more than once to obtain optimum calibration.

Disconnect the LO input lead (TB 1-W) from the excitation return J 1 pin 2. Connect the sense and excitation leads to the strain bridge as indicated in the previous setup and operations section on page 23.

CALCULATIONS

Full Scale input voltage? .... [ ]

Display reading at "S"? .... [ ]

> (20,000/0) *5 = Scale Volts "SV"

? (20,000/ __________)* __________= .... [ ]

Set Divide/Multiply in Divide
Input Option Jumper Value?......................... [ ]

> 1/(SV * OJ) = Scaling "SC"

?1/(_______ * ______________) = ………… [ ]

Course Scaling?... [ ]

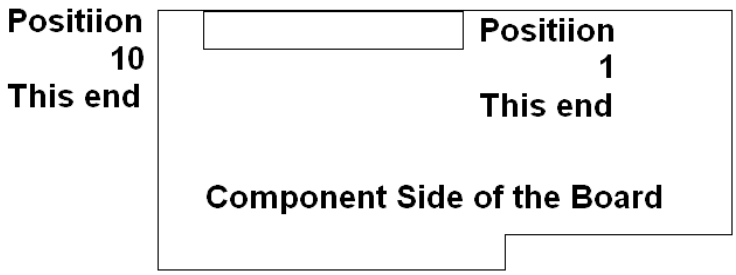
Fine Scaling? .... [ ]

This area is for calculating.

This area reserved for analog output options calculations.

OPTION-OS ADJUSTMENT
(4-20 milliamps OUTPUT)

The 4-20 milliamps option board has an adjustment range of from 200 counts to 20,000 counts of display change is equal to 4-20 milliamps output. The zero is also adjustable over a wide range so that 4 milliamps output doesn't necessarily have to relate to a 0 volt input, although the 20 milliamps output will represent the more positive input voltage. On the 4-20 milliamps output option board, there is a jumper which is numbered as follows:



Using the variables and values from the input adjustment, solve one of the following equations for "P" to determine the option board jumper Position:

> 1.6/(S * SC * OJ * 2) = P

Set the jumper on the 4-20 milliamps output option board as follows:

If P is between:	Set jumper in position:
0-9	1
10-19	2
20-29	3
30-39	4
40-49	5
50-59	6
60-69	7
70-79	8
80-89	9
90-99	10

In adjusting the analog output option board, if using a voltage standard, the low input pin TB1-W must be tied to the analog common pin J1-2. If using a strain bridge, excitation supply is on pin J1-A, and return is on pin J1-2. Attach the sense lead to the voltage standard or strain bridge, which ever is being used. With a zero volt input to the meter, (or no load on the strain bridge), adjust the output offset pot (on the output option board, the pot which is closer to the main board) for an output of 4 milliamps out (the load being driven must be less than 5000).

Now with the full scale voltage input (or the desired full load applied to the strain bridge), adjust the output full scale pot (on the output option board, the pot which is further from the main board) for 20 milliamps out.

This process of adjusting offset and scale may have to be repeated more than once to obtain optimum calibration. Fine tuning adjustments may be made through the lens, (see the n Adjustments Locators" section).

OPTION-09 ADJUSTMENT
(ANALOG OUTPUT)

The analog output option board has an adjustment range of from 200 counts to 20,000 counts of display change equals 0 to 10 volts out. The zero is also adjustable over a wide range so that 0 volts output doesn't necessarily have to relate to a 0 volt input, although the + 10 volts output will still represent the most positive input voltage.

For use in the following equations, the desired output voltage at full scale input voltage "S", will be referred to as "W" and the output voltage at 0 volts input will be referred to as "Z". Using the variables and values from the input adjustment, solve the following equation for “P” to determine the analog output option board jumper Position:

> (W- Z)/(S * SC * OJ * 2) = P

Now set the jumper position on the analog output option board as follows:

If P is between:	Set jumper in position:
0-19	1
20-39	2
40-59	3
60-79	4
80-99	5

In adjusting the analog output option board, if using a voltage standard, the low input pin TB1-W must be tied to the analog common pin J1-2. If using a strain bridge, excitation supply is on pin J1-A and return is on pin J1-2.

Attach the sense leads to a voltage standard or strain bridge, which ever is being used. With a zero volt input to the meter, (or no load on the strain bridge), adjust the output offset pot (on the output option board, the pot which is closer to the main board) for the desired output voltage “Z”.

Now with the full scale voltage input (or the desired full load applied to the strain bridge), adjust the output full scale pot (on the output option board, the pot which is further from the main board) for the desired output voltage "W".

This process of adjusting zero and scale may have to be repeated more than once to obtain optimum calibration. Fine tuning adjustments may be made through the lens, (see the" Adjustments Locators" section).

OPTION-10 OPERATION
(RS232CSerialCommunications)

Setup of the RS232C Serial Communications Interface is accomplished via the right hand set of thumbwheel switches on the front of the unit, and a setup pin located on J2 at the rear of the unit. Note that the RS232C option is not available on a 204C, 205C, 230C, 260C or a 265C. Following are the functions of each of the limit switches during setup. Once a set of conditions is programmed into the switches, pulling pin 19 of J2 low for a short time will program the new setup into the unit. This setup will be maintained until reprogrammed. The polarity switch is not used in setup.

LIMIT 1 (RIGHT SIDE)

+	D5	D4	D3	D2	D1

D5 = 0: Sets limit control, serial baud rate, and serial address.

D2 & D1, in order, make up the unit's address on the serial line. If D1 is set at 2 and D2 is set at 6, then the unit's address is 62. The address may be anywhere in the range of 00 to 99. If the address is set at 0 the unit is enabled to communicate serially with out the need for the AE command. See AE, AD and SA serial commands.

D3 sets the baud rate. There are five choices:

If D3 =0, The baud rate is 9600.
If D3 =1, The baud rate is 1200.
If D3 =2, The baud rate is 300.
If D3 =3, The baud rate is 2400.
If D3 =4, The baud rate is 4800.

D4 Sets the limit(s) mode of operation. There are three modes of operation. See LC serial command.

If D4 =0: The limit(s) mode is in standard operation.
If D4 =1: The limit(s) mode is in dual low limit operation.
In this mode the low limit is in standard operation. The high relay, LED and logic outputs energize for a display reading less than the limit setting. That is to say, the high output, relay and LED actually represent low conditions. Note that for single limit models, this mode produces a unit which switches below the limit instead of above the limit.
If D4 = 2: The limits mode is in dual high limit operation. In this mode the high limit is in standard operation. The low relay, LED and logic outputs energize for a display reading grA~tp.r than the limit setting. That is to say, the low output, relay and LED actually represent high conditions. Note that for single limit models, this mode produces the same results as standard operation.

On page 41 is a graphic representation of the operation of the limits. Please note the following when referring to the graph:
The graph is expanded at the limits to show which logic conditions are valid at the limit as well as one count below and above the limit(s).
For single limit models, the "In" logic output is invalid and there is not a "low" relay.

D5 = 1: Sets time between which the meter automatically outputs data on the serial interface (Continuous Reading).

D4 through D1 will set time in minutes and seconds, in the format of D4 tens of minutes, D3 minutes, D2 tens of seconds and D1 seconds, max time 99:99 minutes and seconds, this time will determine the delay between the continuous reading mode, this mode periodically puts out the display reading and/or time and date through the RS232 serial interfaces. See CR serial command.

D5 = 2: Sets up continuous reading format.

D2 and D1 will set the format of the serial output continuous reading.

D1 selects continuous reading time: if D1 is set to 0 then the time selected by D5 = 1 in minutes and seconds is used, if D1 is set to 1 then the reading is output on each conversion of the A/D converter and if D1 is set to 2 the readings are output every .5 seconds.

D2 sets the format of the serial output: if D2 is 0 then the A/D reading is output only. The following modes, 1 through 4 set the reading, time and date format. If D2 is 1 then the time and reading is output, if D2 is 2 then date, time, and reading is output, if D2 is 3 then date, and time is output, and if D2 is 4 then time only is output.

D3 and D4 select the legend of the output data.

D3 & 04	=	0	No Legend	11	PSI
	=	1	LBS	12	PSIA
	=	2	TEMP	13	PSIG
	=	3	C	14	RPM
	=	4	F	15	FPM
	=	5	mV	16	GPM
	=	6	V	17	MPH
	=	7	A	18	IMP
	=	8	Ohms	19	Hz
	=	9	KOhms	20	VAC
	=	10	MOhms	21	RADS

D5 = 3: Sets real time clock Seconds.

D4 through D2 will set the seconds and time mode. See ST serial command for more information.

D2 = 0 sets am time, 02 = 1 sets pm time, and D2 = 2 sets 24 hour mode.

D4 is tens of seconds, D3 is seconds.

D5 = 4: Sets real time clock hours.

D4 through D1 will set the hours and minutes. See ST serial command for more information.

D4 & D3 sets hours, and D2 & 01 sets minutes.

D5 = 5: Sets real time clock date and day of week.

D4 through D1 will set the day of the month and day of the week.

See SD serial command for more information.

D4 & D3 set day of month, D4 is tens of days, and D3 is days. D2 sets day of week 1 through 7. Sun is 1, Sat is 7.

D5 = 6: Sets real time clock year and month.

04 through D1 will set the year and month. See SD serial command.
D4 & D3 sets year where 04 is tens of years and D3 is years
D2 & D1 sets month where D2 is tens of years and 01 is units of months.

D5 = 7: Sets echo and line Feed.

D1 = 0 is Echo Off	D 1 = 1 is Echo On
D2 = 0 is line Feed Off	D2 = 1 is line Feed On

D5 = 8: Sets the remote serial command and device code.
See SC serial command for more information.

D1 (ones) & D2 (tens) = # of serial command
D3 = 1 Device Code is On
D3 = 0 Device Code is Off

D5 = 9: Send Test Message ..

Setting D5 to 9 and pulling the setup line low will enable a test message, this will send out all setup parameters either to a serial printer or computer terminal. The message is sent by pulling the setup line low a second time, this allows the limit switches to be returned to their limit value for verification in the test message.

The following commands are for communications via the RS232C port and are uppercase ASCII at the selected baud rate, each command and data must have a carriage return, leading spaces before the data is ignored. Before the command is recognized the unit must be enabled, except for the AE command which will enable the unit of which the address is selected or the address for the unit is set to O. If a unit is enabled and another AE command is sent with a different address all units without this address will be disabled.

Command'	Description:
3 AExx	Address Enable. (xx = 0 to 99)
4 ADxx	Address Disable. (xx = 0 to 99)
5 RD	Read Display. Returns the current display reading.
6 L1	Read HI Limit. Returns the current setting of the high limit switches (right hand bank on dual limit models).
7 L2	Read LO Limit. Returns the current setting of the low limit switches (left hand bank on dual limit models). This command is invalid on single limit models.
8 S 1xxxxxx	Set Limit 1. Sets the internal HI limit value between -19999 and + 19999. Use the CLx command to activate the internal limit(s). If no parameter is entered limit 1 value is returned.
9 S2xxxxxx	Set Limit 2. Sets the internal LO limit value between -19999 and + 19999. Use the CLx command to activate the Internal limits. If no parameter is entered limit 2 value is returned.
10 V1	Read Limit 1. Returns the current setting of the internal HI limit for verification.
11 V2	Read Limit 2. Returns the current setting of the internal LO limit for verification.
12 LCx	Limit Control. Performs the same function as D4 does during setup. See the setup section (page 35) for details. If no parameter is entered lc value is returned. (x = 0, 1, or 2)
13 RCx	Relay Control. If x = 0, the relays and logic outputs will operate according to the limits and display comparison. If x = 1, the relays and logic outputs will be overridden and can be controlled by the INx, LLx, and HLx commands. If no parameter is entered rc value is returned.
14 Clx	Computer Limits. If x = 0, CL is off and the front panel switch limit(s) are used in determining the logic and relay outputs. If x = 1, CL is on and the internallimit(s) set by S1 and S2 will be used for comparisons. If no parameter is entered cl value is returned.
15 VS	Verify Status. Returns three conditions: CL on or off, LC = 0, 1, or 2, and RC auto or man.
161Nx	In Logic Control. Controls the state of the "In" logic output. This command is valid only if RC is in manual mode (RCx = 1) and the unit is a dual limit unit.
17 LLx	Low Logic Control. Controls the state of the "Low" logic output (and its relay on dual limit models). This command is valid only if RC is in manual mode (RCx = 1).

18 HLx	High Logic Control. Controls the state of the "High" logic output and its relay. This input is valid only if RC is in manual mode (RCx = 1).
2 LFx	Line Feed. If x = 1, a line feed control character will be returned after a carriage return is sent by the unit or a carriage return is detected by a incoming command.
1 EHx	Echo. If x = 1 each character received by the unit is echoed out the seri.al port and must be turned on if several units are daisy changed together.
20 SAxx	Set unit address 0 to 99. If no parameter is entered the unit address is returned.
21 BRxxxx	Set :the unit baud rate entered as 9600, 1200 etc. The baud rate is changed at:the completion of the command and any return value will be garbage.
22 CRxx xx	Continuous reading, the first parameter is the time interval of the reading -1 is every atod conversion, -2 is each .5 second, 9999 is minutes and seconds, the second parameter is optional and is the display format 0 to 4, see switch settings for format. If no parameter is entered the continuous reading time and format is returned.
23 SD mm:dd:yy x	Set the real time clock month day and year in the format of mm:dd:yy, colons can be replaced by spaces. A number from 1-7 input for x will set the day of the week. If no parameters are entered the date is returned.
25 ST hh:mm:ss x	Set the real time clock time hours, minutes, seconds, and 0 = am, 1 = pm, 2 = 24hour mode. If no parameters are entered the time is returned.
19TM	Sends out the test message as described in the setup section.
26 LRxx	Enables the printing of a legend after the reading. 0 disables, 1-21 see list on page 36 and 37.
27 SCxx xx	Allows the transmission of a control code to the next unit on the line. The next unit processes this control code and executes the command indicated by the command number in the receiving unit. The first parameter is the number of the command to be processed. The command number is listed above next to the command.
28 DPx	This command allows a decimal point to be output with the reading. o = No Decimal Point 1 = 1888.8 2 = 188.88 3 = 18.888 4; =1.8888

REMOTE INPUTS ON THE COMPARATOR BOARD

Pin 19 Setup: After setting the thumbwheels with setup information, connecting this pin with pin 14 momentarily will enter the setup information into memory. This information is them stored even if power is removed.

Pin 20 Relay latch: Connecting this pin to pin 14 will cause the relays to latch when activated. Disconnecting the pin will allow the relays to change normally. This feature is standard and the unit does not need the -10 option installed for operation.

Pin 21 Request Data: Connecting this pin to pin 14 momentarily will cause the unit to output its reading over the serial port. The format of the output follows the programmed output format for reading, date and time.

Connection and Programming for using two 200C RS-232 units together with a printer

Connection

Designate one unit as a master and the other as a slave. Connect the ground of both units and the printer together.
Connect the transmit (J2-18) of the Master to receive (J2-16) of the Slave. Connect the transmit (J2-18) of the slave to receive of the printer.

Programming

In the following directions the Master and Slave are setup differently. In the switch settings shown, an x denotes a don't care setting. These settings below are the minimum that must be programmed for the units to work properly with the printer. All other settings must be programmed according to the customers requirements. For an explaination of these features please consult the appropriate commands earlier in this manual. For Master: