CCR Model 400

4-Channel MFC Power Supply/Controller Manual

CCR
Process Products

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5/08

TABLE OF CONTENTS

PRODUCT DESCRIPTION

The CCR Model 400 is a high performance, microprocessor-based 4-channel power supply/controller designed for use with Mass Flow Controllers (MFC). A linear regulator provides a low noise, foldback current limited, thermal overload protected +15Vdc and -15Vdc power supply @ 250mA each for each of the (4) MFC's. The CCR 400 accepts, user selectable 0-5Vdc, 0-10Vdc or 4-20mA input signals. It also supplies 0-5Vdc, 0-10Vdc or 4-20mA setpoint signals, for each channel, for flow control.

The firmware utilizes a Real Time Operating System (RTOS) for real time multitasking capabilities. This allows continuous monitoring of each channel's flow rates, total flow and setpoints regardless of the task being performed. A 16-bit multi-channel, high speed, sigma-delta analog-to-digital converter provides accurate flowrate data. A 32K x 8 battery backed RAM stores more than 90 Units of Measure and 190 Gas Identifiers selectable by the user. All pertinent data, required by the microprocessor at power-up to re-initialize the system, is also stored in the same RAM.

Ratio control is user selectable for master/slave operation. Channel 1 is always the master and any of the other 3 channels may be selected as slaves. This master/slave arrangement utilizes the actual flow of Channel 1 as the master signal.

The CCR400 utilizes a 4-line by 20 character back lighted LCD display. A built in Totalizer, one for each channel automatically recognizes the units of measure selected and adjusts the time base for the integrator accordingly. The user can select either Flow or Total to be displayed for each channel. When selected, the setpoint signal is displayed and can be altered via the front panel switches. Override controls for opening or closing the MFC valves are also available for each channel. Annunciator LED's display the selected valve override conditions.

Both RS232 and RS485 serial communications are available. All functions selectable from the front panel switches are also accessible via the RS232/RS485 serial ports. Only one, either RS232 or RS485, serial port is active at any one time. Selection, including a baud rate of 9600 or 19.2K, is made via the front panel switches.

Each flow channel has a high and low user programmable alarm. The alarms activate an opto-isolated open collector transistor output capable of switching 25Vdc @ 10mA.

The unit can be rack mounted using standard half-rack hardware or can be bench mounted using the retractable stand provided. Input power is selectable, via the rear panel power selector for 100, 115 or 230 Vac, 50-400 Hz.

SPECIFICATIONS

Signal Input

Number of Channels	4
Signal Type	0-5Vdc, 0-10Vdc, 4-20mA , user selectable
Input Resistance	
Voltage	>10 Megohm
Current	120 ohms

Setpoint Output (Control Signal)

Signal Type	0-5Vdc, 0-10Vdc, 4-20mA (user selectable)
Accuracy (typ)	+/-0.05% FS (Voltage), +/-0.1% FS (Current)

Analog-to-Digital Converter

Inputs	4
Technique	Sigma-Delta
Resolution	16-bit (bi-polar)
Speed (max)	100 Hz

Totalizer (Each Channel)

Technique	Integrated (Riemann Sum) Value
Time Base (Quartz Crystal)	20MHz
Accuracy (typ)	+/- 30ppm

Microprocessor

Type	80C31
Speed	20MHz
Operating System	RTOS with multitasking capabilities
Non-volatile memory	32K x 8 Battery backed Ram

Serial Communications

RS232	Bi-directional (user-selectable)
RS485	Full-duplex (user-selectable)
Baud Rate	9600 or 19.2K baud (user-selectable)

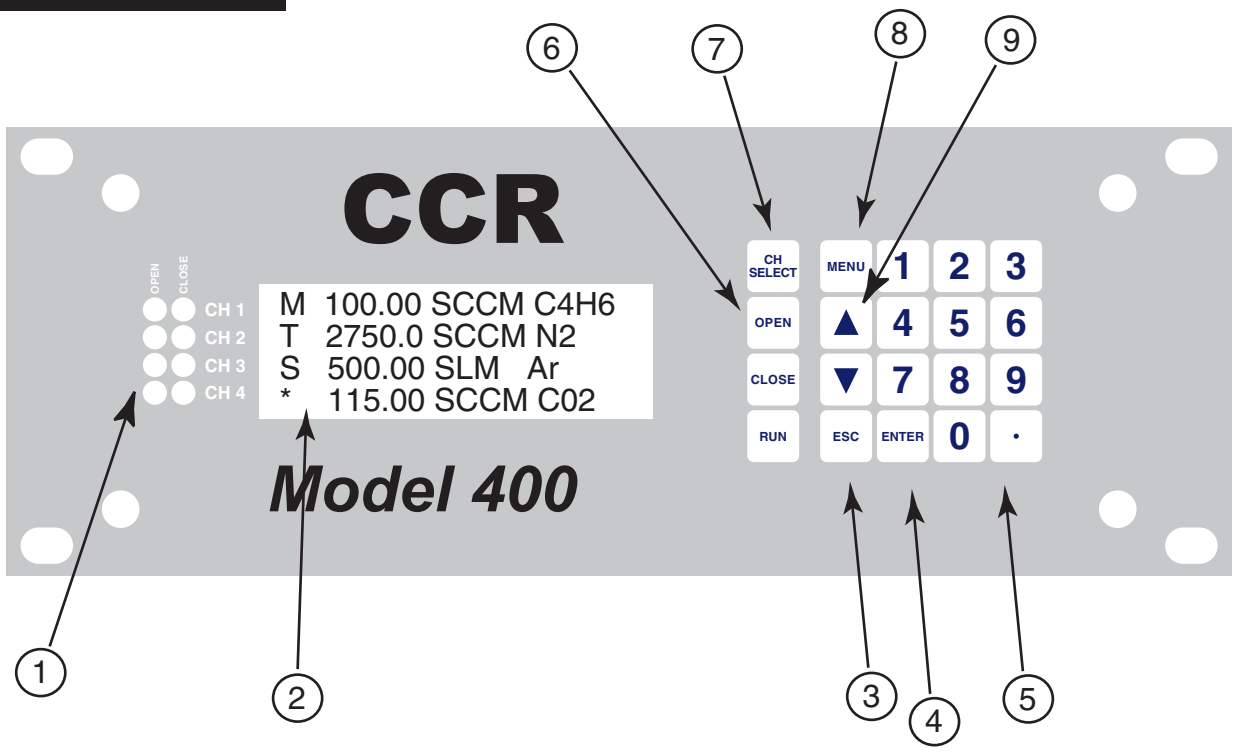
Transducer Power Supply (Each Channel)

Voltage	+/-15Vdc, +/-0.75Vdc
Current (min)	250mA

Input Power

Voltage	100/115/230 Vac, +/-10% (switch selectable)
Current (typ)	500 mA
Fuse	1 amp SLO BLO (Time Delay)

FRONT PANEL



1. ANNUNCIATORS: Displays OVERRIDE signal status of each channel. If annunciators are not illuminated, the Setpoint (Control) voltage is active.

2. DISPLAY AREA

Column 1:	Reserved for displaying (*) Active Channel, (M) Master Channel, (S) Slave Channel or (T) Totalizer.
Column 2:	Reserved for polarity indicator (minus sign for negative signal, none for positive).
Col's 3 - 8:	Actual scaled value of input signal. Displays FLOW or TOTAL in normal display mode. Displays the Setpoint (Control) value when CH SEL is depressed.
Column 9:	Space
Col's 10-14:	Units of Measure
Column 15:	Space
Col's 16-20:	Gas Identifier

3. ESC: Escape key used to exit MENU sequence without updating current settings.

4. ENTER: Key used to enter new settings.

5. KEYPAD: Used to quickly enter new settings.

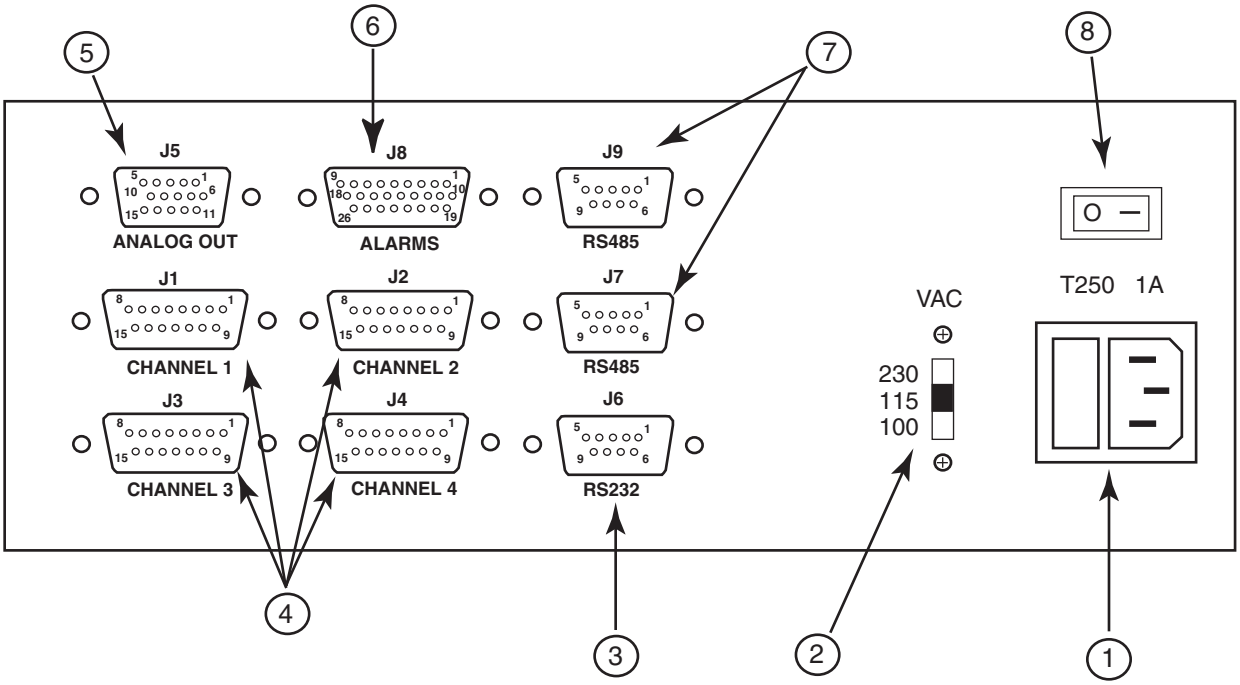
6. OVERRIDE: Used with CH SEL to override Setpoint (Control) voltage inputs with valve OPEN or valve CLOSE signals. RUN disables OPEN or CLOSE selection.

7. CH SEL: Used to scroll through Channels 1, 2, 3 and 4 to update the selected Channel's Setpoint (Control) voltage or to send the selected OVERRIDE signal.

8. MENU: Key used to enter MENU or manual setup sequence.

9. SCROLL: Used to scroll MENU selections UP or DOWN

REAR PANEL

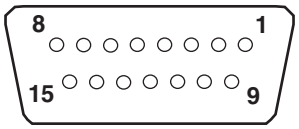


1. POWER INLET WITH FUSE (1 amp TIME DELAY or SLO BLO)
2. POWER SELECTOR SWITCH
3. RS232 SERIAL PORT (J6)
4. TRANSDUCER CONNECTORS (J1, J2, J3, J4)
5. ANALOG OUTPUT (J5)
6. ALARMS (J8)
7. RS-485 SERIAL PORT (J7, J9)
8. POWER ON/OFF SWITCH

CONNECTOR PIN DESIGNATIONS

TRANSDUCER CONNECTORS (J1, J2, J3, J4)

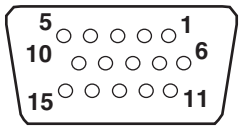
1 SIGNAL COMMON
2 SIGNAL INPUT
3 GROUND
4 VALVE OPEN
5 SETPOINT COMMON
6 -15Vdc
7 NC
8 SETPOINT SIGNAL
9 GROUND
10 GROUND
11 NC
12 VALVE OFF
13 +15Vdc
14 NC
15 NC



Transducer Connector (Female)
Rear Panel View

ANALOG OUTPUT (J5)

1 SIGNAL CH 1
2 SIGNAL COMMON CH 1
3 SIGNAL CH2
4 SIGNAL COMMON CH2
5 NC
6 NC
7 NC
8 NC
9 NC
10 NC
11 SIGNAL CH3
12 SIGNAL COMMON CH3
13 SIGNAL CH4
14 SIGNAL COMMON CH4
15 NC

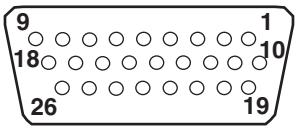


Analog Output Connector (Female)
Rear Panel View

CONNECTOR PIN DESIGNATIONS

ALARMS (J8)

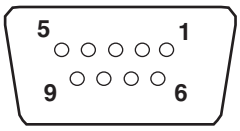
1 CH1 HIGH ALARM
2 CH 1 LO W ALARM
3 CH1 ALARM COMMON
4 CH2 HIGH ALARM
5 CH2 LOW ALARM
6 CH2 ALARM COMMON
7 NC
8 NC
9 NC
10 NC
11 NC
12 NC
13 NC
14 NC
15 NC
16 NC
17 NC
18 NC
19 CH3 HIGH ALARM
20 CH3 LOW ALARM
21 CH3 ALARM COMMON
22 CH4 HIGH ALARM
23 CH4 LOW ALARM
24 CH4 ALARM COMMON
25 NC
26 NC



Alarm Connector (Female)
Rear Panel View

RS232 (J6)

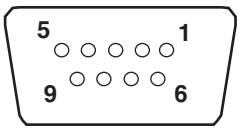
1 NC	6	DSR
2 TXD	7	NC
3 RXD	8	NC
4 DTR	9	NC
5 DIGITAL GROUND		



RS232 Connector (Female)
Rear Panel View

RS485 (J7, J9)

1 NC	6	NC
2 RXD(-)	7	RXD(+)
3 TXD(+)	8	TXD(-)
4 DIGITAL GROUND	9	NC
5 NC		



RS485 Connector (Female)
Rear Panel View

START-UP

The CCR 400 has a 100 Vac, 115 Vac or 230 Vac, 50/60 Hz power selector switch located at the rear of the instrument. Please refer to page 4 to locate this switch. Verify the power selector switch is in the proper position prior to connecting the power cable to the unit. Verify power ON/OFF switch is in the OFF position. Then perform the following steps.

1. Connect the power cable to the instrument and apply the proper input power. Do not make any other connections to the instrument.
2. Turn power ON/OFF switch ON.
3. The display will momentarily display the current version of the firmware utilized, then show the following factory default display.

   126.72 SCCM #1
   126.72 SCCM #2
   126.71 SCCM C3H6O
   126.72 SCCM C2H3N

   Note: All 4 channels should have the CLOSE annunciators illuminated. The values 126.71 and 126.72 are approximate and is the display for an open signal input . It may not correspond exactly to the display shown on this unit.

4. Change the Units of Measure and Gas Identifiers as desired. Please refer to page 10. To blank the Units of Measure select "00" then "ENT". To blank the Gas Identifier select "000" then "ENT". To blank the entire line, please refer to RS232/485 Commands, Selecting/Blanking/Reading Display on page 21.
5. The CCR 400 is factory calibrated at 0.000 and 5.000Vdc to display 0.00 and 100.00 for each channel. To change the display range, without recalibration, see MANUAL CAL/RANGE, Range(Changing Range) on page 15. To enter a Gas Correction Factor or Multiplier, refer to MANUAL CAL/RANGE, Calibrate (Multiplier) on page 16. *The factory Multiplier setting is 1.0000.*
6. The CCR 400 can accept 0-5Vdc, 0-10Vdc or 4-20mA input signals. If either 0-10Vdc or 4-20mA is required, the instrument needs to be recalibrated. Select the proper signal input for the Transducer to be used for each channel. Please refer to MANUAL SETUP, Selecting Input on page 11. Do not attempt to recalibrate the instrument at this time. *The factory Input setting is 0-5Vdc.*
7. Select Filter to optimize reading stability and conversion speed. *The factory Filter setting is 15Hz.*
8. Allow 30 minutes warm-up time.
9. Turn power ON/OFF switch OFF.
10. Connect Transducer #1 to J1 on the CCR 400 using the Connector Pin Designation information on page 5. Connect all ground connections available to the transducer. Example: If the transducer has 3 ground pins, connect all three ground pins shown on J1. All ground pins on J1, J2, J3 and J4 are common but are routed on separate wires from the connector to a ground plane on the instrument motherboard.
11. Connect Transducers #2, 3 and 4 to the instrument. The instrument is designed to provide +/-15Vdc @ 250 mA to each transducer. ***Do not use a Transducer that requires more than +/-15Vdc @ 350mA on any channel.***
12. Verify the display illuminates and the transducer readings are essentially correct. If the selected signal input for a channel is 0-5Vdc proceed to Step 11 for that channel. If the selected signal input for a channel is 0-10Vdc or 4-20mA, that channel needs to be recalibrated. Refer to MANUAL CAL/RANGE, Calibrate section pages 14 and 15 to recalibrate that channel.

13. To utilize the Setpoint (Control) voltage for MFC's, set the Setpoint voltage for each channel to the desired setting. Please refer to MANUAL SETUP, Selecting Setpoint (Control Voltage) on page 10. *The factory Setpoint default is 0.0000 for all 4 channels.*

    The Setpoint voltage, for a 0-5Vdc signal input, is calculated as follows.

    Setpoint Voltage = (Setpoint Value/Range Value) * 5.000Vdc
    Example: If the Setpoint Value = 120.00 SCCM and the Range Value is 250.00 SCCM, the Setpoint Voltage = (120.00/250.00)*5.000 = 2.400Vdc.

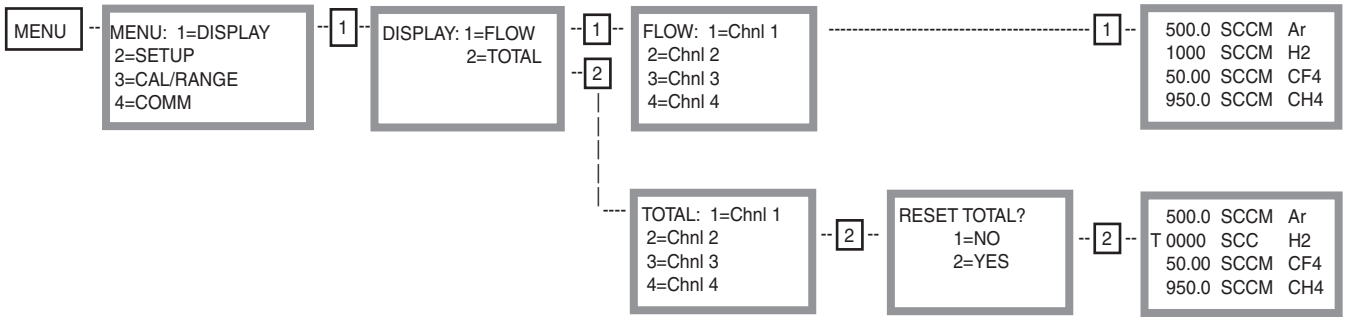
    For a 0-10Vdc signal input
    the Setpoint Voltage= (120.00/250.00)*10.000Vdc = 4.800Vdc

    For a 4-20mA signal input
    the Setpoint Current = (120.00/250.00)*16mA + 4mA = 11.68mA.

14. The Flowrate Alarms are used to monitor the flowrate of the MFC. If the flow rate is not within the selected HIGH and LOW Alarm values, an opto-isolated open collector output is activated. This output can be used to illuminate warning lights to alert the user if the Flow Controller's Setpoint (Control) voltage is not controlling the flow within a desired window. Refer to MANUAL SETUP, Selecting Alarms on page 12. *The factory default is HIGH Alarm set at 75.000, LOW Alarm at 25.000 and HYSTERESIS at 010 counts.*
15. To activate the Setpoint (Control) voltage to the MFC, select RUN for the desired channel. Reference MANUAL SETUP, Selecting Valve Override (Open, Close or Run) on page 9. *The default at power-up is Valve Close.*
16. If the Units of Measure are in flow units, the CCR 400 automatically calculates TOTAL flow using a Riemann Sum Integration method. To display TOTAL or to reset the TOTAL display, refer to MANUAL/SETUP, Selecting Display (Flow or Total) on page 9. If the Units of Measure are not in flow units, the TOTAL is not calculated or displayed.
17. The CCR 400 has both RS232 and RS485 serial communications ports. Only one port is active at any one time and is user selectable. The RS232 port has (1) 9-pin D-sub connector, while the RS485 port has (2) 9-pin D-sub connectors. All Setups described earlier can be performed using the serial communications ports. Reference RS232/485 Hookup and Commands on pages 17 through 26.

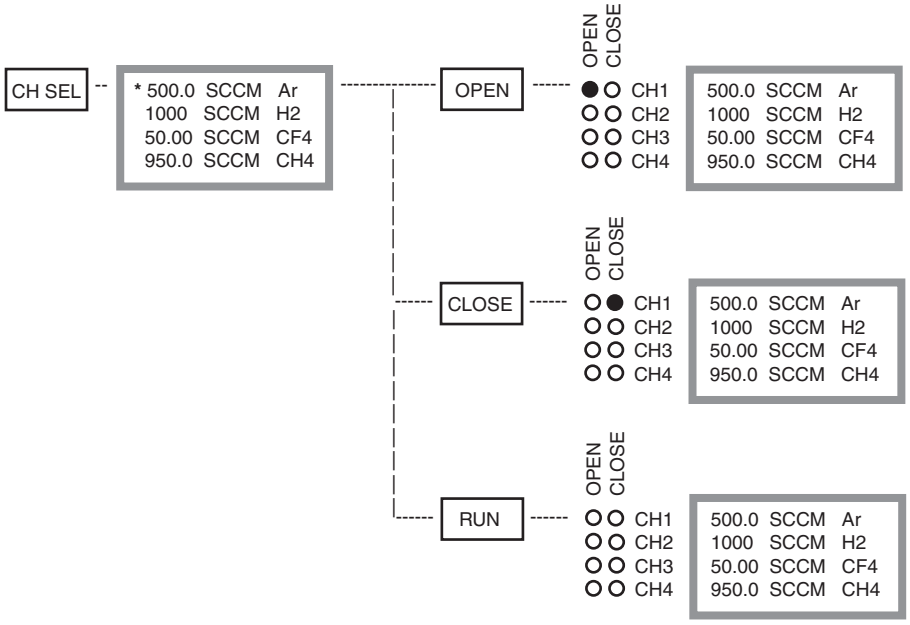
MANUAL SETUP

Selecting Display (Flow or Total)



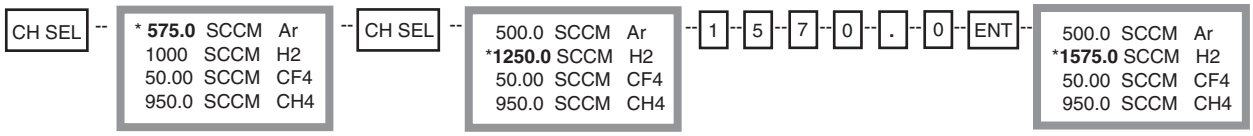
If Flow is selected, the most significant digit location will be left blank. If Total is selected, a "T" appears in this location and the Unit of Measure changes accordingly. If the Unit of Measure selected is not a flow rate unit of measure, Total will not be displayed.

Selecting Valve Overide (Open, Close or Run)



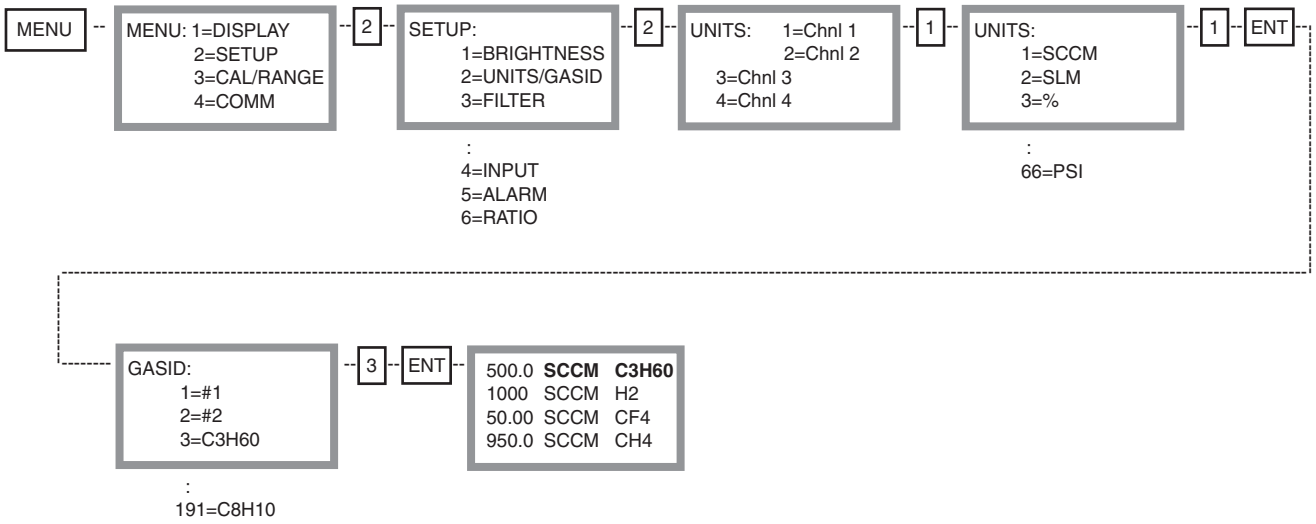
Channel 1 is shown selected above. An asterisk appears to signify the Channel selected. To select Channel 2, depress **CH SEL** switch twice, then select **OPEN**, **CLOSE** or **RUN**. If **OPEN** is selected, ground is applied to the appropriate channel connector pin-4. This ground is at the same potential as pin-9. If **CLOSE** is selected, ground is applied to pin-12. Both pin-4 and pin-12 are grounded with an open collector transistor capable of sinking 250mA at 25V. If **RUN** is selected, no override signals are sent and the MFC Setpoint control is activated.

Selecting Setpoint (Control Voltage)



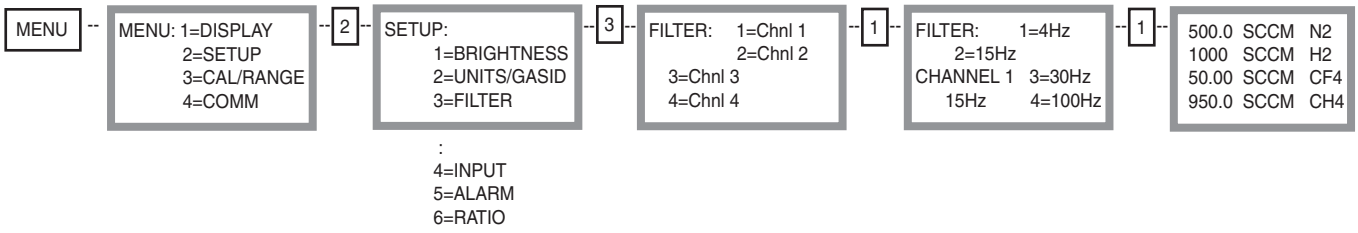
The example above shows how the setpoint for Channel 2 is changed. When **CH SEL** is depressed an asterisk points to the channel selected. To select Channel 4, depress **CH SEL** switch 4 times. The value displayed after the asterisk is the current setpoint value. Typing in a new value overrides the old value. If **ESC** is depressed instead of **ENT,** the old value is retained.

Selecting Units of Measure and Gas Identifiers



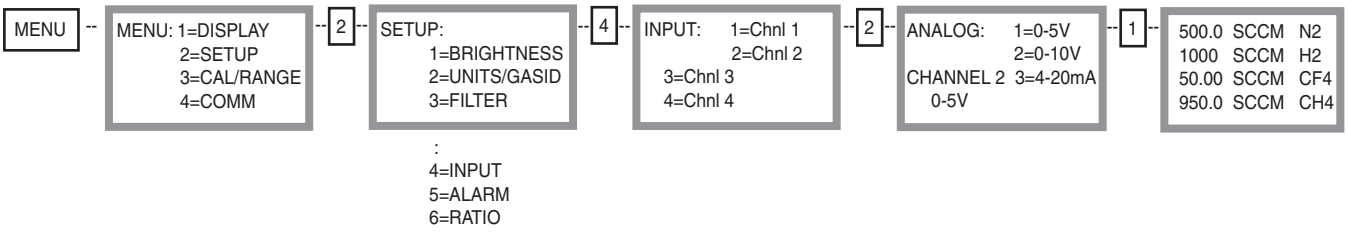
The bold characters shown in the above flow chart indicate the updated Units of Measure and Gas Identifier selected. *Note: When the Units of Measure and Gas Identifiers are selected,* **ENT** *must be depressed before the selection is made.* This is because it may require the inputting of more than 1 digit to make the desired selection.

Selecting Filter (-3db A/D Converter Filter Frequency)



The Filter selection sets the output word rate which in turn sets the corner frequency for the sigma-delta A/D converter. With an output word rate of 15Hz, the filter's corner frequency is typically 12.7Hz. The filters are optimized to settle to full accuracy every conversion and yield better than 80dB rejection for both 50 and 60Hz with output word rates at or below 15Hz. The last filter output word rate setting for the selected channel is displayed for user convenience. Each channel may be set to a different filter output word rate. The factory default is15Hz for each channel to optimize response time and noise rejection.

Selecting Input (0-5Vdc, 0-10Vdc or 4-20mA Signal Input)

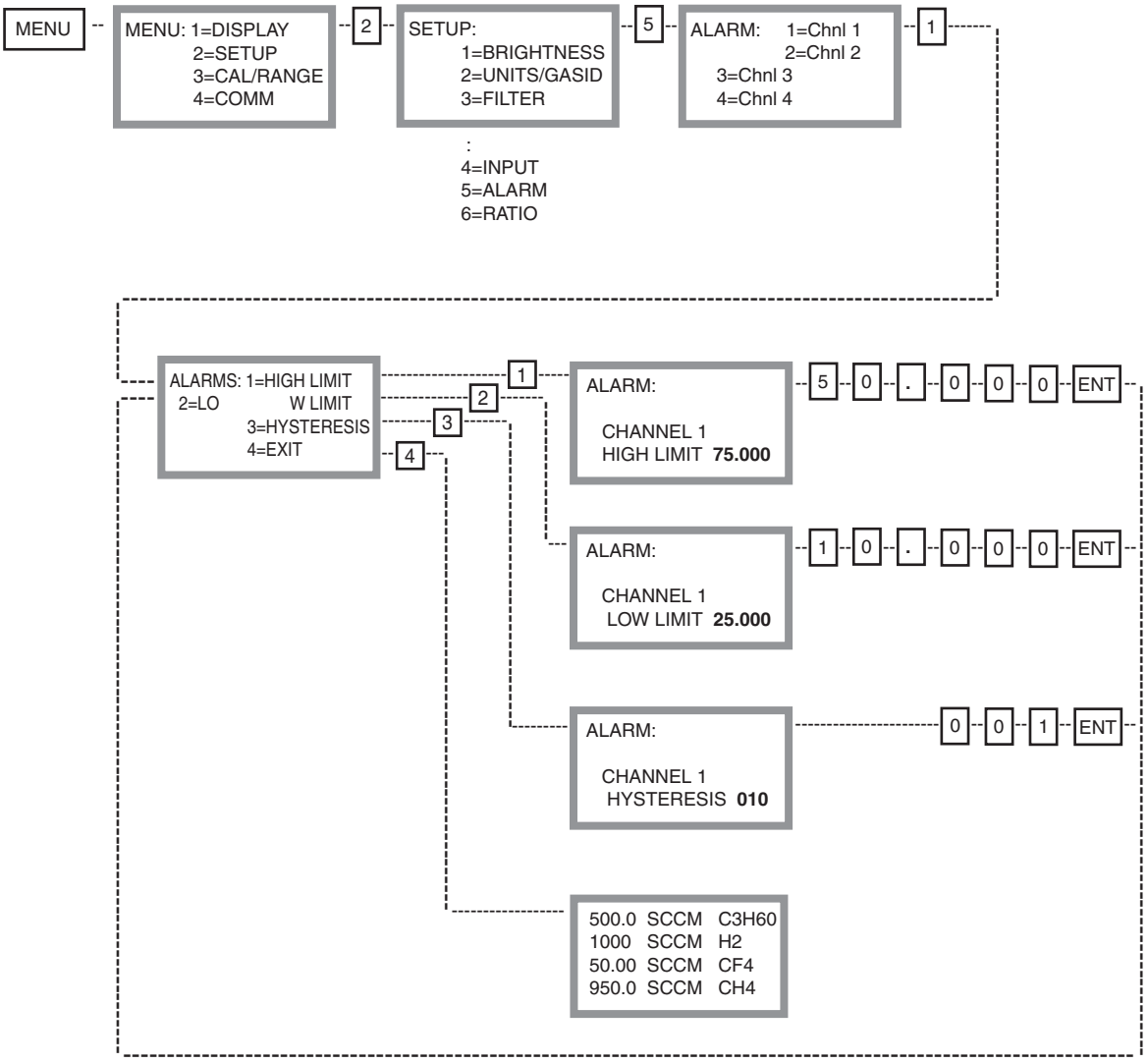


The Input selection sets the full scale input signal and the full scale setpoint (control) signal for the selected channel. The selected channel and the input signal setting that was previously selected is displayed during selection. The factory default is 0-5V for each channel. Any input may be selected for any channel. The instrument compensates for any incompatibilities even in the Master/Slave configuration.

Example: If the full scale input selected is 0-10V, then the full scale setpoint output is also 0-10V. If the Master Channel is 0-10V and the Slave Channel is 4-20mA, the instrument compensates for the incompatibility and sends a 0-10V setpoint signal for the Master and a 4-20mA setpoint signal proportional to the 0-10V input signal for the Slave.

Note: For most MFC's the full scale input is 0-5V, while for pressure transducers the input is 0-10V.

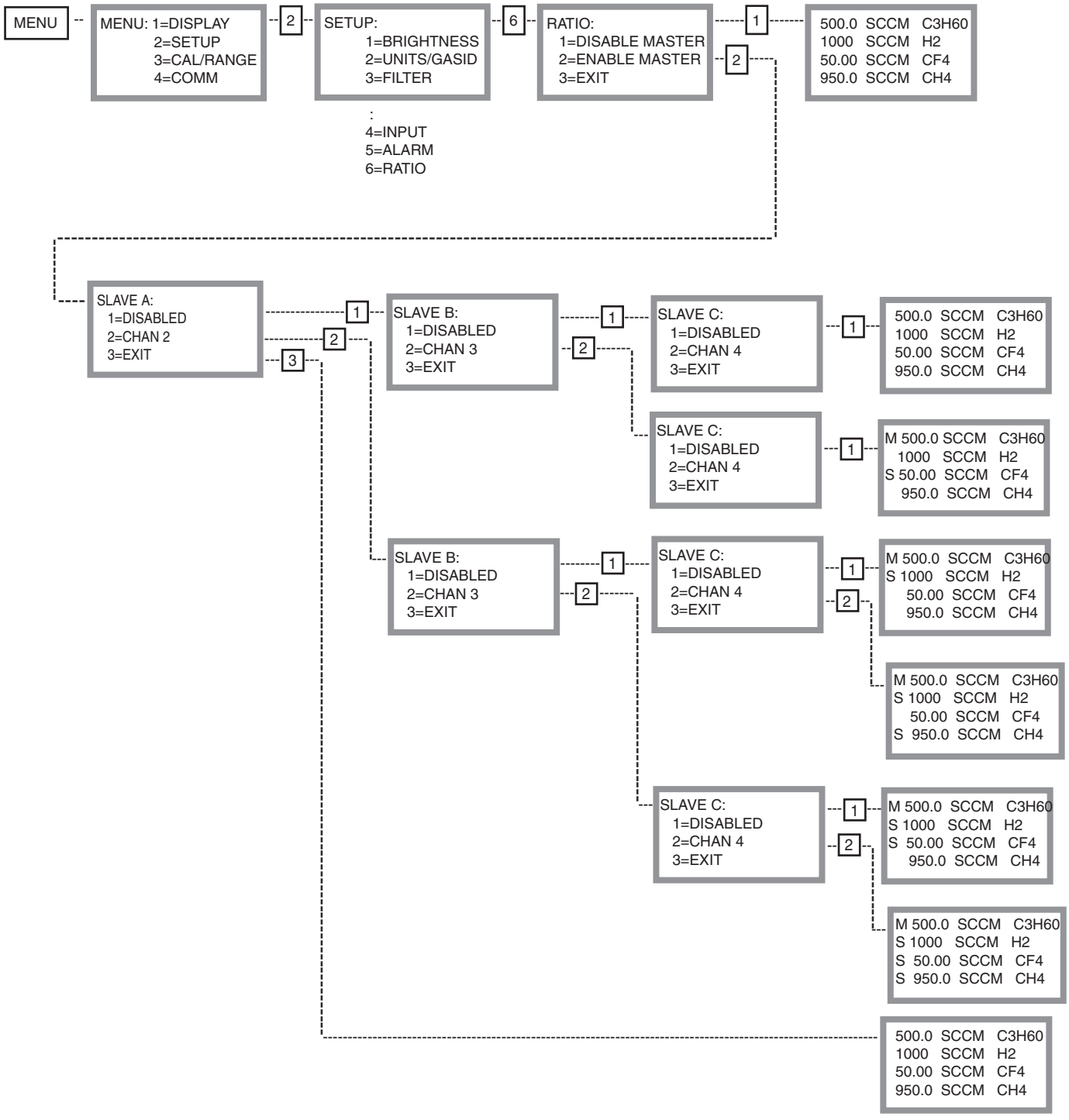
Selecting Alarms (High and Low with Hysteresis)



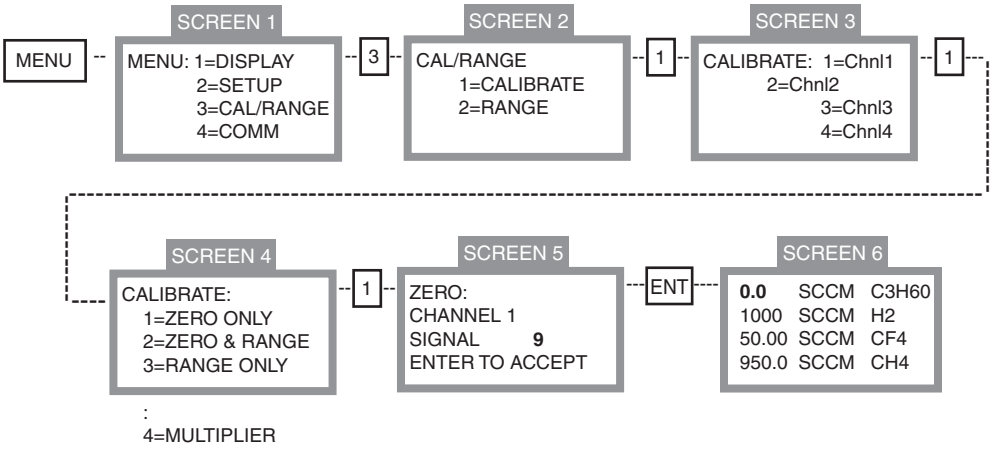
Each channel has a HIGH and LOW alarm to monitor the flow rate signal. If the flow rate is higher than the HIGH alarm or less than the LOW alarm, an optically isolated open collector output is turned on. This alarm may be used as a warning that the flow rate is not within the limits set by the setpoint (control) signal. A programmable HYSTERESIS of 1 to 999 counts provide a deadband for the alarms. To exit the alarm setup a **"4"** to exit must be selected.

In the above example, the HIGH alarm limit was changed from 75.000 to 50.000, the LOW alarm limit from 25.000 to 10.000 and HYSTERESIS from 010 to 001. The factory default is 75.000, 25.000 and 010 for the HIGH, LOW and HYSTERESIS settings, respectively.

Selecting Ratio (Master/Slave Operation)

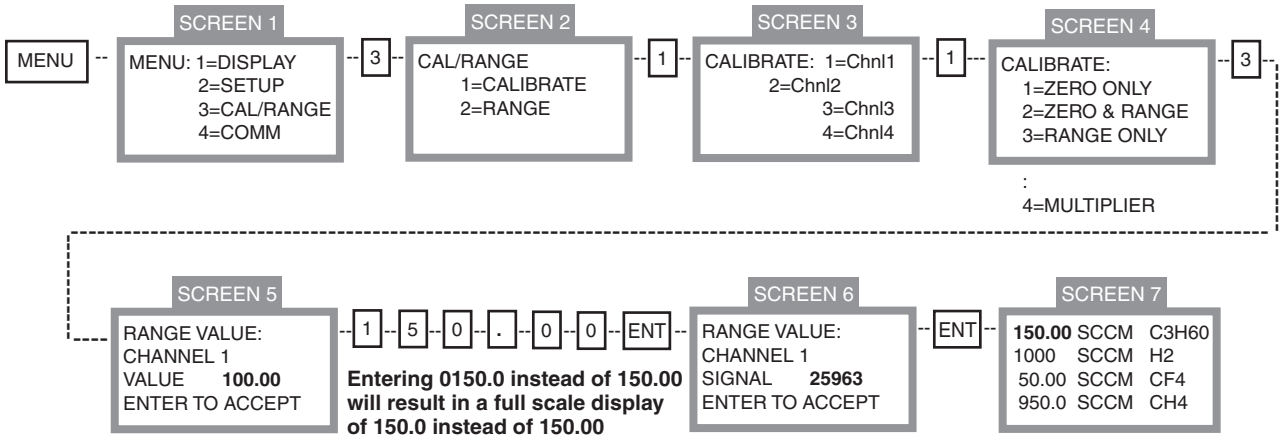


Calibrate (Zero only)



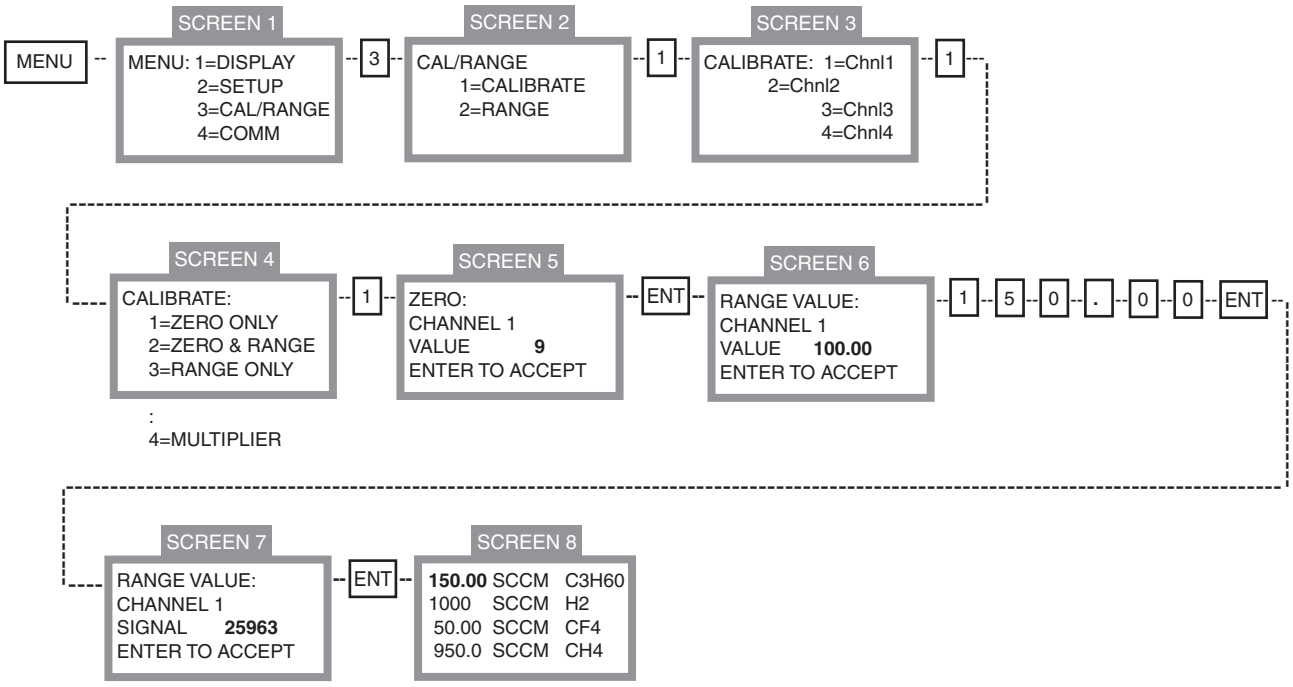
The "Zero only" sequence shown above is used to zero the MFC. Verify the input signal is at or close to zero prior to performing this sequence. In **SCREEN 5**, the data shown after "SIGNAL" is the raw analog-to-digital data corresponding to the input signal applied. This data is live and will change as the input signal is changed. It should be close to zero, unless the MFC is being zeroed at a point other than zero. If **ENT** is depressed during **SCREEN 5**, the value present at the input will be zeroed on the display, as shown in **SCREEN 6**. If **ESC** is entered, the previous zeroed value applies.

Calibrate (Range only)



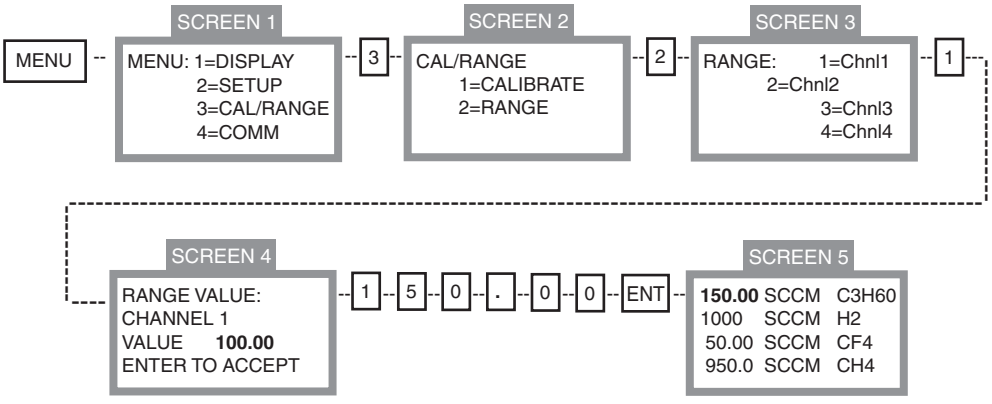
The Range only sequence is used to calibrate the full scale reading of the MFC. Apply a full scale input signal, typically 5Vdc to the signal input prior to performing this sequence. At **SCREEN 5**, the user has 2 alternatives. The first is to accept the display **RANGE** value shown by depressing **ENT**. The second is to enter a new **RANGE** value, as shown above, prior to completing the RANGE sequence. The Signal displayed on **SCREEN 6** is the live, un-scaled analog-to-digital converter data, and will change as the input changes. The value present when **ENT** is depressed will be used in the full scale calibration calculations. If **ESC** is entered instead of **ENT**, the previous calibration applies. *NOTE: DO NOT USE THE RANGE ONLY SEQUENCE TO CHANGE RANGES. USE SELECTION 2 SHOWN IN SCREEN 2.*

Calibrate (Zero & Range)



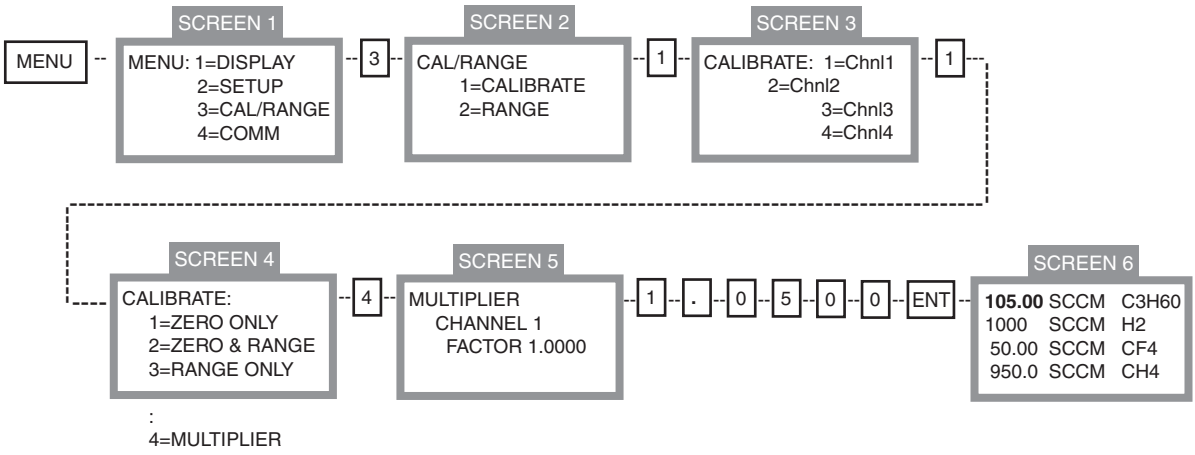
The Zero & Range calibration allows both zero and full scale calibrations to be performed in the same sequence. The input signal needs to be changed from a zero to a full scale value during the calibration sequence. The same rules apply as previously mentioned in the Zero only and Range only procedures.

Range (Changing Range)



The Range sequence is **not** a calibration sequence. Changing the Range value simply replaces the Range value used during the previous full scale calibration. The analog-to-digital converter data used during the previous full scale calibration is still valid. Ranging is a simple way to change ranges when changing MFC's. It assumes the full scale output voltage of the new MFC is the same as the previous MFC.

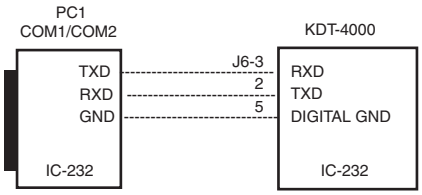
Calibrate (Multiplier)



Entering a MULTIPLIER value changes the display by that multiplier factor. All data values are multiplied by the MULTIPLIER prior to display. The MULTIPLIER is sometimes referred to as a GAS CORRECTION factor when used with MFC's. If the MFC is calibrated with nitrogen and another gas is used with the MFC, a GAS CORRECTION factor can be entered to recalibrate the MFC to the gas used.

RS232/485 HOOKUP

BI-DIRECTIONAL RS-232 CONNECTION



RS232/485 data is transmitted at 9600 or 19.2K baud (user-selectable) in the following format:

One Start Bit
Eight Data Bits in ASCII Format
No Parity Bit
One Stop Bit

Note: All commands and queries are case sensitive and require an upper case character.

Reading Display

RS232 Query:

C1 Response: "CH1<>sddd.dd<>eeeee<>xxxxx<>z

where: <>= blank (ASCII 20)

s= polarity sign (blank for +, ASCII 2E for -)

ddd.dd= data in ASCII format with decimal in displayed position.

eeeee= unit of measure

xxxxx= gas id

z= carriage return (ASCII 0D)

C5 Response: "CH1<>sddd.dd<>eeeee<>xxxxx<>z
CH2<>sddd.dd<>eeeee<>xxxxx<>z
CH3<>sddd.dd<>eeeee<>xxxxx<>z
CH4<>sddd.dd<>eeeee<>xxxxx<>z"

RS485 Query:

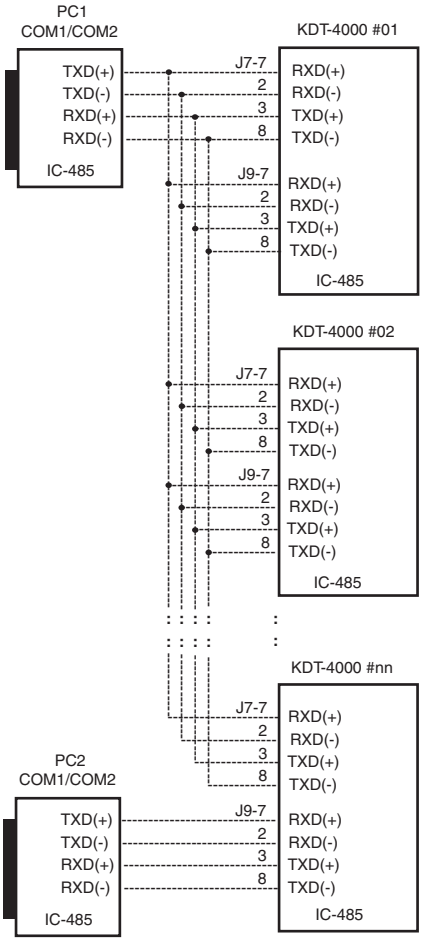
*aaC1 Response: "CH1<>sddd.dd<>eeeee<>xxxxx<>z

*aaC5 Response: "CH1<>sddd.dd<>eeeee<>xxxxx<>z
CH2<>sddd.dd<>eeeee<>xxxxx<>z
CH3<>sddd.dd<>eeeee<>xxxxx<>z
CH4<>sddd.dd<>eeeee<>xxxxx<>z"

where: aa= CCR 400 address

Reference: Checking/Changing RS485 Address on pg 19.

MULTIDROP/4-WIRE FULL DUPLEX RS-485 CONNECTION



Note: nn=32 maximum (drivers and receivers)

RS232/485 COMMANDS

Checking CCR 400 RS485 Address Setting

RS485 Query:

*00X Response: "MULTIDROP ADDRESS: 01"

Note: All CCR 400's will respond to * 0 0 X. To prevent bus contention, connect only 1 CCR 400 to the RS485 port for this check.

Setting Setpoint (Control) Voltage

RS232 Command:

SP1<dd.ddd> Set CH1 Setpoint to dd.ddd

SP2<dd.ddd> Set CH2 Setpoint to dd.ddd

SP3<dd.ddd> Set CH3 Setpoint to dd.ddd

SP4<dd.ddd> Set CH4 Setpoint to dd.ddd

Example: Send S P 1 1 0 0 . 0 0
CH1 Setpoint (Control) Voltage setting will be 100.00.

Note: < > must contain 5 digits and 1 decimal point.
<ddddd.> is a valid entry. Setpoint is always positive.

RS485 Command:

*aaSP1<dd.ddd> Set CH1 Setpoint at Address 01 to dd.ddd

*aaSP2<dd.ddd> Set CH2 Setpoint at Address 01 to dd.ddd

*aaSP3<dd.ddd> Set CH3 Setpoint at Address 01 to dd.ddd

*aaSP4<dd.ddd> Set CH4 Setpoint at Address 01 to dd.ddd

Example: Send * 0 1 S P 2 2 5 0 0 . 0
CCR 400 with Address 01 will have CH2 Setpoint (Control) Voltage set to 2500.0

Setting Alarms

RS232 Command:

A1H<dd.ddd> Set CH1 High Alarm to dd.ddd

A2L<dd.ddd> Set CH1 Low Alarm to dd.ddd

A2H<dd.ddd> Set CH2 High Alarm to dd.ddd

A2L<dd.ddd> Set CH2 Low Alarm to dd.ddd

A3H<dd.ddd> Set CH3 High Alarm to dd.ddd

A3L<dd.ddd> Set CH3 Low Alarm to dd.ddd

A4H<dd.ddd> Set CH4 High Alarm to dd.ddd

A4L<dd.ddd> Set CH4 Low Alarm to dd.ddd

Example: Send A 4 L 3 5 . 0 0 0
CH4 Low Alarm Setpoint will be 35.000

RS485 Command:

*aaA1H<dd.ddd> Set CH1 High Alarm at Address 02 to dd.ddd

*aaA1L<dd.ddd> Set CH1 Low Alarm at Address 02 to dd.ddd

*aaA2H<dd.ddd> Set CH2 High Alarm at Address 02 to dd.ddd

*aaA2L<dd.ddd> Set CH2 Low Alarm at Address 02 to dd.ddd

*aaA3H<dd.ddd> Set CH3 High Alarm at Address 02 to dd.ddd

*aaA3L<dd.ddd> Set CH3 Low Alarm at Address 02 to dd.ddd

Example: Send *02A3H500.00
CCR 400 with Address 02 will have CH3 High Alarm set to 500.00

Changing CCR 400 RS485 Address Setting

RS485 Command:

*00x<aa> Set CCR 400 Address to aa

Example: Send * 0 0 x 2 2
CCR 400 will respond with a "spade" character to acknowledge receipt of this command and change its Address to "22"

Reading Setpoint (Control) Voltage

RS232 Query:

SP1 Response: "SP1ddd.dd"

SP2 Response: "SP2ddd.dd"

SP3 Response: "SP3ddd.dd"

SP4 Response: "SP4ddd.dd"

RS485 Query:

*aaSP1 Response: "SP1ddd.dd"

*aaSP2 Response: "SP2ddd.dd"

*aaSP3 Response: "SP3ddd.dd"

*aaSP4 Response: "SP4ddd.dd"

Reading Alarms

RS232 Query:

A1H Response: A1H ddd.dd

A1L Response: A1L ddd.dd

A2H Response: A2H ddd.dd

A2L Response: A2L ddd.dd

A3H Response: A3H ddd.dd

A3L Response: A3L ddd.dd

A4H Response: A4H ddd.dd

A4L Response: A4lL ddd.dd

RS485 Query:

*aaA1H Response: A1H ddd.dd

*aaA1L Response: A1H ddd.dd

*aaA2H Response: A2H ddd.dd

*aaA2L Response: A2L ddd.dd

*aaA3H Response: A3H ddd.dd

*aaA3L Response: A3L ddd.dd

*aaA4H Response: A4H ddd.dd

*aaA4L Response: A4L ddd.dd

RS232/485 COMMANDS

Setting Alarm Hysteresis

RS232 Command:

HY1<ddd> Set CH1 Alarm Hysteresis to ddd
HY2<ddd> Set CH2 Alarm Hysteresis to ddd
HY3<ddd> Set CH3 Alarm Hysteresis to ddd
HY4<ddd> Set CH4 Alarm Hysteresis to ddd
where 000<ddd<250

Example: Send HY1010
CH1 Alarm Hysteresis set to 10 counts.

RS485 Command:

*aaHY1<ddd> Set CH1 Hysteresis at Address aa to ddd
*aaHY2<ddd> Set CH2 Hysteresis at Address aa to ddd
*aaHY3<ddd> Set CH3 Hysteresis at Address aa to ddd
*aaHY4<ddd> Set CH4 Hysteresis at Address aa to ddd

Example: Send * 0 1 HY3100
CCR 400 with Address 01 will have CH3 Alarm Hysteresis set to 100

Setting Units of Measure

RS232 Command:

UM1<dd> Set CH1 Unit of Measure to selection dd
UM2<dd> Set CH2 Unit of Measure to selection dd
UM3<dd> Set CH3 Unit of Measure to selection dd
UM4<dd> Set CH4 Unit of Measure to selection dd

Reference Units of Measure Table on pg 14 for selection

Example: Send UM101
CH1 Unit of Measure will be SCCM

RS485 Command:

*aaUM1<dd> Set CH1 Unit of Measure at Address 02 to selection dd
*aaUM2<dd> Set CH1 Unit of Measure at Address 02 to selection dd
*aaUM3<dd> Set CH3 Unit of Measure at Address 02 to selection dd
*aaUM4<dd> Set CH2 Unit of Measure at Address 02 to selection dd

Example: Send *03UM366
CCR 400 with Address 02 will have CH3 Unit of Measure set to PSI

Setting Gas Idenfifier

RS232 Command:

GS1<ddd> Set CH1 Gas Identifier to selection dd
GS2<ddd> Set CH2 Gas Identifier to selection dd
GS3<ddd> Set CH3 Gas Identifier to selection dd
GS4<ddd> Set CH4 Gas Identifier to selection dd

Reference Gas Identifier Table on pgs 15, 16 and 17 for selection

Example: Send GS1050
CH1 Gas Identifier will be C2H6O

Reading Alarm Hysteresis

RS232 Query:

HY1 Response: HY1ddd
HY2 Response: HY2ddd
HY3 Response: HY3ddd
HY4 Response: HY4ddd

Example: Send IN3 Response: IN3

RS485 Query:

*aaHY1 Response: HY1ddd
*aaHY2 Response: HY2ddd
*aaHY3 Response: HY3ddd
*aaHY4 Response: HY4ddd

Reading Units of Measure

RS232 Query:

UM1 Response: UM1dd
UM2 Response: UM2dd
UM3 Response: UM3dd
UM4 Response: UM4dd

Example: Send UM1
Response: UM11 if CH1 Unit of Measure was SCCM

RS485 Query:

*aaUM1 Response: UM1dd
*aaUM2 Response: UM2dd
*aaUM3 Response: UM3dd
*aaUM4 Response: UM4dd

Reading Gas Identifier

RS232 Query:

GS1 Response: GS1ddd
GS2 Response: GS2ddd
GS3 Response: GS3ddd
GS4 Response: GS4ddd

Example: Send GS3
Response: GS3050 if CH1 Gas Identifier was C2H60

RS232/485 COMMANDS

Setting Signal Input

RS232 Command:

IN1<d> Set CH1 Signal Input to selection d
IN2<d> Set CH2 Signal Input to selection d
IN3<d> Set CH3 Signal Input to selection d
IN4<d> Set CH4 Signal Input to selection d
where d=1 Signal Input = 0-5V
d=2 Signal Input = 0-10V
d=3 Signal Input = 4-20mA

Example: Send IN33
CH3 Signal Input selection is 4-20mA. This also sets CH3 Setpoint (Control) signal to 4-20mA.

RS485 Command:

*aaIN1<d> Set CH1 Signal Input at Address aa to selection d
*aaIN2<d> Set CH2 Signal Input at Address aa to selection d
*aaIN3<ddd> Set CH3 Signal Input at Address aa to selection d
*aaIN4<ddd> Set CH4 Signal Input at Address aa to selection d

Example: Send *01IN31
CCR 400 with Address 01 will have CH3 Signal Input set for 0-5V.

Setting Filter

RS232 Command:

FL1<d> Set CH1 Filter selection to d
FL2<d> Set CH2 Filter selection to d
FL3<d> Set CH3 Filter selection to d
FL4<d> Set CH4 Filter selection to d

Where d=1 Filter = 4Hz
d=2 Filter = 15Hz
d=3 Filter = 30Hz
d=4 Filter =100Hz

Example: Send FL12
CH1 Filter f(-3dB) will be 15Hz

RS485 Command:

*aaFL1<d> Set CH1 Filter at Address aa to selection d
*aaFL2<d> Set CH1 Filter at Address aa to selection d
*aaFL3<d> Set CH3 Filter at Address aa to selection d
*aaFL4<d> Set CH2 Filter at Address aa to selection d

Example: Send *03FL13
CCR 400 with Address 03 will have CH1 Filter selection set for 30Hz.

Reading Signal Input Selection

RS232 Query:

IN1 Response: IN1<>d<>zzzzz
IN2 Response: IN2<>d<>zzzzz
IN3 Response: IN3<>d<>zzzzz
IN4 Response: IN4<>d<>zzzzz

Where zzzzz = 0-5V for d=1
zzzzz = 0-10V for d=2
zzzzz = 4-20mA for d=3

Example: Send IN3 Response: IN3 3 4-20mA

RS485 Query:

*aaIN1 Response: IN1<>d<>zzzzz
*aaIN2 Response: IN2<>d<>zzzzz
*aaIN3 Response: IN3<>d<>zzzzz
*aaIN4 Response: IN4<>d<>zzzzz

Example: Send *10IN2 Response: IN2 1 0-5V

Reading Filter

RS232 Query:

FL1 Response: FL1<>d<>zzzzz
FL2 Response: FL2<>d<>zzzzz
FL3 Response: FL3<>d<>zzzzz
FL4 Response: FL4<>d<>zzzzz

Where zzzzz = 4Hz for d=1
zzzzz = 15Hz for d=2
zzzzz = 30Hz for d=3
zzzzz = 100Hz for d=4

Example: Send FL1
Response: FL1 2 15Hz if CH1 Filter selection was 2.

RS485 Query:

*aaFL1 Response: FL<>1<>zzzzz
*aaFL2 Response: FL<>2<>zzzzz
*aaFL3 Response: FL<>3<>zzzzz
*aaFL4 Response: FL4<>4<>zzzzz

RS232/485 COMMANDS

Setting Multiplier

RS232 Command:

ML1<d.dddd> Set CH1 Multiplier to d.dddd
ML2<d.dddd> Set CH2 Multiplier to d.dddd
ML3<d.dddd> Set CH3 Multiplier to d.dddd
ML4<d.dddd> Set CH4 Multiplier to d.dddd

Example: Send ML31.1375
CH3 Multiplier=1.1375

RS485 Command:

*aaML1<d.dddd> Set CH1 Multiplier at Address aa to d.dddd
*aaML2<d.dddd> Set CH2 Multiplier at Address aa to d.dddd
*aaIN3<d.dddd> Set CH3 Multiplier at Address aa to d.dddd
*aaIN4<d.dddd> Set CH4 Multiplier at Address aa to d.dddd

Example: Send *05ML31.0000
CCR 400 with Address 05 will have CH3 Multiplier set to 1.0000.

Setting/Blanking Display (Flow or Total)

RS232 Command:

D1<d> Set CH1 Display to selection d
D2<d> Set CH2 Display to selection d
D3<d> Set CH3 Display to selection d
D4<d> Set CH4 Display to selection d

Where d=1 sets Display for TOTAL
d=2 sets Display for FLOW
d=3 blanks Display for selected Channel

Example: Send D11
CH1 Display shows TOTAL

RS485 Command:

*aaD1d Set CH1 Display at Address aa to selection d
*aaD2d Set CH2 Display at Address aa to selection d
*aaD3d Set CH3 Display at Address aa to selection d
*aaD4d Set CH4 Display at Address aa to selection d

Example: Send *03D12
CCR 400 with Address 03 will display FLOW on CH1

Reading Multiplier

RS232 Query:

ML1 Response: ML1<><>d.dddd
ML2 Response: ML2<><>d.dddd
ML3 Response: ML3<><>d.dddd
ML4 Response: ML4<><>d.dddd

Example: Send ML3 Response: ML3 1.1375

RS485 Query:

*aaML1 Response: ML1<><>d.dddd
*aaML2 Response: ML2<><>d.dddd
*aaML3 Response: ML3<><>d.dddd
*aaML4 Response: ML4<><>d.dddd

Reading Display (Selection)

RS232 Query:

D1 Response: D1d
D2 Response: D2d
D3 Response: D3d
D4 Response: D4d

Example: Send D1
Response: D12 indicates d=2 for FLOW on CH1

RS485 Query:

*aaD1 Response: D1d
*aaD2 Response: D2d
*aaD3 Response: D3d
*aaD4 Response: D4d

RS232/485 COMMANDS

Resetting Total

RS232 Command:

T1R	Reset CH1 Total to zero
T2R	Reset CH2 Total to zero
T3R	Reset CH3 Total to zero
T4R	Reset CH4 Total to zero

Example: Send T3R
CH3 Total reset to zero

RS485 Command:

*aaT1R	Reset CH1 Total at Address aa to zero
*aaT2R	Reset CH2 Total at Address aa to zero
*aaIT3R	Reset CH3 Total at Address aa to zero
*aaIT4R	Reset CH4 Total at Address aa to zero

Example: Send *01T1R
Model 400 with Address 01 CH1 Total reset to zero

Setting Range Value

RS232 Command:

SN1<d.dddd>	Set CH1 Range value to d.dddd
SN2<d.dddd>	Set CH2 Range value to d.dddd
SN3<d.dddd>	Set CH3 Range value to d.dddd
SN4<d.dddd>	Set CH4 Range value to d.dddd

Example: Send SN1150.00
CH1 Range value set to 150.00

RS485 Command:

*aaSN1<d.dddd>	Set CH1 Range value at Address aa to d.dddd
*aaSN2 <d.dddd>	Set CH2 Range value at Address aa to d.dddd
*aaSN3 <d.dddd>	Set CH3 Range value at Address aa to d.dddd
*aaSN4 <d.dddd>	Set CH4 Range value at Address aa to d.dddd

Example: Send *03SN35000.0
Model 400 with Address 03 will have CH3 Range value set to 5000.0.

Enable Master Channel (CH1)

RS232 Command:

R11	Enable Master Channel (CH1)
R12	Disable Master Channel (CH1)

Note: Master Channel must be enabled before enabling Slave Channel(s)

Setting Local or Remote Operation

RS232 Command:

RE1	Local Operation (Front Panel Enabled)
RE2	Remote Operation (Front Panel Disabled)

RS485 Command:

*aaRE1	Local Operation (Front Panel Enabled)
*aaRE2	Remote Operation (Front Panel Disabled)

Reading Range Value

RS232 Query:

SN1	Response: SN1d.dddd
SN2	Response: SN2d.dddd
SN3	Response: SN3d.dddd
SN4	Response: SN4d.dddd

Example: Send SN1
Response: SN1150.00

RS485 Query:

*aaSN1	Response: SN1d.dddd
*aaSN2	Response: SN2d.dddd
*aaSN3	Response: SN3d.dddd
*aaSN4	Response: SN4d.dddd

Enable Slave Channels (CH2, CH3 and CH4)

RS232 Command:

R21	Enable Slave A (CH2)
R22	Disable Slave A (CH2)
R31	Enable Slave B (CH3)
R32	Disable Slave B (DH3)
R41	Enable Slave C (CH4)
R42	Disable Slave C (CH4)

RS485 Command;

*aaR21	Enable Slave A (CH2)
*aaR22	Disable Slave A (CH2)
*aa R31	Enable Slave B (CH3)
*aaR32	Disable Slave B (CH3)
*aaR41	Enable Slave C (CH4)
*aa R42	Disable Slave C (CH4)

UNITS OF MEASURE TABLE

# Description	Abbrev	Total
1 Standard Cubic Centimeters per Minute	SCCM	SCC
2 Standard Liters per Minute	SLM	SL
3 Percent	%	NA
4 Volts	V	NA
5 Millivolts	MV	NA
6 Counts	CNT	NA
7 Normal Liters per Minute	NLM	NL
8 Standard Liters per Second	SLS	SL
9 Normal Liters per Second	NLS	NL
10 Standard Liters per Hour	SLH	SL
11 Normal Liters per Hour	NLH	NL
12 Standard Milliliters per Minute	SMLM	SML
13 Normal Milliliters per Minute	NMLM	NML
14 Standard Milliliters per Second	SMLS	SML
15 Normal Mililiters per Second	NMLS	NML
16 Standard Milliliters per Hour	SMLH	SML
17 Normal Milliliters per Hour	NMLH	NML
18 Normal Cubic Centimeters per Minute	NCCM	NCC
19 Standard Cubic Centimeters per Second	SCCS	SCC
20 Normal Cubic Centimeters per Second	NCCS	NCC
21 Standard Cubic Centimeters per Hour	SCCH	SCC
22 Normal Cubic Centimeters per Hour	NCCH	NCC
23 Standard Cubic Feet per Minute	SCFM	SCF
24 Normal Cubic Feet per Minute	NCFM	NCF
25 Standard Cubic Feet per Second	SCFS	SCF
26 Normal Cubic Feet per Second	NCFS	NCF
27 Standard Cubic Feet per Hour	SCFH	SCF
28 Normal Cubic Feet per Hour	NCFH	NCF
29 Standard Cubic Meters per Minute	SCMM	SCM
30 Normal Cubic Meters per Minute	NCMM	NCM
31 Standard Cubic Meters per Second	SCMS	SCM
32 Normal Cubic Meters per Second	NCMS	NCM
33 Standard Cubic Meters per Hour	SCMH	SCM
34 Normal Cubic Meters per Hour	NCMH	NCM
35 Standard Cubic Meters per Hour	SCMH	SCM
36 Normal Cubic Inches per Minute	NCIM	NCI
37 Standard Cubic Inches per Second	SCIS	SCI
38 Normal Cubic Inches per Second	NCIS	NCI
39 Standard Cubic Inches per Hour	SCIH	SCI
40 Normal Cubic Incher per Hour	NCIH	NCI
41 Pounds per Minute	LBM	LB
42 Pounds per Second	LBS	LB
43 Pounds per Hour	LBH	LB
44 Kilograms per Minute	KgM	Kg
45 Kilograms per Second	KgS	Kg
46 Kilograms per Hour	KgH	Kg
47 Grams per Minute	GRM	GR
48 Grams per Second	GRS	GR
49 Grams per Hour	GRH	GR
50 Moles per Minute	MolM	Mol
51 Moles per Second	MolS	Mol
52 Moles per Hour	MolH	Mol
53 Kilomoles per Minute	KMolM	KMol
54 Kilomoles per Second	KMolS	KMol
55 Kilomoles per Hour	KMol	KMol
56 Watts	W	NA
57 Bits per Second	BPS	BP
58 Seconds	S	NA
59 Minutes	M	NA
60 Hours	H	NA
61 Watt*Hours	WH	W
62 Torr	TORR	NA
63 Bar	BAR	NA
64 Pascals	Pa	NA
65 Inches of Water	inH20	NA
66 Pounds per Square Inch	PSI	NA

GAS IDENTIFICATION TABLE

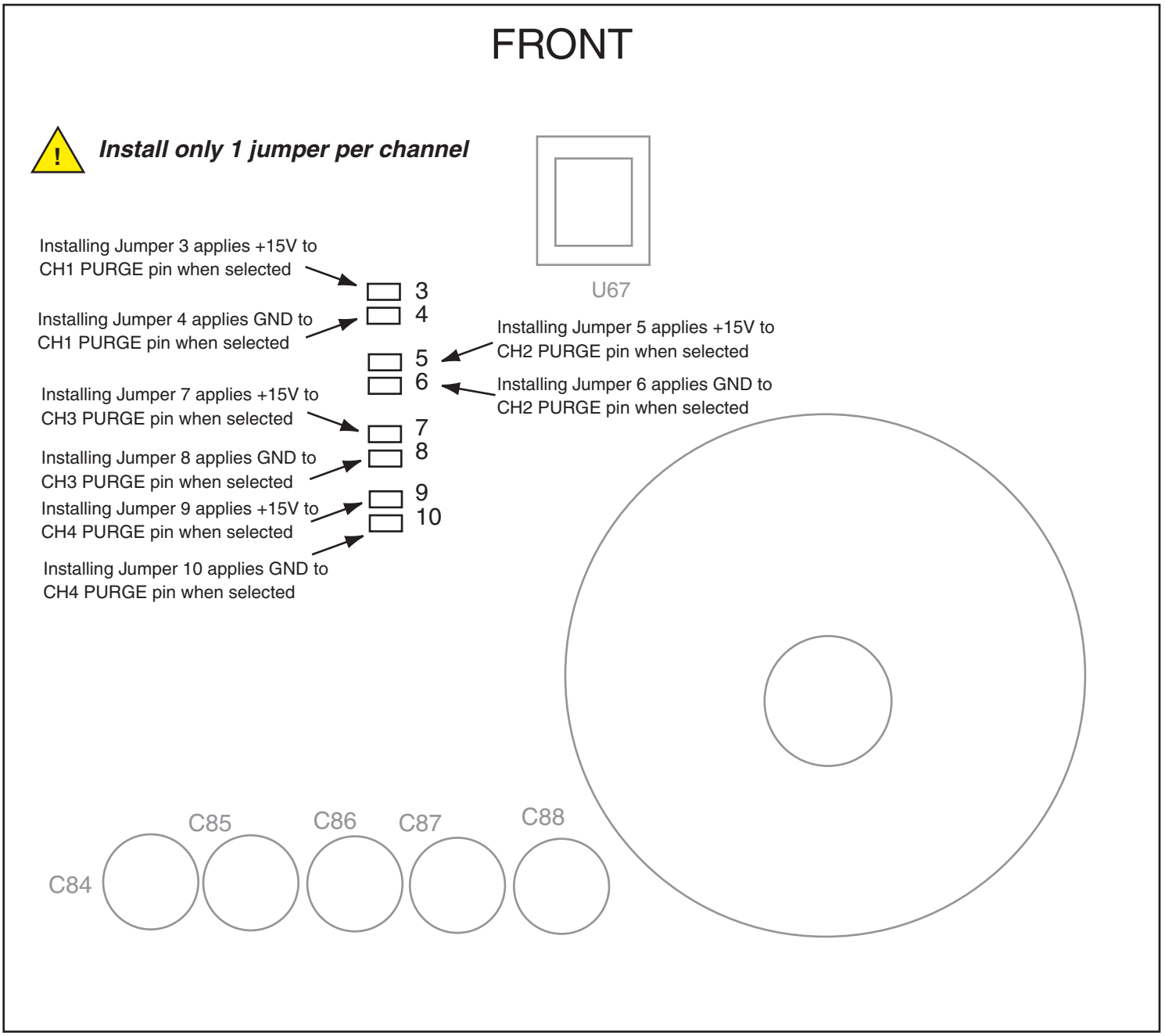
# GAS	GAS ID	DISPLAY
1 Acetic Acid	C2H4F2	#1
2 Acetic Acid, Anhydride	C4H603	#2
3 Acetone	C3H60	C3H60
4 Acetonitryl	C2H3N	C2H3N
5 Acetylene	C2H2	C2H2
6 Air	Air	Air
7 Allene	C3H4	C3H4
8 Ammonia	NH3	NH3
9 Argon	Ar	Ar
10 Arsine	AsH3	AsH3
11 Benzene	C6H6	C6H6
12 Boron Trichloride	BCl3	BCl3
13 Boron Triflouride	BF3	BF3
14 Bromine	Br2	Br2
15 Bromochlorodifluoromethane	CBrClF2	#15
16 Bromodifluoromethane	CHBrF2	#16
17 Bromotrifluormethane	CBrF3	CBrF3
18 Butane	C4H10	C4H10
19 Butanol	C4H10O	C4H10O
20 Butene	C4H8	C4H8
21 Carbon Dioxide	CO2	CO2
22 Carbon Disulfide	CS2	CS2
23 Carbon Monoxide	CO	CO
24 Carbon Tetrachloride	CCl4	CCl4
25 Carbonl Sulfide	COS	COS
26 Chlorine	Cl2	Cl2
27 Chlorine Trifluoride	ClF3	ClF3
28 Chlorobenzene	C6H5Cl	#28
29 Chlorodifluoroethane	C2H3ClF	#29
30 Chloroform	CHCl3	CHCl3
31 Chloropentafluoroethane	C2ClF5	#31
32 Chloropropane	C3H7Cl	#32
33 Cisbutene	C4H8	C4H8
34 Cyanogen	C2N2	C2N2
35 Cyanogen Chloride	ClCN	ClCN
36 Cyclobutane	C4H8	C4H8
37 Cyclopropane	C3H6	C3H6
38 Deuterium	H22	H22
39 Diborane	B2H6	B2H6
40 Dibromodifluoromethane	CBr2F2	#40
41 R21	CHCl2F	R21
42 Dichloromethane	CH2Cl2	#42
43 Dichloropropane	C3H6Cl2	#43
44 Dichlorosilane	H2SiCl2	#44
45 Diethyl Amine	C4H11N	#45
46 Diethyl Ether	C4H10O	#46
47 Diethyl Sulfide	C4H10S	#47
48 Difluoroethylene	C2H2F2	#48
49 Dimethylamine	C2H7N	C2H7N
50 Dimethyl Ether	C2H6O	C2H6O
51 Dimethyl Sulfide	C2H6S	C2H6S
52 Divinyl	C4H6	C4H6
53 Ethane	C2H6	C2H6
54 Ethane, 1-chloro-1,1,2,2-tetraflouro-	C2HClF4	#54
55 Ethane, 1-chloro-1,2,2,2-tetrafluoro-	C2HClF4	#55
56 Ethanol	C2H6O	C2H6O
57 Ethylacetylene	C4H6	C4H6
58 Ethyl Amine	C2H7N	C2H7N
59 Ethylbenzene	C8H10	C8H10
60 Ethyl Bromide	C2H5Br	#60
61 Ethyl Chloride	C2H5Cl	#61
62 Ethyl Fluoride	C2H5F	C2H5F
63 Ethylene	C2H4	C2H4
64 Ethylene Dibromide	C2H4Br2	#64
65 Ethylene Dichloride	C2H4Cl2	#65
66 Ethylene Oxide	C2H4O	C2H4O

GAS IDENTIFICATION TABLE

# GAS	GAS ID	DISPLAY
67 Ethyleneimine	C2H4N	C2H4N
68 Ethylidene Dichloride	C2H4Cl2	#68
69 Ethyl Mercaptan	C2H6S	C2H6S
70 Fluorine	F2	F2
71 Formaldehyde	CH2O	CH2O
72 Freon 11	CCl3F	CCl3F
73 Freon 12	CCl2F2	#73
74 Freon 13	CClF3	CClF3
75 Freon 14	CF4	CF4
76 Freon 22	CHClF2	#76
77 Freon 23	CHF3	CHF3
78 Freon 114	C2Cl2F4	#78
79 Furan	C4H4O	C4H4O
80 Helium	He	He
81 Heptafluoropropane	C3HF7	C3HF7
82 HMDS	C6H19NSi2	HMDS
83 Hexamethyldisiloxane	C6H18OSi2	#83
84 Hexane	C6H14	C6H14
85 Hexafluorobenzene	C6F6	C6F6
86 Hexene	C6H12	C6H12
87 Hydrazine	N2H4	N2H4
88 Hydrogen	H2	H2
89 Hydrogen Bromide	HBr	HBr
90 Hydrogen Chloride	HCl	HCl
91 Hydrogen Cyanide	CHN	CHN
92 Hydrogen Fluoride	HF	HF
93 Hydrogen Iodide	HI	HI
94 Hydrogen Selenide	H2Se	H2Se
95 Hydrogen Sulfide	H2S	H2S
96 Isobutane	C4H10	C4H10
97 Isobutanol	C4H10O	#97
98 Isobutene	C4H8	C4H8
99 Isopentane	C5H12	C5H12
100 Isopropyl Alcohol	C3H8O	C3H8O
101 Isoxazole	C3H3NO	#101
102 Ketene	C2H2O	C2H2O
103 Krypton	Kr	Kr
104 Methane	CH4O	CH4O
105 Methanol	CH4O	CH4O
106 Methyl Acetate	C3H6O2	#106
107 Methyl Acetylene	C3H4	C3H4
108 Methylamine	CH5N	CH5N
109 Methyl Bromide	CH3Br	CH3Br
110 Methyl Chloride	CH3Cl	CH3Cl
111 Methylcyclohexane	C7H14	C7H14
112 Methyl Ethyl Amine	C3H9N	C3H9N
113 Methyl Ethyl Ether	C3H8O	C3H8O
114 Methyl Ethyl Sulfide	C3H8S	C3H8S
115 Methyl Fluoride	CH3F	CH3F
116 Methyl Formate	C2H4O2	#116
117 Methyl Iodide	CH3I	CH3I
118 Methyl Mercaptan	CH4S	CH4S
119 Methylpentene	C6H12	C6H12
120 Methyl Vinyl Ether	C3H6O	C3H6O
121 Neon	Ne	Ne
122 Nitric Oxide	NO	NO
123 Nitrogen	N2	N2
124 Nitrogen Dioxide	NO2	NO2
125 Nitrogen Tetroxide	N2O4	N2O4
126 Nitroge Trifluoride	NF3	NF3
127 Nitromethane	CH3NO2	#127
128 Nitrosyl Chloride	NOCl	NOCl
129 Nitrous Oxide	N2O	N2O
130 n-Pentane	C5H12	C5H12

GAS IDENTIFICATION TABLE

# GAS	GAS ID	DISPLAY
131 Octane	C8H18	C8H18
132 Oxygen	O2	O2
133 Oxygen Difluor ide	F2O	F2O
134 Ozone	O3	O3
135 Pentaborane	B5H9	B5H9
136 Pentane	C5H12	C5H12
137 Perchloryl Fluoride	ClFO3	CLFO3
138 Perfluorocyclobutane	C4F8	C4F8
139 R116	C2F6	C2F6
140 Perfluoropropane	C3F8	C3F8
141 Phenol	C6H6O	C6H6O
142 Phosgene	COCl2	COCl2
143 Phosphine	PH3	PH3
144 Phosphorus Trifluoride	PF3	PF3
145 Propane	C3H8	C3H8
146 Propyl Alcohol	C3H8O	C3H8O
147 Propyl Amine	C3H9N	C3H9N
148 Propylene	C3H6	C3H6
149 Pyradine	C5H5N	C5H5N
150 R32	CH2F2	CH2F2
151 R123	C2HCl2F3	R123
152 R123A	C2HCl2F3	R123A
153 R125	C2HF5	C2HF5
154 R134	C2H2F4	R134
155 R134A	C2H2F4	R134A
156 R143	C2H3F3	R143
157 R143A	C2H3F3	R143A
158 R152A	C2H4F2	R152A
159 R218	C3F8	C3F8
160 R1416	C2H3Cl2F	R1416
161 Radon	Rn	Rn
162 Sec-butanol	C4H10O	#162
163 Silane	SiH4	SiH4
164 Silicon Tetrafluoride	SiF4	SiF4
165 Sulfur Dioxide	SO2	SO2
166 Sulfur Hexafluoride	SF6	SF6
167 Sulfur Tetrafluoride	SF4	SF4
168 Sulfur Trifluoride	SF3	SF3
169 Sulfur Trioxide	SO3	SO3
170 Tetrachloroethylene	C2Cl4	#170
171 Tetrafluoroethylene	C2F4	C2F4
172 Tetrahydrofuran	C4H8O	C4H8O
173 Tert-butanol	C4H10O	#173
174 Thiophene	C4H4S	C4H4S
175 Toluene	C7H8	C7H8
176 Transbutene	C4H8	C4H8
177 Trichloroethane	C2H3Cl3	#177
178 Trichloroethylene	C2HCl4	#178
179 R113	C2Cl3F3	R113
180 Triethylamine	C6H15N	#180
181 Trimethyl Amine	C3H9N	C3H9N
182 Tungsten Hexafluoride	WF6	WF6
183 Uranium Hexafluoride	UF6	UF6
184 Vinyl Bromide	C2H3Br	#184
185 Vinyl Chloride	C2H3Cl	#185
186 Vinyl Fluoride	C2H3F	C2H3F
187 Water Vapor	H2O	H2O
188 Xenon	Xe	Xe
189 Xylene, m-	C8H10	C8H10
190 Xylene, 0-	C8H10	C8H10
191 Xylene, p-	C8H10	C8H10



Jumper Locations for Selecting GND or +15V Purge Signals for CH1, CH2, CH3 and CH4