

Model: CAT3
DC or AC Powered Microprocessor
Controlled Transmitter

USER'S MANUAL



HP-312
September 2013

H **HOFFER FLOW CONTROLS, INC.**
PERFECTING MEASUREMENT™

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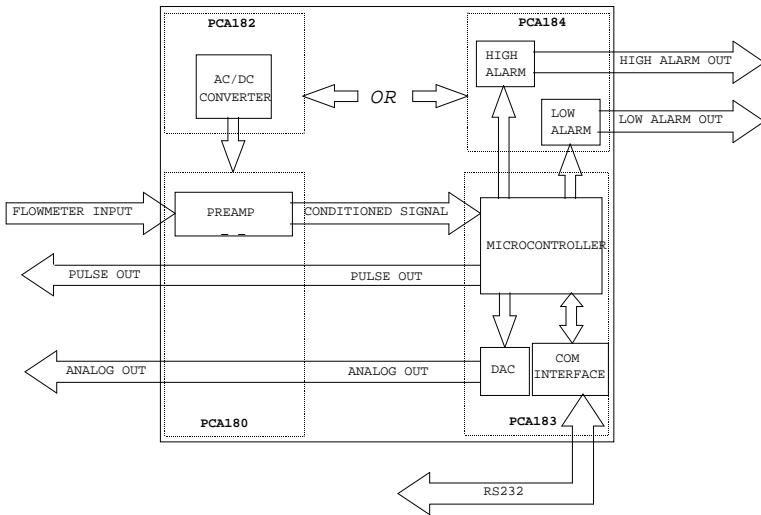
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1. Introduction

The CAT3 is a versatile DC or AC powered microprocessor-based transmitter, which provides pulse output, analog output and High/Low flow alarm options. Up to 3 circuit boards may be installed to provide a variety of input/output options.

The flowmeter input circuitry will accept a variety of signal types including, low level sinusoidal, MCP/RF, pulse and contact closure. Optional 20-point linearization is available to correct for flowmeter non-linearities, improving overall system accuracy. The CAT3 is compatible with all Hoffer turbine flowmeters as well as the H.O.G. series positive displacement flowmeters.

CAT3 Block Diagram

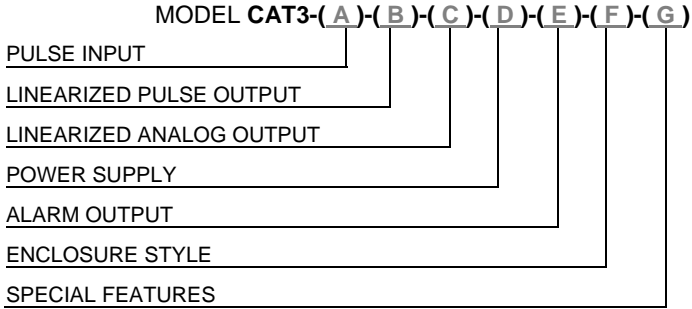


An RS232 communications port located under the top plate allows CAT3 to be remotely configured using a Windows based application that included with all units. Configuration and remote monitoring may also be performed using any PC based communications program (e.g., HyperTerminal) or ASCII terminal.

2 Introduction

The standard unit is packaged in an extruded aluminum enclosure for wall mounting or may be mounted directly on a flowmeter using an optional NEMA 4X or EX enclosure. An optional bracket is also available for mounting on standard DIN rail.

1.1. Model Number Designation



PULSE INPUT

MODEL CAT3-(A)-()-()-()-()-()-()

OPTION (A)

- (1) MAG COIL, PULSE, DRY CONTACT
- (2) MC3P
- (3) ISOLATED PULSE, RPM, RPR AND HALL EFFECT COILS

LINEARIZED PULSE OUTPUT

MODEL CAT3-()-(B)-()-()-()-()-()

OPTION (B)

- (1) 0-5 TTL / CMOS
- (2) OPEN COLLECTOR
- (3) OPEN COLLECTOR WITH PULL UP TO V+
- (4) AC SQUARE WAVE
- (5) 0-10V SQUARE WAVE

LINEARIZED ANALOG OUTPUT

MODEL CAT3-()-()-(C)-()-()-()-()

OPTION (C)

- (1) 4-20 MA
- (5) 1-5 VDC

POWER SUPPLY

MODEL CAT3-()-()-()-(D)-()-()-()

OPTION (D)

- (DC) 13-30 VDC
- (AC) 100-240 VAC

**NOTE: WHEN (AC) IS SELECTED, THE ALARM OPTION IS NOT AVAILABLE.
USE REMOTE ACC39B POWER SUPPLY IF REQUIRED.**

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ALARM OUTPUT

MODEL CAT3-()-()-()-()-(E)-()-()

OPTION (E)

- (4) HIGH OPEN COLLECTOR
- (5) HIGH TTL / CMOS
- (6) HIGH RELAY ONE SPDT, CONTACT RATED @ 2A 30V
- (7) LOW OPEN COLLECTOR
- (8) LOW TTL / CMOS
- (9) LOW RELAY ONE SPDT, CONTACT RATED @ 2A 30V

**NOTE: WHEN ALARM OPTION IS SELECTED, (AC) POWER IS NOT AVAILABLE.
USE REMOTE ACC39B POWER SUPPLY.**

ENCLOSURE STYLE

MODEL CAT3-()-()-()-()-()-(E)-()

OPTIONS (F)

- (1) GENERAL PURPOSE.
2.6"L X 2.6"H X 2.6"W MINIMUM MOUNTING SPACE.
- (D) 2" LONG DIN RAIL MOUNT SINGLE UNIT.
UP TO 20 CAT3 UNITS CAN BE MOUNTED ON A SINGLE
RAIL. ADD 2" PER UNIT.
- (E3) EXPLOSION-PROOF
 - FM: CLASS I, DIV. 1, GR. ABCD, CLASS II/III, DIV. 1, GR. EFG,
TYPE 4X
 - CSA: CLASS I, DIV. 1, GR. ABCD, CLASS II, DIV. 1, GR. EFG,
CLASS III, TYPE 4X, Ex d IIC, CLASS 1, ZONE 1, IP 66
 - ATEX: Ex II 2GD, Ex d tD IIC, IP66/IP68
 - IEC: Ex d IIC, IP68

NOTE: FOR UL LISTED EXPLOSION-PROOF ENCLOSURES CONTACT FACTORY.

- (E4) EXPLOSION-PROOF - FOR USE WITH AC POWERED CAT ONLY
 - FM: CLASS I, DIV. 1, GR. ABCD, CLASS II/III, DIV. 1, GR. EFG,
TYPE 4X
 - CSA: CLASS I, DIV. 1, GR. ABCD, CLASS II, DIV. 1, GR. EFG,
CLASS III, TYPE 4X, Ex d IIC, CLASS 1, ZONE 1, IP 66
 - ATEX: Ex II 2GD, Ex d tD IIC, IP66/IP68
 - IEC: Ex d IIC, IP68

NOTE: FOR UL LISTED EXPLOSION-PROOF ENCLOSURES CONTACT FACTORY.

SPECIAL FEATURES

MODEL CAT3-()-()-()-()-()-()-(G)

OPTIONS (G)

- (CE) MARK REQUIRED FOR EUROPE
- (SP) ANY SPECIAL FEATURES THAT ARE NOT COVERED IN THE MODEL NUMBER, USE A WRITTEN DESCRIPTION OF THE -SP
- (MIL) DESIGNED TO MEET EMC STDS EN5011-1992 AND EN61326-1:1997

- NOTES:
1. IF ENCLOSURE IS MOUNTED ON TURBINE FLOWMETER, RISER MUST BE SPECIFIED ON METER.
 2. PULSE SCALING IS SUPPLIED AS A STANDARD IN THE BASE PRISE AND IS SCALED TO THE UNIT MEASURE.
 3. WINDOWS® BASED SETUP AND CABLE KIT CONSISTS OF:
 - 1 EA. HIT2A-301
 - 1EA. CABLE MODEL 26886
 - 1 EA. WINDOWS® BASED SETUP DISC

IF THE CAT IS SHIPPED UN-CALIBRATED, THIS MUST BE ORDERED TO CALIBRATE OR RE-CALIBRATE IN THE FIELD.

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3. Specifications

General Specifications

Input Signal Type:	Magnetic pick up, MCP pick up, Contact Closure, Pulse
Input frequency range:	0.2 Hz to 4 KHz
Signal level:	10 mV rms to 30 Vdc
Power supply:	13-30 Vdc (Reverse polarity protected) 100-240 Vac (Fuse rating 0.5A, 250 Vac)
Analog Output:	4-20mA, 1-5V 24mA overflow condition
Load resistance:	Max 650 Ohms at 24 Vdc
Accuracy:	+/- 0.02% of full scale @ 20° C
Temperature drift:	40ppm/deg C
Pulse output	0-5, 0-10V, Open Collector, AC square Internal pull-up resistor 10k Ohms Recommended load min. 50k Ohms
Pulse Scaling	Per flow unit of measure, divide by 1, 10, 100
Hi/Lo Alarm	Relay (2A, 30 Vdc), 0-5V, Open Collector (0.5A, 30 Vdc)
Communications	RS232 port for Configuration and diagnostics
Operating temperature:	-40 to 85 C°
Humidity:	0-90% Non-condensing
Enclosure:	Extruded aluminum DIN rail mount Explosion Proof
Regulatory:	CE compliant

Options

20 point linearization

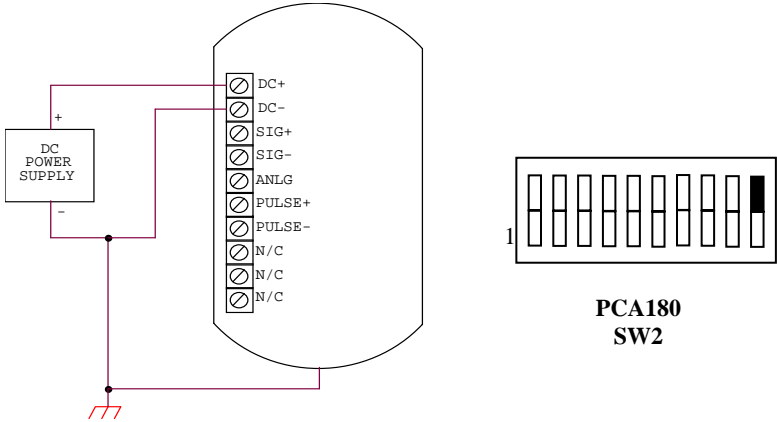
8 Specifications

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4. Installation and Operation

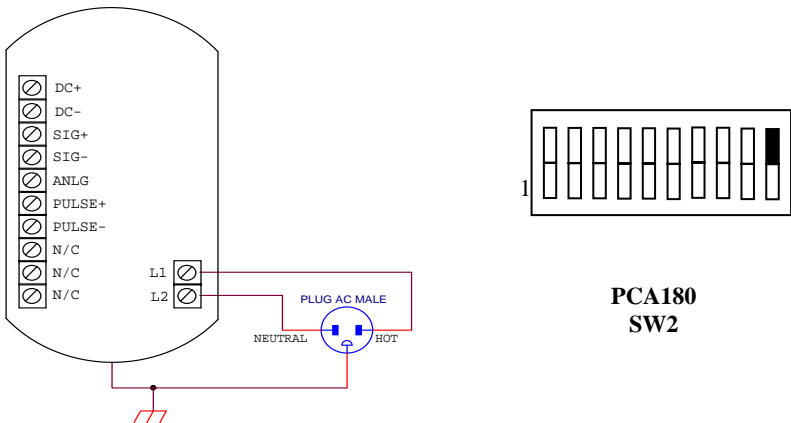
4.1. Power Supply

DC Power (13-30 VDC)



AC Power (100-240 VAC)

AC power for CAT3 requires an optional circuit board, PCA182. The Alarm option (PCA184) is not available when the AC Power option is equipped.

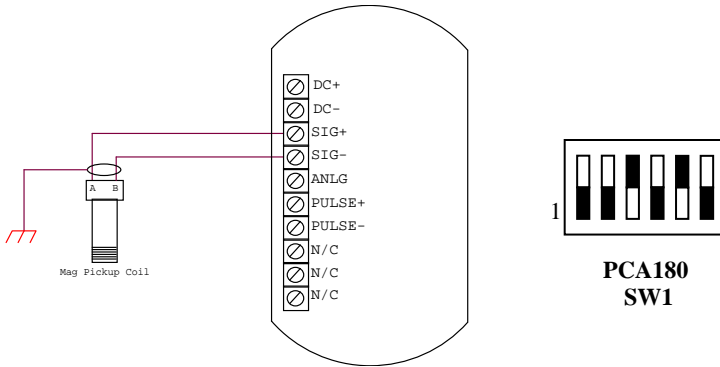


10 Installation and Operation

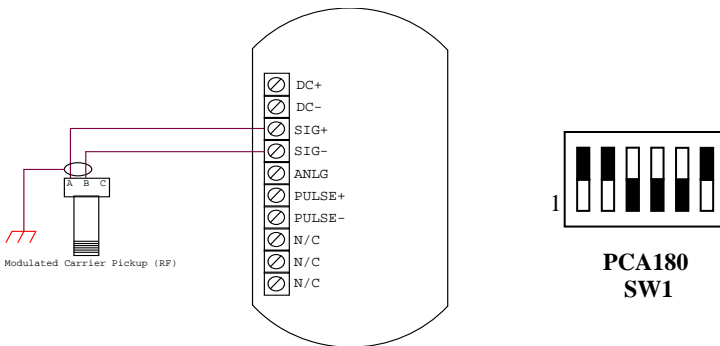
4.2. Flowmeter Input

The Preamp circuitry for conditioning the flow signal is located on PCA180. The following drawings illustrate typical connections and switch settings on PCA180 for various input signals.

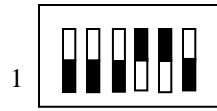
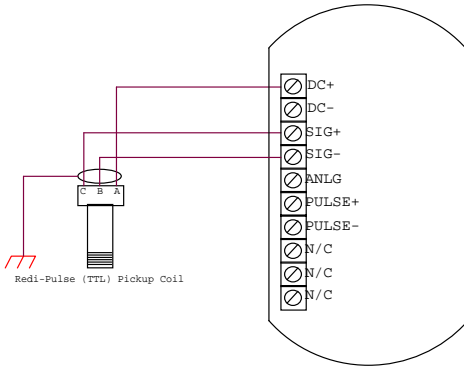
Magnetic Pickup Coil



MCP/RF Coil

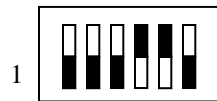
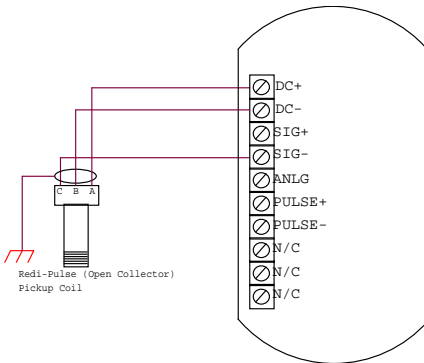


Redi-Pulse (TTL Pulse)



**PCA180
SW1**

Redi-Pulse (Open Collector)



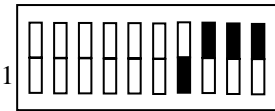
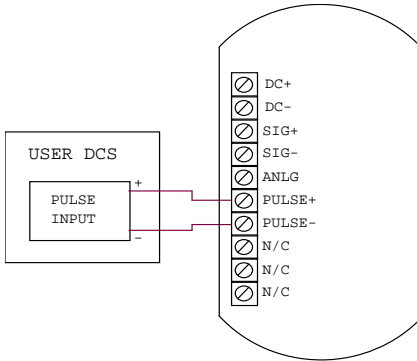
**PCA180
SW1**

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4.3. Pulse Output

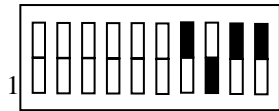
CAT3 provides a Pulse Output option that is scaled per flow unit of measure by a factor of 1, 10 or 100. The following drawings illustrate typical connections and switch settings for various pulse output options.

TTL(0-5V), 0-10V, High Level (DC In), AC Square



**PCA180
SW2**

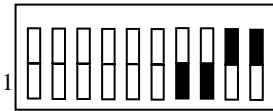
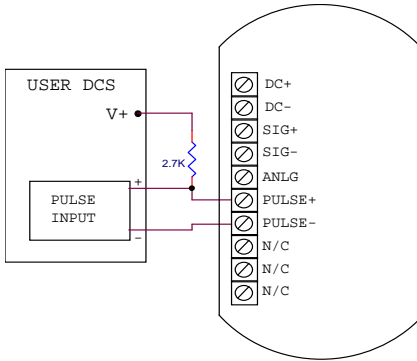
TTL(0-5V), 0-10V, AC Square



**PCA180
SW2**

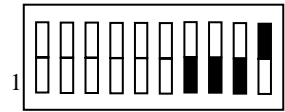
High Level Pulse, AC Square

Open Collector, Isolated Pulse



**PCA180
SW2**

Open Collector



**PCA180
SW2**

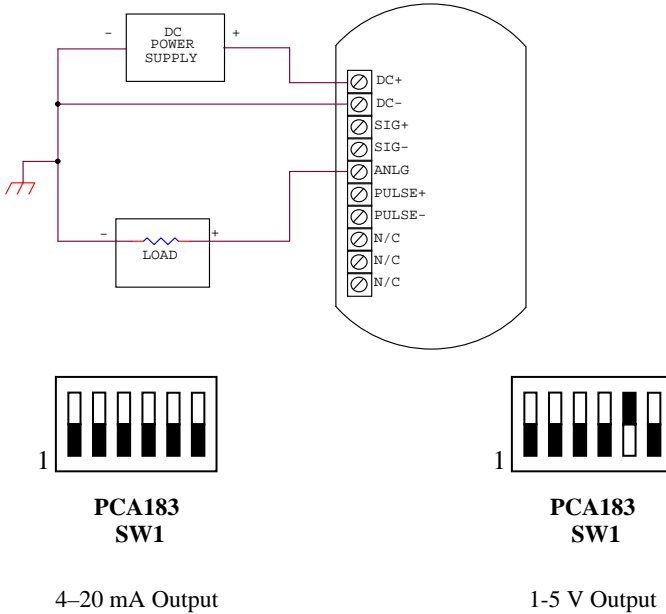
Isolated Pulse

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4.4. Analog Output

CAT3 provides an Analog Output option that will output an analog current or voltage that is proportional to the flow rate.

Analog Output



The Microcontroller, located on PCA183, accepts the square-wave output of the preamplifier and performs all of the calculations that are required to control the Loop Driver. After measuring the frequency of the square-wave, the Microcontroller uses the following equations to compute the flow rate and current.

$$flowrate = \frac{frequency}{Kfactor} \times 60^{FM} \times CF$$

Where:

- Kfactor = Is dependent on the Flow Calculation Method setting and is either the Average K-Factor or the Linearized K-Factor from the Frequency / K-Factor table.
- FM = Is the Flow rate Units setting of 0, 1, or 2. Where “0” is for Seconds, “1” is for Minutes, and “2” is for Hours.
- CF = Is the Correction Factor setting.

$$current = 4mA + \left(16mA \times \frac{flowrate}{AF} \right)$$

Where:

- AF = Is the 20 mA maximum Flow rate value.

If the calculated flowrate is greater than the AF setting, the current will be set to 24mA to indicate an “Over-range” condition. After calculating the current, the Microcontroller digitally sends the current information to the Loop Driver. The loop driver, located on PCA183, uses the digital information sent to it by the Microcontroller to set the current of the loop. The Loop Driver also supplies power to the Microcontroller.

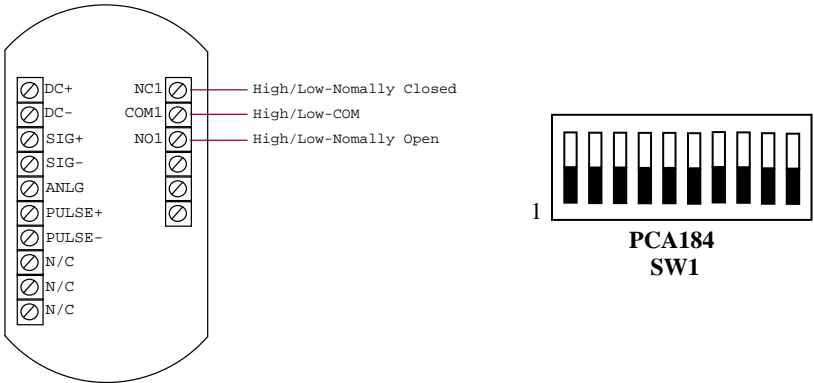
The analog output response time to reach steady state due to a change in the flow rate is approximately 1/8 of a second. When flow stops, the time for the analog output to return to 4 mA will be between 3 and 12 seconds, depending on the Maximum Sample Time (MST) setting. MST is adjusted using the NB=(DATA) command, where NB is a value between 1 and 80. The default MST setting is NB= 1. Adjusting the MST is only recommended for low flow applications where the minimum input frequency is below 1 Hz.

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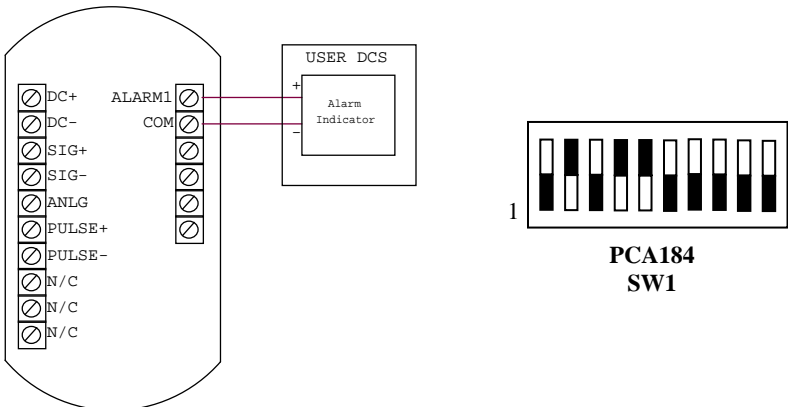
3.5 Alarm Outputs

CAT3 provides an optional High/Low Flow Alarm feature. Alarms require an optional circuit board, PCA184. The Alarm option is not available when the AC Power option is equipped. The drawings below illustrate the typical connections and switch settings for various alarm options.

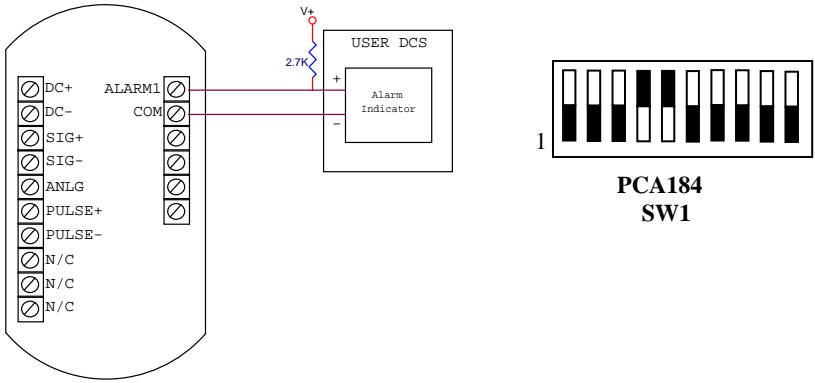
Hi/Lo Alarm Relay



Hi/Lo Alarm TTL(0-5V)



Hi/Lo Alarm Open Collector



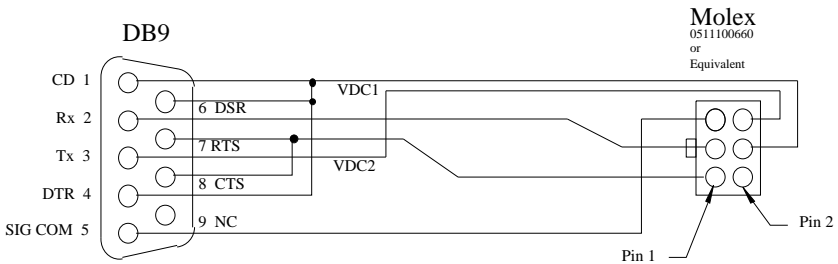
18 Installation and Operation

4.5. Communications Connections

The RS232 serial port connector is located under the top plate of CAT3 and may be accessed by removing the two screws from the top plate. A matching connector is provided with HOFFER HIT2A-301 Communications Cable. CAT3 unit has to be powered from external supply in order to be able to communicate. Additional power for CAT3 communication circuitry is supplied by the RS232 serial port of the computer/terminal. COM port settings must be set as follows:

Baud Rate: 2400
Data Bits: 8
Parity: None
Stop bits: 1
Handshaking: None

HOFFER HIT2A-301 Communications Cable



4.6. Wiring

When installing CAT3, it is a good practice to use shielded cables for all input and output signals. The shield should be connected to the earth ground lug on the CAT3. The shield on the opposite end of the cable should be left open.

This wiring practice is mandatory in order to comply with the requirements for Electromagnetic Compatibility, as per EMC-Directive 89/336/EEC of the Council of European Community.

Appendix A – Default Configuration

Factory default configuration:

<i>FIELD</i>	<i>Value</i>
DN	10000000
FC	0 (<i>Average</i>)
KD	3
AK	1.00
NP	20
F01	4999.981
F02	4999.982
F03	4999.983
F04	4999.984
F05	4999.985
F06	4999.986
F07	4999.987
F08	4999.988
F09	4999.989
F10	4999.990
F11	4999.991
F12	4999.992
F13	4999.993
F14	4999.994
F15	4999.995
F16	4999.996
F17	4999.997
F18	4999.998
F19	4999.999
F20	5000.000
K01	1.00
K02	1.00
K03	1.00
K04	1.00
K05	1.00
K06	1.00
K07	1.00
K08	1.00
K09	1.00
K10	1.00
K11	1.00
K12	1.00
K13	1.00
K14	1.00
K15	1.00

20 Appendix A – Default Configuration

<i>FIELD</i>	<i>Value</i>
K16	1.00
K17	1.00
K18	1.00
K19	1.00
K20	1.00
CF	1.000
TU	100 (<i>GAL</i>)
FM	1 (<i>MIN</i>)
NB	01
LF	00000.000
AF	99.999
PS	0 (<i>OFF</i>)
FO	8
UA	Off
AL	99999.981
OC	0 (<i>Rate</i>)
TP	No
AS	No

Appendix B - Communications

Message Format And Timeout

Communication messages consist of a string of ASCII characters terminated by a carriage return character. The maximum message length coming to the CAT3 is 20 characters, including the carriage return. The CAT3 will transmit no more than 35 characters before transmitting a carriage return.

If a message longer than 20 characters sent, the instrument responds with

"Command Sequence is Too Long! <NL>"

If an unrecognized or invalid command is sent, the instrument responds with

"Invalid Command! <NL>"

The sending unit RS232C serial port configuration must be configured as follows:

Baud rate:	2400
Data bits:	8
Parity:	none
Stop bits:	1
Handshaking:	none

The CAT3 echoes all received messages and then transmits a response string terminated with a carriage return. If the sending unit takes longer than one minute to send a message, CAT3 aborts the message by clearing the receive buffer.

If the sending unit (PC or other such device) wishes to change a setting on the CAT3, the sending unit shall follow the command with an equal sign (“=”) with the data following immediately after the equal sign. The carriage return terminates the message.

Any CAT3 response that sends data back to the sending unit shall have an equal sign (“=”) followed by the data. Space is allowed between the equal sign and the data on the return message, but the total message length is limited to 35 characters.

READ Example:

If the sending unit wishes to read the number of points that the CAT3 has in the K factor table, the sending unit shall send

"NP<CR>"

The CAT3 echoes the sent message, and responds with

"NUM PTS = 2<CR>"

WRITE Example:

If the sending unit wishes to change the number of points to 20 in the K factor table, the sending unit shall send

"NP=20<CR>"

The CAT3 echoes the sent message and responds with

"NUM PTS = 20<CR>".

The CAT3 checks the ranges for data and rejects writes that are not within the allowed range. If the sending unit sends data that is not within the allowed range, the CAT3 echoes the sent message and responds with the value that is currently stored in the CAT3.

Example:

If the sending unit wishes to change the max sample time to 2000 from the previous setting of 10, the sending unit shall send

"NB=2000<CR>"

The CAT3 echoes the sent message, and responds with

"MAX M TIME= 10<CR>".

Messages

Commands Supported By Communications Messages

Command	Description/Allowed Data/Response
<p>DN</p>	<p>Tag Number "0" to "99999999" "TAG NUM = (DATA)" The first three digits are the units code for total. Changing these digits will change the TU settings.</p>
<p>FC</p>	<p>Linearization "0" = Average K factor "1" = Linearization table "F C METHOD = AVG" for Average K factor or "F C METHOD = LIN" for Linearization table</p>
<p>KD</p>	<p>K Factor Decimal Point Location "0" for 0000000. "1" for 000000.0 and all K Factors are less than 999999.9, otherwise not allowed "2" for 00000.00 and all K Factors are less than 99999.99, otherwise not allowed "3" for 0000.000 and all K Factors are less than 9999.999, otherwise not allowed "K-FAC DECL=(DATA)"</p>
<p>AK</p>	<p>Average K Factor "0.001" to "99999.999" if KD = 3 "99999.99" if KD = 2 "999999.9" if KD = 1 " 9999999" if KD = 0 "AVG KFAC =(DATA)"</p>
<p>NP</p>	<p>Number Points in the Table "2" to "20" "NUM PTS =(DATA)"</p>

Command	Description/Allowed Data/Response
F##	<p>Frequency 1-20</p> <p>F01 has a range of "0.000" to the value of F02 minus 0.001; F20 has a range of the value from F19 plus 0.001 to "5000.000"; Frequencies F02 to F19 must be 0.001 greater than the previous frequency and 0.001 less than the next frequency.</p> <p>"FREQ ## =(DATA)" for F01 through F20. Data to fixed three decimal places.</p>
K##	<p>K-Factor 1-20</p> <p>"K-FACT # =(DATA)" for K01 through K09.</p> <p>"K-FACT ## =(DATA)" for K10 through K20.</p> <p>DATA to decimal places as per KD command.</p>
CF	<p>Correction Factor</p> <p>"0.001" to "9999999.999"</p> <p>"CORR FACT =(DATA)"</p>
TU	<p>Total Units</p> <p>"100" for gallons</p> <p>"140" for liters</p> <p>"110" for cubic feet</p> <p>"150" for cubic meters</p> <p>"180" for barrels</p> <p>All other integer values from 0 and less than 999 will map to custom units</p> <p>"TOT UNITS =(DATA)"</p> <p>(DATA) shall be:</p> <p>"GAL" for gallons</p> <p>"LIT" for liters</p> <p>"FT3" for cubic feet</p> <p>"M3 " for cubic meters</p> <p>"BBL" for barrels</p> <p>"CUS" for custom</p> <p>These three numbers will be the same as the first three digits of the tag number. Changes to this menu shall cause the changes to the tag number.</p>

Command	Description/Allowed Data/Response
<p>FM</p>	<p>Rate Units</p> <p> "0" for seconds</p> <p> "1" for minutes</p> <p> "2" for hours</p> <p> "3" for days</p> <p> "FLOW UNITS=(DATA)"</p> <p> (DATA) shall be:</p> <p> "SEC" for seconds</p> <p> "MIN" for minutes</p> <p> "HR " for hours</p> <p> "DAY" for days</p>
<p>NB</p>	<p>Max Sample Time</p> <p> "1" to "80"</p> <p> "MAX M TIME=(DATA)"</p>
<p>LF</p>	<p>Out Low</p> <p> "0.000" to a maximum value of the Out High setting</p> <p> "4mA FLOW =(DATA)"</p>
<p>AF</p>	<p>Out High</p> <p> Minimum is the Out Low Setting (LF) to a maximum of the following:</p> <p> "99999.999" if RD = 3</p> <p> "999999.99" if RD = 2</p> <p> "9999999.9" if RD = 1</p> <p> " 99999999" if RD = 0</p> <p> "20mA FLOW =(DATA)"</p>
<p>PS</p>	<p>Pulse Scale</p> <p> "0" for OFF</p> <p> "1" for 1</p> <p> "10" for 10</p> <p> "100" for 100</p> <p> "PULS SCALE=(DATA)"</p> <p> (DATA) shall be:</p> <p> "OFF" for OFF</p> <p> "1" for 1</p> <p> "10" for 10</p> <p> "100" for 100</p>

Command	Description/Allowed Data/Response
FO	Pulse Frequency "1" "2" "4" "8" "PULS FREQ = (DATA) "
UA	Alarm Function "0" for OFF "1" for RATE "2" for TOTAL "ALARM FUNC= (DATA) " (DATA) shall be: "OFF" for OFF "RAT" for RATE "TOT" for TOTAL
AL	Alarm Out "0.001" to a maximum defined as follows: If UA is RATE: "99999.999" if RD = 3 "999999.99" if RD = 2 "9999999.9" if RD = 1 " 99999999" if RD = 0 If UA is Total or Off: "99999.999" if TD = 3 "999999.99" if TD = 2 "9999999.9" if TD = 1 " 99999999" if TD = 0 "ALARM OUT = (DATA) "
OC	Current Out "0" - Current output follows rate. "1" - Current output set to 4mA. "2" - Current output set to 12mA. "3" - Current output set to 20mA. For "0", response = " Output equal to input." For "1", response = " Output is 4mA." For "2", response = " Output is 12mA." For "3", response = " Output is 20mA."

Command	Description/Allowed Data/Response
PR	Pulse Output Controlled By PS and FO " Pulse Output Released " The PS and FO menus shall control the pulse output. Used to terminate the TP command.
TP	Output 1Hz Test Frequency for Pulse Output " Test Pulse Output " Sets output to 1Hz, 50% duty cycle signal. This mode is for factory test.
RA	Release Alarm Output for Control According to Menu Settings " Alarm Released " Releases alarm output for control by the alarm output settings.
AS	Alarm Output Test "0" – Alarm output is set low. "1" - Alarm output is set high. For "0", response = " Alarm Active " For "1", response = " Alarm Released " After using the "AS" command, you must initiate a RA command to allow CAT3 to return to normal operation.

System Commands Supported by Communications Messages

System Command	Description/Response/Comments
OI	Output 4mA " Output is 4mA." Current output set to 4mA.
MO	Output 12mA " Output is 12mA." Current output set to 12mA.
OM	Output 20mA " Output is 20mA." Current output set to 20mA.
OF	Output = Rate (Input) " Output equal to input." Current output follows rate.
AA	Auto Data "F (DATA) R (DATA) T (DATA)" The response, not the echo, is sent every two seconds until it receives another message from the master. The (DATA) following the F denotes the frequency of the pulses to a precision of three places past the decimal, the (DATA) following the R denotes the rate to a precision of three places past the decimal, and the (DATA) following the T denotes the total to a precision of three places past the decimal.
DA	Dump All All of the responses in previous table. The CAT3 gives all responses except for the CL command.
UI	Unit Identification "UNIT MODEL= XX YY.ZZ" Model and software number for the unit. XX is the hardware revision number, YY.ZZ is the software revision where YY is the major software revision and ZZ is the minor software revision.

System Command	Description/Response/Comments
<p>RR</p>	<p>Read Rate "FLOW = (DATA)" (DATA) = "0" to the following maximums: "99999.999" if RD = 3 "999999.99" if RD = 2 "9999999.9" if RD = 1 " 99999999" if RD = 0</p>
<p>CN</p>	<p>Adjust 4mA output point "CN=# (DATA)"</p> <p>DATA) is the integer value that the CAT3 sends to the 4-20mA converter to output 4mA</p> <p>This parameter is passed to the CAT3 to adjust the 4mA output point of the device. This value is used in production at the test step to calibrate the 4mA output point. "CN" will cause an Invalid Command response and absence of the # symbol will cause the CAT3 to ignore the data.</p>
<p>CM</p>	<p>Adjust 20mA output point "CM=# (DATA)"</p> <p>DATA) is the integer value that the CAT3 sends to the 4-20mA converter to output 20mA</p> <p>This parameter is passed to the CAT3 to adjust the 20mA output point of the device. This value is used in production at the test step to calibrate the 20mA output point. "CM" will cause an Invalid Command response and absence of the # symbol will cause the CAT3 to ignore the data.</p>
<p>SA</p>	<p>Set Alarm Output On " Alarm Active "</p> <p>Sets the alarm output active regardless of the settings.</p>