Model: CAT3-DC-MIL
DC Powered Microprocessor Controlled Transmitter
Style 5 Enclosure

USER’S MANUAL

HP-324-5
January 2018

HOFFER
Flow Controls
Perfecting Measurement™

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FORWARD

The manual contains the information required to install, operate, maintain, and repair a CAT3-DC-MIL Flow Rate Signal Converter.

The CAT3-DC-MIL unit is intended to provide ships personnel with the ability to monitor flow of fuel and other liquids.
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1. SAFETY

The CAT3-DC-MIL Fuel Metering unit is designed to satisfy the safety requirements for shipboard use.

The safety precautions and warnings described here are to be observed at all times. Additional precautionary messages appear throughout this manual.
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2. **COMPLIANCE**

This instrument is designed to conform to the EMC-Directive of the Council of European Communities 89/336/EEC. This instrument has been certified to meet MIL-S-901D for shock and vibration and MIL-STD-461F for EMI compliance.
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3. SPECIFICATIONS

Input Signal Type: Magnetic pick up
Input frequency range: 0.2 Hz to 4 KHz
Signal level: 10 mV rms to 30 Vdc
Power supply: 13-30 VDC
Analog Output: 4-20mA, 24mA overflow condition
Response Time: 1/8 sec.*
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
Maximum Pulse Frequency 1, 2, 4, 8, 100, 50% Duty Cycle
Pulse Scaling Per flow unit of measure, divide by 1, 10, 100
100 Hz max frequency
Communications RS232 port for Configuration and diagnostics
Operating temperature: -40 to 85°C
Humidity: 0-90% Non-condensing
Enclosure: Extruded aluminum housed in Style 5 enclosure (NEMA 4)
Regulatory: CE compliant
Linearization: 20 point

*Limited by signal frequency and MST settings. Refer to Section 4-3.
3-1 Model Number Designation

MODEL  \text{CAT3-}(A)-(B)-(C)-(D)-(E)-(F)-(G)

PULSE INPUT
MODEL CAT3-\text{(A)}-\text{(B)}-\text{(C)}-\text{(D)}-\text{(E)}-\text{(F)}-\text{(G)}
OPTION (A)  
(1) MAG COIL, PULSE, DRY CONTACT

LINEARIZED PULSE OUTPUT
MODEL CAT3-\text{(A)}-\text{(B)}-\text{(C)}-\text{(D)}-\text{(E)}-\text{(F)}-\text{(G)}
OPTION (B)  
(4) AC SQUARE WAVE

LINEARIZED ANALOG OUTPUT
MODEL CAT3-\text{(A)}-\text{(B)}-\text{(C)}-\text{(D)}-\text{(E)}-\text{(F)}-\text{(G)}
OPTION (C)  
(1) 4-20 MA

POWER SUPPLY
MODEL CAT3-\text{(A)}-\text{(B)}-\text{(C)}-\text{(D)}-\text{(E)}-\text{(F)}-\text{(G)}
OPTION (D)  
(DC) 13-30 VDC

ALARM OUTPUT
MODEL CAT3-\text{(A)}-\text{(B)}-\text{(C)}-\text{(D)}-\text{(E)}-\text{(F)}-\text{(G)}
OPTION (E)  
(X) NONE

ENCLOSURE STYLE
MODEL CAT3-\text{(A)}-\text{(B)}-\text{(C)}-\text{(D)}-\text{(E)}-\text{(F)}-\text{(G)}
OPTIONS (F)  
(5) STYLE 5 ENCLOSURE, NEMA 4

SPECIAL FEATURES
MODEL CAT3-\text{(A)}-\text{(B)}-\text{(C)}-\text{(D)}-\text{(E)}-\text{(F)}-\text{(G)}
OPTIONS (G)  
(MIL) DESIGNED TO MEET EMC STDS EN5011-1992 AND EN61326-1:1997

HP-324-5
4. **OPERATION**

The CAT3-DC-MIL is a DC powered microprocessor-based transmitter, which provides pulse and analog outputs. The flowmeter input circuitry will accept a magnetic type pickup, pulse and contact closure. Optional 20-point linearization is available to correct for flowmeter non-linearity, improving overall system accuracy.

**CAT3-DC-MIL Block Diagram**

**4-1 Preamplifier**

The Preamplifier receives signals from the flow sensor pick up coil. The signal is amplified, filtered, and converted into a logic level square-wave before sending it to the Microcontroller.

**4-2 Microcontroller**

The Microcontroller performs all of the calculations that are required to control the analog output and pulse output. The following equations are used to calculate the flowrate and the analog output current.
8 Operation

Flowrate = frequency/K-factor x 60

Where:

K-factor = Is the flow meter calibration factor in pulses/gal

Flowrate is in gal/min.

Frequency is in Hertz.

4-3 Analog Output

CAT3-DC-MIL provides an analog output current that is proportional to the flow rate. The analog output is scaled as follows:

4 mA = 0 GPM
20mA = Max Flow Rate in GPM

If the calculated flowrate is greater than the 20mA setting, the current is set to 24mA to indicate an “Over-range” condition. Microcontroller calculates the current and sends data to the Loop Driver. The Loop Driver, located on PCA183 controls the current of the loop. The Loop Driver also supplies power to the Microcontroller.

The analog output is updated 8 times per second (8 Hz). When flow stops, the time for the analog output to return to 4 mA is between 250 mS and 8 seconds, depending on the Maximum Sample Time (MST) setting. MST is a value between 1 and 80, with each count equal to 1/10th of a second. The MST setting adjusts the amount of time the electronics will wait for the next input pulse before returning to zero. This will prevent the displayed flow rate and/or analog output from going to 0 when the input frequency is less than the update time of the electronics. Adjusting the MST is only recommended for low flow applications where the minimum input frequency is below 10 Hz. The default MST setting is 1.
4-4  Scaled Pulse Output

CAT3-DC-MIL Pulse Output can be configured for turbine raw frequency or for unit of measure scaled for the least significant digit of the internal total. A scaling factor of 1, 10 or 100 is available to reduce or increase the resolution of the pulse output. For example, if the Total Decimal Point is set to 0000000.0, and the Pulse Scale is 1, then 1 pulse will be output for each tenth (0.1) of a unit of measure. Changing the Pulse Scale to 10, would result in an output pulse for each 1.0 unit of measure. The output must be scaled so that the pulse frequency does not exceed the Pulse Frequency setting (100 Hz. Max) at the maximum flow rate.

4-5  Communications Interface

An RS232 communications port located under the top plate allows CAT3-DC-MIL to be remotely configured and trouble-shoot using a Windows based program. Refer to the Appendix B section for communication details.

The communication function is available only when CAT3-DC-MIL device is powered.
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5. INSTALLATION

5-1 Wiring

When installing CAT3-DC-MIL, 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-DC-MIL. 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.
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6. **PREVENTATIVE MAINTENANCE**

6-1 **Introduction**

Observe any scheduled organizational level maintenance instructions dictated by the requirements of the Planned Maintenance System (PMS) established by the Naval Sea System Command for fuel system components.

6-2 **Unit Removal**

1. Turn off the power supply.
2. Open the Style 5 enclosure and unplug the 10-pin terminal from the header.
3. Remove the top plate screw from the blue enclosure to disconnect ground wire.
4. Remove two mounting screws from the mounting plate on the bottom of the blue enclosure.
5. Remove the unit and install new one.
6. Replace all mounting screws.
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7. TROUBLESHOOTING

7-1 Introduction

The troubleshooting techniques in this chapter are designed to isolate and locate the area of failure and to present the procedures for the replacement of subassemblies to make the system operational.

7-2 Troubleshooting Procedures

The required test equipment for troubleshooting is as follows:

Digital Multimeter: Fluke Model 8060A or equal.

Identify one of the symptoms listed below and follow the procedure. In each case proceed to the next step only if the defect is not found.

7-2-1 Symptom: No flow indication when flow is present

1. Visually examine the interconnecting signal cable for broken or shorted leads.

2. With an established flowrate, configure the digital multimeter to measure AC volts, using the two volt scale. Measure voltage at the terminal, on Pin 3, SIG+ and Pin 4 SIG-. Depending on the flowrate, an approximate voltage reading of 10 millivolts to 1 volt should be measured. If voltage is present replace the electronic unit. If no voltage go to step 3.

3. Disconnect the signal cable from the electronics unit and from the flow sensor. Check the continuity of each lead of the cable. If defective replace or repair.

4. With the signal cable disconnected from the flow sensor measure the DC resistance of the pickup coil. The resistance should read between 1500 and 2200 ohms between pin A and pin B. A short or an open indicates a defective pickup coil and the pickup coil must be replaced.
5. With an established flowrate, configure the digital multimeter to measure AC volts, using the two volt scale. Connect the positive lead to pin A of pickup coil. And the negative lead to pin B of pickup coil. Depending on the flowrate an approximate voltage reading of 10 millivolts to 1 volt should be measured.

6. If zero volts are measured, a stalled rotor condition is indicated. Remove the flow sensor from the piping. Refer to flow sensor manual.

**7-2-2 Symptom: Flow indication with no flow present**

This symptom indicates the presence of electrical noise pickup.

1. Disconnect the signal cable from the electronics unit and from the flow sensor. Check the continuity of each lead of the cable. If defective replace or repair.

2. With the signal cable disconnected from the flow sensor measure the DC resistance of the pickup coil. The resistance should read between 1500 and 2200 ohms between pin A and pin B. A short or an open indicates a defective pickup coil and the pickup coil must be replaced.

3. Verify cable shield connection.

4. Verify electronics unit enclosure connection to ships ground.
### Appendix A – Default Configuration

Factory default configuration:

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<th>Value</th>
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<td>ALARM TEST</td>
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</table>
Appendix B - Communications

Communications Interface

CAT3-DC-MIL is equipped with a serial communication interface RS232 to allow changing flow sensor calibration parameters (k-factors). The calibration parameters must be updated whenever the flow sensor is recalibrated. The serial port may be accessed by removing the two screws from the top plate of the blue enclosure. External power must be supplied to the CAT3 in order to communicate.

Communications with the CAT3-DC-MIL also requires the use of the HOFFER HIT2A-301 Communications Cable and the Hoffer Windows Device Configuration Software. The computer serial port must be set to the following:

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

![Diagram of DB9 connector with pin assignments](image)

**HIT2A-301 Communications Cable**
Appendix C – Drawings