Hoffer Intelligent Signal Conditioner

Model: HIT-3

USER'S MANUAL

HP-308
August 2004

HOFFER FLOW CONTROLS, INC.
The Turbine Flowmeter Company

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NOTICE

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This manual has been provided as an aid in installing, connecting, calibrating, operating, and servicing this unit. Every precaution for accuracy has been taken in the preparation of this manual; however, Hoffer Flow Controls, Inc. neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages that result from the use of the products in accordance with information contained in the manual.

HOFFER FLOW CONTROLS' policy is to provide a user manual for each item supplied. Therefore, all applicable user manuals should be examined before attempting to install or otherwise connect a number of related subsystems.

During installation, care must be taken to select the correct interconnecting wiring drawing. The choice of an incorrect connection drawing may result in damage to the system and/or one of the components.

Please review the complete model number of each item to be connected and locate the appropriate manual(s) and/or drawing(s). Identify all model numbers exactly before making any connections. A number of options and accessories may be added to the main instrument, which are not shown on the basic user wiring. Consult the appropriate option or accessory user manual before connecting it to the system. In many cases, a system wiring drawing is available and may be requested from Hoffer Flow Controls.

HOFFER FLOW CONTROLS' policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering. The information contained in this document is subject to change without notice.

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HOFFER FLOW CONTROLS, INC. ("HFC") warrants HFC's Precision Series and API Series of turbine flowmeters to be free from defects in material and workmanship under normal use and service, only if such goods have been properly selected for the service intended, properly installed and properly operated and maintained as described in the turbine flowmeter manual. Reference "turbine flowmeter manual" for specific details. This warranty shall extend for a period of five (5) years from the date of shipment to the original purchaser and covers the Precision Series and API Series of flowmeters All other HFC products carry a one (1) year warranty. This warranty is extended only to the original purchaser ("Purchaser"). *Purchaser's sole and exclusive remedy is the repair and/or replacement of nonconforming goods as provided in the following paragraphs.*

In the event Purchaser believes the Hoffer product is defective, the product must be returned to HFC, transportation prepaid by Purchaser, within the appropriate warranty period relative to the product. If HFC's inspection determines that the workmanship or materials are defective and the required maintenance has been performed and, has been properly installed and operated, the product will be either repaired or replaced, at HFC's sole determination, free of additional charge, and the goods will be returned, transportation paid by HFC, using a transportation method selected by HFC.

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This warranty shall not apply to any HFC product or parts thereof, which have been repaired outside HFC's factory or altered in any way, or have been subject to misuse, negligence, or accident, or have not been operated in accordance with HFC's printed instructions or have been operated under conditions more severe than, or otherwise exceeding, those set forth in the specifications.

FOR **NON-WARRANTY** REPAIRS OR **CALIBRATIONS**, consult HOFFER FLOW CONTROLS for current repair/calibration charges. Have the following information available BEFORE contacting HOFFER FLOW CONTROLS:

1. P.O. number to cover the COST of the repair/calibration,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

CONTENTS

1. INTRODUCTION

The HIT-3 is a microprocessor-based intelligent signal conditioner for turbine flowmeters. It improves meter linearity to +/- 0.05% over the specified meter flow range. It is limited only by the repeatability of the meter. The HIT-3 can also provide pulse security for level B applications. The instrument is compatible with all Hoffer turbine flowmeters.

The instrument can accept a low-level frequency signal, a pulse signal, or a contact closure on the input and provide a linearized pulse output.

The HIT-3's K-factors, frequencies, and time base are fully configurable via the RS232 communications port. The configuration and monitoring can be performed using any PC based communications program (e.g., HyperTerminal) or ASCII terminal.

The instrument is housed in a general-purpose enclosure and can be mounted directly on a flowmeter, Din Rail or wall mounted using optional mounting brackets or an EX enclosure.

This instrument has been designed to conform to the EMC-Directive of the Council of European Communities 89/336/EEC and the following standards:

Generic Emission Standard EN 50081-1
Residential, Commercial & Light Industry Environment.

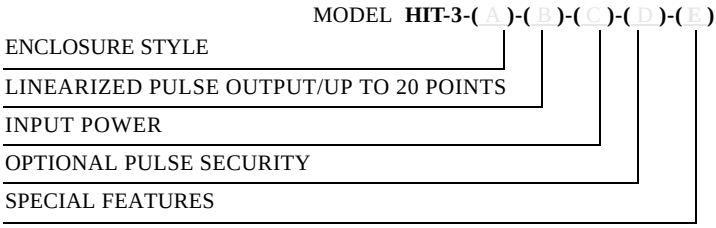
Generic Emission Standard EN 50081-2
Industrial Environment.

Generic Emission Standard EN 50082-1
Residential, Commercial & Light Industry Environment.

Generic Emission Standard EN 50082-2
Industrial Environment.

As of the date of publication of this document, the instrument is undergoing compliance testing.

1-1 Model Number Designation



ENCLOSURE STYLE
MODEL **HIT-3-(A)-( )-( )-( )-( )**
OPTION (A)

(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 HIT-3 UNITS CAN BE MOUNTED ON A SINGLE RAIL.
ADD 2" PER UNIT.

(3/O)* MEETS CLASS 1, DIV. 1 AND 2, GROUPS C**, D
(3H/O)*** CLASS II, GROUPS E, F, G
BODY KILARK #GECCT-3, STOCK #200-0945

*** USE FLAT COVER FOR OPTION (3/O), STOCK #200-0533, KILARK #GECBC.**
**** DOME COVER DOES NOT MEET GROUP C.**
***** USE DOME COVER FOR MODEL (3H/O).**
***** DOME COVER MUST BE USED FOR A/C POWERED UNITS.**

(3B/O)* MEETS CLASS I, DIV. 1 AND 2, GROUPS A, B, C, D
(3BH/O)** CLASS 1, ZONES 1 AND 2, GROUPS IIB + H2, IIA
CLASS II, DIV. 1 AND 2, GROUPS E, F, G
CLASS III, NEMA 3, 4, 7 (B, C, D), 9 (E, F, G)
CERTIFIED CENELEC, CSA, UL, FM
BODY KILARK #HKB, STOCK #200-0406

*** USE FLAT COVER FOR OPTION (3B/O), STOCK #200-0773, KILARK #HKB-B.**
**** USE DOME COVER FOR MODEL (3BH/O), STOCK #200-0405, KILARK #HK2D.**

(3B/O-ATEX) MEETS CLASS I, DIV. 1 AND 2, GROUPS A, B, C, D
CLASS 1, ZONES 1 AND 2, GROUPS IIB + H2, IIA
CLASS II, DIV. 1 AND 2, GROUPS E, F, G
CLASS III, NEMA 3, 4, 7 (B, C, D), 9 (E, F, G)
CERTIFIED ATEX, CENELEC, CSA, UL, FM
BODY/COVER STOCK #200-2006

LINEARIZED PULSE OUTPUT/UP TO 20 POINTS
MODEL **HIT-3-(__)-(B)-(__)-(__)-(__)**
OPTION (B)
(1) OPTO-ISOLATED OPEN COLLECTOR.
ACCURACY 0.05% +1/-0 PULSES.

INPUT POWER
MODEL **HIT-3-(__)-(__)-(C)-(__)-(__)**
OPTION (C)
(D) 5 TO 30 VDC LESS THAN 4MA EXTERNAL POWER

(AC) 115/220 VAC 50/60HZ EXTERNAL POWER.
USE MODEL ACC39B

OPTIONAL PULSE SECURITY
MODEL **HIT-3-(__)-(__)-(__)-(D)-(__)**
OPTION (D)
(PSB) PULSE SECURITY. REQUIRES TWO COILS ON THE TURBINE SPACED 90 ELECTRICAL DEGREES. COMPLIES WITH ISO 6551.

SPECIAL FEATURES
MODEL **HIT-3-(__)-(__)-(__)-(__)-(E)**
OPTION (E)
(CE) CE MARK REQUIRED FOR EUROPE.

(CSA) CSA APPROVED INTRINSICALLY SAFE
CLASS I, DIV. 1, GROUPS A, B, C.

(W) WINDOWS® BASED RS-232 SERIAL PORT CONFIGURATION PROGRAM WITH DISK AND 6 FT COMMUNICATION CABLE (OTHER LENGTHS NOT AVAILABLE). **IF 3 OR MORE HIT'S ARE ORDERED ON THE SAME PURCHASE ORDER ONE SET IS SUPPLIED AT NO CHARGE.**

(SP) ANY SPECIAL FEATURES THAT ARE NOT COVERED IN THE MODEL NUMBER, USE A WRITTEN DESCRIPTION OF THE -SP.

NOTE: INPUTS: ACCEPTS MAGNETIC, REDI-PULSE AND HALL EFFECT COILS.

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2. SPECIFICATIONS

2-1 General

K-factor:	The pulses per unit of Total (e.g. pulses/gallon) are configurable in the range 0.001 to 99,999,999.
Linearization:	Up to 20 points.
Decimal Points:	Decimal Point positions are fully configurable for K-Factors.
Accuracy:	±1 count
Temperature drift:	50 ppm/°C

2-2 Inputs

Magnetic Pickup:

Frequency Range:	10 Hz to 3500 Hz.
Signal Type:	Low-level sinusoidal (30 mV P-P minimum).

Opto-Isolated DC Pulse:

Frequency Range:	10 Hz to 3500 Hz.
Signal Type:	DC pulse.
High (Logic 1):	4 to 30 VDC
Low (Logic 0):	< 1 VDC
Min Current:	0.5 mA
Hystersis:	0.4 VDC
Min Pulse width:	0.1 msec

Contact Closure:

Frequency Range:	10 Hz to 3500 Hz.
Signal Type:	Contact closure to DC common
High (Logic 1):	Open or 4 to 30 VDC
Low (Logic 0):	< 0.5 VDC
Internal Pull-up:	220 kΩ to +3.3 VDC

2-3 DC Power

Voltage:	5 to 30 VDC
Current:	< 4 mA
Protection:	Reverse polarity protected

2-4 AC Power

Voltage:	100 to 240 VAC
Frequency:	47 – 440 Hz
Current:	150 mA
Protection:	Short circuit, Over voltage, & Over temperature

2-5 Physical

Temperature:	Operating:	-22 °F (-30°C) to 158 °F (70 °C) 32 °F (0°C) to 140 °F (60°C) with AC power option.
Humidity:	0 – 90% Non-condensing.	
Packaging:	General Purpose, Din Rail & Explosion proof	

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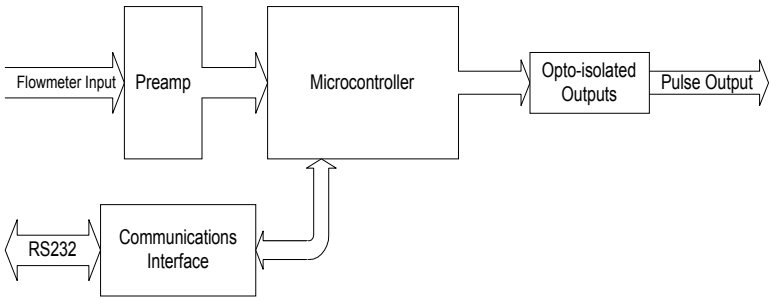
3. THEORY OF OPERATION

The HIT-3 reads input frequency once every second. Based on the input frequency, the turbine K-factors stored in the memory, and the number of pulses received during the last second, the HIT-3 calculates the incremental volume of fluid that flowed through the turbine during the last second. The volume is then multiplied by the stored average K-factor to determine the number of output pulses. The calculated number of pulses is sent to the output in a burst beginning at the start of the next second. The frequency of the burst is scaled such that all pulses are output during the one-second period. Typically, the output number of pulses and the output frequency are very close to the input number of pulses and the input frequency. The difference is determined by the ratio of the "actual" K-factor at the flowing frequency to the "averaged" K-factor stored in the HIT-3. The number of output pulses has to be an integer number, and therefore any fraction that results from the calculations is added to the next one-second period. As a result, even at steady flow, the number of output pulses may fluctuate +/-1 pulse. The output pulses are delayed by one second with respect to the input flow they are representing. When flow stops, the output continues sending pulses for about one second until all calculated pulses have been sent.

3-1 Functional Blocks

The HIT-3 consists of four functional blocks. These functional blocks are the Preamplifier, Microcontroller, Pulse Output and Communications Interface.



3-1-1 Preamplifier

The Preamplifier accepts the input from the flowmeter. The Preamplifier applies amplification, low-pass filtering, and wave-shaping to the input signal. The wave shaping function converts the signal into a square-wave before sending it to the Microcontroller.

3-1-2 Microcontroller

The Microcontroller accepts the square-wave output of the preamplifier and performs all of the calculations that are required to control the Pulse Output. After measuring the frequency of the square-wave, the Microcontroller uses the following equations to compute the pulse output.

$$pulse\_output = \frac{frequency}{Kfactor} \; x \; Kavg$$

Where:

Frequency = the # of pulses per second.

Kfactor = Is the Linearized K-Factor from the Frequency / K-Factor table.

Kavg = Is the average K-Factor.

3-1-3 Pulse Output

The Pulse output is an optically isolated open collector output. The pulse output provides a linearized pulse output calculated from the flowing frequency and the K-Factors. The output is rated for 100 VDC at 100 mA.

3-1-4 Communications Interface

The communication is provided through a RS232C interface to the Microcontroller. The external terminal device provides the power for the RS232 interface. The Communications Interface is used to configure the device. See section 4-2 for operating instructions.

3-2 Pulse Security

A transmission line between flow meter pick up coil and an electronic flow computing device is subject to electromagnetic interference (EMI) generated by external electrical sources. The exposure to the EMI may result in injecting faulty pulses into the transmission line, which can cause the computing device to calculate an incorrect amount of measured fluid.

The HIT-3 Pulse Security option is designed to protect against errors resulting from interfering pulses injected into the transmission line. The Pulse Security option requires a dual coil meter, which generates a quadrature signal and dual transmission lines between meter and a computing device.

The HIT-3 Pulse Security option complies with ISO6551 requirements for pulse security systems.

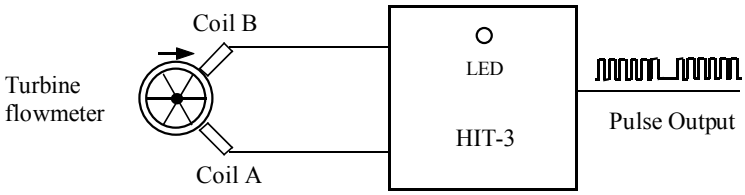


Fig. 1 Pulse Security System with HIT-3

3-2-1 Normal operation

Under normal operating conditions, each pulse generated by coil B is paired with a pulse generated by coil A. Pulses from coil A are lagging behind the pulses from coil B by about 90 degrees of electrical phase. The HIT-3 front panel LED indicator stays off. If connections to coil A and B are reversed, or if the flow reverses, the LED turns ON to indicate incorrect sequence between pulses A and B.

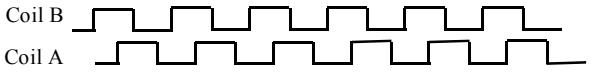


Fig 2. Normal condition pulse sequence

3-2-2 Double pulse condition

A double pulse condition exist when an external EMI interference generates simultaneous pulses on the transmission lines of A and B, or when pulses appear on line A and B within 30 uS (microseconds) of each other, or at zero electrical phase. The double pulses are rejected and are not counted by HIT-3. A momentary flash of the LED indicates double pulses.

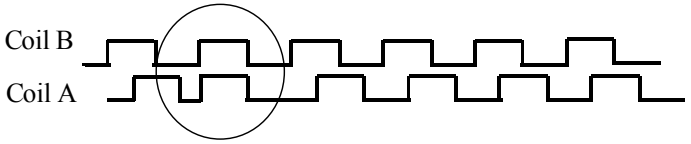


Fig 3. Double pulse condition

3-2-3 Missing Pulse

If pulses are missing from coil B, HIT-3 continues to count pulses from coil A and operates like a system with no pulse security option. Pulses missing from coil A are NOT counted by HIT-3.

Pulses missing from either coil A or B are indicated by the LED. For a single missing pulse the LED flashes momentarily, according to the width of the pulse. If there is a group of pulses missing, the LED stays ON until pulses appear again.

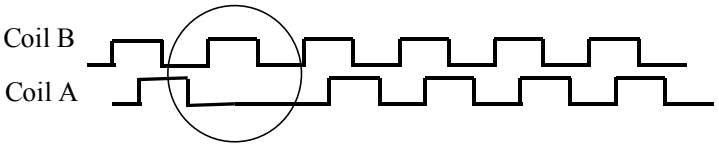


Fig 4. Missing pulse condition

4. INSTALLATION

The HIT-3 has an input conditioning circuit, which accepts signals from most frequency or pulse producing flowmeters.

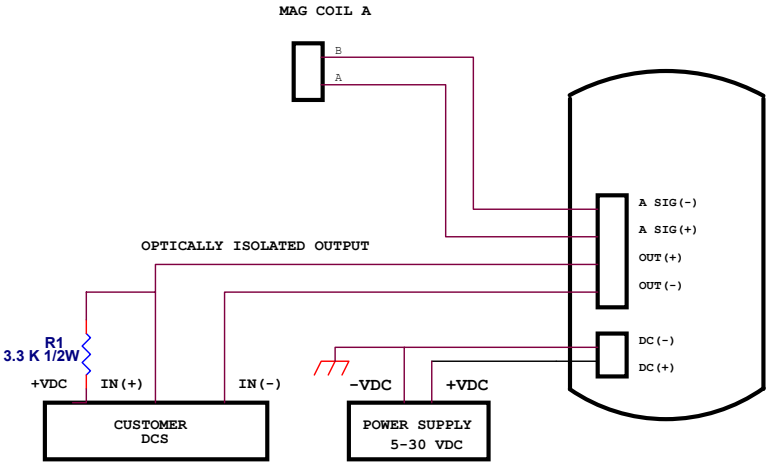
The input will interface directly to:

- Turbine Flowmeters
- Reed Switches
- Logic Signals
- Open Collector Outputs

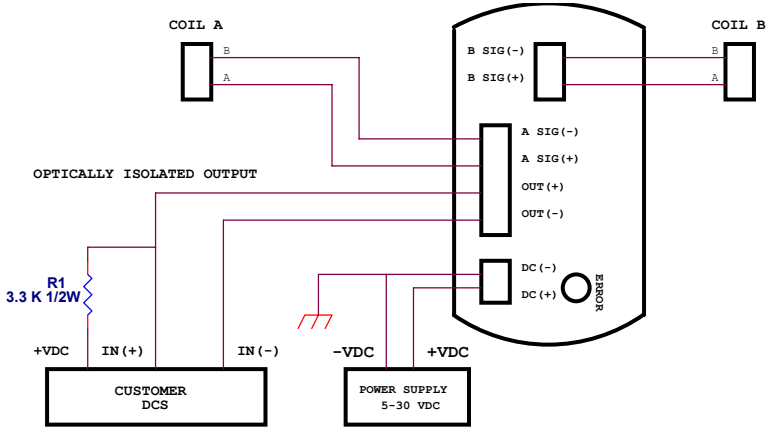
The input is protected for over voltage up to 50 volts.

The flowmeter input must be configured for the selected signal type by the input selection resistors found on the HIT-3 signal input circuit

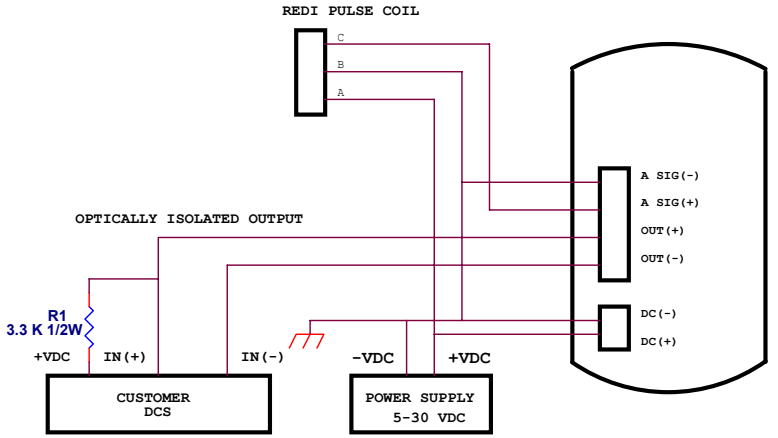
4-1 Typical Input Connections



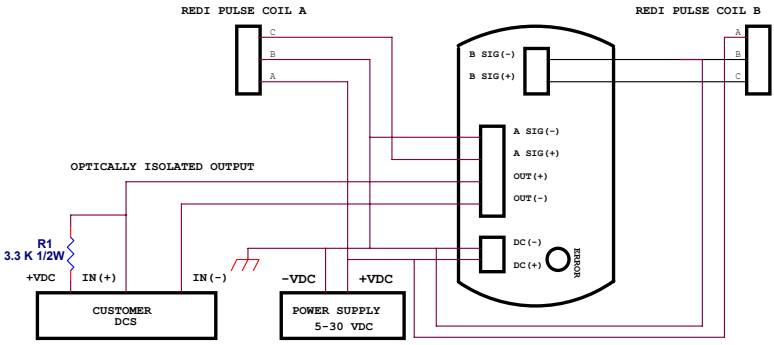
SINGLE COIL INSTALLATION



MAG COIL INSTALLATION W/PULSE SECURITY



REDI PULSE COIL INSTALLATION

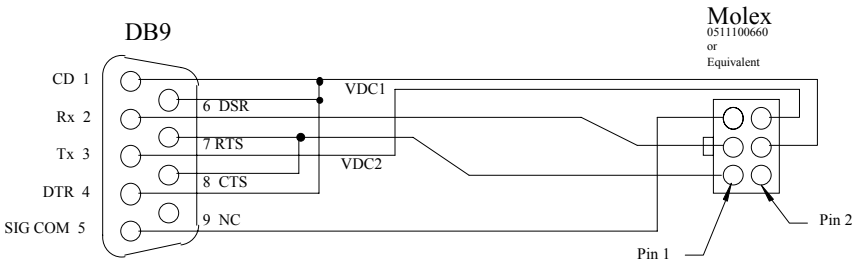


REDI PULSE COIL INSTALLATION W/PULSE SECURITY

4-2 Communications Connections

The HIT-3's K-factors, frequencies, and time base are fully configurable via the RS232 communications port. The configuration and monitoring can be performed using any PC based communications program (e.g., HyperTerminal) or ASCII terminal. Communication with the HIT-3 requires removal of the face plate and a Hoffer Flow Controls HIT2A-301 Communications Cable. The RS232 serial port of the computer/terminal externally powers the communication circuits of the HIT-3. Power must be supplied to the HIT-3 DC(+) and DC(-) to communicate with the HIT-3. The serial port configuration must also be set to the following:

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



Hoffer HIT2A-301 Communications Cable

4-3 Wiring

When connecting the HIT-3, it is good practice to use shielded cable. The shield should be connected to earth ground near the instrument. The other end of the shield should not be connected.

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

4-4 Terminal Designations

Terminal	Description
DC(+)	DC Power Input (+)
DC(-)	DC Power Input (-)
OUT(-)	Pulse Output (-)
OUT(+)	Pulse Output (-)
A SIG(+)	Flow Meter Input(+)
A SIG(-)	Flow Meter Input(-)
B SIG(+)	Flow Meter Input(+) (Pulse Security Option)
B SIG(-)	Flow Meter Input(-) (Pulse Security Option)

5. CONFIGURATION

The HIT-3 is fully configurable, with all parameters being stored in non-volatile memory. When the instrument is purchased with a Hoffer Flowmeter or calibration and configuration data are supplied, the HIT-3 is configured at the factory before shipment.

5-1 Default Configuration

When the instrument is shipped without specific configuration information, the instrument is configured with default values. Refer to Appendix A for a listing of the HIT-3 factory default configuration.

5-2 Windows Configuration

Follow the instructions from section 4-2 to setup the equipment for communications. For instructions on the windows configuration program see the HIT-3 Windows Configuration Program manual.

5-3 Remote Configuration

Establish communications with the HIT-3 via the RS232 interface by using the steps outlined in section 4-2. Follow the steps outlined below. Refer to Appendix B for the communications details.

1) Type "DA<cr>"
2) Observe the data displayed on the pc. It should match the calibration data of the meter.
3) If it does proceed to section 6 and continue installing the device for operation.
4) If the data displayed on the pc resembles that in Appendix A, you will need to configure the HIT-3 for operation.
5) Enter the following data into the HIT-3 by typing the following commands.
   a) "FM=0<cr>"
   b) "FC=1<cr>"
   c) "KD=3<cr>"
   d) "AK=XXXX.XXX<cr>" (XXXX.XXX is the average K-Factor Value determined form the calibration data)
   e) "TU=XX0<cr>" (XX0 is the volume unit)
   f) "NP=XX<cr>" (XX is the number of data points in you calibration. The range is 02-20)
   g) "F01=XXXX.XXX<cr>" (This is the lowest frequency value in your calibration data)

h) “K01=XXXX.XXX<cr>” (This is the K-Factor value that was determined at the frequency value in F01)

NOTE

Continue entering frequencies and K-Factors until you have entered as many frequencies and K-Factors as you have Number of Points (NP)

6) The HIT-3 is now configured and ready for use. Proceed to Section 6 to continue installing the HIT-3.

6. OPERATION AND MAINTENANCE

6-1 Operation

To begin operation, the HIT-3 must be programmed with the calibration data of the appropriate meter. The calibration data consist of the number of points (NP), Frequency (F##), K-Factor (F##) and the Average K-Factor (AK). If the meter and HIT-3 were purchased from Hoffer Flow Controls, it has already been programmed and is ready for use. By following the procedures outlined in section 4-2 and 5-2 or 5-3, you can check the device to see if it has been programmed. After insuring that the HIT-3 is programmed, it is ready to be installed.

Connect the flow meter or suitable pulse producing device to the HIT-3 signal input terminals A SIG(+) and A SIG(-). If you have purchased the pulse security option, the second meter will need to be connected to the signals labeled B SIG(+) and B SIG(-). Refer to section 4 for the installation drawings of several common applications. If you have a special application or are unsure of the proper wiring configuration, please contact Hoffer Flow Controls for assistance. The signal input circuit was configured at the factory by using the appropriate internal resistors. If you decide to change the input signal, please consult the factory.

Once properly wired, the operation of the HIT-3 is automatic. The flow rate is calculated every second and a pulse train is produced that linearizes the meter. The unit goes into a low power state to conserve power, if the flow is stopped.

6-2 Maintenance

The HIT-3 does not require any routine maintenance. In the case that the HIT-3 does fail to operate, maintenance should only be performed by a qualified technician.

APPENDIX A – DEFAULT CONFIGURATION

Factory Default Settings

FIELD	*Value*
DN	10000000
AF	99.999
CF	1.000
AK	1.00
LF	00000.000
AL	99999.981
ST	00000.000
NB	01
NP	20
PA	1234
TU	100 *(GAL)*
FM	1 *(MIN)*
FC	0 *(Average)*
KD	3
TD	1
RD	3
PS	0 *(OFF)*
FO	8
LK	No
UA	Off
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

FIELD	*Value*
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
K16	1.00
K17	1.00
K18	1.00
K19	1.00
K20	1.00

HyperTerminal Response

```
 HOFFER FLOW CONTROLS, INC.
 HIT-3  (c) 2001  Ver 0.05
==============================
To read setting, enter command
followed by <CR>.  To edit,
enter comm. follow by <=>,
<new value>, and <CR>.
COMMANDS----------------------
DN -TAG NUM       | F##-FREQ 01-20
TU -TOT UNITS     | K##-KFAC 01-20
NB -MAX M TIME  | UI -UNIT MODEL
CF -CORR FACT     | DA -DUMP ALL
FM -FLOW UNITS  | AA -AUTO DATA
FC -F C METHOD   | US -UNIT STAT
KD -K-FAC DECL   | CS -CLEAR STAT
AK -AVG KFAC      | PR -PULSE REL
NP -NUM PTS
```

APPENDIX B - COMMUNICATIONS

Message Format

Communication messages consist of a string of ASCII characters terminated by a carriage return character. The maximum message length coming to the HIT-3 is 20 characters, including the carriage return. The HIT-3 will transmit no more than 35 characters before transmitting a carriage return.

If a message longer than A 20 characters command is 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 HIT-3 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, the HIT-3 aborts the message by clearing the receive buffer.

If the sending unit (PC or other such device) wishes to change a setting on the HIT-3, 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 HIT-3 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 HIT-3 has in the K factor table, the sending unit shall send

"NP<CR>"

The HIT-3 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 HIT-3 echoes the sent message and responds with

"NUM PTS = 20<CR>".

The HIT-3 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 HIT-3 echoes the sent message and responds with the value that is currently stored in the HIT-3.

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

"NP=200<CR>"

The HIT-3 echoes the sent message, and responds with

"NUM PTS = 20<CR>".

Messages

Commands Supported By Communications Messages

Command	Description/Allowed Data/Response
DN	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.
TU	Total Units "100" for gallons "140" for liters "110" for cubic feet "150" for cubic meters "180" for barrels All other integer values from 0 and less than 999 will map to custom units "TOT UNITS =(DATA)" (DATA) shall be: "GAL" for gallons "LIT" for liters "FT3" for cubic feet "M3 " for cubic meters "BBL" for barrels "CUS" for custom 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.
NB	Max Sample Time "1" to "80" "MAX M TIME=(DATA)"
CF	Correction Factor "0.001" to "9999999.999" "CORR FACT =(DATA)"

Command	Description/Allowed Data/Response
FM	Rate Units "0" for seconds "1" for minutes "2" for hours "3" for days "FLOW UNITS=(DATA)" (DATA) shall be: "SEC" for seconds "MIN" for minutes "HR " for hours "DAY" for days
FC	Linearization "0" = Average K factor "1" = Linearization table "F C METHOD = AVG" for Average K factor or "F C METHOD = LIN" for Linearization table
KD	K Factor Decimal Point Location "0" for 00000000. "1" for 0000000.0 and all K Factors are less than 9999999.9, otherwise not allowed "2" for 000000.00and all K Factors are less than 999999.99, otherwise not allowed "3" for 00000.000 and all K Factors are less than 99999.999, otherwise not allowed "K-FAC DECL=(DATA)"
AK	Average K Factor "0.001" to "99999.999" if KD = 3 "999999.99" if KD = 2 "9999999.9" if KD = 1 " 99999999" if KD = 0 "AVG KFAC =(DATA)"
NP	Number Points in the Table "2" to "20" "NUM PTS =(DATA)"

Command	Description/Allowed Data/Response
F##	Frequency 1-20 `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. `"FREQ ## =(DATA)"` for F01 through F20. Data to fixed three decimal places.
K##	K-Factor 1-20 `"K-FACT # =(DATA)"` for K01 through K09. `"K-FACT ## =(DATA)"` for K10 through K20. DATA to decimal places as per KD command.
UI	Unit Identification `"UNIT MODEL=HIT2A 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.
DA	Dump All All of the responses in previous table. The HIT-3 gives all responses except for the CL command.
AA	Auto Data `"F (DATA) R (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.
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.

System Commands Supported by Communications Messages

System Command	Description/Response/Comments
US	Unit Status "UNIT STAT = <DATA>" Requests the status. The values for <DATA> with no or only one error present are: "0" – No Errors present. "128" – EPULSE error (0x080) "129" – ETOTAL error (0x081) "130" – ERATE error (0x082) "132" – EFLOW error (0x084) "129" – EERES error (0x088) (EEPROM reset to factory defaults) If multiple errors occur, the error codes are logically OR-ed. For example, if the unit has an ETOTAL and ERATE error occurring at the same time, the <DATA> = "131" (0x83).
CS	Clear Status " Status Cleared " Clears all errors.