Model 163

Digital Flow Rate Indicator

USER'S MANUAL

HP-252
September 2004

HOFFER Flow Controls
Perfecting Measurement™

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Notice

HOFFER FLOW CONTROLS, INC. MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

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 may result from the use of 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 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.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the Hoffer Flow Controls Customer Service Department, telephone number (252) 331-1997 or 1-800-628-4584. BEFORE RETURNING ANY PRODUCT(S) TO HOFFER FLOW CONTROLS, PURCHASER MUST OBTAIN A RETURNED MATERIAL AUTHORIZATION (RMS) NUMBER FROM HOFFER FLOW CONTROLS' CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned RMA number should then be marked on the outside of the return package and on any correspondence.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting HOFFER FLOW CONTROLS:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

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.

LIMITED WARRANTY

HOFFER FLOW CONTROLS, INC. ("HFC") warrants HFC's products ("goods") described in the specifications incorporated in this manual to be free from defects in material and workmanship under normal use and service, but only if such goods have been properly selected for the service intended, properly installed and properly operated and maintained. This warranty shall extend for a period of (1) year from the date of delivery to the original purchaser (or eighteen (18) months if the delivery to the original purchaser occurred outside the continental United States). 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 goods are defective, the goods must be returned to HFC, transportation prepaid by Purchaser, within twelve (12) months after delivery of goods (or eighteen (18) months for goods delivered outside the continental United States) for inspection by HFC. If HFC's inspection determines that the workmanship or materials are defective, the goods 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 the lowest cost transportation available.

Prior to returning the goods to HFC, Purchaser must obtain a Returned Material Authorization (RMA) Number from HFC's Customer Service Department within 30 days after discovery of a purported breach of warranty, but no later than the warranty period; otherwise, such claims shall be deemed waived. See the Return Requests/Inquiries Section of this manual.

If HFC's inspection reveals the goods are free of defects in material and workmanship or such inspection reveals the goods were improperly used, improperly installed, and/or improperly selected for service intended, HFC will notify the purchaser in writing and will deliver the goods back to purchaser upon (i) receipt of Purchaser's written instructions and (ii) the cost of transportation. If Purchaser does not respond within 30 days after notice from HFC, the goods will be disposed of in HFC's discretion.

HFC does not warrant these goods to meet the requirements of any safety code of any state, municipality, or any other jurisdiction, and purchaser assumes all risk and liability whatsoever resulting from the use thereof, whether used singly or in combination with other machines or apparatus.

This warranty shall not apply to any HFC goods or parts thereof, which have bee 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 such goods.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTLY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. HFC SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE RESULTING, DIRECTLY OR INDIRECTLY, FROM THE USE OF LOSS OF USE OF THE GOODS. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, THIS EXCLUSION FROM LIABILITY EMBRACES THE PURCHASER'S EXPENSES FOR DOWNTIME, DAMAGES FOR WHICH THE PURCHASER MAY BE LIABLE TO OTHER PERSONS, DAMAGES TO PROPERTY, AND INJURY TO OR DEATH OF ANY PERSON. HFC NEITHER ASSUMES NOR AUTHORIZES ANY PERSON TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OR USE OF HFC'S GOODS, AND THERE ARE NO AGREEMENTS OR WARRANTIES COLLATERAL TO OR AFFECTING THE AGREEMENT. *PURCHASER'S SOLE AND EXCLUSIVE REMEDY IS THE REPAIR AND/OR REPLACEMENT OF NONCONFORMING GOODS AS PROVIDED IN THE PRECEDING PARAGRAPHS. HFC SHALL NOT BE LIABLE FOR ANY OTHER DAMAGES WHATSOEVER INCLUDING INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.*

Disclaimer:
Specifications are subject to change without notice.
Some pages are left intentionally blank.

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SECTION I

Digital Flow Rate Indicators and Totalizers by Hoffer

General Series Description

The Series 160/250 is a family of low cost flow instrumentation systems intended for applications which require economical, panel mounted instrumentation to be used where conventional AC line power is available.

Two distinctly different digital flowrate indicators are available within the Series 160. Both offer analog outputs and switch selectable response times. Accuracy and long term stability were key design requirements for the Series 160.

The Model 163 is a general purpose, low cost, 3½ digit flowrate indicator. Features include analog voltage, current outputs, dummy trailing zero, optional Mini-Flowmeter linearization, and choice of line voltage. The full scale indication and analog output span are independently adjustable as is their response time.

The Model 164 is a 4½ digit, digital flowrate indicator which offers extremely high accuracy at low cost for applications where accurate flow measurement is required over wide flow ranges. In addition, the unit is calibrated directly through engineering entry of a calibration constant into a switch array. Complicated setup procedures which require a test bench are not necessary.

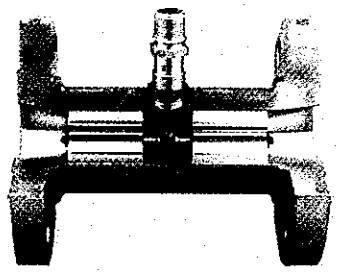
An optional BCD output is available for the Model 164 which is configurable to be fully parallel, or even digit pair serial by using the tristate capability. A busy signal may be used to generate service interrupts, while display hold allows the reading to be held constant while being read.

The Series 250 is a 7 digit flow totalizer which may be used to totalize flow in any user specified unit of measure. In the event of a power loss the Series 250 continues to operate with the display blanked and the reset inhibited. Front panel reset is provided as well as provision for remote reset and start/stop. A scaled pulse output is standard and may be used to drive remote instrumentation. A Mini-Flowmeter linearization option is available for this model. The Series 250 may be reconfigured to function as a flowrate indicator. This added versatility may be an important consideration on some applications.

All the instruments in the Series 160/250 share a common enclosure style which meets DIN Standard 43700 specifications. The attractive, plastic enclosure is rugged and impact resistant as well as flame retardant. The front lens and bezel are removable to gain access to the calibration and setup controls.

The high intensity, high efficiency LED displays are ideal for panel mounted installations. The large digit size, 0.43" allows for viewing up to 25 feet away.

All members of this instrument family

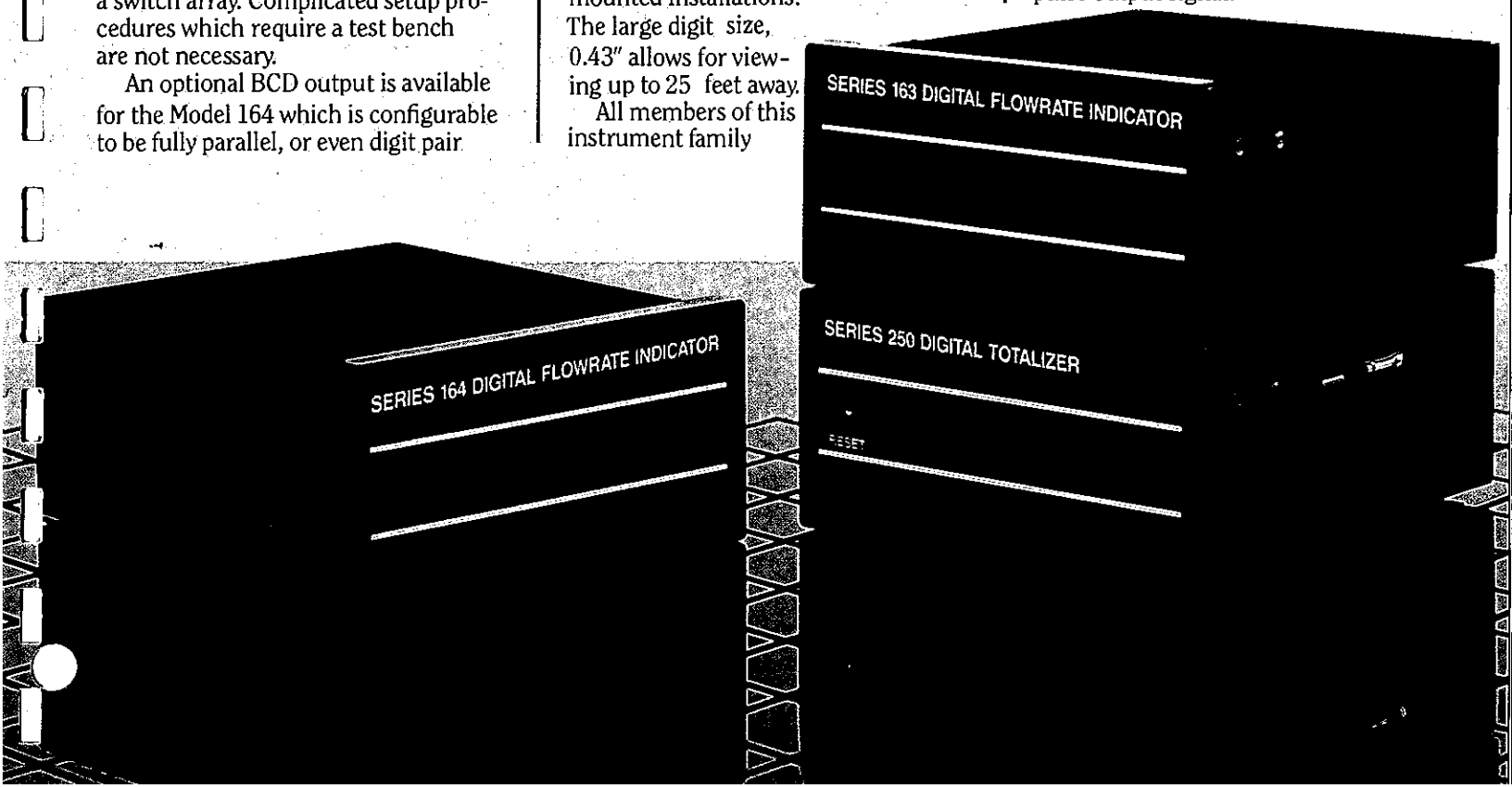


feature both a low level, magnetic pickup compatible input and a opto-isolated input which may be driven from a remote signal conditioner. Another feature is the availability of a high level, conditioned, configurable pulse output.

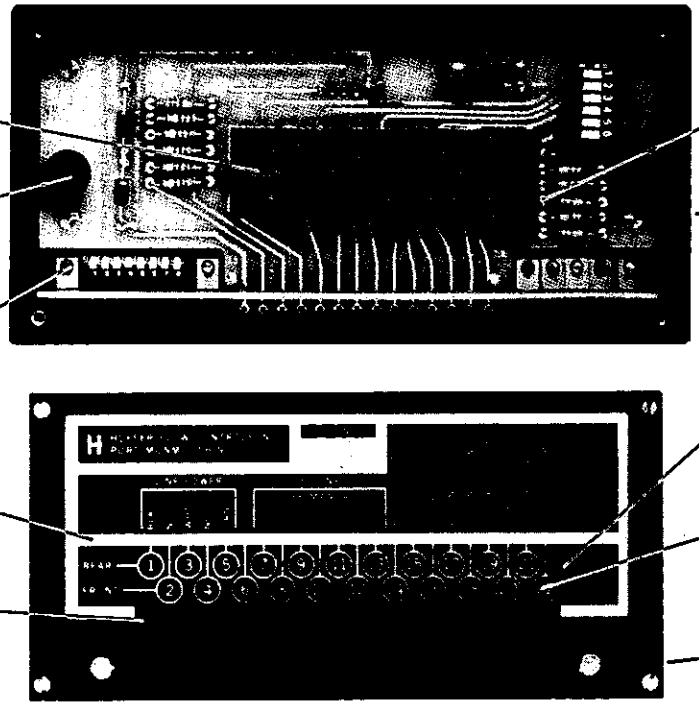
DC excitation voltage is available for powering remote signal conditioners. This commonly required feature is not found on many indicators.

The rear screw terminal block accepts wire leads for rapid trouble free solderless installation. The unit is modular in design and may be removed from the front without disconnecting the field wiring.

The Series 160/250 have been designed to integrate into most system environments. The unit will accept inputs from turbine flowmeters or other suitable transducers which produce a pulse output signal.



Product Highlights



0.43" Hi-Intensity LED Display

Modular, front panel plug in construction

Convenient, hidden front panel adjustments

Versatile, high level pulse output

Screw terminal directly accepts wire leads

User programmable decimal points

Models available for flow totalization and flow rate indication

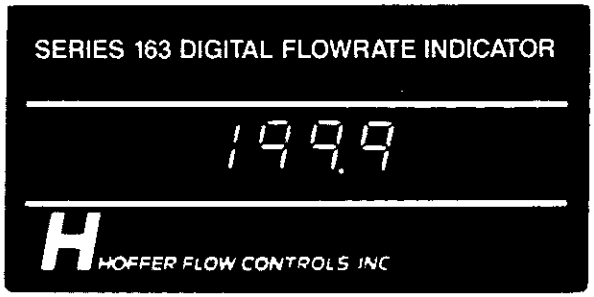
Provides excitation voltage for remote signal conditioners

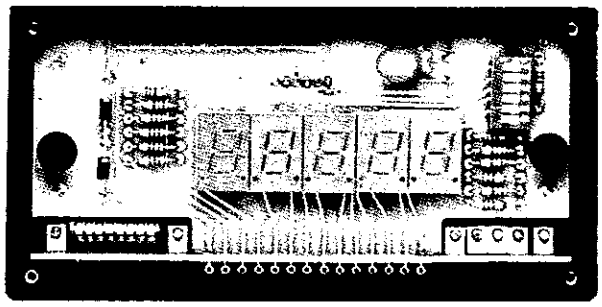
Two inputs standard (magnetic pickup and opto-isolated)

Compact DIN panel enclosure

General Specifications Common to Series 160/250

Indicator—Display	Type Red LED Digit height 0.43" Selectable Decimal Points Viewing Angles +/−60 Degrees (Typ.)
Input—Low Level	Sensitivity—10mVrms (10Hz to 2500Hz) Adjustable Trigger Level Input Protected, RF and Bandpass Filtered Input Impedance—40 Kohm (Nominal) Overvoltage—130 Vrms maximum
Opto-Isolated	Input Signal Range—3 to 30 Vdc Minimum Input Pulse Duration—0.1 mSec Input Impedance—1.2 Kohms Maximum Isolation Voltage—2500Vdc
Signal Conditioner Excitation	+15Vdc +/−20% 25 mA Maximum
Pulse Outputs—	(User configurable)
TTL/CMOS	Logic "0" 0.4 V @ 100mA Logic "1" 4.5 V @ −2.4mA
HTL	Logic "0" 0.4 V @ 100mA Logic "1" 10 V @ 1mA
Open Collector	Maximum off leakage current 25μA Maximum off voltage 50V Saturation on voltage 0.4 Vdc @ 100mA
Opto-Drive	On current 3mA (nominal) Off current less than 25μA
Power—	115/220 Vac +/−10% 50/60 Hz
Environmental—	Operating Temperature Limits—0 to 70 degrees C Storage Temperature Limits—−55 to 130°C Relative Humidity—0 to 95% non condensing
Enclosure	Cutout Size—2.63" high by 5.44" wide DIN Standard 43700 Material—Nory (Glass Filled) User Termination-Screw Termination accepts wire directly Temperature Resistant to 130 degrees C Depth Behind Panel—7 inches (nominal)





Series 163 Highlights

General

The Series 163 is the low cost digital flowrate indicator member of the Hoffer family of economical flow instrumentation.

The Series 163 digital rate indicator conditions and scales the flowrate signal from the turbine flowmeter and provides a 3½ digital display in the desired units of flowrate measurement. In addition, both analog and pulse rate outputs are also generated. Mini-flowmeter linearization is optionally available for use with the Hoffer low flow MF Series.

The pulse output provided by the Model 163 is a high level, shaped square wave reproduction of the input signal (after linearization if this option is equipped).

All calibration functions and controls for the display as well as the analog outputs may be adjusted from the front by simple removal of the snap-on bezel. The entire unit may be removed from the enclosure without disconnecting the field wiring to the rear terminal.

Application

The Model 163 may be used to provide digital indication of flowrate information in any flowmeter based system where the flowrate varies by a flowrate turndown ratio of 30:1 or less.

The flowrate signal may be in any unit of measure i.e.; GPM, LPH, or Cubic Feet per Day. Any maximum flow rate reading in the range of .199 to 19990 can be displayed since both decimal point selection and trailing zero indication is available.

Analog output options include both voltage and current outputs. These outputs may be used as part of a control loop, to drive a chart recorder or as a means of transmitting the flow rate signal to a data logging or computer data acquisition system. The current output is an advanced configuration suitable for driving grounded or floating loads.

The pulse output may be configured for TTL/CMOS compatability, or as an open collector, or to provide a 0 to 10 V pulse output, or to directly drive an optoisolator on a remote data acquisition system.

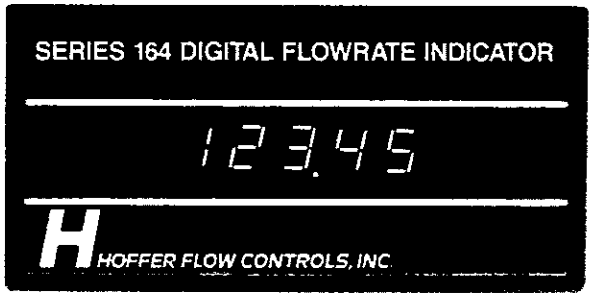
The selectable response time allows the user to decide whether faster response or more stable indication are of paramount importance in his measurement. The response time constant of the indicator and analog output are independently adjustable.

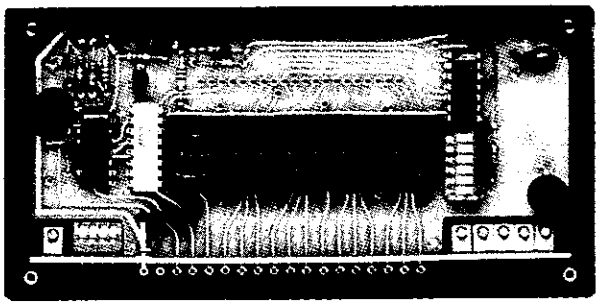
Specifications Model 163

Indicator—	Accuracy—0.05% F.S. + / − 1 digit + / − 200 ppm/degree C Response Time—adjustable from 0.25 to 20 seconds Decimal Points—programmable positions of 1.9.9.9.0. Overrange Indication—Display will indicate 1bbb0 where b indicates a blank digit Update Rate—1 conversion/sec

Analog Output Specifications

Current Output	Range—4 to 20 mA Accuracy—0.05% F.S. + / −200 ppm/degree C Response Time (10 to 90%)—adjustable from 0.25 to 5 seconds Maximum Load—500 ohms
Voltage Output—	Available Ranges-0 to 5 Vdc or 0 to 10 Vdc Accuracy—0.05% F.S. + / −200 ppm/degree C Response Time (10 to 90%)—adjustable from 0.25 to 5 seconds Output Impedance—less than 10 ohms
Pulse Output	Available forms, TTL/CMOS, HTL, Open Collector, Opto-Drive. See general specifications for details.
Linearization Option	The Hoffer MF Series of Mini-flowmeters requires linearization prior to indication for accurate flowrate indication. This option is required for Mini-flowmeters.





Series 164 Highlights High Precision 4½ Digit Flowrate Indicator

General

The Series 164 is the high accuracy, digital flow rate indicator member of Hoffer's family of economical flow instrumentation.

The Series 164 conditions and scales the flowrate signal from the turbine flowmeter and provides a 4½ digit display in the desired units of flowrate measurement. In addition, outputs are available in the form of analog voltage and current outputs, a pulse rate output, and optionally a BCD output.

The Model 164 has the display resolution and the linearity needed to achieve the high precision required in a true 4½ digit flowrate indicator. It provides the perfect display for systems which utilize the performance enhancement made possible by the Hoffer range extending modulated carrier signal conditioners and the 0.1% flow measurement accuracy made possible by the Hoffer Model ACC-100, Intelligent Signal Conditioner/Linearizer.

The superior panel meter design is truely programmable through direct entry of the calibration scaling factor into a coded switch array. This switch entry automatically calibrates both the display and analog output. Added programmable features include selectable decimal points and response times. The wide usable range of the Model 164, and the 1 update per second conversion rate, allow for easy reading with negligible display bounce.

The optional BCD output is versatile in that is may be configured in several ways to ease interface to the user's system. Full, parallel BCD output is the most commonly utilized. However, digit pair serial/parallel BCD, is possible since the BCD output may be tristated. This later configuration requires the user to provide the digit select lines to the BCD output card. Control and status signals are also available to notify the receiving instrument when new information is available and to allow the receiving instrument to hold the latest information until it can be read.

The analog output is available in both industry standard voltage and current output ranges. The current output is an advanced configuration suitable for driving grounded or floating loads.

The pulse output provided by the Model 164 is a high level, buffered, square wave reproduction of the input signal. The pulse output may be configured to suit the user's interface requirements.

Applications

The high precision offered by the Model 164 make it ideal for applications which require high resolution flowrate indication over wide flowranges, of up to 100:1.

Such systems are likely to occur when using flowmeters equipped with modulated carrier signal conditioners and advanced intelligent signal conditioners functioning as flowmeter linearizers.

The flowrate indication may be in any unit of measure requested by the user. Any flowrate reading from .1999 to 19999 may be displayed.

The BCD output option has the same high precision available as the indicator display itself. For high accuracy applications, this digital output may be preferred over analog outputs to assure preservation of the measurement to the interface of the host computer.

The conventional analog and pulse output provide the necessary vehicles of information transmission in more customary user interface in process measurement and control systems. (See information on these options in the Model 163.)

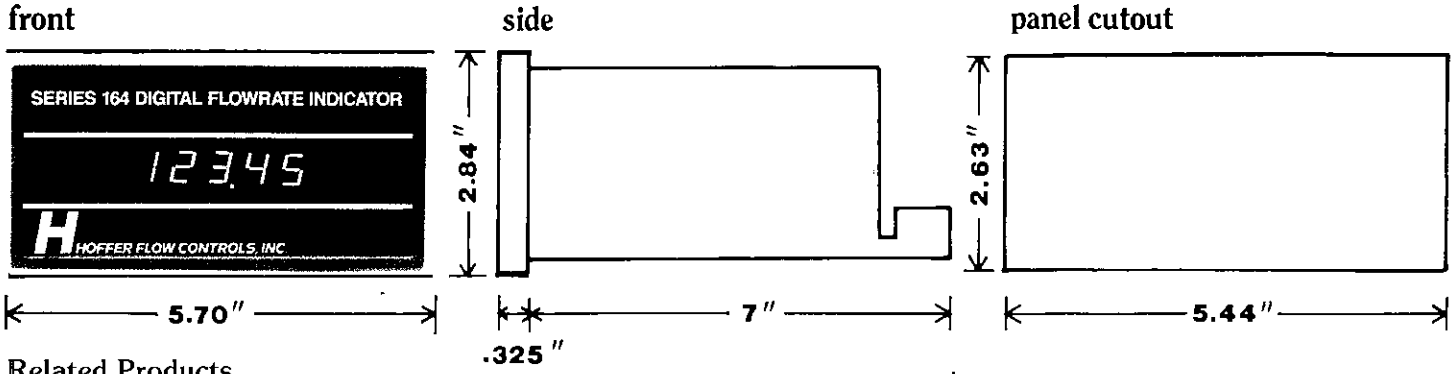
Specifications Model 163

Indicator—	Linearity—0.01% F.S. +/−1 digit +/−20 ppm/degree C Response Time—selectable from 0.1 to 5 seconds Update Rate—1 conversion per second Decimal Points—selectable 1.9.9.9.9. Overrange Indication—blinking display

Analog Output Specifications

Current Output—	Range 4 to 20 mA Accuracy—0.025% F.S. +/− 150 ppm/degree C Response Time—adjustable from 0.25 to 5 seconds Maximum Load—500 ohms
Voltage Output—	Available Ranges—0 to 5 or 0 to 10 Vdc Accuracy—0.025% F.S. +/− 75 ppm/degree C Response Time—Adjustable from 0.25 to 5 seconds Output Impedance—less than 100 ohms
Pulse Output—	Available forms, TTL/CMOS, HTL, Open Collector, Opto-Drive. See general specifications for details.
Optional BCD Output—	Control Lines-run/hold, 0E1, 0E2, 0E3 Status Lines—busy, overrange, polarity Data Lines—B1, B2, B4, for D1 thru D5 Compatibility—TTL/CMOS

Panelmeter Case Dimensions



Related Products
Turbine Flowmeters

Hoffer offers a full line of turbine flowmeters for both liquid and gases with flow ranges of .007 to 15,000 GPM in line sizes from ¼ to 12", as well as a full line of insertion type flowmeters. Request the Hoffer Flow Engineering Guide for the most comprehensive detailed flow guide available.

Signal Conditioners/Converters

Hoffer offers a full line of interface signal conditioners/converters including 4-20mA two wire transmitters, turbine flowmeter range extending preamplifiers for up to 100:1 turn down ranges and field programmable linearizers for 0.1% accuracy.

Digital Totalizer/Rate Indicators

In addition to the digital panel meters shown in this brochure, Hoffer offers a complete line of electronics, some of which include: battery operated units, temperature and pressure compensation for gases and liquids, BTU systems, digital blending systems, LCD displays as well as many other functions.

Ordering Information

Model

Prefix	(163) 3½ digit rate (164) 4½ digit rate (250) 7 digit total
Analog output option	(3) 0-5 Vdc (4) 0-10 Vdc (7) 4-20 mA Available on Model 163 &164 only. Supplied standard-select one — If not specified (3) supplied.
Pulse Output Option	(1) TTL/CMOS (2) Open Collector (3) Opto-Isolator Driver (4) High Level Pulse Note: Supplied standard all Models — select one — if not specified (1) supplied. Specify pulse duration in msec for Model 250
Input Power	(1) 115 Vac 50/60 Hz (2) 220 Vac 50/60 Hz
Mini-flowmeter Linearization or BCD Output	(L) Available Model 163 & 250 only (BCD) Available 164 only
Enclosure	(P) Panel Mount - DIN Std. 43700 (N) NEMA 4 weather proof (E) Explosion proof, Class I, Group D; Class II, Group's E, F, & G; NEMA 7 & 9
Terminal Connector	(PCB) PCB3S22S Solderless Screw Terminal

Hoffer Flow Control Literature

Turbine Flowmeters-Engineering Guide	HO-TF
Turbine Flowmeters-Interface Signal Conditions/ Converters	HO-SCC
Intelligent Signal Conditioner For Turbine Flowmeter	PB-ACC-100
Cryogenic Systems For LIN/LOX/LAR & Hydrogen	HO-CR
Energy Measurement Systems—BTU—Gas	HO-EMS
Flow Totalizer/Indicator—Battery Powered, Field Mounted	PB-46
Flowrate Totalizers—Pressure & Temperature Compensated Gas And Liquids	HO-125
Flowrate Indicators—Pressure & Temperature Compensated Gas And Liquids	HO-116
Preset Batch Totalizer/ Controllers	HO-126
Airborne Totalizer/Indicator	PB-150
Signal Conditioner/Pulse Scaler Field Mounted	PB-ACC51
High Pressure (15,000 PSI) Turbine Flowmeters WECO	PB-HO-WF
Grooved Turbine Flowmeters Victaulic	PB-HO-GF

HO-EL-01

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SECTION II

FLOWMETER INSTALLATION

GENERAL

Proper application of the turbine flowmeter requires a suitable piping installation in order to achieve accurate and reliable operation.

The piping configuration immediately preceding and following the flowmeter is termed the meter run. Refer to the manufacturer's outline and installation instructions when installing the flowmeter and meter run.

RELATIVE - The performance of the meter run immediately downstream of pumps, partially opened valves, bends or other similar piping configurations. In addition, the area surrounding the flowmeter should be free of sources of electrical noise such as motors, solenoids, transformers and power lines which may be coupled to the pickoff device.

METER RUN - In general, the meter run should be chosen to have the same inner diameter as the meter bore. A minimum of 10 pipe diameters of straight pipe up stream and 5 pipe diameters downstream are required. Where this optimum line configuration can not be implemented, it is advisable to install a flow straightener properly positioned upstream of the flowmeter. Orientation is not a critical factor, however, horizontal is a preferred orientation.

BYPASS RUN - A properly sized bypass run with suitable blocking valves may be equipped where an interruption in fluid flow for turbine meters servicing can not be tolerated.

STRAINER - A strainer, filter and/or air eliminator is recommended mesh size.

On initial start-up of a line, it is advisable to install a spool piece purging the line to eliminate damaging the flowmeter, due to flux, tape, solder, welds, or other contaminates carried along by the fluid stream.

INSTALLATION WIRING LAYOUT FOR INTERCONNECTIONS

In considering the interconnections between the flowmeter and the flow measurement system some attention must be given to the interconnecting wiring.

Noise signals may be coupled inductively or capacitively into the wiring between the flowmeter and the electronic measuring systems. In general, utilizing a shielded, twisted pair for the interconnection greatly reduces this coupling. The shield should be grounded on one end of the cable only. In general, grounding only on the electronic measuring system is best.

However, even with proper interconnecting cabling cross talk with other signal lines or power lines may still occur and should be avoided. Physical isolation in the manner in which the wiring is run reduces the chance of potential problems.

It is common to transmit the low level output signal from the flowmeter several hundred feet through a shielded, twisted pair instrument cable. Where a noisy environment is suspect, it is recommended that a pre-amplifier be installed on or near the flowmeter to assure the preservation of flow information from the flowmeter to the electronic measuring system. Suitable accessory models are available from manufacturer.

INSTALLATION WIRING LAYOUT FOR INTERCONNECTIONS

In considering the interconnections between the flowmeter and the flow measurement system some attention must be given to anticipated noise sources and to the coupling of these noise sources to the interconnecting wiring.

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The PC-85 REP pickup must be connected to the magnetic pickup input for connections to this pickup see drawing 163-703.

The pulse output option requires both rear wiring and in some cases internal solder gap/jumper connections to program it. Sample connnections are shown on the user wire drawing for this option. The form of the output is specified by the user when ordering although it may be changed in the field by a competent person family with P.C. Board repair procedures.

Connections for power should assure the proper line voltage is present before making connections to the Series 163. A ground wire is required. The line should be an 'instrument grade' whose various loads do not contain solinoid valves, motors, or other similiar transient producing loads which might adversely effect the operation of the system. In addition, the power line to the Series 163 should be fused or otherwise overcurrent protected by a 1/4 amp fuse.

After all connections have been made double check the complete wiring to verify conformance before applying power.

Most systems supplied by Hoffer come setup to user specifications if provided at the time of purchase. Review the factory calibrated systems appear to be in conformance with expectations. If the unit has not been calibrated or is different than originally requested, proceed to Section III for setup instructions.

When all installations and setup procedurers have been completed, go to Section IV for a discussion of initial startup and any final adjustments which might be necessary.

Installation of the Series 163

The Series 163 should be placed in a convenient location where both ease of viewing and wiring access are maintained. Viewing considerations should include due consideration of excessive ambient lighting or glare.

The panel cutout requirements are depicted in drawing 160/250-701. Be sure to allow adequate space behind the panel for the wiring terminations. The mounting brackets are easily removed by pushing them forward and then across the side of the enclosure. Slide the case thru the cutout and reattach the mounting brackets to the case. Tighten the bracket screw to finish the mounting to the panel.

Before making any connections verify that the Series 163 has the desired options by checking the Model number.

Two connector schemes are available for the 163. The first is a terminal block that directly accepts wire leads, the second in a card edge, solder type connector.

The terminal block style connector directly accepts wire leads but it is a prefered practice to tin stranded wire leads before inserting them into the connector. Each wire should be stripped to a length of 5/8" +/- 1/16" before inserting into the connector. Care must be exercised to assure that each wire is inserted into the correct terminal of the connector. The connector holes are labeled both on the back plate and the connector body itself. Odd numbers are on the back row (closer to the case), even numbers are in the front row.

The solder style connector has a single row of contacts to which wires must soldered. It is recommended that the wires have a sleeve of heat shrink tubing installed around each wire to provide for a neatly dressed installation. When installed the connector must have the number/wire edge of the connector facing the top of the case.

The complete wiring terminations are shown on drawing 163-701 for the case of an ACC-27 Signal Conditioner.

Refer to the other wiring installation drawings for details of the connections for each option.

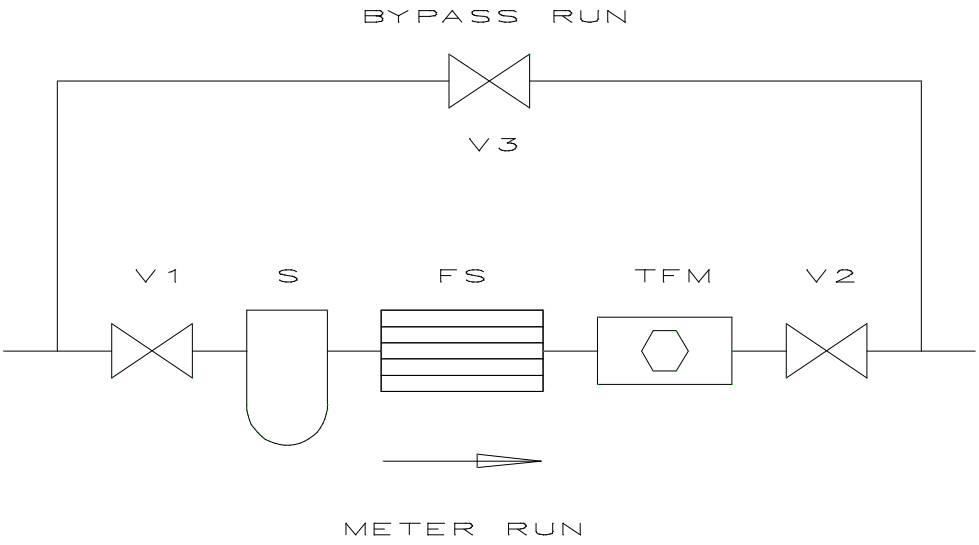
Magnetic Inputs are directly connected to terminals 21 and 22 with the shield terminated on 20. See drawing 163-702.

It is recommended that the high level outputs from remote Flowmeter Signal Conditioners be used to drive the Opto-Isolated Inputs. Typical connections are shown on the drawing for this option on drawing 163-701.

NOTES:
1. FACTORY RECOMMENDS 10" PIPE DIA. UPSTREAM AND 5 PIPE DIA. DOWNSTREAM OF SAME SIZE PIPE AS FLOWMETER. A FLOW STRAIGHTENER IS RECOMMENDED IF THIS IS NOT POSSIBLE OR FOR CUSTODY TRANSFER APPLICATIONS.

REVISIONS

REV	DESCRIPTION	DATE	APP
A	REDRAWN	1-31-92	
B	ADDED NOTE 2, CHG'D MESH SIZE	3-17-92	
C	DRAWING NO. WAS INSTL-104.	950907	



METER SIZE	MESH SIZE
MF SERIES	100
1/4" – 1/2"	100
5/8" – 1 1/4"	70
1 1/2" – 3"	40
4" – 12"	24

V1, V2	BLOCKING VALVE
S	STRAINER
FS	FLOW STRAIGHTENER
TFM	TURBINE FLOWMETER
V3	BYPASS VALVE

REPLACES INSTL-104

NEXT ASSY	USED ON
APPLICATION	

MATERIAL

FINISH

		DATE
DRAWN	DW	1-31-92
CHECK	JD	1-31-92
QA	H.COVELL	1-31-92
PROJ ENG	KRH	1-31-92

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES OTHER THAN RAW MATERIAL SHALL BE HELD AS FOLLOWS:

2 PLACE DECIMAL	±.01
3 PLACE DECIMAL	±.005
FRACTIONAL	±1/64
ANGULAR	±1/2°

HOFFER FLOW CONTROLS, INC.
ELIZABETH CITY, NC 27909

TITLE

TYPICAL TURBINE INSTALLATION

SIZE	CAGE CODE	DWG NO	REV
A	33321	500-0194	C

SCALE		SHEET
NONE		1 OF 1

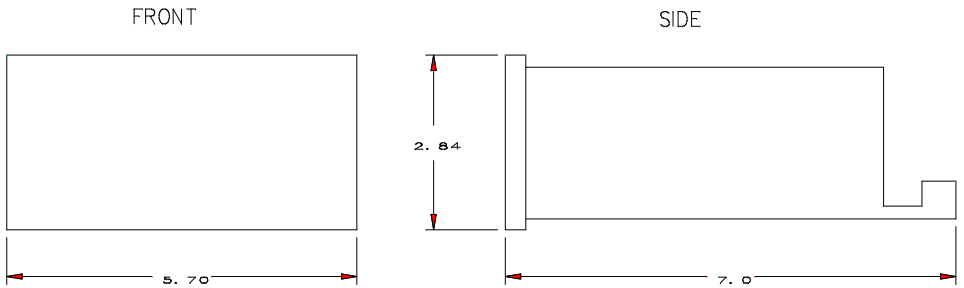
H:\dRAWINGS\500\50001941.DWG

DWG NO.	500-0270	SH 1	REV A

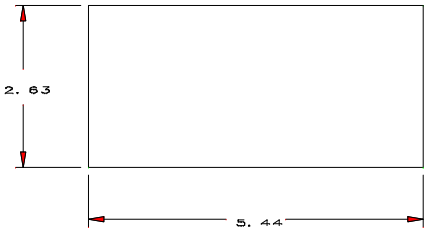
REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPD
	A	DRAWING NO. WAS 160/250-701. (CS)	951108	

NOTES:
1. CASE CONFORMS TO DIN STANDARD 43700.
2. CASE IS CONSTRUCTED OF NORY (GLASS FILLED) PLASTIC, WHICH IS TEMPERATURE RESISTANT TO 130°C.
3. ALL DIMENSIONS ARE NOMINAL VALUES.



CASE DIMENSIONS

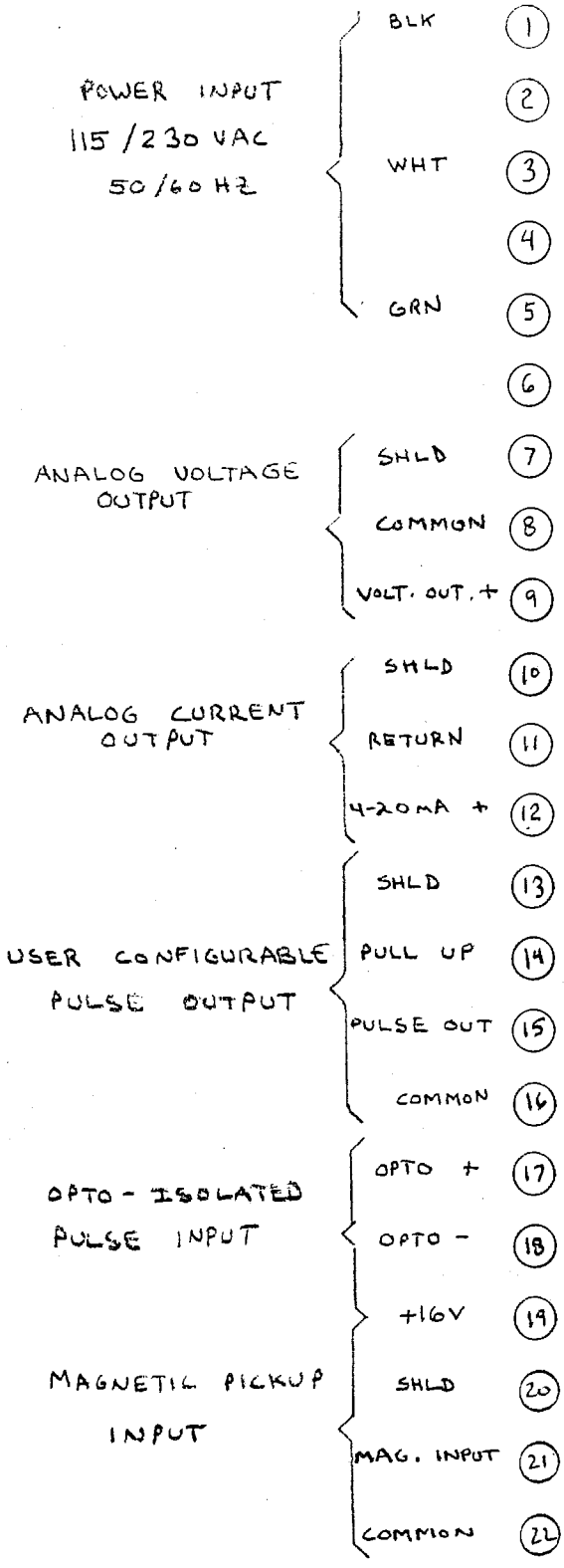


PANEL CUTOUT

		MATERIAL	DRAWN JD	DATE 11/85	HOFFER FLOW CONTROLS, INC. ELIZABETH CITY, NC 27909
			CHECK		
			PRODUCTION		
		FINISH	PROJ ENG		TITLE: CASE DIMENSIONS, SERIES 160/250
NEXT ASSY	USED ON				SIZE B / CAGE CODE 33321 / DWG NO 500-0270 / REV A
APPLICATION					SCALE NONE / SHEET 1 OF 1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES, TOLERANCES OTHER THAN THE SIZE OF RAW MATERIAL SHALL BE HELD AS FOLLOWS:

2 PLACE DECIMAL	± .01
3 PLACE DECIMAL	± .005
FRACTIONAL	± 1/64
ANGULAR	± 1/2°



NOTES -

1. POWER OPTION FACTORY WIRED
2. EITHER A VOLTAGE OR CURRENT OUTPUT IS AVAILABLE
3. PULSE OUTPUT MAY BE CONFIGURED TO SUIT NEEDS, SEE MANUAL
4. FLOWMETER SIGNAL MAY BE INPUT TO EITHER THE MAGNETIC PICKUP OR OPTO-ISOLATOR INPUT BASED ON SIGNAL TYPE AVAILABLE. SEE MANUAL.

LET.	DATE	CHANGE	BY	APP.
REVISIONS				

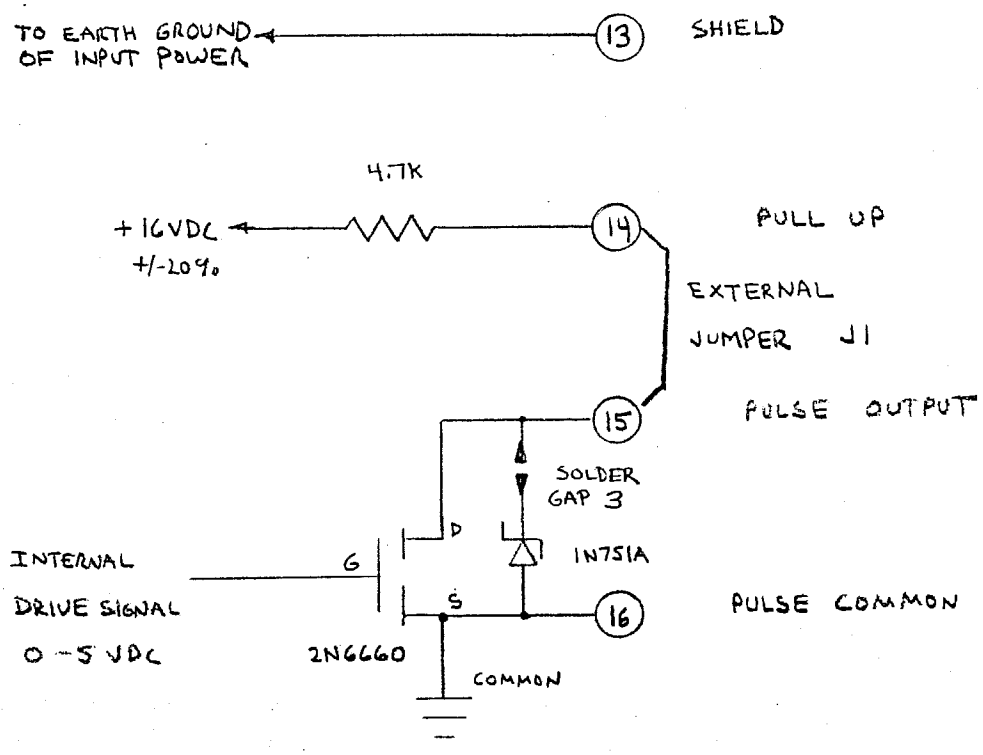
DWN. R. Grubb	DATE	CK.	
ENGR.	MFG. ENGR.	DATE	

TITLE
USER WIRING FOR SERIES 163/164

HOFFER FLOW CONTROLS, INC.	CODE 33321

DWG. SIZE A	163/164 - 701	REV.
SCALE N/A	SHEET 1 OF 1	

55459



PULSE FORM	WIRING DESCRIPTION	SIGNAL +	SIGNAL -
OPEN COLLECTOR	OMIT J1, SOLDER GAP 3	15	16
TTL / CMOS	EQUIP J1, SOLDER GAP 3	15	16
HTL	EQUIP J1, OMIT SOLDER GAP3	15	16
OPTO DRIVE	OMIT J1, SOLDER GAP 2	14	15

LET.	DATE	CHANGE	BY	APP.
REVISIONS				
DWN.	DATE	CK.		
ENGR.	MFG. ENGR.	DATE		

TITLE
CONFIGURING THE 163
PULSE OUTPUT STAGE

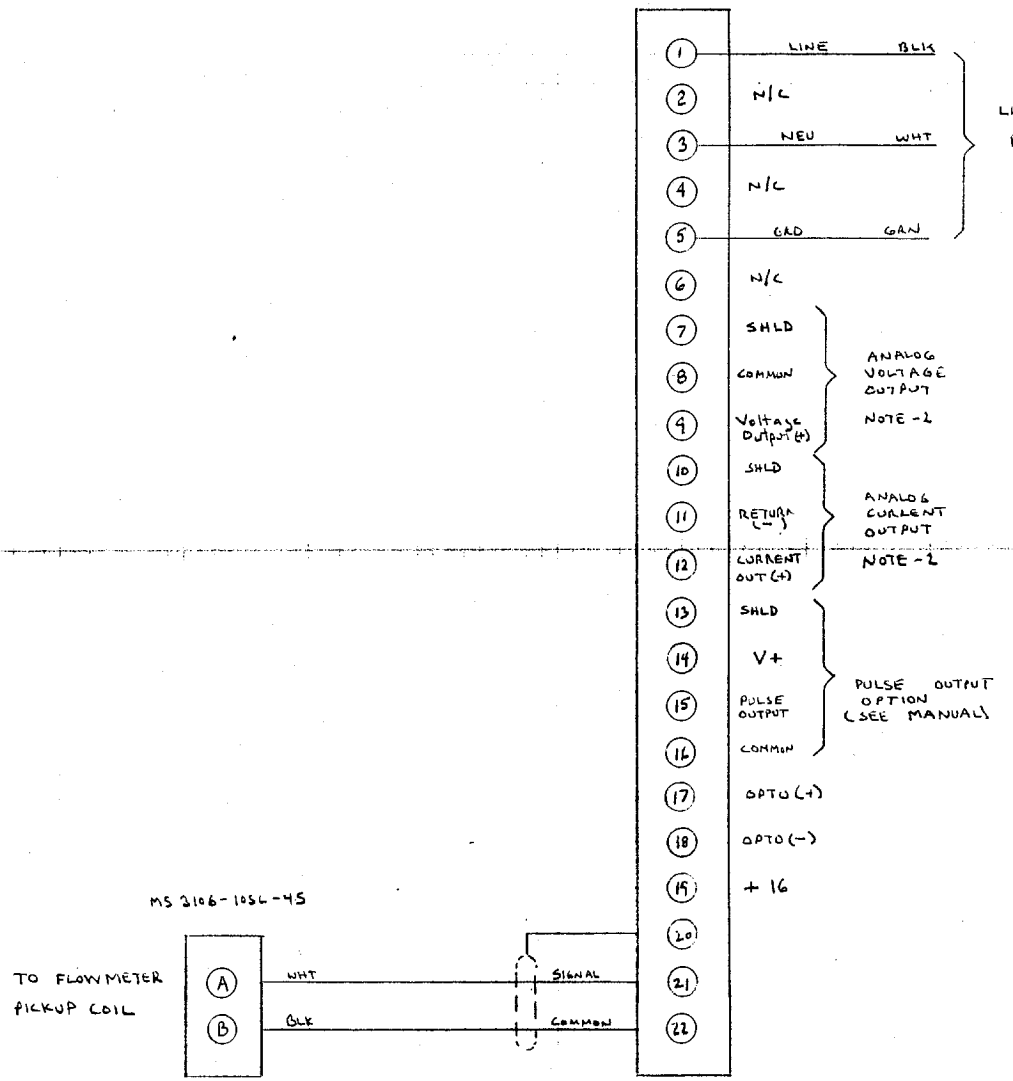
HOFFER FLOW CONTROLS, INC.

CODE 33321

DWG. SIZE		REV.
A	163-301	
SCALE N/A	SHEET	OF 1

55459

TB-1 OF
163-( )-( )-( )-( )



NOTES -

1. INPUT POWER OPTION EITHER 115 VAC OR 230 VAC BASED ON FACTORY WIRED POWER OPTION
2. EITHER VOLTAGE OR CURRENT OUTPUT MAY BE EQUIPPED BASED ON ORDERING OPTION

LET.	DATE	CHANGE	BY	APP.
REVISIONS				
DWN. RSmith	DATE 11/85	CK.		
ENGR.	MFG. ENGR.	DATE		

TITLE
INTERCONNECTING WIRING DRAWING FOR MAG. PICKUP SERIES 163

HOFFER FLOW CONTROLS, INC. CODE 33321

SIZE B | 163-702 | REV.
SCALE N/A | SHEET | OF

SECTION III

CALIBRATION OF SERIES 163 DIGITAL RATE INDICATOR

General Considerations-

In general, all flow measurement systems supplied by Hoffer Flow Controls have been factory calibrated free of charge as specified by the user, at the time of purchase.

All systems which underwent such a factory calibration have a calibration sheet which accompanies the unit. This sheet contains the following information which should be verified upon receipt of any order:

1- The corresponding flowmeter model and serial number
2- The Series 163 model and serial number
3- Accessories, Connectors, and Cables provided
4- The Range and Units of Rate Indication
5- The Type and Span of the Analog Output
6- Special notes concerning other aspects of the system such as the pulse output type and notes to the operator

This information should be reviewed and verified by the user prior to installing or using the equipment. Questions which may arise should be addressed to the applications group at Hoffer.

Field calibration or setup is only required when a change has occured or is sought to the measuring system. Such a change may be due to repair, replacement, or recalibration of the system or one of it's components. In addition, a change in the range of the analog output or the readout units will also require a new setup of the Series 163.

PROCEDURE-

The procedure for calibration of a digital rate indicator involves setting up the indicator to display in the desired units of measure and setting up the analog output have the desired output span based on the frequency signal generated by the input transducer at the maximum rate. As such it involves addressing the specifics of the input transducer and the units of measure desired by the user for display and analog output.

The Equipment Specifications give the desired units of measure and the maximum rate, Designated R(Max) and the range and type of analog output desired. The Calibration Sheet for the flowmeter, or other input device, gives the specifics of the input transducer. Use the setup sheet provided in this section.

Begin by noting the required Units of measure for indication, and analog output (i.e. 4-20mA is 0 to 150 L/S). The maximum rate in the desired units of measure, R(max), is equivalent to the full scale of the analog output. Record this as R(Max) on the setup sheet.

The following discussion relates primarily to rate indicators used with pulse producing flowmeters. The setup with other input devices will be similiar.

From R(Max), determine the equivalent maximum volumetric flow rate in gallons per minute expected by this application. Term this quanity GPM(MAX).

GPM(MAX) is usually determined from R(Max) thru a conversion factor for the desired range of the analog output from the desired units of measurement but alternately it may be based on the maximum flowrate limit for the flowmeter when readout is in GPM.

For example, for a flowmeter with a flowrange of 6 to 93 GPM, a convienent analog output range might have a span of 0 to 100 GPM. Alternately 0 to 93 GPM could be used since this is the range of the flowmeter.

For units where the output is in mass units, for example pounds per hour, GPM(MAX) is determined from R(Max) and the density at the flowing conditions of temperature and pressure.

For example, for a mass flowrange of 0 to 1000 pounds per hour, at a density of 8.337 pounds per gallon, the GPM(Max) would be 1.9991 GPM. The most convenient analog output would have a range of 0 to 1000 PPH.

From the calibration sheet for the flowmeter, obtain the Average Calibration Factor for the flowmeter, designate this as K-Factor.

For MF Series miniflowmeters, also record the "OFFSET FREQUENCY". This is listed on the calibration sheet for the MF Series flowmeter. Designate this F(OS).

For insertion flowmeters this Calibration Factor is that for the total metering run and must be first calculated from the metering run dimensions and the K-Factor for the flowmeter rotor. See the insertion meter manual and perform this calculations at this time, then return to this section.

Perform the following calculation to obtain the setup full scale frequency and designate it as F(Max):

$$F(max) = \frac{K\text{-Factor} \times GPM(MAX)}{60} - F(OS)$$

Where the F(OS) term only appears when the flowmeter to be used is one of the MF Series, Mini-Flowmeter.

Record F(MAX), and F(OS) if a miniflowmeter is being used, are used in later steps during the setup of the instrument.

User Requirements and Use Limitations-

Concerning the 3 1/2 Digit Indicator-

At this point, it is necessary to determine how the maximum flowrate can be best represented within the limitations for a 3 1/2 digit display.

The display may indicate any number between 0000 and 1999.

The dummy trailing zero extends this range to 19990, and may be used to conviently represent R(Max)'s between 2000 and 19990.

The decimal points may be arbitrarily programmed in any one of the following positions (.0.0.0.0.0).

For number greater than 19990, a decal can be provided indicating a convient unit which can fit within the limitations of the display. For example, 1,500,000 gallons per minute could be represented as 1500 thousands of gallons per minute or as 1.500 millions of gallons per minute.

To decide on how best to represent R(MAX), consider the following:

Ignoring the decimal point for a moment, examine how many significant figures of R(MAX) in the desired units may be represented in a 3 1/2 digit display without exceeding the displays capabilities at the maximum flowrate. As you can see the significant digits of R(MAX) should be greater than 200 and less than 1999.

For example , suppose the maximum flowrate is 21.76 GPM. The significant digits of 2176 will not fit within the range of 0200 to 1999. The dummy digit is not active and can not be considered a significant digit. A reading of 21. would not be making full use of the available resolution. A reading of 217 is therefore the best representation which is avilable on a 3 1/2 Digit display. Rounding off to the nearest significant digit, 218, would give higher accuracy. For this example, in subsequent calculations involved in the setup of the instrument 218 would be used for R(MAX). After setting up the display, the "decimal point" switch may be used to program the decimal point to the desired position for the final indication of 21.8 GPM.

At this point you should have decided on the number and value of significant digits of R(MAX) to be used in subsequent calculations as well as the decimal point location and whether or not the trialing zero will be used.

SERIES 163 CALIBRATION AND SETUP WORKSHEET-

APPLICATION REQUIREMENTS-

Desired Units of Rate Indication _____
Maximum Rate _____

Desired Analog Output Type _____
Desired Span _____

Desired Pulse Output Type _____
Limitations On Pulse
Output Frequency _____

FLOWMETER SPECIFICATIONS-

K-Factor _____

Offset Frequency _____
(MF Series Only)

Maximum GPM Limit _____

163 SETUP PARAMETERS-

R(MAX) _____

GPM(MAX) _____

F(MAX) _____

Range Selected _____

SET(FREQ) _____

SET(FS) _____

Decimal Point _____

SET(ZERO) _____

SET(SPAN) _____

Pulse Output Setup-

Pulse Output Form _____
Pulse Scaling _____

Pulse Output
Calibration Factor _____

TEST SETUP FOR CALIBRATING THE SERIES 163-

The test setup to perform a calibration of the Series 163 requires the use of a stable, low frequency oscillator which is capable of being set to desired frequency to at least the nearest Hz. The oscillator should generate either a sinusoidal, a triangular or a AC square wave signal of a nominal 50/50 duty cycle. Also required is a Frequency Counter with a resolution to the nearest Hz or prefferably the nearest 1/10 th Hz.

Alternately, a more accurate test setup may be performed with the aid of a programmable, crystal oscillator based, signal generator such as the Hoffer model ACC-6. This setup does not require the use of a frequency counter since the desired frequency is directly selected by programmed the signal generator. The resolution of 1/10 th Hz allows for extremely fast, and accurate setup of the Series 163 since no drift or difficulty in establishing the desired frequency is encountered.

The Calibration Test Setup is shown in Figure 3A.

Connections from the signal generator to the Series 163 are made to Terminal 21 (Signal) to 22 (Signal Common). The signal level should be between 100 mVrms and 5 Vrms.

Power connections are made to 1(Blk), 3(Wht), and 5(Grn). The line voltage should be the same as the power option specified in the model number.

The analog output, either the voltage or the current output depending on the option supplied, should be monitored with a digital multimeter which has an accuracy of 0.05% and at least 4-1/2 Digits.

DETAILED SETUP PROCEDURE FOR SERIES 163

Indicator and analog output setup requires the snap-off front bezel and lens be removed. This is accomplished by pulling off the bezel on units which have not yet been mounted to a panel, and removing the red lens. On units already installed in the panel, remove the bezel by pushing down and pulling out the bezel with the finger tips. The lower portion of the frame will distort with moderate pressure and enable the user to pop off the bezel.

The controls and adjustments are now exposed.

Before continuing with the remainder of this procedure you should have calculated the following setup parameters:

F(MAX)
R(MAX)
Analog Output Span and Zero

Decided on the switch settings for:

Course Range Selection
Decimal Point Selection
Dummy Trailing Zero use (If any)
Offset Frequency (If a MF Series is to be used)

For Mini-Flowmeter Linearization Option Only-

If the miniflowmeter linearizer option has been supplied it must be programmed first. To do this remove the rear connector by removing the two machine screws which hold it to the case, and pull the board ejectors to remove the assembly from the case. See Figure 3B. Unplug the Linearizer card from the display card to expose the offset frequency switches. Program the desired offset frequency. Reassembly the linearizer to the display board. Reinstall the assembly into the case. Reconnect the rear terminal block.

Indicator Display Setup for all Flowmeter Types-

With input signal source off (no input frequency present), adjust Display Zero Adjust, P7, to obtain an indication of 0000.

Turn the Sensitivity Adjust, P1, fully clockwise, or 20 turns.

Turn the Display Full Scale Adjust, P3, fully counter clock wise or 20 turns.

Turn the Fine Range Adjust, P2, fully counter clockwise or 20 turns.

Apply the input signal as shown in Figure-3A at the desired Full Scale Frequency, Fmax, corresponding to the desired Full Scale Rate, Rmax.

Turn "ON" the one desired switch position of the Course Range Select Switch, SW-1, which corresponds to the range in which Fmax will fall. See Table 3.1A for this selection for HO and HP SERIES, or for MF SERIES see Table 3.1B.

The display should now indicate some reading between approximately 0100 and 0200.

Turn the Fine Range Adjust, P2, clockwise to obtain a display indication equal to 0200.

Turn the Display Full Scale Adjust, P3, clockwise to obtain an indication equal to R(max). (Ignore as yet unselected Decimal Points and the trailing zero which are to be inserted later.)

If a decimal point is to be used, use the decimal point switch to illuminate the desired location.

If the dummy zero is to be used, use the Decimal Switch position 6 to illuminate the trailing zero.

Analog Output Setup-

Turn Off the Signal Source. Adjust the Zero Adjustment to obtained the desired zero as measured with the digital multimeter within the tolerance specified in Table 3.2.

Turn On the Signal Source. Adjust the Span Adjustment to obtain the desired span as measured with the digital multimeter within the tolerance specified in Table 3.2.

Iterate the above two steps as necessary to bring the result within the recommended tolerances. Note that oscillator drift will manifest itself as drifting readings on the analog output is non-crystal oscillators are used.

Table 3.1A Course Range Selection for HO and HP SERIES

Full Scale Frequency	Switch Position
75-150	1
150-300	2
300-600	3
600-1200	4
1200-2400	5
2400-4800	6

Table 3.1B Course Range Selection for MF SERIES

Full Scale Frequency	Switch Position
600-1200	1
1200-2400	2

Table 3.2 Analog Output Setup Tolerances

Desired Output Range	Set up Tolerance Span	Zero
0-10 Vdc	+/- 5 mV	+/- 5 mV
0-5 Vdc	+/- 2.5 mV	+/- 2.5 mV
4-20 mAdc	+/- 8 uA	+/- 8 uA

HOFFER FLOW CONTROLS, INC.
107 Kitty Hawk Lane, P.O. Box 2145, Elizabeth City, NC 27906
919-331-1997 800-628-4584 FAX 919-331-2886

Applications of ACC Series Signal Conditioner/Converters to Gas Measurement Applications under Fixed Temperature and Pressure.

General-

Hoffer's ACC Series of Signal Conditioner/Converters are often applied to gas metering applications. Where the analog output is to represent a mass flow rate or the equivalent amount of gas at reference conditions, special considerations need to be applied. These considerations are outlined in the following paragraphs.

Conversion to Volumetric Flow Rates-

Where an analog output span is to be setup as flowrate expressed in mass units or in equivalent flow of gas at a reference condition, a conversion to equivalent ACFM is necessary before the calibration and setup may be performed.

Begin by converting the given flowrate to SCFM units of measure at a reference condition of 70°F, and a pressure of 14.696 PSIA.

Next convert the assumed flowing pressure to units of PSIA, designate this FLOWING_P.

Next convert the assumed flowing temperature to units of Degrees Rankine, designate this FLOWING_T.

Next calculate the equivalent maximum flowrate under the assumed line pressure and temperature to find the equivalent ACFM using the equation which follows:

$$ACFM = SCFM \times \frac{14.696}{FLOWING\_P} \times \frac{FLOWING\_T}{530}$$

Finally, follow the setup procedure listed for the Signal Conditioner to determine the equivalent full scale frequency, Fmax for this application.

Follow the procedure listed in the User's Manual, and the calibration setup listed, to adjust the span and zero controls to achieve the desired analog span.

Note that the above procedure assumes the standard conditions to be 70°F and 14.696 PSIA, these vary reference conditions from industry to industry and from country to country. It is important that any variations of the reference conditions be considered in the setup of the instrument.

CALIBRATION OF ANALOG OUTPUT - GENERAL CONSIDERATIONS FOR GAS APPLICATIONS

INTRODUCTION

In general, all flow measurement systems supplied by Hoffer Flow Controls have been factory calibrated as specified by the user, at the time of purchase, free of charge.

All systems which underwent such a factory calibration have a calibration card attached prior to shipment. This card contains the details of analog outputs, as well as, other useful calibration data.

Field calibration is only required when a change has occurred or is sought to the measuring system. Such a change may be due to repair, replacement or recalibration of the flowmeter, or perhaps a change in the analog output span.

PROCEDURE

Begin by determining the equivalent maximum volumetric flow rate in ACFM, expected by the application, term this ACFM(MAX). ACFM(MAX) may be calculated based on the analog output scale requirements or may be the maximum flow rate listed on the flowmeter's calibration sheet.

From the calibration constant (or K-Factor) listed on the data sheet for the flowmeter, obtain the frequency corresponding to ACFM(MAX) using Equation-1 and designate this frequency F(MAX).

Equation-1

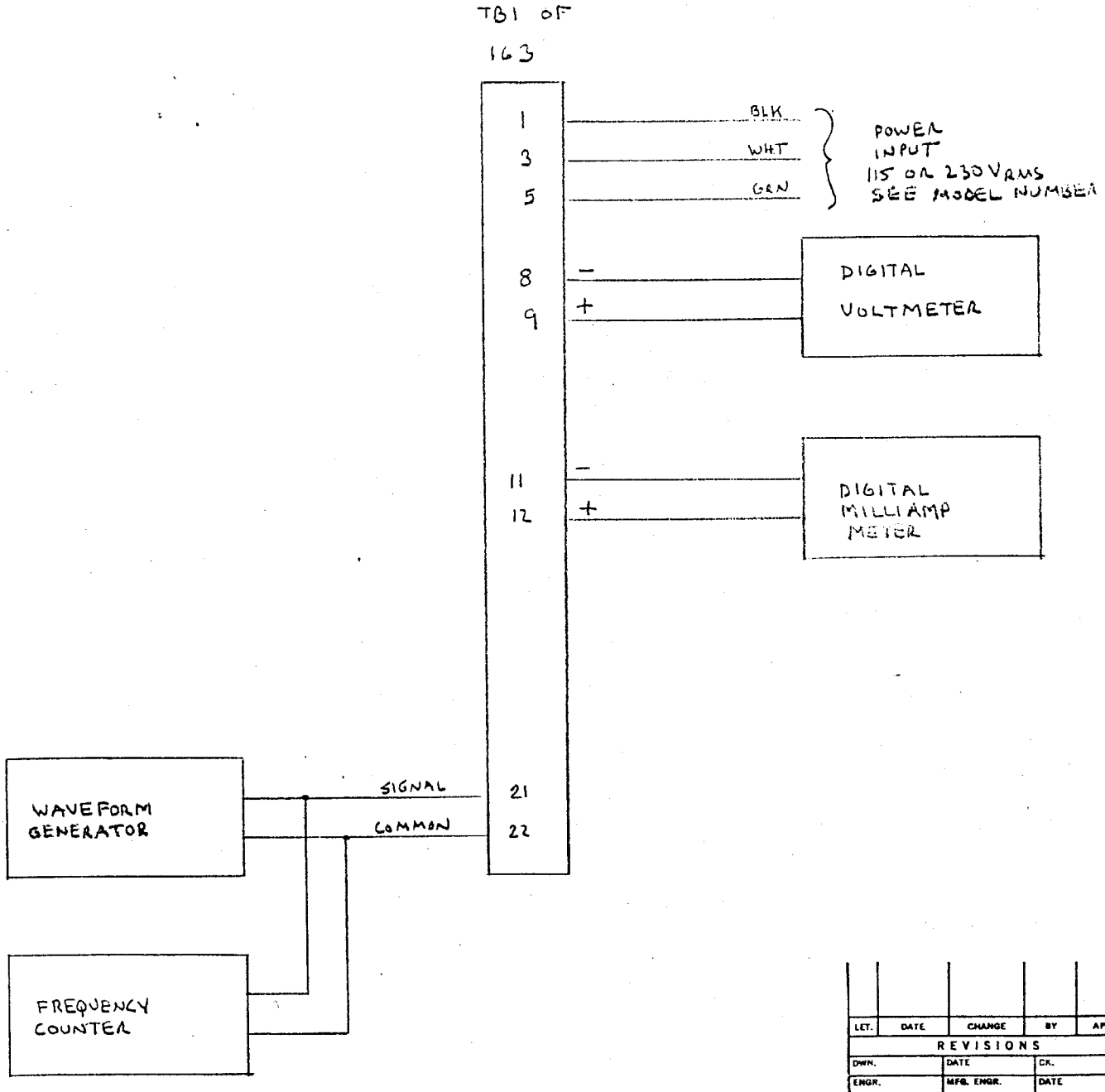
$$F_{MAX} = \frac{K_{AVG} \times ACFM_{MAX}}{60}$$

The analog output of the ACC-32 may be calibrated with the aid of an external oscillator used in conjunction with a frequency counter.

The external oscillator is used to supply a test frequency. In this method, the external oscillator is connected to the signal input terminals as shown in Figure-1. The oscillator's output frequency is set to equal F(MAX) as indicated on the frequency counter.

1. The course range adjustment is accomplished by selecting a switch position on a DIP switch located on the PCA-58 printed circuit card. See Table A to determine required switch position and set into switch as shown on drawing ACC-32-403 for anticipated F(MAX).

   NOTE: It is necessary to open the cover of the enclosure by removing two screws on the side of the box and the lifting cover. Two printed circuit cards are attached. The "RANGE" Dip Switch may be programmed with a pen. Input power should be removed during this step.



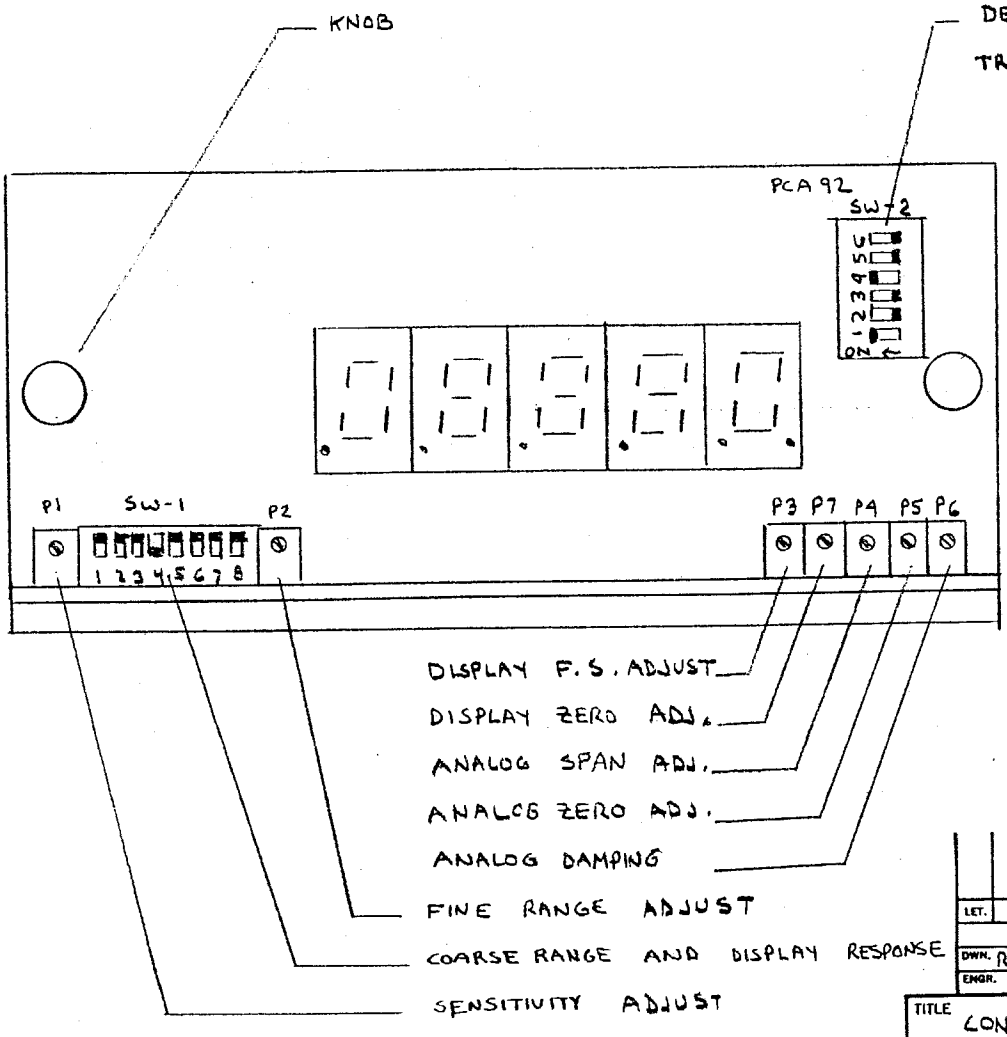
LET.	DATE	CHANGE	BY	APP.
REVISIONS				
DWN.	DATE	CK.		
ENGR.	MFG. ENGR.	DATE		

TITLE
CALIBRATION TEST
SETUP FOR SERIES 163

HOFFER FLOW CONTROLS, INC. CODE 33321

DWG. SIZE		REV.
A	FIGURE 3A	
SCALE N/A	SHEET 1 OF 1	

55459



LET.	DATE	CHANGE	BY	APP.
REVISIONS				
DWN. R.G.	DATE 11/85	CK.		
ENGR.	MFG. ENGR.	DATE		

TITLE
CONTROLS AND ADJUSTMENTS FOR SERIES 163

HOFFER FLOW CONTROLS, INC. CODE 33321

DWG. SIZE		REV.
A	163-401	
SCALE 1:1	SHEET 1 OF 1	

55459

SECTION IV

INITIAL STARTUP-

On initial startup of any new piping system, a high risk of damage to a turbine flowmeter exists until the lines has been flushed of debris from the piping assembly process. Perform any purging of the piping with a blank spool piece substituted for the turbine flowmeter.

Once the lines have been cleared, install the flowmeter and make connections to the pickup and/or signal conditioner before applying power to the Indicator.

Turn power to the indicator "ON". With no flow, the display should indicate 0000 (Ignoreing the decimal point a any trialing zero).

If the display instead indicates some other constant or varying value, noise pickup may be present. Turn the "Sens." control on the 163 (Or on the Signal Condition if one is used) Counter Clockwise untill a zero reading is achieved. The sensitivity control on the 163 effects the magnetic input only.

The unit is now ready to be used. The units of measurement are those that were established during the setup of the instrument. The analog output span corresponds to that type equipped with a span and zero as established during the setup procedure.

If during operation of this unit objectional bounce in the display is found to occur, it is possible to minimize bounce by slowing the response time of the display. Turning "ON" Positions 7 and 8 of SW-1, provides for a wide range of rate averaging. This does slow the response of the instrument to changing flow rates.

In like manner, if objectionable bounce or ripple is found on the analog output, turning the "Analog Damping" Adjustment P6 Counter Clockwise will reduce this behavior by slowing the response of the analog output to changing flowrates.

For additional information on how to successfully apply the Series 163, contact the Applications Group of Hoffer Flow Controls.

General Discription-

The Series 163 is a Digital Rate Indicator whose basic theory of operation may be summarized in the following manner.

The Series 163 contains Input Signal Conditioning circuitry suitable for use with magnetic pickups or with compatible remote signal conditioners. If the miniflowmeter linearizer option has been equipped, the offset frequency is injected in order to compensate for the nonlinear characteristic. A shaped and buffered form of the input signal is output. The frequency signal proportional to rate is then converted into a DC voltage signal whose magnitude is proportional to rate with a Frequency to Voltage Converter. This signal is then passed to a Digital Voltmeter Circuit for final display. In like manner the output of the Frequency to Voltage Converter is also scaled and passed to an analog output stage for remote transmission as either a standardized voltage or current signal. A power supply circuit provides the necessary operating bias.

A more detailed discription of operation now follows. Drawing 163-601 is a pictorial Block Diagram which highlights each of the major functional blocks and which represents the signal flow occuring within the unit. As such, this drawing should be referenced while proceding thru the theory of operation.

Detailed Discription of the Theory of Operation-

Magnetic Pickup Signal Conditioner-

The magnetic pickup signal conditioning is composed of a variable attenuator, a bandpass filter, and a comparitor with hysterisis. The bandpass filter is used to reject spurious noise which is out of the normal frequency range generated by a turbine flowmeter(i.e. 10 to 2500 Hz) while amplifing the in band signal of the turbine flowmeter. The attenuator and comparitor with hysterisis function to provide a selectable trigger level which is usually set above background noise pickup yet below the signal normally generated by a turbine flowmeter. This combination assures that zero flow is indicated when zero flow conditions exist.

Opto-Isolated Input-

The opto-isolated input is constructed about a opto-isolated transistor with suitable input current limiting and output conditioning to provide a isolating signal path. This configuration is intended to be used with remote signal conditioners. The isolated input eliminates the installation problems related to equipment grounding and can accept 3 to 30 Vdc pulses of the appropriate polarity. The output conditioning circuitry produces a output swing suitable for use with the logic circuitry found within the Series 163.

Pulse Combinator-

The Pulse Combinator functions as a "OR" Gate so that either the conditioned outputs of either the Magnetic Pickup Compatible Input or the Opto-Isolated Input may be used to drive the Indicator.

Miniflowmeter Linearizer-

For low flow measurement applications which make use of pelton wheel turbine flowmeters such as the Hoffer MF Series a special section of circuitry is needed to eliminate the nonlinear transfer characteristic of the MF Series. See Hoffers "Flowmeter Engineering Guide" for a discussion of the MF Series.

The Miniflowmeter Linearizer implements the offset frequency injection method of linearization by injecting into the conditioned input frequency signal, the particular offset frequency necessary for linearization. A plug in Printed Circuit Card is populated with the necessary circuitry to perform this.

A Thumb wheel Programmable oscillator is used to generate the offset frequency. After injection, a post scaling divide by eight circuit is used to reduce the phase jiggle or irregular pulse spacing which inherently occurs in this circuit implementation.

A low flow cutout circuit is implemented with a retriggerable monostable circuit such that the offset frequency is effectly blocked during conditions of no or little flow. Typically 1 to 10% of full scale.

Pulse Output-

The linearized and conditioned frequency signal proportional to flowrate is passed to a user configurable pulse output buffer. This circuit is configured thru a combination of rear user wiring and internal solder gap jumper programming to meet the required signal type and level to assure interface compatibiliy with the remote recieving instrument. The basic output is a open collector transistor of adequate drive capabilty for most applications. By rear termal jumpering a pullup resistor this output may be configured to produce a high level pulse output. With the addition of a internal solder gap jumper, the output becomes TTL/CMOS compatible.

Precision Pulse Width Generator-

The precision pulse width generator is composed of a binary frequency divider, a frequency range select switch and a adjustable Pulse Width Monostable Circuit.

The Precision Pulse Width Generator has been designed for maximum accuracy over a 200:1 range of input frequency, and to provide a time and temperature independent , adjustable pulse width generator.

The combination of the binary divider and selection switch divide down the input frequency so that the resulting scaled frequency is within the optimum range.

Precision Level Drivers-

The output of the Precision Pulse Width Generator is of a fixed width. To assure the amplitude stability required in precision Frequency to Voltage conversion this signal is passed thru the Precision Level Drivers prior to being Low Pass Filtered into a DC Voltage proportional to flowrate. These circuits are powered by a precision voltage reference found within the power supply circuitry so that the output levels are virtually independent of power line and temperature induced variations.

The outputs of the precision level drivers may then be passed thru a low pass filter to complete the frequency to voltage conversion. The Low Pass Filters have been made switch programmable in order to provide for signal averaging in pulsating flow applications. Thes switches are termed "Display Response".

Digital Voltmeter/Indicator-

The Digital Voltmeter Circuit converts the DC Voltage proportional to flowrate into the coded signals necessary to drive the LED's of the Rate Display.

A variable attenuator designated "Display FS" is used to scale down the normalized output of the Frequency to Voltage Converter to a voltage equal to the desired display indication.

The "Display Zero" control is used to null out any residual DC Offset Voltages left over from the F/V Conversion.

Decimal Points are illuminated as is the trailing zero by lighting the desired segment(s) of the display thru a switch and current limiting resistor(s). A display test is also available.

Analog Voltage and Current Output Amplifiers-

The Analog Output Amplifiers are configured to generate the required industry standard output voltage and current levels from the normalized output levels occuring at the output of the F/V Converter. See specifications for drive levels available.

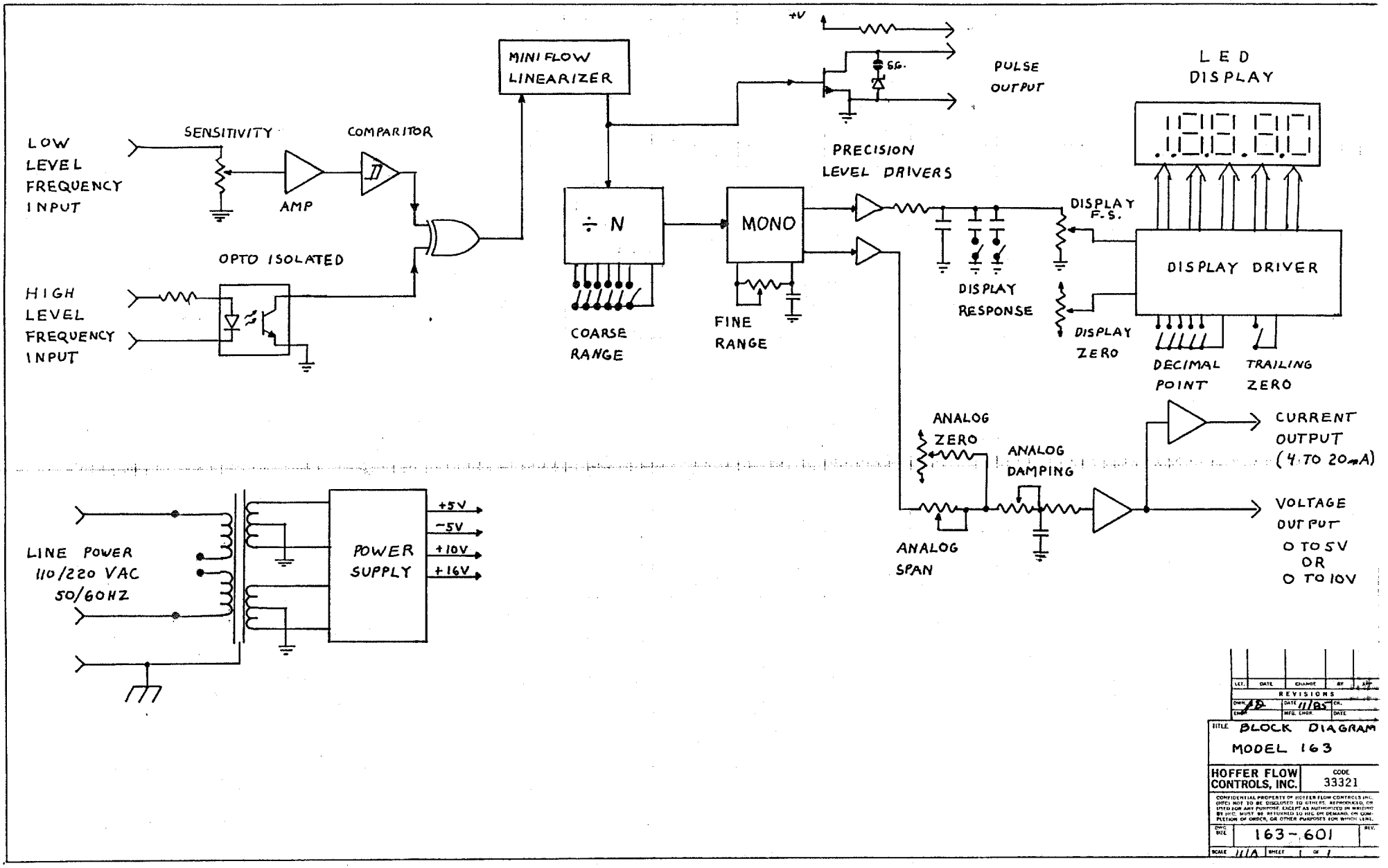
"Analog Span" provides for fine tuning of the output span. In like manner, "Analog Zero" provides for limited adjustment of the zero output signal. Adjustment ranges of +/- 10 % of Span are typical.

An Adjustable Low Pass Filter is provided, termed "Analog Damping", which allows the user to reduce the analog output ripple resulting from flow pulsations and nonideal frequency to voltage conversion. The user than has an option to trade off response time and output ripple content. Response Times (10-90%) from 0.25 to 5 Seconds are possible.

Power Supply-

The power supply consists of a split primary/dual secondary transformer, two rectifier bridges with power filters, and three regulators which provide the operating bias voltages for the various circuitry within the Series 163. In addition, a +16 Vdc voltage at 20 mA is provided for excitation of remote signal conditioners if desired.

The transformer primary is jumper programmable for operation at either 115 Vac or 230 Vac. Transient suppression is provided by surge suppression MOV's.



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TITLE: BLOCK DIAGRAM
MODEL 163

HOFFER FLOW CONTROLS, INC. CODE 33321

DWG. SIZE A | 163-601 | REV.

SCALE NONE | SHEET 1 OF 1

SECTION V

MAINTENANCE, GENERAL

Hoffer Flow Controls Flow Measurement Systems are constructed to give a long service life in the targeted measuring field and service environment. However, problems do occur from time to time and the following points should be considered for preventive maintenance and repairs.

The bearing type used in the flowmeter was chosen to give compromise between long life, chemical resistance, ease of maintenance and performance. A preventive maintenance schedule should be established to determine the amount of wear which has occurred since last over haul. See users manual for flowmeter for further instructions.

A spare Parts List has been provided which, at the discretion of the user, may be user stocked. Consult with the manufacturer if an abridged spare parts list is sought. The recommended spare parts list may be found following this section and in the users manual for the flowmeter.

In case the flow measurement system malfunctions or becomes inoperative, a trouble shooting procedure is enclosed.

Factory consultation is available to assist in diagnosing problems. In addition, factory repair parts and service are available for individuals who wish to utilize this service.

A complete set of schematic diagrams for all printed cards is available from Hoffer Flow Controls for users who wish their own personnel to service the measuring system.

Trouble Shooting and Maintenance for Series 163

In case of an inoperable or malfunctioning system, the following procedurers can be used to isolate the faulty wiring, printed circuit board and/ or other causes.

A recommended spare parts list is given immediately following this trouble shooting section.Recommended spare parts for the flowmeter are listed in the flowmeter manual and are also available from the manufacturer.

Factory consultation is available to assist in diagnosing problems. Note that in some cases factory repairs can be performed more easily than can be accomplished in the field since repair and replacement of components mounted on printed circuit assemblies is beyond the exposure of most individuals who will be servicing this equipment.

To test the Model 163 requires the use of a digital multimeter, a frequency generator and a frequency counter. The required test setup is the same as that discribed in Section IV.

Hoffer offers a number of low cost test accessories for testing Rate Indicators and flow totalizers. These items should be considered for those individuals who do not have the recommended test equipment at this time. Contact the application group at Hoffer for a discussion of the benefits offered by these low cost trouble shooting aids.

Proper Opertion of the 163 may be assumed when:

a. With power applied to the unit the displays are lit.

b. Injecting a test frequency signal equal to F(max) results in the expected display R(max)

c. Injecting a test frequency signal equal to F(max) results in a a analog output equal to Set(span).

d. Injecting a test frequency signal results in a Pulse Output signal of the anticipated voltage drive levels.

e. The appropriate excitation voltage is available for use by the Remote Signal Conditioner (If present).

f. With no flow present, the display indicates 0000 and the analog output is equal to Set(zero).

g. With flow present, the indicator and analog output function as expected without excessive display bounce or analog output ripple over the flow range (frequency range) expected by the application.

Problem Diagnosis and Corrective Action-

OBSERVED CONDITION	CORRECTIVE ACTION
Unit repeatedly blows fuses to it	1. Inspect wiring for conformity to installation requirements 2. Verify fuse size 3. Trouble shoot PCA-88 Assembly.
Unit Indicates Flow on no flow conditions	1. Noise pickup is present. Turn "Sens." control C.C.W. untill zero reading is obtained 2. Input wiring error or bad pickup correct,repair, or replace 3. Display zero drift occured. Null display with Display Zero Adjust. 4. Trouble Shoot PCA-88 Assembly
Unit displays 0000 with flow present	1. Input Wiring Error or bad pickup or signal conditioner. Correct, repair or Replace. 2. Turn "Sens." C.W. 3. Unit not setup correctly. See Sectionm III. 4. Malfunction. Trouble shoot PCA 88
Unit inaccurate at low flow rates	1. Noise present. Check grounds and shields. Adjust "Sens.". 2. Flowmeter out of linear range or requires maintenance.
Objectionable Display bounce	1. Use Display response select swithes to minimize bounce 2. Pulsating Flow is really present, install surge tank
Objectionable Analog Output Ripple	1. Adjust Analog Damping to minimize ripple 2. Check grounding and shielding 3. Pulsations in flow are really present, install surge tank
Display Segment Failure or Malfunction suspect	1. Try jumpering display test on PCA-88. If O.K. 1888 will be displayed. 2. Trouble shoot PCA 88 and 92
Voltage Output Malfuction	1. Check for shorts on output wiring. Correct as required. 2. Load resistance to low. 3. Trouble shoot PCA-88

Current Output Malfunction	1. Check wiring for open circuits Correct as required. 2. Input Resistance to high on recieving device. 3. Trouble Shoot PCA-88
Pulse Output Malfunction	1. Check wiring to pulse output 2. Verify correct jumper options are equipped on PCA-88 3. Verify recieving device 4. Trouble Shoot PCA-88
Opto-Isolator Input Does not work properly	1. Verify Wiring and polarity of Input Pulse 2. Input wave form duty cycle not 30/70 to 70/30 3. Input drine levels not 3-30 V 4. Trouble Shoot PCA-88 5. Random noise comimg in on magnetic pickup input. Turn Sens. 20 turnsa C.C.W.
Magnetic Pickup Input does not work properly	1. Check Input Wiring 2. Turn "Sens." C.W. 3. Inadequate Signal Level 30 mVp-p minimum 10 to 2500 Hz. 4. Input signal waveshape not of compatible waveform 30/70 to 70/30 duty cycle 5. Trouble Shoot PCA-88
Indicator Inaccurate with HO Series Flowmeter	1. Check Setup of 163 2. Null display with no flow 3. Check for Noise Pickup. Adjust Sensitivity. 4. Inspect Flowmeter for damage. 5. Many fluid and installation factors may cause this. Contact Manufacturer.
Indicator Inaccurate with MF Series Flowmeter	1. Check setup of MF Linearizer 2. Check setup of 163 3. Check for noise pickup. Adjust Sensitivity 4. Inspect Flowmeter for damage. 5. Many Fluid and installation factors may influence accuracy. Check with manufacturer.

Indicator Inaccurate with HP Series Flowmeter	1. Check Insertion Deapth and allignment with pipe 2. Check calculations for meter factor and setup of 163 3. Check for noise pickup 4. Check for rotor damage 5. Many Fluid and installation factors influence accuracy. Contact Manufacturer.
LED Segments fail to light	1. Trouble Shoot PCA-92 2. Trouble Shoot PCA-88
Display and Analog Output decrease above certain flowrate with increasing flow	1. Display and Output overranged, recalibrate for higher range 2. MCP Signal Conditioner and Flowmeter overrange. Purchase Flowmeter of correct range. 3. Inadequate input signal level or unsuitable waveform or duty cycle.
Signal Conditioner Failure or Malfunction	1. See manual for specific model wiring and corrective action recommendations

Detailed Trouble Shooting Aids for Technicians available from Hoffer

A. Schematic Drawings
   1. PCA-88-201
   2. PCA-92-201
   3. PCA-93-202

B. Component Lists
   1. PCA-88
   2. PCA-92
   3. PCA-93

C. Component Assembly Drawings
   1. PCA-88-401
   2. PCA-92-401
   3. PCA-93-402

D. Test Waveforms
   1. PCA-88
   2. PCA-92
   3. PCA-93

Model 163 Available Spare Parts List-

The specific spare parts list applicable to user will depend on the options the user has specified for his application. See the Model Numbering Guide in Section I for details.

Due to the limited modular construction of this product series the user is advised to simply purchase a spare unit to function as the spare part while a defective unit is being serviced.

The recommended spare parts list for the flowmeter may be found in the manual for the flowmeter or may be obtained from the manufacturer. General Items worthy to be considered are listed below. In addition, it is important to note that in most cases factory repairs may be made at a small fraction of the cost of purchasing a new system. All products made by Hoffer are factory repairable.

The following list presents a number of the most frequently requested items applicable to this model.

Partial Available Spare Parts List

Parts Number	Discription	Quanity
PCA-88	Main PCA with 4-20 mAdc Option	1
PCA-88	Main PCA with 0-5 Vdc Option	1
PCA-88	Main PCA with 0-10 Vdc Option	1
PCA-92	Display Subassembly	1
PCA-93-2	Mini Flowmeter Linerarizer	1
	Pickup Coil	1
	Flowmeter Electrical Connector	1
	Flowmeter Signal Conditioner	1
	Lens	1
	Bezel	1
	Enclosure	1
	Mounting Bracket Set	1
	Card Edge Connector	1
	Spare Cable Set	1

ARNOLD SP163-3-X-1-X

SPECIFICATIONS

INPUT POWER	110/220 VAC +/- 10% 50/60 hz user jumper selectable. With battery backup for 48 hour continuous use.
INPUT SIGNAL	LOW LEVEL Input filtered, RF and Bandpass filtered. Adjustable triger level 10 millivolt RMS (minimum) 5 hz to 5000 hz. Over voltage capability 120V RMS (absolute). Input impedance 40 kilo ohm (nominal). OPTO-ISOLATED Input signal range 3 to 30 Vdc. Minimum input pulse duration 0.1mSec. Input impedance 1.2 kilo ohms. Maximum isolation voltage 2500 Vdc.
RATE DISPLAY	Type 3-1/2 digit light emitting diode (LED) Character height 0.45 inches Viewing distance 25 feet Accuracy +/- .05% F.S. +/- 1 digit
OUTPUT CHARACTERISTICS	OPEN COLLECTOR - TYPE 2N6660 Vmax 60 Vdc absolute maximum Imax 1.2 Adc absolute maximum TTL/CMOS Logic 1 2.4Vdc @ .800mA Logic 0 0.4Vdc @ 2.6mA HTL Logic 0 0.4Vdc @ 100mA Logic 1 10.0Vdc @ 1mA OPTO-DRIVE On current 3ma (nominal) Off current less than 25uA

Turn the Display Full Scale Adjust, P3, clockwise to obtain an indication equal to R(max). (Ignore as yet unselected Decimal Points and the trailing zero which are to be inserted later.)

If a decimal point is to be used, use the decimal point switch to illuminate the desired location.

If the dummy zero is to be used, use the Decimal Switch position 6 to illuminate the trailing zero.

Analog Output Setup-

Turn Off the Signal Source. Adjust the Zero Adjustment to obtained the desired zero as measured with the digital multimeter within the tolerance specified in Table 3.2.

Turn On the Signal Source. Adjust the Span Adjustment to obtain the desired span as measured with the digital multimeter within the tolerance specified in Table 3.2.

Iterate the above two steps as necessary to bring the result within the recommended tolerances. Note that oscillator drift will manifest itself as drifting readings on the analog output is non-crystal oscillators are used.

Table 3.1A Course Range Selection for HO and HP SERIES

Full Scale Frequency	Switch Position
112 - 225	1
225 - 450	2
450 - 900	3
900 - 1800	4
1800 - 3600	5
3600 - 7200	6