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CONTENTS

SECTION 1 GENERAL INFORMATION

1.1 Description
1.2 Specifications

SECTION 2 INSTALLATION

2.1 Unpacking and Inspection
2.2 107B Transducer Installation
2.3 Cabling and Interconnections

SECTION 3 OPERATION

3.1 General
3.2 Theory of Operation

SECTION 4 MAINTENANCE

4.1 General
4.2 Troubleshooting

SECTION 1

GENERAL INFORMATION

1.1 DESCRIPTION

The MKS Type 107B Transducer is the result of over twenty five years experience with capacitance manometers and the addition of a new sensor design

(Patent Pending). This design marks the first time that six decades of pressure measurement are available using a single capacitance manometer. When coupled with MKS Type 116 or 146 Power Supply/Readouts, the 107B can replace two or more pressure instruments in applications such as data logging or process control, where environmental and process conditions are particularly demanding. Only Inconel is exposed to the process, which permits use of corrosive or dirty gases, and eliminates contamination of the process with gauge materials.

Measurements are independent of gas composition; the 107B measures true total pressure, regardless of gas species or mixtures.

The Type 107B is the first MKS transducer to be digitally linearized. Linearization constants are stored inside EEPROM memory located in each transducer, and thus a 107B is usable with any 116 or 146 readout.

In normal operation, the 107B Transducer heater circuit warms the sensor to 45°C for good stability and to reduce process condensation.

1.2 SPECIFICATIONS

ELECTRICAL

Power Requirements

Circuit: ±15 VDC ±5% @ 30 mA
Heater: ±15 VDC ±5% @ 300 mA OR
24 VAC ±5% @ 325 mA

Range: 1 mTorr - 1000 Torr

Accuracy: see Table 1-1*

Media Compatibility: any gas compatible with Inconel

Maximum pressure: 1800 Torr

Warmup time: 4 hours

Mechanical: see Figure 1-1

Cable length: 10 feet standard.

Environmental:

Operating ambient Temperature: 15-40°C.

Humidity: 0-95% non-condensing.

* Accuracy is the system accuracy when used with either a 116 or 146 Power Supply/ Readout.

TABLE 1-1
Pressure Specification

Figure 1-1
Mechanical Outline 107B

1-4

SECTION 2

INSTALLATION

2.1 UNPACKING AND INSPECTION

Reasonable care has been taken to pack the Type 107B in a manner that it reach you in perfect operating condition. However, upon receiving these units you should check for defects, cracks, broken connectors, etc. to be certain that damage has not occurred during shipment. If you find any damage, notify your carrier and MKS immediately. If return of the instrument is necessary, an Equipment Return Authorization (ERA) number is required from MKS Customer Service to accept, expedite, repair, and return.

2.2 TYPE 107B TRANSDUCER INSTALLATION

The Type 107B comes with fitting options identical to all other 100 Series Transducers (Cajon 8 VCR, Cajon 8VCO, KF16, and 1/2" diameter tublation.) The sensor port will easily carry the weight of the transducer. It is always suggested that chamber pressure measurement ports be located such that the capacitance manometer is vertical with its port facing downward. In this way process products which may appear in the sensor will fall out into the chamber where they can be pumped, preserving the integrity of the pressure measurement. The pressure transducer should be mounted such that it is firmly supported and isolated from any vibration.

Note that temperature controlled transducers, such as the 107B, need a minimum of four hours to achieve best thermal stability. After warmup, all newly installed sensors should be zeroed. For a 107B, this means pumping the unit to below $5x10^{-5}$ Torr and Remote Zeroing the 116 or 146 display. Refer to the instruction manual of either unit for the appropriate procedure to follow when remote zeroing.

The 107B/readout combination comes with MKS cable #CB107-1 or #CB107-2 which is used between the transducer and readout. The -1 cable is the standard 10 foot version. The -2 version is a special cable of longer length. The connectors are male and female type "D" and come complete with captive mounting hardware (Reference Figure 2-1). With power off, insert connectors into their respective 107B or readout sockets and tighten the connector screws, two on either end of the cable.

NOTE:

DUE TO THE FAILURE OF MANY USERS TO FOLLOW THE PROPER TIGHTENING PROCEDURES FOR SINGLE OR DOUBLE METAL FERRULE COMPRESSION TYPE VACUUM FITTINGS AND THE RESULTING DAMAGE CAUSED TO THE PRESSURE SENSOR, MKS DOES NOT WARRANTY THIS PRODUCT WHEN SUCH FITTINGS ARE USED.

2.3 CABLING AND INTERCONNECTIONS

GROUNDING

Power, Analog, and Digital commons are all tied together in the power supply; and transducer Signal common and Power common are tied together in the transducer. Even though these commons are connected together internally, it is important that each ground be used only for its stated purpose; otherwise ground noise and loops can cause significant errors. These commons are connected to chassis by a 10K ohm 1/4 W resistor, shunted by several 50 volt capacitors totalling more than 2uF. Maximum potential difference must be limited to avoid introducing noise.

CABLING

Since each 107B transducer comes with its own linearity correction data stored in EEPROM memory on board, a 107B may be used with any 116 or 146 readout. The cable supplied with the 107B is a CB107-1 or CB107-2 which requires that two screws be tightened on each end. Table 2-1 shows the transducer cable connections.

Figure 2-1

* Heater Power: AC or DC not polarity sensitive.

TABLE 2-1
Transducer Connector

SECTION 3

OPERATION

3.1 GENERAL

The Type 107B Transducer consists of a new-technology capacitance manometer (Patent Pending) enclosed by a heated chamber with two printed circuit (PC) boards which provide signal conditioning, heating control and memory for calibration constants.

3.2 THEORY OF OPERATION

SENSOR

The new sensor technology employed by the Type 107B maintains rugged construction of previous MKS pressure transducers with their Inconel stretched diaphragm and enclosure. A new electrode arrangement allows the transducer to develop useful output over a six decade pressure range. Minimum resolvable readings are 1 milliTorr and the 107B's full scale is 1000 Torr.

The variable capacitance sensor has rigidly attached electrodes located in an evacuated chamber behind the metal diaphragm. This reference chamber is permanently evacuated, sealed and gettered thus making the pressure measurement totally independent of the gas type or composition.

The sensor and signal conditioning PC board are housed in a temperature-controlled thermal chamber which is heated to 45°C. This allows the 107B to operate in many systems without effects due to condensation. Also it improves the effective sensor and electronics temperature coefficients by at least 30:1.

ELECTRONICS

The electronics package consists of three distinct circuits. These are (1) the signal conditioner, (2) the heater control and (3) the calibration constant memory circuit.

Signal conditioning is shown in the block diagram (Fig. 3-1).

A precision constant frequency oscillator is used to excite a diode bridge arrangement. Through the bridge the excitation reaches two capacitances, one of which is a highly stable fixed capacitor and the other is the sensor. With the transducer held to zero pressure (high vacuum) the two capacitances will be equal and the bridge arrangement will have zero output. (For calibration purposes, at zero the 107B really develops between -50 millivolts and -125 millivolts output.) As the pressure increases, the sensor capacitance will increase and the bridge circuit will be unbalanced causing a DC voltage across the bridge. This signal is then filtered and amplified by subsequent stages such that at full scale pressure of 1000 Torr the output will be between 9.5 volts and 10.0 volts.

Figure 3-1
107B Block Diagram

Setting the output for a specific value is not needed since the transducer's complete output curve is described by the data stored in EEPROM on board the transducer. The circuitry needed to perform this task consists of a 5 volt regulator to drop the supply +15 VDC line down to logic power levels, the serial EEPROM memory IC, and Schmitt trigger inverters for extra noise immunity. During calibration or power-on of a Type 116 or 146, clocking is provided by the interfacing power supply/readout while data is either sent or received by the EEPROM. Up to 60 pressure/voltage pairs are stored in the memory and these are used by the readouts to construct linearization look-up tables used in finding any given pressure.

The third circuit section is the heater control circuit, located on the PC board which is outside of the heated shell. This circuit is a balanced-resistor-bridge arrangement which provides analog PID control which is optimized for this particular application. Two thermistors sense the heater temperature and the ambient as seen by the inner enclosure to provide "lead" and "lag" thermal signals to an integrator which controls the duty-cycle oscillator. This oscillator will run over a large frequency range, with 33Khz being nominal, and an enhancement
mode FET provides the heater switching.

SECTION 4

MAINTENANCE

4.1 GENERAL

The MKS Type 107B contains no user serviceable parts or adjust-ments. Should the unit need repair or calibration, it is necessary to contact MKS Customer Service and obtain an ERA (equipment return authorization) number which should be included with the returned equipment.

Unlike most capacitance manometers, the 107B does not require or allow user adjustment of its zero pressure output voltage, because this value is stored in EEPROM memory within the 107B. Acceptable changes in the 107B zero pressure output voltage are corrected by the Remote Zero function of the Type 116 or 146 readout.

Contamination, diaphragm leaks, excessive shock etc. can cause zero shifts which can prevent the Remote Zero function from working. The Remote Zero function cannot be field repaired. However, by monitoring and recording the 107B output voltage at zero pressure (and other pressures if available) as part of routine maintenance, these problems can be identified or anticipated. The 107B output at zero pressure should normally be between -125 millivolts and -50 millivolts, although the transducer will operate satisfactorily with shifts of ±50 milli-volts outside of this range.

It is NOT recommended that the user attempt to repair the transducer signal conditioner electronics since replacement or movement of many PC board componenets may require complete recalibration of the unit by MKS.

4.2 TROUBLESHOOTING

A. Transducer Contamination

It is NOT recommended that the user attempt to clean the sensor. Capacitance manometers will often exhibit calibration shifts due to cleaning, which rezeroing will not correct; cleaning can destroy the sensor. ANY ATTEMPT TO CLEAN A CONTAMINATED SENSOR WILL VOID ITS WARRANTY. If contamination is suspected, return the unit to MKS for repair and recalibration.

B. Readout Display is Frozen

It has been noticed on occasion that a mis-read of informa- tion from the 107B on-board EEPROM will cause a readout to freeze during its power-on starting sequence. If this occurs, power down the display and restart. If there is no change then check for tight cable connections at both ends. Also if other 107B units or display readouts are available, then by substitution the user should be able to determine whether the source of the malfunction is the 107B or the readout.

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