# MKS Baratron® Type 120 Capacitance Manometer

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# SECTION 1

# DESCRIPTION

The Type 120 MKS Baratron Vacuum Gauge is a capacitance manometer designed to provide accurate, reliable, and repeatable pressure measurements in the range from 25000 Torr (25000 mmHg) to less than $10^{-5}$ Torr. The new Type 120 Transducer is the result of over twenty-five years experience with capacitance manometers and is the most accurate stand-alone Baratron transducer available. Designed for the increasing demands of process technology, the Type 120 provides improved accuracy, lower temperature coefficients, and an additional decade of usable measurement range over previously available process transducers. The Type 120 combines the proven MKS Type 390 high-accuracy sensor, together with power and signal conditioning electronics (oscillator, demodulator, amplifier and remote zero circuitry), within a single, chemically inert, injection molded, high impact, RFI shielded enclosure.

The Type 120 transducer yields a linear, high level DC output signal of 0-10 Volts which can be read directly by a DVM, data acquisition system, MKS readout/power supply instruments, or used with MKS controllers for accurate pressure control. Standard features include a remotely-activated range turndown capability (to provide full scale output of 0-10 volts for 100% or 10% of sensor range), remotely-activated zeroing capability, and a DC output signal which is isolated from input power and chassis ground.

The Type 120 controls the sensor temperature at 45 C which minimizes effects of ambient or process temperature variations typically encountered in process environments. RFI shielding is standard, to prevent interference from RF or noisy electrical environments. Power requirements are industry standard +/-15 VDC (with power supply common not connected) or 24 to 30 VDC. Full scale ranges of 1 to 25000 mmHg absolute and differential are available using a rugged all-welded sensor. Its single-sided, dual electrode design results in superior corrosion resistance with only Inconel and Stainless Steel exposed to the process gas.

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SECTION 2

# SPECIFICATIONS

## PRESSURE

| | | |
|---|---|---|
| Type of Measurement | | Absolute or Differential |
| Full Scale Ranges | | 1, 10, 100, 1000, 5000, 10000, 15000, 20000, 25000 mmHg |
| Resolution | | $1X10^{-6}$ of Full Scale |
| Usable Measurement Range | | F.S. to $1X10^{-5}$ (5 Decades) |
| Accuracy | | ±0.12% of Reading Standard<br>Consult Factory for Optional Accuracies. |
| Temperature Coefficient | | |
| Zero | | ±.002% of F.S./ C max. (20ppm/ C) |
| Span | | ±.01% of Rdg./ C max. (100ppm/ C) |
| Media Compatibility | | Any gas compatible with Inconel, 316 Stainless Steel. |
| Volume | Absolute: | 1-1000 mmHg F.S. : 2.2 cc. |
| | | 5000-25000 mmHg F.S. : 14.0 cc. |
| | Differential: | 1-1000 mmHg F.S.: 8.0 cc. Pr Port<br>1.9 cc. Px Port |
| | | 5K-25K mmHg F.S.: 8.0 cc. Pr Port<br>14.0 cc. Px Port |
| Max. Overpressure | | 125% of F.S. or 20 psia, whichever is greater. |
| Maximum Line Pressure (Differential) | | 150 psig |
| Line Pressure Effects on Span (Differential) | | <.003% of Reading/15 psi |
| Time Response | | < 40 msec. |

ENVIRONMENTAL

Operating Temperature Range — 15-40 Degrees Celsius (Temperature Controlled at 45 C)

Humidity — 0-95% non-condensing

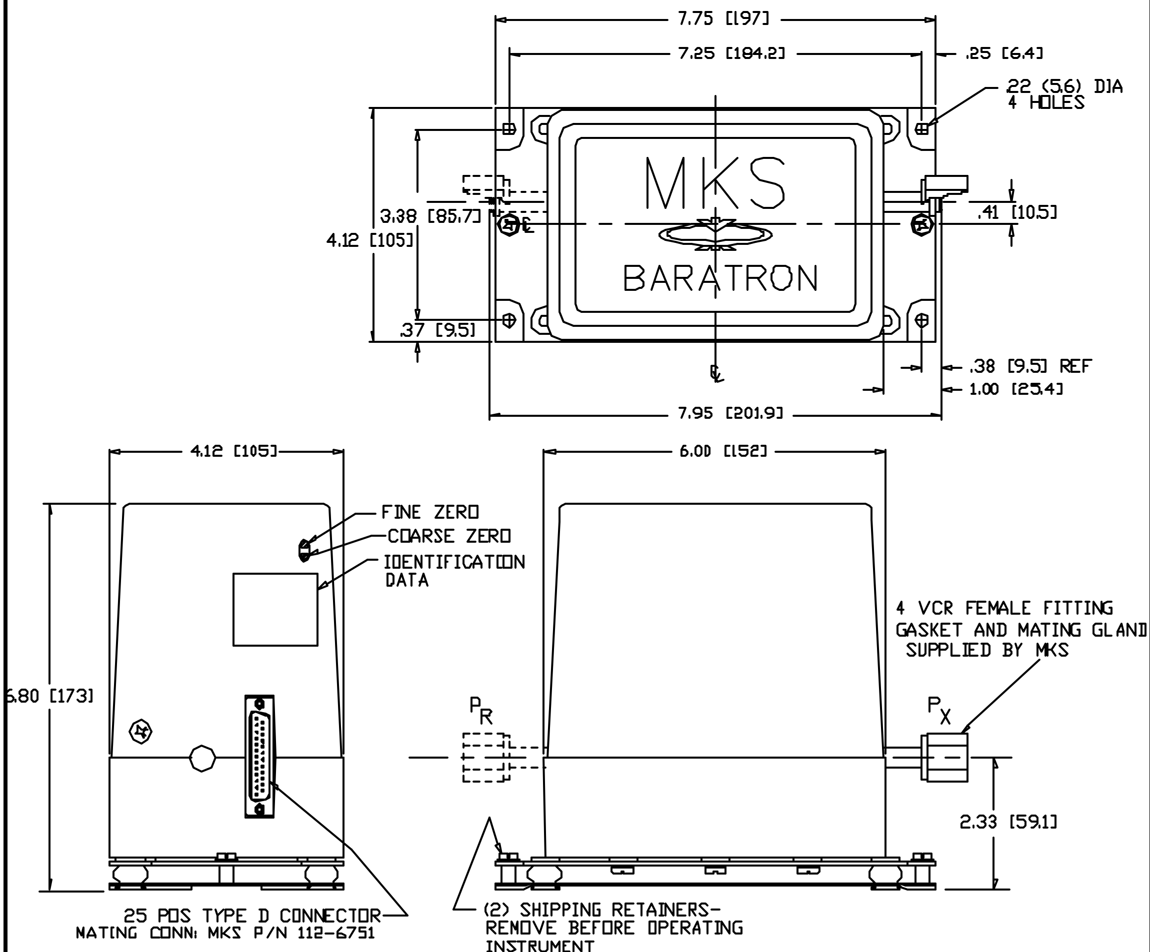
ELECTRICAL

| | |
|---|---|
| Power Required | ±15 VDC (With supply common not connected) or 24 to 30 VDC @700 ma maximum on turn on, (450ma typical after 4 hour warm-up). |
| Output | 0-10 VDC into >10K OHM Load. |
| Remote Range Turndown | X1 and X0.1 of range, initiated by TTL logic low or shorting (pin 16) to digital ground. |
| Range Identification (output) | Range I/D (pin 18)<br>TTL high on X1 range.<br>TTL low on X0.1 range. |
| Remote Zero | Correction Range: ±2% of Full Scale<br>Resolution: ±1ppm of Full Scale<br>Repeatability: ±5ppm of Full Scale.<br><br>Correction Time: < 3.5 Seconds<br><br>Cycle initiated by TTL logic low or shorting (pin 15) to digital ground. |
| Remote Zero Overange (output) | Overange goes to TTL logic high upon zero greater than ±2% of full scale. |
| Remote Zero Bypass (input) | This function removes the "remote zero" correction. It can be used to reset manual zero correction.<br>Remote zero bypass initiated by TTL logic low or shorting pin 19 to digital ground. |
| Connector | 25 pin, type "D" male |

MECHANICAL

| | |
|---|---|
| Fittings | Cajon$^{R}$ 4 VCR |
| Mechanical Outline | See Figure 2-1 |

Specifications subject to change without notice.




NOTE:
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES (MILLIMETERS REFERENCED)

Figure 2-1
Mechanical Outline

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SECTION 3

# INSTALLATION

PLEASE READ AND UNDERSTAND THESE INSTRUCTIONS before operating the Type 120 Transducer. Any questions concerning the operation of this instrument can be answered by calling your local sales office or MKS, Andover, Mass. USA.

## 3.1 Unpacking and Inspection

Much care has been taken to pack the 120 in a manner such that it will reach you in perfect operating condition. However, upon receiving these units you should check for 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. See inside back cover for nearest MKS service center.

## 3.2 Mounting

The Type 120 transducer should be mounted horizontally upon its vibration isolation base with the following points noted:

**Warning**

**The unit *must* be mounted horizontally.**

**Do *not* mount the Type 120 pressure transducer vertically or upside down. The vibration mount assembly is not designed to support the weight of the unit in either position.**

A. All units are supplied with vibration isolators which should be used for maximum stability. A flexible bellows connection is suggested to minimize vibration. It is recommended that the sensor be mounted such that the diaphragm plane is perpendicular to the major axis of vibration (diaphragm plane is perpendicular to the port axis).

B. Access should be provided to the two zero pots and cable connector mounted on one end of the transducer.

C. Ambient temperature around the 120 must not rise above 40 C as this will cause the 45 -47 C control temperature to go out of regulation, thus reducing the system temperature stability.

D. Mount the transducer as far away from RFI and EMI sources as practical. Field experience has shown that care in positioning the transducer initially will prevent future difficulties. The transducer is internally protected against RFI and EMI. However, in systems where several ground potentials are possible, a noisy environment may cause the output to be unstable. When this happens, we have found the only solution to be an examination and correction of the source of RFI/EMI. Never run the 120 cable in the same wiring bundle as RF or SCR signals.

E. The vibration mount assembly is shipped from MKS with two shipping screws in place. For isolation mounting, these screws must be removed. However, when this transducer is subsequently reshipped on a piece of equipment, these screws MUST BE REINSTALLED as the rubber feet will withstand no more than 3 g's force.

F. When installing a 120 Differential Transducer, allow for a cross-porting manifold; i.e. connecting the two ports together. In order to properly set the zero on any differential sensor, there must be equal pressures on both sides of the sensor.

G. Vacuum connections:

To maximize the life and zero repeatability of the sensor, in most process applications an isolation valve is suggested. Set its closing point at or slightly above the sensors full scale range. An isolation valve protects the sensor from overpressure, which is common in processing systems that incorporate pressure purging cycles in excess of sensor specifications, as well as protecting the sensor from process chemistry/moisture contamination, which is present when a process system is vented to atmosphere. Moisture can often combine with residue on the sensor surfaces, and form acids such as HCL when Chlorine or Flourine based processes are used.

The sensor inlet should be connected to the isolation valve with the appropriate length of stainless steel bellows tubing with welded Cajon® fittings. The use of flexible bellows completes vibration isolation of the sensor, allowing it to function independently of significant system vibration or stress that could be induced during operation.

For Type 120 Differential Sensors the Px port must be connected to the high side of any system whose differential pressure is to be measured. The Pr side will then be connected to the low pressure side. If connections are reversed, the instrument will output a negative signal whose accuracy is not specified. A Type 120 Differential sensor may be used to make an absolute measurement by continually pumping the Pr port to a pressure below that of the resolution of the sensor.

For your convenience, MKS makes available several lengths of these bellows assemblies, including the mating VCR fittings welded to the bellows tubing.

**Caution**

**Hard coupling of the sensor inlet tube so that the transducer is suspended by this tube is not recommended as the weight of the entire assembly will cause stress on the sensor.**

**Do not attempt to change the inlet tube fitting by cutting or welding. If a different fitting is desired, make up an adapter, or consult MKS for a quotation on a special-version sensor.**

## 3.3 Cabling and Interconnections

Refer to Figure 2-1 for the location of the connector on the 120 housing. Table 3-1 shows the transducer cable pin-out. Certain interface cables can be supplied by MKS, or the user may choose to make up their own provided the appropriate specifications contained herein are maintained.

For convenience, when a user purchases a complete measurement system with all MKS components, MKS can supply the appropriate shielded cable with connector(s), in standard nominal lengths. See Figure 3-2 for cable numbers used with various readout/controller systems. Cable pricing may be obtained from a local salesperson or MKS order entry group. Shielded cable assemblies in a nominal 10' (3m) length, with one end terminated in "flying leads" (pigtail) fashion are available at nominal cost. The electrical connections are shown in Figure 3-3. Shielded cable assemblies are recommended, especially if the transducers environment contains high EMI/RFI noise.

Figures 3-4, 3-5, 3-6, and 3-7 show the connections of cables used to interface the Type 120 to various MKS controllers and power supply readout devices along with the part numbers of the connectors. All cables are shielded and provide full access to the Type 120 features. Refer to Section 4 for wiring information to utilize the Type 120 remote zero and downranging features.

| **120 Transducer Pin Connections** | |
|---|---|
| **Pin #** | **Function** |
| 1, 25 | Chassis Common |
| 7 | Digital Common |
| 9 | Pressure Output + |
| 10 | Pressure Output Common |
| 11 | Supply Input - |
| 12 | Supply Input + |
| 15 | Remote Zero Input |
| 16 | x 0.1 Range Input |
| 17 | Remote Zero Overrange Output |
| 18 | Range Ident Output |
| 19 | Remote Zero Bypass Input |
| 2-6, 8 | Spares Reserved |
| 13, 14, 20-24 | Spares Free |

Table 3-1
120 Transducer Pin Connections

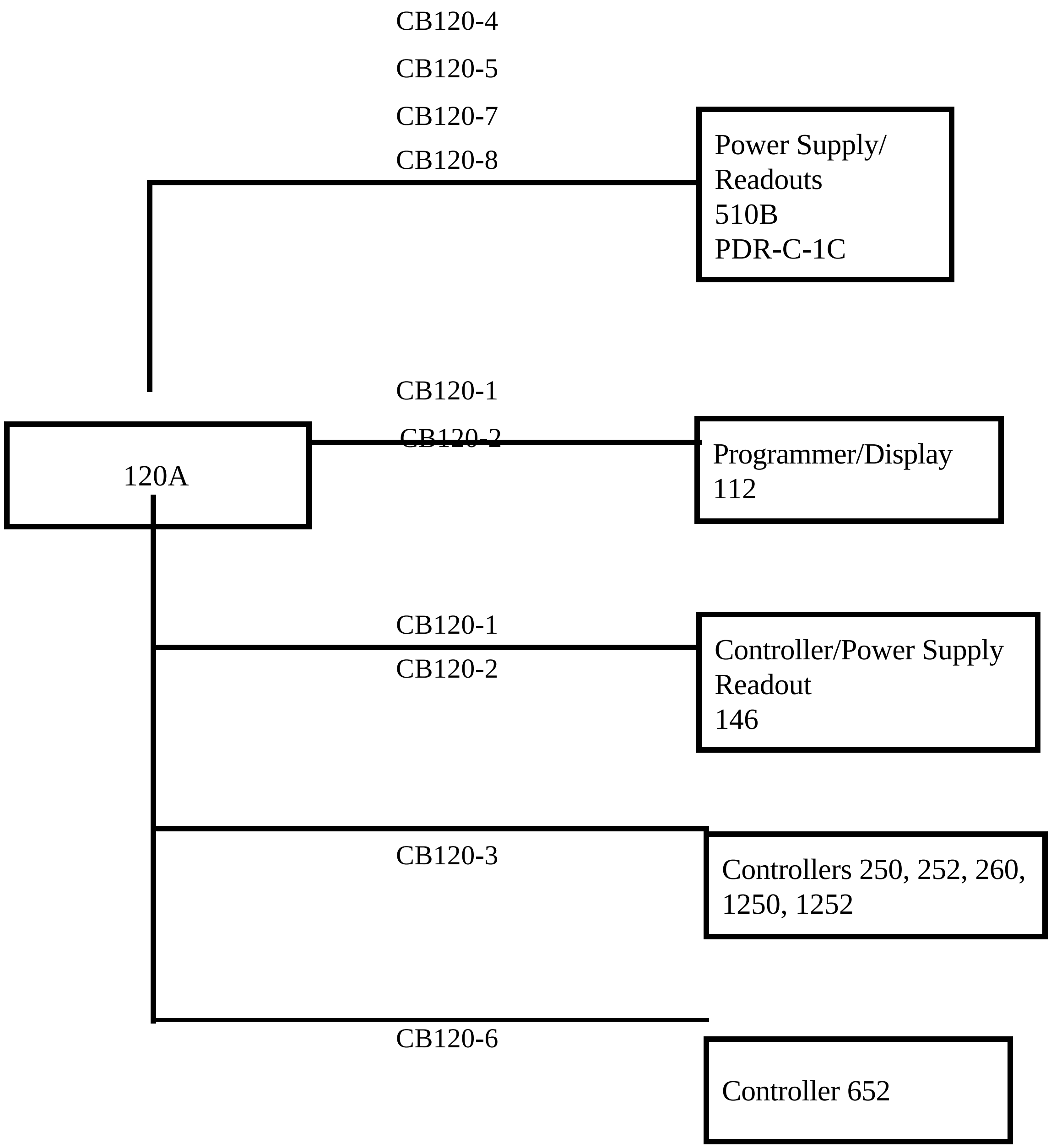


Figure 3-2
Type 120 Cables

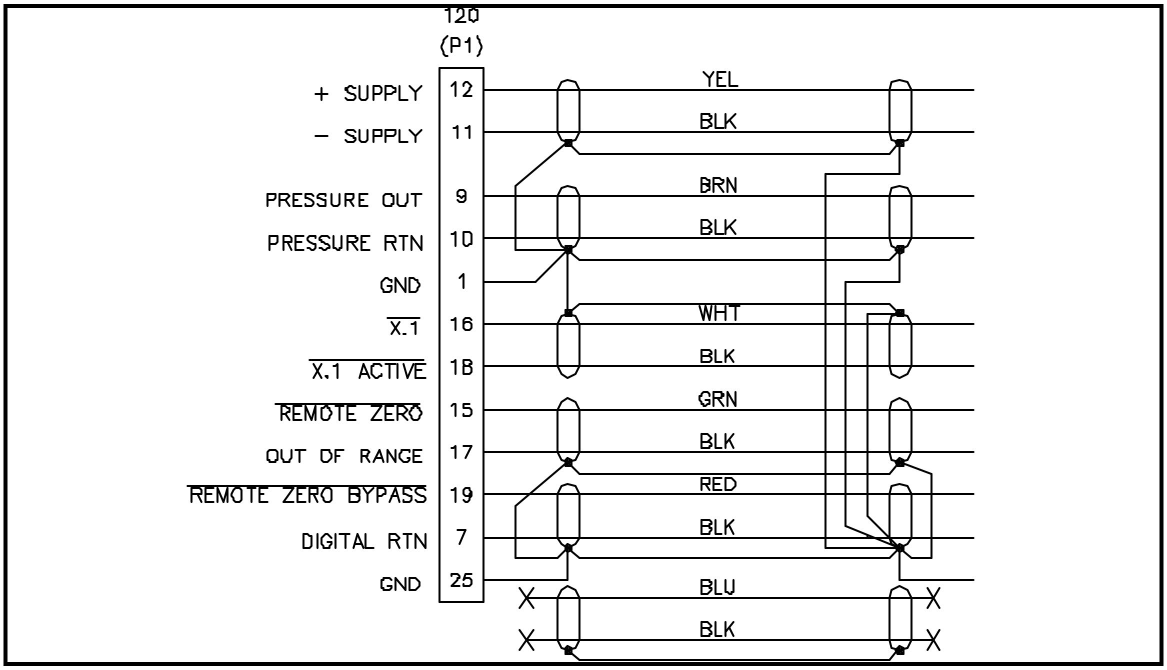


Figure 3-3
120 To PDR-C-2C Connections ("Flying Leads")
CB120-4, CB120-5

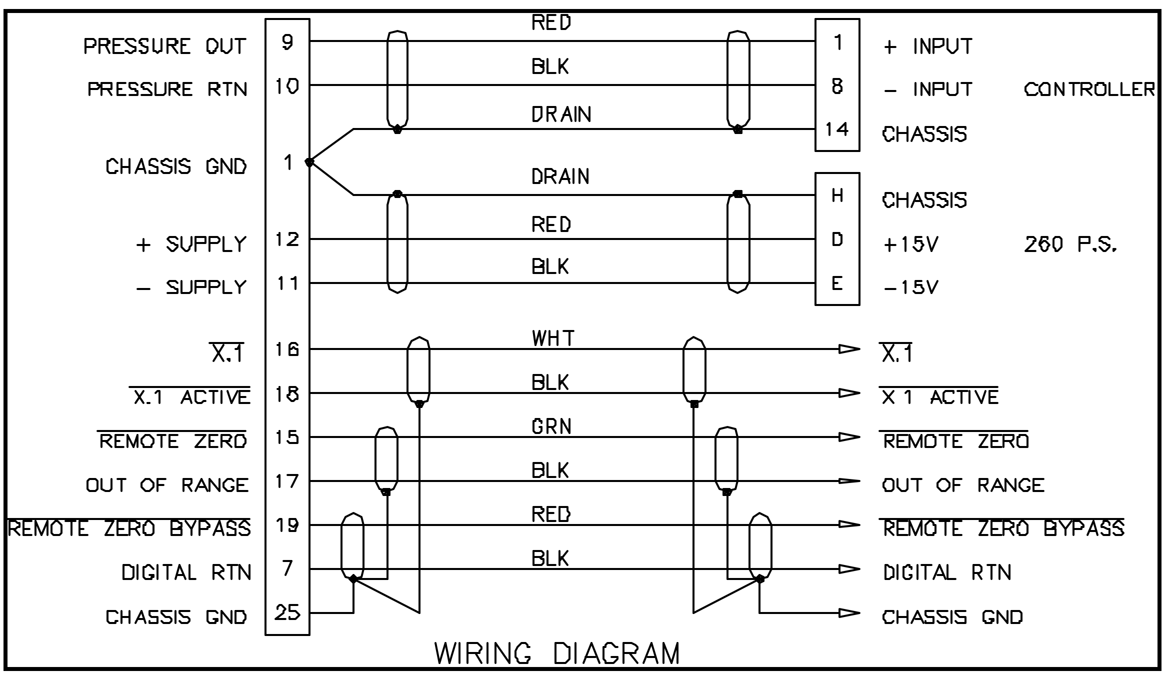


Figure 3-4
120 To MKS Controllers Types 250, 252, 260, 1250, 1252
CB120-3

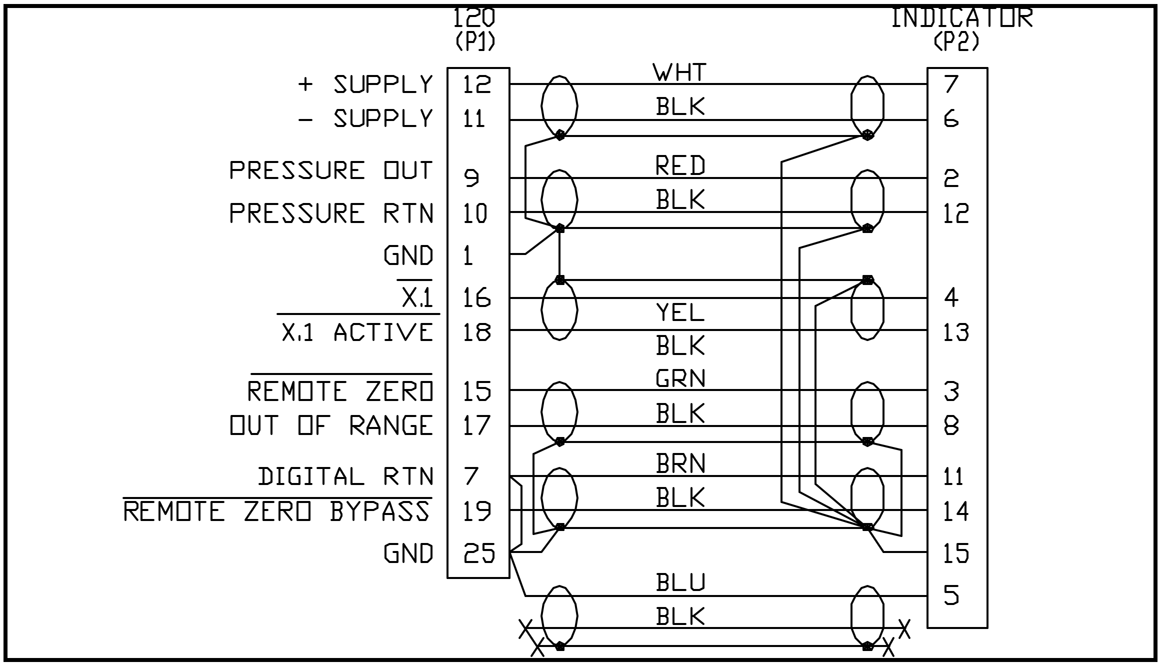


Figure 3-5
120 to Type 112, 146
CB120-1, CB120-2

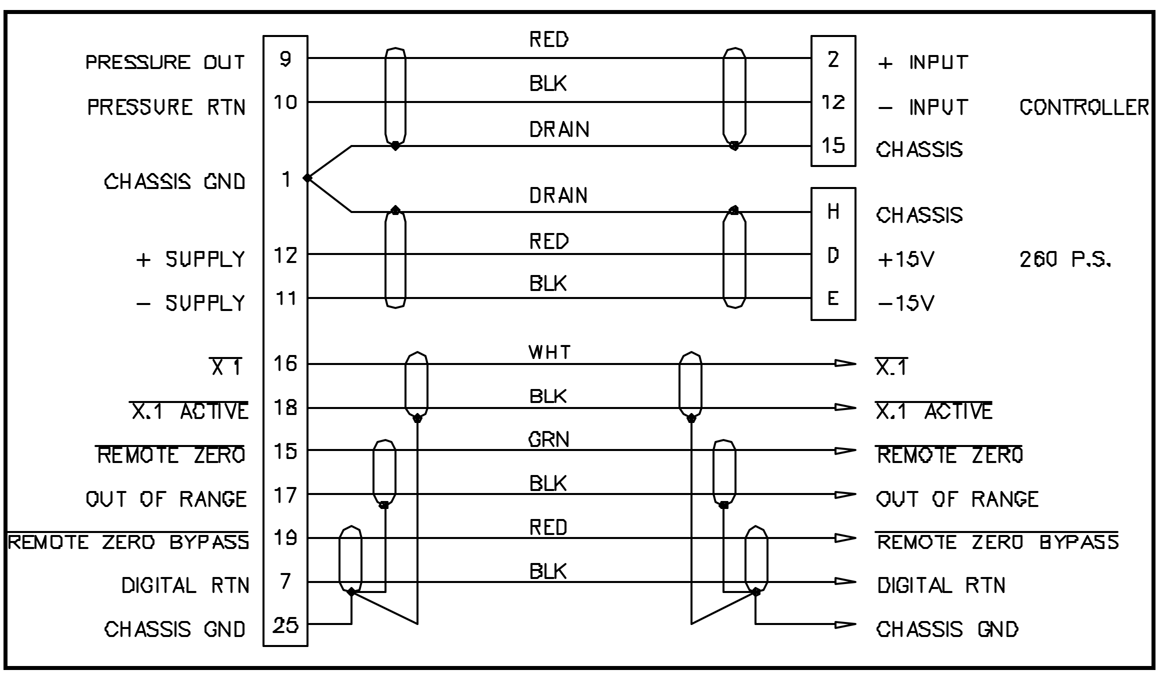


Figure 3-6
120 to 652 Controller
CB120-6

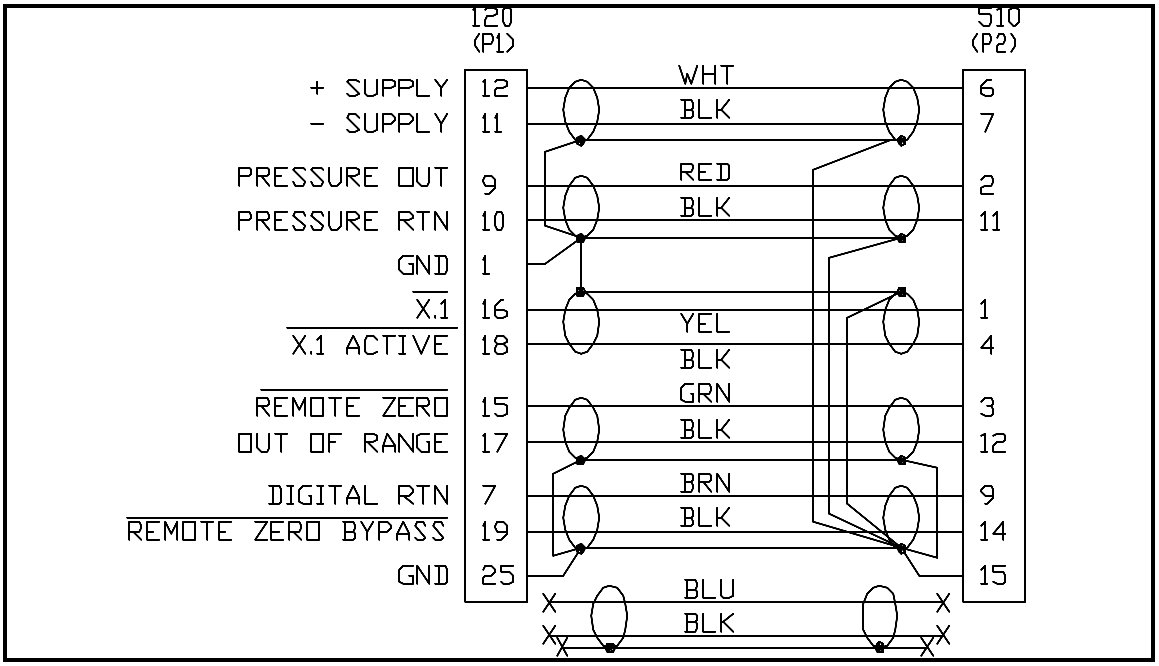


Figure 3-7
120 to 510B
CB120-7, CB120-8

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# SECTION 4

# OPERATION

## 4.1 General

The Type 120 transducer should first be inspected and installed as outlined in the installation section of this manual. The transducer will operate with a single 24-30 VDC supply or a dual +/-15 VDC supply with the supply common not connected. This power supply must be capable of providing 700ma of current maximum for a cold transducer. Only TTL compatible inputs and outputs should be connected to the Type 120 digital inputs and outputs. The Type 120 pressure output voltage signal is isolated from chassis ground. It is recommended that this isolation be maintained, in order to prevent any offsets in the DC output that may result due to system ground loops.

It is important to remember that all temperature controlled, diaphragm-variable capacitance pressure transducers require the user to set "zero" after suitable warm-up and pumping have been accomplished. After the sensor has been installed and power applied, a minimum of four (4) hours, should be allowed for the heater in the transducer package to thermally stabilize the sensor at control temperature. While waiting for the sensor to reach stable thermal equilibrium, the appropriate vacuum pumps in the processing system should be engaged, so as to pump down the sensor below its useable resolution. In differential units, the processing system should be engaged, in such a manner to provide equal pressure on both sides of the sensor. This can also be accomplished by cross-porting, i.e., connecting the two ports together.

## 4.2 Manual Zero Adjustment

This section deals with the manual adjustment pot only. If the remote (digital) zero correction feature is used section 4.3 is applicable as well.

After the above warm-up time and pumping requirements have been met, the zero can be properly set. Before attempting to set zero it is important to establish a pressure at the transducer which is below its resolution. Each full scale range has different base pressure criteria. Table 4-1 summarizes the basic pressures needed prior to setting the "zero".

| Maximum Pressures For Proper Zero Setting | | |
|---|---|---|
| **Range Full Scale** | **Highest Pressure for Zero Adjust** | **Warm-Up Time Before Zero Adjust** |
| 1 Torr | <1 X $10^{-6}$ Torr | 4 Hours Minimum* |
| 10 Torr | <1 X $10^{-5}$ Torr | " |
| 100 Torr | <1 X $10^{-4}$ Torr | " |
| 1000 Torr | <1 X $10^{-3}$ Torr | " |
| 10000 Torr | <1 X $10^{-2}$ Torr | " |
| **It is recommended that all temp-controlled transducers be powered continuously.* | | |

Table 4-1

Maximum Pressures For Proper Zero Setting

To zero a differential transducer it is necessary to cross-port the two pressure ports (Px and Pr) to equalize the pressure on each side of the diaphragm.

For initial operation, and periodically as required, the transducer zero can be set by adjusting the coarse and fine zero potentiometer. The placement of these potentiometers is shown in Figure 2-1. It is important that the zero adjustment procedure be performed only after the unit is fully stabilized. Zero the indicated output using the coarse and fine zero potentiometers. For increased stability, these are precision wirewound potentiometers which actually act as a 100 step switch, not a potentiometer. The stability of the setting is extremely good if the pot is adjusted to center the wiper on one wire. To correctly set the potentiometer take the following steps.

1. Verify that there are 4 distinct steps in the DC output per revolution.

2. Zero the transducer and then turn the shaft an extra 1/2 turn in the same direction.

3. Come back slowly until the desired zero is obtained. Turn an additional 1/8 turn in this same direction. This will center the pot in the middle of a step, for maximum stability.

This procedure is followed first for the coarse adjustment and then with the fine adjustment as required.



For reference, the frequency of setting zero will depend on use, variations in ambient temperature, and application. For extremely critical measurements of very low pressures, checking the zero more often will ensure the most accurate measurements attainable with this transducer. Total rangeability of the zero potentiometer range from approximately ±2% of range for higher pressure ranges to ±5% for 1 Torr full scale transducers.

4.3 Remote (Digital) Zero

The Remote Zero feature is available on all Type 120 transducers. This feature allows the user to cancel out any zero offset up to ±2% of full scale (in addition to manual zero potentiometer) by either shorting pin 15 to pin 7 on the 120 connector or inputting a TTL low signal on pin 15. In order to do this refer to the previous section showing the pinout for the Type 120 and associated color code of the wire for the particular cable being used. It is important to note that during the time that the instrument is in an active remote zero cycle the analog pressure output signal is invalid. For the remote zero function to work properly, the vacuum system to which the transducer is attached must be pumped down to a pressure below the minimum resolution of the sensor used, or in the case of the differential transducers, the sensor should be cross-ported to equalize the pressure on both sides of the diaphragm. It is also important the sensor temperature has stabilized. Refer to section 4.2 for details. If power to the Type 120 is interrupted for any reason the remote zero correction information is saved in EEprom. Once power is returned, this information is re-established as zero correction in the circuitry.

As detailed in Section 2 of this manual the remote zero feature as a rangeability of ±2% of full scale, resolution of ±1ppm and repeatability of ±5ppm (all on the X1 sensor range). The correction cycle time is typically less than 3.5 seconds (during hich time the analog pressure output signal is invalid) to achieve maximum resolution. To initiate a remote zero, pin 15 must be pulled to a TTL low for a minimum of 10msec to properly trigger the conversion cycle.

Overange

If the signal to be corrected exceeds ±2% of full scale an overange condition exists.  In such a case the remote zero circuitry will sense the polarity of the offset and correct as much as possible and set the overange output signal to a TTL high level.

This signal is pin 17 on the Type 120 connector and can drive 1 TLL load.  If this zero reading is not sufficient the user has the ability to then re-set the manual zero potentiometer to achieve the required zero reading.

Bypass

The user has the ability to manually re-set the zero reading while disabling or "bypassing" the remote zero feature.  This is done by pulling pin 19, which is the Remote Zero Bypass pin, on the Type 120 to a TTL low.  This effectively removes any correction signal that the remote zero feature injects into the circuitry. The remote zero function will be bypassed as long as pin 19 is held low. The advantage of this is that the user can manually set the zero using the zero potentiometer so that the full range of the remote zero function can be utilized once again.

After the unit is zeroed manually the Remote Zero Bypass can be removed.  The output reading will then show the amount of correction which was added prior to bypassing and manual zeroing and this signal can be eliminated merely by initiating another remote zero cycle.

It is also important to note that the remote zero function only corrects for zero offset of the Type 120 output reading.  The readout instrument, such as a DVM, may have an internal offset.  The Type 120 remote zero cannot correct for this reading.

## 4.4  Remote Range Turndown

A standard feature of the Type 120 is a remotely activated range turndown capability to provide full scale output of 0-10VDC for 100% or 10% of sensor range ( X1 or X.1 of full scale).  To set the transducer for a full scale output of 10VDC for 10% of sensor range, short pin 16 ( X.1 pin) to pin 7 (digital common) or input a TTL low on pin 16. Once again, refer to the previous section to determine the color code of these wires for the particular cable being used.  The transducer will be in the downranged mode until the TLL low input is removed.

As a range identification output from the Type 120, pin 18 will have a TTL low output when in the downranged mode (X.1 range) and will output a TTL high when in the X1 range (10VDC output for 100% of sensor range). This output can drive 1 TTL load and can be monitored to indicate the range of the sensor. Note that whenever the range is changed the user should wait 250 milliseconds minimum before reading the analog pressure output signal to allow it to stabilize.



4.5 Digital Interfacing Considerations

In order to utilize the Type 120 remote zero and range functions the user can either momentarily connect the appropriate input to digital common or inject the correct TTL logic level as discussed in previous sections. The digital outputs can be monitored by LEDs or computer as long as interfacing concerns have been met.

Figures 4.1, 4.2, and 4.3 are timing diagrams to facilitate handshaking when the digital interfacing is handled by a computer. Figure 4.1 shows the power-up sequence of the transducer. In the diagram it takes approximately 200 milliseconds for the power to be within the operating range for instrument. After power is within tolerance the reset signal is kept in the active state for a maximum of 1 second to allow the power supply and processor to stabilize. When the reset goes to the inactive state, the EEprom is read and the circuitry is loaded with the remote zero value which was saved when power went down. Once this function is completed the initialization cycle is complete and all digital functions are operational. The last timing trace in Figure 4.1 shows the total initialize time. This is measured by monitoring the Range Ident. output. The X0.1 line was purposely tied to digital common on power-up and the Range Ident. output line monitored for a TTL low. It took a maximum of 1.3 seconds on power-up for the transducer to initialize and range change.

Figure 4.2 details a typical timing sequence for a remote zero function. In this sequence Rem. zero input is used together with the X0.1 input and the Range Ident. output to initiate a remote zero cycle and monitor the status of a remote zero function. To initiate a remote zero the transducer is first placed in the X1 range. When this is done the Range Ident. output can be used as a remote zero status indicator since a remote zero is done in the X0.1 range. Once in the X1 range it takes 250 milliseconds for the analog output to stabilize. If the transducer is already in the X1 range these these steps are not required. After the output is stabilized a remote zero is initiated by a TTL low for 10 milliseconds minimum. The transducer is then internally set to the X0.1 range (to zero on the most sensitive range) and reset to the X1 range when the remote zero cycle is complete.

The EEprom is then updated with the new remote zero data and the Range Ident. line goes high (X1 range) to indicate the cycle is complete. The cycle time is 3.5 seconds maximum. The remote zero overange line is low to indicate that the zero offset was within the correction range of the transducer. Note that during the remote zero cycle the analog pressure output signal is invalid and also that whenever the transducer is switched between the X1 and X0.1 ranges, the user should wait 250 milliseconds minimum before reading the analog pressure output signal to allow the output to stabilize.

Figure 4.3 again shows the remote zero cycle and timing. In this case the zero offset is greater than the remote zero correction range of the transducer. This condition is detected within 2 seconds and the overange line is a TTL high to indicate an overange condition.



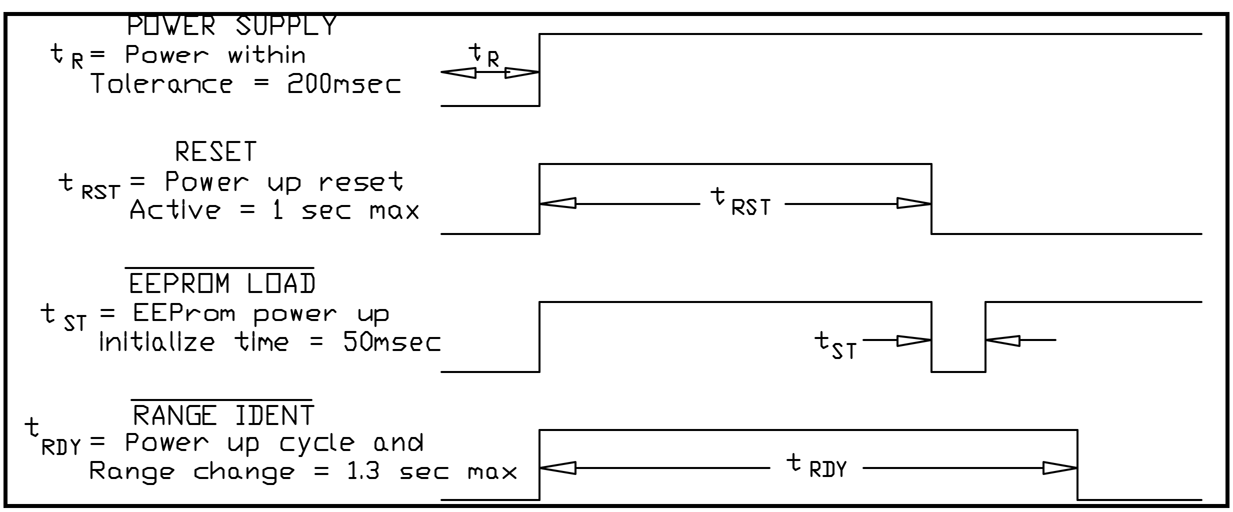


Figure 4-1
120A Power-Up Timing

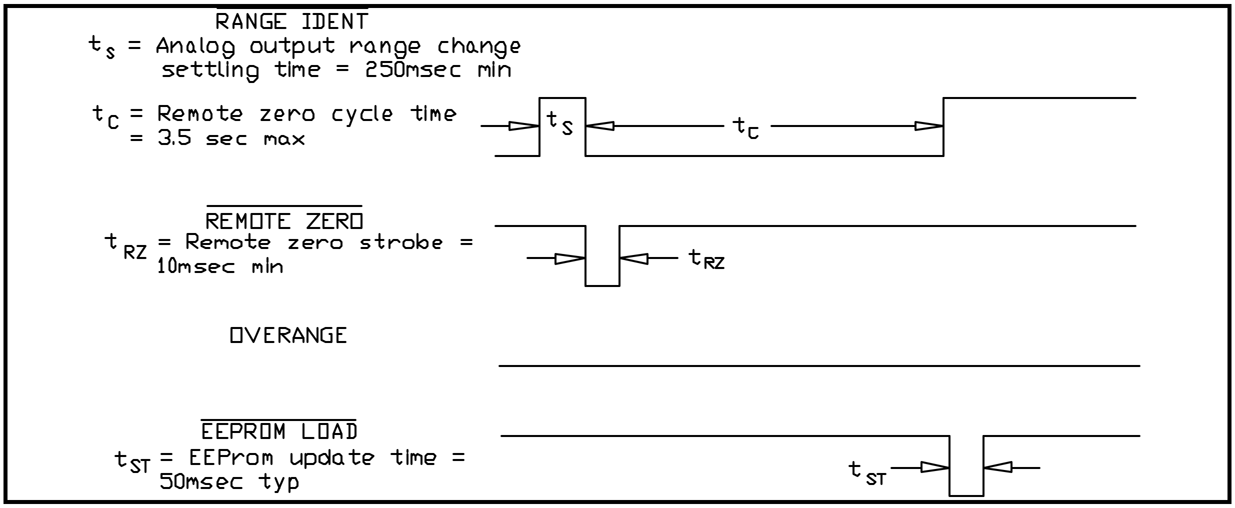


Figure 4-2
120A Remote Zero Timing



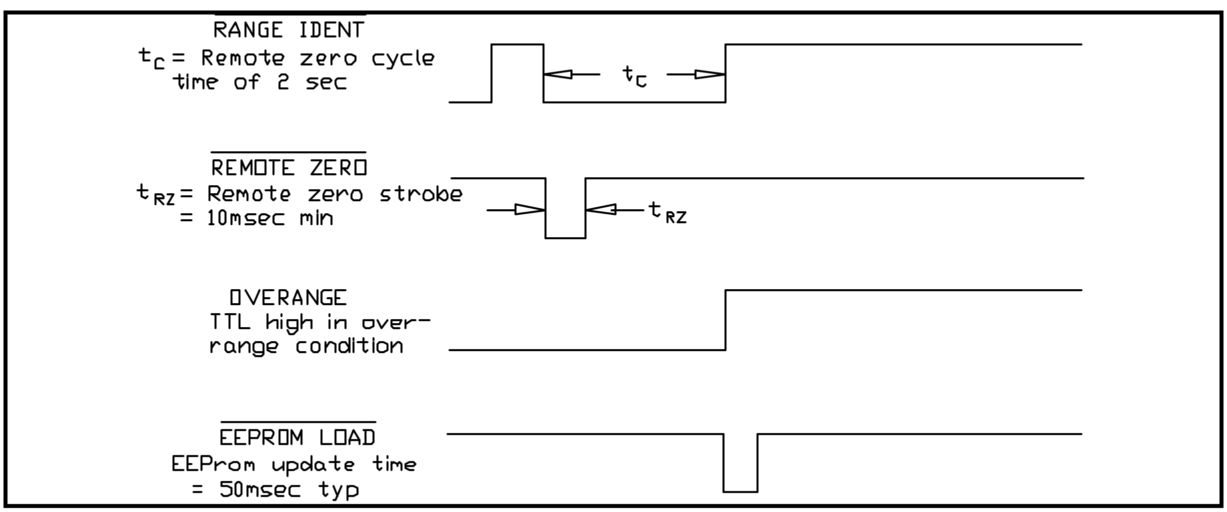


Figure 4-3
120A Remote Zero Overange Timing

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# SECTION 5

# THEORY OF OPERATION

## 5.1 General

The Type 120 is composed of seven subsections assembled within a single chemically inert, injection molded, high impact enclosure.

These sections are: 1) an Inconel variable capacitance diaphragm sensor; 2) an electronic preamplifier and bridge circuit; 3) an inner temperature controlled housing; 4-7) power, and signal conditioning printed circuit boards. The Inconel sensor, together with its high impedance bridge circuit and preamplifier, is mounted within a thick walled, temperature controlled aluminum housing. This miniature "environmental chamber" reduces the ambient temperature effects upon the sensor and bridge circuit by more than a factor of 50 to 1.

The Type 120 absolute pressure sensor is able to make a reliable absolute pressure measurement by virtue of its own built-in "zero" pressure reference cavity. During production, the low pressure side of the sensor is pumped to less than $1x10^{-7}$ mmHg, outgassed thoroughly, chemically gettered, and permanently sealed. The extremely low gas loads and active gettering material in the reference cavity assure the user of many years of useful service.

The Type 120 differential is unique in that the entire differential sensor is surrounded by an Inconel guard volume case. Ambient line pressure appears between the sensor and this case, thus eliminating sensitivity changes due to line pressure induced stress variations within the sensor structure. Careful deadweight testing has shown a variation of less than .003% of reading as line pressure varies from 1 to 15 psia.

The variable capacitance sensor consists of rigidly attached capacitive electrodes located on the back or reference side of a metal diaphragm. When pressure is applied to the diaphragm, its deflection produces a change in the distance between the electrodes and the diaphragm and a resultant capacitance change. The center electrode increases its capacitance at a greater rate than the outer concentric electrode. This imbalance in capacitance caused by pressure is converted into an AC voltage by the high impedance bridge circuit and preamplifier which is excited by a precision constant frequency oscillator. This AC signal is then amplified, and synchronously demodulated, resulting in a very stable 0-10VDC output, directly proportional to pressure. Figure 5.1 is a block diagram of the transducer and electronics.

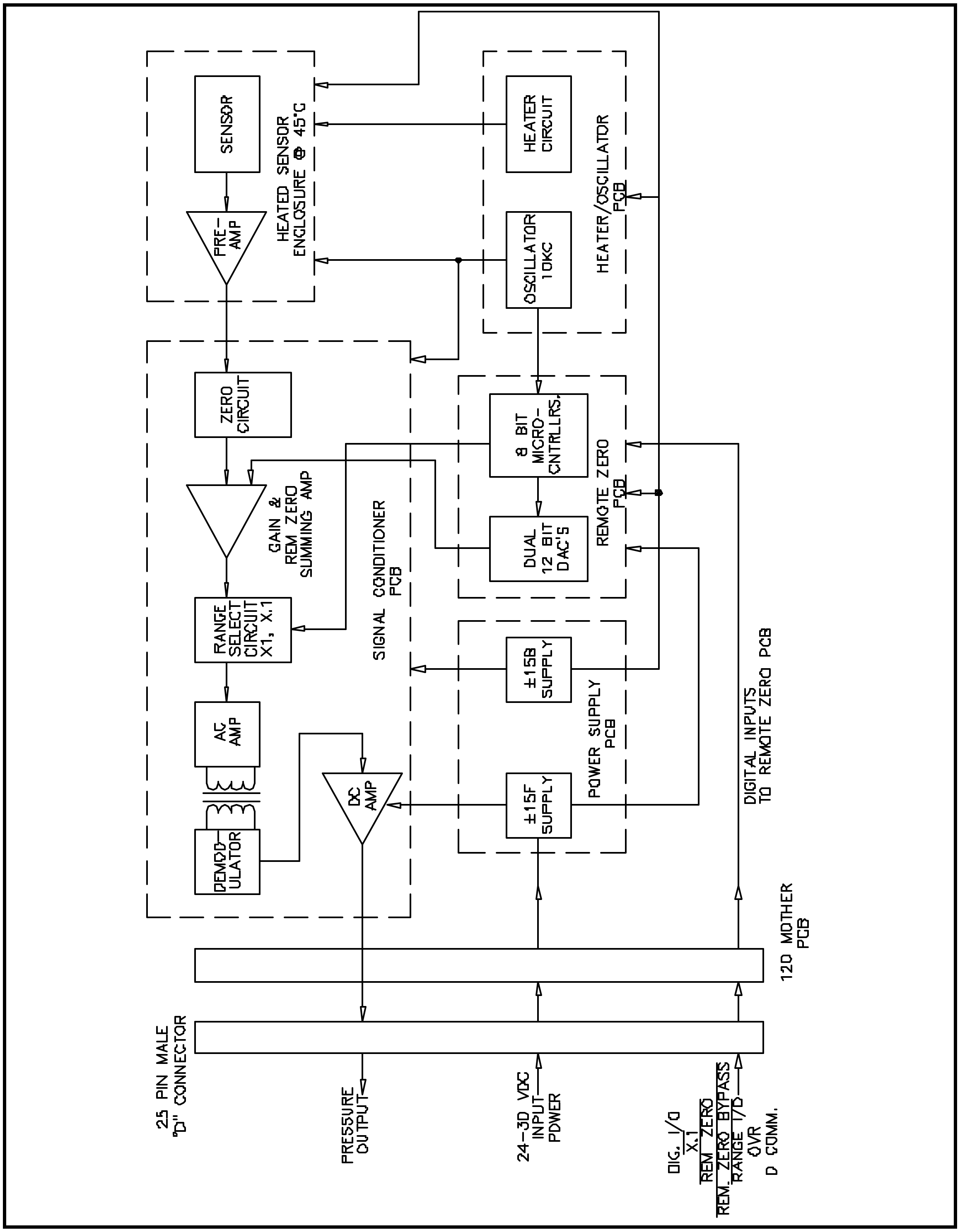


Figure 5-1
120 Block Diagram

# SECTION 6

# MAINTENANCE

## 6.1 General

Generally, nothing needs to be done to maintain the transducer other than its proper installation and operation. If it fails to operate after doing so for a period of time, return it to MKS for service. Obtain from the nearest MKS Service Center an ERA- Equipment Return Authorization - number to expedite handling and assure proper servicing of your transducer. If it fails to operate upon receipt, check the power/signal cable for correct continuity. Also check for shipping damage.

If after extended use the measurement goes slowly negative with time and eventually runs out of zero adjustment there may be a reference leak, which requires sensor replacement. If the measurement goes slowly positive with time and eventually runs out of zero adjustment there could be a build up of contamination in the measurement cavity or an overpressure condition which may require a sensor replacement. If the signal output is overange positive or negative, the sensor may be shorted or the interface cable may be damaged.

## 6.2 Troubleshooting

A. Cannot zero

Symptom: Pressure not below the reading resolution.
Remedy: Pump down measurement side (Px) to less than 1 X $10^{-6}$ of full scale. For differential transducers, equalize the pressure on both sides of the diaphragm by cross-porting.

Symptom: Cannot zero when power first applied. Sensor not at operating temperature.
Remedy: Allow time to stabilize (at least four (4) hours).

Symptom: Cannot zero on most sensitive range due to amplifier overload or system noise.
Remedy: Go to less sensitive range and try again or try better vibration isolation.

B. Zero Shift

Symptom: Zero shift after applying power.
Remedy: Allow four (4) hour minimum stabilization time.

Symptom: Zero shift after changing from atmospheric to vacuum operation.
Remedy: Allow time for outgassing completion.

Symptom: Zero shift caused by a leak in the vacuum system.
Remedy: Check pressure connections at head and other fittings.

Symptom: Zero Shift upon turn on of RF power in systems such as sputtering systems due to interference pickup.
Remedy: Replace interface cable with shielded version or relocate sensor on system or try better grounding.

## 6.3 Repair

If any difficulties are encountered in using the instrument, contact any MKS Service/Calibration Center for repair instructions.

IF IT IS NECESSARY TO RETURN THE INSTRUMENT TO MKS FOR REPAIR, PLEASE CONTACT THE MKS CUSTOMER SERVICE COORDINATOR AT ANY OF THE MKS SERVICE/CALIBRATION CENTERS LISTED ON THE INSIDE BACK COVER FOR AN E.R.A. NO. (EQUIPMENT RETURN AUTHORIZATION NUMBER) TO EXPEDITE THE HANDLING AND ASSURE PROPER SERVICING OF YOUR INSTRUMENT.