MKS Instruments 270B-4

High Accuracy Signal Conditioner

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MKS

Instruction Manual

TYPE 270C
HIGH ACCURACY
SIGNAL CONDITIONER

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MODEL DIFFERENCES 270B TO 270C

The 270B has been replaced by the 270C. The only differences between the two units is found in the power input components. The changes are:

1. The power line input connector, line voltage selector switch and fuse holder have been replaced by a single Power Entry Module which is UL/CSA and VDE approved.
2. The power transformer has been redesigned to VDE specifications.
3. The power switch has been replaced by a VDE approved type.

These are the only changes between the two models. The 270C specifications are identical to those of the 270B. Likewise all connector inputs/outputs are identical.

INSTALLATION AND OPERATING INSTRUCTIONS FOR 200 SERIES TYPE 270 HIGH ACCURACY SIGNAL CONDITIONER

Section 1 GENERAL DESCRIPTION

The 270 is a complete signal conditioner and 4½ or 5½ digit display, packaged in the standard MKS ½ rack mount unit. This unit contains the power supplies, oscillator and heater supply necessary to interface with MKS 300 Series Pressure Sensors. A pressure units display switch provides for a front panel display in various pressure units. With the 300 Series Pressure Sensor, this unit forms a high accuracy pressure measurement system.

The 270 can be combined with the 274 multiplex unit to provide pressure measurement for up to three 300 series sensors. Also a complete pressure/flow system can be created by adding a series controller and valve. The controller interfaces to the 270 through the REMOTE and ACCESSORY connectors.

Units that contain option boards will be shipped with additional manuals that reference those options.

SPECIFICATIONS

Input:	Accepts signals from 398, 390, 370, 310, 315, and 317 pressure sensors, 25K to 1 mmHg.
Ranges:	X1, X0.1 and X0.01 of full range of the pressure sensor.
Output Voltage:	0 to +10V into 10K ohms or greater, available at rear connectors.
Display:	4½ Digit in 270-4 5½ Digit in 270-5, 7 segment red LED's, 0.5 inches high.
Displayed Pressure Units:	in Hg, in H_2O, mmHg, mbars, KPa, CmH_2O and psi* (*psi not available on 270-5)
BCD Outputs:	Pressure information is parallel line 3 state logic. Decimal points, channel ID and range ID outputs are buffered TTL levels. All outputs can drive 1 TTL load.
Package:	½ rack size cabinet
Weight:	8 lbs.
Operating Temperature:	15 to 40°C
Operating Voltage:	100-135/200-270VAC 50/60 Hz.
Power Consumption:	40 watts @ 115VAC (21 watts without heater)
Output Impedance:	Less than 1 ohm
Output Zero Drift:	Less than 0.05 mv/°C
Output Linearity:	±(0.005% of RD +0.001% of FS)
Output Noise:	Low frequency, less than 70 microvolts all ranges @ 0.4 Hz bandwidth
	High frequency, 4 Mv peak-to-peak (1 KHz - 1 MHz)
Display Accuracy:	4½ Digit ±0.01% of RD ±1 Count 5½ Digit ±0.001% of RD ±1 Count
Display Update Rate:	2 samples/sec for both displays
	Specifications subject to change without notice.

Section 2 INSTALLATION AND OPERATION

INSTALLATION

THE 270 MUST BE MOUNTED IN SUCH A MANNER AS TO PROVIDE ADEQUATE AIR CIRCULATION ABOUT THE UNIT!!

The 270 can be mounted in a panel cutout or a 19″ rack when supplied with the RM-6 Rack Mount option. FIGURE A shows the cables necessary to connect between the 270 and other instruments.

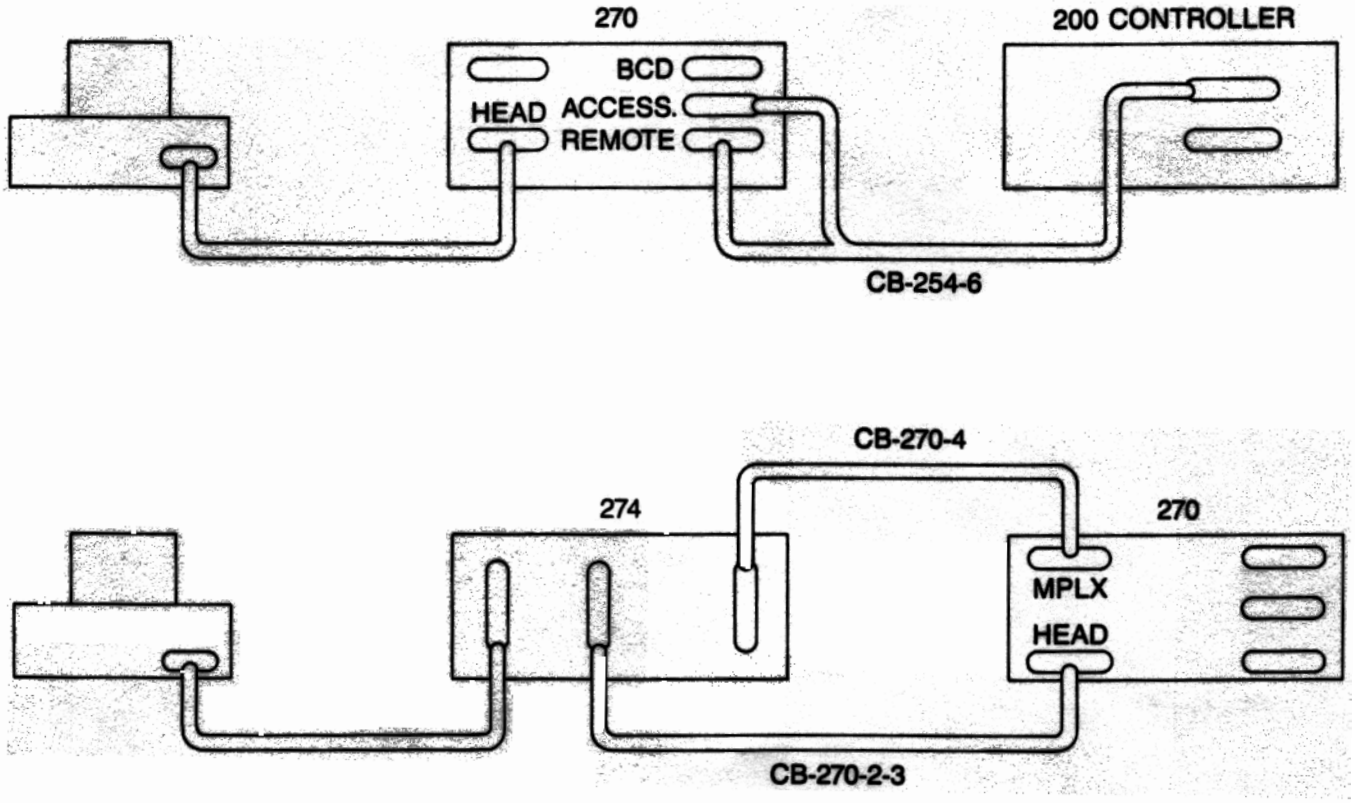


FIGURE A
INTERCONNECTION CABLES

J401
ACCESSORY CONNECTOR

Pin No.		Pin No.	
1.	DC Output Voltage	8.	DC Output Return
2.	N.C.	9.	N.C.
3.	Digital Common	10.	N.C.
4.	$\overline{\text{X1 Range ID}}$	11.	N.C.
5.	$\overline{\text{X0.1 Range ID}}$	12.	N.C.
6.	$\overline{\text{X0.01 Range ID}}$	13.	N.C.
7.	N.C.	14.	Chassis Ground

J405
MULTIPLEX INTERFACE CONNECTOR

Pin No.		Pin No.	
1.	N.C.	14.	N.C.
2.	10K	15.	N.C.
3.	1K	16.	N.C.
4.	100	17.	N.C.
5.	10	18.	N.C.
6.	1	19.	N.C.
7.	N.C.	20.	N.C.
8.	$\overline{\text{CH.1 ID Input}}$	21.	Remote Read
9.	$\overline{\text{CH.2 ID Input}}$	22.	Digital Ground
10.	$\overline{\text{CH.3 ID Input}}$	23.	Digital Ground
11.	$\overline{\text{Multiplex Select}}$	24.	N.C.
12.	N.C.	25.	Chassis Ground
13.	N.C.		

J402
REMOTE INTERFACE CONNECTOR

Pin No.		Pin No.	
1.	DC Output Voltage	6.	Chassis Ground
2.	N.C.	7.	N.C.
3.	$\overline{\text{Select X0.1 Range}}$	8.	DC output Return
4.	$\overline{\text{Select X0.01 Range}}$	9.	N.C.
5.	Digital Common		

270-4
BCD OUTPUT CONNECTOR
(4½ DIGIT DPM)

1. N.C.	18. +5V @25 mA	35. 80
2. N.C.	19. $\overline{\text{HOLD}}$	36. 2
3. Digital Ground	20. Good Data*	37. 4000
4. Digital Ground	21. Decimal $\overline{+4P}$	38. 4
5. 10000	22. Decimal $\overline{+3P}$	39. 2000
6. N.C.	23. Decimal $\overline{+2P}$	40. 8
7. $\overline{\text{Enable Digit 2}}$	24. Decimal $\overline{-4P}$	41. $\overline{\text{Enable Digit 3}}$
8. 1	25. $\overline{\text{CH.3 ID}}$	42. 800
9. N.C.	26. $\overline{\text{Overrange}}$	43. $\overline{\text{CH.1 ID}}$
10. 100	27. Polarity (+)	44. Decimal $\overline{+1P}$
11. 200	28. Digital Ground	45. Decimal $\overline{OP}$
12. 40	29. N.C.	46. Decimal $\overline{-3P}$
13. 400	30. Data Ready	47. Decimal $\overline{-2P}$
14. 20	31. $\overline{\text{Enable Digit 5}}$	48. Decimal $\overline{-1P}$
15. 1000	32. $\overline{\text{Enable Digit 4}}$	49. +5 Volt Ground
16. 10	33. 8000	50. $\overline{\text{CH.2 ID}}$
17. $\overline{\text{Enable Digit 1}}$	34. $\overline{\text{Enable Remainder}}$	

*Used only by MKS.

270-5
BCD OUTPUT CONNECTOR
(5½ DIGIT DPM)

1. 8000	18. +5V @25 mA	35. 40
2. 2000	19. $\overline{\text{HOLD}}$	36. 10
3. 80000	20. Good Data*	37. 4
4. 20000	21. Decimal $\overline{+4P}$	38. 1
5. Data Ready	22. Decimal $\overline{+3P}$	39. N.C.
6. Overrange	23. Decimal $\overline{+2P}$	40. N.C.
7. Digital Ground	24. Decimal $\overline{-4P}$	41. N.C.
8. 800	25. $\overline{\text{CH.3 ID}}$	42. N.C.
9. 200	26. 4000	43. $\overline{\text{CH.1 ID}}$
10. 80	27. 1000	44. Decimal $\overline{+1P}$
11. 20	28. 40000	45. Decimal $\overline{OP}$
12. 8	29. 10000	46. Decimal $\overline{-3P}$
13. 2	30. Polarity (+)	47. Decimal $\overline{-2P}$
14. N.C.	31. 100000	48. Decimal $\overline{-1P}$
15. N.C.	32. $\overline{\text{Enable BCD}}$	49. +5V Return
16. N.C.	33. 400	50. $\overline{\text{CH.2 ID}}$
17. N.C.	34. 100	

*Used only by MKS.

$\overline{\text{XXXXXX}}$ When used with inputs: This indicates that the line must be pulled low.

$\overline{\text{XXXXXX}}$ When used with outputs: This indicates that the output is active low.

REMOTE METER $\overline{\text{HOLD}}$

This line is brought out for remote reading control of the meter. Left open, the meter will free run at a rate of 2.5 samples/second. Holding this line low prohibits the meter from reading. To command the meter to read, generate a positive going pulse with a duration of 50 micro sec. minimum to 2 msec. maximum.

DATA READY

This line goes high when the data is valid and ready to read.

DECIMAL INFORMATION

This information is presented as the exponent of 10, example: The decimal point for a Full Scale reading of 1000.0 is $+3\overline{P}$ where the bar indicates a negative true. Likewise the decimal for .10000 is displayed as $-1\overline{P}$.

ENABLE LINES

The BCD information is controlled by enable lines. The 4½ digit dpm has six enable lines while the 5½ digit dpm has only one. When these lines are connected to ground all of the BCD information is present at the rear connector and can be read when the DATA READY line goes high. When these lines are left open or connected to +5V then all of the BCD outputs are open. This is done when several meters are connected in parallel to a common bus. Each meter is strobed for a reading by grounding these control lines and then when the reading has been taken the lines are forced high again and the outputs are open.

IMPORTANT!! CHANNEL ID AND DECIMAL POINT INFORMATION IS NOT CONTROLLED BY THESE ENABLE LINES. THIS DATA WILL BE ACTIVE AT ALL TIMES.

OVERRANGE OUTPUT ON THE 5½ DIGIT DPM

The panel meter used by MKS overranges at 130000 counts. This would normally cause it to flash on and off. Since this would not allow the proper full scale reading in mbars, Kpa or cmH_2O the flashing feature has been disabled. The meter will continue to read correctly until it reaches approximately 138000 counts. When it reaches its maximum count it will simply stay locked at that reading. Because of this you must be careful of readings greater than Full Scale on these ranges. Also the BCD OVERRANGE signal WILL BECOME ACTIVE AT 130000 counts.

Section 3 OPERATION

FRONT PANEL CONTROLS (See Figure B)

RANGE SELECT (A)

This switch controls the measurement mode of the instrument. The Remote, X1, X0.1 and X0.01 positions are active measurement ranges while the System Check, Null and Full Scale are functional check positions.

NULL (B)

When the range switch is placed in the NULL position, the input to the 270 is placed at ground level. This control is then adjusted to produce a zero reading at the DC output. (Signal Conditioner Null)

FULL SCALE (C)

When the Range Multiplier switch is placed in the Full Scale position, the input to the 270 is connected to an internal calibration signal. This control is then adjusted to produce a Full Scale (+10V) at the DC output. (Signal Conditioner Full Scale)

SENSOR ZERO-COARSE (D)

This control is used in conjunction with the Sensor Coarse Zero to provide an approximate zero setting.

SENSOR ZERO-FINE (E)

This control is used in conjunction with the 270 Coarse Zero to provide high resolution in the zero setting.

HEATER (F)

This lamp comes on when power is being applied to the heaters.

REG/OFF (G)

This switch controls power to the heaters. When placed in the REG. position, power is applied to the heaters in the sensor to maintain a preset temperature. This minimizes zero and span drift due to ambient temperature variation. This switch is a locking type and the handle must be PULLED BACK to change positions.

RESPONSE (H)

This switch controls the electrical bandwidth of the instrument. The three positions are:

FAST	165HZ	1 mSEC
NORMAL	4Hz	40 mSEC
SLOW	0.4Hz	400 mSEC

ON/OFF (I)

This switch controls power to the 270.

SENSOR RANGE SELECTOR (J)

When switched to the range of the sensor in use, this switch combines the sensor range, display units and the multiplier level of the 270 to properly position the decimal point.

DISPLAY UNITS SELECTOR (K)

This switch selects the type of units used to display pressure on the front panel display.

$X10^{-3}$ LAMP (L)

Since it is not possible to display the decimal point to the left of the MSD, a Full Scale reading of +.10000 is displayed as +100.00 and the $X10^{-3}$ lamp is illuminated.

$X10^{-6}$ LAMP (M)

Similar function as the $X10^{-3}$ lamp. A Full Scale reading of +.10000 $X10^{-3}$ would be displayed as +100.00 and the $X10^{-6}$ lamp is illuminated.

DIGITAL READOUT (N)

Displays the pressure signals in the pressure units selected by the display unit selector.

REAR PANEL CONTROLS (See Figure C.)

REMOTE (A)

Provides connection to range selection circuits when used with a controller or other external device to range change. The three ranges (1, 0.1, 0.01) along with a 0.10VDC output on each range is available through this connector.

ACCESSORY (B)

Interfaces with accessory units. Provides 0-10VDC output and range ID.

INPUT (C)

Sensor cable or other sensor conditioning cable is inserted in this connector to receive excitation, heater power, etc.

POWER ENTRY MODULE (D)

This module contains:
1. RFI power line filter.
2. IEC power line connector.
3. Line voltage selector.
4. Power line fuses (2).

The fuses and line voltage selector drum are accessed by opening the cover with a small screwdriver.

The module is matched to the line voltage by removing the selector drum, turning it to the proper position, and re-inserting it. The value of the selected voltage will be visible through the window in the cover when it is closed.

The fuses are contained in fuse carriers. These carriers are removed by inserting a small screwdriver blade behind the cover tabs and pulling them straight out.

The fuse values are marked on the rear panel. They are:
100/120 Vac = 0.6 Amperes Slow Blow Type
220/240 Vac = 0.3 Amperes Slow Blow Type

BCD CONNECTOR (E)

This connector provides BCD and decimal point outputs. See Section 2 for the pin assignments.

MULTIPLEX CONNECTOR (F)

This connector provides access to the logic circuits of the meter. When the SENSOR RANGE switch is in the MPX position, the multiplex unit controls the placement of the sensor range and channel ID through this connector.

FIGURE B
FRONT PANEL CONTROLS

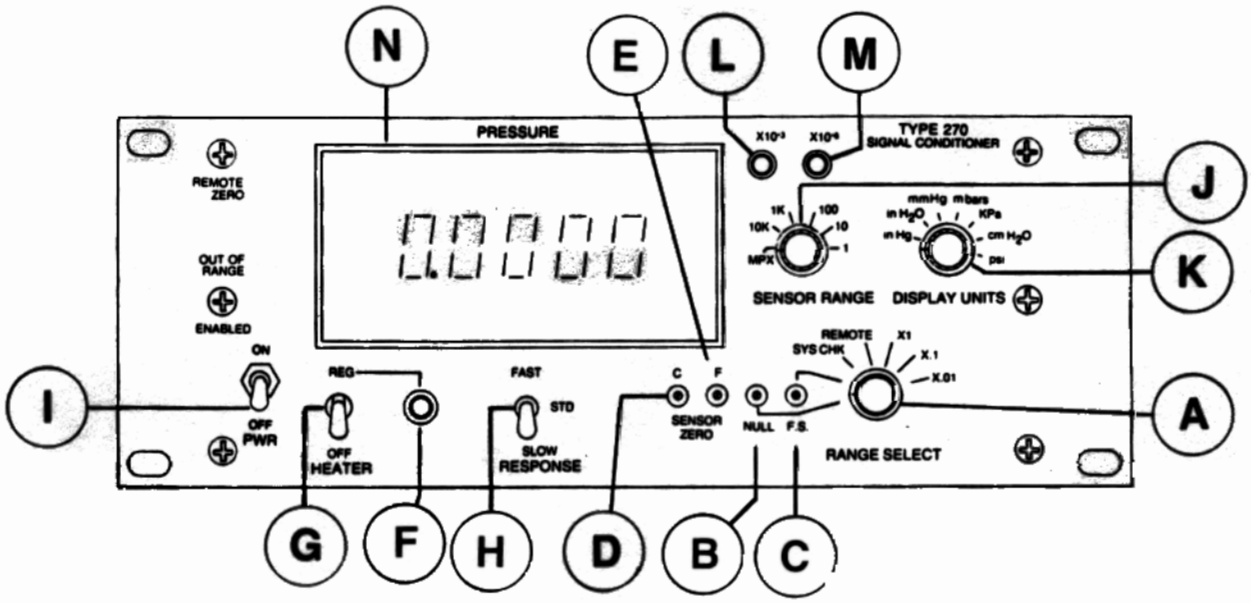
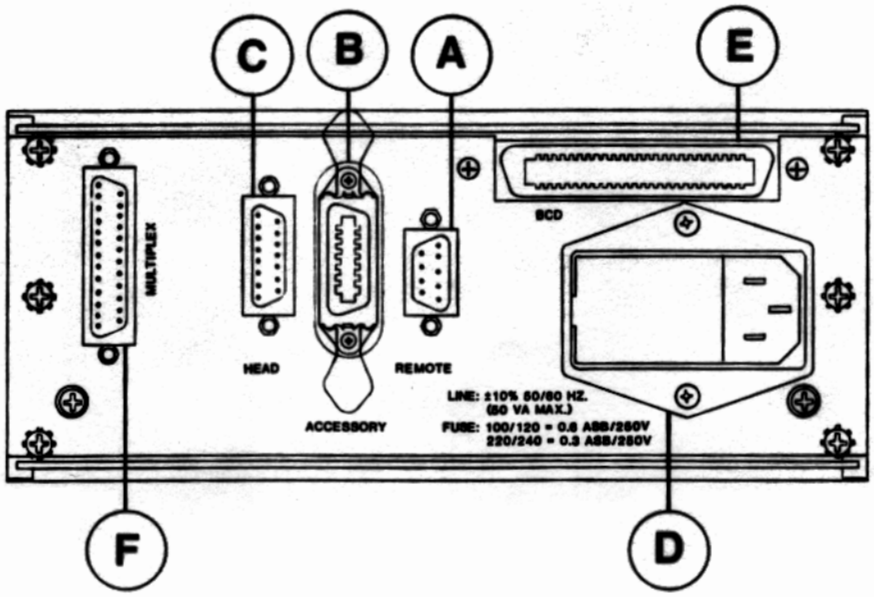


FIGURE C
REAR PANEL CONTROLS



OPERATION

1. Connect the 300 Series Pressure Sensor to the 270 with the appropriate sensor cable. Should there be any more accessories they are wired in as outlined in Figure A.
2. Plug the power cable from the 270 into a 115 VAC-60Hz power source. For 230-50Hz sources, the power entry module, Figure C-item D, must be set to the proper voltage.
3. Apply power by turning on the Power switch. (Figure B-item I)
4. Place the Sensor Range switch, Figure B-item J, to the full scale value of the pressure sensor in use.
5. Place the Display Units switch, Figure B-item K, to the mmHg position.
6. Place the Heater switch, Figure B-item G, to the REG position. This applies power to the proportional heater circuit in the sensor. There will be a small delay between the closing of this switch and the lighting of the HEATER lamp, Figure B-item F. The lamp should come on brightly, go out and then come on and remain on at a lower intensity. Should the system contain a 274 multiplex unit, the heater supply is included in that unit and the REG switch on the 270 must be placed in the OFF position. Allow a minimum of 4 HOURS to stabilize a "cold" sensor. For sensors that have just been received, it is recommended that they be left on heat overnight. To achieve the best possible accuracy the heater should always be on.
7. Place the Response switch, Figure B-item H, to the STD position. This provides the best all around response vs. noise for pressure measurement. When using a series 200 controller, use the FAST position. The SLOW position is used when low noise on the DC output is more important than fast response.
8. Place the Range SELECT switch, Figure B-item A, to the NULL position. If necessary, adjust the Null Control, Figure B-item, to produce a zero reading on the Digital Display. (Figure B-item N)
9. Place the Range SELECT to the F.S. position. If necessary, adjust the F.S. control, Figure B-item C, to produce a full scale reading of +10000* on the panel meter. *(100000 on a 270B-5)
10. Place the Range SELECT to the X0.01 position. Pump the pressure sensor below its resolution (or cross-port differential units) and check the zero. Correct, if necessary, with the Coarse and Fine zero controls, Figure B-item D&E. Should these controls lack the range for this adjustment, refer to the Zero and Span adjustment section in the MKS Instruction Manual for 170 Series Sensors.

    NOTE: SHOULD A MULTIPLEX UNIT BE IN USE, THE ABOVE CONTROLS ARE BYPASSED AND THE ZERO CORRECTION IS DONE AT THE MULTIPLEX UNIT.

11. Place the Range SELECT in the System Check position and compare this reading with the system check number on the sensor calibration sheet. If the reading is incorrect, refer to the maintenance section.
12. Place the Range SELECT in the X1 position. The system is now ready to display the pressure range of the sensor. For 1/10 of that range, use the X0.1 position, for 1/100 use the X0.01 position.

REMOTE RANGE SELECTION

The X1, X0.1 & X0.01 ranges can be remotely selected by placing the Range Select in the Remote position and applying the proper logic levels to the Remote interface connector.

RANGE TO BE SELECTED	REMOTE CONNECTOR	
	J402-3	J402-4
1	HI	HI
0.1	LO	HI
0.01	HI	LO

Section 4 THEORY OF OPERATION

The first portion of this section will deal with the signal flow through the instrument while later portions will cover the operation of specific circuits in more detail.

Referring to *Figure D,* it is seen that the 270 interfaces with the pressure sensor via the sensor connector. This connector also provides the preamp voltage, heater voltage and oscillator voltage to run the pressure sensor.

The pressure signal is applied to the zero circuit when it comes directly from the pressure sensor. Should it come from the multiplex unit, the zero circuit is bypassed so that the zero controls in the multiplex unit override the zero controls on the 270.

The output from the zero circuit is applied to the Input Selector switch. This switch connects the input of the AC amplifiers to the pressure signal or to the internal cal signals. Another pole of this switch selects the gain of the AC amplifiers.

The Input Selector switch applies the signal to the 1st AC amplifier where it is amplified and passed on to the divider circuit and 2nd AC amplifier. The divider circuit controls the amplitude of the AC output signal by command of the range select circuit which in turn is controlled by the Input Selector switch.

The output of the 2nd AC amplifier is applied to the demodulator transformer which interfaces it to the demodulator circuit. The demodulator fullwave rectifies the AC output and applies it to the DC amplifier. This demodulator is synchronized to the oscillator to block quadrature signals.

The DC amplifier acts as an integrator and filters the input signal to produce a smooth DC output signal. This circuit also has a Response Speed Selector switch which selects one of three possible bandwidths for this amplifier.

The signal from the DC amplifier goes to the Remote and Accessory connectors and is applied to the panel meter via the Display Units Divider circuit. The panel meter is interfaced with a Digital Interface circuit which converts the setting of the Input Selector switch, Display Units switch and the Sensor Range Selector switch into the proper decimal point selection. The decimal point information plus the BCD output from the panel meter is then applied to the BCD output connector.

Power for the heater and voltage for the electronics is supplied by the main power supply circuits. These supplies also provide power for the oscillator which produces a highly regulated 10KHz sinewave output. This voltage is used for excitation of the Pressure Sensor and for internal calibration signals as well as synchronization of the demodulator. A more detailed circuit description follows.

−13 VOLT SUPPLY: See figure E - Section A

Both power supplies are identical floating 13 volt power supplies. The negative terminal of one is connected to the positive terminal of the other and grounded. This produces the required +13v and −13V at the other remaining terminals.

The regulations are the three terminal adjustable type. An adjustment range of approximately 1V is obtained from potentionmeters R19, R22. These regulators provide current limit and thermal overload protection. The rectifiers CR4, CR5 protect against voltage reversal.

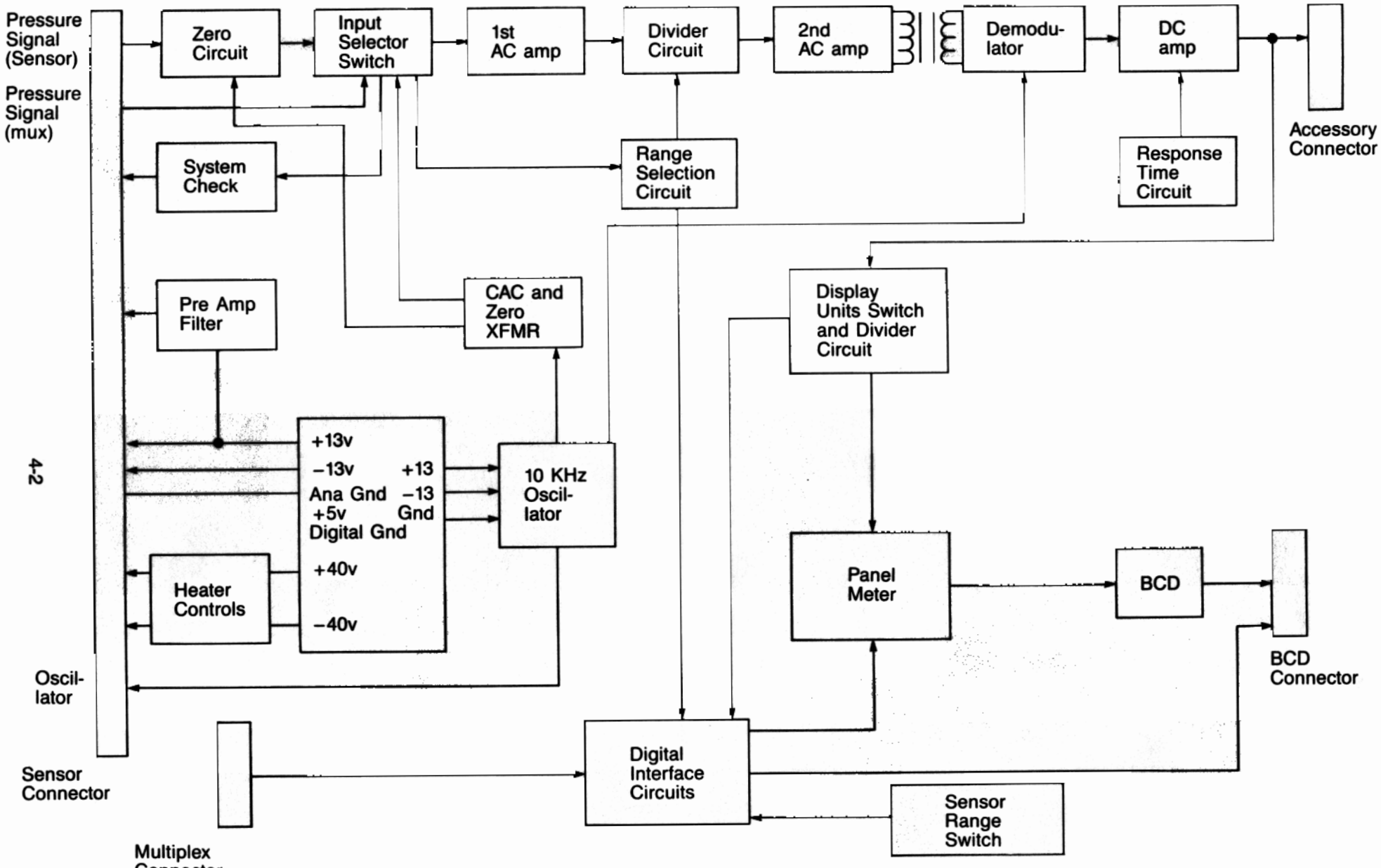


FIGURE D
270 BLOCK DIAGRAM

At the output of each supply there is a jumper bus. This bus doubles as a test point and a means of isolating the power supply when troubleshooting the circuit.

CAUTION: To avoid damage to internal circuits, never operate the instrument with one power supply disconnected. Both supplies must be disconnected at the same time.

+5VOLT SUPPLY: See Figure E – Section A

The logic supply consists of an adjustable three terminal regulator similar to the above supplies. It also provides internal current limit and other protection circuits. The voltage level is adjusted by R16 and CR3 provides reverse voltage protection.

HEATER POWER SUPPLY: See Figure E – Section A

The heater supply consists of bridge rectifier DB1 and the RC filter R12 & C7. The voltage at no load is approx. 110 volts which will be approx. 85V under full heater load. (approx. 12 Watts) The heater supply is totally above ground so some care must be taken not to ground the heater return. Power is supplied through VR1 and the heater lamp. This parallel combination provides a visual heater indication when used with the proportional heaters in the sensor.

10KHz OSCILLATOR: See Figure F – Section A

Oscillator is a Wein Bridge type which has a buffered output and amplitude stabilization to insure constant output voltage under all load conditions. The oscillator is formed by amplifier U12 and the bridge network C45, C47 and R90, R93. The frequency is factory adjusted to 10 KHz by adjustment of R91. The output of U12 passes through the buffer amplifier formed by Q10-Q13. This output is fed back to the oscillator input by R94. Diodes CR16-17 act to shut down the buffer amplifier in the event of a short circuit at the output. Amplitude stabilization is accomplished by rectifying the output and comparing the DC level against the temperature regulated precision reference VR2. This reference voltage is applied to the positive input of the integrating amplifier U14. The negative input of this amplifier is connected to precision half wave rectifier U13. The integrator compares the difference between the reference voltage and the rectified output and produces a control signal for Q14. Should the rectified output exceed the reference voltage, Q14 is biased OFF and the gain of the oscillator amplifier is descreased. When the rectified output falls below the reference voltage, Q14 is biased ON and the gain of the oscillator amplifier is increased.

This technique of buffering and amplitude stabilization produces a high purity sine wave capable of driving loads on the order of 100 ohms or less with almost no change in the output amplitude.

AC AMPLIFIERS: See Figure F – Section B

The input signal is applied to the input of the first stage AC amplifier, U9. This amplifier multiplies the signal by a gain of 3 and drives the range transformer, T2. Depending on the range selected, the signal is either passed through directly (X0.01 range), or divided by 10 for the X0.1 range, or divided by 100 for the X1 range. Selection of the proper taps is done by turning ON or OFF FET switches Q3-A5. The signal passes from the transformer to the high impedance input of the 2nd AC amplifier, U10. U10 multiplies the signal by a gain of 31 and couples it through C26-C27 to the primary of T3.

AC TO DC CONVERTER: See Figure F – Section C

T3 along with the switching FET's Q8 and Q9 form the synchronous detector. The FET's are driven 180 deg. out of phase by a 25V P-P switching squarewave which is synchronized perfectly to the 10KHz oscillator. The FET's are turned ON and OFF, first grounding one end of the secondary of T3 and then the other, this causes the center of the transformer to produce a full wave rectified signal. By switching in this manner, all 60Hz and all 90 deg. quadrature signals are blocked from the output.

The rectified signal then passes through to the input of the DC integrator U11 which filters and amplifies the waveform to produce a noise free DC output signal. The signal is adjusted to the proper full scale of 10 volts with the coarse span adjust R70 and is filtered once more by L1 and C37 and then applied to the proper output connectors.

The demodulator drive provides a fast switching waveform that is synchronized with the oscillator to drive the switching FET's in the demodulator (synchronous detector), and is done by applying the oscillator input voltage to the comparator U15. When the oscillator crosses through zero the comparator switches, one output goes high while the other goes low. These outputs are applied to the high speed "flip flop" that is formed by Q15-Q18. The demodulator drive circuit increases the switching speed and produces a waveform that switches between ± 13 volts. This waveform and its complement are connected to the switching FET's through C28, C29.

OVERRANGE DETECTOR: See Figure E – Section B

When the output from the AC to DC converter exceed ± 11 volts, the amplifiers are entering their saturation region and may become non linear. This comparator will go to a high state whenever the input exceeds ± 11 volts and will turn on transistor Q1 which blanks the display on the panel meter.

RANGE SELECTION CIRCUITS: See Figure F – Section D

The range selection circuit provides a means to select the proper sensitivity range either by the manual range switch or by the external control connector and to provide decimal point infomration to the panel meter. The switching is based on the principle that the X1 range is selected by the absence of a command to the X0.1 or X0.01 ranges. The command to select the X0.1 or X0.01 range by the range switch is done by applying a ground closure via S1 while the REMOTE position is left in the hi state to "LOCKOUT" any commands from the REMOTE connector. Nand gate U7 produces the range commands which are applied to U8. U8 interfaces the digital logic levels to the higher levels required to drive the switching FET's. U5 selects the proper decimal command to be sent to the ACCESSORY connector.

In the REMOTE position the "LOCKOUT" is defeated and commands from the REMOTE connector can be entered through U5. The outputs of U5 are passed through the "LOCKOUT" gates (U6) to the inputs of U7. At this point the range selection is identical to the process described above.

DIGITAL INTERFACE CIRCUITS: See Figure G – Section A

The placement of the decimal point is determined by the position of the DISPLAY UNITS selector, RANGE SELECTOR and the SENSOR RANGE selector. This is done by creating a BCD number for each switch position and then adding these numbers together. These numbers are indicated on the schematic as logic code numbers and are processed in the following manner:

1. The DIPSLAY UNITS selector generates a logic code which is applied to the A inputs of U1.
2. The RANGE ID's generate a logic code which is applied to the B inputs of U1.
3. The sum of the A&B inputs is applied to the B inputs of U2.

FOR EXAMPLE: The TORR setting of S1 generates a code of 2L and X1 gain position generates a code of 2L. The sum, 4L, is applied to the B inputs of U2.

4. The SENSOR RANGE selector, or the multiplex unit when in use, is connected to a digital interface circuit which generates a BCD number for each position of the switch.

FOR EXAMPLE: The 1000 range generates a logic code of 4L which applied to the A inputs of U2.

5. The sum of U2, 8L, is then applied to the decoder, U3. This causes the 8 output to go high and activate the 1000.0 decimal point.

Section 5 MAINTENANCE AND TROUBLESHOOTING

GENERAL

Should any difficulties be encountered in the use of your instrument, it is recommended that you contact any authorized MKS Sales Office or Home Office for repair instructions.

IF IT IS NECESSARY TO RETURN THE INSTRUMENT TO MKS FOR REPAIR, PLEASE CONTACT MKS' CUSTOMER SERVICE REPRESENTATIVE AT THE NEAREST MKS SERVICE CENTER FOR AN ERA NO. (EQUIPMENT RETURN AUTHORIZATION NUMBER) TO EXPEDITE HANDLING AND ASSURE PROPER SERVICING OF YOUR INSTRUMENT. SEE LIST OF SERVICE CENTERS INSIDE BACK COVER.

TROUBLESHOOTING

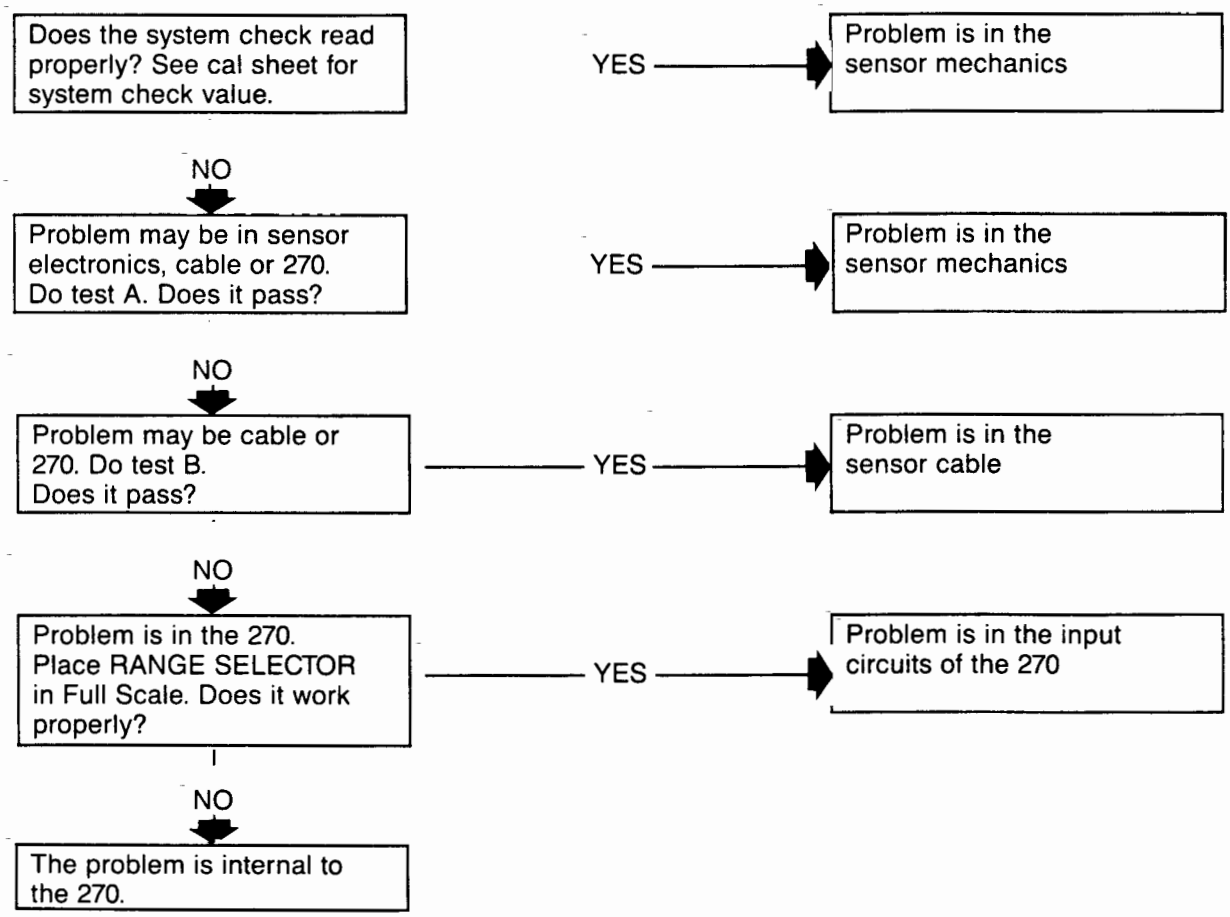
Should difficulties be encountered in the use of any 270 system, information in this section should help to isolate the source of the problem. Whenever similar equipment is available the method of substitution is recommended.

If the pressure reading is overranged >11V, or otherwise suspect, make the checks listed below:

Check to be sure that all vacuum fittings are tight and that the sensor is properly pumped down. Low range absolute sensors (100mmHg and below) will be overranged at atmospheric pressure.

Connect another meter, analog or digital, to the output to verify the proper operation of the panel meter in the 270.

Place the RANGE SELECTOR in the SYSTEM CHECK position, DISPLAY UNITS selector in the mmHg position, and perform the following checks:



TEST A
LOCALIZING MALFUNCTION TO CABLE OR ELECTRONICS UNIT

Equipment required: VOM

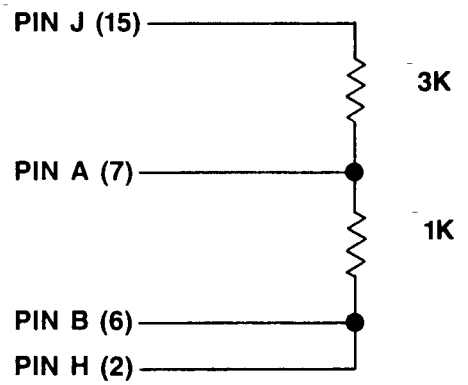
1. Disconnect the sensor from the sensor cable.
2. Place the RANGE SELECTOR in the system check position.
3. Place the REG switch in the OFF position.
4. Use the VOM to check the voltages at the sensor end of the cable. Reference the VOM to pin H (2)*

SENSOR CABLE VOLTAGE CHECKS

SENSOR CABLE PIN NO.	VOLTAGE	FUNCTION
I OR (13)*	+12 to +13	SENSOR ELECTRONICS SUPPLY VOLTAGE
D OR (14)*	+12 to +13	SYSTEM CHECK COMMAND
J OR (15)*	6V RMS	EXCITATION VOLTAGE

*Some sensor cables use number while other use letters.

5. Connect two resistors to the sensor cable as shown. This should produce a negative Full Scale ± 10% with the RANGE SELECTOR in the System Check Position.



6. Connect a short circuit across the 1K resistor and place the RANGE SELECTOR in the X0.01 position. Adjust the COARSE zero control. It should be possible to adjust this control ±40% of full scale.

TEST B
LOCALIZING MALFUNCTIONS TO ELECTRONICS UNITS

1. Disconnect the sensor cable from the 270 and check voltages at the sensor connector. (Reference VOM to pin 2)

ELECTRONICS UNIT VOLTAGE CHECKS

CONNECTOR PIN	VOLTAGE	FUNCTION
13	+12 to +13	SENSOR ELECTRONICS SUPPLY VOLTAGE
14	+12 to +13	SYSTEM CHECK COMMAND
15	6V RMS	EXCITATION VOLTAGE

2. Repeat step 5 of TEST A at the sensor connector. Results should be the same.

RECALIBRATION

Whenever components have been replaced in the 270 it is necessary to perform the following calibration check.

1. Adjust the NULL for a zero setting.
2. Place the DIPSLAY UNITS SELECTOR in the mmHg position.
3. Switch the RANGE SELECTOR to the F.S. position and adjust for +10000 ± 0.01% (100000 for a 270-5)

Should the problem be traced to the 270 unit, it can be troubleshot by placing the RANGE SELECTOR in the F.S. position for signal tracing purposes. The proper voltage levels and waveforms are included on the schematic. To properly synchronize an oscilloscope for signal tracing, trigger it externally from the oscillator output. Trigger shall be set for a positive slope. The power supplies are separated from their loads by jumpers which may be removed for test purposes. **CAUTION!!** All supplies should be disconnected at the same time. Damage to the unit may occur if one supply is disconnected while the others are connected to the circuit.