QUALITROL® 930 series
Electronic Pressure Monitor

Installation Instructions

Document ID: IST-930-1 Rev-42171

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About Qualitrol®

QUALITROL® manufactures substation and transformer monitoring and protection devices used by electric utilities and OEM manufacturing companies. It is the global leader in sales and installations of transformer asset protection equipment, fault recorders, and fault locators. Established in 1945, QUALITROL® produces different types of products on demand, customized to meet unique requirements.

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Qualitrol Electronic Pressure Monitor

The Qualitrol Electronic Pressure Monitor (Model #930 Series) is designed for mounting on the load tap changer compartment or the main transformer tank. The instrument consists of two major components. These are a sensor and a control panel. The 930 utilizes a sensitive electronic pressure sensor which translates the pressure to an electronic signal, which is then transmitted through a shielded cable to the 930 control panel, usually mounted in a control cabinet. The control panel is designed to monitor the transformer pressure and react quickly in the event that a sudden, potentially damaging, pressure increase occurs. The rapid pressure "signal" from the device can be used to either activate an Alarm or to automatically shut down the transformer (Trip). The Electronic Pressure Monitor also provides a continuous output proportional to the pressure in the transformer tank. This signal can be used for remote indication or input to a SCADA system.
The device is designed to be mounted in the transformer control cabinet and requires mains power.

There are two major product variations: A single PCB module and sensor, and a triple sensor/PCB unit.

Safety

The following symbols appear throughout the manual and indicate important safety instructions:

Warning

Indicates information is important for personal shock safety. Failure to follow may result in personal injury or death.

Caution

Indicates information is important for the proper operation of the equipment. Failure to follow may result in damage to the equipment.

Operation outside of the intended use shall not be the responsibility of Qualitrol.

Single module and sensor unit

FAST PRESSURE RISE LIGHT — A light is located on the control panel to indicate when a preset rate of pressure rise has been exceeded.

SLOW PRESSURE RISE LIGHT — A light is located on the control panel to indicate when a preset pressure level has been exceeded.

RESET SWITCH — A push button is located on the control panel to reset the fast pressure rise contacts and light and slow pressure rise contacts and light when they are being held in their actuated position by the seal-in circuit. The seal-in is jumper configured on the PCB.

Figure 1

Single module and sensor unit

Function	Connection	Energized IF	Seal-in mode	Momentary mode
K1	TB3, 1-3	Power and sensor OK	Not Available	Always
K2	TB1, 1-3	Static * pressure setpoint exceeded	J2, 2 to 3 jumper	J2, 1 to 2 jumper
K3	TB1, 4-6	Rapid pressure rate exceeded	J6, 2 to 3 jumper	J6, 1 to 2 jumper
K4	TB1, 7-9	Rapid pressure rate exceeded	J6, 2 to 3 jumper	J6, 1 to 2 jumper
Current loop	TB2, 3-4	Always indicates static pressure**		

*J4, 2-3 jumper sets K2 to static pressure mode; J4, 1-2 jumper will set K2 to rapid mode. R25 adjusts set-point of static trip level. See calibration section.
**4 to 20 mA is standard. To change to 0 to 1 mA, remove R37 and R59.

NOTE: see Figure 2 for jumper and resistor locations.

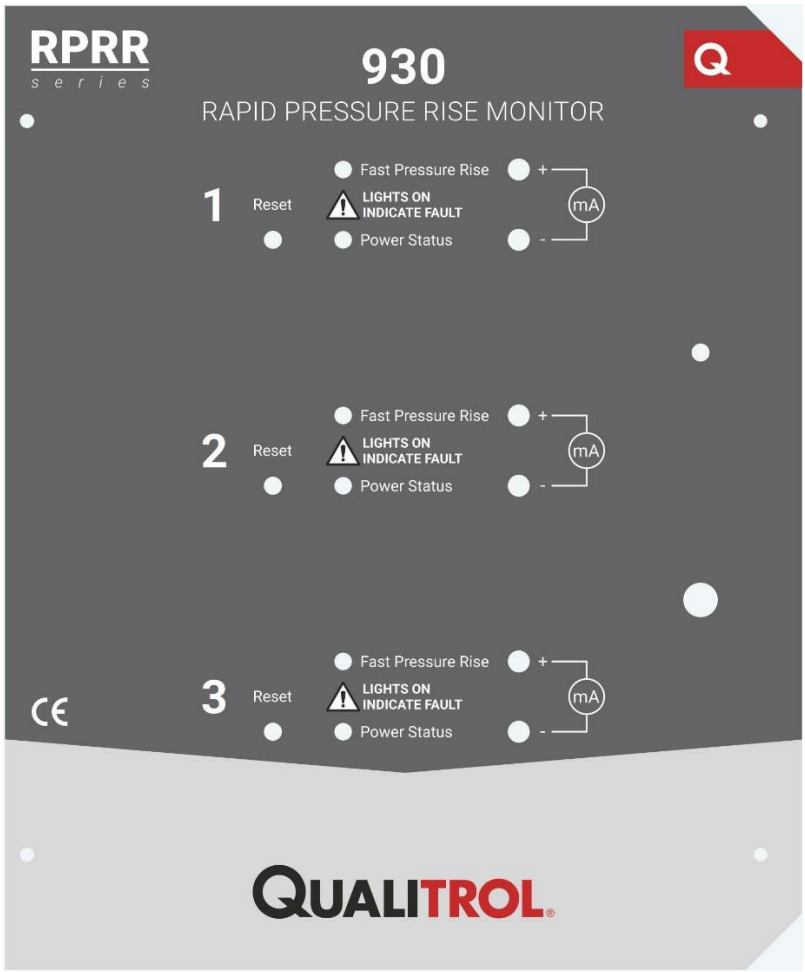
Triple module and sensor unit

FAST PRESSURE RISE LIGHT — Lights are located on the control panel to indicate when a preset rate of pressure rise has been exceeded from its respective PCB module. Driven from the K2 circuit (seal-in).

RESET SWITCH — These buttons will reset the Fast Pressure Rise lamp from its respective PCB module.

POWER STATUS LIGHT — These lamps are illuminated when its respective sensor and PCB module are OK.

CURRENT LOOP OUTPUT — These banana jacks provide a local measurement point for static pressure. Remove any provided jumper before measurement, then replace.



Triple module and sensor unit

PCB module configuration:

Function	Jumper position	Energized IF	Seal-in	Momentary
Rapid pressure rise detected, K3,4	J6, 1-2	Rapid pressure setpoint exceeded	J6, 2 to 3 jumper*	J6, 1 to 2 jumper (Typical)
Rapid pressure rise detected, K2	J4, 1-2 J2, 2,3	Rapid pressure setpoint exceeded	J2, 2 to 3 jumper (Typical)	J2, 1 to 2 jumper*
Slow pressure alarm detected K2***	J4, 2-3 J2, 2-3	Static pressure setpoint exceeded	J2, 2 to 3 jumper (Typical)	J2, 1 to 2 jumper*
Power or sensor fail alarm, K1	n/a	PCB and sensor healthy	Not Available	Always
Current loop		Always indicates static pressure**		

*Possible, but not standard setting
**4 to 20 mA is standard. To change to 0 to 1 mA, remove R37 and R59 on each PCB module.
***J4, 2-3 jumper sets K2 to static pressure mode; J4, 1-2 jumper will set K2 to rapid pressure mode. R25 adjusts setpoint of static trip level. See calibration section.

NOTE: See Figure 2 for jumper and resistor locations.
Configuration shown may vary by application.
All three modules should share the same jumper settings.

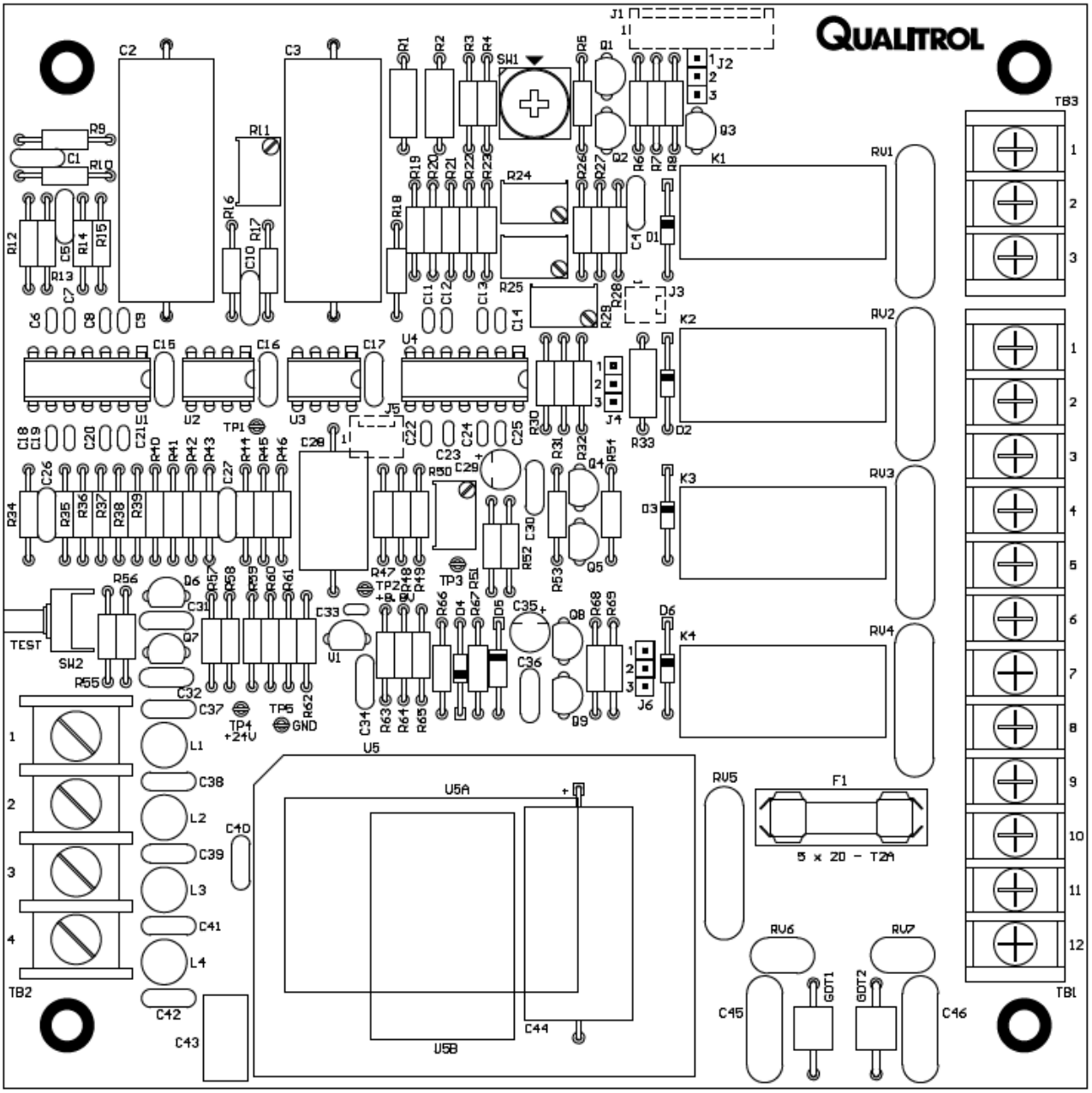

QUALITROL
J1
J2
SW1
TB3
TB1
TB2
RV1
RV2
RV3
RV4
RV5
RV6
RV7
K1
K2
K3
K4
F1
5 x 20 - T2A
TEST
SW2
TP1
TP2
TP3
TP4
+24V
TP5
GND
U1
U2
U3
U4
U5
U5A
U5B
GDT1
GDT2

Figure 2

Required Equipment and Instruments

- Regulated 30-psig air pressure source
- 0-30 psig pressure gauge.
- Mains power source
- PCBA view-Figure 2 for entire board view

Function	Adjust	Response	Most sensitive	Less sensitive
Static pressure alarm	R25	K2 status	Anti-clockwise	Clockwise
Rapid pressure detection in oil	SW1, 0 to 7	K3, K4	7	0
Rapid pressure detection in gas	SW1, 8 to F	K3, K4	F	8

Fast Pressure Rise Adjustment

Sensitivity Adjustment Feature: In the event a particular transformer is subject to false trips, the 930 Series Pressure Monitor, has a feature to change the level of sensitivity and eliminate this problem. The 930 can be calibrated to reduce or increase the factory-calibrated sensitivity.

Refer to the Sensitivity Selection Table for the choice of fast pressure rise response times. Choose the appropriate setting from the Sensitivity Selection Table. Locate Selector Switch S1 on the printed circuit board. Turn Selector Switch SW1 to the setting chosen from the Selector Sensitivity Table.

NOTE: Positions 0-7 correspond to units mounted under oil, and positions 8-F correspond to units mounted in the gas space of the tank.

Slow Pressure Rise Adjustment

Connect a regulated 30-psig-air pressure source to the ¼-18 NPT opening on the Electronic Pressure Monitor Sensor.

NOTE: A 0-30 psig pressure gauge should be connected in-line between the pressure source and the sensor.

Connect the cable from the Electronic Pressure Monitor Sensor to the Control Panel by wiring the control cable to Terminal Board TB2. The red wire is connected to terminal 1, the black wire is connected to terminal 2 and the shield drain is connected to ground. Slowly increase the pressure to the pressure sensor until the Slow Pressure Rise Light actuates. Note the pressure at which the Slow Pressure Rise light actuates. This is the present slow pressure rise setpoint. If the slow pressure rise setpoint requires adjustment, decrease the sensor pressure to a point below the desired setting. Allow several seconds for this circuit to respond.

NOTE: If the slow pressure rise contacts are configured for momentary actuation (as determined by the light will de-actuate as the pressure drops. If the contacts are configured for seal-in, it will be necessary to push the Reset Button on the front panel to de-actuate the light.

Locate Potentiometer R25 on the printed circuit board.

To adjust the slow pressure rise setpoint, rotate the screw on Potentiometer R25 as follows:

Setpoint	Rotate R25 Screw
Increase	Clockwise
Decrease	Counter-clockwise

NOTE: Each turn of the potentiometer changes the setpoint by approximately 1 psig. After making the adjustment, slowly increase the pressure to the sensor and observe the pressure at which the Slow Pressure Rise light actuates.

Repeat steps until the desired slow pressure rise setpoint is achieved.

THE ELECTRONIC PRESSURE MONITOR IS NOW READY FOR INSTALLATION ON A TRANSFORMER.

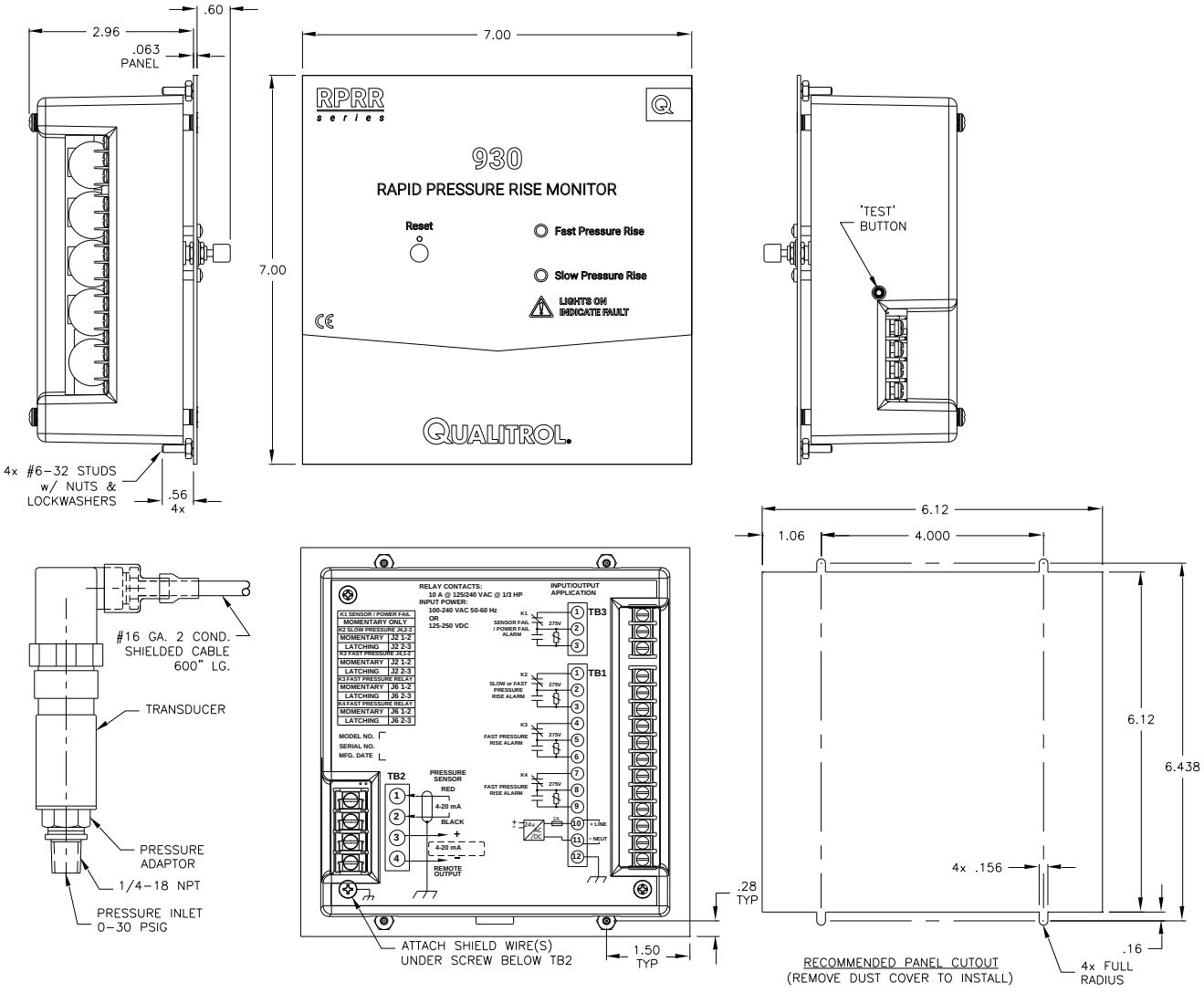
Warning

- Switch off the power supply before performing installation or maintenance.
- Mains conductors (Line and Neutral) may not exceed 250V reference earth ground.
- Hazardous voltage may still be present at the relay area, even if mains power is disconnected.

Caution

- Use AWG 16 to 14 (1.2 to 2.5 mm^2) copper wire for mains and relay outputs.
- The sensor shield connection and earth bonding wire shall connect at the 930 panel shown below.
- Current loop connections must be made with shielded cabling; the shield shall ONLY attach at the 930 panel ground point(s).
- All wire shall be rated at 80 deg. C or higher.
- Do not connect heater equipped units to a DC source. The heater element is NOT a universal voltage device.

Single module and sensor unit



Single module and sensor unit

- Module screw torque spec is .7N-m (6 in-lbf).

Pressure Sensor Connections

A shielded two conductor twisted pair control cable is permanently attached to the Electronic Pressure Monitor Sensor. The two conductors and shield drain should be connected to the Electronic Pressure Monitor Control Panel as follows:

Lead	PCB TB2 Terminal Number
Red	1
Black	2
Shield Drain	Chassis Ground

NOTE: Sensor wiring should be continuous, and the shield drain lead must be grounded only at the monitor. The 930 shall be mounted to a grounded surface.

K1 Contact Connections (wired Failsafe)

Power OK/Sensor OK Contacts K1	PCB TB3 Terminal Number
Normally Closed	1
Common	2
Normally Open	3

K2 Contact Connections

One (1) set of single pole double throw contacts is actuated when the slow (or rapid) pressure rise setting is reached. Connection to these contacts should be made as follows;

Pressure Rise Contacts K2	Terminal Board TB1 Terminal Number
Normally Closed	1
Common	2

Normally Open	3

Single module and sensor unit

K3, K4 Contact Connections

Two sets of single pole double throw contacts are actuated when the rate of pressure rise setting is exceeded. These relays operate together. Connection to these contacts should be made as follows:

Pressure Rise Contacts	Terminal Board TB1
K3	Terminal Number
Normally Closed	4
Common	5
Normally Open	6

K4	Terminal Number
Normally Closed	7
Common	8
Normally Open	9

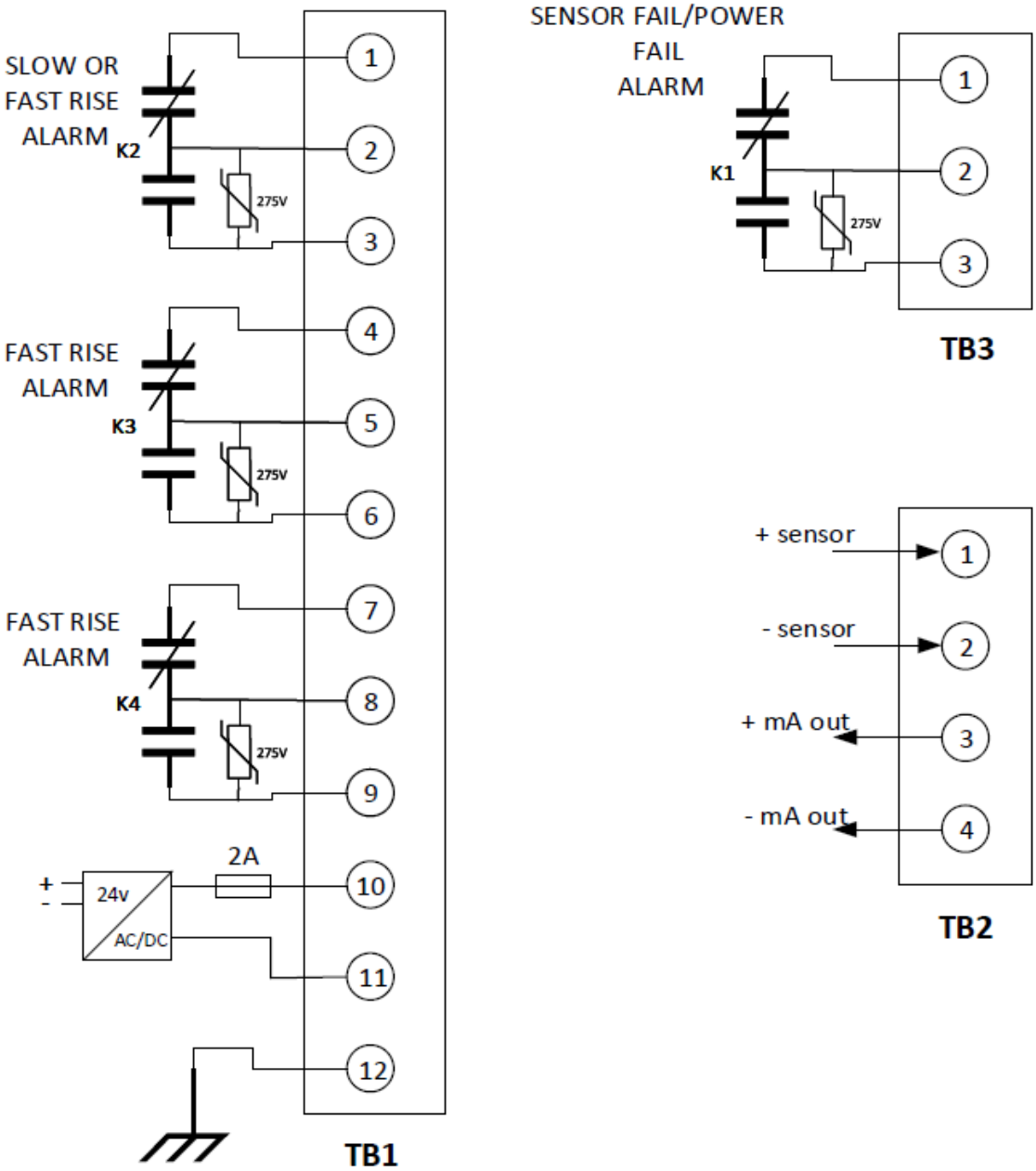
Pressure Output Signal

A 0-1 or 4-20 ma output signal is supplied for remote transformer pressure indication or for use with SCADA devices. This signal is accessed via Terminal Board TB2, terminals 3 and 4. The wiring shall be shielded and the shield shall connect only at the 930.
The range of 0-1 or 4-20 ma corresponds proportionately to the 0-30 psi range of the Electronic Pressure Monitor.

Supply Power

Note the correct mains voltage listed in the Specifications section. Supply power is applied to Terminal Block TB1, terminal numbers 10(+ or Line) and 11(- or Neutral). Power ground is applied to terminal 12.

Single module and sensor unit



Triple module and sensor unit

Pressure Sensor Location and Mounting

Mounting of the pressure sensors is accomplished by mounting the flange on any smooth surface. The four (4) bolt holes are located on 4.00” centers.

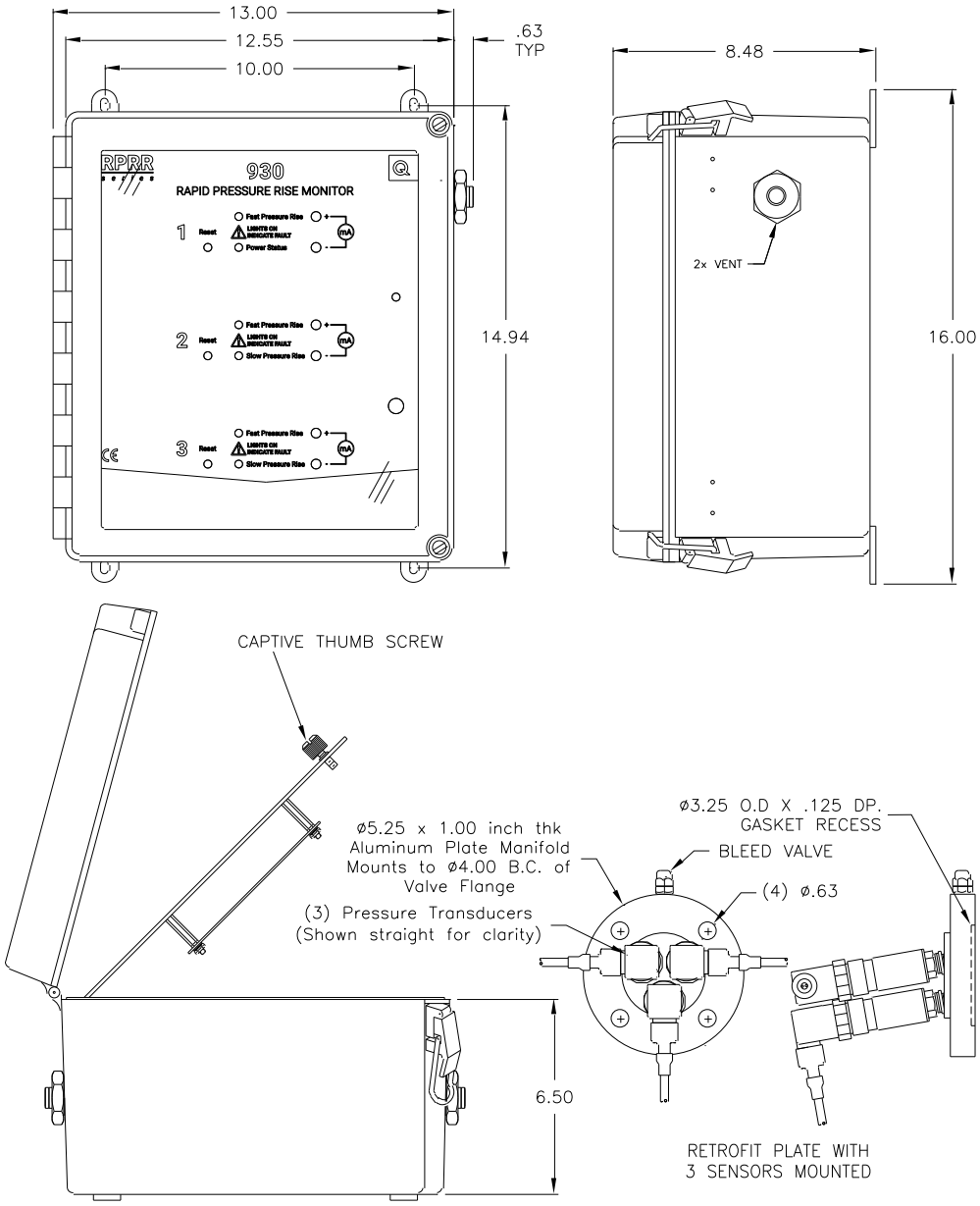
When installed, the pressure sensor will extend approximately 5.00" from the tank wall.

NOTE: The pressure sensor enclosure is sealed. Care should be taken to insure the bleed valve is pointed upward when installation is complete.

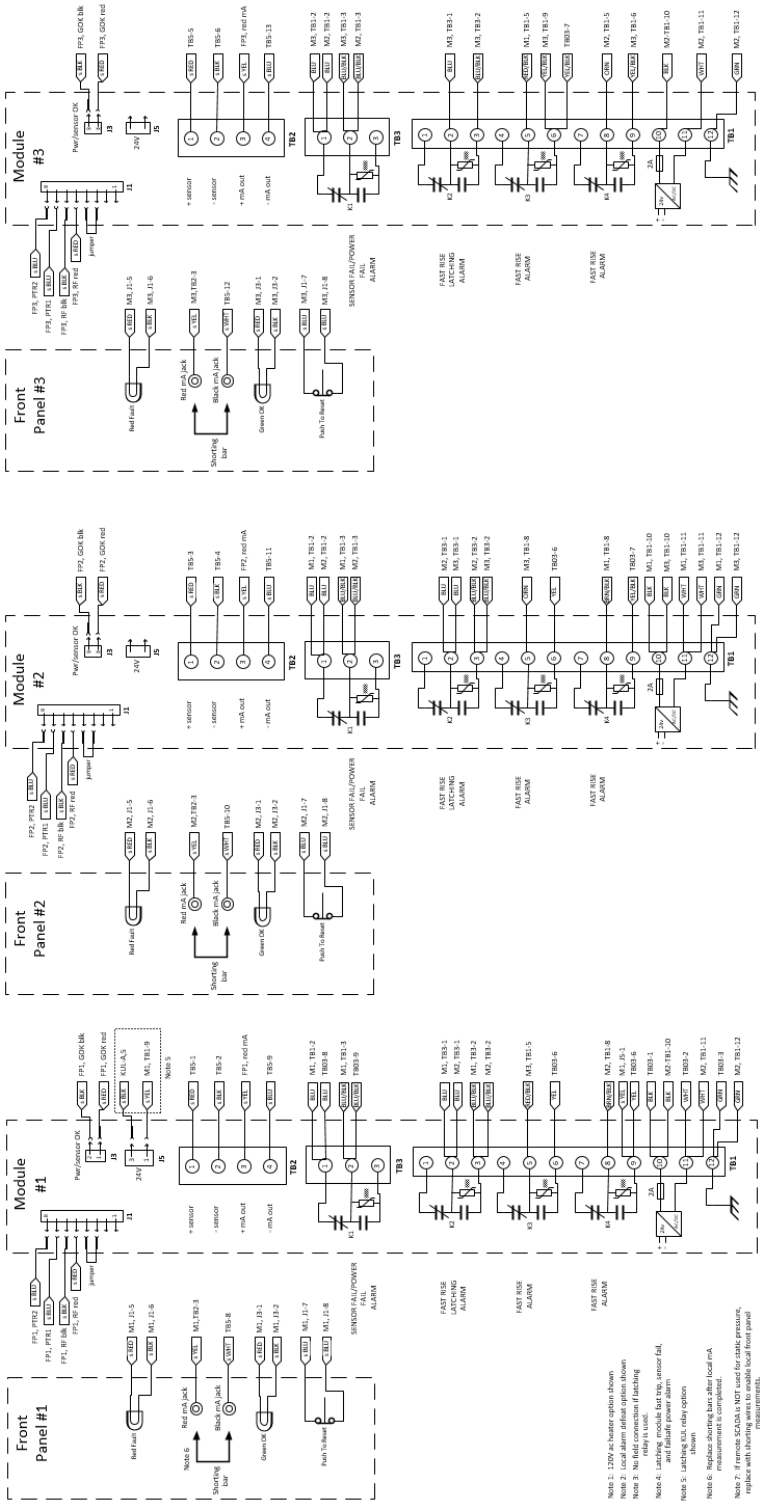
If the flange/Sensor are mounted on a valve they should never be left on with the shut-off valve closed. If it is the practice of the transformer manufacturer to close this valve for shipment, then the flange/senor should be removed and re-mounted after the transformer is in place and filled with oil. Note also that closing the shut-off valve while the sensor is connected to an energized breaker tripping circuit may cause unintentional tripping.

Control Panel Location and Mounting

The Electronic Pressure Monitor Sensor is designed to be back-mounted on any smooth surface. Four 0.31" diameter holes are provided for use of 1/4" diameter fasteners. The Pressure monitor requires an approximate area of 13" wide by 16" high and is 8 1/2" deep. Additional area below the temperature monitor should be allotted for wiring harness. Pressure input and mounting is accomplished via the flange mount adapter on the sensor. The sensor can be located in either the gas space or the oil space of the transformer tank.

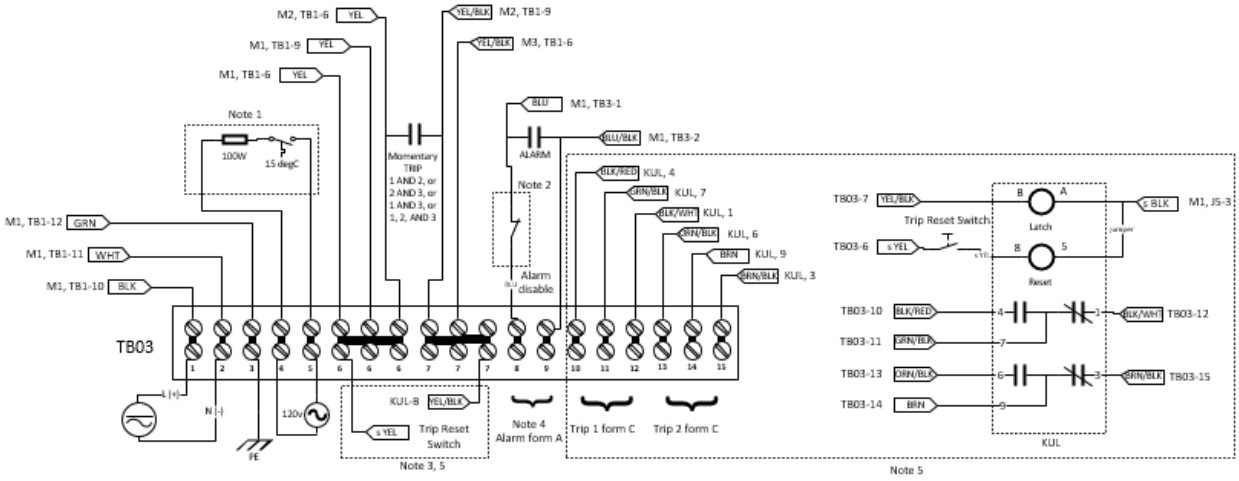


Triple module and sensor unit



Module wiring diagram

Triple module and sensor unit



Power and relay field wiring

Note 1: 120V ac heater option shown

Note 2: Local alarm defeat option shown

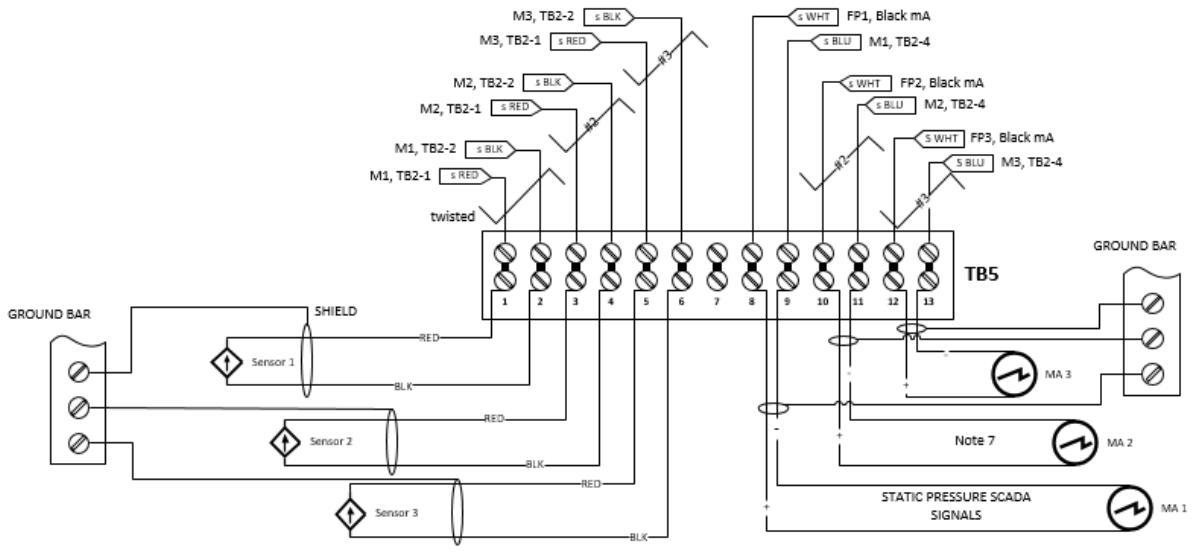
Note 3: No field connection if latching relay is used.

Note 4: Latching module fast trip, sensor fail, and failsafe power alarm

Note 5: Latching KUL relay option shown

- DIN rail terminals screw torque spec is .6N-m (5 in-lbf).

Triple module and sensor unit



Sensor and mA output field wiring

Note 7: If remote SCADA is NOT used for static pressure, replace with shorting wires to enable local front panel measurements.

Automatic Operation

The Electronic Pressure Monitor operates automatically. The Fast Pressure Rise Light and its associated contacts will actuate in response to a pressure rise greater than the preset rate. The Slow Pressure Rise Light will actuate when the preset pressure level is exceeded.

Momentary Actuation

If the fast pressure rise or slow pressure rise contacts are configured for momentary actuation, the light and contacts will automatically reset when the condition which initiated actuation no longer exists.

Seal-In-Actuation

If the fast pressure rise or slow pressure rise contacts are configured for seal-in actuation, the light and contacts will remain actuated after the condition, which initiated actuation no longer, exists.

NOTE: Pressing the RESET button breaks the seal-in circuit and de-actuates the light and contacts.

Signal Display

A signal proportional to the pressure in the transformer tank can be displayed by wiring a current meter across terminals 3 and 4 on Terminal Board TB2. The 0-1 or 4-20 ma range equates to 0-30 psig.

Testing the System

Field testing the transducer output and calibrating the slow pressure rise relay is done by using a regulated pressure supply, such as a nitrogen bottle with a low pressure regulator (30 PSI maximum).

A means of obtaining zero (0) to thirty (30) psi is necessary to test the transducer.

Connect a DC Milliammeter (to read between 0 and 20 milliamps) in series with either the black wire or the red wire attached to TB2-1 or TB2-2.

Varying the input pressure to the transducer from zero (0) to thirty (30) PSI should create a current in the Milliammeter of four (4) milliamps (at the lowest pressure) to twenty (20) milliamps (at the highest pressure)

The slow pressure rise (static pressure) relay can be calibrated by setting the pressure source at the desired set point pressure and adjusting potentiometer R25 until the slow pressure rise relay and the slow pressure indicator activate.

The rapid pressure rise relay function can be tested by momentarily pushing the switch SW2, located just above the terminal block TB2. This applies a milliamp load (rapidly) to TB2 terminal 2. The fast pressure relays and the fast pressure indicator should activate.

Use a 0 to 1mA meter in an equivalent manner as above. In this case, 1mA responds to 30psig.

The front panel banana jacks provide a convenient point for a portable mA meter for any of the three static pressures. Replace the jumpers after measurement to close the current loop.

Electrical	
Mains rated Voltage / frequency; (standard)	100 – 240 Vac, 50/60 Hz; OR 125 - 250 Vdc
Mains rated Voltage (LV DC option)	24 Vdc OR 55 Vdc
Mains rated Voltage (Enclosure heater option)	120 or 240V factory specified, 50/60 Hz only
Mains operating range	EN60255-1; +/- 10% of rated ac V; +/- 5% frequency; +/- 20% of rated dc V.
EMC emissions	EN55011 Class A
EMC immunity	EN61000-6-5, Substation category, interface 4 IEEE C37.90.2, RFI to 35V/m
Dielectric Isolation-MAINS and RELAYS	2000 Vac for 60 seconds
Dielectric Isolation-sensor and current loop	500 Vac for 60 seconds
Power Consumption	Module power < 10 Watts
	Heater power = 100/200 Watts @120/240V (optional)
Functions	
Visual Indicator	Red LED on panel for tripped condition
Relay K1	Power fail and/or sensor fail; Fail safe coil
Relay K2	Rapid rise OR adjustable static pressure
Relay K3, K4	Adjustable rapid rise; Momentary or latching
Relay contact rating	10 Amps at 30 Vdc resistive 10 Amps at 250 Vac resistive
Failure detection	Power fail and sensor fail operation is supported
Analog output signal	4 - 20 mA @ maximum 500 Ohms load or, 0-1 mA @ maximum 3000 Ohms load

Operating Conditions	
Device Temperature	-40°C to 70°C
Analog output signal drift	< +/- 3% of full scale over operating temperature
Safety ratings	Overvoltage Category III, Pollution degree 2, Insulation class 1; per IEC60255-27
Enclosure protection	IP20 (indoor model); IP33 (outdoor model)
Vibration	50/60 Hz @ .004” displacement
Altitude	2000 meters maximum

Table 1. Specifications

There is no routine maintenance recommended for the 930 PCB module.

Fusing

The 930 PCB module contains one 5 x 20 mm, 250V rated, replaceable fuse.

1. A 2 Amp, time delay (type T) is used for the module power.
2. This is the only field replaceable part on the circuit board.

Warning

Make sure that the unit is de-energized from the power source before fuse replacement.