WARRANTY

Intek, Inc. warrants each Rheotherm product to be free from defects in material and workmanship under normal use and service, Intek's obligation under this warranty being limited to making good any part or parts thereof which shall, within one (1) year after delivery of such product to the original purchaser, be returned to Intek with transportation charges prepaid and which Intek's examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties, express or implied and all other obligation or liabilities on Intek's part. The purchaser will assume all responsibility and expense for removal, decontamination and reinstallation of equipment.

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SECTION 1 – GENERAL INFORMATION

1.1 INTRODUCTION

The Model 200 is a "smart" instrument having performance characteristics described in SECTIONS 3, 4, and 6. Rheotherm® precision flow meters are designed to provide accurate linear or non-linear (depending on the model) representation of fluid flow rate. They are manufactured exclusively by Intek, Inc. and employ a patented thermal technique used by industry since 1978. The unique transducer designs have protected sensors, are easy to install and require little or no maintenance.

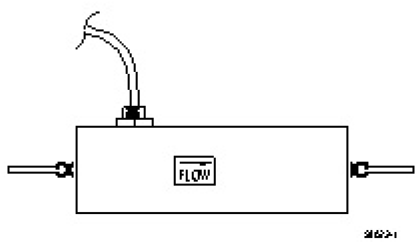
Each Rheotherm flow meter consists of two elements — a transducer and a transmitter unit. The transducers come in two basic designs, intrusive and nonintrusive (SECTION 2.1). Design selection is based on application constraints or customer preference. The transmitter, for signal processing, is housed in one of four basic enclosure styles (SECTION 2.2). Again, selection is based on application requirement.

Key features of Rheotherm instruments are:

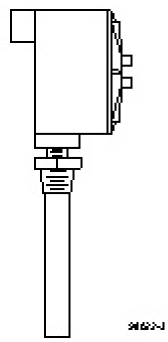
- <u>Nonintrusive flow measurement</u> — For pipe sizes from 0.030 to 2 inches, flow sensing can be done from outside the flow tube.
- <u>No moving parts</u> — There are no rotating, translating, undulating or oscillating parts to wear, stick, break or fatigue.
- <u>Chemical compatibility</u> — The wetted surface(s) can be any of a number of corrosion resistant metals or alloys. There are no internal joints or seals in most TU type transducers.
- <u>Flexibility</u> — Rheotherm meters can be ordered calibrated for mass or volumetric units or in average velocity. Flow rate, totalization and fluid temperature displays or output signals are available, as well as rangeability up to 100:1 or more.
- <u>Fluid pressure options</u> to 10,000 psi (check transducer tag for rating on your unit).
- <u>Withstands over ranging</u> — No damage or change in calibration will occur due to excessive flow rates many times higher than calibration range.
- <u>Immunity to shock and vibration</u>.
- <u>Optional nuclear radiation hardening</u>.
- <u>Range of application</u> includes measurements in capillary tubes to large diameter pipes or ducts.

1.2 DESCRIPTION OF OPERATION

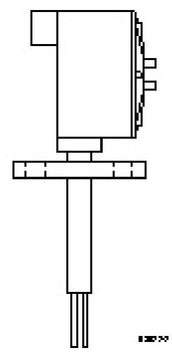
Rheotherm flow meters are available with various nonintrusive and intrusive transducer designs, but they all use the same thermal sensing technique. Two temperature sensors are used — one is in thermal equilibrium with the fluid and provides a fluid temperature reference, while the second temperature sensor is located near a heater so that its temperature is slightly above that of the fluid. In a TU transducer, the temperature sensors and heater are attached to the outside of the flow tube, whereas the probe transducers have the sensors and heater located in the probe(s) that are inserted into the stream. The rate at which heat is removed from the heated sensor by the stream is related to fluid velocity. Hence, the measured temperature differential between the reference sensor and heated sensor is a function of flow rate. Intek, Inc. is licensed to use this patented and trademarked flow measurement method.



Nonintrusive transducer (TU)



Example of single probe with NPT fitting



Example of dual probe with flange fitting

1.3 PRECAUTIONS

!! CAUTION: Throughout the manual this caution notation indicates that failure to execute the accompanying instructions may cause the instrument or external equipment to malfunction.

!! WARNING: A warning indicates that failure to execute the accompanying instructions may cause permanent damage to the instrument or external equipment.

1. Use proper input power — Check the label on the transmitter for the input power requirements.

2. Use reasonable care in handling the transducer. Do not try to disassemble the transducers; there are no removable parts.

   TU — Excessive twisting or bending can damage the sensor. The flow tubes are thin-walled tubing.

Probes (NPT/2I, NPT/I, BF/2I, BF/I, etc.) — Take care not to bend the probes or damage the tips. Do not try to remove or turn the conduit junction box.

3. Check the transducer maximum temperature rating — Do not operate a transducer at or subject it to a temperature above its specified limit.

4. Keep moisture out of the electronic enclosure and sensor junction box. Once cable connections are made in the junction box, make sure the lid is tightly closed. Seal conduit lines if they can become wet inside.

5. Keep transducer wetted surfaces clean and free of permanent layer build-up.

6. Do not exceed pressure limits of the tube or fittings.

7. Maintain a thermally stable environment (short-term) for the transducer and adjacent line (See SECTION 2 — INSTALLATION).

These instructions cover installation, calibration and maintenance of Rheotherm meters in standard configurations. Any special information pertaining to your unit is covered under CUSTOM INFORMATION (SECTION 6). Time should be taken to carefully read these instructions prior to installation of the equipment. Should any questions arise or problems occur, call Intek for immediate assistance.

SECTION 2 - INSTALLATION

2.1 TRANSDUCER

!! CAUTION: All transducers have a directional arrow on the tag and/or etched into a metal part. Before installing a sensor, please note proper flow direction. This is critical to sensor operation.

!! CAUTION: If you have more than one Rheotherm unit, make sure the complete serial number of the transducer matches the complete serial number of the transmitter. The transducer and transmitter are a matched set. Components with different serial numbers should not be interchanged unless specifically ordered as spares. The transducers have no user serviceable parts, so do not try to disassemble, as permanent damage may result.

The transducer style supplied with your meter is listed in the model code number in SECTION 6. Proper installation of the sensor is necessary for achieving accuracy and repeatability. Installation suggestions for each type of standard transducer are given here. For custom transducer installations, refer to CUSTOM INFORMATION — SECTION 6.

Be sure wetted surfaces are clean before installing. If cleaning is needed, use non-residue solvent and wipe dry. If the sensor has a junction box, keep moisture out. Make sure the lid is tightly sealed and, if supplied, the gasket is in place. Seal conduit lines at the junction box if conduit lines can become wet.

1. TU (nonintrusive) — TU 1/16 and TU⅛ transducers particularly require special care in handling and installing to avoid damage to sensor tube stubs.

   !! WARNING: TU transducers are made with thin-walled tubing — use care when installing.

   All TU transducers (other than 1/16 & ⅛ inch) should have straight line input and output sections, typically 20 pipe diameters on the inlet and 6 to 10 diameters on the outlet. If installed vertically, the flow should be flowing up through the sensor. Connection in the line is via compression fittings, hose with clamp, threaded fittings or flanges, whichever is appropriate. Care must be taken not to transmit a twisting force through the transducer's midsection. The TU transducer, whether flanged or not, must not be used to pull other piping together or to make up angular mismatch of fittings. The transducer junction box (if supplied) should never be rotated for any reason.

   TU 1/16 transducers may be sleeved with a ⅛" tube for added support. Connection should always be made to the 1/16" tube, as there is no assured seal between the 1/16" tube and the sleeve.

Some TU transducers have an integrally mounted cable; do not pull on this cable, or attempt to remove the fitting where the cable enters the sensor shell.

Fluid temperatures other than ambient require special attention. Thermal gradients from one end of the transducer to the other, as well as along the radius of the connection pipe, are undesirable. Therefore, effective insulation should be installed around the inlet and outlet straight line runs. Gradients which may exist in the line further up stream can be removed if an insulated elbow is installed in the line prior to entering the straight line portion of the plumbing. Metallic support braces for the sensor or adjoining plumbing can act as a heat sink and cause operational problems in high temperature applications. The support braces should be thermally isolated from the line to avoid large heat conduction effects.

If the transducer is for use above 212°F, it will have a side arm and connector box, where the internal high temperature wiring is connected to the lower temperature transducer cable. Free air should be allowed to flow around the side arm and connector box to keep the box cool. The side arm can be insulated up to one third of its length from the transducer body.

In these applications, proper thermal control is vital to accurate meter performance. Non-uniform heat tracing, relay on/off temperature controllers and oscillating proportional type control should always be avoided. Steam trace lines with good pressure regulation or properly tuned proportional temperature control systems are effective in maintaining uniform fluid temperature. ***A box around the sensor and inlet tubing is highly recommend for operating temperatures higher than room ambient. Allow enough inlet tubing inside the box to allow the fluid temperature to become the same temperature as the surrounding air. Separately control the box air temperature at the same temperature as the incoming fluid temperature to minimize thermally induced indication errors.***

Flow stream conditioning must also be considered to maximize meter performance. Avoid upstream protrusions and short distance straight runs. Flow pulsations, such as those created by metering pumps, may cause the instrument to differ from the factory calibration. Furthermore, if the flow is varied by stroke and by pump speed adjustment, the indication will most likely be non-repeatable. If you are using a pump of this type, it is recommended that a pulsation dampening device be used to provide smooth continuous flow. ***A second choice would require readjustment of the instrument calibration after installation (See SECTION 4.2).***

For liquid measurement systems using high pressure gas to force flow, the effects of the absorbed gas must be considered. In these cases, sudden pressure drops up stream of the sensor such as line size expansions, control valves, and pressure dropping regulators must be avoided. Sudden pressure drops can cause the absorbed gas to release into the liquid, making the flow sporadic and difficult to measure. Control valves should be placed down stream of the sensor.

The ideal installation will provide the sensor with well established smooth flow, uniform system temperature and consistent fluid media.

2. Intrusive Probes —

!! IMPORTANT: Recommended straight run for best accuracy is *a **minimum 20 diameters up stream and 10 diameters down stream.***

The various probe transducers are mounted through a threaded collar (NPT/2I and NPT/I) or flanged tee (BF/2I or BF/I). Other fittings and sensor designs are also available and are discussed on the Custom Information page. Generally the probes are sized so the tips extend ½ to 1 inch beyond the pipe center line when properly installed. There are exceptions to this in certain applications; see CUSTOM INFORMATION (SECTION 6) as it applies.

Proper alignment of the sensor with flow is important; the flow direction is indicated on the transducer tag and/or etched into the transducer. All dual probe transducers (NPT/2I, BF/2I) are installed so that the two probes are side-by-side across the fluid stream. Never rotate the junction box that houses the terminal cable connection. If this occurs the transducer could be damaged and/or installed misaligned with the flow direction.

For high temperature applications, the sensor and surrounding line should be well insulated. Leave a portion of the transducer neck un-insulated to allow heat dissipation before reaching the junction box.

2.2 TRANSMITTER ELECTRONICS

Various types of transmitter housings are available. These include NEMA 4, laboratory bench type, explosion proof, and panel mount enclosures as well as special models to meet customer requirements. These come in different sizes to accommodate options and special features.

1. NEMA 4 — The standard industrial housing, this enclosure is watertight (non-submersible) when the door is properly clamped shut. The housing should be mounted such that wire/cable ports are located at the bottom of the housing, to reduce problems associated with water spray, condensation and settling of dust and dirt. An all stainless steel version (NEMA 4X) for corrosive environments is also available.

2. NEMA 7 — For use in hazardous (class I) environments. The lid should be closed and all bolts tightened before the unit is powered up. If a NEMA 7/NEMA 4 enclosure was ordered, the unit will have a rubber gasket in a groove in the top of the enclosure base. Conduit seals are frequently required, so applicable code requirements should be met when installing the conduit into the box.

3. Laboratory — This table-top unit is NEMA 1 only; do not spill liquid on it or use in a wet environment. This unit typically has a grounded power cord, and all transducer and output connections are located on the back of the enclosure.

4. Panel Mount — For use in a control panel, mounted so the enclosure face is flush with the panel surface. Most or all connections are made on the back of the enclosure. This unit is NEMA 1 only; do not use in a wet environment.

The transmitter housing should be installed keeping in mind the length and routing of the transducer cable. Standard cable length is six feet but it can be specified up to 200 feet. If, after calibration of the unit, the cable length is changed (a portion cut off or additional cable spliced on), there may be a shift in the calibration due to the change in cable resistance. ***The size of this effect depends on the amount of change. If a noticeable shift occurs, it may be necessary to adjust the output as described in the calibration instructions in SECTION 4.2.***

Unless otherwise specified, normal ambient environment for the transmitter is 0-120°F. Recommended maximum temperature is 135°F.

2.3 ELECTRICAL CONNECTIONS

1. Verify/configure the input power. The input power requirement is listed on the tag on the transmitter enclosure. Be sure the input power source to be used is properly selected in the unit. Input power can be either 115 Vac or 230 Vac single phase, 50-60 Hz. The power configuration may be changed in the field. Using Figure 1, locate the power select switch on the lower printed wiring board and slide the power select switch to either the 115V or the 230V position. ***Do not apply power to the instrument until all other connections and optional selections have been made.***

   !! CAUTION: The following output signals, both − and +, are isolated from the transducer and power ground. However, the outputs are not isolated from each other. All of the 4 to 20 mA receiver channels must have independently isolated inputs. Again, the 4-20 mA, RS232/422, and status outputs are all common to each other.

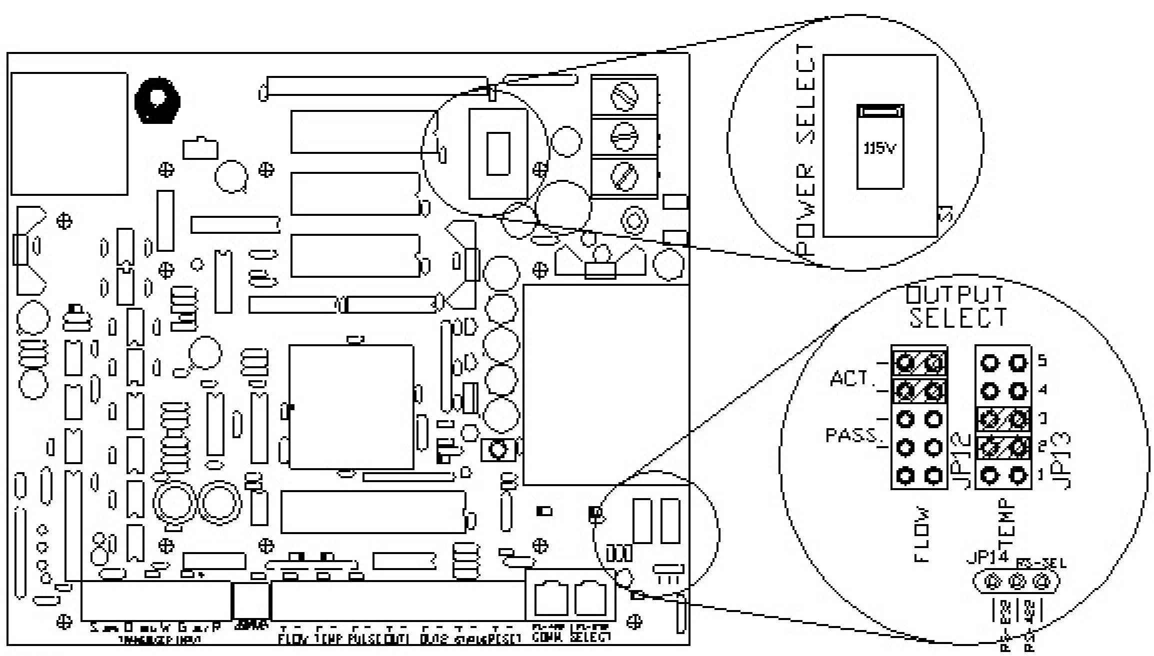


Figure 1 - Transmitter Hardware Configuration

2. Check the analog output configuration of the transmitter and your input device. The analog output terminals for flow and probe temperature are shown in Figure 2 at the far left terminals of JP7. If the instrument is configured for current outputs, set the flow and temperature output type for either passive or active transmitter by positioning the header pin shunts shown in Figure 1 at JP12 and JP13. (Active: Current to loop is sourced by transmitter. Passive: Output receiver sources current.) This figure shows an active configuration for the flow output and a passive configuration for the temperature output. Typically, units are shipped configured in the active mode, unless the voltage output option is specified.

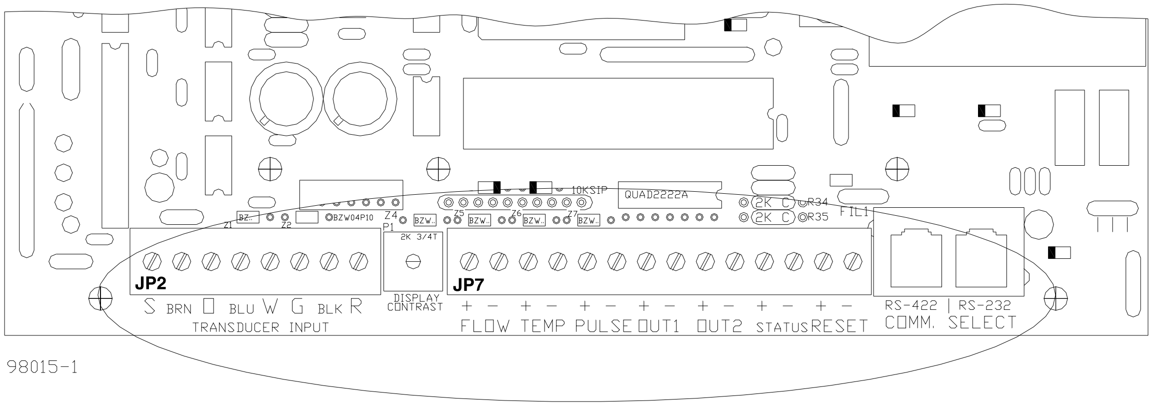


Figure 2 - Transmitter Terminal Connections

3. The next JP7 output is a 2KHz full scale pulse output. The standard configuration is a 0-15Vdc pulse that is proportional to flow with a 50% duty cycle. Unless otherwise specified, the minimum pulse duration is 250 µs $\frac{1}{2f}$.

   The two possible configurations are:

   a. Voltage pulse (standard) — This option uses the same circuit and connections as the open collector. A 1kΩ pull-up resistor is added and tied to a +15V voltage source. This provides the 0-15 Vdc pulse.

   b. Open collector (optional) — The (+) connection on the output terminal is the collector of a 2N2222A NPN transistor. The (−) connection is the emitter of the same transistor. The pulse rate is linear with flow. Recommended maximum current is 150 mA; maximum open circuit voltage is +36Vdc.

   !! **WARNING:** ***Do not reverse the terminal polarity when connecting to an external supply.***

4. Outputs ‘OUT1’ and ‘OUT2’ are 0-15Vdc digital outputs factory default set as low flow and high temperature indicators respectively. OUT1 is factory set to alarm at flows below the lowest calibrated flow. OUT2 is set to alarm at temperatures above the rated maximum temperatures. The alarm state of these outputs is 0Vdc, which also occurs when power to the instrument is lost.

5. The status output, also located on field wiring terminal, JP7, is a digital 0-15Vdc output. This output will go low in the event of a fault or power loss. If a non-standard option has been ordered there will be additional notes in the SECTION 6.3 — SPECIAL INSTRUCTIONS.

6. The reset input terminals are provided for remote reset of the totalizer. To reset the totalizer these two terminals need to be shorted together. The '+' terminal is connected to an internal +5Vdc supply '+' and the '-' terminal is connected to an internal input device and to output ground through a 47kΩ resistor. If an open collector (NPN) is used to make this connection, wire the collector to the '+' terminal and the '-' to the emitter. Reverse the polarity if a PNP type open collector transistor is used. ***Connections to this input must be isolated. A grounded (connected to instrument output ground) emitter of the open collector may destroy the open collector transistor.***

7. Choose a path for the transducer to transmitter cable conduit. Route the transducer interface cable conduit. ***Do not cut or splice the cable, as this may affect the instrument calibration.*** Pull the cable through the conduit starting at either end; coil up the remaining length outside the transmitter or transducer enclosure, or in a cable junction box.

8. Pull wires through the conduit. Wire for power connection must be at least 24 gauge or as required by applicable local or company wiring codes. After pulling the wire, pot the conduit or wires near the enclosure if there is any possibility of water from condensation or spray entering the enclosure through the conduit.

    !! WARNING: The transmitter unit is not protected against condensed liquid water inside the enclosure. Be sure conduit interfaces are dry or sealed at the instrument to prevent condensation that may be present in conduit lines from entering the enclosure.

9. Make wiring connections. ***Power should be off at this time***. Refer to Figure 3 for system wiring detail.

    !! !! WARNING: Verify the wiring. The equipment can be permanently damaged if not wired as instructed in this manual.

10. Close the lid of the enclosure. Make sure it is tight enough to make a good seal against the gasket and ensure all other enclosure openings are completely watertight.

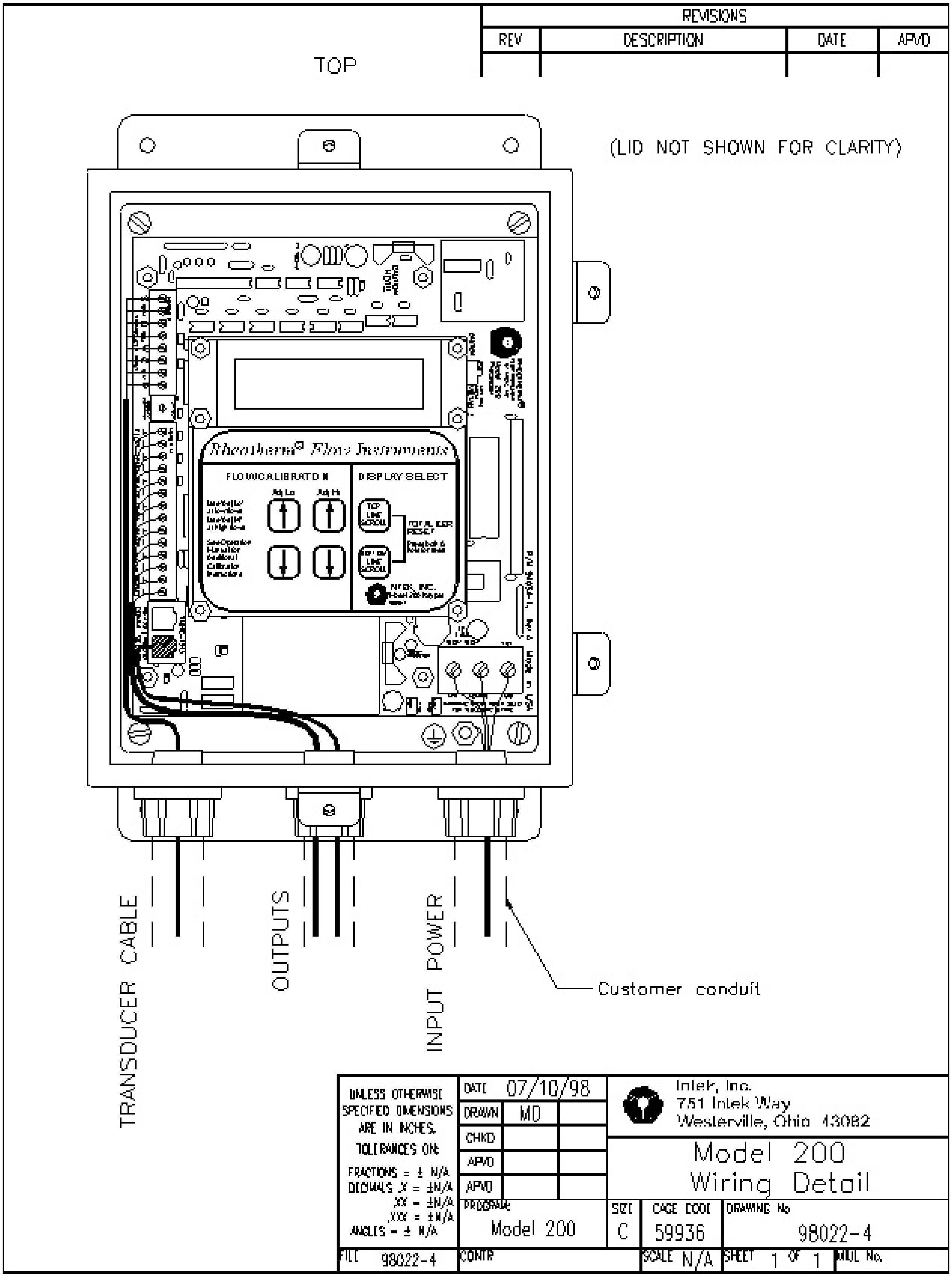


Figure 3. System Wiring Detail

2.4 SERIAL OUTPUT

The Model 200 has RS232/422 output receptacles used during factory calibration. There is a data stream that can be accessed with a specially wired six-position RJ-11 jack (modular telephone jack) and computer connection. See Table 1 and Figure 4 for wiring information.

If a distance of greater than twenty-five feet is needed for the serial communications, RS-422 should be used instead of RS-232. Inspect the jumper at JP14 (Figure 2) for the proper communication type.

TABLE I. RJ-11 to DB-9 Module Adapter

RS-232 CONFIGURATION				RS-422 CONFIGURATION			
RJ-11 Pin Out		DB-9 Pin Out		RJ-11 Pin Out		DB-9 Pin Out	
1	Tx (transmit)	1	N/C	1	Tx+ (transmit+)	1	Rx− (receive−)
2	N/C	2	Tx (transmit)	2	Tx− (transmit−)	2	Rx+ (receive+)
3	Rx (receive)	3	Rx (receive)	3	Rx+ (receive+)	3	Tx+ (transmit+)
4	N/C	4	N/C	4	Rx− (receive−)	4	N/C
5	Power (+5V)	5	Ground	5	Power (+5V)	5	Ground
6	Ground	6	Pulled high	6	Ground	6	Tx− (transmit−)
		7	N/C			7	TBD
		8	Pulled high			8	TBD
		9	N/C			9	TBD

Custom software may be developed by the user to receive and archive Model 200 data into a computer system. The electronics has a serial data protocol of 9600 baud, no parity check, eight data bits and one stop bit (i.e., 9600,N,8,1). Each transmitted group of data is sent in a standard ASCII coded format representing each process variable value, instrument identification and status information.

The data stream consists of six fields, followed by a carriage return <RETURN>. The first three fields are the process values. Following the process variables are the Model 200 serial number (ten bytes), the process identification tag number (ten bytes), and the system status (seven bytes). The data stream is then ended by a single <RETURN> byte (ASCII code 13). The total number of bytes transmitted in each data stream is 50 bytes including the trailing <RETURN>. This data group is sent about once every second. The field names and number of bytes in one data stream are shown below.

Flow Rate (%)	Totalizer (Field Units)	Temp. (°F)	Instrument S/N	ID Tag No.	Status	Term. (CR)
6 Bytes	10 Bytes	6 Bytes	10	10	7	1

The first and third process variables, % of full scale flow rate and temperature, are sent in the fixed decimal format of xxx.xx with leading and trailing zeros inserted to maintain the six byte character length. The second process variable sent is total flow, with a ten byte character length and leading and trailing zeros, as well as a fixed decimal point (if used), inserted. The next three fields are ASCII text strings followed by the <RETURN>. Example: The six bytes for a temperature of 75.5°F would be 075.50, or 48,55,53,46,53,48 ASCII.

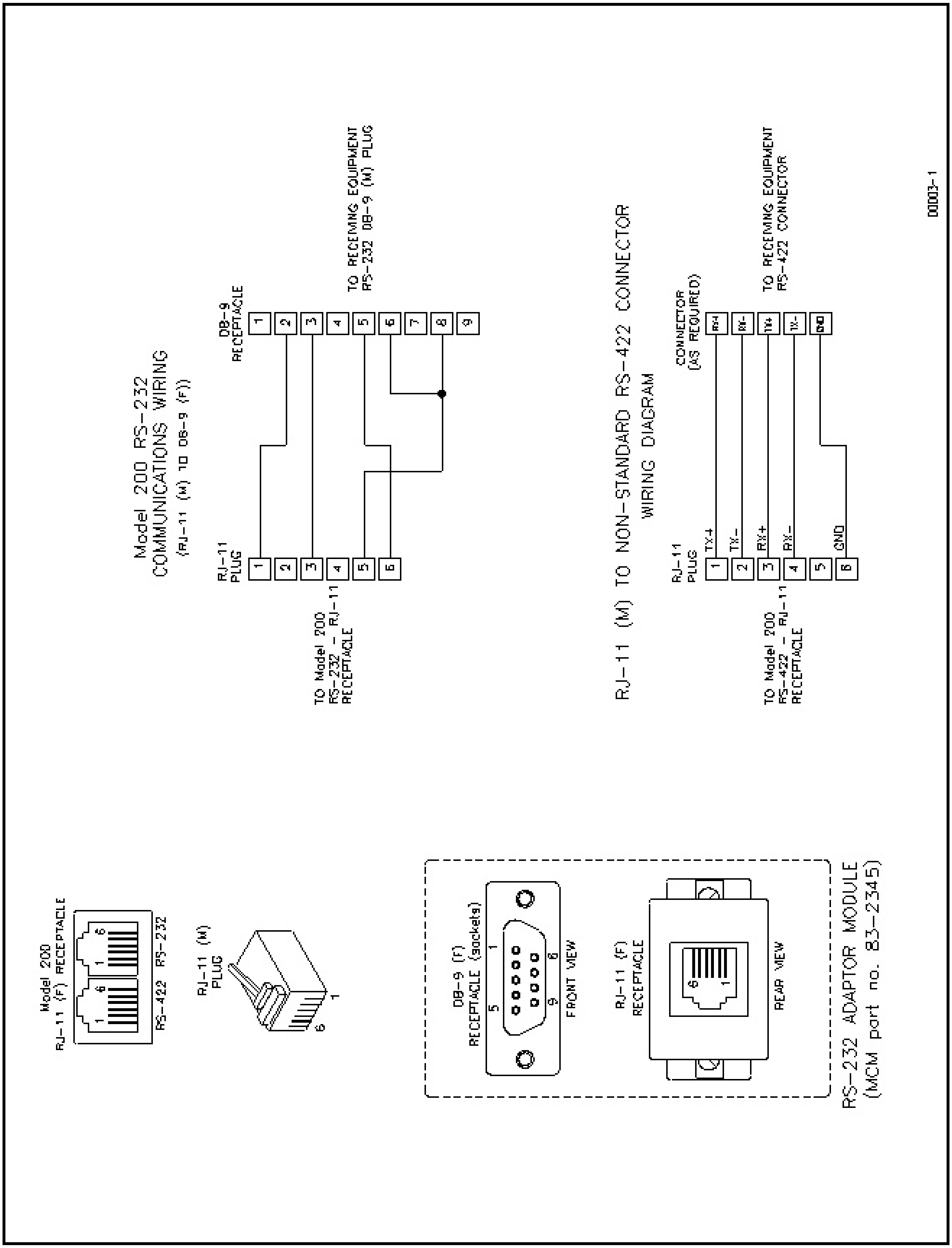


Figure 4 - Serial Communications Interface

SECTION 3 – OPERATION

3.1 START UP

Typically, the instruments come from the factory set up for the flow range of interest to the customer. Following installation all that is required is to switch on power and initiate flow in the measurable flow rate range. Flow sensors that are not calibrated directly on the fluid to be measured are so indicated in this manual (SECTION 6) and require an in-line field calibration.

When power is first turned on, the output reading or signal will indicate full scale. The alpha numeric display will have the message of ‘*INTEK, INC.*’ on the top line and ‘(614)895-0301’ on the bottom. After a few seconds the message will change to ‘s/n xxxxx-xx Cal x’ / ‘Software Ver: xxxxxx’. Again after a few seconds the top display line will change to ‘initializing.’ The status output will be low (alarm condition) and the flow output will be 100%. The flow value will be internally software monitored for stability or a factory set time-out (10 sec. default) will occur before the display is set to the normal state (Flow / Temperature will be the factory default). After ten to forty-five seconds (depending on flow meter response) the reading will stabilize. The instrument time constant is generally between 4 to 12 seconds. Higher average flow rates will result in an observed faster response time for a given unit.

3.2 GENERAL INFORMATION

The Rheotherm instrument is compensated for a wide range of both ambient and flowing media temperatures. However, abrupt changes in the temperature of the flowing material can cause the instrument output to deviate from the true representation of flow rate. An accurate reading is obtained only when the transducer is in thermal equilibrium with the material. Typically, a 20°F abrupt change in temperature may require 40 seconds to stabilize. To maintain optimum accuracy temperature ramps should be kept below 1°C/minute.

Rheotherm instruments are calibrated for a particular fluid, either at the factory or in the field. If the fluid changes properties, the calibration changes. Therefore, once calibrated, do not allow fluid properties such as density and viscosity to change (other than the intrinsic changes which occur with temperature variation). If the fluid is changed, a recalibration may be attempted following the procedure in SECTION 3.4.3. If this procedure does not provide a good calibration for the range of interest on the new fluid, contact the factory.

3.3 OUTPUT SIGNALS

Standard features for all Model 200 instruments include one 2 x 20 alpha numeric LED backlit display, two 4-20 mA or 0-10Vdc analog outputs, one 0-15Vdc digital pulse flow output, two 0-15Vdc digital flow/temperature alarm outputs, one 0-15V digital status port, and one serial communication port. Both flow and temperature process variables are linear, temperature compensated values. Each output signal is scaled such that 4 mA (0Vdc for voltage output) represents 0% of the rated full scale value and 20 mA (10Vdc) represents 100% of the rated full scale value. The factory set full scale values and definitions of process variables are listed in Table II.

1. Analog Outputs — The unit will have two 0-5Vdc, 0-10Vdc or 4-20 mA signals for flow and temperature outputs. The default configuration for each output is 4-20 mA active transmitter. See SECTION 2.3.3 for a discussion of the output types. The 'FLOW' output covers zero to 100% of full scale flow and quickly drops to zero below the instrument's calibrated low flow value. Refer to the Output Curve (Figure A-1) at the end of the manual. Similarly, the 'TEMP' output covers zero to 100% of the specified temperature range. Note that the zero output value is not necessarily 0°F or 0°C (see Output Definition, SECTION 6).

2. Pulse Output — The factory standard for pulse frequency is 2 KHz at full scale flow as a flow rate or totalization signal. Specific units of volume or mass per pulse may also be supplied to drive a customer supplied totalizer. Refer to Output Definition, SECTION 6.

3. Digital Alarm Outputs — The two outputs labeled 'OUT1' and 'OUT2' can be used for monitoring critical process conditions and for alarming exceeded process limits. They are factory default set for low flow and high temperature alarms respectively. Refer to Output Definition, SECTION 6 for specific alarm values or custom configuration information regarding these outputs.

The Status alarm output indicates a processor busy, instrument or sensor fault, or a loss of instrument power. When this output is low, the instrument is not capable of indicating flow or temperature properly and may produce unexpected outputs. This output will normally go low when initializing or when special diagnostic commands are specifically sent to the instrument. Otherwise, when the status output is low observe the display for additional information and refer to the Trouble Shooting Section of this manual.

3.4 KEYPAD an

The keypad can be
calibration.

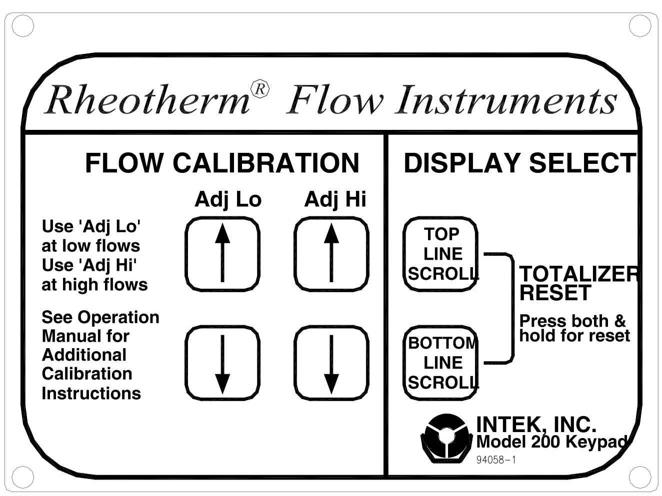


Figure 5 - Keypad

!! !! CAUTION: Do not use the keypad while the serial communication port is actively receiving data or commands from an external source. Temporarily unplug the RJ-11 serial communication cable to avoid possible signal contention while using the keypad.

1. CHANGING THE DISPLAY VARIABLES

Each display line can be independently set for flow, temperature, totalizer, time, date, serial number/calibration/software version or last factory or field calibration adjustment. Use the *TOP* or *BOTTOM LINE SCROLL* keys (see Figure 5) to select the desired display variable.

Flow =	Four or five digit indication of flow in the specified calibration units.
Temp =	A four digit (0.01 degree resolution) indication of temperature in degrees C.
Temp =	A four digit (0.01 degree resolution) indication of temperature in degrees F.
Tot =	A nine digit totalizer count is available on either the top or bottom line of the alphanumeric display. Totalizer reset can be performed as described in SECTION 3.4.2.
Time	Used for internal archiving and event recording.
Date	Used for internal archiving and event recording.
S/N, Cal	The serial number of the transmitter with the selected calibration. There are four possible calibrations A, B, C or D, which can correspond to different fluids, sensors, or process configurations. See the Special Instructions Section if a multi-calibration option is ordered.
Software Ver:	Installed version of instrument software. Factory may require this number when providing assistance.
Last Cal:	Date of the last calibration or field adjustment performed on the instrument.

2. RESETTING THE TOTALIZER

There are two ways to reset the totalizer:

A. Using the keypad, set either the top or bottom line display to 'Tot = ...'. Then simultaneously press and hold the *TOP LINE SCROLL* and the *BOTTOM LINE SCROLL* buttons until the totalizer value zeros.

B. The totalizer can also be reset remotely by closing contacts across the remote reset terminals. See SECTION 2.3.7 for reset terminal instructions.

3. FLOW CALIBRATION ADJUSTMENT

SmartSpan is a feature that allows a two point calibration to be easily performed using the keypad. Any two flow values can be accurately and independently set using the FLOW CALIBRATION 'Adj Lo' or 'Adj Hi' buttons. Using a unique Intek algorithm, adjusting either flow point will not interact or interfere with the previous adjustment in any way.

Establish flow at a known flow value near the low range of normal use (e.g., 15-20% of full scale flow). Press either the 'Adj Lo ↑' or 'Adj Lo ↓' button to increase or decrease the flow indication respectively. As you continue to hold the button the sensitivity will continue to increase. For fine adjustment, release the button and continue to press and release to change the offset incrementally. Recheck the measured flow, compare with the instrument indication, and readjust as needed. Use the 'Adj Hi ↑' or 'Adj Hi ↓' buttons similarly at a high flow (e.g., 85-95% of full scale flow) to complete the two point calibration.

A message of ‘Flow Not Valid’ during calibration means either there is no flow, or flow is out of the measurable range of the unit.

> **!! !! CAUTION**: Although the calibration adjustments can be made at any flow value it is recommended that the low and high flows be at least 10% apart from each other. If the desired accuracy is not met with this technique, a factory assisted recalibration may be required.

A separate feature of the SmartSpan is the ability to disable and re-enable the calibration adjustment function. This is done by setting both the top and bottom display lines to the ‘DATE’ field, then simultaneously pressing the *TOP LINE SCROLL* and *BOTTOM LINE SCROLL* buttons. The message ‘Flow Calibration Disabled’ will be displayed when disabling, and ‘Flow Calibration Enabled’ when re-enabling.

Restoring the factory calibration settings can be accomplished by setting both the top and bottom display lines to the ‘Software Version’ field, then simultaneously pressing the *TOP LINE SCROLL* and *BOTTOM LINE SCROLL* buttons. The message ‘Factory Calibration Restored’ will be displayed when this is performed.

4. SELECTING DIFFERENT CALIBRATIONS

Use this feature to select one of four (A, B, C, or D) different calibrations. This can be done by setting both the top and bottom display lines to the ‘S/N, Cal Selection,’ then simultaneously pressing the *TOP LINE SCROLL* and the *BOTTOM LINE SCROLL* buttons. Each time the two keys are pressed simultaneously the cal field will advance to the next calibration (A, B, C or D).

Check your model number and if it contains a “-SW-” suffix, you have ordered a special multi-calibration option. This means that two or more calibrations have been custom configured at the factory. In this case refer to the Special Instructions Section for more information.

In general, a unit with a single calibration (which is the standard), will be shipped from the factory with the B, C and D calibrations as duplicates of the original ‘A’ calibration. This allows you to custom calibrate up to three additional different calibration settings while preserving the original factory calibration.

3.5 OUTPUT CURVE

Figure A-1 is the final linearized flow output curve for your unit. The instrument has been calibrated over the actual flow rate range indicated on the ordinate (Y axis).

SECTION 4 – MAINTENANCE

4.1 GENERAL MAINTENANCE

Certain precautions should be taken to insure proper performance of all models of flow instruments. Since the measurement technique involves a signal resulting from heat transfer to the flowing medium, care should be exercised to prevent build-up of varying layers on the walls of the transducer. Layers such as bacterial growth, dried paints, gas bubbles and non-solubles can result in measurement below actual flow rates. Periodic checks and cleaning should be performed to insure a clean pipe or probe surface.

It should be part of normal maintenance procedure to check the system for proper functioning. Experience and other observable conditions should be utilized to determine the frequency of inspection. Long term drift in the unit calibrations is not expected, but if a recalibration is required, refer to SECTION 3.4.3. To test the flow switch action, the flow rate should be reduced below (for low flow switch) or raised above (for high flow switch) the switching level. Then check and insure relay action and continuity of the shut down or warning circuits which it operates.

The joints of all intrusive probes tips should be inspected for wear and corrosion.

4.2 FLOW CALIBRATION ADJUSTMENT

Occasionally over time or due to process condition changes a slight realignment of the calibration may be required to maintain the desired indication accuracy. Periodically verify the instrument calibration by comparing the indication versus another accurate flow measurement or against a trusted primary standard. After characterizing the drift tendencies and considering the accuracy requirements, determine a regular calibration verification cycle. Otherwise, an annual verification is recommended for typical installations. Calibration instructions are located in SECTION 3.4.3 of the operation manual.

4.3 SPARE PARTS

The transducer and transmitter electronics are calibrated as a set, and cannot be randomly interchanged with others. For critical applications, a complete spare flow meter (transducer and electronics) should be stocked. A spare transducer can be stocked, if it is ordered and calibrated at the same time as the flow meter. A spare electronics unit can be ordered anytime; this requires that special software also be purchased in order to upload transducer specific calibration parameters. Contact the factory for more information.

There are also two fuses which can be stocked: Wickmann part numbers 3740250041 (F2) and 3740160041 (F1) respectively, or equivalent.

4.4 TRANSDUCER & TRANSMITTER FUNCTIONAL TESTS

A test of the Rheotherm instrument functional operation can be performed in three phases:

1. Transducer continuity check.
2. Transducer isolation check.
3. Electronic circuit board check.

1. The transducer continuity check is performed as follows (see Figure 6-A):

   A. Disconnect the transducer cable from the transmitter.
   B. Make resistance measurements between the cable pairs as shown in Figure 6-A. The readings should be as indicated; if not, consult factory for repair.

2. The transducer isolation check is performed as follows (see Figure 6-B):

   A. Disconnect the transducer cable from the transmitter.
   B. Make the circuit connections illustrated in Figure 6-B.
   C. Probe all the conductors and note the voltage with respect to the instrument flow tube or probe shaft. All readings should be less than 0.5 Vdc.

3. The sensor input to flow output of the electrical circuit is checked as follows (see Figure 6-C):

   A. Construct the dummy transducer as illustrated in Figure 6-C. Select R2* and R3* for approximate 'TEMP' value.
   B. Turn off power to the unit.
   C. Disconnect the transducer cable from the instrument.
   D. Connect the dummy transducer to the instrument input.
   E. Restore power.
   F. Set both the top and bottom display lines to the 'TIME' field and simultaneously press the *TOP LINE SCROLL* and *BOTTOM LINE SCROLL* buttons. '*TEMP*' and '*ΔT*' fields should appear on the top and bottom display lines.
   G. Adjust R1* (fine) for 'ΔT' value.
   H. Compare the measured flow rate and the indicated flow rate to original calibration data SECTION 6. Recheck 'TEMP' and 'ΔT'.

*resistors of transducer simulator

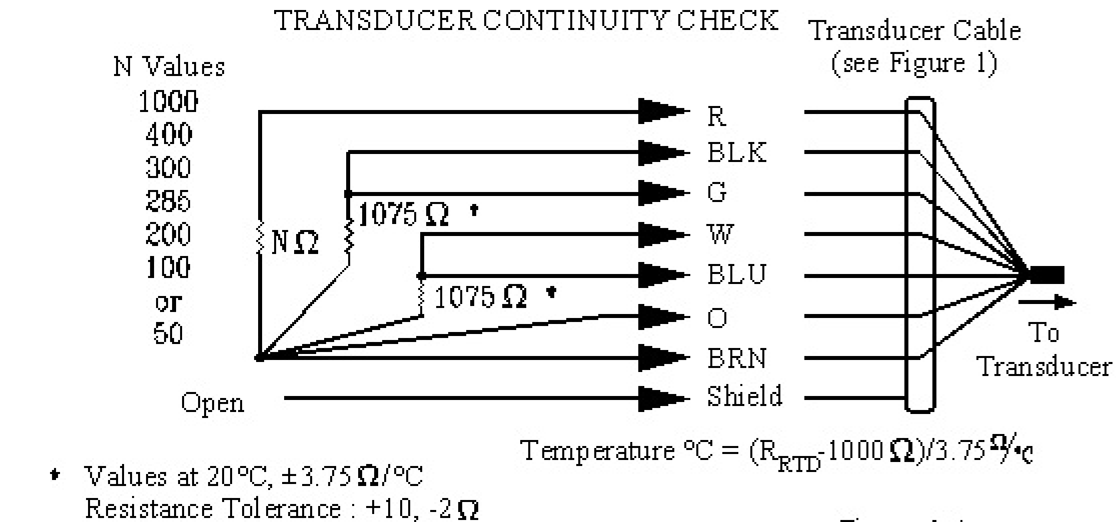


Figure 6-A

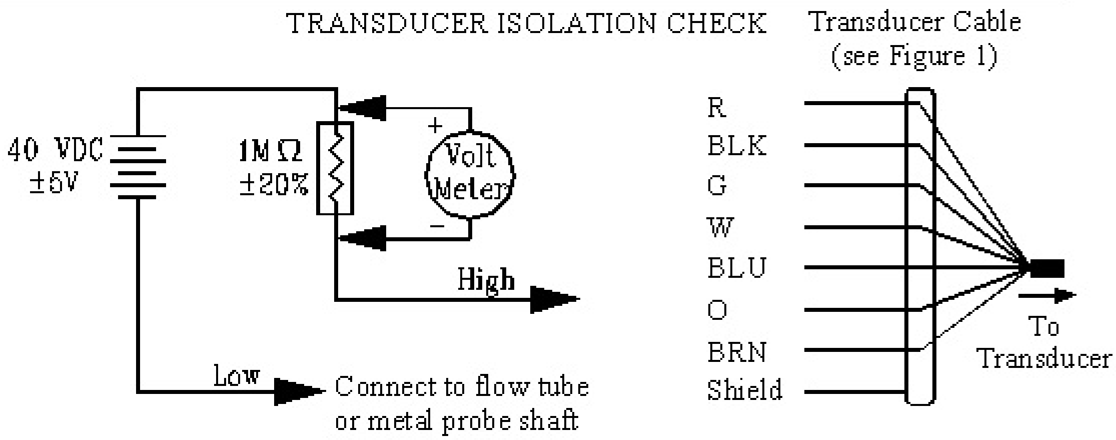


Figure 6-B

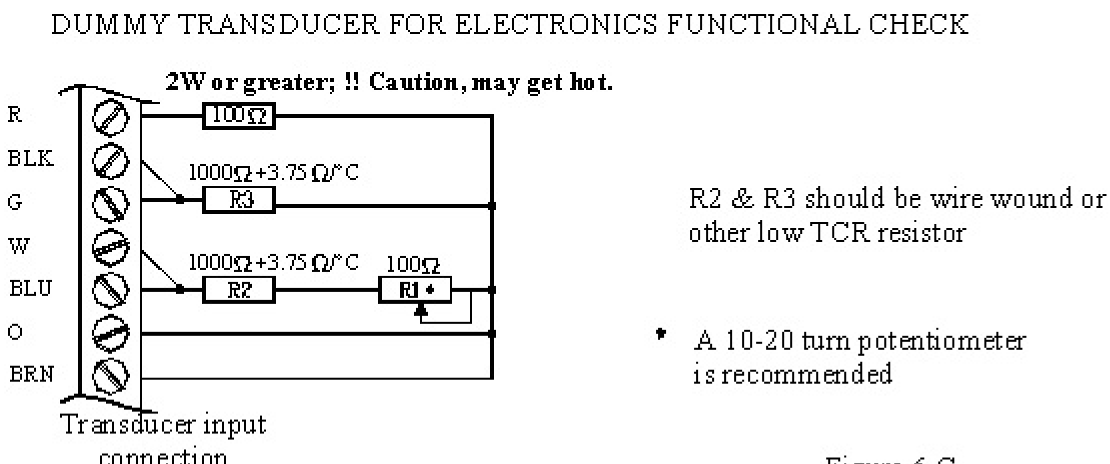


Figure 6-C

(Dwg# 98021-1)

Figure 6 - Transducer / Electronics Test Configuration

4.5 TROUBLE SHOOTING

The following tables provide easy-to-follow instructions to trouble shoot flow indication problems and interpret instrument fault codes. The last table asks for data required by the factory in order to assist you. Be sure to use a high input impedance digital voltmeter for the readings identified in Table IV. All readings are to be taken from terminals BRN through R on JP2 (Figure 2). Complete Table IV and fax it to the factory, (614) 895-0319.

TABLE II. Trouble Shooting Guide - Flow indication problems

OBSERVATION	PROBABLE CAUSE	REMEDY
Flow indication continually drifting downward with constant flow.	1. Coating forming on wetted surface of transducer.	1. Clean transducer periodically or adjust calibration (Section 3.4.3) until layer build-up stabilizes.
Flow indication saturates high or low — will not respond to flow change.	1. Flow rate not within range of meter. 2. Calibration out of range of actual flow. 3. Partially failed component in transducer or transmitter.	1. Check flow range requirements. 2. Refer to SECTION 3.4.3 for Flow Calibration Adjustment. 3. Perform transducer and transmitter functional test (see SECTION 4.4). Write results down and consult factory. 4. Replace fuse as needed.
Flow indication varies with flow but not stable.	1. Fluid temperature not stable. 2. Fluid mixture not properly blended. 3. Gas mixed with liquid. 4. Flow not fully developed.	1. Tune temperature controller, add insulation and/or add static mixer in front of transducer. Monitor temperature indication. Refer to Installation Section for discussion on thermal stabilizing flow system. 2. Add static mixer in front of transducer. 3. Reduce gas pressure or check for air ingress on suction side of pump. Refer to Installation Section. 4. Check inlet and outlet for proper straight line length & freedom from obstructions.

TABLE III. Trouble Shooting Guide - Instrument diagnosed problems

OBSERVATION	PROBABLE CAUSE	ACTION
'GENERAL FAULT' 'MODE 0'	1. Cable cut or not connected at all	1. Check cable for contact and continuity
'GENERAL FAULT' 'MODE 1'	1. Improper cable hookup 2. Failed A/D circuit. Short between sensor terminals O and BLU of JP2. 3. Damaged flow sensor	1. Verify cable hookup is correct 2. Check cable connections for proper contacts or moisture & corrosion 3. * Contact factory
'GENERAL FAULT' 'MODE 2'	1. Cable contact corroded 2. Damaged flow sensor	1. Check both ends of cable for moisture or corrosion 2. * Contact factory
'GENERAL FAULT' 'MODE 3'	1. Shorted cable connection 2. Damaged flow sensor	1. Check for short in cable due to moisture or corrosion 2. * Contact factory
'GENERAL FAULT' 'MODE 4'	1. Blown heater fuse at F1 2. Damaged flow sensor	1. Check wiring and replace fuse 2. * Contact factory
'GENERAL FAULT' 'MODE 5'	1. Sensor's heater connection is open between terminal O and R of JP2 2. Damaged flow sensor	1. Check sensor heater for an open connection 2. * Contact factory
'GENERAL FAULT' 'MODE 6'	1. Temperature is above the specified maximum (see instrument tag) 2. Possible sensor damage	1. Record temperature and remove sensor from flow stream 2. * Contact factory
Oscillating status output and/or flashing display.	1. Software malfunction or corrupt calibration parameters. 2. Failed electronic component.	1. Contact factory regarding restoring factory calibration parameters. 2. * Contact factory

* Complete Table IV before contacting factory.

Record voltages in Table IV (last column) before contacting the factory. Be sure to use a high input impedance digital voltmeter for the readings identified in Table IV. All readings are to be taken from terminals BRN through R on JP2 (Figure 2) with power on and a typical flow rate flowing through the sensor. Complete Table IV and fax it to the factory (614-895-0319).

TABLE IV. Field Check Readings

JP4WIRE LABEL†		TRANSDUCER CABLE / WIRE SIGNAL DEFINITION	EXPECTED VOLTAGE [Vdc]	RECORDED VOLTAGE [Vdc]
+	−			
O	BRN	Flow sensor common voltage sense	Range: −5 to −50mV	
BLU	BRN	Flow sensor heated RTD voltage sense	Range: .2 to .4V	
W	BRN	Flow sensor heated RTD current source	Range: .2 to .4V	
G	BRN	Flow sensor reference RTD voltage sense	Range: .2 to .4V	
BLK	BRN	Flow sensor reference RTD current source	Range: .2 to .4V	
R	BRN	Flow sensor heater	<10V	

† Connect + lead of volt meter to + column; Connect − lead of volt meter to − column.

SECTION 5 – CUSTOMER SERVICE

Intek's corporate philosophy is to solve our customer's difficult flow measurement problems. This means that each instrument is custom configured and calibrated for the application. When you purchase a Rheotherm instrument you also receive Intek's outstanding customer service. For sales or product service, call your local representative or Intek directly at (614) 895-0301, 8AM to 5PM EST/EDT weekdays or fax us anytime at (614) 895-0319. E-mail inquiries should be sent to *sales@Intekflow.com* or *techsupport@Intekflow.com*. Our customer service staff will provide assistance promptly.

5.1 QUESTION ON EXISTING HARDWARE

To allow us to help you more quickly, please have the serial number of the equipment available before you call. If your company is not the original purchaser the identity of the original recipient will also be helpful.

5.2 TROUBLE SHOOTING

If you have reviewed SECTION 4.4 TROUBLE SHOOTING and have questions, please call our experienced engineers for assistance. In many cases we can solve a problem over the phone. Please provide as complete a description as possible of the problems encountered.

5.3 FACTORY AND FIELD SERVICE

If you request field service, Intek has experienced engineers available to meet your needs. Many of the repairs or recalibrations will require returning the instrument to the factory. If a problem cannot be solved over the phone, with your help, we will determine if factory service or field service will be the best solution.

To request factory service, a Return Material Authorization (RMA) and purchase order is required. Our customer service staff will assist you with the required information to return instruments for service.

5.4 DECONTAMINATION OF EQUIPMENT

For the safety of your personnel and ours, any hardware that has been in contact with potentially hazardous liquids or gases must be properly decontaminated before shipment to Intek.

5.5 QUESTIONS ON NEW EQUIPMENT

For a new Rheotherm application or any liquid or gas flow measurement need, contact your local Rheotherm representative or the Intek technical sales department at the above phone/fax numbers. Our staff will be pleased to answer all questions and provide quotations.

SECTION 6 – CUSTOM INFORMATION

6.1 UNIT IDENTIFICATION

Model no.: ____

Serial no.: ____

Customer identification: ____________________________

6.2 CONFIGURATION

The configuration of this unit, as originally shipped from the factory:

Input Power:
☐ 115 Vac, 50/60 Hz ☐ 230 Vac, 50/60 Hz ☐ Other _____________

Outputs: Display: 2 x 20 alphanumeric LCD Line Connection:

6.3 SPECIAL INSTRUCTIONS

	Reference		Reference
☐ None	____________	☐ Installation	____________
☐ Calibration adjustment required for start up	3.4.3	☐ Other	____________

TABLE OF ORIGINAL CALIBRATION DATA
FOR FUNCTIONAL TEST

Unit Serial Number - __________

I	II	III	IV	V
TEMP	ΔT	Flow Output _________	Instrument Display _________	Flow Rate ________

Note: An offset of data in column III (with respect to Column II) may appear if the instrument has been field adjusted.

OUTPUT DEFINITION TABLE

S/N:		CALIBRATION:	
Output Name	Output Range	Process Variable (PV)	PV Range
FLOW			
TEMP			
PULSE			
OUT1	*		
OUT2	*		
STATUS	*		

* The normal state is 15Vdc as 0Vdc indicates alarm when power is removed.