DRT
Digital Rate
Totalizer

May 1993

LED
Instruction Manual

Micro Motion

FISHER-ROSEMOUNT™ Managing The Process Better.™

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Addendum

Change of Relay Rating and Operation with the DRT, FMS-3, and DMS

Relay Ratings: The output relays for the Micro Motion DRT, FMS-3, and DMS peripheral devices have been changed. Contact ratings for these new relays are 0.2 amps maximum at a maximum of 28 volts AC (RMS) or DC.

WARNING: Do not exceed these relay ratings!

New Designation: DRT, FMS-3, and DMS units with the new relays are designated as being "Series B." Series B units can be identified by the "B" prefix in the unit's serial number.

Relay Operation and Wiring

The DRT, FMS-3, and DMS contain two relays for controlling external equipment. They are both single-pole, double-throw, break-before-make, Form C relays. The relay terminals are part of the 20-pin connector block on the back of the DRT, FMS-3, and DMS. Terminal numbers 15 (N.O.), 16 (common), and 17 (N.C.) are for the primary relay; terminal numbers 18 (N.O.), 19 (common), and 20 (N.C.) are for the secondary relay.

Relay operation and wiring will depend on the load the relays are to control. Some examples are discussed in this addendum. Examples of methods for using the relays for control and/or signaling are discussed in the respective DRT, FMS-3, or DMS instruction manuals.

For loads within the 28 volt maximum relay ratings: The loads may be switched directly by the device relays. Wire the load to the DRT, FMS-3, or DMS terminal strip. Terminal numbers 15 (N.O.), 16 (common), and 17 (N.C.) are for the primary relay; terminal numbers 18 (N.O.), 19 (common), and 20 (N.C.) are for the secondary relay.

For loads exceeding the 28 volt maximum relay ratings: The DRT, FMS-3, or DMS relays **must not** be used to directly control the load if the load exceeds the maximum ratings of these relays. Where the load requirements exceed these maximum ratings, an external user-supplied intermediate relay and power source, rated for the load, must be used.

Users may use their own power source and relays or purchase modules produced for this purpose.

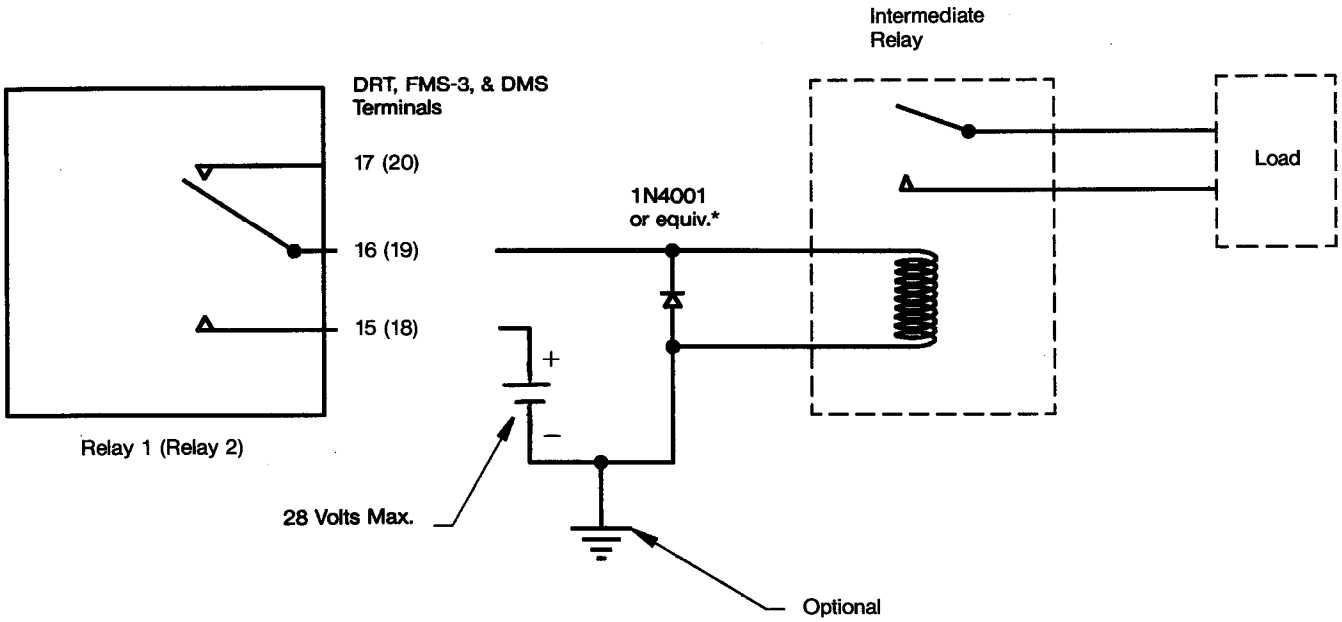
External intermediate relay with external power supply: A typical application using an intermediate relay is shown in Figures 1 and 2. The ground connection is optional.

For DC operation, the diode is used to absorb energy produced by the intermediate relay when the DRT, FMS-3, or DMS relay is opened. **Important:** Be sure to observe the polarity of the diode and power source. The intermediate relay's coil requirements **must not** exceed the maximum DRT, FMS-3, or DMS relay ratings.

For AC operation, use an RC network to protect the relay contacts. (Suggested values: R = 47 ohms, C = 0.1 μF.)

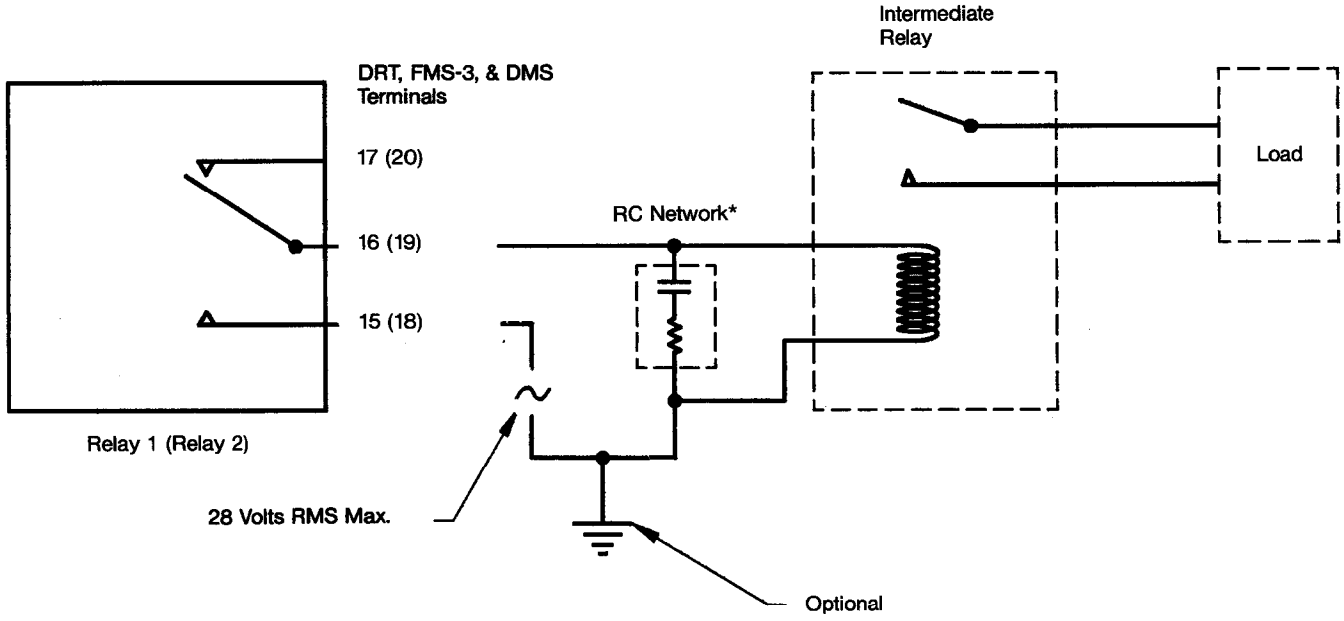
CAUTION: For inductive loads, including electromechanical relays, the following information should be noted. When inductive loads are connected to the intermediate relays, the relay contacts should be protected. See Figures 1 and 2 for examples.

Figure 1
Relay Wiring;
DC External Power Supply



* Recommended for inductive loads and electromechanical relays

Figure 2
Relay Wiring;
AC External Power Supply



* Recommended for inductive loads and electromechanical relays

P/N 1003203, Rev. C
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1 DRT Digital Rate Totalizer

1.1 General

The Micro Motion® DRT Digital Rate Totalizer displays the current, peak and valley levels of the 4½-digit filtered rate. The unit also features two 8-digit totalizers, one of which may be locked from reset. The unit operates in conjunction with the frequency output from any Micro Motion Mass Flowmeter.

Highly readable 0.56" LEDs are used for all displays. The 4½-digit rate display has a variable decimal point. The rate time constant filter may be programmed for one of six choices. The rate may be scaled for units of measure per second, minute, or hour. Two programmable alarms are provided for rate monitoring (either relay may be set to detect high or low limits). The unit is currently available with one of two operating programs. With the totalizer inhibit program, totalizer counts may be inhibited without interrupting the rate display. With the forward/reverse program, the unit displays both forward and reverse flow.

Peak rate, valley rate and total information, as well as all the programmed constants, are retained in the unit's memory, even if power to the unit is interrupted.

The entire unit fits into a DIN standard 138 by 138 mm (5.45 by 5.45 inches) panel cutout. The surface withstands high pressure washdowns. The unit may be operated and programmed through the membrane keyboard or computer interface.

The computer interface is optional. Communications are via standard RS-232-C interface at one of seven user selectable baud rates. Rate and total status may be sent to the computer VDT or printer.

Table 1 Technical Specifications

Power requirements	115 VAC ± 25%, 48 to 62 Hz, .2 amp 230 VAC ± 25%, 48 to 62 Hz, .1 amp 12 to 30 VDC, 1 amp
Frequency input requirements	0 to 20 kHz
High	4.0 to 15.0 volts
Low	0.0 to 1.0 volts
Input impedance	1 kohm
Rate display accuracy	± 0.1%
Rate filter	6 choices, selectable from 0.25 seconds minimum to 10 seconds maximum
Outputs	
Alarm 1 control relay	0.2 amp resistive max., up to 28 VAC/VDC, Form C
Alarm 2 control relay	0.2 amp resistive max., up to 28 VAC/VDC, Form C
Operating temperature	32° to 130° F (0° to 55° C)
Storage termperature	-40° to 130° F (-40° to 55° C)
Enclosure	DIN-standard panel mount
Dimensions	5 27/64" W by 5 27/64" L by 6 1/2" D (138 mm W by 138 mm L by 164 mm D)
Optional output ports	RS-232-C serial I/O with 7 programmable baud rates from 150 bps to 9600 bps
Optional enclosures	NEMA IV waterproof. NEMA IV explosion-proof, FM approved for Class I, Div. 1, Groups C and D, and Class II, Div. 1, Groups E and G (IP65)
Displays	7-segment LED
Hazardous areas	FM and CSA approved for Class I, Div. 2, Groups A, B, C, and D

1.2 Unit Identification

The DRT identification tag is located on the back of the unit. The tag consists of the following information:

Serial number
Model number
Power input
Fuse AGC Amp rating

These items are self-explanatory, except for the model number. The model number identifies which features a specific unit has and may be deciphered using Table 2.

The typical model number shown in Table 2 identifies the unit as a standard totalizer. It is set for 115 VAC (this is field adjustable), and has an LED display. It does not have an RS-232-C serial board and the terminal strip is enclosed in a junction box for standard panel mount installation. The unit has the totalizer inhibit firmware (operating program).

Figure 1
DRT Display Face

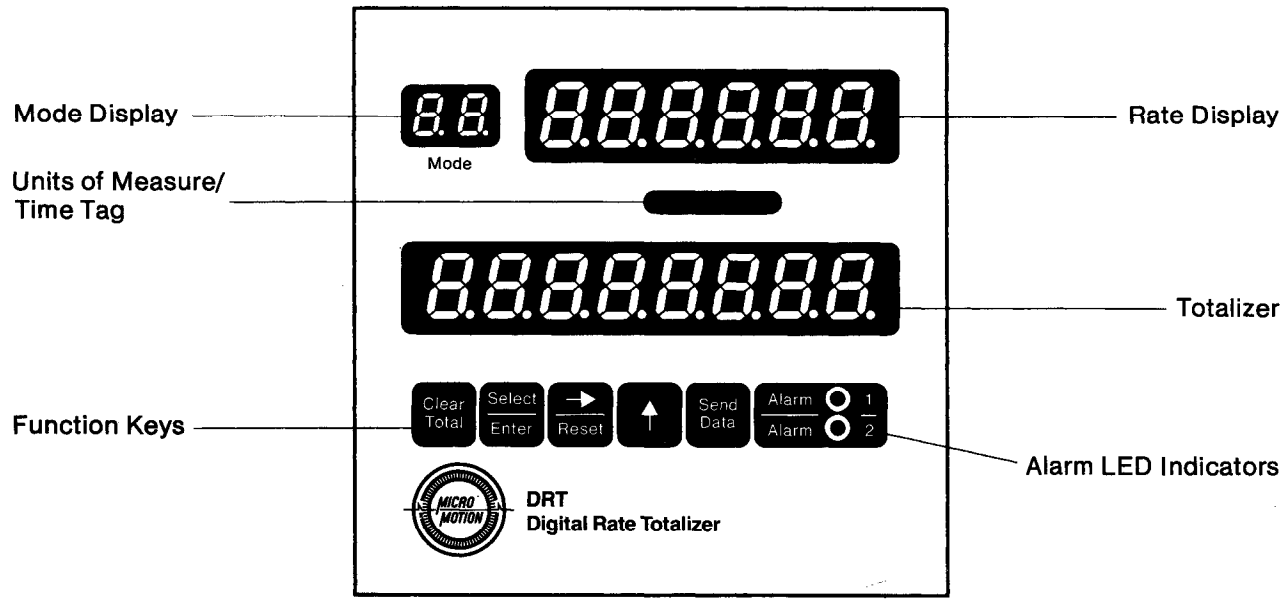


Table 2
Model Number

Model Code	Power Code	RS-232 I/O Code	Jct. Box Code	Display Code	Description
DRT					Digital Rate Totalizer
	1 2 3				110/115 VAC 230 VAC VDC
		RS NA			With RS-232 I/O Without RS-232 I/O
			0 1		Without junction box (when ordered with enclosure, or CSA)* With junction box*
				C E	LCD LED
DRT	1	RS	0	C	

(Typical Number)

Software options - specify ONE to complete model number

If an LCD, specify the following:

A	Totalizer Inhibit (0222302)
B	Forward/Reverse (0222303)

If an LED, specify the following:

A	Totalizer Inhibit (0213735)
B	Forward/Reverse (0213736)
C	Prog DRT, per day rate (0213745)

NOTE: With the Series B power board, the DRT is approved by FM and CSA for Class I, Div. 2, Groups A, B, C, and D locations. CSA approval is valid only if the DRT is ordered without the optional junction box (option "0" under Jct. box code).

1.3 Operational Features

This section provides a brief description of the displays, standard operating modes, and the primary functions (membrane keyboard or pushbutton switches).

Displays.

Mode display. The **Mode** display consists of two seven-segment LEDs, which indicate the unit's operating mode. Six different modes may be displayed during normal operating conditions. (During normal operation the program constants are locked by attaching a jumper to short terminal 8 to terminal 10 on the rear terminal block.)

Rate display. The 6-digit display indicates the flow rate, peak rate, valley rate, alarm limit or one of the programmed constants.

Totalizer display. The 8-digit display indicates either the resettable total or the inventory total depending upon the mode selected.

Alarm LEDs. The two LED indicator lights are located by the function keys. Labeled Alarm 1 and 2, they indicate alarm conditions and the state of the alarm relays.

Operating Modes.

Rate/Total. In the rate/total mode r.t. displays in the mode window, the filtered rate displays in the 6-digit window and the resettable total displays in the 8-digit window.

Rate/Inventory. In the rate/inventory mode r.I. displays in the mode window, the filtered rate displays in the 6-digit window and the inventory total displays in the 8-digit window. The operator may only reset the inventory totalizer, while in this mode, with the program unlocked.

Peak Rate. In the peak rate mode the unit displays Hi in the mode window, the peak rate in the 6-digit window and the total in the 8-digit window. The peak rate detector may be reset to the current rate in this mode.

Valley rate. In the valley rate mode the unit displays Lo in the mode window, the valley rate in the 6-digit window and the total in the 8-digit window. The valley rate detector may be reset to the current rate in this mode.

Alarm 1. In the alarm 1 mode the unit displays A1 in the mode window, the alarm limit and H or L in the 6-digit window and the total in the 8-digit window. The alarm may be programmed to activate when the rate drops below a preset absolute value (L) or exceeds a preset absolute value (H), but not both. The operator may program the alarm while in this mode.

Alarm 2. In the alarm 2 mode the unit displays A2 in the mode window, the alarm limit and H or L in the 6-digit window and the total in the 8-digit window. The alarm may be programmed to activate when the rate drops below a preset absolute value (L) or exceeds a preset absolute value (H), but not both. The operator may program the alarm while in this mode.

Primary Functions.

Clear Total. The clear total key is used to clear the resettable totalizer. The totalizer may be cleared while the unit is in any operating mode. Depressing this key holds the totalizer at the current value. Releasing it resets the totalizer to zero.

Select/Enter. The select/enter key (or switch) is dual function. The select function allows the operator to select the various operating modes. The enter function is used when resetting the operating parameters (e.g. scale factor, units). Once the new operating parameters are established the enter function enters the new parameters and completes the reset function.

→/Reset. The →/reset key (or switch) is also dual function. Both functions are used when the operator is performing a reset procedure. First, the operator uses the key to enact a reset procedure. Then, the operator uses the key to move to the number position which must be reset.

↑, Increment. The ↑ increment function allows the operator to increment the value of the parameter being reset.

Send Data. The send data key is used to output the ASCII message. It is used only with the optional RS-232-C interface.

Other Features.

The function of rear terminal 6 depends on the operating program selected. With the totalizer inhibit program, closing this circuit to ground inhibits both totalizers. This terminal is converted to a forward/reverse flow input with the forward/reverse program. Rates are displayed as negative (−) in reverse flow and the totalizers decrement.

1.4 Programming Features

In addition to the preceding features, the rate monitor has operating modes which are used when programming the unit. These items are only accessible when the program is unlocked (terminal 8 to 10 not connected).

Note: Some of the programming modes are used to set constants, such as the scale factor. During reset procedures the totalizers do not increment; the rate should be zero to prevent data loss. As a reminder, the 8-digit window displays the message 'In rESEt'.

Programming Modes.

Time Constant. In the time constant mode the 2-digit window displays t.c., the 6-digit window displays the actual time constant and the 8-digit window displays the total. The time constant value may be .25, .5, 1.0, 2.5, 5.0, or 10 seconds.

Decimal Point. In the decimal point mode the 2-digit window displays dP, the 6-digit window displays the decimal point location and the 8-digit window displays the total. The operator may change the decimal point location in this mode.

Scale Factor. In the scale factor mode the 2-digit window displays SF, the 6-digit window displays the scale factor and the 8-digit window displays the total. The scale factor is the number by which the incoming pulse train is divided to scale the totalizers. Since the Micro Motion mass flow meter has no meter factor requirements, a limited menu provides choices of second, minute, and hour time base compensation. The time bases may be multiplied by 1, 10 or 100.

Identification number. In the identification mode the 2-digit window displays Id, the 6-digit window displays the unit identification number, and the 8-digit window displays the total. This mode is only used with the optional computer interface.

Units of measure. In the units mode the 2-digit window displays Un, 6-digit window displays the units of measure code and the 8-digit window displays the total. This mode is only used with the optional computer interface.

Baud rate. In the baud rate mode the 2-digit window displays bd, 6-digit window displays one of seven baud rates and the 8-digit window displays the total. This mode is only used with the optional computer interface.

Reprogram. In the reprogram mode the 2-digit window displays rP, 6-digit window displays the rate and the 8-digit window displays the total. When the reset procedure is activated the 8-digit window displays reProG, followed by the LED test and the rate/total mode. This mode is used to reprogram the nonvolatile memory.

2 Installation

2.1 Location

The unit should be located as far as possible from switching gear, such as noisy solenoids and relays. Install the unit in the "safe" area for use near hazardous locations.

Caution: The DRT is not intrinsically safe.

2.2 Mounting

The unit may be panel mounted through a 5.45 by 5.45 inch (138 by 138 mm) cutout. A minimum clearance of 1¼" on either side of the unit back is required for attaching the mounting clips. A gasket on the back of the unit provides a waterproof seal between the unit and the panel opening.

Figure 2 shows the mounting dimensions and the required thickness for the panel cutout.

Follow these steps to mount the unit:

1. Insert the unit through the panel cutout.
2. The factory sends four preassembled mounting clips, which are labeled items 9 and 20 in Figure 3. Four prongs on each clip must be inserted into the unit case.
   a) Hold the clip assembly with the screw perpendicular to the side of the unit.
   b) Insert the angled prongs into the holes closest to the front panel of the unit (shown in Figure 3).
   c) To engage the straight protusions in the back holes and lock the clips in place, move the screw-head end of the clip toward the back of the unit.
3. Tighten all four screws to ensure a watertight seal.

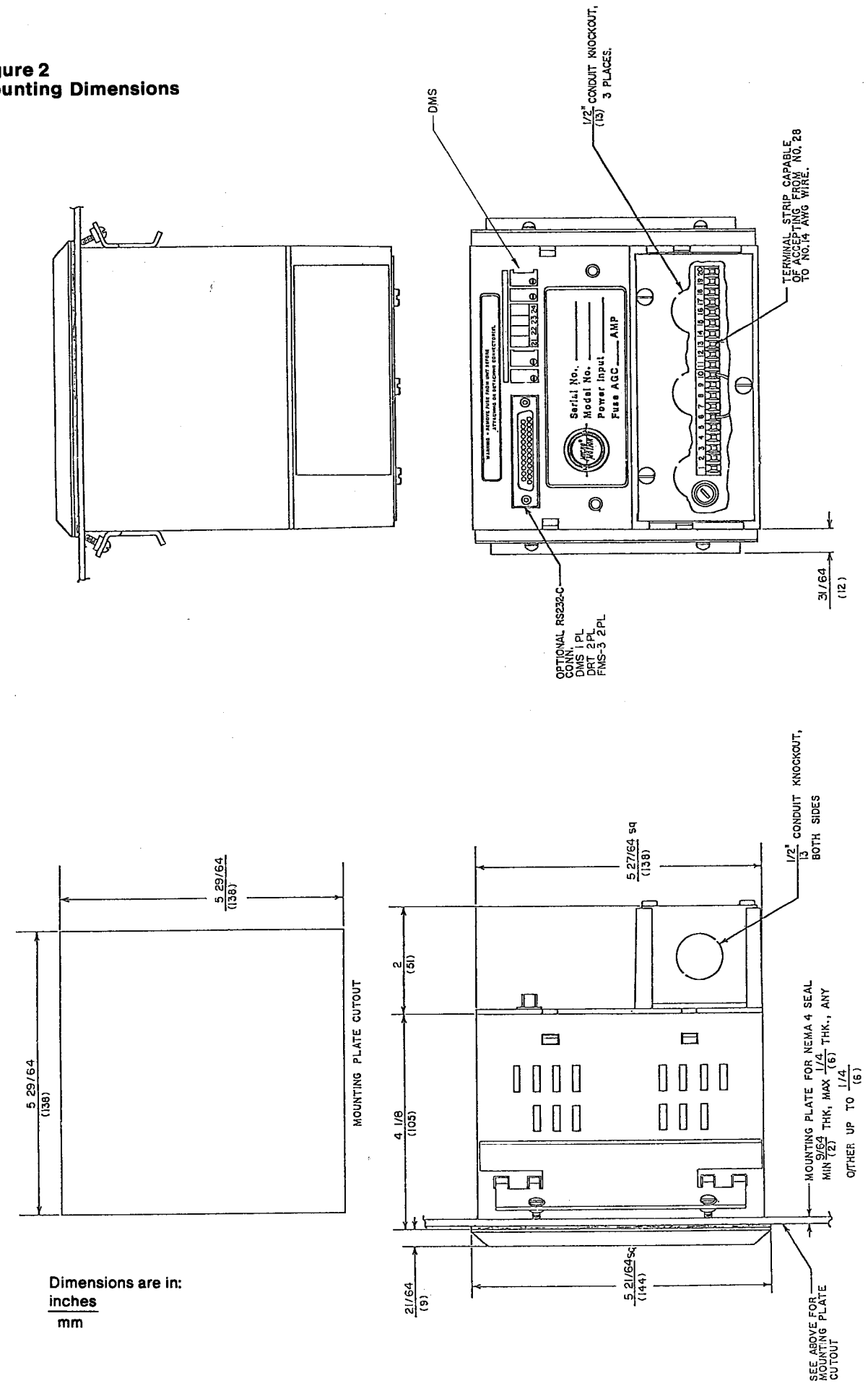
2.3 Wiring

The terminal block on the back of the unit must be unplugged for field wiring of the unit and ease of maintenance. Figure 2 shows the location of the terminal strip. The terminal designations are listed below.

Table 3 Terminal Designations

Terminal	Designation
1	Clear Total
2	Select/Enter
3	→/Reset
4	↑
5	Send Data
6	Totalizer Inhibit or Forward/Reverse
7	Switch Common
8	Program Lock
9	Frequency Input
10	Signal and Power Ground
11	12-30 VDC In
12	AC Line
13	AC Neutral
14	AC Ground
15	Alarm 1 N.O.
16	Alarm 1 Common
17	Alarm 1 N.C.
18	Alarm 2 N.O.
19	Alarm 2 Common
20	Alarm 2 N.C.

Figure 2
Mounting Dimensions



Dimensions are in:
inches
mm

Locate the unit as close to the transmitter as possible. The signal wiring to the unit should be compatible with the frequency output wiring requirements of the flowmeter (less than 10 ohms resistance per output loop). Wiring connections to the terminal strip on the back of the unit may be accomplished with No. 28 to No. 14 AWG wire. Cable length between components (meter electronics to DRT or DRT to remote switches) should not exceed 500 feet (152 meters). Two 1/2" (12.7 mm) conduit knockouts are provided on the terminal cover. Figure 4a shows a typical wiring diagram for a DRT with the totalizer inhibit program. Figure 4b shows a typical wiring diagram for a DRT with the forward/reverse program.

2.3.1 Power Wiring

If DC power is used, power connections to the unit are made at terminals 10 and 11. Terminal 11 is the 12-30 VDC input and terminal 10 is the ground return. If AC power is used, it should be applied to terminals 12, 13, and 14. Terminal 12 is the AC line, 13 is AC neutral, and 14 is AC ground.

CAUTION: IF A BATTERY BACKUP IS USED, IT MUST BE LESS THAN 18 VDC. IT WILL NOT BE CHARGED BY THE DRT.

2.3.2 Signal Wiring

The input frequency signal from the mass flowmeter (usually flowmeter output terminal 19) is connected to terminal 9. The signal ground (usually flowmeter output terminal 18) is connected to terminal 10.

2.3.3 Remote Switches

Function Keys. The function keys may be remoted using terminal connections 1 through 5 and 7. Normally open momentary switches are required. The Clear Total function key (terminal 1) may be closed to a common ground with other DRTs, if a simultaneous reset is desired.

Program Lock. When terminals 8 and 10 are jumpered together (program locked), only the six primary operating modes may be displayed. The reprogramming modes may not be accessed with the program locked. Also, the inventory totalizer may not be cleared. It may be desirable to locate a toggle or key lock switch on the panel for the program lock. Micro Motion, Inc. recommends Alco SWK-12 or C&K Y101-1U-0-C1-03-N-QA key lock switches.

Note: Micro Motion, Inc. strongly recommends operating the DRT with the program locked to prevent accidental alteration of the operating parameters stored in the unit's nonvolatile memory.

Totalizer Inhibit. When a switch or relay is placed between terminal 6 and ground (terminal 10) the totalizer may be inhibited without interrupting the rate display. The totalizer is enabled when there is no switch connection or an open switch, (e.g., when the flow is diverted from a recirculating loop to the process). When the switch is closed, the totalizer is inhibited. The switch may be operated manually, or in conjunction with the valve or relay which diverts fluid to the process.

Note: The unit may be equipped with either a totalizer inhibit program or a forward/reverse program, not both.

Forward/Reverse. The transmitter must be properly configured and wired to output a bidirectional flow signal. A high signal indicates forward flow; a low signal indicates reverse flow. If the electronics unit is an RFT9712, terminal 26 needs to be connected to terminal 6 on the DRT (see Figure 4b).

Note: When wiring remote switches, use a separate shielded cable. Wire the shield to signal ground (terminal 10).

Figure 3
Exploded View

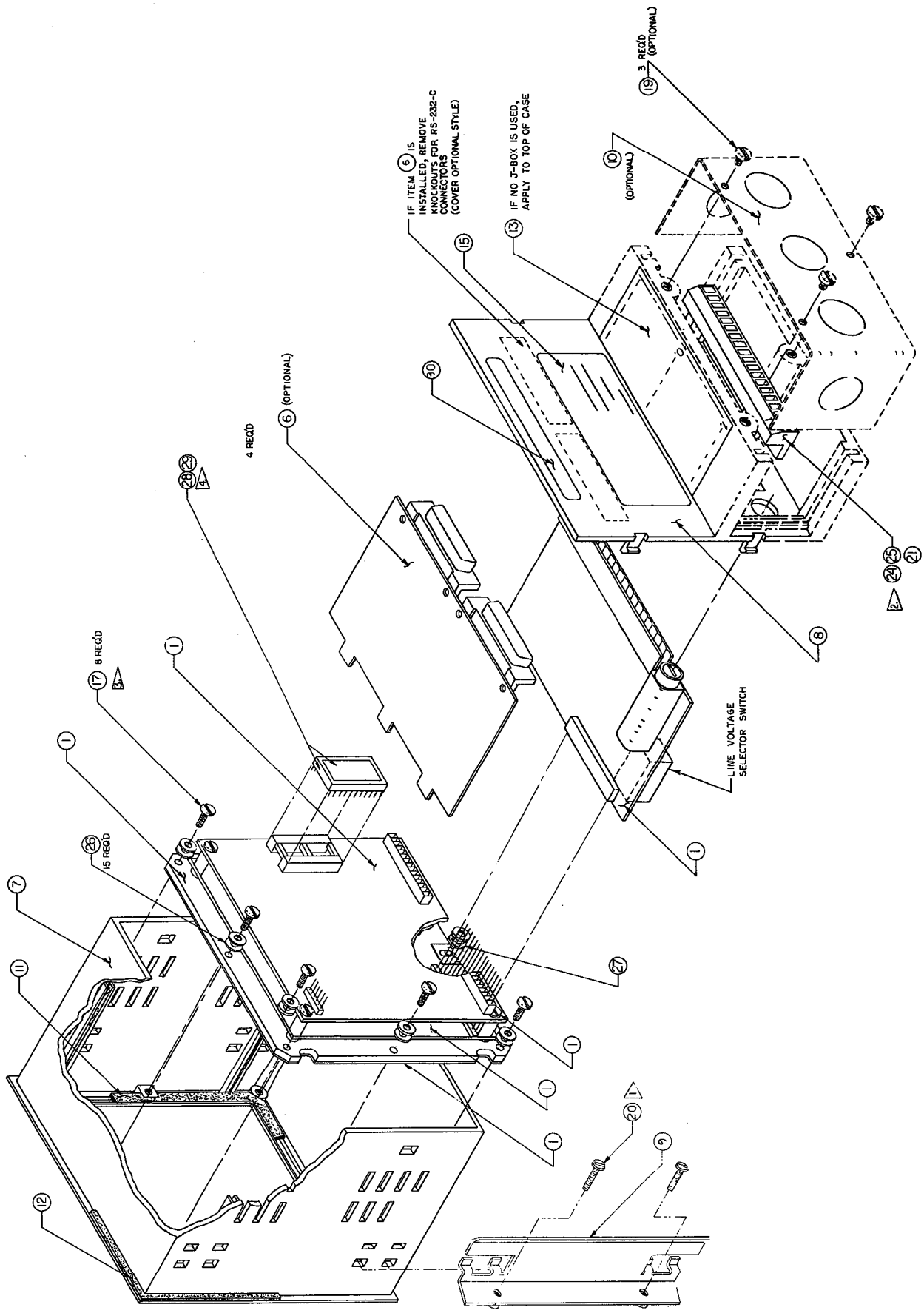


Figure 4a
Typical Wiring Diagram
Totalizer Inhibit Wiring

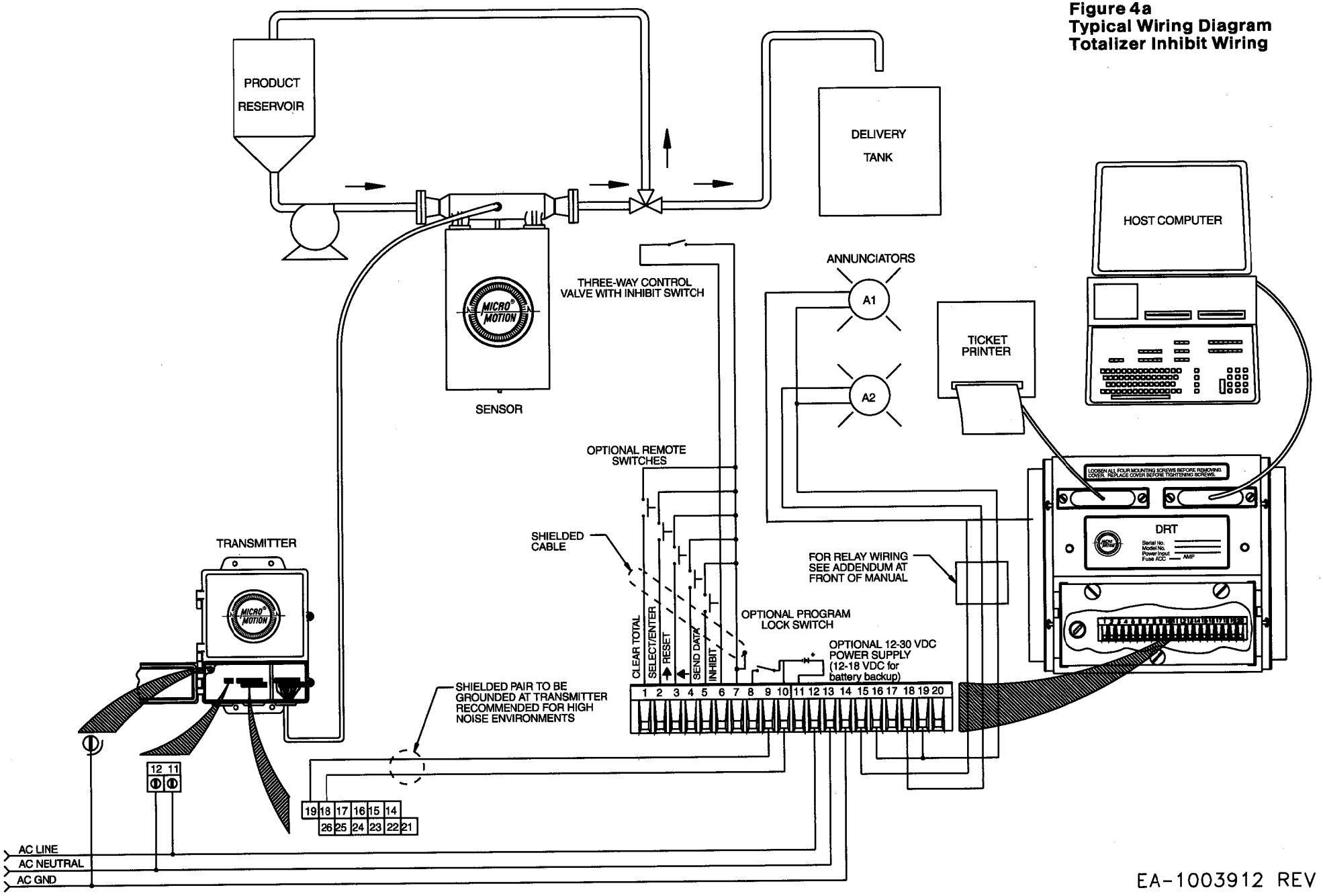


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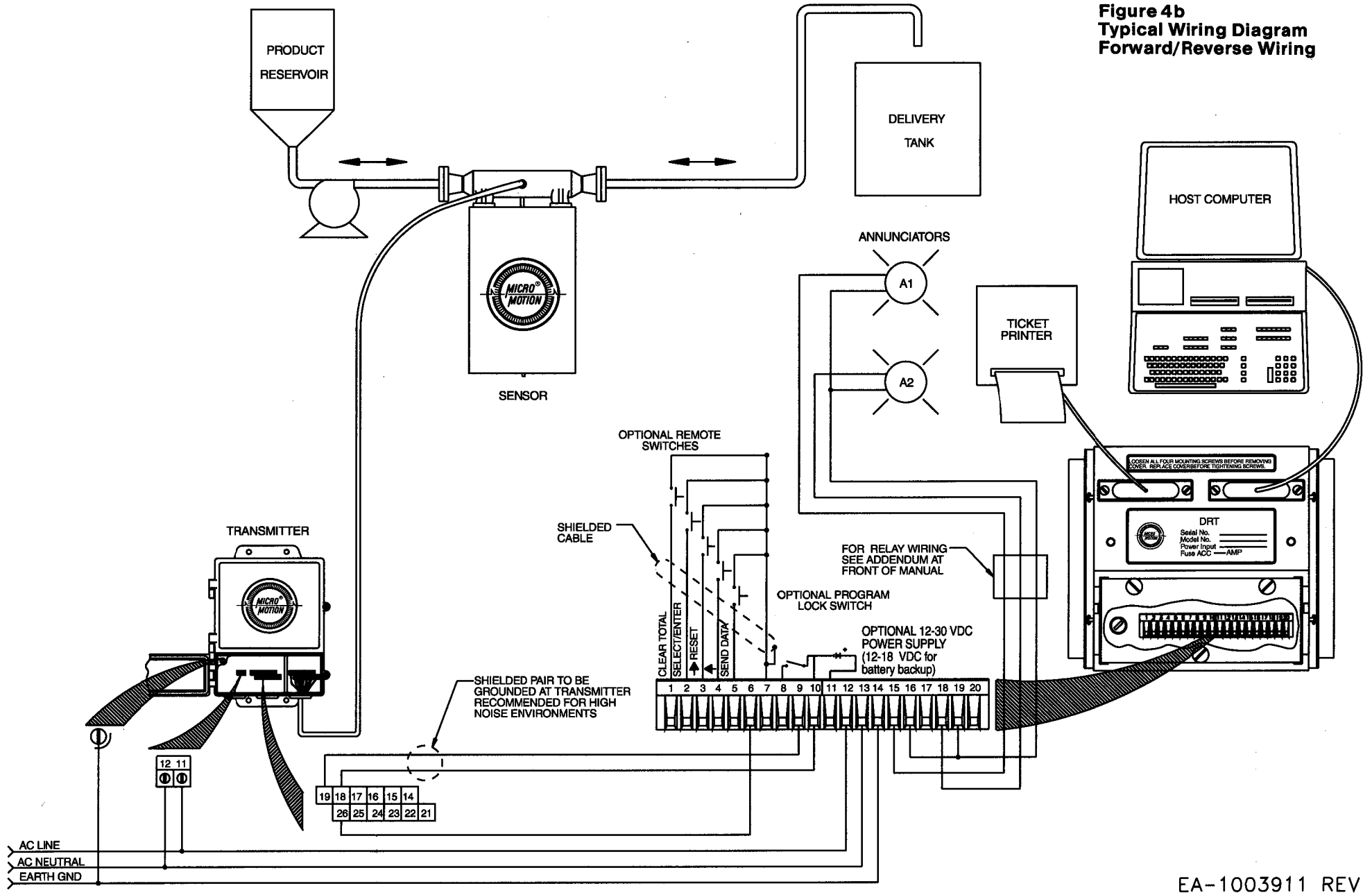
Figure 4b
Typical Wiring Diagram
Forward/Reverse Wiring



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3 Operation and Set Up

3.1 General

The factory calibrates all items on the DRT, except the alarms, if meter calibration is provided at the time the unit is ordered. The operator should be familiar with the displays and functions before attempting to operate the unit. Section 1.3 describes the displays and operating modes as well as providing a brief description of the functions.

3.2 Initial Startup

When the unit first receives power, the LEDs are tested. All segments of all displays light for approximately two seconds. After the LED test the display is momentarily blank, then the following data is displayed:

2-digit display = rt
6-digit display = #####, (filtered rate)
8-digit display = resettable totalizer value

All of the previously recorded data and the programmed information are in the unit's memory and may be recalled using the select/enter key. If any blanks, other than lead zeroes appear when any of the modes are displayed, the non-volatile memory is scrambled and the entire unit must be reprogrammed before operation.

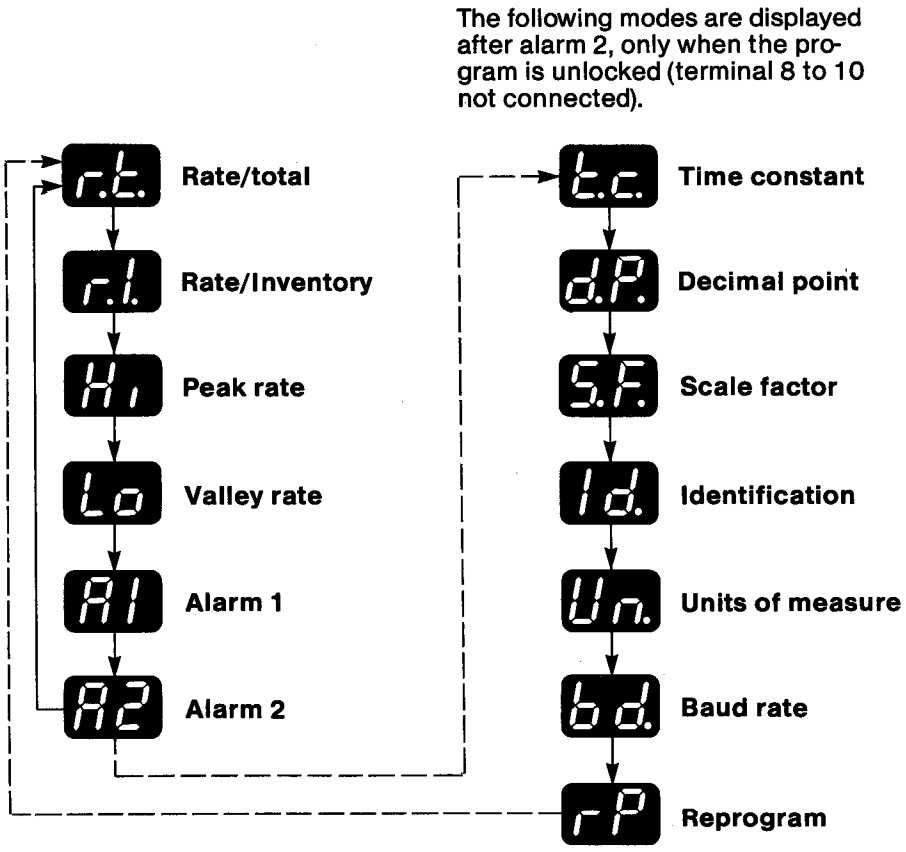
3.3 Operating Functions

The function keys operate the unit. Their purpose was briefly described in Section 1.3, this section covers their use in detail. Since the keys are used in combination, their use is broken down into three subsections:

3.3.1 Mode Selection
3.3.2 Totalizer Clear
3.3.3 Set/Reset Procedure

3.3.1 Mode Selection

Select / Enter The select/enter key allows the operator to choose the mode of operation. The first mode displayed after the LED test is the rate/total mode. When the select/enter key is pressed, the modes change in the sequence shown below:



3.3.2 Totalizer Clear

Clear Total A single function key is used to clear the resettable totalizer in any mode. When the clear total key is pressed, the resettable total count is stopped. When the key is released, the resettable total is zeroed.

3.3.3 Set/Reset Procedure

This section describes the function keys used to perform a reset procedure. The specific steps to follow when resetting the normal operating parameters are outlined in Sections 3.3.3.1 through 3.3.3.3.

Reset Function. Each mode allows a different item to be set or reset. First the mode must be selected. Then, when the reset key is pressed, it will initiate a reset procedure. Either a single digit or the entire 6-digit display will begin to flash. The decimal point will remain lit in the appropriate displays.

If a single digit flashes, each digit of the display can be reset individually. The flashing digit is ready to be reset. When the digit is reset, and the reset key is pressed again, the digit to the right of the one just reset will begin to flash and may be reset. Once the furthest right digit is reset, the furthest left digit will begin to flash.

If the entire display begins to flash, the mode has a limited selection and the whole display may be reset at one time. For example, the unit may accept only one of seven baud rates, therefore only those rates display when resetting the baud rate. The entire number flashes and increments at one time. The following section describes the increment function.

Caution: When reprogramming the constants (time constant, decimal point, scale factor, units of measure, and baud rate), the rate should be zero. Otherwise, data may be lost, since the totalizers do not increment during these reset procedures. In these modes the DRT displays the message 'in rESEt', when the reset key is activated.

Increment Function. The ↑ arrow key is used to increment the value of individual digits or change the display, when performing a reset procedure. If a single digit of the display is flashing and the ↑ arrow key is pressed, the digit value will be incremented by one. If the digit value is 9 and the key is pressed, the digit value returns to 0. If the entire display is flashing, a different value is displayed each time the key is pressed. The values are selected in ascending order, beginning with the set value. When the greatest value is reached, it returns to the lowest selection value.

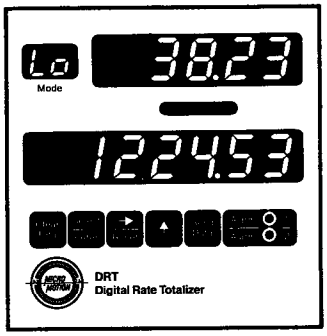
Enter Function. The select/enter key is used to enter the new value. After all digits have been reset and the desired value is displayed, pressing the select/enter key enters the new value and completes the reset procedure.

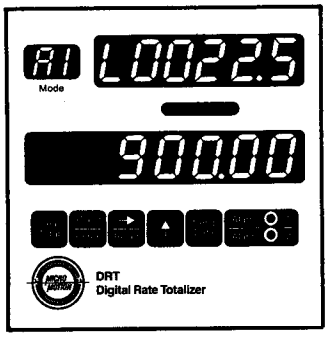
3.3.3.1 Inventory Totalizer Reset

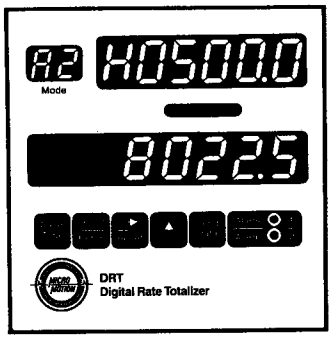
Caution: Once the inventory totalizer is reset, the previous total cannot be recalled. Record the information before resetting the totalizer, if necessary.

Follow these steps to clear the inventory total:

1. The program must be unlocked (terminal 8 to 10 not connected).
2. Select the rate/inventory mode.
3. Activate the →/reset key. This immediately clears the inventory total to zero and a new value cannot be entered. The totalizer reset is complete.







3.3.3.2 Peak and Valley Rate Monitors

The high and low flow rates are detected from the filtered flow rate.

Follow these steps to reset either the peak (high) or valley (low) rate indicator:

1. Select the desired mode, "Lo" or "Hi".

2. Press the →/reset key. This resets the high or low rate, whichever is displayed, to the current flow rate. Logging of new highs or lows begins from this rate.

3.3.3.3 Alarm Indicators

There are two alarm indicators identified as alarm 1 and alarm 2. When the flow rate drops below a user-specified limit or exceeds a user-specified limit, the alarm is triggered. Each alarm may be set either high or low.

Note: The alarms recognize only the absolute value of the rate. The negative sign (−) cannot be entered.

Follow these steps to set the alarms:

1. Select the desired mode, alarm 1 (A1) or alarm 2 (A2).

2. Activate the →/reset key. The leftmost character in the 6-digit display (either an H or an L) will begin to flash.

3. Press the, ↑, increment key to toggle the high/low (H/L) setting of the alarm.

4. Press the →/reset key to enter the high/low setting. The first digit to the right of the high/low indicator will begin to flash. The first digit can only be 0 or 1, since the maximum alarm limit is 19999.

5. Increment the flashing digit, if desired, until the correct number is displayed in the flashing position.

6. Repeat steps 4 and 5 until all digits have been reset.

7. Enter the new alarm setting.

4 Troubleshooting

Troubleshooting will be covered in two main categories: operating problems, and unit or system problems.

4.1 Operating Problems

Operating problems occur when the operator tries to make an entry or perform a function which the unit cannot accept.

Unit not responding to function key. The unit will not respond to certain function keys under some operating conditions. For example, the unit will ignore the increment key, ↑, unless the reset key has been activated.

4.2 Unit/System Problems

Operating program scrambled. A power spike or an electrical storm may cause the nonvolatile memory within the unit to store bad data. If the data stored appears incorrect (LEDs may light in an erratic pattern), the unit must be reprogrammed according to Section 5.2.

Blank digits in displays. If blanks, other than leading zeroes, appear in either display, the operating program is scrambled and must be reprogrammed according to Section 5.2.

Totalizers do not increment. If the totalizers do not increment with flow, check the totalizer inhibit wiring (Section 2.3.3). Also, if the 8-digit window is displaying the 'in rESEt' message, the totalizers will not increment until the reset procedure is completed. If the unit has the forward/reverse program, check the flow meter wiring (Section 2.3.3); the totalizers will not increment with reverse flow, unless the flow meter is correctly wired.

Display does not light. If the display does not light at all, check the power wiring to the unit. Also, check and replace the fuse if necessary.

Note: If the fuse was blown, be sure the input voltage agrees with the voltage stated on the unit. Power connections are provided for either AC or DC operation. The selection switch for 115 or 230 VAC is located on the power board. Figure 3 in Section 2.2 shows the location of the fuse, relays, and voltage selector switch.

4.3 Factory Service

The Micro Motion Customer Service Department can be reached at 1-800-522-MASS (in Alaska and Colorado, call 303-530-8400). This same phone number can be used for 24-hour emergency assistance.

5 Reprogramming

5.1 General

There are two instances when it is necessary to reprogram the unit. First, when the mass flow meter calibration is changed. Second, if the nonvolatile memory should become scrambled.

The mass flow meter is calibrated to output a given frequency at a maximum full scale flow rate. The flow rate is set in units of measure/time. When the DRT receives the frequency input, it must compensate for the second, minute or hour time units, in order to display the totals in the proper units. Also, it must adjust the decimal point location based on the ratio of the frequency to the flow rate. These adjustments are performed by setting the decimal point and scale factor. Therefore, the meter calibration must be compatible with two requirements of the DRT:

1. The relationship between the flow meter frequency output and the full scale flow rate must be a multiple of 1, 10, 100, etc.
2. The full scale frequency output should be greater than 1,000 Hz, if possible.

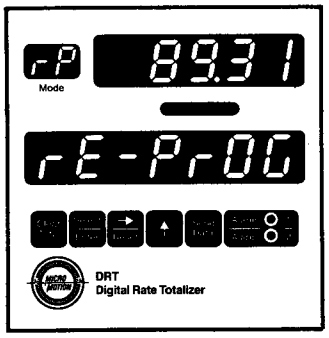
Before attempting to reprogram the DRT, the following information must be known:

Flow meter frequency output
Full scale flow rate
Maximum total desired

5.2 Reprogramming Modes

The reprogramming modes are the reprogram mode, the decimal point mode, the scale factor mode and the time constant mode.

5.2.1 Reprogramming the Nonvolatile Memory



Reprogram Mode. When the program is unlocked, the reprogram mode is used to reprogram the entire nonvolatile memory. This mode is used to clear data stored in the unit's memory prior to resetting the program.

5.2.1.1 Clearing the Memory

Follow these steps to clear the memory

1. Unlock the program. Depending upon the installation, this involves either removing a jumper installed between terminals 8 and 10 of the DRT or switching off a user installed toggle or key lock switch.
2. The flow rate should be zero.
3. Select the reprogram mode (rP).

Select / Enter

4. Activate the reset function key. All totalizer information and previous setup information will be erased and the reprogram message will briefly appear on the totalizer display. Then, all segments will light for approximately 2 seconds followed by the rate/total mode display. Three items should now be reset in the following order: decimal point, scale factor and time constant. (If the unit is supplied with the optional RS-232-C interface, the units, baud rate and identification should also be reprogrammed.)

Reset

If the units of measure were also changed when the unit was reprogrammed, the tag below the 6-digit display should also be changed. Additional tags for the 24 standard units/time are shipped with the DRT. Also, blank labels are included for lettering nonconventional units of measure. Micro Motion strongly recommends attaching the tags to the front of the unit rather than disassembling the unit. If the tag must be inserted into the window within the unit, it should be done by a Micro Motion service technician.

5.2.2 Decimal Point

Decimal point mode. The decimal point mode is used to reset the rate decimal point. The programmer only needs to be concerned with the location of the decimal point for the rate display; setting the DRT scale factor will adjust the location for the totalizer displays.

5.2.2.1 Decimal Point Location.

Follow these steps to determine the correct decimal point location:

1. Calculate the rate multiple using the flow meter frequency output and full scale flow rate:

frequency/flow rate = rate multiple

The rate multiple determines the location of the decimal point in the rate display. Compare the rate multiple to the table below to determine the decimal point location. Then, enter the decimal point location according to Section 5.2.2.2

Table 4 Rate Decimal Location

Rate Multiple	Decimal Point Location
1	000000.
10	00000.0
100	0000.00
1000	000.000
10000	00.0000
100000	0.00000

Note: No further adjustment of the decimal point is necessary. The unit automatically adjusts the decimal point location for the other displays.

The scale factor affects the location of the decimal point in the totalizer displays. Table 5 shows the location of the decimal point in the totalizer display for different scale factors, with respect to a hypothetical rate decimal point. When the scale factor divides the pulses per second (1), minute (60) or hour (3600) by 1, the decimal point is in the same location in the totalizer displays as it is in the rate display. Dividing by an additional 10 moves the decimal point in the totalizer display one place to the right; by 100 moves the decimal point two places to the right, by 0.1 moves the decimal point one place to the left, etc.

Table 5 Decimal Point Location

Hypothetical rate decimal point: 00.0000

Scale factor	Pulses per	Divided by	Totalizer decimal point
1	second	1	0000.0000
10	second	10	00000.000
100	second	100	000000.00
1000	second	1000	0000000.0
6	minute	0.1	000.00000
60	minute	1	0000.0000
600	minute	10	00000.000
6000	minute	100	000000.00
36	hour	0.01	00.000000
360	hour	0.1	000.00000
3600	hour	1	0000.0000

5.2.2.2 Decimal Point Reset.

Follow these steps to reset the decimal point:

1. The rate should be zero, otherwise data will be lost.
2. The program must be unlocked (terminal 8 to 10 not connected).
3. Select the decimal point (dP) mode.

4. Activate the reset function key. The 6-digit display will show only the decimal point. The message 'in rESEt' will show on the 8-digit display.

5. Use the increment key to position the decimal point.

6. Enter the new decimal point location.

5.2.3 Scale Factor

Scale factor mode. In the scale factor mode the programmer may change the engineering units scale factor. Since the Micro Motion mass flow meter does not have a meter factor, this is a relatively easy procedure. The unit may be programmed to divide the incoming pulse train by 1, 60, or 3600 for seconds, minutes, or hours, respectively, times factors of 10 for long term inventory.

5.2.3.1 Scale Factor Determination.

Follow these steps to calculate the scale factor:

1. Calculate the displayed total for the maximum inventory total, when the scale factor is equal to the pulses per time unit (1, 60, or 3600) divided by 1.

max. total × freq./flow rate = displayed total

2. Compare the number of digits required for the total display to the number available. The total may have up to 8 digits (7 digits with the forward/reverse option).

If the total requires more digits than the number available, proceed to step 3. Or, if the total uses less than half of the available digits the pulses per time unit should be divided by a number other than 1, according to steps 3 and 4.

If no adjustment is needed, set the scale factor to divide the pulses per time unit (1, 60, or 3600) by 1.

3. To reduce the number of digits required, choose a scale factor which divides the pulses per time unit by a greater number. For instance, to reduce the number of digits required in the total display by 1, divide by 10; by 2, divide by 100, etc.

If more digits are desired, choose a scale factor which divides the pulses per time unit by a lesser number. For instance, to add 1 digit to the total display, divide by 0.1; to add 2 digits, divide by 0.01.

4. Divide the total by the new divider to check the new scale factor.

displayed total/new divider = new total

For example, assume the following information is known:

1200 hertz frequency output
12 pounds/minute full scale flow rate
100,000 pound maximum inventory total

Following step 1, calculate the displayed total, when the scale factor is 60. The scale factor of 60 is used because the flow rate is in pounds per minute and there are 60 seconds in one minute (time unit divided by 1).

100000 X 1200/12 = 10000000 displayed total

Following step 2, the total requires 8 digits. Therefore, the scale factor of 60 may be entered, steps 3 and 4 are not required.

5.2.3.2 Scale Factor Reset:

Follow these steps to reset the scale factor:

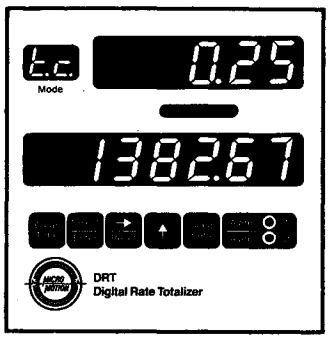
1. The flow rate should be zero, otherwise, data will be lost.
2. The program must be unlocked (terminal 8 to 10 not connected).
3. Select the scale factor (SF) mode.

4. Activate the reset function key.

5. Use the increment key to display the different scale factors. The unit will display from the factor shown up to 3600 and then start over at 1. The entire range of choices consists of: 1, 10, 100, 1000, 6, 60, 600, 6000, 36, 360, and 3600.

6. When the desired factor is displayed, use the select/enter key to enter it.

5.2.4 Time Constant



Time constant mode. The time constant filter is used to filter undesirable output from the flow meter caused by low level noise or fluctuations in the flow rate. In the time constant mode the filter may be set for .25, .5, 1.0, 2.5, 5.0 or 10 seconds. The smallest time constant necessary to stabilize the display should be used. A long time constant causes the display to lag behind the actual flow changes.

Time Constant Reset.

Follow these steps to reset the time constant:

1. The rate should be zero, otherwise, data will be lost.
2. The program must be unlocked (terminal 8 to 10 not connected).
3. Select the time constant (tc) mode.
4. Activate the reset function key. The upper display will show the current time constant. The 8-digit display will show 'in rESEt'.
5. Use the increment key to change the time constant.
6. Enter the desired time constant when it displays.

6 Computer Interface Option

6.1 General

This section covers the installation and use of the optional computer interface. The optional equipment is a transceiver PC board which provides a communications link between the user's computer and the DRT. The DRT transmits and receives data from data terminal equipment using standard ASCII code. The ASCII data stream is sent from the DRT via standard RS-232-C serial interface. The DRT will output the following data:

Flow rates: current, peak and valley (RATE, HI, and LO)

Totals: resettable and inventory (TOTAL and INV.)

Also, the following constants programmed into the DRT are included in the message:

Identification number

Units of measure per units of time (UNITS)

Alarm values (ALARM 1 and ALARM 2)

Time constant setting (FILTER)

Scale factor (DIVIDE BY)

Figure 5 below shows a typical printout.

Figure 5
Data Printout

```
IDENT: 080585
UNITS: lbs/min
RATE: 0081.90
HI: 0083.82
LO: 0081.90
TOTAL: 000026.92
INV: 000123.33
ALARM1: L020.00
ALARM2: H110.00
FILTER: .25sec
DIVIDE BY: 60
```

Table 8 in Section 6.4 provides a complete description of the message.

The user may send various commands to the DRT-3 via the same RS-232-C interface. The factory preprograms the unit to correspond with the meter calibration and the baud rate of the customer's computer, if the information is supplied with the order.

6.2 Installation

The back of the DRT has two parallel-wired 25 pin D subminiature connectors. Only one should be connected to a data terminal, the other is intended for connection to a receive only device, such as a dumb printer. The DRT operates in the half-duplex mode (i.e. transmit and receive cannot occur simultaneously).

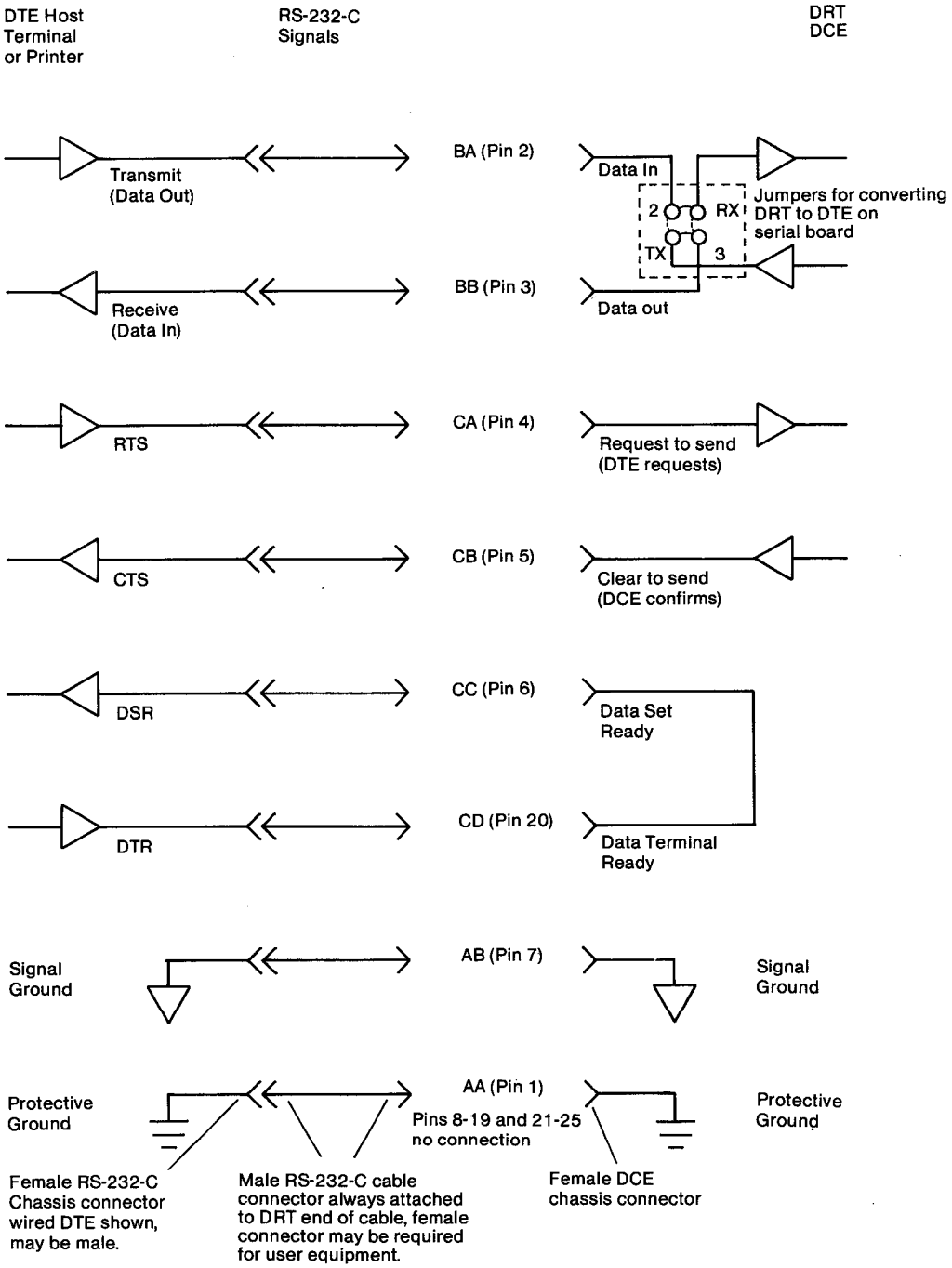
The DRT is a DCE device (data communications equipment). A female DCE chassis connector is provided on the back of the unit. Typically, the unit will be communicating with a DTE device (data terminal equipment), such as a printer or terminal. Figure 6 shows the RS-232-C cable connections. If the user connects the DRT to a DCE device, such as a modem, an adapter or other cable must be used.

When connecting the DRT to data terminal equipment (DCE or DTE) the cable length should not exceed the distance listed in Table 6 for the different baud rates. Also, low capacitance cable such as types 59/U, 59/AU, and 62/AU should be used.

Table 6
Cable Lengths

Baud Rate	Maximum Cable Length
9600	150 ft.
4800	300 ft.
2400	600 ft.
1200	1200 ft.
600	2400 ft.
300	2400 ft.
150	2400 ft.

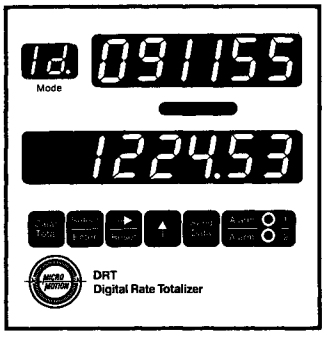
Figure 6
RS-232-C Signals



6.3 Interface Modes

The additional operating modes which are used with the serial interface are: the identification mode (Id), the units mode (Un), and the baud rate mode (bd).

6.3.1 Identification Number



Identification number. In the identification mode the unit identification number appears in the 6-digit display and the resettable total appears in the 8-digit. The user may select any 6-digit number to identify the unit. For instance, this may be a number assigned to the unit, the date for data logging, the instrument tag number, or the serial number. If no number is specified on the purchase order, the factory will enter the serial number.

Follow these steps to reset the identification number:

1. The program should be unlocked (terminal 8 to 10 not connected).
2. Select the identification (Id) mode.
3. Activate the reset function key. The leftmost digit of the 6-digit display will begin to flash.
4. Increment the flashing digit, if desired, to obtain the correct value.
5. Press the →/reset key to move to the next digit.
6. Repeat steps 4 and 5 until all digits are reset to the desired value.
7. Enter the new value.

6.3.2 Units of Measure

Units. The units of measure per time for the data transmission are selected in this mode. There are 21 selections representing 24 different units of measure/time. In this mode the setup/rate display will show a two digit number and the totalizer display will show the last batch total. The first digit shown in the 6-digit display represents the unit of measure, the second digit represents the unit of time (e.g. 1 = seconds, 2 = minutes, and 3 = hours). Table 7 shows the entire menu for this mode:

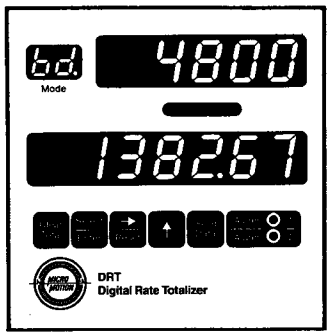
Table 7
Units of Measure

Units of Measure	per Second	per Minute	per Hour
grams	11	12	13
kilograms	21	22	23
liters	31	32	33
ounces	41	42	43
pounds	51	52	53
gallons	71	72	73
tons (std. or metric)	61	62	63

Follow these steps to reset the units:

1. The rate should be zero, otherwise, data will be lost.
2. The program must be unlocked (terminal 8 to 10 not connected).
3. Select the units mode. (Select / Enter)
4. Activate the reset function key. Both of the digits will begin to flash. (→ / Reset)
5. Change the display to the correct number by pressing the increment key. The DRT will display the entire menu of measurement/time units beginning with the previously set value. It will go up to 73 and return to 11. The preceding table indicates the measurement per time unit each number represents. If values other than those in the table are displayed, the nonvolatile memory must be reprogrammed according to Section 5.2.1. (↑)
6. Enter the new selection. (Select / Enter)

6.3.3 Baud Rate



Baud Rate. In the baud rate mode the programmed baud rate appears in the 6-digit display and the resettable total appears in the 8-digit display. The user may select one of seven baud rates for computer interface. The choices range from 150 bps to 9600 bps. If both serial output ports are used, the baud rate for both units to which the DRT is connected must be the same.

Follow these steps to reset the baud rate.

1. The rate should be zero, otherwise, data will be lost.
2. The program must be unlocked (terminal 8 to 10 not connected).
3. The baud rate mode must be selected. (Select / Enter)
4. Activate the reset function key. The entire baud rate number will begin to flash. (→ / Reset)
5. Use the increment key to display the baud rate menu. All selections will display beginning with the previously set baud rate. The choices are 150, 300, 600, 1200, 2400, 4800, and 9600 bps. If values other than these are displayed, the nonvolatile memory must be reprogrammed according to Section 5.2.2 (↑)
6. Enter the new selection. (Select / Enter)

6.4 Send Data Function

Send Data

The send data function key is used to output the ASCII message via the RS-232-C interface. When the send data key is pressed the 176 character ASCII message is sent out both serial ports. There is no provision for 'handshaking' prior to sending the message. This enables the message to be sent to a dumb printer as well as a terminal.

The DRT transmits and receives data using the 11 bit/character format. No other ASCII format is accepted. The format consists of:

1 — start bit
8 — data bits (no parity)
2 — stop bits

Table 8 shows the entire ASCII message transmitted by the DRT.

6.5 RS-232-C Commands

The user may issue commands to the DRT via the RS-232-C interface. The CTS (clear to send) signal will be sent when the DRT is ready to receive. The CTS signal will not be sent if the DRT is in the process of outputting a data message or is resetting a parameter. If the transmission rate is set for 150 baud, the transmission time is approximately 12 seconds and the DRT will not accept any other commands. This section describes the DRT's reponse to properly received ASCII control characters.

HEX 10 - Control P (print). The data terminal operator enters the control P to request the standard message from the DRT. When the unit receives the message, the following steps occur.

1. It enables the serial output line for transmission.
2. It transmits the message. The unit assumes that if the message has been requested, the receiver is listening. It will begin transmission without any "handshaking". If the message is to be printed out on a dumb terminal as well as appearing on the video terminal, the printer should be turned on and waiting before the message is requested. Upon detecting a control P the unit will send the current data including the units of measure, current, peak and valley rates, resettable and inventory totals, the alarm settings, the filter setting, and the scale factor.

Note: At a baud rate of 150 bps, it takes more than 12 seconds to transmit the message during which time the unit will not receive any commands.

3. It disables the serial output line.

Note: Be sure you want to reset the totalizer before sending control T. Once the resettable total is zeroed, it cannot be recalled.

Hex 14 — Control T (totalizer reset). When the user sends a control T, the resettable total is zeroed.

Hex 15 — Control U (update the mode). When the user sends a control U, the next mode is selected and displayed. Whether or not all modes display depends on whether or not the program is locked.

Hex 08 — Control H (peak rate). Whe the user sends a control H, the peak rate will be reset to the current rate.

Hex 0C — Control L (valley rate). When the user sends a control L, the valley rate will be reset to the current rate.

Hex 06 — Control F (find). When the user sends a control F, the unit echoes a control F back. The unit will only respond with a control F when it receives a control F at its programmed baud rate. If the data terminal sends a control F at each possible baud rate, the unit baud rate may be detected.

Note: The baud rate can only be changed through the membrane keyboard (Section 6.3).

Table 8
Standard Message

Character No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Character	stx	I	D	E	N	T	:	sp	dig	dig	dig	dig	dig	dig	cr	lf
Hex code	02	49	44	45	4E	54	3A	20	actual data						0D	0A

Character No.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Character	U	N	I	T	S	:	sp	un	un	un	/	tm	tm	tm	cr	lf
Hex code	55	4E	49	54	53	3A	20	actual data			2F	actual data			0D	0A

Character No.	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Character	R	A	T	E	:	sp	char	dig	dig	dig	dig	dig	dig	cr	lf
Hex code	52	41	54	45	3A	20	actual data							0D	0A

Character No.	48	49	50	51	52	53	54	55	56	57	58	59	60
Character	H	I	:	sp	char	dig	dig	dig	dig	dig	dig	cr	lf
Hex code	48	49	3A	20	actual data							0D	0A

Character No.	61	62	63	64	65	66	67	68	69	70	71	72	73
Character	L	O	:	sp	char	dig	dig	dig	dig	dig	dig	cr	lf
Hex code	4C	4F	3A	20	actual data							0D	0A

Character No.	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
Character	T	O	T	A	L	:	sp	dig	dig	dig	dig	dig	dig	dig	dig	dig	cr	lf
Hex code	54	4F	54	41	4C	3A	20	actual data									0D	0A

Character No.	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107
Character	I	N	V	:	sp	dig	dig	dig	dig	dig	dig	dig	dig	dig	cr	lf
Hex code	49	4E	56	3A	20	actual data									0D	0A

Character No.	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124
Character	A	L	A	R	M	1	:	sp	char	dig	dig	dig	dig	dig	dig	cr	lf
Hex Code	41	4C	41	52	4D	31	3A	20	actual data							0D	0A

Character No.	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141
Character	A	L	A	R	M	2	:	sp	char	dig	dig	dig	dig	dig	dig	cr	lf
Hex Code	41	4C	41	52	4D	32	3A	20	actual data							0D	0A

Character No.	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157
Character	F	I	L	T	E	R	:	sp	dig	dig	dig	s	e	c	cr	lf
Hex Code	46	49	4C	54	45	52	3A	20	actual data			73	65	63	0D	0A

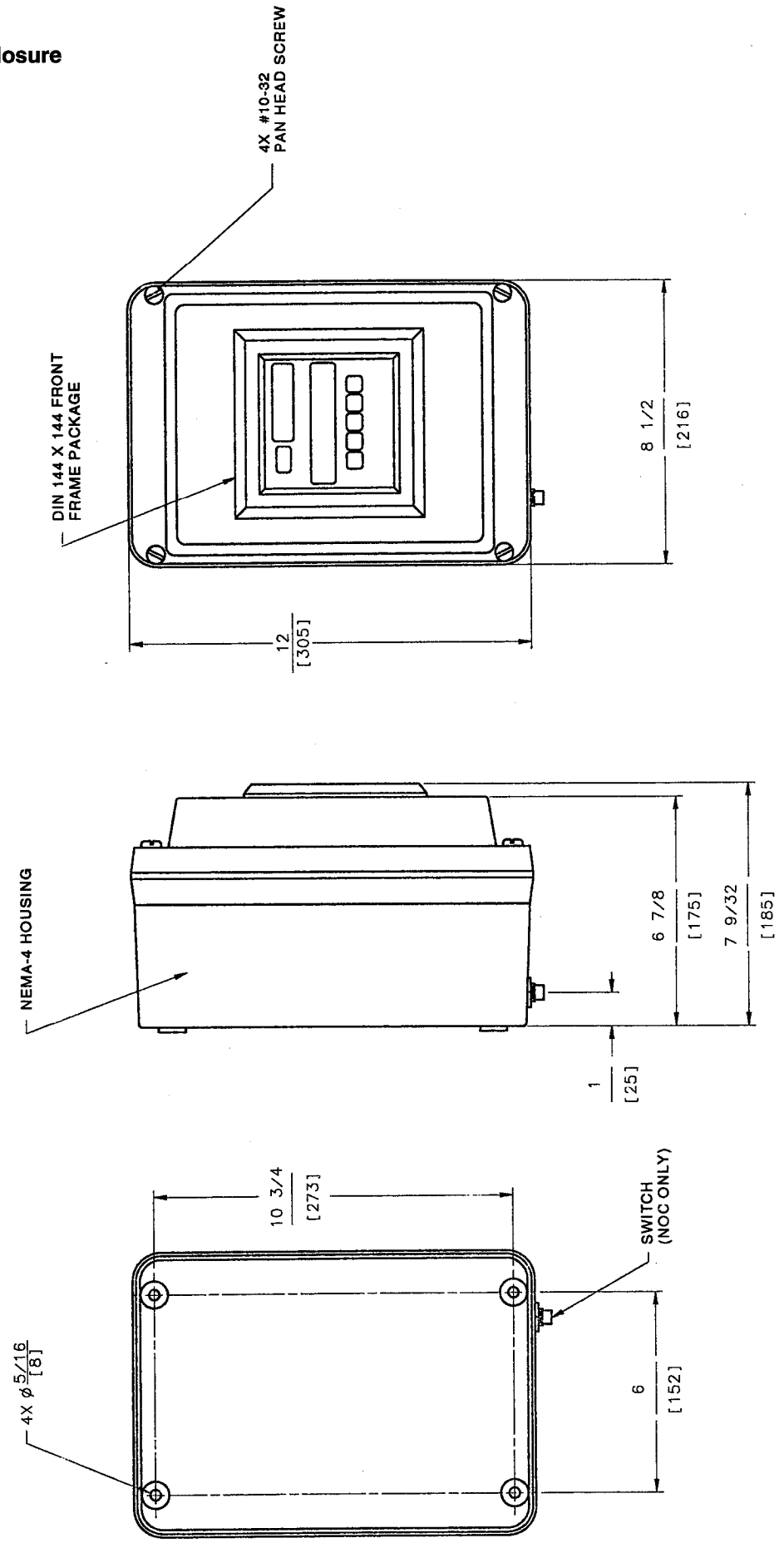
Character No.	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176
Character	D	I	V	I	D	E	sp	B	Y	:	sp	dig	dig	dig	dig	cr	lf	etx	eot
Hex Code	44	49	56	49	44	45	20	42	59	3A	20	actual data				0D	0A	03	04

stx = start of text character
sp = space character
dig = decimal digit (30H-39H), space (20H), decimal point (2EH) or E(45H) if decimal point is out of range
cr = carriage return character
lf = line feed character
un = units of measure abbreviation (g, kg, lit, oz, lbs, ton, gal)
tm = units of time abbreviation (sec, min, hr)
char = character indicating type of flow, blank is forward flow, – is reverse flow, H indicates a high alarm, L indicates a low alarm
etx = end of text character
eot = end of transmission character

Since the unit operates half duplex, no input command can be received during this transmission.

Figure 7
NEMA IV Enclosure

Dimensions are in:
inches
mm



7 Optional Housings

7.1 General

Optional housings are available for the DRT. If the installation requires a watertight unit, it may be installed in a NEMA IV housing. Or, for hazardous locations, an explosion-proof housing is available.

7.2 NEMA IV Enclosures

NEMA IV enclosures are watertight and dusttight and meet IP-65 requirements. They protect the enclosed equipment against splashing water, seepage of water, hosedowns, and severe external condensation. (The product has been type-tested to withstand hosedowns of 65 gallons/minute for 5 minutes from a distance of 10-12 feet.)

7.2.1 Description

Figure 7 shows the NEMA IV enclosure. It includes a DRT designed for enclosure installations. Micro Motion Mounts the DRT inside the housing.

7.2.2 Installation

Figure 7 provides mounting dimensions for the NEMA IV assembly. The housing is designed to house the REU or RFT9712 as well as the DRT. Allow sufficient clearance to install the unit. The conduit entrance may be located on any side of the housing for convenience. Therefore, the conduit openings are not predrilled.

Note: The conduit hubs should be sealed to keep moisture out of the housing.

Directions for attaching the mounting feet to the smaller housing are enclosed in the housing. Wiring instructions are covered in Section 2.3 of this manual.

7.3 Explosion-Proof Housing

The DRT explosion-proof enclosure has been designed for used in the following hazardous areas: Class I, Groups C and D, Class II, Groups E, F, and G, and 1EXdIIB T6. This enclosure has been approved for use in hazardous areas by FM, CSA, and SAA.

7.3.1 Description

The DRT explosion-proof assembly consists of the enclosure and a DRT designed for enclosure installations. Micro Motion mounts the DRT inside the housing. The factory also completes the wiring connections between the DRT and the explosion-proof switches.

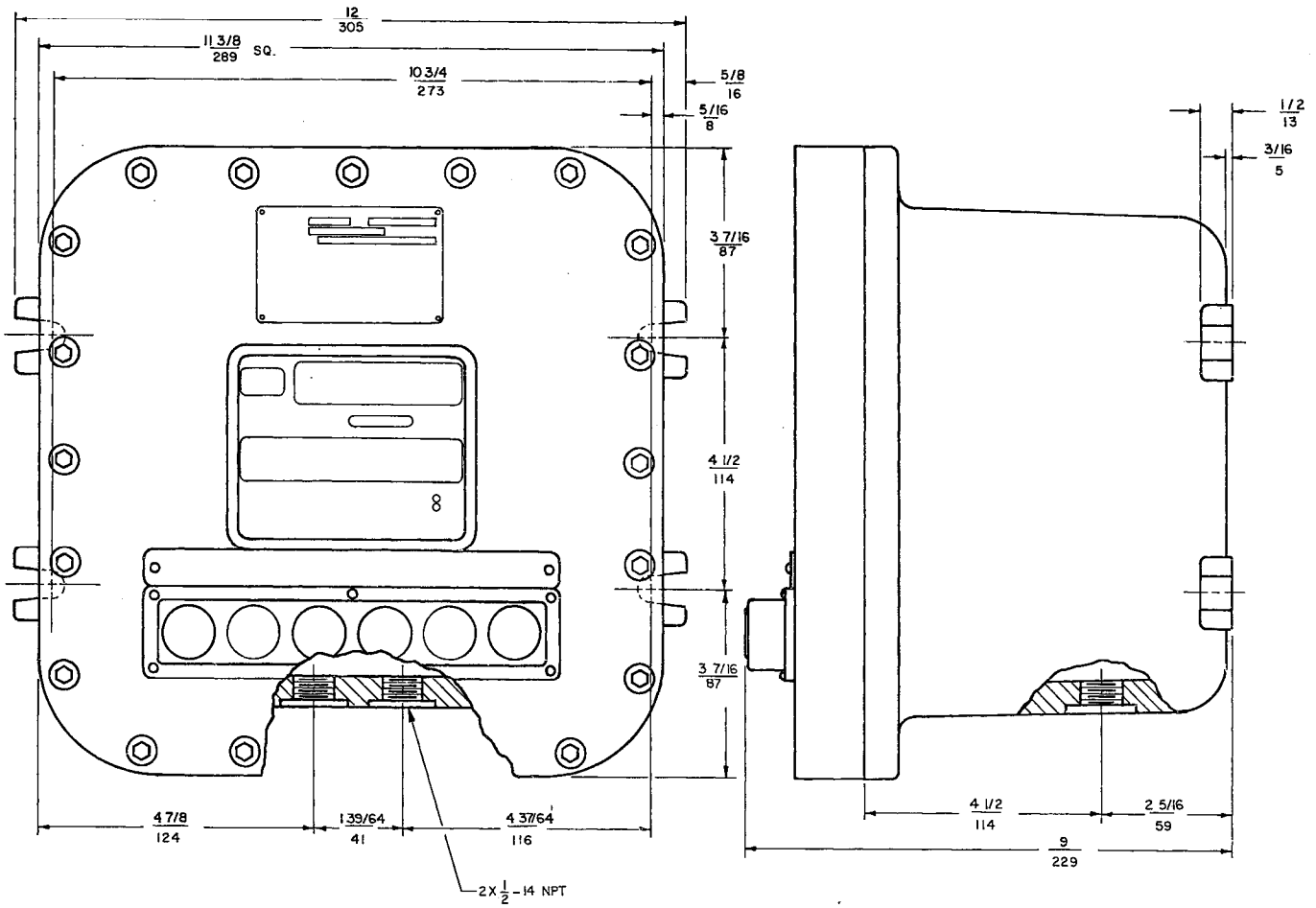
7.3.2 Installation

Figure 8 provides mounting dimensions for the explosion-proof housing. Four mounting brackets are located on the back of the unit for wall or floor mounting. Two conduit entrances are provided on the bottom of the unit for flowmeter and power wiring.

Note: The unit must be installed per applicable sections of the National Electrical Code for Explosion-Proof Installations. Conduit seals must be installed within 2 inches of the enclosure.

CAUTION: TO PREVENT IGNITION OF HAZARDOUS ATMOSPHERES, DISCONNECT FROM SUPPLY CIRCUIT BEFORE OPENING ENCLOSURE. KEEP TIGHTLY CLOSED WHEN CIRCUITS ARE LIVE. COVER JOINTS MUST BE CLEANED BEFORE REPLACING COVER. CONDUIT SEALS SHALL BE INSTALLED WITHIN 2 INCHES (50 mm) OF THE ENCLOSURE.

Figure 8
Explosion-Proof Housing



1. THIS HOUSING IS USED WITH: FMS-3, DMS, DRT, NOC, NFC.
2. DIMENSIONS ARE INCHES / mm

Figure 9a
DRT to RFT9712 Wiring Connections

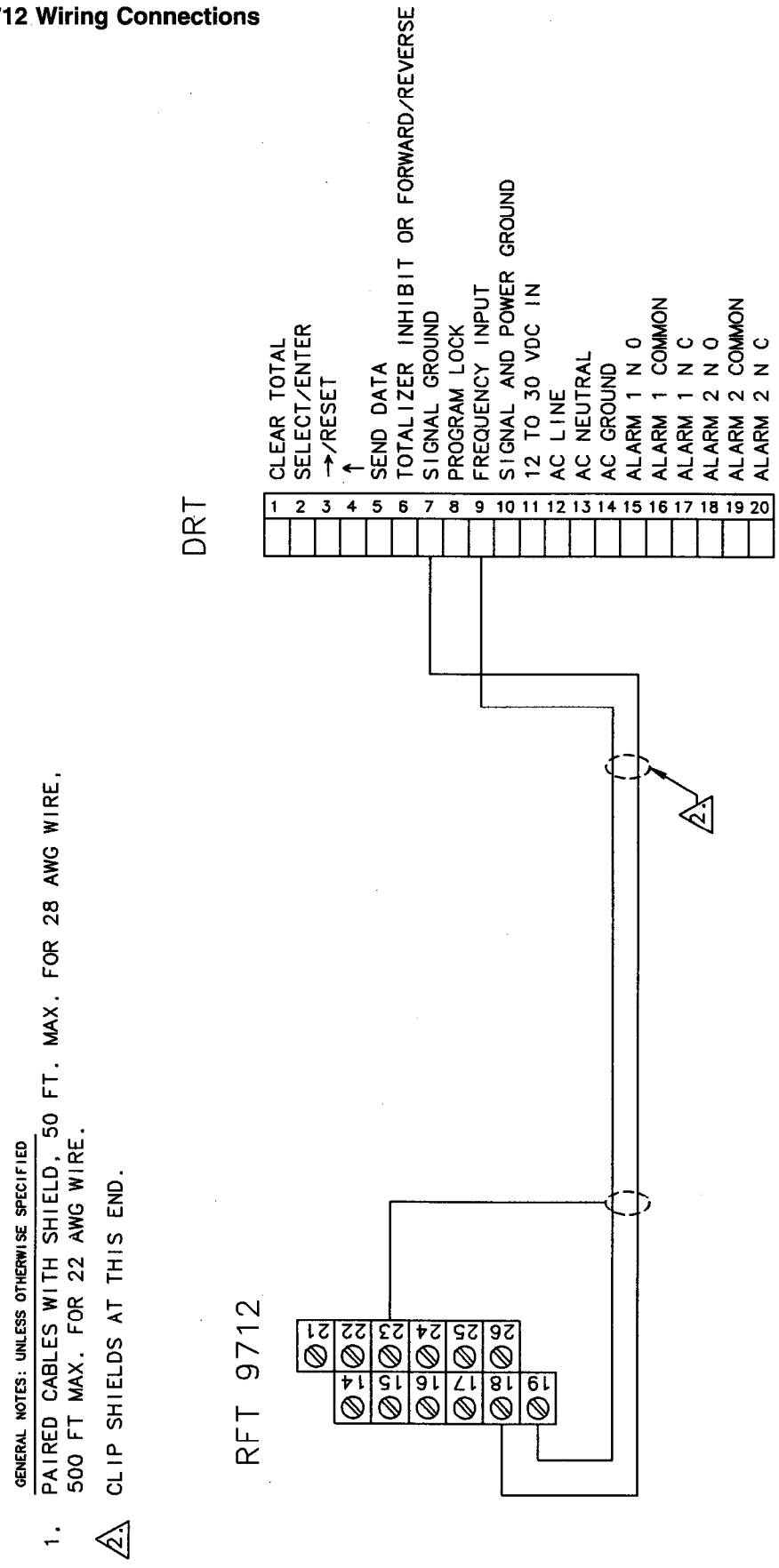


Figure 9b
DRT to FlowScale System Wiring Connections

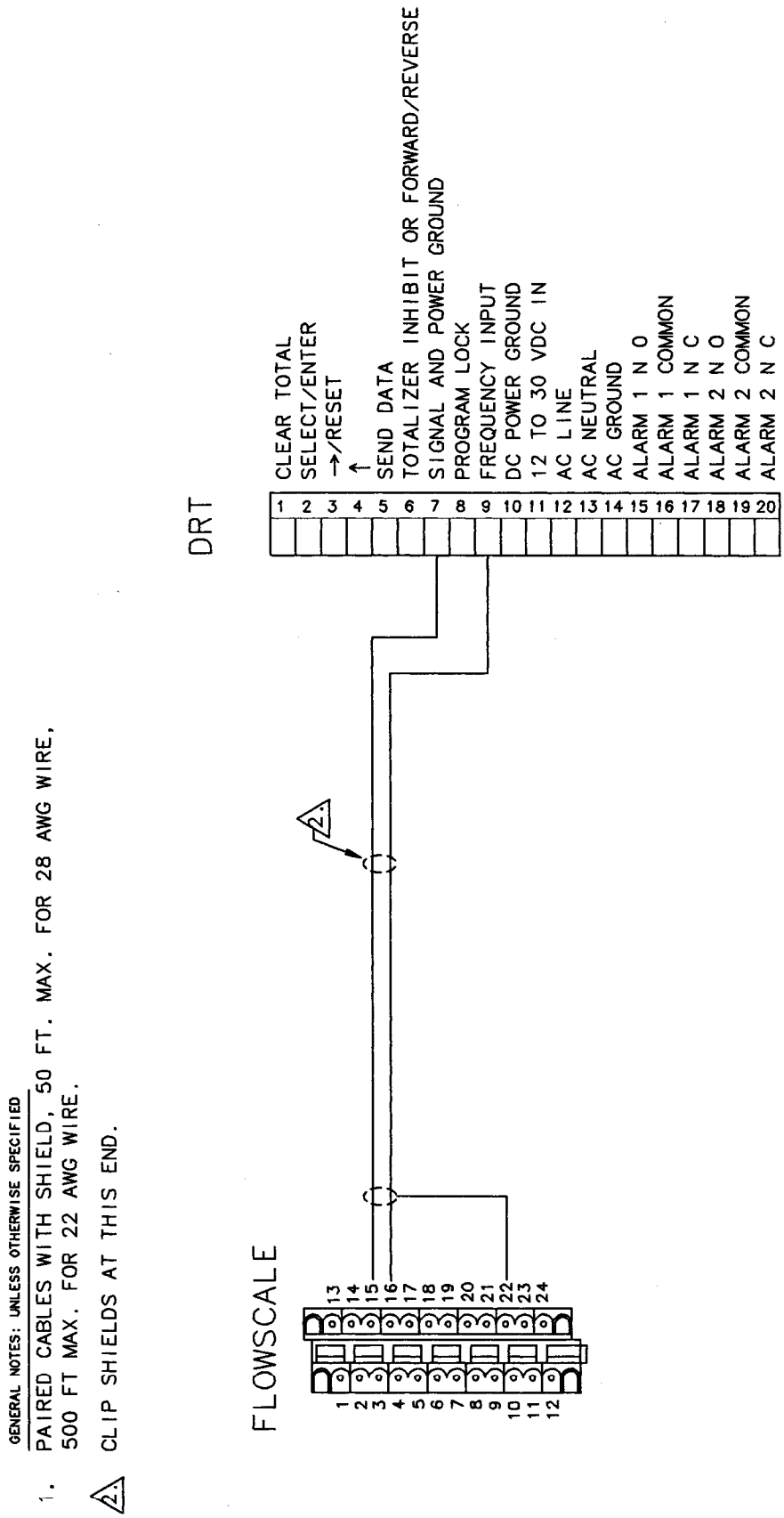
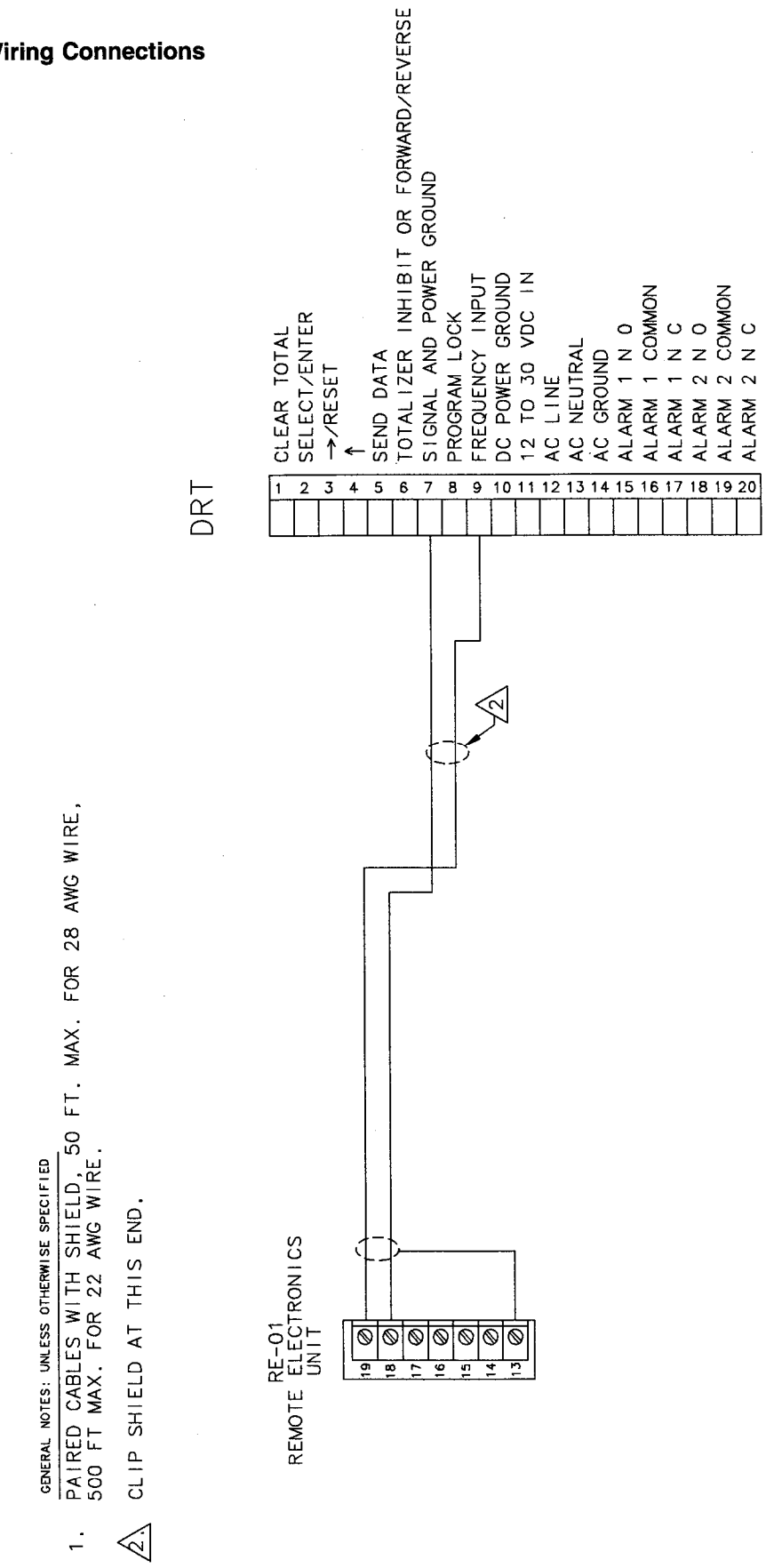


Figure 9c
DRT to REU Wiring Connections



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