

Apollo Flow Measurement Ltd
RT7 Manual
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Installation & Operation of the RT7 Rate Totaliser

Note

Read this manual prior to installation

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1 INTRODUCTION

The RT/7 is a microprocessor based instrument designed for the measurement of instantaneous flow rate and the accumulation of total flow. The input circuit has been designed to accept the wide range of pulsed signals generated by flow measurement equipment. Both rate and total can be simultaneously displayed on the two large



LED displays. The total can be reset via the front panel, with an accumulated non resettable total available at the push of a button. The rate can be displayed in engineering units, with a time base of seconds, minutes or hours.

The instrument can compensate for flowmeter non-linearities by enabling the scaling factor to be corrected in eight distinct frequency steps, with linear interpolation between points.

As an option, user programmable flow rate alarms are available. In addition to the relay outputs, LED's on the front panel indicate the status of these alarms.

Another option is a 4-20mA output, proportional to the flowrate.

The instrument is fully programmable via the front panel and the information is stored in non volatile memory.

The instrument will operate directly from voltages between 12 and 28 VDC and from the AC mains. A DC output is provided from the rear of the instrument to power remote sensors.

2 QUICK SETUP

Calibration

To enter the calibration mode disconnect any remote button inputs and short terminals 11 and 12. Pressing “Prog” will cycle through entries, while the “Right Arrow” button will select the next digit to the right and the “Up Arrow” button will increment the flashing digit. To store any changes remove the link while the unit is powered up.

<u>Display</u>	<u>Options</u>	<u>Description</u>	<u>Section</u>
Cal 1		Integer value of K factor	5.1
Cal 2		Decimal value of K factor	
Cal 3	r	Rate on upper display	
	t	Total on upper display	
Cal 3.1	0 to 4	Decimal places for rate display	
Cal 3.2	0	Units per second	
	1	Units per minute	
	2	Units per hour	
Cal 3.3	0	No filtering	5.2
	to		
	99	Heavy filtering	
Cal 3.4		Filter bandwidth	
Cal 4	0,1 or 2	Decimal points for total	
	3,4 or 5	Units x 10, x100 or x1000	
Cal 5	E	Enable alarms	5.4
	d	Disable alarms	
If enabled:			
Cal 5.1		Low alarm flow rate (in engineering units)	
Cal 5.2		High alarm flow rate (in engineering units)	
Cal 6	E	Enable linearisation	5.3
	d	Disable linearisation	
If enabled			
	F1 to F8	Lowest to highest frequencies	
	d	Deviation at each frequency	
Note: If a frequency of 0000 is entered, no further deviations need to be programmed and the sequence will move to Cal 1 unless the 4-20mA version has been supplied. In this case the sequence will move to Cal 7			
Cal 7	E	Enable 4 - 20 mA output	5.5
	d	Disable 4 - 20 mA output	
	L	Rate (in engineering units) for 4 mA	
	H	Rate (in engineering units) for 20 mA	
Cal 7.1		Fixed output for loop test. A figure between 0 and 65536 will give a signal between 4 and 20mA. FOR NORMAL OPERATION FIGURE SHOULD BE SET TO ALL ZEROS.	

3 OPERATION

Front Panel

The display will show the rate and resettable total in the engineering units determined by the K factor, and time base programmed during Calibration. LEDs will indicate if either of the flow rate alarms are active.

The total can be reset with the “Reset” Button.

A non resettable total can be displayed by pressing the “Up Arrow” button.

Once the totals have reached the maximum displayable they will roll over to zero, and the unit will continue to totalise.

If power to the instrument is lost all totals will be stored in the non volatile memory, and recalled when power is reapplied.

4 INSTALLATION

4.1 General

The standard rate totaliser is supplied as a panel mounting instrument, with side clips to secure it to the panel. The cut-out should be 92mm x 92mm.

The instrument will operate from either 12 - 28 VDC or from the AC mains. The mains voltage is factory set to either 115V or 230V nominal. An internal mains transformer provides isolation between the mains and the electronic circuits. The use of a mains filter (typically RS 210-443) will give added protection from mains borne transients. An earthing point is provided via a stud on the back panel. This earthing point provides the earth for the case. For EMC purposes or where the instrument is connected to the mains this point must be connected to a clean earth via a suitable cable.

It is recommended that shielded cable is used for all signal connections to the instrument. Shields should be connected to earth at the instrument only. To comply with Directive 89/336/EEC of the Council of European Community, this wiring practice is mandatory. It is also good practice to separate power cables from those carrying signals.

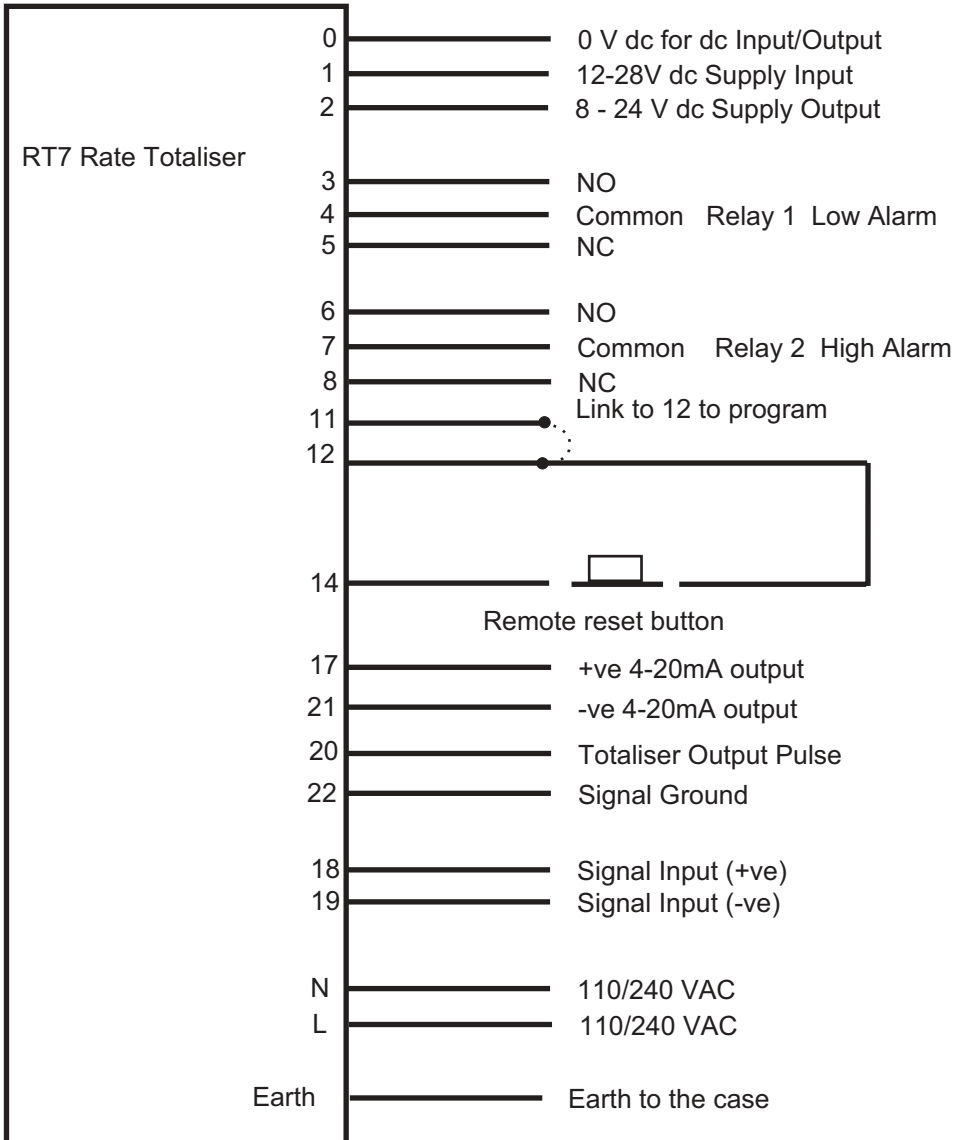
There are no user serviceable parts within the instrument.

A regulated output voltage is provided to power external sensors. If the instrument is mains powered it is adjustable between 8 - 28 VDC via a potentiometer on the side of the instrument. If the instrument is DC powered the maximum voltage will be 3.5 V less than the supply voltage. The maximum current is 50 mA.

4.2 Signal Connections

<u>Signal Type</u>	<u>Typically From</u>	<u>Connections</u>	<u>DIP Switches On</u>
Voltage Pulse (Square Wave)	PPW Amplifier TTL	+ve to 18 -ve to 19	5 7
Voltage Pulse (Sine Wave)	Turbine Meter RN & Hoverflo	18 & 19 No Polarity	1 4
Switch (Contact Closure)	Reed Switch PT Meter	18 & 19 No Polarity	3 5 7 8
Open Collector	Magnetic Meters	+ve to 18 -ve to 19	5 8
Current Pulse	P/5 Amplifier	+ve to 2 -ve to 18 220R between 18 & 19	2 5 6
Current Pulse	Namur Sensor	+ve to 2 -ve to 18 Adjust voltage @ 2 to 8.2 VDC	2 5 6

4.3 Installation Diagram



5 PROGRAMMING OPTIONS

5.1 K Factor

This is the number of pulses per unit volume generated by a flowmeter. Changes to this number will allow different engineering units to be displayed.

e.g.. Suppose a flowmeter gives out 100.00 pulses per litre:

Setting a K factor to 100.00 pulses per unit would give a display in litres

Setting the K factor to 454.6 pulses per unit would give a display in gallons, assuming a conversion of 4.546 litres =1gallon.

5.2 Filtering

Filter Constant

Frequency fluctuations caused by pulsating flow through a flowmeter, vibration on a shaft, or speed variations in a motor may make the rate display unstable. The RT/7 has a digital filter to average out these fluctuations and ease the reading of the instrument. The level of filtering can be adjusted to give stable readings without excessive lag. As a guide the following table gives the response time in seconds for the displayed value to reach 90% and 99% of a step change.

<u>Constant</u>	<u>90%</u>	<u>99%</u>
2	1	2
4	3	6
6	4	8
10	7	14
20	14	28
40	28	56
60	42	84
80	56	112
99	70	140

Filter Bandwidth

While filtering has tremendous advantages in producing a steady and accurate reading of rate, it has the disadvantage of slowing the response to intended changes in frequency.

To overcome this problem a window can be programmed to define the frequency range over which the filtering operates. If the input frequency jumps by more than this window, the displayed value will immediately track the new rate.

The bandwidth is defined in relation to the input frequency in Hz and is symmetrical about the current input frequency.

e.g. If the input frequency is 500 Hz and the window is set to 100 Hz, the signal will be filtered between 450 and 550 Hz. If the signal jumps to 600 Hz, the display will immediately update to this rate and the filtering will be between 550 and 650 Hz.

In practice the following procedure will give the optimum balance between filtering and bandwidth:

- 1) Set the window to 5000 Hz, effectively disabling it.
- 2) Increase the filter constant until a steady reading is obtained.
- 3) Decrease the window bandwidth until the display becomes unsteady. (The fluctuation exceeds the displayed bandwidth)
- 4) Finally increase the window bandwidth slightly again to steady the display.

5.3 Non-Linearity Correction

Description

Most flowmeters have some form of linearity error, where the K factor at a particular flow rate differs from the average. Many flowmeter manufacturers can provide a calibration certificate which list these errors. Provided the error is repeatable the accuracy of the display can be greatly improved.

The correction can be performed over the frequency range 0 to 5.0 kHz, with a deviation of up to 9.99%.

Example

A low cost flowmeter may have the characteristics as shown below:
Average Pulses/Lit (K Factor): 35.46

<u>Frequency(Pulses/Sec</u>	<u>Pulses/Lit</u>	<u>Flow Error (%)</u>
104	33.69	4.99
216	34.42	2.93
398	35.05	1.16
611	35.95	-1.38
805	37.23	-4.99
1102	35.40	0.17

From this example the overall accuracy is +/- 4.99%, using the average K factor.

Programming the deviations into the RT/7 will result in the accuracy being improved by up to 10 times, provided the errors are repeatable.

Programming Correction Factors

In the calibration sequence, with linearisation enabled, up to 8 frequencies can be programmed with their respective deviations. The first frequency entered should be the lowest one required. At lower frequencies the microprocessor will use this first correction factor. The deviation will show xx.xx, with the first digit being P for positive deviations and - for negative. The remaining digits represent the percentage difference between the K factor entered in Cal 1 and 2, and the actual pulses per unit at the frequency in question. If a frequency of 0000 is entered the instrument will move back to Cal 1, allowing the user to set fewer than 8 correction factors.

5.4 Flow Rate Alarm Option

Two flow rate alarms are available on the instrument.

Relay 1 will energise when the displayed rate falls below the “Low” figure programmed during calibration, while relay 2 will energise when the rate exceeds the “High” rate programmed. The flow rates should be programmed in the same engineering units as the rate display.

LEDs on the front panel will indicate if either of the relays are energised.

5.5 Current Output Option

A 4 - 20 mA output is available from terminals 17 (+ve) and 21 (-ve). The flow rates corresponding to 4 mA and 20 mA are set in engineering units during calibration.

A loop test function is available. A setting of 0 will give a constant 4mA, a setting of 65536 will give a constant 20mA. Current values in between can be obtained.

FOR NORMAL OPERATION THE VALUE SHOULD BE SET TO ALL ZEROS.

6 EXTERNAL WIRING OPTIONS

6.1 Inhibiting the Front Panel Switches

The “reset” switch on the front panel can be disabled by linking terminals 12 and 15. If only an external reset is required, this can be achieved by connecting a momentary switch across terminals 12 and 15 in place of the link. The reset will occur when re-making the link with the switch.

The non-resettable total can be displayed as the default by connecting terminals 12 and 14.

Note: All links must be installed while the instrument is powered down. On powering up, the microprocessor notes the existence of the links and configures the software accordingly.

6.2 Scaled Output Pulse

An output pulse is available at terminal 20 of the instrument, for driving remote counters. A pulse is produced each time the least significant digit of the resettable total increments by one.

The pulse is a current sinking pulse of approximately 50 mSec, produced by an open collector. The transistor is limited to 100 mAmps. In most cases the counters will provide the load for the open collector, but for those that require a voltage pulse an external pull-up resistor may be required.

The output is purely intended for totalisation, the uneven spacing of the pulses makes them unsuitable for rate indication.

7 SPECIFICATION

Display	2 rows of 6 digit, 7 segment LEDs. Upper row: 14mm Lower row: 10mm
Input Frequency	Rate 0.25 Hz to 5.0 kHz Total 0 to 5.0 kHz
Input Circuit	Will accept most sine, logic or switch inputs
Scaling Factor Range	0.0001 to 99999.9999
Non-linearity Correction	Up to 8 correction factors, maximum correction 9.99%
Accuracy	Better than 0.05%
Display Update	0.25 Second
Pulse Output	One 50 mSec pulse on each increment of the displayed total Open collector will sink 100 mA
Current Output	4 - 20 mA adjustable Accuracy 0.2%
Supply Output	Adjustable from 8 to 24 VDC if mains powered Adjustable from 8 to (Input - 3.5 V) if DC powered 50 mA Maximum
Power Requirements	AC mains factory set to 95-135 or 190-260 VAC 12 - 28 VDC 200 mA Typical
Flow Alarm Relays	Max switching voltage: 250 VAC, 30 VDC Max switching current: 8 Amps for a resistive load. Operate time: 15mSec approx. Release time: 10mSec approx
Ingress Protection	IP65
Operating Temp	0 - 45 C
Dimensions	96 x 96 x 130 mm
Cut-out	92 x 92 mm

8 TROUBLESHOOTING

Instrument will not start counting

Check: fluid is flowing in your line
 cables are connected correctly
 DIP switches are on correct setting for your flowmeter
 type
 flowmeter is operating correctly

Instrument will not reset

Check: that the reset button is not inhibited with a link on the
 rear terminals

No display

Check: there is power to the instrument
 the voltage is correct

Counting erratically or when no flow is present

This is probably due to interference. In electrically noisy areas it is essential that good quality screened cable is used, correctly earthed and routed away from power cables.

For voltage pulse inputs the logic zero threshold can be raised by switching off 7. This will reduce the effects of interference.