

Flow Instrumentation

with Temperature Compensation for Liquids

Models 405L & 414L

Features

- Mass Flow calculation
- Volume Correction for petroleum products
- Single and quadrature pulse inputs
- Ticket printing option with time and date

Applications

- General liquids
- Petroleums
- LPG
- Custody Transfer
- Truck Mounted



Overview

Mass Flow measurement at a comparatively low cost can be achieved using the Model 405L and 414L instruments, an RTD temperature sensor and a volumetric flowmeter such as a turbine or positive displacement meter.

Volume correction to 15°C or 60°F for petroleum products is also possible. Petroleum tables and equations that comply with API/ASTM standards for metric and US units are included in both instruments.

With additional features such as a 10 point non-linearity correction and quadrature pulse input, the Models 405L and 414L are ideally suited to the precise measurement of flow, as required in custody transfer applications.

Displayed Information

The 405L Flow Computer displays Flow Rate, Resettable Total, Accumulated Total, Gross Total and Temperature.

The 414L Batch Controller displays Batch Total, Preset Quantity, Accumulated Total, Flow Rate, Gross Total and Temperature.

Computer/Printer Interface

An RS232/422/485 option enables ticket printing and communications with a computer. Software drivers are included for a number of printers.

A ticket with time and date, a sequential delivery/batch number and the gross, net and accumulated totals can be printed with an optional header if required.

Quadrature input capability

Quadrature applies only to frequency type inputs and requires two input signals, 90° out of phase, from a single flowmeter. Through the phasing of signals, forward and reverse flows can be detected, as well as loss of signal.

This capability makes the 405L and 414L suitable for custody transfer applications where integrity of signal can be assured.

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Versatile performance options

The 414L incorporates two relays that can be used to control a single or two stage control valve.

Both instruments will operate from 12 to 28V dc or from 110/220V ac mains.

The facias are watertight to Nema 4X (IP65) and resistant to most chemicals.

Each instrument is supplied with a sheet of self-adhesive engineering unit labels. A recess, adjacent to the display, is provided in which the correct label can be placed.

The instruments are supplied as standard in a panel mount enclosure. Field enclosures and explosionproof enclosures are optionally available.

Input Options

The input options for the 405L and 414L are shown in the following table:

Model	405LA	405LR	414LA	414LR
Temperature 4-20mA RTD	•	•	•	•
Frequency Single Quadrature	•	•	•	•
Analog Flow 4-20mA	•	•	•	•
Density 4-20mA	•	•	•	•

Temperature Compensation

Three methods of compensation are built into the instruments with the appropriate method selected during setup.

Density Correction

Providing a fluid has a known relationship between density and temperature, the density can be determined by measuring the temperature. Up to five temperature and density points can be programmed and the resulting curve is used to determine density.

The Mass Flow is then calculated as:

$$\text{Mass Flow} = \text{Volumetric Flow} \times \text{Density}$$

The volumetric flow can be accurately determined by turbine, positive displacement or vortex flowmeters.

(Note: Non-volumetric inputs from pressure transmitters can also be handled.)

Volume Correction for Petroleum

Volume correction to 15°C or 60°F, as determined by API/ASTM Tables for metric and US units, is possible to the following tables:

Crude Oil	Tables 24A and 54A
Gasoline, Jet Fuels, Kerosene & Solvents	Tables 24B and 54B
Diesel, Heating Oils & Fuel Oils	Tables 24C and 54C
LPG	Tables 34 and 54

Volume Correction for General Liquids

The thermal co-efficient of expansion can be programmed and a volume corrected flow, to a programmable base temperature, will be calculated as follows:

$$\text{Net Flow} = \frac{\text{Volumetric Flow}}{1 + (T_f - T_b) \cdot a}$$

where

T_f is the flow temperature (°C or °F).

T_b is the base temperature (°C or °F).

a is the thermal co-efficient of expansion.

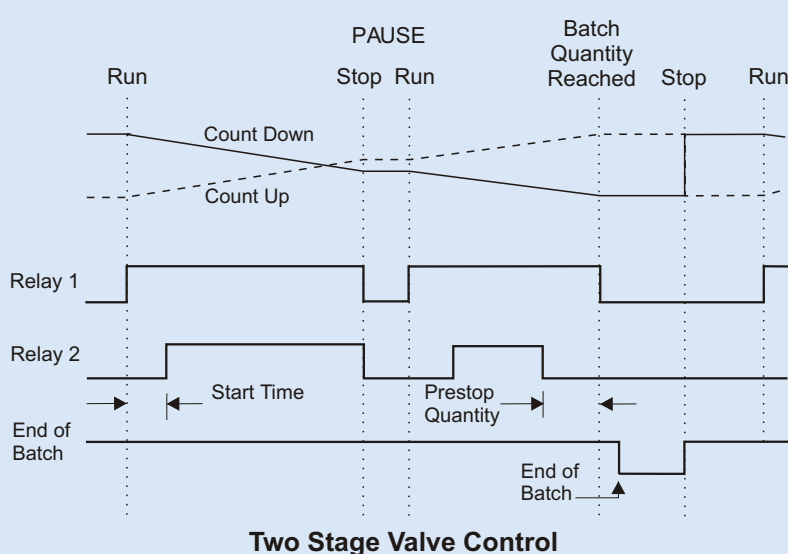
Batch Control - 414L

One or two stage valve control

Two output relays provide control for single or dual stage valve operation. The first relay will energise at the start of the batch and de-energise when the batch is complete.

The second relay can be programmed to energise at a set time after the start, and to de-energise at a set quantity prior to completion of the batch. This feature enables a slow start-up and slow shutdown of the flow.

The Batch Controller can also be programmed to count up from zero or down from the batch quantity.



Batch Functions

Batch Total	Batching can be performed on the Gross Total, or on the Net Total (or Mass Total).
Remote Start/Stop	Inputs on rear panel to connect momentary switches to the RUN and STOP keys.
Signal Timeout	If the flow cuts out midway through a batch, the outputs are de-energised and an alarm signalled. Timeout: 0-999s.
Batch Limit	The maximum batch limit can be programmed.
End of Batch	An open collector output signals the end of batch.
Auto-Restart	The Batch Controller can be programmed to continually repeat batches with a delay of up to 99 minutes between batches.

Batch Operations

Four key switches on the front fascia, enable the batch quantity to be set, and batch operations to be started, stopped or reset.

To set batch quantity, The Batch Set key is pressed, and then the ▸ and △ keys can be used to change and increment digits. Once set, the Batch Set key is again pressed to return to RUN mode. Key operations are straight forward and four LED's indicate the operational status at all times.

In the RUN mode, the Display key can be used to display Flow Rate, Gross Total, Accumulated Total and Temperature.

The unique four-key operation of the Batch Controller is designed to simplify operation, making the instrument suited to use by operators with minimal training.

General

Display	6 digit 0.7" (17.8mm) high LCD.
Display Update Rate	0.25s.
Data Retention	All set-up parameters and totals are stored in a non-volatile memory with 10 years retention.
Transducer Supply	8-24V dc field adjustable, 50mA maximum.
Power Requirements	
dc Supply:	11.5-28.5V dc, 130mA typical current (no options).
ac Supply:	ac mains set internally to 95-135V ac or 190-260V ac.
Operating Temp	0 to 55°C.

Frequency Input

Frequency Range	
Rate:	0.25 to 10kHz.
Total:	0 to 10kHz.
Input Circuits	Will accept most logic, proximity switch, mV, pulse and reed switch inputs.
Scaling Range	0.1000 to 50,000.

RTD Input

Measurement	
Range:	-100°C (212°F) to 200°C (392°F).
Accuracy:	0.1°C.
RTD Type	PT100.
Linearity Correction	Internally compensated.
Adjustment	Offset can be programmed to compensate for RTD tolerance.

4-20mA Inputs

Measured	Flow, temperature and density.
Input Impedance	250 ohms.
Measurement Accuracy	0.05%.
Isolation	Inputs are non-isolated.

Temperature Measurement Ranges

General Liquids	-273°C to 200°C (-459°F to 392°F).
Petroleum	-100°C to 200°C (-148°F to 392°F).
LPG	-45°C to 60°C (-49°F to 140°F).

Pulse Output

Type	Open collector.
Pulse Width	10ms (negative going pulse).
Max Rate	49 pulses per second.
Scaling	The pulse output is scaled and outputs one pulse each time the accumulated total increments.

Relay Outputs

Max Power	1250VA.
Max Voltage	250V ac, 30V dc.
Max Current	5 Amps.

4-20mA Output Option (Model 405L only)

Resolution	10 bits.
Accuracy	Better than 0.1%.
Maximum Load	500 ohms internally powered. 950 ohms if powered from 24V.
Isolation	Output is isolated.

RS232/422 Option

Baud Rate	300-9600.
Parity	None, odd or even.
Word Length	7 or 8 bits.
ID Code	0-999.
Clock	24 hour clock will keep time for a minimum of 72 hours without power to the instrument.
Date	US or European format.

Optional Enclosures

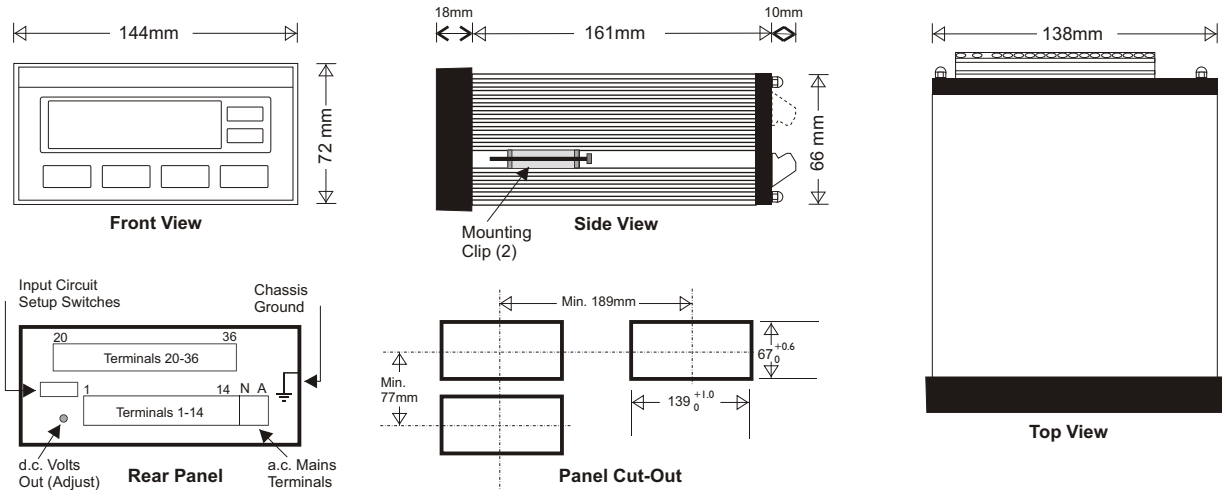
Field Enclosures	IP67 (Nema 4X).
Explosionproof Enclosures	CENELEC, FM, CSA and SAA approved enclosures available for hazardous areas.

Approvals

Electrical Interference	ETL (US) approved to UL 508 and CSA. CE Compliance.
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Important: Specifications are subject to change without notice.

Dimension Drawings



Terminal Descriptions

Standard Terminal Connections 405LR & 414LR			
No.		No.	
1	Calibration Link	8	Flow Common (-)
2	Signal Ground	9	Flow Pulse Input (Ch. 1)
3	Flow Pulse Input (Ch. 2)	10	Pulse Out
4	PT100 I (+)	11	dc Power Out (8-24V)
5	PT100 Signal (+)	12	dc Ground
6	PT100 Signal (-)	13	dc Power Input
7	Flow Alarm	14	PT100 (-)

Standard Terminal Connections 405LA & 414LA			
No.		No.	
1	Calibration Link	8	Flow Common (-)
2	Signal Ground	9	Flow Pulse Input (Ch. 1)
3	Flow Pulse Input (Ch. 2)	10	Pulse Out
4	Not to be used	11	dc Power Out (8-24V)
5	Temperature Input (4-20mA)	12	dc Ground
6	Not to be used	13	dc Power Input
7	Flow Alarm	14	Flow Input (4-20mA)

Relay Outputs 405L	
No.	
31	Relay 2 - Normally Open
32	Relay 2 - Normally Closed
33	Relay 2 - Common
34	Relay 1 - Normally Open
35	Relay 1 - Normally Closed
36	Relay 1 - Common

Relay Outputs & Switches 414L	
No.	
28	Remote RUN Switch
29	Remote STOP Switch
30	End of Batch
31	Relay 2 - Normally Open
32	Relay 2 - Normally Closed
33	Relay 2 - Common
34	Relay 1 - Normally Open
35	Relay 1 - Normally Closed
36	Relay 1 - Common

RS232/422/485 Option All Models	
No.	
20	RS232 Signal Ground
21	RS232 Data In
22	RS232 Data Out
23	RS422/485 (-) Data Out
24	RS422/485 (+) Data Out
25	RS422/485 (-) Data In
26	RS422/485 (+) Data In
27	RS232 CTS

Analog Flow Output (4-20mA) - 405L Only	
No.	
20	Not to be used
21	0 Volts
22	0-10 Volts
23	-12 Volts
24	I (-)
25	I (+)
26	+15 Volts
27	Not to be used

Ordering Information

When specifying please indicate model(s) required using the following method.

<p>Basic Model 405 Flow Computer 414 Batch Controller</p> <p>Liquid Compensation - L</p> <p>Temperature Input Type RTD Temperature Input - R 4-20mA Temp/Density Input - A</p> <p>Mounting Options Panel Mount - 1 Field Mount Enclosure - N Explosionproof Enclosure - 3</p>	<h3>405 L R . 1 0 E</h3>	<p>Power Supply E - 220-240V ac A - 110-120V ac D - 12-28V dc J - 100V ac</p> <p>Communications 0 - No options 1 - 4-20mA (Model 405L only) 2 - RS232/422/485 3 - High/low flow rate (Model 405L only) 4 - 4-20mA and high/low flow rate (Model 405L only) 5 - RS232/422/485 and high/low flow rate (Model 405L only)</p> <p><i>Note: It is not possible to combine the 4-20mA and RS232/422/485 options in one instrument</i></p>
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