RS232/422/485
COMMUNICATION OPTION
FOR THE 400 SERIES

01/03/2014

CONTENTS

1. OVERVIEW

This manual is a supplement to the main operating manual for the instrument, and contains information specific to the RS232/422/485 Option.

Details of the RS232/422/485 Interface are covered in the main operating manual in the section entitled "The RS232/422/485 Interface Option". Programming the setup parameters for the option are covered in the section entitled "Calibration". Both these sections of the instrument operating manual should be read, prior to reading this manual.

In connecting to computers or printers, the user should also have relevant information about the device to which the instrument is being connected. Even though some examples are included in this manual, the operation and connection of the computer or printer is outside the scope of this manual.

This manual applies to the following instruments with RS232/422/485 options:

Models 405A, 405B, 405D, 405Q, 405LA, 405LR, 405S.
Models 414A, 414B, 414D, 414Q, 414LA and 414LR.
Models 415A, 415C and 415R.

2. COMPUTER COMMUNICATIONS

2.1 HARDWARE INTERCONNECTION

Communication with the computer is via either the RS232, RS422 or RS485 interface. The appropriate interface is selected during Calibration.

RS422

Connection to the RS422 interface is shown below:

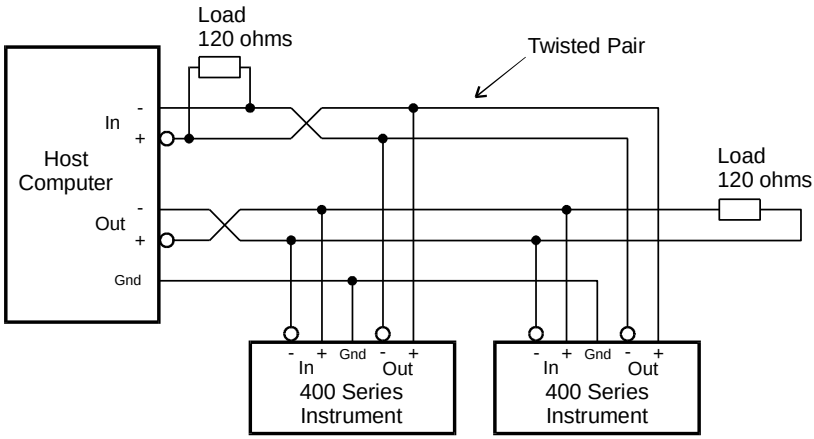


Diagram 1

Note that on RS422 links, an external terminating resistor must be used. This must be connected at the furthest point from the transmitting device. When multiple instruments are connected, they should be "daisy chained" and the terminating resistor put at the instrument furthest from the computer and at the computer, as shown.

RS485

Connection to the RS485 interface is shown below:

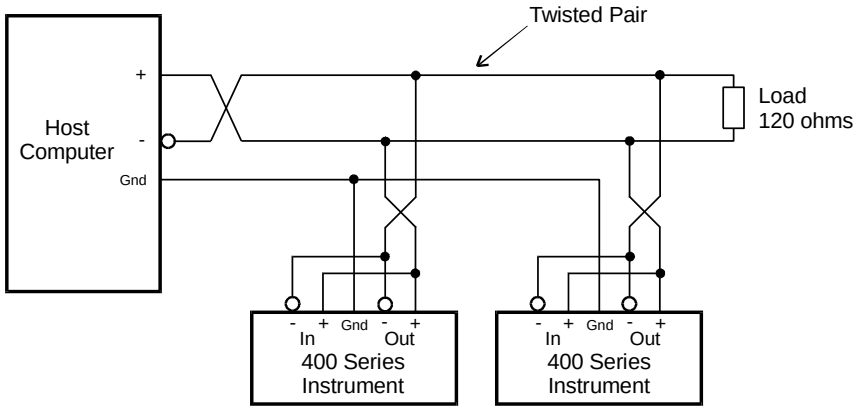


Diagram 2

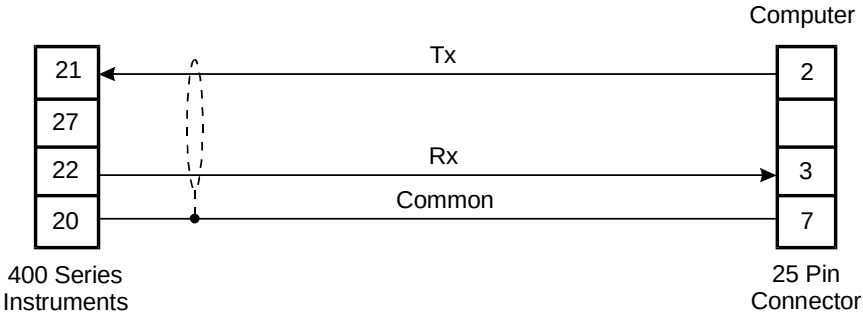
Note that on RS485 links, an external terminating resistor must be used and should only be connected at the furthest end of the cable. When multiple instruments are connected, they should be "daisy chained" in a multidrop configuration as shown in diagram 2. Up to 32 units can be connected to the interface. All 400 series instruments, when fitted with the RS232/422/485 interface option, require the following connections.

To convert the RS422 interface to an RS485 interface, the RS422 (-) Data In Terminal must be connected to the RS422 (-) Data Out Terminal and the RS422 (+) Data In Terminal must be connected to the RS422 (+) Data Out Terminal. These connections will convert the RS422 4 wire interface to the RS485 2 wire interface, as shown in diagram 2.

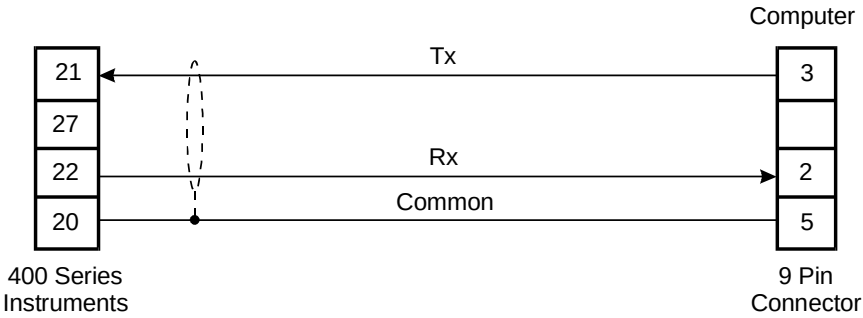
To enable RS485 operation, set "SIGNAL" to RS422 in the options menu during instrument calibration. Consult the instrument operation manual for specific terminal designations and calibration details.

RS232

Computers use either 9 pin or 25 pin D type connectors and connections to each type are shown below. In DOS based computers the serial port is generally termed COM1 or COM2.



Connection to Computers with 25 Pin Connectors



Connection to Computers with 9 Pin Connectors

2.2 SOFTWARE PROTOCOL

Two types of protocol are supported on the serial interface board:

- Standard ASCII Protocol, where all messages are terminated by a carriage return.

- Framed ASCII Protocol, where all messages are started with a colon (:) and terminated by a carriage return.

Note: Only the 405 and 414 models (not including 405S, 415A, 415C and 415R) that are operating with software versions 4.120 and greater support the selection of the Framed ASCII Protocol.

For the relevant models the selection of protocol type is by means of a link on the serial interface board. The factory default setting for the communications protocol is for standard ASCII protocol. If the framed ASCII protocol is required then a link should be placed and LK A8 on the serial option board. When this link is in position the selection of the framed protocol is indicated by the message "**Fr. Pro**" which is displayed at the end of the **Option** sequence in calibration.

When the framed protocol is selected there are some additional changes from the standard protocol which allow for greater control, flexibility and verification via the serial communication interface. These additional features are covered in the following sections on Framed ASCII Protocol.

ASCII Protocol is commonly used since it is easy to interface to, using "string" commands which are supported by C and Basic.

Maximum Delay Time

There must be no more than a 2 second delay between successive characters transmitted from a host computer or terminal. If there is more than a 2 second delay, the first character after the delay will be accepted as the first character of a new command, ie. the buffer receiving the input characters are cleared after a character timeout has elapsed.

Important Note

Commands sent to the instruments cannot, and should not, be concatenated together.

2.2.1 Echoing Commands

The 405S and 415 instruments can be programmed to Echo all commands it receives back to the host computer. This is termed Full Duplex and is most often used with a terminal which is also working in Full Duplex mode.

Alternatively, on these instruments the Echo can be programmed to off and command strings are not echoed back to the host computer. This is called Half Duplex and is commonly used in communicating with computers.

The 405 and 414 instruments only operate in half duplex mode where the command strings are not echoed back to the host computer.

2.2.2 Response Times

For the 405 and 414 models with software versions 4.120 and greater the whole string or command is processed at one time after having received a carriage return which allows the response time from previous versions to be much improved. Regardless of the command, the time from the receipt of the carriage return terminating the command to the first character of the response is nominally less than 160ms.

2.2.3 Standard ASCII Protocol

This protocol requires that all command strings be terminated with a carriage return and the command will only be executed on receipt of the carriage return.

All messages received from the instrument will be terminated with a carriage return and a line feed.

2.2.4 Framed ASCII Protocol

This protocol requires that all command strings be initiated with a colon (:) and terminated with a carriage return. The command will only be responded to after the receipt of both the colon and carriage return.

On receipt of the frame start character ":", a new message is started and any unterminated commands are cleared. The unit will not execute any command if it was not commenced with a colon. All responses sent from the instrument will be terminated with a carriage return and a line feed.

2.3 COMMANDS AND RESPONSES FOR STANDARD PROTOCOL

Commands sent to the instruments consist of two ASCII characters. If the command includes a value (such as a batch quantity), the value follows immediately after the two characters. Commands can be sent in upper or lower case. Unrecognised commands are answered with a "Invalid Command" message from the instrument.

Single Instrument Communications

If a single instrument is connected to a computer, the ID number for that instrument should be programmed during the instrument Calibration procedure to:

ID = 0

All commands issued by the computer will always be accepted by the instrument and there is no need for the computer to address the instrument with an ID number.

Multipoint Communication

Where a number of instruments are connected over a common RS422/485 bus, each instrument must have its own unique ID number which is programmed during Calibration.

An instrument is selected by the computer sending the command:

IDx
where x is the ID number

Once selected, any of the commands relevant to that instrument can be sent by the computer, without having to again select the instrument.

It is also possible to determine which instrument is currently selected by sending the command:

ID

without the value x. On receiving this command the selected instrument will reply with its ID number.

2.3.1 Flow Computers

The following commands are recognised by all the 405 Flow Computers:

Commands

IDx	Select an instrument, where x is the ID number (x will be accepted with leading zeros). No serial response is returned.
TR	Reset the resettable total.
T?	Request totals to be sent.
R?	Request flowrate to be sent.

On receipt of a "T?" request, the instrument sends the following:

xx	xx.x	xx.x	xx.x	CRLF
ID	Resettable Total	Gross Total (405L)	Accumulated Total	Carriage Return Line Feed

The gross total is only sent by Models 405LA and 405LR. All other models, except the Model 405S, send only the Resettable Total followed directly by the Accumulated Total.

The Model 405S is an exception as follows. On receipt of a "T?" request, the Model 405S sends the following:

xx	xx.x	xx.x	xx.x	CRLF
ID	Net Total	Total 1 (Input 1)	Total 2 (Input 2)	Carriage Return Line Feed

On receipt of a "R?" request, the instrument sends the following:

xx	xx.x	xx.x	CRLF
ID	Rate	Temperature/ Density	Carriage Return Line Feed

The temperature/density is only sent by the Models 405LA & 405LR. All other models send only the rate.

On receipt of a "R?" request, the Model 405S sends the following:

xx	xx.x	xx.x	xx.x
ID	Net Rate	Rate 1 (Input 1)	Rate 2 (Input 2)

All values are variable length and are as displayed on the instrument. The values are transmitted in ASCII with one or more spaces (ASCII code 20) between each field.

2.3.2 Batch Controllers

The following commands are recognised by all 414 Batch Controllers:

Commands

Idx — Select an instrument, where x is the ID number (x will be accepted with leading zeros). No serial response is returned.

BVxx.x — New batch value to be entered. The value xx.x is a variable length field. All values including the decimal are sent as ASCII characters. The value is tested against the limits entered under BATCH in calibration. The Batch Controller must be in the Delivery Complete status to use this command.

BS — Request Status of the Batch Controller. The Batch Controller will return an ASCII value to indicate the status of the instrument as follows:

xx	*xx*
ID	Status

Status

1 — Batch Delivery is complete.

2 — Batch is Paused.

3 — Batch is in Slow Start cycle.

4 — Batch is in Prestop cycle.

5 — Batch is in Full Flow cycle (ie. both relays energised).

Commands

Status

6 Batch Delivery complete but "End of Batch" has not yet been reached.

7 Flow alarm detected due to signal timeout midway through a batch.

BH Stops or Pauses a Batch Delivery. This is the same as pressing the STOP key on the front facia. A Batch Status message is returned on receipt of this command. The BH command can also be used to acknowledge a flow alarm (or temperature error for Models 414LA and 414LR) in the same way as the STOP key is used.

BR Reset Batch total. The batch total is cleared to zero (if in count up mode) or to the batch preset quantity (if in count down mode). A Batch Status message is returned on receipt of this command. The Batch Controller must be in the Delivery Complete status to reset the batch total.

BC Start or Resume Batch Delivery. This is the same as pressing the RUN key on the front facia. A Batch Status message is returned on receipt of this command.

T? Request batch totals.

R? Request flowrate.

B? Request batch preset.

On receipt of a "T?" request, the instrument sends the following:

xx ID No	xxxx Batch	xx.x Batch Total (414L)	xx.x Gross Total	xx.x Accumulated Total	CRLF Carriage Return Line Feed

The Gross total is only sent by Models 414LA and 414LR. All other models send only the Batch total followed directly by the Accumulated total.

On receipt of a "R?" request, the instrument sends the following:

xx	xx.x	xx.x	CRLF
ID	Rate	Temperature/ Density	Carriage Return Line Feed

The temperature/density is only sent by the Models 414LA & 414LR. All other models send only the rate.

All values are variable length and as displayed on the instrument itself. The values are transmitted in ASCII with one or more spaces (ASCII Code 32) between each field.

2.3.3 Gas & Steam Computers

The following commands are recognised by all Model 415 Gas & Steam Flow Computers:

Commands

IDx The instrument ID number and the value (either 1 or 2 ASCII characters depending on the value).

VR Reset Totals. On receipt of the VR command, the instrument replies with the instrument ID Number, IDx.

V? Request Totals to be sent. In reply, the instrument sends the following:

xx	xx.x	xx.x	CRLF
ID	Volume Total or Energy Total (Steam only)	Mass Total	Carriage Return Line Feed

For the Model 415C, the instrument responds with:

xx	xx.x	xx.x	xx.x	xx.x	CRLF
ID	Net Energy Total	Mass Total	Steam Total	Condensate Total	Carriage Return Line Feed

Commands

R? Request Flowrates to be sent. In reply, the instrument sends the following:

xx ID	xx.x Volume Rate or Energy Rate (Steam only)	xx.x Mass Rate	CRLF Carriage Return Line Feed

For the Model 415C, the instrument responds with:

xx ID	xx.x Net Energy Rate	xx.x Mass Rate	xx.x Steam Rate	xx.x Condensate Rate	CRLF Carriage Return Line Feed

P? Request Pressure to be sent. The instrument responds with:

xx ID	xx.x Pressure	CRLF Carriage Return Line Feed

For the Model 415C, the instrument responds with:

xx ID	xx.x Steam Pressure	xx.x Condensate Pressure (as programmed in Setup)	CRLF Carriage Return Line Feed

T? Request Temperature to be sent. The instrument responds with:

xx ID	xx.x Temperature	CRLF Carriage Return Line Feed

For the Model 415C, the instrument responds with:

xx ID	xx.x Steam Temperature	xx.x Condensate Temperature	CRLF Carriage Return Line Feed

Commands

D? Request Flowing Density. The instrument will responds with:

xx	xx.x	CRLF
ID	Density	Carriage Return
		Line Feed

B? For General Gas, the instrument will respond with the base compressibility, Z_b. If the instrument is programmed for steam, the enthalpy value, h, will be returned. The format is:

xx	xx.x	CRLF
ID	Z_b or h	Carriage Return
		Line Feed

For the Model 415C, the instrument will respond with the steam enthalpy value followed by the condensate enthalpy value. The format is:

xx	xx.x	xx.x	CRLF
ID	Steam	Condensate	Carriage Return
	Enthalpy, h	Enthalpy, h	Line Feed

F? For General Gas, the instrument will respond with the flowing compressibility, Z_f. If the instrument is programmed for Natural Gas the supercompressibility value, F_{PV}, will be returned and for steam, the Specific Weight, ν, will be returned. The format is:

xx	xx.x	CRLF
ID	Z_f, F_{PV} or ν	Carriage Return
		Line Feed

2.4 COMMANDS AND RESPONSES FOR FRAMED PROTOCOL

Commands sent to the instruments consist of the frame start character (colon :) and two ASCII characters. If the command includes a value (such as a batch quantity), the value follows immediately after the two character command. Commands can be sent in upper or lower case. Unrecognised commands are answered with a "Invalid Command" message from the instrument.

Single Instrument Communications

If a single instrument is connected to a computer, the ID number for that instrument should be programmed during the instrument Calibration procedure to:

ID = 0

All commands issued by the computer will always be accepted by the instrument and there is no need for the computer to address the instrument with an ID number.

Multipoint Communication

Where a number of instruments are connected on a common RS422/485 bus, each instrument must have its own unique ID number which is programmed during Calibration.

An instrument is selected by the computer sending the command:

:IDx
where x is the ID number

Once selected, any of the commands relevant to that instrument can be sent by the computer, without having to again select the instrument.

It is also possible to determine which instrument is currently selected by sending the command:

:ID

without the value x. On receiving this command the selected instrument will reply with its ID number.

2.4.1 Flow Computers

The following commands are recognised by all the 405 Flow Computers:

Commands

:IDx	Select an instrument, where x is the ID number (x will be accepted with leading zeros). No serial response is returned.
:TR	Reset the resettable total.
:T?	Request totals to be sent.
:R?	Request flowrate to be sent.

On receipt of a ":T?" request, the instrument sends the following:

xx	xx.x	xx.x	xx.x	CRLF
ID	Resettable Total	Gross Total (405L)	Accumulated Total	Carriage Return Line Feed

The gross totals are only sent by Models 405LA and 405LR. All other models send only the Resettable Total followed directly by the Net Accumulated Total and then the carriage return and line feed.

On receipt of a "R?" request, the instrument sends the following:

xx	xx.x	xx.x	CRLF
ID	Rate	Temperature/ Density	Carriage Return Line Feed

The temperature/density is only sent by the Models 405LA & 405LR. All other models send only the rate.

All values are variable length and are as displayed on the instrument. The values are transmitted in ASCII with one or more spaces (ASCII code 0x20) between each field.

2.4.2 Batch Controllers

The following commands are recognised by all 414 Batch Controllers:

Commands

:IDx Select an instrument, where x is the ID number (x will be accepted with leading zeros). No serial response is returned.

:BVxx.x New batch value to be entered. The value xx.x is a variable length field. All values including the decimal are sent as ASCII characters. The value is tested against the limits entered under BATCH in calibration. The unit responds with its ID number and the batch preset value that the instrument has accepted. This is the same as for a :B? command. The Batch Controller must be in the Delivery Complete status to change the batch value.

:BS Request Status of the Batch Controller. The Batch Controller will return an ASCII value to indicate the status of the instrument as follows:

xx	*Sxx*
ID	Status

The upper case "S" preceding the actual status number indicates the characters after the ID number is a status number. This eliminates any possible confusion between response types.

Status

01 Batch Delivery is complete.

02 Batch is Paused.

03 Batch is in Slow Start cycle.

04 Batch is in Prestop cycle.

05 Batch is in Full Flow cycle (ie. both relays energised).

06 Batch Delivery complete but "End of Batch" has not yet been reached.

07 Flow alarm detected due to signal timeout midway through a batch.

Commands

Status

08 Temperature Error has been detected midway through a batch (for Models 414LA and 414LR only).

09 The instrument is in either calibration or batch set mode. Unit can still be selected and deselected in this status.

:BH Stops or Pauses a Batch Delivery. This is the same as pressing the STOP key on the front facia. A Batch Status message is returned on receipt of this command. The BH can also be used to acknowledge a flow alarm (or temperature error for Models 414LA and 414LR) in the same way as the STOP key is used.

:BR Reset Batch total. The batch total is cleared to zero (if in count up mode) or to the batch preset quantity (if in count down mode). A Batch Status message is returned on receipt of this command. The Batch Controller must be in the Delivery Complete status to reset the batch total.

:BC Start or Resume Batch Delivery. This is the same as pressing the RUN key on the front facia. A Batch Status message is returned on receipt of this command.

:T? Request batch totals.

:R? Request flowrate.

:B? Request batch preset.

On receipt of a ":T?" request, the instrument sends the following:

xx ID	xxxx Batch No	xx.x Batch Total	xx.x Gross Total (414L)	xx.x Accumulated Total	CRLF Carriage Return Line Feed

The gross totals are only sent by Models 414LA and 414LR. All other models send only the Batch total followed directly by the Net Accumulated total and then the carriage return and line feed.

On receipt of a ":R?" request, the instrument sends the following:

xx	xx.x	xx.x	CRLF
ID	Rate	Temperature /Density	Carriage Return Line Feed

The temperature/density is only sent by the Models 414LA & 414LR. All other models send only the rate.

On receipt of a :B? request, the instrument sends the following:

xx	xx.x	CRLF
ID	Preset Value	Carriage Return Line Feed

All values are variable length and as displayed on the instrument itself. The values are transmitted in ASCII with one or more spaces (ASCII Code 0x20) between each field.

All received commands are given a reply from the instrument. A selected unit will reply with a Batch Status to all commands if the unit is in calibration or batch set mode.

2.4.3 Practices to Achieve Guaranteed Communications

Since the :IDx command (see 1.2.2 Multipoint Communication for details) for selecting an instrument on a multipoint communication line does not return any response it is suggested that to ensure no communications errors a delay of at least 200ms must separate the :IDx command and any subsequent command.

It is also suggested good practice to follow any :IDx selection command with an :ID request to check that the desired unit is selected. And to ensure that it is only the desired instrument that is selected the host computer should continue to scan for received data for a minimum of 200ms (not just to the first terminating CRLF) to ensure that no other instruments are selected. If more than one instrument replies or there is corrupted data the :IDx selection command will need to be resent. This safety measure need only apply to the first ID request command after a IDx selection command.

3. PRINTER COMMUNICATIONS

The following printers are supported by the Models 405 and 414:

PTYPE

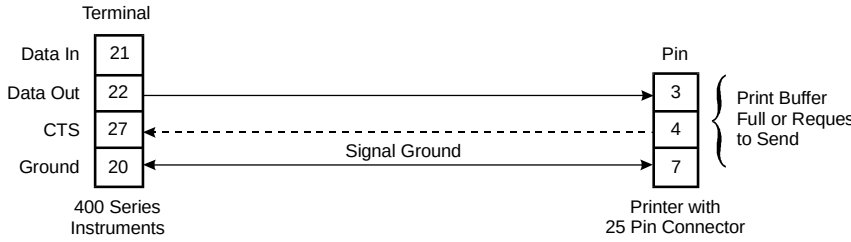
00	Standard Computer Printer
01	Epson CTM290 Slip Printer
02	Contrec Model 624 Printer
03	Epson CTM290-2 / TM-295 Slip Printer
04	Contrec Model 632-2 Printer
05	Syntest SP-210

PTYPE refers to the menu displayed during the instrument Calibration when the appropriate printer must be selected.

The Model 415 Gas & Steam Computer will operate with printer types 00, 02, 04 and 05 but does not support the slip printers.

3.1 HARDWARE INTERCONNECTION

1. Standard Computer Printer

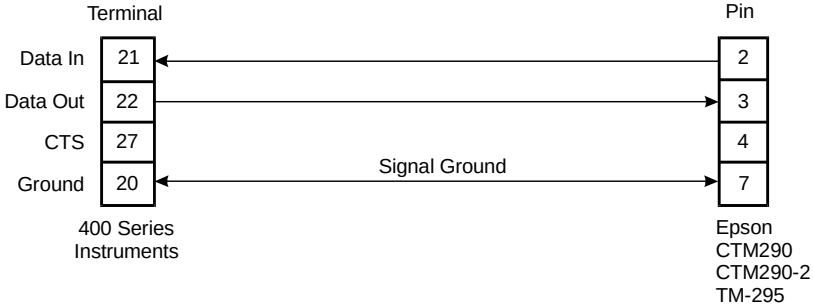


The printer must have a serial interface installed to be able to communicate with the instrument. Communication via a parallel port on the printer is not possible.

Normally, it is only necessary to connect the Data Out signal and the Signal Ground. However, the CTS input on the instrument also allows a "Print Buffer Full" or "Request to Send" output from the printer to be connected to the instrument. This line is used only when the printer has a very small buffer and there is danger of overwriting the contents of the printer's buffer (see operating manual for the printer).

In most cases the printer will have an adequate buffer and this line can be left unconnected.

2. Epson CTM290 and CTM290-2 Slip Printer



The Data In line from the printer must be connected for the interface to work properly. The instrument interrogates the CTM290 to ensure that there is paper in the printer before printing a ticket.

For the Epson CTM290-2 and TM-295, interconnect pins 6, 8 and 20 on the printer's 25 way connector and when CTS is not used, interconnect pins 4 and 5. When the 400 Series instrument is programmed for:

9600 baud
8 bits
and no parity

set all DIP switches OFF on the slip printer.

DIP switches on the printer should only be changed while the printer power is OFF.

3.2 OPERATION

With the Flow Computers, a ticket is printed whenever the RESET key is pressed. The Flow Computer will first print the ticket and then reset to zero.

The Batch Controllers will print a ticket on reaching the "End of Batch" (see instrument operating manual for a description of End of Batch).

The Gas & Steam Flow Computer, Model 415, can be programmed to print a ticket whenever the RESET key is pressed, as well as at programmed time intervals (see the Model 415 Operating Manual).

3.3 INFORMATION PRINTED

The format with which the data is printed depends on the type of printer selected. Samples of different printouts are included at the end of this section.

Each printout includes the following:

1. Header — This is a factory programmed header on the ticket which can show the company or product name. (Maximum 30 characters.)

   The required header must be specified on ordering the instrument.

2. Unit ID — This is the ID number programmed during Calibration.

3. Ticket Number — The ticket number is a sequential number which increments and is printed with every ticket. It enables each ticket to be uniquely identified.

4. Time/Date — An internal clock enables the ticket to be printed with the time & date. The date can be programmed to print in European (dd/mm/yy) or US (mm/dd/yy) format.

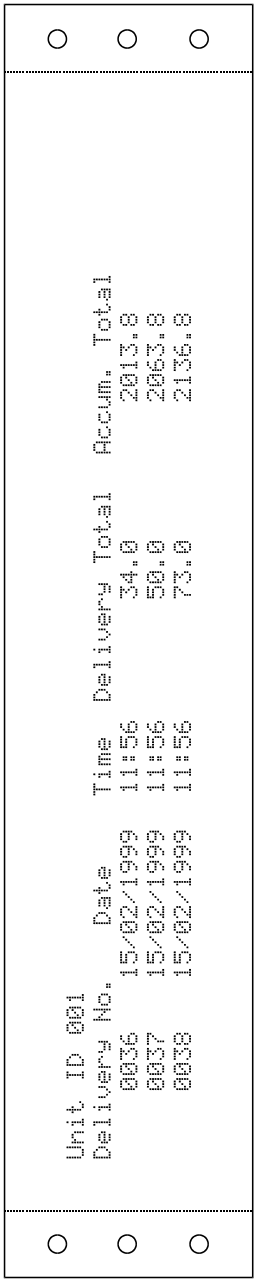
   Note that the clock can only maintain the time/date for a maximum of 3 days without power applied to the instrument.

The remainder of the ticket comprises of the totals as displayed on the front LCD display.

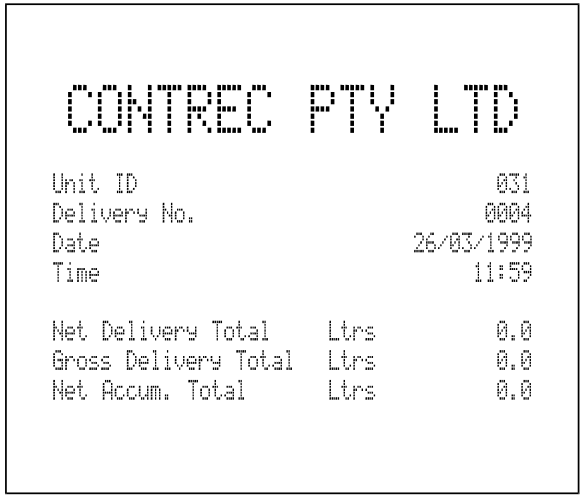
The Model 405S will print the rates as well as the totals.

The Model 415 will print the total which was selected as the default display together with the temperature and pressure.

The Model 415C will print the steam and condensate temperatures, the steam and condensate pressures and the mass, steam, condensate and net energy totals.



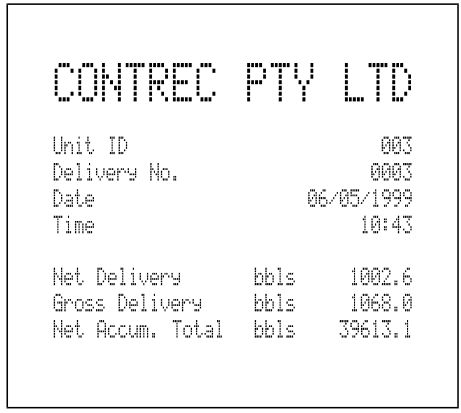
Example of a printout for a standard 80 Column computer printer (not to scale).
No header is shown with this printout.



CONTREC PTY LTD

Unit ID		031
Delivery No.		0004
Date		26/03/1999
Time		11:59
Net Delivery Total	Ltrs	0.0
Gross Delivery Total	Ltrs	0.0
Net Accum. Total	Ltrs	0.0

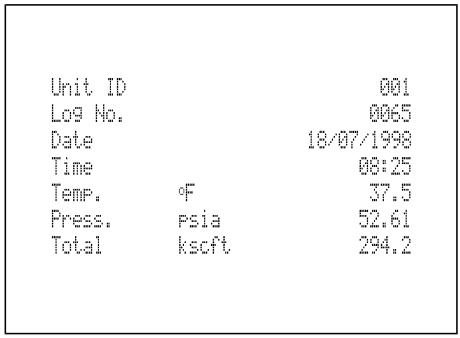
Example of a ticket printed on an Epson CTM290 printer (not to scale).



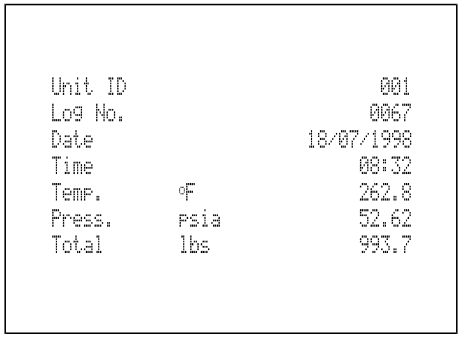
CONTREC PTY LTD

Unit ID		003
Delivery No.		0003
Date		06/05/1999
Time		10:43
Net Delivery	bbls	1002.6
Gross Delivery	bbls	1068.0
Net Accum. Total	bbls	39613.1

Example of a ticket printed on a Model 624 Roll Printer (not to scale).



Example of a ticket for the Model 415 programmed for gas flow (not to scale).



Example of a ticket for the Model 415
programmed for steam with energy as the default display (not to scale).