CHAPTER 15, GAS FLOW CALCULATING RTUs

15.01 SUMMARY:

Modern gas production, transportation and distribution companies are faced with an increasing need to accurately calculate gas flow, especially at custody transfer metering points. The age old circular chart mechanisms have proven unreliable and inaccurate for many applications.

Modern RTUs are capable of calculating and correcting gas flow in orifice runs, turbine meters, orifice flow meters and other metering runs at a far greater accuracy than that obtainable with circular charts.

15.02 GAS FLOW EQUIPMENT AND ACCESSORIES

ScanData manufactures different RTUs that have found their way into the gas production, transmission and distribution industries. Among them are the SLR, the LMR, the LMX, the SMR and the M-system RTUs.

ScanData also manufactures accessories such as the C24 12V to 24V converter, the FSD-202A line splitter and combiner (multi drop amplifier), the FWA series of line amplifiers and a wide range of specialized Telemetry and Scada test equipment.
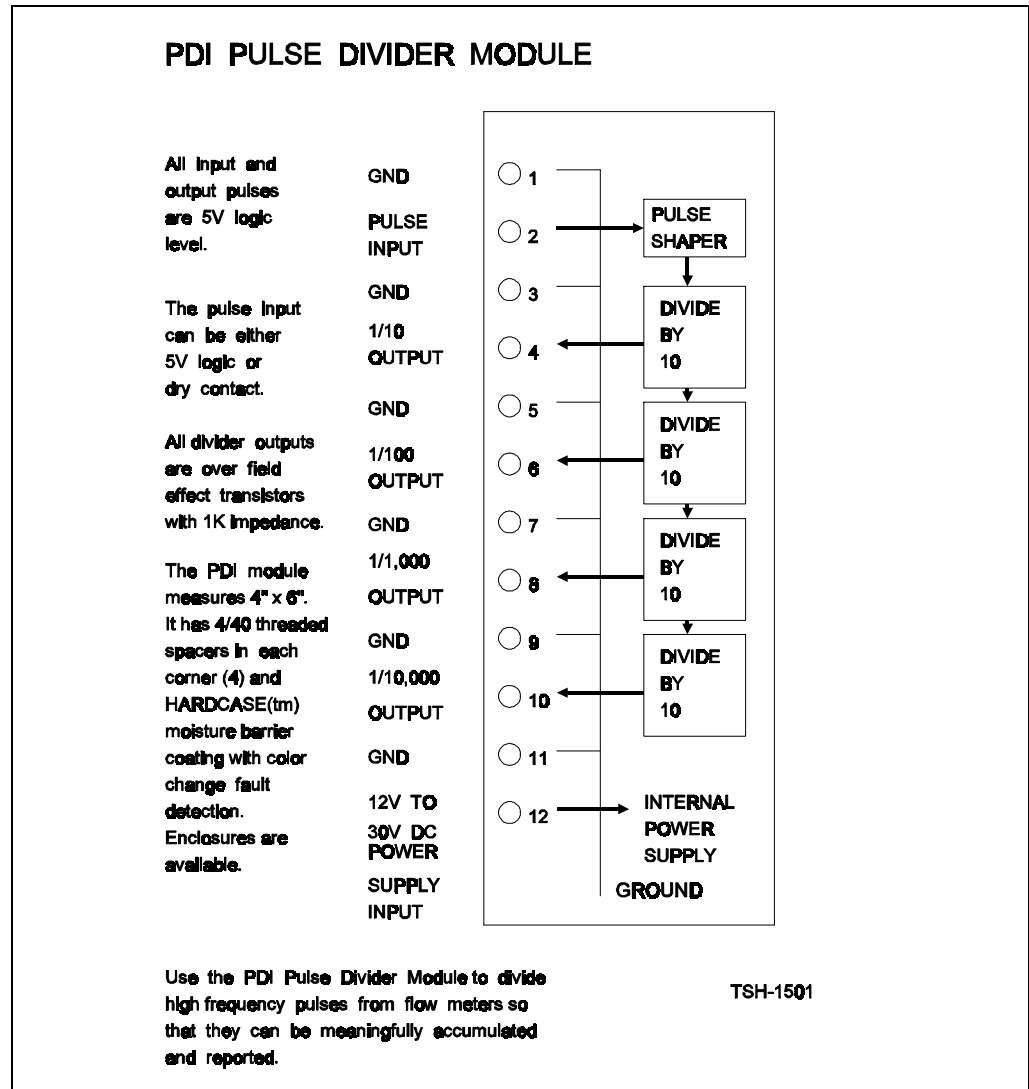
15.03 THE PDI PULSE DIVIDER MODULE

The PDI pulse divider module is a device often used by gas companies in installations where the pulses from a pulsing flow meter are output at a very high rate, too high to meaningful count and accumulate.

These pulses can be converted to an analog signal and reported as a flow rate. There are disadvantages with this approach. The flow rate very often varies very rapidly. To use this flow rate to calculate accumulated flow at certain time intervals would introduce serious errors as it the flow rate between the intervals is not taken into account.

It is better to divide the flow pulses into pulses that can be accumulated and corrected. Each pulse then represents a unit of flow and accuracy is maintained.

The PDI module allows dividing the flow pulses by 110, 100, 1,000 or by 10,000.

PDI PULSE DIVIDER MODULE

All input and output pulses are 5V logic level.

The pulse input can be either 5V logic or dry contact.

All divider outputs are over field effect transistors with 1K impedance.

The PDI module measures 4" x 6". It has 4/40 threaded spacers in each corner (4) and HARDCASE(tm) moisture barrier coating with color change fault detection. Enclosures are available.

Pin	Signal
1	GND
2	PULSE INPUT
3	GND
4	1/10 OUTPUT
5	GND
6	1/100 OUTPUT
7	GND
8	1/1,000 OUTPUT
9	GND
10	1/10,000 OUTPUT
11	GND
12	12V TO 30V DC POWER SUPPLY INPUT

PULSE SHAPER → DIVIDE BY 10 → DIVIDE BY 10 → DIVIDE BY 10 → DIVIDE BY 10

INTERNAL POWER SUPPLY GROUND

Use the PDI Pulse Divider Module to divide high frequency pulses from flow meters so that they can be meaningfully accumulated and reported.

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15.04 GAS FLOW CALCULATING RTUs

The SMR and M-system RTUs make excellent gas flow calculators. The ScanData gas flow circular chart replacement RTU software fills today's increased demands on accuracy and details in gas flow reporting. In addition to the SMR and M-system, Scandata has many other RTUs available, among them the SLR (Super Low Power RTU) which is designed to very cost effectively connect to compensated flow meters.

15.05 SMR & M-SYSTEM RTUS:

Installing SMR or M-system RTUs at main purchase and delivery points makes for a state of the art gas flow reporting system. The RTUs connect to the existing orifice and/or turbine metering runs and calculate the full AGA gas flow calculation with supercompressibility. These RTUs can be remotely accessed over the phone line, over radio and leased cable or locally accessed with a laptop computer.

15.06 SLR RTUS:

Low cost SLR RTUs can be installed at metering points where compensated flow meters are available and where there is no need for gas flow calculations. The SLR operates on its internal battery for up to five years and can share an existing phone line.

15.07 COMMUNICATION MODES:

The RTUs can connect to telephone company supplied RJ-1l jacks. The SMR and M-system RTUs also operate in Mode-B (scanned) operation where one or more central PC 386/486 computer(s) periodically dial (or scan) the RTUs with the ScadaGraph(tm), ScadaMaster(tm) or AutoAcc(tm) software. These programs are not copy protected and can run in several different computers.

15.08 REPORT HANDLING:

Reports from each RTU are automatically printed and stored on disk. Virtually any variable can be reported and logged, such as totalized compensated flow, flow rates, temperature, pressure, delta pressure, maximum and minimum values for each hour, etc. Any RTU operating in Mode-A can be accessed at any time from anywhere with any PC running the ScadaMaster(tm) software.
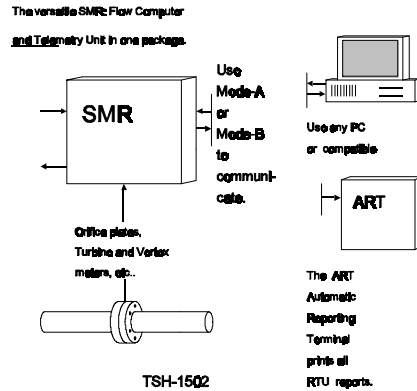
Information from RTUs that cannot be connected to a telephone jack can be downloaded at the site into a laptop computer and then up-loaded into the central station software.

15.09 AUTOMATIC ALARM REPORTS:

The SMR and M-system RTUs has large programming capabilities. Among the instructions that can be programmed into their data bases is alarm telephone numbers to be dialed and the condition under which to dial these numbers. Typically, high and low flow, high and low pressures and contact alarm conditions

can cause alarm out dialing. These RTUs can also be set to dial a number and leave a comprehensive gas flow report once a day.

15.10   THE AUTOMATIC REPORTING TERMINAL (ART):

The versatile SMR Flow Computer and Telemetry Unit in one package.

SMR

Use Mode-A or Mode-B to communi-cate.

Orifice plates, Turbine and Vertex meters, etc..

TSH-1502

Use any PC or compatible

ART

The ART Automatic Reporting Terminal prints all RTU reports.

ScanData manufactures an Automatic Reporting Terminal, the ART, which connects to a dialing telephone line and automatically receives reports from any SMR and M-system RTU. The ART automatically answers incoming calls, performs the necessary hand shakes and then sends the incoming report to a printer connected to the ART.

15.A   AN INTRODUCTION TO THE SMR AND M-SYSTEM FLOW CALCULATION CAPABILITIES

The SMR and M-system are modern telemetry units with built in flow computing capabilities. The nine digit floating point software calculator handles all the flow computing equations with speed and ease.

These RTUs are designed for remote installations at flow measuring and custody transfer sites. They have been proven in over twenty years of service in harsh environments and have earned an excellent reputation for reliability and ease of interfacing with existing systems.

The SMR can handle up to two orifice runs or up to three turbine meter inputs with accuracies far exceeding circular chart procedures.

The M- (modular) system uses the same software package as the SMR but its modularity allows it to be configured to virtually any gas flow computing task. For instance, an M-system calculates nineteen simultaneous gas flow calculations at the EXXON Hondo gas lift platform near Santa Barbara, California.

These RTUs are delivered pre-programmed and ready to run with customer specified gas flow calculation and transducer conversion constants and factors. New constants and values can be programmed in by the customer at any time.

Complete and detailed instructions on how to program the RTUs is included in the manual that is delivered with the RTU. The following is a summary of the programming of the SMR and M-system gas flow calculating RTUs:

15.B   READING THE CORRECTED TOTALIZED FLOW:

The corrected totalized flow (accumulated flow) is always available in the RTU message. It is read in six digits and is normally scaled in thousands of cubic feet (MSCF). It can be scaled to other values.
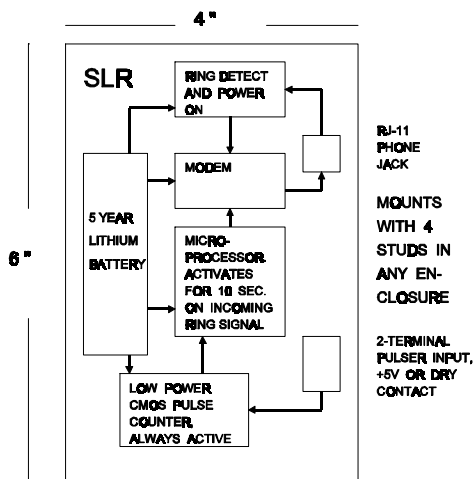
CONNECT THE SLR TO THE FLOW PULSER AND TO THE PHONE LINE. IT ACTIVATES ITSELF. CALL IT FROM ANYWHERE WITH A COMPUTER AND A MODEM TO GET AN ACCURATE ACCUMULATED FLOW COUNT.

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15.C   SETTING THE CORRECTED TOTALIZED FLOW TO CORRESPOND TO A CERTAIN VALUE:

In certain applications it may be necessary to initialize the accumulated flow in the report to coincide with some existing value. This is accomplished by the 'set flow' command to the RTU.

15.D   READING THE HOURLY CORRECTED ACCUMULATED FLOW (FOR UP TO 32 DAYS):

The RTU places the corrected flow total onto a stack on the passing of every hour. This stack is 24 x 32 blocks long, which means that the RTU logs the total totalized flows every hour for up to 32 days. Any one of these day blocks will be delivered on request.

15.E   READING THE TEMPERATURE, PRESSURE, TURBINE METER FLOWS AND ORIFICE DELTA PRESSURES:

These values are always available in the RTU message and are shown in three whole digits and one decimal. Internally they are carried as 9 digits in the flow calculation package for maximum accuracy.

15.F   READING THE CORRECTED FLOW RATE:

The corrected flow rate is always available in the RTU. Scaling of this value, together with the scaling of the totalized flow, can be set by the operator.

15.G   READING THE STATUS (CONTACT AND ALARM) INPUTS:

The status, contact or alarm inputs to the RTU are placed in the message as a **'0'** for an open contact and a **'1'** for a closed contact.

15.H   SENDING COMMANDS (RELAY OPENINGS AND CLOSURES) TO THE RTU:

The relay drivers at the RTU can be made to open or close by sending the secret password along with the proper relay actuator code to the RTU.

15.I   READING THE TIME AND DATE:

The correct time of day and date are always available in the RTU, provided they have been properly set.

15.J   SETTING THE TIME AND DATE:

When the RTU is first powered up, it will be necessary to set the present time and date into the RTU operating memory. This is accomplished by using the **'set time'** and **'set date'** commands.

15.K   READING THE RESULTS OF THE LOAD STUDY:

The RTU has a built in automatic load study program available. The results of this load study are shown in the **'MIN'** and **'MAX'** lines of the SMR report.

The load study program continuously checks the line pressure and the flow rate. If any of these values read lower than the present **'MINDPRE1'** or **'MINFLRAT'** values, the new low value replaces the old and the date and time of this occurrence is placed in the report. The same procedure is applied to the **'MAXDPRE1'** and **'MAXFLRAT'** values.

In this manner, an accurate record of the minimum flows and pressures and of the maximum flow and pressures at the station are maintained. As this load study program can be reset at any time, an accurate record of the hourly variations (if the program is reset every hour) or the daily variations (if the program is reset every day) or of any other time period is automatically obtained.

15.L   RESETTING THE LOAD STUDY PARAMETERS:

The load study program can be made to start from the existing values of pressure and flow over a special reset command. Sending this command sets the minimum and maximum values to the existing values, and record the time when this reset was performed.

15.M   CHECKING PROPER TRANSDUCER OPERATION:

The RTU automatically reports on transducer failures in the **'TRERR'** position in the report message. A faulty transducer is reported as a **'1'**. This transducer error reporting is necessary as the RTU will continue to operate with the fall back default value in the data base, should any transducer fail or be taken out of service.

15.N   CALIBRATING THE TRANSDUCERS:

The span and zero for each transducer can be set by the operator, using the password and the proper command.

15.O   ANALOG ALARMS:

The RTU will alarm (dial out) on many different alarm conditions. The can be set to dial out on out of range analog input conditions. These ranges can be set by the operator. Alarms are shown as below limit (below 4 mA) or as above limit (above 20 mA).

15.P SETTING THE ANALOG ALARM LIMIT CONDITIONS:

The analog alarm limit values can be set and read by the operator, using the proper code and pass words.

15.Q SETTING THE STATUS ALARM CONDITIONS:

The status alarms are activated by special commands from the operator. They can also be set for normally open or normally closed operation.

15.R SETTING TRANSDUCER FAILURE ALARMS:

The transducer failure alarms can also be activated or de- activated. Note that all alarms are de-active on start up, to prevent excessive out dialing should any value be out of limits.

15.S SETTING THE TELEPHONE NUMBERS TO BE DIALED:

The RTU can routinely dial up to three telephone numbers. The desired numbers can be set into the SMR by the operator over the programmable operating memory. These telephone numbers can also be set on an active or non-active status.

15.T SETTING THE 24 HOUR DAILY REPORTING TIME:

The RTU will dial out, once a day, at the end of the measurement day, and report a summary of the day's total corrected flows. A normal RTU report is sent, along with a 24 hour summary of the hourly corrected flows for the last 24 hours.

15.U SETTING SUBSTITUTE (FALL BACK) ANALOG VALUES:

Internal substitute values for temperature, pressure and orifice delta pressure are used by the RTU when a transducer fails or is under repair or calibration. These substitute values are settable by the operator.

15.V   PERFORMING GAS FLOW CALCULATION ACCURACY CHECKS:

As described above, the RTU can use substitute values for all analog inputs needed for the gas flow calculations. The operator can also force the RTU to use substitute values by setting one or more flags in the data base.

In this manner, known analog substitute values can be entered into the RTU and the resulting gas flow calculation can be very accurately checked.

15.X   CHANGING OPERATING MODE BETWEEN TURBINE METER RUNS AND ORIFICE METER RUNS.

The RTU can calculate and correct turbine meter runs or orifice meter runs. On start up, it defaults to a turbine meter run calculator.

An operator settable flag in the operating memory makes the RTU decide what metering mode to choose. Setting the flag to **'1'** changes the RTU to an orifice run calculator.

15.Y   SETTING THE GAS FLOW OPERATING PARAMETERS:

The RTUs have a very complete programmable operating memory with a built in data base manager. These proprietary programs start operating automatically on power up. Pre-programmed values from EPROM are loaded into the programmable operating memory on start up, giving the RTU reasonable starting values for its gas flow calculations. These values can be changed by the operator, using the correct code and password.

15.Y.1   SETTING GAS COMPOSITION PARAMETERS:

The RTU starts operating by loading in the default values of percent dioxide and percent nitrogen, specific gravity and other gas calculation parameters from EPROM. The operator can examine and change these values at any time.

15.Y.2   SETTING BASE PRESSURE:

The base pressure used by the RTU at start up is 14.73. It can be changed by the operator at any time.

15.Y.3   SETTING PIPE AND ORIFICE DIAMETERS:

The RTU defaults on start up to a pipe diameter of 3.068" and an orifice diameter of 1.50" for both runs. These are operator changeable.

15.Y.4   SETTING THE TURBINE METER FACTOR:

The RTU looks at the turbine meter factor in the programmable data base to see how many cubic feet per pulse of uncompensated flow to use in its calculation. The start up default is normally 1,000 cubic feet per pulse (or per revolution). This is operator changeable.

15.Y.5   SETTING THE CALCULATION SCALING FACTOR:

The scaling factor affects both the flow rate and the totalized flow. This scaling factor is normally set to give a flow rate and a totalized flow in thousands of standard cubic feet per hour (MSCF/H). It can be examined (using the secret password) and changed to any value.

The value of **'001000'** (the start up default value) makes the RTU report flow rate and totalized (accumulated) corrected flow in thousands of standard cubic feet per hour. The value of **'0100000'** makes the RTU report in hundreds of cubic feet, etc. This scaling factor can scale or adjust the calculations up or down in increments as low as 1/10 of one percent.

15.Y.6   READING THE FLOW VALUES OVER THE LOCAL READOUTS:

In certain installations it may be desirable to be able to read the temperature, pressure, primary flow values (turbine meter inputs or delta pressures) and corrected totalized flows over a local read out device.

Both the SMR and M-system RTUs have an optional LED readout panel. It is normally turned off to save current as the station is normally unattended. Pressing a button the the panel makes it cycle through the readings, pausing at each one to give the operator time to read it.

15.Z   CONCLUSION:

The ScanData RTU gas flow computing software packages have been refined in over 20 years of delivering gas flow computing RTUs to major utilities and companies all over the world.

Special RTU software, such as automatic odorizer injection, controlling compressors to meet desired gas flow, gas lift control at offshore wells and others have been developed based on customer requests.

These applications and others have given ScanData a wide experience and a considerable library of specialized gas flow software programs. This experience and this library of software makes it easy for ScanData to meet other customer special requests.

WHERE CAN I GET MORE INFORMATION?

The following descriptions, pertinent to this chapter, are included in the DESCRIPT directory on the SCADAtech(TM) CD:

pri-0901.pdf   Design Guide and Price List.

smr-1142.pdf   SMR gas flow computer programming panel.

smr-1120.pdf   SMR gas flow computer RTU with modem.

smr-1145.pdf   SMR gas flow computer technical manual.

An easy way to get the latest and most recently updated versions of these descriptions is to go on our WEB site:

www.scan-data.com

When you are there, click on the blue button near the bottom of the WEB page that says **Technical Information.** Then click on the description # you need.