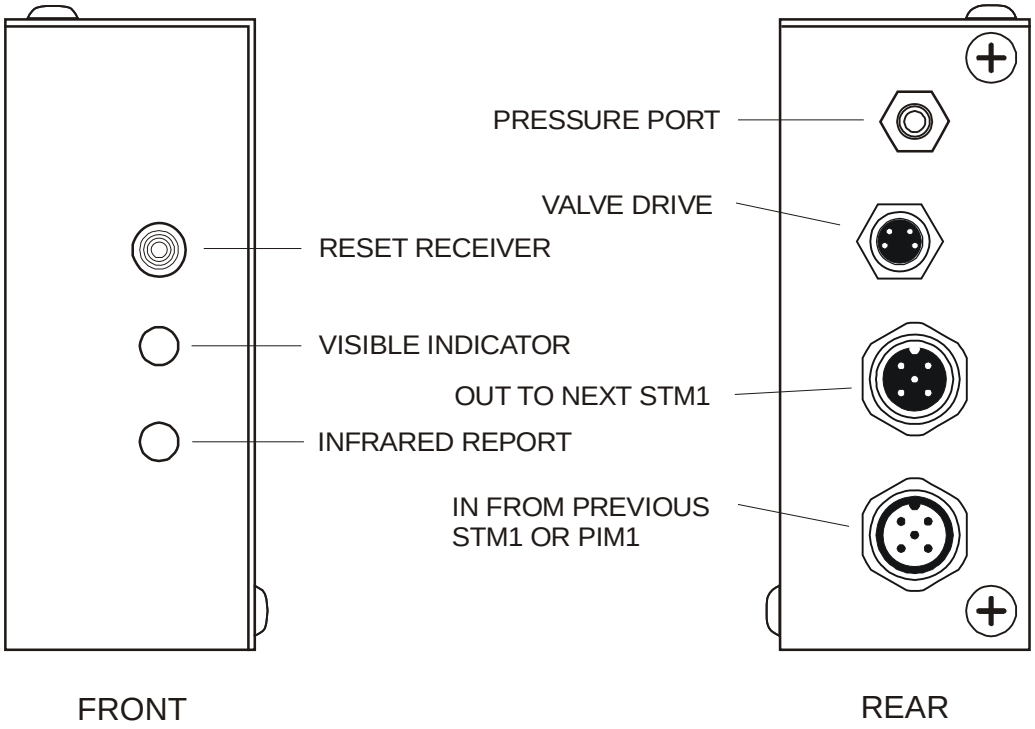
SMART TEST MODULE DOCUMENTATION

Prime Controls, Inc.



This document provides user information for the STM1 smart test module. The STM1 provides a building block for a variety of leak test machines. The machine builder, through the master controller, sets the module parameters and modes for the appropriate machine type and function.

All STM1 modules communicate with a PIM (PLC Interface Module) via an RS-485 bus. The PIM communicates in ASCII characters with a master controller (usually a PLC) through a simple RS-232 link. The ASCII commands are converted by the PIM to binary commands with error checking and retransmission. Since the RS-485 bus operates half duplex, the modules always operate in slave mode and only communicate on the bus in response to commands and inquiries from the master controller.

Once set up, the STM1 acts autonomously in performing the test function. The type of test performed is determined by the mode (M parameter) assigned to the STM1 by the master controller. Most STM1 modes are for executing leak tests, however, several modes exist for diagnostic purposes only. The STM1 modes are:

Mode	Description
0	Idle mode – no test mode active.
1	Transmit new pressure value every 10 mS while ATTN asserted.
2	Peak pressure capture, hard-wired reset and reject report (single transducer end test).
3	Peak pressure capture, optical reset and reject report.
4	Two-point container decay test using hard-wired reset and reject report.
5	Two-point container decay test using optical reset and reject report.
6	Two-point pocket test using hard-wired reset and reject report.
7	Two-point pocket test using hard-wired reset and reject report.
8	Two-point container decay test with fast fill and vent and using hard-wired reset and reject report.
9	Two-point container decay test with fast fill and vent and using optical reset and reject report.
10	Optical input diagnostic.
11	Optical output and valve switch diagnostic.

Each mode is described in more detail later in this document.

Control Connections

STM1 modules connect to each other and to a PIM1 or master controller through standard industrial cables.

Cable:	5 conductor, 22AWG, PUR jacketed.
Inter-module Connectors:	12 mm circular, 5 pole
Sensor Input Connector:	12 mm circular, 5 pole male
Sensor Output Connector:	12 mm circular, 5 pole female.

Each STM1 has one male 12mm circular connector through which power, the RS-485 signals from the master controller, and a logic input are brought into the unit. Each unit also has one female 12 mm circular connector through which power, the RS-485 bus, and one logic output pass on to the input of another STM1 if multiple sensors are in use.

The number of STM1 modules on a leak test machine may vary from 1 to 128, limited only by the number of devices that can be supported on the RS485 bus without a repeater. When a single STM1 module is used on a machine, the reset and reject functions may be hard-wired using the ATTN signals available on the 12mm circular connectors. When multiple STM1s are used on a machine, the reset and reject reporting is done through optical devices.

In multi-sensor systems, the cables connect in a daisy-chain fashion from the output connector of one module to the input connector of the next module. The last module output connector must be terminated with a special connector containing a terminating resistor for the RS-485 bus.

The five conductors carry signals and/or power as follows:

Brown:	+24 volts @ 3 amps
Blue:	Common
Gray:	ATTN (attention) signal
White:	RS-485 high side
Black:	RS-485 low side

In multi-sensor arrangements all signals except ATTN are connect in parallel within each module. The ATTN signal is daisy chained from one module to the next. The incoming ATTN signal of the first module in the chain connects to the ATTN output of a PIM or a logic output of a master controller. The outgoing ATTN signal from the first module connects to the incoming ATTN signal of the 2nd module in the chain, the 2nd output to the 3rd input, etc.

The RS-485 high and low side conductors are a differential pair that carry the RS-485 serial signals. ATTN is used to get the attention of a specific sensor module before the modules have been assign a specific address or ID. The master controller or PIM controls the ATTN signal to the first sensor module. Each module controls the ATTN signal that connects from that module's output connector to the input connector of the next module in the chain.

The STM1 optical reset requires a visible light source, chopped at 2000 Hz as provided by the Prime model RI100 Reset Illuminator. The STM1 optical report is in the form of an infrared LED flashing at a 5000 Hz rate. The Prime model RR100 Reject Receiver is designed to receive the chopped infrared signal from the STM1 and drive a controller logic input.

An 8 mm circular connector on the STM1 provides two drive outputs for controlling valves during the test process. These outputs, when on, supply 24 volts at up to 500 mA. The pattern of switching the valve outputs is determined by the test mode in effect.

The STM1 has one multicolor LED for communicating status to the user.

Command Interface

All STM1s on a machine connect to the same RS-485 bus for communication with a master controller. The master controller communicates with STMs through a PIM (PLC Interface Module) that drives the RS-485 bus. The master controller communicates with a PIM through an RS-232 port set for either 9600 or 38400 baud (See separate PIM1 document).

STM internal parameters are accessed using single letter identifiers. The “F” identifier, together with a numeric argument, invokes a variety of special functions as defined later in this document. The commands are listed immediately below and defined in detail later in this document. All command entries must be terminated with a return character (ASCII 13).

Command Summary

- **A** Return **A**ll parameter values – inquiry only.
- **B** Set or read the **B**egin test time value – the first test point of slope test.
- **C** Set or read the container **C**harge (fill) time limit value.
- **D** Set or read the test pressure **D**elta threshold value. The delta is measured between first and second test points.
- **E** Set or read the **E**nd test time value – the second test point of slope test.
- **F** **F**unction command. Executes function defined by the function number.
- **I** Set module address value.
- **L** Set or read the **L**ow limit for vent pressure (Version 1.10 and higher).
- **M** Set or read the test **M**ode value.
- **N** Set or read the limit for mi**N**imum delta (Version 1.09 and higher).
- **O** Set or read the pocket test purge valve **O**pen time.
- **P** Read the most recent adjusted **P**ressure value (P = U – Q).
- **Q** Set or read the pressure offset adjustment value.
- **R** Read the most recent test **R**esults.
- **S** Set the **S**ystem type (also sets the module address to zero.
- **T** Set or read the test **T**hreshold value.
- **U** Read the most recent **U**nadjusted pressure
- **V** Set or read the fill **V**alve turn-off pressure.
- **W** Set or read the vent valve turn-off pressure (Version 1.07 and higher).

See Command Details later in this document

Function Definitions

The functions that may be invoked through the F command are listed here.

F0 Transmit the firmware version number.

F1 Turn valve 1 on.

F2 Turn valve 1 off.

F3 Turn valve 2 on.

F4 Turn valve 2 off.

F5 Turn the ATTN output on.

F6 Turn the ATTN output off.

F7 Turn the green LED on.

F8 Turn the green LED off.

F9 Turn the red LED on.

F10 Turn the red LED off.

F11 Turn both green and red on.

F12 Turn the IR LED on.

F13 Turn the IR LED off.

F14 Turn on valve modulation – modally remembered through power cycles.

F15 Turn off valve modulation – modally remembered through power cycles.

F16 Display the logic levels of the ATTN input (A), the reset receiver input (I), and the hardware pressure monitor comparator (P).

F17 Generates the pressure offset value Q by averaging 64 readings at the current pressure. The sensor must be vented to atmosphere for accurate calibration.

F18 Return the vent pressure value (See “L” parameter).

Command Details

A Inquiry only. Can be invoked from all modes though the relevance of particular parameters depends upon the mode currently in effect.

*nn***A?** Return all setup parameters from station nn in a single string. The returned parameter string begins with the two-digit module address followed by the four-digit parameters B, C, D, E, T, V, M and O in that order. Units with firmware version 1.07 or higher also return the "W" parameter in the string in the following order: B, C, D, E, T, V, W, M and O. Units with firmware version 1.09 or higher also return the "N" parameter in the string in the following order: B, C, D, E, T, V, W, M, O, N. The parameters are defined individually below.

B Command sets and reads the B parameter. Applies to modes 4, 5, 6, 7, 8 and 9, all firmware versions.

*nn***B***dddd* Set the test start time to dddd where dddd can be any value from 0 to 1000 Resolution is .01 seconds, max value is 10 seconds. This value must be less than the ending value E. The B value is non-volatile.

*nn***B?** Display the current test start time in units of 0.01 seconds for station nn.

C Command sets and reads the C parameter. Applies to modes 4, 5, 6, 7, 8, and 9, all firmware versions.

*nn***C***dddd* Set the C time value for station nn to dddd where dddd can be any value from 0 to 1000. Resolution is .01 seconds, max value is 10 seconds. In Modes 4, 5, 8, and 9, the C parameter sets a limit for the charge valve on-time in the event the pressure fails to build enough to trigger automatic turn-off. In Modes 6 and 7 this parameter determines when the purge valve is closed. The C value is non-volatile.

*nn***C?** Displays the current valve close time in units of .01 seconds for station nn.

D

Command sets and reads the D parameter. Applies to modes 4, 5, 6, 7, 8 and 9, and all firmware versions.

*nn***D***dddd* Set the delta threshold to dddd where dddd can be any value from 0 to 2000. In modes 4, 5, 8 and 9, the delta is computed as the pressure reading at time B minus the pressure reading at time E. During test, if the measured delta is greater than this threshold, a reject is reported. In modes 6 and 7, the delta is computed as the pressure reading at time E minus the pressure reading at time B. If the measured value is greater than this threshold, a reject is reported. The D value is non-volatile.

*nn***D?** Displays the current delta threshold value (format dddd) for station nn.

E

Command sets and reads the E parameter. Applies to modes 4, 5, 6, 7, 8, and 9.

*nn***E***dddd* Set the test end time to dddd where dddd can be any value from 0 to 1000. Resolution is .01 seconds, max value is 10 seconds. This value must be greater than the B value. The E value is non-volatile.

*nn***E?** Displays the current test end time for station nn in units of 0.01 seconds

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F

Command executes special functions. Applies to all modes.

*nn***F***dd* Execute function dd. The function codes are defined later in this document.

I

Command sets the module address. This command must be executed once after power up or after any execution of the S command.

0I*dd* Assign address value dd to the STM whose ATTN line is asserted. Note that the addressed module must have an address of zero to receive a new address. Consequently, any module with address greater than zero ignores this command. All module addresses are set to zero at power up. Broadcasting the system command (S) also forces all addresses to zero.

L Command sets and reads the L parameter. Applies to modes 6 and 7, firmware versions 1.10 and higher.

*nn***L***dddd* Set the vent pressure threshold to dddd where dddd can be any value from 0 to 2000. In modes 6 and 7, the peak pressure value is captured in the interval between reset and the close of the purge valve (C time). If the L threshold is set to a non-zero value and the captured peak pressure (vent pressure) is less than this threshold, a reject is reported. If this threshold value is set to zero, a test for minimum vent pressure is not performed. The L value is non-volatile. Use F18 to read the vent pressure.

*nn***L?** Displays the current minimum vent pressure threshold value (format dddd) for station nn.

M Command sets and reads the M parameter. Applies to all modes.

*nn***M***dd* Changes the mode for station nn to dd, where dd can be any value from 0 through 11. The modes are defined later in this document. Modes cannot be changed directly from one non-zero value to another. An attempt to do so will force the mode to zero from which other modes may be selected. The mode value is volatile.

*nn***M?** Displays the current mode value for station nn.

N Command sets and reads the N parameter. Applies to modes 6 and 7, firmware versions 1.09 and higher.

*nn***N***dddd* Set the minimum delta threshold to dddd where dddd can be any value from 0 to 2000. In modes 6 and 7, the delta is computed as the pressure reading at time E minus the pressure reading at time B. If this threshold is set to a non-zero value and the measured delta value is less than this threshold, a reject is reported. If this threshold value is set to zero, a test for minimum delta is not performed. The N value is non-volatile.

*nn***N?** Displays the current minimum delta threshold value (format dddd) for station nn.

O

Command sets and reads the O parameter. Applies to modes 6 and 7.

*nn***O***dddd* Set the purge valve open time to dddd where dddd can be any value from 0 to 1000. Resolution is .01 seconds; max value is 10 seconds. The fill valve is closed at this same time. This parameter applies to pocket testing only. The O value is non-volatile.

*nn***O?** Displays the purge valve open time value for station nn.

P

Command reads the pressure value. Applies to all test modes.

*nn***P?** Displays the current adjusted pressure value. This value is read-only and has the Q offset applied. The returned value may range from 0 to 4095, the 12-bit range of the analog to digital converter. The conversion factor to PSI depends upon pressure range of the STM model in use. See the section on **Pressure Scaling** later in this document.

Q

Command sets and reads the Q parameter. Applies to all test modes.

*nn***Q***dddd* Set the pressure offset for station nn to dddd where dddd may be any value from 0 to 500. Normally the Q value is set by executing function F17. This command allows the offset value to be forced to zero. The Q value is non-volatile.

*nn***Q?** Displays the current pressure offset for station nn.

R

Command reads the latest test results. Applies to modes 2 through 9.

*nn***R?** Returns the last test results for station nn. The values that are returned are a function of the mode setting. This command affects the state of the STM1 visual LED and reject signals in modes 4 through 9. See individual mode descriptions for details.

S

Command sets and reads the system type and sets the module addresses to zero. This command is mode independent.

255S*d* Sets the system type to d for all stations. This command acts as a reset to all modules. Its effect is to set all module addresses to zero, all modes to zero, and turn all valves off.

*nn***S?** Displays the system type recorded at station nn.

T

Command sets and reads the T parameter. Applies to modes 2, 3, 4, 5, 6, 7, 8, and 9.

*nn***T***dddd* Sets the absolute test threshold value for station nn to dddd where dddd can be any value from 0 to 4095. The threshold value may range from 0 to 4095. The conversion factor to PSI depends upon pressure range of the STM model in use. See the section on **Pressure Scaling** later in this document. The T value is non-volatile.

*nn***T?** Displays the current value of the threshold register for station nn.

U

Command reads the unadjusted pressure. Applies to modes 2, 3, 4, 5, 6, 7 8, and 9.

*nn***U?** Displays the current unadjusted pressure value. This value is read-only and does not have Q offset applied. The pressure value may range from 0 to 4095, the 12-bit range of the analog to digital converter. The conversion factor to PSI depends upon pressure range of the STM model in use. See the section on **Pressure Scaling** later in this document.

V

Command sets and reads the V parameter. Applies to modes 8 and 9.

*nn***V***dddd* Sets the value of the valve threshold for station nn to dddd where dddd can be any value from 0 to 4095. This register sets the reference pressure against which the charge pressure value is compared to automatically de-energize the fill valve output. The four least significant bits of the value represented by V have no meaning since the number is scaled down by a factor of 16 before being used by the hardware. The conversion factor to PSI depends upon pressure range of the STM model in use. See the section on **Pressure Scaling** later in this document.

*nn**V**?* Displays the current value of the fill valve threshold for station nn.

W Command sets and reads the W parameter. Applies to modes 8 and 9. This parameter exists only in firmware Versions 1.07 and later.

*nn***W***dddd* Sets the value of the vent threshold for station nn to dddd where dddd can be any value from 0 to 4095. This register sets the reference pressure against which the charge pressure value is compared to automatically turn the vent valve output off. The four least significant bits of the value represented by W have no meaning since the number is scaled down by a factor of 16 before being used by the hardware. The conversion factor to PSI depends upon pressure range of the STM model in use. See the section on **Pressure Scaling** later in this document.

*nn***W?** Displays the current value of the vent valve threshold for station nn.

Mode Descriptions

The mode value is normally specified after a module has been powered up, the system type has been specified through the S command, and the module address has been assigned through the I command while ATTN is asserted. The mode value is specified through the M command and is a volatile parameter i.e. it defaults back to zero if power is lost. The available modes are as follows:

Mode 0	Idle mode. LED flashed green at a 1 Hz rate.
Mode 1	Transmit pressure value repetitively every 10 mS while ATTN is asserted.
Mode 2	Single transducer peak pressure capture using hard-wired or optical reset and report.
Mode 3	Single transducer peak pressure capture using only optical reset and report.
Mode 4	Negative slope decay test using hard-wired or optical reset and report.
Mode 5	Negative slope decay test using optical reset and report.
Mode 6	Positive slope (pocket) test using hard-wired or optical reset and report.
Mode 7	Positive slope (pocket) test using optical reset and report.
Mode 8	Two-point decay test with rapid fill and vent, using hard-wired or optical reset and report.
Mode 9	Two point decay test with rapid fill and vent, using optical reset and report.
Mode 10	Diagnostic mode for Optical pickup.
Mode 11	Diagnostic mode for optical pickup, optical report and valve drivers.

The modes operate as described below

Mode 0 Idle mode. Green LED flashes at 1 Hz rate.

Mode 1 Read and transmit pressure value repetitively (every 10 mS) while ATTN is asserted.

The REPORT outputs, both optical and hardwired, are off.
LED is amber when ATTN not asserted.
LED is green when ATTN is asserted.

The pressure value is captured and transmitted every 10 milliseconds while ATTN is asserted. The return value is in the form of nnpppp where nn is the address of the module and pppp is a four digit pressure reading from the analog to digital converter. The returned pressure has been adjusted by the Q offset value.

This mode is intended to allow continuous display or collection of pressure data either for test or calibration purposes.

Mode 2 Single transducer peak capture mode. This mode uses either hard-wired or optical RESET and REPORT and requires that the following parameters be specified before testing begins:

T = test threshold pressure.

Initial State:

REPORT, both hard-wired and optical, not asserted (indicating reject)
VALVE off
LED amber

Repeat steps 1 through 8 until mode is changed.

1. Set REPORT off (reject condition) and LED to amber
2. Await assertion of ATTN or optical RESET
3. Turn on VALVE1, set LED to green, set optical and hardware REPORT on (accept condition), and initialize peak capture registers
4. Read the pressure
5. If pressure exceeds threshold T, then
   REPORT, hard-wired and optical, turns off (reject condition)
   LED set to red
   Else
   REPORT, hard-wired and optical, remains on
   LED remains green
   End if
6. If pressure exceeds captured peak, replace peak with new pressure
7. IF RESET still asserted go to step 4
8. Save peak pressure value in the Response Array for retrieval through the **R?** command then go to step 2 then go to step 1

If the master controller issues the **R?** command after end of test, the peak pressure value is returned.

Parameter change/update/interrogate is available in this mode.

Mode 3 Single transducer Peak capture mode. This mode uses optical only RESET and REPORT and requires that the following parameters be specified before testing begins:

T = test threshold pressure.

Initial State:

REPORT not asserted (indicating reject)
VALVE off
LED amber

Repeat steps 1 through 8 until mode is changed.

1. Set REPORT off (reject condition) and LED to amber
2. Await assertion of optical RESET
3. Turn on VALVE1, set LED to green, set optical REPORT on (accept condition), and initialize peak capture registers
4. Read the pressure
5. If pressure exceeds threshold T, then
   REPORT off (reject condition)
   LED set to red
   Else
   REPORT remains on
   LED remains green
   End if
6. If pressure exceeds captured peak, replace peak with new pressure
7. IF RESET still asserted go to step 4
8. Save peak pressure value in the Response Array for retrieval through the **R?** command then go to step 2 then go to step 1

Mode 4. Container decay test (negative slope) mode. This mode uses either hard-wired or optical RESET and REPORT and requires that the following parameters be specified before testing begins:

C = valve close time (.01 second resolution, max = 10 sec.)

B = time value for pressure 1 sample

E = time value for pressure 2 sample

D = delta threshold (max allowed pressure 1 minus pressure 2)

T = minimum pressure for valid test

V = valve turn-off threshold

Initial State:

REPORT, both hard-wired and optical, not asserted (indicating reject)
VALVE1 off
LED = red
Data Available Flag = false

Repeat steps 1 through 12 until a new mode is selected.

1. If ATTN or optical RESET asserted, go to step 4
2. If Data Available Flag is true, go to step 1 Else set LED to red and set REPORT to off (reject)
3. Wait for assertion of ATTN or optical RESET
4. Set LED to amber, VALVE1 on, Initialize the Timer
5. If Timer = C time, insure VALVE1 off. If fill pressure exceeds V value, VALVE1 turns off automatically
6. If Timer = B time, capture pressure reading P1
7. If Timer = E time, capture pressure reading P2 Else go to step 5
8. Compute Delta = Abs(P1-P2)
9. If Delta < D threshold and P1 > T threshold then set Delta = max
10. Save Delta and P1 value in Response Array for retrieval by **R?** and set the Data Available Flag
11. If Abs(Delta) > Delta threshold or P1 < T threshold THEN
    Set REPORT, hard-wired and optical, off (reject condition)
    Set LED red
    Else
    Set REPORT, hard-wired and optical, on (accept condition)
    Set LED green
    End if
12. Wait for ATTN and optical RESET to be released then go to 1

If the master controller issues the **R?** command after end of test in this mode, the delta value and the first test point pressure reading are returned in that order. The **R?** command also resets the Data Available Flag, after which the LED is set to red and the REPORT is set to off.

Parameter change/update/interrogate is available in this mode.

Mode 5. Container decay test (negative slope) mode using only optical RESET and REPORT. This mode requires that the following parameters be specified before testing begins:

C = valve close time (.01 second resolution, max = 10 sec.)

B = time value for pressure 1 sample

E = time value for pressure 2 sample

D = delta threshold (max allowed pressure 1 minus pressure 2)

T = minimum pressure for valid test

V = valve turn-off threshold

Initial State:

REPORT not asserted (indicating reject)
VALVE off
LED = red

Repeat steps 1 through 12 until a new mode is selected.

1. If optical RESET asserted, go to step 4
2. If Data Available Flag is true, go to step 1 Else set LED to red and set optical REPORT to off (reject)
3. Wait for assertion of optical RESET
4. Set LED to amber, VALVE1 on, Initialize the Timer
5. If Timer = C time, insure VALVE1 off. If fill pressure exceeds V value, VALVE1 turns off automatically
6. If Timer = B time, capture pressure reading P1
7. If Timer = E time, capture pressure reading P2 Else go to step 5
8. Compute Delta = Abs(P1-P2)
9. If Delta < D threshold and P1 > T threshold then set Delta = max
10. Save Delta and P1 value in Response Array for retrieval by **R?** and set the Data Available Flag
11. If Abs(Delta) > Delta threshold or P1 < T threshold THEN
    Set optical REPORT off (reject condition)
    Set LED red
    Else
    Set optical REPORT on (accept condition)
    Set LED green
    End if
12. Wait for release of optical RESET to be released then go to 1

If the master controller issues the **R?** command after end of test in this mode, the delta value and the first test point pressure reading are returned in that order. The **R?** command also resets the Data Available Flag, after which the LED is set to red and the REPORT is set to off.

Parameter change/update/interrogate is available in this mode.

Mode 6 Pocket (positive slope) test mode using hard-wired or optical RESET and REPORT. This mode requires that the following parameters be specified before testing begins:

C = purge valve close time (.01 second resolution)

B = time value for first pressure sample

E = time value for second pressure sample

L = low limit for pressure during vent (set to zero to exclude test)

O = time value for opening the purge valve

D = delta threshold

N = minimum delta threshold (set to zero to exclude test)

T = max absolute pressure threshold for gross leak detection

V = valve turn-off threshold

See the pages that follow for detailed diagram of Mode 6 operation.

If the master controller issues the **R?** command after end of test in this mode, the delta value and the second test point pressure reading are returned in that order. The **R?** command also resets the Data Available Flag, after which the LED is set to red and the REPORT is set to off.

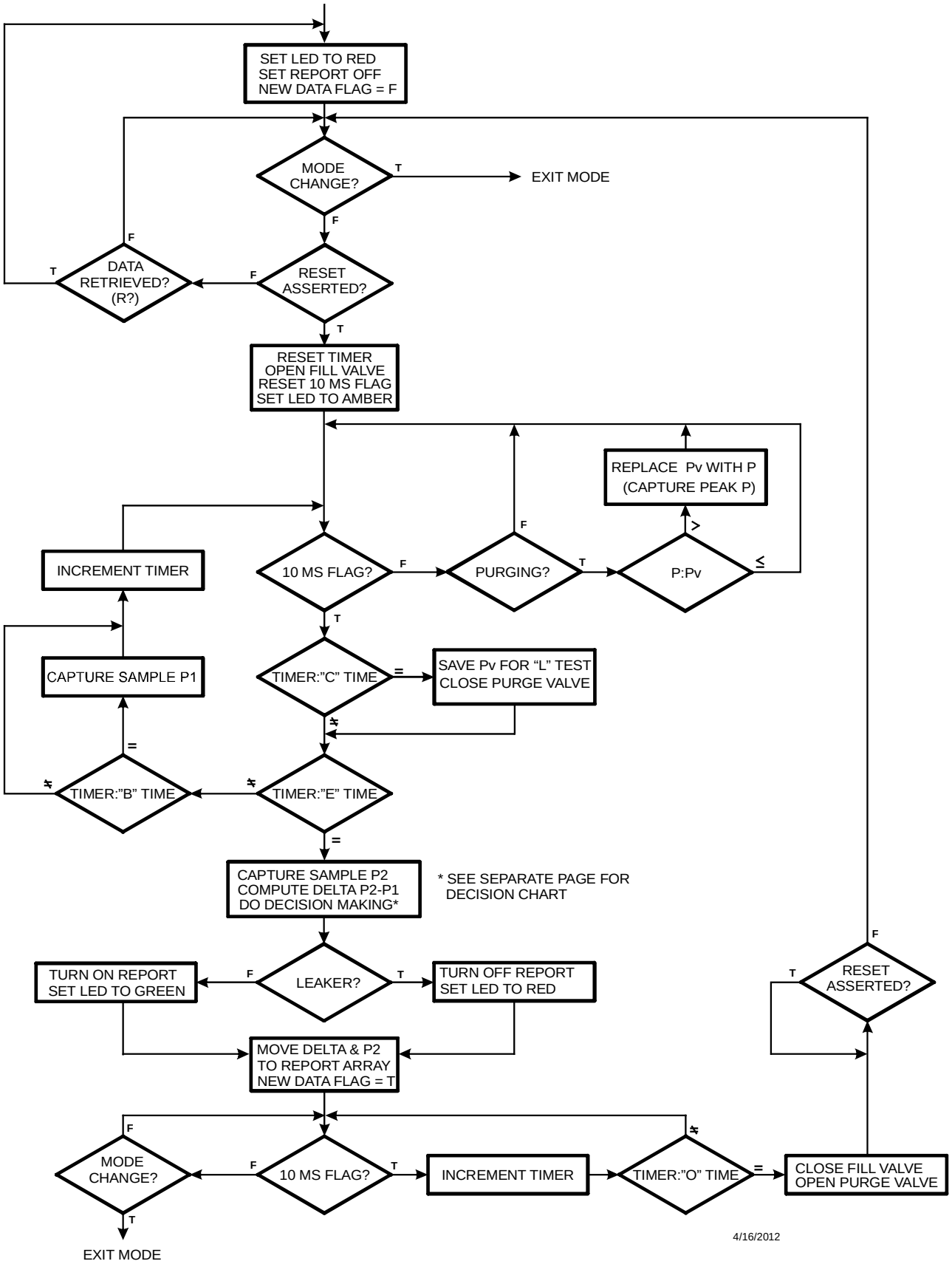
Parameter change/update/interrogate is available in this mode.

Mode 7 This mode is identical to Mode 6 with the exception that the hard-wired RESET and REPORT are disabled; only optical RESET and REPORT can be used.

See the pages that follow for a detailed diagram of Mode 7 operation.

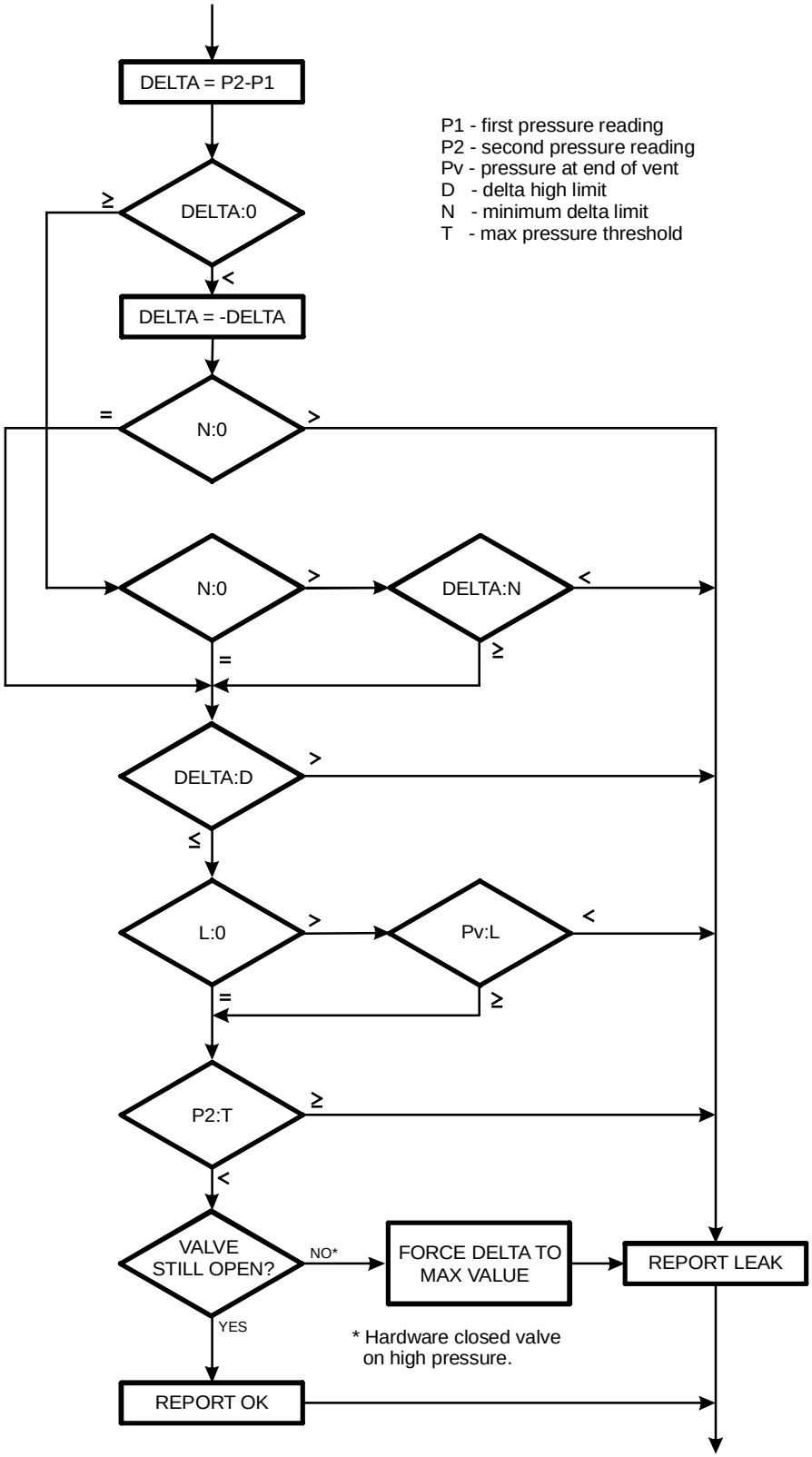
Parameter change/update/interrogate is available in this mode.

STM1 MODE 6 & 7 LOGIC FLOW



STM1 MODES 6 & 7 DECISION LOGIC

FIRMWARE VERSION 1.10 AND LATER



Mode 8 Container decay test (negative slope) mode with “fill and vent”. This mode uses either hard-wired or optical RESET and REPORT and requires that the following parameters be specified before testing begins:

C = fill and vent max time limit (.01 second resolution, max = 10 sec.)

B = time value for pressure 1 sample

E = time value for pressure 2 sample

D = delta threshold (max allowed pressure 1 minus pressure 2)

T = minimum test pressure threshold

V = valve turn-off pressure threshold

W = vent valve turn-off threshold

Initial State:

REPORT, both hard-wired and optical, not asserted (indicating reject)
VALVE1 (Fill) off, VALVE2 (Vent) off
LED = red
Data Available Flag = false

Repeat steps 1 through 15 until a new mode is selected.

1. If ATTN or optical RESET asserted, go to step 4
2. If Data Available Flag is true, go to step 1 Else set LED to red and set REPORT to off (reject)
3. Wait for assertion of ATTN or optical RESET
4. Set LED to amber, VALVE1 on, Initialize the Timer
5. When Timer = C time, if VALVE1 still on, set Reject Flag and turn VALVE1 off, go to step 9
6. If fill pressure exceeds V value, VALVE1 turns off automatically
7. If VALVE1 on, go to step 5 Else turn VALVE2 on
8. If Timer = C time and if VALVE2 still on, set Reject Flag and turn VALVE2 off, go to step 9
9. If pressure falls below W value turn VALVE2 off else go to step 7
10. Capture pressure reading P1 at B time
11. Capture pressure reading P2 at E time
12. If Reject Flag set, set Delta = max value else compute Delta = P1-P2
13. Save Delta and P1 value in Response Array for retrieval by **R?** and set the Data Available Flag
14. If Abs(Delta) > Delta threshold or P1 < T threshold THEN
    Set REPORT, hard-wired and optical, off (reject condition)
    Set LED red
    Else Set REPORT, hard-wired and optical, on (accept condition)
    Set LED green
    End if
15. Wait for ATTN and optical RESET to be released then go to step 1

If the master controller issues the **R?** command after end of test in this mode, the delta value and the first test point pressure reading are returned

in that order. The **R?** command also resets the Data Available Flag, after which the LED is set to red and the REPORT is set to off.

Parameter change/update/interrogate is available in this mode.

Mode 9 Container decay test (negative slope) mode with "fill and vent". This mode uses optical RESET and REPORT and requires that the following parameters be specified before testing begins:

C = fill and vent max time limit (.01 second resolution, max = 10 sec.)

B = time value for pressure 1 sample

E = time value for pressure 2 sample

D = delta threshold (max allowed pressure 1 minus pressure 2)

T = minimum test pressure threshold

V = valve turn-off pressure threshold

W = vent valve turn-off threshold

Initial State:

REPORT not asserted (indicating reject)
VALVE1 (Fill) off, VALVE2 (Vent) off
LED = red
Data Available Flag = false

Repeat steps 1 through 15 until a new mode is selected.

1. If optical RESET asserted, go to step 4
2. If Data Available Flag is true, go to step 1 Else set LED to red and set REPORT to off (reject)
3. Wait for assertion of optical RESET
4. Set LED to amber, VALVE1 on, Initialize the Timer
5. When Timer = C time, if VALVE1 still on, set Reject Flag and turn VALVE1 off, go to step 9
6. If fill pressure exceeds V value, VALVE1 turns off automatically
7. If VALVE1 on, go to step 5 Else turn VALVE2 on
8. If Timer = C time and if VALVE2 still on, set Reject Flag and turn VALVE2 off, go to step 9
9. If pressure falls below W value turn VALVE2 off else go to step 7
10. Capture pressure reading P1 at B time
11. Capture pressure reading P2 at E time
12. If Reject Flag set, set Delta = max value else compute Delta = P1-P2
13. Save Delta and P1 value in Response Array for retrieval by **R?** and set the Data Available Flag
14. If Abs(Delta) > Delta threshold or P1 < T threshold THEN
    Set optical REPORT off (reject condition), Set LED red
    Else
    Set optical REPORT on (accept condition), Set LED green
    End if
15. Wait for optical RESET to be released then go to step 1

If the master controller issues the **R?** command after end of test in this mode, the delta value and the first test point pressure reading are returned in that order. The **R?** command also resets the Data Available Flag, after which the LED is set to red and the REPORT is set to off.

Parameter change/update/interrogate is available in this mode.

Mode 10 Optical I/O Diagnostic. This mode provides a quick check of the functionality of the optical RESET and optical REPORT devices.

With no illumination of the STM1 RESET Receiver the visible LED displays red. To check the RESET receiver, power and enable a Prime Controls model RI100 and illuminate the STM1 RESET Receiver. If the receiver is functioning properly, the visible LED turns green when the receiver is illuminated. Remove the illumination and the visible LED turns red.

In this mode, the STM1 module repetitively turns the infrared REPORT transmitter on for one half second and off for one half second. Place a powered RR100 receiver probe in front of the STM1 infrared transmitter and observe the RR100 output switch repetitively at a 1 Hz rate.

Mode 11 Optical I/O, Valve Driver, and Digital Pot Diagnostic. This mode provides a quick check of the optical RESET, optical REPORT, valve drivers and digital potentiometer.

With no illumination of the STM1 RESET Receiver the visible LED is red. To check the RESET receiver, power and enable a Prime Controls model RI100 and illuminate the STM1 RESET Receiver. If the receiver is functioning properly, the visible LED turns green. Remove the illumination and the visible LED turns red.

In this mode, the STM1 module repetitively turns the infrared REPORT transmitter on for one full second and off for a half second. Place a powered RR100 receiver probe in front of the STM1 infrared transmitter and observe the RR100 output switch repetitively on for 1 second and then off for a half second.

The valve driver diagnostic turns both valves off for half second, then VALVE1 on and VALVE2 off for half second, followed by VALVE1 off and VALVE2 on for half second. The cycle then repeats until the mode is changed.

While the infrared output and valve drivers are cycling, the digital pot is repetitively set to its lowest value for half second, to midrange for half second, and to its highest value for half second. The digital pot output can be observed with an oscilloscope.

Electrical Connections

Male Circular 12 mm 5 Pole:

Connect the male 12mm circular connector through a standard cable color coded as follows:

Pin 1	Brown -	+24 volts (30 mA for single unit without valve)
Pin 3	Blue -	Common
Pin 5	Gray -	ATTN Input (Drive from a sourcing output)
Pin 2	White -	RS-485
Pin 4	Black -	RS-485

Female Circular 12 mm 5 Pole:

Connect through a male-female cable to the next module in sequence or install a terminating connector with 120 ohms between pins 2 and 4.

Pin 1	Brown -	+24 volts out
Pin 3	Blue -	Common
Pin 5	Gray -	ATTN/REJECT out (+23 volts at 50 mA max)
Pin 2	White -	RS-485
Pin 4	Black -	RS-485

Female Circular 8 mm 4 Pole:

Pin 1	Brown -	Common
Pin2	White -	Valve 2 Drive (+23 volts at 0.5A max)
Pin3	Blue -	Common
Pin 4	Black -	Valve 1 Drive (+23 volts at 0.5A max)

Optical Interface

Top:	RESET pickup (requires 2kHz chopped visible light source)
Middle:	STATUS output, (visual, red/green/amber)
Bottom:	REPORT output (5 kHz chopped infrared)

Pneumatic Interface

The pneumatic interface to the STM1 comprises a plastic barbed male fitting, at the top of the rear face, requiring 1/8 inch I.D. tubing.

Electrical Specifications

Power:	24 volts at 30 mA plus valve power Max current through module: 5 Amps
ATTN Input:	Input impedance: 10K ohms to common Max input voltage: 30 volts. Off threshold (high to low): 2.9 volts. On threshold (low to high): 4.0 volts
ATTN Output:	On voltage: Vin minus 1.0 volts Max current: 50 mA Overload protection: Self-resetting thermal fuse Transient protection: 30 volt transient absorber.
Valve Drive Outputs:	On voltage: Vin minus 1.0 volt Max current: 0.5 A continuous Overload protection: Self-resetting thermal fuse Transient protection: 30 volt transient absorber.

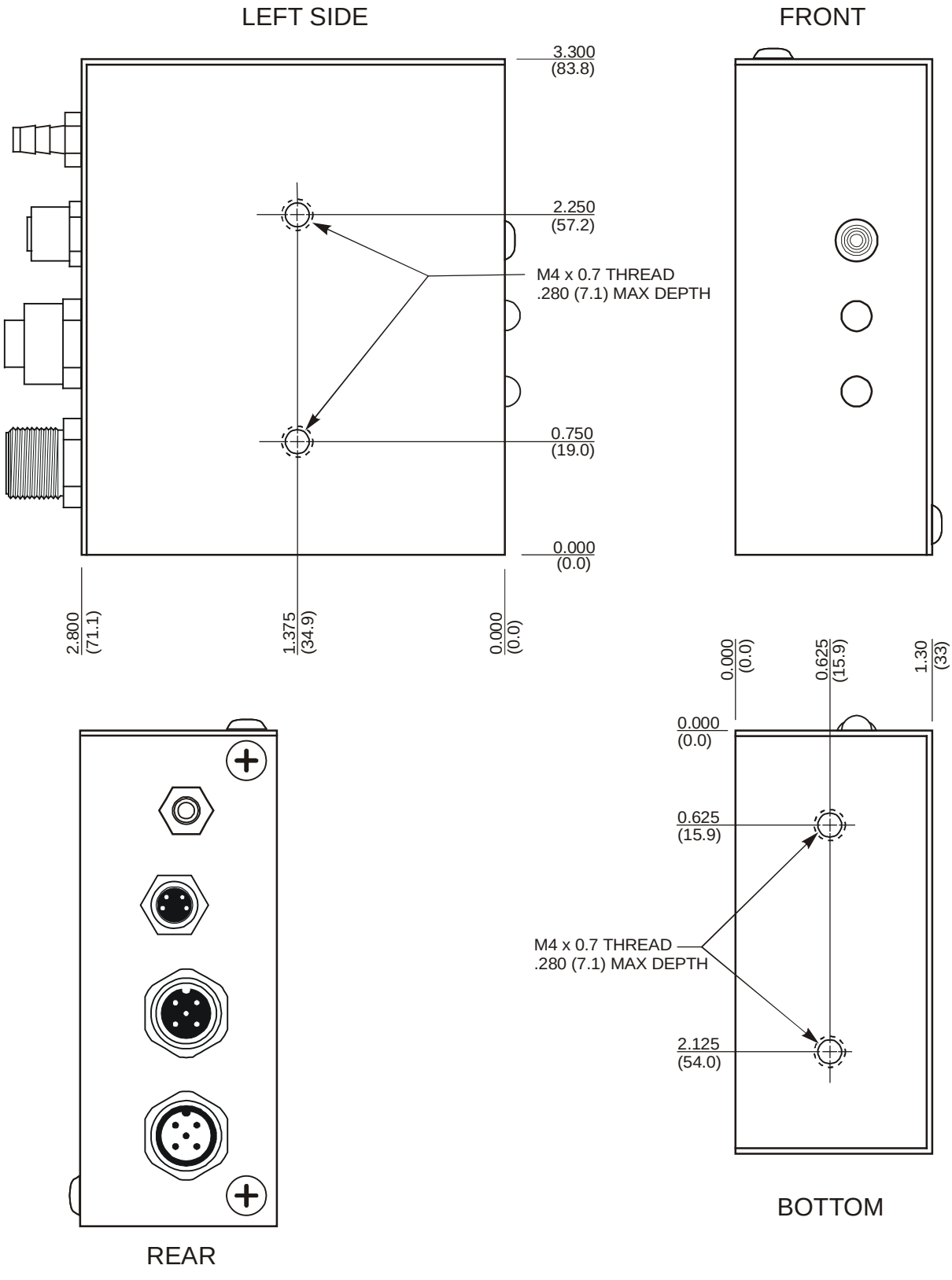
HyperTerminal Setup

HyperTerminal may be used to communicate interactively with the STM1 through a PIM. Connect a serial port from your PC to the serial port of a PIM. Using a male-female cable, connect the female 12mm circular connector of the PIM to the male 12mm circular connector of the STM1. From the keyboard, generate the appropriate ASCII command strings.

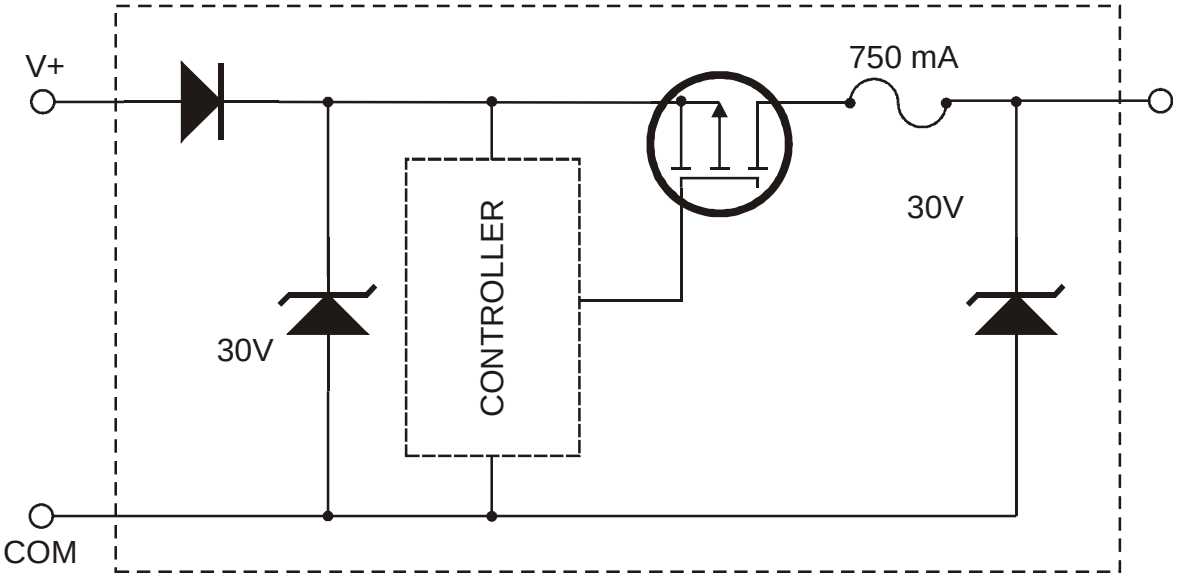
Set HyperTerminal for 8 data bits, no parity, 1 stop bit, no handshake. Choose either 9600 or 38400 baud. Set the PIM for 38400 by setting the left DIP switch to the up position or for 9600 by setting the switch to the down position.

From the keyboard, generate the appropriate ASCII command strings. The PIM does not echo received characters nor does it provide a line feed following the end of a received message. To use HyperTerminal most effectively with the STM1, set the HyperTerminal options as follows:

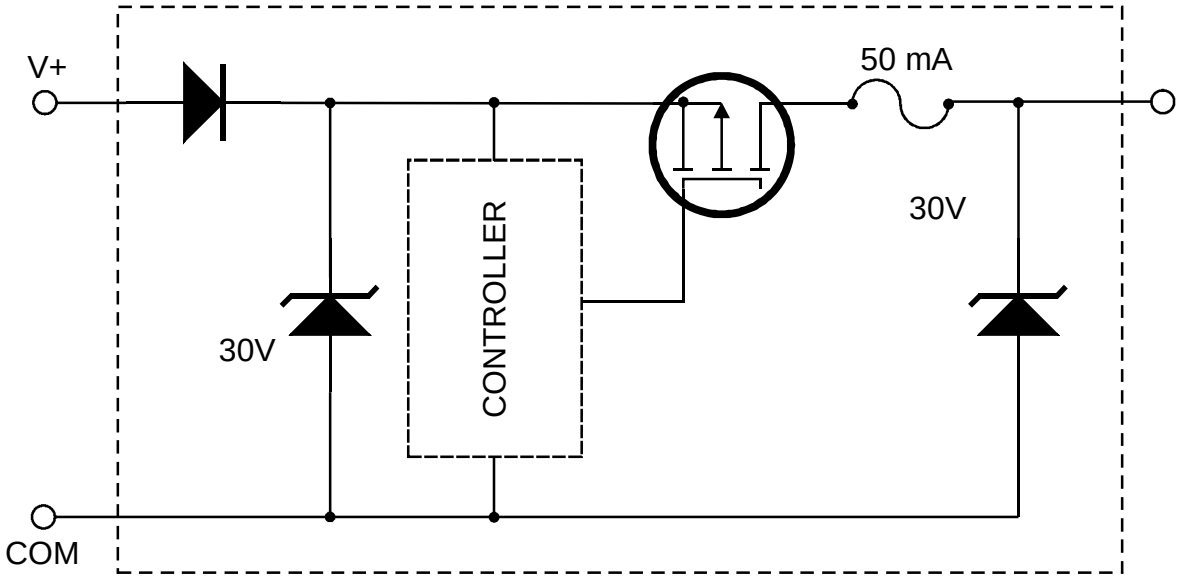
Bring up the options dialogue box by selecting File Properties. Select the Settings tab and press the ASCII Setup command button. Under ASCII Sending, check the box for “Echo typed characters locally” Under ASCII Receiving, check the box for “Append line feeds to incoming line ends”.



STM1 MOUNTING DIMENSIONS



VALVE DRIVE CIRCUITRY



ATTN DRIVE CIRCUITRY