USERS MANUAL FOR
MODELS LISTED
(V1.0, 8-14)

PRELIMINARY FOR DISCUSSION

New Technology Meters
NTM Series Common User's Manual

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HOW TO USE THIS MANUAL

This manual is designed to familiarize the user with the NTM, TNT and NTT series, covering all of their standard features and their usage. Due to the variety of options and displays that can be ordered, portions of this manual may not apply. Compare your model number to the ordering information for details. For meter customizations, contact OTEK at sales@otekcorp.com or (520) 748-7900.

Note: To save time, this manual is divided into two sections:

A) Loop or Signal Power, Section 1.2.1
B) External Power, Section 1.2.2
C) Transmitters, Section 1.2.3

ABOUT the NEW TECHNOLOGY series:

In 1974 we introduced the 1st loop powered LCD DPM. In 1985, the 1st LED loop powered DPM. In 1998, the 1st auto tricolor bargraph LCD loop powered bar-meter. In 2005, the 1st LED loop powered bar-meter.

Now we bring you the culmination of 40 years dedicated to the POWER of the LOOP!

All models use the same patent pending technology.

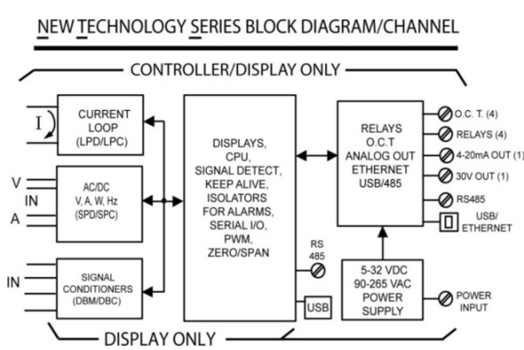
The TNT (Technology New Transmitter) is the combination of all of the above and packaged in a standard DIN Rail to bring you all their features: serial I/O, loop or signal or external power, tricolor bargraph, 4 digits, >30 signal inputs, retransmission [4-20 mA], and relays.

The NTT (New Technology Transmitter) is panel mounted and allows the operator to control the loop manually via a front panel potentiometer or from DCS/SCADA via serial port USB, RS485 or Ethernet. Just like the NTM, the automatic tricolor bargraph tells you at a glance where your process is at.

All commands apply to ALL series, but *only* if the options are included. Check your part number versus the ordering information.

As you can see, once you learn one, you'll know them all!

MODEL TNT



MODEL NTT

Should any problems arise while setting up the controller, please refer to the troubleshooting section found in the reference section of this manual.

Revision History:

Date	Edition	Description	Software Edition
August 2014	1st	Initial release	1.0

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Contents

1. Introduction

This manual covers several related products with application-specific variations. For ease of description in the manual, products are categorized as follows:

Loop & Signal Powered (Display & Serial I/O Only)
External Powered (All I/O Functions Available)
Process Transmitters (All I/O Functions Available)

1.1 Purpose

The 4-20mA current loop has proven to be a simple, effective, and reliable means of transmitting electronic signals and power on a single pair of wires. Since current is constant for all points in a loop, current loops can transmit lossless signals over kilometers of wiring. Large facilities have widely adopted the 4-20mA signal as a primary means of data transmission to ensure signal integrity.

Often, these signals are received by an analog meter, where the indicating needle reflects the intensity of the flow of current through it. The loop itself powers the mechanism that moves the needle—no external or additional power is required. This setup is simple and convenient, but the application is mostly limited to basic display functionality. Mechanical failures of the meter or a failure in the loop can be impossible to detect when the only level of human-machine interfacing (HMI) is the position of a needle.

Advances in technology have started a push toward digital instrumentation. Digital meters allow for higher precision through digit-based displays, better visibility with light-emitting diodes (LEDs), clearer trend indication with color-configurability, integration into networks through serial interfacing, and many more benefits. These come with a significant drawback, however: digital meters draw far more power than the analog meters they are meant to replace. Additional power supplies, battery backups, and inspections can make the cost of a digital installation out of reach of many whom could benefit from the versatility of digital instrumentation.

The New Technology series is designed to combine the best features of digital and analog instrumentation into a simple-to-install and low-power, yet robust solution to process measurement needs. Using the newest LED and embedded nanotechnology, Otek has expanded its loop-powered technology to include automatic color-changing LED bargraphs, process diagnostics, and isolated serial communication in a powerful, yet low-power package for the first time.

1.2 Product Overview/Differentiation

1.2.1 Loop and Signal Power

These options serve as intelligent indicators, the core of OTEK's New Technology products. Using the newest of nanotechnology and ultra-high efficiency LEDs, these products consume between 10mW and 80mW—less than 1% of existing digital meters—allowing direct replacement of analog meters and greatly lessening the requirements of backup power supplies. These products can have up to four isolated channels, and input signal types include DC current, AC current, AC voltage, AC frequency, and AC power.

All models feature Otek's award winning input signal failure detection and alarming design, as well as isolated USB or 485. The NTM will display INPT FAIL on the display and transmit alarm data for ~20 seconds after loss of signal.

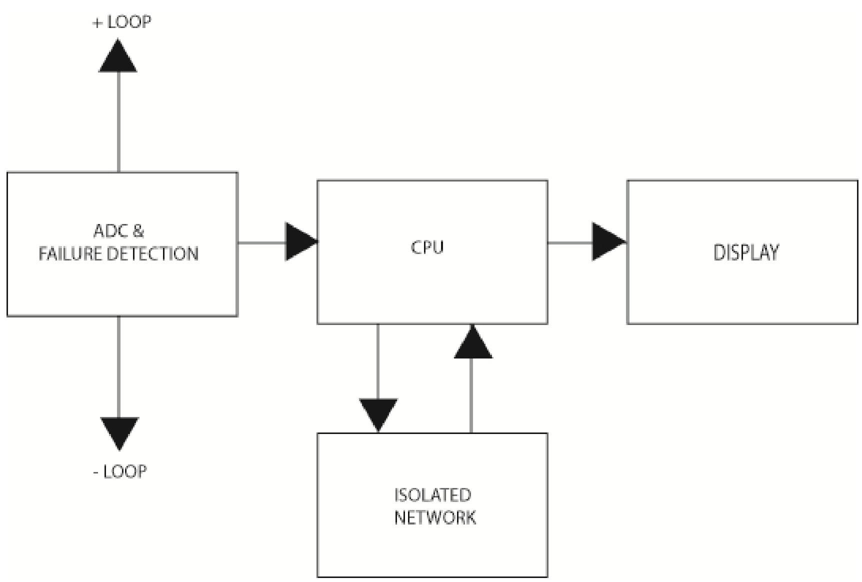

Figure 1: Block diagram of Powerless™ NTM component interactions

1.2.2 External Power

These models have additional functionality over their display-only equivalents, including relay outputs, DACs, PID control, and more than 30 types of signal inputs. Though these units are low-power, the nature of some available signals and outputs demands that this line of products uses an external power supply. With a 4-20mA DAC, these products can be used as transmitters, and they can be used in conjunction with a display unit for long-distance, low-power industrial supervision solutions. Isolated Ethernet, IRDA and uSD memory, and USB and RS485 are all optional (some models). The complete command set is included so you can control your process locally or around the globe.

1.2.3 Process Transmitters

You can use any external power NTM as a transmitter by selecting option 1, 3, 5 or 7 on digit 12 of the ordering information. But if you want a dedicated and plug and play transmitter, the TNT is a 1/8 DIN (DIN rail mount) and the NTT is panel mount with a built in potentiometer for manual control (PID) and/or serial input control from your SCADA/DCS. Please reference Section 6.2 for additional information.

1.3 Features

All models offer the features listed below, only limited by the mechanical package (Digit 4 on the ordering information) selected.

1.3.1 Color-Changing Bargraph Display

The digital bargraph is used to simulate older analog meters. 51 segments allow for a quick qualitative understanding of the process level, and automatic color-changing makes alarm states and ranges visible from afar. Default bargraph colors include red, amber, and yellow, and modes include draw-from-top, draw-from-bottom, draw-from-center, or 1-, 3-, or 5-segment mode. All configurations are accessible via the serial port.

1.3.2 Four-Digit Digital Display

The digital display allows for far higher precision than a needle or bargraph display. With a display range from -1999 to 9999 and a configurable decimal point, the digital display allows processes to be more safely run at optimal levels. The digital display is also capable of displaying most ASCII characters, allowing warning messages to be displayed to the operator.

1.3.3 Isolated Serial Communications

All models are configured through a serial port using USB, ETHERNET (IRDA) or RS485 interfacing. Because the communication is isolated, the meter can remain in operation while connected to a serial network without risking ground loops or potential damage to either the current loop or network transmitter. While networked, the meter is capable of logging data, showing its status, and having its configuration changed.

1.3.4 Input Transformation

4-20mA transmitters are used widely, and each output has a specific meaning. In order to translate the signal strength into a meaningful value, the NTM offers several input transformations and linearizations to accommodate a wide range of applications. These include scale, offset, polynomials, X-Y tables, and custom mathematical inputs (+, -, x, ÷, √) and more.

1.3.5 Self-Diagnostics

Unforeseen accidents can lead to product degradation, with potential disastrous consequences in process control. To assist in diagnosing whether a problem exists, the NTM has several self-diagnostics features, making sure both the loop and the NTM itself are functioning in a normal state.

1.4 Functional Overview

A central processing unit (CPU) is what sets the NTM apart from traditional analog meters. Figure 1 illustrates a high-level interaction diagram of the components of the NTM.

Without a network connection, the meter is capable of normal display operation. This means that with only a 2-wire connection to the loop, the NTM can operate in full display capacity.

1.5 Common Questions

Do I need a computer to configure and communicate with the controller?

Yes. However, when ordered, your model can ship from the factory preconfigured—all you need to do is hook it up. Many of the error indications are visible through the face of the meter, so a computer is not necessary.

Do I have to learn a programming language to use the controller?

No. If changes need to be made in the field, all settings are user-configurable with an easy command structure. Connecting to the unit can be done through HyperTerminal™ or any terminal emulator.

I want to configure the meter in a way not listed. Is this possible?

OTEK offers **free firmware development** for controllers purchased in quantity. Plus, our software library is being continuously expanded. For smaller and specialized applications, **custom software** can be ordered. Contact Otek for more information.

2. YOUR OWN NOTES HERE:______________________________

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The meter offers several communication options. Please refer to the ordering information found in **Section 8** correctly determine your communication option, or compare your communication port to those **Section 3.1**.

3.1 Serial Communications Port Settings

The meter supports the use of RS-485, USB or Ethernet (Control models only). Use the following communication setup to speak with a factory-default meter:

9600 baud
1 start bit
8 data bits
No parity
1 stop bit
No flow control

A terminal emulator works best if set to TTY emulation.

3.2 Communicating with the Unit

With the serial communication lines properly wired and your terminal emulator connected, apply power to the unit. The following power-on message will be transmitted:

```
NTM revision 1.0 by OTEK
Address: 1

Initializing…

Done!
```

If this message does not appear, check to make sure physical connections are secure between the unit and the communication terminal. Also make sure the proper baud rate, flow control and COM port settings are selected in any communication software being used.

3.3 Sending Serial Commands

The following command format is used to send commands to the meter:

<S><ADDRESS><COMMAND TYPE><CHANNEL #><PARAMETER><CR>

Commands are not case-sensitive; all characters are automatically converted to uppercase. Each element of the command may be separated by spaces for user clarity, if desired. The following explains how each element is used:

<S>

This argument is always the character ‘S’. Having a start character (‘S’) prevents incomplete, unintentional, or concatenated commands from being received by the meter.

<ADDRESS>

This is the unit’s address. The address serves as a unique identifier so that multiple units placed on the same communication line can be controlled independently. A unit’s current address is shown in its power-on message or the **SHOWSTAT** command. The address is configurable through the **ADDR** command and is, by default, 01. An address can be set blank if desired, effectively removing the <ADDRESS> element from command execution.

<COMMAND TYPE>

This is the command to execute. For a full listing of commands, refer to S**ection 7.2**.

<PARAMETER>

Some commands set values or are executed in multiple ways. The <PARAMETER> section of a command is used to specify these details. For commands that may apply to just one channel, a SPACE must be inserted between the channel number and the input value. For example, to change hysteresis on channel 1’s High-High limit to 3, one would issue the command

```
S1HYSTHH1 3
```

with a space between the 1 and the 3. If no space is found, the user will be prompted with an error.

See **Section 7.2** for command usage details.

<CR>

This argument is always a carriage return (<CR>). If using a terminal emulator with a keyboard, a <CR> is sent when the ENTER key is pressed. When a meter reads a <CR>, the command is parsed and executed.

Commands not accepted or not understood will be answered with a question mark.

To change the unit's address, one would use the following command:

```
S1ADDRTANK1<CR>
```

This would change the channel address from the default of "1" to "TANK1". All commands sent to this specific meter must begin with the text "`STANK1`" to be recognized.

Serial communication is the primary means of meter configuration. Before changing anything, make sure to print the unit's present configuration for reference or backup. This can be done with the **SHOW** command:

```
S<ADDRESS>SHOW<CHANNEL #><CR>
```

Issuing a **<u>WRITE</u>** command will save the unit's current configuration. After writing, all previously-written settings will be **overwritten**, so make sure the unit behaves in the desired manner before permanently **erasing** previous settings.

4. Input Processing & Transformation

4.1 Channel Inputs

By default, all units have a linear mapping of the magnitude of their sensor input to the value displayed. How a sensor's output varies with its input can be obtuse, however—many sensors give nonlinear relations. Several types of input linearizations are therefore accessible to translate analog readings to a useful metric. The general sequence of their application is described as follows:

Figure 2: Flow diagram of input manipulation.

Calibrations are set at the factory and need not be adjusted. The remaining input transformations are described throughout the section.

4.1.1 Linearization Options

There are five primary initial linearization options:

None
User Table
User Polynomial
Thermocouple
RTD

These settings are exclusive—only one can be enabled at a time. The linearization method used by the meter is determined with the LIN command:

LIN[OFF, PZ, TZ, SENSOR TYPE]
TZ = user table
PZ = user polynomial
RTDC = 0.00385 (DIN) PT100, °C
ANSI = 0.00392, TC °C
JC = type J, °C
TC = type T, °C
KC = type K, °C

Additionally, a signal value can be further modified with custom linearization using the **EQN** command (described in **Section 4.2.3**).

4.1.1.1 User-Defined Table

The user-defined table (TZ) is a set of 25 (X,Y) points which are used to represent a difficult-to-model curve. The input data is seen as an X value, and a corresponding Y value is obtained through interpolation. The current user table can be seen with the **SHOWTABLE** command, and the entire table can be set with the **SETT** command. To enter or modify a single table entry, use the **SETX** and **SETY** commands.

SETX[n][m]
Sets entry 'n' to value 'm'

SETY[n][m]
Sets entry 'n' to value 'm'

In order to process inputs quickly, the meter requires the X-coordinates to be in ascending order. The first X-coordinate that is smaller than the previous X-coordinate will mark the end of the table. This is useful for defining tables with fewer than 25 points. For example, to use a 3-point table, the following coordinates could be entered:

Coordinate Number	X	Y
0	4	0
1	12	10
2	20	100
3	0	0

Table 5.1: Example of X-Y linearization table

The following table shows the input to output correlation from the above table.

INPUT	OUTPUT
4	0
8	5
12	10
16	55
20	100

Table 5.2: Example of use of table values in **Table 5.1**

The table works as an approximation of a complex curve. To calculate a value from the table, each adjacent pair of points is treated as if a straight line connects them. While the overall function may not be linear, the interpolation between two points is, and a point value is determined from this local linearization. This example illustrates how to calculate an expected output value based on a given input:

The first step is to calculate the slope *m* of the line. Use the following equation with X_1 being the first X value less than the input and X_2 being the first X value greater than the input:

$$m = (Y_1 - Y_2) / (X_1 - X_2)$$
$$m = (0 - 10) / (4 - 12)$$
$$m = 5 / 4$$

This slope is then plugged into the following equation along with either of the previously-used points to calculate the offset *b*:

$$Y_1 = m * X_1 + b$$
$$0 = (5 / 4) * 4 + b$$
$$b = -5$$

Any value between X_1 (4) and X_2 (12) can be determined with the following equation:

$$Y = (5 / 4) * X - 5$$

Output = ((5 / 4) * Input) – 5

Use the value 8 to verify the result in **Table 5.2**:

Output = (5/4) * 8 – 5
Output = 5

4.1.1.2 User-Defined Polynomial

The user-defined polynomial (PZ) is a single segment, 9th-order polynomial defined by its coefficients in the form:

$$Y = A_9X^9 + A_8X^8 + A_7X^7 + A_6X^6 + A_5X^5 + A_4X^4 + A_3X^3 + A_2X^2 + A_1X + A_0,$$

where Y is the output and X is the input.

The current values of these coefficients can be viewed with the **SHOWPOLY** command, and the entire set can be written with the **SETP** command. To change an individual coefficient, use the **SETA** command.

4.1.1.3 Thermocouple

All models have built-in thermocouple linearization for J-, K-, and T-type thermocouples. When using one of these sensors, this functionality makes linearization possible in one command. For other types of thermocouples, an X-Y table can be used.

4.1.1.4 RTD

Two resistance temperature detector types are supported: ANSI (0.00392) and DIN (0.00385). Select one with a LIN command, or set up an X-Y table to linearize other types. For other contact types, including 10 Ohm copper RTD, contact Otek.

4.1.2 User Equation

If a smooth mathematical model can be used to linearize an input signal, use the built-in equations to model the curve. To set up an equation to transform input data, use the EQN command:

EQN[equation]
Sets a linearization equation with which to convert input data.

Operators and their priorities are listed in table **5.3**. Be sure to remember the order of operations when entering an equation.

Operator Text	Mathematical Operation	Priority
+	Addition	3
–	Subtraction	3
*	Multiplication	2
/	Division	2
%	Modulus	2
^	Power	1
SQRT(*ARG*)	$\sqrt{ARG}$	0
SIN(*ARG*)	Sine(*ARG*)	0
COS(*ARG*)	Cosine(*ARG*)	0
TAN(*ARG*)	Tangent(*ARG*)	0
ASIN(*ARG*)	Arcsine(*ARG*)	0
ACOS(*ARG*)	Arccosine(*ARG*)	0
ATAN(*ARG*)	Arctangent(*ARG*)	0
HSIN(*ARG*)	Hyperbolic sine(*ARG*)	0
HCOS(*ARG*)	Hyperbolic cosine(*ARG*)	0
HTAN(*ARG*)	Hyperbolic tangent(*ARG*)	0
ABS(*ARG*)	Absolute value(*ARG*)	0
LN(*ARG*)	$\log_e(ARG)$	0
LOG(*ARG*)	$\log_{10}(ARG)$	0
LOGX(*ARG*)	$\log_X(ARG)$	0
EXP(*ARG*)	e^{ARG}	0

Table 5.3: Listing of available operations in the **EQN** command

4.1.3 Scale & Offset

Beyond the linearization stage, data can further be manipulated to shift it to a specific range. All data is pushed through a multiplicative scale factor (default 1). This value is used to increase or decrease the output range of the signal through direct multiplication. For example, an input that by default corresponds to a reading of 0 – 10 will shift to 0 – 20 with a scale factor of 2. Set the Scale is set with the SCALE command:

SCALE[n]

Sets a value [n] with which to scale linearized data Offset is used to shift the output data. The offset value is set in terms of the display units and is the last transformation applied. Regardless of linearization and scaling, the Offset will be set as the value entered. The Offset is set through the OFFSET command:

OFFSET[n]

Sets a final offset value [n] to linearized data

Scale and offset values apply once, as shown in **Figure 4.1**. These values are relative to the output of the linearization and not the display. This means that, for example, if a meter currently had an Offset of 10, changing its Offset to 8 would *decrease* the display value by 2. To view current Scale and Offset values, use the **SHOWIN** command.

4.1.4 Units

If the user desires, the input can be associated with engineering units through the UNITS command:

UNITS[unit string]

Sets a text string of units for the input data

This string is for user convenience only—it is a message concatenated to the end of sent serial data and logged data. This has no effect on the numeric value.

4.2 Calibration

The meter has 1 pair of potentiometers per channel found on the rear of the unit. A SPAN potentiometer adjusts the scale of a channel reading, and a ZERO potentiometer shifts the value up and down. Quick calibration can be done through minor tweaks to these potentiometers as explained below. This example is for channel 1; the procedure is analogous for all other channels.

1) Apply a signal of value zero to channel 1. Adjust the zero potentiometer so the meter reads the desired value. In the case of a 4-20mA loop, the zero value is usually 4mA.

2) Apply a full-scale signal to channel 1 and adjust the span potentiometer so the meter reads the desired full-scale value.

3) Check your zero. Repeat steps 1-3 if necessary; each iteration will decrease errors in the calibration.

If adjusting these is not enough to calibrate a meter, a Full Factory Calibration may need to be performed.

The meter has 1, 2 or 3 analog input channels. Each analog input has 2 sets of calibration data: factory calibration and user calibration. Both of these must be correct to ensure the unit will display the correct information. Both factory and user calibration use the following linear equation to scale and offset the reading:

$$Y = (m \cdot X) + b$$

In this equation, X is the input signal, m is the scale factor, b is the offset, and Y is the output. In command terminology, the equation looks as follows:

(Value Displayed) = (Scale · Input) + Offset

For example, to map a 4-20mA to a display value of 0-100%, the following parameters must be used:

Scale = 6.25
Offset = –25

Applying the values to the above equation, we find

$$(\mathbf{4} \cdot 6.25) - 25 = 0$$

and

$$(\mathbf{20} \cdot 6.25) - 25 = 100,$$

thus 4-20 input should map to 0-100 on the display.

The spreadsheet found at http://www.otekcorp.com/content/configuration-guides is designed to simplify the process of calculating the scale and offset values needed. If preferred, the calculation can be performed by hand using the method illustrated in **Section 4.3.1**.

Calibration values are changed through the serial port. To communicate with the meter, you will need a computer with a terminal emulation program. Windows XP comes standard with HyperTerminal™, but many other programs are available. The default communication settings required are 9600 baud, 8 data bits, no parity bit, 1 stop bit and no flow control. Usually, when connecting to the DB-9 in the back of the computer, this is COM Port 1. For further information about serial communication, refer to **Section 3**.

Before beginning, it is recommended that the old calibration settings be written down so the current state can be returned to. The following commands will display the calibration information for unit 1:

<CHANNEL #>
```
S1SHOW
```

4.2.1 Checking Factory Calibration

To check the factory calibration, user calibration settings must be undone. If these values are saved to EEPROM, they will be restored if the unit is reset. This example if for a unit of address 1, but the procedure is analogous for all channels.

The following 2 commands will clear out the user calibration data for unit 1:

```
S1SCALE1 1          // sets user Scale for unit 1 to 1
S1OFFSET1 0     // sets user Offset for unit 1 to 0
```

Now check the factory calibration. Apply an input to the channel to be calibrated. In this example, the input is 4-20mA. At 4mA, the meter should display “4”, and at 20mA, the meter should display “20”. If these values are accurate, skip to **Section 4.3.3** “Setting User Calibration”. Otherwise, factory calibration must be performed.

4.2.2 Setting Factory Calibration

To most easily re-calibrate the unit, the factory calibration values must be reset. The following 2 commands will clear out the factory calibration data for channel 1. The command is analogous for channels 2 and 3.

```
S1GACO1 1        // sets factory scale factor for channel 1 to 1
S1OFCO1 0        // sets factory offset for channel 1 to 0
```

To calculate the new GACO (gain coefficient) and OFCO (offset coefficient) values, use the following table and system of equations:

Signal In	**Displayed Value**
In_{LO}	$Disp_{LO}$
In_{HI}	$Disp_{HI}$

Table 4.1: Guideline for establishing factory calibrations

$GACO = (In_{HI} - In_{LO}) / (Disp_{HI} - Disp_{LO})$
$OFCO = In_{LO} - (GACO \cdot Disp_{LO})$

Example:
1) Apply a 4mA signal to the meter. Let the unit stabilize. The In_{LO} value is 4, and the $Disp_{LO}$ value is what the channel reads. In this example, we read 0.4.

2) Apply a 20mA signal to the meter. Let the unit stabilize. The In_{HI} value is 20, and the $Disp_{HI}$ value is what the channel reads. In this example, we read 1.0.

Signal In	**Displayed Value**
4	0.4
20	1.0

Table 4.2: Example of factory calibration parameters

3) Solve the system of equations to find GACO and OFCO:

$GACO = (4 - 20) / (0.4 - 1) = 26.6667$
$OFCO = 4 - (26.6667 \cdot 0.4) = -6.6667$

4) The following 2 commands will set the factory calibration values for channel 1:

`S1GACO1` <calculated value>
`S1OFCO1` <calculated value>

5) Apply a 4-20 mA signal to the meter. It should display 4 at 4mA and 20 at 20mA. If not, carefully repeat the procedure, *making sure that both user and factory calibration settings are reset.*

6) We now need to save the current calibration. Do this with a **WRITE** command:

```
S1WRITE
```

The unit will respond with the text "`Done!`" when the calibration is saved.

4.2.3 Setting User Calibration

To most easily re-calibrate the unit, the user calibration values must be reset. The following 2 commands will clear out the user calibration data for channel 1. The command is analogous for channels 2 and 3:

```
S1SCALE1 1          //sets user scale factor for channel 1 to 1
S1OFFSET1 0         //sets user offset for channel 1 to 0
```

To calculate the new Scale and Offset values, use the following table and system of equations:

Desired Display Value	Displayed Value
$Desired_{LO}$	$Disp_{LO}$
$Desired_{HI}$	$Disp_{HI}$

Table 4.3: Guideline for establishing user calibration

$$\text{Scale} = (Desired_{HI} - Desired_{LO}) / (Disp_{HI} - Disp_{LO})$$
$$\text{Offset} = Desired_{LO} - (\text{SCALE} \cdot Disp_{LO})$$

Example:
Note: This example assumes that a 4-20 mA input will map to a 0-100 reading. For other inputs or display values, change the parameters accordingly.

1) Apply a 4mA signal to the meter. Let the unit stabilize. The $Disp_{LO}$ value should be 4, and the $Desired_{LO}$ value is what the display should read. In this example, we want 0.

2) Apply a 20mA signal to the meter. Let the unit stabilize. The $Disp_{HI}$ value should be 20, and the $Desired_{HI}$ value is what the display should read. In this example, we want 100.

Desired Display Value	Displayed Value
0	4
100	20

Table 4.4: Example of user calibration parameters

3) Solve the system of equations to find a new Scale and Offset:

$$\text{Scale} = (0 - 100) / (4 - 20) = 6.25$$
$$\text{Offset} = 0 - (6.25 \cdot 4) = -25$$

4) The following 2 commands well set the new user calibration values:

`S1SCALE<CHANNEL #>`<calculated value>
`S1OFFSET<CHANNEL #>`<calculated value>

5) Apply a 4-20mA signal the meter. At 4mA, it should display the desired lower value, and at 20mA, it should display the desired upper value. If not, *make sure the factory calibration is correct* and repeat the user calibration procedure, *making sure to clear the previous user calibration values*.

6) We now need to save the current calibration. This is done using the **WRITE** command:

```
S1WRITE
```

The unit will respond with the message "`Done!`" when the calibration is saved.

5. Display Configuration

All displays are highly customizable to suit the preferences of the operator. This section discusses what customizations are available and how to set the display up to a user's preferences.

5.1 General Setup

5.1.1 Intensity

The units display have variable intensity. Use the **DINT** command to change the LED brightness:

DINT[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
Sets the display intensity from 0 (off) to 9 (brightest)

5.1.2 Flashing

Some applications demand immediate attention if a limit is to be exceeded. In addition to color adjustment, Limit Flashing can be enabled, causing the bargraph to flash when a limit is exceeded to better grab an operator's attention. Limit Flashing is controlled with two commands:

DLFLASH
Turns Limit Flashing on

DLNFLASH
Turns Limit Flashing off

5.2 Bargraph Setup

5.2.1 Bargraph Mode

The bargraph can be drawn in three modes to suit different display ranges: Bottom-to-top, top-to-bottom, and bi-directional.

Bottom-to-top/left-to-right mode: Bargraph LEDs begin illumination from the bottom of the bargraph. Increasing the signal value will illuminate LEDs higher on the bargraph.

Top-to-bottom/right-to-left mode: Bargraph LEDs begin illumination at the top of the bargraph. Increasing signal illuminates LEDs downward.

Bi-directional (center zero) mode: Bargraph LEDs begin illumination at a user-defined bargraph origin. An input corresponding to a reading lower than the bargraph origin will illuminate LEDs downward from the origin, whereas a larger input will illuminate LEDs upward from the origin.

Pointer mode: The signal is marked with a small group of LEDs instead of a continuous, full bargraph. This can be 1, 3, or 5 adjacent LEDs.

Set the mode with the **DMODE** command:

DMODE[BOT, TOP, BI, P<1,3,5>]
Sets the display mode to Bottom-to-Top (BOT), Top-to-Bottom (TOP), Bi-directional (BI), or Pointer (P)

5.2.2 Bargraph Scale

The range of values displayed on a bargraph is determined by its Bargraph Full-Scale (BFS) and Bargraph Zero (BZ) parameters. BFS determines the maximum number a bargraph can display before all segments are illuminated. BZ sets the value at which bargraph segments begin illumination; at the BZ value, only the bottom segment will be illuminated. For example, setting BFS to 200 and BZ to 100 will set the display range from 100 to 200. An input of 150 would light half of the bargraph's bars. Use these commands to set the scale:

BFS`<CHANNEL #>`[*FFFF*]
Sets BFS to *FFFF*

BZ`<CHANNEL #>`[*FFFF*]
Sets BZ to *FFFF*

When using bi-directional mode, the bargraph will illuminate up to the BFS value or down to the BZ value. To set from where the segments begin to light, use the **BO** command:

BO`<CHANNEL #>`[*FFFF*]
Sets the bargraph origin to *FFFF*

The bargraph origin applies only to displays in bi-directional mode.

5.2.3 Limits

Limits set with the **HH**, **H**, **L**, and **LL** commands will by default be shown as an illuminated LED on the bargraph. Their specific location depends on the BFS and BZ values. If a limit is outside the range of BFS, the topmost LED will be illuminated. Likewise, if a limit is less than BZ, the bottommost LED will be illuminated.

A default bargraph is scaled from 0 to 100%, with limits as such:
HH: Readings greater than **90%** violate the HH limit and are colored **red**.

H: Readings greater than **80%** violate the H limit and are colored **amber**.
L: Readings under **20%** violate the L limit and are colored **amber**.
LL: Readings under **10%** violate the LL limit and are colored **red**.

For values **between 20% and 80%,** the bargraph is **green**. All of these parameters are adjustable.

If the user finds limit marks visually distracting, they can be disabled using the **DLIM** command:

DLIM[ON/OFF]
Enables/disables limit marks

Disabling limit marks will neither disable normal limit operation nor bargraph color-changing. If the user desires the bargraph to remain one color while still having limit-based control, the limit colors can be set to the bargraph color.

5.2.4 Color

By default, three colors are available for the bargraph: green, red, and amber. Its color is based on six parameters:

Normal operation:
If a channel is under normal operating conditions, its segments will illuminate uniformly. Set the normal operating color with the DCOLOR command:

DCOLOR<CHANNEL #>[G, R, A]
Sets the bargraph color to Green, Red, or Amber

High-High limit breaking:
If a channel reading passes the High-High limit, segments beyond the limit will change to the High-High color. Set the High-High color with the HHD command:

HHD<CHANNEL #>[G, R, A]
Sets the High-High color to Green, Red, or Amber

High limit breaking:
If a channel reading passes the High limit, segments beyond the limit will change to the High color. Set the High color with the HD command:

HD<CHANNEL #>[G, R, A]
Sets the High color to Green, Red, or Amber

Low limit breaking:
If a channel reading passes below the Low limit, segments beyond the limit will change to the Low color. Set the Low color with the LD command:

LD<CHANNEL #>[G, R, A]

Sets the Low color to Green, Red, or Amber

<u>Low-Low limit breaking</u>:
If a channel reading passes below the Low-Low limit, segments beyond the limit will change to the Low-Low color. Set the Low-Low color with the LLD command:

LLD<CHANNEL #>[G, R, A]
Sets the Low-Low color to Green, Red, or Amber

5.3 Digit Setup

5.3.1 Decimal Fix

For readability of the display, the decimal point is fixed. Set the decimal point based on the magnitude of the input signal. To adjust the decimal point position, use the **DFIX** command:

DFIX<CHANNEL #>[0, 1, 2, 3]
Sets the number of digits following a decimal point to 0, 1, 2, or 3

If a number is too large to fit on a display, the bargraph will operate as normal, but the display will read ovr for “over range” or Und for “under range”.

5.3.2 CHN Command

When channel reading is turned off, displays by default go blank. In this state, the displays can be manually overwritten with the **CHN** command to send a message to the operator, display a general status message, or hard-code an effective reading:

CHN[*n*][XXXX]
Writes string XXXX of characters from **Table 13.1** and **Table 13.2** to channel *n*’s display

6. Quick Reference

6.1 Troubleshooting (Firmware & Hardware)

Note: See section 8 for all typical connection drawings.

SYMPTOM	SOLUTION
No startup message on serial port	Check power connections. Make sure the TXD, RXD or D-, D+ lines are wired properly. Verify communications protocol for baud rate, parity, number of start/data/stop bits. Note: Your TXD becomes our RXD and your RXD becomes our TXD. The USB connector uses the same wiring for RS485. Make sure the meter is not in "network" mode by issuing a "LOC" command. No characters will appear in terminal emulation, but the unit could still be receiving serial data.
Garbage characters appear instead of a startup message	Check communications protocol for proper baud rate, parity, number of start/data/stop bits. Standard settings are 8N1, 9600 baud.
Characters sent to unit appear twice on terminal	Turn off LOCAL ECHO in your terminal emulation program.
After the startup message, the unit does not respond to commands	Make sure the RXD or D- line is properly connected. Check communications software for proper settings. Be sure to use 'S' + the unit's *address* when sending commands.
Analog input always reads zero or doesn't change	Check connections between unit and input signal. Check **Figure 2.1** for signal input location.
Unit stalls on power-up	Check that a power-on delay hasn't been set using the POR command.
Displays read "Err"	The unit is reading a signal value too large or too small. Confirm your calibration and linearization settings through methods described in **Section 4**.
No display/Signal Fail Message	No signal or power. The signal fail detector needs ~10 minutes of signal at >1/2 full scale to operate. See DINT command
Scale or Offset Wrong	Apply zero (or equivalent) signal and adjust ZERO potentiometer to desired value; apply full scale signal and adjust SPAN potentiometer to desired value or use SCALE & OFFSET commands. Always do ZERO before span. Repeat if required.
No Serial I/O	USB, RS485 & Ethernet are required to supply 5V~3mA to power the internal isolator on all loop/signal powered models. All other require external power.
Erratic Display	Unstable signal. A 0.1uF across inputs is helpful. Use a twisted and shielded pair of wires for noisy environments. For internal failure, contact OTEK and request an RMA. The unit has a lifetime warranty!
Can't Communicate With Other Channels	No channels exist. Check the model part number to the ordering information at the end of this manual. Check if the unit is addressed correctly (see command Ch. On/Off). Serial I/O is isolated from the rest of the instrument, but common within itself.
No O.C.T./Relays Output	None included. No "Pull Up"/load connected, common emitter not connected. O.C.T. max load: 30v/30mA. Relays: 1A@120VAC/30VDC resistive. See typical connections sections. See Alarms section.
No 4-20mA Compliance Out	Non included. Check the model part number to the ordering information at the end of this manual. No compliance connected through your load, no commands executed. See DAC Commands. The unit has a blue LED in series with 4-20mA out to indicate "Loop On."
Nothing Works	Check your signal and/or power input and fuses.
WARNING:	Unauthorized repair will void the lifetime warranty!

Table 12.1: Troubleshooting Guide

Still having problems? Send OTEK an email at support@otekcorp.com or call (520) 748-7900.

6.2 TNT & NTT (Transmitters) Troubleshooting

Because the TNT and NTT transmitters share the same hardware and software as the NTM, all instructions and commands are the same. The only difference is that the transmitters are essentially NTMs without dedicated 4-20mA transmission (the same as NTM digit 12, options 1, 3, 5 or 7 on the ordering information) as configured by the user for retransmission or altered by mathematical algorithms or manual potentiometers (NTT).

7. Appendix

7.1 ASCII Lookup Tables

7.1.1 Alphabetical Characters

Decimal		Hexa-Decimal		ASCII	
65	97	41	61	A	A
66	98	42	62	B	b
67	99	43	63	C	C
68	100	44	64	D	d
69	101	45	65	E	E
70	102	46	66	F	F
71	103	47	67	G	G
72	104	48	68	H	h
73	105	49	69	I	I
74	106	4A	6A	J	J
75	107	4B	6B	K	K
76	108	4C	6C	L	L
77	109	4D	6D	M	M

Decimal		Hexa-Decimal		ASCII	
78	110	4E	6E	N	n
79	111	4F	6F	O	o
80	112	50	70	P	P
81	113	51	71	Q	q
82	114	52	72	R	r
83	115	53	73	S	S
84	116	54	74	T	t
85	117	55	75	U	U
86	118	56	76	V	u
87	119	57	77	W	W
88	120	58	78	X	X
89	121	59	79	Y	Y
90	122	60	70	Z	Z

Table 13.1: Alphabetical listing of all letters and how they are displayed. Capital and lower-case letters appear identically

7.1.2 All Other Displayed Characters

Decimal	Hexa-decimal	ASCII	
32	20	SPACE	
33	21	!	I
34	22	"	''
35	23	#	H
36	24	$	S
37	25	%	≡
38	26	&	P
39	27	'	'
40	28	(	C
41	29	)	]
42	2A	*	r
43	2B	+	⊣
44	2C	,	,
45	2D	-	0
46	2E	.	0

Decimal	Hexa-decimal	ASCII	
47	2F	/	/
48	30	0	0
49	31	1	1
50	32	2	2
51	33	3	3
42	34	4	4
53	35	5	5
54	36	6	6
55	37	7	7
56	38	8	8
57	39	9	9
58	3A	:	=
59	3B	;	=
60	3C	<	r
61	3D	=	=

Decimal	Hexa-decimal	ASCII	
62	3E	>	¬
63	3F	?	?
64	40	@	a
91	5B	[	C
92	5C	\	\
93	5D	]	]
94	5E	^	n
95	5F	_	_
96	60	`	'
123	7B	{	A
124	7C	|	d
125	7D	}	9
126	7E	~	I

Table 13.2: Listing of all non-alphabetical characters that can be displayed, organized by ASCII value

7.2 Command Set

7.2 Command Set

COMMAND	FUNCTION	EXAMPLE
ADBAND[chn] [n] Or ADBAND[chn]	Sets the A/D band. If the difference between two consecutive readings exceeds the A/D band, averaging on the meter is reset (0 < x < 10,000).	S01ADBAND1 0.5 If the A/D reading changes by 0.5 for channel 1, the running average displayed on the meter is reset. S01ADBAND1 This command will display the current value of the channel 1 A/D band.
ADDR[newaddress]	Changes the unit's address. The new address must be in ASCII and is limited to 8 characters. If the command is given without an argument, the address is changed to NULL, meaning the channel has no address.	SAADDR45 This command changes the unit's address from "A" to "45". The unit will only respond when "S45" precedes the command. S45ADDR This sets the unit's address to NULL. Even though the address is now NULL, 'S' must still precede every command sent to the unit.
AVG[chn] [n] Or AVG[chn]	Sets an average number of samples *n* and uses the result as the display value or value to send over serial port. Valid arguments are 0-255.	S01AVG1 0 This turns the built-in averaging off for channel 1. S01AVG2 4 This activates the running averaging using 4 samples for channel 2. S01AVG1 This will display the current average number of samples taken for channel 1.
BAUD[baud rate] Or BAUD	Changes the baud rate of the unit. After execution of this command, the channel changes its baud rate immediately, so the subsequent commands must be sent with the	S01BAUD19200 This changes the unit's baud rate to 19200. S01BAUD

COMMAND	FUNCTION	EXAMPLE
	new baud rate. The default baud rate is 9600, and valid arguments are 1200, 2400, 4800, 9600, 19200 or 19.2K. Don't forget to change your PC's baud rate.	This will display the current baud rate for the unit.
BFS[chn] [n] Or BFS[chn]	Controls the bargraph's full scale or the maximum value the bargraph can display. This command only affects the bargraph. See **DMODE** for different bargraph display options.	S01BFS1 5 This command will change the bargraph full scale to 5 for channel 1. S01BFS1 This will display the current bargraph full scale for channel 1.
BO[chn] [n] Or BO[chn]	Sets the bargraph origin. This value only applies in bi-directional display mode and is the value from which the bargraph is initially drawn up or down.	S01BO1 15 This will cause the bargraph to be drawn from the location 15 on the display for channel 1. Values below 15 will be drawn downward; values above it will be drawn upward. S01BO1 This will display the current bargraph origin for channel 1.
BZ[chn] [n] Or BZ[chn]	Controls the bargraph zero location. By default, it is 0. Changing it to 0.2 would mean that the bargraph will only start lighting when 0.2 is exceeded. This command only affects the bargraph.	S01BZ1 0.2 This command will change the bargraph starting point to 0.2 for channel 1. S01BZ1 This will display the current bargraph zero for channel 1.
CHN[chn] [XXXX] Or CHN[chn]	Displays an ASCII string that is 4 characters long. If the value is fully numeric, the unit will react appropriately to a reading of that value. Inserting a blank argument will result in erasing the current display value. **IN ORDER TO USE**	S01CHN1 PASS This command will display the word "PASS" on the display for channel 1. S01CHN2 87 This will display "87" on

COMMAND	FUNCTION	EXAMPLE
	THIS COMMAND THE CORRESPONDING CHANNEL MUST BE TURNED OFF USING THE "CH" COMMAND.	the 4 7 segment digits for channel 2. It will also change the bargraph to display a value of "87". S01CHN1 This command will empty the channel buffer, displaying nothing on the 4 7 segment digits for channel 1. S01CHN2 This command clear the buffer for channel 1.
CH[chn] [ON/OFF] Or CH[chn]	Turns the A/D input on or off. With the input off, the CHN command can be used to remotely control the channel.	S01CH1OFF Channel 1 can now display ASCII Strings. S01CH1 This displays the current state of the A/D input whether it is on or off.
CMD[chn][limit] [cmd]	Sets a command to when the *limit* is passed; allowable *limit* inputs include HH, H, L, LL, and PANIC.	S01CMD1HH DINT3 Sets command to "DINT1" to channel 1's HiHi limit; when channel 1's HiHi is exceeded, the DINT1 command will be executed changing the display intensity of the channel a bargraph to 3. S01CMD2LL FLASH1ON Sets command to "FLASH1ON" to channel 2's LoLo limit; when channel 2's LoLo is exceeded, the FLASH1ON command will be executing causing the display to flash for channel 1.
DAC[chn] [n] Or DAC[chn] [ON/OFF]	Sets the DAC output to value *n*. Also sets the ON/OFF status of the DAC.	S01DAC1 15 This will set the output value of the DAC to 15

COMMAND	FUNCTION	EXAMPLE
Or DAC[chn]		mA. S01DAC1 This will display the current state of the DAC and the output value.
DCOLOR[chn] [color] OR DCOLOR[chn]	Changes the color of the bargraph or backlight when a limit is not being exceeded (i.e. the color when the channel is in a normal state). The colors are **R**ed, **A**mber, and **G**reen	S01DCOLOR1R This will change the bargraph display color to red for channel 1when a limit is not being exceeded. S01DCOLOR1 This will display the current bargraph display color.
DEFAULT	Resets the unit back to its factory defaults. This command has no arguments.	S01DEFAULT This will reset the unit.
DELAY[chn][limit] [n] Or DELAY[chn][limit]	Controls the amount of time a limit must be exceeded before the relay will activate. The value is set in 100ms increments. $0 \le n \le 255$	S01DELAY1HH 4 The HiHi limit for channel 1 will have to be exceeded for more than 400ms for the relay to toggle and the bargraph color to change. S01DELAY1HH This displays the current HiHi delay time for channel 1.
DFIX[chn] [n] Or DFIX[chn]	Sets the decimal point location (in digits from the right) on the display. Valid arguments are 0, 1, 2 and 3.	S01DFIX1 1 This will select the first decimal point on the display (XXX.X) for channel 1. S01DFIX1 This displays the current decimal point location for channel 1.
DH[chn] [n] Or DH[chn]	Sets the DAC Hi limit. This is the value (in mA) that the DAC is not allowed to exceed: Lo $\le n \le$ 24mA.	S01DH1 19 This will set the DAC Hi limit to 19mA. The DAC will never output greater than 19mA.

COMMAND	FUNCTION	EXAMPLE
		S01DH1 This displays the current DAC's Hi limit for channel 1.
DIAG[chn]	This command runs the diagnostic test on the display for the respective channel. It will check for shorts then allow the user to perform a visual test on the LED bargraph and 4 7-segment display digits. This command will temporarily stop the channel being tested.	S01DIAG1 This will test the display by running through a display diagnostic for channel 1.
DINT[chn] [n]	This command controls the display intensity based on a scale from 0-9 for *n* where 0 is the lowest intensity (off) while 9 is the highest intensity.	S01DINT5 This sets the display intensity to 50%.
DLFLASH[chn] [n/ON/OFF] Or DLFLASH[chn]	Turns on limit flashing, meaning a channel's bargraph will begin to flash if its limit is exceeded.	S01DLFLASH1 ON Enables limit flashing for channel 1. S01DLFLASH1 23 This will change the flash speed to 23 S01DLFLASH2 This will display the current flash rate and flashing status for channel 2.
DLIM[chn] [ON/OFF] Or DLIM[chn]	Turns the limit indicators for the bargraph on or off.	S01DLIM1 ON Enables limit indicators for channel 1. S01DLIM1 This displays the current limit indicators for channel 1.
DL[chn] [n] Or DL[chn]	Sets the DAC Lo limit. This is the value (in mA) that the DAC is not allowed to go below: 0mA ≤ *n* ≤ HI.	S01DL2 This will set the DAC low limit to 2mA. When powered on the DAC will output a minimum of 2mA. S01DL1 This displays the current DAC's Lo limit for channel

COMMAND	FUNCTION	EXAMPLE
		1.
DMODE[chn] [mode] Or DMODE[chn]	Changes the format of the bargraph. Valid mode argument are *BOT,*, *TOP,* AND *BI*. "BOT" is a bottom-to-top display, "TOP" is a top-to-bottom display, and "BI" is a bidirectional display with the BO being the drawing point.	S01DMODE1BI This will set the display format to bidirectional for channel 1. S01DMODE1 This displays the current format of the bargraph for channel 1.
DOFFSET[chn] [n] Or DOFFSET[chn]	Offsets the DAC output. By default, this is 0mA, and 4-20mA in equals 4-20mA out. $-1999 \leq n \leq 9999$ DAC output = (DSCALE) (INPUT) + DOFFSET	S01DOFFSET1 4 This command will offset the DAC 4Ma for channel 1. If your output is 4mA at default settings, executing this command will result in an output of 8mA. S01DOFFSET1 This displays the current DAC offset value.
DSCALE[chn] [n] Or DSCALE[chn]	Scales the DAC output. By default, this is 1, and 4-20mA in equals 4-20mA out. $-1999 \leq n \leq 9999$ DAC output = (DSCALE) (INPUT) + DOFFSET	S01DSCALE2 This command will scale the DAC by a factor of 2. If your output was 3mA, executing this command would shift the output to 6mA. This scaling takes place before DOFFSET is applied. S01DSCALE1 This displays the current DAC scale value.
DSCI[chn] [ON/OFF] Or DSCI[chn]	Changes the digits to display the channel value in scientific notation. In order to change out of this method of display, another type of method of display must be input such as **DFIX**.	S01DSCI1ON or S1DSCI1 Changes the channel 1 digit display to scientific notation.
DSYM[chn] [ON/OFF] Or DSYM[chn]	Enables display symmetry. When enabled, a bargraph fully changes its color to the limit it exceeds. When disabled, only the portion beyond the limit changes color.	S01DSYM1 ON This will have the channel's entire bargraph change to the limit color for channel 1.

COMMAND	FUNCTION	EXAMPLE
		S01DSYM1 This displays the current display symmetry state.
EQN[chn][variable] [equation]	Defines an equation to use in calculations. The equations can be used to adjust the following *variable*s of channel *chn*: CH (channel), DAC, HH, H, L, LL, and SETP (setpoint). Valid numerical operations include the following: SIN, COS, TAN, ASIN, ACOS, ATAN, SINH, COSH, TANH, ABS, SQRT, EXP, LN, and LOG. Variables may also be used in other variable equations.	S01EQN1HH CH1+55 This will assign the equation "CH1+55" to the channel 1 HiHi limit. The HiHi limit will actively change depending on the equation which is the channel 1 value plus 55.
FIX[n] Or FIX	Formats numbers (for all channels) on the serial port to have a fixed number of digits to the right of the decimal point. Valid values are: $0 \leq n \leq 7$	S01FIX1 This will assign numbers to have one decimal point at the serial port. S01FIX This will display the current number of digits being displayed after the decimal point for values sent through the serial port.
FLASH[chn] [n] Or FLASH[chn] [ON/OFF] Or FLASH[chn]	Enables display flashing and flash rate. When enabled the bargraph will flash where 0 is one cycle per 2 seconds and 9 is 4 cycles per second: $0 \leq n \leq 9$	S01FLASH1 5 This will change the flash rate for the channel 1 bargraph and digits to approximately once per second. S01FLASH1 ON This will cause the entire channel 1 bargraph and digits to flash at the current flash rate. S01FLASH2 This displays the current flash rate and flashing status for channel 2.
HD[chn] [color]	Changes the Hi limit alarm color.	S01HD1A

COMMAND	FUNCTION	EXAMPLE
Or HD[chn]	When the limit is exceeded, the bargraph uses this color. Color = **R**ed, **A**mber, **G**reen	This command will change the Hi limit color to amber. S01HD1 This displays the current Hi limit alarm color for channel 1.
HELP	Prints a list of commands and their descriptions.	S01HELP The channel will respond with a list of all commands.
HHD[chn] [color] Or HHD[chn]	Changes the HiHi limit alarm color. When the limit is exceeded, the bargraph uses this color. The colors are **R**ed, **A**mber, and **G**reen	S01HHD1R This command will change the HiHi limit color to red. S01HHD1 This displays the current HiHi limit alarm color for channel 1.
HH[chn] [n] Or HH[chn]	Sets the HiHi limit. $-1999 \leq n \leq 9999$ HH > H > L > LL	S01HH1 95 This changes the HiHi limit value to 95. The HiHi limit is 90 by default. S01HH1 This displays the current HiHi limit value for channel 1.
HOLD[chn] [ON/OFF] Or HOLD[chn]	Holds the last displayed value by turning off the A/D converter. Valid commands are ON or OFF.	S01HOLD1 ON This command will cause the channel to hold the last value on the display. S01HOLD2 This displays the current hold status of channel 2.
HYST[chn][lim] [n] Or HYST[chn][lim] Or HYST[chn]	Sets the limit hysteresis. The hysteresis is a dead zone around the limit that the value must exceed before the limit actions will be triggered. This is mainly used for the relay outputs with a noisy signal input. The hysteresis is defined in counts: $0 \leq n \leq 9999$	S01HYST1HH 0.25 This will change the channel 1’s HiHi limit hysteresis to 0.25. The limit will have to be exceeded by 0.25 counts before the relay will activate. Hysteresis is 0 by default.

COMMAND	FUNCTION	EXAMPLE
		S01HYST1HH This will display the channel 1 HiHi limit hysteresis. S01HYST1 This displays the HiHi, Hi, Lo, and LoLo limit hysteresis for channel 1.
H[chn] [n] Or H[chn]	Sets the Hi limit. $-1999 \leq n \leq 9999$ HH > H > L > LL	S01H1 60 This changes the Hi limit value for channel 1 to 60. The Hi limit is 80 by default. S01H1 This displays the current Hi limit for channel 1.
IDELAY[n] Or IDELAY	Sets a power-on delay in seconds: $0 \leq n \leq 255$	S01IDELAY15 Sets a 15-second delay upon power-up before the unit will begin normal operation. The unit has, by default, no delay upon startup. S01IDELAY This will display the current value for the delay upon power-up.
K[chn][P/I/D] [n] Or K[chn][P/I/D]	Set's the appropriate value for PID constants to the value *n*.	S01K2I 1 Sets the integral value to 1 for channel 2's PID. S01K1D This will display the current differential value for channel 1's PID.
LD[chn] [color] Or LD[chn]	Changes the Low limit alarm color. When the limit is exceeded, the bargraph uses this color. Color = **R**ed, **A**mber, **G**reen	S01LD1AMBER This command will change the Low limit color to amber. S01LD1 This displays the current

COMMAND	FUNCTION	EXAMPLE
		Low limit alarm color.
LIM[chn] [ON/OFF] Or LIM[chn]	Turns the limit checking on or off. If limit checking is turned off, the bargraph will not change color, and the relays will not change state.	S01LIM1OFF This turns off limit-checking for channel 1. S01LIM1 This will display the current limit checking status for channel 1.
LIN[chn][table]	Turns on the internal linearization for thermocouples, RTDs, or user-defined tables or polynomials. Valid inputs: OFF, TZ, RTDC, ANSI, PZ, JC, KC and TC. TZ = user table PZ = user polynomial RTDC = 0.00385 (DIN) PT100 ANSI = 0.00392 TC JC = type J degrees C TC = type T degrees C KC = type K degrees C	S01LIN1ANSI This command will change the linearization to ANSI RTD.
LLD[chn] [color] Or LLD[chn]	Changes the LoLo limit alarm color. When the limit is exceeded, the bargraph uses this color. color = **R**ed, **A**mber, **G**reen	S01LLD1 RED This command will change the LoLo limit color to red. S01LLD1 This displays the current LoLo limit alarm color.
LL[chn] [n] Or LL[chn]	Sets the LoLo limit. $-1999 \leq n \leq 9999$ HH > H > L > LL	S01LL1 20 This changes the LoLo limit value to 20. The LoLo limit default value is 10. S01LL1 This displays channel 1
LOC	Enables local echoing of characters. The channel will send back everything that is transmitted to it and will prompt error messages.	S01LOC This command will cause the channel to echo back everything that is sent to it.
LOG[ON/OFF]	Enables unit to begin logging the unit's address, time, and reading over the serial port.	S01LOGON Enables logging of the unit.
L[chn] [n] Or	Sets the Low limit. $-1999 \leq n \leq 9999$	S01L115 This changes the Low limit

COMMAND	FUNCTION	EXAMPLE
L[chn]	HH > H > L > LL	value to 15. The Low limit default value is 20.
M[chn][limit] [message] Or M[chn] [ON/OFF] Or M[chn]	Sets a message of 32 characters max in for any channel's limit for when it is triggered. Valid limits are as follows: *HH, H, L, LL, OVERRANGES, OVERRANGED, UNDERRANGES*, and *UNDERRANGED*. The *OVERRANGED* and *UNDERRANGED* limits are exclusively for the 4 7 segment displays when the unit over or under ranges. The *OVERRANGES* and *UNDERRANGES* limits are exclusively strings sent only over the serial port.	S01M1HH TOO HIGH This will cause channel 1 to contain the message "TOO HIGH" when the HiHi limit is passed on channel 1. S01M1 OFF This turns off messages from appearing on the serial port. S01M1 This displays the current status of message, whether or not it is ON and will transmit valid messages which are passed the respective limit points or OFF.
NET	Sets the unit in networked mode. The channel will only respond when it is directly queried.	S01NET This command will cause the channel to only respond when it is directly queried.
NEW[chn] [MIN/MAX]	This function will reset the current new min and max value depending on the given input argument.	S01NEW1MIN This will reset the min value for channel 1. S01NEW2MAX This will reset the max value. For channel 2.
OFFSET[chn] [n]	Adds the offset specified to the value processed by the A/D conversion. This command can be used just like the hardware offset. Valid arguments are all numbers in the range -1999 to 9999.	S01OFFSET1 100 This will offset the number displayed by 100 S01OFFSET1 -12.5 This will decrease the displayed value by 12.5
OVERRANGE[chn] [n] Or OVERRANGE[chn] [ON/OFF] Or OVERRANGE[chn]	This will manipulate the over ranging message and when it is activated. An over ranging value of *n* can be input that when passed, it will cause the over ranging message to appear on the digits (if the over	S01OVERRANGE1 135 This will change the value to which the reading is considered over range to 135 for channel 1.

COMMAND	FUNCTION	EXAMPLE
	range is on). The over ranging message on the 4 7 segment digits are controlled by the *M* command.	S01OVERRANGE1 ON This enables the over range function so that when the reading is over the over range value, the digits will display the over range message for channel 1. S01OVERRANGE1 This will show the over range value and the status of the over range function for channel 1
PANIC	Puts the meter in its panic state. The panic state is defined using the **SETPANIC** command.	S01PANIC Puts the meter in a panic state.
PASSWORD[XXXX]	Used to either set a password or enable password-protection of the menu system. A password can be up to 16 ASCII characters in length. When a new password is entered, the unit will wait for approximately 25 seconds before locking out the user. It will then prompt the user for the address and password. If the unit's address is S01 and the password entered is 1234 to unlock the unit, enter "S011234" and then the unit will be unlocked for another 25 seconds before locking out the user again.	S01PASSWORDOTEK Enables password protection and sets the password to "OTEK". S01PASSWORD This will create disable the password functionality of the unit by placing in an "empty password."
PEAK[chn] [ON/OFF] Or PEAK[chn]	Turns peak detection on or off. With peak detection on, the unit will display the highest input value it has received since peak detection was enabled. Valid arguments are ON or OFF. NOTE: For faster sampling rates, contact OTEK.	S01PEAK1 ON Channel 1 will now only display the largest value thus far obtained from the A/D conversion. S01PEAK2 This will display the current status of the *PEAK* command for channel 2.
PID[ON/OFF] Or PID	This will enable the PID functionality of the meter.	S01PIDON This will enable the PID of the meter.

COMMAND	FUNCTION	EXAMPLE
		S01PID This will display the current state of the PID functionality of the meter.
POLL[ON/OFF]	Enables/disables the polling for the status command. If poll is off, then a continuous serial representation of the displayed information is broadcast (**in a RS-485 network, no polling "POLLOFF" is not advised**; the constant transmission of data can overwhelm the network). If poll is on, then the unit awaits the status command to send data to the serial port. Valid arguments are ON and OFF **(see STATUS)**.	S01POLLON This command will cease the constant broadcast of serial data from the unit. The channel will still accept all commands, but it will only send A/D information when the "STATUS" command is used.
RESET	Performs a software reset of the device. Startup mode will be determined by the current state of the DEFAULT jumper inside the housing.	S01RESET This will perform a software reset of the device.
RESPONSE[response type] Or RESPONSE	This will set the response type of the meter: NONE/NET/LOC/LONG.	S01RESPONSELONG This will set the response type of the meter to long, giving more descriptive longer response to the user for mistyped commands and other information. S01RESPONSE This will return the current response type of the meter.
RUNTIME[ON/OFF] Or RUNTIME	Enables or disables the runtime of the meter. This will display the time at which each channel measurement is taken, e.g. when polling is off and runtime is on for a two channel unit, the unit will send "0:06:39 25.45 67.89" through the serial communication port.	S01RUNTIMEON This will enable the runtime of the meter. S01RUNTIME This displays the current runtime of the meter.
RUN	Brings the meter out of a stopped or panicked state.	S01RUN Causes the meter to resume normal operation.
R[chn] [n] [H/L]	Sets relay *n* high or low. If a relay	S01R1 2 H

COMMAND	FUNCTION	EXAMPLE
	state is defined as a smart-alarm action, it cannot be controlled until channel reading is disabled through the “CH” command.	Sets channel 1’s R2 to a high state if R1 is not controlled through smart-alarming.
SA[chn][trigger][actions]	Defines what actions a meter should take when the listed trigger takes place. **Triggers:** N No limits are exceeded [lim] The given limit of the given channel is exceeded **Actions:** R[n][H/L] Sets a relay high or low	S01SA1N R1L R2L Relays 1 and 2 will be set low when no limits are exceeded
SCALE[chn] [n] Or SCALE[chn]	Scales the displayed output using a multiplying factor. This can be used in a similar way as the hardware scale. The final result is in the form: (A/D result) * (scale) = displayed value Valid arguments are -1999 to 9999, excluding 0.	S01SCALE1 2 This command will multiply the final A/D result by a factor of 2. S01SCALE1 This displays the current scaling output used on the A/D reading.
SCI[chn]	This will format the data sent over the serial port to be in the form of scientific notation. This command changes the format into scientific notation and the user must define a different command to change the formatting of the digits, e.g. FIX.	S01SCI1 This will cause the data sent over the serial port to be in scientific notation for channel 1.
SEND[chn] [n]	Runs the main loop if it had been halted. It will run it for channel *chn* for *n* loops. It can send up to 255 values.	S01SEND1 100 This will run the main loop for channel 1 100 times.
SETA[chn] [n] [x] Or SETA[chn] [n]	Sets the coefficients of the user polynomial. The polynomial is of the form: OUTPUT = $A_9X^9 + A_8X^8 + A_7X^7 +$	S01SETA1 0 2.3 This would set the A_0 term for channel 1 of the polynomial to 2.3.

COMMAND	FUNCTION	EXAMPLE
	$A_6X^6 + A_5X^5 + A_4X^4 + A_3X^3 + A_2X^2 + A_1X + A_0$	S01SETA1 1 This displays the current value for the second A_1 variable in the polynomial table.
SETPANIC[chn] [PanicState]	Sets the state of all outputs when the meter goes into a panicked state. All non-defined outputs are set low. Available parameters: R[n][H/L] Sets relay *n* high or low D[chn][X] Sets channel *chn*'s DAC to value *X*	S01SETPANIC1 R1R2D115 When the meter panics, relays 1 and 2 are set high and DAC1 will output 15mA for channel 1. S01SETPANIC1 Sets all outputs for channel 1 to low in a panic state.
SETPOINT[chn] [n] Or SETPOINT[chn]	Sets the PID set point for each respective channel.	S01SETPOINT1 35 This will set the PID set point at 35 for channel 1. S01SETPOINT2 This will show the current set point value for channel 1.
SETX[chn] [n] [x] Or SETX[chn] [n]	This command sets the nth variable to the value specified by x in the X portion of the X-Y table; **the values for x must be in increasing order as listed in terms of variable order:** **$x[n_0] < x[n_1]\ldots < x[n_{23}] < x[n_{24}]$**	S01SETX2 0 1 This command will set the first *x* value in the linearization table to 1 for channel 2. S01SETX1 2 This displays the current value for the third *x* variable in the linearization table for channel 1.
SETY[n][y] Or SETY[n]	This command sets the nth variable to the value specified by y in the Y portion of the X-Y table.	S01SETY0 1 This command will set the first *y* value in the table to 1. S01SETY1 This displays the current value for the second *y* variable in the linearization table.
SHOWACT[chn]	Shows the relays, commands, and	S01SHOWACT1

COMMAND	FUNCTION	EXAMPLE
	messages statuses for the channel *n*.	This will show the relay statuses, commands, and messages for channel 1.
SHOWCONFIG[chn]	This will show the jumper, color schemes, and LED driving configurations for channel *chn*.	S01SHOWCONFIG1 This will show all the general configuration statuses for channel 1.
SHOWPOLY[chn]	Shows user defined polynomial coefficients.	S01SHOWPOLY1 This will show the user defined polynomial for channel 1.
SHOWTABLE[chn]	Shows user defined linearization table. The table contains *n* many table values where: $0 \leq n \leq 24$. Since values for the coefficient *x* must be input in increasing value, the table will only display the *x* and *y* coefficients that are relevant and maintain the increasing trend.	S01SHOWTABLE2 This will show the user defined linearization table for channel 2.
SHOW[x]	With no argument, this command shows the general unit information. In order to view more channel specific information, use the SHOW command in conjunction with one of the following arguments: ACT[chn], CONFIG[chn], POLY[chn], TABLE[chn], and [chn].	S01SHOW2 This will show all the general configuration statuses for channel 2.
STATUS[chn] [n] Or STATUS[chn]	With polling disabled, this command triggers the channel to send the last 'n' numbers processed by the A/D conversion. Valid inputs range from 1 to 10 **(See POLL)**.	S01STATUS1 4 After executing this command, channel 1 will send back the last 4 values processed by the A/D conversion. S01STATUS1 This displays the current number of values that have yet to be returned for channel 1.
STIMER [n]	This will set the limit message timer at a value *n* many 100ms.	S01STIMER2 23 This will cause the limit message timer for channel 2 to be 23*100ms = 2.3 seconds.

COMMAND	FUNCTION	EXAMPLE
STOP	Stops normal operation of the meter. The meter will do nothing more than respond to button presses and serial commands.	S01STOP Stops the meter.
TARE[chn] [ON/OFF] Or TARE[chn]	Turning tare ON zeroes the A/D reading by applying an offset equal to its current value. This offset is applied until tare is turned off. Valid arguments are ON or OFF.	S01TARE1 ON If the current A/D value was 200 and a subsequent value after the command was issued was 400, then the channel would show and transmit 200. S01TARE1 This displays the current stare of the TARE function, whether it is currently ON or OFF.
TUNIT[chn] [x]	Sets temperature conversion of the reading of the meter, assuming the input is in °C. Valid arguments are C, F, and K.	S01TUNIT1 F Converts the input from °C to °F. S01TUNIT1 C Removes temperature conversion from the input.
UNDERRANGE[chn] [n] Or UNDERRANGE[chn] [ON/OFF] Or UNDERRANGE[chn]	This will manipulate the over ranging message and when it is activated. An over ranging value of *n* can be input that when passed, it will cause the over ranging message to appear on the digits (if the over range is on).	S01UNDERRANGE1 135 This will change the value to which the reading is considered over range to 135 for channel 1. S01UNDERRANGE1 ON This enables the over range function so that when the reading is over the over range value, the digits will display the over range message for channel 1. S01UNDERRANGE1 This will show the over range value and the status of the over range function for channel 1

COMMAND	FUNCTION	EXAMPLE
UNITID[ON/OFF] Or UNITID	This will enable or disable whether the unit address will precede all polled channel values sent from the unit.	S01UNITIDON This will cause the unit to send its address prior to every value. S01UNITID This will display the current status of the UNITID function.
UNITS[chn] [unit] Or UNITS[chn]	This will assign a unit to the values sent from the channel. Each channel has its own units.	S01UNITS1 FEET This will assign the units "FEET" to the channel 1 values. S01UNITS1 This will cause the channel to be unit less.
WDTEST[chn]	Performs a watchdog test of the unit. If the watchdog timer is working properly, the watchdog LED will blink momentarily.	S01WDTEST1 Performs a watchdog test on channel 1 of the unit. If the watchdog timer is working properly, the watchdog LED will blink momentarily.
WRITE	This command writes the current configuration data to the EEPROM. This allows the channel to go back to the user-programmed settings when power is lost. If this command is not issued after user configurable settings have been changed, the next time the channel is powered down, these settings will be lost. There are no arguments for this command.	S01WRITE This command saves all user configurable settings to EEPROM. See **Table 7.4** for details.

Table 13.3: List of commands and their usage

7.3 EEPROM Settings:

Value Stored	Default Value	Associated Command
Channel Reading State	On	CH
Limit Checking	On	LIM
HiHi Limits	90.0	HH
Hi Limits	80.0	H
Lo Limits	20.0	L
LoLo Limits	10.0	LL
Limit Delays	0.0 seconds	DELAY
Hysteresis Values	0.0	HYST
Scale	1.0	SCALE
Offset	0.0	OFFSET
Linearization Option	None	LIN
Table	0.0 for all entries	SETT
Polynomial	0.0 for all entries	SETP
Peak	Off	PEAK
Hold	Off	HOLD
Averaging	0 Samples	AVG
A/D Band	0.0	ADBAND
Temperature Conversion	None	TUNIT
Units	-Blank-	UNITS
A/D Range	High	RANGE
DAC High Limit	24mA	DH
DAC Low Limit	0mA	DL
DAC Scale	1.0	DSCALE
DAC Offset	0.0	DOFFSET
Running	On	RUN/STOP
Commands	All Blank	CMD
NORM Smart Alarm	All outputs low	SA
HH1 Smart Alarm	R1H	SA
L1 Smart Alarm	R3H	SA

Value Stored	Default Value	Associated Command
Address	01	ADDR
Baud Rate	9600	BAUD
Polling	On	POLL
Echo	On	NET/LOC
Intensity	5	DINT
Decimal Fix	3	DFIX
Bargraph Full Scale	10.0	BFS
Bargraph Zero	0.0	BZ
Bargraph Origin	0.0	BO
Limit Flashing	On	DLFLASH
Limit Marks	On	DLIM
Display Symmetry	Off	DSYM
Bargraph Color	Green	DCOLOR
HH Color	Red	HHD
H Color	Amber	HD
L Color	Amber	LD
LL Color	Red	LLD
IDelay	0.0 Seconds	IDELAY
SD Card Log Interval	1 Second	LOGTIME
SD Card Logging	Off	DLOG
Date Format	YYYY/MM/DD	DATE
Time Format	24-hour	TIME
H1 Smart Alarm	R2H	SA
LL1 Smart Alarm	R4H	SA
Alarms	January 1, 2000	ALARM

Table 13.4: Listing of user-defined values saved to EEPROM

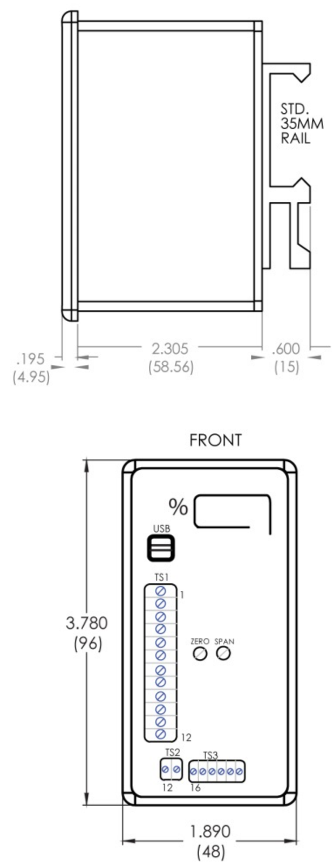
8. Ordering Information/Typical Connections & Mounting (Continued)

NTM™ NEW TECHNOLOGY HOUSING ENVIRONMENTAL SPECIFICATIONS

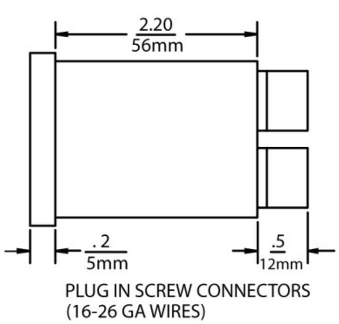
METERS & CONTROLLERS Housing (**Digit 4**)	Environmental	Bar Length/ Digit Size
Option 0: 3.8x1.9" 1/8 DIN Plastic or Metal	Nema 3	2.5"/.6"
Option 1: 5.7x1.9" Metal	Nema 3	4"/.4"
Option 2: 5.7x2.84" Metal	Nema 3	4"/.4"
Option 3: 4" ANSI Switchboard, Plastic or Metal	Nema 3, 4X	6.5"/.3 &.25"
Option 4: 1.4"x11" Plastic or Metal	Nema 3	8"/.3"
Option 5: 3x6" Plastic or Metal	Nema 3, 4X	4"/.3"
Option 6: 7x1.4" Metal	Nema 3	4"/.3"
Option 7: 7.2x2.8" Metal	Nema 3	4"/.3"
Option 8: 6.3x2.8" Metal	Nema 3	4"/.3"
Option 9: 6x1.74" Plastic or Metal	Nema 3	4"/.3"
Option A: 3.8x3.8" 1/4 DIN Plastic or Metal	Nema 3	2.5"/.4"
Option D: 3 1/2" Barrel Analog Meter Plastic	Nema 3	3"/.4"
Option F: 2x3" Flat Pack Plastic	Nema 3, 4X	3"/.3"
Option L: 2.9x1.5" Plastic or Metal	Nema 3, 4X	2.5"/.25"
Option M: ANSI Swbd. 4", P/M	Nema 3, 4X	6.5"/.6"
Option N: ANSI Swbd. 4", P/M	Nema 3, 4X	6.5"/.6"
Option P: 6.6x1.4" Plastic	Nema 3	4"/.25"
Option S: 6x1" Plastic	Nema 3	2.5"/.25"
Option X: 4x4" Explosion Proof, Metal	Nema 3, 4X	3"/.3"
TRANSMITTERS		
TNT: Transmitter Only 1.9x3.8" Plastic	Class 1, Div. 1, NEMA 3	4"/.25"
NTT: Transmitter only 1.9x3.8" Plastic	Class 1, Div. 1, NEMA 3	4"/.25"

NEW TECHNOLOGY TRANSMITTER TNT AND NTT MECHANICAL & MOUNTING

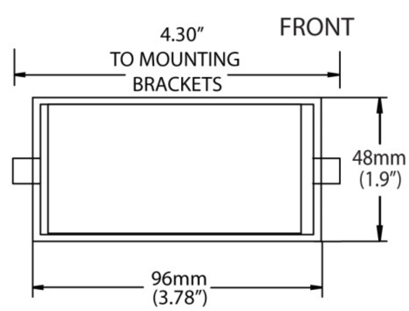
DIN-Rail Mount Mechanical



TNT Panel Mount

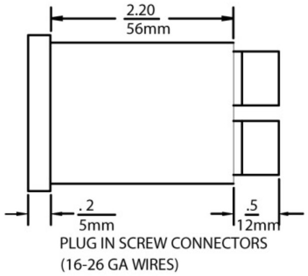


Panel Cutout: 46x92mm
(1.85x3.62")



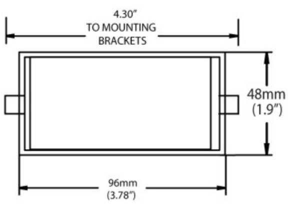
NTM™ **NEW TECHNOLOGY MECHANICAL & MOUNTING INFORMATION BY CASE STYLE (Digit 4 & Option #)**

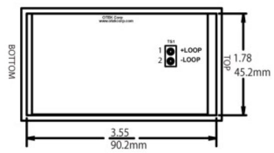
OPTION-0
1/8 DIN 3.8x1.9” Bezel Mechanical



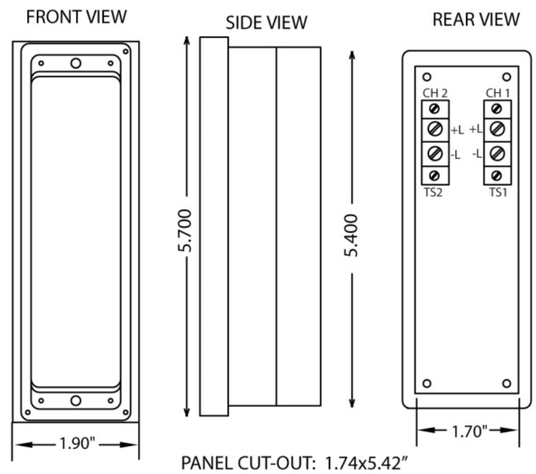
Panel Cutout: 46x92mm (1.85x3.62”)

FRONT REAR





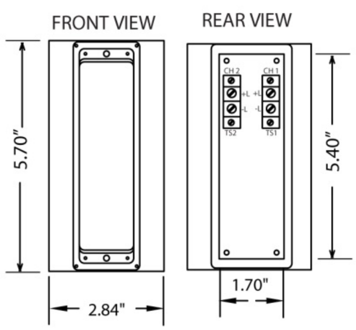
Option -1
5.7x1.9” Metal Bezel Mechanical

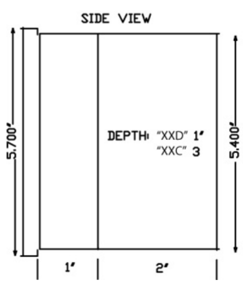


PANEL CUT-OUT: 1.74x5.42”

NOTE: INDUSTRAIAL HAS EURO PLUG CONNECTORS
(MIL OR EPRI HAS FILTERED TERMINAL CONNECTORS)
DEPTH VARIES WITH OPTION. MAX: 3”

OPTION-2
2.84X5.7” Bezel Mechanical

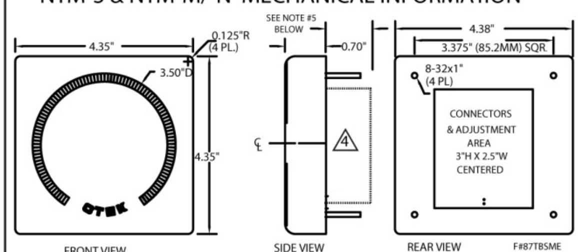




Panel Cutout: 5.42x2.70”
Depth: 1” (Display Only
3” (Controller)

OPTION-3
ANSI 4” Switchboard Mechanical

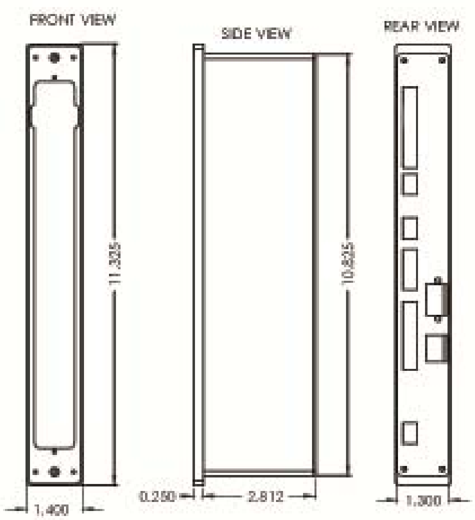
NTM-3 & NTM-M/-N MECHANICAL INFORMATION



NOTES:
1. ANSI 4"(3.375") CASE CAN ALSO BE MOUNTED IN 1/4 DIN PANEL CUTOUT.
2. CONNECTORS AND 3.375" STUDS SPACING MEET ANSI39.1 STANDARD FOR SWITCHBOARD METERS. CONNECTORS FALL WITHIN EXISTING "BARREL" CUTOUT.
3. WIRE: 26-16GA
4. SHIELDED VERSIONS WILL EXTEND ~2" BEHIND THE PANEL.
5. PLASTIC IS 1" THICK; METAL IS 0.7" THICK.

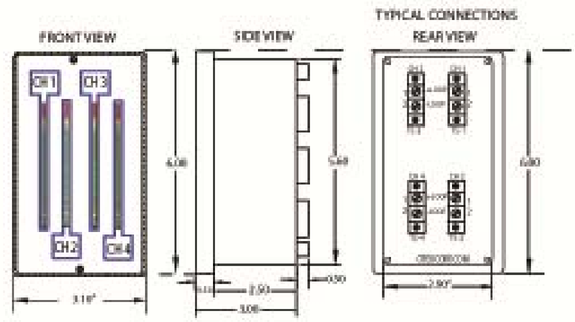
NTM™ NEW TECHNOLOGY MECHANICAL & MOUNTING INFORMATION BY CASE STYLE (Digit 4 & Option #)

OPTION -4
11.3x1.4" Bezel Mechanical



PANEL CUT-OUT: 1.34x10.88"

OPTION -5
3x6" Bezel Mechanical



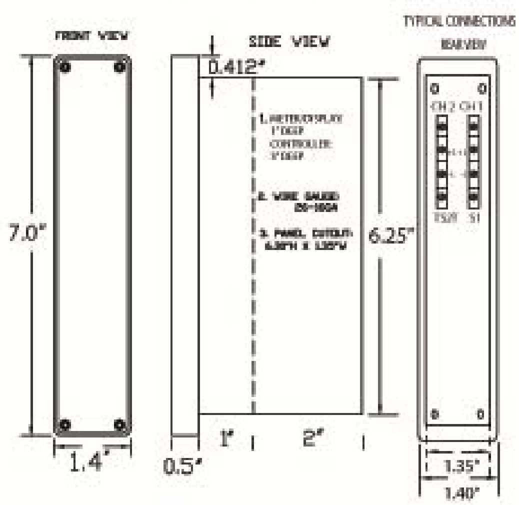
Mounting: 1. REMOVE FILTER

2. TWIST MOUNTING TABS (2) CLOCKWISE

3. REPLACE FILTER

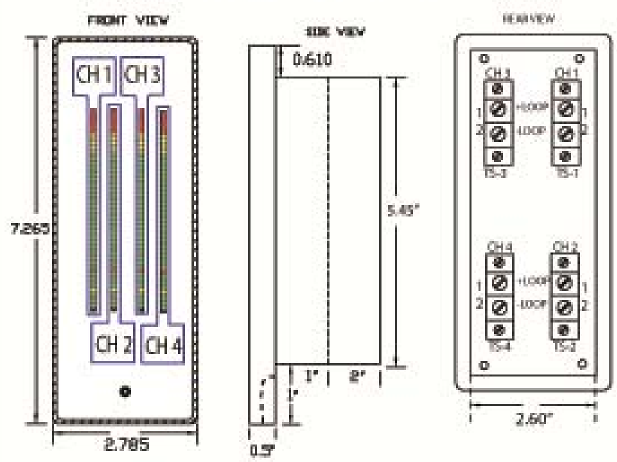
PANEL CUT-OUT: 3x5.6"

OPTION-6
7x1.4" Bezel Mechanical



PANEL CUT-OUT: 1.35x6.30"
DEPTH: 1" (DISPLAY ONLY)
3" (CONTROLLER)

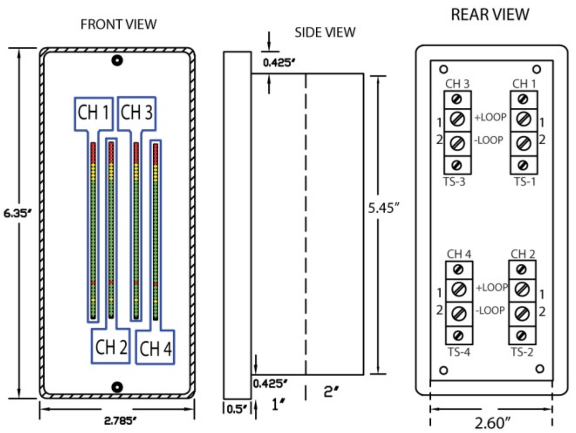
OPTION-7:
7.2x2.8" Bezel Mechanical



PANEL CUT-OUT: 2.65x5.50"
DEPTH: 1" (DISPLAY ONLY)
2" (CONTROLLER)

NTM™ NEW TECHNOLOGY MECHANICAL & MOUNTING INFORMATION BY CASE STYLE (Digit 4 & Option #)

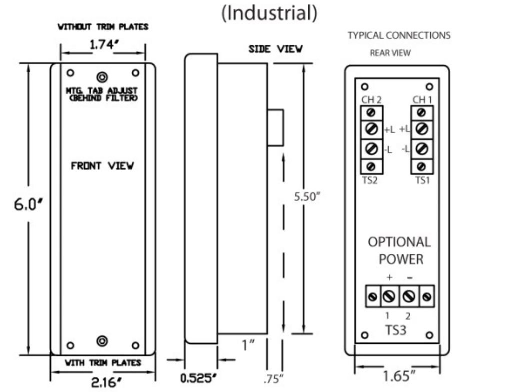
OPTION -8: 6.3x2.8" Bezel Mechanical

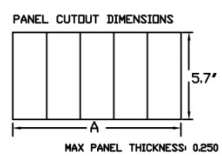


PANEL CUT-OUT: 2.65x5.50"
DEPTH: 1" (DISPLAY ONLY)
3" (CONTROLLER)

OPTION -9: (Industrial) 6x1.74" Bezel Mechanical

(Industrial)





NOTE: DISPLAYS ARE 1" DEEP
CONTROLLERS ARE 2.3" DEEP

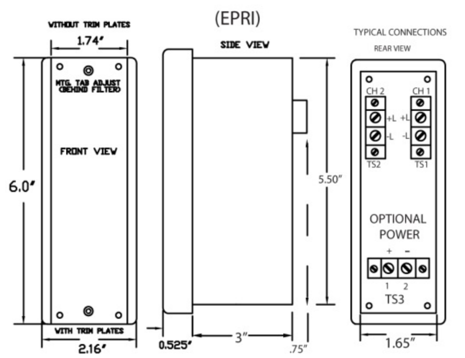
DIMENSION "A"	+0.03 -0.00	+0.76 -0.00
# UNITS	INCHES	mm
1	1.77	44.96
2	3.52	89.41
3	5.26	133.60
4	6.99	177.55
5	8.73	221.74

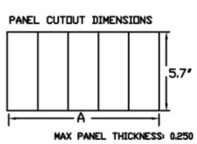
PANEL CUT-OUT: 1.70x5.70"
DEPTH VARIES W/OPTIONS. MAX: 3"

OPTION -9 (EPRI) 6x1.74" Bezel Mechanical

LPD-9 MECHANICAL INFORMATION

(EPRI)



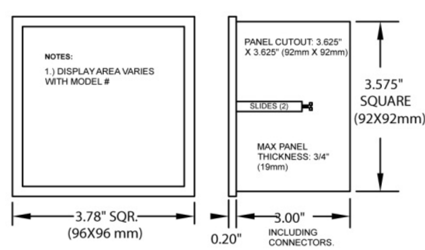


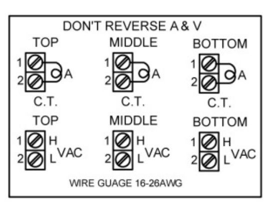
NOTE: DISPLAYS ARE 1" DEEP
CONTROLLERS ARE 2.3" DEEP

DIMENSION "A"	+0.03 -0.00	+0.76 -0.00
# UNITS	INCHES	mm
1	1.77	44.96
2	3.52	89.41
3	5.26	133.60
4	6.99	177.55
5	8.73	221.74

PANEL CUT-OUT: 1.70x5.70"
DEPTH: 3"

OPTION -A 1/4 DIN: 3.8x3.8" Bezel Mechanical

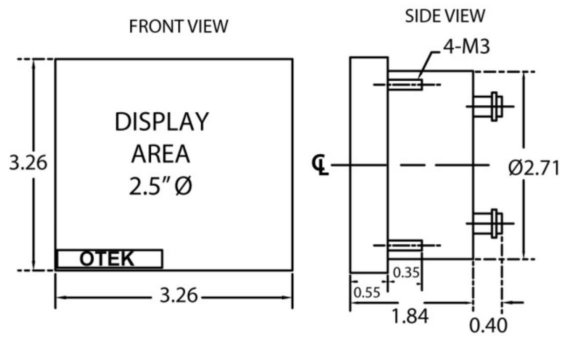


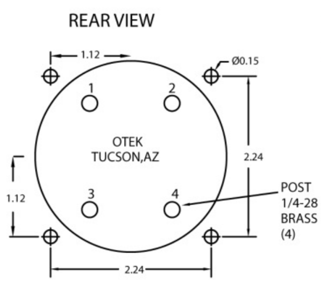


NOTES: 1.) USE 10A FUSE FOR AMPS & 1A FOR VOLTS.
2.) USE 5A.C.T. &120V P.T.
3.) SHOWN FOR 3 Φ, FOR 1 Φ ONLY THE "MIDDLE" CONNECTORS ARE INCLUDED.

NTM™ NEW TECHNOLOGY MECHANICAL & MOUNTING INFORMATION BY CASE STYLE (Digit 4 & Option #)

OPTION -D
3 1/2" Analog Meter Case Mechanical

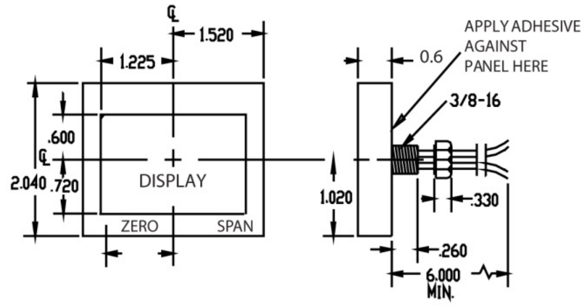




HOLE DIAMETER: 2.75"
MTG. HOLES (4): 0.15" Ø

NOTE: ZERO, SPAN & SERIAL I/O ARE BEHIND THE COVER.

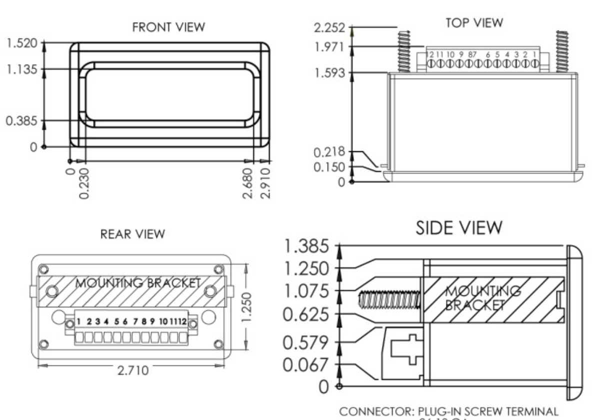
OPTION -F
Flat Pack 2x3" Mechanical



Mounting Instructions:
1. ***Drill a 3/8 - 1/2" diameter hole.***
2. ***Attach supplied double sided tape to back of it.***
3. ***Pass wires through hole.***
4. ***Align and Press NTM-F on panel (that is all!)***
5. ***Don't pull on wires (26 gage)!***

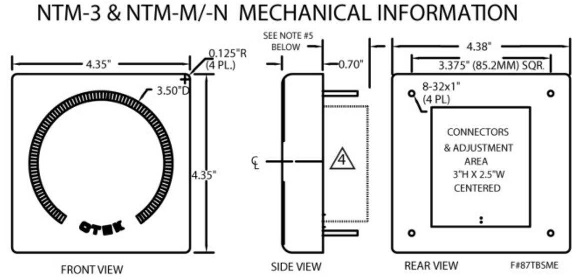
NO PANEL CUT-OUT!

OPTION -L:
2.9x1.5" Bezel Mechanical



OPTIONS -M & -N:
ANSI 4" Switchboard Mechanical

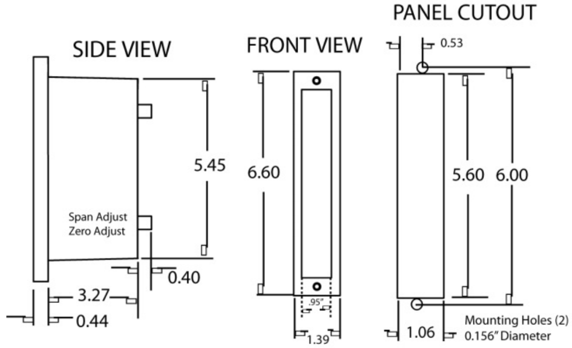
NTM-3 & NTM-M/-N MECHANICAL INFORMATION



NOTES:
1. ANSI 4"(3.375") CASE CAN ALSO BE MOUNTED IN 1/4 DIN PANEL CUTOUT.
2. CONNECTORS AND 3.375" STUDS SPACING MEET ANSI39.1 STANDARD FOR SWITCHBOARD METERS. CONNECTORS FALL WITHIN EXISTING "BARREL" CUTOUT.
3. WIRE: 26-16GA
4. SHIELDED VERSIONS WILL EXTEND ~2" BEHIND THE PANEL.
5. PLASTIC IS 1" THICK; METAL IS 0.7" THICK.

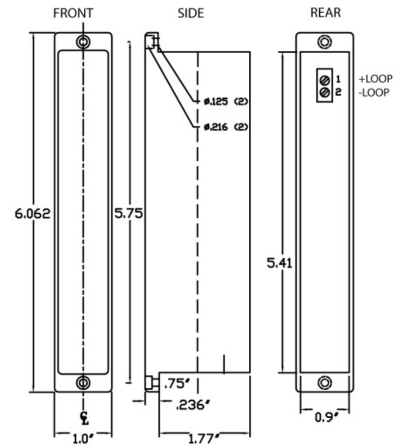
NTM™ **NEW TECHNOLOGY MECHANICAL & MOUNTING INFORMATION BY CASE STYLE (Digit 4 & Option #)**

OPTION -P:
6.6x1.4” Bezel Mechanical



PANEL CUT-OUT: 1.06x5.60”

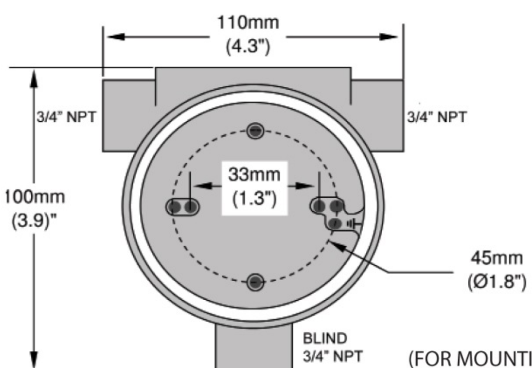
OPTION -S:
6 x1” Bezel Mechanical



NOTES:
1. MOUNTING HOLES (2) FOR#4 CLEARANCE HARDWARE SUPPLIED.
2. WIRE SIZE ACCEPTED: >24 <16GA.
3. ALL DIM +/- 0.010"
4. FOR STACKED APPLICATIONS MAKE MOUNTING HOLES ON 1.05" CENTERS
5. METER/DISPLAY ONLY: 0.75" DEEP
CONTROLLER: 1.77" DEEP

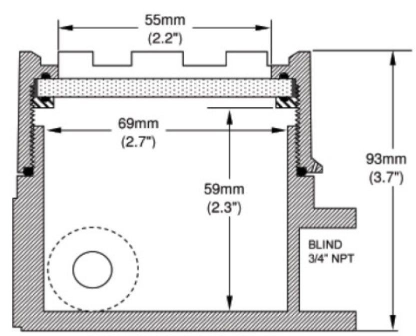
PANEL CUT-OUT: .95x5.45”

OPTION -X
4x4”
Explosion Proof Mechanical



TOP VIEW OF HOUSING

(FOR MOUNTING ON 3/4 NPT PIPE)



SIDE VIEW OF HOUSING