

TEM203P User Manual

1.0 DESCRIPTION

The head mounted temperature transmitter connects to any standard pt100 resistance sensor and converts the linearised temperature to a (4 to 20) mA signal. The transmitter is a two wire device, and is fully configurable by the user, over a wide temperature range, with the aid of a simple push button. This new design incorporates additional configuration menus, allowing the user to push button trim the transmitter output at both zero and span, ideal for trimming out sensor errors. The transmitters advanced circuitry guarantees high stability over the wide operating ambient temperature ranges experienced by head mounted devices.

One of the transmitters features is the program LED, which provides visual indication of sensor fault when in normal operation and is also used to guide the operator through the simple menus during configuration.

2.0 RECEIVING AND UNPACKING

Please inspect the packaging and instrument thoroughly for any signs of transit damage. If the instrument has been damaged, please notify your supplier immediately.

3.0 SPECIFICATION @ 20 °C

INPUT	
Sensor Type	PT100 100 R @ 0°C 2 or 3 Wire
Sensor Range	(-195 to +845) °C (18 to 390) Ω
Sensor Connection	Screw terminal
Minimum span (see note 1)	25 °C
Linearisation	BS EN 60751(IEC 751) standard / JISC1604
Accuracy (see note 2)	±0.1 °C ±0.05% of Reading
Thermal Drift	± 0.02 °C / °C
Excitation current	< 200 uA
Lead Resistance effect	0.002 °C / Ω
Maximum lead Resistance	20 Ω per leg

- Note 1 Any span may be selected, full accuracy is only guaranteed for spans greater than the minimum recommended span.
- Note 2 Basic measurement accuracy includes the effects of calibration, linearisation and repeatability

OUTPUT	
Type	Two wire (4 to 20) mA sink
Limits	Low >3.9 mA ; high 21.5 mA
Accuracy	±(mA out / 2000) or ±5 uA which ever greater
Loop Effect	± 0.2 uA / V measured @ 50 Hz 1 V (peak to peak)
Thermal Drift	± 2 uA / °C
Max Load	[(Vsupply - 10)/21] KΩ

GENERAL	
Operating Voltage	(10 to 30) Volts DC
Update Time	0.5 Seconds
Response Time	1 Second to reach 90% of final value
Start up time	From power up typically 5 Seconds
Filter Factor	Adaptive
Ambient Temperature	(-40 to 85) °C
Connection	Screw Terminal
Approvals	BS EN 61326 – Electrical equipment for measurement and control ANNEX A ; ANNEX F

Factory Default (0 to 100) °C upscale burnout (0.0 °C user trim)

4.0 INSTALLATION AND WIRING

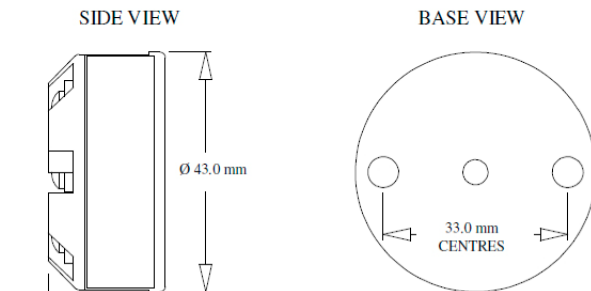


Figure 1

Mounting holes : two holes 5.5 mm diameter, 33 mm centres
Centre Hole sensor wire entry : 4 mm

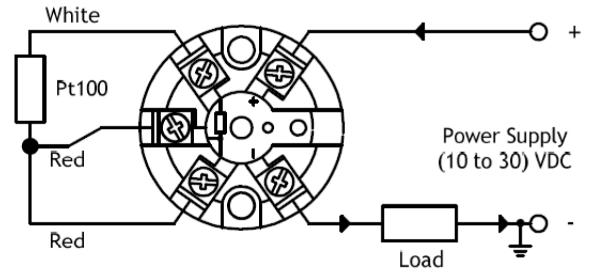
4.1 Mechanical

The transmitter has been specifically designed to fit inside a DIN standard probe head enclosure, which provides adequate protection from moisture, dust, corrosive atmosphere etc. All cable entries must be sealed using the correct size gland. Likewise any probe assembly fitted must be sealed. Care must be taken when locating the transmitter to ensure the working ambient temperature range of (-40 to 85) °C is not exceeded. The enclosure has a centre hole allowing the sensor wired to enter screw terminals from the transmitter centre, this is applicable when the sensor is mounted directly below the transmitter.

4.2 Electrical

Electrical connections to the transmitter are made to the screw terminal provided on the top face. The sensor wires must be equal length and type for the lead compensation to work correctly. The screw terminals allow for wires to enter either inner or outer direction. The transmitter is protected against reverse connection and over voltage. If no sensor (input) connection is made the transmitter will go into either up or down scale output current, depending on configuration. Figure 2 gives connection details, the output is shown connected to a 24 V supply. The load symbol represent any other device connected in the loop, such as Monitoring equipment, panel indicators and loop isolators. The load value can range from 0 ohms to the max loop load for given supply, refer to section 3 "Max load" for more information. The transmitter conforms with EC directive BS EN 61326 when correctly installed in a termination head providing at least IP54 protection and with sensor wires less than 3 metres. Screened or twisted pair wires are recommended for output wires. Always ensure the (4 to 20) mA loop is grounded at one point, this would normally be at the monitoring equipment or loop power supply. In normal operation the program LED acts as over-range LED.

Figure 2



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5.0 USER CONFIGURATION

IMPORTANT
READ COMPLETE SECTION BEFORE ATTEMPTING CONFIGURATION
PARTICULAR CARE SHOULD BE TAKEN REGARDING TIMEOUTS IN MENU 2 & 3

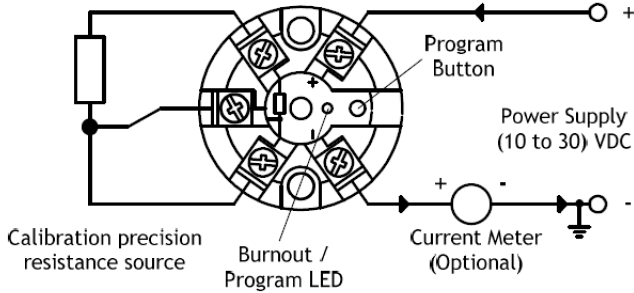


Figure 3 Configuration circuit

User Configuration

User configuration uses three menus, each menu sets a different parameter:-

Menu 1	Set range
Menu 2	Set direction of output on sensor burnout
Menu 3	User trim at 4 mA and 20 mA.

The configuration menus are navigated using the push button and program LED. The push button is located under the hole in the keyhole shaped wiring label. To press the button use a 3 mm screw driver (flat blade) inserted into the hole. The button has a slight click action.

Three types of button press are used:-

- Single button press = Advance
- Double press within 0.5 seconds = Escape or change direction
- Press and hold button > two seconds = Enter

When a menu is selected the Program LED will flash in bursts of one to three flashes, the number of flashes represents the menu number.

Navigating the menus

- To access menus, press and hold button > 2 second, then program LED will start to flash, one flash every burst. This Indicates "menu 1" is selected.
- Use single button press to advance selection to "menu 2", the program LED will now show two flashes per burst. The Next single presses will advance the selected menu to menu 3 and the next single press will advance selected menu back to menu 1. Repeated single presses will cycle the selected menu back around menus 1 to 3, in the above sequence.
- Double press button to escape from menus, and return to normal. Normal operation can also be selected by turning transmitter power off and on. Note the transmitter will not time out and automatically escape from menus.

Using Menus

Menu 1 Range configuration (No Timeout)

Configuration will require the following tools and equipment :-

- DC Supply (10 to 30) V @ 30 mA
- Precision resistance decade box to simulate PT100 sensor. (Do not use electronic calibrator)
- Screw driver flat blade 3mm wide
- PT100 resistance tables
- Current meter (user trim)

To re-range the temperature scale follow the following instructions:-

- Refer to figure 3, connect resistance box to the input terminals using three wire connection. Connect output to a DC supply, observe polarity. Turn power on and allow 1 minute warm up period.
- Set calibrator to the equivalent resistance of the pt100 sensor, at required low range temperature. If the program LED is on at this stage the input is out of range, check resistance and connection.
- Press and hold button > 2 seconds to enter menus, menu 1 will then be selected, indicated by one flash every burst.
- Whilst menu 1 is selected, press and hold button > 2 seconds to enter menu 1, at which stage the program LED toggle on and off at a slow rate.
- Allow twenty seconds then single press button to store low range setting, the program LED will now flash at a fast rate.
- Set calibrator to the equivalent resistance of the pt100 sensor, at required high range temperature and allow twenty seconds.
- Press button to store high range setting, the program LED will flicker for one second before the transmitter returns to normal operation. The transmitter is now re-ranged.

Menu 2 Burnout Selection (Timeout is 3 Seconds)

- Refer to figure 3, Connect output to a DC supply, observe polarity. For this menu the input can be connected or open circuit. Turn power on.
- Press and hold button > 2 seconds to enter menus, menu 1 will then be selected, indicated by one flash every burst.
- Single press button to advance selection to menu 2, indicated by two flashes of the program LED every burst.
- Whilst menu 2 is selected, press and hold button > 2 seconds to enter menu 2, at which stage the program LED will either toggle on and off at a slow indicating low scale burnout or fast rate indicating upscale burnout.
- To change burnout direction single press button. The Program LED toggle rate will change to the other setting. Repeated single presses will toggle between up and down scale.
- To store setting allow 3 seconds with no button action, the program will then timeout, store new setting then return to normal operation.

Menu 3 User trim (Timeout is 20 Seconds)

This menu allows the user to trim the output current at 4 mA and 20 mA points, (similar function to trim potentiometers) and is very useful for trimming out sensor errors.

The input of the transmitter must be connected to either a calibrator or a temperature sensor held at a known temperature. The (4 to 20) mA loop current will also need to be monitored with a current meter.

- Refer to figure 3, connect sensor or resistance box to the input terminals using three wire connection. Connect output to a DC supply, observe polarity, connect current meter in series with loop. Turn power on and allow 1 minute warm up period.
- Set calibrator to the equivalent resistance of the pt100 sensor, at required trim point. Alternatively ensure sensor temperature is at the required calibration point.
- The transmitter will automatically trim the 4 mA end if the output is within the active band of (3.8 to 6) mA, and trim the 20 mA end if the output is within the active band of (18 to 21.5) mA. No setting adjustment is performed if the output current is not within these two bands. Ensure your calibration points are within these bands.
- Press and hold button > 2 seconds to enter menus, menu 1 will then be selected, indicated by one flash every burst.
- Single press button to advance selection to menu 2, and single press again to select menu 3 indicated by three flashes of the program LED every burst.
- Whilst menu 3 is selected, press and hold button > 2 seconds to enter menu 3, at which stage the program LED toggle on and off at either a slow rate indicating downward trim direction or fast rate indicating upwards trim direction.
- To change trim direction double press button. The Program LED toggle rate will toggle to the opposite direction. Repeated double presses will toggle between up and down trim direction
- To trim output current, single press button to advance current 2 uA in set direction, or press and hold button to auto advance in set direction release button to stop advance. Note after approximately 20 seconds of continuous button press, the auto trim rate will speed up. Monitor the current change on the current meter.
- To store new setting allow 20 seconds with no button action, the program will then timeout, store new setting then return to normal operation.

Aid to User trim

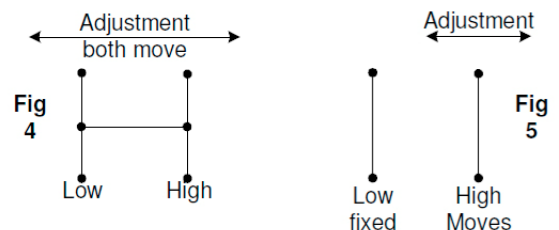
- 1) Trim the 4 mA end first. The 4 mA trim is an offset adjustment and will affect both low and high ends, they will trim by the same amount (Fig 4)
- 2) Trimming the 20 mA end will not affect the 4 mA end, it will stretch or contract the 'span' between them. (Fig 5)

Reset to factory default settings

If required the unit can be reset to factory default setting, this procedure also removes any user trim adjustment. Factory default settings are :

Range	(0 to 100) °C
Burnout	up-scale
User trim	All user adjustment cleared

To reset to factory setting, hold the button down whilst the SEM203P is powered up.



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TEM203T User Manual

1.0 DESCRIPTION

The transmitter is an in-head (4 to 20) mA transmitter that connects to a standard thermocouple sensor and converts the sensors temperature to a linear temperature (4 to 20) mA signal.

The transmitter sensor type and range can be requested at the time of order, but if desired the user can re-configure the transmitter parameters by use of a single push button and the range "R", menu "M" LEDs. Two methods of configuration are available, the first "USER RANGING" acts only on the transmitter range, similar to the previous design. The other method "ADVANCED USER CONFIGURATION" offers full configuration. This level is entered by holding down the push button on power up. The advanced level has the following menus:-

- Menu 1 - Selection of input type, seven popular thermocouples or mV input.
- Menu 2 - Select either user push button set range or one of seven fixed ranges.
- Menu 3 - Select either up or down scale output on sensor burnout.
- Menu 4 - User trim allow trim of output current at high and low range
- Menu 5 - Reset factory default.

The addition of fixed ranges to this product allows the user to re-range the product without the need for specialist equipment. The transmitter input is isolated.

2.0 RECEIVING AND UNPACKING

Please inspect the packaging and instrument thoroughly for any signs of transit damage. If the instrument has been damaged, please notify your supplier immediately.

3.0 SPECIFICATION @ 20 °C

INPUT

Sensor	Range (°C)	Accuracy
K	-200 to 1370	± 0.1% of F.S. ± 0.5 °C (plus any sensor error)
J	-100 to 1200	± 0.1% of F.S. ± 0.5 °C (plus any sensor error)
E	-100 to 1000	± 0.1% of F.S. ± 0.5 °C (plus any sensor error)
N	-180 to 1300	± 0.1% of F.S. ± 0.5 °C (plus any sensor error)
T	-100 to 400	± 0.2% of F.S. ± 0.5 °C (plus any sensor error)
R	-10 to 1760	± 0.1% of F.S. ± 0.5 °C (plus any sensor error) over range 800 to 1600
S	-10 to 1760	± 0.1% of F.S. ± 0.5 °C (plus any sensor error) over range 800 to 1600
	Range (mV)	
mV	-10 to 70	± 0.02% of full scale

Isolation Tested to 250V dc
Sensor Burnout Either up or down scale output
Cold Junction Range (-40 to 85) °C; Accuracy ± 0.5 °C
 Tracking ± 0.05 °C / °C
Stability Offset 0.15 °C / °C ; Span 0.1 °C / °C

OUTPUT

Type Two wire (4 to 20) mA sink
Limits Low 3.8 mA ; high 21.5 mA
Accuracy (mA out / 2000) or 5 uA which ever greater
Loop Effect ± 0.2 uA / V measured @ 50 Hz 1V (peak to peak)
Thermal Drift ± 2 uA
Max Load [(Vsupply - 12)/20] KΩ

GENERAL

Operating Voltage (12 to 30) Volts DC
Update Time 0.5 Seconds
Response Time 1 Second to reach 90% of final value
Start up time From power up typically 5 Seconds
Filter Factor Adaptive
Ambient Temperature (-40 to 85) °C
Connection Screw Terminal
Approvals BS EN 61326 ; - Electrical equipment for measurement and control ANNEX A ; ANNEX F
Factory Default (0 to 1000) °C type K, upscale burnout (0.0 °C user trim)

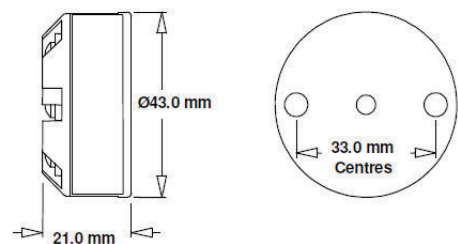
4.0 INSTALLATION AND WIRING

4.1 Mechanical

The transmitter has been specifically designed to fit inside a DIN standard probe head enclosure, which provides adequate protection from moisture, dust, corrosive atmosphere etc. All cable entries must be sealed using the correct size gland. Likewise any probe assembly fitted must be sealed.
 Care must be taken when locating the transmitter to ensure the working ambient temperature range of (-40 to 85) °C is not exceeded. The transmitter enclosure has a centre hole allowing the sensor wired to enter screw terminals from the transmitter centre, this is applicable when the sensor is mounted directly below the transmitter.

Figure 1

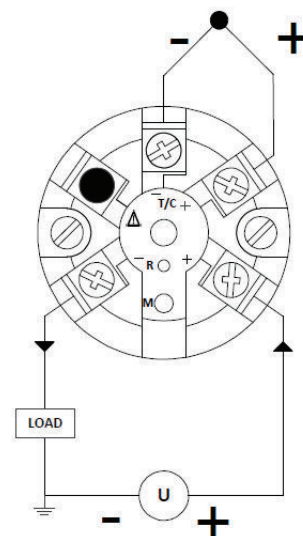
Mounting holes : two holes 5.5 mm diameter, 33 mm centres
 Centre Hole sensor wire entry : 4mm



4.2 Electrical

Electrical connections to the transmitter are made to the screw terminal provided on the top face. The correct type of thermocouple wire must be used to connect sensor, this will normally be provided as part of the probe assembly. The screw terminals allow for wires to enter either inner or outer direction. Never attempt to unscrew the spare terminal which secures the factory fitted cold junction sensor. The terminal is fitted with a tamperproof screw to avoid accidental adjustment.
 The transmitter is protected against reverse connection and over voltage. If no sensor (input) connection is made the transmitter will go into either up or down scale output current, depending on configuration setting.
 Figure 2 gives connection details, the output is shown connected to a 24 V supply. The load symbol represent any other device connected in the loop, such as Monitoring equipment, panel indicators and loop isolators. The load value can range from 0 ohms to the max loop load for given supply, refer to section 3 "Max load" for more information.
 The transmitter conforms with EC directive BS EN 61326 : when correctly installed in a termination head providing at least IP20 protection and with sensor wires less than 3 metres. Screened or twisted pair wires are recommended for output wires. Always ensure the (4 to 20) mA loop is grounded at one point, this would normally be at the monitoring equipment or loop power supply.
 In normal operation the range "R" LED acts as over-range LED. The menu LED is always off.

Figure 2



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TEM203T User Manual

5.0 USER RANGING

The transmitter may be purchased pre-configured, if specified at the time of order. User ranging is provided to allow the temperature range of the transmitter to be set to a custom range. This configuration level cannot change the input type. If the input type or other parameters require change, then please refer to the advanced configuration section. To confirm the present input type set on the transmitter is correct for your application, count the number of flashes of the range "R" LED at power up then refer to the chart in section 6 "Menu 1" to establish the type set.

The push button is located under the slot in the key hole label, the slot located next to the menu "M" LED. To press the button use a 3 mm screw driver (flat blade), inserted into the slot and locate resistance of button key. The button has a slight click action.

It may be worth noting at this stage the advance user configuration provides the user with the option of selecting fixed ranges, this may be a more attractive option if a suitable range is available, as no calibration equipment will be required.

Configuration will require the following tools and equipment:-

- DC Supply (12 to 30) V @ 30 mA
- Thermocouple calibrator
- Thermocouple compensating wire
- Screw driver flat blade 3mm wide

To re-range the temperature scale follow the following instructions:-

- Connect thermocouple calibrator to transmitter input terminals using correct thermocouple compensation wire. Observe polarity.
- Connect the output terminals to the DC supply, observe polarity.
- Turn DC supply on.
- Set calibrator to the required low scale temperature. Note Range "R" LED if on indicates input connection error or input out of range, please check input.
- Allow 1 minute warm up period.
- To "enter" ranging, press and keep pressed the push button until Range "R" LED flashes at a slow rate, then release button
- The "R" LED will flash at a slow rate for a approximately one second during which period the low scale range is stored. Once the store is complete the "R" LED will flash at a medium rate indicating the transmitter is ready to store the high range setting.
- Set the calibrator to the required high range temperature and allow ten seconds.
- Press button to store high range setting, the "R" LED will flicker for one second before the transmitter returns to normal operation. The transmitter is now re-ranged.

The above procedure also applies to mV input, but please ensure only copper wire is used for connection to mV calibrator.

6.0 ADVANCED USER CONFIGURATION

The advanced user configuration option is based on five menus, each menu Sets a different parameter:-

- Menu 1 Selects one of eight input types.
- Menu 2 Selects either custom user range or one of seven fixed range
- Menu 3 Selects the output direct on sensor burnout
- Menu 4 Provide User trim at 4mA and 20 mA.
- Menu 5 Reset to factory default setting

The advance configuration menus are navigated using the push button, menu "M" LED and range "R" LED. The push button is located underneath the slot in the key hole label, located just below the "M" LED. To press the button use a 3 mm screw driver (flat blade) inserted into the slot. The button has a slight click action.

Three commands are used to navigate menus, performed by clicking the button as follows:-

- Advance Single button press or click
- Escape or change direction Double press or click within 0.5 seconds
- Enter Press and hold button > two seconds

When a menu is selected the "M" LED will flash a burst of 1 to 5 flashes, the number of flashes represents the menu number.

Note the range "R" LED will only operate when a selected menu has been entered, then the "R" LED uses a series of flashes or toggle flash rates to indicate the state or stage of the open menu.

Navigating the menus (Read all of this section before attempting configuration)

To access the advanced user menus press and hold down button during transmitter power up. The advance user menus will now be enabled and remain enabled until transmitter power is removed. Note the "USER RANGING" level will not be active at this stage, the push button will now serve to navigate "advance user menus" as follows:-

- To "enter" menus press and hold button for > 2 seconds. The "M" LED will then starts to flash, rate one flash per burst (indicating menu 1).
- To "advance" to the next menu use single button press, the "M" LED will advance to two flashes per burst, indicating menu 2 is selected. Repeated single presses will advance menu, once menu 5 is reached, the next press will return to menu 1, for a repeat cycle around the menus.
- To "escape" from menus back to normal operation use a double click of the button or remove transmitter power. Note menus have no timeout escape and therefore will remain selected indefinitely.
- To "enter" a selected menu press and hold button for two seconds, at which stage the "R" LED will start to flash between bursts of the "M" LED, indicating the state of the opened menu.

MENUS (First Select the required menu and open as described above.)

Menu 1 Input type

- On Entry "M" LED single flash every burst (menu 1), followed by a burst of between 1 to 8 "R" LED flashes, flash count represents the input type as listed below. Timeout is 10 seconds so be sure to act quickly if the type needs changing.

"R" LED flashes	Input Type
1	Type K
2	Type J
3	Type E
4	Type N
5	Type T
6	Type R
7	Type S
8	mV

- Single button press to "advance" to the next input type, when type 8 is reached the next "advance" will cycle back to type 1. To ensure valid indication of input menu, allow one to two burst cycle after "advance", before counting the "R" LED flashes.
- Once the desired type is selected, allow 10 seconds with no button action, the transmitter will then store the selected input type, (indicated by flicker of "R" LED) before return back to normal operation.

Menu 2 Fixed ranges

- On "Entry" the "M" LED flashes twice every burst (menu2), followed by a "R" LED flashes between 1 to 8, flash count represents the range selected as described below. Timeout is 10 seconds so be quick to act.
- Range 1 is allocated for the user custom push button set range. When a new custom range (see USER RANGING) is entered, the range selected will automatically return to 1.

Range "R" LED flashes	Inputs K, J, E, & N (°C)	Input T (°C)	Inputs R, & S (°C)	Input mV mV
1	User Ranged			
2	0 to 1000	0 to 400	800 to 1760	0 to 70
3	0 to 1200	0 to 250	800 to 1600	0 to 5
4	0 to 600	0 to 200	800 to 1400	0 to 10
5	0 to 500	0 to 150	1000 to 1760	0 to 20
6	0 to 250	0 to 100	1000 to 1600	0 to 25
7	0 to 100	0 to 50	1000 to 1400	0 to 50
8	-100 to 100	-100 to 150	0 to 1600	-10 to 10

- Single button press to "advance" to the next range, once range 8 is reached, the next "advance" will cycle range back to 1. To ensure valid indication of range menu, allow one to two burst cycle after "advance", before counting flashes.
- Once the desired range is selected allow for 10 seconds with no button action, the transmitter will then store new range (indicated by flicker of "R" LED) before returning to normal operation.

Menu 3 Burnout Selection

- On "Entry" - "M" LED, three flash every burst (menu 3), followed by a "R" LED toggle flash, either at a slow rate (every second) or a faster medium rate. Be quick to act as timeout is 10 seconds.
- Slow rate indicated low scale burnout, fast rate indicates upscale burnout.
- To "advance" to the other burnout direction press button.
- To store new setting allow 10 seconds with no button action, the burn out selection menu will then timeout, store new setting, (indicated by a flicker of the "R" LED), before returning back to normal operation.

Menu 4 User trim

This menu allows the user to trim the output current at zero and span, (similar function to trim potentiometers) and is very useful for trimming out sensor errors. The input of the transmitter must be connected to either a calibrator or a temperature sensor held at a known temperature. The (4 to 20) mA loop current will also need to be monitored with a current meter. This menu has extended timeout of 20 seconds.

- The trim action will only operate within certain output current bands, the zero will be trimmed when the out current is between (3.8 to 6.0) mA, and the span will be trimmed when the output current is between (18.0 to 21.5) mA.
- On "Entry" - "M" LED, four flash every burst (menu 4), followed by a "R" LED toggle flash, either at a slow rate (every second) or a faster medium rate.
- Slow rate indicates trim direct down, whilst fast rate indicate trim direction up.
- To "change direction" the trim direction double click button.
- To trim, single press button to "advance" current by 2 uA, or press and hold button to auto advance, after two seconds the trim will adjust automatically at a rate of 3 uA per second until the button is released. Note after approximately 20 seconds of continuous button press, the auto trim rate will speed up to a rate of 10 uA per second.
- To store new setting allow 20 seconds with no button action, the User Trim menu will then timeout and store any new setting(s), (indicated by a flicker of the "R" LED), before returning back to normal operation.

Menu 5 Set factory default

- On "Entry" - "M" LED, five flashes every burst (menu 5), followed by "R" LED toggle flash at a slow rate (every second).
- To set factory default and zero any user trim, press button. Default setting will then be loaded and stored into the transmitter, indicated by a flicker of the "R" LED. The transmitter will then return to normal operation.
- To avoid any action, allow 10 seconds with no button action, Set factory default menu will then timeout, without storing any default configuration. The transmitter will then return to normal operation.

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