SC5010
TWO-WIRE ISOLATED TEMPERATURE TRANSMITTER WITH DISPLAY

FM APPROVED

OVERVIEW

The SC5010 Silver Series transmitter provides a direct current output proportional to the temperature as measured with a thermocouple or RTD. The transmitter displays the sensed temperature when operated in the linearized mode, or loop current when operated in the non linearized mode, on a Liquid Crystal Display *(LCD)*.

The display is an accurate temperature/loop current indicator that functions over the entire range of the selected sensor. In linearized mode, the temperature displayed is independent of the selected range for the 4 to 20 mA output. Even if the output goes over-range, the display continues to accurately indicate the sensor temperature.

The user may select between thermocouple types J, K, R, S, T, E or N, or 3850 or 3920 RTDs. RTD input connections are provided for 2, 3 and 4 wire operation. The transmitter compensates for the lead resistance in the 3 wire configuration and provides true measurement of the resistive element without wire lead error in the 4 wire configuration. In addition, the RTD configuration provides an automatic high gain/narrow input span mode for input spans as narrow as 15°C, when the SPAN value (i.e., the FULL SCALE value) is set anywhere between 0°C (32°F) and 150°C (302°F), inclusive. Input span and zero adjustments provide full rangeability over all the above sensors.

Linearization is furnished for all the thermocouple types as well as 3850 and 3920 micro-ohm/ohm/°C 100 ohm platinum resistance elements or may be used on the non-linearized mode.

TECHNICAL DESCRIPTION

The SC5010 is designed and manufactured to be intrinsically safe. The case is completely flame retardant, consisting of an extruded aluminum shell with a stamped aluminum back-plate and injection molded UL94-V0 rated polyester face.

A microprocessor controls input settings, cold junction temperature compensation, input auto-zero, variable input signal damping, normal/reverse acting output, and uses lookup tables with dynamic nonlinear extrapolation to perform thermocouple linearization to publication NIST Monograph 175. RTD's are linearized to DIN 43760 *(*a= *0.00385 or 0.00392)*.

The SC5010 utilizes a microprocessor controlled single slope integrating converter to transform the input voltages from the T/C or RTD, the cold junction sensor, ground and a reference voltage to their time equivalents. The microprocessor then digitally performs linearization, compensation for offsets, compensation for drift, and develops a digital signal with a duty cycle proportional to the corrected input signal amplitude. This signal is coupled through an isolating pulse transformer to the output circuitry which modulates the current at the output terminals (PS + and - terminals).

The transmitter contains adaptive filtering and conditioning to reduce susceptibility to transients and noisy environments. Large sample averaging increases the unit's accuracy and stability while a separate small sample average allows the unit to rapidly track larger changes in temperature.

A watchdog circuit protects the unit against power disturbances by restarting the microprocessor's operation after a specified period of inactivity.

The output is fully isolated from the input and ground. The unit is not susceptible to problems caused by ground loops and common mode voltages, and the factory settings, stored in nonvolatile memory, are not susceptible to brownouts or power losses.

The SC5010 is self contained and no programming device is required, though a calibrator may be used to set it up. A four switch membrane keypad and the LCD provide the user with full configuration capability.

LABELS

(Figure 1) shows the clearly labeled switches of the membrane keypad located on the front of the transmitter. A label on the top side above the output terminals (Figure 2) relates the temperature sensor selection to the displayed 'TC/RTD *(number)*', and shows wiring diagrams for the thermocouples and RTDs. The product model and factory setup information is shown on a label (Figure 3) located directly below the input terminals. This label contains a space to write field setup information. to the right of the display, a label indicates the units as °C or °F.

Figure 1

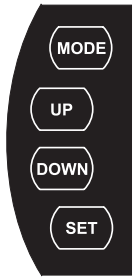


Figure 2

INPUT SELECTION			WIRING GUIDE
IND	T/C	RTD Ω	
0	J	3850µ 2/4W	T/C ① ② ③ ④
1	K	3850µ 3W	RTD 2W ① ② ③ ④
2	R	3920µ 2/4W	
3	S	3920µ 3W	RTD 3W ① ② ③ ④
4	T	NOT USED	
5	E	NOT USED	RTD 4W ① ② ③ ④
6	N	NOT USED	JUMPER AT TERMINALS

Figure 3

INSTALLATION & MOUNTING

MP8500 Mounting Plate is used to mount the transmitter on a flat surface orin a 2 ¾" wide PVC track. Use the mounting plate as a template to locate and drill holes for surface mounting. To screw the mounting plate to the transmitter, remove the appropriate diagonal screws from the back of the unit and reinstall with mounting plate in place against the back of the unit.

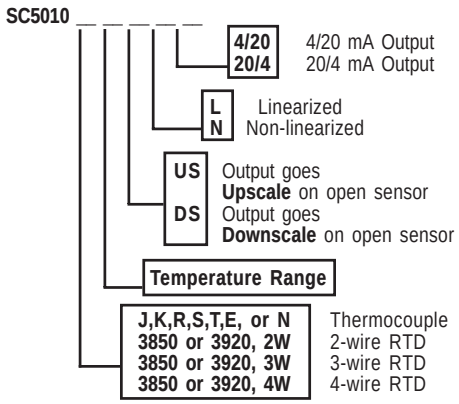
DMP8500 Mounting Plate is used to mount the transmitter on a standard 35mm DIN rail. The mounting plate is normally configured to mount the transmitter horizontally, but by rotating the mounting clip 90°, the user may mount the transmitter vertically to obtain higher density mounting on the DIN rail.

CLP5000 is a factory installed retainer clip which holds the transmitter in a $3^{3}/_{16}$" I/D housing. For mounting in A 3½" I/D housing, a larger clip, **CLP8500** is also available.

Once mounting is complete, connect the output wires from the power supply and load to the PS + and - terminals. The transmitter is protected against accidental polarity reversal, but will only function with the correct polarity. Next, connect the sensor input wires as shown on the label above the output terminals (Figure 2). The terminal to terminal jumpers must be installed for proper operation.

CONFIGURATION

The SC5010 is factory configured to the temperature span and sensor as noted on the Model label in the following format:



Example: SC5010, J, 0/500F, US, L, 4/20

Note: *Model SC5010 will be supplied configured as shown in the example unless otherwise specified, but can be reconfigured in the field without test equipment.*

The SC5010 can be setup from the on-board keypad and display using one of three different methods:

1. Self setup in linearized mode
2. Setup using a calibrator.

The membrane keypad has four individual momentary contact switches;

SWITCH	FUNCTION
MODE	Steps through the various modes without changing the present setup.
UP	Steps upward through options for selected mode.
DOWN	Steps downward through options for selected mode.
SET	Writes selected options in all modes to memory and returns the unit to RUN mode.

By repeatedly pressing the MODE switch, all of the configuration parameters can be stepped through in the order listed below, without affecting the 4/20 mA output.

STEP	MODE
0	Normal RUN condition
1	Sensor type
2	Degree C or F
3	Zero temperature
4	4 mA trim ***(**CAUTION)***
5	Full Scale temperature
6	20 mA trim ***(**CAUTION)***
7	Upscale/Down scale burnout
8	Linearize/Non-Linearize output
*9	Normal/Reverse Acting output

** Next MODE actuation returns to Step 1.*

*****CAUTION - Read* SETUP USING A CALIBRATOR *below before using these adjustments.***

No switch action for more than 3 minutes in any mode other than RUN *(Display indicating temperature or loop current)* will cause the transmitter to return to RUN mode without saving the most recent changes, if made.

In the ZERO and FULL SCALE modes, each depression of the UP or DOWN switch will change the number 0.1°. Holding the switch for longer than a second will cause the number to change in increments of 1.0°. Holding it longer than 10 seconds will cause the number to change in 10° increments. Releasing and again pressing the switch at anytime during this cycle will cause it to start changing by 0.1° again.

SELF SETUP IN LINEARIZED MODE

1. Connect output leads (PS + and - terminals) to Power Supply.
2. Sensor connection is not required. To setup without a sensor, input terminals 3 and 4 must be jumpered together. The display will show "**+ burn**" or "**- burn**" instead of temperature in the RUN mode until a sensor is connected.
3. Press the MODE switch 1 time. The Display will show the current sensor selection. Press the UP or DOWN switch to change the desired sensor.
4. Press the MODE switch 1 time. The Display will show the current selection of °C or °F units of temperature. Use the UP or DOWN switch to change the desired unit.
5. Press the MODE switch 1 time. The Display will show the current temperature setting for ZERO. Use the UP or DOWN switch to change the desired ZERO temperature setting. *(Slow blinking arrow indicates ZERO mode)*
6. Press the MODE switch 2 times *(skip the 4 mA trim position).* The Display will show the current temperature setting for FULL SCALE. Use the UP or DOWN switch to change the desired FULL SCALE temperature setting. *(Fast blinking arrow indicates FULL SCALE mode)*
7. Press the MODE switch 2 times *(skip the 20 mA trim position).* The Display will show the active burnout choice. Use the UP or DOWN switch to change the desired burnout condition.

Display	Condition
+ burn	Upscale on open sensor
- burn	Down scale on open sensor

8. Press the MODE switch 1 time. The Display will show the active choice for linearization. Use the UP or DOWN switch to display **+ Lin**.

Display	Linearization Condition
+ Lin	Linearization on
- Lin	Linearization off

9. Press the MODE switch 1 time. The Display shows the choice for output action. Use the UP or DOWN switch to change the desired choice of output action.

Display	Output Action
+ out	Normal output (4/20 mA)
- out	Reverse output (20/4 mA)

   At this time, the MODE switch may be repeatedly pressed to step through the choices made and any desired changes may be made.

10. Once the setup is as desired, press the SET switch to write your choices into memory. The mode also goes to the RUN mode. If a sensor is connected, the temperature will be displayed. If no sensor is connected, and terminals 3 and 4 are jumpered, the display will show "**+ burn**" or "**- burn**", but the setup is still accurate.

    If no sensor is connected, and terminals 3 and 4 are jumpered, the display will show "**+ burn**" or "**- burn**", but the setup is still accurate.

THERMOCOUPLE		RTD'S	
Display	**Sensor**	**Display**	**Sensor**
tc 0	J	rtd 0	3850 2/4 W
tc 1	K	rtd 1	3850 3 W
tc 2	R	rtd 2	3920 2/4 W
tc 3	S	rtd 3	3920 3 W
tc 4	T	rtd 4	Not Used
tc 5	E	rtd 5	Not Used
tc 6	N	rtd 6	Not Used

SETUP USING A CALIBRATOR

1. Connect output leads (PS + and - terminals) to Power Supply.
2. Connect a calibrator to the input and monitor the output loop current.
3. Press the MODE switch 1 time. The Display will show the current sensor selection. Press the UP or DOWN switch to change the desired sensor.
4. Press the MODE switch 1 time. The Display will show the current selection of °C or °F units of temperature. Use the UP or DOWN switch to change the desired unit.
5. Press the MODE switch 5 times *(skip ZERO, 4 mA trim, FULL SCALE, and the 20 mA trim position).* The Display will show the current burnout choice. Use the UP or DOWN switch to change the desired burnout condition.

Display	Condition
+ burn	Upscale on open sensor
- burn	Down scale on open sensor

6. Press the MODE switch 1 time. The Display will show the current choice for linearization. Use the UP or DOWN switch to change the desired linearization.

Display	Linearization Condition
+ Lin	Linearization on
- Lin	Linearization off

7. Press the MODE switch 1 time. The Display will show the current choice for output action. Use the UP or DOWN switch to change the desired choice of output action.

Display	Output Action
+ out	Normal output (4/20 mA)
- out	Reverse output (20/4 mA)

8a. Press the SET switch 1 time to write your choices into memory. The mode also goes to the RUN mode (Note: If the unit was set to 'Linearization off' in step 6, skip to step 8b below). Enter the desired ZERO value into the calibrator, then observe and record the corresponding value displayed on the SC5010. Enter the desired FULL SCALE value into the calibrator, again observe and record the corresponding value displayed on the SC5010.

There may be a slight difference between the calibrator readings and the SC5010 display readings. The SC5010 is factory calibrated to read absolute temperature within the limits of its accuracy. Any differences should not be more than the combined accuracies of the calibrator and the SC5010. After calibration, the 4/20 mA output will be accurate to the calibrator's input.

8b. (Note: If the unit was set to 'Linearization on' in step 6, skip to step 9 below). If the unit was set to 'Linearization off in step 6, the display will show the loop current instead of an erroneous non-linearized temperature. While in the RUN mode press the SET switch 1 time to temporarily change the display from showing the loop current to showing a non-linearized temperature for this setup procedure.

Enter the desired ZERO value into the calibrator, then observe and record the corresponding non-linearized temperature displayed on the SC5010. Enter the desired FULL SCALE value into the calibrator, again observe and record the corresponding non-linearized temperature displayed on the SC5010.

Press the SET switch 1 time to revert the display back to loop current. (Note: If the unit is left alone for more than 3 minutes, the display will automatically revert back to showing loop current).

9. Press the MODE switch 3 times. The BACK ARROW on the display will be blinking at a slow rate. This indicates the transmitter is in the ZERO adjustment mode. Use the UP or DOWN switch to increment or decrement the number displayed to the ZERO value recorded in Step 8a or 8b. The transmitter will output 4 mA at this temperature when it is in the RUN mode.

10. Press the MODE switch 1 time to make the display show .004A. The transmitter has been factory set to output 4 mA at the ZERO temperature set on the display and normally no adjustment is required. The output current will stay at a value which represents the present input signal until an UP or DOWN switch is depressed once. Pressing either switch will make the output current go to 4 mA which represents the Zero temperature selected in Step 9. By metering the output and using the UP or DOWN switch, this value may be adjusted to suit the users requirements. The adjustments are intended to trim the 4 mA to match the user's calibration requirements, even though they may create a small error.

***CAUTION:* Once the trim adjustment in step 10 has been made, the transmitter will need to be recalibrated before self calibration can be used. See RECALIBRATION section below.**

11. Press the MODE switch 1 time. The BACK ARROW on the display will be blinking at a fast rate. This indicates the transmitter is in the FULL SCALE adjustment mode. Use the UP or DOWN switch to increment or decrement the number displayed to the FULL SCALE value recorded in Step 8a and 8b. The transmitter will output 20 mA at this temperature when it is in the RUN mode.

12. Press the MODE switch 1 time to make the display show .020A. The transmitter has been factory set to output 20 mA at the FULL SCALE temperature set on the display and normally no adjustment is required. The output current will stay at a value which represents the present input signal until an UP or DOWN switch is depressed once. Pressing either switch will make the output current go to 20 mA. By metering the output and using the UP or DOWN switch, this value may be adjusted to suit the users requirements. The adjustments are intended to trim the 20 mA to match the user's calibration requirements, even though they may create a small error.

13. Press the SET switch to write your choices into memory. The mode also goes to the RUN mode. If a sensor or calibrator is connected, the temperature or loop current will be displayed depending on linearization. If no sensor is connected and terminals 3 and 4 are jumpered, the display will show "**+ burn**" or "**- burn**", but the setup is still accurate.

RECALIBRATION

If the 4 mA or 20 mA trim adjustment has been used and it is desired to recalibrate the output to factory specifications, the following procedure should be used.

1. Refer to the SELF SETUP IN LINEARIZED MODE section.

2. Connect an accurate digital current meter to monitor the output loop current.

3. Step the MODE switch to the 4 mA trim position and use the UP/DOWN switches to set the output to exactly 4 mA. (Note: In this mode, once the UP or DOWN switch is pressed, the output current will go to the 4mA setup level and will not be dependent on an input signal until this mode is left).

4. Step the MODE switch to the 20 mA trim position and use the UP/DOWN switches to set the output to exactly 20 mA. (Note: In this mode, once the UP or DOWN switch is pressed, the output current will go to the 20mA setup level and will not be dependent on an input signal until this mode is left).

5. Press the SET switch 1 time to write your choices into memory. The mode also goes to the RUN mode. The output is now recalibrated.

SETUP WITH A COMPUTER

CAUTION: USER SETUP MUST BE PERFORMED IN A LOCATION CLASSIFIED NON-HAZARDOUS.

The SC5010 can be setup by the user from the on-board membrane keypad and display, or from a computer via Wilkerson Instrument's COMPUTER INTERFACE KIT (CIK005).

The SC5010 is factory set to the specifications on the customer's order. The CIK005 makes it possible for the user to set-up a quantity of transmitters or to review the set-up configurations via a computer.

The CIK005 contains a cable which plugs into an RS232 interface adapter via an RJ11 modular plug. The CIK unit contains active circuitry which conditions the I/O signals between the computer and the transmitter. The CIK is then plugged into the RS232 serial port of an IBM compatible personal computer. A 9-pin to 25-pin adapter is included, if needed. The other end of the cable has a 4 position modular handset plug which plugs directly into the SC5010.

The configuration utility program is provided on a 3.5" floppy and should be installed on the hard drive. This program is used to interactively configure and monitor the operating parameters of the transmitter. Additionally, set-up files can be generated and stored on disk, which can then be recalled and downloaded to the transmitter as needed. Help files are included in the program to assist the user with the set-up process. Instructions for installing the program are on the disk label.

The configuration program runs on an industry compatible Personal Computer running DOS 3.2 or later with at least 100K of available RAM, a CGA, EGA, VGA or SVGA Graphics Adapter. It requires a dedicated serial ports (COM1: or COM2:) set at the following:

Baud Rate:	4800
Data Bits:	8
Parity:	None
Stop Bits:	1
Flow Control:	Xon/Xoff

Two additional features are available to the user when setting up from a computer. When in the 'OFF-LINE/EDIT CONFIG' mode, the cold junction temperature compensation may be deactivated, and the 0.1 digit on the unit's display may be disabled.

WARRANTY

The SC5010 Series of products carry a limited permanent warranty. In the event of a failure due to defective material or workmanship, the unit will be repaired or replaced at on charge.

SPECIFICATIONS

INPUT

Thermocouple
Types J, K, R, S, T, E, & N

Spans:
User configurable from 5 mV minumum to maximum usable range

Linearization:
Maximum linearized range:

J	-210°C to + 760°C
K	-250°C to +1372°C
R	-50°C to +1768°C
S	-50°C to +1768°C
T	-270°C to + 400°C
E	-260°C to +1000°C
N	-250°C to +1300°C

Reference Junction
Compensation Accuracy:
± 0.25°C

Impedance:
> 1 megohm

Span Adjustment:
Continuous from 6.25% to 100% of T/C range
(5 mV minimum span)

RTD
100 Ohm Platinum, 0.00385 and 0.00392 alpha, 2, 3, or 4 wire connection

Maximum usable range:
-200°C to +850°C *(470°C for .00392)*

Minimum Span:
45°C (15°C in high gain/narrow input span mode. See OVERVIEW)

Zero Adjustment:
Continuous from 0% to 90% of sensor range

OUTPUT

Range:
4/20 mAdc

Modes: (User Configured)
Normal / Reverse acting
Linear / Non-linear

Burnout Indication:
Thermocouple Only
Upscale / Downscale
(User Configured)

Linearity:
±0.25°C of NIST Tables

Test Points:
Monitor Loop Current

Accuracy:
±0.05% of span

Repeatability:
±0.01% of span

Input to output linearity:
±0.01% of span

Response time:
< 1 sec.

Ripple *(peak to peak)*:
< 0.1% of full scale

Power supply effect:
< 0.001% of span / Volt

Ambient temperature effect:
±0.005% of span / °C

Long term stability:
±0.0005% of span / 6 months

COMMON MODE REJECTION
120 dB, DC to 60 Hz

ISOLATION, OUTPUT TO INPUT
> 500 megohms

BREAKDOWN, OUTPUT TO INPUT
> 1000 Volts RMS sine wave

OPERATING TEMPERATURE
-40°C to +80°C / *(-40°F to +176°F)*

RFI IMMUNITY
Filtering and shielding to reject RFI interference

POWER
12 VDC to 36 VDC
(current limited to 30 mA max.)

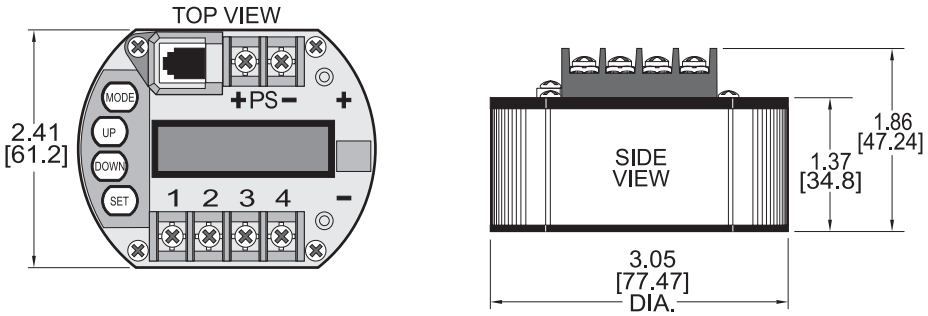
DISPLAY *(SC5010)*
Digit size:
0.35 inches high, 4½ digits

Update rate:
3 / second

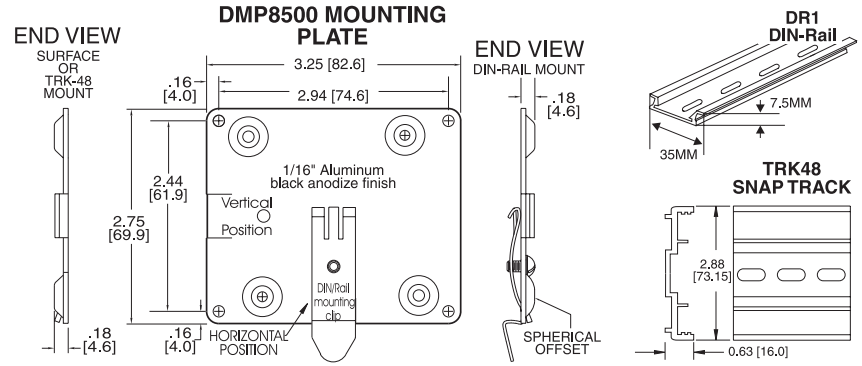
Operating temperature:
-20°C to +80°C / *(-4°F to +176°F)*

The test points are across a silicon diode and the meter must not drop more than 250 mV or it will not read accurately.

CASE DIMENSIONS INCHES [mm]

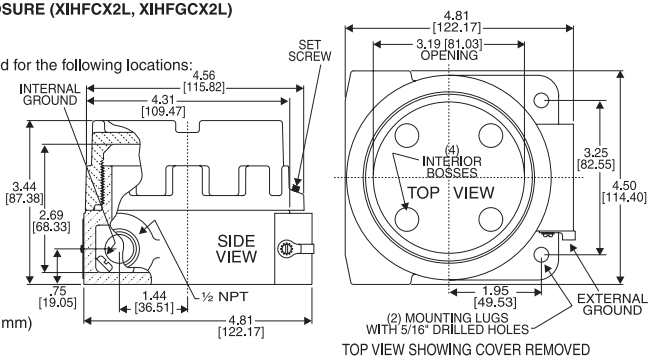


ACCESSORIES



EXPLOSION-PROOF ENCLOSURE (XIHFCX2L, XIHFGCX2L)
LISTINGS/APPROVALS
(ADALET XIH SERIES)
CSA certified and FM approved for the following locations:
Class I, Groups B, C, & D
Class II, Groups E, F, & G
NEMA 4 & 7

APPROVALS:
CSA certified
FM approved
STANDARD MATERIALS:
BOX AND COVERS
Copper-free aluminum
O-RING SEALING GASKET
Buna-N-rubber.
GLASS LENS (OPTIONAL)
3/8" thick tempered glass (9.5 mm)



Dwg#W103370E 3/07

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