REV A.1

# CMCP810 SERIES RUNOUT KIT WITH SENSOR INTERFACE MODULE

INSTRUCTION MANUAL

STI VIBRATION MONITORING INC
WWW.STIWEB.COM

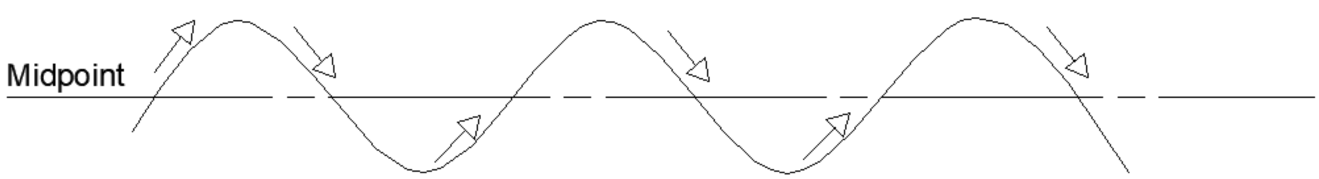
## About the Runout Kit

The CMCP810 Series Electrical Runout Kit uses industry standard sensors to detect and locate areas of high electrical runout. Electrical runout must be minimized to allow Proximity probes to work properly while the machine is in operation. The kit combines the typical industrial sensors normally used for permanent vibration detection in order to allow for in shop detection of electrical runout using the supplied oscilloscope. Electrical runout can be detected and recorded using the waveform function and then processed for reporting using the optional FlukeView software for PC's or a PC based Oscilloscope. The CMCP810 Runout Kit is supplied with the following parts;

- Fluke 192 Series Scopemeter or Picoscope PC Based Oscilloscope
- Oscilloscope Charger
- CMCP810-SIM Sensor Interface Module (Battery Powered)
- CMCP810-SIM Charger
- 200mV/mil Proximity Probe System (Probe and Driver)
- Optical Phase Reference Sensor
- Roll Reflective Tape
- Two Magnetic Flexible Arm Sensor Holders
- Two BNC to BNC Cables
- Banana to BNC Adapter
- Clipboard with Manuals and Optional Software

### The Basics of an Eddy Current Probe Signal

An Eddy Current Probe is a non-contact sensor capable of the measuring the position of a ferrous material with high resolution. The output of the probe can be viewed as a waveform showing the motion towards and away from the probe.




In order to display a positive and negative going signal in electronics an offset voltage must be provided to allow the voltage signal to swing up and down. To do this the eddy probe driver creates a DC offset voltage for the AC voltage signal to ride on. The DC voltage is referred to as the "gap" voltage and is typically set to -12VDC. Since most modern oscilloscopes only allow for up to a 5VDC offset a bucking circuit must be used to move the -12VDC offset to within the oscilloscopes measurement range.

### About the Sensor Interface Module (CMCP810-SIM)

The CMCP810SIM Sensor Interface Module provides a single access point for the sensors and oscilloscope, eliminating the need of dual power supplies and a mix of wiring in between. An internal lithium-ion battery provides -24VDC for the Proximity Probe and +15VDC for the Phase sensor. The battery can be recharged using the charger provided with the CMCP810SIM module. Spare batteries may also be purchased. The main purpose of the Sensor Interface Module is the bucking amplifier capabilities. The CMCP810SIM can remove the entire DC offset so that only the AC signal is viewable on the oscilloscope.

### CMCP810-SIM Front Panel Connections

The front of the CMCP810SIM module features a On/Off switch with an LED On indicator, Voltage Adjust knob and two BNC connectors for the signal outputs. Once the sensors and oscilloscope are connected, the Voltage Adjust knob can be set so that the Proximity Probes signal is within the oscilloscopes viewing range.

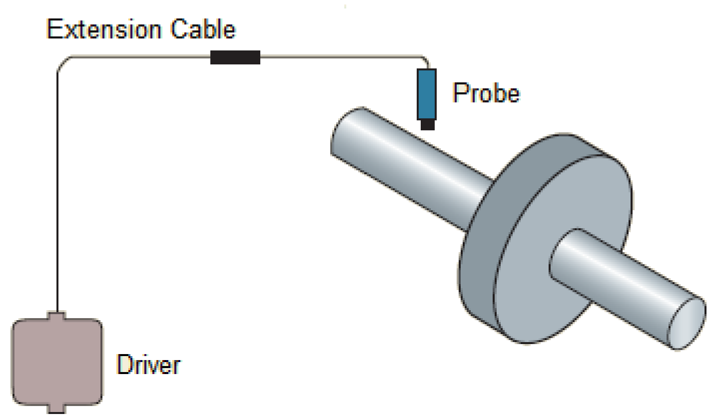

**CMCP810-SIM Rear Panel Connections**

The back side of the CMCP810SIM module features the Phase and Eddy Probe sensor inputs and battery charger socket. A 3-wire adapter is provided to allow the CMCP810SIM to connect to the Eddy Probe Driver's wire terminals. See wiring details on the 3-wire adapter (Signal, -24VDC and GND).


## About the Sensors

**Proximity Probe:**

The supplied Proximity Probe is the same type of sensor normally permanently installed to measure vibration. This model sensor provides a 200mV output per mil (0.001") of electrical runout on a 4140 series shaft. An Proximity Probe is made up of three specifically tuned components, the probe, extension cable and driver, all three must be connected together in order for it to operate; unlike many instruments this sensor is -24VDC powered and powered is supplied by the CMCP810-SIM Sensor Interface Module. To learn more about how Eddy Probes operate see our application note on Radial Vibration in the Knowledge Base section on our website.



## About the Optical Sensor

**Optical Sensor:**

The optical sensor provided with the CMCP810 Runout Kit provides a phase (location) reference to the electrical runout. The sensor is powered by the CMCP810-SIM Sensor Interface Module. When the sensor detects a reflective surface, the output will spike to 5VDC. A roll of reflective tape is provided with the kit. The power unit for the optical sensor can operate on AC power or on the internal batteries. The oscilloscope should be setup so that at least one revolution of the shaft is displayed on the oscilloscope screen while the shaft is turning. This will allow the operator to see the area of the high electrical runout.

### Sensor Mounting Options:

The CMCP810 Kit comes with 2 sensor mounting options, the adjustable magnetic arm holders and custom vice grips. The holders can be used with either sensor and in any orientation that allows the sensors so sit securely above the target positions. It is important that the proximity probe does not move during the measurement process.

### Sensor Placement

**Proximity Probe (Runout):**

The Proximity Probe should be installed in one of the supplied holders and positioned above the burnished area of the shaft as specified in the shop drawings. The probe requires a gap between the shaft and the probe tip in order for it to operate correctly. The gap can be set by measuring the DC voltage output from the driver, position the sensor until the output from the driver reads approximately -12VDC using the voltmeter function on the oscilloscope, this gap voltage corresponds to about 60 mils on 4140 series steel. To measure the gap voltage with the ScopeMeter simply disconnect the Channel A BNC Cable, attach the Banana to BNC Adapter and plug into the voltage input connectors. Take note of the polarity when using the adapter, the common lug has a flag on the post showing “GND”. After gapping the probe be sure to move the BNC cable back to the Channel A input. During runout measurements the Proximity Probe should be set to Channel 1, also known as Channel A, which is displayed on Trace A.

**Optical Sensor (Phase):**

The optical sensor should be installed in one of the supplied holders and positioned near the Proximity Probe. A 1” piece of the supplied reflective tape needs to be placed on the shaft below the sensor. The gap between the optical sensor and the reflective tape can be up to 6”. To verify that the sensor is sensing the reflective tape rotate the shaft and visually inspect that the green light on the back of the optical sensor flickers once per revolution. During the runout measurement the optical sensor should be set to Channel 2, also known as Channel B, which is displayed on Trace B.

**Sensor Interface Module Setup:**

Connect the Proximity Probe to the Proximity Probe Driver
Connect the Proximity Probe Driver to the CMCP810-SIM using the 3 Wire to M12 Adapter
    Be sure CMCP810-SIM battery is charger.
Plug the Optical Phase Reference Sensor into the CMCP810-SIM Socket on the Rear Panel
Connect the Runout Signal BNC on the Sensor Interface Module to Channel A on the Oscilloscope
Connect the Phase Signal BNC on the Sensor Interface Module to Channel B on the Oscilloscope
Turn the Sensor Interface Module On

## Fluke ScopeMeter Settings:

Prior to being used the ScopeMeter settings must be configured to operate with the supplied runout sensors. The settings should be verified every time the unit is powered on as they may be restored to default without any notifications when the battery is completely drained. It is suggested that the ScopeMeter is regularly checked for a charge. Familiarity with the operation of the ScopeMeter is necessary, refer to the Fluke operators training manual for more information.

## Fluke ScopeMeter General Setup (First Measurement)

Note: For the purposes of measuring runout Channel A, also referred to as Channel 1 is used with the Proximity Probe for taking the electrical runout measurement. Channel B, also referred to as Channel 2, is used with the optical sensor to show phase (location) relative to the runout. To apply the settings, follow the directions below (Based on Fluke 190-102 ScopeMeter).

### Channel Input Settings

**Channel A Setup (Runout Measurement with Proximity Probe):**

Press the “A” button.
Press F1 to turn Input A to “On”
Press F2 to change to Coupling to “AC”
Press F3 to enter the Probe Menu.
Under Probe Type select “Voltage” and press enter.
Under Attenuation select “1:1” and press enter.
Adjust the “Range” button until A ~50mV, shown on the bottom left of the screen.

**Channel B Setup (Phase Measurement with Optical Sensor):**

Press the “B” button.
Press F1 to turn Input B to “On”
Press F2 to change to Coupling to “DC”
Press F3 to enter the Probe Menu.
Under Probe Type select “Voltage” and press enter.
Under Attenuation select “1:1” and press enter.
Adjust the “Range” button until B ~2V.

### Scope/Waveform Settings

**Channel A Setup (Proximity Probe)**

Press the “Scope” button.
Press F1 to turn Readings to “On”.
Press F2 to enter the “Reading” menu.
Press F1 until “Readings 1” is highlighted.
Use arrow keys to highlight “on A” and press enter.
Use arrow keys to select “Vac” and press enter.

**Channel B Setup (Optical Sensor)**

Press the “Scope” button.
Verify Readings in “On”.
Press F2 to open the “Reading” menu.
Press F1 until “Readings 2” is highlighted.
Use arrow keys to highlight “on B” and press enter.
Use arrow keys to highlight “Vdc” and press enter.

## Making the Runout Measurement:

In order to collect the runout measurement the shaft needs to be rotated on shaft support blocks either by hand or by motor at a slow and constant speed.

**Step 1:**

Verify CMCP810-SIM Sensor Interface Module is On and Cables and Sensors are Connected.

**Step 2:**

Adjust the Proximity Probes DC gap voltage for a 10 to 12 VDC output.

**Step 3:**

Adjust the Optical Sensor so it detects the reflective tape on each shaft revolution.

**Step 4: Note – The shaft must be rotating from this step forward.**

Adjust the "Time" button until there are no more than three shaft revolutions shown on the screen. The shaft revolution is sensed by the optical sensor and displays on trace B, the blue line. The trace in between two pulses references one full shaft revolution.

**Step 5:**

When taking the Runout measurement the ScopeMeter should be set to show no more than three shaft revolutions on the screen. The shaft revolution is shown by the "B" trace in blue. To zoom in and out press the "Time" button until the "B" trace shows the revolutions clearly. Trace A showing the electrical runout should be visible in between the revolutions, the range setting on either channel can be adjusted to zoom in on either the runout signal or phase signal. If the signals are over lapping use the "Move ↑↓" buttons to move the traces away from each other.

**Step 5:**

Once a good pattern is visible on the ScopeMeter press the "Hold/Run" button one time. To measure the amount of electrical runout press the "Cursor" button then press F1 to select the horizontal lines. Use the arrow keys to bring the top and bottom cursors to the very top edge and very bottom edge of the runout signal in between the phase spike so that the measurement is taken during the period of 1 shaft revolution on Trace A. Hit F2 to switch between the top and bottom lines.

Note: If the runout signal is not displayed on the oscilloscope screen, adjust the DC offset on the CMCP810-SIM Sensor Interface Module "Adjust" knob in either direction until the signal is displayed on the screen.

**Step 5:**

After the cursors have been placed at the top and bottom of the runout signal, the ScopeMeter will calculate the total amplitude between the two lines and display it at the top of the screen in millivolts. The output of the proximity probe is 200mV/mil on 4140 series steel. To calculate to total amount of runout divide the ScopeMeters reading by the output calibration of the probe. See page 6 for sample screen shot.

Ex. ScopeMeter Reads 52mV
52÷200 = 0.26 mils of electrical runout

**Step 6:**

Save the file by pressing the "Save" Button. Each save will enter a time stamp and will allow the user to provide a project name.

Note: The ScopeMeter's setup can also be saved so that each time the ScopeMeter is powered on the user can simply recall the setup by pressing the "Save" button and selecting "Recall". An external USB drive can also be used to save the file for easy PC transfers. Refer to the Fluke user manual for more information on the ScopeMeter and FlukeView software functions.

## API 670 on Runout:

"The combined total electrical and mechanical runout does not exceed 25 percent of the maximum allowed peak to peak vibration amplitude or 0.25 mil (6 micrometers), whichever is greater. The shaft surface finish should be from 16 to 32 micro inches (0.4 to 0.8 micrometers) root mean square."

## Runout Reduction:

**Diamond Burnishing**

A diamond burnishing tool is used to work the shaft surface into a uniform finish.

**Degaussing**

Residual magnetism in a shaft can cause major electrical runout and can cause unstable runout readings. It is necessary to measure the magnetism to ensure that it is not over 2.0 gauss or if the area has variations over 1.0 gauss. If either is found the shaft should be degaussed. The CMCP810 Series Runout Kit can be supplied with the optional Gauss Meter.

**Further Machining**

If the amount of runout cannot be reduced with a diamond burnishing tool then the target area can be reground.

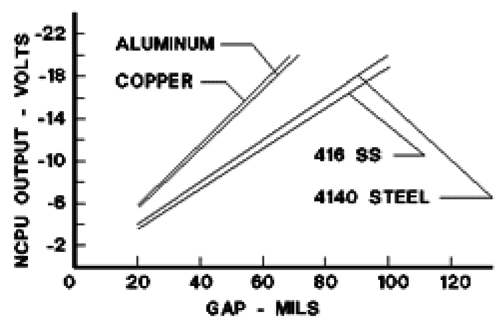
**Polishing**

Similar to diamond burnishing but not as highly effective.

## Proximity Probe Sensitivity with Alternate Materials:

All standard Proximity probes are calibrated to 4140 series steel. When measurements need to be taken on different shaft materials the true Proximity probe sensitivity needs to be known in order to calculate the proper electrical runout reading. To measure the probes sensitivity with specific materials follow the steps below.

**Step 1:**
Using plastic feeler gauges, or other non-metallic materials, place a 60 mil thick piece of material between the probe tip and the shaft and measure the millivolt output from the driver. Record this voltage.



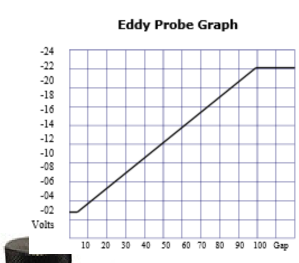

**Step 2:**
Add a 10 mil thick piece of material on top of the 60 mil piece and measure the output driver. Record this voltage.

**Step 3:**
Add a 5 mil thick piece of material on top of the 60 mil and 10 mil pieces and measure the output from the driver. Record this voltage.

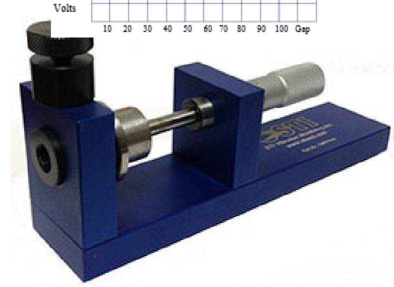
**Step 4:**
Take the total measurement in millivolts (mV) and divide by 15. This is the probes sensitivity to be used for calculating the total runout with that specific material.

Ex. 15 mils = 1350mV
1350 ÷ 15 = 90 mV/mil

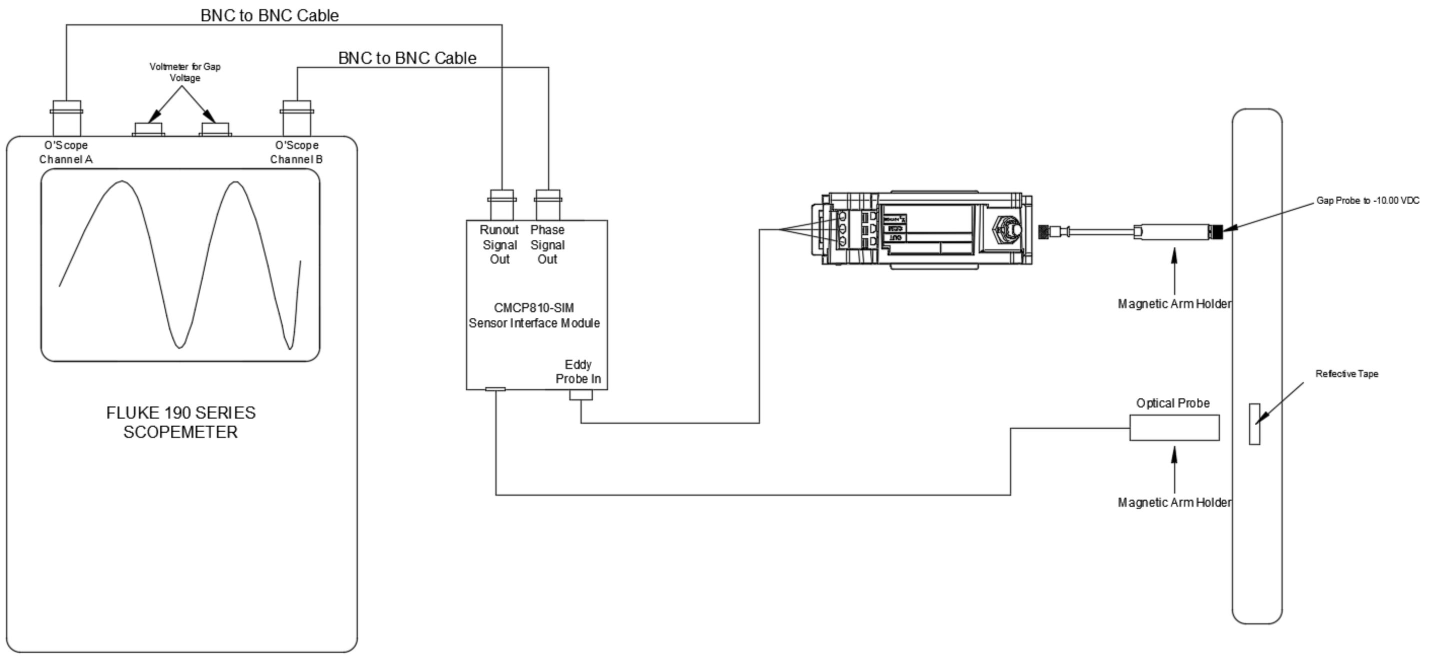
## Proximity Probe Conformance Check:



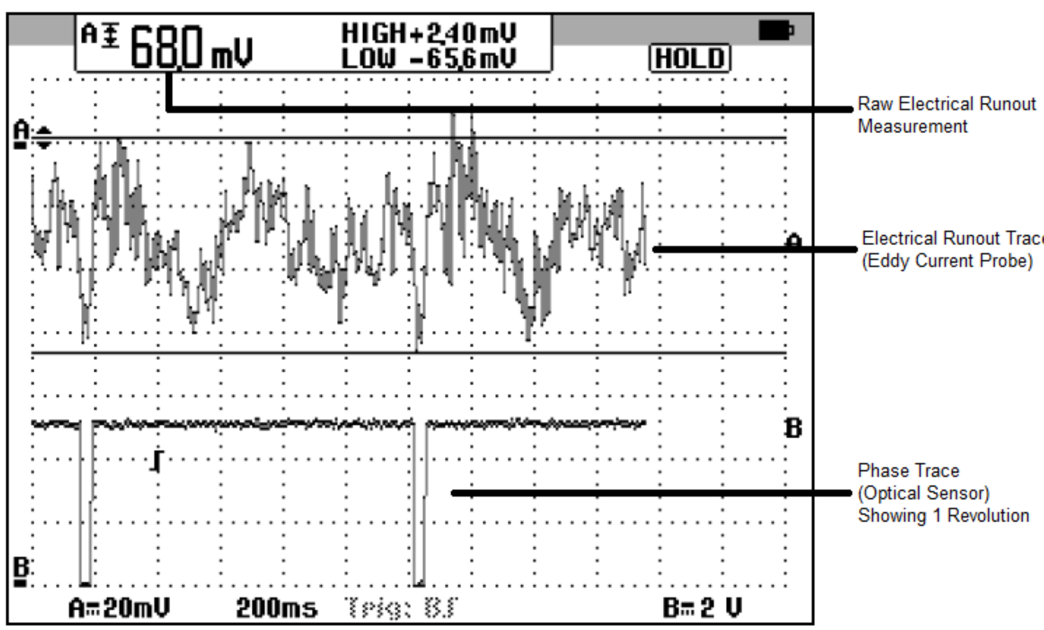

All Proximity Systems (Probe, Cable and Driver) should be tested every once in a while to ensure the probe is still operates within its specified range. This can be done by using a CMCP610 Static Calibrator (sold separately), -24 VDC Power Supply and a Digital Volt Meter. The Probe is installed in the tester with the target set against the Probe tip. The micrometer with target attached is then rotated away from the Probe in 0.005" or 5 mil increments. The voltage reading is recorded and graphed at each increment. The CMSS601 Calibrator will produce a voltage change of 1.0 VDC +-0.05 VDC for each 5 mils of gap change while the target is within the Systems linear range.



**CMCP810 Series Runout Kit Setup and Connections (Provided with Kit)**




**Screenshot Description:**




**Screenshot from Fluke ScopeMeter above Shows 0.3 mils of Electrical Runout**

68.0mV ÷ 200mV/mil = 0.3 mils of electrical runout on 4140 series shaft.

If you have any question or require technical support please feel free to contact our technical services group.

STI Vibration Monitoring Inc.
League City, Texas USA
Tel.: 281.334.0766
Fax: 281.334.4255