REEDHOLM

DATA SHEET

DS-11038

Self Calibration Module [SCM]

- **Accurate & Stable Voltage Reference**
- **Precision WW Resistor Divider**
- **Instrument Grade Power Op Amp**
- **Outputs from ±250mV to ±100V**
- **Provides Tracing to Corporate Standards**
- **Determines Offset/Gain Correction Factors**
- **Eliminates DC Manual Calibrations**
- **Helps Satisfy ISO900X Requirements**

The Self Calibration Module (SCM) provides an easy, cost-effective method of making Reedholm instrumentation traceable to corporate voltage and resistance standards. An accurate, stable voltage reference coupled with an instrument grade high voltage amplifier provides precision currents and voltages that span the voltage ranges of most Reedholm instruments.

A precision, multiple-tap resistive divider built from zero temperature coefficient wire-wound resistors provides accurate voltages from ±250mV to ±100V. A pair of precision resistors (10kΩ and 10MΩ) and the high voltage amplifier translate those voltages into precision currents from ±100nA to ±10mA.

Not only does the SCM simplify VF, VFIF, and DMM calibration, it also works with the HISMU, HVSMU, and PPG-4. Use of the SCM and associated software eliminates the need for manual calibrations of those modules.

After the SCM has been used to generate offset and gain error correction factors, they are used in applications software to prevent source and measurement errors. As long as the self-calibration software can correct module accuracy, the module meets its accuracy specifications. Other Reedholm self-test programs are used to fully assure functional operation.

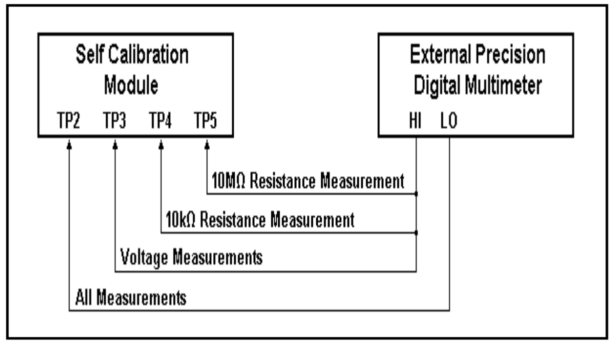

Figure 1 - SCM to DMM Connections

Using with Quality Programs

The SCM provides a straightforward way to prove the system is accurate and repeatable, so it fits well with quality assurance standards such as ISO9000 and its successors.

In addition to providing assurance of modules being within calibration, offset and gain correction factor outputs of the self-calibration software can be tracked using statistical process control (SPC) techniques. In this way, modules that might be drifting can be identified and repaired before they cause problems in production or development.

Transfer Accuracy (24 Hr, ±2C°)

Voltage Range (V)	Error (% of Value)	Current Range (A)	Error (% of Value)
0.25	0.05	100n	0.04
0.50	0.03	1µ	0.02
1.00	0.02	10µ	0.02
2.50	0.01	100µ	0.02
5.00	0.01	1m	0.02
10.0	0.01	10m	0.02
25.0	0.01	100m	N/A
50.0	0.01	1	N/A
100	0.01		

Calibrating the Self Calibration Module

The RDS DOS SCal utility program is used to measure the cardinal SCM outputs with an external precision digital multimeter and put those measurements into the SCal data file. Figure 1 shows the multimeter connected to test points on the SCM front edge using the SelfCal Test Lead Set, Reedholm P/N 16360. Figure 2 is a screen capture of the data output that can also be sent to a printer.

This special lead set avoids inaccuracies that would otherwise be introduced by thermally generated voltages, series resistance, and external noise pickup. Most importantly, the lead set avoids the leakage resistance associated with common lead sets when measuring the precision 10MΩ resistor on the SCM. Support note SN-116, SelfCal Test Lead Set, goes into more detail on why the lead set needs to be used.

After measurements are taken and input, the results are displayed for review before being stored and used to correct module outputs and measurements. Figure 2 is an example output of the voltage and resistance measurements used to essentially transfer accuracy of the external meter to the SCM. Note that the nominal measured voltages outputs are less than the range values. That was deliberately so that corrections could be made on each current and voltage without causing an over range condition.

```
Self Cal Module S/N --->[9470-932-03] Date ----->[Jul18,2002]
Operator -------------->[WAT        ] Time ----->[2:48:48 PM]
Tester ID ------------->[RI-40#2]

VOLTAGES ENTERED:
Range        Positive        Negative
-------      -----------     ------------
 250mV          246.27m         -247.93m
 500mV          493.25m         -494.91m
    1V          987.32m         -988.95m
  2.5V          2.4698          -2.4715
    5V          4.9405          -4.9422
   10V          9.8819          -9.8834
   25V          24.699          -24.714
   50V          49.406          -49.421
  100V          98.818          -98.832

RESISTANCES ENTERED:
Range        Actual
-------      -----------
  10K         10.0008k
  10M         10.0061M

Overwrite SelfCal.DAT (Y/N)? N
```

Figure 2 - SCal Output Screen

Performing System Calibration

Self calibration software determines gain and offset errors relative to those expected from the SCal data file. Correction factors are generated and displayed for each module. Operator approval is required before they are stored in the SelfCal.ini file and then used for correction. The RDS DOS self calibration software output is shown in figure 3 for a DMM-16. Of all the modules, DMM's produce the richest set of calibration data because they have the most ranges.

During operation, the self calibration software forces the SCM and the module being calibrated to voltages and currents ~1% below full-scale range points. DMM#1 is calibrated first. If there is a DMM#2 in the system, it is calibrated next. Afterwards, the calibrated DMM#1 is used to calibrate the VFIF and VF modules. Finally, correction factors are generated for those optional instruments capable of dc calibration.

```
                          DMM #1 (DMM16)
           Measured Value                       Test Limits
Range   Gain Factor      Offset            Gain Factor    Offset
-----   -----------   -----------          -----------    ------
250mV    999.975m     -283.205u            1.0 ± .0006    1.1E-3
500mV    1.00003       -291.55u            1.0 ± .0006    1.1E-3
   1V    1.00001      -301.904u            1.0 ± .0006    1.4E-3
 2.5V    1.00002      -340.194u            1.0 ± .0006    1.4E-3
   5V    1.00005      -395.535u            1.0 ± .0006    1.5E-3
  10V    1.00003      -510.714u            1.0 ± .0006    1.9E-3
  25V    999.988m     -2.74776m            1.0 ± .0006    2.8E-3
  50V    1.00002      -3.42857m            1.0 ± .0006    4.4E-3
 100V    999.973m     -4.83035m            1.0 ± .0006    6.3E-3
100nA    999.047m      8.72424p            1.0 ± .0040    3.E-10
  1uA     999.91m     -60.4868p            1.0 ± .0030    4.E-10
 10uA    999.816m     -776.623p            1.0 ± .0010    4.0E-9
100uA    1.00001      -8.58347n            1.0 ± .0010    4.0E-8
  1mA    1.00023       -75.625n            1.0 ± .0010    4.0E-7
 10mA    1.00005      -773.214n            1.0 ± .0010    4.0E-6
100mA    1.00068      -6.63392u            1.0 ± .0010    4.0E-5
   1A          1      -73.8392u            1.0 ±  N/A     4.0E-4

Pausing - Press <Enter>
```

Figure 3 – SelfCal DMM Output Screen