

Stator Insulation Monitoring System

Bently Nevada* Asset Condition Monitoring



Description

The Bently Nevada* Stator Insulation Monitoring System uses state of the art technologies to measure the leakage current of motors sized up to 7.5 kV and 1000 Amps. The measurements are made while the motor is online and the system processes the measured data in real time to determine the condition of the stator insulation in the motor. The system consists of a 9-channel 3500/82 monitor that accepts inputs from the 350820 High Sensitivity Current Transformer (HSCT), 350822 High Voltage Sensors (HVS), and 4-20 mA process signals corresponding to motor temperature measurements. The 3500/82 processed data and results can be displayed on the 3500/94 Display. The user can configure the 3500/82 using the 3500 Rack Configuration Software to perform the following functions:

- Display instantaneous stator leakage current on each phase of the motor.
- Display compensated dissipation factor and change in dissipation factor from a given reference point.
- Display motor stator temperature and average temperature.
- Display line voltage and frequency data values.
- Retrieve historic data stored on board the monitor for data analysis.
- Set alarm levels for annunciation.
- Configure the temperature range and time period for learn and extend modes for temperature learning, and view the current learning state.
- View the number of temperature samples, vs. operating temperatures, that builds the learning curve used for temperature compensation.

Note: The 3500/82 monitor should not be used for machine protection.

The 3500/82 can accept 3 HSCT, 3 HVS, and 3 4-20mA process inputs from stator RTD temperature measurements. Since the interface modules are capable of driving long field cables, the monitor can be situated in a control or instrumentation room up to 330 meters (1,000 feet) away from the motor or the interface modules.

The 3500/82 is featured with measurement trending by comparing the current measurements to any historical data taken in the last 10 years (if the historical data is available). The time window for comparison is user configurable.

The 3500/82 monitor has eight buffered outputs for diagnostic purposes, 3 each HVS and HSCT values for each of those corresponding inputs, an average temperature from the temperature inputs, and a synchronization phase pulse reference signal.



Monitor Specifications

Parameters are specified from +20 °C to +30 °C (+68 °F to +86 °F) and at 50/60 Hz unless otherwise indicated.

Note: Operation outside these specified limits may result in a larger variation in readings from what is listed below, or a loss of machine monitoring all together.

Inputs

Input Signals

Accepts 3 HSCT, 3 HVS, and 3 4-20mA temperature inputs.

Input Impedance

150 k Ω // 1nF (for HSCT & HVS)
200 Ω (for 4-20 mA temperature)

Input Frequency Range

40 to 70 Hz

Power Consumption (not including external power supply)

15 watts, typical

HSCT External Power Required

+24V \pm 2% @ 0.75 A Nominal Over temperature

Outputs

Front Panel LEDs

OK LED

Indicates when the system is operating properly.

TX/RX LED

Indicates when the 3500/82 is communicating with other modules in the 3500 rack.

Bypass LED

Indicates when the 3500/82 is in Bypass Mode.

Buffered Outputs

The front of the monitor has eight coaxial BNC connectors for each of the HVS and HSCT outputs and average temperature output, and a phase reference pulse (Sync). Each connector is short-circuit protected. The output from all 8 BNCs is voltage proportional to the input signals.

Output Impedance

499 Ω \pm 1%

Output Range HVS and HSCT Channels (6 BNCs)

Dynamic: 1.6 to 10.4V, \pm 5%.
Bias: 6V \pm 5%.

Output Range Average Temperature Channel (1 BNC)

2.0 to 10.0V, \pm 5%, for -40 to 200 °C (default, but can be user configurable)

Output Range Sync (1 BNC)

Digital Pulse: 0 to 10.0V, \pm 5%.

Sensor Specifications

Parameters are specified from +20 °C to +30 °C (+68 °F to +86 °F) and at 50/60 Hz unless otherwise indicated.

Note: Operation outside these specified limits may result in a larger variation in readings from what is listed below, or a loss of machine monitoring all together.

Sensitivity

HSCT Output Sensitivity

3.3mV / mA nominal, each unit marked with its specific sensitivity \pm 1%
Linearity: \pm 0.25%

Phase

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6° nominal, each unit marked with specific phase shift for that unit, ±0.5°.
 Linearity: ±0.5°
 Temperature impact on phase: +2° at minimum operating temperature, -1° at maximum operating temperature.

±2% of full-scale, Maximum

Phase

±1°, Typical
 ±2°, Maximum

Filter Quality High-Pass

2-pole (40 dB per decade)

Low-Pass

2-pole (40 dB per decade)

Overall Accuracy

±1% of full-scale, Typical
 ±2% of full-scale, Maximum

Current

1.4 A peak to peak (sine wave) full-scale.

HVS Output

0.76mV / V ±5%
 8 kVrms full-scale (line to neutral)

Interface Module Outputs

HSCT Interface Module Output

Gain: 3V/V

HVS Interface Module Output

Gain: 0.625V/V with 77 kΩ source impedance

Temperature Interface Module Output

66.6 μA / °C ±2%. (default)
 -40 to 200 °C full-scale (user configurable)

Temperature

Overall Frequency Response

3 Hz -3.0 dB

Overall Accuracy

±1% of full-scale, Typical.
 ±2% of full-scale, Maximum.

Filter Quality Low-Pass

2-pole (40 dB per decade)

Overall Accuracy

±1% of full-scale, Typical.
 ±3% of full-scale, Maximum.

Signal Conditioning in 3500/82 Monitor

HVS and HSCT

Overall Frequency Response

Direct

1 Hz to 8.5 kHz ±3.0 dB
 User configurable

1X Filter

50 or 60 Hz
 User configurable

Overall Accuracy Amplitude

±1% of full-scale, Typical

System Alert/Alarm Setting

Alarm Setpoints

The user can use software configuration to set Alert levels for each value measured by the monitor and Alarm setpoints for any values measured by the monitor. Alarms are adjustable from 0 to 100% of full-scale for each measured value.

Alarm Time Delays
The user can program alarm delays using software as follows:

Alert & Danger
From 1 to 60 seconds in 1 second Intervals.

Note: Applies to temperature, voltage and current measurements. The 3500/82 system Alert/Alarms are for annunciation only and should not be used for machine protection.

Environmental Limits

Operating Temperature Range

Transducers & Interface Modules

-20 °C to +70 °C
(-4 °F to +158 °F)

3500/82 Monitor

-30 °C to +65 °C
(-22 °F to +149 °F)

MTL and P+F Barriers

-20 °C to +60 °C
(-4 °F to +140 °F)

Storage Temperature

Transducers / Interface Modules

-40 °C to +85 °C
(-40 °F to +185 °F)

3500/82 Monitor

-40 °C to +85 °C
(-40 °F to +185 °F)

MTL Barriers

-40 °C to +80 °C
(-22 °F to +149 °F)

P+F Barriers

-25 °C to +70 °C
(-13 °F to +158 °F)

Shock Survivability

Transducers

100 g peak, maximum

Interface Modules

200 g peak, maximum

3500/82 Monitor

200 g peak, maximum

Relative Humidity

95% non-condensing
(75% non-condensing for P+F barriers)

Magnetic Field Susceptibility

<500µV/gauss (50 gauss, 50-60Hz)

Transducers Common Mode Line Current

Up to 1,000A rms, nominal

Line Voltage

Up to 7.5kV† rms, nominal

†Operating voltage less than 2kV has limitations from the HVS.

Physical

Monitor Module

Dimensions (Height x Width x Depth)

241.3 mm x 24.4 mm x 241.8 mm
(9.50 in x 0.96 in x 9.52 in)

Weight

0.97 kg (2.14 lb.)

I/O Module

Dimensions (Height x Width x Depth)

241.3 mm x 24.4 mm x 91.1 mm
(9.50 in x 0.96 in x 3.90 in)

Weight

0.41 kg (0.91 lb.)

Rack Space Requirements

Monitor Module

1 full-height front slot

I/O Module

1 full-height rear slot

HVS and HSCT Interface Modules

Dimensions

(Height x Width x Depth)

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See Figures 2 & 3

Weight
0.21 kg (0.46 lb.)

Signal Input Connector
2-pin circular Lemo (HVS)
3-pin circular Lemo (HSCT)

Power/Sig out Connector
5-pin spring compression

HSCT
Overall Diameter
See Figure 4

Height
See Figure 4

Weight
4.2 kg (9.25 lb.)

Case Material
Aluminum

Connector
2-pin Mil-C- 26482

Polarity
Pin A = Positive Signal
Pin B = Negative Signal

Mounting
Bracket Mount

HVS
Dimensions
(Height x Width x Depth)
See Figure 6

Weight
1.7kg (3.7lbs)

Integral Cable
22 AWG twisted shielded pair

Case Material
Epoxy

Polarity
Pin A = Positive Signal
Pin B = Negative Signal

Mounting
Bracket Mount

Temperature Interface Module
Dimensions
(Height x Width x Depth)
See Figure 7

Weight
0.13 kg (0.28 lb.)

Mounting
DIN rail mount

Entity Parameters

The following parameters apply for both CSA-NRTL/C and ATEX approvals.

HVS and HSCT Channel Approval Parameters

MSIM Circuit Parameters

$V_{max} (PWR) = 28 V$
 $I_{max} = 60 mA$
 $V_{+/-SIG} = 12 V$
 $I_{+/-SIG} = 10 mA$
 $R_{min} (PWR) = 253 \Omega$
 $R_{+/-SIG} = 253 \Omega$

Channel Parameters (entity)

$V_{max} (PWR) = 28 V$
 $I_{max} = 119 mA$
 $R_{min} (PWR) = 253 \Omega$
 $R_{+/-SIG} = 253 \Omega$

Interface Module Circuit Parameters

$V_{max} (PWR) = 15 V$
 $I_{max} = 50 mA$
 $V_{+/-SIG} = 12 V$
 $I_{+/-SIG} = 10 mA$
 $R_{+/-SIG} = 253 \Omega$

Temperature Interface Module Approval Parameters

MSIM Circuit Parameters

$V_{SIG} = 15 V$

$I_{SIG} = 20 \text{ mA}$
 $R_{SIG} = 100 \Omega$

Channel Parameters (entity)

$V_{sig} = 15 \text{ V}$
 $I_{sig} = 20 \text{ mA}$
 $R_{SIG} = 100 \Omega$

Interface Module Circuit Parameters

$V_{max} \text{ (PWR)} = 35 \text{ V}$
 $I_{max} = 200 \text{ mA}$
 $V_{SIG} = 12 \text{ V}$
 $I_{SIG} = 20 \text{ mA}$

Compliance and Certifications

EMC

Standards:
EN 61000-6-2 Immunity for Industrial Environments
EN 55011/CISPR 11 ISM Equipment
EN 61000-6-4 Emissions for Industrial Environments

European Community Directives:
EMC Directive 2004/108/EC

Electrical Safety

Standards:
EN 61010-1

European Community Directives:
2006/95/EC Low Voltage

Hazardous Area Approvals (3500/82 Monitor)

North America

CSA Zone 2 / Class I, Division 2

European/ATEX

No approvals, must be installed in a non-hazardous area.

Hazardous Area Approvals (Sensors and Interface Modules)

North America

CSA Zone 2 / Class I, Division 2
CSA Zone 0 / Class I, Division 1 (when installed with barriers)

European/ATEX

ATEX Zone 0 (when installed with barriers)

For further certification and approvals information please visit the following website:
www.ge-mcs.com/bently

Ordering Considerations

General

The 3500/82 monitor requires 50% more power than other 3500 monitors. To prevent overloading the 3500 systems power budget on a full size rack, a blank slot is recommended for each 3500/82 monitor installed. 3500/82 Stator Insulation Monitors added to an existing 3500 Monitoring System, require the following (or later) firmware and software versions:

3500/82 Firmware

Version 1.00, or later, for approvals certification

3500/22M RIM Firmware

Revision 1.70 or later

3500 Rack Configuration Software

Version 4.9 or later

3500/93 System Display Firmware

Version 3.0 or later

3500/94 VGA Display Firmware

Version 3.0 or later

System 1™ Software

Version 6.0 or later

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3500/91 & 3500/92

All Versions Supported

System Components

The following hardware components are required for a successful installation:

- Three (3) 350820 High Sensitivity Current Transformers (HSCTs)
- Three (3) 350821 HSCT Interface Modules
- Three (3) 350825 HSCT Interface Cables
- A minimum of Two (2) 350822 High Voltage Sensors (HVSs). Three (3) are recommended.
- One (1) 350823 High Voltage Sensor Interface Module for each 350822 ordered.
- Three (3) barriers for each HSCT and HVS to be installed. *Applicable to Hazardous Area installations only.*
- One (1) 350824 RTD temperature convertor. Three (3) are recommended.
- One (1) 3500/82 Stator Insulation Monitor with corresponding I/O module.
- One (1) 181945 24 VDC 3.5A external power supply for each 3500/82 monitor. Larger power supplies can be used to power multiple 3500/82 monitors. Consult the input power requirements when selecting a different power supply.

Ordering Information

Monitor

3500/82-AXX-BXX-CXX

- A:** I/O Module Type
- | | |
|-----------|--|
| 01 | MSIM I/O Module with Internal Terminations |
|-----------|--|
- B:** External Power Supply Option
- | | |
|-----------|----------------------------|
| 00 | Not Provided |
| 01 | 24Vdc, 3.5A DIN Rail Mount |
- C:** Agency Approval Option
- | | |
|-----------|-------------------------------|
| 00 | None |
| 01 | CSA (Class 1, Zone 2 / Div 2) |

HSCT

350820-AXX-BXX

- A:** Inner Diameter
- | | |
|-----------|---------------|
| 01 | Up to 7.5 kV* |
|-----------|---------------|
- *Operating voltage less than 2kV has limitations from the HVS.
- B:** Agency Approval Option
- | | |
|-----------|--------------------------------|
| 00 | No Approvals |
| 04 | CSA C/US Zone 2 / Div 2 |
| 05 | Multi-Approvals Zone 0 / Div 1 |

HSCT Interface Module

350821-AXX-BXX

- A:** Mount configuration
- | | |
|-----------|-------------|
| 00 | Panel Mount |
| 01 | DIN Mount |
- B:** Agency Approval Option
- | | |
|-----------|--------------------------------|
| 00 | No Approvals |
| 04 | CSA C/US Zone 2 / Div 2 |
| 05 | Multi-Approvals Zone 0 / Div 1 |

HSCT Cable

350825-AXX

- A:** Cable Length
- | | |
|-----------|----------|
| 05 | 5 meters |
|-----------|----------|

HVS

350822-AXX-BXX

- A:** Voltage Divider
- | | |
|-----------|------------------------|
| 01 | 15 kV Full Scale Range |
|-----------|------------------------|
- B:** Agency Approval Option
- | | |
|-----------|--------------------------------|
| 04 | CSA C/US Zone 2 / Div 2 |
| 05 | Multi-Approvals Zone 0 / Div 1 |

HVS Interface Module

350823-AXX-BXX

- A:** Mount configuration
- | | |
|-----------|-------------|
| 00 | Panel Mount |
| 01 | DIN Mount |
- B:** Agency Approval Option
- | | |
|-----------|--------------------------------|
| 00 | No Approvals |
| 04 | CSA C/US Zone 2 / Div 2 |
| 05 | Multi-Approvals Zone 0 / Div 1 |

Temperature Interface Module

350824-AXX

- A:** Preconfigured Temperature Range & Sensor Type
- | | |
|-----------|-------------------|
| 01 | -40 °C to +200 °C |
|-----------|-------------------|

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(-40 °F to +392 °F)
3-wire 100Ω PT RTD

Barriers

Barriers are required to protect the HSCT and HVS when installing them in Zone 0 hazardous areas. Barriers are installed between the 3500/82 monitor and the HSCT/HVS interface modules. There are 3 barriers required for each sensor, 1 barrier for power, and 2 for signal (SIG + and SIG -).

MTL Barriers

100M1770

MTL 7715+ safety barrier for signal

100M1771

MTL 7728P+ safety barrier for power

For further information on these MTL barriers, please visit the following website:
http://www.mtl-inst.com/product/mtl7700_series_barriers/

Pepperl+Fuchs Barriers

100M5332

P+F Z715+ safety barrier for signal

100M5333

P+F Z779.H safety barrier for power

For further information on these P+F barriers, please visit the following website:
http://www.pepperl-fuchs.com/global/en/classid_2414.htm

Spares

100M2907-01

3500/82 Stator Insulation Monitor

324197-01

MSIM I/O Module

181945

28 Vdc 3.5A Power Supply (Din Rail Mount)

100M1761

Base unconfigured MTL5575 temperature isolator. Requires 143324-01 to configure.

102M0274-01

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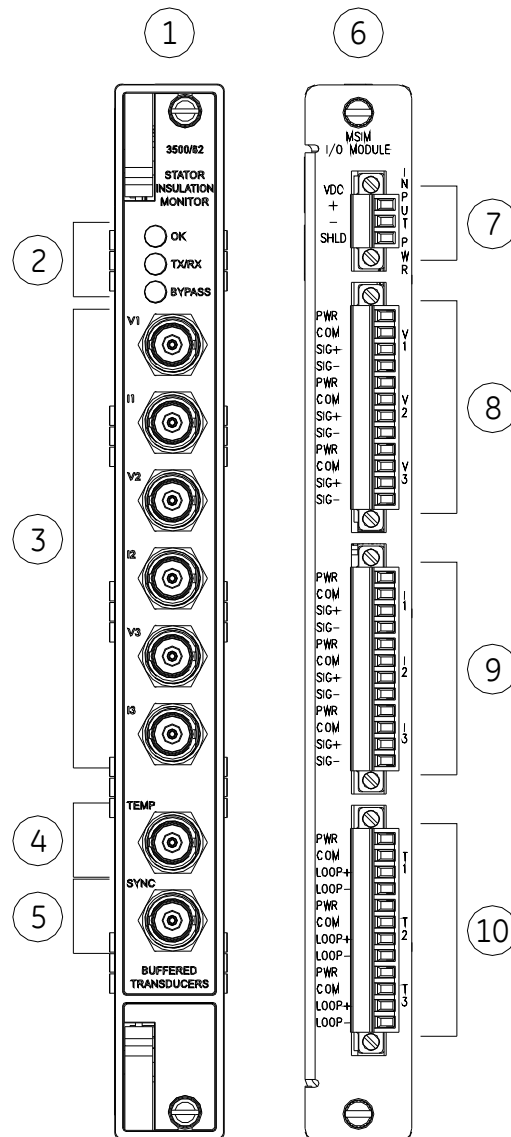
Field Wiring Considerations

4 wire shielded 18 AWG shielded cable.

02171490

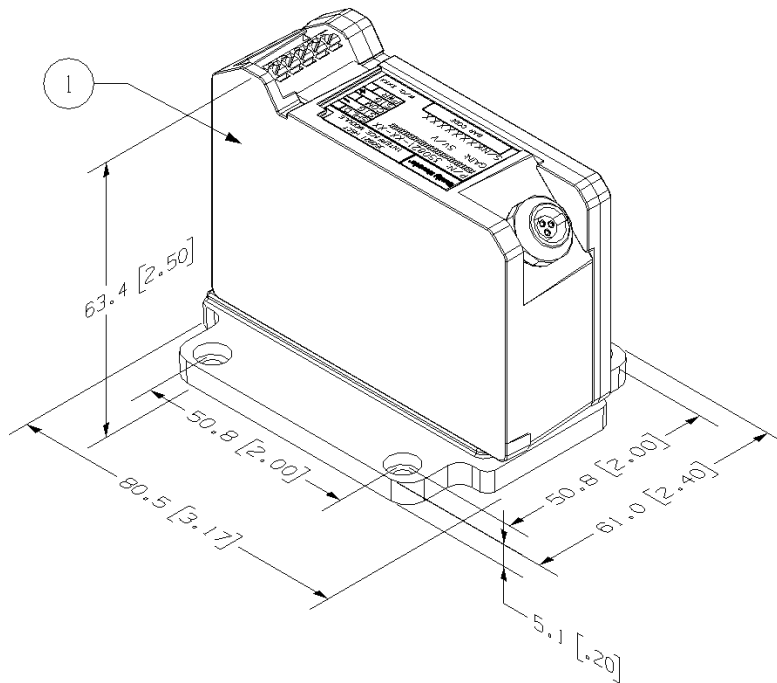
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Graphs and Figures



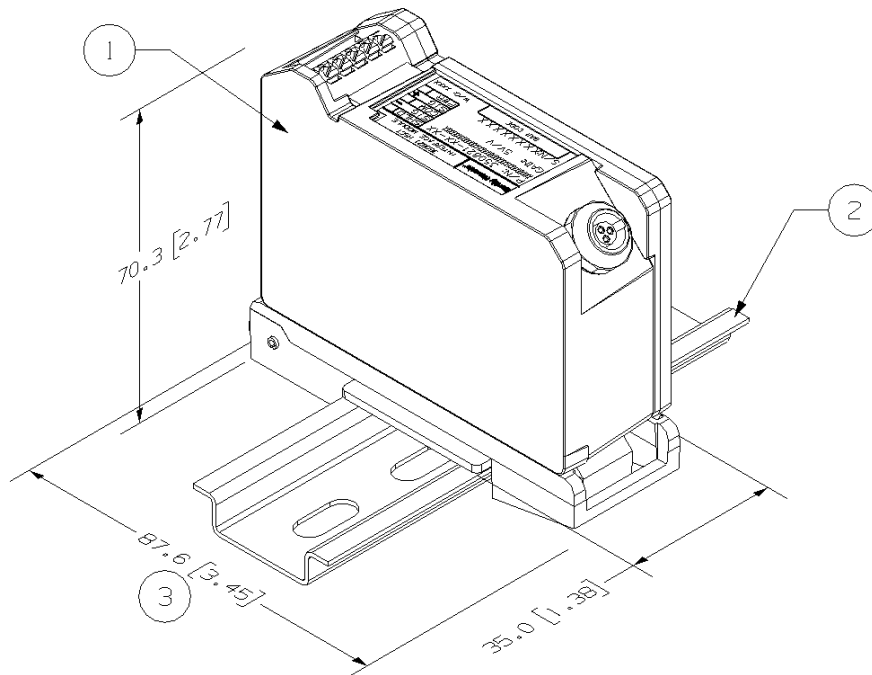
1. 3500/82 Monitor (front view)
2. Status LEDs
3. Buffered Transducer Outputs (HSCT & HVS)
4. Buffered Transducer Output (Average Temperature)
5. Buffered Transducer Output (Phase Synchronization)
6. MSIM I/O Module
7. External 28 Vdc Power Input
8. HVS Inputs
9. HSCT Inputs
10. Temperature Inputs (4-20 mA)

Figure 1: 3500/82 Stator Insulation Monitor and I/O Module



1. 350821/350823 Mounting Option AXX = 00

Figure 2: Panel Mount HSCT/HVS Interface Module



1. 350821/350823 Mounting Option AXX = 01
2. 35mm DIN rail (Not Included)
3. Additional 3 mm [0.120 in] required to remove from DIN rail.

Figure 3: DIN Rail Mount HSCT/HVS Interface Module

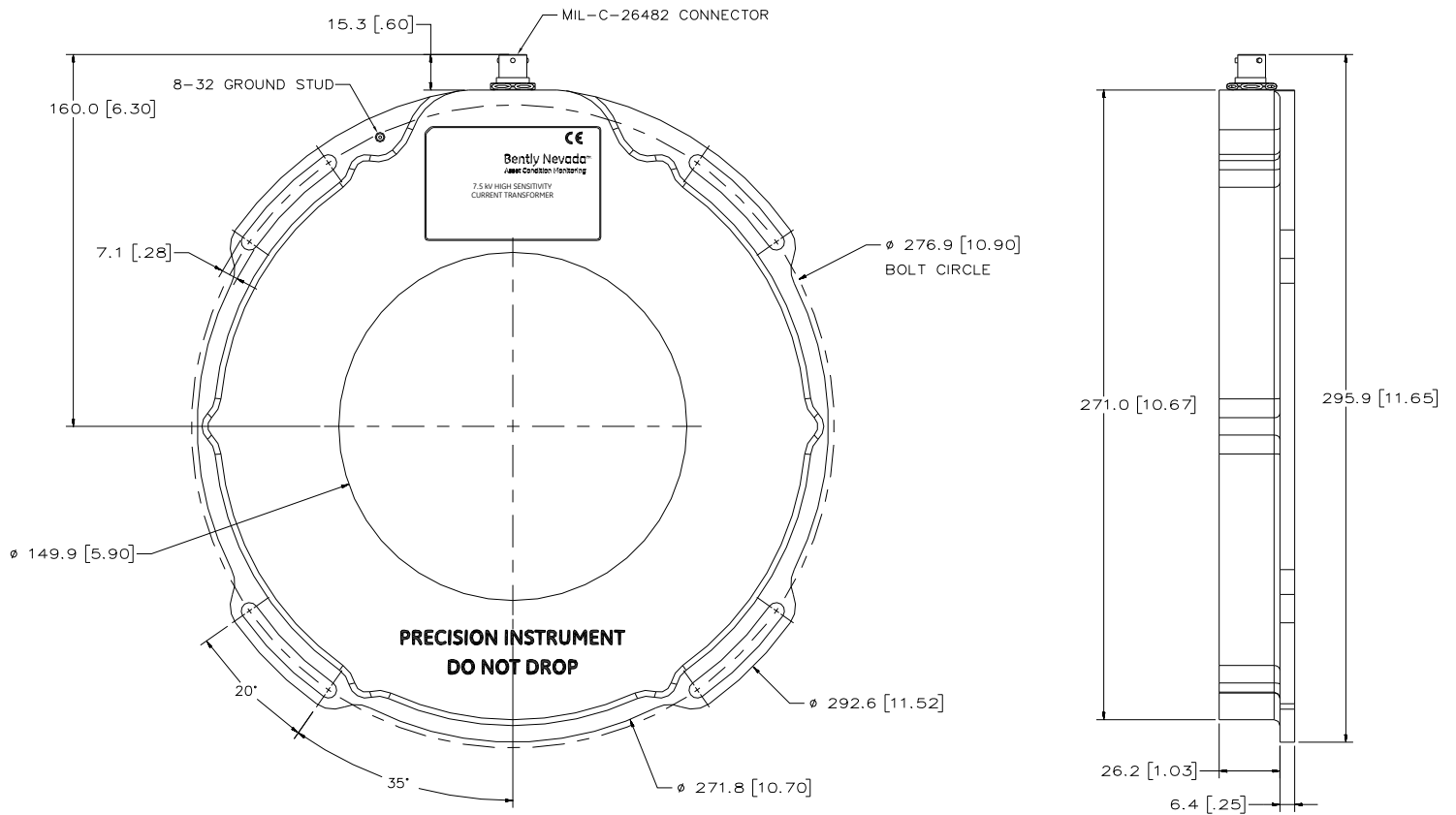
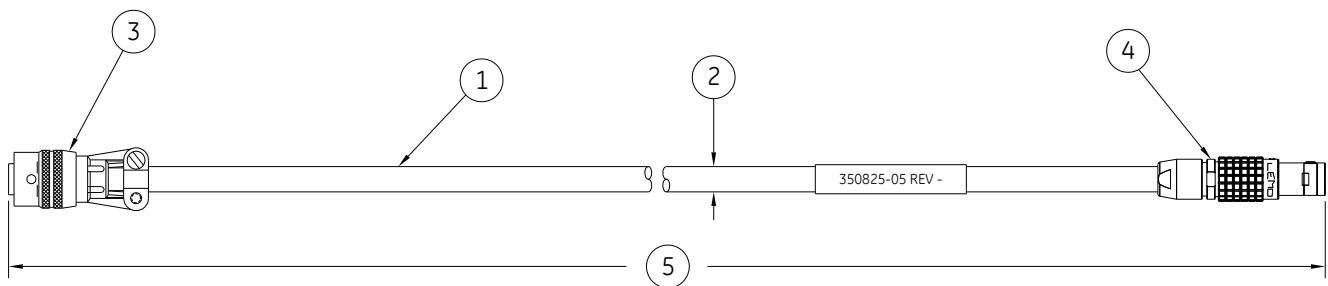


Figure 4: High Sensitivity Current Transformer

Note: Dimensions above represents AXX option = 01.



1. 300V, 105°C, 22 AWG twisted shielded pair PVC cable
2. 5.5 mm [0.216 in] maximum diameter
3. MIL-C-26482 circular connector (connects to HSCT)
4. LEMO 3-pin circular connector (connects to the HSCT interface module)
5. Cable Length = 5 +/- 0.2 meters

Figure 5: HSCT Interface Cable

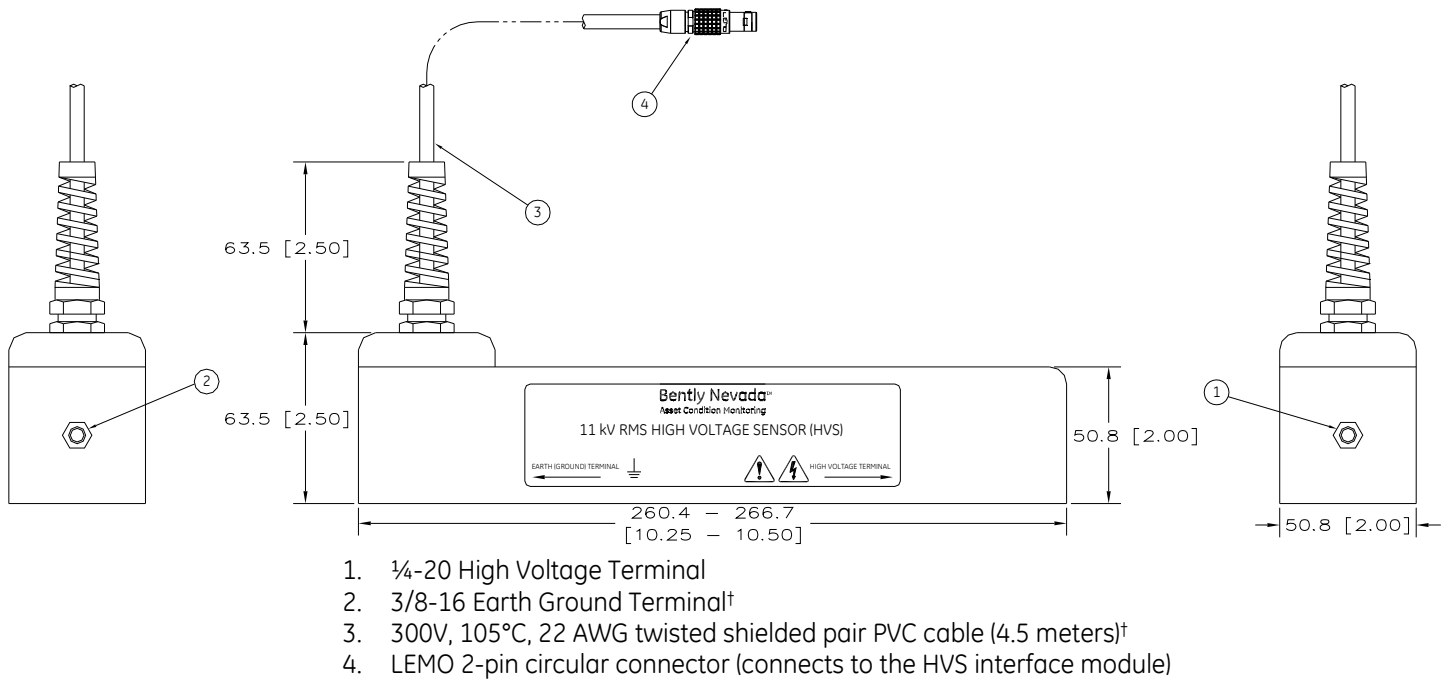


Figure 6: High Voltage Sensor

†This terminal is an electrically isolated mounting terminal on the intrinsically safe HVS. Consult field wiring drawing 100M5071 for important grounding requirements for hazardous area installations.

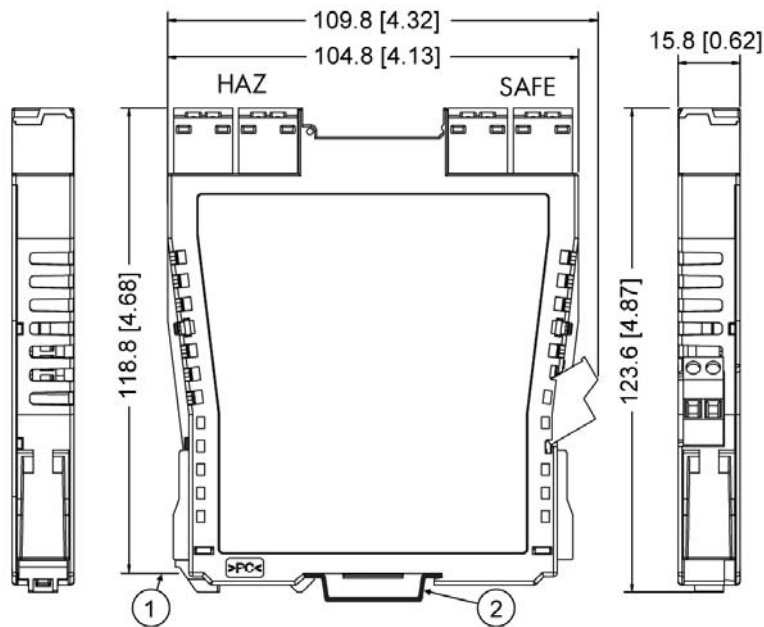


Figure 7: Temperature Interface Module

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