

LineScope[®]

Voltage and Current Sensor
with Fault Indication

US Patent Nos. 9664710B2, 9746498B2, and 9810720B2

LineScope®

Overview

The LineScope® is a three-phase power monitoring system for use on circuits from 4kV to 138kV that is capable of 0.5% voltage and current measurement. The system consists of three conductor-mounted LineProbe sensors and a data consolidating remote terminal unit (RTU3212) that can be housed in any enclosure. **The LineScope® system can function properly on systems with or without a ground.**

The LineProbe does not have the limitation of current-powered sensors, as it is powered by line voltage. The unit is battery-free, which removes the need for regular maintenance, and contains a supercapacitor for last-gasp functionality.

Data Reporting

Using a patented synchronization scheme, the sensors are precisely synchronized to the RTU, enabling the calculation of neutral currents and phase-to-phase voltages. COMTRADE files capture the current and voltage waveforms during overcurrent events.

The system utilizes a 915MHz spread spectrum radio link to stream data at a rate of 32 samples per cycle from each phase. All available data is digital, preserving full resolution and accuracy of all measured parameters. Data is transmitted automatically in event of user-defined exceptions and can be retrieved on demand or on a specified schedule. The LineScope® system does not require server-side software; it integrates directly into DNP 3.0 SCADA and smart-grid systems.

The LineScope® system reports:

- RMS voltages
- Load currents to 1,600A RMS
- Neutral current
- Fault currents to 32kA peak
- Fault direction
- Watts/VARs
- Total Harmonic Distortion
- Power angle
- Power factor
- LineScope® system radio signal strength

RTU3212

The RTU3212 is a full-featured RTU capable of supplementing—or even replacing—an existing RTU. The device features fifteen digital inputs, four digital outputs, and provides two RS232 ports, an RS485 port, and an Ethernet port. The RTU has a small footprint (4.18" x 6") and minimal power requirements (<1W at 9-30VDC). The RTU3212 can be installed in any enclosure and retrofit applications are provided with an antenna kit.



CommBridge

The CommBridge contains all of the components necessary to receive LineScope® data and report it to the SCADA system. The CommBridge is available in two models, the CommBridge-B and the CommBridge-S, with the latter having reduced backup functionality and a smaller form factor.

	CommBridge-B	CommBridge-S
Power Source	120VAC or Solar	120VAC
Backup Power	8Ah Battery	Supercapacitor
Communications	RTU and Radio	External Radio



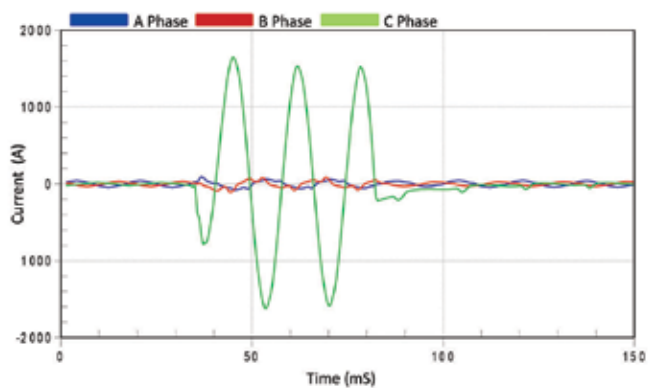
CommBridge-B



CommBridge-S

Fault Reporting

In the event of a fault, the LineScope® automatically reports the event and generates a COMTRADE file. The RTU stores up to 64 COMTRADES locally that are 30 cycles in length. The waveforms below show COMTRADE examples.



Local Fault Indication

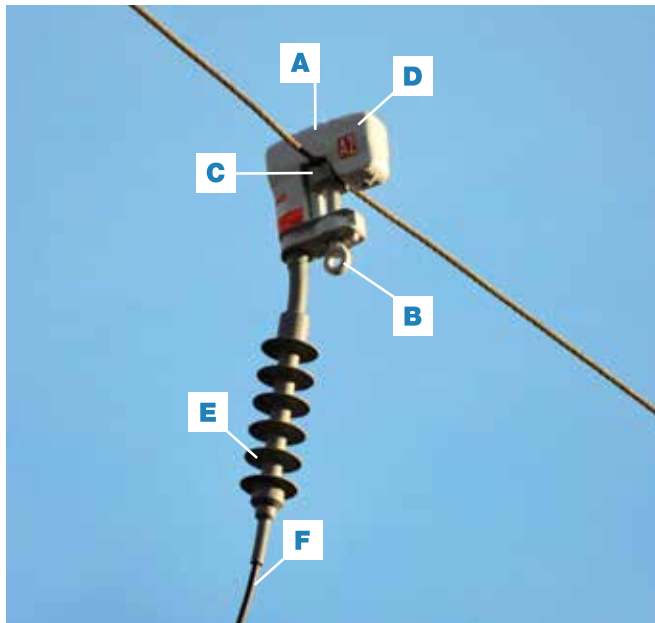
An optional indicating light box can be installed above the enclosure with any battery-powered enclosure to provide daylight visible local fault indication.



LineScope® LineProbe

The LineProbe is a lightweight sensor that can be attached to an energized conductor with a hotstick. The sensor continuously streams current and voltage data to the RTU3212.

A resistance voltage reference cable connection is used to obtain extremely accurate voltage measurements without the need of current flow in the overhead line. It has the flexibility to be applied on any circuit configuration – delta or Wye – with or without a ground (refer to Easy Installation for any Circuit Configuration).



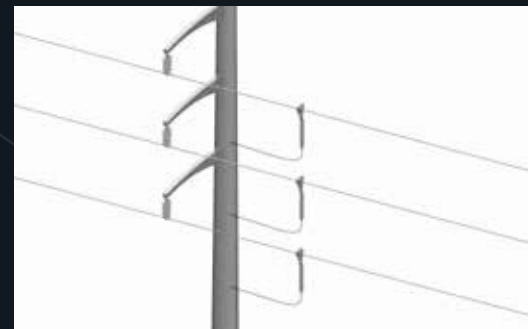
- A** The sensor head contains the sensing modules, a power-harvesting module, spread spectrum radio, and supercapacitor reserve power supply.
- B** A hotstick mounting screw clamp is used to attach the sensor to the line. The screw clamp incorporates a slip clutch mechanism to prevent over-tightening.
- C** The LineProbe head accommodates conductor cable diameters from 0.1" - 1.2".
- D** Line and load-side identifiers are molded into the sensor head.
- E** The leakage distance of the LineProbe exceeds IEEE Standard C57.19.100 requirement for very high pollution level at most voltages.
- F** The voltage reference cable is insulated to 55kV for distribution and 70kV for transmission and has UV-resistant insulation.

Easy Installation for any Circuit Configuration

Line to Ground/Neutral

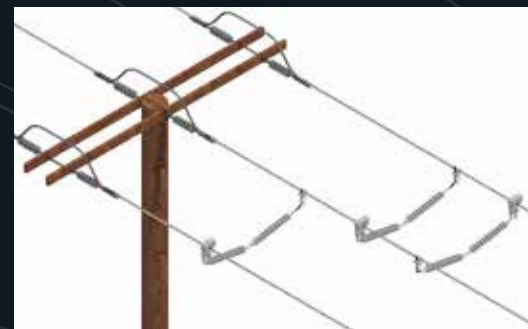


Horizontal Construction



Vertical Construction

Line to Line



Horizontal Construction



Vertical Construction

LineScope® Technical Specifications

Measurement Specifications

Available system voltages (60Hz)	4kV, 8kV, 15kV, 23kV, 34.5kV, 46kV, 69kV, 115kV, 138kV
Voltage accuracy	+/- 0.5% ¹
Nominal current measurement range	0 - 1600A
Current accuracy	+/- 1A up to 200A, +/- 0.5% 200 – 1600A
Fault current measurement	Up to 32kA peak
Fault current tolerance	100kA peak
Fault detection response time	Adjustable - 2 or more cycles
Fault direction	Yes
Sampling rate	32 samples/cycle/phase
Power measurement	Watts, VARs, Power Angle, Power Factor
Power angle accuracy	+/-1°
Neutral current calculated	Yes
Voltage/current THD	Yes - to the 11th harmonic
Waveform capture	4 cycles before inception of an event and 30 cycles total with storage for 64 COMTRADE files

¹ For Line to Line connected systems, voltage and power angle accuracy assumes balanced phases and 120° separation

Operational Specifications

LineProbe powering method	Voltage based line harvesting
Line temperature range	-40°C to 125°C
Conductor diameter range	0.1" - 1.2"
LineProbe housing material	UV-stabilized plastic
LineProbe ingress protection	IP68 - 3' for 33 hours
CommBridge ingress protection	NEMA 4
Design life	>20 years
LineProbe to RTU communications	915MHz spread spectrum radio
Grid communication protocol	DNP 3.0, MODBUS
Sensor to RTU communication range	150' line of sight
Maximum co-located installations	Four LineScope® sets

LineProbe Characteristics	4kV/8kV		15kV		23kV		34.5kV		46kV		69kV		115kV		138kV	
	L-G ²	L-L ³	L-G ²	L-L ³	L-G ²	L-L ³	L-G ²	L-L ³	L-G ²	L-L ³	L-G ²	L-L ³	L-G ²	L-L ³	L-G ²	L-L ³
Basic Impulse Level (kV)	110	110	110	110	150	150	200	200	250	250	350	350	550	550	650	650
Resistor assembly leakage distance in/(cm)	25.4" (65)	25.4" (65)	25.4" (65)	42.9" (109)	42.9" (109)	65.3" (166)	65.3" (166)	82.8" (210)	65.3" (166)	123" (311)	105" (267)	162" (413)	145" (368)	242" (615)	208" (527)	316" (802)
Power frequency dry withstand RMS voltage (kV)	50	50	50	50	70	70	95	95	120	120	175	175	280	280	335	335
Weight lbs/(kg)	4.8 (2.2)	4.8 (2.2)	4.8 (2.2)	6 (2.7)	6 (2.7)	7.4 (3.4)	7.4 (3.4)	8.6 (3.9)	7.4 (3.4)	11.2 (5.1)	14.1 (6.4)	18.2 (8.3)	19.8 (9.0)	26.8 (12.2)	22.7 (10.3)	29.7 (13.5)

² LineProbe connected from Line to Ground

³ LineProbe connected from Line to Line

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