Electric Field Meter

Model CS110

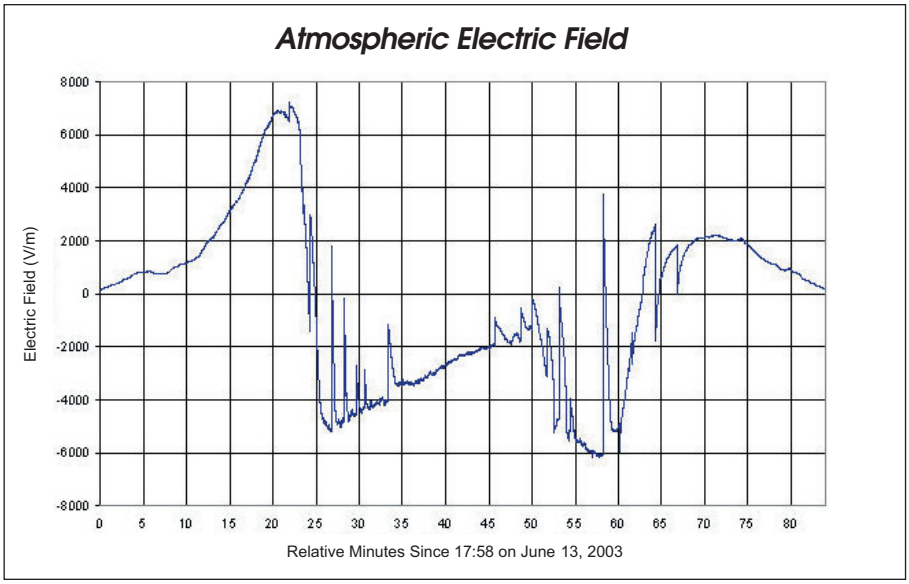
The CS110 Electric Field Meter measures the vertical component of the atmospheric electric field at the earth's surface. These atmospheric electric field measurements are useful for assessing the local lightning hazard and for thunderstorm research.

Reciprocating Shutter

Instead of the traditional rotating vane field mill, the CS110 uses a reciprocating shutter electrically connected to ground potential by a flexible stainless steel strap. The strap operates below its fatigue limit, resulting in an ultra-reliable electrical ground connection to the shutter.

The reciprocating approach provides better low-frequency error performance than the traditional rotating vane field mill because it has a convenient zero-field (closed shutter) reference. The zero-field reference allows the CS110 to measure and then correct for electronic offset voltages, contact potentials, and leakage currents of each individual measurement (Patent Pending).

The CS110 also contains circuitry to measure and compensate for insulator leakage currents occurring on the charge amplifier input, eliminating measurement errors caused by fouled insulators. If insulator surfaces become conductive because of surface contamination, a leakage current compensation circuit applies an equal and opposite polarity current to the charge amplifier input that prevents saturation of the electronics.



Data recorded by the CS110 during a thunderstorm in Cache Valley Utah is shown above. The rapid changes of the electric field are due to lightning discharges, some of which are hazardous cloud-to-ground strikes.

Simplified Maintenance

The stator can be easily removed for cleaning (proper cleaning does not invalidate the calibration). The CS110 also incorporates extensive diagnostic self-checking for each measurement to reduce or eliminate scheduled maintenance. The self-checking monitors internal humidity, insulator cleanliness/power supply voltage, and verifies that CS110 components such as the charge amplifier and shutter open/close are functioning properly.

Using the CS110 as an Automated Weather Station

The CS110 contains an embedded CR1000 datalogger, sealed connectors for attaching meteorological sensors, and three digital control ports for controlling external devices and/or triggering alarms. The datalogger measures the sensors, processes the measurements, stores the data in tables, and can initiate communications. Communication options compatible with the CR1000 include direct connect, Ethernet, phone modems (land-line and cellular), radios, short haul modems, GOES satellite transmitters, and multidrop modems.

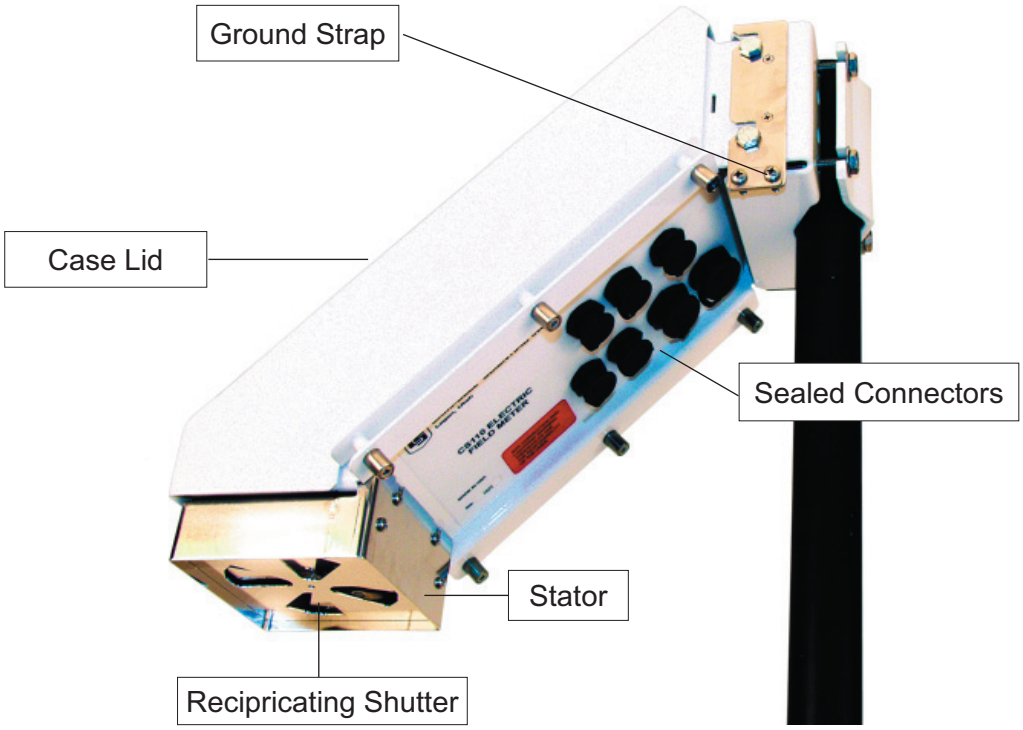
Programming

The CR1000's on-board programming language, CRBasic, provides data processing and analysis routines that support user control over sample (measurement) rates and setting of alarm conditions. LoggerNet Datalogger Support Software facilitates programming, communications, and data retrieval between the CS110 and a PC.

The CS110 is designed for easy attachment to a tripod or tower (shown attached to a CM10 10 ft steel tripod.

CS110 Specifications and Features

The overall gain of an electric field meter is dependent upon the electric-field enhancement or attenuation caused by a given site configuration. Consequently, it is necessary to reference a specific site configuration when discussing measurement performance. The CS110 is factory calibrated using a large (1 meter Hexagonal plates) parallel-plate electric-field calibrator. This parallel-plate configuration is equivalent to an outdoor unit mounted facing upward with the sense aperture flush with the surface of the earth. Inverted and elevated mounting is more practical and recommended for outdoor applications. Inverting and elevating the CS110 results in electric-field enhancement as compared to the parallel-plate configuration, with the enhancement dependent upon instrument height above the ground.



Electric Field Measurement Performance:

Parallel-Plate Configuration				*2 m CM10 Tripod Configuration*[2]			
Accuracy	±1% of reading + 60 V m^{-1} offset[1]			***Accuracy:***	±5% of reading + 8 V m^{-1} offset[1]		
Measurement Range*[3] (V m^{-1})	***Resolution (V m^{-1})***	***Sensitivity (µV/V m^{-1})***	***Noise (V m^{-1} RMS)***	***Measurement Range*[3] (V m^{-1})***	***Resolution (V m^{-1})***	***Sensitivity (µV/V m^{-1})***	***Noise (V m^{-1} RMS)***
±(0 to 21,000)	3	12	4.0	±(0 to 2,200)	0.32	1.2	0.42
±(21,000 to 212,000)	30	118	18.0	±(2,200 to 22,300)	3.2	13	1.9

[1]Typical offset for clean electrodes is ≤ | 30 V m^{-1} | for the parallel-plate configuration, which is reduced by the field enhancement factor for typical inverted and elevated mounting configurations.

[2]Field enhancement due to typical inverted and elevated mounting requires additional site correction, estimated at ±5% accuracy when done in appropriate high field conditions. Practical outdoor CS110 electric field measurement accuracy is estimated at ±5% of reading + 8 V m^{-1} for the CS110 2 meter CM10 Tripod Site.

[3]The CS110 incorporates automatic gain ranging between two input ranges. The measurement is first tried on the lowest input range. If the signal is too large for the lowest range, the larger range is used.

CS110 Specifications and Features Continued

Standard Mounting: 2 m height on a CM10 tripod mast

Site Correction: Site correction factors available for several standard mounting configurations

Sample (Measurement) Rate: Programmable sample rate up to 5 samples per second, variable sample rates possible. Variable example: sample every 10 seconds until field exceeds threshold then sample once a second until field returns to normal.

Power Requirements: 11 to 16 Vdc; peak-current demand is 750 mA during motor operation.
7 mA @ 12 V = 0.08 W average power consumption at 1 sample per 10 seconds
60 mA @ 12 V = 0.7 W average power consumption at 1 sample per second
120 mA @ 12 V = 1.4 W average power consumption at 2 samples per second
300 mA @ 12 V = 3.6 W average power consumption at 5 samples per second

Communication: 1 RS-232 port; 1 CS I/O port used to interface with our peripherals such as a COM310 Voice Modem; digital control ports 1, 2, and 3 for alarm, SDI-12 communications, or asynchronous communications

Baud Rates: Selectable from 300 to 115,200 bps

ASCII Protocol: one start bit, one stop bit, eight data bits, no parity

Lightning Protection: Multi-stage transient protection on all external interfaces

CE Compliance: Standards to which conformity is declared—BS EN61326:2002

Connector/Compatible Sensors:

Connector Label	*Compatible Sensors (one sensor per connector)*
Temp/RH	HMP45C-LC
Wind	05103-LC, 05106-LC, 05305-LC, 034B-LC, 03001-LC
Solar	LI200X-LC pyranometer, CS100 barometer, CS106 barometer *(barometers connect to the CS110 via the 17460 cable; they should be housed in a separate enclosure such as the ENC10/12)*
Rain	CS700-LC, TB4-LC, TE525-LC, TE525WS-LC, TE525MM-LC

Programmability: CRBasic™ programming allows the selection of sample rate, data processing and storage options and setting output ports based on alarm conditions. LoggerNet™ includes the CRBasic editor and compiler.

Rugged Construction: Ultra-reliable metallic ground connection to reciprocating shutter (no wiping contact), brushless stepper motor, powder-coated aluminum case, Teflon insulators, and electro-polished 316L stainless steel used for corrosion protection of critical exposed metallic parts

Easy Maintenance: The stator is easily removed for cleaning (proper cleaning does not invalidate calibration). Instrument self-checking allows maintenance to be performed on an as needed basis. The self-checking also monitors internal humidity, insulator cleanliness, and power supply voltage, and verifies that CS110 components such as the charge amplifier and shutter open/close are functioning properly.

Operating Temperature Range: -25° to 50°C standard, -55° to +85°C optional

RH Range: 0 to 100% RH

Dimensions: 6" x 6" x 17" (15.2 x 15.2 x 43.2 cm)

Weight: 9 lbs (4 kg)

Warranty: The CS110 has a one year warranty against defects in materials and workmanship. A three year warranty is provided for the embedded CR1000M Measurement and Control Module.

815 W. 1800 N. | Logan, Utah 84321-1784 | USA | phone (435) 753-2342 | www.campbellsci.com
Australia | Brazil | Canada | England | France | Germany | South Africa | Spain | USA [headquarters]

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