

C12 IN-PLACE INCLINOMETER

Datasheet C12



Description

The In-Place Inclinerometer (IPI) is used to measure lateral displacement within a borehole.

Most commonly, the IPI is used in a system where multiple IPIs are installed at varying depths. In this manner the profile of the displacement can be monitored.

The IPI itself consists of one or two (uniaxial or biaxial) MEMS tilt sensors mounted in a stainless steel housing. Each sensor

incorporates an on-board microprocessor which performs an automatic temperature compensation of the tilt (g) data.

The sensor itself is a small discrete device which measures in g (gravity). The sensors are powered and read by a data logger such as the Campbell Scientific CR1000. Argus software can produce a near real time profile of displacement that is constantly updated.

Features

- **Sensor strings give a readily automated profile of vertical or horizontal displacements**
- **Accurate and precise measurements using MEMS sensors**
- **Available in Uniaxial and Biaxial versions**
- **Inbuilt temperature compensation**
- **Stainless steel construction, waterproof to 2000kPa**

Benefits

- **Easy to automate using data acquisition systems and Argus software**
- **Removes the need for manual monitoring**
- **Recoverable and reusable**
- **Suitable for safety critical applications**
- **Low power consumption**



Comprehensive information about this product and our full range is available at www.itmsoil.com
If you would like to speak with someone directly please call +44 (0)1825 765044 or email sales@itmsoil.com

PRECISELY MEASURED
instrumentation and monitoring



+56 34 243 6500



www.gmgeomonitoring.com



Av. Argentina Ote.17 Of 403, Los Andes Chile

MICROELECTROMECHANICAL SYSTEMS (MEMS)



Microelectromechanical Systems, or MEMS, is a technology that uses miniaturised mechanical and electromechanical elements that are made using the techniques of microfabrication. The physical dimensions of MEMS devices can vary from well below one micron all the way to several millimetres.

Our MEMS microsensors are small discrete devices that convert a measured mechanical signal, gravity (g) into a voltage signal.

Operation

IPIs are installed in inclinometer casing within a borehole; a sprung wheel assembly on the IPI engages into the keyways of the inclinometer casing to ensure alignment.

Multiple IPIs are installed at varying depths, secured using gauge rods connected to the next/previous IPI; the final gauge rod is secured at the top of the borehole using a top support assembly.

Each IPI is connected to a data logger such as a Campbell Scientific CR1000; the datalogger powers the sensors, initiates readings and communicates the data.

Argus monitoring software can also be used to display and monitor the data.

Applications

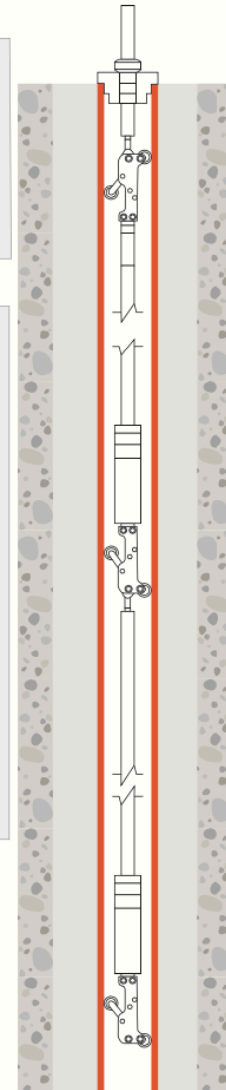
IPI systems measure lateral movement in the ground or in a structure. They are useful for determining the depth, direction, magnitude, and also rate of movement.

For example, they can be used to ascertain the stability of retaining walls by measuring bending and rotation in the retaining wall. They can also reveal ground movement that could affect other buildings. Inclinometer systems can also be used to detect movement in the downstream and upstream side of dams and to define shear zones in the foundations of concrete faced dams.

The measurements of recorded movement can be utilised to check that the deflections are within the design assumptions. Monitoring should be continued to establish any longterm effects after works have finished.

Inclinometer casings can be used in boreholes, embedded in fill material, cast into concrete or attached to structures for the following typical applications:

- Detecting slopes and landslides
- Determining shear and slip zones
- Monitoring diaphragm or sheet pile walls
- Monitoring bending in piles
- Verifying design assumptions and finite element analysis
- Long term monitoring purposes
- Monitoring dams
- Detecting and recording ground movement due to tunnelling operations
- Monitoring retaining walls
- Use horizontal IPI systems to measure settlement and deformation of concrete slabs and tank bases



Associated products

For details on:	Catalogue code:
Dataloggers	D1
EC (Easy Connect) Inclinometer Casing	C9
Standard Inclinometer Casing	C18
Quick Drive Inclinometer Casing	C9-4
Argus Monitoring Software	D4
IPI Handheld Readout	C12-7.4

View our full product range on www.itmsoil.com

THE TECHNICAL RATING FOR THIS PRODUCT:

As the correct installation of any monitoring sensor or system is vital to maximise performance and accuracy, itmsoil makes the following recommendations, for the skill level of the installation contractor.

ADDITIONAL SUPPORT

itmsoil offer installation and monitoring services to support this system. For more information please email : sales@itmsoil.com or call **+44 (0) 1825 765044**

ADVANCED



ADVANCED



INTERMEDIATE



BASIC



The installer is trained and experienced in the installation of this type of instrument or systems, and is ideally a specialist Instrumentation and Monitoring contractor.

The installer already has previous experience and/or training in the installation of this instrument or system.

As a minimum the installer has read and fully comprehends the manual, and if possible has observed these instruments or systems being installed by others.



+56 34 243 6500



www.gmgeomonitoring.com



Av. Argentina Ote.17 Of 403, Los Andes Chile

Specifications

Sensors

Calibrated Range	$\pm 3^\circ$ $\pm 5^\circ$ $\pm 10^\circ$ $\pm 15^\circ$
Resolution ¹	0.008% FS
Sensor accuracy	$\pm 0.05\%$ FS
Operating temperature	-20°C to +80°C
Repeatability	$\pm 0.01\%$ FS
Minimum casing internal diameter	56mm
Maximum casing internal diameter	72mm
Weight (without cable)	540g
Dimensions	192mm x \varnothing 32mm
Input voltage	10-16VDC
Signal output at full range	± 2.5 VDC differential
Current consumption	9mA (uniaxial) / 17mA (biaxial)
Ingress protection	IP68 to 200mH ₂ O (2000kPa)
Housing material	Stainless steel

Wheel Assembly

Material	Stainless steel
Dimensions	100mm x 85mm x 12mm
Weight	90g

Top/End Support Assembly

Gauge length	1m	2m	3m
Total length	1.9m	2.9m	3.9m
Weight	3.1kg	3.4kg	3.7kg
Range of adjustment	940mm		
Material	Stainless steel/PVC		

Cables

Type	Uniaxial	Biaxial
Construction	4 conductor screened polyurethane outer sheath	6 conductor screened polyurethane outer sheath
Weight	26g	33g
Cable diameter	5mm	6mm

Gauge Extension Tubes

Gauge length	1m	2m	3m
Length	0.76m	1.76m	2.76m
Weight	370g	766g	1130g
Diameter	19mm		
Material	Stainless steel		

¹Dependent on readout equipment



Ordering Information

In-Place Inclinometer Sensor (uniaxial)

Includes sensor in 32mm diameter stainless steel housing

C12-1.6	Vertical uniaxial ±52.3mm/metre (±3 arc degrees)
C12-1.1	Vertical uniaxial ±87.2mm/metre (±5 arc degrees)
C12-1.2	Vertical uniaxial ±173.6mm/metre (±10 arc degrees)
C12-1.7	Vertical uniaxial ±258.8mm/metre (±15 arc degrees)
C12-1.5	Horizontal uniaxial ±87.2mm/metre (±5 arc degrees)
C12-3.1	Wheel assembly; one per sensor, for 70mm OD casing
CA-3.1-4-C	Instrument cable 4 core, 7/0.20; screened, priced per metre, polyurethane jacket, for use with uniaxial sensors

In-Place Inclinometer Sensor (biaxial)

Includes sensor in 32mm diameter stainless steel housing

C12-1.8	Vertical biaxial ±52.3mm/metre (±3 arc degrees)
C12-1.3	Vertical biaxial ±87.2mm/metre (±5 arc degrees)
C12-1.4	Vertical biaxial ±173.6mm/metre (±10 arc degrees)
C12-1.9	Vertical biaxial ±258.8mm/metre (±15 arc degrees)
C12-3.1	Wheel assembly; one per sensor, for 70mm OD casing
CA-3.1-6-C	Instrument cable, 6 core, 7/0.20; screened, priced per metre, polyurethane jacket, for use with biaxial sensors

In-Place Inclinometer Extension Tubes

Includes rod end and fixings, one per sensor, minus one per hole

C12-2.1	1 metre gauge length
C12-2.2	2 metre gauge length
C12-2.3	3 metre gauge length

In-Place Inclinometer Top Support and Termination Wheel Assembly

One per borehole. Includes: top of borehole support; support rod; non-articulated wheel assembly; final gauge tube & fixings. For 70mm outer diameter casing

C12-4.1	1 metre gauge tube
C12-4.2	2 metre gauge tube
C12-4.3	3 metre gauge tube
C12-7.1	Installation tool kit for standard IPI system; tool box includes: metric Allen keys, pliers, screwdriver, wire cutters, M6 nut spinner, knife, cable ties, spare nuts, hammer and bolts

In-Place Inclinometer Top Support and Termination Wheel Assembly For GRP Rod Suspension

One per borehole. Includes: top of borehole support; support rod; non-articulated wheel assembly; final gauge tube & fixings. For 70mm outer diameter casing

C12-6.1	1 metre gauge tube
C12-6.2	2 metre gauge tube
C12-6.3	3 metre gauge tube
C12-7.3	Fibreglass rod for suspension; priced per metre, not recommended for use over 30 metres
C12-7.2	Installation tool kit for GRP rod IPI system; tool box as C12-7.2 including adhesive, hand drill and 2.5mm diameter drill

In-Place Inclinometer Discontinuous Extension Tubes For GRP Rod Suspension

Includes rod ends and fixings, one per sensor, minus one per hole

C12-6.4	1 metre gauge length
C12-6.5	2 metre gauge length
C12-6.6	3 metre gauge length

Installation Tools

C12-7.4	Manual IPI readout
---------	--------------------

Manual

MAN-186	In-Place Inclinometer Manual
---------	------------------------------

itmsoil

Bell Lane, Uckfield, East Sussex
TN22 1QL United Kingdom

t: +44 (0) 1825 765044
f: +44 (0) 1825 744398

e: info@itmsoil.com
w: www.itmsoil.com

itmsoil Group Ltd. Registered in England. Number: 4239206. Registered Office: Bell Lane, Uckfield, East Sussex TN22 1QL.



+56 34 243 6500



www.gmgeomonitoring.com



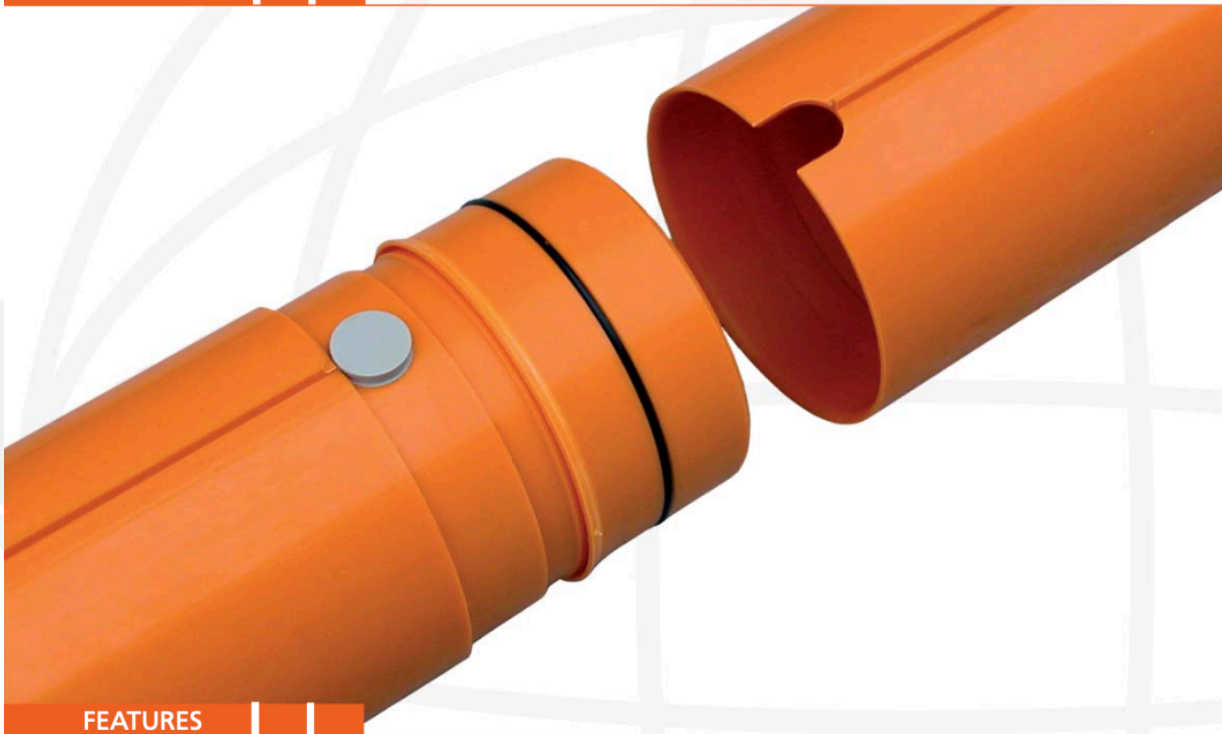
Av. Argentina Ote.17 Of 403, Los Andes Chile

EC (EASY CONNECT) INCLINOMETER CASING



DATASHEET C9

PRODUCTS



FEATURES

- Consistent, reliable joints - The machined slot ensures consistent keyway alignment for accurate data.
- Watertight - An 'O' ring on each joint prevents ingress of water or grout, better long term data.
- Low spiral, deep tight groove profile, more accurate data.
- Joint tested to ensure resistance to collapse (pressure) and twist (spiral).
- Significant savings in installation time reduces both labour cost and drill rig standing charges.



EC (Easy Connect) Casing is an ABS inclinometer casing manufactured in 3 metre lengths, using advanced extrusion techniques. The result is an accurate groove profile equivalent to broached casing.

Designed to replace traditional inclinometer casing, EC Casing is both faster and easier to install. EC Casing can be extended or joined at any point along its length; telescoping couplings can also be installed to cope with significant settlement or heave.

Each order of EC Casing is supplied with a laminated installation guide.

Extremely simple installation, no rivets, tape or glue. Just push together and the joint is made.



+56 34 243 6500



www.gmgeomonitoring.com



Av. Argentina Ote.17 Of 403, Los Andes Chile

TECHNICAL APPLICATIONS

THE SOIL INSTRUMENTS' EASY CONNECT CASING

EC Casing is a specially manufactured ABS extrusion with precise keyways formed at 90° into the internal surface. The keyways allow for the accurate placing and orientation of inclinometer probes and IPI's.

EC Casing can be used in boreholes, embedded in fill material, cast into concrete or attached to structures. It is designed to move with the ground, material or structural movement and provide inclination information over an extended period of time. (Its useful life only ends when the movement of the material or structure causes the casing to shear or prevents the inclinometer probe from passing down the full length of the installation.)



INCLINOMETER SYSTEMS PROVIDE DATA FOR:

SITE INVESTIGATION

- Evaluating the soil strength and stability.

VERIFICATION OF DESIGN ASSUMPTIONS

- Installed in structures EC casing can confirm initial design assumptions by proving actual movement compared to design predictions.

LONG TERM MONITORING

- Long term monitoring of structures and ground conditions to establish changes after works have finished.

EC CASING AND INCLINOMETERS ARE SUITABLE FOR THE FOLLOWING APPLICATIONS:

SLOPES AND LANDSLIDES

Inclinometer tube is installed to determine the shear and slip zones and whether shear is planar or circular. Correct installation will determine if the movement is constant, slowing or accelerating.

DIAPHRAGM OR SHEET PILE WALLS

Inclinometer systems can be used to ascertain the stability of the retaining wall and check that deflections are within design assumptions. The system should also show ground movement that could affect other buildings and can verify the performance of struts and ground anchors.

DAMS

Can be used to detect movement in the downstream and upstream side of the dam and define shear zones in foundations. Inclinometer systems can also monitor deformation of concrete face dams and will determine shear, depth, direction, magnitude, and rate of movement (i.e. constant, accelerating, or decelerating)

TUNNELS

Detect and record soil movement due to tunnelling operations. Verify design assumptions and element analysis.

RETAINING WALLS

Measure bending and rotation in the retaining wall.

LATERALLY LOADED PILES

Monitor bending of piles. EC Casing has been extensively tested to ensure that the coupling joint is strong and resists the ingress of water and grout. These tests are detailed below.

TESTING PROCEDURES

1. TWIST TEST

This test is performed to determine how much twist (torque) the EC joint can withstand.

2. JOINT STRENGTH TEST

This test is performed to determine how much pull the EC joint can withstand, equivalent to how long a length of 3 metre sections can support their own weight in tension.

3. BENDING (RADIUS) TEST

This test is performed to determine how elastic EC Casing is. The casing is bent to a point whereby the joint fails.

4. COLLAPSE (PRESSURE) TEST

This test is performed to determine how deep EC Casing can be installed in a borehole before the pressure of water or grout will deform the casing.

FOR DETAILS ON:

Quick Drive Inclinometer Casing, see data sheet: C9-4.

Standard Inclinometer Casing, see data sheet: C18

In-Place Inclinometer, See data sheet: C12.

Digital Bluetooth Inclinometer System, See data sheet: C17.

In-Site Data Presentation Software, See data sheet: C13.

This information is intended as a general guide. For full installation instructions please refer to the relevant user manual. Our staff are available to provide technical support or to carry out complete installations as required.



CASING SPECIFICATIONS

Material	ABS (Acrylonitrile Butadiene Styrene)
Groove Spiral	< 0.5° / 3m
Collapse Rating	1960kPa
Bend Rating	252N
Maximum Temperature	80°C
Tensile Strength	585kgF
Torque	25Nm

DIMENSIONS

Effective Length	3m
Length	3.06m
Outside Diameter	70mm
Inside Diameter	59mm

WEIGHTS

Casing	3.8kg
End Cap	360g
Top Cap	48g
Loackable Top Cap	718g
Telescoping Section	1.89kg

TELESCOPING SECTIONS

Effective Length	1m
Length	1.06m
Telescoping Range	±0.3m
Outside Diameter	83mm
Inside Diameter	59mm

Soil Instruments Limited has an ongoing policy of design review and reserves the right to amend these specifications without notice.



ORDERING INFORMATION

PART NO.	DESCRIPTION
C9-1.1	EC Casing, 3m Length, Ø70mm OD
C9-4.3	EC Casing, 1m Length, Ø70mm OD
C9-1.2	Telescoping Section: 300mm travel, 1m long, Ø83mm OD
C9-1.2.1	Repair Coupling: 300mm in length Ø83mm OD
C9-1.3	Bottom Cap
C9-1.4	Top Cap
C9-1.5	Lockable Top Cap Assembly
C9-1.9	Grout valve
C9-1.10	Grout valve coupling 1inch BSP female thread
W6-1.2	Bentonite powder (per 25kg)
C9-3.10	Pop riveting tool
C9-3.11	Hand drill
C9-3.9	4.2mm stub drill bit for telescoping couplings



CONTACT DETAILS:

Soil Instruments Limited, Bell Lane, Uckfield, East Sussex, TN22 1QL, United Kingdom

Tel: +44(0)1825 765044 Fax: +44(0)1825 761740

Web: www.soil.co.uk Enquiries: sales@soil.co.uk



+56 34 243 6500



www.gmgeomonitoring.com



Av. Argentina Ote.17 Of 403, Los Andes Chile



CR6 Series

Measurement and Control Datalogger



One Datalogger, Countless Applications

Featuring advanced
vibrating-wire technology

Overview

The CR6-series measurement and control datalogger is a powerful core component for your data-acquisition system. We combined the best features of all our dataloggers and added faster communications, low power requirements, built in USB, compact size, and improved analog input accuracy and resolution. The CR6 series also

introduces our new universal (U) terminal—an ingenious way for allowing virtually any sensor (analog, digital, or smart) to be connected to any U terminal. This is also our first multipurpose datalogger capable of doing static vibrating-wire measurements.

Benefits and Features

- › Powerfully versatile, multi-tool of data acquisition
- › U terminals configurable to what you want them to be: analog or digital, input, or output
- › Static vibrating wire measurements using our patented spectral analysis
- › Surge and over-voltage protection on all terminals
- › Flexible power input from solar panel, dc power supply, 12 V battery, USB
- › Onboard communication via Ethernet 10/100
- › Wiring made easy through removable terminal block
- › MicroSD card drive for extended memory requirements
- › Serial sensors support with RS-232 and RS-485 native
- › CPI for hosting Campbell high speed sensors and distributed modules (CDM)
- › Programmable with CRBasic or SCWin program generator, completely PakBus compatible
- › Shared operating system (OS) with the popular CRBasic CR1000 and CR3000 dataloggers

Specifications

- › **CPU:** 32 bit with hardware FPU, running at 100 MHz
- › **Internal Memory:** 4 MB SRAM for data storage, 6 MB flash for OS, 1 MB serial flash (CPU) for program files
- › **MicroSD Drive** for extended data storage up to 16 GB
- › **Clock Accuracy:** ±3 min per year, optional GPS correction to 10 μs
- › **USB micro B** for direct connection to PC (limited power source during configuration), 2.0 full speed, 12 Mbps
- › **10/100 Ethernet RJ45** for LAN connection
- › **CS I/O port** for connection to Campbell Scientific modems and displays
- › **CPI port** for terminal expansion using Campbell Distributed modules (CDM)
- › **Battery terminal pair** for regulated 12 V power input or rechargeable 12 V VRLA for UPS mode
- › **Charge terminal pair** for 16 to 32 V from dc power converter or 12 or 24 V solar panel
- › **Two switched 12 V terminals** for powering sensors or communication devices, 1100 mA @ 20°C
- › **Continuous 12 V terminal**

More info: 435.227.9100

www.campbellsci.com/cr6



+56 34 243 6500



www.gmgeomonitoring.com



Av. Argentina Ote.17 Of 403, Los Andes Chile

Specifications Continued

- › **Twelve Universal (U) Terminals:** U terminals are software configurable for analog or digital functions
 - Analog functions consist of:
 - ◆ Analog inputs: 12 single-ended or 6 differential with ± 5000 mV, ± 1000 mV, ± 200 mV ranges 24 bit ADC
 - ◆ Analog outputs: ± 2.5 V or ± 2 mA ranges for bridge measurements 12 bit DAC
 - ◆ Static frequency-analyzed vibrating wire: terminal pair both excites to 12 V p-p and 100 Hz to 6.5 kHz and reads vibrating-wire transducers
 - ◆ Thermistor: completion resistor internal 5 k Ω
 - ◆ Period average: up to 200 kHz, amplitude dependent
 - ◆ Low level ac: 1 Hz to 20 kHz, amplitude dependent
 - Digital I/O functions consist of 5 V or 3.3 V logic levels for:
 - ◆ General status/control
 - ◆ Voltage source: 5 V, 3.3 V, 20 mA @ 3.5 V
 - ◆ Timer I/O
 - ◆ Switched closure (150 Hz) or high frequency counter (1 MHz)
 - ◆ Pulse width modulation
 - ◆ Interrupts
 - ◆ SDI-12 and SDM
 - ◆ Serial asynchronous communication Tx/Rx pairs

- › **Four control (C) Terminals:** C terminals are software configurable for digital functions
 - Digital I/O functions consist of 5 or 3.3 V logic levels for:
 - ◆ General status/control
 - ◆ Voltage source 5 V, 3.3 V: 11 mA @ 3.5 V
 - ◆ Timer I/O
 - ◆ Switched closure (150 Hz) or high frequency counter (1 MHz)
 - ◆ Pulse width modulation
 - ◆ Interrupts
 - ◆ SDI-12 and SDM
 - ◆ RS-232/RS-485: half or full duplex, Tx/Rx pairs
 - › **Maximum Multiplexed Analog Measurement Rate:** 354 Hz (2.8 ms)
 - › **Best Analog Accuracy:** $\pm(0.03\%$ of reading + 3 μ V), 0° to 40°C
 - › **Best Effective Resolution:** 50 nV (± 200 mV range, differential measurement, input reversal, 5 Hz f_{NI})
 - › **Weight:** 0.42 kg (0.92 lb)
 - › **Dimensions:** 20.3 x 10.2 x 6.1 cm (8.0 x 4.0 x 2.4 in)

Programmable Terminals

Twelve U terminals and four C terminals are programmable for the following functions.

Analog Input Function	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	Max
Single Ended					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
Differential					H	L	H	L	H	L	H	L	H	L	H	L	6
Period Average					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
Vibrating Wire						✓		✓		✓		✓		✓		✓	6
Thermistor						✓		✓		✓		✓		✓		✓	6
Analog Output Function	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	Max
Switched-Voltage Excitation					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
Switched-Current Excitation					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
Digital I/O Function	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	Max
RS-232	Tx	Rx	Tx	Rx													2
RS-485 (Half Duplex)	Tx-	Tx+	Rx-	Rx+													2
RS-485 (Full Duplex)	Tx	Rx	Tx	Rx													1
RS-232 TTL	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	8
SDI-12	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	8
SDM	DATA	CLK	ENABLE		DATA	CLK	ENABLE		DATA	CLK	ENABLE		DATA	CLK	ENABLE		1
General I/O Pair	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
5 V or 3.3 V Source	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Pulse-Width Modulation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Timer I/O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Interrupt	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Pulse Counting Function	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	Max
Switch Closure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
High Frequency	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Low Level AC						✓		✓		✓		✓		✓		✓	6

Terminal Pair Use Examples

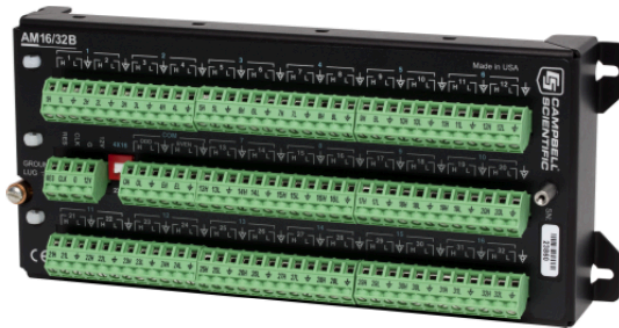
- 1.If U1 is programmed for analog input or output, its associated pair, U2, may only be used as an analog input or output.
- 2.If U6 is programmed as a low level ac pulse connection, its associated pair, U5, may only be used for digital I/O or pulse counting.





AM16/32B

16- or 32-Channel Relay Multiplexer



Greatly Increases Sensor Capacity

Connects many sensors to single datalogger

Overview

The AM16/32B multiplexer significantly increases the number of sensors that can be measured by a Campbell Scientific datalogger. It interfaces with the datalogger and

adds terminals for wiring additional sensors of almost any type.

Benefits and Features

- › Significantly increases the number of sensors the data logger can measure
- › Can multiplex 16, 32, or 48 sensors
- › Supports many types of sensors including thermistors, potentiometers, strain gages, vibrating wires, reflectometers, and soil moisture blocks
- › Decreases the cost of cabling individual sensors on long wire runs
- › Allows a relay address to be used to go directly to a specific channel—reducing power consumption and wear on the relay switches
- › Electrical surge protection via gas tubes on all analog I/O, and varistors or TVS diodes on all other connections
- › Prevents sensor-cable damage by providing strain relief for sensor leads and independent routing for sensor shield lines
- › Eliminates the requirement for dc blocking capacitors for gypsum soil moisture blocks, significantly reducing sensor cost

Technical Description

Depending on sensor type, the AM16/32B can multiplex 16, 32, or 48 sensors. Up to six AM16/32Bs may be connected to the same data logger, depending on the number of control ports and analog inputs available.

The AM16/32B either multiplexes 16 groups of four lines (a total of 64 lines) through four common (COM) terminals. Alternatively, a manual switch setting allows the AM16/32B to multiplex 32 groups of two lines (also a total of 64 lines) through two COM terminals. A cable connects the common terminals to data logger analog inputs, excitation channels,

or ground as required by the sensor. The data logger controls the multiplexer using two control ports, or one control port and one excitation channel.

Electrical Surge Protection

The equipment is protected from electrical surges using gas tubes on all inputs. A 35 V varistor is connected between the shield ground and ground lug to provide surge protection. The Reset, Clock, and +12 V terminals are protected by 18 V TVS diodes.

For comprehensive details, visit: www.campbellsci.eu/am16-32b 



+56 34 243 6500



www.gmgeomonitoring.com



Av. Argentina Ote.17 Of 403, Los Andes Chile

Specifications

-NOTE-	<i>The protection on the reset, clock, and +12 V inputs are provided by 18 V TVS diodes.</i>
Power	Unregulated 9.6 to 16 Vdc
Scan Advance	Occurs on the leading edge of the clock pulse transition (from below 1.5 V to above 3.3 V)
Minimum Clock Pulse Width	1 ms
Maximum Actuation Time for Relay	20 ms
Relay Operation	Break before make
Initial Relay Resistance, Closed	0.1 ohm
Maximum Switching Current	500 mA (Switching currents greater than 30 mA [occasional 50 mA current is acceptable] will degrade the contact surfaces of the mechanical relays and increase their resistance. This will adversely affect the suitability of these relays to multiplex low voltage signals. Although a relay used in this manner no longer qualifies for low voltage measurement, it continues to be useful for switching currents in excess of 30 mA.)
Maximum Switching Voltage	50 Vdc A voltage divider such as the VDIV10:1 may be needed between the AM16/32B and the data logger to stay within the

input limits of the data logger channel.

Minimum Contact Life	5 x 10 ⁷ operations
Maximum Contact Voltage Rating	70 V
Maximum Voltage	8 Vdc (clock level)
CE Compliance	› EN 55022:1998 Class B › EN 61326:1998
Surge	Complies with IEC61000-4-5, test level 3 (±2 kV, 2 ohm coupling impedance)
Operating Temperature Range	› -55° to +85°C (extended) › -25° to +50°C (standard)
Dimensions	23.9 x 10.2 x 4.6 cm (9.4 x 4.0 x 1.8 in.)
Weight	~680 g (~1.5 lb)

ESD

Air Discharge	Complies with IEC61000-4-2, test level 4 (±15 kV).
Contact Discharge	Complies with IEC61000-4-2, test level 4 (±8 kV).

Typical Current Drain

Quiescent	< 210 µA
Active	› 11 mA (typical in 4x16 mode) › 6 mA (typical in 2x32 mode)

Reset Levels

Inactive	< 0.9 V
Active	3.3 to 8 V

For comprehensive details, visit: www.campbellsci.eu/am16-32b 



80 Hathern Road, Shepshed, LE12 9GX UK | +(0)1509 828888 | sale@campbellsci.co.uk | www.campbellsci.eu
AUSTRALIA | BRAZIL | CANADA | CHINA | COSTA RICA | FRANCE | GERMANY | INDIA | SOUTH AFRICA | SPAIN | THAILAND | UK | USA

© 2020 Campbell Scientific, Ltd. | 10/16/2020



+56 34 243 6500



www.gmgeomonitoring.com



Av. Argentina Ote.17 Of 403, Los Andes Chile



Reliable charging sources for remote locations

Photovoltaic power sources

Overview

Solar panels are photovoltaic power sources capable of recharging batteries. The minimum battery size and solar panel output required depends on 1) the average current drain of the system, 2) the maximum time the battery must supply power to the system without being charged, and 3) the location of the site. If you need assistance in selecting a solar panel, refer to our Power Supplies brochure, application note, or contact a Campbell Scientific Applications Engineer.

Solar panel characteristics assume 1 kW m⁻² illumination and 25°C solar panel temperature. Individual panels may vary up to 10%. The output panel voltage increases as the panel temperature decreases. All solar panels are shipped with hardware for mounting to a tripod or tower.

SP5-Series 5-Watt Solar Panels

The SP5-series solar panels are intended only for CR200(X)-series applications that have minimal power requirements.

- **SP5's** cable has a 4.5 m length and can be fitted with a connector that mates with the ENC200 enclosure's power connector.

SP10-Series 10-Watt Solar Panels

The SP10-series solar panels source sufficient current for many system configurations at most tropical to temperate latitudes. These solar panels include a 4.5 m cable. The models differ as follows:

- **SP10** uses the regulator in the PS150, PS200, CR6, or CR3000 to recharge their batteries. A CH150 or CH200 regulator is required to recharge the BP12, BP17 or BP24 batteries. The SP10's cable has stripped leads that connect to the power supply or datalogger battery base.

- **SP10R** is supplied with a regulator. It can recharge a user-supplied deep-cycle battery. The SP10R's cable has stripped leads that connect to the battery. Please note that the SP10R draws a continuous 5 mA current drain.

SP30-Series 30-Watt Solar Panels

The SP30-series solar panels are often used for system configurations that have higher than average power requirements, or in higher elevation and latitude locations. The models differ as follows:

SP30 uses the regulator in the PS150, PS200, CR3000, CR6 to recharge their batteries. The SP30 has a 5 m cable with stripped leads that connect to the power supply or datalogger battery base.

- **SP30R** is supplied with a regulator. It can recharge a user-supplied deep-cycle battery. This solar panel has a 5 m cable with stripped leads that connect to the battery. Please note that, the SP30R draws a continuous 5 mA current drain.

SP60 60-Watt Solar Panels

The SP60 solar panel is used for our CS110 Electric Field Meter or other systems that require 60 W solar panels. It needs to be connected to a CH150, CH200 Smart Charge Controller or 008116 Morningstar SunSaver regulator (see below).

The SP60 has a 5 m standard length; maximum length is 15 m.

NOTE: Power ratings quoted on this sales leaflet apply to European customers only.

More info: +44(0) 1509 828 888

www.campbellsci.co.uk/solar_panels



SP100 100-Watt Solar Panels

The SP100 solar panel is used in Eddy Covariance, or other systems that require high-power solar panels. This solar panel needs to be connected to 008116 Morningstar SunSaver regulator (see below).

The SP100 has a 5 m standard length cable; maximum length is 15 m.

Regulators for the SP60 and SP100

CH150 Smart Charge Controller

The CH150 is a micro-controller-based smart charger with temperature compensation that optimizes battery charging and increases the battery's life. It is for use with a separate larger battery such as our BP12, BP24, or a user-supplied battery.

CH200 Smart Charge Controller

The CH200 limits charging current to a maximum of 40 Adc typical, has a quiescent current drain of only 0.3 mA and can precisely charge the following battery families: Yuasa NP Series (includes our PS200, BP12 and BP24), EnerSys Cyclone Series, Concorde Sun Xtender Series or a custom battery.

008116 Morningstar SunSaver

The Morningstar SunSaver limits charging current to approximately 10 A, has a quiescent current drain of approximately 8 mA, and can charge sealed (includes our BP17, BP24) or flooded batteries.

Mounting

The SP5 and SP10 solar panels are supplied with simple, single 'V' bolt fitting for mounting on a pole in the size range of 25-54 mm diameter (see the image on the front page of this leaflet). The angle of the solar panel can be adjusted to be 0 to 90 degrees relative to the pole. If necessary the V-bolt fitting can be removed and the panel fixed to a vertical surface with screws. Optional band clamps are available to allow the brackets to be fitted to larger poles up to 120 mm in diameter.

The SP30 and larger standard panels are supplied with a Solar Panel Multi-Fit bracket (Part number 006607). This is a substantial bracket that fits many different sizes of panels by simply clamping under the rear lip of the frame at either side of the panel (it works with panels up to 500 mm internal width). See the diagrams below showing the multi-fit bracket. This allows easy exchange of the panel in the field, e.g. to upgrade to a larger size panel.

One bracket is supplied as standard with each panel which is suitable for mounting the SP30 panel on poles, tripods or towers in most applications. A single bracket may also be adequate with larger panels in sheltered sites where the lower edge of the panel rests on the ground or on the tripod legs. For exposed windy sites, especially with the larger panels, e.g. the SP60 or SP100, a second bracket should be ordered to allow the panel to be mounted on two vertical tubes rather than one. Those tubes could be the two sides of a larger tower or user supplied poles which are fixed into the ground.

Each bracket has two 'V' bolt fittings for poles in the range of 25-54 mm diameter. Optional band clamps are available to allow the brackets to be fitted to larger poles up to 120 mm in diameter. Larger poles can be catered for to special order. The panel angle can be adjusted in one of six steps from 0-90 degrees relative to the pole.

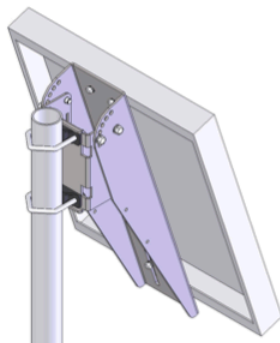


Diagram of a solar panel mounted to pole

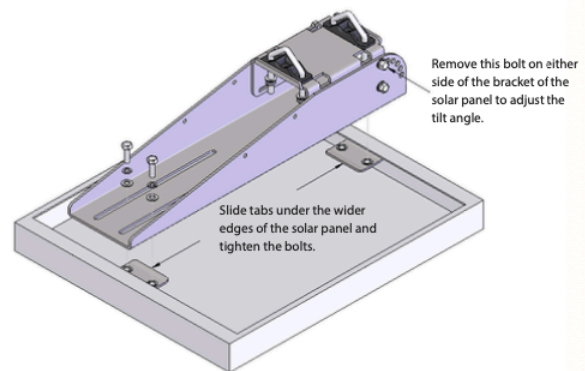


Diagram showing the method of fixing the bracket to the panel

Note: With some smaller panels the bracket will protrude at the bottom side of the panel.

	SP5	SP10	SP30	SP60	SP100
Typical maximum power (W)	4.5(±10%)	10(±10%)	35(+/-5%)	70(+/-5%)	110(+/-5%)
Voltage at peak power**	16.5	16.8	18.1	18.1	17.6
Current at peak power (A)	0.27	0.57	1.94	3.87	6.25
Short circuit current (A)	0.30	0.6	2.1	4.2	6.8
Open circuit voltage**	20.5	21.0	21.7	21.7	21.1
Dimensions (excluding bracket)	251x269 mm	420x269 mm	415x510 mm	535x734 mm	1037x527 mm
Weight (excluding bracket and cable)	0.9 kg	1.9 kg	2.3 kg	4.18 kg	7 kg
Temp. coeff. of voltage (mV/°C)	-80	-72	-63	-61	-61
Temp. coeff. of power (%/°C)	-0.5	-0.37	-0.38	-0.38	-0.38
Cable *** termination	Fixed 4.5 m lead	Fixed 4.5 m lead	0.9 m lead with MC4 connectors	0.9 m lead with MC4 connectors	0.9 m lead with MC4 connectors

*Power ratings are obtained under standard test conditions of 1000 Wm² and 25°C cell temperature.

**These are voltages at the panel surface. If an external regulator or long cables are used the apparent output voltage will be lower.

***Larger panels have two separate output leads fitted with MC4 connectors. A single dual-core extension cable is supplied with mating connectors to make the standard total cable length 5 m.

Common Specifications:

Maximum temperature range: -40 to +85°C

Maximum system voltage: 50 V

Warranty on power output (90% of initial power): 10 years

Note: Due to variations in the supply of solar panels and also continued improvement in solar panel technology all specifications are subject to change.





Robusto, versátil

Montaje fácil y seguro de equipos Campbell



[Imágenes](#)

[Productos similares](#)

[Descripción técnica](#)

[Especificaciones](#)

[Compatibilidad](#)

[Documentos](#)

[FAQs](#)

[Casos aplicación](#)

Resumen

El armario ENC16/18 es el modelo más grande que disponemos. En su interior podemos albergar un datalogger, fuente de alimentación y uno o más periféricos. Es habitual utilizarlo en aplicaciones que requieran una de nuestras baterías de tamaño grande y/o si es necesario fijar diversos periféricos de medida o control.

[Leer más](#)

Ventajas y características

- › Para uso en intemperie, y para proteger los instrumentos
- › Placa de montaje diseñada de forma que sea fácil fijar componentes Campbell Scientific
- › Armario color blanco, estabilizado UV que refleja la radiación solar—reduciendo los gradientes de temperatura dentro del armario sin necesidad de un protector para la radiación

Descripción detallada

The RF451 is a frequency-hopping spread-spectrum radio, capable of operating between 902 to 928 MHz and transmitting with up to 1 Watt (30 dBm). The specific frequencies used may be selected when operating outside the US and Canada to meet local regulations. Additionally, the RF power output may be adjusted to as low as 10 mW via software.

Typical communication distances are greater than 4 miles with up to 60 miles achievable under ideal conditions. Extended communication distances are possible using repeaters.

The operating frequency band of this radio modem may be shared with other non-licensed services such as cordless telephones and with licensed services including emergency broadcast and air-traffic control.

The RF451 consists of a radio module manufactured by FreeWave Technologies and a Campbell Scientific interface board. It reduces susceptibility to RF interference from other spread-spectrum devices by providing user-selectable frequency hopping patterns. Spread-spectrum radios spread the normally narrowband information signal over a relatively wide band of frequencies. This process allows communications to be more immune to noise and other interference.

RF451 radios, like all FCC Part 15 devices, are not allowed to cause harmful interference to licensed radio communications and must accept any interference that they receive. Most Campbell Scientific users operate in open or remote locations

where interference is unlikely. If there is a problem, interference can be reduced using methods such as moving the device, reorienting or using a different type of antenna, or adding RF shielding.

Powering the Radio

At least two radios are required to create a link. The radio may be powered through the dc barrel connector or via a CS I/O connection. When ac power is available, the 15966 wall charger is commonly used. At remote sites, the RF451 typically is powered through the CS I/O or the 14291 field cable.

Antennas

Campbell Scientific offers a variety of antennas for this radio. The 14204 is a 0 dBd, 1/2 wave omnidirectional whip antenna that connects directly to the radio (no cable required) and can transmit short distances (up to 1 mile). The 15970 dipole antenna includes adhesive for window or wall mounting and a cable for connecting to the radio.

Our higher gain 14221 omnidirectional and 14205 Yagi antennas require a cable to connect them to the radio. The 31314 surge protector is available for radios susceptible to lightning or electrostatic buildup or when the cable length needs to be longer than 3 m (10 ft), as measured between the transceiver and the antenna.



+56 34 243 6500



www.gmgeomonitoring.com



Av. Argentina Ote.17 Of 403, Los Andes Chile

Especificaciones

Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Frequency	902 to 928 MHz
Country Used In	US, Canada, Australia
Power Output	10 to 1,000 mW (user-selectable)
Transmission Distance	<ul style="list-style-type: none">> <i>-Note- Transmission distance assumes line-of-sight and appropriate antenna. Line-of-sight obstructions, RF interference, and antenna type will affect transmission distance.</i>> 20.92 to 96.56 km (13 to 60 mi) depending on antenna and line-of-sight
Modulation	2 level GFSK
RF Data Rate	115.2 or 153.6 kbps (selectable speeds)
Occupied Bandwidth	142 kHz (applicable to FCC ID KNYAMM0921TT)
Hopping Patterns	15 per band, 105 total (user-selectable)
Hopping Channels	50 to 111 (user-selectable) applicable to FCC ID KNYAMM0921TT
Frequency Zones	16
Receiver Sensitivity	<ul style="list-style-type: none">> -108 dBm at 115.2 kbps (for 10^{-4} BER)> -103 dBm at 153.6 kbps (for 10^{-4} BER)



Power

Input Voltage

7 to 28 Vdc

Powered Over

CS I/O or barrel plug

Connector

Barrel plug, center positive 12 V (used to connect the 14291 Field Power Cable or 15966 ac adapter)

USB

-NOTE-

Used for connection to computer for network communications or device configuration. Does not supply enough power for normal operation; RF451 must be powered through dc barrel plug or CS I/O.

Type

USB standard B (device only)

