

# XCI

## PRODUCT MANUAL



### Mace USA LLC

PO Box 7144

Overland Park, KS 66207

United States of America

Ph: 888 440 4215 Fax: 888 440 6999

Email: [sales@maceusa.com](mailto:sales@maceusa.com)

[www.maceusa.com](http://www.maceusa.com)

### Measuring & Control Equipment (MACE) P/L

PO Box 911, Pennant Hills

NSW 1715, Australia

Ph: (02) 9658 1234 Fax: (02) 9651 7989

Email: [sales@macemeters.com](mailto:sales@macemeters.com)

[www.macemeters.com](http://www.macemeters.com)

Includes

### *FloCom<sup>+</sup>*

Configuration Software

**mace**   
Water Monitoring Solutions

[www.macemeters.com](http://www.macemeters.com)

**mace**   
Water Monitoring Solutions

# XCi Product Manual - Interactive PDF

This user manual is setup as an interactive PDF. The user can click on any of the “**Chapters**” in the table of contents to navigate directly to the corresponding page.

To return to the table of contents click on the “**Contents**” button at the bottom of each page.



# Essential Reading

## **Section A:** The XCi Device

## **Section B:** Doppler Ultrasonic Velocity Sensors

- *Only necessary if installing MACE Doppler ultrasonic velocity sensors*

## **Section C:** Flocom+ Software

## **Section D:** FloSeries3 Cards

- Chapter 14.0 Introduction to FloSeries3 cards

- Chapter 15.0 Installing FloSeries3 cards

- The chapter/s relevant to the FloSeries3 card/s in your XCi device

# MACE XCi Product Manual

## Product Support

Should you experience difficulty in using this product, please contact your local MACE vendor. We also welcome feedback from customers who feel that their experience may provide an improvement to the product or may be beneficial to other users.



**NOTE: MACE strongly recommends that users register for Software Updates on the “Support” page of the [www.macemeters.com](http://www.macemeters.com) website. Releases of product enhancements occur periodically and we recommend that these are uploaded into your XCi device.**

Please go to [www.macemeters.com](http://www.macemeters.com)

## Disclaimer

No warranties of any nature are extended by this document.

Measuring and Control Equipment Co. Pty. Ltd. (MACE) will not accept any financial or other responsibility that may be the result of your use of this information, including direct, indirect, special or consequential damages.

You must be careful to ensure that the use of this information complies with the laws, rules and regulations of the jurisdictions with respect to which it is used. MACE assumes no responsibility for personal or property damage caused by the misuse of this equipment.

## Copyright

Information in this document is subject to change without notice. The software described in this document is furnished under a license agreement or nondisclosure agreement. The software may be used or copied only in accordance with the terms of those agreements. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or any means electronic or mechanical, including photocopying and recording for any purpose other than the purchaser's personal use without the written permission of Measuring & Control Equipment P/L.

Copyright © 1996-2011. MACE P/L. All rights reserved.

Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

## WARNINGS

### Water damage

MACE recommends that the XCi device be mounted above known flood peak levels. MACE will not be liable for damage caused by flooding. (The unit is weatherproof, but NOT waterproof and should NOT be submerged).

### Sunlight

MACE recommends that the XCi device be mounted so that the LCD faces in a direction away from direct sunlight (ie South in the Southern Hemisphere and North in the Northern Hemisphere).

### Cable damage

MACE recommends that all cables be appropriately routed through electrical conduit or other similar mechanism. MACE will not be liable for damage to cables, especially if it is caused by vehicles, digging implements, animals or debris in the pipe or channel.

### Insects and moisture

After the XCi system has been installed and fully tested, MACE recommends the use of expanding “space filler” foam down the first 5 to 10cm (2 to 4”) of the conduit or mounting pole to prevent insect/moisture ingress.

### Battery life

Care must be taken when a mains power supply is used to charge the internal battery instead of a solar panel. If the mains power remains disconnected for an extended period of time, the internal battery may be permanently damaged.

### Electromagnetic compatibility (EMC)

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

### Intrinsic Safety

The XCi is NOT an intrinsically safe instrument and should not be installed in hazardous (explosive) environments. Should an intrinsically safe instrument be required, MACE can offer other instruments with this approval level.

## About MACE

MACE is an family company founded in 1968 by electrical and mechanical engineer Lawrence Campbell who recognized the importance of flow measurement and flow monitoring in the global environment.

For 40 years MACE has designed and manufactured electronic monitoring instrumentation including ultrasonic flow meters, data loggers and controllers. Continued commitment to research and development over the past three decades has ensured MACE's provision of the most advanced high technology equipment for the agricultural, industrial and environmental markets.

MACE has a core team of research and development engineers who are focused on providing customer driven products that are both easy to use and withstand the test of time in often remote and harsh environmental conditions.

MACE is committed to providing its clients with personalized service, training and technical back-up to ensure successful monitoring.

MACE continues to innovate with the introduction of the new XCi Multiple Card Interface found in all our new range of flow meters and data loggers. XCi enables the user to connect just about any environmental sensor quickly and easily. This offers the customer a highly flexible, cost effective water monitoring solution.

With the addition of a new MACE WebComm card to any XCi device, customers are able to access their data remotely for free from the MACE website.

## About Doppler ultrasonics

MACE XCi devices utilise the Doppler Effect to measure velocity of stream flows. The Doppler Effect (after C. J. Doppler 1803-53) is defined as, "the apparent change in the frequency of sound or electromagnetic radiation due to relative motion between the source and the observer" (Uvarov & Isaacs (1986). Dictionary of Science).

The MACE Doppler ultrasonic velocity sensors transmit an ultrasonic (sound) wave into the flow. This sound wave is reflected by acoustically reflective particles (e.g. air bubbles, suspended solids) and the instrument detects the reflected frequencies. The difference between the transmitted frequency and the received frequencies is directly proportional to the velocity of the stream flow.



In full or partially full pipes, the velocity of the stream flow varies markedly across the cross-section of the pipe. Typically, velocity is zero along the wall of the pipe and increases to a maximum at or about the centre of the pipe. MACE Doppler ultrasonic velocity sensors receive reflected frequencies from particles moving at these different velocities. The greater the area of flow moving at a particular velocity, the greater the number of reflections with the respective frequency shift. The average velocity of the stream is therefore calculated by averaging those frequency reflections received across the whole stream profile.

In laymans terms a simple analogy for the way MACE Doppler ultrasonics operate is that it's similar to "switching on a flashlight in a fog". Any reflective particle that moves within the "beam" will be seen by the ultrasonic sensor. MACE Doppler ultrasonic velocity sensors provide a true average stream velocity.

<b>CHAPTER</b>		<b>PAGE</b>
1.0	Overview of the XCi system	1
<b>Section A: The XCi Device</b>		
2.0	Introducing the XCi device	5
3.0	Installing an XCi device	7
3.1	Installing on a 2" pole	7
3.2	Installing on a wall	10
4.0	Installing XCi power options	11
4.1	Solar panel installation on a 2" pole	11
4.2	Installing a MACE mains powered trickle charger	13
4.3	Powering the XCi device with an external battery	14
5.0	XCi device maintenance	15
5.1	Battery maintenance	15
5.2	Solar panel maintenance	15

# 1.0 Overview of the XCi system

This manual describes the installation, use and maintenance of a MACE XCi device. There are three MACE XCi devices which are specifically optimised for our three main markets:



### FloPro XCi Wastewater, stormwater and industrial flows

The FloPro XCi can be used to monitor just about any water quantity and quality sensor. Whether you need to measure flow as well as conductivity, pH and rainfall or utilize a downward looking ultrasonic depth sensor to measure pond levels the FloPro is fully expandable to your needs. Furthermore, FloPro is easily interfaced to SCADA/telemetry systems.



### AgriFlo XCi Agricultural water and wastewater flows

The AgriFlo XCi can be used to monitor just about any agricultural sensor. Use the versatility of AgriFlo XCi to monitor inputs as diverse as: irrigation flows; farm wastewater flows; water quality; dam levels; soil moisture and engine management systems.



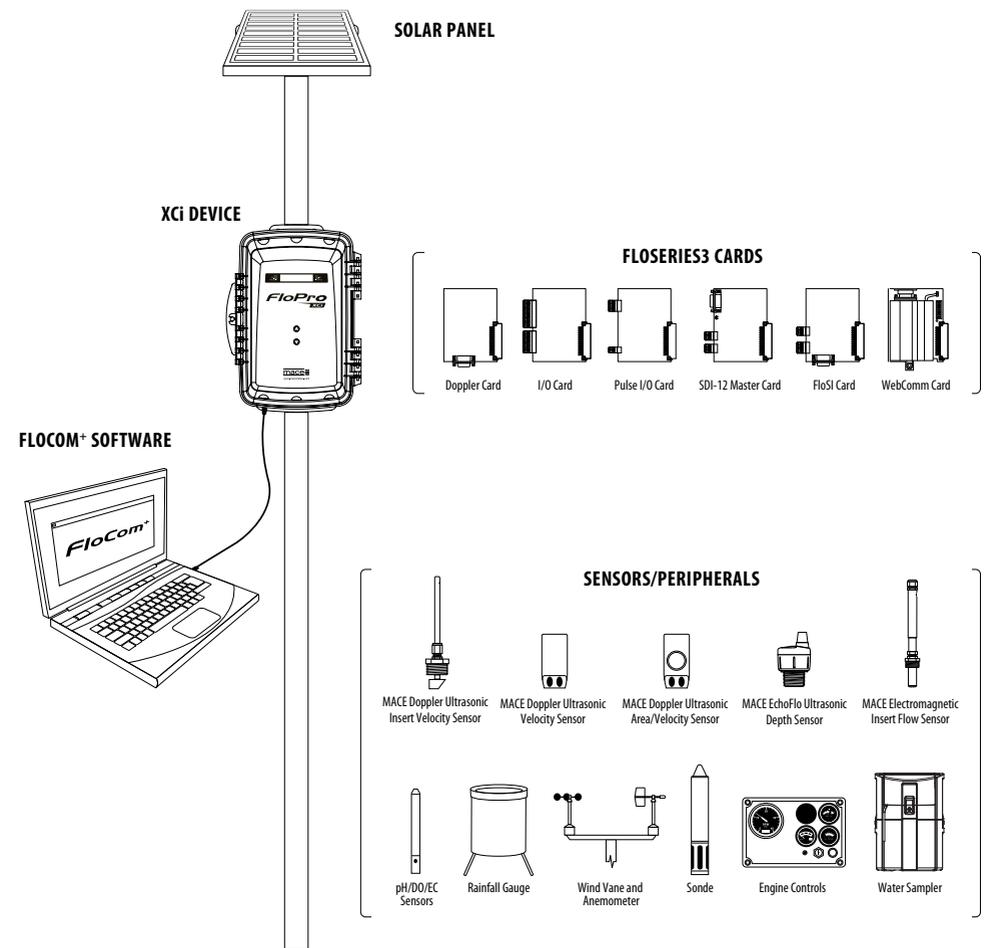
### HydroMace XCi Environmental monitor and data logger

The HydroMace XCi can be used to monitor just about any environmental sensor. Use the versatility of HydroMace XCi to monitor inputs as diverse as: Flumes & weirs, water quality sensors & rainfall gauges, drinking water flows (leak detection) and weather stations.

The HydroMace XCi continues the long heritage established by MACE over 40 years ago for remote data logging and telemetry.

The XCi system typically consists of five main components:

1. The XCi device
2. The solar panel (or power supply)
3. The sensor(s) or peripherals
4. Flocom+ software enabling you to configure and download data from your XCi device
5. FloSeries3 card(s) providing inputs for connecting an array of sensors



*Section A:*

# The XCi device

**Installation, powering & maintenance**

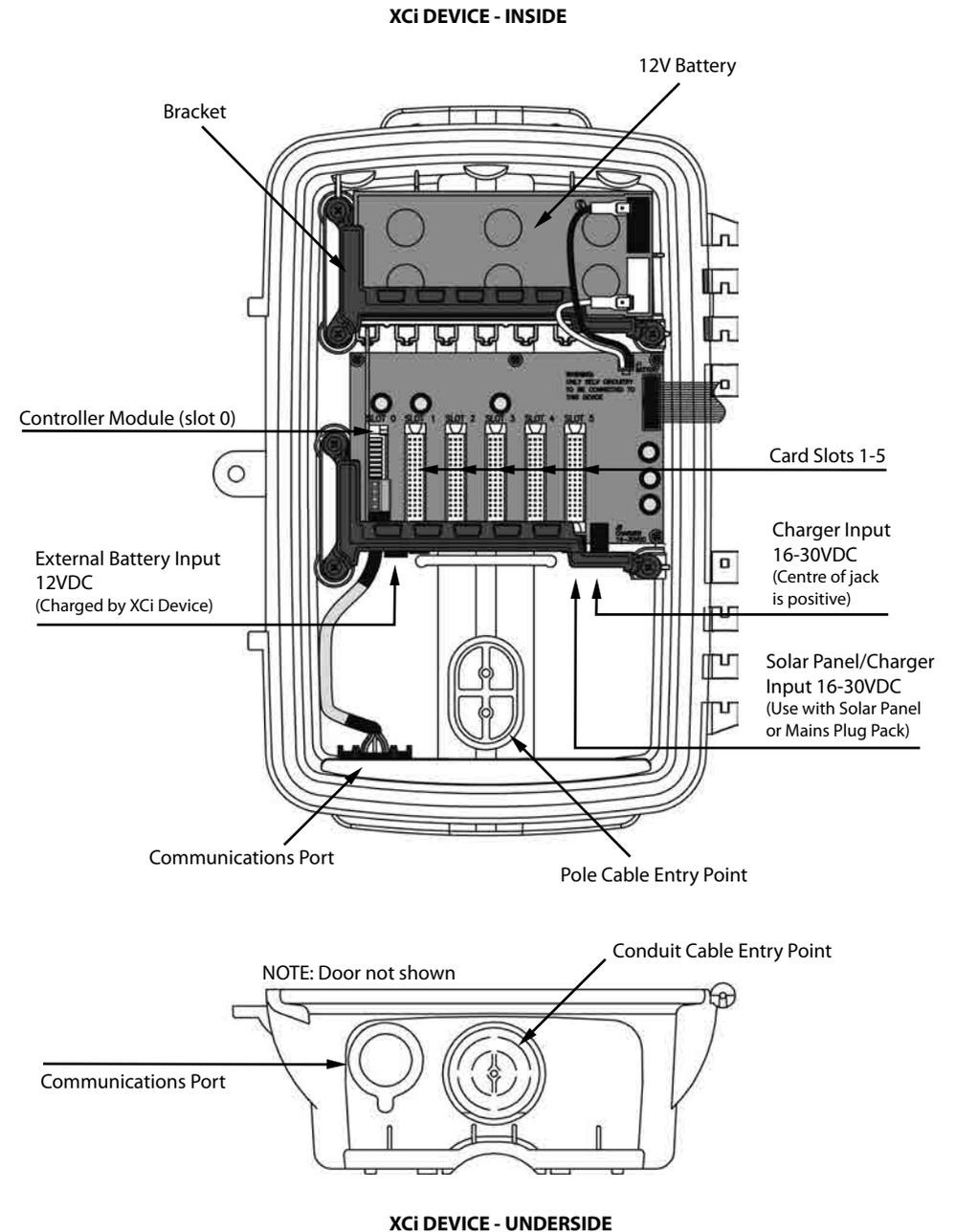
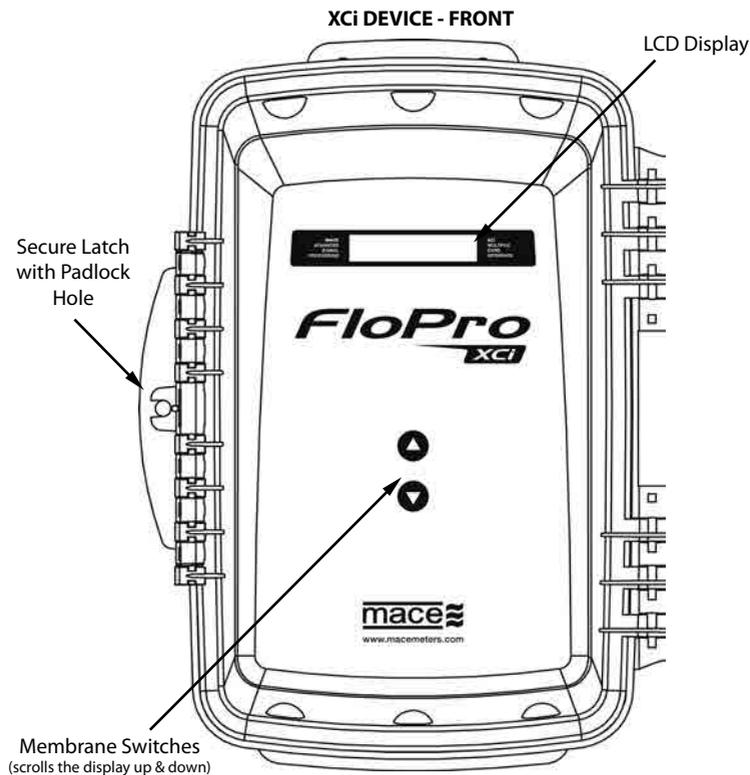
## 2.0 Introducing the XCi device

The XCi device is the central processing unit of the system and includes the enclosure, battery and five card slots allowing the user to install any of the six different FloSeries3 cards that control the sensors.

On the front of the XCi device, a backlit liquid crystal display (LCD) allows the user an on-site readout of parameter values and status messages. Pressing either membrane switch will turn on the LCD.

The membrane switches can be used to scroll the display between the various parameters being measured.

A communications port is located on the bottom face of the main enclosure. Using a MACE USB data cable (Part No. 850-363) between this port and a PC, users can configure, troubleshoot and download data from the device using the MACE FloCom+ software downloadable from [www.macemeters.com](http://www.macemeters.com)



## 3.0 Installing an XCi device

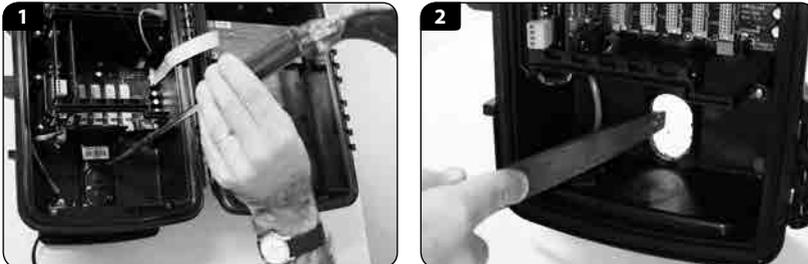
The sensor and power cables can be routed either directly through the inside of the 2" mounting pole or through electrical conduit. Installation directions for both are provided below.

**!** MACE recommends that the XCi device be mounted so that the LCD faces in a direction away from direct sunlight.

### 3.1 Installing on a 2" pole

#### 3.1.1 Sensor and power cables routed inside the pole

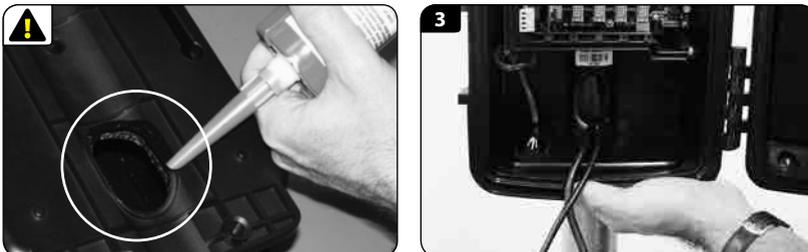
1. Place the XCi device on a work bench and using a hammer and screwdriver carefully knock out the plastic cable entry point from the rear of the enclosure. It is only thin plastic and is designed to break away at the edges so work your way around the edge of the oval shape until the cover is completely broken free of the unit.



**!** **IMPORTANT:** Apply **NON-ACIDIC** cure silicon sealant to the back of the XCi device in the channel around the cable entry point. This will stop water flowing down the pole and into the XCi device.

2. File away any rough edges from the plastic cable entry point

3. Hold the XCi device up against the pole so that the oval cut-away on the pole matches the cable entry point. Route the sensor and power cables through the cable entry point as shown.

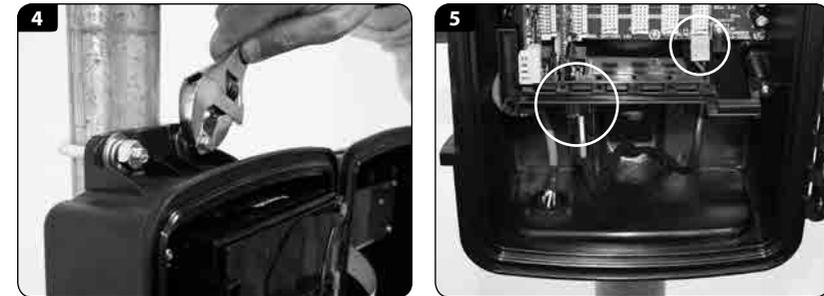


4. Use the two "U" bolts, 3/8" nuts and 3/8" washers provided to secure the XCi device to the pole.

**!** **Do not overtighten the pole mounting bolts as permanent damage may occur to the electronics enclosure**

5. Plug in both the sensor cable and solar panel cable into the sockets as shown in the picture below.

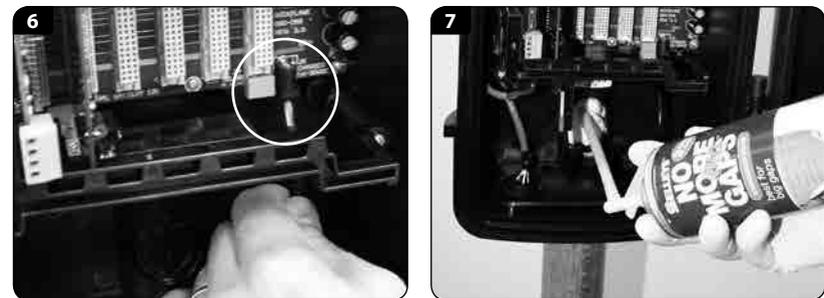
**!** **The Doppler sensor cable should be looped prior to connecting to act as a form of strain relief. Ensure that the sensor cable is securely attached by tightening the thumb screws.**



**!** **Ensure that the cable from the solar panel/charger is terminated using the three-pin connector provided in the electronics box and that the polarity is correct. The polarity is labelled on the circuit board near the connector**

6. If using a 16-30VDC mains charger then plug this into the socket shown in the picture below. Alternatively, the charger may be wired into the solar panel screw terminal block (to the left of the socket).

7. Once all the cables are connected the system should be fully tested. Assuming everything is connected and fully functional the cable entry point should be filled with expanding "space filler" foam. This is to prevent insects and/or moisture damaging the system.



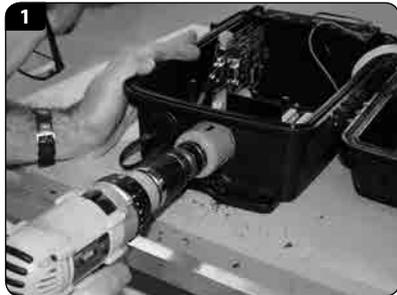
### 3.1.2 Sensor and power cables routed through conduit

1. Place the XCI device on a work bench. Using a power drill and 2" holesaw, carefully drill out the round plastic cable entry point at the base of the unit as shown below. It is only thin plastic and is designed to break away. Alternatively, the round cable entry point may be removed using the "hammer and screwdriver" method described in **Chapter 3.1**.

2. Use the two "U" bolts, 3/8" nuts and 3/8" washers provided to secure the XCI device to the pole.



**Do not overtighten the pole mounting bolts as permanent damage may occur to the electronics enclosure**



3. Carefully attach an electrical conduit adaptor (*Clipsal 50mm or Carlon 1 1/2"*) to the XCI device.

4. Plug in both the sensor cable and solar panel cable into the sockets as shown in the picture below.



**The Doppler sensor cable should be looped prior to connecting to act as a form of strain relief. Ensure that the sensor cable is securely attached by tightening the thumb screws.**

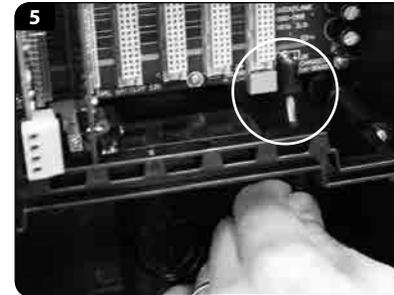


**Ensure that the cable from the solar panel/charger is terminated using the three-pin connector provided in the electronics box and that the polarity is correct. The polarity is labelled on the circuit board near the connector.**



5. If using a 16-30VDC mains charger then plug this into the socket shown in the picture below. Alternatively, the charger may be wired into the solar panel screw terminal block (*to the left of the socket*).

6. Once all your cables are plugged in you need to fully test the system. When you are happy that everything is connected and working properly you need to fill the cable entry point with expanding "space filler" foam. Fill down the first 5 to 10cm (*2" to 4"*) of the conduit. This is to prevent insects and/or moisture damaging the system.



## 3.2 Installing on a wall

1. Follow instructions on the previous page to drill out the cable entry point for routing cables through conduit.

2. Use four M8 screws, bolts or coach screws to secure the box to the wall. (*Use flat washers between the screw head and the box*).



**Do not overtighten the wall mounting bolts as permanent damage may occur to the electronics enclosure**

3. Follow instructions 3-6 on the previous page for routing the cables through conduit.



## 4.0 Installing XCi power options

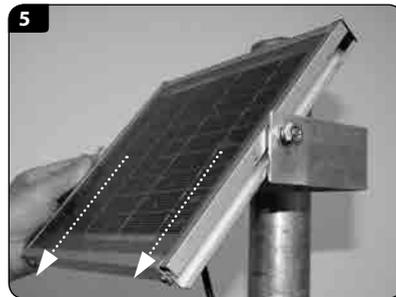
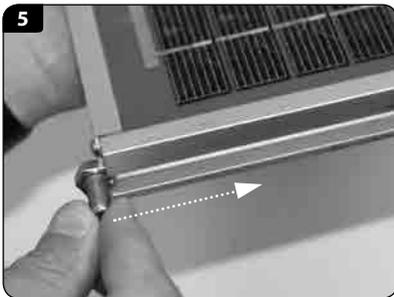
### 4.1 Solar panel installation on a 2" pole

The solar panel is used to charge the internal battery of the XCi device where mains power is unavailable.



**Users are advised to ascertain the suitability of solar panels for their application by checking relevant solar radiation maps for their region (for example those found at [http://rredc.nrel.gov/solar/old\\_data/nsrdb/redbook/atlas/](http://rredc.nrel.gov/solar/old_data/nsrdb/redbook/atlas/)). As a guideline, for an AgriFlo XCi/FloPro XCi with three Doppler sensors (or an HydroMace XCi with three I/O cards) and measuring every five minutes, at least three hours sunlight is required per day.**

1. Place an M8 bolt with M8 flat washer through the hole in left arm of the mounting bracket. Ensure that the head of the bolt is on the INSIDE and the thread faces outward.
2. On the OUTSIDE of the bracket, place an M8 spring washer then an M8 nut. DO NOT TIGHTEN THE NUT.
3. Repeat these two steps on the right hand side of the bracket.
4. Holding the solar panel carefully, hold it above the two arms of the mounting bracket.



5. Slide the solar panel down so that the head of each of the M8 bolts fits in the channel on either side of the solar panel.



**Ensure that the gutter of the solar panel is positioned between the flat washer and the head of the M8 Bolt**

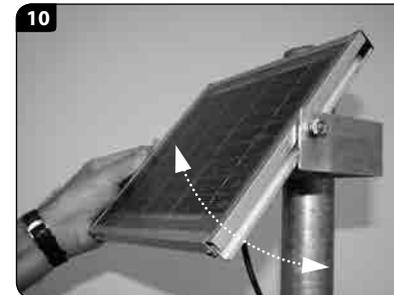
6. Place the u-bolt provided in the solar panel mounting kit around the pole.

7. Place the solar panel mounting bracket onto the u-bolt. Ensure that the arms of the bracket face out from the pole and that the mounting hole on each arm is towards the top of each arm.

8. Slide the bracket to the desired position on the pole, taking care to place it at the desired height and so that the open face of the bracket faces towards the sun.

9. Place the  $\frac{3}{8}$ " flat and spring washers on to the U-bolt and tighten the two nuts so that the bracket is secured on the pole.

10. Tilt the solar panel so that the active side faces towards the sun (North in Southern hemisphere, South in Northern hemisphere) at an angle specified in the data sheet provided. (your latitude + 15°).



11. Now tighten the M8 nuts on each side of the mounting bracket to secure.

12. The cables from the solar panel/charger to the electronics unit must be enclosed to minimise exposure to the elements. The cable should be either routed through conduit or through the solar panel mounting pole. You will need a hole drilled in the mounting pole at the top near the solar panel as well as a cut away where the electronics unit is to be mounted. Refer to the pictures below.

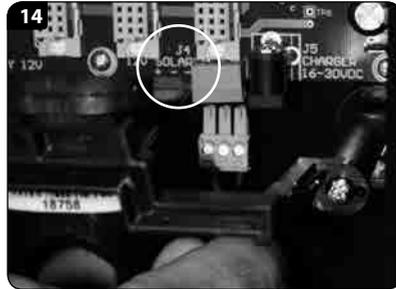
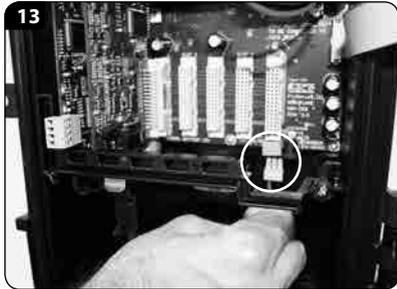


## 4.1 Solar panel installation on a 2" pole - Continued

13. Ensure that the cable from the solar panel is terminated using the three-pin connector provided in the XCi device and that the polarity is correct. The photo below shows the internal location of the three-pin connector.

14. The polarity is labelled on the circuit board near the connector.

**NOTE: When wiring the solar panel either of the ground (-ve) terminals may be used**



**NOTE: The XCi device should be installed before connecting the solar panel.**

**MACE highly recommends the use of Tri-spikes on the top of the solar panel to reduce accumulation of bird droppings on the front face of the solar panel**



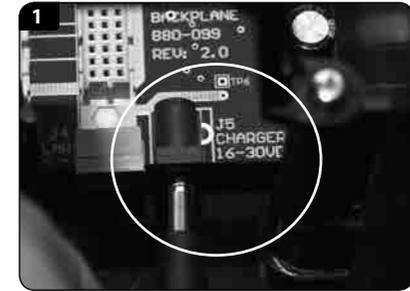
## 4.2 Installing a MACE mains powered trickle charger

In certain applications or where the use of a solar panel is impractical or undesirable, the XCi device can be powered from any DC source of 16-30 Volts (2Amps).

**When the ambient temperature is less than -10°C (14F), the battery should be removed to avoid permanent damage to the battery. The XCi device should be powered by an external power source**

1. The charger available from MACE (Part No. 850-323) comes complete with a circular barrel connector that plugs directly into the XCi device. *See photos over page.*

**The barrel connector for the 16-30VDC charger input is centre positive**

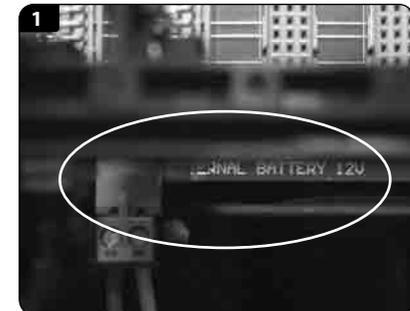
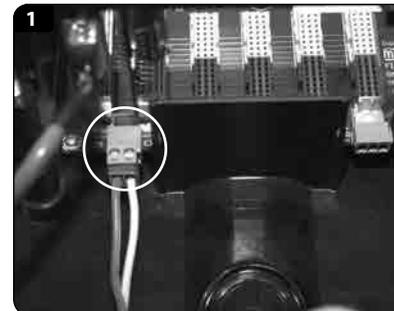


2. Alternatively, if a DC source other than a MACE charger is used, this is terminated using the same three-pin connector as for the solar panel described above.

## 4.3 Powering the XCi device with an external battery

In certain applications, it may be desirable to power the XCi device with an external battery.

1. The XCi device can be powered by an external 12V battery through the dedicated "External Battery 12V" terminal. *See photos below.*



2. If a solar panel is connected to the device as in Chapter 4.1, the internal charging circuit of the device will also charge the external battery. The charging circuitry of the XCi device has a 20 Watt capacity.

**If the external battery is charged via its own solar panel and NOT through the XCi charging circuit, the internal device battery will discharge completely**

## 5.0 XCi device maintenance

---

### 5.1 Battery maintenance

---

The XCi device's internal battery, if kept fully charged should last many years. However, if the battery remains flat for an extended time, it may be damaged and should be replaced. Contact your vendor for a replacement battery.

#### 5.1.1 Removing the damaged/flat battery

1. Disconnect the battery cable assembly from the backplane board.
2. Carefully hold the battery in position.
3. Use a #2 Phillips head screwdriver to remove the three screws which fasten the battery bracket to the main enclosure.
4. Carefully remove the battery from the main enclosure.
5. Disconnect the battery cable from the battery terminals.

#### 5.1.2 Installing the new battery

1. Connect the battery cable to the new battery, with the red lead to the positive terminal of the battery and the black lead to the negative terminal.
2. Place the battery in the main enclosure and hold it in place.
3. Secure the new battery in place using the battery bracket and three screws.
4. Tighten all three screws.
5. Reconnect the battery cable assembly to the backplane board.



**Damage to the XCi device caused by incorrect battery replacement will void the warranty**



**Using a battery that is not approved MAY damage the XCi device and void the warranty**

### 5.2 Solar panel maintenance

---

The solar panel should be checked regularly for build up of solids such as dust and bird droppings. These type of build-ups can affect the performance of the solar panel and result in a decrease of the charge that is received by the internal battery.

The solar panel should be cleaned with a wet brush or rag.



**Do not use steel bristle brushes that may cause damage to the glass of the solar panel**