CAMPBELL SCIENTIFIC Australia, Pty Ltd
WHEN MEASUREMENTS MATTER

Training Schedule 2009

Our Gold Coast courses sold out in record time! Bookings are now being taken for our Melbourne and Townsville courses. We remind everyone that there are only seven seats available for our advanced course – they do sell out extremely quickly so we recommend booking in advance to ensure you get a seat.

Our CRBasic 3 day training course offers users the chance to learn how to use and program Campbell data loggers in a hands on environment. Our new two day advanced course takes users to the next level of programming, and is only suitable for those who are up to speed with LoggerNet and the CRBasic programming language.

Below is our training schedule for 2009, for all pricing and info please contact bree@campbellsci.com.au

COURSE	WHERE	WHEN	SEATS
CRBASIC 3 DAY	Melbourne	4-6th MAY	18
ADVANCED 2 DAY	Melbourne	7-8th MAY	7
CRBASIC 3 DAY	Townsville	6-8th JUL	18
ADVANCED 2 DAY	Townsville	9-10th JUL	7
CRBASIC 3 DAY	Sydney	26-28th OCT	18
ADVANCED 2 DAY	Sydney	29-30th OCT	7

Belinda Says Goodbye to CSA

After almost 5 years, our trusty go-to girl Belinda Beer has left us. Belinda (or Bill as she was known around the office) started at CSA as our receptionist, but her keen intelligence and eye for detail saw her move up the ranks to the sales and tech department.

Her bright smile and ability to remember even the most obscure part numbers will be greatly missed by us all. We wish Bill only the best of luck in the future.

CSA 2009 Price List Now Available

CSA has just released the new 2009 price list!

All current quotes are still valid, but orders placed without current quotes will be subject to the new pricing. For a copy of the new price list please contact bree@campbellsci.com.au or any of our sales & technical team.

CSA Data Logger Trivia

A common question that is asked by our clients is: How many channels does the CR1000 have and how far can it be expanded?

There are a large number of ways to expand the number of channels of the logger and some prove better than others depending on the specific application. We issue a challenge to our clients to calculate how many channels a Campbell Scientific CR1000, data logger can measure using our standard range of expansion peripherals. Some examples (calculated by our CSA team) are shown on Page 5, but we'd love to hear your suggestions – especially if you can come up with a way to expand the channels beyond what we've got in Option 4!

NL120 - Ethernet Module

Campbell Scientific's NL120 allows a CR1000 or CR3000 data logger to communicate over a local network or a dedicated Internet connection via TCP/IP. This 10baseT Ethernet module connects directly with the 40-pin peripheral port on a CR1000 or CR3000.

The NL120 is set up using the Device Configuration utility (DevConfig) which is bundled with our PC400, RTDAQ, and LoggerNet software and is available for free download at www.campbellsci.com.au/downloads

DOT600 - Roadbed Water Content Meter

The DOT600 is used in construction applications to measure volumetric and gravimetric water content of samples of earthen material in roadbeds and foundations.

Portability, along with quick and accurate measurements, makes the DOT600 a valuable tool for evaluating roadbed material both at the construction site and in the soil-test lab. Samples collected from laboratory or field sites are compacted to a chosen pressure (15 to 45 psi), then the water content is measured using dielectric permittivity sensitive methods. A separate scale and magnetic linear sensors measure the sample volume, which allows calculation of bulk density and conversion of the measured volumetric water content to gravimetric water content.

Measurement results are written to a data table for permanent record. All measurements are controlled by a Campbell Scientific CR850 data logger. The CR850 includes an eight line display and keypad for interface.

COM320 - Voice Synthesized Telephone Modem

Campbell Scientific's COM320 voice-synthesizer modem provides a CR800, CR850, CR1000, or CR3000 data logger with speech capability - enabling the user to call a site for a spoken summary of real-time or historical data. The COM320 supports communication rates up to 115.2 kbps between modem and data logger (in practice, data transmission through phone lines is generally limited to 33.6 kbps) and can also act as a standard modem if required.

As well as providing real-time or historical data the COM320 can report specific conditions or allows selection of information by pressing numbers on a touch-tone telephone. The modem also enables the data logger to call into a specified phone number and provide verbal warnings based on conditions set by the user.

RTMC Pro Version 3.0 Released

CSI have just released the new version of RTMC Pro software, with a number of new features. The software is available as full version or special upgrade pricing is available for users of previous versions.

New features for RTMC Pro 3.0 include -

- Secure email support for clients such as Gmail.
- Ability to send alarm emails to multiple recipients
- FTP support enhanced to include Passive and Active FTP as well as FTPS, FTPES, and STP.
- Ability to use data files and/or multiple communications servers as data sources.
- Ability to override LoggerNet's scheduled collection interval.

and much more...

For those new to RTMC check out our new tutorial on the downloads page -

http://www.campbellsci.com.au/25/1/773
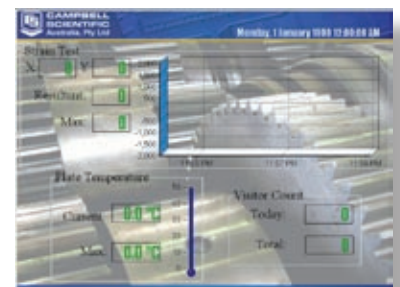
Flood Warning Systems

Don't get caught out this wet season...

As a result of our changing climate, extreme flooding appears to becoming increasingly common – and prediction, prevention and warning of floods which result in risk to life or cause damage to property has become more important than ever.

A flood warning system configured around a Campbell Scientific data logger offers a solution which can be scaled from a single monitoring point to an integrated network of hundreds of stations, allowing users to monitor flood-prone regions and respond accordingly.

Early Warning

A Campbell data logger and suitable sensors can provide early warning of a flood risk, allowing action such as road closures, flood proofing or even evacuation to be taken, thus alleviating the possibility of injury and damage.

Warnings can be sent using various communication methods – internet protocols, SMS, cellphones, voice-synthesised telephone message (using the new COM320 modem) or radio networks, depending on the location of the stations. Using the powerful control capability of the data loggers, Campbell Scientific systems can also activate warning signals such as sirens, flashing lights and road signs, alerting drivers to possible flood dangers.

Rainfall Rates

Most inland floods are the result of heavy rainfall, often where it falls on ground which is already saturated by previous rain events. Monitoring soil moisture levels and rainfall rates at key catchments and run-off sites can provide an early indication of the likelihood of a flood.

Networked Monitoring Points

With a Campbell Scientific system it is possible to collect data from multiple sites to provide a clear picture of what is happening in near real time. Soil moisture and rain-fall rate data from run-off sites upstream, measurement of flow rates and water levels from feeder streams, creeks and drainage channels, and measurement of the river prone to flooding - all combine to provide a detailed picture of the current situation as well as information necessary for the accurate prediction of what is likely to happen over the coming hours.

Using the control capabilities of Campbell loggers alarming conditions such as road signals can alert drivers of unsafe road conditions during flood events

Networking several site allows users to get a "big picture" view of flooding conditions.

Archived data collected over time can also be used for flood prediction modelling and for highlighting areas of the water system which could be improved to help prevent future flooding, perhaps by improved drainage, flood defence, stream bed dredging, etc.

Damage costs due to the recent Nth QLD floods have been estimated at $25 million, while emergency supplies had to the flown in for inland residents as roads & rail lines were cut off.

Small Scale Systems

Localised damage to property can occur when a normally sedate creek becomes a raging torrent as a result of a sudden deluge upstream, often causing land slips as well as flooding. A pressure transducer to measure water level and a flow sensor connected to a single data logger could provide all the early warning required to minimise damage or injury to those in the path of such danger.

Additional Measurements

As well as the parameters already mentioned there are others which may be added for a broader picture. These include:

- Wind Speed & Direction
- Turbidity
- Solar radiation
- Tide level
- Air & water temperature
- Dissolved oxygen
- Conductivity

See our ALERT flood reporting article on page 5 for more info on flood warning systems or contact our team on info@campbellsci.com.au

Managing CRBasic

Tips for More Manageable Code

New features are constantly being added to the new generation of Campbell data loggers, increasing both the power and flexibility of what Campbell loggers can achieve. However these features can also increase the size and complexity of the programs used to control the data logger. Here are a few helpful tips for keeing large programs under control....

Comment Everything

By far the most effective method for making code more manageable is commenting every bit of code which is entered. This is a hard habit to get into, but it is certainly worth the effort. A well commented program will be much easier to pick up again after a couple of months of not seeing it, and be easier for others in the office (or on site) to understand what the program is doing (even if they don't fully understand CRBasic). Keep a revision history at the top of the program to track which changes have been made to the program and who made them *(see right)*.

```
' 22 Jan 2009 - WeatherStation_v3.CR1 - Gavin Shaw, CSA
' ===================================================
' o Added temperature and rh sensor on SE3 and SE4
' o Moved SMS code to a sub routine to make the program more modular
```

Describe what is stored in each public variable, along with units. This way anyone can look at the top of the program and understand what is being shown in the numeric screen *(see right)*.

```
Public MET_AirTemp       ' 107 Air Temperature Measurement (degC)
Public MET_WindSpeed     ' 03001 Wind Speed Measurement (m/s)
Public MET_WindDirection ' 03001 Wind Direction Measurement (deg)
```

Enter a short description of what each line of code is doing, even if it seems like unnecessary repetition. Someone else reading the code may pick up what is going on more quickly reading the comment, rather than the line of code itself *(see right)*.

```
' If the air temperature is greater than 32 degrees,
' turn Pump 1 on (connected to C1)
If AirTemp > 32 Then PortSet (1,1)
```

Organise the Public Variables

Public variables are used to store a variety of information from the running program. In larger programs the list of public variables can easily number over 100. This can make it hard to find a specific variable both in the connect screen and in the CRBasic program. To help with these two issues try the following:

- Append group names to the front of public variables such as MET_AirTemp, MET_RH, PPP_IpAddress, FTP_Success, FTP_Server. Now the public variables can be sorted alphabetically in the numeric screen and automatically arranged into groups.

- Variable declarations do not necessarily need to be at the top of the program, if a variable is only used in a particular sub routine or slow sequence, declare the public variable above this part of code (See the example below).

Modularise Code

Identify code which performs one particular function and put this in a sub routine, this sub routine can then be copied and pasted into other programs to perform that function again *(see below)*.

```
' -- SMS Sub Routine -----------------------------------------------

Dim SMS_Message as String * 140 ' The message to be sent via SMS,
'                                 (max 140 chars)
Dim SMS_Number as String      ' The cell number to send the SMS to,
'                                 (eg. 0401234567)
Sub SendSMS
  ' SMS Code Here
EndSub
' ------------------------------------------------------------------

BeginProg
  Scan (10,Min,0,0)
    ' Send an SMS every 10 minutes
    Call SendSMS
  NextScan
EndProg
```

By placing the variable declarations on top of the sub routine and bounding with comment lines, users not familiar with the program will find the area of code dealing with SMS a lot more easily than searching through the main scan.

ALERT Flood Reporting

Using Campbell Scientific Data Loggers

For many years, flood warning networks throughout the world have used ALERT methods to report water level and rainfall events in real time. Real time reporting of critical data parameters in this way allows the flood warning groups and the emergency services to give up to date information of the situation and forecasts of the likelihood of future water levels and flows. ALERT reporting generally involves short transmissions of data on a regular time basis or when an event occurs. This radio transmission is received by a receiver/decoder station where the data is entered into a database managed by the relevant organisation in the area – usually the Bureau of Meteorology.

Significant radio infrastructure exists throughout Australia for receiving and repeating these ALERT messages. This infrastructure allows the ALERT network to have rapid updates of data over a wide area which is critical to managing the risk of these events.

Campbell Scientific data loggers have long been used to monitor environmental parameters (including water level and rainfall). The CR800, CR1000 and CR3000 loggers can easily be interfaced with the appropriate VHF radio/modem to operate as part of these ALERT networks. Programs have been developed that allows the loggers to be used to transmit ALERT messages and also to receive and decode or repeat the ALERT messages from other stations in the area.

The multiple serial ports of the logger allow multiple radio/modems to be connected to allow a CR1000-based receiver decoder system to receive ALERT data on as many as 5 different radio frequencies simultaneously. This data could then be re-transmitted to the ALERT network managers using another format such as any of the standard internet protocols. Transmission of the data via the internet can provide a redundant path for the data and would also allow ALERT stations to be installed in locations where there was no existing ALERT infrastructure.

The advantage of using a Campbell Scientific data logger as an ALERT station is the ability to monitor almost any sensor and report that data (if needed) using the real time messaging. Similarly, the logger can be used to perform on-board calculations or averages of various parameters and report events based on these computed values if needed.

The low power requirements and rugged design of the loggers makes them ideal for use in these applications as many of the locations that require monitoring are in remote areas that are not easily serviceable.

Answers for CSA Trivia....

Option 1: 132 channels
CR1000 + 4 x AM16/32B multiplexers

Option 2: 225 channels
7 x AM16/32B multiplexers using the 8 control ports of the CR1000 to control them.
C1 – C7: RES for the 7 AM16/32B
C8 : CLK for all AM16/32B's.

Option 3: 8327
CR1000 + 16 x SDM-CD16D + 260 x AM16/32B multiplexers. The 16 SDM-CD16D devices are addressed differently and as such are controlled by the same 3 SDM Control ports (C1, C2, C3). This provides 256 separately controlled digital outputs that can provide the RES signal for an AM16/32B multiplexer. C8 will be used as a common CLK signal for all AM16/32B multiplexers. C4 – C7 will provide the CLK signals for 4 AM16/32B multiplexers. Assuming all multiplexers use the same analog channel as a set of common terminals, that leaves 7 unused analog channels on the CR1000.

There is a theoretical option 4 which is much larger, but very impractical and unrealistic from a real-world point of view. It is in the order of 32^{256}. If you're interested to know the details, please contact our support team on support@campbellsci.com.au

---

(from previous page)

In some cases, a well placed ContinueScan instruction can make code easier to understand than using If statements *(see right)*.

Can be replaced with: *(see below right)*

The `ContinueScan` instruction will bypass the rest of the `scan` and return to the Scan instruction to wait for the next scan interval. Using this method keeps the measurements on the same line of indentation as the rest of the scan and neatly splits the code into two sections; that which runs every scan, and that which runs only when Measure is True.

```
' Check if we are ready to make measurements
If Measure = True then
  ' Perform measurements here
EndIf
```

```
' If we are not ready to measure yet, don't run the rest of the scan
If Measure <> True Then ContinueScan

' -- Measurement Code -------------------------------------------------

' Perform measurements here
```
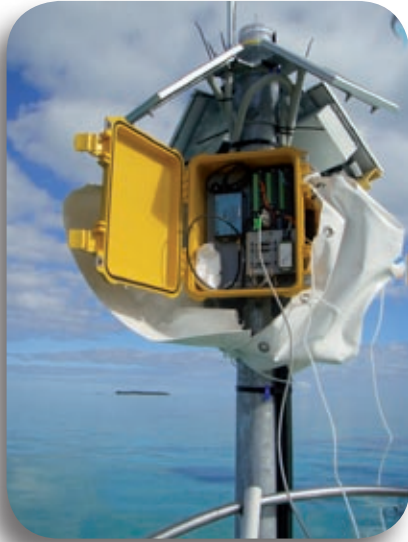
More Help

If you are new to CRBasic and are not familiar with sub routines or any of the other concepts above and would like to know more, we offer CRBasic training courses for both beginners and advanced users, contact training@campbellsci.com.au for more info on our training courses.

Monitoring Reef Survival

Campbell Scientific products instrumental in monitoring the Great Barrier Reef...

Like a patient at risk of a heart attack, Australia's famed Great Barrier Reef is being hooked up to a high-tech monitoring system.

The Great Barrier Reef Ocean Observing System (otherwise known as GBROOS), will monitor conditions crucial to the reef's survival and provide an early warning from its biggest threat – global warming.

GBROOS is a network of observing systems that will provide real-time measurements over much of the reef's 2000 km length. The project is also part of a national program to study oceans around Australia, the Integrated Marine Observing System. See www.imos.org.au for more details.
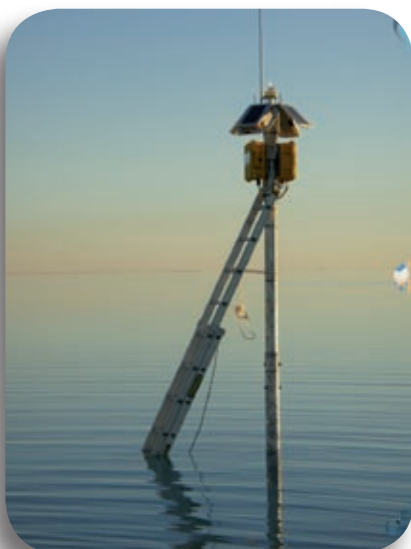
Townsville's Australian Institute of Marine Science (AIMS) will lead the project as part of a consortium, which also includes James Cook University, Great Barrier Reef Island Research Stations, University of Melbourne and the Commonwealth Scientific and Industrial Research Organisation.

Each station contains a CR1000 data logger & RF411 spread spectrum radio modem

GBROOS will consist of sensor networks on offshore reefs between Cooktown and Gladstone where automatic weather stations are already deployed. With the first data to be available by mid 2009, it is planned that installation of the seven reef-based sensor networks will be completed at these locations by the end of 2009. At each location, sensors will monitor water temperature, salinity and the intrusion of nutrients from ocean upwelling.

Bouys collect data from the sensor network and sends data back to the main network hub

Approximately thirty Campbell Scientific CR1000 data loggers and RF411 spread spectrum radio modules are used within the sensor networks to measure and transmit data between sites. The high accuracy sensors measure temperature, conductivity & pressure while an inductive modem is used by the CR1000 data logger to interrogate the various underwater sensors at each site. Campbell RF411 spread spectrum radio modems are used to transmit data from each CR1000 back to the network hub.

To transmit data from each network hub back to the land-based research stations, the GBROOS network will use a blend of communication technologies including high-frequency coastal radar, experimental over-the–horizon microwave technology and the 3G mobile phone network.

Network hub stations transmit the data back to land using high tech communication methods

Application at a Glance

Application
Marine Monitoring

Project Area
QLD, Australia

Data Logger
CR1000

Sensors
Third party Temperature, Conductivity & Pressure Sensors

Communication
RF411 SS Radio Modem

Photographs courtesy of the Australian Institute of Marine Science.