

CS-GPRS Communications

User Guide

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PLEASE READ FIRST

About this manual

Some useful conversion factors:

Area: 1 in² (square inch) = 645 mm²

Length: 1 in. (inch) = 25.4 mm
1 ft (foot) = 304.8 mm
1 yard = 0.914 m
1 mile = 1.609 km

Mass: 1 oz. (ounce) = 28.35 g
1 lb (pound weight) = 0.454 kg

Pressure: 1 psi (lb/in²) = 68.95 mb

Volume: 1 UK pint = 568.3 ml
1 UK gallon = 4.546 litres
1 US gallon = 3.785 litres

Recycling information



At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility.

Campbell Scientific Ltd can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories.

For further advice or support, please contact Campbell Scientific Ltd, or your local agent.



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CS-GPRS Communications

This manual is designed to act as an addendum to the CS-GSM manual that describes general use of the COM110 modem (and similar Wavecom based modems) with Campbell Scientific dataloggers.

This manual specifically covers use of these modems for GPRS communications with the CR800, CR1000 and CR3000 series dataloggers and details use with the SC-105 interface. This is the best interface to use in GPRS configurations because of its speed buffering capabilities and also because it can be used to efficiently share the CSIO port with other communications devices. It also allows the datalogger to go into a low power state between data transmissions. Much of the instructions given in this manual also apply to using the modem with either a direct RS232 connection to the datalogger or via the SC-WMI interface.

Please contact Campbell Scientific for instructions on how to setup the COM110 to provide GPRS connectivity with dataloggers other than the CR800 series, CR1000 and CR3000.

1. Introduction to GPRS

In recent years GPRS (General Packet Radio Service) has become a standard for “always-on” data connections with GSM mobile phones. GPRS technology offers many potential advances in remote telemetry. These include:

- Fast connection time compared to phone/GSM – as fast as a few seconds
- Lower cost of data transfer
- Always on connection – if your system has the power to keep a GPRS modem powered all the time then it is possible to set-up a system that is “always-on” which can be connected from anywhere on the net at any time
- Higher speed data transfer from the datalogger back to the PC
- Easy access from anywhere in the world
- Alternative ways of accessing data in the datalogger due to it being connected to an IP network.

Those alternative ways include:

- Direct Loggernet IP Pakbus communications
- Supports a telnet connection (like the serial terminal mode), including talk-through modes
- Supports Modbus and DNP3 over IP
- Supports serving webpages – which are user defined
- Supports requesting data with http commands
- Supports acting as an ftp (file) server.

Plus, under program control:

- Can send email messages (emailsend)
- Can send files by ftp (ftpcient)

- Can synchronise the datalogger clock to Internet time (networktimeprotocol).
- Can send data to other loggers via IP (Send/Get variables, files and data)
- Can do a normal callback to a Loggernet server (send variables)
- Can do a one way transmission to Loggernet or another logger (Senddata)
- Can open virtual serial ports to other dataloggers or sensors via the IP network.

2. Hardware

The standard CS-GPRS comprises a modem, an aerial, an SC105 interface, an SC12 cable for connection of the SC105 to the datalogger CS I/O port plus a cable to connect between the modem port of the SC105 and the modem. A mounting bracket is also provided. The modem can be fitted to one side of the bracket and the SC105 on the other.

The modem has been configured as is normal for the CS-GSM except the serial port is configured to run at 115200 baud. No additional setup is required of the modem.

The SC105 interface will be shipped, in SDC7 addressed mode for the datalogger, with the serial port set to operate at 115200 baud in modem mode.

NOTE

Units supplied prior to January 2011 will have been configured to run at 9600 baud as is standard for the CS-GSM. If swapping parts of the kits around it is advisable to make sure both the modem and SC105 are set to the same baud rate.

2.1 Power use considerations

The accompanying CS-GSM manual describes ways of minimising the power use of the modem, especially between calls, see Appendix B. The power consumption figures for the modem between calls still applies as do the program examples for cleanly shutting down the modem and restarting it. However, if the modem is used in an “always-on” configuration, to allow instant access, the modem will stay in a higher power state for most of the time. It is critical to take this into consideration when considering suitable power supplies and battery sizes.

When using an SC105 the average power consumption there is an open PPP/GPRS connection the power use will typically be 30 mA. With only low level traffic flowing through the connection the datalogger itself will often be able to drop into a lower power state, i.e. not consume extra current. During communications activity both the datalogger and modem power use will increase significantly – the transmitter using an extra 100-400 mA depending on the installation and speed of communication.

If, instead of the SC105 interface, you use a direct connection to the RS232 port or use an SC-WMI interface, both of these interfaces will be in a high power state whilst the PPP connection is active, plus the datalogger will remain in a high power state throughout, using an extra 10-20 mA.

NOTE

The maximum baud rate the SC-WMI interface can run at is 38400 baud.

3. Network Contract and SIM card

The modem needs to be used with an airtime contract that allows GPRS communications. Some SIMs are sold as “3G” compatible which means they can be used in 3G phones too. It is important to check with your supplier that any SIM supplied will work in a GSM/GPRS phone and that GPRS operation is enabled and any 3G compatibility does not slow down the log-on process to the network (which has been seen on UK O2 networks).

When buying a contract for GPRS the standard offering in Europe is that when you connect you are allocated a dynamic, private IP address. This can be used with Campbell dataloggers and is often the cheapest way to get a system up and running. However, when operating in this way you can only have a limited numbers of PCs or loggers connected to one logger and you lose the ftp server, http and some other functions as the logger cannot accept unsolicited calls made to it because it is on a private network behind a firewall.

For full flexibility specialist suppliers provide a service to give individual devices a fixed IP address, which can either be private (accessed via a VPN connection) or a public address on the internet. In the UK the suppliers include Wireless Logic, Wireless Innovation Ltd and Wyless.net. Such companies are suitable for larger scale networks and provide additional on-line tools to let you monitor the state of your GPRS connections, traffic use etc. Alternative suppliers can be found by searching for “Fixed IP SIM” on the internet making sure the offering is not a 3G only card. Currently Campbell Scientific Ltd does not resell these services nor can they provide support for the setup and running of the service.

It is important to ensure you are aware of the likely costs of GPRS data transfer. Prices can range from £0.005 to £10.00 per Megabyte of data transferred. As it can require in excess of 50 Kbytes of data per day to check and keep a GPRS connection open, let alone transfer any data, it is important to find the right tariff and realise the likely costs. Where an always on connection is required, a flat-rate tariff will likely be more economic or you should at least negotiate a volume discount tariff with your provider. In the UK it is now possible to buy data only access for few GBP per month for several tens of MB data transfer.

Before using the system you need to know the APN server name of your provider, plus your username and password to gain access to the GPRS IP services.

4. Datalogger firmware

The GPRS modems this manual covers, requires support for PPP (point to point connection protocol) which is currently available for the CR800 series, CR1000 and CR3000 dataloggers (not the CR200, CR5000 or CR9000X).

The most reliable release of fully tested code is in release 25 (or later) of the CR1000 operating systems (and partner CR800 and CR3000 versions) released in mid-2012.

5. PC Software required

The logger connects to the network using a PPP login (Point to Point Protocol). To configure the PPP settings in the logger the CS Device Configuration program version 1.8 or later is required. The latest version can be obtained from www.campbellsci.com/downloads. It is also included in Loggernet which includes support for some of the CRBasic instructions added relevant to TCP/IP

and PPP. Please check for later updates on the download site and/or contact Campbell Scientific for further details if you need to use these.

Please note that the appearance of the Device Configurations screens and some setting labels has varied in different versions. Versions other than 1.17/1.18 used to capture the screen images in this manual may vary but as long as you are able to see and amend the relevant settings the version of the PC program used is not critical.

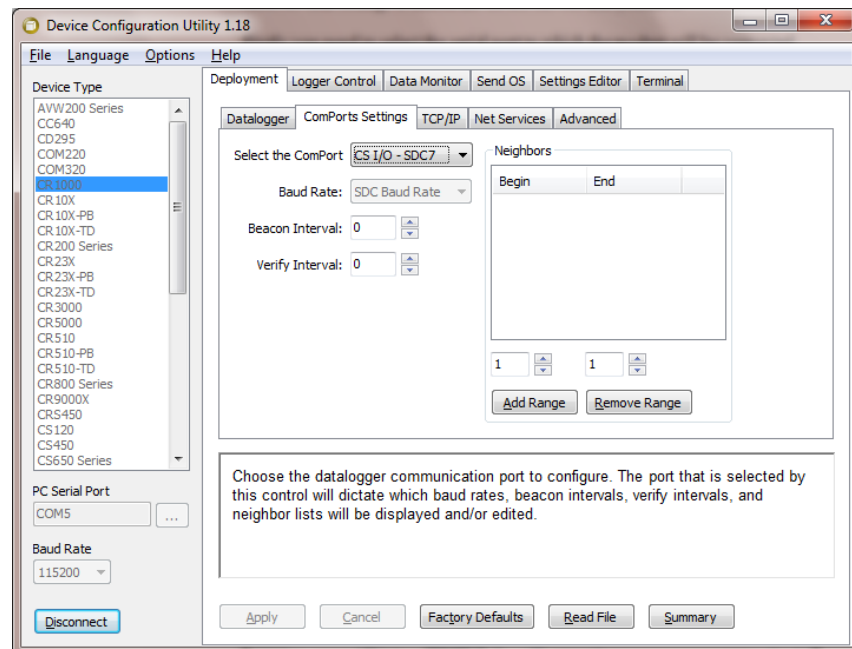
Loggernet 3 onwards supports basic support for outgoing IP connections. However, Loggernet 4.1 on supports reliable call-back options including a way of accepting calls from multiple dataloggers via a single IP socket.

6. Basic Datalogger setup

You need to connect to the datalogger using the device configuration utility and enter several settings to match the GPRS service that you have.

Firstly you need to select the serial port to which the modem will be connected, e.g. RS232, COM1..4 or CS I/O ME or CS I/O SDC (for the CS I/O port).

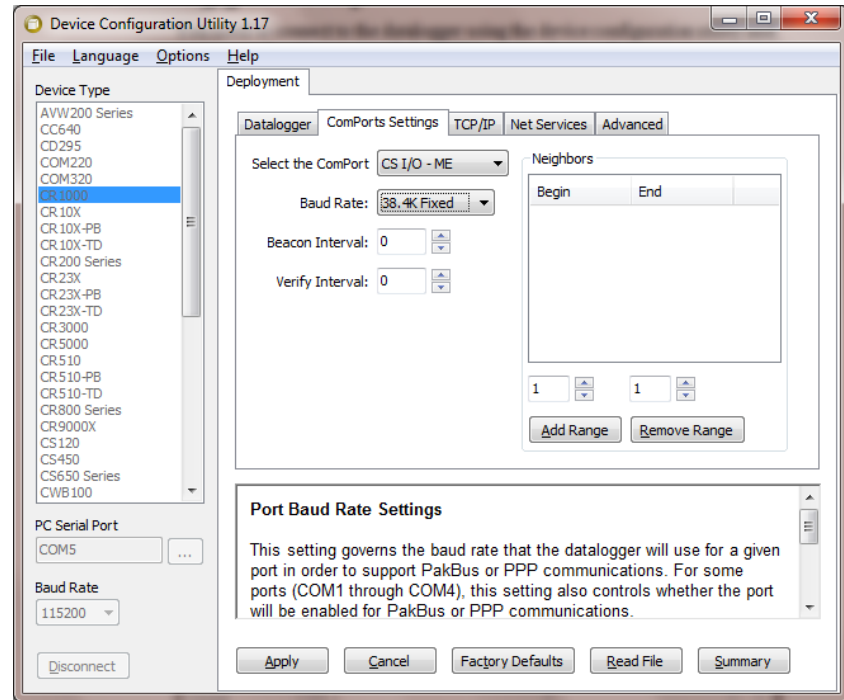
Select CS I/O - SDC7 to use the SC105 supplied as part of the CS-GPRS as below.



The speed at which the logger talks to the SC105 is called the SDC Baud rate and is normally fixed at a default speed. SDC baud rate can be checked in the advanced screen if need be. For maximum speed with standard SC12 cables it should be left at the default of 115.2 kbaud.

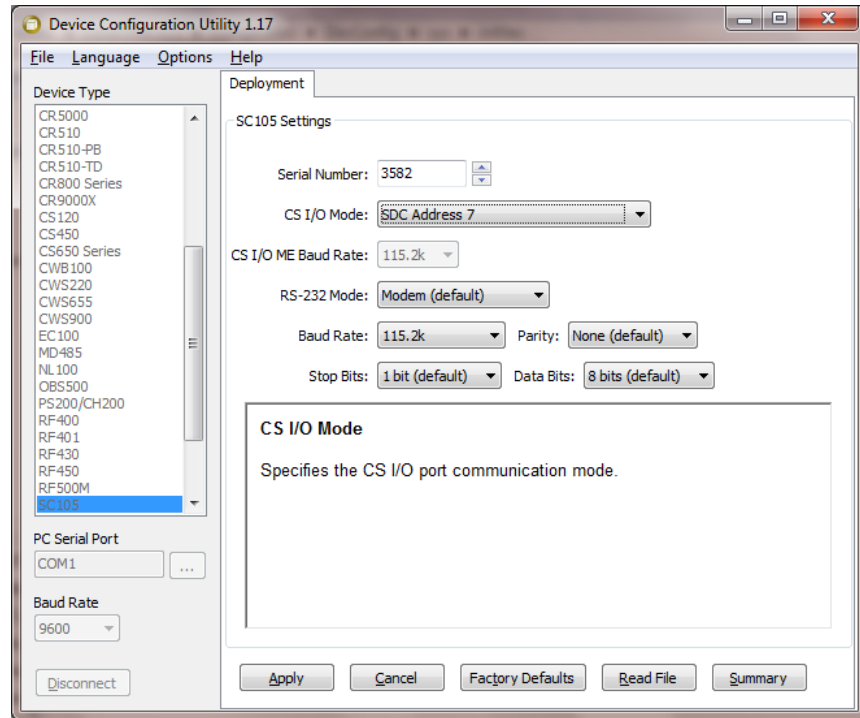
If using an interface other than the SC105 it is then necessary to fix the baud rate for the serial port to match that the modem is connected to. This is done using the ComPort Settings tab. Set the baud rate for the relevant port to a fixed baud rate which matches the fixed baud rate programmed in the modem. As a starting point set both to 115.2 Kbaud. If connecting via an SC-WMI interface supplied with the standard CS-GSM kit the baud rate should be set to 9600. The SC-WMI is a CS I/O – ME device. For increased speed, reconfigure both the modem and the

datalogger to 38400 baud (maximum). See the screen image below for the logger setting.



If using an SC105 interface which was not supplied as part of a CS-GPRS you may also need to setup the SC105 so that it is set to match the datalogger SDC address (SDC7 by default) and also that the serial port of the SC105's baud rate is set to match the modem RS232 baud rate (115.2 kbaud by default, in recent CS-GPRS) and the SC105 is set in modem mode.

This is done using the Device configuration program as shown below, which shows the baud rate changed to 115.2 kbaud (which you might consider if wanting to optimise speed of data transfer):



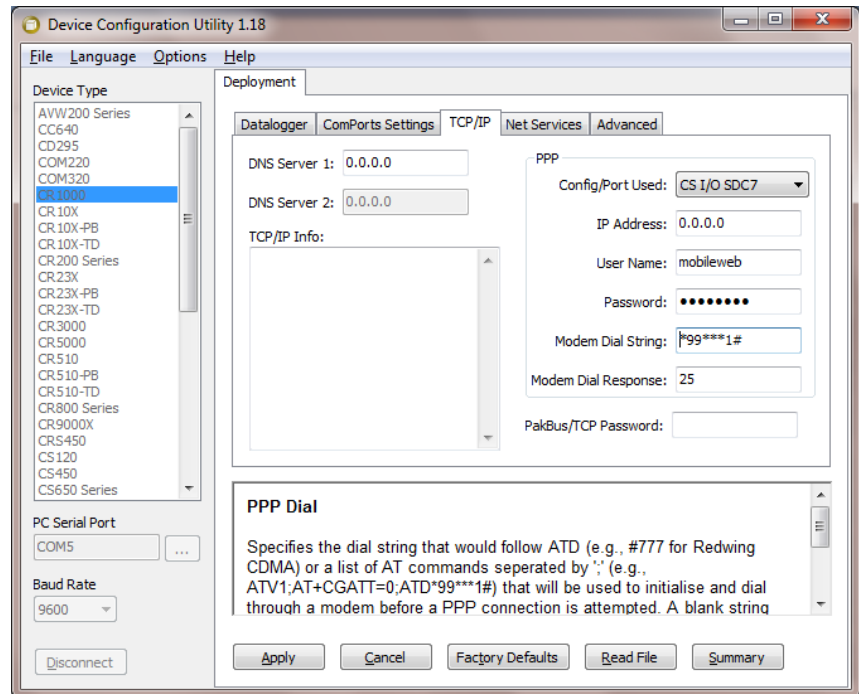
Returning to the datalogger setup, once the port/baud rate is set you will find the main PPP settings under the Deployment, TCP/IP tab.

You need to enter your username and password provided by the airtime company (this is sometimes blank or a non-user specific value for open networks). You also need to specify the GPRS dial command for your modem. For most modems the full string is "ATD*99***1#" "The logger will automatically send the ATD part of the string if the dial string entered does not start with "AT", so you need only enter "*99***1#" as shown below, without the double quotes.

Finally you need to enter the code or text that the modem sends back when it makes a successful GPRS connection. For the COM110 modem it will normally be set to verbal response messages. However if your modem is set to respond with numeric response codes, the code is 25 if running at 115.2 kbaud (the default) and 21 if running at 9600 baud. However, if the modem is set to give text/verbal responses the response of "CONNECT" generally works for all baud rates and most modems. If in doubt switch the modem to text responses by including an ATV1 in the dial string and use the default CONNECT response, e.g.

ATV1;ATD*99***1#

The examples strings below can be modified likewise.



In addition you need to program the modem with its APN server setting. This is the server it logs into to gain access to network services. This involves issuing the following command to the modem, where the server name is as specified by your provider:

```
AT+CGDCONT=1,"IP","servername"
```

For example for O2 enter:

```
AT+CGDCONT=1,"IP","mobile.o2.co.uk"
```

There are different ways of entering this setting in the modem. The setting can be set by connecting the modem to a PC using the relevant serial cable and entering this setting directly in the modem, via a terminal program, such as Hyperterminal or the terminal screen of the unknown device type in the Device configuration program. The cable supplied with the GS-GPRS kit allows the modem to be connected to a PC serial port so this can be set. Before issuing the command make sure the modem responds to a normal AT command, such as ATZ.

The modem will automatically store and remember this setting.

The setting can also be sent from the datalogger program itself (contact CS for details of how to do this).

Alternatively you can append the command to the start of the dial string the logger sends which you enter in this screen of the Device Configuration program, e.g. enter:

```
AT+CGDCONT=1,"IP","servername";ATD*99***1#
```

(With the double quotes within the string and ATD before the dial command).

NOTE

The double quotes should be the standard ASCII double quotes character, " , not extended characters, e.g. “”

As outlined in the CS-GSM manual you are recommended to control the power to the modem to allow it to be reset at regular intervals as well as controlling power use. The modems can also be instruction to reset¹ (a soft reset) by shutting down the PPP connection and issuing a command to the modem from within the logger program, however this is not quite as “bullet-proof” as a power reset and does not give you the flexibility of being able to save power if required by turning the modem off for longer periods.

Below are two sections of example code which run in a slow sequence. One shows the correct process of shutting down any active PPP connection, logging off the network and then resetting the modem by turning the power on and off. The other shows how to do a soft reset.

Program example showing how to reset the modem by cycling the power

```
Slowsequence `normally run as a slowsequence
' Variables for GPRS modem reset function
Const GPRS_ModemSwitchPort = 8 'The control port number used to switch on and off the modem (C8)
Const GPRS_ModemBaudRate = 115200 'This is the baud rate at which the modem is already configured
Const GPRS_ModemPort = ComSDC7 'This is the port to which the modem is attached
Const GPRS_CR = CHR(13)
Const GPRS_OK = CHR(10)& "OK"
' At 00:00 and 12:00, turn off GPRS modem elegantly and then power backup
Scan (12,Hr,3,0)
  'Shutdown procedure
  PPPClose
  SerialOpen(GPRS_ModemPort,GPRS_ModemBaudRate,0,20000,100)
  'Send the modem shutdown command, trying up to 3 times to try to ensure the command
  'is actioned.
  SerialOut(GPRS_ModemPort,"AT+CFUN=0" & GPRS_CR,GPRS_OK,3,200)
  Delay(1,5,sec) 'delay a few more seconds just to be sure the modem is offline
  SerialClose(GPRS_ModemPort) 'Release the serial port connection.
  'Turn off the modem (where necessary)
  PortSet(GPRS_ModemSwitchPort,0)
  'Wait some more time to make sure the message we have logged off gets into
  'the network databases
  Delay(1,10,sec)
  'Turn on the modem
  'You may wish to include code here to check if the Battery voltage is OK
  'before doing so
  PortSet(GPRS_ModemSwitchPort,1)
  'Wait for the modem to power up and get online before starting PPP
  Delay(1,15,sec)
  PPPOpen
NextScan
```

Program example showing how to reset the modem using a “soft reset”

```
Slowsequence `normally run as a slowsequence
' Variables for GPRS modem reset function
Const GPRS_ModemBaudRate = 115200 'This is the baud rate at which the modem is already configured
Const GPRS_ModemPort = ComSDC7 'This is the port to which the modem is attached
Const GPRS_CR = CHR(13)
Const GPRS_OK = CHR(10)& "OK"
' At 00:00 and 12:00, reset the modem by sending the soft reset command AT+CFUN=1
```



```

Scan (12,Hr,3,0)
  'Shutdown procedure
  PPPClose
  SerialOpen(GPRS_ModemPort,GPRS_ModemBaudRate,0,20000,100)
  'Send the modem detach command, trying up to 3 times to try to ensure the command
  'is actioned.
  SerialOut(GPRS_ModemPort,"AT+CFUN=0" & GPRS_CR,GPRS_OK,3,200)
  Delay(1,5,sec) 'delay at least 5 seconds just to not confuse the network
'Now reset the modem and reconnect
  SerialOut(GPRS_ModemPort,"AT+CFUN=1" & GPRS_CR,GPRS_OK,3,200)
  Delay(1,15,sec) 'delay at least 15 seconds just to be sure the modem is back online
  SerialClose(GPRS_ModemPort) 'Release the serial port connection.
  PPPOpen 'Restart the PPP session
NextScan

```

NOTE

Previous versions of this manual recommended including a reset command at the start of the dial string. Whilst this does work, it has been found that on some networks significant and sometimes unpredictable delays need to be left after the reset command is issued, before the network will allow a GPRS connection to be made. This can result in unreliable and delayed reconnections. To avoid this issue please use a technique such as that above to do a soft or hard reset of the modem at regular intervals.

The DNS settings on the TCP/IP tab are usually left at the default settings as most network providers will issue preferred DNS server addresses to the logger as part of the DHCP process (which also allocates an IP and gateway address). Fixed DNS servers are only normally used if instructed to do so by the network provider, e.g. for some private networks. In most cases, even if you have a fixed IP, you should leave the IP address field at 0.0.0.0 so that the logger picks up the address and other information by DHCP. After connection the allocated addresses can be seen in the status table of the datalogger. It is worth noting that the IP address allocated to the datalogger may be different to any fixed public IP address you are told your SIM has. This is because the logger may still be on a private network, with the public IP address being routed to it from the internet (please check with your provider for further details).

The Pakbus/TCP Password setting is an option in new logger operating systems that is used to block Pakbus connections to the logger unless a valid password is supplied. This is useful where the logger is accessible from the public internet and offers improved security over the normal password setting of the datalogger as a much longer password can be used (31 characters) and the password uses a challenge-authentication technique. To gain access to the logger a matching password must be entered in Pakbus tab of the logger settings in the setup screen of Loggernet (version 4.0 onward).

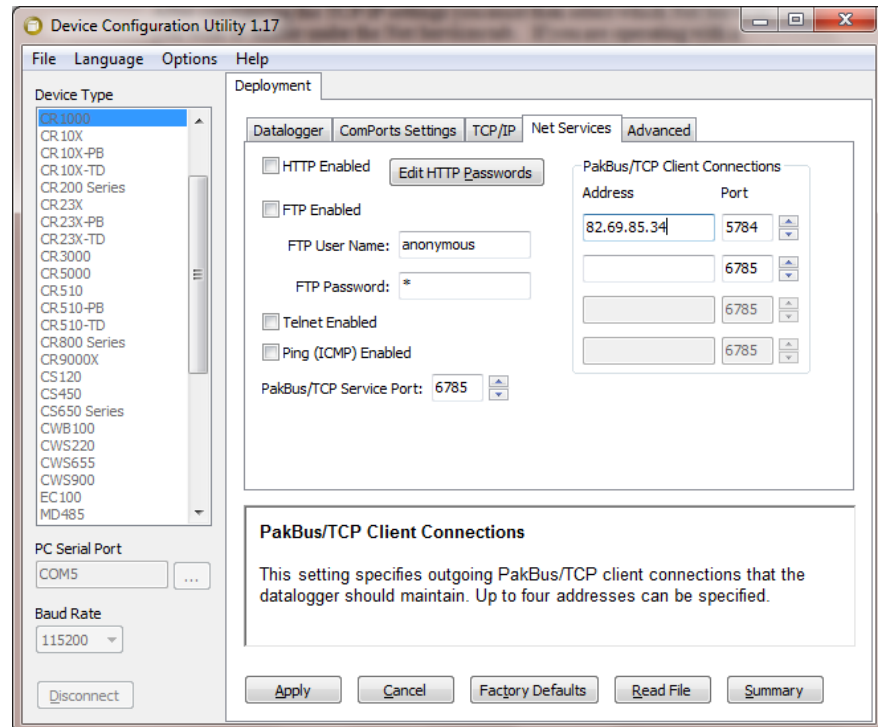
¹Note the command to force a full reset varies with other makes of modem.

NOTE

The TCP/IP info box shown on the TCP/IP tab of the Device Configuration program will only show valid IP address values once a PPP connection has been established. The values are only loaded once when the program is started so are not updated as a connection is negotiated. To get a dynamic view of these settings use the data monitor and view the PPP information in the Status table of the datalogger.

After configuring the TCP/IP settings you must then select which Net Services you wish to enable under the Net Services tab. If you are operating with a dynamic, private IP link (as is common on most GSM/GPRS links in Europe) and intend the datalogger to hold open a connection back to your Loggernet server then the only relevant service function will be in setting the Pakbus/TCP Client Connections port (see section 7.2 below). All the other functions are not usable due to the lack of a fixed IP, so can be disabled.

If you have a fixed IP then you should select which functions you wish to use (see the NL115 user guide). You must also make sure that any firewall built into the airtime providers network is opened to allow incoming connection to these services (and also to the Pakbus port).



7. General Principles of Operation

Once the PPP setting is enabled on a serial port the datalogger will immediately try to establish a PPP connection. It repeats the dial attempt every few seconds. If the modem is able to dial and everything is set correctly a successful connection will take 5-10 seconds to establish. The datalogger will then try to hold the PPP connection open forever, unless there are instructions within the running program to control this.

One way a successful connection can be checked is by monitoring the status table of the datalogger and seeing that the IPInfo updates with valid ppp IP addresses once the connection is made.

7.1 Using systems with fixed IP addresses

If you have a fixed IP service it may be either with routing to a public internet address or to a private fixed IP address that you connect to via a VPN tunnel.

If it is via a VPN tunnel please seek the advice from the SIM provider on how to setup and use the VPN tunnel. The tunnel will need to be open and kept open automatically if you wish to use Loggernet to call the logger automatically.

With a fixed IP address, once connected to the network the logger will be able to accept incoming connections for the services you have enabled. If you connect to the logger for normal datalogger communications (via the Pakbus/TCP service port) the datalogger will automatically start to send beacon messages once per minute to the device that called. This will hold the connection open (which is useful as some GPRS providers will cut-off inactive connections) and also ensures the connection is working, however this does incur data traffic charges. (See the help within Loggernet for connecting via an IP port – the port number must match that set for the Pakbus/TCP Service port set in the logger.)

With a fixed IP address, Loggernet should be able to call out to the logger on demand so it is possible to setup scheduled data collection. To minimise data charges you can prevent the extra traffic outside the scheduled calls by unchecking the box on the Pakbus port that forces it to stay open.

With a fixed IP it should also be possible for multiple PCs to call the same logger either for data collection or connecting to the logger's web or ftp server functions. If you choose to do this though be careful to ensure the logger has an adequate power supply to support multiple and lengthy connections and also check that you are certain the traffic costs will not get out of hand. If calling the datalogger from multiple PCs that use the Pakbus protocol please make sure that Pakbus port of each copy of the calling software has a unique Pakbus address.

7.2 Using systems with dynamic IP addresses

For a few networks even though the datalogger has a dynamic IP address which can vary on each connection, it is a public IP address so can connect to it from the public internet if you can track the address assigned to it. It is possible to use a dynamic name service in this instance (please contact Campbell Scientific for more details).

More commonly if you have a dynamic IP SIM you will not be able to call out to the logger as it is on a private network behind a router/firewall. Instead you have to get the datalogger to open a connection back to the Loggernet PC which itself must have a public IP address (see firewall issues below) and have Loggernet hold the connection open.

There are two ways of doing this.

1) using the Device Configuration program you can configure the logger to automatically establish a socket connection to a remote system, e.g. your Loggernet server. It will do this as soon as it is powered up and a PPP connection is established. It will try to open the socket once per second, until successful. This is done by entering the IP address and socket in the Net Services tab, as a

Pakbus/TCP Server settings, as shown above. This method is easy to setup and does not rely on the datalogger program.

2) alternatively you can call the TCPOpen/TCPClose command in your program at regular intervals (the speed determines how quickly the logger will re-establish a broken link). In the TCPOpen command you need to give the public address of the Loggernet server and the port you are going to connect on. This method is only normally used where the logger needs to conserve power so the modem is not on all of the time or more than four connections to different servers are required.

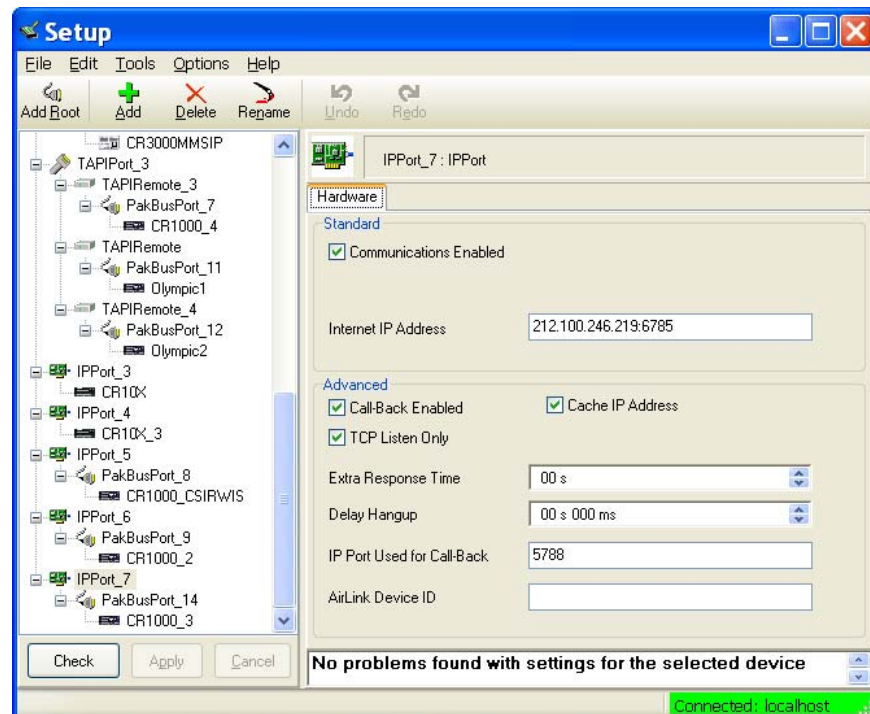
For either method the port (socket) number must match the call-back port number entered in the setup screen of Loggernet (see below). You should also enable call-back for the datalogger on the datalogger hardware tab.

The method of managing Loggers which call back over IP varies with the Loggernet version.

7.2.1 Setting up call-back in Loggernet 3

Version 3.x versions of Loggernet require an IPPort be entered for each logger and a separate call-back socket be allocated to each IPPort. For each socket you will need to open a hole in your firewall(s) and possibly put an entry in your router tables, if using one.

In versions of Loggernet of 3.4 there is an extra setting in the setup screen called "TCP Listen only". This should be set when using dynamic, private IP addresses to prevent Loggernet trying to call back out to the logger in some circumstances, e.g. loss of a connection. This setting ensures Loggernet returns to a state of waiting for another call-back as soon as possible. The setup screen for Loggernet 3.4 is shown below.



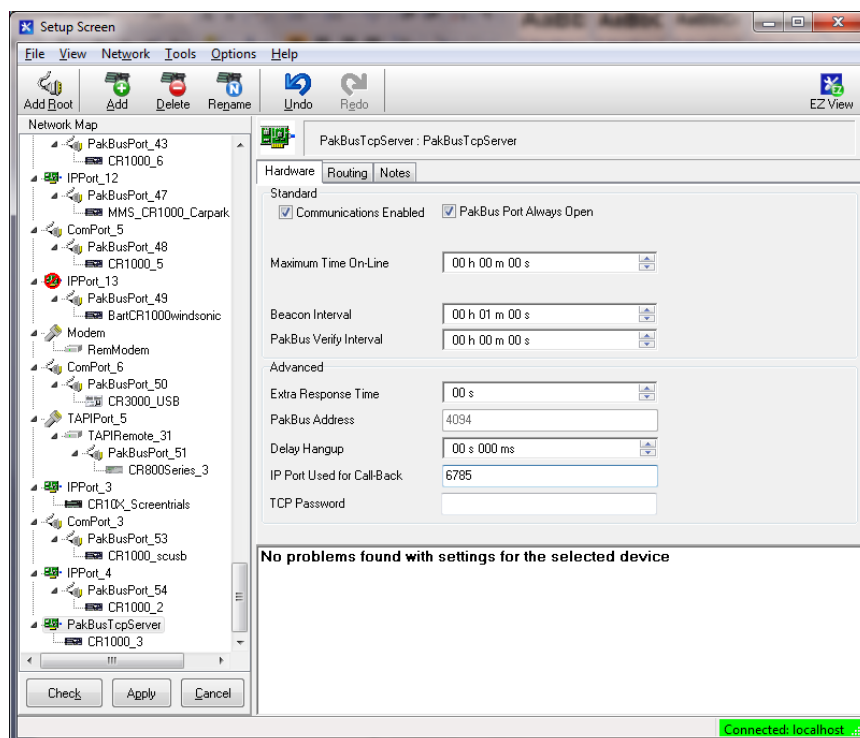
When filling in that setup screen, the settings for the Internet address and the IPPort on the IPPort hardware screen are largely irrelevant in this case as Loggernet cannot make new outgoing calls as most loggers with dynamic IPs

(assigned to the datalogger) do not allow incoming connections. You should still add a valid IP address and match the port number to the Pakbus port number in the datalogger to prevent Loggernet flagging errors. When a successful connection is made from a remote logger you will see that Loggernet updates the IP address of the remote logger, as viewed in the Setup screen. Unless your provider allows this, do not expect to be able to make connections out to this address though as it is normally the address of an intermediate router that is the barrier between the private and public networks. If you have several systems with service from the same airtime provider you will often find the same IP address shown for several of different loggers.

7.2.2 Setting up call-back in Loggernet 4

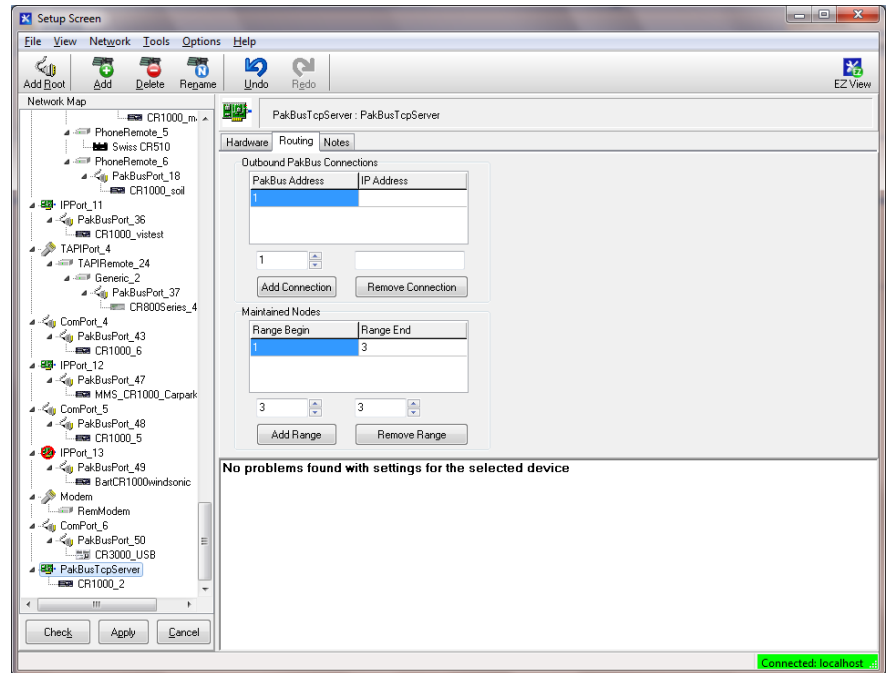
In Loggernet 4 there is a new root device called a PakbusTCPserver that has a single call-back port. Multiple dataloggers are attached to this port and are identified, when they call-back, by their Pakbus address rather than the port they call-back on. This simplifies the configuration of the dataloggers and only requires one port to be configured in firewalls/routers.

The call-back port is entered in the hardware tab as shown below.



The details of the way calls are routed via this port are entered in the routing tab as shown below and fully documented in the Loggernet help system. If you are able to call out to a device that has a fixed IP address enter it in the Outbound Pakbus connection table, matching the logger Pakbus address to its fixed IP address, with the logger's Pakbus service port appended to the end.

If the logger can only call back and you wish Loggernet to try to hold on and maintain the connection, enter the logger or range of loggers with a specific Pakbus address into the Maintained node table.



You then need to attach a datalogger entry to the PakbusTCPServer for each datalogger in your GPRS network, making sure each logger has a unique Pakbus address which matches the logger Pakbus address set in the logger using the Device Configuration program. Other settings, such as data collection parameters, clock correction are set as normal in the datalogger tabs.

7.3 Keeping the connection open

Once a connection between the logger and the Loggernet PC is established, if the connection is set to be maintained (Loggernet 4) or always open, Pakbus messaging will keep the port open and allow Loggernet to make outgoing calls to the logger, e.g. scheduled data collections. Note, for the connection to stay open you must set the Pakbus port to be always open (but do not set this setting if the logger is making less frequent call-back connections controlled by code in the logger to conserve power).

Whether operating in call-back or fixed IP mode if no valid TCP/IP packets are received by the datalogger within a few minutes, it will test the PPP link locally using a special PPP link test that most providers support. If that fails or 30 minutes pass with no real data being transferred it will attempt to hang up the PPP connection and reconnect. This process allows detection and recovery from a broken GPRS connection (which is not uncommon on some networks).

In many cases a broken connection may be detected earlier than 30 mins because for instance Windows detects the loss of the TCP/IP connection within a few minutes. Please be aware though that these delay can be lengthy when checking for and debugging lost connections. If you have a poor connection it is possible to speed up the detection of loss routing back to Loggernet by adding code to the logger program, e.g. using the PingIP command. Please contact Campbell Scientific Ltd for further details.

If you are not using Loggernet for Pakbus communications, e.g. you are collecting data by FTP, you either need to setup some FTP activity at an interval less than 30 minutes or set up another process, e.g. low frequency ping, to prevent the datalogger resetting the connection.

It should be noted that when you download a program to the datalogger via a TCP/IP connection, the datalogger will reset that connection as part of the process of compiling the program. This will cause it to drop the PPP connection for some tens of seconds. This process should not be evident from a user standpoint as Loggernet should wait long enough for this to take place so should not report an error in most instances.

7.4 Firewall Issues

When using any of the above call-back methods you need to have the Loggernet PC either be directly attached to the internet with its own public IP, or be behind a router that forwards incoming calls to specific ports onto the Loggernet PC. With some airtime providers you might also be able to setup a private network connection (or VPN) to the Loggernet PC to avoid it being on the public network.

In addition to allow incoming connections to that PC you will need to open up “holes” in any firewall software running on the PC and/or external routers to allow incoming connections to the call-back sockets and outgoing responses from those sockets.

If using a PC running Windows XP with SP2/SP3, Vista or Windows 7 (or equivalent server versions) as the Loggernet server you will as a minimum need to check the Firewall settings, via the advanced setting, and add Exception rules for the incoming port numbers you wish to allow dataloggers to call back in on.

You can test the firewall settings by using that PC from outside your local network to make a connection to Loggernet using the Telnet program (this is an optional part of recent Windows installations that you may need to enable first). If enabled use Start, Run, cmd <enter> and then type

```
telnet n.n.n.n port <enter>
```

Where n.n.n.n is the public IP address of the LN server and port is the callback port defined in your IPPort or PakbusTCP Server. When you run this a black telnet window should appear on the screen and say connected in the top bar. You should also see messages in Loggernet’s logfile indicating something has connected to LN on a particular socket (which it is listening on). It will eventually timeout (as you cannot emulate logger speak). If the telnet box flashes on the screen or generates an error message in the top bar it is likely one or more of the firewall, router or Loggernet are setup incorrectly.

Note: if you are unable to install your Loggernet server outside a firewall or getting routing enabled through the firewall it is possible to use an NL200 device (installed outside the firewall) to route traffic to a Loggernet server. Please contact Campbell Scientific for more details.

7.5 Minimising call costs and power use

Because the process of keeping the connection alive involves significant data traffic which will cost money and also power, it may be desirable to shutdown the PPP connection for periods of time (and shut off the power to modem too). This can be done by including the command PPPClose in the datalogger program to shutdown the PPP connection and PPPOpen to restart dialling. Power control of the modem can be done in the conventional way after the PPPClose command is executed and a delay of 10 s allowed letting the shutdown finish cleanly. When shutting down the modem it is important to deregister the modem from the network before turning off the power. This is usually done by sending a command AT+CFUN=0 to the modem and waiting at least 2 seconds before turning off the

power. Failure to do this may result in subsequent connections to the network being refused for prolonged periods or the modem even being barred from the network if this is done frequently. When powering up the modem again and using PPPOpen it is advisable to add delays (of 10s or so) in the program for the modem to register on the network and the PPP session to start before starting to send out any data.

NOTE

By implication the logger defaults to the PPPOpen state as soon as a port is activated for PPP. This is not dependent on a program running. To stop a PPP connection being made when a program is recompiled, include a PPPClose instruction after the BEGIN instruction. Do this with consideration because if you load a program that incorrectly calls PPPClose you could block further communications. .

Where power and data costs have to be kept to an absolute minimum other approaches can be adopted, these are where the logger turns on the modem, opens the connection and then sends data back to the PC (or even another datalogger) using the Senddata command, prior to shutting the port, closing down the PPP connection and turning off the modem.

Alternatively you can use the “call-back” function of Loggernet (see call-back under the CRBasic help) to make a special call back to the logger (using the Sendvariables command) which in turn triggers a normal data collection from the logger. Once completed the TCP port and PPP connection can be shut down.

Please contact CS for more details on these options.

7.6 Calling the logger in GSM dialup mode (CSD mode)

In some circumstances it may be advantageous to call out to the system in GSM dialup mode by dialling and connecting with a phone modem. This may be necessary in the event of failure of the GPRS network or network connections that prevent dial-back to the Loggernet server. It is possible to call the logger in the standard way (refer to the CS-GSM manual) providing you know the GSM data phone number and also providing the logger has periods of operation when the PPP connection is not enabled, i.e. PPPClose has been called.

NOTE

It is not possible to establish a GSM data connection whilst a PPP session is in progress.

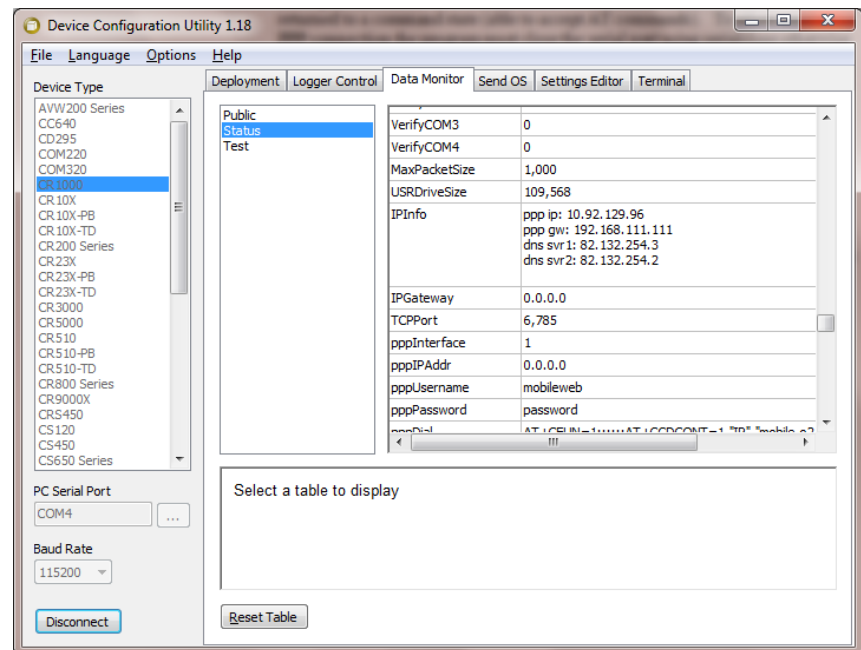
7.7 Sending configuration commands to the modem

It is often advisable to reset the modem at regular intervals (see the CS-GSM manual) or send other configuration commands to the modem, for instance to enable very low power states between calls. This can be done within the datalogger program by opening the serial port to which the modem is connected and sending out commands using the serialout command. When you open the serial port the current PPP connection is automatically shutdown and the modem returned to a command state (able to accept AT commands). To allow another PPP connection the program must close the serial port using serialclose otherwise the PPP connection will be permanently blocked.

8. Fault finding

8.1 First stage fault finding

There is no external feedback provided by the datalogger of the state of the PPP connection, e.g. an LED indicator (although this could be done if required by including code in your logger program and an LED to a control port). There are some other methods of checking if a connection has at least been established. The simplest of these is to connect a PC to the other spare serial port on the datalogger (CS I/O or RS232 depending on which interface is used for the modem, and presuming you have a compatible cable/interface). Run the Device Configuration program screen, connect to the datalogger and use the data monitor tab to view the status table, which is updated every few seconds. Scroll down to view the IPInfo values. If the ppp IP field is 0.0.0.0 there is no active connection. If valid IP addresses are shown a connection has been made, as in the example below.



If the IP address shown above stays at 0.0.0.0, here are some basic checkpoints to follow:

- Check the cabling to the logger, power supply and aerial. Check the modem is powered and on network (there is normally an LED which flashes slowly to indicate this). If the LED is on permanently then check the SIM card is inserted correctly and the retaining switch is clicked across. If it still does not work try the SIM in a mobile handset and follow the fault finding tips in the CS-GSM manual, including checking the signal strength and network registration.
- Check the modem was configured correctly.
- Check the setup of the logger particularly for the baud rate and TCP/IP setting of the dial string, response code, username and password.
- Check you have set the APN correctly either by programming the modem or embedding the command in the dial string.
- Double check with your airtime provider that the SIM is GPRS enabled.

- Check the datalogger operating system is up to date.

If the datalogger has firmware version 22 onwards additional information is provided in the IPInfo field of the status table that can be used to track progress of PPP connection. The information is shown at the end of the address messages after the "ppp gw:..." information. This field can be monitored with the Device Configuration program, or in the Table monitor of the Connect client of Loggernet. Either of those programs only update every second, at best, which may not be fast enough as some of the information messages displayed are transitory. To get a faster update of the message you need to use the numeric monitor screen and show the IPInfo field alone. You can decrease the update interval below 1 second. You can also increase the field width to see the whole message.

Messages that can appear include:

Message	Cause/Fault
ppp initialized	PPP was enabled and initialised OK
ppp program opening	PPPOpen in the program
ppp program closing	PPPClose in the program
ppp closing	Now trying to hang up the connection
ppp closed failed	Could not hang up the modem. Check the modem/settings
ppp close success	The PPP session was closed successfully
ppp dialling	The datalogger is trying to dial
ppp dial connecting	The dial string was accepted. Waiting for a connection.
ppp dial failed	Invalid dial string or service not available
ppp dialled	The PPP server has been dialled OK – a connect message was received.
ppp opening	Starting negotiations with the PPP server
ppp authenticating	Sending the username password information
ppp authentication failed	Username/Password invalid for APN being used
ppp authenticated	Username/Password accept and OK
ppp up: ip xxx.xxx.xxx.xxx peer xxx.xxx.xxx.xxx	

At the end of a call "ppp up:" should end up showing the same values as ppp ip: and ppp gw:

Where "peer" should be the gateway.

For a successful connection the messages should follow a sequence such as initialized, dialling, dial connecting, dialled, opening, authenticating, authenticated

and up. If the sequence stops along the way and reports a failed message this gives an indication of the cause of the failure as shown in the table above.

NOTE

If there is no dial string, or if the dial string is PPP, then dialling is skipped and ppp “opening” should start up immediately.

If the PPP link works (i.e. you get a non-zero IP address in the screen above) but you do not get a connection to Loggernet, check these points for calling out to fixed IP addresses:

- That you are using the right IP and port setting in Loggernet to match those assigned to you for the SIM.
- Make sure any local firewalls allow you to make outgoing connections on the ports being used. (Some institutions limit you to standard ports) .
- Make sure the service provider lets you use non-standard ports over GPRS (a very few apply default firewalls – although normally only for calls to the logger).
- Double check the Net Services settings for the Logger using Device Configuration program.

If you are using a SIM with a dynamic address check these:

- Check the IP address of Loggernet used is correct – it needs to be a public address (possibly redirected to the LN server by a router if the PC is on an internal private network).
- That the router and PC firewall has holes opened for the logger to call into. This requires low level configuration of the firewall which might be Windows own firewall or third party firewall software running on the machine.
- That the server port in Devconfig matches the port specified in Loggernet.
- Check you have an up to date version of Loggernet.

You can also look in Loggernet’s Status/log tool to make sure Loggernet is listening on the socket for call-backs. When a call-back is made you should see activity in the log showing a connection is being made.

8.2 Advanced fault finding

The datalogger has an advanced tracing capability that can be used to debug IP connection problems at a very low level. The easiest way to capture this information is to connect a PC to the datalogger via another serial port on the datalogger, other than the one to which the GPRS modem is connected as described below. The full trace information can then be captured into a file for long periods.

If this is not possible it is possible to capture some key trace messages either into a datatable or file in the datalogger memory. The former is done using the IPTrace command in your program (see the CRBasic help), however only a limited amount of information can be captured that way. To capture the trace to a file on the logger use the File Manager (accessed via the Advanced settings in the Device configuration utility) and set the ID to 3212. Enter a valid filename and the maximum filesize in the “count” parameter taking into account the free memory available in the datalogger. The problem with either of these techniques is that

you still have to be able to connect to the datalogger to recover the trace data unless data can be stored to a card or SC115.

If a second serial connection can be established, follow this process, noting this assumes the trace capture port will be the RS232 port:

Connect to the logger with the Device configurator program (Devconfig). Open the settings screen. Go to the bottom and find the IP Trace Code setting. Enter a value of 65535 in there. On the line above click on the IP Trace Com port and select RS232 (or the port to be used to capture the trace). Press enter and then click Apply. This turns on a low level trace output out of the RS232 port.

Now disconnect and in Devconfig go to the bottom of the device list and select "Unknown". Select the com port is the one you are using and the baud rate is the same as you last used the serial port at (usually 115200). (If using the ME port or another com port for logging the trace, you need to set the baud rate in the port in the logger settings first) Click on connect. This opens a dumb terminal emulator. You should see trace data coming through on the screen if the logger is powered and is trying to make a connection. Click on Start export and enter a filename (end it in .txt). Turn the logger off then on and then leave the logger trying to connect for some minutes or long enough to capture enough data to cover the problematic event. When done click on end export.

When we have finished this process you need to remember to turn off the IP Trace function before returning the logger to normal use.

This will capture the IPtrace log in the file specified. You can open the file in a text editor and review the information there. The information in that file can be interpreted by many familiar with PPP connections and sometimes errors are obvious, e.g. mistyped dial strings. For expert diagnosis the file can be emailed to your support contact at Campbell Scientific who should be able to work out what is the problem and the solution for it.

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