FTP Push and SMS Alarms Using a Dual Interface Modem

Data loggers are often used in locations which may be either inaccessible or inconvenient for manual downloading of data. To remedy this, the dataTaker DT8x series data loggers have the ability to transfer data using networks and modems. Advanced modems (such as the Call Direct CDM-882seu or CDR-790seu) are now widely available and can be used to initiate data transfer over the internet in addition to providing features such as dialing out and SMS message sending.

The dataTaker can use its inbuilt schedules to power up an advanced modem, connect to the internet, upload recorded data to a remote FTP server and power down the modem.

- The benefits of this approach include:
- simplifying the data retrieval process,
- faster data transfer rates (than PTSN dial up),
- offsite data storage (acts as a backup),
- ability to access data without special/custom software needs,
- password protection,
- data can be downloaded anywhere in the world with an Internet connection,
- SMS alarms can be sent through the same modem, and
- lower power consumption by powering down the modem when not in use.

The following sections in this technical note describe how to use the Call Direct CDM-882seu or CDR-790seu advanced modems to transfer data to an FTP server, send SMS messages and minimize power consumption.

1   Prerequisites

- Nil

2   Equipment required

- dataTaker DT8x data logger (firmware version 8.00>8.08 only)
- Call Direct CDM-882seu/CDR-790seu dual-interface modem
- UTMS/HSDPA compatible SIM card
- Cross-over Ethernet cable
- Serial RS232 DE-9 cable
- 5.5mm OD / 2.1mm ID DC Jack and suitable cable

NOTE: The SIM card must be configured for data access by the network carrier. You may need to ask the carrier to enable 'Internet access'.

3   Modem set up

NOTE: If you require additional information regarding the other functions or advanced settings for the Call Direct CDM-882seu or CDR-790seu modem, please consult the user manual, which can be freely obtained from www.call-direct.com.au

Before the modem can be used with the *dataTaker*, it needs to be configured. In order to do this, first insert your SIM card, power up the modem and plug it into the Ethernet port of your PC using a *cross-over* Ethernet cable. Ensure that you have automatic IP addressing on your PC (which you can check from **control panel** -> **network connections**), otherwise further set up will be required. Once your computer has established a connection to the modem, open

your web browser and type in the address "192.168.1.50" into the address bar and press enter.

The default username will be **admin** and the password will be **password**. Enter these details when prompted and you will be directed to the status page:

Each item in the left hand column relates to a configuration page, but most of them can be left as default and only the following pages need to be configured:

- Data Connection
- Modem
- Security

3.1 Data Connection page

- Change Auto connect to **Enable**
- Click **Save**
- The **PPP User Settings** may be stored on the SIM card and are network specific. If the settings are blank or incorrect, you will need to contact your network carrier for assistance. An example of the APN and dialing number is '**telstra.internet**' and '**atd*99#**' as shown above.
- Some networks require a username and password, these should be provided by the network carrier.

3.2 Modem page

- Change **Inter Character Timeout** to **1000**
- Change **RI Action** to **Incoming Ring**
- Change **Circuit AutoAnswer Rings** to **4**
- Click **Save**

3.3 *Security page*

This page only needs to be configured if the SIM card is locked and has a PIN, if so then you may enter the details here.

3.4 *Back up your new configuration*

Go to the **Application Load/Save** Page and click the **SAVE** button to back up these settings so that they can be restored in the future.

4 Connecting the modem to the dataTaker

There are two points where the modem connects to the *dataTaker* for communications, more so when the *dataTaker* is in control of the power to the modem.

4.1 Ethernet

Connect the two devices using a cross-over Ethernet cable. Ensure the cable is secure and that the two ends 'click' into place.

4.2 Serial Cable

Connect the two devices using a DB9 serial cable that has the (RS232 DE-9) pinout:

Pin	Name	Direction	Description
1	CD	→	Carrier Detect
2	RX	→	Receive Data
3	TX	←	Transmit Data
4	DTR	←	Data Terminal Ready
5	GND		System Ground
6	DSR	→	Data Set Ready
7	RTS	←	Request to Send
8	CTS	→	Clear to Send
9	RI	→	Ring Indicator

Use the screws to ensure that the cable is secured and will not fall out.

4.3 Power

If you wish to control the power of the modem with the *dataTaker* (highly recommended for power sensitive operations), then you will need to use the RELAY connections on the dataTaker. It is not possible to use the 12V output because it has a current limit of approximately 150mA. If you do not wish to control the power to the dataTaker then you can skip this step, but you are limited to using the basic programs in the later sections of this technical note. To use the RELAY connection, follow these steps:

- Obtain a 5.5mm/2.1mm DC jack with cable (Figure 1) such as those available from http://www.action-electronics.com/dcpowerplugs.htm

Figure 1 – DC Jack with cable

- Use a multi meter and check which of the two wires connects to the pin (inner terminal) of the DC Jack, this is the positive wire.
- Cut the positive wire (identified above) approximately 20cm from the end
- Strip the wire insulation back about 5mm in each direction of the cut to provide two bare-wire connections. (You may tin this with a soldering iron if desired)
- Secure these two bare-wire ends into the RELAY A and B inputs on the *dataTaker* (as shown in Figure 2).

Figure 2 – Relay connection for the modem power cable

- Connect the end of the positive wire into the positive terminal on the side of the logger (next to the DC jack on the *dataTaker*)
- Connect the end of the negative wire into the negative terminal on the side of the logger.
- Double-check your connections and that they are secure
- Turn on the power source
- Check with your multi meter that there is no voltage on the modems DC jack
- Issue the 1RELAY=1 command to the *dataTaker* using the web interface or DeTransfer
- Re-measure the voltage across the DC jack terminals, ensure that the pin (inner terminal) has a positive voltage with respect to the outer, and that the voltage is that of your power source (8-28V source dependant).
- Now plug the newly wired DC jack into the modem and check that it powers up.

You are now ready to set up the *dataTaker*.

5 *dataTaker* configuration

Now that the modem has been set up, the *dataTaker* can now be configured to talk to the modem.

5.1 Profile settings

Using either the web interface or DeTransfer, issue the following profile commands to the logger.

5.1.1 Ethernet settings

The IP address has to be specified in order to avoid conflicts and any DHCP delays. The gateway is the IP address of the modem (which is 192.168.1.50 by default).

```
PROFILE ETHERNET IP_ADDRESS="192.168.1.51"
PROFILE ETHERNET SUBNET_MASK="255.255.255.0"
PROFILE ETHERNET GATEWAY="192.168.1.50"
```

Host-modem settings
The host-modem strings have been cleared because this application note does not cover dialing out with the CDM-882seu

```
PROFILE HOST_MODEM DIAL=""
PROFILE HOST_MODEM INIT=""
```

5.1.2 Host-port settings

The host-port settings have to match those specified by the CDM-882seu set up pages, otherwise you will not be able to communicate to the modem. The default settings for the modem are as follows:

```
PROFILE HOST_PORT BPS="115200"
PROFILE HOST_PORT FLOW="NONE"
PROFILE HOST_PORT DATA_BITS="8"
PROFILE HOST_PORT STOP_BITS="1"
PROFILE HOST_PORT PARITY="NONE"
PROFILE HOST_PORT FUNCTION="SERIAL"
```

5.2 *dataTaker* program 1 (FTP push only)

5.2.1 Overview

The following describes a basic dataTaker program which uses the Call Direct CDM-882seu modem to push data to an FTP server. Functionality built into this program includes automatic retries, but it does not include control of the power to the modem, or provision for SMS sending. It is also assumed that the power to the modem is not controlled by the dataTaker, and the modems data connection is always active.

The K (FTP handler) schedule handles all FTP transfers. It uses the COPYD command which keeps track of the data that has successfully been copied in the past, therefore it will only transfer new data to the FTP server. On a failed attempt it will recall the point at which the copy was first attempted and copy this plus any new data on subsequent attempts.

5.2.2 Program Code

```
BEGIN "CD882B1"
'=====================================================
'Call Direct CDM882seu Basic Sample Program number 1
'   - Sends all logged data to an FTP server each hour
'=====================================================


'=====================================================
' Schedule A (SAMPLE USER SCHEDULE)
'   - Logs up to 1MB of data records and overwrites when full
'   - Runs every 10 seconds
'=====================================================
RA(DATA:OV:1MB)10S LOGONA
     REFT("Internal_Temp") 'sample internal temperature
     1-TK("External_Temp") 'sample external temperature
'=====================================================
' Schedule K (FTP HANDLER)
'   - Copies new data to an ftp server every hour
'   - If a transfer fails, a transfer retry will occur next hour
'   - ALL schedules will be copied, unless specified (i.e. sched=ab)
'   - For polled pushes, change to a polled schedule (RKX)
'=====================================================
RK1H LOGOFFK
    DO{COPYD merge=N id=1 start=new dest=ftp://user:pass@host.com/}
END
```

5.3 dataTaker program 2 (basic SMS program)

5.3.1 Overview

The following describes a very basic dataTaker program which uses the Call Direct CDM 882seu modem to send SMS messages. Functionality built into this program does not include control of the power to the modem, provision for FTP transfers or any smart control of the SMS queue. It is also assumed that the power to the modem is not controlled by the dataTaker, and the modem is connected to a mobile network.

5.3.2 How it works

The SMS command is sent to the modem as a set of serial AT commands which follows this sequence (from the logger perspective):

A). → AT+CMGF=1<CR>   (send AT command to force text messaging mode)
B). ← Logger waits 500ms for command to take effect
C). → AT+CMGS="+61412345678"<CR>   (request to send to specified number)
D). ← Logger waits for prompt ">" character
E). → MESSAGE<ESC><CR> (send text message contents)
F). ← Logger waits 5 seconds for message to be sent (forced delay from the modem)

5.3.3 Program Code

```
BEGIN "CD882B2"
'=================================================
'Call Direct CDM882seu Basic Sample Program number 2
'   - Sends SMS messages only
'=================================================
'=================================================
' Schedule A (SAMPLE USER SCHEDULE)
'   - Runs every 10 seconds
'=================================================
RA("B:",ALARMS:OV:10KB,DATA:OV:1MB)10S LOGONA
    'measure the sensors
    1TK("Sensor1")
    'alarms to send SMS message in text format using AT+CMGS command
    ALARM(&Sensor1>30){2SERIAL("{AT+CMGF=1\\013}\\W[500]")}
    ALARM(&Sensor1>30){2SERIAL("{AT+CMGS=\\034}")} 'send SMS command
    ALARM(&Sensor1>30)'+61412345678'    'enter the phone number here
    'the following line instructs to wait for the ">" character
    ALARM(&Sensor1>30){2SERIAL("{\\034\\013}\\m[\\062]")}
    ALARM(&Sensor1>30)'MESSAGE'  'enter the message text here
    ALARM(&Sensor1>30){2SERIAL("{\\026\\013}\\W[5000]")}'delay
END
```

5.4 dataTaker program 3 (multiple SMS alarms)

5.4.1 Overview

The following describes a dataTaker program which uses the Call Direct CDM-882seu modem to handle multiple alarms and SMS messages. Functionality built into this program does not include control of the power to the modem, or provision for FTP transfers. It is also assumed that the power to the modem is not controlled by the dataTaker, and the modem is connected to a mobile network.

This program has the capability to send multiple alarms, which are queued to be sent sequentially. Often modems require a delay between sending SMS messages and this program caters for this by using a 5-second schedule, which will send one message from the queue each time it is run. It is possible to simplify this program by using the DELAY command; however this would delay operation of all schedules and therefore is not ideal.

5.4.2 A Schedule

The A schedule is a sample of how to implement the alarms, it contains two measurements and three alarm lines. The key to this schedules operation is a queue for each alarm (201CV, 202CV, etc) and a main queue (200CV), which are incremented when the alarm is true.

NOTE: Avoid using repeating alarms (ALARMR), otherwise many SMSes will be put into one queue and prevent other alarms from being sent.

5.4.3 K Schedule

The K schedule runs every 5 seconds, interrogating the global queue. If the number of messages in the global queue is greater than zero then it will progress through the individual SMS queues one at a time, send any outstanding SMS alarms and adjust the queue accordingly. The SMS commands are sent in the same order as per section 5.3.2.

NOTE 1: Each polled alarm must have an IF statement in the following format (where the orange text is the message.

```
IF(200CV>1)AND IF(201CV>1)'Alarm 1'{201CV=201CV-1}
```

In the event that there is more than one alarm used in the program then priority becomes important, and the messages must be sent in order. In this case, the previous queue must also be empty therefore an entry would look like this:

```
IF(201CV<1)AND
IF(200CV>1)AND IF(202CV>1)'Alarm 2'{202CV=202CV-1}
```

Putting it together, it would look like this:

```
IF(202CV<1)AND
IF(200CV>1)AND IF(203CV>1)'Alarm 3'{203CV=203CV-1}


IF(201CV<1)AND
IF(200CV>1)AND IF(202CV>1)'Alarm 2'{202CV=202CV-1}


IF(200CV>1)AND IF(201CV>1)'Alarm 1'{201CV=201CV-1}
```

Notice the reverse order and that "Alarm 2" requires the "Alarm 1" queue (201CV) to be empty, and "Alarm 3" requires the "Alarm 2" queue (202CV) to be empty

5.4.4 Program Code

```
BEGIN "CD882B3"
'=====================================================
'Call Direct CDM882seu Basic Sample Program number 3
'    - Sends SMS messages based on different alarms
'    - Each alarm message has an associated queue, and one global
'    - Two queues are included which can be expanded upon
'    - SMS phone number and messages are defined in the K schedule
'=====================================================
'=====================================================
'Initialise variables
    200..203CV("GlobalQueue",W)=0 'reset queues
'=====================================================
'=====================================================
' Schedule A (SAMPLE USER SCHEDULE)
'    - Runs every 10 seconds
'=====================================================
RA("B:",ALARMS:OV:10KB,DATA:OV:1MB)10S LOGONA
    'measure the sensors
    1TK("Sensor1")
    2TK("Sensor2")
    'TO SEND AN SMS ALARM, Increment the global and SMS queues
    ALARM(&Sensor1>30){200CV=200CV+1 201CV=201CV+1}'queue1
    ALARM(&Sensor2<01){200CV=200CV+1 202CV=202CV+1}'queue2
    ALARM(&Sensor2>40){200CV=200CV+1 203CV=203CV+1}'queue3
'=====================================================
' Schedule K (SMS HANDLER SCHEDULE)
'    - Processes the SMS queues one by one every 5 seconds
'=====================================================
RK5S LOGOFFK
    'if a message in the queue, start the message sequence
    IF(200CV>1){2SERIAL("{AT+CMGF=1\\013}\\w[500]{AT+CMGS=\\034}")}
    IF(200CV>1)'+61412345678'   'enter the phone number here
    IF(200CV>1){2SERIAL("{\\034\\013}\\m[\\062]")} 'wait for ">"
    'send messages in order of priority (queue1 = highest priority)
    'The order is reversed programmatically (203CV->201CV)
    IF(202CV<1)AND
    IF(200CV>1)AND IF(203CV>1)'Sensor3>40 deg'{203CV=203CV-1}
    IF(201CV<1)AND
    IF(200CV>1)AND IF(202CV>1)'Sensor2<01 deg'{202CV=202CV-1}
    IF(200CV>1)AND IF(201CV>1)'Sensor1>30 deg'{201CV=201CV-1}
    'complete the serial string and remove 1 from the global queue
    IF(200CV>1){2SERIAL("{\\026\\013}") 200CV=200CV-1}
END
```

5.5   Advanced dataTaker program

5.5.1   Overview

The following program incorporates four schedules which are dedicated to the operation of the modem (schedules H I J & K) and two generic schedules (A & B) which are user configurable. There are two queue systems used in this program, an SMS queue (as per section 5.4) and an FTP queue (104CV). In addition, the logger detects the modem connection to the mobile data network by monitoring the state of the modem hardware lines. Using these functionalities it is possible for the dataTaker to power-up the modem, send SMSes and FTP data, then power-down then modem to save power.

5.5.2   The A Schedule

The A schedule takes measurements from a digital input and a thermocouple and tests these against alarm conditions. If the alarm condition is met, the SMS queues are incremented (see section 5.4 for details) and the modem power handler. The alarm will not re-trigger unless the condition is false, then true again, this prevents SMSes being sent continuously. There are four parameters which can be changed for this schedule, including the schedule rate, schedule letter, measurement types and alarm conditions.
Note the SMS message itself and its destination phone number is defined in the J schedule.

5.5.3   The B Schedule

The B (FTP) schedule queues an FTP request once per hour and calls the modem power handler. The schedule rate determines the time period for the FTP data. The FTP server address is defined in schedule K.

5.5.4   The H Schedule

The H (Modem power handler) schedule, when polled, provides power to the modem via a relay. When the relay is closed, the ATTN light on the dataTaker front panel is activated. If the modem is already powered up, polling the H-schedule has no effect.

5.5.5   The I Schedule

The I (Modem connection handler) schedule waits for the modem to assert the DCD, DSR and CTS lines on the RS232 connection, which indicates that the modem is online and connected to the data network. It retries failed connection attempts by cycling the modem power. Once online, it activates the J schedule.

5.5.6   The J Schedule

The J (online activity handler) schedule transfers the SMS messages and FTP data. The sending of SMS messages is as per section 5.4, in parallel with the FTP transfers. The system variable 29SV is monitored to determine the status of the FTP transfer. Once the transfer is complete or has failed for any reason, the transfer is removed from the queue and the hang-up schedule is started. In the event that an FTP transfer has failed, the data will be sent on subsequent attempts. The only parameters that can be changed here are the SMS message and phone number and the FTP destination; otherwise this should not be edited.

5.5.7   The K Schedule

The K (Modem hang-up handler) schedule waits for all FTP transfers to complete and and all SMS messages to be sent, then hangs up the modem.

5.5.8 Program Code

```
BEGIN "CD882A1"
'=====================================================
'Call Direct CDM882seu Advanced Sample Program
'    - Controls modem power to save total power consumption
'    - Sends FTP data for all schedules
'    - SMS queues are supported
'    - SMS phone number and messages are defined in the K schedule
'=====================================================
'=====================================================
'Initialise variables
    104CV("FTP QUEUE",W)=0
    200..202CV("SMS QUEUES",W)=0
    '110CV are reserved
    1RELAY=0 1WARN=0 'modem and warning light off
'=====================================================
'=====================================================
'USER SETTINGS
    106CV("CONNECT_TIMEOUT",W)=12  'x10 seconds
    109CV("CONNECT_RETRIES",W)=4  'number of modem power cycles to attempt
'=====================================================
'=====================================================
'Schedule A: Sample User Schedule
'    - Measures the current load and monitors the load threshold
'    - Logging ON (2MB for data, 10KB for alarms)
'    - Runs every 10 seconds
'  TO SEND AN SMS ALARM:
'    - Increment the global (200CV) and individual (201CV, 202CV, etc) SMS queues
'    - Call the H schedule
'=====================================================
RA(DATA:2MB,ALARMS:10KB)10S LOGONA
    'take measurements
    4DS("Measurement1",NR)
    1TK("Temperature1",NR)
    'set alarms
    ALARM1(&Measurement1<01)"ALARM 1 TRIGGERED"{200CV=200CV+1 201CV=201CV+1 XH}
    ALARM2(&Temperature1>30)"ALARM 2 TRIGGERED"{200CV=200CV+1 202CV=202CV+1 XH}
'=====================================================
'Schedule B: Sample FTP Scheduler
'    - Triggers data to be sent to an FTP server every hour
'    - Logging ON (10KB for alarms)
'=====================================================
RB(ALARMS:10KB)1H LOGONB
    104CV(W)=1  'schedule FTP transfer
    DO"FTP TRIGGERED"{XH}       'call the modem power handler
'=====================================================
'Schedule H: Modem power handler ===DO NOT EDIT===
'    - Call this when a transmission is required
'    - Checks if the modem is connected to the network
'      - If not, powers up the modem and attempts connection
'    - Logging ON (10KB for alarms)
'    - 16SV Monitors hardware lines to detect DCD, DSR and CTS signals
'=====================================================
```

```
RH(ALARMS:10KB)X LOGONH
    IF(16SV<1)"Powering ON modem"{1WARN=1 1RELAY=1 110CV=109CV 107CV=106CV+1 GI}
'=====================================================
'Schedule I: Modem connection handler ==DO NOT EDIT==
'    - Waits for the modem to connect to the mobile network
'    - Cycles the power on the modem on connection failure
'    - Logging ON (10KB for alarms)
'    - Activates online functions once connected
'=====================================================
RI(ALARMS:10KB)10S HI LOGONI
    107CV("Retries remaining",W)=107CV-1
    'if powered down (due to cycling power), power back on
    IF(1RELAY<1)"Modem power re-applied,(?110f0) retries remaining "{1RELAY=1}
    'Connection timeout. Power down modem and decrement retries remaining
    IF(107CV<1)"Resetting Modem"{1RELAY=0 107CV=106CV+1 110CV(W)=110CV-1}
    IF(110CV<1)"Cannot connect to network"{HI}
    IF(16SV>7)"Connected"{101CV=0 GJ HI}
'=====================================================
'Schedule J: Online Activity Handler ==DO NOT EDIT==
'    - Attempts to send any FTP data and SMS messages
'    - SMS messages processed according to priority
'    - runs every 10 seconds until modem hangs up
'    - Logging ON (100KB for alarms)
'=====================================================
RJ(ALARMS:100KB)10S  HJ LOGONJ
    'Test FTP status before attempting transfer,101CV provides 10 second delay
    IF(101CV>1)AND IF(29SV>2)"FTP Transfer success at # @"{104CV=0 101CV=0}
    IF(101CV>1)AND IF(29SV<0)"FTP Transfer failed at # @"{104CV=0 101CV=0}
    'initiate FTP transfer for all new data in all schedules
    IF(104CV>1)AND
    IF(29SV<>1,2){COPYD dest=ftp://user:pass@ip_address/ merge=N id=1 start=new}
    'send SMS messages in the queue
    IF(200CV>1){2SERIAL("{AT+CMGF=1\\013}\\w[500]{AT+CMGS=\\034}")}
    IF(200CV>1)'+61412345678'   'enter the phone number here
    IF(200CV>1){2SERIAL("{\\034\\013}\\m[\\062]")} 'wait for ">"
    IF(201CV<1)AND
    IF(200CV>1)AND IF(202CV>1)'Temperature 1 >30 deg'{202CV=202CV-1}
    IF(200CV>1)AND IF(201CV>1)'Measurement 1 OFF'{201CV=201CV-1}
    IF(200CV>1)"SMS SENT"{2SERIAL("{\\026\\013}\\m[CMGS]") 200CV=200CV-1}
    IF(200CV>1)"?200f0 SMS still in Queue"
    101CV("SecondRun",W)=1  'set flag
    DO{GK}   'start hang-up handler
'=====================================================
'Schedule K: Modem Hang-up Handler ==DO NOT EDIT==
'    - Runs every 1 second
'    - Hangs up modem when all activities are completed
'    - Logging ON (1KB for alarms)
'=====================================================
RK(ALARMS:1KB)1S   HK LOGONK
    'If FTP and SMS queues empty, reset connect flag and turn off modem
    IF(104CV<1)AND IF(200CV<1)"Powering OFF modem"{1RELAY=0 1WARN=0 HJ HK}
END
```