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Making machines talk.

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1. Overview

The purpose of this document is the description of some special AT command procedures that may be used with the Telit UC864-AK module by Hyundai Motors Co.. In this document, all the basic functions of a UC864-AK WCDMA module are taken into account and for each one of them, a proper command sequence will be suggested. In the Advanced operation section the more useful services and features of the GSM and WCDMA network supported by the Telit UC864-AK module is taken into account and some command sequence and usage are provided for each one of them. This document and its suggested command sequences must not be considered mandatory; instead, the information given must be used as a guide for properly using the Telit module. For further commands and features that may not be explained in this document refer to the UC864-AK Product Description document where all the supported AT commands are reported.



NOTICE:

(EN) The integration of the WCDMA/HSDPA/GSM/GPRS UC864-AK cellular module within user application must be done according to the design rules described in this manual.

(IT) L'integrazione del modulo cellulare WCDMA/HSDPA/GSM/GPRS UC864-AK all'interno dell'applicazione dell'utente dovrà rispettare le indicazioni progettuali descritte in questo manuale.

(DE) Die Integration des WCDMA/HSDPA/GSM/GPRS UC864-AK Mobilfunk-Moduls in ein Gerät muß gemäß der in diesem Dokument beschriebenen Konstruktionsregeln erfolgen

(SL) Integracija WCDMA/HSDPA/GSM/GPRS UC864-AK modula v uporabniški aplikaciji bo morala upoštevati projektna navodila, opisana v tem piročniku.

(SP) La utilización del modulo WCDMA/HSDPA/GSM/GPRS UC864-AK debe ser conforme a los usos para los cuales ha sido diseñado descritos en este manual del usuario.

(FR) L'intégration du module cellulaire WCDMA/HSDPA/GSM/GPRS UC864-AK dans l'application de l'utilisateur sera faite selon les règles de conception décrites dans ce manuel.

(HE) האינטגרציה של המודול UC864-AK לתוך המערכת של המשתמש תיעשה לפי הכללים המפורטים במסמך זה.
 עם המוצר.

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2. Basic Operations

2.1. Command Syntax

In the next paragraphs the following notations are used:

<cr> represents the Carriage Return Character (13)

<lf> represents the Line Feed Character (10)

<xx> represents a parameter with changing name is in place of the double x. (< and > characters are only for limiting the parameter and must not be issued to the terminal).

[<xx>] represents an optional parameter whatever name is in place of the xx. ([and] characters are only for limiting the optional parameter and must not be issued to the terminal).

2.2. Command Response Timeout

Every command issued to the Telit UC864-AK returns a result response if response codes are enabled (default) (see command ATQn). The time needed to process the given command and return the response varies and may depend also on the network on which the command may interact. As a result, every command is provided with a proper timeout time. If this time elapses without any result from the operation, then the ERROR response is reported as if the operation was not successful.

The timeout time is quite short for commands that imply only internal set up commands, but may be very long for commands that interact with the network (or even Networks).



NOTE:

In case no response is received after the timeout time has been elapsed, then try repeating the last command and if still no response is received until the timeout time, an Unconditional Shutdown **MUST** be issued and the device must be powered ON again.

In the table below are listed all the commands whose timeout differs from the default 100 ms and their effective timeout is reported:

Command	Time-Out (Seconds)
+CREG	5
+CMEE	5
+CPIN	20
#PCT	10
#SHDN	10



2.3. Turning ON the UC864-AK

(see UC864-AK HardWare User Guide)

2.4. Turning OFF the UC864-AK

The turning off of the device can be done in three ways:

- by software command
- by hardware shutdown (see UC864-AK Hardware User Guide)
- by the Hardware Unconditional Restart (see UC864-AK Hardware User Guide)

When the device is shut down by software command or by hardware shutdown, it issues to the network a detach request that informs the network that the device is not reachable any more.

2.4.1. Software Shutdown

- Send command AT#SHDN<cr>
- wait for OK response

The device shuts down with the following sequence of activities:

- Detach from the network
- Module Shutdown

In the case of Network unavailability detaching is attempted in few seconds (typical 6secs).

After this timeout the module is shut down.

2.5. Checking WCDMA Device Functionality

After a proper power on, the device is ready to receive AT commands on the USB or serial port.

Several things must be checked in order to be sure that the device is ready to send and receive calls and SMS.



	to give SIM PUK2 have failed, so SIM PIN2 cannot use anymore.	AT+CPIN=<SIM PUK>
+CPIN: READY	SIM is present and no PIN code is required to proceed	Proceed ahead
+CME ERROR: 10	SIM is not inserted	Insert SIM or require SIM insertion and repeat from par. 2.5.2.2
+CME ERROR: 13	SIM is failure	Check SIM insertion or require a new SIM not defected and repeat from par. 2.5.2.2
+CME ERROR: 14	SIM is busy	retry later
+CME ERROR: 15	SIM is wrong type	Check SIM, it must be a GSM SIM or UMTS SIM(USIM).

2.5.2.3. Provide SIM PIN (only if required see point 2.7.2.2)

- send command **AT+CPIN=****<cr>** where **** stands for the SIM PIN code (e.g. 1234)
- wait for response:

Response	Reason	Action
OK	SIM PIN was correct	Proceed ahead
ERROR	the PIN code inserted is not correct	Retry from par. 2.5.2.2



NOTE:

When receiving the ERROR message, repeat Query SIM presence and status since after 3 failed attempts SIM PIN is not requested anymore, but SIM PUK is requested instead. You may need to go through procedure 2.7.2.4

2.5.2.4. Provide SIM PUK (only if required see par. 2.7.2.2)

- send command **AT+CPIN=*****,<newpin><cr>** where ***** stands for the SIM PUK code (e.g. 12345678) and <newpin> (e.g. 1234) will replace the old pin in the SIM.
- wait for response:

Response	Reason	Action
OK	SIM PUK was correct	Proceed ahead
ERROR	the SIM PUK code inserted is not correct	Retry from par. 2.5.2.4





TIP:

When receiving the ERROR message, be careful to check if the SIM PUK is correct before trying again. After 10 failed attempts to provide the SIM PUK the SIM Card will lock and will not be usable anymore.

2.5.3. Network Checking

2.5.3.1. Query Network Status

- send command **AT+CREG?<cr>**
- wait for response:

Response	Reason	Action
+CME ERROR: 10	SIM not present or damaged	Check SIM or require SIM insertion and repeat from par. 2.5.2.2
+CME ERROR: 11	SIM is present and PIN is required to continue operations	Repeat par. 2.5.2.3
+CREG: 0,0 or +CREG: 1,0	No network is found	Check for antenna cable connection (antenna may be disconnected or damaged) or change position if the antenna is OK. Repeat par. 2.5.3.1 until a network is found.
+CREG: 0,1 or +CREG: 1,1	Mobile is registered on its home network.	Proceed ahead. Ready to call
+CREG: 0,2 or +CREG: 1,2	Mobile is currently not registered on any network but is looking for a suitable one to register.	Repeat procedure at par. 2.5.3.1 to see if it has found a suitable network to register in.
+CREG: 0,3 or +CREG: 1,3	Mobile has found some networks but it is not allowed to register on any of them, no roaming was allowed.	Try in another place, and repeat procedure at par. 2.5.3.1.
+CREG: 0,4 or +CREG: 1,4	Mobile is in an unknown network status	Repeat procedure at par. 2.5.3.1 to see if it has found a suitable network to register in
+CREG: 0,5 or +CREG: 1,5	Mobile has found some networks and is currently registered in roaming on one of them	Proceed ahead. Ready to call





TIP:

When a response **+CREG: x,1** or **+CREG: x,5** is received, then the device is ready to place and receive a call or SMS. It is possible to jump directly to call setup procedures or SMS sending procedures.

2.5.3.2. Check for Received Signal Strength

Once the mobile has registered on one network, it may be useful to know the received signal strength of the network.

send command **AT\$RSSI?<cr>**

wait for response in the format:

<rssi>

OK

where:

<rssi> is an real Received signal strength, unit dBm. If strength is less than -106, **<rssi>** is displayed as -106.

Or,

send command **AT\$PING?<cr>**

wait for response in the format:

<rssi grade>,<connect>

OK

where:

<rssi grade> is an integer from 0 to 6 that indicates a level grade of Received signal strength. RSSI range that each grade indicates is able to be set by **AT\$RSSIGRADE** command . **<connect>** is an integer that indicates connection state.

<connect>	Connect state
2	Connected to network
4	Disconnected to network



2.6. Voice call

Before a voice call can be placed, it is recommended to check if the mobile is registered on a network (see par.2.5.3.1) and if the signal strength is enough to ensure a call can be made.

2.6.1. Voice Call Device Setup

2.6.1.1. Set the Desired Audio Volume

The UC864-AK has 5 level different audio volume grade.

- Send command **AT\$VOL=<n><cr>**

where:

<n> = 0 Mute

<n> = 1..4 Rx volume

- wait for response in the format:

2.6.1.2. Check for Microphone Mute Setting

The microphone can be muted with an AT command; to be sure that it is not muted, it is suggested to check it with this command

- Send command **AT\$MIKE?<cr>**
- wait for response in the format:

<mute>

OK

where:

<mute> is the muting setting for the microphone:

0 - microphone active

1 - microphone muted

If Mike is muted, it is suggested to set it unmuted with this command.

- Send command **AT\$MIKE=<mute><cr>**
- wait for **OK** response.



NOTE:

The mute setting is different from Volume setting.



2.6.2. Phone Number Dialing

Send command **AT\$ORI<PhoneNumber>**

where:

<PhoneNumber> is the phone number to be dialed

wait for **OK** response and then this response sequentially:

Response	Reason	Action
\$VCALL<PhoneNumber>	The call is placing	Wait for \$VCON
\$VCON	The call is placed	Wait for CONNECT
CONNECT	The call is connected	
NO ANSWER	cannot place a call	Check registration state

For example:

1- Let us assume you have to call the international number +386-40-4192111 without previously setting the +FCLASS=8 (voice),

command

AT\$ORI+386404192111<cr>

OK

\$VCALL+386404192111

\$VCON

CONNECT

2.6.3. Hang up the Voice Call

- send command **AT\$REL<cr>**
- wait for **OK** response and then **NO CARRIER**

2.6.4. Answering the Voice Call

When an incoming call is detected, the device reports an unsolicited code **RING**.

2.6.4.1. Auto Answering

To set auto answering the call:

- send command **AT\$ATAN=<n><cr>**



- wait for **OK** response.

Where:

<n> is auto answering mode selection

0 – auto answering disable.

1 – auto answering enable.

2.6.4.2. Answering using command

To answer the call:

- send command **ATA<cr>** or **AT\$QCCAV<cr>**
- wait for **OK** response and then this:

Response	Reason	Action
\$VCON	The incoming call was a DATA one and called modem is now on line.	exchange data
CONNECT	No incoming call is found, call may have been lost	call lost



3. Advanced Operations

3.1. DTMF Tones

DTMF tones are managed by specific AT commands. These tones are generated with AT commands only during voice calls. The minimum duration of a DTMF tone can be set on 10 ms but it must be considered that this value can vary with the limitations of the network.

	Group high		
Group low	1209 Hz	1336 Hz	1477 Hz
697 Hz	1	2	3
770 Hz	4	5	6
852 Hz	7	8	9
941 Hz	*	0	#



NOTE:

The GSM/WCDMA system architecture defines that the audio signal of the DTMF tones is inserted by the network switches on commands sent by the Mobile Station (MS). Thus, the default duration parameters may vary from network to network. In case that the devices are controlled by DTMF, they become sensitive related to the duration of the tones and timing of the sequences. Dedicated investigations on the parameter settings must be made.

3.2. Power Saving Mode

Power Saving Mode means that Device is in sleep mode with disabling the interface UART/USB). Deactivated PowerOn signal, Module transfer the mode to power saving mode.(and module is shut down finally after some duration set by

AT\$MOBISACCOFF command – refer to “UC864-AK AT_commands_Reference_Guide Rev.0.doc”)

UC864-AK makes it possible for DTE to receive the event such as incoming Emergency SMS while both DTE and Modem are in sleep mode with disabling all serial interfaces.

DTE must require below specification to achieve the reduction of power consumption.

- DSR/DTR/RTS/CTS Pin control on Main UART port.
- DSR/DTR/RTS/CTS Pin emulation on Telit USB Modem port.

If DTE satisfies above requirement, UC864 family can provide the functionalities:



- Keep URC message.
- Keep Incoming data during data mode, until DTE wake up from sleep mode.
- UC864-AK help DTE to reduce their power consumption using below rules.
- Use WakeUp-Pin to wake up DTE from sleep mode. (DTE must always monitor Wake-Up pin during power saving mode).
- Use PowerOn-Pin to place Modem in sleep mode or wake up Modem from sleep mode and Main Uart must be connected.



NOTE:

The GSM/WCDMA system architecture defines that the audio signal of the DTMF tones is inserted by the network switches on commands sent by the Mobile Station (MS). Thus, the default duration parameters may vary from network to network. In case that the devices are controlled by DTMF, they become sensitive related to the duration of the tones and timing of the sequences. Dedicated investigations on the parameter settings must be made.



Emergency Message in Power Saving Mode

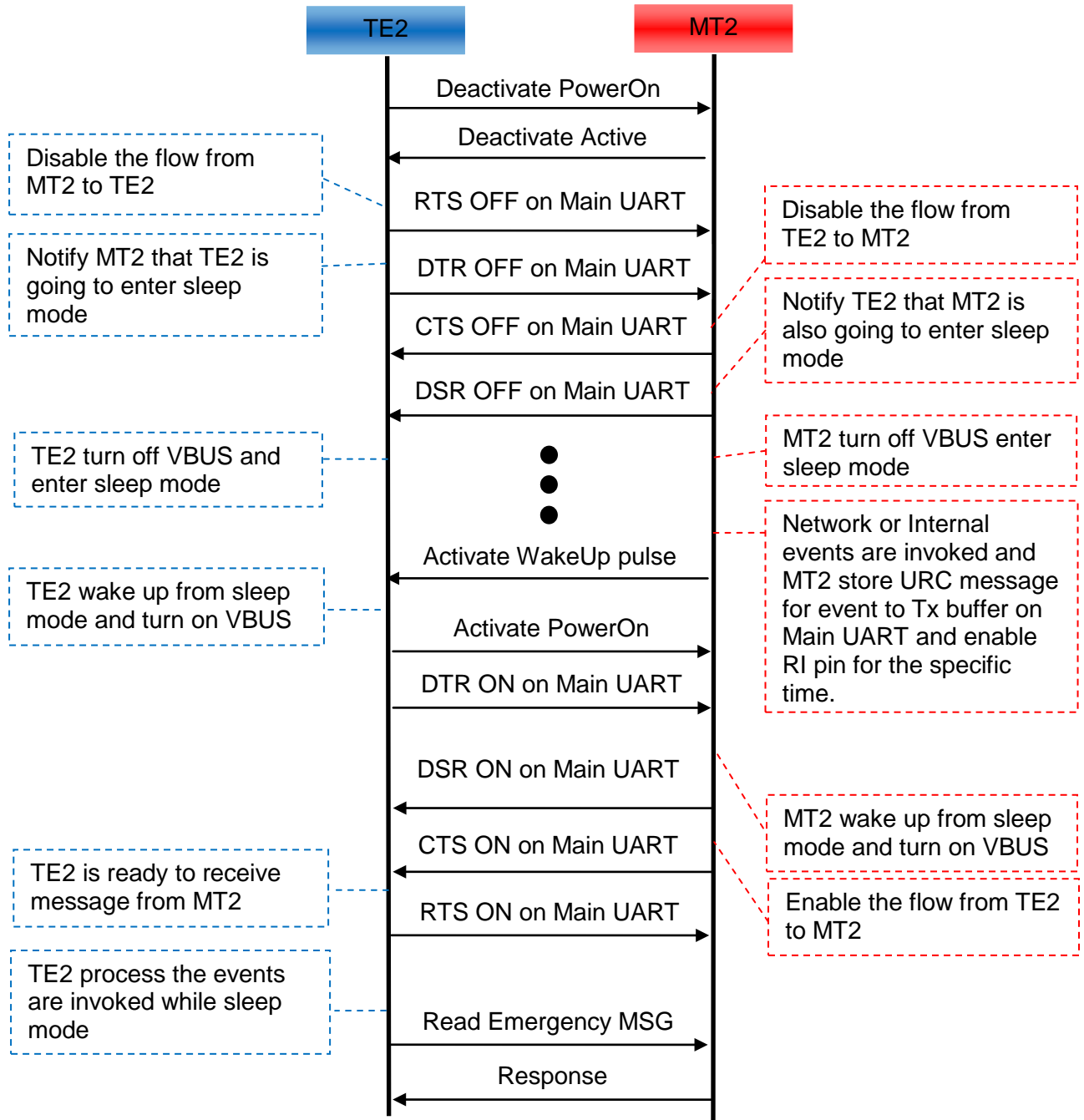


Figure 3.1-1 The flow chart for Emergency message in power saving mode

3.2.1. Wake up the Modem from sleep mode

DTE can wake up from sleep mode by WakeUp pin, while it's in sleep mode.
WakeUp Signal is issued only if Emergency message is received in sleep mode.

3.2.1.1. WakeUp Signal for Emergency message

WakeUp signal is activated for duration set by **AT\$MOBISMSGPIN** command when Emergency message is received.

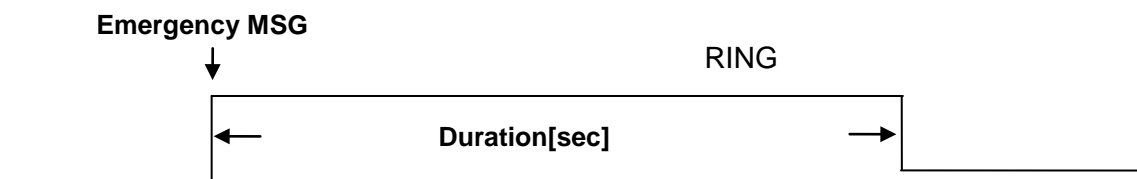


Figure 3.3.1-2 RI signal for \R2

If **AT\$MOBISMSGPIN** setting is 0, WakeUp signal is not deactivated until all Emergency messages are read.

When WakeUp signal is detected, DTE can wake up modem by activate the PowerOn Signal

3.3. SMS Handling

The Telit UC864-AK supports the Short Message Service, it is possible to store, delete, write, send and receive a SMS, which is a short text message up to 160 characters long.

3.3.1. Sending a New SMS

A new SMS can be sent directly to the network without storing it.

- send command **AT\$SMSMO<n>=<da>,<ca>,<tid>,<msg>**
- wait for **OK** response and then **\$SMSMOACK<n>** or **\$SMSMONAK<n>** notification response.

where:

<n>: address index for storing message

<da>: destination address



<ca>: callback address

<tid>: Teleservice ID

<msg>: message body in format of hexa string.

Response	Reason	Action
\$SMSMOACK<n>	SMS Send successful	
\$SMSMONAK<n>	SMS Send fail	Retry or some

For example:

1- Let us assume you want to directly send a new SMS to the destination address number +39338123456789.

command

AT\$SMSMO0=+39338123456789,<callback address>,4098,54455354

OK

\$SMSMOACK0

3.3.2. Reading and Deleting an SMS

When a new SMS message is arrived, \$SMSALERT notification message is transmitted to DTE. And DTE can read a new SMS message using **AT\$SMSREAD?<cr>**.

- send command **AT\$SMSREAD? <cr>**
- wait for response in format:

<timestamp>,<caller address>,<tid>,<msg>

Where:

<timestamp>: time stamp in format: YYYYMMDDhhmm

<caller address>: caller address

<tid>: Teleservice ID

4098 : General SMS message

32870 : Emergency SMS message for Mozen Service of Hyundai Motors

<msg>: message body in format of hexa string.

SMS message is deleted automatically after reading.





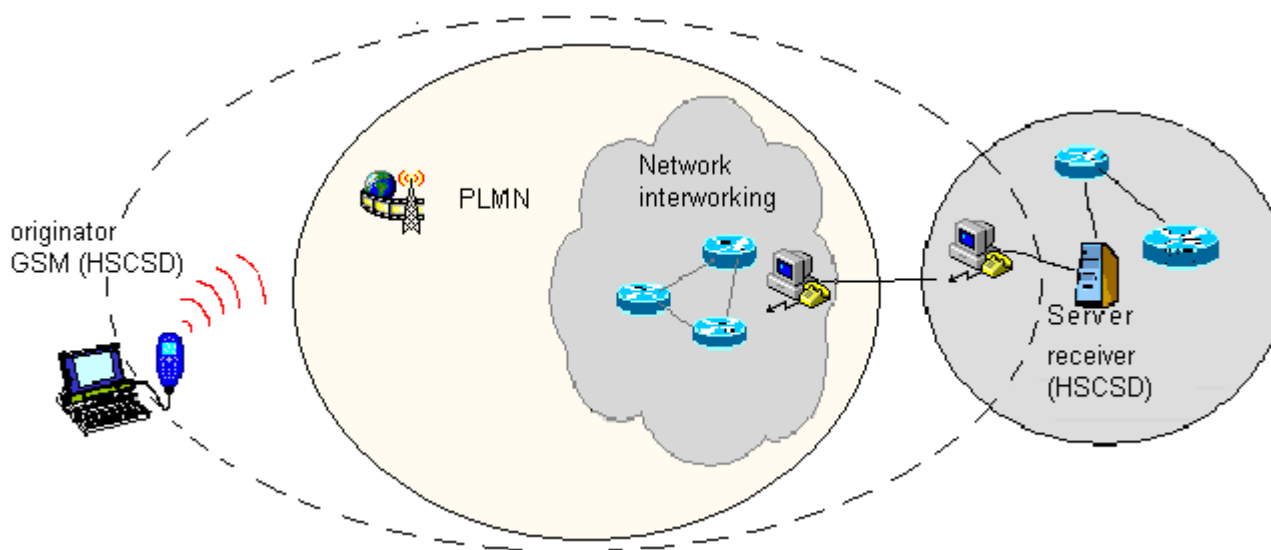
NOTE:

Most simple method is just described here. Other methods and to handle SMS could be made by user refer to command described in “UC864-AK AT_Commands_Reference_Guide Rev.0_RD.doc”.



4.1. Introduction

An example of this kind of operation is shown in the following picture, where the point to point connection is between the two peers as if all the devices inside the dashed line are not present:

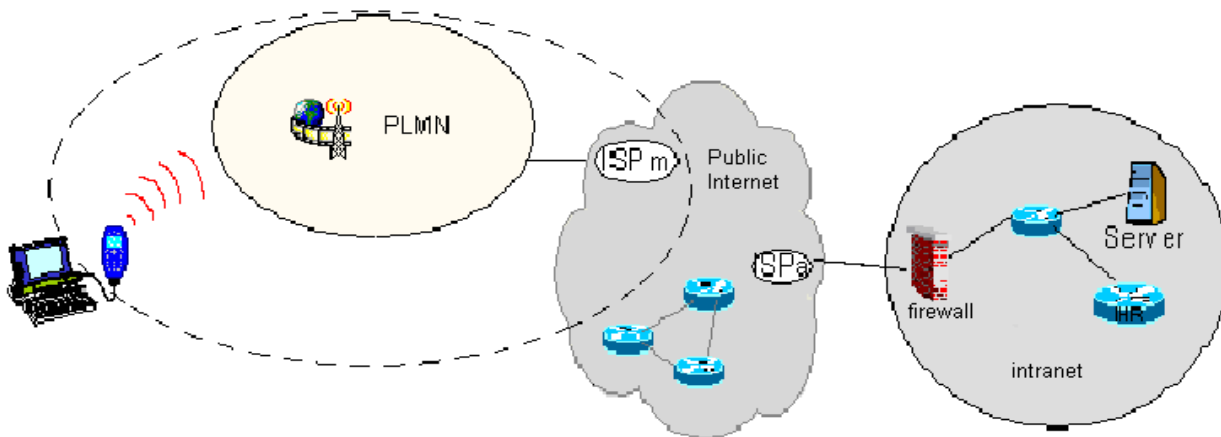


Wireless Cellular CSD interconnectivity



In PSD operations instead, the connection is made directly towards internet as if the PSD modem which support GPRS/EDGE/WCDMA/HSDPA was a network IP socket interface. There is no data path reserved for the data exchange between the two peers, instead the resources are allocated dynamically on demand and the data exchanged is organized into packets typically TCP/IP, furthermore the maximum transfer speed can be much faster than GSM CSD.

An example of PSD connection is shown in the following picture, where the PSD connection is between the PSD modem and the internet as if all the devices inside the dashed line are not present:



Wireless Cellular PSD *interconnectivity*

Due to this kind of connection, when activating the PSD connection you must provide the network parameters to enter through the internet point of the GPRS/EDGE/WCDMA/HSDPA network ISP (Internet Service Provider) and not the phone number to be dialed. Therefore, it is not possible to establish a direct point-to-point PSD connection between two modems as in CSD case. instead an internet tunneling must be done to achieve a point to point connection between two peers.

This approach as the immediate advantage of projecting the controlling application of the PSD modem directly on the internet, ready to be accessed virtually from anywhere in the world at the same cost on the GPRS/EDGE/WCDMA/HSDPA network. Actually the billing of the PSD connection is based on the amount of data exchanged (number of packets transferred) independently from the time the connection is active or where these packet must be delivered. Therefore, it is possible to leave the controlling application always connected and ready to receive/send data on demand, while paying only for the data really exchanged.

The drawback of the PSD connection is that the controlling application must have its own TCP/IP protocol stack embedded to decode the packets that arrive from GPRS/EDGE/WCDMA/HSDPA network and encode the ones to be sent through the internet.

There are few considerations than must be done on the PSD connections:



- the GPRS connection speed with a GPRS class 12 multislot device is asymmetrical, 4 time slots in reception (80000 bps max in CS4), 4 time slot in sending (80000 bps max in CS4) and 5 time slot in active(tx time slot + rx time slot).
- the EDGE connection speed with a EDGE class 12 multislot device is asymmetrical, 4 time slots in reception (236800 bps max in MCS9), 4 time slot in sending (236800 bps max in MCS9) and 5 time slot in active(tx time slot + rx time slot).
- the WCDMA connection speed is symmetrical, 384kbps in reception and sending.
- the HSDPA connection speed with a category 8 device is asymmetrical, 7.2Mbps in reception and 384kbps in sending.
- The controlling application of the module must have a TCP/IP - PPP software stack to interface with the PSD modems.
- The controlling application must relay on some ISP that may be the Network Operator of the SIM or USIM to gain access to the internet through the PSD connection.
- Because of the point before, the receiving application must have internet access either.
- Since the communication is based upon TCP/IP packets, then it is possible to talk contemporarily with more than one peer.
- When required, the data security in internet must be guaranteed by security protocols over the TCP/IP that must be managed by the controlling application.



The Telit UC864 modules firmware can be updated through the USB interface, which is used normally for the Trace (Diagnostic Monitoring). Since the software group is continuously working, in order to improve the overall performances and introduce new features on the product, we suggest, in order to keep updated the module's firmware, to foreseen an external access to that interface, which allows connecting a Windows-based PC. It must be possible to start the update procedure at POWER OFF condition of the module and then switch it ON to continue.

During the application development or evaluation phase of the UC864 module, the USB port implemented on the Telit Evaluation Kit EVK2 with UC864 interface board can be used to connect to a Windows-based PC on which the specific program for updating the Software (TFI) can be run.

The firmware update can be done with a specific software tool provided by Telit that runs on Windows based PCs.

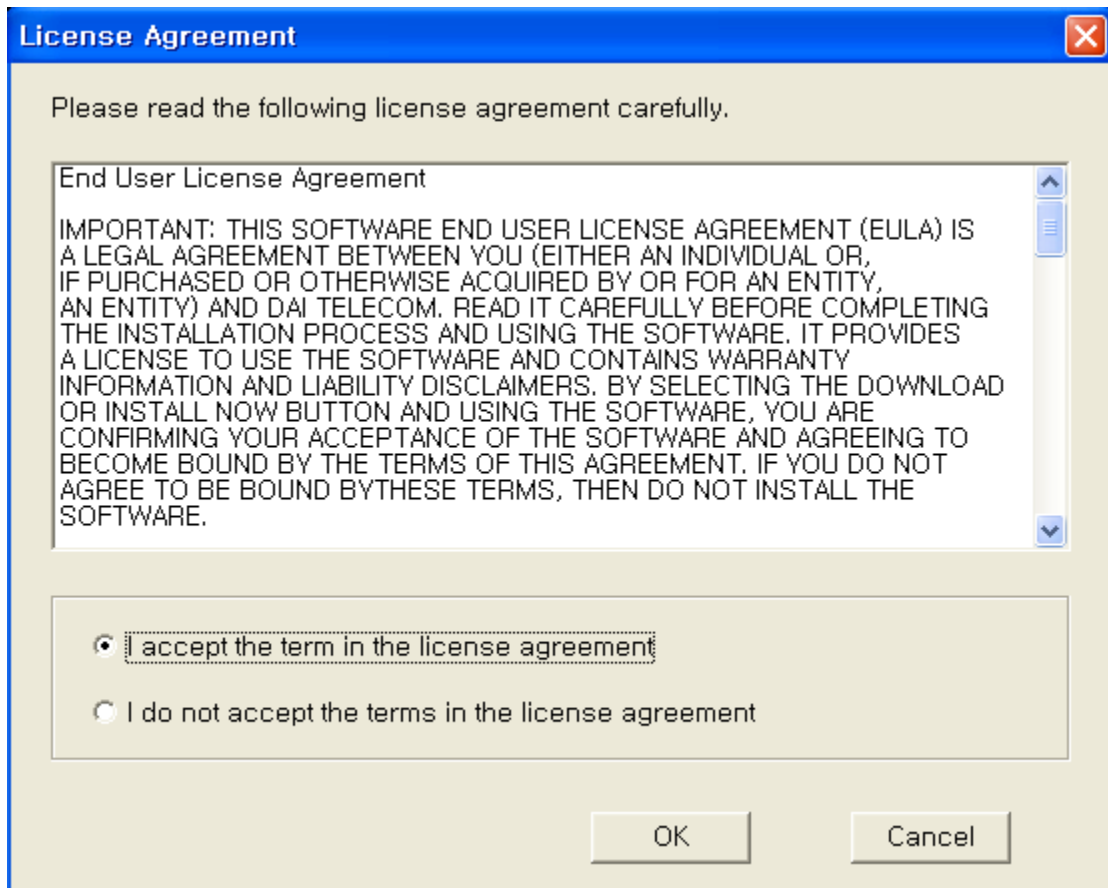
First the program will erase the content of flash memory, then the program will write on the flash memory. To update the firmware of the module, we suggest the following procedure:

- Run the file **xxxx_TFI_S.exe**. The following window must be displayed, Select the language preferred by pressing the correspondent button.

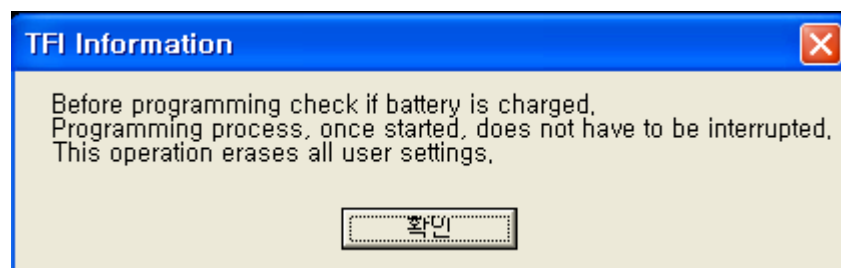


- The End User License Agreement will appear. Please, read it and accept the terms if you are going to proceed.





- Press OK to the initial message.

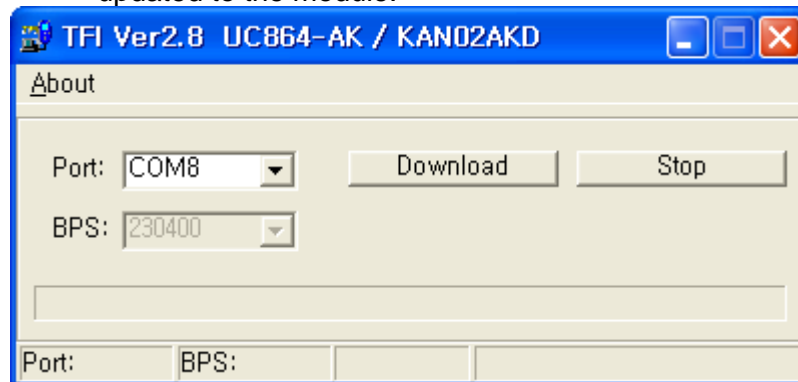


Note: In connection with the UC864 modules, charged battery has to be understood that the power supply must not be disconnected during the firmware update.

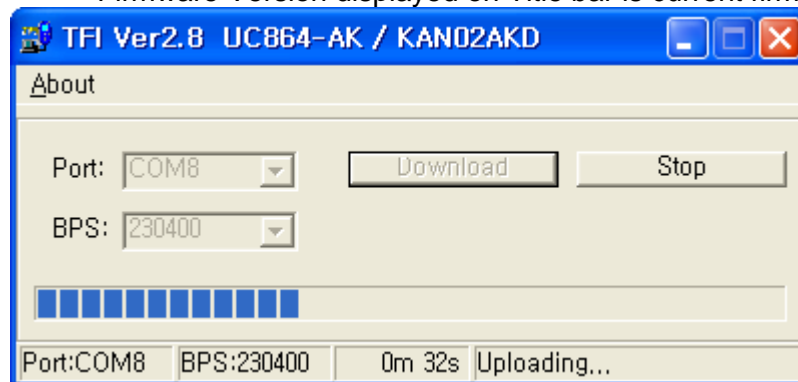
- Download ready screen – If “Diagnostic” COM Port is automatically detected then the baudrate is fixed to 230400. But automatically port detection is depending on Window OS and it is targeting on Window XP. If COM Port is not detecting then must recheck that connecting status of modem USB cable and USB driver installation. Firmware Version displayed on Title bar is new firmware version and this version will be



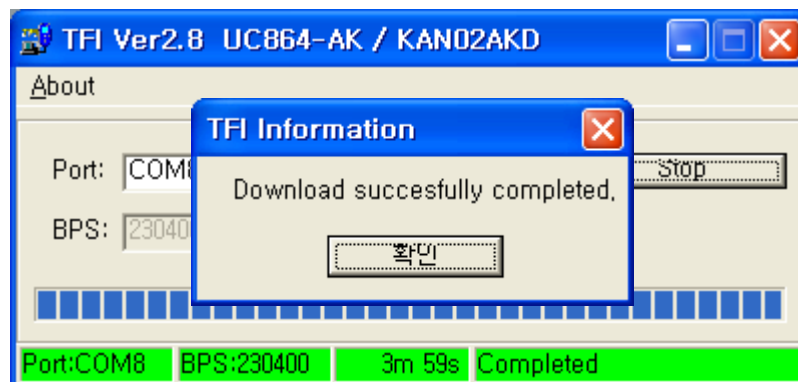
updated to the module.



- Select the right COM port and speed. Note that to go faster than 115200 you need a special hardware on the PC. Then Press the Download button and within 5 seconds power-on the UC864.
- Firmware Version displayed on Title bar is current firmware version.



Wait for the end of programming green message OK.



The Telit UC864 module is now programmed with the new firmware.



6. Document Change Log

Revision	Date	Changes
Rev.0	May 2009	First release

