LN920

Software User Guide
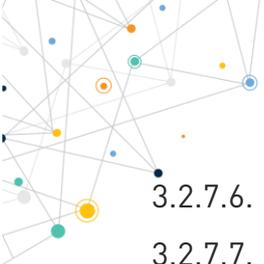
Telit Technical Documentation

APPLICABILITY TABLE

PRODUCTS	PART NUMBER
LN920A12-WW	
LN920A6-WW	

CONTENTS

1. INTRODUCTION

1.1. Scope

This document introduces the Telit LN920 module and presents possible and recommended software solutions for the development of a product based on this module. All the features and solutions described in this document are applicable to all LN920 variants listed in the applicability table.

1.2. Audience

This document is intended for Telit customers, especially system integrators, about to implement their applications using the Telit LN920 module.

1.3. Contact Information, Support

For general contact, technical support services, technical questions and report of documentation errors contact Telit Technical Support at:

- *TS-EMEA@telit.com*
- *TS-AMERICAS@telit.com*
- *TS-APAC@telit.com*
- *TS-SRD@telit.com*
- *TS-ONEEDGE@telit.com*

Alternatively, use:

http://www.telit.com/support

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

http://www.telit.com

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates the user feedback on our information.

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1.4.   Symbol Convention

⚠️	**Danger:** This information MUST be followed or catastrophic equipment failure or personal injury may occur.
✋	**Warning:** Alerts the user on important steps about the module integration.
📌	**Note/Tip:** Provides advice and suggestions that may be useful when integrating the module.

Table 1: Symbol Conventions

All dates are in ISO 8601 format, that is. YYYY-MM-DD.

1.5.   Related Documents

- 80675ST11077A LN920 AT Commands Reference Guide
- 1VV0301730 LN920 HW Design Guide

2. BASIC OPERATION

2.1. SW package Information

2.1.1. SW Image concept

The diagram below includes the main software components of the LN920 software:

- The Boot area (SBL/AOP/TZ)
- Modem image
- Application software

The LN920 can host at most three modem images. The CNV file includes both network operator and customer-specific configuration settings.

TFI/XFP software upgrade files include image boot/modem/application/cnv
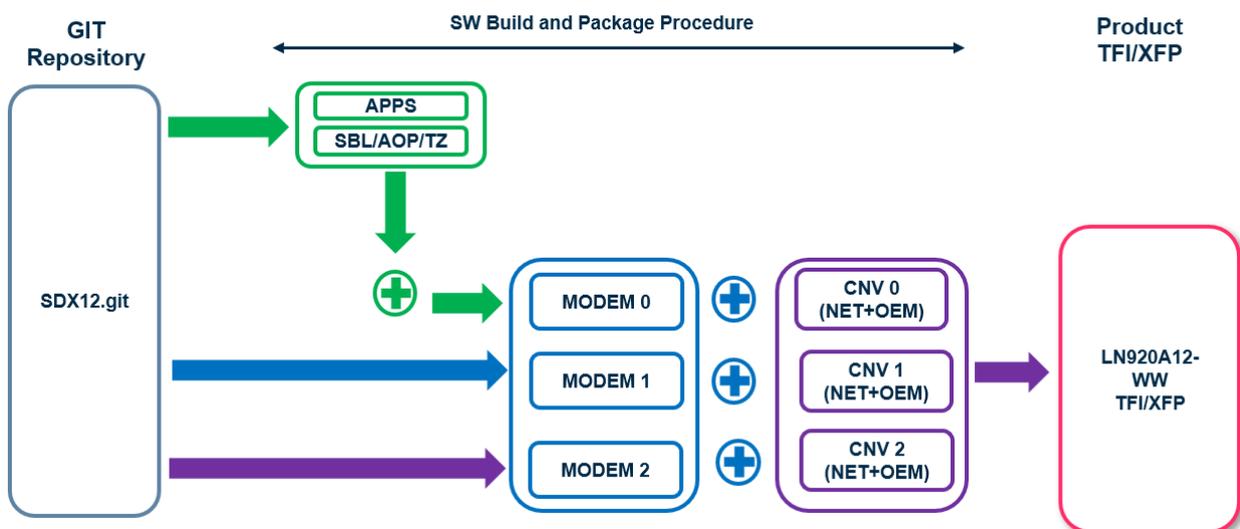
2.1.2. Basic SW package Concept

The diagram below depicts the differenc components of each LN920 image.
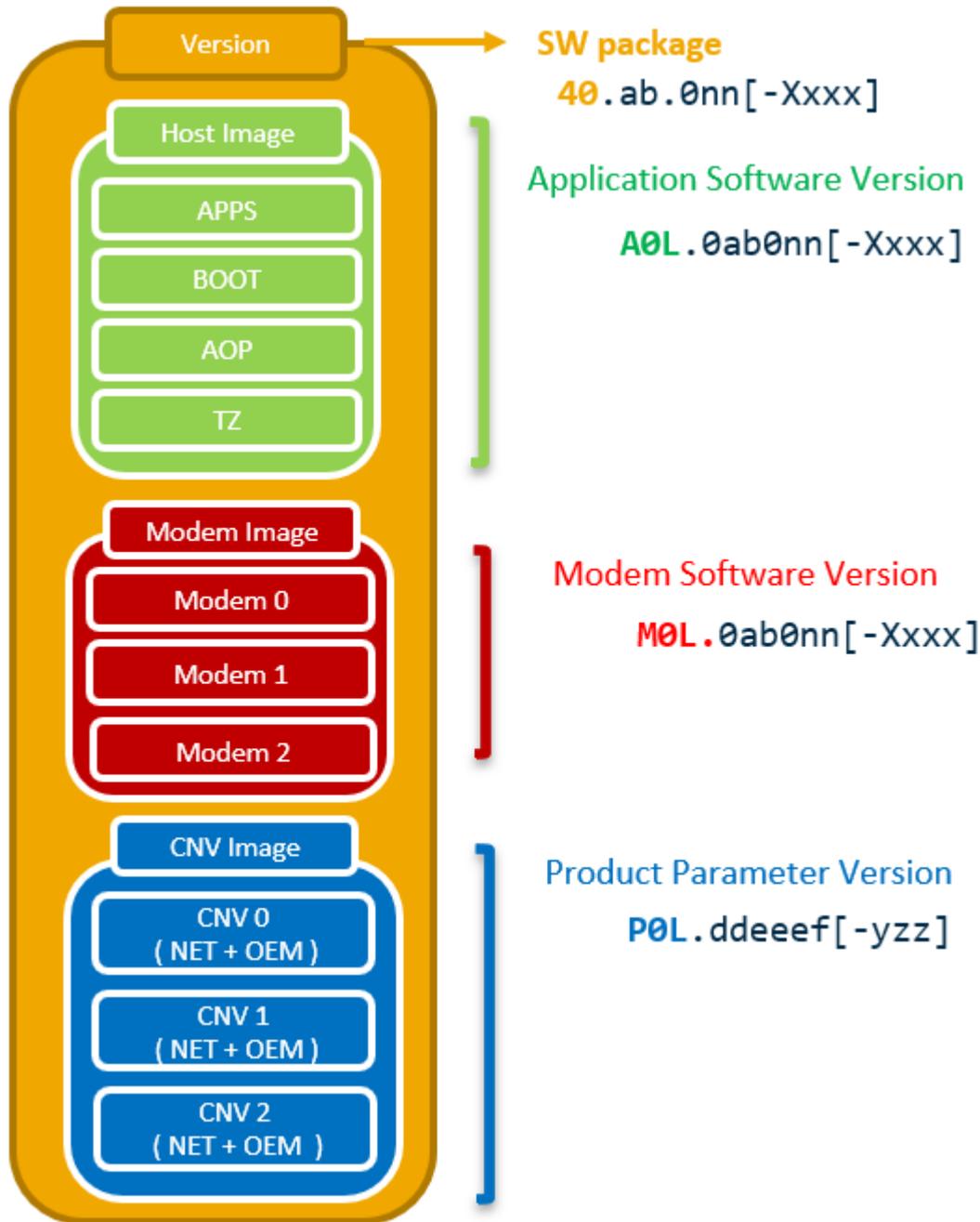
Platform Version: 40.

Modem Platform: M0L.

Application Platform: A0L.

Product Parameter: P0L.

Naming convention is as follows:

a: product variant (0: LN920A12-WW, 1: LN920A6-WW, 2: TBD)

b: major version (0:LE1.0, 1:LEx.x, 2:LEx.x)

c: modem ID (1-9: Carrier ID for each variant)

nn: minor software version

X: build type (Beta , Alpha , Test)

xxx: build number (000-999)

dd: MNO id

00: GEN GCF,01: GEN PTCRB,10: ATT,11: TMO,12: VZW,20: SKT,30: NTT, …

eee: CNV version number (000-999)

f: CNV extension number (0-9)

yzz: OEM CNV version

This file is shown only if OEM CNV (customer configuration files) is activated

y – OEM ID (1-9) , zz – PRI version number (1-99)

0: reserved field

2.1.3.   SW Configuration concept
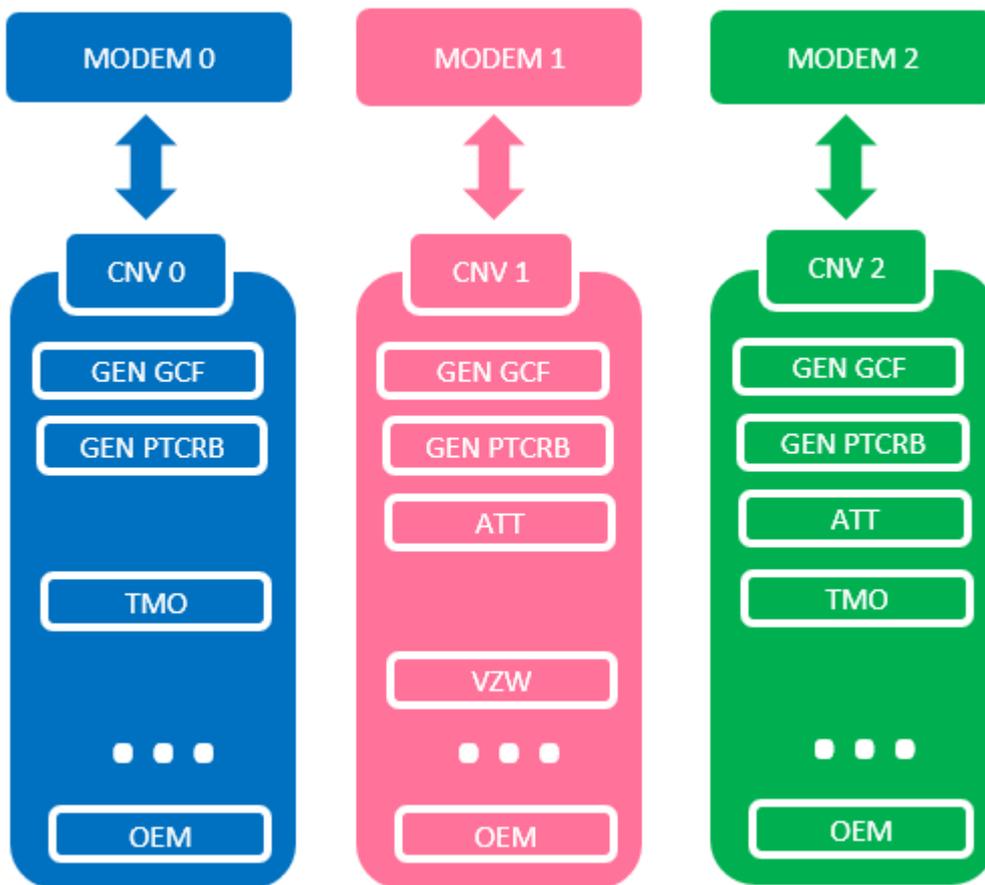
- CNV (TMCFG) configures NV/EFS values for the specified network operator and OEM customer on Modem FW

- AT#FWSWITCH allows to change Modem FW and Network Config

- Each Modem FW has its own CNV file

- CNV consists of Network and OEM configurations

- CNV has the package version for the composition of network

- AT#CMGF command shows all CNV version information (package, network and OEM)

- Each Network/OEM config has its own version

- OEM config is optional

| Index | Mobile Network Operator | |
	Region	Operator
0	Rest of World	Generic-GCF
1	North America	Generic-PTCRB
10	North America	AT&T
11	North America	T-Mobile
12	North America	Verizon Wireless
20	Korea	SK Telecom
30	Japan	NTT
31	Japan	KDDI

How to check the current SW version:

AT#SWPKGV – Show SW package version

AT#SWPKGV

<Telit Software Package Version>-<PrRioduction Parameters Version>

<Modem Package Version>

<Production Parameters Version>

<Application Version>

OK

Example:

AT#SWPKGV

40.00.001-B001-P0L.001010

M0L.000001-B001

A0L.000000-B001

AT+GMR or AT#CGMR – Show modem version

Example:

AT+GMR

M0L.000001-B001

OK

AT#CGMF – Show product parameter version

Example:

AT#CGMF

P0L.001010

OK

2.1.4.   How to check the current SW version

AT#FWSWITCH – Change modem FW binary and network configuration

Example:

Generic GCF config on modem 0

AT#FWSWITCH=0,0

OK

* ATT config on modem 1

AT#FWSWITCH=10,1

OK

More detailed information described in Reference [1]. AT command Reference Guide.

3. FUNCTIONAL DESCRIPTION

3.1. General Functionality and Main Features

Application processor:

- Cortex-A7 up to 1.28 GHz; 256 KB L2 cache
- Primary boot processor

Modem processor:

- Qualcomm® Hexagon™ DSP6 processor at up to 1 GHz
- 1.5 MB L2 cache

RPM processor:

- Cortex-M3 up to 300 MHz

External memory:

- EBI1
    - o 32-bit LPDDR2 SDRAM up to 533 MHz
- EBI2
    - o 8-bit NAND flash
    - o (EBI2 muxed with GPIOs)

USB

- USB 3.0 SuperSpeed with USB 2.0 high-speed backward compatibility

The latest air interface standards are supported

- DC-HSPA+, GSM, UMTS, LTE up to Cat6/Cat9/Cat12, FDD and TDD, including 3x CA

GNSS

- Qualcomm® Location Suite: Gen 9V1; GPS, GLONASS, BeiDou, and Galileo

3.2. Basic AT Commands

Note: The basic commands are to be compatible with the existing Telit model, but it may not be supported by changing the chipset and SW architecture.

Not Subject to NDA

3.2.1. Serial Ports Arrangements (USB Configuration)

The LN920 family module provides the USB compositions indicated below.

The USB composition can be configured by means of #USBCFG command.

Product ID	MI	Service Name
1060	0	DIAG
	1	ADB
	2	RMNET
	3	NMEA
	4	MODEM
	5	MODEM
	6	AUX
1061	0	DIAG
	1	ADB
	2,3	MBIM
	4	NMEA
	5	MODEM
	6	MODEM
	7	AUX
1062	0,1	RNDIS
	2	DIAG
	3	ADB
	4	NMEA
	5	MODEM
	6	MODEM
	7	AUX
1063	0	DIAG
	1	ADB
	2,3	ECM
	4	NMEA
	5	MODEM
	6	MODEM
	7	AUX

Note: LN920 family doesn't support hot-plug on USB.

The default USB composition is 1060 (PID)

3.1.1. Set and Query composition

#USBCFG command sets USB composition.

Example 1:

Set up USB composition to 1060.

AT#USBCFG=1

OK

Query current configuration.

AT#USBCFG?

#USBCFG: 1

3.2.1.   Command Syntax

The following notations are used in the next paragraphs:

<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).

3.2.2.   Command Response Timeout

Every command issued to the Telit modules returns a result response if response codes are enabled (default). The time needed to process the given command and return the response varies, depending on the command type. Commands that do not interact with the SIM/UICC or the network, and involve only internal set up settings or readings, have an immediate response, depending on SIM/UICC configuration (e.g., number of contacts stored in the phonebook, number of stored SMS), or on the network the command may interact with.

In the table below are listed only the commands whose interaction with the SIM/UICC or the network could lead to long response timings. When not otherwise specified, timing is referred to set command. For phonebook and SMS writing and reading related commands, timing is referred to commands issued after phonebook sorting is completed. For DTMF sending and dialing commands timing is referred to module registered on network ("AT+CREG/+CEREG?" answer is "+CREG/+CEREG: 0,1" or "+CREG/+CEREG: 0,5").

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.

Command	Time-Out (Seconds)
+COPS	180 (test command)
+CLCK	15 (SS operation)
	5 (FDN enabling/disabling)
+CPWD	15 (SS operation)
	5 (PIN modification)
+CLIP	15 (read command)
+CLIR	15 (read command)
+CCFC	15
+CCWA	15
+CHLD	60
+CPIN	30
+CPBS	5 (FDN enabling/disabling)
+CPBR	5 (single reading)
	15 (complete reading of a 500 records full phonebook)
+CPBF	10 (string present in 500 records full phonebook)
	5 (string not present)
+CPBW	5
+CACM	5
+CAMM	5
+CPUC	180
+VTS	20 (transmission of full "1234567890*#ABCD" string with no delay between tones, default duration)
+CSCA	5 (read and set commands)
+CSAS	5
+CRES	5
+CMGS	120 after CTRL-Z; 1 to get '>' prompt

Command	Time-Out (Seconds)
+CMSS	120 after CTRL-Z; 1 to get '>' prompt
+CMGW	5 after CTRL-Z; 1 to get '>' prompt
+CMGD	5 (single SMS cancellation)
	25 (cancellation of 50 SMS)
+CNMA	120 after CTRL-Z; 1 to get '>' prompt
+CMGR	5
+CMGL	100
+CGACT	150
+CGATT	90
D	120 (voice call)
	Timeout set with ATS7 (data call)
A	60 (voice call)
	Timeout set with ATS7 (data call)
H	60
+CHUP	60
+COPN	10
+CPOL	180
+WS46	10
+CRSM	180
#TONE	5 (if no duration specified)
#STSR	30
#CSURV	180
#CSURVC	180

3.2.3. AT Error Report Format

Disable the Error Report in numerical and verbose format.

AT+CMEE=0

OK

Enable the Error Report in numerical format.

AT+CMEE=1

OK

Enable the Error Report in verbose format.

AT+CMEE=2

3.2.4. Module Identification

Use the following AT commands to verify the Software Versions and module identification.

Check the Software Versions.

AT+CGMR

32.00.040-B001

OK

Check the module identification.

AT+CGMM

LN920

OK

3.2.5. Select 3G or 4G Network

The following AT command selects the technology: 3G, 4G, or both.

AT+WS46=[<n>]

AT+WS46=?

+WS46: (22,28,31)   this command supports only 3 mode.

OK

Note: The <n> parameter is stored in NVM. If on the air are present both technologies 3G and 4G, the second one is preferred.

Examples:

Select 3G Technology only.

AT+WS46=22

OK

Select 4G Technology only.

AT+WS46=28

OK

Select both Technologies: 3G and 4G.

AT+WS46=31

OK

3.2.6. Band Configuration

In manual band selection the following AT command selects the current band for both technologies UTRAN and EUTRAN:

AT#BND=<GSM band>[,<UMTS band>[,<LTE band>]]

Examples:

AT#BND=0,0,2   selected band: B1 (3G) + B2(4G)OK

Note: The module uses a band out of the two entered with the previous command.

The selected band will be in accordance with +WS46 command parameters and the technologies available on the air.

LN920 module doesn't support GSM and the default value is '0'(dummy).

3.2.7. SIM/USIM Management

3.2.7.1. SIM Presence and PIN Request

The following AT command checks if the SIM device requires the PIN code:

AT+CPIN?

Examples:

Assume that the SIM is inserted into the module and the PIN code is needed.

AT+CPIN?

+CPIN: SIM PIN

OK

Assume that the SIM is not inserted, and Extended Error result code is not enabled. Check if PIN code is needed, just to see the response command:

AT+CPIN?

ERROR

Assume that the SIM is not inserted, and Verbose Extended error result code is enabled. Check if PIN code is needed, just to see the response command:

AT+CPIN?

+CME ERROR: SIM not inserted

Assume that the SIM is not inserted, and Numerical Extended error result code is enabled. Check if PIN code is needed, just to see the response command:

AT+CPIN?

+CME ERROR: 10

3.2.7.2. Enter PIN code

Use the following AT command to enter the PIN code:

AT+CPIN=<pin>

Examples:

Assume to enter a wrong PIN code, and Extended Error result is not enabled.

AT+CPIN=1235

ERROR

Now, enter the correct PIN code:

AT+CPIN=1234

OK

Enable Verbose Extended error result code:

AT+CMEE=2

OK

Enter a wrong PIN code:

AT+CPIN=1235

+CME ERROR: incorrect password.

Note: After 3 PIN code failed attempts, the PIN code is no longer requested, and the SIM is locked. Use SIM PUK to enter a new PIN code and unlock the SIM.

3.2.7.3. Enter PUK code

Enter the following AT command if PUK or PUK2 code is required:

AT+CPIN=<pin>[,<newpin>]

Note: After 10 PUK code failed attempts, the SIM Card is locked and no longer available.

3.2.7.4. SIM Status

Use the following AT command to enable/disable the SIM Status Unsolicited Indication.

AT#QSS=<mode>

Example 1:

Enable the unsolicited indication concerning the SIM status change.

AT#QSS=1   enable URCs: #QSS:0/1

OK

#QSS: 0,0   unsolicited indication: the SIM in slot1 is extracted.

#QSS: 1,0   unsolicited indication: the SIM in slot1 is inserted.

Example 2:

AT#QSS=2   enable URCs: #QSS:0/1/2/3

OK

AT+IPR=19200   select the Main Serial Port speed = DTE speed

OK

AT&W0   store the setting on profile 0

OK

AT&P0   at Power on use profile 0

OK

Now, power off the module:

#QSS: 0,0   unsolicited indication: SIM in slot1 is extracted.

Now, power on the module:

#QSS: 1,0   unsolicited indication: SIM in slot1 is inserted.

AT+CPIN?

+CPIN: SIM PIN   SIM is locked

OK

AT+CPIN=<PIN>   enter PIN

OK

#QSS: 2,0   unsolicited indication: SIM in slot1 is unlocked.

#QSS: 3,0   unsolicited indication: SMS and Phonebook are accessible

---

Note: The time interval between the two unsolicited indications (#QSS: 2 and #QSS: 3) depends from the number of SMS stored on the module and the Phonebook size.

3.2.7.5. SIM Detection Mode

Use the following AT command to manage the SIM Detection Mode:

AT#SIMDET=<mode>

Or

Use the following AT command to enable/disable the SIM Status Unsolicited Indication.

AT#QSS=<mode>

Example:

AT#SIMDET?

#SIMDET: 0,0

OK

0 = SIM slot1 is activated.

0 = SIM not inserted, If SIMIN pin is not connected, it is always 0.

AT#QSS?

#QSS: 0,1,0

OK

0 = Disable URC

1 = SIM inserted

0 = SIM slot1

Enable the unsolicited indication concerning the SIM status change.

AT#QSS=1
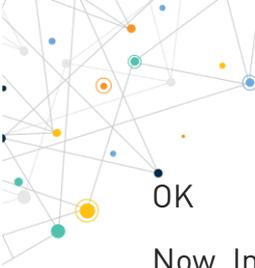
OK

Now, Insert the SIM into SIM slot2.

AT#SIMDET=1   switch to SIM slot2

OK

#QSS: 0,0   unsolicited indication, SIM not inserted on SIM slot1.

#QSS: 1,1   unsolicited indication, SIM inserted on SIM slot2.

AT#SIMDET?

#SIMDET: 1,0   1 = SIM slot2 is activated, 0 = If SIMIN pin is not connected, it is always 0.

OK

AT#SIMDET=0   switch to SIM slot1

OK

#QSS: 0,1   unsolicited indication, SIM not inserted on SIM slot2

#QSS: 1,0   unsolicited indication, SIM inserted on SIM slot1

AT#SIMDET?

#SIMDET: 0,0   0 = SIM slot1 is activated, 0 = If SIMIN pin is not connected, it is always 0.

OK

3.2.7.6.   SIM/USIM Access File

AT+CSIM command is used to read/write SIM/USIM files. The format of AT+CSIM parameters and AT+CSIM commands sequence must be in accordance with the card protocol. The distinction between SIM and USIM <command> format is needed because AT+CSIM command works directly on the (U)SIM card.

AT+CSIM=<length>,<command>

Example:

AT+CSIM=1   Lock SIM interface

OK

. . . .

To read/write card files refer to the LN920 AT Command Reference Guide.

. . . .

AT+CSIM=0   Unlock SIM interface

OK

3.2.7.7.   MSISDN

MSISDN is a number uniquely identifying a subscription in a GSM or UMTS mobile network. MSISDN is defined by the ITU-U Recommendation which defines the numbering plan: a number uniquely identifies a public network termination point and typically consists of three fields, CC (Country Code), NDC (National Destination Code), and SN (Subscriber Number), up to 15 digits in total.

Select the "ON" storage:

AT+CPBS="ON"

OK

Write a new record on the selected storage:

AT+CPBW=1,"+393912457",145,"MyNumber"

OK

Read the just entered number:

AT+CPBF="MyNumber"

+CPBF: 1," +393912457",145,"MyNumber"

OK

3.2.8. Network Information

3.2.8.1. Network Status

Enter the following AT command to verify if the module is registered on a network.

AT+CREG?

3.2.8.2. Circuit Service Network Registration status in (E)-UTRAN

Send command **AT+CREG?**

Wait for response:

Response	Reason	Action
+CREG: 0,0 or +CREG: 1,0	SIM not present or damaged or SIM is present, and PIN is required to continue operations	Check the inserted SIM/USIM status(Please refer to the "SIM/USIM management "contents)
+CREG: 0,1 or +CREG: 1,1	Mobile is registered on its home network.	Proceed ahead. Ready to CS 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 "Fast Network Status Check" contents 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 or reset, then repeat procedure at "Fast Network Status Check" contents
+CREG: 0,4 or +CREG: 1,4	Mobile is in an unknown network status	Repeat procedure at "Fast Network Status Check" contents 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 CS call

3.2.8.3. Packet Service network registration status in UTRAN

Send command **AT+CGREG?**

Wait for response:

Response	Reason	Action
+CGREG: 0,0 or +CGREG: 1,0	SIM not present or damaged or SIM is present and PIN is required to continue operations	Check the inserted SIM/USIM status(Please refer to the "SIM/USIM management "contents)
+CGREG: 0,1	Mobile is registered on its home network.	Proceed ahead. Ready to PS call

Response	Reason	Action
or **+CGREG: 1,1**		
+CGREG: 0,2 **or** **+CGREG: 1,2**	Mobile is currently not registered on any network but is looking for a suitable one to register.	Repeat procedure at "Fast Network Status Check" contents to see if it has found a suitable network to register in
+CGREG: 0,3 **or** **+CGREG: 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 or reset, then repeat procedure at "Fast Network Status Check" contents
+CGREG: 0,4 **or** **+CGREG: 1,4**	Mobile is in an unknown network status	Repeat procedure at "Fast Network Status Check" contents to see if it has found a suitable network to register in
+CGREG: 0,5 **or** **+CGREG: 1,5**	Mobile has found some networks and is currently registered in roaming on one of them	Proceed ahead. Ready to PS call

3.2.8.4. Packet Service network registration status in E-UTRAN

Send command **AT+CEREG?**

Wait for response:

Response	Reason	Action
+CEREG: 0,0 **or** **+CEREG: 1,0**	SIM not present or damaged or SIM is present and PIN is required to continue operations	Check the inserted SIM/USIM status(Please refer to the "SIM/USIM management "contents)
+CEREG: 0,1 **or** **+CEREG: 1,1**	Mobile is registered on its home network.	Proceed ahead. Ready to PS call
+CEREG: 0,2 **or** **+CEREG: 1,2**	Mobile is currently not registered on any network but is looking for a suitable one to register.	Repeat procedure at "Fast Network Status Check" contents to see if it has found a suitable network to register in
+CEREG: 0,3 **or** **+CEREG: 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 or reset, then repeat procedure at "Fast Network Status Check" contents
+CEREG: 0,4 **or** **+CEREG: 1,4**	Mobile is in an unknown network status	Repeat procedure at "Fast Network Status Check" contents to see if it has found a suitable network to register in
+CEREG: 0,5 **or** **+CEREG: 1,5**	Mobile has found some networks and is currently registered in roaming on one of them	Proceed ahead. Ready to PS call

Not　Subject to NDA

Note: When a response +CREG/+CGREG/+CEREG: x,1 or + CREG/+CGREG/+CEREG: 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.

3.2.8.5. Network Operator Identification

Use the following AT command to query the module for Network Operators Identifications once the mobile has registered on a mobile network (or if it has returned +CREG/+CGREG/+CEREG:x,3), it is possible to query the mobile for network identifications, codes and names:

Send command **AT+COPS=?**

Wait for response in the following format:

+COPS: [list of supported (<stat>,long alphanumeric <oper>,short alphanumeric <oper>,numeric <oper>,< AcT>)s]

[,,(list of supported <mode>s),(list of supported <format>s)]

where:

<stat> operator availability

0 - unknown

1 - Available

2 - current

3 - Forbidden

<AcT> access technology selected

0 GSM

2 UTRAN

7 E-UTRA

Note: Since with this command a network scan is done, this command may require some seconds before the output is given.

In example:

AT Command

Not Subject to NDA

AT+COPS=?

Answer:

+COPS: (2,"","SKTelecom","45005",7),(3,"KT","KT","45008",7),(3,"KOR LG Uplus","LG U+","45006",7),,(0-4),(0-2)

OK

In this case the mobile is registered on the **"SKTelecom"**, which is a network from Korea, code: 450 and Network ID: 05.

Note: This command issues a network request and it may require quite a long time (up to 180 s) to respond since the device has to wait for the network answer. It is suggested not to use this command unless necessary.

3.2.8.6. Preferred Network Operator List

Use the following AT command to manage the Preferred Operator List stored on SIM.

AT+CPOL=[<index>][,<format>[,<oper>[,<GSM_AcT>,<GSM_Compact_AcT>,<UTRAN_AcT, <EUTRAN_AcT>]]]

Check the supported number of operators in the SIM preferred operator list and the format:

AT+CPOL=?

+CPOL: (1-16),(0-2)   The used SIM supports 16 positions; the supported format (0) is long format alphanumeric, (1) is short format alphanumeric and (2) is numeric

OK

AT+CPOL?

+CPOL: 1,2,"20801",0,0,1,1

+CPOL: 2,2,"21407",0,0,1,1

...

+CPOL: 16,2,"73001",0,0,1,1

OK

Note: LN920 family module does not support GSM access technology.

<GSM_Compact_Act> is not supported but set value is accepted.

The User controlled PLMN values could not read/write returned values and range on some SIM cards such as AT&T when it set to CPLS 0 because the EF_PLMNwACT field does not exist.

3.2.8.7. Signal Strength & Quality

Assume that the module is registered on a network using either 3G or 4G technology. The following AT command returns the received signal strength & quality giving an indication about the radio link reliability.

AT+CSQ

Assume that no antenna is connected to the module, or network coverage is completely absent.

AT+CSQ

+CSQ: 99,99

OK

Now, the antenna is connected to the module and network coverage is present. Enter again the previous AT command:

AT+CSQ

+CSQ: 17,0   17 = <rssi> = Received Signal Strength Indication

OK   0   = <ber> = Bit Error Rate

Now, a wrong parameter is entered just to display the result format when Verbose Extended Error result is enabled:

AT+CSQ?

+CME ERROR: operation not supported

3.2.8.8. Extended Signal Strength & Quality

Assume that the module is registered on a network using either 3G or 4G technology. The following AT command returns the received signal strength & quality providing an indication about the radio link reliability.

AT+CESQ

Assume that the antenna is not connected to the module or network coverage is completely absent.

AT+CESQ

+CSQ: 99,99,255,255,255,255

OK

Now, the antenna is connected to the module and network coverage is present. Enter again the previous AT command:

AT+CESQ

+CSQ: 99,99,94,97,255,255   94 = <rscp> = Received Signal Code Power

OK   47 = <ecno> = Ratio of the received energy per PN chip to the total received power spectral density.

AT+CESQ

+CSQ: 99,99,255,255,32,95   32 = <rsrq> = Reference Signal Recevied Quality

OK   95 = <rsrp> = Reference Signal Received Power

Now, a wrong parameter is entered just to see the result format when Verbose Extended Error result is enabled:

AT+CESQ?

+CME ERROR: operation not supported

3.2.8.9. Fast Network Status Check

Once the module is registered on a network, no matter which radio technology (3G or 4G) is used, it is useful to know the received signal strength and the network on which the module is registered. This information is gathered by means of the following standard AT commands: +CREG, +COPS and +CSQ.

The response to commands, especially +COPS could be slow in terms of response time. If the objective is to keep the application as general as possible, the above mentioned standard AT commands should be used.

Telit modules proprietary AT commands provide a simpler and quicker way to gather all the information:

- **AT#MONI**
- **AT#SERVINFO**

AT#MONI and AT#SERVINFO commands should be used only to collect network name and signal strength information. To check if the module is registered or it is looking for a suitable network to register on, use +CREG command. In fact, if the network signal is too weak and module loses the registration, until a new network is found the two commands report the last measured valid values and not the real ones. The TA (timing advance parameter) is valid only during a call.

Check network registration with +CREG command. When module is registered, query the module for network operator name and signal strength with AT#MONI command.

3.2.8.9.1.   3G Network

Suppose that the 3G Technology is present on the air. Use the command AT+WS46=22 to force the module to 3G mode.

Examples:

Check if the module is using 3G Technology:

AT+COPS?

+COPS: 0,0,"KOR SK Telecom",2

OK

Yes, it is using 3G Technology.

Select the Serving Cell:

AT#MONI=0

OK

Collect information:

AT#MONI

#MONI: KOR SK Telecom PSC:14 RSCP:-64 LAC:21E1 Id:3CDA520 EcIo:-2.5 UARFCN:10713 PWR:-59 dbm DRX:64 SCR:224

OK

Use the following AT command to collect only the Serving Cell Information:

AT#SERVINFO

#SERVINFO: 10713,-61,"KOR SK Telecom","45005",14,21E1,64,3,-66,"I",01

OK

Use this command to get the current network status.

AT#RFSTS

#RFSTS: "450 05",10713,14,-5.0,-68,-63,21E1,01,,64,19,0,1,001,3CDA520,

"450050217220238","KOR SK Telecom",3,1

OK

3.2.8.9.2. 4G Network

Suppose that the 4G Technology is present on the air. Use the command AT+WS46=28 to force the module to 4G mode.

Examples:

Check if the module is using 4G Technology:

AT+COPS?

+COPS: 0,0,"KOR SK Telecom",7

OK

Yes, it is using 4G Technology.

Select the Serving Cell:

AT#MONI=0

OK

Collect information:

AT#MONI

#MONI: KOR SK Telecom RSRP:-79 RSRQ:-9 TAC:310C Id: 06FC047 EARFCN:1350 PWR:-53dbm DRX:128

OK

Use the following AT command to collect only the Serving Cell Information:

AT#SERVINFO

#SERVINFO: 1350,-60,"KOR SK Telecom","45005",06FC047,310C,128,3,-94

OK

Use this command to get the current network status.

AT#RFSTS

#RFSTS: "450 05",1350,-94,-59,-
13,310C,255,,128,19,0,06FC047,"450050217220238","KOR SK Telecom"3,3

OK

3.2.8.10. Enhanced Network Selection and AT&T functions

Use the following AT command to enable/disable the Enhanced Network Selection and the AT&T features. ENS will be functional if both the module and the SIM card are both ENS-capable.

AT#ENS=[<mode>]

AT#ENS?

#ENS: 0   factory setting

Enter the following setting. Power OFF/ON the module to make active the new entered setting.

AT#ENS=1

OK

The following chapters describe the features enabled by the AT#ENS command for each module/software version.

3.2.8.10.1. No AT&T SIM cards

The module supports the following features, independently from the #ENS setting:

- +PACSP AT command to display the PLMN Mode Bit read from CPHS file on SIM (refer to AT&T Device Requirement)

3.2.8.10.2. AT&T SIM cards

Assume that #ENS=1. The module supports the features the following:

- Acting Home PLMN (refer to AT&T Device Requirement)

3.2.8.11. Network Survey

Use the following AT command to perform a quick survey through channels belonging to the current band:

AT#CSURV[=[<s>,<e>]]

Parameters: <s> - starting channel, <e> - ending channel

Examples:

AT#CSURV

Network survey started ...

earfcn: 2850 rxLev: -60 mcc: 450 mnc: 05 cellId: 7323799 tac: 12556 phyCellId: 6

4 cellStatus: CELL_SUITABLE rsrp: -97 rsrq: -17 bw: 20

earfcn: 3050 rxLev: -56 mcc: 450 mnc: 06 cellId: 51999232 tac: 8471 phyCellId: 8

7 cellStatus: CELL_FORBIDDEN rsrp: -87 rsrq: -11 bw: 20

earfcn: 2600 rxLev: -63 mcc: 450 mnc: 06 cellId: 51999238 tac: 8471 phyCellId: 8

7 cellStatus: CELL_FORBIDDEN rsrp: -91 rsrq: -11 bw: 10

earfcn: 8890 rxLev: -47 mcc: 450 mnc: 05 cellId: 448779 tac: 12556 phyCellId: 27

3 cellStatus: CELL_SUITABLE rsrp: -75 rsrq: -11 bw: 10

earfcn: 3200 rxLev: -74 mcc: 450 mnc: 05 cellId: 7323839 tac: 12556 phyCellId: 6

4 cellStatus: CELL_SUITABLE rsrp: -102 rsrq: -11 bw: 10

earfcn: 66711 rxLev: -110 mcc: 450 mnc: 05 cellId: 7321443 tac: 12556 phyCellId:

 99 cellStatus: CELL_BARRED rsrp: -140 rsrq: -11 bw: 15

earfcn: 66911 rxLev: -110 mcc: 450 mnc: 08 cellId: 2487055 tac: 26 phyCellId: 16

5 cellStatus: CELL_FORBIDDEN rsrp: -140 rsrq: -11 bw: 15

earfcn: 2850 rxLev: -73 phyCellId: 99 cellStatus: CELL_SUITABLE rsrp: -105 rsrq:

 -20

uarfcn: 10737 rxLev: -0 mcc: 450 mnc: 05 scr code: 224 cellId: 63808800 lac: 867

3 cellStatus: CELL_SUITABLE rscp: -58 ecio: -4.0

uarfcn: 10836 rxLev: -0 mcc: 450 mnc: 08 scr code: 1488 cellId: 14909569 lac: 71

70 cellStatus: CELL_FORBIDDEN rscp: -70 ecio: -12.0

Network survey ended

OK

> **Note:** LN920 module does not support GSM access technology. The #CSURV could not indicate a survey of the channels that belonging to GSM

3.2.9. Software Shutdown

The following command is dedicated to module shutdown:

`AT#SHDN`

`OK`

During shutdown, the module executes the following actions:

- Detachment from the mobile network

- Module power off

To gather more information about module procedure and timing, please refer to the appropriate HW User Guide.

> **Note:** If VBATT is maintained and FULL_CARD_POWER_OFF_N pin is asserted high, module will turn on automatically after shutdown.

3.3. ADVANCED AT COMMANDS

3.3.1. SMS Management

The modules provide the SMS Service to store, send, receive, and delete SMS.

SMS are short text messages up to 160 characters long. Before using the SMS messages, the Short Message Service must be configured.

3.3.1.1. Select SMS Format Type

The Telit Module supports two SMS formats:

- PDU mode

- Text mode

The module uses PDU format to send a message on the air. The PDU mode enables the user to edit the message in PDU format as well.

The present document uses Text mode to explain how to operate with SMS. The AT command to select the mode is:

AT+CMGF=<mode>

Examples:

Check the supported range of values:

AT+CMGF=?

+CMGF: (0,1)

OK

Set up Text Mode for the SMS:

AT+CMGF=1

OK

This setting is stored and remains active until the module is turned OFF.

3.3.1.2. Set Text Mode Parameters

When SMS format is Text mode, the SMS parameters that usually reside on the header of the PDU must be set apart with the +CSMP command.

AT+CSMP=<fo>,<vp>,<pid>,<dcs>

Example 1:

Set the SMS parameters as follow:

- <fo> expressed in binary format, see table below. The binary number expressed in decimal format is 17.

-

0		0	0	1	0	0	0	1
Module is not requesting a status report		Always 0	Replay Path not requested	Validity period field present in relative format		Always 0	SMS-SUBMIT	

- <vp> validity period (in relative format) = 24 hours is coded into 167 decimal format.

- <pid> protocol identifier.

- <dcs> data coding scheme, default value 0.

AT+CSMP= 17,167,0,0

OK

Example 2:

Set the SMS parameters as follow:

- <fo> expressed in binary format, see table below. The binary number expressed in decimal format is 25.

0	0	0	1	1	0	0	1
Module is not requesting a status report	Always 0	Replay Path not requested	Validity period field present in absolute format		Always 0	SMS-SUBMIT	

- <vp> validity period in absolute format represents the expiration date of the message, for example:

- date: 29/06/02; time: 02:20; in the time zone of Italy (+1) is formatted as follows: "29/06/02,02:20:00+1"

- <pid> protocol identifier.

- <dcs> data coding scheme:

  o Default Alphabet

  o Class 0 (immediate display SMS)

Data coding scheme is coded in the following binary format: 11110000, corresponding to 240 in decimal format.

AT+CSMP=25,"29/06/02,02:20:00+1",0,240

OK

Note: Use dcs=0 if no particular data coding scheme is needed. Not all dcs combinations described in the 3GPP TS 23.038 are jointly supported by Networks and Telit Modules: some features may be not implemented on Networks or on Telit Modules. This no matching is resulting in an ERROR result code, use different dcs.

3.3.1.3. Character Sets

Use the following AT command to select the character set:

AT+CSCS=<chset>

The supported character sets are the following:

- "GSM" default alphabet

- "IRA" – ITU-T.50

- "8859-1" – ISO 8859 Latin 1

- "PCCP437" – PC character set Code Page 437.

- "UCS2" – 16-bit universal multiple-octet coded character set (ISO/IEC10646)

Examples:

Check the supported character sets:

AT+CSCS=?

+CSCS: ("GSM","IRA","8859-1","PCCP437","UCS2")

OK

Check the current character set:

AT+CSCS?

+CSCS: "IRA"

OK

Select a non-existent character set, merely to see the response format:

AT+CSCS="GSA"

ERROR

Enabling the Error report in verbose format:

AT+CMEE=2

OK

Select again a non-existent character set:

AT+CSCS="GSA"

+CME ERROR: operation not supported

3.3.1.3.1. IRA Character Set

The IRA character set is used in Text mode. IRA set defines each character as a 7-bit value: from 0x00 to 0x7F. The table below lists all the supported characters and their hexadecimal code.

		Most Significant Nibble							
		0x	1x	2x	3x	4x	5x	6x	7x
Least Significant Nibble	x0			SP[1]	0	@	P		p
	x1			!	1	A	Q	a	q
	x2			"	2	B	R	b	r
	x3			#	3	C	S	c	s
	x4			$	4	D	T	d	t
	x5			%	5	E	U	e	u
	x6			&	6	F	V	f	v
	x7			'	7	G	W	g	w
	x8			(	8	H	X	h	x
	x9			)	9	I	Y	i	y
	xA	LF[2]		*	:	J	Z	j	z
	xB			+	;	K		k	
	xC			,	<	L		l	
	xD	CR[3]		-	=	M		m	
	xE			.	>	N		n	
	xF			/	?	O	£	o	

1 – SP stands for space character

2 – LF stands for Line Feed character

3 – CR stands for Carriage Return character

The following examples show how to use the IRA table:

- Get the IRA code of the character '&': the most significant nibble is 2, the least significant nibble is 6, so the IRA code for the '&' character is the hexadecimal value: 0x26.

- Translate IRA code 0x6B into the corresponding character: the most significant nibble is 6, the least significant nibble is B, the cell at the crossing of column 6 and row B holds the character: "k".

3.3.1.3.2. UCS2 Character Set

The UCS2 Character Set is used in Text mode.

- Phone number 329 05 69 6... converted into "UCS2" format: 3=0033, 2=0032, 9=0039, 0=0030, 5=0035, 6=0036, 9=0039, 6=0036 ...

- Text HELLO converted into UCS2 format: H=0048, E=0045, L=004C, O=004F

3.3.1.4. Read SMSC Number

The module sends the SMS to the SMSC (Short Messages Service Center) where the message is dispatched towards its final destination or is kept until the delivery is possible. To ensure the correct operation of this service the number of the SMSC needs to be configured on the module in accordance with the network operator used.

To know the SMSC number stored on the module, use the following AT command.

AT+CSCA?

Check the stored SMSC number:

AT+CSCA?

+CSCA: "+39X20XX58XX0",145

OK

SMSC number is compliant with the international numbering scheme.

3.3.1.5. Set SMSC Number

Use the following AT command to store a new SMSC number. The old number is overwritten.

AT+CSCA=<number>,<type>

Set up the desired SMSC number in international format:

AT+CSCA=+39X20XX58XX0,145

OK

Enable extended result code in verbose format:

AT+CMEE=2

OK

Enter the command with no parameters:

AT+CSCA=

+CME ERROR: operation not supported

3.3.1.6. Send a SMS

Use the following AT command to send a SMS.

AT+CMGS

Note: To read and set the SMSC number see § 5.1.2 and 5.1.3.

Example 1:

Send a SMS to the module itself and do not store it. Use the UCS2 character set.

Select Text Mode.

AT+CMGF=1

OK

Select the UCS2 character set.

AT+CSCS="UCS2"

OK

Set SMS parameters:

AT+CSMP=17,168,0,26

OK

Select how the new received message event is notified by the DCE to the DTE.

AT+CNMI=1,1,0,0,0

OK
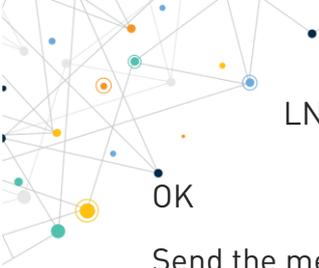
Send the message to the module itself. The UCS2 character set is used:

- Phone number 329 05 69 628 is converted into "UCS2" format: 3=0033, 2=0032, 9=0039, 0=0030, 5=0035, 6=0036, 9=0039, 6=0036, 2=0032, 8=0038

- Text CIAO is converted into UCS2 format: C=0043, I=0049, A=0041, O=004F

AT+CMGS=00330032003900300035003600390036003200388

> 004300490041004F (close the message with Ctrl Z)

+CMGS: 81

OK

The module itself receives the SMS, the following unsolicited indication is shown on DTE:

+CMTI: "SM",3

Note: The SMS was successfully sent to the SMSC and its network reference number is 81. Do not confuse message reference with message index position: the first one indicates the network reference for identifying the sent message, the second one – reported by the unsolicited indication – indicates that the module receives the message and it is stored on the position 3 of the "SM" storage.

Select the "SM" storage as indicated by the unsolicited indication.

AT+CPMS="SM"

+CPMS: 3,50,3,50,3,50

OK

Read the message from the storage position indicated by the unsolicited indication.

AT+CMGR=3

+CMGR:"REC UNREAD","002B0033003900330032003900300035003600390036003200388",

"00570049004E0044002000530049004D","08/05/13,12:22:08+08"

004300490041004F

OK

Example 2:

Send a SMS to the module itself and do not store it.

Select Text Mode

AT+CMGF=1

OK

Select how the new received message event is notified by the DCE to the DTE.

AT+CNMI=1,1,0,0,0

OK

Send the message to the module itself.

AT+CMGS="+39329X569YYY"

> SEND THE SMS #1 TO ITSELF (close the message with Ctrl Z)

+CMGS: 76

OK

The module itself receives the SMS #1, the following unsolicited indication is shown on DTE:

+CMTI: "SM",1

The SMS was successfully sent to the SMSC and its network reference number is 76. Do not confuse message reference with message index position: the first one indicates the network reference for identifying the sent message, the second one – reported by the unsolicited indication – indicates that the module has received the message and it is stored on the position 1 of the "SM" storage.

Use unsolicited indication parameter to read the SMS #1 for the first time.

AT+CMGR=1

+CMGR: "REC UNREAD","+39329X569YYY","WIND SIM","08/04/18,13:58:04+08"

SEND THE SMS #1 TO THE MODULE ITSELF

OK

3.3.1.7. Select/Check SMS Storage Type

Telit Modules can provide two type of SMS storage, in agreement with the family of belonging:

- "SM" – SIM Card Memory
- "ME" – Mobile Equipment Memory
- "SR" – Status Report Message Memory.

Use the following AT command to select memory storage:

AT+CPMS=<memr>,<memw>,<mems>

The SMS are usually stored (this is true for both the originated and the received SMS) in the SM/ME storage.

The LN920 family module allows the user to select a different storage for the read-delete, write-send, and reception-saving SMS operations.

Examples:

AT+CPMS=? ← Check the supported SMS storage types

+CPMS: ("ME","SM","SR"),("SM","ME"),("SM","ME")

OK

AT+CPMS? ← Check the current active storage type

+CPMS: "SM",1,50,"SM",1,50,"SM",1,50

OK

AT+CPMS="ME" ← Select "ME" storage type

+CPMS: 0,50,1,50,1,50

OK

AT+CPMS? ← Check the current active storage types

+CPMS: "ME",0,50,"SM",1,50,"SM",1,50 ← Two SMS storage types are active: "ME"

OK   and "SM"

3.3.1.8. Store a SMS

Use the following AT command to store a SMS.

AT+CMGW="<da>"

Example:

Store a SMS in the "SM" storage, send it to the module itself and read the message in the receiving storage.

AT+CMGF=1   Select Text Mode

OK

AT+CSMP=17,168,0,240   Assume to send a SMS of Class 0

OK

Select how the new received message event is notified by the DCE to the DTE

AT+CNMI=1,1,0,0,0

OK

Store into "SM" the SMS message to be sent to the module itself.

AT+CMGW="+39329X569YYY"

> SEND THE STORED SMS #1 TO THE MODULE ITSELF (close with Ctrl Z or ESC to abort)

+CMGW: 5

OK

Use index 5 to read SMS #1 from "SM" storage type.

AT+CMGR=5

+CMGR: "STO SENT","+39329X569YYY","WIND SIM"

SEND THE STORED SMS # 1 TO MODULE ITSELF

OK

Send the stored SMS #1using the storage position 5 returned by the previous command.

AT+CMSS=5

+CMSS: 78

OK

The module itself receives the SMS #1, the following unsolicited indication is shown on DTE:

+CMTI: "SM",6

Check the current SMS storage type.

AT+CPMS?

+CPMS: "SM",6,30,"SM",6,30,"SM",6,30

OK

Use index 6 to read received SMS #1 from "SM" storage memory.

AT+CMGR=6

+CMGR: "REC UNREAD","+39329X569YYY","WIND SIM","08/04/21,09:56:38+08"

SEND THE STORED SMS # 1 TO THE MODULE ITSELF

OK

Use index 6 to read again received SMS #1 from "SM" storage memory.

AT+CMGR=6

+CMGR: "REC READ","+39329X569YYY","WIND SIM","08/04/21,09:56:38+08"

SEND THE STORED SMS # 1 TO THE MODULE ITSELF

OK

3.3.1.9. Send a Stored SMS

A SMS stored in the "SM" storage type is sent using the following AT command. Its storage location index is needed.

AT+CMSS=<index>

Example:

Send the stored SMS to the module itself:

Select Text Mode

AT+CMGF=1

OK

Select "SM" storage to read SMS

AT+CPMS="SM"

+CPMS: 1,50,1,50,1,50

OK

Read the SMS stored on position 1.

AT+CMGR=1

+CMGR: "STO SENT","+39329X569YYY","WIND SIM"

SEND THE STORED SMS # 1 TO MODULE ITSELF

OK

Select how the new received message event is indicated by the DCE to the DTE.

AT+CNMI=1,1,0,0,0

OK

Send the stored SMS # 1 message to module itself.

AT+CMSS=1

+CMSS: 79

OK

The module itself receives the SMS #1, the following unsolicited indication is shown on DTE:

+CMTI: "SM",2

3.3.1.10. Delete an SMS

Use the following AT command to delete an SMS stored on the "SM" storage type.

AT+CMGD=<index>

Example:

Deleting an SMS stored in "SM" storage type:

AT+CPMS="SM"   Select memory storage

+CPMS: 13,50,13,50,13,50

OK

AT+CMGD=?   Check the SMS

+CMGD: (1,2,3,4,5,6,7,8,9,10,11,12,13),(0-4)

OK

Delete SMS in memory position 1.

AT+CMGD=1

OK

Check if the SMS is deleted:

AT+CMGD=?

+CMGD: (2,3,4,5,6,7,8,9,10,11,12,13),(0-4)

OK

Delete all SMS. Disregard the first parameter of the +CMGD.

AT+CMGD=1,4

OK

AT+CMGD=?

+CMGD: (),(0-4)

OK

3.3.1.11. Read an SMS

An SMS is read with the following command:

AT+CMGR=<index>

Example:

AT+CPMS?

+CPMS: "SM",1,50,"SM",1,50,"SM",1,50

OK

Read the SMS #1, for the first time, in storage memory "SM", position 1:

AT+CMGR=1

+CMGR: "STO SENT","+39329X569YYY","WIND SIM"

SEND THE STORED SMS # 1 TO MODULE ITSELT

OK

3.3.1.12. SMS Status

SMSs can be gathered into 5 different groups depending on their Status:

- REC UNREAD: received messages still not read

- REC READ: received messages already read

- STO UNSENT: written messages not yet sent

- STO SENT: written messages already sent

- ALL: all types of messages

Use the following AT command to query the SMS status:

AT+CMGL=<stat>

Check if Text Mode is active

AT+CMGF?

+CMGF: 1   Text Mode is active

OK

Check the supported SMS status

AT+CMGL=?

+CMGL: ("REC UNREAD","REC READ","STO UNSENT","STO SENT","ALL")

OK

Check the available SMS storage type

AT+CPMS?

+CPMS: "SM",6,30,"SM",6,30,"SM",6,30

OK

List all the SMSs stored on "SM" storage with their Status.

AT+CMGL="ALL"

+CMGL: 1,"REC READ", •••• SMS body ••••

+CMGL: 2,"REC READ", •••• SMS body ••••

+CMGL: 3,"REC READ", •••• SMS body ••••

+CMGL: 4,"STO SENT", •••• SMS body ••••

+CMGL: 5,"STO SENT", •••• SMS body ••••

+CMGL: 6,"REC READ", •••• SMS body ••••

OK

List the SMSs stored on "SM" storage with their Status=STO SENT

AT+CMGL="STO SENT"

+CMGL: 4,"STO SENT", •••• SMS body ••••

+CMGL: 5,"STO SENT", •••• SMS body ••••

OK

3.3.1.13. Cell Broadcast Service

GSM Standards specify two different SMS types:

- SMS Point to Point (SMS/PP),

- SMS Cell Broadcast (SMS/CB).

The first type can send a text message long up to 160 characters from a module to the another (as stated on the previous paragraphs), the second type allows the Network to send, at the same time, a message to all modules contained in the defined area including one or more radio cells. The availability and the implementation of the Cell Broadcast Service are strictly connected with the Network Operator of the subscriber.

Use the following AT command to enable the Cell Broadcast Service:

AT+CSCB=[<mode>[,<mids>[,<dcss>]]]

Select Text Mode.

AT+CMGF=1

OK

Select the District service.

AT+CSCB=0,50,0

OK

Select how the new received message event is indicated by the DCE to the DTE.

AT+CNMI=2,0,2,0,0

OK

After a while the "District" broadcast message is displayed on the DTE.

+CBM: 24,50,1,1,1

TRIESTE

+CBM: 4120,50,2,1,1

TRIESTE

+CBM: 8216,50,1,1,1

TRIESTE

+CBM: 12312,50,2,1,1

TRIESTE

The network operator can provide the following list of Services, it is not mandatory:

<mids>	Service name
000	Index
010	Flashes
020	Hospitals
022	Doctors
024	Pharmacy
030	Long Distant Road Reports
032	Local Road Reports
034	Taxis
040	Weather
050	District
052	Network Information
054	Operator Services
056	Directory Inquiries (national)
057	Directory Inquiries (international)
058	Customer Care (national)
059	Customer Care (international)

3.3.2.   Phonebooks

The user can access the different Phonebook types, stored on the SIM card or on the NVM memory, by means of the dedicated AT commands. The modules support the Phonebooks described in the following sub-chapters.

3.3.2.1. Phonebook types

The choice of the Phonebook type must be the first Phonebook operation. Once storage is selected, it is no longer needed to select it again until the desired storage remains the same, and the module is not turned off.

<storage>

- **"SM" – SIM Phonebook**: is used to store and recall phone numbers.

- **"FD" – SIM Fixed Dialing-Phonebook**: It is accessible by means of the PIN2 code.

- E.g.: if the "FD" storage holds the following string numbers 0432, 040, the module can call only phone numbers starting with one of the two string numbers.

- **"LD" – SIM Last-Dialing-Phonebook**: is the list of the last dialed phone numbers; it is updated automatically in SIM. +CPBW command can be only used to delete phone numbers.

- **"MC" – NVM Missed-Calls-Phonebook:** is the list of the received calls not answered. It is updated automatically. +CPBW command can be only used to delete phone numbers.

- **"RC" – NVM Received-Calls-List:** is the list of the received and answered calls. It is updated automatically. +CPBW command can be only used to delete phone numbers.

- **"DC" – NVM Last-Dialing-Phonebook:** is the list of the last dialed phone numbers stored on the module (NVM); it is updated automatically. +CPBW command can be only used to delete phone numbers.

- **"MB" – SIM Mail-Box-List**: is a read only list of the phone mailbox numbers. The MB must be supported by SIM.

- **"ME" – NVM Module Phonebook:** is used to store and recall phone numbers.

- "EN" - SIM Emergency List: is a read only list of the emergency phone numbers stored on SIM.

- **"ON" – SIM Own Number:** is the list of the SIM numbers, e.g.: SIM number for voice call and SIM number for data call.

- **"SD" – SIM Service Dialling Numbers:** (SDN) phonebook. +CPBW is not applicable for this storage.

3.3.2.2. Select Phonebook Memory Storage

Use the following AT command to select the Phonebook Memory Storage:

AT+CPBS=<storage>

Examples:

AT+CPBS=?   ← Read the supported range of Phonebook Storages

+CPBS: ("SM","FD","LD","MC","RC","DC","ME","EN","ON","MB","SD")

OK

AT+CPBS?   ←   Read the current phonebook storage

+CPBS: "SM",19,250

OK

3.3.2.3. Search Phonebook Entries

Use the following AT command to search a Phonebook entry.

AT+CPBF=<findtext>

Examples:

Read the current Phonebook storage and select "SM" storage:

AT+CPBS?

+CPBS: "MC",0,20

OK

AT+CPBS="SM"

OK

AT+CPBS?

+CPBS: "SM",10,250

OK

Look for entries having name starting with "FA" on the selected storage:

AT+CPBF="FA"

+CPBF: 7,"+39404192",145,"Fabio",0,"","",129,"",""

+CPBF: 9,"040492",129,"Fabrizio",0,"","",129,"",""

OK

Look for an entry not present on the selected storage. Before doing that verify if the Extended Error result code is enabled.

AT+CMEE?

+CMEE: 2

OK

AT+CPBF="FAUSTO"

+CME ERROR: not found

Note: The search for <name> string is not case sensitive, and the string may or may not be included in double brackets.

3.3.2.4. Read Phonebook Entries

Use the following AT command to read a Phonebook entry:

AT+CPBR=<index1>[,<index2>]

Select "SM" storage:

AT+CPBS="SM"

OK

Look for the entry at the position index = 7:

AT+CPBR=7

+CPBR: 7,"+39404192",145,"Fabio",0,"","",129,"",""

OK

Look for the entries from position 7 up to position 9:

AT+CPBR=7,9

+CPBR: 7,"+39404192",145,"Fabio",0,"","",129,"",""

+CPBR: 9,"040492",129,"Fabrizio",0,"","",129,"",""

OK

The position 8 is empty.

3.3.2.5. Write Phonebook Entry

Use the following AT command to write a Phonebook entry:

AT+CPBW=[<index>][,<number>[,<type>[,<text>[,<group>[,<adnumber>[,<adtype>
[,<secondtext>[,<email>[,<hidden>]]]]]]]]]

Examples:

Select the "SM" phonebook:

AT+CPBS="SM"

OK

Write a new record on the first free position of the selected "SM" phonebook:

AT+CPBW=,"0404192",129,"NewRecord"

OK

Check where the new record has been written:

AT+CPBF="NEW"

+CPBF: 8,"0404192",129,"NewRecord",0,"","",129,"",""

OK

4.2.6. Delete Phonebook Entry

Use the following AT command with only <index> parameter to delete a Phonebook entry:

AT+CPBW=<index>

Examples:

Select the "SM" phonebook:

AT+CPBS="SM"

OK

Delete record 7 on the "SM" phonebook:

AT+CPBW= 7

OK

Try to delete a non-existent record on the "SM" phonebook, just to see the format response:

AT+CPBR=7

OK

Note: The delete command overwrites the <index> record number with an empty record.

3.3.3.   GPIO Control

Telit module provides various GPIO pins, which can be configured as input or output by means of the AT#GPIO AT command.

User applications, through AT#GPIO command, can control external user equipment connected to GPIO pins. Simple or no circuitries are needed to perform the required hardware interface.

3.3.3.1. Set GPIO pin as Output

Use the following AT command to set a GPIO as output with Low or High status.

AT#GPIO=<pin>,<value>,1

Example:

Set GPIO3 pin as output with Low status:

AT#GPIO=3,0,1

OK

Set GPIO4 pin as output with High status:

AT#GPIO=4,1,1

OK

3.3.3.2. Set GPIO pin as Input

Use the following AT command to set a GPIO as input with internal pull-up/down.

AT#GPIO=<pin>,<mode>,0

Example:

Set GPIO3 pin as Input with internal pull-down:

AT#GPIO=3,4,0

OK

Set GPIO4 pin as Input with internal pull-up:

AT#GPIO=4,3,0

OK

3.3.3.3. Set GPIO pin status

Use the following AT command to read a GPIO status.

AT#GPIO=<pin>,2

Example:

Set GPIO3 pin as output with low status.

AT#GPIO=3,0,1
OK

Set GPIO4 pin as input with internal pull-down.

AT#GPIO=4,4,0
OK

Now, connect GPIO3 with GPIO4 physically and then check the GPIO4 status.

AT#GPIO=4,2
#GPIO: 0,0,4   ← GPIO4 status is low by GPIO3 pin

OK

Set GPIO3 pin as output with high status.

AT#GPIO=3,1,1
OK

Check GPIO4 status.

AT#GPIO=4,2
#GPIO: 0,1,4   ← GPIO4 status is high by GPIO3 pin

OK

Check GPIO3 status.

AT#GPIO=3,2
#GPIO: 1,1   ← GPIO3 status is high as configured before

OK

Note: GPIO_09 and GPIO_10 are assigned to I2C alternate function as default.

3.3.4.   Clock

3.3.4.1. Set Module Clock

Use the following AT command to update the module clock:

AT+CCLK="<time>"

Set up the clock to 7 November 2002 at 12h 24m 30s for the time zone +01h central Europe:

AT+CCLK="02/11/07,12:24:30+04"

OK

The time is successfully set.

Note: The updated time starts immediately after the time setting command.

3.3.4.2. Read the Current Date and Time

Use the following AT command to display the current module time.

AT+CCLK?

Read the current time:

AT+CCLK?

+CCLK="02/11/07,12:26:47"

OK

Current date/time is: 7 November 2002 12h 26m 47s

Enter the current time: year/month/day,hour:minute:seconds±time zone:

AT+CCLK="08/05/16,09:20:30+00"

OK

Read the current time:

AT+CCLK?

+CCLK: "08/05/16,09:20:52"

OK

Note: The three last characters of <time> are not returned by the command because the used module does not support time zone information.

3.3.4.3. Automatic Data/Time updating

Use the following AT command to enables or disables the data/time updating:

AT#NITZ=<val>,<mode>

Please note that not all Operators support this feature.

Examples:

AT#NITZ?

#NITZ: 7,0

OK

AT#NITZ=15,1   enable full data/time updating

OK

AT&W0

OK

AT&P0

OK

Power cycle the module, after network registration, depending on the Network Provider configuration, the following unsolicited indication will appear:

#NITZ: 10/11/30,14:36:37+04,0   ←   date/time and time zone + daylight saving time

Now, type in the following commands just to compare between the commands responses formats.

AT+CCLK?

+CCLK: "10/11/30, 14:36:42+04"   ←   date/time and time zone

OK

3.3.5.   TCP/IP Protocol

3.3.5.1. 3G Dialup Connection

The following two sub-chapters describe how to establish a dialup connection. The connection uses the following protocols:

- PPP   running on the PC (or Application Equipment), and on the module
- TCP/IP   running only on the PC (or Application Equipment)

Check the current network operator.

AT+COPS?

+COPS: 1,0,"network operator",2   ← 2 = UTRAN

OK

Check the current module attachment state.

AT+CGATT?

+CGATT: 1

OK

Use <cid>=1 to configure the PDP context.

AT+CGDCONT=1,"IP","APN"

OK

Type in the dialup command to enter the ONLINE Mode. By default, the command uses the <cid>=1.

ATD*99#

CONNECT

Now, your application should start the PPP protocol, which triggers the PDP context activation.

3.3.5.2. Default/Dedicated EPS Bearers

In GPRS and 3G networks, the data session is established by means of the Packet Data Protocol (PDP) Context procedure. Before the PDP context can be established, the module must perform an Attach procedure, which communicates to the SGSN (Serving

GPRS Support Node) that the module needs to initiate a data session. After the Attach procedure is completed, the module can perform the first PDP Context procedure that will establish the data session, and allocate an IP address to the module. This PDP Context will have a QoS (Quality of Service) associated with it, based on the current needs. If the module needs to establish multiple data sessions, it will set up and activate a second, third PDP Context activation and so on.

In LTE (4G) modules, there are two types of data session setups.

- **Default Evolved Packet System (EPS) Bearer.**

When UE attaches to the network for the first time, it will be assigned a default bearer that remains as long as UE is attached. UE can have additional default bearers as well. Each default bearer comes with a separate IP address. Default bearer does not have specific QoS (non-GBR bearer) associated with it.

- **Dedicated Evolved Packet System (EPS) Bearer.**

It is created when the requested service cannot be fulfilled through default bearer. Some services require a high level of QoS like VoIP, video etc. Therefore, the network creates a dedicated bearer with required QoS (can be GBR or non-GBR).

A dedicated bearer does not require a separate IP address: only additional default bearers needs an IP address, therefore dedicated bearer is always linked to one of the default bearer established previously.

To gather information on AT commands syntax and related parameters please refer to the LN920 AT commands reference guide document [1].

3.3.5.2.1. Default EPS Bearer at UE Power on

Example:

Power on a LN920 moden (4G). By default, the <p_cid>=1 context identifier is assigned to a not-defined APN.

AT+CGDCONT?

+CGDCONT: 1,"IPV4V6","","",0,0

OK

When the network recognizes the attach request with a not defined APN, it assigns its Default EPS Bearer to <p_cid>=1. The UE is 4G attached.

AT+CGATT?

+CGATT: 1

OK

After the Attach procedure, the <p_cid>=1

identifies the PDP context assigned by the network.

AT+CGACT?

+CGACT: 1,1

OK

List the parameters regarding the Default PDP Context assigned by the network, and associated to <p_cid>=1 context identifier.

AT+CGCONTRDP=1

+CGCONTRDP:

1,	p_cid
5,	bearer_id
"lte.tim.it.mnc001.mcc222.gprs",	apn
"10.178.43.36",	ip_addr
,	gw_addr
"213.230.129.10",	DNS_prim_addr
"168.126.63.1",	DNS_sec_addr

OK

___

> **Note:** The functionalities of the Default PDP context assigned by the network depend on the Network configuration.

___

When <p_cid>=1 is associated to a user APN, i.e. the APN identifier is not empty, that APN is used by the module during the 4G registration and data connection procedures. Some Network Operators could not allow the 4G registration when the user APN is used, and they could force a detach. If this happens, it is recommended to set the user APN on a <p_cid> different from 1 and keep on <p_cid> 1 the empty APN.

3.3.5.2.1.1. Change a Default EPS Bearer at UE Power on

Following these steps, it is possible to replace the Default EPS Bearer with a user-defined PDP Context. Set up the new PDP Context associated to <p_cid>=1.

AT+CGDCONT=1,"IP","ibox.tim.it"

OK

Check the setting of the new PDP Context.

AT+CGDCONT?

+CGDCONT: 1,"IP","ibox.tim.it","",0,0

OK

Detach the UE from the network.

AT+CGATT=0

OK

Attach the UE: in a 4G network, the new PDP Context associated to <p_cid>=1 is automatically activated.

AT+CGATT=1

OK

List the parameters regarding the new Default EPS Bearer set and activated by the user.

AT+CGCONTRDP=1

+CGCONTRDP:

1,	p_cid
5,	bearer_id
"ibox.tim.it.mnc001.mcc222.gprs",	apn
"2.192.4.65",	ip_addr
,	gw_addr
"10.207.43.46",	DNS_prim_addr
"10.205.56.223",	DNS_sec_addr

OK

The UE saves the Default EPS Bearer parameters in NVM: at each reboot, the modem protocol stack uses them.

Reboot the module and verify the PDP Context.

AT+CGDCONT?

+CGDCONT: 1,"IP","ibox.tim.it","",0,0

OK

3.3.5.2.2. Establish a Default EPS Bearer

In LTE networks, the default EPS bearer associated with <p_cid>=1 is activated by piggybacking on LTE attach procedure and maintained until detached

The following commands can establish another default EPS Bearers:

- **QMI WDS command**

  Please refer to the QMI interface user guide document. Connection manager should be implemented in Host side, based on capability of communicating with the module with QMI technology.

- **AT+CGACT**

  Establishes a Default EPS Bearer. If the module (UE) is not attached, it does the Attached procedure and then activates the PDP Context. It is only for the purpose of testing rather than real use case.

- **ATD**

  Establishes a Default EPS Bearer. It provides a dialup connection: PPP protocol is used to exchange data between the PC (or Application Equipment) and the module (UE), the TCP/IP stack is running on the PC.

Note: The AT commands shown in this chapter cannot use together the same <cid>.

3.3.5.2.2.1. IP Easy Connection

Example 1:

Assume that the Default EPS Bearer associated to the <p_cid>=1 is "IP","ibox.tim.it".

AT+CGDCONT?

+CGDCONT: 1,"IP","ibox.tim.it","",0,0

OK

Check if the UE is registered on a 4G network.

AT+COPS?

+COPS: 0,0,"I TIM",7   7 = E-UTRAN

OK

Check if the Default EPS Bearer is active

AT+CGCONTRDP=?

+CGCONTRDP: (1)

OK

Check the IP address

AT+CGPADDR=

+CGPADDR: 1,"2.192.16.194"

OK

3.3.5.2.2.2. Dialup Connection

Dialup is a legacy method to access the internet service using public switched telephone network. The DTE uses a modem to send and receive internet protocol packets. Thus, it is limited to support high speed data rate over LTE technology.

It is not recommend to use this method for internet access.

Example:

Use COM1 port to enter the next commands, and assume that the Default EPS Bearer associated to the <p_cid>=1 is "IP","ibox.tim.it".

AT+CGDCONT?

+CGDCONT: 1,"IP","ibox.tim.it","",0,0

OK

Check if the UE is registered on a 4G network.

AT+COPS?

+COPS: 0,0,"I TIM",7   7 = E-UTRAN

OK

Check if the Default EPS Bearer is active

AT+CGCONTRDP=?

+CGCONTRDP: (1)

OK

Enter the following command to force the UE in the ONLINE Mode. The command uses the <cid>=1.

ATD*99*1#**

CONNECT

Now, your application should start the PPP protocol.

3.3.5.2.2.3. Mobile Broadband Networking (RmNet)

RmNet is a proprietary USB virtual Ethernet framework developed by Qualcomm for its mobile phone platforms. RmNet provides for improved throughput via the Thin Layer Protocol (TLP) and allows for Quality of Service flow control.

To support LTE high speed data rate, this product provides mobile broadband USB interface where DTE can be experienced high quality data service over LTE technology without any limitation.

This network interface is configured on Device Manager of Windows once USB driver is installed, followed by this product being connected to DTE using USB cable

Telit USB WWAN Adapter
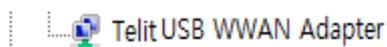
Connecting to mobile broadband networking is possible through "Control" →"Network and Internet" → "Network Connection" over Windows

It is strongly recommended that the application supports RmNet technology to leverage LTE high speed date rate.

3.3.6.   GNSS operation

3.3.6.1. Introduction

The LN920 family module is equipped with IZat™ Gen 9 GNSS receiver, controllable by the modem using a set of AT commands or dedicated NMEA sentences.

3.3.6.2. LN920 family module Serial Ports

4 virtual serial ports are available on the module:

- MODEM #1 USB SERIAL PORT

- MODEM #2 USB SERIAL PORT

- AUX USB SERIAL PORT

- NMEA USB SERIAL PORT

3.3.6.3. WGS 84

GPS receivers perform initial position and velocity calculations using an earth-centered earth-fixed (ECEF) coordinate system. Results may be converted to an earth model (geoid) defined by the selected datum. For LN920 family module's default datum is WGS 84 (World Geodetic System 1984) which provides a worldwide common grid system that may be translated into local coordinate systems or map dates. (Local map dates are a best fit to the local shape of the earth and not valid worldwide)

3.3.6.4. NMEA 0183

The NMEA 0183 is a specification created by the National Marine Electronics Association (NMEA), defining the interface between other marine electronic equipment. The standard allows marine electronics to send information to computers and other marine equipment. GPS receiver communication is defined within this specification. The currently supported version is **4.10.**

The provided NMEA sentences are:

GGA   GPS Fix Data. Time, position and fix type data.

GLL   Geographic Position - Latitude/Longitude

GSA   GPS receiver operating mode, satellites used in the position solution and DOP values.

GSV   The number of GPS satellites in view satellite ID numbers, elevation, azimuth, and SNR values.

RMC   Time, date, position, course and speed data.

VTG   Course and speed information relative to the ground

GNS   GNSS fix data.

Note: The NMEA USB port provides the following sentences with $GPSNMUN command: GGA, GLL, GSA, GSV, RMC, VTG.

The NMEA USB port provides the following sentences with $GPSNMUNEX command: GNS.

3.3.6.4.1. GGA – Global Position System Fixed Data

This sentence provides time, position, and fixes related data for a GPS Receiver. Table A contains the values for the following example:

$GPGGA,161229.48,3723.247522,N,12158.341622,W,1,07,1.0,72.1,M,18.0,M,,*18

Table A: GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header GP: GPS Talker ID GN: GNSS Talker ID BD: Beidou Talker ID
UTC Time	161229.48		hhmmss.ss
Latitude	3723.247522		ddmm.mmmmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.341622		dddmm.mmmmmm
E/W Indicator	W		E=east or W=west
Position Fix Indicator	1		See Table B
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude	72.1	meters	Antenna Altitude above/below mean-sea-level (geoid).
Units	M	meters	Units of antenna altitude
Geoid Separation	18.0	meters	The difference between the WGS-84 earth ellipsoid and the mean-sea-level (geoid), "-" means mean-sea-level below ellipsoid.
Units	M	meters	Units of geoidal separation
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID			Null fields when DGPS is not used

Table A: Position Fix Indicator

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3	GPS PPS Mode, fix valid
4	Real Time Kinematic
5	Float RTK
6	Estimated (dead reckoning) Mode
7	Manual Input Mode

8	Simulator Mode

3.3.6.4.2. GLL – Geographic Position – Latitude/Longitude

This sentence provides latitude and longitude of vessel position, time of position fix and status. Table C contains the values for the following example:

$GPGLL,3723.247522,N,12158.341622,W,161229.48,A,A*41

Table C: GLL Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header GP : GPS Talker ID
Latitude	3723.247522		ddmm.mmmmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.341622		dddmm.mmmmmm
E/W Indicator	W		E=east or W=west
UTC Time	161229.48		hhmmss.ss
Status	A		A=data valid or V=data not valid
Mode Indicator	A		See Table D
Checksum	*41		
<CR> <LF>			End of message termination

Table D : Mode Indicator

Value	Description
N	Fix not available or invalid
A	GPS SPS Mode, fix valid
D	Differential GPS, SPS Mode, fix valid
P	GPS PPS Mode, fix valid
R	Real Time Kinematic
F	Float RTK
E	Estimated (dead reckoning) Mode
M	Manual Input Mode
S	Simulator Mode

3.3.6.4.3. GSA – GNSS DOP and Active Satellites

This sentence reports the GPS receiver's operating mode, satellites used in the navigation solution reported by the GGA sentence and DOP values. Table D contains the values for the following example:

$GPGSA,A,3,07,02,26,27,09,04,15, , , , , , ,1.8,1.0,1.5,1*33

<p align="center">Table E: GSA Data Format</p>

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header GP : GPS Talker ID GN : GNSS Talker ID
Mode 1	A		See Table F
Mode 2	3		See Table G
Satellite Used1. Satellite used in solution.1	07		Sv on Channel 1 GPS : 1-32 SBAS : 33-64 (offset 87) GLONASS : 65-96. GALILEO :1-36 (offset 300) BEIDOU :1-37 (offset 200) QZSS: 1-5 (offset 192)
Satellite Used1	02		Sv on Channel 2
....			
Satellite Used1			
PDOP	1.8		Position Dilution Of Precision
HDOP	1.0		Horizontal Dilution Of Precision.
VDOP	1.5		Vertical Dilution Of Precision.
GNSS System ID	1		1=GPS 2=GLONASS 3=GALILEO 4=BEIDOU 5=QZSS
Checksum	*33		
<CR> <LF>			End of message termination

<p align="center">Table F: Mode 1</p>

Value	Description
M	Manual—forced to operate in 2D or 3D mode
A	2D Automatic—allowed to automatically switch 2D/3D

<p align="center">Table G: Mode 2</p>

Value	Description
1	Fix not available
2	2D (<4 SVs used)
3	3D (>3 SVs used)

3.3.6.4.4.   GSV – GNSS Satellites in View

This sentence reports the number of satellites (SV) in view, satellite ID numbers, elevation, azimuth and SNR value. There could be four satellites information per transmission so; if the number of satellites in view is bigger, separated GSV sentences will be generated. The number of sentence in transmission and the total to be transmitted

is shown in the first 2 fields of the sentence. Table G contains the values for the following example:

$GPGSV,2,1,07,07,79,048,42,02,51,062,43,26,36,256,42,27,27,138,42,1*71

$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42,1*41

Table H: GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header GP: GPS Talker ID GL: GLONASS Talker ID BD: BEIDOU Talker ID
Number of Messages	2		Range 1 to 3
Message Number1	1		Range 1 to 3
Satellites in View	07		
Satellite ID	07		Channel 1 GPS : 1-32 SBAS : 33-64 (offset 87) GLONASS : 65-96. GALILEO :1-36 (offset 300) BEIDOU :1-37 (offset 200) QZSS: 1-5 (offset 192)
Elevation	79	degrees	
Azimuth	048	degrees	
SNR (C/No)	42	dBHz	
....	....	....	
Satellite ID	27		Channel 4
Elevation	27	degrees	Channel 4 (Maximum 90)
Azimuth	138	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, null when not tracking
Signal ID	1		GPS, SBAS: 1 (L1C/A) GLONASS: 1 (L1C/A) GALILEO: 7(L1B/C) BEIDOU: 1(B1I) QZSS: 1 (L1C/A)
Checksum	*71		
<CR> <LF>			End of message termination

3.3.6.4.5.   RMC – Recommended Minimum Specific GNSS Data

This sentence reports Time, date, position, and course and speed data. Table H contains the values for the following example:

$GPRMC,161229.48,A,3723.247533,N,12158.341633,W,0.13,309.62,281118,6.1,W,A,V*10

Table I: RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header GP : GPS Talker ID
UTC Time	161229.48		hhmmss.ss
Status	A		A=data valid or V=data not valid

Latitude	3723.247533		ddmm.mmmmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.341633		dddmm.mmmmmm
E/W Indicator	W		E=east or W=west
Speed Over Ground	0.13	knots	
Course Over Ground	309.62	degrees	True
Date	281118		ddmmyy
Magnetic Variation	6.1	degrees	E=east or W=west
Mag variation direction	W		E/W. E subtracts mag var from true, W adds mag var to true.
Mode Indicator	A		See Table D
Navigational status Indicator	V		V (equipment is not providing navigational status indication).
Checksum	*10		
<CR> <LF>			End of message termination

3.3.6.4.6.   VTG – Course over Ground and Ground Speed

This sentence reports the actual course and speed relative to the ground.

Table I contains the values for the following example:

$GPVTG,309.62,T, ,M,0.13,N,0.2,K,A*23

Table J: VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header GP : GPS Talker ID
Course	309.62		Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		Magnetic
Speed	0.13	knots	Measured horizontal speed
Units	N	Knots	
Speed	0.2	km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Mode Indicator	A		See Table D
Checksum	*23		
<CR> <LF>			End of message termination

3.3.6.4.7.   GNS – GNSS fix data

This sentence reports the GNSS fix data.

Table I contains the values for the following example:

$GNGNS,084509.00,3731.283789,N,12655.755481,E,ANNN,07,1.2,110.7,18.0,,,V*26

Table K: GNS Data Format

Name	Example	Units	Description
Message ID	$GNGNS		GNS protocol header GN : GNSS Talker ID
UTC Time	084509.00		hhmmss.ss

Latitude	3731.283789		ddmm.mmmmmm
N/S Indicator	N		N=north or S=south
Longitude	12655.755481		dddmm.mmmmmm
E/W Indicator	E		E=east or W=west
Mode Indicator	ANNN	km/hr	Fixed length field; contains four characters, The first symbol relates to GPS The second one – to GLONASS The third one – to GALILEO The fourth one – to BEIDOU The fifth one – to QZSS See Table D
Satellites Used	07		Number of satellites in use, (Gps+Glonass+Galileo+Beidou)
HDOP	1.2		Horizontal Dilution Of Precision.
MSL Altitude	110.7	meters	Antenna Altitude above/below mean-sea-level (geoid)
Geoid Separation	18.0		The difference between the WGS-84 earth ellipsoid and the mean-sea-level (geoid), "-" means mean-sea-level below ellipsoid.
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID			Null fields when DGPS is not used / 0000-1023
Navigational Status	V		V (Equipment is not providing navigational status indication)
Checksum	*26		
<CR> <LF>			End of message termination

3.3.6.5. Checking GNSS Device Functionality

After power on, the device is ready to receive AT commands on the MODEM serial port.

When the **$GPSP** command is issued, The GNSS receiver also will be powered on and it will start the scan of the available GNSS signals.

On the NMEA USB port (default 115200 bps, 8, n, 1), the GNSS data stream will be outputed when the NMEA sentences are configured through $GPSNMUN command.

3.3.6.6. Controlling GNSS Receiver

The LN920 family module is provided by a set of AT commands that allow to configure and use it through the MODEM serial port.

3.3.6.6.1. Power Control of GNSS Receiver

The GNSS receiver is switched off by default at the first power on. If is necessary to switch it on or off is possible to use the AT$GPSP command. The GNSS receiver is usable if the module is switched on (or at least in power saving). This command also switches off the GNSS antenna supply.

GNSS receiver "On" or "Off" means GNSS positioning session Start or Stop.

Syntax of the command **AT$GPSP=<status>**

Where:

<status> - 0 Stop GNSS positioning session (default), 1 Start GNSS positioning session, ? Returns the range of values accepted

AT$GPSP? will return the current status.

Example 1: (to switch on the GNSS)

AT$GPSP=1<CR>

OK

Example 2: (to know the status)

AT$GPSP?<CR>

The answer will be:

$GPSP: 0

OK

3.3.6.6.2.   GNSS Reset

With the command **AT$GPSR=<reset_type>** is possible to reset the GNSS module.

Parameter:

<reset_type>

0 - Factory reset: This option clears all GPS memory including clock drift.

1 - Coldstart (No Almanac, No Ephemeris): this option clears all data that is currently stored in the internal memory of the GPS receiver including position, almanac, ephemeris, and time. The stored clock drift however, is retained.

2 - Warmstart (No ephemeris): this option clears all initialization data in the GPS receiver and subsequently reloads the data that is currently displayed in the Receiver Initialization Setup screen. The almanac is retained but the ephemeris is cleared.

3 - Hotstart (with stored Almanac and Ephemeris): the GPS receiver restarts by using the values stored in the internal memory of the GPS receiver; validated ephemeris and almanac.

Example:

It is available to set **<reset_type>** in non-controlled mode.

Let's suppose to perform a cold start of the GNSS receiver.

AT$GPSR=1<CR>

OK

The Receiver will clear all the parameters in its memory and it will start a scanning of the available satellites.

AT$GPSP=1<CR>

OK

It is available in controlled mode too.

AT$GPSP=1<CR>

OK

Let's suppose to perform a cold start of the GNSS receiver.

AT$GPSR=1<CR>

OK

The Receiver will clear all the parameters in its memory and it will start a new scanning of the available satellites.

3.3.6.6.3.   GNSS Antenna Management

The GNSS receiver supports active antennas, whose LNA DC supply (3.1V) could be supplied by the module through the GNSS antenna port. By default, the antenna supply is set to OFF.

Refer to the following **$GPSANTPORT** command to configure the port and type of GNSS antenna.

The syntax is AT$GPSANTPORT=<type>

Parameter:

<type> : Enabled Port type

0 – Disable GNSS on AUX Port and GNSS Port. (GNSS Off)

1 – Enable GNSS on AUX port and disable GNSS on GNSS port; Internal LNA On, DC-Bias Off. (Passive antenna on Aux Port)

2 – Enable GNSS on GNSS port and disable GNSS on AUX port; Internal LNA On, DC-Bias Off. (Passive antenna on GNSS Port) (**Default**)

3 – Enable GNSS on GNSS port and disable GNSS on AUX port; Internal LNA Off, DC-Bias On. (Active antenna on GNSS Port)

4 – Enable GNSS on GNSS port and disable GNSS on AUX port; Internal LNA On, DC-Bias On. (Active antenna on GNSS Port, High Gain)

3.3.6.6.4. GNSS Parameters Save

This command allows saving the set parameters in the module's memory

Syntax of the command

AT$GPSSAV

3.3.6.6.5. Restore GNSS Parameters

This command allows restoring the factory default parameters for the GNSS module

Syntax of the command:

AT$GPSRST

After this command the module should be restarted to make the changes effective.

Note: If the GPS controller is powered up (see $GPSP), the GPS controller is powered down because the GPS parameters should be reset with factory default.

3.3.6.6.6. Read Acquired GNSS position

This command allows reading the position acquired by the GNSS receiver

Syntax of the command

AT$GPSACP

The response syntax is:

$GPSACP:<UTC>,<latitude>,<longitude>,<hdop>,<altitude>,<fix>,<cog>, <spkm>,<spkn>,<date>,<nsat>

The fields contain the following information:

<UTC>:   (referred to GGA sentence)

hhmmss   UTC of Position

Values:

    hh (hour) 00 to 23

    mm (minutes) 00 to 59

    ss (seconds) 00 to 59

<latitude>:   (referred to GGA sentence)

ddmm.mmmmmm N/S

Values:

    dd (degrees) 00 to 90

    mm.mmmmmm (minutes) 00,000000 to 59.999999

    N/S: North / South

<longitude>:   (referred to GGA sentence)

dddmm.mmnnmm E/W

Values:

    ddd (degrees) 00 to 180

    mm.mmmmmm (minutes) 00,000000 to 59.999999

    E/W: East / West

<hdop>:   (referred to GGA sentence)

x.x   Horizontal Diluition of Precision

<altitude>:   (referred to GGA sentence)

xxxx.x   Altitude - mean-sea-level (geoid) (meters)

<fix>:

    0 - Invalid Fix

    2 - 2D fix

    3 - 3D fix

<cog>:   (referred to VTG sentence)

ddd.mm   Course over Ground (degrees, True)

Values:

    ddd: 000 to 360 degrees

mm 00 to 59 minutes

<spkm>: (referred to VTG sentence)

xxxx.x Speed over ground (Km/hr)

<spkn>: (referred to VTG sentence)

xxxx.x Speed over ground (knots)

<date>: (referred to RMC sentence)

ddmmyy Date of Fix

Values:

dd (day) 01 to 31

mm (month) 01 to 12

yy (year) 00 to 99 (2000 to 2099)

<nsat>: (referred to GNS sentence)

nn Total number of GNSS satellites in use

Example:

$GPSACP: 080220,3206.402028N,03450.267836E,1.1,3.3,0,0.0,0.0,0.0,030613,18

OK

3.3.7. Fast Shutdown

Once fast shutdown is triggered, the module enters into power off state within a short time. There methods to trigger fast shutdown are:

- Send AT#FASTSHDN command

- Control GPIO after set AT#FASTSHDN=1,<gpio>

- Control GPIO after enable Dying gasp with

    AT#SETCUSTFEAT="DGENABLE",<cust_value>

3.3.7.1. Fast Shutdown by GPIO

Customers can configure one of the GPIOs as fast shutdown trigger pin with following AT commands:

Not Subject to NDA

AT#FASTSHDN=1,<gpio>[,<trigger>]
OK

This configuration is applied at runtime, the GPIO assigned as fast shutdown alternate function with AT#GPIO command can be displayed:

AT#GPIO=<gpio>,2

#GPIO=5,<state>,<mode>

OK

Once the fast shutdown GPIO is controlled by the host and transitions from high to low or low to high according to the <trigger> parameter, the module starts shutdown process and then enters off state.

3.3.7.2.   Fast Sh

It is possible to configure one of the GPIOs as dying gasp trigger pin with the following AT command.

AT#SETCUSTFEAT="DGENABLE",<cust_value>
OK

This configuration is applied at runtime and it is possible to check the GPIO assigned as dying gasp alternate function with AT#GPIO command.

AT#GPIO=<gpio>,2

#GPIO=7,<state>,<mode>

OK

The difference from *3.3.7.1. Fast Shutdown by GPIO* is that dying gasp can trigger some actions before fast shutdown. The action is configured using the command.

AT#SETCUSTFEAT="DGACTION",<cust_value>
OK

Once dying gasp GPIO is controlled by host from high to low or low to high according to **<cust_value>**, module do dying gasp action and progress shutdown operation and then enter off state.
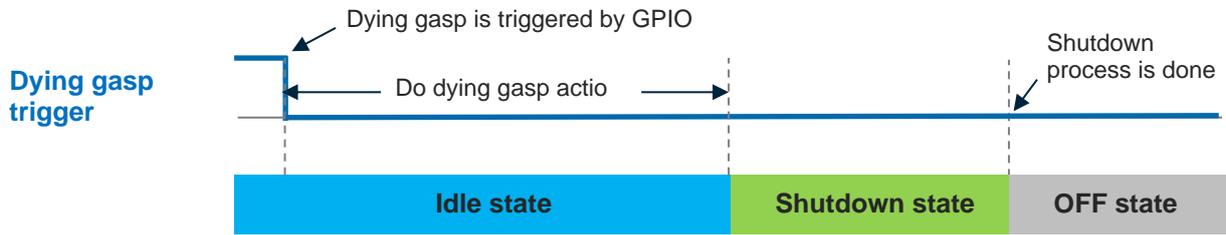
Note: If VBATT is maintained and FULL_CARD_POWER_OFF_N pin is asserted high, the module will turn on automatically after shutdown by fast shutdown trigger.

To remain in OFF state without rebooting automatically Shutdown Indication must be enabled. Please refer 3.8. Shutdown Indication section for details.

3.3.8.   Shutdown Indication

Shutdown indication function can be enabled with one of GPIOs through AT command. Shutdown indication pin is used for two purposes:

- Notification of completed shutdown process.

- Notification of completed boot

On M.2 type modules, module powers on automatically as defined by hardware specifications after shutdown through software (AT or QMI commands). Thus, in order to prevent automatic power on after shutting down, shutdown indication is available.

When the shutdown process inside the module is completed, shutdown indication transitions from High to Low to indicate the module can be powered off safety.

When the module is in OFF state, module power supply can be removed. The modem will not power up until VPH_PWR removal or SYS_RESIN_N is asserted to Low.
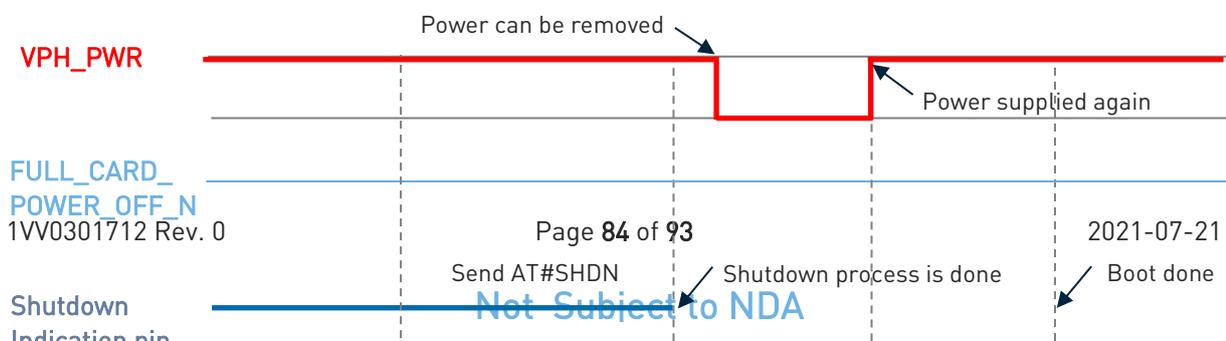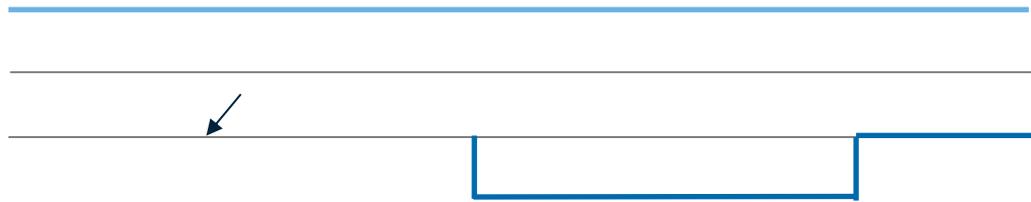
It is also possible to configure the module to remain in OFF state after all shutdown cases: normal shutdown, fast shutdown or both. Please *refer 3.3.11. Enable Shutdown Indication section*.

> In case Shutdown indication is enabled, host should monitor not USB interface but shutdown indication pin signal for distinguish if module is entered OFF state.

3.3.9.   Boot OK Indicator

Shutdown indication pin is also used as "boot okay" pin. When module boot is completed, this pin switches from Low to High and the application can detect that the module has successfully completed boot up.

3.3.10.   Enable Shutdown Indication

AT#SHDNIND command allows enable the shutdown indication function with one of GPIOs. Set command requires two parameters :

```
AT#SHDNIND=<enable>[,<gpio>]
OK
```

Enable GPIO_03 as shutdown indication pin and make module remains on OFF state for both normal and fast shutdown.

```
AT#SHDNIND=3,3
OK
```

To enable shutdown indication with persistent OFF state after shutdown only, use '1' instead of '3' as **<enable>** parameter. In this case, module will reboot automatically after shutdown if fast shutdown was triggered.

```
AT#SHDNIND=1,3
OK
```

3.3.11.   Preserved APN information during F/W upgrade

When this feature is activated by AT command, APN profiles currently stored are backed up to EFS file system and APN profiles that were already backed up and associated with new firmware are restored during firmware upgrade. If no APN profiles are backed up, default carrier profiles are loaded after upgrade. This feature takes effect on not only downloading new firmware or switching the active firmware (ie using AT commands such as AT#FWSWITCH).

3.3.11.1. How to back up APN profiles

Enable the feature by means of AT#PERSISTAPN command

AT#PERSISTAPN=1

OK

AT#PERSISTAPN?

#PERSISTAPN: 1

OK

When downloading new software or switching the active firmware, the APN profiles are backed up and previous back-up data are deleted, if any.

3.3.11.2. How to restore APN profiles

If prerequisites are met, start restoring the APN profiles with backup data.

• 	This feature is enabled by AT command

• 	APN profiles that were already backed up exist.

3.3.11.3. Example

TBD.

3.4.　　FIRMWARE UPDATE TOOL

3.4.1.　　TFI Tool

The firmware update can be performed with a specific software tool provided by Telit running on Windows-based PCs. The program will erase the flash memory content, then will write on the flash memory. "LN920_xxx_TFI.exe" file includes binary image. The binary image included in the TFI package will be checked with SHA256 hash before the TFI firmware update procedure starts. If there are If data corruption is detected, update will be aborted.

The LN920 has three modem slots (M0, M1 and M2) and TFI will handle three modem images. The slot the firmware will be writted to is pre-determined.

When downloading through TFI, the modem slot will be updated as follows:

1. TFI with multi modem image :
   M0, M1 and M2 slots are updated with TFI download.
2. TFI binary with single modem image :
   M0 slot is updated with TFI download, and M1, M2 slots are empty.
   The active slot it changed to M0.

3.4.1.1.　TFI Update Procedure

The TFI update procedure is described as follows.

1.　　Before update with TFI, please check "Telit Serial Diagnostics Interface" in your Windows device manager.
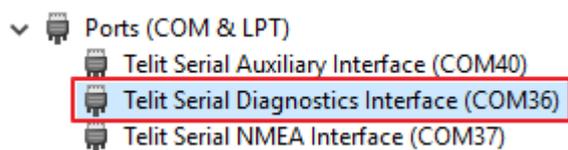
2.　　If you launch LN920_xxx_TFI.exe, Windows CMD prompt will be popped up.

3.　　TFI downloader detects "Telit Serial Diagnostics Interface" automatically and starts download.

```
============================
    TFI V2 (Version 1.02)
============================
Update started at Fri Apr 23 14:06:53 2021


Verifying hash...DONE

File name: LN920_40.00.000-A003_CUST_0010_TFI.exe
Product: LN920
Version: 40.00.000-A003
```

4.   Programming completed message will be displayed after flashing is successfully completed.

```
All binaries flashed...


Firmware update is successful and module will reboot.
----------
 All DONE.
----------
```

5.   Telit LN920 module is now updated with the new firmware.

3.4.2. XFP generator - TBD

- TBD

3.4.3. XFP Update

The XFP is a firmware update method provided by Telit allowing firmware update from the customer's host unit.

The XFP firmware image has CRC for each block and this CRC value is transferred to the module with the binary data. The update will be stop if there are any corrupted data detected on the module.
The LN920 has 3 modem slots (M0, M1 and M2) and XFP stream binary supports one to three modem images that include the pre-determined slot the firmware will be written to. When downloading streaming binary with XFP, modem slot will be updated as following rule.

1. Stream binary has multi modem image :
   M0 and M1 slots both are updated with XFP download.
2. Stream binary has single modem image :
   M0 slot is updated with XFP download, and M1,M2 slot is preserved.
   The active slot is not changed.
3. Stream binary has single modem image for M1 :
   M0, M2 slot are preserved and M1 slot is updated with XFP download.
   The active slot is not changed.
4. Stream binary has single modem image for M2 :
   M0 and M1 slots are preserved, M2 slot is updated with XFP download.
   The active slot is not changed.

3.4.3.1. Window OS

-TBD

3.4.3.2. Linux OS

Telit will supply a reference HOST tool source called uxfp for customers porting on their own host. More detailed information can be found in the UXFP User Guide.

4. GLOSSARY

APN	Access Point Name
BCCH	Broadcast Control Channel
CSD	Circuit Switched Data
CTM	Cellular Text Telephone Modems
CTS	Clear To Send
DCE	Data Circuit-Terminating Equipment
DRX	Discontinuous Reception
DTE	Data Terminal Equipment
DTMF	Dual Tone Multiple Frequency
DTR	Data Terminal Ready
GBR	Guaranteed Bit Rate
GERAN	GSM EDGE Radio Access Network
GNSS	Global Navigation Satellite Sservices
GPIO	General Purpose Input/Output
GUI	Graphic User Interface
HF	Hands Free (old terminology)
HS	Hand Set (old terminology)
HSPA	High Speed Packet Access
IMS	IP Multimedia Subsystem
IRA	International Reference Alphabet
ME	Mobile Equipment
MSISDN	Mobile Station International Subscriber Directory Number
NMEA	National Marine Electronics Association
NVM	Non-Volatile Memory
PDN	Public Data Network
PDP	Packet Data Protocol
PDU	Protocol Data Unit
PIN	Personal Identification Number
PPP	Point to Point Protocol
QMI	Qualcomm MSM interface, Qualcomm modem interface
QMUX	QMI Multiplexing Protocol

QoS	Quality of Service
SIM	Subscriber Identification Module
SMS	Short Message Service
SMSC	Short Message Service Center
TCP/IP	Transmission Control Protocol / Internet Protocol
TTY	Text Telephone Typewriter
UART	Universal Asynchronous Receiver Transmitter
UE	User Equipment
URC	Unsolicited Result Code
USIM	Universal Subscriber Identification Module
UTRAN	Universal Terrestrial Radio Access Network

5. DOCUMENT HISTORY

Revision	Date	Changes
0	2021-08-02	Initial revision

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