

User Manual

**MLiS Basic
Dual/Quad-Band
GSM/GPRS Terminal**

Model: MLB-S-55 /MLB-S-55-DC

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WARNING: The MLiS GSM Terminal is a RF product intended for interfacing and operated with a host device. Local relevant RF regulations such as allowed frequencies and usage in commercial flights must be observed. Safety instructions must be included in the manuals of the host device. Schmidt & Co., (HK) Ltd assumes NO liability for customer failure to comply with these precautions.

CE Declaration of Conformity

For the following equipment, MLiS Basic Terminal

C € 0984

It is herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Laws of the Member States relating to Electromagnetic Compatibility (EMC 2004/108/EC), Low-voltage Directive (73/23/EEC) and the Amendment Directive (93/68/EEC), the procedures given in European Council Directive 99/5/EC and 89/336/EEC.

The equipment was passed. The test was performed according to the following European standards:

EN 301 511 12.1/12.2

EN 301 489-1 V.1.8.1 (2008) / EN 301 489-7 V.1.3.1 (2005)

EN 60950-1:2006

A minimum separation distance of 20cm must be maintained between the user/bystander and the vehicle mounted antenna to satisfy CE RF exposure requirements.

Revision History

Version	Date	Description
1.0	July 2008	1 st Release
2.0	October 2008	General Updates
3.0	December 2008	Inclusion of MLB-S-55; MLB-S-55-DC Quad-Band mode

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1.0 Product Overview

The MLI^S MLB-S-52/MLB-S-55;MLB-S-52-DC;MLB-S-55-DC Dual/Quad-Band GSM/GPRS terminal is designed as a low cost and compact size robust terminal for industrial use and featuring in-built TCP/IP stack to support various internet services. It is suitable for use in applications like metering and security systems and more.

The physical control to the terminal is made easily through a RS232 serial interface for both command and data. The terminal accepts a wide range of input supply voltages and provides an external hardware reset switch. The status of the terminal is indicated by an LED.

2.0 Function Block Diagram

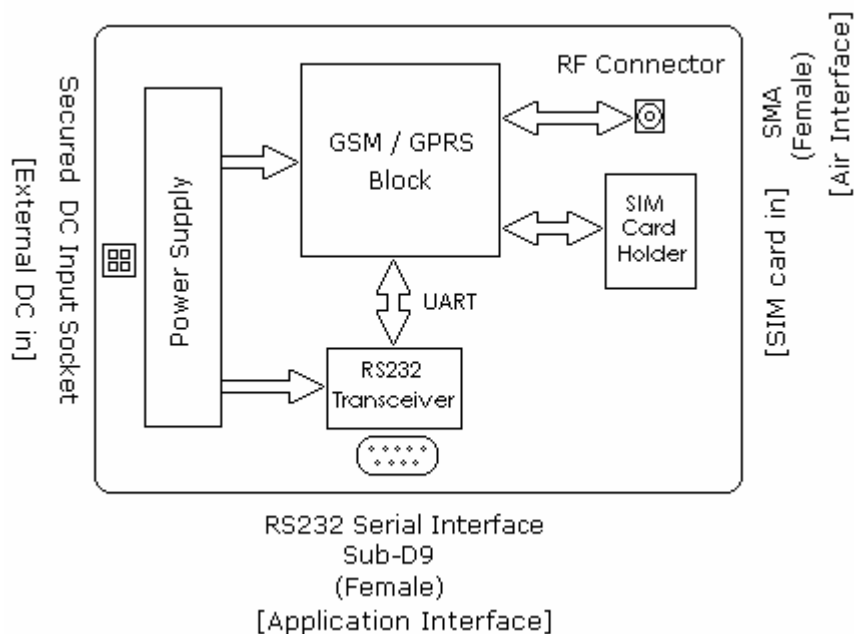


Figure 1: Functional Block Diagram

The MLI^S Terminal comprises of a fully certified (FCC and CE approved) GSM Engine and other parts like the SIM Card Holder, RS232 Transceiver and Regulated Power Supply.

The control and data interface to the application is via a RS232 Serial Interface and the air interface is via a SMA Connector to an external 50 ohm antenna specified for the correct frequency band.

The Power can be supplied externally to the terminal between +9Vdc and +30Vdc. The suggested rating is 10VA_{min}.

3.0 Terminal Features and Electrical Specifications

S/N	Feature	Specifications
1	Frequency Bands	Dual-Band 900/1800 – See Appendix A on list of supported countries and country codes Quad Band 850/900/1800/1900MHz
2	RF Output Power (according to Release 99,v5)	GSM 850 MHz +26.37dBm GSM 1900 MHz +26.22dBm GPRS 850MHz +26.44dBm GPRS 1900Mhz +26.59dBm (Class 1)
3	Power Supply	+9Vdc ; 2A (onboard Molex Micro-fit 3.0 DR Female 4 pin socket)
4	Power Consumption	SLEEP mode: typ. 13mA IDLE mode: typ. 25mA GPRS Class 10: typ. 460mA
5	Operating Temperature	-20°C to +55°C (ambient) up to +70°C Auto-switch-off at < -40 °C or > +80°C
6	Humidity	Max. 90°C relative humidity
7	Data Transfer	GPRS Multi-slot Class 10 Datarate _(max) @ 85.6kbps/42.8kbps (DL/UL) Full PBCCH Support Mobile Station Class B Coding Scheme 1~4 Supports PAP and CHAP of PPP stack
		CSD V.110, RLP, non-transparent @ 2.4, 4.8, 9.6 & 14.4kbps USSD

Table 1: Features and Specifications


S/N	Feature	Specifications
8	SMS	Point-to-Point MT and MO Cell Broadcast Text and PDU Mode Storage: SIM Card plus 25 SMS locations in mobile equipment
9	TCP/IP Stack	Protocols: TCP, UDP, HTTP, FTP, SMTP, POP3 Access by AT commands
10	AT Commands	AT-Hayes 3GPP TS 27.007, TS 27.005, Siemens
11	Real time clock	Timer functions via AT commands
12	Serial Interface	Sub-D9 RS232 9pins (Female socket) Bi-directional Bus for AT commands and data 8-wire Modem Interface with status and control lines, unbalanced, asynchronous Fixed bit rate: 300bps to 230400bps Autobauding: 1200bps to 230400bps Flow Control: Hardware RTS0/CTS0 and Software XON/OFF Multiplex ability according to GSM 07.10 Multiplexer Protocol
14	SIM Interface	Insert through SIM Card Slot Supported SIM Cards: +1.8V/+3V
15	Antenna	50 ohms via external SMA Female Connector. Antenna use male SMA connector
16	Power ON/OFF	Switch ON automatically along with Power Supply Automatic Switch OFF during critical voltage or temperature conditions Remove supply to shut down
17	Reset	Orderly Shut down and Reset by AT Command (AT+CFUN=1,1) External Hardware Reset Switch (press & hold for 2 sec)
18	 RoHS	All hardware components are fully compliant with the EU RoHS directive 2002/95/EC Exception: MLB55IN

Table 1: Features and Specifications

4.0 Chassis Dimension and Mechanical Description

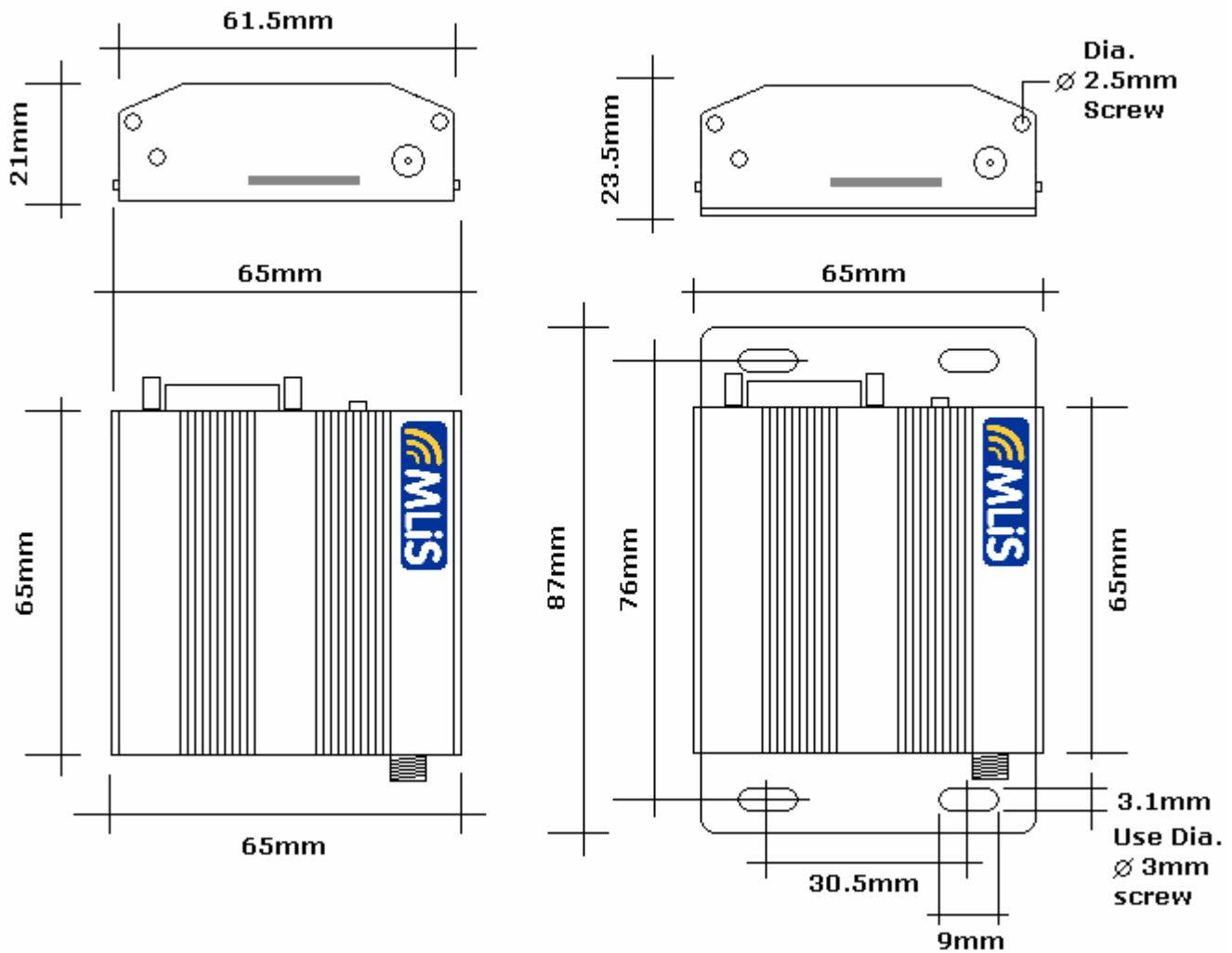


Figure 2: Chassis Dimension

SN	Parameter	Side Mounting Bracket	
		No	Yes
1	Weight	80g	90g
2	Chassis Material	Aluminium	
3	Mounting Standard	Suitable for use with DIN Rail clips	Suitable for use with DIN Rail clips or extended brackets and screws

Table 2: Chassis Dimensions and Mechanical Description

5.0 Operating Modes

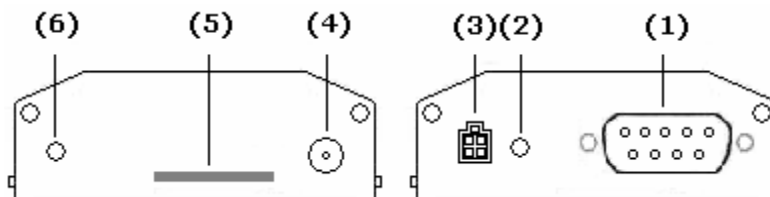
The table below gives an overview of various operating modes in the MLiS Terminal:

Mode	Function
GSM/GPRS SLEEP	Various power saving modes can be set by the AT+CFUN command. Software is active to minimum extent. If the MLiS Terminal was registered to the GSM network in IDLE mode, it is registered and paging with the BTS in the SLEEP mode too. The non-cyclic SLEEP mode set by AT+CFUN=0 disables the AT interface. The cyclic SLEEP modes AT+CFUN=5, 6, 7, 8 and 9 alternatively activates and deactivates the AT interface to allow permanent access to all AT commands.
GSM IDLE	Software is active. Once registered to the GSM network, paging with BTS is carried out. MLiS Terminal is ready to send and receive.
GPRS IDLE	MLiS Terminal is ready for GPRS data transfer, but no data is currently sent or received. Power consumption is dependent on network settings and GPRS configuration eg. Multi-slot settings.
GPRS DATA	GPRS data transfer in progress. Power consumption is dependent on network settings eg. Power control level, uplink/downlink data rates and GPRS configuration eg. Multi-slot settings.

Table 3: Operating Modes

6.0 Interface Descriptions

6.1 Overview



Front / Back View

Figure 3: External Interfaces/Indicators

The MLIS Terminal interfaces and Indicators are as follows:

Item	Description	Function
1	RS-232 Serial Interface (Sub-DB9 Female socket)	Data and Control Interface with Host Application (EIA/TIA-232-F Standards) Refer to Section 6.2 for details
2	External Hardware Reset Switch	Press & hold for 2 Sec if Terminal does not respond to AT Commands anymore
3	External DC Supply Input Socket	Apply DC Supply range between +9V and +30V (suggested 10V _{Amin}) Refer to Section 6.4 for details
4	Radio Interface RF Connector (SMA Female)	Connects to external 50 ohms antenna of correct frequency band. Use antenna with male SMA connector Refer to Appendix B for Antenna Performance Recommendations

Table 4: Interfaces and Indicator Description

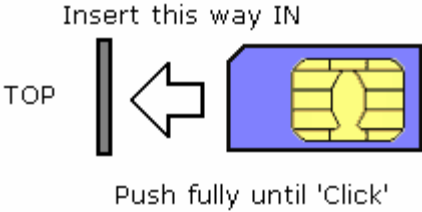
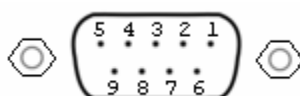
Item	Description	Function
5	SIM Card Interface Slot	<p>Push SIM card totally into 'locking position'. Press again to eject SIM card</p> <p>Only Insert or retrieve SIM card after Power Off</p> <p>Insert with SIM card contacts face up</p> <div style="text-align: center;"> <p>Insert this way IN</p>  <p>TOP</p> <p>Push fully until 'Click'</p> </div>
6	Status LED Indicator	LED blinks according to GSM/GPRS Connection and Power Consumption status. Set by AT^SSYNC
	600ms ON / 600ms OFF Limited network service	No SIM card inserted or no PIN entered, or network search in progress, or ongoing user authentication, or network login in progress.
	75ms ON / 3s OFF IDLE mode	The terminal is registered to the GSM network. No call is in progress.
	75ms ON / 75ms OFF / 75ms ON / 3s OFF	One or more GPRS PDP contexts activated.
	500ms ON / 25ms OFF	Packet switched data transfer in progress

Table 4: Interfaces and Indicator Description

6.2 RS-232 Serial Interface (Socket Type Sub DB9 Female) – COM port

The serial RS232 (EIA/TIA-232-F Standards) interfaces to the host application for Control and Data communication purposes. Use a 9-pin RS232 cable (male side) to connect to the MLiS terminal.

The figure below shows the pin configuration of the RS232 socket on the terminal.



View Directly at Socket on Terminal

Figure 4: Pin numbers of the RS232 COM Interface (Female)

The table below defines the RS232 Socket pin configuration on Terminal:

Pin No.	Signal Name	I/O	Function
1	DCD	O	Data carrier Detected
2	RxD	O	Receive Data
3	TxD	I	Transmit Data
4	DTR	I	Data terminal ready
5	GND	-	Ground
6	DSR	O	Data Set Ready
7	RTS	I	Request to send
8	CTS	O	Clear to send
9	RI	O	Ring Indication

Table 5: RS232 COM Port Pin Configuration

The RS232 COM port to the application accepts voltage levels between -25Vdc and +25Vdc. Do not exceed these levels minimum or maximum.

The minimum requirement for MLiS Terminal to communicate with the application or DTE is through using the following pins:

- TxD: Where the Application sends data through to MLiS Terminal
- RxD: Where the Application receives data through from MLiS Terminal

6.3 Radio Interface (Type SMA Connector Female) - RF Antenna

Use an antenna with a male SMA connector to connect to the RF input of the terminal.

The connection of the antenna or other equipment must be decoupled from DC voltage before connecting to the RF connector on the terminal i.e. do not pass DC voltages into the RF input of the terminal.

For optimum RF performance, the MLI_S Terminal has to be connected to an external RF antenna matched to 50ohms including other connecting cables across the operating frequency bands.

Choose suitable types of low attenuation coaxial cables if possible. In general the RG174 or RG58 50 ohms types should be good for normal use. Avoid excessive cable length of > 10 metres.

Please refer to Appendix B for more details on selecting the correct RF Antenna.

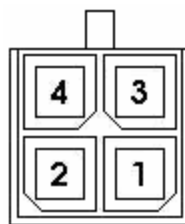
Suitable RF antennas with 3m coaxial cable lengths are available for order.

6.4 Power Supply

The DC power supply input range for operating the MLI_S Terminal should be within +9Vdc and +30Vdc @ 10VA_{min} with the pin assignments as shown in Figure 5.

The power handling capacity of the DC input has to be adequate to maintain supply stability to the terminal during transmission bursts.

Suitable universal 110~240V/50~60Hz AC-DC Power adaptors are available for order.



View Directly at Socket on Terminal

Figure 5: Pin numbers of the DC Power Supply Socket (Female)

The table below defines the DC Power Supply Socket pin configuration:

Pin No.	Signal Name	Function
1,2	GND	DC GND
3,4	VCC	DC Power Supply Input Apply +9Vdc to +12Vdc @ 10VA _{min}

Table 6: DC Power Supply Socket Configuration

Pin 1 and 2 GND are shorted internally in the terminal.

Pin 3 and 4 VCC are shorted internally in the terminal.

The recommended mating connector to the Secure DC Power Supply Socket is:

Description: Molex Cable Plug Micro-Fit 3.0 DR Rcpt 4ckt

Part Number: Molex 43025-0400 (Please choose 4 positions type)

7.0 General AT Commands Listing

7.1 Configuration Commands

AT&F	Set all current parameters to manufacturer defaults
AT&V	Display current configuration
AT&W	Stores current configuration to user defined profile
ATZ	Set all current parameters to user defined profile
AT+CFUN	Set phone functionality
AT+CMEE	Set Mobile equipment error message format
AT+CSCS	Select TE character set

7.2 Status Control Commands

AT+CIND	Indicator control
AT^SIND	Extended Indicator control

7.3 Serial Interface Control Commands

AT\Q	Flow Control
ATE	Command Echo
AT+IPR	Set Baud rate

7.4 Security Commands

AT+CPIN	Pin Authentication
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7.5 Identification Commands

ATI	Display product identification information
AT+CGSN	Request IMEI

7.6 Call Related Commands

ATA	Answer a call
ATD	Mobile originated call to specific number
ATH	Disconnect existing connection
AT+CHUP	Hang up call
ATSO	Set number of rings before automatically answering a data call
ATO	Switch from Command Mode to Data Mode/PPP online Mode
+++	Switch from Data Mode to Command Mode

7.7 Network Services Commands

AT+COPS	Operator selection
AT+CSQ	Check Signal quality – between 2 to 31
AT^SMONC	Cell Monitoring
AT^SMOND	Cell Monitoring
AT^MONI	Monitor Idle Mode and Dedicated Mode
AT^MONP	Monitor neighbour cell
AT^SMONG	GPRS monitor

7.8 Internet Services Commands

AT^SICS	Internet Connection Setup Profile
AT^SICI	Internet Connection Information
AT^SISS	Internet Service Setup Profile
AT^SISI	Internet Service Information
AT^SISO	Internet Service Open
AT^SISC	Internet Service Close
AT^SISR	Internet Service Data Read
AT^SISW	Internet Service Data Write
AT^SISE	Internet Service Error Report

7.9 GPRS Commands

AT+CGACT	PDP Context activate or deactivate
AT+CGATT	GPRS attach or detach
AT+CGAUTO	Automatic response to a network request for PDP context activation
AT+CGEREP	GPRS event reporting
AT+CGDATA	Enter data state
AT+CGDCONT	Define PDP context
AT+CGPADDR	Show PDP address
AT+CGREG	GPRS network registration status
AT^SGAUTH	Set type of authentication for PPP connection
AT^SGCONF	Configuration of GPRS related parameters
ATA	Manual response to a network request for PDP context activation
ATD*99#	Request GPRS service
ATD*98#	Request GPRS IP service
ATH	Manual rejection of a network request for PDP context activation
ATSO	Automatic response to a network request for PDP context activation

7.10 Short Message Services (SMS) Commands

AT+CMGD	Delete Short message from memory
AT+CMGF	Select SMS message format – Text or PDU
AT+CMGL	List SMS messages from preferred store
AT+CMGR	Read SMS message from memory
AT+CMGS	Send SMS message
AT+CMGW	Write short message to memory
AT+CMSS	Send short message from memory
AT+CNMI	New short message indication
AT+CPMS	Preferred SMS message storage
AT+CSCA	SMS service center address
AT^SSMSS	Set short message storage sequence

7.11 Hardware Related Commands

AT^SSYNC	Configure SYNC pin – 0 or 1
AT^SBV	Check supply voltage in mV
AT+CALA	Set alarm time
AT+CCLK	Real time clock

7.12 Phonebook Commands

AT+CPBR	Read from phonebook
AT+CPBS	Select phonebook memory storage
AT+CPBW	Write into phonebook
AT^SPBG	Display phonebook entries in alphabetical order

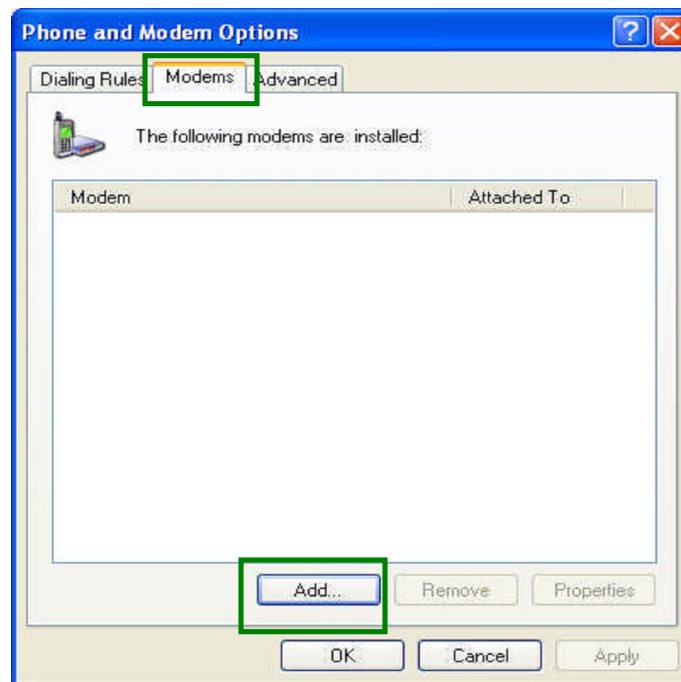
8.0 GPRS Connection Setup for Windows XP

8.1 Add a Terminal through Windows Control Panel

The MLiS Terminal GPRS connection can be added using the Windows Control Panel. First connect the Terminal to a COM Port on your PC followed by the step by step instructions below:

Select **Start > Control Panel > Phone and Modem Options**.

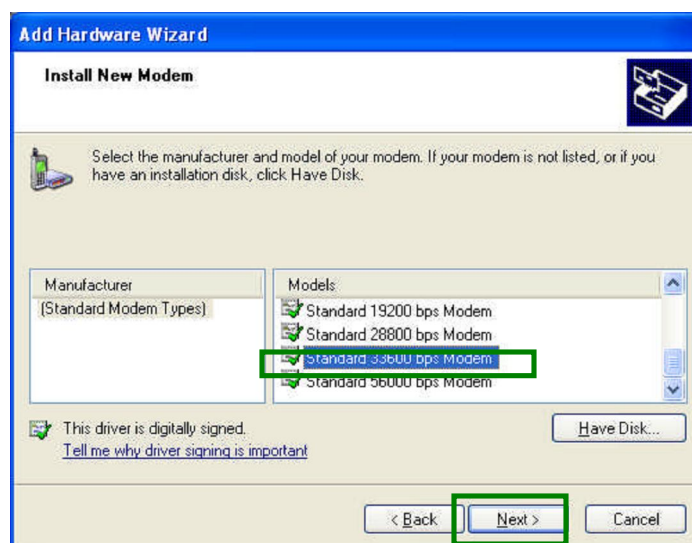
Click on **Modems** tab along the top of the dialog box and then click on **Add...** as shown in the following picture.



In the next dialog box, 'check' on **Don't detect my modem; I will select it from a list**, and continue by clicking the **Next >** button.



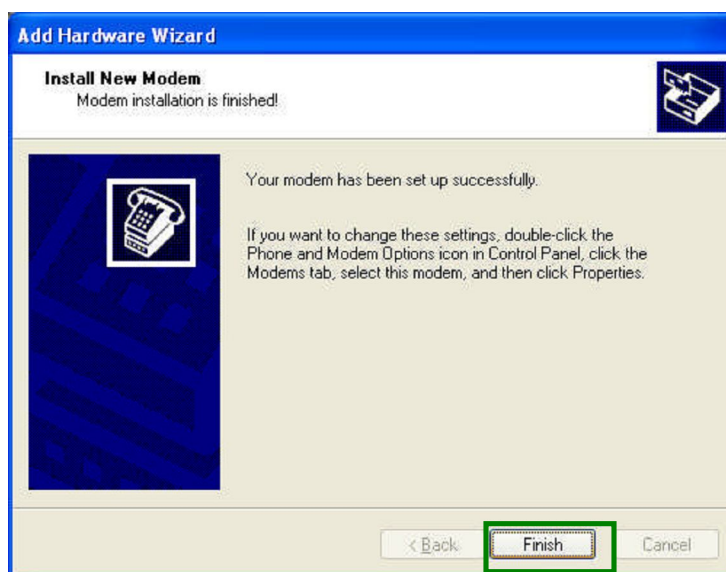
After clicking on the next button, the following window should appear. Please select the **Standard 33600 bps Modem** from the Models List on the right, and then click **Next >** button.



Please select the correct Communication Port **Com Number** that the GPRS modem is to be installed on by highlighting it and then click **Next >** button as shown in the below picture.

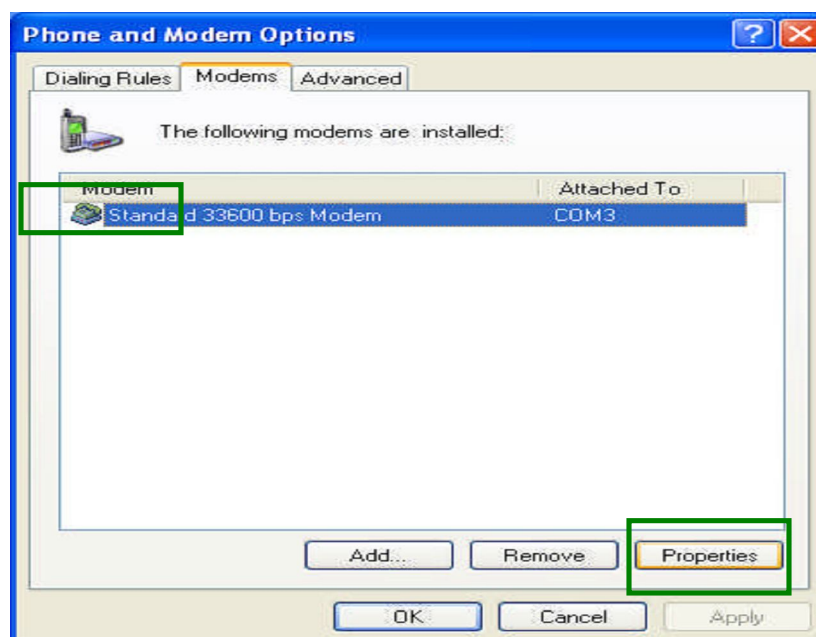


Next screen should confirm that the modem has been set up successfully as shown in picture below. Click **Finish** button to complete installing the MLI_S terminal for GPRS connection on your PC.



Check that the newly added modem has been displayed on the **Phone and Modem Options** screen using the steps mentioned in previous pages.

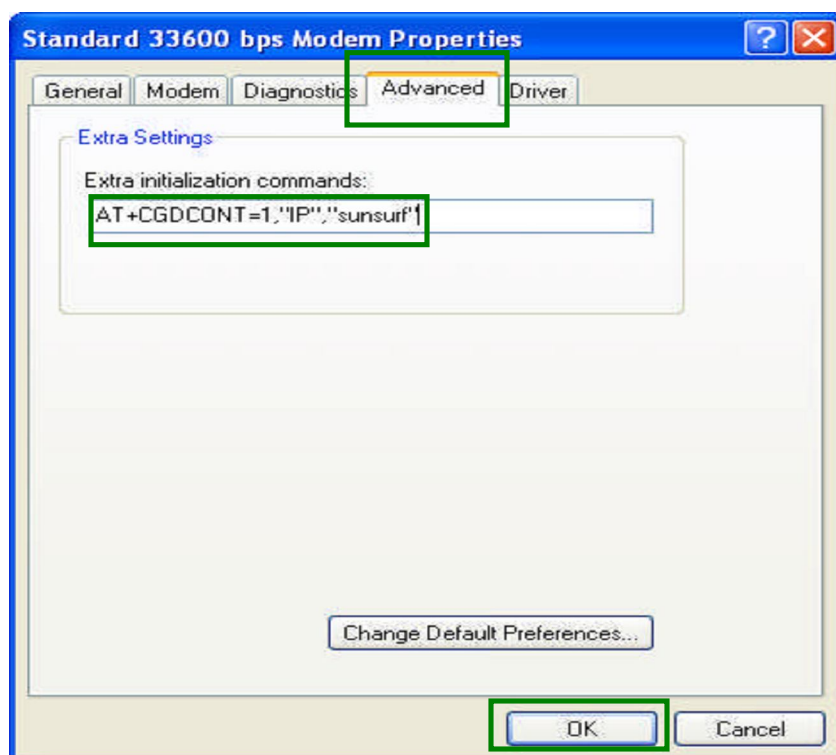
Select the newly installed **Standard 33600 bps Modem** and click the **Properties** button to bring up the modem properties window. Note: Make sure that the correct communication parameter has been set up i.e. the Maximum Port Speed should be 115200bps.



Click on the **Advanced** tab and ensure that the correct **APN**, which is provided by your GPRS network provider, is entered correctly into the text box as shown.

The generic command is **AT+CGDCONT=1,"IP","<APN>"**. Change the **APN** accordingly. In this example, the <APN> entered is sunsurf using Singapore M1 GPRS connection.

Click **OK** button to finish the modem properties configuration.

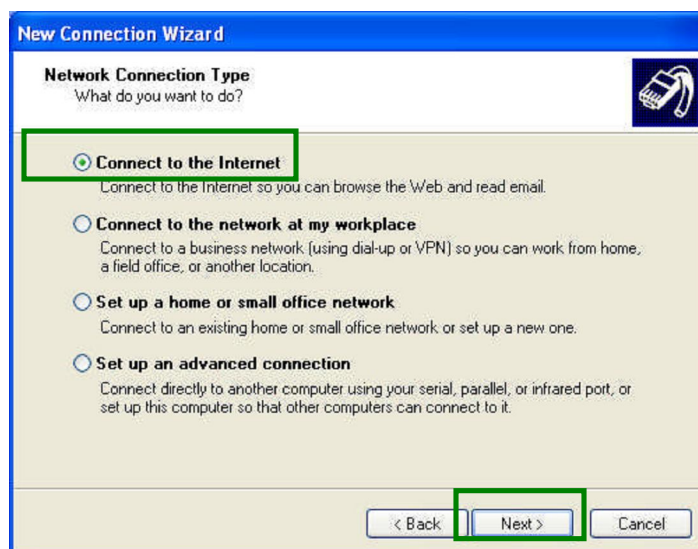


8.2 Make a Dial-up Connection with GPRS

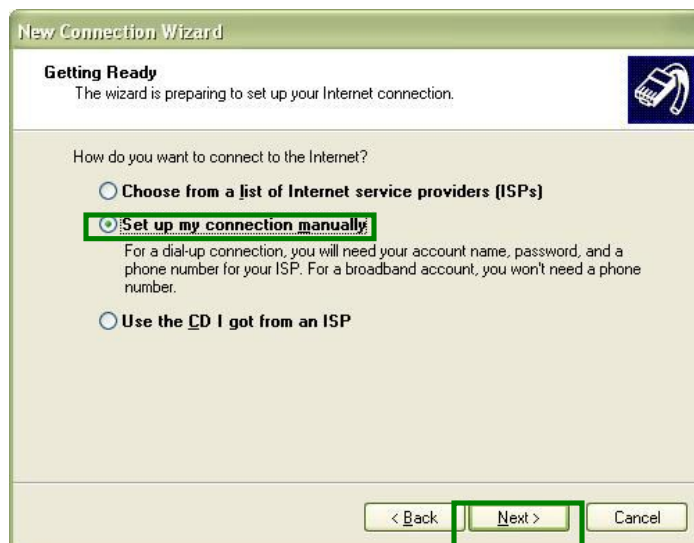
On the Control Panel screen, select the **Network Connections** and then select **File > New Connection** to bring up the New Connection Wizard Dialog Box. Now click **Next >** to continue.



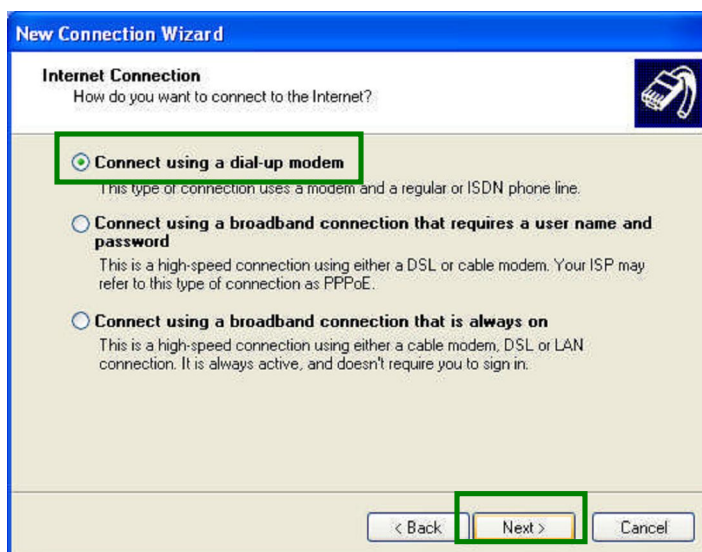
On the Network Connection Type screen, select **Connect to the Internet**, and then click **Next >** button.



On the Getting Ready screen, select **Set up my connection manually**, and then click **Next >**

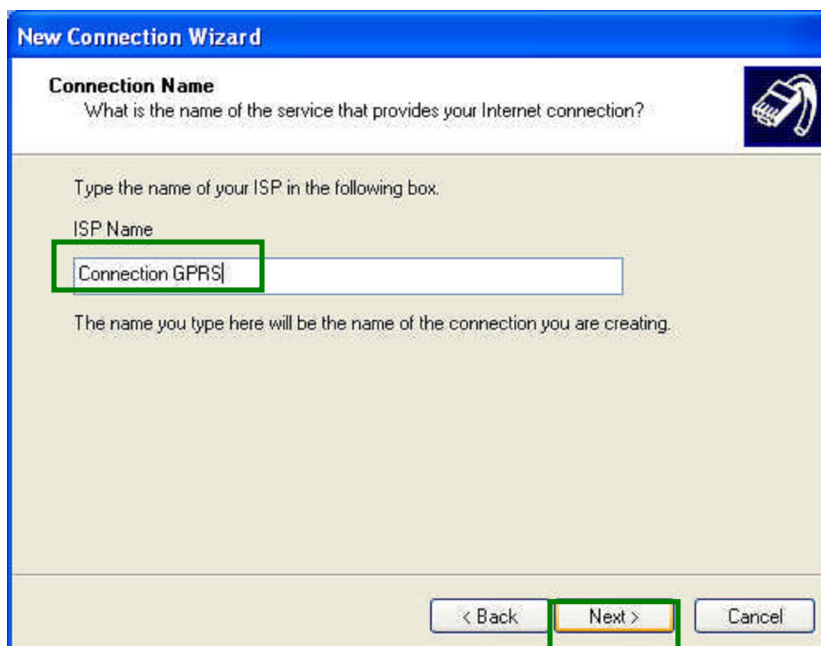


On the Internet Connection screen, select **Connect using a dial-up modem** and click **Next >** button.



You will be prompted to select the device for this connection under the 'Select a device' screen. Please 'check' on the connection using the newly added device i.e. **Modem – Standard 33600 bps Modem (COM X)** and click **Next >**.

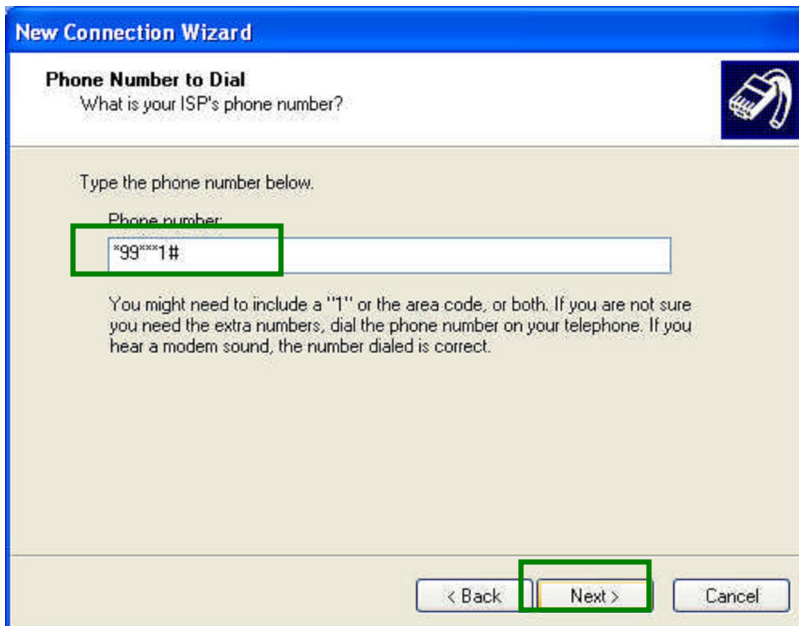
On the Connection Name screen, enter an **ISP Name** for the connection you are creating (User preference – this name will appear with the icon created) and click **Next >** button.



The image shows a screenshot of the 'New Connection Wizard' window, specifically the 'Connection Name' step. The window has a blue title bar with the text 'New Connection Wizard'. Below the title bar, there is a section titled 'Connection Name' with a question: 'What is the name of the service that provides your Internet connection?'. To the right of this text is a small icon of a mobile phone. Below the question, there is a text box labeled 'ISP Name' containing the text 'Connection GPRS'. Below the text box, there is a note: 'The name you type here will be the name of the connection you are creating.' At the bottom of the window, there are three buttons: '< Back', 'Next >', and 'Cancel'. The 'Next >' button is highlighted with a green border.

On the Phone Number to dial screen, enter the dial-up number, which is provided by your GPRS network provider, in the **Phone number** field. For Singapore M1 GPRS, ****99***1#** is used.

Click the **Next >** button to continue.



The image shows a Windows-style dialog box titled "New Connection Wizard". The main heading is "Phone Number to Dial" with a sub-question "What is your ISP's phone number?". There is a small icon of a mobile phone in the top right corner. The instruction "Type the phone number below." is followed by a text input field labeled "Phone number:". The field contains the text "**99***1#". Below the field, a note states: "You might need to include a '1' or the area code, or both. If you are not sure you need the extra numbers, dial the phone number on your telephone. If you hear a modem sound, the number dialed is correct." At the bottom, there are three buttons: "< Back", "Next >", and "Cancel". The "Next >" button is highlighted with a green rectangle.

Select your **Connection Availability** preference accordingly under the Connection Availability screen.

On the Internet Account Information screen, you may leave the contents blank and continue by clicking the **Next >** button.



The screenshot shows the 'New Connection Wizard' window, specifically the 'Internet Account Information' step. The window has a blue title bar and a light beige background. At the top, it says 'Internet Account Information' and 'You will need an account name and password to sign in to your Internet account.' Below this, there is a text box for 'User name:', a 'Password:' field, and a 'Confirm password:' field. There are three checkboxes: 'Use this account name and password when anyone connects to the Internet from this computer', 'Make this the default Internet connection', and 'Turn on Internet Connection Firewall for this connection'. At the bottom, there are three buttons: '< Back', 'Next >', and 'Cancel'. The 'Next >' button is highlighted with a green rectangle.

Click the **Finish** button to complete the Dial-up connection settings.



The screenshot shows the 'New Connection Wizard' window, specifically the 'Completing the New Connection Wizard' step. The window has a blue title bar and a light beige background. On the left, there is a blue sidebar with a globe icon. The main area says 'Completing the New Connection Wizard' and 'You have successfully completed the steps needed to create the following connection:'. Below this, it lists 'Connection GPRS' with four bullet points: 'Make this the default connection', 'This connection is firewalled', 'Share with all users of this computer', and 'Use the same user name & password for everyone'. It also says 'The connection will be saved in the Network Connections folder.' and 'Add a shortcut to this connection to my desktop' with an unchecked checkbox. At the bottom, it says 'To create the connection and close this wizard, click Finish.' and there are three buttons: '< Back', 'Finish', and 'Cancel'. The 'Finish' button is highlighted with a green rectangle.

8.3 Dial Up to the internet using GPRS connection

Select **Start > Control Panel > Network Connections**. Double-click on the Dial-up icon (Look for newly created ISP Name icon).

You may leave the User name and Password field blank if not entered previously (refer to Section 6.2 - Make a Dial-up connection with GPRS for details), and then click the **Dial** button.



During the Dial-up process, a pop-up Dialog Box will show message:

Now “Dialing.....”, “Verifying user name and password...”, and “Registering your computer on the network...”.

Finally, a networking icon will show on the bottom taskbar or desktop of your PC after a successful connection.

Appendix A1

MLB-S-52;MLB-S-52-DC List of supported countries and country codes

S/N	Country	Supported MCCs
1	Abu Dhabi	430
2	Australia	505
3	Bangladesh	470
4	China	460, 461
5	Hong Kong	454
6	India	404, 405
7	Indonesia	510
8	Laos	457
9	Macao	455
10	Malaysia	502
11	Mongolia	428
12	Nepal	429
13	New Zealand	530
14	Pakistan	410
15	Philippines	515
16	Singapore	525
17	Sri Lanka	413
18	Taiwan	466
19	Thailand	520
20	United Arab Emirates	431
21	Vietnam	452

The MLB-S-52;MLB-S-52-DC terminal is especially suited for operation with SIM cards from any network provider in the countries listed above. The country configuration is factory set and permanent and cannot be changed by AT command.

If SIM cards from other countries are inserted, the terminal cannot register to the GSM network. Only network independent functions are accessible. The URC "+CIEV: mcclock, 1" notifies the user that the SIM is not accepted.

Roaming in networks of all partners of the supported operators is fully functional.

Appendix A1

Appendix B1

Antenna Performance Recommendation

Applicable for frequency bands for 850MHz, 900MHz, 1800MHz, 1900MHz

Frequency Band Summary

824-894MHz	North America
880-960MHz	EGSM Europe
1710-1880MHz	DCS Europe
1850-1990MHz	PCS North America

Impedance

The antenna including contact device, coaxial cable, connectors and matching circuit (if required), when installed in the device shall have a nominal impedance of 50 ohms across the frequency bands noted above.

VSWR

VSWR is measured at the antenna's coaxial connector when the antenna is installed in the device with the cable routed to the GSM module. An HP8753E network analyzer or equivalent should be used.

Peak Gain and Radiation Patterns

Free space gain patterns shall be measured in a calibrated 3-D anechoic chamber. Gain data shall be collected over the complete spherical far field surface. No void should exist more than 5 degrees from a measured point (i.e. maximum sample point spacing 10 degrees). At each sample point two orthogonal polarizations tangential to the sphere shall be collected.

The peak gain shall be determined as the maximum gain (magnitude of the vector sum of both the gains measured in the two orthogonal linear polarizations). All tests are to be conducted in reference to a linearly polarized antenna such as a standard dipole and reported in dBi.

Appendix B1

Appendix B2

Peak gain requirements are provided as a guideline. Most antennas once integrated onto the device do not provide omni-directional gain patterns. In this condition, Peak gain performance can be affected by many parameters including; antenna size, location and design type. As such, antenna gain patterns are fixed unless one or more of these parameters change. Therefore, antenna ***Peak Gain is not a good indication of the antenna performance.*** It is ***recommended to use antenna efficiency*** as the primary parameter for evaluating the antenna system.

Note: In applications where peak antenna gain is approaching or exceeding +4dBi, the Module limits for MPE must also be considered.

Efficiency

The efficiency data shall be collected using a 3-D measurement system in an anechoic chamber. Data shall be collected over the complete spherical far field surface. A near to far field transformation will be performed and a normal efficiency computation applied.

Associated coaxial cable losses must be identified in this measurement. If the cable losses are inclusive, the data must indicate such. If cable losses are to be considered separately, the loss data must be provided for each test frequency. Efficiency limits provided in table below are considered as "system limits" and are inclusive of all system integration losses.

Power Rating

The power endurance is measured during a period of 4hrs (estimated talk time). The frequency of the CW test signal is set to the middle of the PCS Tx Band (1880MHz for PCS)

Appendix B2

Appendix B3

Electrical Tests Requirement

For the purpose of this table, the following frequencies are considered:

Low band: 824-894MHz and 880-960MHz

High band: 1710-1880MHz, 1850-1990MHz and 1920-2170MHz.

Test	Procedure	Specification																
VSWR	With the antenna mounted on the terminal, measure VSWR in free space. Measurement has to be taken at the Low and High frequency bands	<div>Free Space Maximum VSWR</div> <table><tr><th>Freq Band</th><th>Low</th><th>Mid</th><th>High</th></tr><tr><td>Low</td><td>2.5</td><td>2.0</td><td>2.5</td></tr><tr><td>High</td><td>2.5</td><td>2.0</td><td>2.5</td></tr><tr><td>1574-1576</td><td>3.0</td><td>3.0</td><td>3.0</td></tr></table>	Freq Band	Low	Mid	High	Low	2.5	2.0	2.5	High	2.5	2.0	2.5	1574-1576	3.0	3.0	3.0
Freq Band	Low	Mid	High															
Low	2.5	2.0	2.5															
High	2.5	2.0	2.5															
1574-1576	3.0	3.0	3.0															
Peak Gain	With the antenna mounted on the terminal, measure the peak gain.	<table><tr><th>Freq Band</th><th>Rx \ Tx</th></tr><tr><td>Low</td><td>+1 to +4dBi Typical</td></tr><tr><td>High</td><td>+1 to +4dBi Typical</td></tr></table>	Freq Band	Rx \ Tx	Low	+1 to +4dBi Typical	High	+1 to +4dBi Typical										
Freq Band	Rx \ Tx																	
Low	+1 to +4dBi Typical																	
High	+1 to +4dBi Typical																	
Efficiency	With the antenna mounted on the terminal, measure efficiency using a 3-D measurement system. Repeat test for retracted position if applicable.	<table><tr><th>Freq Band</th><th>Efficiency (min)</th></tr><tr><td>Low</td><td>50%</td></tr><tr><td>High</td><td>50%</td></tr></table>	Freq Band	Efficiency (min)	Low	50%	High	50%										
Freq Band	Efficiency (min)																	
Low	50%																	
High	50%																	
Power Rating	With the antenna mounted on the terminal, apply a 2 watt CW signal at 1880MHz for 4hrs (estimated talk time).	There shall be no visual deterioration or cracking in the antenna after the test is completed.																

Appendix B3

Notes:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference.

(2) This device must accept any interference received, including interference that may cause undesired operation.

FCC Part 15.21 information for user You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment

for mobile devices without co-location condition (the transmitting antenna is installed or located more than 20cm away from the body of user and near by person)

FCC RF radiation exposure statement: This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device must be installed by professional.

