MLB-Z1001 Terminal

User Manual

MLiS 900 MHz RF Terminal

Model Number

MLB-Z1001

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WARNING: The MLiS GSM Terminal is a RF product intended for interfacing and operating 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 customers, who fail to comply with these precautions.

Service and Support

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Revision History

Version	Date	Description
1.0	April 2014	1st Release

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1 INTRODUCTION

1.1 Description

The MLiS MLB-Z1001 900 MHZ ZigBee terminal is a compact terminal that is designed for wireless M2M communications.

The MLB-Z1001 terminal uses the DB9 Connector to provide data communication interface and the DC jack to provide power input. LEDs are used to indicate the status of the terminal.

MLB-Z1001 is taking advantage of the specific Mesh networking protocol, featuring dense network operation and supporting for sleeping routers, and are also available in a proprietary point-to-multipoint configuration.

The MLB-Z1001 terminal can be used to provide a wireless communications link for many applications, including warehouse, building automation, and street light applications.

1.2 Highlights

Interface

- DC jack Connector for power
- DB9 connector for data communications
- SMA Female Connector (Antenna connector)

General Features

- ZigBee 902 to 928 MHZ, software selectable channel mask for interference immunity
- Supply voltage range: 5 to 32 VDC
- Temperature range
  - Operating: -40°C to 85°C
  - Restricted operating: 65°C to 80°C
- Surge protection: IEC61000-4-5 LV1
- Casing Material: Metal
- Dimensions (L) x(W) X(H) : 85 x97 x24 mm (excluding connectors)
- Weight: 210 g

Data Transmission

- RF Data Rate: 10 Kbps or 200 Kbps
- Indoor/Urban Range: up to 2000 foot (610 m)
- Outdoor/ Line-Of-Sight Range: Up to 9 miles (14 km) w/ dipole antenna;
  Up to 28 miles (45 km) w/ high-gain antenna
- Transmit Power: Up to 24 dBm (250 mW) software selectable
- Receiver Sensitivity: -101 dBm @ 200 Kbps, -110 dBm @ 10 Kbps

1.3 Functional Block diagram

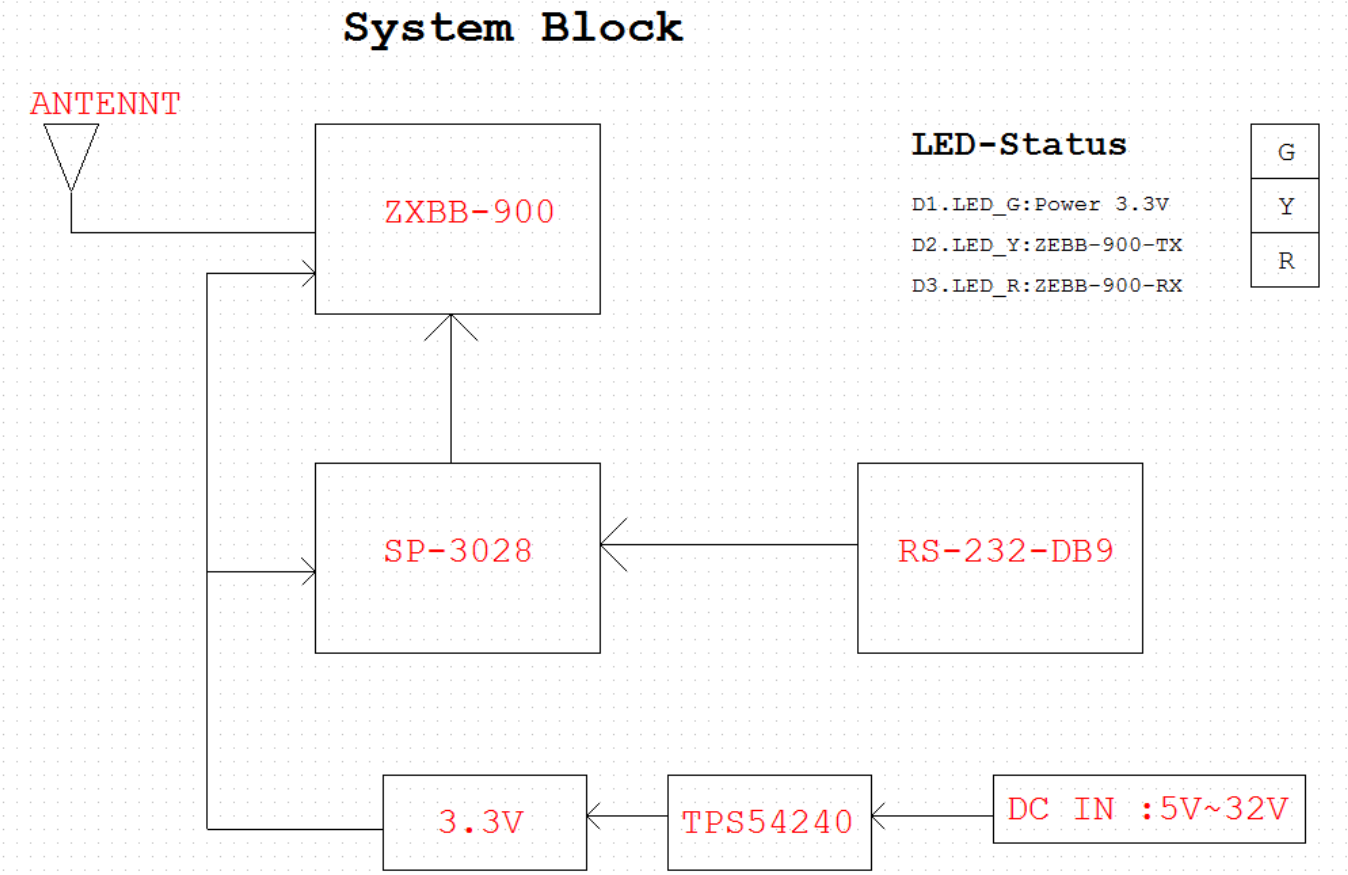


Figure 1: Functional Block Diagram for MLB-Z1001

The MLB-Z1001 consists of a fully certified (CE approved) GSM/GPRS engine, SIM card holder and power regulator.

The terminal is supplied with power via the DC jack connector. The DB9 female connector pins are used for data communications.

The SMA female connector provides the air interface to an external 50 ohm antenna specified for the correct frequency band.

1.4 Main Features and Services

The MLB-Z1001 performs a set of ZigBee services according. The services and functions of the MLB-Z1001 are implemented by issuing customized applications embedded on the device, or over the DB9 to RS232 serial interface.

1.4.1 Operating Modes

The table below briefly summarizes the various operating modes referred to in the following chapters.

S/N	Feature	Specifications
1	Frequency Bands	ZigBee-900MHZ
2	RF Output Power	Up to 24dbm (250mw) software selectable
3	Power Supply	5 to 32 VDC
4	Operating Temperature	Normal operation: -40°C to +85°C Restricted operation: -40°C to -30°C, +85°C to +90°C
5	Data Transfer	RF Data Rate:10 kbps or 200 kbps
		Indoor/Urban Range: up to 2000 ft (610m)
6	AT Commands	Access by AT Commands
7	Serial Interface	RS232 connector
8	Antenna	50 ohms via External SMA Connector
9	HW Reset	Reset Key
10	RoHs	All hardware components are fully compliant with the EU RoHs directive 2002/95/EC Exception: MLB55IN

Table 1: Operating Modes

1.4.2 Terminal Features and Electrical Specifications

	MLB-Z1001
General Features	
Frequency Band	902 to 928 MHZ , software selectable channel mask for interference immunity
Power input	5 to 32 VDC
Operating Temptation	-40°C to +85°C
ESD Protection	IEC61000-4-5 LV1
Dimension (L)x(W)x(H)	85 mm x97 mm x24 mm (excluding connectors)
Weight	210g
Casing Material	Metal
Data Transmission	
RF Data Rate	10 Kbps or 200 Kbps
Indoor/Urban Range	up to 2000 ft (610 m)
Outdoor/ Line-Of-Sight Range	Up to 9 miles (14 km) w/ dipole antenna; Up to 28 miles (45 km) w/ high-gain antenna
Transmit Power	Up to 24 dBm (250 mW) software selectable
Receiver Sensitivity	-101 dBm @ 200 Kbps, -110 dBm @ 10 Kbps
Special Features	
Networking Topologies	Mesh, Repeater, Point-to-Point, Point-to-Multipoint, Peer-to-Peer
Spread Spectrum	FHSS (Software Selectable Channels)
Interfaces	
RF Antenna Socket	50ohm SMA
Power Connector	DC jack Connector
Serial Interface	DB9 connect for RS-232 (Female)
LED	1 x for Power , 1 x for Tx, 1 x for Rx Indicator
Reset	HW Reset
Approvals	
CE	Yes

Table 2: Features and Specifications

1.5 Precautions

The MLB-Z1001 terminal is designed for indoor use only. For outdoor use it has to be integrated into a weatherproof enclosure. Do not exceed the environmental and electrical limits as specified in the user manual.

2 MECHANICAL DESCRIPTION

2.1 Overview

The pictures below show the mechanical design of the terminal along with the positions of the different connectors. The terminal case is made of durable PC/ABS plastic.

2.2 Dimensions

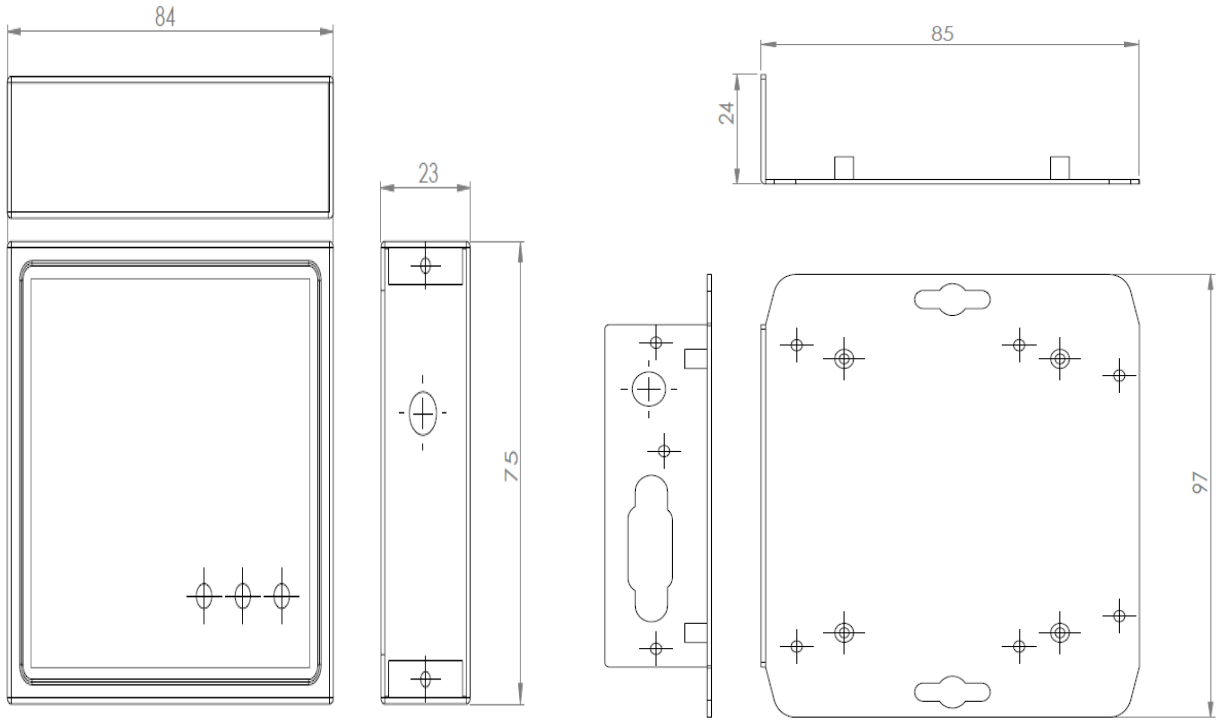


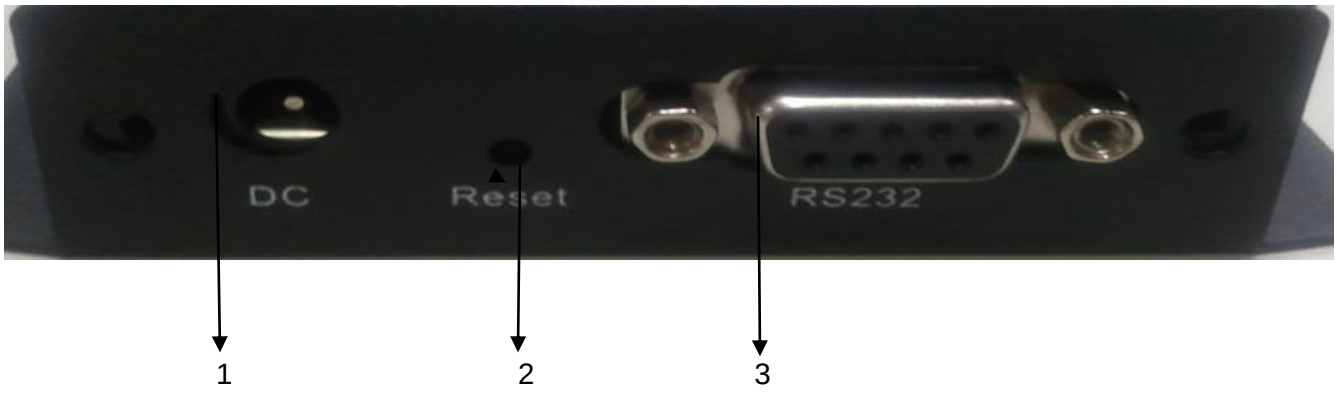
Figure 2: Chassis Dimension for MLB-Z1001

S/N	Parameter	Value
1	Height (H)	24mm
2	Length (L)	85mm
3	Width (W)	97mm
4	Weight	210g
5	Chassis Material	Metal
6	Mounting Standard	Suitable for use with DIN Rail Clips

Table 3: Chassis Dimensions and Mechanical Description for MLB-Z1001

3 ELECTRICAL INTERFACE DESCRIPTIONS

3.1 Overview



Front/Back View

Figure 3: External Interfaces/Indicators for MLB-Z1001

Table below defines the RS232 pin configuration on the Terminal：

Pin No.	Signal Name	Function
1	DCD	Input
2	RXD	Input
3	TXD	Output
4	DTR	Output
5	GND	GND
6	DSR	Input
7	RTS	Output
8	CTS	Input
9	Not used	

Table 4：RS 232 connector configuration for MLB-Z1001

The interfaces and indicators for MLB-Z1001 are as follows：

●	Item	●	Description	●	Function
●	1	●	DC-jack	●	For Power
●	2	●	Reset	●	RF-Reset-Key
●	3	●	RS232	●	Signal Transmission Signal Trans

Item	Description	Function	Status
1	LED (Green)	Power LED	Turn on the power LED is lit
2	LED (Yellow)	TX- LED	Data transfer LED will light
3	LED(Red)	RX-LED	Receive Data LED will light

Table 5：Interfaces and Indicators Description of MLB-Z1001

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

Figure 4: Antenna Connector for MLB-Z1001

The connection of the antenna or other equipment must be decoupled from DC voltage.

For optimum RF performance, the MLiS Terminal has to be connected to an external RF antenna matched to 50ohms including other connecting cables across the operating frequency bands. Please use a SMA Male connection for the terminal.

Choose suitable types of low attenuation coaxial cables if possible. In general, the ohm types RG174 or RG58 50 can be used. Avoid excessive cable length of > 10 meter

Compatible RF antennas (PCB patched or Monopole type) are available for order, please refer to accessories document.

3.3 Power on the Modem

The modem is usually fully operational within 4 seconds, after powering it up. Depending on the signal strength of the network in the area, logging into a network may take longer and is outside the control of the modem.

3.3.1 Data Connection Demo

HW installation

Step 1：Please connect serial port to device as follow pinout

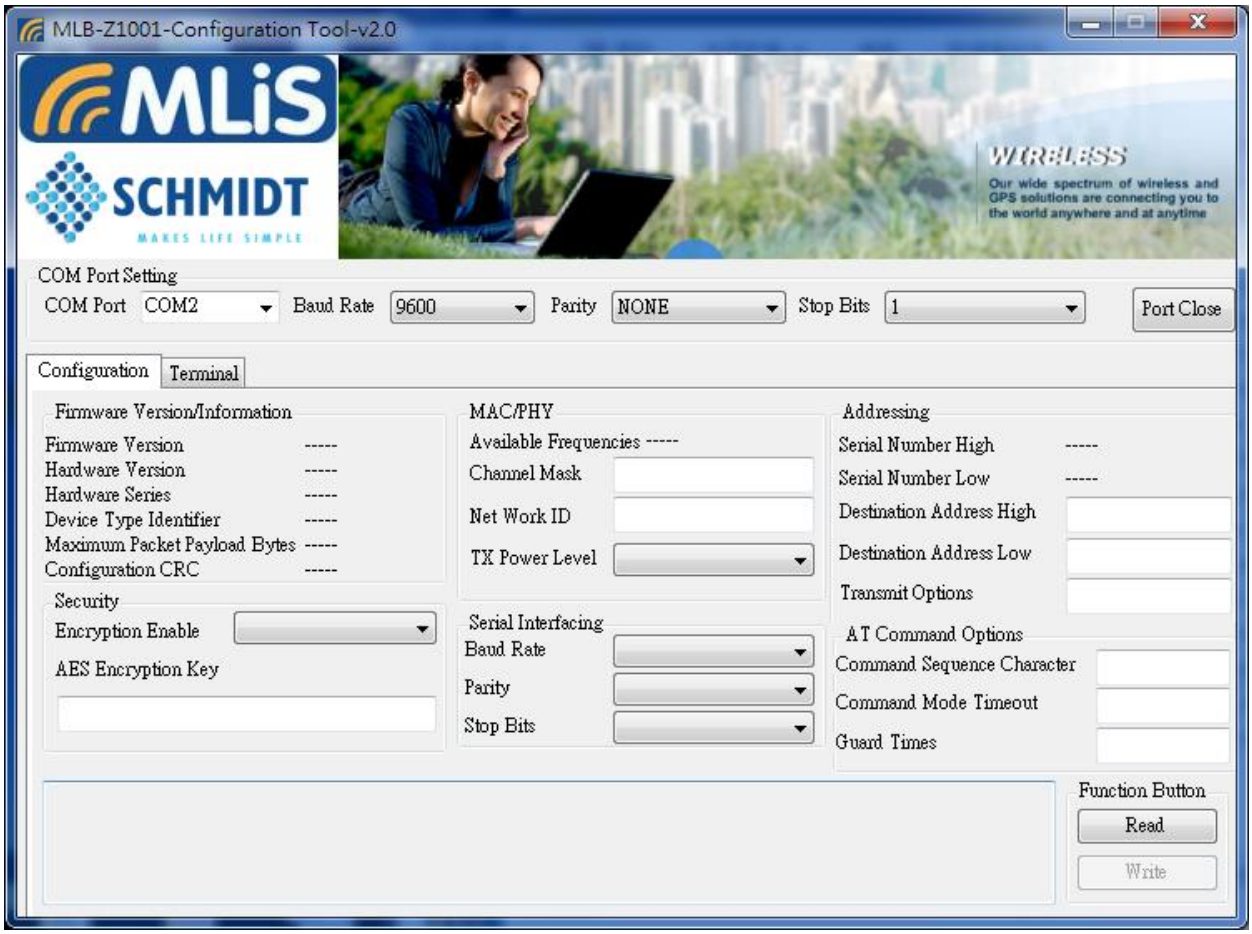
Pin No.	Signal Name	Function
1	DCD	Input
2	RXD	Input
3	TXD	Output
4	DTR	Output
5	GND	GND
6	DSR	Input
7	RTS	Output
8	CTS	Input
9	Not used	

Step 2：Please connect to 5~32 VDC power supplier, after boot up, the LED of power will light up.

Step 3：After plugging in power adapter. The modem is usually fully operational within 4 seconds, after powering it up. Depending on the signal strength of the network in the area, logging into a network may take longer and is outside the control of the modem.

The device is ready after LED of signal is lighted. Then user can operate it.

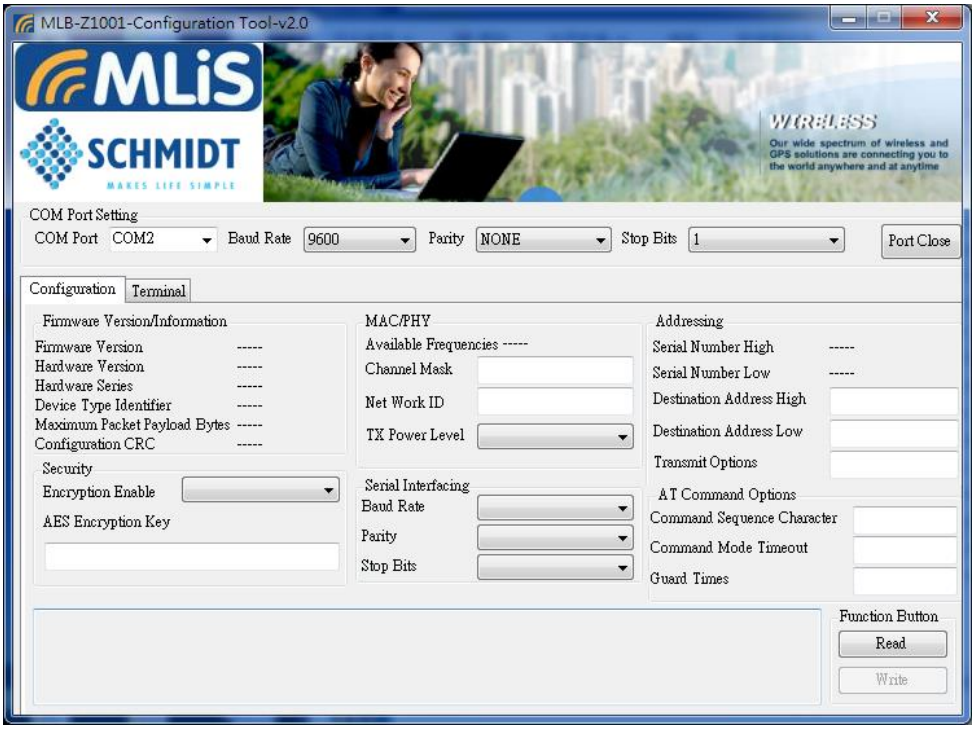
SW Installation



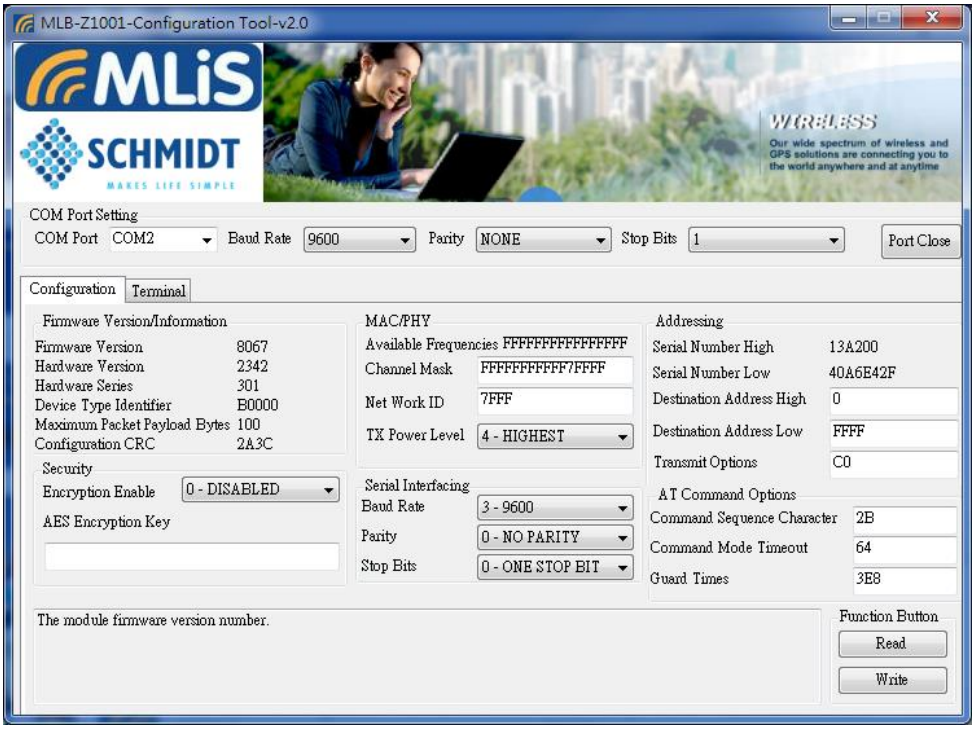
The MLB-Z1001 Configuration Tool can be used to set Network ID,MAC Address, Destination Address and send data for test MLB-Z1001.

Data Connection Demo

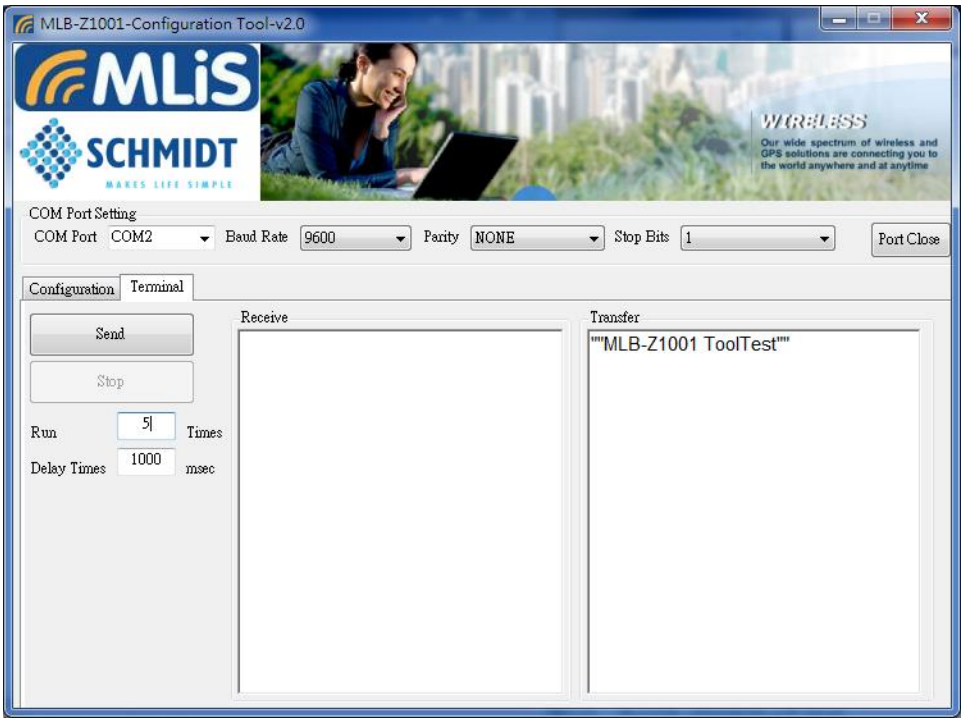
Step 1：Click the button “Read”



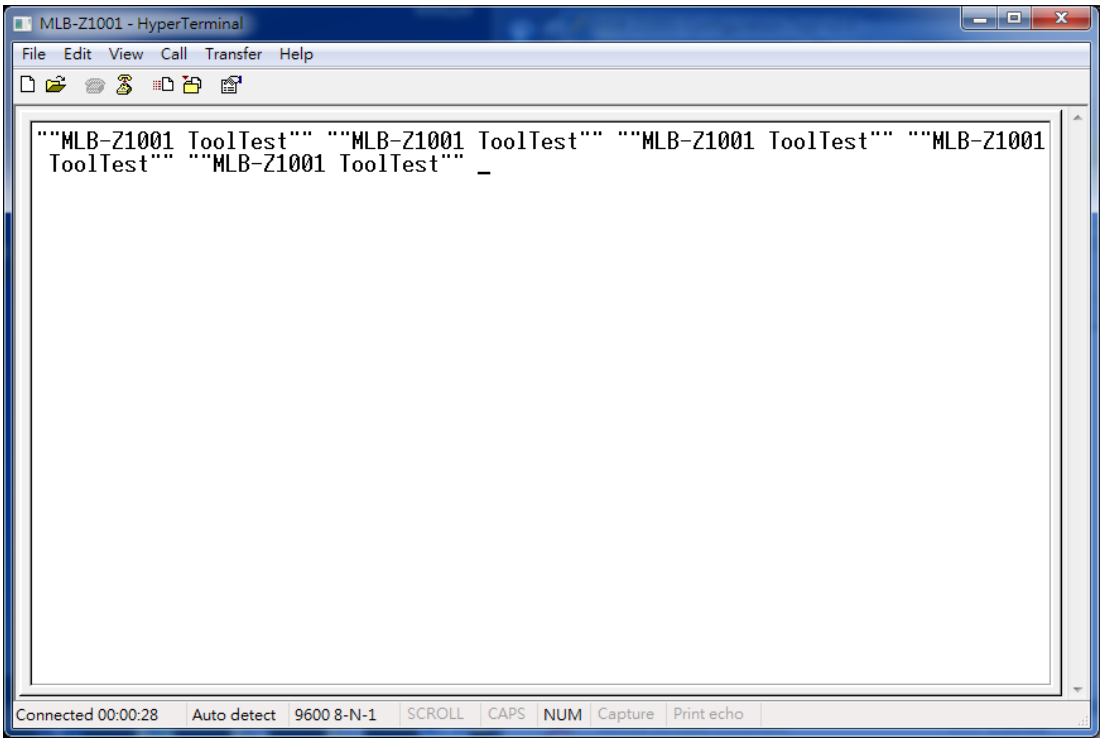
Step 2：“MLB-Z1001 related data” is shown



Step 3：Input ““MLB-Z1001 Tool Test”” at the window, and click the button” Send”



Step 4：Monitor of Terminal will receive “MLB-Z1001 Tool Test”



4 MLB-Z1001 AT Commands

AT Commands

To Enter AT Command Mode:

Send the 3-character command sequence “+++” and observe guard times before and after the command characters. [Refer to the “Default AT Command Mode Sequence” below.]

Default AT Command Mode Sequence (for transition to Command Mode):

- No characters sent for one second [GT (Guard Times) parameter = 0x3E8]
- Input three plus characters (“+++”) within one second [CC (Command Sequence Character) parameter = 0x2B.]
- No characters sent for one second [GT (Guard Times) parameter = 0x3E8]

Once the AT command mode sequence has been issued, the MLB-Z1001 sends an "OK\r" out the UART pin. The"OK\r" characters can be delayed if the MLB-Z1001 has not finished transmitting received serial data.

When command mode has been entered, the command mode timer is started (CT command), and the MLB-Z1001 is able to receive AT commands on the UART port.

All of the parameter values in the sequence can be modified to reflect user preferences.

NUTE: Failure to enter AT Command Mode is most commonly due to baud rate mismatch.

By default, the BD (Baud Rate) parameter = 3 (9600 bps).

Command Response

When a command is sent to the MLB-Z1001, the MLB-Z1001 will parse and execute the command. Upon successful execution of a command, the MLB-Z1001 returns an “OK” message. If execution of a command results in an error, the MLB-Z1001 returns an “ERROR” message.

To Send AT Commands

AT + ASCII_COMMAND + Space + Parameter + Carriage Return

Example：ATDT 1F <CR>

The preceding example would change the MLB-Z1001's Destination Address to "0x1F". To store the new value to non-volatile (long term) memory, the Write (ATWR) command must subsequently be sent before powering off the MLB-Z1001.

System Response

When a command is sent to the MLB-Z1001, the MLB-Z1001 will parse and execute the command. Upon successful execution of a command, the MLB-Z1001 returns an "OK" message. If execution of a command results in an error, the MLB-Z1001 returns an "ERROR" message.

To Exit AT Command Mode

- If no valid AT Commands are received within the time specified by CT (Command Mode Time-out) Command, the MLB-Z1001 automatically returns to Idle Mode. [OR]
- Send ATCN (Exit Command Mode) Command.

Command Reference Table

Table A-03. AT Commands (The MLB-Z1001 expects numerical values in hexadecimal. "d" denotes decimal equivalent.)

AT Command	Binary Command	AT Command Name	Range	Command Category	# Bytes Returned	Factory Default
*AM	0x3A (58d)	Auto-set MY	-	Networking & Security	-	-
AT	0x05 (5d)	Guard Time After	0x02 – 0xFFFF [x 100 msec]	Command Mode Options	2	0x0A (10d)
BD	0x15 (21d)	Interface Data Rate	Standard baud rates: 0 – 6 Non-standard baud rates: 0x7D – 0xFFFF	Serial Interfacing	2	0x03 9600bps
BT	0x04 (4d)	Guard Time Before	2 – 0xFFFF [x 100 msec]	Command Mode Options	2	0x0A (10d)
CC	0x13 (19d)	Command Sequence Character	0x20 – 0x7F	Command Mode Options	1	0x2B ("+")
CD	0x28 (40d)	DO3 Configuration	0 - 4	Serial Interfacing	1	0
CN	0x09 (9d)	Exit AT Command Mode	-	Command Mode Options	-	-
CS	0x1F (31d)	DO2 Configuration	0 – 4	Serial Interfacing	1	0
CT	0x06 (6d)	Command Mode Timeout	0x02 – 0xFFFF [x 100	Command Mode Options	2	0xC8 (200d)
DT	0x00 (0d)	Destination Address	0 – 0xFFFF	Networking	2	0
E0	0x0A (10d)	Echo Off	-	Command Mode Options	-	-
E1	0x0B (11d)	Echo On	-	Command Mode Options	-	-
ER	0x0F (15d)	Receive Error Count	0 – 0xFFFF	Diagnostics	2	0
FH	0x0D (13d)	Force Wake-up Initializer	-	Sleep (Low Power)	-	-
FL	0x07 (7d)	Software Flow Control	0 – 1	Serial Interfacing	1	0
FR	N/A	Forces the MLB-Z1001 to Reset		(Special)		
FT	0x24 (36d)	Flow Control Threshold	0 – (DI buffer – 0x11)	Serial Interfacing	2	varies
GD	0x10 (16d)	Receive Good Count	0 – 0xFFFF	Diagnostics	2	0
HP	0x11 (17d)	Hopping Channel	0 – 6	Networking	1	0
HT	0x03 (3d)	Time before Wake-up Initializer	0 – 0xFFFF [x 100 msec]	Sleep (Low Power)	2	0xFFFF
ID	0x27 (39d)	MLB-Z1001 VID	User set table: 0x10 - 0x7FFF Read-only:	Networking	2	-
LH	0x0C (12d)	Wake-up Initializer Timer	0 – 0xFF [x 100 msec]	Sleep (Low Power)	1	1
MD	0x32 (50d)	RF Mode	0 – 4	Networking & Security	1	0
MK	0x12 (18d)	Address Mask	0 – 0xFFFF	Networking	2	0xFFFF
*MY	0x2A (42d)	Source Address	0 – 0xFFFF	Networking & Security	2	0xFFFF
NB	0x23 (35d)	Parity	0 – 5	Serial Interfacing	1	0
PC	0x1E (30d)	Power-up Mode	0 – 1	Command Mode Options	1	0
*PK	0x29 (41d)	RF Packet Size	0 - 0x100 [bytes]	Serial Interfacing	2	0x40 (64d)
*PL	0x3c (60d)	RF Power Level	0-4	(Special)	1	4
PW	0x1D (29d)	Pin Wake-up	0 – 1	Sleep (Low Power)	1	0
*RB	0x20 (32d)	Packetization Threshold	0 - 0x100 [bytes]	Serial Interfacing	2	0x01
RE	0x0E (14d)	Restore Defaults	-	(Special)	-	-
RN	0x19 (25d)	Delay Slots	0 – 0xFF [slots]	Networking	1	0
RO	0x21 (33d)	Packetization Timeout	0 – 0xFFFF [x 200 µsec]	Serial Interfacing	2	0
RP	0x22 (34d)	RSSI PWM Timer	0 - 0x7F [x 100 msec]	Diagnostics	1	0

RR	0x18 (24d)	Retries	0 – 0xFF	Networking	1	0
RS	0x1C (28d)	RSSI	0x06 – 0x36 [read-only]	Diagnostics	1	-
RT	0x16 (22d)	DI2 Configuration	0 - 2	Serial Interfacing	1	0
*RZ	0x2C (44d)	DI Buffer Size	[read-only]	Diagnostics	-	-
SB	0x36 (54d)	Stop Bits	0 - 1	Serial Interfacing	1	0
SH	0x25 (37d)	Serial Number High	0 – 0xFFFF [read-only]	Diagnostics	2	-
SL	0x26 (38d)	Serial Number Low	0 – 0xFFFF [read-only]	Diagnostics	2	-
SM	0x01 (1d)	Sleep Mode	0, 1, 3 - 8	Sleep (Low Power)	1	0
ST	0x02 (2d)	Time before Sleep	0x10 – 0xFFFF [x 100	Sleep (Low Power)	2	0x64 (100d)
SY	0x17 (23d)	Time before Initialization	0 – 0xFF [x 100 msec]	Networking	1	0 (disabled)
TR	0x1B (27d)	Transmit Error Count	0 – 0xFFFF	Diagnostics	2	0
TT	0x1A (26d)	Streaming Limit	0 – 0xFFFF [0 = disabled]	Networking	2	0xFFFF
VR	0x14 (20d)	Firmware Version	0 - 0xFFFF [read-only]	Diagnostics	2	-
WR	0x08 (8d)	Write	-	(Special)	-	-

AT (Guard Time After) Command

Command Summary	Description
AT Command: ATAT	<Command Mode Options> AT Command is used to set the time-of-silence that follows the command sequence character (CC Command). By default, AT Command Mode will activate after one second of silence. Refer to the AT Commands section to view the default AT Command Mode Sequence.
Binary Command: 0x05 (5 decimal)	
Parameter Range:0x02 – 0xFFFF[x 100 milliseconds]	
Number of bytes returned: 2	
Default Parameter Value: 0x0A (10decimal)	
Related Commands: BT (Guard Time Before), CC (Command Sequence Character)	

BD (Interface Data Rate) Command

<table>
<tr><th>Command Summary</th><th>Description</th></tr>
<tr><td colspan="2">AT Command: ATBD</td><td rowspan="11"><Serial Interfacing> BD Command allows the user to adjust the UART interface data rate and thus modify the rate at which serial data is sent to the MLB-Z1001. The new baud rate does not take effect until the CN (Exit AT Command Mode) Command is issued. The RF data rate is not affected by the BD Command. Although most applications will only require one of the seven standard baud rates, non-standard baud rates are also supported. Note: If the serial data rate is set to exceed the fixed RF data rate of the MLB-Z1001, flow control may need to be implemented as described in the Pin Signals and Flow Control sections of this manual. Non-standard Interface Data Rates: When parameter values outside the range of standard baud rates are sent, the closest interface data rate represented by the number is stored in the BD register. When the BD command is sent with a non-standard interface data rate, the UART will adjust to accommodate the requested interface rate. In most cases, the clock resolution will cause the stored BD parameter to vary from the parameter that was sent (refer to the table below). Reading the BD command (send “ATBD” command without an associated parameter value) will return the value that was actually stored to the BD register.</td></tr>
<tr><td colspan="2">Binary Command: 0x15 (21 decimal)</td></tr>
<tr><td colspan="2">Parameter Range (Standard baud rates): 0 – 6(Non-standard baud rates): 0x7D –0xFFFF (125d – 65535d)</td></tr>
<tr><td>Parameter</td><td>BAUD (bps)</td></tr>
<tr><td>0</td><td>1200</td></tr>
<tr><td>1</td><td>2400</td></tr>
<tr><td>2</td><td>4800</td></tr>
<tr><td>3</td><td>9600</td></tr>
<tr><td>4</td><td>19200</td></tr>
<tr><td colspan="2">Number of bytes returned: 2</td></tr>
<tr><td colspan="2">Default Parameter Value: Set to equal</td></tr>
<tr><td colspan="2">MLB-Z1001’s factory-set RF data rate</td></tr>
</table>

Parameter Sent vs. Parameter Stored

BD Parameter Sent (HEX)	Interface Data Rate (bps)	S3B BD Parameter Stored
0	1200	0
4	19,200	4
6	57600	5
12C	300	12B
E100	57600	E10D

BT (Guard Time Before) Command

Command Summary	Description
AT Command: ATBT	<Command Mode Options> BT Command is used to set the DI pin silence time that must precede the command sequence character (CC Command) of the AT Command Mode Sequence. Refer to the AT Commands section to view the default AT Command Mode Sequence.
Binary Command: 0x04 (4 decimal)	
Parameter Range:2 – 0xFFFF[x 100 milliseconds]	
Default Parameter Value: 0x0A (10 decimal)	
Number of bytes returned: 2	
Related Commands: AT (Guard Time After), CC (Command Sequence Character)	

CC (Command Sequence Character) Command

Command Summary	Description
AT Command: ATCC	<Command Mode Options> CC Command is used to set the ASCII character to be used between Guard Times of the AT Command Mode Sequence (BT+ CC + AT). The AT Command Mode Sequence activates AT Command Mode (from Idle Mode).Refer to the AT Commands section [p.18] to view the default AT Command Mode Sequence.
Binary Command: 0x13 (19 decimal)	
Parameter Range: 0x20 – 0x7F	
Default Parameter Value: 0x2B (ASCII “+”sign)	
Number of bytes returned: 1	
Related Commands: AT (Guard Time After), BT (Guard Time Before)	

CN (Exit AT Command Mode) Command

Command Summary	Description
AT Command: ATCN	<Command Mode Options> CN Command is used to explicitly exit AT Command Mode.
Binary Command: 0x09 (9 decimal)	

CT (Command Mode Time out) Command

Command Summary	Description
AT Command: ATCT	<Command Mode Options> CT Command sets the amount of time before AT Command Mode terminates automatically. After a CT time of inactivity, the MLB-Z1001 exits AT Command Mode and returns to Idle Mode. AT Command Mode can also be exited manually using CN (Exit AT Command Mode) Command.
Binary Command: 0x06 (6 decimal)	
Parameter Range:0x02 – 0xFFFF[x 100 milliseconds]	
Default Parameter Value: 0xC8 (200decimal, 20 seconds)	
Number of bytes returned: 2	

DT (Destination Address) Command

Command Summary	Description
AT Command: ATDT	<Networking> DT Command is used to set the networking address of a MLB-Z1001.MLB-Z1001s use three network layers –Vendor Identification Number (ATID),Channels (ATHP), and Destination Addresses (ATDT). DT Command assigns an address to a MLB-Z1001 that enables it to communicate only with other MLB-Z1001s having the same addresses. All MLB-Z1001s that share the same Destination Address can communicate freely with each other.MLB-Z1001s in the same network with a different Destination Address (than that of the transmitter) will listen to all transmissions to stay synchronized, but will not send any of the data out their serial ports.
Binary Command: 0x00	
Parameter Range:0 – 0xFFFF	
Default Parameter Value: 0	
Number of bytes returned: 2	
Related Commands: HP (Hopping Channel), ID (MLB-Z1001 VID), MK (Address Mask)	

E0 (Echo Off) Command

Command Summary	Description
AT Command: ATE0	<Command Mode Options> E0 Command turns off character echo in AT Command Mode. By default, echo is off.
Binary Command: 0x0A (10 decimal)	

E1 (Echo On) Command

Command Summary	Description
AT Command: ATE1	<Command Mode Options> E1 Command turns on the echo in AT Command Mode. Each typed character will be echoed back to the terminal when ATE1 is active. E0 is the default.
Binary Command: 0x0B (11 decimal)	

ER (Receive Error Count) Command

Command Summary	Description
AT Command: ATER	<Diagnostics> Set/Read the receive-error. The error-count records the number of packets partially received then aborted on a reception error. This value returns to 0 after a reset and is not non-volatile (Value does not persist in the MLB-Z1001's memory after a power-up sequence). Once the "Receive Error Count" reaches its maximum value (up to 0xFFFF), it remains at its maximum count value until the maximum count value is explicitly changed or the MLB-Z1001 is reset.
Binary Command: 0x0F (15 decimal)	
Parameter Range:0 – 0xFFFF	
Default Parameter Value: 0	
Number of bytes returned: 2	
Related Commands: GD (Receive Good Count)	

FH (Force Wake-up Initializer) Command

Command Summary	Description
AT Command: ATFH	<Sleep (Low Power)> FH Command is used to force a Wake-up Initializer to be sent on the next transmit. WR (Write) Command does not need to be issued with FH Command. Use only with cyclic sleep modes active on remote MLBZ1001s.
Binary Command: 0x0D (13 decimal)	

FL (Software Flow Control) Command

<table>
<tr><th>Command Summary</th><th>Description</th></tr>
<tr><td colspan="2">AT Command: ATFL</td><td rowspan="8"><Serial Interfacing> FL Command is used to configure software flow control. Hardware flow control is implemented with the MLB-Z1001 as the DO2 pin (), which regulates when serial data can be transferred to the MLB-Z1001. FL Command can be used to allow software flow control to also be enabled. XON character used is 0x11 (17 decimal). XOFF character used is 0x13 (19 decimal).</td></tr>
<tr><td colspan="2">Binary Command: 0x07 (7 decimal)</td></tr>
<tr><td colspan="2">Parameter Range: 0 – 1</td></tr>
<tr><td>Parameter Value</td><td>Configuration</td></tr>
<tr><td>0</td><td>Disable software</td></tr>
<tr><td>1</td><td>Enable software</td></tr>
<tr><td colspan="2">Default Parameter Value: 0</td></tr>
<tr><td colspan="2">Number of bytes returned: 1</td></tr>
</table>

FR (Force Reset) Command

Command Summary	Description
AT Command: ATFR	<Special> FR command is used in order to reset the MLB-Z1001 through the UART. The characters “OK”<CR> will be returned and the MLB-Z1001 will reset 100m
Binary Command: Not available	

FT (Flow Control Threshold) Command

Command Summary	Description
AT Command: ATFT	<Serial Interfacing> Flow Control Threshold - Set or read flow control threshold. De-assert CTS and/or send XOFF when FT bytes are in the UART receive buffer. Re-assert CTS when less than FT - 16 bytes are in the UART receive buffer.
Binary Command: 0x24 (36 decimal)	
Parameter Range:0 – (DI buffer size minus 0x11 bytes)	
Default Parameter Value: DI Buffer size minus 0x11 (17 decimal)	
Number of bytes returned: 2	
Minimum Firmware Version Required:4.27B	

GD (Receive Good Count) Command

Command Summary	Description
AT Command: ATGD	<Diagnostics> Set/Read the count of good received RF packets. Parameter value is reset to 0 after every reset and is not non-volatile (Value does not persist in the MLB-Z1001's memory after a power-up sequence). Once the "Receive Good Count" reaches its maximum value (up to 0xFFFF), it remains at its maximum count value until the maximum count value is manually changed or the MLB-Z1001 is reset.
Binary Command: 0x10 (16 decimal)	
Parameter Range:0 – 0xFFFF	
Default Parameter Value: 0	
Number of bytes returned: 2	
Related Commands: ER (Receive Error Count)	

HP (Hopping Channel) Command

Command Summary	Description
AT Command: ATHP	<Networking> HP Command is used to set the MLB-Z1001's hopping channel number. A channel is one of three layers of addressing available to the MLB-Z1001. In order for MLB-Z1001s to communicate with each other, the MLB-Z1001s must have the same channel number since each network uses different hopping sequence. Different channels can be used to preventMLB-Z1001s in one network from listening to transmissions of another.
Binary Command: 0x11 (17 decimal)	
Parameter Range:0 – 6	
Default Parameter Value: 0	
Number of bytes returned: 1	
Related Commands: DT (Destination Address), ID (MLB-Z1001 VID), MK (Address Mask)	

HT (Time before Wake-up Initializer) Command

Command Summary	Description
AT Command: ATHT	<Sleep (Low Power)> If any MLB-Z1001s within range are running in a "Cyclic Sleep" setting, a wake-up initializer must be used by the transmitting MLB-Z1001 for sleeping MLB-Z1001s to remain awake [refer to the LH ("Wake-up Initializer Timer") Command]. When a receiving MLB-Z1001 in Cyclic Sleep wakes, it must detect the wake-up initializer in order to remain awake and receive data. The value of HT Parameter tells the transmitter, "After a period of inactivity (no transmitting or receiving) lasting HT amount of time, send a long wake-up initializer". HT Parameter should be set to match the inactivity time out [specified by ST (Time before Sleep) Command] used by the receiver(s). From the receiving MLB-Z1001 perspective, after HT time elapses and the inactivity time out [ST Command] is met, the receiver goes into cyclic sleep. In cyclic sleep, the receiver wakes once per sleep interval to check for a wakeup initializer. When a wake-up initializer is detected, the MLB-Z1001 will stay awake to receive data. The wake-up initializer must be longer than the cyclic sleep interval to ensure that sleeping MLB-Z1001s detect incoming data. When HT time elapses, the transmitter then knows that it needs to send a long Wake-up Initializer for all receivers to be able to remain awake and receive the next transmission. Matching HT to the time specified by ST on the receiving MLB-Z1001 guarantees that all receivers will detect the next transmission.
Binary Command: 0x03 (3 decimal)	
Parameter Range:0 – 0xFFFF[x 100 milliseconds]	
Default Parameter Value: 0xFFFF (means that long wake-up initializer will not be sent)	
Number of bytes returned: 2	
Related Commands: LH (Wake-up Initializer Timer), SM (Sleep Mode), ST (Time before Sleep)	

ID (Modem VID) Command

Command Summary	Description
AT Command: ATID	<Networking> Set/Read the “Vendor Identification Number”. Only modems with matching IDs can communicate with each other. MLB-Z1001s with non-matching VIDs will not receive unintended data transmission.
Binary Command: 0x27 (39 decimal)	
Parameter Range (user-set table) 0x10 - 0x7FFFF(Factory-set and read-only) 0x8000 – 0xFFFF	
Number of bytes returned: 2	

LH (Wake-up Initializer Timer) Command

Command Summary	Description
AT Command: ATLH	<Sleep (Low Power)> LH Command adjusts the duration of time for which the RF initializer is sent. When receiving MLB-Z1001s are put into Cyclic Sleep Mode, they power-down after a period of inactivity [specified by ST (Time before Sleep) Command] and will periodically awaken and listen for transmitted data. In order for the receiving MLB-Z1001s to remain awake, they must detect~35ms of the wake-up initializer. LH Command must be used whenever a receiver is operating in Cyclic Sleep Mode. This lengthens the Wake-up Initializer to a specific amount of time (in tenths of a second).The Wake-up Initializer Time must be longer than the cyclic sleep time that is determined by SM (Sleep Mode) Command. If the wake-up initializer time were less than the Cyclic Sleep interval, the connection would be at risk of missing the wake-up initializer transmission. Refer to Figures 3.1 & 3.2 of the SM Command description to view diagrams of correct and incorrect configurations. The images help visualize the importance that the value of LH be greater than the value of SM.
Binary Command: 0x0C (12 decimal)	
Parameter Range:0 – 0xFF	
Default Parameter Value: 1	
Number of bytes returned: 1	
Related Commands: HT (Time before Wake-up Initializer), SM (Sleep Mode), ST (Time before Sleep)	

MD (RF Mode) Command

Command Summary		Description
AT Command: ATMD		<Networking & Security> The MD command is used to select/read the RF Mode (Peer-to-peer or Repeater Modes) of the MLB-Z1001. Repeater Mode enables longer range via an intermediary MLB-Z1001. When MD=3, the MLB-Z1001 will act as a “store and forward” repeater. Any packets not addressed to this node will be repeated. A Repeater End Node (MD=4) handles repeated messages, but will not forward the data over-the-air. Refer to the Repeater Mode section [p. 40] for more information.
Binary Command: 0x32 (50 decimal)		
Parameter Range: 0, 3, 4		
Parameter	Configuration	
0	Peer-to-Peer (transparent operation	
3	Repeater & End Node	
4	End Node	
Default Parameter Value: 0		
Number of bytes returned: 1		

MK (Address Mask) Command

Command Summary	Description
AT Command: ATMK	<Networking> MK Command is used to set/read the Address Mask. All data packets contain the Destination Address of the transmitting MLB-Z1001.When an RF data packet is received, the transmitter’s Destination Address is logically “AN Ded” (bitwise) with the Address Mask of the receiver. The resulting value must match the Destination Address or the Address Mask of the receiver for the packet to be received and sent out the MLB-Z1001’s DO serial port. If the “AN Ded” value does not match either the Destination Address or the Address Mask of the receiver, the packet is discarded. (All “0” values are treated as “irrelevant” values and are ignored.)
Binary Command: 0x12 (18 decimal)	
Parameter Range:0 – 0xFFFF	
Default Parameter Value: 0xFFFF (Destination address (DT parameter) of the transmitting MLB-Z1001 must exactly match the destination address of the receiving MLB-Z1001.)	
Number of bytes returned: 2	
Related Commands: DT (Destination Address), HP (Hopping Channel), ID (MLB-Z1001 VID)	

MY (Source Address) Command

Command Summary	Description
AT Command: ATMY	<Networking & Security> Set/Read the source address of the MLB-Z1001. Refer to the Addressing section [p. 38] of the RF Communication Modes chapter for more information.
Binary Command: 0x2A (42 decimal)	
Parameter Range: 0 – 0xFFFF	
Default Parameter Value: 0xFFFF (Disabled – the DT (Destination Address) parameter serves as both source and destination address.)	
Number of bytes returned: 2	
Related Commands: DT (Destination Address), HP (Hopping Channel), ID (Modem VID), MK (Address Mask), AM (Auto-set MY)	
This command is only supported on S3BMLB-Z1001s.	

NB (Parity) Command

Command Summary		Description
AT Command: ATNB		<Serial Interfacing>Select/Read parity settings for UART communications
Binary Command: 0x23		
Parameter Range: 0 – 5		
Parameter	Configuration	
0	8-bit(no parity bit)	
1	8-bit even	
2	8-bit odd	
3	8-bit mask	
4	8-bit space	
5	9-bit data	
Default Parameter Value: 0		
Number of bytes returned: 1		

PK (RF Packet Size) Command

Command Summary	Description
AT Command: ATPK	<Serial Interfacing> Set/Read the maximum size of the RF packets sent out a transmitting MLB-Z1001. The maximum packet size can be used along with the RB and RO parameters to implicitly set the channel dwell time.Changes to this parameter may have asecondary effect on the RB (Packet Control Characters) parameter. RB must always be less than or equal to PK. If PK is changed to a value less than the current value of RB, RB is automatically lowered to be equal to PK.
Binary Command: 0x29 (41 decimal)	
Parameter Range: 0 – 0x100 [Bytes]	
Default Parameter Value: 0x40 (64 decimal)	
Number of bytes returned: 2	
Related Commands: RB (Packetization Threshold), RO (Packetization Time out)	
This command is only supported on S3B MLB-Z1001s.	

PL (MLB-Z1001 Power Level) Command

<table>
<tr><th colspan="2">Command Summary</th><th>Description</th></tr>
<tr><td colspan="2">AT Command: ATPL</td><td rowspan="11"><Special Commands> Set/Read the power level at which the
RF transmits conducted power</td></tr>
<tr><td colspan="2">Binary Command: 0x3C (60 decimal)</td></tr>
<tr><td colspan="2">Parameter Range: 0 – 4</td></tr>
<tr><td>Parameter</td><td>Configuration</td></tr>
<tr><td>0</td><td>+7 dBm(5 mW)</td></tr>
<tr><td>1</td><td>+15 dBm(32mW)</td></tr>
<tr><td>2</td><td>+18 dBm(63mW</td></tr>
<tr><td>3</td><td>+21 dBm(125mW)</td></tr>
<tr><td>4</td><td>+21 dBm(125mW)</td></tr>
<tr><td colspan="2">Default Parameter Value: 0</td></tr>
<tr><td colspan="2">Number of bytes returned: 1</td></tr>
</table>

RB Packetization Threshold) Command

Command Summary	Description
AT Command: ATRB	<Serial Interfacing> RF transmission will commence when data is in the DI Buffer band either of the following criteria are met: • RO times out on the UART receive lines(ignored if RO = 0) • RB characters have been received by the UART (ignored if RB = 0) If PK is lowered below the value of RB; RB is automatically lowered to match PK. Note: RB and RO criteria only apply to the first packet of a multi-packet transmission. If data remains in the DI Buffer after the first packet transmissions will continue in streaming manner until there is no data left in the DI Buffer (UART receive buffer).
Binary Command: 0x20 (32 decimal)	
Parameter Range: 0 – 0x100 [Bytes] (Maximum value equals the current value of PK Parameter (up to 0x100 HEX (800 decimal))	
Default Parameter Value: 1	
Number of bytes returned: 2	
Related Commands: PK (RF Packet Size), RO (Packetization Time out)	
This command is only supported on S3B MLB-Z1001s.	

RE (Restore Defaults) Command

Command Summary	Description
AT Command: ATRE	<Diagnostics> RE Command restores all Configurable parameters to factory default Setting
Binary Command: 0x0E (14 decimal)	

RN (Delay Slots) Command

Command Summary	Description
AT Command: ATRN	<Networking> RN Command is only applicable if retries have been enabled [RR (Retries) Command], or if forced delays will be inserted into at transmission [refer to TT (Streaming Limit) Command]. RN Command is used to adjust the time delay that the transmitter inserts before attempting to resend a packet. If the transmitter fails to receive an acknowledgement after sending a packet, it will insert arandom number of delay slots (ranging from 0 to (RN minus 1)) before attempting to resend the packet.Each delay slot lasts for a period of 38ms.If two MLB-Z1001s attempted to transmit at the same time, the random time delay after packet failure would allow one of the two MLB-Z1001s to transmit the packet successfully, while the other would wait until the channel
Binary Command: 0x19 (25 decimal)	
Parameter Range:0 – 0xFF [slots]	
Default Parameter Value: 0 (no delay slots inserted)	
Number of bytes returned: 1	

RO (Packetization Time out) Command

Command Summary	Description
AT Command: ATRO	<Serial Interfacing> RO Command is used to specify/read the time of silence (no bytes received) after which transmission begins. After a serial byte is received and if no other byte is received before the RO time out, the transmission will start.
Binary Command: 0x21 (33 decimal)	
Parameter Range:0 – 0xFFFF [x 200 µs]	
Default Parameter Value: 0	
Number of bytes returned: 2	

RP (RSSI PWM Timer) Command

Command Summary	Description
AT Command: ATRP	<Diagnostics> RP Command is used to enable a PWM (“Pulse Width Modulation”) output on the Con fig pin which is calibrated to show the level the received RF signal is above the sensitivity level of the MLB-Z1001. The PWM pulses vary from zero to 95 percent. Zero percent means the received RF signal is at or below the published sensitivity level of the MLB-Z1001. The following table shows levels above sensitivity and PWM values. The total period of the PWM output is 8.32ms. There are 40 steps in the PWM output and therefore the minimum step size is 0.208ms.
Binary Command: 0x22 (34 decimal)	
Parameter Range:0 - 0x7F[x 100 milliseconds]	
Default Parameter Value: 0 (disabled)	
Number of bytes returned: 1	

PWM Chart

A non-zero value defines the time that the PWM output will be active with the RSSI value of the last received RF packet. After the set time when no RF packets are received, the PWM output will be set low (0 percent PWM) until another RF packet is received. The PWM output will also be set low at power-up. A parameter value of 0xFF permanently enables the PWM output and it will always reflect the value of the last received RF packet.

RZ (DI Buffer Size) Command

Command Summary	Description
AT Command: ATRZ	<Diagnostics> The RZ command is used to read the size of the DI buffer (UART RX (Receive)).Note: The DO buffer size can be determined by multiplying the DI buffer size by 1.5.
Binary Command: 0x2C (44 decimal)	
Parameter Range: Read-only	
Number of bytes returned: 1	
This command is only supported on S3B MLB-Z1001s.	

dBm above Sensitivity	PWM percentage (high period / total period)
10	47.5 %
20	62.5 %
30	77.5 %

RR (Retries) Command

Command Summary	Description
AT Command: ATRR	Networking> RR Command specifies the number of retries that can be sent for a given RF packet. Once RR Command is enabled (set to a non-zero value), RF packet acknowledgements and retries are enabled. After transmitting a packet, the transmitter will wait to receive an acknowledgement from a receiver. If the acknowledgement is not received in the period of time specified by the RN (Delay Slots) Command, the transmitter will transmit the original packet again. The packet will be transmitted repeatedly until an acknowledgement is received or until the packet has been sent RR times. Note: For retries to work correctly, all MLB-Z1001s in the system must have retries enabled.
Binary Command: 0x18 (24 decimal)	
Parameter Range:0 – 0xFF	
Default Parameter Value: 0 (disabled)	
Number of bytes returned: 1	

RS (RSSI) Command

Command Summary	Description
AT Command: ATRS	<Diagnostics> RS Command returns the signal level of the last packet received. This reading is useful for determining range characteristics of the MLB-Z1001s under various conditions of noise and distance. Once the command is issued, the MLB-Z1001 will return a value between 0x6 and 0x36 where 0x36 represents a very strong signal level and 0x4 indicates a low signal level.
Binary Command: 0x1C (28 decimal)	
Parameter Range: 0x06 – 0x36 [read- only]	
Number of bytes returned: 1	

SB (Stop Bits) Command

Command Summary		Description
AT Command: ATSB		SB Command is used to Set /read the number of stop bits in the data packets
Binary Command: 0x36 (54 decimal)		
Parameter Range: 0 - 1		
Parameter	Configuration	
0	1 stop bit	
1	2 stop bit	
Default Parameter Value: 0		
Number of bytes returned: 1		

SH (Serial Number High) Command

Command Summary	Description
AT Command: ATSH	<Diagnostics> Read the serial number high word of the MLB-Z1001.
Binary Command: 0x25 (37 decimal)	
Parameter Range:0 – 0xFFFF [read-only]	
Number of bytes returned: 2	
Related Commands: SL (Serial Number Low)	

SL (Serial Number Low) Command

Command Summary	Description
AT Command: ATSL	<Diagnostics> Read the serial number low word of the MLB-Z1001.
Binary Command: 0x26 (38 decimal)	
Parameter Range:0 – 0xFFFF [read-only]	
Number of bytes returned: 2	
Related Commands: SH (Serial Number High)	

SM (Sleep Mode) Command

<table>
<tr><th>Command Summary</th><th>Description</th></tr>
<tr><td>AT Command: ATSM</td><td rowspan="14"><Sleep Mode (Low Power)> SM Command is used to adjust Sleep mode settings. By default, Sleep mode is disabled and the MLB-Z1001 remains continually active.SM command allows MLB-Z1101 to run in low-power state and be configured in one of eight setting. Cyclic Sleep settings wake the MLB-Z1001 after the amount of time designed.by SM Command. If the MLB-Z1001 detects a wake-up initializer during the time it is awake, it will synchronize with the transmitter and start receiving data after the wake-up initializer runs its duration.</td></tr>
<tr><td>Binary Command: 0x01</td></tr>
<tr><td>Parameter: Configuration
0: Disable
1: Pin Sleep
3: Cyclic 0.5 second sleep (MLB-Z1001 wakes Every 0.5 seconds
4: Cyclic 1 second sleep
5: Cyclic 2 second sleep
6: Cyclic 4 second sleep
7: Cyclic 4 second sleep
8: Cyclic 8 second sleep</td></tr>
<tr><td>Parameter Range: 0, 1 , 3-8</td></tr>
<tr><td>Default Parameter Value: 0</td></tr>
<tr><td>Number of bytes returned: 1</td></tr>
<tr><td>Related Commands</td></tr>
<tr><td>For Pin Sleep – PC (Power-up Mode), PW (Pin Wake-up)

For Serial Port Sleep – ST (Time before Sleep

For Cyclic Sleep – ST (Time before Sleep),

LH (Wake-up Initializer Timer),

HT (Time Before Wake-up Initializer), PW (Pin Wake- up)</td></tr>
</table>

ST (Time before Sleep) Command

Command Summary	Description
AT Command: ATST	<Sleep Mode (Low Power)> ST Command sets the period of time (in tenths of seconds) in which the MLB-Z1001remains inactive before entering into Sleep Mode. For example, if the ST Parameter is set to 0x64 (100 decimal), the MLB-Z1001 will enter into Sleep mode after 10 seconds of inactivity (no transmitting or receiving). This command can only be used if Cyclic Sleep or Serial Port Sleep Mode settings have been selected using SM (Sleep Mode) Command.
Binary Command: 0x02	
Parameter Range:0x10 – 0xFFFF[x 100 milliseconds]	
Default Parameter Value: 0x64 (100 decimal)	
Number of bytes returned: 2	
Related Commands: SM (Sleep Mode), LH (Wake-up Initializer Timer), HT (Time before Wake-up Initializer)	

SY (Time before Initialization) Command

Command Summary	Description
AT Command: ATSY	<Networking> SY Command keeps a communication channel open as long as MLB-Z1001 transmits or receives before the active connection expires. It can be used to reduce latency in a query/response sequence and should be set 100ms longer than the delay between transmissions. This command allows multiple MLB-Z1001s to share a hopping channel for a given amount of time after receiving data. By default, all packets include an RF initializer that contains channel information used to synchronize any listening receivers to the transmitter hopping pattern. Once a new MLB-Z1001 comes within range, it is able to instantly synchronize to the transmitter and start receiving data. If no new MLB-Z1001s are introduced into the system, the synchronization information becomes redundant once MLB-Z1001s have become synchronized.SY Command allows the MLB-Z1001s to remove this information from the RF Initializer after the initial synchronization. For example, changing the SY Parameter to 0x14 (20 decimal) allows all MLB-Z1001s to remain in sync for 2 seconds after the last data packet was received. Synchronization information is not re-sent unless transmission stops for more than 2 seconds. This command allows significant savings in packet transmission time.
Binary Command: 0x17 (23 decimal)	
Parameter Range:0 – 0xFF[x 100 milliseconds]	
Number of bytes returned: 1	
Default Parameter Value: 0 (Disabled - channel initialization information is sent with each RF packet.)	

TR (Transmit Error Count) Command

Command Summary	Description
AT Command: ATTR	<Diagnostics> TR Command records the number of retransmit failures .This number is incremented each time a packet is not acknowledged within the number of retransmits specified by the RR (Retries) Command. It therefore counts the number of packets that were not successfully received and have been dropped. The TR Parameter is not non-volatile and will therefore be reset to zero each time the MLB-Z1001 is reset.
Binary Command: 0x1B (27 decimal)	
Parameter Range:0 – 0xFFFF	
Default Parameter Value: 0	
Number of bytes returned: 2	
Related Commands: RR (Retries)	

TT (Streaming Limit) Command

Command Summary	Description
AT Command: ATTT	<Networking> TT Command defines a limit on the number of bytes that can be sent out before a random delay is issued. TT Command is used to simulate full-duplex behavior. If a MLB-Z1001 is sending a continuous stream of RF data, a delay is inserted which stops its transmission and allows other MLB-Z1001s time to transmit (once it sends number of bytes specified by TT Command). Inserted random delay lasts between 1 & 'RN + 1' delay slots, where each delay slot lasts 38ms.
Binary Command: 0x1A (26 decimal)	
Parameter Range:0 – 0xFFFF (0 = disabled)	
Default Parameter Value: 0xFFFF (65535 decimal)	
Number of bytes returned: 2	
Related Commands: RN (Delay Slots)	

5 SALES CONTACT

Website : www.schmidt.com	
Singapore	Schmidt Electronics (S.E.A.) Pte Ltd 158 Kallang Way #06-10, Performance Building Singapore 349245 T (65) 6272-7233 F (65) 6273-4750 E info.sg@schmidtelectronics.com
Malaysia	Schmidt Electronics (Malaysia) Sdn Bhd Suite G2, Ground Floor, Wisma Tecna, No. 18A, Lot 318, Jalan 51A/223, 46100 Petaling Jaya, Selangor Darul Ehsan, Malaysia T (60-3) 7957-1080 F (60-3) 7956-8670 E info.kl@schmidtelectronics.com
Shenzhen, China	Schmidt & Co., (China) Ltd. Shenzhen Branch Schmidt (Shenzhen) Co., Ltd 3/F Unit E, International Culture Building, Fu Tian Road, Shenzhen 518033 T (86-755) 8376-0232 F (86-755) 8376-0025 E info@schmidthk.com
Taiwan	Schmidt & Co., (Hong Kong) Limited 5/F, 139 Song Jiang Road, Taipei 104, Taiwan T (886-2) 2502-5095 F (886-2) 2502-6717 E info@schmidthk.com
Thailand	Schmidt Electronics (Thailand) Ltd 252/97 (B), 19th Fl., Tower B, Muang Thai-Phatra Complex Building, Ratchadaphisek Rd., Huaykwang Subdistrict, Huaykwang District Bangkok 10310 Thailand T (66-0) 2693-3445 F (66-0) 2693-3448 E info.th@schmidtelectronics.com

6 ORDER INFORMATION

MLiS Product

MLB-Z1001: MLiS 900MHZ ZigBee Terminal

Power Adaptor

MLA-PSP-100: Input: AC 100 ~ 240V Output: 9V/1.3A DC jack 5.5/2.1

MLA-PSP-101: US Adapter Plug

MLA-PSP-104: British Adapter Plug

MLA-PSP-103: European Adapter Plug

MLA-PSP-102: Australia Adapter Plug

MLA-CAB-001: DC jack power line 5.5/2.1

Cable

MLA-CAB-101: DB9 connector for RS232 (Female)

Antenna

MLA-ANT-004: 900MHZ RPSMA antenna 2.1dBi

Notes: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