EZBee™

2.4GHz Zigbee Serial Module

User Manual: Zigbee Module

Manual Version 1.1

EZ way to go wireless with ZigBee

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Revision History: User Manual of EZBee™

Version	Document Number	Changed Contents	Date
1.1	EZB_manual_1201	Commands Addition by Firmware Updates	12/01/2005
Pre	EZB_manual_0927	Preliminary Version	09/26/2005

Module Version History

Part no.	Description	Version	Release Date
EZB-001	2.4GHz Zigbee Module Short Range	VER.C.0.9.1 VER.R.0.9.0 VER.E.0.9.0	Sept 26, 2005
EZB-001EK	EZB-001 Evaluation Kit	VER.C.0.9.1 VER.R.0.9.0	Sept 26, 2005

<EZB-001EK: EZB-001 Evaluation Kit>

To have more information on Evaluation Kit,

please refer to the user manual of EZB-001EK (Doc# EZB_EK_manual_1201)

Contents

1. About EZBee™

EZBee™ is a compact Zigbee single-board module which is compliant to the 2.45GHz Zigbee specification v1.0 of IEEE 802.15.4. With EZBee™, users may enable Zigbee wireless network easily without a professional knowledge on Zigbee protocol. EZBee™ is designed to be used as a serial RF module to a Host system.

<Fig. 1.1: EZBee™- EZB-001>

Using AT commands provided, users may communicate with EZBee™. Full AT commands available can be found from page 8.

EZBee modem provides two ways of transmitting messages between modules, ***Connectionless mode and Connection mode***.

Connectionless Mode: In this mode, users may send data (point-to-point or broadcast) to the other nodes in the connected Zigbee network by AT commands.

Connection Mode: In this mode, users may send data WITHOUT AT commands to other nodes in connected network.

Each modules has extended address, short address and unique ID. The unique ID is used in both connectionless & connection mode.

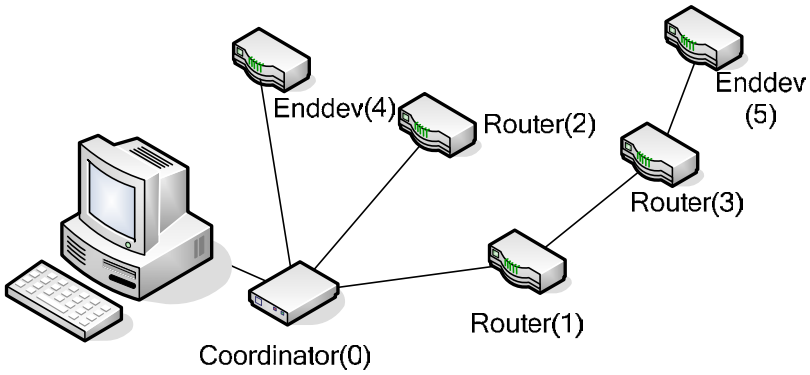


Figure 1.2 ZigBee Network With EZBee™

Key Features

- IEEE 802.15.4 compliant PHY and MAC
- Full Function Device (FFD)
- 16 x 33.5 x 3.3 mm compact shield module for SMD mounting
- 128KB Flash memory, 4KB SRAM, 4KB EEPROM
- UART, SPI and JTAG interface
- 16 Channels in the 2.45GHz ISM band
- Up to 250kbps
- Integrated chip antenna or External Antenna options
- 2.7 ~ 3.6V supply voltage
- -30°C to 85°C operating temperature
- Conforms with ETSI EN 300 440 (Europe), FCC CFR-47 part 15.247 and 15.249 (USA), ARIB STD-T66 (Japan)

Applications

- Wireless remote control
- Building automation
- Personal area network
- Industrial control
- OEM equipment
- PC peripherals

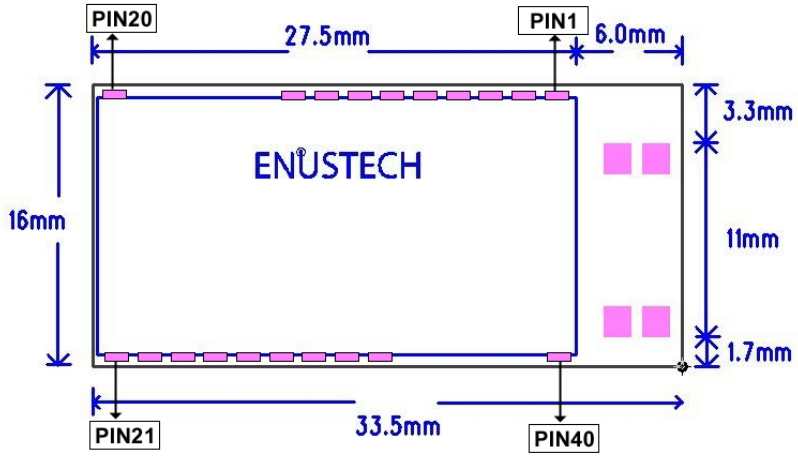
2. Specification

Parameters	EZB-001
Performance	
Range (LOS)	30m
Output Power	-25dBm~0dBm (1mW)
Data Rate	250Kbps
Receiver Sensitivity (PER=1%)	-94dBm
Power Requirements	
Supply Voltage	2.7~3.6V
Tx Current (typical)	27mA
Rx Current (typical)	30mA
Power-down current	< 10uA
General	
Operating Frequency	2.4~2.4835GHz
Dimensions	16 x 33.5 x 3.3 mm
Operating Temp.	-30°C ~ 85°C
Antenna Options	Integrated / External

Networking	
Supported Network Topologies	Point-to-point, Point-to-multipoint, Mesh
Channels	16
Certifications	
FCC/CE	Pending

3. Hardware Structure

3.1 Mechanical Drawing



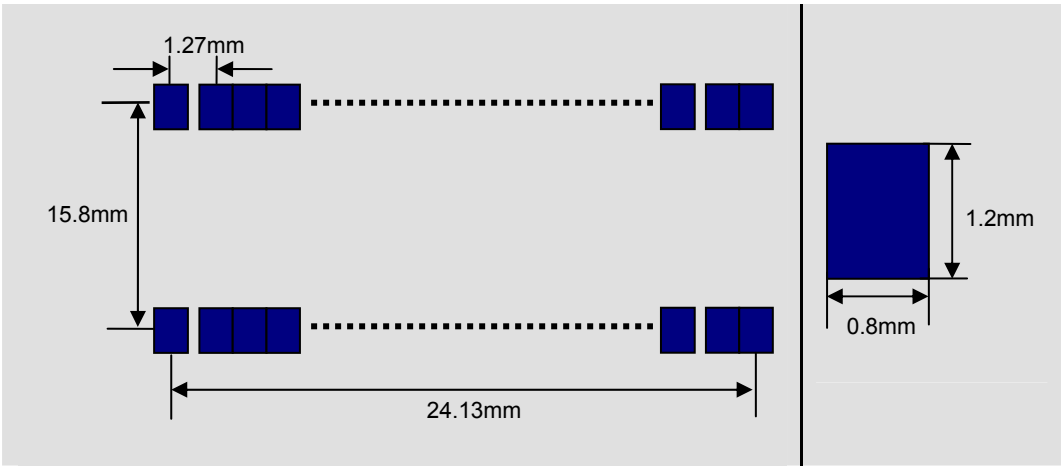
<Fig. 3.1 Mechanical drawing of EZBee™>

3.2 Pin Assignment

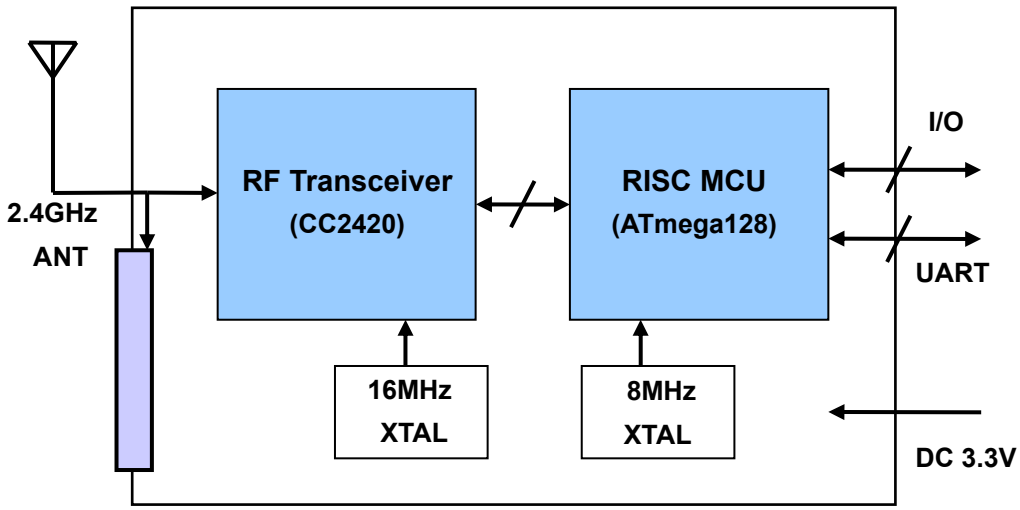
Pin no.	Description	Pin no.	Description
1	GND	40	INT5
2	RF_SIGNAL	39	INT4
3	GND	38	AIN1
4	VCC	37	AIN0
5	RXD	36	TXD485
6	TXD	35	RXD485
7	RTS	34	AREF
8	CTS	33	ADC0
9	DIO8 (A8)	32	ADC1
10	DIO9 (A9)	31	ADC2
11	DIO10 (A10)	30	ADC3

12	DIO11 (A11)	29	TCK
13	DIO12 (A12)	28	TMS
14	RESET	27	TDO
15	OC2/OC1C	26	TDI
16	OC0	25	GND
17	RI	24	DIO0
18	DCD	23	DIO1
19	DTR	22	DIO2
20	DSR	21	DIO3

3.3 PCB Layout



3.4 Block Diagram



4. Module Configuration

Users may configure EZBee™ series with simple and easy AT commands. Following AT commands set can be used with your module. If you will need any further technical support, please contact to info@hantz.com

4.1 AT Commands

AT commands interface can be divided into network commands and system commands.

Default serial setting of EZBee™:
38,400bps / 8 Data bit / 1 Stop bit / Non Parity / No hardware flow control

AT commands Set

AT command	Category	Description	Parameter	Default
D	Network	Connect	<Destination ID>	
H	Network	Disconnect	None	
SP	Network	Start/Join PAN	None	
DP	Network	Disjoin from PAN	None	

&ANS	Network	Connection request accept	None	
&MSG	Network	Send message	<Node ID>, <message>	
&RJT	Network	Connection request reject	None	
Z	System	Module reset	None	
V	System	Shows module version	None	
S	System	Shows module status	None	
+AS	System	Get/Set auto start/join PAN	0 or 1	1
+ATAN	System	Get/Set connection auto answer	0 or 1	1
+BM	System	Get/Set beacon mode	0~15	15
+BR	System	Set serial baud rate	1200, 2400, 4800, 9600, 19200, 31250, 38400, 57600, 76800, 115200	38400
+CH	System	Get/Set channel	11~26	19
+DST	System	Get/Set destination ID	<Destination node ID>	0
+E	System	Serial echo off/ echo on	0 or 1	1
+EA	System	Set/Get 64-bit extended address	<extended address>	Factory set
+ID	System	Set/Get node ID	<Node ID>	
+NWK	System	Get network configuration	None	
+PID	System	Get/Set PAN ID	0~0x3FFF or 0xFFFF	0xFFFF
+SA?	System	Show 16-bit short address	None	

Notification message

message	Parameter		Description
$CONFLT_ID	none		My ID conflict
	<Conflict ID>		Confliction with the module with ID <Conflict ID>
$INIT	None		Network stack init
$JOIN	<Module ID>,<Module saddr>,<Module eaddr>		For Coordinator, shows the status of joining of other modules.
	FAIL		For Router or Enddev, Join FAIL message
$LEAVE	<extended address>		Network disjoin indication or confirmation
$LOST	None		Network lost indication
$MSG	<Node ID>, <Message>,<Link-quality>		Notify incoming message
	Parameter description	<Node ID>	Source ID(0~0xFFFF)
		<Message>	Variable even size message length
		<Link-quality>	0~0xFF
$PNS	COORD/ROUTER		PAN Start mode
$REQC	<Request node ID>		Connection request indication
$RESET	None		Module reset
$SADDR	<short address>		Network join confirm
$SEND	OK / FAIL		Notify message send success or failure

Result message

Result messages show the result after the command process.

Message	Description
ALREADY START	Network already started
BUSY	Peer is busy
CANCEL	Connection cancelled
CONNECT	Connection success
CONN RESET	Peer reset connection
DISCONNECT	Disconnection success

ERROR	Invalid command or parameter
INVALID_MAC	Invalid 64-bit extended address
NET STOP	Network did not start
NO CARRIER	Can't send message to destination
NO RESPONSE	Peer does not response
NOMEM	Exhaust memory
NOEXIST ID	There is not such ID
OK	Command recognition success
REJECT	Peer reject connection request
SELF ID	Destination is myself

4.2 Description of AT Commands

Users may communicate with EZBee modules via RS232 interface.

Default serial port setup	
Baud rate	38400
Data	8-bit
Parity	None
Stop bit	1-bit
Flow control	None

Serial interface of EZBee modules can be configured by AT commands.

Command	Parameter	Result	Description
AT+BR?	none	<baud rate>	Show current serial baud rate
AT+BR=	**1200**	**OK**	Set baud rate
	2400		
	4800		
	9600		
	19200		
	31250		
	38400		
	57600		
	76800		

*NOTE: 115200bps will be available with officially released version from Jan. 2006

Setup echo mode

Users may configure echo options of serial communication.

Command	Parameter	Result	Description
AT+E0	None	**OK**	Serial echo off
AT+E1	None	**OK**	Serial echo on

PAN Start / Join

After start-up of module operation, for data communications, one module should start PAN network or join the existing PAN. Following commands may be used to join or disjoin PAN.

To start PAN or join the existing PAN:

Command	Parameter	Result	Description
ATSP	None	**$PNS=COORD**	PAN coordinator start
		$PNS=ROUTER	PAN router start
		$SADDR=<shortaddr>	PAN join (router/enddev)

After successful joining, the Coordinator gets following message:

Command	Parameter	Description
$JOIN=	<Module ID>, <Module short address>, <Module extended address>	Shows ID, short address, and extended address of the newly joined module.

When failed to join, the Router or the Enddev gets following message:

Command	Parameter	Description
$JOIN=	**FAIL**	Join Failure

PAN auto start / join

When start the module, users may configure the PAN starts, or join the PAN automatically

Command	Parameter	Result	Description
AT+AS?	None	**0**	Automatic Start mode OFF
		1	Automatic Start mode ON
AT+AS=	**0**	**OK**	Configures Automatic Start mode OFF
	1		Configures Automatic Start mode ON

PAN disjoin*

To disjoin from the joined PAN:

Command	Parameter	Result	Description
ATDP	None	**$LEAVE=OK**	Disjoin request success
		$LEAVE=FAIL	Disjoin request failed
		$LEAVE=<extaddr>	Disjoin indication from <extaddr>

* This command will be upgraded with officially released version.

Configuration of PAN ID

Users may assign PAN ID to distinguish each PAN nearby, or to prohibit joining of unauthorized modules, in the range 0x0~0x3FFF or 0xFFFF. If PAN ID is configured in the range between 0x0~0x3FFF, only modules with such a PAN ID may joined the PAN network.

Command	Parameter	Result	Description
AT+PID?	none	<PAN ID>	Shows current PAN ID in ASCII hexadecimal a
AT+PID=	**0~3FFF** or **FFFF**	**OK**	Configures PAN ID
		ERROR	

After setting of PAN ID, the module will reset itself to activate new PAN ID.

Configuration of Module ID

As short address of a module can be changed even after restart or reset of PAN, it is recommended to use unique ID of module for data communication between the modules. So, before to start communication between modules, unique module ID should be configured.

Command	Parameter	Result	Description
AT+ID?	None	**COORD**	This module works as Coordinator.
		<Module ID>	Shows current Module ID.
AT+ID=	**1~FFFE**	**OK**	Configures module ID
		ERROR	
		$CONFLT_ID	This ID has been used by other modules. ID confliction.
		$CONFLT_ID=<Module ID>	ID confliction with module of ID <Module ID>

If module ID is '0' or 'COORD', this means the module is the Coordinator, and 'FFFF' or 'BROAD' means the address of broadcast.
Reset will NOT be performed even after module ID change.

Message Transmission without connection

EZBee™ may send/receive data in Not-connected status by AT commands.

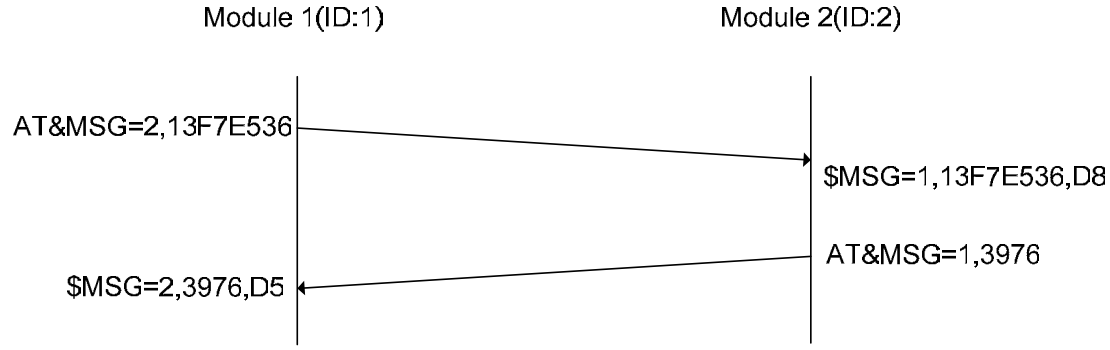
Command	Parameter	Result	Description
AT&MSG=	<Module ID>, <Message>	**OK**	Request to send message to a module
		ERROR	
		$SEND=OK	Success of message transmission. (Not applicable for Broadcasting message)
		$SEND=FAIL	Failure of message transmission (Not applicable for Broadcasting message)
		NOEXIST ID	If no modules with such module ID does exist.

The module who received the message from sender by 'AT&MSG=' command will show following messages:

Command	Parameter	Description
$MSG=	<src ID>, <message>, <link quality>	Message received from the module with <src ID>

Message should be transmitted in ASCII hexadecimal format, and should not exceed 62 characters length including AT commands.

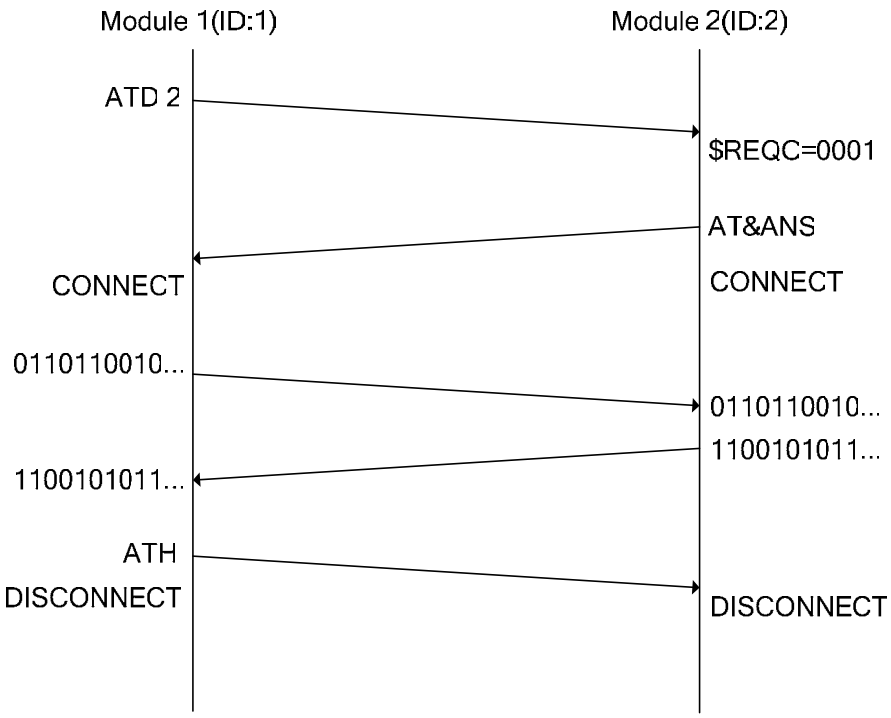
Following shows example of message transmission:



In above drawing, module 1 is sending '0x13f7e536' to module 2, and when module 2 receives this message, link quality is '0xd8'. When module 2 is sending '0x3976' to module 1, the link quality when received by module 1 is '0xd5'.

Message Transmission after connection

EZBee™ provides connection mechanism between the connected modules via message pipes. So it is possible to send/receive serial data WITHOUT AT commands between the modules. Max. length of each message is 64bytes, and should have 5msec of time gap between each message. Following drawing shows the procedure from connection to disconnection:



1) Connection Command

Command	Parameter	Result	Description
ATD	<space> <Node ID> or None	**SELF ID**	Destination module to connection is myself
		NOEXIST ID	No module with such ID
		NO RESPONSE	No response from the peer during connection transaction
		CANCEL	connection transaction was cancelled by the Peer
		BUSY	The Peer was already connected or trying to connect to the other module
		REJECT	The Peer rejected connection request.
		CONNECT	The Peer accepted connection request

The Peer module which received Connection request from the sender may have following messages.

Command	Parameter	Description
$REQC=	<Source ID>	Connection request message received from the module of <Source ID>

If parameter after ATD command is not specified, the module will try to connection to destination module configured by “AT+DST” command.

2) Disconnection command

Users may disconnect with currently connected module:

Command	Parameter	Result	Description
ATH	None	**DISCONNECT**	Finish current connection
+++		**NO RESPONSE**	No response from the Peer during Disconnect transaction

Configuration of Default Destination ID

Users may omit the parameter of ATD command, by configuring default destination ID.

Command	Parameter	Result	Description
AT+DST?	None	<Dest ID>	Shows currently configured destination module ID
AT+DST=	<Node ID>	**OK** / **ERROR**	Configures Default ID of destination module

Connection Request Accept

When received Connection request message, receiver module may accept the request of connection:

Command	Parameter	Result	Description
AT&ANS	None	**CONNECT**	Connection request was accepted
		ERROR	No connection request has been arrived.
		NO RESPONSE	No response from the Peer

Connection Request Reject

When received Connection request message, receiver module may reject the request of connection:

Command	Parameter	Result	Description
AT&RJT	None	**OK**	Connection request was rejected
		ERROR	No connection request has been arrived.

Automatic Answering Configuration on Connection Request

By following commands, users may accept connection request automatically.

Command	Parameter	Result	Description
AT+ATAN?	None	**0**	Currently this auto-answer mode is OFF.
		1	Currently this auto-answer mode is ON.
AT+ATAN=	**0**	**OK**	Configures Auto-answer mode to be OFF
	1		Configures Auto-answer mode to be ON

Reading Network Configuration

Reads current configuration of Network

Command	Parameter	Result	Description
AT+NWK?	None	<NETMODE>, <MAXCHILD> <MAXROUTER> ,<MAXDEPTH>	Shows current network configuration

Each parameters of result message by 'AT+NWK?' command means:

Field	Parameter	Description
<NETMODE>	**MESH**	Current Network Mode
	STAR	
	TREE	
<MAXCHILD>	Decimal number	The number of max. child nodes which may join to one node.
<MAXROUTER>	Decimal number	The number of max. router nodes which may join to one node. The number of max. routers should be same or smaller than the number of max. childs.
<MAXDEPTH>	Decimal number	Max. depth of network from the Coordinator

Configuration of Beacon Mode

Users may use Beacon mode to synchronize the modules in ZigBee Network:

Command	Parameter	Result	Description
AT+BM?	None	<beacon mode>	Shows current value of beacon mode
AT+BM=	**0~15**	**OK**	Configures Beacon mode

Beacon mode available:

Mode	Description	Mode	Description
15	No beacons	7	2 seconds
14	4 minutes	6	1 seconds
13	2 minutes	5	480 milliseconds
12	1 minutes	4	240 milliseconds
11	31 seconds	3	120 milliseconds
10	15 seconds	2	60 milliseconds
9	7.5 seconds	1	30 milliseconds
8	4 seconds	0	15 milliseconds

Configuration of Default Channel

Using following commands, users may read/configure the default channel to scan, start or join the Zigbee network.

Command	Parameter	Result	Description
AT+CH?	None	<default channel>	Reads current default channel
AT+CH=	**11~26**	**OK**	Configures Default channel

Default channels available:

Channel	Description	Channel	Description
11	2405 MHz	19	2445 MHz
12	2410 MHz	20	2450 MHz
13	2415 MHz	21	2455 MHz
14	2420 MHz	22	2460 MHz
15	2425 MHz	23	2465 MHz
16	2430 MHz	24	2470 MHz
17	2435 MHz	25	2475 MHz
18	2440 MHz	26	2480 MHz

Reading of Short Address

Reads current 16-bit short address assigned to the Coordinator or the Router by following command:

Command	Parameter	Result	Description
AT+SA?	None	<short address>	Reads currently assigned Short address

If the short address is 'FFFF', this means short address has not been assigned.

Reading of Extended Address

Reads/Configures current IEEE 64-bit extended address assigned to the Coordinator or the Router by following command:

Command	Parameter	Result	Description
AT+EA?	None	<extended address>	Reads currently assigned extended address
AT+EA=	<eaddr>	**OK**	Configures the extended address as <eaddr>.

The module will Reset itself after configuration of Extended address for applying newly assigned address.

Module Reset

Software Reset by following command:

Command	Parameter	Result	Description
ATZ	None	**$RESET**	S/W reset

Reading Module Version

Reads version of the module

Command	Parameter	Result	Description
ATV	None	**VER.C.0.9.2**	Coordinator version 0.9.2
		VER.R.0.9.2	Router version 0.9.2
		VER.E.0.9.2	Enddev version 0.9.2

Reading Module Status

Reads current status of module

Command	Parameter	Result	Description
ATS	None	<Module type>.<Net start>. <Total mem>.<Current used mem>. <highly used mem>	Reads current status of the module

Each parameters of Result by ATS command means:

Field	Value	Description
<Module type>	C	Coordinator
	R	Router
	E	Enddev
<Net start>	S	Network start
	T	Network stop

5. Legal Notice & Contact

About this Document

This document provides introductory instructions on how to set up and manage EZBee™-DK001 within your networking environment. Should you require more information, please refer to website at www.hantz.com .

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