Smart Outlet

User Manual

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Ⅰ **Summary**

1. Introduction

LinkSprite smart outlet system consists of one or more smart outlet controller unit and one or more smart outlet. The smart outlet system can be controlled by host (PC or MCU) through serial port using convent AT commands. Smart outlet can be turned on/off, report real time power, and report accumulated energy consumed remotely by LinkSprite powerline communication technology.

A smart outlet controller unit works as gateway to communicate with the remote smart outlets by powerline communication. On the smart outlet controller motherboard, there is a 20-pin receptacle, users can choose different daughter boards based on the interface needs. This 20-pin receptacle is pin-compatible with Xbee module from Digi (www.digi.com). So an Xbee module can also be used on smart outlet controller. Available interface cards are UART-RS232 daughter board, UART-RS485 daughter board, UART-USB daughter board, UART-Ethernet daughter board and Zigbee.

The smart outlet controller can also be configured to transparently move serial data over the powerline network, and achieves the target of replacing cables by the ubiquitous powerline network.

All LinkSprite modules, including smart outlet controller and smart outlet have the built-in packet-level repeater function. This feature can greatly extend the coverage of the powerline communication.

LinkSprite smart outlet controller and smart outlet have both physical and logic addresses. In a network, both physical and logic addresses can be used to address different nodes in the network, and can also broadcast within the same domain.

2 Features

A Smart Outlet Controller with a UART-RS232 daughter card

A Smart Outlet OEM board

- Remote control and status (real time power consumption and accumulated energy consumed) onitoring of outlets through powerline and/or Zigbee communications
- Built-in error correction codes.
- Built-in repeater function to extend the coverage.
- Physical and logic address
- AT commands.
- 3.3V TTL UART, Optional RS232, RS485. USB, Ethernet, Zigbee

interfaces

- FSK（Frequency Shift Keying）modulation used in physical layer

- Low power (Peak Current During Transmission < 100mA, current During Receiving < 50mA, Standby current < 30mA)

- RoHS

- Small module size (55mm X 85mm including the on-board power switch regular keep out area), and easy to be implemented into existing products.

3 Specifications

| Product name	Smart outlet, smart outlet controller
Interface	3.3V TTL UART Optional interface cards: RS232 (model/ordering no: UART-RS232) RS485 (model/ordering no: UART-RS485) USB (model/ordering no: UART-USB) Ethernet (model/ordering no: UART-Ethernet) Zigbee (model: Xbee from Digi.com)
Voltages	230VAC/50Hz, 110VAC/60Hz
Maximum Power Rating of Outlet	2000W
Modulation	FSK（Frequency Shift Keying）
Carrier frequency	262K/144KHz
Error Correction	FEC（Forward Error Correction）
Data rate on Powerline	30Kbps
Repeater Hops	3 Hops
Transmission distance	300 feets（no repeater）
Support nodes number	65535
LED	Power Line Activity LED system LED serial port LED

4 Applications

- AMR

- Home automation

- Industry manufacture and control

- Safeguard, fire alarm, smoke alarm

- Collect and transmit instrument data

- Safeguard and monitor

- Solar/Wind electricity generation system

Ⅱ Diagram

1 Board Layout of Controller Unit
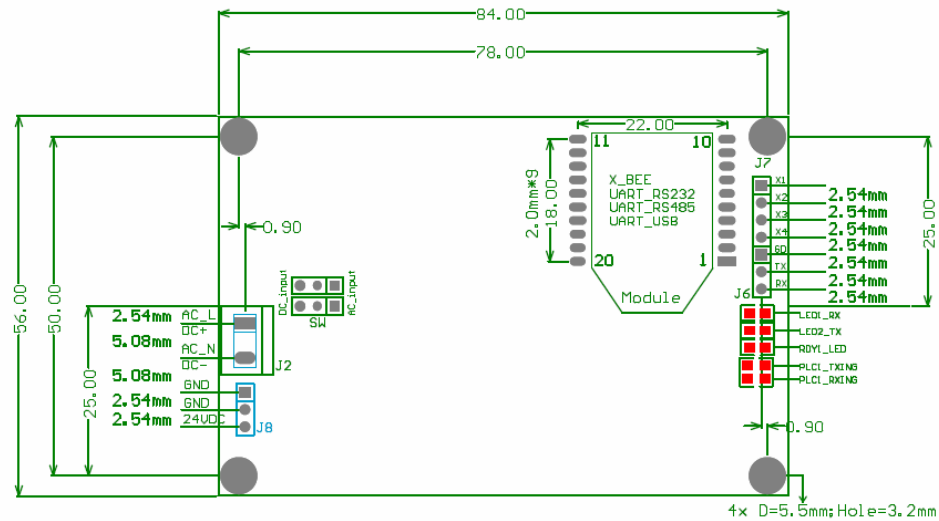
2 LED

PLC LED	PLC LED: green mans module is sending data to PLC; red means module is receiving data from PLC
RDY_LED	System LED，green means system is in normal
LED1	Serial port LED，green means module is receiving data from aerial port; red means module is sending data to serial port

3 Definition of DIP Pins

```
1) Module=X_BEE:
   J7_1(X1) -> NONE
   J7_2(X2) -> NONE
   J7_3(X3) -> NONE
   J7_4(X4) -> NONE
   J6_1(GD) -> GND
   J6_2(TX) -> UART_TX   TTL
   J6_3(RX) -> UART_RX   TTL


2) Module=UART_RS232:
   J7_1(X1) -> GND
   J7_2(X2) -> UART_TX   RS232
   J7_3(X3) -> UART_RX   RS232
   J7_4(X4) -> NONE
   J6_1(GD) -> GND
   J6_2(TX) -> UART_TX   TTL
   J6_3(RX) -> UART_RX   TTL


3) Module=UART_RS485:
   J7_1(X1) -> GND
   J7_2(X2) -> UART_485_A
   J7_3(X3) -> UART_485_B
   J7_4(X4) -> NONE
   J6_1(GD) -> GND
   J6_2(TX) -> UART_TX   TTL
   J6_3(RX) -> UART_RX   TTL


4) Module=UART_USB:
   J7_1(X1) -> USB_GND
   J7_2(X2) -> USBDP(+)
   J7_3(X3) -> USBDM(-)
   J7_4(X4) -> VBUS
   J6_1(GD) -> GND
   J6_2(TX) -> UART_TX   TTL
   J6_3(RX) -> UART_RX   TTL
```
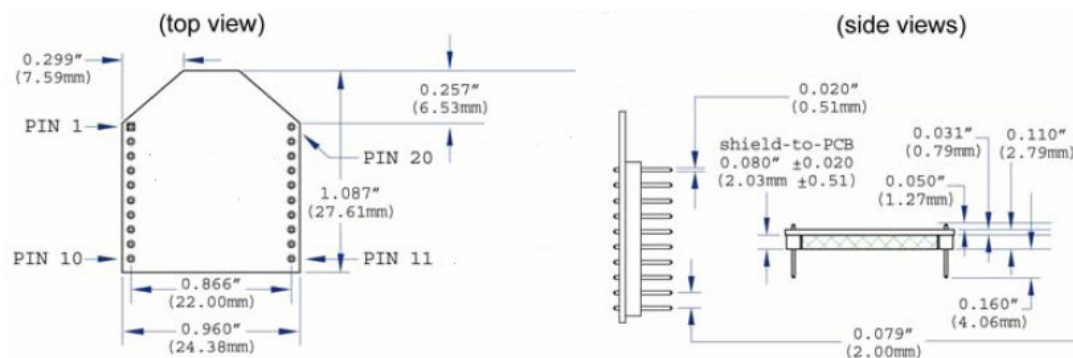
4 Interface Card Socket Definition and Layout

The pin layout of interface cards is compatible with Xbee module from Digi (www.digi.com). The socket on the PLC-UART motherboard can be used to receive any interface card with the pin out shown below:

Pin assignment of the interface card socket:

Pin #	Name	Direction	Description
1	VCC	-	3.3V Power supply
2	DOUT	Output	UART Data Out
3	DIN	Input	UART Data In
4	EX4	Depending on model of daughter card	Route daughtercard final interface signal back to mother board, and to the DIP pins to user's board
5	RESET	Input	Module Reset
6	EX3	Depending on model of daughter card	Route daughtercard final interface signal back to mother board, and to the DIP pins to user's board
7	EX2	Depending on model of daughter card	Route daughtercard final interface signal back to mother board, and to the DIP pins to user's board
8	EX1	Depending on model of daughter	Route daughtercard final interface signal

		card	back to mother board, and to the DIP pins to user's board
9	SLEEP	Input	Pin Sleep Control Line
10	GND	-	Ground
11	Unused	-	-
12	Unused	-	-
13	Unused	-	-
14	Unused	-	-
15	Associate	Output	Associated Indicator
16	Unused	-	-
17	Unused	-	-
18	Unused	-	-
19	Unused	-	-
20	Unused	-	-

Ⅲ Command Interface

Smart Outlet controller can work as command center to the remote smart outlet (command mode) and can also work as data modem to transparent move user data between serial port and powerline network (data mode). The default mode is command mode. The default mode after power cycle can also be configured to be either command mode or data mode using AT command.

1 Command Mode

1.1 Enter command mode

In data mode, the controller can be put into command mode by sending "###" through serial port. The module will respond with an "ok". In order to prevent the situation where the user data" ###"mistakenly triggers the command mode, there must be no serial port data input one second before and after the receiving of "###". At the same time, the gap between the three "#" should not be more than one second, otherwise, it will be considered as a data rather than a command.

1.2 Exit command mode

The only way is to input command "ATEX". The controller will response "exited".

2 Arguments and Responses

For all the commands with arguments: if the parameters are correct, the module will respond with an "ok". Otherwise, the modules will response with an "invalid para". If there are no arguments associated with the commands, it will be treated as polling modem and the module will respond with the existing arguments residing in the module.

3 Command List

Command	Description	Arguments	Description	Default
			Control Class		
###		none	Enter command mode in data mode	
ATEX	Exit	none	Exit command mode	
ATCM	Change default mode after power on	1,0	1: Command mode after power on 0: Data mode after power on	0
ATRS	Reset	none	Software reset	

Outlet Class				
ATON	Turn On Outlet	Destination Serial Number	If without argument, turn on all outlets within the same logical domain If with argument, turn on the outlet with the specified serial number	
ATOF	Turn Off Outlet	Destination Serial Number	If without argument, turn off all outlets within the same logical domain If with argument, turn off the outlet with the specified serial number	
ATPW	Poll the real time power	Destination Serial Number	Poll the outlet with the specified serial number, the return will be Watts.	
ATEG	Poll the accumulated energy since last energy clearing	Destination Serial Number	Poll the outlet with the specified serial number The return will be W.h, instead of kW.h.	
ATEZ	Clear accumulated energy register	Destination Serial Number	Clear accumulated energy register of the outlet with the specified serial number	
Network class				
ATDA	Domain Address	1-32767	Domain Address of Logic Address	1

| ATNA	Node Address	1-65535	Node Address of logical address	1
Function class				
ATRP	Repeater	Y,N	Relay function, Y is on, N for off	Y
ATNM	Name	A string with length less than 15	Set the name of the module	PU-R485A
Communication class				
ATBD	Baud Rate	1200, 2400, 4800, 9600, 19200	Baud Rate	9600
ATDB	Data Bit	5,6,7,8	Data bit	8
ATPA	Parity	N, O, E	Parity bit，N = no, O = odd, E = even	N
ATST	Stop Bit	1,2	Stop bit	1
Debug class				
ATRW	Raw	Y,N	The raw data for debugging. The module will output sent raw packets from host to the module, and not just the payload. Y means turn on this function, N means turning off.	N

| ATSR	Search	none	Search for peer module on the power line network	

Ⅳ Repeater Function

1 Introduction

To extend the coverage, Linksprite modules have built-in repeater function.

When the module's repeater function is turned on (off is the default setting), the module echos the data packet from the power line, while entertaining the data sent by host through the serial port.
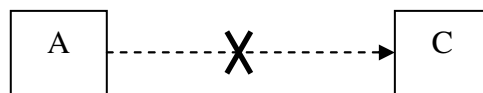
Because of far distance, data transmission can not be reached.
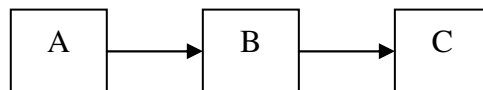
After adding repeater function to proper locations, the data can be transmitted farther.

Transceiver function is not influenced by repeater function, that is to say, each module can be used as a separate repeater or can be seen as repeater when sending and receiving data. It can not only send and receive data from the power line, but also repeat other data packets.

In order to prevent network congestion, the module is smart smart enough to know the data were sent or repeated by itself and will discard the data packets when receiving the duplicated ones.

Note: Due to the fact that repeaters will resent the received data packets, if the number of repeater is too large, a number of repeaters will seize the channel, and lead to increased communication time. When deploying the repeater, one should take full account of the balance of reliability and real-time.

2 Function Setting

AT command 'ATRP' is designed to set up the repeater function.

2.1 Turn on repeater function

Steps	input	response	description
1	+++	ok	Enter command mode
2	ATRP	Y or N	Poll current repeater status, Y is on, N for off
3	ATRP Y	ok	Turn on repeater function
4	ATRP	Y	Check present repeat status, ON
5	ATEX	exit	Exit command mode

2.2 Turn off repeater function

steps	input	response	description
1	+++	ok	Enter command mode
2	ATRP	Y or N	Check current repeater status, Y is on, N for off
3	ATRP N	ok	Turn off repeater function

4	ATRP	N	Check current repeater status, OFF
5	ATEX	exit	Exit command mode

2.3 Setting Illustration

●Repeater function is available in the factory.

●Once repeater function is modified; it will immediately take effect and be preserved permanently, even if the module is restarted.

3 Repeater Hops

A data packet could at most pass through third repeater three times. It is shown as follows：
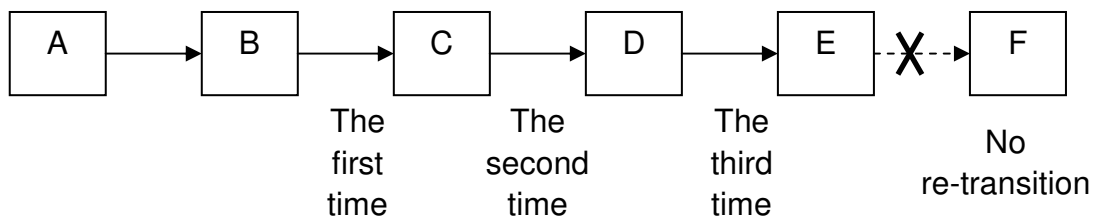
Data packet is sent from module A to module B. From module B to module C is the first time, to module D is the second time, and to module E is the third time. Module F is the termination. Therefore, data packet won't be sent to module F.

Ⅴ Logic Address

1 Logic Address

Module data packets are transmitted in the way of broadcasting in power lines. All modules will receive the data packets issued by the module and sent them, through the serial port under carrier signals area.

When multiple modules are installed on the same power line network, however, one does not want them to communicate directly; thus, the networks can be addressed by the logic address.

Logic address is composed of two parts: domain and nodes. For example, the logic address (10:200) means that the domain value is 10, node value is 200. Logic address is the default setting (1:1).

Module data packets can only be received and processed by the module at the same domain. Other modules, even detecting the carrier signal will not receive, nor to transmit to the serial port or repeater.
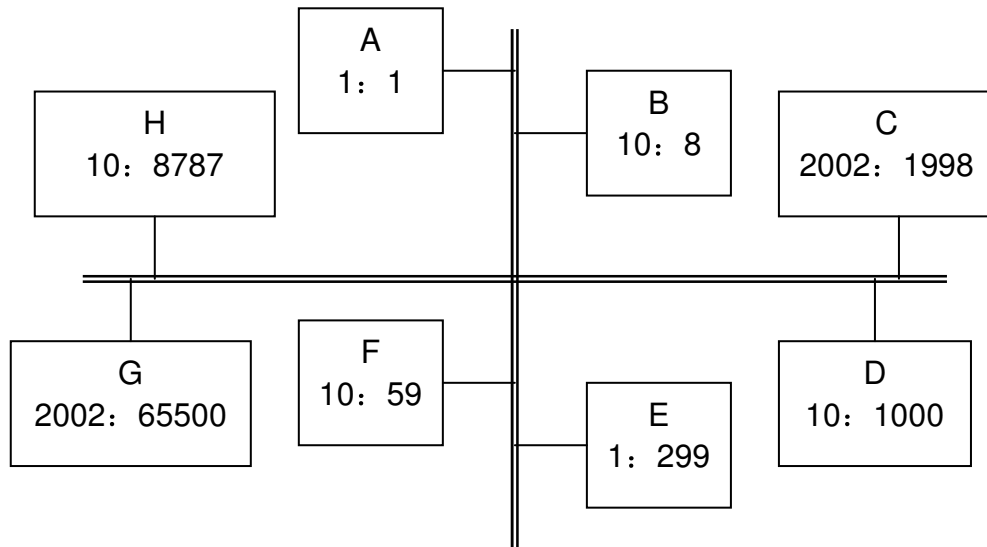
On the above figure, A, E are at the same network, their domain values are 1; B, D, F, H are at the same network, its domain values are10; C, G are at the same network, their domain values are 2002. Although in the physically speaking, all the modules are in a power line network, the packet issued by A, will only be received and processed by E, other modules will not respond. Similarly, packet issued by F, only B, D, H will receive and process packet issued by F, other modules will not work.

2 Address Setting

step	input	response	description
1	+++	ok	Enter command mode
2	ATDA	1-32767	Check domain values of present logic address. Default factory setting is 1.
3	ATNA	1-65535	Check nodes values of present logic address. Default factory setting is 1.
4	ATDA 2	ok	Set domain value of logic address as 2

5	ATNA 45	ok	Set nodes of logic address as 45
6	ATDA	2	Check domain values of logic address
7	ATNA	45	Check node values of logic address
8	ATEX	exited	Exit command mode

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