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A7 eb101 Serial Firmware Version 1.0.025
A7 eb101/eb301 Bluetooth Serial Devices
Quick Start Guide

Revised March 23, 2009

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Introduction

A7's eb101 serial firmware provides the basis for the functionality of the eb101 module family for use in scenarios such as cable replacement. In turn a number of A7's Bluetooth adapters, including the eb301 adapters, feature the eb101 module as the core of the adapter.

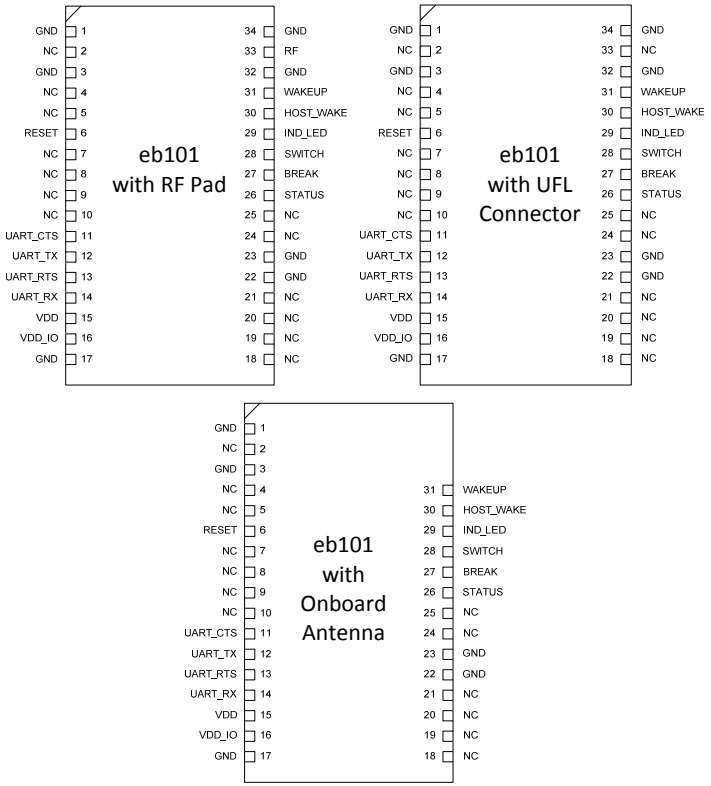
This quick reference guide provides an overview of the command interface and other quick reference information for the serial firmware and the hardware running that firmware.

A7's eb101 serial firmware is designed to abstract the details of Bluetooth and to make setup and connection to other eb101 serial firmware products as well as other standard Bluetooth devices a simple task.

The firmware supports two main operating modes: EasyConnect mode and Command mode. EasyConnect mode is generally used in simple cable replacement scenarios; while Command mode provides a rich set of functions that allow programmatic control.

A7 eb101 Bluetooth Serial Modules

For detailed information about the eb101 hardware please refer to the datasheet for the eb101 Bluetooth Serial Module available via our website. The pin outs are shown here for quick reference.



Name	Pin	Type	Description
RESET	6	CMOS input with weak internal pull-up	Reset if low. Input debounced; must be low for >5ms to cause a reset
UART_CTS	11	CMOS input with weak internal pull-down	UART clear to send, active low
UART_TX	12	CMOS output	UART data output, active high
UART_RTS	13	CMOS output, tristate with internal pull-up	UART request to send, active low
UART_RX	14	CMOS input with weak internal pull-down	UART data input, active high
VDD	15	Supply voltage	Positive supply. Usage is optional if supplying 3.3V to VDD_IO
VDD_IO	16	Supply voltage	Positive supply for UART and I/O ports
STATUS	26	CMOS output	Low when there is an active connection; otherwise high
BREAK	27	CMOS input with weak internal pull-up	Break if low, Input debounced; must be signaled for >5ms to cause a break
SWITCH	28	CMOS input with weak internal pull-up	Signaled if low. Can be used to initiate EasyConnect or factory reset
IND_LED	29	CMOS output	For connection to an indicator LED. A maximum of 8mA may be drawn from this line
HOST_WAKE (future firmware feature)	30	CMOS output	Active low wake signal. Indicates UART communication to host is imminent
WAKEUP (future firmware feature)	31	CMOS input with weak internal pull-up	Awake if low. Input debounced; must be low for >5ms to cause a wake
RF (RF Pad version only)	33	Bi-directional analog	Connect to a 50Ω Bluetooth ISM Band antenna

All GND pads are to be grounded. (1, 3, 17, 22, 23, 32, & 34)

All NC pads should be left unconnected. (2, 4, 5, 7, 8, 9, 10, 18, 19, 20, 21, 24, & 25)

A7 eb301 Bluetooth Serial Adapters

The eb301 Bluetooth Serial adapters provide not only a board level Bluetooth Serial solution; but also a reference design for the eb101 Bluetooth Serial Module. The complete design package for the eb301 is available on the A7 website including gerbers, schematic, and BOM.

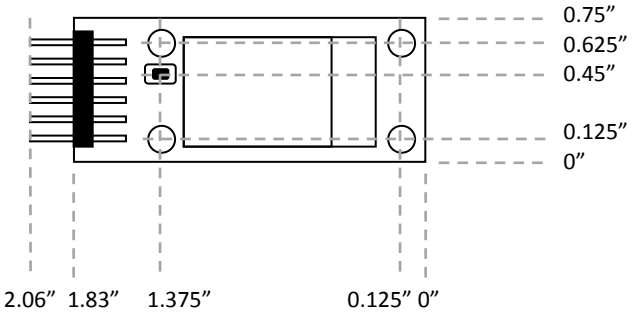
The eb301 is available with the onboard antenna version of the eb101 or the UFL connector version. Both are available with either a 3.3V / 5V interface or a RS232 level interface.

*The **3.3V / 5V version** is designed to work with either logic level and, in turn, to be powered accordingly. This version is designed for direct connection to most microcontrollers.

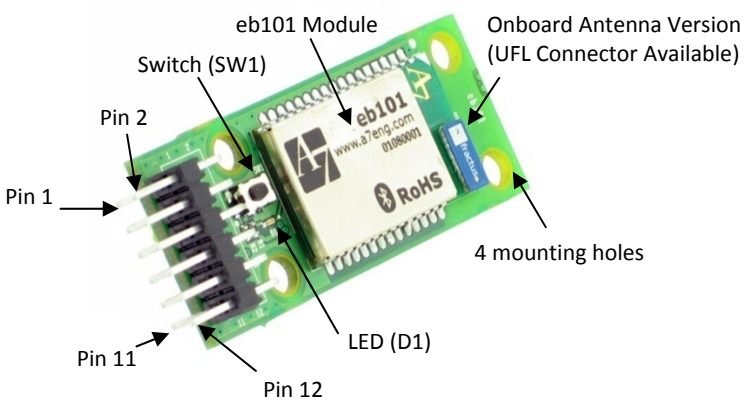
*The **RS232 version** is designed to be powered with 5 volts and requires a RS232 level interface typical of devices that have RS-232 compatible line driver/receivers.

All versions use the same PWB with version being determined by component population.

The following diagram illustrates the dimensions of the eb301 adapters.



The following picture identifies many of the features of the eb301.



The eb301 features a pin out that provides access to the primary features of the eb101 module.

ⓘ *As the eb301 is designed for embedded systems, the RS232 version of the eb301 would require an adapter to be made to connect to a standard D9 serial port on a personal computer.*

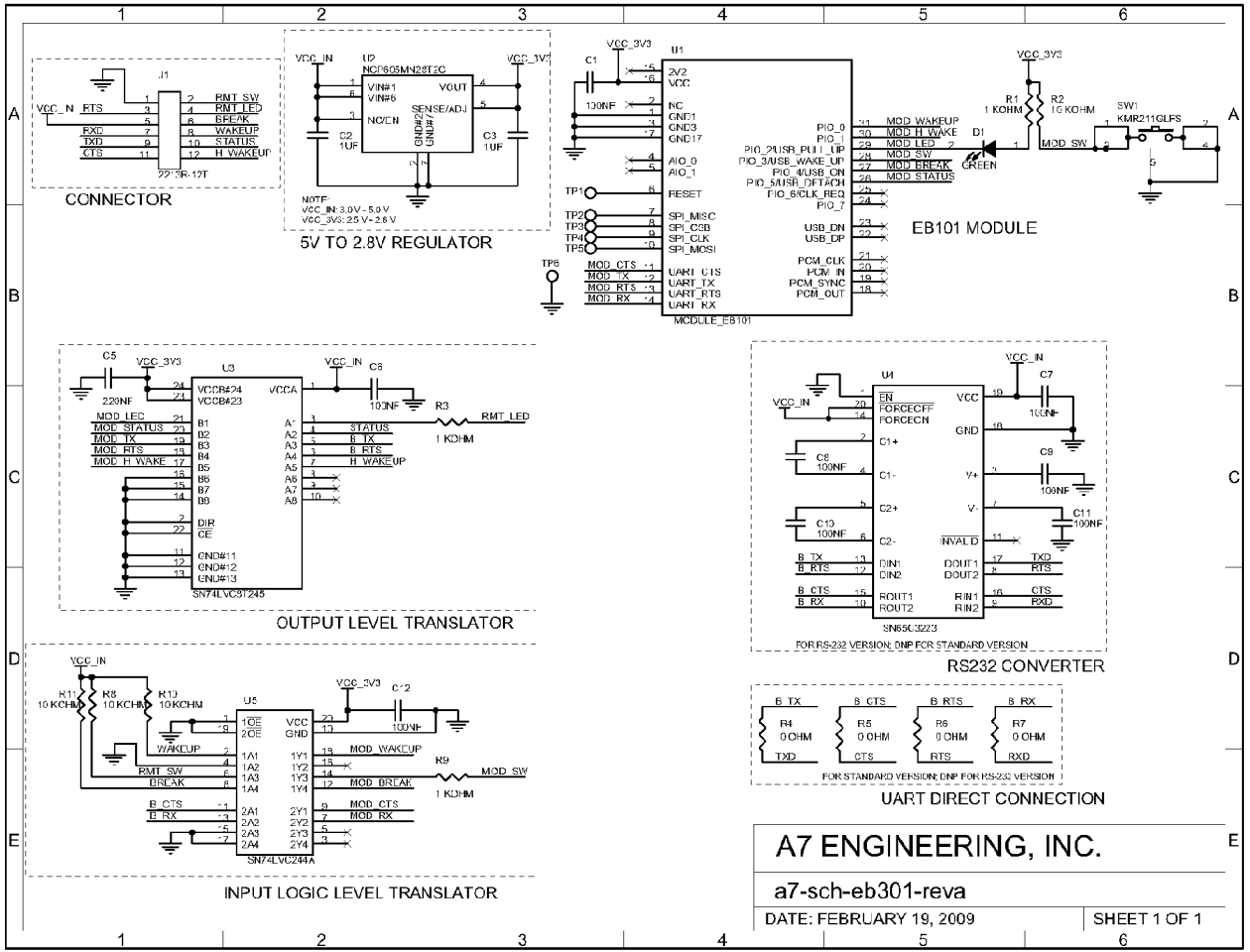
ⓘ *For the 3V/5V version of the eb301, the bottom row (odd pins) is directly compatible with the available USB to serial cable, part number 1000162, for testing and use on a personal computer. (Black wire, ground, to pin 1).*

The pin out of the eb301 header is as follows:

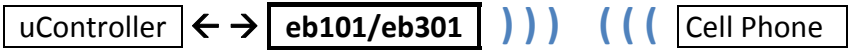
```
   ------------------
  | 2  4  6  8 10 12 | <-- 0.1" 2 x 6 Male header
  | 1  3  5  7  9 11 |
 ====================== <- PCB
```

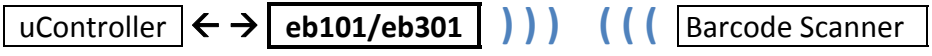
Pin	Direction	Name	Description
Pin 1	<-	GROUND	
Pin 2	<-	RMT_SWITCH	(Optional) Active low input to eb301. Remote switch for EasyConnect and factory reset.
Pin 3	->	RTS	(Optional) Serial ready to send output from eb301.
Pin 4	->	RMT_LED	(Optional) Active low output from eb301. Remote LED for duplicating functionality of onboard LED.
Pin 5	<-	VCC_IN	
Pin 6	<-	BREAK	(Optional) Active low input to eb301. Used to enter command mode and to return to data mode.
Pin 7	<-	RXD	Serial receive input to eb301.
Pin 8	<-	WAKEUP	(Optional) Active low input to eb301.
Pin 9	->	TXD	Serial transmit output from eb301.
Pin 10	->	STATUS	(Optional) Active low output from eb301. Indicates connection active.
Pin 11	<-	CTS	(Optional) Serial clear to send input to eb301.
Pin 12	->	H_WAKEUP	(Optional) Active low output from eb301.

The following is the schematic for the eb301 adapter. This schematic may be used in part or in its entirety for designs.


CONNECTOR
5V TO 2.8V REGULATOR
EB101 MODULE
OUTPUT LEVEL TRANSLATOR
RS232 CONVERTER
INPUT LOGIC LEVEL TRANSLATOR
UART DIRECT CONNECTION
A7 ENGINEERING, INC.
a7-sch-eb301-reva
DATE: FEBRUARY 19, 2009
SHEET 1 OF 1

The following illustrates some of the many device scenarios for the eb101 module and eb101 module based adapters such as the eb301 adapters.













The Commands

*Note that a lone carriage return cancels any command that is currently in progress with the exception of connect.

Command	Description	Format		
			Parameters	**Parameter Description**
con	Establishes a connection to another Bluetooth device.	con address [profile]<CR>		
			address	Bluetooth address of the remote device.
			profile	Bluetooth profile to connect with. Must be either spp or dun.
del	Deletes trusted devices.	del trusted all | address<CR>		
			all	Remove all trusted devices
			address	Bluetooth address of device to delete.
dis	Disconnects the wireless connection.	dis<CR>		
lst	Returns a list of Bluetooth devices.	lst trusted | visible [name] [timeout]<CR>		
			trusted	List all trusted devices.
			visible	List all visible devices.
			name	Include the names of visible devices.
			timeout	Seconds before aborting the list visible attempt (default 15; max 60).
ret	Returns the local device to data mode if there is an active connection.	ret<CR>		
rst	Resets the local device optionally resetting factory defaults.	rst [factory]<CR>		
			factory	Restore factory default settings.
ver	Retrieves the current firmware version.	ver [all]<CR>		
			all	Specifies to return detailed version information.

Command	Description	Format		
			Parameters	Parameter Description
get	Retrieves local and remote device settings.	get variable<CR>		
			address local	Returns the local device address.
			address remote	Returns the remote device address.
			connectable	Returns the connectable mode setting; on or off.
			ecbonding	Returns the EasyConnect bonding setting; initiator or responder.
			ecconnection	Returns the EasyConnect connection setting; auto, initiator, or responder.
			encryption	Returns the encryption mode setting; on or off.
			escchar	Returns the current escape sequence character.
			flow	Returns the flow control setting; none or hardware.
			linktimeout	Returns the link timeout setting.
			name local	Returns the local device name.
			name remote	Returns the remote device name.
			parity	Returns the parity setting; odd, even, or none.
			security	Returns the security setting; on or off.
			sleep	Returns the sleep setting; on, off, or idle.
			sniff	Returns the sniff setting; on or off.
			status	Returns the connection status; true or false.
			trustedlist	Returns the trusted list status; on or off.
			txpower	Returns the transmit power setting (1-10)
			visible	Returns the visible mode setting; on or off.

Command	Description	Format		
			Parameters	Parameter Description
set	Updates local device settings.	set variable value<CR>		
			baud	Sets the baud rate for UART communications. Valid values include standard rates from 1200 through 460800.
			connectable	Sets the connectable mode setting. Valid values are on and off.
			ecbonding	Sets the EasyConnect bonding setting. Valid values are initiator and responder.
			ecconnection	Sets the EasyConnect connection setting. Valid values are auto, initiator, and responder.
			encryption	Sets the encryption mode setting. Valid values are on and off.
			escchar	Sets the current escape sequence character. Valid values are any single character.
			flow	Sets the flow control setting. Valid values are none and hardware.
			linktimeout	Sets the link timeout setting. Valid values are integers from 1 to 40.
			name	Sets the local device name. Valid values are strings of up to 32 characters.
			parity	Sets the party setting. Valid values are odd, even and none.
			passkey	Sets the local device passkey. Valid values are strings of up to 16 characters.
			security	Sets the security mode setting. Valid values are on and off.
			sleep	Sets the sleep mode. Valid values are on, off, and idle.
			sniff	Sets the sniff mode. Valid values are on and off.
			trustedlist	Sets the trusted list mode. Valid values are on and off.
			txpower	Sets the transmit power setting. Valid values are integers from 1 to 10.
			visible	Sets the visible mode setting. Valid values are on and off.

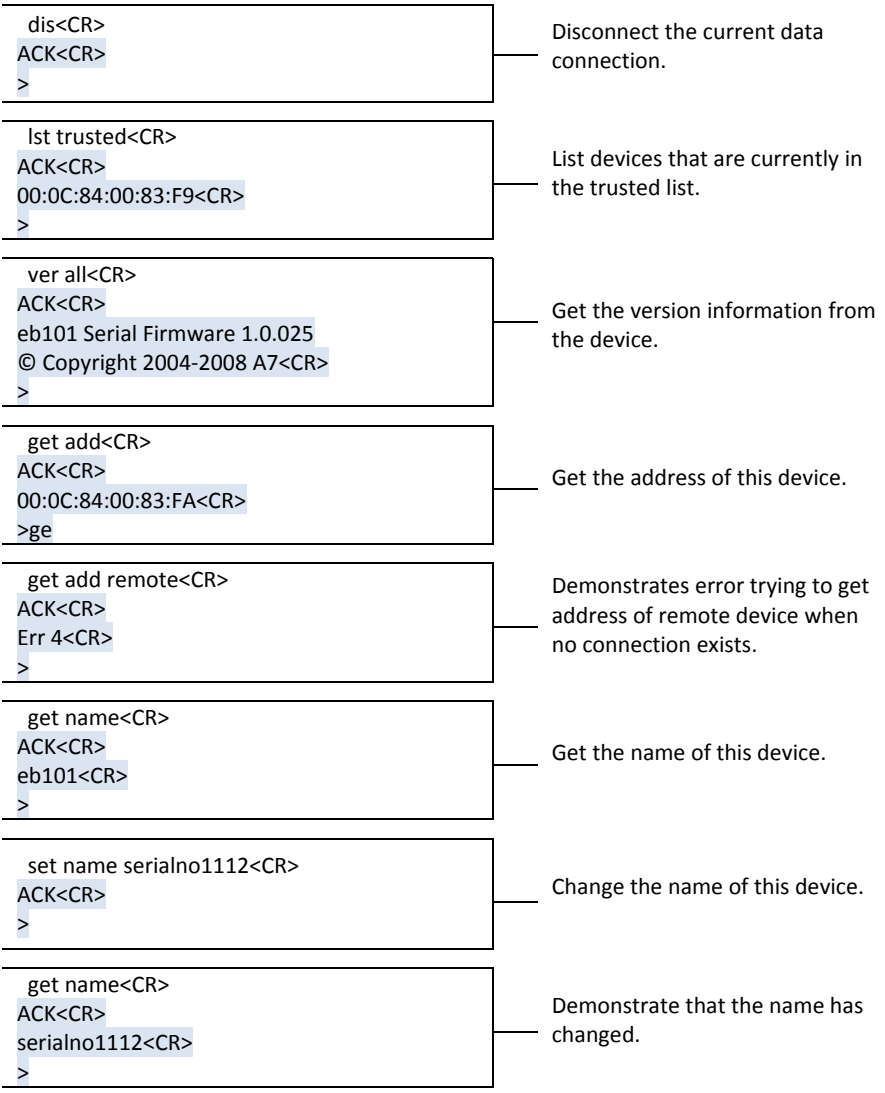
Error Codes

Code	Description
1	Not used.
2	Connection attempt failed. This error occurs when a connection to the remote device could not be established.
3	Command not valid while active. This error occurs when there is an active connection and a command is issued that is not valid while connected with a remote device.
4	Command only valid while active. This error occurs when there is not an active connection and a command is issued that is only valid while connected with a remote device.
5	An unexpected request occurred. This error occurs when the remote device makes an invalid request. This is typically seen with older Bluetooth devices that may have errors in their firmware.
6	Connection attempt failed due to a timeout. This error will be generated if the remote device is available, but not responsive.
7	Connection attempt was refused by the remote device.
8	Connection attempt failed due to a server configuration problem. The server channel specified in the SDP record was not registered on the remote device.
9	Not used.
10	Not used.
11	Not used.
12	Command not valid during startup. This error occurs when a command has been issued before the device is fully powered up and initialized.
13	Command not valid while processing. This error occurs when a command is issued while already actively processing a previously issued command.
14	Connection attempt failed. This error occurs when attempting to connect with an invalid Bluetooth address or a device that is not available. It will also occur when the security settings of the remote and local device are incompatible or their passkeys do not match.
15	Connection attempt failed. Unable to connect with the remote device due to a service level connection error.
16	Connection attempt failed. Unable to connect with the remote device because the service level connection is already established.
17	Connection attempt failed. The remote device terminated the connection.
18	Connection attempt failed. An abnormal disconnect occurred while attempting to establish a connection.
19	Connection attempt failed due to an invalid DUN connection request.
20	An unexpected request occurred while attempting to establish a connection.
21	Command processing failed. The command was parsed successfully, but failed during processing.
22	An unexpected message was received.

Sample Command Scenario

The following diagram illustrates a possible command scenario. The data on the left is the data as it might appear in a terminal application that is directly connected to the A7 eb101 Serial Firmware based device such as the eb301 adapter. The data that is not shaded is the data that is being typed into the terminal to send to the eb101 and the shaded data is the data being received by the terminal from the eb101. The data on the right is a description of what is happening. The row breaks are given for clarity of description only.

>lst visible name 15<CR> ACK<CR> 00:0C:84:00:05:29 MyCellPhone<CR> 00:80:C8:35:2C:B8 JoesLaptop<CR> 00:0C:84:00:83:F9 eb101> >	List devices that are currently visible.
con 00:0C:84:00:83:F9<CR> ACK<CR> >	Connect to a device.
This data will be sent over the wireless link.This is data received over the wireless link from the connected device. This is more data that will b This is more data received over the wirele sent over the wireless link.ess link from the connected device.	Transmitting and receiving data over the Bluetooth connection. (The terminal example here shows that the link is full duplex).
<1 sec>+++<1 sec><CR> >	Temporarily go to command mode by waiting for at least 1 second, sending “+++”, and delaying again for 1 sec.
get addr remote<CR> ACK<CR> 00:0C:84:00:83:F9<CR> >	Get the address of the remote device.
ret<CR> ACK<CR> >	Return to data mode.
This text is being sent over the This text is being received wireless connection<CR>over the wireless connection<CR>	Transmitting and receiving data over the Bluetooth connection.
<1 sec>+++<1 sec><CR> >	Break into command mode.


dis<CR>
ACK<CR>
>
Disconnect the current data connection.
lst trusted<CR>
ACK<CR>
00:0C:84:00:83:F9<CR>
>
List devices that are currently in the trusted list.
ver all<CR>
ACK<CR>
eb101 Serial Firmware 1.0.025
© Copyright 2004-2008 A7<CR>
>
Get the version information from the device.
get add<CR>
ACK<CR>
00:0C:84:00:83:FA<CR>
>ge
Get the address of this device.
get add remote<CR>
ACK<CR>
Err 4<CR>
>
Demonstrates error trying to get address of remote device when no connection exists.
get name<CR>
ACK<CR>
eb101<CR>
>
Get the name of this device.
set name serialno1112<CR>
ACK<CR>
>
Change the name of this device.
get name<CR>
ACK<CR>
serialno1112<CR>
>
Demonstrate that the name has changed.

EasyConnect

This feature provides for very simple pairing of two devices for simple cable replacement scenarios. In order to use the eb101 serial firmware based devices in this scenario the devices must go through the following one time setup procedure. This procedure assumes that the devices are in the factory default state.

1. Power up the eb101 serial firmware based device.
2. Receive the prompt character “>” from the serial connection to the eb101 serial firmware based device.
3. Set the flow control and baud rate using the serial connection to the eb101 serial firmware based device. (Note that once the “set baud” is used to change the baud rate, the host connected to the serial interface will have to set the new baud rate as well.)
4. Remove power from the eb101 serial firmware based device.
5. Power up the eb101 serial firmware based device while activating the SWITCH (EasyConnect) line of the device.
6. Once the IND_LED (indicator) line is asserted the SWITCH (EasyConnect) line must be deactivated.
7. Repeat the above steps 1 – 6 for the second eb101 serial firmware based device.
8. Activate and deactivate (pulse) the SWITCH (EasyConnect) line once more on one of the devices to designate that device as initiator.
9. Wait a moment while the devices complete their pairing.
10. Notice that the IND_LED (indicator) line on both devices begin to toggle at approximately two second intervals. The devices are now paired and may be used for data connection. The connection will automatically be attempted each time the two devices are powered up until the devices are factory reset.

Typically the SWITCH (EasyConnect) line is connected to a push button switch and the IND_LED (indicator) line is connected to an LED so that this process can easily be initiated by a user. See the eb301 design files and documentation for a sample adapter implementation.

Factory Default Settings

The eb101 serial firmware ships with factory default setting that include:

Baud rate: 9600 baud

Parity: none

Flow: none

Security: off

Name: eb101

Passkey: 0000

Changing these settings using the corresponding commands will persist until a factory reset is completed. If you have a need to have the firmware with custom factory defaults that persist even after a factory reset then this can be provided for a nominal fee. Please contact sales@a7eng.com for further information.

Factory Reset

To reset the eb101 serial firmware to the factory default settings the following procedure may be used.

1. Remove power from the device.
2. Activate the SWITCH line of the device implementing eb101 serial firmware. (Continue to activate this line through the next 3 steps.)
3. Apply power to the device.
4. While continuing to activate the SWITCH line the IND_LED line will be asserted within one second.
5. While continuing to activate the SWITCH line the IND_LED line will be de-asserted.
6. Deactivate the SWITCH line.
7. The device will now be in the factory reset state. In the factory reset state the device will boot to Command Mode.

Example using an eb301 adapter

1. *Remove power from the eb301 adapter.*
2. *Press the switch, SW1, and hold through the next three steps.*
3. *Apply power to the eb301 adapter.*
4. *While continuing to press the switch, notice that the LED, D1, turns on.*
5. *While continuing to press the switch, notice that the LED turns off.*
6. *Release the switch.*
7. *The eb301 will now be in the factory reset state.*

Indicator Line (Adapter LED) Pattern

The IND_LED (indicator) line is typically used to drive an LED. The following table provides a description of the various states.

Pattern	Description
Blink Once @ Power On	Command mode; the device can be controlled over the UART connection using the command set.
Blink Twice @ Power On	Device has been previously setup for EasyConnect and will automatically establish a connection.
Solid On	EasyConnect mode setup as responder and is waiting for another device to pair.
Fast Blink (~2Hz)	EasyConnect mode setup as initiator and is trying to find and pair with another device.
Slow Blink (~0.5Hz)	Active Bluetooth connection.
Off	If the device is in command mode then it is idle when the LED is off. If the device is in EasyConnect mode then it is attempting connection. Of course, this could also indicate that no power is applied.

Security

Bluetooth defines being able to see a device and being able to connect to a device as part of the security model. These features are exposed by the eb101 Serial Firmware through the 'set visible' and 'set connectable' commands. This is a very coarse level of control, but it is also quite effective and can be used in combination with other security features.

The eb101 Serial Firmware uses the 'set security' command to configure access control. When security is turned off, connection attempts will be allowed from all remote devices. Forming a trusted relationship is carried out automatically in this mode the first time that a device attempts to establish a connection with the proper passkey. When security is turned on, only connections from trusted devices will be allowed and no new devices may become trusted.

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