BISM-II AT COMMAND SET

Reference Guide
Version 2.2

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REVISION HISTORY

Revision	Date	Description
1.0		Initial Release
2.0	07/15/13	Formatting and general editing
2.1	13 March 2014	Updated S519 to reflect correct range: 100..3000 instead of 100..6000.

CONTENTS

1. INTRODUCTION

This document describes the protocol that controls and configures the following Laird Bluetooth devices:

- Laird Module
- Laird PCMCIA Adaptor
- Laird RS232 Adaptor
- Laird Universal RS232 Adaptor
- Go blue Activator

The protocol is similar to the industry standard Hayes AT protocol used in telephony modems which is appropriate for cable replacement scenarios, as both types of devices are connection oriented. The telephony commands have been extended to make the Laird device perform the two core actions of a Bluetooth device, which is make/break a connection, and inquiry. Many other AT commands are also provided to perform ancillary functions, such as pairing, trusted device database management and S Register maintenance.

Just like telephony modems, the Laird device powers up in an unconnected state and only responds via the serial interface. In this state the Laird device does not even respond to Bluetooth inquiries. Then, just like controlling a modem, the host issues AT commands map to various Bluetooth activities. The command set is extensive enough to allow a host to make connections which are authenticated and/or encrypted, or not authenticated and/or encrypted, or any combination of these. Commands can be saved so that on a subsequent power up the device is discoverable or automatically connects.

The device has a serial interface which can be configured for baud rates from 1200 up to 921600, and an RF communications end point. The latter has a concept of connected and unconnected modes and the former has a concept of command and data modes. This leads to the matrix of states shown below.

	RF Unconnected	RF Connected
Local Command Mode	OK	OK
Remote Command Mode	ILLEGAL	OK
Data Mode	ILLEGAL	OK

The combinations 'Data and RF Unconnected Mode' and 'Remote Command and RF Unconnected Mode' do not make sense and are ignored.

Navigation between these states is done using the AT commands which are described in detail in subsequent sections.

2. AT COMMAND SET

2.1 Assumptions

The CSR (Cambridge Silicon Radio) BC2 chipset in Laird devices is memory resource limited. Therefore, it is NOT proposed that there be full implementation of the AT protocol as seen in modems. The claim made for this device is that it will have a protocol *similar* to an AT modem. In fact, the protocol is similar enough so that existing source code written for modems can be used with very little modification with a Laird device.

Therefore the following assumptions are made:

- All commands terminate by the carriage return character 0x0D, represented by the string **<cr>** in descriptions below. This cannot be changed.
- All responses from the Laird device have carriage return and linefeed characters preceding and appending the response. These dual character sequences have the values 0x0D and 0x0A respectively and are represented by the string **<cr,lf>.**
- All Bluetooth addresses are represented by a fixed 12 digit hexadecimal string, case insensitive.
- All Bluetooth Device Class codes are represented by a fixed 6 digit hexadecimal string, case insensitive.
- All new Bluetooth specific commands are identified by the string **+BTx**, where **x** is generally a mnemonic of the intended functionality.

2.2 Commands

This section describes all available AT commands. Many commands require mandatory parameters and some take optional parameters. These parameters are integer values, strings, Bluetooth addresses, or device classes.

The following convention is used when describing the various AT commands:

<bd_addr>	A 12 character Bluetooth address consisting of ASCII characters '0' to '9', 'A' to 'F' and 'a' to 'f'.
<devclass>	A 6 character Bluetooth device class consisting of ASCII characters '0' to '9', 'A' to 'F' and 'a' to 'f'.
n	A positive integer value.
m	An integer value which could be positive or negative, which can be entered as a decimal value or in hexadecimal if preceded by the '$' character. E.g. the value 1234 can also be entered as $4D2
<string>	A string delimited by double quotes. E.g. "Hello World". The " character MUST be supplied as delimiters.
<uuid>	A 4 character UUID number consisting of ASCII characters '0' to '9', 'A' to 'F' a 'a' to 'f'.

2.2.1 ^^^ {Enter Local Command Mode}

When in data and connected mode, the host can force the device into a command and connected mode so that AT commands can issue to the device. The character in this escape sequence is specified in the S2 register, so it can be changed. In addition, the escape sequence guard time is specified by S Register 12. By default the guard time is set to 100 milliseconds. Please refer to the Dropping Connections section for more related information.

In modems this escape sequence is usually "+++".

"^^^" is specified to avoid confusion when the module provides access to a modem.

Response: <cr,lf>**OK**<cr,lf>

2.2.2 !!! {Enter Remote Command Mode}

When in data and connected mode, the host can force the remote device into a command and connected mode so that AT commands can issue to the device remotely. The escape sequence guard time is specified by S Register 12 and is the same as per the ^^^ escape sequence. By default the guard time is set to 100 milliseconds. The remote device issues ATO as normal to return to data mode. (Refer to the ATO Command section).

For this command to be effective S Register 536 must be set to 1.

Response: <cr,lf>**OK**<cr,lf>

2.2.3 AT

Checks the module is available.

Response: <cr,lf>**OK**<cr,lf>

2.2.4 ATA {Answer Call}

Accepts an incoming connection, which is indicated by the unsolicited string <cr,lf>**RING123456789012**<cr,lf> every second. **123456789012** is the Bluetooth address of the connecting device.

Response: <cr,lf>**CONNECT 123456789012**<cr,lf>

2.2.5 ATD<U><Y><bd_addr>,<uuid> {Make Outgoing Connection}

Make a connection to device with Bluetooth address <bd_addr> and profile <uuid>. The <uuid> is an optional parameter which specifies the UUID of the profile server to attach to, and if not supplied then uses the default UUID from S Register 101. As this is a Laird device which utilises the RFCOMM layer as described in the Bluetooth Specification, it necessarily implies that only profiles based on RFCOMM can be accessed.

If <U> is not specified, then authentication is as per register 500, otherwise the connection authenticates.

If <Y> is not specified, then encryption is as per register 501, otherwise the connection enables encryption.

The timeout is specified by S register 505.

Response: <cr,lf>**CONNECT 123456789012**<cr,lf>

Or <cr,lf>**NO CARRIER**<cr,lf>

Due to a known issue in the Bluetooth RFCOMM stack, it is not possible to make more than 65525 outgoing connections. If that number is exceeded, then the connection attempt fails with the following response:

Response: <cr,lf>**CALL LIMIT**
Or <cr,lf>**NO CARRIER**<cr,lf>

In that case, issuing an ATZ to reset the device resets the count to 0 and more connections are possible.

The following RFCOMM-based UUIDs are defined in the Bluetooth Specification:

Profile Name	UUID
Serial Port	1101
LAN Access using PPP	1102
Dial-up Networking	1103
IrMC Sync	1104
OBEX Object Push	1105
OBEX File Transfer	1106
IrMC Sync Command	1107
Headset	1108
Cordless Telephony	1109
Intercom	1110
Fax	1111
Audio Gateway	1112
WAP	1113
WAP_CLIENT	1114

2.2.6 ATD<U><Y><bd_addr>,<ServiceName> {Make Connection}

Make a connection to a device with Bluetooth address <bd_addr>, profile specified via S Reg 101 AND, which has a service name starting with the string <ServiceName>. The ServiceName parameter is a string delimited by ".

If <U> is not specified, then authentication is as per register 500, otherwise the connection authenticates.

If <Y> is not specified, then encryption is as per register 501, otherwise the connection enables encryption.

The timeout is specified by S register 505.

Response: <cr,lf>**CONNECT 123456789012**<cr,lf>
Or <cr,lf>**NO CARRIER**<cr,lf>

2.2.7 ATD<U><Y>L {Remake Connection}

Make a connection with the same device and service as that specified in the most recent ATD command. The <UY> modifiers are optional. An error returns if the 'L' modifier and a Bluetooth address are specified.

If both 'L' and 'R' modifiers are specified then an error returns.

Response: <cr,lf>**CONNECT 123456789012 AE**<cr,lf>
Or <cr,lf>**NO CARRIER**<cr,lf>

2.2.8 ATD<U><Y>R {Make Connection to peer specified in AT+BTR}

Make a connection with the device address specified in the most recent AT+BTR command. The service is as specified in S Register 101. The <UY> modifiers are optional. An error returns if the 'R' modifier and a Bluetooth address are specified.

If both 'R' and 'L' modifiers are specified then an error returns.

Response: <cr,lf>CONNECT 123456789012 AE<cr,lf>

Or <cr,lf>NO CARRIER<cr,lf>

2.2.9 ATEn {Enable/Disable Echo}

This command enables or disables the echo of characters to the screen. A valid parameter writes to S Register 506.

E0	Disable echo
E1	Enable echo

All other values of n generate an error.

Response: <cr,lf>OK<cr,lf>

Or <cr,lf>ERROR nn<cr,lf>

2.2.10 ATH {Drop Connection}

Drop an existing connection or reject an incoming connection indicated by unsolicited RING messages.

Response: <cr,lf>NO CARRIER<cr,lf>

2.2.11 ATIn {Information}

This returns the following information about the Laird device:

I0	The product name/variant.
I1	The CSR firmware build number.
I2	The Laird firmware build number. For internal use only.
I3	The Laird firmware revision.
I4	A 12 digit hexadecimal number corresponding to the Bluetooth address of the Laird device.
I5	The manufacturer of this device.
I6	The maximum size of trusted device database.
I7	The manufacturer of the Bluetooth chipset.
I8	The chipset format.
I9	0 if not in a connect state and 1 if in a connect state.
I11	The reason why a "NO CARRIER" resulted in the most recent attempt at making an outgoing connection. The response values are as follows:

0	No prior connection.
1	Connection timeout.
2	Connection attempt cancelled.
3	Normal disconnection.
4	Peer device has refused connection.
5	Service profile <uuid> requested not available on remote device.

6	Connection has failed.
32	ATH was entered.
33	Incoming connection aborted because too many rings.
34	Unexpected incoming connection.
35	Invalid address.
36	DSR is not asserted.
37	Call limit of 65531 connections has been reached.
38	Pairing in progress.
39	No link key.
40	Invalid link key.
255	Unknown reason.

I12 The last ERROR response number.

I13 The Sniff status returns as follows:

Response: <cr,lf>**a:b,c,d,e**<cr,lf>**OK**<cr,lf>

Where:

a	0 when not online, 1 when online and sniff is enabled
b	Sniff attempt parameter
c	Sniff timeout parameter
d	Minimum sniff interval
e	Maximum sniff interval

All parameters 'b', 'c', 'd' and 'e' are given as Bluetooth slots which are 625 microseconds long converted from values of S Registers 561, 562, 563, and 564 respectively.

I14 The current boot mode (only for firmware 1.18.0 and newer).

I15 The maximum length of an AT command, including the terminating carriage return (only for firmware 1.6.10 and newer).

I16 The size of AT command input buffer.

I20 Returns the number of bytes pending to be sent in the RF buffer when a connection is up.

I33 Version number of multipoint application

Note: ATI is provided for compatibility in multipoint mode; other AT commands are not available.

I42 State information, where the response values are as follows:

13	NotOpen
14	OpenIdle
15	Ringing
16	OnlineCommand
172 to 177	Waiting for connectible and/or discoverable where the lowest significant digit equates to the value stored in S Register 512 or 555.

Note: When n=16, ATI9 returns to 1.

I101 The RSSI value in dBm. If a connection does NOT exist then a value of -32786 returns.

I111 Returns LinkQual. In the CSR chipset, it is defined as BER (Bit Error Rate). This returns a value which is the number of bits in error out of one million. Hence a value of 0 is best, and larger values are worse. As the value approaches 1000 (BER = 0.1%) it is an indication that the link is very bad and a large number of Bluetooth packets are being lost.

For recognised values of n. All other values of n generate an error.

Response: <cr,lf>**As Appropriate**<cr,lf>**OK**<cr,lf>

Or <cr,lf>**ERROR nn**<cr,lf>

2.2.12 ATO {Enter Data Mode} (letter 'o')

Return to data mode. Assume that the module is in data mode after it receives an OK. The module responds with an error if there is no Bluetooth connection.

Response: <cr,lf> CONNECT 123456789012<cr,lf>

Or <cr,lf>ERROR nn<cr,lf>

2.2.13 ATSn=m {Set S Register}

As with modems, the Laird Bluetooth module employs a concept of registers which store parameters (such as the escape sequence character, inquiry delay time, etc.) as listed in detail below.

The value part 'm' can be entered as decimal or hexadecimal. A hexadecimal value is specified via a '$' leading character. For example, $1234 is a hexadecimal number.

When S register values change, the changes are not stored in non-volatile memory UNTIL the AT&W command is used.

Note: AT&W does not affect S registers 520 to 525, or 1000 to 1010, as they are updated in non-volatile memory when it receives the command.

Register	Default	Range	Comment
S0	1	-1..15	Number of RING indications before automatically answering an incoming connection. A value of 0 disables autoanswer. If -1, then autoanswer on one RING and DO NOT send RING/CONNECT response to the host. This emulates a serial cable replacement situation. Setting values >= 0 resets S Register 504 to 0, and <0 forces 504 to 1. If S0 <> 0 and S100 <> 0 then S0 must be < S100. If an entered value violates this rule, then ERROR 29 sends in response. If S504 =1 then this register returns -1, regardless of the actual value stored in non-volatile memory.
S2	0x5E	0x20..0x7E	Escape sequence character. It is not '+' by default as a Bluetooth serial link can be used to connect to a mobile phone which exposes an AT command set, which in turn uses '+' as default. So if both use '+' there is confusion. 0x5e is the character '^'.
S12	100	40..5000	Escape sequence guard time in ms, with a granularity of 20 ms. New values round down to the nearest 20 ms multiple.
S100	15	0..15	Number of RING indications before an auto disconnection initiates. A value of 0 disables this feature. If S0 <> 0 and S100 <> 0 then S0 must be < S100. If an entered value violates this rule, then ERROR 29 sends in response.
S101	$1101	0..$ffff	UUID of default SPP based profile when not specified explicitly in the ATD command.

Register	Default	Range	Comment
S102	1	1..$7F	Defines a set of bits masks for enabling profile servers. Values can be ORed. 1 Serial Port Profile 2 Headset (S Reg 580 allows remote volume control bit to be adjusted) 4 DUN 8 Audio Gateway (Headset) 16 Handsfree (S Reg 581 allows supported feature field to be adjusted) 32 OBEX FTP 64 Audio Gateway (Handsfree) Due to memory resource issues, Laird recommends not more than 2 profiles be activated at the same time.
S103	1	1..7	Boot Mode on cold boot.
S126	?	0 .. 0xFFFF	Primer for changing to Multipoint mode.
S127	?	0 .. 0xFFFF	0x100 for AT mode. 0x200 for Multipoint mode. Other values are reserved.
S400	0	0..1	Pio daemon. 1 = Hostless Audio gateway Operation.
S401	1000	100..5000	In Hostless Audio Gateway Operation – GPIO4 flash period while inquiring.
S402	0	0..100	In Hostless Audio Gateway Operation – GPIO4 flash duty cycle while inquiring.
S403	1000	100..5000	In Hostless Audio Gateway Operation – GPIO4 flash period when there is an ACL connection only to the headset.
S404	0	0..100	In Hostless Audio Gateway Operation – GPIO4 flash duty cycle when there is an ACL connection only to the headset.
S405	1000	100..5000	In Hostless Audio Gateway Operation – GPIO4 flash period when there is an ACL and SCO connection to the headset.
S406	0	0..100	In Hostless Audio Gateway Operation – GPIO4 flash duty cycle when there is an ACL and SCO connection to the headset.
S407	0	0..1	In Hostless Audio Gateway Operation – 'Lift-Hook' output follows SCO state.
S408	0	0..1	In Hostless Audio Gateway Operation – if set to 1, then delete trusted device database when inquiry initiates to look for headsets.
S409	0	0..1	In Hostless Audio Gateway Operation – when inquiring and pairing, use the device class code of the response to classify which UUID to connect to the headset when initiating a Bluetooth connection from the gateway.
S410	0	0..1	In AudioGateway Hostless mode, if set to 1, AG"" async responses are forced out from the UART – good for debugging.
S411	500	4000	In AudioGateway Hostless mode, Short press duration in milliseconds. 500 msec granularity.

Register	Default	Range	Comment
S412	500	4000	In AudioGateway Hostless mode, component of medium press duration in milliseconds. 500msec granularity. Actual duration is this value plus S411.
S413	500	4000	In AudioGateway Hostless mode, component of long press duration in milliseconds. 500msec granularity. Actual duration is this value plus S412 plus S411.
S414	30	240	In AudioGateway Hostless mode, The inquiry to search for headsets aborts after this amount of time, in seconds. The granularity is 30 seconds.
S420	0	1	If this is set, then the module maintains a second counter. Use ATI420 to read the count value. It is basically the time the module has been powered up in seconds.
S500	0	0..1	Authentication for outgoing connections. Set to 1 to Enable Authentication.
S501	0	0..1	Encryption for outgoing connections. Set to 1 to Enable Encryption.
S502	0	0..1	Authentication for incoming connections. Set to 1 to Enable Authentication.
S503	0	0..1	Encryption for incoming connections. Set to 1 to Enable Encryption.
S504	0	0..1	Setting to 1 forces S0 to -1 and suppresses messages arising from connections or pairing. E.g. CONNECT, NO CARRIER, RING, PAIR etc. Suppressing connection based messages allows the Laird device to be configured in cable replacement mode.
S505	10	2..120	Minimum delay before abandoning connection attempt as a master. Referenced by ATD. In units of seconds. See S Registers 530 and 543. **Note:** As disconnection time can vary, this register only guarantees the minimum delay. For invalid addresses specified in the ATD command, the "NO CARRIER" response is immediate. See S register 560 for specifying disconnect max timeout.
S506	1	0..1	Enable/Disable echoes. The ATEn command also affects this.
S507	0	0..2	When set to 0, a connection can be dropped using ^^^ escape sequence only and the state of DSR line is ignored. When set to 1 a connection can be dropped using EITHER the ^^^ escape sequence OR the DSR handshaking line. When set to 2, a connection can only drop using a deassertion of DSR. Mode 2 provides for the highest data transfer rate. If the status of the DSR line is to be conveyed to the remote device as a low bandwidth signal, then this register MUST be set to 0, otherwise a deassertion of DSR is seen as a request to drop the Bluetooth connection. This register affects S Register 536 – see details of 536. For the Go blue Activator variant this can only be set to 0.

Register	Default	Range	Comment
S508	640	10..2550	Page Scan Interval in milliseconds. Minimum is 11.25 ms, so 10/11 ms gives 11.25 ms.
S509	320	10..2550	Page Scan Window in milliseconds. Minimum is 11.25 ms, so 10/11 ms gives 11.25 ms.
S510	640	10..2550	Inquiry Scan Interval in milliseconds. Minimum is 11.25 ms, so 10/11 ms gives 11.25 ms.
S511	320	10..2550	Inquiry Scan Window in milliseconds. Minimum is 11.25 ms, so 10/11 ms gives 11.25 ms.
S512	1	0..7	Specify power up state. When set to 0, AT+BTO is required to open the device for Bluetooth activity. When set to 1, it proceeds to a state as if AT+BTO is entered. When set to 2, it is discoverable only, similar to issuing AT+BTQ. When set to 3, it is connectable but not discoverable, e.g. AT+BTG When set to 4, it is connectable and discoverable, e.g. AT+BTP. When set to 5, it is like 2 but all UART Rx traffic discards in absence of a connection while DSR asserts. If DSR is not asserted, then it behaves exactly as per mode 2. When set to 6, it is like 3 but all UART Rx traffic discards in absence of a connection while DSR asserts. If DSR is not asserted, then it behaves exactly as per mode 3. When set to 7, it is like 4 but all UART Rx traffic discards in absence of a connection while DSR asserts. If DSR is not asserted, then it behaves exactly as per mode 4. **Note:** By implication, a change to this can only be seen after a power cycle AND if AT&W **actions** prior to the power cycle. If S Reg 554 is non-zero and this register is between 2 and 7 inclusive, then the S554 values specifies the time in seconds that the device remains in the specified mode after power up. On timeout, the device falls back to the mode specified in S Register 555. In modes 5,6,7 when all Rx activity is ignored, only the special command (capitalised) AT+BT&BISM& terminated by a <cr> forces the module temporarily back into modes 2,3 and 4 respectively. In some firmware builds, S Registers 565 to 569 inclusive are visible, which allows the start-up mode to depend on the state of RI line (Setting S Reg 565 forces the RI pin to be configured as an input). For this feature to be active, set SReg 565 to 1. In that case, on start-up and if RI is asserted, then the start-up mode is defined by S Reg 566 and if deasserted then S Reg 567.
S513	1	0..1	Pairing Authentication, 1 = Enable
S514	10	1..60	Pairing Timeout in seconds. This includes the time a host takes to supply the PIN number when PIN? messages are indicated.

Register	Default	Range	Comment
S515	0x001F00	0.. 0xFFFFFF	Default Device Class Code to be used with AT+BTO when it is not explicitly specified. When queried, the value always prints as a hexadecimal number. To change the device class of the module, after AT+BTO, use the command AT+BTC.
S516	0x000000	0..0x2FFFFFF	Default Device Class filter used with AT+BTI when it is not explicitly specified. When queried, the value is always printed as a hex number. The seventh most significant digit can be 0, 1, or 2, and specifies the type of device class filter. When 0, it specifies no filtering. When 1, it specifies an AND mask and all 24 bits are relevant. When 2, it specifies a filter to look for devices with matching major device class which occupies a 5 bit field from bits 8 to 12 inclusive (assuming numbering starts at bit 0). All other 19 bits MUST be set to 0.
S517	20	2..61	Inquiry Length in units of seconds. This parameter is referenced by the AT+BTI command
S518	8	0..255	Maximum number of responses from an inquiry request. The AT+BTI command references this parameter. If this number is set too high, then AT+BTI returns ERROR 27. For a particular firmware revision, determine the effective maximum value by trial and error. That is, set to a high value, send AT+BTI and if ERROR 27 returns, then retry with a smaller value. This effective max value remains unchanged for that particular firmware build.
S519	500	100..3000	When S507>0 and in a connection, DSR can be used to change from data to command state by deasserting the DSR line for less than the time specified in this register. This value is rounded down to the nearest 100 ms.
S520	Depends on device – see comments	1200..115200	Change to a standard baud rate. The effect is immediate and in fact the OK sends at the new baud rate. Only one of the following baud rates are accepted: 1200,2400,4800,9600,19200,28800,38400,57600,115200. If S register 525=1, then the maximum baud rate limits to 115200. The default is 9600 for Laird's BISM and Embedded Modules and 115200 for other Laird Bluetooth devices. For the Go blue Activator variant of the module, this register is read only. See S Register 526 for further information.

Register	Default	Range	Comment
S521	See Comment	1200..921600	Change baud rate to non-standard value. Laird's modules support any baud rate. The only limitation is the integer arithmetic involved, which may adjust the applied rate slightly. If the internally computed baud rate is more than 2% offset from the desired input value, then an ERROR returns and the old baud rate prevails. To inspect the actual baud rate, perform ATS521? Only use S521 for non-standard baud rates. For standard baud rates, use S520. The effect is immediate and the OK sends at the new baud rate. If S Register 525=1, then the max baud rate limits to 115200. In the event that a non-standard baud rate is requested, it is entirely possible that the host is not capable of generating such a baud rate. In this case, the Laird device cannot communicate. There is a procedure to recover from this situation, described in the Factory Default Mode section. The default is 9600 for the Laird Module and 115200 for other Laird devices. For the Go blue Activator variant of the module, this register is read only. See S Register 526 for further information
S522	1	1	1 = CTS/RTS hardware handshaking enabled. For the Go blue Activator variant of the module, this register is read only. See S Register 526 for further information.
S523	1	1..2	Number of Stop bits. For the Go blue Activator variant of the module, this register is read only. See S Register 526 for further information.
S524	0	0..2	Parity. 0=None, 1=Odd, 2=Even. For the Go blue Activator variant of the module, this register is read only. See S Register 526 for further information.
S525	See Comment	0..1	Apply multiplier of 8 to baud rate internally. This is set to 0 (disabled) by default for the Laird Module/RS232 Adaptor/ Universal RS232 Adaptor, and set to 1 (enabled) by default for the Laird PC Card. It is required in the PC Card because the UART chip on the PC Card is driven by a 14.7456 MHz crystal instead of 1.8432 MHz. This means that when a host asks for a baud rate, in reality it gets a baud rate which is 8 times faster. If S Register 521 > 115200, this register cannot be set to 1. For the Go blue Activator variant of the module, this register is read only. See S Register 526 for further information.

Register	Default	Range	Comment
S526	3	1..3	This register specifies a 2 bit mask that qualifies how S Registers 520 through 525 are actioned. When bit 0 is 1, the new comms parameter affects the UART immediately. When bit 1 is 1, the new comms parameter stores in non-volatile Memory. For example, to change comms parameter but have them come into effect only after subsequent power cycles, then this register should be set to 2; and likewise to affect immediately and yet not have it persist over a power cycle, the value should be set to 1. Must be set before the baud rate change.
S530	1000	100..15000	Reconnect delay when configured as master in pure-cable-replacement mode. This value rounds down to the nearest 100 ms. See S Register 505 and 543.
S531	0	0..5	Specifies the mode on connection establishment. 0 = Normal, that data exchanges between UART and RF. 1 = LOCAL_COMMAND. UART input parses by the AT interpreter and RF data is discarded. 2 = REMOTE_COMMAND. RF input parses by the AT interpreter and discards the UART data. If S Reg 536 is not 1, then this register cannot be set to 2 and an ERROR returns. 3=LOCAL_COMMAND. UART input is parsed by the AT interpreter and incoming RF data sends to the host using the RX<string> asynchronous response. 4=LOCAL_COMMAND and on the RF side, the GPIO is automatically sent when there is a change in input. See Digital I/O Cable Replacement for more details. 5= DAEMON mode.
S532	0	0..7	If not zero then on every connection, a SCO channel (audio) initiates. Bit 0 for HV1, Bit1 for HV2 and Bit2 for HV3. When the connection is lost, the SCO channel disappears along with it.
S533	1	0..2	If set to 1, then GPIO5 follows RI state. If set to 2 then it follows the state of DSR. If 0 it is not driven and GPIO5 is available as a user I/O. This register is not necessarily effective immediately after changing the value. It must save to non-volatile memory using AT&W and operate as expected after an ATZ or a power cycle.
S534	1	0..2	When set to 0, GPIO4 is available as user I/O. If set to 1 then right LED follows DCD state. If set to 2 then the LED behaves as per setting 1 but in addition, when not in a connection, if the device is connectable or discoverable then the LED blinks. This register is not necessarily effective immediately after changing the value. It must save to non-volatile store using AT&W and operate as expected after an ATZ or a power cycle.
S535	20	0..41	Link Supervision Timeout. If units go out of range, then a NO CARRIER message sends to the host after time specified here.

Register	Default	Range	Comment
S536	0	0..1	When set to 1, a remote device can 'capture' the AT parser of this unit by sending this module an escape "!!!" sequence. The inter character timing sets via S Register 12. If S Register 507 is >= 2, then reading this register always returns 0 and writing 1 results in ERROR 33.
S537	X	X..X	This register is no longer available – see 551, 552, and 553 instead. It only exists in firmware version 1.1.12 to 1.1.47. The functionality it controlled is now defined by registers 551,552 and 553.
S538	0	0..1	If 1, then when a successful pairing occurs, it automatically saves in the trusted device database – if it has room to store it.
S539	0	0..1	When set to 1 in idle mode (S512=1), UART Rx characters discard if DSR deasserts.
S540	0	0 48..127	Sets the MTU in L2CAP configuration negotiations. The value of 0 is a special value which means that the current value remains.
S541	6	-50..6	Sets the power level in dBm when inquiring or paging. Reading this register returns the value stored in non-volatile memory.
S542	6	-50..6	As per S541, however reading this register returns the current power level as set in the base band. The read can be different from S541because the actual power is set using a lookup table and the base band rounds down to the nearest value in the table.
S543	0	0..1	If this is set to 1, then incoming pairing attempts are accepted (if a pin code has been pre-entered using AT+BTK) while in the wait phase of auto connect cycle initiated by the AT+BTR command. In addition to accepting pairing attempts, if the pairing is successful, then the new device automatically sets as the peer address for automatic connections (as if an explicit AT+BTR command was entered). See S Registers 505 and 530.
S544	1	0..1	Configure the UART for either low latency or maximum throughput. A setting of 1 gives maximum throughput.

Register	Default	Range	Comment
S551	0x3211	0xFFFF	This register specifies in each 4 bit nibble how the outgoing modem status bits to the remote peer gets its value. Bluetooth allows for RTR, RTC, DV, and IC bits to exchange over an RFCOMM connection. Nibble 0..3 specifies the source for RTC. 4..7 specifies the source for RTR. 8..11 specifies the source for DV (i.e. DCD). 12..15 specifies the source for IC (i.e. RI). Each nibble can take the following value: 0 always set to 0. 1 always set to 1. 2 If DCD (pin 8 on module connector) is output, then always 1. If DCD is input and DCD asserts, then 1; otherwise 0. 3 If RI (pin 6) is output, then always 0. If RI is input, then 1 if RI asserts; otherwise 0. 4 If DSR (pin 10) asserts, then 1; otherwise 0. In the event that a nibble specifies DSR as the source of its state, be aware that if S Register 507 is anything other than 0 a de-assertion of DSR causes the Bluetooth connection to drop. If bits 0..3 and 4..7 are set to 0, then some Bluetooth devices use that as a signal to stop sending any data back. For example, Nokia 6310 stops responding. If this register changes while in command and connected mode, then on going back online using the ATO command, a fresh signal sends to the peer to update the bits.
S552	0x0122	0x0FFF	This register specifies how the DTR, DCD, and RI output pins are controlled in each 4 bit nibble when in a Bluetooth connection. Nibble 0..3 specifies the source for DTR. 4..7 specifies the source for DCD. 8..11 specifies the source for RI. Each nibble can take the following value: 0 Do NOT touch the I/O. 1 Always deassert. 2 Always assert. 3 If RTC bit in CONTROL_IND is 1, then assert; otherwise deassert. 4 If RTR bit in CONTROL_IND is 1, then assert; otherwise deassert. 5 If DV bit in CONTROL_IND is 1, then assert; otherwise deassert. 6 If IC bit in CONTROL_IND is 1, then assert; otherwise deassert. If this register changes while in command and connected mode, then on going back online using the ATO command, the modem output lines refresh.

Register	Default	Range	Comment
S553	0x0201	0x0FFF	This register specifies how the DTR, DCD, and RI output pins are controlled in each 4 bit nibble when NOT in a Bluetooth connection. Nibble 0..3 specifies the source for DTR. 4..7 specifies the source for DCD. 8..11 specifies the source for RI. In addition it also refers to S Register 552 to see if the relevant pin is an input or not to be touched. If the nibble in 552 is 0, then the relevant pin is an input. Each nibble can take the following value: 0: Always deassert. 1: Always assert. 2: Assert if RING sends to the host. The default for the Universal RS232 Adaptor is $0200.
S554	0	0..900	If S Register 512>=2 and <=7, then this register specifies a time in seconds for which the device stays in the S512 mode after power up or reset. On timeout, it aborts the discoverable and/or connectable and falls back into S512=1 mode when it is deaf and dumb. **Note:** If AT+BTR is used to specify a peer device, then on reverting to mode 1, it attempts to make a connection to that peer device. A power cycle, reset via BREAK or ATZ, is required to see the effects of change.
S555	1	1..7	If S Register 554 is nonzero, then after the post reset window expires the mode reverts to the mode specified in this register. This allows the device to be discoverable and connectable on power up (mode 4 or 7), and on window timer expiry to revert to connectable only (mode 3 or 6). A power cycle, reset via BREAK or ATZ, is required to see effects of a change. In some firmware builds, S Registers 565 to 569 inclusive are visible, which allows the start-up mode to depend on the state of RI line (setting S Reg 565 forces the RI pin to configure as an input). For this feature to be active, set SReg 565 to 1. In that case, on start-up and if RI is asserted, then the start-up mode is defined by S Reg 568 and if deasserted then S Reg 569.
S556	0	0..3	Allows GPIO or ADC values to be read via the minor class field in an inquiry response. When this value is non-zero, bits 2 to 7 contain information as follows: 1 : ADC1 2 : ADC2 3 : GPIO1 to GPIO6 Set to 0 to disable this feature. This allows I/O information to convey without a connection.
S557	32	4..900	Specified in seconds, the update interval for the feature enabled via S Reg 556.

Register	Default	Range	Comment
S558	0	0..1	When 1, the responses "RING", "NO CARRIER", and "CONNECT" are replaced by "BTIN", "BTDOWN", and "BTUP" respectively. This eliminates ambiguity when the module has a Bluetooth connection to an AT modem which also gives these responses.
S559	0	0..3	This specifies a mask. When Bit 0 is 1, the response word "ERROR" is replaced by "BTERR", and "OK" is replaced by "ok". When Bit 1 is 1, then error responses do not include the error number and instead the error number can be retrieved using ATI12.
S560	15	15..120	Disconnect timeout in seconds. This timer specifies how long to wait for a confirmation from the peer device and/or the underlying stack that the connection was successfully torn down. There can be instances where a confirmation does not arrive. In this case this timer 'closes off' the procedure and puts the state machine back into a proper mode for new operations. Time is specified with 15 second intervals.
S561	0	0..1000	Sniff Attempt Time in units of milliseconds. 0 means disable. See the "Power Consumption and Reset" section in the user guide for more details.
S562	0	0..1000	Sniff timeout Time in units of milliseconds. 0 means disable. See section "Power Consumption and Reset" in the user guide for more details.
S563	0	0..1000	Sniff Minimum Interval in units of milliseconds. 0 means disable. See section "Power Consumption and Reset" in the user guide for more details.
S564	0	0..1000	Sniff Maximum Interval in units of milliseconds. See section "Power Consumption and Reset" in the user guide for more details.
S565	0	1	If set to 1, RI (Ring Indicate) line configures as an input and forces the start-up mode (SReg512) and post-timeout on start-up mode (SReg555) to depend on the state of RI. The RI conditional modes are defined by SRegs 566 to 569 inclusive.
S566	1	7	If S565=1, and RI asserts, then the device starts in this mode.
S567	1	7	If S565=1, and RI deasserts, then the device starts in this mode.
S568	1	7	If S565=1, and RI asserts, then this is the mode the device assumes after the post-start-up timeout defined in SReg 554 instead of mode defined in SReg555.
S569	1	7	If S565=1, and RI deasserts then this is the mode the device assumes after the post-start-up timeout defined in SReg 554, instead of the mode defined in SReg555.
S580	0	0..1	Remote volume control feature for Headset profile when ATS102 enables headset profile.

Register	Default	Range	Comment
S581	0	0..63	Lowest 6 bits of the Supported features field for Handsfree profile when ATS102 enables Handsfree profile. See S Reg 594 which allows the HandsFree Profile version number to be selected.
S582	0	0..1	FTP Related: 0 = BodyLen in PUT obex packet = 0 1 = BodyLen in PUT obex packet = 1
S583	0xB	0 .. 0x1F	This specifies the initial state of the following modem control lines sent to the peer. Bit 0 := RTC (DTR/DSR) Bit 1 := RTR (RTS/CTS) Bit 2 := IC (Ring Indicate RI) Bit 3 := DV (DCD) Bit 4 := FC (Reserved)
S584	0	0..1	Enable/Disable eSCO. When changing the unit returns ERROR 14 it implies the device is either in a connection or waiting for a connection, and so the new value cannot be accepted. For the former, drop the connection, then issue the command AT+BTX and set the new value. For the latter issue, the command AT+BTX prior to setting the register.
S585	0	0..9	GPIO pin set to 0 to disable the feature.
S586	1000	100..5000	Pulse period in milliseconds (rounded down to nearest multiple of 50).
S587	0	0..100	Duty cycle in percent (rounded to the nearest multiple of 4).
S587	0	0..100	Duty cycle in percent (rounded to the nearest multiple of 4).
S588	0	0..1	After a disconnection, there is a cold reset.
S589	8	0..F	Codec output gain.
S590	1	0..3	Codec input gain.
S591	0	0..1FF	Codec input gain. S591 0 0..1FF Default GPIO output states when not in a connection. This is used when virtual digital I/O cable replacement mode is in operation.
S592	0	0..1	Set this to 1 to reduce the trusted device database to one record when autosaving of pairing is enabled via S reg 538.
S593	0	0..1	Automatically append last 6 digits of local Bluetooth address to the friendlyname, which was set via AT+BTN or AT+BTF.
S594	0	0..1	Set handsfree profile version in SDP record. Set to 0 for 1.1 and to 1 for 1.5.
S595	1	0..1	Set handsfree gateway profile version in SDP record. Set to 0 for 1.1 and to 1 for 1.5.
S596	0	1..1FF	Audio Gateway features to be advertised in SDP record. See handsfree profile specification for exact bit mapping.
S597	0	0..2	Audio gateway Mode: 0 for SDP record advert only, 1 for hosted operation, and 3 for hostless operation. See Audio Gateway specific documentation for more details.

Register	Default	Range	Comment
S598	0	0..1	In hostless audio gateway serviced mode: if this is 1, incoming voice calls reflect to bonded headset.
S599	0	0..2	SCO control for hostless gateway operation. 0 for normal, 1 for as early as possible, 2 leaves SCO to be controlled by headset.
S600	?	0..65535	Number of times this module has gone through a reset cycle. This feature is enabled by S Reg 601. Writing any value to this register initialises it to a certain value.
S601	0	0..1	If this is 1, then on reset S Reg 600 value increments.
S610	0	0..7FFF	Set direction of digital I/O lines. This is a mask made up of 5 bits. Setting a bit to 1 makes that I/O line an output. GPIO1 is bit 0, GPIO2 is bit 1, up to bit 4 for GPIO5. In BISM1 the range is limited to 0..1F.
S611	0	1	Set to 1 to invert the logic of GPIO outputs. For example, ATS621=1 sets the output pin to low and vice versa.
S620	n/a	0..31	Read/Write to all 8 Digital lines in one atomic step. The value returns as a 4 digit hexadecimal value with trailing 0s.
S621	n/a	0..1	Read/Write to GPIO1.
S622	n/a	0..1	Read/Write to GPIO2.
S623	n/a	0..1	Read/Write to GPIO3.
S624	n/a	0..1	Read/Write to GPIO4.
S625	n/a	0..1	Read/Write to GPIO5.
S626	n/a	0..1	Read/Write to GPIO6 – Not available in BISM1.
S627	n/a	0..1	Read/Write to GPIO7 – Not available in BISM1.
S628	n/a	0..1	Read/Write to GPIO8 – Not available in BISM1.
S629	n/a	0..1	Read/Write to GPIO9 – Not available in BISM1.
S631	n/a	0..65535	When GPIO1 configures as an input, low to high transitions are counted. There is no software debouncing. External RC circuit may be required. The counter wraps to 0 when it overflows beyond 65535.
S632	n/a	0..65535	When GPIO2 configures as an input, low to high transitions are counted. There is no software debouncing. External RC circuit may be required. The counter wraps to 0 when it overflows beyond 65535.
S641	n/a	0..65535	As per 631, but the action of reading the value resets the count to 0.
S642	n/a	0..65535	As per 632, but the action of reading the value resets the count to 0.
S701	n/a	0..65535	Read/Write to Analogue Line 0, when reading value returns in decimal.
S702	n/a	0..65535	Read/Write to Analogue Line 1, when reading value returns in decimal.
S711	n/a	0000..FFFF	Read/Write to Analogue Line 0, when reading value returns in hexadecimal.

Register	Default	Range	Comment
S712	n/a	0000..FFFF	Read/Write to Analogue Line 1, when reading value returns in hexadecimal.
S721	0	0	Set direction of Analogue Line 0.
S722	0	0	Set direction of Analogue Line 1.
S1001 to S1010		0.. 2^32	10 General Purpose 32 bit Registers for use by host. These are stored in non-volatile memory.

2.2.14 ATSn? {Read S Register Value}

This returns the current value of register n.

For recognised values of n:

Response: <cr,lf>As Appropriate<cr,lf>OK<cr,lf>

For unrecognised values of n:

Response: <cr,lf>ERROR nn<cr,lf>

2.2.15 ATSn=? {Read S Register – Valid Range}

This returns the valid range of values for register n.

For recognised values of n:

Response: <cr,lf>Sn:(nnnn..mmmm)<cr,lf>OK<cr,lf>

For unrecognised values of n:

Response: <cr,lf>ERROR nn<cr,lf>

2.2.16 ATX<string> {Send Data in Local Command and Connected Mode}

This command sends data to the remote device when in local command and connected mode.

The parameter <string> is any string not more than 24 characters long. If a non-visual character is to be sent, then insert the escape sequence \hh, where hh are two hexadecimal digits. The 3 character sequence \hh converts into a single byte before transmission to the peer.

Response: <cr,lf>OK<cr,lf>

2.2.16a ATY<string> {Send Data in Local Command and Connected Mode}

This command is similar to ATX in syntax and functionality, except that the string only copies to the output RF buffer. Only when an empty string presents does all pending data in the output RF buffer flush out.

The parameter <string> is any string not more than 24 characters long. If a non-visual character is to be sent then insert the escape sequence \hh where hh are two hexadecimal digits. The 3 character sequence \hh converts into a single byte before transmission to the peer.

Response: <cr,lf>OK<cr,lf>

2.2.17 ATZ<n> {Hardware Reset and emerge into mode 'n'}

Forces the device through a hardware reset, which means it eventually comes alive in the local command and unconnected mode. This allows changes to the PS store to take effect. Prior to version 2.7.0, allow about 2 seconds for the device to start responding to AT commands again. The best way to determine if the device is alive again is to keep sending it AT<cr> until it responds with an OK. After v2.7.0 it is safe to communicate after receiving an OK.

The optional parameter <n> is only available for firmware 2.7.0 and newer and is a value in the range 0 to 7 (up to version 7.18.0). Post 9.18.6 valid values are 0 to 4 inclusive.

ATZ and ATZ0 signify reset and emerge into the current mode (see command ATI14). ATZ1 to ATZ4 instructs the module to reset and then emerge into the appropriate boot mode. Note that S Reg 103 specifies the boot mode from cold.

For firmware prior to v2.7.0:

Response: <cr,lf>**OK**<cr,lf> and *OK returns before the RESET*

For firmware v2.7.0 and newer:

Response: <cr,lf>**OK**<cr,lf> and *OK returns after the RESET*

2.2.18 AT&Fn {Set S Register Defaults}

This command only works when the device is in local command and unconnected mode. Depending on the value of 'n' it installs S Register values appropriate for various power modes, ranging from minimum power consumption to maximum.

Legal values of 'n' are as per the following table. All other values of n generate a syntax error response. If 'n' is not specified then a default value of 0 is assumed where the baud rate is NOT changed.

&F0 (Default)	Medium power consumption, UART baud rate unchanged, Left LED off, Right LED = DCD
&F1	Minimum power consumption, UART baud rate set to 9600, Left and Right LED off
&F2	Minimum power consumption, UART baud rate set to 38400, Left and Right LED off
&F3	Minimum power consumption, UART baud rate set to 115200, Left and Right LED off
&F4	Medium power consumption, UART baud rate set to 115200, Left LED off, Right LED = DCD
&F5	Maximum power consumption, UART baud rate set to 115200, Left LED=DSR, Right LED = DCD
&F6	Maximum power consumption, UART baud rate set to 115200, Left LED=DSR, Right LED = DCD Explicitly set higher baud rates using ATS521=n

Please refer to the "Power Consumption" chapter in the relevant Laird device user guide for more detailed information of power usage.

The new values are NOT updated in non-volatile memory until the AT&W command sends to the Laird device.

Response: <cr,lf>**OK**<cr,lf>

Or <cr,lf>**ERROR nn**<cr,lf>

2.2.19 AT&F* {Clear Non-volatile Memory}

The AT&F* variant of the command installs values in S registers as per command AT&F4, and then erases all other user parameters in non-volatile memory. This means that the trusted device database clears, and so do parameters related to the following commands: AT+BTR, AT+BTN, AT+BTS.

Response: <cr,lf>**OK**<cr,lf>

Or <cr,lf>**ERROR nn**<cr,lf>

2.2.20 AT&F+ {Clear Non-volatile Memory}

This command erases all user parameters in non-volatile memory except S Registers 520 to 525. This means that the trusted device database clears, and so do parameters related to the following commands: AT+BTR, AT+BTN, AT+BTS.

Response: <cr,lf>**OK**<cr,lf>

Or <cr,lf>**ERROR nn**<cr,lf>

2.2.21 AT&W {Write S Registers to Non-volatile Memory}

This command writes current S Register values to non-volatile memory so that they are retained over a power cycle.

Response: <cr,lf>**OK**<cr,lf>

Or <cr,lf>**ERROR nn**<cr,lf>

2.2.22 AT+BTAn {Control Audio Channel}

Once a Bluetooth connection is active, **and assuming the peer device is a Laird device**, this command starts/stops a SCO channel which connects the PCM interfaces of the two peer devices. This means that if a codec is attached to the PCM pins, then 2-way audio can be established.

+BTA0: Switch off the channel.

+BTA1: Switch on the channel.

On receipt of the command, the following response immediately follows:

Response: <cr,lf>**OK**<cr,lf>

The lower layers then go through the process of setting up the SCO channel, and as soon as a SCO link establishes, the following response asynchronously sends to the host:

Response: <cr,lf>**AUDIO ON**<cr,lf>

If the SCO failed to establish:

Response: <cr,lf>**AUDIO FAIL**<cr,lf>

On the peer device, the host asynchronously gets:

Response: <cr,lf>**AUDIO ON**<cr,lf>

2.2.23 AT+BTC<devclass> {Set Device Class Code}

This command sets the device class code which sends in subsequent inquiry responses. It can be read back using the AT+BTC? command, as described below.

<devclass> is a 6 digit hexadecimal number derived as per section "1.2 The Class of Device/Service Field" of the Bluetooth specification "Bluetooth Assigned Numbers".

The 24 bits are made of 4 fields briefly described as follows (bit 0 corresponds to the least significant bit):

Bits 0-1:	Format Type. This field currently only has a value of 00 (i.e. format type 1).
Bits 2-7:	These 6 bits define the Minor Device Class and the value is interpreted differently based on the Major Device class stored in the next 5 bits.
Bits 8-12:	These 5 bits define the Major Device Class as per Table 1.3 in "Bluetooth Assigned Numbers".
Bits 13-23:	This is an 11 bit field used as a mask to define the Major Service Class, as per Table 1.2 in "Bluetooth Assigned Number".

Laird devices do not map to any predefined Major Service Class or Major Device Class and so the default devclass as shipped is 001F00, which means no Major Service Class and "Unclassified" Major Device class.

Other examples of device class codes are as follows:

Code (Hexadecimal)	Name	Major Service	Major Device	Minor Device
001F00	Unclassified	None	Unclassified	n/a
200404	Headset	Audio	Audio	Headset

Response: <cr,lf>**OK**<cr,lf>

Or for an invalid <devclass> value (usually a value which is not 6 hexadecimal characters long):

Response: <cr,lf>**ERROR 08**<cr,lf>

2.2.24 AT+BTC? {Read Device Class Code}

This command reads the current device class code.

Response: <cr,lf>**123456**

<cr,lf>**OK**<cr,lf>

2.2.25 AT+BTD<bd_addr> {Remove Trusted Device}

This command removes the specified device from the list of trusted devices in the non-volatile database. If the device is not in the database then the response is still an OK.

Response: <cr,lf>**OK**<cr,lf>

2.2.26 AT+BTD* {Remove All Trusted Devices}

This command removes all devices from the list of trusted devices in the non-volatile database. *No confirmation is asked.*

WARNING: If you make an authenticated connection, the link key caches in the underlying stack. So if you subsequently delete the key using AT+BTD* and immediately request an authenticated connection to the same device, the connection establishes. To ensure this does not happen, either send ATZ after the AT+BTD* OR send AT+BTD<bd_addr> for each item in the trusted device database.

Response: <cr,lf>**OK**<cr,lf>

2.2.27 AT+BTF=<string> {Set Friendly Name}

This sets the friendly name of this device as seen by other devices.

Response: <cr,lf>OK<cr,lf>

2.2.28 AT+BTF<bd_addr> {Get Remote Friendly Name}

This command gets the remote friendly name of the peer specified.

Response: <cr,lf><bd_addr>,"Friendly Name"

<cr,lf>OK<cr,lf>

2.2.29 AT+BTG<bd_addr> {Enable Cautious Page Scanning ONLY}

Enable page scanning and wait for a connection from device with Bluetooth address <bd_addr>. If the specified address is 000000000000, then incoming connections are accepted from any device, is as per AT+BTP without an address. Inquiry Scans are disabled.

This command also has variants which allow authentication and encryption to be explicitly specified. For example:

AT+BTGU123456789012

AT+BTGY123456789012

AT+BTGUY123456789012

AT+BTGYU123456789012

Response: <cr,lf>OK<cr,lf>

2.2.30 AT+BTG {Enable Promiscuous Page Scanning ONLY}

Enable page scanning only and wait for a connection from any device. Inquiry scans are disabled. Authentication and Encryption is as per S registers 502 and 503.

Response: <cr,lf>OK<cr,lf>

2.2.31 AT+BTGU {Enable Promiscuous Page Scanning ONLY}

Enable page scanning only and wait for a connection from any device. Inquiry scans are disabled. Authentication enables and encryption disables.

Response: <cr,lf>OK<cr,lf>

2.2.32 AT+BTGY {Enable Promiscuous Page Scanning ONLY}

Enable page scanning only and wait for a connection from any device. Inquiry scans disabled. Authentication disables and encryption enables.

Response: <cr,lf>OK<cr,lf>

2.2.33 AT+BTGUY {Enable Promiscuous Page Scanning ONLY}

Enable page scanning only and wait for a connection from any device. Inquiry scans are disabled. Authentication and encryption both enable. The order of U and Y is not significant.

Response: <cr,lf>OK<cr,lf>

2.2.34 AT+BTI<devclass> {Inquire}

This makes the device perform an inquiry for device class code for **delay** milliseconds and **max** number of unique responses, where **delay** is specified by S register 517 and **max** is specified by S register 518. The <devclass> is an optional parameter where the value specifies either a 6 digit device class code or a 2 digit major device class. If it is not specified, then the value is taken from S register 516.

When <devclass> is 6 hexadecimal characters long, it specifies an AND mask which filters inquiry responses. When <devclass> is 2 hexadecimal characters long, it forces the inquiry to filter responses to devices that match their major device class code to this value – which can only be in the range 00 to 1F.

Response: <cr,lf>**12346789012**

<cr,lf>**12345678914**

<cr,lf>**OK**<cr,lf>

If the module is waiting for an incoming connection, (entered via AT+BTP, AT+BTG, AT+BTQ), then it responds with ERROR 14. To perform the inquiry, send AT+BTX to put the module back into idle mode.

Response: <cr,lf>**ERROR 14**<cr,lf>

ERROR RESPONSE

A Bluetooth inquiry process is such that for a single inquiry request a device could respond many times. To ensure that an address sends to the host only once for a particular AT+BTI, an array of addresses are created at the start of each AT+BTI and fill as responses come in. This array of addresses storedsin dynamic memory and if the memory allocation fails ,then the inquiry procedure aborts. In that case an error response sends to the host.

*To clarify, a single AT+BTI **never** returns the same Bluetooth address more than once, but as long as the responding device is active, all AT+BTI commands always return it.*

Response: <cr,lf>**ERROR 27**<cr,lf>

2.2.35 AT+BTIV<devclass> {Inquire}

As per AT+BTI but the response includes the device class code for all inquiry responses.

Please refer to the 'ERROR RESPONSE' note in the description for AT+BTI<devclass>.

Response: <cr,lf>**12346789012,123456**

<cr,lf>**12345678914,123456**

<cr,lf>**OK**<cr,lf>

2.2.36 AT+BTIN<devclass> {Inquire}

As per AT+BTI but the response includes the device class code and friendly name for all inquiry responses. Please refer to the 'ERROR ESPONSE' note in the description for AT+BTI<devclass>. The friendly name strings are in UTF-8 format as per the Bluetooth specification.

Response: <cr,lf>12346789012,123456,"TDK SYSTEMS AT DONGLE 1"
<cr,lf>12345678914,123456, "TDK SYSTEMS RS232"
<cr,lf>OK<cr,lf>

Note: Many releases of firmware return the product name as LAIRD, e.g.

Response: <cr,lf>12346789012,123456,"TDK SYSTEMS AT DONGLE 1"
<cr,lf>12345678914,123456, "TDK SYSTEMS RS232"
<cr,lf>OK<cr,lf>

We strongly recommend that any software implementation that uses this command checks for both LAIRD and TDK SYSTEMS to ensure backwards and forwards compatibility.

2.2.37 AT+BTK=<string>{Set Passkey}

This command provides a passkey when **PIN? 12345678** indications receive asynchronously. If a pairing is not in progress then the pin writes to non-volatile memory for future use. Specifying an empty string deletes the key from the non-volatile memory. The string length must be in the range 0 to 8, otherwise an error returns.

Response: <cr,lf>OK<cr,lf>

2.2.38 AT+BTM<bd_addr> {Set Incoming Peer Address}

This command stores a peer address for incoming connections in non-volatile memory. A value of 000000000000 has the special meaning of invalid peer address.

When S register 512 = 3, 4, 6, or 7, it waits for an incoming connection from the peer address specified. If the peer address is not 000000000000, it waits for a connection from the specified master; otherwise it will connect to anyone.

Response: <cr,lf>OK<cr,lf>

2.2.39 AT+BTM {Delete Incoming Peer Address}

This command deletes the peer address previously stored using AT+BTR<bd_addr>.

Response: <cr,lf>OK<cr,lf>

2.2.40 AT+BTM? {Read Incoming Peer Address}

This command displays the peer address stored in non-volatile memory, which puts the module in pure cable replacement mode.

Response: <cr,lf>12346789012

<cr,lf>OK<cr,lf>

If the location is empty the response is as follows:

Response: <cr,lf>00000000000

<cr,lf>OK<cr,lf>

2.2.41 AT+BTN=<string> {Set Friendly Name in Non-volatile Memory}

This sets the default friendly name of this device as seen by other devices. It stores in non-volatile memory. Use AT+BTF to make the name visible to other devices. Use AT+BTN? to read it back. An empty string (“”) deletes the string from non-volatile memory which forces the default name to be used.

Response: <cr,lf>OK<cr,lf>

2.2.42 AT+BTN? {Read Friendly Name from Non-volatile Memory}

Read the default friendly name from non-volatile memory.

Response: <cr,lf>"My FriendlyName"<cr,lf>

<cr,lf>OK<cr,lf>

2.2.43 AT+BTO<devclass> {Open and make Unit Detectable}

After power up and ATZ, this command sends so that RFCOMM initialises and opens and the service name as specified in AT+BTN exposes via the SDP registry.

The <devclass> value specifies an optional fixed length hexadecimal device class code. If it is not specified, then the device class code is taken from S Register 515.

For this command to be effective, S Register 512 must be set to 0.

Response: <cr,lf>OK<cr,lf>

2.2.44 AT+BTP<bd_addr> {Enable Cautious Page/Inquiry Scanning}

Enable page scanning and wait for a connection from device with Bluetooth address <bd_addr>. If the specified address is 000000000000, then incoming connections are accepted from any device is as per AT+BTP without an address. Inquiry scanning also enables.

This command also has variants which allow authentication and encryption to be explicitly specified. For example:

AT+BTPU123456789012

AT+BTPY123456789012

AT+BTPUY123456789012

AT+BTPYU123456789012

Response: <cr,lf>OK<cr,lf>

2.2.45 AT+BTP {Enable Promiscuous Page/Inquiry Scanning}

Enable page scanning and wait for a connection from any device. Inquiry scanning also enables. Authentication and encryption is as per S registers 502 and 503.

Response: <cr,lf>OK<cr,lf>

2.2.46 AT+BTPU {Enable Promiscuous Page/Inquiry Scanning}

Enable page scanning and wait for a connection from any device. Inquiry scanning also enables. Authentication enables and encryption disables.

Response: <cr,lf>OK<cr,lf>

2.2.47 AT+BTPY {Enable Promiscuous Page/Inquiry Scanning}

Enable page scanning and wait for a connection from any device. Inquiry scanning also enables. Authentication disables and encryption enables.

Response: <cr,lf>OK<cr,lf>

2.2.48 AT+BTPUY {Enable Promiscuous Page/Inquiry Scanning}

Enable page scanning and wait for a connection from any device. Inquiry scanning also enables. Authentication and encryption both enable. The order of U and Y is not significant.

Response: <cr,lf>OK<cr,lf>

2.2.49 AT+BTQ {Enable Inquiry Scans ONLY}

When inquiry scan enables, it implies that this device responds to inquiries from other devices. Use AT+BTX to disable inquiries.

Response: <cr,lf>OK<cr,lf>

2.2.50 AT+BTR<bd_addr> {Set Outgoing Peer Address}

This command stores a peer address for outbound connections in non-volatile memory. A value of 000000000000 has the special meaning of invalid peer address. This command sets up a module in pure cable replacement mode.

If S register 512 = 1 and the peer address is NOT 000000000000, then it periodically (time specified via S register 505) attempts to connect to the peer address specified. In this circumstance all commands from the host buffer in the receive buffer until a Bluetooth connection establishes with the peer device and it then sends the buffer. This means that if the peer device is not in the vicinity and will never be there, the device effectively becomes useless, as in this circumstance a host would want to get attention of the AT parser to send it new commands – probably one to delete the peer device.

In this circumstance, a recovery is possible by one of two methods. The first method assumes that the DTR from the host is connected to the DSR line of the module and the second method assumes that this connection is absent. In the first method, it is enough to deassert the DTR line from the host and that aborts the autoconnect cycle. The second method initiates by resetting the device and then ensuring that the text string "AT+BT&BISM&<cr>" sends. There is special code which looks out for this command and terminates the autoconnect cycle if it sees it and confirms to the host of that fact by sending an OK response.

Response: <cr,lf>OK<cr,lf>

2.2.51 AT+BTR {Delete Outgoing Peer Address}

This command deletes the peer address previously stored using AT+BTR<bd_addr>.

Response: <cr,lf>**OK**<cr,lf>

2.2.52 AT+BTR? {Read Outgoing Peer Address}

This command displays the peer address stored in non-volatile memory, and puts the Laird device in pure cable replacement mode.

Response: <cr,lf>**12346789012**

<cr,lf>**OK**<cr,lf>

If the location is empty the response is as follows:

Response: <cr,lf>**00000000000**

<cr,lf>**OK**<cr,lf>

2.2.53 AT+BTS=<string> {Set Service Name}

This writes the name to non-volatile memory. It is used after ATZ, power cycle, or AT+BTO if it has not been issued yet. Use AT+BTS? to read it back from non-volatile memory. An empty string ("") deletes the string from non-volatile memory which forces the default service to be used.

Response: <cr,lf>**OK**<cr,lf>

If the service name cannot be set for any reason then an error response **ERROR 11** returns.

2.2.54 AT+BTS? {Read Service Name from Non-volatile Memory}

Reads the default service name from non-volatile memory.

Response: <cr,lf>**"My ServiceName"**<cr,lf>

<cr,lf>**OK**<cr,lf>

2.2.55 AT+BTT {Add Trusted Device}

This command stores the cached link key in the non-volatile database. If the database is full, it responds with an ERROR. If the device is already in the database, then the key is replaced.

If the link key cache is empty, that is, a pairing has not been performed since the device was powered, then the response is an ERROR.

Response: <cr,lf>**OK**<cr,lf>

Or <cr,lf>**ERROR**<cr,lf>

2.2.56 AT+BTT? {List Trusted Device}

This command lists the contents of the trusted device database. The link key does NOT display so the response is as shown below. If the list is empty then just the OK response sends; otherwise an OK terminates the list. Use the command ATI6 to read the maximum size of the trusted device database.

Response: <cr,lf>12346789012

<cr,lf>12345678913

<cr,lf>12345678914

<cr,lf>OK<cr,lf>

2.2.57 AT+BTV<U><Y><bd_addr>,<uuid> {SDP Query for Service }

This command interrogates the SDP database of the peer device <bd_addr> for the service <uuid>. It results in an ACL connection and then a SDP transaction.

If the <uuid> service is present:

Response: <cr,lf>0

<cr,lf>OK<cr,lf>

If the <uuid> service is not present:

Response: <cr,lf>1

<cr,lf>OK<cr,lf>

If the device < bd_addr > cannot be reached, or is in non-connectable mode:

Response: <cr,lf>2

<cr,lf>OK<cr,lf>

If the SDP database is corrupt or invalid:

Response: <cr,lf>3

<cr,lf>OK<cr,lf>

If the device is not in idle mode:

Response: <cr,lf>4

<cr,lf>OK<cr,lf>

In this case, the command AT+BTX may put the device into the correct idle mode.

2.2.58 AT+BTW<bd_addr> {Initiate Pairing}

This initiates pairing with a device whose Bluetooth address is <bd_addr>. An OK response sends and when the PIN is required, asynchronous indications send to the host in the form **PIN? <bd_addr>,** where the address confirms the device with which the pairing is performed. To supply a PIN, use the AT+BTK command.

For a successful pairing, the link key stores in a volatile cache which is overwritten every time a new pairing initiates using this command. The link key can store in a non-volatile database within the device. Manage the list of trusted devices using commands AT+BTT?, AT+BTT, and AT+BTD. The AT+BTT? command produces a list of trusted Bluetooth addresses (link key NEVER displays) and AT+BTT stores the cached link key. The command AT+BTD123456789012 removes the specified device from the database.

The OK response sends immediately on receipt of the AT+BTW command. On pairing completion, an unsolicited message sends to the host in the form PAIR n <bd_addr>. See PAIR n <bd_addr> for more details.

If AT+BTI, AT+BTP, AT+BTG, AT+BTQ, or ATD issues between the AT+BTW command and the subsequence PAIR asynchronous response, then an ERROR response sends to those commands as the device is not in a mode from where such commands can be actioned.

Response: <cr,lf>**OK**<cr,lf>

2.2.59 AT+BTW? {List Cached Trusted Device}

This command lists the cached trusted device.

Response: <cr,lf>**12346789012**

<cr,lf>**OK**<cr,lf>

If the cache is empty the response is as follows:

Response: <cr,lf>**OK**<cr,lf>

2.2.60 AT+BTX {Disable Page/Inquiry Scanning}

Disable page/inquiry scanning. This means it does not accept incoming connections or inquiry requests. In fact this negates the effect of AT+BTQ, AT+BTG and AT+BTP commands.

Response: <cr,lf>**OK**<cr,lf>

2.2.61 AT+AG<command><parm> {Audio gateway Control}

See audio gateway specific specification for more details.

3. UNSOLICITED RESPONSES

The 'AT' Protocol is a command/response type of protocol. This means that the Laird device normally only responds to AT commands.

Under special circumstances, unsolicited responses send to the host. They are described in the following subsections.

3.1 RING

This string sends to the host when a remote device initiates a serial port connection. The fully qualified string is in the form RING 01234567890, where 012345678901 is a 12 digit hexadecimal number corresponding to the remote device's Bluetooth address. This response sends to the host every 2 seconds until the host either accepts the connection using the ATA command or rejects it using the ATH command.

3.2 PIN?

This response sends to the host during a pairing negotiation.

The fully qualified string is PIN? 012345678901, where 012345678901 is the Bluetooth address of the peer device. In response, the host must supply a pin code that is entered using the AT+BTK command.

If the peer address does not supply the address in the message exchange, then the address is specified as 000000000000 – and the paring proceeds as normal.

3.3 AUDIO ON

This response sends to the host when a SCO channel establishes.

3.4 AUDIO OFF

This response sends to the host when an existing SCO channel closes.

3.5 AUDIO FAIL

This response sends to the host when a SCO channel setup fails.

3.6 ERROR 27

This response sends to the host on power up if the firmware is unlicensed.

3.7 PAIR n <bd_addr>

This response sends to the host on termination of a pairing process. If pairing was successful then 'n' = 0, if a timeout occurred then 'n'=1, and for all other unsuccessful outcomes the value is 2.

The parameter <bd_addr> is the address of the peer device if available.

3.8 PAIR 0 <bd_addr> MM

This response sends to the host on termination of a successful pairing process. The optional MM only sends if S Register 538 is set to 1 to automatically save the link key. The value MM indicates the result of the save operation and a value of 00 implies success; otherwise the value corresponds to an error code.

3.9 RX<string>

This response sends to the host when the unit is in online-command mode, S Register 531 is set to 3, and data arrives from a peer.

If the data from the string contains non-visual characters (for example ASCII 0 to 31 and ASCII 128 to 255), then those characters translate into a 3 character escape sequence starting with '\'. For example, the embedded <cr><lf> sequence sends as the 6 character string \0D\0A.

If the data contains the character '"' then it sends as \22.

If the data contains the character '\' then it sends as \5C

3.10 AG<string>

This response sends to the host when a serviced audio gateway connection is in progress and the profile requires some action from the host.

4. Incoming Connections

The Laird device can be configured using the AT+BTP or AT+BTG command so that it scans for incoming connections from other Bluetooth devices. It can also be configured via S Register 512 to be in this mode by default on power up.

When the lower layers detect an incoming call, a RING 123456789012 string sends to the host every second. The command ATA accepts the connection and ATH rejects it.

On connection, if the S0 Register is >=0, then confirmation to the host is in the form:

CONNECT 123456789012

CONNECT 123456789012 A

CONNECT 123456789012 E

CONNECT 123456789012 AE

'A' means authenticated connection and 'E' means encryption is enabled.

When S0 register is -1, neither RING nor CONNECT sends to the host and the connection is silently accepted.

If the S 100 register is non-zero, then after the ring indications specified by this register have been sent to the host, and the host has failed to accept or reject the incoming connection, an automatic 'hangup' initiates.

5. Dropping Connections

In a conventional telephony modem, a call normally terminates by first sending a +++ character sequence enveloped by an escape sequence guard time (of the order of 100 to 1000 milliseconds) to enter local command and connected mode and then the ATH command.

Laird Bluetooth modules provide a variety of ways to drop a connection. One method is similar to the above, but instead uses a ^^^ character sequence; this is to eliminate ambiguity when a data call is in progress via a mobile phone which established using the mobile phone's Bluetooth AT modem. The second method involves the host dropping the DTR (DSR from the module's viewpoint) handshaking line.

Note: Being able to drop a connection using the escape sequence ^^^ has a severe penalty on data throughput; in fact, the data rate is of the order of 85kbps instead of ~200kbps. To cater for this performance hit, the device's connection drop capability is configurable to be in one of two modes.

One mode allows for a connection to drop using either method, and the other mode allows for a connection drop using the DTR method only. By default, the device is in the first mode. Select this mode using the S507 register. See the S register table described in an earlier section.

To reiterate, the escape sequence is as follows:

<Guard time><Esc Chr><Guard time><Esc Chr><Guard time><Esc Chr><Guard time>

This means that even when a file transfer is occurring and it happens to be full of <Esc Chr> characters, then it is not going to drop into command mode because when transferring a file it is going to happen as fast as possible; the inter character gap is going to be significantly shorter than the <Guard time>.

The <Esc Chr> character can be changed via the S2 register and the <Guard time> interval can be specified via the S12 register.

6. Pairing and Trusted Devices

When authentication enables via S register 500 or when using the 'u' modifier in the ATD and AT+BTP commands, a connection attempt requires a link key for the peer device. Obtain the link key prior to connection by invoking the AT+BTW and AT+BTK commands. Obtain a new link key as often as required; it stores in a volatile cache. At any time, this cached link key can be added to the trusted devices database using the AT+BTT command. A trusted device can be deleted using the AT+BTD command. To view a list of trusted device issue the command AT+BTT?.

Note: If S Register 538 is set to 1, then on a successful pairing the link key automatically saves to the trusted device database. In that case, the asynchronous message PAIR 0 <bd_addr> has an error code appended at the end to convey the result of the save operation.

When a connection attempt requires a link key, the trusted device database is searched automatically and if one exists, it is provided without host interaction. If the link key is not present, then the connection attempt terminates and gives a NO CARRIER response to the ATD command.

A typical session to pair a device (such as an Ericsson T68i) to a serial module is:

1. Make the T68i discoverable and send AT+BTI to the serial module. This results in inquiry responses from all devices. Make a note of the Bluetooth address of the phone, e.g. 123456789012.
2. On the T68i, start the pairing procedure by selecting "Phone accepts" in the relevant Bluetooth menu.
3. Send command AT+BTW123456789012 to the serial module.
4. Confirm that you receive an OK response and PIN? responds on a two second interval.
5. Enter a pin code on the phone, e.g. 12345768.
6. Enter the command AT+BTK="12345678".
7. The phone confirms success and likewise the serial module responds with OK.
8. On success, the serial module sends an unsolicited message in the form of PAIR 0 <bd_addr>.
9. Send AT+BTT to the serial module so that the pairing information stores in the nonvolatile database.
10. Confirm that the link key is stored by sending the command AT+BTT?. This results in a list of all devices paired with the module.

If two Laird devices need paired, accomplish it as follows:

1. Send ATI4 to Device 1. It responds with the local Bluetooth address, e.g. 123456789001.
2. Send AT+BTP to Device 1. It becomes discoverable and connectable.
3. Send AT+BTW123456789001 to Device 2. It responds with OK.
4. On both devices, PIN? asynchronous responses display.
5. Send AT+BTK="12345678" to both modules. On success, the serial module sends an unsolicited message in the form of PAIR 0 <bd_addr>.
6. The pairing link key is in volatile memory at this stage, so send AT+BTT to both.
7. The two units now have pairing information which survives a power cycle.

7. Error Responses

All error responses from the Laird device are in the form <cr,lf>**ERROR nn**<cr,lf>, where nn is a number in the range 00 to 99.

Error	Description
01	Register not recognised.
02	Value for register is out of range.
03	Incoming call NOT pending.
04	No call to connect. This error code has meaning for ATO only.
05	Syntax Error.
06	Empty String.
06	Device Class could not be stored.
08	Invalid Device Class Code.
09	Invalid Bluetooth Address.
10	Could not set Service or Friendly name.
11	PS Store Write.
12	PS Store Read.
13	Not Idle.
14	Incorrect Mode.
15	Already Scanning.
16	Pairing is already in progress.
17	NOT USED.
18	NOT USED.
19	NOT USED.
20	Not safe to write to Non-volatile Store - Ongoing Bluetooth Connection.
21	Link Key Cache is empty.
22	Link Key Database is full.
23	Malloc returned NULL - Resource Issue.
24	Remote Address same as Local Address.
25	Connection Setup Fail, DSR Not asserted.
26	Unauthenticated licence.
27	Max Responses (See S Register 518) too high. Memory allocation error.
28	The length of Pin in AT+BTK is too long.
29	Invalid Ring count specified for S Register 0 or 100. If S0<>0 and S100<>0, then S0 must be < S100.
30	ADC Error.
31	Analogue Value cannot be read as it is set for output.
32	Analogue Value cannot be written as it is set for input.
33	S Register Value is invalid.
34	Both L and R modifier cannot be specified in ATD command.
35	Invalid Major Device Class – valid value in range 0x00 to 0x1F inclusive.
36	Pairing in progress – Command cannot be actioned – try again later.
37	Invalid Sniff parameter specified, e.g. new Attempt value greater than MinInterval. Solution is to first increase MinInterval and re-enter the Attempt value.
38	Get Remote Friendly name failed.
39	Failed to change mode to multipoint.
40	7 Bit mode requires parity to be even or odd.

8. Factory Default Mode

Laird devices are capable of operating at a very wide range of baud rates. S Registers 520 and 521 allow the baud rate to be set very easily. The baud rate clock generator in the Laird device is more versatile than that available in a standard 16550 UART commonly available in PCs.

As long as the equation BAUDRATE * 0.004096 produces an integer value, there is 0% error in clocking for that baud rate. It is possible to set a baud rate that a PC cannot cope with; in that circumstance it is virtually impossible to communicate with it.

To cater for this circumstance, the Laird device comes out of reset using 9600,N,8,1 comms settings for exactly 750 ms and then reverts to the comms parameters as per the S Registers.

If the host sends the string **!<BISM>!<cr>** where <cr> is the carriage return character within that 750 ms period, then the module remains at 9600,N,8,1 and also configures itself using factory default S Register values.

9. Miscellaneous Features

This section describes various features that cannot be categorized appropriately.

9.1 RI dependent Start-up Mode

The UART_RI line can be configured as an input, and on power its state can force the device into one of two modes. See description for S Registers 565 to 569 inclusive for more details.

For example, the feature could allow a device to make an outgoing connection if RI is in one state, and be ready for an incoming connection in the other.

9.2 Pulse a GPIO pin

To flash a GPIO pin, set it as an output using S Reg 610 and then use S Reg 585 to 587 inclusive to set the pin, period, and duty cycle respectively.

9.3 Flash LED on Connectable Mode

S Reg 534 now takes a value up to 2. A value of 2 configures it so that it blinks when the module is in connectable mode.

9.4 Reset via BREAK

The module can reset by sending a BREAK signal. A BREAK signal exists when the module's UART_RX input is in a non-idle state (0v) for more than 125 ms.

9.5 Digital I/O Cable Replacement

The module has a number of general purpose digital I/O pins. The direction of these pins is specified via S Reg 610.

When S Reg 531 is set to 4 at both ends of the connection, then on connection any changes in the states of the inputs at one end transmit to the peer, which then reflects those states on the appropriate I/O pins if they are configured as outputs.

It is recommended that the value of S Reg 610 at one end be the one's complement of the other end. That way, inputs at one end are mirrored at the other end and vice versa.

In addition S Reg 506 MUST be set to 0, which disables echoes.

Note: Due to inherent latency of Bluetooth transmission, expect the change of state to delay. This value is typically 100 ms and can be much more if the quality of the link is bad, which results in many retries.

It is assumed that an audio channel is not active at any time.

9.6 Append Bluetooth Address to Friendly name

If S Reg 593 is set to 1, then the last 6 hex digits of the Bluetooth address automatically append to the friendly name. This allows multiple devices with the same name in a neighbourhood to be differentiated.

10. Disclaimers

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The definitions used herein are:

a) Life support devices or systems are devices which (1) are intended for surgical implant into the body, or (2) support or sustain life and whose failure to perform when properly used in accordance with the instructions for use provided in the labelling can reasonably be expected to result in a significant injury to the user.

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Laird does not assume responsibility for use of any of the circuitry described; no circuit patent licenses are implied and Laird reserves the right at any time to change without notice said circuitry and specifications.

10.1 Data Sheet Status

Laird reserves the right to change the specification without prior notice in order to improve the design and supply the best possible product.

11. Changes Between Release

Although every effort is made to ensure compatibility, the functionality of some features has changed due to the evolution of the Bluetooth chips and stack implementations. Users migrating between firmware variants should check the following differences:

2.2.17 ATZ

2.2.36 AT+BTIN

S626 – S629 BISMII Only

Please check with Laird for the most recent data before initiating or completing a design.