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Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
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Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

BTM430/431 DATA MODULE

User Guide
Version 5.0

global solutions: local support

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852-2923-0610
wireless.support@lairdtech.com
www.lairdtech.com/bluetooth

1 REVISION HISTORY

Revision	Date	Description	Approved By
1.0	3 Jan 2012	Initial Release	Jonathan Kaye
2.0	20 Mar 2012	Updates to firmware v11.28.1.0	Jonathan Kaye
3.0	11 May 2012	Formatting and general editing	Jonathan Kaye
4.0	7 Jan 2013	Updated FCC Statement, new mech. drawings, general editing / formatting	Jonathan Kaye
4.1	15 Mar 2013	Converted to Laird formatting	Sue White
5.0	04 Feb 2014	Separated into two separate docs (Hardware Integration Guide and User Guide). Added a Related Documents section.	Sue White

2 TABLE OF CONTENTS

1. OVERVIEW AND KEY FEATURES

The BTM430 and BTM431 Bluetooth® modules from Laird Technologies have been designed to meet the needs of developers who wish to add robust, short range Bluetooth data connectivity to their products. They are based on the market leading Cambridge Silicon Radio BC04 chipset, providing exceptionally low power consumption with outstanding range.

With physical sizes as small as 12.5 x 18.0mm and best of class, low-power operation, these modules are the ideal choice for applications where designers need both performance and minimum size. For maximum flexibility in systems integration, the modules are designed to support a separate power supply for I/O.

To aid product development and integration, Laird Technologies has integrated a complete Bluetooth protocol stack within the modules, including support for the Bluetooth Serial Port Profile. The modules are fully qualified as Bluetooth End Products, allowing designers to integrate them within their own products with no further Bluetooth Qualification. They can then list and promote their products on the Bluetooth website free of charge.

A comprehensive AT command interface is included, which simplifies firmware integration. Combined with a low cost developer's kit, this ensures that the choice of Laird Technologies Bluetooth modules guarantees the fastest route to market.

FEATURES AND BENEFITS

- Bluetooth® v2.0+EDR
- Adaptive Frequency Hopping to cope with interference from other wireless devices
- External or internal antenna options
- Comprehensive AT interface for simple programming
- Bluetooth® END Product Qualified
- Compact size
- Class 2 output – 4dBm
- Low power operation
- UART interface
- PCM and SCO for external codec
- GPIO lines under AT control
- Support for multiple profiles
- Wi-Fi co-existence

2.1 APPLICATIONS

- Embedded Devices
- Phone Accessories
- Security Devices
- Medical and Wellness Devices
- Automotive Applications
- Bluetooth Advertising
- ePOS

3 AT COMMAND SET REFERENCE

3.1 Introduction

This document describes the protocol used to control and configure the following Laird Technologies Bluetooth devices:

- BTM430
- BTM431

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 Technologies device perform the two core actions of a Bluetooth device, which is make/break a connection and Inquiry. 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 Technologies device powers up in an unconnected state and will only respond via the serial interface. In this state the Laird Technologies device will not even respond to Bluetooth Inquiries. Then, just like controlling a modem, the host can issue AT commands which 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 will have a concept of command and data modes. This leads to the matrix of states shown below.

Table 1: Matrix of mode states

	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 will be ignored.

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

3.2 Assumptions

The CSR (Cambridge Silicon Radio) BC04 chipset in Laird Technologies 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 Technologies device.

Therefore the following assumptions are made:

- All commands are terminated by the carriage return character 0x0D, which is represented by the string <cr> in descriptions below this cannot be changed.
- All responses from the Laird Technologies device have carriage return and linefeed characters preceding and appending the response. These dual character sequences have the values 0x0D and 0x0A respectively and shall be 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 +BT**x**, where **x** is generally a mnemonic of the intended functionality.

3.3 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 (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' and 'a' to 'f'.

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 be issued to the device. The character in this escape sequence is specified in the S2 register, so 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 Section 5: Dropping Connections for more related information.

In modems this escape sequence is usually "+++". "^^^" is specified to avoid confusion when the module is providing access to a modem.

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

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 be issued 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 2.2.12)

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

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

3. AT

Used to check the module is available.

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

4. ATA {Answer Call}

Accept an incoming connection, which is indicated by the unsolicited string

<cr,lf>RING 123456789012<cr,lf> every second. 123456789012 is the Bluetooth address of the connecting device.

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

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 the default UUID from S Register 101 is used. As this is a Laird Technologies 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 will be authenticated.

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

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. Therefore if that number is exceeded, then the connection attempt will fail 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 will reset 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
Dialup 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

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

Make a connection to device with Bluetooth address <bd_addr> and 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 will be authenticated.

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

The timeout is specified by S register 505.

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

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

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 will be returned if the 'L' modifier is specified AND a Bluetooth address.

If both 'L' and 'R' modifiers are specified then an error will be returned.

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

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

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 will be returned if the 'R' modifier is specified AND a Bluetooth address.

If both 'R' and 'L' modifiers are specified then an error will be returned.

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

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

9. ATEn {Enable/Disable Echo}

This command enables or disables the echo of characters to the screen. A valid parameter value will be written to S Register 506.

E0	Disable echo.
E1	Enable echo.

All other values of n will generate an error.

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

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

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>

11. ATIn {Information}

This will return the following information about the Laird Technologies device.

I0	The product name/variant.
I1	The CSR firmware build number.
I2	The Laird Technologies firmware build number. For internal use only.
I3	The Laird Technologies firmware revision.
I4	A 12 digit hexadecimal number corresponding to the Bluetooth address of the Laird Technologies 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. Where 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 is returned as follows:- **Response:** <cr,lf>**a:b,c,d,e**<cr,lf>**OK**<cr,lf> Where 'a' = 0 when not online and 1 when online and Sniff has been enabled, 'b' is the Sniff Attempt parameter, 'c' is the Sniff timeout parameter, 'd' is the minimum sniff interval and 'e' is the 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 connectable and/or discoverable where the lowest significant digit equates to the value stored in S Register 512 or 555. **Note**: When n=16, ATI9 will return 1.

I101	The RSSI value in dBm. If a connection does NOT exist then a value of -32786 is returned. A value of 0 means the RSSI is within the golden range this is quite a large band, therefore RSSI is not always a useful indicator. Use ATI111 instead which returns the bit error rate.
I111	Returns LinkQual which in the CSR chipset is defined as BER (bit error rate). This returns a value which is the number of bits in error out of 1 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.
I333	Returns extended firmware version number.

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

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

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

12. ATO {Enter Data Mode} (letter 'o')

Return to data mode. Assume that the module is in data mode after OK is received. Responds with an error if there is no Bluetooth connection.

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

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

13. ATSn=m {Set S Register}

As with modems, the Laird Technologies Bluetooth module employs a concept of registers which are used to store parameters (such as escape sequence character and inquiry delay time) 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 are changed, the changes are **not** stored in non-volatile memory UNTIL the AT&W command is used. Note that AT&W does not affect S registers 520 to 525 or 1000 to 1010 as they are updated in non-volatile memory when the command is received.

Table 2: S Registers

Register	Default	Range	Comment
S0	1	-1..15	Number of RING indication 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 S504 to 0 and <0 forces 504 to 1. If S0 <> 0 and S100 <> 0 then S0 must be < S100. If a value is entered which violates this rule, then ERROR 29 is sent in response. If S504 =1 then this register will return -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 will in turn use '+' as default. So if both used '+' there will be confusion. 0x5e is the character '^'.

Register	Default	Range	Comment
S12	100	40..5000	Escape sequence guard time in milliseconds, with a granularity of 20ms. New values are rounded down to the nearest 20ms multiple.
S100	15	0..15	Number of RING indications before an auto disconnection is initiated. A value of 0 disables this feature. If S0 <> 0 and S100 <> 0 then S0 must be < S100. If a value is entered which violates this rule, then ERROR 29 is sent in response.
S101	$1101	0..$ffff	UUID of default SPP based profile when not specified explicitly in the ATD command.
S102	1	1..$7F	Defines a set of bits masks for enabling profile servers. Values can be ORed. 1 is Serial Port Profile 2 is Headset (S Reg 580 allows remote volume control bit to be adjusted) 4 is DUN 8 is Audio Gateway (Headset) 16 is Handsfree (S Reg 581 allows supported feature field to be adjusted) 32 is OBEX FTP 64 is Audio Gateway (Handsfree) It is recommended that due to memory resource issues, not more than 2 profiles are 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 deamon. 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

Register	Default	Range	Comment
S408	0	0..1	In Hostless Audio Gateway Operation – if set to 1 then delete trusted device database when inquiry is initiated 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 will be forced out from the UART – good for debugging
S411	500	4000	In AudioGateway Hostless mode, Short press duration in milliseconds. 500msec granularity
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 will be aborted after this amount of time, in seconds. The granularity is 30 seconds.
S420	0	1	If this is set, then the module maintains a seconds 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 will force S0 to -1 and will suppress messages arising from connections or pairing. E.g. CONNECT, NO CARRIER, RING, PAIR etc. Suppressing connection based messaged allows the Laird Technologies 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 also. Please note that as disconnection time can vary; this register only guarantees the minimum delay. Note that for invalid addresses specified in the ATD command, the “NO CARRIER” response will be immediate. See S register 560 for specifying disconnect max timeout.
S506	1	0..1	Enable/Disable echoes. The ATEn command also affects this.

Register	Default	Range	Comment
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 dropped 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 will be 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.
S508	640	10..2550	Page Scan Interval in milliseconds. Minimum is 11.25ms so 10/11ms will give 11.25ms.
S509	320	10..2550	Page Scan Window in milliseconds. Minimum is 11.25ms so 10/11ms will give 11.25ms.
S510	640	10..2550	Inquiry Scan Interval in milliseconds. Minimum is 11.25ms so 10/11ms will give 11.25ms.
S511	320	10..2550	Inquiry Scan Window in milliseconds. Minimum is 11.25ms so 10/11ms will give 11.25ms.
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 was entered. When set to 2, it will be discoverable only, similar to issuing AT+BTQ. When set to 3, it will be connectable but not discoverable e.g. AT+BTG When set to 4, it will be connectable and discoverable e.g. AT+BTP. When set to 5, it will be like 2, but all UART RX traffic is discarded in absence of a connection while DSR is asserted. If DSR is not asserted, then it behaves exactly as per mode 2. When set to 6, it will be like 3, but all UART RX traffic is discarded in absence of a connection while DSR is asserted. If DSR is not asserted, then it behaves exactly as per mode 3. When set to 7, it will be like 4, but all UART RX traffic is discarded in absence of a connection while DSR is asserted. 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 is actioned prior to the power cycle. If S Reg 554 is non-zero and this register is between 2 and 7 inclusive, then the value of S554 specifies the time in seconds that the device will remain in the specified mode after power up. On timeout, the device will fall back to the mode specified in S Register 555.

Register	Default	Range	Comment
			In modes 5, 6, 7 when all RX activity is ignored, only the special command (capitalised) AT+BT&BISM& terminated by a <cr> will force 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, SReg 565 should be set to 1. In that case, on start-up, 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.
S515	0x001F00	0.. 0xFFFFFF	Default Device Class Code to be used with AT+BTO when it is not explicitly specified. When queried, the value is always printed 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 to be 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 is used to specify 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. This parameter is reference by the AT+BTI command. If this number is set too high, then AT+BTI will return 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 is returned, then retry with a smaller value. This effective max value will remain unchanged for that particular firmware build.
S519	500	100..6000	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 100ms

Register	Default	Range	Comment
S520	Depends on device – see comments	1200..115200	Change to a standard baud rate. The effect is immediate and in fact the OK will be sent 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 is limited to 115200 The default is 9600 for Laird Technologies' BTM430 / BTM431. For the Go blue Activator variant of the module this register is read only See S Register 526 for further information.
S521	See Comment	1200.. 921600	Change baud rate to non-standard value. Laird Technologies' 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 will be returned and the old baud rate will prevail. To inspect the actual baud rate, do ATS521? S521 should only be sued for non-standard baud rates. For standard baud rates use S520. The effect is immediate and in fact the OK will be sent at the new baud rate. If S Register 525=1, then the max baud rate is limited 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 Technologies device cannot be communicated with. If this happens, there is a procedure to recover from this situation which is described in section titled "Factory Default Mode" The default is 9600 for the Laird Technologies Module and 115200 for other Laird Technologies 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.

Register	Default	Range	Comment
S525	See Comment	0..1	Apply multiplier of 8 to baud rate internally. This is set to 0 (disabled) by default for the Laird Technologies Module/RS-232 Adaptor/Universal RS-232 Adaptor, and set to 1 (enabled) by default for the Laird Technologies PC Card. It is required in the PC Card because the UART chip on the PC Card is driven by a 14.7456MHZ crystal instead of 1.8432MHz. 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 then 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.
S526	3	1..3	This register specifies a 2 bit mask used to qualify how S Registers 520 to 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 is stored in non-volatile memory. For example, to change comms parameters, 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 is rounded down to the nearest 100ms. See S Register 505 and 543 also
S531	0	0..5	Specifies the mode on connection establishment. 0 = Normal, that data is exchanged between UART and RF 1 = LOCAL_COMMAND. UART input is parsed by the AT interpreter and RF data is discarded 2 = REMOTE_COMMAND. RF input is parsed by the AT interpreter and UART data is discarded. If S Reg 536 is not 1 then this register cannot be set to 2 and an ERROR will be returned 3=LOCAL_COMMAND. UART input is parsed by the AT interpreter and incoming RF data is sent 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 section 9.5 for more details. 5=DEAMON mode
S532	0	0..7	If non zero, then on every connection, a SCO channel (audio) will be initiated. Bit 0 for HV1, Bit1 for HV2 and Bit2 for HV3. When the connection is lost, the SCO channel disappears along with it.

Register	Default	Range	Comment
S533	1	0..2	If set to 1, then GPIO5 follows RI state, if set to 2 then it follows the state of DSR and if 0 it is not driven and GPIO5 is available as a user I/O. This register will not necessarily be effective immediately after changing the value. It must be saved to non-volatile memory using AT&W and will 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 will blink. This register will not necessarily be effective immediately after changing the value. It must be saved to non-volatile store using AT&W and will 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 will be sent to the host after the time specified here
S536	0	0..1	When set to 1, a remote device can 'capture' the AT parser of this unit by it sending this module an escape "!!!" sequence. The inter character timing is set via S Register 12. If S Register 507 is >= 2, then reading this register will always return 0 and writing 1 will result in ERROR 33.
S537	X	X..X	This register is no longer available – see 551,552,553 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 is automatically saved 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 are discarded if DSR is deasserted.
S540	0	0 48..127	Sets the MTU in L2CAP configuration negotiations. The value of 0 is a special value which is taken to mean that the current value should remain.
S541	6	-50..6	This 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.

Register	Default	Range	Comment
S543	0	0..1	If this is set to 1, then incoming pairing attempts will be 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 is automatically set as the peer address for automatic connections (as if an explicit AT+BTR command was entered). See S Register 505 and 530 also
S544	1	0..1	Configure the UART for either low latency or maximum throughput. A setting of 1 gives maximum throughput.
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 be exchanged 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 then 1 if DCD is asserted otherwise 0 3 If RI (pin 6) is output then always 0 If RI is input then 1 if RI is asserted otherwise 0 If DSR (pin 10) is asserted 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 will cause the Bluetooth connection to be dropped. If bits 0..3 and 4..7 are set to 0, then some Bluetooth devices will use that as a signal to stop sending any data back. For example, Nokia 6310 stops responding. If this register is changed while in command and connected mode, then on going back online using the ATO command, a fresh signal will be sent to the peer to update the bits.

Register	Default	Range	Comment
S552	0x0122	0x0FFF	This register specifies in each 4 bit nibble, how the DTR, DCD, RI output pins are controlled 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 is changed while in command and connected mode, then on going back online using the ATO command, the modem output lines will get refreshed.
S553	0x0201	0x0FFF	This register specifies in each 4 bit nibble, how the DTR,DCD,RI output pins are controlled 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 is being sent to the host The default for the Universal RS-232 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 will stay in the S512 mode after power up or reset. On timeout, it will abort the discoverable and/or connectable and fall back into S512=1 mode, when it is deaf and dumb. Note that if AT+BTR has been used to specify a peer device, then on reverting to mode 1, it will attempt to make a connection to that peer device. A power cycle, reset via BREAK or ATZ is required to see the effects of change.

Register	Default	Range	Comment
S555	1	1..7	If S Register 554 is nonzero, then after the post reset window expires, the mode will revert to the mode specified in this register. This allows, for example, 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 be configured as an input). For this feature to be active, SReg 565 should be set to 1. In that case, on start-up, 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, bits2 to 7 contain information as follow:- 1 :- ADC1 2 :- ADC2 3 :- GPIO1 to GPIO6 – see section 3.11 Known Issues Set to 0 to disable this feature. This allows i/o information to be conveyed without a connection.
S557	32	4..900	Specified in seconds, the update interval for the feature enabled via S Reg 556
S558	0	0..1	When 1, the following responses; "RING", "NO CARRIER" and "CONNECT" are replaced by "BTIN", "BTDOWN" and "BTUP" respectively. This will eliminate 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 confirmation (from the peer device and/or the underlying stack) that the connection has been successfully torn down. There can be instances where a confirmation does not arrive and so in this case this timer is used to 'close off' the procedure and put the state machine back into a proper mode for new operations. Time is specified with 15 seconds intervals.

Register	Default	Range	Comment
S561	0	0..1000	Sniff Attempt Time in units of milliseconds. 0 means disable. See section "Power Consumption and Reset" 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 is configured as an input and forces the start-up mode (SReg512) and post-timeout on Start-up mode (SReg555) to be dependent 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 is asserted then this is the mode the device will start up in.
S567	1	7	If S565=1, and RI is deasserted then this is the mode the device will start up in.
S568	1	7	If S565=1, and RI is asserted then this is the mode the device will assume after the post-start-up timeout defined in SReg 554 instead of mode defined in SReg555
S569	1	7	If S565=1, and RI is deasserted then this is the mode the device will assume after the post-start-up timeout defined in SReg 554 instead of mode defined in SReg555
S580	0	0..1	Remote volume control feature for Headset profile when ATS102 enables headset profile
S581	0	0..63	Lowest 6 bits of the Supported features field for Handsfree profile when ATS102 enables handsfree profile. See also 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)

Register	Default	Range	Comment
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 then set the new value and 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 percentage (rounded to the nearest multiple of 4)
S588	0	0..1	After a disconnection, there will be a cold reset
S589	8	0..F	Codec output gain
S590	1	0..3	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 -– see section 3.11 Known Issues
S592	0	0..1	Set this to 1 to reduce the trusted device database to just 1 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
S598	0	0..1	In hostless audio gateway serviced mode, if this is 1, then incoming voice calls will be reflected to bonded headset
S599	0	0..2	Sco control for hostless gateway operation. 0 for normal, 1 for as early as possible, 2 leave 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 will initialise it to a certain value
S601	0	0..1	If this is 1, then on reset S Reg 600 value will be incremented.
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 – see the Known Issues section.

Register	Default	Range	Comment
S611	0	1	Set to 1 to invert the logic of GPIO outputs. For example, ATS621=1 will set the output pin to low and vice versa – see the Known Issues section.
S620	n/a	0..31	Read/Write to all 8 Digital lines in one atomic step. The value is returned 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 – see the Known Issues section.
S626	n/a	0..1	Read/Write to GPIO6 – see the Known Issues section.
S627	n/a	0..1	Read/Write to GPIO7 – see the Known Issues section.
S628	n/a	0..1	Read/Write to GPIO8
S629	n/a	0..1	Read/Write to GPIO9 – Not available in BTM430 / BTM431
S631	n/a	0..65535	When GPIO1 is configured 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 is configured 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 will reset the count to 0.
S642	n/a	0..65535	As per 632, but the action of reading the value will reset the count to 0.
S701	n/a	0..65535	Read/Write to Analogue Line 0, when reading value is returned in decimal. – Not available in BTM430 / BTM431
S702	n/a	0..65535	Read/Write to Analogue Line 1, when reading value is returned in decimal. – Not available in BTM430 / BTM431
S711	n/a	0000..FFFF	Read/Write to Analogue Line 0, when reading value is returned in hexadecimal. – Not available in BTM430 / BTM431
S712	n/a	0000..FFFF	Read/Write to Analogue Line 1, when reading value is returned in hexadecimal. – Not available in BTM430 / BTM431
S721	0	0	Set direction of Analogue Line 0. – Not available in BTM430 / BTM431
S722	0	0	Set direction of Analogue Line 1. Not available in BTM430 / BTM431
S1001 to S1010		0.. 2^32	10 General Purpose 32 bit Registers for use by host. These are stored in non-volatile memory.

14. ATSn? {Read S Register Value}

This will return 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>

15. ATSn=? {Read S Register – Valid Range}

This will return 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>

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

This command is used to send 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 will be converted into a single byte before transmission to the peer.

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

17. ATY<string> {Send Data in Local Command and Connected Mode}

This command is similar to ATX in syntax and functionality, except that the string is only copied to the output RF buffer. Only when an empty string is presented will all pending data in the output RF buffer be flushed 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 will be converted into a single byte before transmission to the peer.

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

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

Forces the device through a hardware reset which means it will eventually come 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 for about 2 seconds for the device to start responding to AT commands again. The best way of determining that the device is alive again, is to keep sending it AT<cr> until it responds with an OK response. Post 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 –