



BlueMod+S42M AT Command Reference

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DOCUMENTATION

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APPLICABILITY TABLE

PRODUCTS

- BLUEMOD+S42M
- BLUEEVA+S42M

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1. INTRODUCTION

1.1. Scope

This document specifies the command interface for the BlueMod+S42M firmware.

1.2. Audience

This document is intended for Telit customers, especially system integrators, about to implement Bluetooth modules in their application.

1.3. Contact and Support Information

For general contact, technical support services, technical questions and report documentation errors contact Telit Technical Support at:

- TS-SRD@telit.com

Alternatively, use:

<https://www.telit.com/contact-us>

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

<https://www.telit.com>

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

1.4. Text Conventions



Danger – This information **MUST** be followed or catastrophic equipment failure or bodily injury may occur.



Caution or Warning – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.



Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.5. [Related Documents](#)

- [1] BlueMod+S42M Hardware User Guide, 1VV0301379
- [2] BlueMod+S42M Software User Guide, 1VV0301391
- [3] Bluetooth Core Specification Version 4.2
- [4] UICP+ UART Interface Control Protocol, 30507ST10756A

2. FEATURES

The BlueMod+S42M supports AT command mode.

In the factory-default configuration the BlueMod+S42M is set to AT command mode using a UART baud rate of 115,200 bps, 8 data bits, no parity, 1 stop bit (8N1) and hardware flow control.

2.1. AT Command Mode

Each command line consists of a prefix, a body and a terminator.

All command lines begin with the prefix AT (ASCII 065, 084) or at (ASCII 097, 116).

The body is a string of characters in the ASCII range 032-255. Control characters other than <CR> (carriage return; ASCII 013) and <BS> (back space; ASCII 008) in a command line are ignored.

Note: The control characters are configurable via S registers.

- Carriage return character (CR) S3 register
- Line feed character (LF) S4 register
- Back space character (BS) S5 register

The terminator is <CR>.

There is no distinction between upper-case and lower-case characters. A command line can have a maximum length of 128 characters. It is automatically discarded if the input is longer. Corrections are made using <BS>. Multiple commands on the same command line are not allowed.

Commands have the following syntax:

Syntax	Description
AT<command>=<value><CR>	Write the value of the command
AT<command>?<CR>	Read the value of the command



Exceptions of this syntax are marked separately.

Responses are sent back to the host and can be any of the following:

Responses	Description
<CR><LF>value<CR><LF>	Current value
<CR><LF> list entry 1<CR><LF> list entry 2<CR><LF> ... list entry n<CR><LF> <CR><LF>	List value (e.g. AT+BNDLIST)
<CR><LF>OK<CR><LF>	Successful final message
<CR><LF>ERROR<CR><LF>	Error message, command not supported

2.2. Escape Sequence

To enter the command mode during an active data connection the following sequence (escape sequence) can be used:

<delay time ¹><+><+><+><delay time>

The time interval between each of the three plus signs must not exceed 1 second. The escape sequence remains transparent to the remote device.



The escape sequence character is configurable via S2 register.

2.3. Connection Establishment Procedure

On a peripheral, 200 ms after an incoming connection establishment the peripheral will check if the used connection parameters are compatible with the parameters AT+LECONINTMIN, AT+LECONINTMAX and AT+LESLAVELAT. If the parameters are not compatible, the peripheral will update the connection parameters automatically to the configured parameters. The connection supervision timeout used by automatic parameter update is calculated due to conform to the Bluetooth core spec. If connection parameter update fails, the peripheral retries the connection parameter update. The maximum number of attempts is 3 and the time between the retries is 5 seconds.

2.4. Hangup

All active data connections will be disconnected at once by setting the HANGUP pin (GPIO4) to high level.

¹ Delay time defined in the S12 register (see page 27)

3. COMMAND SUMMARY

The description of the commands is structured into the following parts:

- General commands
- Bluetooth Low Energy (BLE) specific commands
- Generic Attribute Profile (GATT) specific commands

The factory-default values of the commands are marked using the bold letter format.

3.1. General

%B	Baud Rate
----	-----------

AT syntax: **AT%B<value>**

This command determines the baud rate for the UART.

The following standard baud rates are supported:

Value	Description
4	9,600 bps
5	19,200 bps
6	38,400 bps
7	57,600 bps
8	115,200 bps
9	230,400 bps
22	460,800 bps
23	921,600 bps

Additionally, to the standard baud rates described above, it is possible to set the following baud rates.

Value	Description
1200	1,200 bps
2400	2,400 bps
4800	4,800 bps
9600	9,600 bps
14400	14,400 bps
19200	19,200 bps
28800	28,800 bps
38400	38,400 bps
57600	57,600 bps
76800	76,800 bps
115200	115,200 bps
230400	230,400 bps
250000	250,000 bps
460800	460,800 bps
921600	921,600 bps
1000000	1,000,000 bps

To set a baud rate write the desired value in the command.

Examples:

AT%B9	Set baud rate to 230,400 bps
AT%B250000	Set baud rate to 250,000 bps



Information regarding the deviation of the real baud rate to the value set can be found in the *BlueMod+S42M Hardware User Guide [1]*.

&F Load Factory Defaults

AT syntax: **AT&F<value>**

The factory-default values will be loaded. For storing values in non-volatile memory, use the **AT&W** command.

Value	Description
0	Set all parameters except bndlist to factory defaults
1	Set all parameters to factory defaults



Some restored values require an additional reset to get active (e.g. AT+LETIO, AT+UICP).

&W Store Active Configuration

AT syntax: **AT&W**

The active configuration is stored in non-volatile memory.

A Accept Incoming Call

AT syntax: **ATA**

This command is supported for compatibility reasons only. A Bluetooth low energy device has to answer every connection automatically. See also register S0 description.

+BIOCAP SSP I/O Capabilities

AT syntax: **AT+BIOCAP=<value>**

This command sets the input and output capabilities of the device used for SSP.

Value	Description	Related commands	Related events
0	Display only	n.a.	SSPPIN
1	Display Yes/No	+BSSPCONF (secure connection)	SSPPIN (LE legacy pairing) SSPCONF (secure connection)
2	Keyboard only	+BSSPPIN	SSPPIN
3	No input no output	n.a.	n.a.
4	Display and keyboard	+BSSPPIN (LE legacy pairing) +BSSPCONF (secure connection)	SSPPIN (LE legacy pairing) SSPCONF (secure connection)

+BMITM	SSP Man in the Middle Protection
---------------	---

AT syntax: **AT+BMITM=<value>**

This command controls the man in the middle (MITM) protection of the device during SSP. It must be set in context with **AT+BIOCAP** command. In SSP there are scenarios where MITM protection is not possible.

Value	Description
0	Man in the middle protection disabled
1	Man in the middle protection enabled

In case the user choose a scenario where MITM protection is not possible but one of the communication devices is configured to **AT+BMITM=1** (MITM protection enabled), the pairing is refused.

For possible combinations of I/O capabilities and the possibility of MITM protection/authentication level see command **BIOCAP** and the *BlueMod+S42M Software User Guide [2]*.

+BNAME	Local Device Name
---------------	--------------------------

AT syntax: **AT+BNAME=<name>**

This command allows the modification of the local device name. The device name is shown on a remote Bluetooth device during device/service discovery. It is limited to 19 characters. The device name can contain a format element to include the device's own address or parts of it in the name.

In BLE advertising the name is truncated to the first 19 characters.

Format: "%[<s>][<d>]a"

"%"	Identifier start format element
<s>	Character separator on byte order (optional)
<d>	Number (1-12) of digits included in device name (optional, default is 4)
"a"	Identifier end format element

Examples: Device address = "0123456789AB"

AT+BNAME=BM+S42M/SRV %4a	Display on remote end: BM+S42M/SRV 89AB
AT+BNAME=BM+S42M/SRV %4a	Display on remote end: BM+S42M/SRV 89AB
AT+BNAME=BM+S42M/SRV %:3a	Display on remote end: BM+S42M/SRV 9:AB
AT+BNAME=BM+S42M/SRV %3a	Display on remote end: BM+S42M/SRV 9AB
AT+BNAME=BM+S42M/SRV %:12a	Display on remote end: BM+S42M/SRV 01:23:45:67:89:AB

+BNDDEL Delete Bonding Information

AT syntax: **AT+BNDDEL=<value>**

This command deletes the bonding information stored by the BlueMod+S42M.

Value	Description
Bluetooth address	Delete the bond of the device with specified address from the bonded-device list
*	Delete all bonded devices from the bonded-device list



This command can only be executed while not connected.

+BNDLIST Show Bonded Device List

AT syntax: **AT+BNDLIST**

This command shows information about the devices bonded with the BlueMod+S42M.

Each entry in the bonded-device list contains the Bluetooth address and the link type (see chapter 4.2).

Example:

AT+BNDLIST	0080254800DA 0x02 9C04EB06ACA2 0x03 OK
------------	--

+BOAD	Bluetooth Own Device Address
--------------	-------------------------------------

AT syntax: **AT+BOAD**

This command reads the Bluetooth devices' own device address.



This command is read only.

+BPAIRMODE	Configure Pairable Mode
-------------------	--------------------------------

AT syntax: **AT+BPAIRMODE=<mode>**

This command controls the pairable mode of the BlueMod+S42M.

When set to "0" the module is only connectable for clients stored in the local bondlist. New pairing requests will be rejected.

Mode	Description
0	No pairing allowed, BlueMod+S42M advertises TIO as "functional"
1	Pairing allowed, BlueMod+S42M advertises TIO as "bondable and functional"



This command restricts the access only to security enabled characteristics.

For Terminal I/O this means AT+LETIO has to be set to a value different than 0 or 2.

For the GATT Server the permission parameters of the command AT+LEATTRIB have to be set to a value that requires authentication (e.g. "AT+LEATTRIB=charval,uuid=2A19,perm=0022,len=1" with "perm" for read with authentication permitted and write with authentication permitted).

+BSSPCONF Security Pairing Confirmation

AT syntax: **AT+BSSPCONF <Bluetooth address>,<address type>,<value>**

If a pairing is initiated and LE secure connection is supported, depending on the security settings AT interface generates an event SSPCONF and asks the user for confirmation.

Event: SSPCONF <Bluetooth address>,<address type> <passkey> ?

The user must confirm the passkey with the above command. If no confirmation is sent by the user within the bonding timeout or in case of active reject, the pairing is rejected with NO CARRIER message.

Value	Description
0	Reject passkey confirmation request
1	Accept passkey confirmation request

Example:

SSPCONF 00802507C08D,t2 794851 ? AT+BSSPCONF 00802507C08D,t2,1 OK	Receive SSP pairing request Send SSP pairing confirmation
RING	
CONNECT	

+BSSPPIN SSP Passkey Response

AT syntax: **AT+BSSPPIN <Bluetooth address>,<address type>,<SSP passkey>**

If an authentication is initiated, depending on the I/O capabilities (**AT+BIOCAP**) the AT interface generates an event SSPPIN and asks the user for the SSP passkey.

Event: SSPPIN <Bluetooth address>,<address type> ?

The user must answer this request with the SSP passkey displayed on the remote device.

Example:

SSPPIN 00802507C08D,t2 ? AT+BSSPPIN 00802507C08D,t2,314546 OK	Receive SSP passkey request Send SSP passkey response
RING	
CONNECT	

+DFUMODE	Firmware Update
-----------------	------------------------

AT syntax: **AT+DFUMODE=<value>**

This command is used to set the device into firmware update mode.

For further information, see *BlueMod+S42M Software User Guide [2]*.

Value	Description
1	Sets device to serial firmware update mode
2	Sets device to Over the Air (OTA) firmware update mode

+DFUSTART	Start Bootloader
------------------	-------------------------

AT syntax: **AT+DFUSTART**

This command sets the device into the configured firmware update mode.

Note: OTA update time should not exceed 2 minutes.

E	Local Echo
----------	-------------------

AT syntax: **ATE<value>**

This command selects the local echo in command mode.

Value	Description
0 or empty	No local echo
1	Local echo on in command phase

H	Disconnect
----------	-------------------

AT syntax: **ATH**

This command disconnects the existing Bluetooth connection.

I	Display Version Information
----------	------------------------------------

AT syntax: **ATI<value>**

Displays different information about version number and settings.

Value	Description
0 or empty	Returns the device name (e.g. "BM+S42M/SRV %4a")
1	Returns "0"
2	Returns "OK"
3	Returns the version string: "V1.xyz"
4	Returns the manufacturers name: "Telit"
5	Returns "ERROR"
6	Returns the copyright string: "(c) Copyright Telit"
7	Returns "OK"
8	Returns "ERROR"
9	Returns "OK"
77	Returns patch versions and sensor configuration
99	Returns the detailed firmware version

+IOACFG**Config of Pin IOA**

AT syntax: **AT+IOACFG=<value>**

This command configures the function of the IOA pin (GPIO8). GPIO8 can be configured as output signal "Device Ready". The signal is low active, a low level shows the device ready to process commands and establish Bluetooth connections after startup.



Early engineering hardware samples uses GPIO2 instead of GPIO8.

Value	Description
0	Disconnected (no function, lowest power consumption)
1	Output: Signal "Device Ready"

+IOBCFG**Config of Pin IOB**

AT syntax: **AT+IOBCFG=<value>**

This command configures the function of the IOB pin (GPIO3). GPIO3 can be configured as output signal "Data Carrier Detect" (DCD). The signal is low active. A low-level signals

that the device is connected on Terminal I/O level to a remote device. In addition, the IOB pin can be configured as output signal which can be controlled via BLE.

Value	Description
0	Disconnected (no function, lowest power consumption)
1	Output: Signal "DCD"
2	Output: Low level if a lower layer connection is active
3 ^{*)}	Output: Remote switchable via BLE characteristic. Low level if a '1' will be write on this characteristic. This characteristic with the UUID: 00000005-0000-2000-8000-008025000000 can be found in the Environmental Sensing Profile of BlueMod+S42M

^{*)} Supported since firmware version 1.02

To activate a new value, it is necessary to store the settings (**AT&W**) and perform a reset (**AT+RESET**).

+LOAD Load Stored Parameter Setting

AT syntax: **AT+LOAD**

This command loads all parameters stored in non-volatile RAM.

O Return to Online State

AT syntax: **ATO**

If the BlueMod+S42M is in command mode after issuing an escape sequence while a connection is active, **ATO** returns the BlueMod+S42M to data mode.

+PNPPID PnP Product ID

AT syntax: **AT+PNPPID=<value>**

This command sets the product ID provided in the device information service (DIS). The format is a 16-bit hex value. The default value depends on the hardware configuration:

- 0xB019 = Telit product ID for BlueMod+S42M peripheral firmware
- 0xB01A = Telit product ID for BlueMod+S42M peripheral with sensors firmware

To activate a new value, it is necessary to store the settings (**AT&W**) and perform a reset (**AT+RESET**).

+PNPPVER	PnP Product Version
-----------------	----------------------------

AT syntax: **AT+PNPPVER=<value>**

This command sets the product version provided in the device information service (DIS). The format is a 16-bit hex value. The default value is the version number of the Telit BlueMod+S42M firmware, e.g. 0x0100 for firmware version 1.00.

To activate a new value, it is necessary to store the settings (**AT&W**) and perform a reset (**AT+RESET**).



After setting the vendor ID (AT+PNPVID) to a different value than the default 0x008F the user has to set his own product version (otherwise the value 0x0100 will be used).

+PNPVID	PnP Vendor ID
----------------	----------------------

AT syntax: **AT+PNPVID=<value>**

This command sets the vendor ID provided in the device information service (DIS). The format is a 16-bit hex value. The default value is 0x008F (Telit vendor ID).

To activate a new value, it is necessary to store the settings (**AT&W**) and perform a reset (**AT+RESET**).

+PNPVSRC	PnP Vendor ID Source
-----------------	-----------------------------

AT syntax: **AT+PNPVSRC=<value>**

This command sets the vendor ID source provided in the device information service (DIS).

Value	Description
1	Bluetooth SIG assigned company ID
2	USB assigned company ID

To activate a new value, it is necessary to store the settings (**AT&W**) and perform a reset (**AT+RESET**).

Q	Suppress Results
----------	-------------------------

AT syntax: **ATQ<value>**

This command allows/suppresses result codes and messages.

Value	Description
0 or empty	Enable result messages after command input
1	Suppress result messages after command input

+RESET	Reset Device
---------------	---------------------

AT syntax: **AT+RESET**

This command resets the whole functionality of the BlueMod+S42M by a forced hardware reset (like power off/on).

+RFMAXTXPWR	Maximum Output Power
--------------------	-----------------------------

AT syntax: **AT+RFMAXTXPWR=<value>**

This command sets the maximum output power of the Bluetooth radio of the device. A changed value becomes active immediately.

Value	Description
6	0 dBm
0	-40 dBm (whisper mode)

+RBMA	Read BMA Sensor
--------------	------------------------

AT syntax: **AT+RBMA**

This command reads the BMA Sensor and prints the acceleration values in the X, Y, and Z axes respectively.

The G-Force values of the X, Y, and Z axes are printed in sequence separated by space.



This command is read only.

Example:

Command	Response	Description
AT+RBMA	0.02 0.01 1.04 OK	The values of BMA sensor are: X=0.02 g Y=0.01 g Z=1.04 g

+RHDC Read HDC Sensor

AT syntax: **AT+RHDC**

This command reads the HDC sensor and prints the values of Temperature, Humidity, Temperature Max, and Humidity Max respectively. The values of Temperature and Temperature Max are in degree centigrade (°C) whereas, the values of Humidity and Humidity Max are relative humidity values (%).



This command is read only.

Example:

Command	Response	Description
AT+RHDC	30.39 30.46 35.95 31.29 OK	The values of HDC sensor are: Temperature=30.39 °C Humidity=30.46 % Temperature Max=35.95 °C Humidity Max=31.29 %

S ATS Register

AT syntax: **ATSx=<value>**

This command configures the S register settings.

Mode	Description
Sx?	Show the current setting of register Sx
Sx=1	Set register Sx to 1

AT command S register set (all values in decimal format):

Register	Value	Description
S0	1	Immediate call acceptance <i>Note: Setting of S0 only allow value 1 for BLE. In case of BLE connections always one RING is signalized and automatic call acceptance is set.</i>
S2	43	Character for escape sequence
S3	13	Carriage-return character
S4	10	Line-feed character
S5	08	Backspace character
S12	100	Delay time by using the escape sequence in 10 ms increments

+SYSTEMOFF Enter System Off Mode

AT syntax: **AT+SYSTEMOFF**

This command sets the module into low power mode during the time the module is not used. The module will restart on GPIO activity. The host can use the IOA pin to monitor the system status.

Possible use cases and an usage example are described in the *BlueMod+S42M Software User Guide [2]*.

+UICP Set UART Interface Control Protocol

AT syntax: **AT+UICP=<mode>**

This command sets the mode of the UART Interface Control Protocol (UICP [4]).

To activate UICP, it is necessary to store the settings and perform a reset.

Mode	Description
0	UICP off
1	UICP on

This command activates UICP immediately.

V Result Message Format

AT syntax: **ATV<value>**

This command determines the format of the result messages.

Value	Description
0 or empty	Result message is presented numerically (followed by <CR>)
1	Result message is presented as text

W	Extended Result Codes
---	-----------------------

AT syntax: **ATW<value>**

This command enables/disables extended result codes.

Value	Description
0 or empty	Result message is presented without extended result codes
1	Result message is presented with extended result codes (include error causes)

3.2. Bluetooth Low Energy

+LEFIXPIN Fix PIN for Pairing Procedure

AT syntax: **AT+LEFIXPIN=fixpin**

This command specifies a 6-digit fixpin, to be used for the security procedure. If this value has a length of 0 (no digit specified in command) “**AT+LEFIXPIN=**” a randomly generated PIN is used. The default is a fixpin with length 0. To use this feature, see also commands **AT+LETIO**, **AT+BIOCAP**. The command **AT+BIOCAP=0** must be used before using a fixpin is allowed.

For further information, see *BlueMod+S42M Software User Guide* [2].

Parameter	Description
fixpin	6 digits pin value e.g. “000000” (digit 0..9 only) (default is 0 length pin ””)

+LEADINTMAX Maximum Advertising Interval

AT syntax: **AT+LEADINTMAX=<value>**

This command configures the maximum advertising interval (in milliseconds) for a Bluetooth Low Energy Peripheral.

Value	Description
$n=20\dots10240$	Use maximum advertising interval of n ms
1280	Use maximum advertising interval of 1280 ms



Make sure that the value of AT+LEADINTMAX is higher or equal the value of AT+LEADINTMIN.

+LEADINTMIN Minimum Advertising Interval

AT syntax: **AT+LEADINTMIN=<value>**

This command is not used in the BlueMod+S42M. It is just provided for compatibility reasons. The used advertising interval is set by **AT+LEADINTMAX** parameter.

+LECONINTMAX Maximum Connection Interval

AT syntax: **AT+LECONINTMAX=<value>**

This command configures the maximum connection interval for a Bluetooth Low Energy connection. The unit is in 1.25 milliseconds timeslots.

Value	Description
$n=6\dots3200$	Use maximum connection interval of $n * 1.25$ ms
32	Use maximum connection interval of 40 ms



Make sure that the value of AT+LECONINTMAX is higher or equal the value of AT+LECONINTMIN.

+LECONINTMIN Minimum Connection Interval

AT syntax: **AT+LECONINTMIN=<value>**

This command configures the minimum connection interval for a Bluetooth Low Energy connection. The unit is in 1.25 milliseconds timeslots.

Value	Description
$n=6\dots3200$	Use minimum connection interval of $n * 1.25$ ms
16	Use minimum connection interval of 20 ms



Make sure that the value of AT+LECONINTMAX is higher or equal the value of AT+LECONINTMIN.

+LECONPARAM Connection Parameter Handling

AT syntax:

AT+LECONPARAM=connHnd,[connIntMin],connIntMax,slaveLat[,connTimeout]
AT+LECONPARAM?connHnd

The command “AT+LECONPARAM” used with “=” requests new connection parameters to be used for the connection defined by connHnd.

The command “AT+LECONPARAM” used with “?” shows the active connection parameters used by the connection defined by connHnd. A LECONPARAM event is generated containing the active connection parameters.



If the device does not support a connection handle in the CONNECT message use 0x00 as fix value for connHnd.

The connection establishment procedure is described in chapter 2.3.

The parameter connIntMin is mandatory.

The new connection parameters are signaled by event LECONPARAM.

The result is OK or ERROR.

+LECPEVENT Enable LECONPARAM Event Signaling

AT syntax: **AT+LECPEVENT=<enable>**

This command enables/disables the automatic signaling of LECONPARAM events.

enable	Description
0	Disable automatic LECONPARAM event signaling
1	Enable automatic LECONPARAM event signaling

The result is OK or ERROR.

+LEROLE Bluetooth Low Energy Device Role

AT syntax: **AT+LEROLE=<value>**

This command configures the Bluetooth Low Energy role of the device.

Value	Description
0	Set device role to “Peripheral”

When set to “Peripheral” (default), the device advertises and accepts incoming BLE connections.

+LETIO Enable Terminal I/O Service

AT syntax: **AT+LETIO=<value>**

This command controls the Terminal I/O service. If set to 0 the Terminal I/O service is disabled. To activate the change, it is necessary to store the settings (**AT&W**) and perform a reset (**AT+RESET**).

Value	Description
0	Terminal I/O service disabled (no advertising, no characteristics)
1	Terminal I/O service enabled, security is required with encryption (no MITM)
2	Terminal I/O service enabled, no security (authentication or encryption) required
3	Terminal I/O service enabled, authenticated pairing with encryption (MITM required)
4	Terminal I/O service enabled, authenticated LE secure connections pairing with encryption (MITM required, LE secure connections required)

The valid sequence to change the setting is:

AT+LETIO=1

AT&W

AT+RESET

+LEADDATA Setup Advertise Data for Customized Advertising

AT syntax: **AT+LEADDATA=<value₁> .. <value_k>**

This command is used to setup the advertise data for a customized advertising.

Value_k represents an octet in hexadecimal format, $k \leq 31$.

The coding of the data is according to the *Bluetooth 4.2 Core Specification / Vol. 3, Part C, Chapter 11 and 18 (Length/Type/Value coding)* [3].

Example:

AT+LEADDATA=02010603020F18	Set flags + UUID of battery service
----------------------------	-------------------------------------

+LEADE Enable Customized Advertising

AT syntax: **AT+LEADE=<value>**

This command controls the advertising behavior.

With **AT+LEADE=0** only the build in Terminal I/O service is advertised.

With **AT+LEADE=1** only the customized advertising value is advertised.

With **AT+LEADE=3** the module stops all advertising. With disabled advertising the client (e.g. iPhone) is not able to discover the device or to connect to the device. This should only be done when the service is not in use to save battery power.

With disabled internal TIO due to **AT+LETIO=0**, the values 0 and 3 show the same behavior. There will be no advertising and no connection.

Value	Description
0	Customized advertising disabled, internal TIO advertising enabled
1	Customized advertising enabled, internal TIO advertising disabled
2	Reserved for future use
3	Advertising off, customized advertising disabled, internal TIO advertising disabled

+LEADPAR Setup Parameters for Customized Advertising

AT syntax: **AT+LEADPAR=par₁=<value₁>[, .. [,par_n=<value_k>]]**

This command is used to setup parameters for a customized advertising.

par _n	value _k
advtype	Type of advertising: 0: undirected (default)
Optional	2: scannable
Coding: decimal.	3: non-connectable

This command is optional, if not submitted these defaults apply:

- advtype = 0 - advertising type “undirected”



The values for the minimum and maximum of the advertising interval may be set with the AT+LEADINTMIN and AT+LEADINTMAX commands.

Example:

AT+LEADPAR=ADVTYPE=0	Set type of advertising “undirected”
----------------------	--------------------------------------

+LESCDATA Setup Scan Response Data for Customized Advertising

AT syntax: **AT+LESCDATA=<value₁> .. <value_k>**

This command is used to setup the scan response data for a customized advertising.

Value_k represents an octet in hexadecimal format, $k \leq 31$.

The coding of the data is according to the *Bluetooth 4.2 Core Specification / Vol. 3, Part C, Chapter 11 and 18 (Length/Type/Value coding) [3]*.

Example:

AT+LESCDATA=03020F18	Set UUID of battery service
----------------------	-----------------------------

3.3. GATT

3.3.1. GATT Server Definition

+LEATTRIB Define Attributes for a Service

AT syntax: **AT+LEATTRIB=<type>[,par₁=<value₁>[, .. ,par_n=<value_k>]..]**

This command is used to define attributes for one or more services in the GATT server. The maximum number of services and characteristics depends on the used features. Every combination results in a different number of possible service and characteristic combinations. The maximum number of possible characteristics is limited to 20. This restriction results from the limited size of the internal definition array. If the space is completely used the command "AT+LEATTRIB=charval,..." returns "ERROR".

The GAP and GATT services that each GATT server must expose are built-in services in the BlueMod+S42M and thus shall not be defined by the application!

The presence of parameters par_1, \dots, par_n depends on the value of $\langle type \rangle$:

type	par ₁	par ₂	par ₃	par ₄
pserv	uuid=<16/128bit UUID>			
Mandatory	Mandatory Coding: hexadecimal.			
char	prop=<properties>			
Mandatory	Mandatory Coding: hexadecimal. <i>properties</i> may have the bitmask values <i>Read</i> , <i>Write Without Response</i> , <i>Write</i> , <i>Notify</i> and <i>Indicate</i> set. Note: internally the controller generates an additional Client Characteristic Configuration Descriptor (CCCD) attribute with permissions „readable and writable without authentication or authorization“ if bits <i>Notify</i> or <i>Indicate</i> are set.			
charval	uuid=<16/128bit UUID>	perm=<permissions>	len=<length>	val=<value>
Mandatory	Mandatory Coding: hexadecimal.	Mandatory Coding: hexadecimal. 16-bit value that decodes the access permissions and authentication requirements.	Mandatory Coding: decimal. Maximum supported length is 20 bytes. A length of 0 means a variable length of the characteristic (up to 20 bytes)	Optional Coding: hexadecimal. Pre-defined characteristic value that will be loaded when the service set is activated.

type	par1	par2	par3	par4
chardcccd	perm=<permissions>			
Optional	<p>Mandatory</p> <p>Coding: hexadecimal.</p> <p>This command is needed only if a CCCD shall be generated with permissions other than „readable and writable without authentication or authorization“. See note in <i>type=char</i> description.</p> <p>CCCDs are required to be readable without authentication and required to be writable.</p>			
chardusrd	usrd=<user description>	perm=<permissions>		
Optional	<p>Mandatory</p> <p>Coding: UTF-8 string.</p> <p>User description string.</p> <p>Note:</p> <ul style="list-style-type: none"> - Since <i>Extended Properties</i> (see <i>type=char</i>, parameter <i>properties</i> description) are not supported the remote peer may not write to this characteristic descriptor. - The number of characters is limited to 13. Internally the character sequence is terminated by a zero-byte resulting in an ASCII-Z string. 	<p>Optional</p> <p>Coding: hexadecimal.</p> <p>16-bit value that decodes the access permissions and authentication requirements.</p> <p>User Descriptions are required to be readable and required to be not writeable.</p> <p>If this parameter is omitted the default <i>readable without authentication or authorization</i> applies.</p>		
complete	No parameter.			
Mandatory	Used to signal that all attribute definitions have been sent to the controller.			

The characteristic properties are coded as a hexadecimal bitmask as defined in *Bluetooth Core Spec 4.2 Volume3 Part G Chapter 3.3.1.1 [3]*.

Value	Properties
02	Read
04	Write without response
08	Write
10	Notify
20	Indicate

The values can be combined, for example read & notify result in 12.

The attribute permissions (parameter perm=<permissions>) are bit coded in a 16-bit hexadecimal value.

Bit	Value	Function
0,1	0	Read not permitted
	1	Read permitted
	2	Read with authentication permitted
	3	Read with authentication and MITM protection permitted
2,3	-	Reserved
4,5	0	Write not permitted
	1	Write permitted
	2	Write with authentication permitted
	3	Write with authentication and MITM protection permitted
6..15	-	Reserved

Example: Value for read only is 0001.

The complete service/s is/are defined through repeated submissions of the **AT+LEATTRIB** command (see example below).

The **AT+LEATTRIB** commands must be submitted in a specific order:

Definition of first service:

AT+LEATTRIB=pserv, ...

Definition of first characteristic of first service:

AT+LEATTRIB=char, ...

... optional characteristic descriptors (AT+LEATTRIB=chardxxx) ...

AT+LEATTRIB=charval, ...

Definition of second characteristic of first service:

AT+LEATTRIB=char, ...

... optional characteristic descriptors (AT+LEATTRIB=chardxxx) ...

AT+LEATTRIB=charval, ...

...

Definition of second service:

AT+LEATTRIB=pserv, ...

Definition of first characteristic of second service:

AT+LEATTRIB=char, ...

... optional characteristic descriptors (AT+LEATTRIB=chardxxx) ...

AT+LEATTRIB=charval, ...

...

...

Completion of service and characteristics definition:

AT+LEATTRIB=complete

Upon successful execution of the **AT+LEATTRIB** command with *type=charval* the device returns the data channel ID which is associated to the characteristic value.

Format: <CR><LF>0x<channel><CR><LF>

Data belonging to the characteristic value is exchanged with the AT+LESRVDATA command / LESRVDATA event.

Example:

The example below shows the Battery Service. Battery Service is a simple service which exposes the battery charging level as single characteristic value.

Command	Response	Description
AT+LEATTRIB=pserv,uuid=180F	OK	Declares the properties of the battery level value
AT+LEATTRIB=char,prop=12	OK	
AT+LEATTRIB=charval,uuid=2A19,perm=0001,len=1	0x02 OK	Declares the battery level value (one byte in the range 0,...,100). Battery level values are exchanged over channel 0x02
AT+LEATTRIB=complete	OK	Completes the service definition sequence

3.3.2. GATT Server Data Handling

+LESRVDATA GATT Server Data Exchange

AT syntax: **AT+LESRVDATA=<channel>,<hexdata>**

This command allows the user to set new data on a GATT server characteristic.

Channels are created during GATT server definition using the **AT+LEATTRIB** command. After **AT+LEATTRIB=complete**, the GATT server is ready to be used.

All data for defined characteristics is sent over the corresponding channel. If a characteristic has a length of 4, 4 bytes of data has to be sent. The only exception is a defined length of 0, which means a variable length characteristic. All data sizes between 1 and 20 are allowed.

Parameter	Description
channel	Channel ID from AT+LEATTRIB command
hexdata	ASCII coded byte stream as hexadecimal values e.g. 017aFF for a three-byte value

3.3.3. Data Handling with or without Connection

All data which is set during a connection is directly sent to the remote side if characteristic definition supports indication or notification. If indications or notifications are not supported only the local server value is updated.

All data which is set without a connection is only updated in the local server.

Only the last value written to a characteristic is stored in the local server.

With every new connection all not signaled data in the server is sent over the link if possible.

4. APPENDIX

4.1. Data Formats

4.1.1. Data Array

Data arrays are encoded as a hexadecimal ASCII based byte stream.

E.g. a Byte array containing the four bytes 0x11, 0x22, 0x33 and 0x44 is encoded as:
11223344

4.1.2. Bluetooth Address

The BlueMod+S42M supports public and random Bluetooth addresses. The differentiation between the address types is done using the parameter “t2” for public addresses and “t3” for random addresses.

A Bluetooth address value itself is a special byte array variant. There are two valid representations.

The Bluetooth addresses “**008025540203**” and **00:80:25:54:02:03** are equivalent.

E.g. public address: 00:80:25:54:02:03,t2 or 008025540203,t2
 random address: F1:B9:EB:41:D8:1E,t3 or F1B9EB41D81E,t3

4.1.3. UUID

UUIDs are special byte array variants.

16 Bit UUIDs are encoded with four hexadecimal digits.

E.g. UUID 0xFEFB is encoded as FEFB.

128 Bit UUIDs are encoded with 32 hexadecimal digits.

E.g. 00000002000010008000008025000000.

The format 00000002-0000-1000-8000-008025000000 known from the profile specifications is also supported for 128-bit UUIDs.

4.1.4. Values

A parameter value could be encoded hexadecimal or signed decimal. The value range depends on the command specification.

Hexadecimal values shall be encoded with a leading “0x” e.g. 0x01FF.

Positive decimal values shall be encoded without a leading character e.g. 512.

Negative decimal values shall be encoded with a leading “-” e.g. -69.

4.1.5. Bit Arrays

Bit arrays shall be coded as hexadecimal values with a leading “0x”.

For an example see parameter PROP in command AT+LEATTRIB.

4.2. Linktype

Linktype	Meaning
0x02	Bluetooth low energy using public address
0x03	Bluetooth low energy using random address

4.3. AT Result Codes

Result codes (numerical and verbose):

Numeric	Text	Meaning	Extended Result Codes
0	OK	Command completed	No
1	CONNECT	Connection established	Yes
2	RING	Indicates an incoming call	Yes
3	NO CARRIER	Connection disconnected	Yes
4	ERROR	Illegal command or error	No

Extended result codes (numerical and verbose) are available after activation with ATW1 command.

OK	Command Completed
----	-------------------

Syntax: OK

Command completed successfully.

CONNECT	Connection Established
---------	------------------------

Syntax: CONNECT [<bdaddr linktype>]

With this result code the user is informed about the establishment of a connection.

Parameter	Description
Bdaddr	Remote Bluetooth address, only as extended result code
Linktype	Remote Bluetooth address type see chapter Linktype, only as extended result code

NO CARRIER	Connection Disconnected
------------	-------------------------

Syntax: NO CARRIER [<errorcode>]

With this result code the user is informed about the disconnection of a connection.

Parameter	Description
errorcode	Bluetooth release code

RING Link Request Received

Syntax: RING [<bdaddr linktype>]

With this result code the user is informed about an incoming connection request.

Parameter	Description
Bdaddr	Remote Bluetooth address, only as extended result code
Linktype	Remote Bluetooth address type see chapter Linktype, only as extended result code

ERROR Illegal Command or Error

Syntax: ERROR

With this result code the user is informed about an error condition. This could be e.g.:

- an illegal command syntax
- an illegal state for the command
- an error that cannot be indicated otherwise

4.4. Release/Error Codes

Error code	Meaning
0x0000	Success
0x0001	Accept
0x0002	Reject
0x0003	Resource error
0x0004	Invalid parameter
0x0005	Invalid state
0x0006	Connection disconnect
0x0007	Connection paused
0x0008	Connection lost
0x0009	Authentication failed
0x000A	Flow control violation
0x000B	Init timeout
0x000C	Init out of sync
0x000D	Init hardware failure
0x000E	Lower layer error
0x00FD	Unspecified
0x00FE	Not supported

Examples:

AT mode	Numerical (ATV0)	3 <0006>
	Verbose (ATV1)	NO CARRIER <0006>

4.5. Events

SSPCONF SSP Passkey Confirmation

Syntax: **SSPCONF Bdaddr,tx Passkey ?**

With this event the module requests the confirmation of the passkey displayed on both devices.

Parameter	Description
Bdaddr	Remote Bluetooth address
tx	x is the remote Bluetooth address type (see chapter Bluetooth Address)
Passkey	Passkey to be acknowledged on local side (see command +BSSPCONF)

SSPPIN SSP Passkey Request

Syntax: **SSPPIN Bdaddr,tx ?**

With this event the module requests the entry of the PIN displayed on the remote device.

Parameter	Description
Bdaddr	Remote Bluetooth address
tx	x is the remote Bluetooth address type (see chapter Bluetooth Address)

SSPPIN SSP Passkey Display

Syntax: **SSPPIN Bdaddr,tx Passkey**

With this event the module shows the PIN to be entered on the remote device.

Parameter	Description
Bdaddr	Remote Bluetooth address
tx	x is the remote Bluetooth address type (see chapter Bluetooth Address)
Passkey	PIN to be entered on remote side

LECONPARAM Connection Parameters Updated

Syntax: **LECONPARAM:connHnd,connInt,slaveLat,connTimeout**

With this event the user is informed about a connection parameter update.

Parameter	Description
connHnd	Connection handle from CONNECT event
connInt	Actual connection interval in steps of 1.25 ms
slaveLat	Actual slave latency in connection intervals
connTimeout	Actual connection supervision timeout in steps of 10 ms



If the device does not support a connection handle in the CONNECT message use 0x01 as fix value for connHnd.

LESRVDATA GATT Server Data Exchange

Syntax: **LESRVDATA:<channel>,<data>**

With this event the user is informed about new data on a GATT server characteristic.

Channels are created during GATT server definition using the **AT+LEATTRIB** command. After **AT+LEATTRIB=complete**, the GATT server is ready to be used.

Parameter	Description
channel	Channel ID from AT+LEATTRIB command
hexdata	ASCII coded byte stream as hexadecimal values e.g. 017aFF for a three-byte value

5. GLOSSARY AND ACRONYMS

AT	Attention Command
GAP	Generic Access Profile
GATT	Generic Attribute Profile
SSP	Secure Simple Pairing
UART	Universal Asynchronous Receiver/Transmitter
UICP	UART Interface Control Protocol
UUID	Universal Unique Identifier

6. DOCUMENT HISTORY

Revision	Date	Changes
0	2017-06-26	First issue
1	2017-08-21	Change ATI4 response to Telit
2	2018-09-18	Added +LECONPARAM, +LECPEVENT, +PNPPID, +PNPPVER, +PNPVID, +PNPVSRC Revised description of +LEFIXPIN Revised note of +BPAIRMODE Added +IOBCFG=3 value
3	2018-11-28	Added +RBMA for reading BMA sensor, and +RHDC for reading HDC sensor
4	2019-02-21	Added +DFMODE for firmware update Added a note under +DFUSTART
5	2020-03-13	Corrected ATS command description



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