LM068

FCC ID: VVXLM068

IC: 10531A-LM068

SPP with GAP Central Application

USER GUIDE

Firmware Version: SPPC_02XX

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Revision	Date	Changes Description
v1.0	06/03/2019	Merged LM961, LM068 and LM074 manuals. Modified the content as per SPPC_0115 firmware version.
V1.2	12/03/2019	Changes for SPPC_0115 firmware. Changed the section numbering. Added support for UART FW upgrade interface.
V1.3	06/19/2019	Added changes for Version SPPC_0201.

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Firmware Revision History

Version: 0107

1. Up to Version_0106, the device will indicate the input pairing request to use and process it as per the Accept or Reject response from the user.
2. In Version_0107, this dependency is removed (like the LM048) and the device will accept all the pairing requests. The device will indicate the success or failure of the pairing procedure.

Version: 0107 – Recreated images for **Ver_0107** – 20Th June 2018

1. The images were recreated, the SPP_ESC_Sequence timeout is 2 seconds.
2. Other features are the same.
3. LM961 tested again with the LM154 test tool, passed the test successfully.
4. Added all production and OTA bin images

Version: 0108 – 29th June 2018

1. Version _0108 released for LM961/LM074 and LM068.
2. Bug fix – LM961/LM074/LM068 was not connecting to the WIN-PC after a successful pairing. The RFCOMM-Serial-Over-Bluetooth ports were not being created, and the error “device not supporting Serial service” was displayed on the PC. This was resolved by adding the default SDP record from CSR-Example-code.
3. Added production and OTA bin images for all devices.

Version: 0109 – 19th Sept 2018

1. Version _0109 released for LM961/LM074 and LM068.
2. LED Blinking was modified to be similar to the LM048 LEDs. Blue LED Blinking if Not connected. Yellow LED as LINK-Data-Transfer LED.
3. Escape sequence detection logic was also modified to be similar to the LM048.
4. Added the feature to upgrade the device name using the last two bytes of the BD-Address. Set as default True. Users can turn it OFF using the AT command AT*UpdateName=ON/OFF.
5. The name of the LM068 adapter is 068SerialADTxx, xx are the last two bytes of BD-address.

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Version: SPPC_0114 – 19th November_2018.

1. Changes for Simple Secure Pairing (SSP) pairing with dynamic-key/Passkey. As LM068/LM961/LM074 are BT4.1 device, while pairing with BT2.0 devices it uses PIN and while pairing with BT2.1 and above devices it uses DPIN/MITM/IO-Type settings.
2. By default, for pairing with BT2.1 and above devices, LM961/LM074/LM068 device will use security settings as DPIN=ON, MITM=ON, IO-Type=KB_Only (settings can be changed with AT commands).
3. By default, for BT2.0 devices, Default PIN=1234 (can be changed with AT command).
4. Minor bug fixes/improvements in classic SPP role.
5. Added AT command for UART configuration as "AT*UARTCONF=LATENCY/THROUGHPUT" and "AT*UARTCONF=?". Default setting for LMs Generic firmware is "THROUGHPUT" meaning the device will support maximum throughput over UART.

Version: SPPC_0115 – 6th December 2018.

1. Added the firmware upgrade interface as UART.
2. By connecting the LM074/Lm961/LM068 to UART on PC or micro-controller, user can put the module in upgrade mode and send the upgrade-image over UART interface.
3. AT*UPGRADEINT=?, AT*UPGRADEINT=OTA(default), AT*UPGRADEINT=UART.
4. Few Minor bug fixes.

Version: SPPC_0201 – 8Th April 2019

1. Added the patch for BT5.0 compliance for CSRB5348 chipset.
2. Minor bug fixes.
3. UpgradeINT and UARTCONF settings included in AT*Settings report, AT*Reset=2 command resets the UpgradeINT and UARTCONF settings.
4. Default Upgrade interface is UART.
5. Default UARTCONF is maximum throughput.
6. Added Command AT*STACKVER=? To check the HCI and Stack version for BT5.0 stack.

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1. Introduction

This document describes the functionality of the “SPP with GAP Central” application for the LM961 and LM074 modules, and the LM068 adapter.

In this document the firmware “SPP with GAP Central” is referred to as “SPPC_XXYY”. SPPC refers to “SPP with GAP-Central”, while XX and YY refer to the major and minor FW version numbers respectively.

The LM961, LM074 and LM068 have the same standard application, providing Bluetooth SPP and GAP Central functionality.

The LM961 and LM074 offer UART interface lines for a Host microcontroller or an external FTDI chip, whereas the LM068 is an adapter and provides a standard DB9 serial interface connector. The LM068 adapter also has a DTE/DCE selection switch, modem transfer lines etc.

In this document the term “LM device” refers to the features which are supported on the LM961 and LM074 modules, and the LM068 adapter, whereas it clearly mentions the module or adapter name if the feature is not applicable.

This document provides information about:

1. AT command Parser module of LM devices
2. Firmware version history for SPP_with_GAP_Central (SPPC_XXYY) application
3. LED indication information
4. SPP with GAP Central application specific AT commands and information
5. AT commands related to core Bluetooth functions and default configurations
6. Over the Air Firmware Upgrade procedure
7. UART interface Firmware Upgrade procedure
8. Secure simple pairing procedure

The device is a dual mode Bluetooth module or adapter with the capability for simultaneous connections to Bluetooth (v1.0 – v3.0) devices and Bluetooth low energy devices. LM Technologies supports various firmware applications on the device enabling users to develop their own applications with the help of a rich AT command set.

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2. Functionality of SPP with GAP Central application

With the SPPC_XXYY application, the LM device can be configured as following:

a. SPP only device – Default configuration
b. Dual mode device – SPP and GAP central
c. BLE only device – Connected to BLE devices only

2.1 SPP only device:

The SPPC_XXYY application configures the LM devices to be SPP only by default. i.e. GAP-Enable setting is set to OFF by default.

This ensures that the LM device functions like LM Technologies existing BC04 based products, such as the LM400/LM072/LM048/LM068 devices.

In this configuration:

- LM devices only perform SPP related functionality.
- LM devices respond with ERR to any BLE related AT commands.

2.2 Dual mode Bluetooth device – SPP and GAP enabled

Users can enable the GAP role with the SPPC_XXYY application by issuing the AT command “AT*GAPENB=ON”.

The LM device then performs a soft reset and reboots itself with the GAP role enabled. In this configuration the LM device is acting as a dual mode Bluetooth device.

For the Bluetooth low energy role, the LM device will be in the GAP Central role and can have up to five BLE connections simultaneously. In Dual mode, the LM device can have a maximum of six active connections simultaneously i.e. One SPP connection and up to five BLE connections.

For the BLE GAP Central role, the user can perform all functions normally performed by Android tablets or handsets. Using the LM device, the user can initiate discovery of nearby Bluetooth low energy peripherals. The LM device can report up to ten BLE peripheral devices in the report. The user can then connect to any of those devices and read or write data on various services or characteristics using AT commands.

The Bluetooth low energy connection also supports whitelisting. When BLE device discovery is enabled, the LM device will only report advertising packets from the devices previously added to the whitelist.

Reports or messages reported on the UART should be carefully parsed if the LM device is in dual mode. When the user has issued any BLE related AT command and is waiting for a response, a SPP functionality might give any indication on UART.

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To avoid accidental messages from the SPP connection, the user can put the LM device as a SPP master and ACON as OFF (these settings ensure that the LM device will only start the SPP after user initiation).

2.3 BLE only role

The SPP role is always enabled by default.

When the setting GAPENB=ON, the LM device is in Dual mode. In this mode the user can only use the BLE related commands.

The SPP role on LM devices cannot be disabled. If the user wants to only use BLE related functionality then the SPP role can be set to Master and ACON to OFF, and the module will be BLE only. In this case the LM device will start any SPP functionality only after the user issues the SPP related AT commands.

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3. AT command Parser on LM devices:

This section describes the AT command parser on LM devices.

Serial terminals (such as Hercules, HyperTerminal, Tera Term or Putty) can be used for serial communication with the LM device.

Every AT command string should be terminated with the “CR-LF” character sequence. The LM device will start to parse the AT command strings only after receiving this sequence.

AT Commands are case insensitive e.g. “At*Resp=On”, “at*resp=on” and “AT*RESP=ON” are all valid to make the Response setting ON.

AT command types:

1. Query only commands - Commands to query Adapter state, firmware version number etc.
2. Query and Set commands - Commands to query the setting and modify Adapter setting e.g. discoverability, Role, Baud, etc.
3. Execution only command – commands to perform specific action e.g. start discovery for Bluetooth devices, start connection procedure, start upgrade procedure etc.

The LM device reports messages to the user through the serial port to indicate connection/pairing requests, confirmation of connection/pairing, result of Bluetooth device discovery, disconnection indication etc.

After the indication message is displayed, the LM device waits for input from the user to execute further action. For example, after incoming pairing indications, enter accept/reject pair response or after indication for PASSKEY_cfm, provide yes/no confirmation for the passkey etc.

The LM device responds to each AT command with “OK”\r\n or “ERR”\r\n. After this response, the LM device accepts the requested action or it will output a report to the user via UART.

If the LM device does not receive “AT” at the start of new command, the LM device may not respond to the command even if it is terminated with “\r\n” (e.g. instead of “AT*NAME=?”, user issues “A*name=?”). In this case, the LM device will reject the string and will be ready to receive and process new AT commands.

When the LM device does not receive any commands on UART for more than 30 seconds, the LM device enters into deep sleep mode. The LM device awakes from this mode if there is any activity on UART or is there is BT activity. If the user enters AT commands while the adapter is in deep sleep mode, the LM device may lose the first character of an AT command, e.g. for command “AT*NAME=?”, the adapter may show the echo as “t*name=?” or “Ñname=?” i.e. some garbage characters at the start. The LM device will not respond to AT commands such as ERR/OK, but will ignores thi data and wait for a new AT command to process.

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Some AT commands will expect the BT address to be in the AT command string. In this document "0126f357215" is considered a reference BT address, whereas 0012 is NAP, 6f is UAP and 357215 is LAP in the BT address. Users should use the BT address of their devices.

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4. Basic configuration AT commands

6.1 Basic configuration AT commands for Quick reference:

This section lists the basic configuration AT commands for quick reference and the default settings wherever applicable.

6.1.1 General settings AT commands:

Sr no	AT command string	Command type	Default setting
1	AT*ADDR	Query only	--
2	AT*NAME	Query and set	Firmware version dependent e.g. 074LM_SPP_0106
3	AT*UPDATENAME	Query and set	ON
4	AT*ECHO	Query and set	ON
5	AT*RESP	Query and set	ON
6	AT*DCOV	Query and set	ON
7	AT*PAIR	Query and set	ON
8	AT*STATE	Query only	--
9	AT*VER	Query only	--
10	AT*RESET	Execution only	--
11	AT*SETTINGS	Query only	Refer command details

6.1.2 UART settings AT commands:

Sr no	AT command string	Command type	Default setting
1	AT*BAUD	Query and set	19200 (5)
2	AT*PAR	Query and set	No parity (0)
3	AT*STOP	Query and set	One stop bit (0)
4	AT*FLOW	Query and set	Off
5	AT*CTS	Query only	--
6	AT*RTS	Set only	--
7	AT*DTR	Set only	--
8	AT*DSR	Query only	--
9	AT*MODEM	Query and set	NONE
10	AT*UARTCONF	Query and set	Throughput

Note: CTS, RTS, DTR, DSR, MODEM commands are not applicable for LM961 module.

6.1.3 Bluetooth security settings commands:

Sr no	AT command string	Command type	Default setting
1	AT*PIN	Query and set	1234

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2	AT*DPIN	Query and set	OFF
3	AT*MITM	Query and set	OFF
4	AT*IOTYPE	Query and set	NO_InOut
5	AT*DEL	Execution only	--
6	AT*PASSKEY	Execution only	--
7	AT*PASSCFM	Execution only	--
8	AT*STOPPAIR	Execution only	--
9	AT*PAIRLIST	Query only	--

6.1.4 SPP related AT commands:

Sr no	AT command string	Command type	Default setting
1	AT*FIND	Execution only	--
2	AT*ROLE	Query and set	Dual
3	AT*ACON	Query and set	OFF
4	AT*CONN	Execution only	--
5	Escape sequence “+++”	Execution only	--
6	AT*AUTO	Execution only	--
7	AT*DROP	Execution only	--
8	AT*BOND	Query and set	Default bond device address = 0000-00-000000

6.1.5 Firmware Upgrade AT commands:

Sr no	AT command string	Command type	Default setting
1	AT*UPGRADEINT	Query and set	UART interface
2	AT*UPGRADE	Execution only	--

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6.2 Adapter Settings commands:

6.2.1 "AT*ADDR"\r\n

i. Query only command
ii. Query Bluetooth device address of the LM device
iii. Address query: "AT*ADDR=?"\r\n
iv. Address query report: "REP*:ADDR=00025b00a5a5"
v. Normally the AT parser of LM devices, responds OK/ERR to the AT command and then issues the report, but only for Address query command, AT parser first gives the report i.e. BD address and then replies OK.
vi. Observe the below sequence.

```
at*addr=?at*addr=?
REP*:ADDR=0002-5b-080419
OK

at*name=?at*name=?
OK
REP*:NAME=068SerialADT19

at*ver=?at*ver=?
OK
REP*:VER=068LM_SPP+GAPCEN_02.01
```

6.2.2 "AT*NAME"\r\n

i. Query and set command
ii. Query or set Name of the LM device, This name appears in Bluetooth devices discovery.
iii. Name query: "AT*NAME=?"\r\n
iv. Name query report: "REP*:NAME=068SerialADTF9"
v. Name set command: "AT*NAME=testname"
vi. Default name: (Depends on firmware version number and UPDATENAME feature)
vii. Refer AT*updateName command for more details

6.2.3 "AT*UPDATENAME"\r\n

i. Query and set command
ii. To avoid the situation where multiple LM devices in the near field are displayed with the same Bluetooth name, UPDATENAME feature is used.
iii. By default, UPDATENAME feature is ON.
iv. When the UPDATENAME feature is ON, the last two characters from the BD-address of the LM device are attached in the Bluetooth name of the device.
v. Query the setting as "AT*UPDATENAME=?"
vi. Response to the query command will be "REP*:UpdateName=ON" or "REP*:UpdateName=OFF".

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vii. Use command “AT*UPDATENAME=ON” / “AT*UPDATENAME=OFF” to change the setting.
viii. If the setting is OFF and user issues command to make the setting OFF, then ERR response is received otherwise OK response is received. Same thing applies for ON setting.
ix. Below messages shows the possible scenarios:

```
at*addr=?at*addr=?
REP*:ADDR=34c9-f0-8119f9
OK
at*updatename=?at*updatename=?
OK
REP*:UpdateName=ON
at*name=?at*name=?
OK
REP*:NAME=068SerialADTF9
at*name=testsnameat*name=testsname
OK
at*name=?at*name=?
OK
REP*:NAME=testsnameF9


at*updatename=offat*updatename=off
OK
at*name=testsnameat*name=testsname
OK
at*name=?at*name=?
OK
REP*:NAME=testsname


at*updatename=onat*updatename=on
OK
at*name=?at*name=?
OK
REP*:NAME=testsnameF9
```

6.2.4 “AT*ECHO”\r\n

i. Query and set command
ii. Echo of AT commands
iii. Echo query: “AT*ECHO=?”\r\n
iv. Echo query report: “REP*:ECHO=ON” or “REP*:ECHO=OFF”
v. Echo enable command: “AT*echo=on”
vi. Echo disable command: “AT*echo=off”
vii. Default Echo: “ON”

6.2.5 “AT*RESP”\r\n

i. Query and set command
ii. Query command: “AT*RESP=?”\r\n
iii. Response query report: “REP*:RESP=ON” or “REP*:RESP=OFF”
iv. Response enable command: “AT*RESP=on”
v. Response disable command: “AT*RESP=off”

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vi. Default Response: "ON"
vii. When response is ON, the LM device responds as "OK" or "ERR" to every command string before sending report/response of the command.
viii. When response is OFF, the LM device will not provide "OK" or "ERR" reply to any AT command. This might not be helpful to users as the user will not get any response if incorrect AT command strings are entered.
ix. Below is the sequence of messages when ECHO and RESP are ON.

```
at*echo=?at*echo=?
OK
REP*:ECHO=ON
at*resp=?at*resp=?
OK
REP*:RESP=ON
at*name=?at*name=?
OK
REP*:NAME=068LM_SPP_0104
```

x. Below is the sequence of messages when ECHO is OFF and RESP is ON.

```
at*echo=offat*echo=off
OK
at*echo=?OK
REP*:ECHO=OFF
at*resp=?OK
REP*:RESP=ON
at*name=?OK
REP*:NAME=068LM_SPP_0104
```

xi. Below is the sequence of messages when ECHO and RESP are both off. The LM device will show only reports for the query commands. The LM device will not show any indication messages for connect or disconnect. This is to ensure backwards compatibility with LM048/LM058/LM072 adapter/module firmware.

```
at*resp=?REP*:RESP=OFF
at*echo=?REP*:ECHO=OFF
at*name=?REP*:NAME=068LM_SPP_0104
```

6.2.6 "AT*DCOV"\r\n

i. Query and set command
ii. Discoverable query: "AT*DCOV=?"\r\n
iii. Discoverable query report: "REP*:DCOV=ON" (Adapter discoverable for classic role) or "REP*:DCOV=OFF" (Adapter non discoverable for classic role)
iv. Command to make LM device discoverable: "AT*DCOV=ON"
v. Command to make LM device non-discoverable: "AT*DCOV=OFF"
vi. Default discoverability : "ON"
vii. Enabling discoverability may generate further events of incoming pairing/connection requests.

6.2.7 "AT*PAIR"\r\n

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i. Query and set command
ii. Pairable query: “AT*PAIR=?”\r\n
iii. Pairable query report: “REP*:PAIR=ON” (LM device is in pairable state and will give indications to host of any incoming pairing requests)
iv. Pairable query report: “REP*:PAIR=OFF” (LM device is in non-pairable state and will reject pairing request internally)
v. Command to make LM device pairable: “AT*PAIR=ON”
vi. Command to make LM device non-pairable : “AT*PAIR=OFF”
vii. Default Pairable: ON
viii. Enabling pair-ability may generate further events of incoming pairing/connection requests.
ix. By default LM device accepts all the incoming paring requests.
x. Some previous LM applications (lower than SPPC_0109) waits for user action to accept or reject the incoming paring requests.
xi. After pairing procedure is complete, adapter shows indication message for success or failure of pairing “IND*:PAIR=OK,00126f357215” or “IND*:PAIR=ERR,00126f357215” .

6.2.8 “AT*STATE”\r\n

i. Query only command
ii. LM device state query: “AT*STATE=?”\r\n
iii. LM device state query report: “REP*:STATE-DP=ON,ON” (“STATE-DP” indicates states as D-discoverable is ON and P-Pairable is ON)
iv. LM device state query report: “REP*:STATE-DP=ON,OFF” (“STATE-DP” indicates states as D-discoverable is ON and P-Pairable is OFF)

6.2.9 “AT*VER”\r\n

i. Query only command
ii. Firmware version query: “AT*VER=?”\r\n
iii. Firmware version query report: “REP*:VER=abcLM_SPP+GAPCEN_XXYY”.
iv. In the report above the string abc should mention the actual device type i.e. 961/074/068. The string XXYY should mention the major and minor firmware version number respectively.

```
at*ver=?at*ver=?
OK
REP*:VER=068LM_SPP+GAPCEN_01.15
```

6.2.10 “AT*RESET”\r\n

i. Execution only command
ii. LM devices supports execution of two “Reset” levels
iii. “AT*RESET=1”\r\n
    1. LM device applies soft reset and starts execution as if applied power on-off cycle.
    2. LM device retains all user modified settings

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3. LM device causes disconnection of all Bluetooth/BLE connections

iv. "AT*RESET=2"\r\n
1. LM device applies hard reset
2. Loads default settings for all configuration settings
3. LM de causes disconnection of all Bluetooth/BLE connections
4. LM device deletes all the paired devices (Bluetooth and BLE) and corresponding data

6.2.11 "AT*SETTINGS"\r\n

i. Query only command
ii. LM device settings query: "AT*SETTINGS=?"\r\n
iii. Report for "AT*SETTINGS=?" command is multiple line, at the end of the report a message "REP*:SETTINGS=END" is delivered.
iv. Adapter settings query report varies according to thr DPIN setting. If DPIN is OFF i.e. supporting to BT2.0, Adapter PIN is displayed. If DPI is ON, i.e. support to BT2.1, then settings for IO-capability, MITM are displayed.

"AT*Settings" report when DPIN is OFF	"AT*Settings" report when DPIN is ON
at*settings=?at*settings=? OK NAME=068SerialADT19 ADDR=0002-5b-080419 PAIR=ON DCOV=ON BAUD=19200(2) STOP=Stop_One(0) PARITY=None(0) FLOW=OFF ECHO=ON RESP=ON MODEM=NONE SPPRole=SLAVE ACON=OFF BOND=0000-00-000000 RICD=OFF DPIN=ON MITM=ON IOTYPE=KB_Only ENBGAP=OFF VER=068LM_SPP+GAPCEN_02.01 UARTCONF=UART_THROUGHPUT UPGRADEINT=UART REP*:SETTINGS=END at*settings=?at*settings=? OK NAME=068SerialADT19 ADDR=0002-5b-080419	at*settings=?at*settings=? OK NAME=068SerialADT19 ADDR=0002-5b-080419 PAIR=ON DCOV=ON BAUD=19200(2) STOP=Stop_One(0) PARITY=None(0) FLOW=OFF ECHO=ON RESP=ON MODEM=NONE SPPRole=SLAVE ACON=OFF BOND=0000-00-000000 RICD=OFF DPIN=OFF PIN=1234 ENBGAP=OFF VER=068LM_SPP+GAPCEN_02.01 UARTCONF=UART_THROUGHPUT UPGRADEINT=UART REP*:SETTINGS=END at*settings=?at*settings=? OK NAME=068SerialADT19 ADDR=0002-5b-080419

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PAIR=ON DCOV=ON BAUD=19200(2) STOP=Stop_One(0) PARITY=None(0) FLOW=OFF ECHO=ON RESP=ON MODEM=NONE SPPRole=SLAVE ACON=OFF BOND=0000-00-000000 RICD=OFF DPIN=ON MITM=ON IOTYPE=KB_Only ENBGAP=ON LE_SEC=OFF LE_AUTO_SCAN=ON VER=068LM_SPP+GAPCEN_02.01 UARTCONF=UART_THROUGHPUT UPGRADEINT=UART REP*:SETTINGS=END	PAIR=ON DCOV=ON BAUD=19200(2) STOP=Stop_One(0) PARITY=None(0) FLOW=OFF ECHO=ON RESP=ON MODEM=NONE SPPRole=SLAVE ACON=OFF BOND=0000-00-000000 RICD=OFF DPIN=OFF PIN=1234 ENBGAP=ON LE_SEC=OFF LE_AUTO_SCAN=ON VER=068LM_SPP+GAPCEN_02.01 UARTCONF=UART_THROUGHPUT UPGRADEINT=UART REP*:SETTINGS=END

v. Actual values of PIN, MITM, IOTYPE are displayed as per the current settings of the device.
vi. The response also depends on the ENBGAP settings. Refer to section 1.2 “Enable GAP Central role” for more details.
vii. If the ENBGAP setting is ON, LESEC and LE_AUTO_SCAN settings are displayed.
viii. Response to the settings command varies on the LM device type, e.g. the LM068 adapter shows the MODEM setting but this setting is not applicable for LM961 or the LM074.

6.3 UART Settings commands:

6.3.1 “AT*BAUD”\r\n

i. Query and set command
ii. Baud rate query: “AT*BAUD=?”\r\n
iii. Baud rate query report: “REP*:BAUD=19200(2)”. Number in brackets shows the serial number as per the table below.
iv. Baud rate set command: “AT*BAUD=3” (Set Adapter’s baud rate as 38400 bps)
v. The LM device does not to perform power-on-off after the baud rate setting has been changed.
vi. Refer to the table below for baud rate settings:

Sr No	Actual baud rate	LM device Baud rate code	Report from LM DEVICE
1	9600	1	“REP*:BAUD=9600(1) ”
2	19200	2 – Default baud rate	“REP*:BAUD=19200(2)”

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3	38400	3	“REP*:BAUD=38400(3) ”
4	57600	4	“REP*:BAUD=57600(4)"
5	115200	5	“REP*:BAUD=115200(5)"
6	230400	6	“REP*:BAUD=230400(6)"
7	460800	7	“REP*:BAUD=460800(7)"
8	921600	8	“REP*:BAUD=921600(8)"
9	1382400	9	“REP*:BAUD=1382400(9)"

6.3.2 “AT*PAR”\r\n

i. Query and set command
ii. Parity query command: “AT*PAR=?”\r\n
iii. Parity query report: “REP*:PARITY=None(0)” (LM device uses default parity setting as parity = none). Number in curly brackets shows the serial number as per below table.
iv. Parity set command: “AT*PAR=1” (Set Adapter parity as odd)
v. The LM device does not need to perform power-on-off after the parity setting has been changed.
vi. Refer to the table below for parity settings:

Sr No	Actual parity	LM device parity code	Report from LM device
1	Parity None	0 – default parity	“REP*:PARITY=None(0)”
2	Parity odd	1	“REP*:PARITY=Odd(1)”
3	Parity even	2	“REP*:PARITY=Even(2)”

6.3.3 “AT*STOP”\r\n

i. Query and set command
ii. Stop bit query command: “AT*STOP=?”\r\n
iii. Stop bit query report: “REP*:STOP=Stop_One(0)” (adapter uses default stop bit as = one). Number in curly brackets shows the serial number as per below table.
iv. Stop bit set command: “AT*STOP=1” (Set adapter stop bit as two)
v. The LM device does not need to perform power-on-off after the parity setting has been changed.
vi. Refer to the table below for stop bit settings:

Sr No	Actual Stop bit	LM device Stop bit code	Report from LM device
1	Stop bit One	0 – default stop bit	“REP*:STOP=Stop_One(0)”
2	Stop bit two	1	“REP*:STOP=Stop_Two(1)”

6.3.4 “AT*FLOW”\r\n

i. Query and set command
ii. Flow control query command: “AT*FLOW=?”\r\n

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iii. Flow control query report: “REP*:FLOW=OFF” (adapter uses default flow control OFF)
iv. Flow control set command: “AT*FLOW=ON” (Set adapter flow control ON)
v. If the user is changing the flow control, the LM device shows “REP*:FLOW_CHANGE= IN_Progress” after accepting the command.
vi. The LM device will then perform a reboot with the new flow control setting.
vii. If the LM device is in flow control OFF and the user sends the command to turn the flow control OFF, then the device will respond with OK but will not perform a reboot. This also applies to the flow control ON setting.

6.3.5 “AT*CTS”\r\n:

i. Query command
ii. CTS query command: “AT*CTS=?”\r\n
iii. CTS query report: adapter will report the actual status of CTS line e.g. “REP*:CTS=OFF” or “REP*:CTS=OFF”.
iv. CTS line cannot be set/reset.
v. This command is applicable for the LM074 module and LM068 adapter.

6.3.6 “AT*DSR”\r\n:

i. Query command
ii. DSR query command: “AT*DSR=?”\r\n
iii. DSR query report: adapter will report the actual status of DSR line e.g. “REP*:DSR=OFF” or “REP*:DSR=OFF”.
iv. DSR line cannot be set/reset.
v. This command is applicable for the LM074 module and LM068 adapter.

6.3.7 “AT*RTS”\r\n:

i. Set only command
ii. RTS line set/reset command: “AT*RTS=ON”\r\n or “AT*RTS=OFF”\r\n.
iii. RTS line cannot be queried.
iv. This command is applicable for LM074 module and LM068 adapter.

6.3.8 “AT*DTR”\r\n:

i. Set only command
ii. DTR line set/reset command: “AT*DTR=ON”\r\n or “AT*DTR=OFF”\r\n.
iii. DTR line cannot be queried.
iv. This command is applicable for LM074 module and LM068 adapter.

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6.3.9 "AT*MODEM"\r\n:

i. Query and set command
ii. MODEM query command: "AT*MODEM=?"\r\n
iii. MODEM query report: "REP*:MODEM=NONE" (adapter uses default MODEM settings as "none")
iv. MODEM set command: "AT*MODEM=LOCAL" or "AT*MODEM=Remote".
v. Refer below table for MODEM settings:

Sr No	Modem setting	Comment
1	None	Default setting
2	Local	LM068/LM074 uses RTS/CTS and DTR/DSR in loopback mode
3	Remote	When the LM068/LM074 is connected to the remote device, LM068/LM074 sends RTS /DTR line status to remote device and receives CTS/DSR line status from remote device

vi. Modem settings LOCAL and REMOTE are followed when Flow-control is off.
vii. MODEM command is applicable for LM074 module and LM068 adapter.

6.3.10 "AT*UARTCONF"\r\n:

i. Query and set command.
ii. UARTCONF query command: "AT*UARTCONF=?"\r\n
iii. UARTCONF query report: "REP*:UARTCONF=UART_THROUGHPUT" (Default setting of UART configuration is Maximum UART throughput)
iv. "REP*:UARTCONF=LATENCY" (User can change the UART configuration to Low-Latency)
v. UARTCONF set command: "AT*UARTCONF=LATENCY" or "AT*UARTCONF=throughput".
vi. When the UART configuration is set to Throughput, the UART is configured to transfer the block of data (upto 8K blocks), UART waits for considerable data to be available on UART before transferring it to the remote device over SPP.
vii. When the UARTCONF is set to LATECNY, the UART is configured to deliver the data received on UART as soon as possible to the remote device to make sure low latency while data transfer over Bluetooth.
viii. The UART configuration as Latency is applicable for the EPOS/small printer customers where timing of data transfer is important, and the strings are small up to 64 bytes.
ix. The Throughput configuration of UART is applicable for the users which use SPP to transfer large blocks of data e.g. to send the data continuously or in large chunks.

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x. If the UARTCONF setting is Throughput and user issues command to make the setting as Throughput then ERR response is received otherwise OK response is received. Same thing applies for Latency setting.
xi. When the user changes the UART configuration, the device reboots itself to apply new configuration.
xii. AT*RESET=2 does not reset the UART configuration setting.
xiii. Refer to the scenario below

```
at*UARTconf=?at*UARTconf=?
OK
REP*:UART_CONFIG=UART_THROUGHPUT
at*UARTconf=throughputat*UARTconf=throughput
ERR
at*UARTCONF=Latencyat*UARTCONF=Latency
OK
Device will Reboot
SPP+GapCentral_Message_Loop
at*UARTCONF=?at*UARTCONF=?
OK
REP*:UART_CONFIG=UART_LATENCY
at*UARTCONF=latencyat*UARTCONF=latency
ERR
at*UARTCONF=throughputat*UARTCONF=throughput
OK
Device will Reboot
SPP+GapCentral_Message_Loop
```

6.4 Bluetooth Security Settings commands:

6.4.1 “AT*PIN”\r\n

i. Query and set command
ii. PIN query command: “AT*PIN=?”\r\n
iii. PIN query report: “REP*:PIN=1234” (adapter uses default PIN as 1234)
iv. PIN set command: “AT*PIN=00112233” or “AT*PIN=Abcd”.
v. Maximum PIN length supported is as per BT2.1 standard i.e. 16 bytes. PIN string can be numeric only, alpha only, or alpha numeric.
vi. Examples for valid PIN set commands: “AT*PIN=00112233445566778” or “AT*PIN=001122aaBBccDDeef”

6.4.2 “AT*DPIN”\r\n

i. Query and set command
ii. Dynamic PIN query command: “AT*DPIN=?”\r\n
iii. Dynamic PIN query report: “REP*:DPIN=OFF” (adapter uses default DPIN as off)
iv. Dynamic PIN set enable or disable command: “AT*DPIN=ON” or “AT*DPIN=off”.

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v. When LM device has DPIN setting as OFF, LM device uses a fixed PIN (provided by default as 1234 or user modified PIN).
vi. When LM device has DPIN setting as ON, it expects the dynamic PIN from customer as per the MITM and IO-Type settings.
vii. For detailed pairing procedure of LM devices with AT commands, refer to the section 8: "Simple Secure Pairing between LM device and remote device"

6.4.3 "AT*MITM"\r\n

i. Query and set command
ii. (Man IN The Middle) MITM query command: "AT*MITM=?"\r\n
iii. MITM query report: "REP*:MITM=OFF" (LM device uses default MITM as off)
iv. MITM set enable or disable command: "AT*MITM=ON" or "AT*MITM=off".

6.4.4 "AT*IOTYPE"\r\n

i. Query and set command
ii. (Input Output type for Dynamic PIN) IOTYPE query command: "AT*IOTYPE=?"\r\n
iii. IOTYPE query report: "REP*:IOTYPE=NO_InOut" (adapter uses default IOTYPE as "no input output")
iv. IOTYPE modify command: "AT*IOTYPE=KB_ONLY" or "AT*IOTYPE=kB_OnLy".
v. Following IO-types are supported:

Sr No	IO type	String for IOTYPE	IOTYPE set command	IOTYPE query response
1	No input output	NO_InOut	at*iotype=no_inout	REP*:IOTYPE=NO_InOut
2	Key Board only	KB_Only	at*iotype=Kb_OnLy	REP*:IOTYPE=KB_Only
3	Display only	Disp_Only	at*iotype=DISP_only	REP*:IOTYPE=Disp_Only
4	Display and confirmation for Yes / No	Disp_YN	at*iotype=DISP_YN	REP*:IOTYPE=Disp_YN

6.4.5 "AT*DEL"\r\n

i. Execution only command.
ii. User issues this command to delete the device from its paired list.
iii. DEL command: "AT*del=00126f357215"\r\n
iv. "OK" response will be provided if the string entered has valid BT address. LM device deletes the device from its pairing list.

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v. "Err" response will be provided if invalid BT address, invalid length of address is provided.
vi. If device is deleted from the pairing list, LM device will perform pairing procedure before getting connected with the device.

6.4.6 "AT*PASSKEY"\r\n

i. Execution only command.
ii. When the LM device has DPIN=ON, MITM=ON and IOTYPE as Keyboard Only, in pairing procedure adapter gives indication "IND*:PASSK=?".
iii. User shall provide the pass key in following format: "AT*PASSKEY=1234"\r\n .
iv. Any integer within the range uint32 is considered as valid Passkey.
v. For detailed pairing procedure of LM devices with AT commands, refer to the section 8: "Simple Secure Pairing between LM device and remote device"

6.4.7 "AT*PASSCFM"\r\n

i. Execution only command.
ii. When the LM device has DPIN=ON, MITM=ON and IOTYPE as DISPLAY confirmation Yes/No, in pairing procedure adapter gives indication "IND*:PASSK=xxxxxx".
iii. User shall provide the confirmation for pass key in following format: "at*passcfm=00126f357215,Yes"\r\n or "at*passcfm=00126f357215,no"\r\n
iv. For detailed pairing procedure of LM devices with AT commands, refer to the section 8: "Simple Secure Pairing between LM device and remote device"

6.4.8 "AT*STOPPAIR"\r\n

i. Execution only command.
ii. Used to stop the pairing procedure for a device.
iii. Once the LM device starts pairing procedure, the stack completes the procedure within maximum 90 seconds. User can stop the pairing procedure within this time.
iv. Issue command to stop the pairing procedure with the BT address of the peer device e.g. "AT*stoppair=00126f357215"

6.4.9 "AT*PAIRLIST"\r\n

i. Query only command.
ii. Pairlist query command: "AT*PAIRLIST=?"\r\n
iii. Pairlist report may be multiple line if adapter is paired with more than one device. Paired devices report is shown in following format

"REP*:PAIRLIST=00126f357201,
REP*:PAIRLIST=00126f357215,
REP*:PAIRLIST=END"

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iv. Pairlist report can be multiple line, to indicate end of the report "REP*:PAIRLIST=END" is displayed at end.

5. SPP Related commands:

5.1 SPP profile AT commands:

The following section describes the SPP profile related AT commands.

5.1.1 "AT*FIND"\r\n

i. Execution only command.
ii. Used to start the discovery of Bluetooth devices nearby.
iii. Start discovery command format is "AT*FIND=ON"\r\n
iv. Stop discovery of Bluetooth devices by command "AT*FIND=Off"\r\n.
v. LM device shows discovered devices with their name and addresses. Each device is reported as soon as it is discovered.
vi. Report for each device is sent with new line. To indicate the end of the discovery report, "REP*:FIND=END" message is shown.
vii. If LM device did not get reply to name query of remote device, it will display NULL in name string (e.g. row 3 in below report).
viii. Once started the discovery procedure, LM device discovers the devices for 60 seconds and then terminates the Discovery. At the end of discovery time, LM device issues the "REP*:FIND_END= 4 devices found" message where it mentions the actual number of devices discovered.
ix. Example report for discovery:

"at*find=onat*find=on
OK
REP*:FIND=Start..
= 1 0002-5b-00a5a5 Serial Adapter
= 2 0026-4a-a19172 LML11
= 3 442a-60-da6c58 NULL
= 4 4c49-e3-68b246 Redminote
REP*:FIND_END= 4 devices found."

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5.1.2 "AT*ROLE"\r\n

i. Query and Set command.
ii. Query command = "AT*ROLE=?"\r\n
iii. Report for SPP role query is "REP*:SPPRole=SLAVE"\r\n . Default role is Slave mode supporting SPP incoming connections.

Sr No	SPP Role	SPP Role set command	SPP Role query response
1	Dual role (SPP Slave and SPP master role)	At*role=dual	REP*:SPPRole=DUAL
2	SPP Slave Only	At*role=slave	REP*:SPPRole=SLAVE
3	SPP Master only	At*role=master	REP*:SPPRole=MASTER

iv. When the LM device is in Dual mode, it can accept incoming SPP connections as well as initiate outgoing SPP connection whereas LM device cannot accept or initiate new connection when it is already connected to any remote device. E.g. if LM device has established an outgoing connection, then after terminating the outgoing connection it can accept incoming connection.
v. In slave-only role
   1. BOND=Valid-BD-address. (e.g. BOND=0012-6f-357215)
      - LM device will accept connection request only from bonded device. Connection requests from other devices will be rejected by LM device.
   2.BOND=0000-00-000000.
      - LM device will accept connection request from any device.
vi. In master-only role, Refer ACON and BOND command for more details.
vii. In any role (dual, Slave only or Master only role) LM device can support only one SPP connection at an instance.

5.1.3 "AT*ACON"\r\n

i. Query and set command.
ii. This setting is applicable for Master only role.
iii. Auto connect query command: "AT*ACON=?"\r\n
iv. Auto connect query report: "REP*:ACON=OFF"
v. Command to set ACON as ON is "AT*ACON=ON"\r\n
vi. When the LM device is in Master-only role and ACON setting is ON,
   1. BOND=Valid-BD-address. (e.g. BOND=0012-6f-357215)
      - If device has valid address for BOND, it keeps issuing connection request to that device till the connection is established.
   2.BOND=0000-00-000000.

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- If LM device has BOND address as Zero, it will start discovery of nearby Bluetooth devices and issues connection request to first found device.

vii. When LM device is in Master-only role and ACON setting is OFF, LM device will wait for AT command from user to initiate the connection request (LM device will not accept any incoming connection request).

5.1.4 "AT*BOND"\r\n

i. Query and set command.
ii. Set command: "AT*BOND=00126f357215"\r\n. Device will establish connection only with remote device having BD address as 00126f357215.
iii. Set command: "AT*BOND=000000000000"\r\n. Device will establish connection with any device.
iv. This setting is applicable for Master-only, slave-only role. When Bond Address setting holds a valid Bluetooth address then LM device will establish connection only with that device.
v. LM device can be paired with maximum 8 devices and stores the device addresses in its permanent memory (this is called as TDL-Trusted_Devices_List or PDL-Paired_Devices_List) whereas it can be bonded to only one device at a time whose address is mentioned in BOND command setting.
vi. Bond device address query command: "AT*BOND=?"\r\n.
vii. Default settings is: "REP*:BOND=0000-00-000000".
viii. Setting for default bond device address is Zero i.e. device is not bonded to any remote device and can accept or issue connection request to any remote device.

5.1.5 "AT*CONN"\r\n

i. Execution only command.
ii. Supported in SPP Master-only and Dual mode.
iii. If LM device is in MASTER role and ACON setting is ON, the adapter will always respond to AT*CONN=BD-address command as "ERR" as it only issues a connection request to BOND device, or it performs discovery on its own and attempts to connect to first device found.
iv. When ACON is OFF, User can start to initiate outgoing SPP connection.
v. Outgoing connection command: "AT*conn=00126f357215"\r\n
vi. "OK" response will be provided if the string entered has valid BT address, adapter is not connected to any device.

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vii. "Err" response will be provided if invalid BT address, invalid length of address is provided or if the adapter is already in connected state.
viii. After LM device gives OK response to AT*CONN command, it starts the connection procedure. Result of connection procedure is indicated as indication message.
    1. "IND*:CONN_FAILURE=00126f357215" message is shown to indicate the failure in connection with BD address 0012-6f-357215.
    2. "IND*:CONNECTED=00126f357215" message is shown to indicate the SPP connection is successfully established and the devices are in connected state.
    3. Once the devices are connected, LM device enters in **SPP-connected-online-data** mode. Every string entered by user on UART is treated as data and is transmitted to connected device.
    4. User can come out of this mode by entering the Escape sequence.

5.1.6 Escape sequence "+++"

i. Execution only command/sequence.
ii. Supported only in **SPP-connected-online-data** mode.
iii. User issues this command to enter in **SPP-connected-online-command** mode.
iv. If the user issues escape sequence in SPP-connected-online-data mode, OK response is given by adapter and adapter enters in **SPP-connected-online-command** mode.
v. Once the adapter enters in SPP-connected-online-command mode, any strings entered on UART are considered as AT commands and are processed by adapter (still the adapter is in connected state).
vi. In SPP-connected-online-command mode, users can query/update adapter settings and start the disconnection by issuing at*drop command.

5.1.7 "AT*AUTO"\r\n

i. Execution only command/sequence.
ii. Supported only in **SPP-connected-online-command** mode.
iii. User issues this command to enter back in **SPP-connected-online-data** mode.
iv. After entering in SPP-connected-online-data mode, any data entered on UART is transmitted to the remote device over Bluetooth.

5.1.8 "AT*DROP"\r\n

i. Execution only command.
ii. Supported in all SPP roles (dual, master-only or slave-only).

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iii. User issues this command in SPP-connected-online-command mode to terminate the existing SPP connection (applicable for existing incoming or outgoing SPP connection).
iv. connection termination command: e.g. "AT*DROP=00126f357215"\r\n
v. "OK" response will be provided if the string entered has valid BT address and LM device is connected to the device with entered BT address and LM device is in online-command mode.
vi. "Err" response will be provided if invalid BT address, invalid length of address is provided, adapter is not connected to any device.
vii. AT*drop command causes the indication message to indicate the devices are successfully disconnected.
viii. "IND*:DISCONNECTED=00126f357215" indication message is shown to indicate the LM device is disconnected from the device with BT address 0012-6f-357215.

5.2 Firmware Upgrade commands:

5.2.1 "AT*UPGRADEINT"\r\n

i. Query and set command.
ii. Query the current Upgrade interface: "AT*UPGRADEINT=?"\r\n.
iii. Response to the query upgrade interface command: "AT*UPGRADEINT=OTA" or "AT*UPGRADEINT=UART" is received.
iv. Change the upgrade interface using command "AT*UPGRADEINT=UART" or "UPGARDEINT=OTA" command.
v. When upgrade interface is mentioned as OTA, the New firmware image for FW upgrade can be provided by a remote device using SPP profile where LM device and remote device are connected over Bluetooth.
vi. When the upgrade interface is set as UART, the new firmware image is sent to the LM device using its own UART.
vii. AT*RESET=2 does not reset the upgrade interface setting.
viii. Refer below commands for more information:

```
at*UARTCONF=?at*UARTCONF=?
OK
REP*:UART_CONFIG=UART_LATENCY

at*UPGRADEINT=?at*UPGRADEINT=?
OK
REP*:UPGRADEINT=UART

at*UPGRADEINT=UARTat*UPGRADEINT=UART
ERR

at*upgradeint=OTAat*upgradeint=OTA
OK

at*upgradeint=?at*upgradeint=?
OK
REP*:UPGRADEINT=OTA

at*upgradeint=OTAat*upgradeint=OTA
```

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```
ERR

at*UPGRADEINT=UARTat*UPGRADEINT=UART
OK

at*upgradeint=?at*upgradeint=?
OK
REP*:UPGRADEINT=UART
```

5.2.2 "AT*UPGRADE"\r\n

i. Execution only command.
ii. Using this command, the LM device can be set ready to receive the new firmware image.
iii. The command format is "AT*upgrade=password".
iv. The password is dependent on the actual type of LM device and current firmware version on the LM device.
v. E.g. "AT*UPGRADE=LMUPDATEV_abcLM_SPP+GAPCEN_XXYY" here the string abc refers to the actual type of LM device i.e. 961/068/074 and XXYY refers to the major and minor number of current firmware version.
vi. All the letters in the password are case sensitive e.g. "at*upgrade=LMUPDATEV_068LM_SPP+GAPCEN_0115"
vii. For more details on Firmware upgrade procedure, Refer to the AT*UPGRADEINT command and section 7 "Firmware upgrade on LM devices".

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6. GAP Central Role relates AT commands

This section describes the AT commands for the GAP Central role of LM device to initiate a BLE connection, pair, whitelist, or read/write data to a BLE peripheral device.

The SPP with GAP Central application enables the SPP and BLE connections. If the LM module is in the slave role, it is ready to accept an SPP connection at any time. If the user application only requires GAP Central roles, then set the SPP role as Master and ACON as OFF should be used. This means that adapter will only connect to a remote SPP device when the connection is initiated by the LM device with an AT command.

If the user application requires a SPP connection with ACON ON and BLE connections it's possible that the LM device might connect with a remote SPP master device while reading/writing data on the BLE Peripheral, or while performing some other task. This will be indicated to user with "IND*:CONNECTED=001122334455". If so the user should use the escape sequence i.e. +++ to come out of SPP-Online-Connected mode and then issue the required AT commands.

If the GAP Central role is disabled on LM device then for every AT command of GAP Central functionality or settings, LM device will respond with "ERR" response.

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6.1 GAP Central AT commands in brief

The table below shows the AT commands for the GAP Central role with examples for reference.

Sr no	AT command string	Command type	Default setting	AT command format for reference
1	“AT*ENBGAP”	Query and Set	OFF	AT*ENBGAP=? AT*ENBGAP=ON AT*ENBGAP=OFF
2	“AT*LESEC”	Query and set	OFF	AT*LESEC=ON AT*LESEC=OFF ATLESEC=?
3	“AT*GETCID”	Query only	-	
4	“AT*LEFIND”	Execution only	-	AT*LEFIND=ON AT*LEFIND=OFF
5	“AT*LECONN”	Execution only	-	AT*LECONN=001122334455
6	“AT*LEDROP”	Execution only	-	AT*LEDROP=001122334455
7	“AT*ENBCCFG”	Execution only	-	AT*ENBCCFG=CID,CHAR-Handle e.g. At*enbccfg=5,0019
8	“AT*BLECONN”	Query only	-	AT*BLECONN=?
9	“AT*INDRESP”	Execution only	-	AT*INDRESP=CID e.g. At*indresp=5
10	“AT*FINDSERV”	Execution only	-	AT*FINDSERV=CID e.g. At*findserv=5
11	“AT*FINDCHAR”	Execution only	-	AT*FINDCHAR=CID,Start-Handle,End-Handle e.g. At*findchar=5,0001,ffff
12	“AT*CLRWHITE”	Execution only	-	AT*CLRWHITE

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Sr no	AT command string	Command type	Default setting	AT command format for reference
13	"AT*WRWORESP"	Execution only	-	AT*WRWORESP=CID,Char-Handle,no-of-bytes,actualbytes e.g. at*wrworesp=5,0012,14,0123456789012345678 9
14	"AT*RDCHARVAL"	Execution only	-	AT*RDCHARVAL=CID,char-handle e.g. At*rdcharval=5,0020
15	"AT*WRCHARVAL"	Execution only	-	AT*WRCHARVAL=CID,char-handle,no-of-bytes,actualbytes e.g. at*wrcharval=5,0012,14,0123456789012345678 9
16	"AT*LEAUTOSCAN"	Query and Set	-	AT*LEAUTOSCAN=ON AT*LEAUTOSCAN=OFF AT*LEAUTOSCAN=?
17	"AT*RDMULTCHAR"	Execution only	-	AT*RDMULTCHAR=CID,no-of-read,char-handle1,char-handle-2,char-handle3,char-handle4, char-handle5 e.g. At*rdmultchar=5,05,0003,0005,0008,0008,000a
18	"AT*RDLONGCHAR"	Execution only	-	AT*RDLONGCHAR=CID,Char-Handle e.g. at*rdlongchar=5,0029
19	"AT*SIWRWORESP"	Execution only	-	AT*SIWRWORESP=CID,Char-Handle,no-of-bytes,actual-bytes e.g. at*siwrworesp=5,0028,14,01234567890123456789

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6.2 Enable GAP Central functionality:

6.2.1 "AT*ENBGAP"\r\n

i. Query and Set command.
ii. To query setting use the command "AT*ENBGAP=?"
iii. Response to the query command will be "OK"/"ERR" and report will be "REP*:GAP_ENABLE=ON" or "REP*:GAP_ENABLE=OFF"
iv. By default, this setting is OFF i.e. the GAP Central role is disabled. By default, the LM device is only initialized for the SPP functionality.
v. To enable the GAP Central role, issue the command "AT*ENBGAP=ON".
vi. The LM device will respond with "OK" response and display the message "Adapter soft-Reset.." to indicate that the LM device is performing a soft reset to enable the GAP Central role.
vii. After reset, the adapter shows the power on sequence "SPP+GapCentral_Message_Loop"
viii. If the LM device currently has ENBGAP set to OFF, and command is issued to turn it OFF, the LM device gives an ERR response. Similarly, if the current setting is ON and the command is issued to turn it ON, the LM device will give ERR response.
ix. Response of the "AT*SETTINGS=?" query command depends on the ENBGAP setting.
x. Response of the AT*SETTINGS=? Command displays the settings of LESEC, LE-Auto-Scan only if the ENBGAP is ON.

```
at*enbgap=?at*enbgap=?
OK
REP*:GAP_ENABLE=OFF

at*settings=?at*settings=?
OK
 NAME=LM068_GAP_Central
 ADDR=0002-5b-00a5a5
 FLOW=OFF
 SPPRole=SLAVE
 ACON=OFF
 BOND=0000-00-000000
 DPIN=OFF
 PIN=1234
 GAP_ENABLE=OFF
 VER=074LM_GAPCEN_01.06
REP*:SETTINGS=END

at*enbgap=offat*enbgap=off
ERR

at*enbgap=onat*enbgap=on
OK
 Adapter soft-Reset..SPP+GapCentral_Message_Loop

 GATT Initialised
REP*:LESEC=Success


at*settings=?at*settings=?
```

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```
OK
 NAME=LM068_GAP_Central
 ADDR=0002-5b-00a5a5
 FLOW=OFF
 SPPRole=SLAVE
 ACON=OFF
 BOND=0000-00-000000
 DPIN=OFF
 PIN=1234
 GAP_ENABLE=ON
 LE_SEC=OFF
 LE_AUTO_SCAN=ON
 VER=074LM_GAPCEN_01.06
REP*:SETTINGS=END

at*enbgap=?at*enbgap=?
OK
REP*:GAP_ENABLE=ON

at*enbgap=onat*enbgap=on
ERR

at*enbgap=offat*enbgap=off
OK
  Adapter soft-Reset..SPP+GapCentral_Message_Loop
```

6.3 BLE discovery commands:

6.3.1 "AT*LEFIND"\r\n

i. Execution only command.
ii. To begin discovery of nearby BLE peripheral devices, issue command "AT*LEFIND=ON"
iii. The LM device will respond as OK if it is not already scanning the BLE devices, otherwise it will respond as ERR.
iv. The LM device reports the name and BT address of the device as soon as it finds the advertisement packet and keeps on updating the report as devices are discovered.
v. The LM device stops the BLE scanning process when it finds 10 BLE devices and displays END of report string.
vi. There is no time limit set in the firmware to end the BLE devices discovery process. If the user wants to terminate the discovery process, issue the command "AT*LEFIND=OFF".
vii. If LM device is executing the BLE devices discovery process and displaying the discovered devices and user issues a connection request to establish BLE connection then LM device terminates the discovery process and executes the BLE connection procedure.
viii. The LM device indicates the beginning and end of discovery report as "REP*:BLE_SCAN_REP=START" and "REP*:BLE_SCAN_REP=END" respectively.
ix. Below is an example report for BLE peripheral devices discovery:

```
"at*lefind=onat*lefind=on
OK
```

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```
REP*:BLE_SCAN_REP=START
 = 1 :1028-00-5b0002 :0
 = 2 :1032-00-5b0002 :0
 = 3 :3333-33-333333 :0
 = 0: 3333-33-333333, LM Serial Server
 = 4 :8863-df-be936c :0 :LML8
 = 5 :0000-00-000000 :3
 = 6 :1029-00-5b0012 :0 :CSR BP Sensor
 = 7 :1030-00-5b0012 :0 :CSR HR Sensor
 = 8 :1031-00-5b0012 :0 :CSR HR Sensor
at*lefind=offÑlefind=off
at*lefind=offat*lefind=off
OK"
```

x. If the user terminates the scanning process by issuing the "AT*LEFIND=OFF" command, the adapter responds to it with an OK/ERR message but it does not issue an end of report message.

xi. When the adapter finds a BLE advertising report, it does not show the device in the report immediately, it waits for the advertising packet in which BLE-Device-name is included.
    a. If the adapter finds address and name in the same packet, it displays both the address and the name.
    b. If the adapter finds address only it shows address and waits for name.
    c. When the adapter finds name of the device for which it has reported address previously, it will show name in report with the serial number as 0 to indicate this is not new device but only name is appended for the device already reported.

xii. If the LM device has setting "AT*LESEC=OFF", LM device reports BLE devices even if those are not present in its Whitelist. If setting is "AT*LESEC=ON", then LM device will only report advertisings from the devices which are in its whitelist.

xiii. In the discovery report, after the BD-address there is an indication for "advertising Indication type" ranging from 0 to 5 as mentioned below.
    a. ble_adv_event_connectable_undirected = 0 = Connectable Undirected Advert.
    b. ble_adv_event_connectable_directed = 1 = Connectable Directed Advert.
    c. ble_adv_event_discoverable = 2 = Discoverable advert.
    d. ble_adv_event_non_connectable = 3 = Non-connectable.
    e. ble_adv_event_scan_response = 4 = Scan Response.
    f. ble_adv_event_unknown = 5 = Unknown event type.

xiv. The LM device with SPP with GAP central application also supports SPP connection. The adapter may establish a SPP connection while performing LE discovery. When the adapter connects with the SPP device, it enters in SPP-Data mode and shows data from the remote device on UART. It treats data sent on local UART as data to be sent to remote device. To access UART for commands and

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responses, the user needs to use the escape sequence and then continue with other AT commands.

xv. Refer to the screenshots below.

```
at*lefind=onat*lefind=on
OK
REP*:BLE_SCAN_REP=START
 = 1 :1032-00-5b0002 :0
 = 2 :1028-00-5b0002 :0
 = 3 :3333-33-333333 :0
 = 0: 3333-33-333333, LM Serial Server
 = 4 :8863-df-be936c :0 :LML8
IND*:CONNECTED=0012-6f-0819c2
+++OK
 = 7 :2053-ca-20126e :0
 = 8 :2053-ca-20126f :0
at*lefind=offat*lefind=off
OK
```

xvi. Data during the SPP connection and receive of escape command is lost in this report (data is lost as UART is given to SPP connection).

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6.4 BLE security commands:

6.4.1 "AT*LESEC"\r\n

i. Query and Set command.
ii. LESEC stands for Low Energy Security i.e. whether to apply whitelist security or not.
iii. Query command to query the setting is "AT*LESEC=?".
iv. Query report is "REP*:LE_SEC=OFF" or "REP*:LE_SEC=ON".
v. When LESEC is ON, the LM device will scan advertising packets only from whitelist added devices and connect to the devices already added to whitelist (i.e. already BLE paired devices)
vi. When LESEC is OFF, the LM device will scan and connect to any BLE discoverable and connectable device (LM device will discover and connect any device even if it is not paired with adapter before)

Note: If the user wants to add a new device in the whitelist of the LM device then while establishing the connection with the device at first time user should use setting "AT*LESEC=OFF". This enables the authentication procedure to start to add a new device to the white list.
Once the LM device completes the pairing procedure successfully the BLE device is added to its white list. Then the LM device can use the setting "AT*LESEC=ON" for further connections with the same device.

6.4.2 "AT*CLRWHITE"\r\n

i. Execution only command.
ii. This command is used to delete all the devices from BLE paired devices list i.e. White list.
iii. Command format is "AT*CLRWHITE"
iv. Adapter responds OK and deletes all the BLE paired devices from the whitelist.

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6.5 BLE connection commands:

6.5.1 "AT*LEAUTOSCAN"\r\n

i. Query and set command.
ii. Enable or disable the feature to scan the connected BLE peer device automatically for its services.
iii. Low energy auto scan query: "AT*LEAUTOSCAN=?".
iv. Low energy auto scan query report: "REP*:LE_AUTOSCAN_SERVER=ON" (Adapter default setting as LE-Auto-Scan enabled)
v. Low energy auto scan enable command: : "AT*LEAUTOSCAN=ON".
vi. Low energy auto scan disable command: : "AT*LEAUTOSCAN=OFF"
vii. If LEAUTOSCAN setting is OFF, Then LM device does not scan the Peer device for its services and characteristics automatically. User need to issue "AT*FindServ=CID" command to start the service discovery.

6.5.2 "AT*BLECONN"\r\n

i. Query only command.
ii. User can query the number of current BLE connections the LM device has established and details for those connections.
iii. Command format is : "AT*BLECONN=?"
iv. GAP Central application can have maximum 5 BLE connections simultaneously.
v. Example report for this command shall be as shown below

```
at*BLECONN=?at*BLECONN=?
OK
REP*:BLE_CONN
 = 1 : 3333-33-333333 : 0101
 = 2 : 1030-00-5b0012 : 0182
 = 3 : 1032-00-5b0002 : 0203
 = 4 : Open
 = 5 : Open
REP*:BLE_CONN END
```

vi. The report above shows that the LM device is now connected with the three BLE peripheral devices. The report lists connection ID given by the LM device, remote device BD-Address and Connection-ID i.e. CID given by BLE stack.
vii. Start and end of report is mentioned.
viii. E.g. In above report, row "= 3 : 1032-00-5b0002 : 0203" mentions that LM device has 3rd BLE connection with 1032-00-5b0002 device and CID given by BLE stack is 0203.

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ix. CID given in above response is referred while reading/writing data with AT commands, reporting disconnection, notification etc. User should note this carefully.
x. Response to this AT command depends on current state of the LM device for BLE connections.
xi. In a scenario where LM device had established 3 connections as shown above and if it drops connection 2 then the response to command AT*BLECONN=? Will be

```
at*BLECONN=?at*BLECONN=?
OK
REP*:BLE_CONN
 = 1 : 3333-33-333333 : 0101
 = 2 : Open
 = 3 : 1032-00-5b0002 : 0203
 = 4 : Open
 = 5 : Open
REP*:BLE_CONN END
```

6.5.3 "AT*LECONN"\r\n

i. Execution only command
ii. This command is used to establish BLE connection between LM device and the remote BLE peripheral device.
iii. User need to mention the BD address of the remote device with which the BLE connection is to be established, e.g. if the command "at*leconn=1031-00-5b0012" is issued to LM device, then it starts BLE connection procedure with "1031-00-5b0012" device.
iv. Response to this command will be ERR if any of the following is true
    a. string format is incorrect
    b. BT address is invalid
    c. 5 BLE connections are already established
    d. GAP role is not enabled
v. Response to this command will be OK if all the following conditions are true
    a. Command string format is correct
    b. BT address is valid
    c. Adapter has at least one BLE connection open
vi. After displaying OK response, LM device starts the BLE connection procedure.
vii. If the connection is failed the report is given with the error code e. g. "REP*:BLE_CONN_FAIL:=1031-00-5b0012,4 err_code:0014"\r\n.
viii. Refer the Error code list mentioned in the appendix section.
ix. If the adapter is successfully connected to a remote device it will show a report with details about the connection. E.g. "REP*:BLE_CONNECTED:=1030-00-5b0012-0 : 1 : 0080 : 0017 : 0008"\r\n
x. Here report includes extra information for the connection details as below.
    a. 1030-00-5b0012 is BD address of the remote BLE device.
    b. -0 with the address mentions Address type of remote BLE device.

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c. TYPED_BDADDR_PUBLIC is noted as 0, TYPED_BDADDR_RANDOM is noted as 1.
d. 1 indicates Connection ID given by the LM device (refer to BLEconn=? report).
e. 0080 mentions CID given by BLE stack (hex value 0x0080).
f. 0017 is MTU i. e. Maximum Transfer Unit for this BLE connection (hex value 0x0017).
g. 0008 is Connection configuration flag (hex value 0x0008)

xi. User should take note of MTU mentioned in connection report. User can read or write maximum of MTU number of bytes from/to the device (rdcahval/wrworesp etc). If user need to read/write more than MTU number of bytes, it needs two commands.

```
at*leconn=1030005b0012at*leconn=1030005b0012
OK
REP*:BLE_CONNECTED:=1030-00-5b0012-0 : 1 : 0080 : 0017 : 0008
BLE Auth start
OK
REP*:SERVICE START: =1030-00-5b0012
 = 1 : 1801 : 0001 : 0004
 = 2 : 1800 : 0005 : 000b
 = 3 : 180d : 000c : 0013
 = 4 : 180f : 0014 : 0017
REP*:BLE_PAIR=1030-00-5b0012,Success
 = 5 : 00001016d10211e19b2300025b00a5a5 : 0018 : 0021
 = 6 : 180a : 0022 : ffff
REP*:SERVICE END: =1030-00-5b0012
```

xii. BLE Pairing:
a. After LM device is connected with Peer device, If LESEC i.e. LE Security is OFF, LM device starts BLE Authentication process and Shows message "BLE Auth start" to indicate start of authentication process.
b. If LESEC is ON, adapter will report or connect to only with previously Paired devices which are present in its whitelist.
c. Pairing Success or Failure indication report is given to user as "REP*:BLE_PAIR=1030-00-5b0012,Success" or "REP*:BLE_PAIR=1030-00-5b0012,Fail" .
d. After LM device completes the pairing procedure successfully, it adds this device to its whitelist automatically.
e. Pairing procedure runs at the background and LM device can show the status message of pairing procedure at any time. e.g. above report shows the pairing report has displayed while showing Service-scan report.

xiii. If LEAutoScan server setting is ON then, LM device starts scanning services supported on the remote device and displays the report. If LEAutoScan server setting is OFF, LM device waits for commands from user to scan the services (FINDSERV).

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6.5.4 “AT*LEDROP”\r\n

i. Execution only command
ii. Command is used to disconnect the BLE connection. Command requires peer devices BT address.
iii. BLE connection disconnection command format:
“AT*LEDROP=1030005b0012”\r\n
iv. Response for BLE drop connection will be OK if the LM device is connected to the BLE device with the same address provided in Drop command.
v. Response for BLE drop connection will be ERR if the LM device is not connected with BLE device or BD address mentioned in the AT command is not same as any of the connected BLE device.
vi. Adapter shows a report for the disconnection command e.g.

```
at*ledrop=1030005b0012at*ledrop=1030005b0012
OK
REP*:BLE_DIS_CONN:=1030-00-5b0012,2 err_code:0000
```

vii. Error code 0000 mentions the device has terminated connection gracefully i.e. either device started disconnection procedure.
viii. Number 2 near the BD address mentions the BLE Connection ID (refereed to BLEconn=? response).
ix. If disconnection is started by remote device or due to link loss the indication for disconnection is shown as below with the reason code.
“REP*:BLE_DIS_CONN:= 1030-00-5b0012,2 err_code:0019”
x. Refer to the error code in the appendix.

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6.6 BLE Services/characteristic scan commands:

6.6.1 "AT*FINDSERV"\r\n

i. Execution only command
ii. Command is used to scan services supported on connected BLE device.
iii. User needs to state connection ID for the device whose services are to be scanned. E. g. "at*findserv=1" finds services on 1st connected device.
iv. The LM device provides a detailed report for the services supported by the remote BLE device.
v. BLE service UUID can be 16 bit or 128 bit long. If the remote BLE device has any service with 128-bit UUID then it is indicated with all bytes.
vi. IN below report the row mentions " 1 : 1800 : 0001 : 0005 " where "1" is serial number, "1800" is 16bit UUID for service, "0001" is start handle of the service and "0005" is end handle of the service.
vii. Report is marked for start and end.
viii. For e.g refer below report.

```
at*findserv=1at*findserv=1
OK
REP*:SERVICE START: =3333-33-333333
 = 1 : 1800 : 0001 : 0005
 = 2 : 180a : 0006 : 0016
 = 3 : 00005500d10211e19b2300025b00a5a5 : 0017 : 001a
 = 4 : 180f : 001b : ffff
REP*:SERVICE END: =3333-33-333333
```

6.6.2 "AT*FINDCHAR"\r\n

i. Execution only command
ii. Command used to scan characteristics supported by services on the BLE device.
iii. User needs to mention connection ID for the device whose services are to be scanned. And start and end handle of the services for which scan is to be performed.
iv. User can scan characteristics for only one service or multiple services or for all services in single command.

```
at*findserv=1at*findserv=1
OK
REP*:SERVICE START: =3333-33-333333
 = 1 : 1800 : 0001 : 0005
 = 2 : 180a : 0006 : 0016
 = 3 : 00005500d10211e19b2300025b00a5a5 : 0017 : 001a
 = 4 : 180f : 001b : ffff
REP*:SERVICE END: =3333-33-333333
```

v. Considering the above report for services, below are the possible commands.

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a. Scan characteristics of single service i.e. 1800 service, handles are 0001 and 0005. Command should be "AT*findchar=1,0001,0005"
b. Scan characteristics for first two services i.e. 1800 and 180a. User shall issue command as "at*findchar=0001,0016".
c. Scan characteristics of all services in single command, user shall issue command "at*findchar=1,0001,ffff".

vi. Report is marked for start and end.
vii. The example report below shows a characteristic scan command report.

```
at*findchar=1,0001,001bat*findchar=1,0001,001b
OK
REP*:CHAR start
 =1: 2a00 : 0003 : 02 : 0002 [ Rd ]
 =2: 2a01 : 0005 : 02 : 0004 [ Rd ]
 =3: 2a25 : 0008 : 02 : 0007 [ Rd ]
 =4: 2a24 : 000a : 02 : 0009 [ Rd ]
 =5: 2a23 : 000c : 02 : 000b [ Rd ]
 =6: 2a27 : 000e : 02 : 000d [ Rd ]
 =7: 2a26 : 0010 : 02 : 000f [ Rd ]
 =8: 2a28 : 0012 : 02 : 0011 [ Rd ]
 =9: 2a29 : 0014 : 02 : 0013 [ Rd ]
 =10: 2a50 : 0016 : 02 : 0015 [ Rd ]
 =11: 00005501 : 0019 : 14 : 0018 [ Wr_cmd CCFG ]
REP*:CHAR END
```

viii. For report above, the row "=1: 2a00 : 0003 : 02 : 0002 [Rd]" indicates "1" as serial number, "2a00" as 16 bit characteristic UUID, "0003" is characteristic handle, "02" is properties value and "0002" is declaration value for that characteristic.
ix. For details on Characteristic value and Declaration values refer appendix A.
x. "=11: 00005501 : 0019 : 14 : 0018 [Wr_cmd CCFG]" row indicates the characteristic has 128 bit UUID, but here only lower 32 bits are displayed. "0019" is characteristic handle. "14" is properties value, this characteristic has two properties as WR-cmd and CCFG. "0018" is declaration value for that characteristic.
xi. User needs to use characteristic-Handle to read or write data on that characteristic.

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6.7 BLE read data from Characteristic:

6.7.1 "AT*RDCHARVAL"\r\n

i. Execution only command
ii. This command is used to read data from the BLE device for the characteristic which has properties as read "Rd" i.e. 0x02.
iii. The command format is "AT*RDCHARVAL=conn-ID, char-Handle".
iv. e.g. "at*rdcharval=1,0003" command is used to read data from 1st connected device, for characteristic 0003.
v. The LM device shall output an OK response if the CID and the Char-handle is correct.
vi. After the LM device gives OK response to read command, adapter shows data received from remote device as a report.
vii. E.g. "REP*:RDCHARVAL=1:Rcvd_Bytes:0010 LM Serial Server" is a report of read data for characteristic 0003.
viii. Report shows connection ID as 1, Received bytes as 0x10 i.e. 16 bytes, and the actual bytes are "LM Serial Server".
ix. If LM device receives an error response from remote BLE device, it is reported to the user with the error code.
x. Users can refer to error codes as mentioned in the appendix section.

```
at*rdcharval=1,000cat*rdcharval=1,000c
OK
REP*:RDCHARVAL=0001:Err_code:02
```

xi. Below show some reference reports for read command.

```
at*rdcharval=1,0003at*rdcharval=1,0003
OK
REP*:RDCHARVAL=1:Rcvd_Bytes:0010
LM Serial Server

at*rdcharval=1,0005at*rdcharval=1,0005
OK
REP*:RDCHARVAL=1:Rcvd_Bytes:0002

at*rdcharval=1,000aat*rdcharval=1,000a
OK
REP*:RDCHARVAL=1:Rcvd_Bytes:0016
CSR-GATT-SERVER-MODEL-

at*rdcharval=1,000cat*rdcharval=1,000c
OK
REP*:RDCHARVAL=0001:Err_code:02
```

xii. Above screenshots are taken on Hercules software on Windows PC, it does not show non-printable characters in received response. If user analyse the RX line on Oscilloscope or protocol analyser, all bytes can be seen.

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6.7.2 “AT*RDMULTCHAR”\r\n

i. Execution only command
ii. This command is used to read data from multiple characteristics on a single remote device.
iii. User can read data from remote BLE device for the characteristic which has properties as “Rd” i.e. 0x02.
iv. Maximum of 5 characteristic’s data can be read in one single command.
v. Command format is “AT*RdMultChar=conn-ID, no-of-chars-to-read, char-Handle1, char-Handle2, char-Handle3, char-Handle4, char-Handle5,”.
vi. e.g. command to read data from 3 characteristics shall be “at*rdmultchar=1,03,0008,000a,0010” command is used to read data from 1st connected device, on characteristic 0003, 0008 and 0010.

at*rdcharval=1,0008at*rdcharval=1,0008
OK
REP*:RDCHARVAL=1:Rcvd_Bytes:0005
SR_no

at*rdcharval=1,000aat*rdcharval=1,000a
OK
REP*:RDCHARVAL=1:Rcvd_Bytes:0006
mod_no

at*rdcharval=1,0010at*rdcharval=1,0010
OK
REP*:RDCHARVAL=1:Rcvd_Bytes:0006
FW_Ver

at*rdmultchar=1,03,0008,000a,0010at*rdmultchar=1,03,0008,000a,0010
OK
REP*:RDMULTCHAR=1:Success length:0011
SR_nomod_noFW_Ver

vii. If the read number of bytes from characteristics exceeds than MTU bytes then lower bytes are lost and only first MTU bytes are reported. This is limitation of BLE stack and not of LM device application.
viii. E.g. refer below response. (last bytes form 0003 characteristic are lost while reading multiple characteristics in one command)

at*rdcharval=1,0008at*rdcharval=1,0008
OK
REP*:RDCHARVAL=1:Rcvd_Bytes:0005
SR_no

at*rdcharval=1,000aat*rdcharval=1,000a
OK
REP*:RDCHARVAL=1:Rcvd_Bytes:0006
mod_no

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at*rdcharval=1,0010at*rdcharval=1,0010
OK
REP*:RDCHARVAL=1:Rcvd_Bytes:0006
FW_Ver

at*rdcharval=1,0012at*rdcharval=1,0012
OK
REP*:RDCHARVAL=1:Rcvd_Bytes:0007
App_ver

at*rdcharval=1,000eat*rdcharval=1,000e
OK
REP*:RDCHARVAL=1:Rcvd_Bytes:000b
CSR101x A05

at*rdmultchar=1,05,0008,000a,0010,0012,000eat*rdmultchar=1,
05,0008,000a,0010,0012,000e
OK
REP*:RDMULTCHAR=1:Success length:0016
SR_nomod_noFW_VerApp_v

ix. Above screen shots are taken on Hercules software on Windows PC, it does not show non printable characters in received response. If user analyse the RX line on Oscilloscope or protocol analyser, all bytes can be seen.

6.7.3 "AT*RDLONGCHAR"\r\n

i. Execution only command
ii. When the Characteristic Value is longer than can be sent in a single Read Response message, user can use this command to read that value in one command.
iii. User can read data from remote BLE device for the characteristic which has properties as "Rd" i.e. 0x02.
iv. Command format is "AT*RdLongChar=conn-ID, char-Handle".
v. Commands which support "rdcharval" can also be read by this command.
vi. Response to the command shows bytes received, offset of current data with respect to the whole data, and MoreToCome (MTC) flag if there is next data packet expected on the same characteristic read.
vii. Refer following read examples for more detail.

at*leconn=333333333333at*leconn=333333333333
OK
REP*:BLE_CONNECTED:=3333-33-333333-0 : 1 : 0100 : 0017 : 0008
BLE Auth start
OK
REP*:SERVICE START: =3333-33-333333
= 1 : 1800 : 0001 : 0005
= 2 : 180a : 0006 : 0016
= 3 : 00005500d10211e19b2300025b00a5a5 : 0017 : 001a
= 4 : 180f : 001b : ffff
REP*:SERVICE END: =3333-33-333333

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```
                    at*rdlongchar=1,0008
OK
REP*:RDLONGCHAR=1:0008:Success  Rcvd:0005 Offset:0000
MTC:0
SR_no

                    at*rdlongchar=1,000a
OK
REP*:RDLONGCHAR=1:000a:Success  Rcvd:0024 Offset:0000
MTC:0
abcdEFGHIJklmnopQRSTUvwxyz0123abcdEF

                    at*rdlongchar=1,000c
OK
REP*:RDLONGCHAR=1 Err_code:0002

                    at*rdlongchar=1,0005
OK
REP*:RDLONGCHAR=1:0005:Success  Rcvd:0002 Offset:0000
MTC:0

                    at*rdlongchar=1,0003
OK
REP*:RDLONGCHAR=1:0003:Success  Rcvd:0010 Offset:0000
MTC:0
LM Serial Server
```

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6.8 BLE write data on Characteristic:

6.8.1 "AT*ENBCCFG"\r\n

i. Execution only command.
ii. Command used to enable the Client-Configuration-Flag (CCFG) on a specific characteristic.
iii. When the LM device scans the characteristics of the connected BLE device, it shows the CCFG flag if supported by that characteristic. E.g Serial-Over-Gatt service supports this flag (highlighted yellow in below report).
iv. While issuing command, user should mention the device-connection-ID and characteristic handle.
v. E.g The device 1 has CCFG flag characteristic with handle 0019. To enable the CCFG flag use command "at*enbccfg=1,0019".
vi. LM device shall give OK response if the characteristic has CCFG flag otherwise adapter shall give ERR response or invalid Characteristic handle is supported.
vii. After the LM device responds with "OK", the adapter receives feedback from the BLE device regarding success or failure, which is reported to the user.
viii. The report "REP*:WRCHARVAL=1:Success" shows enable CCFG operation is performed successfully.

```
at*findchar=1,0001,001bat*findchar=1,0001,001b
OK
REP*:CHAR start
 =1: 2a00 : 0003 : 02 : 0002 [ Rd ]
 =2: 2a01 : 0005 : 02 : 0004 [ Rd ]
 =3: 2a25 : 0008 : 02 : 0007 [ Rd ]
 =4: 2a24 : 000a : 02 : 0009 [ Rd ]
 =5: 2a23 : 000c : 02 : 000b [ Rd ]
 =6: 2a27 : 000e : 02 : 000d [ Rd ]
 =7: 2a26 : 0010 : 02 : 000f [ Rd ]
 =8: 2a28 : 0012 : 02 : 0011 [ Rd ]
 =9: 2a29 : 0014 : 02 : 0013 [ Rd ]
 =10: 2a50 : 0016 : 02 : 0015 [ Rd ]
 =11: 00005501 : 0019 : 14 : 0018 [ Wr_cmd CCFG ]
REP*:CHAR END


at*enbccfg=1,0019at*enbccfg=1,0019
OK
REP*:WRCHARVAL=1:Success
```

6.8.2 "AT*INDESPr\n

i. Execution only command.

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ii. In SPPC_XXYY application, the LM device has BLE role as BLE-GAP-Central/Client and remote BLE device has the role as BLE-Peripheral device/Server.
iii. This command facilitates user to send feedback to server/peripheral i.e. remote BLE peripheral device for notification indication received from that server/peripheral device.
iv. This command is used to acknowledge the sever that client (BLE-Central/LM device) has received characteristic value Indication, and server(BLE-Peripheral/remote BLE device) may send another indication.
v. Command format is "at*INDRESP=Conn-ID".
vi. e.g. "AT*INDRESP=1" gives indication response for 1st connected BLE device for receiving notification indication.
vii. OK/ERR response is given by LM device after checking the Connection ID and Connection status.
viii. After OK response is given Response is forwarded to remote device by BLE-Stack.
ix. No feedback form BLE-Stack is provided to this command.

6.8.3 "AT*WRWORESP"\r\n

i. Execution only command
ii. This command is used to send data to remote BLE device with the properties as "Wr_cmd" i.e. 0x04.
iii. Command format is "AT*WRWORESP=conn-ID, char-Handle, length, actual-bytes ".
iv. e.g. "at*wrworesp=1,0019,10,12345abcdef!()12" command is used to send data to 1st connected device, on characteristic 0019. No of bytes to write are 0x10 i.e. 16 and actual bytes are 1,2,3,4,5,a,b,c,d,e,f,!,(,),1,2.
v. As shown in the example command, the number of bytes to transmit is hex value.
vi. As shown in the example command, actual data bytes are not separated by a comma. When the value 0x31 and 0x32 are sent i.e. ASCII 1 and 2 numbers are sent, the data buffer is copied and sent to remote device transparently.
vii. **Note :** The actual data bytes to be sent shall not have "\r\n" as the data itself because it is the terminating string for AT command parser.
viii. For command "AT*WRWORESP=conn-ID, char-Handle, length, actual-bytes" adapter gives OK response if all the following conditions are true:
    a. connection ID is correct (if adapter is connected to 3 devices and CID mentions 4, then it is invalid)
    b. Characteristic handle has WR_cmd properties
    c. Value of "length" field is less than 21 i.e. (0x15), This is BLE stack limitation.
    d. Actual data bytes are same as value of "length" field.

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ix. After the LM device responds to the above command with "OK", the LM device sends the data to the remote BLE device.
x. If the remote device receives the data and sends feedback to the LM device, that feedback is reported to user.
xi. E.g. report shows, "REP*:WRWORESP=1:0019:Success" which indicates the data has been received by the remote device successfully. 1 is the CID-given by LM device and 0019 is the characteristic handle.

```
at*wrworesp=1,0019,05,12345at*wrworesp=1,0019,05,12345
OK
REP*:WRWORESP=1:0019:Success
at*wrworesp=1,0019,10,12345abcdef!()12at*wrworesp=1,0019,10,1
2345abcdef!()12
OK
REP*:WRWORESP=1:0019:Success
```

6.8.4 "AT*WRCHARVAL"\r\n

i. Execution only command
ii. This command is used to send data to BLE device with the properties as "Wr_req" i.e. 0x08.
iii. Command format is "AT*WRCHARVAL=conn-ID, char-Handle, length, actual-bytes".
iv. e.g. "at*WRCHARVAL=1,0019,10,12345abcdef!()12" command is used to send data to 1st connected device, on characteristic 0019. No of bytes to write are 16 (0x10) and actual bytes are 12345abcdef!()12.
v. As shown in the example command, no of bytes to transmit is hex value
vi. As shown in the example command, actual data bytes are not separated by comma. When the values 0x31 and 0x32 are sent i.e. ASCII 1 and 2 are sent, the data buffer is copied and sent to remote device transparently.
vii. **Note :** The actual data bytes to be sent should not have "\r\n" as the data itself because it is the terminating string for AT command parser.
viii. For command "AT*WRWORESP=conn-ID, char-Handle, length, actual-bytes" adapter gives OK response if all the following conditions are true:
    a. connection ID is correct (if adapter is connected to 3 devices and CID mentions 4, then it is invalid)
    b. Characteristic handle has Wr_req properties
    c. Value of "length" field is less than 21 i.e. (0x15). This is BLE stack limitation.
    d. Actual data bytes are same as value of "length" field.

ix. After adapter responds to this command as "OK", adapter sends the data to remote BLE device.

```
at*findchar=2,0001,ffffat*findchar=2,0001,ffff
OK
```

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```
REP*:CHAR start
 =1: 2a05 : 0003 : 20 : 0002
[ Indi ]
 =2: 2a00 : 0007 : 0a : 0006
[ Rd Wr_req ]
 =3: 2a01 : 0009 : 02 : 0008
[ Rd ]
 =4: 2a04 : 000b : 02 : 000a
[ Rd ]
 =5: 2a37 : 000e : 10 : 000d
[ CCFG ]
 =6: 2a38 : 0011 : 02 : 0010
[ Rd ]
 =7: 2a39 : 0013 : 08 : 0012
[ Wr_req ]
 =8: 2a19 : 0016 : 12 : 0015
[ Rd CCFG ]
 =9: 00001013 : 001a : 0a : 0019
[ Rd Wr_req ]
 =10: 00001018 : 001c : 08 : 001b
[ Wr_req ]
REP*:CHAR END

at*wrcharval=2,0013,05,12345at*wrcharval=2,0013,05,12345
OK
REP*:WRCHARVAL=2:Err_code:fd
at*wrcharval=2,0007,05,12345at*wrcharval=2,0007,05,12345
OK
REP*:WRCHARVAL=2:Success

at*wrcharval=2,0007,05,abCDEat*wrcharval=2,0007,05,abCDE
OK
REP*:WRCHARVAL=2:Success
at*wrcharval=2,001c,05,abCDEat*wrcharval=2,001c,05,abCDE
OK
REP*:WRCHARVAL=2:Err_code:0d
at*wrcharval=2,001a,05,abCDEat*wrcharval=2,001a,05,abCDE
OK
REP*:WRCHARVAL=2:Err_code:0e
at*wrcharval=2,0013,05,abCDEat*wrcharval=2,0013,05,abCDE
OK
REP*:WRCHARVAL=2:Err_code:fd
```

x. If the remote device receives the data and sends feedback to the LM device, that feedback is reported to the user.
xi. Above report shows the WRCharval command is successful only on characteristic 0005 and 0007.
xii. If the WrCharVal command fails in execution, then the error code reported by BLE-stack is reported to user in failure report. E.g. Err_code:fd , Err_code:0e, Err_code:0d
xiii. Refer Appendix section for more details on error code.

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