

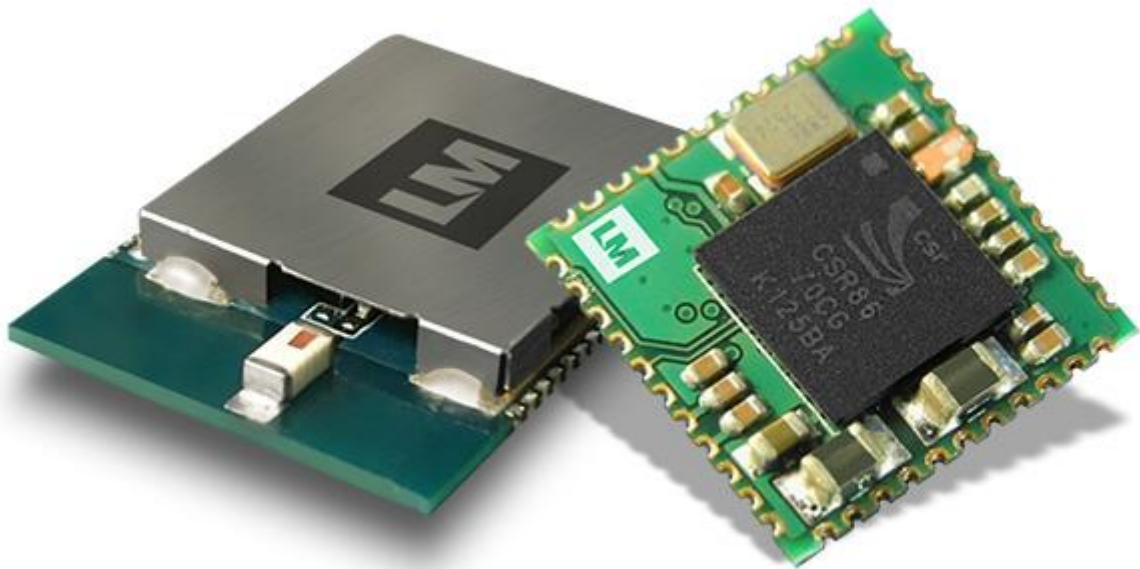


LM74x

LM Audio FW LM74x_ATSRC_0103

AGHFP, SPP, GATT

USER GUIDE



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Revision	Date	Changes Description
v1.0	07/12/2017	First revision of this document.
V2.0	11/01/2017	Added commands for BLE manager role with firmware version "LM74X_ATSRC_0103"
V2.1	05/31/2018	Minor revisions.

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1. Introduction

This document describes the AT command structure for the LM746/LM747 module software.

Serial terminals like Hercules, HyperTerminal, Tera Term, Putty or microcontroller/processor-UART can be used for serial communication with the device.

AT Commands are case insensitive e.g. “At*Resp=On”, “at*resp=on” and “AT*RESP=ON” are all valid commands with the same functionality.

Every command is terminated with “CR-LF”. The module will start parsing the AT command strings after receiving this sequence.

The modules may output reports to the user through UART to indicate connection/pairing requests, results of connection/pairing and results of Bluetooth device discovery and disconnection.

After the indication message is displayed the module will wait for input from the user to execute further action for some commands. For example, after an incoming pairing indication the user should enter either accept/reject to respond. Or, after an indication for PASSKEY_cfm, the user should enter either yes/no to confirm the passkey.

For every AT command issued by the user via UART, the module will respond with either OK/ERR.

Some AT commands expect the Bluetooth address to be in the string. In this document “001122334455” is considered as the reference Bluetooth address, whereas 0011 is nap, 22 is uap and 334455 is lap in the Bluetooth address. Users should use the Bluetooth address of their devices.

Note:

Firmware version “LM74x_ATSRC_0103” has the same capabilities as “LM74x_ATSRC_0102” with the addition of the BLE serial over GATT service. This enables the BLE-GAP-Central device (e.g. Android tablet or Phone) to send/receive data whilst the module acts as a BLE-Peripheral.

2. UART Settings

The module firmware supports AT commands on UART at fixed settings.

UART settings are Baud=115200, Parity=None, Stop-Bit=1, Data-bits=8.
UART Flow-Control is off.

Every AT command string is terminated with the “\r\n” sequence.

3. LED Indication

3.1 Power on LED sequence

1. All LEDs will blink fast during power on for 3 seconds. The LEDs will blink 6 times.
2. The module shows the power on LED sequence after AT*Reset=1 and AT*Reset=2 commands.

3.2 LED0

1. LED0 will keep blinking to indicate that the module is powered and active for AT commands, Bluetooth discovery, audio or SPP functionality.
2. If LED0 is not blinking the module may not be powered correctly, or not initialised.
3. The state of LED0 is irrespective of SPP and HSP connection or pairing state.

3.3 LED1

1. LED1 indicates the HSP connection.
2. When the module is not connected to the HSP device, LED1 is OFF.
3. When the module is connected to the HSP device but the audio is not active, LED1 will blink at a fast rate.
4. When the module is connected to the HSP device and has an active audio connection, LED1 will blink at a slow rate.

3.4 LED2

1. LED2 indicates the SPP connection.
2. When the module is not connected to the SPP device, LED2 is OFF.
3. When the module is connected to the SPP device and is in “SPP-connected-online-Command” mode, i.e. send SPP data using AT command or receives SPP data as an indication, LED1 blinks at fast rate.
4. When the module is connected to the SPP device and is in “SPP-connected-online-data” mode, i.e. module UART transparently sends

and receives the data to/from the SPP device, LED1 will blink at a slow rate when it is waiting for the escape sequence.

3.5 Pairing mode LED Sequence

1. LED1 and LED2 display fast blinking when the module initiates an outgoing pairing procedure, or the module has accepted the incoming pairing request.
2. After completing the incoming or outgoing pairing procedure, LED1 and LED2 show the states as per HSP and SPP connection respectively.

4. General Commands

4.1 ECHO

1. AT*ECHO=ON (default ON)
2. AT*ECHO=OFF
3. AT*ECHO=?
4. The default echo setting is ON i. e. the module echoes back any string entered on the UART TX line.
5. Echo can be turned off with the command AT*ECHO=OFF
6. The current setting of ECHO can be queried using query command AT*ECHO=? , response to this command should be "REP*:ECHO=ON" / "REP*:ECHO=OFF".

4.2 RESP

1. AT*RESP=?
2. AT*RESP=ON (default ON)
3. AT*RESP=OFF
4. Any data entered on UART when terminated by \r\n is considered as an AT command, and decoded by AT command parser.
5. For every AT command, the AT command parser responds with either OK/ERR if the Response setting is ON.
6. The default Response setting is ON. It can be turned OFF with the command AT*RESP=OFF, the current setting can be queried by command AT*RESP=?

4.3 ADDR

1. AT*ADDR=?
2. The module's Bluetooth device address can be queried with the command "AT*ADDR=?". The module will respond with "REP*:ADDR=001122334455"

4.4 NAME

1. AT*NAME=?
2. AT*NAME=TESTname1234
3. The module name can be queried, or set with the NAME command.

4. The module name can be 31 bytes long including numbers, letters and characters represented by the ASCII character set.
5. A name set by the NAME command will appear in Bluetooth device discovery.

4.5 RESET=1

1. The module supports a RESET command at two different levels.
2. AT*RESET=1 causes the firmware to reset and start execution as if a new power cycle is applied.
3. Retains all user modified settings
4. Causes disconnection for Bluetooth connections

4.6 RESET=2

1. The module loads default settings (DCOV, PAIR, NAME, RESP, ECHO, AGM, AGS etc.)
2. Module starts execution as if a new power cycle is applied
3. Causes disconnection of current Bluetooth connections
4. Deletes all the paired devices and corresponding data

4.7 LESEC

1. The module supports whitelist security for BLE connections.
2. By default, LESEC is set to OFF.
3. Users can query the setting. AT*LESEC=?,
4. Users can change the settings. AT*LESEC=ON or AT*LESEC=OFF.
5. When LESEC is OFF, the module can advertise itself to any BLE GAP-Central device. When set to OFF, the user can establish a connection with a new GAP-Central device, and complete the pairing procedure. If pairing is completed successfully the device is added to the module's whitelist.
6. When LESEC=ON, the module only advertises itself to BLE-Paired devices or devices on the whitelist.

5. Speaker and Mic control commands

5.1 AGS

1. AT*AGS=?
2. AT*AGS=01 / AT*AGS=15
3. The module's speaker volume can be set by command e.g. AT*AGS=07.
4. AT*AGS command accepts a number from 01 (min) to 15 (max) incrementing in step of 1.
5. The current AGS settings can be queried with the the command AT*AGS=? the module will respond to this command as "REP*:AGS=10" (default value 10), module should respond to the current setting of AGS.

5.2 AGM

1. AT*AGM=?
2. AT*AGM=01 / AT*AGM=15
3. The module's microphone gain can be controlled/queried with this command.
4. AT*AGM command accepts a number from 01(min) to 15(max) with increments of 1.
5. The current AGM settings can be queried with the command AT*AGM=?, the module will respond to this command with "REP*:AGM=05" (default value 05), the module should respond the current setting of AGM.

6. Security Manager commands

The module supports incoming and outgoing pairing commands. The module can pair with Bluetooth 2.0, Bluetooth 2.1 and later devices. When the module is pairing with Bluetooth 2.0 devices it will require a PIN from the user. If pairing with a Bluetooth 2.1 device it requires a PASSK (passkey).

Users can control the module's discoverability and pairing ability using DCOV and PAIR commands.

6.1 PIN

1. The module can pair with Bluetooth 2.0 devices using a PIN. When the module is pairing with a Bluetooth 2.0 device (incoming / outgoing), the module needs to share the PIN.
2. The module will indicate the user as "IND*:PIN=?"
3. User should respond to this command as "AT*PIN=xxxxxx". Replace xxxxxx with the actual characters of the PIN.
4. The PIN can be Alpha, Numeric, Alpha-Numeric but must not exceed 31 characters.

6.2 PASSK

1. The module can pair with Bluetooth 2.1 devices using a Passkey. When the module is pairing with a Bluetooth 2.1 device (incoming / outgoing), the module needs to share the Passkey.
2. The default setting on the module for MITM=ON, IOTYPE=Keyboard Only.
3. The module will indicate this to the user as "IND*:PASSK=?"
4. User should respond to this command with "AT*PASSK=xxxxxx". Replace xxxxxx with the actual numeric passkey.

6.3 DCOV

1. Users can control a module's discoverability using the DCOV command.
2. AT*DCOV=ON makes the module discoverable (default setting).
3. AT*DCOV=OFF makes the module non-discoverable.
4. User can query the current discoverability settings with "AT*DCOV=?", module shall respond as "REP*:DCOV=ON" / "REP*:DCOV=OFF".

6.4 PAIR

1. Users can control a module's pairing ability using the PAIR command.
2. AT*PAIR=ON makes the module pairable (default setting).
3. AT*PAIR=OFF makes the module non pairable.
4. User can query current setting for pairing ability as "AT*PAIR=?", module shall respond as "REP*:PAIR=ON" / "REP*:PAIR=OFF".

6.5 PAIR (Outgoing request)

1. The module can initiate the pairing procedure with a remote device by using the pair command (outgoing pair command),
"AT*PAIR=001122334455"
2. Depending on the type of remote device, either Bluetooth 2.0 or Bluetooth 2.1, the module will provide an indication for PIN/PASSKEY.
3. The module will display the pairing result as
"IND*PAIR=001122334455,OK" or "IND*PAIR=001122334455,err".
4. The default pairing time is 90 seconds. The module waits this time to receive a response from other-device for PIN or PASSKEY.

6.6 PAIR (Incoming request)

1. The module supports incoming pairing requests.
2. When the remote device starts the pairing procedure, the module indicates this as "IND*PAIR=001122334455".
3. User should respond to this request with
"AT*PAIR=001122334455,accept" to accept the pairing request or
"AT*PAIR=001122334455,Reject" to reject the pairing request.
4. The module should display the pairing result as
"IND*PAIR=001122334455,OK" or "IND*PAIR=001122334455,err".
5. The default pairing time is 90 seconds. The module waits for this time to receive a response from the other-device for PIN or PASSKEY.

6.7 STOPPAIR

1. The module can stop the current pairing procedure with STOPPAIR command as "AT*STOPPAIR=001122334455".
2. The module stops the pairing procedure. This may result with a ERR message.

6.8 STATE

1. The module's current state of pairing and discoverability can be queried with the command AT*STATE=?
2. This is a query only command.
The module will respond to this command with
"REP*:STATE=discover,pair" i.e. if both ON "REP*:STATE=ON,ON". If pairing off but discoverable "REP*:STATE=ON,OFF" etc.

6.9 PAIRLIST

1. The module can store up to 8 devices in its paired devices list.
2. The current paired devices list can be viewed with "AT*PAIRLIST=?"
3. This is a query only command.
4. The module will respond to this command with a list of paired devices, citing their BD-address and device names.
5. To indicate the end of report, the module displays the string
"REP*:PAIRLIST=END".

6. For example, if the module is paired with 2 devices, the following report will be shown (address and name shall refer to the actual paired device).
REP*:PAIRLIST=00126f356fd6,Serial_Adapter
REP*:PAIRLIST=00025b00a5a5,LM-AudioSink
REP*:PAIRLIST=END
7. To indicate the end of the report, the module shows the string "REP*:PAIRLIST=END".

6.10 DELETE

1. The module can delete the paired device with the command "AT*DELETE=001122334455".
2. Module will respond as OK if the valid Bluetooth address is entered.
3. Module does not check whether the Bluetooth device address is present in the paired-devices-list.

7. Bluetooth devices discovery

1. The module can begin discovery for remote Bluetooth devices when the command "AT*FIND=ON" is received.
2. The module continues to look for devices for 60 seconds.
3. The user can stop the discovery procedure at any time with the command AT*FIND=OFF.
4. The module indicates the start of discovery report with "REP*:DISC=Start.."
5. The module indicates the end of discovery report with "REP*:DISC_END= N devices found." Where N is the actual number of devices found in discovery.
6. Each device is reported as "IND*:= 1 00126f356fd6 SerialADTD6", here 1 indicates that the device is found first.
7. If the module cannot find the name of the remote device, or the name does not exist, it is indicated as "NULL".
8. E.g. Discovery report as below:

```
at*find=onat*find=on
OK
REP*:FIND=Start..
IND*:= 1 28e31f6364a7 RedmiSMY
IND*:= 2 4c49e368b246 Redminote
IND*:= 3 00264aa19172 NULL
IND*:= 4 00126f356fd6 SerialADTD6
REP*:FIND_END= 4 devices found.
```

8. Test modes

8.1 AT*AUTEST

AT*AUTEST=ON
AT*AUTEST=OFF

1. AUTEST is the audio input and output test mode on the LM74x.
2. In this mode the module performs a loopback action on audio and input from the local-mic is routed to the local speaker.
3. Use AT*aatest=on to turn the test on, and At*aatest=off to turn the test off.
4. Users should enter AUTEST mode when not connected to a remote device.

8.2 AT*TONETEST

AT*TONETEST=ON
AT*TONETEST=OFF

1. TONETEST is audio output test mode on the LM74x.
2. In this mode the module plays an audio tone from software and the local-speaker of the module will play this audio tone. During this time the mic is muted.
3. Tone-test is played separately in left and right output alternately.
4. Use AT*Tonetest=on to turn the tone-test on, and At*Tonetest=off to turn the test off.
5. Users should enter in AUTEST mode when not connected to the remote device.

9. Version and Upgrade

9.1 VER

1. Users can query the current FW version of the module with the command "AT*VER=?".
2. The module will respond to this command with "REP*:VER=74xLM_ATSRC_01.01" where major FW version is 1 and minor FW version number is 1. The module will report the current FW version number.

9.2 UPGRADE

1. The current FW of the module can be upgraded over USB interface.
2. Users can put the module in DFU (Device Firmware Upgrade) mode using the FW-Upgrade command.
3. FW upgrade commands require a valid password. The password is dependent on the current FW version of module.
4. E.g. if current version on module is "REP*:VER=74xLM_ATSRC_01.01" then the FW upgrade password will be "LMUPDATEV_74xLM_ATSRC_0101".
5. If the module password is correct then the module responds with OK and indicates this as "IND*:FW Upgrade Mode...".
6. After this message, the module appears as "CSR BlueCore Bluetooth device" on the PC and the upgrade can be performed.
7. The detailed procedure for the FW upgrade is covered in a separate document.

```
at*upgrade=LMUPDATEV_74xLM_ATSRC_0101at*upgrade=LM
UPDATEV_74xLM_ATSRC_0101
OK
IND*:FW Upgrade Mode...
```

10. Incoming connection

```
AT*INCONNECT=001122334455,accept
AT*INCONNECT=001122334455,reject
```

1. The module will indicate incoming connections as "IND*:INCONNECT=001122334455", mentioning the bd-addr of the remote device.
2. The user should accept or reject this with AT commands using either "AT*INCONNECT=001122334455,accept" / "AT*INCONNECT=001122334455,reject".
3. The module indicates if a successful connection has been established e.g. "IND*:CONNECT=OK,001122334455,HSP". Or "IND*:CONNECT=OK,001122334455,SPP".
4. The module provides connection error message if it fails to establish the connection or user rejects incoming connection request e.g. "IND*:INCONNECT=160114170911,ERR".
5. When module establishes HSP connection, it may show further indication messages for Call request, AGM and AGS etc.

6. Module need to accept the connection request two times.

11. Outgoing connection

```
AT*CONNECT=001122334455,SPP
AT*CONNECT=001122334455,HSP
```

The module's firmware supports both AGHFP and SPP connections. SPP and AGHFP connections can be simultaneous or one at a time. There is no specific sequence for profile connections.

11.1 AGHFP connection

1. The module should be paired with the remote HFP/HSP device before establishing a connection.
2. Users can set the module to start the HSP connection with a remote device with the command "AT*CONNECT=001122334455,HSP"
3. The module indicates if a successful connection has been established e.g. "IND*:CONNECT=OK,160114170911,HSP".
4. The module provides a connection error message if it fails to establish the connection or the user rejects the incoming connection request e.g. "IND*:CONNECT=ERR,012600000116,HSP".
5. This is SLC (Service level connection) connection. For an audio connection use the SCOCNN command after a successful SLC level connection.
6. If the device issues a connection request and the module cannot find the device nearby (non-discoverable or not in range), the module indicates an ERR as "IND*:CONNECT=ERR,001122334455,PageTimeout". The page timeout mentions that no response was received from the remote device in the specified connection time.

11.2 SPP connection

1. The user can set the module to start the SPP connection with a remote device with the command "AT*CONNECT=001122334455,SPP"
2. If the module was not paired to the remote device before issuing this command, the module begins the pairing procedure. If the pairing is successful it then performs the SPP connection procedure.
3. The module indicates if a successful connection has been established e.g. "IND*:CONNECT=OK,001122334455,SPP".
4. If the module indicates Connect-OK message, then the module is in SPP-connected-online-command mode.
5. In this mode, the module can send data to the remote device using the AT*SPPDATA command. The module reports any incoming data as "IND*:SPPREC".
6. E.g. if the remote device has sent the string "1234567890ABCDE_abcdef_", the module will indicate this as "IND*:SPPREC=17,1234567890ABCDE_abcdef_".
7. Users can set SPP-connected-online-data-mode (streams are connected directly for transparent data transfer) using the

AT*SPPAUTO command. Refer to “**Section 15 SPP details**” for more details on SPP connection.

8. If the device issues a connection request and the module cannot find the device nearby (non-discoverable or not in range), the module shows an ERR as “IND*:CONNECT,001122334455,ERR, PageTimeout”. The page timeout mentions that no response was received from the remote device in the specified connection time.
9. Users can send and receive data via SPP connection without any headers using “SPP-connected-online-data mode”. Refer to “**Section 15 SPP Details**” for more details.

12. DROP connection

12.1 AT*DROP=001122334455,HSP

1. The module can start the connection drop procedure on receiving the “AT*DROP” command with the connected device address and profile.
2. For AGHFP connection drop, the command should be “AT*DROP=001122334455,HSP”.
3. The AGHFP profile drop command will result in any active audio connections to drop.
4. User will have indication message for SCOCONN drop and SLC connection drop e.g. “IND*:DROP=001122334455,HSP,NORM”.

12.2 AT*DROP=001122334455,SPP

1. For SPP connection drop, the command should be “AT*DROP=001122334455,SPP”.
2. SPP profile drop command will cause indication message for connection drop e.g. “IND*:DROP=001122334455,SPP,NORM”.
3. When the module is in “SPP-connected-online-command” mode, it can issue the connection request directly.
4. When the module is in “SPP-connected-online-data-mode”, user needs to use the escape sequence and enter “SPP-connected-online-command” mode before issuing the drop command.

13. DROP Indication

IND*:DROP=001122334455,SPP,NORM / IND*:DROP=001122334455,HSP,NORM
IND*:DROP=001122334455,SPP,OTHER / IND*:DROP=001122334455,HSP,OTHER
IND*:DROP=001122334455,SPP,LINKLOSS /
IND*:DROP=001122334455,HSP,LINKLOSS

1. When the module loses connection with a remote device, it notifies the user with a message providing details of the remote device address, profile and the reason for disconnection.
2. HSP or SPP indicates the profile for which connection has dropped.
3. Reason code:
 1. If the module initiated the connection with a drop procedure using AT*drop command, or the remote device terminates the connection gracefully, the reason code will be normal i.e. "NORM".
 2. If connection drop is due to link-loss, the reason code will be "LINKLOSS".
 3. If the connection is dropped due to any other reason, the reason code will be "OTHER".

14. Audio connection

14.1 AT*SCOCONN=001122334455

1. After establishing a SLC service level connection to the remote device, the LM74x can establish an audio connection with the remote device. Users need to use the command AT*SCOCONN=001122334455.
2. The module indicates if a successful audio connection has been established with "IND*:SCOCONN=001122334455".
3. After establishing a SCO connection, the module provides an update of AGS and AGM levels.
4. If the module fails to establish the audio connection, it indicates this with "IND*:SCOCONN=001122334455,ERR".
5. When the module initiates and completes a SCO connection, the audio connection is transferred towards HF.
6. Users can toggle or transfer the audio connections towards AG/HF with the command AT*CALLXFER.
7. The module does not support incoming SCO-connection requests.

14.2 AT*SCODROP=001122334455

1. The module can initiate a SCO connection drop when it receives the command "AT*SCODROP=001122334455".
2. SCODROP command only drops the SCO connection. SLC-Service level connection may still exist.
3. User will receive an indication for SCO connection drop when the drop is initiated by the user as "IND*:SCODROP=OK,160114170911".

4. When the remote device drops the active SCO connection due to a power loss or abruptly, the module will show separate indications for SCO connection drop “IND*:SCODROP=CallXfer-towards-AG” meaning the call is now towards AG and SLC connection drop “IND*:DROP=160114170911,HSP,NORM”.

14.3 CallXFER – Call transfer

By default, when the module establishes an SCO connection with a headset the call is towards HF.

1. AT*CALLXFER=TOAG :
 - 1.1 This command is used to transfer the call towards AG from HF.
 - 1.2 Module will indicate that “IND*:CallXfer=Already-have-Audio” if the call was previously with AG.
 - 1.3 Module will indicate that “IND*:SCODROP=CallXfer-towards-AG” if the call is now towards AG.
2. AT*CALLXFER=TOHF
 - 2.1 This command is used to transfer the call towards HF from AG.
 - 2.2 By default, when the outgoing SCOCONN is successful, the call is transferred towards HF.
 - 2.3 Module will indicate that “IND*:CallXfer=Already-have-Audio” if the call was previously with HF.
 - 2.4 Module will indicate that “IND*:SCODROP=CallXfer-towards-AG” if the call is successfully transferred from HF towards AG.
3. AT*CALLXFER=GGLE
 - 3.1 This command is used to toggle the call transfer between AG and HF.
 - 3.2 When the command AT*CALLXFER=GGLE is issued, the call is transferred to the other device.
 - 3.3 Module will indicate that “IND*:SCOCONN=OK,160114170911” if the call was previously with HF.
 - 3.4 Module will indicate that “IND*:SCODROP=CallXfer-towards-AG” if the call is now towards AG.

15. SPP details

1. "AT*CONNECT=001122334455,SPP". As mentioned in "**Section 11.2 SPP Connection**" this starts the SPP profile connection.
2. "IND*:CONNECT=001122334455,spp". Indication message that the device is connected for SPP profile
3. "AT*DROP=001122334455,spp". If the device 001122334455 has multiple profiles connected to the LM74x module, drop only SPP connection
4. "IND*DROP=001122334455,spp". Indication that device has dropped the SPP connection
5. When the device connects to the remote device for the SPP connection, it enters "SPP-connected-online-command" mode, so strings entered on UART are treated as AT commands.
6. In "SPP-connected-online-command" mode, data transmitted to the remote device is sent via the command AT*SPPDATA and data received from the remote device is indicated as "IND*:SPPREC".
7. AT*SPPdata=00fe,0..FE.
 1. User can send up to 254 bytes to a remote SPP device in one command.
 2. Data sent needs to be encoded as described below.
8. IND*:SPPREC=fe,0....FE.
 1. The local device can report up to 254 bytes from a remote SPP device at once.
 2. Data received from a remote device will be sent via local UART without any encoding.
 3. 74x will report the data received transparently on UART as headers describing the length of data and the data itself.
9. SPP data encode/decode:
 1. AT commands are terminated with \r\n (0x0d, 0x0a). This means that data sent using the AT*SPPdata command should not have \r\n within the data itself.
 2. The encoding below results in a 100% overhead on data transfers, but avoids the limitation of sending "\r\n" as data.
 3. E.g. if a user wants to send the below 9 bytes buffer "Ab\r\n1^&\r\n" i.e "0x41, 0x62, 0x0d, 0x0a, 0x31, 0x5e, 0x26, 0x0d, 0x0a".
 4. The AT command should be AT*SPPdata=0012,data-1....data-n (length is hex code, here 0x12 is decimal 18.).
 5. The AT command with the encoded data will be "AT*SPPOUT=(0x30, 0x30, 0x31, 0x32), (0x34,0x31), (0x36, 0x32), (0x30, 0x3d), (0x30, 0x3a), (0x33, 0x31), (0x35, 0x3e), (0x32, 0x36), (0x30, 0x3d), (0x30, 0x3a)"\r\n
 6. Length is transmitted in 4 bytes; the higher two bytes will be always 0x00. The 3rd byte represents the higher digit and the 4th represents the lower digit. E.g 254 = 0xfe shall be sent as (0x00, 0x00, 0x0f).
 7. For the length field, 0xFE, 0xFE, 0xfe, 0xFE are all the same and valid for the decimal value 171.
 8. Every data-byte is encoded and sent as a higher nibble first.
 9. Data received from the remote end will be shown without any encoding.

10. “AT*SPPAUTO” – “SPP-connected-online-data” mode

1. This mode will be useful when the user wants to send/receive more than 254 bytes over SPP profile.
2. SPP Data on UART in this mode is pure data (encode/decode is not required).
3. In this mode, the remote SPP device and local UART streams will be transparently connected.
4. In this mode, any data entered on local UART will be sent to the remote device.
5. Any data received from the remote SPP device will be output on local UART without any headers.
6. In this mode the module cannot report any other indications for HSP/HFP profile.
7. If the module disconnects a SPP connection abruptly in this mode, it comes out of the mode and shows that the SPP connection has been dropped.
8. To come out of the “SPP-connected-online-data” mode and enter the “SPP-connected-online-command” mode, input the escape sequence +++ on UART. If the module responds “OK” to the escape sequence, that confirms that the module is in “SPP-connected-online-command” mode.

16. BLE connection

The module can advertise itself as a BLE peripheral. It implements a mandatory standard-GAP-service, as well as a Serial-Over-GATT service provided by CSR for data transfer over GATT.

The module advertises itself for the peripheral role with the whitelist either enabled or disabled according to the LESEC setting. LESEC is set to OFF by default, meaning that the module is advertising to all BLE Central devices. After the module has connected with a GAP-Central device it completes the pairing procedure. If the pairing procedure is successful the module adds the device to the whitelist.

16.1 AT*LETXDATA=000a,1234567890

1. The module receives a connection request from the GAP-Central device e.g. Android tablet or mobile phone.
2. The module accepts all connection requests without user input.
3. The module indicates a connection as shown below:


```

      REP*:BLE_CONNECTED:=59ef4ac8f0b9
      BLE Auth start!IND*:PAIR=59ef4ac8f0b9
      at*PAIR=59ef4ac8f0b9,acceptat*PAIR=59ef4ac8f0b9,accept
      OK
      REP*:BLE_PAIR=59ef4ac8f0b9,Success
      REP*:BLE_DIS_CONN:=59ef4ac8f0b9
      
```
4. The log shows that the module is connected for BLE to the GAP-Central device with the address "59ef4ac8f0b9".
5. As the LESEC setting is OFF, and this is the new device module is connect, e.g. to, module starts the BLE Authentication procedure which is indicated by message "BLE Auth start".
6. The module indicates the pairing request as "IND*:PAIR=59ef4ac8f0b9".
7. Here, the user can accept or reject the pairing request. Accept the pairing request with "at*PAIR=59ef4ac8f0b9,accept". After the BLE pairing procedure, the module displays the result. The message "REP*:BLE_PAIR=59ef4ac8f0b9,Success" indicates that the pairing procedure has been completed successfully.
8. The module indicates disconnection with the message "REP*:BLE_DIS_CONN:=59ef4ac8f0b9" where it reports the address of the BLE device disconnected.
9. When the module is connected to a remote device it can send/receive data from a GAP-Central device over GATT using the Serial-Over-GATT service. The Serial-Over-GATT service is implemented by CSR with a 128 bit UUID as "0000-5500-d102-11e1-9b23-0002-5b00-a5a5".
10. Ensure that the GAP central device has enabled Client-Configuration flag by clicking it. If the CCFG is not enabled, data sent by the module cannot be seen on the GAP-Central device. The module always shows data from the GAP-Central device irrespective of the CCFG flag status.
11. The module can send data to a remote device with the command "AT*LETXDATA={data-length},{actual_data}". 'Data-length' is 4 bytes in

- hex and 'actual_data' is the hex data to be transmitted. The data-length cannot be more than 20 bytes.
12. E.g. "AT*LETXDATA=000a,1234AbCDe" will send 10 bytes of data from the module to the GAP-Central device where the data is "1234AbCDe". Data sent cannot include this in itself, as this is the AT command terminator string.
 13. Data sent by GAP-Central device to the module is indicated by the module on UART as "**REP*:BLE_IN_DATA={data-length},{actual data}**" e.g. "REP*:BLE_IN_DATA=20,data from gap-centra". In a single packet, a maximum of 20 bytes can be received. Data length is mentioned in two bytes as decimal field.

16.2 AT*LEDROP=001122334455

1. The module can initiate a BLE connection drop with the command "AT*LEDROP=001122334455" where "001122334455" is the BLE device address for the connected GAP-Central device. The module will report this on UART as "REP*:BLE_DIS_CONN:=001122334455".
2. If the BLE Gap-central device drops the connection or the BLE connection is lost due to signal strength, the module indicates this on UART as "REP*:BLE_DIS_CONN:=001122334455".

17. Appendix

The following section describes the AT commands and the subsequent result code for user reference.

AT commands are sent as ASCII characters.

e.g. AT*NAME=? is actually sent as (41 54 2a 6e 61 6d 65 3d 3f 0d 0a)

OK is received as (4f 4b 0d 0a)

Report is received as "REP*:NAME=1234ABcd_" as

(52 45 50 2a 3a 4e 41 4d 45 3d 31 32 33 34 41 42 63 64 5f 0d 0a)

Note: In the commands below the terminating characters "\r\n" are not shown but users should note that every command (OK/ERR response, Indication, Report) is terminated with the "\r\n" sequence.

AT*name=?AT*name=?{0D}{0A}

OK{0D}{0A}

REP*:NAME=1234ABcd_{0D}{0A}

17.1 General AT commands

MessageLoop_7777

at*addr=?at*addr=?

OK

REP*:ADDR=333333333333

at*ver=?at*ver=?
OK
REP*:VER=74xLM_ATSRC_01.01

at*AGS=?at*AGS=?
OK
REP*:AGS=10

at*AGM=?at*AGM=?
OK
REP*:AGM=05

at*echo=?at*echo=?
OK
REP*:ECHO=ON

at*resp=?at*resp=?
OK
REP*:RESP=ON

at*DCOV=?at*DCOV=?
OK
REP*:DCOV=ON

at*PAIR=?at*PAIR=?
OK
REP*:PAIR=ON

at*NAME=?at*NAME=?
OK
REP*:NAME=LM747-Master

at*STATE=?at*STATE=?
OK
REP*:STATE=ON,ON

at*echo=?at*echo=?
OK
REP*:ECHO=ON
at*echo=offat*echo=off
OK
at*echo=onOK
at*echo=onat*echo=on
OK
at*echo=?at*echo=?
OK
REP*:ECHO=ON

17.2 Find command

```
at*find=ONat*find=ON
OK
REP*:DISC=Start..
IND*:= 1 00126f97f768 SerialADT68
IND*:= 2 00025b00a5a5 Serial Adapter
IND*:= 3 160114170911 Bluedio
at*find=offat*find=off
OK
```

17.3 Pair command

```
at*pair=160114170911at*pair=160114170911
OK
IND*:PAIR=160114170911,Bond-Suceess
```

17.4 Pair-list commands

```
at*pairlist=?at*pairlist=?
OK
REP*:PAIRLIST=160114170911,
REP*:PAIRLIST=00025b00a5a5,
REP*:PAIRLIST=END

at*del=160114170911at*del=160114170911
OK
at*pairlist=?at*pairlist=?
OK
REP*:PAIRLIST=00025b00a5a5,
REP*:PAIRLIST=END
```

17.5 AGHFP incoming connection commands

The device accepts an incoming pairing request after a successful pairing accepts an incoming AGHFP connection request, then issues a SCO connection request and call-transfer command.

```
IND*:PAIR=160114170911
at*PAIR=160114170911,acceptat*PAIR=160114170911,accept
OK
IND*:PAIR=160114170911,Bond-Suceess
IND*:INCONNECT=160114170911
at*INCONNECT=160114170911,acceptat*INCONNECT=160114170911,accept
IND*:INCONNECT=160114170911
at*INCONNECT=160114170911,acceptat*INCONNECT=160114170911,accept
IND*:CONNECT=OK,160114170911,HSP
IND*:HSP=AT+VGS=10
IND*:HSP=AT+VGM=13
IND*:AGHFP=CALL-AUDIO-REQ-IND
at*scoconn=160114170911at*scoconn=160114170911
OK
IND*:SCOCONN=OK,160114170911
at*callxfer=TGLEat*callxfer=TGLE
OK
IND*:SCODROP=CallXfer-towards-AG
```



```
at*callxfer=TGLEat*callxfer=TGLE
OK
IND*:SCOCONN=OK,160114170911
at*callxfer=TGLEat*callxfer=TGLE
OK
IND*:SCODROP=CallXfer-towards-AG
at*callxfer=TGLEat*callxfer=TGLE
OK
IND*:SCOCONN=OK,160114170911
at*callxfer=ToHFat*callxfer=ToHF
OK
IND*:CallXfer=Already-have-Audio
at*callxfer=ToAGat*callxfer=ToAG
OK
IND*:SCODROP=CallXfer-towards-AG
at*callxfer=ToAGat*callxfer=ToAG
OK
IND*:SCODROP=CallXfer-towards-AG
at*callxfer=ToHFat*callxfer=ToHF
OK
IND*:SCOCONN=OK,160114170911
at*callxfer=ToAGat*callxfer=ToAG
OK
IND*:SCODROP=CallXfer-towards-AG
at*callxfer=ToAGat*callxfer=ToAG
OK
IND*:SCODROP=CallXfer-towards-AG
at*callxfer=ToHFat*callxfer=ToHF
OK
IND*:SCOCONN=OK,160114170911
at*callxfer=ToHFat*callxfer=ToHF
OK
IND*:CallXfer=Already-have-Audio
at*scodrop=160114170911at*scodrop=160114170911
OK
IND*:SCODROP=OK,160114170911
at*drop=160114170911,hspat*drop=160114170911,hsp
OK
IND*:DROP=160114170911,HSP,NORM
```

17.6 AGHFP outgoing connection commands

These commands show if a remote headset has not been paired before. If so the user needs to pair the headset first and then perform the connection commands. If it has been paired before issue the HSP command.

```
at*pair=160114170911at*pair=160114170911
OK
IND*:PAIR=160114170911,Bond-Suceess

at*connect=160114170911,hspat*connect=160114170911,hsp
OK
IND*:CONNECT=OK,160114170911,HSP
IND*:HSP=AT+VGS=10
IND*:HSP=AT+VGM=13
at*scoconn=160114170911at*scoconn=160114170911
OK
IND*:SCOCONN=OK,160114170911
```

```
at*drop=160114170911,hspat*drop=160114170911,hsp
OK
IND*:DROP=160114170911,HSP,NORM
```

```
at*CONNECT=160114170911,hspat*CONNECT=160114170911,hsp
OK
IND*:CONNECT=OK,160114170911,HSP
IND*:HSP=AT+VGS=10
IND*:HSP=AT+VGM=13
at*scoconn=160114170911at*scoconn=160114170911
OK
IND*:SCOCONN=OK,160114170911
IND*:SCODROP=CallXfer-towards-AG
IND*:DROP=160114170911,HSP,NORM
```

```
at*CONNECT=00126f002525,hspat*CONNECT=00126f002525,hsp
OK
IND*:CONNECT=ERR, 00126f002525,PageTimeout
```

17.7 SPP pair and incoming connection

```
IND*:PIN=?
at*PIN=1234at*PIN=1234
OK
IND*:PAIR=00025b00a5a5,Bond-Suceess
IND*:INCONNECT=00025b00a5a5
at*INCONNECT=00025b00a5a5,acceptat*INCONNECT=00025b00a5a5,acce
pt
IND*:INCONNECT=00025b00a5a5
at*INCONNECT=00025b00a5a5,acceptat*INCONNECT=00025b00a5a5,acce
pt
IND*:CONNECT=OK,00025b00a5a5,SPP
IND*:SPPREC=01,d
IND*:SPPREC=13,ata_from_remote_dev
IND*:SPPREC=03,ice
at*sppdata=000c,313233340:0=at*sppdata=000c,313233340:0=
OK
at*sppdata=000c,313233340:0=at*sppdata=000c,313233340:0=
OK
at*drop=00025b00a5a5,sppat*drop=00025b00a5a5,spp
OK
IND*:DROP=00025b00a5a5,SPP,NORM
```

17.8 SPP outgoing connection

```
at*connect=00025B00A5A5,sppat*connect=00025B00A5A5,spp
OK
IND*:CONNECT=OK,00025b00a5a5,SPP
IND*:SPPREC=01,d
IND*:SPPREC=13,ata_from_remote_dev
IND*:SPPREC=0c,ice_to_LM74x
```

These commands show that the data received from the remote device is transparent data (no encoding), which represents the number of bytes and then the actual bytes.

17.9 SPP data encoding table

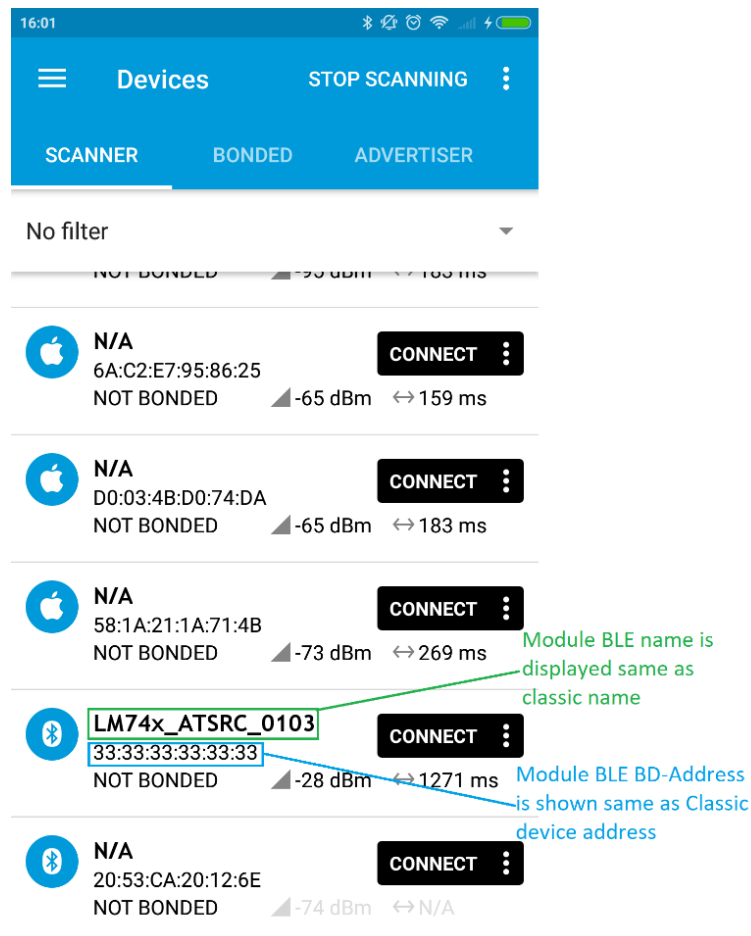
The table below describes the encoding of characters. If the user wants to send 0x31, it should be sent as 0x33, 0x31. If the data 0x05 is to be transmitted, it should be sent as 0x30, 0x35.

ASCII Character	Hex value for ASCII char	Hex encoding of character	
A	41	34	31
B	42	34	32
c	63	36	33
d	64	36	34
1	31	33	31
2	32	33	32
9	39	33	39
0	30	33	30
\r	0d	30	3d
\n	0a	30	3a
<	3c	33	3c
>	3e	33	3e
,	2c	32	3c
.	2e	32	3e
?	3f	33	3f
/	2f	32	3f
:	3a	33	3a
@	40	34	30
;	3b	33	3b
'	27	32	37
{	7b	37	3b
}	7d	37	3d
[5b	35	3b
]	5d	35	3d
!	21	32	31
"	22	32	32
\$	24	32	34
%	25	32	35
^	5e	35	3e
&	26	32	36
*	2a	32	3a
(28	32	38
)	29	32	39
-	2d	32	3d
=	3d	33	3d
_	5f	35	3f
+	2b	32	3b

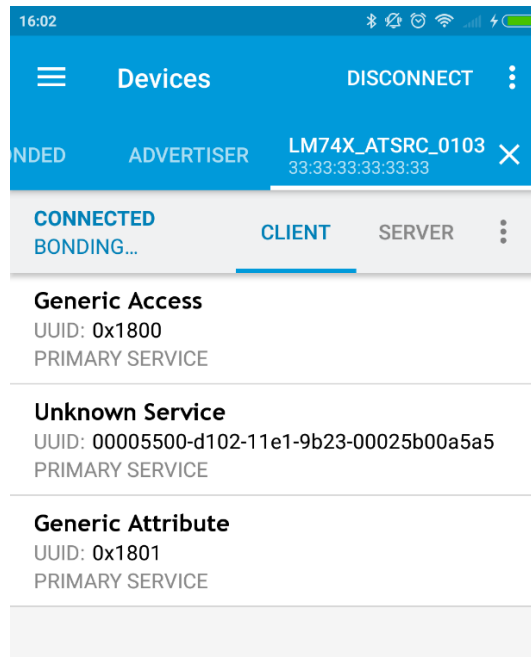
18. GAP-Central Application screenshots

The following section shows screenshots of an Android device running a third party BLE connect application. Users can download similar Android applications or use their own if they have developed one.

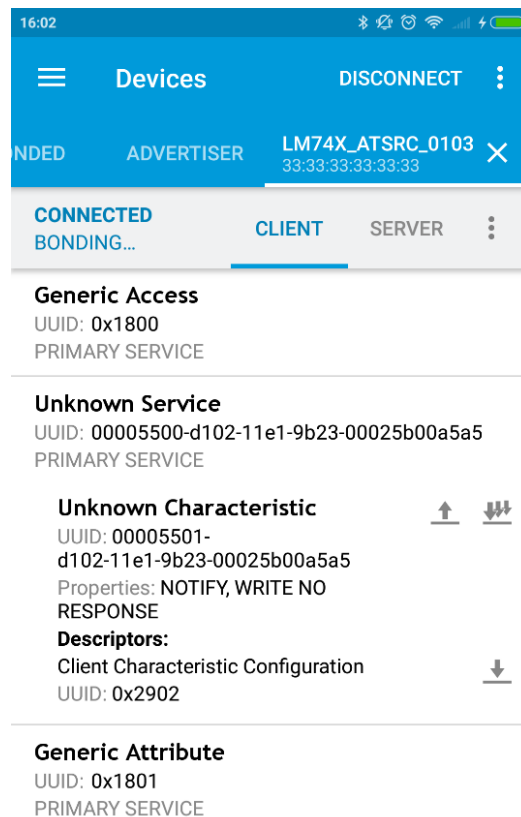
18.1 GAP-Central device discovery of nearby BLE peripheral devices



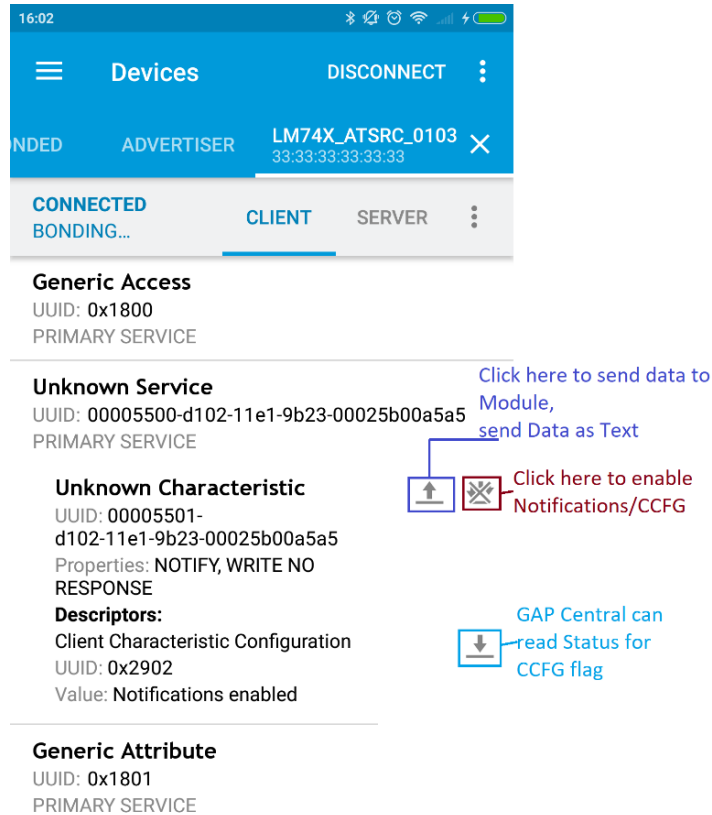
18.2 GAP-Central device connects to the LM74x module



18.3 Services present on the LM74x module for BLE



18.4 Details of Serial-Over-GATT service on module as a BLE peripheral



16:02

Devices DISCONNECT

NAME: LM74X_ATSRC_0103
ADVERTISER: 33:33:33:33:33:33

CONNECTED BONDING...

CLIENT SERVER

Generic Access
UUID: 0x1800
PRIMARY SERVICE

Unknown Service
UUID: 00005500-d102-11e1-9b23-00025b00a5a5
PRIMARY SERVICE

Unknown Characteristic
UUID: 00005501-d102-11e1-9b23-00025b00a5a5
Properties: NOTIFY, WRITE NO RESPONSE
Descriptors:
Client Characteristic Configuration
UUID: 0x2902
Value: Notifications enabled

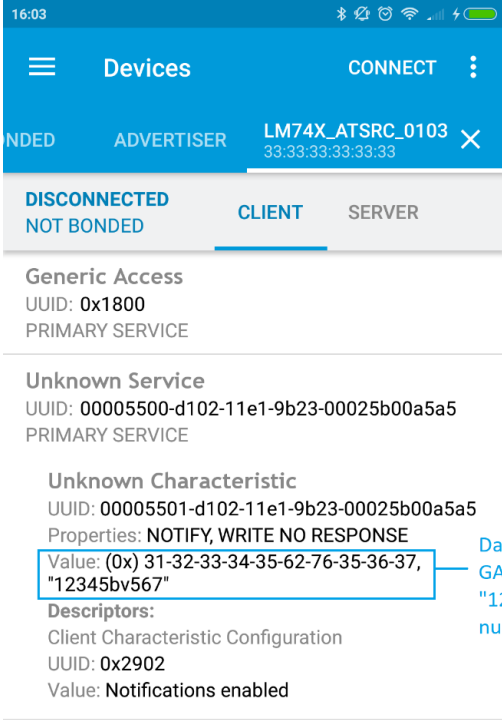
Click here to send data to Module, send Data as Text

Click here to enable Notifications/CCFG

GAP Central can read Status for CCFG flag

Generic Attribute
UUID: 0x1801
PRIMARY SERVICE

18.5 Data transfer on Serial-Over-GATT service



16:03

Devices CONNECT

NDDED ADVERTISER **LM74X_ATSRC_0103** 33:33:33:33:33:33

DISCONNECTED NOT BONDED CLIENT SERVER

Generic Access
 UUID: 0x1800
 PRIMARY SERVICE

Unknown Service
 UUID: 00005500-d102-11e1-9b23-00025b00a5a5
 PRIMARY SERVICE

Unknown Characteristic
 UUID: 00005501-d102-11e1-9b23-00025b00a5a5
 Properties: NOTIFY, WRITE NO RESPONSE
 Value: (0x) 31-32-33-34-35-62-76-35-36-37, "12345bv567"
 Descriptors:
 Client Characteristic Configuration
 UUID: 0x2902
 Value: Notifications enabled

Data sent by Module to GAP-Central Device "12345bv567" and ascii numbers of that

Generic Attribute
 UUID: 0x1801
 PRIMARY SERVICE