

ISP15 / ISP18 / ISP19 series

Application note AN200301



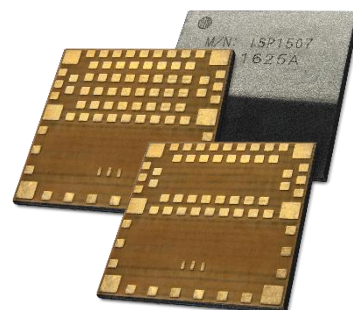
BLE AT Command Set

ISP1507-AX

ISP1807-LR

ISP1907-HT

ISP1907-LL



Introduction

Scope

This document gives details on how to use AT commands to control Insight SiP's modules.

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1. Overview

1.1. Introduction

This solution allows using an Insight SiP module as a BLE device. The device is controlled by a host (external microcontroller or computer terminal) using AT-style command set.

When connected to another compatible device the module will act as an “over the air” UART interface.

1.2. Limitations

Currently supported modules are ISP1507-AX, ISP1807-LR, ISP1907-LL and ISP1907-HT.

Only one concurrent BLE connection is supported.

Pairing/bonding is not supported yet.

1.3. Connection to host

The connection between the host and the module is as follow:

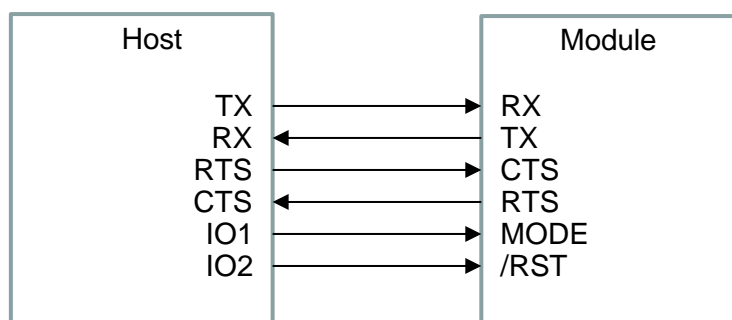


Figure 1: Host - Module connection

The pin assignment for the ISP module is described below.

Module	RX pin	TX pin	CTS pin	RTS pin	Mode pin	RST pin
ISP1507-AX	P0.08	P0.06	P0.07	P0.05	P0.04	P0.21
ISP1807-LR	P0.08	P0.06	P0.07	P0.05	P0.04	P0.18
ISP1907-HT	P0.08	P0.06	P0.07	P0.05	P0.04	P0.18
ISP1907-LL	P0.08	P0.17	P0.03	P0.05	P0.11	P0.21

1.4. Mode

The host controls the behavior of the module by setting high or low the “MODE” pin. If this pin is set low the module is in configuration mode and if it is set high the module is in data mode.

In configuration mode, all received data from the UART interface are parsed and interpreted as AT command. These commands are used to set different parameters such as connection parameters, device name, etc.

In data mode (and assuming a BLE connection between 2 modules in already established), the BLE connection will emulate an “over-the-air” UART interface.

It means data can be sent back of forth between the UART interface of 2 BLE devices.

1.5. BLE Connection

The solution implements the Nordic UART Service (NUS).

2. Getting started

2.1. Using the development kit

1. Connect the test board (ISP1507-AX-TB, ISP1807-LR-TB, ISP1907-HT-TB or ISP1907-LL-TB) to the ISP130603 Interface Board with the 3 FPC cables (0.5 mm pitch, provided in the Development Kit). Connect the provided USB cable from the Interface Board ISP130603 to your computer.
2. On the ISP130603 Interface Board, using cables or jumpers connect the necessary pins using the table in [Connection to host](#) chapter.
3. Flash the module with the firmware corresponding to your module.
4. The ISP130603 interface board has an USB-to-UART converter so we can directly access the module's UART interface via a COM port. Using a terminal (such as RealTerm), configure the port with the following parameters:
 - Baud rate: 38400
 - Parity: None
 - Data bits: 8
 - Stop bits: 1
 - Hardware Flow Control: None
5. Test the communication by sending AT<CR> or AT<LF>. The module should answer with OK.

2.2. Setting the central side device

For evaluation purpose, the 2 easiest ways to set up a central device is using:

- ✚ A smartphone with nRF ToolBox (and selecting UART profile).
- ✚ Another Insight SiP module loaded with either:
 - The NUS client example from Nordic Semi SDK
 - The Insight SiP AT-Commands example in central mode.

2.3. Scenario example

This is a step-by-step example between 2 Insight SiP modules.

Have 2 development kits with modules loaded with both loader with the AT commands. One of the modules will be configured as peripheral BLE device and the other as a central BLE device. We started with both device in configuration mode (Mode pin set to low).

On peripheral side enter the following commands:

```
#Check UART connection to the module
AT
OK
#Retrieve BLE address of the module
AT+BLEADDR?
+BLEADDR: 6CCDC18883C6
OK
#Switch module to peripheral role
AT+BLEROLE=0
OK
#Set BLE device name
AT+BLENAME=Dev1
OK
#Start Advertising (needed to be connectable)
AT+BLEADVSTART
OK
```

On central side enter the following commands:

```
#Check UART connection to the module
AT
OK
#Switch module to central role
AT+BLEROLE=1
OK
#Start scanning
AT+BLESCANSTART
OK
#Wait a bit and request a list of compatible devices
AT+BLESCANLIST?
+BLESCANLIST: -56, Dev1, 6CCDC18883C6
OK
#Request a connection to the peripheral module
AT+BLECONNECT=6CCDC18883C6
OK
#Wait a bit and check that we are connected
AT+BLECONNSTATE?
+BLECONNSTATE: 2
OK
```

Both modules are now connected. We can switch to data mode (Mode pin set to high) and we can now exchange data between the 2 modules.

3. AT commands list

3.1. Format and syntax

The format is based on the Hayes AT-style command. The custom AT command set can be declined in 3 categories:

Type	Description	Syntax
Set	Set values or perform actions	<CMD>=... or <CMD>
Read	Check values	<CMD>?
Test	Test existence and provide info	<CMD>=?

The rules are the following:

- ✚ Every command starts with “AT”.
- ✚ Commands are case sensitive.
- ✚ Parameters are not case sensitive.
- ✚ Commands can be terminated by <CR> or <LF>.
- ✚ Every command (except the reset command) is followed by a final response. The final response ends with <CR><LF>.
- ✚ Read and Test commands gives an additional response before the final response. The additional response ends with <CR><LF>.

The final response format is:

<Status><CR><LF>

Where <Status> can be:

- ✚ OK: Command run successfully.
- ✚ UNKNOWN_CMD: The command is unknown.
- ✚ ERROR_NOT_SUPPORTED: The command exists but the type (set, read or test) is not supported.
- ✚ ERROR_INVALID_PARAM: There is an error in one of the parameters.
- ✚ ERROR_INVALID_LENGTH: The parameter is too long.
- ✚ ERROR_INVALID_STATE: The command cannot be executed in the current state.
- ✚ ERROR_FORBIDDEN: The command is refused. Possibly because the command is not available in the current BLE role.
- ✚ ERROR: All other errors.

The additional response format is:

<CMD(without AT)>: <Returned value><CR><LF>

3.2. Standard Commands

3.2.1. AT

The module responds with "OK". This command can be used to check if communication between the host and the module.

Examples:

```
AT
OK
```

3.2.2. ATZ

Reset module.

Examples:

```
ATZ
```

3.2.3. ATE

Enable or disable echo of input commands.

Examples:

```
ATE=1
OK
```

```
ATE=0
OK
```

3.2.4. ATI

Display module information:

- Module name
- Device ID
- Firmware version

Examples:

```
ATI
ISP507-AX
AABBCCDDEEFF1122
1.0.0
OK
```


3.3. Custom Commands

3.3.1. AT+DEEPSLEEP

Go to deep sleep mode.

In this mode the module is in its lowest power consumption mode. It can only leave deep sleep by performing a reset.

Type	Input parameters	Additional response	Final response
Set	-	-	OK
Test	-	-	OK

Note:

The module will go to deep sleep mode before sending the Final response. This means that host will not receive an “OK” acknowledgement.

Examples:

AT+DEEPSLEEP=?
OK

AT+DEEPSLEEP

3.3.2. AT+FACTORYRESET

Clear configuration from the non-volatile memory and perform reset.

Type	Input parameters	Additional response	Final response
Set	-	-	-
Test	-	-	OK

Note:

The module will reset before sending the Final response. This means that host will not receive an “OK” acknowledgement.

Examples:

AT+FACTORYRESET=?
OK

AT+FACTORYRESET

3.3.3. AT+DCDC

Enable or disable the DC-DC converter.

Type	Input parameters	Additional response	Final response
Set	Mode	-	OK ERROR_INVALID_PARAM
Read	-	Mode	OK
Test	-	All accepted parameters	OK

Parameters/Responses:

- Mode: Enable / Disable the DCDC converter (0=Disable, 1=Enable)

Examples:

AT+DCDC=1
 OK

AT+DCDC?
 + DCDC: 1
 OK

AT+DCDC=?
 +DCDC: (0,1)
 OK

3.3.4. AT+UART

Configure the serial interface. The new UART configuration will be effective after a reset.

Type	Input parameters	Additional response	Final response
Set	flow_control baudrate	-	OK ERROR_INVALID_PARAM
Read	-	flow_control baudrate	OK
Test	-	Accepted parameters	OK

Parameters:

- flow_control: Enable or disable the flow control (0=Disable, 1=Enable)
- baudrate: Select the baudrate (1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600 or 1000000)

Examples:

AT+UART=0,115200
 OK

AT+UART?
 + DCDC: 0,115200
 OK

AT+UART=?
 +UART:(0,1),(1200,2400,4800,9600,19200,38400,57600,115200,230400,460800,921600,1000000)
 OK

3.3.5. AT+BLECONNSTATE

Get the BLE connection state (Connected / Not connected).

Type	Input parameters	Additional response	Final response
Read	-	State	OK
Test	-	-	OK

Parameters/response:

- State: State of the BLE connected (0=Disconnected, 1=Connected/Peripheral, 1=Connected/Central)

Examples:

AT+BLECONNSTATE?
 + BLECONNSTATE: 1
 OK

AT+BLECONNSTATE=?
 OK

3.3.6. AT+BLETXP

Set BLE Transmit power (in dBm).

Type	Input parameters	Additional response	Final response
Set	TXP	-	OK ERROR_INVALID_PARAM
Read	-	TXP	OK
Test	-	Accepted parameters	OK

Parameters/Response:

- TXP: TX power in dBm (-40, -20, -16, -12, -8, -4, 0, 3,4, 5, 6, 7 or 8)

Note: 5, 6 ,7 and 8 dBm are only available on the ISP1807-LR.

Examples:

AT+BLETXP=4
 OK

AT+BLETXP?
 + BLETXP: 4
 OK

AT+BLETXP=?
 +BLETXP: (-40, -20, -16, -12, -8, -4, 0, 3, 4)
 OK

3.3.7. AT+BLEPHY

Change the PHY mode (1M, 2M or Coded). The PHY mode can only be changed when a BLE connection is established. The command will need to be called each time a new BLE connection is established.

Type	Input parameters	Additional response	Final response
Set	tx_phy rx_phy	-	OK ERROR_INVALID_PARAM
Read	-	tx_phy rx_phy	OK
Test	-	Accepted parameters	OK

Parameters/Response:

- tx_phy: Phy of the transmit packet (0=Auto, 1=1M, 2=2M, 4=Coded)
- rx_phy: Phy of the receive packet (0=Auto, 1=1M, 2=2M, 4=Coded)

Note: Coded Phy is only available on the ISP1807-LR.

Examples:

AT+PHY=2,2
 OK

AT+PHY?
 +PHY: 2,2
 OK

AT+PHY =?
 +PHY: (0,1,2),(0,1,2)
 OK

3.3.8. AT+BLEADVPARAM

Change BLE advertising interval.

Type	Input parameters	Additional response	Final response
Set	interval	-	OK ERROR_INVALID_PARAM
Read	-	interval	OK
Test	-	Accepted parameters	OK

Parameters/Responses:

- interval: Advertising interval in ms (20-10240)

Examples:

AT+BLEADVPARAM=500
 OK

AT+BLEADVPARAM?
 +BLEADVPARAM: 500
 OK

AT+BLEADVPARAM=?
 +BLEADVPARAM: (20-10240)
 OK

3.3.9. AT+BLECONNPARAM

Change BLE connection parameters. These parameters can only be changed when a BLE connection is established. The command will need to be called each time a new BLE connection is established.

Type	Input parameters	Additional response	Final response
Set	min_interval max_interval latency timeout	-	OK ERROR_INVALID_PARAM
Read	-	min_interval max_interval latency timeout	OK
Test	-	(7.5-4000),(7.5-4000),(0-500),(10-32000)	OK

Parameters/Responses:

- min_interval: Minimum connection interval in ms
- max_interval: Maximum connection interval in ms
- latency: slave latency
- timeout: Connection timeout in ms

Examples:

AT+BLECONNPARAM=20,50,0,3000
+BLECONNPARAM: 1
OK

AT+BLECONNPARAM?
+BLECONNPARAM: 20,50,0,3000
OK

AT+BLECONNPARAM=?
+BLECONNPARAM: (7.5-4000), (7.5-4000), (0-500), (10-32000)
OK

3.3.10. AT+BLEADDR

Display BLE address.

Type	Input parameters	Additional response	Final response
Read	-	address	OK
Test	-	-	OK

Responses:

- address: BLE Address in hex format

Examples:

AT+BLEADDR?
+BLEADDR: FE-DC-BA-98-76-54
OK

3.3.11. AT+BLENAME

Change the BLE advertising name.

Type	Input parameters	Additional response	Final response
Set	name		OK ERROR_INVALID_PARAM ERROR_INVALID_LENGTH
Read	-	name	OK
Test	-	-	OK

Parameters/Responses:

- name: Device name (26 characters max)

Examples:

AT+BLENAME=MyName
OK

AT+BLENAME?

+BLENAME: MyName
 OK

AT+BLENAME=?
 OK

3.3.12. AT+BLEADVSTART

Start the BLE advertising. The module needs to be in peripheral role otherwise it will return ERROR_FORBIDDEN. If the module is already advertising, it will return ERROR_INVALID_STATE.

Type	Input parameter	Additional response	Final response
Set	-	-	OK ERROR_INVALID_STATE ERROR_FORBIDDEN
Test	-	Accepted parameters	OK

Examples:

AT+BLEADVSTART
 OK

AT+BLEADVSTART=?
 OK

3.3.13. AT+BLEADVSTOP

Stop the BLE advertising. The module needs to be in peripheral role otherwise it will return ERROR_FORBIDDEN. If the module is not advertising, it will return ERROR_INVALID_STATE.

Type	Input parameter	Additional response	Final response
Set	-	-	OK ERROR_INVALID_STATE ERROR_FORBIDDEN
Test	-	Accepted parameters	OK

Examples:

AT+BLEADVSTOP
 OK

AT+BLEADVSTOP=?
 OK

3.3.14. AT+BLERSSI

Get last BLE RSSI.

Type	Input parameter	Additional response	Final response
Read	-	RSSI	OK
Test	-	-	OK

Responses:

- RSSI: RSSI in dBm

Examples:

AT+BLERSSI?
+BLERSSI: -64
OK

AT+BLERSSI=?
OK

3.3.15. AT+BLEROLE

Select the module role (Peripheral or central).

Type	Input parameter	Additional response	Final response
Set	role		OK ERROR_INVALID_PARAM ERROR_FORBIDDEN
Read		role	OK
Test			OK

Parameters/ Responses:

- role: select the BLE role (0=Peripheral, 1=Central)

Note: ISP1907-LL cannot be a central device.

Examples:

AT+BLEROLE=1
OK

AT+BLEROLE?
+BLEROLE: 1
OK

AT+BLEROLE=?
+BLEROLE: (0, 1)
OK

3.3.16. AT+BLEDISCONNECT

Disconnect from BLE peer device.

Type	Input parameter	Additional response	Final response
Set			OK
Test			OK

Examples:

AT+BLEDISCONNECT
 OK

3.3.17. AT+BLESCANSTART

Start BLE scan. Usable only when the module is configured as central. If the device is already scanning it will return ERROR_INVALID_STATE.

Type	Input parameter	Additional response	Final response
Set	-	-	OK ERROR_INVALID_STATE ERROR_FORBIDDEN
Test	-	*	OK

Examples:

AT+BLESCANSTART
 OK

AT+ BLESCANSTART=?
 OK

3.3.18. AT+BLESCANSTOP

Stop BLE scan. Usable only when the module is configured as central. If the device is not scanning it will return ERROR_INVALID_STATE.

Type	Input parameter	Additional response	Final response
Set	-	-	OK ERROR_INVALID_STATE ERROR_FORBIDDEN
Test	-	-	OK

Examples:

AT+BLESCANSTOP
 OK

AT+BLESCANSTOP=?
 OK

3.3.19. AT+BLESCANLIST

Return list of scanned devices. Usable only when the module is configured as central.

Type	Input parameter	Additional response	Final response
Read	-	device_list	OK ERROR_FORBIDDEN
Test	-	-	OK

Responses:

- device_list: List of found BLE devices. For each device it displays: rssi, name and the address.

Examples:

```
AT+BLESCANLIST?  
+BLESCANLIST: -52, MyDevice, AABBCCDDEEFF  
OK
```

```
AT+BLESCANLIST=?  
OK
```

3.3.20. AT+BLECONNECT

Connect to another device. Usable only when the module is configured as central.

Type	Input parameter	Additional response	Final response
Set	address	-	OK ERROR_INVALID_PARAM ERROR_FORBIDDEN
Test	-	-	OK

Examples:

```
AT+BLECONNECT=AABBCCDDEEFF  
OK
```

```
AT+BLECONNECT=?  
OK
```