

 ABRACON [®] <small>The Power of Linking Together</small>	Bluetooth Low Energy Software Interface for Mesh Application Manual	 RoHS Compliant
Date of Issue: Feb 5 th , 2015	ABBTM-NVC-MDCS71-MESH	 ESD Sensitive
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Source Control Drawing

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1. Introduction

The Abracon Control Interface (ACCI) is a set of ASCII commands and indicators with which the user can control the Abracon's Bluetooth Module via UART interface by a host (PC, MCU, etc.).

The commands are used to control the Bluetooth Module sent by host. The indicators (or the response of the commands) are output from the Bluetooth Module to the host to indicate the status of the module.

ACCI for Mesh can be considered as a subset and/or extension of the common ACCI. It has special commands and indicators to access the Mesh functionalities of the ABBTM-NVC-MDCS71-MESH Bluetooth low energy module.

The current version of the firmware for ABBTM-NVC-MDCS71-MESH supports light control via a Mesh network. Lights integrated with ABBTM-NVC-MDCS71-MESH can be associated with a Mesh network by a smart phone app. After that, each light can be controlled from the app if the light is nearby the smart phone or there is a route to connect the light and the phone through other lights.

The default firmware can drive 3 PWM IOs and it is very useful to control a RGB color light control directly by ABBTM-NVC-MDCS71-MESH.

RED PWM control PIO: PIO9

GREEN PWM control PIO: PIO10

BLUE PWM control PIO: PIO11

In addition to light control, the firmware also supports transmission of customer data between network endpoint. After associated with the same Mesh network, each device will be allocated a unique 16bits device ID, which can be used as an address by data transmission commands.

1.1. Default UART Configuration

The default configuration of UART is given below:

Baud rate: 2400

Data bits: 8

Stop bits: 1

Parity: None

Flow control: None

The configuration of UART can be changed by ACCI and the new configuration is stored and used for further communication.

2. Command and Indicator Syntax




2.1. General Syntax

The general syntax of ACCI command is shown as below:

BC:<CMD>[=Para1][,Para2][,RawData][,...]<CR><LF>

The general syntax of ACCI indicator is shown as below:

<IDC>[=Para1][,Para2][,RawData][,...]<CR><LF>

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Description of each field:

BC: is the command line prefix.

CMD is the basic command. All of the commands are listed in section 3.

IDC is the basic indicator. All of the indicators are listed in section 0.

= is the separator between command/indicator and parameter. It's only needed if a parameter is presented.

Para1 is the first parameter. Not all of the commands have a parameter.

, is the separator between parameters. It's only needed if subsequent parameter is presented.

Para2 is the second parameter if available.

RawData is the raw data which will be sent by the command. Only parts of the commands have this field.

<CR><LF> is the terminator of the command line.

Notes:

1. If a parameter is mandatory, it will be surrounded by { }. If a parameter is optional, it will be surrounded by [].
2. **<CR>** means Carriage Return, and **<LF>** means Line-Feed.
3. All of the parameters are composed of ASCII characters while the **RawData** field can be composed of any data contents.
4. In indicators, the module prints hex values in low case. For other places in the document we always use upper case characters for hex values.

2.2. Examples

Here are some examples showing how to use the ACCI commands and indicators.

Ex. 2.1




→ BC:NM=Mesh001<CR><LF> ← *configure the GAP device name characteristic. The new name is "Mesh001".*

← OK<CR><LF> ← *response from the module to indicate the command is adopted.*

Notes:

1. For the examples in this document, the command sent to the Bluetooth Module will be shown with "→" at the beginning of the line, while the indicator output by Bluetooth Module will be shown with "←" at the beginning of the line.
2. For the examples in this document, the comments will start with a "←" and be written in italic.
3. For the examples in this document, only the characters in grey background color are the real content of a command or indicator.

For a full example using the module with iOS devices, please check 7.1.




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3. Command List

All the available ACCI commands for ABBTM-NVC-MDCS71-MESH are listed and briefly described in the tables below. The detailed description of each command is given in chapter 5.

Table 3.1 ACCI for BLE Command List

Command	Short Description
AC	Query the Mesh authorization code
AD	Query the Bluetooth address of the module
AL	Read the given AIO voltage level.
AT	Query the Mesh network association status.
BL	Query the battery level at the module's power pin.
BR	Query or change the UART baud rate.
CA	Clear the stored Mesh network association.
CC	Query or configure the peripheral preferred connection parameter characteristic
DC	Disconnect from remote BLE central.
DI	Query the Mesh network device ID. The device ID is allocated after associated with a Mesh network.
FT	Query or configure the features of the Bluetooth Module.
GI	Query the Mesh network group ID. The group ID is allocated by the Mesh control app running on a smart phone.
MB	In a Mesh network, send a block of data.
MD	Make the Bluetooth Module discoverable/connectable or not.
MS	In a Mesh network, send data in stream.
NM	Query or change the GAP device name characteristic.
RI	Query the RSSI for the current connection.
RT	Query the current radio status.
PD	Power down the module, put it into dormant or hibernate state, or warm reset it.
TM	Enter RF test mode, the test mode works though the standard 2-wire UART interface as defined in Bluetooth Core Spec V4.0. Default baud rate is 2400.
UD	Query the Mesh device UUID

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4. Indicator List

All the available ACCI indicators are listed and briefly described in the tables below. The detailed description of each indicator is given in chapter 6.

Table 4.1 ACCI for BLE Indicator List

Indicator	Short Description
AC	Indicates the device authorization code .
AD	Indicates the Bluetooth address of the Module
AL	Indicates the AIO voltage level .
AT	Indicates the Mesh network association status .
BL	Indicates the battery level at the module's power pin.
BR	Indicates the UART baud rate .
CC	Indicates the peripheral preferred connection parameter characteristic
DI	Indicates the Mesh network device ID . The device ID is allocated after associated with a Mesh network.
FT	Indicates the features of the Bluetooth Module.
GI	Indicates the Mesh network group ID .
ER	Indicates there is an error detected in the command sent by the host.
MB	Indicates that in the Mesh network , a data block is received.
MR	Indicates the status of Mesh network receive data stream .
MS	Indicates that in the Mesh network , new data of a stream is received.
NM	Indicates the GAP device name characteristic.
OK	Indicates a command was adopted by the Bluetooth Module.
RI	Indicates the RSSI for the current connection.
RT	Indicates the current radio status .
UD	Indicates the device UUID .

5. Description of ASCII Commands

5.1. General Information Commands

5.1.1. AD - Bluetooth Address

5.1.1.1. Description:




This command can query the Bluetooth address of local module. The response also contains the remote device address if it's bonded. Once the Bluetooth Module adopted this query request, it will report its Bluetooth address by the Indicator AD.

5.1.1.2. Syntax:

Synopsis:
BC:AD<CR><LF>

5.1.1.3. Parameter Description:

None.

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5.1.1.4. Examples:

Ex. 5.1. To query the Bluetooth address of local module:

➔ **BC:AD<CR><LF>** ← *query the Bluetooth address of local module.*
 ← **AD=00,5cb6cc00abcd <CR><LF>** ← *the Bluetooth address is using a public Bluetooth address,
 5C:B6:CC:00:AB:CD.*

5.1.2. FT - Features

5.1.2.1. Description:

This command can query or configure the features of Bluetooth Module. Once configured, the configuration will take effect immediately. The Bluetooth module stores the value in its non-volatile memory so the value won't change until be set again.

If the parameter is not presented, the Bluetooth Module will report current feature configuration by the Indicator FT. If the user wants to configure the features, all of the parameters should be given together.

5.1.2.2. Syntax:

Synopsis:
FT[=Features]<CR><LF>

5.1.2.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Features	A 16-bit value as a bit mask, for example, 8000 means the bit 15 is 1 and all other bits is 0. The features are defined with the 16 bits mask, 1 is enable. Bit 0-15: reserved for future use.	O	

Notes:

1. The default feature configuration may be different per software version.

5.1.2.4. Examples:

Ex. 5.2. To query current feature configuration of Bluetooth Module:




➔ **BC:FT<CR><LF>** ← *query current feature configuration.*
 ← **FT=0000<CR><LF>** ← *report current feature configuration.*

5.1.3. CC - Preferred Connection Parameters Characteristic

5.1.3.1. Description:

This command can query or configure the GAP preferred connection parameter characteristic of Bluetooth Module. Once configured, the configuration will take effect at the next time when a Bluetooth connection is being established. The Bluetooth module stores the value in its non-volatile memory so the value won't change until be set again.

If the parameter is not presented, the Bluetooth Module will report current configuration by the Indicator CC.

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5.1.4.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Name	The new device name of the Bluetooth Module. Length: 1—19 characters Default: Per software version.	O	

5.1.4.4. Examples:

Ex. 5.5. To query current local friendly name of Bluetooth Module:

➔ BC:NM<CR><LF> ← query current GAP device name character value.
 ⬅ NM=NVCmesh<CR><LF> ← report current GAP device name character value, it's "NVCmesh".

Ex. 5.6. To change the local friendly name of Bluetooth Module:

➔ BC:NM=NVCmesh01<CR><LF> ← change the GAP device name character value to "NVCmesh01"
 ⬅ OK<CR><LF> ← response from the module to indicate the command is adopted.

5.1.5. BR—UART Baud Rate

5.1.5.1. Description:

This command can query or change the UART baud rate of Bluetooth Module. Once changed, the new baud rate will take effect immediately. The Bluetooth module stores the value in its non-volatile memory so the value won't change until be set again.




If the parameter is not presented, the Bluetooth Module will report current baud rate by the Indicator BR.

5.1.5.2. Syntax:

Synopsis:
BC:BR[=Baud Rate]<CR><LF>

5.1.5.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Baud Rate	The new baud rate of the Bluetooth Module. Value: 00h—0Ch 00: 2400 01: 9600 02: 19200 03: 38400 04: 57600 05: 115200 06: 230400 07: 460800 08: 921600 09: 1382400 0A: 1843200 0B: 2764800 0C: 3686400 Default: 00 (2400)	O	The default baud rate may not be 2400 per software version. There's an advantage using default 2400 baud rate – no need to assert (pull up to high logic level) the WAKE pin to wake up the module from deep sleep before transmitting to it.

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Warning:

1. Please do NOT try to change to a new baud rate if you don't have a host which can work in that baud rate, for there is no other way to reset it except for UART port.
2. If baud rate other than 2400 is used, please keep pulling up the WAKE pin during sending data to the module.

5.1.5.4. Examples:

Ex. 5.7. To query the baud rate of Bluetooth Module:

➔ BC:BR<CR><LF> ← query the baud rate.
 ← BR=00<CR><LF> ← report the baud rate, it's 2400.

Ex. 5.8. To change the baud rate of Bluetooth Module:

➔ BC:BR=01<CR><LF> ← change the baud rate to 9600.
 ← ← There's no response for the set command. The new baud rate is effective immediately after receive the command. And the following commands and indicators are in new baud rate.

5.2. Connection and Data Transfer Commands

5.2.1. MD - Discoverable

5.2.1.1. Description:

This command can start or stop the BLE advertising. The module is discoverable/connectable only when the module is advertising.

5.2.1.2. Syntax:

Synopsis:
BC:MD{=Flag}<CR><LF>




5.2.1.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Flag	Switch on/off advertising. Value: 00h or 01h 00: Stop advertising. 01: Start advertising.	M	

5.2.1.4. Examples:

Ex. 5.9. To make Bluetooth Module discoverable:

➔ BC:MD=01<CR><LF> ← make Bluetooth Module discoverable.
 ← RT=01<CR><LF> ← response from the module to indicate the command is adopted.

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5.2.2. DC—Disconnect with remote BLE Central

5.2.2.1. Description:

This command disconnects the Bluetooth Module from the connected Bluetooth BLE central.

5.2.2.2. Syntax:

Synopsis:
BC:DC<CR><LF>

5.2.2.3. Parameter Description:

None.

5.2.2.4. Examples:

Ex. 5.10. To disconnect with the connected devices:

- ➔ BC:DC<CR><LF> ⤵ *disconnect with current connected devices.*
- ⤵ RT=04<CR><LF> ⤵ *the Bluetooth Module is disconnecting.*
- ⤵ RT=01<CR><LF> ⤵ *the Bluetooth Module is now disconnected and return to connectable state.*

5.2.3. RT—Radio Status

5.2.3.1. Description:

This command is used to query the status of the local BLE radio.

5.2.3.2. Syntax:

Synopsis:
BC:RT<CR><LF>




5.2.3.3. Parameter Description:

None.

5.2.3.4. Examples:

Ex. 5.11. To query the state of BLE radio:

- ➔ BC:RT<CR><LF> ⤵ *query the state of BTLE connection.*
- ⤵ RT=03,01,00189600abcd<CR><LF> ⤵ *the Bluetooth Module is now bonded to the BLE central device whose random address is 00:18:96:00:AB:CD.*

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5.2.4. RI—RSSI

5.2.4.1. Description:

This command is used to query the RSSI (radio signal strength indication) of the current connection.

5.2.4.2. Syntax:

Synopsis:
BC:RI<CR><LF>

5.2.4.3. Parameter Description:

None.

5.2.4.4. Examples:

Ex. 5.12. To query the RSSI of the current connection:

- BC:RI<CR><LF> ← *query the RSSI of the current connection.*
- ← RI=bb<CR><LF> ← *the RSSI of the current connection is -69dBm.*

5.3. Power Mode Commands

5.3.1. PD—Power Down the Module

5.3.1.1. Description:

This command can power down the module into a dormant or hibernate state. In dormant state the module can only be woken up by the pull high the WAKE pin. In hibernate state it will automatically wake up after a given timeout. This command can also be used to warm reset the module.

There's no indicator or response from the UART when the module is power down.

5.3.1.2. Syntax:




Synopsis:
BC:PD[=Mode, Timeout Value]<CR><LF>

5.3.1.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Mode	The power down mode. Value: 00: Dormant, the module power down immediately. 01: Hibernate, the module wake up after the timeout 02: warm reset	M	
Timeout value	7 hex value, the time out unit is 2 ²⁰ microseconds, about 1second. So the valid range is 1s to 8.9 years.	Should not be used with Dormant or Warm reset. M for hibernate	

Notes:

- When in dormant, the module can only wake up by pull WAKE pin to logic 1 (high logical voltage).

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5.3.1.4. Examples:

Ex. 5.13. To put the module into hibernate and make it automatically wake up after 16 seconds:

➔ **BC:PD=01,0000020<CR><LF>** ← Put the module into hibernate, and ask it automatically wake up after 32 seconds.

Ex. 5.14. To put the module into dormant state:

➔ **BC:PD=00<CR><LF>** ← Put the module into dormant, can only wake it up by WAKE pin.

Ex. 5.15. To warm reset the module:

➔ **BC:PD=02<CR><LF>** ← Reset the Bluetooth Module.

5.4. Mesh Network Commands

5.4.1. UD—Query the Device UUID

5.4.1.1. Description:

This command queries the device UUID used by Mesh network.

5.4.1.2. Syntax:

Synopsis:
BC:UD<CR><LF>

5.4.1.3. Parameter Description:

None.

5.4.1.4. Examples:

Ex. 5.16. To query the device UUID:

➔ **BC:UD<CR><LF>** ← Query the device UUID.
 ← **UD=1725,5b04,0002,b286,4dd2,ac23,7735,9ec0<CR><LF>** ← The device UUID is
 “9EC07735-AC23-4DD2-B286-00025B041725”

5.4.2. AC—Query the Device Authorization Code

5.4.2.1. Description:




This command queries the device authorization code used by Mesh network.

5.4.2.2. Syntax:

Synopsis:
BC:AC<CR><LF>

5.4.2.3. Parameter Description:

None.

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5.4.2.4. Examples:

Ex. 5.17. To query the authorization code:

➔ BC:AC<CR><LF> ← Query the device authorization code.
 ← AC=7990,963d,6de5,e4b3<CR><LF> ← The authorization code is “0xE4B36DE5963D7990”

5.4.3. CA—Clear the Mesh Network Association Information

5.4.3.1. Description:

This command clears the Mesh network association information.

5.4.3.2. Syntax:

Synopsis:
BC:CA<CR><LF>

5.4.3.3. Parameter Description:

None.

5.4.3.4. Examples:

Ex. 5.18. To clear the paired device list:

➔ BC:CA<CR><LF> ← Clear the Mesh network association information.
 ← OK<CR><LF> ← Response from the module to indicate the command is adopted

5.4.4. AT—Query Mesh Network Association Status

5.4.4.1. Description:

This command queries if the module has been associated with a Mesh network.

5.4.4.2. Syntax:

Synopsis:
BC:AT<CR><LF>




5.4.4.3. Parameter Description:

None.

5.4.4.4. Examples:

Ex. 5.19. To query the association status:

➔ BC:AT<CR><LF> ← Query the association status.
 ← AT=02<CR><LF> ← Response from the module to indicate the module has been associated with a Mesh network.

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5.4.5. DI—Query Mesh Network Device ID

5.4.5.1. Description:

When the BLE module associates with a Mesh network, a 16bit device ID is allocated to it. This command can be used to query the allocated device ID.

5.4.5.2. Syntax:

Synopsis:
BC:DI<CR><LF>

5.4.5.3. Parameter Description:

None.

5.4.5.4. Examples:

Ex. 5.20. To query the Mesh network device ID:

➔ BC:DI<CR><LF> ⬅ *Query the Mesh network device ID.*
 ⬅ DI=8001<CR><LF> ⬅ *Response from the module to indicate the device ID is 0x8001.*

5.4.6. GI—Query Mesh Network Group ID

5.4.6.1. Description:

When the BLE module associates with a Mesh network, a 16bit group ID is allocated to it. This command can be used to query the allocated group ID.

5.4.6.2. Syntax:

Synopsis:
BC:GI<CR><LF>




5.4.6.3. Parameter Description:

None.

5.4.6.4. Examples:

Ex. 5.21. To query the Mesh network group ID:

➔ BC:GI<CR><LF> ⬅ *Query the Mesh network group ID.*
 ⬅ GI=0001<CR><LF> ⬅ *Response from the module to indicate the group ID is 0x0001.*

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5.4.7. MB—Send Data Blocks over Mesh Network

5.4.7.1. Description:

After the BLE module associates with a Mesh network, it can send and receive data to/from other endpoints within the same network. Data can be sent in blocks or stream. When in blocks, the receiving endpoint does not acknowledge the transmission.

5.4.7.2. Syntax:

Synopsis:
BC:MB={device ID,data}<CR><LF>

5.4.7.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Device ID	Target device ID to which the data needs to be sent. Value format is in four hex values	M	
Date	Data to be sent. The maximum length is 10 bytes.	M	

Notes:

1. The <CR><LF> sequence is treated as the terminator of a command line. If the user wants to send these special characters to remote device, precede them with a backslash character “\” (So send “\\” for “\”).

5.4.7.4. Examples:

Ex. 5.22. To send data “abcd” to Mesh network endpoint whose device ID is 0x8003:

➔ BC:MB=8003,abcd<CR><LF> ← Send “abcd” to device “0x8003”.

← OK<CR><LF> ← The command is accepted by the module and the data is sent.

5.4.8. MS—Send Data Stream over Mesh Network




5.4.8.1. Description:

After the BLE module associates with a Mesh network, it can send and receive data from other endpoints within the same network. Data can be sent in blocks or stream. When in stream, the receiving endpoint send acknowledgement to the transmission endpoint for each received data packet. If there’s no acknowledgement in 1.5 seconds, at the transmission side the stream should be considered as stopped.

Multiple streams in parallel are not allowed. Use “BC:MS” (without parameter) to stop the current transmission stream before start a new stream. And if there is a receive stream opened, transmission stream is only allowed to target the same remote endpoint.

5.4.8.2. Syntax:

Synopsis:
BC:MS[=device ID,data]<CR><LF>

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5.4.8.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Device ID	Target device ID to which the data needs to be sent. When this parameter is not given, the command will flush the current opened transmitting stream and end it. Value format is in four hex value.	O	
Date	Data to be sent. The maximum length is 8 bytes.	O	

Notes:

1. The <CR><LF> sequence is treated as the terminator of a command line. If the user wants to send these special characters to remote device, precede them with a backslash character “\” (So send “\” for “\”).
2. If the data cannot be transmitted successfully, there won't be any acknowledgement from the module. The module will try for 3 times in 1.5 seconds internally, after that, the transmission and the stream is stopped.

5.4.8.4. Examples:

Ex. 5.23. To send data “abcd” to Mesh network endpoint whose device ID is 0x8003:

➔ BC:MS=8003,abcd<CR><LF> ← Send “abcd” to device “0x8003”.
 ← OK<CR><LF> ← The is sent to device “0x8003” successfully.

Ex. 5.24. When there is an existing data stream receiving with 0x8003, it cannot open another data stream to 0x8004:

➔ BC:MS=8004,abcd<CR><LF> ← Try to open a data stream to “0x8004” and send “abcd”.
 ← ER=01<CR><LF> ← The command cannot be processed in current state.

Ex. 5.25. When there is an existing data stream receiving with 0x8003, it cannot open another data stream to 0x8004:

➔ BC:MS=8004,abcd<CR><LF> ← Try to open a data stream to “0x8004” and send “abcd”.
 ← ← No response from the module in 1.5 seconds, transmission/stream stopped.

5.5. IO Access Commands

5.5.1. AL—Analogue IO Voltage Level

5.5.1.1. Description:




This command can be used to read the voltage level on a given AIO of the Bluetooth module.

5.5.1.2. Syntax:

Synopsis:
BC:AL={index of AIO}<CR><LF>

5.5.1.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Index of AIO	The BLE module has several analogue IOs. The parameter specifies which IO is using in reading. Value: 00~02	M	

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5.5.1.4. Examples:

Ex. 5.26. To read the voltage of AIO1:

- ➔ BC:AL=0001<CR><LF> ← Read the voltage level of AIO1.
 ← AL=0001,004e<CR><LF> ← The voltage level of AIO1 is 78mV.

5.5.2. BL—Battery Voltage Level

5.5.2.1. Description:

This command can be used to read the voltage level on the battery pin of the Bluetooth module.

5.5.2.2. Syntax:

Synopsis:
BC:BL<CR><LF>

5.5.2.3. Parameter Description:

None.

5.5.2.4. Examples:

Ex. 5.27. To read the battery voltage level:

- ➔ BC:BL<CR><LF> ← Read the battery voltage level.
 ← BL=0d28<CR><LF> ← The battery voltage level is 3368mV.

5.6. RF Test Mode Commands

5.6.1. TM—Enter Test Mode

5.6.1.1. Description:

The module supports standard 2-wire direct test mode as described in Volume 6, Part F Chapter 3 in Bluetooth Core Spec 4.0. The Baud rate is 2400 by default. To put it into test mode, the test mode command is used.

5.6.1.2. Syntax:

Synopsis:
BC:TM<CR><LF>




5.6.1.3. Parameter Description:

None.

5.6.1.4. Examples:

Ex. 5.28. To put the module into test mode:

- ➔ BC:TM<CR><LF> ← Put the module into 2-wire UART direct test mode.
 ← ← The UART interface works as 2-wire direct test mode immediately.

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6. Description of ASCII Indicators

6.1. General Indicators

6.1.1. OK - Command was adopted by the Bluetooth Module

6.1.1.1. Description:

This indicator indicates a command was adopted by the Bluetooth Module successfully.

6.1.1.2. Syntax:

Synopsis:
OK<CR><LF>

6.1.1.3. Parameter Description:

None.

6.1.1.4. Examples:

Ex. 6.1. To make Bluetooth Module discoverable:

➔ BC:MD=01<CR><LF> ⬅ *make Bluetooth Module discoverable.*
 ⬅ OK<CR><LF> ⬅ *response from the module to indicate the command is adopted.*

6.1.2. ER - Error

6.1.2.1. Description:




This indicator indicates there is an error detected in the command sent by the host.

6.1.2.2. Syntax:

Synopsis:
ER{=Error Code}<CR><LF>

6.1.2.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Error Code	The error code to give the reason of an error. Value: 01h—05h 01: The command is not allowed in current state. 02: The command is not given in proper format. 03: The command cannot be recognized. 04: Internal error happens when the command is processed. 05: The command has no effect under current status.	M	

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6.1.4.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Features	Refer to 5.1.2.3	M	

Notes:

- The default feature configuration may be different per software version.

6.1.4.4. Examples:

Refer to the examples in section 5.1.2.4.

6.1.5. CC - Preferred Connection Parameter Characteristic

6.1.5.1. Description:

This indicator report the GAP preferred connection parameter characteristic of Bluetooth Module.

6.1.5.2. Syntax:

Synopsis:
CC{=Min Interval,Max Interval, Latency, Supervision Timeout}<CR><LF>

6.1.5.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Min interval	The minimum value for the connection interval. Hex Value: xxxx (0006 to 0C80, FFFF means not specifically defined) Default depends on firmware	M	
Max interval	The maximum value for the connection interval. Hex Value: xxxx (0006 to 0C80, FFFF means not specifically defined) Default depends on firmware	M	
Latency	The slave latency for the connection in number of connection events. Hex Value: xxxx (0000 to 03E8) Default depends on firmware	M	
Supervision timeout	The connection supervisor timeout multiplier as a multiple of 10ms. Hex Value: xxxx (0006 to 0C80, FFFF means not specifically defined) Default depends on firmware	M	

6.1.5.4. Examples:

Refer to the examples in section 5.1.3.4.




6.1.6. NM - GAP Device Name Characteristic

6.1.6.1. Description:

This indicator will report current GAP device name characteristic of the Bluetooth Module.

6.1.6.2. Syntax:

Synopsis:
NM{=Name}<CR><LF>

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6.1.6.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Name	Refer to 5.1.4.3	M	

6.1.6.4. Examples:

Refer to the examples in section 5.1.4.4.

6.1.7. BR - UART baud rate

6.1.7.1. Description:

This indicator will report current UART baud of the Bluetooth Module.

6.1.7.2. Syntax:

Synopsis:
BR{=Baud Rate}<CR><LF>

6.1.7.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Baud Rate	Refer to 5.1.5.3	M	

6.1.7.4. Examples:

Refer to the examples in section 5.1.5.4.

6.2. Connection and Data Packet Indicators




6.2.1. RT - Radio State

6.2.1.1. Description:

This indicator reports the radio state.

6.2.1.2. Syntax:

Synopsis:
RT{=Radio State],[Remote Bluetooth Address Type],[Remote Bluetooth Address]<CR><LF>

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6.2.1.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Radio State	The state of radio connection. State Value: 00h-03h 00: idle and no connection can be made. 01: the module is connectable. 02: reserved. 03: the module is connected with a BLE central. 04: the module is disconnecting.	M	
Remote Bluetooth Address Type	The type of the connected BLE central address. Value: 00h-01h 00: Public device address 01: Random device address	O	Only available when there's a connection existed (state =03).
Remote Bluetooth Address	The Bluetooth address of the connected BLE central.	O	

6.2.1.4. Examples:

Refer to the examples in section 5.2.3.4.

6.2.2. RI - RSSI

6.2.2.1. Description:

This indicator reports the RSSI of the current connection.

6.2.2.2. Syntax:

Synopsis:
RI{=RSSI}<CR><LF>

6.2.2.3. Parameter Description:




Parameter	Description	Mandatory or Optional	Comments
RSSI	The RSSI of the current connection. The value is in dBm and the accuracy is 6dB. The value is in two's complement signed format. So the 2 hex characters have a range of +127 to -128.	M	

6.2.2.4. Examples:

Refer to the examples in section 5.2.4.4.

6.3. Power Mode Indicators

The module goes directly to the power mode which "PD" command requests. It doesn't send any indicator when power mode changes.

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6.4. Mesh Network Indicators

6.4.1. UD – Device UUID

6.4.1.1. Description:

This indicator reports the device UUID.

6.4.1.2. Syntax:

Synopsis:
UD{=Device UUID}<CR><LF>

6.4.1.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Device UUID	The device UUID string in low word first order, for a 128bits UUID, there are 8 words separated by comma. Value: xxxx, xxxx, xxxx, xxxx, xxxx, xxxx, xxxx, xxxx	M	

6.4.1.4. Examples:

Refer to the examples in section 5.4.1.4.

6.4.2. AC – Device Authorization Code

6.4.2.1. Description:

This indicator reports the device authorization code.

6.4.2.2. Syntax:

Synopsis:
AC{=Device Authorization Code}<CR><LF>

6.4.2.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Device Authorization Code	The authorization code is 64bits and printed in low word first format. The four words are separated by comma. Value: xxxx,xxxx,xxxx,xxxx	M	

6.4.2.4. Examples:

Refer to the examples in section 5.4.2.4.




6.4.3. AT – Mesh Network Association Status

6.4.3.1. Description:

This indicator reports the Mesh network association status.

6.4.3.2. Syntax:

Synopsis:
AT{=Status}<CR><LF>

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6.4.3.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Status	When the BLE module has been associated with a Mesh network. Value: 00: The module is not associated with any Mesh network. 01: Reserved. 02: The module is associated with a Mesh network.	M	

6.4.3.4. Examples:

Refer to the examples in section 5.4.4.4.

6.4.4. DI – Mesh Network Device ID

6.4.4.1. Description:

When the BLE module associates with a Mesh network, a 16bits device ID is allocated to it. This indicator reports the mesh network Device ID.

6.4.4.2. Syntax:

Synopsis:
DI{=Device ID}<CR><LF>

6.4.4.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Device ID	A 16bits device ID in hex string. Value: 0000~ffff	M	

6.4.4.4. Examples:

Refer to the examples in section 5.4.5.4.

6.4.5. GI – Mesh Network Group ID

6.4.5.1. Description:




When the BLE module associates with a Mesh network, a 16bits group ID is allocated to it. This indicator reports the mesh network group ID.

6.4.5.2. Syntax:

Synopsis:
GI{=Group ID}<CR><LF>

6.4.5.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Group ID	A 16bits group ID in hex string. Value: 0000~ffff	M	

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6.4.5.4. Examples:

Refer to the examples in section 5.4.6.4.

6.4.6. MB – Mesh Network Data Block

6.4.6.1. Description:

After the BLE module associates with a Mesh network, it can send and receive data from other endpoints within the same network. Data can be sent in blocks or stream. This indicator reports the received data in blocks

6.4.6.2. Syntax:

Synopsis:
MB{=device ID, data}<CR><LF>

6.4.6.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Device ID	Source device ID from which the data is sent. Value format is in four hex values.	M	
Data	Data received. The maximum length is 10 bytes.	M	

6.4.6.4. Examples:

Ex. 6.4. On a device whose ID is 0x8002, send data “abcd” to Mesh network endpoint whose device ID is 0x8003:

➔ **BC:MB=8003,abcd<CR><LF>** ⬅ *Send “abcd” to device “0x8003”.*

⬅ **OK<CR><LF>** ⬅ *The command is accepted by the module and the data is sent.*

At the receiver side (the endpoint whose device ID is 0x8003):

⬅ **MB=8002,abcd<CR><LF>** ⬅ *A data block “abcd” is received from device “0x8002”.*

6.4.7. MR – Mesh Network Receive Stream Status

6.4.7.1. Description:




After the BLE module associates with a Mesh network, it can send and receive data from other endpoints within the same network. Data can be sent in blocks or stream. This indicator reports the current Mesh receive stream status.

6.4.7.2. Syntax:

Synopsis:
MR{=receive stream status}<CR><LF>

6.4.7.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Receive Stream Status	Value: 00: receiving stream closed. 01: receiving stream opened.	M	

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6.4.7.4. Examples:

Ex. 6.5. Close the current transmission stream:

➔ BC:MS<CR><LF> ← Close the current transmission stream.
 ← OK<CR><LF> ← The command is accepted by the module.

At the receiver side:

← MR=00<CR><LF> ← The receive stream is closed.

6.4.8. MS – Mesh Network Data Stream

6.4.8.1. Description:

After the BLE module associates with a Mesh network, it can send and receive data from other endpoints within the same network. Data can be sent in blocks or stream. This indicator reports the received data in stream.

6.4.8.2. Syntax:

Synopsis:
MS{=device ID, data}<CR><LF>

6.4.8.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Device ID	Source device ID from which the data is sent. Value format is in four hex values.	M	
Data	Data received. The maximum length is 8 bytes.	M	

6.4.8.4. Examples:

Ex. 6.6. On a device whose ID is 0x8002, send data “abcd” to Mesh network endpoint whose device ID is 0x8003:

➔ BC:MS=8003,abcd<CR><LF> ← Send “abcd” to device “0x8003”.
 ← OK<CR><LF> ← The data is sent successfully (acknowledgement from 8003 is received).

At the receiver side (the endpoint whose device ID is 0x8003):

← MS=8002,abcd<CR><LF> ← “abcd” is received from device “0x8002”.

6.5. IO Access Indicators




6.5.1. AL – Analogue IO Voltage Level

6.5.1.1. Description:

This indicator reports the voltage level of a given analogue IO.

6.5.1.2. Syntax:

Synopsis:
AL{=index of AIO, voltage level in mV}<CR><LF>

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6.5.1.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Index of AIO	The BLE module has several analogue IOs. The parameter specifies which IO is using in reading. Value: 00~02	M	
Voltage Level in mV	A four character hex value of the voltage level in mV. The maximum value depends on the maximum acceptable voltage level of the BLE module.	M	

6.5.1.4. Examples:

Refer to the examples in section 5.5.1.4.

6.5.2. BL—Battery Voltage Level

6.5.2.1. Description:

This indicator reports the voltage level of the battery pin.

6.5.2.2. Syntax:




Synopsis:
BL{=voltage level in mV}<CR><LF>

6.5.2.3. Parameter Description:

Parameter	Description	Mandatory or Optional	Comments
Voltage Level in mV	A four character hex value of the voltage level in mV. The maximum value depends on the maximum acceptable voltage level of the BLE module.	M	

6.5.2.4. Examples:

Refer to the examples in section 5.5.2.4.

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7. Appendix A

7.1. Work with the CSR Android app “CSRmesh”

To work with the ABBTM-NVC-MDCS71-MESH, CSR’s Android app “CSRmesh” can be used. Or customer can develop their own app with the help of lib released by CSR.

When powered on, the ABBTM-NVC-MDCS71-MESH is automatically connectable. Open the app “CSRmesh” and click the button to scan and connect. The app scans the nearby devices and automatically connects to the one with strongest signal power.

To associate several ABBTM-NVC-MDCS71-MESH modules into one Mesh network, a network with a pass key can be generated in “Security Settings” in the app. Please always enable using “Authorize Devices” because that is a more security way for the Mesh networks.

To associate each ABBTM-NVC-MDCS71-MESH module with the Mesh network, enter “Device Association” in the app and use “QR code” to scan the QR code with the module,



Figure 7.1 QR code example

The contents of the QR code is actually a string in the following format,




&UUID=9EC07735AC234DD2B28600025b041726&AC=e4b36de5963d7990

In this example, the unique device UUID is “9EC07735-AC23-4DD2-B286-00025b041726” and the authorization code is “e4b36de5963d7990”. The device UUID and authorization code can be queried by command “UD” and “AC”, so the user can read them out and convert the code string into a text format QR code, then use the QR scan on the smart phone to associate the module.

Ex. 7.1, automatically advertising after power up:

➔ Novacomm Mesh V1.0<CR><LF>	← The module powers up and print its version number 1.0.
➔ AT=00<CR><LF>	← The module is not associated with any Mesh network when first power up.
← RT=01<CR><LF>	← The module is connectable after power up.
← RT=03,00,ac220b3dc1e4<CR><LF>	← The module has been connected with an device whose address is AC:22:0B:3D:C1:E4.
➔ AT=02<CR><LF>	← The CSRmesh app associates the module with the QR code.
← DI=8001<CR><LF>	← After associated, the module reports its device ID.

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8. Notes

- i) The parts are manufactured in accordance with this specification. If other conditions and specifications which are required for this specification, please contact ABRACON for more information.
- ii) ABRACON will supply the parts in accordance with this specification unless we receive a written request to modify prior to an order placement.
- iii) In no case shall ABRACON be liable for any product failure from in appropriate handling or operation of the item beyond the scope of this specification.
- iv) When changing your production process, please notify ABRACON immediately.
- v) ABRACON Corporation's products are COTS – Commercial-Off-The-Shelf products; suitable for Commercial, Industrial and, where designated, Automotive Applications. ABRACON's products are not specifically designed for Military, Aviation, Aerospace, Life-dependant Medical applications or any application requiring high reliability where component failure could result in loss of life and/or property. For applications requiring high reliability and/or presenting an extreme operating environment, written consent and authorization from ABRACON is required. Please contact ABRACON for more information.
- vi) All specifications and Marking will be subject to change without notice.

9. ABRACON LLC – TERMS & CONDITIONS OF SALE




The following are the terms and conditions under which Abracon LLC ("AB") agrees to sell, to the entity named on the face hereof ("Buyer"), the products specified on the face hereof (the "Products"). Notwithstanding Buyer's desire to use standardized RFQs, purchase order forms, order forms, acknowledgment forms and other documents which may contain terms in addition to or at variance with these terms, it is expressly understood and agreed that other forms shall neither add to, nor vary, these terms whether or not these terms are referenced therein. Buyer may assent to these terms by written acknowledgment, implication and/or by acceptance or payment of goods ordered any of which will constitute assent.

1. **Prices:** Prices shown on the face hereof are in US dollars, with delivery terms specified herein and are exclusive of any other charges including, without limitation, fees for export, special packaging, freight, insurance and similar charges. AB reserves the right to increase the price of Products by written notice to Buyer at least thirty (30) days prior to the original date of shipment. When quantity price discounts are quoted by AB, the discounts are computed separately for each type of product to be sold and are based upon the quantity of each type and each size ordered at any one time. If any discounted order is reduced by Buyer with AB's consent, the prices shall be adjusted to the higher prices, if applicable, for the remaining order.
2. **Taxes:** Unless otherwise specified in the quotation, the prices do not include any taxes, import or export duties, tariffs, customs charges or any such other levies. Buyer agrees to reimburse AB the amount of any federal, state, county, municipal, or other taxes, duties, tariffs, or custom charges AB is required to pay. If Buyer is exempt from any such charges, Buyer must provide AB with appropriate documentation.
3. **Payment Terms:** For each shipment, AB will invoice Buyer for the price of the Products plus all applicable taxes, packaging, transportation, insurance and other charges. Unless otherwise stated in a separate agreement or in AB's quotation, payments are due within thirty (30) days from the date of invoice, subject to AB's approval of Buyer's credit application. All invoicing disputes must be submitted in writing to AB within ten (10) days of the receipt of the invoice accompanied by a reasonably detailed explanation of the dispute. Payment of the undisputed amounts shall be made timely. AB reserves the right to require payment in advance or C.O.D. and otherwise modified credit terms. When partial shipments are made, payments for such shipments shall become due in accordance with the above terms upon submission of invoices. If, at the request of Buyer, shipment is postponed for more than thirty (30) days, payment will become due thirty days after notice to Buyer that Products are ready for shipment. Any unpaid due amounts will be subject to interest at one decimal five percent (1.5%) per month, or, if less, the maximum rate allowed by law.
4. **Delivery and Shipment:** Shipment dates are estimates only. Failure to deliver by a specified date shall neither entitle Buyer to any compensation nor impose any liability on AB. AB reserves the right to ship and bill ten percent more or less than the exact quantity specified on the face hereof. All shipments will be made Ex Works as per Incoterms 2000 from AB's place of shipment. In the absence of specific instructions, AB will select the carrier. Claims against AB for shortages must be made in writing within ten (10) days after the arrival of the shipment. AB is not required to notify Buyer of the shipment. Buyer shall pay all freight charges, insurance and other shipping expenses.

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Freight charges, insurance and other shipping expenses itemized in advance of actual shipment, if any, are estimates only that are calculated on the basis of standard tariffs and may not reflect actual costs. Buyer must pay actual costs.

5. **Purchase Order Changes and Cancellations:** Purchase orders for standard AB Products may not be canceled within sixty (60) days of the original shipping date. Purchase orders for non-standard AB Products are non-cancelable and non-returnable. All schedule changes must be requested at least thirty (30) days prior to original shipping date. Maximum schedule change "push-out" shall be no more than thirty (30) days from original shipping date. AB may terminate or cancel this order, in whole or in part, at any time prior to the completion of performance by written notice to Buyer without incurring any liability to Buyer for breach of contract or otherwise. AB reserves the right to allocate Products in its sole discretion among Buyer and other potential buyers, or defer or delay the shipment of any Product, which is in short supply due to any reason.
6. **Title and Risk of Loss:** AB's responsibility for any loss or damage ends, and title passes, when Products are delivered Ex Works as per Incoterms 2000 at AB's designated shipping location to carrier, to Buyer or to Buyer's agent, whichever occurs first.
7. **Packing:** Packaging shall be AB's standard shipping materials or as specified on the face hereof. Any cost of non-standard packaging and handling requested by Buyer shall be abided by AB provided Buyer gives reasonable prior notice and agrees in writing to pay additional costs.
8. **Security Interest:** Buyer hereby grants AB a purchase money security interest in the Products sold and in the proceeds of resale of such Products until such time as Buyer has paid all charges. AB retains all right and remedies available to AB under the Uniform Commercial Code.
9. **Specifications:** Specifications for each Product are the specifications specified in the published datasheets of such Product, as of the date of AB's quotation (the "Specifications"). Except as otherwise agreed, AB reserves the right to modify the Specifications at any time without adversely affecting the functionality.
10. **Acceptance:** Unless Buyer notifies AB in writing within ten (10) days from the date of receipt of Products that the Products fail to conform to the Specifications, the Products will be deemed accepted by Buyer. No such claim of non-conformity shall be valid if (i) the Products have been altered, modified or damaged by Buyer, (ii) the rejection notice fails to explain the non-conformance in reasonable detail and is not accompanied by a test report evidencing the non-conformity, or (iii) rejected Products are not returned to AB within thirty (30) days of rejection; provided, that no Product returns may be made without a return material authorization issued by AB.
11. **Limited Warranties and Disclaimers:** AB warrants to Buyer that each Product, for a period of twelve (12) months from shipment date thereof, will conform to the Specifications and be free from defects in materials and workmanship. AB's sole liability and Buyer's exclusive remedy for Products that fail to conform to this limited warranty ("Defective Products") is limited to repair or replacement of such Defective Products, or issue a credit or rebate of no more than the purchase price of such Defective Products, at AB's sole option and election. This warranty shall not apply: (i) if Products have been damaged or submitted to abnormal conditions (mechanical, electrical, or thermal) during transit, storage, installation, or use; or (ii) if Products are subject to Improper Use (as defined below); or (iii) if the non-conformance of Products results from misuse, neglect, improper testing, storage, installation, unauthorized repair, alteration, or excess usage at or beyond the maximum values (temperature limit, maximum voltage, and other Specification limits) defined by AB; (iv) to any other defect not attributable to AB; or (v) removal, alteration, or tampering of the original AB product labeling. This warranty does not extend to Products or components purchased from entities other than AB or AB's authorized distributors or to third-party software or documentation that may be supplied with any Product. In the event no defect or breach of warranty is discovered by AB upon receipt of any returned Product, such Product will be returned to Buyer at Buyer's expense and Buyer will reimburse AB for the transportation charges, labor, and associated charges incurred in testing the allegedly Defective Product. The above warranty is for Buyer's benefit only, and is non-transferable. OTHER THAN THE LIMITED WARRANTY SET FORTH ABOVE, AB MAKES NO WARRANTIES, EXPRESS, STATUTORY, IMPLIED, OR OTHERWISE AND SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT, TO THE MAXIMUM EXTENT PERMITTED BY LAW. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING DISCLAIMERS, AB INCORPORATES BY REFERENCE ANY PRODUCT-SPECIFIC WARRANTY DISCLAIMERS SET FORTH IN THE PUBLISHED PRODUCT DATASHEETS.
12. **Limitation of Liability:** AB SHALL HAVE NO LIABILITY FOR LOSS ARISING FROM ANY CLAIM MADE AGAINST BUYER, OR FOR SPECIAL, INDIRECT, RELIANCE, INCIDENTAL, CONSEQUENTIAL, OR PUNITIVE DAMAGES INCLUDING, WITHOUT LIMITATION, LOSS OF USE, PROFITS, REVENUES, OR COST OF PROCUREMENT OF SUBSTITUTE GOODS BASED ON ANY BREACH OR DEFAULT OF AB, HOWEVER CAUSED, AND UNDER ANY THEORY OF LIABILITY. BUYER'S SOLE REMEDY AND AB'S SOLE AND TOTAL LIABILITY FOR ANY CAUSE OF ACTION, WHETHER IN CONTRACT (INCLUDING BREACH OF WARRANTY) OR TORT (INCLUDING NEGLIGENCE OR MISREPRESENTATION) OR UNDER STATUTE OR OTHERWISE SHALL BE LIMITED TO AND SHALL NOT EXCEED THE AGGREGATE AMOUNTS PAID BY BUYER TO AB FOR PRODUCTS WHICH GIVE RISE TO CLAIMS. BUYER SHALL ALWAYS INFORM AB OF ANY BREACH AND AFFORD AB REASONABLE OPPORTUNITY TO CORRECT ANY BREACH. THE FOREGOING LIMITATIONS SHALL APPLY REGARDLESS OF WHETHER AB HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND NOTWITHSTANDING THE FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY.

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13. **Improper Use:** Buyer agrees and covenants that, without AB's prior written approval, Products will not be used in life support systems, human implantation, nuclear facilities or systems or any other application where Product failure could lead to loss of life or catastrophic property damage (each such use being an "Improper Use"). Buyer will indemnify and hold AB harmless from any loss, cost, or damage resulting from Improper Use of the Products.

14. **Miscellaneous:** In the event of any insolvency or inability to pay debts as they become due by Buyer, or voluntary or involuntary bankruptcy proceeding by or against Buyer, or appointment of a receiver or assignee for the benefit of creditors of Buyer, AB may elect to cancel any unfulfilled obligations. No Products or underlying information or technology may be exported or re-exported, directly or indirectly, contrary to US law or US Government export controls. AB will be excused from any obligation to the extent performance thereof is caused by, or arises in connection with, acts of God, fire, flood, riots, material shortages, strikes, governmental acts, disasters, earthquakes, inability to obtain labor or materials through its regular sources, delay in delivery by AB's supplies or any other reason beyond the reasonable control of AB. In the event any one or more of the provisions contained herein shall for any reason be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability shall not affect any other provision hereof and these terms shall be construed as if such invalid, illegal, or unenforceable provision had never been contained herein. A waiver of a breach or default under these terms shall not be a waiver of any subsequent default. Failure of AB to enforce compliance with any of these terms shall not constitute a waiver of such terms. These terms are governed by the laws of the State of California without reference to conflict of law principles. The federal and state courts located within the State of California will have exclusive jurisdiction to adjudicate any dispute arising out of these terms.