



HUAWEI M.2 Module

# **BodySAR Function Application Notes**

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## About This Document

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### Revision History

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# 1 Overview

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## 1.1 Purpose

The specific absorption rate (SAR) is the electromagnetic energy absorption rate of wireless products, for example, mobile phones. The SAR typifies the electromagnetic power that is absorbed or consumed by a unit mass in human tissues. The international scientific community uses the SAR to quantize and measure the mobile phone radiation. The higher the SAR value of a mobile phone is, the more the mobile phone affects the human body.

The SAR solution is designed to satisfy SAR requirements from FCC, and it is a significant issue to ensure user safety.

The essential purpose is that device would automatically reduce TX power when it detects human proximity .

## 1.2 Organization

- Huawei BodySAR Solution
- Hardware Interface
- Software Interface
- Function Usage and Test Usage

## 1.3 Application Scope

For the PC or tablet vendors which use Huawei WWAN Module.

# 2 Introduction to BodySAR Function

## 2.1 About This Chapter

The module product provides a BodySAR function, which uses relevant AT command interfaces to dynamically limit the maximum transmitting power and accordingly limit the SAR value.

This document describes the interfaces of hardware and software related to the BodySAR function and the common usages and processes of these interfaces.

## 2.2 Background

FCC has adopted limits for safe exposure to radiofrequency (RF) energy. These limits are given in terms of a unit referred to as the Specific Absorption Rate (SAR), which is a measure of the amount of radio frequency energy absorbed by the body when using a mobile phone. The FCC requires cell phone manufacturers to ensure that their phones comply with these objective limits for safe exposure. Any cell phone at or below these SAR levels (that is, any phone legally sold in the U.S.) is a "safe" phone, as measured by these standards. The FCC limit for public exposure from cellular telephones is an SAR level of 1.6 watts per kilogram (1.6 W/kg).

Different regions have different SAR requirements, as follow:

**Table 2-1** SAR requirements of different regions

	SAR (USA,Korea,Taiwan)			SAR (Europe,Australia,Japan,China)		
	General average	Specific position	Hand, wrist, foot	General average	Specific position	Hand,wrist, foot
Employee	0.4 W/kg	8.0 W/kg	20.0 W/kg	0.4 W/kg	10.0 W/kg	20.0 W/kg
The public	0.08W/kg	1.6 W/kg	4.0 W/kg	0.08 W/kg	2.0 W/kg	4.0 W/kg

## 2.3 Huawei BodySAR Solution

### Software-based solution

According to MSFT's recommendation for Win8, an UMDF driver consists of GPIO sensor module, SAR back-off logic and MB device-specific module. Huawei will provide MBIM based API to control SAR back-off and support OEM/ODM to develop the UMDF driver. This solution provides most flexibilities to host system to control SAR power back-off, such as multiple sensor in different directions, and change power back-off dynamically in runtime, etc.

### Hardware-based solution

Through connecting the proximity sensor to the WWAN module directly, the module could do SAR back-off automatically when it gets the human present notification from the sensor. In this case, the UMDF driver will not be needed any more. it could simplify the OEM/ODM's system design.

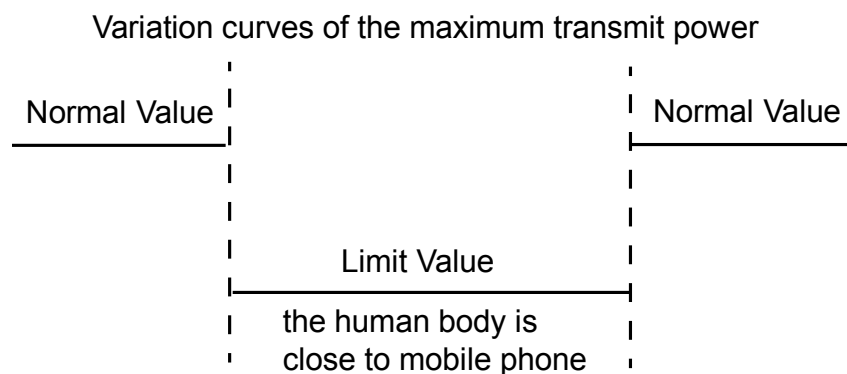
Take care that we should only use the software-based solution or hardware-based solution. It's not recommend to use them at the same time.

## 2.4 BodySAR Feature

When the human body approaches to the mobile phone (or tablet) equipment, it detects the body proximity, and reports to the system. Then the system provides decreased SAR target power to WWAN module. The module sets the maximum transmit power according to the corresponding frequency and mode, to limit the transmitting power.

When the human body leaves the mobile phone (or tablet) equipment, it feels the human body to leave, and reports to the system. Then the system disables the BodySAR function. The WWAN module resumes the normal transmitting power.

**Figure 2-1** BodySAR feature diagram



### Main Features

- Supporting to set the power back-off values for any band and any mode such as GSM, UMTS, CDMA, LTE, etc.





- Supporting to set the power back-off values statically and dynamically, that is, both pre-written in manufactory and modified in runtime (only available for software-based solution).
- Once there are power back-off values set, only need to enable and disable the function when it needs in runtime, that is, only need to switch on/off when there is human present or not, and the module will do proper power back-off according to current working band.
- Supporting both Win8 and Win7/XP, on Win8, control this function through MBIM extension API, and on pre-Win8, through AT commands or SDK APIs.

# 3 Hardware Interface

## 3.1 About This Chapter

Huawei module BodySAR design contains hardware and software design. This chapter describes the hardware design.

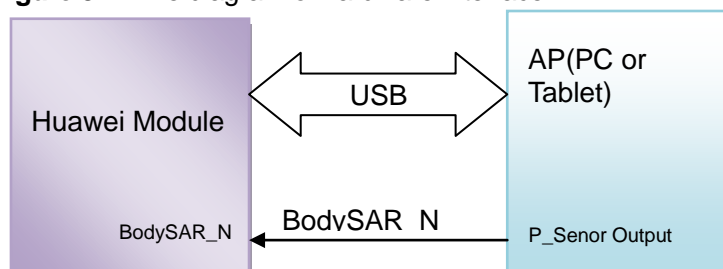
Huawei module supports one GPIO pin (BodySAR\_N) to communicate with AP, and turn on or turn off the BodySAR function. BodySAR\_N signal is an input for Huawei Module, and a hardware switch.

When BodySAR\_N is low, the BodySAR function will be enabled; when BodySAR\_N is high, the BodySAR function will be disabled.

**Table 3-1** Hardware interface signals

Pin Name		I/O	Description	DC Characteristics (V)		
Normal	MUX			Min.	Typ.	Max.
BodySAR_N		I	Hardware pin for BodySAR Detection H: No TX power backoff (default) L: TX power backoff	-0.3	1.8	3.6

**Figure 3-1** The diagram of hardware interface

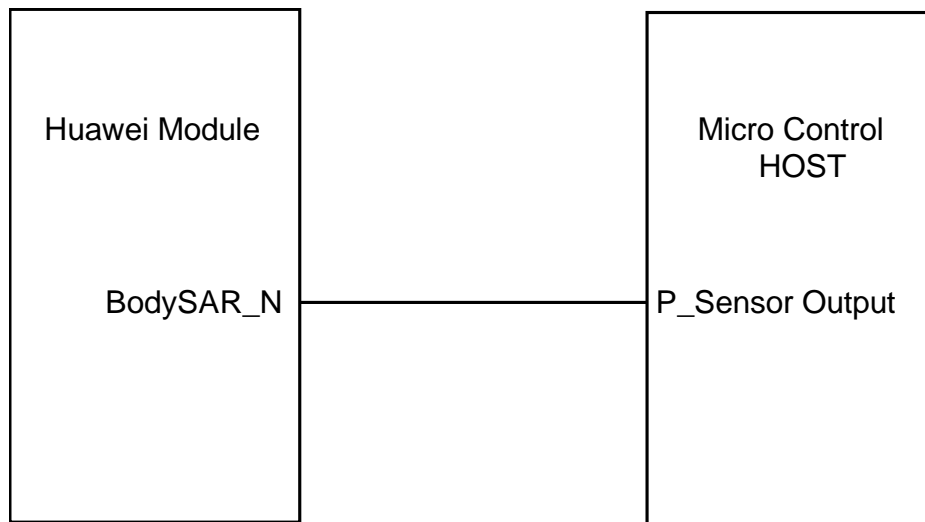


## 3.2 BodySAR\_N Pin

The BodySAR\_N signal is used to monitor the proximity sensor's output (The controlling signal form the host which is not limited to the output of a proximity sensor) and trigger the power backoff actions. It's low active.

Its work scheme is simple: if BodySAR\_N is driven low, Huawei module will enable the BodySAR function; if BodySAR\_N is driven high, Huawei module will disable the BodySAR function. BodySAR\_N is internally pulled up to 1.8 V.

**Figure 3-2** Connections of the BodySAR\_N pin



BodySAR\_N supports 1.8 V and 3.3 V,  $V_{il} \leq 0.3 V$

# 4 Software Interfaces

## 4.1 About This Chapter

This chapter describes the software interfaces of the BodySAR function.

## 4.2 AT^BODYSARON-Disable/Enable BodySAR

### 4.2.1 Command Syntax

<b>Set command</b>
AT^BODYSARON=<on>
<b>Possible Response(s)</b>
<CR><LF>OK<CR><LF>
In case of an MT-related error:
<CR><LF>ERROR<CR><LF>
<b>Read command</b>
AT^BODYSARON?
<b>Possible Response(s)</b>
<CR><LF>^BODYSARON: <on><CR><LF><CR><LF>OK<CR><LF>
In case of an MT-related error:
<CR><LF>ERROR<CR><LF>
<b>Test command</b>
AT^BODYSARON=?
<b>Possible Response(s)</b>
<CR><LF>^BODYSARON: (0,1)<CR><LF><CR><LF>OK<CR><LF>

## 4.2.2 Interface Description

The set command enables or disables the BodySAR function.

The read command queries the current BodySAR function status.

The test command checks the parameter value range supported by this command.

## 4.2.3 Parameter Description

<on>:

- 0            Disable BodySAR (default value)
- 1            Enable BodySAR

## 4.2.4 Property Description

Saving upon Power-off	PIN
N	N

# 4.3 AT^BODYSARWCDMA–Set the Maximum Tx Power Limit of WCDMA

## 4.3.1 Command Syntax

<p><b>Set command</b></p> <p>AT^BODYSARWCDMA=&lt;power&gt;[,&lt;band&gt;[,&lt;power&gt;,&lt;band&gt;]...]</p>
<p>Possible Response(s)</p> <p>&lt;CR&gt;&lt;LF&gt;OK&lt;CR&gt;&lt;LF&gt;</p> <p>In case of an MT-related error:</p> <p>&lt;CR&gt;&lt;LF&gt;ERROR&lt;CR&gt;&lt;LF&gt;</p>
<p><b>Read command</b></p> <p>AT^BODYSARWCDMA?</p>
<p>Possible Response(s)</p> <p>&lt;CR&gt;&lt;LF&gt;^BODYSARWCDMA: list of (&lt;power&gt;,&lt;band&gt;) s&lt;CR&gt;&lt;LF&gt;&lt;CR&gt;&lt;LF&gt;OK&lt;CR&gt;&lt;LF&gt;</p> <p>In case of an MT-related error:</p> <p>&lt;CR&gt;&lt;LF&gt;ERROR&lt;CR&gt;&lt;LF&gt;</p>

<b>Test command</b>
AT^BODYSARWCDMA=?
<b>Possible Response(s)</b>
<CR><LF>^BODYSARWCDMA: (12-24) , <band><CR><LF><CR><LF>OK<CR><LF>

### 4.3.2 Interface Description

The set command sets the maximum Tx power limit of WCDMA for each band. Set the maximum Tx power limit of WCDMA for selected band according to the value of band bit field, and you can send this command for several times and set the different power limit when the values of bands are set differently.

The read command queries the maximum Tx power limit of WCDMA for each band. If the parameter values are not set, the default values are displayed after the query.

The test command checks the band range supported by WCDMA and the parameter values supported by the maximum Tx power limit for each band.

### 4.3.3 Parameter Description

<power>: the maximum Tx power limit, integer ranging from 12 to 24 in dBm.

<band>: band bit field, 32-bit digit with hexadecimal. A binary bit indicates a frequency band. The value of binary bit is shown in the following table (or parameter superimposed values except 3FFFFFFF).

Parameters	Band
00000001	WCDMA_I_IMT_2000
00000002	WCDMA_II_PCS_1900
00000004	WCDMA_III_1700
00000008	WCDMA_IV_1700
00000010	WCDMA_V_850
00000020	WCDMA_VI_800
00000040	WCDMA_VII_2600
00000080	WCDMA_VIII_900
00000100	WCDMA_IX_1700
3FFFFFFF	All supported bands

[, <band>[, <power>, <band>]...]: indicates that select all supported bands when all parameters are default. The parameter can set several groups (less or equal to eight

groups) of power at one time. One <power> is set according to <band> in the same group.

### 4.3.4 Property Description

Saving upon Power-off	PIN
Y	N

### 4.3.5 Example

```

Run:          AT^BODYSARWCDMA=?
Response:    ^BODYSARWCDMA: (12-
              24),00000007
              OK
Run:          AT^BODYSARWCDMA=20,00000001,18
              ,00000006
Response:    OK
Run:          AT^BODYSARWCDMA?
Response:    ^BODYSARWCDMA: (20,00000001), (
              18,00000006)
              OK
  
```

Indicates that the firmware supports WCDMA I, WCDMA II and WCDMA III; the power is from 12 to 24.

Indicates that set the maximum WCDMA I Tx power limit to 20 and the maximum WCDMA II and WCDMA III Tx power limit to 18.

Indicates that the current maximum WCDMA I Tx power limit is set to 20 and the maximum WCDMA II and WCDMA III Tx power limit is set to 18.

## 4.4 AT^BODYSARGSM-Set the Maximum Tx Power Limit of GSM

### 4.4.1 Command Syntax

<b>Set command</b>
AT^BODYSARGSM=<power>[,<band>[,<power>,<band>]...]
<b>Possible Response(s)</b>
<CR><LF>OK<CR><LF>

In case of an MT-related error: <CR><LF>ERROR<CR><LF>
<b>Read command</b> AT^BODYSARGSM?
Possible Response(s)
<CR><LF>^BODYSARGSM: list of (<power>, <band>) s<CR><LF><CR><LF>OK<CR><LF>
In case of an MT-related error: <CR><LF>ERROR<CR><LF>
<b>Test command</b> AT^BODYSARGSM=?
Possible Response(s)
<CR><LF>^BODYSARGSM: (15- 33), <band><CR><LF><CR><LF>OK<CR><LF>

## 4.4.2 Interface Description

The set command sets the maximum Tx power limit of GSM GPRS and EGPRS for each band single time-slot. Set the maximum Tx power limit of GSM for selected band according to the value of band bit field, and AP can send this command for several times and set the different power limit when the values of bands are set differently.

The read command queries the maximum Tx power limit of GSM for each band. If the parameter values are not set, the default values are displayed after the query.

The test command checks the band range supported by GSM and the parameter values supported by the maximum Tx power limit for each band.

## 4.4.3 Parameter Description

<power>: the maximum Tx power limit, integer ranging from 15 to 33 in dBm.

<band>: band bit field, 32-bit digit with hexadecimal. A binary bit indicates a frequency band. The value of binary bit is shown in the following table (or parameter superimposed values except 3FFFFFFF).

Parameters(GPRS)	Parameters(EGPRS)	Band
00000001	00010000	GSM850
00000002	00020000	GSM900
00000004	00040000	GSM1800
00000008	00080000	GSM1900
3FFFFFFF		All supported bands



[, <band>[, <power>, <band>]...]: indicates that select all supported bands when all parameters are default. The parameter can set several groups (less or equal to eight groups) of power at one time. One <power> is set according to <band> in the same group.

#### 4.4.4 Property Description

Saving upon Power-off	PIN
Y	N

#### 4.4.5 Example

```

Run:          AT^BODYARGSM=?
Response:    ^BODYARGSM: (15-33),0000000F
              OK
Indicates that the firmware supports GSM850, GSM900, GSM1800 and GSM1900; the power is from 15 to 33.

Run:          AT^BODYARGSM=20
Response:    OK
Indicates that default value, set the the maximum Tx power limit for the band supported by firmware to 20.

Run:          AT^BODYARGSM?
Response:    ^BODYARGSM: (20,3FFFFFFF)
              OK
Indicates that the the maximum Tx power limit for the band supported by firmware is set to 20.

```

### 4.5 AT^BODYSARLTE-Set the Maximum Tx Power Limit of LTE

#### 4.5.1 Command Syntax

<b>Set command</b>
AT^BODYSARLTE=<power>[, <band>[, <power>, <band>]...]
<b>Possible Response(s)</b>
<CR><LF>OK<CR><LF>
In case of an MT-related error:
<CR><LF>ERROR<CR><LF>

<b>Read command</b>
AT^BODYSARLTE?
<b>Possible Response(s)</b>
<CR><LF>^BODYSARLTE: list of (<power>, <band>)s<CR><LF><CR><LF>OK<CR><LF>
In case of an MT-related error: <CR><LF>ERROR<CR><LF>
<b>Test command</b>
AT^BODYSARLTE=?
<b>Possible Response(s)</b>
<CR><LF>^BODYSARLTE: (19- 24), <band><CR><LF><CR><LF>OK<CR><LF>

## 4.5.2 Interface Description

The set command sets the maximum Tx power limit of LTE for each band. Set the maximum Tx power limit of LTE for selected band according to the value of band bit field, and you can send this command for several times and set the different power limit when the values of bands are set differently.

The read command queries the maximum Tx power limit of LTE for each band. If the parameter values are not set, the default values are displayed after the query.

The test command checks the band range supported by LTE and the parameter values supported by the maximum Tx power limit for each band.

## 4.5.3 Parameter Description

<power>: the maximum Tx power limit, integer ranging from 19 to 24 in dBm.

<band>: band bit field, 64-bit digit with hexadecimal. A binary bit indicates a frequency band. The value of binary bit is shown in the following table (or parameter superimposed values except FFFFFFFFFFFFFFFF).

Parameters	Band
0000000000000001	band 1
0000000000000002	band 2
0000000000000004	band 3
0000000000000008	band 4
0000000000000010	band 5
0000000000000020	band 6
0000000000000040	band 7



Parameters	Band
0000000000000080	band 8
0000000000000100	band 9
0000000000000200	band 10
0000000000000400	band 11
0000000000000800	band 12
0000000000001000	band 13
0000000000002000	band 14
0000000000004000	band 15
0000000000008000	band 16
0000000000010000	band 17
0000000000020000	band 18
0000000000040000	band 19
0000000000080000	band 20
0000000000100000	band 21
0000000000200000	band 22
0000000000400000	band 23
0000000000800000	band 24
0000000001000000	band 25
0000000002000000	band 26
0000000004000000	band 27
0000000008000000	band 28
0000000010000000	band 29
0000000020000000	band 30
0000000040000000	band 31
0000000080000000	band 32
0000000100000000	band 33
0000000200000000	band 34
0000000400000000	band 35
0000000800000000	band 36
0000001000000000	band 37
0000002000000000	band 38



Parameters	Band
00000040000000000	band 39
00000080000000000	band 40
00000100000000000	band 41
00000200000000000	band 42
00000400000000000	band 43
00000800000000000	band 44
00001000000000000	band 45
00002000000000000	band 46
00004000000000000	band 47
00008000000000000	band 48
00010000000000000	band 49
00020000000000000	band 50
00040000000000000	band 51
00080000000000000	band 52
00100000000000000	band 53
00200000000000000	band 54
00400000000000000	band 55
00800000000000000	band 56
01000000000000000	band 57
02000000000000000	band 58
04000000000000000	band 59
08000000000000000	band 60
10000000000000000	band 61
20000000000000000	band 62
40000000000000000	band 63
80000000000000000	band 64
FFFFFFFFFFFFFFFFF	All supported bands

[,<band>[,<power>,<band>]...]: indicates that select all supported bands when all parameters are default. The parameter can set several groups (less or equal to eight groups) of power at one time. One <power> is set according to <band> in the same group.

## 4.5.4 Property Description

Saving upon Power-off	PIN
Y	N

## 4.5.5 Example

Run: AT^BODYSARLTE=?

Response: ^BODYSARLTE: (19-24),00000000000000007  
OK

Indicates that the firmware supports band1, band2 and band3; the power is from 19 to 24.

Run: AT^BODYSARLTE=20,FFFFFFFF  
FFFFFF

Indicates that set the maximum Tx power limit of bands supported by firmware to 20.

Response: OK

Run: AT^BODYSARLTE?

Response: ^BODYSARLTE: (20,FFFFFFFF  
FFFFFF)  
OK

Indicates that the maximum Tx power limit of bands supported by firmware is set to 20.

## 4.6 AT ^BODYSARCDMA-Set the Max tx Power Limit of CDMA

### 4.6.1 Command Syntax

<b>Set command</b>
AT^BODYSARCDMA=<power>[,<band>[,<power>,<band>]...]
<b>Possible Response(s)</b>
<CR><LF>OK<CR><LF>
In case of an MT-related error:
<CR><LF>ERROR<CR><LF>
<b>Read command</b>
AT^BODYSARCDMA?
<b>Possible Response(s)</b>

```
<CR><LF>^BODYSARCDMA: list of
(<power>, <band>) s<CR><LF><CR><LF>OK<CR><LF>
```

In case of an MT-related error:

```
<CR><LF>ERROR<CR><LF>
```

**Test command**

```
AT^BODYSARCDMA=?
```

**Possible Response(s)**

```
<CR><LF>^BODYSARCDMA: (19, 24) <CR><LF><CR><LF>OK<CR><LF>
```

## 4.6.2 Interface Description

This command is used to set the max transmit power limit of CDMA. The read command can queries current value of the max transmit power limit. The test command returns supported value of the max transmit power limit.

## 4.6.3 Parameter Description

<power>: the max transmit power limit of CDMA, integer ranging from 19 to 24 in dBm; default value is 24.

<band>: band bit field, 32-bit digit with hexadecimal. A binary bit indicates a frequency band. The value of binary bit is shown in the following table (or parameter superimposed values except 3FFFFFFF).

Parameters	Band
00000001	BC0 A
00000002	BC0 B
00000004	BC1
00000008	BC2
00000010	BC3
00000020	BC4
00000040	BC5
00000080	BC6
00000100	BC7
00000200	BC8
00000400	BC9
00000800	BC10
00001000	BC11
00002000	BC12

Parameters	Band
00004000	BC13
00008000	BC14
00010000	BC15
00020000	BC16
00040000	BC17
00080000	BC18
00100000	BC19
3FFFFFFF	All supported bands

[, <band>[, <power>, <band>]...]: indicates that select all supported bands when all parameters are default. The parameter can set several groups (less or equal to eight groups) of power at one time. One <power> is set according to <band> in the same group.

#### 4.6.4 Property Description

Saving upon Power-off	PIN
Y	N

#### 4.6.5 Example

```

Run:          AT^BODYSARCDMA=?
Response:    ^BODYSARCDMA: (19-24),00000081  Indicates that the
                                                    firmware supports BC0
                                                    A and BC6; the power
                                                    is from 19 to 24.
                                                    OK
Run:          AT^BODYSARCDMA=20,00000001
                                                    Indicates that set the
                                                    maximum Tx power
                                                    limit of BC0 A
                                                    supported by firmware
                                                    to 20.
Response:    OK
Run:          AT^BODYSARCDMA?

```



Response: ^BODYSARCDMA: (20,00000001), (24,00000080)  
  
OK

Indicates that the current maximum BC0 A Tx power limit is set to 20 and the maximum BC6 Tx power is remain the default value 24.

## 4.7 WIN8 MBIM Command

### 4.7.1 Service UUID

Service Name	UUID Value
HUAWEI_BODYDMSAR	10E40D69-375A-42CE-A297-906164F2754C

### 4.7.2 MBIM Command Codes

Service Name	UUID Value
MBIM_CID_SAR_CONFIG	0x00000001

### 4.7.3 MBIM\_CID\_SAR\_CONFIG

#### Description

Set: Information Buffer on MBIM\_COMMAND\_MSG contains BIM\_SAR\_CONFIG. MBIM\_SAR\_CONFIG is returned in Information Buffer of MBIM\_COMMAND\_DONE.

Query: Information Buffer on MBIM\_COMMAND\_MSG is not used. MBIM\_SAR\_CONFIG is returned in Information Buffer of MBIM\_COMMAND\_DONE.

Unsolicited Event: There is no unsolicited event.

#### Parameters

	Set	Query	Notification
MBIM_CID_SAR_CONFIG	MBIM_SAR_CONFIG	Empty	NA
Response	MBIM_SAR_CONFIG	MBIM_SAR_CONFIG	NA





## MBIM\_SAR\_STATUS

Type	Value	Description
MBIM_SAR_STATUS_ENABLED	1	Enable BodySAR
MBIM_SAR_STATUS_DISABLED	0	Disable BodySAR

## MBIM\_SAR\_CONFIG

Offset	Size	Type	Description
0	4	MBIM_SAR_STATUS	The status of the SAR power restriction (enabled or disabled).

# 5 Function Usage

## 5.1 About This Chapter

This chapter describes the usage of the BodySAR function.

## 5.2 Usage Description

After a module is powered on, the default BodySAR function status is disabled, and the default power control function in the system is used.

The maximum transmitting power parameters take effect in real time only when the following requirements are met:

- The **AT^BODYSARWCDMA** or **AT^BODYSARGSM** or **AT^BODYSARLTE** or **AT^BODYSARCDMA** command is used to set the maximum transmitting power parameters successfully.
- The **AT^BODYSARON=1** command is used to enable the BodySAR function.

When the maximum transmitting power parameters are not set or the BodySAR function is disabled, the default power control function in the system is used.

After the maximum transmitting power parameters are set, the **AT^BODYSARON=0** command can be used to disable the BodySAR function. Then the default maximum transmitting power is resumed. If the **AT^BODYSARON=1** command is used to enable the BodySAR function again, the maximum transmitting power parameters that have been set take effect in real time.

The maximum transmitting power parameters are saved in flash. As a contrast, the current BodySAR function status is not saved. That means if the module restarts, the values of the maximum transmitting power parameters are the same with which before restarting, but the BodySAR function status is disable.

The **AT^BODYSARGSM** set command sets the maximum Tx power limit of GSM, GPRS and EGPRS for each band in single time-slot. When the module changes into multislot configuration, the maximum Tx power limit of each time-slot will be reduced. The power reduction in multislot configuration is as follow:



Number of timeslots in uplink assignment	Reduction of maximum Tx power (dB)
1	0
2	3
3	5
4	6
5	7
6	8
7	8.5
8	9

## 5.3 Test Usage

### 5.3.1 Test Usage Description

For testing the function of BodySAR, we provide a tool, called 'MTOOL'. Clients of Huawei Module can get this tool from the product service manager. When we make sure that the BodySAR button is on, the module is powered on and the config of MTOOL is set rightly, MTOOL can test BODYSARGSM/ BODYSARWCDMA/ BODYSARCDMA/ BODYSARLTE. As for the detailed instruction, clients can refer to the user guide of MTOOL.

### 5.3.2 Test Example

After that the BodySAR button is on and a module is powered on, we get the BodySAR through the mtool command, for example:

Input : mtool bodysar -gsm

Output:

```
*****  
Date : 2012-07-05 14:32  
BODYSAR CHECK:  
BODYSAR : OFF  
BODYSARGSM : 33, 33, 31, 31  
BODYSARWCDMA : 24  
*****
```

# 6 Acronyms and Abbreviations

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Acronym or Abbreviation	Expansion
CDMA	Code Division Multiple Access
GSM	Global System for Mobile Communications
LTE	Long Term Evolution
SAR	Specific Absorption Rate
SDK	Software Development Kit
WCDMA	Wideband Code Division Multiple Access