Cinterion® ENS22-E

AT Command Set

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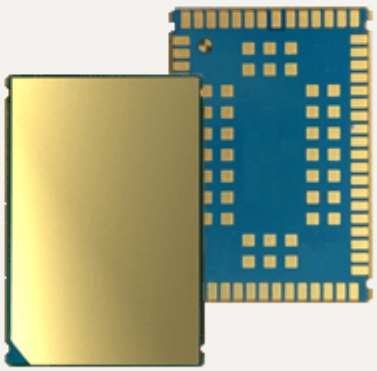

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1. Introduction

1.1 Scope of the document

This document presents the AT Command Set for
ENS22-E LTE Engine, Release 01.000.

Before using the ENS22-E or upgrading to a new firmware version please read the latest product information provided in "ENS22-E Release Notes, Version 01.000".

DISCLAIMER:
AT commands or parameters not documented in this document are subject to change and reserved for future use. THALES DIS AIS Deutschland GmbH reserves the right to modify or even eliminate these options in later releases.

ENS22-E features packet switched (PS) data capability, but does not support circuit switched (CS) data transmission. Hoewever, for reasons of compatibility with other products, and for compliance with 3GPP TS specificatiions, some AT commands imply parameters or values related to CS data capability.

1.2 Related documents

[1] ENS22-E Release Notes, Version 01.000

[2] ENS22-E Hardware Interface Description, Version 01.000

[3] Application Note 16: Updating ENS22-E Firmware

[4] Application Note 62: Transport Layer Security for Client TCP/IP Services

[5] 3GPP TR 21.905 (descendant of 3GPP TR 01.04): Vocabulary for 3GPP Specifications

[6] International Organization for Standardization (ISO): ISO/IEC10646: Universal Multiple-Octet Coded Character Set (UCS) - Part 1: Architecture and Basic Multilingual Plane.
This international standard is closely related to the Unicode Standard published by the Unicode Consortium

[7] The Unicode Consortium: Mapping of ETSI GSM 03.38 7-bit default alphabet characters into Unicode [.TXT!]

[8] ITU-T V.24 List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)

[9] ITU-T V.250 Serial asynchronous automatic dialling and control

[10] 3GPP TS 11.11: Specification of the Subscriber Identity Module - Mobile Equipment (SIM - ME) interface

[11] 3GPP TS 31.101: UICC-terminal interface; Physical and logical characteristics

[12] 3GPP TS 31.102: Characteristics of the Universal Subscriber Identity Module (USIM) application

[13] ETSI TS 102 221: Smart Cards; UICC-Terminal interface; Physical and logical characteristics

[14] 3GPP TS 11.14: Specification of the SIM Application Toolkit for the Subscriber Identity Module - Mobile Equipment (SIM - ME) interface

[15] 3GPP TS 31.111: Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)

[16] ETSI TS 102 223: Smart Cards; Card Application Toolkit (CAT)

[17] 3GPP TS 22.002 (descendant of 3GPP TS 22.02): Circuit Bearer Services (BS) supported by a Public Land Mobile Network (PLMN)

[18] 3GPP TS 22.004 (descendant of 3GPP TS 02.04): General on supplementary services

[19] 3GPP TS 22.030 (descendant of 3GPP TS 02.30): Man-Machine Interface (MMI) of the Mobile Station (MS)

[20] 3GPP TS 22.060 (descendant of 3GPP TS 02.60): General Packet Radio Service (GPRS); Service description; Stage 1

[21] 3GPP TS 23.060 (descendant of 3GPP TS 03.60): General Packet Radio Service (GPRS); Service description; Stage 2

[22] 3GPP TS 22.081 (descendant of 3GPP TS 02.81): Line Identification Supplementary Services; Stage 1

[23] 3GPP TS 22.082 (descendant of 3GPP TS 02.82): Call Forwarding (CF) Supplementary Services; Stage 1

[24] 3GPP TS 22.083 (descendant of 3GPP TS 02.83): Call Waiting (CW) and Call Holding (HOLD); Supplementary Services; Stage 1

[25] 3GPP TS 22.085 (descendant of 3GPP TS 02.85): Closed User Group (CUG) supplementary services; Stage 1

[26] 3GPP TS 22.088 (descendant of 3GPP TS 02.88): Call Barring (CB) supplementary services; Stage 1

[27] 3GPP TS 22.090 (descendant of 3GPP TS 02.90): Unstructured Supplementary Service Data (USSD); Stage 1

[28] 3GPP TS 23.038 (descendant of 3GPP TS 03.38): Alphabets and language specific information

[29] 3GPP TS 23.040 (descendant of 3GPP TS 03.40): Technical realization of the Short Message Service (SMS)

[30] 3GPP TS 23.041 (descendant of 3GPP TS 03.41): Technical realization of Cell Broadcast Service (CBS)

[31] 3GPP TS 23.107: Quality of Service (QoS) concept and architecture

[32] 3GPP TS 24.011 (descendant of 3GPP TS 04.11): Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface

[33] 3GPP TS 24.008 (descendant of 3GPP TS 04.08): Mobile radio interface Layer 3 specification; Core network protocols; Stage 3

[34] 3GPP TS 24.080 (descendant of 3GPP TS 04.80): Mobile radio interface layer 3 supplementary services specification; Formats and coding

[35] 3GPP TS 24.301 Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS)

[36] 3GPP TS 25.133 Requirements for support of radio resource management

[37] 3GPP TS 27.005 (descendant of 3GPP TS 07.05): Use of Data Terminal Equipment - Data Circuit terminating Equipment (DTE - DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)

[38] 3GPP TS 27.007 (descendant of 3GPP TS 07.07): AT command set for User Equipment (UE)

[39] 3GPP TS 27.060 (descendant of 3GPP TS 07.60): Mobile Station (MS) supporting Packet Switched Services

[40] 3GPP TS 36.133 Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management

[41] 3GPP TS 36.331 Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification

[42] 3GPP TS 45.008 (descendant of GSM 05.08): Radio subsystem link control

1.3 Document Conventions

Throughout this document ENS22-E is also referred to as LTE Engine or short UE, MS (Mobile Station) or Mobile Terminal (MT). In related documents the equivalent term DCE (Data Communication Equipment) may be found. AT commands are used to control the ENS22-E. The controlling device is referred to as Customer Application or short TE. Related documents may use the equivalent term DTE (Data Terminal Equipment).
All abbreviations and acronyms used throughout this document are based on 3GPP specifications. For definitions please refer to 3GPP TR 21.905 [5].

1.3.1 Quick Reference Table

Each AT command description includes a table similar to the example shown below. The table is intended as a quick reference to indicate the following functions:

PIN: Is the AT command PIN protected?
- **+** Yes
- **-** No
- **±** Usage is dependent on conditions specified for the command, or not all command types are PIN protected (for example write command PIN protected, read command not).

Note: The table provided in Section 15.2, `Available AT Commands and Dependency on SIM PIN` uses the same symbols.

Last: If commands are concatenated, this AT command must be the last one.
- **+** Yes
- **-** No

Note: See also Section 1.4, AT Command Syntax for details on concatenated AT commands.

Example:

PIN	Last
-	-

1.3.2 Superscript notation for parameters and values

Table 1.1: Symbols used to mark the type of parameters

Parameter type	Meaning
<param>(num)	Parameter value must be numeric type.
<param>(str)	Parameter value must be string type.
<param>(text)	Parameter value is a string according to selected character set. Not enclosed in double quotes
<param>(u)	Unspecified, i.e. parameter value may be numeric or string type.

Table 1.2: Symbols used to indicate storage options or correlations with other commands

Parameter option	Meaning
<param>(+CSCS)	Parameter value has to be (is) coded according to current setting of <chset> (see AT+CSCS for details)
<param>(&W)	Parameter value is stored to user profile in non-volatile memory after executing AT&W
<param>(&V)	Parameter value is displayed by AT&V
<param>(NV)	Parameter is stored in non-volatile memory.

Table 1.3: Symbols used to mark different types of default values of parameters

Value option	Meaning
[x]	Default value set if parameter is omitted.
x(&F)	Factory value restored by AT&F
x(P)	Powerup value of a parameter not stored in non-volatile memory.
x(D)	Delivery value of a parameter which may be overridden from non-volatile setting (refer to symbol (NV) and symbol (&W) above).

1.4 AT Command Syntax

The "AT" or "at" prefix must be set at the beginning of each command line. To terminate a command line enter <CR>. Commands are usually followed by a response that includes "<CR><LF><response><CR><LF>". Throughout this document, only the responses are presented, <CR><LF> are omitted intentionally.

Table 1.4: Types of AT commands and responses

AT command type	Syntax	Function
Test command	AT+CXXX=?	The test response returns supported parameters and supported values. Values can be shown as a list of single values or a range, for example, (1,2,3) or (1-3).
Read command	AT+CXXX?	This command returns the currently set value of the parameter or parameters.
Write command	AT+CXXX=<...>	This command sets user-definable parameter values.
Exec(ution) command	AT+CXXX	The execution command reads non-variable parameters determined by internal processes in the UE.

1.4.1 Using Parameters

- Multiple parameters are separated by commas. This applies to write commands, command responses, URCs and result codes. Please note that throughout this document spaces behind commas may be added for better readability.
- Optional parameters are enclosed in square brackets. If optional parameters are omitted, the current settings are used until you change them.
- Optional parameters or subparameters can be omitted unless they are followed by other parameters. If you want to omit a parameter in the middle of a string it must be replaced by a comma.
- A parameter value enclosed in square brackets represents the value that will be used if an optional parameter is omitted.
- When the parameter is a character string the string must be enclosed in quotation marks. Symbols in quotation marks will be recognized as strings.
- All spaces will be ignored when using strings without quotation marks.
- It is possible to omit the leading zeros of strings which represent numbers.
- If an optional parameter of a ITU-T V.250 command is omitted, its value is assumed to be 0.

1.5 Communication between Customer Application and ENS22-E

After power-up or restart ensure that the UE is in ready state before trying to send any AT command or data. For detailed information on timing conditions, signal states and particularly the startup behavior of the ENS22-E's signal lines refer to the Hardware Interface Description [2].

Leaving hardware flow control unconsidered the Customer Application (TE) is coupled with the ENS22-E (UE) via a receive and a transmit line.
Since both lines are driven by independent devices collisions may (and will) happen. For example, if the TE issues an AT command and the ENS22-E starts sending a URC. This will probably cause the TE to misinterpret the URC being part of the AT command's response. To avoid this conflict the following measures must be taken:

- If an AT command is finished (with "OK" or "ERROR") the TE shall always wait at least 100 ms before sending the next one. This applies to bit rates of 9600 bps or higher (see AT+IPR). At bit rates below 9600 bps the delay must be longer: 300 ms at 1200 bps, and 500 ms at 300 bps.
  The pause between two AT commands gives the ENS22-E the opportunity to the transmission of pending URCs and get necessary service.
- The TE shall communicate with the ENS22-E using activated echo (ATE1), i.e. the ENS22-E echoes characters received from the TE.
  Hence, when the TE receives the echo of the first character "A" of the AT command just sent by itself it has control both over the receive and the transmit paths.

Using Backspace at command line:

- As the standard GSM alphabet does not provide a backspace functionality the ENS22-E is designed to use the character "08" (hex 0x08) as backspace for command line input. This allows the user to easily erase the last character when writing an AT command. On the other hand, this solution requires entering the escape sequence \08 for writing the "ò" character in GSM character string parameters.
- If command echo is enabled (ATE1) Backspace may cause 08 - 32 - 08 (decimal) character sequence or no echo, depending on serial interface and speed of character input.

1.6 Supported character sets

ENS22-E supports two character sets: *GSM 7 bit*, also referred to as GSM alphabet or SMS alphabet (3GPP TS 23.038 [28]) and *UCS216 bit* (ISO-10646 [6]). See AT+CSCS for information about selecting the character set. Character tables can be found below.

Explanation of terms

- Escape Character
  There are two types of escape sequences which lead to an alternative interpretation on subsequent characters by the UE:
  - AT command interface
    Escape sequences starting with character value 0x5C are used for the UE's non-UCS2 input and output.
  - GSM 7 bit default alphabet
    If the escape sequence used within a text starts with character value 0x1B in the GSM 7 bit default alphabet, which represents the extension character and needs to be correctly interpreted by the TE, both for character input and output. To the ENS22-E, an escape sequence appears like any other byte received or sent.
- TE Character Set
  The character set currently used by the Customer Application is selected with AT+CSCS. It is recommended to select UCS2 setting.
- Data Coding Scheme (DCS)
  DCS is part of a short message and is saved on the SIM.
- International Reference Alphabet (IRA)
  The International Reference Alphabet is equivalent to ASCII (American Standard Code for Information Interchange) and ISO 646, i.e. it defines a 7-bit coded character set. The mapping can be obtained from the character set tables below (UCS2 values 0x0000 to 0x007F).

When you enter characters that are not valid characters of the supported alphabets the behavior is undefined.
If GSM alphabet is selected, all characters sent over the serial line (between TE and UE) must be in the range from 0 to 127 (7 bit range).
Note: If the UE is configured for GSM alphabet, but the Customer Application (TE) uses ASCII, bear in mind that some characters have different code values, such as the following:

- "@" character with GSM alphabet value 0 is not displayable by an ASCII terminal program, e.g. Microsoft© Hyperterminal®.
- "@" character with GSM alphabet value 0 will terminate any C string! This is because value 0 is defined as C string end tag. Therefore, the GSM Null character will cause problems on application level when using 'C'-functions, e.g. "strlen()". Using an escape sequence as shown in the table below solves the problem. By the way, this may be the reason why even network providers sometimes replace '@' with "@=*" in their SIM application.
- Some other characters of the GSM alphabet may be misinterpreted by an ASCII terminal program. For example, GSM "ö" (as in "Börse") is assumed to be "|" in ASCII, thus resulting in "B|rse". This is because in both alphabets there are different characters assigned to value 7C (hexadecimal).

If the TE sends characters differently coded or undefined in ASCII or GSM (e.g. Ä, Ö, Ü) it is possible to use escape sequences. The UE's input parser translates the escape sequence to the corresponding GSM character value.

Note:
The UE also uses escape sequences for its non-UCS2 output: Quotation mark (") and the escape character itself (\, respectively Ö in GSM alphabet) are converted, as well as all characters with a value below 32 (hexadecimal 0x20).
Hence, the input parser of the Customer Application needs to be able to translate escape sequences back to the corresponding character of the currently used alphabet.
Unsupported characters are shown as a space (hexadecimal 0x20).

Table 1.5: Exemplary escape sequences generated by ENS22-E for its non-UCS2 output

Character Value	ASCII Character	GSM Character	UCS2 Character	Escape Sequence	Numeric Escape Sequence
0x5C	\	Ö	00D6	\5C	0x5C 0x35 0x43
0x22	"	"	0022	\22	0x5C 0x32 0x32
0x00	NULL	@	n/a	\00	0x5C 0x30 0x30

Usually terminal programs are not able to recognize escape sequences, and thus, handle them as normal characters.
To prevent misinterpretation of control characters or special characters it is recommended to always use UCS2 alphabet and PDU mode.

1.6.1 GSM alphabet tables and UCS2 character values

This section provides tables for the GSM default alphabet (3GPP TS 23.038 [28]) supported by the ENS22-E. Below any GSM character find the corresponding two byte character value of the UCS2 alphabet. For details refer to "ETSI GSM 03.38 mapping into Unicode" [7].

Main character table of GSM 7 bit default alphabet				b7	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1
b4	b3	b2	b1		0	1	2	3	4	5	6	7
0	0	0	0	0	@ 0040	Δ 0394	SP 0020	0 0030	¡ 00A1	P 0050	¿ 00BF	p 0070
0	0	0	1	1	£ 00A3	_ 005F	! 0021	1 0031	A 0041	Q 0051	a 0061	q 0071
0	0	1	0	2	$ 0024	Φ 03A6	" 0022	2 0032	B 0042	R 0052	b 0062	r 0072
0	0	1	1	3	¥ 00A5	Γ 0393	# 0023	3 0033	C 0043	S 0053	c 0063	s 0073
0	1	0	0	4	è 00E8	Λ 039B	¤ 00A4	4 0034	D 0044	T 0054	d 0064	t 0074
0	1	0	1	5	é 00E9	Ω 03A9	% 0025	5 0035	E 0045	U 0055	e 0065	u 0075
0	1	1	0	6	ù 00F9	Π 03A0	& 0026	6 0036	F 0046	V 0056	f 0066	v 0076
0	1	1	1	7	ì 00EC	Ψ 03A8	' 0027	7 0037	G 0047	W 0057	g 0067	w 0077
1	0	0	0	8	ò 00F2 [3]	Σ 03A3	(0028	8 0038	H 0048	X 0058	h 0068	x 0078
1	0	0	1	9	Ç 00E7	Θ 0398	) 0029	9 0039	I 0049	Y 0059	i 0069	y 0079
1	0	1	0	10/A	LF [LF] [2]	Ξ 039E	* 002A	: 003A	J 004A	Z 005A	j 006A	z 007A
1	0	1	1	11/B	Ø 00D8	[1]	+ 002B	; 003B	K 004B	Ä 00C4	k 006B	ä 00E4
1	1	0	0	12/C	ø 00F8	Æ 00C6	, 002C	< 003C	L 004C	Ö 00D6	l 006C	ö 00F6
1	1	0	1	13/D	CR [CR] [2]	æ 00E6	- 002D	= 003D	M 004D	Ñ 00D1	m 006D	ñ 00F1
1	1	1	0	14/E	Å 00C5	ß 00DF	. 002E	> 003E	N 004E	Ü 00DC	n 006E	ü 00FC
1	1	1	1	15/F	å 00E5	É 00C9	/ 002F	? 003F	O 004F	§ 00A7	o 006F	à 00E0

Figure 1.1: Main character table of GSM 7 bit default alphabet

1) This code is an escape to the following extension of the 7 bit default alphabet table.
2) This code is not a printable character and therefore not defined for the UCS2 alphabet. It shall be treated as the accompanying control character.
3) See Section 1.5 for further details on using backspace and "ò" character.

Extension character table of GSM 7 bit default alphabet				b7	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1
b4	b3	b2	b1		0	1	2	3	4	5	6	7
0	0	0	0	0					| 007C			
0	0	0	1	1								
0	0	1	0	2								
0	0	1	1	3								
0	1	0	0	4		^ 005E						
0	1	0	1	5							€ [2] 20AC	
0	1	1	0	6								
0	1	1	1	7								
1	0	0	0	8			{ 007B					
1	0	0	1	9			} 007D					
1	0	1	0	10 /A	[3] [LF]							
1	0	1	1	11 /B		[1]						
1	1	0	0	12 /C				[005B				
1	1	0	1	13 /D				~ 007E				
1	1	1	0	14 /E				] 005D				
1	1	1	1	15 /F			\ 005C					

Figure 1.2: Extension character table of GSM 7 bit default alphabet

1) This code value is reserved for the extension to another extension table. On receipt of this code, a receiving entity shall display a space until another extension table is defined.
2) This code represents the EURO currency symbol. The code value is the one used for the character 'e'. Therefore a receiving entity which is incapable of displaying the EURO currency symbol will display the character 'e' instead.
3) This code is defined as a Page Break character and may be used for example in compressed CBS messages. Any mobile which does not understand the 7 bit default alphabet table extension mechanism will treat this character as Line Feed.

If the Customer Application receives a code where a symbol is not represented in Figure 1.2, Extension character table of GSM 7 bit default alphabet it shall display the character shown in the main GSM 7 bit default alphabet table (see Figure 1.1, Main character table of GSM 7 bit default alphabet).

1.6.2 UCS2 and GSM character coding and conversion

This section provides basic information on how to handle input and output character conversion, e.g. for SMS text mode, if the character representation of UE and Customer Application differ, i.e. if the Data Coding Scheme and the TE character set use different mappings.

1.6.2.1 Output of SIM data (UE to TE)

Used character set	DCS = 7 bit GSM	DCS = 8 bit Data	DCS = 16 bit UCS2
GSM	Case 1 GSM (1:1)	Case 2 8 bit to IRA (1:2)	Case 3 UCS2 to IRA (2:4)
UCS2	Case 4 GSM to IRA (1:4)	Case 5 8 bit to IRA (1:4)	Case 6 UCS2 to IRA (2:4)

Note: The ratio of SIM bytes to output bytes is given in parentheses.

Case 1
Every GSM character is sent to the TE as it is (8-bit value with highest bit set to zero).
Example: 47'H, 53'H, 4D'H → 47'H, 53'H, 4D'H, displayed as "GSM"

Case 2
Every data byte is sent to the TE as 2 IRA characters each representing a halfbyte.
Example: B8'H (184 decimal) → 42'H, 38'H, displayed as "B8"

Case 3
Every 16-bit UCS2 value is sent to the TE as 4 IRA characters.
Example: C4xA7'H (50343 decimal) → 43'H, 34'H, 41'H, 37'H, displayed as "C4A7"
Problem: An odd number of bytes leads to an error because there are always two bytes needed for each UCS2 character

Case 4
Every GSM character is sent to the TE as 4 IRA characters to show UCS2 in text mode.
Example: 41'H ("A") → 30'H, 30'H, 34'H, 31'H, displayed as "0041"

Case 5
Every data byte is sent to the TE as IRA representation of UCS2 (similar to case 4).
Example: B2'H → 30'H, 30'H, 42'H, 32'H, displayed as "00B2"

Case 6
Every 16-bit value is sent to the TE as IRA representation of it. It is assumed that number of bytes is even.
Example: C3x46'H → 43'H, 33'H, 34'H, 36'H, displayed as "C346"

1.6.2.2 Input of SIM data (TE to UE)

Used character set	DCS = 7 bit GSM	DCS = 8 bit Data	DCS = 16 bit UCS2
GSM	Case 1 GSM (1:1)	Case 2 IRA to 8 bit (2:1)	Case 3 IRA to 16 bit (4:2)
UCS2	Case 4 UCS2 to GSM (4:1)	Case 5 UCS2 to 8 bit (4:1)	Case 6 UCS2 to 16 bit (4:2)

Note: The ratio between the number of input characters and bytes stored on the SIM is given in parentheses.

Case 1
Every character is sent from TE to UE as GSM character (or ASCII with standard terminal emulation, e.g. Hyperterminal®).
Character value must be in range from 0 to 127 because of 7-bit GSM alphabet.
To reach maximum SMS text length of 160 characters in 140 bytes space characters will be compressed on SIM.
Example: "ABCDEFGH" typed is sent and stored uncompressed as → 4142434445464748'H (stored compressed as 41E19058341E91'H)

Case 2
Every data byte is sent as 2 IRA characters.
Maximum text length is 280 IRA characters which will be converted into 140 bytes SMS binary user data
Example: "C8" typed is sent as 43'H, 38'H → stored as C8'H

Case 3
Every 16-bit value is sent as 4 IRA characters.
Maximum text length is 280 IRA characters which will be converted into 70 UCS2 characters (16-bit each)
Number of IRA characters must be a multiple of four because always 4 half bytes are needed for a 16-bit value
Example: "D2C8" typed is sent as 44'H, 32'H, 43'H, 38'H → stored as D2C8'H

Case 4
Every GSM character is sent as 4 IRA characters representing one UCS2 character.
Example: To store text "ABC" using UCS2 character set you have to type "004100420043".
This is sent as 30'H,30'H,34'H,31'H, 30'H,30'H,34'H,32'H, 30'H,30'H,34'H,33'H → detected as IRA representation of 3 UCS2 characters, converted to GSM character set and stored as 41'H, 42'H, 43'H.
Maximum input is 640 IRA characters representing 160 UCS2 characters when compression is active. These are converted to 160 GSM 7-bit characters.
Without compression only 140 GSM characters can be stored which are put in as 560 IRA characters.
Values of UCS2 characters must be smaller than 80'H (128 decimal) to be valid GSM characters.
Number of IRA characters must be a multiple of four. Problems:
- "41" → Error, there are four IRA characters (two bytes) needed
- "0000" → Error, not an UCS2 character
- "4142" → Error, value of UCS2 character > 7F'H
- "008B" → Error, value of UCS2 character > 7F'H
  This affects the maximum input length of a string

Case 5
Every UCS2 character is sent as 4 IRA characters and is converted into two 8-bit values. This means that the first two characters have to be '00'.
Example: UCS2 character 009F'H typed as "009F" is sent as 30'H,30'H,39'H,46'H → converted into 8-bit value 9F'H.
Maximum number of UCS2 characters is 140 which are represented by 560 IRA characters. Number of IRA characters must be a multiple of four.

Case 6
Every UCS2 character is sent as 4 IRA characters each and is converted into a 16-bit value again.
Example: UCS2 character 9F3A'H typed as "9F3A" is sent as 39'H,46'H,33'H,41'H → converted into 9F3A'H.
Maximum number of UCS2 characters is 70 which are represented by 280 IRA characters. Number of IRA characters must be a multiple of four.
Invalid UCS2 values must be prevented.

Case 7
In the range from 0 to 32 in character table of GSM 7 bit default alphabet (Below hexadecimal 0x20), "@" and "$" are the only two which are supported by normal escape.
The other characters will be displayed by "\" and two IRA characters.
For example, a UCS2 character "00A3" escape as a GSM character "\01", while a UCS2 character "00A5" escape as a GSM character "\03"
Invalid UCS2 values must be prevented.

Case 8
The first two characters have to be '00' because 4 IRA characters are converted into two 8-bit values. If this is not the case, conversion is not supported.
Number of IRA characters must be a multiple of four. Problems:
- "03A6" → Error, not support
- "039E" → Error, not support

Invalid UCS2 values must be prevented.

Case 9
Quotation mark (") and the escape character itself (\, respectively Ö in GSM alphabet) regard as illegal character.
Problems:
- "\" → Error, invalid characters in text string
- """ → Error, invalid characters in text string

The character "\" in front of the escape character itself indicates that it needs to be transferred. That means "\\" can be transformed into an UCS2 character "00D6".
The character (") can be represented by "\22" as a GSM character. That means "\22" can be transformed into an UCS2 character "0022".
Invalid UCS2 values must be prevented.

Case 10
Extension character table of GSM 7 bit default alphabet starting with "1B" can be correctly interpreted. Extension character table of UCS2 value can be displayed by escape sequences.
Example:
The character "^" with GSM alphabet value "1B14" can be transformed into an UCS2 character "005E".
But "005E" with UCS2 value will transformed into a GSM value "\1B\14".

1.7 Unsolicited Result Code Presentation

URC stands for Unsolicited Result Code and is a report message issued by the UE without being requested by the TE, i.e. an URC is issued automatically when a certain event occurs. Hence, a URC is not issued as part of the response related to an executed AT command.
Typical events leading to URCs are received short messages, changes in temperature, network registration etc. For most of these messages, the UE needs to be configured whether or not to send a URC. Descriptions of these URCs are provided with the associated AT command. A summary of all URCs can be found in Section 15.5, Summary of Unsolicited Result Codes (URC).

Important: If the interface used for URC output is reserved by an active data connection or a long running AT command, URCs are buffered internally and will be issued after the interface becomes idle again. A pending URC will be signaled on the URC output interface via RING line. This allows to systematically suspend any longer data connection (refer +++) to check for pending URCs after being signaled!
For detailed information regarding configuration of URC signaling refer to AT^SCFG, "URC/Ringline", <urcRinglineCfg>.

1.7.1 Common URCs

This section contains all URCs not associated to a certain AT command. They cannot be defined by the user and appear automatically when the voltage conditions described below occur.

Notes for "^SBC" URCs reporting undervoltage/overvoltage conditions:
Please refer to [2] for specifications regarding the minimum and maximum operating voltage limits. If the supply voltage exceeds the defined thresholds the UE switches off automatically. The automatic shutdown procedure is equivalent to the power-down initiated with the AT^SMSO command.

URC 1

```
^SYSSTART
```

Indicates that the UE has been restarted to Normal mode and is ready to operate.

URC 2

```
^SBC: Undervoltage Warning
```

Supply voltage is close to the defined undervoltage threshold.

URC 3

```
^SBC: Undervoltage Shutdown
```

Undervoltage threshold exceeded. UE automatically switches off.

URC 4

```
^SBC: Overvoltage Warning
```

Supply voltage is close to defined overvoltage threshold.

URC 5

```
^SBC: Overvoltage Shutdown
```

Overvoltage threshold exceeded. UE automatically switches off.

1.8 Errors and Messages

The command result codes "+CME ERROR: <err>" and "+CMS ERROR: <err>" indicate errors related to mobile equipment or network functionality.

The format of <err> can be either numeric or verbose and is selectable via AT+CMEE.

A result error code terminates the execution of the command and prevents the execution of all remaining commands that may follow on the same command line. If so, neither "ERROR" nor "OK" result codes are returned for these commands. A 30 seconds timeout will deliver "ERROR" when the input of a command is not complete.

Using the wrong command syntax may result in errors: For example, using the execute command syntax although the command has no execute format, causes "ERROR" to be returned. Likewise, using the write command syntax although the command has no write format causes "+CME ERROR: <err>" to be returned.

See also:

- Section 2.9.1, CME/CMS Error Code Overview
- Section 2.5.1, Verbose and numeric result codes

2. Configuration Commands

The AT Commands described in this chapter allow the external application to determine the ENS22-E's behaviour under various conditions.

2.1 AT&F Reset AT Command Settings to Factory Default Values

AT&F resets AT command settings to their factory default values.

For a list of affected parameters refer to Section 15.4, Factory Default Settings Restorable with AT&F.

Syntax

Exec Command	
AT&F[<value>]	
Response(s)	
OK	

PIN	Last	Reference(s)
-	-	V.250

Parameter Description

<value>(num)	
[0]	Reset parameters in Section 15.4, Factory Default Settings Restorable with AT&F to their factory default values.

2.2 AT&V Display current configuration

AT&V returns the current parameter setting. The configuration varies depending on whether or not PIN authentication has been done.

Syntax

Exec Command

AT&V[<value>]

Response(s)

ACTIVE PROFILE:
... (see Section 2.2.1, AT&V responses)
OK

PIN	Last
-	-

Reference(s)

V.250

Parameter Description

<value>(num)

[0]	Profile number

2.2.1 AT&V responses

The following table shows different kinds of responses depending on whether or not the PIN is entered.

PIN authentication done	No PIN authentication
ACTIVE PROFILE: E1 Q0 V1 &C1 &D2 &S0 \Q3 S3:013 S4:010 S5:008 +CSCS: GSM +CMEE: 2 +ICF: 3 +CSMS: 0,1,1,1 +COPS: 0,0,"operator" +CEREG: 0,1 OK	ACTIVE PROFILE: E1 Q0 V1 &C1 &D2 &S0 \Q3 S3:013 S4:010 S5:008 +CSCS: GSM +CMEE: 2 +ICF: 3 OK

2.3 AT&W Store AT Command Settings to User Defined Profile

AT&W stores the current AT command settings to a user defined profile in non-volatile memory of ENS22-E. The AT command settings will automatically be restored from the user defined profile during power-up or if ATZ is used. AT&F restores AT command factory default settings. Hence, until first use of AT&W, ATZ works as AT&F. A list of parameters stored to the user profile can be found at Section 15.3, AT Command Settings storable with AT&W.

Syntax

Exec Command
AT&W[<value>]
Response(s)
OK ERROR +CME ERROR: <err>

PIN	Last
-	-

Reference(s)
V.250

Parameter Description

<value>(num)	
[0]	User Profile Number

2.4 ATQ Result Code Presentation Mode

ATQ controls if the ENS22-E transmits any result code to the TE. Other information text transmitted as response is not affected.

Syntax

Exec Command

ATQ[<n>]

Response(s)

If <n>=0:
OK
If <n>=1:
(none)

PIN	Last
-	-

Reference(s)

V.250

Parameter Description

<n>(num)(&V)(&W)

Result Code Presentation Mode.
It is not recommended to change this value.

[0](&F)(D)	UE transmits result code.
1	Result codes are suppressed and not transmitted.

2.5 ATV Result code format mode

This command determines the contents of header and trailer transmitted with AT command result codes and information responses. Possible responses are described in Section 2.5.1, Verbose and numeric result codes.

Syntax

Exec Command

`ATV[<value>]`

Response(s)

`OK`
`ERROR`

PIN	Last
-	-

Reference(s)

ITU-T V.250 [9]

Parameter Description

`<value>`(num)(&V)(&W)

[0]	Information response: <text><CR><LF> Short result code format: <numeric code><CR>
1(&F)(D)	Information response: <CR><LF><text><CR><LF> Long result code format: <CR><LF><verbose code><CR><LF>

2.5.1 Verbose and numeric result codes

Verbose format	Numeric format	Meaning
OK	0	command executed, no errors
CONNECT	1	link established
ERROR	4	invalid command or command line too long

2.6 ATZ Restore AT Command Settings from User Defined Profile

First ATZ resets the AT command settings to their factory default values, similar to AT&F. Afterwards the AT command settings are restored from a user defined profile in non-volatile memory of ENS22-E, if one was stored with AT&W before. Any additional AT command on the same command line may be ignored. A delay of 300 ms is required before next AT command is sent.

Syntax

Exec Command
ATZ[<value>]
Response(s)
OK

PIN	Last
-	-

Reference(s)
V.250

Parameter Description

<value>(num)

[0]	User Profile Number

2.7 AT+CFUN Functionality Level

AT+CFUN controls ENS22-E's functionality levels. It can also be used to reset the UE.

Syntax

Test Command

AT+CFUN=?

Response(s)

+CFUN: (list of supported <fun>s), (list of supported <rst>s)
OK
ERROR
+CME ERROR: <err>

Read Command

AT+CFUN?

Response(s)

+CFUN: <fun>
OK
ERROR
+CME ERROR: <err>

Write Command

AT+CFUN=<fun>[, <rst>]

Response(s)

OK
ERROR
+CME ERROR: <err>
If <fun>= 0:
OK

If <rst>= 1:
OK
^SHUTDOWN
^SYSSTART

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<fun>(num)

0	Minimum functionality. Shuts down TX and RX RF-circuits whereby ENS22-E logs off from the network. Access to the (U)SIM is also disabled. AT commands whose execution requires a radio connection or (U)SIM access either return an error result code (e.g. "+CME ERROR: 524") or reflect the limited operating state. See Section 2.9.1, CME/CMS Error Code Overview. To return to normal mode the command AT+CFUN=1 can be used. After this, AT+COPS= 0 is necessary for registering to a network.
1(D)	Full functionality level.

<rst>(num)

Parameter <rst> applies only to <fun>=1.

[0]	UE switches to <fun> level without reset.
1	UE resets and restarts to full functionality level. "^SHUTDOWN" URC indicates that the UE has completed the reset procedure and will restart. "^SYSSTART" URC indicates that the UE has restarted and is ready to operate.

2.8 AT^SMSO Switch Off ENS22-E

AT^SMSO initiates ENS22-E's power-off procedure. Do not send any other AT command after this.

Low level of the ME's V300 signal and the URC "^SHUTDOWN" notify that the procedure has completed and the ME has entered the POWER DOWN mode. Therefore, be sure not to disconnect the operating voltage until the V300 signal has gone low and until the URC "^SHUTDOWN" is displayed. Otherwise, you run the risk of losing data. For further details on how to turn off the ME refer to [2].

Syntax

Test Command

```
AT^SMSO=?
```

Response(s)

```
OK
```

Exec Command

```
AT^SMSO
```

Response(s)

```
^SMSO: MS OFF
OK
ERROR
```

PIN Last

- +

Unsolicited Result Code

^SHUTDOWN

Indicates that the power-off procedure is finished and the module will be switched off in less than 1 second.

2.9 AT+CMEE Error Message Format

AT+CMEE controls the format of error result codes that indicates errors related to ENS22-E functionality. Format can be selected between plain "ERROR" output, error numbers or verbose "+CME ERROR: <err>" and "+CMS ERROR: <err>" messages.
Possible error result codes are listed in Table 2.1, General "CME ERROR" Codes (3GPP TS 27.007), Table 2.3, EPS related "CME ERROR" Codes (3GPP TS 27.007) and Table 2.4, SMS related "CMS ERROR" Codes (3GPP TS 27.005).

Syntax

Test Command

```
AT+CMEE=?
```

Response(s)

```
+CMEE: (list of supported<errMode>s)
OK
```

Read Command

```
AT+CMEE?
```

Response(s)

```
+CMEE: <errMode>
OK
```

Write Command

```
AT+CMEE=<errMode>
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38], 3GPP TS 27.005 [37]

Parameter Description

<errMode>(num)(&V)(&W)	
0(&F)(D)	Disable result code, i.e. only "ERROR" will be displayed.
1	Enable error result code with numeric values.
2	Enable error result code with verbose (string) values.

Example

To obtain enhanced error messages it is recommended to choose <errMode>=2.

```
AT+CMEE=2
OK
```

2.9.1 CME/CMS Error Code Overview

Table 2.1: General "CME ERROR" Codes (3GPP TS 27.007)

<err> Code	Text (if AT+CMEE=2)
0	phone failure
1	no connection to phone
2	phone adapter link reserved
3	operation not allowed
4	operation not supported
5	PH-SIM PIN required
6	PH-FSIM PIN required
7	PH-FSIM PUK required
10	SIM not inserted
11	SIM PIN required
12	SIM PUK required
13	SIM failure
14	SIM busy
15	SIM wrong
16	incorrect password
17	SIM PIN2 required
18	SIM PUK2 required
20	memory full
21	invalid index
22	not found
23	memory failure
24	text string too long
25	invalid characters in text string
26	dial string too long
27	invalid characters in dial string
30	no network service
31	network timeout
32	network not allowed - emergency calls only
40	network personalization PIN required
41	network personalization PUK required
42	network subset personalization PIN required
43	network subset personalization PUK required
44	service provider personalization PIN required
45	service provider personalization PUK required
46	corporate personalization PIN required
47	corporate personalization PUK required
48	hidden key required
49	EAP method not supported
50	incorrect parameters

<err> Code	Text (if AT+CMEE=2)
51	command implemented but currently disabled
52	command aborted by user
53	not attached to network due to MT functionality restrictions
55	operation not allowed because of MT functionality restrictions
57	temporarily out of service due to other MT usage
58	language/alphabet not supported
59	unexpected data value
60	system failure
61	data missing
63	message waiting indication subscr
100	unknown

Table 2.2: General "CME ERROR" Codes (proprietary)

<err> Code	Text (if AT+CMEE=2)
150	invalid mobile class
256	operation temporary not allowed
259	user abort
260	data Uplink busy
261	SS not executed
262	SIM blocked
263	invalid block
271	write operation temporary not allowed
272	parameter out of range
273	service profile ID out of range
274	connection profile ID out of range
275	no service
276	service already in use
277	service not in UP status
278	error in address
279	operation not allowed
286	server already existed
287	PDP activation in progress
288	PDP configuration was modified
289	PDP activation failure
290	PDP no DNS received
291	DNS invalid server
292	DNS undefined error
294	operation timeout
512	Required Parameter Not Configured
513	TUP Not Registered
529	FOTA is updating
514	AT Cmd Internal Error

<err> Code	Text (if AT+CMEE=2)
515	cid is active
516	radio test state error
517	cid is invalid
518	cid is not active
519	link security error
520	Last PDN disconnection not allowed
521	cid is not defined
522	AT UART parity error
523	AT UART frame error
524	UE not power on
525	sent data sequence repeat error
526	AT command abort error
527	command interrupted
528	configuration conflicts
530	not the AT allocated socket
531	SIM PIN is blocked
532	SIM PUK is blocked
533	not mipi module
534	file not found
535	conditions of use not satisfied
536	at uart buffer error
537	back off timer is running

Table 2.3: EPS related "CME ERROR" Codes (3GPP TS 27.007)

<err> Code	Text (if AT+CMEE=2)
103	illegal MS (#3)
106	illegal ME (#6)
107	EPS services not allowed (#)
111	PLMN not allowed (11)
113	roaming not allowed in this tracking area (#13)
132	service option not supported
133	requested service option not subscribed
134	service option temporary out of order
181	unsupported QCI value

Table 2.4: SMS related "CMS ERROR" Codes (3GPP TS 27.005)

<err> Code	Text (if AT+CMEE=2)
302	operation not allowed
303	operation not supported
320	memory failure
340	no +CNMA acknowledgement expected

2.10 AT+CSCS Character Set

AT+CSCS write command informs the ENS22-E which character set is used by the TE. This enables the UE to convert character strings correctly between TE and UE character sets. Please also refer to Section 1.6, Supported character sets.
Note: If UE-TE interface is set to 8-bit operation (AT+ICF) and selected character set is <chset>="GSM" (7-bit), the highest bit will be set to zero.

Syntax

Test Command

```
AT+CSCS=?
```

Response(s)

```
+CSCS: (list of supported<chset>s)
OK
```

Read Command

```
AT+CSCS?
```

Response(s)

```
+CSCS: <chset>
OK
```

Write Command

```
AT+CSCS=<chset>
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<chset>(str)(&V)(&W)	
"GSM"(&F)(D)	GSM 7 bit default alphabet (3GPP TS 23.038 [28], Subclause 6.2.1).
"UCS2"	16-bit universal multiple-octet coded character set (ISO-10646 [6]). UCS2 character strings are converted to hexadecimal numbers in the range 0000 to FFFF; e.g. "004100620063" equates to three 16-bit characters with decimal values 65, 98 and 99.

2.11 AT^SCFG Extended Configuration Settings

AT^SCFG can be used to query and configure various settings of the ENS22-E.
AT^SCFG read command returns a list of all supported parameters and their current values.
AT^SCFG write command queries a configuration parameter (if no value is entered) or sets its value(s).
Input of parameter names is always coded in GSM character set, parameter values are expected to be given as specified via AT+CSCS.

Syntax

Test Command

AT^SCFG=?

Response(s)

^SCFG: "GPIO/mode/ASC1", (list of supported <g_mode>s)
^SCFG: "GPIO/mode/DCD0", (list of supported <g_mode>s)
^SCFG: "GPIO/mode/DSR0", (list of supported <g_mode>s)
^SCFG: "GPIO/mode/DTR0", (list of supported <g_mode>s)
^SCFG: "GPIO/mode/RING0", (list of supported <g_mode>s)
^SCFG: "GPIO/mode/SPI", (list of supported <g_mode>s)
^SCFG: "GPIO/mode/I2C", (list of supported <g_mode>s)
^SCFG: "GPIO/mode/SYNC", (list of supported <g_mode>s)
^SCFG: "MEopMode/SRPOM", (list of supported <SrpomMode>s)
^SCFG: "MEopMode/PowerMgmt/Suspend", (list of supported <Suspend>s)
^SCFG: "MEShutdown/sVsup/threshold", (list of supported <vthresh>s)
^SCFG: "Radio/Band/4G", (list of supported <lte_mask>s)
^SCFG: "Tcp/WithURCs", (list of supported <tcpWithUrc>)
^SCFG: "URC/Ringline", (list of supported <urcRinglineCfg>s)
^SCFG: "URC/Ringline/ActiveTime", (list of supported <urcRinglineDuration>s)
OK

Read Command

AT^SCFG?

Response(s)

^SCFG: "GPIO/mode/ASC1", <g_mode>
^SCFG: "GPIO/mode/DCD0", <g_mode>
^SCFG: "GPIO/mode/DSR0", <g_mode>
^SCFG: "GPIO/mode/DTR0", <g_mode>
^SCFG: "GPIO/mode/RING0", <g_mode>
^SCFG: "GPIO/mode/SPI", <g_mode>
^SCFG: "GPIO/mode/I2C", <g_mode>
^SCFG: "GPIO/mode/SYNC", <g_mode>
^SCFG: "MEopMode/SRPOM", <SrpomMode>
^SCFG: "MEopMode/PowerMgmt/Suspend", <Suspend>
^SCFG: "MEShutdown/sVsup/threshold", <vthresh_curr>, <vthresh_request>
^SCFG: "Radio/Band/4G", <lte_mask>
^SCFG: "Tcp/WithURCs", <tcpWithUrc>
^SCFG: "URC/Ringline", <urcRinglineCfg>
^SCFG: "URC/Ringline/ActiveTime", <urcRinglineDuration>
OK

Write Command

Configure ASC1 interface lines RXD1, TXD1, RTS1, CTS1 shared with GPIO16 - GPIO19 lines

AT^SCFG="GPIO/mode/ASC1"[, <g_mode>]

Response(s)

^SCFG: "GPIO/mode/ASC1", <g_mode>
OK

Write Command (Continued)

Configure ASC1 interface lines RXD1, TXD1, RTS1, CTS1 shared with GPIO16 - GPIO19 lines

AT^SCFG="GPIO/mode/ASC1"[, <g_mode>]

Response(s)

ERROR
+CME ERROR: <err>

Write Command

Configure DCD0 line of ASC0 interface shared with GPIO2

AT^SCFG="GPIO/mode/DCD0"[, <g_mode>]

Response(s)

^SCFG: "GPIO/mode/DCD0", <g_mode>
OK
ERROR
+CME ERROR: <err>

Write Command

Configure DSR0 line of ASC0 interface shared with GPIO3 line

AT^SCFG="GPIO/mode/DSR0"[, <g_mode>]

Response(s)

^SCFG: "GPIO/mode/DSR0", <g_mode>
OK
ERROR
+CME ERROR: <err>

Write Command

Configure DTR0 line of ASC0 interface shared with GPIO1 line

AT^SCFG="GPIO/mode/DTR0"[, <g_mode>]

Response(s)

^SCFG: "GPIO/mode/DTR0", <g_mode>
OK
ERROR
+CME ERROR: <err>

Write Command

Configure RING0 line of ASC0 interface shared with GPIO24 line

AT^SCFG="GPIO/mode/RING0"[, <g_mode>]

Response(s)

^SCFG: "GPIO/mode/RING0", <g_mode>
OK
ERROR
+CME ERROR: <err>

Write Command

Configure SPI lines MOSI, MISO, SPI_CLK and SPI_CS shared with ASC1 lines and GPIO16 - GPIO19 lines

AT^SCFG="GPIO/mode/SPI"[, <g_mode>]

Response(s)

^SCFG: "GPIO/mode/SPI", <g_mode>
OK
ERROR
+CME ERROR: <err>

Write Command

Configure I2C lines I2CDAT and I2CCLK shared with GPIO9 and GPIO10 lines

AT^SCFG="GPIO/mode/I2C"[, <g_mode>]

Response(s)

^SCFG: "GPIO/mode/I2C", <g_mode>
OK
ERROR
+CME ERROR: <err>

Write Command

Configure Status LED line shared with GPIO5 line

AT^SCFG="GPIO/mode/SYNC"[, <g_mode>]

Response(s)

^SCFG: "GPIO/mode/SYNC", <g_mode>
OK
ERROR
+CME ERROR: <err>

Write Command

Enable or disable RPM if inserted (U)SIM contains no RPM files.

AT^SCFG="MEopMode/SRPOM"[, <SrpomMode>]

Response(s)

^SCFG: "MEopMode/SRPOM", <SrpomMode>
OK
ERROR
+CME ERROR: <err>

Write Command

Enable/disable the Suspend mode.

AT^SCFG="MEopMode/PowerMgmt/Suspend"[, <Suspend>]

Response(s)

^SCFG: "MEopMode/PowerMgmt/Suspend", <Suspend>
OK
ERROR
+CME ERROR: <err>

Write Command

Query / configure undervoltage threshold

AT^SCFG="MEShutdown/sVsup/threshold"[, <vthresh>]

Response(s)

^SCFG: "MEShutdown/sVsup/threshold", <vthresh_curr>, <vthresh_request>
OK
ERROR
+CME ERROR: <err>

Write Command

Radio band selection

AT^SCFG="Radio/Band/4G"[, <lte_mask>]

Response(s)

^SCFG: "Radio/Band/4G", <lte_mask>
OK
ERROR
+CME ERROR: <err>

Write Command

Configuration of Internet Service URCs:

AT^SCFG="Tcp/WithURCs"[, <tcpWithUrc>]

Response(s)

^SCFG: "Tcp/WithURCs", <tcpWithUrc>
OK
ERROR
+CME ERROR: <err>

Write Command

Subcommand controls the behaviour of the RING line if it is selected for URC signalization.

AT^SCFG="URC/Ringline"[, <urcRinglineCfg>]

Response(s)

^SCFG: "URC/Ringline", <urcRinglineCfg>
OK
ERROR
+CME ERROR: <err>

Write Command

Subcommand controls duration of active RING line if it is selected for URC signalization.

AT^SCFG="URC/Ringline/ActiveTime"[, <urcRinglineDuration>]

Response(s)

^SCFG: "URC/Ringline/ActiveTime", <urcRinglineDuration>
OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Unsolicited Result Codes

URC 2

^SUSPEND_AVALIABLE

The URC is issued when the Suspend mode is available. The Suspend mode is available when:

- Suspend mode is enabled by <Suspend>="1", and
- PSM or eDRX mode is enabled

URC 4

^SUSPEND_NOT_AVALIABLE

The URC is issued when the Suspend mode is not available. The Suspend mode is not available when:

- Suspend mode is disabled by <Suspend>="0", or
- PSM and eDRX mode are both disabled

URC 6

^SUSPEND_READY

The URC is issued when the module is ready to go to Suspend mode. The module will automatically go to Suspend mode when UARTs enter to Sleep mode.

URC 8

^SUSPEND_NOT_READY

The URC is issued when the module is no longer ready to go to Suspend mode. The module will not go to Suspend mode when UARTs enter to Sleep mode.

URC 10

^SYSRESUME

The URC is issued when the module is waked up from the Suspend mode.

Parameter Description

<g_mode>(str)(+CSCS)(NV)

Mode of operation for signal lines

This parameter can be used to configure shared signal lines of the ENS22-E module. Depending on the connected devices the setting determines the specific function assigned to the related signal line(s). Keep in mind that the functions assigned to shared lines are mutually exclusive. When a line is reserved for one interface, then the <g_mode> parameter is automatically set to 'rsv' for all other interfaces that use this line.
For example, to enable the SPI interface select AT^SCFG="GPIO/mode/SPI","std". This will automatically set AT^SCFG= "GPIO/mode/ASC1","rsv" for ASC1 (ASC1 lines used as SPI lines). At the same time this will lock the GPIO functionality of GPIO16, GPIO17, GPIO18, GPIO19.
To enable, for example, the second serial interface ASC1 select AT^SCFG="GPIO/mode/ASC1","std".
The changes will take effect after restart of the UE and are non-volatile.

“std“	Signal lines are assigned to this interface.
“gpio“	Signal lines are used as GPIO.
“rsv“	Signal lines are reserved by other interface. This value cannot be set by the AT^SCFG write command.

<SrpomMode>(str)(+CSCS)(NV)

RPM Mode

This parameter enables or disables the usage of the Radio Policy Manager (RPM) according to "GSMA's IoT Device Connection Efficiency Guidelines", Version 4.0, Chapter 8. It is possible to enable or disable RPM by using the <SrpomMode> parameter. Note that RPM setting will be ignored on the inserted (U)SIM.

“0“(D)	RPM disabled
“1“	RPM enabled

<vthresh>(str)(NV)

Undervoltage threshold value

The undervoltage thresholds defined for the BB (base band) domain are calculated for max. 400 mV voltage drops. Power supply sources for ENS22-E applications shall be designed to tolerate 400 mV voltage drops without crossing the lower limits of 3.1 V. For ENS22-E applications operating at the limit of the allowed tolerance the default undervoltage warning threshold may be adapted by selecting a <vthresh> value.
New settings take effect after restart.

“-4“	2.90 V
“-3“	2.95 V
“-2“	3.00 V
“-1“	3.05 V
“0“(D)	3.10 V
“1“	3.15 V
“2“	3.20 V

“3“	3.25 V
“4“	3.30 V

<vthresh_curr>(str)

Current BB undervoltage threshold

For values see <vthresh>.

<vthresh_request>(str)

BB undervoltage threshold after next restart

For values see <vthresh>.

<Suspend>(str)(NV)

Enable Suspend mode

Enable or disable Suspend mode.

“0“(D)	Suspend is disabled.
“1“	Suspend is enabled.

For the module to enter Suspend mode, URCs "^SUSPEND_AVALIABLE", "^SUSPEND_NOT_AVALIABLE", "^SUSPEND_READY", "^SUSPEND_NOT_READY", and "^SYSRESUME" are used as feedback.

<lte_mask>(str)(+CSCS)(NV)

LTE radio band(s) mask

<lte_mask> specifies LTE frequency bands in *hexadecimal 32-bit value order*. Every bit corresponds to a dedicated band number as defined in 3GPP standard TS 36.101 (4G).
When a bit (corresponding to a dedicated band) is set, the band is enabled, when the bit is cleared, the dedicated band is disabled respectively. The <lte_mask> value should be a string starting with '0x', to be transferred into binary follow below pattern.

Mask in Hexadecimal:	[Hex8]	[Hex7]	.....	[Hex2]	Hex1
Mask in binary:	b32b31b30b29	b28b27b26b25	.....	b8b7b6b5	b4b3b2b1

Hex8 to Hex2 can be omit if all zero, but <lte_mask> should contain no more than 8 hexadecimal digitals, and also contain at least one hexadecimal digital.

ENS22-E supported band listed below:

“0x00000004“	LTE BAND III (BC3)
“0x00000010“	LTE BAND V (BC5)
“0x00000080“	LTE BAND VIII (BC8)
“0x00080000“	LTE BAND XX (BC20)
“0x08000000“	LTE BAND XXVIII (BC28)

Parameter sets the LTE frequency band(s) the UE is allowed to use. The setting can be either a single or a multiple band value. Delivery default is the combination of all bands supported by the ENS22-E. Parameters must be set when ENS22-E is in minimum functionality (refer to AT+CFUN=0).
A changed value takes effect immediately.
An ERROR result code will be returned when the user tries
- to set a band not supported by the ENS22-E,
- to set <lte_mask>= "0x00000000"

<tcpWithUrc>(str)(+CSCS)(NV)

URC mode or polling mode for Internet service commands

This parameter enables or disables the presentation of the following URCs related to Internet service commands: "^SISR" URC, "^SISW" URC and "^SIS" URC for parameter <urcCause>=0 (Internet service events). "^SIS" URCs with <urcCause>=1 or 2 used to indicate incoming Socket connections are always enabled.

"on"(D)	Enable URCs related to Internet service commands. Throughout the Chapter "Internet Service AT Commands" the mode is also referred to as URC mode.
"off"	Disable URCs related to Internet service commands. This requires the TE to employ polling techniques when using the Internet service AT commands: The TE is responsible to retrieve all status information needed to control an Internet session. The method is referred to as polling mode.

<urcRinglineCfg>(str)(+CSCS)(NV)

Parameter specifies the ring line to be used for signaling URCs both for idle interface and while interface is reserved, i.e. while busy on AT command execution or data transmission.
For details about URC presentation refer to Section 1.7, Unsolicited Result Code Presentation.
For details on using the RING0 line to wake up the TE refer to [2].
Setting is local for every interface.

"off"	URCs are not indicated by a ring line. This applies also when "off" is set on the ASC0 interface.
"local"(D)	URCs are indicated by an activated ring line on the same interface where the URC appears.
"asc0"	URCs are indicated by activated RING0 line of the ASC0 interface (low active).

<urcRinglineDuration>(str)(+CSCS)(NV)

This parameter determines how long the ring line is activated in order to indicate a URC. For details about URC presentation refer to Section 1.7, Unsolicited Result Code Presentation. For more information on the RING0 line and its timing for different types of URCs please refer to [2]. <urcRinglineDuration> is applicable to all types of URCs except the RING URC. The timing of the RING URC (incoming calls) is not configurable by AT command.
The type of ring line used for URC indication depends on parameter <urcRinglineCfg>.
Setting is global for all interfaces.

"0"	RING line will be activated for about 5s.
"1"	RING line will be activated for about 100 ms.
"2"(D)	RING line will be activated for about 1 s.

Example

Usage of "URC/Ringline":

AT+CSCS="GSM"	Switch to GSM character set.
OK	
AT^SCFG?	Query all parameters.
...	
^SCFG:"URC/Ringline","local"	URCs on this interface will be indicated by Ring line associated to the interface (e.g. RING0 for ASC0).
...	
OK	
AT^SCFG="URC/Ringline","asc0"	

`^SCFG:"URC/Ringline","asc0"`
 	
`OK`
	URCs on *this* interface will be indicated by an activated RING0 no matter whether or not the UE-TE link is reserved.

`AT^SCFG="URC/Ringline","off"`
 	
`^SCFG:"URC/Ringline","off"`
`OK`
	Disable any Ring line indication for URCs on this interface.

2.12 AT^SPOW Set UART Mode and SLEEP Mode on UART

AT^SPOW enables or disables the UE's UART interfaces ASC0 and ASC1 and controls SLEEP mode on both interfaces. Parameter settings are non-volatile and common for all interfaces.

Please refer to "ENS22-E Hardware Interface Description, Version 01.000" for more information on power saving.

Syntax

Test Command

```
AT^SPOW=?
```

Response(s)

```
^SPOW: (list of supported <mode>s), (time range of <timeout>)
OK
ERROR
+CME ERROR: <err>
```

Read Command

```
AT^SPOW?
```

Response(s)

```
^SPOW: <mode>,<timeout>
OK
ERROR
+CME ERROR: <err>
```

Write Command

```
AT^SPOW=<mode>,<timeout>
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Parameter Description

<mode>(num)(NV)	
1	UART interfaces ASC0 and ASC1 are activated without sleep mode support.
2(D)	UART interfaces ASC0 and ASC1 are activated with sleep mode support.

<timeout>(num)(NV)	
100...5000(D)...10000	In SLEEP mode (<mode>=2), time in milliseconds the UE remains awake after the last sent character, in case the UART is ready to go SLEEP mode (i.e., the TE set RTS0 line to logical high). Minimum value: 100 ms, recommended 5000 ms. <timeout> values below 100 are denied with ERROR.

Note

- The change takes effect after restart of the UE, e.g. with AT+CFUN=1,1.

3. Status Control Commands

The AT Commands described in this chapter allow the external application to obtain various status information from the ENS22-E.

3.1 AT^SIND Extended Indicator Control

AT^SIND queries the status of extended indicator.

Syntax

Test Command

AT^SIND=?

Response(s)

^SIND: (<indDescr>, list of supported <indValue>s)[, (<indDescr>, list of supported <indValue>s)[, ...]], (list of supported <mode>s)
OK

Read Command

AT^SIND?

Response(s)

^SIND: <indDescr>, <mode>[, <indValue>]
[^SIND: <indDescr>, <mode>[, <indValue>]]
...
OK
ERROR
+CME ERROR: <err>

Write Command

AT^SIND=<indDescr>, <mode>

Response(s)

^SIND: <indDescr>, <mode>[, <indValue>]
OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Parameter Description

<indDescr>(str)

This section describes <indDescr> values and their associated <indValue> ranges.
For command input on the AT^SIND write command line <indDescr> values are handled as string type. In responses <indDescr> values are output without quotation marks.

“celevel“	Coverage Enhancement Level: "celevel" delivers the current coverage enhancement level (CE level) of the serving cells. 0 Enhanced coverage level 0. 1 Enhanced coverage level 1. 2 Enhanced coverage level 2. 255 Default invalid value before any random access.

<indValue>(num)

Integer type value in the range stated above for the corresponding <indDescr>.

<mode>(num)

Mode of a specific indicator <indDescr>.

2	Requests the current value of a single indicator type.

4. Serial Interface Control Commands

The AT Commands described in this chapter allow the external application to determine various settings related to the ENS22-E's serial interface.

4.1 AT\Q Flow Control

AT\Q allows to configure flow control on the ENS22-E's asynchronous serial interface ASC0 and ASC1. AT\Q setting is always common for all interfaces and can be changed, for compatibility reasons, on each interface, but is only applicable to ASC0 and ASC1.

Syntax

Exec Command
AT\Q[<n>]
Response(s)
OK

PIN	Last
-	-

Parameter Description

<n>(num)(&V)(&W)	
0 - 2	These values are accepted, but don't have any effect. AT\Q setting is always reported as <n>=3 in the active profile (see AT&V).
[3](&F)(D)	RTS/CTS hardware flow control

4.2 AT&C Set Data Carrier Detect (DCD) Line Mode

The AT&C command controls the behavior of the UE's DCD line.

AT&C offers full functionality only if the DCD0 line is enabled with AT^SCFG="GPIO/mode/DCD0","std". Otherwise AT&C will respond "+CME ERROR: operation not allowed".

Syntax

Exec Command	
AT&C[<value>]	
Response(s)	
OK	

PIN	Last	Reference(s)
-	-	V.250

Parameter Description

<value>(num)(&V)(&W)

[0]	DCD line shall always be on.
1(&F)	DCD line shall be on only when data carrier signal is present.
2	DCD line shall be on when one or more Internet services defined on the related serial channel are in an active state as described below. For details on the various service states refer to AT^SISI, parameter <srvState> or AT^SISO, parameter <srvState>. The DCD line status for an Internet service is signaled at the interface where the service had been opened with the AT command AT^SISO. • Transparent UDP client, SOCKET: DCD shall be on when <srvState>="Connnecting" or "Up"

4.3 AT&D Set Data Terminal Ready (DTR) Line Mode

AT&D determines how the UE responds if the DTR line is changed from ON to OFF state during data connection (active Internet Services transparent access mode; refer to AT^SIST).

AT&D offers full functionality only if the DTR0 line is enabled with AT^SCFG="GPIO/mode/DTR0","std". Otherwise AT&D will respond "+CME ERROR: operation not allowed".

Syntax

Exec Command	
AT&D[<value>]	
Response(s)	
OK	

PIN	Last
-	-

Reference(s): V.250

Parameter Description

<value>(num)(&V)(&W)	
[0]	UE ignores status of the DTR line.
1	ON->OFF on DTR: Change to command mode while retaining the data connection.
2(&F)	ON->OFF on DTR: The behaviour is like AT&D1.

4.4 AT&S Set Data Set Ready (DSR) Line Mode

AT&S determines how the UE sets the DSR line depending on its communication state.

AT&S offers full functionality only if the DSR0 line is enabled with AT^SCFG="GPIO/mode/DSR0","std". Otherwise AT&S will respond "+CME ERROR: operation not allowed".

Syntax

Exec Command
AT&S[<value>]
Response(s)
OK

PIN	Last
-	-

Reference(s)
ITU-T V.250 [9]

Parameter Description

<value>(num)(&V)(&W)	
[0](&F)	DSR line is always ON
1	UE in command mode: DSR is OFF. UE in data mode: DSR is ON.

4.5 ATE AT Command Echo

ATE controls if the ENS22-E echoes characters received from TE during AT command state.

Syntax

Exec Command
ATE[<value>]
Response(s)
OK

PIN	Last
-	-

Reference(s)
V.250

Parameter Description

<value>(num)(&V)(&W)	
[0]	Echo mode off
1(&F)	Echo mode on

4.6 AT+ICF Character Framing

AT+ICF controls character framing and parity format used for receiving and transmitting data via ENS22-E's asynchronous serial interfaces (UART).

Following settings are supported:

- 7 bits, even parity, 1 stop bit (AT+ICF=5,1)
- 7 bits, odd parity, 1 stop bit (AT+ICF=5,0)
- 8 bits, even parity, 1 stop bit (AT+ICF=2,1)
- 8 bits, no parity, 1 stop bit (AT+ICF=3)
- 8 bits, odd parity, 1 stop bit (AT+ICF=2,0)
- 8 bits, no parity, 2 stop bits (AT+ICF=1)

If the current <format> setting uses no parity (e.g. <format>=3) and AT+ICF is used to switch to a format with parity (e.g. <format>=2), it is necessary to explicitly set parameter <parity>, e.g. AT+ICF=2,1. If not done correctly ENS22-E will respond with "+CME ERROR: incorrect parameters". This is because for <format>=3, the parameter <parity> is set to the internal value 'no parity' which is not supported by <format>=2.

Syntax

Test Command

```
AT+ICF=?
```

Response(s)

```
+ICF: (list of supported <format>s), (list of supported <parity>s)
OK
```

Read Command

```
AT+ICF?
```

Response(s)

```
+ICF: <format>[, <parity>]
OK
```

Write Command

```
AT+ICF=[<format>[, <parity>]]
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	+

Reference(s): V.250

Parameter Description

<format>(num)(&V)(&W)

Specifies the character format used for receiving and transmitting.

1	8 data 0 parity 2 stop
2	8 data 1 parity 1 stop
3(&F)(D)	8 data 0 parity 1 stop
5	7 data 1 parity 1 stop

<parity>(num)(&V)(&W)

Specifies the method of calculating the parity bit, if a parity bit is supported by <format>.
If <format> does not support parity, this parameter has to be omitted.

0	odd
1	even

Note

- Generally, AT+ICF should be used as a standalone command as specified in Section Combining AT commands on the same command line.
  If nevertheless combinations with other commands on the same command line cannot be avoided, there are several constraints to be considered:
  - Avoid combinations with the AT commands listed in Section Combining AT commands on the same command line.
  - Keep in mind that there shall be a minimum pause between two AT commands as specified in Section 1.5, Communication between Customer Application and ENS22-E.
  - The selected setting is stored in the user defined profile with next AT&W. It will only be used on next start of the module. AT+ICF read command will always show the setting stored in the user defined profile, not a currently detected character framing.

4.7 AT+IPR Bit Rate

AT+IPR allows to query and set the bit rate of the ENS22-E's asynchronous serial interface (UART).
The test command returns the values of supported fixed bit rates.
The read command returns the current bit rate of the interface.
The write command determines the bit rate to be used for the interface.

It is not recommended to set bit rates lower than 9600 bps in order to avoid timing problems (see Section 1.5, Communication between Customer Application and ENS22-E for details about timing).
It is highly recommended to use AT+IPR as a standalone AT command, i.e. better do not combine with other commands on the same AT command line.
The current setting of AT+IPR will be preserved after firmware download (i.e. a firmware update does not restore the factory setting), or in the event of power failure.

Syntax

Test Command

```
AT+IPR=?
```

Response(s)

```
+IPR: ( ) , (list of supported selectable <rate>s)
OK
```

Read Command

```
AT+IPR?
```

Response(s)

```
+IPR: <rate>
OK
```

Write Command

```
AT+IPR=<rate>
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Reference(s)

V.250

Parameter Description

<rate>(num)(&V)(NV)

Bit rate per second (bps)

1200
2400
4800
9600
19200
38400
57600
115200(D)
230400

460800

921600

Note

- Generally, AT+IPR should be used as a standalone command as specified in Section Combining AT commands on the same command line.
  If nevertheless combinations with other commands on the same command line cannot be avoided, there are several constraints to be considered:
  - Avoid combinations with the AT commands listed in Section Combining AT commands on the same command line.
  - Keep in mind that there shall be a minimum pause between two AT commands as specified in Section 1.5, Communication between Customer Application and ENS22-E.
  - If switching to the new bit rate takes effect while a response is being transmitted, the last bytes may be sent with the new bit rate and thus, not properly transmitted. The following commands will be correctly sent at the new bit rate.
    Please consider this effect especially when local echo is active (ATE1).

5. Identification Commands

The AT Commands described in this chapter allow the external application to obtain various identification information related to the ENS22-E and linked entities.

5.1 ATI Display product identification information

The ATI execute command delivers a product information text.

Syntax

Exec Command

ATI

Response(s)

Cinterion
ENS22-E
REVISION <revUE>
OK

Exec Command

ATI1

Response(s)

Cinterion
ENS22-E
REVISION <revUE>
A-REVISION <revApp>
OK

PIN	Last
-	-

Reference(s)

ITU-T V.250 [9]

Parameter Description

<revUE>(num)

Version xx and variant yyy of software release.

<revApp>(num)

Revision of Application software in the format XX.YYY.ZZ, where X, Y and Z are numbers.

5.2 AT+CGMI Request manufacturer identification

AT+CGMI returns a manufacturer identification text.

Syntax

Test Command
AT+CGMI=?
Response(s)
OK

Exec Command
AT+CGMI
Response(s)
Cinterion OK

PIN	Last
-	-

Reference(s)
3GPP TS 27.007 [38]

5.3 AT+CGMM Request model identification

AT+CGMM returns a product model identification text.

Syntax

Test Command	
AT+CGMM=?	
Response(s)	
OK	

Exec Command	
AT+CGMM	
Response(s)	
ENS22-E OK	

PIN	Last
-	-

Reference(s)
3GPP TS 27.007 [38]

5.4 AT+CGMR Request revision identification and software version

AT+CGMR delivers product firmware version identification.

Syntax

Test Command

AT+CGMR=?

Response(s)

OK

Exec Command

AT+CGMR

Response(s)

REVISION <number>
OK

PIN	Last
-	-

Parameter Description

<number>(str)

Version xx and variant yyy of software release.

5.5 AT+CGSN Request International Mobile Equipment Identity (IMEI)

AT+CGSN delivers the International Mobile Equipment Identity (IMEI).

Syntax

Test Command

AT+CGSN=?

Response(s)

+CGSN: (list of supported <snt>s)
OK

Exec Command

AT+CGSN

Response(s)

<sn>
OK

Write Command

AT+CGSN=<snt>

Response(s)

If <snt>=0
<sn>

If <snt>=1
+CGSN: <sn>

If <snt>=2
+CGSN: <imeisv_number>

If <snt>=3
+CGSN: <SVN>
OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<sn>(str)

International Mobile Equipment Identity (IMEI) identifying a mobile equipment used in the mobile network. IMEI is composed of Type Allocation Code (TAC) (8 digits), Serial Number (SNR) (6 digits) and the Check Digit (CD) (1 digit). For information on IMEI refer to 3GPP TS 23.003, subclause 6.2.1 and 3GPP TS 27.007 [38].

<snt>(num)

Integer type indicating the serial number type that has been requested.

<imeisv_number>(num)

IMEISV (International Mobile station Equipment Identity and Software Version number).
The 16 digits of IMEISV are composed of Type Allocation Code (TAC) (8 digits), Serial Number (SNR) (6 digits) and the software version (SVN) (2 digits). For information on IMEISV refer to 3GPP TS 23.003, subclause 6.2.2 and 3GPP TS 27.007 [38].

<SVN>(num)

Current SVN which is a part of IMEISV; refer 3GPP TS 23.003, subclause 6.2.2 and 3GPP TS 27.007 [38]. This allows identifying different software versions of a given mobile.

5.6 AT+CIMI Request International Mobile Subscriber Identity (IMSI)

AT+CIMI delivers the International Mobile Subscriber Identity (IMSI). The IMSI permits the TE to identify the individual SIM attached to the UE.

Syntax

Test Command

```
AT+CIMI=?
```

Response(s)

```
OK
```

Exec Command

```
AT+CIMI
```

Response(s)

```
<imsi>
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
+	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<imsi>(str)

International Mobile Subscriber Identity (string without quotes).

6. Security Commands

The AT Commands described in this chapter allow the external application to determine various security related settings.

6.1 AT+CPIN PIN Authentication

The AT+CPIN write command can be used to enter one of the passwords listed below.
The read command checks whether or not the UE is waiting for a password, or which type of password is required.

Each time a password is entered with AT+CPIN the module starts reading data from the SIM. The duration of reading varies with the SIM card. This may cause a delay of several seconds before all commands which need access to SIM data are effective. See Section 15.1, Restricted access to SIM data after SIM PIN authentication for further detail.

Syntax

Test Command

```
AT+CPIN=?
```

Response(s)

```
OK
```

Read Command

```
AT+CPIN?
```

Response(s)

```
+CPIN: <code>
OK
ERROR
+CME ERROR: <err>
```

Write Command

```
AT+CPIN=<pin>[, <new pin>]
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<pin>(str)

Password (string type), e.g. SIM PIN1.
If the requested password was a PUK then <pin> must be followed by <new pin>.

<new pin>(str)

If the requested code was a PUK: specify a new password or restore the former disabled password.

<code>(text)	
SIM PIN authentication	
READY	PIN has already been entered. No further entry needed.
SIM PIN	ME is waiting for SIM PIN1.
SIM PUK	ME is waiting for SIM PUK1 if PIN1 was disabled after three failed attempts to enter PIN1.

Notes

- Successful PIN authentication only confirms that the entered PIN was recognized and correct. The output of the result code OK does not necessarily imply that the mobile is registered to the desired network.
  Typical example: PIN was entered and accepted with OK, but the ME fails to register to the network. This may be due to missing network coverage, denied network access with currently used SIM card, no valid roaming agreement between home network and currently available operators etc.
  ENS22-E offers various options to verify the present status of network registration: For example, the AT+COPS command indicates the currently used network. With AT+CEREG you can also check the current status and activate an unsolicited result code which appears whenever the status of the network registration changes (e.g. when the ME is powered up, or when the network cell changes).
- See AT+CPWD for information on passwords.
- See AT+CLCK for information on lock types.

6.2 AT+CLCK Facility lock

AT+CLCK can be used to lock, unlock or interrogate a network or UE <facility>. The command can be aborted when network facilities are being set or interrogated.

Syntax

Test Command

AT+CLCK=?

Response(s)

+CLCK: list of supported <facility>s
OK

Write Command

AT+CLCK=<facility>, <mode>[, <password>]

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38],
3GPP TS 22.004 [18],
3GPP TS 22.088 [26],
3GPP TS 23.088,
3GPP TS 24.088

Parameter Description

<facility>(str)

"SC"	SIM (lock (U)SIM cards) (U)SIM requests password upon UE power-up and when this lock command is issued. <password>: SIM PIN1.

<mode>(num)

0	Unlock
1	Lock

<password>(str)

Password string used to lock and to unlock a <facility>. Length and authority for passwords depend on the <facility> in question and are therefore listed in the section on parameter <facility>. Passwords can be modified with AT+CPWD.

Example

Lock (U)SIM card (<facility>= "SC")

AT+CLCK="SC",1,"9999"	The "SC" parameter enables or disables the SIM PIN authentication (PIN 1) when you power up the UE.
OK	(U)SIM card locked. As a result, SIM PIN 1 must be entered to enable UE to register to the network.

`AT+CLCK="SC",0,"9999"` `OK`	Unlocks SIM card. When powered up, UE registers to the network without requesting SIM PIN1. Note: Depending on the services offered by the provider, this feature is not supported by all SIM card types. If so, the command returns ERROR when you attempt to unlock the card.

6.3 AT+CPWD Change Password

AT+CPWD allows to define a new password for a password protected <facility> lock function. Each password is a string of digits, the length of which varies with the associated <facility>. The test command returns a list of pairs which represent the available facilities and the maximum length of the associated password. See AT+CLCK for more information on the various lock features.

Syntax

Test Command

AT+CPWD=?

Response(s)

+CPWD: list of supported (<facility>, <password length>)
OK

Write Command

AT+CPWD=<facility>, <old password>, <new password>

Response(s)

New password has been registered for the facility lock function.
OK
If parameter <old password> was not correct:
+CME ERROR: 16 (+CME ERROR: incorrect password)
If the password for the selected <facility> has been invalidated due to too many failed attempts:
+CME ERROR: ...
If error is related to ME functionality:
+CME ERROR: <err>

PIN	Last
+	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<facility>(str)

"SC"	SIM PIN. (U)SIM requests password upon ME power-up and when this lock command is issued. If incorrectly entered three times, the SIM PUK is required to perform authentication. Input of the SIM PUK password is possible only with AT command AT+CPIN. <password length>: 4 to 8 digits.

<password length>(num)

4...8	Length of password. The range of permitted length for a password depends on the associated <facility>. It is available from the test command response, or in the description of parameter <facility>.

<old password>(str)

Password specified for the facility.

<new password>(str)

New password.

7. Network Service Commands

The AT Commands described in this chapter are related to various network services.

7.1 AT+COPN Read operator names

The AT+COPN command returns the list of operator names from the UE. Each operator code <numericn> that has an alphanumeric equivalent <alphan> in the UE memory is returned.

Syntax

Test Command

```
AT+COPN=?
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

Exec Command

```
AT+COPN
```

Response(s)

```
+COPN: <numericn>,<alphan>
[+COPN: ...]
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<numericn>(str)

Operator in numeric format

<alphan>(str)

Operator in long alphanumeric format

7.2 AT+COPS Operator Selection

AT+COPS queries the present status of the ENS22-E's network registration and allows to determine whether automatic or manual network selection shall be used.

Two operator selection modes are available with AT+COPS:

- Automatic
  ENS22-E searches for the home operator automatically. If successful the ENS22-E registers to the home network. If the home network is not found, ENS22-E goes on searching. If a permitted operator is found, ENS22-E registers to this operator.
  If no operator is found the ENS22-E remains unregistered.
- Manual
  Desired operator can be determined using the AT+COPS write command. If the operator is found, ENS22-E registers to it immediately. If the selected operator is forbidden, the ENS22-E remains unregistered.

The AT+COPS test command lists sets of five parameters, each representing an operator present in the network. A set consists of

- an integer indicating the availability of the operator,
- long alphanumeric format of the operator's name,
- short alphanumeric format of the operator's name,
- numeric format representation of the operator and
- an integer indicating the acccess technology of the operator.

Any of the parameters may be unavailable and will then be an empty field (,,). The list of operators comes in the following order: Home network, networks referenced in SIM and other networks.
The operator list is followed by a list of the supported <mode>s and <format>s. These lists are delimited from the operator list by two commas.
The reponse to the AT+COPS test command is independent on the settings made with <mode> and <rat>. The AT+COPS test command will return a list of operators with the supported <rat>s.

The reponse to the AT+COPS read command depends on the registration status. If the UE is not registered, the read command returns only the current <mode>. If the UE is registered the response returns the currently selected operator, the currently set format and the currently used <rat>.

The AT+COPS write command forces an attempt to select and register to a network operator. If the selected operator is not available, no other operator will be selected. The selected operator name <format> will apply to further read commands, too.

Syntax

Test Command

```
AT+COPS=?
```

Response(s)

```
+COPS: [list of supported (<opStatus>, long alphanumeric <opName>, short alphanumeric <opName>, numeric <opName>, <rat>)s ], , (list of supported <mode>s), (list of supported <format>s)
OK
ERROR
+CME ERROR:<err>
```

Read Command

```
AT+COPS?
```

Response(s)

```
+COPS:<mode>[, <format>, <opName>[, <rat>]]
OK
ERROR
+CME ERROR:<err>
```

Write Command

AT+COPS=<mode>[, <format>[, <opName>[, <rat>]]]

Response(s)

OK
ERROR
+CME ERROR:<err>

PIN	Last
±	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<opStatus>(num)

Operator Status

0	Unknown
1	Operator available
2	Current operator
3	Operator forbidden

<opName>(str)(&V)

Operator Name

If test command: Operator name in long alphanumeric format, short alphanumeric format and numeric format.
If read command: Operator name as per <format>.
If write command: Operator name as per <format>.

<mode>(num)(&V)

0(D)	Automatic mode; <opName> field is ignored.
1	Manual operator selection After restarting the UE the network will be selected according to the priority order specified in 3GPP TS 23.122: "Last Registered PLMN", "Home PLMN", "Preferred PLMN" (related (U)SIM elementary files are EF_LOCI, EF_IMSI, EF_PLMNwAcT). The same priority order applies when swapping the (U)SIM during operation. In manual mode, only <format>=2 is supported.
2	Manually deregister from network and remain unregistered until <mode>=0 or 1 is selected.
3	Set only <format> (for AT+COPS read command).

<rat>(num)

Radio Access Technology (RAT)

9	E-UTRAN (NB-S1 mode)

<format>(num)(&V)(&W)

0(&F)(D)	Long alphanumeric format of <opName>.
1	Short alphanumeric format of <opName>.
2	Numeric format of <opName>. This is the Location Area Identification (LAI) number, which consists of the 3-digit Mobile Country Code (MCC) plus the 2- or 3-digit Mobile Network Code (MNC).

7.3 AT+CESQ Extended Signal Quality

The AT+CESQ command returns received signal quality parameters. If the current serving cell is not a GERAN cell, <rxlev> and <ber> are set to value 99. If the current serving cell is not a UTRA FDD or UTRA TDD cell, <rscp> is set to 255. If the current serving cell is not a UTRA FDD cell, <ecno> is set to 255. If the current serving cell is not an E-UTRA cell, <rsrq> and <rsrp> are set to 255.

Syntax

Test Command

AT+CESQ=?

Response(s)

+CESQ: (list of supported <rxlev>s), (list of supported<ber>s), (list of supported<rscp>s), (list of supported<ecno>s), (list of supported<rsrq>s), (list of supported<rsrp>s)
OK

Exec Command

AT+CESQ

Response(s)

+CESQ: <rxlev>, <ber>, <rscp>, <ecno>, <rsrq>, <rsrp>
OK
ERROR

PIN	Last
+	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<rxlev>(num)

Received signal strength level (see 3GPP TS 45.008 [42] subclause 8.1.4). For 2G networks only

99	not known or not detectable

<ber>(num)

Channel bit error rate (in percent). For 2G networks only

99	not known or not detectable

<rscp>(num)

Received signal code power (see 3GPP TS 25.133 [36] subclauses 9.1.1.3 and 9.1.1.1.3) For 3G networks only

255	not known or not detectable

<ecno>(num)

Ratio of the received energy per PN chip to the total received power spectral density (see 3GPP TS 25.133 [36] subclause 9.1.2.3) For 3G networks only

255	not known or not detectable

<rsrq>(num)

Reference signal received quality (see 3GPP TS 36.133 [40] subclause 9.1.7). For 4G networks only

0	rsrq < -19.5 dB
1	-19.5 dB ≤ rsrq < -19 dB
2	-19 dB ≤ rsrq < -18.5 dB

...	
32	-4 dB ≤ rsrq < -3.5 dB
33	-3.5 dB ≤ rsrq < -3 dB
34	-3 dB ≤ rsrq
255	not known or not detectable

<rsrp>(num)

Reference signal received power (see 3GPP TS 36.133 [40] subclause 9.1.4). For 4G networks only

0	rsrp < -140 dBm
1	-140 dBm ≤ rsrp < -139 dBm
2	-139 dBm ≤ rsrp < -138 dBm
...	
95	-46 dBm ≤ rsrp < -45 dBm
96	-45 dBm ≤ rsrp < -44 dBm
97	-44 dBm ≤ rsrp
255	not known or not detectable

7.4 AT+CTZR Time Zone Reporting

The AT+CTZR command enables and disables event reporting for changes of time zone and daylight saving time. If reporting is enabled the ENS22-E returns unsolicited result codes whenever the time zone changes.

Syntax

Test Command

```
AT+CTZR=?
```

Response(s)

```
+CTZR:(list of supported <mode>s)
OK
```

Read Command

```
AT+CTZR?
```

Response(s)

```
+CTZR: <mode>
OK
ERROR
+CME ERROR: <err>
```

Write Command

```
AT+CTZR=<mode>
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Unsolicited Result Codes

URC 1

```
+CTZV: <tz>
```

The URC indicates that the time zone has changed.

URC 2

```
+CTZE: <tz>, <dst>[, <time>]
```

The URC provides information on local time and daylight saving time.

URC 3

```
+CTZEU: <tz>, <dst>[, <utime>]
```

The URC provides information on universal time and daylight saving time.

Parameter Description

<mode>(num)	
0(P)	Disable event reporting by URCs
1	Enable time event reporting by "+CTZV"
2	Enable time event reporting by "+CTZE"
3	Enable time event reporting by "+CTZEU"

`<tz>`(str)

String type value representing the sum of the local time zone (difference between the local time and GMT expressed in quarters of an hour) plus daylight saving time.

`<time>`(str)

Time in format "yyyy/mm/dd,hh:mm:ss", wherein characters indicates year, month, day, hour, minutes, seconds.

`<utime>`(str)

Time in format "yyyy/mm/dd,hh:mm:ss", wherein characters indicates year, month, day, hour, minutes, seconds.

`<dst>`(num)

Parameter indicates daylight saving time as follows:

0	No adjustment for daylight daving time
1	+1 hour adjustment for daylight saving time
2	+2 hour adjustment for daylight saving time

7.5 AT+CPSMS Enable or Disable Power Saving Mode

AT+CPSMS controls settings of the UE's power saving mode (PSM) parameters. It controls whether the UE wants to apply PSM or not, as well as the requested extended periodic TAU value in E-UTRAN and the requested Active Time value.

Syntax

Test Command

AT+CPSMS=?

Response(s)

+CPSMS: (list of supported <mode>s),,, (list of supported <RequestedPeriodicTAU>s), (list of supported <RequestedActiveTime>s)
OK
ERROR
+CME ERROR:<err>

Read Command

AT+CPSMS?

Response(s)

+CPSMS:<mode>,,[, <RequestedPeriodicTAU>][, <RequestedActiveTime>]
OK
ERROR
+CME ERROR:<err>

Write Command

AT+CPSMS=[<mode>,,[, <RequestedPeriodicTAU>[, <RequestedActiveTime>]]]

Response(s)

OK
ERROR
+CME ERROR:<err>

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<mode>(num)(NV)

Enable/disable the use of power saving mode (PSM) in the UE.

0	Disable the use of PSM
1(D)	Enable the use of PSM
2	Disable the use of PSM and discard all parameters for PSM, or if available, reset to the manufacturer specific default values

<RequestedPeriodicTAU>(str)(NV)

One byte in an 8 bit format.
Requested extended periodic TAU value to be allocated to the UE in E-UTRAN. The requested extended periodic TAU value is coded as one byte (octet 3) of the GPRS Timer 3 information element coded as bit format (e.g. "01000111" equals 70 hours). For more information on coding and value range, see 3GPP TS 24.008 [33], table 10.5.163a).

<RequestedActiveTime>(str)(NV)

One byte in an 8 bit format.
Requested Active time value to be allocated to the UE. The requested Active Time value is coded as one byte (octet 3) of the GPRS Timer 2 information element coded as bit format (e.g. "00100100" equals 4 minutes). For more information on coding and value range, see 3GPP TS 24.008 [33], table 10.5.163).

7.6 AT^SMONI Monitoring Serving Cell

The AT^SMONI command supplies information of the serving cell.

Syntax

Test Command

AT^SMONI=?

Response(s)

OK

Exec Command

AT^SMONI

Response(s)

See: Section 7.6.1, AT^SMONI Responses

OK

PIN Last

- -

7.6.1 AT^SMONI Responses

UE is not connected:

- UE is camping on a LTE (NB-IoT) cell and registered to the network:

```
Syntax:
^SMONI: ACT,EARFCN,Band,Deployment type,PLMN code,TAC,Cell ID,RSRP,RSRQ,RSSI,TX
power,Connection state,SNR
Example:
^SMONI: NB-IoT,3736,8,4,46000,3d45,3632849,-805,-117,-720,210,NOCONN,83
```

- UE is searching and could not (yet) find a suitable LTE (NB-IoT) cell:

```
Syntax:
^SMONI: ACT,EARFCN,Band,Deployment type,PLMN code,TAC,Cell ID,RSRP,RSRQ,RSSI,TX
power,Connection state,SNR
Example:
^SMONI: NB-IoT,,,,,,,,,SEARCH,
```

- UE is camping on a LTE (NB-IoT) cell and registered to the network in PSM:

```
Syntax:
^SMONI: ACT,EARFCN,Band,Deployment type,PLMN code,TAC,Cell ID,RSRP,RSRQ,RSSI,TX
power,Connection state,SNR
Example:
^SMONI: NB-IoT,3736,8,4,46000,3d45,3635748,-838,-113,-734,210,SLEEP,132
```

UE is connected:

- LTE (NB-IoT) cell:

```
Syntax:
^SMONI: ACT,EARFCN,Band,Deployment type,PLMN code,TAC,Cell ID,RSRP,RSRQ,RSSI,TX
power,Connection state,SNR
Example:
^SMONI: NB-IoT,3736,8,4,46000,3d45,3635749,-874,-123,-738,210,CONN,37
```

Columns for LTE (NB-IoT) Serving Channel parameters:

Column	Description
ACT	Access Technology
EARFCN	E-UTRA Absolute Radio Frequency Channel Number
Band	E-UTRA frequency band (see 3GPP 36.101)
Deployment type	Unknown mode (0), in-band different PCI mode (1), in-band same PCI mode (2), guard band (3) or stand-alone (4)
PLMN code	Public Land Mobile Network code
TAC	Tracking Area Code (see 3GPP 23.003 Section 19.4.2.3)
Cell ID	Cell ID
RSRP	Reference Signal Received Power as measured by L1 in cBm (see 3GPP 36.214 Section 5.1.1.)
RSRQ	Reference Signal Received Quality as measured by L1 in cB (see 3GPP 36.214 Section 5.1.2.)
RSSI	Received signal strength indicator in cbm
TX power	Used Uplink Power in cbm
Conn_state	Connection state. Can be one of following: CONN, SLEEP, NOCONN or SEARCH
SNR	Signal-to-noise ratio

7.6.2 Service states

Depending on the service state, an additional textual output is generated (refer also to the response examples):

- "SEARCH" (Searching) - The MS is searching, but could not (yet) find a suitable cell. This output appears after restart of the MS or after loss of coverage.
- "NOCONN" (No connection) - The MS is camping on a cell and registered to the network. The service state is 'idle', i.e. there is no connection established or a dedicated channel in use.
- "SLEEP" (Sleeping) - The MS is in LTE PSM (Power Saving Mode).

7.7 AT^SMONP Monitoring Neighbour Cells

The AT^SMONP supplies information of active cells and all neighbour cells.

Syntax

Test Command

AT^SMONP=?

Response(s)

OK

Exec Command

AT^SMONP

Response(s)

See: Section 7.7.1, AT^SMONP Responses

OK

PIN Last

- -

Notes

- Due to the fact that not all necessary information of the neighbour cells can be decoded during a connection, only neighbour cells that have already been visible in IDLE mode will be further updated, as long as they are still included in the list.
- The neighbour cells have the same PLMN as the serving cell. In case of searching for a network the serving cell can change and the UE shows different sets of neighbour cells depending on the PLMN of the serving cell.

7.7.1 AT^SMONP Responses

- In case of a NB-IoT serving cell:

```
Syntax:
NB-IoT:
EARFCN1,PCI1,RSRP1,RSRQ1,RSSI1,SNR1
EARFCN2,PCI2,RSRP2,RSRQ2,RSSI2,SNR2
...
EARFCNn,PCIn,RSRPn,RSRQn,RSSIn,SNRn



Example:
NB-IoT:
3736,294,-793,-108,-676,-106
OK
```

Columns for NB-IoT parameters:

Column	Description
EARFCN	E-UTRA Absolute Radio Frequency Channel Number
PCI	Physical Cell ID

Column	Description
RSRP	Reference Signal Received Power as measured by L1 in cBm (see ETSI TS 136 214 version 10.1.0 Section 5.1.1.)
RSRQ	Reference Signal Received Quality as measured by L1 in cB (see ETSI TS 136 214 version 10.1.0 Section 5.1.3.)
RSSI	Received Signal Strength Indication as measured by L1 in cBm
SNR	Signal to Noise Ratio

7.8 AT+CEDRXS eDRX Setting

The AT+CEDRXS command controls the settings of eDRX parameters of the UE. The command controls whether the UE wants to apply eDRX or not, as well as the requested eDRX value for each specified type of access technology.

The AT+CEDRXS test command displays the supported <mode>s and the value ranges for the access technology and the requested eDRX value as compound values.

The AT+CEDRXS read command displays current settings for each defined value of <AcT-type>.

Syntax

Test Command

AT+CEDRXS=?

Response(s)

+CEDRXS: (list of supported <mode>s), (list of supported <AcT-type>s), (list of supported <Requested_eDRX_value>s)
OK

Read Command

AT+CEDRXS?

Response(s)

[+CEDRXS: <AcT-type>, <Requested_eDRX_value>]
OK
ERROR
+CME ERROR: <err>

Write Command

AT+CEDRXS=[<mode>[, <AcT-type>[, <Requested_eDRX_value>]]]

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Unsolicited Result Code

When <mode>=2:

+CEDRXP: <AcT-type>[, <Requested_eDRX_value>[, <NW_provided_eDRX_value>[, <Paging_time_window>]]]

eDRX is enabled and URC code is enabled when the eDRX values provided by network has changed.

Parameter Description

<mode>(num)

Enable or disable use of eDRX in the UE. This parameter is applicable to all specified types of access technology, i.e. the most recent setting of <mode> will take effect for all specified values of <AcT-type>.

[0]	Disable the use of eDRX.
1	Enable the use of eDRX.

2	Enable the use of eDRX and enable the <+CEDRXP> unsolicited result code.
3	Disable the use of eDRX and reset the <Requested_eDRX_value> to default.

<AcT-type>(num)(NV)

Type of access technology. This parameter is used to specify the relationship between the type of the access technology and requested eDRX value.

0	Access technology is not using eDRX. This parameter value is only used in the unsolicited result code
5	E-UTRAN (NB-S1 mode)

<Requested_eDRX_value>(str)(NV)

Half a byte in a 4 bit format. The values are coded as follows:

“0010“	20,48 seconds
“0011“	40,96 seconds
“0101“	81,92 seconds
“1001“	163,84 seconds
“1010“	327,68 seconds
“1011“	655,36 seconds
“1100“	1310,72 seconds
“1101“	2621,44 seconds
“1110“	5242,88 seconds
“1111“	10485,76 seconds

<NW_provided_eDRX_value>(str)

Half a byte in a 4 bit format. The values are coded in the same way as for <Requested_eDRX_value>

<Paging_time_window>(str)

Half a byte in a 4 bit format. The requested values are applied immediately and are stored non-volatile. In case the module is attached to the network the change of the values will trigger tracking area update. The stored configuration is used during the network attach after restart in case the auto-attach is enabled.

The values are coded as follows:

“0000“	2,56 seconds
“0001“	5,12 seconds
“0010“	7,68 seconds
“0011“	10,24 seconds
“0100“	12,8 seconds
“0101“	15,36 seconds
“0110“	17,92 seconds
“0111“	20,48 seconds
“1000“	23,04 seconds
“1001“	25,6 seconds
“1010“	28,16 seconds
“1011“	30,72 seconds
“1100“	33,28 seconds

“1101“	35,84 seconds
“1110“	38,4 seconds
“1111“	40,96 seconds

7.9 AT+CEDRXRDP Read dynamic eDRX parameters

The AT+CEDRXRDP command reads the current dynamic eDRX parameters applied in the cell. The command returns <AcT-type> and <Requested_eDRX_value>, <NW_provided_eDRX_value> and <Paging_time_window> if eDRX is used for the cell that the MS is currently registered to. If the cell that the MS is currently registered to is not using eDRX, the <AcT-type>=0 is returned.

Syntax

Test Command

```
AT+CEDRXRDP=?
```

Response(s)

```
OK
```

Exec Command

```
AT+CEDRXRDP
```

Response(s)

```
+CEDRXRDP:<AcT-type>[, <Requested_eDRX_value>[, <NW_provided_eDRX_value>[,
<Paging_time_window>]]]
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

7.10 AT^SNLWM2M Lwm2m Configuration Settings

AT^SNLWM2M can be used to query and configure Lwm2m settings of the ENS22-E.
AT^SNLWM2M write command queries a configuration parameter (if no value is entered) or sets its value(s).
AT^SNLWM2M read command returns a list of parameters and their current values.

Syntax

Test Command

AT^SNLWM2M=?

Response(s)

^SNLWM2M:"cfg","dft", "/0/0/2",("0","3")
^SNLWM2M:"cfg","dft", "/0/0/0",("IP:Port")
^SNLWM2M:"cfg","dft", "/0/0/3",("PSK Id, 15-digit number")
^SNLWM2M:"cfg","dft", "/0/0/5",("PSK Value,32-digit hexadecimal number")
^SNLWM2M:"URC/srv", "dft","enabled",("0", "1")
^SNLWM2M:"URC/procedure", "dft","fwdownload","enabled",("0", "1")
^SNLWM2M:"URC/procedure", "dft","fwupdate","enabled",("0", "1")
^SNLWM2M:"act","dft",("start", "stop")
OK

Write Command

Resource configure and Query <rsc value> on AT^SNLWM2M interface.

AT^SNLWM2M="cfg","dft", <mgmt rsc>[, <rsc value>]

Response(s)

^SNLWM2M: "cfg","dft", <mgmt rsc>, <rsc value>
OK
ERROR
+CME ERROR: <err>

Write Command

Enable LwM2M client

AT^SNLWM2M="act" , "dft",<action>

Response(s)

^SNLWM2M: "act", "dft",<action>
OK
ERROR
+CME ERROR: <err>

Write Command

Configure FOTA URC switch to inform about the server connection status

AT^SNLWM2M="URC/srv","dft", <urc setting>[, <urc value>]

Response(s)

^SNLWM2M: "URC/srv","dft", <urc setting>,<urc value>
OK
ERROR
+CME ERROR: <err>

Write Command

Configure FOTA URC switch to inform about the client automatic processing

AT^SNLWM2M="URC/procedure","dft", <procedure>, <urc setting>[, <urc value>]

Response(s)

^SNLWM2M: "URC/procedure","dft", <procedure>,<urc setting>,<urc value>
OK

Write Command (Continued)

Configure FOTA URC switch to inform about the client automatic processing

AT^SNLWM2M="URC/procedure","dft", <procedure>, <urc setting>[, <urc value>]

Response(s)

ERROR
+CME ERROR: <err>

PIN	Last
-	-

Unsolicited Result Codes

URC 1

URC for status change of server connection:

^SNLWM2M: "srv","dft",<srv id>,"<srv status>"[, <status parameter>]

URC 2

URC for status change of server connection:

^SNLWM2M: "procedure","dft"[, <srv id>],<procedure>,<procedure status>[, <indication text>]

Parameter Description

<mgmt rsc>(str)

The following resource is configurable on AT^SNLWM2M interface. Where:

“/0/0/0“	LwM2M Server URI Resource. The <rsc value> is corresponding to <Lwm2m Server>.
“/0/0/2“	Security Mode.The <rsc value> is corresponding <DTLS Switch>.
“/0/0/3“	Public Key or Identity.The <rsc value> is corresponding to <PSK Id>.
“/0/0/5“	Secret Key.The <rsc value> is corresponding to <PSK Value>.

<rsc value>(str)(NV)

Resource value is depending to <mgmt rsc>.

<Lwm2m Server>(str)(NV)

This parameter is used for configure Lwm2m server when <mgmt rsc> is "/0/0/0". And format will be like this: "IP:Port". Where:

“IP“	IPv4 address in dot-separated numeric (0-255) parameter of the form: a1.a2.a3.a4.
“Port“	0~65535. If the port value is omitted, the port is 5683 by default.
“NOTE“	Only IPv4 is supported. IMEI must be set prior to execute this command. The changes will take effect after reboot.

<DTLS Switch>(str)(NV)

This parameter is used for enable/disable DTLS function when <mgmt rsc> is "/0/0/2". Where:

“0“	Disable DTLS Function.
“3“	Enable DTLS Function.

`<PSK Id>`(str)(NV)

This parameter is used for configure DTLS PSK Id when `<mgmt rsc>` is "/0/0/3".
This parameter must be set to the IMEI (a 15-digit number) of the equipment.
Example: "353251080007729".

“PSK Id“	Indicates the PSK index.

`<PSK Value>`(str)(NV)

This parameter is used for configure DTLS PSK Value when `<mgmt rsc>` is "/0/0/5".
This parameter must be set to a 32-digit hexadecimal number.
Example: "30313233343536373839404142434445"

“PSK Value“	Indicates "***" when as a response .

`<action>`(str)(NV)

This parameter is designed to execute an action which shall start/stop LWM2M client, where:

“start“	Start the service
“stop“(D)	Stop the service

`<procedure>`(str)

This parameter is used for enabling URCs to inform about the client automatic processing, where:

“fwdownload“

“fwupdate“

`<urc setting>`(str)

Configures the urc property as "enabled" which means the URC is sent.

`<urc value>`(str)(NV)

Configures the urc property if the URC is sent or not, where:

“0“	The URC is not sent
“1“	The URC is sent

`<srv status>`(str)

This parameter is used for URC status when there is a change of server connection. Registered is the default value that are uniquely supported.

`<srv id>`(num)

1...x - short server id that initiated the action, procedure or status change.

1	Default values that are uniquely supported.

`<procedure status>`(str)

This parameter is used for URC in case of client internal procedure, where:

“init“

“finished“

`<status parameter>`(str)

IP Address Registered to Server. e.g."35.221.220.95:5684"

`<indication text>`(str)

Downloaded IP address. e.g."coaps://35.221.220.95"

7.11 AT+CIPCA Initial PDP context activation

AT+CIPCA controls whether an initial PDP context shall be established automatically following an attach procedure when the UE is attached to GERAN or UTRAN RATs, and whether the UE is attached to E-UTRAN with or without a PDN connection.
The AT+CIPCA test command returns values supported as a compound value.
The AT+CIPCA read command returns the current setting of the command.
The AT+CIPCA write command controls whether the UE is attached to E-UTRAN with or without a PDN connection.

Syntax

Test Command

```
AT+CIPCA=?
```

Response(s)

```
+CIPCA: (list of supported<n>s), (list of supported<AttachWithoutPDN>s)
OK
```

Read Command

```
AT+CIPCA?
```

Response(s)

```
[+CIPCA:<n>, <AttachWithoutPDN>]
OK
ERROR
+CME ERROR: <err>
```

Write Command

```
AT+CIPCA=[<n>[, <AttachWithoutPDN>]]
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<n>(num)

Activation of PDP context upon attach.

3	No change in current setting.

<AttachWithoutPDN>(num)(NV)

EPS Attach with or without PDN connection.

[0]	EPS Attach with PDN connection.
1	EPS Attach without PDN connection.

8. Internet Service Commands

ENS22-E has an embedded TCP/IP stack that is driven by AT commands and enables the host application to easily access the Internet. The advantage of this solution is that it eliminates the need for the application manufacturer to implement own TCP/IP, thus minimizing cost and time to integrate Internet connectivity into a new or existing host application. This chapter is a reference guide to all the AT commands and responses defined for use with the TCP/IP stack.

The embedded TCP/IP stack provides the following services:

1. Socket Services:
   - UDP Client in Non-Transparent or Transparent Mode
   - Non-Transparent UDP Endpoint

Please note that a total number of 5 sockets is available for usage.

Step-by-step overview of how to configure and use TCP/IP communications with ENS22-E:

- Select URC mode or polling mode as described below.
- First of all, create a GPRS connection profile with AT^SICS. The connection profile is a set of basic parameters which determines the type of connection to use for Internet service. The connection type is also referred to as bearer. Up to 5 connection profiles can be defined, each identified by the <conProfileId>.
- Secondly, use AT^SISS to create a service profile based on one of the connection profiles. Up to 5 service profiles can be defined, each identified by the <srvProfileId>. The service profile specifies the type of Internet service to use, e.g., Socket. To assign a connection profile to a service profile, the <conProfileId> of AT^SICSmust be entered as "conId" value of the AT^SISS parameter <srvParmTag>.
  This offers flexibility to combine connection profiles and service profiles.
- Once the connection profile and the service profile are created, an Internet session can be opened by entering the AT^SISO write command and the desired <srvProfileId>.
  A URC indicates how to proceed. The "^SISW" URC means that data can be sent. The "^SISR" URC means that received data are available for reading. If an error occurs, the "^SIS" URC is delivered instead.
- The next steps differ depending on the service type and the transfer mode (Non-Transparent or Transparent).
- Once a service is opened, the AT^SISI command shall be used to monitor the progress of the session. The command reports the service state of the used service profile and indicates the number of bytes received, the number of bytes sent.
- If an error occurs during a session, you can enter the AT^SISE command and the <srvProfileId> to identify the reason. This is especially important in the polling mode.
- The AT^SICI command can be used at any time to query the current status of one or all connection profile(s).
- Finally, to close an open service, enter the AT^SISC write command and the <srvProfileId>.
- All profile settings of AT^SISS and AT^SICS are volatile. To store the settings to non-volatile memory and load the stored profiles, AT^SIPS can be used.

Transparent Mode or Non-Transparent Mode:

- *Transparent Mode* is stream-oriented, i.e. a single data stream can be sent, and another single data stream can be received. Packetizing of data is done automatically by the embedded TCP/IP stack.
  Transparent Mode is activated with AT^SIST and then indicated by the "CONNECT" result code. The mode eliminates the need for AT^SISW and AT^SISR read and write sequences.
- *Non-Transparent Mode* is packet-oriented, i.e. data is transferred in separate packets. Maximum packet size is 1358 bytes for UDP. To read and write data, AT^SISW and AT^SISR sequences shall be used.
  To send or receive more than 1358 bytes, the read or write action shall be repeated until the data transfer has completed. Each read or write action requires that the command response (of AT^SISR or AT^SISW) confirms that the service is ready to send or receive data. The read/write cycles can be controlled by URCs or polling. For details, see section "URC mode and polling mode" below.
- UDP Endpoint employs Non-Transparent Mode.
  UDP client can employ both modes, and may even mix both modes in the same connection.

Socket service used with UDP protocol
The significant differences between the TCP and UDP protocols imply that UDP sometimes requires particular procedures or even specific parameters. Details on how to handle UDP services can be found in extra notes or are included in the general parameter descriptions.

The ENS22-E offers two kinds of Socket service with UDP protocol.

- *UDP Client:* Intended for connections to a given remote host. In this case, the IP address and the UDP port of the remote host are set as a fixed parameter in the service profile. The UDP Client can use Transparent Mode and Non-Transparent Mode.
- *Non-Transparent UDP Endpoint:* IP address and UDP port of the remote hosts are handled in each read (AT^SISR) and write (AT^SISW) request. This enables the host application to communicate with different remote hosts.
  See example in Section 8.14.2, UDP Scenario.

Secure connection (DTLS)
UDP Client services support server and client authentication for Datagram Transport Layer Security (DTLS) (see RFC 6347).

- To set DTLS, add "s" to the address type, such as sockudps. For details see AT^SISS <srvParmTag> parameter "address"<srvParmTag>.
- Only support pre-shared keys(PSKs) for authentication.These pre-shared keys are symmetric keys, shared in advance among the communicating parties (see RFC4279).
- To add and delete pre-shared keys (PSKs), use the commands AT^SBNW.
- To read cipher-suites use the commands AT^SBNR.
- When a UDP Client service establishes secure connection with the server, the maximum send packet size is changed to 835 bytes.
- Due to memory limitations, only one secure connection can be supported at a time.

URC mode or polling mode (for non-Transparent Mode only)
The ENS22-E offers two modes of controlling a Non-Transparent Mode session opened with AT^SISO. To select the mode, use the AT^SCFG command, parameter "Tcp/WithURCs" (refer to <tcpWithUrc>).

- URC mode (delivery default):
  The progress of a Non-Transparent Mode session is URC driven. The URCs notify the host whether data can be sent or received, whether data transfer has completed, whether the service can be closed or whether an error has occurred. This mechanism eliminates the need to poll the service until the necessary progress information is received.
  To enable the URC mode, select: AT^SCFG="Tcp/WithURCs",on.
- Polling mode:
  In polling mode, the presentation of URCs related to Internet Services is disabled. The host is responsible to retrieve all the status information needed for controlling the Internet session. This is done by polling, where the host application keeps sending the commands AT^SISR, AT^SISW, AT^SISI.
  To enable the polling mode select: AT^SCFG="Tcp/WithURCs",off.
  The disabled URCs are the following: "^SISR" URC, "^SISW" URC and "^SIS" URC for parameter <urcCause>=0 (Internet service events), but not for all other <urcCause>s (needed Endpoint and therefore always enabled).

Additional AT commands designed for controlling and monitoring the connection profiles (bearers):

- The AT^SICI command can be used at any time to query the current status of one or all connection profile(s).
- The AT^SISX command sends ICMP (Internet Control Message Protocol) Echo Requests to a target IP address to verify the TCP/IP network connection.

Address notation
Server addresses shall be provided as IPv4 addresses in standard dot format, e.g. "192.168.1.2", or as IPv6

addresses in standard colon format enclosed in square brackets, e.g. "[FE80::2]".

Timeouts
Timeouts are not part of the Internet AT command functionality implemented in ENS22-E and, if desired, are the responsibility of the host application. It is recommended that the host application validates URCs and AT command responses and reacts adequately, for example by sending a close message or starting a timer.

Using the DCD line to detect the connection status of Internet services
With AT&C you can configure the DCD line of the used serial interface to indicate whether an Internet service is active. For Socket, the states "Up" or "Connecting" are indicated.

Usage of IP Service commands on different interfaces
The UE allows to create an Internet service profile on one interface with AT^SISS and to use it on another interface with AT^SISO, AT^SISC, AT^SISR, AT^SISW, AT^SIST. Nevertheless, to avoid conflicts a profile should be handled on the same interface where it was created with AT^SISS, at least where it was opened with AT^SISO.

8.1 AT^SICS Internet Connection Setup Profile

AT^SICS serves to create and edit Internet connection profiles. A connection profile can be assigned to one or more service profiles defined with AT^SISS, and thus, determines which type of connection is to be established when opening a service profile with AT^SISO.

The AT^SICS read command requests the current settings of all Internet connection profiles.

The AT^SICS write command specifies all parameters of a connection profile identified by <conProfileId>. To add or change the settings the write command needs to be executed for each single <conParmTag>. All profile parameters set with AT^SICS are volatile. To save profile settings in non-volatile memory please refer to AT^SIPS.

ENS22-E is designed to use PAP authentication (Password Authentication Protocol) when parameters "user" and "passwd" are given within the connection profile. If credentials are omitted, no authentication is performed.

The list below shows which <conParmTag> parameters are mandatory (= m) or optional (= o).

Table 8.1: Applicability of AT^SICS <conParmTag> values

<conParmTag>	<conParmValue-conType> GPRS0 or GPRS6
"conType"	m
"user"	o
"passwd"	o
"apn"	o
"alphabet"	o

Syntax

Test Command

```
AT^SICS=?
```

Response(s)

```
OK
```

Read Command

```
AT^SICS?
```

Response(s)

```
^SICS: <conProfileId>, <conParmTag>, <conParmValue>
[^SICS: ...]
OK
```

Write Command

```
AT^SICS=<conProfileId>, <conParmTag>, <conParmValue>
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN Last

- -

Parameter Description

<conProfileId>(num)	
0...4	Internet connection profile identifier. The <conProfileId> identifies all parameters of a connection profile, and, when a service profile is created with AT^SISS the <conProfileId> needs to be set as "conId" value of the AT^SISS parameter <srvParmTag>.

<conParmTag>(str)	
Internet connection parameter.	
“conType“	Type of Internet connection. For supported values of <conParmValue> refer to <conParmValue-conType>.
“alphabet“	Selects the character set for input and output of string parameters within a profile. The selected value is bound to the specific profile. This means that different profiles may use different alphabets. It is recommended that "alphabet" should be set after <conParmValue-conType> and before other parameters. For supported values of <conParmValue>, refer to <conParmValue-alphabet>.
“user“	User name string: maximum 31 characters (where "" is default).
“passwd“	Password string: maximum 31 characters (where ***** is default).
“apn“	Access point name (APN) string value: maximum 63 characters (where "" is default).

<conParmValue>(str)(+CSCS)
Parameter value; type and supported content depend on related <conParmTag>.

<conParmValue-conType>(str)(+CSCS)	
Supported connection type values in <conParmValue> for <conParmTag> value "conType".	
“GPRS0“	Packet switched connection type IPv4.
“GPRS6“	Packet switched connection type IPv6.
“none“	Clears the connection profile.

<conParmValue-alphabet>(str)(+CSCS)	
Supported string parameter character set selections in <conParmValue> for <conParmTag> value "alphabet".	
[“0“]	Applicable character set is determined by current setting of AT+CSCS.
“1“	International Reference Alphabet (IRA, seven bit ASCII).

Note

- After entering AT^SISO, ENS22-E automatically tries to find and attach to an existed Packet Domain with same <conParmValue-conType> and APN, if not found, ENS22-E automatically tries to define and activate a new Packet Domain with <conParmValue-conType> and APN. After entering AT^SISC, the automatically defined Packet Domain will be deleted if no opening service is based on it. Yet, the only exception is AT+CGATT which can be used any time to detach from the Packet Domain and thus disconnect the bearer opened with AT^SISO.

8.1.1 Example: GPRS connection profile

`at^sics=0,"conType","GPRS0"`	Select connection type GPRS0.
`OK`	
`AT^SICS=0,"alphabet","1"`	The character set of string parameters(ASCII).
`OK`	
`AT^SICS=0,"passwd","t-d1"`	Password for GPRS services provided by the German operator T-D1.
`OK`	
`AT^SICS=0,"apn","internet.t-d1.de"`	APN to access the GPRS services provided by the German operator T-D1.
`OK`	

8.2 AT^SICI Internet Connection Information

The AT^SICI read command requests the current status of the Internet connection profiles currently defined with AT^SICS.

The AT^SICI write command displays the status of the specified Internet connection profile. If the connection profile is not defined yet, the command returns a "+CME ERROR" response.

Syntax

Test Command

```
AT^SICI=?
```

Response(s)

```
^SICI:(list of supported <conProfileId>s)
OK
```

Read Command

```
AT^SICI?
```

Response(s)

```
[^SICI: <conProfileId>, <conState>, <numServices>, <conAddr>]
[^SICI: ...]
OK
```

Write Command

```
AT^SICI=<conProfileId>
```

Response(s)

```
^SICI: <conProfileId>, <conState>, <numServices>, <conAddr>
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Parameter Description

<conProfileId>(num)

Internet connection profile. Internet connection profile identifier as defined by AT^SICS (<conProfileId>).

0...4

<conState>(num)

State of the Internet connection profile.

0	Down - Internet connection is defined but not connected.
1	Connecting - A service has been opened and so the Internet connection is initated.
2	Up - Internet connection is established and usable by one or more services.
3	Limited Up - Internet connection is established, but temporarily no network coverage.

<numServices>(num)

Number of services using this Internet connection profile.

0...5

<conAddr>(str)

Local IPv4 address of the Internet connection profile ("0.0.0.0" if no address is associated yet), or local IPv6 address ("::" if no address is associated yet).

8.2.1 Checking Connection Profile Status

at^sici? ^SICI: 1,2,1,"10.10.0.161" OK	Query the current status of the connection profile. One connection profile has been created at <conProfileId>=1, and one service is opened using this connection profile. The Internet connection is in <conState>=2 ("Up").

Assume the network connection is temporarily not available. (If URC presentation mode of network registration is enabled the state is shown by the URC "+CEREG: 2").

at^sici? ^SICI: 1,3,1,"10.10.0.161" OK	Query once again the current status of the connection profile. Parameter <conState> has changed to state "Limited up".

The network connection is temporarily not available but the Internet connection is still established, so the host may decide to stop the data transfer to minimize the risk of losing data due to memory limitations.

at^sici? ^SICI: 1,2,1,"10.10.0.161" OK	Query once again the current status of the connection profile. After re-establishing the network connection, <conState> reverts to state "Up".

Another service has been opened with AT^SISO:

at^sici? ^SICI: 1,2,2,"10.10.0.161" OK	Query once again the current status of the connection profile. After opening another service, parameter <numServices> has increased.

After closing one service with AT^SISC:

at^sici? ^SICI: 1,2,1,"10.10.0.161" OK	Query once again the current status of the connection profile. Parameter <numServices> has decreased.

After closing the last service with AT^SISC:

at^sici? ^SICI: 1,0,0,"0.0.0.0" OK	Query the current status. The bearer is closed now. Parameter <numServices> has decreased.

8.3 AT^SIPS Internet Profile Storage

AT^SIPS saves and loads the settings of the Internet connection and service profiles in the non-volatile memory. AT^SIPS can also be used to reset the settings to their default values without saving.

Syntax

Test Command

AT^SIPS=?

Response(s)

^SIPS: (list of supported <type>s), (list of supported <action>s), (list of supported <ProfileId>s)
OK

Write Command

AT^SIPS=<type>, <action>[, <ProfileId>]

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN Last
- -

Parameter Description

<type>(str)

Internet profile storage type parameter.

“connection“	Handle AT^SICS parameter set.
“service“	Handle AT^SISS parameter set.
“all“	Handle AT^SICS parameters and AT^SISS parameters listed above.

<action>(str)

Internet profile storage action parameter

“reset“	Reset current profile(s) for given <type> to default settings without saving. If <ProfileId> is given only specific profile will be reset. Only the connections which are in "Down" status and the services which are in "Allocated" status could be affected.
“save“	Stores current profile(s) for given <type>. If <ProfileId> is given only specific profile will be stored.
“load“	Loads stored profile(s) for given <type>. If <ProfileId> is given only specific profile will be loaded.

<ProfileId>(num)

Internet connection or service profile storage identifier

0...4	In case of connection profile, max = 4, please see <conProfileId>. In case of a service profile, max = 4, please see <srvProfileId>. If parameter is omitted, AT^SIPS applies to all possible profile identifiers of used <type>.

Note

- All stored settings of IP service cannot be loaded automatically during startup. They can only be loaded from non-volatile memory by executing AT^SIPS=<type>, load[,<ProfileId>].

8.4 AT^SISS Internet Service Setup Profile

AT^SISS serves to set up the necessary parameters in the Internet service profiles. Service profiles can then be used to control a data link in conjunction with AT^SISI, AT^SISO, AT^SISC, AT^SISR, AT^SISW, AT^SIST, and AT^SISE.

The AT^SISS read command requests the current settings of all Internet service profiles. One line is issued for every possible parameter of a given <srvParmTag> "srvType" value.

The AT^SISS write command specifies the parameters for a service profile identified by <srvProfileId>. At first the type of Internet service needs to be selected via <srvParmTag> value "srvType". This determines the applicability of all other <srvParmTag> values related to this "srvType" and sets their defaults. Changing the <srvParmTag> "srvType" of an existing service profile will reset the <srvParmTag> default values to suit the new "srvType".
To change the settings the write command needs to be executed for each single <srvParmTag>. All profile parameters set with AT^SISS are volatile. To save profile settings in non-volatile memory please refer to AT^SIPS.

The list below shows which <srvParmTag> parameters apply to each Internet service and which of them are mandatory (= m) or optional (= o).

Table 8.2: Applicability of AT^SISS <srvParmTag> values

<srvParmTag>	Mandatory or optional
Non-transparent Socket service	
"srvType"	m
"conId"	m
"alphabet"	o
"address"	m
Transparent Socket service	
"srvType"	m
"conId"	m
"alphabet"	o
"address"	m

Syntax

Test Command

```
AT^SISS=?
```

Response(s)

```
OK
```

Read Command

```
AT^SISS?
```

Response(s)

```
^SISS: <srvProfileId>, <srvParmTag>, <srvParmValue>
[^SISS: ...]
OK
ERROR
+CME ERROR: <err>
```

Write Command

AT^SISS=<srvProfileId>, <srvParmTag>, <srvParmValue>

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Parameter Description

<srvProfileId>(num)

0...4	Internet service profile identifier. The <srvProfileId> is used to reference all parameters related to the same service profile. Furthermore, when using the AT commands AT^SISO, AT^SISR, AT^SISW, AT^SIST and AT^SISC the <srvProfileId> is needed to select a specific service profile.

<srvParmTag>(u)

Internet service profile parameter.

srvType	Type of Internet service to be configured with consecutive usage of AT^SISS. For supported values of <srvParmValue> refer to <srvParmValue-srvType>.
alphabet	Selects the character set for input and output of string parameters within a profile. The selected value is bound to the specific profile. This means that different profiles may use different alphabets. It is recommended that "alphabet" should be set after <srvParmValue-srvType> and before other parameters. For supported values of <srvParmValue> refer to <srvParmValue-alphabet>.
conId	Internet connection profile to be used, for details refer AT^SICS.
address	String value containing the URL for the specific service: If address contains a semicolon, quotes are mandatory. When GSM alphabet is enabled (see AT+CSCS), keep in mind that escape sequences are required for some special characters: For example, underscore "_" shall be escaped with \11. See also Section 1.6, Supported character sets for more information on character set and escape sequences. **1.** Non-transparent Socket - UDP endpoint URL "sockudp://:<localPort>" - UDP client URL "sockudp[s]://<host>:<remotePort>[;port=<localPort>]" **2.** Transparent Socket - Transparent UDP client "sockudp[s]://<host>:<remotePort>[;port=<localPort>];etx[=<etxChar>][;timer=<value>]" Supported parameters for Socket services: - <host>:IPv4 address in standard dot format, e.g. "192.168.1.2", or IPv6 address in standard colon format enclosed in square brackets, e.g. "[FE80::2]". - <remotePort>: 1 ... 2^{16}-1 for the remote port number.

- <localPort>: 1 ... 2^{16}-1 for the local port number.
- "port": Local port of UDP client:
  0: Port number will be assigned from service (default).
  1...2^{16}-1: defines the local port number for the UDP client.
- "etx": Parameter is mandatory for Transparent Socket. Otherwise Socket service is non-transparent.
- "<etxChar>": Specifies the character used to change from transparent access mode to AT command mode.
  range: 1...15,17...255 (16 is not allowed because it is used as DLE (0x10))
  If parameter is not set no escaping is configured, thus requiring either +++ or DTR ON-OFF transition for changing to AT command mode. If value is set, the transmitted bytes are parsed for the DLE (0x10) character followed by the specified <etxChar> value. If both characters are found the service returns to AT command mode without transmitting these two bytes (same as +++).
  If you wish to send DLE characters as normal text string within your payload data the characters shall be doubled (DLE DLE).
- "timer": The parameter configures the Nagle algorithm, which is used in transparent access mode.
  range: 20...[100]...500 milliseconds in steps of 20.

`<srvParmValue>`(str)(+CSCS)

Parameter value; type and supported content depend on related <srvParmTag>.

`<srvParmValue-srvType>`(str)(+CSCS)

Supported Internet service type values in <srvParmValue> for <srvParmTag> value "srvType".
Before changing the "srvType" of an existing service profile be sure that the profile is closed. To verify the connection state of the service profile enter the read command AT^SISI. Only when <srvState>=2 is returned for this specific service profile you can change its service type.

“Socket“	ENS22-E acting as client or server UDP. "etx" subparameter in URL configures Transparent mode for Socket service.
“none“	Reset Internet service profile settings. Operation is not allowed if profile is in use, i.e. it was activated via AT^SISO.

`<srvParmValue-alphabet>`(str)(+CSCS)

Supported string parameter character set selections in <srvParmValue> for <srvParmTag> value "alphabet".

[“0“]	The applicable character set is determined by the current setting of AT+CSCS.
“1“	International Reference Alphabet (IRA, seven bit ASCII).

8.5 AT^SISI Internet Service Information

AT^SISI serves to monitor the status of Internet service profiles defined with AT^SISS.

The AT^SISI read command requests the current status of all defined Internet service profiles.

The AT^SISI write command requests the status of the specified Internet service profile. If the specified service profile is not defined yet, "+CME ERROR" is returned.

Syntax

Test Command

```
AT^SISI=?
```

Response(s)

```
[^SISI:(list of defined <srvProfileId>s)]
OK
```

Read Command

```
AT^SISI?
```

Response(s)

If response is related to service profile(s) created / opened on this interface:

```
[^SISI: <srvProfileId>, <srvState>, <rxCount>, <txCount>, <ackData>, <unackData>]
[^SISI: ...]
```

If response is related to service profile(s) created / opened on other interface(s):

```
[^SISI: <srvProfileId>, <srvParmTag>value "srvType"]
[^SISI: ...]
OK
ERROR
```

Write Command

```
AT^SISI=<srvProfileId>
```

Response(s)

```
^SISI: <srvProfileId>, <srvState>, <rxCount>, <txCount>, <ackData>, <unackData>
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Parameter Description

`<srvProfileId>`(num)

Internet service profile identifier as defined by AT^SISS (<srvProfileId>).

0...4

`<srvState>`(num)

Internet service state (for details see AT^SISO parameter <srvState>).

2	Allocated
3	Connecting
4	Up
6	Down

`<rxCount>`(num)

Number of bytes received via AT^SISR or AT^SIST since last successful AT^SISO write command.
This is the same value as displayed by the AT^SISO read command with the parameter <rxCount>.

`<txCount>`(num)

Number of bytes sent via AT^SISW or AT^SIST since last successful AT^SISO write command.
This is the same value as displayed by the AT^SISO read command with the parameter <txCount>.

`<ackData>`(num)

Number of data bytes already sent and acknowledged at TCP layer. Value 0 indicates that no sent data is acknowledged yet.
Parameter is not applicable to Socket with UDP. For these services the counter is always set to 0.

`<unackData>`(num)

Number of data bytes already sent but not yet acknowledged at TCP layer. A value 0 indicates that all sent data is already acknowledged.
This is the same value as displayed in the response of the AT^SISW write command with the parameter <unackData>.
Parameter is not applicable to Socket with UDP. For these services, the counter is always set to 0.

Note

- If a service is in state "Down", the responses for <rxCount>, <txCount>, <ackData> and <unackData> are the last known values for the service in the states "Connecting" and "Up".

8.6 AT^SISO Internet Service Open

The AT^SISO write command starts the Internet session configured by the service profile. All further steps needed to control the session depend on whether you are using URC mode or polling mode. The AT^SISO read command returns the current status of all Internet services.

URC mode:
If the service opens successfully, the URCs "^SISW" and "^SISR" will trigger the action to follow, either writing data with AT^SISW or reading data with AT^SISR. If a special event occurs, e.g. an error or a warning, after opening or while using a service then the URC type "^SIS" will be delivered.

Polling mode:
After opening the service, all progress information needed to control the session shall be explicitly requested by the host application. The particular sequence of AT commands varies depending on the service used. The following list summarizes, by way of an example, the steps normally involved in managing an upload or download job.

- Upload (Socket):
  - Enter the AT^SISO command, e.g. AT^SISO=4.
  - Enter AT^SISW, specify <reqWriteLength>, e.g. AT^SISW=4,20. Check resulting response for <cnfWriteLength>. Optionally, check error with AT^SISE, e.g. AT^SISE=4. If necessary, repeat the sequence several times.
  - Query available data with AT^SISR, e.g. AT^SISR=4,1358.
  - Check service state with AT^SISI, e.g. AT^SISI=4, if necessary several times until <srvState>=6 ("Down").
  - Check error with AT^SISE, e.g. AT^SISE=4.
  - Close service with AT^SISC, e.g. AT^SISC=4.
- Download (Socket):
  - Enter the AT^SISO command, e.g. AT^SISO=4.
  - Enter AT^SISR, specify <reqReadLength>, e.g. AT^SISR=4,1000. Check resulting response for <cnfReadLength>. If necessary, repeat the sequence several times until <cnfReadLength>= -2 (end of data) or ERROR.
  - Check error with AT^SISE, e.g. AT^SISE=4.
  - Close service with AT^SISC, e.g. AT^SISC=4.
- Socket service (upload and download possible in one session):
  - Recommended: Set AT+CMEE=2 to enable extended error text.
  - Enter the AT^SISO command, e.g. AT^SISO=4.
  - Enter AT^SISR or AT^SISW, specifying <reqReadLength> or <reqWriteLength>, e.g. AT^SISR=4,20 or AT^SISW=4,20. Check resulting response for <cnfReadLength> or <cnfWriteLength>. If necessary, repeat the sequence several times.
  - Check error with AT^SISE, e.g. AT^SISE=4.
  - Query available data with AT^SISR, e.g. AT^SISR=4,1358.
  - Close service with AT^SISC, e.g. AT^SISC=4.
- Transparent UDP client:
  - Enter the AT^SISO command, e.g. AT^SISO=4.
  - Enter AT^SIST to enter transparent data mode. After communication has finished, return to AT command mode via +++ escape sequence.
  - Check error with AT^SISE, e.g. AT^SISE=4.
  - Close service with AT^SISC, e.g. AT^SISC=4.

Syntax

Test Command

AT^SISO=?

Response(s)

OK

Read Command

AT^SISO?

Response(s)

^SISO: <srvProfileId>, <srvType>[, <srvState>, <socketState>, <rxCount>, <txCount>, <locAddr>, <remAddr>]
[^SISO: ...]
OK

Write Command

AT^SISO=<srvProfileId>

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN Last

± -

Parameter Description

<srvProfileId>(num)

<srvProfileId> 0 ... 4 specified with AT^SISS.

<srvType>(str)

The type of the internet service as specified by the AT^SISS parameter <srvParmValue-srvType>.

<srvState>(num)

Internet service state.
Please note that the state of an Internet service may influence the state of the serial DCD line. For details see description of value 2 for parameter <value> of command AT&C.

2	Allocated Service profile resources are allocated, i.e. at least the service type has been set (parameter <srvParmTag>, value "srvType" of AT^SISS). The service is not opened, but ready for configuration.
3	Connecting State after opening a service with AT^SISO where the connection is being established. If connection setup is successful, the service proceeds to the state "4" (Up) and one of the URCs "^SISW" and "^SISR" may follow. If connection setup is not successful, the "^SIS" URC may appear and the service enters <srvState> 6 (Down).
4	Up The service performs its purpose. The data transfer process is the major function at this state.
6	Down This state is entered if - the service has successfully finished its session (see note on Socket), - the remote peer has reset the connection or

	- the IP connection has been closed because of an error (see note below on service or network errors). If a service is in this state, make sure to close it with AT^SISC before reopening it.

<socketState>(num)

Socket state identifier.

1	Socket not assigned, i.e. no UDP connection active.
2	Socket assigned as CLIENT.
3	Socket assigned as UDP Endpoint.

<rxCount>(num)

Number of bytes received via AT^SISR or AT^SIST since the last successful AT^SISO write command.

<txCount>(num)

Number of bytes sent via AT^SISW or AT^SIST since the last successful AT^SISO write command.

<locAddr>(str)

Recently used local IPv4 address in a dotted-four-byte format and TCP port separated by colon, e.g. "192.60.10.10:80", or recently used local IPv6 address in colon format enclosed in square brackets, e.g. "[FE80::2]" and TCP port separated by colon, e.g. "[FE80::2]:80".

<remAddr>(str)

Remote IPv4 address in the dotted-four-byte format and TCP port, separated by colon, e.g. "192.60.10.10:80", or remote IPv6 address in the colon format enclosed in square brackets, e.g. "[FE80::2]") and TCP port separated by colon, e.g. "[FE80::2]:80".
If the Socket service is configured to UDP Endpoint, a remote IP address cannot be assigned, and a default value will be shown instead.

Notes

- If a service or network error occurs during an IP session and the "^SIS" URC or the AT^SISE command display an error message, the service enters <srvState>=6, i.e. the IP connection is closed. In this case, the service still allows reading the data stored in the buffer, but writing data is denied. After reading, close the service and open it again.
- As in polling mode, no error URCs are available, you are advised to integrate the commands AT^SISI and AT^SISE into the command sequences for upload and download jobs. So, the AT^SISO command may be followed by AT^SISI to check that the service has entered the <srvState>=4 before sending AT^SISR, AT^SISW or AT^SIST. This helps you to detect errors even though the "^SIS" URCs are disabled. A typical example is that the service fails to be opened because the service profile contains a wrong destination address. In such a case, after opening with AT^SISO and responses OK, the service quickly enters the states <srvState>=2, 4 and 6, with an error being returned no earlier than after sending the first AT^SISR or AT^SISW command. In URC mode, an error URC, such as "Host not found" would be received in this situation, but in polling mode, the only way to detect the state is using AT^SISI or, alternatively, AT^SISO.

8.7 AT^SISC Internet Service Close

The AT^SISC write command closes the TCP/IP connection to the remote peer which was opened with AT^SISO. All resources are released; all status information parameters, e.g. <srvState>, <unackData>, <ackData>, <rxCount> and <txCount> counters are reset. Only the initial configuration settings are preserved. The service can be restarted any time, using the same configuration or a new one.

Syntax

Test Command

AT^SISC=?

Response(s)

OK

Write Command

AT^SISC=<srvProfileId>

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN Last

± -

Parameter Description

<srvProfileId>(num)

0...4	<srvProfileId> specified with AT^SISS.

8.8 AT^SISR Internet Service Read Data

The AT^SISR command either triggers a read operation (download) or queries the number of bytes in the internal buffer.
The "^SISR: x, 1" URC is also used to report status changes of the Transparent UDP service while the client is in AT command mode.

The AT^SISR write command may return the following errors:

- "+CME ERROR: operation temporary not allowed" e.g. if the service has no network resources allocated.
- "+CME ERROR: operation not allowed" e.g. if the service is not configured.

Syntax

Test Command

```
AT^SISR=?
```

Response(s)

```
OK
```

Write Command

```
AT^SISR=<srvProfileId>, <reqReadLength>
```

Response(s)

```
^SISR: <srvProfileId>, <cnfReadLength>[, <remainUdpPacketLength>[, <Udp_RemClient>]]
```
Number of data bytes are sent as specified by <cnfReadLength>. If peek operator was used, no data bytes are sent.
```
OK
ERROR
+CME ERROR: <err>
```

PIN Last

± +

Unsolicited Result Code

```
^SISR: <srvProfileId>, <urcCauseId>
```

Data availability status of the Internet service configured with AT^SISS has changed. The URC is issued when:

- data is available after opening an Internet service or
- less data was confirmed (in <cnfReadLength>) than requested (with <reqReadLength>) during the last "Read Data" operation and new data are available.

The URC is disabled in polling mode. See AT^SCFG, parameter "Tcp/WithURCs", <tcpWithUrc>.
The maximum data that can be cached is less than 4096 bytes, depending on the remaining memory size.

Parameter Description

<srvProfileId>(num)

<srvProfileId> 0 ... 4 specified with AT^SISS.

<reqReadLength>(num)

0	Peek Operator: Query number of received bytes within internal buffers. The behaviour of the peek operator depends on the selected Internet service, i.e. it may not be supported by all IP Services. For "Socket" service configured for UDP the size of the next available UDP packet is returned.
1...1358	Requested number of data bytes to be read via the Internet service specified in <srvProfileId>.

<cnfReadLength>(num)

-2	Indicates the end of data. Data transfer has been finished (all data have been read) and the service can be closed with AT^SISC.
0	Indicates that no further data is available at the moment.
>0	Number of available data bytes. The range is determined by <reqReadLength>: If <reqReadLength> was greater than 0, then <cnfReadLength> may be less or equal to the value requested with <reqReadLength>. If <reqReadLength> equals 0 (peek operator), the value indicated by <cnfReadLength> may be greater than 1358.

<urcCauseId>(num)

Indicates whether or not the data is available for reading with AT^SISR and AT^SIST.

1	*Meaning of value "1" for all services exceptTransparent UDP service:* Data is available and can be read by sending the AT^SISR command. The URC appears when fewer data was confirmed (in <cnfReadLength>) than requested (with <reqReadLength>) during the last "Read Data" operation and new data is available. *Meaning of value "1" for Transparent UDP service:* If the Transparent UDP service is in AT command mode the "^SISR: x, 1" URC notifies the client that the server has sent new data. In this case the client shall enter the AT^SIST command to go to transparent access mode and read the data.
2	End of data. Data transfer has completed (all data read). The service can be closed with AT^SISC.

<remainUdpPacketLength>(num)

Optional third parameter of the AT^SISR write command response displayed only if the Socket service uses the UDP protocol.
The reception of each datagram must be completed before the next datagram can be received. This may be a problem if the buffer of the host application is limited and not designed to handle the maximum packet size of 1358 bytes. To compensate this, the host is advised to request, via <reqReadLength>, an amount less or equal its maximum buffer capacity and wait for the resulting AT^SISR write command response with parameter <remainUdpPacketLength>. The benefit of this approach is that the host may properly receive all parts of a UDP datagram, as after each received data part the number of remaining bytes is synchronized, until reading the datagram is finished.
If the currently read datagram is smaller than the number of bytes requested by the host, the <remainUdpPacketLength> parameter is omitted.
.

0	Indicates that all bytes of the current UDP datagram are read.
(max. data size)-1...1	Indicates that the currently read UDP datagram is not yet complete. The displayed value is the remaining number of bytes. <remainUdpPacketLength> is unequal 0 until reading all parts of the current datagram is finished.

<Udp_RemClient>(str)

Service specific parameter of the AT^SISR write command response. If the Socket service is configured as UDP endpoint, this parameter shows the IP address and the UDP port of the remote host that has sent the current UDP data. See example in Section 8.14.2, UDP Scenario.

Notes

- The URC "^SISR: x, 1" notifies that a package data is available for reading. If this package data is not read out, the notification of the next package data will not be displayed. 4096 bytes data can be cached at most. If the newly received data is larger than the remaining capacity, it will be discarded.
- ENS22-E can't handle packet after IP fragment. For this reason, the data sent to ENS22-E needs to be less than the Path MTU.

8.8.1 Example: Socket Host Reads Small Amounts of UDP Data Packets (URC Mode)

This section applies only to the Socket service using the UDP protocol. The example shows how to read UDP packets if the buffer of the host application can handle only a few bytes. There are two datagrams available for reading.
Buffer size: 6 bytes
Datagram A = 18 bytes (content "THIS_IS_DATAGRAM_A")
Datagram B = 3 bytes (content "NEW")

^SISR: 0, 1	Service profile 0 is configured for Socket service and UDP. The URC notifies the host that data is available for reading.
at^sisr=0,6	The host requests to read 6 bytes.
^SISR: 0, 6, 12 THIS_I OK	The first 6 bytes of datagram A are confirmed and transmitted. Another 12 bytes are still available.
at^sisr=0,6	The host requests to read the next part of 6 bytes.
^SISR: 0, 6, 6 S_DATA OK	The next 6 bytes of datagram A are confirmed and transmitted. Another 6 bytes are still available.
at^sisr=0,6	The host requests to read the next part of 6 bytes.
^SISR: 0, 6, 0 GRAM_A OK	Last part of datagram A was received, no remainder is left.
at^sisr=0,6	Again, the host requests to read 6 bytes. This time, the request refers to datagram B which has only 3 bytes. As the read datagram is smaller than the size requested by the host, the response does not include the <remainUdpPacketLength>.
^SISR: 0, 3 NEW OK	3 bytes are confirmed and transmitted. Datagram B was properly received.

8.9 AT^SISW Internet Service Write Data

AT^SISW triggers a write operation (upload) and queries the amount of data already sent, but not acknowledged at the TCP layer.

AT^SISW write command may return the following errors:

- "+CME ERROR: operation temporary not allowed" e.g. if the service has no network resources allocated.
- "+CME ERROR: operation not allowed" e.g. if the service is not configured.

Syntax

Test Command

```
AT^SISW=?
```

Response(s)

```
OK
```

Write Command

```
AT^SISW=<srvProfileId>, <reqWriteLength>[, <Udp_RemClient>]
```

Response(s)

```
^SISW: <srvProfileId>, <cnfWriteLength>, <unackData>
```

Number of data bytes as specified by <cnfWriteLength>.

```
OK
ERROR
+CME ERROR: <err>
```

PIN Last

± +

Unsolicited Result Code

```
^SISW: <srvProfileId>, <urcCauseId>
```

The URC indicates the following status changes:

- After opening a UDP client with AT^SISO, the "^SISW" URC indicates that the service is ready to accept data. After this initial "^SISW" URC, the UDP Client can proceed in Transparent Mode or Non-Transparent Mode. The initial "^SISW" URC is not issued after a UDP Endpoint was opened, because the "^SIS" URC will be issued.
- During AT^SISW write cycles the "^SISW" URC indicates that the service is ready to accept new data.

The URC is disabled in polling mode. See AT^SCFG, parameter "Tcp/WithURCs", <tcpWithUrc>.

Parameter Description

<srvProfileId>(num)

<srvProfileId> 0 ... 4 specified with AT^SISS.

<reqWriteLength>(num)

0...1358

Specifies the number of bytes to be sent with AT^SISW or, if set to 0, requests the amount of data already sent with AT^SISW but not yet acknowledged:

- Parameter <reqWriteLength> may be 1...1358 bytes to specify the amount of data to be sent with AT^SISW.
- If Socket service is selected with UDP protocol
  - <reqWriteLength>=0 can be used to send an empty UDP packet;

- it is recommended that the size of each data packet be limited to 1358 bytes.

<Udp_RemClient>(str)

Service-specific parameter of the AT^SISW write command. If the Socket service is configured as UDP end-point, this parameter is mandatory, and specifies the IP address (in dotted format) and the UDP port of the remote host. For each write request another IP address and UDP port may be given. See example in Section 8.14.2, UDP Scenario.

<cnfWriteLength>(num)

0...1358	Confirmed number of data bytes which can be transmitted via the Internet service configured in <srvProfileId>. This number may be less or equal to the value requested with <reqWriteLength>. The application has to deliver exactly the number of bytes indicated by <cnfWriteLength>. A 0 value means that no data can be written at this time, i.e. it serves as a flow control mechanism.

<unackData>(num)

Number of data bytes already sent but not yet acknowledged at the TCP layer.
The value is constantly changing until the entire upload job has completed. If the value equals 0 all data sent so far is acknowledged.
<unackData> includes the <cnfWriteLength> value of the pending write operation. Therefore, the very first write operation of an upload job returns identical values for <cnfWriteLength> and <unackData>.
This mechanism allows the host application to easily verify whether the remote host has successfully received the data.
Parameter is not applicable to Socket with UDP protocol. For these services the counter is always set to 0.

<urcCauseId>(num)

1	The service is ready to accept new user data.

Notes

- Do not send any characters after AT^SISW command line termination(ATS3) until "^SISW" URC is received. This is necessary to avoid that any characters related to the AT command can be interpreted as being part of the data stream to be transferred. Also refer to Section 1.4, AT Command Syntax.
- Enter AT^SISW, specify <reqWriteLength>, e.g. AT^SISW=4,20, then received response that 20 bytes can be sent(indicated by <cnfWriteLength>), at this time, the data will be sent when your entered data size is reached 20, and the excess input will be truncated.
- If you want to terminate an upload data stream, after the last AT^SISW command, you will receive "^SISW: x, 1", then the service can be closed with AT^SISC.

8.10 AT^SIST Enter Transparent Mode

AT^SIST activates / deactivates Transparent Mode.

After entering the AT^SIST command, the CONNECT response notifies that the service has entered Transparent Mode and is ready to transparently send and receive payload data over the AT command interface.

There are several ways to quit the Transparent Mode and revert to AT Command Mode:

- +++ escape sequence
- DTR ON-OFF transitions (see AT&D for configuring DTR line)
- "etxChar" parameter set within the server address (see AT^SISS, <srvParmTag> "address" for Socket service URLs.

Switching back and forth between both modes does not affect the underlying socket and has no influence on the service <srvState>.
If the service is in AT Command Mode the "^SISR: x, 1" URC appears once to indicate that the remote side has sent new data. In this case, the client shall enter AT^SIST to go to Transparent Mode and read out the new data.

If the connection is released by the remote side or the network is unavailable, the following applies:

- If the service is in Transparent Mode (CONNECT mode): UE returns to AT Command Mode, issues a specific "NO CARRIER" result code and goes to <srvState> 6 ("Down") in case of UDP Client. The "NO CARRIER" result code starts with 0x10 (DLE) and 0x04 (EOT) and ends with the command line termination character (ATS3), followed by the response formatting character (ATS4).
- If the service is in AT Command Mode the "^SISR: x, 1" URC appears to indicate that the state of the service has changed. In this case, the client shall go to Transparent Mode with AT^SIST in order to read remaining data (if any) and get the "NO CARRIER" result code. After this, the service changes to <srvState> 6 ("Down"). Otherwise, if the client does not go to Transparent Mode after receiving "^SISR: x, 1" URC the service remains in <srvState> 4 ("Up") even though the remote side has shut down.
  In some cases, depending on the remote side and the network, it is possible that "^SIS" URCs may be reported, for example, "^SIS" URCs with <urcInfoId> 15 ("Remote host has reset the connection") and 19 ("Socket has been shut down). See Section 8.13, Internet Service URC "^SIS" for a list of possible URCs.
- In all the above scenarios, the Transparent service shall be closed with AT^SISC. Trying to return to Transparent Mode with AT^SIST would only end up with "NO CARRIER" once again and is not recommended.
- Use AT^SISO and AT^SISI to check the <srvState>.

Syntax

Test Command

AT^SIST=?

Response(s)

OK

Write Command

AT^SIST=<srvProfileId>

Response(s)

CONNECT
(indicates that UE has entered Transparent Mode)
OK
ERROR
+CME ERROR: <err>

PIN Last

- +

Parameter Description

`<srvProfileId>`(num)

`<srvProfileId>` 0 ... 4 specified with `AT^SISS`.

Notes

- There can be only one Socket service in Transparent Mode at the same time.
- `AT^SIST` is only usable on the ASC0 interface.
- Transparent mode will block module goes into sleep mode and suspend mode.

8.11 AT^SISX Internet Service Execution

The AT^SISX command can be used to send ICMP (Internet Control Message Protocol) Echo Requests to a target IP address.
If the AT^SISX write command is executed for Ping, then the command returns one row for every ICMP Echo Request. The last Ping response line is followed by two lines to report a statistic calculated from the Echo Request responses. After starting the ping command, the AT channel is blocked until all ICMP requests are executed. To stop the periodic ping early, send any character (user break).

Syntax

Test Command

```
AT^SISX=?
```

Response(s)

```
^SISX: "Ping", (list of supported <conProfileId>s), (range of supported <request>s), (range of supported <timelimit>s)
OK
```

Write Command

```
AT^SISX=<service>, <conProfileId>, <address>[, <request>[, <timelimit>]]
```

Response(s)

In case of <pingInfoType>= 1: ICMP Echo Requests (1 - 30 rows)

```
^SISX: "Ping", <pingInfoType>, <conProfileId>, <ip-address>, <roundTripTime>
[...]
```

In case of <pingInfoType>= 2: Packet statistic (1 row)

```
^SISX: "Ping", <pingInfoType>, <conProfileId>, <sent>, <received>, <lost>, <lostPercent>
```

In case of <pingInfoType>= 3: Time statistic (1 row)

```
^SISX: "Ping", <pingInfoType>, <conProfileId>, <minRTT>, <maxRTT>, <meanRTT>

OK
ERROR
+CME ERROR: <err>
```

PIN Last

\+ -

Parameter Description

<service>(str)

“Ping“	Ping host.

<conProfileId>(num)

The PDP Context Identifier as defined with AT+CGDCONT for the PDP context definition to be used (see <cid>). For AT^SISX, only PDP Context Identifier 0 can be used. If the specified PDP context is not yet activated, then AT^SISX returns ERROR.

<address>(str)

In case of "Ping" this is theIP address (i.e. "192.168.1.3"),

<ip-address>(str)

The IP address of the host (i.e. "192.168.1.3").

<request>(num)

[1]...30 Number of "Ping" ICMP Echo Requests to be sent.

<timelimit>(num)

200...[5000]...10000 Amount of time, in milliseconds, to wait for an ICMP Echo Response message related to a previously sent Echo Request message.

<pingInfoType>(num)

Indicate the type and format of the information given in the command responses (see syntax of the AT^SISX write command above).

1 Ping status received for the ICMP Echo Request(s). Depending on parameter <request> 1 - 30 rows. Address and Round Trip Time are returned for each request.

2 one row packet statistic calculated from the ping response(s) received for <pingInfoType>=1.

3 one row time statistics calculated from the ping response(s) received for <pingInfoType>=1 (displayed only if at least one Echo response message was received).

<roundTripTime>(num)

Round Trip Time in milliseconds. If the Echo Response message is not received within the time specified by <timelimit>, the value -1 is returned (e.g. when the bearer shuts down during command execution).

<sent>(num)

Number of sent packets.

<received>(num)

Number of received packets.

<lost>(num)

Number of lost packets.

<lostPercent>(num)

Lost packets in percent.

<minRTT>(num)

Minimum Round Trip Time in milliseconds.

<maxRTT>(num)

Maximum Round Trip Time in milliseconds.

<meanRTT>(num)

Average Round Trip Time in milliseconds.

8.12 AT^SISE Internet Service Error Report

The AT^SISE write command returns the current error status of the specified Internet service profile. If the service profile is not defined or the value is invalid, "+CME ERROR" response is returned.
The error status is identical to the content of the "^SIS" URC last issued.
If a service fails, the commands AT^SISR, AT^SISW or AT^SIST will return an error response.

Syntax

Test Command

```
AT^SISE=?
```

Response(s)

```
OK
```

Write Command

```
AT^SISE=<srvProfileId>
```

Response(s)

```
^SISE: <srvProfileId>, <infoID>[, <info>]
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Parameter Description

<srvProfileId>(num)

Internet service profile identifier as defined by AT^SISS <srvProfileId>.

0...4

<infoID>(num)

Reason for Internet service error. This is a subset of <urcInfoId> which can be found in Section 8.13, Internet Service URC "^SIS".
The value 0 indicates there is no special Internet service error.

<info>(str)

Information text related to <infoID>. This is a subset of <urcInfoText> which can be found in Section 8.13, Internet Service URC "^SIS".

8.13 Internet Service URC "^SIS"

This section first describes the syntax and the parameters of the "^SIS" URC. The second part consists of tables listing the information elements delivered within the "^SIS" URC and the command response of AT^SISE.

The presentation of the "^SIS" URC containing the parameter <urcCause>=0 or <urcCause>=5 can be disabled or enabled depending on whether polling mode or URC mode is preferred. To do so, use the AT^SCFG command, parameter "Tcp/WithURCs" (refer to <tcpWithUrc>). However, if related to <urcCause>=1 or 2, the "^SIS" URC will always be delivered regardless of the setting made with AT^SCFG.

Unsolicited Result Code

Indicates an event, an error or an information element. The same information can be obtained via AT^SISE.

^SIS: <srvProfileId>, <urcCause>[, [<urcInfoId>][, <urcInfoText>]]

The URC may appear if an event or an error occurs, for example, after opening an Internet service with AT^SISO or any time during operation. The URC also indicates a request for a mobile terminated Internet service client connection, or a failure if a mobile terminated request is rejected. Furthermore, the URC may deliver an information element resulting from a specific command given in the service profile.

A list of possible causes can be found in the tables below. The tables contain the <urcInfoId> and, if applicable, a specific <urcInfoText>. If marked with *) the precise text related to a <urcInfoId> varies greatly depending on the scenario and the implementation of the remote server. In these cases, only a brief explanation of the scenario can be found in the table column "Description".

Parameter Description

<urcCause>(num)

URC cause identifier.

0	An event has occurred after opening or while using an Internet service. The event number is presented via <urcInfoId> and could be an error, a warning, an information element or a note. Optionally additional information may be supplied via <urcInfoText>.
1	Indicates that an opened Non-Transparent Listener service is receiving a connection request from a remote client. The incoming socket connection is dynamically assigned to the next free Internet service profile. In this case, the parameter <urcInfoId> inside the "^SIS" URC equals the <srvProfileId> of the dynamically assigned service profile. This ID shall be used to accept the connection request with AT^SISO or to reject it with AT^SISC.
2	Incoming Socket service client connection has failed. The client request was rejected automatically because no free Internet service profile was available.
5	Only for Non-Transparent UDP endpoint. The service is ready to use.

<urcInfoId>(num)

Information identifier related to <urcCause>. See tables below for further detail. The <urcInfoId> number ranges indicate the type of information element:

0	Service is working properly.
2...94	Error, service is aborted and enters <srvState>=6 (Down).

<urcInfoText>(str)

Information text related to <urcCause>. See tables below for further detail. The maximum length of an information text is 255 bytes. Any longer messages will be truncated.

8.13.1 Information Elements Related to the Service Application

The following table lists the informatiomation elements which may be returned by all supported services within the "^SIS" URC and the command response of AT^SISE. It should be noted that TCP/IP socket problems may occur in all Internet service connections (Socket or Transparent UDP).

<urcInfoId>	<urcInfoText>	Description
Information Elements Returned by the TCP/IP socket		
2	Invalid socket descriptor	Socket error
3	Bad address specified	Socket error
4	Invalid operation	Socket error
5	No free socket descriptors	Socket error
6	The operation would block	Socket error
7	A previous attempt at this operation is still ongoing	Socket error
8	Socket is not bound	Socket error
11	Operation not supported	Socket error
12	The address is already in use	Socket error
13	The network is unavailable	Socket error
14	An established connection was aborted (transmission time-out or protocol error)	Socket error
15	Remote host has reset the connection	Socket error
16	No buffer space available	Socket error
17	The socket is already connected	Socket error
18	For TCP/IP sockets, the socket is not connected	Socket error
20	Connection timed out	Socket error
22	Remote host is unreachable	Socket error
23	An unexpected error occurred	Socket error
27	The port is already in use	Socket error
General Information Elements		
48	Remote peer has closed the connection	Remote peer has closed the connection unexpectedly, and no data are available. The host shall close the service. Note that the "^SIS" URC only indicates the <urcInfoId>, but the AT^SISE command indicates both the <urcInfoId> and the <urcInfoText>.
49	Fatal: No memory is available for service action	
56	Syntax error in URL	
62	DTLS unexpected Error	DTLS error
63	DTLS bad parameter	DTLS error
64	DTLS OS Error	DTLS error
65	DTLS timer Error	DTLS error

<urcInfoId>	<urcInfoText>	Description
66	DTLS data Error	DTLS error
67	DTLS CTR DRBG seed failed	DTLS error
68	DTLS configuration default failed	DTLS error
69	DTLS configuration PSK failed	DTLS error
70	DTLS setup failed	DTLS error
71	DTLS socket failed	DTLS error
72	DTLS handshake timeout	DTLS error
73	DTLS handshake failed	DTLS error
74	DTLS write failed	DTLS error
75	DTLS initial failed	DTLS error
76	DTLS alloc failed	DTLS error
77	DTLS peer closed	DTLS error
90	PDP: internal error 1	
91	PDP: internal error 2	
94	PDP: connection failed	

8.14 Examples of how to Configure and Use Internet Service Profiles

Below you can find selective examples of how to configure and use Internet service profiles. To visualize the difference between the URC mode and the polling mode, the operation of services (after opening with AT^SISO) is explained in separate examples for either mode.

For all examples it is assumed that a connection profile has been created as explained in Section 8.1.1.

When GSM alphabet is enabled (see AT+CSCS), keep in mind that escape sequences are required for some special characters: For example, underscore "_" shall be escaped with \11. See also Section 1.6, Supported character sets for more information on character set and escape sequences.

8.14.1 Selecting URC Mode or Polling Mode

To enable or disable the presentation of URCs for the Internet services, use the AT^SCFG command, type "TcpIp/WithURCs" and select "on" or "off" for parameter <tcpWithUrc>.

```
at^scfg=tcp/withurcs                    Query the current setting.
^SCFG: "Tcp/WithURCs","on"              URC mode is enabled (delivery default).
OK
at^scfg=tcp/withurcs,off                Select polling mode (by switching off URC mode).
^SCFG: "Tcp/WithURCs","off"             Polling mode is accepted.
OK
```

8.14.2 UDP Scenario

The following example shows communication between a UDP endpoint (host 1) and a UDP client (host 2).
Part 1 of the example refers to the UDP endpoint and shows the configuration which allows the UDP endpoint to communicate with any UDP client.
Part 2 shows the settings of a UDP client.
Part 3 and 4 are running in parallel: Part 3 shows the procedures on the UDP endpoint side done when communicating with a UDP client. Part 4 shows the equivalent steps done by the UDP client when communicating with the UDP endpoint.

Part 1 - host 1 is configured for use as UDP endpoint:

```
AT^SISS=0,"srvType","Socket"            Select service type Socket.
OK
AT^SISS=0,"alphabet","1"                The character set of string parameters(ASCII).
OK
AT^SISS=0,"conId",1                     Select connection profile 1.
OK
AT^SISS=0,"address","sockudp://:6666"   Specify the local UDP port.
OK
```

Part 2 - host 2 is configured for use as UDP client:

```
AT^SISS=1,"srvType","Socket"            Select service type Socket.
OK
AT^SISS=1,"alphabet","1"                The character set of string parameters(ASCII).
OK
AT^SISS=1,"conId",1                     Select connection profile 1.
OK
```

`AT^SISS=1,"address","sockudp://10.10.0.219:6666"` `OK`	Specify the address of host 1.

Part 3 - host 1 opens the service and communicates with host 2:

`AT^SISO=0` `OK`	Open the service.
`^SIS: 0, 5`	URC indicates that host 1 is waiting (on UDP port 6666).

`AT^SISO?`
`^SISO: 0,"Socket",4,3,0,0,"10.10.0.219:6666","0.0.0.0:0"`
`^SISO: 1,""`
`^SISO: 2,""`
`^SISO: 3,""`
`^SISO: 4,""`
`OK`
	Request connection status.

`AT^SISR=0,100` `OK`	Host 1 requests to read 100 bytes.

`^SISR: 0, 22, "10.10.0.222:6561"`
`Hello, I'm the client!`
`OK`
	Host 1 is reading the text string received from host 2 (see part 4 of the example) and gets information about the remote client, i.e. the address of host 2.

`AT^SISW=0,25,0,"10.10.0.222:6561"`
`^SISW: 0, 25, 0`
`OK`
	Host 1 starts sending 25 bytes to host 2.
	Host 1 is sending the message "Hi, I'm the UDP end-point!" (25 bytes) to host 2. As a result, host 2 is receiving the URC "^SISR: 1, 1" shown below in part 4 of the example.

`^SISW: 0, 1`	URC confirms that host 1 can send data again.
`AT^SISC=0` `OK`	Close the service.

Part 4 - host 2 opens the service and communicates with host 1:

`AT^SISO=1` `OK`	Open the service.
`^SISW: 1, 1`	URC indicates that host 2 can send data.

`AT^SISO?`
`^SISO: 0,""`
`^SISO: 1,"Socket",4,2,0,0,"10.10.0.222:6561","10.10.0.219:6666"`
`^SISO: 2,""`
`^SISO: 3,""`
`^SISO: 4,""`
`OK`
	Request connection status.

`AT^SISW=1,22`
`^SISW: 1, 22, 0`
`OK`
	Host 2 starts to write 22 bytes.
	Host 2 is writing the message "Hello, I'm the client!" (22 bytes). As a result, host 1 is receiving the URC "^SISR: 0, 1" shown above in part 3 of this example.

`^SISW: 1, 1`	URC confirms that host 2 could send data.
`^SISR: 1, 1`	URC indicates that host 2 has received data from host 1.
`AT^SISR=1,100`	Host 2 requests to read 100 bytes.

^SISR: 1, 25 Hi, I'm the UDP endpoint! OK	Response indicates that host 2 has received 25 characters from host 1.
AT^SISC=1 OK	Close the service.

8.14.3 Creating Transparent UDP Socket Client

AT^SISS=1,"srvType","Socket" OK	Select service type "Socket".
AT^SISS=1,"alphabet","1" OK	The character set of string parameters(ASCII).
AT^SISS=1,"conId",1 OK	Select connection profile 1.
AT^SISS=1,"address","sockudp:// 10.10.0.110:9996;etx=26;timer=200" OK	Specify server address. Add "etx" parameter to set Transparent mode.

8.14.4 Opening and Closing Transparent UDP Service

AT^SISO=1 OK	Open Transparent UDP service.
^SISW: 1, 1	URC indicates that Transparent UDP service is ready.
at^sist=1 CONNECT	Open transparent access mode. Service is ready to send or receive data. Client is sending data, e.g Good Morning (not visible in example). Client types +++ to return to AT command mode (+++ not visible in example).
OK	
at^sisi=1 ^SISI: 1,4,0,16,0,0 OK	Check the service state of service profile 1. Service is in state "Up" (4). 0 bytes received, 16 bytes sent.
AT^SISO? ^SISO: 0,"" ^SISO: 1,"Socket",4,2,0,16,"10.10.0.200:1024","10. 10.0.108:65532" ^SISO: 2,"" ^SISO: 3,"" ^SISO: 4,"" OK	Check the service state of service profile 1. Service is in state "Up" (4). Socket is assigned. 0 bytes received, 16 bytes sent. Local and remote IP address are assigned.
AT^SISC=1 OK	Close the service.
at^sisi=1 ^SISI: 1,2,0,0,0,0 OK	Check the service state of service profile 1. Service profile 1 is in state "Allocated" (2).
AT^SISO? ^SISO: 0,"" ^SISO: 1,"Socket",2,1,0,0,"0.0.0.0:0","10.10.0.108 :65532"	Check the service state of service profile 1. Service is in state "Allocated" (2). Socket not assigned.

```
^SISO: 2,""
^SISO: 3,""
^SISO: 4,""
OK
```

8.14.5 Ping

The following example shows a Ping output:

```
AT^SISX="Ping",0,192.168.1.2,4,2000

^SISX: "Ping",1,0,"192.168.1.2",1043
^SISX: "Ping",1,0,"192.168.1.2",586
^SISX: "Ping",1,0,"192.168.1.2",531
^SISX: "Ping",1,0,"192.168.1.2",415
^SISX: "Ping",2,1,4,4,0,0
^SISX: "Ping",3,1,415,1043,643

OK
```

9. Packet Domain Related Commands

The AT commands described in this chapter allow the Customer Application to control packet switched services in networks.

9.1 AT+CGACT PDP context activate or deactivate

The AT+CGACT write command is used to activate or deactivate the specified PDP context(s). After the command has completed, the MT remains in V.250 command state. If any PDP context is already in the requested state, the state for that context remains unchanged. If the MT is not PS attached when the activation form of the command is executed, the MT first performs a PS attach and then attempts to activate the specified contexts.

For EPS, if an attempt is made to disconnect the last PDN connection, then the MT responds with ERROR or, if extended error responses are enabled, a +CME ERROR. For EPS, the activation request for an EPS bearer resource will be answered by the network by either an EPS dedicated bearer activation or EPS bearer modification request. The request must be accepted by the MT before the PDP context can be set into established state.

The AT+CGACT read command returns the current activation states for all the defined PDP contexts.
The AT+CGACT test command is used for requesting information on the supported PDP context activation states.

Syntax

Test Command

```
AT+CGACT=?
```

Response(s)

```
+CGACT: (list of supported <state>s)
OK
```

Read Command

```
AT+CGACT?
```

Response(s)

```
+CGACT: [<cid>, <state>]
[+CGACT: <cid>, <state>]
...
OK
```

Write Command

```
AT+CGACT=<state>, <cid>
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
+	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

`<state>`(num)

Indicates the state of PDP context activation.

0	Detached
[1]	Attached

`<cid>`(num)

Parameter specifies a particular PDP context definition (see `AT+CGDCONT` parameter `<cid>`). The parameter is used in other PDP context-related commands.

Note

- A maximum of 11 contexts can be activated at the same time, no matter on which interface. Note that, depending on the provider, the number of activated contexts may be further restricted.

9.2 AT+CGATT PS attach or detach

The AT+CGATT write command is used to attach the MT to, or detach the MT from the Packet Domain service. After the command has completed, the MT remains in V.250 command state. If the MT is already in the requested state, the command is ignored and the OK response is returned. Any active PDP contexts will be automatically deactivated when the attachment state changes to detached.

The AT+CGATT read command returns the current Packet Domain service state.

The AT+CGATT test command is used for requesting information on the supported Packet Domain service states.

Syntax

Test Command

```
AT+CGATT=?
```

Response(s)

```
+CGATT: (list of supported <state>s)
OK
```

Read Command

```
AT+CGATT?
```

Response(s)

```
+CGATT: <state>
OK
```

Write Command

```
AT+CGATT=[<state>]
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
+	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<state>(num)

Indicates the state of Packet Domain attachment. The parameter is global for all interfaces.

0(P)	Detached
[1]	Attached

9.3 AT+CGAUTH Define PDP Context Authentication Parameters

The AT+CGAUTH write command specifies the type of authentication protocol for the specified PDP context. The AT+CGAUTH read command returns the current settings for each defined PDP context. If no PDP context is defined the read command returns only OK result code.

Syntax

Test Command

AT+CGAUTH=?

Response(s)

+CGAUTH: (range of supported<cid>s), (list of supported <auth_prot>s), (max. string length of <userId>s), (max. string length of <password>s)
OK
ERROR
+CME ERROR: <err>

Read Command

AT+CGAUTH?

Response(s)

[+CGAUTH: <cid>, <auth_prot>, <userId>, <password>]
[+CGAUTH: <cid>, <auth_prot>, <userId>, <password>]
[+CGAUTH: ...]
OK
ERROR
+CME ERROR: <err>

Write Command

AT+CGAUTH=<cid>[, <auth_prot>[, <userId>, <password>]]

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<cid>(num)

Specifies a particular PDP context definition (see AT+CGDCONT parameter <cid>).

0...10

<auth_prot>(num)

Types of authentication to be used for specified PDP context.

[0]	none Used to indicate that no authentication protocol is used for this PDP context. Username and password are removed if previously specified.
1	PAP
2	CHAP

<userId>(str)

Specifies the user name used for authentication.

<password>(str)

Specifies the password used for authentication.

Note

- The length of <userId> and <password> can be 0 to 60 characters.

9.4 AT+CGDCONT Define PDP Context

The AT+CGDCONT write command specifies the parameters for a PDP context identified by the context identifier <cid>. The number of contexts that may be in a defined state at the same time is given by the range indicated in the test command response. A special form of the write command (AT+CGDCONT=<cid>) causes the values for context <cid> to become undefined. The initial PDP context (+CGDCONT: 0,"IPV4V6",,0,0,0) is supported, and AT+CGDCONT=0 resets context number 0 to its particular default settings.
The AT+CGDCONT read command returns the current settings for each defined PDP context.
The AT+CGDCONT test command returns supported values as a compound value.

Syntax

Test Command

```
AT+CGDCONT=?
```

Response(s)

```
+CGDCONT: (range of supported<cid>s), <PDP_type>, , (list of supported <d_comp>s), (list of supported <h_comp>s), (list of supported <NSLPI>s)
OK
ERROR
+CME ERROR: <err>
```

Read Command

```
AT+CGDCONT?
```

Response(s)

```
+CGDCONT: <cid>, <PDP_type>, <APN>, <d_comp>, <h_comp>, <NSLPI>
[+CGDCONT: ...]
OK
ERROR
+CME ERROR: <err>
```

Write Command

```
AT+CGDCONT=<cid>[, <PDP_type>[, <APN>[, <d_comp>[, <h_comp>[, <NSLPI>]]]]]
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<cid>(num)(NV)

PDP Context Identifier

Parameter specifies a particular PDP context definition. The parameter is used in other PDP context-related commands.
The <cid> value cannot be set to 7 when Bearer Independent Protocol (BIP) is enabled.
Only the context definition with <cid>=0 is stored in non-volatile (NV) memory.

0(D)...10

<PDP_type>(str)(NV)

Packet Data Protocol type

Specifies the type of the packet data protocol. It is stored in non-volatile (NV) memory only when <cid>=0.

“IP“	Internet Protocol (IETF STD 5)
“IPV6“	Internet Protocol, version 6 (IETF RFC 2460)
“IPV4V6“(D)	Virtual <PDP_type> introduced to handle dual IP stack UE capability (see 3GPP TS 24.301)
“NONIP“	None IP

<APN>(str)(NV)

Access Point Name

The logical name that is used to select the GGSN or the external packet data network. Maximum length: 63 characters. If the value is null or omitted, then the subscription value will be requested. It is stored in non-volatile (NV) memory only when <cid>=0.

<d_comp>(num)(NV)

Data Compression

Controls the PDP data compression; applicable for Subnetwork Dependent Convergence Protocol (SNDCP) only. It is stored in non-volatile (NV) memory only when <cid>=0. See 3GPP TS 44.065 for details.

[0]	off

<h_comp>(num)(NV)

Header Compression

Controls the PDP header compression. It is stored in non-volatile (NV) memory only when <cid>=0. See 3GPP TS 44.065, 3GPP TS 25.323 for details.

[0]	off

<NSLPI>(num)

Numeric parameter used to indicate the NAS signalling priority requested for this PDP context. The MT utilises the provide NSLPI information as specified in 3GPP TS 24.301; and 3GPP TS 24.008.

[0]	Indicates that this PDP context is to be activated with the value for the low priority indicator configured in the MT.
1	Indicates that this PDP context is to be activated with the value for the low priority indicator set to "MS is not configured for NAS signalling low priority".

Notes

- Only the context definitions with <cid>=0 can be stored in non-volatile (NV) memory.
- Only the context definitions with <cid>=0 can be stored when module is in minimum functionality (AT+CFUN=0). If the module is set to minimum functionality, all the other context definitions will be lost.

9.5 AT+CEREG EPS Network Registration Status

AT+CEREG write command enables presentation of URC "+CEREG: <stat>" when <n>=1 and UE's EPS network registration status in LTE changes, or URC "+CEREG: <stat>[, <tac>, <ci>[, <AcT>]]" when <n>=2 and the current network cell in LTE changes. The parameters <AcT>, <tac> and <ci> are provided only if available. The value <n>=3 further extends the URC with [,<CauseType>,<RejectCause>], when available, when the value of <stat> changes.

If the UE wants to apply PSM for reducing its power consumption the set command controls the presentation of an URC "+CEREG: <stat>[, [<tac>], [<ci>], [<AcT>][, [<CauseType>], [<RejectCause>][, [<Active-Time>], [<PeriodicTAU>]]]]". When <n>=4 the URC will provide the UE with additional information for the Active Time value and the extended periodic TAU value if there is a change of the network cell in E-UTRAN. The value <n>=5 further enhances the URC with <CauseType> and <RejectCause> when the value of <stat> changes. The parameters <AcT>, <tac>, <ci>, <CauseType>, <RejectCause>, <ActiveTime> and <PeriodicTAU> are provided only if available.

AT+CEREG read command queries the current URC presentation status and <stat> which shows whether the network has currently indicated the registration of the ME.

Syntax

Test Command

AT+CEREG=?

Response(s)

+CEREG: (list of supported <n>s)
OK

Read Command

AT+CEREG?

Response(s)

+CEREG: <n>, <stat>[, [<tac>], [<ci>], [<AcT>][, [<CauseType>], [<RejectCause>][, [<ActiveTime>], [<PeriodicTAU>]]]]
OK

Write Command

AT+CEREG=<n>

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Unsolicited Result Codes

URC 1

+CEREG: <stat>

Indicates a change in the UE's EPS network registration status.

URC 2

+CEREG: <stat>[, <tac>, <ci>[, <AcT>]]

Indicates a change in the UE's EPS network registration status or a change of the network cell including location information.

URC 3

+CEREG: <stat>[, [<tac>], [<ci>], [<AcT>][, <CauseType>, <RejectCause>]]

Indicates a change in the UE's EPS network registration status, or a change of the network cell including location information, and the EMM cause value information.

URC 4

+CEREG: <stat>[, [<tac>], [<ci>], [<AcT>][, , [, [<ActiveTime>], [<PeriodicTAU>]]]]

For a UE that wants to apply PSM, indicates a change in the UE's EPS network registration status or a change of the network cell including location information

URC 5

+CEREG: <stat>[, [<tac>], [<ci>], [<AcT>][, [<CauseType>], [<RejectCause>][, [<ActiveTime>], [<PeriodicTAU>]]]]

For a UE that wants to apply PSM, indicates a change in the UE's EPS network registration status or a change of the network cell including location information and EMM cause value information

Parameter Description

<n>(num)(&V)(&W)	
0(&F)(D)	Disable network registration URC
1	Enable network registration URC "+CEREG: <stat>".
2	Enable network registration URC "+CEREG: <stat>[, <tac>, <ci>[, <AcT>]]".
3	Enable network registration, location information and EMM cause value information URC "+CEREG: <stat>[, [<tac>], [<ci>], [<AcT>][, <CauseType>, <RejectCause>]]".
4	For a UE that wants to apply PSM, enable network registration and location information URC "+CEREG: <stat>[, [<tac>], [<ci>], [<AcT>][, , [, [<ActiveTime>], [<PeriodicTAU>]]]]".
5	For a UE that wants to apply PSM, enable network registration, location information and EMM cause value information URC "+CEREG: <stat>[, [<tac>], [<ci>], [<AcT>][, [<CauseType>], [<RejectCause>][, [<ActiveTime>], [<PeriodicTAU>]]]]".

<stat>(num)	
0	Not registered, ME is not currently searching an operator to register to.
1	Registered, home network.
2	Not registered, but ME is currently trying to attach or searching an operator to register to.
3	Registration denied.
4	Unknown, e.g. out of E-UTRAN coverage.
5	Registered, roaming.

<tac>(str)

Two byte tracking area code in hexadecimal format (e.g. "00C3" equals 195 in decimal)

<ci>(str)

Four byte LTE cell ID in hexadecimal format.

<AcT>(num)

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9	E-UTRAN (NB-S1 mode)

Note: 3GPP TS 36.331 specifies the System Information blocks which give the information about whether the serving cell supports NB-IoT, and which corresponds to E-UTRAN (NB-S1 mode).

<CauseType>(num)

Indicates the type of <RejectCause>

0	Indicates that <RejectCause> contains an EMM cause value.
1	Indicates that <RejectCause> contains a manufacturer-specific cause.

<RejectCause>(num)

Contains the cause of the failed registration. The value is of type as defined by <CauseType>.

<ActiveTime>(str)

Indicates the Active Time value (T3324) allocated to the UE in E-UTRAN. The Active Time value is coded as one byte (octet 3) of the GPRS Timer 2 information element coded as bit format (e.g. "00100100" equals 4 minutes). For the coding and the value range, see the GPRS Timer 2 IE in 3GPP TS 24.008 [33], table 10.5.163a, 3GPP TS 23.682, and 3GPP TS 23.401.

<PeriodicTAU>(str)

Indicates the extended periodic TAU value (T3412) allocated to the UE in E-UTRAN. The extended periodic TAU value is coded as one byte (octet 3) of the GPRS Timer 3 information element coded as bit format (e.g. "01000111" equals 70 hours). For the coding and the value range, see the GPRS Timer 3 IE in 3GPP TS 24.008 [33] Table 10.5.163a/3GPP TS 24.008. See also 3GPP TS 23.682 and 3GPP TS 23.401.

9.6 AT+CGPADDR Show PDP Address

The AT+CGPADDR exec command returns a list of PDP addresses for all defined contexts.

The AT+CGPADDR write command returns a list of PDP addresses for the specified context identifiers. If a context is not defined, then no output line is generated for it. If no <cid> is specified, the addresses for all defined contexts are returned.

The AT+CGPADDR test command returns a list of defined <cid>s.

Syntax

Test Command

AT+CGPADDR=?

Response(s)

[+CGPADDR: (list of defined <cid>s)]
OK

Exec Command

AT+CGPADDR

Response(s)

[+CGPADDR: <cid>[, <PDP_address_1>[, <PDP_address_2>]]]
[+CGPADDR: ...]
OK
ERROR
+CME ERROR: <err>

Write Command

AT+CGPADDR=<cid>[,<cid>[, ...]]

Response(s)

[+CGPADDR: <cid>[, <PDP_address_1>[, <PDP_address_2>]]]
[+CGPADDR: ...]
OK
ERROR
+CME ERROR: <err>

PIN	Last
+	-

Reference(s)

3GPP 27.007

Parameter Description

<cid>(num)

Parameter specifies a particular PDP context definition (see AT+CGDCONT parameter <cid>).

<PDP_address_1>(str)

A string that identifies the MT in the address space applicable to the PDP. The address may be static or dynamic. If address is not available parameter is omitted.
Parameter specifies the assigned address as a dot-separated numeric (0-255) parameter of the form "a1.a2.a3.a4" for IPv4, or colon-separated hex numeric (0000-FFFF) parameter of the form "a1:a2:a3:a4:a5:a6:a7:a8" for IPV6.

<PDP_address_2>(str)

A string that identifies the MT in the address space applicable to the PDP. The address may be static or dynamic. Parameter is displayed only when both IPv4 and IPv6 addresses are assigned, with <PDP_address_1> containing the IPv4 address and this parameter the IPv6 address.
Parameter specifies the assigned IPv6 address as a colon-separated hex numeric (0000-FFFF) parameter of the form "a1:a2:a3:a4:a5:a6:a7:a8".

9.7 AT+CSODCP Sending of originating data via the control plane

The AT+CSODCP command is used by the TE to transmit NONIP data over control plane to network via MT.

Syntax

Test Command

AT+CSODCP=?

Response(s)

+CSODCP: (range of supported <cid>s), (maximum number of bytes of the <cpdata_length>), (list of supported <RAI>s), (list of supported <type_of_user_data>s), (list of supported <sequence>s)
OK

Write Command

AT+CSODCP=<cid>, <cpdata_length>, <cpdata>[, <RAI>[, <type_of_user_data>[, <sequence>]]]

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN	Last
+	-

Reference(s)

3GPP TS 27.007 [38]

Unsolicited Result Code

When <sequence> is present:

+CSODCPR: <sequence>, <status>

Report data sent status.

Parameter Description

<cid>(num)

PDP Context Identifier

Parameter specifies a particular PDP context definition (see AT+CGDCONT parameter <cid>). The parameter is used in other PDP context-related commands.

0...10

<cpdata_length>(num)

cpdata length

Indicates the number of octets of the <cpdata> information element. When there is no data to transmit, the value shall be set to zero. The maximum data length is 1358 bytes when NONIP is used. Data exceeding the maximum length will be discarded.

<cpdata>(str)

string of octets. Contains the user data container contents (refer to 3GPP TS 24.301 subclause 9.9.4.24). When there is no data to transmit, the <cpdata> shall be an empty string (""). This parameter shall not be subject to conventional character conversion as per +CSCS. The coding format of the user data container and the maximum length of <cpdata> are implementation specific.

`<RAI>`(num)

release assistance indication

Indicates the value of the release assistance indication. Refer to 3GPP TS 24.301 subclause 9.9.4.25.

0	No information is available.
1	The MT expects that exchange of data will be completed with the transmission of the ESM DATA TRANSPORT message.
2	The MT expects that exchange of data will be completed with the receipt of an ESM DATA TRANSPORT message.

`<type_of_user_data>`(num)

Indicates whether the user data that is transmitted is regular or exceptional.

0	Regular data
1	Exception data

`<sequence>`(num)

Sequence of data. If omitted, module will not report data sent status.

1...255

`<status>`(num)

Data sent status

0	Error
1	Sent

9.8 AT+CRTDCP Reporting of terminating data via the control plane

The AT+CRTDCP write command is used to enable and disable reporting of data from the network to the MT that is transmitted via the control plane in downlink direction.
The AT+CRTDCP read command returns the current settings.
The AT+CRTDCP test command returns supported values as compound values.

Syntax

Test Command

```
AT+CRTDCP=?
```

Response(s)

```
+CRTDCP: (list of supported <reporting>s), (range of supported <cid>s), (maximum number of bytes of the <cpdata_length>)
OK
```

Read Command

```
AT+CRTDCP?
```

Response(s)

```
+CRTDCP: <reporting>
OK
```

Write Command

```
AT+CRTDCP=<reporting>
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
+	-

Reference(s)

3GPP TS 27.007 [38]

Unsolicited Result Code

If reporting is enabled, <reporting>=1, the MT returns the unsolicited result code:

```
+CRTDCP:<cid>, <cpdata_length>, <cpdata>
```

when data is received from the network.

Parameter Description

<reporting>(num)

controlling reporting of mobile terminated control plane data events.

0	Disable reporting of MT control plane data.
1	Enable reporting of MT control plane data by the unsolicited result code +CRTDCP.

<cid>(num)

PDP Context Identifier

Parameter specifies a particular PDP context definition (see AT+CGDCONT parameter <cid>). The parameter is used in other PDP context-related commands.

0...10

<cpdata_length>(num)

cpdata length

Indicates the number of octets of the <cpdata> information element. When there is no data to receive, the value is set to 0. The maximum data length is 1358 bytes when NONIP is used. Data exceeding the maximum length will be discarded.

<cpdata>(str)

string of octets. Contains the user data container contents (refer to 3GPP TS 24.301 subclause 9.9.4.24). When there is no data to receive, the <cpdata> is an empty string (""). This parameter shall not be subject to conventional character conversion as per +CSCS. The coding format of the user data container and the maximum length of <cpdata> are implementation specific.

Notes

- Only one message is buffered at one time.
- Terminating data via the control plane before enabling reporting will be discarded.

10. Short Message Service (SMS) Commands

The AT Commands described in this chapter allow an external application to use the Short Message Service with the ENS22-E.

10.1 SMS Parameters

Parameter Description

<ackpdu>(num)

Format is same for <pdu> in case of SMS, but without 3GPP TS 24.011 [32] SC address field and parameter shall be bounded by double quote characters like a normal string type parameter.

<alpha>(str)

String type alphanumeric representation of Destination Address or Originating Address corresponding to the entry found in phonebook. This feature is not supported.
For ENS22-E, the <alpha> value is always 0.

<length>(num)

Message Length

Integer type value indicating in PDU mode the length of the actual TP data unit in octets.

<mr>(num)

Message Reference

3GPP TS 23.040 [29] TP-Message-Reference in integer format.

<pdu>(num)

In the case of SMS: 3GPP TS 24.011 [32] SC address followed by 3GPP TS 23.040 [29] TPDU in hexadecimal format: UE converts each octet of TP data unit into hexadecimal numbers containing two IRA characters, e.g. octet with integer value 42 is represented as two characters "2A", IRA 50 and 65 (decimal).

<sca>(str)(+CSCS)

Service Center Address

3GPP TS 24.011 [32] RP SC address Address-Value field in string format; BCD numbers (or GSM default alphabet characters) are converted to characters of the currently selected TE character set (AT+CSCS); type of address given by <tosca>. The <sca> cannot be an empty string.

<tosca>(num)

Type of Service Center Address

3GPP TS 24.011 [32] RP SC address Type-of-Address octet in integer format (when first character of <sca> is + (IRA 43) default is 145, otherwise default is 129).

10.2 AT+CMGC Send SMS Command

Syntax

Test Command

AT+CMGC=?

Response(s)

OK

Write Command

PDU mode

AT+CMGC=<length><CR> PDU can be entered <CTRL-Z>/<ESC>

Response(s)

+CMGC: <mr>[, <ackpdu>]
OK
If sending fails
ERROR
+CMS ERROR: <err>

PIN	Last
+	-

Reference(s)

3GPP TS 27.005 [37]

Notes

- After invoking the commands AT+CMGS or AT+CMGC, it is necessary to wait for the prompt ">" before entering PDU.
- In general but especially at baudrates below 19200, it is recommended to only use the command line termination character (ATS3) before starting PDU input. Use of line termination character followed by an additional response formatting character (ATS4) may cause the problem that the latter will become part of the input data.
- The <length> value ranges from 8 to 174.

10.3 AT+CMGS Send SMS

AT+CMGS write command transmits a short message to network (SMS-SUBMIT).
After invoking the write command wait for the prompt ">" and then start to write the message. To send the message simply enter <CTRL-Z>.
To abort sending use <ESC>. Abortion is acknowledged with "OK", though the message will not be sent.
The message reference <mr> is returned by the UE on successful message delivery. The value can be used to identify the message in a delivery status report provided as an unsolicited result code.

Syntax

Test Command

AT+CMGS=?

Response(s)

OK

Write Command

PDU mode

AT+CMGS=<length><CR> PDU can be entered. <CTRL-Z>/<ESC>

Response(s)

+CMGS: <mr>[, <ackpdu>]
OK
If sending fails see notes below.

PIN	Last
+	-

Reference(s)

3GPP TS 27.005 [37]

Notes

- The <length> value ranges from 7 to 164.
- In general but especially at baudrates below 19200, it is recommended to only use the command line termination character (ATS3) before starting PDU input. Use of line termination character followed by an additional response formatting character (ATS4) may cause the problem that the latter will become part of the input data.

10.4 AT+CNMA New Message Acknowledgement to UE/TE

In PDU mode write command is used to send either positive (RP-ACK) or negative (RP-ERROR) acknowledgement to the network. Parameter <n> defines which one will be sent.
When AT+CSMS <service>=1, ENS22-E will not send another "+CMT" URC to the TE until previous one is acknowledged. When AT+CSMS <service>=0, ENS22-E will send "+CMT" URC to the TE for each incoming SMS, independent of acknowledgement of the previous SMS.
If the UE does not receive acknowledgement within required time (network timeout), it sends an "RP-ERROR" message to the network.

Syntax

Test Command

AT+CNMA=?

Response(s)

+CNMA: (list of supported <n>s)
OK

Write Command

AT+CNMA=<n>[, <length><CR> PDU can be entered <CTRL-Z>/<ESC>]

Response(s)

OK
ERROR
+CMS ERROR: <err>

PIN	Last
+	-

Reference(s)

3GPP TS 27.005 [37]

Unsolicited Result Code

+CMT: [<alpha>], <length><CR><LF><pdu>

Indicates that new message has been received.

Parameter Description

<n>(num)

Parameter required only for PDU mode.

1	Send positive (RP-ACK) acknowledgement to the network. Accepted only in PDU mode.
2	Send negative (RP-ERROR) acknowledgement to the network. Accepted only in PDU mode.

Notes

- Write command shall only be used when AT+CSMS <service>=1 (Phase 2+), and an URC is issued by the module: +CMT: [<alpha>], <length> <CR> <LF> <pdu>.
- The <length> for CNMA in PDU mode ranges from 0 to 232.

10.5 AT+CSCA SMS Service Center Address

The AT+CSCA write command updates the SMSC address, through which mobile originated SMs are transmitted. In PDU mode, setting is used by the send and write commands, when the length of the SMSC address coded into the <pdu> parameter equals zero.

Syntax

Test Command

```
AT+CSCA=?
```

Response(s)

```
OK
```

Read Command

```
AT+CSCA?
```

Response(s)

```
+CSCA: <sca>, <tosca>
OK
```

Write Command

```
AT+CSCA=<sca>[, <tosca>]
```

Response(s)

```
OK
```

PIN	Last
+	-

Reference(s)

3GPP TS 27.005 [37]

Notes

- This command writes the service center address to non-volatile memory.
- The SMS service center address should be entered as specified by the service provider.
- The service center address cannot be an empty string.

10.6 AT+CSMS Select Message Service

Syntax

Test Command

AT+CSMS=?

Response(s)

+CSMS: (list of supported<service>s)
OK

Read Command

AT+CSMS?

Response(s)

+CSMS: <service>, <mt>, <mo>, <bm>
OK

Write Command

AT+CSMS=<service>

Response(s)

+CSMS: <mt>, <mo>, <bm>
OK
ERROR
+CMS ERROR: <err>

PIN	Last
+	-

Reference(s)

3GPP TS 27.005 [37]

Parameter Description

<service>(num)(&V)(&W)

0(&F)(D)	3GPP TS 23.040 [29] and 3GPP TS 23.041 [30] (the syntax of SMS AT commands is compatible with 3GPP TS 27.005 [37] Phase 2 version 4.7.0; Phase 2+ features which do not require new command syntax may be supported, e.g. correct routing of messages with new Phase 2+ data coding schemes)
1	3GPP TS 23.040 [29] and 3GPP TS 23.041 [30] (the syntax of SMS AT commands is compatible with 3GPP TS 27.005 [37] Phase 2+ version; the requirement of <service> setting 1 is mentioned under corresponding command descriptions).

<mt>(num)(&V)

Mobile Terminated Messages:

0	Type not supported
1(P)	Type supported

<mo>(num)(&V)

Mobile Originated Messages:

0	Type not supported
1(P)	Type supported

<bm>(num)(&V)

Broadcast Type Messages:

Feature not applicable to ENS22-E.

0	Type not supported

Note

- Phase 2+ (<service>=1) must be set before the following features can be used:
  - Acknowledging incoming short messages with AT+CNMA.

11. (U)SIM related Commands

AT commands described in this chapter are related to the Subscriber Identity Module ((U)SIM) connected to the ENS22-E.

11.1 AT+CCID (U)SIM Card Identification Number

AT+CCID serves to query the (U)SIM card identification number. This information is retrieved from (U)SIM Elementary File EF_{ICCID}. For details refer to 3GPP TS 11.11 [10], 3GPP TS 31.101 [11], 3GPP TS 31.102 [12].

Syntax

Test Command

```
AT+CCID=?
```

Response(s)

```
OK
```

Read Command

```
AT+CCID?
```

Response(s)

```
+CCID: <ICCID>
OK
ERROR
+CME ERROR: <err>
```

Exec Command

```
AT+CCID
```

Response(s)

```
+CCID: <ICCID>
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Parameter Description

<ICCID>(str)

ICCID (Integrated Circuit Card ID) of the (U)SIM card

12. Miscellaneous Commands

The AT Commands described in this chapter are related to various areas.

12.1 ATS3 Command Line Termination

ATS3 is implemented for compatibility reasons only, and has no effect.

Syntax

Read Command

```
ATS3?
```

Response(s)

```
<n>
OK
```

Write Command

```
ATS3=<n>
```

Response(s)

```
OK
ERROR
```

PIN	Last
-	-

Reference(s)

ITU-T V.250 [9]

Parameter Description

<n>(num)(&V)(&W)

000...013(&F)...127

Notes

- Command ATS3 is dummy, and has no effect on module behavior.
- Read command will return value written by user or default value n=13.
- Write command will return OK or ERROR. OK - when parameter <n> is in range, ERROR otherwise.
- Despite OK returned in case of any parameter from range, no changes will be made.
- Parameter is volatile.
- If changing this setting the new value has no effect for "^SHUTDOWN" URC.

12.2 ATS4 Response Formatting

ATS4 is implemented for compatibility reasons only, and has no effect.

Syntax

Read Command

```
ATS4?
```

Response(s)

```
<n>
OK
```

Write Command

```
ATS4=<n>
```

Response(s)

```
OK
ERROR
```

PIN	Last
-	-

Reference(s)

ITU-T V.250 [9]

Parameter Description

<n>(num)(&V)(&W)

000...010(&F)...127

Notes

- Command ATS4 is dummy, and has no effect on module behavior.
- Read command will return value written by user or default value n=10.
- Write command will return OK or ERROR. OK - when parameter <n> is in range, ERROR otherwise.
- Despite OK returned in case of any parameter from range, no changes will be made.
- Parameter is volatile.

12.3 ATS5 Command Line Editing

ATS5 is implemented for compatibility reasons only, and has no effect.

Syntax

Read Command

```
ATS5?
```

Response(s)

```
<n>
OK
```

Write Command

```
ATS5=<n>
```

Response(s)

```
OK
ERROR
```

PIN	Last
-	-

Reference(s)

ITU-T V.250 [9]

Parameter Description

<n>(num)(&V)(&W)

000...008(&F)...127

Notes

- Command ATS5 is dummy, and has no effect on module behavior.
- Read command will return value written by user or default value n=8.
- Write command will return OK or ERROR. OK - when parameter <n> is in range, ERROR otherwise.
- Despite OK returned in case of any parameter from range, no changes will be made.
- Parameter is volatile.

12.4 AT^SBNR Binary Read

Syntax

Write Command

If <type>="ciphersuites": Read default values of TLS Cipher Suites for embedded IP stack:

AT^SBNR="ciphersuites", "default"

Response(s)

```
(default ciphers string)
OK
ERROR
+CME ERROR: <err>
```

Write Command

If <type>="ciphersuites": Read current TLS Cipher Suites for embedded IP stack.

AT^SBNR="ciphersuites", "current"

Response(s)

```
(current ciphers string)
OK
ERROR
+CME ERROR: <err>
```

Write Command

If <type>= "is_cert": Read certificates for secure connection of client IP services

AT^SBNR="is_cert"

Response(s)

```
^SBNR:<index>, <pskUrl>, <pskID>, <pskKey>
[... ]
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Parameter Description

<type>(str)

“ciphersuites“	Read TLS Cipher Suites for embedded IP stack
“is_cert“	Read certificate details See also AT^SISS, AT^SIND and AT^SBNW.

<index>(num)

Certificate index

0...5	Index 0 is handled as the password for signature (only 1 allowed). Indexes from 1 to 5 are handled as server certificates.

<pskUrl>(str)

URL of PSK (Pre-Shared Keys) certificate

<pskID>(str)

ID of PSK certificate

<pskKey>(str)

Key of PSK certificate

The key is masked as asterisks(*).

Note

- Only the following ciphering suit is supported:
  - TLS_PSK_WITH_AES_128_CBC_SHA256
  Thus the <type>="ciphersuites" default value and current value are the same.

12.5 AT^SBNW Binary Write

Syntax

Write Command

Certificate management for secure connection of client IP services

`AT^SBNW=<type>, <subType>`

Response(s)

```
CONNECT

SECURE CMD READY: SEND COMMAND ...
```

(Indicates that UE has entered binary data mode. Secure command data can be transferred.)
When secure command data is processed the UE will send one of following answers:

```
SECURE CMD LENGTH ERROR
SECURE CMD ERROR
SECURE CMD END OK
```

PIN	Last
-	-

Parameter Description

<type>(str)	
"is_cert"	Secure Command Mode (Manage Certificates) See also AT^SISS and AT^SBNR.

<subType>(num)	
1	Start Secure Command Block Transfer mode

12.6 +++ Escape from Data Mode to AT Command Mode

The +++ escape sequence is only available during a packet switched connection. The +++ character sequence causes the ENS22-E to pause data mode and return to AT command mode. This allows to enter AT commands while maintaining the data connection to the remote device. The same task can be performed by toggling the DTR line if AT&D is set to 1.
To prevent the +++ character sequence from being misinterpreted as data, it must be preceded and followed by a pause of 1000 ms. The +++ characters must be entered in quick succession, all within 1000 ms.

Syntax

Exec Command
+++
Response(s)
OK

PIN	Last
-	-

Reference(s)
ITU-T V.250 [9]

12.7 AT^SNFWPUPDS Incremental Firmware Update

The AT^SNFWPUPDS command allows to update the firmware of the module via serial port using an incremental firmware update file.

Syntax

Test Command

AT^SNFWPUPDS=?

Response(s)

^SNFWPUPDS: (0-5)
OK

Write Command

AT^SNFWPUPDS=<Command>[, <SN>, <Length>, <Data>, <CRC>]

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Parameter Description

<Command>(num)

This parameter determines the processes of the incremental firmware update. To download incremental firmware patch, the value must be 1.

0	Erase existing firmware package in the module's flash file system (FFS).
1	Download a firmware package segment to the module's FFS. For Download the parameters <SN>, <Length>, <Data> and <CRC> are mandatory.
2	Show validation result of the last firmware package update.
3	Show firmware package's name.
4	Show firmware package's version.
5	Start the firmware update process.

<SN>(num)

An integer value indicating the sequence number of firmware patch segment.
It starts with 0 and increments by 1 for each package segment. This parameter is required only for <Command>= 1.

<Length>(num)

This parameter is the segment length in bytes. The length can be 32, 64, 128, 256 or 512 bytes. This parameter is required only for <Command>= 1.

<Data>(str)(NV)

The package segment data to be transmitted, in hex string format.
The data length must be equal to the <Length> value. This parameter is required only for <Command>= 1.

<CRC>(str)

This parameter is xor8 of each byte in every package segment. It is sent as a hex format. This parameter is required only for <Command>= 1.

13. Hardware related Commands

All AT commands described in this chapter are related to the hardware interface of the ENS22-E. Further information regarding this interface is available in the "ENS22-E Hardware Interface Description" [2].

13.1 AT+CCLK Real Time Clock

The AT+CCLK write command sets the Real Time Clock in the UE.
The AT+CCLK read command shows the time.

Syntax

Test Command

```
AT+CCLK=?
```

Response(s)

```
OK
```

Read Command

```
AT+CCLK?
```

Response(s)

```
+CCLK: <time>
OK
```

Write Command

```
AT+CCLK=<time>
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Reference(s)

3GPP TS 27.007 [38]

Parameter Description

<time>(str)

Format is "yy/mm/dd,hh:mm:ss+zz", where the characters indicate the two last digits of the year, followed by month, day, hour, minutes, seconds and time zone. For example 6th of July 2016, 22:10:00 GMT+2 hours equals to "16/07/06,22:10:00+08".

Time zone tz is given as a positive (east) or negative (west) offset from UTC in units of 15 minutes: Format is "yy/mm/dd,hh:mm:ss+zz" or "yy/mm/dd,hh:mm:ss-zz".
.

Notes

- The <time> will be reset to its factory default upon power down (via AT^SMSO), power reset, or module restart. In this case, the clock starts with <time>= "70/01/01,00:00:00+00".
- Once the module is registered to the network successfully, <time> will be automatically updated with the time from the network.

13.2 AT^SBV Battery/Supply Voltage

AT^SBV allows to monitor the supply (or battery) voltage of the module. The voltage is periodically measured. The displayed value is averaged.

The measurement is related to the reference points of BATT+ and GND. For details on the reference points please refer to the Hardware Interface Description [2]. If the measured average voltage drops below or rises above the given voltage thresholds the UE will report alert messages by sending the "^SBC" URCs listed in Section 1.7.1, Common URCs.

Syntax

Test Command

```
AT^SBV=?
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

Exec Command

```
AT^SBV
```

Response(s)

```
^SBV: <Voltage>
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Parameter Description

`<Voltage>`(num)

Supply (or battery) voltage in mV

13.3 AT^SCTM Critical Operating Temperature Monitoring

AT^SCTM allows to monitor the operating temperature range of the ENS22-E device. Refer to "ENS22-E Hardware Interface Description" [2] for specifications on critical temperature ranges. To avoid damage the module will shut down once the critical temperature is exceeded. The procedure is equivalent to the power-down initiated with AT^SMSO.

The AT^SCTM write command controls the presentation of URCs to report critical operating temperature limits. Use parameter <UrcMode> to enable (1) and disable (0) URC presentation.

URCs indicating alert level "-1" is intended to enable the user to take precautions, such as protect the ENS22-E from exposure to extreme conditions, or save or back up data etc. The presentation of level "-1" or "0" URCs depends on <UrcMode>.

Level "2" or "-2" URCs are followed by immediate shutdown. The presentation of these URCs is always enabled, i.e. they will be output even though <UrcMode> equals "0".

AT^SCTM read command returns:

- The URC presentation mode.
- Information about the current temperature range of the ENS22-E device.
- The board temperature (in degree Celsius) if parameter <tempCtrl>=1.

Syntax

Test Command

```
AT^SCTM=?
```

Response(s)

```
^SCTM:(list of supported <UrcMode>s)[, (list of supported <tempCtrl>s)]
OK
```

Read Command

```
AT^SCTM?
```

Response(s)

```
^SCTM: <UrcMode>, <UrcCause>[, <temp>]
OK
ERROR
+CME ERROR: <err>
```

Write Command

```
AT^SCTM=<UrcMode>[, <tempCtrl>]
```

Response(s)

```
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Unsolicited Result Codes

URC 1

URCs will be sent to the TE when the temperature reaches or exceeds the critical level, or when it is back to normal.

^SCTM_B: <UrcCause>

URC 2

URC indicated after "^SCTM_B" URC with <UrcCause> value 2 or -2 before the UE switches off.

^SHUTDOWN

Parameter Description

<UrcMode>(num)	
URC presentation mode	
0(P)	Disable URC presentation (except for <UrcCause> equal to -2 or +2).
1	Enable URC presentation.

<UrcCause>(num)	
-2	Below lowest temperature limit (causes immediate switch-off)
-1	Below low temperature alert limit
0	Normal operating temperature
2	Above uppermost temperature limit (causes immediate switch-off)

<tempCtrl>(num)	
0(P)	Suppress output of <temp> in read command.
1	Output <temp> in read command.

<temp>(num)

Board temperature in Celsius. Is comprised between the lowest temperature warning level and the uppermost temperature warning level.

Examples

EXAMPLE 1

URCs issued when the operating temperature is out of range:

^SCTM_B: 2	Alert: Module is above overtemperature limit and switches off.
^SCTM_B: -1	Caution: Module close to undertemperature limit.
^SCTM_B: -2	Alert: Module is below undertemperature limit and switches off.

EXAMPLE 2

URCs issued when the temperature is back to normal (URC is output once):

^SCTM_B: 0	Module back to normal temperature.

13.4 AT^SSPI Serial Protocol Interface

The AT^SSPI command enables the module to be connected to external I²C or SPI devices.

I²C lines are shared with GPIO9 and GPIO10. Therefore, a connected I²C device is only accessible if AT^SCFG="Gpio/mode/I2C" is set to "std".
SPI lines are shared with GPIO lines or with ASC1 lines. Therefore, a connected SPI device is only accessible if AT^SCFG="Gpio/mode/SPI" is set to "std" instead of "gpio". Keep in mind that in this case the command AT^SCFG="Gpio/mode/ASC1" automatically switches to "rsv".

The I²C/SPI datastream is mapped through an internal I²C/SPI driver to and from an ASCII hex protocol which can be exchanged with an external application via V24.

The AT^SSPI write command configures and activates the I²C/SPI interface and changes from command mode into data mode. All values must be given in hexadecimal format (0 - 9, A - F) without "0x". For details on data mode please refer to Section 13.4.2, Transmitting Data over AT Interface.

Syntax

Test Command

AT^SSPI=?

Response(s)

^SSPI: (list of supported <basicConfiguration>s), (list of supported <wordLength>s), (list of supported <extendedSpiConfiguration>s)
OK

Read Command

AT^SSPI?

Response(s)

^SSPI: <connectionState>, <basicConfiguration>, <wordLength>, <extendedSpiConfiguration>
OK
ERROR
+CME ERROR: <err>

Write Command

AT^SSPI=[<basicConfiguration>[, <wordLength>[, <extendedSpiConfiguration>]]]

Response(s)

CONNECT
(indicates that ME has entered data mode)
ERROR
+CME ERROR: <err>

PIN Last

\- +

Parameter Description

<connectionState>(num)

Parameter returned by the AT^SSPI? read command.
Indicates whether or not the I²C or SPI channel is used. When the channel is open and the ME is in data mode, the read command can only be used if one of the remaining interfaces is available.

[0]	Not connected (channel closed). All following parameters are the factory settings ^SSPI: 0,0000,0000,0000.
1	Connected (channel open, ME in data mode). All following parameters are the values currently used, for example ^SSPI: 1,0000,0000,0000.

<basicConfiguration>(num)

Parameter <basicConfiguration> is a 16 bit word which contains four subparameters to control the following functions:

Subparameter	Bit	Hexadecimal	Selected function
Interface type	D15 - D12	0 1	I²C bus (default) SPI device
Port	D11 - D8	0	Internal port
Data transfer rate	D7 - D4	0 1 0 1 2 3	I²C at 100 kbps (default) I²C at 400 kbps (not supported) SPI at 100 kbps SPI at 200 kbps SPI at 400 kbps SPI at 800 kbps
Protocol	D3 - D0	0	ASCII (hex coding)

<wordLength>(num)

For SPI only:

0000 Length of SPI word = 8 bits

<extendedSpiConfiguration>(num)

For SPI only: Parameter <extendedSpiConfiguration> is a 16 bit word which contains four subparameters to control the following functions:

Subparameter	Bit	Hexadecimal	Selected function
SPI mode	D15 - D12	0	Only support SPI mode 0. Phase and polarity of all SPI modes are illustrated in Section 13.4.1, Selecting SPI Mode.
Chip Select (CS) mode	D11 - D8	0	One Chip Select per Transfer Frame.
Arrangement of bytes	D7 - D4	0	Big endian
Bit sequence (arrangement of bits on the SPI)	D3 - D0	0	MSB first

13.4.1 Selecting SPI Mode

The figure shows the four types of SPI mode selectable by setting the appropriate hexadecimal value within the parameter <extendedSpiConfiguration>.

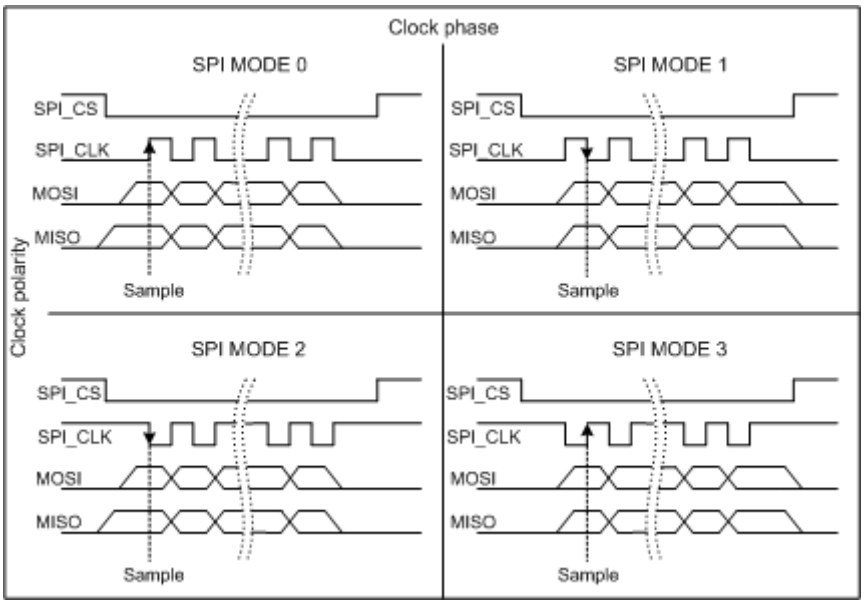

Figure 13.1: SPI modes selectable on SPI

13.4.2 Transmitting Data over AT Interface

This section provides information on the protocol used for data transmission to or from I²C /SPI devices and explains the data mode. It is assumed that you are familiar with the I²C specification.
Throughout this section the following document conventions are used to mark the direction of send and receive:
Transfer Message: AT → I²C or SPI device driver
Response Message: AT ← I²C or SPI device driver

Channel Open / Close:
To change from command mode to data mode use the AT^SSPI write command. To close down the channel and return to command mode send the ASCII code # (0x23).

ASCII Protocol for I²C or SPI communication over AT interface:
The protocol allows using a Terminal program for the communication between the module and the I²C slave device/SPI device. To visualize transferred characters and response data it is recommended to run the Terminal program in chat mode or to switch on local echo.
For transfer and response, special characters are defined, such as Start and Stop to mark a single message and Close to disconnect the data channel. All valid special characters are listed below:

Table 13.1: Special characters for ASCII coding

Direction AT - Driver	Function in protocol	Special character	Hex value	Description
→	Start Transfer Message	<	0x3C	Special character sent to the I²C/SPI driver to start sending.
→	Stop Transfer Message	>	0x3E	Special character sent to the I²C/SPI driver to stop sending.
→	Channel Close	#	0x23	For signalling. Channel Close can be sent any time inside or outside a transmit or receive message. Causes the transfer to be aborted and takes the ME back to AT command mode.
←	Start Response Message	{	0x7B	Special character sent to the I²C/SPI driver to mark the beginning of a Response Message.
←	Stop Response Message	}	0x7D	Special character sent to the I²C/SPI driver to mark the end of a Response Message.
←	Protocol error	!	0x21	For signalling. Reports to the AT interface that the Transfer Frame does not comply with the protocol definition (syntax error).
←	Transmission OK (in I²C protocol referred to as ACK)	+	0x2B	Notifies the AT interface that data were successfully transmitted or, on the I²C bus, the I²C Slave Address was recognized.
On I²C bus only:				
←	Transmission error (in I²C protocol referred to as NAK)	-	0x2D	Notifies the AT interface that data transmission failed or the I²C Slave Address was not recognized. On the I²C bus, the faulty data byte (16 bit byte counter) is identified as well.

Message syntax:
Each Message consists of a Start and Stop character, a Message-ID, further protocol data and user data. The notation of all elements is explained below:

Notation of Message-ID:

- All ASCII characters between 0x00...0x7F. It is recommended to use only the characters 0...9, A...Z, a...z.
- Length of the Message-ID: only one character

Notation of protocol data (except Message-ID) and user data:

- Hex (0...9, a...f, A...F)
- Without "0x" (0x01 → 01)
- Each hex value consists of 2 characters (1 → 01)
- Without delimiters such as comma, semicolon, space etc. (0xAE 0x01 0xA5 → AE01A5)
- In a Transfer Message, the number of all characters after the Message ID shall be even. If it is odd, a protocol error will be reported. On the I²C bus, this applies to the I²C Slave Address and all subsequent written user data. On the SPI this applies to the Read Offset Byte and the Read Length and, if available, all written user data. (Keep in mind that the number of all characters transmitted between Start "<" and Stop ">" of the Transfer Frame shall always be odd because the ID is one character only.)
- Length of I²C Slave Address and user data: ≤ 16 bytes

The first element of each message is the Start character ("<" for Transfer, "{" for the Response). Accordingly, the last character of a message is the Stop character (">" for Transfer, "}" for the Response).

The second element of each message is the Message ID (1 character). The Message ID serves the user to distinguish between different messages. It is only relevant on protocol level (between AT interface and I²C device driver), i.e. it is not sent to the I²C slave device.

Each transfer to the device is followed by a Response Message sent from the driver to the AT interface. The response includes the Message ID and either OK ("+") or error characters ("-" or "!"). A successful response to a Read Message contains the OK character and the read data. If an error occurs on the I²C bus, the response consists of an error character followed by a 16 bit code specifying the faulty byte.

After each Transfer Message, wait for the Response Message before sending the next Transfer Message.

All characters entered outside a valid message (i.e. not input between Start character "<" and Stop character ">") are ignored.

13.4.2.1 Structure of Messages on the I²C Bus

Table 13.2: Structure of Transfer and Response Messages on the I²C bus

Frame	Format
Write Transfer Message	< *ID SlaveAddress Data* > Maximum length: 16 bytes for I²C Slave Address and written data. LSB of I²C Slave Address = "0".
Read Transfer Message	< *ID SlaveAddress ReadLength* > Read Length ≤ 16 bytes. LSB I²C of Slave Address = "1".
Response Message Write OK Read of x bytes OK NAK for x^{th} byte if Read or Write Protocol error in x^{th} byte	 {*ID* + } {*ID* + *Data* } {*ID* - *xxxx* } {*ID* ! *xxxx* }

On the I²C bus, read and write data are handled in two separate frames transmitted one after the other. This is because the I²C bus has only two bus lines, I2CDAT for the serial data and I2CCLK for the serial clock. Write data are packed into a Transfer Frame. Read data are packed into a Response Frame. The Transfer Frame con-

tains a Receive or Transmit Request (R/W Request) for the I²C master.

In a Transfer Message (Read or Write), the third element is the 7-bit I²C Slave Address (2 characters) that identifies each single device connected to the bus. The 8th bit of this byte is the LSB that determines the direction of the message. If the LSB is "0" the master will write information to the selected slave. If the LSB is "1" the master will read information sent from the slave.

In a Read Transfer Message on the I²C bus, the size of the expected data must be specified explicitly. This is an element of 4 characters stating the number of bytes to be read. It must be placed after the I²C Slave Address.

13.4.2.2 Structure of Messages on the SPI

Table 13.3: Structure of Transfer and Response Messages for SPI

Message	Format
Transfer Message	Read data:<*ID ReadOffset ReadLength*> Write data: <*ID Data*> Read and write data: <*ID ReadOffset ReadLength Data*> Read Offset = 8 bits Read Length = 16 bits Max. length of data: 128 bytes
Response Message Write OK Reading x bytes was OK Protocol error in x^th byte	 {*ID* +} {*ID + Data* } {*ID ! xxxx* }

The SPI has two serial data lines, MOSI for sending data from the master to the slave, and MISO for receiving data sent from the slave to the master. Both data lines are controlled by one serial clock line SPI_CLK. ENS22-E acts as master providing the clock. Write and read data are handled in the same Transfer Messages and Response Messages. In a Transfer Message, the next two elements after the ID are the Read Offset and the Read Length, both required to enable reading data from the slave. The Read Offset specifies where to start reading, i.e. which byte is the first to start reading from. If the Read Offset is zero then reading starts from the first byte. The Read Length specifies the number of expected bytes. If the Read Offset is zero and the Read Length does not equal zero, the master reads the specified number of bytes, starting from the first byte. If the Read Length is zero, the Read Offset is ignored, meaning that the master will not read data from the slave. To transmit data from the master to the slave all data can be entered after the Read Length.

In a Response Message the ID is followed by a special character to indicate the result of reading. If successful, "+" is given, followed by the read data. If reading fails only "!" is received.

13.4.3 Error Handling on the I²C Bus

Protocol error:
If a protocol error is detected the ASCII value "!" is sent to the AT interface. Also, a Stop Condition is sent to the I²C device.
A protocol error occurs if

- any data / address characters do not equal 0...9, a...f and A...F
- the length of a read word is smaller or greater than 16 bits
- the number of ASCII data is odd (e.g. "af1" instead of "af01")
- the Read or Write request is greater than 16 Bytes (0x0010).

Acknowledge:
Once a transmission has completed successfully (Write or Read), the special character "+" (ACK) is included in the Response sent to the AT interface.
During a Write Transfer, the I²C driver acknowledges each transferred byte, but the Response contains only one

ACK which is transmitted only if all bytes are successfully transferred. During a Read Transfer, an ACK is sent when the I²C slave device notifies that it has recognized the I²C Slave Address.

Not Acknowledge:
During a Transmit Transfer, a NAK is given when the I²C Slave Device notifies a failure to receive either the I²C Slave Address or a data byte. In this case, a Stop Condition is sent to the I²C device.
During a Receive Transfer, a NAK is transmitted only when the I²C does not receive any reponse for the I²C Slave Address. The I²C device never acknowledges the validity of the received data (by sending an ACK the master acknowledges each received byte to the slave).

13.4.4 Example: Using I²C Bus

As stated above, it is recommended to run the Terminal program in chat mode or to use the local echo. First, activate the I²C interface:

`AT^SSPI=0000,0000,0000` `CONNECT`	The first group of characters forms the <basicConfiguration>, where the first "0" sets I²C, the second "0" is the internal port, the digit "0" sets 100 kbps bit rate on the I²C bus, and the next "0" selects ASCII coding. Note: If omitted all above parameters are assumed by default. Therefore, instead of AT^SSPI= 0000,0000,0000 it is sufficient to enter only AT^SSPI=

The module is in data mode now. This allows you to send a Write Transfer Message:

`<aAE000102030405060708090A0B0C0D0E0F>`	Write Transfer Frame, where a = ID, AE = Slave Address and write request.
`{a+}`	Write Response Message, where a = ID.
`<bAF0010>`	Read Transfer Message, where b = ID, AF = Slave Address and read request, 0010 = number of expected bytes.
`{b+000102030405060708090A0B0C0D0E0F}`	Read Response Message, where b = ID.

To quit data mode and return to command mode enter the Close character "#":

`#` `OK`	The response OK confirms that the ME is back to command mode and ready to accept any AT commands.

If the ME is in command mode, the response to the read command contains the factory settings.

`AT^SSPI?`
`^SSPI: 0,0000,0000,0000`
 	
`OK`
	The read command returns the connection state "not connected" (Channel closed) and the factory settings for I²C.

If the ME is in data mode, the response to the read command contains the current settings.

`AT^SSPI?`
`^SSPI: 1,0000,0000,0000`
 	
`OK`
	The read command returns the connection state "connected" (Channel open) and the current settings for I²C.

13.4.5 Error Handling on the SPI Bus

Protocol error:
If a protocol error is detected the ASCII value "!" is sent to the AT interface. Also, a Stop Condition is sent to the SPI device.
A protocol error occurs if

- any data / address characters do not equal 0...9, a...f and A...F
- the number of ASCII data is odd (e.g. "af1" instead of "af01")
- the Read or Write request is greater than 128 Bytes (0x0080).

13.4.6 Example: Transfer and Response Messages on SPI

The following examples shall illustrate the message structure and write/read procedures explained in Section 13.4.2.2, Structure of Messages on the SPI. Blanks are inserted only to better visualize frame elements. In practice no blanks are allowed.

<0 00 0000 06> {0 +}	Transfer Message: The master enable write to slave. Response Message: Transmission successful.
<0 00 0000 02 00 11 22 33> {0 +}	Transfer Message: The master writes 3 bytes. Response Message: Transmission successful.
<1 00 0010 03 00> {1 + FF FF 11 22 33 78 99 99 99 CC CC CC CA AA AB BB}	Transfer Message: The master requests to read 16 bytes from the slave. Read Offset is zero, therefore, reading starts from the first byte. Response Message: Reading data successful.
<2 02 0008 03 00> {2 + 11 22 33 78 99 99 99 CC}	Transfer Message: The master requests to read 8 bytes from the slave. Read Offset is 2, therefore, reading starts from the third byte. Response Message: Reading data successful.
<4 02 0010 03 00 {4!0006}	Transfer Message: No 'stop sign' in transfer Message. Response Message: Protocol error in the sixth byte.
>4 02 0010 03 00> or >4 02 0010 03 00< >4 02 0010 03 00> or >4 02 0010 03 00<	Transfer Message: No 'start sign', or no data after 'start sign'. Response the message itself, the wrong format message is ignored.

14. General Purpose I/O (GPIO) Pin related Commands

This chapter describes the AT commands used to access and configure the GPIO pins of ENS22-E.

Please also refer to [2] for electrical specifications of the GPIO pins.

14.1 AT^SPIO GPIO Driver Open/Close

AT^SPIO write command opens and closes the General Purpose I/O (GPIO) driver. The command must be executed before any GPIO related command can be used. The command does not reserve any GPIO lines, only the driver required for their management will be started.

Syntax

Test Command

AT^SPIO=?

Response(s)

^SPIO:(list of supported <mode>s)
OK

Write Command

AT^SPIO=<mode>

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Parameter Description

<mode>(num)	
0	Close General purpose I/O driver
1	Open General purpose I/O driver

14.2 AT^SCPIN Pin Configuration

The AT^SCPIN write command serves to add (or remove) and configure GPIO lines. Keep in mind that some GPIO lines share functions with other interfaces. For details see AT^SCFG "GPIO/mode/xxx" settings, Section 14.2.1, GPIO Configuration Table and following AT commands:, AT^SSPI

Syntax

Test Command

AT^SCPIN=?

Response(s)

^SCPIN: (list of supported <mode>s), (list of supported <pin_id>s), (list of supported <direction>s), (list of supported <startValue>s)
OK

Write Command

AT^SCPIN=<mode>, <pin_id>, <direction>[, <startValue>]

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Parameter Description

<mode>(num)	
0	Close GPIO line
1	Open GPIO line

<pin_id>(num)	
Pin identifier	
0	GPIO1
1	GPIO2
2	GPIO3
3	GPIO4
4	GPIO5
7	GPIO8
8	GPIO9
9	GPIO10
15	GPIO16
16	GPIO17
17	GPIO18
18	GPIO19
23	GPIO24

<direction>(num)

Parameter <direction> is mandatory when opening a GPIO line, but can be omitted when closing a GPIO line.

0	Input
1	Output

<startValue>(num)

Can be set only for outputs.

[0]	Low
1	High

Notes

- For closing a GPIO line with the write command (<mode>=0), the parameter <direction> is not needed.
- Before changing the configuration of a GPIO line be sure to close the GPIO line.

14.2.1 GPIO Configuration Table

Some GPIO lines are shared with other interfaces, such as ASC1, SPI (Serial Peripheral Interface). The following table shows the configuration variants. All variants are mutually exclusive, i.e. a line configured for GPIO usage is locked for alternative use and vice versa.

GPIO Pin	GPIO Handler	ASC0	ASC1	SPI	I2C
GPIO1	yes	yes	no	no	no
GPIO2	yes	yes	no	no	no
GPIO3	yes	yes	no	no	no
GPIO4	yes	no	no	no	no
GPIO5	yes	no	no	no	no
GPIO8	yes	no	no	no	no
GPIO9	yes	no	no	no	yes
GPIO10	yes	no	no	no	yes
GPIO16	yes	no	yes	yes	no
GPIO17	yes	no	yes	yes	no
GPIO18	yes	no	yes	yes	no
GPIO19	yes	no	yes	yes	no
GPIO24	yes	yes	no	no	no

14.3 AT^SGIO Get IO State of a Specified Pin

Syntax

Test Command

```
AT^SGIO=?
```

Response(s)

```
^SGIO: (list of supported <io_id>s)
OK
```

Write Command

```
AT^SGIO=<io_id>
```

Response(s)

```
^SGIO: <value>
OK
ERROR
+CME ERROR: <err>
```

PIN	Last
-	-

Parameter Description

<io_id>(num)

This is an already configured <pin_id> (see AT^SCPIN).

<value>(num)

State read on this <io_id>.

0	Low for <pin_id>
1	High for <pin_id>

14.4 AT^SSIO Set IO State of a Specified Pin

Syntax

Test Command

AT^SSIO=?

Response(s)

^SSIO: (list of supported <io_id>s), (list of supported <value>s)
OK

Write Command

AT^SSIO=<io_id>, <value>

Response(s)

OK
ERROR
+CME ERROR: <err>

PIN	Last
-	-

Parameter Description

<io_id>(num)

This is an already configured <pin_id> (see AT^SCPIN).

<value>(num)

State to be set for this <io_id>.

0	Low for <pin_id>
1	High for <pin_id>

15. Appendix

15.1 Restricted access to SIM data after SIM PIN authentication

The following commands can be used only after data from the SIM have been read successfully for the first time. Reading starts after successful SIM authentication has been performed, and may take up to 30 seconds depending on the SIM used. While the read process is in progress, an attempt to use any of the following commands will result in "+CME Error: 14" (SIM busy).

ø ... AT Command not available
- ... AT command accessible immediately after PIN entry has returned OK
+ ... AT command fully accessible after SIM PIN authentication has been completed

AT Command	Exec	Test	Read	Write
AT+CSCA	ø	-	+	-

15.2 Available AT Commands and Dependency on SIM PIN

ø ... Command not available
- ... Command does not require PIN1
+ ... Command requires PIN1
± ... Command sometimes requires PIN1

Table 15.1: Available AT Commands and Dependency on SIM PIN

AT Command	Exec	Test	Read	Write
Configuration Commands				
AT&F	-	ø	ø	ø
AT&V	-	ø	ø	ø
AT&W	-	ø	ø	ø
ATQ	-	ø	ø	ø
ATV	-	ø	ø	ø
ATZ	-	ø	ø	ø
AT+CFUN	ø	-	-	-
AT^SMSO	-	-	ø	ø
AT+CMEE	ø	-	-	-
AT+CSCS	ø	-	-	-
AT^SCFG	ø	-	-	-
AT^SPOW	ø	-	-	-
Status Control Commands				
AT^SIND	ø	-	-	-
Serial Interface Control Commands				
AT\Q	-	ø	ø	ø
AT&C	-	ø	ø	ø
AT&D	-	ø	ø	ø
AT&S	-	ø	ø	ø
ATE	-	ø	ø	ø
AT+ICF	ø	-	-	-
AT+IPR	ø	-	-	-
Identification Commands				
ATI	-	ø	ø	ø
AT+CGMI	-	-	ø	ø
AT+CGMM	-	-	ø	ø
AT+CGMR	-	-	ø	ø
AT+CGSN	-	-	ø	-
AT+CIMI	+	+	ø	ø

AT Command	Exec	Test	Read	Write
Security Commands				
AT+CPIN	ø	-	-	-
AT+CLCK	ø	-	ø	-
AT+CPWD	ø	+	ø	+
Network Service Commands				
AT+COPN	-	-	ø	ø
AT+COPS	ø	-	-	±
AT+CESQ	+	+	ø	ø
AT+CTZR	ø	-	-	-
AT+CPSMS	ø	-	-	-
AT^SMONI	-	-	ø	ø
AT^SMONP	-	-	ø	ø
AT+CEDRXS	ø	-	-	-
AT+CEDRXRDP	-	-	ø	ø
AT^SNLWM2M	ø	-	ø	-
AT+CIPCA	ø	-	-	-
Internet Service Commands				
AT^SICS	ø	-	-	-
AT^SICI	ø	-	-	-
AT^SIPS	ø	-	ø	-
AT^SISS	ø	-	-	-
AT^SISI	ø	-	-	-
AT^SISO	ø	-	-	+
AT^SISC	ø	-	ø	+
AT^SISR	ø	-	ø	+
AT^SISW	ø	-	ø	+
AT^SIST	ø	-	ø	-
AT^SISX	ø	+	ø	+
AT^SISE	ø	-	ø	-
Packet Domain Related Commands				
AT+CGACT	ø	+	+	+
AT+CGATT	ø	+	+	+
AT+CGAUTH	ø	-	-	-
AT+CGDCONT	ø	-	-	-
AT+CEREG	ø	-	-	-
AT+CGPADDR	+	+	ø	+
AT+CSODCP	ø	+	ø	+
AT+CRTDCP	ø	+	+	+

AT Command	Exec	Test	Read	Write
Short Message Service (SMS) Commands				
AT+CMGC	ø	+	ø	+
AT+CMGS	ø	+	ø	+
AT+CNMA	ø	+	ø	+
AT+CSCA	ø	+	+	+
AT+CSMS	ø	+	+	+
(U)SIM related Commands				
AT+CCID	-	-	-	ø
Miscellaneous Commands				
ATS3	ø	ø	-	-
ATS4	ø	ø	-	-
ATS5	ø	ø	-	-
AT^SBNR	ø	ø	ø	-
AT^SBNW	ø	ø	ø	-
+++	-	ø	ø	ø
AT^SNFWPUPDS	ø	-	ø	-
Hardware related Commands				
AT+CCLK	ø	-	-	-
AT^SBV	-	-	ø	ø
AT^SCTM	ø	-	-	-
AT^SSPI	ø	-	-	-
General Purpose I/O (GPIO) Pin related Commands				
AT^SPIO	ø	-	ø	-
AT^SCPIN	ø	-	ø	-
AT^SGIO	ø	-	ø	-
AT^SSIO	ø	-	ø	-

15.3 AT Command Settings storable with AT&W

Table 15.2: Settings Stored to User Profile

AT Command	Stored Parameters
Configuration Commands	
ATQ	<n>
ATV	<value>
AT+CMEE	<errMode>
AT+CSCS	<chset>
Serial Interface Control Commands	
AT\Q	<n>
AT&C	<value>
AT&D	<value>
AT&S	<value>
ATE	<value>
AT+ICF	<format>, <parity>
Network Service Commands	
AT+COPS	<format>
Packet Domain Related Commands	
AT+CEREG	<n>
Short Message Service (SMS) Commands	
AT+CSMS	<service>
Miscellaneous Commands	
ATS3	<n>
ATS4	<n>
ATS5	<n>

15.4 Factory Default Settings Restorable with AT&F

Table 15.3: Factory Default Settings Restorable with AT&F

AT Command	Factory Defaults
Configuration Commands	
ATQ	<n>=0
ATV	<value>=1
AT+CMEE	<errMode>=0
AT+CSCS	<chset>="GSM"
Serial Interface Control Commands	
AT\Q	<n>=3
AT&C	<value>=1
AT&D	<value>=2
AT&S	<value>=0
ATE	<value>=1
AT+ICF	<format>=3
Network Service Commands	
AT+COPS	<format>=0
Packet Domain Related Commands	
AT+CEREG	<n>=0
Short Message Service (SMS) Commands	
AT+CSMS	<service>=0
Miscellaneous Commands	
ATS3	<n>=013
ATS4	<n>=010
ATS5	<n>=008

15.5 Summary of Unsolicited Result Codes (URC)

Table 15.4: Summary of Unsolicited Result Codes (URC)

AT Command	URC
Unsolicited Result Code Presentation	
	^SYSSTART
	^SBC: Undervoltage Warning
	^SBC: Undervoltage Shutdown
	^SBC: Overvoltage Warning
	^SBC: Overvoltage Shutdown
Configuration Commands	
AT^SMSO	^SHUTDOWN
AT^SCFG	^SUSPEND_AVALIABLE
AT^SCFG	^SUSPEND_NOT_AVALIABLE
AT^SCFG	^SUSPEND_READY
AT^SCFG	^SUSPEND_NOT_READY
AT^SCFG	^SYSRESUME
Network Service Commands	
AT+CTZR	+CTZV: <tz>
AT+CTZR	+CTZE: <tz>, <dst>[, <time>]
AT+CTZR	+CTZEU: <tz>, <dst>[, <utime>]
AT+CEDRXS	+CEDRXP:<AcT-type>[, <Requested_eDRX_value>[, <NW_provided_eDRX_value>[, <Paging_time_window>]]]
AT^SNLWM2M	^SNLWM2M: "srv","dft",<srv id>,"<srv status>"[, <status parameter>]
AT^SNLWM2M	^SNLWM2M: "procedure","dft"[, <srv id>],<procedure>,<procedure status>[, <indication text>]
Internet Service Commands	
AT^SISR	^SISR: <srvProfileId>, <urcCauseId>
AT^SISW	^SISW: <srvProfileId>, <urcCauseId>
Internet Service URC "^SIS"	^SIS: <srvProfileId>, <urcCause>[, [<urcInfoId>][, <urcInfoText>]]
Packet Domain Related Commands	
AT+CEREG	+CEREG: <stat>
AT+CEREG	+CEREG: <stat>[, <tac>, <ci>[, <AcT>]]
AT+CEREG	+CEREG: <stat>[, [<tac>], [<ci>], [<AcT>][, <CauseType>, <RejectCause>]]
AT+CEREG	+CEREG: <stat>[, [<tac>], [<ci>], [<AcT>][, , [, [<ActiveTime>], [<PeriodicTAU>]]]]
AT+CEREG	+CEREG: <stat>[, [<tac>], [<ci>], [<AcT>][, [<CauseType>], [<RejectCause>][, [<ActiveTime>], [<PeriodicTAU>]]]]
AT+CSODCP	+CSODCPR: <sequence>, <status>
AT+CRTDCP	+CRTDCP:<cid>, <cpdata_length>, <cpdata>

AT Command	URC
Short Message Service (SMS) Commands	
AT+CNMA	+CMT: [<alpha>], <length><CR><LF><pdu>
Hardware related Commands	
AT^SCTM	^SCTM_B: <UrcCause>
AT^SCTM	^SHUTDOWN

15.6 Alphabetical List of AT Commands

Table 15.5: Alphabetical List of AT Commands

AT Command	Description	Section and Page
+++	Escape from Data Mode to AT Command Mode	Section 12.6, page 160
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