EZ-Star

CDMA/1XRTT
Cellular AMR Interface

Technical Reference Manual

GLOBAL DATA

Quality Communications Products

11-1030-02

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1 INTRODUCTION

1.1 OVERVIEW

The EZ-Star CDMA/1XRTT cellular AMR interface is an end-point communications interface device designed specifically for automated meter reading applications. EZ-Star is based on a combination of Global Data's standard StarPoint communications platform and the Marwell family of meter socket adapters. The resulting product provides an economical AMR solution that rivals under the glass solutions for cost of installation and surpasses under the glass solutions for ease of maintenance and ease of upgrade.

Designed to operate on networks utilizing the CDMA and/or 1XRTT Packet Radio Service, EZ-Star supports bi-directional data communication which may be originated by either the meter or host application.

1.2 NETWORK MODES

The CDMA network is designed to support digital voice and data transmission. Data transmission can occur as either circuit switched data, or with the 1XRTT overlay, as packet data. Many traditional host applications communicate via modem to endpoints through analog cellular connections or public switched telephone networks (PSTN). Utilizing the CDMA circuit switched data mode, these applications can seamlessly switch to digital cellular connectivity. Host applications capable of communicating via Internet Protocol (IP) can utilize 1XRTT as a means of communicating with endpoint hardware. In 1XRTT mode, data remains in IP packet format from the host application through the carrier network, to the endpoint communication device, and back.

1.3 FEATURES

- Dual Frequency Bands – 800Mhz (Cellular) and 1900Mhz (PCS)
- Wide range AC power supply
- Multiple data modes - Circuit Switched data and 1XRTT packet data
- Thermal Protection
- AMR Meter Direct Connection – RJ-11 jack accepts the standard RS-232 option board cable provided with General Electric, Elseter (ABB) and Landis + Gyr (Siemens) meters.
- Remote Reprogramming – A smart-change feature allows for remote reprogramming of the device parameters without dispatching personnel to the remote location.

2 THEORY OF OPERATION

The CDMA/1XRTT networks support two methods of data transmission: circuit switched and packet switched.

In circuit switch mode, CDMA provides an error corrected data path through the network. Because of the error correction characteristics, applications must be prepared for lower throughput and higher latency characteristics that are similar to those experienced on a packet network. In circuit switched mode, modem banks in the CDMA network act as the gateway for all inbound and outbound data traffic. These modems communicate with the customer's host-application modem and deliver a digital data stream into the CDMA network where it is then delivered to the endpoint device via an

error correcting protocol.

In 1XRTT packet based communications, the customer's host application communicates with the CDMA network via an IP connection. The 1XRTT network delivers packet data directly to an endpoint device such as EZ-Star. The EZ-Star contains TCP/IP protocol support so that standard asynchronous meters may be attached to the 1XRTT network. Various protocol layers within the EZ-Star may be disabled to accommodate meters that are IP capable.

3 ARCHITECTURE

The EZ-Star integrates multiple components into a compact rugged design. These components work together to provide CDMA/1XRTT communications optimized for AMR applications. The components include an RS-232 serial interface, a micro controller with onboard memory, and a CDMA/1XRTT radio.

3.1 SERIAL INTERFACE

The RS-232 serial interface may be configured for direct connection to most electric meters by setting jumpers on the EZ-Star circuit board. A quick connect RJ-11 is provided for connections to electric meters manufactured by General Electric, Elster, and Landis + Gyr.

3.2 MICRO CONTROLLER

The Micro Controller provides a standard feature set including configuration control, diagnostic tools and protocol support. Global Data firmware is designed to optimize network efficiency by controlling packet size, framing and latency. On board user expandable flash memory provides support for customized protocols. Standard memory included onboard the Micro Controller is 128Kb with over 115Kb available for customer customized protocol development. The device may be ordered with an optional 256Kb of flash memory in place of the standard 128Kb.

3.3 RADIO

The CDMA/1XRTT Radio included in EZ-Star has been designed specifically for telemetry applications. This device has been tightly integrated with the Micro Controller and Serial Interface to provide dependable cellular service with standard interfaces.

4 MODULE INTERFACE AND CONNECTORS

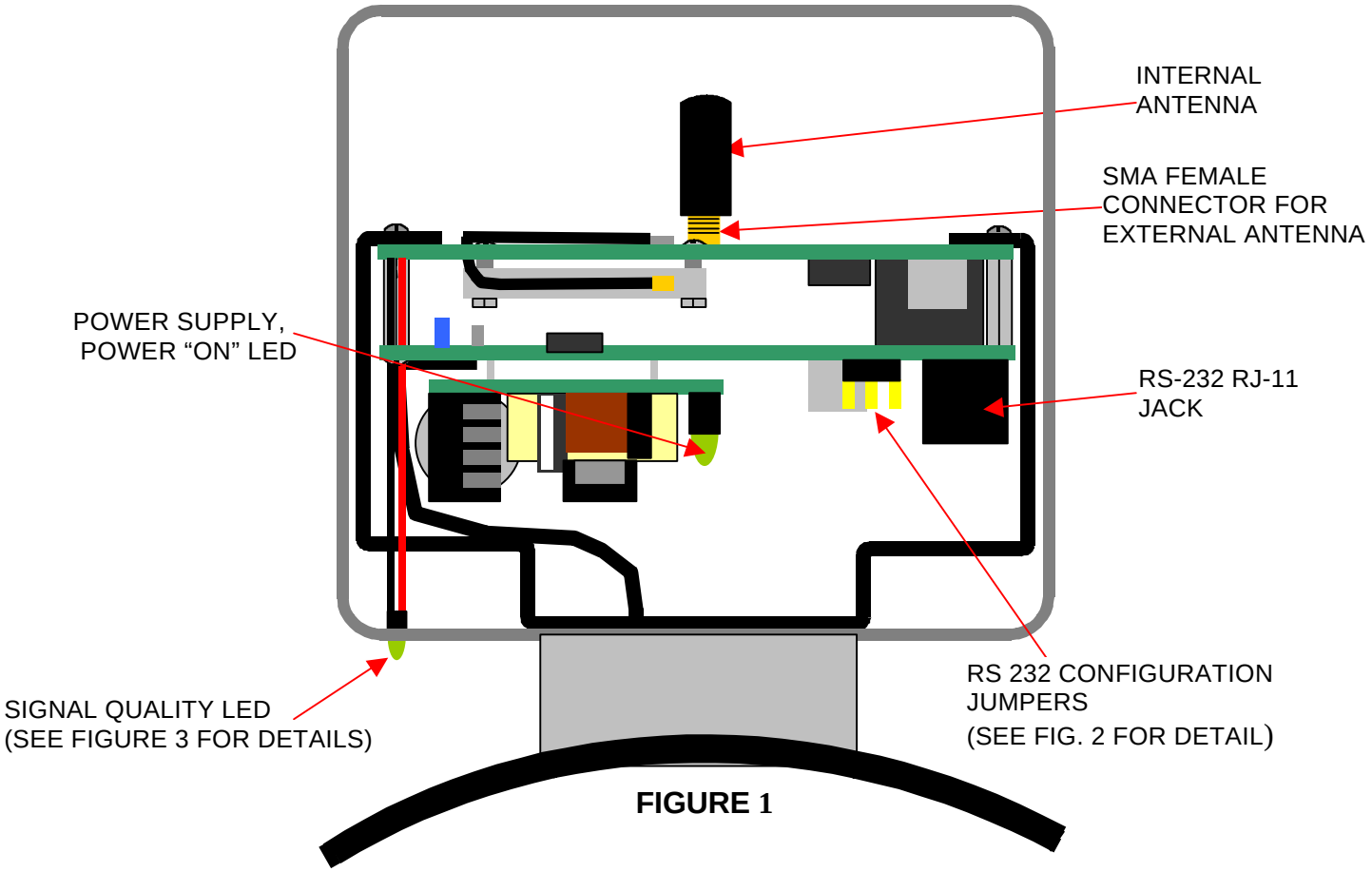

FIGURE 1

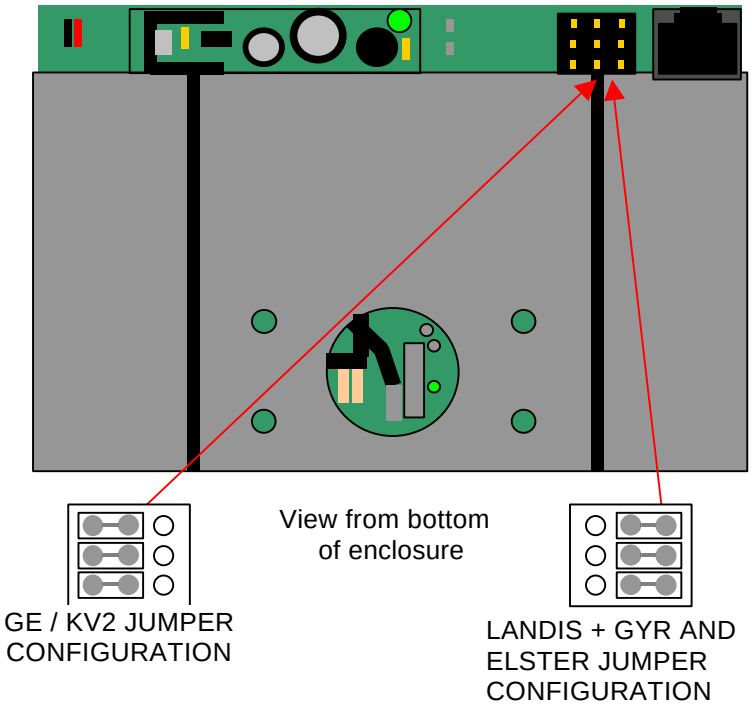

FIGURE 2

RS-232 JUMPER CONFIGURATION

FIGURE 3

SIGNAL QUALITY LED

LED COLOR	LED STATE	RSSI LEVEL(dBm)	INSTALLATION GUIDANCE
GREEN	ON	GREATER THAN -90	INTERNAL ANTENNA USAGE ADEQUATE
GREEN	BLINKING	-90 TO -100	EXTERNAL ANTENNA RECOMMENDED
RED	BLINKING	-101 TO -113	EXTERNAL ANTENNA NECESSARY
RED	ON	NO SERVICE/ NOT REGISTERED	
OFF	OFF	NO POWER OR TIMER S100 EXPIRED	

4.1 POWER SUPPLY LED

Indicates that AC power is present.

4.2 SIGNAL QUALITY LED

Figure 3 presents a summary of the status information available from this LED. This information may be used as a guideline for installation and troubleshooting. Please note that S register 100 controls the length of time that this LED will remain active.

4.3 INTERNAL ANTENNA AND SMA CONNECTOR

The internal antenna is carefully tuned for optimum performance. However, there may be installations where an external antenna is required. In these cases, the internal antenna may be removed from its mounting connector, which is a standard SMA female type. An external antenna cable may then be attached to this connector.

4.4 RS-232 RJ-11 JACK

The signals on this jack have been implemented specifically for interconnecting to the RS-232 option boards in meters from Elster, Landis+Gyr and GE. Please see Figure 2 for configuration detail.

4.5 RS-232 CONFIGURATION JUMPERS

These jumpers configure the signals on the RJ-11 connector for interconnection with a specific meter type. Figure 2 provides configuration detail for each manufacturer supported. Please note that figure 2 presents a view from the bottom of the EZ-Star enclosure.

5 CONFIGURATION AND OPERATION

5.1 ESTABLISHING CELLULAR SERVICE

To use EZ-Star, you must first establish cellular service with a provider. You must provide the following information to CDMA network service provider:

- **THE ESN OF YOUR MODULE** - Every EZ-Star is identified by a unique number called an ESN (Electronic Serial Number). You will find this 8 digit hexadecimal number printed on a label attached to the EZ-Star. You may obtain the ESN of your module by using the AT>I command that is defined in the following section.

- **DEVICE TYPE** - Your CDMA network service provider may ask you to identify the manufacturer and model name. Indicate that it is a Global Data EZ-Star CDMA module.

To activate your cellular modem, you must obtain the following information from your cellular service provider:

- **MIN** – The MIN (Mobile ID Number) is the actual telephone number that is assigned to your device. Like any standard North American telephone number, it will be comprised of a 3-digit area code and a 7-digit phone number. (Example: 5825825168)

- **Network Access user ID and Password (1XRTT MODE ONLY)** – For CDMA 1XRTT packet data service, your network provider must assign a user ID and password to your device. (Example: Verizon's user ID is 5825825168@vzw3g.com and password is vzw). This ID is not necessary for circuit switched operation. In 1XRTT mode, you must also ask your carrier to enable the Caller ID feature in order for the EZ-Star CDMA module to function properly.

5.2 ACTIVATING EZ-STAR

Most network service providers will ask you to activate your CDMA device within 72 hours after establishing service with them. Perform the following steps when activating your CDMA module:

- **CONFIGURE YOUR DTE** – Before issuing any AT commands you must configure the DTE (such as Hyper Terminal) to have the same data format as EZ-Star. The default data format is 9600bps, 8-N-1 (eight data bits, no parity, and one stop bit). You may use the AT\D command to change the bit rate to meet your equipment requirements.

- **SET MIN** – Use the **AT>M** command to set the MIN assigned by your service provider.

- **SET NETWORK SERVICE MODE** – Use the **AT>N** command to select circuit switched or packet data service mode.

- **SET NETWORK ACCESS ID & PASSWORD (1XRTT MODE ONLY)** – Use AT>U and AT>W to set the user ID and password.

- **DEFINE CALLER ID (1XRTT MODE ONLY)** – Use the AT>Zn command to define up to ten caller IDs that the StarPoint will answer.

- **REVIEW CONFIGURATION –** Use the AT>I command to review the configuration from

previous steps.

- **SAVE CURRENT CONFIGURATION AND RESET** – Use the AT&W command to save your configuration and then either power cycle the unit or use the ATZ command to do a soft reset.

5.3 EVALUATING SERVICE QUALITY

Using the signal quality LED, analyze the signal quality at your location. You may also use the AT>Q command to evaluate the signal quality.

6 SOFTWARE INTERFACE

6.1 AT COMMAND OVERVIEW

The basic AT commands used to control device operation are defined in this section.

6.1.1 Command Format

A command line is a string of characters sent from a device such as a laptop or a meter (DTE), to the modem (DCE) while the modem is in a command state. A command line has a prefix, a body, and a terminator. Each command line must begin with the character sequence AT and be terminated by a carriage return (except the repeat command A/).

Characters within the command line are interpreted as commands with associated parameter values. The basic commands consist of single ASCII characters, or single characters proceeded by a prefix character (e.g., "&"), followed by a decimal parameter. Missing decimal parameters are interpreted as 0.

The AT sequence may be followed by any number of commands in sequence, except for commands such as Z, D, or A. Commands following commands Z, D, or A on the same command line will be ignored. The maximum number of characters on any command line is 39 (including "A" and "T"). If a syntax error is found anywhere in a command line command, the remainder of the line will be ignored and the ERROR result code will be returned.

6.1.2 Escape Code Sequence

When the device has established a connection and has entered the on-line data mode, it is possible to break into the data transmission in order to issue further commands to the modem in an on-line command mode. This is achieved by sending the modem a sequence of three ASCII characters specified by register S2. The default character is '+'. The timing of the three characters must comply with specific time constraints. There is a guard time before the first character (the pre-sequence time), a guard time following the third character (the post-sequence time), and a guard time-out between the first and second characters and between the second and third characters (the inter-character time). These times are controlled by the value recorded in register S12.

6.2 AT COMMAND SET

6.2.1 Generic Control Commands

6.2.1.1 A/ – Repeats Previous Command String

This command, which does **not** require the *AT* prefix, is a special command used to repeat the previous command string. The device behaves as though the last command line had been resent by the DTE.

6.2.1.2 ? – Help Command

Display the summary of all AT command set and S registers.

6.2.1.3 In – Identification

The modem reports to the DTE the requested result according to the parameter specified.

I0	Reports product code “SP134”.
I1	Reports "OK".
I2	Reports "OK".
I3	Reports “GDI EZ-Star CDMA/1XRTT V1.00”.
I4	Reports “Copyright (C) 2003 Global Data, Inc.”
I5	Reports "OK".
I6	Reports CDMA/1XRTT radio software revision.
I7	Reports "OK".

6.2.1.4 Z – Soft Reset and Restore Profile

The modem performs a soft reset and restores the configuration profile from a non-volatile memory (NVRAM).

6.2.1.5 &F – Restore Factory Configuration

Restore the factory default configuration. The following command strings are equivalent to the factory default:

AT E1 Q0 V1 &C1 &K0 \R1\S0
AT S0=1 S2=43 S7=50 S12=80 S30=0 S100=30 S101=144 S102=70 S103=60

6.2.1.6 &V – Display Current Configuration and Stored Profiles

Displays the current (active) configuration, the stored user (user) profiles, and the stored destination IP addresses.

Example:
ACTIVE PROFILE:
E1 Q0 V1 &C1 &K0 \D3 \R1\S0
S00:1 S02:43 S07:50 S12:80 S30:0 S100:30 S101:144 S102:70 S103:60
S104:30 S105:2

STORED PROFILE:
E1 Q0 V1 &C1 &K0 \D3 \R1\S0
S00:1 S02:43 S07:50 S12:80 S30:0 S100:30 S101:144 S102:70 S103:60

TELEPHONE NUMBERS:
0 = 1 =
2 = 3 =

CALLER ID DIRECTORY:
0= 1=
2= 3=
4= 5=
6= 7=
8= 9=

OK

6.2.1.7 &W – Save Current Configuration

Saves the current configuration and S-Registers into the user's profile that is kept in a non-volatile memory (NVRAM).

6.2.1.8 &Z – Store Phone Number

Store phone number in the non-volatile memory (NVRAM).

&Zn=ddddddddddd	Where n is the index number from 0 to 3 and ddddddddddd is the standard 10-digit phone number. To clear an entry in the stored phone number directory, enter AT&Zn= without a phone number. The entry defined by n will be cleared.

6.2.2 DTE Interface Commands

6.2.2.1 En – Echo Control

Enables or disables the echo of characters to the DTE according to the parameter specified.

E0	Disables command echo.
E1	Enables command echo. (Default)

6.2.2.2 Qn – Quiet Results Codes Control

Enables or disables the sending of result codes to the DTE according to the parameter specified.

Q0	Enables sending of result codes to the DTE. (Default)
Q1	Disables sending of result codes to the DTE.

6.2.2.3 Vn – Result Code Format

Selects whether short-form or long-form result codes are sent to the DTE.

V0	Enables short-form or terse (i.e., hexadecimal digits) result codes.
V1	Enables long-form or verbose (i.e., English words) result codes. (Default)

6.2.2.4 Wn – Connect Messages

This command is included for compatibility. All valid parameters will be accepted but will not impact operational characteristics. The device will always operate in ATW0 mode where DTE speed will be reported upon establishment of a connection.

6.2.2.5 &Cn – RLSD (DCD) Option

Controls the RLSD output in accordance with the parameter specified.

&C0	RLSD remains ON at all times.
&C1	RLSD follows the state of the connection. (Default)

6.2.2.6 &Dn – DTR Option

This command is included for compatibility. All valid parameters will be accepted but will not impact operational characteristics.

6.2.2.7 &Kn – Flow Control

Defines the DTE/DCE (terminal/modem) flow control mechanism.

&K0	Disables flow control. (Default)
&K3	Enables RTS flow control.

6.2.2.8 \Dn – DTE Data Rate Selection

Allows the user to select a fixed bit rate between the DTE and EZ-Star.

\D0	1200 bps	
\D1	2400 bps	
\D2	4800 bps	
\D3	9600 bps	(default)
\D4	19200 bps	
\D5	38400 bps	
\D6	57600 bps	

6.2.3 Call Progress Commands

6.2.3.1 A – Answer

For CDMA CSD (Circuit Switch Data) mode, this command forces the module to answer the inbound call.

6.2.3.2 D – Dial, Outbound Call Setup

For CDMA CSD mode, EZ-Star initiates an outbound call by dialing the specified phone number.

Dnnnnnnnnnn	Where nnnnnnnnnn is the destination phone number
DS=n	Where n is the index number of stored phone number directory (See AT&Z command in Section 6.2.1)

For CDMA 1XRTT packet mode, EZ-Star establishes a TCP connection to the specified IP address and port number.

Daaa.aaa.aaa.aaa,ppppp	Where aaa.aaa.aaa.aaa is the destination IP address and ppppp is the destination port number.
DS=n	Where n is the index number of the stored IP address and port number of the caller ID directory (See AT>Z command in section 6.2.4)

6.2.3.3 H – Disconnect (Hang-Up)

Modem drops the socket connection if it was in on-line data modem and then tries to register on the network again.

6.2.3.4 O – Online Data Mode

Modem switches back to data mode from online command mode during connection. Modem reports ERROR when it stays in idle (command) mode.

6.2.4 Cellular Control Commands

6.2.4.1 >I – View Cellular Setup

Displays cellular radio setting including Electrical Serial Number (ESN), Mobile Identification Number (MIN), Network Service Mode, Network preference Access User ID, and Network Access User Password.

Example:

```
AT>I
ESN                          = 6C107732
MIN                          = 5825825168
Network                      = Circuit Switch
Network Access User ID       = 5825825168@vzw3g.com
Network Access User Password = vzw

OK
```

6.2.4.2 >M – Mobile Identification Number

The CDMA network service provider assigns a unique phone number (MIN) for every cellular modem. This MIN has to be set and saved into NVRAM before activating the modem.

Example:

```
AT>M=5825825168
```

6.2.4.3 >N – Network Service Mode

Selects CDMA circuit switch or packet data service mode.

```
AT>N=n,    Where    n = 0, CDMA circuit switch (default);
                    n = 1 CDMA 1XRTT packet data
```

6.2.4.4 >Q – View Current Cellular Status

Displays current status of the modem, including Receiving Signal Strength Indication, Modem State, Registration State, and Current Channel.
Example:

```
AT>Q
Service Provider    = VERIZON
Network             = CDMA2000 1X Network
Current SID         = 2
Current Band Class  = 800 MHz Cellular Band
Roaming Status      = Roaming
RSSI                = -86 dBm

OK
```

6.2.4.5 >U – Network Access User ID

Sets the network access user specified by your service provider.

>U=*ID Where *ID is a character string.

Example:

AT>U=5825825168@vzw3g.com

6.2.4.6 >W – Network Access User Password

Sets the network access user password specified by your service provider

>W=*P Where *P is a character string (maximum length is 16 bytes).

Example:

AT>W=vzw

6.2.4.7 >Z – Caller ID Directory (1XRTT ONLY)

This command creates a directory that is used for establishing both inbound (to EZ-Star) and outbound (from EZ-Star) initiated 1XRTT packet connections. Inbound initiated connections are established by first placing a circuit switched trigger call to EZ-Star. EZ-Star will accept the inbound caller ID but will not answer the call. EZ-Star will then search the caller ID directory for a caller ID match. If a match is found, EZ-Star will establish a TCP connection back to the IP address and port number associated with the caller ID. Outbound calls, may be initiated using the ATDS command to select one of the 10 entries in this table. EZ-Star will establish a TCP connection to the IP address and port number associated with that entry

>Zn=ddddddddddd, aaa.aaa.aaa.aaa, ppppp

Where n is the index number of the IP address directory in the range of 0-9 and ddd.ddd.ddd.ddd is the inbound caller ID that will trigger EZ-Star to establish a TCP connection to IP address aaa.aaa.aaa.aaa, port pppp.

To clear an entry in the caller ID directory, enter AT>Zn= with no parameters. The entry defined by n will be cleared.

6.2.5 Remote Configuration Command

6.2.5.1 \P+ – Store Remote Configuration Password

Store up to ten ASCII characters as the password (case sensitive) to enable the security feature of remote configuration.

Example:

AT\P+gdi5825168
OK

6.2.5.2 \P- – Delete Remote Configuration Password

Delete the stored password and disable the security feature of remote configuration.

6.2.5.3 \P? – View Remote Configuration Password

Displays the stored remote configuration password.

6.2.5.4 \Rn – Remote Configuration

Enables or disables remote configuration. When remote configuration is enabled, the modem responds to a special escape sequence "~ ~ ~" from the calling modem. When the escape sequence is recognized, the modem goes into online command mode and allows the caller to issue any valid AT command.

\R0	Disable remote configuration.
\R1	Enable remote configuration. (Default)

6.2.5.5 \Sn – Secure Password Authentication

Enables or disables Secure Password Authentication. For packet data mode, modem will send the Caller ID to the server as the password for authentication.

\S0	Disable secure password authentication (Default)
\S1	Enable secure password authentication

6.3 S-REGISTERS

The table in this section summarizes the S-Registers and their default values. All registers are stored in the user profile by entering the *AT&W* command. The value of these registers can be viewed and changed by using ATSn=d and ATSn? commands.

6.3.1 S-REGISTER SUMMARY

Register	Function	Range	Units	Profile 0 Default
S0	Rings to Auto-Answer	0 – 1 0 = don't answer	Ring	1
S2	Escape Character	0 – 255	ASCII	43 (+)
S7	Wait Time for Carrier	1 – 255	Sec.	50
S12	Escape Prompt Delay	0 – 255	10 ms	80
S30	Inactivity Timer for Call Termination	0 – 255 0 = never time out	Min.	0
S100	Signal quality LED shut off timer	0 – 255 0 = always off 255 = always on	Min	30
S101	Radio re-registration timer	0 - 255	10 Min	144
S102	Thermal shut down threshold (Threshold for disabling radio operation)	0 – 70	° C	70
S103	Thermal reactivation threshold (Threshold for reactivating radio once thermal shut down has occurred)	0 - 65	° C	60
S104	Current temperature (read only)	-127 - +127	° C	N/A
S105	Over temperature counter (read only) (Incremented every time that the thermal shut down threshold is exceeded)	0 - 255	N/A	N/A

7 SPECIFICATIONS

7.1 FCC NOTICES

PART 15 - This equipment generates and uses radio frequency energy, which may cause interference to radio and TV reception if it is not installed and used according to the manufacturer's instructions. This equipment has been tested and complies with the limits for a Class B computing device according to U.S. Code of Federal Regulations, Title 47, FCC Rules and Regulations Part 15, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

RF EXPOSURE INFORMATION – In August of 1996, the Federal Communications Commission (FCC) of the United States with its action in Report and Order FCC 96-326, adopted an updated safety standard for human exposure to radio frequency electromagnetic energy emitted by FCC regulated transmitters. Those guidelines are consistent with the safety standard previously set by both U.S. and international standards bodies. The design of this device complies with the FCC guidelines and these international standards.

- Operating Requirements
    - The user cannot make any changes or modifications not expressly approved Global Data, otherwise it could void the user's authority to operate the equipment.
    - To satisfy FCC RF exposure compliance requirements for a mobile transmitting device, this device and its antenna should generally maintain a separation distance of 20cm or more from a person's body.
- Special Accessories
    - In order to ensure this device in compliance with FCC regulation, only special accessories approved by Global Data may be used with the device. The user is not allowed to use any accessories other than those accessories approved or offered by Global Data.

7.2 ELECTRICAL AND ENVIRONMENTAL

PARAMETER	**RATING**	**UNITS**
Supply Voltage	100 - 277V ± 10%	VAC
Operation Temperature Range	-20 to +70	°C (max)
Humidity (relative, non-condensation)	95	%
Antenna connection (SMA – Female)	50	Ohm
Sensitivity	-104	dBm (nom)
Transmit Power	300	mW (nom)

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