SIGRAND

SHDSL modem
Sigrand SG-16G

User's Guide
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How to use this Guide

To ease using this Guide the following notational conventions are provided here (icons as well as relevant fonts):

Icons

Icon	Meaning	Explanation
	Pay attention!	The text marked by this icon contains information making easy setup and maintenance of equipment
	Important information!	The text marked by this icon contains important information explaining details of operation of equipment or software. This allows to save your time and efforts while equipment setup.
	Do not make this!	Knowing this information allow you to avoid actions that can cause damage to hardware and/or personal injury.

Font usage

Designation	Explanation
`Picture on the screen`	This font shows contents of terminal screen while modem setup.
Name of keyboard button	This font shows computer keyboard buttons, e.g. **"Enter"**, which are used in the console management mode.
Select Property in the File menu	*Italic* notes the fragments of this Guide containing important information (together with the relevant icons). It also marks software buttons of menu in the text.
`dsl stat`	**`Bold`** font is used to designate modem management commands while a terminal session.

➔ *Before starting installation of the modem we recommend you to look for a updated version of this User's Guide as well as the firmware and the drivers available at our site www.sigrand.com*

1. Modem description

The Sigrand SG-16G modem is a SHDSL-modem. It features an E1 system interface (ITU-T G.703/G.704, 2048 kbps) and is intended to be used as a line termination unit of TDM-based communication equipment. The modem allows to make connections between devices equipped with E1 interfaces such as telco equipment, routers and access servers.

The SHDSL interface of the modem conforms to ITU-T G.991.2.bis standard and uses TCPAM (Trellis-Coded Pulse Amplitude Modulation) line coding.

Features of the TCPAM line coding:
The TCPAM line coding used by G.991.2 (G.SHDSL) compatible modems has a few modes. The modes differ in complexity of coding algorithm. The modes with larger number of modulation positions (TCPAM16, TCPAM32) are applicable for higher rates, the modes with less number of modulation positions (TCPAM4, TCPAM8) are applied for lower rates. Respectively, the more complicated the coding algorithm the worse the channel noise immunity and vice versa.
So take special attention to the TCPAM line coding algorithm selection while configuring the line rate. It may be necessary to change the line coding to achieve the best result.

Table 1 shows the line coding options and respective data rate ranges.

Table 1

Line coding	Data rate range (kbps)
TCPAM32	256 – 2048
TCPAM16	192 – 2048
TCPAM8	192 – 1216
TCPAM4	64 – 704

Manual line coding selection is available only in the console management mode – see chapter 3 of this Guide

Compatibility:
The Sigrand SG-16G modem line coding is compatible with all Sigrand SG-16 series and Granch SBNI16 series modems.

The modem features the following interfaces:

- one SHDSL interface (conforms to ITU-T G.991.2.bis standard) providing the data rate range from 64 to 2048 kbps.
- one E1 interface (G.703/G.704, 2048 kbps).
- one EIA-232C (RS-232C) interface for modem management.

1.1 DSL interface specifications

Link type	point-to-point
Number of wires per line	2 (one pair)
Permitted cabling	any UTP
Line coding	TCPAM
Input/output impedance, Ω	135
Data rate range, kbps	64-2048
Data rate step, kbps	64
Transmission type	full duplex
Data transfer mode	synchronous, by packets
Packet type	HDLC
Checksum type	CRC32
Connector type	RJ-45
Galvanic decoupling transformer breakdown voltage, min, V	1500
Surge protector triggering voltage (differential), V	30
Arrester breakdown voltage (common-mode), V	350

1.1.1 Maximum reach performance

Brief information about the maximum reach performance of the Sigrand SG-16G modem is shown on Table 2. The Bit Error Rate (BER) at the maximum reach is equal to or less than 10^{-7}. The specified reach is proved by testing at the Sigrand lab reference line. Full version of the rate table is available at

our site www.sigrand.com. An actual reach may vary against the shown data due to variations of cable performance.

Table 2

Data rate (kbps)	Line coding	Rating	TPP50-0.4 cable (26 AWG)	TPP50-0.5 cable (24 AWG)
2048	TCPAM16	Length (km/ft)	**3.8/12400**	**5.6/18300**
		R (Ω)	1064	980
1536	TCPAM16	Length (km/ft)	**4.4/14400**	**6.4/20100**
		R (Ω)	1232	1120
1024	TCPAM8	Length (km/ft)	**5.0/16400**	**7.6/24900**
		R (Ω)	1400	1330
512	TCPAM8	Length (km/ft)	**5.8/19000**	**9.0/29500**
		R (Ω)	1624	1575
256	TCPAM8	Length (km/ft)	**6.6/21600**	**10.0/32800**
		R (Ω)	1848	1750
128	TCPAM4	Length (km/ft)	**7.4/24200**	**11.4/37400**
		R (Ω)	2072	1995
64	TCPAM4	Length (km/ft)	**7.4/24200**	**11.4/37400**
		R (Ω)	2072	1995

1.2 E1 interface specifications

Type of interface	RJ-45, Balanced
Number of wires per line	4
Line coding	HDB3, AMI
Data rate, kbps	2048
Maximum reach, km (ft)	
TPP50-0.4 cable (26 AWG)	1.2 (3900)
TPP50-0.5 cable (24 AWG)	2.4 (7800)
Frame type	G.704
Superframe types	CRC4, CAS

Unframed mode	available

1.3 RS-232C interface specifications

Baud rate	9600, 57600
Protocol parameters	8-N-1
Flow control	N/A
Connector type	RJ-45 (DB-9F with converter)

1.4 Power supply unit

Type	BPN-12-1V
Input voltage	220V/50Hz
Output voltage	12V
Maximum load current	1A
Polarity of the central contact of the connector	positive

1.5 Miscellaneous data

Overall modem dimensions:	
• height, mm/in.	45/1.77
• width, mm/in.	225/8.86
• depth, mm/in.	165/6.5
Weight, g/lb	450/1
Weight with PSU, g/lb	1050/2.32
Power consumption, W	6

1.6 Shipment contents

Sigrand SG-16G modem	1 pc.
Power supply unit	1 pc.
Guide	1 pc.
Cable with converter RJ-45-DB-9	1 pc.
Package	1 pc.

1.7 Environmental specifications

The modem is designed to operate under office conditions as follows:

air temperature	10 .. 40 °C (50 .. 104 °F)
relative air humidity	up to 85 %
atmosphere pressure	84 .. 107 kPa (630 .. 802 mmHg)

1.8 Appearance, controls, indicators and connectors

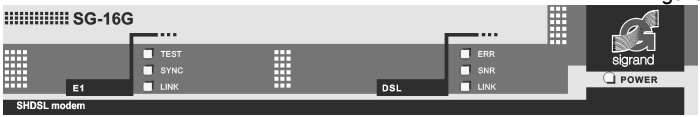
The Sigrand SG-16G modem can be connected to any equipment having E1 interface such as telco equipment, routers and access servers.

The modem is manageable by switches placed on the rear panel as well as by console management port (ch. 4.1). To manage the modem as well as to monitor its status you should have an ANSI-compatible terminal emulation software installed on your computer. Configure your terminal program according to ch. 1.3 of this Guide.

1.8.1 Front panel and indicators

The front panel indicators display the status of device operation.

Figure 1



Purpose of Sigrand SG-16G indicators

Table 3

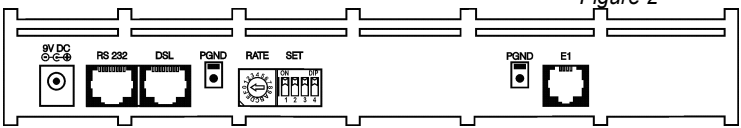
Indicator	Status	Explanation
POWER		
POWER	On	Modem is on

	Off	Modem is off	
DSL			
LINK	On	Active link to remote modem	
	Off	No link to remote modem	
SNR	LINK on	Blink	Bad signal/noise ratio
		Off	Good signal/noise ratio
	LINK off	Blink	Link activation in progress
		Off	No link
ERR	LINK on	Blink	A packet with error received
		Off	No error
	LINK off	On	Fatal error
E1			
LINK	On	Signal from E1 equipment detected	
	Off	No signal from E1 equipment	
SYNC	On	Frame synchronization detected or Unframed mode	
	Off	Frame synchronization not detected	
TEST	On	Test mode	
	Off	Operation mode	

1.8.2 Rear panel and connectors

Layout of connectors and switches on the rear panel of the Sigrand SG-16G modem

Figure 2

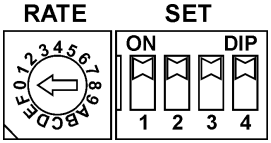


Purpose of connectors and switches of the Sigrand SG-16G modem

Table 4

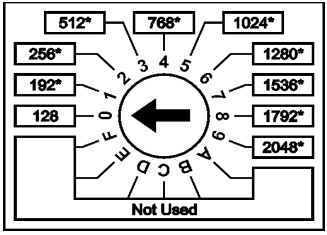
Power supply unit plug	**9-12V DC**
RS-232C console port for modem management	**RS232**
DSL line connector	**DSL**
Terminal to connect to protective ground	**PGND**
Dial to select fixed rate for DSL channel	**RATE**
DIP switches to set up modem operation mode	**SET**
E1 interface socket	**E1**

Fig. 3



The “RATE” dial and the “SET” DIP switches (fig.3) specify operation mode of the DSL channel. The dial sets a DSL channel data rate (fig.4).

Fig. 4



The “SET1” DIP switch sets “Master/Slave” mode, the “SET2” switch defines a method of the DSL channel rate negotiation and the “SET4” switch sets a mode of modem management. Purpose of the switches are shown on Table 5.

Table 5

Switch	Purpose	Position	Meaning
SET1	Operation mode	ON	master modem (STU-C)
		OFF	slave modem (STU-R)
SET2	Rate selection	ON	Automatic
		OFF	Manual
SET3	RS-232C console port data rate	ON	57600 bps
		OFF	9600 bps
SET4	Modem management method	ON	by console port
		OFF	by DIP switches

Attention!
Reboot the modem to activate a new modem operation mode, changed by the DIP switches!

2. Modem setup directions

2.1 Connecting modem to a line

Make sure the line has no foreign devices varying its specifications such as fuses, inductors, load coils and other similar line conditioning devices. These devices may cause serious modem performance limitations or even completely prevent operation of an xDSL modem!

Make sure that the communication line in use has neither external voltage supply nor attached foreign telco devices! Ignoring this rule may cause permanent damage to both the modems and those foreign telco equipment!

2.1.1 Requirements to a communication line

The line must comply with the following requirements for proper operation and performance:

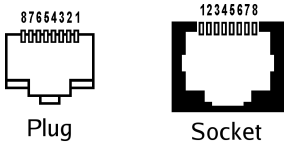
- It must have neither leakage to ground nor to other wires (both connected and loosed). It should not have taps (branches).
- Both wires must belong to the same twisted pair if a multi-pair cable is used.
- Parallel connection of a few pairs (e. g., to reduce the line resistance) is not permitted.

Ignoring the aforementioned requirements may cause significant modem performance limitations or even completely prevent operation of an xDSL modem.

After you verify that the line comply with the aforementioned requirements -

- Fix the supplied RJ-45 plug on the cable in accordance with figure 5. The Sigrand SG-16G modem uses only one pair of pins, namely 4 and 5. Other pins are not assigned.
- Attach the cable to the DSL connector of the modem.

Fig.5



2.2 Choosing modem management method

There are two ways to manage the modem:

- by the DIP-switches placed on the rear panel of the modem (see fig.4);
- by a terminal program via the RS-232C console port.

Both modes have certain advantages over each other so a user is free to choose either setup mode according to actual requirements for modem operation.
Setup by switches is described here as the most simple method. Management by a terminal program is described in Chapter 3.

To use setup by switches, set the SET4 switch to OFF state. For quick reference use the sticker at the bottom side of the modem enclosure.

2.3 ”Master”/”slave” mode

Two modems operating peer-to-peer must be configured by the SET1 DIP switch (fig. 3, table 4) such as one modem is set up as a “master” (SET1 is ON) and another one as a “slave” (SET1 is OFF). We recommend to use as a “master” the modem which is more accessible for management and maintenance.

2.4 Setting DSL rate

Fixed rate value is set by dial switch RATE (figures 2 and 4). One of 9 fixed data rates have to be selected by the dial (1 to 9). The SET2 switch is OFF for fixed rate.

2.4.1 Rate selection guidelines

Before setting the data rate you should have known the performance of the line the modems are intended for. If the line performance is unavailable, apply the following technique to select the proper data rate:

- Measure resistance of the line. To do this, make short-circuit on either line side and attach an ohmmeter to another one. Then determine a maximum rate providing reliable communication by table 2.
- Switch carefully the dial to the required position with a screwdriver. Reboot both modems to activate the new settings. Link activation takes up to 2 or 3 minutes to succeed.
- If the link is not activated (the DSL LINK LED is not getting light) during the mentioned time, set a smaller value on the rate dial and do the next attempt to activate the link.
- If you can't get the link activated, consider to use console management mode (Chapter 3). In this mode you can try to succeed by varying the line coding (Chart 1) as well.

2.4.2 Automatic rate selection

Set the SET2 DIP switch to “ON” position for each modem to enable DSL automatic rate selection (Line Probe). Automatic rate selection operates in the range conforming to ITU-T G.991.2 within 192 to 2048 kbps with TCPAM16 line coding only. Besides, the RATE dial sets the upper limit for the rate. If the modems have different dial settings, the rate is limited by the least value.

2.5 E1 interface setup

2.5.1 Connecting E1 interface

Equipment attached to the modem is required to have a balanced E1 port, typically implemented as an RJ-45 socket. The interface uses 2 loops, one to receive and another to transmit the data. Pins 1 and 2 are assigned to the E1 receiver input, pins 4 and 5 are assigned to the transmitter output (Table

6, figure 5). Other pins are not assigned. It is not necessary to recognize polarity of the connection.

Table 6

Pin	E1 circuit
1	Receive + (Rx Tip)
2	Receive – (Rx Ring)
4	Transmit + (Tx Tip)
5	Transmit – (Tx Ring)

2.5.2 Configuring E1 interface

In the DIP switches setup mode (SET4 is OFF) the E1 port always has the following fixed settings:

- Long-Haul mode
- HDB3 line coding
- CRC4 and CAS superframes are disabled

The RATE dial defines the DSL interface rate and the number of mapped E1 timeslots, as shown in the Table 7. When possible, unframed mode is used (RATE is “9”, 2048 kbps).

Table 7

Rate	Timeslots	Rate	Timeslots
0	Not used	8	1-28
1	1-3	9	Unframed
2	1-4	A	Not used
3	1-8	B	Not used
4	1-12	C	Not used
5	1-16	D	Not used
6	1-20	E	Not used
7	1-24	F	Not used

3. Modem management via console port

The modem is manageable by a terminal attached to the RS-232C console port or by a computer with any applicable terminal emulation software.

3.1 Terminal setup

Set the the SET4 DIP-switch to “ON” position to manage the modem through the console port. (see Table 5, Figure 2).
Set the baud rate of the modem console port by the SET3 switch. SET3 is OFF stands for 9600 baud, SET3 is ON stands for 57600 baud.
Attach the RS-232C port to a serial port of your computer by the supplied cable.
Configure the terminal emulation software installed on your computer (for example, HyperTerminal) as follows:

Data bits: 8
Parity: None
Stop bits: 1
Flow control: None

Baud rate (Bits per second) should be set to 9600 or 57600 in accordance with SET3 switch setting.

Power on or reboot the modem. If the terminal has been set up properly, the following message appears on the screen:

```
Sigrand SG-16B SHDSL modem V.2.4
Interface module M16-G
Initialization complete
:
```

3.2 General purpose commands

The modem is managed by a set of commands conventionally divided into two types: the “general purpose” commands such as **`help`**, **`info`**, **`update`**, **`default`**, **`reboot`**, and the interface management commands such as **`dsl`** and **`e1`**.

Capabilities of the console management mode allow to configure the DSL interface as well as to control the E1 interface. It is also possible to watch status of the interfaces, etc. The summary of the general management capabilities can be invoked by the **help** command:

```
: help
  ****  Available commands: ****
HELP - display this text
HELP [ETH|DSL|PORT|E1|FXS|FXO] - detailed interface help
INFO - view information about hardware and firmware
STAT [RESET] - show all statistics (or clear it)
ETHx - view or change ETHx settings, x=1,2 (see HELP ETH)
DSL - view or change DSL settings (see HELP DSL)
PORT - view or change PORT settings (see HELP PORT)
E1 - view or change E1 settings (see HELP E1)
FXSx - view or change FXS settings, x=1,2 (see HELP FXS)
FXOx - view or change FXO settings, x=1,2 (see HELP FXO)
UPDATE - update sg16 firmware
DEFAULT - set factory defaults
REBOOT - reboot the modem
:
```

*The SG-16 modems are multi-functional devices with various types and combinations of system interfaces such as E1, V.35, FXO/FXS. Therefore the **help** command displays commands for each interface available in this firmware.*

The **info** command displays information about the firmware version, the modem uptime, and current status of the modem interfaces.

```
: info
Sigrand SG-16B SHDSL modem V.2.4
Setup mode: Terminal
SHDSL firmware: V.5.00
Interface module M16-G
Uptime: 0 days 01:08:55
E1A: Long-Haul UNFRAMED Code=HDB3 - OFFLINE
DSL: Rate=2048 kbit/s Code=TCPAM16 MASTER - OFFLINE
:
```

The **stat** command displays current status and statistics of the modem interfaces:

```
: stat
E1A: Long-Haul FRAMED CAS Code=HDB3 - ONLINE
FAS_Sync=No CAS_Sync=No
CV=0 FASE=0
Loop Loss: 37.5 dB
DSL: Rate=3072 kbit/s Code=TCPAM32 MASTER - ONLINE
LOSW=13 CRC6=14 RETRAIN=3 of 4
Loop Loss: 0.0 dB  Noise Margin: +22.0 dB
Total online time: 0 days 00:21:24
Total offline time: 0 days 00:02:11
Connect duration: 0 days 00:23:35
:
```

Upon completion of this command any statistics data of the E1 interface is automatically reseted (see ch. 3.4.4 of this Guide) unlike statistics data of the DSL interface. That data should be reseted explicitly by the **stat** command with the **reset** or **dsl stat reset** options (see ch. 3.3.4).

The **default** command resets all modem settings to factory default values.

```
: default
Load factory default and reboot? (y/n) Y
Default settings loaded
Rebooting…
```

entering cancel **N** or any other character except **Y** breaks the command execution and causes the prompt to enter a next command.

The **reboot** command performs reset of the modem.

```
: reboot
Rebooting...

Sigrand SG-16B SHDSL modem V.2.4
Interface module M16-G
Initialization complete
:
```

The **update** command is used to update the modem firmware. Detailed procedure of firmware reprogramming is discussed in chapter 4 of this Guide.

➔ *Not recognized commands causes appearance of the message* **Unknown command**, *illegal command options causes appearance of the message* **Unknown keyword.**

3.3 DSL interface management

We advise to invoke the **help dsl** command in advance to get informed about the DSL interface management features available through the console management mode:

```
: help dsl
DSL - show current DSL settings
DSL RATE [rrrr|AUTO] | CODE cccc | MASTER | SLAVE - set mode
for DSLx
DSL STAT [RESET] - show statistics for DSL (or clear it)
DSL RETRAIN - force DSL to retrain
:
```

The **DSL** command allows to view statistics, to enter or to change settings of the DSL interface.
The command invoked with no option displays current settings of the interface

```
: dsl
DSL: Rate=2048 kbit/s Code=TCPAM16 MASTER – OFFLINE
:
```

3.3.1 "Master"/"slave" mode selection

Configure one peer modem as "master", do another one as "slave" for proper operation.

This is performed by the **dsl** command with the **master** or **slave** options:

```
: dsl master
DSL: Rate=2048 kbit/s Code=TCPAM16 MASTER - OFFLINE
: dsl slave
DSL: Rate=2048 kbit/s Code=TCPAM16 SLAVE – OFFLINE
:
```

3.3.2 Setting DSL rate

The rate setup is performed by the **RATE rrrr** option ("**rrrr**" stands for rate in kbps). The rate is within 64 to 2048 kbps range with 64 kbps step.

The rate should be set the same for both sides:

```
: dsl rate 64
DSL: Rate=64 kbit/s Code=TCPAM4 MASTER - OFFLINE
: dsl rate 2048
DSL: Rate=2048 kbit/s Code=TCPAM16 MASTER – OFFLINE
:
```

The line coding mode is also changed accordingly upon the rate change. See how rates match line coding on Chart 1.

3.3.2.1 Automatic rate selection

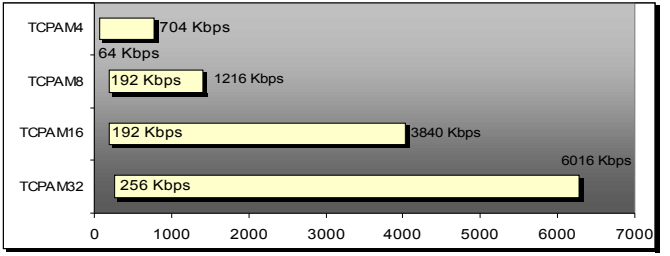
The automatic rate selection mode (Line Probe) is turned on by the **rate auto** option. The valid data rate range for automatic selection is from 192 to 2304 kbps. The maximum rate can be specified after the **auto** option.

```
: dsl rate auto
DSL: Rate=Auto 0 of 2304 kbit/s Code=TCPAM16 MASTER - OFFLINE
: dsl rate auto 2048
DSL: Rate=Auto 0 of 2048 kbit/s Code=TCPAM16 MASTER – OFFLINE
:
```

3.3.3 Line coding selection

As mentioned above, different TCPAM line coding modes are used to transmit data with different rates.

Chart 1



The **`code cccc`** option of the **`dsl`** command provides a way to select a line coding mode of 4 available (TCPAM32, TCPAM16, TCPAM8 and TCPAM4). It allows to select a proper mode in according to ratings of the line.

```
: dsl code tcpam8
DSL: Rate=512 kbit/s Code=TCPAM8 MASTER - OFFLINE
:
```

➔ *As follows from Chart 1, many data rates allows to use multiple line coding modes. Rule: apply a coding mode with less positions (TCPAM8, TCPAM4) on a line exposed to high level of noise; apply a coding mode with more positions (TCPAM32, TCPAM16) if bandwidth is limited.*

For automatic rate selection only the TCPAM16 line code is allowed.

If the data rate is not within the permitted range for an entered line coding mode, the following message appears: **invalid line code for this rate.**

3.3.4 Link statistics

Use the **dsl** command with the **stat** option to view link statistics:

```
: dsl stat
DSL: Rate=512 kbit/s Code=TCPAM8 SLAVE - ONLINE
TX=1341 RX=1231 ERR=1 LOSW=12 CRC6=11 RETRAIN=2 of 5
Loop Loss: 0.0 dB  Noise Margin: +22.0 dB
Total online time: 0 days 00:42:19
Total offline time: 0 days 00:18:02
Connect duration: 0 days 00:15:53
:
```

Legend:
ONLINE – the DSL link is activated;
OFFLINE – the DSL link is not activated;
TX – the number of transmitted packets;
RX – the number of received packets;
ERR – the number of received packets with errors;
LOSW – the number of frame synchronization loss events;
CRC6 – the number of CRC6 checksum errors;
RETRAIN – the number of successful attempts to establish the link with regard to the total number of attempts;
Loop Loss – loop loss (attenuation level), dB;
Noise Margin – loop noise margin, dB;
Total online time – total time elapsed when link is on;
Total offline time – total time elapsed when link is off;
Connect duration – duration of the last successful session;

Use the **dsl** command with the **stat reset** option to clear the statistics counters:

```
: dsl stat reset
DSL: Rate=512 kbit/s Code=TCPAM8 SLAVE - ONLINE
TX=0 RX=0 ERR=0 LOSW=0 CRC6=0 RETRAIN=0 of 0
Loop Loss: 0.0 dB  Noise Margin: +22.0 dB
Total online time: 0 days 00:00:00
Total offline time: 0 days 00:00:00
Connect duration: 0 days 00:00:00
:
```

3.3.5 How to force a retrain

Retraining of the DSL interface is performed by the **`dsl`** command with the **`retrain`** option:

```
: dsl retrain
DSL: Rate=512 kbit/s Code=TCPAM8 SLAVE - OFFLINE
:
```

3.4 E1 interface management

The Sigrand SG-16G modem features one E1 (G.703/G.704, 2048 kbps) port.

The following commands allow to manage the port:

```
:help e1
E1 - show current E1 settings
E1 [SHORT|LONG] - select Short-Haul or Long-Haul mode
E1 CODE [AMI|HDB3] - set E1 line code
E1 [/]FRAMED [/]CRC4 [/]CAS - set E1 framing options
E1 MAP - show E1 timeslot map
E1 MAP [ADD|DEL] [0]..[31] [ALL] - add/delete timeslots
E1 STAT - show E1 statistics and clear it
:
```

The **e1** command allows to view the statistics and to configure the E1 interface.
Execution of the command without options and arguments shows current settings of the interface:

```
: e1
E1A: Long-Haul FRAMED CAS Code HDB3 - ONLINE
:
```

3.4.1 Long/Short Haul modes

The **short** option of the **E1** command turns off the E1 interface line amplifier. The **long** option conversely turns it on. Respectively, the short-haul mode range is within 400 meters (1200 feet) for 0.4 mm wire (26 AWG) cable. The long-haul mode range is expanded up to 1200 meters (3600 feet).

```
: e1 long
E1A: Long-Haul UNFRAMED Code=HDB3 – ONLINE
: e1 short
E1A: Short-Haul UNFRAMED Code=HDB3 – ONLINE
:
```

3.4.2 Framing modes and superframe options

The G.704 framed mode is enabled by the **e1** command with the **framed** option and additional keys **crc4** and **cas**. These keys defines enable the appropriate CRC4 and CAS superframes.

```
: e1 framed crc4 cas
E1A: Long-Haul FRAMED CRC4 CAS Code=HDB3 – ONLINE
:
```

The error message follows up any attempt to enable superframing in unframed mode:

```
: e1 crc4
Invalid option for unframed mode
: e1 cas
Invalid option for unframed mode
:
```

Disabling superframes and frame synchronization is performed by the **e1** command with the **/framed** option and the **/crc4** and **/cas** keys.

```
: e1
E1A: Long-Haul FRAMED CRC4 CAS Code=HDB3 - ONLINE
: e1 /cas
E1A: Long-Haul FRAMED CRC4 Code=HDB3 - ONLINE
: e1 /crc4
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
: e1 /framed
E1A: Long-Haul UNFRAMED Code=HDB3 - ONLINE
:
```

Disabling framing synchronization also disables the CRC4 and CAS superframes.

```
: e1
E1A: Long-Haul FRAMED CRC4 CAS Code=HDB3 - ONLINE
: e1 /framed
E1A: Long-Haul UNFRAMED Code=HDB3 - ONLINE
:
```

3.4.3 Line coding

The line coding type is set by the **E1** command with the **code** option and keys **ami** or **hdb3**.

```
: e1 code ami
E1A: Long-Haul FRAMED CRC4 CAS Code=AMI - ONLINE
: e1 code hdb3
E1A: Long-Haul FRAMED CRC4 CAS Code=HDB3 - ONLINE
:
```

ITU-T G.703 recommendation requires the HDB3 line coding.

3.4.4 E1 interface statistics

Use the **e1** command with the **stat** option to view the statistics:

```
: e1 stat
E1A: Long-Haul FRAMED CAS Code=HDB3 - ONLINE
FAS_Sync=No CAS_Sync=No
CV=0 FASE=0
Loop Loss: 37.5 dB
:
```

FAS_Sync – framing synchronization status;
CAS_Sync – CAS superframe synchronization status;
CRC4_Sync – CRC4 superframe synchronization status;
CV – the number of code violations
FASE – the number of Frame Alignment Signal Errors
CRC4E – the number of CRC4 errors
E-bits – the number of far end errors;
Loop Loss – line loop loss, dB;

*Execution of the **e1 stat** command does automatic reset of any current statistics of the interface!*

3.4.5 Timeslot map

The G.704 E1 frame structure consists of 32 8-bit channels (so-named "timeslots") which have been assigned numbers from 0 to 31.
The timeslot 0 is used to transmit the frame alignment signal (FAS) and the additional (service) bits (Sa, Si).
The timeslots 1 through 31 are used to transmit payload data. The timeslot 16 may be retained for signaling.

The SGI-16BG modem supports transmission within the range from 1 to 32 timeslots. An actual amount of the slots depends on feasible DSL rate. The rate must be at least N*64 kbps to be able to transmit N timeslots. For example, DSL rate must be at least 512 kbps to transmit 8 timeslots. Timeslot numbers destined for transmission are defined by timeslot map. Each of 32 timeslots can be individually included or excluded from the number of transmitted timeslots.

The **`e1`** command with the **`map`** option allows to view and modify the timeslot map. The timeslots destined for transmission are marked by asterisk (`*`). The timeslots marked by minus (`-`) sign are not transmitted.

```
: e1 map
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0        . 1      .    2    .      3
01234567890123456789012345678901
-***************---------------
Used timeslots: 16 Payload: 1024 kbit/s
:
```

To add timeslots use the **`e1`** command with the **`map`** option and a key alike **`add N`** with **`N`** standing for number of an added timeslot.

```
: e1 map add 24
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0        . 1      .    2    .      3
01234567890123456789012345678901
-***************--------*-------
```

```
Used timeslots: 17 Payload: 1088 kbit/s
:
```

To add several timeslots specify those by a list: **e1 map add 3 4 6**, or by a range: **e1 map add 8-11**. To enable all timeslots simultaneously use the following command: **e1 map add all**.

```
: e1 map add 3 4 6
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0        . 1      .    2    .      3
012345678901234567890123456789 01
---**-*-------------------------
Used timeslots: 3 Payload: 192 kbit/s
:
: e1 map add 8-11
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0        . 1      .    2    .      3
012345678901234567890123456789 01
---**-*-****---------------------
Used timeslots: 7 Payload: 448 kbit/s
:
: e1 map add all
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0        . 1      .    2    .      3
012345678901234567890123456789 01
*******************************
Used timeslots: 32 Payload: 2048 kbit/s
:
```

If total capacity of timeslots exceeds the DSL interface rate, the following warning appears while map examination: **"Too many timeslots for this DSL rate"**

To delete timeslots from the transmission list use the **map del N** option with **N** standing for number of a deleted timeslot. To delete several timeslots specify those by a list: **map del 1 2 3** or by a range: **map del 7-14**. It also possible to remove all timeslots: **map del all**.

```
: e1 map del 1 2 3
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0       . 1     .   2   .     3
01234567890123456789012345678901
---*****************************
Used timeslots: 29 Payload: 1856 kbit/s
:
: e1 map del 7-14
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0       . 1     .   2   .     3
01234567890123456789012345678901
---****--------*****************
Used timeslots: 21 Payload: 1344 kbit/s
:
: e1 map del all
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0       . 1     .   2   .     3
01234567890123456789012345678901
--------------------------------
Used timeslots: 0 Payload: 0 kbit/s
:
```

To apply a new timeslot map enter the **`dsl retrain`** *command. It is required to reconfigure the DSL interface upon changing the map.*

Defining of timeslots is possible in framed mode only. In unframed mode the entire E1 trunk is passed through DSL so the required DSL rate is 2048 kbps.

The error message appears on any attempt to change the timeslot map in unframed mode:

```
: e1
E1A: Long-Haul UNFRAMED Code HDB3 - ONLINE
: e1 map add 1-5
Invalid option for unframed mode
:
```

3.4.5.1 Timeslot 0

The timeslot 0 usually is not included in a list of transmitted timeslots since it is used for framing synchronization and carries no payload data, but its transmission demands another 64 kbps of the DSL rate.

If the timeslot 0 is used to transmit payload data in additional (service) bit positions, it may also be included to the list of transmitted timeslots:

```
: e1 map add 0
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0        . 1      .    2    .     3
01234567890123456789012345678901
*__*****************************
Used timeslots: 30 Payload: 1920 kbit/s
:
```

3.4.5.2 Timeslot 16

The timeslot 16, conforming to G.704 recommendation, is reserved for signaling.

The timeslot 16 must be included in a list of transmitted timeslots regardless of other timeslots if equipment connected by the modems requires a channel for signaling, e.g. telco devices.

```
: e1 map add 0
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0        . 1      .    2    .     3
01234567890123456789012345678901
---*****--------*---------------
Used timeslots: 6 Payload: 384 kbit/s
:
```

In the example above the timeslots 3 through 7 are used to carry voice channels and the timeslot 16 is used to transmit signaling. The modem recognizes all those timeslots as payload data, so the required DSL rate is 384 kbps.

3.4.6 E1 interface behavior in the Automatic DSL rate selection mode

E1 interface operation of the SG-16G modems has a number of features in the automatic DSL rate selection mode.

The number of transmitted timeslots may vary from one connection session to another since the DSL rate is selected automatically per each connection session.

In this mode the timeslot map defines timeslot numbers that are subject to transmit through DSL regardless a selected rate so a total amount of those timeslots specifies the lowest permitted rate.

The link remains down if the line provides no such rate. Additional timeslots can be transmitted if the link rate exceeds the lowest permitted rate. Those slots are marked in the map by (+) sign upon DSL link activation.

```
: dsl
DSL: Rate=Auto 1408 of 2304 kbit/s Code TCPAM16 SLAVE - ONLINE
: e1 map
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0        . 1      .    2    .     3
01234567890123456789012345678901
---***************++++++---------
Used timeslots: 16 Payload: 1024 kbit/s
:
```

In the example above timeslots 1 through 16 are required to transmit (marked by asterisk “*”) so that demands 1024 Kbps DSL rate. Upon the link activation the actual rate (1408 kbps) exceeds the lowest permitted rate so 6

timeslots are added. These are timeslots 17 through 22 (marked by plus "+").
All free timeslots are arranged as additional timeslots in ascending order starting from 1. The timeslot 0 cannot be used as an additional one.

Upon disconnecting all additional timeslots are removed automatically.

```
: dsl
DSL: Rate=Auto 1408 of 2304 kbit/s Code TCPAM16 SLAVE -
OFFLINE
: e1 map
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0       . 1     .   2   .     3
012345678901234567890123456789 01
---**************---------------
Used timeslots: 16 Payload: 1024 kbit/s
:
```

4. Updating built-in modem firmware

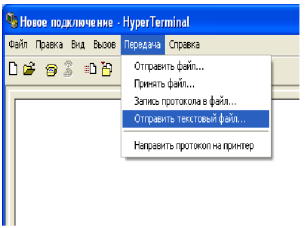
Use the **update** command to update the built-in firmware of the Sigrand SG-16G modem in the following order:

```
: update
Load new image? (y/n) Y
```

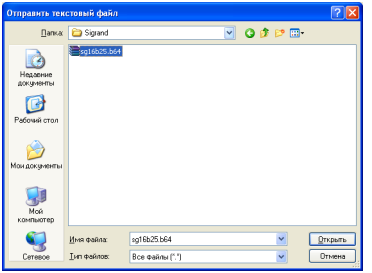
Upon entering procedure acknowledgement **Y** the memory buffer is clearing and the prompt to download the image file appears here:

```
Clearing buffer memory... OK
Loading image...
```

Then select the *"Send Text File"* option in the *Send* menu of the terminal program (here we suppose you are using HyperTerminal from standard Microsoft Windows shipment),



then specify location of the image file planned to load to the modem. Image files look like *.b64. Since the firmware can contain a few image files, the update procedure has to be performed for each file. Order of file updating may be arbitrary.




```
Clearing buffer memory... OK
Loading image... OK
Checking image... OK, Type=SG16HOST V.2.5
Program new image? (y/n) Y
```

Enter acknowledgement **Y** to complete the write procedure:

```
Checking BootLoader... OK
Self-Programming... OK
Rebooting...
```

press **N** or **Esc** as a response to any prompt to cancel the update procedure:

```
: update
Load new image? (y/n) N
Update canceled!
:
```

Warranty and scope of liability

The Manufacturer warrants its Modem to be free from defects in materials and workmanship. This warranty applies only if the Purchaser has been used and maintained the Modem in accordance with the operating and maintenance directions given in this Guide. This warranty does not apply if the Modem has been subject to misuse, negligence, accident, fire or other casualty.

This warranty is valid for a period of 5 (five) years from either the purchase date as marked on the Warranty Coupon or the stated manufacturing date if the purchase date has not been marked. Subject to conditions and limitations set forth above and below, the Manufacturer will, at its option, either repair or replace the Modem that prove defective of improper workmanship or materials. The Manufacturer shall in no event be liable for any consequential, indirect or damages or expenses, lost revenues, lost profits, or any other incidential or consequential damages arisingfrom the purchase, use or inability to use the modem, even if the Manufacturer has been advised of the possibility of such damages.

Warranty limitations:

Warranty is void for modems operating on wires having aerial sections.

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www.sigrand.com

WARRANTY COUPON

For Sigrand SG-16G modem

Serial number _____

MFG date ____/____/200__
day month year

Quality checker_____/_____/

Stamp

Seller	
Address	
Phone	
Sale date	
Stamp	
Signature	

Purchaser	
Address	
Phone	
Purchase date	
Stamp	
Signature	

Appendix I. General specifications of TPP cable

Table I.1 Frequency response for twisted-pair cabling with copper conductor and PE-insulation (for reference only)

f, kHz	Primary ratings			Secondary ratings	
	R~, Ω/km	L, H/km*10^{-4}	G,S/km*10^{-4}	|Z|, Ω	α, dB/km
Conductor diameter 0.4 mm (26 AWG)					
20	278	5.51	1.13	225.2	6.81
50	280	5.51	4.24	152.6	9.12
100	283	5.50	11.3	125.7	10.3
250	316	5.46	42.2	113.7	12.2
500	394	5.35	120	110.5	15.6
700	455	5.26	188	109.1	18.2
1000	535	5.15	305	107.7	21.7
Conductor diameter 0.5 mm (24 AWG)					
20	181	5.50	1.13	185.1	5.15
50	182	5.50	4.24	133.3	6.48
100	189	5.49	11.3	118.0	7.17
250	234	5.40	42.2	111.6	9.21
500	310	5.23	120	108.8	12.4
700	361	5.26	188	107.4	14.6
1000	424	5.04	305	106.3	17.2

Table I.2 Cable loop resistance to conductor diameter ratio:

Conductor diameter (mm)	Loop resistance (Ω/km)
0.32	432
0.4	278
0.5	180
0.64	110