SIGRAND

SHDSL modem
Sigrand SG-16G2

User's Guide
v. 2.4

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Contents

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-16G2 modem is a SHDSL-modem. It features two E1 system interfaces (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 key feature of the modem is the capability to transmit two E1 trunks through a single SHDSL interface.

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 – 4096
TCPAM16	192 – 3840
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-16G2 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 4096 kbps.
- two E1 interfaces (G.704/704, 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	64-4096
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-16G2 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)
4096	TCPAM32	Length (km/kft)	**2.2/7200**	**3.0/9800**
		R (Ω)	**616**	**525**
3072	TCPAM32	Length (km/kft)	**3.0/9800**	**4.2/13700**
		R (Ω)	**840**	**735**
2048	TCPAM32	Length (km/kft)	**3.8/12400**	**5.6/18300**
		R (Ω)	980	1064
1536	TCPAM16	Length (km/kft)	**4.4/14400**	**6.4/20900**
		R (Ω)	1232	1120
1024	TCPAM16	Length (km/kft)	**5.0/16400**	**7.6/24900**
		R (Ω)	1400	1330
512	TCPAM8	Length (km/kft)	**5.8/19000**	**9.0/29500**
		R (Ω)	1624	1575
256	TCPAM8	Length (km/kft)	**6.6/21600**	**10.0/32800**
		R (Ω)	1848	1750
128	TCPAM4	Length (km/kft)	**7.4/24200**	**11.4/37400**
		R (Ω)	2072	1995
64	TCPAM4	Length (km/kft)	**7.4/24200**	**11.4/37400**
		R (Ω)	2072	1995

1.2 E1 interfaces 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)

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	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	1100/2.43
Power consumption, W	6

1.6 Shipment contents

Sigrand SG-16G2 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-16G2 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

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Purpose of Sigrand SG-16G2 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 (A/B)			
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-16G2 modem

Figure 2
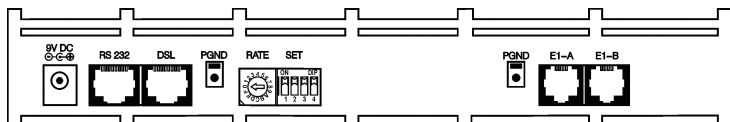
Purpose of connectors and switches of the Sigrand SG-16G2 modem

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 A	**E1-A**
E1 interface socket B	**E1-B**
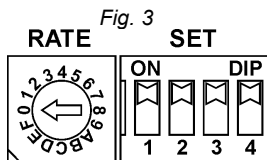
Fig. 3

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

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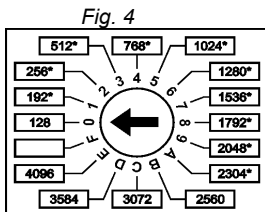
The "SET1" DIP switch selects "Master/Slave" mode, the "SET2" switch is not used and the "SET4" switch sets a mode of modem management. Purpose of the switches are shown on Table 5.

Table 5

Switch	Purpose	Position	Meaning
SET1	Operation mode	ON	Master modem (STU-C)
		OFF	Slave modem (STU-R)
SET2	Not used		
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-16G2 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

Plug   Socket
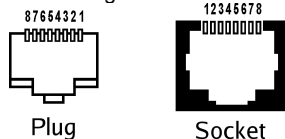
2.2 Choosing modem management method
There are two ways to manage the modem:

- 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 14 fixed data rates have to be selected by the dial. The SET2 switch is OFF for fixed rate.

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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.

2.5 E1 interfaces setup

2.5.1 Connecting E1 interfaces

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)

E1 devices are connected to the E1-A and E1-B ports (RJ-45 sockets, fig. 5) placed on the rear panel of the modem (fig. 2).

2.5.2 Configuring E1 interfaces
In the DIP switches setup mode (SET4 is OFF) the E1 ports always have 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-A and E1-B timeslots with the following rules applied:

- If the DSL rate does not exceed 2048 kbps (the RATE dial set to a position from 1 through 9), only the E1-A timeslots are transmitted.
- If the rate has a capacity to transmit all 32 timeslots, the unframed mode is used because it is more versatile and can transmit both framed and unframed streams.

Table 7 shows all possible options of timeslot mapping in the switches setup mode.

Table 7

Rate	Timeslots		Rate	Timeslots	
	E1-A	E1-B		E1-A	E1-B
0	Not used	Not used	8	1-28	-
1	1-3	-	9	Unframed	-
2	1-4	-	A	Unframed	1-4
3	1-8	-	B	Unframed	1-8
4	1-12	-	C	Unframed	1-16
5	1-16	-	D	Unframed	1-24
6	1-20	-	E	Unframed	Unframed
7	1-24	-	F	Not used	Not used

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2.5.3 E1 interfaces synchronization

The modem can transmit via DSL two entire (unchannelized) or fractional (channelized) E1 trunks with total payload up to 4096 kbps.
The E1-A and E1-B ports of the SG-16G2 modem differ in the clock synchronization. The E1-A port serves as the clock source for the for both E1-A and E1-B streams transferred through a DSL loop.
The incoming E1-A and E1-B streams must be synchronous i.e. they must have one common source of the clock. There are two possible ways to comply with the requirement:

1. Both the E1-A and E1-B modem ports are connected to the same device so the clock for both E1 trunks is provided by the same internal source of the device.
2. The E1-A and E1-B ports are connected to different devices. The clock source is the device connected to the E1-A port. In this case the device connected to the E1-B port is required to use the external clock from the receiver. Both devices connected to the E1-A and E1-B ports of the remote modem are also required to use the external clock from the receiver.

Errors may appear on the E1-B port if the devices connected to the E1-A and E1-B ports are operating with different (not synchronous with each other) clocks .

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 M16-2G
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-A ans E1-B interfaces. 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.5.0
Interface module M16-2G
Uptime: 0 days 00:22:30
E1A: Long-Haul FRAMED CAS Code HDB3 - ONLINE
E1B: Long-Haul FRAMED CAS Code HDB3 - ONLINE
DSL: Rate=4096 kbit/s Code=TCPAM32 SLAVE - ONLINE
:
```

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
E1B: 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.

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

entering cansel **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 M16-2G
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 4096 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 4096
DSL: Rate=4096 kbit/s Code=TCPAM16 MASTER – OFFLINE
:
```
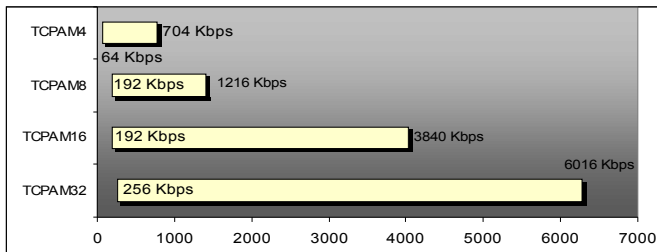
The line coding mode is also changed accordingly upon the rate change.
See how rates match line coding on Chart 1.

3.3.3 Line coding selection

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

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 interfaces management

The Sigrand SG-16G2 modem features two E1 (G.703/G.704, 2048 kbps) ports.

The following commands allow to manage the ports:

```
: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 **e1a (e1b)** 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:

```
: e1a
E1A: Long-Haul FRAMED CAS Code HDB3 - ONLINE
: e1b
E1B: Long-Haul FRAMED CAS Code AMI - OFFLINE
:
```

3.4.1 Long/Short Haul modes

The **short** option of the **E1A (E1B)** 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).

```
: e1a long
E1A: Long-Haul UNFRAMED Code=HDB3 - ONLINE
: e1b short
E1B: Short-Haul UNFRAMED Code=HDB3 - ONLINE
:
```

3.4.2 Framing modes and superframe options

The G.704 framed mode is enabled by the **e1a (e1b)** command with the **framed** option and additional keys **crc4** and **cas**. These keys defines enable the appropriate CRC4 and CAS superframes.

```
: e1a framed crc4 cas
E1A: Long-Haul FRAMED CRC4 CAS Code=HDB3 - ONLINE
:
```

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

```
: e1a crc4
Invalid option for unframed mode
: e1b cas
Invalid option for unframed mode
:
```

Disabling superframes and frame synchronization is performed by the **e1a (e1b)** command with the **/framed** option and the **/crc4** and **/cas** keys.

```
: e1a
E1A: Long-Haul FRAMED CRC4 CAS Code=HDB3 - ONLINE
: e1b /cas
E1B: Long-Haul FRAMED CRC4 Code=HDB3 - ONLINE
: e1 /crc4
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
: e1b /framed
E1B: Long-Haul UNFRAMED Code=HDB3 - ONLINE
:
```

Disabling framing synchronization also disables the CRC4 and CAS superframes.

```
: e1a
E1A: Long-Haul FRAMED CRC4 CAS Code=HDB3 - ONLINE
: e1 /framed
: e1a
E1A: Long-Haul UNFRAMED Code=HDB3 - ONLINE
:
```

3.4.3 E1 line coding

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

```
: e1a code ami
E1A: Long-Haul FRAMED CRC4 CAS Code=AMI - ONLINE
: e1a 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 **e1a (e1b)** command with the **stat** option to view the statistics:

```
: e1a 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 Alingment Signal Errors
CRC4E – the number of CRC4 errors
E-bits – the number of far end errors;
Loop Loss – line loop loss, dB;

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➜ *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-16G2 modem supports transmission within the range from one to 32 timeslots for each E1 interface. An actual amount of the timeslots depends on a feasible DSL rate. The rate must be at least N*64 kbps to be able to transmit N timeslots. For example, any DSL rate must be at least 512 kbps to transmit 8 timeslots.
Timeslots numbers destined for transmission are defined by timeslot map. Each of 32 timeslots of each E1 interface can be individually included or excluded from number of transmitted timeslots.

The **e1a (e1b)** command with the **map** option allows to view and to modify a timeslot map. The timeslots destined for transmission are marked by asterisk (*). The timeslots marked by minus (−) sign are not transmitted.

```
: e1a 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 **e1a (e1b)** command with the **map** option and a key alike **add N** with **N** standing for number of an added timeslot.

```
: e1a 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: **e1a (e1b) map add 3 4 6**, or by a range: **e1a map add 8-11**. To enable all timeslots simultaneously use the following command: **e1a map add all**.

```
: e1a map add 3 4 6
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0       . 1     . 2     . 3
01234567890123456789012345678901
---**-*------------------------
Used timeslots: 3 Payload: 192 kbit/s
:
: e1a map add 8-11
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0       . 1     . 2     . 3
01234567890123456789012345678901
---**-*-****--------------------
Used timeslots: 7 Payload: 448 kbit/s
:
: e1a map add all
E1A: Long-Haul FRAMED Code=HDB3 - ONLINE
0       . 1     . 2     . 3
01234567890123456789012345678901
********************************
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 list transmission list use the **map del N** option with **N** stands for a number of 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 is also possible to remove all timeslots: **map del all**.

```
: e1b map del 1 2 3
E1B: Long-Haul FRAMED Code=HDB3 - ONLINE
0       . 1       . 2       . 3
01234567890123456789012345678901
---*****************************
Used timeslots: 29 Payload: 1856 kbit/s
:
: e1b map del 7-14
E1B: Long-Haul FRAMED Code=HDB3 - ONLINE
0       . 1       . 2       . 3
01234567890123456789012345678901
---****--------*****************
Used timeslots: 21 Payload: 1344 kbit/s
:
: e1b map del all
E1B: 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.

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

```
: e1a
E1A: Long-Haul UNFRAMED Code HDB3 - ONLINE
: e1a 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 in the list of transmitted timeslots:

```
: e1a 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.

```
: e1a 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.

4. Updating built-in modem firmware

Use the **update** command to update the built-in firmware of the Sigrand SG-16G2 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),
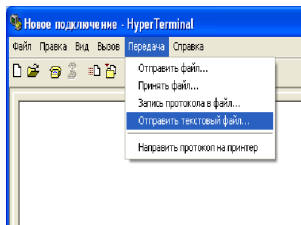
then specify location of the image file planned to load to the modem. Image files look like *.b64. Since the firmware can contain a few image files, the update procedure has to be performed for each file. Order of file updating may be arbitrary.
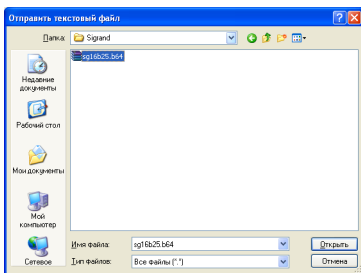
```
Clearing buffer memory... OK
Loading image... OK
Checking image... OK, Type=SG16HOST V.2.5
Program new image? (y/n) Y
```

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!
:
```

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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 casualy.

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 incidental 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.

MANUFACTURER ADDRESS
Sigrand LLC,
pr. Lavrentieva 6,
Novosibirsk,
Russia
Phones +7 (383)-330-02-43, 332-94-37 Fax +7 (383)-332-02-43
www.sigrand.com

WARRANTY COUPON

For Sigrand SG-16G2 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. Кгц	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