

SIGRAND

# Voice/Data exchange equipment set

# SHDSL modems Sigrand SG-16BVo and Sigrand SG-16BVs

User's Guide v. 2.5

Novosibirsk 2006

© 2005, 2006, Sigrand LLC

All trademarks and registered trademarks mentioned hereinafter are the property of their respective owners.

# Contents

Contents	page
How to use this Guide	5
1. Modem description	7
1.1 DSL interface specifications	8
1.1.1 Maximum reach performance	9
1.1.2 File transfer performance	10
1.2 Ethernet interface specifications	10
1.3 Ethernet Bridge specifications	11
1.4 FXO interface specifications	11
1.5 FXS interface specifications	11
1.6 Voice channel specifications	11
1.7 RS-232C interface specifications	12
1.8 Power supply unit	12
1.9 Miscellaneous data	12
1.10 Shipment contents	12
1.11 Environmental specifications	13
1.12 Appearance, controls, indicators and connectors	13
1.12.1 Front panel and indicators	13
1.12.2 Rear panel and connectors	15
2. Modem setup directions	18
2.1 Connecting modem to a line	18
2.1.1 Requirements to a communication line	19
2.2 Choosing modem management method	19
2.3 "Master"/"slave" mode	20
2.4 Setting DSL rate	20
2.4.1 Setting DSL rate for remote modem	20
2.4.2 Rate selection guidelines	21
2.5 Configuring FXo/FXs iterfaces	21
3. Modem management via console port	22
3.1 Terminal setup	22
3.2 General purpose commands	23
Ine help command	23
The info command	23
The stat command	24

The default command	24
The reboot command	25
3.3 DSL interface management	25
The help dsl command	25
The ds1 command	26
3.3.1 "Master"/"slave" mode selection	26
The dsl master and dsl slave	26
commands	
3.3.2 Setting DSL rate	27
3.3.2.1 Setting DSL rate from "master" modem	27
The dsl rate command	27
3.3.2.2 Setting DSL rate manually both sides	28
3.3.3 Line coding selection	28
The dsl code command	29
3.3.4 Link statistics	30
The dsl stat command	30
The dsl stat reset command	30
3.3.5 How to force a retrain	31
The dsl retrain command	31
3.4 Ethernet interfaces management	31
The help eth commands	31
The eth command	32
3.4.1 Rate and duplex type	32
The eth auto, eth /auto, eth	32
rate, eth half, eth full commands	
3.4.2 Flow control	33
The eth flow and eth /flow	34
commands	
3.5 FXO and FXS interfaces management	34
3.5.1 View current settings	35
The fxs, fxo commands	35
3.5.2 Channel ON/OFF control	35
Ine fix* on and fix* off commands	36
5.5.5 Voice codec selection The first code command	36 36
3.5.4 Dynamic bandwidth allocation	37
o.o.+ Dynamic banawath allocation	01

The <b>fx</b> * bwa command	37
3.5.5 Adaptive echo cancellation	37
The fx* ec command	38
<ol><li>Updating built-in modem firmware</li></ol>	39

# 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
Â	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 <i>Property</i> in the <i>File menu</i>	<i>Italic</i> 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 set of the Sigrand SG-16BVo and Sigrand SG-16BVs modems is intended for corporate network applications. The modems allow to transmit two voice channels and one data channel simultaneously using the single pair only. The data channel of the modem features an Ethernet-bridge and can be used to connect various Ethernet 10/100 Base-T devices.

The bridge can transmit VLAN IEEE 802.1Q tagged packets through the DSL interface and the Ethernet interfaces.

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 – 6016
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-16BV modem line coding is compatible with all Sigrand SG-16 series and Granch SBN16 series modems.



Limitations of compatibility:

Interoperability with the Granch SBNI16 modems is supported only within the compatible data rate range from 64 to 4608 kbps.

- one SHDSL interface (conforms to ITU-T G.991.2.bis standard) providing the data rate range from 192 to 5696 kbps and the optional extended range from 64 to 6016 kbps
- two Ethernet 10/100Mb (IEEE 802.3) interfaces with Auto-Negotiation and Auto MDI/MDI-X
- two FXS or FXO interfaces
- one EIA-232C (RS-232C) interface for modem management.

# 1.1 DSL interface specifications

Link type Number of wires per line	point-to-point 2 (one pair)
Permitted cabling	any UIP
Line cooling	125
Deta rata rango, khoa	133 64 6016
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	1500

30
350

#### 1.1.1 Maximum reach performance

Brief information about the maximum reach performance of the Sigrand SG-16BV modem is shown on Table 2. The Bit Error Rate (BER) at the maximum reach is equal to or less than 10<sup>-7</sup>. The specified reach is proved by testing at the Sigrand lab reference line. Full version of the rate table is available at our site <u>www.sigrand.com</u>. 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)
6016	TCDAM22	Length (km/ft)	1.8/3500	2.2/7200
0010	TCPAIVI32	R (Ω)	476	420
4609	TODAM22	Length (km/ft)	2.0/6500	2.6/8500
4606	TCPAIVI32	R (Ω)	560	455
2072	TODAMIC	Length (km/ft)	3.0/9800	4.2/13700
3072 TCPAM16	TCPAIVITO	R (Ω)	840	736
0004 TODAM40	Length (km/ft)	3.8/12400	5.4/17700	
2304	TCPAIVI 10	R (Ω)	1064	945
1526	TODAMIC	Length (km/ft)	4.4/14400	6.4/20100
1536 TCPAM16	TCPAIVI 10	R (Ω)	1232	1120
1024	TCDAMO	Length (km/ft)	5.0/16400	7.6/24900
1024	TCPAIVIO	R (Ω)	1400	1330
540 300		Length (km/ft)	5.8/19000	9.0/29500
512		R (Ω)	1624	1575

	Length (km/ft)	6.6/21600	10.0/32800	
200	I CPAIVIO	R (Ω)	1848	1750
100		Length (km/ft)	7.4/24200	11.4/37400
128 I CPAIVI4	R (Ω)	2072	1995	
64		Length (km/ft)	7.4/24200	11.4/37400
04 I CPAIVI2	TCPAI/14	R (Ω)	2072	1995

## 1.1.2 File transfer performance

Performance of the SG-16BV modem during file transferring by FTP *protocol* is shown on Table 3. The table contains average readings obtained on a line with error rate less than  $10^{-7}$ .

Table 3

Line data	File transfer	Line data	File transfer
rate	performance	rate	performance
(kbps)	(KBps)	(kbps)	(KBps)
6016	700	1792	209
5696	662	1536	179
4608	536	1280	149
4096	478	1024	119
3584	418	768	89
3072	354	512	59
2560	304	256	29
2304	261	192	22
2048	234	128	15

#### 1.2 Ethernet interface specifications

Interface type Number of ports Data rate, Mbps Duplex type 10/100 Base-T 2 10/100 Half and full duplex

Compatibility Auto MDI/MDI-X	ANSI/IEEE Std 802.3 available
1.3 Ethernet Bridge specifications	
MAC-address table size Maximum packet size, bytes Packet buffer size, KBytes:	2048 1536 512 (340 packets)
1.4 FXO interface specifications	
Number of ports Connector type Permitted battery voltage range, V Permitted ring voltage range, V Permitted ring signal frequency range, Hz Nominal impedance of loop termination, $\Omega$	2 RJ-11 30 – 72 30 – 120 16 – 50 600
1.5 FXS interface specifications	
Number of ports Connector type Nominal battery voltage, V Hang-off loop current, mA Peak ring voltage, V Ring voltage frequency, Hz Maximum number of telephone devices Nominal impedance of loop termination, Ω	2 RJ-11 48 30 70 25 2 600
1.6 Voice channel specifications	
Supported codecs Available data rates per one channel, Kbps Sampling rate, Hz Compression 11	G.711, G.726 128, 64, 32, 24 8000 A-law

Nominal gain, dB Frequency range, Hz Flatness of frequency response, max dB Nonlinear distortion ratio, max dB Noice level, max dB	0 300 – 3400 0.5 minus 35 minus 60
1.7 RS-232C interface specifications	
Baud rate Protocol parameters Flow control Connector type	9600, 57600 8-N-1 N/A RJ-45 (DB-9F with converter)
1.8 Power supply unit	
Type Input voltage Output voltage Maximum load current Polarity of central contact of connector	BPN-12-1V 220V/50Hz 12V 1A positive
1.9 Miscellaneous data	
<ul> <li>Overall modem dimensions: height, mm/in.</li> <li>width, mm/in.</li> <li>depth, mm/in.</li> <li>Weight, g/lb</li> <li>Weight with PSU, g/lb</li> <li>Power consumption, W</li> </ul>	45/1.77 225/8.86 165/6.5 450/1 1200/2.65 6
1.10 Shipment contents	
Sigrand SG-16BVs/16BVo modem Power supply unit	1 pc. 1 pc.

Guide	1 pc.
Cable with converter RJ-45-DB-9	1 pc.
Package	1 pc.

#### 1.11 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)

#### 1.12 Appearance, controls, indicators and connectors.

The Sigrand SG-16BV modem should be connected either to a computer equipped with an Ethernet or Fast Ethernet card or to an Ethernet-switch.



We recommend to connect the modem to an Ethernet switch, not a hub, since our equipment is optimized for interaction with Ethernet switches.

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. 1.7 of this Guide.

#### 1.12.1 Front panel and indicators

The front panel indicators display the status of device operation.

Figure 1a

IIIIIIIIII SG-16E	3Vo			<u>a</u>
FXO	RING CH ON ETHERNET	FD/C 100 M LINK DSL	ERR SNR LINK	sigrand Power
SHDSL modem	1 2	1 2		



# Purpose of Sigrand SG-16BVo/BVs indicators

Table 4

Indicator	Status	Explanation					
POWER							
	On		Modem is on				
FOWER	Off		Modem is off				
	[	DSL					
	On	Act	ive link to remote modem				
LINK	Off	N	o link to remote modem				
	LINK on	Blink	Bad Signal/noise ratio				
SNR		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				

ETHERNET ( channels 1 and 2)						
	On	Valid Ethernet link detected				
LINK	Off	Et	thernet link not detected			
	Blink	Traffic exchange				
100M	LINK on	On	100Base-TX link detected			
TUUM	LINK ON	Off	10Base-TX link detected			
		On	Full duplex			
FD/C	LINK on	Off	Half duplex			
		Blink	Collision detected			
	FXo	/ FXs				
ON	Not used					
OH	On	Off-hook state				
RING	On	Ring detected				

1.12.2 Rear panel and connectors

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



1.12.2.2 Layout of connectors and switches on the rear panel of the Sigrand SG-16BVs modem:

Figure 2b



# Purpose of connectors and switches of the Sigrand SG-16BVo and SG-16BVs modem

	Table 5
Power supply unit plug	9-12V DC
RS-232C console port for modem management	RS232
DSL channel connector	DSL
Terminal to connect protective ground	PGND
Dial to select fixed rate for DSL channel	RATE
DIP switches to set up modem operation mode	SET
Socket 1 to connect Ethernet 10/100Base-T	ETH1
Socket 2 to connect Ethernet 10/100Base-T	ETH2
SG-16BVo	
Socket of first FXO port	FXO1
Socket of second FXO port	FXO2
SG-16BVs	·
Socket of first FXS port	FXS1
Socket of second FXS port	FXS2

Fig. 3



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





The "SET1" DIP switch selects "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 6.

Table 5

Switch	Purpose	Position	Meaning
SET1	Operation mode	ON	Master modem (STU- C)
	-	OFF	Slave modem (STU-R)
SET2	Local or Preactivation rate select	ON	Rate is exchanged by Preactivation

		OFF	Rate is set locally on each modem
SET3	RS-232C console port	ON	57600 bps
(SET4= ON)	data rate	OFF	9600 bps
SET3		ON	ADPCM32
(SET4= OFF)	Voice codec type	OFF	PCM64
SETA	Modem management	ON	by console port
3614	mode	OFF	by DIP switches

The SET3 switch has different meaning depending on the modem management mode (SET4). If the modem is managed via console port (SET4 is ON), the SET3 selects the baud rate of the console port. If the modem is controlled by switches (SET4 is OFF), the SET3 selects the voice codec type.



#### 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-16BV 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.



## 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 16 fixed data rates have to be selected by the dial.

## 2.4.1 Setting DSL rate for remote modem

This feature is available only for modems with firmware version 2.5 or higher.

The SET2 switch has the following meaning:

- if SET2 is OFF, the rate is set manually at both ends of the line. (I this case modem uses Annex A for compatibility with firmware version 2.4 and lower)
- if SET2 is ON, the DSL rate is set by the dial switch RATE of the "master" modem. (In this case Annex F is used.)

The SET2 switch must be set to the same position for both modems.



To operate properly peer-to-peer, the modems settings should match each other! Do not forget to configure the remote modem beforehand!

# 2.4.2 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. If the remote rate setting is used (SET2 is ON), change the "master" modem rate only. 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 Configuring FXO/FXS interfaces

For the switches setup mode, (SET4 is OFF), the FXS and FXO interfaces are always configured as follows:

- Both channels are ON
- The voice codec type is set by SET3 switch (ON=ADPCM32, OFF= PCM64)
- Dynamic bandwidth allocation is turned on
- Adaptive echo cancellation is turned off

 If the rate is 192 kbps, then the voice codec type is ADPCM32 regardless the SET3 switch.

# 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.2.5
Interface module ETH1/ETH2
Interface module M16-2Vs
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 eth1/eth2.

Capabilities of the console management mode allow to configure the DSL interface as well as to control the Ethernet 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 DSL) PORT - view or change FIX settings, x=1,2 (see HELP FX) E1 - view or change FXS settings, x=1,2 (see HELP FXS) FXOx - view or change FXS settings, x=1,2 (see HELP FXS) 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.2.5

Setup mode: Terminal

SHDSL firmware: V.5.3E

FPGA configuration: V.2.20

Interface module ETH1/ETH2

Interface module M16-2Vs

Uptime: 0 days 01:08:55

FXS1: ON Code=PCM64 BWA=static EC=off

FXS2: ON Code=PCM64 BWA=static EC=off

ETH1: Rate=100 Mbit/s Duplex=FULL Auto-Neg FlowCont - OFFLINE

ETH2: Rate=100 Mbit/s Duplex=FULL Auto-Neg FlowCont - OFFLINE

DSL: CFG=PREACT Rate=192 Code=TCPAM16 MASTER Annex=F -

OFFLINE

:
```

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

```
: stat
ETH1: Rate=100 Mbit/s Duplex=FULL Auto-Neg FlowCont - OFFLINE
TX=0 RX=0 ERR=0 COL=0
ETH2: Rate=100 Mbit/s Duplex=FULL Auto-Neg FlowCont - OFFLINE
TX=0 RX=0 ERR=0 COL=0
DSL: CFG=LOCAL Rate=5696 Code=TCPAM32 MASTER Annex=A -
OFFLINE
TX=0 RX=0 ERR=1 LOSW=0 CRC6=0 RETRAIN=0 of 1
Total online time: 0 days 00:00:00
Total offline time: 0 days 00:00:09
Connect duration: 0 days 00:00:00
:
```

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 <u>N</u> or any other character except <u>Y</u> 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.2.5
Interface module ETH1/ETH2
Interface module M16-2Vs
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 CFG [LOCAL|PREACT] - configuration mode: Local or G.hs

Preactivation

DSL RATE [rrrr|AUTO] | CODE cccc | MASTER | SLAVE - set mode

for DSLx

DSL ANNEX [A|B|F|G] - set Annex type

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: CFG=PREACT Rate=192 Code=TCPAM16 MASTER Annex=F -
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: CFG=LOCAL Rate=512 Code=TCPAM8 MASTER Annex=A - OFFLINE
: dsl slave
DSL: CFG=LOCAL Rate=512 Code=TCPAM8 SLAVE Annex=A - OFFLINE
:
```

#### 3.3.2 Setting DSL rate

Modems with firmware version 2.5 or higher have the ability to set DSL rate from a "master" modem. The ability to set the rate manually at the both ends of the line is supported as well.

#### 3.3.2.1Setting DSL rate from "master" modem

In order to control the rate by accessing the "master" modem only, configure both modems beforehand for Preactivation (dsl cfg preact) and Annex F (dsl annex f):

```
: dsl cfg preact annex f
DSL: CFG=PREACT Rate=2304 Code=TCPAM16 MASTER Annex=F -
OFFLINE
:
```

The rate setup is performed by the **RATE rrrr** option ("**rrrr**" stands for rate in kbps). The rate is within 192 to 5696 kbps range with 64 kbps step:

```
: dsl rate 192

DSL: CFG=PREACT Rate=192 Code=TCPAM16 MASTER Annex=F -

OFFLINE

: dsl rate 5696

DSL: CFG=PREACT Rate=5696 Code=TCPAM32 MASTER Annex=F -

OFFLINE

:
```

To set a new value of the rate, enter the command at the "master" modem only. The "slave" modem obtains the rate via G.hs Preactivation (ITU-T G.994.1) protocol.

#### 3.3.2.2 Setting DSL rate manually both sides

If the lower rates (64 to 128 kbps) or the higher rates (5696-6016) are required, set the local control mode (dsl cfg local) for both modems. The Annex type can be set A or F, if both modems have firmware version 2.5 or higher. If one of the modems have firmware version 2.4 or lower (including Granch SBNI16 modems), only Annex A should be used for compatibility (dsl annex a).

```
: dsl cfg local annex a
DSL: CFG=LOCAL Rate=5696 Code=TCPAM32 MASTER Annex=A -
OFFLINE
:
```

Manual rate setup is performed by the **RATE rrrr** option ("**rrrr**" stands for rate in kbps). The rate is within 64 to 6016 kbps range with 64 kbps step. The rate should be set the same for both sides:

```
: dsl rate 6016
DSL: CFG=LOCAL Rate=6016 Code=TCPAM32 MASTER Annex=A -
OFFLINE
: dsl rate 64
DSL: CFG=LOCAL Rate=64 Code=TCPAM4 MASTER Annex=A - 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.

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: CFG=LOCAL Rate=512 Code=TCPAM8 MASTER Annex=A - 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.

In the local configuration mode (CFG=LOCAL) all four variations of the line coding are applicable. In the Preactivation mode (CFG=PREACT), only two codings can be used: TCPAM16 in the 192 to 3840 kbps range and TCPAM32 in the 768 to 5696 kbps range.

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: CFG=LOCAL Rate=512 Code=TCPAM8 SLAVE Annex=A - 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 00:14:02
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: CFG=LOCAL Rate=512 Code=TCPAM8 SLAVE Annex=A - 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: CFG=LOCAL Rate=512 Code=TCPAM8 SLAVE Annex=A - OFFLINE
:
```

#### 3.4 Ethernet interfaces management

The Sigrand SG-16BV modem features two Ethernet 10Base-T/100Base-T ports with Auto MDI/MDI-X.

The following commands allow to manage the ports:

```
: help eth
ETHx - show current ETHx settings, ETHx=1,2
ETHx RATE [10|100]|FULL|HALF|[/]AUTO|[/]FLOW - set mode for
ETHx
ETHx STAT [RESET] - show statistics for ETHx (or clear it)
:
```

The eth command allows to view statistics, to enter or to change Ethernet interface settings.

The command requires to specify interface index – eth1 stands for the Ethernet1 interface and eth2 the Ethernet2 interface. The command entered with no arguments allows to view current settings of the interfaces:

```
: eth1
ETH1: Rate=10 Mbit/s Duplex=HALF Auto-Neg FlowCont - ONLINE
:
```

#### 3.4.1 Rate and duplex type

The modem Ethernet interfaces have Auto-Negotiation and flow control settings enabled by default.

Transmission rate and duplex type are detected automatically in Auto-Negotiation mode. The priority of operation mode detection descends from 100Base-TX Full Duplex (the highest priority), 100Base-TX Half Duplex, 10Base-T Full Duplex down to 10Base-TX Half Duplex (the lowest priority).

To disable the Auto-Negotiation mode use the eth1 or the eth2 commands with the /auto option:

```
: eth1
ETH1: Rate=100 Mbit/s Duplex=FULL Auto-Neg FlowCont - ONLINE
: eth1 /auto
ETH1: Rate=100 Mbit/s Duplex=FULL FlowCont - ONLINE
:
```

If Auto-Negotiation mode is off, use either the eth1 or the eth2 commands respectively with the rate 10 or the rate 100 options to set the Ethernet interface rate manually:

```
: ethl rate 100
ETH1: Rate=100 Mbit/s Duplex=FULL FlowCont - ONLINE
: ethl rate 10
ETH1: Rate=10 Mbit/s Duplex=FULL FlowCont - ONLINE
:
```

Also the full or the half options of the commands allows to switch between full and half duplex, use the options on the relevant interface:

```
: eth1 half
ETH1: Rate=10 Mbit/s Duplex=HALF FlowCont - ONLINE
: eth1 full
ETH1: Rate=10 Mbit/s Duplex=FULL FlowCont - ONLINE
:
```

Use the **eth1** or the **eth2** command with the **auto** option to enable Auto-Negotiation mode:

```
: eth1
ETH1: Rate=10 Mbit/s Duplex=FULL FlowCont - ONLINE
: eth1 auto
ETH1: Rate=100 Mbit/s Duplex=FULL Auto-Neg FlowCont - ONLINE
:
```

#### 3.4.2 Flow control

Besides setting of the rate and the transmission mode, the modem features flow control in compliance with the IEEE 802.3x specifications. It improves operation, protects packet buffer against overflowing and prevents data loss. This technique may also improve total network throughput and help to achieve optimal performance.

Use the eth1 or the eth2 commands with the flow option to enable flow control feature:

```
: eth1 flow
ETH1: Rate=100 Mbit/s Duplex=FULL Auto-Neg FlowCont - ONLINE
:
```

Use the eth1 or the eth2 commands with the /flow option to disable the feature:

```
: ethl /flow
ETH1: Rate=100 Mbit/s Duplex=FULL Auto-Neg - ONLINE
:
```

#### 3.5 FXO and FXS interfaces management

FXO and FXS interfaces are controlled by identical commands:

```
: help fxo

[FXSx|FXOx] - show current FXSx or FXOx settings (x=1,2)

[FXSx|FXOx] [ON|OFF] - enable or disable FXS/FXO port x

[FXSx|FXOx] CODE [PCM64|PCM128|ADPCM32|ADPCM24] - select

voice codec

[FXSx|FXOx] BWA [STATIC|DYNAMIC] - static or dynamic

bandwidth

[FXSx|FXOx] EC [ON|OFF] - enable or disable Echo Canceller

:
```



While using FXO and FXS commands, do not forget to add the channel index (1 or 2) to the keyword, e.g. **fxo1, fxo2 or fxs1, fxs2**!



FXO and FXS management commands are applicable only if the corresponding interface is available in the modem. Otherwise,attempt to use these commands causes the message: -M16-2Vs (or M16-2Vo) module is not installed!

#### 3.5.1 View current settings of the FXO and FXS

The command fxo1(2) or fxs1(2) with no options allows to view current settings of the interface:

:fxs1 FXS1: ON Code=PCM64 BWA=static EC=off :fxo2 FXO2: ON Code=PCM64 BWA=static EC=off :

on - Interface is enabled

OFF – Interface is disabled

code-Type of the voice codec. Can be PCM64, PCM128, ADPCM32, or ADPCM24

BWA - bandwidth allocation:

STATIC - the channel always consumes the bandwidth,

DYNAMIC – the bandwidth is allocated for channel in the Off-Hook state only.

EC - adaptive echo cancellation enabled (ON) or disabled (OFF).

## 3.5.2 Channel ON/OFF control

To enable or disable the voice channel, use the fxo (fxs) command with option on or off:

```
:fxsl on
FXSl: ON Code=PCM64 BWA=static EC=off
:fxsl off
FXSl: OFF Code=PCM64 BWA=static EC=off
:
```

When a voice channel is OFF, its bandwidth is reused for data channel.

# 3.5.3 Voice codec selection

As mentioned before, the SG-16BVo/BVs modems support standard voice codecs G.711  $\mu$  G.726. The G.711 codec (the PCM codec) requires 64 kbps of the total DSL bandwidth plus 8 kbps for signaling. The G.726 codec (ADPCM) can operate in the two modes, the 32 kbps mode and the 24 kbps mode, plus 8 kbps for signaling.

Take into account that the speech quality is decreased when lower rate voice codecs are used.

Besides that, the Sigrand SG-16BVo/BVs modems feature a PCM128 codec, which uses 128 kbps bandwidth for a voice channel.

This codec provides the highest quality of speech, as well as the best performance for POTS modems (e.g. V.34, V.90) or facsimile machines operation.

To select a particular voice codec, use the **fxo** (**fxs**) code command widh appropriate option as follows:

- The G.711 codec fxo1 code pcm64
- The G.726 codec fxo1 code adpcm32 or fxo1 code adpcm24
- The 128 kbps codec fxo1 code pcm128

```
:fxol code pcm64
FXO1: ON Code=PCM64 BWA=static EC=off
:fxol code adpcm32
FXO1: ON Code=ADPCM32 BWA=static EC=off
:fxol code adpcm24
FXO1: ON Code=ADPCM24 BWA=static EC=off
:fxol code pcm128
FXO1: ON Code=PCM128 BWA=static EC=off
:
```

The FXS interfaces are configured the same manner.

# 3.5.4 Dynamic bandwidth allocation

The FXO/FXS interfaces can be configured such a way, so in the absence of the voice channel activity its bandwidth can be utilized for the data channel.

This mode is configured individually for each channel by the fxo (fxs) bwa command with static or dynamic option.

The first option disables the dynamic bandwidth allocation mode, the second option enables this mode.

```
:fxol bwa static
FXO1: ON Code=PCM128 BWA=static EC=off
:fxol bwa dynamic
FXO1: ON Code=PCM128 BWA=dynamic EC=off
:
```



The 8 kbps signaling channels are not affected by dynamic bandwidth allocation!

## 3.5.5 Adaptive echo cancellation

The fxo (fxs) ec command with on and off option is used to turn on

or off the adaptive echo cancellation.

```
:fxol ec on
FXOl: ON Code=PCM128 BWA=dynamic EC=on
:fxol ec off
FXOl: ON Code=PCM128 BWA=dynamic EC=off
:
```

#### 4. Updating built-in modem firmware

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

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

Upon entering procedure acknowledgement  $\underline{\mathbf{Y}}$  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.

Отправить тек	стовый файл				? 🛛
<u>N</u> anka	🚞 Sigrand		C	) 🤣 📂 🗔	
ЦЭ Недаение документы	<b>sg16b25.b64</b>				
() Рабочий стол					
🤌 Мон документы					
Мой компьютер					
	Имя файла:	sg16b25.b64		~	<u>О</u> ткрыть
Сетевое	∐ип файлов:	Все файлы (*.*)		~	Отмена

```
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  $\underline{N}$  or  $\underline{Esc}$  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.

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-16BV modem

Serial number		
MFG date//	200 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,	Primary ratings		Seconda	ry ratings	
kHz	R~, Ω/km	L, H/km*10 <sup>-4</sup>	G,S/km*10 <sup>-4</sup>	Z , Ω	α, dB/km
		Conductor diam	neter 0.4 mm (20	6 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 diam	neter 0.5 mm (24	4 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

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

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