ELF2 – PP

Gateway TDM over IP

User Manual

Software version 2.07PP

Attention! The device is not recommended to be used with the physical links unequipped with the lightning conductors.

Contents

ILLUSTRATIONS

1. Introduction

ELF2-PP is meant to organize the E1 virtual channel via the packet data transmission networks. The device allows ground for organization of the multiservice networks (voice+data) based on the Ethernet infrastructure. This solution as compared to VoIP is, sometimes, a preferred choice allowing simplification of configuration and operation of the telecommunication channel.

Necessary operation conditions of ELF2-PP are as follows:
- availability of a separate broadband link with the Ethernet "twisted pair" interfaces
- support by the QOS hardware for the Ethernet commutation in case of simultaneous data and voice transfer
- small delay of packet transmission (no more than 30 ms jitter), otherwise usage of the external echo suppressors is recommended in the E1 channel

Peculiarities of ELF2-PP are as follows:
- transparency for telephone signaling protocols
- complete recovery of initial cyclic and super cyclic structure of the E1 frame
- restoration of temporal characteristics of the G.703 signal
- delay compensation of packet transmission via the Ethernet infrastructure
- usage of UDP or Ethernet packages to encapsulate E1data
- adjustability of the packages sizes and value of the compensating buffer

The Figure below shows a block scheme of the device.
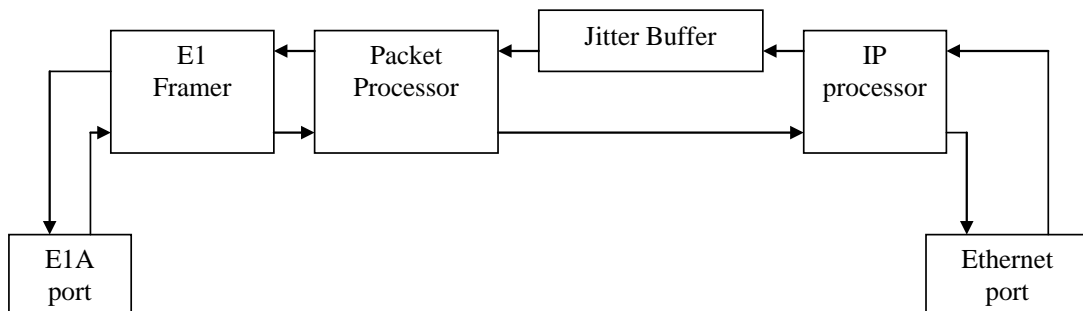
The device is recommended to be used with the following applications:
- arrangement of the phone access points using the 802.11 wireless technology
- arrangement of the communication channels to connect the standard PBX via the data transmission networks

2. Connecting the device
2.1. Location of the control and indication elements and connectors

The front panel of ELF2 bears the following:
- reset button (Reset)
- power-on indicator (Power)
- indicator of the 100 Mbps Ethernet (100TX) mode
- Ethernet link integrity indicator (Link)
- E1 indicator, channel a (E1-a)
- console connector USB-B
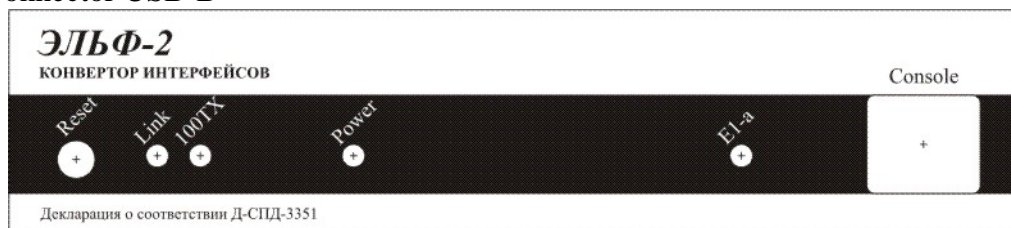
Figure 1. Front panel

The Back panel bears the following connectors:
- 8 - pin connector for connection to the "twisted pair" Ethernet network " of the RJ-45 type
- 8 - pin connector of the E1A port of the RJ-45 type
- a slot for connection of the power source (DC)
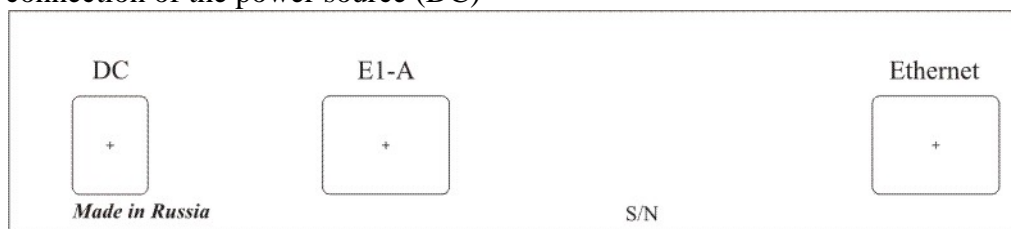
Figure 2. Back panel

2.2. Description of the connectors
2.2.1. Ethernet 10/100 connector signals

Contact	Circuit
1	TX+
2	TX-
3	RX+
4	
5	
6	RX-
7	
8	

2.2.2. E1a connector signals

Contact	Circuit
1	RX+
2	RX-
3	
4	TX+
5	TX+
6	
7	Земля
8	Земля

2.2.3. USB console connector signals

Contact	Signal
1	
2	Data-
3	Data+
4	GND

3. Configuration of the device

The console port is connected to the PC USB port via the cable adapter included into the delivery kit of the device. Console operates in the serial port emulation mode (COM), hence after the cable is connected an additional serial port must appear in the system. It can be checked in the Device Manager. The "USB Serial Port (COM3)" device will appear in the "COM and LPT ports" folder. If the additional port failed to appear, then install a driver of the USB device from the \\asteroid\USB_console_drv\ folder on the CD included into the delivery kit. You can download the driver here: http://www.ftdichip.com.

After the additional port appears, connect to it by means of the Teraterm (or hyperterm, putty) terminal program with the 38400, 8b, 1s, np, flow control=off parameters. Note, that after switching off/on the device, the terminal program must be as well restarted.

Parameters of the device and monitoring over its operation is executed by means of the control language described in this chapter.

3.1. Configuration of the E1 port

Parameters of the E1 port are configured by means of the **e1** command:
e1 [clock=line|int]
e1 [frame=on|off]
e1 [timeslot=all|*range*]
e1 [cfg]
where,

clock=line - sets the synchronization mode from the line (slave)
clock=int - sets the synchronization mode from the internal generator (master)
frame=off – the port works in the unstructured mode (the whole E1 stream is being transmitted transparently), occupied bandwidth 2048 kbit/s + overhead
frame=on – the port works in the structured mode, only timeslots, set by the parameter, shall be restored. Occupied bandwidth $64 + N * 64$ kbit/s+overhead
timeslot=all – transfer and restore all timeslots of the initial stream
timeslot=range – transfer and restore the timeslots specified in the range. The range is being set by listing out the numbers of the timeslots separated by commas or a hyphen, Example: 1,3,6-19. Timeslot 0 is transferred and restored always.
cfg – display configuration of the E1 port

3.2. Configuration of IP interface
Parameters of the IP interface are set by the **ipif** command:
ipif [no] [addr=x.x.x.x] [mask=x.x.x.x]
ipif [vlan=on|off] [vid=%d] [pcp=0] [dei=0]
ipif [bootp=on|off]
ipif [clear]
ipif [up | down] [cfg]
where,
no – delete address
addr – sets the IP address of interface
mask – sets the net mask of interface
vlan – enable support of vlan (on) or disable (off). ID VLAN packages will be set by the parameter vid
vid –VLAN Identifier field of the 802.1Q protocol. Recommended values are from 2 to 4094.
pcp –Priority Code Point field of the 802.1Q protocol. Allowed values are 0...7.
dei – Drop Eligible Indicator field of the 802.1Q protocol. Allowed values 1 or 0.
bootp – run (on) or don't run (off) enquiry for the address and mask by the bootp protocol when the device starts
clear – clear statistics
up – activate the interface.

down – close the interface.
cfg – display the current configuration of interface onto the terminal

Example
ipif no addr=192.168.1.4
ipif addr=192.168.1.6 mask=255.255.255.0
ipif addr=192.168.2.6 mask=255.255.255.0
In this case the 192.168.1.4 address is deleted in the IP interface and two new addresses are added.

3.3. Routing configuration

The routes are set and deleted by the **route** command. The command displays information on configuration of the routing table as well. The routes can be of several types: a route to the host or a route to the sub network, direct or indirect routes. To set a route to the host enter its address only. To set a route to the sub network specify the network address and net mask. Direct routes are set for the stations (networks) in the same broadcast domain as the devices are. For example, if the station in the same Ethernet segment. Indirect the routes are set for the stations (networks) available via the IP gateway only. In this case specify the IP address of the gateway.
The command has the following syntax:
route [no] addr=x.x.x.x [mask=y.y.y.y] [gwip=z.z.z.z]
route cfg
where
no – the route will be deleted
addr – host address or subnet address
mask – net mask, if the route to the network is added
gwip – gateway address
cfg – display current configuration tables of the routes

Notes.
• To set the route by default specify the address **0.0.0.0** or **default**. The route by default must be selected to deliver the package if the package cannot be delivered by another routes.
• The routes to the sub network of IP interface are added automatically

Example

route addr=default gwip=192.168.2.6
The commands set a route to the Gateway "by default" 192.168.2.6.

3.4. General commands

3.4.1. Help (help)
Displays a list of available commands. To display a separate help by the command, enter the command name without parameters and <enter>.

3.4.2. Control over access to the device (access)
access [telnet=on|off] [user=%s] [pswd=%s]
access cfg

telnet – switch on (on) or switch off (off) configuration via telnet.
user – sets the user name when connecting via telnet or http. The user name – a text string without gaps, length up to 32 characters. null – empty name.
pswd – sets a password when connecting via telnet or http. A password – a text string without gaps, length up to 32 characters. null – empty password.

cfg – displays current value of the parameters
All parameters of the access command are checked when the device starts and they won't be analyzed further.

3.4.3. Saving current configuration (write)
Device configuration represents a set of the command strings required for restoration of all parameters after restart. There are two copies of the configuration information– current (running) and recorded into the non-volatile memory (flash). Operator changes current configuration when entering new commands. To copy current configuration into flash the following command is used:
write flash

3.4.4. Warm restart (reboot)
The following command is used to restart software
reboot
without parameters.

3.4.5. The ping command
To check the connection, use the following command:
ping [c %d] [s %d] ipaddr

Parameter **c** sets the quantity of the sent packages (from 1 to 50). Parameter **s** sets a package size (up to 2048 bytes). **ipaddr** represents an IP address of the host in point writing, for example, 192.168.1.1.

3.5. Configuring the E1 over IP
     Configure the E1 channel parameters over IP by the **epipe** command.
     epipe [peer=x.x.x.x]
     epipe [jbsize=%d] [fpp=%d]
     epipe [tos=%x] [udpport=%d]
     epipe [cfg]
     epipe [up] [down]
where,
     peer – sets an IP address of the device-receiver of the E1 stream. Two devices forming the E1 channel must have a complementary pair of addresses, specified by the epipe peer and ipif addr commands
     jbsize – sets the size of the smoothing buffer (in packages). Permissible values range is 8...128. A large value of jbsize can result in large delay and sound echo. A small value can result in package losses and synchronization failures.
     fpp – quantity of E1 frames being sent in a single package. A small value of this parameter will result in expensive operation (small package at a fixed header). A sound echo can cause a large value
     Recommendations for selecting the **jbsize** and **fpp** values are given in the separate chapter.
     tos – the TOS field ip of the headers being sent by the device (0...ff) *. The TOS field can be used by the external switches and routers to assign a high priority to a packages with voice data. The specified value tos is assigned to outgoing packages only with the E1 traffic. Service packages are marked with the value tos = 0. Value tos in the ingoing packages shall be ignored. By default tos=0. Bit assignments of the fields TOS are presented in the Table **.

0	1	2	3	4	5	6	7
priority			D	T	R	0	0

Priority:
111 – network management
110 – internetwork control
101 - CRITIC/ECP

100 - over instantly
011 - instantly
010 - immediately
001 – top-priority
000 - usual route

D=0 - normal delay
D=1 - small delay
T=0 - normal throughput capability
T=1 - high throughput capability
R=0 - usual validity
R=1 - high validity

Notes:
* if parameter encaps=raw, the TOS field shall be ignored
** the TOS field is defined by RFC791 and is given just for reference in this document

udport – UDP protocol port for the data channel. By default udport=5397. Besides the data channel, udport+1 port si used for the service packages.
cfg – display current values of the parameters
up – activate the channel
down – close the channel, stop transfer

3.6. Recommendations on configuring the E1 channel via IP

3.6.1. Configuring E1

A pair of the ELF2-PP devices forming the E1 virtual channel, are working on a master-slave scheme. The slave device must have parameter clock=line, the master device - clock=int. The slave ELF2 must be connected to the master equipment E1 (master), master ELF2 must be connected to the slave equipment E1 (slave). Hence, the master-slave-master-slave scheme must be observed, which it is a prerequisite for absence of channel errors. Master ELF2 at that will be adjusting by the frequency to the master equipment E1. Quantity of adjustments can be seen on the field **VCO-/VCO+** commands show epipe.

3.6.2. Configuring the packeting parameters

Selected **fpp** value influences efficiency of the Ethernet channel. For example, if fpp = 4, one package contains 32 * fpp = 128 data bytes and a header of 56 bytes in length. I.e. efficiency of the channel is 70 %. For **fpp**=8 this value is 82%. At the same time increasing of **fpp** results in increase the delay associated with the packeting and is 0.125 * **fpp** (ms).

Parameter **jbsize** must be selected based on the spread transmission times of the packages via the Ethernet transport network. It is recommended to set a maximum size of the smoothing buffer (**jbsize**=128) at first and determine real spread transmission times (field **Max jitter**, command **show epipe**). Doing so the parameter **jbsize** shall be selected so that the package delay in the smoothing buffer is, at least, twice as much the parameter **Max jitter**. Delay of the smoothing buffer is 0.125 * **jbsize** * **fpp** (ms).

Parameters jbsize and fpp must be the same on both devices forming the E1 virtual channel.

A sign of insufficient value **jbsize** is increasing of the **Jitter buffer underrun/overrun** counters (command **show epipe**) during operation.

Real delay by the formed channel E1 can be evaluated as follows

T (ms) = 0.125 * jbsize * fpp + D,

where D is delay of the Ethernet packet transmission.

The D value is measured and displayed in the field **round trip time** (command **show epipe**).

Selecting the settings when the value T > 30 ms, can result in the large value of sound echo in the E1 channel and in need to install an external echo canceller.

Recommended values: **fpp**=16, **jbsize**=16, **encaps**=udp (for the broadband segment of Ethernet and small delays).

4. Network statistics and operational monitoring

During operation ELF2 accumulates statistical information which can be useful for analysis of the network traffic. The **show** command displays the accumulated statistics.

show [route] [tcp] [udp] [ip] [icmp] [buffers]
show [running-config] [configuration] [system]
show [ipif] [e1] [epipe]

route – display statistics on ip routes
tcp – display statistics on the tcp protocol
udp – display statistics on the udp protocol
ip – display statistics on the ip protocol and state of ip interfaces
icmp – display statistics on the icmp protocol
buffers – display information on memory usage
running-config – display current configuration
configuration – display saved configuration
system – display usage statistics of the processor time and memory
ipif – display the state of IP interface
e1 – display the state of the E1 port
epipe – display the state of the E1 channel via IP

4.1. State of the E1 port

The following information об alarm signals is displayed:
LOS – loss of the carrier
LOF – loss of the frame synchronism
LOM – loss of the super frame synchronism
Prefix **no** before the corresponding word means absence of the alarm signal

4.2. State of the E1 over IP

The fields **Rx/Tx packets** display quantity of the received/transferred packages via the E1 port. As a rule, the field **Tx packets** starts increasing after successful establishment of the E1 channel via IP.

The fields **Giant, Non-octet, Aborted, Overrun, Busy, Underrun** display availability of the internal errors and must not increase in the operational state.

Late in sequence – quantity of delayed packages
Lost in sequence – quantity of lost packages
Jitter buffer underrun/overrun – quantity of underfillings/overfillings of the smoothing buffer
VCO-/VCO+ - quantity of the E1 frequency adjustments (only for the master device by E1)
Current round trip time – current delay time of the Ethernet package.
Average round trip time – average package delay time
Max jitter – variation of the packet delay times in the Ethernet network
Jitter buffer delay – displays a delay caused by presence of the smoothing buffer. Delay value depends on the **jbsize** and **fpp** parameters. In the properly working channel **Max jitter** must be at least less than **Jitter buffer delay**.

Current queue size – quantity of packages in the smoothing buffer. During normal operation this value must be within the 1...**jbsize** range.

Pipe state – state of the E1 channel via IP (connected – connection is established, disconnected – not established).

5.Loader monitor (bootloader)

The loader monitor always gains control upon actuation or restart of the device. Depending on the set parameters, the monitor can immediately after launch start download of the device program or switch to the control mode. The control mode is used for configuration of the monitor and execution of specific service functions. In this mode the monitor performs the commands the user enters via the console commands and displays the result of their performance on the console. A command set depends on the current menu. Contents of the menu can be viewed upon pressing the <h>, <Enter> keys in the terminal program.

The monitor performs the following functions:
- Programming of flash memory
- Performing the service functions on the user command (ARP enquiry, ICMP echo)
- Editing the parameters and network settings
- Copying, filling, testing the memory

Parameters of the monitor are saved in the flash memory and don't depend on the instrument's parameters.

5.1. Console of the monitor

Parameters of the monitor are set via the console. Connection procedure for the console is presented in Chapter 3.

5.2. Editing the parameters of the monitor

Use the **opt** command of the monitor to go to the parameters edit menu.
The following parameters are editable:

myip - enter IP address of the monitor
servip - enter IP address of the server from which the file will be downloaded via the TFTP protocol.
gwip - enter IP address of the network gateway.
mask - enter the net mask
file - name of the file being downloaded from TFTP of the server
loadptr - address of the memory area where the file will be downloaded, must be 0
jumpptr - address of transfer of control by the go command or at auto start. Must be 0x10000.
bootstr - contents of the command prompt, irrelevant.
bootptr - address where the command prompt is being copied
list - displays values of all parameters
flags - switches to the menu of flags setting
The following flags are available:
- "verbose mode" - when setting "on" the monitor displays more test messages during operation;
- "TFTP standalone" – must be set to "on".
- "Auto bootp" - run BOOTP enquiry at restart
- "Auto load" - perform file download by the TFTP protocol at restart (similar to the command load)
- "Auto jump" - perform transfer of control at restart (similar to the command go)
- "Copy bootstring to RAM" - copy the command prompt in-memory at restart

update - save all parameters into flash

5.3. Service commands

pings - the monitor switches to the mode ICMP echo of the server and responds to ping enquiries from another stations in the network/ The mode is used to check the LAN connections. Network settings (IP address, mask, gateway) must be set prior to running the command.

bootp - the monitor asks BOOTP of the server for the network parameters.

arp - the monitor makes the ARP enquiry and receives the Ethernet address of the server on its IP address. The IP address of the server (parameter servip) must be preliminarily set.

load - the monitor loads the file in-memory of the controller via the TFTP protocol. Address memory is set by the parameter loadptr, network address - by the parameter servip, name of the file – by the parameter file. It is used for test purposes.

go - the monitor transfers control at address

mdump - print contents of the memory
mfill - filling the memory area with the code
mtest - testing the memory area

fflash – programming the flash memory. The command is similar to the load command, except for the data being loaded non into in-memory, bur being programmed into flash. The length of the programmed area in the flash memory is determined by the file length.

5.4. Device software update
Do the following to record a new version of software:
- Start the TFTP program of the server on the PC and grant the server with a reading access to some directory.
- Copy the image.bin file with an image of software into this directory
- Connect the console cable and the local network cable to the device
- Start the terminal program on the PC and set the parameters of the serial port: rate 34800, 8 bit, 1 stop bit, no parity.
- Restart the device (command **reboot**).
- Stop the boot process pressing any key. Thereafter the device will be in the monitor mode.
- If required, change the IP address of the monitor and the server, as well as the net mask (menu **opt** of the monitor).
- Programming is executed by the fflash command of the monitor:
  boot> fflash<CR>

6. Gateway delivery kit
The delivery kit of the gateway is as follows:
- Gateway – 1 pcs
- Power unit 220 V – 1 pcs
- Console USB cable – 1 pcs
- CD with documentation – 1 pcs

The following accessories can be purchased separately:
- Power unit 36...72V

7. Package

The gateway is delivered in a corrugated cardboard box. The packaged device can be warehoused in dry indoors, no more than 10 pcs in the stack.