

arcutronix

Synchronize the Ethernet

USER GUIDE

BRX1
GS1



arcutronix GmbH
Deutschland

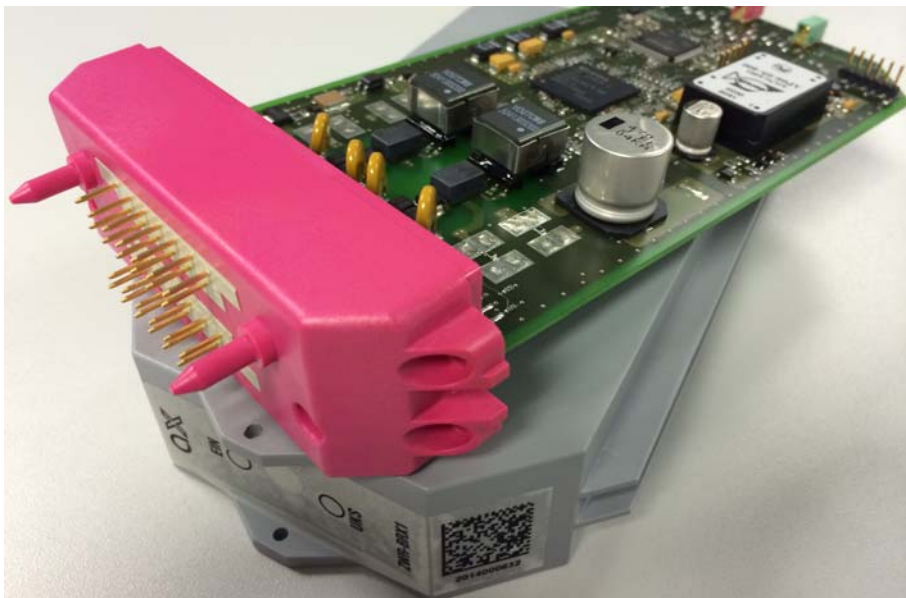
Installation and
Operation Manual

Version 1.4



BRX - Broad SDSL Repeater

USER GUIDE



Covered Variants of BRX1 by this User Guide:

BRX1: 1302 - 1000

Covered Software Versions of BRX1 by this User Guide:

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Document Contents

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About this Book

Document Organization

This guide describes the hardware and software components of the BRX - Broad SDSL Repeater. It provides information on configuration, system installation and technical data.

The intended audience of this document is anyone who is responsible for installing, maintaining or operating the BRX - Broad SDSL Repeater. This person must be aware of the risks, affected with these actions and must be qualified and trained. **Observe the safety precautions in chapter “Safety, Instructions, Statements”.**

The manual is designed as printable book, therefore chapters start at an odd page (the last even page of the chapter before may be empty). The headlines of the pages contain chapter name, chapter count, and chapter headline. The foot lines of the pages contain chapter page count, the revision date and the document title.

Chapters

Chapter 0, **Safety, Instructions, Statements:** Handling, precautions, warnings.

Chapter 1, **Abstract:** General description of the BRX1 devices and applications for use.

Chapter 2, **Getting Started:** Short form about installation, mounting and configuration of BRX1.

Chapter 3, **Hardware & Interfaces:** Description of hardware and front panel elements.

Chapter 4, **Functionality:** Repeater, EOC, SW-Download.

Appendix A, **Technical Specifications:** Technical data of the BRX1.

Appendix EC, **EC Declaration of Conformity:** Valid for the BRX1 product family.

Conventions

This manual uses the following text conventions to convey instructions and information:

Normal text is written in Albany font.

Commands and Arguments are done in `Courier New`.

Notes, cautions, and tips use these conventions and symbols:

NOTE: Means reader take note. Notes contain helpful suggestions or references to materials not contained in this manual.

WARNING:



DANGER

Means reader be careful. In this situation, you might do something that could result in equipment damage or loss of data.

Release History

- 2016-02-27 Version 1.4 Editor: mjz
A new SW-Version (V1.1.06) is released, which operates better in sync-mode together with MSAN vendor.
- 2016-02-23 Version 1.3 Editor: mjz
A new SW-Version (V1.1.05) is released, which supports “new” bonding of MSAN and RDs.
- 2015-05-15 Version 1.3 Editor: mjz
Added and changed the following topics:
- Change some formats.
- 2014-05-07 Version 1.2 Editor: mjz
Added and changed the following topics:
- Update to latest SW-Version, which supports Alcatel-MSAN, too.
- 2014-03-20 Version 1.1 Editor: mjz
Added and changed the following topics:
- New pictures of the device.
 - Adopted power consumption to correct value.
- 2014-01-13 First issue of the BRX1 User Guide.

The commands for Download- and Debug-IF are still missing.

Referenced and Related Documents

- [axManual_BRX-DL] arcutronix GmbH (2013): BRX-DL, Manual and User Guide.
- [ETSI TS 101 524] Technical Specification ETSI TS 101 524 (2003), Access transmission system on metallic access cables; Symmetric single pair high bitrate Digital Subscriber Line (SDSL).
- [ITU-T G.823] Recommendation ITU-T G.823 (2000), The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy.
- [ITU-T G.991.2] Recommendation ITU-T G.991.2 (2003), Single-pair high-speed digital subscriber line (SHDSL) transceivers.
- [ITU-T G.991.2__Amd3] Recommendation ITU-T G.991.2 (2003)– Amendment 3.
- [ITU-T G.994.1] Recommendation ITU-T G.994.1 (2003), Handshake procedures for digital subscriberline (DSL) transceivers.
- [ITU-T G.8261] Recommendation ITU-T G.8261/Y.1361 (2008), Timing and synchronization aspects of packet networks.
- [ITU-T G.8262] Recommendation ITU-T G.8262/Y.1362 (2007), Timing characteristics of synchronous Ethernet equipment slave clock (EEC).

List of Contents

Document Organization	about-1
Chapters	about-1
Conventions	about-2
Release History	about-3
Referenced and Related Documents	about-4

Chapter 0 Safety, Instructions, Statements

Safety Precautions	0-1
Power Precautions	0-1
Handling Precautions	0-1
Preventing Damage From Electrostatic Discharge	0-2
Card Protection	0-2
Grounding Procedure	0-2
Technical Instructions to User	0-4
Inspection	0-4
Commissioning	0-4
Cleaning	0-4
Quality	0-4
Repair	0-5
Disposal and Recycling	0-5
CE Conformity	0-5
Electromagnetic Immunity Statement	0-5
Instructions to User	0-5
Electromagnetic Emissions Statements	0-6

Chapter 1 Abstract

BRX1 Description	1-1
General	1-1
Nomenclature	1-1
Application Area for BRX1	1-2
BRX1 Functions at a Glance	1-3
Functionality	1-3
Clock and synchronization	1-3
Housing and Power Supply	1-3
LEDs	1-4
Order Information	1-4

Chapter 2 Getting Started

Delivered Parts	2-1
-----------------------	-----

Preparing the Start-up	2-1
Operating Conditions	2-1
Ambient Conditions.....	2-1
Preparation	2-2
Mounting Option	2-2
Start-up of the BRX1.....	2-2
Switching on the Device	2-2
Power-Up Sequence.....	2-2

Chapter 3 Hardware & Interfaces

Hardware Overview	3-1
Block-Diagram	3-1
Connectors and LEDs.....	3-3
Line & Power Connectors.....	3-3
LEDs.....	3-5
Test- & Download Interface.....	3-5
Labels.....	3-6

Chapter 4 Functionality

SHDSL Repeater	4-1
Rate-Adaptive	4-2
Mixed Operation	4-2
Pure ax-Operation.....	4-3
EOC-Channel	4-3
Test Loop	4-5
More SHDSL Features	4-6
Tip Ring Reversal	4-6
Signal Transfer Delay	4-6
Z-Bits.....	4-6
Automatic Power Forwarding	4-6
Basics	4-6
Features	4-7
Implementation	4-7
SW Update	4-10
In Field	4-10
In Lab	4-11

Appendix A Technical Specifications

BRX1 Hardware Specification	A-1
Hardware & Power	A-1
Interfaces	A-4
μ Controller & Display	A-5

Appendix EC EC Declaration of Conformity

Declaration of Conformity EC-1

List of Figures

Figure 1-1	BRX1 Application	1-3
Figure 3-1	BRX1 Block-Diagram	3-2
Figure 3-2	BRX1 Connectors.	3-3
Figure 3-3	BRX1 serial Repair-IF.	3-6
Figure 3-4	BRX1 Label	3-6
Figure 4-1	BRX1 Overview	4-1
Figure 4-2	Rate Adoption.	4-2
Figure 4-3	ax Rate Adoption	4-3
Figure 4-4	BRX1 Test Loop	4-5
Figure 4-5	Results of Current-Measurement	4-8
Figure 4-6	FSM of the automatic Power feeding	4-9
Figure 4-7	BRX1 SW-Download with BRX-DL.	4-10
Figure 4-8	Adapter Plate for BRX1 Serial Download-I/F	4-11

List of Tables

Table 0-1	Effects of Cleaning Liquids	0-4
Table 1-1	Denominations	1-2
Table 1-2	Order Matrix	1-4
Table 2-1	Ambient Conditions	2-1
Table 3-1	Pin Assignment Connectors	3-4
Table 4-1	Supported EOC-Messages	4-3
Table A-1	Physics and Environment	A-1
Table A-2	Security and EMC	A-2
Table A-3	Power Supply	A-2
Table A-4	Technical Data of the SHDSL-Interfaces	A-4
Table A-5	Display Functions	A-5
Table A-6	µController	A-5

Chapter 0

Safety, Instructions, Statements

Safety Precautions

The following sections provide the safety precautions for the supplied device. You must always observe the power precautions for the device. You must follow all warning notes ensuring that the procedures are performed safely. You must follow all caution notes ensuring that the device is operated correctly.

WARNING: Serious injury or loss of life is possible, if instructions are not carried out.

CAUTION: Serious damage or destruction is possible, if instructions are not followed.

NOTE: Before installing the device find out if any local technical rules must be observed. These may be defined by ANSI, ITU, IEC, your PTT, or other similar organizations.

Power Precautions



WARNING:

- Disconnect the power cord before opening the device.
- Always plug the power cords into properly grounded receptacles. An improperly wired receptacle could place hazardous voltage on the accessible metal parts of the device.
- Use only approved power cords.
- Use only manufacturer supplied power supplies.
- The power supply must match the power specifications for the device.
- Do not work on the equipment during periods of lightning activity.

Handling Precautions

Note: Precautions for transporting, installing, and operating the device:

- Avoid excessive shocks and vibrations. Install shock absorbers, if you need to use the device for mobile applications.
- Avoid contact with any liquid (e.g. water) or dust or dirt.
- Avoid exposing the device to excessive direct sunlight.

- Ensure sufficient cooling of the device.
- Prevent loose items from falling into the device.
- Avoid damage to components when installing or setting switches or jumpers of the device.
- Always place protective covers on all fibre optic cables and connectors that are not in use to prevent breakage and contamination.
- Inspect all fibre optic connections and clean contaminated surfaces before use.
- Attach a wrist strap and follow ESD procedures, see next paragraph.

Preventing Damage From Electrostatic Discharge



CAUTION: Discharge of static electricity (ESD) can damage or degrade electronic components. The electrostatic potential of a person can be several thousand Volt and a discharge to semiconductor components may have severe consequences. Observe the precautions below when you are handling any hardware with electronic components.

Card Protection

Each card is shipped in a separate, reusable, and anti-static shielding bag. Leave each card in its bag until you are ready to install it into the system. Do not remove the card from its bag unless you are grounded. Do not place a bag on exposed contacts where it can cause short circuits.

Grounding Procedure

Before attempting to install or remove any part of the chassis, ensure that you, the equipment chassis, and the rack mount cards are at ground potential preventing electrostatic discharge (ESD). Electrostatic discharges can damage the components of the system. To place yourself at ground potential, connect the chassis with a ground wire or via the power cord with a grounded mains socket and clip your wrist strap to the chassis.

The following advice will help you preventing ESD damage to electrical components:

- Always use an ESD wrist strap with a metal clip for grounding.
- Limit your movement as much as possible. Movement can cause a build-up of static electricity.
- Handle the system and its components carefully. Never touch the circuitry. Place your hands only on the edges, rails, or frame of the unit.
- Touch a spare component - while it is still in the anti-static wrapping - to an unpainted metal portion of the chassis for at least two seconds. This allows the static electricity to discharge harmlessly from your body and the spare.
- Install the device directly into the chassis after removing it from the anti-static wrapping. Do not remove the anti-static wrapping until you are ready to start the installation. If you must set down an unwrapped spare, set it down on an anti-static mat or on its anti-static wrapping.

- Be aware of weather conditions. Cold weather increases the likelihood of static electricity build-up.
- Be aware of your own conductivity level. Wear ESD shoes to diminish personal static electricity build-up. Wear e.g. an electrostatic dissipative lab coat.

Technical Instructions to User

Do not use this product for other applications than suggested in this manual!

The international standards and the technical rules of your local PTT company must be observed.

All interface cables must be shielded and designed in accordance with proper EMI techniques ensuring compliance with EMC requirements. arcutronix will provide cable shielding specifications on request.

Inspection

Before commissioning, check the content of the consignment for completeness and note whether any damage has occurred during transport. If so, do not use the parts and contact your arcutronix representative.

Commissioning

Work may be carried out only by qualified personnel. The relevant precautions must be taken.

Cleaning



To clean the outer surfaces, use a soft damp (not wet) cloth. Do not let moisture go inside. Please consider the properties of the housing and other material used!

Table 0-1 Effects of Cleaning Liquids

Valuation	ABS/ABS+PC/PC/PPE+PS
well resistant	water, aqueous saline solutions, sud, diluted acid and alkali
conditionally resistant	alcohol, aliphatics, oil and fat
not resistant	concentrated mineral acid, aromatic and halogenated hydrocarbon, ester, ether, ketone

Quality



The quality management of arcutronix GmbH is certified according DIN ISO 9001:2000.

This product is manufactured according to the arcutronix GmbH quality standards.

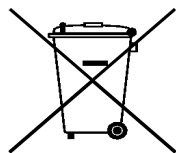
Repair

There are no repairable parts in the device. Defective parts must be sent to arcutronix GmbH for repair. The power supplies of a device may contain fuses. Blown-up mains fuses must be replaced by fuses of the same type and the same ratings. Using repaired fuses or short-circuit the fuse holder are not permitted.

Disposal and Recycling



This symbol on the product or on the packaging indicates that it can be recycled. To save our environment please hand it over to your next recycling point.



This symbol on the product or on its packaging indicates that it shall not be treated as household waste. Instead it shall be handed over to the applicable collection point for the recycling of electronic equipment.



For more detailed information about recycling contact your local city office, your waste disposal service or where you purchased the product.

CE Conformity



arcutronix products complies with the European standard regulation. They are tested according to the Council guideline for harmonizing the legal regulations of the member states on electromagnetic compatibility.

Electromagnetic Immunity Statement

This equipment has been tested and found to comply with the limits of EN 50082-2 (Electromagnetic Immunity for heavy industry).

Instructions to User

All interface cables must be shielded and designed in accordance with proper EMI techniques ensuring compliance with EMC requirements. arcutronix will provide cable shielding specifications on request.

Electromagnetic Emissions Statements

To achieve satisfactory EMC performance, all interface cables must be shielded and designed in accordance with proper EMI techniques. Rack mount cards has to be inserted into the designated chassis. Chassis slots that are not used have to be covered with a blanking plate. The chassis must be bonded to earth. This is usually achieved by installing the power cord to the chassis. An extra earth terminal may be provided. If this device is used in a residential setting, resulting interference must be corrected by the user. Any user modification made to the unit voids the user's authority to operate the unit under the FCC rules.



WARNING: This is a Class A product. In a domestic environment, this product may cause interference in which case the user may be required to take adequate measure. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

United States Federal Communications Commission (FCC) Electromagnetic Emissions Statement

WARNING: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions in this manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of the FCC Rules, which are designed to provide reasonable protection against such interference in which case the user at his own expense will be required to take whatever measures may be required to correct interference.

Canadian Department of Communications (DOC) Statement

WARNING: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions in this manual, may cause interference to radio communications. This digital apparatus has been tested and does not exceed the Class A limits for radio noise for digital apparatus set out in the DOC Radio Interference Regulations. The regulations are designed to provide reasonable protection against radio noise interference in which case the user at his own expense will be required to take whatever measures may be required to correct interference.

European Communities

WARNING: This equipment has been tested and found to comply with the limits of CISPR 22 and EN 55022 Class A for information technology equipment. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

BRX1 Description

General

The BRX - Broad SDSL Repeater is a smart device to extend the reach of SHDSL-lines in EFM mode.

The distance, which is spread by SHDSL technology, between an MSAN and the CPE is limited and dependant on various parameters:

- Data rate on the line,
- Quality of the line,
- Disturbance on the line,
- and others.

In case the distance between MSAN and CPE is too long and a error-free data transmission is not possible, the BRX1 can be inserted in between the two locations to re-refresh the DSL-signals and extend the possible reach.

The BRX1 operates in EFM-mode of SHDSL technology and is good for one single line. In case the MSAN and CPE are operated with line-bundling, one BRX1 is needed for each line.

The BRX1 is an easy to operate device, which needs no configuration or maintenance. One installed, it will not need any further attention.

The BRX1 can be fed locally or remotely from the MSAN location. For remote power supply the arcutronix RPX16 can be used. In case of remote feeding, the device does automatically forward the incoming feeding, in case it is enough power left to feed a second device. In case the power is not sufficient for additional units to serve, the forwarding of the remote power is disabled. This is done fully automatically. A special setting (e.g. DIP-switch etc.) is not necessary.

BRX1 does forward synchronisation information from MASAN to CPE and is so able to forward SyncE towards the customer.

Nomenclature

There are several standards about SHDSL technology available. Unfortunately, these standards do not use the same terminology for the different units within a DSL transmission system. Within this document, we will mainly refer to the ITU-T terminology. For cross reference, use the following list:

Table 1-1 Denominations

ITU [ITU-T G.991.2]	ETSI [ETSI TS 101 524]	Manual
SHDSL: Single-Pair High-Speed DSL	SDSL: Symmetric single pair high bit rate Digital Subscriber Line	SHDSL
STU: SHDSL Transceiver Unit	TU: SDSL Termination Unit	STU
STU-C: SHDSL Transceiver Unit - Central Office	LTU: Line Termination Unit	STU-C
STU-R: SHDSL Transceiver Unit - Remote End	NTU: Network Termination Unit	STU-R
SRU: SHDSL Regenerator Unit	REG: Signal Regenerator	SRU
SRU-C: SHDSL Regenerator Unit - Central Office	REG-C: NTU side of the signal regenerator	SRU-C, downstream
SRU-R: SHDSL Regenerator Unit - Remote End	REG-R: LTU side of the signal regenerator	SRU-R, upstream

Application Area for BRX1

The application for BRX1 is to extend the reach of on SHDSL link over the copper twisted pair. Up to 8 devices may be placed in a daisy-chain. Each device is good to extend one SHDSL line hop-by-hop. In case line-bundling is used on the SHDSL-link, each DSL-line has to be extended individually.

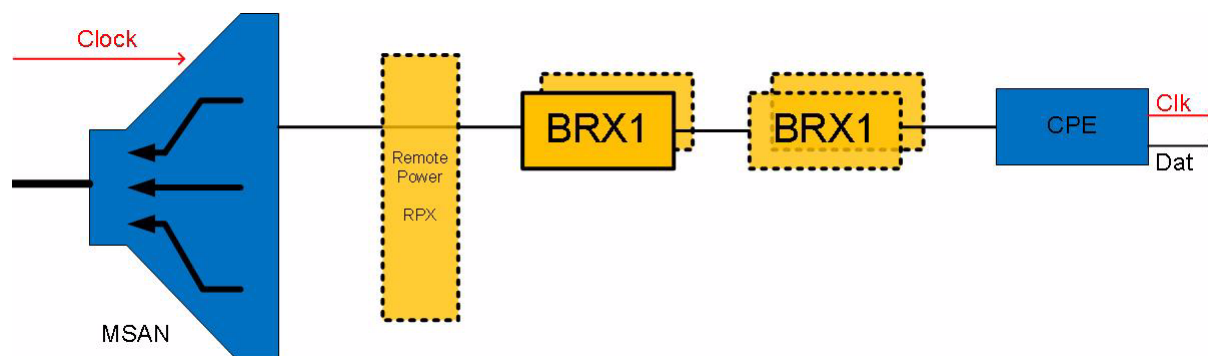


Figure 1-1 BRX1 Application

BRX1 Functions at a Glance

The BRX - Broad SDSL Repeater offers realisation according ITU-T G.991.2, Annex B and Annex G. Interoperability with a wide bunch of MSAN-vendors as well as CPE-vendors is guaranteed.

BRX1 incorporates the following features:

Functionality

- BRX1 supports Ethernet frame-based transfer of digital signals on a single copper twisted pair. The SHDSL transfer protocol with support of variable transfer rates is used, according to ETSI TS 101 524 incl. Annex E (ITU-T G.991.2, Annex B, Annex G).
- The ETSI TS 101 524, Annex E (enhanced SDSL) transfer protocol is supported.
- The adaption layers (TPS/TC) EFM as per ITU-T G.991.2, Amendment 3 is supported
- The BRX1 supports 16-TCPAM and 32-TCPAM modulation.
- EOC according to ITU-T G.991.2.
- Fully inter-operable with all Central Office equipment (LTU) and Remote Units (NTU, CPE), which operates in EFM mode.
- Cross wiring of a-wire and b-wire is detected during pre-activation sequence according to ITU-T G.994.1.

Clock and synchronization

- The BRX1 operates in synchronous mode with full clock transparency.
- The transmit data clock is synchronized to the received data clock.
- Noise generation is less than G.813/G.8262.

Housing and Power Supply

- Local (-48/-60 VDC) or

- Remote (115-55 VDC) power supply.
- Fully automatic power forwarding to next repeater, in case there is sufficient power available (at least 2W).
- After a loss of supply voltage the device is able to continue operation for at least 60 ms.
- Compact repeater design.

LEDs

Two LEDs indicate the actual status of the device

- ON-LED shows the power-status of the device, and
- SDSL-LED indicates the states of the SHDSL-activation.

Order Information

NOTE: All order matrices will be regularly updated. Asked your arcutronix representative for the latest publications.

For the time being, the BRX is the sole member of BRX - Broad SDSL Repeater family.

Table 1-2 Order Matrix

Art.- No.	Short Name	Description
1302-1001	BRX1	SDSL-Repeater: <ul style="list-style-type: none">• single SDSL-Repeater in EFM mode (TPS/TC);• Variable transfer rates;• 16-TCPAM & 32-TCPAM;• ETSI TS 101 524 (ITU-T G.991.2);• Local (-48/-60VDC) or Remote Feeding (55-115VDC) supported.

Chapter 2

Getting Started

For the start-up of the BRX1 please follow the directions in this chapter. You must keep the operating conditions specified for the devices. In the following read about the start-up preparation, the start-up itself, and the possibility to automate the start-up.



WARNING: Read the safety notes at the beginning of this manual carefully before you start the device!

Delivered Parts

Please check if all the items listed below are included in your delivery. Your delivery includes:

- BRX - Broad SDSL Repeater,
- Short User-Information.

Preparing the Start-up

Before you install the device you need to check the operating conditions and install the BRX1 on a proper location (rack-mount, etc.).

Operating Conditions

Read the operating conditions specified in this section carefully to avoid damages to the device or connected systems.

Ambient Conditions

The ambient conditions, which must be maintained for the BRX1, are shown in Table 2-1.

Table 2-1 Ambient Conditions

Operating Temperature	-40°C to +70°C
Max. Relative Humidity (non-condensing)	<100% (30°C)
Input Voltage DC (remote feeding)	115 to 55 VDC

Table 2-1 Ambient Conditions (continued)

Input Voltage DC (local feeding)	-40 to -72VDC
Power Consumption	< 2 W

CAUTION: If operating limits are exceeded, malfunctions and permanent damage to the equipment may result.

Preparation

The unit is a real plug-and-play device. Nothing has to be done before inserting it into the housing and provide power to it. No switch or jumper has to be configured, as this was the case for older repeaters.

Also the (fully automatic) remote-feeding forward does not need any special considerations or configurations. It works, as it is called, automatic.

Mounting Option

The BRX1 can only be inserted in special ZWR housing. When inserting into the housing, watch for the correct position and orientation. The two alignment pins must fit into the holes on the bottom of the ZWR-housing. In case the direction is wrong, the device will not fit into the housing. After inserting the device into the housing, fix the unit to make it save against vibrations and movements.

Start-up of the BRX1

Switching on the Device

The BRX1 does not have any power switch. If power (local or remote) is supplied to the unit, it will start automatically. The ZWR-BRX1 does have 2 redundant power input: Local power supply and Remote Power supply. The local power supply has priority against the remote feeding.

Power-Up Sequence

After providing power to the BRX1, the device will be powered up. The start-up will take less than 1 second, while internal SW is started and some tests are done to verify the unit is not damaged and proper operation can be guaranteed. After successful start of the SW, both LEDs will be on. This is the initial status of the unit, also used as LED test. Next step is to wait for line initialisation (from the STU-C side).

Chapter 3

Hardware & Interfaces

This chapter provides information about the hardware of BRX - Broad SDSL Repeater. This consist of block-diagram and a detailed description of all external interfaces and function indicators.

The BRX1 is a compact unit. All external connection points for data lines and power are accessible on the bottom of the unit. The indicator elements are located on top and are visible, when the device is mounted.

For repair and SW-update reason, there is a serial interface located on-board the BRX1. To get access to this interface, one has to open the case and get direct access to the PCBA. This repair-serial interface is not accessible in normal operation mode.

Hardware Overview

Block-Diagram

The block-diagram shows the principal parts and functions of the BRX1. The main blocks are shown and their logical connections are presented as lines in between.

The BRX1 can be divided into three functional blocks:

- Data-Plane,
- Control-Plane and
- Power.

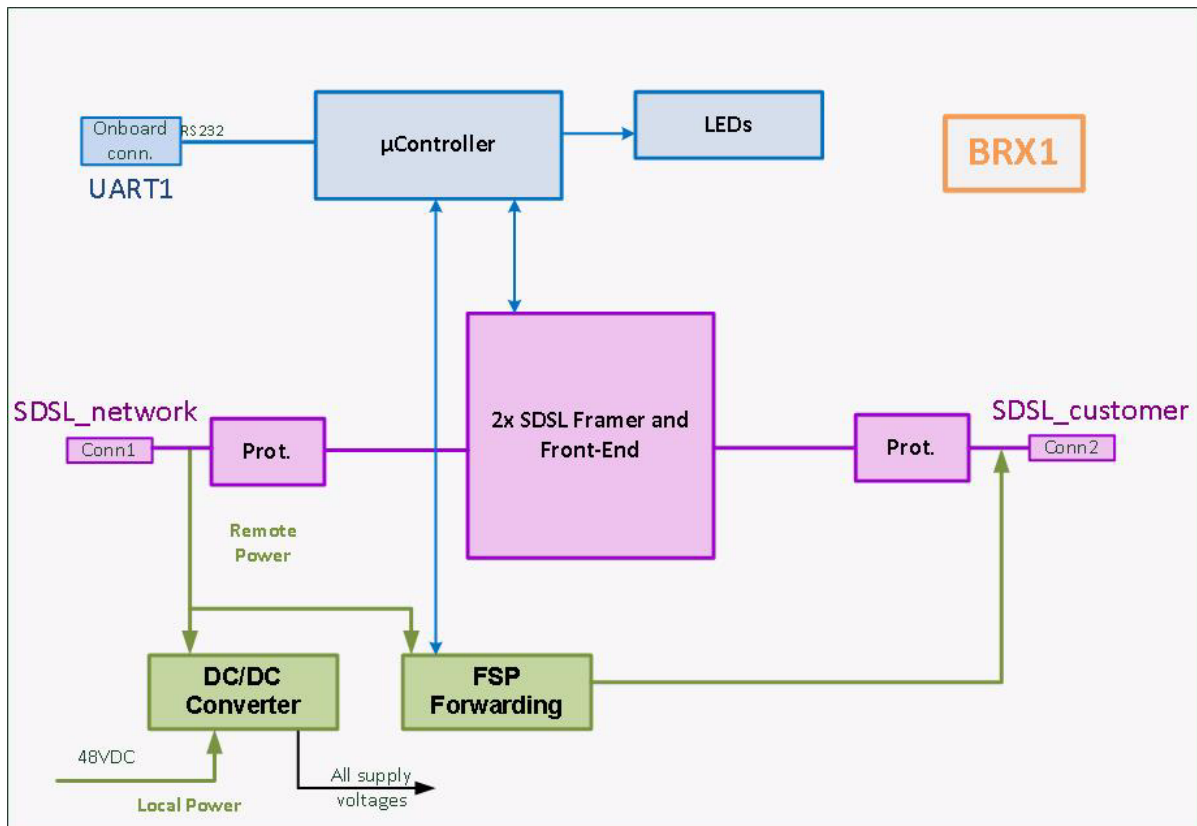


Figure 3-1 BRX1 Block-Diagram

Figure 3-1 gives an overview to the functional blocks. In the middle one see the data-plane with its repeater function. Data from and to two SHDSL interfaces are refreshed and forwarded to the opposite side. The unit is operating in a clock-slave mode, deriving the clock information from the network-site. The recovered clock is forwarded to the customer-site. As the device is installed in harsh environments, protection against over-voltage (lightning etc.) is placed right at the entry of the lines.

The OnBoard-Controller configures and maintains the device after power-up. It controls the SHDSL start-up, performs quality measurement to verify the error-free operation and can be accessed by EOC channel from the line-side.

The power-block generates all required supply voltage out of the local or remote power. The remote power can be forwarded to a next BRX1, depending on the incoming power and the device's location. In case the device detects, that on the customer interface there is not another repeater, but the CPE, the power forwarding will be disabled in any cases. The power forwarding operates fully automatically, only controlled by the onboard micro-controller. No extra settings are needed for proper operation.

Connectors and LEDs

Line & Power Connectors

The two connectors on the bottom of the device are used for all external connections in normal operation. The following figures show the pin assignment for these two connectors.

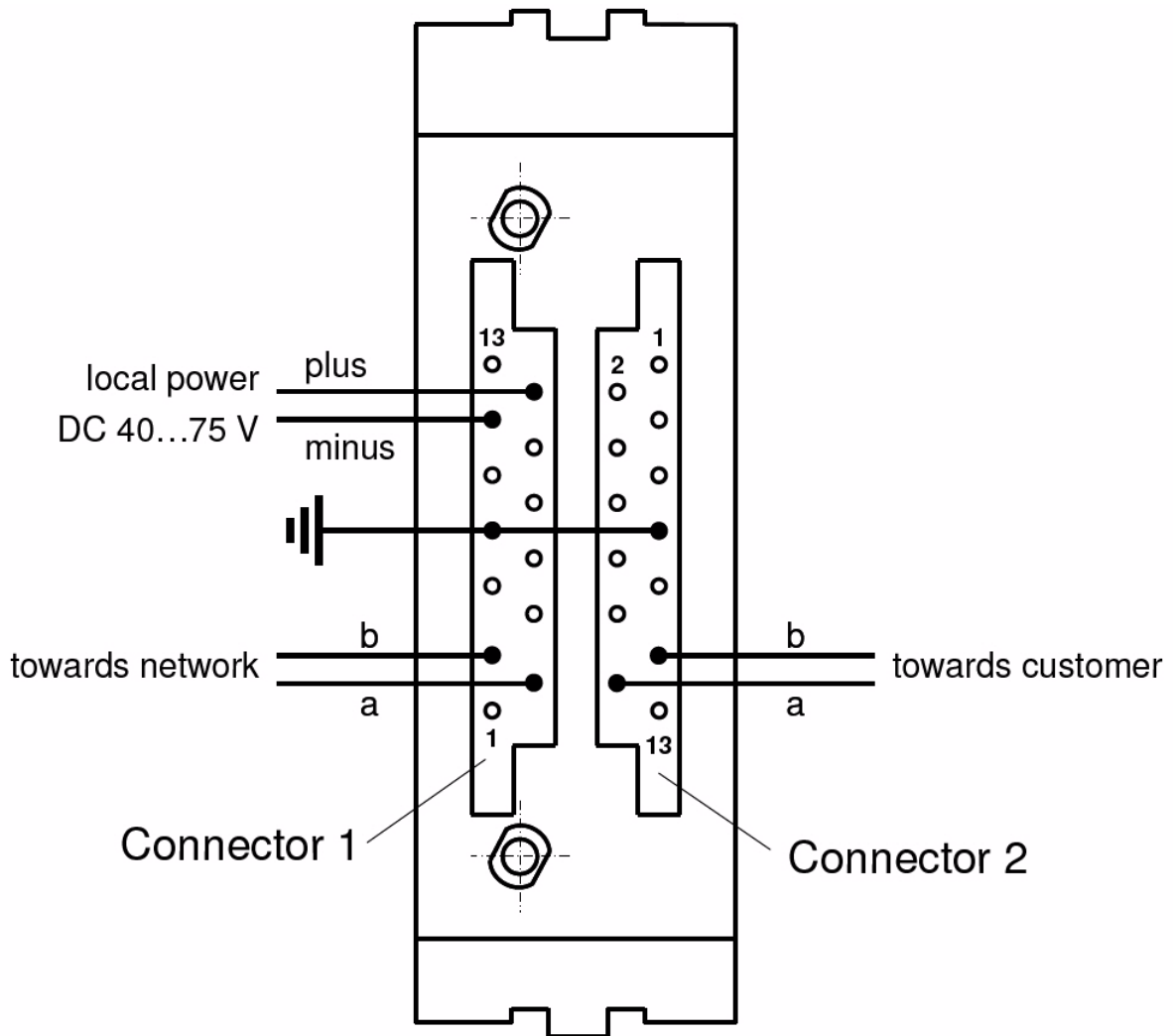


Figure 3-2 BRX1 Connectors

Table 3-1 Pin Assignment Connectors

Connector 1









2	Tip Line A	SHDSL line towards upstream direction to STU-C (MSAN).
3	Ring Line A	
7	FPE	Protection Earth
11	Local Power Supply, negative voltage	Local Power Supply:
12	Local Power Supply, positive voltage	-48 / -60 VDC
All others		not used and assigned

Connector 2

2	Tip Line B	SHDSL line towards downstream direction to STU-R (CPE).
3	Ring Line B	
7	FPE	Protection Earth
All others		not used and assigned

LEDs

Two LEDs show the (operational) status of the device. The ON-LED is used for power-supply indication, while the SDSL-LED shows the status of the SHDSL line activation. After Power-On of the device, both LEDs will be on.

ON-LED	Display states of the LED:	
	off	no supply voltage
	on	supply voltage available
	blinking 4 Hz	Test loop activated
SDSL-LED	Display states of the LED:	
	on	waiting for pre-activation
	flashing	pre-activation (capability exchange)
	blinking 4 Hz	line activation on network side (STU-R)
	blinking 1 Hz	line activation on customer side (STU-C)
	off	line activation completed

Test- & Download Interface

When the device is opened and the case is removed, one gets access to the on-board serial interface. This interface is not intended to be used in field installation but only in repair centres and labs.

The serial “repair-interface” consist of a 5-pin connector, which is located close to the LEDs. The meaning of the pins is written upon the PCB, so it is easy to connect.

NOTE: There is no RS-232 driver on-board the unit! To connect the serial repair-interface with your PC or laptop, you need a special driver-module, which is provided by arcutronix.



Figure 3-3 BRX1 serial Repair-IF

The serial interface is operated in DCE mode and does have the following settings:

- 115200, 8N1
- RxD is an input to the device, while TxD is the output.

Labels

The unit carries 2 labels with all the required data on it.



Figure 3-4 BRX1 Label

Chapter 4 Functionality

SHDSL Repeater

The BRX1 is a device to extend the reach of SHDSL transport on copper lines. The unit does refresh the electrical signals and allows so longer distances to be spread, in upstream as well as in downstream directions.

In simple word, the BRX1 acts on one side like a NT-device (towards upstream), while it's behaviour on the other side is like a reduced LT-device (towards downstream). It is neither a full STU-R nor a full STU-C, but it is a reduced set to establish the SHDSL-line and carry out the inband communication (EOC = embedded operation channel).

A BRX1 is good for extending one SHDSL-line. Up to 2 units can be daisy-chained if remote power is provided. Up to 8 units can be daisy-chained, when local power to each unit is provided.

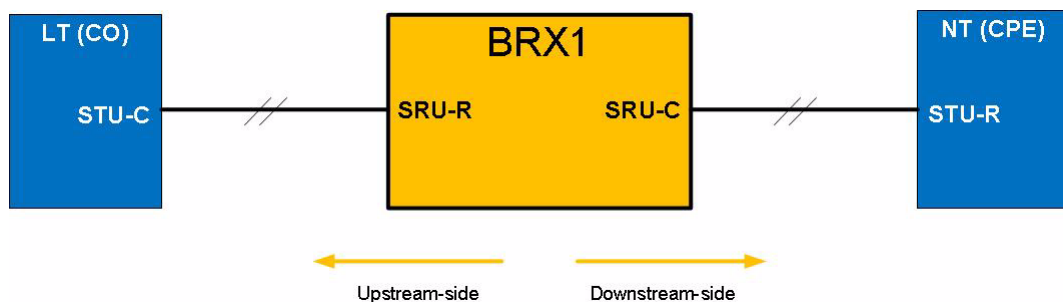


Figure 4-1 BRX1 Overview

The BRX1 transmits data using the SHDSL transmission procedure according to [ITU-T G.991.2]. Any configuration of the regenerator is not required. The unit is a real plug'n'play device. Interoperability with SHDSL equipment from different contractors is based on [ITU-T G.991.2].

The regenerator supports rate-adaptive transmission. The data rate is adjusted automatically via the STU-C device to find the best possible transmission rate. The transmission rate can vary from 192kbps to 5696kbps. The usage of rate-adaptive is according to [ETSI TS 101 524], Annex E and [ITU-T G.991.2], Annex B and G.

The coding on the line may be either 16-TCPAM or 32-TCPAM. The SHDSL signal on the transmitter output creates a noise signal on adjacent wire pairs in the same cable. To limit the distortion of adjacent DSL systems, we recommend to use only 16-TCPAM coding with repeaters.

The BRX1 does not only forward data in both direction, but does also synchronize itself to the clock-information coming from upstream and forward this information to the downstream side. By this, a synchronous transport and synchronous operation of STU-C and STU-R is achieved.

The BRX1 uses for the transmission convergence sub-layer (TC sublayer) the EFM (packet) mode. The EFM mode is specified in [ITU-T G.991.2__Amd3].

ATM mode and pure TDM application is not supported (.yet).

Rate-Adaptive

Mixed Operation

Each segment in the SHDSL line tries to establish the link with the maximum possible data-rate (192kbps up to 5696kbps). Depending on the quality of the line this data-rate is determined during setup. In case, the maximum data-rate is not the same on the different segments, the line will be torn down and re-established with the lowest data-rate. This can take a couple of retries, depending on the different possible rates on the segments and the number of repeaters.

The normal way to do the rate adoption is to propagate the max. data rate one segment upstream and let the line start with the new parameters. So the more segments, the more it takes. Figure 4-2 shows the process, when 3 segments (A, B, and C) with 3 different max data-rates (A=3M, B=2M, and C=1M) are present:

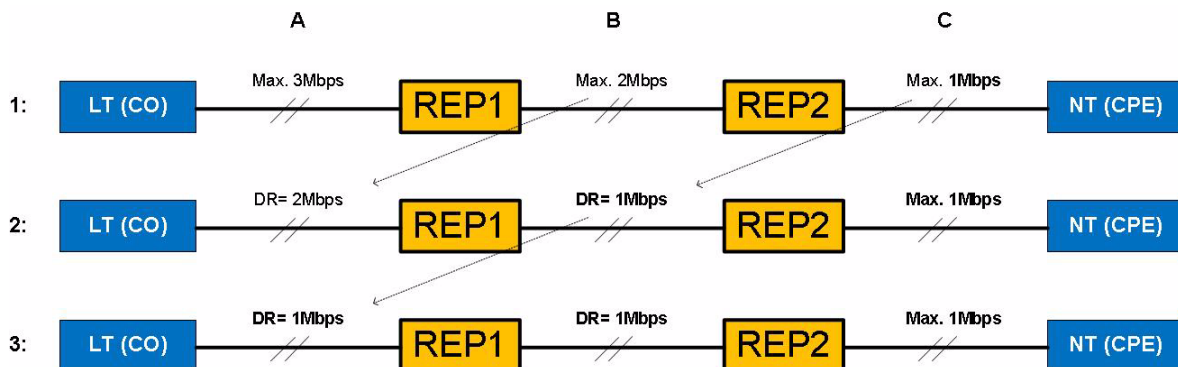


Figure 4-2 Rate Adoption

1. In the first step, all 3 links are established with the maximum data-rate
2. In the second step, segment B will report to segment A, that a maximum of 2M is possible, while segment C reports to B the maximum rate of 1M. When the line is re-establish with the new parameters, REP1 will recognize, that there is still a mismatch on SRU-R and SRU-C side (2m vs. 1M) and the link needs to be torn down again.
3. In the third step, all segments will be established with 1M, which is the maximum on all segments. The complete link will now be operated at 1M.

Pure ax-Operation

As the time to re-established all segments can take several minutes, the BRX1 has incorporated a special behaviour, which allows to propagate the maximum data-rate across all segments in only one single step. This leads to a much quicker line-setup with the maximum parameters. This feature is only available, when only BRX1 are used in the link. Figure 4-3 shows the process, when 3 segments (A, B, and C) with 3 different max data-rates (A=3M, B=2M, and C=1M) are present:

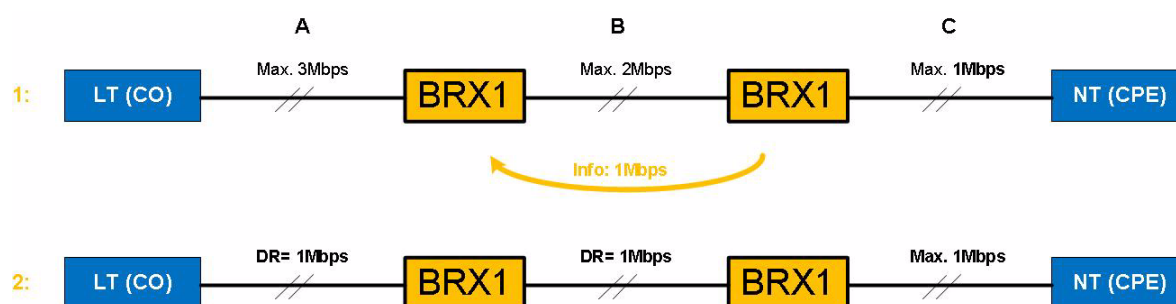


Figure 4-3 ax Rate Adoption

EOC-Channel

The embedded operation channel is specified by the [ITU-T G.991.2] and allows communication between STU-C and the attached devices on the SHDSL-line. It is a 3,3kbps channel within the SHDSL frame and permits network operation systems to access essential functionality in the STU-C, STU-R and intermediate elements that are part of the access line. When an SHDSL line is activated, the EOC is established and communication is enabled.

The BRX1 is fully compatible to the EOC standard and can accept basic orders and does report status via this channel. The access is possible via the STU-C or the STU-R side.

The EOC channel is also used for inband SW update. See “In Field” on page 4-10.

The following EOC-message IDs are supported by the BRX1:

Table 4-1 Supported EOC-Messages

EOC Msg ID	Message Type	Initiating Unit	Remark
1	Discovery Probe	STU-C	[ITU-T G.991.2], chapter 9.5.5.7.1
2	Inventory Request	STU-C	[ITU-T G.991.2], chapter 9.5.5.7.3
3	Configuration Request – SHDSL	STU-C	[ITU-T G.991.2], chapter 9.5.5.7.5

Table 4-1 Supported EOC-Messages

EOC Msg ID	Message Type	Initiating Unit	Remark
10	Maintenance request – Element Loopback	STU-C	[ITU-T G.991.2], chapter 9.5.5.7.19
11	Status Request	STU-C	[ITU-T G.991.2], chapter 9.5.5.7.11
12	Full Status Request	STU-C	[ITU-T G.991.2], chapter 9.5.5.7.12
15	Soft restart/Power backoff disable Request	STU-C	[ITU-T G.991.2], chapter 9.5.5.7.21
18	STU-R Configuration Request – Management	STU-C	[ITU-T G.991.2], chapter 9.5.5.7.9
112	Dwl-ZWR-IMG-Request	BRX-DL	Proprietary Message. Used for SW-Download via EOC.
114	Dwl-ZWR-IMG-Status-Request	BRX-DL	Proprietary Message. Used for SW-Download via EOC.
115	Dwl-ZWR-Block-Status-Request	BRX-DL	Proprietary Message. Used for SW-Download via EOC.
116	Switch-Image-Request	BRX-DL	Proprietary Message. Used for SW-Download via EOC.
117	Dwl-ZWR-Load-Single-Block-Request	BRX-DL	Proprietary Message. Used for SW-Download via EOC.
129	Discovery Response	SRU	Response to a discovery probe message.
130	Inventory Response	SRU	[ITU-T G.991.2], chapter 9.5.5.7.4
131	Configuration Response – SHDSL	SRU	[ITU-T G.991.2], chapter 9.5.5.7.7
137	Maintenance Status Response	SRU	[ITU-T G.991.2], chapter 9.5.5.7.20
139	Status/SNR	SRU	[ITU-T G.991.2], chapter 9.5.5.7.13
140	Performance Status SHDSL Network Side (SRU-R)	SRU	[ITU-T G.991.2], chapter 9.5.5.7.14
141	Performance Status SHDSL Customer Side (SRU-C)	SRU	[ITU-T G.991.2], chapter 9.5.5.7.15
144	Generic Unable to Comply (UTC)	SRU	[ITU-T G.991.2], chapter 9.5.5.7.26

Table 4-1 Supported EOC-Messages

EOC Msg ID	Message Type	Initiating Unit	Remark
240	Dwl-ZWR-IMG-Response	BRX1	Proprietary Message. Used for SW-Download via EOC.
242	Dwl-ZWR-IMG-Status-Response	BRX1	Proprietary Message. Used for SW-Download via EOC.
243	Dwl-ZWR-Block-Status-Response	BRX1	Proprietary Message. Used for SW-Download via EOC.
244	Switch-Image-Response	BRX1	Proprietary Message. Used for SW-Download via EOC.
245	Dwl-ZWR-Load-Single-Block-Request	BRX1	Proprietary Message. Used for SW-Download via EOC.

Test Loop

The cause of transmission problem can be localised by activation of test loop. One can check the SHDSL transmission line and all components connected, when a loop back is activated. During activation of the test loop the incoming data signal is re-transferred into the opposite direction.

There is one test loop available, to locate problems on the line and the repeater. The following figure presents possible test loop:

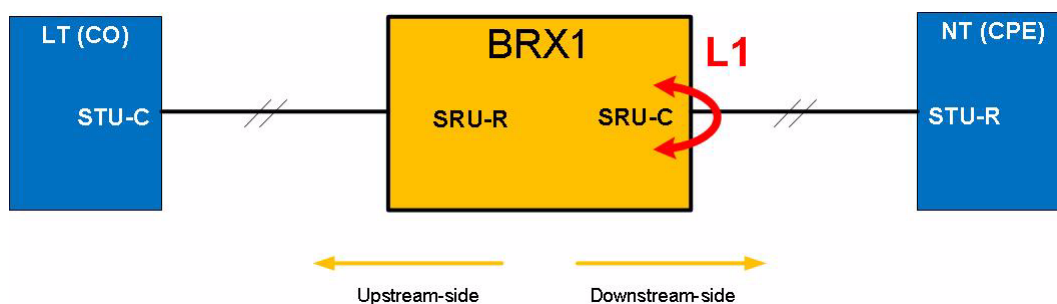


Figure 4-4 BRX1 Test Loop

The test loop can be activated by the EOC-message ID 10 (“Maintenance request – Element Loopback”). The loop can only be activated from the STU-C side (LT, MSAN) and the special command within the message ID 10 is “Initiate Loopback toward Network” (Bit3). See [ITU-T G.991.2], chapter 9.5.5.7.19 for details.

- L1 = Terminal Loop, which loops all data that should be send out on the SUR-C back to the upstream direction.

When loop L1 is closed, the ON-LED will blink (4Hz) to indicate the status of the unit.

More SHDSL Features

Tip Ring Reversal

Cross wiring of a-wire and b-wire is detected during pre-activation sequence according to [ITU-T G.994.1]. If the cross wiring is detected, an automatic Tip-Ring reversal is done.

Signal Transfer Delay

The signal transfer delay of the BRX1 is less than 500 μ s.

Z-Bits

Z-bits are not used by the BRX1. They are forwarded transparently from SRU-R to SRU-C and vice versa.

Automatic Power Forwarding

The Automatic Power Forwarding which is switching through the remote supply voltage to a subsequent regenerator is a new feature of the repeater. The unit does measure in incoming voltage and current and calculates on this inputs, whether there is sufficient power available to feed a following repeater. In case there is not enough power, the forwarding is inhibited. The calculation considers, that a subsequent repeater does not need more than 2W of power. In case the power demand is higher, either due to problems on the line (shortie line), or in the subsequent unit (another repeater or an STU-R) the power forwarding is also disabled. Goal of all action is, that the repeater protects itself from being under-supplied.

Basics

In case the BRX1 is served by remote power, this is provided on the “upstream” SHDSL-interface (SRU-R). A dedicated unit called RPU (e.g. arcutronix RPX16) is providing the remote power onto the line and has the following parameters:

- 115VDC output voltage, max. 70mA

Depending on the length of line and the resulting line resistance between RPU and BRX1, a lower voltage will be measured at the unit.

The BRX1 will, unless power is available, forward the incoming remote power for a second repeater, so that this one can also(!) be powered remotely. The power forwarding is disabled, when the BRX1 detects no further repeater down the line.

Features

- Any overload in the subsequent feeding section does not lead to disturbance in BRX1 (e.g. reboot due to low voltage). This also applies to any load change during operation, e.g. by temperature.
- The automatic power forwarding does not have any influence on the SHDSL signal or the possible distances on any SHDSL segment.
- The automatic power forwarding assumes that a subsequent repeater needs between 1W and 2W.
- In case the BRX1 detects, that it is the last in a chain of repeaters before the STU-R, it will disable the automatic power forwarding.
- An attached CPE device has an input resistance of at least 15kohm.
- If local power supply is provided to the BRX1, no automatic power forwarding is available.
- The BRX1 does have a local battery to store power for at least $T=60\text{ms}$ to overcome any problems on the power input.

Implementation

The forwarding of the incoming remote power

1. is only necessary, when there is an additional repeater down the line and
2. is only allowed, when there is enough power available to feed this device AND the next device on top.

The second requirement will be verified all the time: If the incoming power (voltage) is below 55V, the BRX1 will disable the automatic forwarding within 60ms. The lowering of the incoming voltage below this value may have different reasons. Most probable is, that the remote power unit runs into its current limiter (70mA) and this will drop the output voltage at the source. Some probable causes for the RPU to limit the current are

- (line-) failure between remote feeding unit (RPU) and the BRX1 (upstream line), or
- short on the downstream line when power forwarding is enabled, or
- too big load attached on the downstream line, when power forwarding is enabled.

In any cases, the BRX1 will protect itself by disabling the feeding of any downstream equipment.

When there is enough power available and the unit is running fine with enabled power forwarding, the main requirement is fulfilled: The automatic power forwarding must not affect the local unit. To save energy and power, coming from the remote feeding unit RPU, the BRX1 does verify, whether it is necessary to forward the feeding. In case the unit detects, that there is no repeater attached downstream, the power forwarding will be disabled for power-saving reasons.

The detection, whether another (2nd) repeater is attached downstream, is done in 2 steps. First step is to verify, whether the attached load could be a repeater or not. As an

attached repeater's power consumption is assumed to be less than 2W and the distance on the copper pair is less than 3km, one can calculate that an attached repeater will ask for ~9 to 50mA:

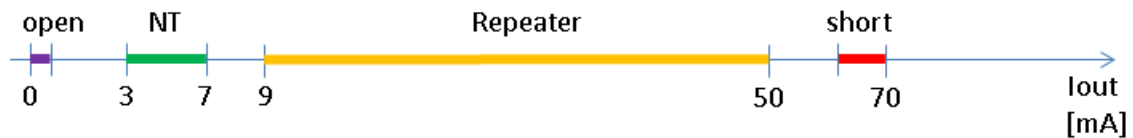


Figure 4-5 Results of Current-Measurement

If the BRX1 does measure less than 9mA on the outgoing feeding, it is assumed that either nothing is attached (“open”) or a remote device (“NT”). In case there is more than 50mA, there is either short circuit or a damaged device. More than 70mA are not possible, as the RPU is designed to limit the current to this value.

In case the measured current is in the given limits, the BRX1 will enable the power forwarding until the EOC channel of the SHDSL link is established. The address-scheme within the EOC allows the BRX1 to verify, whether the next unit is another repeater or a NT. In case the EOC address-scheme results, that there is no repeater attached on the downstream link, the power feeding is disabled. As soon as the SHDSL-link (and the EOC-channel) is tiered down, the process is started again, by only watching the current.

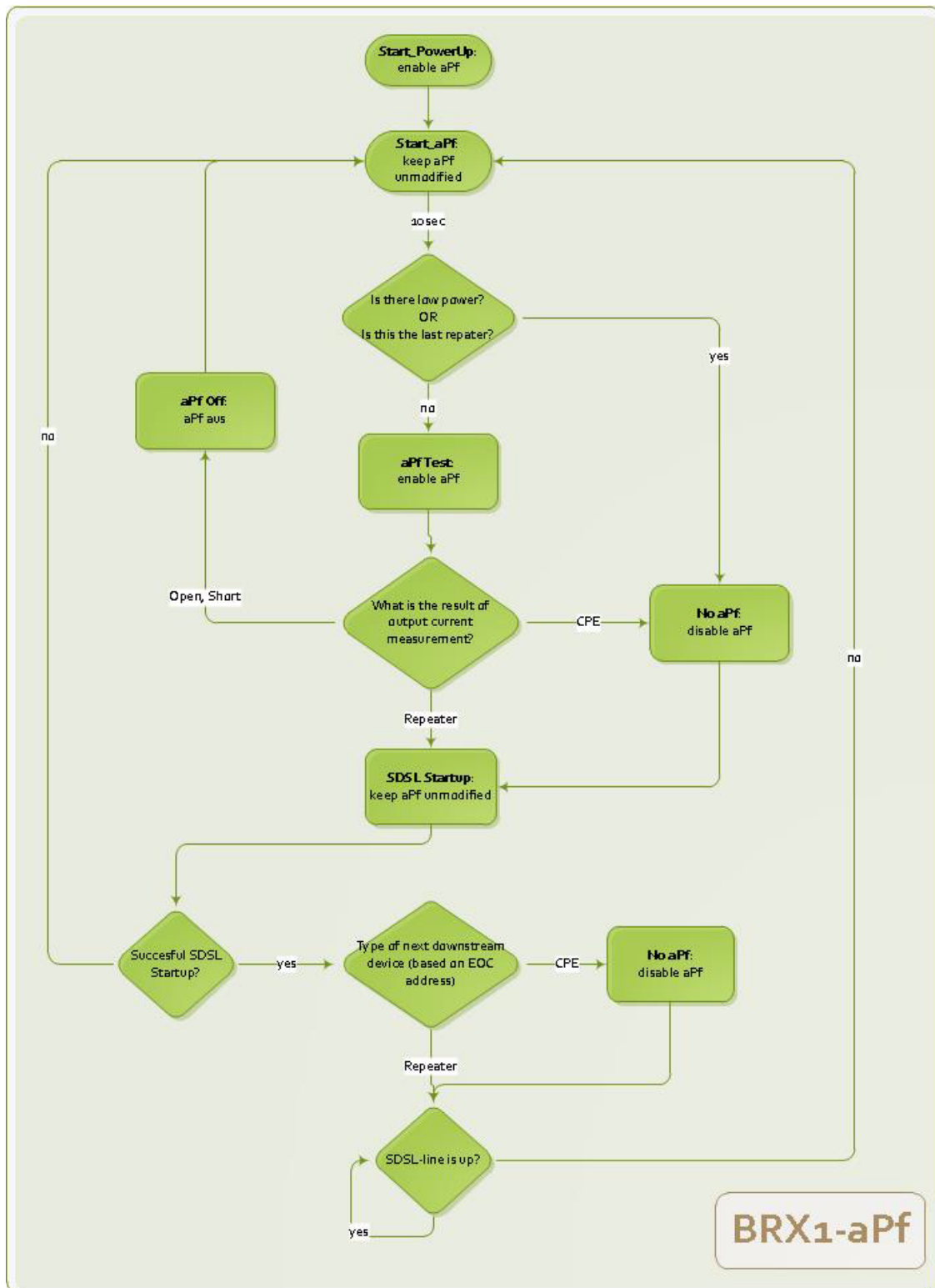


Figure 4-6 FSM of the automatic Power feeding

SW Update

The BRX1 offers the capability to update the SW, running on the unit. This can be done in-field or in the lab. The unit does have 2 memory banks, so the device is always able to return to the latest version, in case the download failed or the file was corrupted.

In Field

When the unit is installed, it will be most often be impossible to get access to it. The places of installation will be hard to reach. The in-field SW-update of the SW, running on the unit, is done via the EOC-channel of the SHDSL-link. No direct access to the unit is required, but one can start from the STU-C end of the line, where access is much more easy and comfortable. After downloading the new SW is activated and the unit reboots with the new SW.

As SW download to a repeater is not specified by ETSI or ITU-T, there is no standard way to do this. To download the BRX1 in-field, a special download unit (BRX-DL) is required. This unit acts as STU-C and offers the possibility to update the SW of the BRX1. See [axManual_BRX-DL] for details.

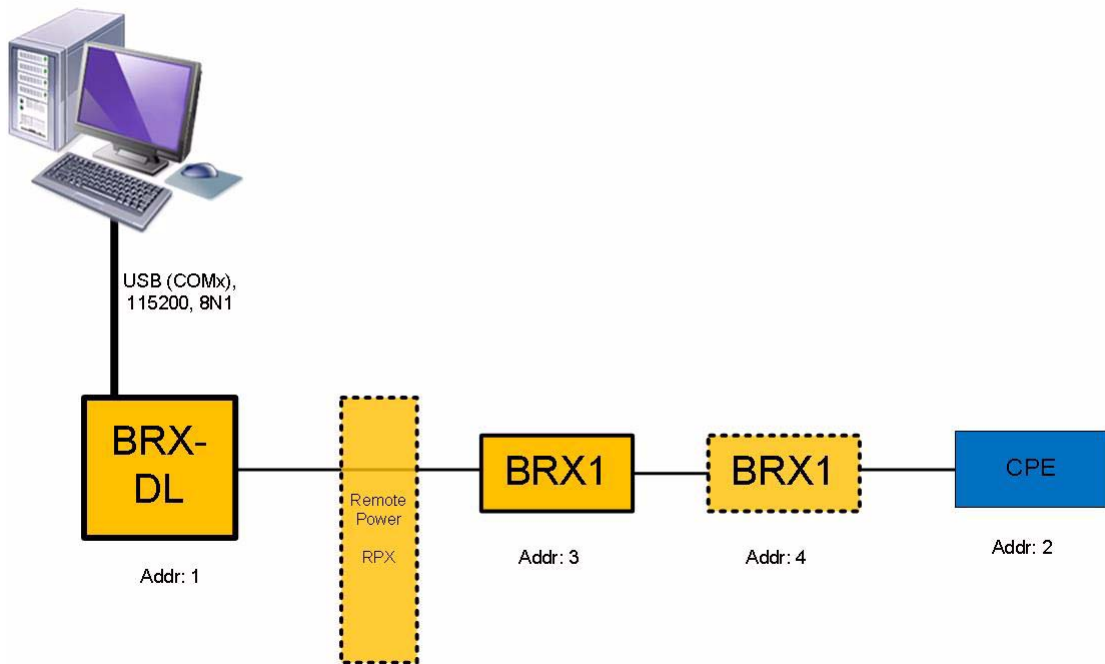


Figure 4-7 BRX1 SW-Download with BRX-DL

In Lab

In the laboratory, the update of the SW can be done like an in-field situation, if this is preferred. Together with BRX-DL the process is as written in the chapter above and [axManual_BRX-DL].

Another way to do the update, is to open the case of the unit and download the new SW directly via serial port. This makes sense, in case of repair or HW upgrade, when the unit has to be unshelved anyway. On the other side, to open the case of the unit is a serious act and should only be done by skilled persons, which have had a training on the unit.

WARNING: Do not open the case, if you are not allowed to do so. Otherwise the warranty is cancelled.

An adaption of the serial signals is required, as your PC / Laptop does operate the serial interface with V.10 voltage (RS-232) while the BRX1 is operating at 3.3V. This adapter plate is available at arcutronix or you can build it by your own, according the following schematic.

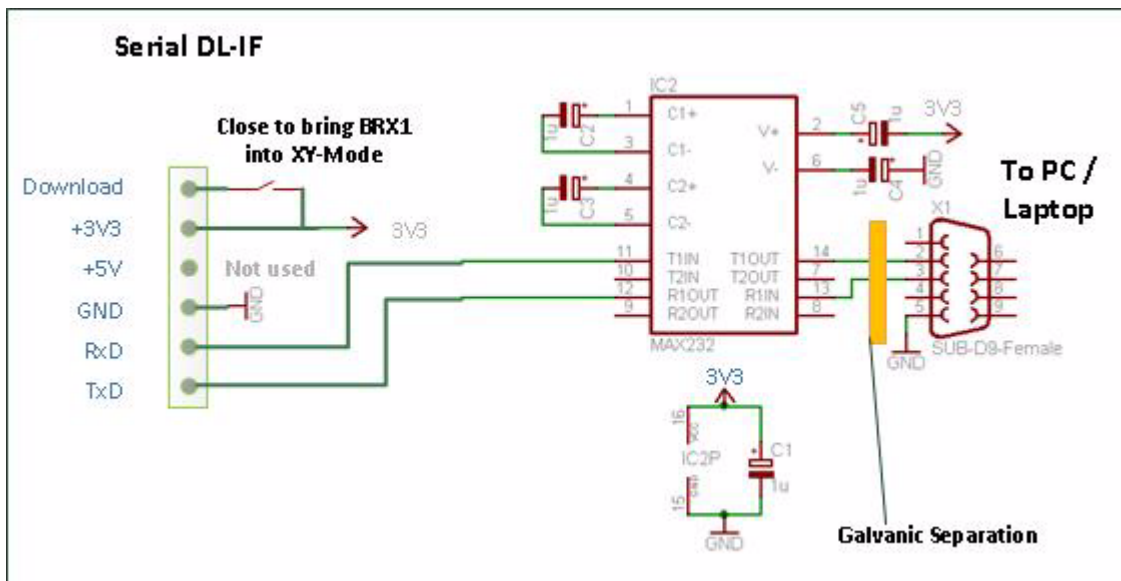


Figure 4-8 Adapter Plate for BRX1 Serial Download-I/F



WARNING: The galvanic separation is very important! If the adapter module does not offer the separation, it is mandatory, that the DC-PowerSupply has this separation. Otherwise damage of the device can occur.

Appendix A

Technical Specifications

BRX1 Hardware Specification

Hardware & Power

Table A-1 to Table A-6 provide the general technical data of the BRX - Broad SDSL Repeater.

Table A-1 Physics and Environment

BRX1-Family	BRX1
Physical Dimensions	
Height	34 mm
Width	110 mm
Depth	215 mm (incl. locating pins)
Weight	300 g
Environmental Conditions	
Operation:	ETSI ETS 300 019-1-4, class 4.1
Temperature	-40 ... +70 °C
Humidity	10 ... 100%, non-cond.
Storage (in packing):	ETSI ETS 300 019-1-1, class 1.2
Temperature	-25 ... +55 °C
Humidity	10 ... 100%, non-cond.
Transportation:	ETSI ETS 300 019-1-2, class 2.3
Temperature	-40 ... +70 °C
Humidity	10 ... 95%, non-cond.
Others	
Ingress Protection:	
DIN EN 60529 (VDE 0470 Part 1)	IP52 for the housing surface (except connector side) IP51 for the connector side of the housing
Fan:	none

Table A-2 Security and EMC

BRX1-Family	BRX1
EMC	
	EN 55022:1998 + A1:2000 class B
	EN 61000-3-2:2000
	EN 61000-3-3:1995 + A1:2001
Product Security	
Electrical security:	EN 60950
Sound emission:	None (no build-in fan)
Conformity:	CE

Table A-3 Power Supply

Power Supply	
Remote power supply (RPF)	
Input:	via the SRU-R interface on connector 1 (see figure Figure 3-2): Pin 2, Pin 3; reverse supply voltage polarity of the remote power (due to an interchange of wires) is supported.
Supply voltage RPF	55...120V DC
Supply current	< 30 mA
Local power supply (LPF)	
Input:	Connector 1 (see figure Figure 3-2): Pin 11 (negative), Pin 12 (positive)
Supply voltage -48VDC	-40...-57 V DC
Supply voltage -60VDC	-50...-72 V DC
Supply current	< 50 mA
Power Consumption	
RPF (when remote powered)	1.7 W
LPF (when local powered)	1.9 W

Table A-3 Power Supply (continued)

Fuses	
RPF (for remote power)	none
LPF (for local power)	2.5A; 125V; onboard

NOTE: If a local power supply is connected it is activated automatically. Remote supply can not be used, when LPF is available.

Interfaces

Table A-4 Technical Data of the SHDSL-Interfaces

SHDSL-Interface	
SRU-C and SRU-R	
Type:	2-wire SHDSL interface
Line Code / Modulation	16 TCPAM; 32 TCPAM; auto-detect
Number of interfaces	2
Impedance	135 Ohms
Transmission mode	Single pair operation
Data-rate (n x 64kbps)	n = 3 to 88
Connector:	2x DIN 41 617, 13pins. See Figure 3-2 for pinout.
Test & Download Interface	
Type:	UART, 3-wire (Rxd, TxD, GND) Voltage level: 3V3
Connector:	5-pin strip
Connection type:	DCE
Speed, Settings:	115,2 kBaud, 8 Bits, 1 stop-bit, no bit parity, no flow control: (115k, 8N1)

µController & Display

Table A-5 Display Functions

Type	
Display Functions	
System:	1 LED (green) for system, operating and error status
SHDSL:	1 LED (red) for activation, status and error

Table A-6 µController

Type	
Main processor:	16 Bit ARM
Non-volatile memory:	1 MB Flash, on-chip
Main memory:	112 kB RAM, on-chip

Appendix EC EC Declaration of Conformity



Declaration of EC-Conformity

We arcutronix GmbH
Garbsener Landstr. 10
D – 30419 Hannover
Germany

declare under our sole responsibility that the product group

Name: BRX – Broad SDSL Repeater
Members: ZWR-BRX1
Number: 1302-1001

to which this declaration relates conforms to the following standards, which have been described in the CE-guideline:

93/68/EEC	CE marking
2004/108/EC	Electromagnetic compatibility (EMC)
2006/95/EC	Safety of low voltage equipment (LVD)
1999/5/EC	Radio & Telecommunications Terminal Equipment (R&TTE)
2002/95/EC	Restriction of the use of certain Hazardous Substances (RoHS)
2002/96/EC	Waste Electrical and Electronic Equipment (WEEE)

The above listed products satisfy all technical regulations, applicable to the products based on following standards:

EN 55022	Electromagnetic compatibility (EMC) for Information technology equipment
EN 55024	Electromagnetic compatibility (EMC) for Information technology equipment
EN 61000-4-1	Electromagnetic compatibility (EMC) for Information technology equipment
EN 61000-4-2	Electrostatic discharge immunity test
EN 61000-4-3	Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4	Electrical fast transient/burst immunity test
EN 61000-4-5	Surge immunity test
EN 61000-4-6	Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests
EN 61000-6-1	Generic immunity standard – Residential, commercial and light industry
EN 61000-6-2	Generic immunity standard – Industrial environment
EN 60950	Safety of Information technology equipment

Hannover, 14.03.2014

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