BRUSA

SOFTWARE

NLG513

LEGAL NOTICE

Publisher	BRUSA Elektronik AG Neudorf 14 CH-9466 Sennwald T +41 81 758 19- 00 Fax: +41 81 758 19 - 99 www.brusa.biz office@brusa.biz
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Updates	In light of the further technical development of our products, we reserve the right for technical changes. Any changes will be disclosed in the relevant manuals through the replacement of the relevant pages and/or a revision of the electronic data storage device.
Writer / Author	Holger Schmidt

REVISIONS

REVISION	DATE	NAME	CHANGE
01	30.01.2012	Holger Schmidt	Textliche Korrekturen
02	19.07.2016	B.Graf	Kap. 4.2 „Documentation scope" korrigiert

VALIDITY

This manual is valid only for the following devices:

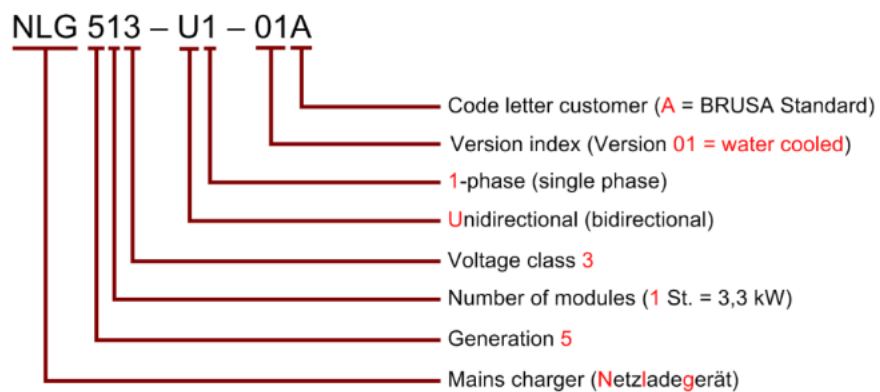| |
|---|
| NLG513-U1-01A (water-cooled version) |
| NLG513-U1-02A (air-cooled version) |

Decoding of the device designation is as follows:

NLG 513 – U1 – 01A

Code letter customer (A = BRUSA Standard)
Version index (Version 01 = water cooled)
1-phase (single phase)
Unidirectional (bidirectional)
Voltage class 3
Number of modules (1 St. = 3,3 kW)
Generation 5
Mains charger (Netzladegerät)

TABLE OF CONTENTS

1   Foreword

Dear customer!

With the BRUSA NLG5 charger you have obtained a very capable and versatile product. As this is a power electronics product with dangerous voltages and currents, specialist knowledge is required for dealing with it as well as operating it!

Read this manual - particularly the chapter *Safety and Warning Instructions* - carefully before you install the NLG5 charger or carry out any other work on it!

2   List of Abbreviations

Throughout this manual, some specific technical abbreviations are used. You will find an overview as well as their meaning in the following table:

ABBR.	MEANING	ABBR.	NAME
CAN	Controller Area Network	PI	Power Indicator
CP	Control Pilot	VCU	Vehicle Control Unit
NLG	Netzladegerät (Mains Charger)	PON	Power ON

3 Safety and Warning Instructions

In this chapter you will find safety instructions which apply to this device. These refer to assembly, start-up and running operation in the vehicle. Always read and observe these instructions in order to protect people's safety and lives and to avoid damage to the device!

3.1 Symbols and their meaning

Throughout this manual, some specific technical abbreviations are used. You will find an overview as well as their meaning in the following table:

PROHIBITION SYMBOLS

SYMBOL	MEANING	SYMBOL	MEANING
	General prohibition		Warning high voltage Touching forbidden
	Switching on forbidden		

WARNING SYMBOLS

SYMBOL	MEANING	SYMBOL	MEANING
	General hazard warning		Electromagnetic field warning
	Potentially explosive warning		Battery hazard warning
	Hot surface warning		High electrical voltage warning
	High pressure warning / fluid spurting out		Fire hazard warning

MANDATORY SIGNS

SYMBOL	MEANING	SYMBOL	MEANING
	Disconnect device from voltage		Disconnect device from mains

INFORMATION SIGNS

SYMBOL	MEANING	SYMBOL	MEANING
	Important information on avoiding possible damage to property		Important information

3.2 Safety instructions and danger levels

DANGER
This instruction warns against serious, irreversible risks of injury and in some cases death!
Avoid these dangers by observing these instructions!

WARNING
This instruction warns against serious, irreversible risks of injury!
Avoid these dangers by observing these instructions!

CAUTION
This instruction warns against serious, irreversible risks of injury!
Avoid these dangers by observing these instructions!

INSTRUCTION
This instruction warns against possible damages to property if the following instructions and work procedures are not observed.

INFORMATION
This type of instruction discloses important information for the reader.

4 General

4.1 Content and Scope of this Manual

The present documentation provides the reader with a description of the state machine along with guidelines for a firmware update.

4.2 Scope of the Entire Documentation

INFORMATION
In order to successfully commission the charger, you need this manual and the hardware manual, and possibly further software. BRUSA will be happy to provide this so-called (documentation-) "customer package" by download links.

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4.3 Contact Information of the Manufacturer

BRUSA Elektronik AG
Neudorf 14
9466 Sennwald
Switzerland

Phone:	+41 81 758 09 - 00
Fax:	+41 81 758 09 - 99
Internet:	www.brusa.biz
E-mail:	support@brusa.biz

5   NLG513 State Machine (Wake-up and Sleep Mechanisms)

INFORMATION
The NLG5 is capable of *waking up* automatically via the following wake-up signals or in connection with a superior unit (e.g. VCU): ➢ Control pilot (CP) ➢ Pin 3*PON*, e.g. switched by superior control as the VCU ➢ CAN signal *NLG5_CTL* (e.g. Rx at 618)

The following graph gives an overview of the state diagram which consists of 5 states in total. Entry into the state diagram takes place when the device is switched on (activated by the wake-up signal) in the *Init* state. After this the NLG5 is always in one of these 5 states up until being switched off (Init, Wake-up, Wait-sleep, In-operation, Off).
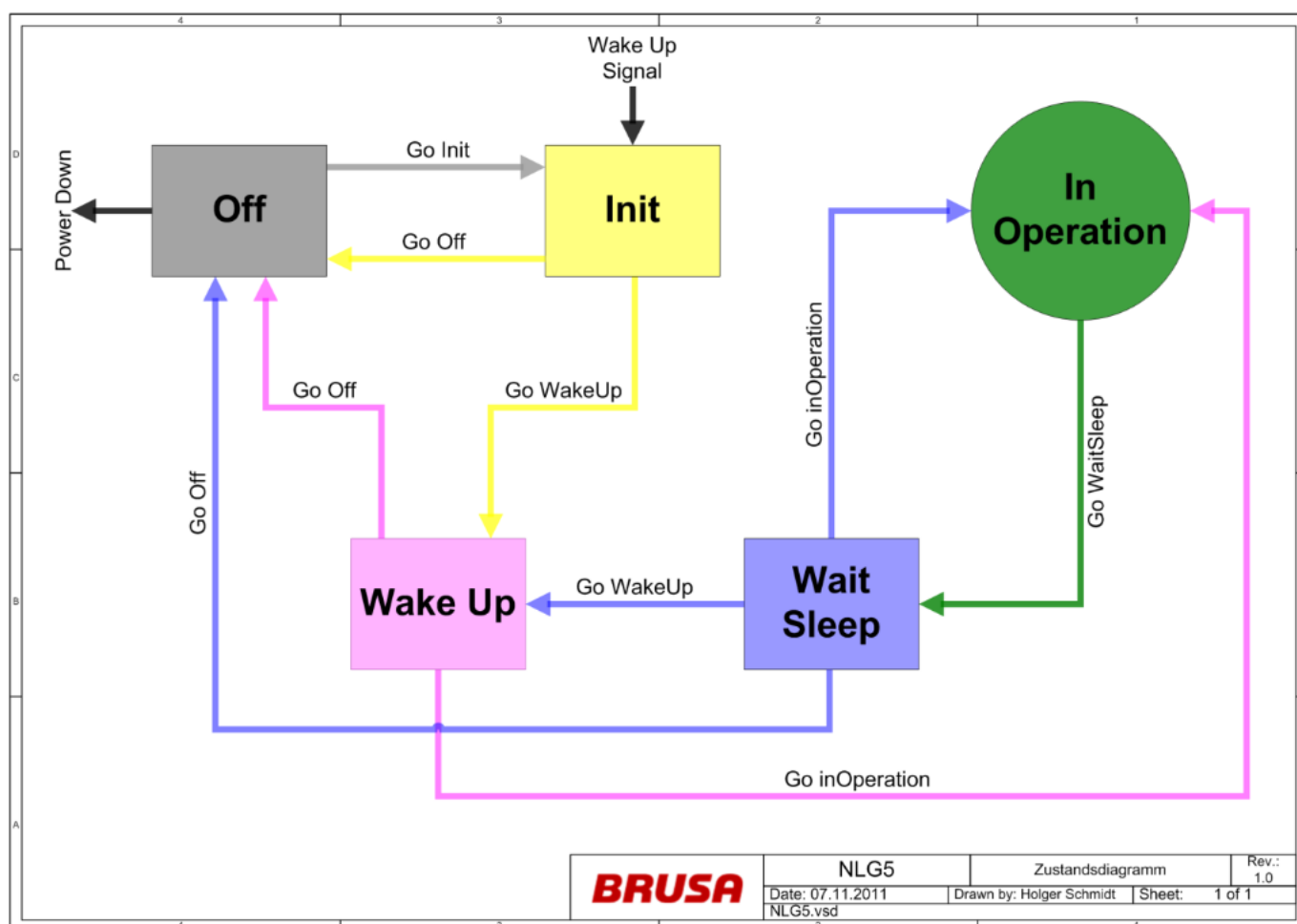
5.1   Init State

In this state, checks are made on whether a superior unit needs to be woken up (e.g. VCU). If this is not the case, the charger is automatically moved back to the *Off* state. Generally this state has the following tasks / functions:

- ➢ Initialisation of the controller
- ➢ Checking whether *Wake-up* is actually needed.
- ➢ Timeout monitoring

Description / Course:

In order to reach the *Init* state, the NLG5 must usually be activated beforehand with a hardware signal (*CP, PON* or *CAN*). With this the charger attempts to enter the *Wake-up* state. In this process the initialising of the system takes place first. Then checks are made on which signal (*CP, PON* or *CAN)* activated the *Wake-up*. If one of these three signals is identified, the charger will switch immediately to the *Wake-up* state. If none of these signals is identified, the charger will continue to repeat the process until either one of the signals has been identified or the timeout of 1 second is surpassed. If a timeout occurs, the NLG5 switches immediately to the *Off* state.
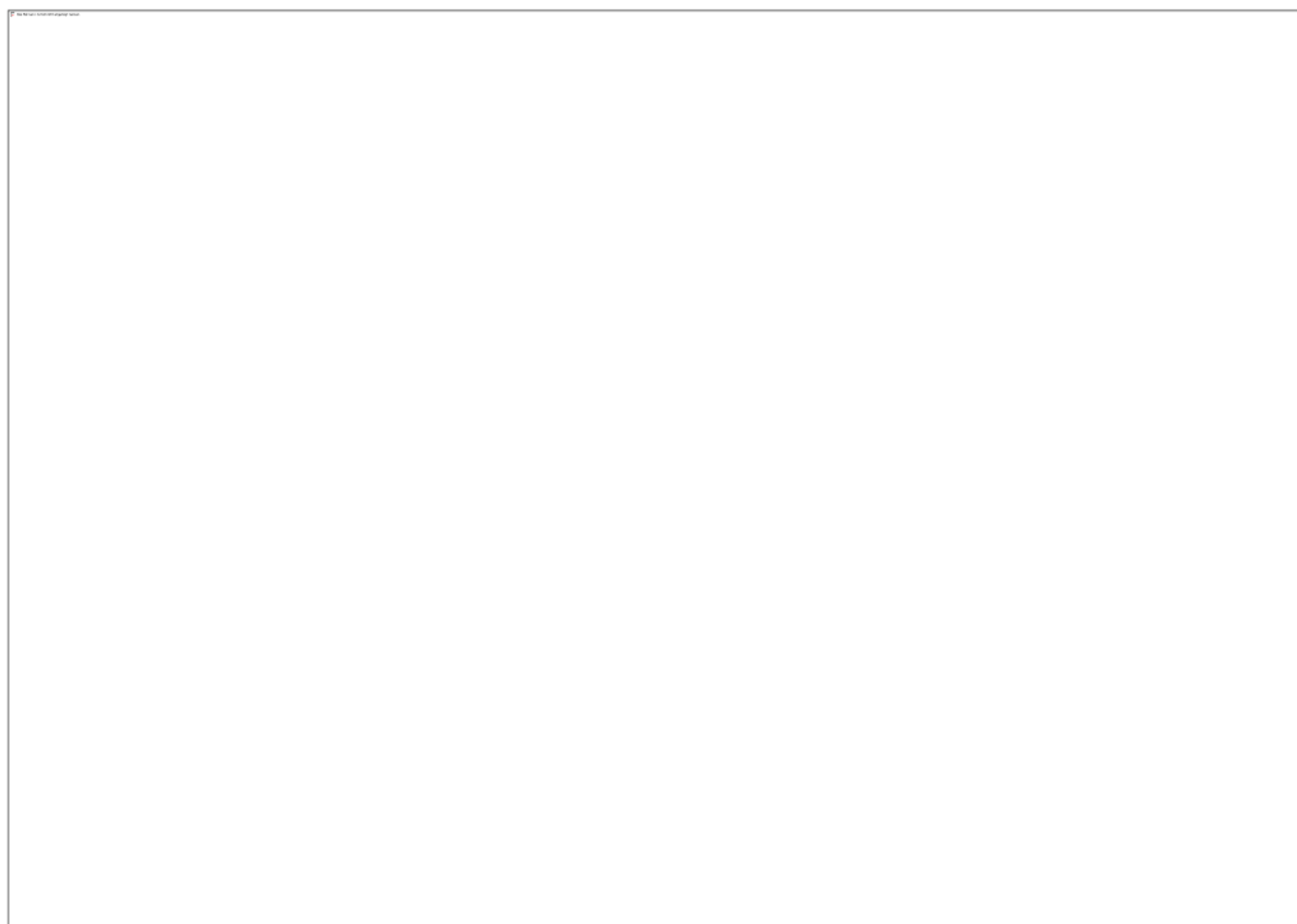
5.2 Wake-up State

In this state, the reaction of the superior unit (signal *PON active*) is waited for. If the charger receives this signal, the switch to the *In-operation* state takes place immediately. Generally this state has the following tasks / functions:

➢ Waking up the superior unit (e.g. VCU)
➢ Waiting until *PON* is active
➢ If *PON* is inactive, switching the charger to the *Off* state

Description / Course:

On entering this state, checks are made first on whether *PON* is active. If this is the case, the device switches immediately to the *In-operation* state. However, if *PON* is inactive, a digital output (pin *DO2*) is switched immediately (0 ms on delivery, the value is configurable with the *PARAM* Software!) This signal has the task of activating the superior control (e.g. VCU).

Alongside this, checks are made on whether valid signals arrive via *CAN* or over the *CP*. The *Wake-up* state is only maintained as long as signals reach the charger. As soon as the signals stop arriving, the charger switches to the *Off* state after a CAN timeout has taken place.
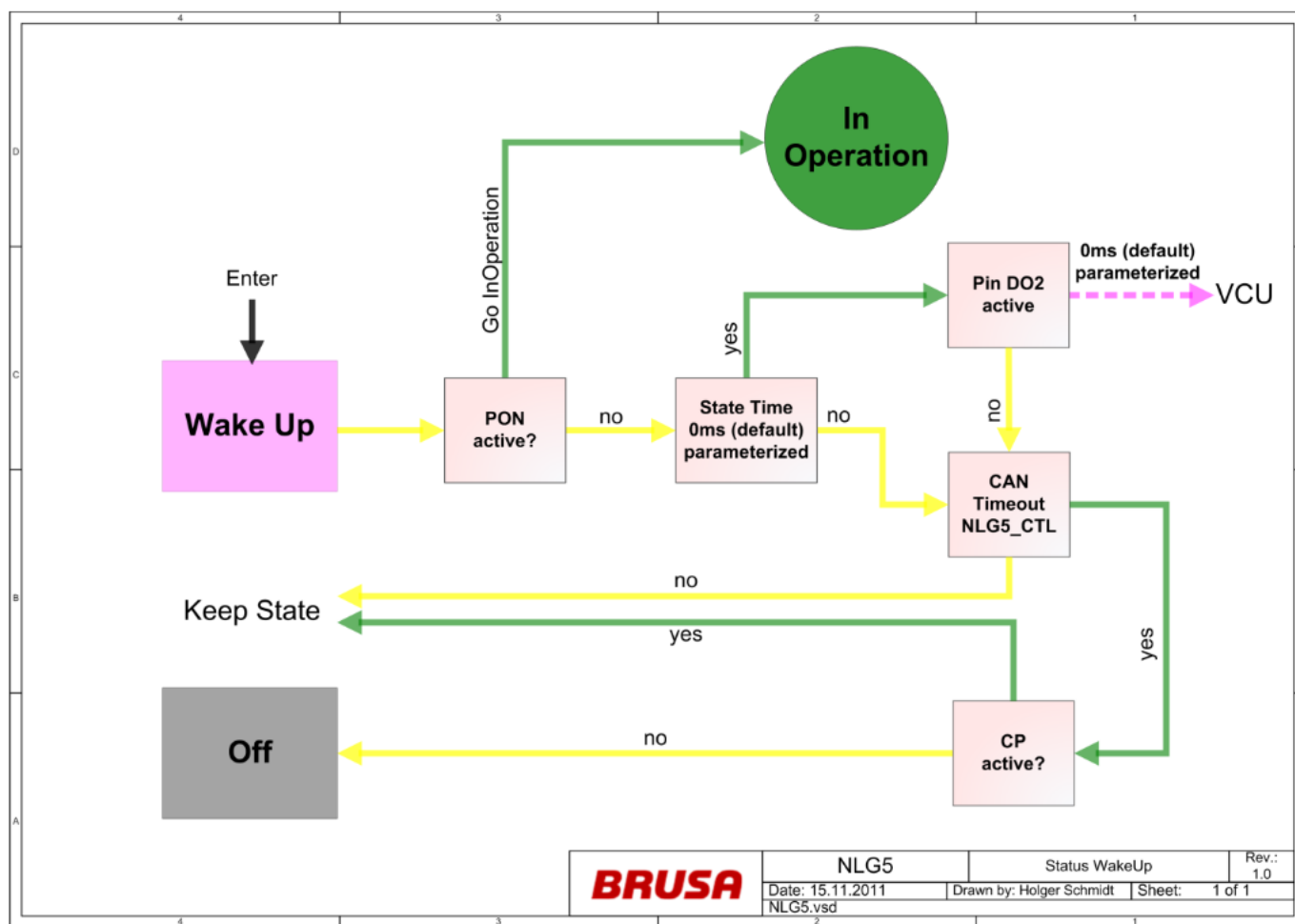
5.3   In-operation State

In this state, the charger is completely ready for operation if all other conditions (AC, DC, CAN) are fulfilled in the process. In this state the CAN data is sent in cycles. The charging of the battery is thereby enabled. This state will be maintained as long as the *PON* signal is active. As soon as the *PON* signal is inactive, the device switches to the *Wait-sleep* state.
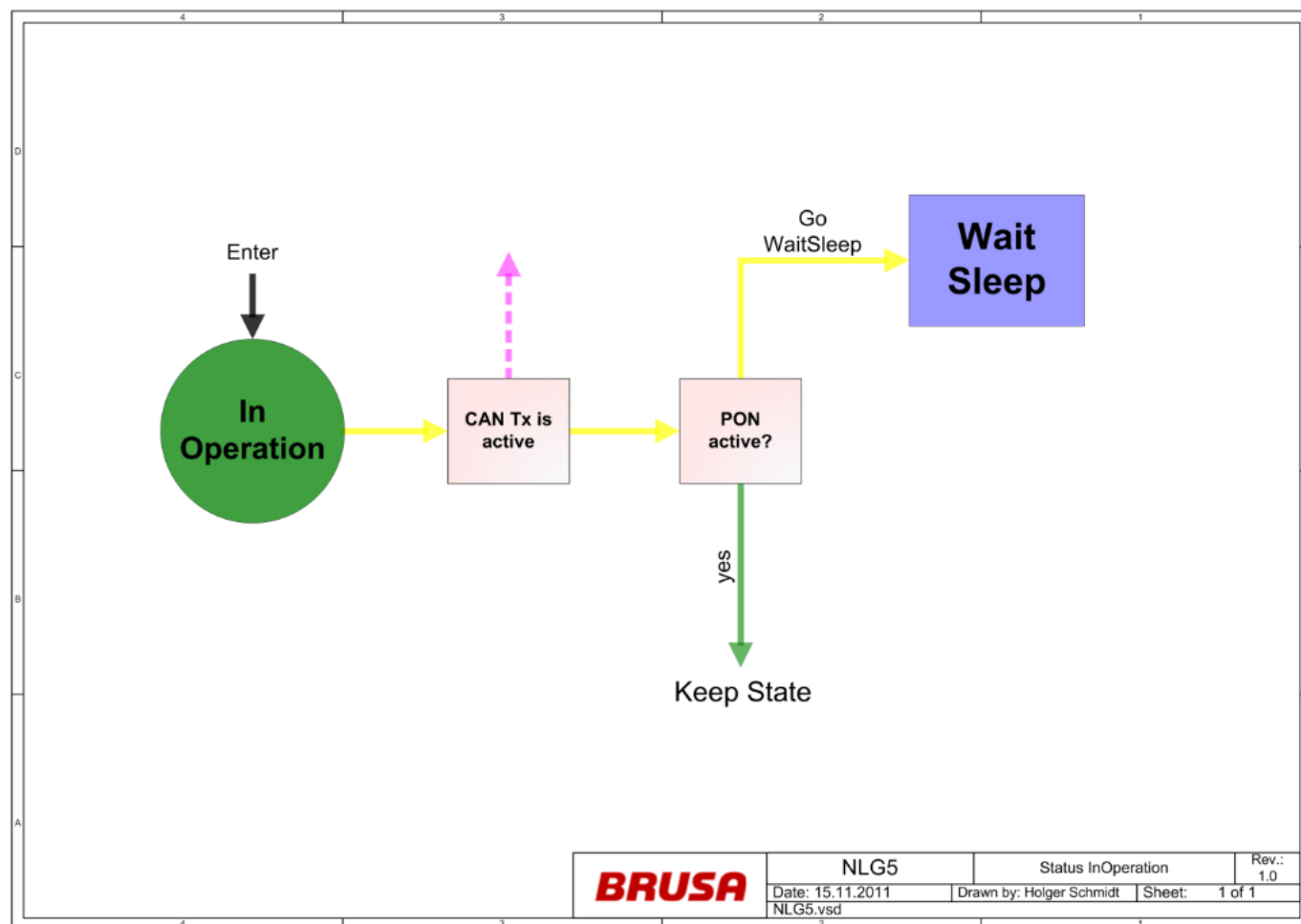
5.4   Wait-sleep State

In this state the charger waits for other requests and decides which state should be activated on the basis of various conditions (*Go-operation* or *Off*).

If the charger is moved to this state, the *PON* signal is checked first. If *PON* is active, the charger is immediately switched to the *In-operation* state. If *PON* is inactive, the *CP* and *CAN* signals are checked. The following is applicable during the signal checking: If one of the two *CP* or *CAN* signals was inactive and became active again, the charger changes to the *Wake-up* state. This signalling means that there is another reason to wake-up. A direct switch to the *In-operation* state is not possible here because the *PON* signal is inactive in the superior control (VCU).

As long as the CAN bus is still active, the charger remains in this state. This also applies if there are no wake-up requests. Even if *CAN* is inactive now, the charger switches to the *Off* state.
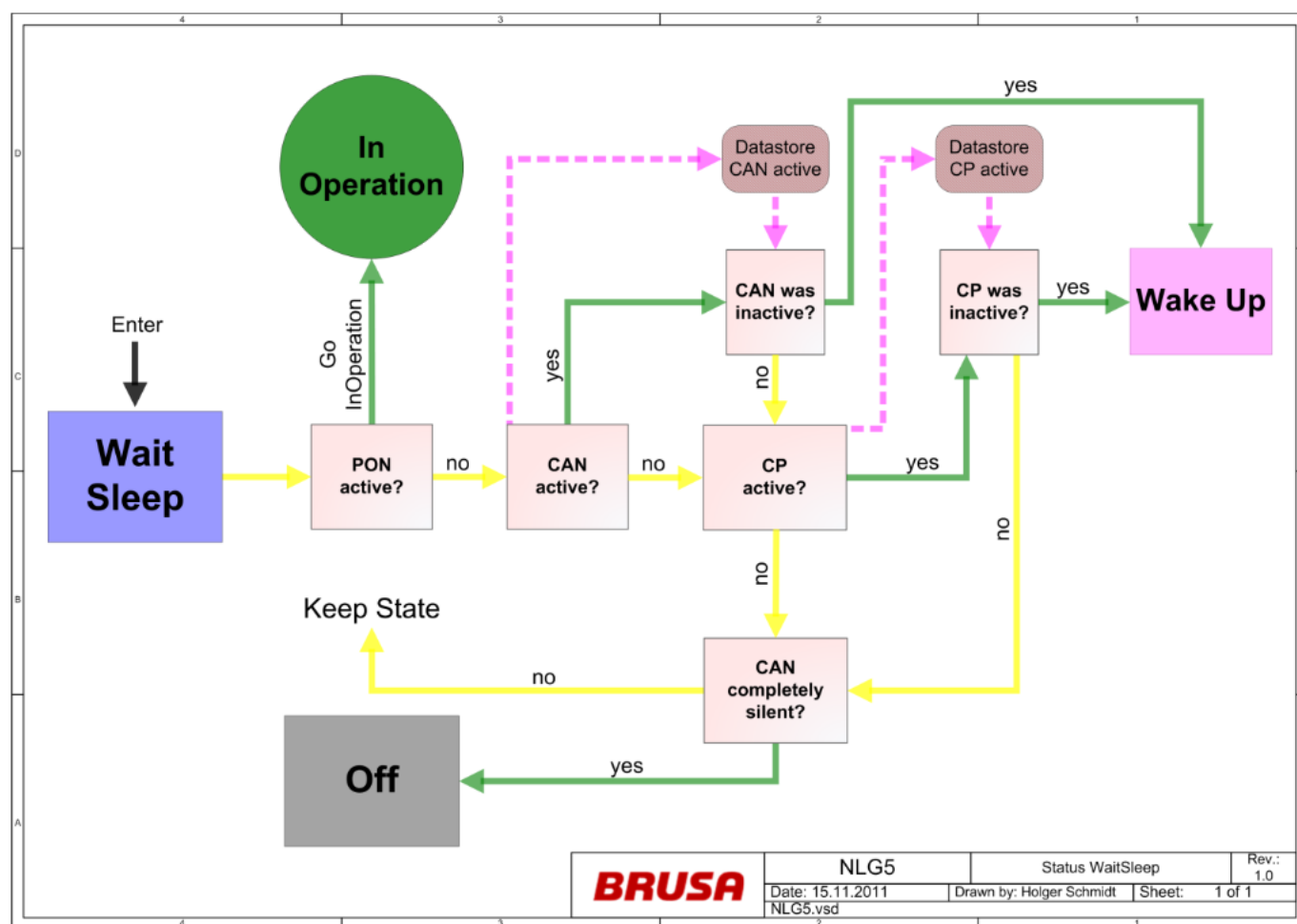
5.5   Off State

In this state the wake-up signals are monitored until the charger is finally shut down.

The shut-down process of the charger has been activated. Until the final shut-down of the processor (max. 1 - 2 s), the charger is in the *Off* state. During this time, the three wake-up signals (*CP*, *PON* and *CAN*) are checked. If one of the wake-up signals becomes active again during the shut-down process, the charger switches to the *Init* state immediately.
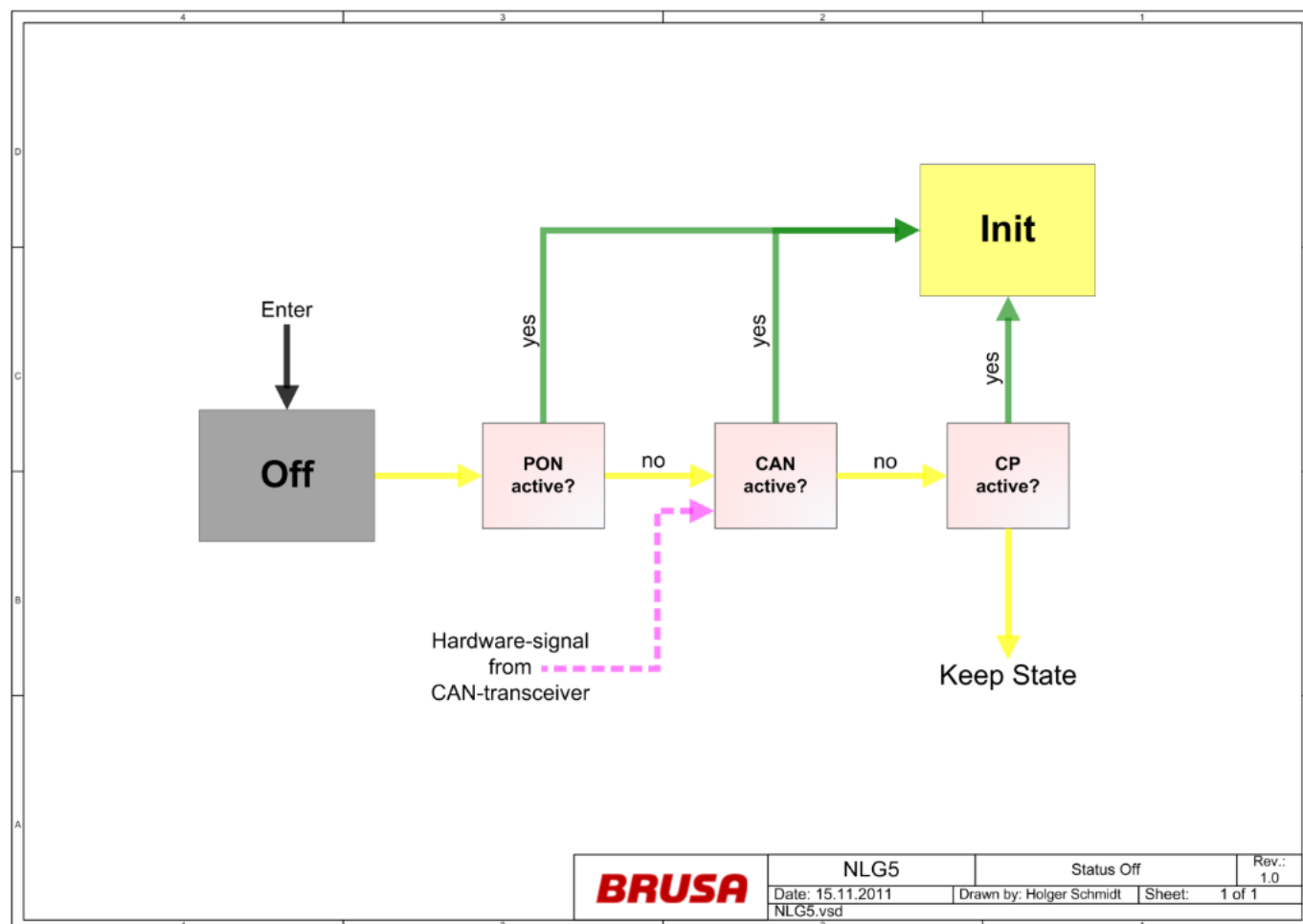
6 CAN Signals and Troubleshooting

INFORMATION
In this chapter you can find a listing and description of the individual CAN signals. All error messages are listed here too. The complete CAN matrix is included in the delivery contents as a *.dbc* file.

TYPE	CAN SIGNAL	BIT POSITION	BIT SIZE	RX / TX	CYCLUS TIME (MS)	DESCRIPTION
Message	**NLG5_CTL**	**0x618**	**7**	**Rx**	**100**	
Bit	NLG5_C_C_EN	0	1	Rx	---	Must be ON to enable power stage of the charger
Bit	NLG5_C_C_EL	1	1	Rx	---	Cycle this value 0-1-0 to clear all latched charger errors
Bit	NLG5_C_CP_V	2	1	Rx	---	Special signal to tell a charging station equipped with the Control pilot interface (SAE J1772) to switch on the facility's ventilation (in order to get rid of battery gases like hydrogen, e.g.)
Bit	NLG5_C_MR	3	1	Rx	---	Enables CP-State C to request mains voltage
Signal	NLG5_MC_MAX	8	16	Rx	---	Maximum current to be drawn from the mains outlet, usually 16 A. Must always contain a valid value in order to keep on charging.
Signal	NLG5_OV_COM	24	16	Rx	---	Desired voltage to be output to the battery. Must always contain a valid value in order to keep on charging.
Signal	NLG5_OC_COM	40	16	Rx	---	Desired battery current. Must always contain a valid value in order to keep on charging.
Message	**NLG5_DIAG_RX**	**0x718**	**8**	**Rx**	**---**	
Signal	LAD_D_ParamRq	0	64	Rx		Diag requested data from host
Message	**NLG5_ST**	**0x610**	**4**	**Tx**	**100**	
Bit	NLG5_S_HE	0	1	Tx	---	Indicates if hardware enabled, i.e. a high or low signal is fed to the 'Power On' pin (pin3 of control connector)
Bit	NLG5_S_ERR	1	1	Tx	---	An error has been detected, red LED is ON, no power is output
Bit	NLG5_S_WAR	2	1	Tx	---	Warning condition on, i.e. charging power limited due to any limiting condition; red LED is blinking
Bit	NLG5_S_FAN	3	1	Tx	---	Charger cooling fan is active
Bit	NLG5_S_EUM	4	1	Tx	---	European mains input detected (230 V, 50 Hz)
Bit	NLG5_S_UM_I	5	1	Tx	---	US mains level 1 (120 V AC / 60 Hz) detected
Bit	NLG5_S_UM_II	6	1	Tx	---	US mains level 2 (240 V AC / 60 Hz) detected
Bit	NLG5_S_CP_DT	7	1	Tx	---	Control pilot signal (SAE J1772) detected
Bit	NLG5_S_BPD_I	8	1	Tx	---	Bypass detection bit 1; 00: no bypass, 01: DC bypass detected, 10: AC bypass in phase, 11: AC bypass not in phase
Bit	NLG5_S_BPD_II	9	1	Tx	---	Bypass detection bit 2; 00: no bypass, 01: DC bypass detected, 10: AC bypass in phase, 11: AC bypass not in phase
Bit	NLG5_S_L_OV	10	1	Tx	---	Output power limited by battery output voltage limit
Bit	NLG5_S_L_OC	11	1	Tx	---	Output power limited by battery output current limit
Bit	NLG5_S_L_MC	12	1	Tx	---	Output power limited by mains current limit
Bit	NLG5_S_L_PI	13	1	Tx	---	Output power limited by analogue input 'power indicator' (PI) limit
Bit	NLG5_S_L_CP	14	1	Tx	---	Output power limited by control pilot signal (SAE J1772)

TYPE	CAN SIGNAL	BIT POSITION	BIT SIZE	RX / TX	CYCLUS TIME (MS)	DESCRIPTION
Bit	NLG5_S_L_PMAX	15	1	Tx	---	Output power limited by maximum power capability of NLG5
Bit	NLG5_S_L_MC_MAX	16	1	Tx	---	Output power limited by maximum mains current capability of NLG5
Bit	NLG5_S_L_OC_MAX	17	1	Tx	---	Output power limited by maximum output current capability of NLG5
Bit	NLG5_S_L_MO_MAX	18	1	Tx	---	Output power limited by maximum output voltage capability of NLG5
Bit	NLG5_S_L_T_CPRIM	19	1	Tx	---	Output power limited by temperature of primary capacitors
Bit	NLG5_S_L_T_POW	20	1	Tx	---	Output power limited by temperature of power stage
Bit	NLG5_S_L_T_DIO	21	1	Tx	---	Output power limited by temperature of diodes
Bit	NLG5_S_L_T_TR	22	1	Tx	---	Output power limited by temperature of transformer
Bit	NLG5_S_L_T_BATT	23	1	Tx	---	Output power limited by battery temperature
Bit	NLG5_S_AAC	31	1	Tx	---	AUX 12 V Automatic Charging Active
Message	**NLG5_ACT_I**	**0x611**	**8**	**Tx**	**100**	
Signal	NLG5_MC_ACT	0	16	Tx	---	Actual mains current
Signal	NLG5_MV_ACT	16	16	Tx	---	Actual mains voltage
Signal	NLG5_OV_ACT	32	16	Tx	---	Actual battery output voltage
Signal	NLG5_OC_ACT	48	16	Tx	---	Output current to the battery
Message	**NLG5_ACT_II**	**0x612**	**8**	**Tx**	**100**	
Signal	NLG5_S_MC_M_CP	0	16	Tx	---	Value of mains current limit, commanded by the control pilot (SAE J1772) signal
Signal	NLG5_S_MC_M_PI	16	8	Tx	---	Value of mains current limit, commanded by the 'power indicator' (PI) analogue input signal
Signal	NLG5_ABV	24	8	Tx	---	Aux battery voltage
Message	**NLG5_TEMP**	**0x613**	**8**	**Tx**	**1000**	
Signal	NLG5_P_TMP	0	16	Tx	---	Power stage temperature
Signal	NLG5_TMP_EXT1	16	16	Tx	---	Value of external battery temperature sensor #1 (if connected and enabled)
Signal	NLG5_TEMP_EXT2	32	16	Tx	---	Value of external battery temperature sensor #2 (if connected and enabled)
Signal	NLG5_TMP_EXT3	48	16	Tx	---	Value of external battery temperature sensor #3 (if connected and enabled)
Message	**NLG5_ERR**	**0x614**	**5**	**Tx**	**1000**	
Bit	NLG5_E_OOV	0	1	Tx	---	Battery output over-voltage; error can only be cleared by cycling power ON-OFF-ON
Bit	NLG5_E_MOV_II	1	1	Tx	---	Mains over-voltage 2 detected
Bit	NLG5_E_MOV_I	2	1	Tx	---	Mains over-voltage 1 detected
Bit	NLG5_E_SC	3	1	Tx	---	Power stage short circuit condition detected; error can only be cleared by cycling power ON-OFF-ON
Bit	NLG5_E_P_OM	4	1	Tx	---	Plausibility battery output voltage measurement wrong
Bit	NLG5_E_P_MV	5	1	Tx	---	Plausibility mains voltage measurement wrong
Bit	NLG5_E_OF	6	1	Tx	---	Output fuse defective
Bit	NLG5_E_MF	7	1	Tx	---	Mains fuse defective

TYPE	CAN SIGNAL	BIT POSITION	BIT SIZE	RX / TX	CYCLUS TIME (MS)	DESCRIPTION
Bit	NLG5_E_B_P	8	1	Tx	---	Wrong battery polarity; error can only be cleared by cycling power ON-OFF-ON
Bit	NLG5_E_T_C	9	1	Tx	---	Temperature sensor for prim capacitor defective
Bit	NLG5_E_T_POW	10	1	Tx	---	Temperature sensor for prim power stage defective
Bit	NLG5_E_T_DIO	11	1	Tx	---	Temperature sensor for diodes defective
Bit	NLG5_E_T_TR	12	1	Tx	---	Temperature sensor for transformer defective
Bit	NLG5_E_T_EXT1	13	1	Tx	---	Ext. temperature sensor 1 defective (if enabled)
Bit	NLG5_E_T_EXT2	14	1	Tx	---	Ext. temperature sensor 2 defective (if enabled), ext. temperature sensor 2 defective (if enabled)
Bit	NLG5_E_T_EXT3	15	1	Tx	---	Ext. temperature sensor 3 defective (if enabled)
Bit	NLG5_E_F_CRC	16	1	Tx	---	Flash memory checksum failure
Bit	NLG5_E_NV_CRC	17	1	Tx	---	NVSRAM check sum failure; contains most of the scaling & calibration values, CAN ID's and charging profile etc.
Bit	NLG5_E_ES_CRC	18	1	Tx	---	Sys EEPROM checksum failure
Bit	NLG5_E_EP_CRC	19	1	Tx	---	Pow EEPROM checksum failure
Bit	NLG5_E_WDT	20	1	Tx	---	Internal Watchdog Timeout
Bit	NLG5_E_INIT	21	1	Tx	---	Initialisation error
Bit	NLG5_E_C_TO	22	1	Tx	---	CAN timeout, no control message received for >300 ms
Bit	NLG5_E_C_OFF	23	1	Tx	---	CAN off, transmit buffer >255
Bit	NLG5_E_C_TX	24	1	Tx	---	CAN transmit buffer >127
Bit	NLG5_E_C_RX	25	1	Tx	---	CAN receiver buffer >127
Bit	NLG5_E_SDT_BT	26	1	Tx	---	Emergency shutdown threshold 'Battery Temperature' is exceeded; see ChargeStar help section 'protective features'; error can only be cleared by cycling power ON-OFF-ON
Bit	NLG5_E_SDT_BV	27	1	Tx	---	Emergency shutdown threshold 'Battery Voltage' is exceeded; see ChargeStar help section 'protective features'; error can only be cleared by cycling power ON-OFF-ON
Bit	NLG5_E_SDT_AH	28	1	Tx	---	Emergency shutdown threshold 'Amp Hours' is exceeded; see ChargeStar help section 'protective features'; error can only be cleared by cycling power ON-OFF-ON
Bit	NLG5_E_SDT_CT	29	1	Tx	---	Emergency shutdown threshold 'Charging Time' is exceeded; see ChargeStar help section 'protective features'; error can only be cleared by cycling power ON-OFF-ON
Bit	NLG5_W_PL_MV	32	1	Tx	---	Output power limited by low mains voltage
Bit	NLG5_W_PL_BV	33	1	Tx	---	Output power limited by low battery voltage
Bit	NLG5_W_PL_IT	34	1	Tx	---	Output power limited by charger internal excessive temperature
Bit	NLG5_W_C_VOR	35	1	Tx	---	Commanded value is out of specified range; max or min applicable value is assumed instead
Bit	NLG5_W_CM_NA	36	1	Tx	---	NLG5 control message not active
Bit	NLG5_W_OD	38	1	Tx	---	LED output driver defective, LEDs can't be controlled by NLG5 anymore. Charging is still possible.
Bit	NLG5_W_SC_M	39	1	Tx	---	Save-Charging-Mode reduces primary current to 3.95 A as long as one of the four internal temperature sensors indicates -18° C or less
Message	**NLG5_DIAG_TX**	**0x71A**	**8**	**Tx**	**---**	
Signal	LAD_D_ParamRp	0	64	Tx	---	

7   Warranty and Guarantee

The company BRUSA Elektronik AG provides a guarantee period of 24 months after the date of purchase provided there are uniquely verifiable material and workmanship defects.

The guarantee acceptance becomes invalid immediately if the seal on the housing is damaged through unauthorised opening or if it is not there at all!

Furthermore, BRUSA Elektronik AG accepts absolutely no liability for damage which results from incorrect or improper handling of the device!

For damage to persons which results from non-observance of the general and product-specific safety guidelines, no liability claims can be asserted against BRUSA Elektronik AG!

For damage to peripheries which results in connection with this device, BRUSA Elektronik AG can accept no liability! If anything is unclear regarding the operation of this product, we would ask you to sort this out with our support team BEFORE you start the installation!

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