Operating Manual
for the
PLUGSYS® Housings

Typ 600 - 607
Version 1.4, (April 15, 2013)

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1. General description

The HSE PLUGSYS® housing takes the various function modules of the PLUGSYS® measuring system. The housing contains the standard power supply as well as the system bus board. The total number of slots available to take function modules is 20, 7 or 1 depending on the model. The mechanical construction of the housing and slots corresponds to the 19" rack standard for Euroboards. The slot spacing equals 4E units, corresponding to 20.32 mm (1E = 5.08 mm). The width of the function modules equals one or several slot spacings; for example, the DBA Type 660 (DC Bridge Amplifier) requires two slot spacings equal to 8E. The maximum number of function modules per housing depends on the width of the modules fitted. The housing is supplied completely wired and ready for use. The provision of special voltages on the bus board is made when the modules are fitted in position, e.g. the LLC Liquid Level Controller Type 661. When supplied from the factory the slots 5, 7, 15 and 17 are prepared with pins for feeding in special voltages. The function modules can be fitted by the user using the information provided in the Instruction Manual.

2. Setting up

There are no special precautions for locating the equipment. Any vibration-free flat surface is suitable. Adequate cooling is ensured provided the unit is not set up close to a source of heat and has at least 10 cm clear space on all sides. Avoid using the equipment in particularly humid or dusty locations! The connection data and ambient conditions are summarised in the table below.

Supply voltage	230 (115) Volt a.c.
Supply frequency	50 to 60 Hz
Ambient temperature	5 to 40 degree Celsius
Humidity	20 to 80%

3. Mains switch

This is located on the left on the front of the housing. After switching on the mains lamp on the switch panel lights up.

4. Installing the PLUGSYS® function modules

The function modules are independent of location and can be installed in any slot. Modules which require special supply voltages for operation, e.g. LLC Liquid Level Controller Type 661, must however be fitted in specified slots. The assignment of the input and output signals takes place on the module through jumpers (see signal description of the PLUGSYS® bus board).

1. Ensure first that the equipment is switched off. Remove the mains supply cable from the back of the housing.

2. Take off the front frame of the PLUGSYS® housing. After removing the fixing screws (right and left side in the front frame) the frame can be taken off the housing (this step is omitted in the case of the rack housing).

3. **Note:** before fitting the module in its slot the internal settings on the board of the function module have to be made in accordance with the appropriate operating instructions.

4. The modules are inserted in the housing along the guide rails and secured with two fixing screws.

5. Empty slots are covered with blanking plates (EXTENSION).

6. Fit the front frame back into position (omitted in the case of the rack housing).

7. Document the input and output signals in the system.

5. Description of the PLUGSYS® system bus signals

The backplane board of the PLUGSYS® measuring system is divided into the following areas:

(1) Power supply
(2) Analogue signal bus
(3) Digital signal bus
(4) Trigger signals
(5) Control lines from computer to PLUGSYS® measuring system
(6) Other signal lines

5.1 Power supply

+5 Volt Supply for the digital circuits and the DC - DC converter for supplying analogue circuits.

D-GND Reference zero of 5 Volt supply

+ ANALOGUE (12 to 15 Volt) Supply voltage for analogue amplifier units without DC - DC converter. This line is not used in the standard form of the PLUGSYS® housing and is linked to the power supply. It is required for feeding in an additional analogue power supply.

- ANALOGUE (12 to 15 Volt) Supply voltage for analogue amplifier units without DC - DC converter. This line is not used in the standard form of the PLUGSYS® housing and is linked to the power supply. It is required for feeding in an additional analogue power supply.

A-GND Reference zero of the analogue supply voltages and the input and output signals.

SHIELD Ground (mains potential), only provided for screening. Do not use as ground connection.

POWER 0 to 2 External voltage supply for special function modules, e.g. LLC Type 661. The voltage is fed in separately for each slot. The permitted voltage range is $\pm$ 40 Volt at 4 A max.

Slots 15 and 17 in the standard version are provided with contacts for feeding in a voltage through POWER 0 to POWER 2.

Important: The reference zeroes of the individual voltages are connected together at a single central point (Terminator-Module) on the board (A-GND with D-GND with SHIELD).

5.2 Analogue signal bus lines (AV1 to AV16)

The analogue signal lines AV1 to AV16 (analogue bus) are used as input and output lines between the function modules of the PLUGSYS® measuring system. The maximum signal voltage is $\pm$ 15 Volt. The assignment of the inputs and outputs is determined by links on the function modules. The function of the modules is therefore independent of the slot position on the system bus.

5.3 Analogue multiplex signal output (AM)

Analogue output signal $\pm$ 15 Volt. A key (MUX ON) on the front panel of the amplifier module is used to pass the output signal to the AM (Analogue Multimeter) signal line. The key function is self-maintained. The line RDVM (Reset Digital Voltmeter Multiplex) is activated at the same time to ensure that the module which had been selected previously releases the AM (Analogue Multiplex) signal line. This provision allows the output signals of the individual amplifier modules to be switched to a central analogue or digital display unit (e.g. DVM Digital Voltmeter module of the PLUGSYS®). When the equipment is switched on, a POWER UP RESET signal is generated which disconnects all analogue multiplex outputs.

5.4 RVDM signal (Reset Digital Voltmeter Multiplex)

See description 2.1 Analogue Multiplex signal output (AM).

5.5 Digital signal bus lines (DV1 to DV12)

The digital bus lines DV1 to DV12 are used as connections between the individual modules on the system bus. The signal level corresponds to TTL logic (0 to 5 Volt). The DV lines are used for the control and synchronisation of complex measuring systems.

5.6 Trigger signals (Trigger1 to Trigger4)

TTL control signals for synchronisation of measurement sequences, e.g. ECG synchronisation. The user has access to the TTL control signals through the Module ROM-T. The control signals TRIG1 and TRIG2 are outputs. TRIG3 and TRIG4 are inputs.

6. Control circuits from computer to PLUGSYS® system bus

The PLUGSYS® measuring system permits the control of function modules from a computer as well as data capture. The system bus board incorporates two interface concepts. Interface cards are available for the personal computer IBM PC (XT and AT) or compatible computers.

6.1 Control of non-intelligent function modules

Data transfer takes place through a parallel interface of 8-bit word length. The selection of the function modules is made through the address lines Card Select (CS-0 to CS-3) and Group Select (GS-0 to GS-2). Data transfer takes place through the data strobe DS-2.

6.1.1 Selection of function module

This takes place through the application of the appropriate address 0 to 15 (0 to F hexadecimal) to the Card Select signal lines CS-0 to CS-3.

6.1.2 Selection of control register on the function module

Application of the appropriate address 0 to 7 to the Group Select signals GS-0 to GS-2 selects the control register.

6.1.3 Choice of data flow direction

The direction during data transfer is set through the control line R/W (Read Write signal line): R/W signal logic one corresponds to the data direction from PLUGSYS® measuring system to the computer (Read function); R/W signal logic zero corresponds to the data direction from the computer to the PLUGSYS® measuring system (Write function).

6.1.4 Writing/reading data

After applying CS-0 to CS-3, GS-0 to GS-2, as well as the R/W signal the data transfer is terminated with the data strobe DS-2 (active logic zero or positive flank).

6.1.5 Normalising the hardware through /RESET signal

Normalising operates through the signal line /RESET from the com-puter or through the POWER-UP RESET on switching the equipment on.

6.1.6 Processing the interrupt requests on the system bus

The signal line B-INT (active logic zero) is arranged on the function modules as open collector (WIRED OR) output. The line is terminated on the computer interface board with a 100 Ohm resistor. The interrupt request of the function module (B-INT logic zero) is stored on the function module in a register (R-S flip-flop) and is output statically through an open collector output through the signal line B-INT. For interrogation during interrupt polling a status register is provided on the module under the address CS XXXX + GS 111. After reading the interrupt status information the interrupt flag register (R-S flip-flop) is reset automatically.

Status register details:

Bit 0 - free (not used)
Bit 1 - free (not used)
Bit 2 - free (not used)
Bit 3 - free (not used)
Bit 4 - bit 0 interrupt vector (LSB)
Bit 5 - bit 1 ditto
Bit 6 - bit 2 ditto (MSB)
Bit 7 - interrupt active (low)

6.1.7 Description of interface signal lines

DB-0 data line bit 0
DB-1 data line bit 1
DB-2 data line bit 2
DB-3 data line bit 3
DB-4 data line bit 4
DB-5 data line bit 5
DB-6 data line bit 6
DB-7 data line bit 7

The data bus (DB0 to DB7) is bidirectional. The signal level corresponds to TTL logic (0 to 5 Volt).

CS-0 card select bit 0
CS-1 card select bit 1
CS-2 card select bit 2
CS-3 card select bit 3

The address lines CS-0 to CS-3 select the function modules on the system bus. The address is in binary code corresponding to the slot addresses 0 to 15. The signal level corresponds to the TTL logic level (0 to 5 Volt).

GS-0 group select bis 0
GS-1 group select bit 1
GS-2 group select bit 2

The address lines GS-0 to HS-2 select the control register on the function module. The address is in binary code corresponding to the register addresses 0 to 7. The signal level corresponds to the TTL logic level (0 to 5 Volt).

DS-2 (Data strobe signal)

The data strobe signal DS-2 controls the data transfer. The signal level corresponds to the TTL logic level (0 to 5 Volt). The data transfer is activated on Low (TTL logic level corresponding to logic zero) or with the rising (positive) flank.

R/W (Read/Write signal)

The R/W signal defines the direction of the data flow. The signal level corresponds to the TTL logic level (0 to 5 Volt). A logic one (Read) defines data transfer from the PLUGSYS® measuring system to the computer. A logic zero (Write) defines data transfer from the computer to the PLUGSYS® measuring system.

/RESET (Reset signal)

The /RESET signal normalises all system components of the PLUGSYS® measuring system. The signal level corresponds to the TTL logic level (0 to 5 Volt). A logic zero normalises the system.

/B-INT (Bus interrupt)

Interrupt request from the function modules to the computer. The signal is active on logic zero, the signal level corresponds to the TTL logic level (0 to 5 Volt).

6.2 Control of intelligent function modules

The control of intelligent modules takes place by software through control codes of the ASCII table.

6.2.1 Data transfer from computer to PLUGSYS® measuring system

The control code DC1 XX (XX = function address of module) activates the function module for data transfer. The code EOT indicates the end of the data block, with automatic de-activation of the module. The hardware handshake operates through the signal lines DAV, NRFD and R/W. The data interchange takes place from the computer to the PLUGSYS® measuring system. The data content is coded according to the ASCII table.

6.2.2 Data transfer from PLUGSYS® measuring system to computer

The control code DC2 XX (XX = function address of the module) activates the interface circuit in the computer for data transfer. On changing over the R/W signal line the computer takes over control of the data transfer to the PLUGSYS® measuring system. The hardware handshake operates through the signal lines NDAC and DS1. The end of the data block is indicated to the computer by sending the control character EOT. At the same time the control of the interface is transferred to the computer. On malfunction during data interchange the computer can enforce the control over the interface by changing over the R/W signal line, e.g. Time-Out error.

6.2.3 Master software reset

The Software Reset of all intelligent function modules operates by sending the control code NL (Null code ASCII table). The Master Software Reset has no effect on the functions of non-intelligent modules.

6.2.4 Selective Software Reset

Sending the control code DC XX (XX = function address of the module) normalises an individual module. The Selective Software Reset has no effect on the functions of non-intelligent modules.

6.2.5 Hardware Reset

The Hardware Reset of the system bus of the PLUGSYS® measuring system has the same effect as the Master Software Reset on the intelligent modules.

6.2.6 Description of interface signal lines

DB-0 data line bit 0
DB-1 data line bit 1
DB-2 data line bit 2
DB-3 data line bit 3
DB-4 data line bit 4
DB-5 data line bit 5
DB-6 data line bit 6
DB-7 data line bit 7

The data bus (DB0 to DB7) is bi-directional. The signal level corresponds to the TTL logic level (0 to 5 Volt).

R/W (Read/Write signal)

The R/W signal defines the direction of the data flow. The signal level corresponds to the TTL logic level (0 to 5 Volt). A logic one (Read) defines data transfer from the PLUGSYS® measuring system to the computer. A logic zero (Write) defines a data transfer from the computer to the PLUGSYS® measuring system.

/RESET (Reset signal)

The /RESET signal normalises all system components of the PLUGSYS® measuring system. The signal level corresponds to the TTL logic level (0 to 5 Volt). A logic zero normalises the system.

DAV control signal

The DAV control signal acts as data strobe from the computer to the function modules during control through ASCII control codes. The signal level corresponds to the TTL logic level (0 to 5 Volt). The data transfer is activated on Low (TTL logic level corresponding to logic zero) or on the rising (positive) flank.

DS-1 control signal

The DS-1 control signal acts as data strobe from the function modules to the computer during control through ASCII control codes. The signal level corresponds to the TTL logic level (0 to 5 Volt). Data transfer is activated on Low (TTL logic level corresponding to logic zero) or on the rising (positive) flank.

NRFD control signal (Not Ready For Data)

The NRFD control signal is the handshake signal for data transfer from the computer to the PLUGSYS® measuring system. It is active on logic zero and arranged on the function modules as Open Collector (WIRED OR) output. The line is terminated on the computer interface board by a 100 Ohm resistor. The signal level corresponds to the TTL logic level (0 to 5 Volt). The NRFD signal line indicates to the computer that the transferred data have not yet been processed by the function modules.

NDAC control signal (Not Data Accepted)

The NDAC control signal is the handshake signal for data transfer from the function modules to the computer. It has the same significance as the NRFD control signal but the signal direction is reversed.

7. Other signal lines on the PLUGSYS® system bus

7.1 CAL signal line

The CAL signal line serves as bus line between all function modules and the signal output of the CGM Type 674 Calibration Generator Module for the dynamic calibration of the entire measuring system. If there is no Calibration Generator Module an external signal (function generator) can be fed in through the module EIM Type 673 External Input odule. The signal level is $\pm$15 Volt max. corresponding to the supply voltage of the amplifier modules.

7.2 TAKT signal line

The TAKT signal line carries a 1 MHz square-wave signal for synchronising time sequences. The signal is not utilised in the standard arrangement of the PLUGSYS® housing. The signal level corresponds to the TTL logic level (0 to 5 Volt).

7.3 X1 to X10 signal lines

The signal lines X1 to X10 provide connections between the individual function modules. The permitted voltage level is $\pm$15 Volt max. The lines X1 to X10 are used as wiring plane in special applications.

7.4 SHIELD line

The SHIELD line (ground or mains ground potential) is provided only for use as screen. It must not be used as mains supply ground line.

8. Pin details of the system bus

VG connector, 96-pin, rows a, b and c used

Row a	Pin No.	Row b	Pin No.	Row c
D-GND	1	D-GND	1	D-GND
A-GND	2	A-GND	2	A-GND
+ ANALOG	3	+ ANALOG	3	+ ANALOG
- ANALOG	4	- ANALOG	4	- ANALOG
DB-0	5	DAV	5	TRIGGER 1
DB-1	6	NRFD	6	TRIGGER 2
DB-2	7	NDAC	7	TRIGGER 3
DB-3	8	R/W	8	TRIGGER 4
DB-4	9	DS-1	9	RDVM
DB-5	10	B-INT	10	AM
DB-6	11	DV-1	11	AV-1
DB-7	12	DV-2	12	AV-2
CS-0	13	DV-3	13	AV-3
CS-1	14	DV-4	14	AV-4
CS-2	15	DV-5	15	AV-5
CS-3	16	DV-6	16	AV-6
GS-0	17	DV-7	17	AV-7
GS-1	18	DV-8	18	AV-8
GS-2	19	DV-9	19	AV-9
DS-2	20	DV-10	20	AV-10
/RESET	21	DV-11	21	AV-11
TAKT	22	DV-12	22	AV-12
X-1	23	X-6	23	AV-13
X-2	24	X-7	24	AV-14
X-3	25	X-8	25	AV-15
X-4	26	X-9	26	AV-16
X-5	27	X-10	27	CAL
POWER-0	28	POWER-0	28	POWER-0
POWER-1	29	POWER-1	29	POWER-1
POWER-2	30	POWER-2	30	POWER-3
SHIELD	31	SHIELD	31	SHIELD
+ 5 VOLT	32	+ 5 VOLT	32	+ 5 VOLT

9. Standard power supply

The primary switch mode power supply used in our PLUGSYS® basic housings is purchased from major industrial suppliers. They conform to the appropriate safety requirements and EMC standards of EC, VDE, IEC, UL etc..

9.1 Altering the supply voltage

All our PLUGSYS® basic housings are available for supply voltages of 230 V or 115 V. The units are normally set by us on despatch according to the requirements of the user's country. See the appropriate supply voltage information on the label, voltage selector, or additional label with supply voltage information. If however it should become necessary to alter the supply voltage setting please proceed as indicated below.

Warning: For safety reasons, any work on the power supply must only be carried out by suitably qualified technical personnel.

In view of the use of different power supply units from different manufacturers depending on the type, year and arrangement of the PLUGSYS® unit it is unfortunately not possible to provide information applicable to all cases. In principle the procedure is as follows:

Before opening the housing the unit has to be switched off. And for your own safety remove the mains supply cable from the power supply by pulling out the supply connector. Before working on a primary switch mode supply it is necessary to wait 5 - 15 minutes after switching off in order to ensure that the primary strorage capicitor is discharged, otherwise there is a risk of electric shock. In particular note also the position of the screws on the power supply housing since incorrectly fitted screws may possibly cause internal short-circuits when re-assembling the power supply.

The power supplies used by us normally contain suitable information on changing the supply voltage, either printed on the housing or marked on the circuit board (e.g. LINK FOR 115 V). In our latest PLUGSYS® basic housings we are increasingly using universal power supplies which no longer require any change for different supply voltages. The adjustment to the supply voltage is made automatically in the unit itself for the voltage range 85 - 264 VAC 47 - 440 Hz.

If you are not completely cartain how the voltage change has to be made on your instrument it is essential that you contact Hugo Sachs Elektronik either by fax or by phone. To deal with such enquiries we require from you information on the type of PLUGSYS® basic housing, the delivery date, and the serial number. We shall provide the required information for your instrument by return and free of charge.

After changing the supply voltage setting it is also necessary to change the two fuses on the supply inputs in accordance with the information provided by us on the lable. The supply cable has to be replaced by a cable conforming to the requirements for the altered power supply, and the altered electrical supply voltage has to be pemanently marked on the back of the unit next to the supply input.

10. CE Declaration of Conformity

CE This product and accessories conform to the requirements of the Low-voltage Directive 73/23 EEC as well as the EMC Directive 89/336 EEC and are accordingly marked with the CE mark. For conformity to the standards during operation it is essential that the details in the instructions provided are observed.

11. Technical data of the power supply

Input AC voltage	115 / 230 Volt ±20% 45 to 450 Hertz
Output voltages	+5 Volt 12 Amp +12 Volt 5 Amp +24 Volt 2 Amp -5 Volt 1 Amp -12 Volt 2 Amp
Rated output	(continuous)100 Watt with convective cooling
Operating temperature	0 to 70 °C
Overload protection	all outputs against permanent shortcircuit through current limitation
Electrical connection	screw terminals (mains connections covered up)
Dimensions	115 x 60 x 210 mm (W x H x L)

12. Technical data of the PLUGSYS® housing Type 600 - 607

Common technical details

Construction	aluminium housing, blue plastic coating
Supply	115 / 230 Volt A.C., 50 to 60 Hz input filter fitted
Standard accessories	supply cable, spare fuses, screw driver for fitting function modules, folder to take the operating instructions for function modules
Special accessories	Option 02: EXTENSION blank panel (4E) to cover unused slots when PLUGSYS® housing is not completely equipped Option 03: EXTENSION blank panel (8E) Option 04: housing for components not connected to system bus (only with Type 605) Option 05: extra power supply (115/230 V 100 W)

12.1 Technical data PLUGSYS® housing Type 601

Construction	bench housing with tilt feet
Number of slots	7, corresponding to 7 x 4E (= 28E)
Load rating	60 Watt
Dimensions	width 260 mm height 160 mm depth 355 mm
Weight	4.8 kg
Extras	——

12.2 Technical data PLUGSYS® housing Type 603

Construction	19 inch housing for rack mounting
Number of slots	20, corresponding to 20 x 4E (= 80E)
Load rating	100 Watt
Dimensions	width 483 mm height 132.5 mm depth 435 mm
Weight	6.5 kg
Extras	1 additional power supply (Option 05)

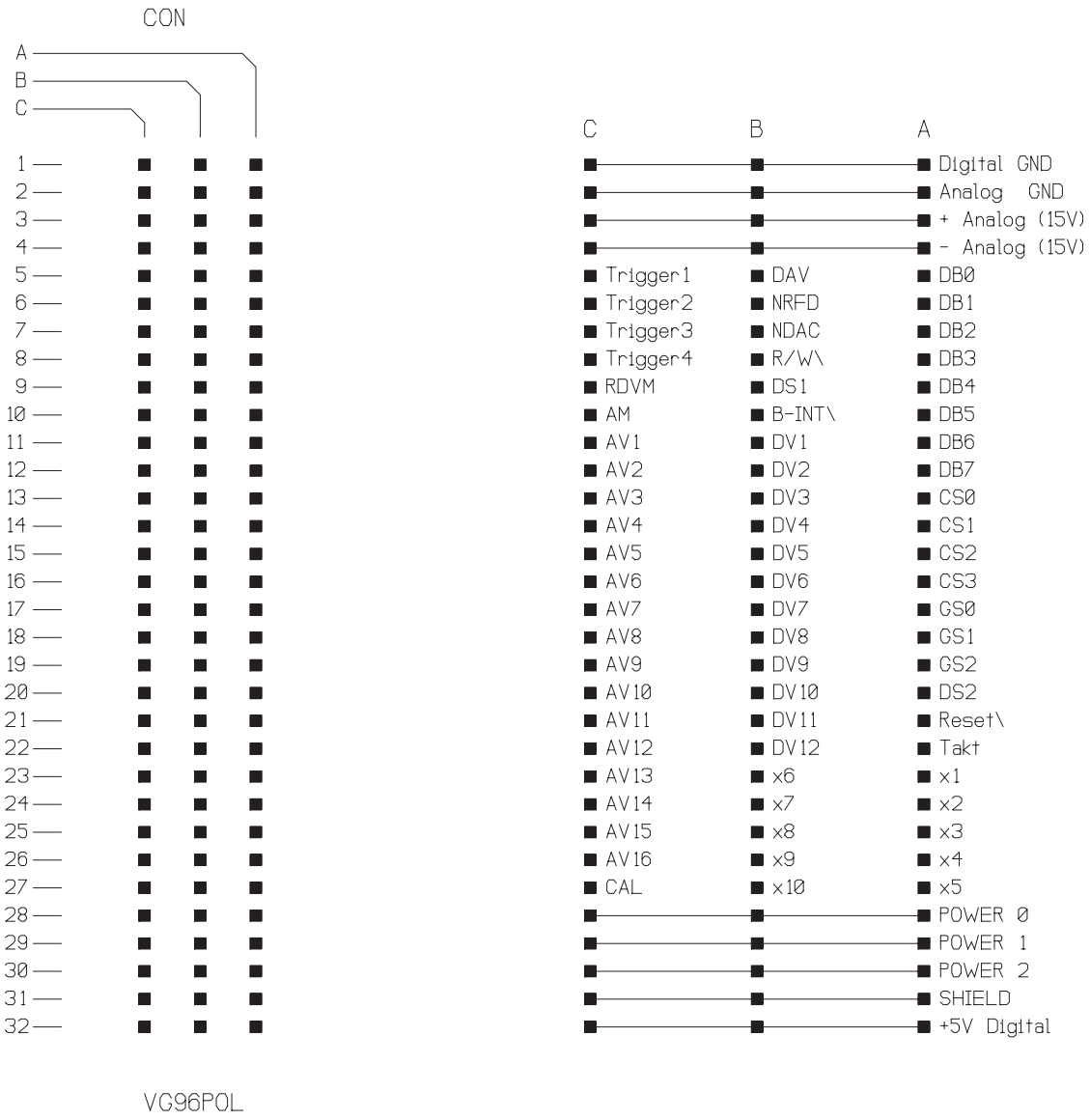
12.3 Technical data PLUGSYS® housing Type 605 (EXTENSION UNIT)

Construction	19 inch housing for rack mounting and tit feet
Number of slots	no Slots, only suitable for PLUGSYS® system elements without bus link
Load rating	max. 100 Watt
Dimensions	width 483 mm height 132 mm depth 435 mm
Weight	6.5 kg
Extras	1 additional power supply (Option 05)

12.4 Technical data PLUGSYS® housing Type 607

Construction	bench housing with tilt feet
Number of slots	only one, without Bus-system
Load rating	max. 30 Watt
Dimensions	width 235 mm height 145 mm depth 310 mm
Weight	3.5 kg
Extras	——

13. Appendix A: Pin details of the system bus



14. I N D E X