3~AC/DC Converter

K1979

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Schaefer Electronics Inc
45 South Street
Hopkinton MA 01748

508-435-6400 (office)

Project Contact:
Jeff Roffee
jroffee@SchaeferPower.com
www.SchaeferPower.com

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Rev.	**Description**	**Date**	**Author**	**Checked by**

Safety and General Instructions

The following general safety precautions must be observed during all phases of operation of the power supply. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the unit. Schaefer Electronics nc assumes no liability for the customer's failure to comply with these requirements.

GENERAL

This product is a Safety Class 1 unit (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operating instructions.
Installation and service work must be performed only by qualified personnel who are familiar with the associated risk.
Operation of the power supply produces dangerous internal voltages. The instructions VDE 0100, 0105, 068 (T2 §5) have to be strictly observed.

ENVIRONMENTAL CONDITIONS

The unit should only be used for its determinate purpose. The power supply is intended for indoor use in overvoltage category II, pollution degree 2 environments, according to EN 60950. To comply with other requirements of EN 60950 in regard to stability (mechanical and thermal), fire hazard, injury, etc., the equipment must be installed in an enclosure or cabinet.
It is designed to operate at a maximum relative humidity of 95% and at altitudes of up to 2000 meters.

Do not operate in an explosive atmosphere.

Do not operate the unit in the presence of flammable gases or fumes.

BEFORE APPLYING POWER

Establish that the input lines are voltage free before attempting to connect them. Establish that the manner of installation is in accordance with applicable electrical regulations, before proceeding with any electrical work.
Verify that the product is set to match the available line voltage, the correct fuse is installed, and all safety precautions are taken. Do not exceed input and output ratings. Note also the level of signal- and control cables

GROUNDING

To minimize shock hazard, the chassis and cabinet must be connected to an electrical ground (PE). For power supplies designed to be hard-wired to the ac power lines (mains supply), connect the protective earth terminal to a protective conductor before any other connection is made. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

FUSES

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuse holders. To do so could cause a shock or fire hazard.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

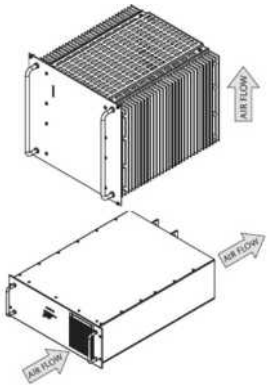
Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modifications to the power supply . Return the unit to Schaefer Electronics Inc for service and repair to ensure that safety features are maintained. To avoid the risk of electrical shock, always disconnect the input voltage, any external power source and wait until the internal capacitors are discharged, before disconnecting the device

Units that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Safety and General Instructions

AIR FLOW

It is preferable that the airflow to the power supply is filtered and below 55°C. An airflow resistivity (pressure drop) of below 20 kPa is required to comply with EN60950 pollution category II. Diffused thermal energy is required to be exhausted and replaced by air as detailed above. Thermal management is required where the air provided to a power supply complies with the power supply's design parameters. The use of fans requires an increase in airflow to a minimum rate of 120m³/h (corresponding to 70 cfm). The airflow resistivity and respective pressure drop should be considered when a fan is required.



DIRECTION OF AIR FLOW

Typically, Schaefer modules and systems are cooled through air supply entering from below and exiting above, with the exception of models of series C/B 5100, 5200, 5300, 5400, 6400 and 6600 whose airflow is from front to back. Custom designs also offer lateral cooling. Such details however, are project specific.

CABINET

A cabinet may be employed to enhance a module / system,.

- This may be required to fulfill the increased IP / NEMA rating, due to a negative effect of the solution on the environment.
- Specifically, with unclean, saturated, corrosive or otherwise aggressive air quality it may be required to employ a cabinet with a combination of features such as hermetical sealing and air exchange amongst others.
- The enclosure must be capable of sustaining the weight of the modules, specifically if module support rails are used.
- Stationary cabinets should be fastened to the ground.
- The center of gravity must be as low as possible with portable systems.

TRANSPORTATION OF MODULE

The grips on the front of the modules are to assist in module insertion into a sub-rack, and not for supporting the weight of the module.

WALL MOUNT / CHASSIS MOUNT

Modules with a mounting plate or angle are designed for integration into the host equipment. They are not for employment outside of an enclosure.

MAINTENANCE

Check the applied voltages and screw connections at periodic intervals in order to recognize any irregularities in the performance of the power supply. If necessary, correct through adjustments and calibration.
Clean the power supply at certain intervals from dirt and dust which may have accumulated.
Record technical, operational and environmental data, that is to be used as a reference for evaluation.

Due to storage conditions, the following maintenance may be necessary:

a. A reforming procedure has to be done after 3 years of voltage-free storage under normal temperatures (+5° …+35°C)
b. A reforming procedure has to be done after 1 year of voltage-free storage under extended temperatures (-40° ...+5°C and +35° ... +85°C).

Reforming procedure:

Due to increased leakage current of the internal electrolytic capacitors after voltage-free storage, the capacitors have to be reformed. For this purpose, the rated input voltage has to be applied to the terminals.
Leave the input voltage applied for a period of 1 hour. Subsequently, the unit is stored under no voltage conditions for 12 to 48 hours at a temperature between 15°C and 35°C.
Afterwards the capacitors are reformed and meet the specified values.

STORAGE INSTRUCTIONS

Storage temperature: -40°C ... +85°C
We recommended the following conditions for storage:
- Do not store the unit at a high temperature (at higher temperatures the ageing process is increased) or in high humidity. Store the unit indoors at a temperature of +5 …+35°C and a humidity of less than 75% RH.
- Keep the unit in the original package.

If the units are stored below the operating temperature, then they have to be left for at least 5 hours at operating temperature conditions to ensure there is no condensing water present before operation.

Specifications K1979

Input

Voltage range:	3 x 187 … 229V AC, unit switches off at under-/ over voltage and phase loss
Input current:	32A per phase at 3~ / 187V AC input voltage and 1800V DC/ 4.6A output power
Frequency:	58.5 - 61.5Hz
Recommended input fuse:	3 x 50A slow, external
Switch-on time:	< 4 sec.
Inrush current:	Resistive inrush current limiting (100Ω)
Power factor (= cos ϕ x cos ⊖):	approx. 0.90 @ 208V AC input voltage and 1800V DC/ 4.6A output power
Connector:	X1, HAN-C Module for male contacts
Network type:	TN-System. In case of IT-System configuration: Max. Voltage of the ungrounded delta may be 300V DC above chassis or safety ground. **DANGER**: After disconnecting mains supply, see warning notice at rubric "General"

Output

Voltage rating:	1500 … 1800V DC, adjustable in 50V DC steps via a switch on the rear side
Current rating	0 …. 4.6A adjustable via potentiometer at the front plate
Output Power	max. 8KW steady state
Load & Line regulation:	0.5 % max.
Ripple and noise at full load:	≤2Vpp max.
Load transient (50-100-50%):	4% max.
Turn-on rise time:	Softstart, 1700 ... 340V DC/sec. typical
Overvoltage protection:	OVP switches off module OVP adjusted to ≤1900V DC
Remote sensing:	internally connected to the output
Potential:	The potential of the positive (+) Output must be close to the protective earth potential (safety ground). This potential definition must be performed externally.
Connector:	X2, HAN HV Module for female contacts

Crow bar

Crowbar resistor:	15KΩ
Discharge time:	Depending on external capacitance
Internal output capacity:	approx. 145µF nominal
Function:	Activation after remove of 208V AC input or deactivation of the power supply via inhibit signal

Human Interface

Control LED:	Converter OK (green)

Signals

Output:

Input Power OK:	logic high (5V DC), input voltage is OK, logic low (0V DC), input voltage is out of specified range. Not latching
DC Output OK:	logic high (5V DC), output voltage is OK, logic low (0V DC), output voltage is out of specified range. Not latching
Over voltage shut down signal:	logic high (5V DC), over voltage shutdown is not activated logic low (0V DC), over voltage shutdown is tripped. Latching signal
Over Temperature shut down signal:	logic high (5V DC), over temperature shutdown is not activated logic low (0V DC), over temperature shutdown is tripped. Latching signal
Over current shut down signal:	logic high (5V DC), over current shutdown is not activated logic low (0V DC), over current shutdown is tripped. Latching signal

Input:

Inhibit (remote ON/OFF control):	logic high (5V DC), Power supply is ON logic low (0V DC), Power supply is OFF
Connector:	X3, HAN EE-Module for male contacts
Function:	A latched signal can be reset by cycling the remote ON/OFF control signal

Specifications K1979

General

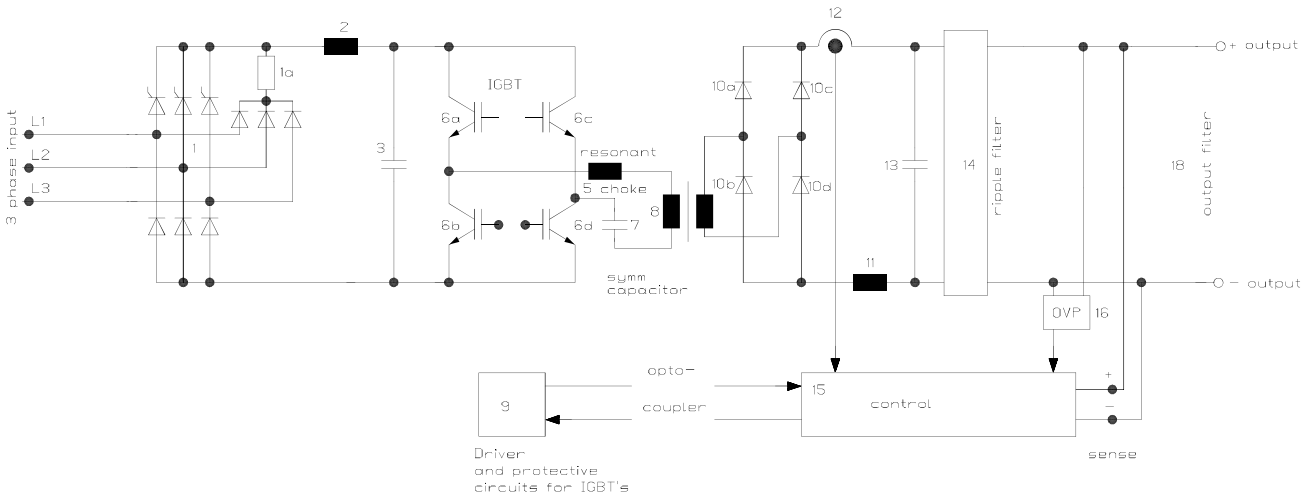
Temperature coefficient:	0.02 %/°K typical	
Operating temperature:	-20°C to +50°C	
Storage temperature:	-20°C to +70°C	
Humidity:	up to 95% RH, non-condensing.	
Thermal switch OFF:	By thermal protector switch. Nominal switch OFF temperature at 90°C ± 5K. Placed on the heat-sink, near the primary switching transistors.	
Cooling:	forced cooling with fans from front to rear	
Efficiency at full load:	90% typical	
Switching frequency:	approx. 20 kHz	
Isolation resistance:	> 10 MΩ at 500V DC	
High voltage test:	- Input v's Output + Case + Signals (with input filter)	2121V_{DC} 2 sec.
	- Output v's Input + Case + Signals	5000V_{DC} 1sec.
	- Signals v's Input + Output + Case	3000V_{DC} 1sec
EMC compatibility-Immunity:	acc. to EN 61000-6-2 / EN 61000-6-4	
Construction (safety):	DIN/EN 60950-1	
Creepage distance:	- primary to secondary 22mm - primary to case 4mm - primary to signals 5.5mm - secondary to case 12.5 mm	
Air distance:	- primary to case 2mm - secondary to case 8.4mm	
Touch current:	< 3.5mA when measured through the human body equivalent circuit as defined in EN60950-1	
Dimensions:	see dimensional drawing	
Connection:	see connection diagram. Stationary equipment! PE must be connected at the separate PE-Connection bolt as a fixed connection before switch on input power!	
Disconnection:	Hazardous voltage at the input connector present for up to 30sec after disconnection from supply! Internal discharge time of the primary smoothing capacitors down to a voltage level <30V is approx. 10min.	
Weight:	tbd. kg	
Protection:	acc. to IP20	

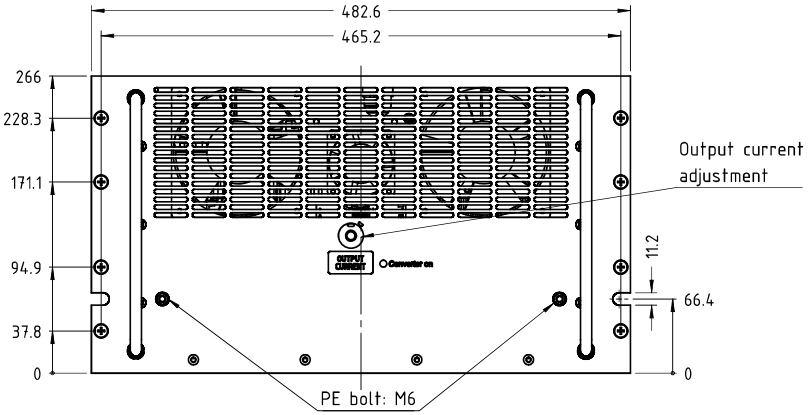
1) Primary Circuit

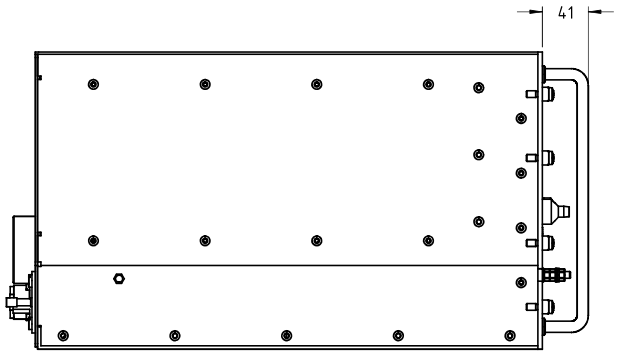
The input is connected to the primary switching system via the 3-phase bridge-connected input rectifier 1, smoothing choke 2, inrush current limiting resistor 1a, storage capacitor 3 and the RFI filter 4. The switching system is a full-bridge connection. Switching transistors 6a, 6b, 6c and 6d are controlled by circuit 9 alternately conducting, controlled in such a way that a voltage with alternating polarity and variable pulse-width is connected to the primary winding of transformer 8. This mode of control provides in conjunction with choke 5 “zero-voltage-switching” operation which improves the efficiency and reduces switching noise.

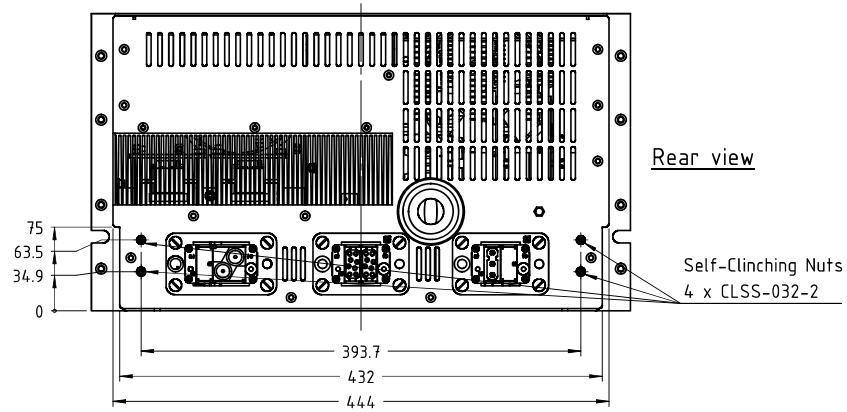
2) Secondary Circuit

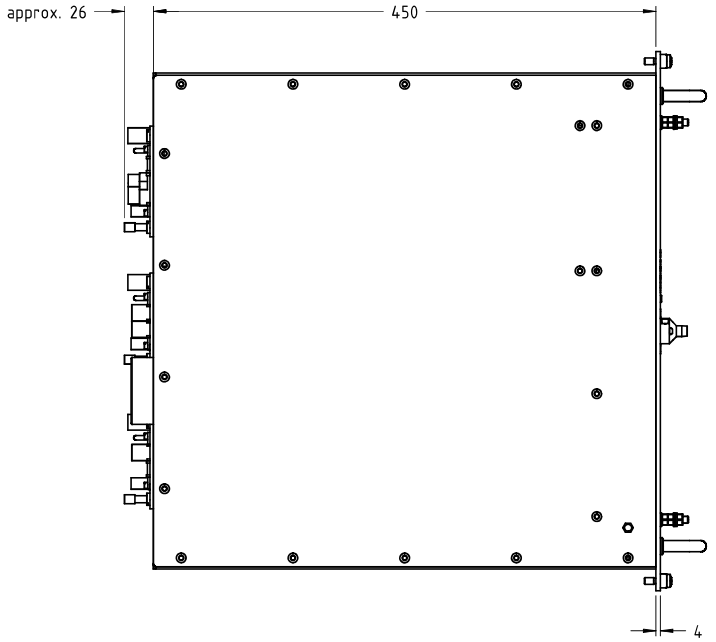
The voltage of the primary winding is transformed to the secondary side in the turns ratio of the windings, is then rectified by diodes (10a/10b) and (10c/10d) and filtered by choke 11 in conjunction with capacitor 13. The average value of the voltage across the capacitor depends on the input voltage and the phase shift between the control signals that are applied to the switching transistors and determine the on/off ratio of the voltage pulses transformed to the secondary side. There it is conducted to the output terminals via ripple filter 14. The output voltage is connected via external sense leads to control circuit 15 which compares it with a reference, and the error signal controls via an opto-coupler the switching transistors at the primary side.
For overvoltage protection (OVP) circuit 16 senses the output voltage and turns off the switching transistors if a certain adjustable level is reached.
For current limiting the signal sensed by LEM transformer 12 starts to reduce the output voltage if the current exceeds a certain limit.

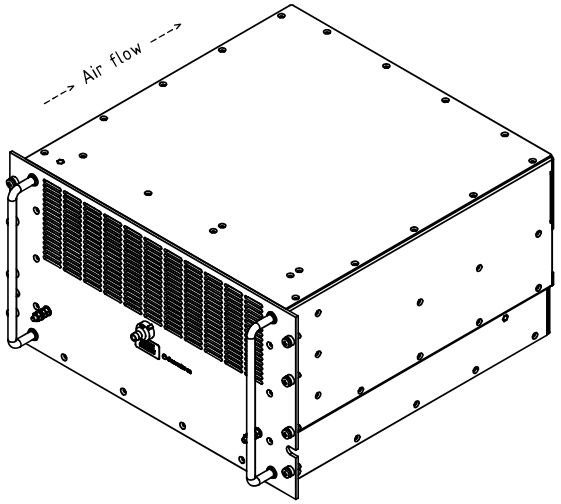












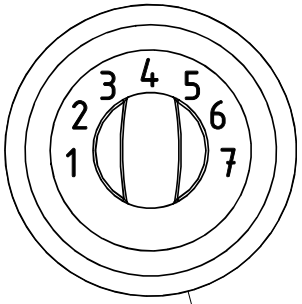
Dimensions in: mm

SCHAEFER				Allgemeintoleranzen DIN ISO 2768-mK		DIN 6 T1 - Proj.methode 1	Material:
					Datum	Name	Oberfläche:
				Erstellt	21.04.2020	N. Deufel	Benennung: Dimensional drawing
				Freig.	15.06.2020	W. Regenold	**K1979**
				EDV			
				Schaefer Electronics Inc www.SchaeferPower.com			Zeichnungsnummer: **74 K1979 E**
Zust.	Änderungen	Datum	Name				Identnr.: / SW: / Blatt / von 1 / 1

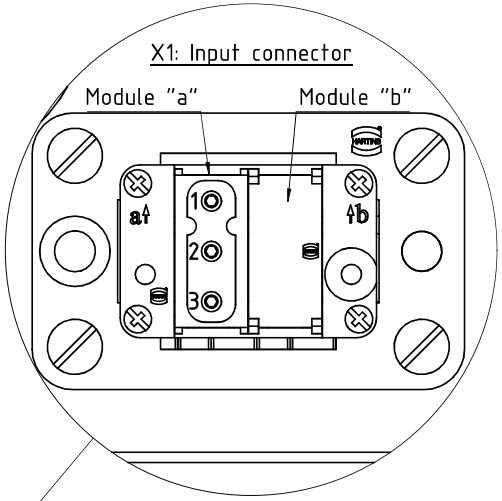
Selector switch	
Pos.	Output voltage
1	1500V DC
2	1550V DC
3	1600V DC
4	1650V DC
5	1700V DC
6	1750V DC
7	1800V DC

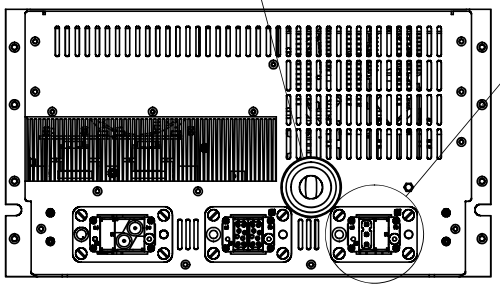
Connector input X1			
Module	Pin	internal wire	Description
a	1	2.5mm²	L1
a	2		L2
a	3		L3
b	Dummy module		

Output voltage selector switch



X1: Input connector





Rear view

HARTING - HAN 6B, consists of:

1 x 09 14 006 0313 Frame for modules, Han-Modular
1 x 09 14 003 2601 Han C Module for male contacts
1 x 09 14 000 9950 Dummy module
1 x 09 30 006 1701 Docking frame

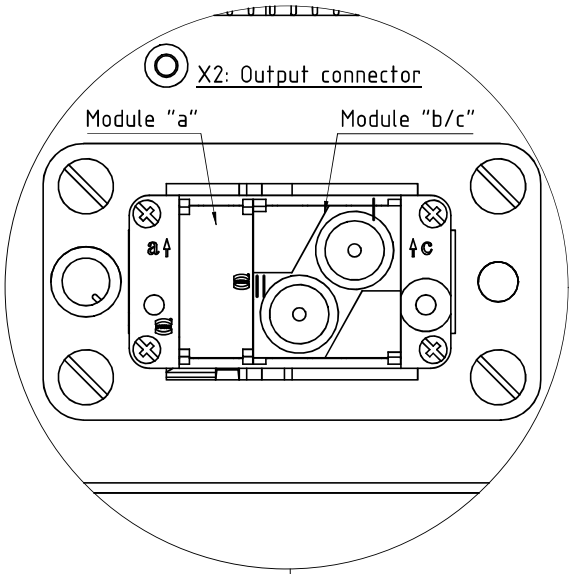
SCHAEFER				Allgemeintoleranzen DIN ISO 2768-mK	DIN 6 T1 - Proj.methode 1	Material:
					Datum	Name	Oberfläche:
				Erstellt	22.04.2020	N. Deufel	Benennung:
				Freig.	15.06.2020	W. Regenold	**K1979**
				EDV			Connection diagram
				Schaefer Electronics Inc www.SchaeferPower.com			Zeichnungsnummer: **73 K1979**
Zust.	Änderungen	Datum	Name				Identnr.: SW: Blatt / von 1 / 2

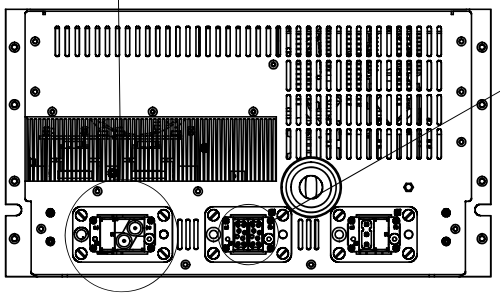
Connector output X2			
Module	Pin	internal wire	Description
a	Dummy module		
b/c	I	2.5mm²	-
b/c	II		+

HARTING - HAN 10B, consists of:

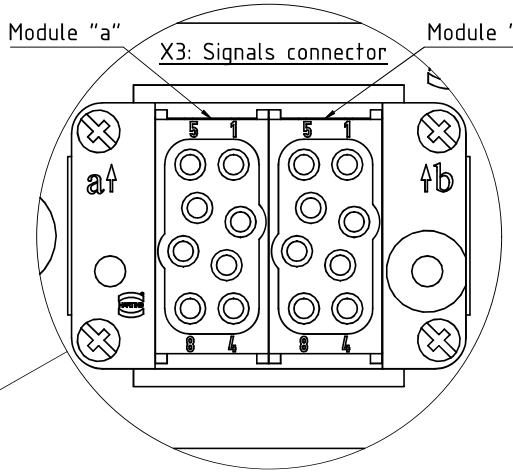
1 x 09 14 010 0313 Frame for modules, Han-Modular
1 x 09 14 002 3121 Han HV Module for female contacts
1 x 09 14 000 9950 Dummy module
2 x 09 33 000 6223 Female contact 2.5mm² Au
1 x 09 30 010 1701 Docking frame

Connector signals X3			
Module	Pin	internal wire	Description
a	1	1.5mm²	Input OK
a	2		*spare*
a	3		
a	4		Inhibit
a	5		RTN Input OK
a	6		*spare*
a	7		
a	8		RTN Inhibit
b	1		DC-OK
b	2		OV Shut down
b	3		OT Shut down
b	4		OC Shut down
b	5		RTN DC-OK
b	6		RTN OV Shut down
b	7		RTN OT Shut down
b	8		RTN OC Shut down





Rear view



HARTING - HAN 6B, consists of:

1 x 09 14 006 0313 Frame for modules, Han-Modular
2 x 09 14 008 3001 Han EE Module for male contacts
16 x 09 33 000 6116 Male contact 1.5mm² Au
1 x 09 30 006 1701 Docking frame

SCHAEFER

Allgemeintoleranzen DIN ISO 2768-mK

DIN 6 T1 - Proj.methode 1

	Datum	Name
Erstellt	22.04.2020	N. Deufel
Freig.	15.06.2020	W. Regenold
EDV		

Material:
Oberfläche:
Benennung:
K1979
Connection diagram
Zeichnungsnummer:
73 K1979

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Zust.	Änderungen	Datum	Name

Identnr.: SW: Blatt / von 2 / 2