

DC/AC INVERTER

INV222

INV211

USER MANUAL



Notes on this manual

ATTENTION! Read this manual very carefully before installing and commissioning the specified module. This manual is a part of the delivered module. Familiarity with the contents of this manual is required for installing and operating the specified module.

The rules for prevention of accidents for the specific country and the general safety rules in accordance with IEC 364 must be observed.

The function description in this manual corresponds to the date of publishing. Technical changes and changes in form and content can be made at any time by the manufacturer without notice. There are no obligations to update the manual continually.

The module is manufactured in accordance with applicable DIN and VDE standards such as VDE 0106 (part 100) and VDE 0100 (part 410). The CE marking on the module confirms compliance with EU standards 2006-95-EG (low voltage) and 2004/108/EG (electromagnetic compatibility) if the installation and operation instructions are followed.

Supplier:

	ELTEK DEUTSCHLAND GmbH BU Industrial Schillerstraße 16 D-32052 Herford
	+ 49 (0) 5221 1708-210
FAX	+ 49 (0) 5221 1708-222
Email	Info.industrial@eltek.com
Internet	http://www.eltek.com

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Revision history

Revision: 2.0

Date: 2014-01-17

Revision	Description of change	Writer	Date
1.0	First edition, based on "UM_INV222_E_R7.0", INV 211 included.	RTH	2011-10-10
1.1	Article codes updated	RTH	2013-01-31
1.2	Chapter 7.3: EN60146, immunity class "A" inserted	RTH	2013-04-29
1.3	Output voltage tolerance	RTH	2013-10-10
2.0	Number of inverter modules capable to be connected in parallel updated	RTH	2014-01-17

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1. Safety Instructions



WARNING!

Because several components of operating electrical modules are charged by dangerous voltage, the improper handling of electrical modules may cause accidents involving electrocution, injury, or material damages.

- Operation and maintenance of electrical modules must be performed by qualified skilled personnel such as electricians in accordance with EN 50110-1 or IEC 60950-1.
 - Install the device only in areas with limited access to unskilled personnel.
 - Before starting work, the device must be disconnected from mains. Make sure that the device is earthed.
 - Do not touch connector pins as they can be charged with dangerous voltage up to 30 seconds after disconnection.
 - Only spare parts approved by the manufacturer must be used.
-

2. Notes to Electronic Waste Disposal

The correct disposal of electronic waste is the responsibility to recycle discarded electronic equipment and is necessary to achieve the chosen level to protect human health and the environment.

In the case of waste disposal of your discarded equipment we recommend to contact a professional waste management company.

3. General information

The inverter INV222 (INV211) converts input side DC voltage to a stable sine wave output voltage.

The INV2xx is a module with rear side connectors and is designed to be mounted in an assembly set sub rack (see [section 4.2](#)).

The inverter is controlled and monitored by internal microprocessors. Due to its state-of-the-art circuitry design, the unit has very low losses and consequently, compact dimensions, low weight and a very high power density.

To increase the reliability the inverter is designed to operate in combination with a static transfer switch of the STS model range. The static transfer switch monitors the connected bypass mains and synchronizes the inverter output with mains frequency and phasing as well. The static transfer switch's default setting is "inverter priority" mode. That means the load is fed via STS by the inverter(s). But in case of inverter faults, high overload or battery low voltage, the STS switches the load supply to bypass mains nearly without interruption (<4 ms). The unit switches back to inverter operation automatically if the reason for switch-over is gone. In case of mains priority mode (optionally) the inverter(s) take over the load if the mains voltage is not present, out of limit or heavily disturbed. The priority source is programmable at the STS unit (see appropriate manual).

The nominal output power of the INV222 unit is 1.8 kW/2.25 kVA at an output voltage value of 230 VAC (INV211: 0.9 kW/1.1 kVA at an output voltage value of 115 VAC). A maximum of 20 modules¹ without static transfer switch can be switched in parallel to increase the system output power or to build redundant power supply systems (n + x principle).

INV222 for **three-phase** applications are available on request (see [Appendix](#)).

3.1 Typical applications

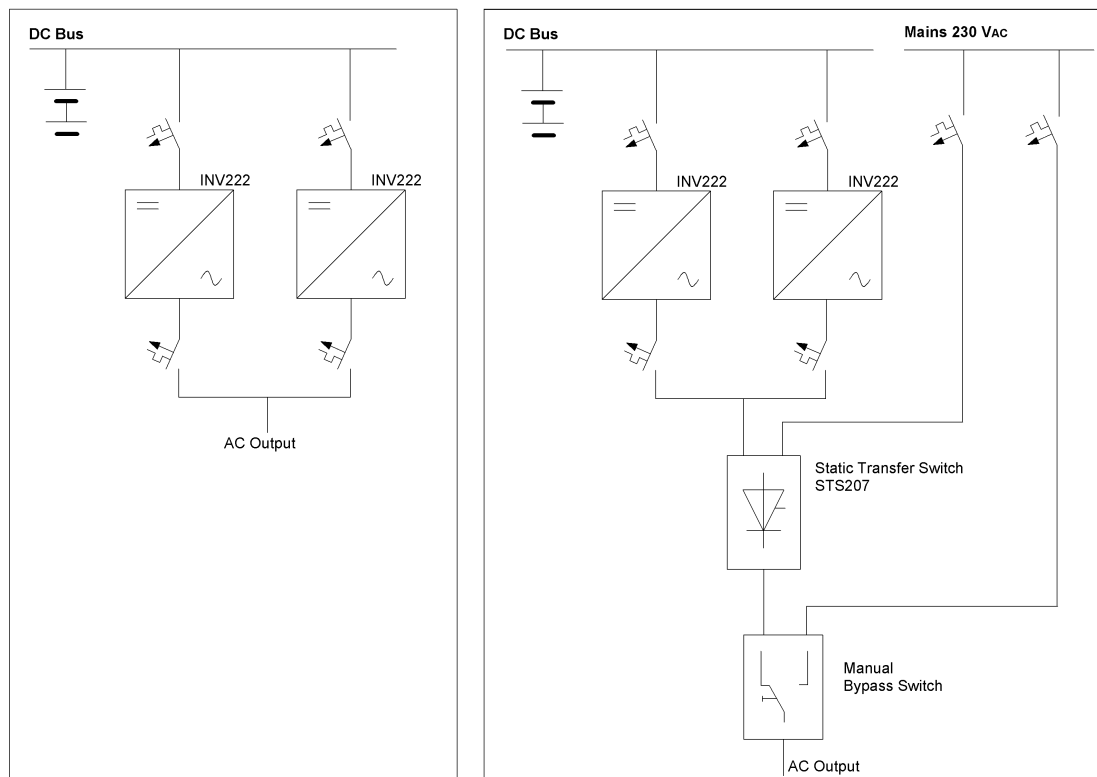


Figure 1. Inverter in parallel operation without STS Figure 2. Inverter in parallel operation with STS

¹INV211/222-48V/60V/110V: From hardware release 03; INV211/222-220V: From hardware release 02

4. Product description/equipment

4.1 Product range

Type designation	Article code	Nominal input voltage	Nominal input current	Input voltage range (V _{MIN} to V _{MAX})	Nominal output voltage
INV222-48/230-50	501-022-515.2.00	48 VDC	41.6 ADC	40.8 to 67.5 VDC	230 VAC/50 Hz
INV222-60/230-50	501-022-615.2.00	60 VDC	33.3 ADC	52 to 76 VDC	230 VAC/50 Hz
INV222-110/230-50 WIR	501-022-715.2.10	108 VDC	18.4 ADC	91.8 to 145 VDC	230 VAC/50 Hz
INV222-220/230-50	501-022-815.00	216 VDC	9.2 ADC	183.6 to 270 VDC	230 VAC/50 Hz
INV211-48/115-60	501-011-595.2.128	48 VDC	20.8 ADC	40.8 to 67.5 VDC	115 VAC/60 Hz
INV211-60/115-60	501-011-695.2.128	60 VDC	16.7 ADC	52 to 76 VDC	115 VAC/60 Hz
INV211-110/115-60	501-011-795.2.128	108 VDC	9.2 ADC	91.8 to 145 VDC	115 VAC/60 Hz
INV211-220/115-60	501-011-895.128	216 VDC	4.6 ADC	183.6 to 270 VDC	115 VAC/60 Hz
NOTE: INV211 providing further special output voltages are available on request.					

For more specific data, [see section 8](#).

NOTE: Article codes of INV222 for **three-phase application**, see [Appendix](#).

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4.2 Available options and assembly equipment

Designation	Material code
AC Rack ACR INV222-6.75 LV (assembly set 19" sub rack 2U including a wired backplane for max. three INV2xx-48 or INV2xx-60 and one static transfer switch STS20x)	502-222-315.LV
AC Rack ACR INV222-6.75 HV (assembly set 19" sub rack 2U including a wired backplane for max. three INV2xx-110 or INV2xx-220 and one static transfer switch STS20x)	502-222-315.HV
AC Rack ACR INV222-9.0 LV (assembly set 19" sub rack 2U including a wired backplane for max. four INV2xx-48 or INV2xx-60)	502-222-405.LV
AC Rack ACR INV222-9.0 HV (assembly set 19" sub rack 2U including a wired backplane for max. four INV2xx-110 or INV2xx-220)	502-222-405.HV
Cover plate (with handle), necessary to cover empty slots, 2U, colour RAL 7035	881-MEC-BPL.02.21.B



Figure 3. AC Rack ACR INV222-6.75 fully equipped with three inverters INV222 and one static transfer switch STS207



Figure 4. AC Rack ACR INV222-9.0 fully equipped with four inverters INV222

4.3 Front view/front LED panel



Figure 5. Front view

The INV2xx is equipped with three LED indicators:

- OPERATION
- OUTPUT OK
- ALARM

For more information about the LED indicators see [section 5.3](#) and [section 7](#)

One captive screw is used for each module to secure it to the sub rack (component of the module).

4.4 Rear side connection

The rear side male connections (DC input voltage, AC output voltage and signals) are shown in figure 6.) and are defined in the following table:

Table: Pin assignment of the rear side male connector:

Pin	Designation
22b, 25b	DC input, plus pole
28b, 31b	DC input, minus pole
11b	PE
5b	AC output, Neutral
2b	AC output, Phase L1
15a	Alarm NC
16c	Alarm COM
19c	SYNC-STAT1 (synchronization bus 1, status line)
20a	SYNC-SIG1 (synchronization bus 1, 50 (60) Hz-signal)
18c	SYNC-STAT2 (synchronization bus 2, status line)
19a	SYNC-SIG2 (synchronization bus 2, 50 (60) Hz-signal)
20c	SYNC-GND (synchronization bus, ground)
14a	CAN-H
14c	CAN-L
13a	CAN-VSS
15c	CAN-VCC
17c	Address coding
16a	AGND

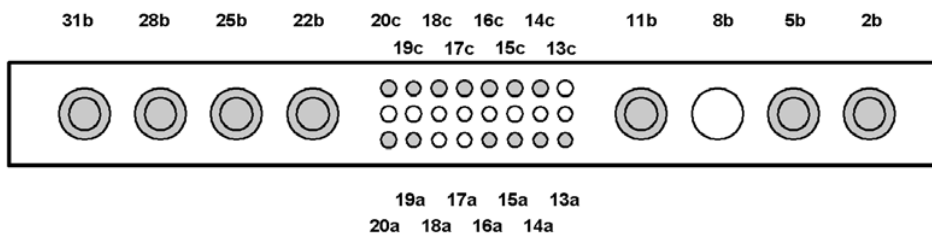


Figure 6. Male connectors (shown from the rear side of the module)

4.5 Module cooling

The unit is cooled by internal fan. The airflow is from the front to rear side. The fan is monitored and speed-controlled dependent on module temperature. To provide sufficient air flow, a minimum space (see item "A" at figure 7.) of 50 mm is required between the unit and the rear cabinet wall as well as an unobstructed supply of air.

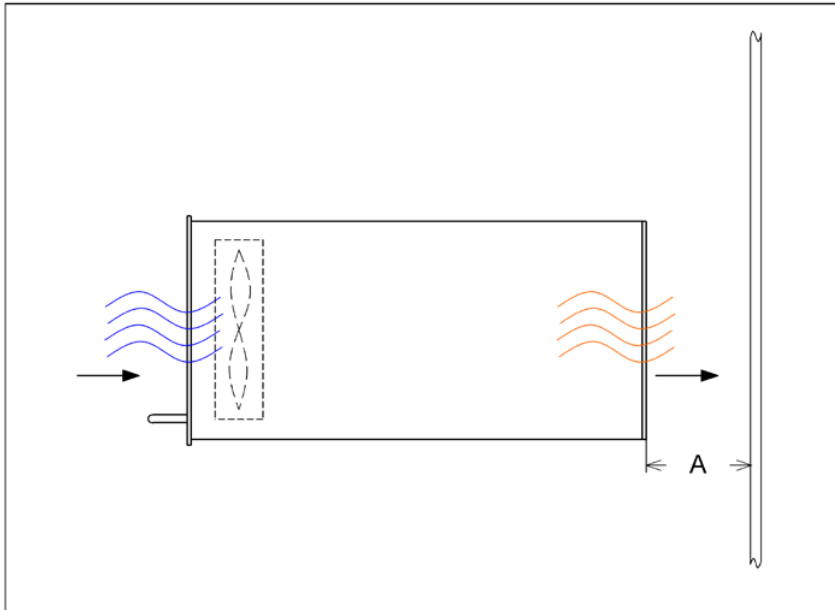


Figure 7. Air flow direction

4.6 Communication interface

The inverter is equipped with a serial data interface in accordance with the Controller Area Network (CAN) specification. The CAN-Bus connection is integrated in the rear side connector.

Several inverters in a system or parallel connection can be controlled and monitored through the CAN-Bus by a central unit which is integrated in the static transfer switch unit STS.

The following parameters of a specific inverter unit can be controlled or monitored:

- Inverter status (OK/failure)
- Output voltage (measurement value)
- Output current (TRMS measurement value)
- Input voltage (measurement value)*
- Input current (measurement value)*
- Output frequency (measurement value)*
- Internal temperature (measurement value)*

*with separate software tool

5. Handling

5.1 Storage

The modules must be stored in a dry, dust free environment with a storage temperature in accordance with the specific technical data ([see section 8](#)).

5.2 Commissioning

Note: Before commissioning the module, make sure that the input voltage corresponds to the nominal input voltage of the unit as specified on the type plate.




1. Carefully unpack the unit
2. Fill the rack beginning with the left slot.
3. Put the unit into an empty slot.
4. Carefully slide in the unit until the module connector touched the backplane connector.
5. Increase the force until the unit fits in completely. Avoid using too much force. If the unit does not fit in, begin again at step 3.
6. Secure the unit using the captive screw (M4 x 12) provided with the module.

Note: Before **removing** a module it must be **switched off** by the external input fuse!

WARNING: After switching off the module the internal capacitors are still fully charged. Do not touch connector pins as they can still be charged with dangerous voltage after disconnection.

5.3 LED indications

Functions of front panel LED indicators

LED	Colour	Function
	Green	OPERATION - Inverter operation; DC input voltage monitoring
	Green	OUTPUT OK - Output voltage monitoring
	Red	Collective Alarm* The following faults result in a collective alarm message: <ul style="list-style-type: none">• Input voltage high or low• Output voltage high or low• Short circuit or over load• Internal temperature higher than specified value• Fan failure

*The module is equipped with an isolated signalling contact (NC). The maximum load is 60 VDC/100 mA.

For more information about the fault status and flashing patterns of the red LED see [section 7](#).

5.4 Internal monitoring

Monitored values/operating conditions

Monitored values	Criteria	Function
DC input voltage	Input voltage out of the range of factory set input voltage range V_{MIN}^* and V_{MAX}^*	1.) At V_{MIN} : Module switches off and on automatically with delay and hysteresis 2.) At V_{MAX} : Immediate switch-off
AC output voltage	Output voltage out of the specified range of $V_{O<}$ and $V_{O>}$ INV222: $V_{O<} = 190$ V (INV211: 95 V) INV222: $V_{O>} = 253$ V (INV211: 127 V)	1.) At $V_{O<}$: Simply a warning signal is generated 2.) At $V_{O>}$: Module switches off automatically. The module must be restarted manually
Short circuit	$I_o > 130\% I_{nom}$ (9.8 A)	Module automatically switches off after three seconds. The module tries to self-restart automatically for three times. If this fails, the module switches off and must be restarted manually
Overload	$I_o > I_{nom}$ (9.8 A) $P_o > P_{nom}$ (1.8 kW/2.25 kVA or 0.9 kW/1.125 kVA, dependent on the type)	Module switches off after 10 seconds automatically. The module must be restarted manually.
Temperature	Internal temperature higher than specified value*	Automatic switch-off at high over temperature and switch-on with hysteresis
Fan speed	$N < 500$ min ⁻¹	Automatic switch-off

* see specific technical data section ([section 8](#))

6. Maintenance

In general, the module is maintenance-free. Exclusively the fan is a component consisting of moving parts. Although it may be expected that the operating life of the fan is more than five years it is recommended to exchange the fan every five years.

By way of precaution a yearly inspection with following checks is recommended:

- Mechanical/visual inspection
- Removal of dust and dirt, especially on radiator surfaces
- Check for internal dust or humidity

Attention!

Dust combined with moisture or water may influence or destroy the internal electronic circuits. Dust inside the unit can be blown out with dry compressed air. Avoid using too high air pressure.

The interval between the checks depends on ambient conditions of the installed module.

7. Trouble shooting





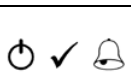















The following table shows all possible combinations of LED signals at the inverter unit.

The LED symbols mean:

Grey = LED off

Green or red = LED permanently on

Green or red with rays = LED is flashing

LED signal	Possible reason	Corrective action										
	1. No DC input voltage 2. Internal fault on circuitry	1. - Check input DC voltage - Check incoming distribution fuses - Check mounting position of the module 2. Exchange the unit										
	Inverter was remotely switched off via CAN-Bus	Check the STS controller for the reason of the switch-off command										
	DC input voltage low or high	Check DC input voltage level										
	Normal operation mode											
	Device switched off due to error	1. Restart the unit by switching on the input DC fuse 2. If the fault remains, exchange the unit										
	Output voltage low	Internal fault in circuitry; exchange the unit										
	Active Error Warning The following four errors are indicated: 1. Overload or short circuit 2. Fan fault 3. Over temperature 4. Output voltage high The module automatically switches off with time delay. Active errors are indicated with the following flashing patterns of the red LED:											
	<table border="0"> <thead> <tr> <th>Active error</th> <th>Flashing pattern</th> </tr> </thead> <tbody> <tr> <td>1. Overload or short circuit</td> <td></td> </tr> <tr> <td>2. Fan fault</td> <td></td> </tr> <tr> <td>3. Over temperature</td> <td></td> </tr> <tr> <td>4. Output voltage high</td> <td></td> </tr> </tbody> </table>	Active error	Flashing pattern	1. Overload or short circuit		2. Fan fault		3. Over temperature		4. Output voltage high		1. Reduce the load to nominal value (see section 7) or check the load circuitry for short circuit 2. Exchange the unit or the internal fan (service personnel only) 3. Check all air ventilations; remove dirt and dust; check the environment temperature (see the values at section 8) 4. Internal fault in circuitry; exchange the unit
Active error	Flashing pattern											
1. Overload or short circuit												
2. Fan fault												
3. Over temperature												
4. Output voltage high												

If the unit still does not work even though all checks have been done, contact your sales agent or the service department of ELTEK DEUTSCHLAND GmbH.

8. Technical specifications

8.1 Specific technical data INV222

Type designation	INV222-48/230-50	INV222-60/230-50	INV222-110/230-50 WIR	INV222-220/230-50
Article code*	501-022-515.2.00	501-022-615.2.00	501-022-715.2.10	501-022-815.00
DC input:				
Nominal input voltage.	48 VDC	60 VDC	108 VDC	216 VDC
Input voltage range (V _{MIN} -V _{MAX})	40.8 to 67.5 VDC	52 to 76 VDC	91.8 to 145 VDC	183.6 to 270 VDC
Reflected input voltage ripple, psophometric (CCITT-A-filter)	≤ 1.8 mV	≤ 1.8 mV	---	---
Nominal input current	41.6 ADC	33.3 ADC	18.4 ADC	9.2 ADC
Recommended external input fuse:	63 A	63 A	25 A	16 A
AC output:				
Nominal output voltage	230 VAC -5 %, factory adjustment range: 200 to 242 VAC			
Threshold value of the output voltage	V _{0<} = 190 VAC; V _{0>} = 253 VAC			
Output frequency	50 Hz ±0.05 %, adjustable to 60 Hz at factory. Synchronization range by external static transfer switch unit: 48 to 52 Hz or 58 to 62 Hz			
Nominal output power	1800 W/2250 VA @ cos phi=0.8			

* Article codes of INV222 for three-phase application: See [Appendix](#).

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8.2 Specific technical data INV211

Type designation	INV211-48/115-60	INV211-60/115-60	INV211-110/115-60	INV211-220/115-60
Article code*	501-011-595.2.128	501-011-695.2.128	501-011-795.2.128	501-011-895.128
DC input:				
Nominal input voltage.	48 VDC	60 VDC	108 VDC	216 VDC
Input voltage range (V _{MIN} -V _{MAX})	40.8 to 67.5 VDC	52 to 76 VDC	91.8 to 145 VDC	183.6 to 270 VDC
Reflected input voltage ripple, psophometric (CCITT-A-filter)	≤ 1.8 mV	≤ 1.8 mV	---	---
Nominal input current	20.8 ADC	16.7 ADC	9.2 ADC	4.6 ADC
Recommended external input fuse:	25 A	20 A	16 A	10 A
AC output:				
Nominal output voltage	115 VAC -5 %, factory adjustment range: 105 to 135 VAC			
Threshold value of the output voltage	Factory-set default: V _{0<} = 95 VAC; V _{0>} = 127 VAC			
Output frequency	60 Hz ±0.05 %, adjustable to 50 Hz at factory. Synchronization range by external static transfer switch unit: 58 to 62 Hz or 48 to 52 Hz			
Nominal output power	900 W/1125 VA @ cos phi=0.8			

8.3 General technical data INV222 & INV211

DC input:	
Inrush current	≤ Nominal input current
Overall efficiency	≥90 %
Internal input fuse	There is no internal input fuse available (recommendation for external fuses see section 8.1 & 8.2)
AC output:	
Nominal output current	9.8 AAC @ power factor= 0.8; 7.8 AAC @ power factor= 1.0 (resistive)
Output power factor range	0.5 inductive ... 1 ... 0.5 capacitive
Overload capability	130 % for 10 sec
Total harmonic distortion	<2 % at linear load
Crest factor	≤ 3
Dynamic behaviour	≤ 3 % for load transients between 10 % ... 100 % ... 10 % of nominal output current (transient time ≤ 0.3 ms)
Short circuit protection	Continuous short circuit proof, short circuit current 3 x I _{nom} for approx. 3 sec (with delayed restart)
Internal output fuse	There is no internal output fuse
External output fuse	10 A gL or MCB characteristic B
Standard equipment:	
Monitoring	DC-input voltage, (V _{MIN} , V _{MAX}) with automatic switch ON/OFF function, AC-output voltage (warning at V _{0<} , switch off at V _{0>}), over temperature and overload with automatic switch off function
LED signalling	OPERATION (green), V ₀ OK (green), ALARM (red)
Electronic protection	Input under voltage, input over voltage, over temperature, overload and short circuit protection
External synchronization	External synchronization by static transfer switch.

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Parallel operation	Parallel operation without any additional equipment and without fixed master possible; max. 20 modules ² , load sharing approx. 5% Inom due to decreasing output characteristic
Communication	CAN-BUS interface to communicate with a static transfer switch STS
Isolated signaling contacts	“Collective Alarm”, relay contact NC; maximum contact load: 60 V/0.1 A
Ambient conditions:	
Climatic conditions	Acc. to IEC 721-3-3 class 3K3/3Z1/3B1/3C2/3S2/3M2
Max. installation altitude	1500 m
Ambient temperature	Operation: -20 °C to +55 °C (power derating 2 %/K above +40 °C); storage: -40 °C to +85 °C
Audible noise	≤ 45 dB (A) at 1 m distance
Mechanical:	
Design	¼ x 19“ subrack, 2U, with connectors on the rear side
Cooling	Fan cooling (temperature regulated, monitored)
Surfaces	Powder coating RAL 7035 (front panel only), print: neutral, black RAL 9005; constructive parts: anodized metal
Dimensions (W/H/D)	106.4/88.4/335 mm (1/4 x 19“, 2U)
Minimum installation depth	400 mm plus 25.5 mm length of the module handle (module integrated in a specific assembly set 19“ sub rack)
Weight	Approx. 3.5 kg
Electrical connectors	DC-Input , AC-Output and signals: DIN 41612-M-connector
Applicable standards:	
CE conformity	Yes
Mechanical construction	Acc. to VDE 0160 edition 5.88 chapter 7.2.2
Protection class	IP20
RFI suppression / immunity	CE-label, (EN50081-1, EN55011/55022, EN50082-2, EN61000-4 part 2/3/4/5)
Compliance to safety standards	Acc. to EN60950-1, VDE0100 T410, VDE0110, EN60146 (class A)

8.4 Dimensional drawings

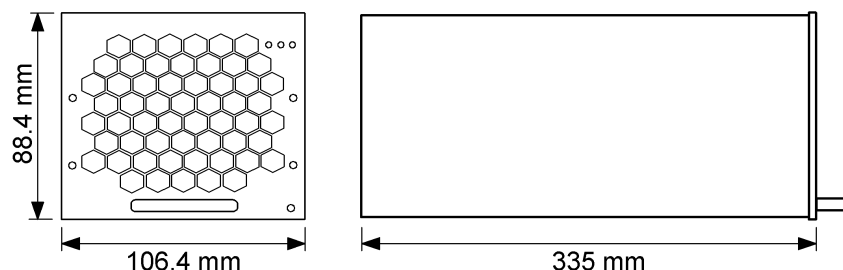


Figure 8. Module dimensions

²INV211/222-48V/60V/110V: From hardware release 03; INV211/222-220V: From hardware release 02

Appendix: Three-phase application INV222

INV222 modules especially programmed for **three-phase application** are available on request. The appropriate article codes are stated in the table as follows:

	Article code			
	INV222-48	INV222-60	INV222-110 WIR	INV222-220
Phase L1/R	501-022-515.2.01	501-022-615.2.01	501-022-715.2.01	501-022-815.01
Phase L2/S	501-022-515.2.02	501-022-615.2.02	501-022-715.2.02	501-022-815.02
Phase L3/T	501-022-515.2.03	501-022-615.2.03	501-022-715.2.03	501-022-815.03

These INV222 are labeled with a sticker on the front plate down left indicating the phase to which the specific INV222 is programmed, such as "Phase **L1/R**", "Phase **L2/S**", "Phase **L3/T**".

NOTE: It is possible to design three-phase systems without or with three-phase static transfer switch as well.

Three-phase systems **without** static transfer switch: A maximum of 20 inverters³ (six for each phase practical) can be used.

Three-phase systems **with** static transfer switch (three-phase UNB): A maximum of 28 inverters⁴ (9 for each phase practical) can be used.

For details about the design of three-phase systems see the user manuals of the INV222 racks "ACR INV222-9.0 LV" and "ACR INV222-9.0 HV".

³INV211/222-48V/60V/110V: From hardware release 03; INV211/222-220V: From hardware release 02

⁴UNB: From hardware release 04



Supplier:

	ELTEK DEUTSCHLAND GmbH BU Industrial Schillerstraße 16 D-32052 Herford
	+ 49 (0) 5221 1708-210
FAX	+ 49 (0) 5221 1708-222
Email	info.industrial@eltek.com
Internet	http://www.eltek.com

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