BENNING

World Class Power Solutions

IGBT rectifier for stationary battery systems

TRANSOTRONIC range

TRANSOTRONIC
IGBT technology for better performance

General remarks

The rectifier range TRANSOTRONIC is designed for the secured supply of DC power for critical loads such as control and monitoring systems as well as data processing technology in power stations and industrial plants.
These plants require, a reliable power supply independent of the public net, which is most often achieved using a battery-secured power supply.

Ranges of application

- Power stations
- Transformer stations
- Chemical factories
- Offshore installations
- Refineries
- Hospitals

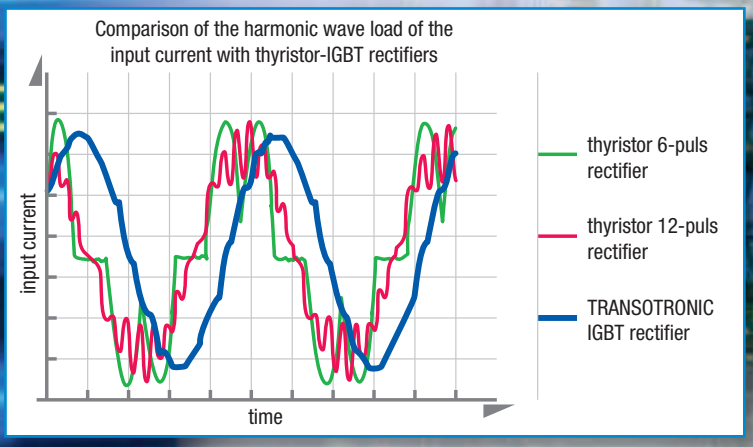

fig. 1: The TRANSOTRONIC with sinusoidal power input ensures distortion free rectifier operation

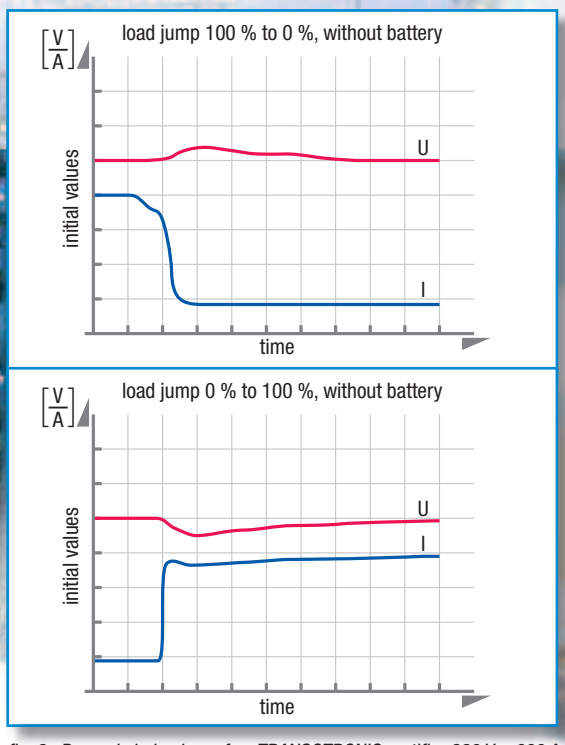

fig. 2: Dynamic behaviour of an TRANSOTRONIC rectifier 220 V – 600 A
[□ = 200 A □ = 50 V d.c. □ = 5 ms]

Particularly in larger plants, devices with 220 V DC output and currents of several hundred amperes are used. For the conversion of AC to DC current rectifiers with thyristor bridges worked satisfactorily.
One of the disadvantages of these devices is however the harmonic distortion fed back to the mains net during the energy conversion.
These harmonic distortions are produced by the ingate control of the thyristors and are able to disturb other loads also connected to the same AC mains.
Further, the net will be loaded with apparent current, due to the power factor cos φ of thyristor rectifiers being within the range of 0,7 - 0,9.

Better performance because of IGBT technology

In the rectifier range TRANSOTRONIC developed by BENNING IGBT semiconductors are used in the power block, which leads to the following improved performance:

- **Substantially smaller harmonic distortion**
  The harmonic distortion on the mains side is reduced to values < 5 % (fig. 1).

- **Better power factor**
  The power factor of the TRANSOTRONIC range reaches 0,99 %. Therefore only a very small reactive power is taken from the mains.

- **Good dynamic behaviour**
  Even when not connected in parallel to a battery, the TRANSOTRONIC has a good dynamic behaviour. The output voltage changes with load jumps from 100 % to 0 % and from 0 % to 100 % by only approx. 8 - 10 % (fig. 2).

- **Easy to do battery capacity test by mains feed back without external load**

TRANSOTRONIC
Type range and specifications

Specifications

Typ TRANSOTRONIC 220 V/…		400	500	600	700	800	900	1000
Input data								
Max. input power at 264 V DC	[kVA]	113	141	170	200	230	260	290
Nominal input current at 400 V AC and 245 V DC	[A]	155	190	230	270	310	350	390
Switch ON current		soft start without inrush current						
Transformer		galvanically isolated						
Input power factor (typical)	[cos φ]	≥ 0,99 (0,97 already at 25 % Last)						
Nominal input voltage	[V]	3 x 400 ± 10 %, neutral conductor not needed						
Nominal input frequency	[Hz]	50 ± 5 %						
External required fuse, Diazed/NH type GL	[A]	200	250	300	315	355	400	500
Total harmonic distortion (at 100 % load)	[%]	≤ 5						
Start up time	[sec]	30						
Output data								
Recommended number of lead acid cells		106 – 112						
Nominal output current	[A]	400	500	600	700	800	900	1000
Float voltage with automatic charging and temperature compensation (option)	[V/cell]	2,23 – 2,3						
Boost voltage with automatic charging and temperature compensation (option)	[V/cell]	2,3 – 2,4						
Voltage tolerance (without batteries)								
static	[%]	± 1						
dynamic 0 % to 100 %	[%]	± 10						
dynamic 100 % to 0 %	[%]	± 10						
Current tolerance	[%]	± 1, rectifier is short circuit proof						
Ripple	[%]	≤ 5, p – p without battery						
Charging characteristic float / boost / equalize		IU in acc. DIN 41773						
General Specifications								
Efficiency 100 % load	[%]	93	93	94	93	93	93	93
Heat dissipation								
100 % load float	[kW]	7,4	9,2	11	12,9	14,8	16,7	18,5
10 % load float	[kW]	1,3	1,5	1,7	1,9	2,1	2,1	2,2
Required air flow volume	[m³/h]	2000	2000	2500	2500	2500	2500	2800
Ambient temperature	[°C]	0 – 40, daily average ≤ 35						
Rel. Humidity	[%]	5 – 95 without condensation						
Installation height	[m]	1000 over sea level without derating						
Power derating over 1000 m	[%]	app. 4,5 per 500 m						
Power derating over 40 °C	[%]	app. 11 per 5 °C						
Humidity class		DIN/IEC 721 2-1-09/86						
Isolation class		DIN/VDE 0110, over voltage category 2						
Funkstörgrad		EN 50091-2 class A						
EMC		free standing steel cabinet, protection IP 20 (DIN/VDE 0470 part 11/92 IEC 529), others optional						
Paint finish		RAL 7035, structured paint finish						
Dimensions (width x depth x height)	[mm	800 x 800 x 2000*	1200 x 800 x 2000*	1600 x 800 x 2000*			2400 x 800 x 2000*	
		(* optional 2200 height)						
Weight	[kg]	app. 900	app. 1200	app. 1500	app. 1800	app. 2400	app. 3000	app. 3300
Cable entry		from bottom (optional from top with side cabinet)						

Cooling: forced cooled with speed controlled, redundant and monitored fans, built in the air inlet, equipped with air flaps, which close in case of fan failure, fans can be changed from front, power blocks and transformers are temperature monitored, prewarning will be sent out, after temperature increase switch OFF, air inlet from front, air outlet from top

Specifications are subject to change without notice.

TRANSOTRONIC
versatile automatic controller and monitoring concept

The TRANSOTRONIC rectifier consists of the following main components:

- Mains input with fuse loaded circuit breakers and mains contactor
- Transformer with electrically isolated windings
- Power block with IGBT semiconductors
- Controller with digital value default
- Digital monitoring
- Indicating and control panel on the front door
- NH fuse loaded circuit breaker in the rectifier output (with solid links)
- Battery output with optional NH fuse loaded circuit breaker

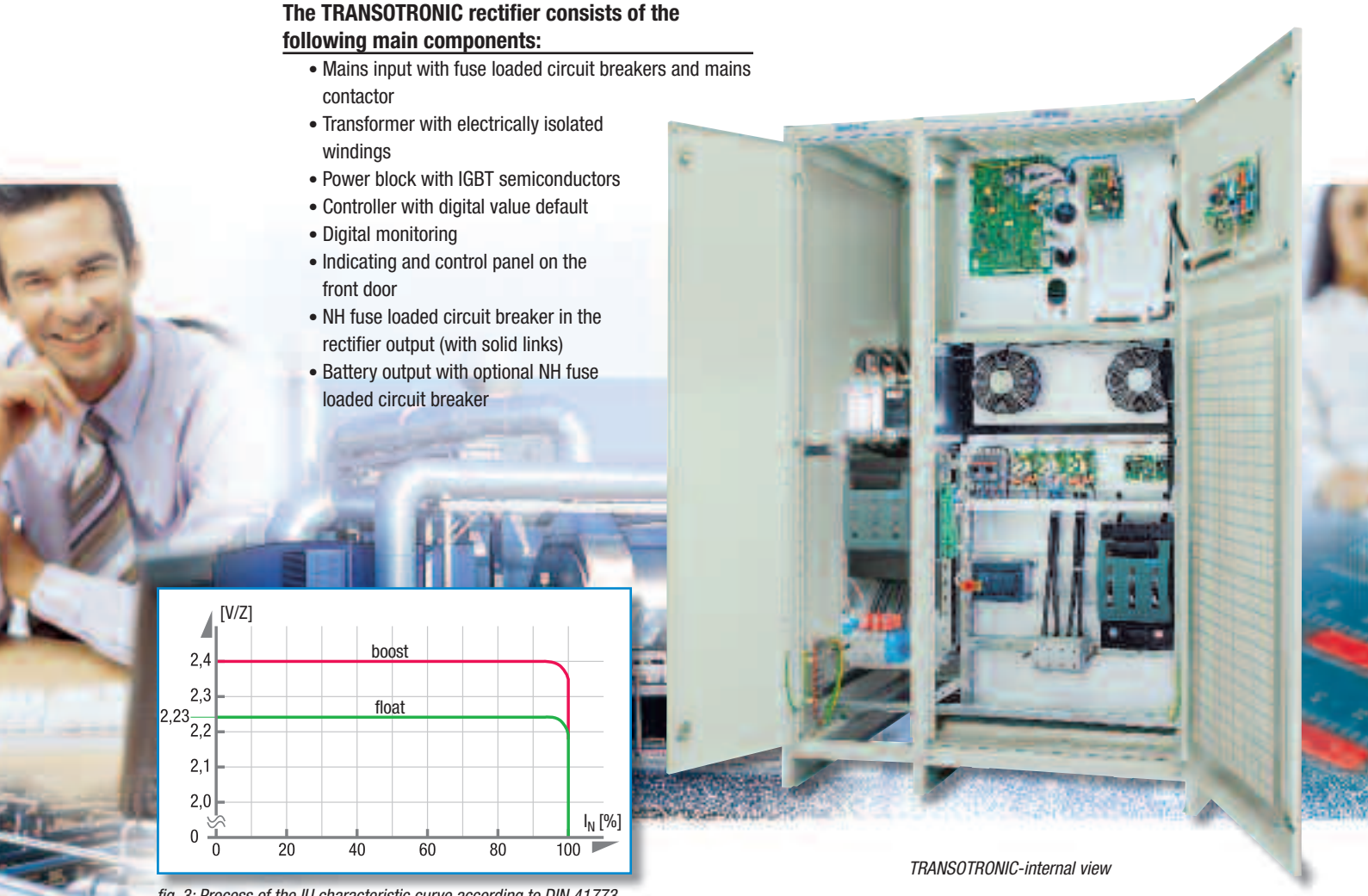

fig. 3: Process of the IU characteristic curve according to DIN 41773 for lead acid batteries

TRANSOTRONIC-internal view

Output characteristic

The output characteristic of the TRANSOTRONIC rectifier is an IU characteristic curve (according to DIN 41773) for standby parallel operation with NiCd or lead acid batteries (fig. 3). For initial charging or equalize charging, the output characteristic can be switched to a W characteristic.

In the modern control and monitoring concept of the TRANSOTRONIC series the following important functions were integrated:

Soft start without Inrush current

When restarting the rectifier after a power failure the starting current of the transformer is limited to the rated current and inrush current is avoided.

Automatic charging

The TRANSOTRONIC controller performs automatically. The change-over from boost to float and vise versa is carried out voltage-current dependent and enables a faster recharge of the battery. The equalizing charge facility is switched manually.

Battery-circuit test

The TRANSOTRONIC includes the important function of an automatic battery circuit test. By decreasing the TRANSOTRONIC output voltage a small current is taken out of the battery. If the battery does not supply this current, a battery error message with common alarm is indicated. If the error is acknowledged, by operation of the RESET key a further test will be carried out as a recheck.

Battery capacity test

The battery capacity test is started manually. Within this test a constant current discharging of the battery with mains feed back will be carried out, i.e. the discharged energy is fed back into the three-phase mains. The battery capacity test can take place with or without attached load. The discharge current is adjusted by default and is generally 10 % of the rectifier rated current (range of adjustment 5 to 100 %).
The TRANSOTRONIC reduces its output voltage, so that the connected load is supplied by the battery. If the load current is smaller than the desired discharge current, the TRANSOTRONIC makes up the difference by feeding back into the mains.
The test is stopped automatically at a deep discharge voltage of 1,8 V/c (adjustable).

TRANSOTRONIC
user friendly monitoring and control panel

Monitoring and control panel

The operation of the TRANSOTRONIC is carried out via a monitoring and control panel built in the front door (fig. 4). The operating condition and any fault signals are represented by coloured LED's.
The indication of the measured values and other information takes place via a 4-line LC display. The electronics of the monitoring and control panel communicate over a CAN bus with the CONTROLLER board.

Apart from the LED operating and fault signals the following measured values are indicated:

Rectifier measured values
Input voltage, input current of each phase, input frequency, output voltage and output current

Battery measured values
Voltage, temperature, charge and discharge current, remaining autonomy time, remaining capacity

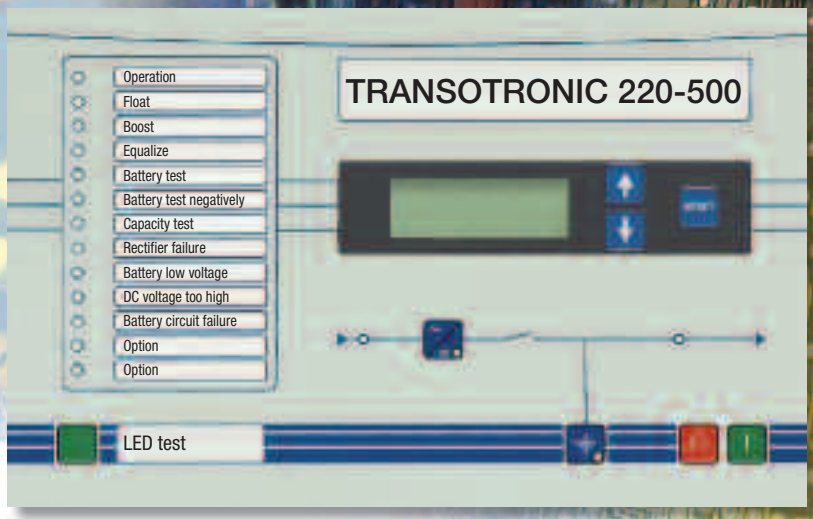

fig. 4: TRANSOTRONIC monitoring and control panel

Event recorder

The included event recorder stores up to 1 – 200 occurring events with date and time stamp (e.g. button pushings, switching actions, error).

Additional monitoring functions

- **Mains monitoring**
- **Rectifier monitoring carried out as current dependent under voltage monitor**
  This monitoring generates an alarm, if the equipment output voltage drops to a value lower than 2,1 V/c with a rectifier output current < 80 % I nom.
- **DC over voltage monitoring with impulse block**
- **Battery under voltage monitor**
- **Operation mode indication**

Optionally three external monitorings can be integrated in the monitoring and indicator concept.

Interfaces

Hardware interfaces:
6 change-over volt free contacts with the following allocations:

- Mains failure
- Battery under voltage
- Common alarm
- Spare
- Spare
- Spare

Digital inputs for volt free relay contacts floating (normally open contacts):

- Spare (e.g. earth fault monitoring system)
- Spare (e.g. ripple monitoring)
- Spare (e.g. battery symmetry monitoring)

Analogue inputs:

- Battery temperature (for temperature compensation)

A transducer 0 to 20 or 4 to 20 mA is configurable. As an option a further hardware interface board with 6 selectable relays is available.

Software interfaces (Protocol gateway):

RS 232 for:

- Network adapters for monitoring over an Ethernet network (option)
- Customer software for MODBUS (e.g. building management)
- PROFIBus (option)

RS 485 for:

- Customer software for MODBUS (e.g. building management)

If several gateways are requested a further gateway is optionally available.

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