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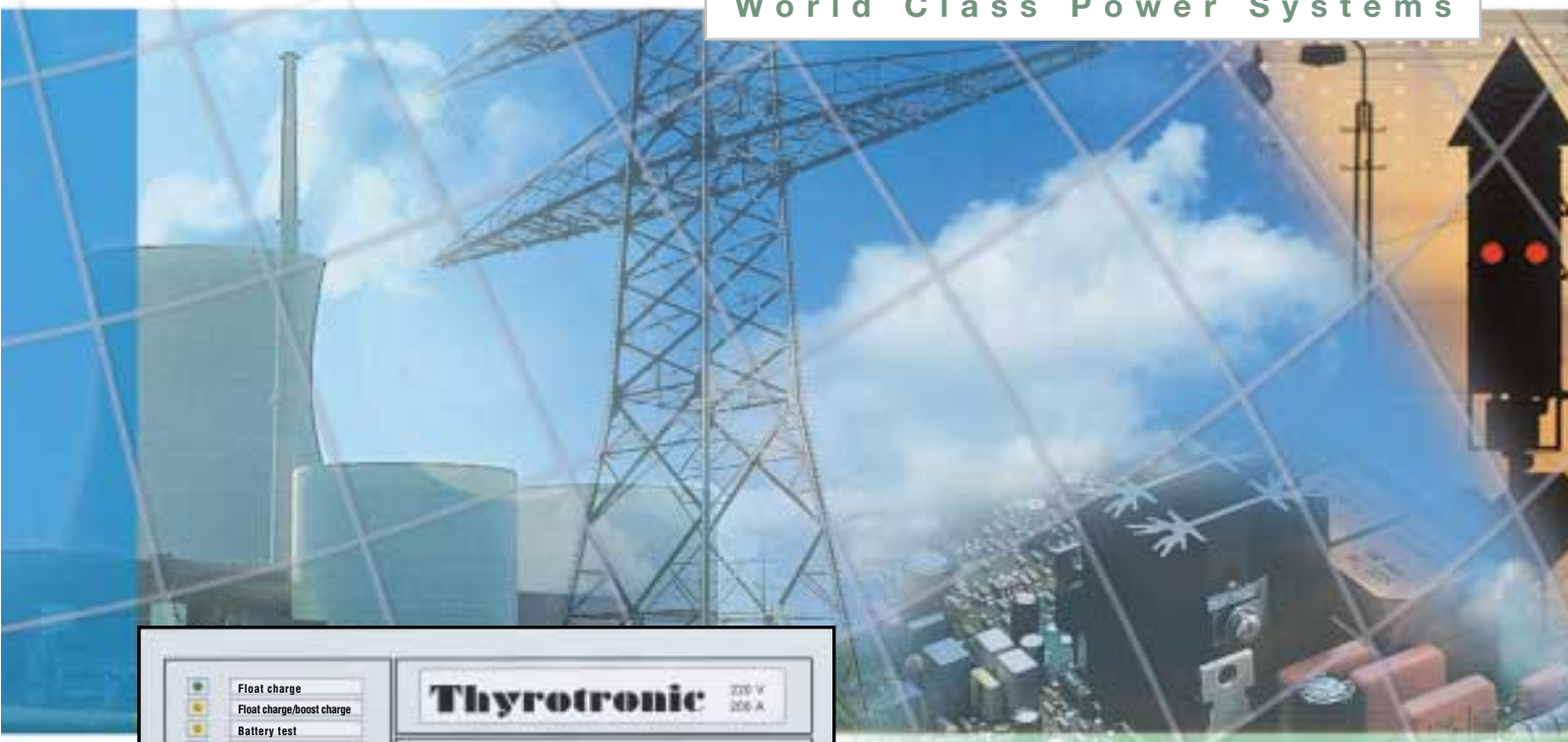
World Class Power Systems



Rectifiers

for stationary battery systems
Standard thyristor-controlled rectifiers
Thyrotronic Line

1. General

In all fields of industry and commerce the need for auxiliary power supplies to protect equipment against power failure is increasing. For many years the DC power supply and battery combination have been used in areas such as measurement, control, and data back up for the supply of the power and protection of the load.

Battery backed DC power supply systems are used in a wide range of applications, such as, monitoring and controlling of production processes, supply of measurement equipment, telemetry, telecomunication and radio systems.

These systems can be found in:

- Hospitals
- Power plants and substations
- Chemical plants
- Petrochemical plants
- Railway equipment
- Offshore projects
- Oil and gas pipeline systems

Rectifier units presently employed for DC power supplies operate almost without exception with a controlled output characteristic (IU-characteristic line in accordance with DIN 41773).

The output voltage is kept constant to the set value with a permissible deviation of ± 1 % within a load range between 0 % and 100 % of the unit current. Mains voltage fluctuations of ± 10 % and mains frequency fluctuations of ± 5 % will be controlled automatically by the thyristor regulator.

Dependant on the application, flooded or valve regulated lead-acid batteries are the main mediums used for energy storage in the power supply systems, in some specialised applications nickel-cadmium batteries are also used.

Fig.1: Thyrotronic rectifier

2. Operation

Lead-acid and nickel-cadmium batteries achieve optimum service life when remaining on float, in a charge condition. The charger floats the battery in a charged state and also supplies the load with power. In the event of mains power failure the battery will then supply the load its required power. This is called ”parallel operation” (see fig. 2).

With substantially discharged batteries, the rectifier unit at first operates in the I-branch of the IU-characteristic line, whereby the charging current for the batteries results from the difference between the nominal current of the rectifier unit and the load current.

When the set output voltage of the rectifier unit (U-branch) has been reached, the unit is changed to constant voltage charging (see fig. 3).

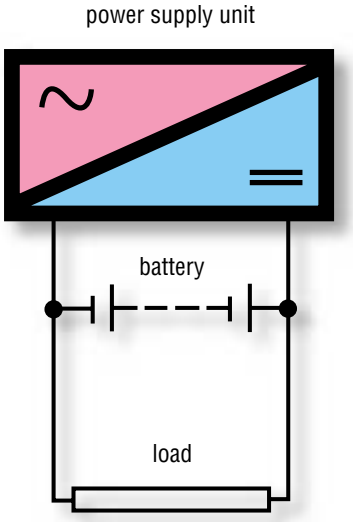


Fig. 2: Standby paralles operation

Switching the charge characteristic, from float charging (e.g. 2.23 V/cell with lead-acid batteries) to boost charging (2.4 V/cell with lead-acid batteries) gives an accelerated recharge which can be manual, dependent on voltage or dependent on voltage and time.

After the battery has been fully charged, a small charge current flows (approx. 0.3 mA to 1 mA per 1 Ah) to balance the internal losses of the battery.

The required autonomy is taken into consideration for calculating the battery size. The standby times vary depending on type of load and mains conditions.

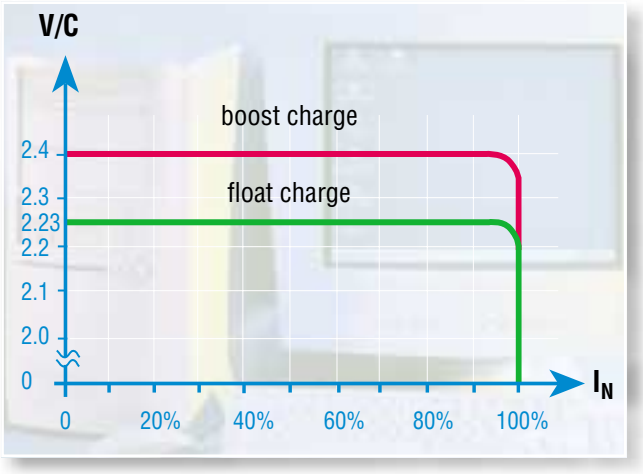
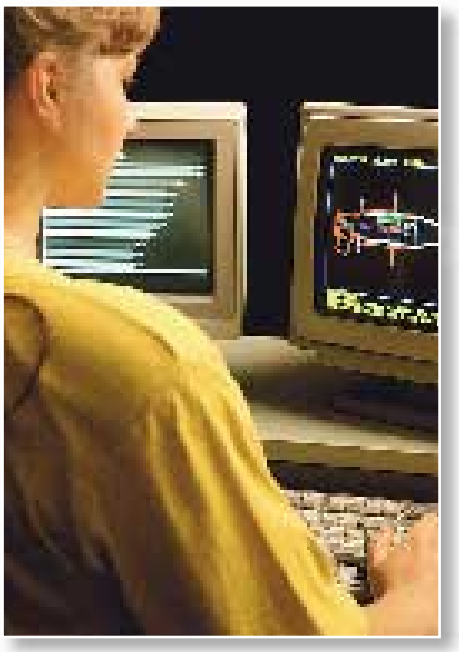


Fig 3: Charging characteristic for lead-acid batteries in accordance with DIN 41773

Typical values:

- 10 - 30 minutes for EDP-systems
- 1 - 3 hours for DC power supply equipment in hospitals and emergency lighting equipment
- 2 - 10 hours for telecommunication systems



Back up of Electronic Data Processing Systems

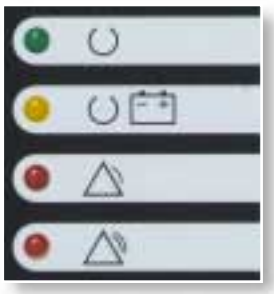
3. Rectifier series

The Thyrotronic series operates with a thyristor-controlled power unit which is combined with a microprocessor-controlled monitoring and control unit. The special feature of this series is the integrated monitoring and signalling concept with the following functions:

- Mains monitoring
- Charger output monitoring, current-dependent low voltage monitoring
- High voltage monitoring with impulse blocking
- Battery low voltage monitoring
- Cyclic battery-circuit test
- Battery availability test
- Earth fault monitoring
- Temperature-dependent floating charge voltage control (temperature sensor required)
- I x R Compensation of voltage drop on the battery lead
- Programmable automatic charging
- Indication of operating mode
- Active load sharing
- Hardware basic setting of the controller in case of processor fault
- Interface for PC or laptop
- Six digital ports for external monitoring functions

The frontpanel with integrated LED's and the LCD-display for indication of current and voltage (see picture 4) enables the use of different languages by way of an exchangeable inscription panel.

The LED's which are integrated beside the push button in the display are provided for fixed functions.



operation

battery operation

general failure

urgent failure

The LED's in the indicator panel have the following standard functions:

- float charge
- float charge/boost charge
- battery test
- mains fault
- unit fault
- high voltage
- low battery voltage
- battery circuit fault
- battery test negative
- earth fault plus
- earth fault minus
- option 1
- option 2

There are 3 potential free relays for the following alarms

- „mains failure“
- „common alarm“
- „low battery voltage“.

A relay card with a further 7 potential free alarm relays is available as an option.

4. Integrated functions

Description of the integrated functions:

Mains monitoring

In case of a mains failure , an electronic regulator block is placed and the LED and the "mains failure relay " will be activated. If the mains volatge returns the unit is automatically switched on after a set time.

Charger output monitoring

The charger output monitoring is a current-dependent low voltage monitoring and monitors the IU-characteristic of the rectifier unit. If the charger output falls below a set value of 2,1 V/cell and the output current falls below 90 % of the rated current the alarm will activate and indicate "unit fault".The corresponding LED and the common relay will be activated.

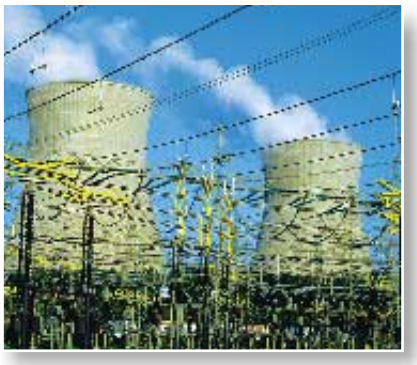
Fig.4: Front view of the thyristor range Thyrotronic

High voltage monitoring

If the output voltage rises too high (value is adjustable) due to an internal or external interference, over 20 msec. The impulse blocking will be activated and the output voltage will be set to zero. This high voltage monitoring works as dynamic monitoring with an automatic reset. If the monitoring responds 4 times within a period of 30 seconds, the mains contactor will be disconnected, the LED "high voltage" and common relay will be activated.

Low battery voltage

If the battery voltage falls below a set value, e.g. 1,8 V/cell (value adjustable) during discharge in a case of mains failure, the alarm "low battery voltage" will appear. LED and common alarm will be activated.



Use as power station power supply

Earth fault monitoring

The earth fault monitoring function monitors the insulation resistance of the DC-output to earth. Plus and minus are measured and monitored alternately. If the insulation resistance falls below the adjusted value (adjustable from 100 kOhm to 1 MOhm), this will be indicated by the LEDs and the common alarm.

I*R Compensation

With I*R Compensation it is possible to balance the voltage drop on the cable between rectifier and battery by entry of cable length and cross-section of the cable.

Battery circuit test

The battery circuit of the power supply system is tested cyclically every 24 hours. For this, the rectifier output voltage is dropped down to 1.9 V/C for a period of 5 secs. and, as a result, the battery is discharged. At the same time, the battery voltage is checked. If the battery voltage stays above 1.9 V/C, the battery circuit will be all right. If it falls below the limiting value, a "battery circuit fault" will be indicated and the LED as well as the common fault signalling relay will be activated.

Caution!
It is not intended that this test should replace battery circuit monitoring!

Battery availability test

During the battery availability test the rectifier output voltage will be dropped and the battery will be discharged as it is the case during the battery circuit test. But the battery will be discharged down to an adjustable minimum voltage limit during an adjustable time. These limits depend on the proportional battery capacity withdrawn during the discharge and can be taken from the discharging curves of the connected battery.
If, during the availability test, the values fall below the adjusted limits, the message "battery test negative" will be indicated by the corresponding LED and the collective fault signalling relay.
After the test the rectifier automatically switches back to boost charge or floating charge.

Programmable float/boost charge change over

If the battery voltage lowers due to mains failure or any other circumstances the rectifier unit will work in current limit. If it operates for more than 30 seconds after the charge start it will automatically be switched over to boost charge characteristic. After the boost charge voltage (current limitation) has been reached and after decreasing to < 90 %, a time stage will be activated. Upon expiry of the set time (0 to 6 h) it will automatically be switched back to float charge.
The automatic charging can be switched off so that only a manual switch-over via the plastic foil key board on the front panel is possible. Switching back to float charge can be done manually as well.If this is not done, the controller will switch back as in the case of automatic charging.
The switch-over to boost charge can be blocked by an external contact or a fixed bridge on the controller.

Equalise charge stage

It is possible to switch to an equalise charge stage via a switch on the front panel.
Here the voltage limitation will be abolished and the nominal unit current will be reduced to 20 % (adjustable from 20-30). An equalise and comissioning charge follows with an I-characteristic up to the final charge voltage of the battery.

After switching to equalise charge, a timer automatically switches back to the float charge on expiry of the set time (16 hours to 72 hours).

Using an external contact or a fixed bridge at the regulator, the equalise charge can be blocked and a switch over to the I-characteristic can be prevented.

Active load sharing

Due to an internal bus connetion between several rectifiers an active load sharing of ± 10 % is possible.

Hardware basic setting

In the case of microprocessor failure in the control unit, the controller internally switches over to a basic setting. That is, the rectifier continues to operate at the adjusted floating charge voltage and supplies the load as well as the battery.

In this case, a fault signal will be indicated by the common fault signalling relay.

Option

As an option, the display and operation unit of MCU 2000 is available with a graphic and alphanumeric display.
Additionally, the unit is equipped with an interface for remote data transfer.

5. Technical data

Mains input

Input voltage:	230 V ± 10 % single phase 3 x 400 ± 10 % three phase
Input current:	see table
Frequency:	50 Hz ± 5 %

Rectifier output

Output voltage:	24, 48, 60, 110, and 220 V
Output current:	see table
Adjustment:	± 5 %
Boast voltage:	2,40 V/Z Pb battery 1,55 V/Z NiCd battery
Float voltage:	2,23 V/Z Pb battery 1,40 V/Z NiCd battery
Equalise voltage:	2,70 V/Z Pb battery 1,70 V/Z NiCd battery
Regulation tolerance:	± 0,5 %
Ripple voltage:	< 5 % eff without battery for option 2 % eff
Cooling:	self-cooling
Ambient temperature:	40 °C
Protection:	IP 20
Painting:	RAL 7032
Acoustic noise level:	Max. 60 dB (A)
Cabinet type:	see table

6. Cabinet type table

Cabinet type		H	W	D
WGZ	755	758	534	470
PSJ	1564	1500	600	400
PSJ	1566	1500	600	600
PSJ	1866	1800	600	600
PSJ	1896	1500	900	600
PS	220808	2200	800	800
PS	221008	2200	1000	800
PS	221208	2200	1200	800

WGZ - wall mounted cabinet
PSJ / PS - floor standing cabinet

7. Type table

Nom. voltage V	No. of cells Pb	No. of cells NiCd	Type	Main voltage V	Curr. consump. A	Cabinet type	Weight Kg
24	12	20	E 230 G 24 / 20 BWrug-TDG	230	4,6	WGZ 755	30
24	12	20	E 230 G 24 / 40 BWrug-TDG	230	9,2	WGZ 755	40
24	12	20	E 230 G 24 / 60 BWrug-TDG	230	13,6	PSJ 1564	60
24	12	20	E 230 G 24 / 80 BWrug-TDG	230	17,8	PSJ 1564	75
24	12	20	D 400 G 24 / 100 BWrug-TDG	3 x 400	5,5	PSJ 1564	150
24	12	20	D 400 G 24 / 125 BWrug-TDG	3 x 400	6,8	PSJ 1564	200
24	12	20	D 400 G 24 / 160 BWrug-TDG	3 x 400	8,7	PSJ 1564	240
24	12	20	D 400 G 24 / 200 BWrug-TDG	3 x 400	10,8	PSJ 1564	290
24	12	20	D 400 G 24 / 300 BWrug-TDG	3 x 400	19,0	PSJ 1564	400
24	12	20	D 400 G 24 / 400 BWrug-TDG	3 x 400	24,3	PSJ 1596	510
48	24	40	E 230 G 48 / 10 BWrug-TDG	230	4,6	WGZ 755	30
48	24	40	E 230 G 48 / 20 BWrug-TDG	230	9,1	WGZ 755	40
48	24	40	E 230 G 48 / 30 BWrug-TDG	230	12,3	PSJ 1564	60
48	24	40	E 230 G 48 / 40 BWrug-TDG	230	16,3	PSJ 1564	75
48	24	40	D 400 G 48 / 50 BWrug-TDG	3 x 400	5,8	PSJ 1564	145
48	24	40	D 400 G 48 / 60 BWrug-TDG	3 x 400	6,7	PSJ 1564	190
48	24	40	D 400 G 48 / 80 BWrug-TDG	3 x 400	8,9	PSJ 1564	220
48	24	40	D 400 G 48 / 100 BWrug-TDG	3 x 400	10,8	PSJ 1564	270
48	24	40	D 400 G 48 / 125 BWrug-TDG	3 x 400	13,8	PSJ 1564	290
48	24	40	D 400 G 48 / 160 BWrug-TDG	3 x 400	17,6	PSJ 1564	340
48	24	40	D 400 G 48 / 200 BWrug-TDG	3 x 400	21,9	PSJ 1866	400
48	24	40	D 400 G 48 / 300 BWrug-TDG	3 x 400	32,0	PSJ 1866	500
48	24	40	D 400 G 48 / 400 BWrug-TDG	3 x 400	48,0	PSJ 1896	600
60	30	50	E 230 G 60 / 10 BWrug-TDG	230	5,1	WGZ 755	30
60	30	50	E 230 G 60 / 20 BWrug-TDG	230	10,3	WGZ 755	40
60	30	50	E 230 G 60 / 30 BWrug-TDG	230	17,5	PSJ 1564	60
60	30	50	E 230 G 60 / 40 BWrug-TDG	230	20,4	PSJ 1564	75
60	30	50	D 400 G 60 / 50 BWrug-TDG	3 x 400	6,8	PSJ 1564	150
60	30	50	D 400 G 60 / 60 BWrug-TDG	3 x 400	8,1	PSJ 1564	220
60	30	50	D 400 G 60 / 80 BWrug-TDG	3 x 400	10,8	PSJ 1564	250
60	30	50	D 400 G 60 / 100 BWrug-TDG	3 x 400	13,5	PSJ 1564	280
60	30	50	D 400 G 60 / 125 BWrug-TDG	3 x 400	17,1	PSJ 1564	300
60	30	50	D 400 G 60 / 160 BWrug-TDG	3 x 400	21,7	PSJ 1564	350
60	30	50	D 400 G 60 / 200 BWrug-TDG	3 x 400	26,5	PSJ 1866	420
60	30	50	D 400 G 60 / 300 BWrug-TDG	3 x 400	40,5	PSJ 1866	520
60	30	50	D 400 G 60 / 400 BWrug-TDG	3 x 400	53,0	PSJ 1896	620
108	54	90	D 400 G 108 / 5 BWrug-TDG	230	4,0	WGZ 755	30
108	54	90	D 400 G 108 / 10 BWrug-TDG	230	8,0	WGZ 755	40
108	54	90	D 400 G 108 / 16 BWrug-TDG	230	13,2	PSJ 1564	60
108	54	90	D 400 G 108 / 25 BWrug-TDG	3 x 400	6,5	PSJ 1564	75
108	54	90	D 400 G 108 / 30 BWrug-TDG	3 x 400	7,5	PSJ 1564	95
108	54	90	D 400 G 108 / 40 BWrug-TDG	3 x 400	10,0	PSJ 1564	180
108	54	90	D 400 G 108 / 50 BWrug-TDG	3 x 400	12,9	PSJ 1564	220
108	54	90	D 400 G 108 / 60 BWrug-TDG	3 x 400	14,7	PSJ 1564	260
108	54	90	D 400 G 108 / 80 BWrug-TDG	3 x 400	20,0	PSJ 1564	330
108	54	90	D 400 G 108 / 100 BWrug-TDG	3 x 400	24,7	PSJ 1866	400
108	54	90	D 400 G 108 / 125 BWrug-TDG	3 x 400	31,5	PSJ 1866	450
108	54	90	D 400 G 108 / 160 BWrug-TDG	3 x 400	40,0	PSJ 1866	500
108	54	90	D 400 G 108 / 200 BWrug-TDG	3 x 400	50,0	PSJ 1896	520
108	54	90	D 400 G 108 / 300 BWrug-TDG	3 x 400	70,0	PSJ 1896	850
108	54	90	D 400 G 108 / 400 BWrug-TDG	3 x 400	100,0	PS 220808	1100
216	108	180	E 230 G 216 / 5 BWrug-TDG	230	9,4	WGZ 755	40
216	108	180	D 400 G 216 / 10 BWrug-TDG	3 x 400	5,1	PSJ 1564	60
216	108	180	D 400 G 216 / 16 BWrug-TDG	3 x 400	8,0	PSJ 1564	80
216	108	180	D 400 G 216 / 20 BWrug-TDG	3 x 400	9,8	PSJ 1564	120
216	108	180	D 400 G 216 / 25 BWrug-TDG	3 x 400	12,4	PSJ 1564	220
216	108	180	D 400 G 216 / 30 BWrug-TDG	3 x 400	15,2	PSJ 1564	260
216	108	180	D 400 G 216 / 40 BWrug-TDG	3 x 400	21,0	PSJ 1564	330
216	108	180	D 400 G 216 / 50 BWrug-TDG	3 x 400	25,2	PSJ 1866	400
216	108	180	D 400 G 216 / 60 BWrug-TDG	3 x 400	30,5	PSJ 1866	450
216	108	180	D 400 G 216 / 80 BWrug-TDG	3 x 400	40,0	PSJ 1866	500
216	108	180	D 400 G 216 / 100 BWrug-TDG	3 x 400	50,0	PSJ 1896	620
216	108	180	D 400 G 216 / 125 BWrug-TDG	3 x 400	63,0	PSJ 1896	720
216	108	180	D 400 G 216 / 160 BWrug-TDG	3 x 400	81,0	PSJ 1896	800
216	108	180	D 400 G 216 / 200 BWrug-TDG	3 x 400	100,0	PS 220808	1050
216	108	180	D 400 G 216 / 300 BWrug-TDG	3 x 400	152,0	PS 221208	1300
216	108	180	D 400 G 216 / 400 BWrug-TDG	3 x 400	203,0	PS 221208	1600

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