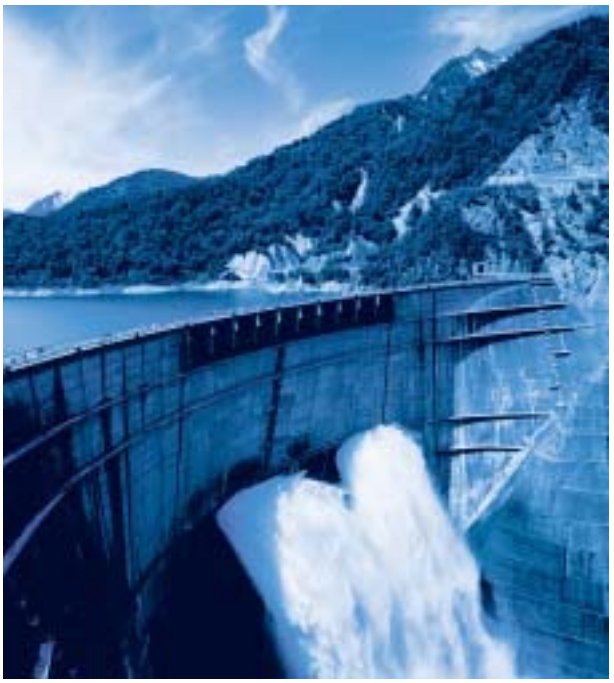
- **Input voltage:** 115 / 230 VAC, single phase, 50 / 60 Hz
  or 208 / 400 / 480 VAC, three phases, 50 / 60 Hz
- **Output voltage:** 12 / 24 / 48 / 60 / 72 / 110 / 220 / 400 VDC
- **Output current:** up to 3250 A
- **Output power:** 100 W - 500 kW



The thyristor-controlled power supplies and battery chargers present the conventional method of rectifying and controlling electric power. The advantages of thyristor-controlled units are given by a simple technical concept resulting in robustness and reliability.

Typical applications

- Power stations
- Sub-stations
- Switch gear stations
- Chemical plants
- Railway on-board
- Railway trackside
- Pipeline systems
- Hospitals

Depending on the application, nickel-cadmium batteries, flooded or valve regulated lead-acid batteries are used for energy storage in the power supply system. Each type of battery requires an individual charging characteristic which can be accomplished by the control cards. In addition, there is a number of options and accessories for individual configuration of the charger system.

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Specifications

Input

Voltage . . . . . 230 VAC ±10 %, 1-phase or
400 VAC ±10 %, 3-phase
(other voltages upon request)
Frequency . . . . . 50 or 60 Hz ±5 %
Current . . . . . see table
Protection . . . . . by fuse

Output

Nominal voltage . . . . . see table (other voltages upon request),
adjustable from 90 – 120 % of U_{nom}
Line regulation (±10 %) . . . . . ±0.5 %
Load regulation (10 – 90 %) . . . ±1 %
Dynamic load (10-90-10 %) . . ±10 % typical
Ripple . . . . . ≤5 % rms without battery, optional:
<2 % rms or 2 mV frequency weighted
Nominal current . . . . . see table, electronic current limitation
adjustable from 60 – 105 % of I_{nom}
Overload protection . . . . . short circuit protected by fuse,
optional: by electronic fuse
Charging characteristic . . . . . IU acc. to DIN 41773 for Pb batteries /
DIN 41774 for NiCd batteries
Charging voltage
- float . . . . . 2.23 – 2.27 V/cell for Pb batteries /
1.4 V/cell for NiCd batteries
- equalize . . . . . 2.35 – 2.4 V/cell for Pb batteries /
1.55 V/cell for NiCd batteries
- boost (manual activated) . . . . 2.7 V/cell for Pb batteries /
1.7 V/cell for NiCd batteries

General

Efficiency
- Series QE . . . . . 78 – 90 %
- Series QD . . . . . 82 – 92 % for models <48 VDC
85 – 97 % for models ≥48 VDC
Operating temperature . . . . . –10 to +40 °C, optional up to +65 °C
Humidity . . . . . up to 95 % RH, non-condensing
Altitude . . . . . up to 1000 m asl
Cooling . . . . . natural convection
Audible noise . . . . . 50 – 70 dB(A) depending on power
Safety / Construction . . . . . acc. to DIN / EN 60950-1: 2003
EMI . . . . . acc. to EN 55022, class A
Enclosure
- Protection category . . . . . IP20 acc. to EN 60529,
optional up to IP55
- Color . . . . . RAL 7035, others upon request
Transformer . . . . . acc. to IEC 76 / IEC 14 / EN 60591 /
DIN VDE 0532

Thyristor-controlled power supplies and battery chargers	Page
► Series QE, thyristor-controlled rectifiers with 1-phase input	106
► Series QD, thyristor-controlled rectifiers with 3-phase input	107
► Options & Accessories	108
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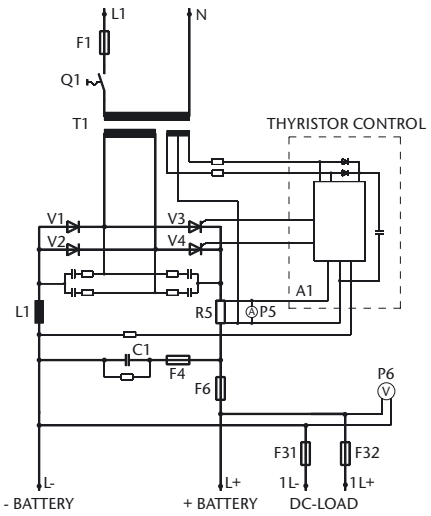

Model designation (example): QE 24 / 20

- single phase input
- nominal output voltage [V]
- max. output current [A]

enclosure size [1]	nominal output voltage						approx. line current [2] [A]	approx. weight [3] [kg]
	12 V	24 V	48 V	60 V	110 V	220 V		
	max. output current [A]							
R2	4	2.5	1.2	1	–	–	0.6	12
	6	4	2.5	2	1	–	1	14
	9	6	–	–	–	–	1.4	15
	12	8	4	3.5	2	1	1.6	18
	16	11	–	–	–	–	2	22
R3	22	14	7	6	3.2	1.6	2.7	26
	30	20	10	8	5	2.5	4	28
	36	25	12.5	10	6	3	5	31
R4	50	32	16	14	8	4	6.5	40
	60	40	20	18	10	5	8	46
R5	80	55	30	25	14	7	11	60
	110	75	40	35	18	9	15	73
R5+	–	100	55	45	25	12.5	20	88
	–	130	70	60	32	16	26	98

[1] Larger size may be required for optional equipment.
[2] Line current is referred to nominal input voltage of 230 VAC.
[3] Weight is referred to thyristor-controlled rectifier on a mounting plate without enclosure.

Enclosures

wall-mounted enclosure designation	weight (empty) [kg]	height	width	depth
		dimensions [mm]		
R2	9	300	380	210
R3	12	380		
R4	17		600	
R4+	26	600		
R4T	22	380		350
R5	31	600		
R5+	38	760		

floor-mounted enclosure designation	weight (empty) [kg]	height*	width	depth
		dimensions [mm]		
R6	66	1200	600	400
R6+	80		800	
R7	127	1800	600	
R7+	150		800	
R8	147	2000	600	500
R8+	175		800	
R9	250		1200	600

*) The height of the base frame, elevated roof and suspension eyes is to be added, if needed.

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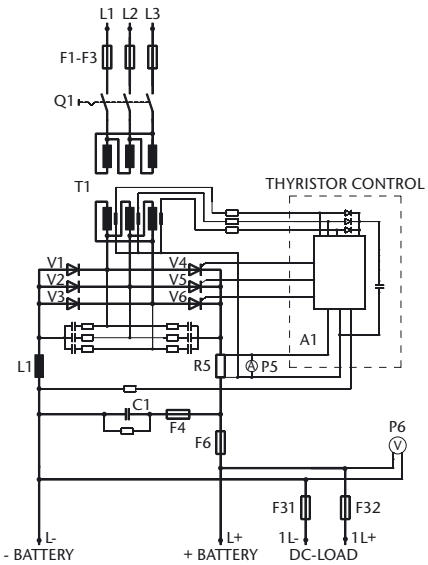

Model designation (example): QD 60 / 32

three phases input
nominal output voltage [V]
max. output current [A]

enclosure size [1]	nominal output voltage 24 V	48 V	60 V	110 V	220 V	approx. line current [2] [A]	approx. weight [3] [kg]
	max. output current [A]						
R4	25	12	10	5	2.5	1.1	48
	40	20	16	8	4	2	62
R5	60	30	25	12	6	3	74
	80	40	32	16	8	4	78
	100	50	40	20	10	5	85
R5+	125	60	50	25	12	6	95
R6	160	80	65	32	16	8	130
	200	100	80	40	20	10	150
R6+	240	120	100	50	25	11	180
	300	150	120	60	30	14	260
R7	350	170	140	70	35	16	310
	400	200	160	80	40	19	340
R7+	500	250	200	100	50	24	390
	600	300	240	120	60	28	420
R8	700	350	280	140	70	33	450
R8+	800	400	320	160	80	38	510
R9	1000	500	400	200	100	48	620
2 x R8+	1200	600	500	250	120	57	680
	1600	800	600	300	150	76	740
	2000	1000	800	400	200	95	780
	2250	1125	900	500	250	120	920
	2750	1375	1100	600	300	142	1000
	3250	1625	1300	700	350	166	1180
2 x R9	–	1800	1450	800	400	190	1300
	–	2250	1800	1000	500	238	1450
	–	–	2750	1500	750	356	1630
3 x R9	–	–	–	2000	1000	475	1875
4 x R9	–	–	–	–	2000	950	2390

[1] Larger size may be required for optional equipment.
[2] Line current is referred to nominal input voltage of 3 x 400 VAC.
[3] Weight is referred to thyristor-controlled rectifier on a mounting plate without enclosure.

Input

- MCB, MCCB or isolator
- soft-start

Output

- parallel operation
- redundant operation
- overload protection by electronic fuse
- 6 or 12-pulse performance
- filtering up to 0.1 % pp (corresponding to 0.035 % rms) or 2 mV frequency weighted
- voltage stabilization

Control

IU characteristic acc. to DIN 41773 and 41774

- manual selection of charging characteristic (float / equalize / boost)
- automatic selection of charging characteristic with timer
- temperature compensated charging voltage

Supervision

analog or micro-processor-controlled

- input voltage
- output voltage
- battery circuit
- ground insulation failure
- over temperature
- fuses

Interface card RS 232 for supervision

Battery

- MCB, MCCB or isolator
- deep discharge protection

DC distribution panel

wired acc. to customer's specification

Mechanics / environment

- enclosures, IP 20 up to IP 55, for charger and / or batteries
- analog or digital meters
- operating temperature up to 65 °C (standard –10 to +40 °C)
- tropical protection
- earthquake-proof
- vermin-proof

Converters and Inverters

- switchmode DC/DC converters from 50 W to 30 kW
- switchmode DC/AC inverters, frequency converters and static switches from 200 VA to 30 kVA

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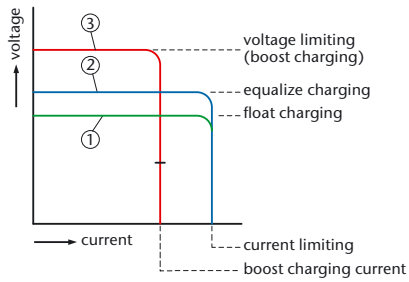
Control

Thyristor-controlled units provide constant output voltage with current limiting according to the IU characteristic:



① Curve 1 shows Constant Voltage / Constant Current operation, both values are adjustable by trim-potentiometer.

② Curve 2 shows Equalize Charge operation with the constant voltage level increased by a certain amount, adjustable by trim-potentiometer. This mode of operation is started manually by pressing a push button or automatically, when the battery voltage has dropped below a certain level. It is terminated manually or by electronic timer.

③ Curve 3 shows Boost Charge operation with the current programmed by a knob and with adjustable voltage limiting. It is started manually only, as attention must be paid not to overcharge the battery. It is terminated manually or by electronic timer. If the voltage limit is reached the charger operates with constant voltage while the current decreases with the battery being filled up more and more.

Additionally, the charger can be equipped with the option “temperature compensated charging voltage“. In case of high battery temperature the charging voltage will be automatically reduced.

Supervision

The charger and battery may be monitored through the use of a variety of plug-in design Supervision Cards. They have LEDs to indicate alarm detection. Additionally, a LED panel is available, typically mounted on the front door of the enclosure. Potential free contacts are provided for remote alarm. A timer circuit for delaying the alarm, or an electronic memory for storing the alarm until it is reset, by pressing a push button, is optionally available.

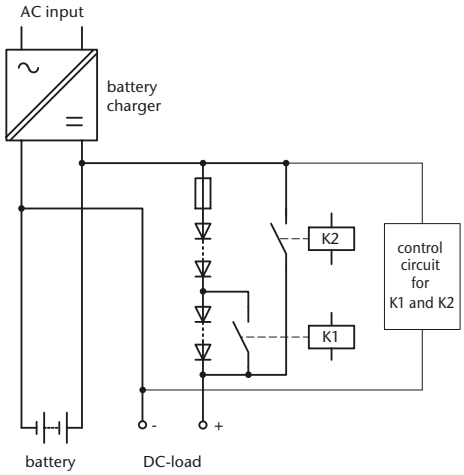
Supervised	Alarm	Alarm Criteria / Utilization
Input	Mains Failure	Voltage of one or more phases drops below an adjustable level.
Output	DC High Voltage	Load or battery voltage exceeds an adjustable level. The alarm signal can be used to INHIBIT (turn off) the charger or for disconnecting the load by means of a contactor.
	DC Low Voltage	Battery voltage drops below an adjustable level. In order to avoid deep discharge of the battery, a contactor could be activated for disconnecting the load.
	Charger Failure	No current flows at low battery voltage.
Battery	Battery Circuit Failure	Deviation of voltage symmetry of two battery sections with respect to a centre point. An initial asymmetry can be compensated by adjustment. The circuit detects conditions such as short circuit of cells, line interruption or poor quality connections between cells.
Ground Insulation	Ground Insulation Failure	Current from the positive or negative pole to ground exceeds an adjustable level, typically ±4 mA.
Temperature	Over Temperature	High temperature may be sensed externally, internally or at semiconductors.
Fuse	DC Fuse Failure	Voltage drop across the charger output fuse, capacitor fuse or load fuse exceeds a certain value.

Output voltage stabilization

The output voltage of a battery charger with parallel connected battery varies substantially with the charging condition of the battery. For many applications, however, the load circuit requires a better stabilized voltage which can be accomplished by:

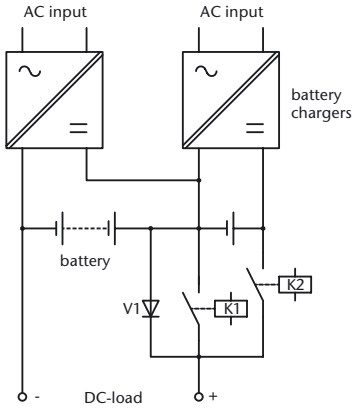
Voltage dropping diodes

being interconnected between battery and load, reduce the voltage to a value suitable for the load. They are short-circuited by one or more contactors if a partial reduction only or no voltage reduction is needed. A control circuit senses the battery voltage and energizes the contactors. Voltage dropping diodes cause substantial power losses as the excess voltage is absorbed by the diodes. However, due to the simplicity this method is frequently used, especially if the voltage reduction is needed during the short periods of high-rate charging only.



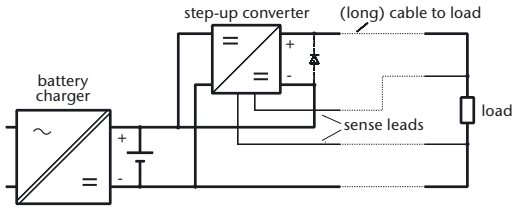
Systems with main and end cells

An economical but rather expensive solution occasionally used for high power systems is to split the battery into main and end cells. As during operation both sections are differently discharged individual chargers are needed. During normal operation, with the battery fully charged, the load circuits are connected via contactor K1 to the main cells. During mains failure the battery voltage decreases, contactor K1 opens and K2 connects the load to the entire battery. The diode maintains the current flow during switch-over. K1 and K2 are electronically controlled by a circuit that senses either the battery or the AC mains voltage.



Switchmode step-up converters

are DC/DC converters supplied from the battery with the output connected in series to the battery. They present a very economical solution as they only add voltage when the battery is discharged. Further details can be found on page 76 / 77.



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