CRS
INDUSTRIAL POWER EQUIPMENT

QUASAR PP & PPR RECTIFIERS

Quasar is a line of switch-mode rectifiers for surface treatment processes, electro-winning and water treatment, that adopts pulse width modulation (PWM) technique for the controlling of current amplitude.

Pulse Plating & Pulse Plating Reverse rectifiers are designed to handle forward and reverse pulsed output current with the possibility to create, via software, special mixed waveforms with DC & pulsed output current. These rectifiers are able to generate very fast and complex current and voltage patterns (repetitive sequence of pulses) where minimum pulse (phase) duration is 1ms. Using these fast pulse patterns in combination with appropriate chemical products, remarkable improvements are obtained.

Electrical Features

> High speed IGBT technology
> Modular power platform
> Microprocessor controlled
> High speed polarity switching
> Up to 40% power saving vs. Silicon Controlled Rectifier (SCR)
> Cos Ø ≥ 0.93 at rated load
> Low output current ripple
> High precision voltage and current regulation (1000 steps)
> Fast response time and high stability to load variation (~1ms)
> Pulse width 1 - 200 mS with 0.1 mS step
> Up to 50 VDC

Hardware Features

> 15 to 180cm height
> 43 x 43cm base size
> Light weight
> Main switch and operator control panel in the front
> All input/output connections in the back for easy access

Software Features

> Simple output parameters and waveform programming from the operator panel (current, voltage, cycle time and ramp time)
> Customized software available
> A/h and A/min meters for precise thickness and dosing pumps control
> Up to 6 phases standard

Available Interfaces

> Included
- CRS-ASCII
- Modbus-RTU

> Optional with additional board:
- Profibus-DP
- DeviceNet
- Modbus/TCP
- Profinet
- EthernetIP

— 2 Years Warranty —

Operation Modes

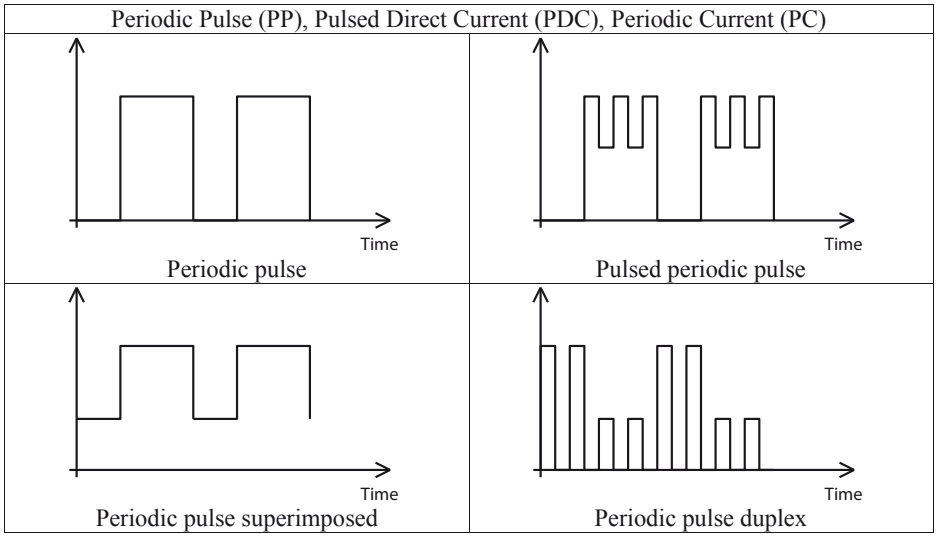
> Manual
> Automatic (Via PC or PLC)

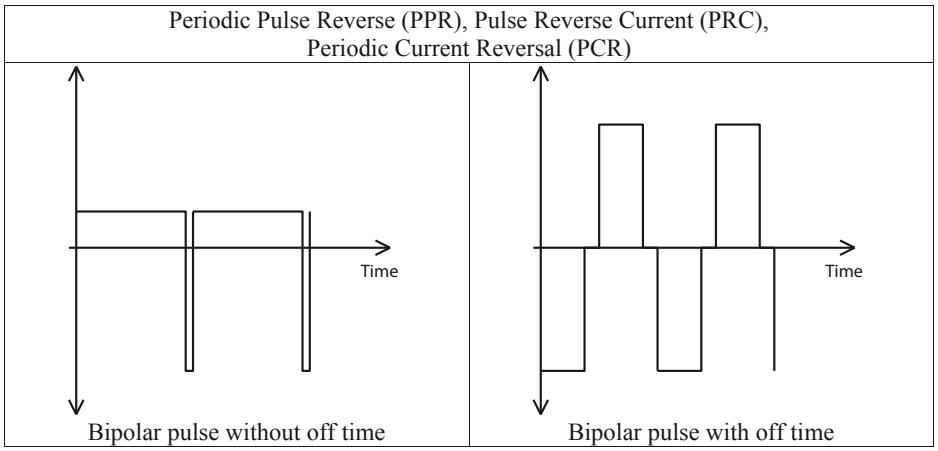
www.crspower.com | sales@crspower.com | Tel. + 39 039 928.5507 | Fax +39 039 598.3566

CRS

Introduction

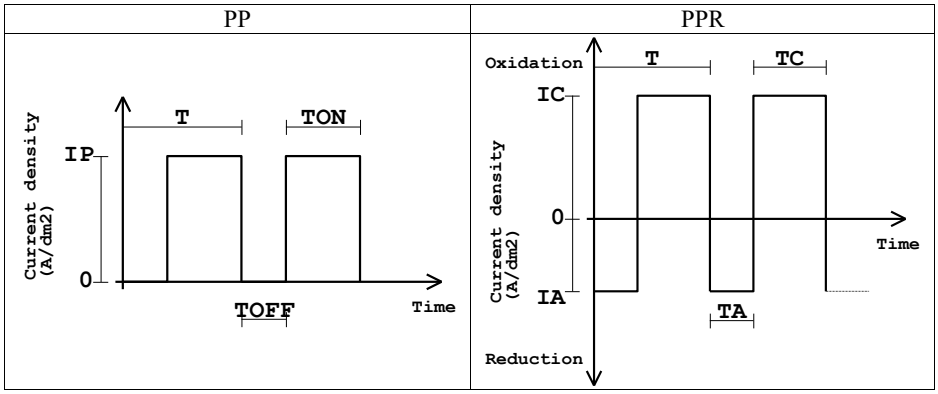
Pulse Electro Deposition (PED) is widely used to improve the electrochemical process. The potential or current is alternated swiftly between different values with the aim to lower the effect of a charged layer forming around the cathode. In PCB manufacturing the combined use of additives and reverse current pulses, improves the uniform distribution of metal on sharp edges. The application are varied: PCB, anodizing, micro-plating, etc. Applications of PED are object of research, and many other uses of this technology may yet be discovered. Generally speaking, there are no limits to pulsed applications. While are not specialized on the chemistry of plating we can propose power supply solutions that best fit your applications.





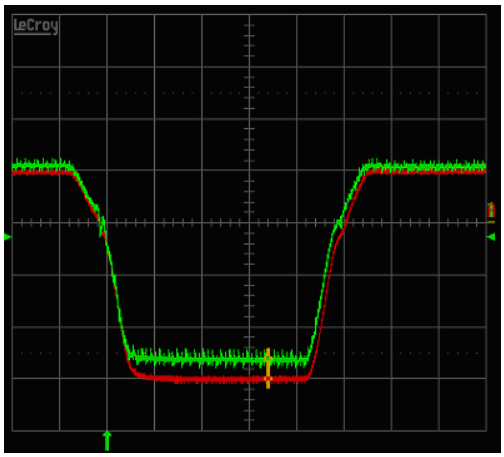
Timing

The key element of the pulsed machines is the timing of the required pattern. The chemistry requires a right angle wave shape that is drawn by lines at right angles.



But the current can't increase (or fall) in null time. It needs time to charge inductive and capacitive component of power supply and output cables.

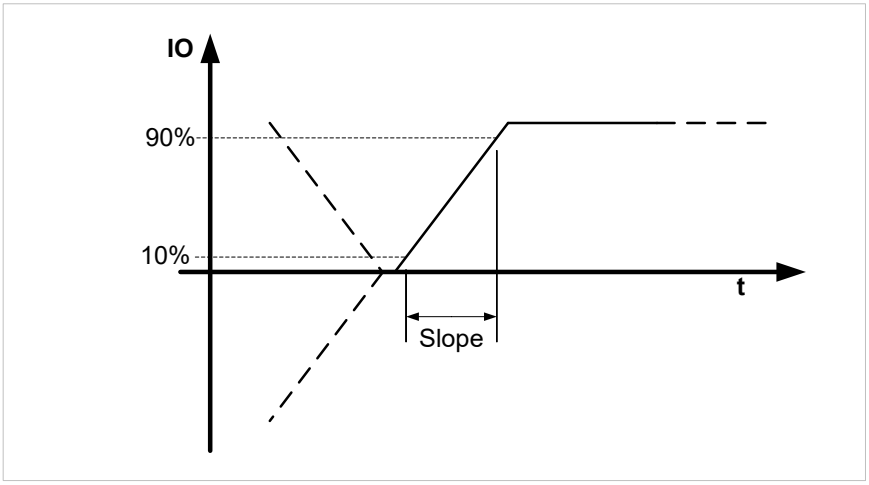
With the aim of stabilizing the output waveform that could occur for the changing of characteristics of Tank and cables, we have introduced "controlled" changes in the current, instead to brutally varying the output. The following is an oscilloscope recording of a pulse of current (red) and voltage (green) over a test Tank



200µs/div

Slope

The changing of current has a rate of growth that can be measured. The Slope is the time needed to increase the current from 10% to 90% of final maximum current.



The CRS software produces a controlled Slope in output current to avoid oscillation, overshoot, undershoot or deviation of chosen pattern. In order to simplify choosing, and to introduce a standardization, CRS has divided the Slope time in three values:

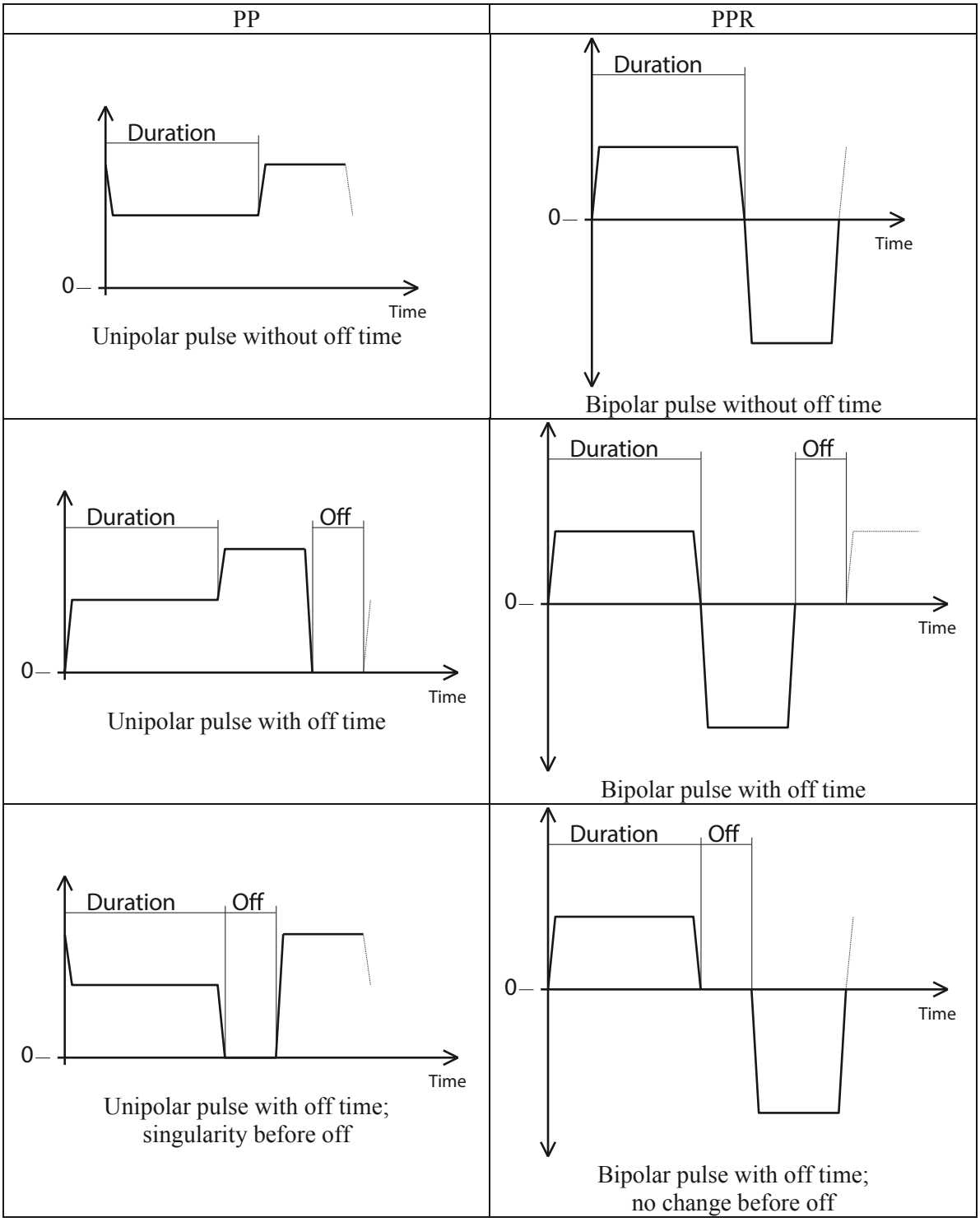
FAST (Slope: 0.09 ms) - Impulses as narrow as 1ms that require great care in output line and stable components in the module. It is used by the PCB manufacturer. To avoid output wave distortions, the design of output line, that connects power supply to tank, must be done by a qualified installer. The design of a pulsed power supply starts by filling in the spreadsheet provided by CRS.

SLOW (Slope: 0.8 ms) - Impulses as narrow as 3ms. No particular care is necessary; we advise only for a summary check of inductance for very long line (greater than 10m). It is often used by anodizers. We encourage using the SLOW Slope instead of FAST, whenever the application permits impulse wider than 3ms. We can drive two towers with the same output waveform, on the condition that the outputs must not be interconnected together.

DC (Slope: 100 ms) - for these slow machines (1000ms), we can realize large installations, with many towers connected together (up and over 1MW). The cabling must keep in account only for the dissipation requirement.

Duration

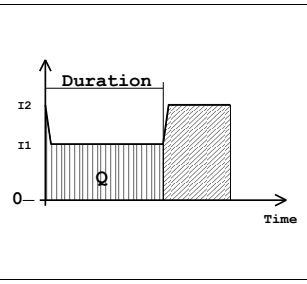
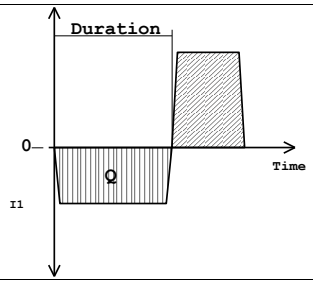
The other fundamental element is the time of one pulse. The Duration is the total time of a pulse both in pulsed or pulse reverse machines. The optional Off time is the time of output null.



Duration is the time the time that completes one single pulse or the zero to zero time.

Charge

Due to the Slope, the total charge moved during one pulse is less due to many factors: power supply speed, line length, and inductance in electrodes. By specifying the Slope all these phenomena are keep under control, because the wave shape is controlled. Also the rms current is more stable because the wave shape overshoot and undershoot, are less severe. This is useful in electrochemical to replicate the design parameters of a bath with less adjustments.

	PP	PPR
		
FAST	$Q = I1 * Duration + (I2 - I1) * 5.6 * 10^{-5}$	$Q = I1 * (Duration - 1.1 * 10^{-4})$
SLOW	$Q = I1 * Duration + (I2 - I1) * 5 * 10^{-4}$	$Q = I1 * (Duration - 1.10^{-3})$
DC	$Q = I1 * Duration + (I2 - I1) * 6.3 * 10^{-2}$	$Q = I1 * (Duration - 1.3.10^{-1})$

E.g. in a FAST PPR machine that deliver 1ms pulse, the total charge is 11% less than the theoretical expected, in SLOW a 3ms pulse has 33% less charge.

Types of rectifiers

We divide machines in six categories:

	Slope [ms]	Min Duration [ms]	Min Off [ms]	PWR Design
PP FAST	0,09	1	0,1	CUSTOM (Custom design of the module and special care in output cable setup)
PPR FAST				
PP SLOW	0,8	3	1	STANDARD
PPR SLOW				
DC	100	1000	1000	STANDARD
DCR				

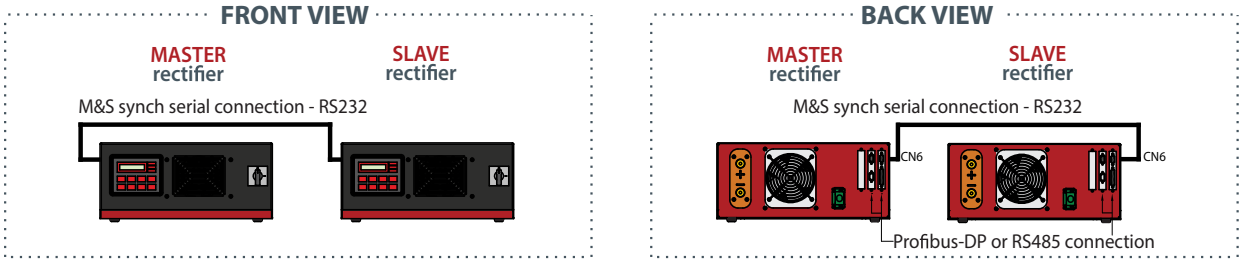
Multi-tower configuration

Multi Tower is needed if the input main current is more than 230Arms. Multi Tower systems can be controlled individually with one tower designated as the Master to synchronize the pulse or one control point thru the Master Box.

	Multitower - Current Control	Multitower - Voltage Control
PP FAST	◦ RS232/RS485 converters required if more than 3 towers	◦ RS232/RS485 converters required if more than 3 towers ◦ only one output pole can be interconnected
PPR FAST		
PP SLOW	◦ RS232/RS485 converters required if more than 3 towers	◦ RS232/RS485 converters required
PPR SLOW		
DC	◦ no special requirement or limit	◦ no special requirement or limit
DCR		

Master & Slave (synchronization)

In order to accomplish synchronized pulses, CRS rectifiers can be networked in Master & Slave configuration allowing to meet all requirements for the applications where different areas need different running processes. One of the two rectifiers acts as Master, which main function is to set the synchronization start. The following diagram shows the connection for the M&S configuration:



Our offering

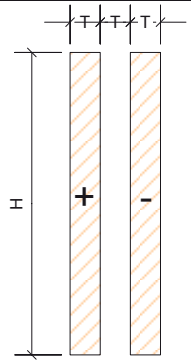
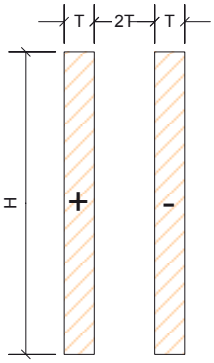
The economical offering of our rectifiers is very attractive because they are derived from our line of standard DC and DCR rectifier that are notoriously very competitive. The standardization introduced in all models of CRS power supply, imply a decrease of the production cost. Many of the principal components are the same like: chassis, primary circuits and CPU.
Generally a pulsed rectifier differs in some parts of secondary circuits. The introduction of reverse stage (if needed) and the tight control of output voltage, inductance, and capacitance are the key elements that bring us to get the right shape of output current.

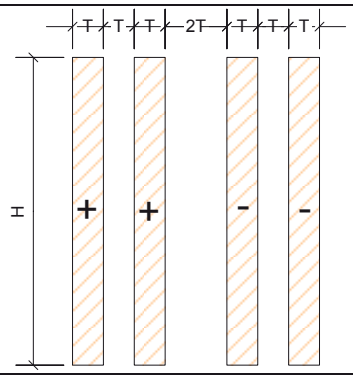
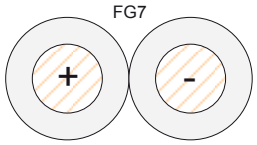
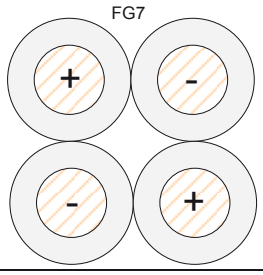
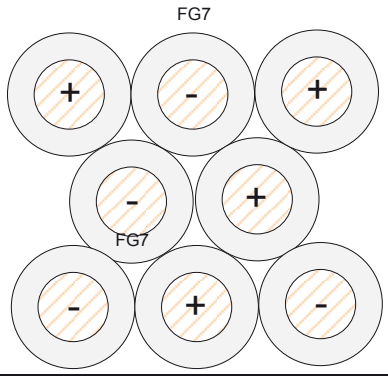
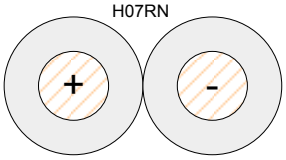
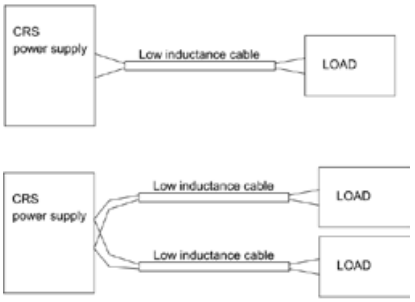
Output wiring guideline

In the following of document some rules to implement output wiring to tank. Start with a list of wires types and disposition, then a series of tables where the green squares indicate the feasibility of each solution. A green square is indicated only if the four conditions are met.

1) Current capabilities comply with IEC 60364-5-52 for insulated cables or the max temperature for bare bars.
2) Voltage drop less than 20% of working output voltage @ max temperature and max output current.
3) Total inductance less than the limit that permit to have a good wave shape.
4) Current density at least 0.5A/mmq. This is due to economic reasons.

This is not an exhaustive manual to implement the output wiring. It is only a guideline to orienting the user before choosing the machine.

Double copper bars spaced as thick – max temp 70 degree. 2xHxT spT **2** bars **x** **H**eight mm **x** **T**hickness in mm **sp**aced the same **T**hickness of the bars	
Double copper bars spaced double thick max 70 degree C. 2xHxT sp2T **2** bars **x** **H**eight mm **x** **T**hickness in mm **sp**aced **2** times the **T**hickness of bars	

Double copper bars, doubled spaced double thick max 70 degree C. 2xHxTx2 sp2T **2** bars **x** **H**eight mm **x** **T**hickness in mm **x** **2** times (doubled per pole) **sp**aced **2** times the **T**hickness of bars	
Double cable FG7 tightly coupled max 70 degree C 2xSmmq **2** conductors x **S**urface in **mmq** of each conductor	
Quad cable FG7 tightly coupled max 70 degree C. 4xSmmq **4** conductors x **S**urface in **mmq** of each conductor	
Eight cable FG7 tightly coupled max 70 degree C 8xSmmq **8** conductors x **S**urface in **mmq** of each conductor	
Double cable H07RN tightly coupled max 90 degree C 2xSmmq **2** conductors x **S**urface in **mmq** of each conductor	
CRS LWR008 low inductance cable up to 90°C. 1x 2x..4x	

CRS INDUSTRIAL POWER EQUIPMENT

QUASAR PP & PPR RECTIFIERS

Technical Specifications

ELECTRICAL SPECIFICATIONS

			Q100 model	Q300 model	Q500 model
Output	Max Current per tower	PP	550/1650A	1700/5100A	8000/24000A
		PPR	250(750)A	1100(3300)A	5000(15000)A
	Voltage	PP	5-450VDC		
		PPR	5-50VDC		
	Max. pulsed current		Up to 3 times the max DC current value depending on the pattern required		
	Operation Mode		Current control or Voltage Control (limited, see page 5)		
	Control accuracy		1/1000 of max current or voltage		
	Current regulation range		2 - 100% of max current (with CTRD02)		
	Voltage regulation range		5 - 100% of max voltage (with CTRD02)		
	Current ripple (RMS)		< 2.0% of rated output current in current operation mode (< 1.0% on Request)		
	Efficiency		89% (typ.) @ rated load / 92% (for >= 160VDC) @ rated load		
	Min. Pulse duration		Slow: 3ms | Fast: 1ms		
	Secondary withstand voltage		50VAC 50Hz 1min. between secondary to earth		
	Pole to be connected to ground		Positive		
Main Supply	Line voltage		3 x 230VAC ± 10%, 3 x 400VAC ± 10%, 3 x 440VAC ± 10%, 3 x 480VAC ± 10%, 3 x 550VAC ± 10% or 3 x 575VAC ± 10%		
	Frequency		50 - 60Hz		
	Neutral		NOT USED		
	Power factor		> 95% @ rated load		
	Primary current in max DC		Max 20A	Max 55A	Max 230A per tower
	Earth leakage current		See EMC filter input specifications		

GENERAL SPECIFICATIONS

			Q100 model	Q300 model	Q500 model
Technology			Switching mode PWM, Full Bridge IGBT inverter		
Cooling Systems			Air		
			Water		
Operation Conditions	Location		Indoor use only		
	Ambient temperature		0 - 40°C (up to 50°C with 15% derating -air cooled- / 10% derating -water cooled-)		
	Relative humidity		15 - 85% not condensing		
	Filter obstruction - air cooled		15% max		
	Water input temp. - water cooled		19 - 22°C (rectifier rev. A1-A49) | 19 - 28°C (rectifier rev. A60 or above)		
	Altitude		<= 2000m		
Degree of Protection		Air cooled	IP31	IP21 (on request NEMA12)	IP32
		Water cooled	IP43	-	IP42 (on request IP65)
Enclosure color			RAL 3004	RAL 5010	RAL 3004
Conformity of EU Directives			2006/95/EC - Low Voltage Directive		
			2004/108/EC - Electromagnetic Compatibility		

PROTECTION

Surge

According to directive	EN 61000-4-5

2kV between each input phase and PE. 1kV across each input phase combination.

Phase Loss

Type	Hardware	Software
Programmed limit	Half cycle	Adjustable via configuration parameter

Output Short Circuit

Type	Software
Programmed limit	25% of *Iout_max*
Detection time	1ms

Thermal Protection

With PTC on each module

www.crspower.com | sales@crspower.com | Tel. + 39 039 928.5507 | Fax +39 039 598.3566

CRS

CRS INDUSTRIAL POWER EQUIPMENT

QUASAR PP & PPR RECTIFIERS

SERIAL INTERFACE

Communication Ports

RS232

RS485

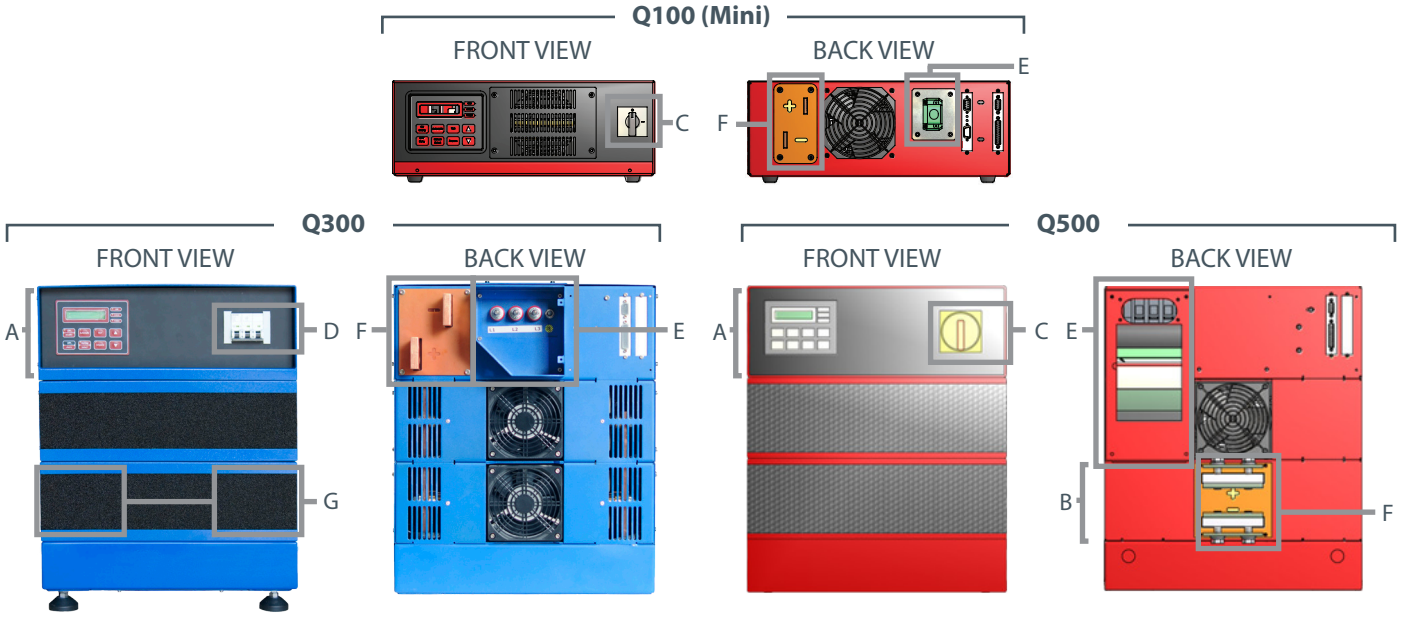
Communication Protocols

CRS-ASCII	Included	RS232 point-to-point and RS485 network
Modbus-RTU	Included	RS232 point-to-point and RS485 network
Profibus-DP	Optional with additional board	Profibus-DP network
DeviceNet	Optional with additional board	CAN bus network
Modbus/TCP	Optional with additional board	Ethernet
Profinet	Optional with additional board	Ethernet
EthernetIP	Optional with additional board	Ethernet

FULL LOAD HARMONICS DISTORTION

Harmonic	Freq. (Hz)	Absorbed Current Distortions
3	150	-
5	250	< 22.5%
7	350	< 12.5%
9	450	-
11	550	< 11.0%
13	650	< 7.6%
17	850	< 8.0%
19	950	< 4.8%
THD		**MAX 30%**

Hardware Differences of Quasar Models



> A. HEADER - only on Q300 & Q500
> B. INTERMEDIATE COOLING UNIT - only on Q500
> C. MAIN I/O SWITCH - only on Q100 & Q500
> D. CIRCUIT BREAKER - only on Q300
> E. AC INPUT UNIT - Type, size and location vary per model
> F. OUTPUT CONNECTIONS - Type and location vary per model
> G. ADDITIONAL FANS ON EACH MODULE - only on Q300 model

www.crspower.com | sales@crspower.com | Tel. + 39 039 928.5507 | Fax +39 039 598.3566

CRS