W H I T E P A P E R

EMPARRO 3PH 5A, 10A, 20A and 40A

1. November 2015

1. General

Emparro 3~ Switched Mode Power Supply – Premium Power.

85690 – Emparro 5-3x360-500/24

85691 – Emparro 10-3x360-500/24

85692 – Emparro 20-3x360-500/24

85693 – Emparro 40-3x360-500/24

2. Energy Savings

Emparro 3ph power supplies are designed to save energy for customers.
With latest technology advancement highest efficiency of up to 95 % is reached.

During periods of minimal demand of power consumption, Emparro 3~ maintains efficient energy consumption and offers minimal power loss to as much as 1.8W as compared to the industry norm of 7-10W in similar conditions.

In comparison to industry standard power supply with 90 % efficiency, 480 W Emparro 3ph power supply will generate 28 W lower losses when operated with full power. Less energy losses means also lower operating costs.

3. Lifetime

High efficiency makes possible to design cool power supplies. As general rule of thumb is, that cooler the power supply, longer the lifetime in real world. As general rule decreasing the component temperature by 10 °C the lifetime of the unit is doubled (Arrhenius law). Major cause for power supply lifetime is electrolytic capacitors, which are used in the primary and the secondary side of the units and are needed also to ensure stable output voltage for the customer.

With Emparro 3ph power supplies, losses are reduced to the minimum (just 25 W losses with 480 W unit), which ensures that internal temperatures of power supply are kept low. When low losses are combined with good thermal design of the power supply, the result is product with long lifetime.

Long lifetime can also be noticed from the calculated MTBF value which is up to 1 million hours!

4. Advanced Parallel Mode

With Advanced Parallel Mode, two or more Emparro 3ph power supplies (same type only) can be connected in parallel even if customer is having slightly different cabling. With the current products require equal cables length for parallel connection, in order to get similar loading of parallel connected power supplies. Now, with Advanced Parallel Mode even when cables have different length, loading of power supplies are close to each other.

Advanced Parallel Mode increases voltage slope of the power supplies, which is balancing the output current of parallel connected units. Advanced Parallel Mode increases the standard voltage slope of 10 mV to 1000 mV. With increased voltage slope, if one power supply's loading is increased, the output voltage of the higher stressed power supply is lowered resulting in decreased voltage output and simultaneously increasing the output voltage of the lower stressed power supply

Advanced Parallel Mode makes easier the usage of parallel connection also, by reducing the requirement of output voltage adjustment accuracy. When advanced parallel mode is used, power supplies output voltage adjustment accuracy needs to be only ±100 mV.

For the best current sharing between parallel connected power supplies, the externally mounted MB Redundancy Balance module should be used.

5. Battery charging

Emparro 3-phase power supplies can be used as a simple battery charger. Battery charging function is obtained by using Advanced Parallel Mode (switched ON). Advantage of this mode is the additional voltage slope described in section 4 , which will charge battery by controlled means. When current is decreasing the charging voltage will be increasing.

6. Integrated Fuses

All Emparro 3ph power supplies use internal 6,3 A(T) UL rated fuses. With internal integrated fuses, selective protection for complete system is obtained and so there is no need for external input fuse according to UL 248 (JDDZ) next to every unit. For safe installation only field wiring protection needs to be arranged inside of the cabinet.

7. High Surge Tolerance

Emparro 3ph units are tested against highest surge impulses. Surge impulses between Line-to-Earth are tested up to ± 6kV and impulses between Line-to-Line are tested up to ± 3kV. All units operate during tested surge pulses without interruption for the 24 VDC side (criterion A).

Emparro 3ph units are using Metal-Oxide-Varistors (MOV) and Gas Discharge Tubes (GDT) in addition to good design, to tolerate high surge and transient impulses. When GDT is activated only small light can be seen from the power supply in case of high transient, and unit continues operation without any interruption for the customer 24 VDC side.

8. Push In Connectors

With usage of push-in connector technology installation of the power supply is made easy. No need for tightening the screws yearly.

Connectors are rated with power supplies to tolerate double the output current of each model types, which makes possible to use daisy chaining with parallel connection of units.

9. Over voltage protection of 24 VDC

Emparro 3ph have external protection circuitry for the 24 VDC, which ensures that even if there would be internal failure of the unit, power supply can only give up to 30 VDC for the output side. This redundant over voltage protection, protects against damages to external units in the system.

If power supply is used with regenerative motor drives, which will back-feed motor energy to the 24 VDC line, power supply will internally switch off when output voltage is 2% higher than adjusted, in order to prevent cases where both power supply and motor's back-feeding energy is pushing the 24 VDC up. In rare cases with back-feeding solutions 24 VDC can increase up to 35 VDC, without causing damages to the Emparro 3ph power supplies. Emparro 3ph units do not have crow-bar type limiting feature for the 24 VDC side, but electrolytic capacitors, which are storing back-feeding energy.

10. Mains bridging

All Emparro 3ph units are designed to tolerate 100 % mains voltage drops for 20 ms duration (EN 61000-4-11). This mains bridging time will ensure that in case of most short interruptions to the mains side, there is no influence to 24 VDC side, but operation can continue.

11. Power boosts

Emparro 3ph units can deliver for the customer both short term and long term power boosts. With long term power boost, units can deliver continuously 120 % output power up when ambient temperature is maximum 45°C.

As a standard power boost feature, Emparro 3ph units delivers as minimum five (5) seconds power boost of 150 % output power and in addition will give shorter 25 ms extra current. These features give absolute flexibility against difficult loading conditions.

12. Short circuit protection

In case of short circuit in the output side (24 VDC) power supplies are protected by continuous output current of typically 110 %. Additional with every minute also power boost current is available min. 150 % output current. Continuous current is kept steady until either short circuit is removed or power supply is disconnected and both the potential free alarm contact and LED will signalize this condition to the customer.

This feature is designed for selective protection and immediately after short circuit is removed output voltage will rise to the 24 VDC.

13. Low inrush current

As industry standard, inrush current limiters are designed with just pure NTC resistor, which is limiting the inrush current during start-up. Negative temperature coefficient (NTC) thermistors are resistors whose resistance value decreases when the temperature they are exposed increases.
Disadvantage of pure NTC usage is that when NTC is warming up, the resistance is getting lower and in case of restarting the inrush current will be much higher.
In case of an example the inrush current can be increasing to hundreds of amperes when NTC is hot, in comparison to standard value of 20A peak when cool.

With Emparro 3ph, though NTC resistor is used during inrush current limiting, integrated bypass feature of NTC is used. With semiconductor bypass components, the NTC is only connected to limiting the inrush current when main electrolytic capacitors are charged and bypassed after charging period. Bypassing the NTC resistor will ensure that NTC will be cooling down and is ready for next start-up operation and will keep then the inrush current with reasonable level.

By lowering the inrush current to the minimum, it makes possible for the customer to use numerous Emparro 3ph units connected to the same mains supply. This feature is practical specially when used with mains UPS in the primary side, which doesn't need to be over dimensioned due to high requirement of peak power.

Additionally due to low inrush current levels, input wiring protection is easy to design as it makes possible to use thinner wires with low ampere rated circuit breakers.

14. 2-phase and DC usage

For maximum uptime, Emparro 3ph units will continue operation even when there is phase failure in the system. When one of the 3-phases is lost, unit will continue operation with 2-phase usage mode without problems, if input voltage is higher than 2x340 VAC.

It is also possible to use power supply continuously with 2-phase operation. 2-phase operation will increase input currents and slight loss of power, however the unit is fully operational.

Emparro 3ph units can also be used with DC input voltage operation, but customer should take care of needed external fuse protection. All external DC fuses needs to be rated to suitable voltage level, and customer needs to check safety rules required in his installation.

15. Protections

All Emparro 3ph units have protections for:

- Over temperature
- Output short circuit (continuous current type)
- Output overload
- Output overvoltage (open circuit type)
- Input overvoltage (shorting type)

16. EMC

All units are tested to comply with requirements of residential, commercial and light industrial emissions (Class B EMI acc. EN61204-3). In addition, units do comply with the requirements of EN 61000-3-2 Harmonic Currents Class A, which is needed if used with residential, commercial and light industrial side.

In addition to having low emissions, units are designed to tolerate high industrial disturbances (Immunity with high severity level).

17. Vibration and shock

By good combination of mechanical and electronic design, units are tested to tolerate shocks of up to 50 g in every direction. This ensures that units will continue operation even case of high mechanical stress.

For the vibration testing, industry standard testing method are used where vibration is tested by just stepping the vibration input frequency over frequency range (random vibration), which in some cases can be just short term testing. In order to get high certainties against vibration stress, Emparro 3ph units are tested with endurance testing specific resonance frequency for 90 minutes, which is common in marine industry. This method ensures that unit will tolerate high vibration stress for longer period of time, and there won't be any interruptions during or after vibration period.