# AN002

*Considerations on Power Supplies for Energy Management*

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# 1 Introduction

The energy management market is growing rapidly.
Smart grid systems allowing reconfiguration of power networks at high voltage (HV) and/or medium voltage (MV) levels are more and more used by energy distribution companies.

The most common standards applied in this industry are:

- EN60255-27: Measuring relays and protection equipment- Product safety requirements
- EN61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use
- EN60068: Environmental testing (temperature, vibrations, ....)
- EN61000-6-2: General EMC immunity for industrial equipments
- EN61000-6-4: General EMC emission for industrial equipments

Every system may have its specific requirements, but it seems that power supplies used in these systems should fulfil a common set of requirements that are peculiar to the energy management applications. This document will summarize some general requirements for power supplies used in energy management systems (EMS), besides the ones specified by the standards.

# 2 Typical system configuration

The most important parts of the system are the HV (or MV) switches used for power network reconfiguration. These switches are able to carry a current in the hundreds of amperes range and at several kilovolts voltage. They are mechanical switches composed of spring loaded contacts. Their operation is achieved by a DC motor that drives a spring compression, used for opening or closing the switch contacts in minimum time and arcing conditions.
These switches are controlled by a central control unit provided with a communication interface, either cabled or wireless.
To guarantee the operability of the system in every condition the main power supply is battery backed up and the status of the battery is continuously monitored.
Therefore, a power system used in EMS may include, besides the power supply, a DC UPS provided with a suitable battery.

# 3 Power supply requirements

Although some governing standards are applied, there are many specific requirements related to the local EMS market, that may pose some “local” constraints on the power supplies used in these systems.
We are outlining below some of the most frequent met on the market.

## 3.1 Output requirements

The output average power is moderate, in the range of 50…100W, since most of the time it powers only control and communication electronics with relatively low power needs. Depending on the system the output voltage can be between 12V and 48V.
In contrast - peak power requirements are consistent, during HV switches manipulations the motors driving the switches may require high inrush currents and the power supply must be able to keep the voltage regulated especially when some control or communication electronics are powered from the same DC bus.

## 3.2 Input requirements

Power supplies for energy management are normally used on universal AC mains voltage (85...264VAC), but they must be tolerant to sustained overvoltage. In a 3-phase system a phase shorted to ground or heavily unbalanced can create an overvoltage on the other phases up to $\sqrt{3} \cdot V_{\max} = \sqrt{3} \cdot 264V_{AC} = 457V_{AC}$. The power supply must be able to withstand this input voltage for an indefinite period of time without damage.
On top of that the power supply is used in installation requiring OVC IV category so the applicable surge immunity and safety distances must be respected.

### 3.3 Isolation requirements

Due to the installation conditions a high voltage cable shorted to ground can create a substantial overvoltage between line and ground exceeding by far the usual 3kVAC used in standard power supplies.
Isolation of 10kVAC and above are required between primary circuits and earth ground and between primary circuits and secondary circuits.
This high insulation voltage requires special construction of the main transformer and special opto-couplers to bridge the isolation barrier.

### 3.4 EMC requirements

The usual EN61000-6-2 and EN61000-6-4 emission and immunity standards are normally applied. For emission there are no special requirements, but for immunity the highest possible test level is required to guarantee the operation in harsh EMC environments.

### 3.5 Environmental requirements

Due to installation environmental conditions the required operating temperature is -40…+70°C. To improve the reliability in humid and/or polluted environment the product must be varnished with conformal coating.

### 3.6 Reliability requirements

Due to the use in critical systems the reliability needs are high. A minimum life time expectancy of 15 years is a common requirement.

## 4 Conclusions

An EMS system should include as minimum a > 10 kV isolation PRI/SEC and PRI /PE, digital communication and a good reliability under harsh conditions.
Under the continuous efforts for updating the utilities' infrastructure this market segment is aimed to grow.