

PMG Excitation Support Systems vs Aux Windings Installed on Synchronous AC Generators

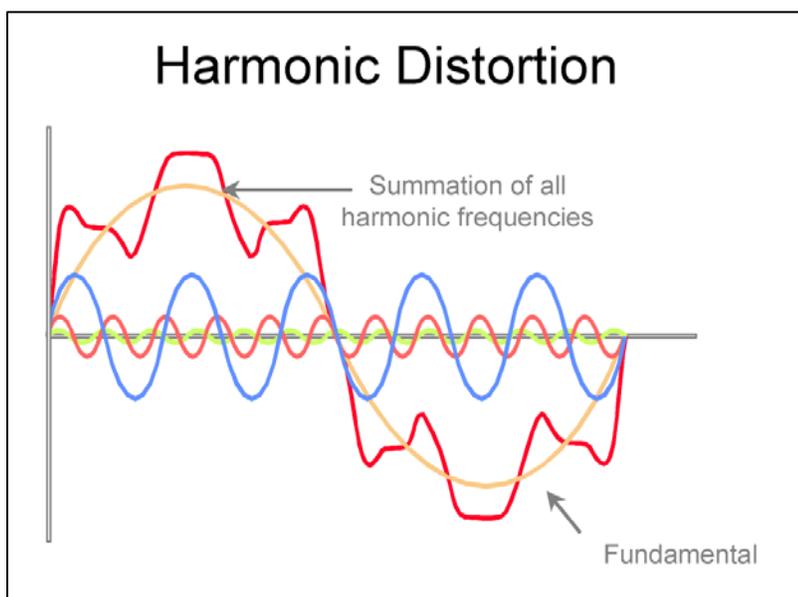
In a shunt excited generator, the AVR is powered by the output from the generator. This simple, low cost design, is suitable for many applications. However, it has several drawbacks – the AVR's ability to maintain generator output voltage is dependent upon the generator's output voltage and output power quality.

PMG and AUX Windings (also known as AREP windings) are two different systems designed to provide power to the AVR independently from the generator – thus maintaining generator's ability to support non-linear loads, start motor loads with minimal voltage dip, and the ability to provide short circuit current support to clear downstream faults. The purpose of this white paper is to compare and contrast these two different excitation support systems.

When a downstream bolted fault is seen at the generator terminals, the output voltage will drop to zero. For shunt excited generators, this results in zero input power to the AVR, and the generator may be unable to force current flow long enough for downstream circuit interrupters to clear the fault, and the entire electrical system will be shut down.

Both PMG and AUX Winding excitation support systems provide power to the AVR independent of the generator output voltage. This allows both systems to continue to provide the excitation necessary to clear the fault. A PMG system, with its appropriate regulator, such as a DVR2000E+ / EC+ or PM500, will also provide 300% short circuit support for ten seconds. AUX Winding systems may not be able to support 300% short circuit current for ten seconds.

Non-linear loads, such as – Variable Frequency Drives (VFDs), LED Lighting Systems, Welders and UPS Systems –can have a severe impact on generators due to the harmonics created by the load.



Harmonics are created anytime diodes and/or thyristors (SCRs) are used to convert AC to DC as they switch on and off, creating the non-linear load. These harmonics distort the generator output waveform.

AUX Windings are magnetically coupled to the generator main stator windings. As a result, the non-linear load harmonics (shown at left) can impact the Aux Winding waveform and this can result in voltage instability.

These harmonics will also affect the AVR's ability to correctly sense the generator terminal voltage which may also result in voltage instability.

In contrast, a PMG excitation support system fully supports non-linear loading with an AVR power supply that is 100% isolated from generator's main stator windings. Regardless of any non-linear load impact on the generator main stator windings, the PMG system will continue to provide full power to the AVR.

The harmonics distorting the generator output waveform may also create notches severe enough to affect the AVR's ability to correctly sense the generator terminal voltage which may also result in voltage instability. Use of the appropriate 3 phase sensing regulator such as a DVR2000E+/EC+ or PM500 can significantly improve the AVR's ability to deal with this waveform distortion.

PMG excitation support systems set the standard in terms of performance and reliability. The following table summarizes the advantages and disadvantages of each system.

PMG	Aux Winding	Advantage
300% short circuit support	300% short circuit support	-
100% isolated AVR power supply fully supports non-linear loads resulting in better voltage regulation.	Aux winding is magnetically coupled to main stator may result in voltage instability under non-linear loading	PMG
PMG assures voltage build-up	Relies on residual magnetism for voltage build-up. May require field flashing	PMG
Highly reliable PMG design is modular. Can be serviced in the field. PMG can be retrofitted in the field to address application issues	A failure in the light duty aux winding is not field repairable and may also damage main stator windings. Replacing the aux winding requires a complete main stator rewind or generator replacement.	PMG
Depending on generator design, PMG may result in additional length	Light duty aux winding incorporated in main stator slots. May result in shorter generator length	-