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CE testing results and explanation

This article summarizes the electromagnetic compatibility testing completed on proportional valve amplifiers (model codes 790-*****B) with Bluetooth communication. This testing was conducted to stay current with European Union directives and Council directive 2009/19/EC relating to the radio interference (electromagnetic compatibility) of vehicles. The testing is also for RED (ETSI 300-328 & 301-489-17) which is the Radio Equipment Directive for electromagnetic compatibility. An independent lab conducted the tests. The full report of test results is available upon request.

Embedded amplifier test results

Emissions Summary

Radiated emissions			
RED ETSI 300-328 & 301-489-17	**Automotive – Directive 2009/19/EC**	**EN61000-6-4 (Industrial)**	**EN61000-6-3 (Residential)**
Not required by the standard	**PASS** (14dB below narrowband limit) (23dB below broadband limit)	**PASS** (22dB below limit)	**PASS** (12dB below limit)

Conducted Emissions			
RED ETSI 300-328 & 301-489-17	**Automotive-Directive 2009/19/EC**	**EN61000-6-4 (Industrial)**	**EN61000-6-3 (Residential)**
Not required by the standard	**PASS** Pulse amplitude <1V (limit +150 & -450V)	Not required by the standard	**PASS** 15dB below "Average" limit & 19dB below "Q-P" limit

ETSI (RED) 300-328 & 301-489-17 requirements on Bluetooth module			
Radiated Emissions (30-6,000MHz)	**Conducted Emissions**	**Spurious Emissions, Harmonics, & EIRP**	**Spectrum Occupancy & Channel Bandwidth**
PASS (12dB below limit)	**PASS** 15dB below "Average" limit &19dB below "Q-P" limit	**PASS** Well within requirements	**PASS** Well within requirements

Immunity Summary

Radiated RF Field			
RED ETSI 300-328 & 301-489-17	**Automotive-Directive 2009/19/EC**	**EN61000-6-2 (Industrial)**	**EN61000-6-1 (Residential)**
PASS Tested at 3V/m level No Variation	**PASS** Tested at 30V/m level <5% Variation	**PASS** Tested at 10V/m level <2.5% Variation	**PASS** Tested at 3V/m level No Variation

Common Mode RF (a.k.a. Conducted Immunity)			
RED ETSI 300-328 & 301-489-17	**Automotive-Directive 2009/19/EC (20-80MHz)**	**EN61000-6-2 (Industrial)**	**EN61000-6-1 (Residential)**
PASS Tested at $3V_{rms}$ No Variation	**PASS** Tested at $30V_{rms}$ No Variation	**PASS** Tested at $10V_{rms}$ No Variation	**PASS** Tested at $3V_{rms}$ No Variation

Power Magnetic Field			
RED ETSI 300-328 & 301-489-17	**Automotive-Directive 2009/19/EC**	**EN61000-6-2 (Industrial)**	**EN61000-6-1 (Residential)**
Not required by the standard	Not required by the standard	**PASS** Tested at 30A/m No Variation	**PASS** Tested at 3A/m No Variation

Fast Transient Bursts (FTB)			
RED ETSI 300-328 & 301-489-17	**Automotive-Directive 2009/19/EC**	**EN61000-6-2 (Industrial)**	**EN61000-6-1 (Residential)**
PASS Tested up to 0.5kV No Variation	Not required by the standard	**PASS** Tested up to 2kV No Variation	**PASS** Tested up to 0.5kV No Variation

Surges			
RED ETSI 300-328 & 301-489-17	**Automotive-Directive 2009/19/EC**	**EN61000-6-2 (Industrial)**	**EN61000-6-1 (Residential)**
PASS Tested up to 0.5kV No Variation	Not required by the standard	**PASS** Tested up to 2kV No Variation	**PASS** Tested up to 0.5kV No Variation

Electro Static Discharge (ESD)			
RED ETSI 300-328 & 301-489-17	**Automotive-Directive 2009/19/EC**	**EN61000-6-2 (Industrial)**	**EN61000-6-1 (Residential)**
PASS Tested at 4kV Contact Tested at 8kV Air No Variation	Not required by the standard	**PASS** Tested at 4kV Contact Tested at 8kV Air No Variation	**PASS** Tested at 4kV Contact Tested at 8kV Air No Variation

Explanation of what it all means

Emission tests are conducted as either a pass or fail criteria. Immunity tests are conducted with different levels of a pass (e.g. “partial credit”). Pass for immunity tests are categorized into one of three categories. Criterion A is a pass when no degradation in performance below that specified by the manufacturer. Sun specified less than 10% variation. Criterion B is a pass if the unit performance is degraded during the test but resumes normal operation after the test with no intervention, and Criterion C is the unit stops operating during the test but resumes normal operation through user intervention or is self recoverable.

Radiated emission test measures the unintended release of electromagnetic energy from the amplifiers. Sources for electromagnetic energy (noise) can be the PWM switching of power to the coil and some of the components used on the circuit board. These issues are present in both mobile and industrial applications and can affect other electronics in both types of applications if the emissions levels are excessive. The Sun amplifiers pass the four different standards tested.

Conducted emissions tests measure the unintended transmission of electromagnetic noise through a DC power supply and onto the AC power mains in an industrial installation. The sources for noise are the same as radiated emissions. Selection of a high quality power supply (either linear or switcher) and the use of an inexpensive AC line filter will prevent noise from being an issue to other electronics that are on the AC power mains in the installation.

RED requirements tests for further measurements of intentional transmitters under ETSI Standards (EN300-328 and EN301-489-17) to address the Radio and Telecommunications Terminal Equipment Directive (R&TTED) – now referred to as the Radio Equipment Directive (RED). This sets limits for, among others, Spurious and Harmonic emissions as well as Spectrum Occupancy requirements. This is usually measured to 5x the intended Tx frequency (nominally 2.5GHz x 5 = 12.5GHz). Please note that, although the Bluetooth module may be deemed compliant in its own right, once the module is incorporated within a product, this compliance is, technically, void. To save the expense of a complete RED re-test to EN300-328 and EN301-489-17 it is accepted that a few "spectrum checks" are sufficient to verify that the incorporation of the module has not invalidated any prior compliance testing.

Radiated RF field tests the susceptibility of the amplifier to radiated radio frequency fields at different levels measured in volts per meter. This test requires a criterion A to pass. Radiated RF might be present at an installation site where lighting ballast, electric switch gear, motors, etc. are present. Tests are conducted in a radio-frequency anechoic chamber. While the amplifier is subjected to the radio frequency, it is observed for abnormal behavior. Sun amplifiers pass this test at criterion A at the levels required for industrial installations and off road equipment. They also pass at the higher standard required in automotive under hood type installations.

Common mode (conducted) RF immunity tests the susceptibility to radio frequency when in direct contact with the cable attached to the amplifier. This test simulates installations where the cable is attached to machine frames that essentially act as antennas. This is a more arduous test than the radiated RF. The pass criterion is A, which the Sun amplifiers passed. Required test levels are 3 Vrms, 10 Vrms, and 30 Vrms. The amplifier passed at all three levels.

Power magnetic field tests the susceptibility of the amplifier to magnetic fields at different levels measured in amperes per meter. Magnetic fields might be present at an installation site where electric motors, welding, etc. are present. The required pass criterion is A at 30 A/m, which the Sun amplifiers passed. Voluntary tests for confidence were conducted at 300 A/m with no effect on the amplifier operation.

Fast transient Immunity tests the immunity of the amplifier to electro magnetic noise from sparking contacts. Sparking contacts can be present in any type of switch gear or relays. The pass criterion is level B and the Sun amplifiers pass at level A.

Surge test verifies the susceptibility of the amplifier to voltage surges that might pass through a power supply to the amplifier. Voltage surges from 500 V to 2000 V are applied to the AC supply to earth ground and across the AC supply. The pass criterion is level B and the Sun amplifiers passed at level A.

Electro Static Discharge tests discharge a probe changed up to ±4000 v onto the amplifier, the mating cable, indirectly to a plane coupled to the amplifier, and ±8000 V in air. The pass criterion is level B and the Sun amplifiers passed at level A. Voluntary tests for confidence were carried out at ±6000 V during the contact discharge and indirect coupling tests with no effect on the operation.

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