

CE Testing Results and Explanation

This article summarizes the electromagnetic compatibility testing completed on proportional valve amplifiers (model codes 790-*****) and the Hand Held Programmer (991-700) and infrared adapters (991-702 and 991-704). This testing was conducted to stay current with European Union directives. An independent lab conducted the tests. The full report of test results is available upon request.

Embedded amplifier test results

Emissions Summary

Radiated emissions			
EN12895	Automotive – Directive 2004/104/EC	EN61000-6-4 (Industrial)	EN61000-6-3 (Domestic)
PASS	PASS	PASS	PASS
(18.2dB margin)	(30.83dB below narrowband limit) (39.87dB below broadband limit)	(24.2dB margin)	(14.2dB margin)

Conducted Emissions				Comments
EN12895	Automotive-Directive 2004/104/EC	EN61000-6-4 (Industrial)	EN61000-6-3 (Domestic)	Note concerning "Sola" switch mode power supply configuration and filtering
Not required by the standard	PASS +ve and -ve pulses <5% of limit for both 12 & 24V systems	PASS >20dB below "Average" limit >19dB below "Q-P" limit	PASS 6.05dB below "Average" limit & 2.85dB below "Q-P" limit (much better with mains filter added)	Requires careful earthing and bonding of cable screen to power supply earth ground. It would be advisable to recommend mains line filtering to ensure compliance (margins are >10dB Q-P and >20dB Average when a Schaffner FN2010 filter is added).

Harmonic Emissions & Flicker			
EN12895	Automotive-Directive 2004/104/EC	EN61000-6-4 (Industrial)	EN61000-6-3 (Domestic)
Not required by the standard	Not required by the standard	N/A power consumption <50W	N/A power consumption <50W

Continuous Immunity Summary

Radiated RF Field			
EN12895	Automotive-Directive 2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
PASS	N/A	PASS	PASS
OK at required 10V/m level	Fails 30V/m test – Sun product unlikely to be used in a road-going vehicle environment	OK at required 10V/m level	OK at required 3V/m level

Common Mode RF (a.k.a. Conducted Immunity)			
EN12895	Automotive-Directive 2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
Not required by the standard	Not required by the standard	PASS (10V_{rms}) Needs stable command input voltage (Internal reference is NOT acceptable)	PASS (3V_{rms}) Needs stable command input voltage (Internal reference is NOT acceptable)

Power Magnetic Field			
EN12895	Automotive-Directive 2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
Not required by the standard	Not required by the standard	PASS Tested at 30A/m - All OK	PASS Tested at 3A/m - All OK

Transient Immunity Summary Fast Transient Bursts (FTB)			
EN12895	Automotive-Directive 2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
Not required by the standard	PASS <i>Tested up to 2kV - All OK</i>	PASS <i>Tested up to 2kV - All OK</i>	PASS <i>Tested up to 1kV - All OK</i>

Surges			
EN12895	Automotive-Directive 2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
Not required by the standard	Not required by the standard	PASS Tested on the AC input of the recommended "Sola" psu at up to 2kV	PASS Tested on the AC input of the recommended "Sola" psu at up to 2kV

Electro Static Discharge (ESD)			
EN12895	Automotive-Directive 2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
PASS Tested to 4kV Contact and 8kV Air	PASS Tested to 6kV Contact and 8kV Air	PASS Tested to 4kV Contact and 8kV Air	PASS Tested on the AC input of the recommended "Sola" psu at up to 2kV

Power Dips and Interruptions			
EN12895	Automotive-Directive 2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
Not required by the standard	Not required by the standard	PASS Tested on the AC input of the recommended "Sola" psu	PASS Tested on the AC input of the recommended "Sola" psu

HHP and IR adapter test results

Radiated emissions			
EN12895	Automotive – Directive 2004/104/EC	EN61000-6-4 (Industrial)	EN61000-6-3 (Domestic)
PASS	PASS	PASS	PASS
(15.21dB margin)	(>25dB below narrowband limit) (>30dB below broadband limit)	(21.21dB margin)	(11.21dB margin)

Conducted Emissions			
EN12895	Automotive-Directive2004/104/EC	EN61000-6-4 (Industrial)	EN61000-6-3 (Domestic)
N/A Not required by the standard	N/A (battery powered)	N/A (battery powered)	N/A (battery powered)

Harmonic Emissions & Flicker			
EN12895	Automotive-Directive2004/104/EC	EN61000-6-4 (Industrial)	EN61000-6-3 (Domestic)
N/A Not required by the standard	N/A Not required by the standard	N/A (battery powered)	N/A (battery powered)

Continuous Immunity Summary

Radiated RF Field			
EN12895	Automotive-Directive2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
N/A Fails 10V/m test - not required as Sun product unlikely to be used in an Industrial truck environment	N/A Fails 30V/m test - not required as Sun product unlikely to be used in a road-going vehicle environment	FAIL Fails 10V/m test	PASS OK at required 3V/m level

Common Mode RF (a.k.a. Conducted Immunity)			
EN12895	Automotive-Directive2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
N/A Not required by the standard	N/A Not required by the standard	N/A (no lead >3m, no power port)	N/A (no lead >3m, no power port)

Power Magnetic Field			
EN12895	Automotive-Directive2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
N/A Not required by the standard	N/A Not required by the standard	PASS Tested at 30A/m - All OK	PASS Tested at 3A/m - All OK

Transient Immunity Summary

Fast Transient Bursts (FTB)			
EN12895	Automotive-Directive2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
N/A Not required by the standard	N/A (no lead >3m, no power port)	N/A (no lead >3m, no power port)	N/A (no lead >3m, no power port)

Surges			
EN12895	Automotive-Directive2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
N/A Not required by the standard	N/A Not required by the standard	N/A (no lead >30m, no power port)	N/A (no lead >30m, no power port)

Electro Static Discharge (ESD)			
EN12895	Automotive-Directive2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
PASS Tested 4kV Contact & 8kV Air	PASS Tested 6kV Contact & 8kV Air	PASS Tested 4kV Contact & 8kV Air	PASS Tested 4kV Contact & 8kV Air

Power Dips and Interruptions			
EN12895	Automotive-Directive2004/104/EC	EN61000-6-2 (Industrial)	EN61000-6-1 (Domestic)
N/A	N/A	N/A	N/A
Not required by the standard	Not required by the standard	(no power port)	(no power port)

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.

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 do not pass at the higher standard required in automotive under hood type installations that Sun voluntarily tested to.

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. Testing demonstrated that using the +5V reference is more susceptible to disturbance than an external analog signal. At lower frequencies some variation in performance is observed, but is within 10%. The pass criterion is A, which the Sun amplifiers passed. Required test levels are 10 Vrms and 3 Vrms. Sun voluntarily tested at 20 Vrms. The amplifiers 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.

Electro Static Discharge tests discharge a probe charged 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.

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.

Dips and Interruptions tests the susceptibility of the amplifier to temporary dips or interruptions to the AC supply to the DC power supply. Dips and interruptions were reduced voltages from 30% to 100% for up to 250 cycles (5 s). The pass criterion is level B for dips of 1.0 cycles or less. The amplifiers passed at level A. Level C criterion is required for cycles greater than 5.0 (100 ms). The Sun amplifiers pass at level A until the cycle count for the dip in power is 250 (5000 ms). At this high cycle count dip, the amplifiers pass at criterion C.

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.

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