

EMC TEST RESULTS FOR POWER-GATE GENERATION 4.0 SOLID-STATE RELAY

TEST DETAILS

Facility: Nemko USA, Inc. 2210 Faraday Ave. Suite 150 Carlsbad, CA 92008

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Device Under Test (DUT):

RYS40B-300-BBX, Serial Number 140989

- Uni-directional relay
- Small package
- Generation 4.0
- 24 V nominal system voltage (36 V maximum)
- 300 A maximum continuous current
- All LEDs enabled
- Active-high, non-isolated, remote main trigger
- Override trigger disabled/not needed

Test Conductor: Steven Newman

Test Requirements and Methods:

The DUT was tested to the requirements of MIL-STD-461G, CE102 and RE102. Three meters of unshielded, untwisted input and output wiring were used for the test setup, along with a 50 μ H Line Impedance Stabilization Network (LISN) to stabilize input power and provide a 50 Ω port for the spectrum analyzer for CE102 testing. Antennas for RE102 testing were placed one meter from the DUT. Refer to the standard's documentation for further test specifics.

The DUT was tested under operational conditions with an input voltage of 36 VDC and a resistive load of 15.15 Ω , yielding a load current of ~2.3 A.

Specification limits for CE102 and RE102 are shown in Figures 1, 2, and 3, while the DUT installed in the anechoic chamber is shown in Figure 4.



Figure 2: RE102 Specification Limits (Aircraft Applications)



Figure 3: RE102 Specification Limits (Ground Applications)



Figure 4: Image of DUT installed in anechoic chamber

CONDUCTED EMISSIONS (CE102) RESULTS

The DUT's conducted emissions were measured between 10 kHz and 10 MHz, on both the positive and return leads. Results are shown in Figures 5 and 6, with the specification limit plotted as well.



Figure 5: CE102 Results (Positive Lead)



Figure 6: CE102 Results (Return Lead)

As can be seen from the figures, conducted emissions are below the specification limits from 10 kHz to \sim 540 kHz and from 4 MHz to 10 MHz, while between 540 kHz and 4 MHz, conducted emissions do not exceed the limits by more than 5 dBµV.

Given the fact that the DUT was tested at its maximum operating voltage, but did not pass the test, the test was repeated at 32 and 28 VDC (more common operational voltages). Results showed no reduction in conducted emissions, suggesting that they are not dependent upon the DUT input voltage.

RADIATED EMISSIONS (RE102) RESULTS

The DUT's radiated emissions were tested between 2 and 1000 MHz using a monopole antenna for the 2 to 30 MHz band, a biconical antenna for the 30 to 200 MHz band, and a double-ridge horn antenna for the 200 to 1000 MHz band. Furthermore, measurements between 30 and 1000 MHz were taken for both horizontal and vertical polarities.

Images of two of the three setups are shown in Figures 7 and 8, while the test results are shown in Figures 9-13.



Figure 7: Test Setup for 30-200 MHz Band



Figure 8: Test Setup for 200-1000 MHz Band



Figure 9: RE102 Results (2-30 MHz)











Figure 12: RE102 Results (200-1000 MHz, Horizontal Polarity)





As can be seen from the figures, radiated emissions are below the most stringent specification limit (Navy mobile and Army) between ~8.7 MHz and ~23 MHz, and between ~25 MHz and 1000 MHz. Between 2 MHz and ~8.7 MHz, radiated emissions do not exceed the limit by more than 6 dB μ V/m, and between ~23 MHz and ~25 MHz, they do not exceed the limit by more than 5 dB μ V/m. It should also be noted that radiated emissions are below the least stringent specification limit (Navy fixed and Air Force) for the entire frequency range of 2-1000 MHz.

Since the radiated emissions exceeded the most stringent specification limit at frequencies within the 2-30 MHz measurement range, the test was performed a second time (for comparative purposes only) with the antenna placed 2 meters from the DUT (as opposed to the standard test distance of 1 meter). The results are shown in Figure 14.



Figure 14: Radiated Emissions at 2 Meters

As can be seen from the figure, radiated emissions in the problematic bands fall beneath the most stringent specification limit at a 2 meter measurement distance.

SUMMARY AND FURTHER REMARKS

Standard tests showed that the conducted emissions do not exceed the specification limits by more than 5 dB μ V, and are below the limits by at least 5 dB μ V (and usually much less) between 10 kHz and 300 kHz. Further tests revealed that varying the DUT's input voltage does not appear to have any effect on the conducted emissions.

Standard tests also showed that the radiated emissions are always below the least stringent specification limits, and only exceed the most stringent limits by a small amount in a few frequency bands between 2 MHz and 30 MHz. Further tests revealed that the radiated emissions in all frequencies from 2-1000 MHz will below the most stringent limits at a distance of two meters from the DUT.

It should also be stated that although the tests were performed with a uni-directional relay, the results should be identical for a bi-directional relay, as both use the exact same printed circuit board, and the PCB is the only component that can generate conducted and radiated emissions.

Finally, it should be noted again that the radiated emission tests were performed with unshielded, untwisted wire. If the input and output wires are instead a twisted pair, and/or shielded, radiated emissions are expected to be below the most stringent limits. Radiated emissions below those limits are also expected if the DUT is installed in a conductive metal enclosure.