3. Configuration and Identification of Device Under Test

The DUT is a 315.0 MHz superregenerative receiver, designed for onboard automobile security/convenience applications, and as such, it is powered from an automotive 12 VDC source. It is housed in a plastic case approximately 6.0 by 4.5 by 1.5 inches. Antenna is internal. When testing for radiated emissions, a 3 meter long bundle of wires was used, containing power and control/signal lines. In the digital section of the receiver, decoding, signal processing, etc. are performed by a micro timed by a 12.0 MHz ceramic resonator.

The DUT was designed and manufactured by Robert Bosch Corporation, Automotive Group, 38000 Hills Tech Drive, Farmington Hills, MI 48331-3417. It is identified as:

Bosch BSM RKE Receiver
PN: 6 002 JE0 015
S/N: 14701
FCC ID: PFJSIP1V6
CANADA: 909104142A

One receiver was provided. The other two models use the same PCB and population, except plastics are different. In our opinion, the other two models need not be tested.

3.1 Modifications Made

There were no modifications made to the DUT by this laboratory.

4. Emission Limits

For FCC the DUT falls under Part 15, Subpart B, "Unintentional Radiators". For Industry Canada the DUT falls under Receiver category and is subject to technical requirement of sections 7.1 to 7.4 in RSS-210. The pertinent test frequencies, with corresponding emission limits, are given in Tables 4.1 and 4.2 below.

4.1 Radiated Emission Limits

Table 4.1. Radiated Emission Limits (FCC: 15.33, 15.35, 15.109; IC: RSS-210, 7.3).

Freq. (MHz)	E_{lim} (3m) μV/m	E_{lim} dB(μV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-2000	500	54.0

Note: Quasi-Peak readings apply to 1000 MHz (120 kHz BW)
Average readings apply above 1000 MHz (1 MHz BW)

4.2 Conducted Emission Limits

Table 4.2. Conducted Emission Limits (FCC: 15.107; IC: RSS-210, 6.6).

Freq. (MHz)	μV	dB(μV)
0.450 - 1.705	250	48.0
1.705 - 30.0	250	48.0

Note: Quasi-Peak readings apply here

4.3 Antenna Power Conduction Limits
(FCC: 15.111(a); IC: RSS-210, 7.2). Pmax = 2 nW; for requency range see Table 4.1.

5. Emission Tests and Results

NOTE: Even though the FCC and/or Industry Canada specify that both the radiated and conductive emissions be measured using the Quasi-Peak and/or average detection schemes, we normally use peak detection since especially the Quasi-Peak is cumbersome to use with our instrumentation. In case the measurement fails to meet the limits, or the measurement is near the limit, it is remeasured using appropriate detection. We note, that since the peak detected signal is always higher or equal to the Quasi-Peak or average detected signal, the margin of compliance may be better, but not worse, than indicated in this report. The type of detection used is indicated in the data table, Table 5.1.

5.1 Anechoic Chamber Radiated Emission Tests
To familiarize with the radiated emission behavior of the DUT, it was studied and measured in the shielded anechoic chamber. In the chamber there is a set-up similar to that of an outdoor 3-meter site, with turntable, antenna mast, and a ground plane. Instrumentation includes spectrum analyzers and other equipment as needed.

To study and test for radiated emissions, the DUT was powered by a laboratory power supply at 13.5 VDC. A 315 MHz CW signal was injected (radiated) from a nearby signal generator using a short wire antenna. When powered up, the receiver stays on continuous for about 20 second and then goes in standby or pulsed mode to reduce current draw. Measurements were made in continuous mode. The DUT was placed on the test table on each of the three axis. At each orientation, the table was rotated to obtain maximum signal for vertical and horizontal emission polarizations. This sequence was repeated throughout the required frequency range.

In the chamber we studied and recorded all the emissions using a ridge-horn antenna, which covers 200 MHz to 5000 MHz, up to 2 GHz. In scanning from 30 MHz to 2.0 GHz, there were no spurious emissions observed other than the LO and injection signal (315 MHz), and the LO harmonics. Figures 5.1 and 5.2 show emissions measured 0-1000 MHz and 1000-2000 MHz, respectively. These measurements are made with a ridge-horn antenna at 3m, with spectrum analyzer in peak hold mode and the receiver rotated on its three axes. The measurements up to 1000 MHz (Fig. 5.1) are used for initial evaluation only, but those above 1000 MHz (Fig. 5.2) are used in final assessment for compliance.

5.2 Open Site Radiated Emission Tests
The DUT was then moved to the 3 meter Open Field Test Site where measurements were repeated up to 1000 MHz using a small bicone, or dipoles when the measurement is near the limit. The DUT was excersised as described in Sec. 5.1 above. The measurements were made with a spectrum analyzer using 120 kHz IF bandwidth and peak detection mode, and, when appropriate, using Quasi-Peak or average detection (see 5.0). The test set-up photographs are in Appendix (i.e., at end of this report).

The emissions from digital circuitry were measured using a standard bicone. These results are also presented in Table 5.1.

5.3 Computations and Results for Radiated Emissions
To convert the dBm's measured on the spectrum analyzer to dB(μV/m), we use expression

$$E_3(dB\mu V/m) = 107 + P_R + K_A - K_G$$

where P_R = power recorded on spectrum analyzer, dB, measured at 3m
K_A = antenna factor, dB/m
K_G = pre-amplifier gain, including cable loss, dB

When presenting the data, at each frequency the highest measured emission under all of the possible orientations is given. Computations and results are given in Table 5.1. There we see that the DUT meets the limit by 17.8 dB.

5.4 Conducted Emission Tests
These tests do not apply, since the DUT is powered from an automotive 12 VDC system.