FCC CERTIFICATION TEST REPORT

for

TRW Automotive Electronics
Stratford Road
Solihull
England B90 4GW

FCC ID: KHH20TN-1

February 14, 2000

WLL PROJECT #: 5576X

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STATEMENT OF QUALIFICATIONS

for

Herbert W. Meadows

Washington Laboratories, Ltd.

I hold a Bachelor of Science in Electronics Engineering Technology. I have over three years of EMI testing experience and nine years of RF and microwave testing experience. I am qualified to perform EMC testing to the methods described in this test report. The measurements taken within this report are accurate within my ability to perform the tests and within the tolerance of the measuring instrumentation.

By: Herbert W. Meadows
Herbert W. Meadows
Compliance Engineer

Date: **February 14, 2000**

FCC CERTIFICATION TEST REPORT

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FCC ID: KHH20TN-1

1.0 Introduction

This report has been prepared on behalf of TRW Automotive Electronics to support the attached Application for Equipment Authorization. The test and application are submitted for a Periodic Intentional Radiator under Part 15.231 of the FCC Rules and Regulations. The Equipment Under Test was TRW Automotive Electronics 20TN-1 Radio Key Low Power Transmitter.

All measurements herein were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and field Strength Instrumentation. Calibration checks are made periodically to verify proper performance of the measuring instrumentation.

All measurements are performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

All results reported herein relate only to the equipment tested. The measurement uncertainty of the data contained herein is ±2.3 dB. Refer to Appendix A for Statement of Measurement Uncertainty. This report shall not be used to claim product endorsement by NVLAP or any agency of the US Government.

1.1 Summary

The TRW Automotive Electronics 20TN-1 Radio Key complies with the limits for a Periodic Intentional Radiator under Part 15.231 of the FCC Rules and Regulations.

2.0 Description of Equipment Under Test (EUT)

The TRW Automotive Electronics Radio Key Transmitter is a 315 MHz low power transmitter mounted in the head of a key that is used as a wireless remote control for vehicle keyless entry systems. The battery powered transmitter is manually operated and used with certified receivers. The unit stops transmitting as soon as the button is released.

2.1 On-board Oscillators

The TRW Automotive Electronics 20TN-1 Radio Key contains a 315 MHz SAW oscillator.

3.0 Test Configuration

To complete the test configuration required by the FCC, the unit was tested in all three orthogonal planes.

3.1 Testing Algorithm

The transmitter was turned on and constantly transmitting at 315MHz. The unit was tested in all three orthogonal planes.

Worst case emissions are recorded in the data tables.

3.2 Conducted Emissions Testing

Conducted emissions testing was not performed as the unit is battery powered.

3.3 Radiated Emissions Testing

The EUT was placed on an 80 cm high 1 x 1.5 meters non-conductive motorized turntable for radiated testing on a 3 meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Biconical and log periodic broadband antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-1992. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak or peak, as appropriate. The measurement bandwidth on the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth.

3.3.1 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are grouped into a composite antenna factor (AFc) and are supplied in the AFc column of Table 1. The AFc in dB/m and AFd (duty cycle factor) in dBµV (see Exhibit 1) are algebraically added to the Spectrum Analyzer Voltage in dBµV to obtain the Radiated Electric Field in dBµV/m. This level is then compared with the limit.

Example:

Spectrum Analyzer Voltage:	VdBµV
Composite Antenna Factor:	AFcdB/m
Duty Cycle Factor:	AFddBµV
Electric Field:	EdBµV/m = VdBµV + AFcdB/m + AFddBµV
To convert to linear units:	EµV/m = antilog (EdBµV/m/20)

Data is recorded in Table 1.

Table 1

FCC 15.231 3M Radiated Emissions Data – Site 2

CLIENT: TRW Automotive Electronics
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BY: Herb Meadows
JOB #: 5576X

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	SA Level (PEAK) dBuV	AFc dB/m	Afd dB	E-Field dBuV/m	E-Field uV/m	Limit uV/m	Margin dB
314.95	H	157.50	1.0	50.2	16.5	-5.1	61.6	1202.3	6041.7	-14.0
314.95	V	22.50	1.0	41.9	16.5	-5.1	53.3	462.4	6041.7	-22.3
629.92	H	67.50	1.0	19.3	24.1	-5.1	38.3	82.2	604.2	-17.3
629.92	V	180.00	1.0	21.1	24.1	-5.1	40.1	101.2	604.2	-15.5
944.88	V	135.00	1.0	6.5	28.8	-5.1	30.2	32.4	604.2	-25.4
944.88	H	225.00	1.0	9.6	28.8	-5.1	33.3	46.2	604.2	-22.3
1260.00	H	90.00	1.0	61.6	-10.6	-5.1	45.9	197.4	604.0	-9.7
1260.00	V	315.00	1.0	55.2	-10.6	-5.1	39.5	94.5	604.0	-16.1
1574.70	H	180.00	1.0	61.2	-8.5	-5.1	47.6	240.9	500.0	-6.3
1574.70	V	0.00	1.0	60.1	-8.5	-5.1	46.5	212.3	500.0	-7.4
1889.80	H	0.00	1.0	50.2	-6.7	-5.1	38.4	83.0	604.0	-17.2
1889.80	V	270.00	1.0	51.5	-6.7	-5.1	39.7	96.4	604.0	-15.9
2204.70	H	270.00	1.0	51.8	-5.7	-5.1	41.0	111.6	500.0	-13.0
2204.70	V	315.00	1.0	51.9	-5.7	-5.1	41.1	112.9	500.0	-12.9
2519.50	H	315.00	1.0	50.5	-5.2	-5.1	40.2	102.4	604.0	-15.4
2519.50	V	180.00	1.0	51.7	-5.2	-5.1	41.4	117.5	604.0	-14.2

Peak Measurements Above 1 GHz:

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	SA Level (PEAK) dBuV	AFc dB/m	E-Field dBuV/m	E-Field uV/m	Limit uV/m	Margin dB
1260.00	H	90.00	1.0	61.6	-10.6	51.0	355.1	6040.0	-24.6
1260.00	V	315.00	1.0	55.2	-10.6	44.6	170.0	6040.0	-31.0
1574.70	H	180.00	1.0	61.2	-8.5	52.7	433.4	5000.0	-21.2
1574.70	V	0.00	1.0	60.1	-8.5	51.6	381.9	5000.0	-22.3
1889.80	H	0.00	1.0	50.2	-6.7	43.5	149.3	6040.0	-32.1
1889.80	V	270.00	1.0	51.5	-6.7	44.8	173.4	6040.0	-30.8
2204.70	H	270.00	1.0	51.8	-5.7	46.1	200.7	5000.0	-27.9
2204.70	V	315.00	1.0	51.9	-5.7	46.2	203.0	5000.0	-27.8
2519.50	H	315.00	1.0	50.5	-5.2	45.3	184.1	6040.0	-30.3
2519.50	V	180.00	1.0	51.7	-5.2	46.5	211.4	6040.0	-29.1

Table 2

System Under Test

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EUT: TRW Automotive Electronics Radio Key 315MHz RF Transmitter; M/N: 20TN-1
FCC ID: KHH20TN-1

Table 3

Interface Cables Used

The EUT was powered via 3 VDC battery.

Table 4

Measurement Equipment Used

The following equipment is used to perform measurements:

Hewlett-Packard Spectrum Analyzer: HP8564E
Hewlett-Packard Spectrum Analyzer: HP8568B
Hewlett-Packard Spectrum Analyzer: HP8593A
Hewlett-Packard Quasi-Peak Adapter: HP85650A
Hewlett-Packard Preselector: HP85685A
Hewlett-Packard Preamplifier: HP8449B
Antenna Research Associates, Inc. Biconical Log Periodic Antenna: LPB-2520A (Site 2)
Antenna Research Associates, Inc. Horn Antenna: DRG-118/A
Solar 50 Ω/50 µH Line Impedance Stabilization Network: 8012-50-R-24-BNC
Solar 50 Ω/50 µH Line Impedance Stabilization Network: 8028-50-TS-24-BNC
AH Systems, Inc. Portable Antenna Mast: AMS-4 (Site 2)
AH Systems, Inc. Motorized Turntable (Site 2)
RG-214 semi-rigid coaxial cable
RG-223 double-shielded coaxial cable

EXHIBIT 1

DUTY CYCLE CALCULATIONS

The following page shows a spectrum analyzer plot of the transmitter coding. The following calculations show the worst case 100 ms duty cycle correction used for calculating the average level of the carrier, harmonics, and emissions.

After the initial 6.5 ms pulse, the wide "on" pulse has a pulse width of 1.95 ms and the narrow "on" pulse has a pulse width of 1.0 ms.

ON TIME PER 100 ms:

(3 x 6.3 ms) + (2 x 1.9 ms) + (33 x 1.0 ms) = 55.7 ms ON TIME PER 100 ms

= 55.7% DUTY CYCLE
= -5.1 dB

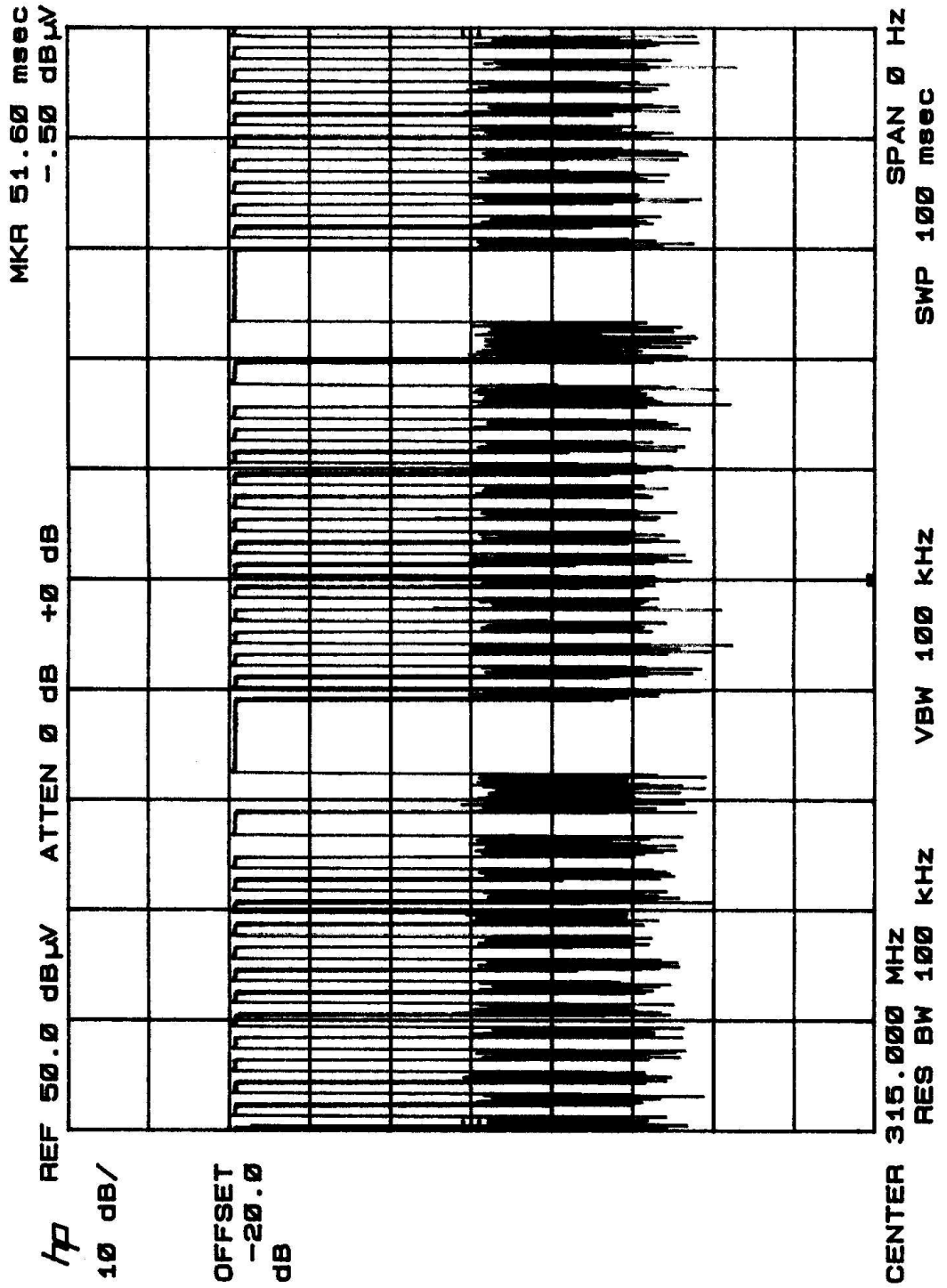

MKR 51.60 msec
-.50 dBµV
REF 50.0 dBµV
ATTEN 0 dB
+0 dB
10 dB/
OFFSET
-20.0
dB
CENTER 315.000 MHz
RES BW 100 kHz
VBW 100 kHz
SPAN 0 Hz
SWP 100 msec

EXHIBIT 2

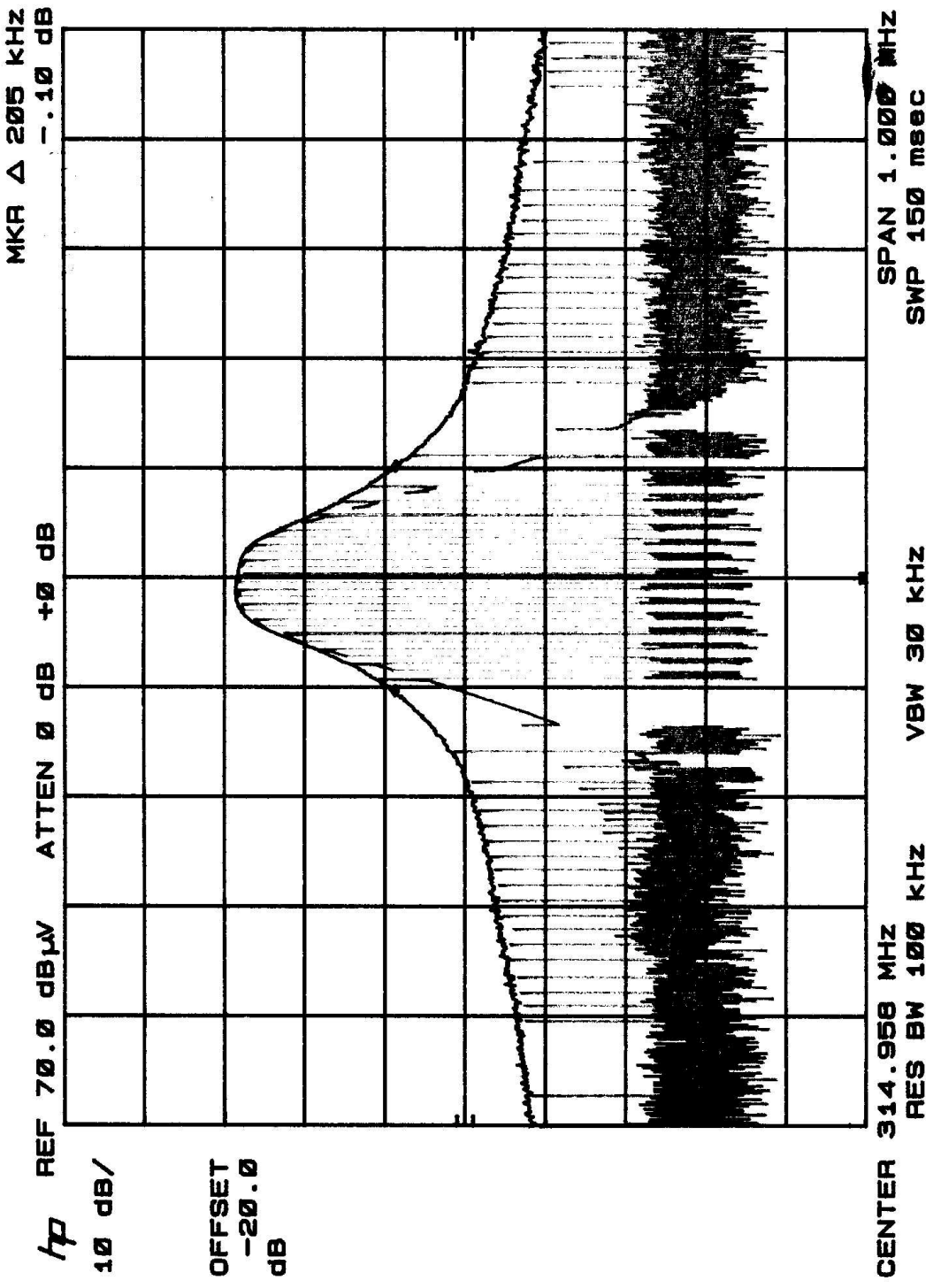
CARRIER BANDWIDTH DATA

The 20 dB modulated bandwidth shall be no wider than 0.25% of the center frequency.

Bandwidth Limit = Carrier Frequency x .0025

Bandwidth Limit = 315 MHz x .0025 = 787.5 kHz

Measured EUT Bandwidth = 205 kHz


MKR Δ 205 kHz
-.10 dB
REF 70.0 dBµV
ATTEN 0 dB +0 dB
10 dB/
OFFSET
-20.0
dB
CENTER 314.958 MHz
RES BW 100 kHz
VBW 30 kHz
SPAN 1.000 MHz
SWP 150 msec

Appendix A

Statement of Measurement Uncertainty

For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:
A = Antenna calibration uncertainty, in dB = 2 dB
B = Spectrum Analyzer uncertainty, in dB = 1 dB
C = Site uncertainty, in dB = 4 dB
n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.