

EMI TEST REPORT

Test Report No. : 22HE0022-HO-1

Applicant : **DENSO CORPORATION**

Type of Equipment : **Keyless Entry System (Transmitter)**

Model No. : **12BBT**

Test standard : **FCC Part 15 Subpart C Section 15.231**

FCC ID : **HYQ12BBT**

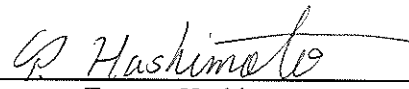
Test Result : **Complied**

1. This test report shall not be reproduced in full or partial, without the written approval of A-PEX International Co., Ltd.
2. The results in this report apply only to the sample tested.
3. This equipment is in compliance with above regulation. We hereby certify that the data contain a true representation of the EMC profile.
4. The test results in this report are traceable to the national or international standards.
5. This test report does not constitute an endorsement by NIST/NVLAP or U.S. Government.

Date of test : April 11 and 12, 2002

Issued date : April 26, 2002

Tested by : 
Hiroka Umeyama

Approved by : 
Tetsuya Hashimoto
Site Manager of Head Office EMC Division

A-PEX International Co., Ltd. EMC Head Office Division.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone: +81 596 24 8116 Facsimile: +81 596 24 8124

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SECTION 1: Client information

Company name : DENSO CORPORATION
Trade name : DENSO CORPORATION
Address : 1-1 showa-cho, kariya-shi, Aichi-ken. 448-8661 Japan
Telephone Number : +81-566-61-2537
Facsimile Number : +81-566-25-4915
Contact Person : MITSUGI OHTSUKA

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment : Remote Keyless Entry System (Transmitter)
Model No. : 12BBT
Serial No. : 002
Rating : 3V DC (Lithium Battery CR2016)
Country of Manufacture : JAPAN
Receipt Date of Sample : April 11, 2002
Condition of EUT : production prototype

2.2 Product Description

Model: 12BBT Remote Keyless Entry System (Transmitter) is mainly used for locking or unlocking the doors of the vehicle.

They are referred to as the EUT in this report.

The specification is as following :

Carrier Frequency : 314.35 MHz
Modulation : ASK
Other Clock Frequency : 1.31 MHz
Information antenna : Built-in Type (Fixed)
Operation Voltage : Lithium Battery DC 3.0V(CR2016)

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
Title : FCC 47CFR Part15 Radio Frequency Device
Subpart C Intentional Radiators
Section 15.231 Periodic operation in the band 40.66 – 40.70 MHz and above 70MHz

3.2 Procedures and results

Item	Test Procedure	Specification	Deviation	Worst margin	Result
Automatically Deactivate	ANSI C63.4:2000	Section 15.231(a)(1)	N/A	-	Complied
Electric Field Strength of Fundamental Emission	ANSI C63.4:2000	Section 15.231(b)	N/A	6.3dB 314.33MHz Horizontal	Complied
Electric Field Strength of Spurious Emission	ANSI C63.4:2000	Section 15.205 Section 15.209 Section 15.231(b)	N/A	7.7dB 2514.64MHz Horizontal/Vertical	Complied
-20dB Bandwidth	ANSI C63.4:2000	Section 15.231(c)	N/A	-	Complied

3.3 Additions to standards

No addition, deviation or exclusion has been made from standards.

3.4 Confirmation

A-PEX INTERNATIONAL hereby confirms that E.U.T. , in the configuration tested, complies with the specifications FCC Part15 SubpartC Section 15.231.

3.5 Uncertainty

Radiated Emission Test

The measurement uncertainty (with a 95% confidence level) for this test using Biconical antenna is $\pm 4.4\text{dB}$.
The measurement uncertainty (with a 95% confidence level) for this test using Logperiodic antenna is $\pm 5.0\text{dB}$.
The measurement uncertainty (with a 95% confidence level) for this test using Horn antenna is $\pm 5.5\text{dB}$.
☐ The data listed in this test report may exceed the test limit because it does not have enough margin.
☒ The data listed in this test report has enough margin.

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3.6 Test location

A-PEX International Co., Ltd. EMC Head Office Division. No.1 semi Anechoic Chamber, 19.2 x 11.2 x 7.7 m
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Telephone: +81 596 24 8116 Facsimile: +81 596 24 8124

This site has been fully described in a report submitted to FCC office, and listed on February, 2002 (Registration number: 313583).

*NVLAP Lab. code: 200572-0

3.7 Test Setup, Data of EMI & Test instruments,

Refer to Appendix 1 to 3.

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SECTION 4: Operation of E.U.T. during testing

4.1 Operating Modes

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to typical use.

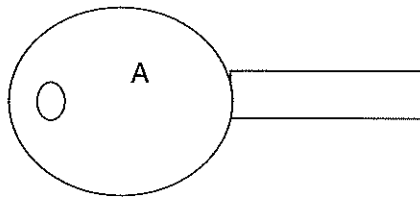
The operating mode/system was as follows:

Operation mode : Transmitting

Justification: The system was configured in typical fashion (as a customer would normally use it) for testing.

4.2 Configuration and peripherals

Top View



*Test data was taken under worse case conditions.

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	FCC ID
A	Transmitter	12BBT	002	DENSO	HYQ12BBT

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SECTION 5: Radiated emission

5.1 Operating environment

The test was carried out in a No.1 semi Anechoic Chamber, 19.2 x 11.2 x 7.7 m.

Temperature : See data
Humidity : See data

5.2 Test configuration

EUT was placed on a platform of nominal size, 1m by 1.5m, raised 80cm above the conducting ground plane. The EUT was set on the center of the tabletop and the rear peripheral was aligned and flushed with rear of tabletop. Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength. A drawing of the set up is shown in the photos of Appendix 1.

5.3 Test conditions

Frequency range : 30MHz-3200MHz
Test distance : 3m
EUT position : Tabletop
EUT operation mode : Transmitting

5.4 Test procedure

The Radiated Electric Field Strength intensity has been measured on an open test site with a ground plane and at a distance of 3m.

Measurements were performed with a quasi-peak detector.

The measuring antenna height was varied between 1 to 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for both vertical and horizontal antenna polarization.

The radiated emission measurements were made with the following detector function of the test receiver.

	Below 1GHz	Above 1 GHz
Detector Type	: Quasi-Peak/Peak	: Average/Peak
IF Bandwidth	: 120 kHz	: 1 MHz

-The noise was measured at each position of all three axes X, Y and Z to compare the level, and the maximum noise occurred at the position showed in the photograph.

-The relative measurements were performed on the fundamental and the spurious emissions with each condition of the key folded and the key set up. The key set-up condition was worse case under both the fundamental and the spurious emissions, we, therefore, tested while the key was set up. See the photograph.

-The reading level was reduced by 6dB for comparison to the limits as this EUT had 50% duty cycle.

See the data in Appendix 3.

5.5 Results

Summary of the test results: Pass

Date: April 11 and 12, 2002

Tested by: H. Umeyama

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APPENDIX 1: Photographs of test setup

Page 9 : Radiated emission

APPENDIX 2: Test instruments

Page 10 : Test instruments

APPENDIX 3: Data of EMI test

Page 11-12 : Automatically Deactivate

Page13 : Radiated emission (Electric Field Strength of Fundamental and Spurious Emission)

Page14-15 : Duty cycle Under Normal Operation

Page16 : -20dB Bandwidth

APPENDIX 1: Photographs of test setup

Radiated emission(Worst case position)



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Test Report No : 22HE00022-HO-1

APPENDIX 2

Test Instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Test Item	Calibration Date * Interval(month)
MAT-06	Attenuator(6dB)	Weinschel Corp	2	RE	2001/12/27 * 12
MBA-01	Biconical Antenna	Schwarzbeck	BBA9106	RE	2001/12/01 * 12
MCC-01	Coaxial Cable	Suhner/storm/Agilent	421-014-10m,4 21-014-16m,42 1-014-7.5m,SF M86PE-15cm,87 65C,SFM141-15 cm,SFM141-15c m,8765C,SFM14 1-10cm,8765C,4 21-010-1m	RE	2001/12/27 * 12
MAEC-01	Anechoic Chamber	TDK	Semi Anechoic Chamber 10m	RE	2001/12/29 * 12
MLA-01	Logperiodic Antenna	Schwarzbeck	USLP9143	RE	2001/12/01 * 12
MTR-01	EMI TEST RECEIVER	Rohde & Schwarz	ES140	RE	2001/11/13 * 12
MPA-02	Pre Amplifier	Agilent	87405A	RE	2001/12/27 * 12
	EMI TEST RECEIVER	Rohde & Schwarz	ES140		
	Anechoic Chamber	TDK	Semi Anechoic Chamber 10m		

All equipment is calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

CE: Conducted emission,

RE: Radiated emission,

H/F: Harmonics and voltage fluctuation

RFI: RFI Power test,

AT: Antenna terminal disturbance voltage

EMS test equipment

Control No.	Instrument	Manufacturer	Model No	Test Item	Calibration Date * Interval(month)

All equipment is calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

ESD: Electrostatic discharge,

RS: Radiated RF electromagnetic field,

EFT/B: Electrical fast transient burst,

SG: Surge,

CS: Radio-frequency conducted disturbances,

MF: Power frequency magnetic field,

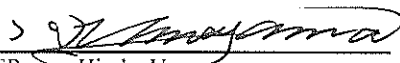
Dip: Voltage dips and short interruptions

DATA OF AUTOMATICALLY DEACTIVATE

A-PEX INTERNATIONAL CO., LTD.
EMC HEAD OFFICE DIVISION No.1 SEMI ANECHOIC CHAMBER

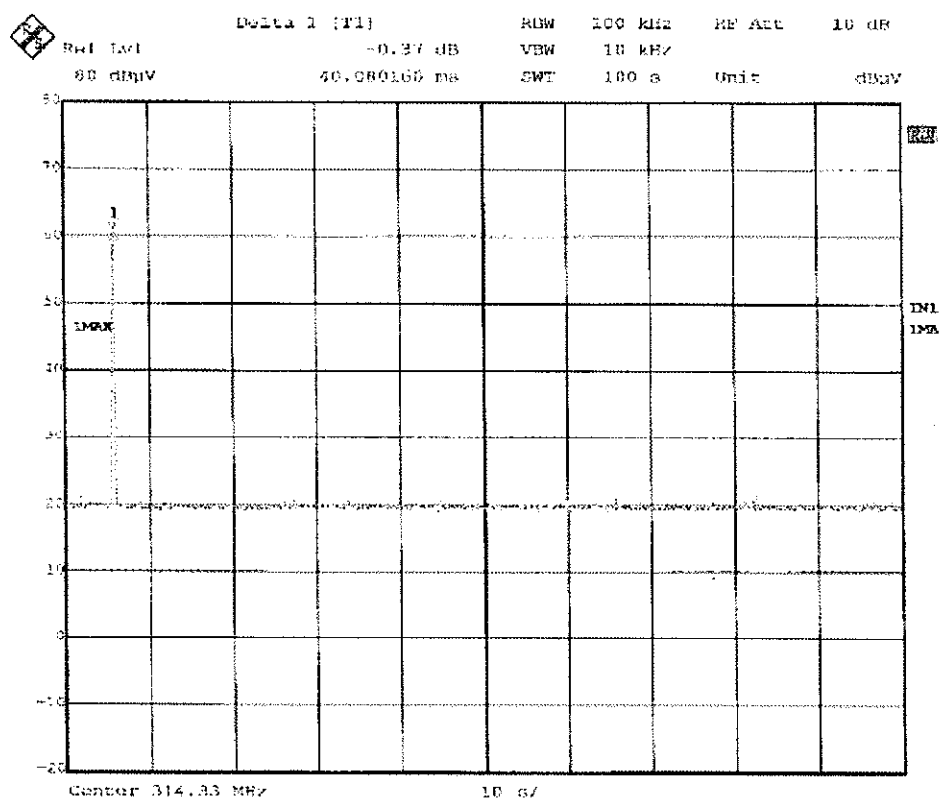
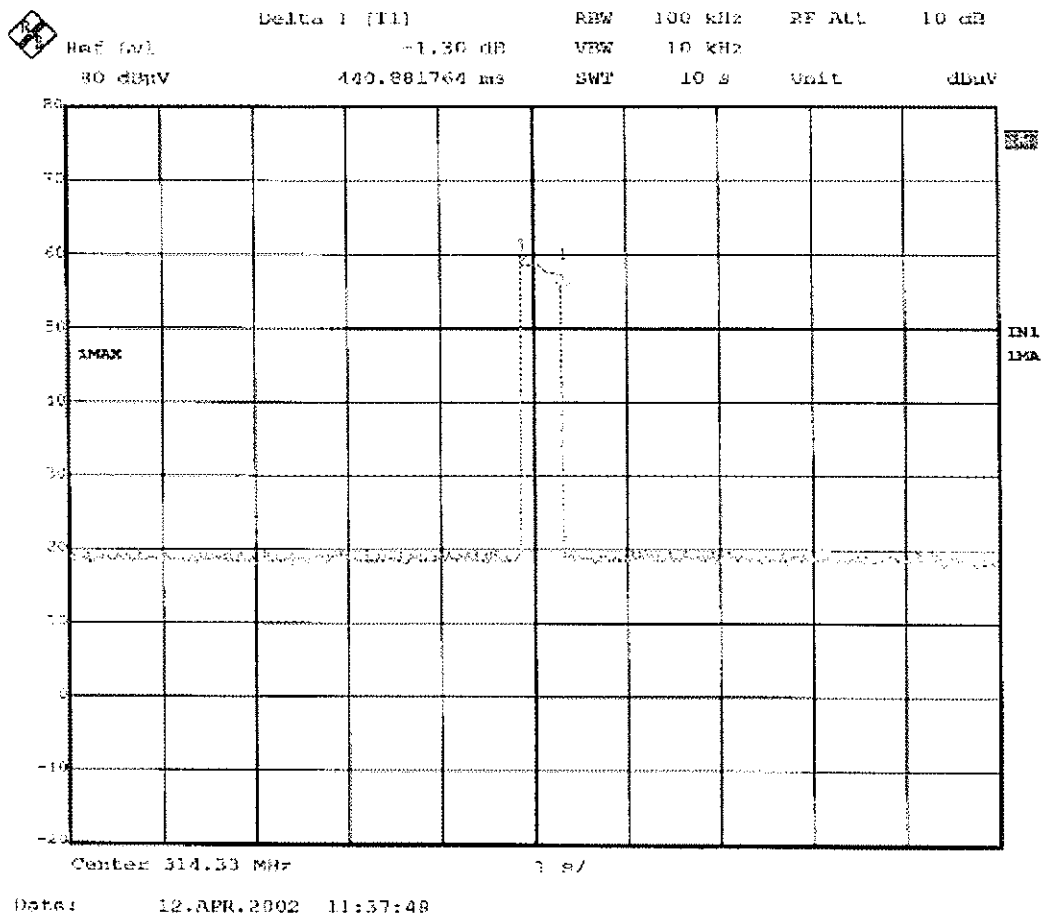
COMPANY : DENSO CORPORATION
EQUIPMENT : Keyless Entry System (Transmitter)
MODEL : 12BBT
S/N : 006
FCC ID : -
POWER : DC3.0V
Mode : Transmitting

REPORT NO : 22HE0022-HO
REGULATION : Fcc Part15 Subpart C 231(a)(1)
TEST DISTANCE : 3m
DATE : 04/12/2002
Temperature : 22°C
Humidity : 39%


 ENGINEER : Hiroka Umeyama

Time of Transmitting	Limit	Result
[sec]	[sec]	
0.44	5.00	Pass

AUTOMATICALLY DEACTIVATE



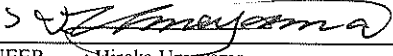
DATA OF RADIATED EMISSIONS

A-PEX INTERNATIONAL CO., LTD.

EMC HEAD OFFICE DIVISION No.1 SEMI ANECHOIC CHAMBER

COMPANY : DENSO CORPORATION
 EQUIPMENT : Keyless Entry System (Transmitter)
 MODEL : 12BBT
 S/N : 002
 FCC ID : -
 POWER : DC3.0V
 Mode : Transmitting

REPORT NO : 22HE0022-HO
 REGULATION : Fcc Part15 Subpart C 231(b) / 205
 TEST DISTANCE : 3m
 DATE : 04/11/2002
 Temperature : 21℃
 Humidity : 37%


 ENGINEER : Hiroka Umeyama

No.	FREQ [MHz]	T/R READING : PK		ANT Factor [dB]	AMP GAIN [dB]	LOSS [dB]	Duty Factor [dB]	RESULT		Limit [dBuV/m]	MARGIN	
		HOR	VER					HOR	VER		HOR	VER
		[dBuV/m]						[dBuV/m]			[dB]	[dB]
1	314.33	74.5	69.9	14.8	23.8	9.8	-6.0	69.3	64.7	75.6	6.3	10.9

No.	FREQ [MHz]	T/R READING : QP		ANT Factor [dB]	AMP GAIN [dB]	LOSS [dB]	Duty Factor [dB]	RESULT		Limit [dBuV/m]	MARGIN	
		HOR	VER					HOR	VER		HOR	VER
		[dBuV/m]						[dBuV/m]			[dB]	[dB]
2	628.66	27.3	29.5	19.4	24.0	11.5	0.0	34.2	36.4	55.6	21.4	19.2
3	942.99	25.0	24.5	22.4	24.0	12.8	0.0	36.2	35.7	55.6	19.4	19.9

No.	FREQ [MHz]	T/R READING : PK		ANT Factor [dB]	AMP GAIN [dB]	LOSS [dB]	Duty Factor [dB]	RESULT		Limit [dBuV/m]	MARGIN	
		HOR	VER					HOR	VER		HOR	VER
		[dBuV/m]						[dBuV/m]			[dB]	[dB]
4	1257.32	37.1	37.9	25.2	23.8	8.1	0.0	46.6	47.4	75.6	29.0	28.2
5	1571.65	41.4	40.7	25.7	23.9	9.0	0.0	52.2	51.5	74.0	21.8	22.5
6	1885.98	40.1	40.8	26.3	24.2	10.0	0.0	52.2	52.9	75.6	23.4	22.7
7	2200.31	41.5	43.2	27.0	24.8	10.8	0.0	54.5	56.2	74.0	19.5	17.8
8	2514.64	43.8	43.8	27.7	25.4	11.5	0.0	57.6	57.6	75.6	18.0	18.0
9	2828.97	39.8	40.0	28.1	25.4	12.4	0.0	54.9	55.1	74.0	19.1	18.9
10	3143.30	38.8	38.1	28.4	25.2	12.9	0.0	54.9	54.2	75.6	20.7	21.4

No.	FREQ [MHz]	T/R READING : AV		ANT Factor [dB]	AMP GAIN [dB]	LOSS [dB]	Duty Factor [dB]	RESULT		Limit [dBuV/m]	MARGIN	
		HOR	VER					HOR	VER		HOR	VER
		[dBuV/m]						[dBuV/m]			[dB]	[dB]
4	1257.32	24.1	25.7	25.2	23.8	8.1	0.0	33.6	35.2	55.6	22.0	20.4
5	1571.65	30.1	29.5	25.7	23.9	9.0	0.0	40.9	40.3	54.0	13.1	13.7
6	1885.98	28.5	29.8	26.3	24.2	10.0	0.0	40.6	41.9	55.6	15.0	13.7
7	2200.31	30.9	32.0	27.0	24.8	10.8	0.0	43.9	45.0	54.0	10.1	9.0
8	2514.64	34.1	34.1	27.7	25.4	11.5	0.0	47.9	47.9	55.6	7.7	7.7
9	2828.97	26.8	26.5	28.1	25.4	12.4	0.0	41.9	41.6	54.0	12.1	12.4
10	3143.30	25.7	25.5	28.4	25.2	12.9	0.0	41.8	41.6	55.6	13.8	14.0

REMARKS

ANTENNA TYPE:30-300MHz Biconical / 300-1000MHz Logperiodic / 1-3.2GHz Horn

CALCULATION RESULT=Reading + ANT Factor - Amp Gain + LOSS (Cable+ ATTEN.)+Duty factor

*Except for the above table : All other spurious emissions were less than 20dB for the limit.

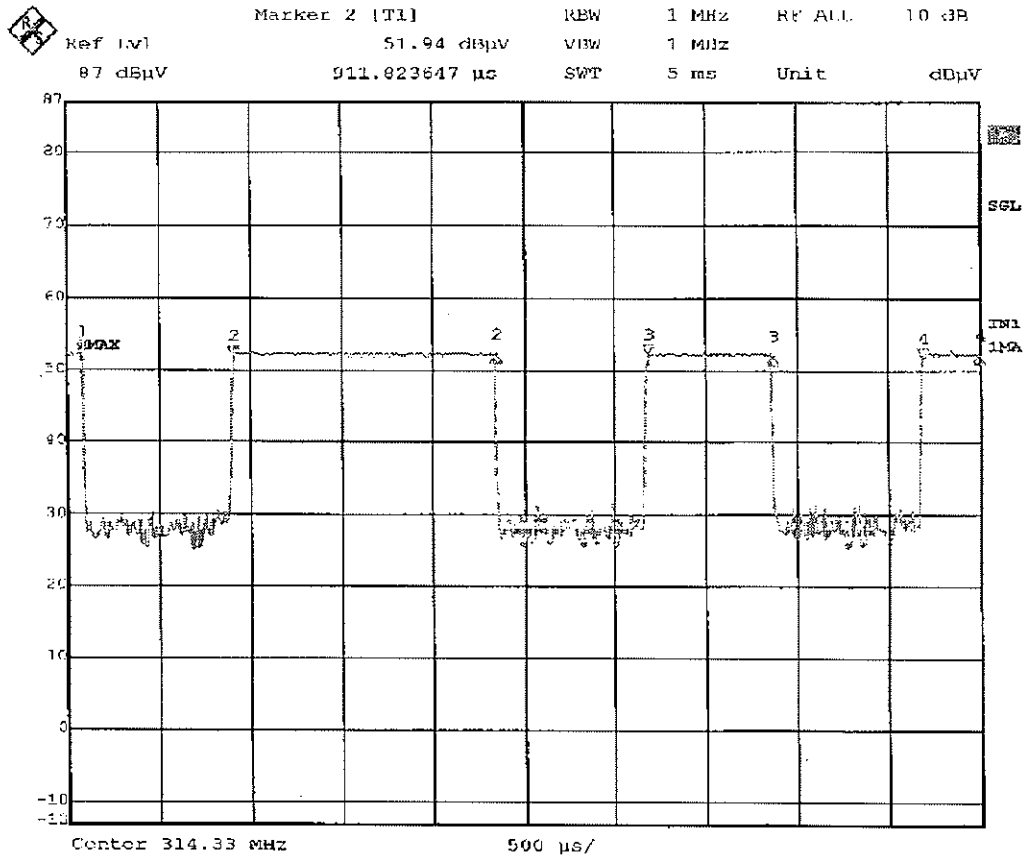
*EUT was placed in X axis when the measurement antenna was positioned horizontally.

*EUT was placed in Y axis when the measurement antenna was positioned vertically.

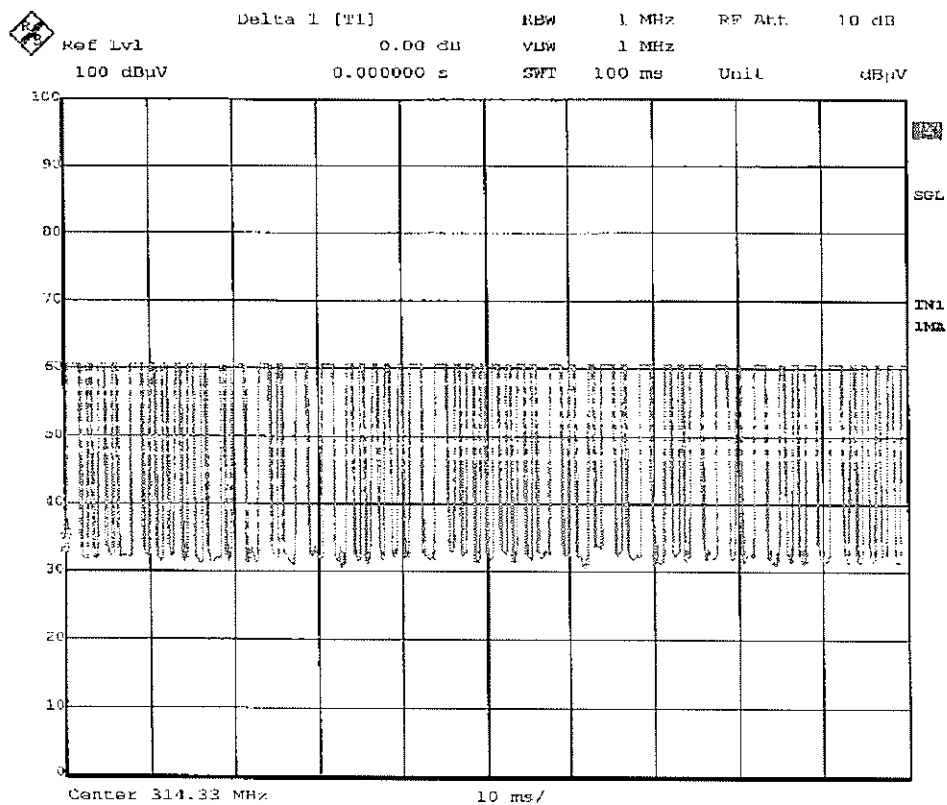
Duty cycle Factor Measurement

The duty cycle factor = $20\log(\Delta 1: 80 + \Delta 2: 1433 + \Delta 3: 681 + \Delta 4: 311 / 5000) = -6.00$

DUTY CYCLE UNDER NORMAL OPERATION



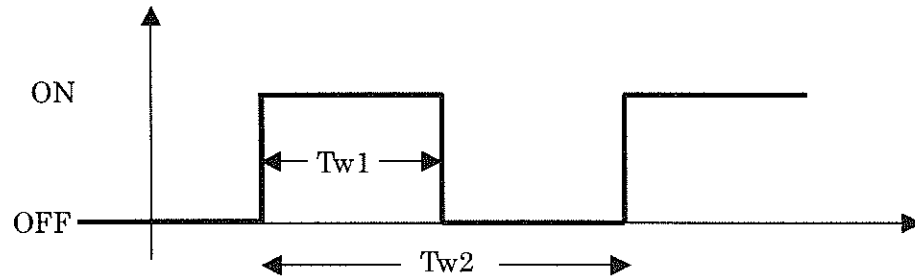
Date: 12.APR.2002 19:37:31



Date: 12.APR.2002 12:43:24

Duty cycle :

Data type :

Frame Format :

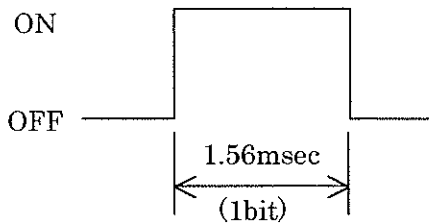
Header (8bit)	Parity bit (8bit)	Function bit (16bit)	ID and Counter bit (64bit)
88bit			

Data Time :

	Tw1/Tw2	
Header	0.78msec/1.56msec	
Parity bit	Data"0"	0.78msec/1.56msec
Function bit	Data"1"	1.56msec/1.56msec or 0msec/1.56msec*
ID and Counter bit		

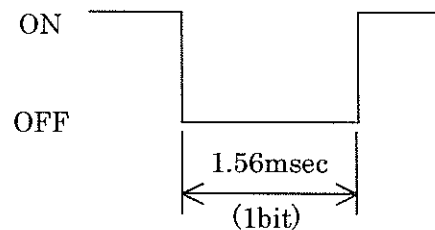
*Data"1"

Pattern A



or

Pattern B

Calculation of the duty factor

$$\text{header} = 0.78\text{msec} / 1.56\text{msec} \times 8\text{bit} = 0.5$$

Duty of Parity bit, Function bit, ID and Counter bit are as follows;

In case of all data="0"

$$0.78\text{msec} / 1.56\text{msec} \times 88\text{bit} = 0.5$$

In case of all data="1"

Ppattern A and Pattern B are appeared alternately.

$$(1.56\text{msec} / 1.56\text{msec}) \times (88\text{bit} / 2) + (0\text{msec} / 1.56\text{msec}) \times (88\text{bit} / 2) = 0.5$$

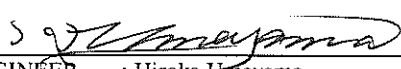
$$\text{Duty Factor} = 20\log 0.5 = \underline{-6.0}$$

DATA OF -20dB-Bandwidth

A-PEX INTERNATIONAL CO., LTD.
EMC HEAD OFFICE DIVISION No.1 SEMI ANECHOIC CHAMBER

COMPANY : DENSO CORPORATION
EQUIPMENT : Keyless Entry System (Transmitter)
MODEL : 12BBT
S/N : 002
FCC ID : -
POWER : DC3.0V
Mode : Transmitting

REPORT NO : 22HE0022-HO
REGULATION : Fcc Part15 Subpart C 231(c)
TEST DISTANCE : 3m
DATE : 04/11/2002
Temperature : 21°C
Humidity : 37%


ENGINEER : Hiroka Umeyama

Bandwidth Limit : Fundamental Frequency 314.35MHz X 0.25% = 785.875kHz

-20dB Bandwidth	Bandwidth Limit	Result
[kHz]	[kHz]	
225.45	785.88	Pass

