



## EMI TEST REPORT

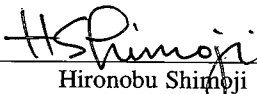
Test Report No. : 24KE0233-HO-1

Applicant : DENSO CORPORATION  
Type of Equipment : Electronic Key  
Model No. : 14AAF  
Test standard : FCC Part 15 Subpart C Section 15.231:2004  
Test Result : Complied  
FCC ID : HYQ14AAF

1. This test report shall not be reproduced in full or partial, without the written approval of UL Apex 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.

Date of test : July 2, 2004

Tested by :   
Hiroka Umeyama  
EMC Service

Approved by :   
Hironobu Shimoji  
Group Leader of EMC Service

UL Apex Co., Ltd.

Head Office EMC Lab.

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## **SECTION 1: Client information**

Company Name : DENSO CORPORATION  
Address : 1-1 Showa-cho, Kariya-city, Aichi-prefecture, 448-8661, Japan  
Telephone Number : +81-566-61-7934  
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 : Electronic Key  
Model No. : 14AAF  
Serial No. : No.1  
Rating : DC3V  
Country of Manufacture : Japan  
Receipt Date of Sample : July 2, 2004  
Condition of EUT : Production prototype  
(Not for Sale: This sample is equivalent to mass-produced items.)

### **2.2 Product Description**

Model No: 14AAF(referred to as the EUT in this report) is an Electronic Key.

The specification is as following;

Carrier frequency : 314.35MHz  
Local Frequency : 314.35MHz SAW resonator, 1MHz CR Oscillator Circuit  
Type of Modulation : A1D  
Information Antenna : Built-in type (Fixed)

FCC 15.31 (e) complies with the power supply:3VDC (one lithium battery).

\*FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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## **SECTION 3: Test specification, procedures & results**

### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C :2004  
Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators  
Section 15.231 Periodic operation in the band 40.66 - 40.70MHz  
and above 70MHz

### **3.2 Procedures and results**

No.	Item	Test Procedure	Specification	Deviation	Worst margin	Results
1	Automatically Deactivate	ANSI C63.4:2003 13. Measurement of intentional radiators	Section 15.231(a)(1)	N/A	-	Complied
2	Electric Field Strength of Fundamental Emission	ANSI C63.4:2003 13. Measurement of intentional radiators	Section 15.231(b)	N/A	4.1dB 314.338MHz Horizontal	Complied
3	Electric Field Strength of Spurious Emission	ANSI C63.4:2003 13. Measurement of intentional radiators	Section 15.205 Section 15.209 Section 15.231(b)	N/A	2.3dB 1886.030MHz Vertical	Complied
4	-20dB Bandwidth	ANSI C63.4:2003 13. Measurement of intentional radiators	Section 15.231(c)	N/A	-	Complied
5	Conducted emission AC Mains	ANSI C63.4:2003 7. AC powerline conducted emission measurements	Section 15.207	N/A*1)	N/A	N/A

Note: UL Apex's EMI Work procedures No. QPM05

\*1) The test is not applicable since the EUT is DC drive and is not connected to the public utility (AC) power line.

\*These tests were performed without any deviations from test procedure except for additions or exclusions.

### **3.3 Uncertainty**

#### Radiated Emission Test

The measurement uncertainty (with a 95% confidence level) for this test using Biconical antenna is  $\pm 4.5$ dB.

The measurement uncertainty (with a 95% confidence level) for this test using Logperiodic antenna is  $\pm 5.2$ dB

The measurement uncertainty (with a 95% confidence level) for this test using Horn Antenna is  $\pm 6.6$ dB.

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

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### 3.4 Test Location

UL Apex Co., Ltd. Head Office EMC Lab. \*NVLAP Lab. code: 200572-0

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	Listed date (for FCC)	FCC Registration Number	IC Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms
No.1 semi-anechoic chamber	February 01, 2002	313583	IC4247	19.2 x 11.2 x 7.7m	7.0 x 6.0m	Preparation room
No.2 semi-anechoic chamber	June 05, 2002	846015	IC4247-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 shielded room	-	-	-	4.7 x 7.5 x 2.7m	4.7 x 7.5m	-
No.4 measurement room	-	-	-	3.1 x 5.0 x 2.7m	N/A	-

\* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1 and No.2 semi-anechoic and No.3 shielded room.

### 3.5 Test set up, Test instruments and Data of EMI

Refer to APPENDIX 1 to 3.

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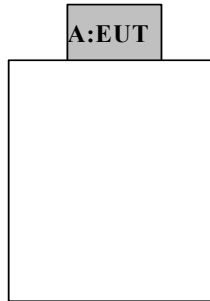
## **SECTION 4: Operation of E.U.T. during testing**

### **4.1 Operating Modes**

The EUT was operated in a manner similar to typical use during the tests.

Operation : Transmitting mode

### **4.2 Configuration and peripherals**



#### **Description of EUT**

No.	Item	Model number	Serial number	Manufacturer	FCC ID
A	Electronic Key	14AAF	No.1	DENSO CORPORATION	HYQ14AAF

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## **SECTION 5: Radiated emission (Fundamental and Spurious Emission)**

### **5.1 Operating environment**

Test place : No.1 semi anechoic chamber  
Temperature : See data  
Humidity : See data

### **5.2 Test configuration**

EUT was placed on a platform of nominal size, 0.5 m by 0.5 m, raised 80cm above the conducting ground plane. The EUT was set on the center of the 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 : Top of Polyurethane  
EUT operation mode : Transmitting

### **5.4 Test procedure**

The Radiated Electric Field Strength intensity has been measured on a semi anechoic chamber with a ground plane and at a distance of 3m.  
The measuring antenna height varied between 1 and 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.

Frequency	Below 1GHz (Spurious )	Below 1GHz (Fundamental)	Above 1GHz
Instrument used	Test Receiver	Spectrum Analyzer	Spectrum Analyzer
IF Bandwidth	QP: BW 120kHz	PK(BW:120kHz) – Duty Factor	PK: RBW:1MHz/VBW: 1MHz AV: RBW:1MHz/VBW:10Hz

- The carrier level was measured at each position of all three axes X, Y and Z, and the position that has the maximum noise was determined.

With the position, the noise levels of all the frequencies was measured.

### **5.5 Results**

Summary of the test results: Pass

Date: July 2, 2004                      Tested by: Hiroka Umeyama

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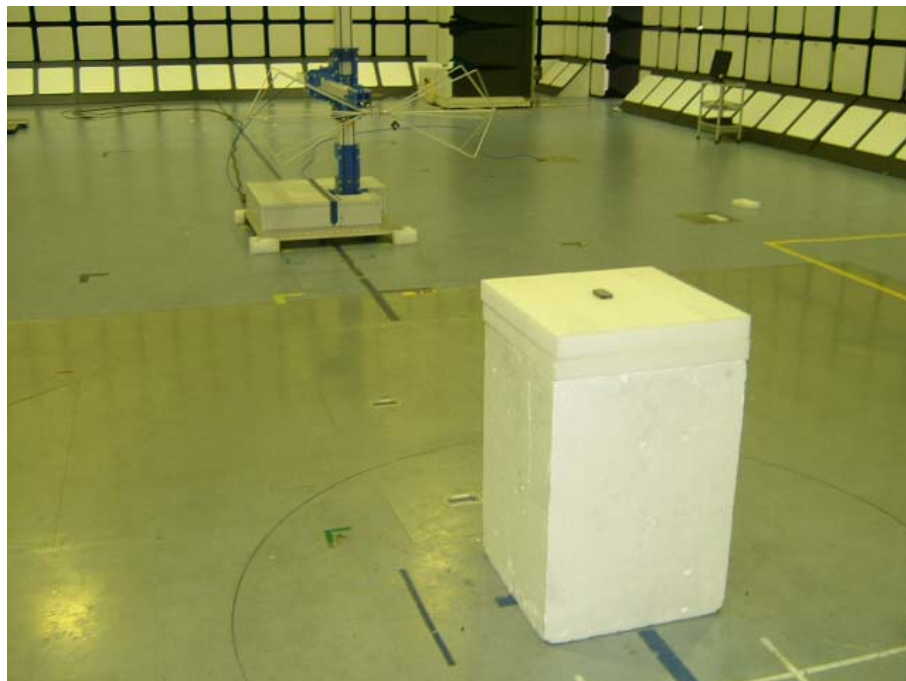
**APPENDIX 1: Photographs of test setup**

**Radiated emission**

**Front**



**Rear**





**X, Y, Z axis**

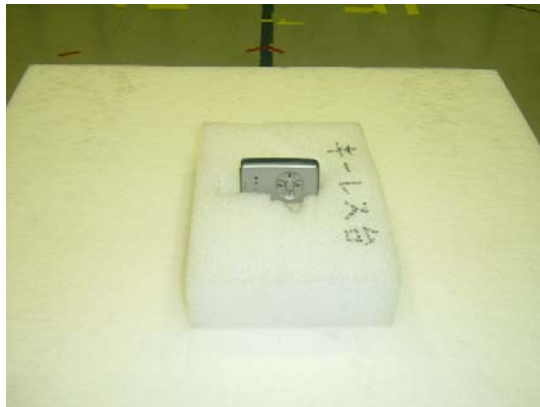
**X-axis**



**Y-axis**



**Z-axis**



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## **APPENDIX 2: Test Instruments**

### **EMI test equipment**

<b>Control No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Test Item</b>	<b>Calibration Date * Interval(month)</b>
MAEC-01	Anechoic Chamber	TDK	Semi Anechoic Chamber 10m	RE	2003/12/27 * 12
MTR-01	Test Receiver	Rohde & Schwarz	ESI40	RE	2003/11/12 * 12
MAT-06	Attenuator(6dB)	Weinschel Corp	2	RE	2003/12/16 * 12
MBA-01	Biconical Antenna	Schwarzbeck	BBA9106	RE	2003/10/15 * 12
MLA-01	Logperiodic Antenna	Schwarzbeck	USLP9143	RE	2003/10/15 * 12
MHA-05	Horn Antenna	Schwarzbeck	BBHA9120D	RE	2004/01/10 * 12
MPA-03	Microwave System Power Amplifier	Agilent	83050A	RE	2004/06/12 * 12
MPA-04	Pre Amplifier	Agilent	8447D	RE	2004/05/25 * 12
MCC-01	Coaxial Cable	Suhner/storm/ Agilent/TSJ	-	RE	2003/12/19 * 12
MCC-05	Microwave Cable	Storm	421-011	RE	2004/01/06 * 12
MCC-23	Microwave Cable	Storm	-	RE	2004/05/01 * 12

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

Test Item:

**RE: Radiated emission**

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**APPENDIX 3: Data of EMI test**

**Radiated emission**

**DATA OF RADIATED EMISSION TEST**

UL Apex Co., Ltd. Head Office EMC Lab. No.1 Semi Anechoic Chamber

Applicant : DENSO CORPORATION  
Kind of EUT : Electronic key  
Model No. : 14AAF  
Serial No. : No.1  
Report No. : 24KE0233-HO  
Power : DC3.0V  
Temp°C/Humi% : 25 / 55  
Operator : Hiroka Umeyama

Mode / Remarks : Transmitting Max-Axis Data (H:X-Axis , V:Z-Axis)

LIMIT : FCC 15C §15.209 3m

MARGIN : All the other spurious emission were less than 20dB for the limit.

No.	FREQ [MHz]	READING [dBμV]	ANT FACTOR [dB/m]	LOSS [dB]	GAIN [dB]	RESULT [dBμV/m]	LIMIT [dBμV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	314.338	74.0*	14.8	10.1	27.4	71.5	75.6	4.1	100	59
2	628.674	38.7	19.7	12.0	28.9	41.5	46.0	4.5	155	23
3	943.007	32.4	22.0	13.1	28.6	38.9	46.0	7.1	100	113
----- Vertical -----										
4	314.338	71.4*	14.8	10.1	27.4	68.9	75.6	6.7	177	76
5	628.674	37.7	19.7	12.0	28.9	40.5	46.0	5.5	100	110
6	943.007	30.0	22.0	13.1	28.6	36.5	46.0	9.5	115	76

\*READING= S/A READING (PK) - Duty Factor:6(Duty Cycle 50%)

CHART: WITH FACTOR ANT TYPE : -30MHz LOOP, 30-300MHz BICONICAL, 300MHz-1000MHz LOGPERIODIC, 1000MHz- HORN  
CALCULATION: RESULT = READING + ANT FACTOR + LOSS (CABLE+ATTEN.) - GAIN (AMP)

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## DATA OF RADIATED EMISSION TEST

UL Apex Co., Ltd. Head Office EMC Lab. No.1 Semi Anechoic Chamber

Applicant : DENSO CORPORATION	Report No. : 24KE0233-HO
Kind of EUT : Electronic key	Power : DC3.0V
Model No. : 14AAF	Temp°C/Humi% : 25 / 55
Serial No. : No.1	Operator : Hiroka Uneyama

Mode / Remarks : Transmitting Max-Axis

LIMIT : FCC15C §15.231(b) & §15.209(a) above 1GHz PK  
MARGIN : All the other spurious emission were less than 20dB for the limit.

No.	FREQ [MHz]	READING PK [dB $\mu$ V]	ANT FACTOR [dB/m]	LOSS [dB]	GAIN [dB]	RESULT [dB $\mu$ V/m]	LIMIT [dB $\mu$ V/m]	MARGIN [dB]
—— Horizontal ——								
1	1257.339	34.3	23.3	3.9	27.1	34.4	74.0	39.6
2	1571.690	42.9	25.1	4.4	27.3	45.1	74.0	28.9
3	1886.030	52.6	28.9	4.9	27.5	58.9	74.0	15.1
4	2200.339	33.3	30.5	5.3	27.5	41.6	74.0	32.4
5	2514.689	37.2	30.8	5.6	27.4	46.2	74.0	27.8
6	2829.150	32.1	31.9	6.0	27.2	42.8	74.0	31.2
7	3143.500	31.8	32.0	6.3	27.1	43.0	74.0	31.0
—— Vertical ——								
8	1257.339	32.5	23.3	3.9	27.1	32.6	74.0	41.4
9	1571.690	47.4	25.1	4.4	27.3	49.6	74.0	24.4
10	1886.030	52.8	28.9	4.9	27.5	59.1	74.0	14.9
11	2200.339	34.7	30.5	5.3	27.5	43.0	74.0	31.0
12	2514.689	38.1	30.8	5.6	27.4	47.1	74.0	26.9
13	2829.150	32.3	31.9	6.0	27.2	43.0	74.0	31.0
14	3143.500	30.3	32.0	6.3	27.1	41.5	74.0	32.5

CHART: WITH FACTOR ANT TYPE : -30MHz LOOP, 30-300MHz BICONICAL, 300MHz-1000MHz LOGPERIODIC, 1000MHz- HORN  
CALCULATION: RESULT = READING + ANT FACTOR + LOSS (CABLE+ATTEN.) - GAIN (AMP)

## DATA OF RADIATED EMISSION TEST

UL Apex Co., Ltd. Head Office EMC Lab. No.1 Semi Anechoic Chamber

Applicant : DENSO CORPORATION	Report No. : 24KE0233-HO
Kind of EUT : Electronic key	Power : DC3.0V
Model No. : 14AAF	Temp°C/Humi% : 25 / 55
Serial No. : No.1	Operator : Hiroka Umeyama

Mode / Remarks : Transmitting Max-Axis

LIMIT : FCC 15C §15.209 3m

MARGIN : All the other spurious emission were less than 20dB for the limit.

No.	FREQ [MHz]	READING AV [dB $\mu$ V]	ANT FACTOR [dB/m]	LOSS [dB]	GAIN [dB]	RESULT [dB $\mu$ V/m]	LIMIT [dB $\mu$ V/m]	MARGIN [dB]
— Horizontal —								
1	1257.339	23.0	23.3	3.9	27.1	23.1	54.0	30.9
2	1571.690	34.1	25.1	4.4	27.3	36.3	54.0	17.7
3	1886.030	45.2	28.9	4.9	27.5	51.5	54.0	2.5
4	2200.339	20.8	30.5	5.3	27.5	29.1	54.0	24.9
5	2514.689	26.9	30.8	5.6	27.4	35.9	54.0	18.1
6	2829.150	19.3	31.9	6.0	27.2	30.0	54.0	24.0
7	3143.500	18.9	32.0	6.3	27.1	30.1	54.0	23.9
— Vertical —								
8	1257.339	19.9	23.3	3.9	27.1	20.0	54.0	34.0
9	1571.690	39.3	25.1	4.4	27.3	41.5	54.0	12.5
10	1886.030	45.4	28.9	4.9	27.5	51.7	54.0	2.3
11	2200.339	21.3	30.5	5.3	27.5	29.6	54.0	24.4
12	2514.689	27.3	30.8	5.6	27.4	36.3	54.0	17.7
13	2829.150	19.8	31.9	6.0	27.2	30.5	54.0	23.5
14	3143.500	18.1	32.0	6.3	27.1	29.3	54.0	24.7

CHART: WITH FACTOR ANT TYPE : -30MHz LOOP, 30-300MHz BICONICAL, 300MHz-1000MHz LOGPERIODIC, 1000MHz- HORN  
CALCULATION: RESULT = READING + ANT FACTOR + LOSS (CABLE+ATTEN.) - GAIN (AMP)

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## -20dB Bandwidth and Automatically deactivate

UL Apex Co., Ltd.  
 Head Office EMC Lab. No.1 Semi Anechoic Chamber

COMPANY : DENSO CORPORATION  
 EQUIPMENT : Electronic Key  
 MODEL : 14AAF  
 S/N : No.1  
 POWER : DC3.0V  
 Mode : Transmitting

REPORT NO : 24KE233-HO  
 REGULATION : Fcc Part15 Subpart C 231(c)  
 TEST DISTANCE : 3m  
 DATE : 07/02/2004  
 TEMPERATURE : 25  
 HUMIDITY : 55%

ENGINEER : Hiroka Umeyama

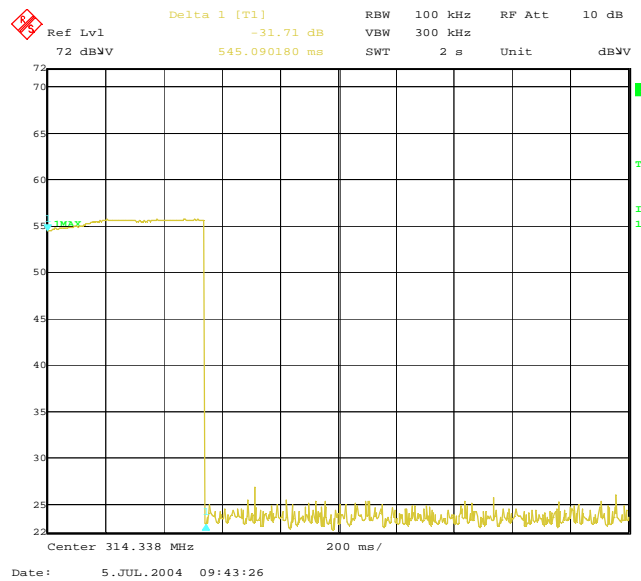
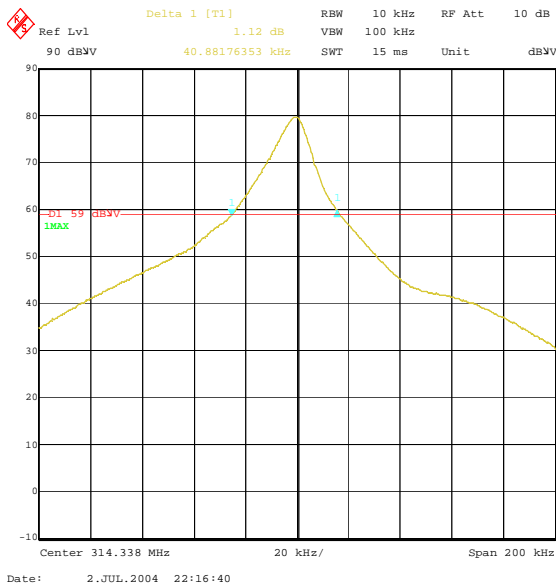
Bandwidth Limit :  $314.35\text{MHz} \times 0.25\% = 785.875$  kHz

-20dB Bandwidth [kHz]	Bandwidth Limit [kHz]	Result
40.9	785.875	Pass

Time of Transmitting [sec]	Limit [sec]	Result
0.55	5.00	Pass

-20dB Bandwidth

Automatically deactivate



**APPENDIX 4:Detail of Transmitting mode: Duty cycle**

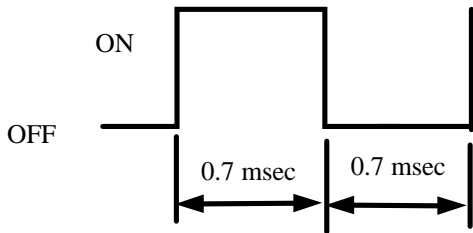
Frame Format:

Header (8bit)	Function bit (22bit)	ID and Counter bit (98bit)
------------------	-------------------------	-------------------------------

Data time: 1bit=1.4msec / TW1+TW2 = 1.4msec

	Tw1/Tw2	
Header	0.7 msec/0.7 msec	
Function bit	Data "0"	0.7 msec/0.7 msec
ID and Counter bit	Data "1"	0 msec/1.4 msec or 1.4 msec/0 msec *

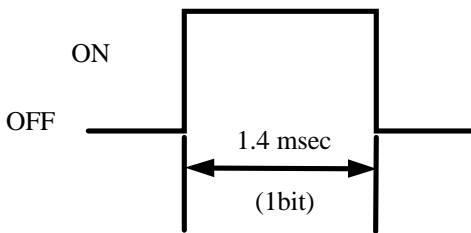
\* Data "0"



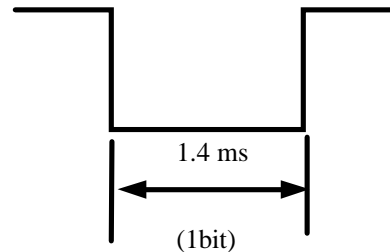
\* Data "1"

Pattern A

Pattern B



or



Calculation of the duty factor:

- Header 0.7 msec/0.7 msec x 8bit : Duty 50%

- Function bit, ID and Counter bit

When Data is "0" ;

0.7msec/0.7msec x 120bit : Duty 50%

When Data is "1" ;

Because, in the case Data 0, it has one cycle that is repeated by Duty50% of 0.7msec/0.7sec by turns. In the other case Data 1, they have 1.4msec ON or 1.4msec OFF in 1 cycle and they are repeated by turns. Thereby, that duty factor may become 50% in all the time.

Therefore

Duty Factor = 20 log 0.5 = -6.0

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