EMC TEST REPORT

for

Futaba Corporation of America

FM 75MHz Radio Control Xmitter

Model No. T2PEKA

EMC Measurement / Technical Report

FCC Test Specification	:	FCC Part 95, Subpart C Radio Control (R/C) Radio Service
Equipment Authorization	:	Certification
Manufacturer	:	Futaba Corporation of America
Equipment Under Test	:	T2PEKA FM 75MHz Radio Control Transmitter
Test Report No.	:	TR1066OC
Purchase Order No.	:	IRV-1035-RCS

Document History					
Revision	***Issue Date***	***Affected Pages***	***Description of Modifications***	***Revised By***	***Approved By***
N/C	16 March, 1999		Initial release		

EMC Measurement / Technical Report
Document No.TR1066OC
From
Garwood Laboratories, Inc.
World Compliance Division

Test for
Futaba Corporation of America
T2PEKA FM 75MHz
Radio Control Transmitter

WRITTEN BY	REVIEWED BY	REVIEWED BY
Arnulfo Tapia *EMC Technician*	*Robert Lynch* *Quality Manager*	*Ed Nakauchi* *EMC Chief Engineer* *NARTE, Certified*

Test Personnel	***Test Dates***
Arnulfo Tapia- EMC Technician	23,24 February 1999

Test Facility	Garwood Laboratories, Inc.-OC
Address	565 Porter Way
City, State, Zip Code	Placentia, CA 92870
Phone	(714) 572-2027
Fax	(714) 572-2025

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MEASUREMENT / TECHNICAL REPORT SUMMARY

Manufacturer Company	Futaba Corporation of America
Address	4 Studebaker
City, State, Zip	Irvine, CA 92718
Country	USA
Contact Name	Steve Helms
Phone	(949) 455-9888
Fax	(949) 455-9899
Type of Authorization	Certification for 75MHz R/C Transmitter
Applicable FCC Rules	PART 95 – PERSONAL RADIO SERVICES Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 (10-1-96 Edition). The following subparts are applicable to the results in this test report: Part 95, Subpart C - Radio Control (R/C) Radio Service Part 95, Subpart E - Technical Regulations Part 2, Subpart J – Equipment Authorization Procedures The test data presented in this report has been acquired using the guidelines set forth in FCC Part 2, §2.981 through §2.1005 and Part 95. The test results presented in this document are valid only for the equipment identified herein under the test conditions described. Repeatability of these test results will only be achieved with identical measurement conditions. The unit is battery operated; therefore, conducted emission measurements are not applicable.
Equipment Under Test	FM 75MHz Radio Control Transmitter
Identification of EUT	Model: T2PEKA FCC ID: AZPT2PEKA-75
Production Quantity	Multiple Units

EMC Test Laboratory	Garwood Laboratories Incorporated
Facility	World Compliance Division
Address	565 Porter Way
City, State, Zip Code	Placentia, CA 92870
Country	USA
Contact Name	Jason Armstrong
Title	General Manager
Phone	(714) 572-2027
Fax	(714) 572-2025

1. General Information

1. General Information

1.1 Product Description

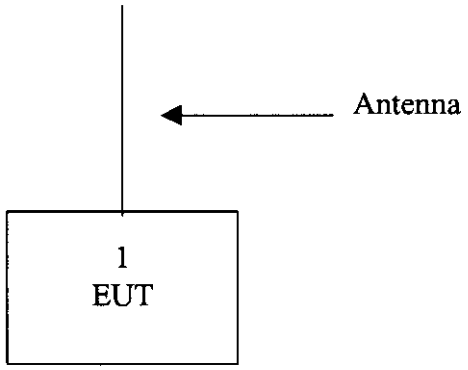
Equipment Under Test	75MHz Radio Control (R/C) Transmitter
Model Number	T2PEKA
Description	The EUT is a radio control transmitter for hobby aircraft and surface craft operation. During testing, the transmitter portion of the EUT was operating at 75.65MHz.
Clock Frequencies	75.65 MHz

1.2 Configuration of Tested System

The following table lists all of the components of the tested system. FCC ID numbers are included if available for a tested system component.

Tested System Details					
Item	*Manufacturer*	*Description*	*Model No.*	*Serial No.*	*FCC ID*
EUT	Futaba Corporation	R/C Transmitter	T2PEKA	N/A	AZPT2PEKA-75

The Equipment Under Test (EUT) was tested as a stand-alone unit. The EUT contains an integral antenna, which was extended to its maximum length during the test. During the field strength measurements, new batteries were installed in the EUT.



1.3 Test Facility

The open area test site (OATS) and measurement facilities used to collect the test data are located at the Garwood Laboratories, Inc., World Compliance Division test facility in Placentia, CA. This site has been fully described in a report submitted to the FCC and accepted in a letter dated 29, January 1999 (31040/SIT 1300F2). The test facility is also recognized and accredited from following accreditation organizations.

NVLAP (NIST)	NVLAP Lab Code: 200119-0 FCC, CISPR	Effective through- 12/31/99
I²T (Interference Tech. International)	Certificate Number: 7619 CE Mark for European Country	Dated: 03/11/1997

2. Technical Information

Type of Emission	F1D
Frequency Range	75-76MHz
Range of Operating Power	Fixed Output Power
Maximum Output Power	162mW
FCC Rating Maximum Transmitting Power	750mW
Final Stage Amplifier DC Voltage, Current	Voltage: 12.0V Current: 160mA

2.1 Circuit Diagram

Refer to the Circuit Schematic in the Attachment section of this report.

2.2 Function of Each Active Device

1. Q1 (2SC1009A) – Oscillator and Multiplier
2. Q2 (2SC3772) – Driver
3. Q3 (2SC4272) – Final Stage RF Amplifier
4. IC1 (FP6324) – Encoder
5. IC2 (78L05) – Voltage Stabilizer

2.3 Tune-up Alignment Procedure

1. Tune the core of L5 counter-clockwise to 1.
2. Tune the core of L6 counter-clockwise to 3.
3. L1, L2, L3, L5, & L6 tune to generate the maximum power.
4. Repeat 1 again
5. L5, L6 tune to generate the maximum power.
6. Adjust L6 for maximum power. Then clockwise to ¼ turn.

2.4 Frequency Stabilization Circuitry

1. D3 (RLZ5, 1B) – Zener diode to regulate the supply voltage of the oscillator.
2. Crystal – Stabilizes oscillating frequency.
3. C1 (UJ 68pF) – Temperature compensation capacitor.
4. C1 (RH 100pF) – Temperature compensation capacitor.
5. C1 (RH 33pF) – Temperature compensation capacitor.

2.5Additional Circuit Information

1. The type of oscillator utilized by the EUT is a Crystal controlled modified Colpitts oscillator.
2. The following components are used for suppression of spurious radiation from the antenna:
   Modified π filter
   - L5, L6 (M7-D3-005)
   - C16 (RH 47pF)
   - C17 (RH 12pF)
   - C19 (RH 56pF)
   - C21 (CH 10pF)
3. Audio Low Pass Filter
   - Q5 2SC2412
   - R18 (10kΩ)
   - R19 (10kΩ)
   - R20 (47kΩ)
   - C30 (2.2nF)
   - C31 (1nF)
4. No Digital Modulation technique was employed.

4. BLOCK DIAGRAM(S) OF EUT

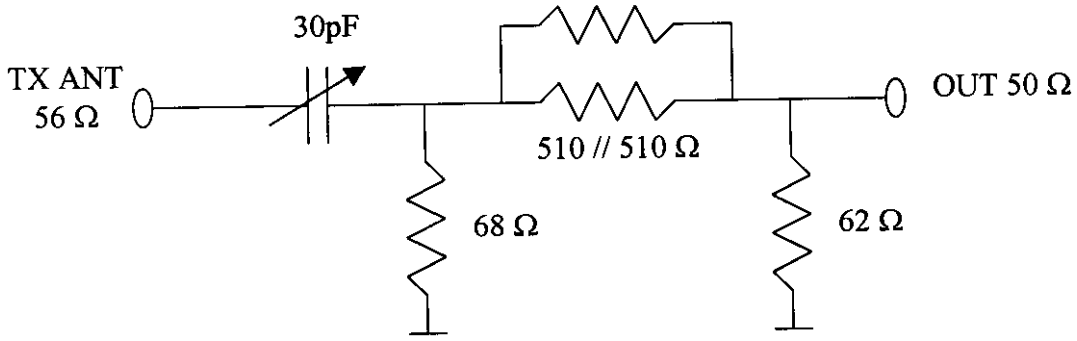
Refer to the Attachment section of this report for a circuit block diagram of the EUT.

5. TEST RESULTS

5.1 RF Power Output

The maximum transmitter power for an R/C transmitter operating in the frequency band of 72–76 MHz should not exceed 0.75 W.

The output power was measured at the RF output terminals of a radio frequency load that was attached to the EUT. The electrical characteristics of the load are as follows:



Attached RF Load provides 20dB attenuation.

The maximum output power was measured with a Spectrum Analyzer at the 50Ω terminal of the load attached to the EUT. The EUT's maximum output power was found to be 22.1dBm / 0.162W. The EUT's output power does not exceed the maximum transmitter power for an R/C transmitter operating in the frequency band of 72 –76MHz.

5.2 Occupied Bandwidth

As stated in 47 CFR 2.989, the occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission. The occupied bandwidth measurements were made with the modulating signal. The authorized bandwidth for any emission type transmitted by and R/C transmitter is 8kHz. The test result plots are enclosed in Appendix B of this report.

5.3 Field Strength of Spurious Radiation

Measurements were made to detect spurious emissions. The EUT was placed 80 centimeters above the ground plane on a non-conductive tabletop 1.0-meter width by 1.5-meter length. The configuration of the EUT and its cables were varied to maximize the amplitude levels of the emissions. The highest emissions were maximized by rotating the turntable 360 degrees and varying the antenna height from 1 to 4 meters. The frequency range up to the 10th harmonic was measured utilizing a BiLog antenna, and the measurements were made in both vertical and horizontal polarization. The distance between the EUT and the measuring antenna was 3 meters. All spurious emissions need to be attenuated by (56 + 10log TP) from the reference carrier field strength. The following table contains the test results.

Tuned Frequency: 75.650MHz
Measurement Distance: 3m
FCC Limit: 110.3 – (56 + 10log 0.162)
= 62.2 dBμV/m

Frequency of Emission (MHz)	*Emission Level (dBμV)*	*Correction Factor* (dB)*	*Corrected Reading (dBμV/m)*	*FCC Limit @ 3 meters (dBμV/m)*	*Delta to FCC limit (dB)*
75.65	126.8	-16.5	110.3		
151.30	63.7	-11.6	52.1	62.2	-10.1
226.95	62.4	-11.4	51.0	62.2	-11.2
302.60	59.0	-7.8	51.2	62.2	-11.0
378.25	47.0	-5.5	41.5	62.2	-20.7
453.90	36.3	-3.5	32.8	62.2	-29.4
529.55	46.4	-1.5	44.9	62.2	-17.3
605.20	52.5	-0.6	51.9	62.2	-10.3
680.85	45.7	1.3	47.0	62.2	-15.2
756.50	38.0	3.4	41.4	62.2	-20.8

* The Correction Factor consist of Antenna Factor + Cable Loss – Preamplifier Gain.

5.4 Frequency Stability

The EUT's carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency over the variations of extreme ambient temperature and supply voltage.

The EUT was placed in a temperature chamber. The temperature was set to the lowest requirement, -30°C, and there was a waiting period of at least 2 hours, until a stable temperature was reached inside the EUT. A frequency measurement was made once a period of time sufficient enough to stabilize all of the components of the oscillator circuit elapsed. The temperature was then increased by 10°C increments. Again, sufficient time was allowed to elapse in order to stabilize the components of the oscillator circuit, and then a frequency was measurement was made. This was done until the maximum requirement, +50°C, was reached. The following table contains the results:

Frequency Stability vs. Temperature

Frequency tuned: 75.650MHz
Frequency Accuracy Required: 0.002%

Operating Temperature (°C)	*Frequency Measured (MHz)*	*Frequency Deviation (Hz)*	*Frequency Deviation (%)*
-30	75.649684	-316.0	-0.000418
-20	75.649839	-161.5	-0.000213
-10	75.649971	-29.5	-0.000039
0	75.650022	22.0	0.000029
+10	75.650064	64.0	0.000085
+20	75.650100	100.0	0.000132
+30	75.650010	9.5	0.000013
+40	75.649828	-172.0	-0.000227
+50	75.649768	-232.5	-0.000307

Frequency stability was measured with variation of primary supply voltage. For battery powered equipment, the primary supply voltage was reduced to the battery operating end point. The following table contains the results:

Frequency Stability vs. Supply Voltage

Frequency Tuned: 75.650MHz Frequency Accuracy Required: 0.002%
Normal Input Voltage: 12VDC Temperature: 20°C

Input Voltage (V)	*Frequency Measured (MHz)*	*Frequency Deviation (Hz)*	*Frequency Deviation (%)*
8.0	75.649785	-215.5	-0.000285
8.5	75.649886	-114.5	-0.000151
9.0	75.649951	-49.0	-0.000065
9.6	75.649997	-3.5	-0.000005
10.0	75.650027	26.5	0.000035
11.0	75.650052	52.0	0.000069
11.5	75.650076	75.5	0.000100
12.0	75.650100	100.0	0.000132

APPENDIX A - TEST EQUIPMENT USED

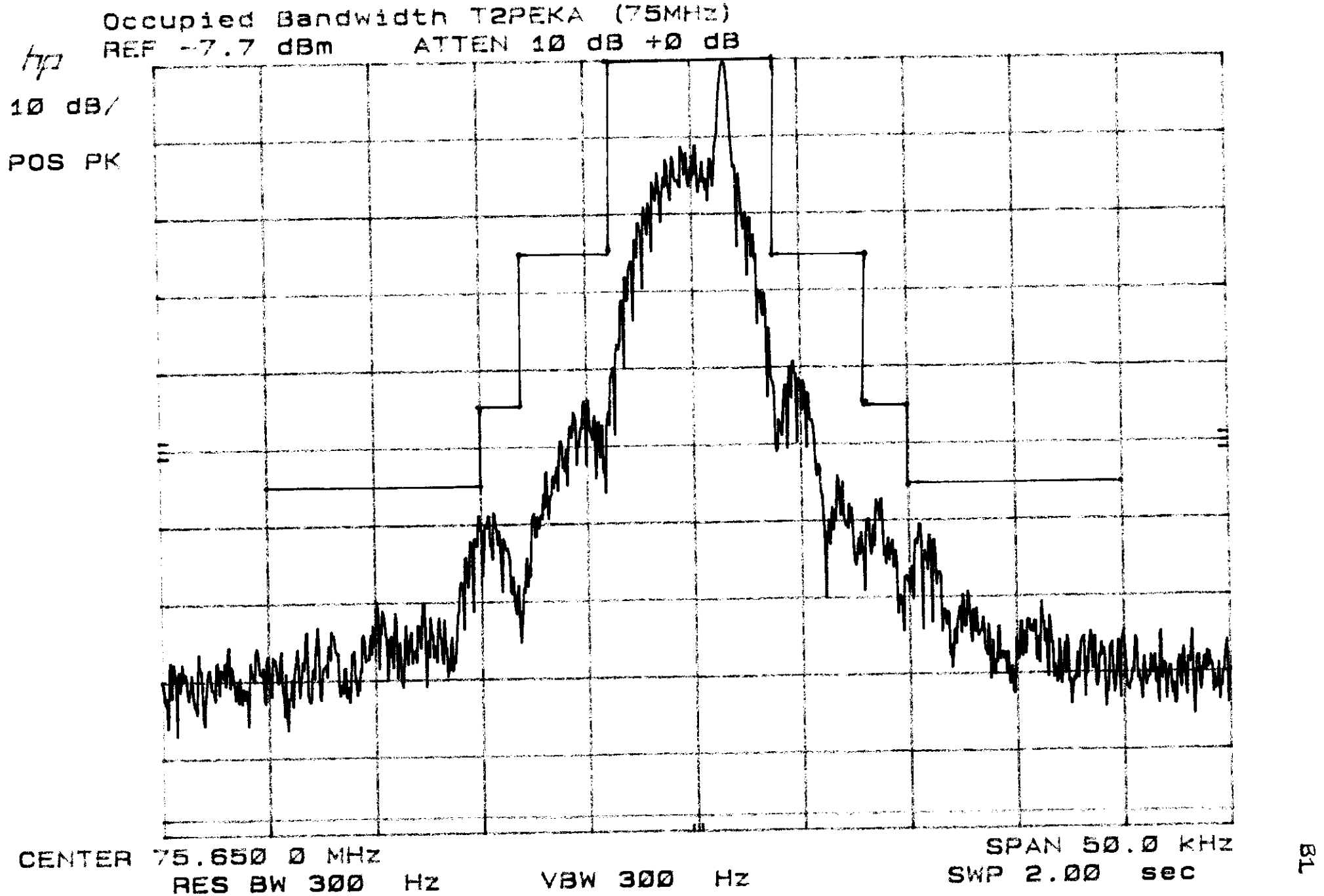
A complete list of test equipment used for each test can be found in their perspective test procedure. The equipment absolute performance calibration, of the equipment requiring calibration, is performed on an as needed basis in accordance with MIL-STD-45662. However, calibration periods do not exceed one (1) year. The test equipment is capable of making measurements within tolerances of at least +/- 2 dB amplitude and +/-2% frequency deviation. Equipment certifications showing traceability to NIST (National institute of Standards and Technology) are maintained on file at Garwood Laboratories, Inc., Placentia CA. All equipment is checked and verified for proper operation before and after each series of tests.

A.1 Specific Equipment Used

Test Instrument	*Mfg / Model No.*	*Serial No.*	*Cal. Due Date*
Radiated Emissions Test			
Spectrum Analyzer	Hewlett Packard / 8568B	2007A01154	10/14/99
Pre-Selector	Hewlett Packard / 85685A	3010A01156	10/14/99
Quasi-Peak Adapter	Hewlett Packard / 85650A	2412A00400	10/14/99
BiLog Antenna	Chase / CBL6111A	1823	04/03/99
Preamplifier (30-1000MHz)	ISCI / ZFL-2000	017	03/05/99
RF Coax Cable	Times Microwave / LMR-600	030	03/05/99
High Pass Filter	Mini-Circuits / NHP-100	N/A	10/10/99
High Pass Filter	Mini-Circuits / NHP-250	N/A	10/10/99

APPENDIX B – SUPPLEMENTAL TEST DATA

Basic Standard	*Test Type*	*Data Format*	*Page No.*
Part 95 Subpart C, E Part 2 Subpart J	Occupied Bandwidth	Plotted	B1
	Frequency Stability	Tabulated	B2


Occupied Bandwidth T2PEKA (75MHz)
REF -7.7 dBm
ATTEN 10 dB +0 dB
10 dB/
POS PK
CENTER 75.650 0 MHz
RES BW 300 Hz
VBW 300 Hz
SPAN 50.0 kHz
SWP 2.00 sec

FREQUENCY STABILITY V.S. TEMPERATURE

Frequency tuned 75.650 MHz

Frequency Accuracy 0.002%

Vcc=12.0v

Operating Tenperature (℃)	Frequency Maesured (MHz)	Frequency Deviation (Hz)	Frequency Deviation (%)
-30	75.649684	-316.0	-0.000418
-20	75.649839	-161.5	-0.000213
-10	75.649971	-29.5	-0.000039
0	75.650022	22.0	0.000029
+10	75.650064	64.0	0.000085
+20	75.650100	100.0	0.000132
+30	75.650010	9.5	0.000013
+40	75.649828	-172.0	-0.000227
+50	75.649768	-232.5	-0.000307

FREQUENCY STABILITY V.S SUPPLY VOLTAGE

Normal Input Voltage 12.0 (V)D.C.

Frequency Tuned 75.650 MHz

Specification Limit:Frequency Accuracy 0.005%

±15% of Input Voltage.

Temperature (20℃)

Input Voltage (V)	Frequency Maesured (MHz)	Frequency Deviation (Hz)	Frequency Deviation (%)
8.0	75.649785	-215.5	-0.000285
8.5	75.649886	-114.5	-0.000151
9.0	75.649951	-49.0	-0.000065
9.6	75.649997	-3.5	-0.000005
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12.0	75.650100	100.0	0.000132

ATTACHMENTS

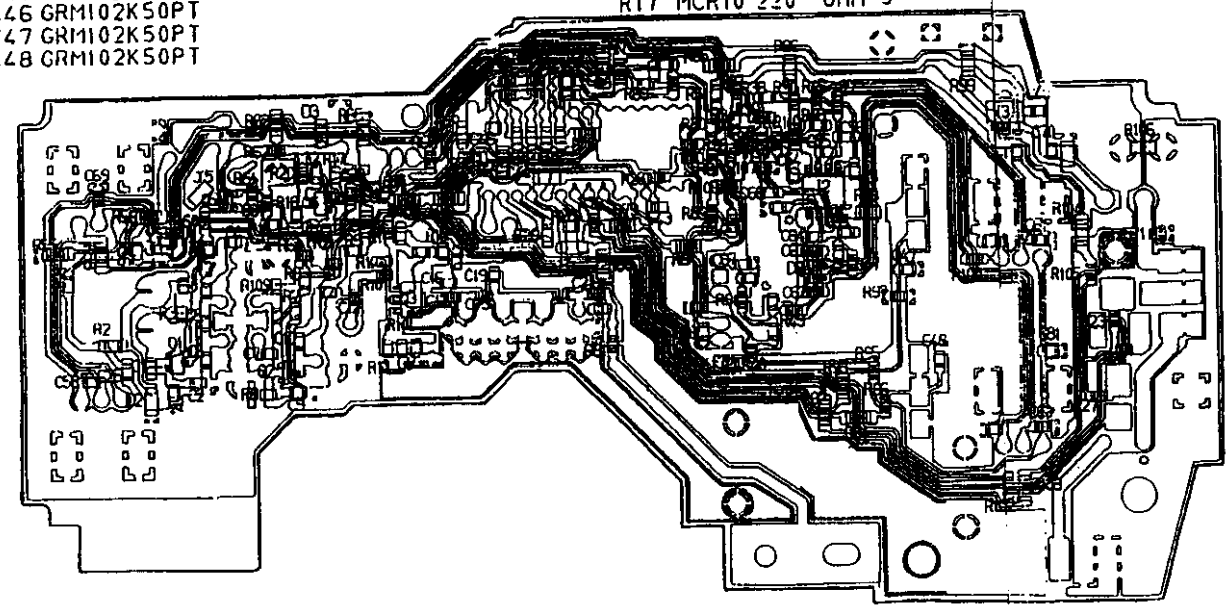
INDEX OF ATTACHMENTS

SYMBOL No.					
APPLICATION	CHARGE	DATE	ANNAL		

C1	C2012UJ1H680J	C50	GRM102K50PT
C2	C2012RH1H101J	C51	GRM102K50PT
C3	C2012RH1H330J	C52	MCR10 JPW
C4	GRM223Z50PT	C53	GRM102K50PT
C5	C2012CH1H010C	C54	GRM223Z50PT
C6	C2012RH1H330J	C55	GRM102K50PT
C7	C2012CH1H560J	C56	GRM102K50PT
C9	GRM223Z50PT	C57	GRM102K50PT
C10	C2012RH1H330J	C58	GRM102K50PT
C11	GRM223Z50PT	C59	GRM102K50PT
C12	GRM223Z50PT	C60	GRM102K50PT
C14	GRM223Z50PT	C61	GRM102K50PT
C15	GRM223Z50PT	C62	GRM102K50PT
C16	C2012RH1H470J	C63	GRM102K50PT
C17	C2012RH1H120J	C64	GRM102K50PT
C19	C2012RH1H560J	C65	GRM102K50PT
C21	C2012RH1H100J	C66	GRM102K50PT
C25	GRM102K50PT	C67	GRM102K50PT
C28	GRM223Z50PT	C68	GRM102K50PT
C31	GRM102K50PT	C69	GRM102K50PT
C32	GRM102K50PT	C70	GRM223Z50PT
C33	GRM102K50PT	C71	GRM223Z50PT
C35	GRM102K50PT		
C40	GRM223Z50PT		
C41	GRM223Z50PT		
C43	GRM102K50PT		
C44	TESVA1E474KI-8R		
C45	GRM223Z50PT		
C46	GRM102K50PT		
C47	GRM102K50PT		
C48	GRM102K50PT		

C75	MCR10 27K OHM J	R18	MCR10 10K OHM J
D2	ISV200-TR	R19	MCR10 10K OHM J
D3	RLZ5.1B	R20	MCR10 47K OHM J
D4	RLS-73TE-11	R21	MCR10 47K OHM J
D8	DA204K-T147	R22	MCR10 47K OHM J
I2	UPC358G E2	R23	MCR10 680 OHM J
I3	UPC78L05T-E1	R24	MCR10 680 OHM J
J5	RCS00000C001A	R26	MCR10 10K OHM J
Q1	2SC1009A-FA4-T1	R27	MCR10 680 OHM J
Q2	2SC3772-3.4-MSP-TA	R28	MCR10 100K OHM J
Q3	2SC4272F-TC	R29	MCR10 4.7K OHM J
Q5	2SC2412S SMT T-96	R30	MCR10 100 OHM J
Q6	2SC2412S SMT T-96	R31	MCR10 100 OHM J
R2	MCR10 10K OHM J	R34	MCR10 15 KOHM F
R3	MCR10 220K OHM J	R35	MCR10 15 KOHM F
R4	MCR10 560 OHM J	R36	MCR10 10 KOHM J
R5	MCR10 22 OHM J	R37	MCR10 4.7K OHM J
R6	MCR10 2.4K OHM J	R38	MCR10 10 KOHM J
R7	MCR10 1.5K OHM J	R39	MCR10 560KOHM J
R8	MCR10 56 OHM J	R40	MCR10 2.2KOHM F
R9	MCR10 22 OHM J	R41	MCR10 2.2KOHM F
R10	MCR10 1 OHM J	R44	MCR10 39 KOHM F
R11	MCR10 2.4K OHM J	R45	MCR10 39 KOHM F
R12	MCR10 220 OHM J	R46	MCR10 91 KOHM G
R13	MCR10 1 OHM J	R47	MCR10 33 KOHM J
R14	MCR10 1 OHM J		
R15	MCR10 680 OHM J		
R16	MCR10 1.2K OHM J		
R17	MCR10 220 OHM J		

R48	MCR10 33 KOHM J	R86	MCR18 JPW
R49	MCR10 51 KOHM J	R87	MCR10 JPW
R50	MCR10 10 KOHM J	R88	MCR10 JPW
R51	MCR10 180KOHM J	R89	MCR10 JPW
R54	MCR10 150KOHM J	R90	MCR10 JPW
R55	MCR18 JPW	R91	MCR10 JPW
R56	MCR10 JPW	R92	MCR18 JPW
R57	MCR10 JPW	R93	MCR18 JPW
R58	MCR18 JPW	R94	MCR18 JPW
R59	MCR18 JPW	R95	MCR10 JPW
R60	MCR10 JPW	R96	MCR10 JPW
R61	MCR10 JPW	R97	MCR10 JPW
R62	MCR10 JPW	R98	MCR18 JPW
R63	MCR18 JPW	R99	MCR18 JPW
R64	MCR10 JPW	R100	MCR10 JPW
R65	MCR18 JPW	R101	MCR10 JPW
R66	MCR18 JPW	R102	MCR10 JPW
R67	MCR10 JPW	R103	MCR18 JPW
R68	MCR10 JPW	R104	MCR18 JPW
R69	MCR18 JPW	R105	MCR10 JPW
R70	MCR18 JPW	R106	MCR18 JPW
R71	MCR10 JPW	R107	MCR10 JPW
R72	MCR18 JPW	R108	MCR18 JPW
R73	MCR10 JPW	R109	MCR10 JPW
R74	MCR18 JPW	R110	MCR18 JPW
R75	MCR18 JPW		
R76	MCR18 JPW		
R77	MCR18 JPW		
R78	MCR10 JPW		
R79	MCR18 JPW		
R80	MCR18 JPW		
R81	MCR10 JPW		
R82	MCR10 JPW		
R83	MCR10 JPW		
R84	MCR18 JPW		
R85	MCR18 JPW		



Solder Side

名称 NAME	T2PEKA FM (75MHz)	基板名 PCB	TA23
設計 DESIGN	製図 DRAWN	検図 CHECKED	承認 APPROVED
洪 99.2.3 清長	佐久 99.2.3 間道		
日付 DATE	1999.2.3	図番 DWG.NO	10R-980105 △
		頁 SHEET	OF
		双葉電子工業株式会社	

EXHIBIT 5