ENGINEERING TEST REPORT

Series 2000, 3000 Remote Control Engine Starter Transmitters
MODEL NO.: AstroStart 2000

FCC ID: J5F-TX2000

In Accordance With

FCC PART 15, SUBPART C, PARA. 15.231
PERIODIC OPERATING TRANSMITTERS AT 372.5 MHz

UltraTech's FILE NO.: ATR6-231

Tested for:

ASTROFLEX INC.
1164, route 220
St-Elie-d'Orford, Quebec
Canada, J0B 2S0

Tested by:

ULTRATECH GROUP OF LABS
4181 Sladeview Crescent, Unit 33
Mississauga, Ontario
Canada L5L 5R2

REPORT PREPARED BY: Dan Huynh

DATE: August 13, 1998

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1. EXHIBIT 1 - SUMMARY OF TEST RESULTS & GENERAL STATEMENT OF CERTIFICATION

FCC PARAGRAPH.	TEST REQUIREMENTS	COMPLIANCE (YES/NO)
15.203	Antenna Requirement	Yes
15.231(a)	Provisions of FCC 15.231	Yes
15.231(a) & (b)	Transmitter Radiated Emissions - Fundamental, Harmonic and Spurious	Yes
1.1310	RF Exposure Limits	Yes
15.231(c)	20 dB Bandwidth	Yes
15.107, 15.109	AC Power Conducted Emissions & Radiated Emissions for Receiver and Digital Circuit Portions	Not applicable for battery operated device.

TESTIMONIAL AND STATEMENT OF CERTIFICATION

THIS IS TO CERTIFY:

1) *THAT the application was prepared either by, or under the direct supervision of the undersigned.*

2) *THAT the measurement data supplied with the application was taken under my direction and supervision.*

3) *THAT the data was obtained on representative production units, randomly selected.*

4) *THAT, to the best of my knowledge and belief, the facts set forth in the application and accompanying technical data are true and correct.*

Certified by:

Tri Minh Luu, P. Eng.
V.P., Engineering

DATE: August 13, 1998

2. EXHIBIT 2 - GENERAL INFORMATION

2.1. APPLICANT

ASTROFLEX INC.
1164, route 220
St-Elie-d'Orford, Quebec
Canada, J0B 2S0

Applicant's Representative: Mr. Normand Dery

2.2. MANUFACTURER

ASTROFLEX INC.
1164, route 220
St-Elie-d'Orford, Quebec
Canada, J0B 2S0

2.3. DESCRIPTION OF EQUIPMENT UNDER TEST

PRODUCT NAME:	Series 2000, 3000 Remote Control Engine Starter Transmitters
MODEL NO.:	AstroStart 2000
SERIAL NUMBER:	Pre-production
TYPE OF EQUIPMENT:	Periodic Low Power Transmitters
OPERATING FREQ.:	372.5 MHz
POWER RATING:	0.00016 mW E.I.R.P
BANDWIDTH (20 dB OBW):	95.4 kHz
EMISSION DESIGNATION @ 15.201:	95K4 P1N
DUTY CYCLE:	6.2%
INPUT SUPPLY:	9 V dc Battery
INTERFACE PORTS:	N/A
ASSOCIATED RECIEVER:	This transmitter is marketed for use with the Astroflex Series 120 remote Control Engine Starter Receiver, Model AstroStart 2000, which was already notified to FCC with FCC ID: J5F-RX120.

2.4. RELATED SUBMITTAL(S)/GRANT

This transmitter is marketed for use with the Astroflex Series 120 remote Control Engine Starter Receiver, Model AstroStart 2000, which was already notified to FCC with FCC ID: J5F-RX120

2.5. TEST METHODOLOGY

These tests were conducted on a sample of the equipment for the purpose of certification compliance with Code of Federal Regulations (CFR47-1991), Part 15, Subpart C, Para. 15.231, Periodic Low Power Transmitters

Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4-1992 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz.

2.6. TEST FACILITY

AC Powerline Conducted Emissions were performed in UltraTech's shielded room, 16'(L) by 12'(W) by 12'(H).

Radiated Emissions were performed at the UltraTech's 3-10 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: July 16, 1997.

The above test site is also filed with Interference Technology International Ltd (ITI - An EC Directive on EMC).

2.7. UNITS OF MEASUREMENTS

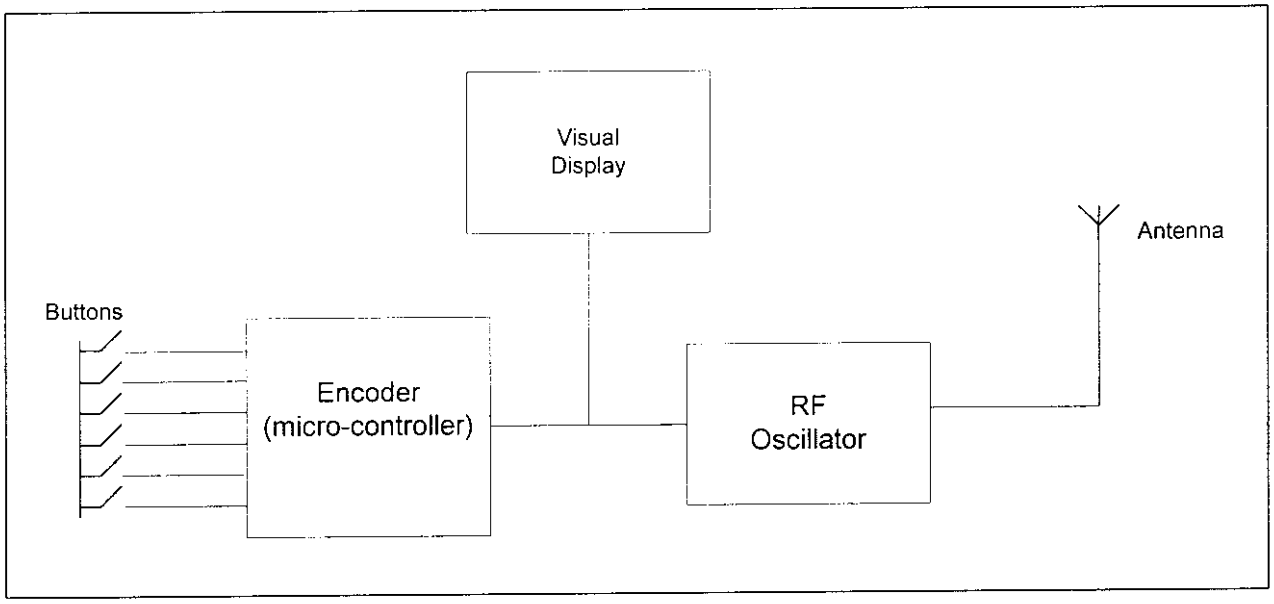
Measurements of conducted emissions are reported in units of dB referenced to one microvolt [dB(uV)].

Measurements of radiated emissions are reported in units of dB referenced to one microvolt per meter [dB(uV)/m] at the distance specified in the report, wherever it is applicable.

3. EXHIBIT 3 - SYSTEM TEST CONFIGURATION

3.1. BLOCK DIAGRAMS FOR CONDUCTED & RADIATED EMISSION MEASUREMENTS

Series 2000, 3000 Remote Control Engine Starter Transmitters



EUT

3.3. JUSTIFICATION

No deviation, in both configuration and operation manners, different from normal operation were required.

3.4. EUT OPERATING CONDITION

The remote transmitter uses a single IC (PIC16C54 8 bits microcontroller (uC)) to detect the status of the input switches and to encode the signal to be transmitted. When a switch is being depressed, power is applied to the uC and it then begins executing the programmed code. When the button or combination of buttons is recognized and approved by the uC, information is sent to the rf oscillator. The RF oscillator reacts to the information by turning itself on and off. This behavior results in an OOK (On Off Keying) modulated RF signal being transmitted by a loop antenna printed on the printed circuit board. As the process progresses, visual displays in the form of a Light Emitting Diode (LED) signal to the user the different stages of transmission. This process was maintained continuously during testing.

3.5. SPECIAL ACCESSORIES

No special accessories were required.

3.6. EQUIPMENT MODIFICATIONS

To achieve compliance, the following change(s) were made by UltraTech's test house during compliance testing:

None noted.

4. EXHIBIT 4 - TEST DATA

4.1. ANTENNA REQUIREMENTS @ FCC CFR 47, PARA 15.203

PRODUCT NAME: **Series 2000, 3000 Remote Control Engine Starter Transmitters, Model No.: AstroStart 2000**

FCC REQUIREMENTS:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Notes: This requirement does not apply to carrier current devices operated under the provisions of @ 15.211, 15.213, 15.217, 17.219 or 15.221.

ENGINEERING ANALYSIS:

Internal integral antenna component mounted on the printed circuit board.

TEST RESULTS: Conforms.

TEST PERSONNEL: Tri Luu, P. ENG.

DATE: August 11, 1998

4.2. PROVISIONS OF FCC 15.231(A) FOR PERIODIC TRANSMITTERS

PRODUCT NAME: **Series 2000, 3000 Remote Control Engine Starter Transmitters, Model No.: AstroStart 2000**

ENGINEERING ANALYSIS

FCC PROVISSIONS	ANALYSIS ON COMPLIANCE
Permitted Type of Devices (alarm systems, door opener, remote switches etc ...)	Remote Switch
Prohibited Type of Devices (radio control of toys)	Not radio control toys
Prohibited Transmission Type (voice, video or data continuous transmission)	Recognition codes to identify other particular component as part of the system
A Manually Operated Transmitter (shall employ with the switch that automatically deactivate the transmitter within 5 seconds of being released)	The transmitter is automatically deactivated within less than 1 seconds (approx. 0.878 seconds of being releases.
Periodic Transmissions: at regular predetermined intervals are not permitted. However, polling or supervision transmissions to determine system integrity of transmitter used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for the transmitter Internal Radiators which are not employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.	N/A

TEST RESULTS: Conforms.

TEST PERSONNEL: Tri Luu, P. ENG.

DATE: August 11, 1998

4.3. TRANSMITTER RADIATED EMISSIONS @ 3 METERS, FCC CFR 47, PARA. 15.231(B)(C), 15.209 & 15.205

PRODUCT NAME: **Series 2000, 3000 Remote Control Engine Starter Transmitters, Model No.: AstroStart 2000**

FCC REQUIREMENTS:

The RF radiated emissions measured at 3 Meter distance shall not exceed the field strength below:

Fundamental Frequency (MHz)	Average Field Strength Limits (μV)	
	Fundamental	Harmonic/Spurious
260 - 470 MHz	3750 - 12,500	375 - 1250

All other emissions inside restricted bands specified in @ 15.205(a) shall not exceed the general radiated emission limits specified in @ 15.209(a)

Remarks:

- Applies to harmonics/spurious emissions that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209.
- **@ FCC CFR 47, Para. 15.237(c)** - The emission limits as specified above are based on measurement instrument employing an average detector. The provisions in **@15.35** for limiting peak emissions apply.

FCC CFR 47, Part 15, Subpart C, Para. 15.205(a) - Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	162.0125 - 167.17	2310 - 2390	9.3 - 9.5
0.49 - 0.51	167.72 - 173.2	2483.5 - 2500	10.6 - 12.7
2.1735 - 2.1905	240 - 285	2655 - 2900	13.25 - 13.4
8.362 - 8.366	322 - 335.4	3260 - 3267	14.47 - 14.5
13.36 - 13.41	399.9 - 410	3332 - 3339	14.35 - 16.2
25.5 - 25.67	608 - 614	3345.8 - 3358	17.7 - 21.4
37.5 - 38.25	960 - 1240	3600 - 4400	22.01 - 23.12
73 - 75.4	1300 - 1427	4500 - 5250	23.6 - 24.0
108 - 121.94	1435 - 1626.5	5350 - 5460	31.2 - 31.8
123 - 138	1660 - 1710	7250 - 7750	36.43 - 36.5
149.9 - 150.05	1718.8 - 1722.2	8025 - 8500	Above 38.6
156.7 - 156.9	2200 - 2300	9000 - 9200	

FCC CFR 47, Part 15, Subpart C, Para. 15.209(a)
-- Field Strength Limits within Restricted Frequency Bands --

FREQUENCY (MHz)	FIELD STRENGTH LIMITS (microvolts/m)	DISTANCE (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

CLIMATE CONDITION:

Standard Temperature and Humidity:

- Ambient temperature: 23+3 °C
- Relative humidity: 50+5 %
- Atmospheric Pressure: 100+5 kPa

POWER INPUT:

9 V dc Battery.

TEST EQUIPMENT:

- **Spectrum Analyzer**, Advantest, Model R3271, S/N: 15050203, 100 Hz to 32 GHz)
- **Microwave Amplifier**, HP, Model 83017A, Frequency Range 1 to 26.5 GHz, 34-38 dBdB gain nominal.
- **Active Loop Antenna**, Emco, Model 6507, SN 8906-1167, Frequency Range 1 KHz - 30 MHz, @ 50 Ohms
- **Log Periodic/Bow-Tie Antenna**, Emco, Model 3143, SN 1029, 20 - 1000 MHz, @ 50 ohms.
- **Horn Antenna**, Emco, Model 3115, SN 9701-5061, Frequency Range: 1 - 18 GHz, @ 50 Ohms.

METHOD OF MEASUREMENTS:

Refer to **ANSI 63.4-1992, Para. 8** for detailed radiated emissions measurement procedures.

Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. the maximum permitted average field strength is listed in Section 15.209. A Pre-Amp and highpass filter are used for this measurement.

- For measurements from 9 KHz to 150 KHz, set RBW = 200 Hz, VBW $\geq$ RBW, SWEEP=AUTO.
- For measurements from 150 KHz to 30 MHz, set RBW = 10 KHz, VBW $\geq$ RBW, SWEEP=AUTO.
- For measurements from 30 MHz to 1 GHz, set RBW = 100 KHz, VBW $\geq$ RBW, SWEEP=AUTO.
- For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz, SWEEP=AUTO.

If the emission is pulsed, modified the unit for continuous operation, then use the settings above for measurements, then correct the reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

FCC CFR 47, Para. 2.997 - Frequency spectrum to be investigated

The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10th harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC CFR 47, Para. 2.993 - Field Strength Spurious Emissions

(a) Measurements was made to detect spurious emissions radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data were supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph 2.989(c) as appropriate. For equipment operating on frequencies below 1 GHz, an Open Field Test is normally required, with the measuring instrument antenna located in the far field at all test frequencies. In event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurement will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with the reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

(b) Measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emission are required to be 60 dB or more below the mean power of the transmitter.
(2) All equipment operating on frequencies higher than 25 MHz
(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
(4) Other types of equipment as required, when deemed necessary by the Commission.

TEST RESULTS: Conforms.

TEST PERSONNEL: Mr. Hung Trinh, Technician

DATE: August 11, 1998

MEASUREMENT DATA

RADIATED EMISSIONS MEASUREMENTS @ 3 METERS

TEST CONFIGURATION

- For measurements from 9 KHz to 150 KHz, set RBW = 200 Hz, VBW ≥ RBW, SWEEP=AUTO.
- For measurements from 150 KHz to 30 MHz, set RBW = 10 KHz, VBW ≥ RBW, SWEEP=AUTO.
- For measurements from 30 MHz to 1 GHz, set RBW = 100 KHz, VBW ≥ RBW, SWEEP=AUTO.
- For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz, SWEEP=AUTO.
- *The following measurements were the worst cases when the radiating antenna was placed in both horizontal and vertical polarization.*
- *The following **AVERAGE** rf levels were obtained from either Peak readings added by the duty cycle correction factor. **DUTY CYCLE FACTOR = $20LOG_{10}(0.062)$ = -24.2 dB***

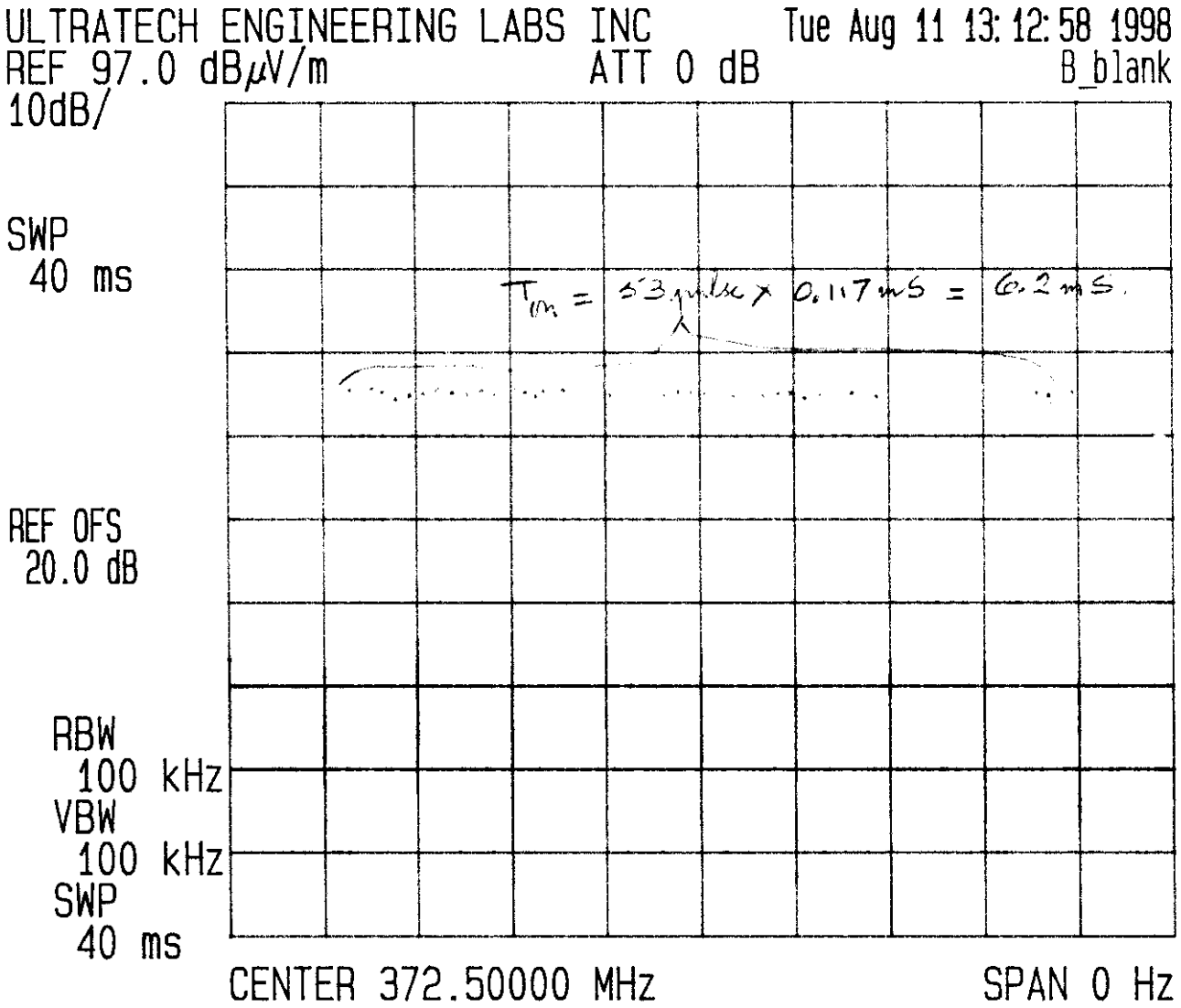
The radiated emissions tests were repeated with the EUT placed in three different orthogonal positions (back down, stand up and side up), and the worst case of measurements were recorded as follows:

FREQUENCY (MHz)	RF PEAK LEVEL (dBuV/m)	RF AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
372.50	81.47	57.3	V	--	78.5 ✓	-21.2	PASS
372.50	77.31	53.1	H	--	78.5	-25.4	PASS
745.00	70.09	45.9	V	~~46.0~~	58.5	-12.6	PASS
745.00	75.66	51.5	H	~~46.0~~	58.5	-7.0	PASS
1117.50	65.44	41.2	V	54.0	~~58.5~~	-12.8	PASS**
1117.50	66.63	42.4	H	54.0	~~58.5~~	-11.6	PASS**
1490.00	67.47	43.3	V	54.0	~~58.5~~	-10.7	PASS**
1490.00	71.22	47.0	H	54.0	~~58.5~~	-7.0	PASS**
1862.50	58.38	34.2	V	~~54.0~~	58.5	-24.3	PASS
1862.50	63.19	39.0	H	~~54.0~~	58.5	-19.5	PASS
2235.00	52.25	28.1	V	54.0	~~58.5~~	-26.0	PASS**
2235.00	51.16	27.0	H	54.0	~~58.5~~	-27.0	PASS**
2607.50	53.50	29.3	V	~~54.0~~	58.5	-29.2	PASS
2607.50	55.03	30.8	H	~~54.0~~	58.5	-27.7	PASS
2980.00	55.72	31.5	V	~~54.0~~	58.5	-27.0	PASS
2980.00	55.03	30.8	H	~~54.0~~	58.5	-27.7	PASS
3352.50	60.00	35.8	V	54.0	~~58.5~~	-18.2	PASS**
3352.50	57.50	33.3	H	54.0	~~58.5~~	-20.7	PASS**
3725.00	63.03	38.8	V	54.0	~~58.5~~	-15.2	PASS**
3725.00	57.31	33.1	H	54.0	~~58.5~~	-20.9	PASS**

No other significant emissions were found in the frequency range from 10 MHz to 10 GHz. Refer to attached plots for details

*** Emission within the restricted band specified in @ 15.205(a)***

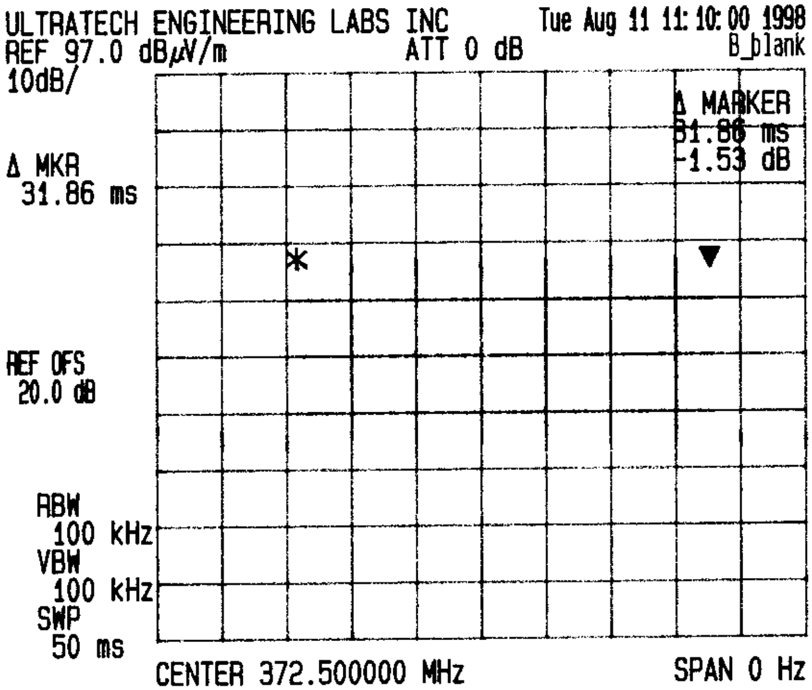
DUTY CYCLE MEASUREMENTS



Date: August 11, 1998
Tested by: Hung Trinh

ASTROFLEX
SERIES 2000,3000 REMOTE CONTROL ENGINE STARTER TRANSMITTER
Model : Astrostart

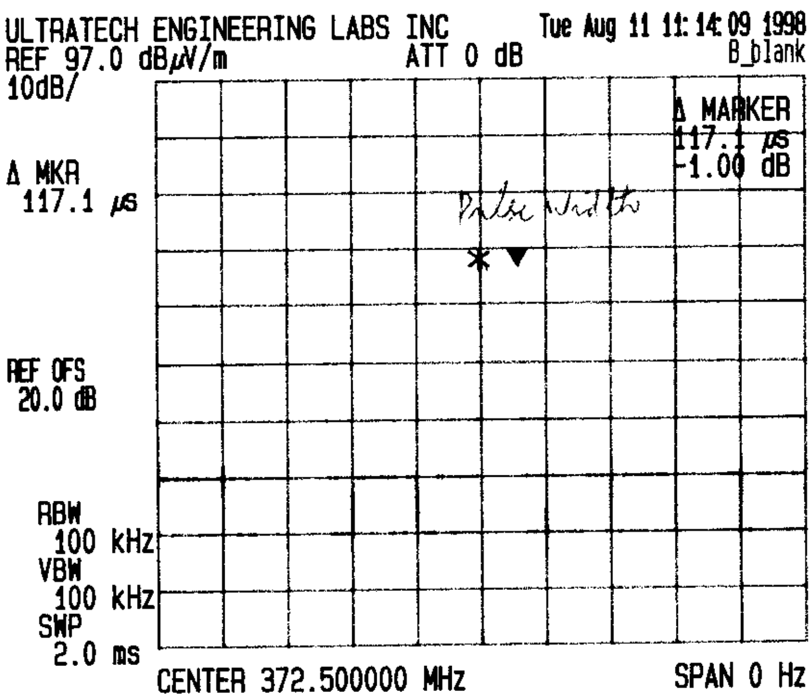
DUTY CYCLE MEASUREMENTS



DUTY CYCLE = $\frac{T_{on}}{T_{on} + T_{off}} = \frac{6.2\ mS}{100\ mS} = 0.062 \approx 6.2\%$

PEAK-TO-AVERAGE FACTOR = $20 \log 0.062 = -24.2\ dB$

~~Maximum Peak-to-Average Factor allowed to be used -20dB~~

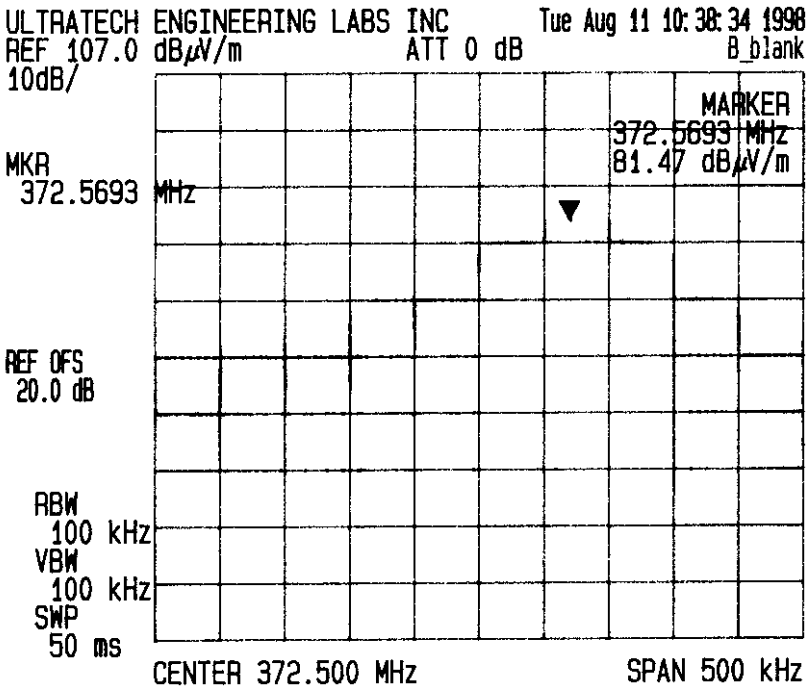


UltraTech
Engineering Labs Inc.

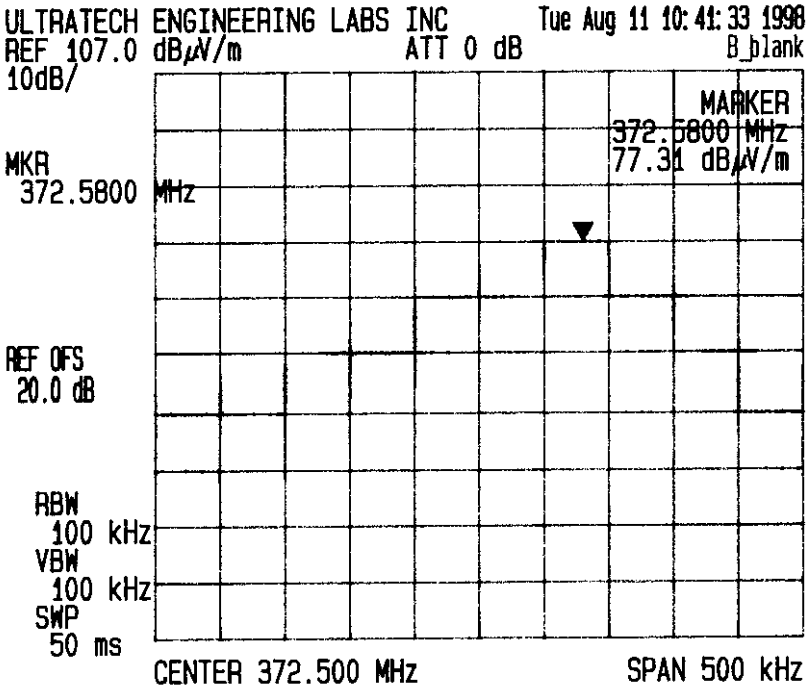
Date: August 11, 1998
Tested by: Hung Trinh

ASTROFLEX
SERIES 2000,3000 REMOTE CONTROL ENGINE STARTER TRANSMITTER
Model : Astrostart

Radiated Emissions Measurements @ 3 Meters
Antenna Polarization: Horizontal & Vertical



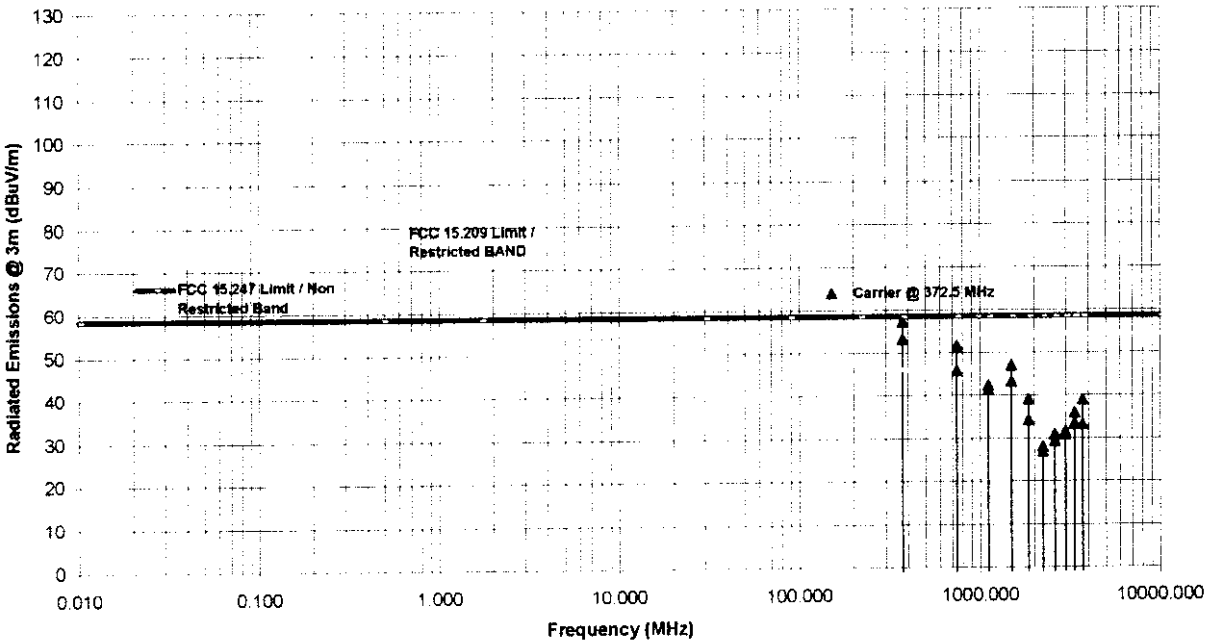
VERTICAL



HORIZONTAL

UltraTech
Engineering Labs Inc.

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
Astroflex Series 2000, 3000 Remote Control Engine Starter Transmitters
Model AstroStart 2000
TRANSMIT Freq.: 372.5 MHz



4.4. 20 DB BANDWIDTH @ FCC CFR 47, PARA. 15.209(C)

PRODUCT NAME: **Series 2000, 3000 Remote Control Engine Starter Transmitters, Model No.: AstroStart 2000**

FCC REQUIREMENTS:

The 20dB bandwidth of the emission shall be no more than 0.25% of the centre frequency for devices operating above 70MHz.

CLIMATE CONDITION:

Standard Temperature and Humidity:

- Ambient temperature: 23+3 °C
- Relative humidity: 50+5 %
- Atmospheric Pressure: 100+5 kPa

POWER INPUT:

9 V dc Battery.

TEST EQUIPMENT:

- Advantest Spectrum Analyzer, Model R3271, S/N: 15050203

TEST RESULTS:

Conforms.

Frequency (MHz)	Measured 26 dB BW	Limit (0.25% Fc)
372.5	95.4 kHz	931.25 kHz

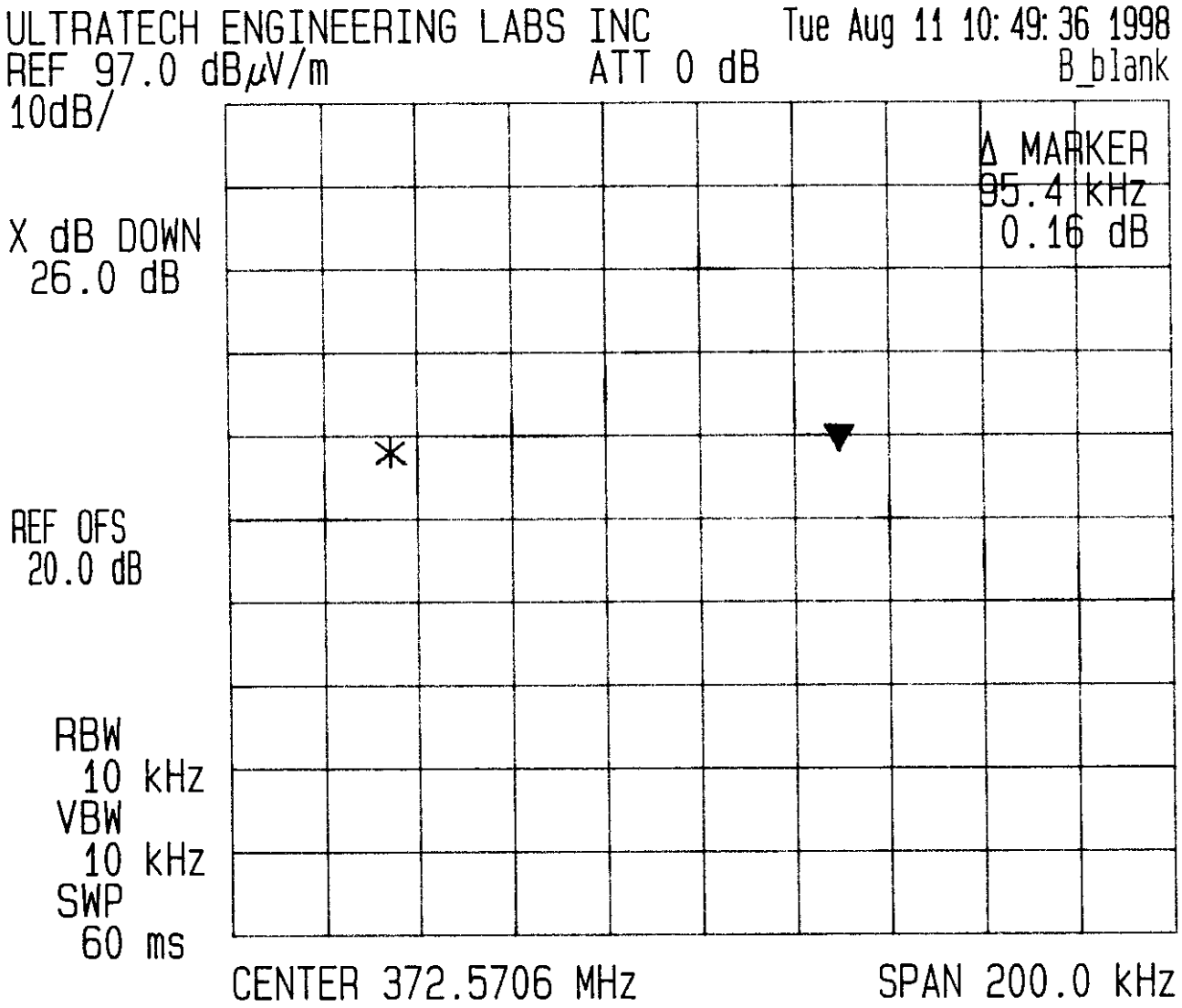
TEST PERSONNEL: Hung Trinh, Technician

DATE: August 11, 1998

UltraTech
Engineering Labs Inc.

ASTROFLEX
SERIES 2000,3000 REMOTE CONTROL ENGINE STARTER TRANSMITTER
Model : Astrostart

Date: August 11, 1998
Tested by: Hung Trinh



4.5. RF EXPOSURE LIMIT FCC 1.1310

PRODUCT NAME: **Series 2000, 3000 Remote Control Engine Starter Transmitters, Model No.: AstroStart 2000**

FCC REQUIREMENTS:

FCC 1.1310:- The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in 1.1307(b).

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
(A) Limits for Occupational/Control Exposures				
30-300	61.4	0.163	1.0	6
300-1500	...	...	F/300	6
(B) Limits for General Population/Uncontrolled Exposure				
30-300	27.5	0.073	0.2	30
300-1500	...	...	F/1500	30

F = Frequency in MHz
* = Plane-wave equivalent power density

CLIMATE CONDITION:

Standard Temperature and Humidity:

- Ambient temperature: 23+3 °C
- Relative humidity: 50+5 %
- Atmospheric Pressure: 100+5 kPa

POWER INPUT:

9 V dc Battery.

METHOD OF MEASUREMENTS:

Based on the maximum RF Field Strength measured in Section 4.1 of this report the RF exposure distance limit can be calculated as follows:

$P = 100(Ed)^2/3G$
$P_d = PG/2\Pi r^2 = 100(Ed)^2/6\Pi r^2$

$r = 10Ed/(6\Pi P_d)^{1/2}$

Where: P peak output power in mW
P_d is power density mW/cm^2
G is transmitting antenna numeric gain
r is distance from the transmitting antenna in cm
d is distance in meters at measured field strength level
E Field strength in V/m level at distance d

FCC radio frequency exposure limits may be exceeded at distances closer than r cm from the antenna of this device

TEST RESULTS: Conforms.

TEST PERSONNEL: Tri Luu P. ENG.

DATE: August 11, 1998

MEASUREMENT DATA:

EFFECTIVE ISOTROPIC RADIATED POWER (EIRP) MEASURED AT 3 METER DISTANCE
(Substitution Method)

TX CHANNEL OUTPUT	FUNDAMENTAL FREQUENCY (MHz)	Tx Antenna Gain (Numeric)	Max. Field Strength Level @ 100 KHz BW At 3 m (dBuV/m)	Max. EIRP POWER In a 100 KHz BW (mW)	POWER LIMIT (mW)
Single channel output	372.5	1.0	57.3	0.00016	N/A

RF EXPOSURE DISTANCE LIMITS: $r = (PG/4\Pi S)^{1/2}$

G= 0 dBi typical or 1 numeric, S = F/300 (F in MHz) mW/cm2 = 0.248 mW/cm^2

TRANSMITTER CHANNEL OUTPUT	FUNDAMENTAL FREQUENCY (MHz)	MESURED EIRP FULL POWER (mWatts)	MNIMUM ALLOWABLE DISTANCE (r) FROM SKIN (cm)
Single channel output	372.5	0.00016	0.007

Since the power density of 0.248 mW/cm^2 is at a very short distance from the radiating antenna (as a trace) integrated on the printed circuit board, and the antenna is completely enclosed inside the case, the RF exposure limit warning or SAR tests are not necessary.