



**EM RESEARCH TEST REPORT**

**FOR THE**

**INTERROGATION TRANSMITTER, 870-00004**

**FCC PERMISSIVE CHANGE II FOR PART 87**

**COMPLIANCE**

**DATE OF ISSUE: SEPTEMBER 18, 2000**

**PREPARED FOR:**

EM Research, Inc.  
2465 Highway 40  
Verdi, NV 89439

P.O. No: 11442  
W.O. No: 73741

**PREPARED BY:**

Joyce Walker  
reports@ckc.com  
CKC Laboratories, Inc.  
5473A Clouds Rest  
Mariposa, CA 95338

Date of test: August 15, 2000

**Report No: FC00-089**

**DOCUMENTATION CONTROL:**

A handwritten signature in black ink, appearing to read 'Tracy Phillips', written over a horizontal line.

Tracy Phillips  
Documentation Control Supervisor  
CKC Laboratories, Inc.

**APPROVED BY:**

A handwritten signature in black ink, appearing to read 'Dennis Ward', written over a horizontal line.

Dennis Ward  
Director of Laboratories  
CKC Laboratories, Inc.

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## ADMINISTRATIVE INFORMATION

**DATE OF TEST:** August 15, 2000

**PURPOSE OF TEST:** To demonstrate the compliance of the Interrogation Transmitter, 870-00004, with the requirements for FCC Permissive Change II to Part 87 devices. This report represents testing of the transmitter with the addition of an output spectrum control filter, which was added to meet output pulse rise and fall times. This modification was initiated as a result of FAA system tests, and spectrum management inputs.

**MANUFACTURER:** EM Research, Inc.  
2465 Highway 40  
Verdi, NV 89439

**REPRESENTATIVE:** Matt Eiting

**TEST LOCATION:** CKC Laboratories, Inc.  
5473A Clouds Rest, Mariposa, CA 95338

**TEST PERSONNEL:** Skip Doyle

**TEST METHOD:** FCC Parts 2 and 87

**FREQUENCY RANGE TESTED:** 450 kHz – 10.3 GHz

**EQUIPMENT UNDER TEST:**  
**Interrogation Transmitter**  
Manuf: EM Research, Inc.  
Model: 870-00004  
Serial: 1845  
FCC ID: NYKEMPA101

## **SUMMARY OF RESULTS**

The EM Research, Inc. Interrogation Transmitter, 870-00004, was tested in accordance with FCC Part 87 devices and Permissive Change II guidelines. As received, the above equipment was found to be fully compliant with the limits of Part 87 devices. The results in this report apply only to the items tested, as identified herein.

### **EQUIPMENT UNDER TEST (EUT) DESCRIPTION**

The system Interrogation Transmitter (ANPC P/N: 870-00004) is used to transmit all of the pulse modulation Interrogation signals used within the landing system. These signals and their purposes are summarized as follows:

- 1030 MHz interrogation pulse pair is transmitted to the tracked aircraft and initiates transponder 1090 MHz response.
- 1030 MHz suppression pulse is transmitted a fixed time after the first 1030 interrogation pulse is received by the airborne transponder and suppresses the 1090 MHz response if receive strength criteria are met.

Both of the above pulses are very low duty cycle as the system interrogation rate is typically set to 10 Hz. The transmitter contains all components required to generate these signals, receiving timing control via a digital control from the Interrogator Control PCBA (ANPC P/N: 690-00100) within the system Base CPU.

### **MEASUREMENT UNCERTAINTY**

Associated with data in this report is a  $\pm 4$ dB measurement uncertainty.

### **EUT OPERATING FREQUENCY**

The EUT was operating at 1029.970 MHz.

## **TEMPERATURE AND HUMIDITY DURING TESTING**

The temperature during testing was within +15°C and + 35°C.  
The relative humidity was between 20% and 75%.

## **PERIPHERAL DEVICES**

The EUT was tested with the following peripheral devices:

### **PC**

Manuf: MEGA  
Model:  
Serial:  
FCC ID: DoC

### **Monitor**

Manuf: Hyundai  
Model:  
Serial:  
FCC ID: DoC

### **Keyboard**

Manuf: Sierra Computers  
Model:  
Serial:  
FCC ID: DoC

## **2.1033(c)(5) – Frequency Range**

1029.970 MHz.

## **2.1033(c)(7) – Maximum Power Rating**

Maximum power rating as defined in the operating part(s) of the rules.

400 watts

## **2.1033(c)(14)/2.1046/87.131 - RF POWER OUTPUT**

Test Location: CKC Laboratories, Inc. • 5473A Clouds Rest Rd, Barn • Mariposa, CA 95338 • (800)-500-4EMC  
Customer: **EM Research**  
Specification: **FCC Part 87.131**  
Work Order #: **73741** Date: 08/15/2000  
Test Type: **FCC Part 2.1046, Power Output** Time: 12:51:16  
Equipment: **Interrogation Transmitter** Sequence#: 1  
Manufacturer: EM Research Tested By: Skip Doyle  
Model: P/N: EMPA-870-00004 S/N: 1845

### ***Test Equipment Used:***

Equipment	Mfg.	Model	S/N	Date Cal.	Cal Due
Coax cable # 3 (2')	Andrew	FSL1-50A	N/A	05/10/2000	05/10/2001
Coax cable # 2 (2')	Andrew	FSL1-50A	N/A	05/10/2000	05/10/2001
Directional Coupler	Werlatone	C2630	3805	04/21/2000	04/21/2001
QP Adapter	HP	85650A	2811A01267	07/07/2000	07/07/2001
Spectrum Analyzer-Display	HP	8566B	2209A01404	07/07/2000	07/07/2001
Spectrum Analyzer-RF Sect.	HP	8566B	2209A01404	07/07/2000	07/07/2001

### ***Equipment Under Test (\* = EUT):***

Function	Manufacturer	Model #	S/N
Interrogation Transmitter*	EM Research	P/N: EMPA-870-00004	1845

### ***Support Devices:***

Function	Manufacturer	Model #	S/N
PC	MEGA		
Monitor	Hyundai		
Keyboard	Sierra Computers		

### ***Test Conditions / Notes:***

Spec Limit for EUT is 400W, which = 56dBm = 163dBuV. EUT operation in accordance with customers setup procedure. Computer timing is producing a pulse @ 10Hz, 0.8uS width pulse pair, and amplitude of 1.5V. Interrogation RF output is connected to Spectrum analyzer via 1 40dB directional coupler with 50 ohm load and 2 6dB Pads. Tested in accordance with FCC Parts 87.131/2.1046.

Measurement Data:		Reading listed by margin.				Test Distance: Direct Connection					
#	Freq MHz	Rdng dBμV	Cable	Cable	dB	dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
			dB	dB							
1	1029.970M	155.9	+0.3	+0.2			+0.0	156.4	163.0	-6.6	None

### **Calculation for Mean Power in watts:**

Total pulse on time = 0.0016ms

1)  $0.0016\text{ms}/100\text{ms}=0.000016$

2)  $0.000016 \times 400\text{watts} = 0.0064\text{Watts}$

3)  $0.0064\text{W}/1\text{mW} = 6.4\text{mW}$

4)  $10\log(6.4) = 8.06\text{dBm}$  mean power

5) Half wave dipole = 2.15dBm

$8.06\text{dBm} + 2.15\text{dBm} = 10.21\text{dBm}$  total mean power

**VIDEO BANDWIDTH AND RESOLUTION BANDWIDTH SETTINGS:**

Frequency Range	Signal Analyzer VBW & RBW Setting
1029.970MHz	1MHz

**PHOTOGRAPH OF TEST SETUP**



## **2.1033(c)(14)/2.1049(i)/87.135 - OCCUPIED BANDWIDTH**

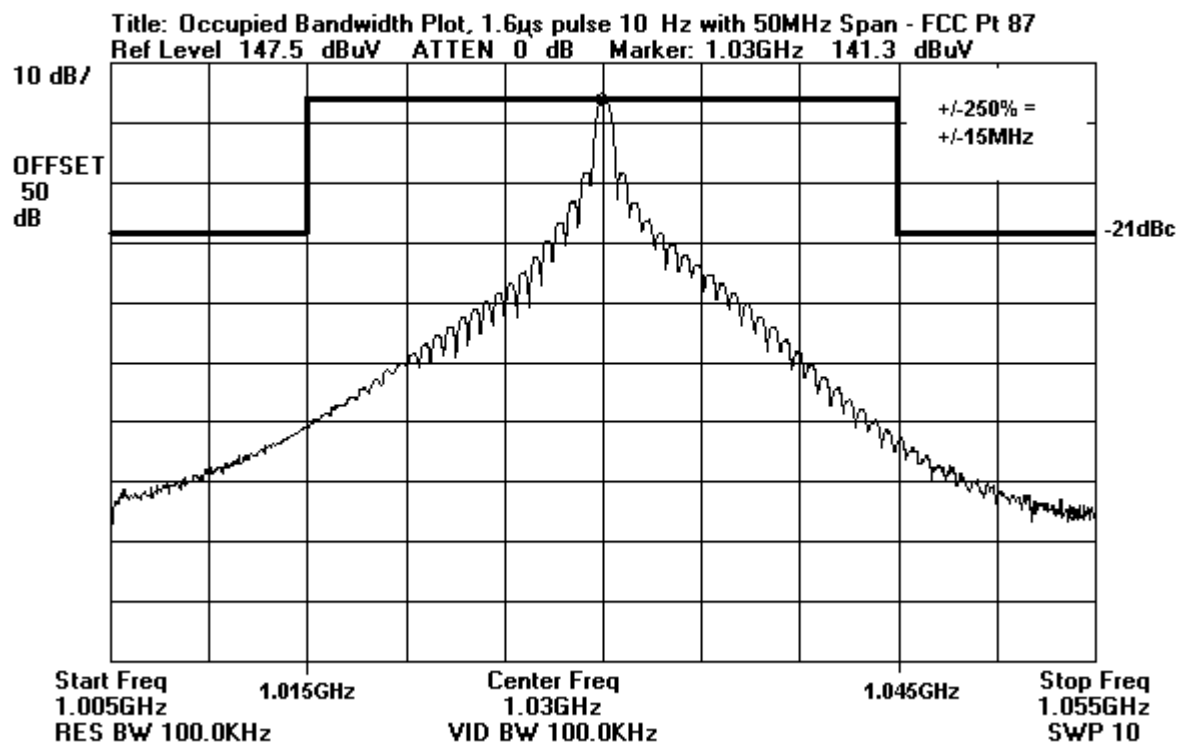
**Test Conditions:** The EUT was connected directly to the signal analyzer. Computer timing is producing a pulse @ 10Hz, 0.8uS width pulse pair, and amplitude of 1.5V. Interrogation RF output is connected to Spectrum analyzer via 1 40dB directional coupler with 50 ohm load and 2 6dB Pads.

The emission designator is 6M00M1D.

### **TEST EQUIPMENT USED:**

<b>Equipment</b>	<b>Mfg.</b>	<b>Model</b>	<b>S/N</b>	<b>Date Cal.</b>	<b>Cal Due</b>
Coax cable # 3 (2')	Andrew	FSL1-50A	N/A	05/10/2000	05/10/2001
Coax cable # 2 (2')	Andrew	FSL1-50A	N/A	05/10/2000	05/10/2001
Directional Coupler	Werlatone	C2630	3805	04/21/2000	04/21/2001
QP Adapter	HP	85650A	2811A01267	07/07/2000	07/07/2001
Spectrum Analyzer-Display	HP	8566B	2209A01404	07/07/2000	07/07/2001
Spectrum Analyzer-RF Sect.	HP	8566B	2209A01404	07/07/2000	07/07/2001





**PHOTOGRAPH OF TEST SETUP**



## **2.1033(c)(14)/2.1051/87.131 - SPURIOUS EMISSIONS AT ANTENNA TERMINAL**

Test Location: CKC Laboratories • 5473A Clouds Rest • Mariposa Ca, 95338 • 209-966-5240  
Customer: **EM Research**  
Specification: **FCC Part 87.131**  
Work Order #: **73741** Date: 08/15/2000  
Test Type: **FCC Part 2.1051, Spurious Emissions** Time: 14:03:57  
**@ Antenna Terminal**  
Equipment: **Interrogation Transmitter** Sequence#: 2  
Manufacturer: EM Research Tested By: Skip Doyle  
Model: P/N: EMPA-870-00004 S/N: 1845

### ***Test Equipment Used:***

Equipment	Mfg.	Model	S/N	Date Cal.	Cal Due
Coax cable # 3 (2')	Andrew	FSL1-50A	N/A	05/10/2000	05/10/2001
Coax cable # 2 (2')	Andrew	FSL1-50A	N/A	05/10/2000	05/10/2001
Directional Coupler	Werlatone	C2630	3805	04/21/2000	04/21/2001
QP Adapter	HP	85650A	2811A01267	07/07/2000	07/07/2001
Spectrum Analyzer-Display	HP	8566B	2209A01404	07/07/2000	07/07/2001
Spectrum Analyzer-RF Sect.	HP	8566B	2209A01404	07/07/2000	07/07/2001

### ***Equipment Under Test (\* = EUT):***

Function	Manufacturer	Model #	S/N
Interrogation Transmitter*	EM Research	P/N: EMPA-870-00004	1845

### ***Support Devices:***

Function	Manufacturer	Model #	S/N
PC	MEGA		
Monitor	Hyundai		
Keyboard	Sierra Computers		

### ***Test Conditions / Notes:***

Spec Limit for EUT is 8.06dBm – 21.06dB = -13.00dBm = 94.00dBuV. EUT operation in accordance with customers setup procedure. Computer timing is producing a pulse @ 10Hz, 0.8uS width pulse pair, and amplitude of 1.5V. Interrogation RF output is connected to Spectrum analyzer via 1 40dB and 2 6dB Pads. Tested in accordance with FCC Parts 87.139/2.1051.

<b>Measurement Data:</b>		Reading listed by margin.				Test Distance: Direct Connection					
#	Freq MHz	Rdng dBμV	Cable dB	Cable dB		Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant	
1	2060.076M	88.6	+0.7	+0.7		+0.0	90.0	94.0	-4.0	None	
2	6179.723M	77.4	+3.2	+2.7		+0.0	83.3	94.0	-10.7	None	

3	764.100M	79.6	+0.0	+0.0	+0.0	79.6	94.0	-14.4	None
4	3090.080M	72.1	+3.3	+3.1	+0.0	78.5	94.0	-15.5	None
5	5150.142M	73.7	+2.3	+1.2	+0.0	77.2	94.0	-16.8	None
6	5150.094M	72.9	+2.3	+1.2	+0.0	76.4	94.0	-17.6	None
7	4120.112M	73.4	+1.5	+1.3	+0.0	76.2	94.0	-17.8	None
8	861.066M	72.3	+0.0	+0.0	+0.0	72.3	94.0	-21.7	None
9	933.676M	70.2	+0.0	+0.0	+0.0	70.2	94.0	-23.8	None
10	2059.966M Ave	52.3	+0.7	+0.7	+0.0	53.7	94.0	-40.3	None

**VIDEO BANDWIDTH AND RESOLUTION BANDWIDTH SETTINGS:**

Frequency Range	Signal Analyzer VBW & RBW Setting
10MHz - 30MHz	9kHz
30MHz – 1MHz	120kHz
1GHz – 10.3GHz	1MHz

**PHOTOGRAPH OF TEST SETUP**



## **2.1033(c)(14)/2.1053/87.139 - FIELD STRENGTH OF SPURIOUS RADIATION**

FCC Part 2.1053 Measurements required: Field strength of spurious radiation											
Polarity	Freq(MHz)	Reading in dBuV/m	PreAmp Factor	Cable Factor	Horn Antenna	High Pass Filter	Corrected E (dBuV/M)	V/M	ERP (Watts)	Spec Limit Watts	Pass or Fail
Vertical	4119.70	76.00	-33.40	8.50	33.00	0.0	84.1	0.016032454	0.000047019	0.082224W	Pass
Vertical	3089.55	71.50	-32.10	10.20	31.90	0.0	81.5	0.011885022	0.000025839	0.082224W	Pass
Vertical	2059.85	81.60	-35.00	5.40	27.10	0.0	79.1	0.009015711	0.000014869	0.082224W	Pass
Notes: Frequency range investigated was from 10MHz to 10.3GHz. All spurious and harmonic emissions were investigated. All emissions detected that were less than 20dB below the permissible value were reported. Rated Power output of transmitter at 400 Watts.											
CALCULATIONS											
Note: The data taken is relative to the radiated power of each spurious emission with reference to the rated mean power output of the transmitter.											
$10 \log (10.21\text{mW}/10) = 1\text{mW}$											
$10.21\text{dBm} - 21.06\text{dBc} = -10.85\text{dBm}$											
$\text{Inv Log } (-10.85\text{dBm}/10) = 0.082224\text{W}$											
Spec Limit = 0.082224 Watts											
ERP = (Ed) <sup>2</sup> /30(G)											
E = V/m											
d= distance											
G = Gain of Antenna ( numerical gain of half wave dipole antenna 1.64) per Part 2.1053(a)											
Conversion of dBuV/m to V/m											
[invlog(Reading in dBuV/m/20)]*.000001 = V/m											

### VIDEO BANDWIDTH AND RESOLUTION BANDWIDTH SETTINGS:

Frequency Range	Signal Analyzer VBW & RBW Setting
10MHz - 30MHz	9kHz
30MHz – 1MHz	120kHz
1GHz – 10.3GHz	1MHz

### PHOTOGRAPH OF TEST SETUP



Front View



Back View