TEST REPORT
for
APPLICATION of CERTIFICATION

For

BECKER FLUNGFUNKWERK GMBH
Baden Airpark
Building B108
D-77836 Rheinmuenster
Germany
Phone: 49 7229 305 216

MODEL: ATC 3401
ATC 3401-(1)-R
FREQUENCY: 1090 MHz

FCC ID: B54ATC3401

Test Date: April 12, 1999

Certifying Engineer: Scot D Rogers

Scot D. Rogers
ROGERS LABS, INC.
4405 W. 259th Terrace
Overland Park, Kansas 66210
Phone: (913)837-3214
FAX: (913)837-3214

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FORWARD:

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 1998, Part 2 Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057; Part 87, Subchapter D, Paragraphs 87.131 through 87.147; and Report and Order FCC 98-58 the following is submitted:

List of Test Equipment

A Hewlett Packard 8591EM and or 8562A Spectrum Analyzer was used as the measuring device for the emissions testing. The analyzer settings used are described in the following table. Refer to Appendix for a complete list of Test Equipment.

HP 8591EM SPECTRUM ANALYZER SETTINGS		
CONDUCTED EMISSIONS:		
RBW	AVG. BW	DETECTOR FUNCTION
9 kHz	30 kHz	Peak/Quasi Peak
RADIATED EMISSIONS (30 – 1000 MHz):		
RBW	AVG. BW	DETECTOR FUNCTION
120 kHz	300 kHz	Peak/Quasi Peak
HP 8562A SPECTRUM ANALYZER SETTINGS		
RADIATED EMISSIONS (1 – 40 GHz):		
RBW	AVG. BW	DETECTOR FUNCTION
1 MHz	1 MHz	Peak/Average
ANTENNA CONDUCTED EMISSIONS:		
RBW	AVG. BW	DETECTOR FUNCTION
100 kHz	300 kHz	Peak

2.1033(c) Application for Certification

1. Manufacturer: BECKER FLUNGFUNKWERK GMBH
   Baden Airpark
   Building B 108
   D-77836 Rheinmuenster
   Germany

2. Identification: Model: ATC 3401
   FCC I.D.: B54ATC3401

3. Refer to Exhibit for Installation and Operating Instructions Manual.

4. Emission Type: 16M0M1D

5. Frequency Range: 1090 MHz.

6. Operating Power Level:

   250 W PEP (2.0 W Ave)

   Nominal Average Power = P_o(PEP) X Duty Factor

   Duty Factor = 1200 RPS X 15 PR X (0.45 X 10^{-6}) PW

   Duty Factor = 0.0081

   RPS = Replies Per Second

   PR = Pulse Reply Rate

   PW = Pulse Width

7. Max P_o: 400 W PEP.

8. Power into final amplifier: 855 Watts PEP (1500 V @ 0.57A).

9. Tune Up Procedure for Output Power:

   There are no tune-up procedures for ATC 3401.

10. Description of Circuitry and Devices Provided for Determining and Stabilizing Frequency, for Suppression of Spurious Radiation, Modulation and Power:

The complete set of schematic diagrams for the Transponder ATC 3401 respectively ATC 3401-(1)-R are part of the equipment manuals. Please refer to these documents.
The final transmit frequency is determined by a ¼ wavelength cavity resonator (MO5001). The cavity is tuned to the final frequency by means of a screw adjustment that changes the tank cavity capacity.

NUMBER	TYPE	FUNCTION
MO5001	C0-2080A	Cavity Oscillator

Description of the Circuits and Devices Used for Suppression of Spurious Radiation; For Limiting Modulation:
The transmitter output is coupled to the antenna through a 4-section low pass filter.

Description of the Circuits and Devices Used for Limiting of Modulation:
The transponder uses the standard pulse format as required by ICAO, Annex 10 for both A and C modes of operation. A pulse train from the airborne unit is emitted after being interrogated by the ground unit. Each pulse has a width of 0.45 microseconds spaced 1.45 microseconds apart. Pulse train width between F1 and F2 is 20.3 microseconds. Rise time and fall time of the pulses is typically 0.050 microseconds.

11. FCC ID Label:

Refer to Exhibit for FCC Label Identification.

12. Photographs of Equipment.

Refer to Appendix of this Report.

13. Description of Digital Modulation:

The modulator receives interrogation trigger pulses from the microprocessor. The pulses are applied to a differential comparator circuit. The output is then connected to the pulse transformer and then to the power modulator FET. This output is then fed through a network of shaping components. The unit conforms to ATCRBS and TSO Standards.

a) ATCRBS

1. Pulse Duration – 0.45 ± 0.10 second.
2. Rise time – 0.05 to 0.1 µ second.
3. Decay time – 0.05 to 0.2 µ second.
4. Pulse amplitude variation ± 1 dB max.
5. Reply Rate – factory adjusted to 1200 replies/second maximum in accordance with TSO C74C.
6. Reply group pulse content – 2 to 15 pulses.
7. Pulse spacing – 1.45 ± 0.1 µSec except for the special position identification (SPI) which shall follow the last reply pulse by 4.35 ± 0.1 µSec.

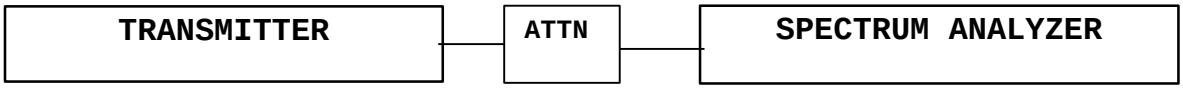
2.1046 RF Power Output

Measurements Required:

Measurements shall be made to establish the radio frequency power delivered by the transmitter into the

standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted below:
If the power output is adjustable, measurements shall be made for the highest and lowest power levels.

Test Arrangement:



The radio frequency power output was measured at the antenna terminal by replacing the antenna with appropriate attenuation, a spectrum analyzer and cable (44 dB attenuation and loss in the cable).

The spectrum analyzer had impedance of 50Ω to match the impedance of the standard antenna. A HP 8591EM Spectrum Analyzer was used to measure the r.f. power at the antenna port. The data was taken in dBm and converted to watts as shown in the following Table. Refer to Figure 1 showing the output power of the transmitter. Data taken per Paragraph 2.1046 and applicable parts of Part 87.

P_{dBm} = power in dB above 1 milliwatt.

$Milliwatts = 10^{(PdBm/10)}$

Watts = (Milliwatts)(0.001)(W/mW)

53.9 dBm = $10^{(53.9/10)}$
= 250,000 mW
= 250 Watts (PEP)
= 250 x 0.0081
= 2.02 Watts (AVE.)

Results:

FREQUENCY	P_{dBm}	OUTPUT POWER WATTS (PEP)	OUTPUT POWER IN WATTS (AVE)
1090	53.9	250	2.02

The specifications of Paragraph 2.1046 and applicable Parts of 87.131 are met. There are no deviations to the specifications.

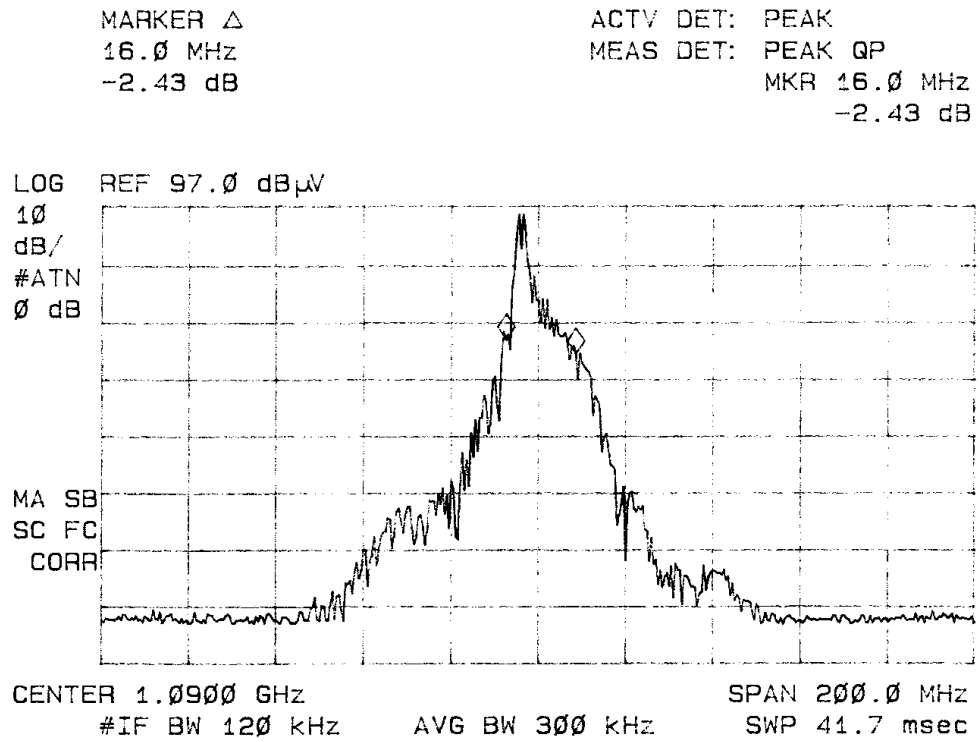


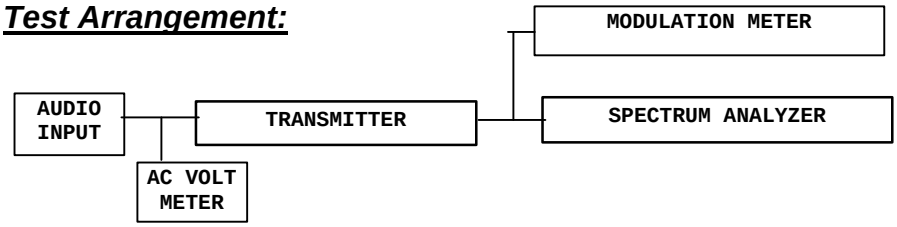
Figure 1: Power Output

2.1047 Modulation Characteristics

Measurements Required:

A curve or equivalent data, which shows that the equipment will meet the modulation requirements of the rules, under which the equipment is to be licensed, shall be submitted.

Test Arrangement:



The radio frequency output was coupled to a HP Spectrum Analyzer and a modulation meter. The spectrum analyzer was used to observe the r.f. spectrum with the transmitter operating in its various modes. The modulation meter was used to measure the frequency deviation.

Results:

ATCRBS	SPECIFICATIONS IN µ SEC.
Rise Time	0.05 to 0.10
Pulse Duration	0.45 ± 0.10
Decay Time	0.05 to 0.20
Pulse Amplitude Variation	1 dB Maximum
Reply Rate	1200 PPS
Pulse Content	2-15 pulses
Pulse Spacing	1.45 ± 0.10

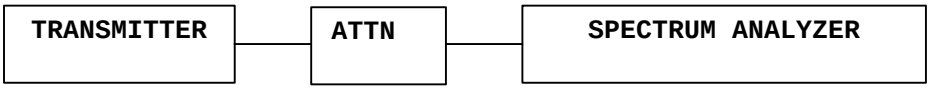
The specifications of Paragraph 2.1047 and applicable Parts of 87.141 are met. There are no deviations to the specifications.

2.1049 Occupied Bandwidth

Measurements Required:

The occupied bandwidth, that is the frequency bandwidth such that below its lower and above its upper frequency limits, the mean powers radiated are equal to 0.5 percent of the total mean power radiated by a given emission.

Test Arrangement:



Results:

RESPONSE	f_c (MHz)	O.B. (MHz)
0000	1090.0	16.0
7777	1090.0	16.0

Refer to figures 2 and 3 for Plots of Occupied Bandwidth.

A spectrum analyzer was used to observe the R.F. spectrum with the transmitter operating in a normal mode. The power ratio in dB representing 99% of the total mean power was recorded from the spectrum analyzer.

Requirements of 2.1049(c)(1) and 87.135 are met. There are no deviations to the specifications.

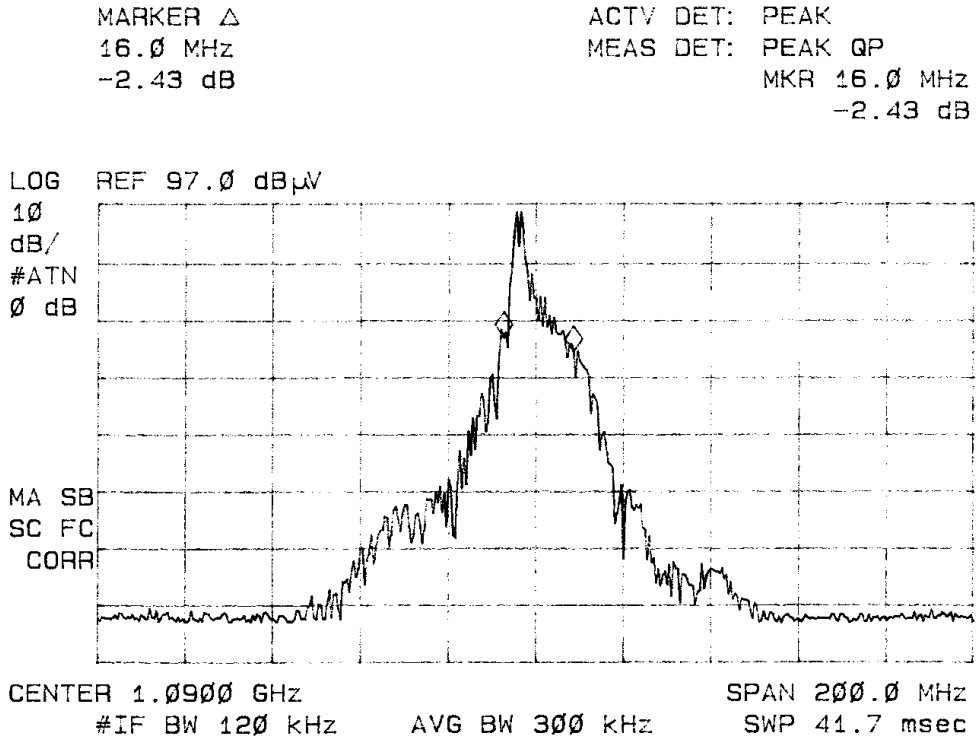


Figure 2: Occupied BandWidth.

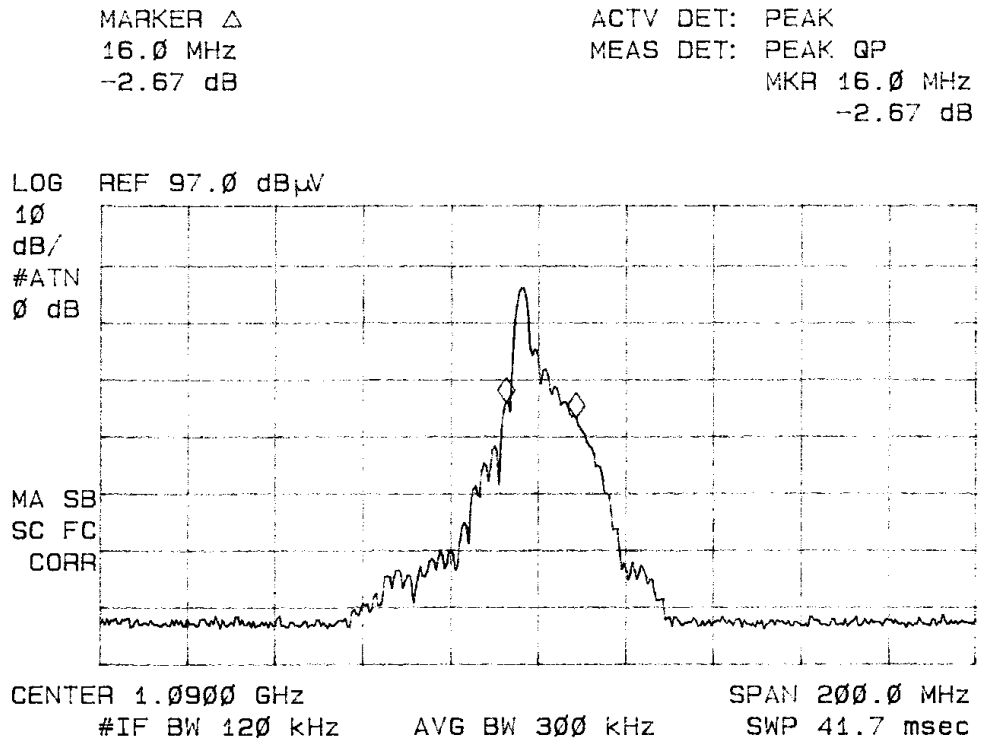


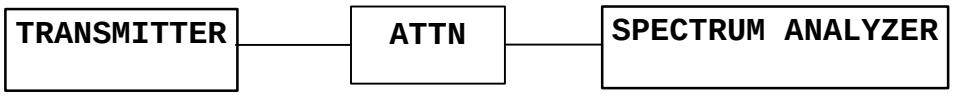
Figure 3: Occupied BandWidth.

2.1051 Spurious Emissions at Antenna Terminals

Measurements Required:

The radio frequency voltage or power generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.

Test Arrangement:



The r.f. output was coupled to a HP 8562A Spectrum Analyzer. The spectrum analyzer was used to observe the r.f. spectrum with the transmitter operated in a normal mode. The frequency spectrum from 0 MHz to 15 GHz was observed and plots produced of the frequency spectrum. Figures 4 and 5 represent data for the ATC

3401. Data taken per 2.1049, 2.1051, 2.1057, and 87.139.

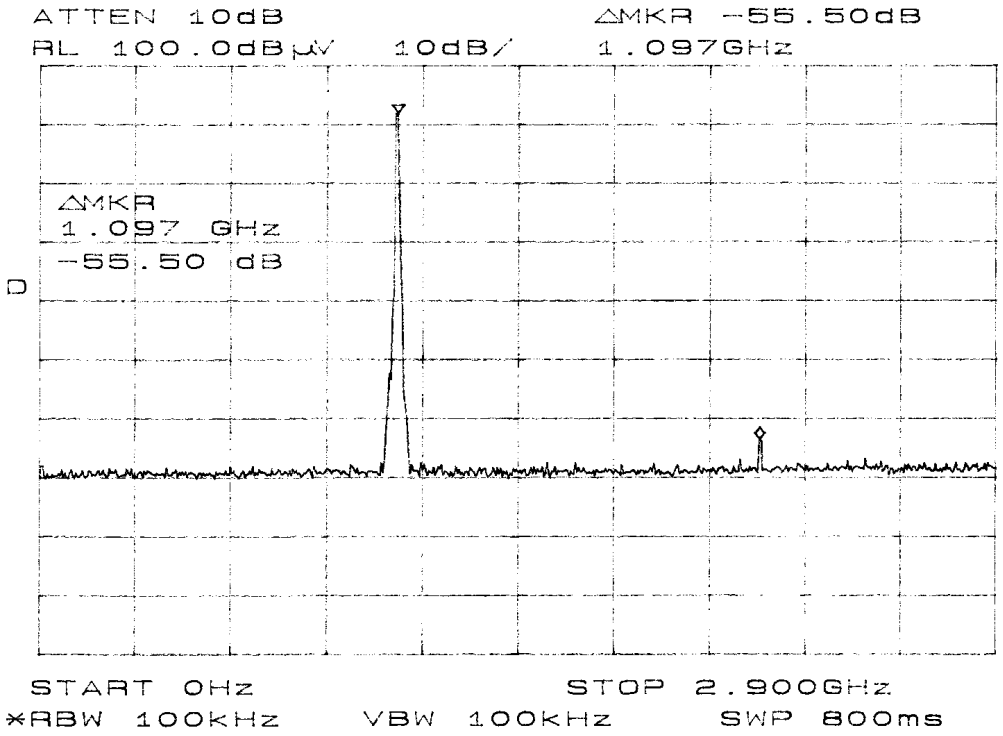


Figure 4: Emissions at Antenna Terminal.

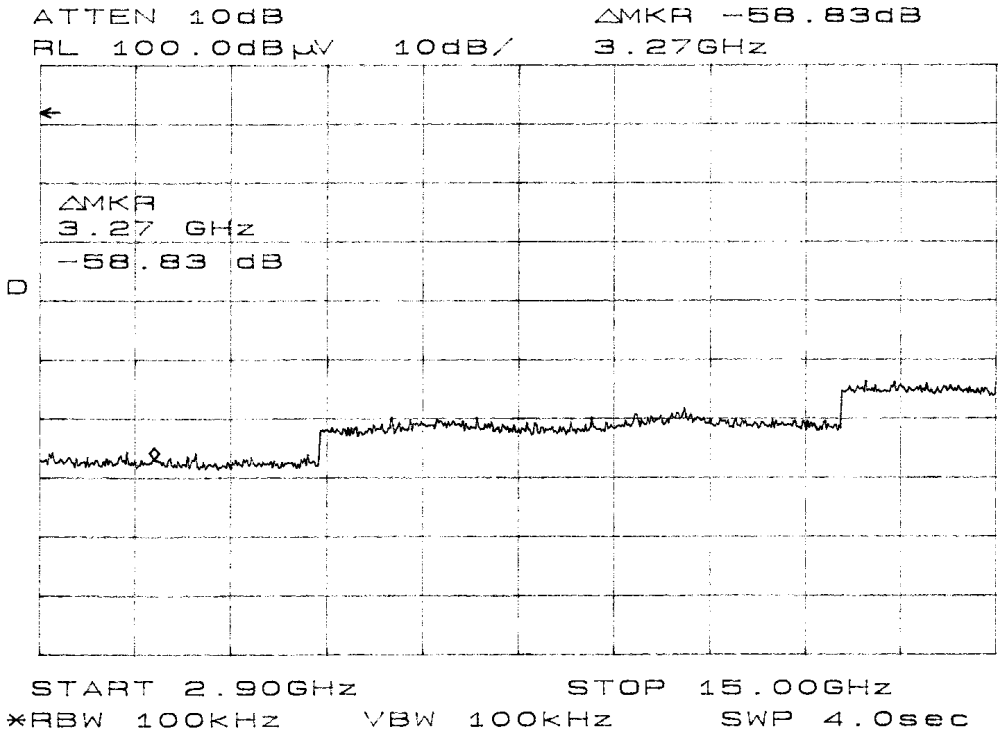


Figure 5: Emissions at Antenna Terminal.

Results:

Data taken per 2.1051 and applicable paragraphs of Part 87. Specifications of Paragraphs 2.1051, 2.1057 and 87.139 are met. There are no deviations to the specifications.

FCC Limit:
= 43 + 10 LOG(P_o (AVE.))
= 43 + 10 LOG(2)
= 43 + 3
= 46 dB

FREQUENCY MHz	SPURIOUS FREQ. (MHz)	LEVEL BELOW CARRIER (dB)
1090.0	2180.0	55.5
	3270.0	58.8

2.1053 Field Strength of Spurious Radiation

Measurements Required:

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation.

Test Arrangement:

The transmitter was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 3 meters from the FSM antenna. The transmitter was activated and the frequency spectrum was observed. The turntable was rotated though 360 degrees to locate the position registering the highest amplitude emission. The frequency spectrum was then searched for spurious emissions generated from the transmitter. The amplitude of each spurious emission was maximized by raising and lowering the FSM antenna and rotating the turntable before data was recorded. A Biconilog antenna for frequencies of 30 MHz to 1 GHz or a log periodic antenna was used for frequencies of 200 MHz to 5 GHz, and pyramidal horn antennas for frequencies of 5 GHz to 40 GHz. Emission levels were measured and recorded from the spectrum analyzer in dBµV. This level was then added to the antenna factor to calculate the field strength at 3 meters. Data was taken at the ROGERS LABS, INC. 3 meters open area test site (OATS). A description of the test facility is on file with the FCC, Reference: 31040/SIT, 1300F2, dated February 6, 1998. The testing procedures used conform to the procedures stated in the ANSI 63.4-1992 document.

Calculations made are as follows:

CFS = Calculated Field Strength
FSM = Field Strength Measurement
CFS = FSM + Antenna Factor – Amp. Gain
CFS = 40.6+ 15.2 - 35
CFS = 20.8

The limit for emissions are defined by the following equations:

Limit = Amplitude of spurious emission must be attenuated by this amount below the level of the fundamental.

Calculating the field strength at 3 meters for the 250-watt (PEP)(2 Watt AVE.) transmitter was done as follows:

$$E = \frac{5.5\ \sqrt{PG}}{3}$$ where E is V/m, P is Watts, G = 1.64 and d is meters.

$$E = \frac{5.5\ \sqrt{2(1.64)}}{3} = 3.3 \text{ V/m} = 3.3 \text{ X } 10^{-6} \text{ µV/m @ 3 Meters}$$

This was converted to dBµV/m using (20*log µV/m) for convience.

20*log (3.3 µV/m) = 130.3 dBµV/m @ 3 meters.

On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth the emissions shall be at least 43 + 10 Log P_o(AVE.) below the fundamental.

Attenuation = 43 + 10 Log (P_o AVE.)
= 43 + 10 Log (2)
= 46

The limit then is expressed as:

Limit = 130.3 – 46
= 84.3 dB

Results:

General Emissions

Frequency (MHz)	FSM Horz. (dBµV)	FSM Vert. (dBµV)	Ant. Factor (dB)	Amp. Gain (dB)	CFS Horz. @ 3m (dBµV/m)	CFS Vert. @ 3m (dBµV/m)	Limit
36.7	40.6	46.9	15.2	35	20.8	27.1	40.0
39.5	40.9	40.7	10.5	35	16.4	16.2	40.0
45.5	40.8	41.3	10.5	35	16.3	16.8	40.0
61.2	43.9	39.8	6.7	35	15.6	11.5	40.0
80.0	40.0	45.8	8.9	35	13.9	19.7	40.0
193.2	42.9	39.3	9.9	35	17.8	14.2	43.5
817.5	36.8	30.5	21.5	35	23.3	17.0	46.0
953.7	31.0	34.8	23.3	35	19.3	23.1	46.0

Channel Frequency 1090 MHz

Frequency (MHz)	FSM Horz. (dBµV)	FSM Vert. (dBµV)	Ant. Factor (dB)	Amp. Gain (dB)	CFS Horz. @ 3m (dBµV/m)	CFS Vert. @ 3m (dBµV/m)	Limit
2180.0	37.0	37.6	29.0	25	41.0	41.6	54.0
3270.0	31.1	31.0	35.6	25	41.7	41.6	54.0

Specifications of Paragraph 2.1053, 2.1057 and 87.139 are met. There are no deviations to the specifications.

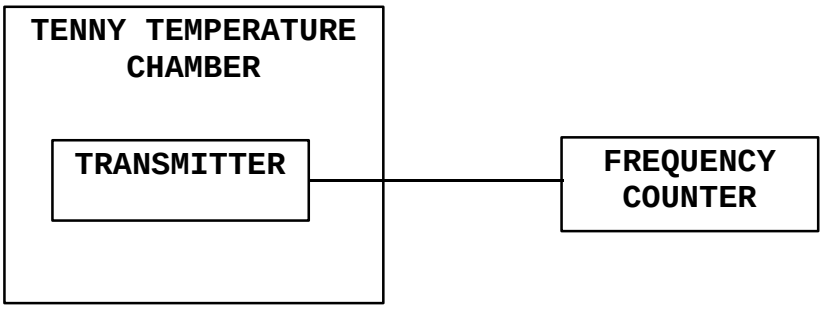
2.1055 Frequency Stability

Measurements Required:

The frequency stability shall be measured with variations of ambient temperature from -20° to +50° centigrade. Measurements shall be made at the extremes of the temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. In addition to temperature stability the frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
(2) For hand carried, batteries powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

Test Arrangement:



The measurement procedure outlined below shall be followed:

Step 1: The transmitter shall be installed in an environmental test chamber whose temperature is controllable. Provision shall be made to measure the frequency of the transmitter.
Step 2: With the transmitter inoperative (power switched "OFF"), the temperature of the test chamber shall be adjusted to +25°C. After a temperature

stabilization period of one hour at +25°C, the transmitter shall be switched "ON" with standard test voltage applied.
Step 3: The carrier shall be keyed "ON", and the transmitter shall be operated unmodulated at full r.f. power output at the duty cycle for which it is rated, for a duration of at least 5 minutes. The r.f. carrier frequency shall be monitored and measurements shall be recorded.
Step 4: The test procedures outlined in Steps 2 and 3, shall be repeated after stabilizing the transmitter at the environmental temperatures specified, -20°C to 50°C in 10 degree increments.

The frequency stability was measured with variations in the power supply voltage from 85 to 115 percent of the nominal value and at the battery end point. A Sorenson DC Power Supply was used to vary the dc voltage for the power input from 6.8 Vdc to 9.2 Vdc. The frequency was measured and the variation in parts per million was calculated. Data was taken per Paragraphs 2.1055(a)(2) and 80.209.

Results:

FREQ. (MHz)	FREQUENCY STABILITY VS TEMPERATURE IN PARTS PER MILLION (PPM)								
	Temperature in °C								
	-30	-20	-10	0	+10	+20	+30	+40	+50
1090.0	12.9	10.7	12.1	12.1	12.9	11.4	0.2	1.4	1.4

FREQUENCY IN MHz	**STABILITY VS VOLTAGE VARIATION (15%) IN PPM INPUT VOLTAGE**		
	23.4 V_{dc}	**27.5 V_{dc}**	**31.6 V_{dc}**
1090.00	0	0	0

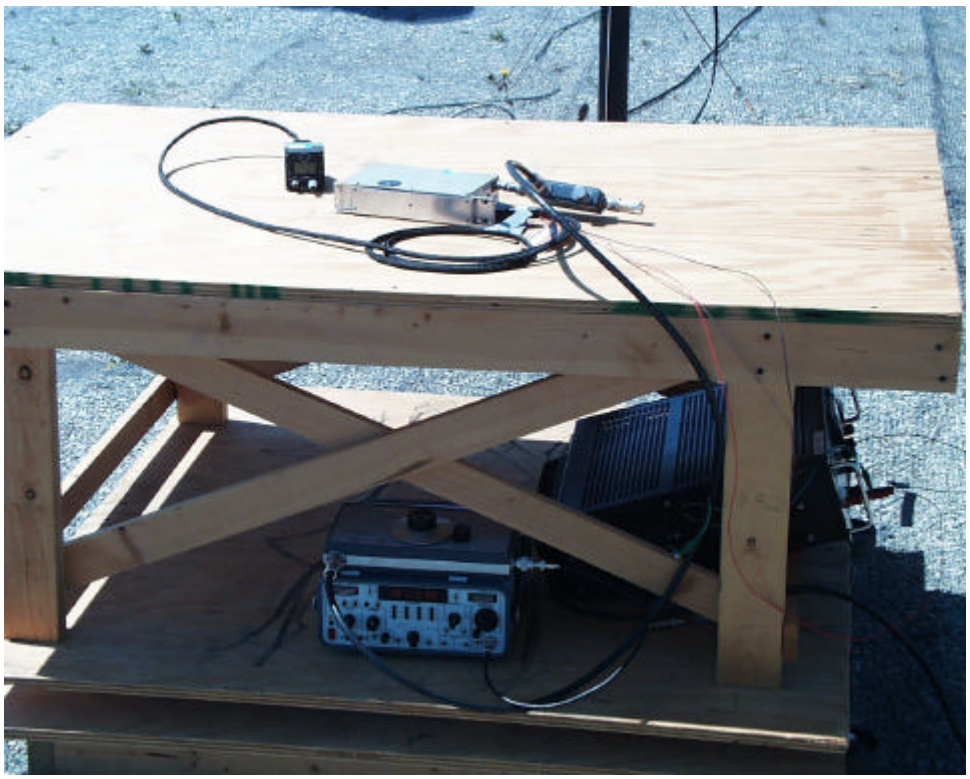
Specifications of Paragraphs 2.1055 and 87.133 parts of 87 are met. There are no deviations to the specifications.

APPENDIX

Model: ATC 3401

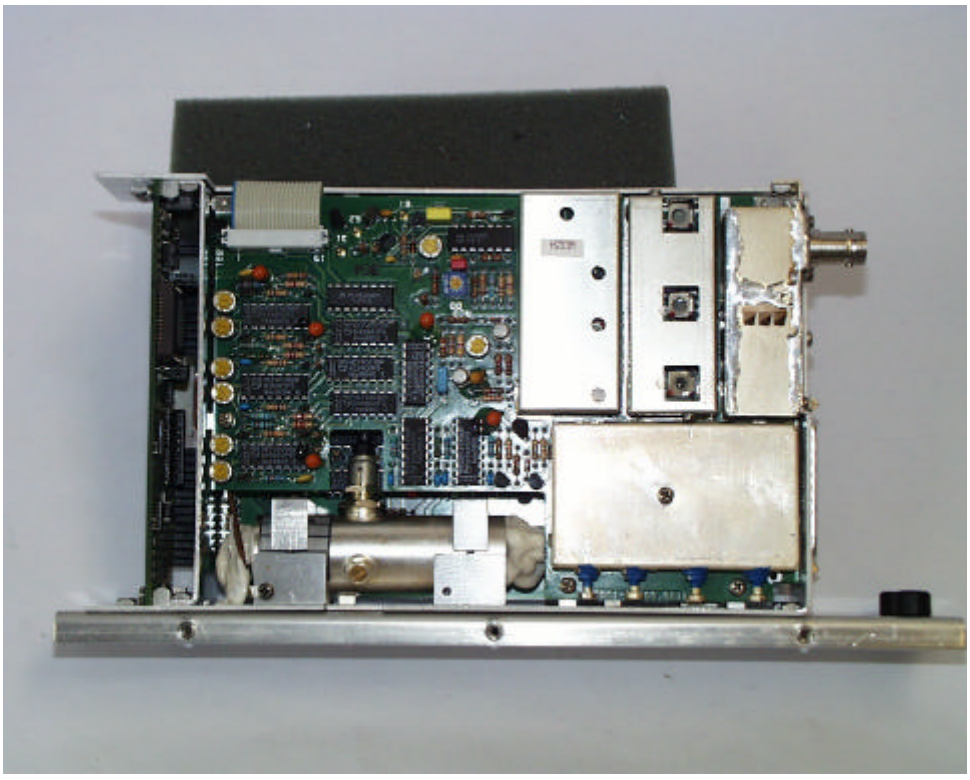
1. Photos of Radiated Emissions Test Set Up.
2. Photos Case Front and Back.
3. Photos RF PC Board.
4. Photo PCB.
5. Photo FCC ID Label Location.
6. Test Equipment List.
7. Rogers Qualifications.
8. FCC Site Approval Letter.

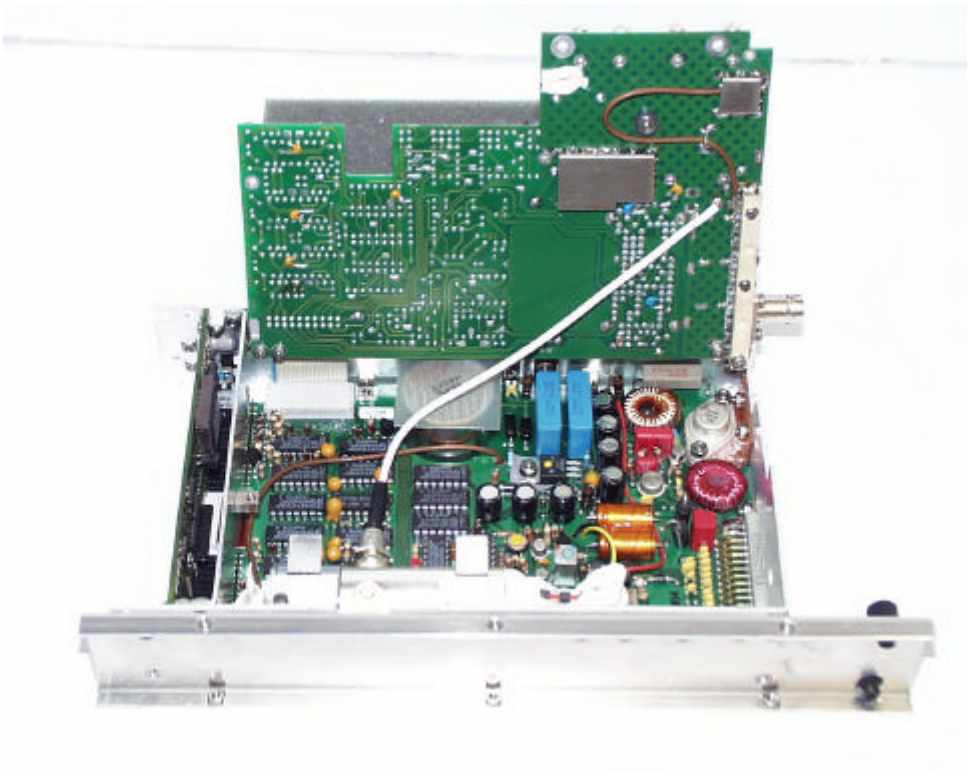
BECKER FLUNGFUNKWERK GMBH
Model: ATC 3401
Photos Radiated Emissions Test Setup



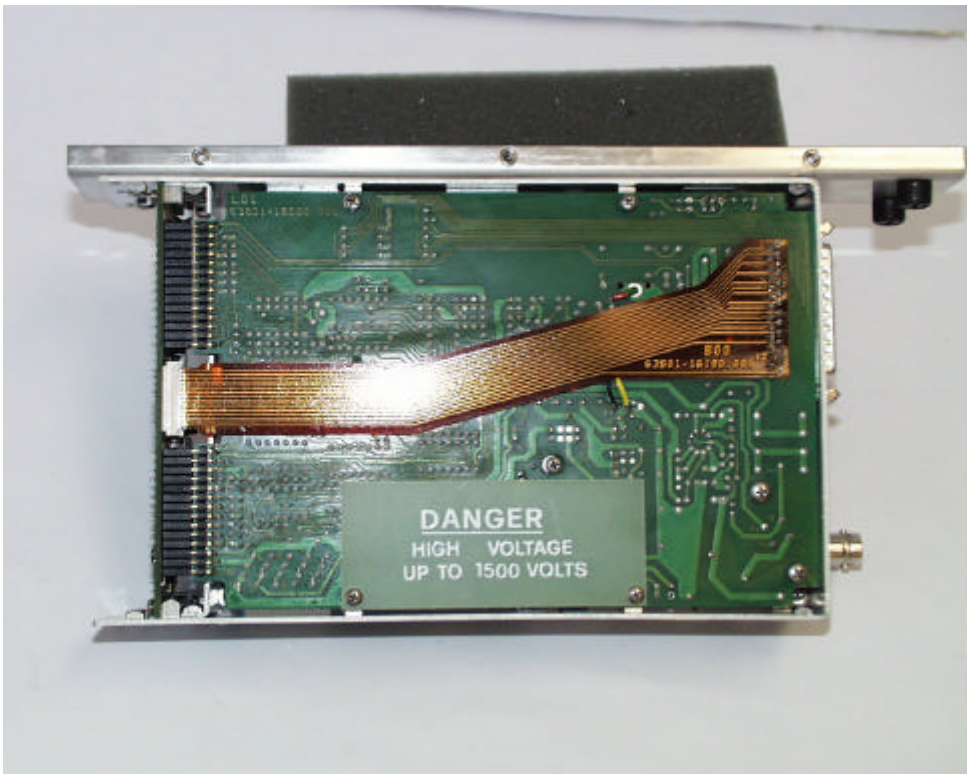
BECKER FLUNGFUNKWERK GMBH
Model: ATC 3401
Photos Case Front and Back

BECKER FLUNGFUNKWERK GMBH
Model: ATC 3401
Photos RF PC Board





BECKER FLUNGFUNKWERK GMBH
Model: ATC 3401
Photo PCB



BECKER FLUNGFUNKWERK GMBH
Model: ATC 3401
Photo FCC ID Label Location

TEST EQUIPMENT LIST FOR ROGERS LABS, INC.

The equipment is used daily and kept in good calibration and operating condition. Calibration of critical items are checked for accuracy each time used.

List of Test Equipment:	Calibration Date:
Scope: Tektronix 2230	2/99
Wattmeter: Bird 43 with Load Bird 8085	2/99
Power Supplies: Sorensen SRL 20-25, DCR 150, DCR 140	2/99
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/99
R.F. Generator: Boonton 102F	2/99
R.F. Generator: HP 606A	2/99
R.F. Generator: HP 8614A	2/99
R.F. Generator: HP 8640B	2/99
Spectrum Analyzer: HP 8562A, Mixers: 11517A, 11980A & 11980K HP Adapters: 11518, 11519, 11520	2/99
Spectrum Analyzer: HP 8591 EM	6/98
Frequency Counter: Weston 1255	2/99
Frequency Counter: Leader LDC 825	2/99
Antenna: EMCO Log Periodic	9/98
Antenna: BCD 235/BNC Antenna Research	9/98
Antenna: EMCO Dipole Set 3121C	2/99
Antenna: C.D. B-100	2/99
Antenna: Solar 9229-1 & 9230-1	2/99
Antenna: EMCO 6509	2/99
Microline Freq. Meter: Model 27B	2/99
Dana Modulation Meter: Model 9008	2/99
Audio Oscillator: H.P. 200CD	2/99
R.F. Power Amp 65W Model: 470-A-1000	9/97
R.F. Power Amp 50W M185- 10-500	9/97
R.F. PreAmp CPPA-102	9/97
Shielded Room 5 M x 3 M x 3.0 M (100 dB Integrity)	
LISN 50 µHy/50 ohm/0.1 µf	9/98
LISN Compliance Eng. 240/20	2/99
SCS Power Amp Model: 2350A	2/99
Power Amp A.R. Model: 10W 1000M7	2/99
Power Amp EIN Model: A300	1/99
Linear Amp Mini Circuits: ZHL-1A (2 Units)	2/99
Combiner Unit Mini Circuits: ZSC-2-1 (2 Units)	2/99
ELGAR Model: 1751	2/99
ELGAR Model: TG 704A-3D	2/99
ELGAR Model: 400SD (PB)	2/99
ESD Test Set 2000i	10/95
Fast Transient Burst Generator Model: EFT/B-100	10/95
Current Probe: Singer CP-105	8/97
Current Probe: Solar 9108-1N	8/97
Field Intensity Meter: EFM-018	10/95

03/01/99

QUALIFICATIONS

Of

SCOT D. ROGERS, ENGINEER

ROGERS LABS, INC.

Mr. Rogers has approximately 12 years experience in the field of electronics. Six years working in the automated controls industry and 6 years working with the design, development and testing of radio communications and electronic equipment.

POSITIONS HELD:

Systems Engineer:	A/C Controls Mfg. Co., Inc. 6 Years
Electrical Engineer:	Rogers Consulting Labs, Inc. 5 Years
Electrical Engineer:	Rogers Labs, Inc. Current

EDUCATIONAL BACKGROUND:

1) Bachelor of Science Degree in Electrical Engineering from Kansas State University.

2) Bachelor of Science Degree in Business Administration Kansas State University.

3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

Scot D Rogers
Scot D. Rogers

6/15/99
Date

1/11/99

FEDERAL COMMUNICATIONS COMMISSION

7435 Oakland Mills Road
Columbia, MD 21046
Telephone: 301-725-1585 (ext-218)
Facsimile: 301-344-2050

February 6, 1998

IN REPLY REFER TO
31040/SIT
1300F2

Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053

Attention: Scot D. Rogers

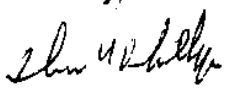
Re: Measurement facility located at above address
(3 and 10 meter site)

Gentlemen:

Your submission of the description of the subject measurement facility has been reviewed and found to be in compliance with the requirements of Section 2.948 of the FCC Rules. The description has, therefore, been placed on file and the name of your organization added to the Commission's list of facilities whose measurement data will be accepted in conjunction with applications for certification or notification under Parts 15 or 18 of the Commission's Rules. Our list will also indicate that the facility complies with the radiated and AC line conducted test site criteria in ANSI C63.4-1992. Please note that this filing must be updated for any changes made to the facility, and at least every three years the data on file must be certified as current.

Per your request, the above mentioned facility has been also added to our list of those who perform these measurement services for the public on a fee basis. This list is updated monthly and is available on the Laboratory's Public Access Link (PAL) at 301-725-1072, and also on the Internet at the FCC Website www.fcc.gov/oet/info/database/testsite/.

Sincerely,



Thomas W. Phillips
Electronics Engineer
Customer Service Branch