13 April, 2001

Tom Jacobson
Rothenbuhler Engineering
PO Box 708
2191 Rhodes Road
Sedro-Woolley WA 98284

Dear Mr. Jacobson,

Enclosed is the FCC Part 90 Subpart I report for the Remote Firing Device Transceiver (Controller), model 1668-2. Please check it thoroughly for discrepancies.

This is an official copy of this report complete with the original Acme Testing staff signatures, which should be retained by you as the official record of testing, as it may be required for future verification of compliance. Please be aware that our internal controls require us to keep a historical copy of your report on file for two years only.

Thank you for your business and we look forward to being of service should you require testing services in the future.

Yours Sincerely,

Steve FitzGerald
President

:dp

Enclosures

FCC PART 90 SUBPART I
REPORT OF MEASUREMENTS

DEVICE:	REMOTE FIRING DEVICE TRANSCEIVER (DETONATOR)
MODEL:	1668-2
MANUFACTURER:	ROTHENBUHLER ENGINEERING
ADDRESS:	PO BOX 708 2191 RHODES ROAD SEDRO WOOLEY WA 98284

THE DATA CONTAINED IN THIS REPORT WAS
COLLECTED ON 28 & 29 DECEMBER 1999 AND COMPILED BY:

PAUL G. SLAVENS
CHIEF EMC ENGINEER

(Table of Contents Continued)

1. General

1.1 Purpose

These tests were conducted on a sample of the equipment for the purpose of compliance with FCC CFR 47 Parts 2 & 90.

1.2 Manufacturer

Company Name:	Rothenbuhler Engineering
Contact:	Tom Jacobson
Mailing Address:	PO Box 708
Street Address:	2191 Rhodes Road
City/State/Zip:	Sedro Woolley WA 98284
Telephone:	360 856-0836
Fax:	360 856-2183
E-mail:	information@rothenbuhlereng.com

1.3 Test location

Company:	Acme Testing Inc.
Street Address:	2002 Valley Highway
Mailing Address:	PO Box 3
City/State/Zip:	Acme WA 98220-0003
Laboratory:	Test Site 2
Telephone:	888 226-3837
Fax:	360 595-2722
E-mail:	acmetest@acmetesting.com
Web:	www.acmetesting.com
Receipt of EUT:	28 December 1999

1.4 Test Personnel

Paul G. Slavens, Chief EMC Engineer

2. Test Results Summary

Summary of Test Results
Remote Firing Device Transceiver (Controller), model 1668-2

Para. No.	Test Criteria	Status
90.217	Exemption From Technical Standards	Pass
2.985	RF Power Output	Pass
2.987	Modulation Characteristics	Info
2.989	Occupied Bandwidth	Info
2.991	Spurious Emission at Antenna Terminals	Info
2.993	Field Strength of Spurious Radiation	Info
2.995	Frequency Stability	Info
90.214	Transient Frequency Behavior	Info

The signed original of this report, supplied to the client, represents the only "official" copy. Retention of any additional copies (electronic or non-electronic media) is at Acme Testing's discretion to meet internal requirements only. The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units, and meet the requirements of the specifications referenced herein.

Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) is factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.

The measurements contained in this report were made in accordance with the referenced standards and all applicable Public Notices received prior to the date of testing. Acme Testing assumes responsibility only for the accuracy and completeness of this data as it pertains to the sample tested.

Paul G. Slavens
Chief EMC Engineer

Date of Issuance

3. Description of Equipment and Peripherals

3.1 Equipment Under Test (EUT)

Device:	Remote Firing Device Transceiver (detonator)
Model Number:	1668-2
Serial Number:	None
Power:	Internal Battery
Grounding:	Local

3.2 EUT Peripherals

None, the EUT is a stand-alone device.

3.3 Description of Interface Cables

None, the EUT is a stand-alone device.

4. Exemption from Technical Standards

4.1 Test Requirement

Sec. 90.217 Exemption from technical standards

Except as noted herein, transmitters used at stations licensed below 800 MHz on any frequency listed in subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 milliwatts are exempt from the technical requirements set out in this subpart, but must instead comply with the following:

(b) For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

4.2 Test equipment

Spectrum Analyzer: Hewlett-Packard 8567A, Serial Number 2602A-00165, Calibrated: 12 March 1999, Calibration due Date: 12 March 2000

RF Preselector: Hewlett-Packard 85685A, Serial Number 2648A-00392, Calibrated: 12 March 1999, Calibration due Date: 12 March 2000

4.3 Test Results

Power Measurement

Manufacturer's nominal RF output power rating = 100 milliwatts.

Measured RF output power =100 milliwatts.

90.217 Band Plot

*please note the following plots are labeled emission mask D, this is incorrect the mask is the mask of 90.217

scan first three plots here

List of Conducted Spurs
Calculation of Limit

10 dBm (100 mW) – 30 dB = –20 dBm

Frequency (MHz)	Limit of spurious emission (dBm)	Measured spurious emission (dBm)	Delta to limit of spurious emission (dBm)
109.8	-20	-56.0	-36.0
306.3	-20	-54.3	-34.3

5. RF Power Output (The EUT is Exempt from this Technical Standard per 90.217, this Data is Provided for Information Purposes)

5.1 Test Requirement

Sec. 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in Sec. 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

5.2 Test Technical Standard

Table 1--150-174MHz--Maximum ERP/Reference HAAT for a Specific Service Area Radius

	Service area radius (km)									
	3	8	13	16	24	32	40	48	64	80
Maximum ERP	1	28	178	500	500	500	500	500	500	500
Up to reference HAAT (m)	15	15	15	15	33	65	110	160	380	670

1. Maximum ERP indicated provides for a 37 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 19 (See Sec. 73.699, Fig.0).

2. Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 37 dBu.

3. When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation:
   ERP allow = ERP max x (HAAT ref / HAAT actual)2.

4. Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 37 dBu.

5.3 Test Procedure

TIA/EIA-603:1993 Section 2.2.1

5.4 Test equipment

Spectrum Analyzer: Hewlett-Packard 8567A, Serial Number 2602A-00165, Calibrated: 12 March 1999, Calibration due Date: 12 March 2000

RF Preselector: Hewlett-Packard 85685A, Serial Number 2648A-00392, Calibrated: 12 March 1999, Calibration due Date: 12 March 2000

5.5 Test Results

Manufacturer's nominal RF output power rating = 100 milliwatts.

Measured RF output power = 100 milliwatts.

The EUT uses a monopole style with a theoretical gain of 2.15 dB relative to an isotropic source.

Therefore the Effective Radiated Power (relative to an isotropic source) is 12.15 dBm.

6. Modulation Characteristics (The EUT is Exempt from this Technical Standard per 90.217, this Data is Provided for Information Purposes)

6.1 Test Requirement

Sec. 2.1047 Measurements required: Modulation characteristics.

(a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

(b) Equipment, which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

(c) Single sideband and independent sideband radiotelephone transmitters, which employ a device or circuit to limit peak envelope power. A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified in paragraph (c) of Sec. 2.1049 for the occupied bandwidth tests.

(d) Other types of equipment. 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.

6.2 Test Technical Standard

Sec. 90.211 Modulation requirements

Each transmitter must meet the requirements of either paragraph (a) or (b) of this section. The requirements of this paragraph do not apply to mobile stations that are authorized to operate with a maximum power output of 2 watts or less.

(a) Transmitters utilizing analog emissions that are equipped with an audio low-pass filter must meet the emission limitations specified in Sec. 90.210. Testing must be in accordance with the rules specified in part 2 of this chapter.

(b) Transmitters utilizing digital or analog emissions without an audio low-pass filter must be tested for certification using the digital or analog modulating signal or signals specified by the part 2 of this chapter. The certification application must contain such information as may be necessary to demonstrate that the transmitter complies with the emission limitations specified in Sec. 90.210.

6.3 Test Procedure

TIA/EIA-603:1993 Section 2.2.3

6.4 Test equipment

Communication Analyzer: IFR COM 120A, Serial Number 2436

6.5 Test Results

RFD Detonator (1668-2) Modulation Characteristics

Modulation Tone	Deviation
1300 Hz	1.96 kHz
2100 Hz	1.98 kHz
1200 Baud Data (using 1300 Hz/2100 Hz tones)	2.21 kHz

7. Occupied Bandwidth (The EUT is Exempt from this Technical Standard per 90.217, this Data is Provided for Information Purposes)

7.1 Test Requirement

Sec. 2.1049 Measurements required: Occupied bandwidth.

The occupied bandwidth, that 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 shall be measured under the following conditions as applicable:

(h) Transmitters employing digital modulation techniques--when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

7.2 Test Technical Standard

Sec. 90.210 Emission masks

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Applicable Emission Masks

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
150-174[2]	B, D, or E	C, D, or E

Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.

(d) Emission Mask D--12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd - 2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two to three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emissions mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (m) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, then an alternate procedure may be used provided prior Commission approval is obtained.

7.3 Test Procedure

TIA/EIA-603:1993 Section 2.2.11

7.4 Test equipment

Spectrum Analyzer: Hewlett-Packard 8567A, Serial Number 2602A-00165, Calibrated: 12 March 1999, Calibration due Date: 12 March 2000

RF Preselector: Hewlett-Packard 85685A, Serial Number 2648A-00392, Calibrated: 12 March 1999, Calibration due Date: 12 March 2000

7.5 Test Results

*Scan in plots here

8. Spurious Emission At Antenna Terminals (The EUT is Exempt from this Technical Standard per 90.217, this Data is Provided for Information Purposes)

8.1 Test Requirement

Sec. 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers 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. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in Sec. 2.1049 as appropriate. The magnitude of spurious emissions, which are attenuated more than 20 dB below the permissible value, need not be specified.

8.2 Test Technical Standard

90.210(d3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

8.3 Test Procedure

TIA/EIA-603:1993 Section 2.2.13

8.4 Test equipment

Spectrum Analyzer: Hewlett-Packard 8567A, Serial Number 2602A-00165, Calibrated: 12 March 1999, Calibration due Date: 12 March 2000

RF Preselector: Hewlett-Packard 85685A, Serial Number 2648A-00392, Calibrated: 12 March 1999, Calibration due Date: 12 March 2000

8.5 Test Results

List of Conducted Spurs
Calculation of Limit

10 dBm (100 mW) – 30 dB = –20 dBm

Frequency (MHz)	Limit of spurious emission (dBm)	Measured spurious emission (dBm)	Delta to limit of spurious emission (dBm)
109.8	-20	-56.0	-36.0
306.3	-20	-54.3	-34.3

9. Field Strength of Spurious Radiation (The EUT is Exempt from this Technical Standard per 90.217, this Data is Provided for Information Purposes)

9.1 Test Requirement

Sec. 2.**1053** Measurements required: Field strength of spurious radiation.

(a) 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. Curves or equivalent data shall be 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 (c) of Sec. 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements 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 reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:
   (1) Those in which the spurious emissions 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.

9.2 Test Technical Standard

90.210(d3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

9.3 Test Procedure

TIA/EIA-603:1993 Section 2.2.12

9.4 Test equipment

Spectrum Analyzer: Hewlett-Packard 8567A, Serial Number 2602A-00165, Calibrated: 12 March 1999, Calibration due Date: 12 March 2000

RF Preselector: Hewlett-Packard 85685A, Serial Number 2648A-00392, Calibrated: 12 March 1999, Calibration due Date: 12 March 2000

Quasi Peak Adapter: Hewlett-Packard 85650A, Serial Number 2521A-00689, Calibrated: 12 March 1999, Calibration due Date: 12 March 2000

Broadband Biconical Antenna (20 MHz to 200 MHz): EMCO 3110, Serial Number 1180, Calibrated: 29 June 1999, Calibration due Date: 29 June 2000

Broadband Log Periodic Antenna (200 MHz to 1000 MHz): EMCO 3146, Serial Number 2852, Calibrated: 29 June 1999, Calibration due Date: 29 June 2000

Double Ridge Guide Horn Antenna: EMCO 3115, Serial Number 5534, Calibrated: 28 December 1999, Calibration due Date: 28 December 2000

EUT Turntable Position Controller: EMCO 1061-3M 9003-1441, No Calibration Required

Antenna Mast: EMCO 1051 9002-1457, No Calibration Required

9.5 Test Results

Frequency of Emissions (MHz)	Polarization H/V	Received Signal Field Strength dBµV/m @3m	Effective Radiated Power dBm	Limit Radiated Power dBm	Delta to Limit dB
305.737	V	56.1	-41.3	-20.0	-21.3
458.605	V	46.8	-50.6	-20.0	-30.6
611.472	V	49.1	-48.3	-20.0	-28.3
764.357	V	58.0	-39.4	-20.0	-19.4
917.229	V	53.5	-43.9	-20.0	-23.9
1070.09	V	61.7	-33.5	-20.0	-13.5
1222.97	V	47.9	-47.3	-20.0	-27.3
1375.81	V	50.8	-44.4	-20.0	-24.4
1528.68	V	51.6	-43.6	-20.0	-23.6

CALCULATION OF RADIATED POWER LIMIT

All emissions below 1000 MHz are expressed in terms of the equivalent power that would have to be fed into a dipole antenna in order to produce the same electric field strength. All emissions above 1000 MHz are expressed in terms of equivalent isotropic power. The equivalent power was determined by using the following formula: $P_t = E^2R^2/30\ G$

Example: If the output power of the transmitter is 3 watts.

The minimum attenuation is 50 + l0 Log 3 = 54.8, so the maximum power of any spurious emission must not exceed 4.8 dBW – 54.8 dBW = - 50 dBW = - 20 dBm = 0.01 mW

Using the above relation we have E = $\sqrt{(30 * G * P)}$/R

For emissions which are less than or equal to 1000 MHz
G =1.64 and E = $\sqrt{}$ (30 x 1.64 x 0.01 x 10^{-3}) / 3 = 7.4 mV/m
= 77.3 dBuV/m

Therefore the electric field strength of emissions must not exceed 77.3 dBuV/m at 3m.

Similarly for emissions which are greater than 1000 MHz, G=1 and the field strength must not exceed 75.2 dBµV/m at 3 m.

CALCULATION OF RADIATED POWER

All emissions below 1000 MHz are expressed in terms of the equivalent power that would have to be fed into a dipole antenna in order to produce the same electric field strength. All emissions above 1000 MHz are expressed in terms of equivalent isotropic power. The equivalent power was determined by using the following formula: $P_t = E^2R^2/30\ G$

Example:	Electric field strength is	E = 41.1 dBuV/m
	Measured at a distance of	R = 3 m
	The gain of a dipole antenna is	1.64

$P_t = [10^{(41.1/20)}\ X\ 10^{-6}]^2 \times 3^2/30 \times 1.64 = 2.36 \times 10^{-9}$ watts = -56.3 dBm

When calculating equivalent isotropic radiated power for emissions above 1000 MHz the gain is G=1.

10. Frequency Stability (The EUT is Exempt from this Technical Standard per 90.217, this Data is Provided for Information Purposes)

10.1 Test Requirement

Sec. 2.1055 Measurements required: Frequency stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: (1) From -30 deg. to +50 deg. centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10 deg. 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. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(d) 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, battery 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. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

10.2 Test Technical Standard

Sec. 90.213 Frequency stability.

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Minimum Frequency Stability
[Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
150-174	[5,11]5	[6]5	[4,6]50

[4] Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.
[5] In the 150-174 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.
[6] In the 150-174 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth or designed to operate on a frequency specifically designated for itinerant use or designed for low-power operation of two watts or less, must have a frequency stability of 5.0 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 ppm.
[11] Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

10.3 Test Procedure

TIA/EIA-603:1993 Section 2.2.1

10.4 Test equipment

Communication Analyzer: IFR COM 120A, Serial Number 485002436

10.5 Test Results

Test run at nominal battery voltage of 12.0Vdc on 152.87 MHz. Temperature in deg C, Error in ppm

-30	-20	-10	0	10	20	30	40	50	60
-4.8	1.1	3.8	4.9	4.4	3.0	1.4	0.2	-0.6	-0.3

Battery Voltage Test Nominal Battery Voltage is 7.2 Vdc; Low Battery Indicated at 6.6Vdc; Error in ppm

7.512	7.324	7.122	6.925	6.730	6.516
-0.1	-0.2	-0.3	-0.4	-0.4	-0.4

11. Transient Frequency Behavior (The EUT is Exempt from this Technical Standard per 90.217, this Data is Provided for Information Purposes)

11.1 Test Technical Standard

Sec. 90.**214** Transient frequency behavior.

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals [1,2]	Maximum frequency difference[3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 mSec	10.0 mSec
t_2	±6.25 kHz	20.0 mSec	25.0 mSec
t_3[4]	±12.5 kHz	5.0 mSec	10.0 mSec

[1] t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t_1 is the time period immediately following t_{on}.
t_2 is the time period immediately following t_1.
t_3 is the time period from the instant when the transmitter is turned off until t_{off}.
t_{off} is the instant when the 1 kHz test signal starts to rise.
[2] During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in Sec. 90.213.
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.
[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

11.2 Test Procedure

TIA/EIA-603:1993 Section 2.2.19

11.3 Test equipment

IFR	Communications Monitor	COM-120A	485002436
HP	Signal Generator	8640B	1741A07326
HP	VHF Attenuator	355D	1204A24115
HP	Triple Output Power Supply	6235A	2450A-06875
Tektronix	Digital Oscilloscope	TDS620B	B030182
Instek	Laboratory DC Supply	PS-3030	9669588
JFW	Directional Coupler	50C-007-10	207963
JFW	RF Detector	50D-003	N/A
RE	Combiner	50-500 Mhz	N/A

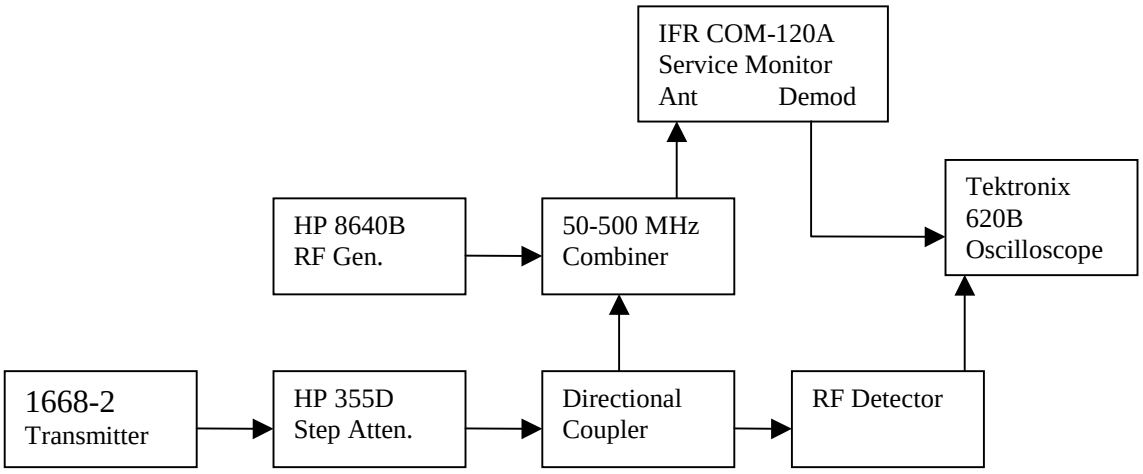
11.4 Test Results

RFD Controller 1668-2 Transient Frequency Tests
With Unmodulated Signal

Time Interval	Allowed Frequency Deviation	Measured Frequency Deviation	Delta to limit
t_1 5.0 mSec	No limit EUT < 100 mW	12.5 kHz	N/A
t_2 20.0 mSec	No limit EUT < 100 mW	2.5 kHz	N/A
t_3 5.0 mSec	No limit EUT < 100 mW	15.0 kHz	N/A

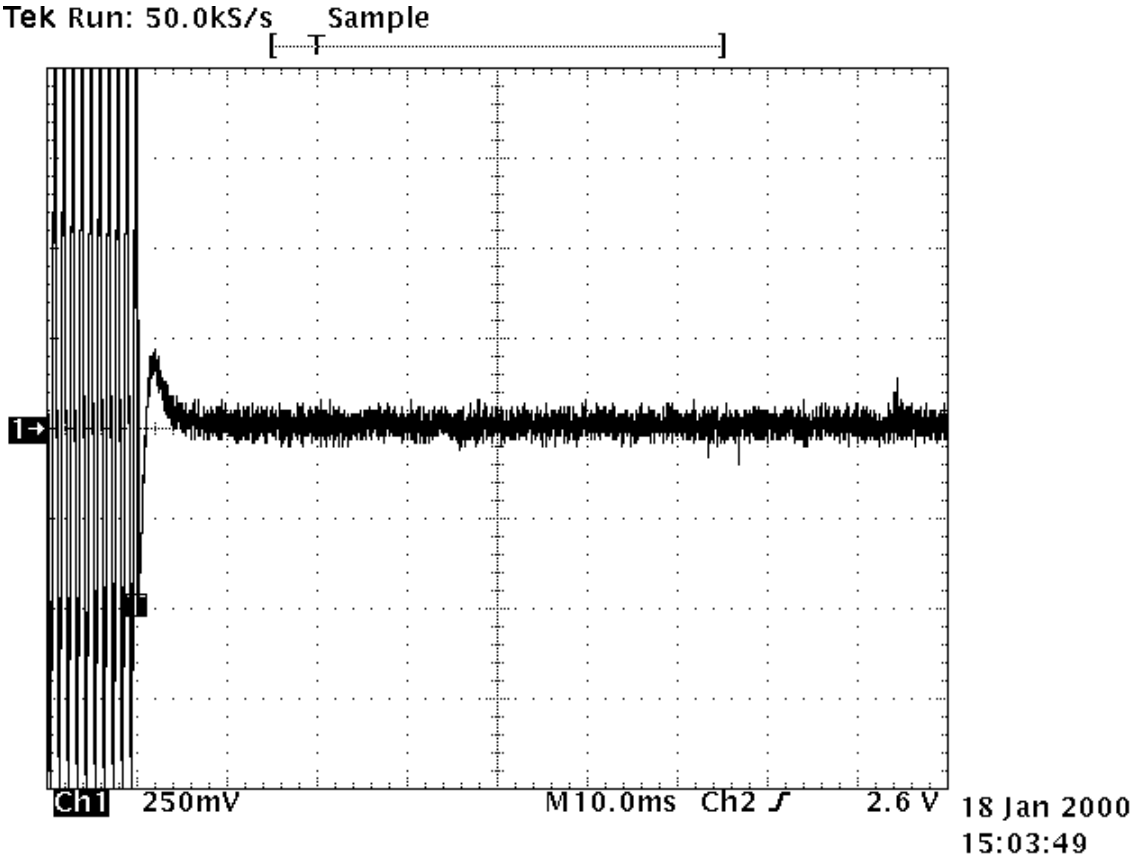
RFD Controller 1668-2 Transient Frequency Tests
With Modulated Signal

Time Interval	Allowed Frequency Deviation	Measured Frequency Deviation	Delta to limit
t_1 5.0 mSec	No limit EUT < 100 mW	12.5 kHz	N/A
t_2 20.0 mSec	No limit EUT < 100 mW	2.5 kHz	N/A
t_3 5.0 mSec	No limit EUT < 100 mW	15.0 kHz	N/A

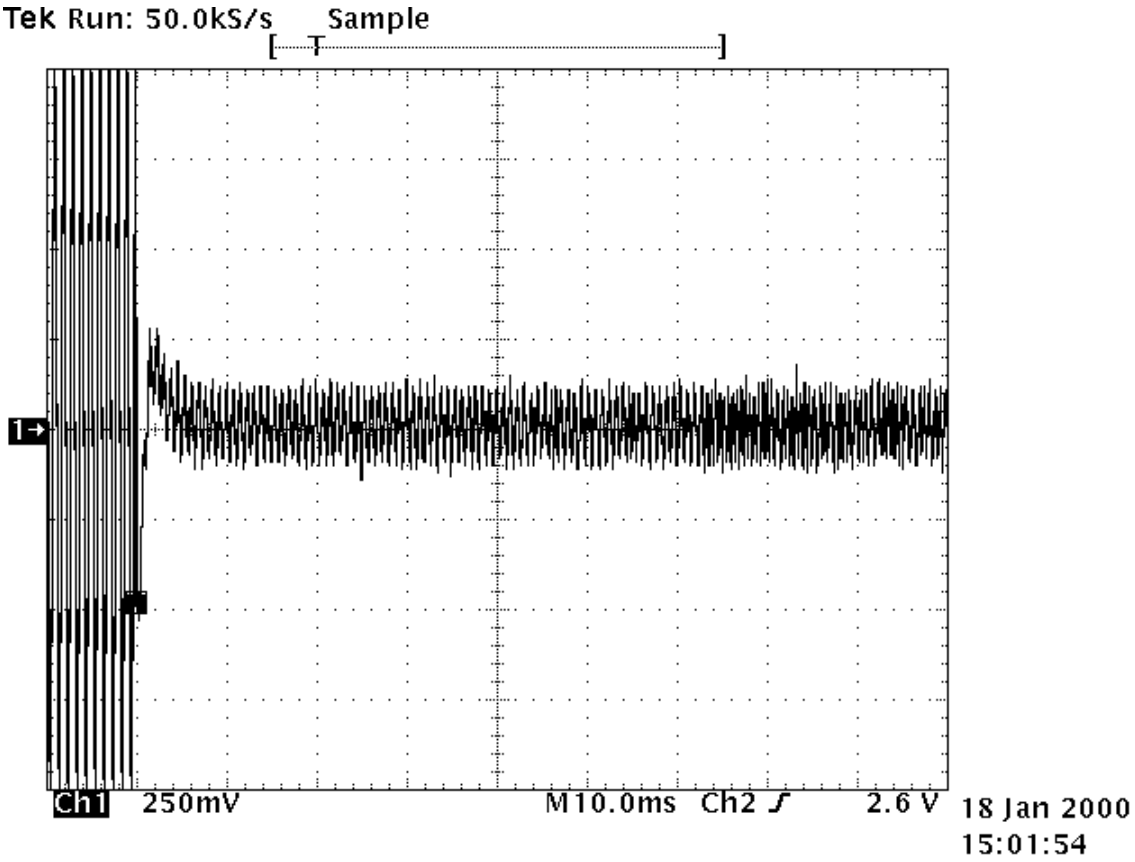


Block Diagram of Test Setup

Turn-on Transient – No Data

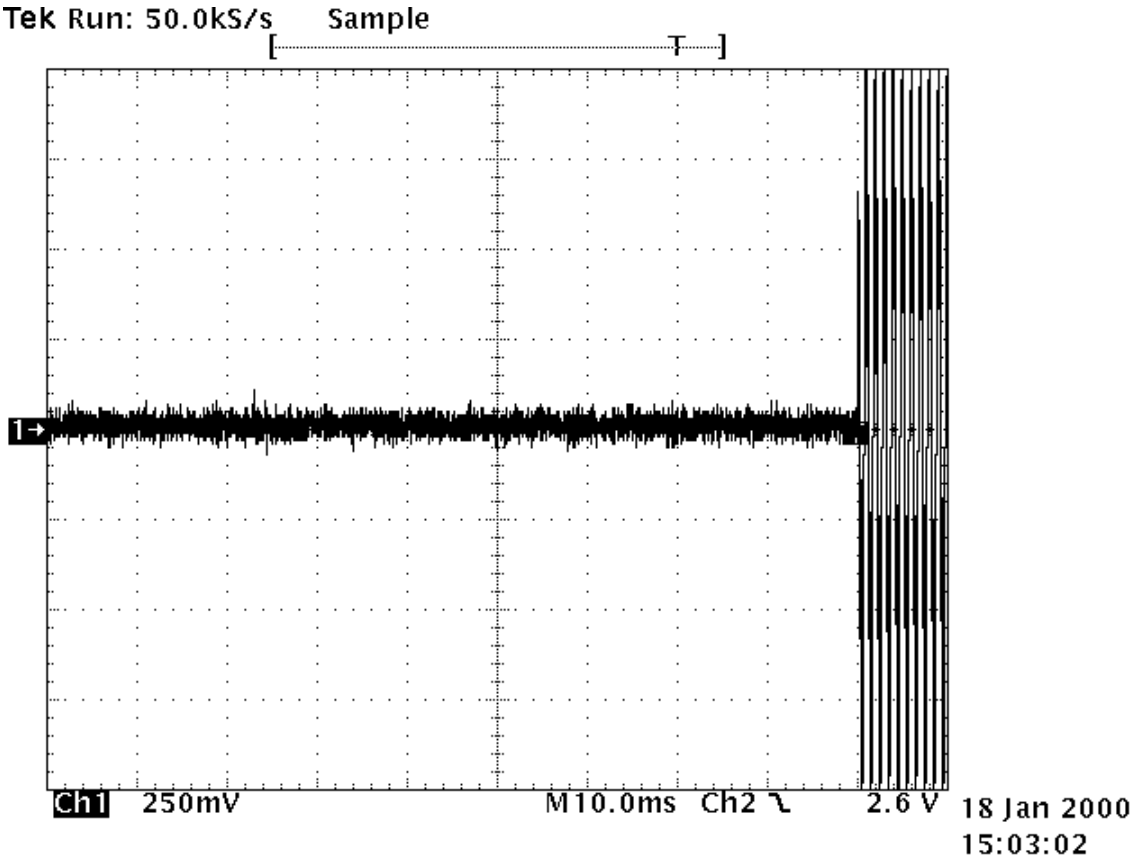


Transient Modulated with Data



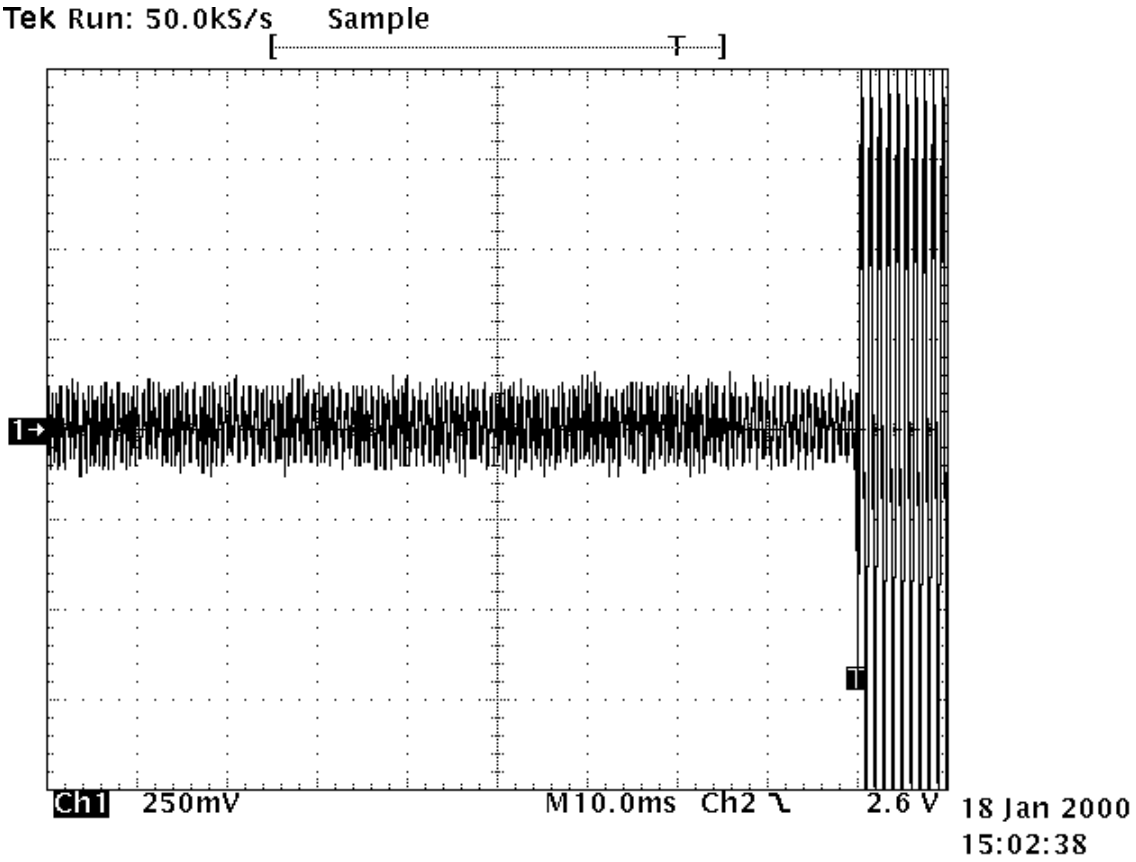
Turn-on

Transient No Data



Turn-off

Modulated Turn Off Transient



12. Miscellaneous Comments and Notes

1. None.