ALPHA 6 VHF Power Amplifier

Test Report for Grant of Certification for Use in Part 97 Amateur Service under the Rules of the Federal Communications Commission

January 11, 2002

Submitted by:
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Table of Contents

1.0 Introduction

This report details the results of the tests performed to demonstrate compliance of the design and manufacturing configuration of the ALPHA 6 amplifier with the applicable portions of the FCC regulations pertaining to this class of equipment.

Two compliance matrices listing the applicable FCC regulations and the corresponding section of the test report that address these rules are provided as Appendices A-1 and A-2 to this report.

The Applicant/Manufacturer under the FCC rules is:

CrossLink Inc.
6185 Arapahoe Road
Boulder, CO 80303
FCC Grantee Code: DGV

The Applicant's point of contact for questions regarding this report is Gordon E. Hardman, Vice President and Chief Technical Officer. His phone number is 303.473.9232 x101, and his e-mail address is geh@crosslinkinc.com.

2.0 Description of Amplifier

2.1. General Features

The ALPHA 6 is an external linear power amplifier designed to be operated in the class AB1 mode. It is capable of boosting by 15 dB the power output of an amateur radio transmitter operating only in the 50-54 MHz segment of the Amateur band. The gain is 15 dB or less, and does not change with power input level. There are no adjustments to change the gain.

The amplifier is capable of in-band power output of 1500 watts (PEP or CW) with 50 watts of input. Since the amplifier is linear, it may be operated with a power input level of less than 50 watts to achieve 15 dB of gain albeit at proportionally lesser power output levels. It is designed for continuous service up to the maximum rated output of 1500 watts. Since it operates in the Class AB1 mode, it is capable of amplifying all emissions authorized under the Amateur Service in the 50-54 MHz band.

The power supply has been designed such that the amplifier is capable of reliable sustained operation at its rated power output level of 1500 watts. The cooling system likewise is capable of maintaining an acceptable equilibrium temperature at maximum RF power output. The power supply and control circuitry were derived from the Alpha manual-tune 1500 watt high-power RF amplifiers with similar output levels that are currently certified for Part 97 service in the 1.8 to 29.7 MHz Amateur bands. All RF tank components, switching relays, cooling fans, etc. are also capable of sustained operation at full power.

The ALPHA 6 is fully assembled and tested at the factory prior to shipment to a customer. Because of the mass of the AC transformer and the concern of damage to the chassis during shipment, the unit is shipped in two packages – one containing the power transformer and the second containing the rest of the fully assembled amplifier. After unpacking, the transformer is installed by the user by mounting it inside the cabinet into four pre-drilled PIM-reinforced mounting holes and is connected electrically to the Amplifier using two factory-installed molex-type connectors. No other assembly is required by the end-user.

After installation of the A/C transformer by the user, the entire Amplifier is contained in one enclosure. There is no band-switching required as the Amplifier is designed to operate as a "mono-bander" only within the 50 MHz to 54 MHz Amateur band. The output stage of the amplifier is designed around a 4CX1600B tetrode, a vacuum tube manufactured by Svetlana Inc. of St. Petersburg, Russia. The data sheet for this tube is provided in Appendix B.

2.2 Design Features

A block diagram illustrating the general configuration of the ALPHA 6 is provided in Appendix C. The amplifier has input and output bypass switching which permits the driving source (transmitter or transceiver) to be directly connected to the load. This allows reception of signals if the load is an antenna and the source a transceiver, or direct transmission from the transmitter without the amplification afforded by the ALPHA 6 if the source is a transmitter. An input matching and input RF detect board detects (in an analog fashion) the presence or absence of drive power from a nominal 50 ohm source, and matches this power to the drive requirements of the tube within the band 50-54 MHz. The 4CX1600B tube amplifies the RF signal, and the output matching network matches this power to a nominal 50 ohm impedance.

The output power is low-pass filtered and returned to the output bypass relay. This power, and any reflected from the load, is monitored by an output power sensor. The power for the operation of the tube and all other circuits is supplied from the AC line by a transformer-coupled power supply of conventional design. A controller module establishes correct operating conditions for the tube and provides operating power for the ancillary circuitry. A front panel display allows the operator to correctly set up the amplifier so that it can be operated in compliance with the FCC requirements. The amplifier does not require any alignment or set-up functionality other than the routine front-panel tuning of the output tank circuit that is required to match the amplifier output to the output load over the 50-54 MHz band.

2.3 DC operating Conditions

The final tube is operated in Class AB1, with an electronic bias switch (EBS) to switch the tube to it's nominal bias setting only when RF is present at the input. The tube plate voltage is approximately 2.9 kV under no-load conditions, and approximately 2.4 kV when tuned up correctly and delivering full output power. The current drain from the high voltage supply is in the range 0.9 to 1.2 Amps under full

load. The screen grid (grid 2) has a 350 Volt supply, which is regulated to stabilize the amplifier gain. The screen grid current is less then 50 mA. The control grid (grid 1) voltage is also regulated, and is set during manufacturing to values that give the correct idle current for the tube. The approximate control grid voltages are: receive, -124 V; operating idle, -95 V; operating active, -70 V. Little or no current is drawn from the control grid supply.

2.4 Special Design Considerations

Care has been taken in the design of the ALPHA 6 to ensure compliance with the applicable FCC requirements set forth in Part 97 and Part 2 of the Commission's rules. Examples of these features include:

2.4.1 Minimal gain at 27 MHz

FCC rules severely restricts gain on either side of the 11m (27MHz) band. The ALPHA 6 has several design features which make achieving useful gain in this frequency range extremely difficult. The input matching circuit is designed in such a way as to present a very poor impedance match in the nominal 50 ohm circuit seen by the driving source. Most modern solid-state transmitters will shut down or severely reduce their output power when presented with a poor match of this magnitude.

Additional gain reduction in the vicinity of 27 MHz is provided by the output, since the output tank circuit is of a novel transmission-line design. A key component of this is a microstrip line, whose impedance matching properties are a function of its length as a fraction of the wavelength being amplified. Not having a traditional lumped element inductor as this circuit element makes modification of the amplifier to operate at a lower frequency extremely difficult, since this would involve "stretching" the microstrip line to approximately double its current length, which would not fit inside the amplifier cabinet.

2.4.2 In-band Gain

Gain in the intended band of 50-54 MHz is limited to no more than 15 dB by means of the way in which the tube is operated. The input circuit is of the "swamped-grid" variety, where the power from the source is dissipated resistively, allowing the desired gain without the requirement for neutralization. Removing or tampering with these components will result in an unstable amplifier which will likely destroy itself.

2.4.3 Spurious Emissions

The output filter is an aggressive 6^{th}-order lumped constant filter, with no stop-band re-entrants up to the 10^{th} harmonic. This allows the amplifier to meet the FCC requirement of –60 dBc for all spurs, with margin. Typical two-tone third-order intermodultation product is 30 dB below the full (pep) output power.

There is no computer, crystal oscillator, switch-mode power supply or other source of spurs non-harmonically related to the driving RF source. The tube circuitry has been designed in accordance with well-established procedures, including the use of an anti-parasitic choke to ensure that the tube will not oscillate by itself at any frequency.

The cabinet is closed by multiple fasteners, which are spaced close enough to prevent accidental leakage of radiation from the seams. The power cord is bypassed to prevent radiation into and from the AC power supply.

2.4.4Anti-tampering Features

There are no user-accessible modifications which allow the amplifier to exceed it's design specifications. The tube is operated in a socket specific to that type of tube, and there are no tubes of greater capability which will fit into that socket. There are no power supply voltage taps or other DC voltage or current adjustments which increase output power. The power supply has been designed such that the amplifier is reliably capable of sustained operation at full power. However, attempting to draw more plate current causes the plate voltage to sag, keeping the power output more-or-less constant.

There is no attenuation of the RF input signal. The input circuit is constructed on a printed wiring board, and it would be difficult for a user to modify this in any way to exceed the specifications without risking consequential damage to the amplifier. The amplifier is a tetrode design, and the control grid circuit uses a "swamped grid" design. Almost all of the RF input power is dissipated as heat in a resistor in the input circuit. This resistor is responsible for amplifier stability. Changing its value or removing it will result in amplifier instability which will likely damage or destroy part of the amplifier.

No features are provided which facilitate operation in other than the amateur service. The amplifier is optimized for the 50-54 MHz 6 meter amateur band and for the emission types and power levels applicable to the amateur service.

3.0 Test Results

Appendices A-1 and A-2 summarize the applicable certification requirements set forth in 47 CFR Section 2.1060 and 47 CFR 97 of the Commission's rules that the ALPHA 6 Amplifier meet in order to be certified for Service under Part 97. Appendix A-1 deals with the requirements set for in Part 2, Section 1033 and Appendix deals with the requirements set forth in Part 97, Sections 307 and 317.

The specific amplifier used in all testing is the Model ALPHA 6, serial number 002. This amplifier was built to the design specifications to which the final (FCC certified) product will be manufactured. Production materials used in the test unit are the same that are anticipated to be used in the production version. No changes to the design of the production version are anticipated.

All of the Certification tests were performed by CrossLink Inc., the manufacturer of the ALPHA-6. The test equipment suite used for all testing is provided in the Table 3.0-1 below.

Equipment	Manufacturer/Model	Unit Serial Number
Spectrum Analyzer	HP 8569 B	2326A00979
Output Wattmeter	Bird 43	161047
Wattmeter Sense Element	Bird 2500A	N/A
Input Wattmeter	Bird 43	141577
Wattmeter Sense Element	Bird 100A	N/A
RF Source	ICOM IC746	04865
Power Attenuator	Bird 8325	2454
50 MHz notch filter	CrossLink 50N	N/A
10 dBi gain reference Yagi	Create 5130	N/A

Table 3.0-1 Test Equipment Suite

The tests were conducted in the four broad categories of tests set forth in the FCC rules. These categories are:

- In-band gain;
- Out-of-band gain;
- Conducted emissions; and
- Radiated emissions.

The test methodology and results for each Test Group is described separately below.

3.1 In-Band Gain

The FCC requirement is to demonstrate that the amplifier will not produce more than 1500 watts output when driven by less than 50 watts input. The test method used was to adjust the amplifier to deliver 1500 watts into an artificial antenna and measure the drive power required to produce this power. The test setup was as shown in Figure 3.1-1 below.

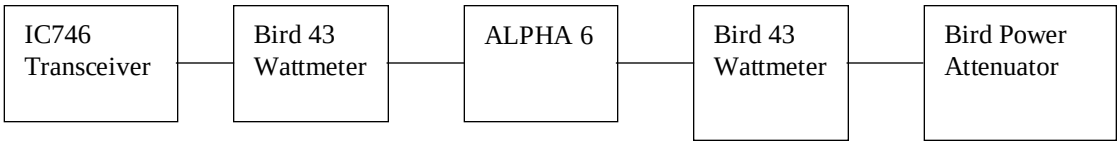


Figure 3.1-1. Test setup for in-band gain measurement

The drive source for this test is a currently available Amateur Radio transceiver manufactured by Icom, the Model IC-746. It has adjustable output power up to about 100 watts across the 50-54 MHz band. For RF power measurement the Bird Model 43 directional wattmeter was chosen for both input and output power measurement.

3.1.1 Test Procedure

The amplifier was tuned up for 1500 watts output power at 50 MHz, as indicated on the output Bird wattmeter. The input RF drive power required to obtain this condition was read from the input Bird wattmeter. A spectrum analyzer was connected to the output of the Bird power attenuator to ensure that the spectrum was clean, and that the amplifier was not being tuned to an oscillation or other spurious output. This was repeated in 1 MHz steps up to 54 MHz.

3.1.2 Results

Across the 50 54 MHz band, 50 watts minimum drive was required to achieve 1500 watts out. The data taken is presented below in Table 3.1.2-1.

Frequency (MHz)	**Input Drive (watts)**	**RF Output (watts)**	**Amplifier Gain (dB)**
50	51	1500	14.65
51	53	1500	14.52
52	58	1500	14.13
53	68	1500	13.44
54	76	1500	12.95

Table 3.1.2-1. In-band drive power and related amplifier output and gain

The input-output power relationship data are shown graphically in Figure 3.1.2-1 below. Also shown is the minimum drive power (50 watts) specified by the FCC regulations ("FCC Power Limit"). Clearly, 50 watts drive or more is required to obtain 1500 watts RF Ouput across the band.

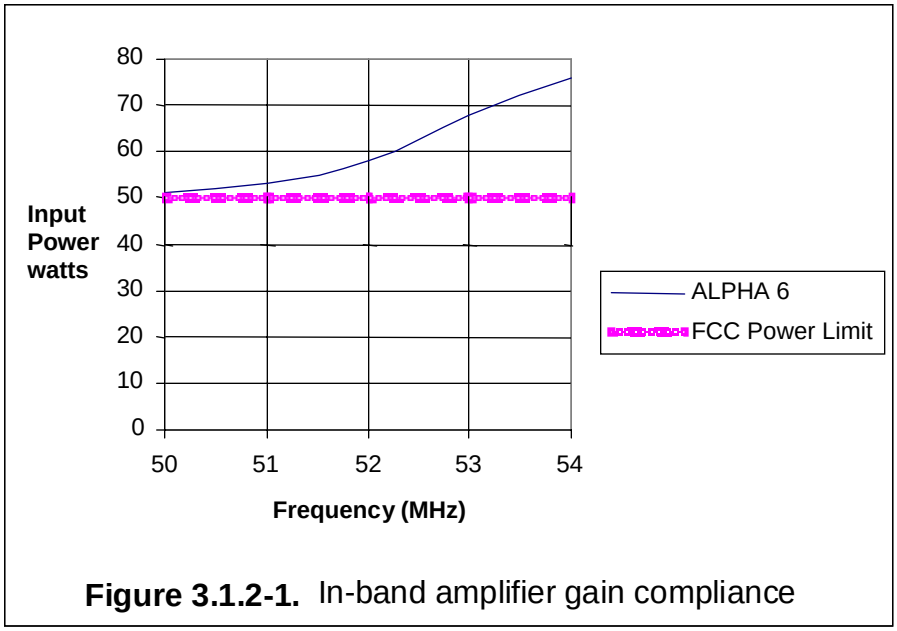


Figure 3.1.2-1. In-band amplifier gain compliance

3.1.3 Conclusion

The ALPHA 6 passes the FCC requirements in this area at all frequencies on which it is intended to operate since (1) the amplifier requires at least 50 Watts of drive to produce the designed output power (2) the amplifier gain does not exceed 15 dB , and (3) since the amplifier is linear, it will proportionally produce less than 1500 watts at lower input levels.

3.2 Out-of-Band Gain

The FCC requirements are that a power amplifier shall exhibit less than 6 dB of gain from 24-26 MHz; less than 0 dB of gain from 26-28 MHz; and less than 6 dB of gain from 28 to 35 MHz (collectively, the "Gain Limit Mask"). The test method used to determine this was to place the amplifier in its operational mode, and adjust it for maximum gain at these frequencies, and then measure the "insertion gain", that is, the gain measured by inserting the amplifier into circuit while controlling the drive power to a constant level. The test setup was identical to that used for in-band gain measurement, and is shown in Figure 3.1-1.

3.2.1 Test Procedure

The amplifier was set to its operational mode, and the gain adjusted for the maximum gain at the frequencies listed above. Since these frequencies are all below the intended band of operation, this corresponded to the condition where both the "Tune" and "Load" capacitors were fully meshed. The IC 746 driver was adjusted to give the maximum drive power it could into the amplifier. As mentioned above, due to the poor input SWR presented by the ALPHA 6 in this frequency range, the protection circuits would sometimes limit this power to less than 50 Watts. The output and input powers were then measured, and their ratio gave the gain of the amplifier.

3.2.2 Results

The data taken is displayed in Table 3.2.2-1 below.

Frequency (MHz)	**Insertion Gain (dB)**
24	-24
25	-22
26	-20
27	-18
28	-16
29	-15
30	-14
31	-13
32	-12
33	-11
34	-10
35	-9.5

Table 3.2.2-1. Out-of-band gain for ALPHA 6

The same data is shown graphically in Figure 3.2.2-1 below. Also shown is the FCC "gain mask", i.e. the maximum allowable gain for a compliant amplifier.

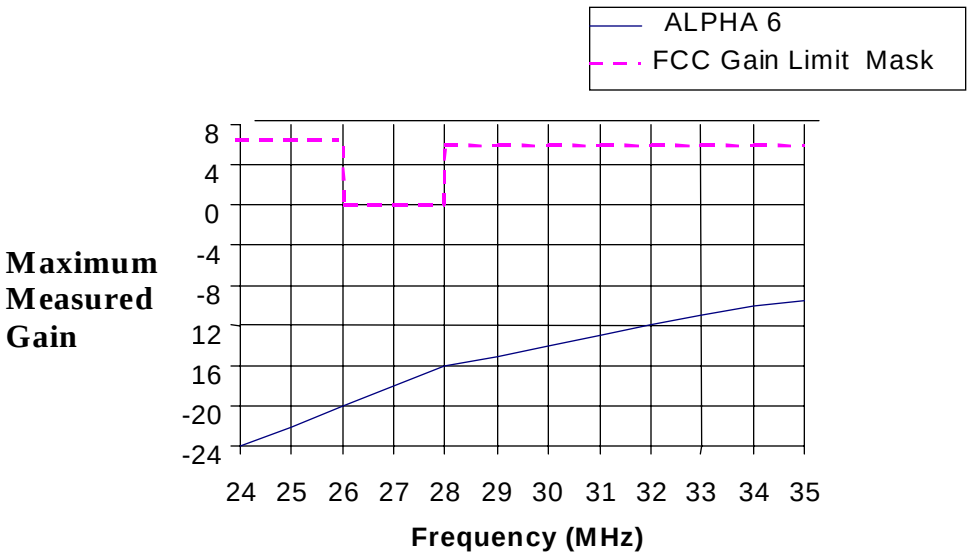


Figure 3.2.2-1. ALPHA 6 OUT-OF-BAND GAIN

3.2.3 Conclusions

The ALPHA 6 complies with the strict FCC requirement for minimal gain over the range of 24 to 35 MHz.

3.3 Conducted Emissions

The conducted emissions are required to be at least 60 dB below carrier (-60dBc) up to the 10th harmonic (500MHz). This is measured at full power into an artificial antenna, and with the amplifier on but in the "Standby" mode.

3.3.1 Test Setup

The test setup is sown in Figure 3.3.1-1 below. Test setup is the same as for the preceding gain measurement, with the addition of a notch filter and spectrum analyzer to the output of the power attenuator. The reason for the notch filter is to increase the dynamic range of the test setup. The dynamic range of the spectrum analyzer is only slightly more than the 60 dB of the FCC requirement. Hence it was necessary to reduce the amplitude of the fundamental in order to ensure that the spectrum analyzer was not overloaded. With this test setup, the dynamic range is estimated to be at least 75 dB.

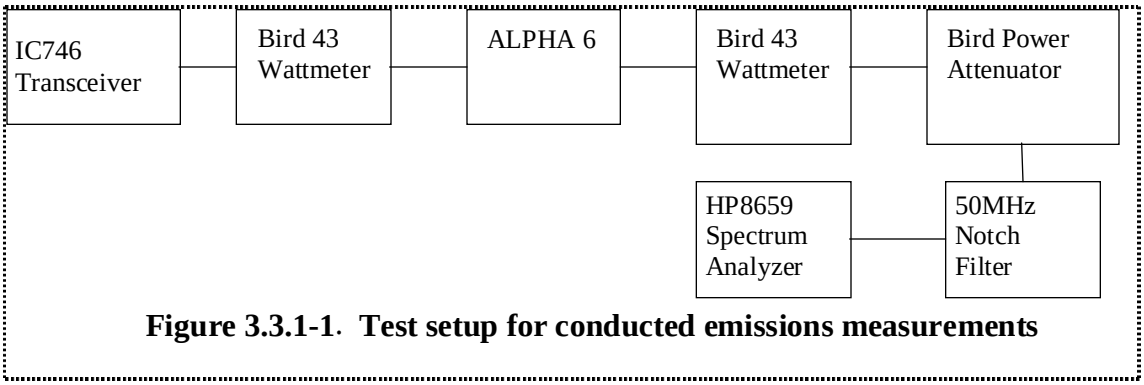


Figure 3.3.1-1. Test setup for conducted emissions measurements

3.3.2 Test Procedure

A calibration run was first performed to account for the presence of the notch filter. The ALPHA 6 was temporarily disconnected from the power attenuator and a signal generator connected in its place. The signal generator was set to +20 dBm output power, and the frequency adjusted in steps from 50 MHz up to 500 MHz. This gave a table of calibration values for the test setup, to be used later in the actual measurement. These coefficients are shown in Table 3.3.2-1 below.

Frequency (MHz)	Level (dBm)	Cal. Factor (dB)	Frequency (MHz)	Level (dBm)	Cal. Factor (dB)
50	-41	0	300	-17	24
100	-18	23	350	-18	23
150	-16	25	400	-18	23
200	-16	25	450	-18	23
250	-16	25	500	-18	23

Table 3.3.2-1. Calibration coefficients for conducted measurements

The amplifier was reconnected to the power attenuator and operated at its rated power output (1500 watts). The spectrum analyzer was used to examine all spurious signals up to 500 MHz. The relationship of these to the carrier (dBc) was calculated by applying the calibration coefficients determined above. The results are shown in Table 3.3.2-2.

Frequency (MHz)	Spur. Level (dBm)	dB Below Carrier (dBc)	Frequency (MHz)	Spur. Level (dBm)	dB Below Carrier (dBc)
100	-52	-76	350	-55	-79
150	-44	-70	400	-52	-76
200	-40	-66	450	>-60	>-84
250	-55	-81	500	>-60	>-84
300	-52	-76			

Table 3.3.2-2. Maximum spurious levels found for the ALPHA 6

3.3.3 Conclusions

The ALPHA 6 has no spurious outputs which violate the FCC requirement for better than -60 dBc purity up to the 10th harmonic. The fourth harmonic, at 200 MHz is the strongest, at –66 dBc.

3.4 Radiated Emissions

The FCC requires that all radiated emissions (from the cabinet, power cable etc.) typical of the amplifier in normal operation be at least 60 dB down in the same range as required for conducted emissions. The levels are measured in the far field, and are referred to a half-wave dipole level.

3.4.1 Test Procedure

The amplifier was operated in a normal configuration, using the test setup of Figure 1. The test setup was arranged on a movable test-cart, with the radio below the amplifier, and the power attenuator mounted off the cart and some 3m away. The test setup was moved to an outdoor range constructed at the CrossLink Inc. facility in Boulder. The test receiver was a spectrum analyzer and a log-periodic antenna of known +10 dBi gain from 30-1300 MHz. This field test setup is shown in Figure 3.4.1-1.

Figure 3.4.1-1 Far field test set-up

3.4.2 Results

The amplifier was operated at 1500 watts output, and the level of each spurious signal found up to the 10th harmonic was recorded. The results are shown in Table 5. In this table FSL is the Free Space Loss, which is calculated in the usual fashion. The antenna was located 30m from the amplifier under test. For each harmonic, the amplifier on the test cart was rotated to find the maximum level at the spectrum analyzer. In each case, this is the level recorded. The results of the test are provided in Table 3.4.2-1 below.

Frequency (MHz)	**FSL (30m)**	**Max allowable (dBm)**	**Measured (dBm)**
50	35.37	-34.35	N/A
100	41.39	-40.38	<-70
150	44.91	-43.90	<-70
200	47.41	-46.40	-61
250	49.35	-48.33	-62
300	50.93	-49.92	-73
350	52.27	-51.26	-80
400	53.43	-52.42	-65
450	54.46	-53.44	-75
500	55.37	-54.35	-74

Table 3.4.2-1. Radiated measurement results for ALPHA 6.

3.4.3 Conclusions

The amplifier possesses no spurious radiated signals which violate the FCC requirements. In all cases the measured spurious output is at least 60 dB down from what would be radiated by the full carrier from a half wave dipole.

4.0 Other Compliance Information

Other compliance information is specified below.

4.1 FCC ID

The FCC ID number will be in located on the outside rear panel of the Amplifier. The Proposed FCC ID is **DGVPA06**. The FCC ID will be printed in black block lettering on the gold-anodized chassis finish in a font size of eight-point (or greater). Graphical depictions of the FCC Information is included in Appendix E.

5.0 Summary

All Applicable certification requirements are met or exceeded by the ALPHA 6.

Appendix A-1 -- Part 97 Compliance Matrix

Controlling Parameter	Standby/Off w/50 watts drive	At Max Gain with less than 50 watt drive	At Full Output w/50 watt drive	Part 97 reference	Test Report Reference
Limits on spurious emissions (radiated and conducted)	-60 dB	n-a	n-a	97.317 (a) (2), 97.307(e)	Section 3.3, Section 3.4
Limits on spurious emissions (radiated and conducted)	n-a	n-a	-60 dB	97.317 (a) (1), 97.307(e)	Section 3.3, Section 3.4
Max gain allowable between 24-26 MHz	n-a	n-a	+6 dB	97.317(b)(1)	Section 2.4.1, Section 3.2
Max gain allowable between 26-28 MHz	n-a	n-a	+0 dB	97.317(b)(2)	Section 2.4.1, Section 3.2
Max gain allowable between 28-35 MHz	n-a	n-a	+6 dB	97.317(b)(1)	Section 2.4.1, Section 3.2
Must be no user-accessible methods to mod amp to exceed specs	yes	yes	yes	97.317(c)	Section 2.4.4
Must not exceed 1500 watts out with 50 watts drive	n-a	n-a	yes	97.317(c)(6)(i)	Section 3.1
Must not amplify drive signal by more than 15 dB	n-a	n-a	yes	97.317(c)(6)(ii)	Section 3.1
Must not exceed 1500 watts out with less than 50 watts drive	n-a	yes	n-a	97.317(c)(6)(iii)	Section 3.1
Must be capable of sustained operation at max power level	n-a	n-a	yes	97.317(c)(6)(iv)	Section 2.1
Must not have attenuation at the input level that if removed or modified would permit the amplifer to reach max gain at less than 50 watts drive	n-a	yes	n-a	97.317(c)(7)	Section 2.4.4
Must not possess any features that would permit operation in other than amateur service	n-a	yes	yes	97.317(c)(8)	Section 2.4.4

Appendix A-2 -- Part 2 Compliance Matrix

Required Report Information	FCC Part 2 Application Reference	Test Report Reference
Name and Address of Applicant and Manufacturer	2.1033 (C) (1)	Section 1.0
Proposed FCC Identifier	2.1033 (C) (2)	Section 4.1, Appendix E
Copy of Installation and Operation Instructions	2.1033 (C) (3)	Appendix C
Type(s) of emissions	2.1033 (C) (4)	Section 2.1
Frequency Range	2.1033 (C) (5)	Section 2.1
Range of operating power values and description of means of varying output levels	2.1033 (C) (6)	Section 2.1, Section 3.1
Maximum power rating	2.1033 (C) (7)	Section 2.1
Measured DC Voltages and Currents at various stages of circuit	2.1033 (C) (8)	Appendix C
Tune up procedures	2.1033 (C) (9)	Appendix D (Draft User Manual, Section 4.2)
Complete set of schematics and detailed circuit description	2.1033 (C) (10)	Appendix F
Photo or drawing of equipment ID plate showing the information to be placed thereon	2.1033 (C) (11)	Appendix E, Section 4.1
8x10 phots of the equipment showing construction detail	2.1033 (C) (12)	Appendix G
FCC Identifier Markings must be Clear and Legible on Product	2.295	Appendix E, Section 4.1

Appendix B -- 4CX1600B Tube Characteristics

4CX1600B
High Performance Tetrode

7/98

The Svetlana ™ 4CX1600B is a high-performance ceramic/metal tetrode with a plate dissipation rating of 1600 Watts with forced air cooling. The performance charac-teristics and internal configuration of the 4CX1600B allow its use as a high gain grid-driven RF amplifier or a grounded grid amplifier. A recommended mode of operation is in grid-driven service with a passive (resistive) 50-Ohm untuned input circuit. This eliminates the need for multiple input tuned circuits and neutralization. In this mode, a simple, stable, low-cost amplifier design with good intermodulation performance can be achieved.

As a linear power amplifier, the 4CX1600B will conservatively produce 1500 Watts PEP SSB, and 1500 Watts Key Down CW in any of the three modes: grid-driven, grid-driven passive input, and cathode-driven. Because of the unique internal geometry of the Svetlana 4CX1600B, the tube will operate efficiently at low plate voltage. Improved electron ballistics using a double-focused electron trap configuration contribute to the superior performance.

Electrical Characteristics:

Cathode: Oxide-coated
Voltage 12.6 ± 0.6 V
Current, at 12.6 volts 4.4 ± 0.3 A
Voltage, cathode-heater, max. ± 100 V
Warm-up time 2.5 min.
Transconductance 50 mA/V
Direct interelectrode capacitances (grounded cathode):
C in 86 pF
C out 12 pF
C gp 0.15 pF
Maximum frequency for full ratings 250 MHz

Mechanical Characteristics

Maximum overall dimensions:
Length 109 mm (4.29 in.)
Diameter 86 mm (3.39 in.)
Net weight 750 g (1.65 lb.)
Operating position Any
Cooling Forced air
Maximum operating envelope temperature 250° C
Recommended Socket Svetlana SK3A
Recommended Anode Connector Svetlana AC-2
Recommended Air System Chimney Svetlana CH1600B

Radio Frequency Linear Amplifier, Maximum ratings

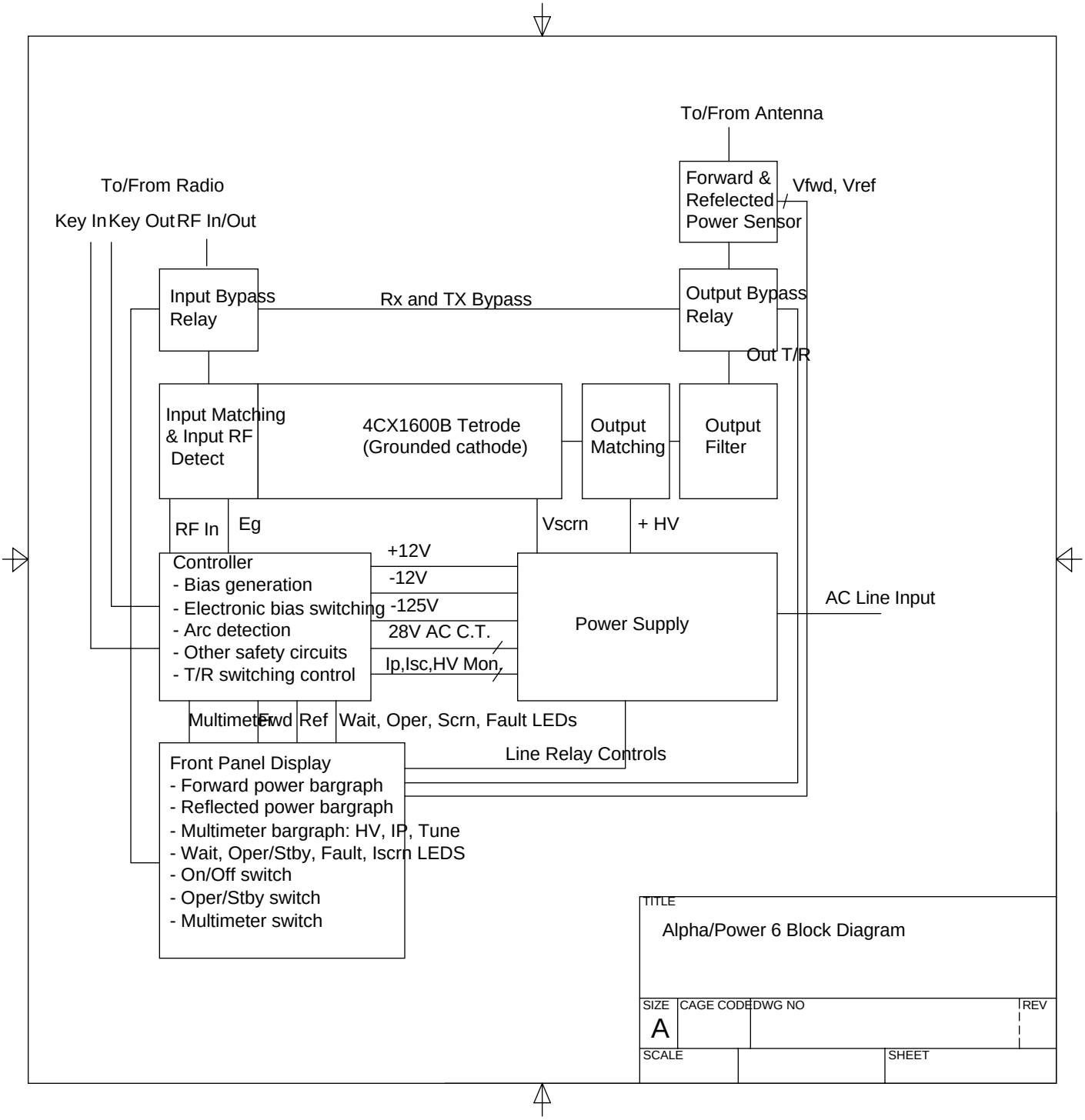
DC plate voltage 3.3 kV
DC screen voltage 350 V
DC grid voltage -150 V
DC Plate current 1.4 A
Plate dissipation 1.6 kW
Screen dissipation 20 W
Grid current 5 mA

Source: SVETLANA TECHNICAL DATA Marketing & Engineering: Headquarters. The manufacturer's complete data sheet is availableas a separate document in Adobe "PDF" file at www.svetlana.com.

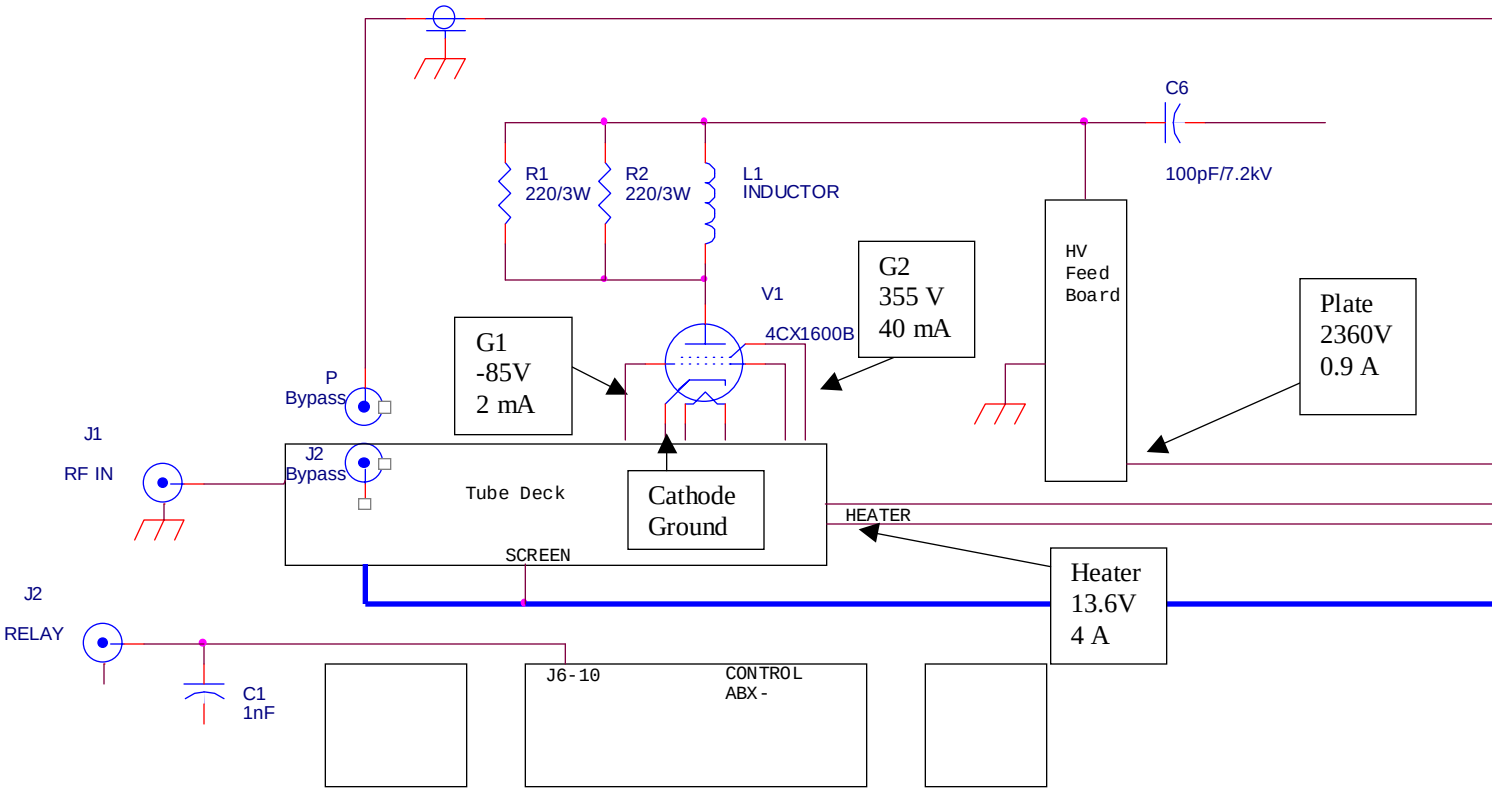
Appendix C – Amplifier Block Diagram and RF Section Voltage and Current Levels

A "B" size block diagram is also included in the "Alpha 6 schematics package" referenced in Appendix F.

General Block Diagram of Alpha 6



RF Section Voltage and Current Levels

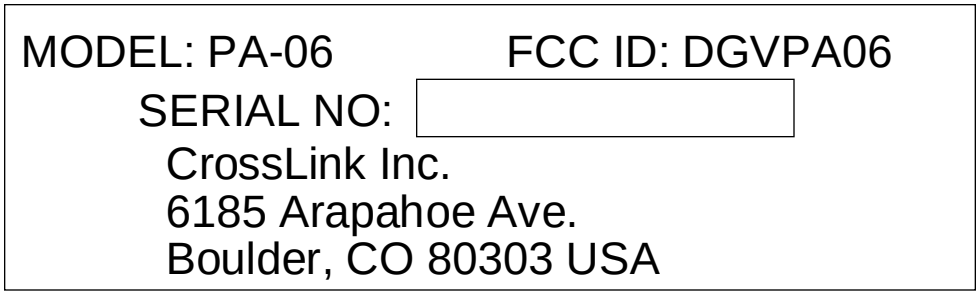


Note: Detail of amplifying portion of circuit with normal measured operating voltages and currents shown. Voltages are measured with respect to ground using a high-impedance digital voltmeter. Values shown are typical for operation at full output power.

Appendix D -- Copy of Installation and Operating Instructions

The Alpha 6 User Manual is submitted as a separate document “Alpha 6 user guide.doc”.

Appendix E-- Drawing of Equipment ID Plate



Note: The above drawing is not to scale. It is shown in expanded view for clarification purposes only. The FCC ID number will be in located on the outside rear panel of the Amplifier. The Proposed FCC ID is **DGVPA06**. The FCC ID will be printed in black block lettering on the gold-anodized chassis finish in a font size of eight-point (or greater).

Appendix F—Complete Set of Schematics

The schematics are submitted as a separate document titled “Alpha 6 schematics package.doc” .

Appendix G -- Detailed Photos of Equipment

The following pictures illustrate the overall construction details of the Alpha 6 50 –54 MHz amplifier. These are submitted separately.

- Alpha 6, Top View, Cover Removed, Transformer Not Installed
- Alpha 6, Birds Eye Side View, Cover Removed, Transformer Installed
- Alpha 6, Front View Looking Back, Cover Removed, Transformer Installed
- Alpha 6, Analog Section Side View, Power Supply Circuit Cards
- Alpha 6, Side View, Front half of RF Section
- Alpha 6, RF Section Back half, RF Tube Dec, No Tube
- Alpha 6, RF Deck, Tune and Load capacitors
- Alpha 6, Fully Assembled, Cover On