A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the STN Atlas Marine radar system in accordance with Part 2, Subpart J of the FCC Rules.

The Type No. Atlas 1000 X-Band 25 kW is a “X” band marine radar transmitter for marine radar applications.

B. GENERAL INFORMATION REQUIRED FOR TYPE CERTIFICATION (Paragraph 2.983 of the Rules)

(a) Name of applicant: STN Atlas Marine Electronics GmbH

(b) Identification of equipment: FCC ID: QO7NG3028X25KW

(1) The equipment identification label is submitted as a separate exhibit.
(2) Photographs of the equipment are submitted as a separate exhibit.

(c) Quantity production is planned.
(d) Technical description:

(1) 100M1P0N emission
(2) Frequency range: 9300 - 9500 MHz
(3) Rated power of the transmitter is 25 kW
(4) The Atlas 1000 X-Band 25 KW complies with the power Limitations of Parts 80.
(5) The nominal dc voltage and dc currents at magnetron:

dc voltage (peak)	dc current (peak)
6.2 kilovolts	7.75 amperes

(6) Function of each active semi-conductor device: submitted as a separate exhibit.
(7) Circuit diagram is submitted as a separate exhibit
(8) A draft instruction book is submitted as a separate exhibit.
(9) The transmitter tune-up procedure is submitted as a separate exhibit.
(10) A description of circuits for stabilizing frequency is included in Appendix 1.

A description of circuits and devices employed For suppression of spurious radiation and for limiting modulation is included in Appendix 2.

(11) (Not applicable)

B.GENERAL INFORMATION REQUIRED FOR TYPE CERTIFICATION (Continued)

(e) Data for 2.985 through 2.997 follow this section B.

(f) (Not applicable)
(g) (Not applicable)

C. RF POWER OUTPUT (Paragraph 2.985(a) of the Rules)

RF power output into a HP LRL 634 dummy load was measured with a HP X752D directional coupler, HP X382A attenuator, and HP 432A power meter with HP 478A thermocouple sensor.

The power meter was corrected for directional coupler attenuation and sensor calibration.

Table 1
RF Power Output

Range, n.m.	0.5	1.5	3.0	6.0
Meas. Avg P (dBm)	35.2	38.4	38.4	39.5
Meas. PRF (Hz)	2000	1000	1000	1000
Nom. Pulse Length (ns)	70	150	300	500
Duty Cycle[1](x10^{-6})	140	150	300	500
Peak Power[2](kW)	23.7	20.1	23.1	17.8
Avg. Power (W)	3.3	3.0	6.9	8.9

Range, n.m.	12.0	24.0	48.0
Meas. Avg P (dBm)	40.6	40.6	40.6
Meas. PRF (Hz)	500	500	500
Nom Pulse Length (ns)	900	900	900
Duty Cycle[1](x10^{-6})	450	450	450
Peak Power 2(kW)	25.6*	25.6*	25.6*
Avg. Power (W)	11.5	11.5	11.5

1)Duty cycle = PRF x Pulse Length
2)Peak Power = Avg. pwr/Duty cycle

*Peak power measured was 0.095 dB over nominal rated power; within uncertainty of the measurement to rated 25 kW.

D. MODULATION CHARACTERISTICS (Paragraph 2.987 of the Rules)

1. Magnetron pulse input was measured with a Tektronix TDS-360 digital storage oscilloscope and Tektronix 6015 high voltage probe; and recorded on an HP C2106A printer. Oscilloscope display for each pulse width, corresponding to range in nautical miles (nm), are included as Figures 1a through 1g for pulse widths of 70, 150, 300, 500, 900, 900, 900 nanoseconds respectively.

2. Graphs of occupied bandwidth for pulse widths of 70, 150, 300, 500, 900, 900, 900 nanoseconds are included as Figures 2a through 2g respectively. The plots were made with Tektronix 494P spectrum analyzer and HP 7550 plotter coupled via the analyzer's IEEE 488 Port.

3. Plots of PRF measurement using the TEK TDS-360 digital storage oscilloscope for radar range settings of 0.5, 1.5, 3, 6, 12, 24 and 48 nm are included as Figures 3a though 3g respectively.

Analysis of the plots demonstrated that 99% of the spectral density is within a 100.1 MHz bandwidth as used in the emission designator. (See Appendix A for analysis technique).

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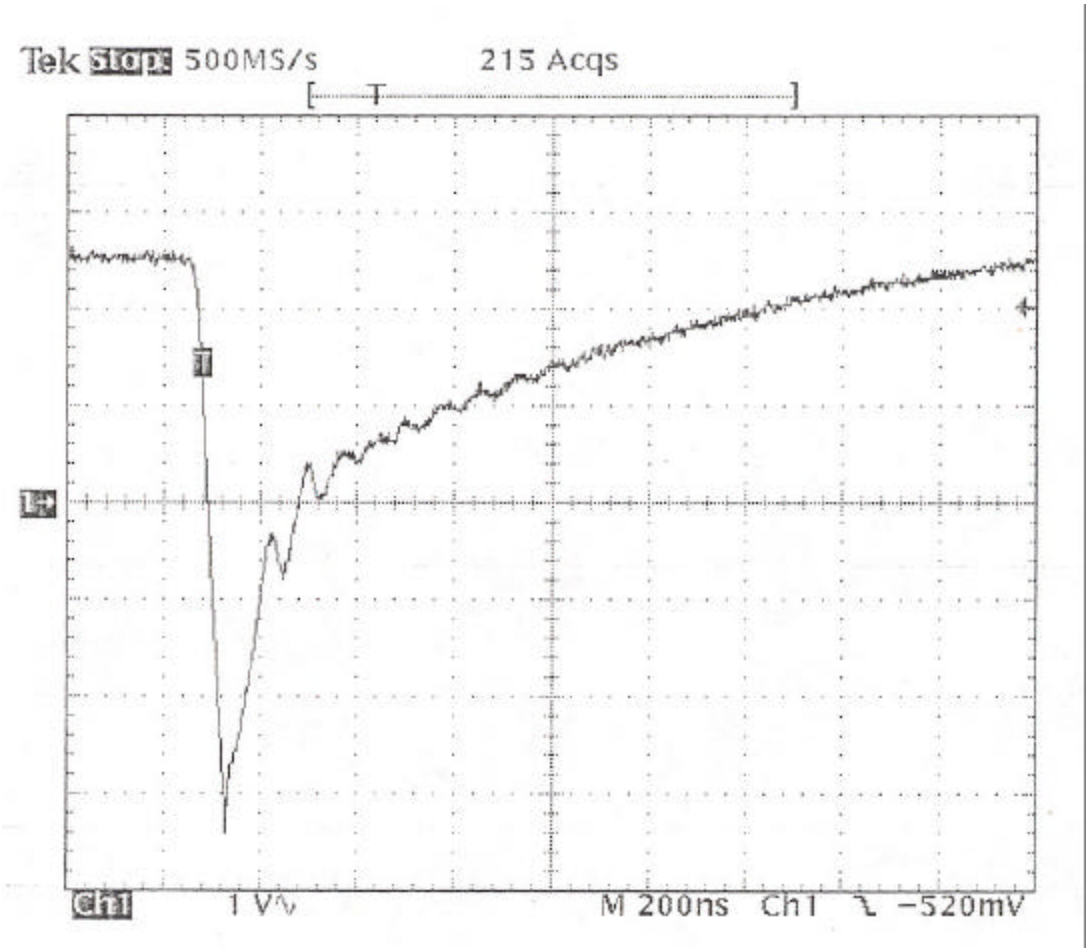
MAGNETRON CONTROL PULSE



Nominal Pulse Width: 0.070 microseconds (0.5 nm range)

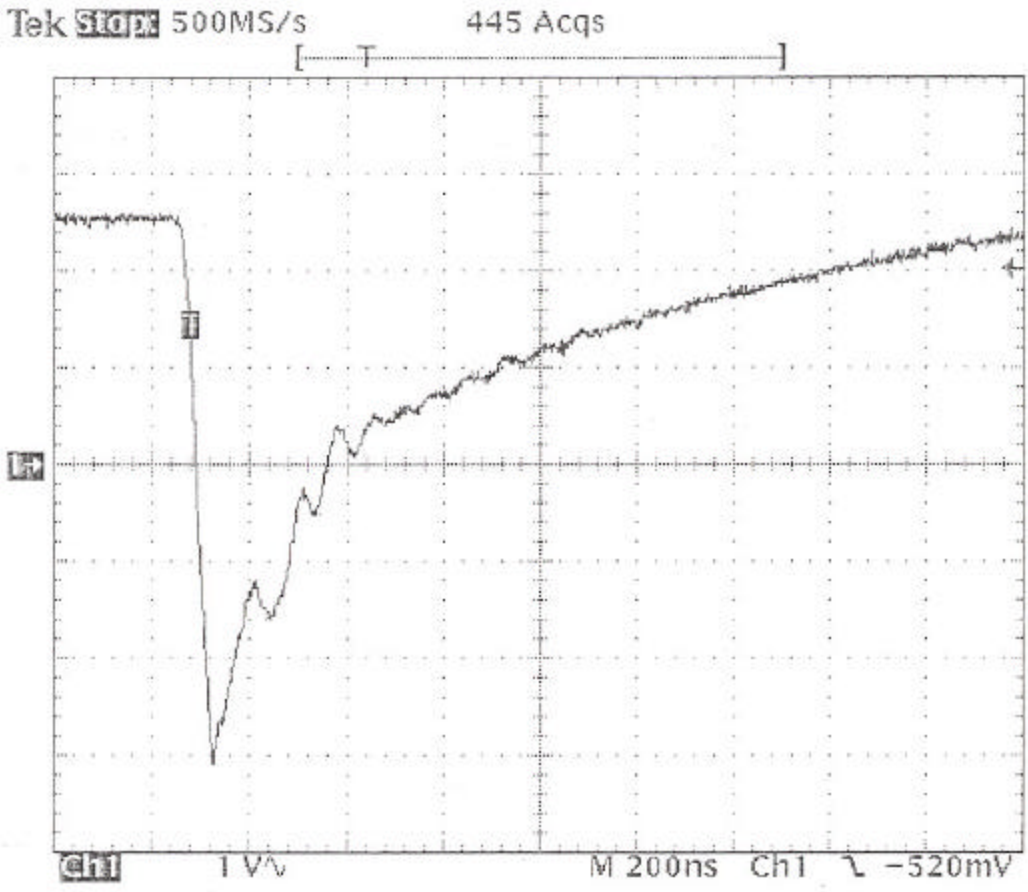
Display:

1000 V per vertical division
0.02 microseconds per horizontal division

MAGNETRON CONTROL PULSE
FCC ID: QO7NG3028X25KW

FIGURE 1a

MAGNETRON CONTROL PULSE



Nominal Pulse Width: 0.150 microseconds (1.5 nm range)

Display:

1000 V per vertical division
0.2 microseconds per horizontal division

FIGURE 1b

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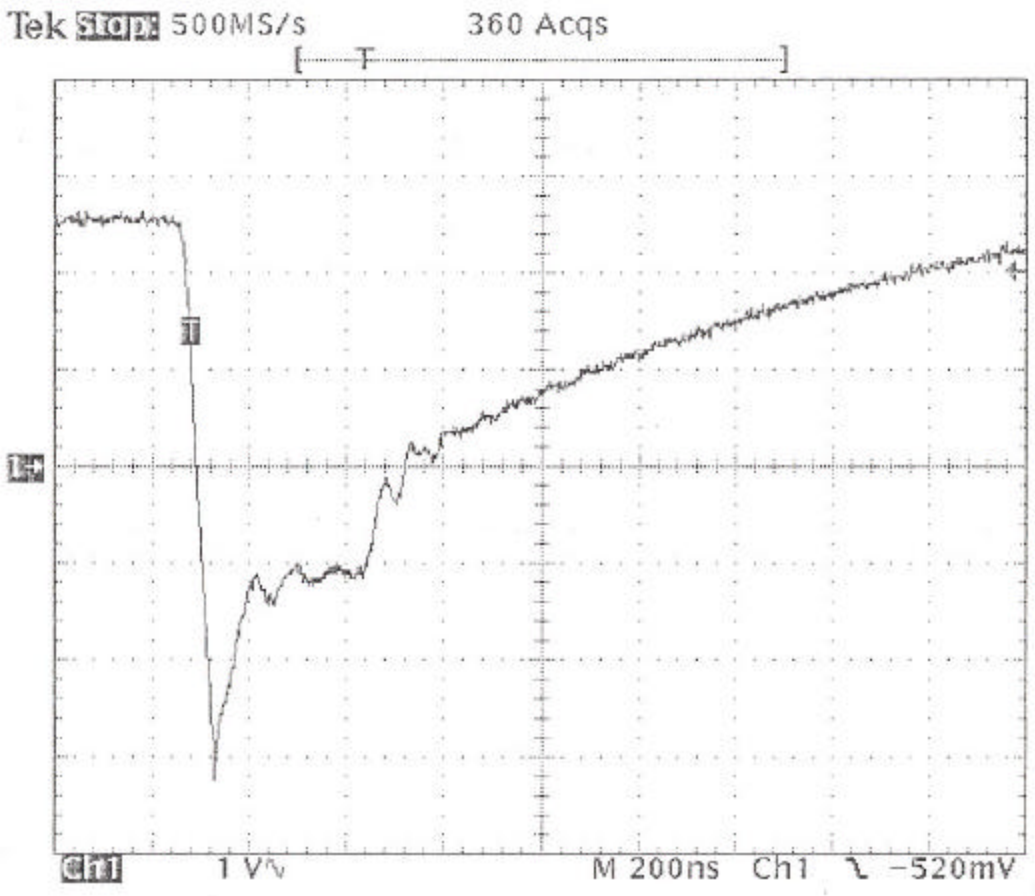
MAGNETRON CONTROL PULSE



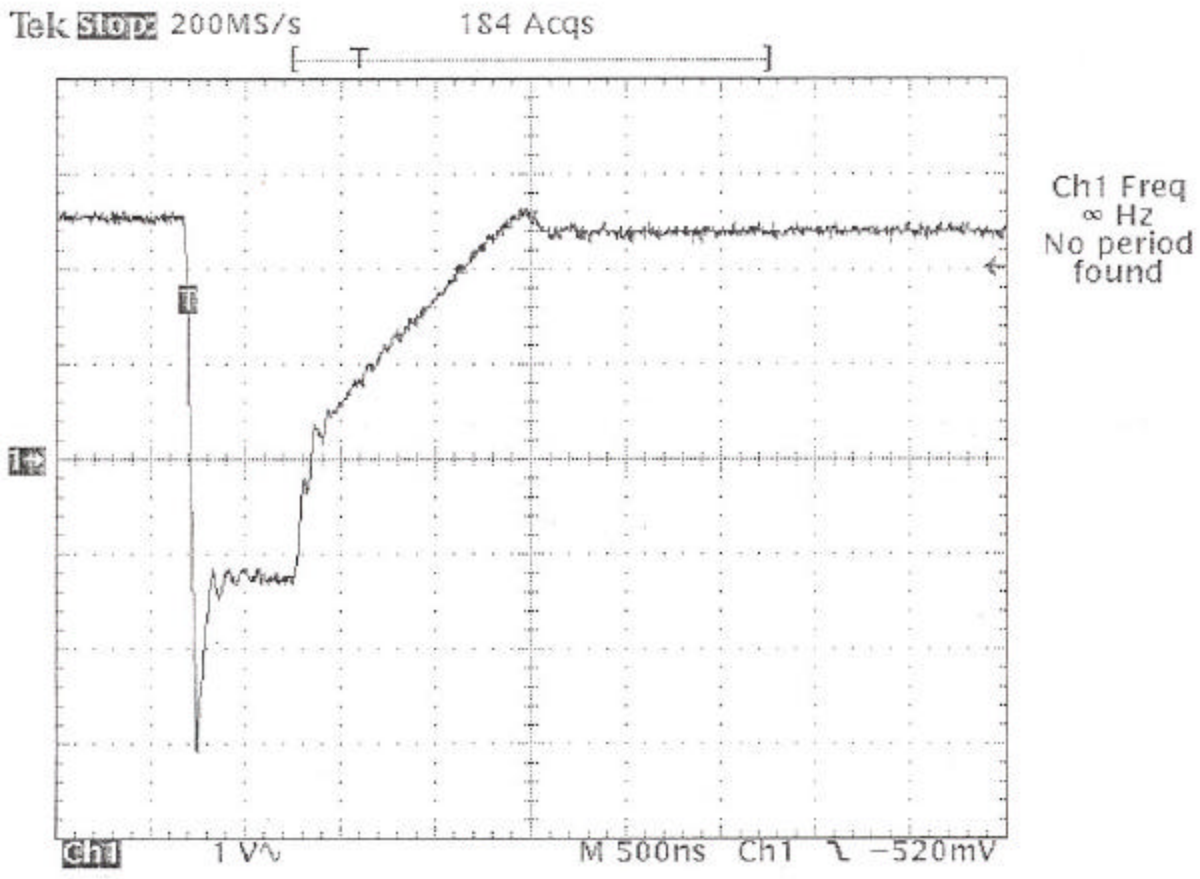
Nominal Pulse Width: 0.300 microseconds (3 nm range)

Display:

1000 V per vertical division
0.2 microseconds per horizontal division

FIGURE 1c

MAGNETRON CONTROL PULSE



Nominal Pulse Width: 0.500 microseconds (6 nm range)

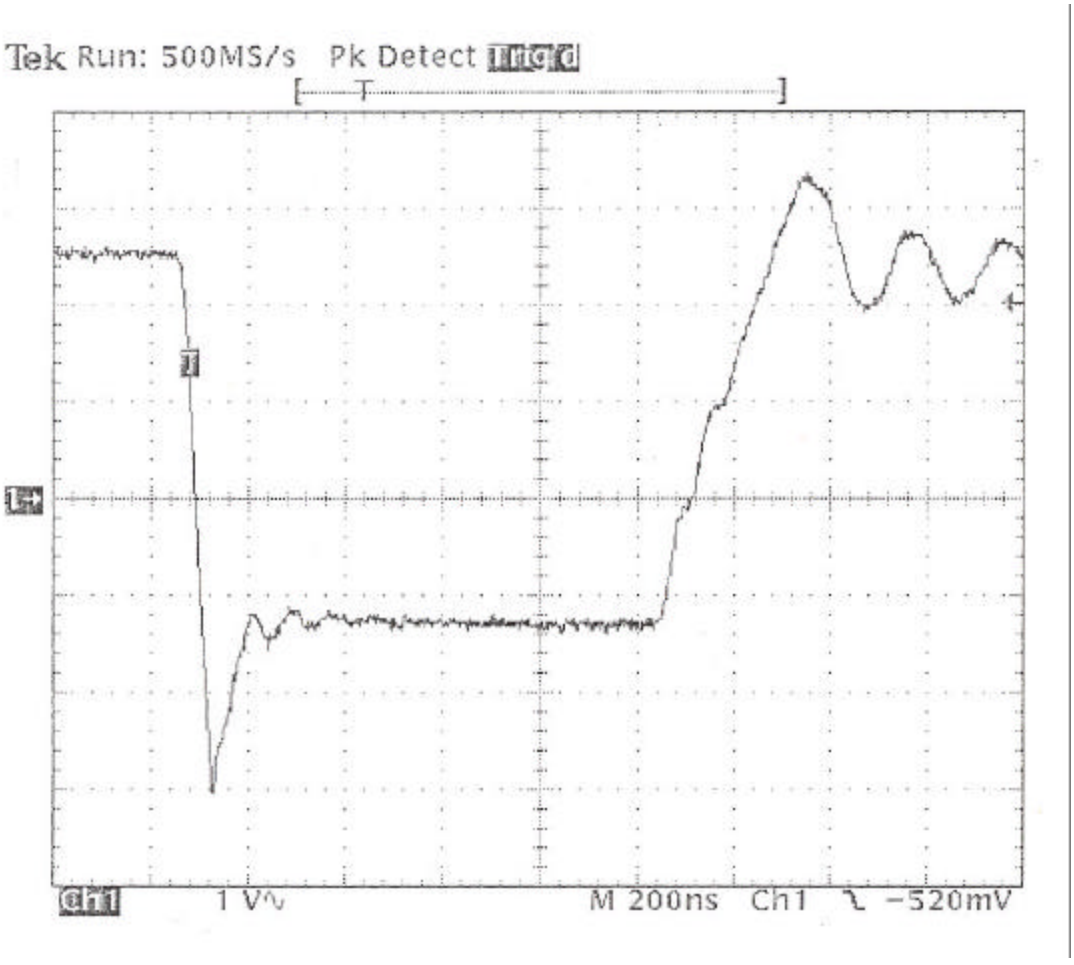
Display:

1000 V per vertical division
0.5 microseconds per horizontal division

MAGNETRON CONTROL PULSE
FCC ID: QO7NG3028X25KW

FIGURE 1d

MAGNETRON CONTROL PULSE



Nominal Pulse Width: 900 microseconds (12 nm range)

Display:

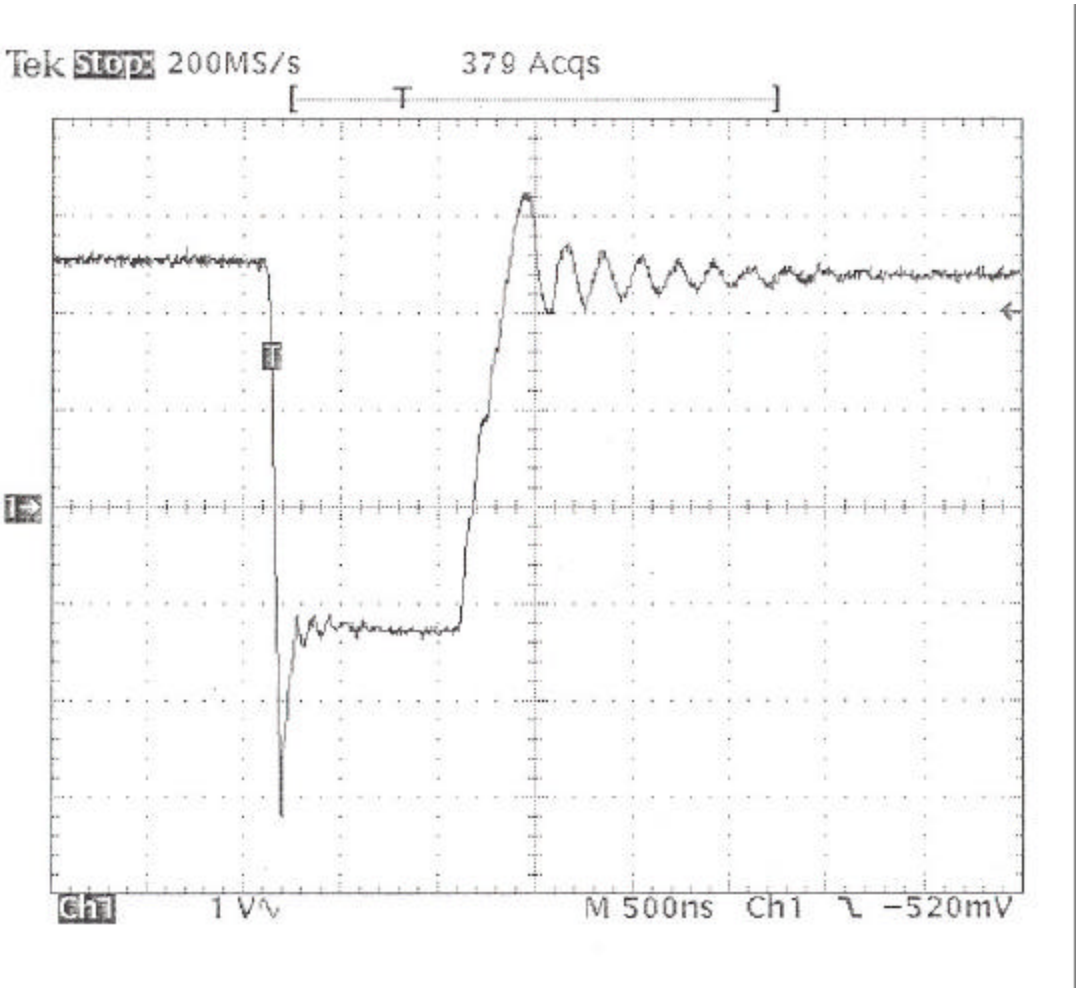
1000 V per vertical division

0.2 microseconds per horizontal division

MAGNETRON CONTROL PULSE
FCC ID: QO7NG3028X25KW

FIGURE 1e

MAGNETRON CONTROL PULSE



Nominal Pulse Width: 900 microseconds (24 nm range)

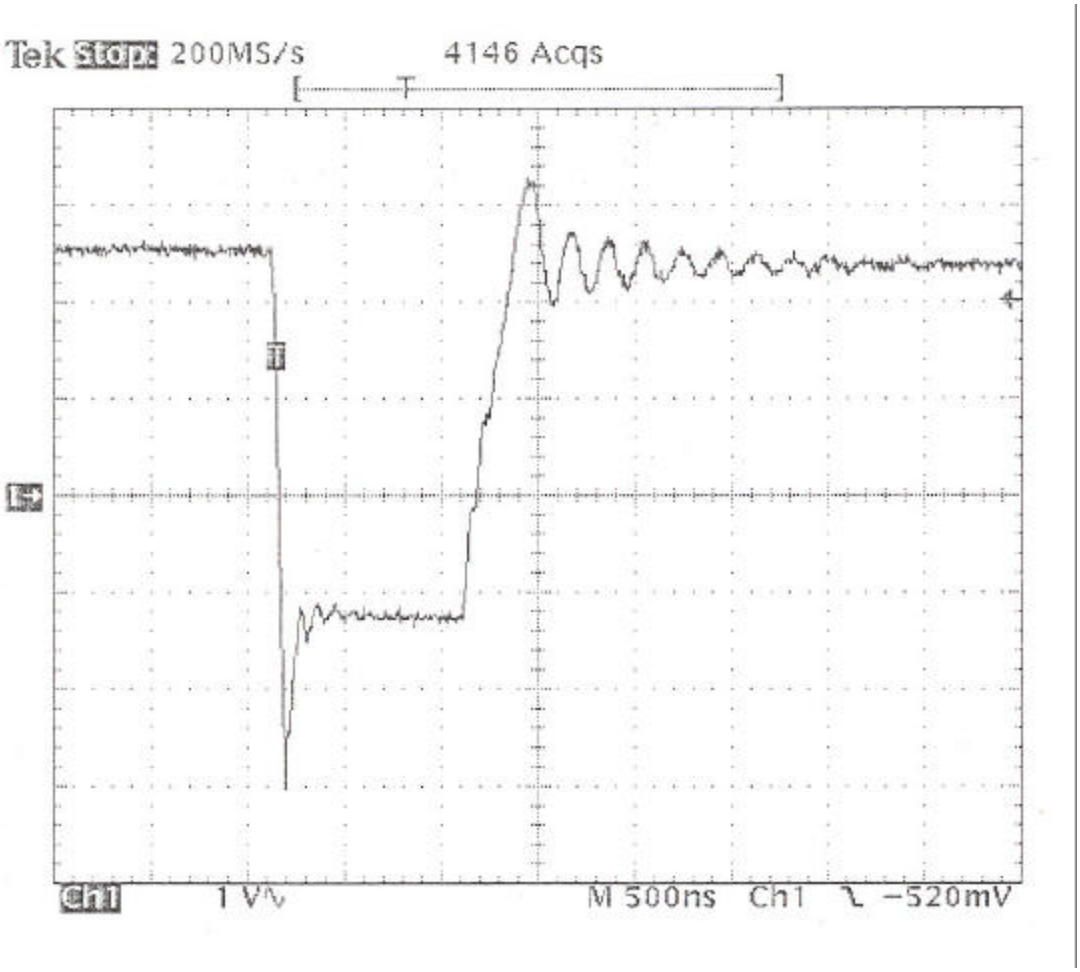
Display:

1000 V per vertical division
0.5 microseconds per horizontal division

MAGNETROL CONTROL PULSE
FCC ID: QO7NG3028X25KW

FIGURE 1f

MAGNETRON CONTROL PULSE



Nominal Pulse Width: 900 microseconds (48 nm range)

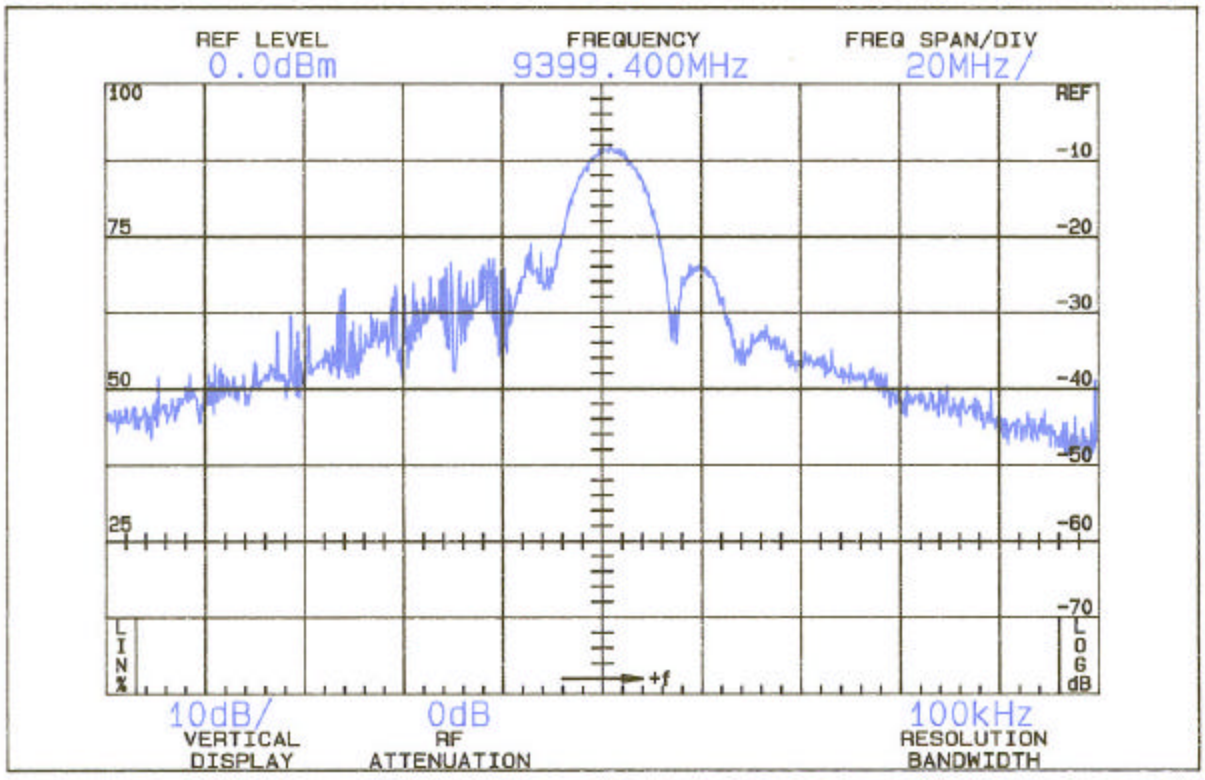
Display:

1000 V per vertical division
0.5 microseconds per horizontal division

MAGNETRON CONTROL PULSE
FCC ID: QO7NG3028X25KW

FIGURE 1g

OCCUPIED BANDWIDTH

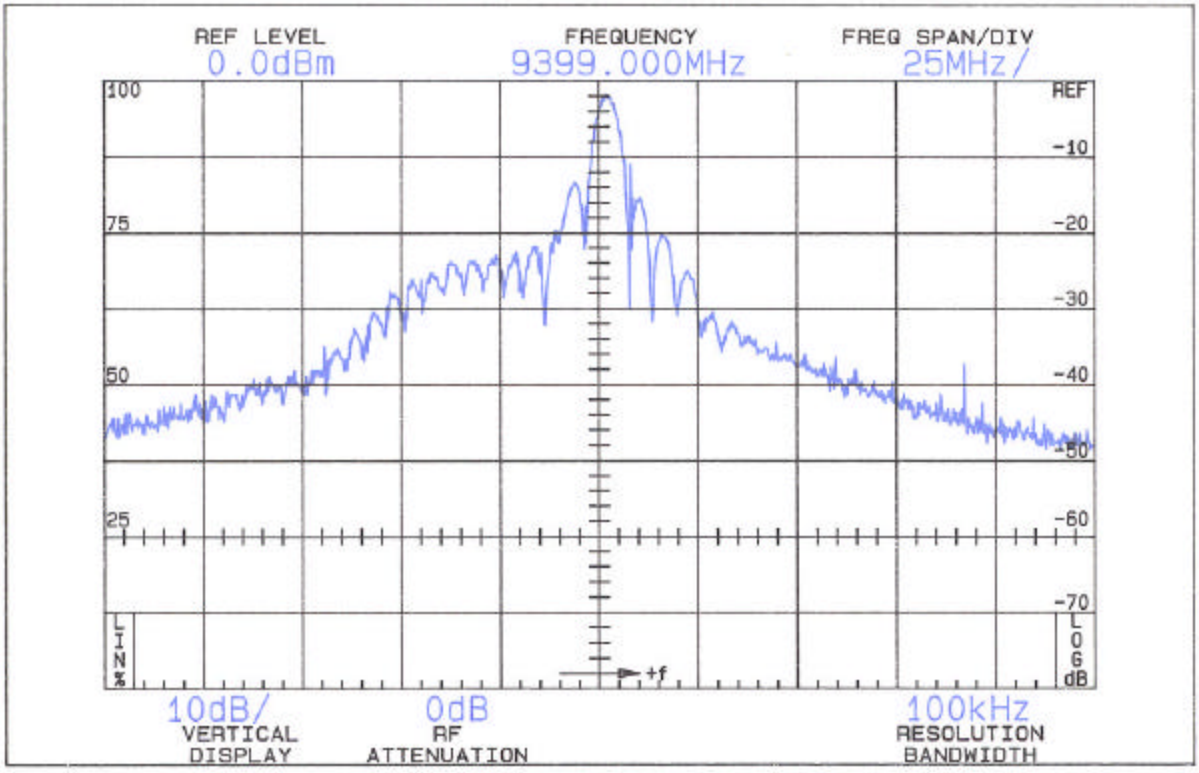


Nominal Pulsewidth: 0.070 microseconds
PRF: 2000 Hz
Range: 0.5 nm

OCCUPIED BANDWIDTH
FCC ID: QO7NG3028X25KW

FIGURE 2a

OCCUPIED BANDWIDTH

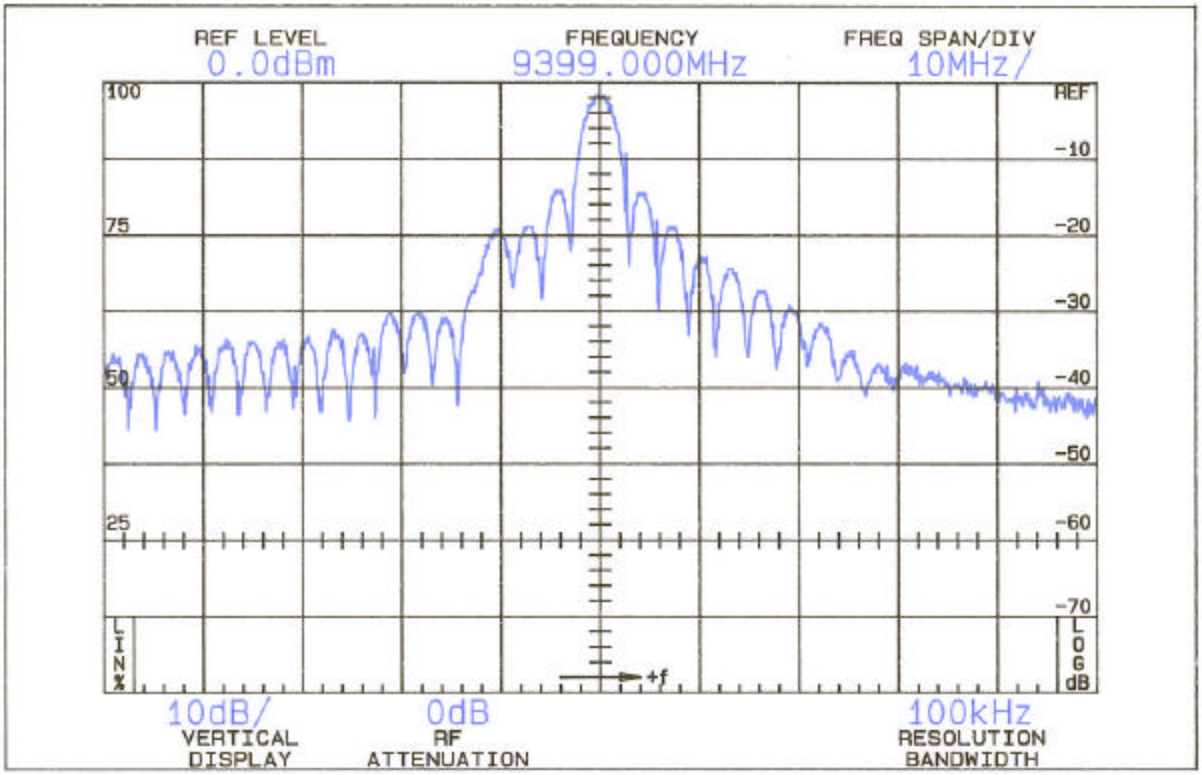


Nominal Pulsewidth: 0.150 microseconds
PRF: 1000 Hz
Range: 1.5 nm

OCCUPIED BANDWIDTH
FCC ID: QO7NG3028X25KW

FIGURE 2b

OCCUPIED BANDWIDTH

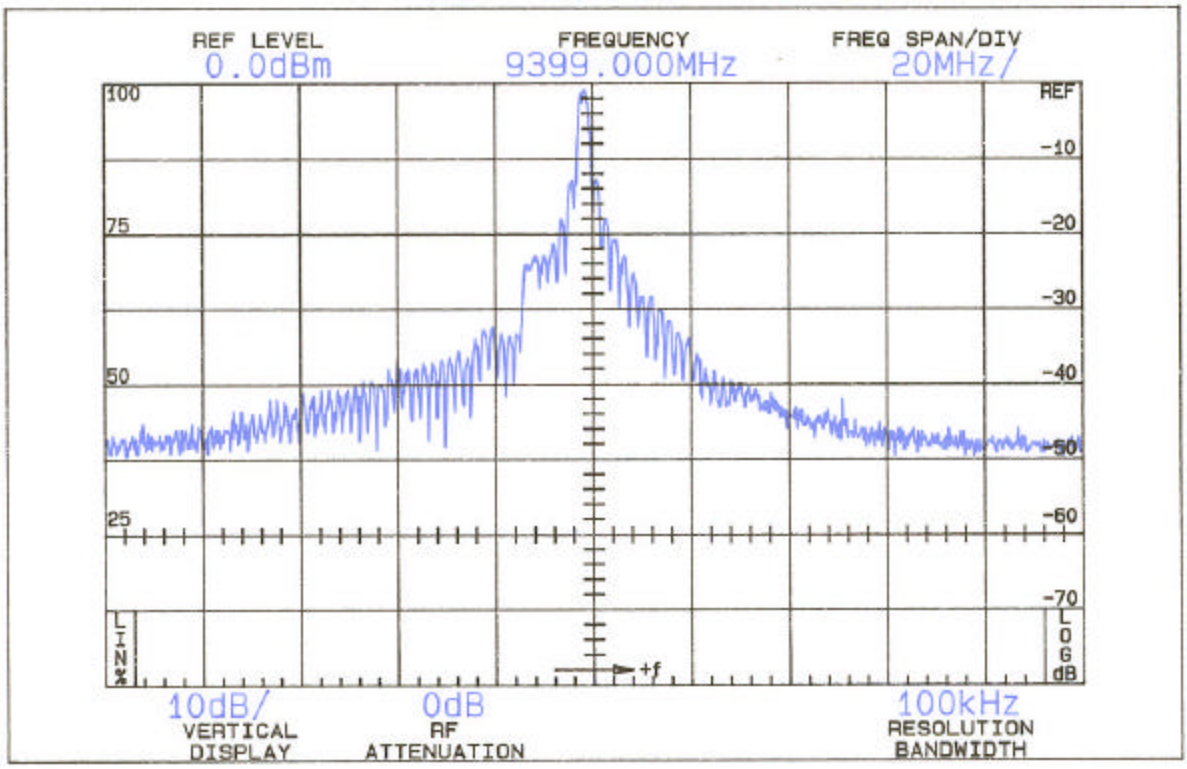


Nominal Pulsewidth: 0.300 microseconds
PRF: 1000 Hz
Range: 3 nm

OCCUPIED BANDWIDTH
FCC ID: QO7NG3028X25KW

FIGURE 2c

OCCUPIED BANDWIDTH



Nominal Pulsewidth: 0.500 microseconds
PRF: 1000 Hz
Range 6 nm

OCCUPIED BANDWIDTH
FCC ID: QO7NG3028X25KW

FIGURE 2d

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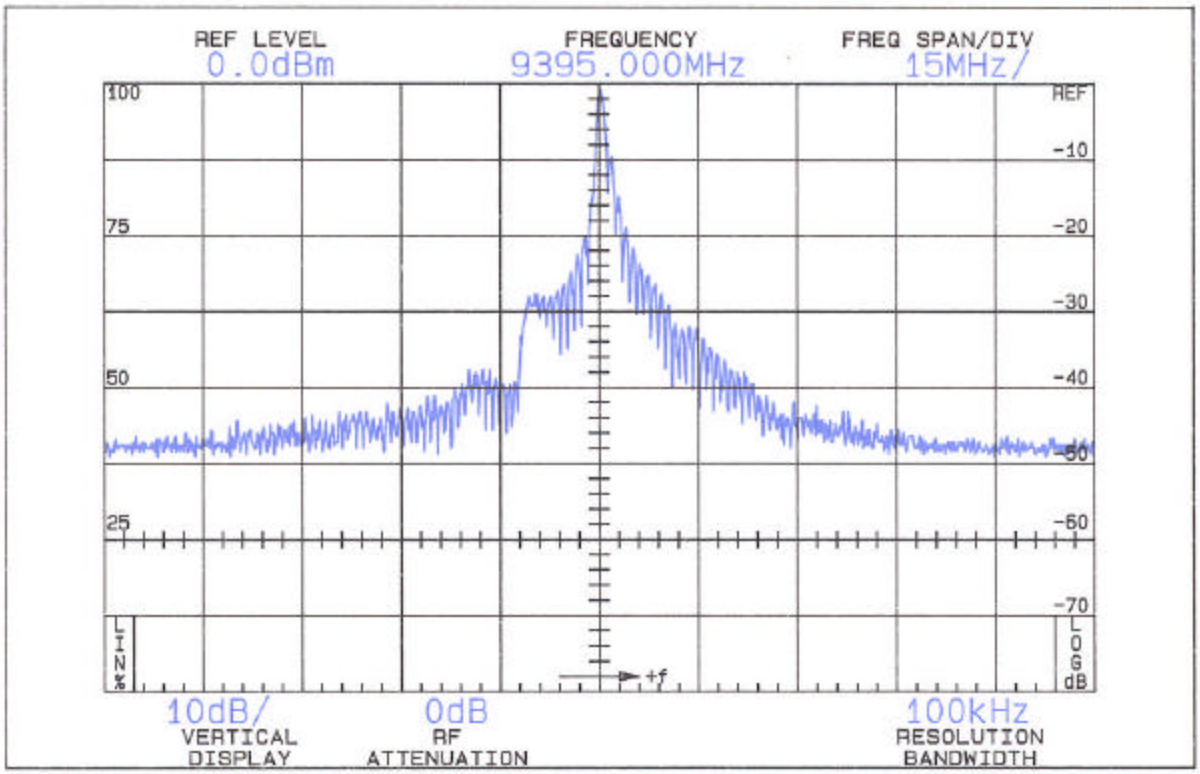
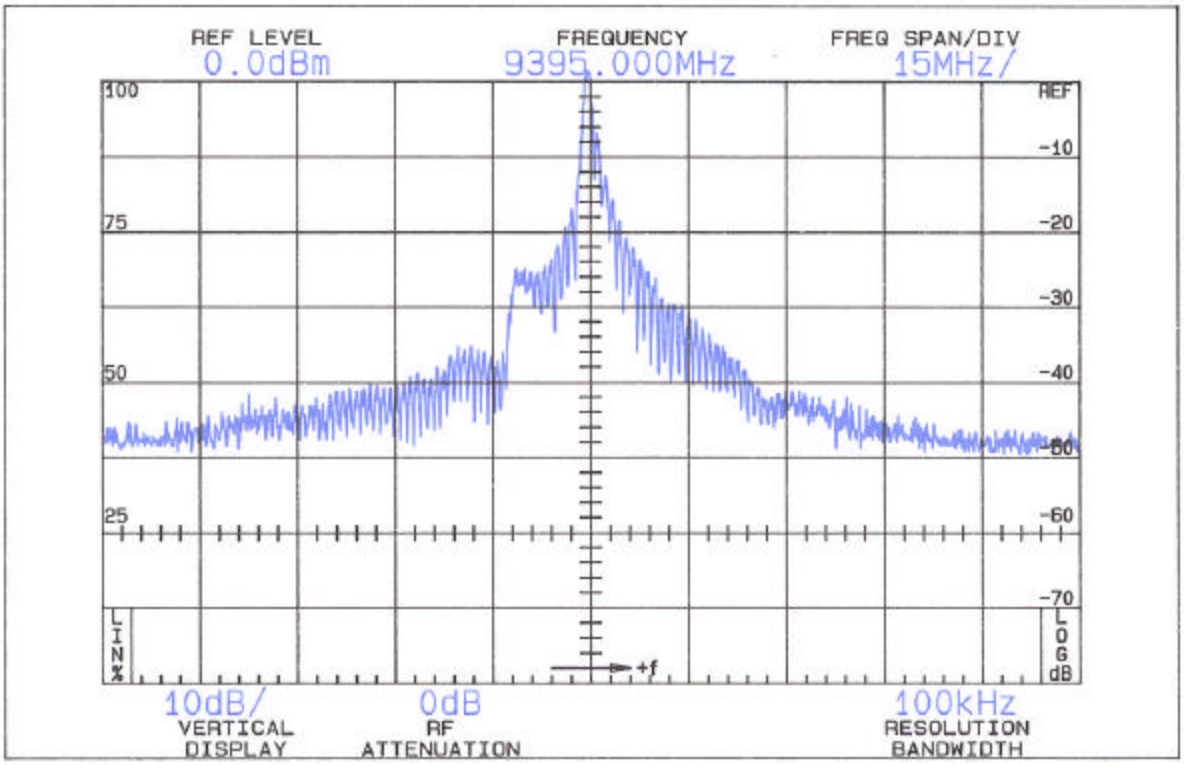
OCCUPIED BANDWIDTH



Nominal Pulsewidth: 900 microseconds
PRF: 500 Hz
Range: 12 nm

FIGURE 2e

OCCUPIED BANDWIDTH



Nominal Pulsewidth 900 microseconds
PRF: 500 Hz
Range 24 nm

OCCUPIED BANDWIDTH
FCC ID: QO7NG3028X25KW

FIGURE 2f

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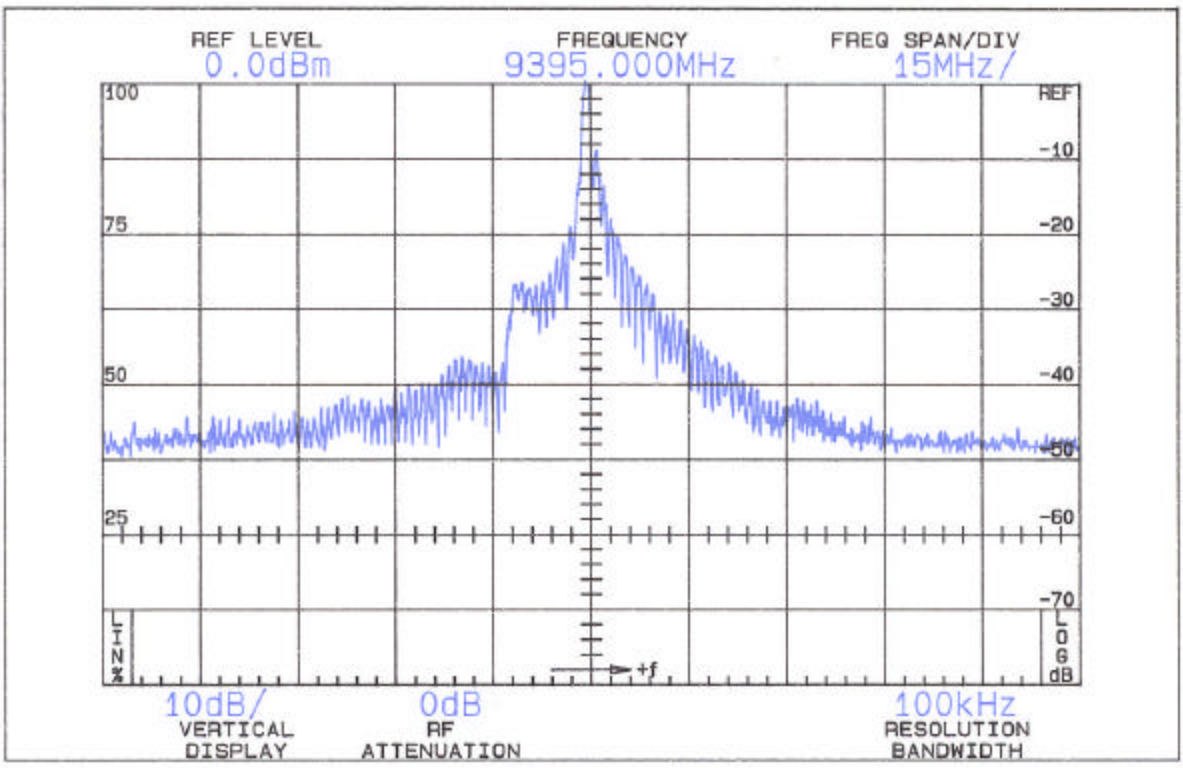
OCCUPIED BANDWIDTH



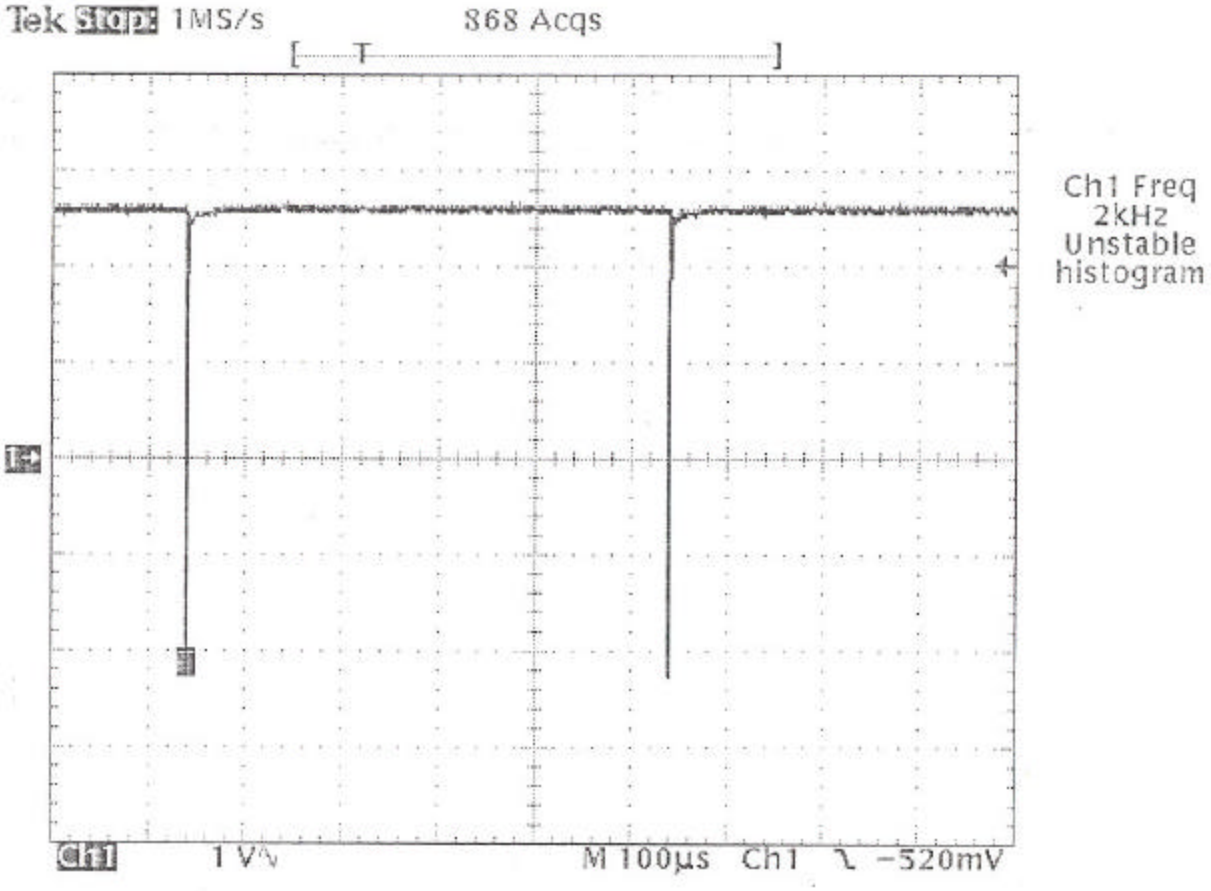
Nominal Pulsewidth: 900 microseconds
PRF: 500 Hz

Range: 48 nm

OCCUPIED BANDWIDTH
FCC ID: QO7NG3028X25KW

FIGURE 2g

PULSE REPITITION FRE QUENCY



PRF: 2000 Hz
Range: 0.5 nm

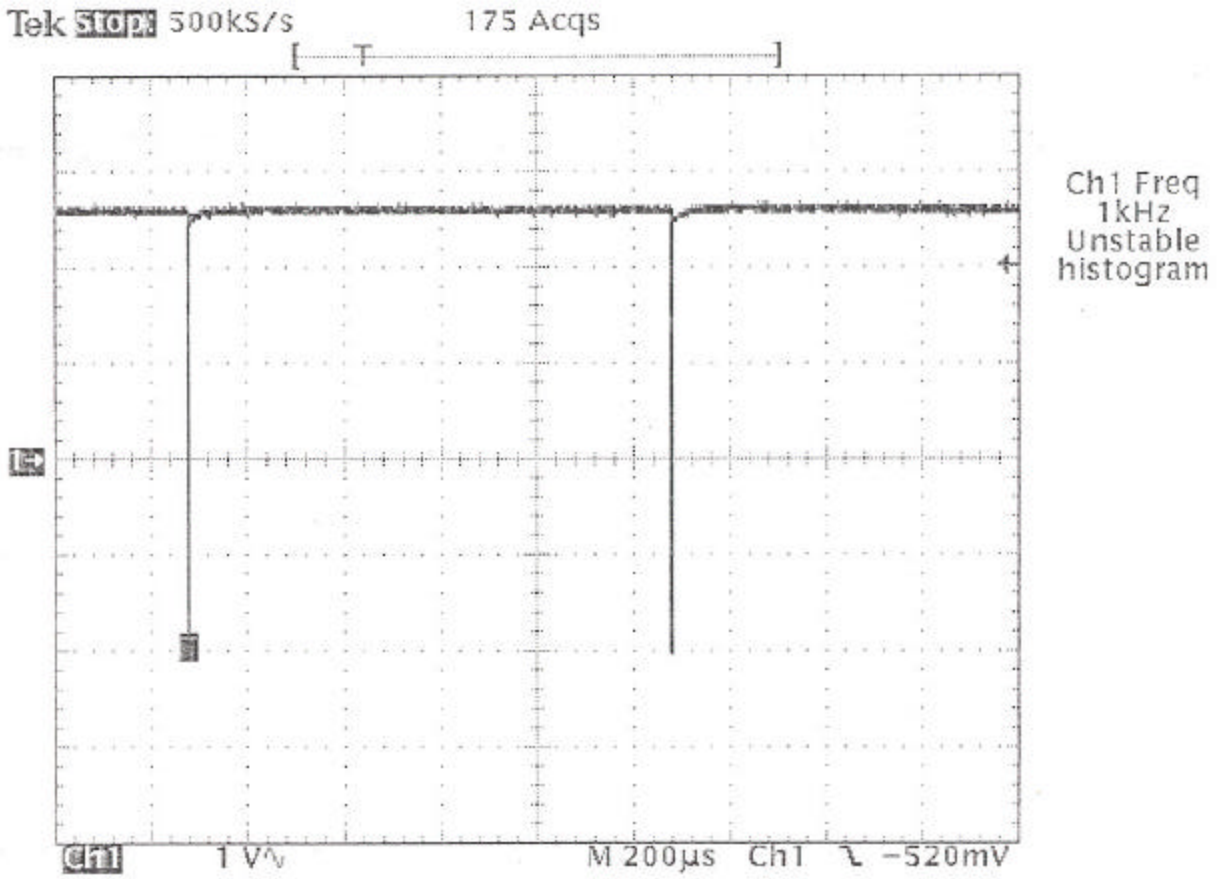
PULSE REPITITION

FREQUENCY

FCC ID: QO7NG3028X25KW

FIGURE 3a

PULSE REPITITION FREQUENCY



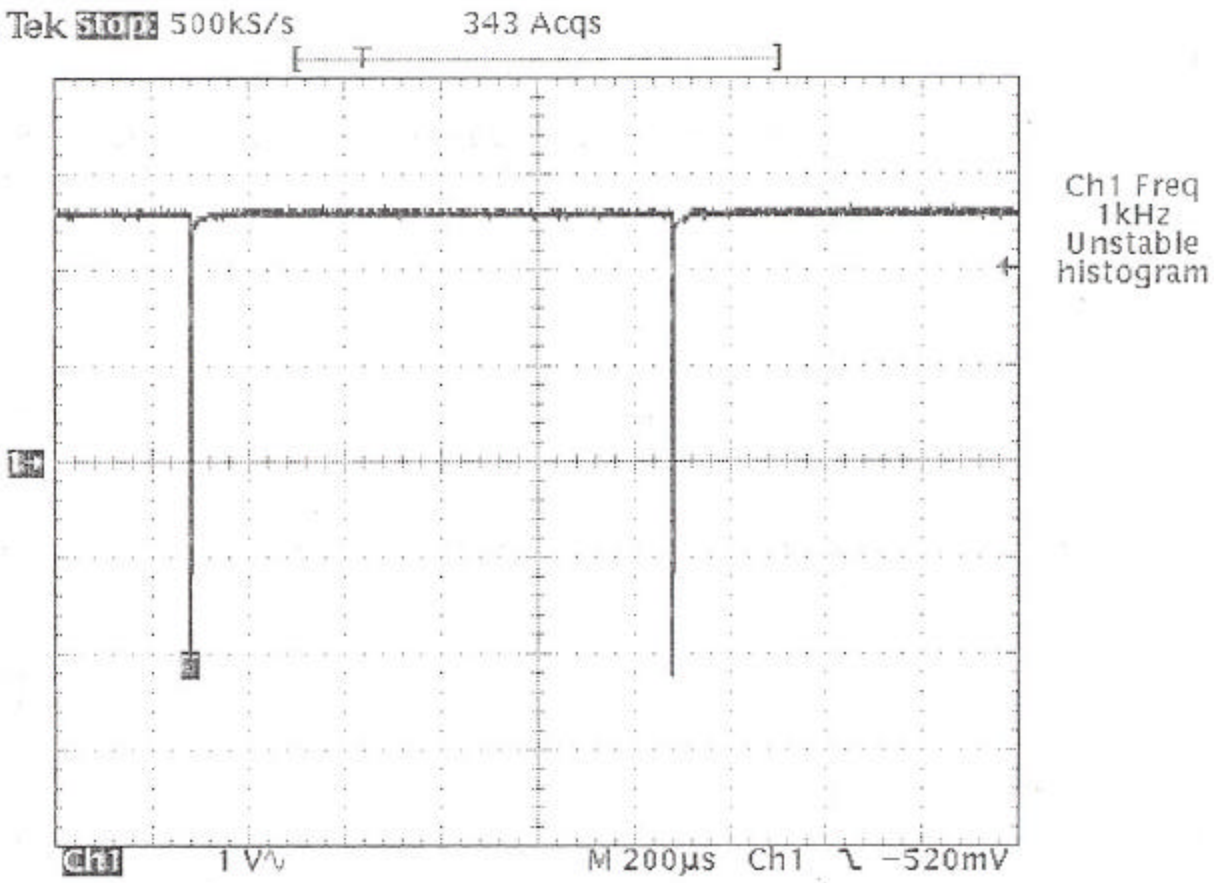
PRF: 1000 Hz
Range: 1.5 nm

PULSE REPITITION FREQUENCY

FCC ID: QO7NG3028X25KW

FIGURE 3b

PULSE REPITITION FREQUENCY



PRF: 1000 Hz
Range: 3 nm

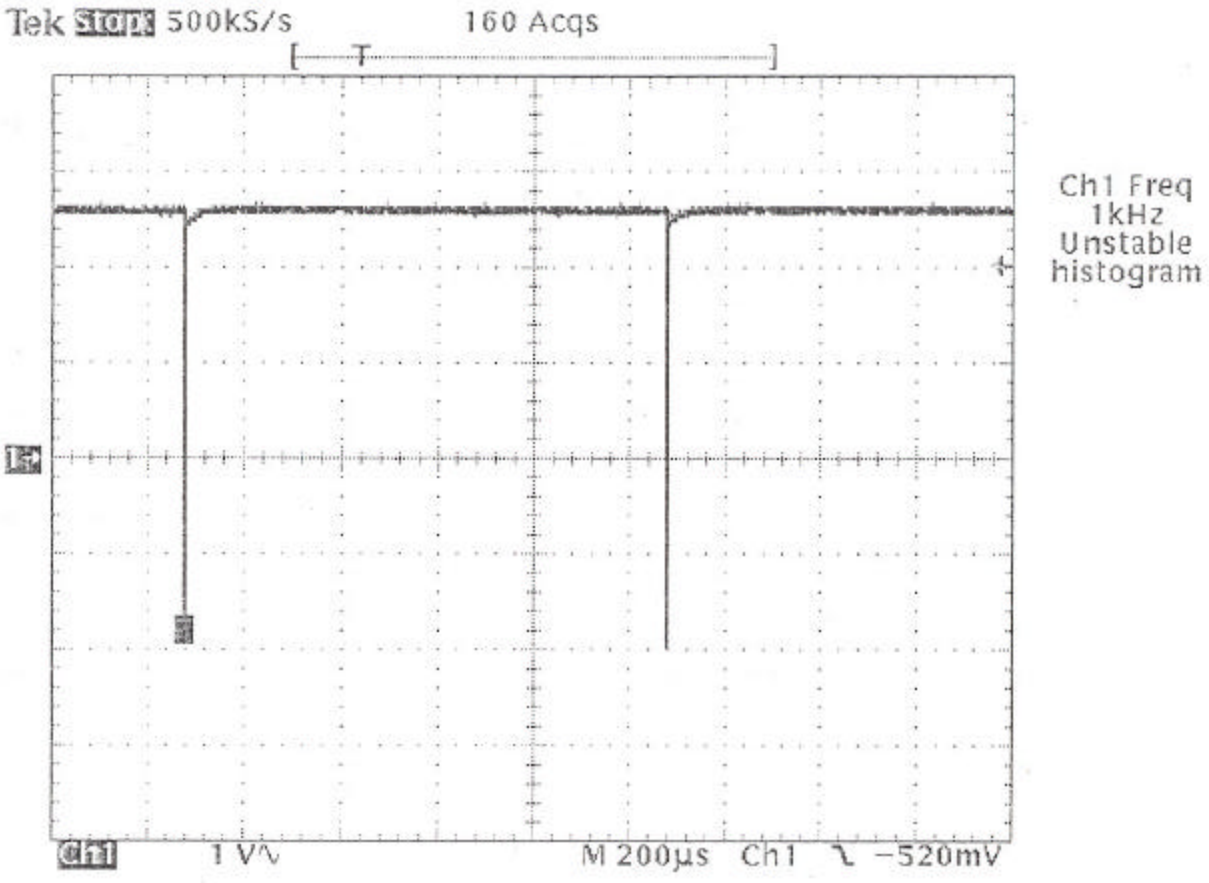
PULSE REPITITION

FREQUENCY

FCC ID: QO7NG3028X25KW

FIGURE 3c

PULSE REPITITION FREQUENCY



PRF: 1000 Hz
Range: 6 nm

PULSE REPITITION FREQUENCY

FIGURE 3d

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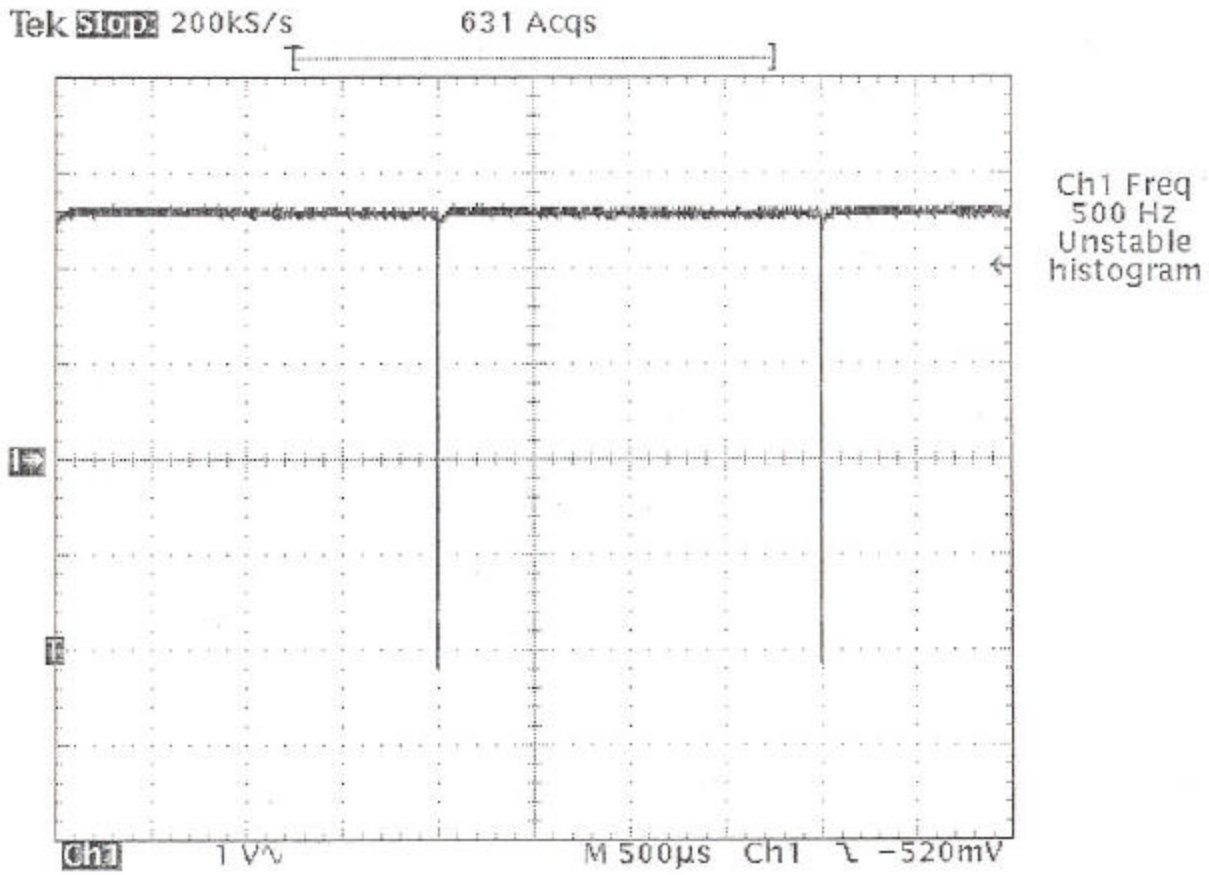
PULSE REPITITION FREQUENCY



PRF: 500 Hz
Range: 12 nm

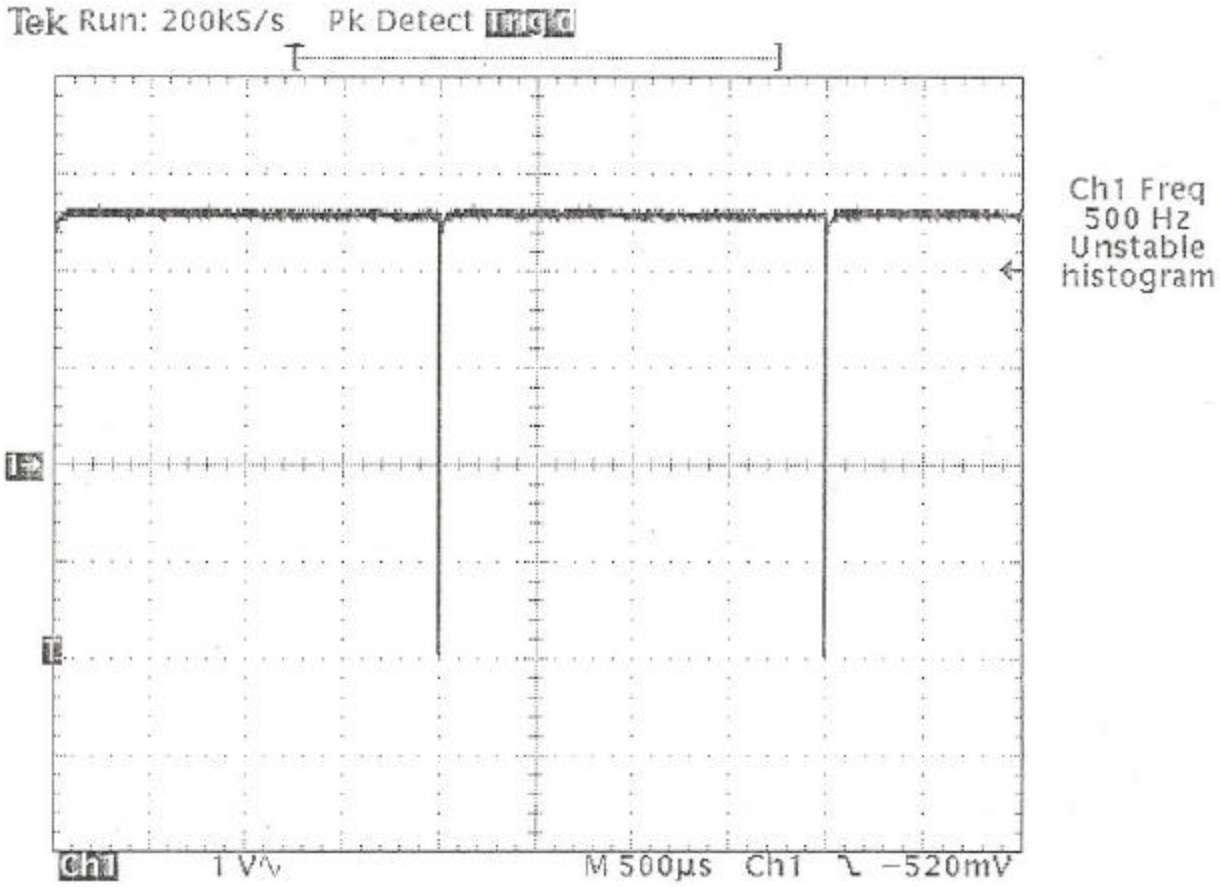
PULSE REPITITION

FREQUENCY

FCC ID: QO7NG3028X25KW

FIGURE 3e

PULSE REPITITION FREQUENCY



PRF: 500 Hz
Range: 24 nm

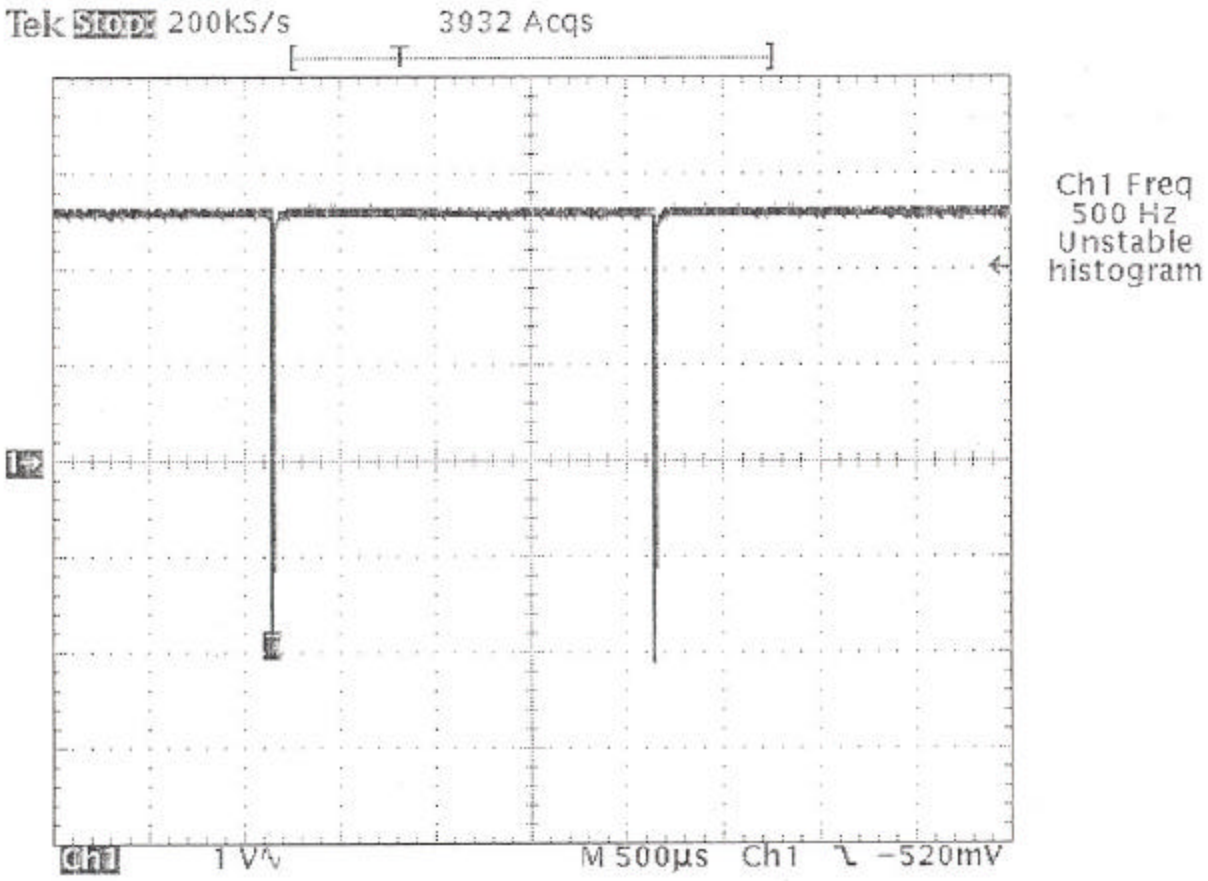
PULSE REPITITION

REEQUENCY

FCC ID: QO7NG3028X25KW

FIGURE 3f

PULSE REPITITION FREQUENCY



PRF: 500 Hz
Range: 48 nm

PULSE REPITITION FREQUENCY

FCC ID: QO7NG3028X25KW

FIGURE 3g

F. SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS
(Paragraph 2.991 of the Rules)

The Atlas 1000 X-Band 25 kW transmitter was tested for spurious emissions while the equipment was modulated with pulsewidths of 0.070 and 0.900 microseconds.

Measurements were made with a Tektronix 494P spectrum analyzer coupled to the transmitter output waveguide through the x-band directional coupler. During the tests, the transmitter was terminated in a 50 ohm x-band load. Supply voltage was maintained at 117 Vac throughout the test.

Spurious emissions were measured throughout the RF spectrum from 100 MHz to 40 GHz. Any emissions that were between the required attenuation and the noise floor of the spectrum analyzer were recorded. Data are shown in Table 2.

Table 2

TRANSMITTER CONDUCTED SPURIOUS

FREQUENCY	dBc for each pulsewidth 0.070	0.900 ($x10^{-6}$)
100 MHz to 40 GHz	*	*
Average power (P) watts	3.3	11.5

Required Attenuation:

43+10LogP	48	54 (dBc)

*No signals were observed above analyzer noise floors:

100 kHz	-	1.8 GHz	-98 dBm	5.4 GHz	-	18 GHz	-80 dBm
1.7 GHz	-	5.5 GHz	-93 dBm	15 GHz	-	21 GHz	-75 dBm
3.0 GHz	-	7.1 GHz	-93 dBm	21 GHz	-	40 GHz	-60 dBm

G. MEASUREMENTS OF SPURIOUS RADIATION
(Paragraph 2.993(a), (b) (2) of the Rules)

Radiated spurious emissions were made by substitution with a Tektronix 494P spectrum analyzer using Singer DM-105A calibrated test antennas below 1 GHz, Emco 3115 double-ridged horn from 1 to 18 GHZ, and Emco 3116 horn to 40 GHz. The transmitter and dummy load were located on a open field site 1 meter from the test antenna and data extrapolated to 3 meters. The transmitter and test antennas were arranged to maximize pickup. Both vertical and horizontal test antenna polarization were employed.

The measurement system was capable of detecting signals 60 dB or more below the reference level. Measurements were made from 100 MHz to 40 GHz.

All spurious emissions were below applicable limit of 56 dBc. (See noise floors, Table 2, Page 25.)

H. FREQUENCY STABILITY AS A FUNCTION OF TEMPERATURE
(Paragraph 2.995 (2) of the Rules)

Measurement of frequency stability versus temperature was made at temperatures from -20^{o}C to 50^{o}C. At each temperature, the frequency determining circuitry of the transmitter was exposed to ambient a minimum of 30 minutes after indicated temperature had stabilized to within $\pm 3^{o}$ of the desired test temperature. Following the soak at each temperature, the unit was turned on, keyed and frequency measured within 2 minutes.

The transmitter output stage was terminated with a dummy load. Primary supply was 117 Vac. Frequency was measured with the spectrum analyzer in the frequency counter mode.

Data are shown in Table 3.

TABLE 3

Frequency vs Temperature

Nominal Temperature, °C	Frequency, GHz
-20	9.399
-10	9.399
0	9.399
10	9.397
20	9.395
30	9.395
40	9.395
50	9.394

These data are within the limits of FCC Rule 80.209(b) which specifies 1.5/T MHz to upper and lower limits of the authorized frequency band, where "T" is pulse duration in microseconds.

For the equipment tested, the authorized frequency band is 9300 - 9500 MHz, and worst-case 1.5/T is 21.4 MHz (0.070) microsecond pulse duration on the minimum range position).

I. FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE
(Paragraph 2.995(d)(1) of the Rules)

Oscillator frequency as a function of power supply voltage was measured with the Tektronix 494P spectrum analyzer as supply voltage was varied ±15% from the nominal 117 Vac volt rating. A Keithley 177 digital voltmeter was used to measure supply voltage at transmitter primary input terminals. Measurements were made at 20°C ambient.

TABLE 4

Frequency vs Supply Voltage

Supply Voltage, Vac	Frequency, GHz
134.6	9.395

117.0	9.395
99.5	9.395

The equipment met applicable limits.

APPENDIX A

POWER-BANDWIDTH DETERMINATION

The bandwidth within which 99% of the emission power density occurs was determined by area integration.

The Tektronix 494P spectrum analyzer digitizes the screen into 1000 x 250 data points as Y-axis (frequency) and X-axis (log amplitude) respectively.

To determine the 99% power density, the digitized spectrum

plot, Figure 2a, was normalized to the noise baseline and the anti-log taken of each resulting X-axis value. This value, now a linear function, was multiplied by the corresponding Y-axis increment and the successive results summed over the 1000 increment total, resulting in an area value.

Additional summations were made in which successive approximations of less than the full 1000 increment Y-axis (frequency) width were included in the integrated area and the result compared to the original area computation.

When a ratio of 0.99 was detected, the successive approximations were halted and the resulting Y-axis value noted. This value was then scaled back into frequency by using the frequency/division calibration of the plot.

Using this method, 99% power bandwidth was 100.1 MHz.

POWER-BANDWIDTH DETERMINATION
FCC ID: QO7NG3028X25KW

APPENDIX A

APPENDIX 1

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

Operating frequency is established by characteristics of the magnetron.

Pulse width and pulse repetition rate is established by conventional pulse-forming circuitry.

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY
FCC ID: QO7NG3028X25KW

APPENDIX 1

APPENDIX 2

CIRCUITS TO SUPPRESS SPURIOUS RADIATION LIMIT MODULATION AND CONTROL POWER

a. Spurious emission suppression is accomplished by waveguide characteristics which attenuate lower frequencies. Spurious radiation suppression is accomplished by shielding and by-passing.

b. Modulation limiting is provided by characteristics of the PRF generator circuitry, trigger SCR, and magnetron.

c. Power output is maintained by power supply regulation, trigger SCR and magnetron.

CIRCUITS TO SUPPRESS....
FCC ID: QO7NG3028X25KW

APPENDIX 2