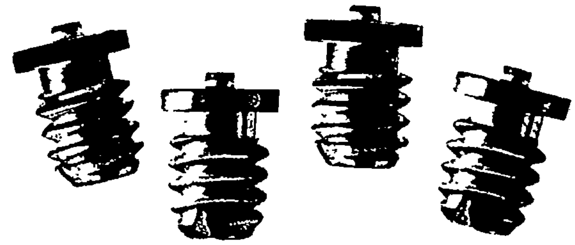
GUNN DIODES
HIGH FREQUENCY 22 to 110 GHz

FEATURES

- GaAs and InP Devices
- High Efficiency
- Low Package Parasitics
- High Reliability
- Low FM and AM Noise
- Good Power and Frequency Stability



DESCRIPTION—APPLICATIONS

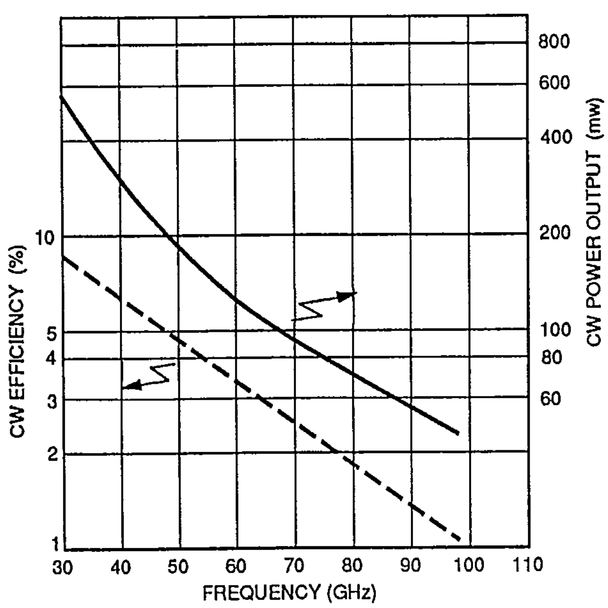
Litton Solid State Division offers the highest performance Gunn diodes commercially available. Uniquely capable of providing both GaAs and InP based devices, we are designed into smart munitions systems such as SADARM, MLRS-TGW, MERLIN and numerous others in concept validation phases. In contrast to the smart munition requirements of high volume, low cost, Litton has also been chosen as the supplier for most of industry's space-based requirements. Litton's proven high reliability and long life diodes have flown on the Space Shuttle, Tiros weather satellites as well as TDRSS, MLS and SSMT systems.

Litton tests these diodes in critically coupled production test fixtures at the center of the frequency range specified. Testing in a user provided cavity is advised for optimizing diode repeatability while minimizing diode circuit correlation problems.

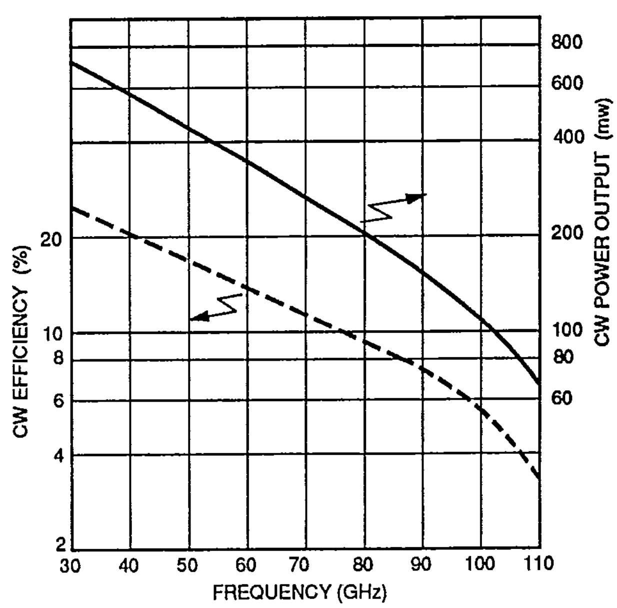
Catalog diode types, as listed on the following pages, are readily available. Both GaAs and InP diode types are stocked for short delivery times. Litton Gunn diodes achieve state-of-the-art performance, as shown below. Custom frequencies and power levels available upon request.

CW POWER AND EFFICIENCY VS FREQUENCY

GaAs GUNN DIODES



InP GUNN DIODES



Litton
Solid State

3251 Olcott Street / Santa Clara, CA 95054 / 408•988-1331 or 408•988-1845

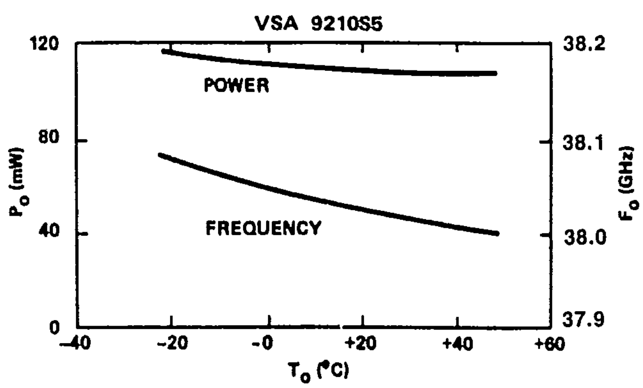
GALLIUM ARSENIDE GUNN DIODES HIGH FREQUENCY 22 TO 95 GHz

GENERAL CHARACTERISTICS				
Type Number	Test Frequency (GHz)	Output Power (mW min)	Typical Bias Parameters Voltage (V)	Typical Bias Parameters Current (mA)
VSK-9204S5		100	8	400
VSK-9204S7	24	200		600
VSK-9204S9	±2	300		850
VSK-9204S11		400		900
VSA-9210S3		50	6.5	300
VSA-9210S5	35	100		400
VSA-9210S7	±2	200		900
VSA-9210S9		300		1000
VSA-9210S10		350		1100
VSQ-9219S3		50	6	550
VSQ-9219S5	44	100		750
VSQ-9219S6	±2	125		1000
VSQ-9219S7		150		1000
VSE-9220S3	56	50	4	1000
VSE-9220S4A	±2	100		1000
VSB-9222S3	94	20	5.5	600
VSB-9222S6	±2	35		750

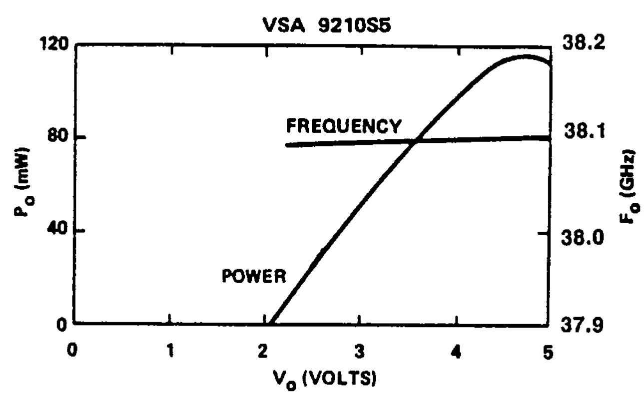
MAXIMUM RATINGS—GaAs

- Storage Temperature: −54°C to +175°C
- Heat Sink Temperature: −54°C to +71°C
- Active Layer Temperature: 260°C
- Soldering Temperature: 230°C for 5 sec

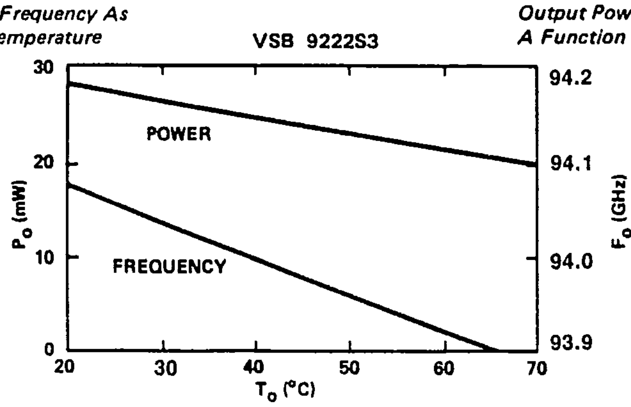
TYPICAL PERFORMANCE CURVES



Output Power And Frequency As A Function Of Temperature



Output Power And Frequency As A Function Of Operating Voltage



Output Power And Frequency As A Function Of Temperature

2

INDIUM PHOSPHIDE GUNN DIODES 30 To 110 GHz

GENERAL CHARACTERISTICS

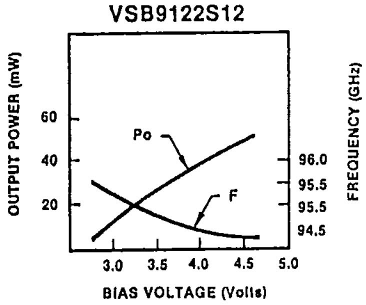
Type Number	Test Frequency (GHz)	Output Power (mW) Min	Typical Bias Parameters		Typical Efficiency %
			Voltage (V)	Current (mA)	
VSA-9110S1 VSA-9110S2 VSA-9110S3 VSA-9110S4	35.0 ±2.0	250 300 350 400	12.0 12.0 12.0 12.0	200 220 240 260	11.0 12.0 13.0 13.0
VSQ-9119S1 VSQ-9119S2 VSQ-9119S3 VSQ-9119S4	44.0 ±2.0	150 200 250 300	11.0 11.0 11.0 11.0	170 200 250 260	9.0 10.0 11.0 11.0
VSE-9120S1 VSE-9120S2 VSE-9120S3	56.0 ±2.0	150 200 250	8.0 8.5 8.5	260 280 360	8.0 9.0 9.0
VSB-9122S1 VSB-9122S2 VSB-9122S3 VSB-9122S4	80.0 ±2.0	20 40 60 80	6.0 6.0 6.0 6.0	200 240 240 310	3.0 3.0 3.0 4.5
VSB-9122S10 VSB-9122S11 VSB-9122S12 VSB-9122S13 VSB-9122S14 VSB-9122S15 VSB-9122S16	94.0 ±2.0	30 40 50 60 45 70 80	5.0 5.0 5.0 10.0 10.0 10.0 10.0	230 280 300 170 160 180 180	3.0 3.0 3.5 3.5 4.0 4.0 5.0
VSB-9122S20	110.0 ±2.0	25	10.0	180	1.5

MAXIMUM RATINGS—INP

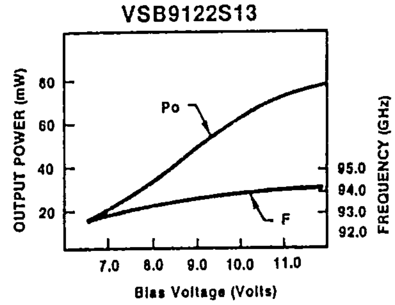
- **Storage Temperature: – 54°C to +175°C**
- **Active Layer Temperature: 175°C**
- **Heat Sink Temperature: – 54°C to + 60°C**
- **Soldering Temperature: 230°C for 5 sec**

TYPICAL PERFORMANCE CURVES*

VSB9122S12

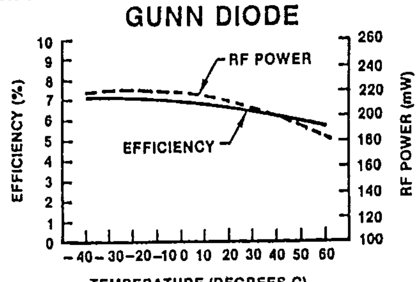


VSB9122S13



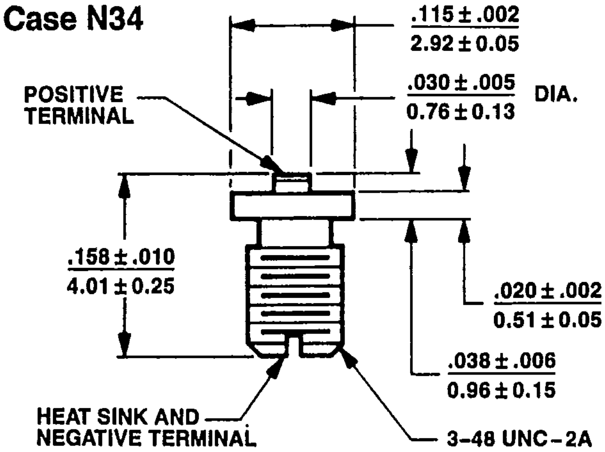
*Performance Curves Generated From Oscillator Circuits Optimized By Litton Solid State

THERMAL CHARACTERISTICS OF VSE9120S2 GUNN DIODE



OUTLINE DRAWING

Case N34



Ls = 0.20 nH Cp = 0.12 pF

NOTES:

1. Voltage specified is the maximum voltage required for operation within the frequency band specified. Bias voltage generally decreases as frequency increases and may vary from diode to diode.
2. The suffix "S1," "S2," etc. denotes power output. The suffix "N34," etc: denotes diode case style. They are used for quoting and ordering purposes. When an order is received at Litton, e.g., VSK-9204S1N34, a two-letter suffix might be assigned, e.g., VSK-9204AP to identify the customer and the exact requirements.
3. Power output is measured in a Litton Critically Coupled Cavity at a heat sink temperature of 25°C at a specified center frequency.

DIODE MOUNTING PROCEDURE AND OPERATING PRECAUTIONS

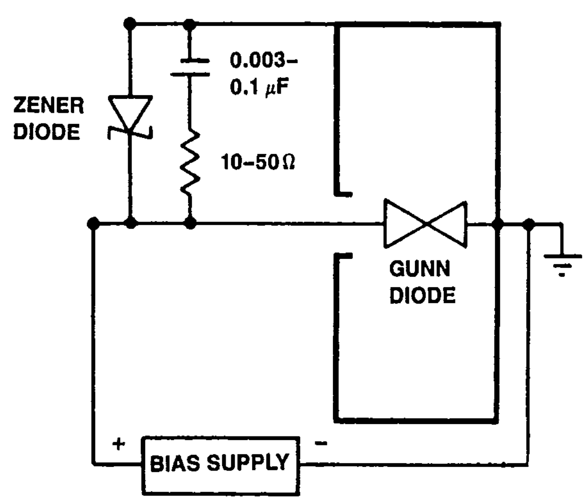
There are two primary causes of catastrophic failures in Gunn diodes—over-heating and over-voltage. The following precautions should be reviewed before assembly and operation.

The Gunn diode is a power generating device with a power dissipation density in the order of 10^5 watts per cm^2. If the diode is improperly heat sunk, it will operate above the maximum active layer temperature ratings leading to probable degradation and eventual failure. To avoid this, the diode should be securely tightened into a sharply tapped 3–48 unc-2A threaded hole. The use of a small amount of thermally conductive heat sink grease is advisable.

When soldering to the lid of an N-34 or N-57 package, use of an Indalloy rather than lead-tin solder is recommended. Lead-tin solder will react with the lid braze material, possibly causing metalization lifting or voids in the lid to ceramic braze.

The breakdown electric field of a Gunn diode is related to the nl product of the device. Depending on the design, practical devices exhibit a pulsed breakdown voltage at room temperatures of 5 to 15 times their threshold voltage. Normal C.W. operating voltage is three to four times threshold allowing for a reasonable safety factor. However, only a voltage spike is necessary to initiate breakdown. As the diode passes through threshold, the current drops and any series inductance in the bias line creates a voltage spike equal to $-L(di/dt)$. If the sum of the spike and operating voltage exceeds breakdown voltage then the device breaks down and may fail. One straightforward way to correct this is to place a 1μF or larger tantalum capacitor as close to the diode as possible. Another, would be to use a bias oscillation supression circuit as illustrated.

The zener diode should have a response time of less than 100nsec. To avoid the possibility of reverse bias damage, a series diode could also be incorporated into the surpression network.



BIAS OSCILLATION SUPRESSION CIRCUIT

Reliability Estimation

Gunn Diode MTBF can be established through the use of long-term life tests. Litton's life test program was initiated in May, 1968. After 18 years of CW operation an MTBF of 385,500 hours at a 90% confidence level has been established for continuous operating devices.