High Reliability Semiconductor – Beam Lead Gallium Arsenide Tuning Varactor Diode

Features

- Constant Gamma of 1.25
- Strong Beam Construction
- Low Parasitic Capacitance
- High Q
- Close Capacitance Tracking

Description

The ML46580S-992 is a Gallium Arsenide Beam Lead Tuning Varactor having a Hyperabrupt junction with a resultant constant gamma characteristic. The constant gamma, high Q values and the elimination of package parasitics are extremely beneficial for the linear tuning of voltage controlled oscillators at frequencies above 20 GHz.

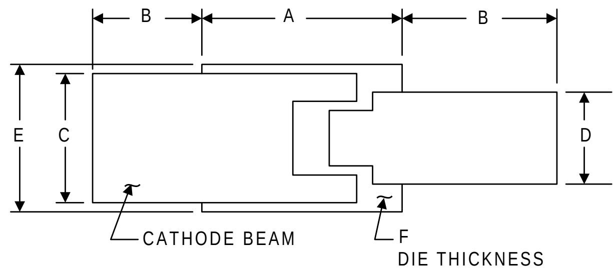
This device has been tested previously for space application in accordance with the requirements of ESA Generic Specifications PSS-01-608 and ESA/SCC 5010.

High Reliability Beam Lead diodes can be supplied using the same procedures established for chip diodes. These procedures detailed in M/A-COM control document MP3021-001 incorporate the essential elements of ESA/SCC 5010.

M/A-COM can also provide Gallium Arsenide Beam Lead Tuning Varactor diodes with a constant gamma of 1.0 and also with capacitance up to 2pF.

The Semiconductor Master Catalogue, available on request, contains detailed information of the following additional Tuning Varactor types many of which are suitable for space application.

Package Outline



	INCHES	MILLIMETERS		
DIM	Min.	Max.	Min.	Max.
A	0.012	0.014	0.305	0.356
B	0.010	—	0.254	—
C	0.006	0.008	0.152	0.203
D	0.004	0.006	0.102	0.152
E	0.007	0.009	0.178	0.229
F	—	0.004	0.305	0.1026

- Surface Mount (SOT-23) Tuning Varactors
- Axial Lead Tuning Varactors
- Silicon Abrupt and Hyperabrupt Junction Tuning Varactors
- GaAs Abrupt Junction Tuning Varactors
- GaAs Hyperabrupt Junction Tuning Varactors with Constant Gamma 0.75, 1.25, 1.5

Maximum Ratings (Tamb = +25°C)

No.	Characteristics	Symbol	Maximum Ratings	Units	Remarks
1	Power Dissipation	P_O	25.0	mW	See Note 1
2	Reverse Voltage	V_R	18	V	
3	Forward Current	I_F	50	mA	See Note 2
4	Operating Temperature	T_{OP}	-65 to +150	°C	
5	Storage Temperature	T_{STO}	-65 to +150	°C	

Notes:
1. Derate linearly to 0 mW from 25°C to 150°C
2. Derate linearly to 0 mA from 25°C to 150°C

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Electrical Measurements at Room Temperature d.c. and a.c. Parameters

No.	Characteristics	Symbol	MIL-STD-750 Test Method	Test Conditions	Limits Min.	Max.	Units
1	Forward Voltage	V_{F1}	4011	$I_F = 10\mu A$	—	1.4	V
2	Reverse Current 1	I_{R1}	4016	$V_R = -12V$	—	20	nA
3	Reverse Current 2	I_{R2}	4016	$V_R = 18V$	—	10	µA
4	Junction Capacitance	$C_{J\,4}$	4001	$V_R = 4V$ F = 1 MHz	0.45	0.55	pF
5	Quality Factor	Q_4	see Note 2	$V_R = 4.0$ v F = 1 MHz	3000	—	—
6	Total Capacitance Ratio	C_{T2} / C_{T12}	4001	$V_R = 2.0$ v $V_R = 12$ v F = 1 MHz see Note 3	4.5:1	6.5:1	—
7	Gamma	γ	see Note 4	$V_R = 2.0V$ to $V_R = 12V$	1.125	1.375	—

Notes:

2. Quality Factor is measured on a sample of 10 Beam Lead devices selected at random from the production wafer and assembled in a ceramic microstrip package. The measurement is carried out at a test frequency above 1 GHz and extrapolated to 50 MHz.
3. Total Capacitance Ratio is measured on the sample of 10 devices used for Q measurement.
4. Measurement/Calculation of Capacitance-Voltage Slope Exponent (Gamma).

   The capacitances of a sample of 10 diodes taken at random from the production lot are measured at 2.0, 3.0, 4.0, 6.0, 8.0, 9.0, 10.0, 12.0, volts reverse bias voltage. Junction capacitance C_J is calculated by subtracting the package capacitance of the test package. The Gamma values are then calculated between each pair of adjacent voltages using the following formula:

$$\gamma = \frac{\log_{10} \{Cj_{(VR1)} / Cj_{(VR2)}\}}{\log_{10} \{V_{R2} + 1.3 / V_{R1} + 1.3\}}$$

Electrical Measurements at High and Low Temperature, -55°C to +125°C

No.	Characteristics	Symbol	MIL-STD-750 Test Method	Test Conditions	Limits Min.	Max.	Units
1	Reverse Current	I_R	4016	$V_R = 12V$	—	50	µA

Parameter Drift Values

No.	Characteristics	Symbol	Change Limits Δ	Test Conditions
2	Reverse Current	I_R	± 10 nA or ± 100% whichever is the greater referred to the initial measurement	$V_R = 12$ Volts
3	Forward Voltage	V_F	± 100 mV or ± 100%	$I_F = 10$ µA

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Conditions for High Temperature Reverse Bias Burn-In

No.	Characteristics	Symbol	Conditions	Units
2	Reverse Voltage	V_R	14 ± 1	V
3	Ambient Temperature	Tamb	+50 +0, -5	°C

Conditions for Operating Life Tests

No.	Characteristics	Symbol	Conditions	Units
1	Reverse Voltage	V_R	14 ± 1	V
2	Ambient Temperature	Tamb	+150 +0, -5	°C

Electrical Measurements at Intermediate Points and Completion of Endurance Testing

No.	Characteristics	Symbol	MIL-STD-750 Test Method	Test Conditions	Limits		
					Min.	Max.	Units
1	Forward Voltage	V_F	4011	I_F = 10 µA		1.4	V
2	Reverse Current	I_R	4016	VR = 12 Volts		20	nA
3	Junction Capacitance	C_{J4}	4001	V_R = 4 Volts F = 1 MHz $C_J = C_{TOTAL} - C_{PACKAGE}$	0.45	0.55	pF

Electrical Measurements During and on Completion of Radiation Testing (only if requested)

No.	Characteristics	Symbol	MIL-STD-750 Test Method	Test Conditions	Δ
1.	Reverse Voltage	V_R	4016	V_R= 12 Volts	20 nA or 200% whichever is greater

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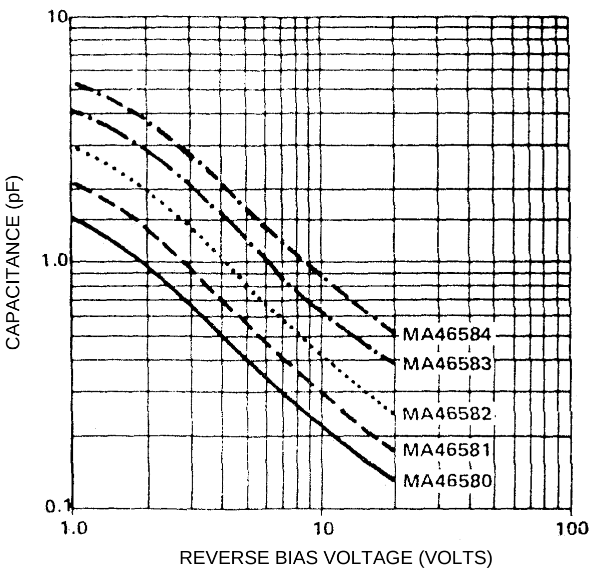
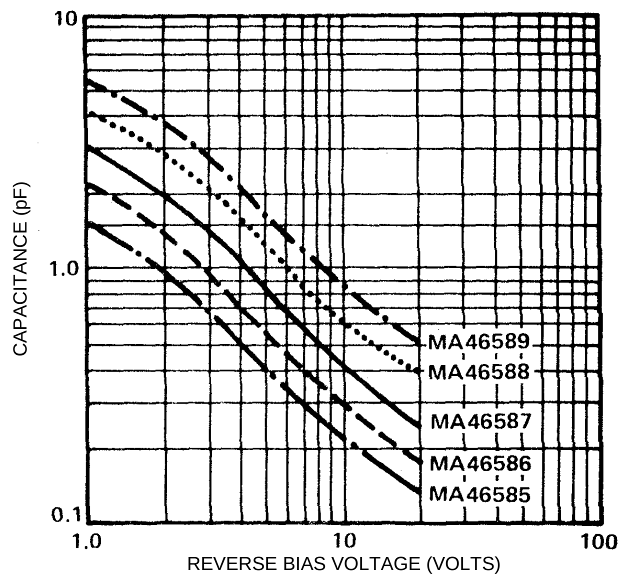
Typical Performance Curves (MA46580 Series)

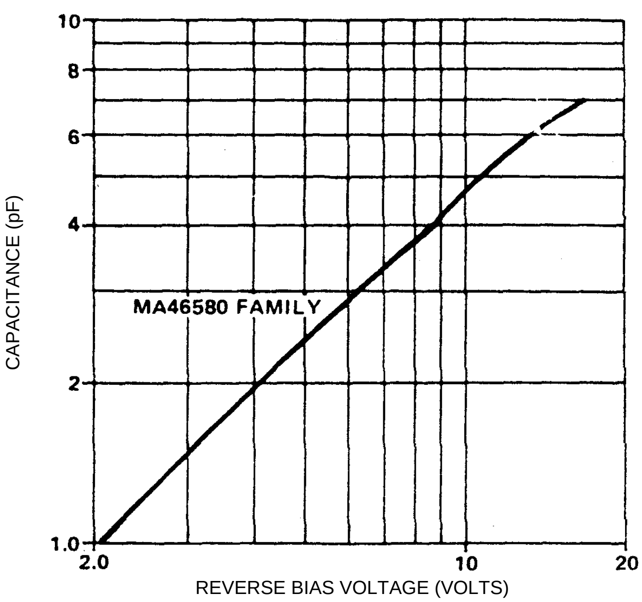
Gamma = 1.0 ± 10% from 2-12 Volts (MA46585 through to MA46589)
Gamma = 1.25 ± 10% from 2-12 Volts (MA46580 through to MA46584)



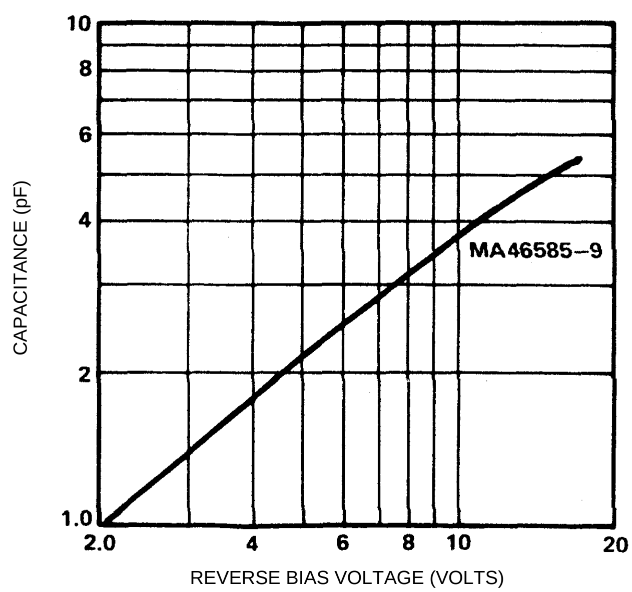
MA46580 – 46584 Capacitance vs Voltage



MA46585 – 46589 Capacitance vs Voltage



Capacitance RatioC$_{T-2}$ /C$_{TV}$ for MA46580-46584 Series



Capacitance Ratio C$_{T-2}$ /C$_{TV}$ for MA46585-46589 Series

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