Microwave Abrupt Tuning Diodes and Chips

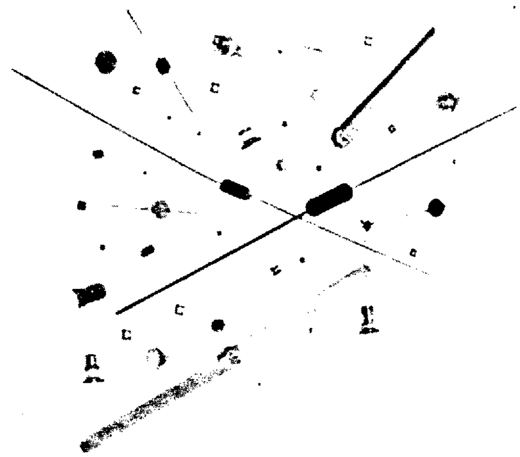
T-07-19

Features

- Highest Q Values Available
- Widest Range of Capacitance, Voltage, and Package Styles
- Low Post-Tuning Drift
- High Stability, Low Leakage
- Meet All MIL-STD-750 Requirements

Types

- DVH6700 Series
- CVH2000 Series



Description

Alpha abrupt-junction tuning varactors have an epitaxial, mesa design and a high density silicon dioxide passivation. This passivation, in conjunction with other processes, results in high reliability, low leakage current, and low post-tuning drift. To minimize series resistance and provide chips capable of being bonded to in a wide variety of packages using conventional bonding techniques, tightly controlled metallization on the top and back surfaces of the chip is utilized.

Variations from square root law are minimized while maintaining high tuning ratios and highest Q by a careful selection of epitaxial silicon and by anode diffusions that are computer controlled. All diodes are available in a wide selection of packages or in chip form. See Section 8 for a complete section of standard packages.

Applications

Tuning diodes are offered in a large selection of capacitance ranges. Alpha also has hyperabrupt tuning diodes for those applications requiring larger capacitances, wider tuning ranges, and linear frequency versus voltage tuning at slightly lower Q. For tuning applications above Ku-band, Alpha has a series of GaAs tuning diodes with exceptionally high Q.

Silicon abrupt junction tuning varactors are ideally suited for frequency tuning applications through Ku-band. They may also be used for tuning filters, phase shifters, oscillators, upconverters and low order multipliers. Typical C_T (total capacitance - includes package) and C_J (junction capacitance) curves are shown in Figures 1 and 2.

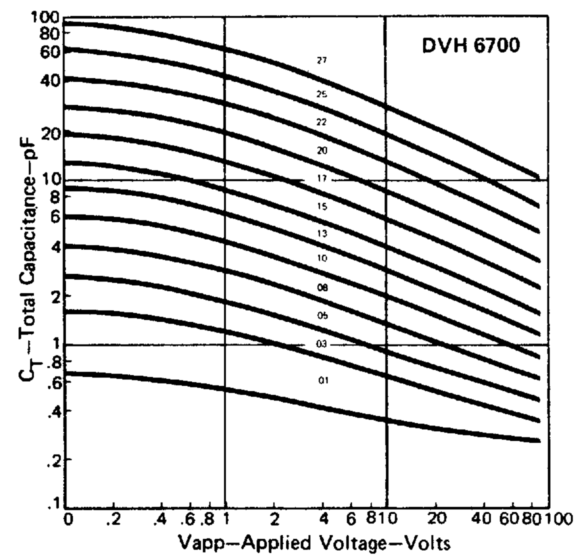


Figure 1. Total Capacitance vs. Applied Voltage

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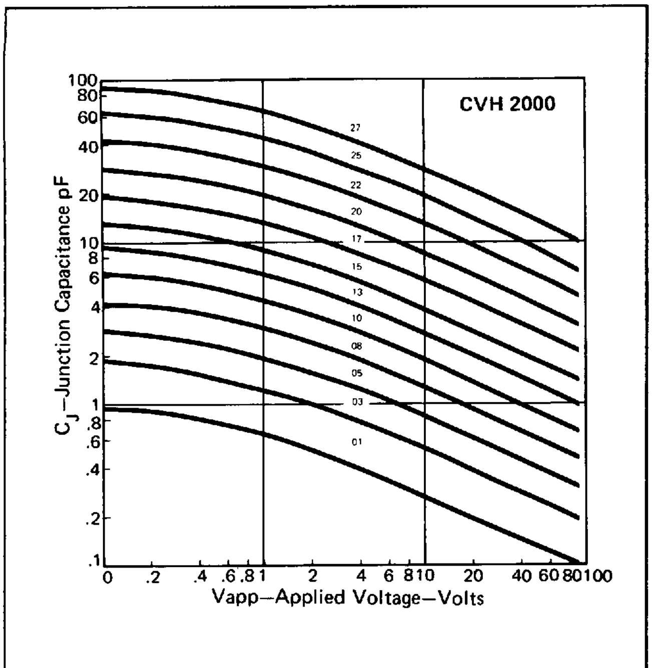

Figure 2. Junction Capacitance vs. Applied Voltage

Diode Q is dependent on several factors. Highest Q is obtained from low breakdown voltage and low capacitance diodes; Q decreases as either breakdown voltage or capacitance is increased. In addition, Q, being an inverse function of capacitance and series resistance, increases with reverse bias. Typical Q vs. reverse bias curves for several diodes of different C_T values are shown in Figure 3. A typical schematic representation of a packaged High Q tuning varactor is shown in Figure 4. Usually the L_s (package series inductance) and C_P (package parallel capacitance) can be designed into most circuits. The junction capacitance of abrupt junction diodes is given by the following equation.

$$C_j(V) = C_o(1 + V/\varphi)^{-n}$$

Where:

$C_j(V)$ = Junction capacitance at reverse voltage, V
Co = Junction capacitance at V=0
V = Applied reverse voltage
φ = Contact potential of the diode=0.8V
n = Slope of C-V curve when plotted on log-log
n = .47 for actual devices: n=.50 for the ideal case.

The total capacitance of a packaged diode is thus $C_T(V) = C_P + C_j(V)$ where C_P is the package stray capacitance.

If $C_j(V)$ is large compared with C_P, no degradation of the diode tuning ratio due to package parasitics is observed. However, if C_P and $C_j(V)$ are of the same order, a substantial decrease in tuning ratio will occur. This is clearly seen by comparing the C_j and C_T vs. voltage curves in Figures 1 and 2.

See Application Note 80000 in Section 7 for suggested handling and bonding procedures for diode chips.

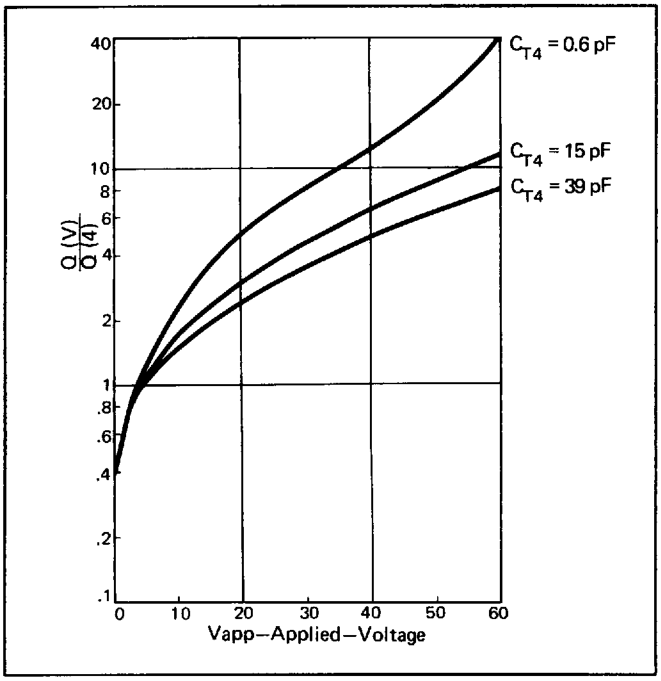

Figure 3. Typical Q vs. Applied Voltage Abrupt Junction Tuning Diode Q Normalized to Q at V=4 Vdc

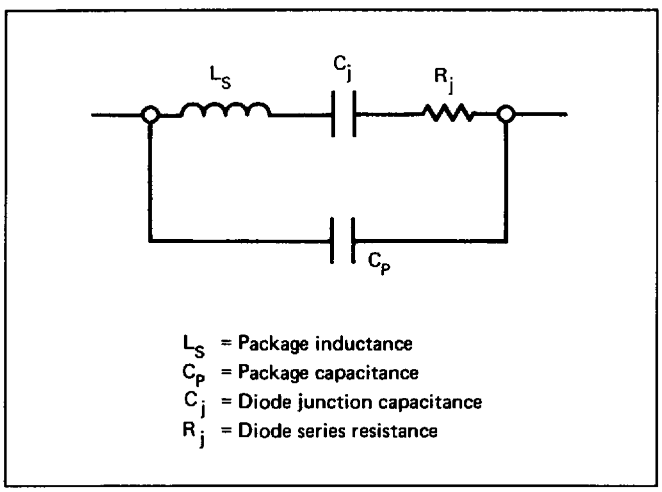

Figure 4. Typical Schematic Representation of a Packaged Tuning Varactor

Microwave Abrupt Tuning Diodes and Chips

Extra High Q DVH6700 Series

Maximum Ratings

Parameter	Symbol	Value	Units
Reverse Voltage	V_R	Same as V_{BR}	Volts
Device Dissipation at T_A=25°C(4)		250	mW
Operating Temperature	T_{op}	-65 to +150	°C
Storage Temperature Range	T_{stg}	-65 to +200	°C

Odering Information
6700 Series
Example:
Desired Device Specification
V_{BR}=45 V C_{T4}=3.3 pF Pkg=135
Resultant Type Number DVH6742-11

Tuning diodes are available which exceed the V_B and C_j values specified on this table. Please contact an Alpha representative at 617-935-5150 for additional information.

Breakdown Voltage³		30 Volt Series		45 Volt Series		60 Volt Series		90 Volt Series	
DVH6700 Extra High Q		DVH6730 DVH6731 DVH6732 DVH6733 DVH6734 DVH3811 DVH3821	099-001 Pkg 023-001 Pkg 135-001 Pkg 168-001 Pkg 168-801 Pkg 130-011 Pkg 247-001 Pkg	DVH6740 DVH6741 DVH6742 DVH6743 DVH6744 DVH3812 DVH3822	099-001 Pkg 023-001 Pkg 135-001 Pkg 168-001 Pkg 168-801 Pkg 130-011 Pkg 247-001 Pkg	DVH6760 DVH6761 DVH6762 DVH6763 DVH6764 DVH3813 DVH3823	099-001 Pkg 023-001 Pkg 135-001 Pkg 168-001 Pkg 168-801 Pkg 130-011 Pkg 247-001 Pkg	DVH6790 DVH6791 DVH6792 DVH6793 DVH6794 DVH3814 DVH3824	099-001 Pkg 023-001 Pkg 135-001 Pkg 168-001 Pkg 168-801 Pkg 130-011 Pkg 247-001 Pkg
C_{T4}(pF)(1)	Suffix Number	C_{T0}/C_{T30}	Q_4(2) 50 MHz	C_{T0}/C_{T45}	Q_4(2) 50 MHz	C_{T0}/C_{T60}	Q_4(2) 50 MHz	C_{T0}/C_{T90}	Q_4(2) 50 MHz
0.4	01	2.2	5000	2.3	3000				
0.6	02	2.7	5000	2.8	3000				
0.8	03	3.2	4800	3.3	2800	3.8	2100	4.2	1000
1.0	04	3.5	4800	3.9	2800	4.3	2100	4.7	1000
1.2	05	3.8	4600	4.3	2600	4.6	2100	5.2	900
1.5	07	4.0	4400	4.6	2400	5.1	2000	5.7	900
1.8	08	4.1	4200	4.9	2300	5.4	2000	6.2	900
2.2	09	4.1	4000	5.1	2200	5.6	2000	6.5	850
2.7	10	4.2	3800	5.2	2200	5.8	1900	6.8	850
3.3	11	4.2	3600	5.3	2100	6.0	1800	7.1	850
3.9	13	4.2	3400	5.4	2000	6.2	1700	7.3	800
4.7	14	4.2	3200	5.4	2000	6.4	1600	7.5	800
5.6	15	4.3	3000	5.5	1900	6.6	1500	7.7	800
6.8	16	4.3	2800	5.6	1800	6.7	1400	7.8	750
8.2	17	4.3	2600	5.7	1700	6.8	1300	7.9	750
10	19	4.4	2400	5.8	1600	6.8	1200	8.0	750
12	20	4.4	2200	5.8	1500	6.9	1100	8.1	700
15	21	4.4	2000	5.9	1400	7.0	1000	8.2	700
18	22	4.4	1800	6.0	1300	7.0	1000		
22	23	4.5	1600	6.0	1200	7.0	950		
27	25	4.5	1400	6.0	1100	7.0	950		
33	26	4.5	1400	6.0	1000				
39	27	4.5	1200						

Notes:
1. Capacitance tolerance is ±10% except ±20% for 0.4 and 0.6 pF. 009 package diodes measured in shielded holder, C_{pkg} = 0.07 pF.
2. Q specified V_R=4 V, 50 MHz equivalent from 1 GHz or 100 MHz measurement.
3. Minimum V_{BR} (breakdown voltage) at10 microamps.
4. For 099-001 Packages.

Microwave Tuning Diodes and Chips

Extra High Q CVH2000 Series Chips

Maximum Ratings

Parameter	Symbol	Value	Units
Reverse Voltage	V_R	Same as V_{BR}	Volts
Device Dissipation at T_A=25°C		250	mW
Operating Temperature	T_{op}	-65 to +150	°C
Storage Temperature Range	T_{stg}	-65 to +200	°C

Ordering Information
2000 Series
Example:
Desired Chip Specification
C_j - 4 Volts=8.2 pF V_{BR}=60 Volts
Resultant Part Number CVH-2060-17

CVH2000 Extra High Q Chips		TYPE CVH2030 30 Volt Series [3] tuning ratio[4] 4.5:1 min		TYPE CVH2045 45 Volt Series [3] tuning ratio[4] 6:1 min		TYPE CVH2060 60 Volt Series [3] tuning ratio[4] 7.5:1 min		TYPE CVH2090 90 Volt Series [3] tuning ratio[4] 8.7:1 min	
C_j-4V (pF)[1]	Suffix Number	Chip Style	Q_4[2]	Chip Style	Q_4[2]	Chip Style	Q_4[2]	Chip Style	Q_4[2]
0.4	01	150-801	5000	150-801	3000				
0.6	02	150-801	5000	150-801	3000				
0.8	03	150-801	4800	150-801	2800	150-801	2100	150-801	1000
1.0	04	150-801	4800	150-801	2800	150-801	2100	150-801	1000
1.2	05	150-801	4600	150-801	2600	150-801	2100	150-801	900
1.5	07	150-801	4400	150-801	2400	150-801	2000	150-802	900
1.8	08	150-801	4200	150-801	2300	150-801	2000	150-802	850
2.2	09	150-801	4000	150-801	2200	150-802	2000	150-802	850
2.7	10	150-801	3800	150-802	2200	150-802	1900	150-802	850
3.3	11	150-802	3600	150-802	2100	150-802	1800	150-802	850
3.9	13	150-802	3400	150-802	2000	150-802	1700	150-802	800
4.7	14	150-802	3200	150-802	2000	150-802	1600	150-802	800
5.6	15	150-802	3000	150-802	1900	150-802	1500	150-802	800
6.8	16	150-802	2800	150-802	1800	150-802	1400	150-802	750
8.2	17	150-802	2600	150-802	1700	150-802	1300	150-803	750
10	19	150-802	2400	150-802	1600	150-802	1200	150-803	750
12	20	150-802	2200	150-802	1500	150-803	1100	150-803	700
15	21	150-803	2000	150-803	1400	150-803	1000	150-803	700
18	22	150-803	1800	150-803	1300	150-803	1000		
22	23	150-803	1600	150-803	1200	150-803	950		
27	25	150-803	1400	150-803	1100	150-803	950		
33	26	150-803	1400	150-803	1000	150-805	900		
39	27	150-803	1200	150-803	1000	150-805	900		

Notes:
1. Capacitance tolerance is ±10% except for ±20% for suffix numbers 01, 02, and 28.
2. Q specified V_R=4 V, 50 MHz equivalent from 1 GHz or 100 MHz measurement.
3. Minimum V_{BR} (breakdown voltage) at 10 microamps.
4. Tuning ratio equals the capacitance at 0 Volts divided by the capacitance at the specified breakdown voltage.