

# Microwave Abrupt Tuning Diodes and Chips

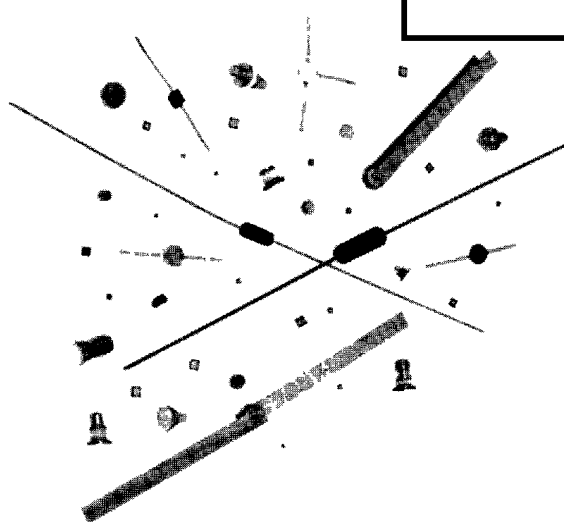
## Features

- 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

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## 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.

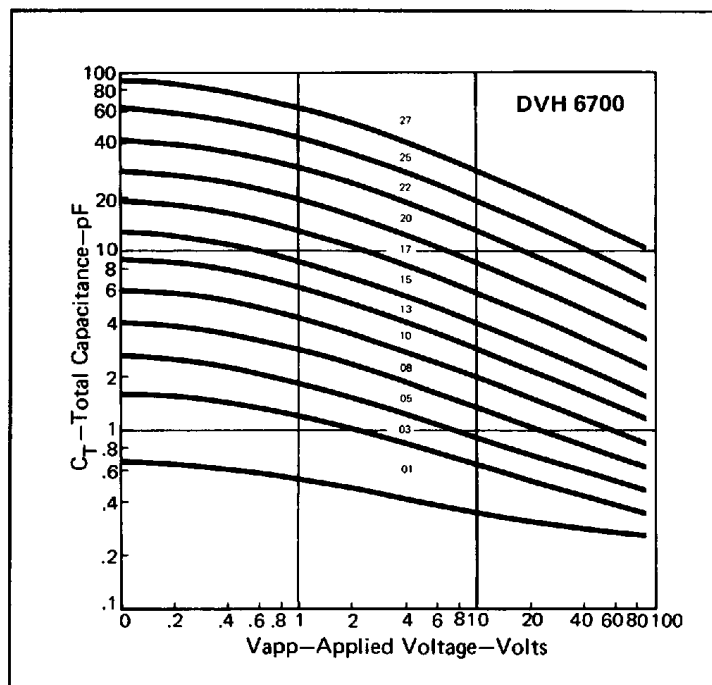
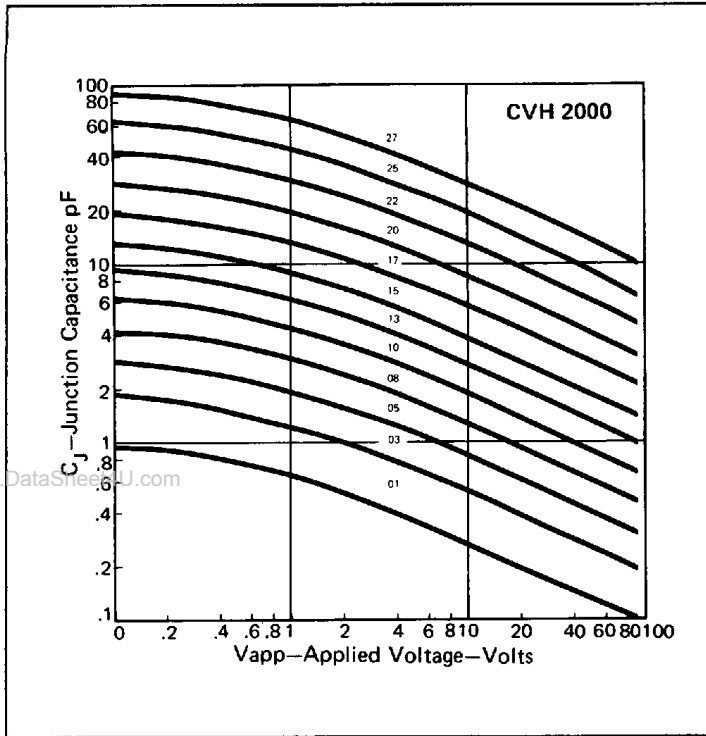


Figure 1. Total Capacitance vs. Applied Voltage

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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  $C_{T4}$  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.

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

Where:

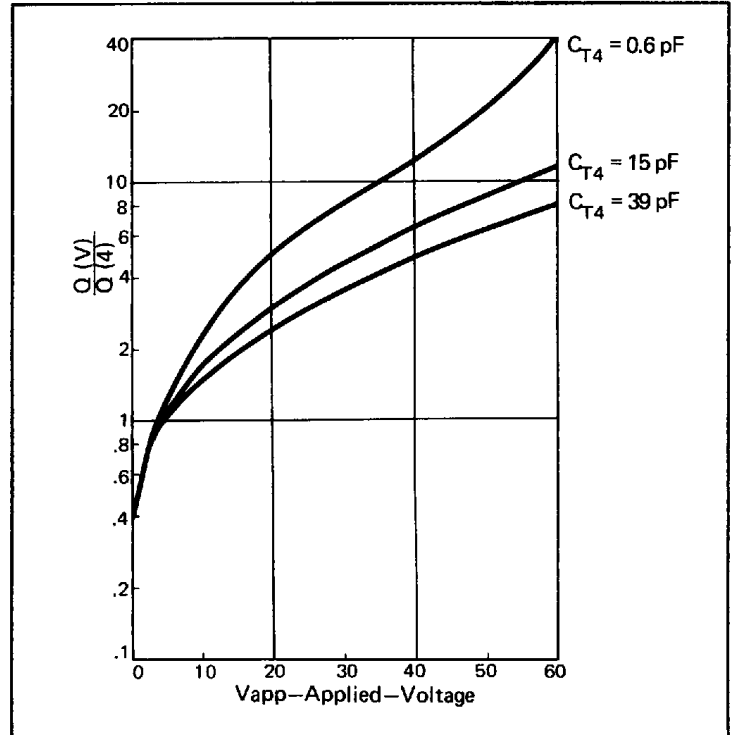
- $C_j(V)$  = Junction capacitance at reverse voltage, V
- $C_o$  = Junction capacitance at  $V=0$
- V = Applied reverse voltage
- $\phi$  = Contact potential of the diode=0.8V
- n = Slope of C-V curve when plotted on log-log
- n = .47 for actual devices: n=.50 for the ideal case.

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.

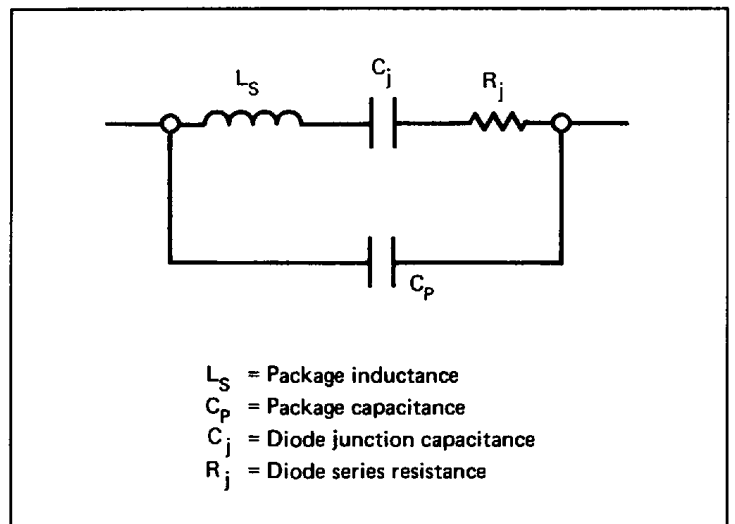
If  $C_j(V)$  is large compared with  $C_p$ , no degradation of

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 $T_A=25^\circ\text{C}^{(4)}$		250	mW
Operating Temperature	$T_{op}$	-65 to +150	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-65 to +200	$^\circ\text{C}$

### Ordering Information

#### 6700 Series

Example:

Desired Device Specification

$V_{BR}=45\text{ V}$   $C_{T4}=3.3\text{ pF}$  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 Voltage <sup>3</sup>		30 Volt Series		45 Volt Series		60 Volt Series		90 Volt Series	
<b>DVH6700</b> <b>Extra High Q</b>		DVH6730	099-001 Pkg	DVH6740	099-001 Pkg	DVH6760	099-001 Pkg	DVH6790	099-001 Pkg
		DVH6731	023-001 Pkg	DVH6741	023-001 Pkg	DVH6761	023-001 Pkg	DVH6791	023-001 Pkg
		DVH6732	135-001 Pkg	DVH6742	135-001 Pkg	DVH6762	135-001 Pkg	DVH6792	135-001 Pkg
		DVH6733	168-001 Pkg	DVH6743	168-001 Pkg	DVH6763	168-001 Pkg	DVH6793	168-001 Pkg
		DVH6734	168-801 Pkg	DVH6744	168-801 Pkg	DVH6764	168-801 Pkg	DVH6794	168-801 Pkg
		DVH3811	130-011 Pkg	DVH3812	130-011 Pkg	DVH3813	130-011 Pkg	DVH3814	130-011 Pkg
		DVH3821	247-001 Pkg	DVH3822	247-001 Pkg	DVH3823	247-001 Pkg	DVH3824	247-001 Pkg
$C_{T4}$ (pF) <sup>(1)</sup>	Suffix Number	$C_{T0}/C_{T30}$	$Q_A^{(2)}$ 50 MHz	$C_{T0}/C_{T45}$	$Q_A^{(2)}$ 50 MHz	$C_{T0}/C_{T60}$	$Q_A^{(2)}$ 50 MHz	$C_{T0}/C_{T90}$	$Q_A^{(2)}$ 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  $\pm 10\%$  except  $\pm 20\%$  for 0.4 and 0.6 pF. 009 package diodes measured in shielded holder,  $C_{pk} = 0.07\text{ pF}$ .
2. Q specified  $V_R=4\text{ V}$ , 50 MHz equivalent from 1 GHz or 100 MHz measurement.
3. Minimum  $V_{BR}$  (breakdown voltage) at 10 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 $T_A=25^\circ\text{C}$		250	mW
Operating Temperature	$T_{op}$	-65 to +150	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-65 to +200	$^\circ\text{C}$

### Ordering Information

#### 2000 Series

Example:

Desired Chip Specification

$C_1$  - 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 <sup>(3)</sup> tuning ratio <sup>(4)</sup> 4:5:1 min		TYPE CVH2045 45 Volt Series <sup>(3)</sup> tuning ratio <sup>(4)</sup> 6:1 min		TYPE CVH2060 60 Volt Series <sup>(3)</sup> tuning ratio <sup>(4)</sup> 7.5:1 min		TYPE CVH2090 90 Volt Series <sup>(3)</sup> tuning ratio <sup>(4)</sup> 8.7:1 min	
$C_1$ 4V (pF) <sup>(1)</sup>	Suffix Number	Chip Style	$Q_4$ <sup>(2)</sup>	Chip Style	$Q_4$ <sup>(2)</sup>	Chip Style	$Q_4$ <sup>(2)</sup>	Chip Style	$Q_4$ <sup>(2)</sup>
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  $\pm 10\%$  except for  $\pm 20\%$  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.