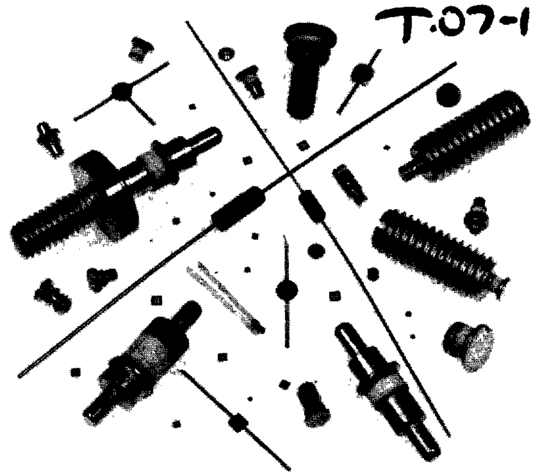
A-Mode Multiplier Diodes, Multichip A-Mode Diodes, A-Mode Chips

Features

- High Efficiency
- High Power Handling
- High Reliability



Description

Alpha A-Mode diodes are oxide passivated, epitaxial silicon mesa designs. Careful attention to diffusion profiles makes these diodes an ideal choice for low order multiplier circuits. They are available in a broad range of packages or in chip form for those who wish to bond A-modes into their own circuits. In addition, multichip packaged devices are available for high power applications.

Application

There are basically four types of multiplier devices in common usage: 1) the resistive multiplier, 2) the varactor (square law or tuning diode) multiplier 3) the A-mode multiplier, and 4) the SRD. The resistive multiplier, typically a Schottky diode, is for low order, low power use and has low efficiency. Varactor multipliers are principally used as doublers or upconverters (N=2), while A-mode multiplier diodes are principally used when high power, high efficiency and wide bandwith (10 to 20%) is required. The SRD is used mainly for high order ($N \geq 4$) multiplication and as a comb generator. Alpha has a complete line of multiplier diodes for each case mentioned above (consult factory).

The Alpha A-Mode diode combines the characteristics of the step recovery diode and the square law varactor to optimize performance in low order multiplication. In operation the A-Mode diode is driven into forward conduction to use the charge storage characteristics of the step recovery diode, but it also uses the reactance change of the square law device to give good bandwidth in low order operation.

In general it is desirable that the minority carrier lifetime (τ) be greater than 10 times the period of the input frequency, while the transition time (T_T) should be less than the period of the output frequency. Figures 2 and 3 are graphs which can be used to easily determine the limiting values s and T_T. Test circuits to determine t and T_T are shown in Figures 4 and 5. For optimum performance an ideal A-Mode will be a punch-through device at minus 10 volts (any increase in reverse bias above minus 10 volts will not decrease capacitance significantly), but will have a highly non-linear capacitance increase as the diode is toward zero volts. This can be clearly seen in Figure 1. A-Mode diodes are highly efficient, and circuits with 10 to 20% bandwidth are possible. Idlers are needed for N>2. A typical A-Mode circuit is shown in Figure 6.

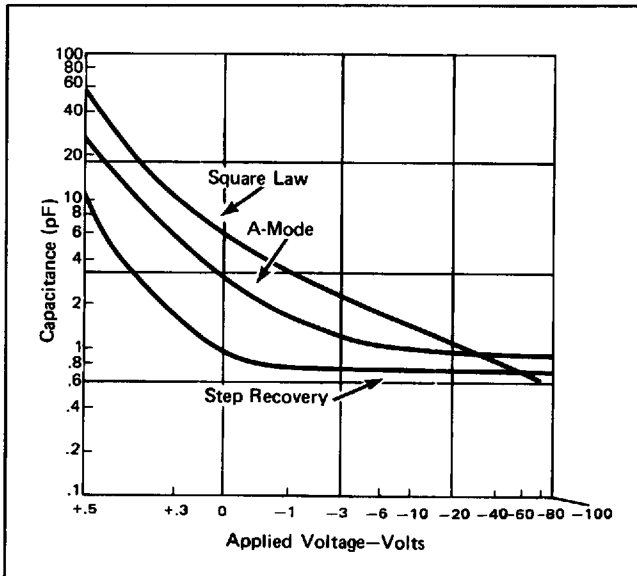


Figure 1. Capacitance vs. Applied Voltage for Square Law and A-Mode Multipliers and Step Recovery Diodes

A-Mode Multiplier Diodes, Multichip A-Mode Diodes, A-Mode Chips

ALPHA IND/ SEMICONDUCTOR 48E D ■ 0585443 0001375 T20 ■ALP T-07-11

When higher microwave power is desired, the normal A-Mode may not be useable, since the necessary breakdown voltage may be too high for the transmission time required. Alpha has solved this problem by using the multichip approach shown in Figure 7. The use of two chips provides improvement in both average power handling and peak power handling capability. For the construction shown on the left side of Figure 7, the chips are electrically in series and thermally in parallel giving lower thermal resistance than chips which are in series both electrically and thermally. Average power is increased because, for a given RF reactance, each chip can have twice the capacitance of the equivalent single chip device. This results in a four time increase in the device area and in average power handling, compared to a single chip.

Alpha will be glad to discuss your multiplier needs and suggest a suitable device for your particular requirements.

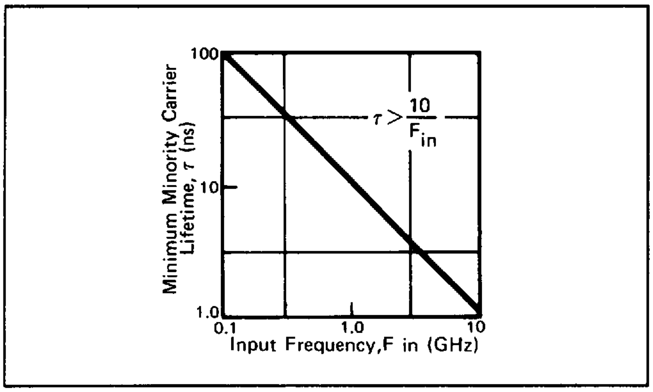


Figure 2. τ vs F_{in}

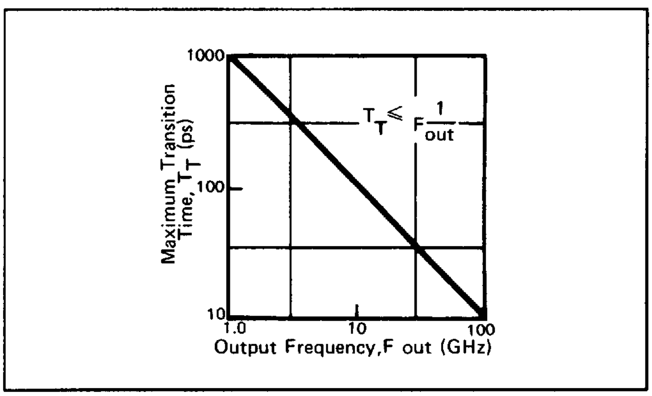


Figure 3. T_T vs F_{out}

Absolute Maximum Ratings

Parameter	Symbols	Value	Unit
Reverse Voltage	V_r	Same as V_B	Volts
Operating Temperature	T_{op}	-65 to +200	°C
Storage Temperature	T_{stg}	-65 to +200	°C

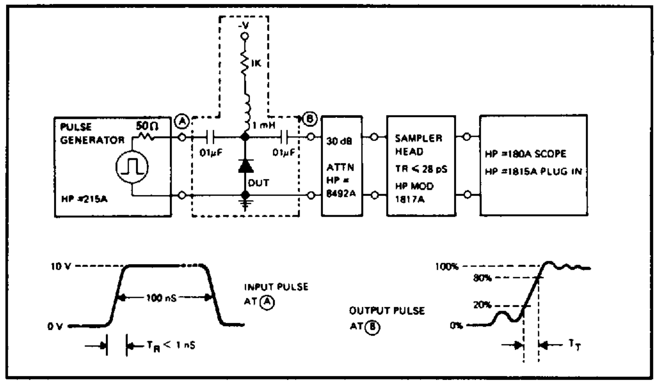


Figure 4. Minority Carrier Lifetime, τ, Test Set-Up

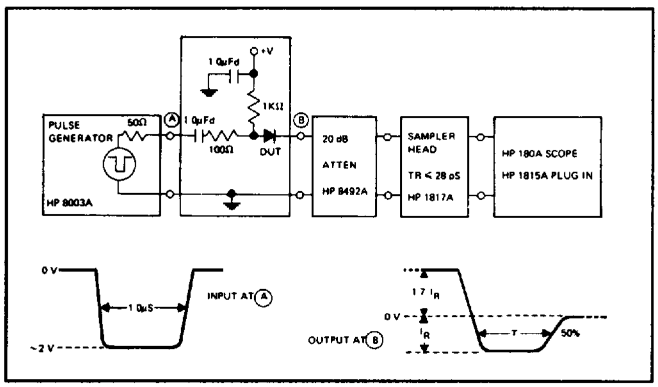


Figure 5. Transition Time, T_T, Test Set-Up

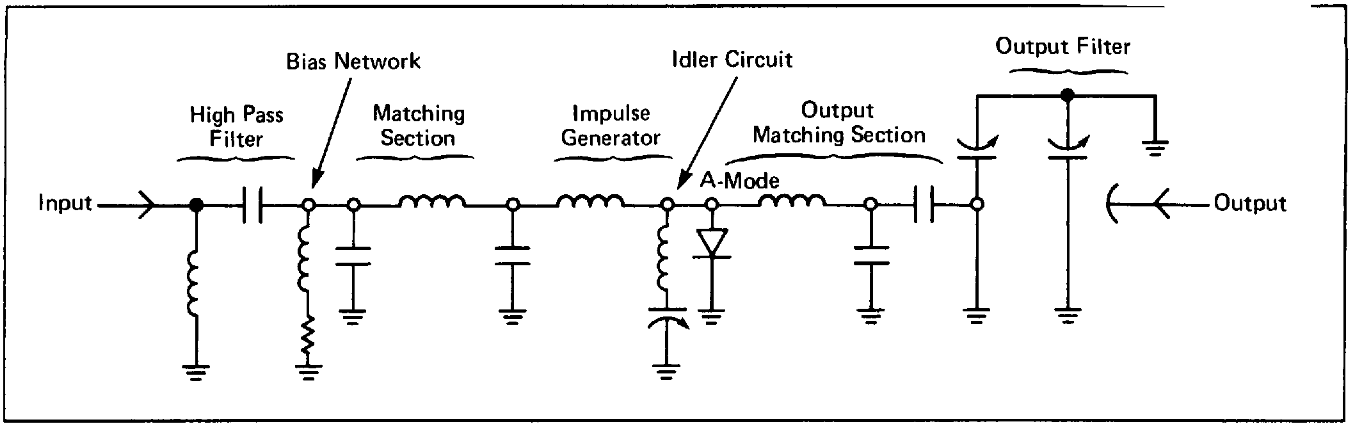


Figure 6. Typical A-Mode Multiplier Circuit

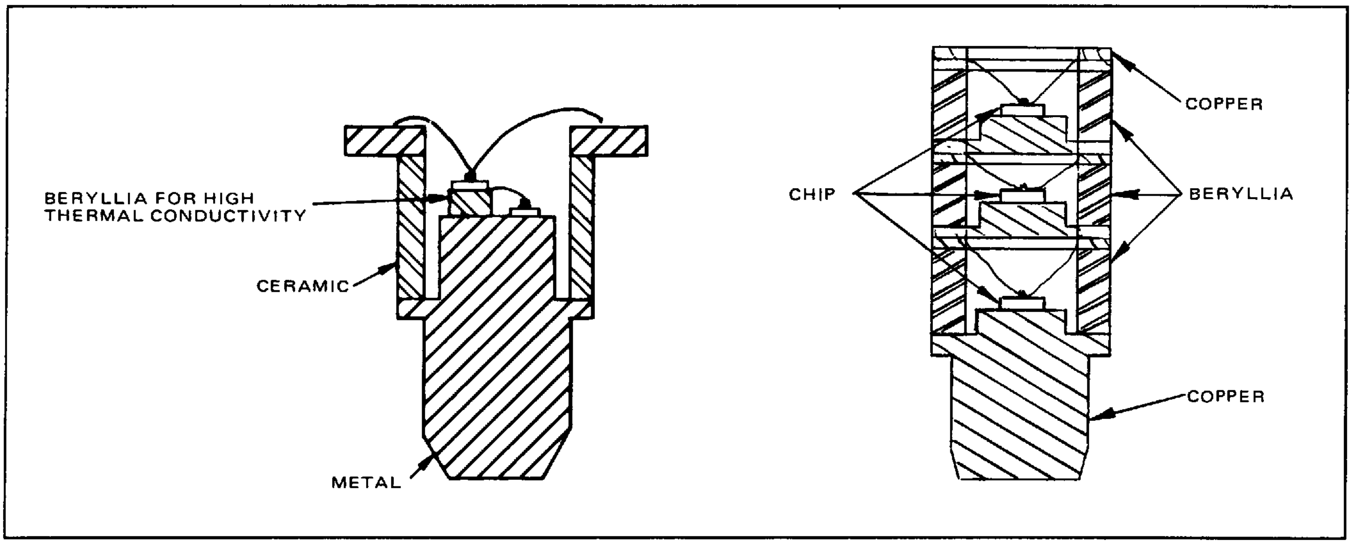


Figure 7. Multichip Diode Construction Techniques

A-Mode Multiplier Diodes, Multichip A-Mode Diodes, A-Mode Chips

A-Mode Multiplier Diodes

Type Number	Package Style	Reverse Breakdown Voltage Min.(V)	Junction Capacitance at -6V & 1 MHz(pF)	Cutoff Frequency[1] Min.(GHz)	Minority Carrier Lifetime[2] Min.(ns)	Transition Time[3] Max.(ps)	Output Frequency Range(GHz)	Typical Efficiency as a Tripler[4] %	Thermal Resistance Max. (°C/W)
DVA6735-06	023-001	30	0.25-0.5	200	10	150	12.0-15.0	30	75
DVA6735-12	023-001	30	0.5-1.0	200	10	150	8.0-12.0	35	50
DVA6735-18	023-001	45	0.5-1.0	175	20	200	8.0-12.0	40	50
DVA6735-24	023-001	45	1.0-1.5	160	25	200	5.0-8.0	50	25
DVA6736-06	158-001	60	1.5-2.5	150	60	400	5.0-8.0	45	15
DVA6736-12	158-001	75	1.5-3.0	150	100	750	5.0-7.0	45	15
DVA6736-18	158-001	75	3.0-6.0	120	100	1000	2.0-5.0	50	13
DVA6736-24	158-001	100	5-10	90	150	2000	1.0-2.0	55	11
DVA6737-06	117-001	125	10-15	90	150	2000	0.5-1.0	55	10
DVA6737-12	117-001	125	5-10	60	200	3000	1.0-2.0	65	7
DVA6737-18	117-001	125	10-15	60	200	3000	0.5-1.0	60	7
DVA6737-24	117-001	150	10-20	40	250	5000	0.5-1.0	60	6
DVA6737-30	117-001	175	15-25	20	300	8000	0.5-1.0	65	5

A-Mode Chips

Type Number	Package Style	Reverse Breakdown Voltage Min.(V)	Junction Capacitance at -6V & 1 MHz(pF)	Cutoff Frequency[1] Min.(GHz)	Minority Carrier Lifetime[2] Min.(ns)	Transition Time[3] Max.(ps)	Output Frequency Range(GHz)	Typical Efficiency as a Tripler[4] %
CVA1116-06	150-801	30	0.25-0.5	200	10	150	12.0-15.0	30
CVA1116-12	150-801	30	0.5-1.0	200	10	150	8.0-12.0	35
CVA1116-18	150-801	45	0.5-1.0	175	20	200	8.0-12.0	40
CVA1116-24	150-801	45	1.0-1.5	160	25	200	5.0-8.0	50
CVA1116-30	150-801	60	1.5-2.5	150	60	400	5.0-8.0	45
CVA1116-36	150-802	75	1.5-3.0	150	100	750	5.0-7.0	45
CVA1116-42	150-802	75	3.0-6.0	120	100	1000	2.0-5.0	50

A-Mode Multiplier Diodes-Multichip For High Power

Type Number	Pkge. Style	Reverse Breakdown Voltage Min.(V)	Junction Capacitance at 12V (pF)	Cutoff Frequency[1] Min.(GHz)	Minority Carrier Lifetime[2] Min.(ns)	Transition Time[3] Max.(ps)	Output Frequency Range (GHz)	Pout (dbm) (Typ.)	Thermal Resistance Max. (°C/W)
DVA6738-06	023-001	60	0.3-0.5	180	10	150	9.0-13.0	30	30
DVA6738-12	023-001	90	0.5-1.0	150	30	300	7.0-10.0	37	45
DVA6738-18	023-001	90	1.0-1.5	145	30	300	7.0-9.0	37	45
DVA6738-24	023-001	120	1.0-1.5	140	50	400	5.5-9.0	38	50
DVA6738-30	158-001	120	1.5-2.5	120	60	500	5.0-8.0	38	50

Notes:

1. Measured at V_R = -6 Volts.
2. Measured in Circuit of Figure 5; I_F = 10 mA, I_R = 6 mA.
3. Measured in Circuit of Figure 4; I_F = 10 mA, V_R = 10 Volts.
4. Typical values for use as guidelines in circuit design. These diodes are recommended for multiplication ratios less than 4.