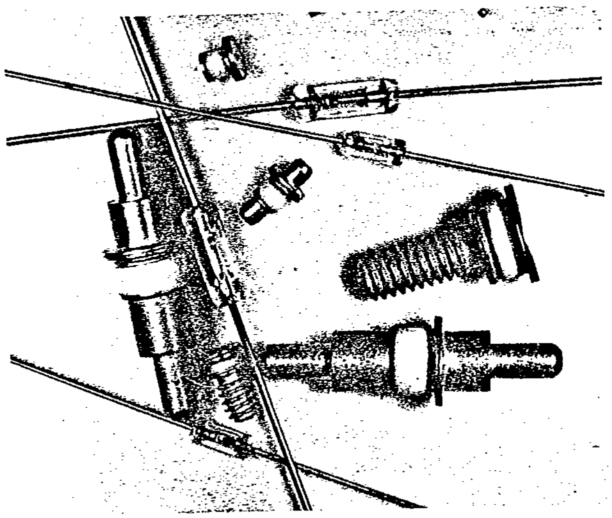
Step Recovery Diodes, Multichip SRD and SRD Chips



Features

- Low Transition Time
- High Cutoff Frequency
- High Reliability

Description

Alpha Step Recovery Diodes (SRD) are oxide passivated, epitaxial silicon mesa designs. Careful attention to diffusion profiles makes these diodes an ideal choice for high order multiplier circuits. They are available in a broad range of packages or in chip form for those who wish to bond SRDs into their own circuits. Also, 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 up-converters (N = 2), while A-Mode multiplier diodes are used on $N \leq 4$ multipliers. The SRD can also be used on $N \leq 4$ multipliers, but its main use is in high order ($N > 4$) multipliers and comb generators where high efficiency is required. Alpha has a complete line of multiplier diodes for each case mentioned above (consult factory).

When an SRD is driven into forward conduction on one half of the RF cycle, the diode stores charge and appears as a low impedance.

On the second half of the cycle, the diode conducts until the stored charge is removed and then switches off very rapidly at a speed governed by the transition time, T_T.

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 of τ and T_T. Test circuits to determine τ and T_T are shown in Figures 4 and 5. For optimum performance an ideal SRD will be a punch-through device at zero volts (any increase in reverse bias above zero volts will not decrease capacitance) but will have a highly non-linear capacitance increase as the diode is forward biased. In actual practice a step recovery diode will not be zero punch-through but will have $C_{J0}/C_{J6} \leq 1.4$. This can be clearly seen in Figure 1. SRDs are highly efficient, and idlers are not needed although, if used, may further increase efficiency. A typical SRD circuit is shown in Figure 6.

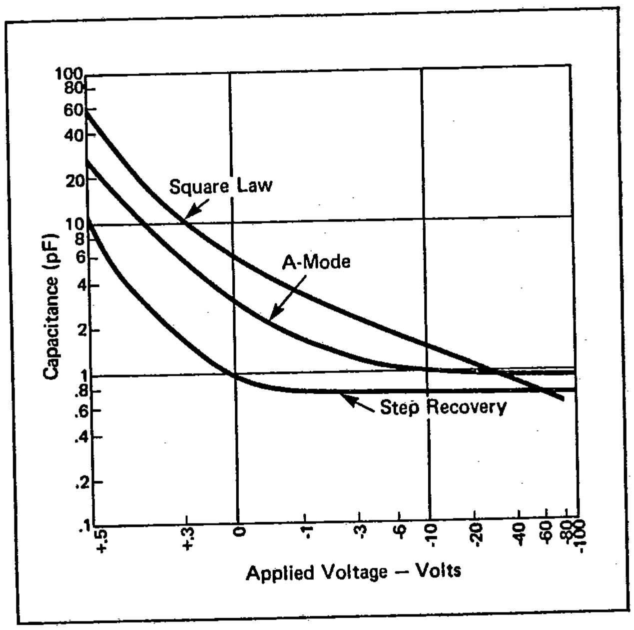


Figure 1. Capacitance vs Applied Voltage for Square Law and A-Mode Multipliers and Step Recovery Diodes

Step Recovery Diodes, Multichip SRD and SRD Chips

When higher microwave power is desired, the normal SRD may not be useable, since the necessary breakdown voltages may be too high for the transition time required. Alpha has solved this problem by using the multichip approach. The use of two chips provides improvement in both average power handling and peak power handling capability. 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 total device area and, hence, in average power handling capability.

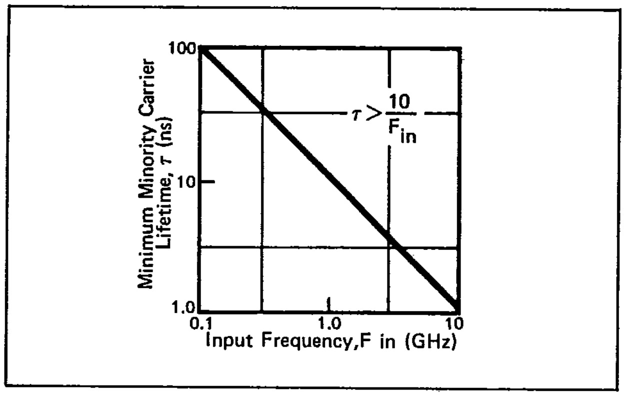


Figure 2. τ vs F in

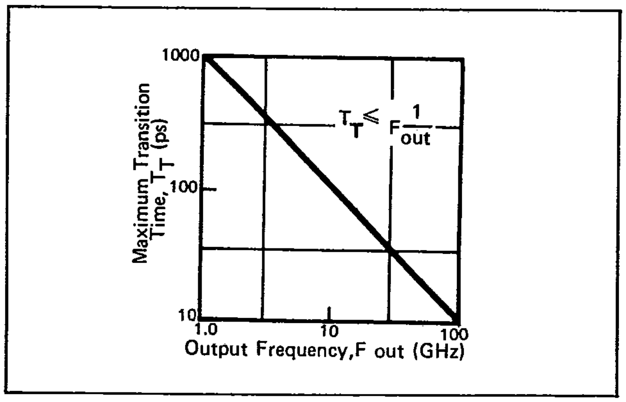


Figure 3. T_T vs F out

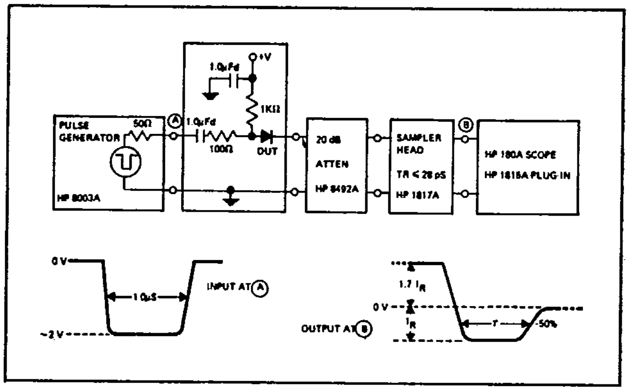


Figure 4. Minority Carrier Lifetime, τ, Test Set-Up

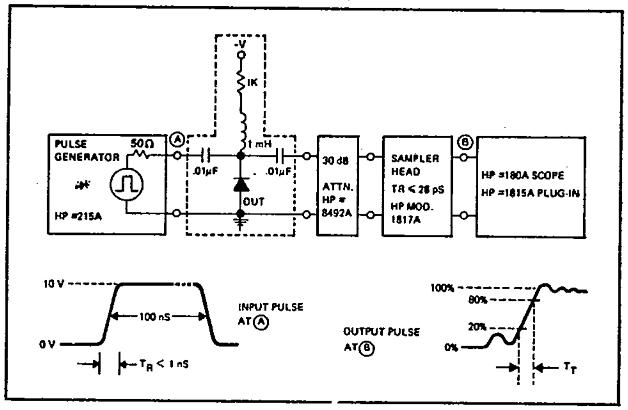


Figure 5. Transition Time, T_T, Test Set-Up

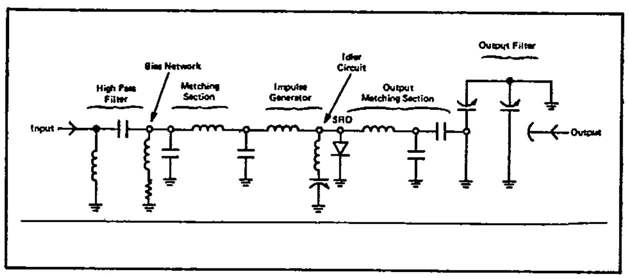


Figure 6. Typical SRD Multiplier

Step Recovery Diodes, Multichip SRD and SRD Chips

Step Recovery Diodes 023-001 Package

Type Number	V_B(1) (Volts) Min.	C_{J-6}(2) (pF)	τ(3) (ns) Min.	T_T(4) (ps) Max.	θ_{Th} (°C/Watt) Typ.	F_{C-6}(5) (GHz) Min.	Typical Input Freq. (GHz)	Typical Output Freq. (GHz)
DVB6100A	15	.25-.50	10	70	60	300	0.5-3.0	9.0-18.0
DVB6100B	15	.50-1.0	10	70	40	300		
DVB6100C	15	1.0-1.5	10	70	30	300		
DVB6101A	30	.25-.50	10	100	60	300	0.5-3.0	5.0-15.0
DVB6101B	30	.50-.75	10	100	45	300		
DVB6101C	30	.75-1.00	10	100	40	300		
DVB6101D	30	1.00-1.25	10	100	35	300		
DVB6101E	30	1.25-1.50	10	100	30	300		
DVB6102A	45	.5-1.0	25	200	50	250	.25-1.5	2.0-7.5
DVB6102B	45	1.0-1.5	25	200	40	250		
DVB6102C	45	1.5-2.0	25	200	30	250		
DVB6102D	45	2.0-3.0	25	200	25	250		
DVB6103A	60	.5-1.0	60	300	30	150	.10-1.0	1.3-4.0
DVB6103B	60	1.0-1.5	60	300	25	150		
DVB6103C	60	1.5-2.0	60	300	20	150		
DVB6103D	60	2.0-3.0	60	300	15	150		
DVB6104A	75	1.5-3.5	100	400	15	125	0.5-.75	.75-3.0
DVB6104B	75	3.5-5.5	100	400	15	125		
DVB6104C	75	5.5-7.5	100	400	10	125		
DVB6104D	75	7.5-10.0	100	400	10	125		

Step Recovery Diode Chips

Type Number	V_B(1) (Volts) Min.	C_{J-6}(2) (pF)	τ(3) (ns) Min.	T_T(4) (ps) Max.	F_{C-6}(5) (GHz) Min.	Typical Input Freq (GHz)	Typical Output Freq (GHz)	Chip Style
CVB1015A	15	0.25-0.50	10	70	300	0.5-3.0	9.0-18.0	150-806
CVB1015B		0.50-1.0						150-801
CVB1015C		1.0-1.5						150-801
CVB1030A	30	0.25-0.50	10	100	300	0.5-3.0	5.0-15.0	150-801
CVB1030B		0.50-1.0						150-801
CVB1030C		1.0-1.5						150-801
CVB1045B	45	0.50-1.0	25	200	250	.25-1.5	2.0-7.5	150-801
CVB1045D		1.0-2.0						150-802
CVB1045E		2.0-3.0						150-802

Notes
1. Measured at I_R = 10 µA
2. Measured at 1 MHz, V_R = 6 volts
3. Measured at I_F = 10 mA, I_R = 6 mA (see Figure 4)
4. Measured at V_R = 10 volts, I_F = 10 mA (see Figure 5)
5. Measured at F = 1 GHz, V_R = 6 volts

Step Recovery Diodes, Multichip SRD and SRD Chips

2 CHIP—023-001 Package

Type Number	(1) V_B (Volts)	(2) C_{J-6} (pF)	(3) τ (ns) Min.	(4) T_T (ps) Max.	θ_{th} (°C/watt) Max.	(5) F_{C-6} (GHz) Min.	Typical Input Freq. (GHz)	Typical Output Freq. (GHz)
DVB6850A		.25-.50			35			
DVB6850B	30	.50-1.0	10	80	25	250	0.5-3.0	9.0-18.0
DVB6850C		1.0-1.5			20			
DVB6851A		.25-.50			35			
DVB6851B	60	.50-1.0	10	100	25	250	0.5-3.0	5.0-15.0
DVB6851C		1.0-1.5			20			
DVB6852A		0.5-1.0			30			
DVB6852B	90	1.0-1.5	25	200	25	225	.25-1.5	2.0-7.5
DVB6852C		1.5-2.0			20			

2 CHIP—017-001 Package

DVB6860A		0.5-1.0			30			
DVB6860B	90	1.0-1.5	25	250	25	225	.25-1.5	2.0-6.0
DVB6860C		1.5-2.0			20			
DVB6861A		0.5-1.0			18			
DVB6861B	120	1.0-1.5	60	350	15	125	0.1-1.0	1.2-4.0
DVB6861C		1.5-2.0			12			
DVB6862A		1.5-3.5			10			
DVB6862B	150	3.5-5.5	100	450	10	100	.05-.75	.75-2.5

3 CHIP—017-001 Package*

DVB6870A		0.5-1.0			20			
DVB6870B	135	1.0-1.5	25	300	15	220	.25-1.5	1.5-5.0
DVB6870C		1.5-2.0			10			
DVB6871A		0.5-1.0			10			
DVB6871B	180	1.0-1.5	60	400	8	120	0.1-1.0	1.0-3.0
DVB6871C		1.5-2.0			6			
DVB6872A		1.5-3.5			7			
DVB6872B	225	3.5-5.5	100	500	6	100	.05-.75	.75-2.0

Notes
1. Measured at I_R = 10 µA
2. Measured at 1 MHz, V_R = 6 volts
3. Measured at I_F = 10 mA, I_R = 6 mA (see Figure 4)
4. Measured at V_R = 10 volts, I_F = 10 mA (see Figure 5)
5. Measured at F = 1 GHz, V_R = 6 volts

*Four chip versions available for some combinations of V_B and C_{J-6}