SILICON MULTIPLIER VARACTORS

The M/A-COM Silicon Products, Inc.'s line of silicon varactor multiplier diodes includes step recovery, DUALMODE™, SUPER DUALMODE™, and BIMODE™ varactors. The DUALMODE™, BIMODE™, and SUPER DUALMODE™ series are used in low-order (N ≤ 4) multiplier applications and in up and down converters where high power and efficiency are required. These devices combine the non-linear reactance properties of conventional C-swing varactors and the stored charge properties of step recovery varactors

HOW TO SELECT SILICON MULTIPLIER VARACTORS FOR HARMONIC GENERATION

When selecting a multiplier diode, the following circuit parameters must be considered:

- Input Frequency
- Output Frequency
- Output Bandwidth
- Output Power
- Circuit Environment (coaxial, stripline, waveguide, etc.)

The choice of varactor type depends on the results required.

Step Recovery Diodes (SRD)

The use of step recovery diodes results in:

- High Efficiency
- Narrow Bandwidth
- Both Low and High Order Multipliers
- Comb Generators

An SRD varactor is an epitaxial diffused device designed to store charge when conducting in the forward direction. Conduction continues for a short time under reverse bias until the stored charge is swept out by the reverse drive. At this point conduction ceases very abruptly. The diode's minority carrier lifetime is a measure of the time the diode will maintain the stored charge and snap time is the speed at which reverse conduction ceases.

In general, SRD varactors have very little capacitance change when reverse biased.

DUALMODE™ or BIMODE™ Diodes

The use of DUALMODE™ or BIMODE™ results in:

- High Output Power
- Low Order (N ≤ 4)
- High Efficiency

C-SWING Varactors

The use of conventional abrupt junction C-swing varactors results in:

- Good Efficiency
- Low Order (N ≤ 4)
- Medium Bandwidth
- Low and Medium Output Power

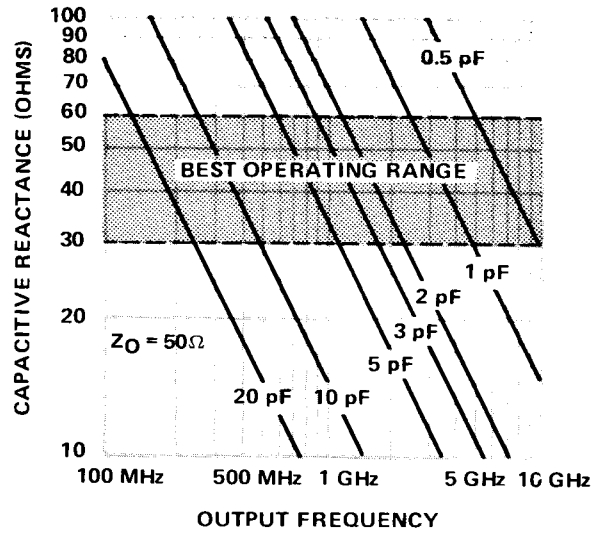
One thing that must be kept in mind is that efficiency, power output and bandwidth are all relative terms and are as much a function of good multiplier design practice as diode selection.

Important Electrical Parameters:

CAPACITANCE (C_T)

The capacitive reactance of the varactor at the operating bias should be a minimum of 30 ohms and preferably a maximum of 60 ohms at the output frequency (if the diode environment is 50 ohms). Special higher power circuits can be used with lower reactances, but efficiency will suffer.

An additional constraint is imposed because this capacitance must be compatible with the required diode thermal impedance. Thermal resistance is inversely proportional to capacitance.



MULTIPLIER VARACTOR CAPACITIVE REACTANCE VS FREQUENCY

MULTIPLIER VARACTORS

PARAMETRIC AMPLIFIER VARACTORS

IMPATT DIODES

CW GUNN DIODES

MICROWAVE TRANSISTORS

GaAs FET's

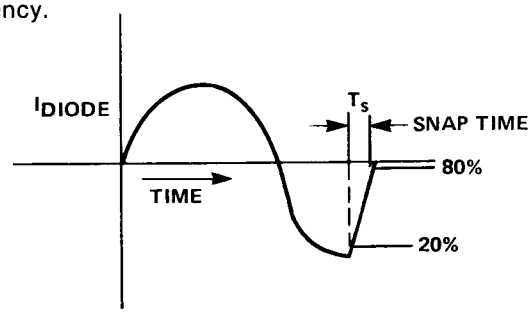
UPCONVERTER DIODES

ATTENUATION DEVICES

HOW TO SELECT SILICON MULTIPLIER VARACTORS FOR HARMONIC GENERATION (CONT'D)

SNAP TIME (T_S)

The snap time or transition time in a stored charge device is the time for the diode to switch from a conducting to a non-conducting state. This is usually measured between the 20% and 80% recovery points. Snap time should be less than a period of the output frequency.



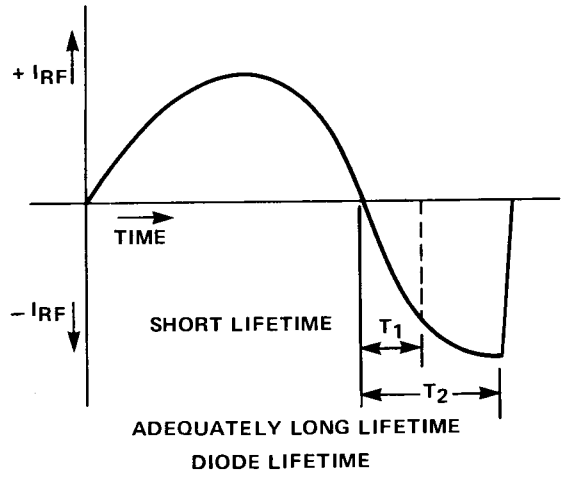
$$T_s < \frac{1}{F_{OUT}}$$

MINORITY CARRIER LIFETIME (T_L)

Lifetime is a measure of the time required for stored charge to be recovered. It should be long enough for the diode to permit RF current to reach a negative peak before it "snaps" back to a high impedance state.

The lifetime of a diode should be a minimum of 10 times the length of a period of the input frequency. i.e.:

$$T_L \geq \frac{10}{F_{IN}} \text{ and } \frac{20 \text{ to } 30}{F_{IN}} \text{ is a better choice.}$$



PACKAGE PARASITICS (L_s, C_p)

The diode package parasitics should be small enough so that the series and parallel resonances will be well above the maximum output frequency. Package parasitics for most common case styles are listed with the outline drawings at the rear of this catalog.

THERMAL RESISTANCE (θ_{jc})

The thermal resistance of the diode must be small enough to allow the diode to remain within the maximum allowable operating temperature. It must be commensurate with the power to be dissipated, i.e:

$$\theta_{jc} = \frac{T_{diode\ max.} - T_A}{P_{Diss.}}$$

where:

θ_{jc} = Thermal Resistance (°C/W)

$T_{diode\ max.}$ = Recommended maximum allowable diode temperature (150°C)

T_A = Heat sink maximum temperature (°C)

$P_{Diss.}$ = Power dissipated in the diode under worst case — (Power in — Power out) (Watts)

BREAKDOWN VOLTAGE (V_B)

The minimum required breakdown voltage of the varactor can be obtained by:

$$V_B = K\sqrt{\frac{2\,Po}{F_{in}\,C_{T-6}}}$$

where:

Po = Power out at F_{out} (Watts)

F_{in} = Input frequency (Hertz)

C_{T-6} = Total Capacitance @ —6 Volts (F)

K = 0.8 for N ≤ 4

K = 1.5 for N > 4

BIAS RESISTOR SELECTION (R_b)

The bias resistor for a SRD, DUALMODE™ or BIMODE™ varactor can be calculated by:

SRD Varactors

$$R_b = \frac{5\,T_L}{N^2\,C_{T-6}}$$

DUALMODE Varactors

$$R_b = \frac{10\,T_L}{N^2\,C_{T-6}}$$

where:

T_L = Lifetime (Seconds)

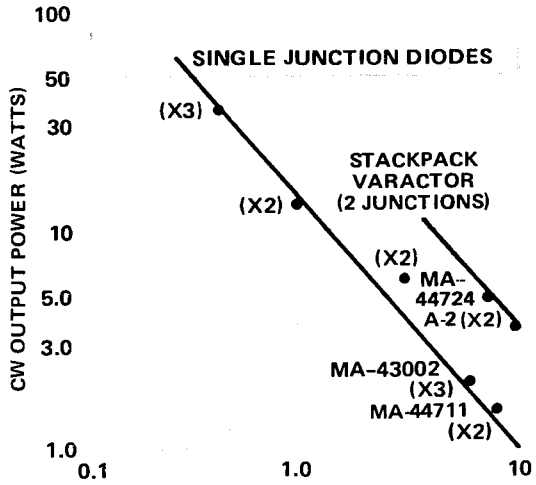
N = Order of Multiplication

C_{T-6} = Total Capacitance @ —6 Volts (F)

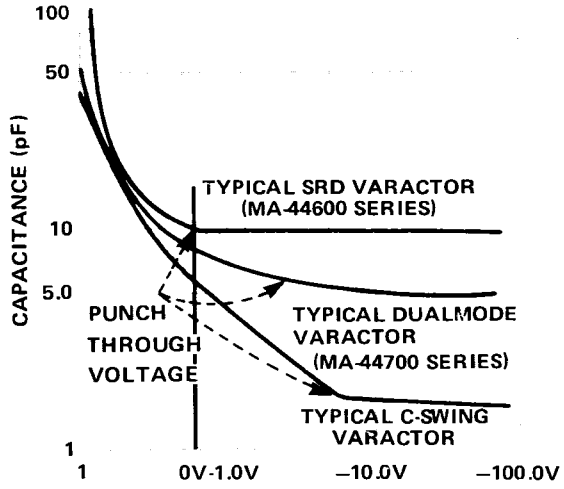
SILICON MULTIPLIER VARACTOR SELECTION GUIDE BY APPLICATION

MULTIPLIER DIODE TYPE	HIGH ORDER MULTIPLIER COMB. GENERATORS (4 OR GREATER)	BROAD-BAND MULTI-PLICATION (x4 MAX.)	HIGH POWER LOW ORDER (x4 MAX.)	HIGH POWER HIGH FREQUENCY	UPCONVERTERS OR DOWN-CONVERTERS	GUARANTEED CIRCUIT PERFORMANCE
STEP RECOVERY	X		X			
DUALMODE™ BIMODE™		X	X		X	
RF CIRCUIT TESTED STEP RECOVERY MA-43000 SERIES	X		X			X
STACKPACK™ AND SUPER STACKPACK™ VARACTOR				X (ABOVE 4 GHz)		

TYPICAL PERFORMANCE FOR SILICON MULTIPLIER VARACTORS



OUTPUT POWER VS FREQUENCY



CAPACITANCE VS BIAS

STEP RECOVERY DIODES (SRD'S)

An SRD varactor is a silicon epitaxial diffused device designed to store charge when conducting in the forward direction. Conduction continues for a short time under reverse bias until the stored charge is swept out by the reverse drive. At this point conduction ceases very abruptly. Lifetime is a measure of the time the diode will maintain the stored charge and snap time (transition time) is the speed at which reverse conduction ceases.

In general, SRD varactors have very little capacitance change when reverse biased.

MODEL NUMBER[1]	MIN. BREAK-DOWN VOLT., V_B[2] (VOLTS)	JUNC. CAP., C_J, RANGE[3] (pF)	MIN. MINOR. CARRIER LIFETIME, T_L 10 mA/6 mA (ns)	TRANSITION (SNAP) TIME, T_S[4] (ps) TYP.	TRANSITION (SNAP) TIME, T_S[4] (ps) MAX.
MA-44611A	10	0.26-0.42	5	30	100
MA-44611B	10	0.42-0.58	5	30	100
MA-44611C	10	0.58-1.60	5	30	100
MA-44611D	10	1.60 & UP	5	30	100
MA-44612A	10	0.26-0.42	5	150	200
MA-44612B	10	0.42-0.58	5	150	200
MA-44612C	10	0.58-1.60	5	150	200
MA-44612D	10	1.60 & UP	5	150	200
MA-44621A	20	0.26-0.42	7	50	100
MA-44621B	20	0.42-0.58	7	50	100
MA-44621C	20	0.58-1.60	7	50	100
MA-44621D	20	1.60 & UP	7	50	100
MA-44622A	20	0.26-0.42	7	150	200
MA-44622B	20	0.42-0.58	7	150	200
MA-44622C	20	0.58-1.60	7	150	200
MA-44622D	20	1.60 & UP	7	150	200
MA-44631A	30	0.26-0.42	8	70	100
MA-44631B	30	0.42-0.58	8	70	100
MA-44631C	30	0.58-1.60	8	70	100
MA-44631D	30	1.60 & UP	8	70	100
MA-44632A	30	0.26-0.42	8	150	200
MA-44632B	30	0.42-0.58	8	150	200
MA-44632C	30	0.58-1.60	8	150	200
MA-44632D	30	1.60 & UP	8	150	200
MA-44641A	40	0.26-0.42	12	90	120
MA-44641B	40	0.42-0.58	12	90	120
MA-44641C	40	0.58-1.60	12	90	120
MA-44641D	40	1.60 & UP	12	90	120

See notes on page 65.

STEP RECOVERY DIODES SRD'S (CONT'D)

MODEL NUMBER[1]	MIN. BREAK-DOWN VOLT., V_B[2] (VOLTS)	JUNC. CAP., C_J RANGE[3] (pF)	MIN. MINOR. CARRIER LIFETIME, T_L 10 mA/6 mA (ns)	TRANSITION (SNAP) TIME, T_S[4] (ps)	
				TYP.	MAX.
MA-44642A	40	0.26-0.42	12	150	200
MA-44642B	40	0.42-0.58	12	150	200
MA-44642C	40	0.58-1.60	12	150	200
MA-44642D	40	1.60 & UP	12	150	200
MA-44643A	40	0.26-0.42	12	250	300
MA-44643B	40	0.42-0.58	12	250	300
MA-44643C	40	0.58-1.60	12	250	300
MA-44643D	40	1.60 & UP	12	250	300
MA-44652A	50	0.26-0.42	15	150	200
MA-44652B	50	0.42-0.58	15	150	200
MA-44652C	50	0.58-1.60	15	150	200
MA-44652D	50	1.60 & UP	15	150	200
MA-44653A	50	0.26-0.42	15	250	300
MA-44653B	50	0.42-0.58	15	250	300
MA-44653C	50	0.58-1.60	15	250	300
MA-44653D	50	1.60 & UP	15	250	300
MA-44663A	60	0.26-0.42	20	250	300
MA-44663B	60	0.42-0.58	20	250	300
MA-44663C	60	0.58-1.60	20	250	300
MA-44663D	60	1.60 & UP	20	250	300

NOTES:

1. When ordering add a suffix to the basic model number to denote the case style desired. Case styles 30, 31, 91 and 113 are available for this diode series.

CASE STYLE	PACK. DESC.
30	Ceramic Metal Pronged
31	Ceramic Metal Cap
91	Ceramic Metal Prong
113	Ceramic Metal Prong

2. Breakdown voltage (V_B) is measured at a reverse bias current of 10 μA.

3. Junction capacitance is measured at a reverse voltage of 6 volts and a frequency of 1 MHz.

4. Transition time is measured between 20% and 80% points on the voltage recovery trace. These values are guaranteed for the A and B capacitance ranges only. Test conditions are + 10 mA and −10 V.

CIRCUIT TESTED STEP RECOVERY DIODES

MODEL NUMBER	STD. CASE STYLE[1]	MIN. OUTPUT PWR. (WATTS)	INPUT FREQ. (GHz)	OUTPUT FREQ. (GHz)	MAX. INPUT PWR. (WATTS)	BREAKDOWN VOLT., V_B[2] RANGE (VOLTS)	JUNC. CAP., C_J[3] RANGE (pF)	MINOR. CARRIER LIFETIME, T_L RANGE 10mA/6mA (ns)	MAX. SNAP TIME, T_S —10 V/ 10 mA (ps)	MAX. THERMAL RESIST., θ_{jc} (°C/W)
MA-4B300	43	8.0	0.4	2.0	30	100—145	5.0 —8.0	300—800	750	7
MA-43000	103	4.0	0.333	2.0	15	85—105	3.0 —4.5	250—500	600	12
MA-43002	91	1.5	2.0	6.0	5	45— 70	1.6 —2.4	75—225	250	25
MA-43004	91	0.3	3.3	13.0	2	30— 45	0.45—0.85	20— 50	150	45

NOTE:

1. A summary of the packages available for this series:

CASE STYLE	PACK. DESC.
43	Ceramic Metal Stud
91	Ceramic Metal Prong
103	Ceramic Metal Stud

When ordering, add a suffix to the basic model number that corresponds to the desired case style. Other case styles are available on request. Please consult factory for additional information.

2. Breakdown voltage is measured at a reverse bias current of 10μA.
3. Junction capacitance is measured at a reverse bias voltage of 6 volts and a frequency of 1 MHz.

HIGH ORDER SNAP VARACTORS FOR USE IN COMB GENERATION

MODEL NUMBER	STD. CASE STYLE[1]	SUGGEST. OUTPUT FREQ.[2] (GHz)	MAX. INPUT PWR. (WATTS)	BREAKDOWN VOLT., V_B[3] RANGE (VOLTS)	JUNC. CAP., C_J[4] RANGE (pF)	MINOR. CARRIER LIFETIME, T_L RANGE 10mA/6mA (ns)	MAX. SNAP TIME, T_S —10 V/ 10 mA (ps)	MAX. THERMAL RESIST., θ_{jc} (°C/W)
MA-43592[1]	30	1-12	1.0	25—40	0.2—0.3	9—27	90	70
MA-43543[2]	93	1-20	1.5	20—50	0.2—0.55	10—25	60	125

NOTES:

1. When ordering, specify the desired case style as a suffix to the basic model number. Both case styles 30 and 93 are axial pronged ceramic enclosures. Other case styles are available on request. Please consult factory for additional information.
2. This is an operable output frequency range and does not imply instantaneous bandwidth.
3. Breakdown voltage is measured at a reverse bias voltage of 10 μA.
4. Junction capacitance is measured at a reverse bias voltage of 6 volts and a frequency of 1 MHz.

DUALMODE™ AND BIMODE™ VARACTORS

The DUALMODE™ varactor is designed for low order broadband (10-20%) multipliers (times 2 to times 4). It also works well in low order, high power, narrow band multipliers but, is not recommended for high order multiplier applications. These diodes differ principally from the SRD diode in that they have a capacitance change of approximately 1.5:1 between zero bias and —6 volts. In general, however, the large signal series resistance at a few volts is somewhat lower than that of an SRD diode.

Selection of DUALMODE™ diodes should be made in the same manner as the SRD except that the bias resistor is approximately double that used with a similar SRD varactor at the same multiplication factor. SRD and DUALMODE™ varactors usually are not interchangeable in the same circuit because of their different large signal impedances. In general, DUALMODE™ varactors require idler circuits for maximum efficiency while SRD diodes do not.

MODEL NUMBER[1]	STD. CASE STYLE	MIN. BREAK-DOWN VOLT., V_B[2] (VOLTS)	JUNC. CAP., C_J[3] (pF)	MIN. CUT-OFF FREQ.[4] (GHz)/ MAX. SERIES RESIST. (OHMS)	TYP. MINOR. CARRIER LIFE-TIME, T_L 10 mA/ 6 mA (ns)	MAX. TRANS. TIME, T_S —10 V/ 10 mA (ps)	OUT-PUT FREQ. RANGE[5] (GHz)	TYP. X 3 EFF.[6] (%)	TYP. AVAIL. OUT-PUT PWR.[7] (WATTS)	MAX. THERMAL RESIST., θ_{jc} (°C/W)
MA-44700	56	200	18.0—26	0.35Ω	450	10000	0.3 —0.75	70	3.0—20	3
MA-44710	56	175	18.0—26	0.35Ω	400	8000	0.5 —1.0	65	2.0—24	3
MA-44720	56	150	10.0—20	40 GHz	350	5000	0.6 —1.2	60	2.0—16	5
MA-44701	56	120	8.0—10	60 GHz	210	3000	0.75—1.5	60	1.0—10	7
MA-44711	56	100	8.0—10	60 GHz	180	2000	1.0 —2.5	65	1.0—10	7
MA-44712	56	100	4.0—5	90 GHz	170	2000	2.0 —4.0	55	1.0— 6	11
MA-44702	30	80	4.0—5	90 GHz	200	3000	1.5 —3.0	55	1.0— 8	10
MA-44722	30	80	4.0—6	110 GHz	180	925	2.0	—	2.0	—
MA-44703	30	80	2.5—3.5	120 GHz	100	1000	3.0 —5.0	50	0.5—4 0	13
MA-44704	30	80	1.5—2.5	150 GHz	60	750	5.0 —7.0	45	0.5—2.5	15
MA-44714	30	60	1.5 —2.5	150 GHz	60	400	5.0—8.0	45	0.3 —1.5	15
MA-44725	30	40	1.0 —1.5	160 GHz	20	150	5.0—8.0	50	2.5	25
MA-44705	30	40	0.5 —0.7	175 GHz	18	150	8.0—12.0	40	0.1 —0.6	50
MA-44706	30	30	0.3 —0.5	200 GHz	10	100	12.0—15.0	30	0.05—0.3	75
MA-44707	92	6	0.15—0.2	350 GHz	3	—	15.0—25.0	15	0.05	300

NOTES:

1. When ordering , specify case style by using the suffix 30, 56 or 92. Each of these case styles is an axial pronged ceramic package. Other case styles are available on request. Contact factory for additional information.
2. Breakdown voltage is measured at a reverse bias current of 10 μA.
3. Junction capacitance is measured at —6 volts and a frequency of 1 MHz.
4. Cutoff frequency measurements are calculated at —6 volts from R_S measurements made at 1 GHz and capacitance measurements made at 1 MHz.
5. This is an operable output frequency range, and not imply an instantaneous bandwidth.
6. Typical values at midpoint of specified frequency range. DUALMODE™ diodes can operate at full efficiency over a broad range of drive power.
7. These are typical values for use as guidelines in circuit design. These diodes are specifically designed for multiplication orders of x2 — x4.

SUPER DUALMODE™ DIODES (For higher output power)

MODEL NUMBER[1]	STD. CASE STYLE	MIN. BREAK-DOWN VOLT., V_B[2] (VOLTS)	JUNC. CAP., C_J RANGE[3] (pF)	MIN. CUT-OFF FREQ. (GHz)/ MAX. SERIES RESIST.[4] (OHMS)	TYP. MINOR. CARRIER LIFE-TIME, T_L 10 mA/ 6 mA (ns)	MAX. TRANS. TIME, T_S —10V/ 10mA (ps)	OUT-PUT FREQ. RANGE[5] (GHz)	TYP. X 3 EFF.[6] (%)	TYP. AVAIL. OUT-PUT PWR.[7] (WATTS)	MAX. THERMAL RESIST., θ_{jc} (°C/W)
MA-44710A	56	140	18.0—26.0	0.30Ω	450	5000	0.5— 1.0	65	40	5
MA-44711A	56	80	8.0—10.0	60 GHz	160	2000	1.0— 2.5	65	24	9
MA-44712A	56	80	4.0— 5.0	90 GHz	130	2000	2.0— 4.0	55	10	12
MA-44713A	56	60	2.5— 3.5	140 GHz	60	700	3.0— 5.0	50	6	15
MA-47714A	30	60	1.5— 2.5	140 GHz	60	500	5.0— 8.0	50	4	17
MA-44724A	30	45	1.0— 1.5	160 GHz	30	300	7.0—10.0	50	2.5	27

NOTES:

1. When ordering, specify the desired case style by using the suffix 30 or 128 along with the basic model number. These two case styles are axial pronged ceramic packages. Other case styles are available on request. Contact factory for additional information.
2. Breakdown voltage is measured at a reverse bias current of 10 μA.
3. Capacitance is measured at 1 MHz and —6 volts. **The nominal tolerance is ± 10%, but** tolerances of ± 3% are available on request.
4. R_S is measured at 1 GHz. Cutoff frequency is calculated at —6 volts from R_S measurements at 1 GHz and capacitance measurements of 1 MHz.
5. This is an operable output frequency range and does not imply instantaneous bandwidth.
7. These are typical values at midpoint of the specified frequency range. SUPER DUALMODE™ diodes can operate at full efficiency over a broad range of drive power.
6. These are typical values for use as guidelines in circuit design. These diodes are specifically designed for multiplication orders of x2 — x4.

STACKPACK™ AND SUPER-STACKPACK™ DIODES

Up to 60 watts CW can be delivered by M/A-COM Silicon Products, Inc.'s SUPER-STACKPACK™ diodes. Both STACKPACK™ and SUPER-STACKPACK™ series diodes consist of high efficiency BIMODE™ diode chips combined in a series stacked configuration. STACKPACK™ diodes contain two chips, whereas SUPER-STACKPACK™ diodes contain three chips. In both families each diode chip is individually housed and the multiple packages are then soldered into a single unit connected electrically in series and thermally in parallel. Power handling capability is substantially greater than that of a single diode because the breakdown voltage of the series chips is additive.

These devices are designed for frequency multiplication, up and down conversion and modulation applications in telemetry and point-to-point microwave transmission systems where high power and efficiency are required. Since these diodes combine the advantage of fast transition time and high breakdown voltage, they are particularly well suited for high-power step-recovery multiplier applications.

STACKPACK™ (2 CHIP DIODES)

MODEL NUMBER[1]	STD. CASE STYLE	MIN. BREAK-DOWN VOLT., V_B[2] (VOLTS)	JUNC. CAP., C_J[3] RANGE (pF)	MIN. CUT-OFF FREQ. (GHz)/ MAX. SERIES RESIST.[4] (OHMS)	TYP. MINOR. CARRIER LIFE-TIME, T_L 10mA/6mA (ns)	MAX. TRANS. TIME, T_S —10V/ 10mA (ps)	OUT-PUT FREQ. RANGE[5] (GHz)	TYP. X 3 EFF.[6] (%)	TYP. AVAIL. OUT-PUT PWR. (WATTS)	MAX. THERMAL RESIST., θ_{jc}[7] (°C/W)
MA-44710A-2	242	280	18.0—26.0	0.40Ω	450	6,000	0.5— 1.0	60	60	3
MA-44711A-2	242	160	8.0—10.0	50 GHz	160	2,000	1.0— 2.5	65	35	7
MA-44712A-2	242	160	4.0— 4.5	70 GHz	130	2,000	2.0— 4.0	55	20	11
MA-44713A-2	242	120	2.5— 3.5	120 GHz	60	700	3.0— 5.0	50	10	13
MA-44714A-2	242	120	1.5— 2.5	120 GHz	60	500	5.0— 8.0	50	7.0	15
MA-44725A-2	250	80	1.0— 1.5	145 GHz	20	180	5.0— 8.0	45	4.0	25
MA-44715A-2	250	120	1.0— 1.5	140 GHz	50	700	5.5— 9.0	50	6.0	18
MA-44716A-2	250	90	0.8— 1.3	150 GHz	30	300	7.0— 9.0	45	5.0	22
MA-44724A-2	250	90	1.0— 1.5	145 GHz	30	300	7.0—10.0	45	5.0	20
MA-44705A-2	250	80	0.5— 0.7	160 GHz	18	180	8.0—12.0	38	2.0	40
MA-44706A-2	250	60	0.3— 0.5	180 GHz	10	120	9.0—13.0	50[8]	2.0[8]	50

See notes on page 70.

SUPER-STACKPACK™ (3 CHIP DIODES)

MODEL NUMBER[1]	STD. CASE STYLE	MIN. BREAK-DOWN VOLT., V_B[2] (VOLTS)	JUNC. CAP., C_J[9] RANGE (pF)	MIN. CUT-OFF FREQ.[4] (GHz)	TYP. MINOR. CARRIER LIFE-TIME, T_L 10mA/6mA (ns)	MAX. TRANS. TIME, T_S —10V/ 10mA (ps)	OUT-PUT FREQ. RANGE[5] (GHz)	TYP. X 3 EFF.[6] (%)	TYP. AVAIL. OUT-PUT PWR. (WATTS)	MAX. THERMAL RESIST., θ_{jc}[7] (°C/W)
MA-44711A-3	243	240	8.0—10.0	50	160	2,000	1.0—2.5	65	50	6
MA-44712A-3	243	240	4.0— 5.0	70	130	2,000	2.0—4.0	55	30	10
MA-44713A-3	243	180	1.5— 2.5	120	60	700	3.0—5.0	50	15	11
MA-44714A-3	243	180	1.5— 2.5	120	60	500	5.0—8.0	50	10	13
MA-44715A-3	247	180	1.0— 1.5	140	50	400	5.5—9.0	50	8	16
MA-44716A-3	247	135	0.8— 1.3	150	30	300	7.0—9.0	45	7	19

See notes on page 70.

NOTES:

1. When ordering, specify the case style desired by adding the case style number as a suffix to the type number. (Example: MA-44711A-3-243.) Case styles 242, 243, 247 and 250 are axial pronged ceramic-metal packages. Other case styles can be furnished upon request. Consult the factory for additional information.
2. Breakdown voltage is specified at a reverse current of 10 μA.
3. Junction capacitance is specified at —12 volts bias and measured at a frequency of 1 MHz. Capacitance tolerance is nominally ± 10%. Tolerances of ± 5% are available on request.
4. R_S is measured at 1 GHz. Cutoff frequency is calculated from R_S measurements at 1 GHz and capacitance measurements at —18 volts at a frequency of 1 MHz.
5. This is an operable output frequency range and does not imply instantaneous bandwidth.
6. These are typical values at the midpoint of the specified frequency range. STACKPACK™ diodes and SUPER-STACKPACK™ diodes can be operated at full efficiency over a broad range of drive power.
7. Thermal resistance is specified with heat sink on cathode end only.
8. Typical power output and efficiency for the MA-44706A-2 are specified in a x2 multiplier.
9. Junction capacitance is specified at —18 volts bias and measured at a frequency of 1 MHz. Capacitance tolerance is nominally ± 10%. Tolerances of ± 5% are available on request.

HIGH POWER SILICON MULTIPLIER DIODES

The MA-44750 series of multiplier diodes delivers as much as 60 watts below 1 GHz, 10 watts from 3 to 5 GHz, 8 watts between 5 and 8 GHz and is capable of operation up to 15 GHz. Typical efficiencies range from 1/N to 2/N where N is the multiplication factor.

These diodes feature a high temperature thermal oxide passivation grown on mesa chips. Gold leads are bonded to the chips using the latest thermocompression bonding techniques.

All packages are hermetically sealed, making these diodes capable of meeting the most stringent of mechanical and environmental requirements. Screening techniques provide the various levels of reliability required to meet a wide range of special customer needs.

MODEL NUMBER[1]	CASE STYLE	OUTPUT FREQ. RANGE[2] (GHz)	TYP. OUT. PUT PWR.[3,4] (WATTS)	MIN. BREAKDOWN VOLT., V_B[5] (VOLTS)	JUNC. CAP., C_J[6] (pF)	TYP. MINOR. CARRIER LIFETIME, T_L 10mA/6mA (ns)	MAX. TRANS. TIME, T_S —10V/10mA (ps)	MAX. THERMAL RESIST., θ_{jc} (°C/W)	TYP. X 3 EFF.[7] (%)
MA-44750	56	0.5— 1	60	180	8.0—12.0	200	800	3	65
MA-44751	56	1 — 3	20	160	5.0— 8.0	150	600	8	60
MA-44752	56	3 — 5	10	120	3.0— 5.0	100	400	10	55
MA-44753	30	5 — 8	8	100	1.5— 3.0	60	250	8	50
MA-44754	30	6 — 9	6	80	1.0— 1.5	30	200	15	45
MA-44755	30	5 — 8	5	70	1.0— 1.5	20	150	20	45
MA-44756	30	8 —12	3	60	0.5— 1.0	18	100	25	40
MA-44757	30	10 —15	2	50	0.3— 0.5	10	80	30	50[8]

See notes on pg. 71

NOTES:

1. When ordering, specify the case style desired by adding the case style number as a suffix. (Example: MA-44752-56.) Both case styles 30 and 56 are ceramic-to-metal axial pronged enclosures.

   Other case styles are available upon request. Contact the factory for further information.

2. Operable range, *not* instantaneous bandwidth.

3. Characteristic values are based on performance tests and include circuit losses amounting to about 1.5 dB. These figures may change without notice as a result of additional data or product refinement. For special circuits, factors other than the diode may cause variations from the values shown. Contact M/A-COM Silicon Products, Inc. before using this information for equipment design.

4. Typical values at the midpoint of the specified frequency range. The MA-44750 series of diodes can be operated at full efficiency over a broad range of drive power.

5. Breakdown voltage is measured at a reverse current of 10 μA.

6. Junction capacitance is measured at 1 MHz and —6 volts. The normal tolerance is ± 10%, but ±3% control is available.

7. Typical values at the midpoint of the specified frequency range for use as guidelines in circuit design. These diodes can be used for multiplication orders from 2 to 6.

8. The efficiency of the MA-44757 is specified in a x2 multiplier.

SILICON MULTI-CHIP PULSED MULTIPLIER VARACTORS

The MA-44950 series of pulsed silicon multi-chip varactors employs a passivated epitaxial mesa design. These devices are ideally suited for low order multiplier circuits in applications such as marine and aircraft radar and other high power, high reliability environments. Each device is housed in case style 141, a metal-ceramic package with a threaded stud.

MODEL NUMBER	TYP. OUTPUT FREQ. RANGE (GHz)	TYP. X2 EFF. (%)	MIN. BREAKDOWN VOLT., V_B[1] (VOLTS)	TOTAL CAP., C_T[2] (pF)	MAX. LEAKAGE CURRENT[3] (na)	TYP. PEAK OUTPUT PWR.[4] (WATTS)
MA-44951	1— 2	50	400	6.0—7.0	20	175
MA-44952	2— 3	50	400	5.0—6.0	20	150
MA-44953	3— 4	48	400	4.0—5.0	20	125
MA-44954	4— 5	44	400	3.0—4.0	20	100
MA-44955	5— 6	40	300	2.5—3.0	20	—
MA-44956	6— 7	39	300	—	20	60
MA-44957	7— 8	38	300	2.0—2.5	20	50
MA-44958	8— 9	35	300	1.5—2.0	20	45
MA-44959	9—10	30	300	1.0—1.5	20	40

NOTES:

1. Breakdown voltage is measured at a reverse current of 10 μA.

2. Capacitance is measured at a reverse bias level of 200 volts and at a frequency of 1 MHz.

3. Leakage current is specified at a reverse bias voltage of 200 volts.

4. Pulse length is between 10 and 40 μs with a duty cycle of .001%.

GALLIUM ARSENIDE MULTIPLIER VARACTORS

The MA-48700[1] series of gallium arsenide multiplier diodes is a family of grown junction epitaxial devices. Their guaranteed reproducibility assures a constantly reliable product. All varactors in this series are available in a choice of 15 different case assemblies and in chip form. The cathode is the heat sink end of the package.

This series is specifically designed to provide single-stage, high-order multiplication at output frequencies ranging from 3 to 80 GHz. These diodes are intended for medium power harmonic generation with high conversion efficiency. For additional characterization information, see notes 4, 5, 6, 7 and 8 on page 73.

MIN. F_{C0}[2] (GHz)	C_{J_0} RANGE[3] (pF) 0.150 — 0.199	0.200 — 0.249	0.250 — 0.299	.300 — .349	0.350 — 0.399
100	MA-48701A	MA-48702A	MA-48703A	MA-48704A	MA-49705A
125	MA-48701B	MA-48702B	MA-48703B	MA-48704B	MA-49705B
150	MA-48701C	MA-48702C	MA-48703C	MA-48704C	MA-49705C
175	MA-48701D	MA-48702D	MA-48703D	MA-48704D	MA-49705D
200	MA-48701E	MA-48702E	MA-48703E	MA-48704E	MA-49705E
225	MA-48701F	MA-48702F	MA-48703F	MA-48704F	MA-49705F
250	MA-48701G	MA-48702G	MA-48703G	MA-48704G	MA-49705G
275	MA-48701H	MA-48702H	MA-48703H	MA-48704H	—
300	MA-48701I	MA-48702I	MA-48703I	—	—
325	MA-48701J	MA-48702J	—	—	—
350	MA-48701K	MA-48702K	—	—	—

MIN. F_{C0}[2] (GHz)	C_{J_0} RANGE[3] (pF) 0.400 — 0.449	0.450 — 0.499	0.500 — 0.549	0.550 — 0.599	0.600 — 0.649	0.650 — 0.699
100	MA-48706A	MA-48707A	MA-48708A	MA-48709A	MA-48710A	MA-48711A
125	MA-48706B	MA-48707B	MA-48708B	MA-48709B	MA-48710B	MA-48711B
150	MA-48706C	MA-48707C	MA-48708C	MA-48709C	MA-48710C	MA-48711C
175	MA-48706D	MA-48707D	MA-48708D	MA-48709D	MA-48710D	MA-48711D
200	MA-48706E	MA-48707E	MA-48708E	MA-48709E	MA-48710E	MA-48711E
225	MA-48706F	MA-48707F	—	—	—	—

NOTES:

1. The standard package for this series is case style 30. However, all GaAs multiplier varactors are available in a variety of case styles listed to the right as well as in chip form. When ordering, specify the desired case by adding the case designation as a suffix to the type number.

CASE STYLE	PACK. DESC.
30	Ceramic-Metal Double Pronged
31	Ceramic-Metal CAP
32	Ceramic-Metal CAP
36	Ceramic-Metal Single Pronged
91	Ceramic-Metal Single Pronged
92	Ceramic-Metal Double Pronged
94	Ceramic-Metal CAP
95	Ceramic-Metal Single Pronged
126	Ceramic-Metal CAP
128	Ceramic-Metal Single Pronged
155	Ceramic-Metal Single Pronged
156	Ceramic-Metal Double Pronged
157	Ceramic-Metal Single Pronged
159	Ceramic-Metal Double Pronged
168	Ceramic-Metal Double Pronged