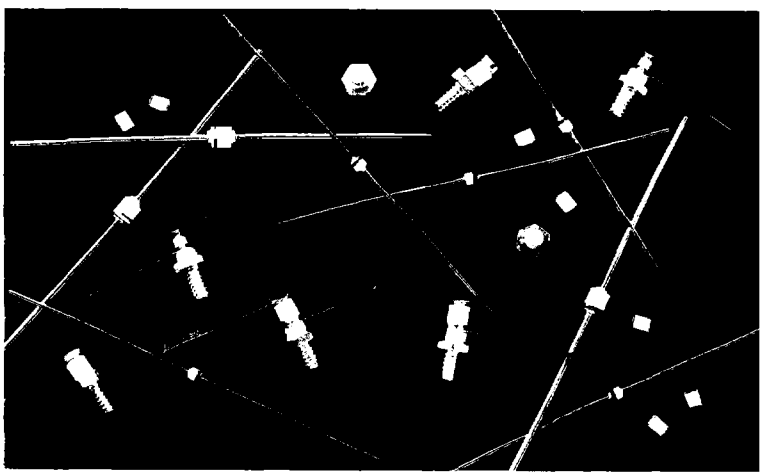
High Power PIN Diodes

MA4P4000, MA4P4300, MA4P7000
MA4P7100, MA4P1200, MA4P1250

NEW

Features

- High Power Handling
- Low Loss, Low Distortion
- Voltage Ratings to 1000 Volts
- Passivated PIN Chip – Full Face Bonded
- Hermetically Sealed
- Low Inductance Axial Lead, Stud and Surface Mount Package Options
- Available as chips



Description

M/A-COM's HIPAX™PIN diodes are designed for service in switch and attenuator applications requiring high power handling and low distortion. HIPAX PIN diodes incorporate a fully passivated PIN diode chip resulting in extremely low reverse leakage current. ALL HIGH VOLTAGE HIPAX™PIN DIODES ARE SPECIFIED AT 1 μA REVERSE CURRENT AT THE VOLTAGE RATING. The chip is full face bonded to refractory metal pins on both anode and cathode. The result is a low loss PIN diode with low thermal resistance due to symmetrical thermal paths.

HIPAX™PIN diodes are packaged in hermetically sealed ceramic enclosures at temperatures exceeding 300°C. Package options include: axial leaded, grounded stud, insulated stud and a surface mount package that has a square, non-rollable outline.

The semiconductor technology utilized in the HIPAX family draws on M/A-COM's substantial experience in PIN diode design. This results in thick intrinsic region PIN diodes specified with low resistance, low capacitance and long carrier lifetime parameters.

SMQ Square Outline Surface Mount

The surface mount HIPAX PIN diode is available in M/A-COM's unique, square outline, non-rollable SMQ package design. This part is available in package style F and as the MA4P1250. The SMQ package eases automatic pick and place indexing and assembly.

Applications

HIPAX PIN diodes are designed for use in a wide variety of switch and attenuator applications from HF through UHF at power levels beyond 1 kW CW. These diodes have been comprehensively characterized to ensure predictable performance.

Design Recommendations

1. 1 kW CW Switches: MA4P4010C, MA4P4010D
2. Low Distortion Attenuators: MA4P4301B
3. Surface Mount Switches: MA4P7101F
4. Cellular Radio Antenna Switches: MA4P1200, MA4P1250
5. High Power Hybrid Integrated Circuit MA4010H

Environmental Capability

HIPAX PIN diodes are appropriate for use in military, industrial and commercial applications. They are capable of meeting the environmental requirements of MIL-STD-750 and MIL-STD-202. HIPAX™PIN DIODES ARE CAPABLE OF HTRB SCREENING AT 80% OF VOLTAGE RATING AT 150°C.

Voltage Ratings and Model Numbers

Voltage Rating	MA4P4000 Series	MA4P4300 Series	MA4P7000 Series	MA4P7100 Series
100 Volts	MA4P4001	MA4P4301	MA4P7001	MA4P7101
200 Volts	MA4P4002	MA4P4302	MA4P7002	MA4P7102
400 Volts				MA4P7104
600 Volts	MA4P4006	MA4P4306	MA4P7006	
800 Volts				MA4P7108
1000 Volts	MA4P4010	MA4P4310	MA4P7010	

Maximum Ratings

DC Reverse Voltage	Voltage Rating
Operating and Storage Temperature	−65°C to +175°C
Installation Temperature	250°C, 30 Seconds

Electrical Specifications @ 25°C

Parameter	Symbol	Condition	MA4P4000 Series	MA4P4300 Series	MA4P7000 Series	MA4P7100 Series
Series Resistance (Max)	R_S	100 mA, 100 MHz	0.5 Ω	1.0 Ω	0.8 Ω	0.5 Ω
Total Capacitance (Max)	C_T	100 V, 1 MHz	2.2 pF	2.0 pF	0.7 pF	1.0 pF
Parallel Resistance (Min)	R_P	100 V, 100 MHz	20 kΩ	50 kΩ	200 kΩ	100 kΩ
Carrier Lifetime (Min)	T_L	10 mA	6 μs	8 μs	3 μs	2.5 μs
Forward Voltage (Max)	V_F	100 mA	1.0 V	1.2 V	1.0 V	1.0 V
Reverse Current (Max)	I_R	Voltage Rating	1 μA	1 μA	1 μA	1 μA
I-Region Width (Nominal)	W		175 μm	300 μm	175 μm	100 μm

Power Dissipation and Thermal Resistance Ratings

Package Style	Condition	MA4P4000		MA4P4300		MA4P7000		MA4P7100	
		P_D	θ_{JC}	P_D	θ_{JC}	P_D	θ_{JC}	P_D	θ_{JC}
B (Axial Leaded)	¼ Inch Total Length to 25°C Free Air Rating	12 W 2.5 W	12.5°C/W	10 W 2.5 W	15°C/W	5 W 1.5 W	30°C/W	6 W 1.5 W	25°C/W
C*, CR** (Stud)	25°C Stud	20 W	7.5°C/W	15 W	10°C/W	7.5 W	20°C/W	7.5 W	20°C/W
D*, DR** (Insulated Stud)	25°C Stud	15 W	10°C/W	12 W	12.5°C/W	6.7 W	22.5°C/W	6.7 W	22.5°C/W
F (SMQ Surface Mount)	25°C Contacts	7.5 W	20°C/W	5 W	30°C/W	3 W	50°C/W	3 W	50°C/W
H (Chip)	25°C Contact	20 W	7.5°C/W	15 W	10°C/W	7.5 W	20°C/W	7.5 W	20°C/W
All	Single 1 μs pulse	100 kW		100 kW		15 kW		15 kW	
All	Single 100 μs pulse	5 kW	.03°C/W	5 kW	.03°C/W	300 W	0.5°C/W	300 W	0.5°C/W

* C, D — Cathode Heat Sink
** CR, DR — Anode Heat Sink

Environmental Ratings

HIPAX PIN diodes may be supplied with JAN TX level screening. The table lists some of the MIL-STD-750 environmental tests HIPAX PIN diodes are designed to meet.

Test	MIL-STD-750 Method	Description
High Temperature Storage	1031	175°C, 250 Hours
Temperature Shock	1051	−65°C to 175°C, 20 Cycles
HTRB	1038	80% V_R, 150°C, 96 Hours
Moisture Resistance	1021	
Fine Leak	1071 Cond. H	1 x 10^{-7} CC/Sec
Constant Acceleration	2006	20,000 G's
Vibration Fatigue	2046	20,000 G's
Solderability	2026	
Lead Fatigue	2036.3 Cond. E	3 cycles, 8 oz., 90°, Bent at Body
Tension	2036.3 Cond. A	2 lbs., 30 seconds

HIPAX™Chips

HIPAX™PIN diode chips, package style H, have gold contact bonding surfaces. They are square in outline with the following nominal dimensions per side on the cathode surface:

MA4P4000H, MA4P4300H — *.066 inches/1.68 mm*
MA4P7000H, MA4P7100H — *.034 inches/0.86 mm*

Anode dimensions are nominally .008 inches (0.20 mm) smaller on each side.

Nominal chip thicknesses are as follows:

MA4P4000H, MA4P7000H — *.012 inches/0.31 mm*
MA4P4300H — *.016 inches/0.41 mm*
MA4P7100H — *.008 inches/0.20 mm*

Ordering Information

HIPAX PIN diodes are designated by "MA4P" followed by four digits which indicate the series and voltage rating. A package style letter suffix follows.

600 volt rating

MA4P400 6 C – Stud Package (cathode heat sink)

4P4000 series

Typical Performance Curves

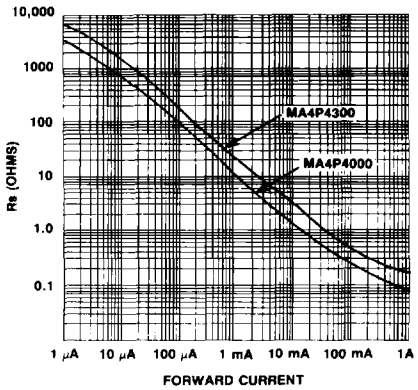


FIGURE 1. SERIES RESISTANCE AT 100 MHz VS. FORWARD CURRENT – MA4P4000, MA4P4300 SERIES

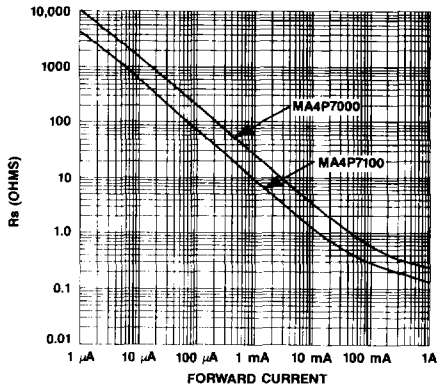


FIGURE 2. SERIES RESISTANCE AT 100 MHz VS. FORWARD CURRENT – MA4P7000, MA4P7100 SERIES

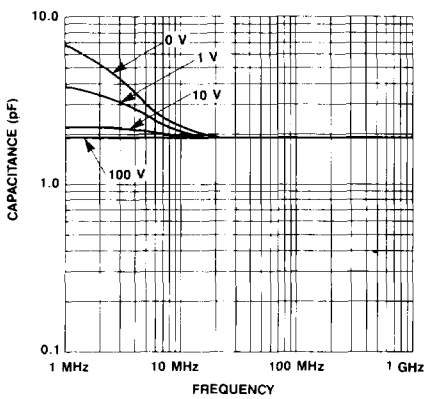


FIGURE 3. CAPACITANCE VS. FREQUENCY AND REVERSE BIAS – MA4P4000 SERIES

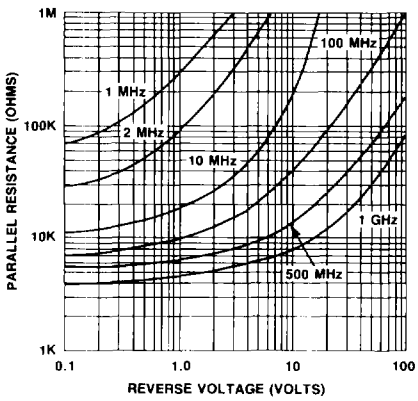


FIGURE 4. PARALLEL RESISTANCE VS. FREQUENCY AND REVERSE VOLTAGE – MA4P4000 SERIES

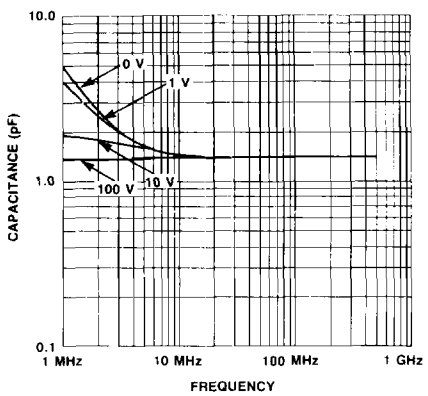


FIGURE 5. CAPACITANCE VS. FREQUENCY AND REVERSE BIAS – MA4P4300 SERIES

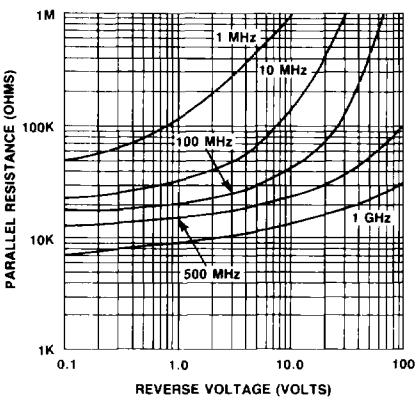
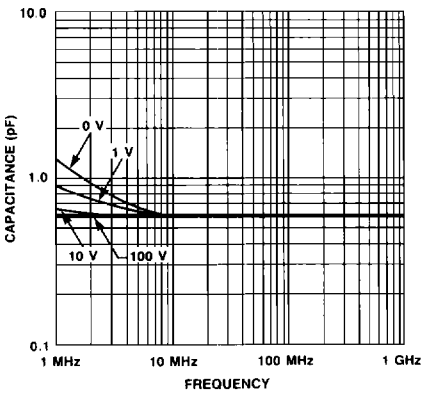


FIGURE 6. PARALLEL RESISTANCE VS. FREQUENCY AND REVERSE VOLTAGE – MA4P4300 SERIES

Typical Performance Curves (Cont'd)



FIGUR E 7. CAPACITANCE VS. FREQUENCY AND REVERSE BIAS – MA4P7000 SERIES

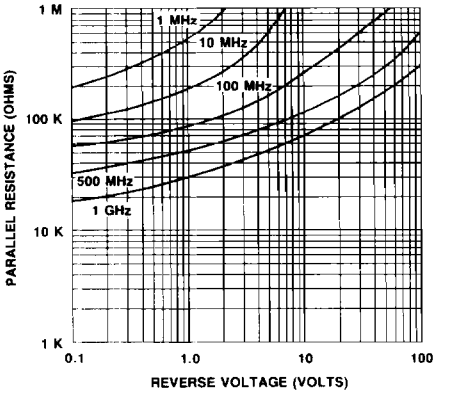


FIGURE 8. PARALLEL RESISTANCE VS. REVERSE VOLTAGE – MA4P7000 SERIES

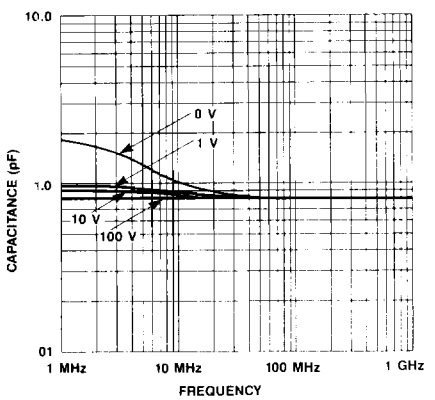


FIGURE 9. CAPACITANCE VS. FREQUENCY AND REVERSE BIAS – MA4P7100 SERIES

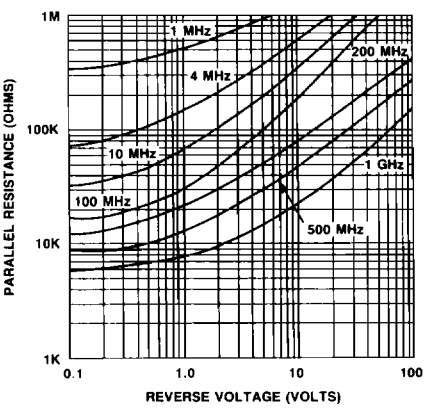


FIGURE 10. PARALLEL RESISTANCE VS. FREQUENCY AND REVERSE VOLTAGE – MA4P7100 SERIES

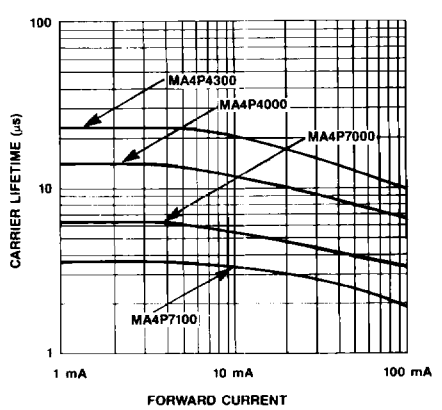


FIGURE 11. CARRIER LIFETIME VS. FORWARD CURRENT

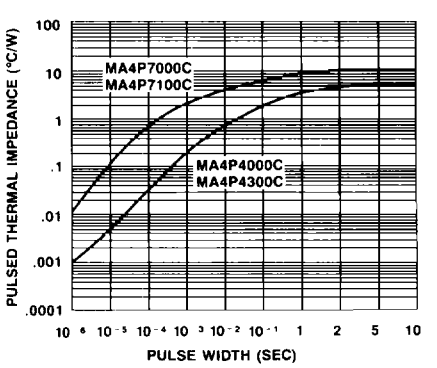


FIGURE 12. PULSED THERMAL IMPEDANCE VS. PULSE WIDTH

MA4P1200 and MA4P1250 PIN Diodes For High Volume Applications

Electrical Specifications @ 25°C

Parameter	Minimum	Typical	Maximum	Unit	Condition
Voltage Rating	50			V	I = 10 μA
Series Resistance		0.5	0.75	Ω	F = 100 MHz I = 50 mA
Capacitance: MA4P1200[1] MA4P1250[2]		1.2 0.9	1.5 1.2	pF	F = 1 MHz V = 50 V
Parallel Resistance	5 K	10 K		Ω	F = 100 MHz V = 0 V
Carrier Lifetime	2.0	4.0		μs	I = 10 mA
Forward Bias Harmonic Distortion (R_a^{2a}, R_a^{3a})	80	90		dBc	F = 100 MHz P = 30 W I = 50 mA
Reverse Bias Harmonic Distortion (R_a^{2a}, R_a^{3a})	60	70		dBc	F = 100 MHz P = 0 dBm V = 0 V
Forward Voltage			1.0	V	I = 50 mA

Maximum Ratings

Operating and Storage Temperature	−65°C to +175°C
DC Reverse Voltage	50 Volts
Power Dissipation:	
MA4P1200 – Free Air	1.5 Watts
¼ inch spaced to 25°C Contacts	5.5 Watts
MA4P1250 – Free Air	1.5 Watts
Contact Surfaces @ 25°C	4.0 Watts

Notes:
1. MA4P1200 available in axial leaded package shown in ODS 401.
2. MA4P1250 available in SMQ square outline surface mount package shown in ODS 1072.

Typical Performance Curves

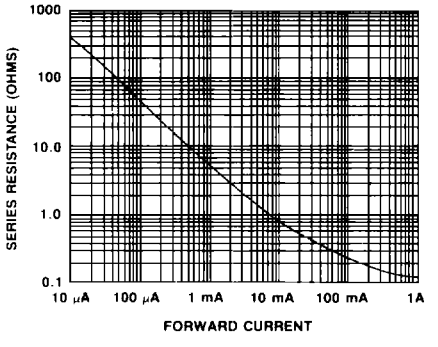


FIGURE 13. SERIES RESISTANCE AT 100 MHz VS. FORWARD CURRENT – MA4P1200 & MA4P1250

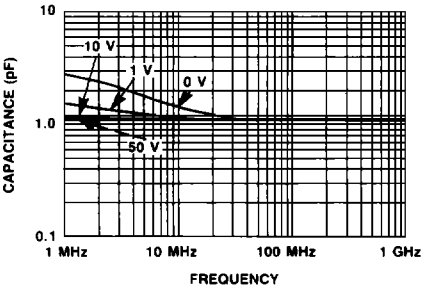


FIGURE 14. CAPACITANCE VS. FREQUENCY – MA4P1200 & MA4P1250

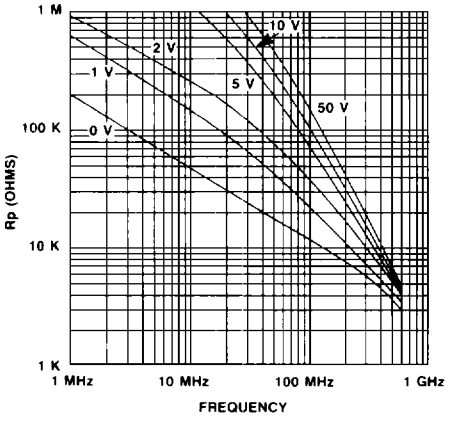


FIGURE 15. PARALLEL RESISTANCE VS. FREQUENCY AND REVERSE BIAS – MA4P1200 & MA4P1250

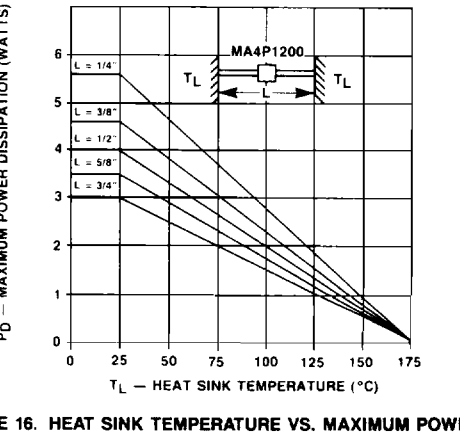
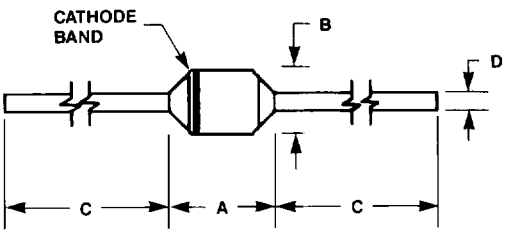


FIGURE 16. HEAT SINK TEMPERATURE VS. MAXIMUM POWER DISSIPATION – MA4P1200

Case Styles

STYLE B – AXIAL LEADED



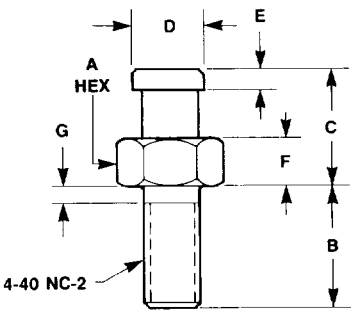
ODS-401
MA4P7000B, MA4P7100B, MA4P1200

DIM.	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.
A	—	.190	—	4.83
B	—	.090	—	2.29
C	.975	—	24.8	—
D	.027	.029	0.69	0.74

ODS-402
MA4P4000B, MA4P4300B

DIM.	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.
A	—	.230	—	5.842
B	—	.140	—	3.556
C	.975	—	24.765	—
D	.039	.041	.991	1.041

STYLE C, CR – STUD



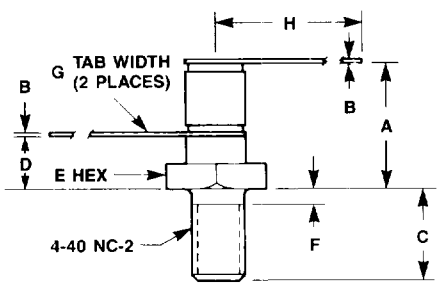
ODS-1047
MA4P7000C, MA4P7000CR, MA4P7100C, MA4P7100CR

DIM.	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.
A(HEX)	.185	.189	4.69	4.80
B	.235	.250	5.97	6.35
C	.215	.240	5.46	6.10
D	.091	.097	2.31	2.46
E	.039	.045	0.99	1.14
F	.090	.096	2.28	2.43
G	—	.035	—	0.88

ODS-1058
MA4P4000C, MA4P4000CR, MA4P4300C, MA4P4300CR

DIM.	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.
A(HEX)	.185	.189	4.69	4.80
B	.177	.187	4.50	4.75
C	.240	.270	4.50	5.00
D	.124	.134	3.14	3.40
E	.039	.045	0.99	1.14
F	.069	.076	1.75	1.93
G	—	.035	—	0.89

STYLE D, DR – INSULATED STUD



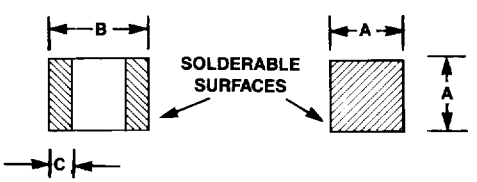
ODS-1059
MA4P7000D, MA4P7000DR, MA4P7100D, MA4P7100DR

DIM.	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.
A	.220	.230	5.58	5.84
B	.005	.008	—	—
C	.180	.190	4.57	4.82
D	.111	.119	2.81	3.02
E(HEX)	.182	.193	4.69	4.80
F	—	.035	—	0.889
G	.090	.096	2.28	2.43
H	.600	—	15.24	—

ODS-1060
MA4P4000D, MA4P4000DR, MA4P4300D, MA4P4300DR

DIM.	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.
A	.260	.270	6.60	6.85
B	.005	.008	—	—
C	.180	.190	4.57	4.82
D	.111	.119	2.81	3.02
E(HEX)	.182	.193	4.69	4.80
F	—	.035	—	0.889
G	.121	.128	3.07	3.25
H	.600	—	15.24	—

STYLE F – SMQ SURFACE MOUNT



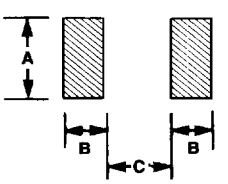
ODS-1072 MA4P7000F, MA4P7100F, MA4P1250

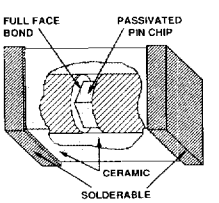
DIM.	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.
A	.080	.095	2.032	2.413
B	.115	.135	2.921	3.429
C	.008	.030	.203	.762

ODS-1091 MA4P4000F, MA4P4300F

DIM.	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.
A	.138	.155	3.51	3.94
B	.180	.200	4.57	5.08
C	.008	.030	.203	.762

Bonding Pad for SMQ





DIM.	ODS-1072 IN.	ODS-1072 MM	ODS-1091 IN.	ODS-1091 MM
A	.093	2.36	.150	3.81
B	.050	1.27	.050	1.27
C	.060	1.52	.100	2.54