Wireless RF, IF and Transmitter Selector Guide

While Motorola is a worldwide leader in semiconductor products, there is not a category in which the selection is more diverse, or more complete, than in products designed for RF system applications. From MOS, bipolar power and signal transistors to integrated circuits, Motorola's RF components cover the entire spectrum from HF to microwave to personal communications. Yet, product expansion continues — not only to keep pace with the progressive needs of the industry, but to better serve the needs of designers for a reliable and comprehensive source of supply.

How to Use This Selector Guide

The RF Monolithic Integrated Circuits and the RF/IF Integrated Circuits products in this guide are divided into three major functional categories: RF Front End ICs, RF/IF Subsystem ICs and Frequency Synthesis. Each of these categories is further subdivided based on circuit functionality. This structure differentiates highly integrated subsystem ICs from fundamental circuit building blocks and discrete transistors.

The Power MOSFETs, Power GaAs Transistors, Power Bipolar Transistors, Power Amplifier Modules and CATV Distribution Amplifiers are FIRST divided into major categories by power level. SECOND, within each category parts are listed by frequency band. THIRD, within a frequency band, transistors are further grouped by operating voltage and, finally, output power.

To Replace Devices in an Existing Design

Call your local Motorola Sales Office or Distributor to determine Motorola's closest replacement device.

Applications Assistance

Applications assistance is only a phone call away — call the nearest Semiconductor Sales office or 1-800-521-6274.

Access Data On–Line!

Use the Motorola SPS Internet to access Motorola Semiconductor Product data at http://www.motorola.com/semiconductors or http://www.motorola.com/semiconductors/rf/. The SPS Internet provides you with instant access to data sheets, selector guide information, package outlines, on–line technical support and much more.

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Access Data On–Line! – Use Motorola's SPS Internet Server

Motorola SPS has provided a World Wide Web Server to deliver Motorola SPS's technical data to the global Internet community. Technical data (such as data sheets, application notes, and selector guides) is available on the Internet server with full search capabilities. All have easy text search capability. Ordering literature from the Literature Center is available on line. Other features of Motorola SPS's Internet server include the availability of a searchable press release database, technical training information, with on–line registration capabilities, an on–line technical support form to send technical questions and receive answers through email, information on product groups, full search capabilities of device models, a listing of authorized distributors, and links directly to other Motorola world wide web servers.

How to reach us:

After accessing the Internet, use the following URL:

http://www.motorola.com/semiconductors/
http://www.motorola.com/semiconductors/rf/

Literature Centers

Printed literature can be obtained from the Literature Centers upon request. For those items that incur a cost, the U.S. Literature Center will accept Master Card and Visa.

How to reach us:

USA/EUROPE/Locations Not Listed:
Motorola Literature Distribution
P.O. Box 5405
Denver, Colorado 80217
Phone: 1–800–441–2447 or 1–303–675–2140

JAPAN:
Motorola Japan Ltd.
SPS, Technical Information Center
3–20–1, Minami–Azabu. Minato–ku
Tokyo 106–8573 Japan
Phone: 81–3–3440–3569

ASIA/PACIFIC:
Motorola Semiconductors H.K. Ltd.
Silicon Harbour Centre
2 Dai King Street, Tai Po Industrial Estate
Tai Po, N.T., Hong Kong
Phone: 852–26668334

Design Tools and Data Available On–Line for Your Design–in Process at: http://www.motorola.com/semiconductors/rf/designtds/designtd.html

Access LDMOS Models and Reference Designs On–line!

Visit our web pages for distribution of our electro–thermal models for RF LDMOS transistors.

The url is: **http://www.motorola.com/semiconductors/rf/models/**

The Motorola Electro Thermal (MET) model for RF LDMOS transistors is a nonlinear model that for the first time examines both electrical and thermal phenomena and can account for dynamic self–heating effects of device performance. It is specifically tailored to model high power RF LDMOS transistors used in base station, HDTV digital broadcast, and land mobile radio applications. Implemented in the Agilent EEsof® EDA Advanced Design System (ADS V1.3) harmonic balance simulator, the MET LDMOS model is capable of performing small–signal, large–signal, harmonic–balance, noise and transient simulations. Because of its ability to simulate self–heating effects, the MET model is more accurate than existing models, enabling circuit designers to predict prototype performance more accurately and reduce cycle time.

The object code can easily be linked with Agilent EEsof EDA ADS harmonic balance simulator and is available for all major computer platforms including Microsoft® Windows® 95, 98 and Windows NT® 4.0, Solaris® 2.6 and HP–UX® 10.2.

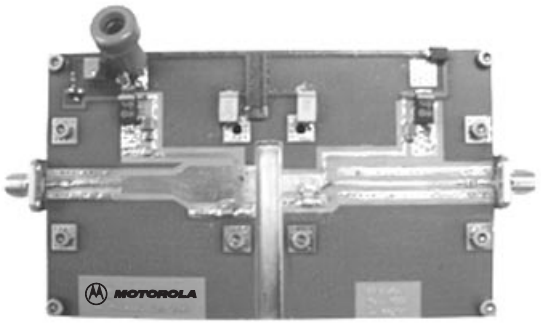
Subscribe to our LDMOS Models mail list to get the latest news on the availability of newly released RF LDMOS Transistor Models. To subscribe, just fill out the RF LDMOS Transistor Model Subscription form on–line at http://www.motorola.com/semiconductors/rf/models/ and you will receive notification of new models as they are posted.

AND, visit our web pages for distribution of Reference Designs.

The url is: **http://www.motorola.com/semiconductors/rf/designtds/designtd.html**

The Reference Design library contains easy–to–copy, fully functional amplifier designs. They consist of “no tune” distributed element matching circuits designed to be as small as possible, include temperature compensated bias circuitry, and are designed to be used as “building blocks” for our customers.

Functional Reference Design test units can be purchased for a nominal fee. Contact your local Motorola Distributor for additional information.



Reference Design Example

RF Front End ICs

Motorola's RF Front End integrated circuit devices provide an integrated solution for the personal communications market. These devices are available in plastic SOT–143, SOT–343, TSSOP–16, TSSOP–16EP, Micro–8, TSSOP–20EP, or BCC32++ packages.

Evaluation Boards

Evaluation boards are available for RF Front End Integrated Circuits. For a complete list of currently available boards and ones in development for newly introduced product, please contact your local Motorola Distributor or Sales Office.

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RF Front End ICs

RFICs

Upconverters/Exciters

Device	RF Freq. Range MHz	Supply Volt. Range Vdc	Supply Current mA (Typ)	Standby Current mA (Typ)	Conv. Gain dB (Typ)	Output IP3 dBm (Typ)	Case No./ Package	System Applicability
MRFIC0954[18b]	800 to 1000	2.7 to 5.0	65	5.0	31	28	948M/ TSSOP–20EP	CDMA, TDMA, ISM
MRFIC1813[18b]	1700 to 2000	2.7 to 4.5	25	0.1	15	11	948C/ TSSOP–16	DCS1800, PCS
MRFIC1854A[18b]	1700 to 2000	2.7 to 5.0	70	5.0	31	23	948M/ TSSOP–20EP	CDMA, TDMA, PCS
MRFIC1884[46a]	800 to 1000	2.7 to 3.2	60	5.0	32	28	1261A/ BCC32++	CDMA, TDMA, ISM, PCS
	1700 to 2000					23		

Power Amplifiers

Device	Freq. Range MHz	Supply Volt. Range Vdc	Saturated P_{out} dBm (Typ)	PAE % (Typ)	Gain P_{out}/P_{in} dB (Typ)	Case No./ Package	System Applicability
MRFIC0919[18b]	800 to 1000	3.0 to 5.5	35.3	48	32.3	948L/ TSSOP–16EP	GSM
MRFIC1819[18b]	1700 to 2000	3.0 to 5.0	33	40	27	948L/ TSSOP–16EP	DCS1800, PCS
MRFIC1856[18b]	800 to 1000	3.0 to 5.6	32	50	32	948M/ TSSOP–20EP	TDMA, CDMA, AMPS
	1700 to 2000		30	35	30		TDMA, CDMA, PCS
MRFIC1859[18b]	800 to 1000	2.8 to 5.5	36.2	53	33.2	873E/ TQFP–32EP	GSM
	1700 to 2000		34	43	29		DCS1800, PCS
MRFIC1869[46a]★	800 to 1000	2.7 to 5.5	35.8	55	35.8	MLF–32	GSM900
	1700 to 2000		34	45	32		DCS1800, PCS

[18]Tape and Reel Packaging Option Available by adding suffix: a) R1 = 500 units; b) R2 = 2,500 units; c) T1 = 3,000 units; d) T3 = 10,000 units; e) R2 = 1,500 units; f) T1 = 1,000 units; g) R2 = 4,000 units; h) R1 = 1,000 units; i) R3 = 250 units; j) T1 = 500 units; k) R2 = 450 units.

[46]To be introduced: a) 1Q01; b) 2Q01; c) 3Q01

★New Product

RF Building Blocks

Amplifiers

Device	RF Freq. Range MHz	Supply Volt. Range Vdc	Supply Current mA (Typ)	Standby Current μA (Typ)	Small Signal Gain dB (Typ)	Output IP3 dBm (Typ)	NF dB (Typ)	Case No./ Package	System Applicability
MBC13706(46a)★	800 to 1000	2.7 to 3.6	10	200	26	6.0	3.0	846A/ Micro–8	GSM, ISM
MRFIC0916(18c)	100 to 2500	2.7 to 5.0	4.7	–	18.5	11	1.9	318A/ SOT–143	ISM, PCS, Cellular
MRFIC0930DM(18b)	800 to 1000	2.7 to 4.5	8.5	20	19	10	1.7	846A/ Micro–8	GSM, AMPS, ISM
MRFIC1808DM(18b)	1700 to 2100	2.7 to 4.5	5.0	8.0	18	13	1.6	846A/ Micro–8	DCS1800, PCS

Low Power Transistors

Device	Gain – Bandwidth		NFmin @ f		Gain @ f		Maximum Ratings		Case No./ Package
	f_τ Typ GHz	I_C mA	Typ dB	GHz	Typ dB	GHz	V(BR) CEO Volts	I_C mA	
MBC13900(46a)★	15	20	1.0	1.0	17	1.0	7.0	20	318M/ SOT–343
			1.3	2.0	14	2.0			
MBC13901(46a)★	15	20	1.0	1.0	17	1.0	7.0	20	318M/ SOT–343
			1.3	2.0	14	2.0			

(18)Tape and Reel Packaging Option Available by adding suffix: a) R1 = 500 units; b) R2 = 2,500 units; c) T1 = 3,000 units; d) T3 = 10,000 units; e) R2 = 1,500 units; f) T1 = 1,000 units; g) R2 = 4,000 units; h) R1 = 1,000 units; i) R3 = 250 units; j) T1 = 500 units; k) R2 = 450 units.

(46)To be introduced: a) 1Q01; b) 2Q01; c) 3Q01

★New Product

RF Front End Integrated Circuit Packages

CASE 318A
(SOT–143)

CASE 318M
(SOT–343)

CASE 846A
(Micro–8)

CASE 873E
(TQFP–32EP)

CASE 948C
(TSSOP–16)

CASE 948L
(TSSOP–16EP)

CASE 948M
(TSSOP–20EP)

CASE 1261A
(BCC32++)

RF/IF Subsystems

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RF/IF Subsystems

Cordless Phone Subsystem ICs

Device	V_{CC}	I_{CC} (Typ)	Dual Conversion Receiver	Universal Dual PLL	Compander and Audio Interface	CVSD Compatible	Low Battery Detect	Notes	Suffix/ Case No.
MC13110A	2.7 to 5.5 V	Active Mode 8.5 mA Inactive Mode 15 µA	✓	✓	✓	–	✓	CT–0	FB/848B FTA/932
MC13111A	2.7 to 5.5 V	Active Mode 8.5 mA Inactive Mode 15 µA	✓	✓	✓	–	✓	CT–0	FB/848B, FTA/932
MC13145	2.7 to 6.5 V	Active Mode 27 mA Inactive Mode 10 µA	✓	–	–	✓	–	Receiver with coilless demod CT–900	FTA/932
MC13146	2.7 to 6.5 V	Active Mode 18 mA Inactive Mode 10 µA	–	–	–	✓	–	Transmitter with VCO CT–900	FTA/977

Tranceivers

Device	V_{CC}	I_{CC}	GSM Receiver	TDMA/iDEN Receiver	Fractional–N PLL	Direct Launch GSM Transmitter	System Applicability	Case No./ Pkg Type
MC13760[46a]★	2.65 to 2.9 4.78 to 5.22 (Charge Pumps)	Transmit 20 mA Receive 30 mA	✓	✓	✓	✓	GSM/DCS, TDMA, iDEN, AMPS	1285/ BGA–104

[46]To be introduced: a) 1Q01; b) 2Q01; c) 3Q01

★New Product

Miscellaneous Functions

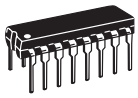
ADCs/DACs

Device	Function	I/O Format	Resolution	Number of Analog Channels	On–Chip Oscillator	Other Features	Suffix/ Case No.
MC144110	DAC	Serial	6 Bits	6	–	Emitter–Follower Outputs	DW/751D
MC144111				4			DW/751G

Encoders/Decoders

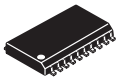
Device	Function	Number of Address Lines	Maximum Number of Address Codes	Number of Data Bits	Operation	Suffix/ Case No.
MC145026	Encoder	Depends on Decoder	Depends on Decoder	Depends on Decoder	Simplex	P/648, D/751B
MC145027	Decoder	5	243	4	Simplex	P/648, DW/751G
MC145028		9	19,683	0	Simplex	

RF/IF Subsystems Packages

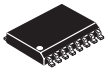


CASE 648
P SUFFIX
(DIP–16)

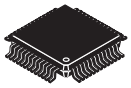
CASE 751B
D SUFFIX
(SO–16)



CASE 751D
DW SUFFIX
(SO–20L)



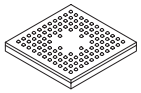
CASE 751G
DW SUFFIX
(SO–16W)



CASE 848B
FB SUFFIX
(QFP–52)

CASE 932
FTA SUFFIX
(LQFP–48)

CASE 977
FTA SUFFIX
(LQFP–24)



CASE 1285
(BGA–104)

Frequency Synthesis

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Frequency Synthesis

Single PLL Synthesizers

Maximum Frequency (MHz)	Supply Voltage (V)	Nominal Supply Current (mA)	Features	Device	Suffix/ Case
20 @ 5.0 V	3.0 to 9.0	7.5 @ 5 V	Parallel Interface	MC145151–2	DW/751F
20 @ 5.0 V	3.0 to 9.0	7.5 @ 5 V	Parallel Interface, Uses External Dual–Modulus Prescaler	MC145152–2	DW/751F
20 @ 5.0 V	3.0 to 9.0	7.5 @ 5 V	Serial Interface	MC145157–2	DW/751G
20 @ 5.0 V	3.0 to 9.0	7.5 @ 5 V	Serial Interface, Uses External Dual–Modulus Prescaler	MC145158–2	DW/751G
100 @ 3.0 V 185 @ 4.5 V	2.7 to 5.5	2 @ 3 V 6 @ 5 V	Serial Interface, Auxiliary Reference Divider, Evaluation Kit – MC145170EVK	MC145170–2	P/648, D/751B, DT/948C
1100	2.7 to 5.5	7 @ 5 V	Serial Interface, Standby, Auxiliary Reference Divider, Evaluation Kit – MC145193EVK	MC145193	F/751J, DT/948D
2000	2.7 to 5.5	4 @ 3 V	Serial Interface, Standby, Auxiliary Reference Device, Evaluation Kit – MC145202–1EVK	MC145202–1	F/751J, DT/948D
2500	2.7 to 5.5	9.5	Serial Interface	MC12210	D/751B, DT/948E
2800	4.5 to 5.5	3.5	Fixed Divider	MC12179	D/751

Dual PLL Synthesizers

Maximum Frequency (MHz)	Supply Voltage (V)	Nominal Supply Current (mA)	Phase Detector	Device	Suffix/ Case
1100 both loops	2.7 to 5.5	12	Serial Interface, Standby, Evaluation Kit – MC145220EVK	MC145220	F/803C, DT/948D

PLL Building Blocks

Prescalers

Frequency (MHz)	Divide Ratios	Single or Dual Modulus	Supply Voltage (V)	Supply Current (mA)	Features	Device	Suffix/ Case
1100	64/65, 128/129	Dual	2.7 to 5.5	2.0 max	Low Power	MC12052A	D/751
1100	10,20,40,80	Single	4.5 to 5.5	5.0 max		MC12080	D/751
1100	2, 4, 8	Single	2.7 to 5.5	4.5 max	Standby	MC12093	D/751
2000	64/65, 128/129	Dual	2.7 to 5.5	2.6 max	Low Power	MC12054A	D/751
2500	2, 4	Single	2.7 to 5.5	14 max	Standby	MC12095	D/751
2800	64, 128, 256	Single	4.5 to 5.5	11.5 max		MC12079	D/751

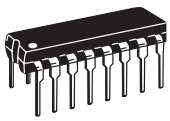
Voltage Control Oscillators

Frequency (MHz)	Supply Voltage (V)	Features	Device	Suffix/ Case
1300	2.7 to 5.5	Two high drive open collector outputs (Q, QB), Adjustable output amplitude, Low drive output for prescaler	MC12149	D/751

Phase–Frequency Detectors

Frequency (MHz)	Supply Voltage (V)	Features	Device	Suffix/ Case
800 (Typ)	4.75 to 5.5	MECL10H compatible	MCH12140	D/751
800 (Typ)	4.2 to 5.5	100K ECL compatible	MCK12140	D/751

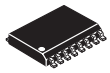
Frequency Synthesis Packages



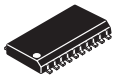
CASE 648
P SUFFIX
(DIP–16)

CASE 751
D SUFFIX
(SO–8)

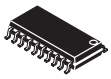
CASE 751B
D SUFFIX
(SO–16)



CASE 751G
DW SUFFIX
(SO–16W)



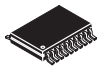
CASE 751J
F SUFFIX
(SO–20)



CASE 803C
F SUFFIX
(SO–20)

CASE 948C
DT SUFFIX
(TSSOP–16)

CASE 948D
DT SUFFIX
(TSSOP–20)



CASE 948E
DT SUFFIX
(TSSOP–20HS)

Motorola RF Discrete Transistors

Motorola offers the most extensive group of RF Discrete Transistors offered by any semiconductor manufacturer anywhere in the world today.
From Bipolar to FET, the user can choose from a variety of packages. They include plastic and ceramic that are microstrip circuit compatible or surface mountable. Many are designed for automated assembly equipment.
Major sub–headings are Power MOSFETs, Power GaAs and Bipolar Transistors.

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Motorola RF High Power Transistors

RF Power MOSFETs

Motorola RF Power MOSFETs are constructed using a planar process to enhance manufacturing repeatability. They are *N–channel field effect transistors* with an oxide insulated gate which controls vertical current flow.

Compared with bipolar transistors, RF Power FETs exhibit higher gain, higher input impedance, enhanced thermal stability and lower noise. The FETs listed in this section are specified for operation in RF Power Amplifiers and are grouped by frequency range of operation and type of application. Arrangement within each group is first by order of voltage then by increasing output power.

Table 1. 2 to 150 MHz HF/SSB – Vertical MOSFETs

For military and commercial HF/SSB fixed, mobile and marine transmitters.

Device	Frequency Band(37)		P_{out} Watts	V_{DD} Volts	Class	Gain (Typ) @ 30 MHz dB	Typical IMD d_3 dB	Typical IMD d_{11} dB	θ_{JC} °C/W	Package/Style
MRF171A	U	2–225	30	28	AB	20	–32	—	1.52	211–07/2
MRF148A	U	2–225	30	50	AB	18	–35	–60	1.5	211–07/2
MRF150	U	2–150	150	50	AB	17	–32	–60	0.6	211–11/2
MRF154	U	2–100	600	50	AB	17	–25	—	0.13	368/2
MRF157	U	2–100	600	50	AB	20	–25	—	0.13	368/2

Table 2. 2 to 225 MHz VHF AM/FM – Vertical MOSFETs

For VHF military and commercial aircraft radio transmitters.

Device	Frequency Band(37)		P_{out} Watts	V_{DD} Volts	Class	Gain (Typ)/Freq. dB/MHz	η Eff. (Typ) %	θ_{JC} °C/W	Package/Style
MRF134	U	30–225	5	28	AB	14/150	55	10	211–07/2
MRF136	U	30–225	15	28	AB	16/150	60	3.2	211–07/2
MRF171A	U	30–225	45	28	AB	19.5/150	65	1.52	211–07/2
MRF173	U	30–225	80	28	AB	13/150	65	0.8	211–11/2
MRF174	U	30–225	125	28	AB	11.8/150	60	0.65	211–11/2
MRF141	U	2–175	150	28	AB	10/175	55	0.6	211–11/2
MRF141G	U	2–175	300	28	AB	13/175	55	0.35	375/2
MRF151	U	2–175	150	50	AB	13/175	45	0.6	211–11/2
MRF151G	U	2–175	300	50	AB	16/175	55	0.35	375/2

Table 3. 30 to 512 MHz VHF/UHF AM/FM – Vertical MOSFETs

For VHF/UHF military and commercial aircraft radio transmitters.

Device	Frequency Band(37)		P_{out} Watts	V_{DD} Volts	Class	Gain (Typ)/Freq. dB/MHz	η Eff. (Typ) %	θ_{JC} °C/W	Package/Style
MRF158	U	30–512	2	28	AB	17.5/500	52	13.2	305A/2
MRF160	U	30–512	4	28	AB	17/500	55	7.2	249/3
MRF166C	U	30–512	20	28	AB	16/500	55	2.5	319/3
MRF166W	U	30–512	40	28	AB	16/500	55	1.0	412/1
MRF177	U	100–400	100	28	AB	12/400	60	0.65	744A/2
MRF275L	U	150–512	100	28	AB	8.8/500	55	0.65	333/2
MRF275G	U	150–512	150	28	AB	11.2/500	55	0.44	375/2

(37)M = Matched Frequency Band; U = Unmatched Frequency Band.

Table 4. Mobile – To 520 MHz

Designed for broadband VHF & UHF commercial and industrial applications. The high gain and broadband performance of these devices make them ideal for large–signal, common–source amplifier applications in 12.5/7.5 volt mobile, portable and base station operation.

Device	Frequency Band(37)		P_{out} Watts	V_{DD} Volts	Gain (Typ)/Freq. dB/MHz	η Eff. (Typ) %	θ_{JC} °C/W	Package/Style
VHF & UHF, Land Mobile Radio, Class AB – LDMOS Die								
MRF1511T1(18f)★	U	136–175	8	7.5	11.5/175	55	2.0	466/1
MRF1517T1(18f)★	U	430–520	8	7.5	11/520	55	2.0	466/1
MRF1513T1(18f)★	U	400–520	3	7.5/12.5	11/520	55	4.0	466/1
MRF1518T1(18f)★	U	400–520	8	12.5	11/520	55	2.0	466/1
MRF1535T1(18j)★	U	400–520	35	12.5	10(Min)/520	50(Min)	0.90	1264/1
MRF1550T1(18j)★	U	136–175	50	12.5	10(Min)/175	50(Min)	0.75	1264/1

Table 5. Broadcast – To 1.0 GHz – Lateral MOSFETs

Device	Frequency Band(37)		P_{out} Watts	V_{DD} Volts	Gain (Typ)/Freq. dB/MHz	η Eff. (Typ) %	θ_{JC} °C/W	IMD dBc	Package/Style
470 – 1000 MHz, Class AB – LDMOS Die									
MRF373A(46a)	U	470–860	75 CW	32	18/860	60	1.0	—	360B/1
MRF373AS(46a)	U	470–860	75 CW	32	18/860	60	0.75	—	360C/1
MRF374A(46a)	U	470–860	130 PEP	32	17.3/860	41	0.65	–31	375F/2
MRF372★	M	470–860	180 PEP	32	17/860	36	0.5	–35	375G/2
MRF377(9)	M	470–860	180 PEP	32	18/860	40	0.5	–30	375G/2
MRF376(9)	M	470–860	400 Pulsed	50	16/860	50	0.4	—	375G/2

Table 6. Cellular – To 1.0 GHz – Lateral MOSFETs

Device	Frequency Band(37)		P_{out} Watts	Test Signal	V_{DD} Volts	Gain (Typ)/Freq. dB/MHz	η Eff. (Typ) %	θ_{JC} °C/W	Pkg/ Style
800 – 1.0 GHz, Class AB – LDMOS Die									
MRF9002R2(18e,46a)	U	960	2 PEP	2–Tone	26	16/960	35	9	978/–
MRF9030MR1(18a,46b)	U	945	30 PEP	2–Tone	26	17/945	41	—	1265/1
MRF9030(46b)	U	945	30 PEP	2–Tone	26	17/945	40	1.9	360B/1
MRF9030S(18a,46b)	U	945	30 PEP	2–Tone	26	17/945	40	1.5	360C/1
MRF9045MR1(18a)★	U	945	45 PEP	2–Tone	28	18.5/945	41	0.8(50)	1265/1
MRF9045★	U	945	45 PEP	2–Tone	28	18.8/945	42	1.4	360B/1
MRF9045S(18a)★	U	945	45 PEP	2–Tone	28	18.8/945	42	1.0	360C/1
MRF9060MR1(18a,46b)	U	945	60 PEP	2–Tone	26	17/945	40	—	1265/1
MRF9060(46a)	U	945	60 PEP	2–Tone	26	17/945	40	1.1	360B/1
MRF9060S(18a,46a)	U	945	60 PEP	2–Tone	26	17/945	40	0.8	360C/1
MRF6522–70(18i)	M	921–960	70 CW	1–Tone	26	16/921,960	58	1.1	465D/1
MRF9080★	M	921–960	75 CW	1–Tone	26	18.5/921,960	55	0.7	465/1
MRF9080S★	M	921–960	75 CW	1–Tone	26	18.5/921,960	55	0.7	465A/1
MRF9085★	M	880	90 PEP	2–Tone	26	17.9/880	40	0.7	465/1
MRF9085S★	M	880	90 PEP	2–Tone	26	17.9/880	40	0.7	465A/1

(9)In development.

(18)Tape and Reel Packaging Option Available by adding suffix: a) R1 = 500 units; b) R2 = 2,500 units; c) T1 = 3,000 units; d) T3 = 10,000 units; e) R2 = 1,500 units; f) T1 = 1,000 units; g) R2 = 4,000 units; h) R1 = 1,000 units; i) R3 = 250 units; j) T1 = 500 units; k) R2 = 450 units.

(37)M = Matched Frequency Band; U = Unmatched Frequency Band.

(46)To be introduced: a) 1Q01; b) 2Q01; c) 3Q01

(50)Simulated

★New Product

Table 6. Cellular – To 1.0 GHz – Lateral MOSFETs (continued)

Device	Frequency Band(37)		P_{out} Watts	Test Signal	V_{DD} Volts	Gain (Typ)/Freq. dB/MHz	η Eff. (Typ) %	θ_{JC} °C/W	Pkg/ Style
800 – 1.0 GHz, Class AB – LDMOS Die (continued)									
MRF9120(46a)	M	880	120 PEP	2–Tone	26	16/880	39	0.7	375B/2
MRF9120S(46a)	M	880	120 PEP	2–Tone	26	16/880	39	0.7	375H/2
MRF9180★	M	880	170 PEP	2–Tone	26	17.5/880	39	0.45	375D/2
MRF9180S★	M	880	170 PEP	2–Tone	26	17.5/880	39	0.45	375E/2

Table 7. PCS and 3G – To 2.1 GHz – Lateral MOSFETs

Device	Frequency Band(37)		P_{out} Watts	Test Signal	V_{DD} Volts	Gain (Typ)/Freq. dB/MHz	η Eff. (Typ) %	θ_{JC} °C/W	Pkg/ Style
1805 – 1990 MHz, Class AB – LDMOS Die (GSM1800, GSM1900, GSM EDGE and PCS TDMA)									
MRF18060A	M	1805–1880	60 CW	1–Tone	26	13/1805,1880	45	0.97	465/1
MRF18060AS	M	1805–1880	60 CW	1–Tone	26	13/1805,1880	45	0.97	465A/1
MRF18060B	M	1930–1990	60 CW	1–Tone	26	13/1930,1990	45	0.97	465/1
MRF18060BS	M	1930–1990	60 CW	1–Tone	26	13/1930,1990	45	0.97	465A/1
MRF18085A(46a)	M	1805–1880	85 CW	1–Tone	26	13/1805,1880	52	0.64	465/1
MRF18085AS(46a)	M	1805–1880	85 CW	1–Tone	26	13/1805,1880	53	0.64	465A/1
MRF18085B(46a)	M	1930–1990	85 CW	1–Tone	26	13/1930,1990	53	0.64	465/1
MRF18085BS(46a)	M	1930–1990	85 CW	1–Tone	26	13/1930,1990	52	0.64	465A/1
MRF18090A	M	1805–1880	90 CW	1–Tone	26	13.5/1805,1880	52	0.7	465B/1
MRF18090AS	M	1805–1880	90 CW	1–Tone	26	13.5/1805,1880	52	0.7	465C/1
MRF18090B	M	1930–1990	90 CW	1–Tone	26	13.5/1930,1990	45	0.7	465B/1
MRF18090BS	M	1930–1990	90 CW	1–Tone	26	13.5/1930,1990	45	0.7	465C/1
1.9 GHz, Class AB – LDMOS Die (2–CH N–CDMA)									
MRF19030★	M	1930–1990	30 PEP	2–Tone	26	13/1990	36	2.1	465E/1
MRF19030S★	M	1930–1990	30 PEP	2–Tone	26	13/1990	36	2.1	465F/1
MRF19045(46a)	M	1930–1990	9.5 AVG	N–CDMA	26	14.5/1990	23.5	1.97	465E/1
MRF19045S(46a)	M	1930–1990	9.5 AVG	N–CDMA	26	14.5/1990	23.5	1.97	465F/1
MRF19060	M	1930–1990	60 PEP	2–Tone	26	12.5/1990	36	0.97	465/1
MRF19060S	M	1930–1990	60 PEP	2–Tone	26	12.5/1990	36	0.97	465A/1
MRF19090	M	1930–1990	90 PEP	2–Tone	26	11.5/1990	35	0.65	465B/1
MRF19090S	M	1930–1990	90 PEP	2–Tone	26	11.5/1990	35	0.65	465C/1
MRF19085★	M	1930–1990	18 AVG	N–CDMA	26	13/1990	23	0.64	465/1
MRF19085S★	M	1930–1990	18 AVG	N–CDMA	26	13/1990	23	0.64	465A/1
MRF19120(3)★	M	1930–1990	120 PEP	2–Tone	26	11.7/1990	34	0.45	375D/2
MRF19120S(3)★	M	1930–1990	120 PEP	2–Tone	26	11.7/1990	34	0.45	375E/2
MRF19125★	M	1930–1990	24 AVG	N–CDMA	26	13.5/1990	22	0.53	465B/1
MRF19125S★	M	1930–1990	24 AVG	N–CDMA	26	13.5/1990	22	0.53	465C/1

(3)Internal Impedance Matched Push-Pull Transistors

(18)Tape and Reel Packaging Option Available by adding suffix: a) R1 = 500 units; b) R2 = 2,500 units; c) T1 = 3,000 units; d) T3 = 10,000 units; e) R2 = 1,500 units; f) T1 = 1,000 units; g) R2 = 4,000 units; h) R1 = 1,000 units; i) R3 = 250 units; j) T1 = 500 units; k) R2 = 450 units.

(37)M = Matched Frequency Band; U = Unmatched Frequency Band.

(46)To be introduced: a) 1Q01; b) 2Q01; c) 3Q01

★New Product

Table 7. PCS and 3G – To 2.1 GHz – Lateral MOSFETs (continued)

Device	Frequency Band(37)	P_{out} Watts	Test Signal	V_{DD} Volts	Gain (Typ)/Freq. dB/MHz	η Eff. (Typ) %	θ_{JC} °C/W	Pkg/ Style
2.0 GHz, Class A, AB – LDMOS Die								
MRF281SR1(18a)★	U	1930–2000	4 PEP	2–Tone	26	12.5/2000	33	5.74	458B/1
MRF281ZR1(18a)★	U	1930–2000	4 PEP	2–Tone	26	12.5/2000	33	5.74	458C/1
MRF282SR1(18a)★	U	1930–2000	10 PEP	2–Tone	26	11.5/2000	28(min)	4.2	458B/1
MRF282ZR1(18a)★	U	1930–2000	10 PEP	2–Tone	26	11.5/2000	28(min)	4.2	458C/1
MRF284	U	1930–2000	30 PEP	2–Tone	26	10.5/2000	35	2.0	360B/1
MRF284SR1(18a)	U	1930–2000	30 PEP	2–Tone	26	10.5/2000	35	2.0	360C/1
MRF286(46a)	M	1930–2000	60 PEP	2–Tone	26	10.5/2000	32	0.73	465/1
MRF286S(46a)	M	1930–2000	60 PEP	2–Tone	26	10.5/2000	32	0.73	465A/1
2.1 GHz, Class AB – LDMOS Die (2–CH W–CDMA, UMTS)								
MRF21010★	U	2110–2170	10 PEP	2–Tone	28	13.5/2170	35	5.5	360B/1
MRF21010S(46a)	U	2110–2170	10 PEP	2–Tone	28	13.5/2170	35	5.5	360C/1
MRF21030★	M	2110–2170	30 PEP	2–Tone	28	13/2170	33	2.1	465E/1
MRF21030S★	M	2110–2170	30 PEP	2–Tone	28	13/2170	33	2.1	465F/1
MRF21045★	M	2110–2170	10 AVG	W–CDMA	28	15/2170	23.5	1.97	465E/1
MRF21045S★	M	2110–2170	10 AVG	W–CDMA	28	15/2170	23.5	1.97	465F/1
MRF21060	M	2110–2170	60 PEP	2–Tone	28	12.5/2170	34	1.02	465/1
MRF21060S	M	2110–2170	60 PEP	2–Tone	28	12.5/2170	34	1.02	465A/1
MRF21085★	M	2110–2170	19 AVG	W–CDMA	28	13.6/2170	23	0.64	465/1
MRF21085S★	M	2110–2170	19 AVG	W–CDMA	28	13.6/2170	23	0.64	465A/1
MRF21090★	M	2110–2170	90 PEP	2–Tone	28	11.7/2170	33	0.65	465B/1
MRF21090S★	M	2110–2170	90 PEP	2–Tone	28	11.7/2170	33	0.65	465C/1
MRF21120(3)★	M	2110–2170	120 PEP	2–Tone	28	11.4/2170	34.5	0.45	375D/2
MRF21120S(3)★	M	2110–2170	120 PEP	2–Tone	28	11.2/2170	34.5	0.45	375E/2
MRF21125	M	2110–2170	20 AVG	W–CDMA	28	13/2170	18	0.53	465B/1
MRF21125S	M	2110–2170	20 AVG	W–CDMA	28	13/2170	18	0.53	465C/1
MRF21180(3,46a)	M	2110–2170	38 AVG	W–CDMA	28	12.5/2170	22	0.39	375D/2
MRF21180S(3,46a)	M	2110–2170	38 AVG	W–CDMA	28	12.5/2170	22	0.39	375E/2

(3)Internal Impedance Matched Push-Pull Transistors

(18)Tape and Reel Packaging Option Available by adding suffix: a) R1 = 500 units; b) R2 = 2,500 units; c) T1 = 3,000 units; d) T3 = 10,000 units; e) R2 = 1,500 units; f) T1 = 1,000 units; g) R2 = 4,000 units; h) R1 = 1,000 units; i) R3 = 250 units; j) T1 = 500 units; k) R2 = 450 units.

(37)M = Matched Frequency Band; U = Unmatched Frequency Band.

(46)To be introduced: a) 1Q01; b) 2Q01; c) 3Q01

★New Product

RF Power GaAs Transistors

Motorola power GaAs transistors are made using an InGaAs PHEMT epitaxial structure for superior RF efficiency and linearity. The FETs listed in this section are designed for operation in base station infrastructure RF power amplifiers and are grouped according to frequency range and type of application. Parts are listed first by order of operating voltage, then by increasing output power.

Table 1. 3.5 GHz – Linear Transistors

Device	Frequency Band(37)	P_{out} Watts	Test Signal	V_{DD} Volts	Gain (Typ)/Freq. dB/GHz	η Eff. (Typ) %	θ_{JC} °C/W	Pkg/ Style
3.5 GHz, Class AB – GaAs (WLL, BWA, W–CDMA)								
MRFG35010(9)	U	3.5 G	1 AVG	W–CDMA	12	10/3.5	26	6	—
MRFG35030(9)	M	3.5 G	4 AVG	W–CDMA	12	10/3.5	24	—	—

(9)In development.

RF Power Bipolar Transistors

Motorola's broad line of bipolar RF power transistors are characterized for operation in RF power amplifiers. Typical applications are in base stations, military and commercial landmobile, avionics and marine radio transmitters. Groupings are by frequency band and type of application. Within each group, the arrangement of devices is by major supply voltage rating, then in the order of increasing output power. All devices are NPN polarity except where otherwise noted.

UHF Transistors

Table 1. 100 – 500 MHz Band

Designed for UHF military and commercial aircraft radio transmitters.

Device	Frequency Band(37)		P_{out} Watts	Gain (Min)/Freq. dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 28 Volts, Class C						
MRF392(3)	M	100–400	125	8/400	0.65	744A/1
MRF393(3)	M	100–512	100	7.5/500	0.65	744A/1

900 MHz Transistors

Table 2. 900 – 960 MHz Band

Designed specifically for the 900 MHz mobile radio band, these devices offer superior gain, ruggedness, stability and broadband operation. Devices are for mobile and base station applications.

Device	Frequency Band(37)		P_{out} Watts	Class	Gain (Min)/Freq. dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 24 Volts — Si Bipolar							
MRF858S	U	840–900	3.6 CW	A	11/900	6.9	319A/2
MRF897(3)	M	900	30	AB	10/900	1.7	395B/1
MRF897R(3)	M	900	30	AB	10.5/900	1.7	395E/1
MRF898(2)	M	850–900	60 CW	C	7/900	1	333A/1
V_{CC} = 26 Volts — Si Bipolar							
MRF6409	M	921–960	20	AB	10/960	3.8	319/2
MRF6414	M	921–960	50	AB	8.5/960	1.3	333A/2
MRF899(3)	M	900	150	AB	8/900	0.8	375A/1

1.5 GHz Transistors

Table 3. 1600 – 1640 MHz Band

Device	Frequency Band(37)		P_{out} Watts	Class	Gain (Min)/Freq. dB/MHz	η Eff. (Min) %	θ_{JC} °C/W	Package/Style
MRF16006	M	1600–1640	6	C	7.4/1600	40	6.8	395C/2
MRF16030	M	1600–1640	30	C	7.5/1600	40	1.7	395C/2

(2)Internal Impedance Matched

(3)Internal Impedance Matched Push-Pull Transistors

(37)M = Matched Frequency Band; U = Unmatched Frequency Band.

Microwave Transistors

Table 4. L–Band Long Pulse Power

These products are designed for pulse power amplifier applications in the 960–1215 MHz frequency range. They are capable of handling up to 10 μs pulses in long pulse trains resulting in up to a 50% duty cycle over a 3.5 millisecond interval. Overall duty cycle is limited to 25% maximum. The primary applications for devices of this type are military systems, specifically JTIDS and commercial systems, specifically Mode S. Package types are hermetic.

Device	Frequency Band(37)		P_{out} Watts	Gain (Min) @ 1215 MHz dB	θ_{JC} °C/W	Package/Style
V_{CC} = 28 Volts — Class C Common Base						
MRF10005	M	960–1215	5	8.5	8	336E/1
V_{CC} = 36 Volts — Class C Common Base						
MRF10031	M	960–1215	30	10	3	376B/1
MRF10120	M	960–1215	120	8	0.6	355C/1
V_{CC} = 50 Volts — Class C Common Base						
MRF10150	M	1025–1150	150	10(7)	0.25	376B/1
MRF10350	M	1025–1150	350	9(7)	0.11	355E/1
MRF10502	M	1025–1150	500	9(7)	0.12	355J/1

Linear Transistors

The following sections describe a wide variety of devices specifically characterized for linear amplification. Included are medium power and high power parts covering frequencies to 2.0 GHz.

Table 5. UHF Ultra Linear For TV Applications

The following device has been characterized for ultra–linear applications such as low–power TV transmitters in Band IV and Band V and features diffused ballast resistors and an all–gold metal system to provide enhanced reliability and ruggedness.

Device	Frequency Band(37)		P_{out} Watts	Gain (Typ)/Freq. Small Signal Gain dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 28 Volts, Class AB						
TPV8100B	M	470–860	100(11)	9.5/860	0.7	398/1

Table 6. Microwave Linear for PCN Applications

The following devices have been developed for linear amplifiers in the 1.5–2 GHz region and have characteristics particularly suitable for PDC, PCS or DCS1800 base station applications.

Device	Frequency Band(37)		P_{out} Watts	Class	Gain (Typ)/Freq. dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 26 Volts–Bipolar Die							
MRF6404(16)	M	1860–1900	30	AB	8.2/1880	1.4	395C/1
MRF20030R	M	2000	30	AB	11/2000	1.4	395C/1
MRF20060R	M	2000	60	AB	9.8/2000	0.7	451/1
MRF20060RS	M	2000	60	AB	9.8/2000	0.7	451A/1

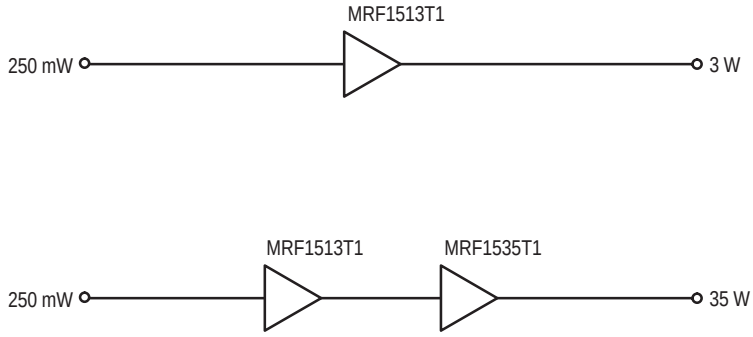
(7)Typical @ 1090 MHz

(11)Output power at 1 dB compression in Class AB

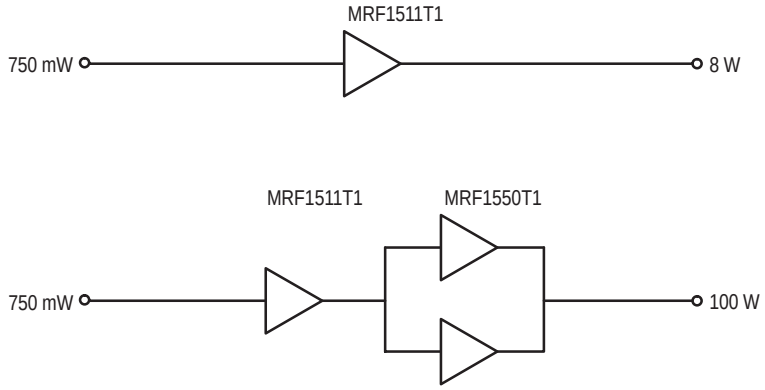
(16)Formerly known as “TP4035”

(37)M = Matched Frequency Band; U = Unmatched Frequency Band.

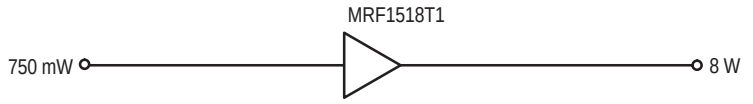
RF LDMOS High Power Transistor Amplifier Line–ups



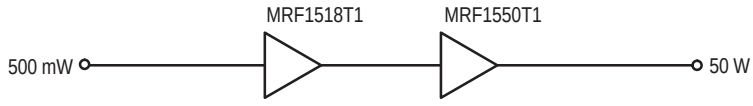
Mobile – UHF



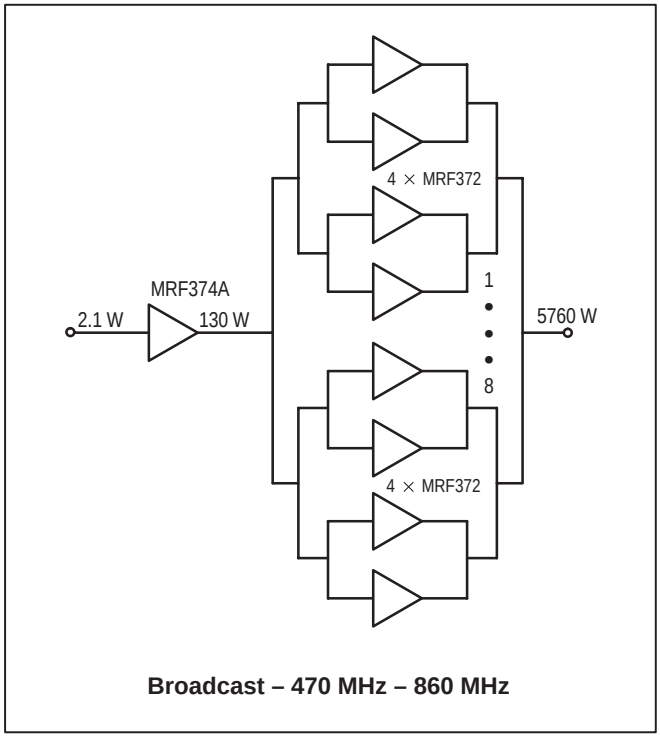
Mobile – VHF



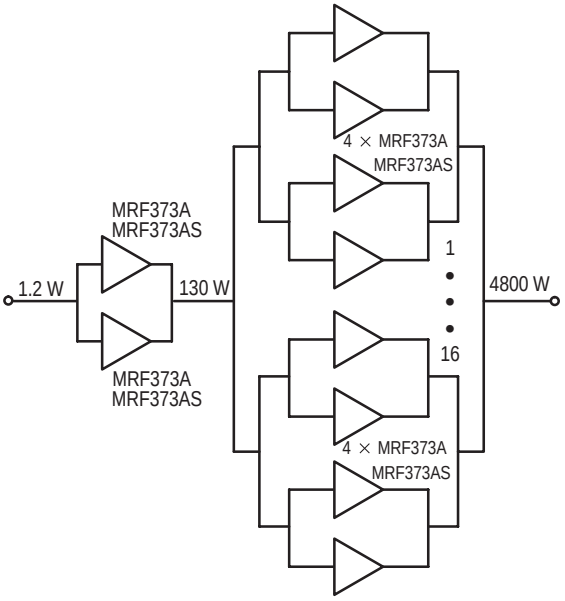
Mobile – UHF



Mobile – VHF



Broadcast – 470 MHz – 860 MHz



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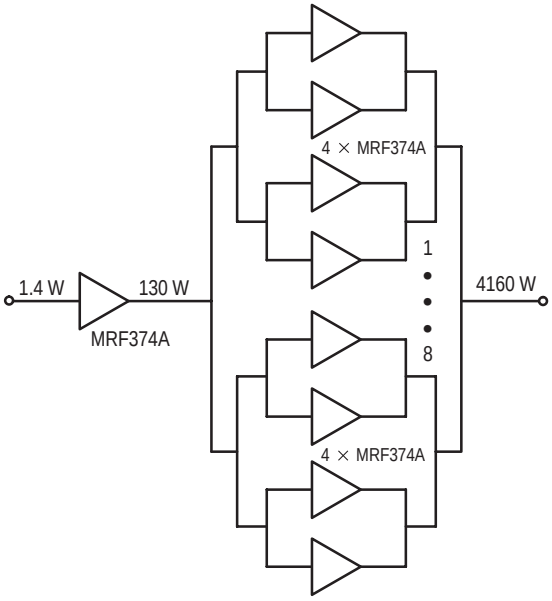
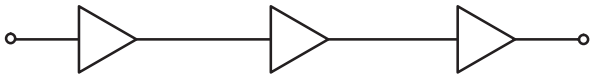


Broadcast – 470 – 860 MHz

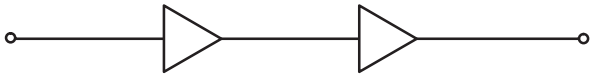
GSM EDGE – 900 MHz



16 dB MRF9002R2 | 17 dB MRF9030/S | 18.5 dB MRF9080/S

P_{in}	Amp1	Amp2	Amp3	P_{out}
0.602 mW	MRF9002R2	MRF9030/S	MRF9080/S	75 W

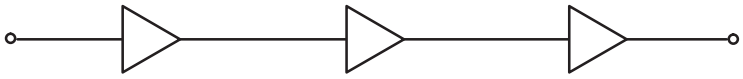
Cellular – 1.0 GHz



16 dB MRF9002R2 | 17.5 dB MRF9180/S

P_{in}	Amp1	Amp2	P_{out}
80 mW	MRF9002R2	MRF9180/S	170 W

GSM1800, GSM1900, GSM EDGE and PCS TDMA – 1.8 – 1.9 GHz



13.5 dB MRF21010/S | 11.5 dB MRF282SR1 MRF282ZR1 | 13 dB MRF19030/S | 13 dB MRF18085A MRF18085B | 13.5 dB MRF18090A MRF18090B

P_{in}	Amp1	Amp2	Amp3	P_{out}
9.5 mW	MRF21010/S	MRF19030/S	MRF18085A	85 W
9.0 mW	MRF21010/S	MRF19030/S	MRF18090A	90 W
9.5 mW	MRF21010/S	MRF19030/S	MRF18085B	85 W
9.0 mW	MRF21010/S	MRF19030/S	MRF18090B	90 W
15 mW	MRF282SR1/ZR1	MRF19030/S	MRF18085A	85 W
14.2 mW	MRF282SR1/ZR1	MRF19030/S	MRF18090A	90 W
15 mW	MRF282SR1/ZR1	MRF19030/S	MRF18085B	85 W
14.2 mW	MRF282SR1/ZR1	MRF19030/S	MRF18090B	90 W

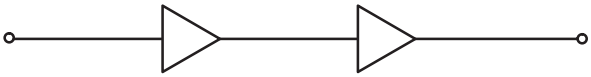
2–CH N–CDMA – 1.9 GHz

13 dB
MRF19030/S
MRF19045/S

11.7 dB
MRF19120/S
MRF19125/S

P_{in}	Amp1	Amp2	P_{out}
406 mW	MRF19030/S	MRF19120/S	120 W
406 mW	MRF19045/S	MRF19125/S	120 W

2–CH W–CDMA, UMTS – 2.1 GHz



13 dB
MRF21030/S

12.5 dB
MRF21180/S

P_{in}	Amp1	Amp2	P_{out}
500 mW	MRF21030/S	MRF21180/S	180 W

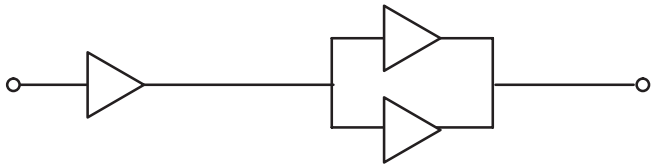
GSM1800, GSM1900 Base Station – Class 1: 30 – 90 Watts, 24 – 26 Volts

60 – 90 W Output

24 dB	13 dB	13 dB	13.5 dB
MHW1810–1 MHW1910–1	MRF18060A MRF18060B	MRF18085A MRF18085B	MRF18090A MRF18090B

P_{in}	Amp1	Amp2	P_{out}
12 mW	MHW1810–1	MRF18060A	60 W
17 mW	MHW1810–1	MRF18085A	85 W
16 mW	MHW1810–1	MRF18090A	90 W
12 mW	MHW1910–1	MRF18060B	60 W
17 mW	MHW1910–1	MRF18085B	85 W
16 mW	MHW1910–1	MRF18090B	90 W

30 – 40 W Output

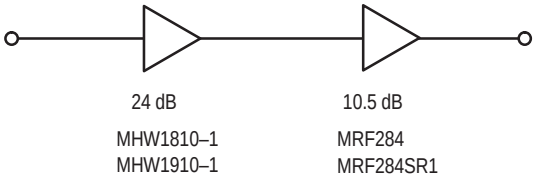


24 dB	10.5 dB	13 dB	14 dB
MHW1810–1 MHW1910–1	MRF284 MRF284SR1	MRF19030/S	MRF19045/S

P_{in}	Amp1	Amp2	P_{out}
10.6 mW	MHW1810–1	MRF284/SR1	30 W
6.0 mW	MHW1810–1	MRF19030/S	30 W
7.13 mW	MHW1810–1	MRF19045/S	45 W
10.6 mW	MHW1910–1	MRF284/SR1	30 W
6.0 mW	MHW1910–1	MRF19030/S	30 W
7.13 mW	MHW1910–1	MRF19045/S	45 W

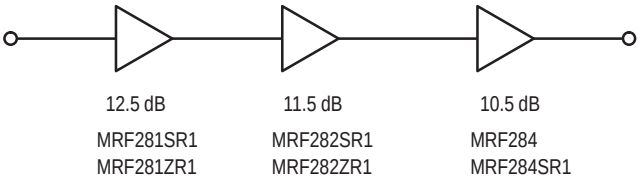
GSM1800, GSM1900 Base Station – Class 2: 30 – 45 Watts, 24 – 26 Volts

30 W Output



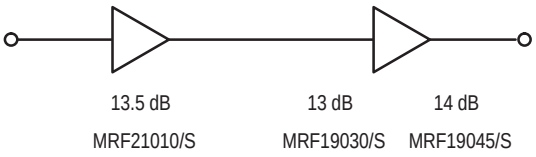
P_{in}	Amp1	Amp2	P_{out}
10.6 mW	MHW1810–1	MRF284/SR1	30 W
10.6 mW	MHW1910–1	MRF284/SR1	30 W

30 W Output



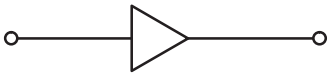
P_{in}	Amp1	Amp2	Amp3	P_{out}
10.6 mW	MRF281SR1/ZR1	MRF282SR1/ZR1	MRF284/SR1	30 W

30 – 45 W Output



P_{in}	Amp1	Amp2	P_{out}
67 mW	MRF21010/S	MRF19030/S	30 W
80 mW	MRF21010/S	MRF19045/S	45 W

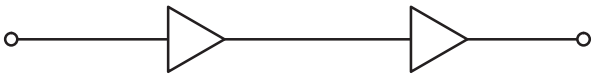
GSM1800, GSM1900 Base Station – Class 3: 5 – 10 Watts, 24 – 26 Volts Microcell



24 dB

MHW1810–1
MHW1910–1

P_{in}	Amp1	P_{out}
40 mW	MHW1810–1	10 W
40 mW	MHW1910–1	10 W

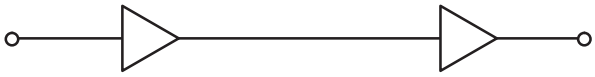


12.5 dB | 13.5 dB | 11.5 dB

MRF281SR1
MRF281ZR1 | MRF21010/S | MRF282SR1
MRF282ZR1

P_{in}	Amp1	Amp2	P_{out}
25 mW	MRF281SR1/ZR1	MRF21010/S	10 W
40 mW	MRF281SR1/ZR2	MRF282SR1/ZR2	10 W

GSM900 Base Station – Class 4: 85 – 120 Watts, 24 – 26 Volts

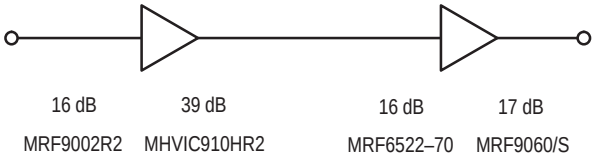


16 dB | 39 dB | 17.9 dB | 16 dB

MRF9002R2 | MHVIC910HR2 | MRF9085/S | MRF9120/S

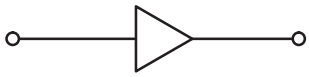
P_{in}	Amp1	Amp2	P_{out}
37 mW	MRF9002R2	MRF9085/S	90 W
76 mW	MRF9002R2	MRF9120/S	120 W
0.183 mW	MHVIC910HR2	MRF9085/S	90 W
0.379 mW	MHVIC910HR2	MRF9120/S	120 W

GSM900 Base Station – Class 5: 60 – 70 Watts, 24 – 26 Volts



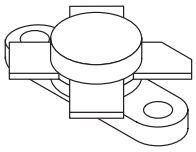
P_{in}	Amp1	Amp2	P_{out}
44 mW	MRF9002R2	MRF6522–70	70 W
30 mW	MRF9002R2	MRF9060/S	60 W
0.221 mW	MHVIC910HR2	MRF6522–70	70 W
0.151 mW	MHVIC910HR2	MRF9060/S	60 W

GSM900 Base Station – Class 7: 5 – 10 Watts, 24 – 26 Volts

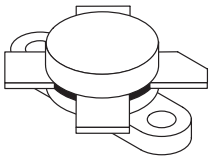


P_{in}	Amp1	P_{out}
252 mW	MRF9002R2	10 W
1.3 mW	MHVIC910HR2	10 W

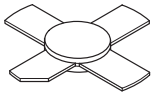
RF Power MOSFETs and Bipolar Transistors Packages



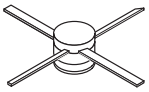
CASE 211–07
STYLE 2
(.380″ FLANGE)



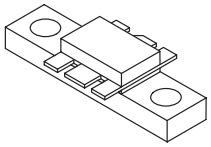
CASE 211–11
STYLE 2
(.500″ FLANGE)



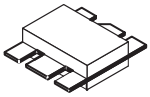
CASE 249
STYLE 3
(.280″ PILL)



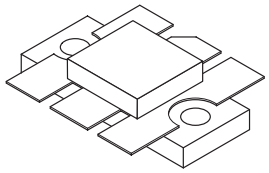
CASE 305A
STYLE 2
(.204″ PILL)



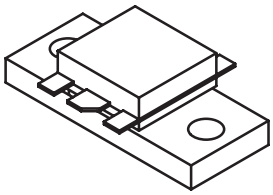
CASE 319
STYLE 2, 3
(CS–12)



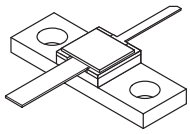
CASE 319A
STYLE 2



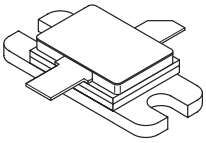
CASE 333
STYLE 2



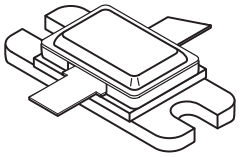
CASE 333A
STYLE 1, 2
(MAAC PAC)



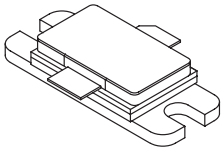
CASE 336E
STYLE 1



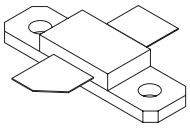
CASE 355C
STYLE 1



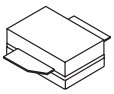
CASE 355E
STYLE 1



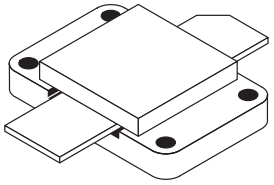
CASE 355J–02
STYLE 1



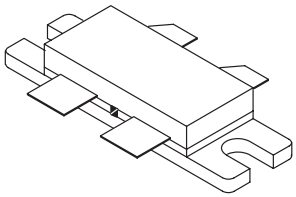
CASE 360B
STYLE 1
(Micro 250)



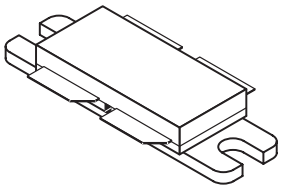
CASE 360C
STYLE 1
(Micro 250S)



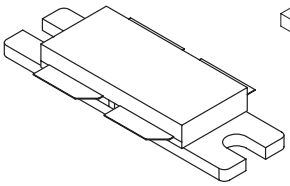
CASE 368
STYLE 2
(HOG PAC)



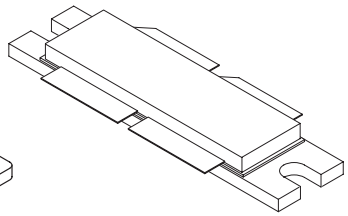
CASE 375
STYLE 2



CASE 375A
STYLE 1

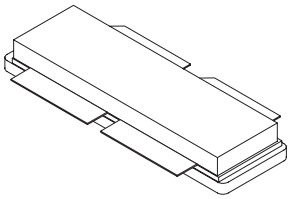


CASE 375B
STYLE 2
(Micro 860)

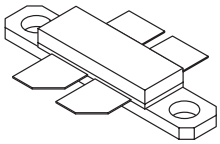


CASE 375D
STYLE 2

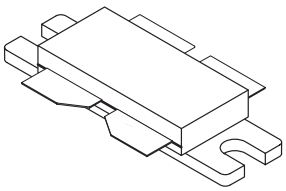
SCALE 1:1



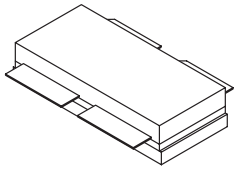
CASE 375E
STYLE 2



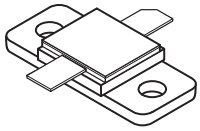
CASE 375F
STYLE 2



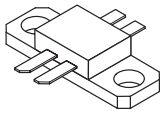
CASE 375G
STYLE 2



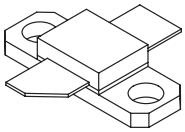
CASE 375H
STYLE 2



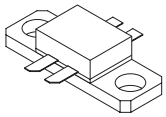
CASE 376B
STYLE 1



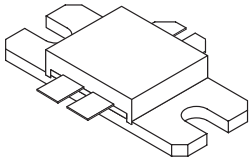
CASE 395B
STYLE 1



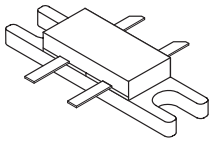
CASE 395C
STYLE 1, 2



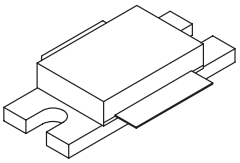
CASE 395E
STYLE 1



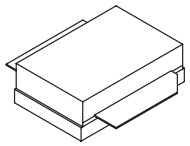
CASE 398
STYLE 1



CASE 412
STYLE 1



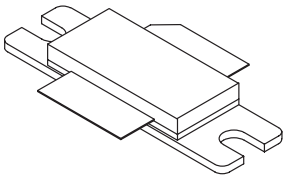
CASE 451
STYLE 1



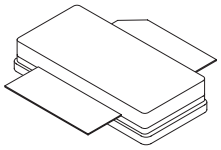
CASE 451A
STYLE 1

CASE 458B
STYLE 1
(Micro 200S)

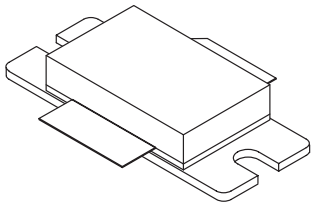
CASE 458C
STYLE 1
(Micro 200Z)



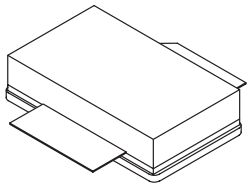
CASE 465
STYLE 1



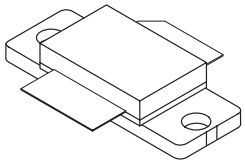
CASE 465A
STYLE 1



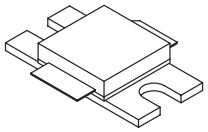
CASE 465B
STYLE 1



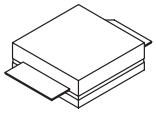
CASE 465C
STYLE 1



CASE 465D
STYLE 1

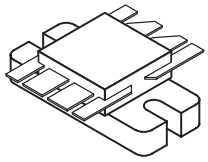


CASE 465E
STYLE 1

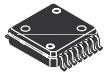


CASE 465F
STYLE 1

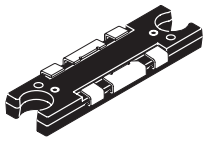
CASE 466
STYLE 1
PLASTIC
(PLD 1.5)



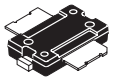
CASE 744A
STYLE 1, 2



CASE 978



CASE 1264
PLASTIC
(TO–272)
STYLE 1



CASE 1265
PLASTIC
(TO–270)
STYLE 1

SCALE 1:1

Motorola RF Amplifier Modules/ICs

Motorola's RF portfolio includes many hybrid designs optimized to perform either in narrowband base station transmitter applications, or in broadband linear amplifiers. Motorola modules feature two or more active transistors (LDMOS, GaAs, or Bipolar die technology) and their associated 50 ohm matching networks. Circuit substrate and metallization have been selected for optimum performance and reliability. For PA designers, hybrid modules offer the benefits of small and less complex system designs, in less time and at a lower overall cost.

Table of Contents

Motorola RF Amplifier Modules/ICs

Complete amplifiers with 50 ohm input and output impedances are available for all popular base station transmitter systems, including GSM and CDMA, covering frequencies from 800 MHz up to 2.2 GHz.

Base Stations

Designed for applications such as macrocell drivers and microcell output stage, these class AB amplifiers are ideal for base station systems at 900, 1800 and 1900 MHz, with power requirements up to 30 watts.

Table 1. Base Stations

Device	Frequency MHz	P1dB Watts	Gain (Min) dB	Supply Voltage Volts	Class	System Application	Die Technology	Package/Style
MHVIC910HR2(18e,46a)	921–960	10	38	26	AB	GSM900	LDMOS–IC	978/–
MHW1810–1	1805–1880	10	24	26	AB	GSM1800	LDMOS	301AW/1
MHW1810–2	1805–1880	10	32	26	AB	GSM1800	LDMOS	301AW/1
MHW1910–1	1930–1990	10	24	26	AB	GSM1900	LDMOS	301AW/1
MHPA19030(46a)	1930–1990	30	25	26	AB	PCS1900	LDMOS	301AP/1
MHPA21030(46a)	2110–2170	30	25	26	AB	W–CDMA	LDMOS	301AP/1

Table 2. Base Station Drivers

These 50 ohm amplifiers are recommended for modern multi–tone CDMA, TDMA and UMTS base station pre–driver applications. Their high third–order intercept point, tight phase and gain control, and excellent group delay characteristics make these devices ideal for use in high–power feedforward loops.

Ultra–Linear (for CDMA, W–CDMA, TDMA, Analog) – Class A (LDMOS Die) – Lateral MOSFETs

Device	Frequency Band MHz	V_{DD} (Nom.) Volts	I_{DD} (Nom.) mA	Gain (Nom.) dB	Gain Flatness (Typ) ±dB	P_{1dB} (Typ) dBm	3rd Order Intercept (Typ) dBm	NF (Typ) dB	Case/ Style
MHL9838	800–925	28	770	31	.1	39	50	3.7	301AP/1
MHL9236	800–960	26	550	30.5	.1	34	47	3.5	301AP/1
MHL9236M	800–960	26	550	30.5	.1	34	47	3.5	301AP/2
MHL9318	860–900	28	500	17.5	.1	35.5	49	3.0	301AS/1
MHL18336(46a)	1800–1900	26	500	30	.2	36	46	4.2	301AP/1
MHL18936(46a)	1800–1900	26	1400	30	.2	41	51	4.2	301AY/1
MHL19338	1900–2000	28	500	30	.1	36	46	4.2	301AP/1
MHL19936★	1900–2000	26	1400	29	.2	41	49.5	4.2	301AY/1
MHL21336	2110–2170	26	500	31	.15	35	45	4.5	301AP/1

(18)Tape and Reel Packaging Option Available by adding suffix: a) R1 = 500 units; b) R2 = 2,500 units; c) T1 = 3,000 units; d) T3 = 10,000 units; e) R2 = 1,500 units; f) T1 = 1,000 units; g) R2 = 4,000 units; h) R1 = 1,000 units; i) R3 = 250 units; j) T1 = 500 units; k) R2 = 450 units.

(46)To be introduced: a) 1Q01; b) 2Q01; c) 3Q01

★New Product

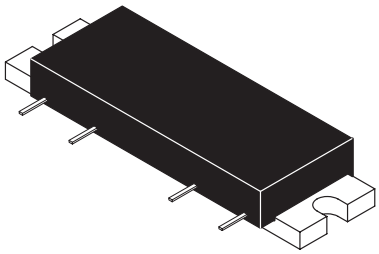
Wideband Linear Amplifiers

Table 1. Standard 50 Ohm Linear Hybrid

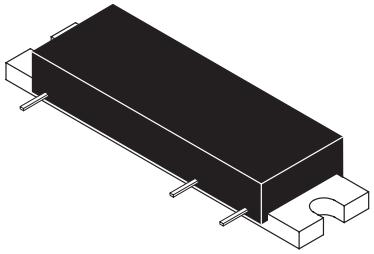
This series of RF linear hybrid amplifier has been optimized for wideband, 50 ohm applications. These amplifiers were designed for multi–purpose RF applications where linearity, dynamic range and wide bandwidth are of primary concern. The MHL series utilizes a new case style that provides microstrip input and output connections.

Device	Frequency Band MHz	V_{CC} (Nom.) Volts	I_{CC} (Nom.) mA	Gain/Freq. (Typ) dB/MHz	Gain Flatness (Typ) ±dB	P_{1dB} (Typ) dBm	3rd Order Intercept Point/Freq. (Typ) dBm/MHz	NF/Freq. (Typ) dB/MHz	Case/ Style
MHL8018	40–1000	28	210	18.5/900	1	26	38/1000	7.5/1000	448/1
MHL8115	40–1000	15	700	17.5/900	1	30	41.5/1000	8.5/1000	448/2
MHL8118	40–1000	28	400	17.5/900	1	30	41.5/1000	8.5/1000	448/1

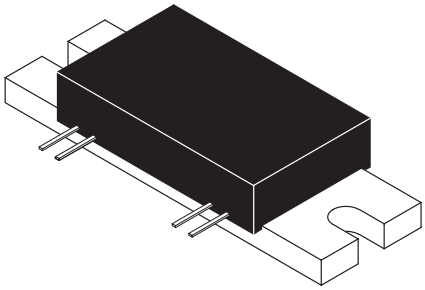
RF Amplifier Modules Packages



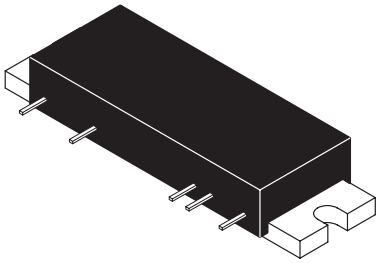
CASE 301AP
STYLE 1, 2



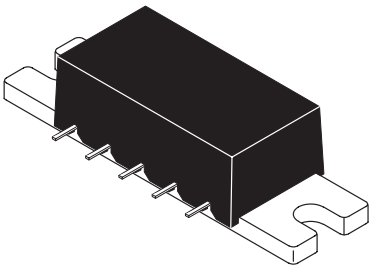
CASE 301AS
STYLE 1



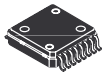
CASE 301AW
STYLE 1



CASE 301AY
STYLE 1



CASE 448
STYLE 1, 2



CASE 978

SCALE 1:1

Motorola RF CATV Distribution Amplifiers

Motorola Hybrids are manufactured using the latest CATV generation technology which has set new standards for CATV system performance and reliability. These hybrids have been optimized to provide premium performance in all CATV systems up to 152 channels. Additions to our CATV product family include 40–870 MHz high output gallium arsenide (GaAs) power doublers as well as low distortion, low power consumption reverse amplifiers.

Table of Contents

Motorola RF CATV Distribution Amplifiers

Motorola Hybrids are manufactured using the latest generation technology which has set new standards for CATV system performance and reliability. These hybrids have been optimized to provide premium performance in all CATV systems up to 152 channels.

Forward Amplifiers

40–1000 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) @ 50 MHz dB	Channel Loading Capacity	Maximum Distortion Specifications				Noise Figure @ 1000 MHz dB Max	Package/ Style
			Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 152 CH	Cross Modulation dB 152 CH		
MHW9182B	18.5	152	+38	–63(40)	–61	–61	7.5	714Y/1
MHW9242A	24	152	+38	–61(40)	–58	–59	8.0	714Y/1

40–870 MHz High Output Gallium Arsenide Power Doubler

Device	Hybrid Gain (Nom.) @ 870 MHz dB	Channel Loading Capacity	Maximum Distortion Specifications				Noise Figure @ 870 MHz dB Max	Package/ Style
			Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 132 CH	Cross Modulation dB 132 CH		
MHW9187(46b)	20	132	+48	–62(34)	–58	–55	4.5	1302/1

40–860 MHz Hybrids

Device	Gain dB Typ @ 50 MHz	Frequency MHz	V_{CC} Volts	2nd Order IMD @ V_{out} = 50 dBmV/ch Max	DIN45004B @ f=860 MHz dBμV Min	Noise Figure @ 860 MHz dB Max	Package/ Style
CA901	17	40 – 860	24	–60	120	8.0	714P/2
Power Doubling Hybrids							
CA922	17	40 – 860	24	–63	123	9.5	714P/2
CA922A	17	40 – 860	24	–67	123	9.5	714P/2

40–860 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) @ 50 MHz dB	Channel Loading Capacity	Maximum Distortion Specifications				Noise Figure @ 860 MHz dB Max	Package/ Style
			Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 128 CH	Cross Modulation FM = 55 MHz dB 128 CH		
MHW8182B	18.5	128	+38	–64(40)	– 66	– 65	7.5	714Y/1
MHW8222B★	21.9	128	+38	–60(40)	– 64	– 63	7.0	1302/1
MHW8242A	24	128	+38	–62(40)	– 64	– 62	7.5	714Y/1
MHW8272A	27.2	128	+38	–64(40)	– 64	– 62	7.0	714Y/1
MHW8292	29	128	+38	–56(40)	– 60	– 60	7.0	714Y/1

(34)Composite 2nd Order; V_{out} = +48 dBmV/ch

(40)Composite 2nd Order; V_{out} = +38 dBmV/ch

(46)To be introduced: a) 1Q01; b) 2Q01; c) 3Q01

★New Product

CATV Distribution: Forward Amplifiers (continued)

40 – 860 MHz Hybrids, V_{CC} = 24 Vdc, Class A (continued)

Device	Hybrid Gain (Nom.) @ 50 MHz dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 128 CH	Cross Modulation FM = 55 MHz dB 128 CH	Noise Figure @ 860 MHz dB Max	Package/ Style
Power Doubling Hybrids								
MHW8185L(21)	18.5	128	+40	–62(39)	– 63	– 64	8.5*	714Y/1
MHW8185LR(28)	18.5	128	+40	–62(39)	– 63	– 64	8.5*	714Y/2
MHW8185	18.8	128	+40	–62(39)	– 64	– 64	8.0	714Y/1
MHW8185R(14)	18.8	128	+40	–62(39)	– 64	– 64	8.0	714Y/2
MHW8205L(22)	19.5	128	+40	–60(39)	– 63	– 64	8.5*	714Y/1
MHW8205	19.8	128	+40	–60(39)	– 63	– 64	8.0	714Y/1
MHW8205R(24)	19.8	128	+40	–60(39)	– 63	– 64	8.0	714Y/2

*@ 870 MHz

40 – 750 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) @ 50 MHz dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 110 CH	Cross Modulation FM = 55 MHz dB 110 CH	Noise Figure @ 750 MHz dB Max	Package/ Style
MHW7182B	18.5	110	+40	–63(39)	– 66	– 64	6.5	714Y/1
MHW7222B★	21.9	110	+40	–60(39)	– 61	– 60	6.5	1302/1
MHW7272A	27.2	110	+40	–64(39)	– 64	– 60	6.5	714Y/1
MHW7292	29	110	+40	–60(39)	– 60	– 60	6.5	714Y/1
Power Doubling Hybrids								
MHW7185CL(23)	18.5	110	+44	–64(36)	–61	–63	7.5	714Y/1
MHW7185C	18.8	110	+44	–64(36)	–62	–63	7.5	714Y/1
MHW7205CL(27)	19.5	110	+44	–63(36)	–61	–62	7.5	714Y/1
MHW7205C	19.8	110	+44	–63(36)	–61	–62	7.5	714Y/1

(14)Mirror Amplifier Version of MHW8185
(21)Low DC Current Version of MHW8185; Typical I_{CC} @ Vdc = 24 V is 365 mA.
(22)Low DC Current Version of MHW8205; Typical I_{CC} @ Vdc = 24 V is 365 mA.
(23)Low I_{CC} Version of MHW7185C; Typical I_{CC} @ Vdc = 24 V is 365 mA.
(24)Mirror Amplifier Version of MHW8205
(27)Low I_{CC} Version of MHW7205C; Typical I_{CC} @ Vdc = 24 V is 365 mA.
(28)Mirror Amplifier Version of MHW8185L
(36)Composite 2nd order; V_{out} = +44 dBmV/ch
(39)Composite 2nd order; V_{out} = +40 dBmV/ch
(46)To be introduced: a) 1Q01; b) 2Q01; c) 3Q01
★New Product

CATV Distribution: Forward Amplifiers (continued)

40–550 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) @ 50 MHz dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 77 CH	Cross Modulation dB 77 CH	Noise Figure @ 550 MHz dB Max	Package/ Style
MHW6342T	34.5	77	+44	–64(35)	–57	–57	6.5	1302/1

Reverse Amplifiers

5–200 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test(30) dB	Composite Triple Beat dB 22 CH	Composite Triple Beat dB 26 CH	Cross Modulation dB 22 CH	Cross Modulation dB 26 CH	Noise Figure @ 175 MHz dB Max	Package/ Style
MHW1224	22	22	+50	–72	–69	–68.5(19)	–62	–62(19)	5.5	714Y/1
MHW1244	24	22	+50	–72	–68	–67.5(19)	–61	–61(19)	5.0	714Y/1

Low Current Amplifiers — 5–200 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB 6 CH	2nd Order Test dB 10 CH	Composite Triple Beat dB 6 CH	Composite Triple Beat dB 10 CH	Cross Modulation dB 6 CH	Cross Modulation dB 10 CH	DC Current mA Typ.	Noise Figure @ 200 MHz dB Max	Pkg/ Style
MHW1223LA★	22.7	6,10	50	–68	–65	–75	–66	–65	–60	95	7.0	1302/1
MHW1253LA★	25.5	6,10	50	–68	–66	–75	–66	–65	–61	95	6.5	1302/1
MHW1303LA★	30.8	6,10	50	–68	–65	–74	–64	–64	–58	95	5.7	1302/1

Low Current Amplifiers — 5–150 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB 6 CH	2nd Order Test dB 10 CH	Composite Triple Beat dB 6 CH	Composite Triple Beat dB 10 CH	Cross Modulation dB 6 CH	Cross Modulation dB 10 CH	DC Current mA Typ.	Noise Figure @ 150 MHz dB Max	Pkg/ Style
MHW1353LA★	35.2	6,10	50	–68	–65	–73	–62	–63	–57	95	5.4	1302/1

(19)Typical
(30)Channels 2 and A @ 7
(35)Channels 2 and M30 @ M39
(36)Composite 2nd order; V_{out} = +44 dBmV/ch
★New Product

CATV Distribution: Reverse Amplifiers (continued)

Low Current Amplifiers — 5–65 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications						DC Current mA Typ.	Noise Figure @ 65 MHz dB Max	Pkg/ Style
			Output Level dBmV	2nd Order Test dB		Composite Triple Beat dB		Cross Modulation dB			
				6 CH	10 CH	6 CH	10 CH	6 CH	10 CH		
MHW1224LA★	22.7	6,10	50	–68	–65	–75	–66	–65	–60	95	7.0	1302/1
MHW1254LA★	25.5	6,10	50	–68	–66	–75	–66	–65	–61	95	6.5	1302/1
MHW1304LA★	30.8	6,10	50	–68	–65	–74	–64	–64	–58	95	5.7	1302/1
MHW1354LA★	35	6,10	50	–68	–65	–73	–62	–63	–57	95	5.2	1302/1

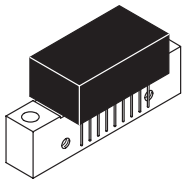
Low Current Amplifiers — 5–50 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	I_{DC} mA Max	Maximum Distortion Specifications				Noise Figure @ 50 MHz dB Max	Package/ Style
				Output Level dBmV	2nd Order Test[30] dB	Composite Triple Beat dB	Cross Modulation dB		
						4 CH	4 CH		
MHW1254L	25	4	135	+50	–70	–70	–62	4.5	714Y/1
MHW1304L	30	4	135	+50	–70	–66	–57	4.5	714Y/1

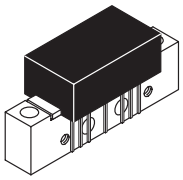
[30]Channels 2 and A @ 7

★New Product

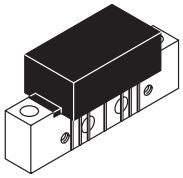
RF CATV Distribution Amplifiers Packages



CASE 714P
STYLE 2



CASE 714Y
STYLE 1, 2



CASE 1302
STYLE 1

SCALE 1:2

Literature

Application Notes, Engineering Bulletins and Article Reprints of special interest to designers of RF and RF/IF equipment are listed below. This technical documentation is available on the Motorola Semiconductor Product Sector Web site or is available through the Motorola Literature Distribution Center. Phone and fax numbers for ordering literature are listed on the back cover of this book and in our Accessing Data On–line section.

Application Notes

AN139A Understanding Transistor Response Parameters
AN211A Field Effect Transistors in Theory and Practice
AN215A RF Small–Signal Design Using Two–Port Parameters
AN238 Transistor Mixer Design Using 2–Port Parameters
AN267 Matching Network Designs with Computer Solutions
AN282A Systemizing RF Power Amplifier Design
AN419 UHF Amplifier Design Using Data Sheet Design Curves
AN423 Field Effect Transistor RF Amplifier Design Techniques
AN535 Phase–Locked–Loop Design Fundamentals
AN548A Microstrip Design Techniques for UHF Amplifiers
AN555 Mounting Stripline–Opposed–Emitter (SOE) Transistors
AN593 Broadband Linear Power Amplifiers Using Push–Pull Transistors
AN721 Impedance Matching Networks Applied to RF Power Transistors
AN749 Broadband Transformers and Power Combining Techniques for RF
AN758 A Two–Stage 1 kW Solid–State Linear Amplifier
AN762 Linear Amplifiers for Mobile Operation
AN779 Low–Distortion 1.6 to 30 MHz SSB Driver Designs
AN790 Thermal Rating of RF Power Transistors
AN791 A Simplified Approach to VHF Power Amplifier Design
AN827 The Technique of Direct Programming by Using a Two–Modulus Prescaler
AN860 Power MOSFETs versus Bipolar Transistors
AN878 VHF MOS Power Applications
AN923 800 MHz Test Fixture Design
AN955 A Cost Effective VHF Amplifier for Land Mobile Radios
AN1022 Mechanical and Thermal Considerations in Using RF Linear Hybrid Amplifiers
AN1024 RF Linear Hybrid Amplifiers
AN1025 Reliability Considerations in Design and Use of RF Integrated Circuits
AN1026 Extending the Range of an Intermodulation Distortion Test
AN1027 Reliability/Performance Aspects of CATV Amplifier Design
AN1028 35/50 Watt Broadband (160 – 240 MHz) Push–Pull TV Amplifier Band III
AN1029 TV Transposers Band IV and VP_O = 0.5 W/1.0 W
AN1030 1 W/2 W Broadband TV Amplifier Band IV and V
AN1032 How Load VSWR Affects Non–Linear Circuits
AN1033 Match Impedances in Microwave Amplifiers
AN1034 Three Balun Designs for Push–Pull Amplifiers
AN1037 Solid–State Power Amplifier — 300 Watt FM, 88–108 MHz
AN1038 1.2 V, 40 – 900 MHz Broadband Amplifier with the TP3400 Transistor
AN1039 470 – 860 MHz — Broadband Amplifier – 5 W
AN1040 Mounting Considerations for Power Semiconductors
AN1041 Mounting Procedures for Very High Power RF Transistors
AN1107 Understanding RF Data Sheet Parameters
AN1207 The MC145170 in Basic HF and VHF Oscillators
AN1253 An Improved PLL Design Method Without ϖn and ζ
AN1277 Offset Reference PLLs for Fine Resolution or Fast Hopping
AN1526 RF Power Device Impedances: Practical Considerations
AN1528 Packaging Considerations for RF Transistors
AN1529 RF Power Circuit Concepts Using FETs and BJTs
AN1530 Motorola Advanced Amplifier Concept Package
AN1531 Parameter Extraction Techniques for RF Power Transistors Models
AN1539 An IF Communication Circuit Tutorial
AN1575 Worldwide Cordless Telephone Frequencies
AN1580 Mounting and Soldering Recommendations for the Motorola Power Flat Pack Package
AN1599 Power Control with the MRFIC0913 GaAs Integrated Power Amplifier and MC33169 Support IC
AN1602 3.6 V and 4.8 V GSM/DCS1800 Dual Band PA Application with DECT Capability Using Standard Motorola RFIC's
AN1617 Mounting Recommendations for Copper Tungsten Flanged Transistors
AN1639 Phase Noise Measurement Using the Phase Lock Technique
AN1643 RF LDMOS Power Modules for GSM Base Station Application: Optimum Biasing Circuit
AN1658 Converting MC13110/13111 Based Designs to the MC13110A,B/13111A,B
AN1670 60 Watts, GSM 900 MHz, LDMOS Two–Stage Amplifier
AN1671 MC145170 PSpice Modeling Kit

Literature (continued)

AN1673 Solder Reflow Mounting Method for the MRF286 and Similar Packages
AN1674 Mounting Method with Mechanical Fasteners for the MRF286 and Similar Packages
AN1687 A Full–Featured Wireless Interface for RS–232 Communications
AN1691 Practical Solutions for Medium Data Rate Wireless Communications
AN1696 Broadband Intermodulation Performance Development Using the Rohde & Schwarz Vector Network Analyzer ZVR
AN1697 GSM900/DCS/1800 Dual–Band 3.6 V Power Amplifier Solution with Open Loop Control Scheme
AN1900 CDMA Upmixer Design Considerations Using the MRFIC1854
AN4005 Thermal Management and Mounting Method for the PLD 1.5 RF Power Surface Mount Package

Article Reprints

AR141 Applying Power MOSFETs in Class D/E RF Power Amplifier Design
AR164 Good RF Construction Practices and Techniques
AR165S RF Power MOSFETs
AR176 New MOSFETs Simplify High Power RF Amplifier Design
AR254 Phase–Locked Loop Design Articles
AR305 Building Push–Pull, Multioctave, VHF Power Amplifiers
AR313 Wideband RF Power Amplifier
AR346 RF Power FETs – Their Characteristics and Applications, Parts 1 & 2
AR347 A Compact 1–kW 2–50 MHz Solid State Linear Amplifier
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AR606 PCS and RF Components
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AR614 Advantages of LDMOS in High Power Linear Amplification
AR624 Aluminum–Based Metallization Enhances Device Reliability
AR628 Impedance Measurements for High Power RF Transistors Using the TRL Method
AR629 Digital Predistortion Techniques for RF Power Amplifiers with CDMA Applications

Engineering Bulletins

EB19 Controlled – Q RF Technology — What It Means, How It's Done
EB27A Get 300 Watts PEP Linear Across 2 to 30 MHz from This Push–Pull Amplifier
EB38 Measuring the Intermodulation Distortion of Linear Amplifiers
EB63 140 W (PEP) Amateur Radio Linear Amplifier 2 – 30 MHz
EB74 A 10 Watt, 225 – 400 MHz Amplifier — MRF331
EB77 A 60–Watt, 225 – 400 MHz Amplifier — 2N6439
EB89 A 1–Watt, 2.3 GHz Amplifier
EB104 Get 600 Watts RF from Four Power FETs
EB105 A 30 Watt, 800 MHz Amplifier Design
EB107 Mounting Considerations for Motorola RF Power Modules
EB202 RF Transistor Design
EB209 Mounting Method for RF Power Leadless Surface Mount Transistors
EB211 Thermal Management and Solder Mounting Method for the MRF286, 60 Watt Power Device in a CuW (Copper Tungsten) Base Package

Product Literature

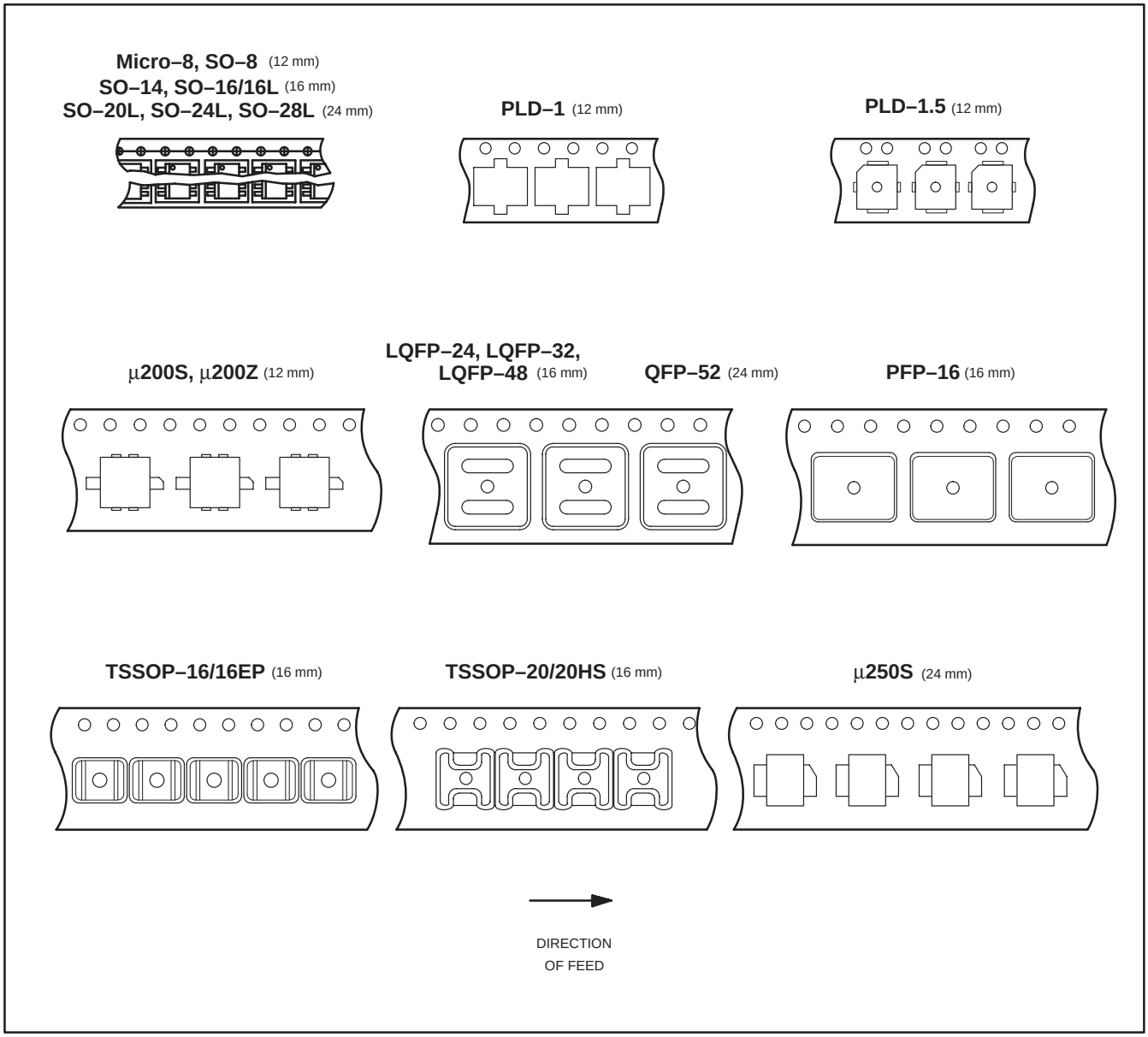
DL110/D Wireless RF, IF and Transmitter Device Data Book
SG46/D Wireless RF, IF and Transmitter Selector Guide
CD301PC/D Wireless RF, IF and Transmitter Data Library CD–ROM for PC
CD301MAC/D Wireless RF, IF and Transmitter Data Library CD–ROM for Macintosh
BR1502/D Wireless Infrastructure Solutions
BR1504/D RF Power Solutions
BR3031/D Wireless Infrastructure DSP Solutions
SG384/D RF LDMOS Infrastructure Technology Selector Guide

RF and IF Tape and Reel Specifications

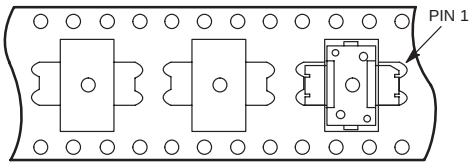
Embossed Tape and Reel is used to facilitate automatic pick and place equipment feed requirements. The tape is used as the shipping container for various products and requires a minimum of handling. The antistatic/conductive tape provides a secure cavity for the product when sealed with the “peel–back” cover tape.

- Two Reel Sizes Available (7″ and 13″)
- Used for Automatic Pick and Place Feed Systems
- Minimizes Product Handling
- EIA 481, –1, –2
- BCC32EP++, Micro–8, PLD–1, PLD–1.5, SO–8, µ200S, µ200Z in 12 mm Tape
- SO–14, SO–16/16L, LQFP24, LQFP–32, LQFP–48, TSSOP–16/16EP, TSSOP–20/20HS in 16 mm Tape
- QFP–52, SO–20L, SO–24L, SO–28L, TO–270, µ250S in 24 mm Tape
- NI–600 in 32 mm Tape
- TO–272 in 44 mm Tape

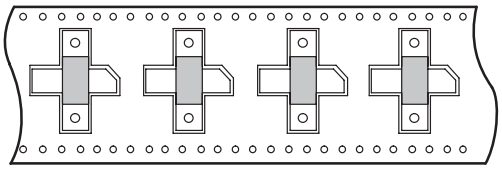
Use the standard device title and add the required suffix as listed in the option table on the following page. Note that the individual reels have a finite number of devices depending on the type of product contained in the tape. Also note the minimum lot size is one full reel for each line item, and orders are required to be in increments of the single reel quantity.



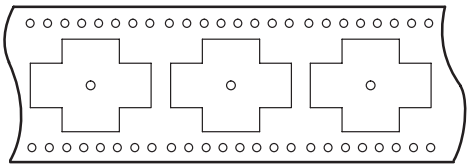
TO–270 (24 mm)



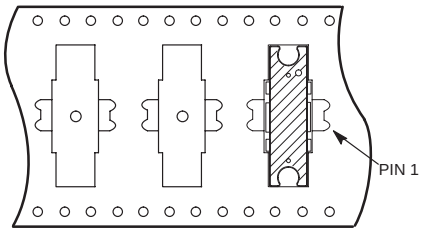
μ250 (32 mm)



NI–600 (32 mm)



TO–272 (44 mm)



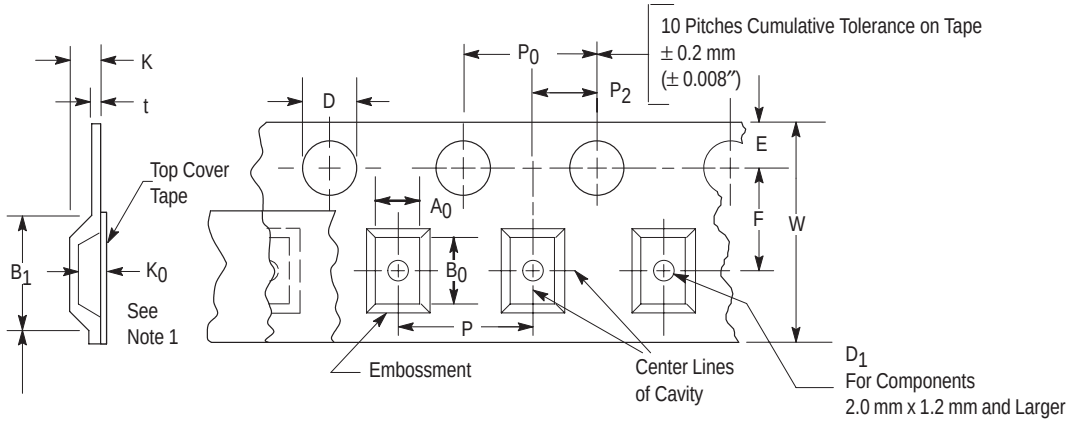
DIRECTION
OF FEED

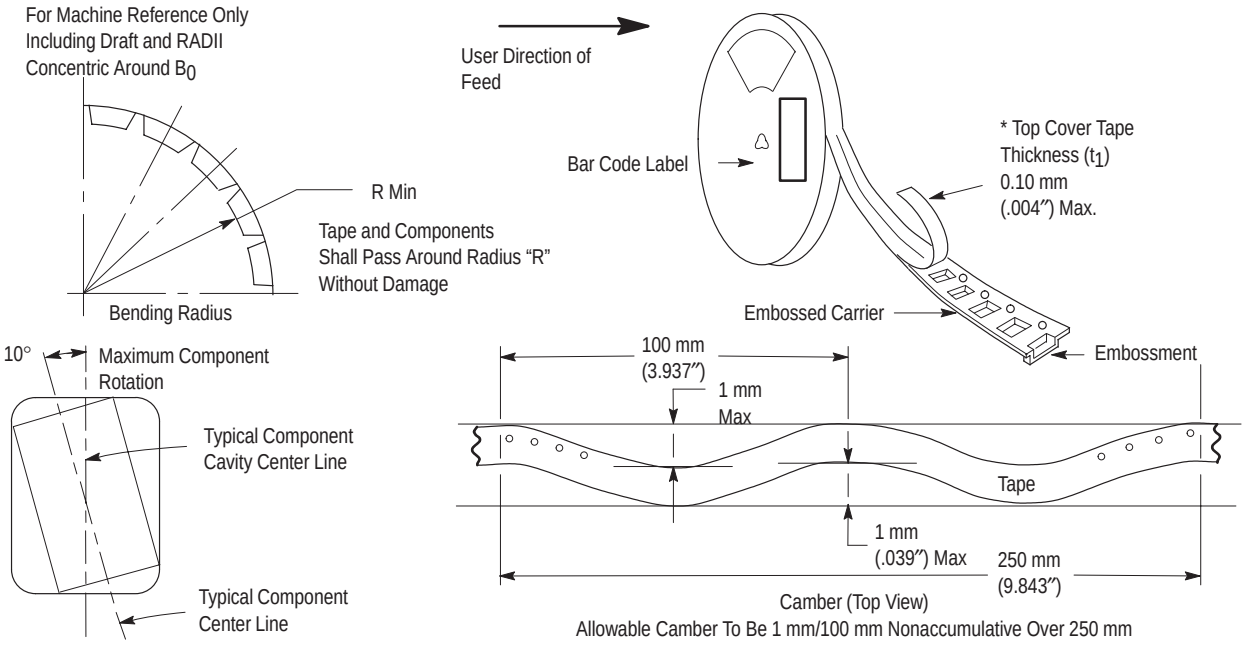
RF and IF EMBOSSED TAPE AND REEL ORDERING INFORMATION

Package	Tape Width (mm)	Pitch mm (inch)	Reel Size mm (inch)	Devices Per Reel and Minimum Order Quantity	Device Suffix
BCC32EP++	12	8.0 ± 0.1 (.315 ± .004)	330 (13)	2,500	R2
Micro–8	12	8.0 ± 0.1 (.315 ± .003)	330 (13)	2,500	R2
PLD–1	12	8.0 ± 0.1 (.315 ± .004)	178 (7)	1,000	T1
PLD–1.5	12	8.0 ± 0.1 (.315 ± .004)	178 (7)	1,000	T1
PFP–16	16	12.0 ± 0.1 (.472 ± .004)	330 (13)	1,500	R2
LQFP–24	16	12.0 ± 0.1 (.472 ± .004)	330 (13)	2,000	R2
LQFP–32	16	12.0 ± 0.1 (.472 ± .004)	330 (13)	1,800	R2
LQFP–48	16	12.0 ± 0.1 (.472 ± .004)	330 (13)	2,000	R2
QFP–52	24	24.0 ± 0.1 (.945 ± .004)	330 (13)	1,500	R2
SO–8	12	8.0 ± 0.1 (.315 ± .004)	330 (13)	2,500	R2
SO–14	16	8.0 ± 0.1 (.315 ± .004)	330 (13)	2,500	R2
SO–16/16L	16	8.0 ± 0.1 (.315 ± .004)	330 (13)	2,500	R2
SO–20L	24	12.0 ± 0.1 (.472 ± .004)	330 (13)	1,000	R2
SO–24L	24	12.0 ± 0.1 (.472 ± .004)	330 (13)	1,000	R2
SO–28L	24	12.0 ± 0.1 (.472 ± .004)	330 (13)	1,000	R2
TSSOP–16/16EP	16	8.0 ± 0.1 (.315 ± .004)	330 (13)	2,500	R2
TSSOP–20/20HS	16	8.0 ± 0.1 (.315 ± .004)	330 (13)	2,500	R2
µ200S (458B)	12	12.0 ± 0.1 (.471 ± .004)	178 (7)	500	R1
µ200Z (458C)	12	12.0 ± 0.1 (.471 ± .004)	178 (7)	500	R1
µ250S (360C)	24	16.0 ± 0.1 (.631 ± .004)	330 (13)	500	R1
µ250 (360B)	32	24.0 ± 0.1 (.945 ± .004)	330 (13)	500	R1
NI–600 (465D)	32	32.0 ± 0.1 (1.26 ± .004)	330 (13)	250	R3
TO–270	24	16.0 ± 0.1 (.631 ± .004)	330 (13)	500	R1
TO–272	44	16.0 ± 0.1 (.631 ± .004)	330 (13)	500	T1

EMBOSSED TAPE AND REEL DATA FOR DISCRETES

CARRIER TAPE SPECIFICATIONS





DIMENSIONS

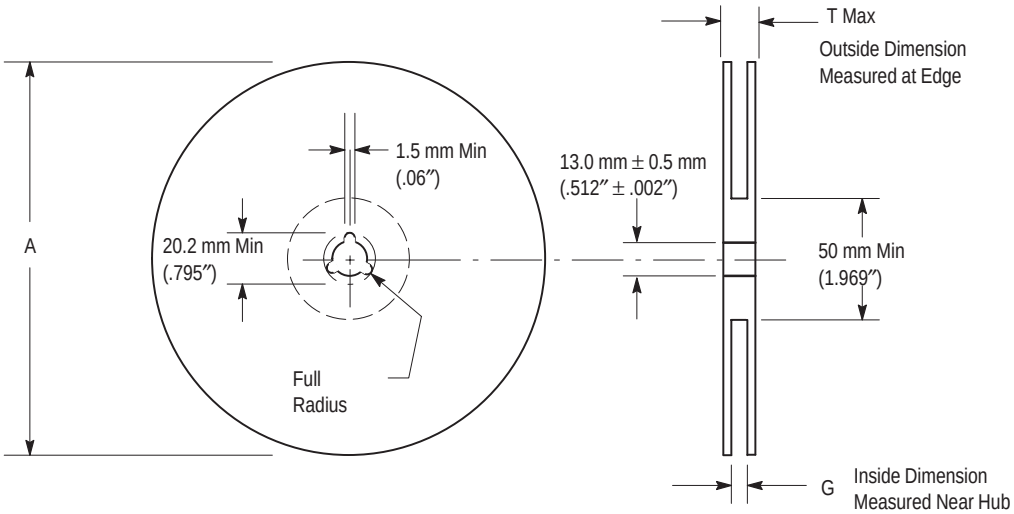
Tape Size	B_1 Max	D	D_1	E_1	F	K	P_0	P_2	R Min	T Max	W Max
12 mm	8.2 mm (.323″)	1.5 + 0.1 mm −0.0 (.059 + .004″ −0.0)	1.5 mm Min (.060″)	1.75 ± 0.1 mm (.069 ± .004″)	5.5 ± 0.05 mm (.217 ± .002″)	6.4 mm Max (.252″)	4.0 ± 0.1 mm (.157 ± .004″)	2.0 ± 0.1 mm (.079 ± .002″)	30 mm (1.18″)	0.6 mm (.024″)	12 ± .30 mm (.470 ± .012″)
16 mm	12.1 mm (.476″)				7.5 ± 0.10 mm (.295 ± .004″)	7.9 mm Max (.311″)					16.3 mm (.642″)
24 mm	20.1 mm (.791″)				11.5 ± 0.1 mm (.453 ± .004″)	11.9 mm Max (.468″)					24.3 mm (.957″)
32 mm	23.0 mm (.906″)		1.5 mm Min (.059″)		14.2 ± 0.1 mm (.559 ± .004″)	—		2.0 ± 0.1 mm (.079 ± .004″)	50 mm (1.969″)		32.2 mm (1.272″)
44 mm	35.0 mm (1.378″)		2.0 mm Min (.079″)		11.5 ± 0.1 mm (.453 ± .004″)	15.9 mm Max (.625″)		2.0 ± 0.15 mm (.079 ± .006″)		50.4 mm (1.984″)	44 ± .30 mm (1.732 ± .012″)

Metric dimensions govern — English are in parentheses for reference only.

NOTE 1: A_0, B_0, and K_0 are determined by component size. The clearance between the components and the cavity must be within .05 mm min. to .50 mm max., the component cannot rotate more than 10° within the determined cavity.

NOTE 3: Pitch information is contained in the Embossed Tape and Reel Ordering Information on pg. 51.

EMBOSSED TAPE AND REEL DATA FOR DISCRETES



Size	A Max	G	T Max
12 mm	330 mm (12.992″)	12.4 mm + 2.0 mm, –0.0 (.49″ + .079″, –0.00)	18.4 mm (.72″)
16 mm	360 mm (14.173″)	16.4 mm + 2.0 mm, –0.0 (.646″ + .078″, –0.00)	22.4 mm (.882″)
24 mm	360 mm (14.173″)	24.4 mm + 2.0 mm, –0.0 (.961″ + .070″, –0.00)	30.4 mm (1.197″)
32 mm	360 mm (14.163″)	32.4 mm + 2.0 mm, –0.0 (1.276″+ 0.79″, –0.00)	0.6 mm (.024″)
44 mm	330 mm (12.992″)	44.4 mm + 2.0 mm, –0.0 (1.748″+ 0.79″, –0.00)	50.4 mm (1.984″)

Reel Dimensions

Metric Dimensions Govern — English are in parentheses for reference only

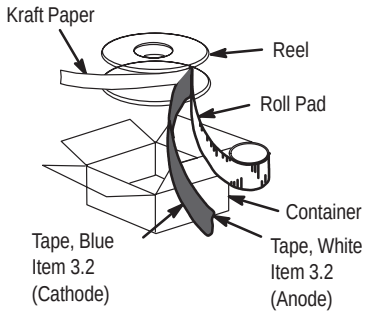


Figure 1. Reel Packing

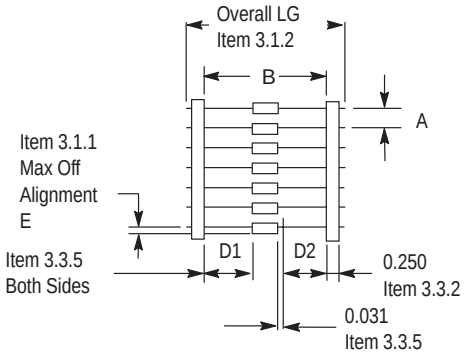


Figure 2. Component Spacing

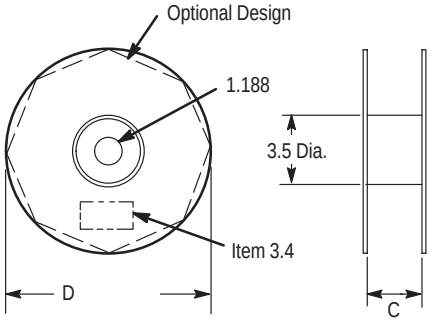
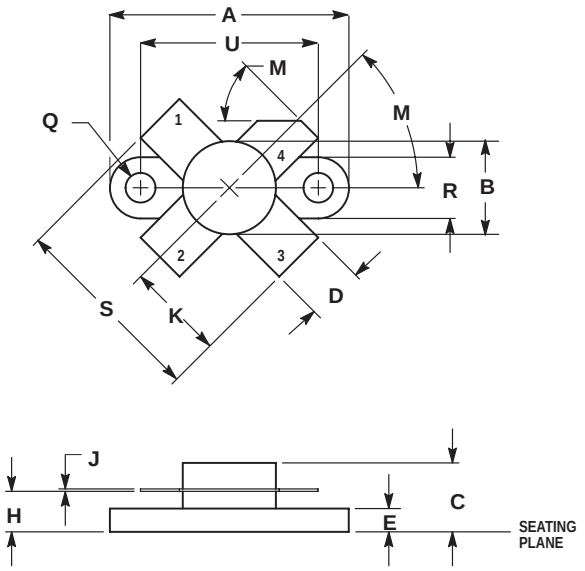


Figure 3. Reel Dimensions

Case Dimensions

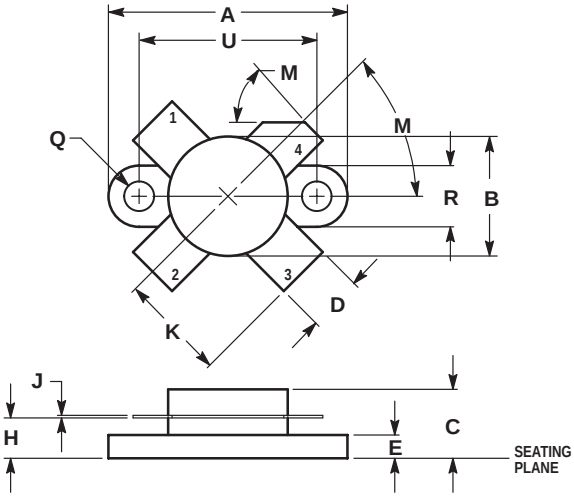


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.960	0.990	24.39	25.14
B	0.370	0.390	9.40	9.90
C	0.229	0.281	5.82	7.13
D	0.215	0.235	5.47	5.96
E	0.085	0.105	2.16	2.66
H	0.150	0.108	3.81	4.57
J	0.004	0.006	0.11	0.15
K	0.395	0.405	10.04	10.28
M	40 °	50 °	40 °	50 °
Q	0.113	0.130	2.88	3.30
R	0.245	0.255	6.23	6.47
S	0.790	0.810	20.07	20.57
U	0.720	0.730	18.29	18.54

STYLE 2:
PIN 1. SOURCE
2. GATE
3. SOURCE
4. DRAIN

CASE 211–07
ISSUE N
(.380″ FLANGE)

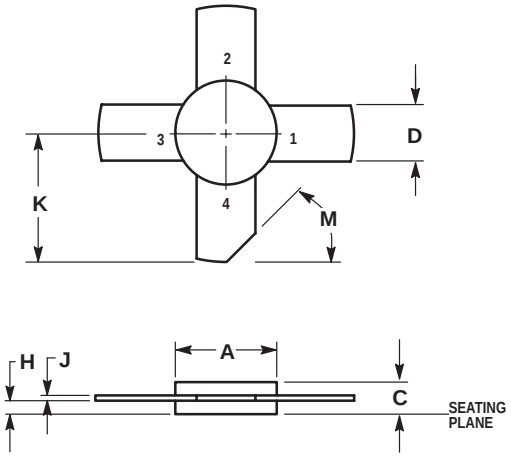


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.960	0.990	24.39	25.14
B	0.465	0.510	11.82	12.95
C	0.229	0.275	5.82	6.98
D	0.216	0.235	5.49	5.96
E	0.084	0.110	2.14	2.79
H	0.144	0.178	3.66	4.52
J	0.003	0.007	0.08	0.17
K	0.435	—	11.05	—
M	45 °NOM		45 °NOM	
Q	0.115	0.130	2.93	3.30
R	0.246	0.255	6.25	6.47
U	0.720	0.730	18.29	18.54

STYLE 2:
PIN 1. SOURCE
2. GATE
3. SOURCE
4. DRAIN

CASE 211–11
ISSUE N
(.500″ FLANGE)

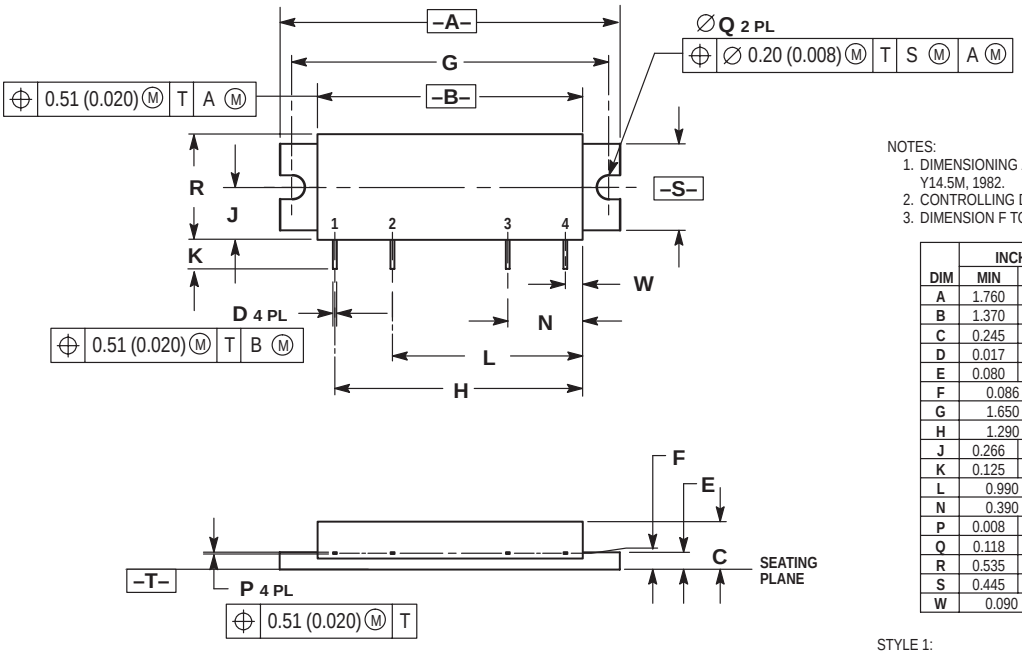


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. SEATING PLANE = GROUND AND IS CONNECTED TO PIN 1 AND 3.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.271	0.286	6.88	7.26
C	0.112	0.136	2.84	3.45
D	0.215	0.235	5.46	5.97
H	0.055	0.065	1.40	1.65
J	0.003	0.007	0.08	0.18
K	0.435	—	11.05	—
M	45° REF		45° REF	

STYLE 3:
PIN 1. SOURCE
2. GATE
3. SOURCE
4. DRAIN

CASE 249–06
ISSUE H
(.280″ PILL)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION F TO CENTER OF LEADS.

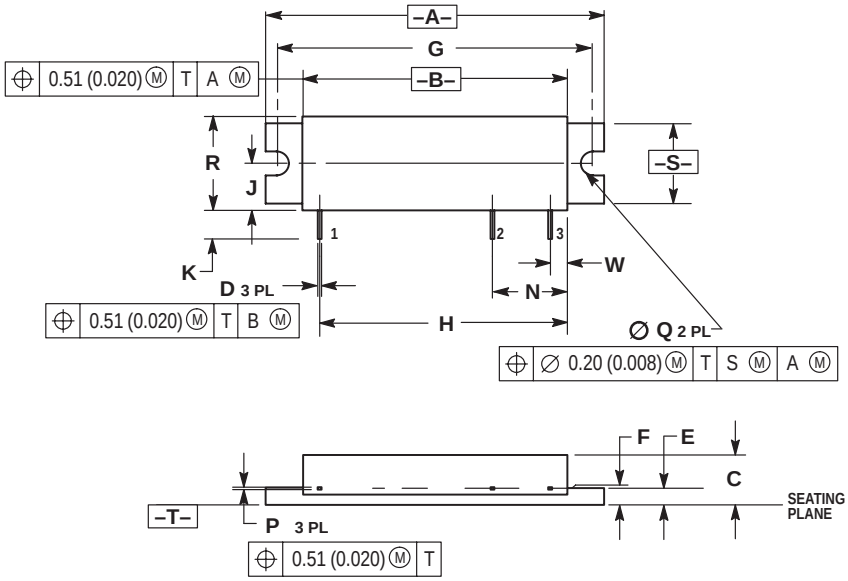
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.760	1.780	44.70	45.21
B	1.370	1.390	34.80	35.31
C	0.245	0.265	6.22	6.73
D	0.017	0.023	0.43	0.58
E	0.080	0.100	2.03	2.54
F	0.086 BSC		2.18 BSC	
G	1.650 BSC		41.91 BSC	
H	1.290 BSC		32.77 BSC	
J	0.266	0.280	6.76	7.11
K	0.125	0.165	3.18	4.19
L	0.990 BSC		25.15 BSC	
N	0.390 BSC		9.91 BSC	
P	0.008	0.013	0.20	0.33
Q	0.118	0.132	3.00	3.35
R	0.535	0.555	13.59	14.10
S	0.445	0.465	11.30	11.81
W	0.090 BSC		2.29 BSC	

STYLE 1:
PIN 1. RF INPUT
2. VDD1
3. VDD2
4. RF OUTPUT
CASE: GROUND

STYLE 2:
PIN 1. RF OUTPUT
2. VDD2
3. VDD1
4. RF INPUT
CASE: GROUND

CASE 301AP–01
ISSUE B

CASE DIMENSIONS (continued)



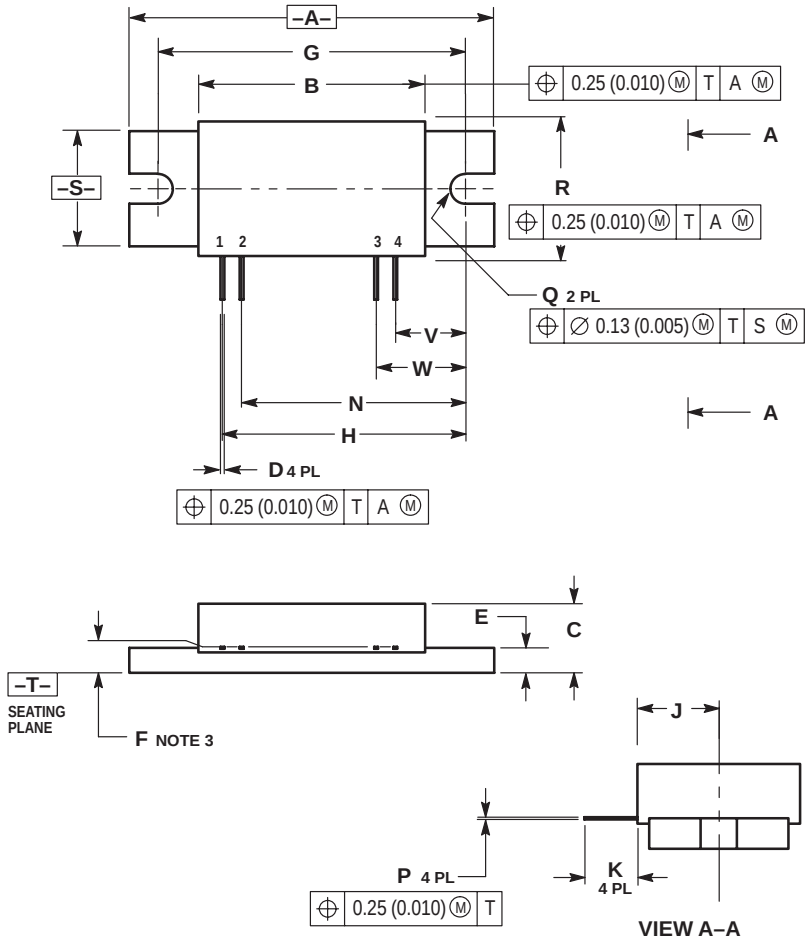
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION F TO CENTER OF LEADS.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.760	1.780	44.70	45.21
B	1.370	1.390	34.80	35.31
C	0.245	0.265	6.22	6.73
D	0.017	0.023	0.43	0.58
E	0.080	0.100	2.03	2.54
F	0.086 BSC		2.18 BSC	
G	1.650 BSC		41.91 BSC	
H	1.290 BSC		32.77 BSC	
J	0.266	0.280	6.76	7.11
K	0.125	0.165	3.18	4.19
N	0.390 BSC		9.91 BSC	
P	0.008	0.013	0.20	0.33
Q	0.118	0.132	3.00	3.35
R	0.535	0.555	13.59	14.10
S	0.445	0.465	11.30	11.81
W	0.090 BSC		2.29 BSC	

STYLE 1:
PIN 1. RF INPUT
2. VDD
3. RF OUTPUT
CASE: GROUND

CASE 301AS–01
ISSUE A

CASE DIMENSIONS (continued)



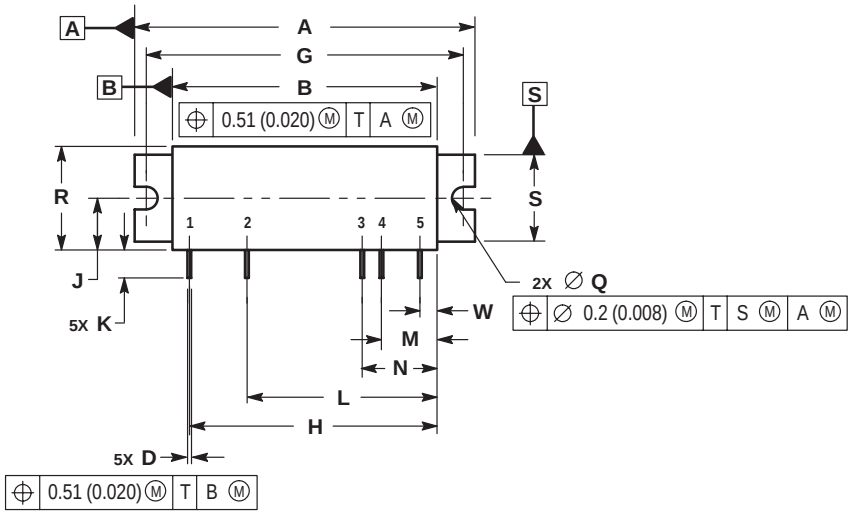
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION F IS FROM THE BOTTOM OF HEATSINK TO THE TOP OF THE LEAD.
4. DIMENSION P TO BE MEASURED AS LEAD EXITS COVER.
5. FLANGE FLATNESS 0.038 (0.0015) MAXIMUM CONVEX, 0.063 (0.0025) MAXIMUM CONCAVE.
6. ADHESIVE MATERIAL SHALL BE INCLUDED IN THE DIMENSIONS LISTED.

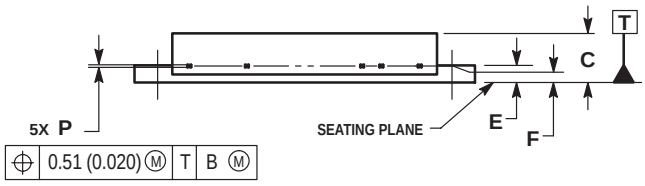
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.890	1.910	48.01	48.51
B	1.170	1.190	29.72	30.22
C	0.350	0.376	8.89	9.55
D	0.018	0.022	0.46	0.55
E	0.115	0.135	2.92	3.42
F	0.170 BSC		4.31 BSC	
G	1.600 BSC		40.64 BSC	
H	1.265 BSC		32.13 BSC	
J	0.325	0.375	8.25	9.52
K	0.225	—	5.72	—
N	1.165 BSC		29.59 BSC	
P	0.010 REF		0.25 REF	
Q	0.150	0.160	3.81	4.06
R	0.685	0.705	17.40	17.90
S	0.598	0.612	15.18	15.54
V	0.365 BSC		9.27 BSC	
W	0.465 BSC		11.81 BSC	

STYLE 1:
PIN 1. RF IN
2. V BIAS
3. V SUPPLY
4. RF OUT

CASE 301AW–02
ISSUE B

CASE DIMENSIONS (continued)



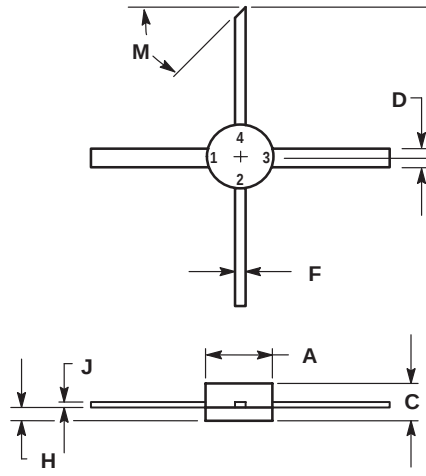


NOTES:
1. CONTROLLING DIMENSION: MILLIMETER.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.
3. DIMENSION F TO CENTER LINE OF LEADS.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	44.7	45.21	1.760	1.780
B	34.8	35.31	1.370	1.390
C	6.22	6.73	0.245	0.265
D	0.43	0.58	0.017	0.023
E	2.03	2.54	0.080	0.100
F	2.18 BSC		0.086 BSC	
G	41.91 BSC		1.650 BSC	
H	32.77 BSC		1.290 BSC	
J	6.76	7.11	0.266	0.280
K	3.18	4.19	0.125	0.165
L	25.15 BSC		0.990 BSC	
M	7.37 BSC		0.290 BSC	
N	9.91 BSC		0.390 BSC	
P	0.2	0.33	0.008	0.013
Q	3	3.35	0.118	0.132
R	13.59	14.1	0.535	0.555
S	11.3	11.81	0.445	0.465
W	2.29 BSC		0.090 BSC	

STYLE 1:
PIN 5. RF INPUT
6. VDD1
7. VDD2
8. VDD3
9. RF OUTPUT
CASE: GROUND

CASE 301AY–01
ISSUE O



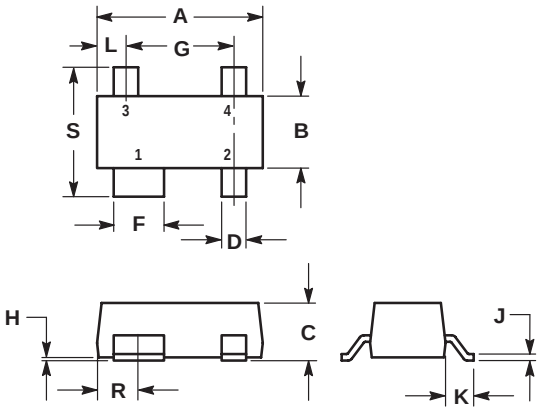
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

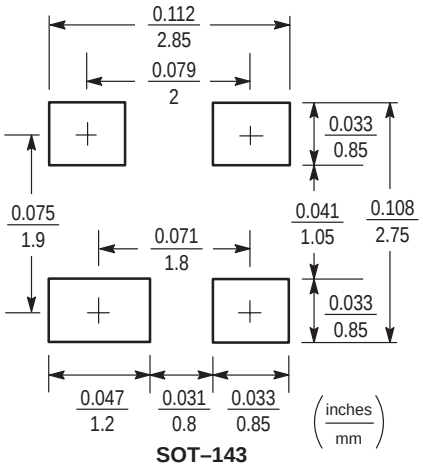
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.200	0.220	5.08	5.59
C	0.095	0.130	2.41	3.30
D	0.055	0.065	1.40	1.65
F	0.025	0.035	0.64	0.89
H	0.040	0.050	1.02	1.27
J	0.003	0.007	0.08	0.18
K	0.435	—	11.05	—
M	45 °REF		45 °REF	

STYLE 2:
PIN 1. SOURCE
2. GATE
3. SOURCE
4. DRAIN

CASE 305A–01
ISSUE A
(.204” PILL)

CASE DIMENSIONS (continued)





SOT–143
FOOTPRINT

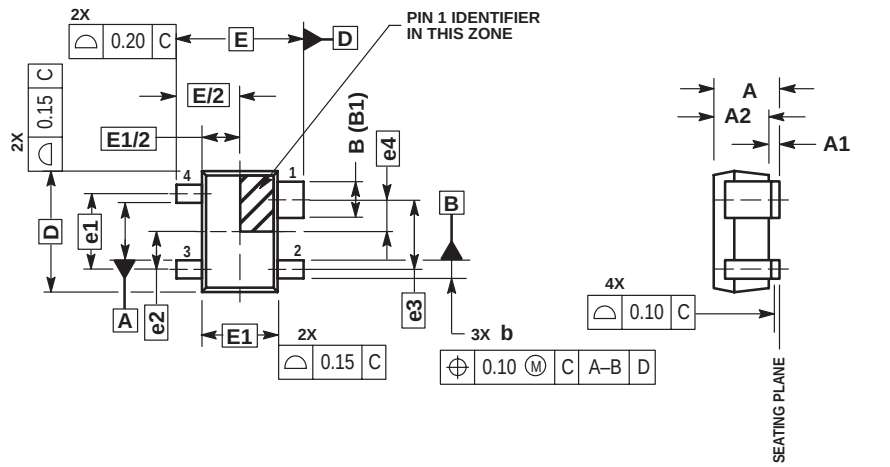
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

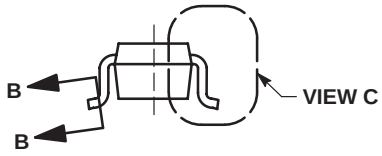
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.80	3.04	0.110	0.120
B	1.20	1.39	0.047	0.055
C	0.84	1.14	0.033	0.045
D	0.39	0.50	0.015	0.020
F	0.79	0.93	0.031	0.037
G	1.78	2.03	0.070	0.080
H	0.013	0.10	0.0005	0.004
J	0.08	0.15	0.003	0.006
K	0.46	0.60	0.018	0.024
L	0.445	0.60	0.0175	0.024
R	0.72	0.83	0.028	0.033
S	2.11	2.48	0.083	0.098

STYLE 1:
PIN 1. COLLECTOR
2. EMITTER
3. EMITTER
4. BASE

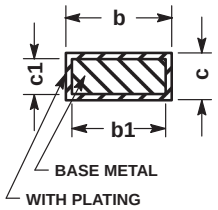
CASE 318A–05
ISSUE R
(SOT–143)

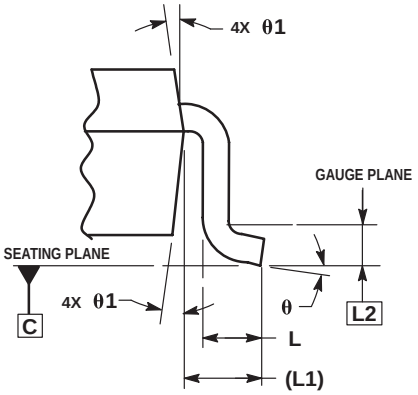
CASE DIMENSIONS (continued)





SECTION B–B
(SEE NOTE 7)





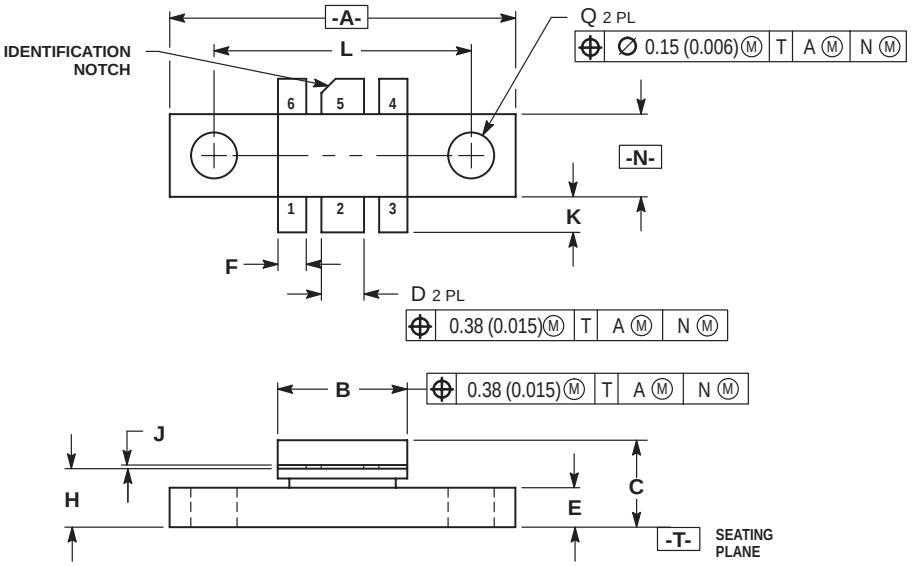
VIEW C

NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15mm PER END. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.15mm PER SIDE.
4. DIMENSIONS D AND E1 ARE DETERMINED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF PLASTIC BODY.
5. DATUMS A, B AND D TO BE DETERMINED 0.10mm FROM THE LEAD TIP.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08mm AND 0.15mm FROM THE LEAD TIP.

	MILLIMETERS	
DIM	MIN	MAX
A	—	1.10
A1	0.00	0.10
A2	0.80	1.00
b	0.25	0.40
b1	0.25	0.35
B	0.55	0.70
B1	0.55	0.65
c	0.10	0.25
c1	0.08	0.20
D	2.00 BSC	
E	2.10 BSC	
E1	1.25 BSC	
e1	1.30 BSC	
e2	0.65 BSC	
e3	1.15 BSC	
e4	0.50 BSC	
L	0.26	0.46
L1	0.425 REF	
L2	0.15 BSC	
θ	0 °	8 °
θ1	4 °	10 °

CASE 318M–01
ISSUE O
(SOT–343)

CASE DIMENSIONS (continued)



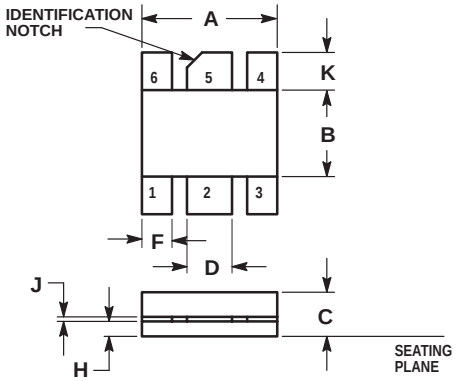
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETER	
DIM	MIN	MAX	MIN	MAX
A	0.965	0.985	24.52	25.01
B	0.355	0.375	9.02	9.52
C	0.230	0.260	5.85	6.60
D	0.115	0.125	2.93	3.17
E	0.102	0.114	2.59	2.90
F	0.075	0.085	1.91	2.15
H	0.160	0.170	4.07	4.31
J	0.004	0.006	0.11	0.15
K	0.090	0.110	2.29	2.79
L	0.725 BSC		18.42 BSC	
N	0.225	0.241	5.72	6.12
Q	0.125	0.135	3.18	3.42

STYLE 2:
PIN 1. EMITTER (COMMON)
2. BASE (INPUT)
3. EMITTER (COMMON)
4. EMITTER (COMMON)
5. COLLECTOR (OUTPUT)
6. EMITTER (COMMON)

STYLE 3:
PIN 1. SOURCE (COMMON)
2. GATE (INPUT)
3. SOURCE (COMMON)
4. SOURCE (COMMON)
5. DRAIN (OUTPUT)
6. SOURCE (COMMON)

CASE 319–07
ISSUE M
(CS–12)

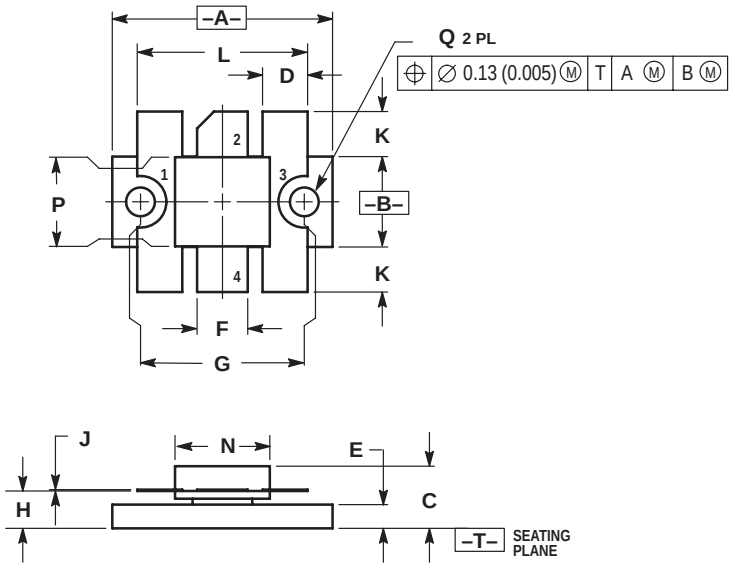


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.355	0.365	9.02	9.27
B	0.225	0.235	5.72	5.96
C	0.110	0.125	2.80	3.17
D	0.115	0.125	2.93	3.17
F	0.075	0.085	1.91	2.15
H	0.035	0.045	0.89	1.14
J	0.004	0.006	0.11	0.15
K	0.090	0.110	2.29	2.79

STYLE 2:
PIN 1. EMITTER
2. BASE
3. EMITTER
4. EMITTER
5. COLLECTOR
6. EMITTER

CASE 319A–02
ISSUE B

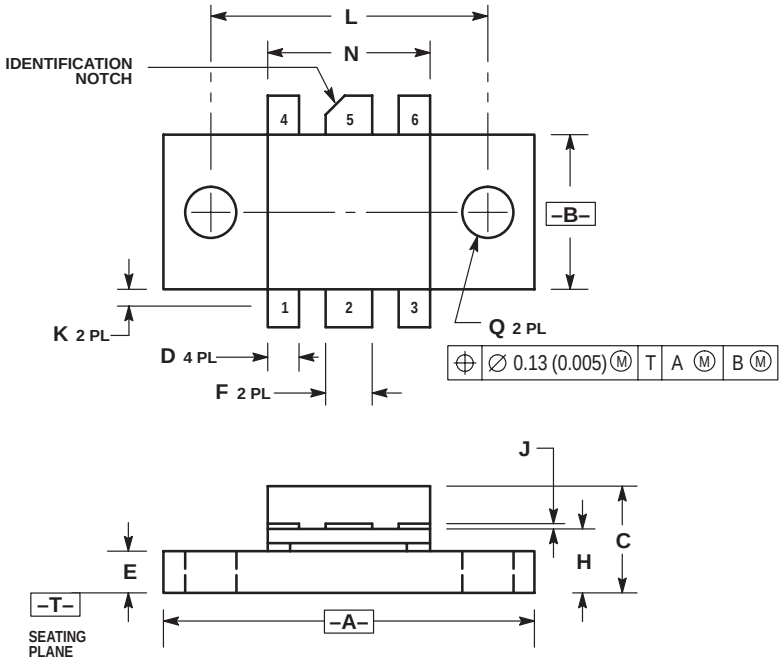


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.965	0.985	24.51	25.02
B	0.390	0.410	9.91	10.41
C	0.250	0.290	6.73	7.36
D	0.190	0.210	4.83	5.33
E	0.095	0.115	2.42	2.92
F	0.215	0.235	5.47	5.96
G	0.725 BSC		18.42 BSC	
H	0.155	0.175	3.94	4.44
J	0.004	0.006	0.10	0.15
K	0.195	0.205	4.95	5.21
L	0.740	0.770	18.80	19.55
N	0.415	0.425	10.54	10.80
P	0.390	0.400	9.91	10.16
Q	0.120	0.135	3.05	3.42

STYLE 2:
PIN 1. SOURCE
2. DRAIN
3. SOURCE
4. GATE

CASE 333–04
ISSUE E



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

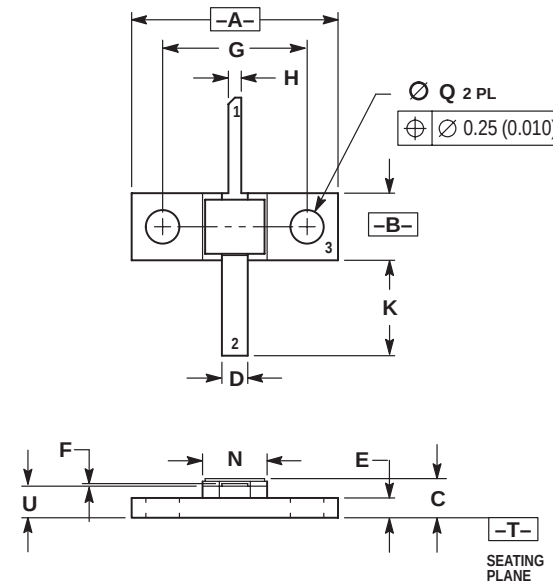
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.965	0.985	24.52	25.01
B	0.390	0.410	9.91	10.41
C	0.250	0.290	6.35	7.36
D	0.075	0.090	1.91	2.28
E	0.095	0.115	2.42	2.92
F	0.110	0.130	2.80	3.30
H	0.155	0.175	3.94	4.44
J	0.004	0.006	0.11	0.15
K	0.090	0.116	2.29	2.94
L	0.725 BSC		18.41 BSC	
N	0.415	0.435	10.55	11.04
Q	0.120	0.135	3.05	3.42

STYLE 1:
PIN 1. BASE
2. EMITTER
3. BASE
4. BASE
5. COLLECTOR
6. BASE

STYLE 2:
PIN 1. EMITTER
2. BASE
3. EMITTER
4. EMITTER
5. COLLECTOR
6. EMITTER

CASE 333A–02
ISSUE C
(MAAC PAC)

CASE DIMENSIONS (continued)

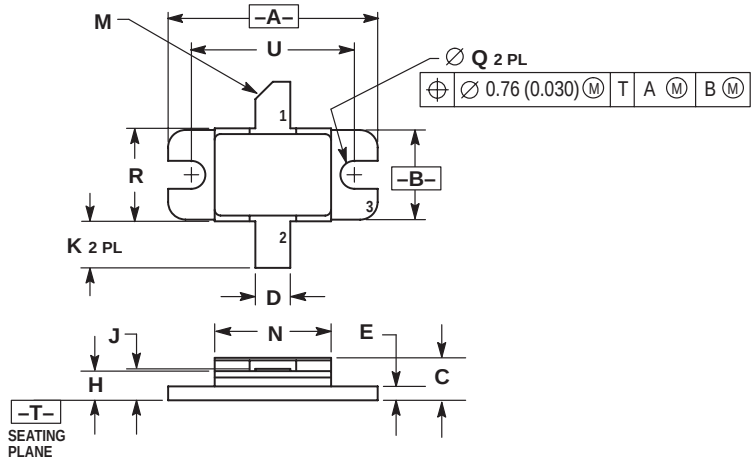


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.790	0.810	20.07	20.57
B	0.253	0.267	6.43	6.78
C	0.144	0.160	3.66	4.06
D	0.093	0.107	2.37	2.71
E	0.074	0.080	1.88	2.03
F	0.002	0.006	0.06	0.15
G	0.560 BSC		14.22 BSC	
H	0.043	0.057	1.10	1.44
K	0.346	0.394	8.79	10.10
N	0.243	0.257	6.18	6.52
Q	0.125	0.135	3.18	3.42
U	0.117	0.128	2.98	3.25

STYLE 1:
PIN 1. COLLECTOR
2. EMITTER
3. BASE

CASE 336E–02
ISSUE B



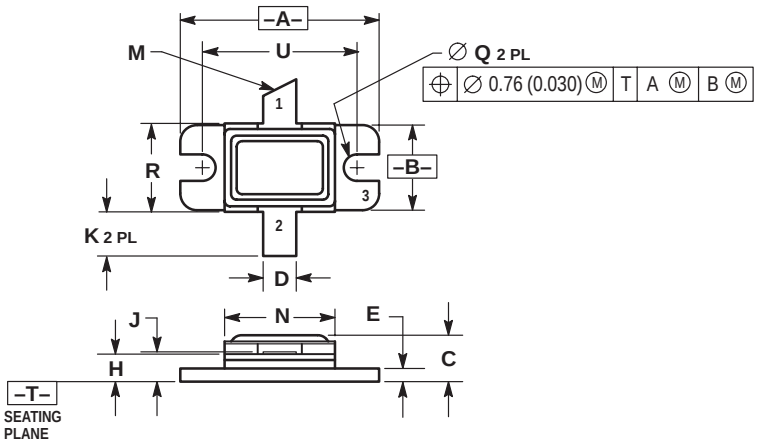
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.890	0.910	22.61	23.11
B	0.375	0.395	9.53	10.03
C	0.150	0.165	3.81	4.19
D	0.145	0.155	3.69	3.93
E	0.055	0.065	1.40	1.65
H	0.120	0.130	3.05	3.30
J	0.003	0.006	0.08	0.15
K	0.185	0.215	4.70	5.46
M	45 ° REF		45 ° REF	
N	0.490	0.510	12.45	12.95
Q	0.115	0.125	2.93	3.17
R	0.395	0.405	10.04	10.28
U	0.700 BSC		17.78 BSC	

STYLE 1:
PIN 1. COLLECTOR
2. EMITTER
3. BASE

CASE 355C–02
ISSUE C

CASE DIMENSIONS (continued)

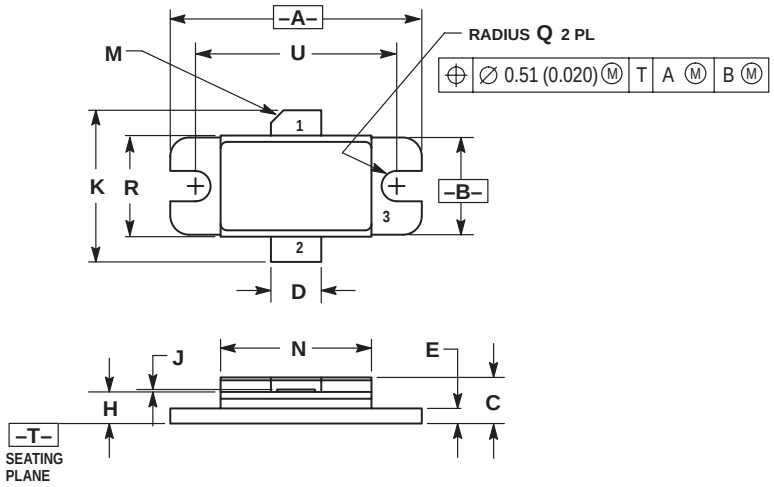


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.890	0.910	22.61	23.11
B	0.375	0.395	9.53	10.03
C	0.190	0.210	4.83	5.33
D	0.145	0.155	3.69	3.93
E	0.055	0.065	1.40	1.65
H	0.120	0.130	3.05	3.30
J	0.003	0.006	0.08	0.15
K	0.185	0.215	4.70	5.46
M	45 ° REF		45 ° REF	
N	0.490	0.510	12.45	12.95
Q	0.115	0.125	2.93	3.17
R	0.395	0.405	10.04	10.28
U	0.700 BSC		17.78 BSC	

STYLE 1:
PIN 1. COLLECTOR
2. EMITTER
3. BASE

CASE 355E–01
ISSUE B

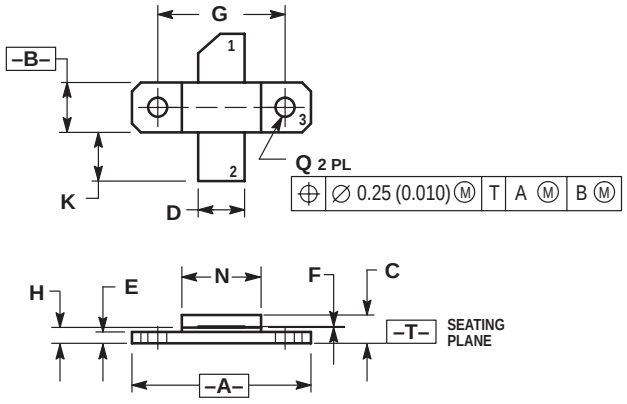


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.990	1.010	25.15	25.65
B	0.375	0.395	9.53	10.03
C	0.145	0.175	3.68	4.45
D	0.195	0.205	4.95	5.21
E	0.055	0.065	1.40	1.65
H	0.117	0.133	2.97	3.38
J	0.003	0.006	0.08	0.15
K	0.580	0.620	14.73	15.75
M	45 ° REF		45 ° REF	
N	0.590	0.610	14.99	15.49
Q	0.055	0.065	1.40	1.65
R	0.395	0.405	10.03	10.29
U	0.800 BSC		20.32 BSC	

STYLE 1:
PIN 1. COLLECTOR
2. EMITTER
3. BASE

CASE 355J–02
ISSUE A

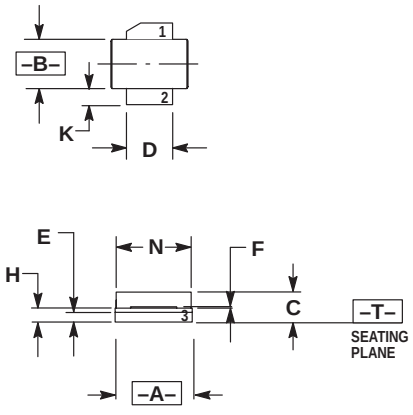


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030" AWAY FROM EDGE OF FLANGE.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.790	0.810	20.07	20.57
B	0.220	0.240	5.59	6.09
C	0.125	0.175	3.18	4.45
D	0.205	0.225	5.21	5.71
E	0.050	0.070	1.27	1.77
F	0.004	0.006	0.11	0.15
G	0.562 BSC		14.27 BSC	
H	0.077	0.087	1.96	2.21
K	0.215	0.255	5.47	6.47
N	0.350	0.370	8.89	9.39
Q	0.120	0.140	3.05	3.55

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 360B–03
ISSUE D



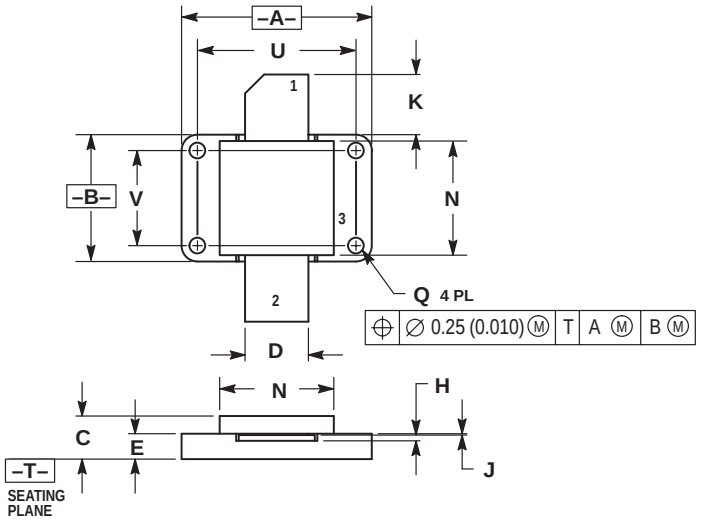
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.370	0.390	9.40	9.91
B	0.220	0.240	5.59	6.09
C	0.105	0.155	2.67	3.94
D	0.205	0.225	5.21	5.71
E	0.035	0.045	0.89	1.14
F	0.004	0.006	0.11	0.15
H	0.057	0.067	1.45	1.70
K	0.085	0.115	2.16	2.92
N	0.350	0.370	8.89	9.39

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 360C–03
ISSUE B

CASE DIMENSIONS (continued)

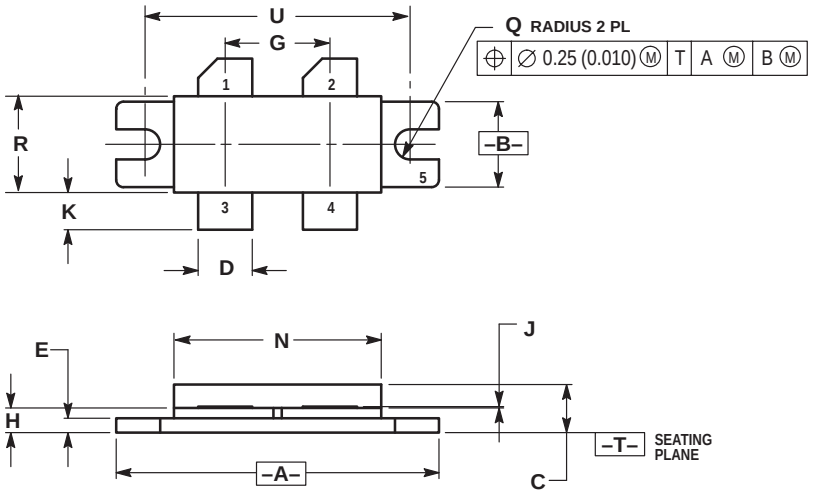


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.490	1.510	37.85	38.35
B	0.990	1.010	25.15	25.65
C	0.330	0.365	8.38	9.27
D	0.490	0.510	12.45	12.95
E	0.195	0.205	4.95	5.21
H	0.045	0.055	1.14	1.39
J	0.004	0.006	0.10	0.15
K	0.425	0.500	10.80	12.70
N	0.890	0.910	22.87	23.11
Q	0.120	0.130	3.05	3.30
U	1.250 BSC		31.75 BSC	
V	0.750 BSC		19.05 BSC	

STYLE 2:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 368–03
ISSUE C
(HOG PAC)



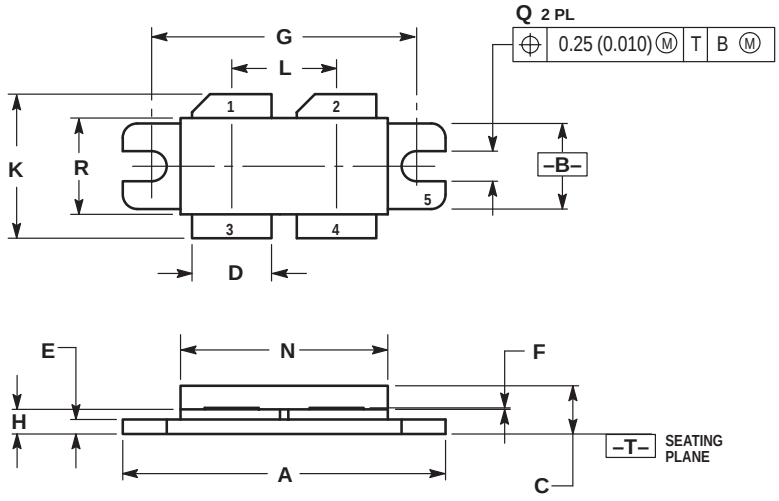
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.330	1.350	33.79	34.29
B	0.370	0.410	9.40	10.41
C	0.190	0.230	4.83	5.84
D	0.215	0.235	5.47	5.96
E	0.050	0.070	1.27	1.77
G	0.430	0.440	10.92	11.18
H	0.102	0.112	2.59	2.84
J	0.004	0.006	0.11	0.15
K	0.185	0.215	4.83	5.33
N	0.845	0.875	21.46	22.23
Q	0.060	0.070	1.52	1.78
R	0.390	0.410	9.91	10.41
U	1.100 BSC		27.94 BSC	

STYLE 2:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

CASE 375–04
ISSUE D

CASE DIMENSIONS (continued)

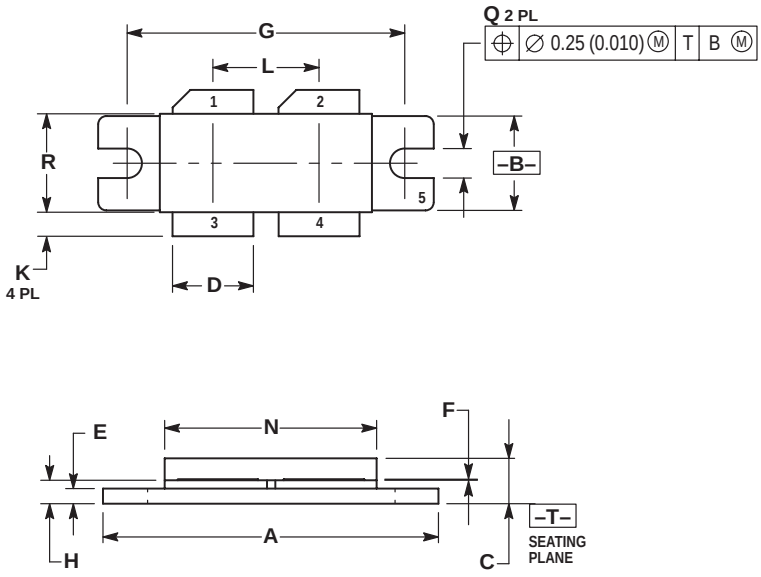


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.330	1.350	33.79	34.29
B	0.375	0.395	9.52	10.03
C	0.180	0.205	4.57	5.21
D	0.320	0.340	8.13	8.64
E	0.060	0.070	1.52	1.77
F	0.004	0.006	0.11	0.15
G	1.100 BSC		27.94 BSC	
H	0.082	0.097	2.08	2.46
K	0.580	0.620	14.73	15.75
L	0.435 BSC		11.05 BSC	
N	0.845	0.875	21.46	22.23
Q	0.118	0.130	3.00	3.30
R	0.390	0.410	9.91	10.41

STYLE 1:
PIN 1. COLLECTOR
2. COLLECTOR
3. BASE
4. BASE
5. EMITTER

CASE 375A–01
ISSUE O



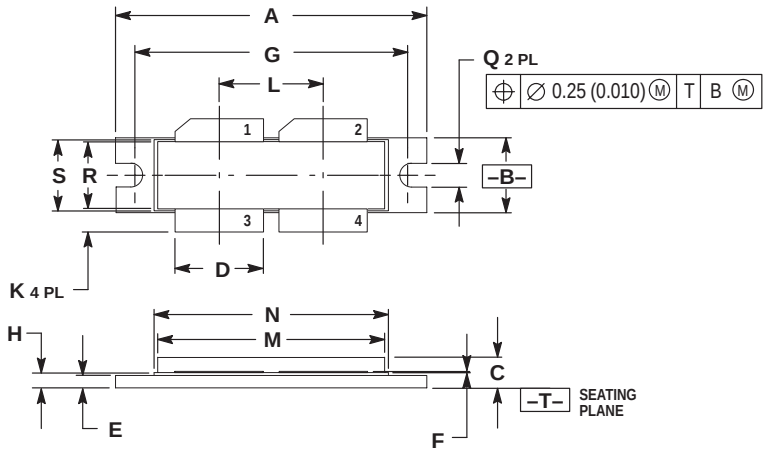
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.330	1.350	33.79	34.29
B	0.375	0.395	9.52	10.03
C	0.180	0.210	4.57	5.33
D	0.320	0.340	8.13	8.64
E	0.060	0.070	1.52	1.77
F	0.004	0.006	0.11	0.15
G	1.100 BSC		27.94 BSC	
H	0.093	0.108	2.36	2.74
K	0.085	0.115	2.16	2.92
L	0.425 BSC		10.80 BSC	
N	0.845	0.875	21.46	22.23
Q	0.118	0.130	3.00	3.30
R	0.390	0.410	9.91	10.41

STYLE 2:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

CASE 375B–02
ISSUE A

CASE DIMENSIONS (continued)

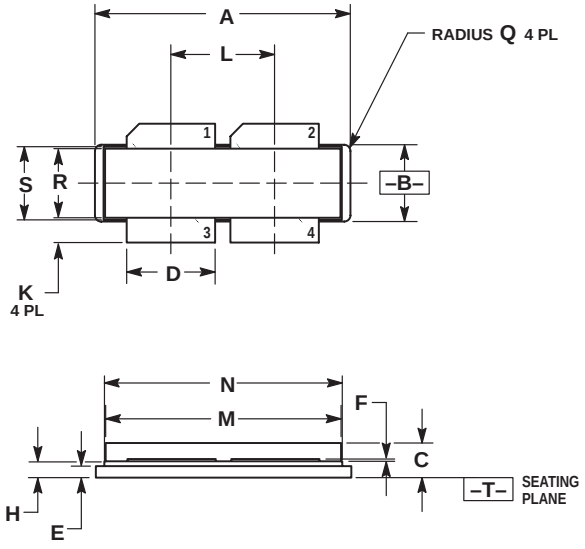


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.610	1.630	40.89	41.40
B	0.390	0.410	9.91	10.41
C	0.150	0.180	3.81	4.57
D	0.450	0.470	11.43	11.94
E	0.060	0.068	1.52	1.73
F	0.003	0.006	0.08	0.15
G	1.400 BSC		35.56 BSC	
H	0.079	0.089	2.01	2.26
K	0.117	0.137	2.97	3.48
L	0.540 BSC		13.72 BSC	
M	1.225	1.235	31.12	31.37
N	1.219	1.241	30.96	31.52
Q	0.120	0.130	3.05	3.30
R	0.350	0.370	8.89	9.40
S	0.360	0.380	9.14	9.65

STYLE 2:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

CASE 375D–01
ISSUE O

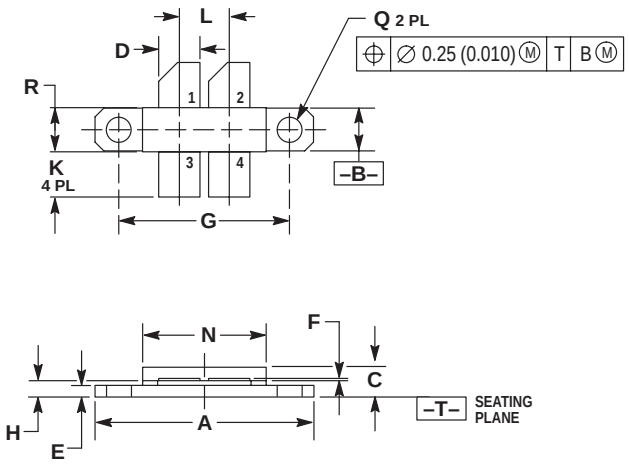


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.325	1.335	33.66	33.91
B	0.390	0.410	9.91	10.41
C	0.150	0.180	3.81	4.57
D	0.450	0.470	11.43	11.94
E	0.060	0.068	1.52	1.73
F	0.003	0.006	0.08	0.15
H	0.079	0.089	2.01	2.26
K	0.117	0.137	2.97	3.48
L	0.540 BSC		13.72 BSC	
M	1.225	1.235	31.12	31.37
N	1.219	1.241	30.96	31.52
Q	0.030 BSC		0.76 BSC	
R	0.350	0.370	8.89	9.40
S	0.360	0.380	9.14	9.65

STYLE 2:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

CASE 375E–01
ISSUE O

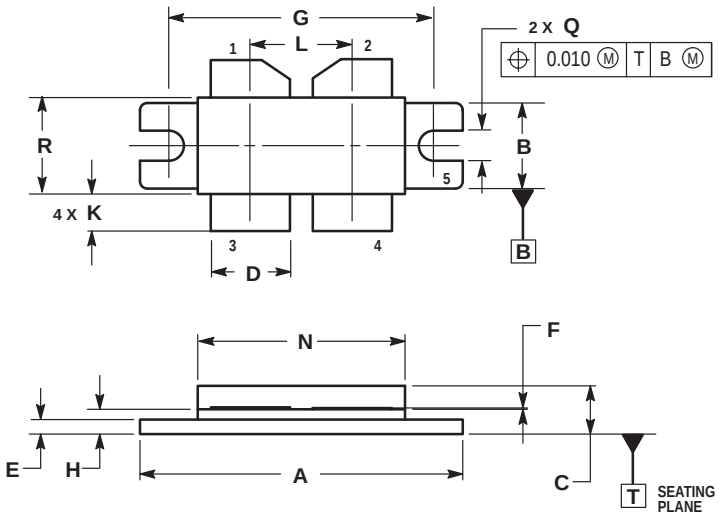


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030" AWAY FROM FLANGE.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.135	1.145	28.80	29.10
B	0.225	0.235	5.72	5.97
C	0.148	0.178	3.76	4.52
D	0.210	0.220	5.33	5.59
E	0.055	0.065	1.40	1.65
F	0.004	0.006	0.110	0.150
G	0.900 BSC		22.86 BSC	
H	0.076	0.086	1.93	2.18
K	0.215	0.255	5.46	6.28
L	0.260 BSC		6.60 BSC	
N	0.638	0.650	16.20	16.50
Q	∅ 0.130 BSC		∅ 3.30 BSC	
R	0.225	0.235	5.72	5.97

STYLE 2:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

CASE 375F–02
ISSUE A

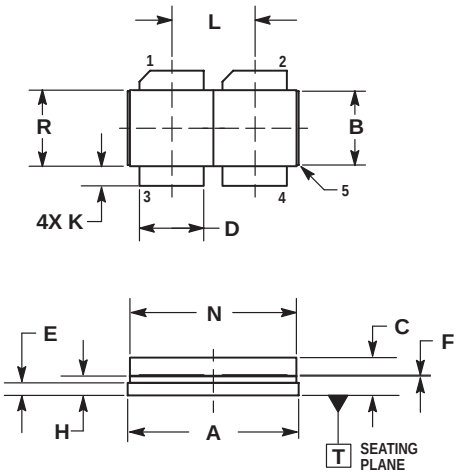


NOTES:
1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.330	1.350	33.78	34.29
B	0.375	0.395	9.52	10.03
C	0.180	0.210	4.57	5.33
D	0.320	0.340	8.13	8.64
E	0.060	0.070	1.52	1.78
F	0.004	0.006	0.1	0.15
G	1.100 BSC		27.94 BSC	
H	0.093	0.108	2.36	2.74
K	0.135	0.165	3.43	4.19
L	0.425 BSC		10.8 BSC	
N	0.845	0.875	21.46	22.22
Q	0.118	0.130	3	3.3
R	0.390	0.410	9.91	10.41

STYLE 2:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

CASE 375G–03
ISSUE B

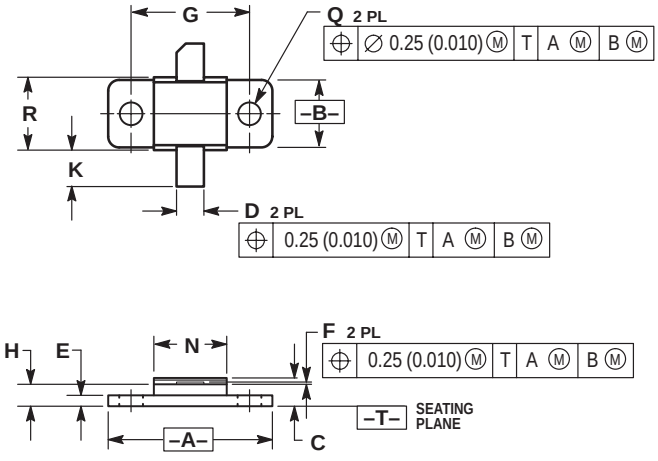


NOTES:
1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	.880	.900	22.35	22.86
B	.375	.395	9.52	10.03
C	.180	.210	4.57	5.33
D	.320	.340	8.13	8.64
E	.060	.070	1.52	1.78
F	.004	.006	0.1	0.15
H	.093	.108	2.36	2.74
K	.085	.115	2.16	2.92
L	.425 BSC		10.8 BSC	
N	.845	.875	21.46	22.22
R	.390	.410	9.91	10.41

STYLE 2:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

CASE 375H–01
ISSUE O



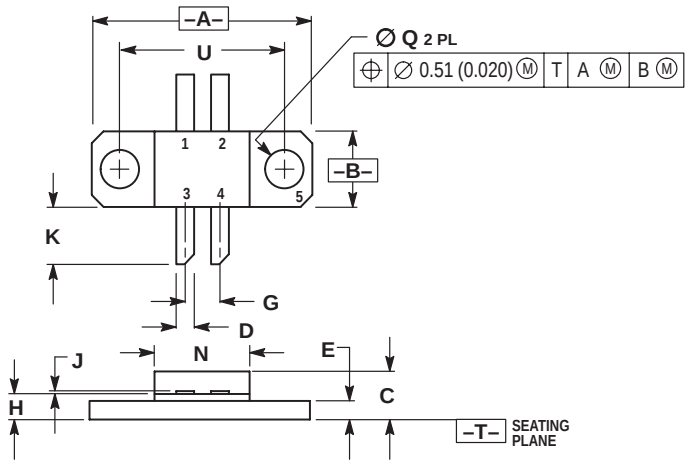
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.890	0.910	22.61	23.11
B	0.370	0.400	9.40	10.16
C	0.145	0.160	3.69	4.06
D	0.140	0.160	3.56	4.06
E	0.055	0.065	1.40	1.65
F	0.003	0.006	0.08	0.15
G	0.650 BSC		16.51 BSC	
H	0.110	0.130	2.80	3.30
K	0.180	0.220	4.57	5.59
N	0.390	0.410	9.91	10.41
Q	0.115	0.135	2.93	3.42
R	0.390	0.140	9.91	10.41

STYLE 1:
PIN 1. COLLECTOR
2. EMITTER
3. BASE

CASE 376B–02
ISSUE B

CASE DIMENSIONS (continued)

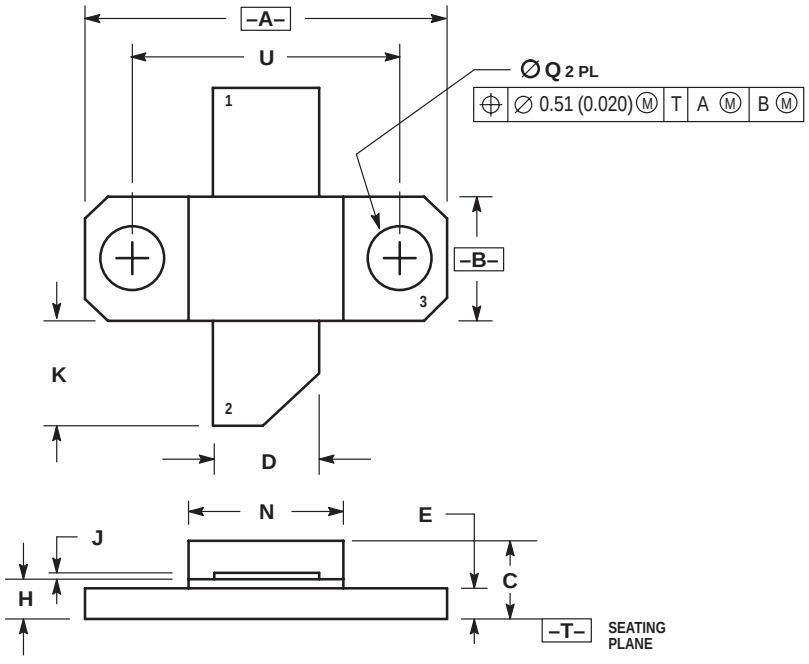


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.739	0.750	18.77	19.05
B	0.240	0.260	6.10	6.60
C	0.165	0.198	4.19	5.03
D	0.055	0.065	1.40	1.65
E	0.055	0.070	1.40	1.78
G	0.110	0.130	2.79	3.30
H	0.079	0.091	2.01	2.31
J	0.003	0.005	0.08	0.13
K	0.180	0.220	4.57	5.59
N	0.315	0.330	8.00	8.38
Q	0.125	0.135	3.18	3.42
U	0.560 BSC		14.22 BSC	

STYLE 1:
PIN 1. BASE
2. BASE
3. COLLECTOR
4. COLLECTOR
5. EMITTER

CASE 395B–01
ISSUE A



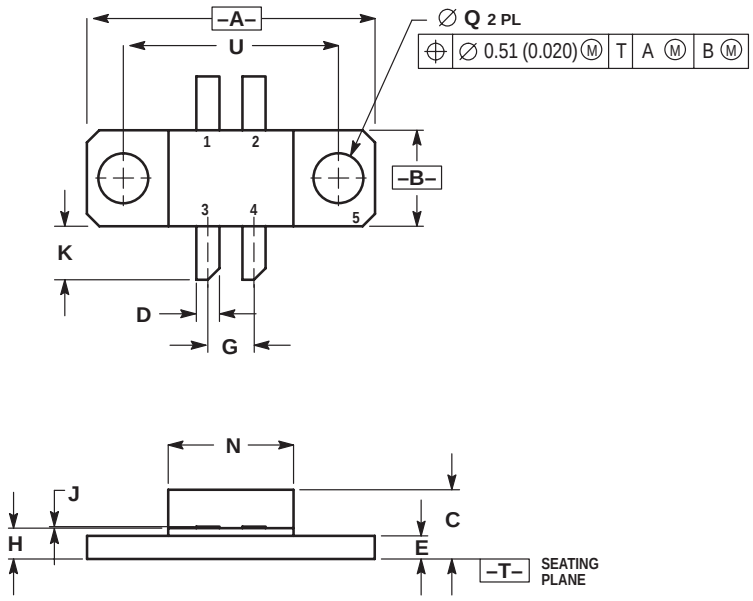
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.739	0.750	18.77	19.05
B	0.240	0.260	6.10	6.60
C	0.165	0.198	4.19	5.03
D	0.215	0.225	5.46	5.72
E	0.055	0.070	1.40	1.78
H	0.079	0.091	2.01	2.31
J	0.004	0.006	0.10	0.15
K	0.210	0.240	5.33	6.10
N	0.315	0.330	8.00	8.38
Q	0.125	0.135	3.18	3.42
U	0.560 BSC		14.23 BSC	

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER

STYLE 2:
PIN 1. EMITTER
2. COLLECTOR
3. BASE

CASE 395C–01
ISSUE A

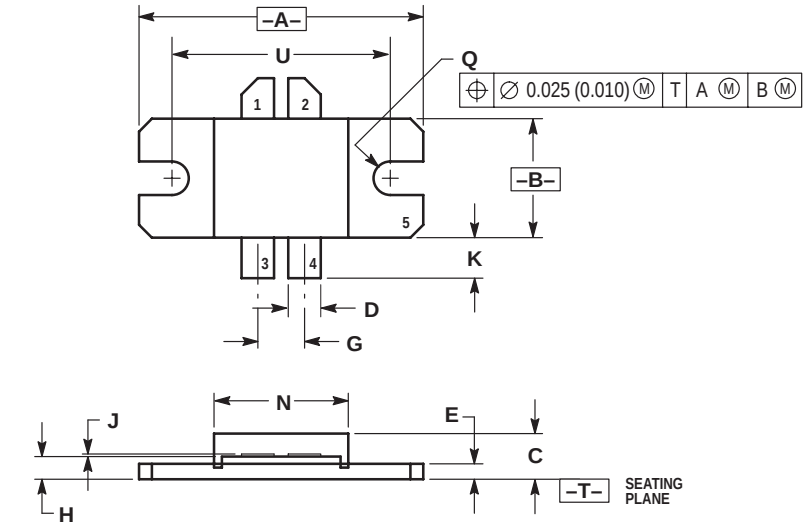


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.739	0.750	18.77	19.05
B	0.240	0.260	6.10	6.60
C	0.165	0.198	4.19	5.03
D	0.055	0.065	1.40	1.65
E	0.055	0.070	1.40	1.78
G	0.110	0.130	2.79	3.30
H	0.079	0.091	2.01	2.31
J	0.003	0.005	0.08	0.13
K	0.120	0.150	3.05	3.81
N	0.315	0.330	8.00	8.38
Q	0.125	0.135	3.18	3.42
U	0.560 BSC		14.23 BSC	

STYLE 1:
PIN 1. BASE
2. BASE
3. COLLECTOR
4. COLLECTOR
5. EMITTER

CASE 395E–01
ISSUE O

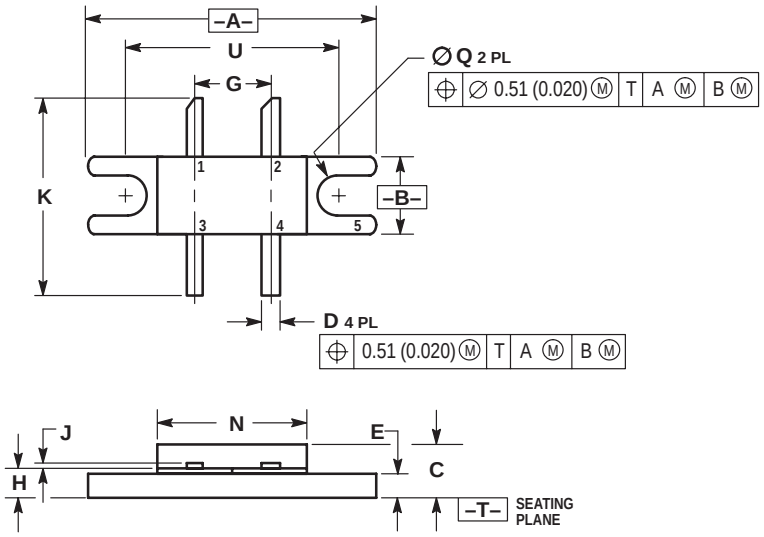


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.094	1.110	27.79	28.19
B	0.457	0.465	11.61	11.81
C	0.165	0.182	4.25	4.62
D	0.121	0.131	3.08	3.32
E	0.055	0.065	1.40	1.65
G	0.177	0.185	4.50	4.69
H	0.081	0.091	2.06	2.31
J	0.002	0.004	0.06	0.10
K	0.142	0.163	3.60	4.14
N	0.510	0.520	12.95	13.21
Q	0.125	0.135	3.18	3.42
U	0.844 BSC		21.44 BSC	

STYLE 1:
PIN 1. COLLECTOR
2. COLLECTOR
3. BASE
4. BASE
5. EMITTER

CASE 398–03
ISSUE C

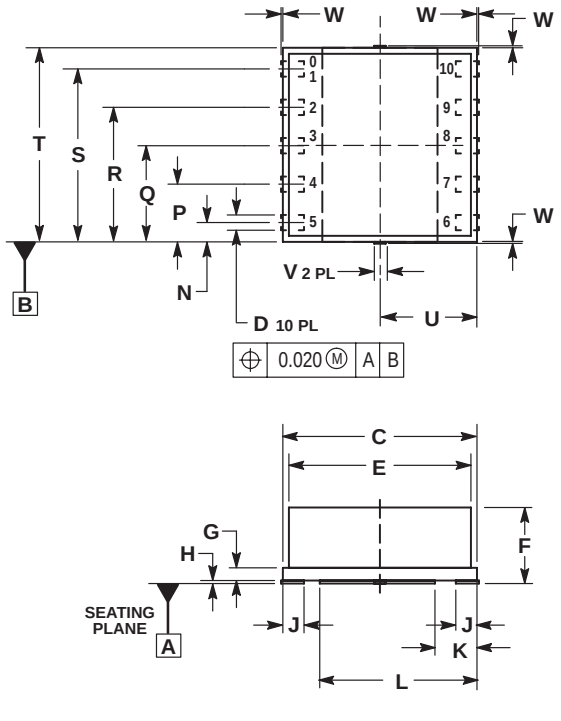


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.965	0.985	24.52	25.01
B	0.245	0.265	6.23	6.73
C	0.165	0.185	4.20	4.69
D	0.050	0.070	1.27	1.77
E	0.070	0.080	1.78	2.03
G	0.254 BSC		6.45 BSC	
H	0.095	0.105	2.42	2.66
J	0.003	0.006	0.08	0.15
K	0.625	0.675	15.88	17.14
N	0.495	0.520	12.58	13.20
Q	0.120	0.140	3.05	3.55
U	0.725 BSC		18.42 BSC	

STYLE 1:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

CASE 412–01
ISSUE O



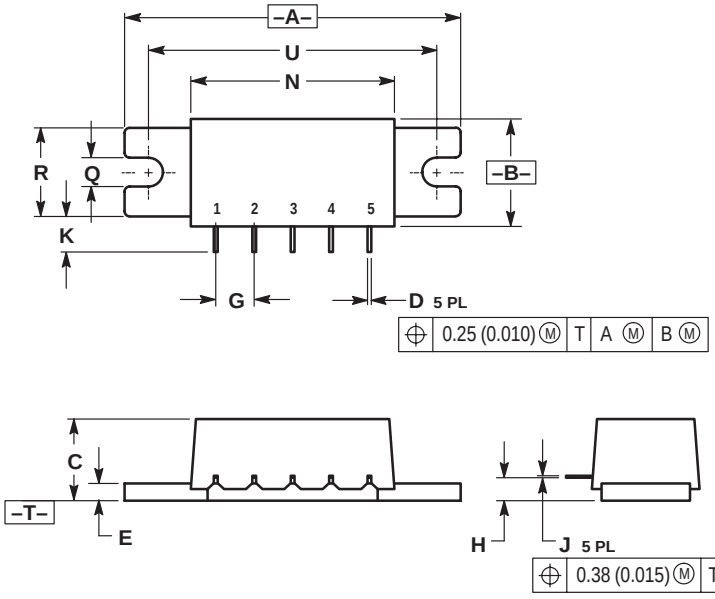
NOTES:
1. DIMENSIONS ARE IN INCHES.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1994.

	INCHES	
DIM	MIN	MAX
C	0.495	0.505
D	0.035	0.045
E	0.474 REF	
F	0.186	0.196
G	0.033 REF	
H	0.008 REF	
J	0.050	0.060
K	0.100 REF	
L	0.400 REF	
N	0.050 REF	
P	0.150 REF	
Q	0.250 REF	
R	0.350 REF	
S	0.450 REF	
T	0.495	0.505
U	0.250 REF	
V	0.025	0.035
W	—	0.005

STYLE 1:
PIN 1. GROUND
2. GROUND
3. R.F. IN
4. GROUND
5. GROUND
6. GROUND
7. GROUND
8. R.F. OUT
9. GROUND
10. +VDC

CASE 438F–01
ISSUE O

CASE DIMENSIONS (continued)



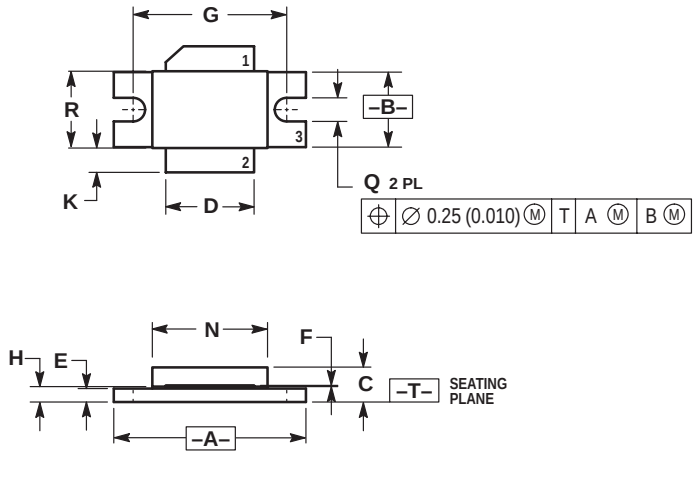
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.740	1.760	44.20	44.70
B	0.550	0.570	13.97	14.49
C	0.405	0.445	10.29	11.30
D	0.018	0.022	0.46	0.55
E	0.085	0.095	2.16	2.41
G	0.200 BSC		5.08 BSC	
H	0.120 BSC		3.05 BSC	
J	0.009	0.011	0.23	0.28
K	0.180	0.220	4.57	5.59
N	1.045	1.075	26.54	27.30
Q	0.145	0.155	3.68	3.94
R	0.455	0.465	11.56	11.81
U	1.490	1.510	37.85	38.35

STYLE 1:
PIN 1. RF INPUT
2. GROUND
3. RESISTOR–GROUND
4. VCC
5. RF OUTPUT

STYLE 2:
PIN 1. RF INPUT
2. GROUND
3. VCC1
4. VCC2
5. RF OUTPUT

CASE 448–02
ISSUE B



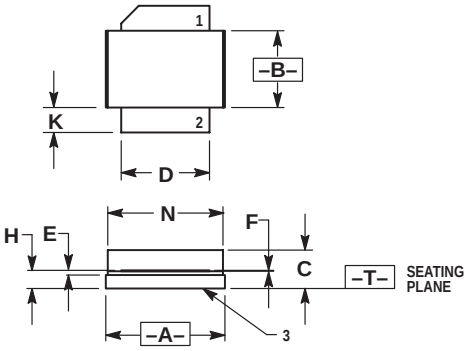
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030" AWAY FROM FLANGE.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.995	1.005	25.27	25.53
B	0.380	0.390	9.65	9.91
C	0.156	0.191	3.96	4.85
D	0.455	0.465	11.56	11.81
E	0.060	0.075	1.52	1.91
F	0.004	0.006	0.10	0.15
G	0.800 BSC		20.32 BSC	
H	0.078	0.090	1.98	2.29
K	0.117	0.137	2.97	3.48
N	0.595	0.605	15.11	15.37
Q	0.120	0.130	3.05	3.30
R	0.395	0.410	10.03	10.41

STYLE 1:
PIN 1. COLLECTOR
2. BASE
3. EMITTER

CASE 451–06
ISSUE F

CASE DIMENSIONS (continued)

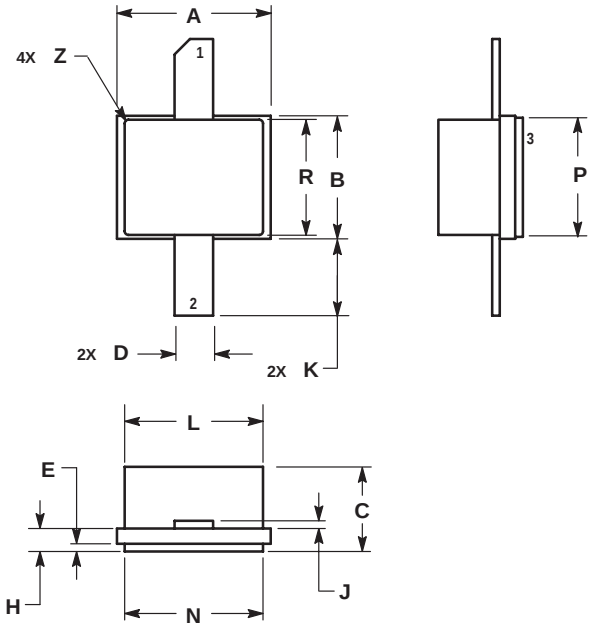


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030" AWAY FROM FLANGE.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.615	0.625	15.62	15.88
B	0.395	0.410	10.03	10.41
C	0.156	0.191	3.96	4.85
D	0.455	0.465	11.56	11.81
E	0.060	0.075	1.52	1.91
F	0.004	0.006	0.10	0.15
H	0.078	0.090	1.98	2.29
K	0.117	0.137	2.97	3.48
N	0.595	0.605	15.11	15.37

STYLE 1:
PIN 1. COLLECTOR
2. BASE
3. EMITTER

CASE 451A–03
ISSUE B

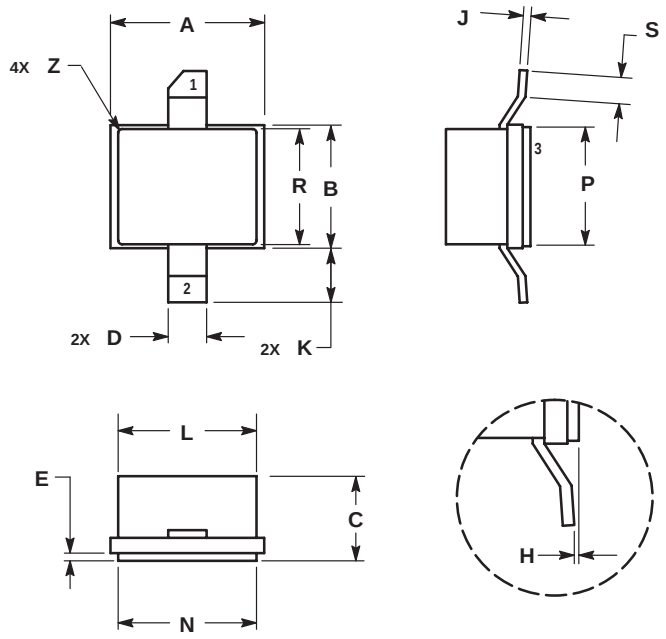


NOTES:
1. CONTROLLING DIMENSIONS: INCHES.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. ALL DIMENSIONS ARE SYMMETRICAL ABOUT CENTERLINE UNLESS OTHERWISE NOTED.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.197	0.203	5.004	5.156
B	0.157	0.163	3.988	4.140
C	0.085	0.110	2.159	2.794
D	0.047	0.053	1.194	1.346
E	0.004	0.010	0.102	0.254
H	0.025	0.031	0.635	0.787
J	0.004	0.010	0.102	0.254
K	0.060	0.110	1.524	2.794
L	0.177	0.183	4.496	4.648
N	0.180	0.200	4.572	5.080
P	0.140	0.160	3.556	4.064
R	0.147	0.153	3.734	3.886
Z	—	0.020	—	0.508

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 458B–02
ISSUE C
(Micro 200S)

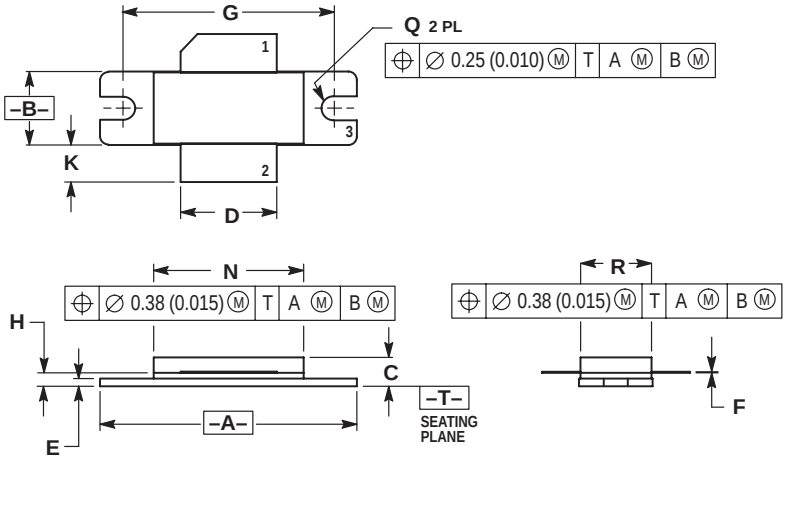


NOTES:
1. CONTROLLING DIMENSIONS: INCHES.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSION H (PACKAGE COPLANARITY): THE BOTTOM OF LEADS AND REFERENCE PLANE T MUST BE COPLANAR WITHIN DIMENSION H.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.197	0.203	5.004	5.156
B	0.157	0.163	3.988	4.140
C	0.085	0.110	2.159	2.794
D	0.047	0.053	1.194	1.346
E	0.004	0.010	0.102	0.254
H	0.000	0.004	0.000	0.102
J	0.004	0.010	0.102	0.254
K	0.050	0.090	1.270	2.286
L	0.177	0.183	4.496	4.648
N	0.180	0.200	4.572	5.080
P	0.140	0.160	3.556	4.064
R	0.147	0.153	3.734	3.886
Z	—	0.020	—	0.508

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 458C–02
ISSUE C
(Micro 200Z)



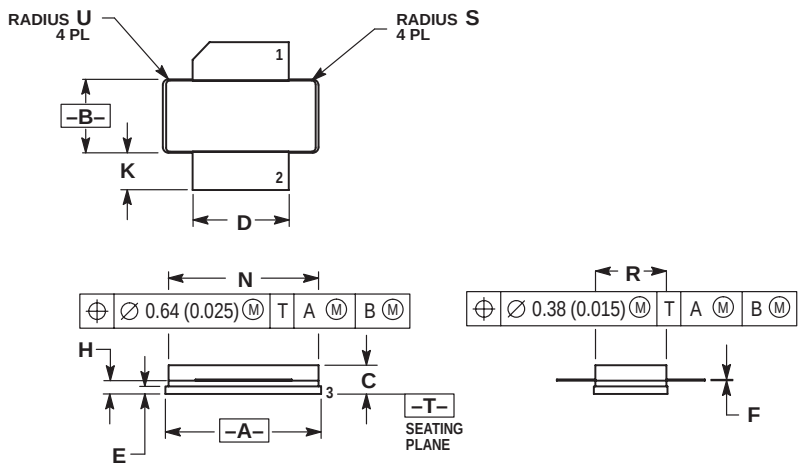
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030" AWAY FROM FLANGE.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.335	1.345	33.91	34.16
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
G	1.100 BSC		27.94 BSC	
H	0.055	0.065	1.40	1.65
K	0.170	0.210	4.32	5.33
N	0.772	0.788	19.60	20.00
Q	0.118	0.138	3.00	3.51
R	0.365	0.375	9.27	9.53

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 465–04
ISSUE D

CASE DIMENSIONS (continued)

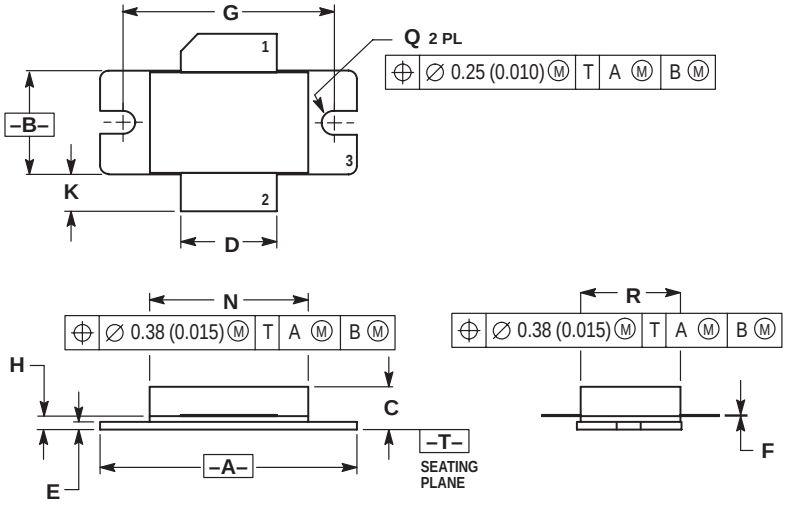


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030" AWAY FROM FLANGE.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.805	0.815	20.45	20.70
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
H	0.055	0.065	1.40	1.65
K	0.170	0.210	4.32	5.33
N	0.775	0.785	19.69	19.94
R	0.365	0.375	9.27	9.53
S	0.020 REF		0.51 REF	
U	0.030 REF		0.76 REF	

STYLE 1:
PIN 1. DRAIN
2. GATE
4. SOURCE

CASE 465A–04
ISSUE D



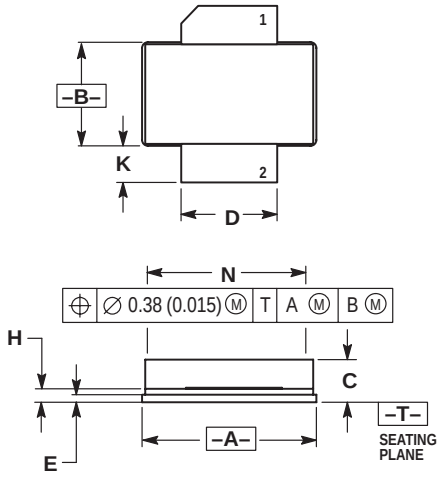
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030" AWAY FROM FLANGE.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.335	1.345	33.91	34.16
B	0.535	0.545	13.6	13.8
C	0.155	0.200	3.94	5.08
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
G	1.100 BSC		27.94 BSC	
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
N	0.871	0.889	19.30	22.60
Q	0.118	0.138	3.00	3.51
R	0.515	0.525	13.10	13.30

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 465B–02
ISSUE A

CASE DIMENSIONS (continued)

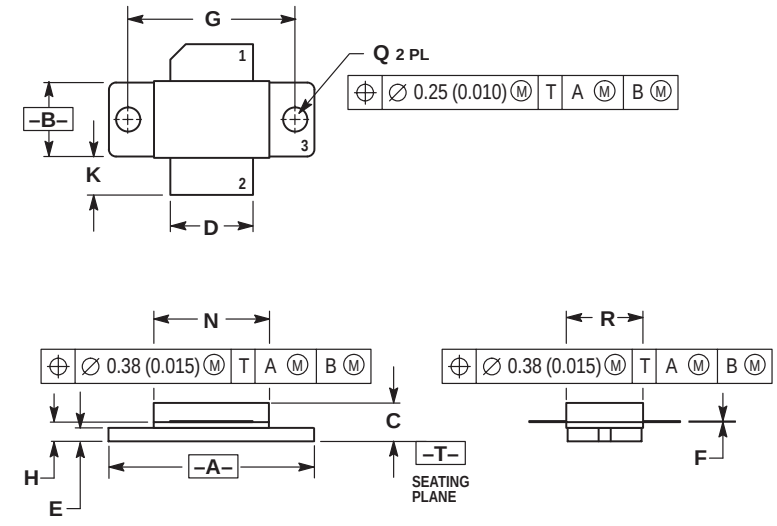


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030" AWAY FROM FLANGE.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.905	0.915	22.99	23.24
B	0.535	0.545	13.6	13.8
C	0.155	0.200	3.94	5.08
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
N	0.871	0.889	19.30	22.60
R	0.515	0.525	13.10	13.30

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 465C–01
ISSUE O



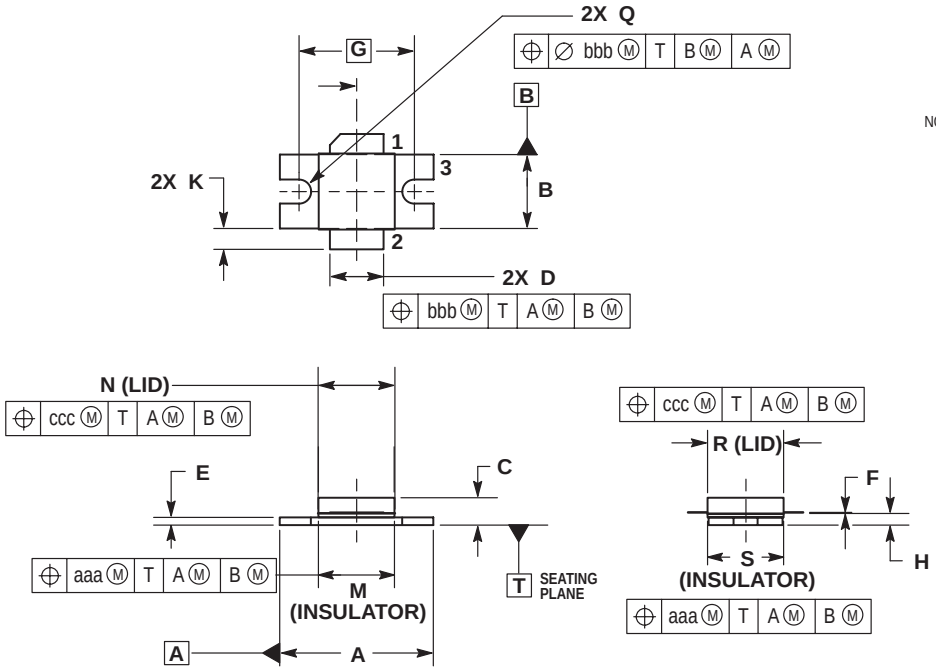
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030" AWAY FROM FLANGE.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.065	1.075	27.05	27.31
B	0.380	0.390	9.65	9.91
C	0.160	0.205	4.06	5.21
D	0.425	0.435	10.80	11.05
E	0.060	0.070	1.52	1.78
F	0.004	0.006	0.10	0.15
G	0.870 BSC		22.10 BSC	
H	0.096	0.106	2.44	2.70
K	0.185	0.215	4.70	5.46
N	0.591	0.601	15.01	15.27
Q	0.124	0.130	3.15	3.30
R	0.392	0.404	9.96	10.26

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 465D–02
ISSUE A

CASE DIMENSIONS (continued)

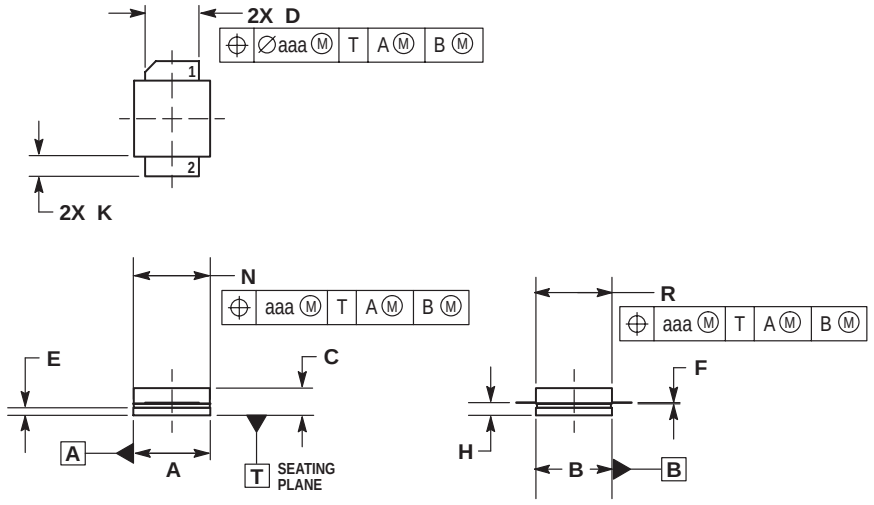


NOTES:
1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSION H IS MEASURED 0.030 INCH AWAY FROM FLANGE.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	.795	.805	20.19	20.44
B	.380	.390	9.65	9.9
C	.125	.160	3.17	4.06
D	.275	.285	6.98	7.24
E	.035	.045	0.89	1.14
F	.003	.006	0.07	0.15
G	.600 BSC		15.24 BSC	
H	.057	.067	1.45	1.7
K	.092	.122	2.33	3.1
M	.395	.405	10	10.3
N	.395	.405	10	10.3
Q	.110	.130	2.79	3.3
R	.395	.405	10	10.3
S	.395	.405	10	10.3
aaa	.005 BSC		0.127 BSC	
bbb	.010 BSC		0.254 BSC	
ccc	.015 BSC		0.381 BSC	

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 465E–02
ISSUE C



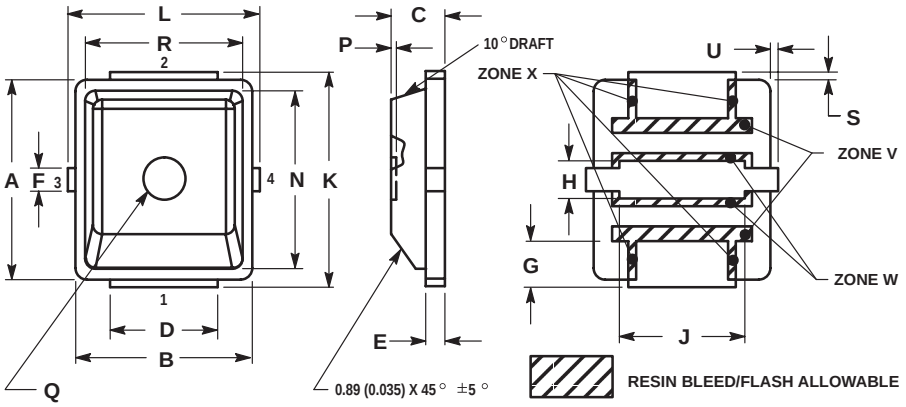
NOTES:
1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DIMENSION H IS MEASURED .30 (0.762) AWAY FROM FLANGE.

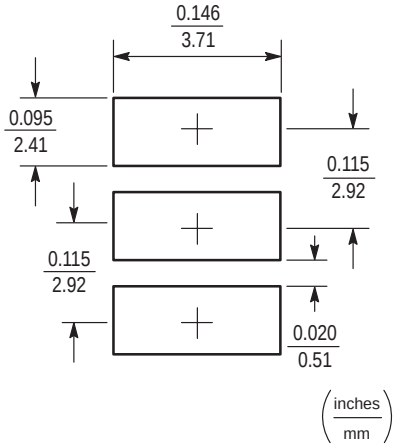
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	.395	.405	10.03	10.29
B	.395	.405	10.03	10.29
C	.125	.16	3.18	4.06
D	.275	.285	6.98	7.24
E	.035	.045	0.89	1.14
F	.003	.006	0.08	0.15
H	.057	.067	1.45	1.70
K	.092	.122	2.34	3.10
N	.392	.4	9.96	10.16
R	.392	.4	9.96	10.16
aaa	.015		0.38	

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 465F–02
ISSUE A

CASE DIMENSIONS (continued)





SOLDER FOOTPRINT

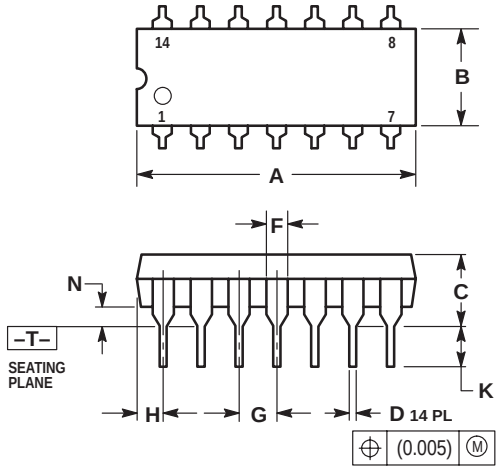
STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE
4. SOURCE

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH
3. RESIN BLEED/FLASH ALLOWABLE IN ZONE V, W, AND X.

CASE 466–02
ISSUE B
(PLD–1.5)

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.255	0.265	6.48	6.73
B	0.225	0.235	5.72	5.97
C	0.065	0.072	1.65	1.83
D	0.130	0.150	3.30	3.81
E	0.021	0.026	0.53	0.66
F	0.026	0.044	0.66	1.12
G	0.050	0.070	1.27	1.78
H	0.045	0.063	1.14	1.60
J	0.160	0.180	4.06	4.57
K	0.273	0.285	6.93	7.24
L	0.245	0.255	6.22	6.48
N	0.230	0.240	5.84	6.10
P	0.000	0.008	0.00	0.20
Q	0.055	0.063	1.40	1.60
R	0.200	0.210	5.08	5.33
S	0.006	0.012	0.15	0.31
U	0.006	0.012	0.15	0.31
ZONE V	0.000	0.021	0.00	0.53
ZONE W	0.000	0.010	0.00	0.25
ZONE X	0.000	0.010	0.00	0.25

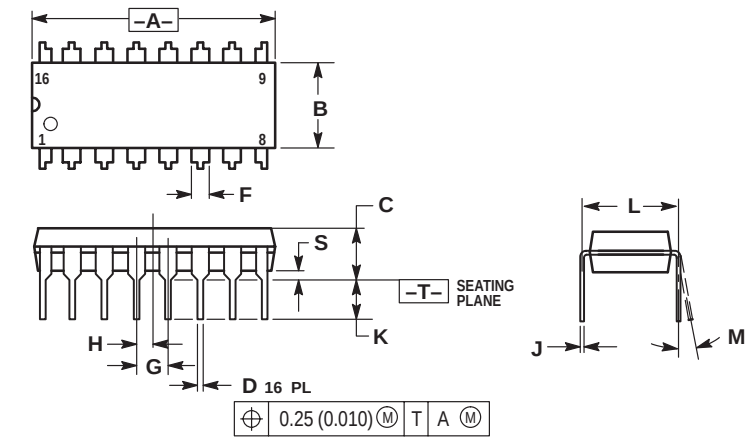
CASE DIMENSIONS (continued)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.
6. 646–05 OBSOLETE, NEW STANDARD 646–06.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.715	0.770	18.16	18.80
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.290	0.310	7.37	7.87
M	—	10°	—	10°
N	0.015	0.039	0.38	1.01

CASE 646–06
ISSUE N
(DIP–14)

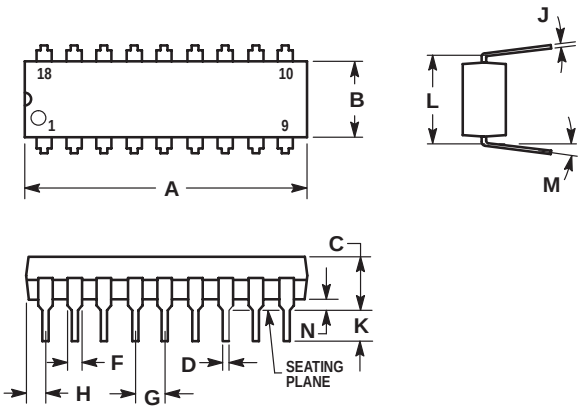


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0°	10°	0°	10°
S	0.020	0.040	0.51	1.01

CASE 648–08
ISSUE R
(DIP–16)

CASE DIMENSIONS (continued)

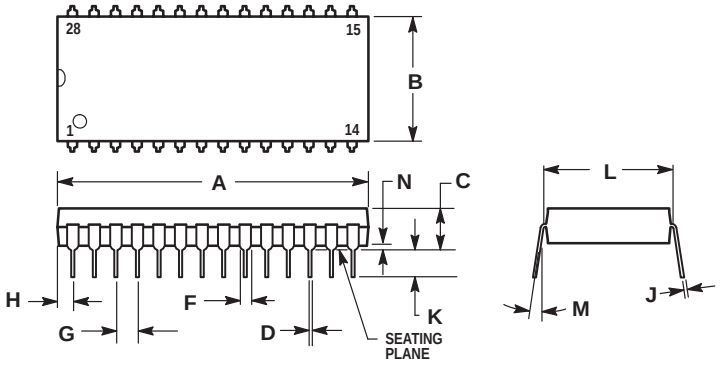


NOTES:
1. POSITIONAL TOLERANCE OF LEADS (D), SHALL BE WITHIN 0.25 (0.010) AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
4. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.875	0.915	22.22	23.24
B	0.240	0.260	6.10	6.60
C	0.140	0.180	3.56	4.57
D	0.014	0.022	0.36	0.56
F	0.050	0.070	1.27	1.78
G	0.100 BSC		2.54 BSC	
H	0.040	0.060	1.02	1.52
J	0.008	0.012	0.20	0.30
K	0.115	0.135	2.92	3.43
L	0.300 BSC		7.62 BSC	
M	0 °	15 °	0 °	15 °
N	0.020	0.040	0.51	1.02

CASE 707–02
ISSUE C
(DIP–18)

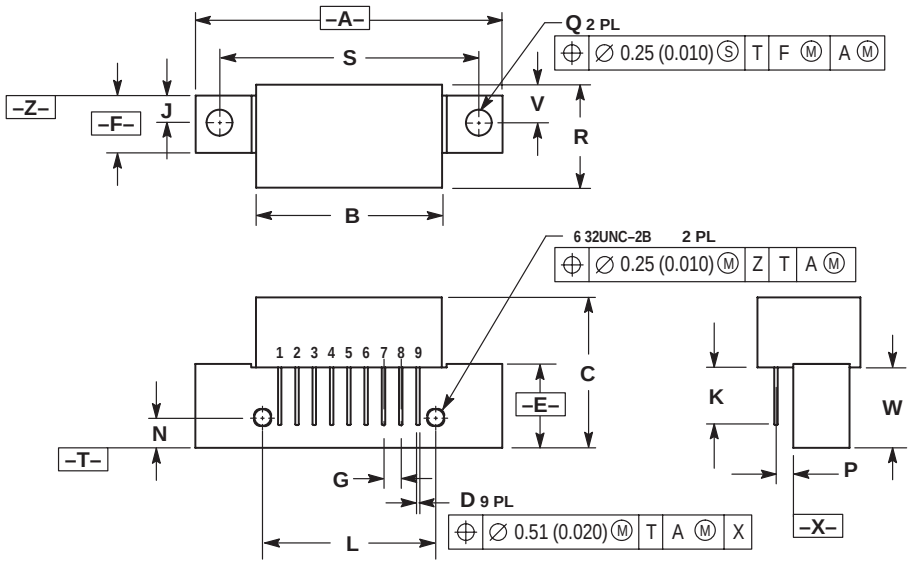
CASE DIMENSIONS (continued)



NOTES:
1. POSITIONAL TOLERANCE OF LEADS (D), SHALL BE WITHIN 0.25 (0.010) AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
4. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.435	1.465	36.45	37.21
B	0.540	0.560	13.72	14.22
C	0.155	0.200	3.94	5.08
D	0.014	0.022	0.36	0.56
F	0.040	0.060	1.02	1.52
G	0.100 BSC		2.54 BSC	
H	0.065	0.085	1.65	2.16
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.600 BSC		15.24 BSC	
M	0°	15°	0°	15°
N	0.020	0.040	0.51	1.02

CASE 710–02
ISSUE B
(DIP–28)



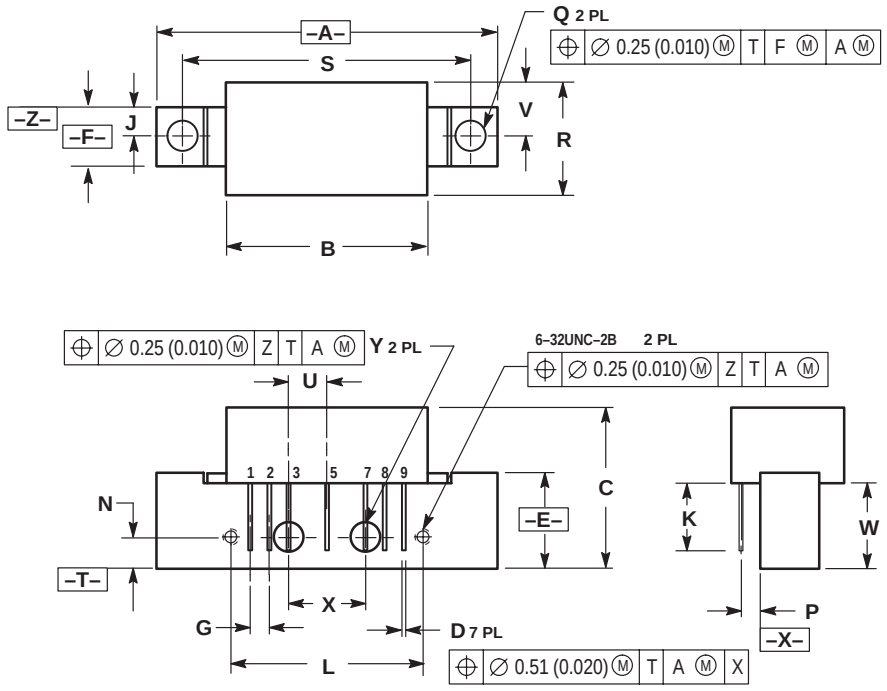
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	—	1.775	—	45.08
B	—	1.085	—	27.56
C	—	0.870	—	22.10
D	0.018	0.022	0.46	0.56
E	0.465	0.510	11.81	12.95
F	0.300	0.325	7.62	8.25
G	0.100 BSC		2.54 BSC	
J	0.156 BSC		3.96 BSC	
K	0.330	0.370	8.38	9.40
L	1.000 BSC		25.40 BSC	
N	0.165 BSC		4.19 BSC	
P	0.100 BSC		2.54 BSC	
Q	0.148	0.168	3.76	4.27
R	—	0.595	—	15.11
S	1.500 BSC		38.10 BSC	
V	0.209	0.239	5.31	6.07
W	0.425	—	10.80	—

STYLE 2:
PIN 1. RF INPUT
2. GROUND
3. GROUND
4. RESISTOR-GROUND
5. GROUND
6. GROUND
7. GROUND
8. V_{CC} 1
9. RF OUTPUT

CASE 714P–03
ISSUE B

CASE DIMENSIONS (continued)



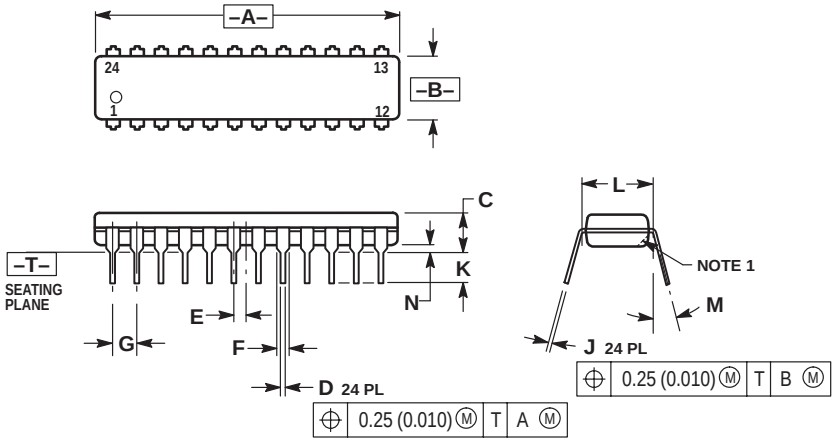
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	——	1.775	——	45.08
B	——	1.085	——	27.56
C	——	0.840	——	21.34
D	0.018	0.022	0.46	0.56
E	0.465	0.510	11.81	12.95
F	0.300	0.325	7.62	8.25
G	0.100 BSC		2.54 BSC	
J	0.156 BSC		3.96 BSC	
K	0.315	0.355	8.00	8.50
L	1.00 BSC		25.40 BSC	
N	0.165 BSC		4.19 BSC	
P	0.100 BSC		2.54 BSC	
Q	0.148	0.168	3.76	4.27
R	——	0.600	——	15.24
S	1.500 BSC		38.10 BSC	
U	0.200 BSC		5.08 BSC	
V	——	0.250	——	6.35
W	0.435	0.450	11.05	11.43
X	0.400 BSC		10.16 BSC	
Y	0.152	0.163	3.85	4.15

STYLE 1:
PIN 1. RF INPUT
2. GROUND
3. GROUND
4. DELETED
5. VDC
6. DELETED
7. GROUND
8. GROUND
9. RF OUTPUT

STYLE 2:
PIN 1. RF OUTPUT
2. GROUND
3. GROUND
4. DELETED
5. VDC
6. DELETED
7. GROUND
8. GROUND
9. RF INPUT

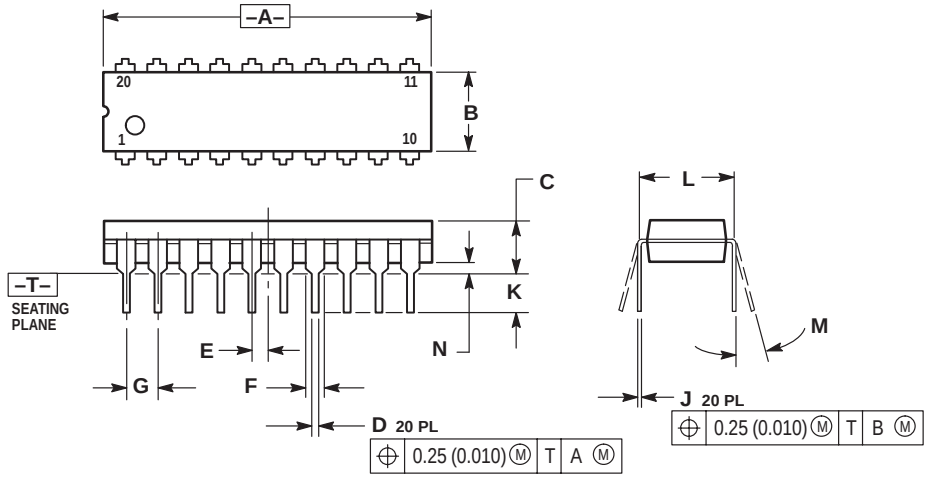
CASE 714Y–03
ISSUE D



NOTES:
1. CHAMFERED CONTOUR OPTIONAL.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
4. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.230	1.265	31.25	32.13
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.020	0.38	0.51
E	0.050 BSC		1.27 BSC	
F	0.040	0.060	1.02	1.52
G	0.100 BSC		2.54 BSC	
J	0.007	0.012	0.18	0.30
K	0.110	0.140	2.80	3.55
L	0.300 BSC		7.62 BSC	
M	0°	15°	0°	15°
N	0.020	0.040	0.51	1.01

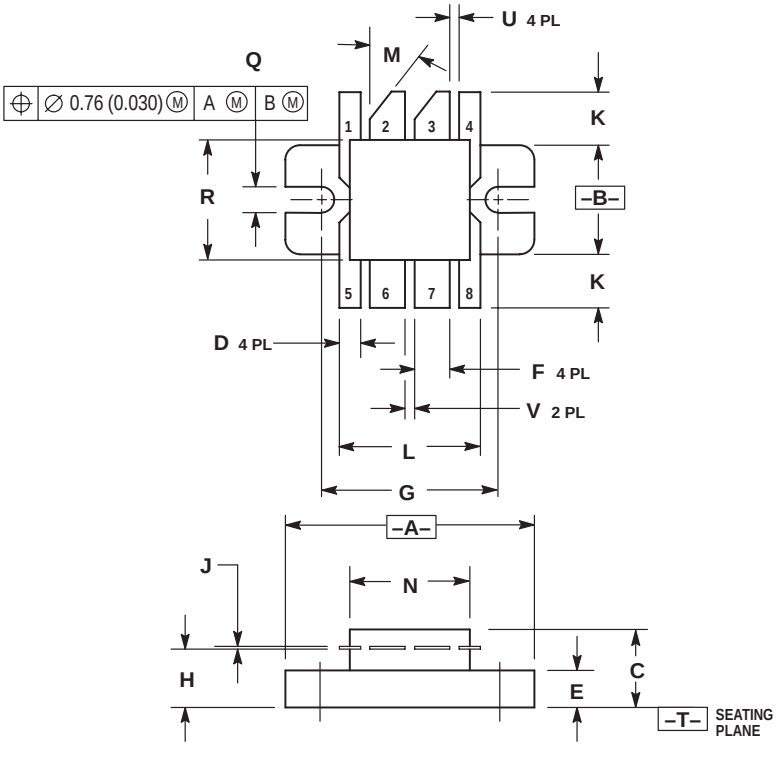
CASE 724–03
ISSUE D
(DIP–24)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.010	1.070	25.66	27.17
B	0.240	0.260	6.10	6.60
C	0.150	0.180	3.81	4.57
D	0.015	0.022	0.39	0.55
E	0.050 BSC		1.27 BSC	
F	0.050	0.070	1.27	1.77
G	0.100 BSC		2.54 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.140	2.80	3.55
L	0.300 BSC		7.62 BSC	
M	0°	15°	0°	15°
N	0.020	0.040	0.51	1.01

CASE 738–03
ISSUE E
(DIP–20)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

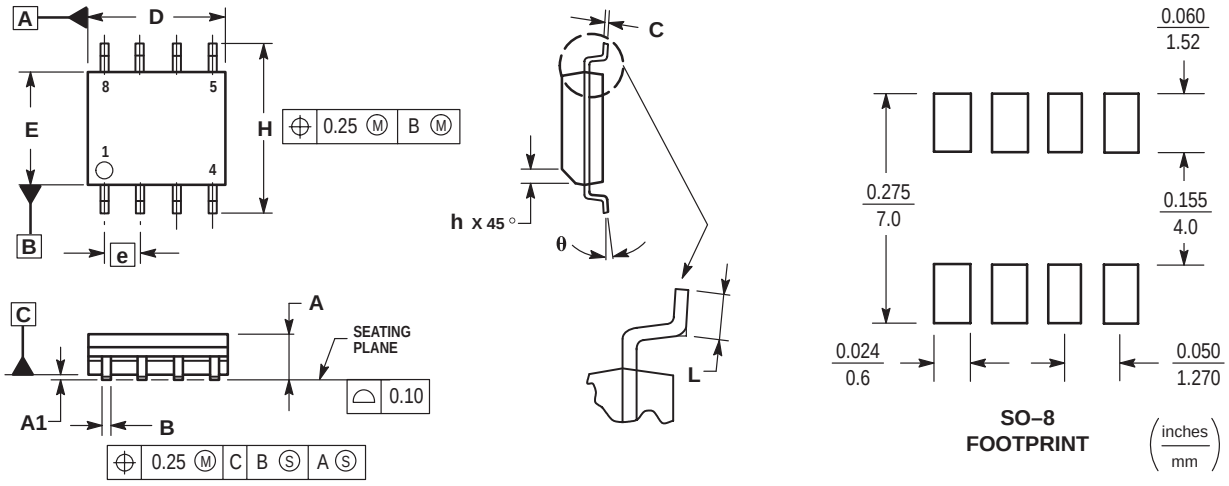
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	22.60	23.11	0.890	0.910
B	9.52	10.03	0.375	0.395
C	6.65	7.16	0.262	0.282
D	1.60	1.95	0.063	0.077
E	2.94	3.40	0.116	0.134
F	2.87	3.22	0.113	0.127
G	16.51 BSC		0.650 BSC	
H	4.01	4.36	0.158	0.172
J	0.07	0.15	0.003	0.006
K	4.34	4.90	0.171	0.193
L	12.45	12.95	0.490	0.510
M	45° NOM		45° NOM	
N	1.051	11.02	0.414	0.434
Q	3.04	3.35	0.120	0.132
R	9.90	10.41	0.390	0.410
U	1.02	1.27	0.040	0.050
V	0.64	0.89	0.025	0.035

STYLE 1:
PIN 1. EMITTER (COMMON)
2. COLLECTOR
3. COLLECTOR
4. EMITTER (COMMON)
5. EMITTER (COMMON)
6. BASE
7. BASE
8. EMITTER (COMMON)

STYLE 2:
PIN 1. SOURCE (COMMON)
2. DRAIN
3. DRAIN
4. SOURCE (COMMON)
5. SOURCE (COMMON)
6. GATE
7. GATE
8. SOURCE (COMMON)

CASE 744A–01
ISSUE C

CASE DIMENSIONS (continued)



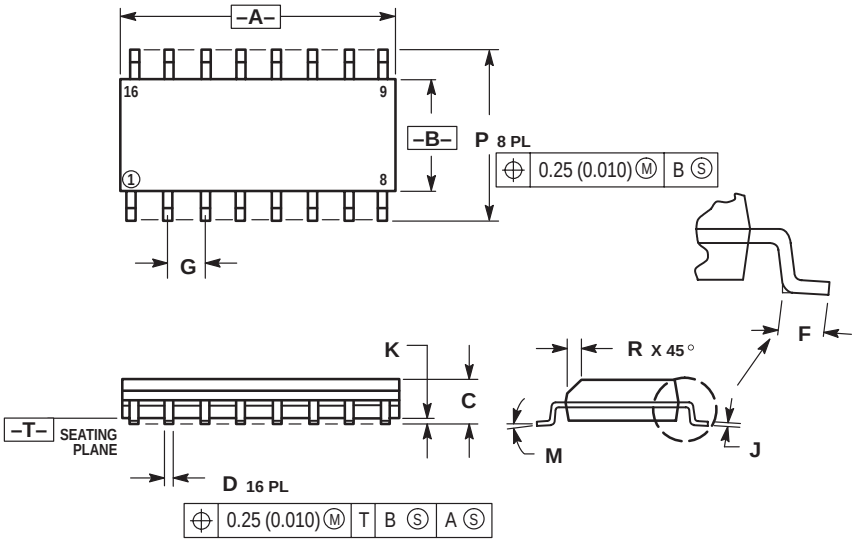
STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. COLLECTOR
4. EMITTER
5. EMITTER
6. BASE
7. BASE
8. EMITTER

STYLE 6:
PIN 1. SOURCE
2. DRAIN
3. DRAIN
4. SOURCE
5. SOURCE
6. GATE
7. GATE
8. SOURCE

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETER.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.35	0.49
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.25
θ	0°	7°

CASE 751–06
ISSUE T
(SO–8)

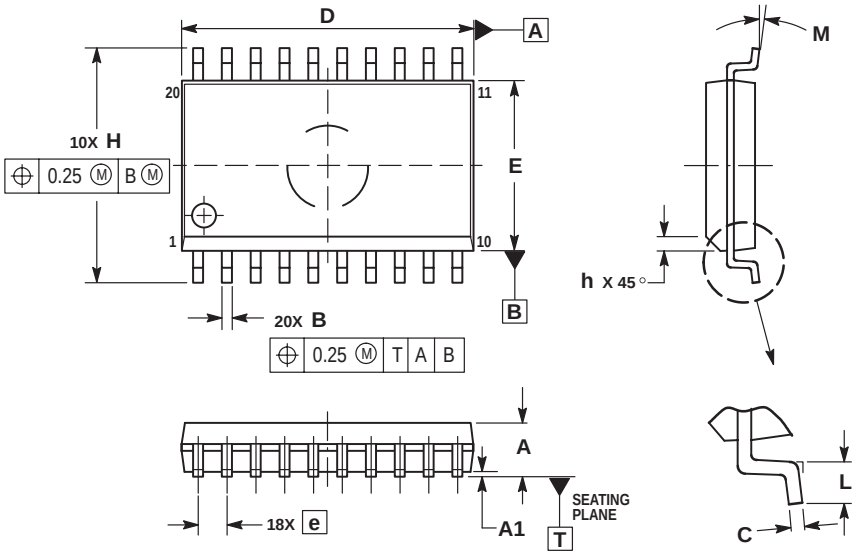


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

CASE 751B–05
ISSUE J
(SO–16)

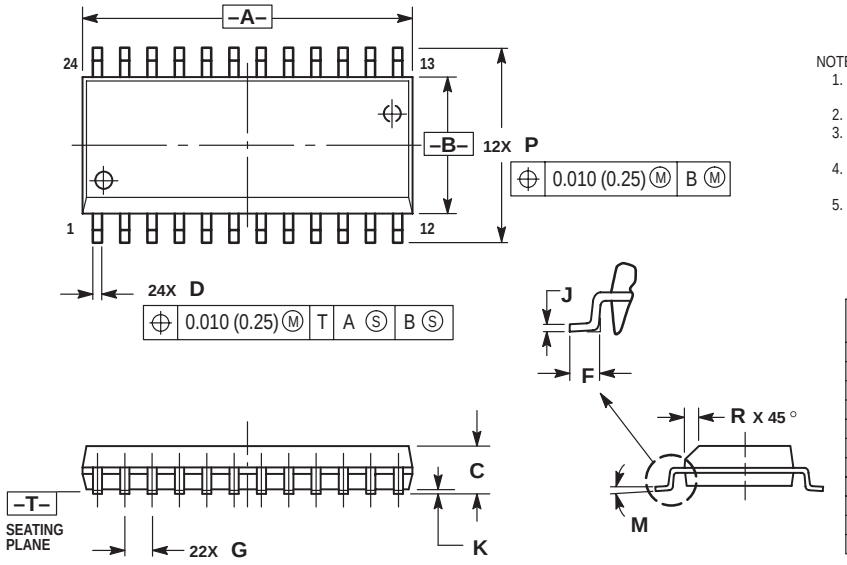
CASE DIMENSIONS (continued)



NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
B	0.35	0.49
C	0.23	0.32
D	12.65	12.95
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.40	1.00
θ	0°	7°

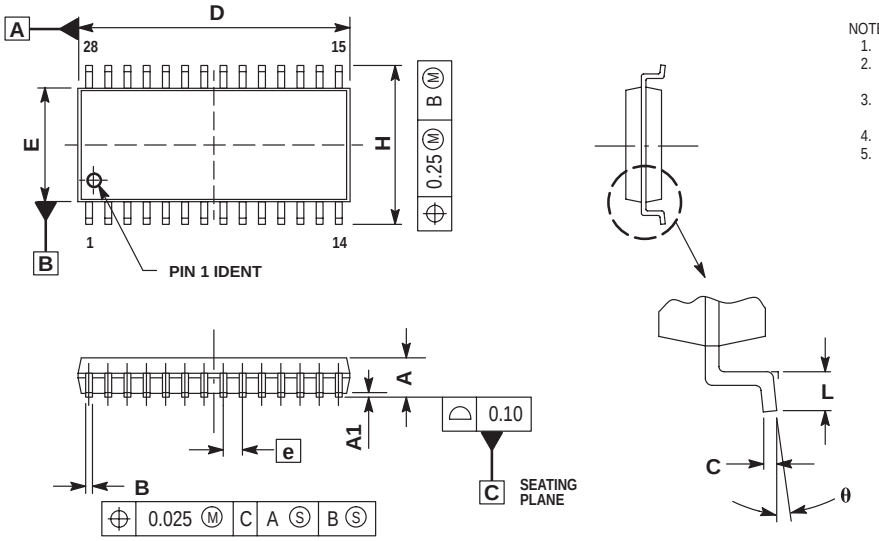
CASE 751D–06
ISSUE G
(SO–20L)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	15.25	15.54	0.601	0.612
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.41	0.90	0.016	0.035
G	1.27 BSC		0.050 BSC	
J	0.23	0.32	0.009	0.013
K	0.13	0.29	0.005	0.011
M	0°	8°	0°	8°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

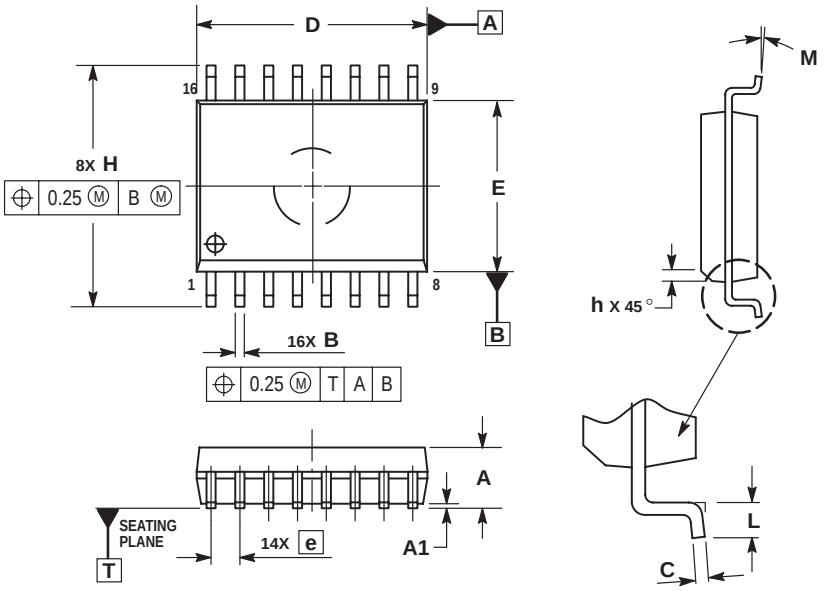
CASE 751E–04
ISSUE E
(SO–24L)



NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
4. MAXIMUM MOLD PROTRUSION 0.015 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	2.35	2.65
A1	0.13	0.29
B	0.35	0.49
C	0.23	0.32
D	17.80	18.05
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
L	0.41	0.90
θ	0 °	8 °

CASE 751F–05
ISSUE F
(SO–28L)

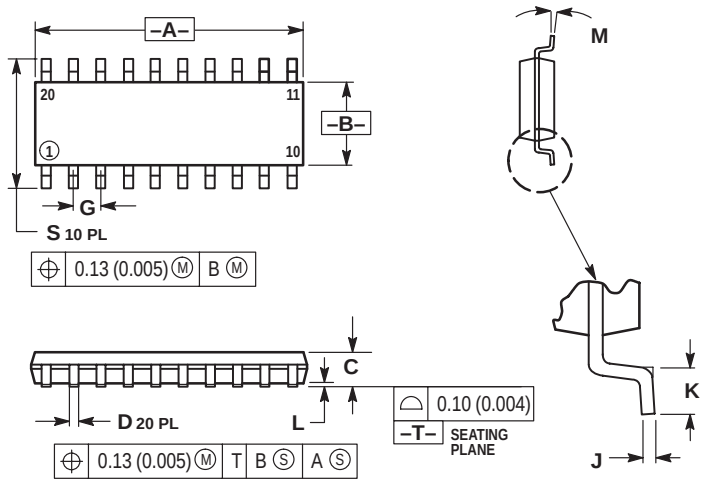


NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INLCUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
B	0.35	0.49
C	0.23	0.32
D	10.15	10.45
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.40	1.00
M	0 °	7 °

CASE 751G–04
ISSUE C
(SO–16W)

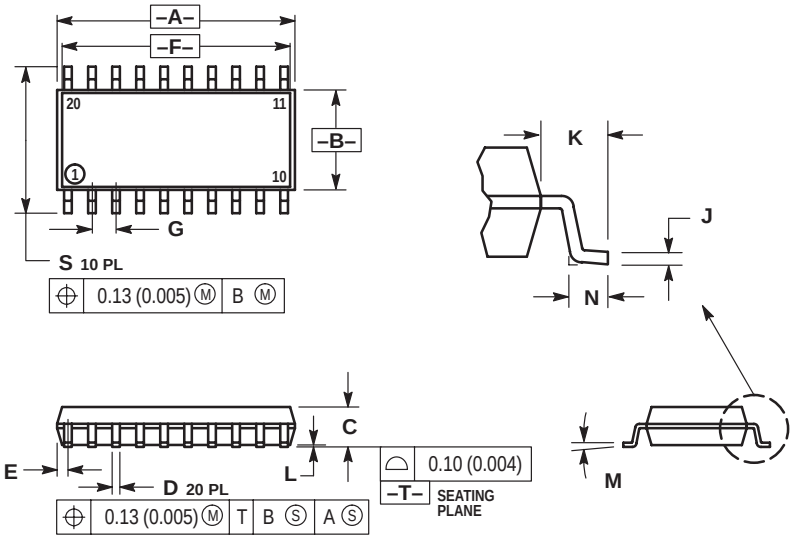
CASE DIMENSIONS (continued)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.12 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	12.55	12.80	0.494	0.504
B	5.10	5.40	0.201	0.213
C	—	2.00	—	0.079
D	0.35	0.45	0.014	0.018
G	1.27 BSC		0.050 BSC	
J	0.18	0.23	0.007	0.009
K	0.55	0.85	0.022	0.033
L	0.05	0.20	0.002	0.008
M	0 °	7 °	0 °	7 °
S	7.40	8.20	0.291	0.323

CASE 751J–02
ISSUE A
(SO–20)



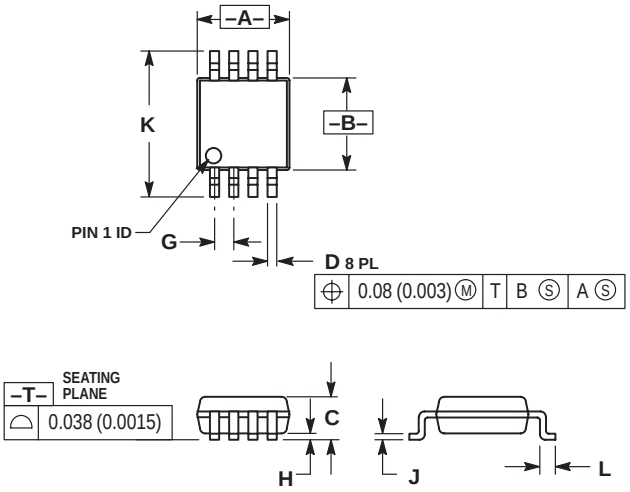
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.008) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.006) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	12.35	12.80	0.486	0.504
B	5.10	5.45	0.201	0.215
C	1.95	2.05	0.077	0.081
D	0.35	0.50	0.014	0.020
E	—	0.81	—	0.032
F	12.40*		0.488*	
G	1.15	1.39	0.045	0.055
H	0.59	0.81	0.023	0.032
J	0.18	0.27	0.007	0.011
K	1.10	1.50	0.043	0.059
L	0.05	0.20	0.001	0.008
M	0 °	10 °	0 °	10 °
N	0.50	0.85	0.020	0.033
S	7.40	8.20	0.291	0.323

*APPROXIMATE

CASE 803C–01
PRELIMINARY
(SO–20L)

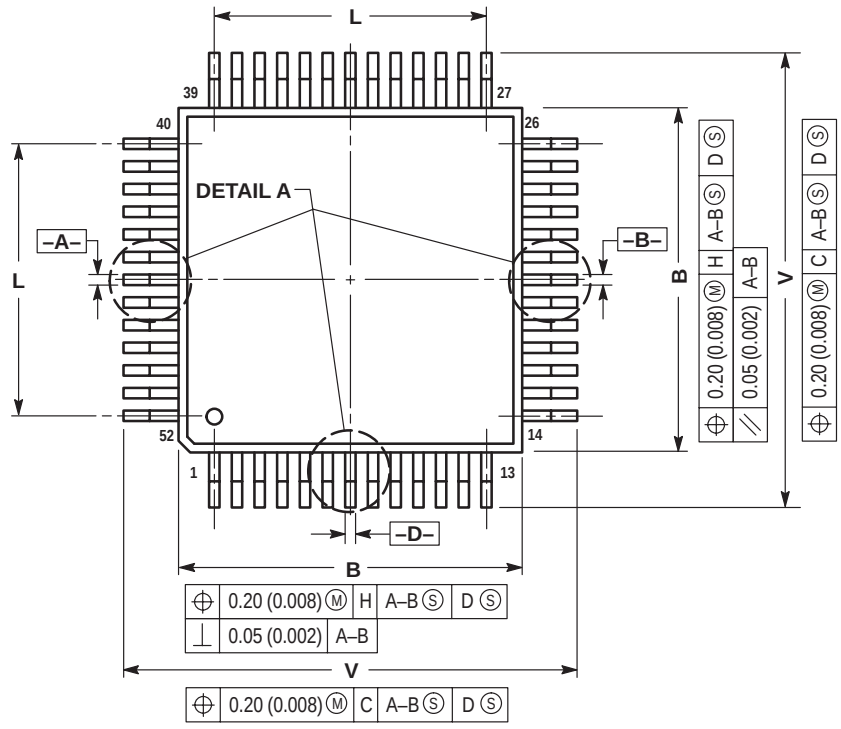
CASE DIMENSIONS (continued)

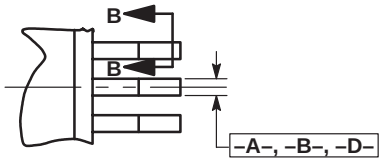


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.

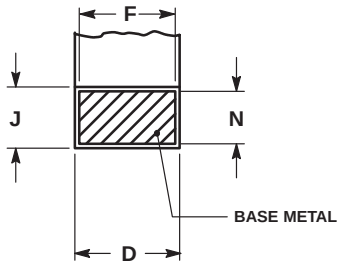
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.90	3.10	0.114	0.122
B	2.90	3.10	0.114	0.122
C	—	1.10	—	0.043
D	0.25	0.40	0.010	0.016
G	0.65 BSC		0.026 BSC	
H	0.05	0.15	0.002	0.006
J	0.13	0.23	0.005	0.009
K	4.75	5.05	0.187	0.199
L	0.40	0.70	0.016	0.028

CASE 846A–02
ISSUE D
(Micro–8)

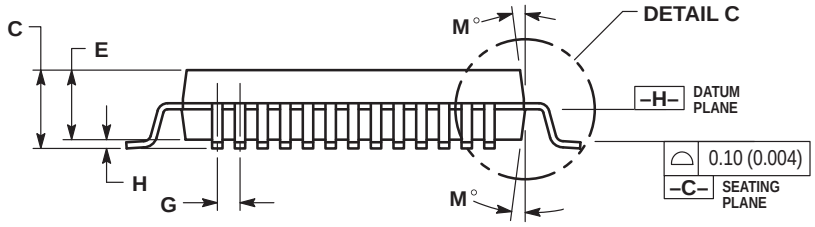


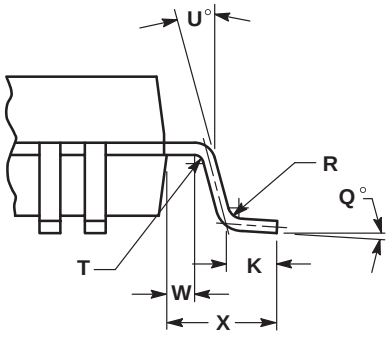


DETAIL A



SECTION B–B



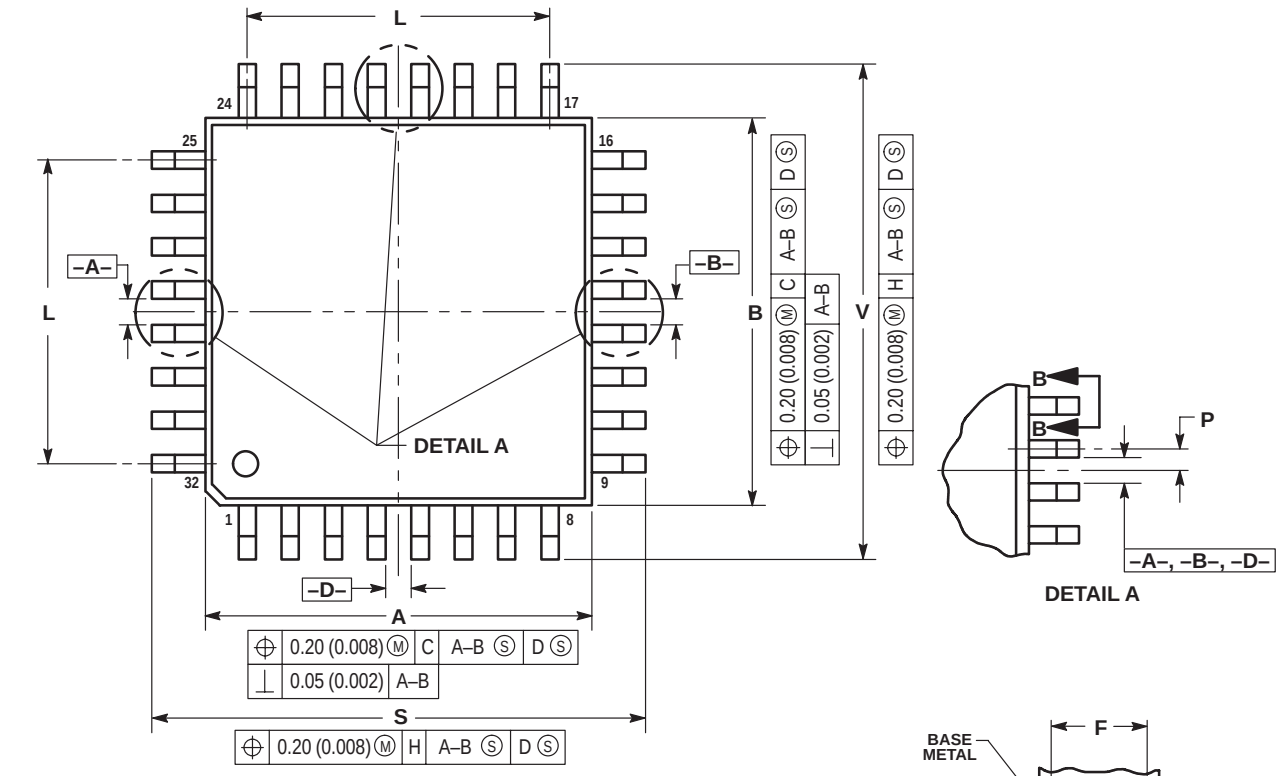


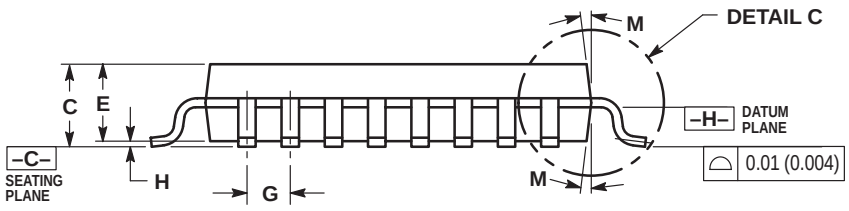
DETAIL C

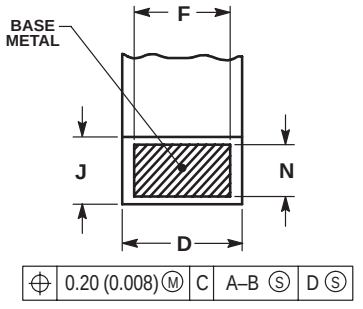
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DATUM PLANE –H– IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DATUMS –A–, –B– AND –D– TO BE DETERMINED AT DATUM PLANE –H–.
5. DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE –C–.
6. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE –H–.
7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.90	10.10	0.390	0.398
B	9.90	10.10	0.390	0.398
C	2.10	2.45	0.083	0.096
D	0.22	0.38	0.009	0.015
E	2.00	2.10	0.079	0.083
F	0.22	0.33	0.009	0.013
G	0.65 BSC		0.026 BSC	
H	—	0.25	—	0.010
J	0.13	0.23	0.005	0.009
K	0.65	0.95	0.026	0.037
L	7.80 REF		0.307 REF	
M	5°	10°	5°	10°
N	0.13	0.17	0.005	0.007
Q	0°	7°	0°	7°
R	0.13	0.30	0.005	0.012
S	12.95	13.45	0.510	0.530
T	0.13	—	0.005	—
U	0°	—	0°	—
V	12.95	13.45	0.510	0.530
W	0.35	0.45	0.014	0.018
X	1.6 REF		0.063 REF	

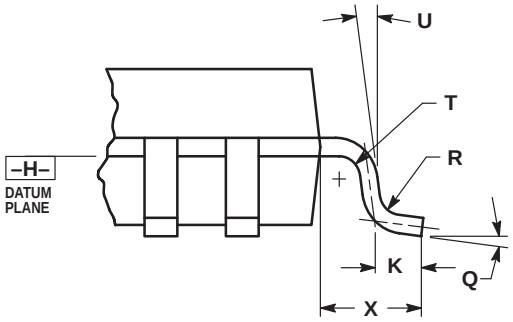
CASE 848B–04
ISSUE C
(QFP–52)







SECTION B–B
VIEW ROTATED 90 ° CLOCKWISE



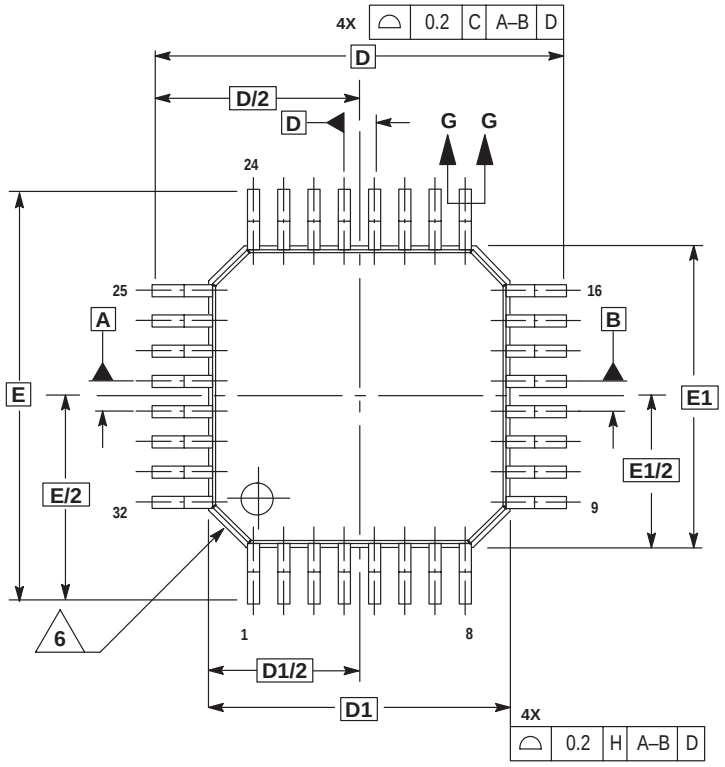
DETAIL C

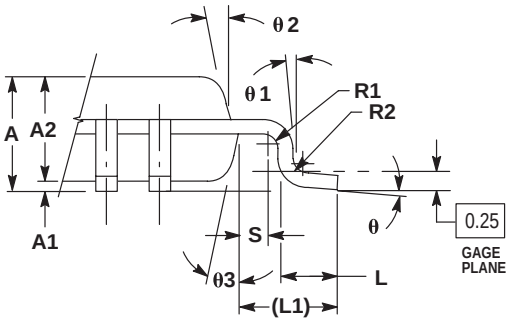
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DATUM PLANE –H– IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DATUMS –A–, –B– AND –D– TO BE DETERMINED AT DATUM PLANE –H–.
5. DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE –C–.
6. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE –H–.
7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	6.95	7.10	0.274	0.280
B	6.95	7.10	0.274	0.280
C	1.40	1.60	0.055	0.063
D	0.273	0.373	0.010	0.015
E	1.30	1.50	0.051	0.059
F	0.273	—	0.010	—
G	0.80 BSC		0.031 BSC	
H	—	0.20	—	0.008
J	0.119	0.197	0.005	0.008
K	0.33	0.57	0.013	0.022
L	5.6 REF		0.220 REF	
M	6 °	8 °	6 °	8 °
N	0.119	0.135	0.005	0.005
P	0.40 BSC		0.016 BSC	
Q	5 °	10°	5 °	10°
R	0.15	0.25	0.006	0.010
S	8.85	9.15	0.348	0.360
T	0.15	0.25	0.006	0.010
U	5 °	11°	5 °	11°
V	8.85	9.15	0.348	0.360
X	1.00 REF		0.039 REF	

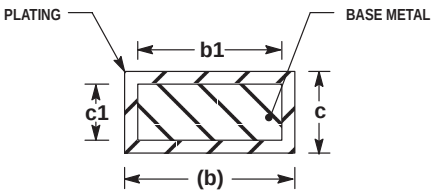
CASE 873–01
ISSUE A
(LQFP–32)

CASE DIMENSIONS (continued)

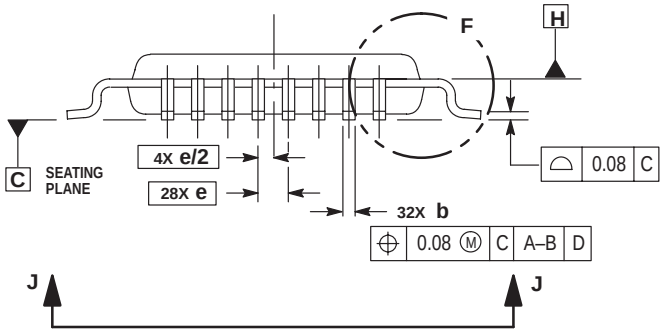




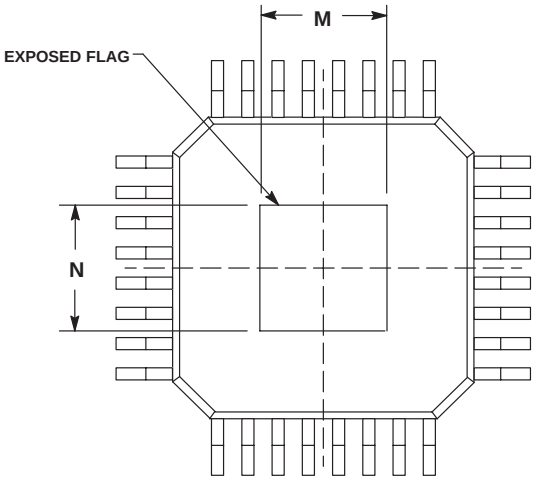
DETAIL F



SECTION G–G



NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DATUMS A, B AND D TO BE DETERMINED AT DATUM PLANE H.
4. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25–MM PER SIDE. D1 AND E1 ARE MAXIMUM PLASTIC BODY SIZE DIMENSIONS INCLUDING MOLD MISMATCH.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED THE MAXIMUM b DIMENSION BY MORE THAN 0.08–MM. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN A PROTRUSION AND ADJACENT LEAD IS 0.07–MM
6. EXACT SHAPE OF CORNERS IS OPTIONAL.

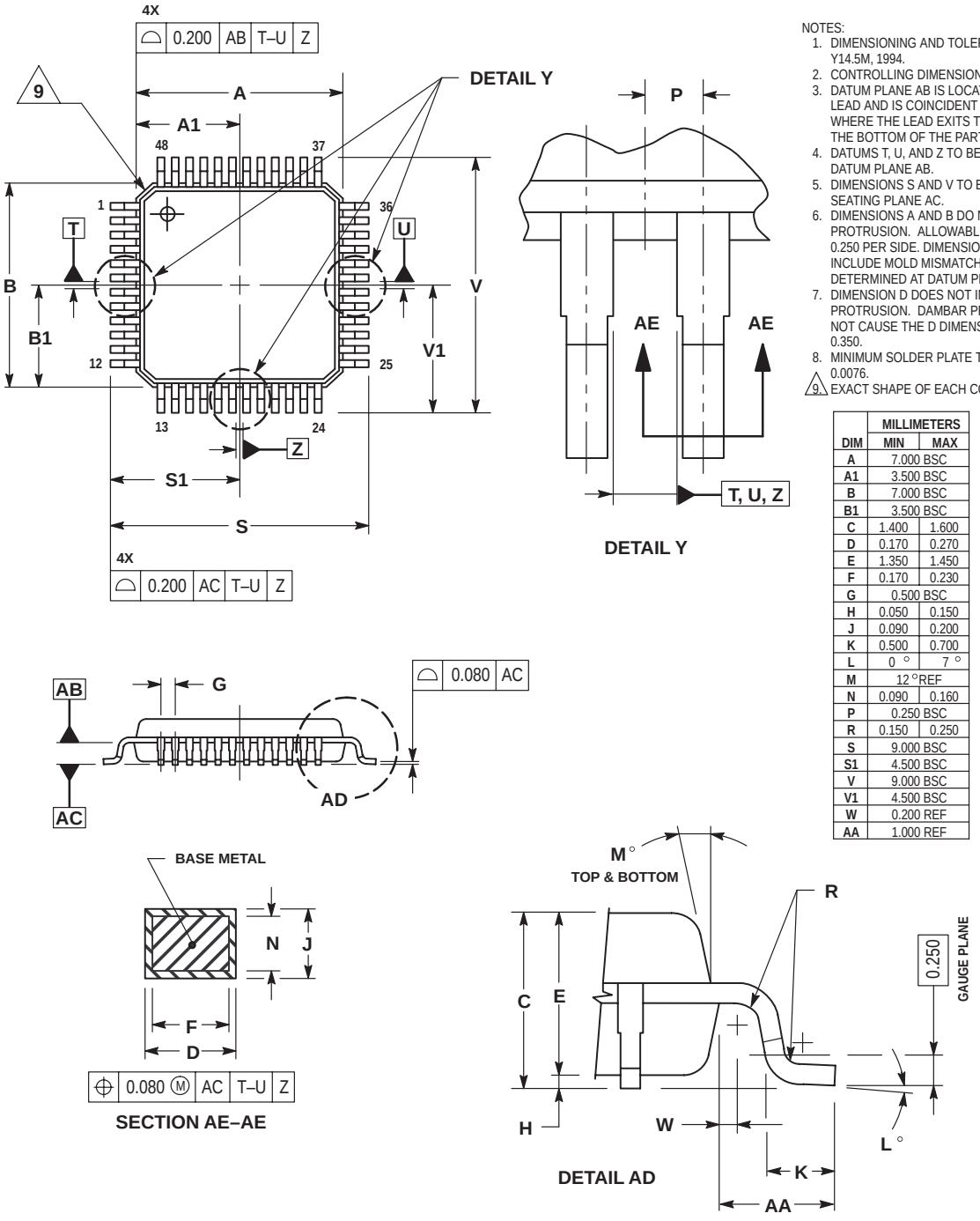


VIEW J–J

	MILLIMETERS	
DIM	MIN	MAX
A	——	1.13
A1	0.039	0.089
A2	0.95	1.05
b	0.17	0.27
b1	0.17	0.23
C	0.09	0.2
C1	0.09	0.16
D	7 BSC	
D1	5 BSC	
e	0.5 BSC	
E	7 BSC	
E1	5 BSC	
L	0.45	0.75
L1	1 REF	
M	2.09	2.19
N	2.09	2.19
R1	0.08	——
R2	0.08	0.2
S	0.2	——
θ	0°	7°
θ1	0°	——
θ2	11°	13°
θ3	11°	13°

CASE 873E–02
ISSUE A
(TQFP–32EP)

CASE DIMENSIONS (continued)

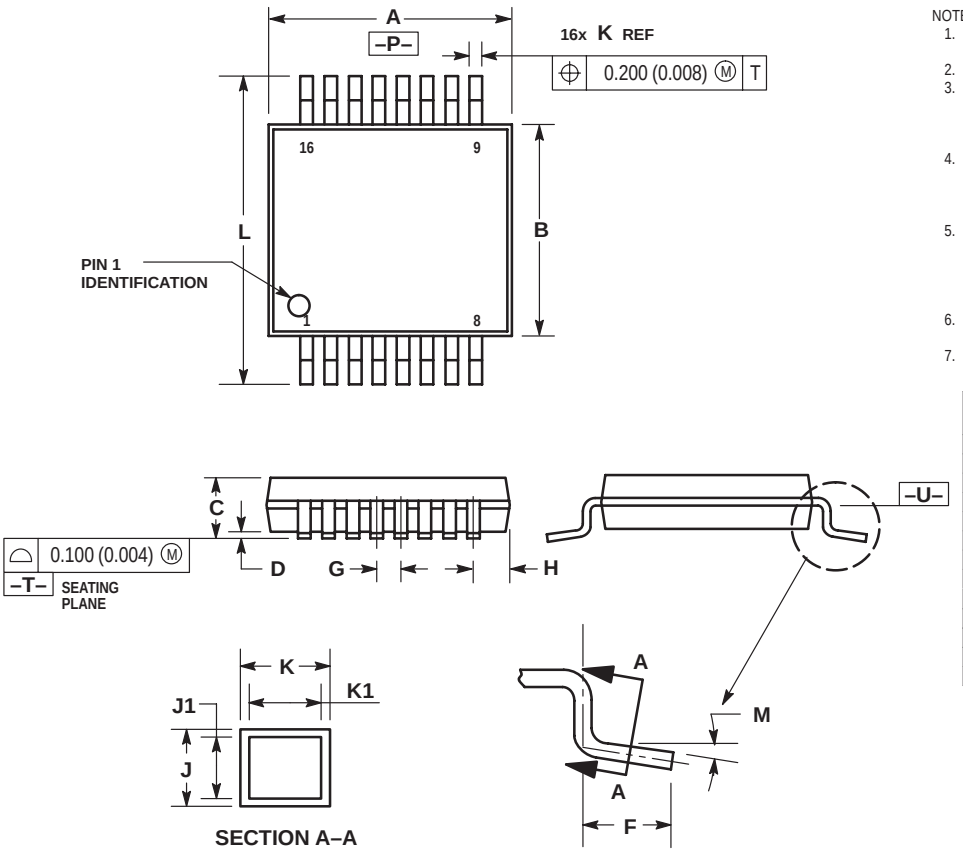


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DATUM PLANE AB IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DATUMS T, U, AND Z TO BE DETERMINED AT DATUM PLANE AB.
5. DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE AC.
6. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE AB.
7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.350.
8. MINIMUM SOLDER PLATE THICKNESS SHALL BE 0.0076.
9. EXACT SHAPE OF EACH CORNER IS OPTIONAL.

	MILLIMETERS	
DIM	MIN	MAX
A	7.000 BSC	
A1	3.500 BSC	
B	7.000 BSC	
B1	3.500 BSC	
C	1.400	1.600
D	0.170	0.270
E	1.350	1.450
F	0.170	0.230
G	0.500 BSC	
H	0.050	0.150
J	0.090	0.200
K	0.500	0.700
L	0 °	7 °
M	12 ° REF	
N	0.090	0.160
P	0.250 BSC	
R	0.150	0.250
S	9.000 BSC	
S1	4.500 BSC	
V	9.000 BSC	
V1	4.500 BSC	
W	0.200 REF	
AA	1.000 REF	

CASE 932–03
ISSUE F
(LQFP–48)

CASE DIMENSIONS (continued)

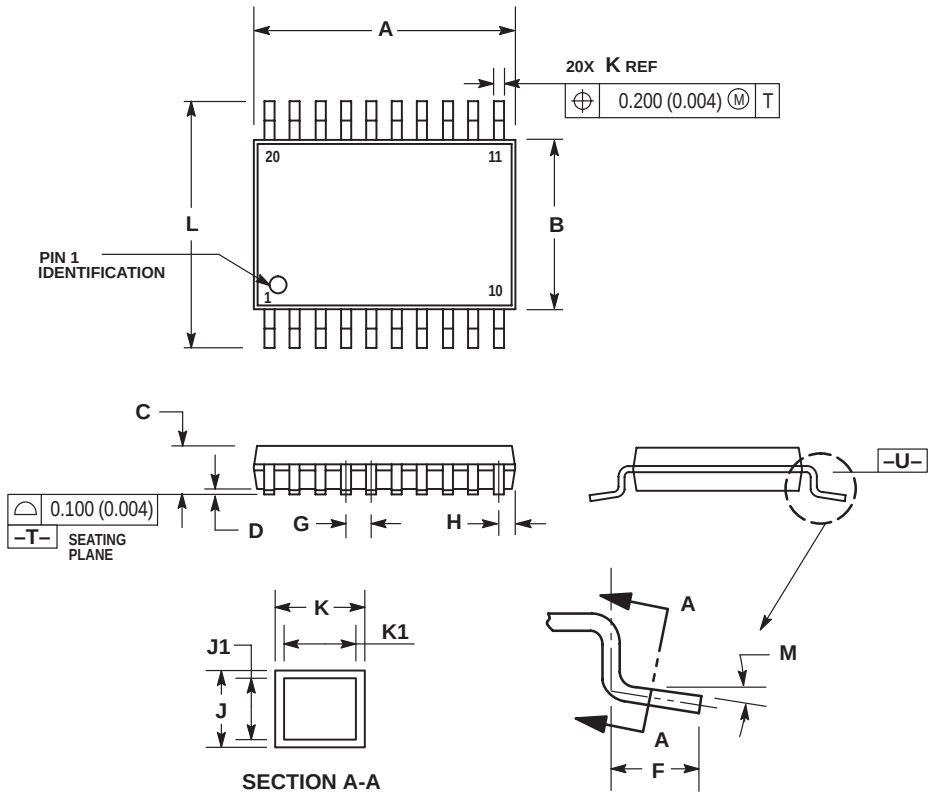


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM PLANE –U–.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	—	5.10	—	0.200
B	4.30	4.50	0.169	0.177
C	—	1.20	—	0047
D	0.05	0.25	0.002	0.010
F	0.45	0.55	0.018	0.022
G	0.65 BSC		0.026 BSC	
H	0.22	0.23	0.009	0.010
J	0.09	0.24	0.004	0.009
J1	0.09	0.18	0.004	0.007
K	0.16	0.32	0.006	0.013
K1	0.16	0.26	0.006	0.010
L	6.30	6.50	0.248	0.256
M	0°	10°	0°	10°

CASE 948C–03
ISSUE B
(TSSOP–16)

CASE DIMENSIONS (continued)

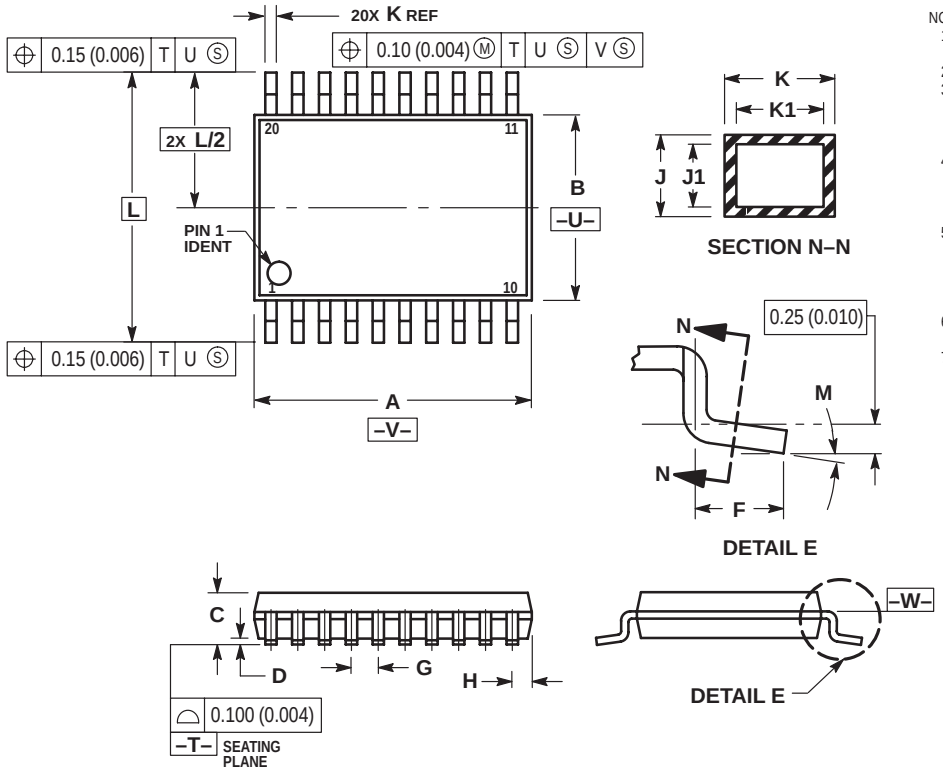


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM PLANE –U–.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	——	6.60	——	0.260
B	4.30	4.50	0.169	0.177
C	——	1.20	——	0.047
D	0.05	0.25	0.002	0.010
F	0.45	0.55	0.018	0.022
G	0.65 BSC		0.026 BSC	
H	0.275	0.375	0.011	0.015
J	0.09	0.24	0.004	0.009
J1	0.09	0.18	0.004	0.007
K	0.16	0.32	0.006	0.013
K1	0.16	0.26	0.006	0.010
L	6.30	6.50	0.248	0.256
M	0°	10°	0°	10°

CASE 948D–03
ISSUE B
(TSSOP–20)

CASE DIMENSIONS (continued)

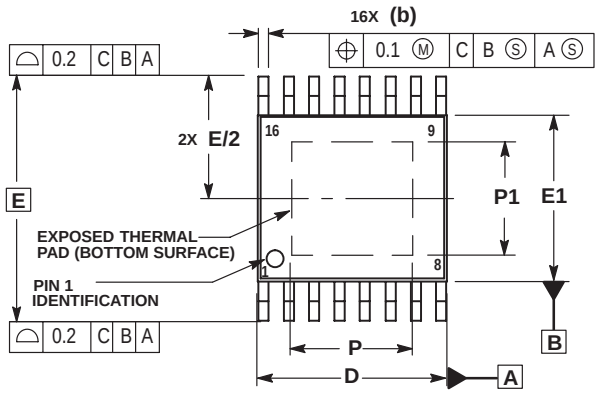


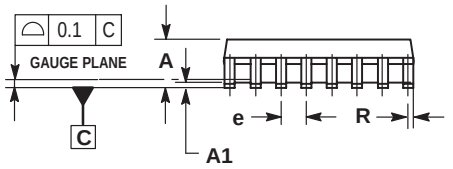
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE –W–.

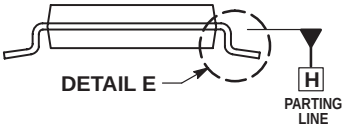
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	—	1.20	—	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

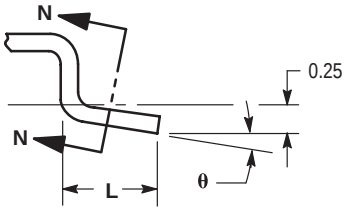
CASE 948E–02
ISSUE A
(TSSOP–20HS)

CASE DIMENSIONS (continued)

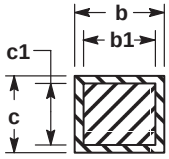








DETAIL E



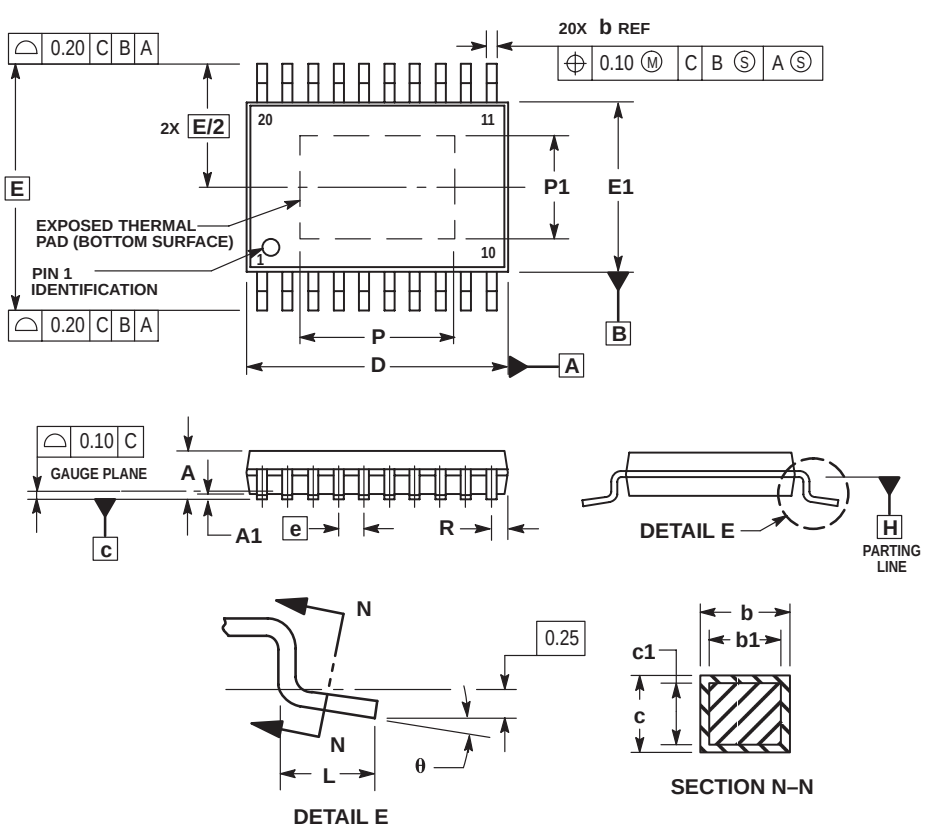
SECTION N–N

NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.
4. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSIONS D AND E1 ARE TO BE DETERMINED AT DATUM PLANE H.

	MILLIMETERS	
DIM	MIN	MAX
A	—	1.2
A1	0	0.15
b	0.19	0.3
b1	0.19	0.25
c	0.09	0.2
c1	0.09	0.16
D	4.9	5.1
E	6.40 BSC	
E1	4.3	4.5
e	0.65 BSC	
L	0.5	0.75
P	—	3.9
P1	—	3
R	0.18	0.28
θ	0°	8°

CASE 948L–01
ISSUE A
(TSSOP–16EP)

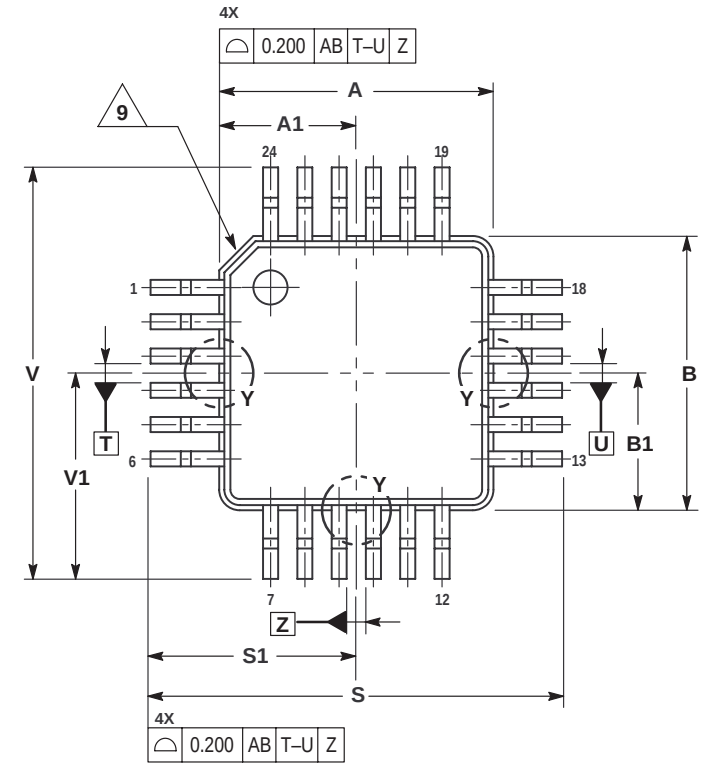
CASE DIMENSIONS (continued)

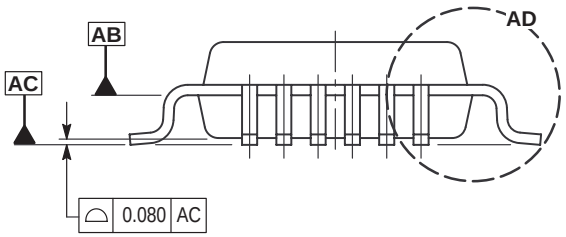


NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.
4. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSIONS D AND E1 ARE TO BE DETERMINED AT DATUM PLANE H.

	MILLIMETERS	
DIM	MIN	MAX
A	—	1.20
A1	0.00	0.10
b	0.19	0.30
b1	0.19	0.25
c	0.09	0.20
c1	0.09	0.16
D	6.40	6.60
E	6.40 BSC	
E1	4.30	4.50
e	0.65 BSC	
L	0.50	0.75
P	—	4.80
P1	—	3.00
R	0.27	0.37
θ	0 °	8 °

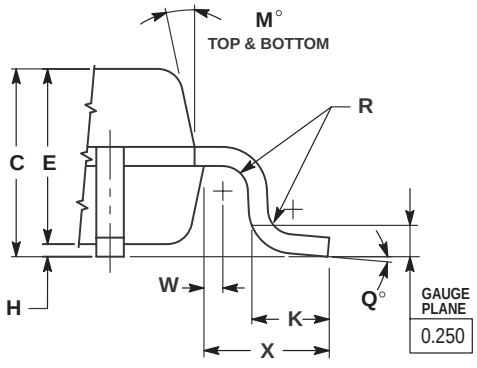
CASE 948M–01
ISSUE O
(TSSOP–20EP)



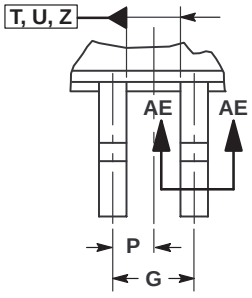


NOTES:
1. CONTROLLING DIMENSION: MILLIMETER.
2. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DATUM PLANE AB IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DATUMS T, U, AND Z TO BE DETERMINED AT DATUM PLANE AB.
5. DIMENSIONS S AND V TO BE DETERMINED AT DATUM PLANE AC.
6. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE AB.
7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.350.
8. MINIMUM SOLDER PLATE THICKNESS SHALL BE 0.0076.
9. EXACT SHAPE OF EACH CORNER IS OPTIONAL.

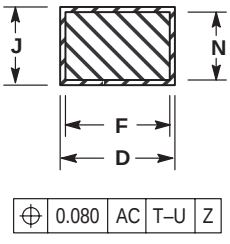
	MILLIMETERS	
DIM	MIN	MAX
A	4.000 BSC	
A1	2.000 BSC	
B	4.000 BSC	
B1	2.000 BSC	
C	1.400	1.600
D	0.170	0.270
E	1.350	1.450
F	0.170	0.230
G	0.500 BSC	
H	0.050	0.150
J	0.090	0.200
K	0.500	0.700
M	12° REF	
N	0.090	0.160
P	0.250 BSC	
Q	0°	7°
R	0.150	0.250
S	6.000 BSC	
S1	3.000 BSC	
V	6.000 BSC	
V1	3.000 BSC	
W	0.200 REF	
X	1.000 REF	



DETAIL AD



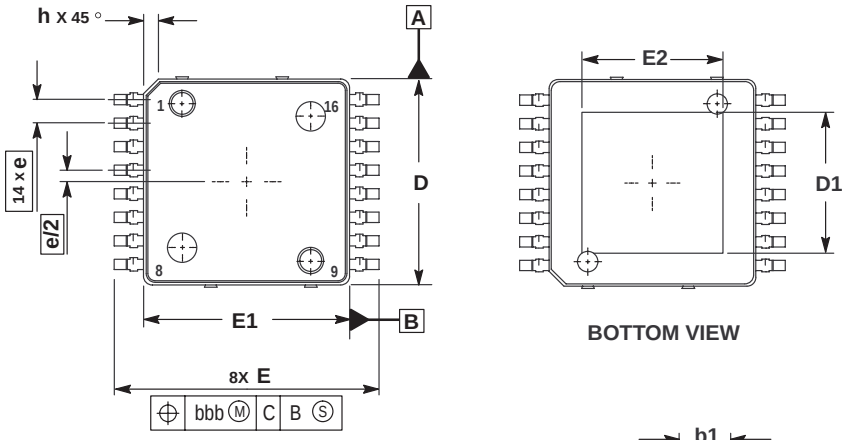
DETAIL Y



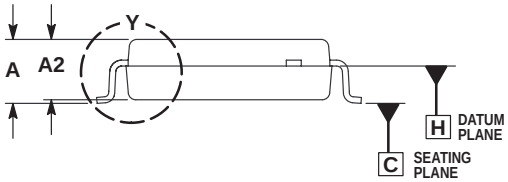
SECTION AE–AE

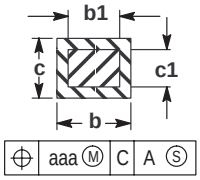
CASE 977–02
ISSUE A
(LQFP–24)

CASE DIMENSIONS (continued)

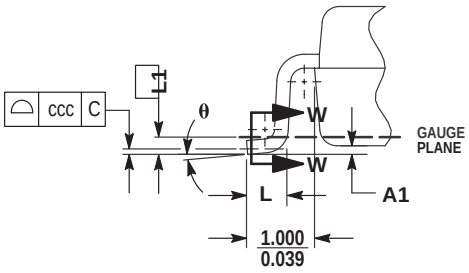


BOTTOM VIEW





SECT W–W



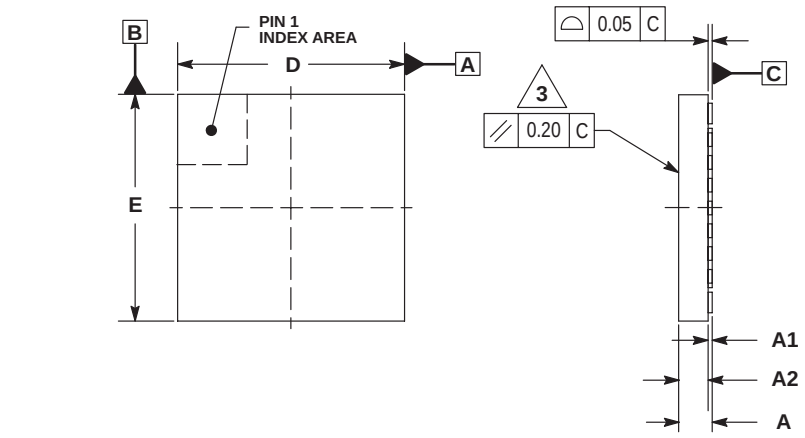
DETAIL Y

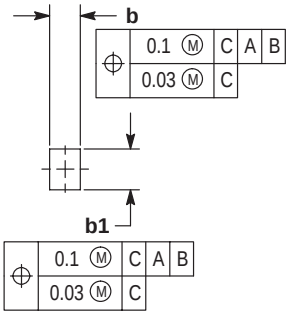
NOTES:
1. CONTROLLING DIMENSION: MILLIMETER.
2. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DATUM PLANE –H– IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 PER SIDE. DIMENSIONS D AND E1 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE –H–.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION IS 0.127 TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS –A– AND –B– TO BE DETERMINED AT DATUM PLANE –H–.

	MILLIMETERS	
DIM	MIN	MAX
A	2.000	2.300
A1	0.025	0.100
A2	1.950	2.100
D	6.950	7.100
D1	4.372	5.180
E	8.850	9.150
E1	6.950	7.100
E2	4.372	5.180
L	0.466	0.720
L1	0.250 BSC	
b	0.300	0.432
b1	0.300	0.375
c	0.180	0.279
c1	0.180	0.230
e	0.800 BSC	
h	—	0.600
θ	0 °	7 °
aaa	0.200	
bbb	0.200	
ccc	0.100	

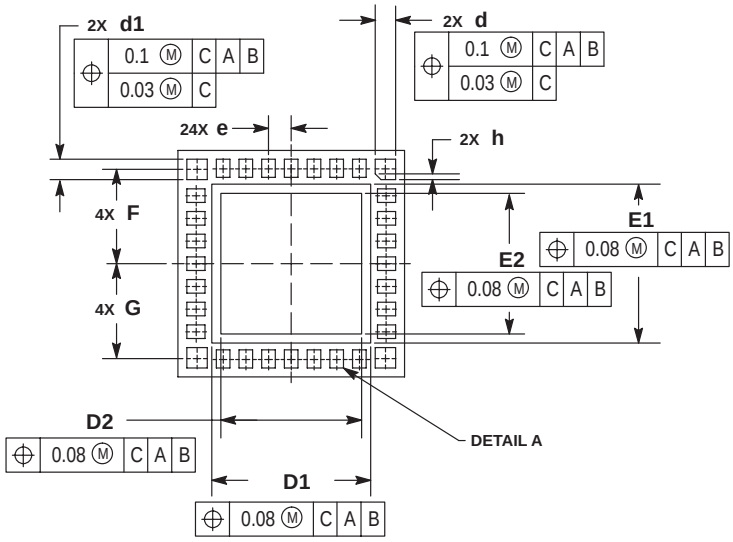
CASE 978–03
ISSUE B
(PFP–16)

CASE DIMENSIONS (continued)





DETAIL A

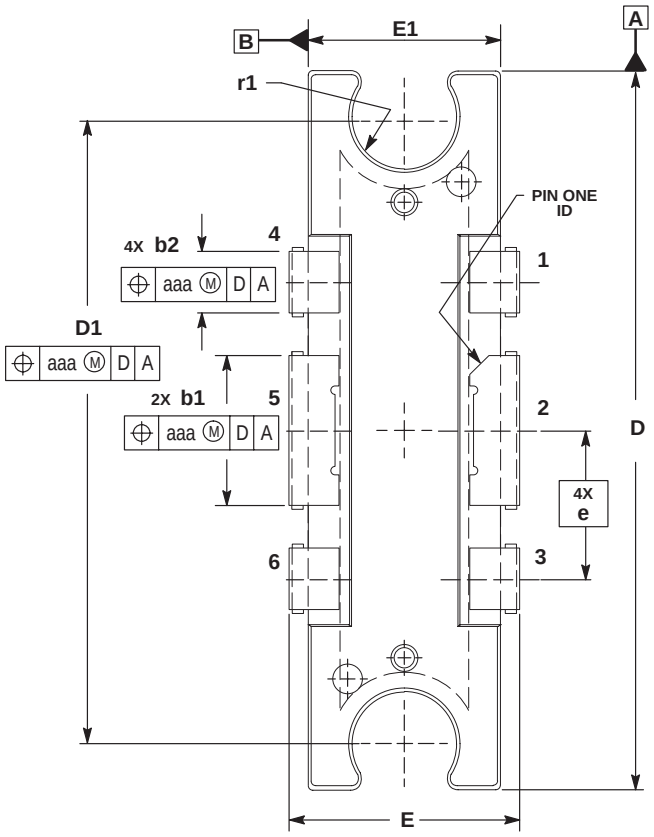


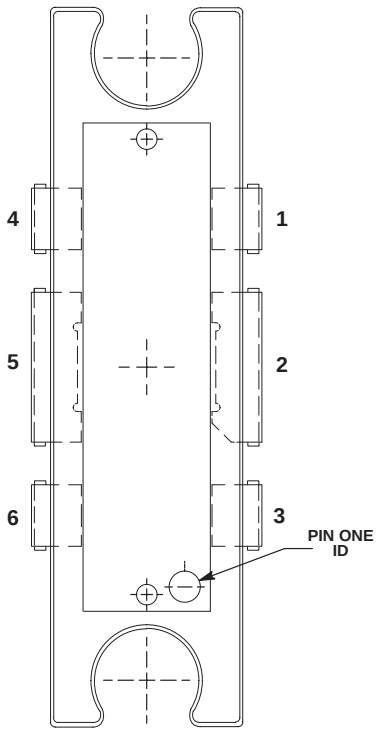
BOTTOM VIEW

NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. PARALLELISM MEASUREMENT SHALL EXCLUDE ANY EFFECTS OF MARKING.
4. THERE IS TO BE MINIMUM SPACE BETWEEN ALL PADS OF 0.14 WHICH MUST BE FREE OF ALL PLATING BLEEDOUT.
5. THERE IS TO BE MINIMUM SPACE BETWEEN THE GROUND RING AND THE PERIPHERAL PADS OF 0.09 WHICH MUST BE FREE OF ALL PLATING BLEEDOUT.

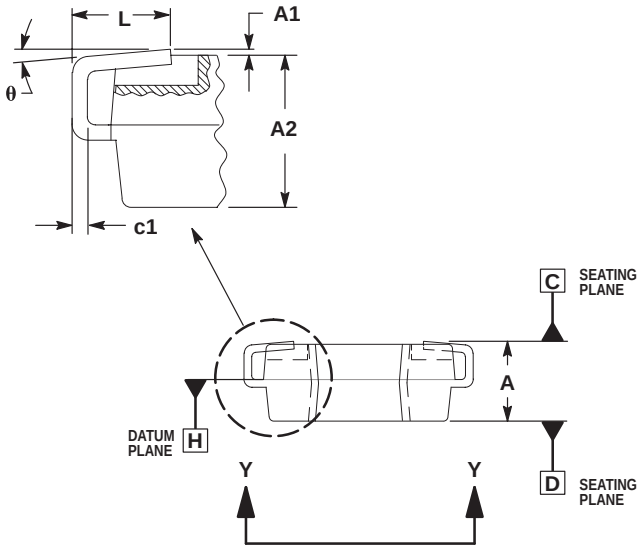
	MILLIMETERS	
DIM	MIN	MAX
A	—	0.80
A1	0.05	0.10
A2	0.60	0.70
b	0.24	0.36
b1	0.34	0.46
D	5.00 BSC	
D1	3.40	3.60
D2	3.00	3.20
d	0.39	0.51
d1	0.39	0.51
E	5.00 BSC	
E1	3.40	3.60
E2	3.00	3.20
e	0.50 BSC	
F	2.10 BSC	
G	2.075 BSC	
h	0.10	0.30

CASE 1261A–01
ISSUE C
(BCC32EP++)





VIEW Y–Y

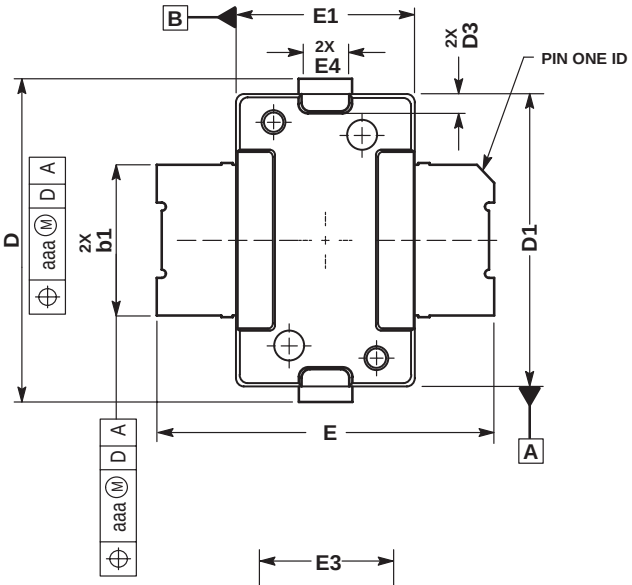


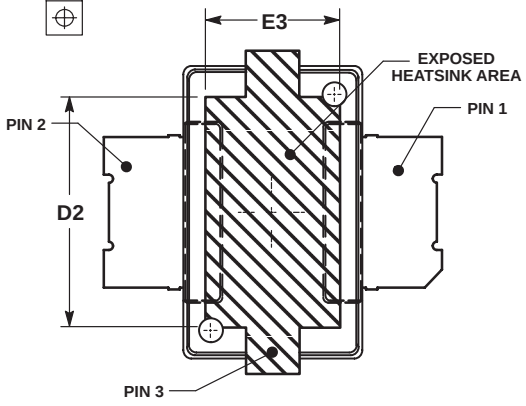
NOTES:
1. CONTROLLING DIMENSION: INCH .
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DATUM PLANE –H– IS LOCATED AT TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSION D AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.006 PER SIDE. DIMENSION D AND E1 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE –H–.
5. DIMENSIONS b1 AND b2 DO NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.005 TOTAL IN EXCESS OF THE b1 AND b2 DIMENSIONS AT MAXIMUM MATERIAL CONDITION.
6. DATUMS –A– AND –B– TO BE DETERMINED AT DATUM PLANE –H–.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.098	0.110	2.489	2.794
A1	0.000	0.004	0.000	0.102
A2	0.098	0.106	2.489	2.692
D	0.926	0.934	23.520	23.724
D1	0.806	0.814	20.472	20.676
E	0.296	0.304	7.518	7.722
E1	0.246	0.254	6.248	6.452
L	0.060	0.070	1.524	1.778
b1	0.193	0.199	4.902	5.055
b2	0.078	0.084	1.981	2.134
c1	0.007	0.011	0.178	0.279
e	0.193 BSC		4.902 BSC	
r1	0.063	0.068	1.600	1.727
θ	0 °	6 °	0 °	6 °
aaa	0.004		0.102	

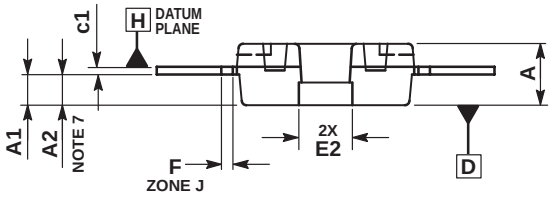
STYLE 1:
PIN 1. SOURCE (COMMON)
2. DRAIN
3. SOURCE (COMMON)
4. SOURCE (COMMON)
5. GATE
6. SOURCE (COMMON)

CASE 1264–06
ISSUE F
(TO–270)





BOTTOM VIEW



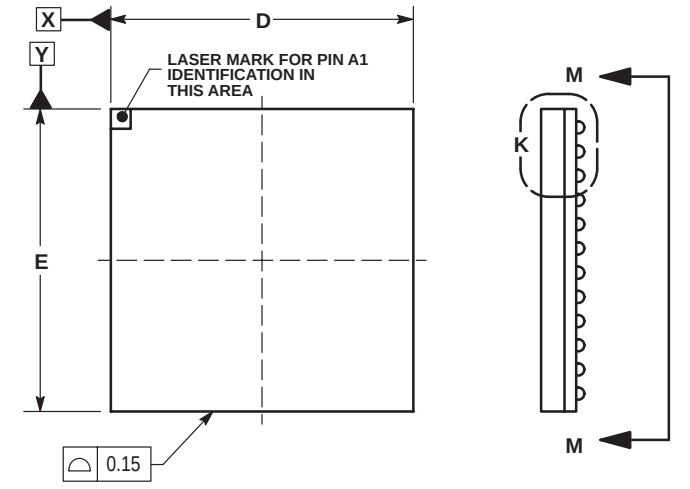
NOTES:
1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DATUM PLANE –H– IS LOCATED AT TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS "D1" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D1" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE –H–.
5. DIMENSION b1 DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE b1 DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS –A– AND –B– TO BE DETERMINED AT DATUM PLANE –H–.
7. DIMENSION A2 APPLIES WITHIN ZONE "J" ONLY.

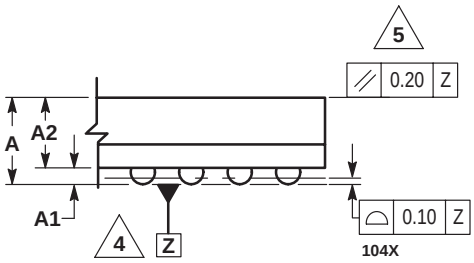
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	.076	.084	1.93	2.13
A1	.038	.044	0.96	1.12
A2	.040	.042	1.02	1.07
D	.416	.424	10.57	10.77
D1	.376	.384	9.55	9.75
D2	.290	.320	7.37	8.13
D3	.016	.024	0.41	0.61
E	.436	.444	11.07	11.28
E1	.236	.244	5.99	6.20
E2	.066	.074	1.68	1.88
E3	.150	.180	3.81	4.57
E4	.058	.066	1.47	1.68
F	.025 BSC		0.64 BSC	
b1	.193	.199	4.90	5.06
c1	.007	.011	0.18	0.28
aaa	.004		0.10	

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

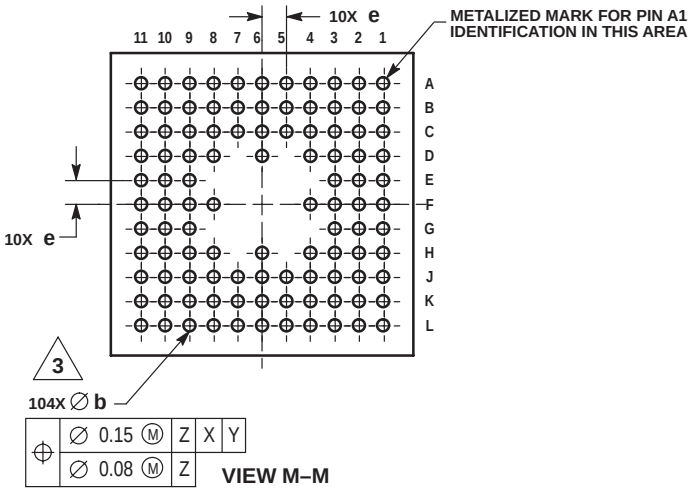
CASE 1265–06
ISSUE E
(TO–272)

CASE DIMENSIONS (continued)





DETAIL K
ROTATED 90° CLOCKWISE

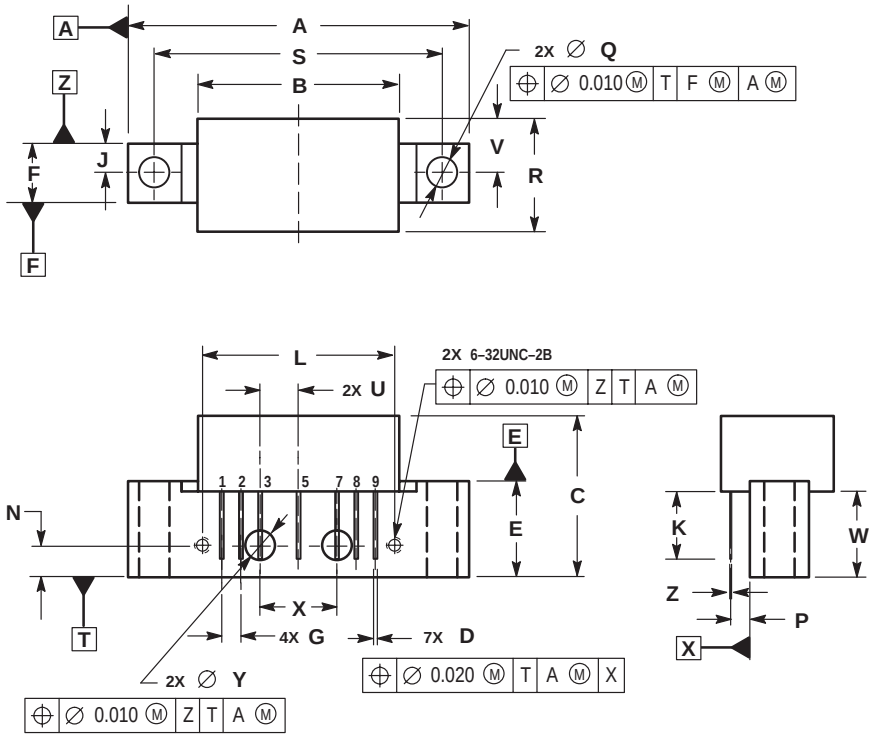


NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSION b IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER, PARALLEL TO DATUM PLANE Z.
4. DATUM Z (SEATING PLANE) IS DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
5. PARALLELISM MEASUREMENT SHALL EXCLUDE ANY EFFECT OF MARK ON TOP SURFACE OF PACKAGE.

	MILLIMETERS	
DIM	MIN	MAX
A	1.25	1.60
A1	0.21	0.40
A2	1.16 REF	
b	0.35	0.45
D	10.00 BSC	
E	10.00 BSC	
e	0.80 BSC	

CASE 1285–01
ISSUE O
(BGA–104)

CASE DIMENSIONS (continued)



NOTES:
1. DIMENSIONS ARE IN INCHES.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	——	1.775	——	45.085
B	——	1.085	——	27.559
C	——	0.840	——	21.336
D	0.015	0.021	0.381	0.533
E	0.465	0.510	11.811	12.954
F	0.300	0.325	7.62	8.255
G	0.100 BSC		2.540 BSC	
J	0.156 BSC		3.962 BSC	
K	0.315	0.355	8.001	9.017
L	1.000 BSC		25.400 BSC	
N	0.165 BSC		4.191 BSC	
P	0.100 BSC		2.540 BSC	
Q	0.148	0.168	3.759	4.267
R	——	0.600	——	15.24
S	1.500 BSC		38.100 BSC	
U	0.200 BSC		5.080 BSC	
V	——	0.250	——	6.350
W	0.435	——	11.049	——
X	0.400 BSC		10.160 BSC	
Y	0.152	0.163	3.861	4.140
Z	0.009	0.011	0.229	0.279

STYLE 1:
PIN 1. RF INPUT
2. GROUND
3. GROUND
4. DELETED
5. VDC
6. DELETED
7. GROUND
8. GROUND
9. RF OUTPUT

CASE 1302–01
ISSUE B

DEVICE INDEX

Device Index (continued)

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