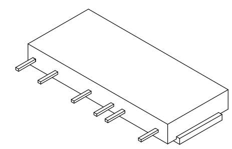
The RF Line
UHF Power Amplifiers

MHW903
MHW953
MHW954

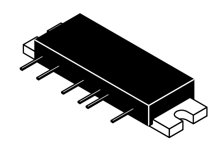
3.5 W
890 to 915 MHz
RF POWER
AMPLIFIERS

. . . designed specifically for the Pan European digital 2.0 watt, GSM hand–held radio. The MHW903, MHW953 and MHW954 are capable of wide power range control, operate from a 7.2 volt supply and require 1.0 mW (MHW903/953) or 100 mW (MHW954) of RF input power.

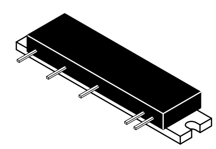
- Specified 7.2 Volt Characteristics:
  RF Input Power — 1.0 mW (0 dBm) MHW903/953; 100 mW (20 dBm) MHW954
  RF Output Power — 3.5 W
  Minimum Gain — 35.4 dB (MHW903/953) or 15.4 dB (MHW954)
  Harmonics — –35 dBc Max @ 2.0 f_o (MHW930/953) or
  –30 dBc Max @ 2.0 f_o (MHW954)
- New Biasing and Control Techniques Providing Dynamic Range and Control Circuit Bandwidth Ideal for GSM
- Low Control Current
- 50 Ohm Input/Output Impedances
- Guaranteed Stability and Ruggedness
- Test fixture circuit board photomaster available upon request by contacting RF Tactical Marketing in Phoenix, AZ.



CASE 413A–02, STYLE 1
(MHW903)



CASE 301V–02, STYLE 1
(MHW953)



CASE 301Y–02, STYLE 1
(MHW954)

MAXIMUM RATINGS (Flange Temperature = 25°C)

Rating	Symbol	Value	Unit
DC Supply Voltage	V_{S1}, V_{S2}, V_{S3}	9.0	Vdc
DC Bias Voltage (MHW903/953) (MHW954)	V_b	5.25 4.75	Vdc
DC Control Voltage (MHW903/953 only)	V_{cont}	3.0	Vdc
RF Input Power (MHW903/953) (MHW954)	P_{in}	2.0 400	mW
RF Output Power (V_S = 9.0 Vdc)	P_{out}	4.5	W
Operating Case Temperature Range Storage Temperature Range	T_C T_{stg}	–30 to +100	°C

ELECTRICAL CHARACTERISTICS ($V_{S1} = V_{S2} = V_{S3}$ = 7.2 Vdc; V_b = 5.0 Vdc for MHW903/953)
($V_{S1} = V_{S2}$ = 7.2 Vdc; V_b = 4.5 Vdc for MHW954)
(T_C = 25°C; 50 ohm system, unless otherwise noted)

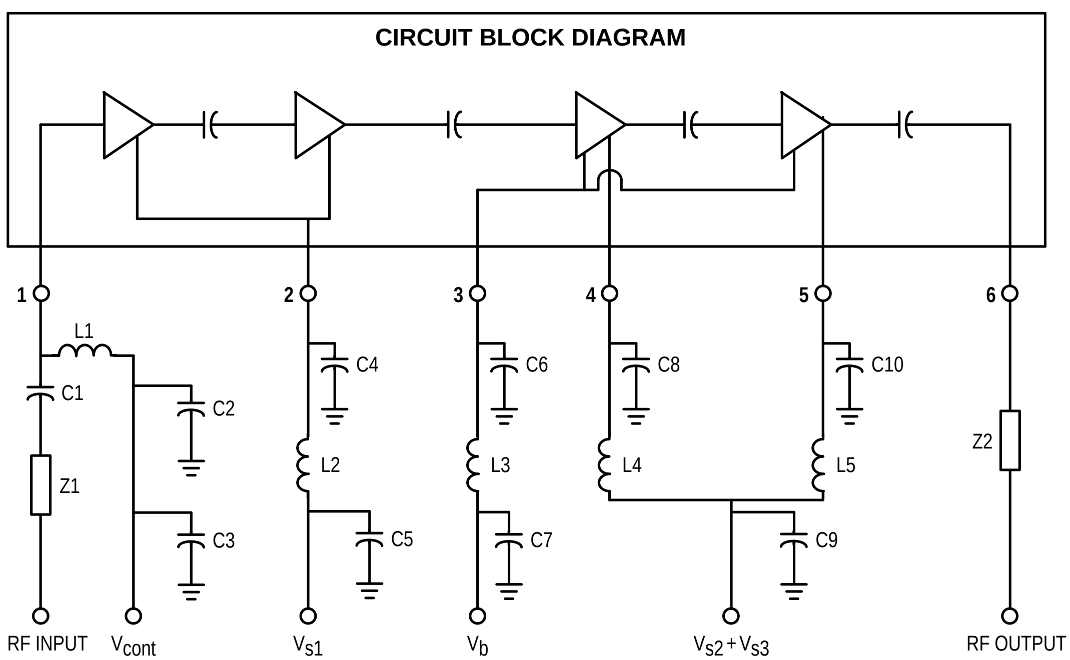
Characteristic	Symbol	Min	Max	Unit
Frequency Range	BW	890	915	MHz
Power Gain (P_{out} = 3.5 mW) MHW903/953 (1) MHW954 (2)	G_P	35.4 15.4	— —	dB
Control Current (P_{out} = 3.5 W; P_{in} = 1.0 mW) MHW903/953 only (1)	I_{cont}	—	1.0	mA
Supply Current (P_{out} = 3.5 W; P_{in} = 1.0 mW) MHW903/953 only (1)	I_b	—	85	mA
Leakage Current (P_{in} = 0 mW; $V_{cont} = V_b$ = 0 Vdc; $V_{S1} = V_{S2} = V_{S3}$ = 9.0 Vdc for MHW903/953. P_{in} = 0 mW; V_b = 0 Vdc; $V_{S1} = V_{S2}$ = 9.0 Vdc for MHW954)	I_L	 — —	 1.0 200	 mA μA
Input VSWR (P_{out} = 3.5 W; P_{in} = 1.0 mW) MHW903/953 (1) (P_{out} = 3.5 W) MHW954 (2)	$VSWR_{in}$	—	2.0:1	—

NOTES:
1. Adjust V_{cont} for specified P_{out}; duty cycle = 12.5%, period = 4.6 ms
2. Adjust P_{in} for specified P_{out}; duty cycle = 12.5%, period = 4.6 ms

ELECTRICAL CHARACTERISTICS — continued ($V_{S1} = V_{S2} = V_{S3}$ = 7.2 Vdc; V_b = 5.0 Vdc for MHW903/953)
($V_{S1} = V_{S2}$ = 7.2 Vdc; V_b = 4.5 Vdc for MHW954)
(T_C = 25°C; 50 ohm system, unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
Efficiency (P_{out} = 3.5 W; P_{in} = 1.0 mW) MHW903/953 (1) (P_{out} = 3.5 W) MHW954 (2)	η	40	—	%
Harmonics (P_{out} = 3.5 W; P_{in} = 1.0 mW) MHW903/953 (1) 2.0 f_o 3.0 f_o (P_{out} = 3.5 W) MHW954 (2) 2.0 f_o 3.0 f_o	—	— — — —	−35 −45 −30 −40	dBc
Noise Power (In 30 kHz Bandwidth, 20 MHz above f_o) (T_C = 25°C−100°C) (P_{out} = 0.3−3.5 W; $V_{S1} = V_{S2} = V_{S3}$ = 6.25−9.0 Vdc, P_{in} = 1.0 mW) MHW903/953 (1) (P_{out} = 0.3−3.5 W; $V_{S1} = V_{S2}$ = 6.25−9.0 Vdc) MHW954 (2)	—	 — —	 −65 −75	dBm
Output Power, Low Voltage (P_{in} = 1.0 mW; $V_{S1} = V_{S2} = V_{S3}$ = 6.25 Vdc; V_{cont} = 3.0 Vdc) MHW903/953 (P_{in} = 100 mW; $V_{S1} = V_{S2}$ = 6.25 Vdc) MHW954	P_{o1}	2.0 2.3	— —	W
Isolation (P_{in} = 1.0 mW; V_{cont} = 0 Vdc; $V_{S1} = V_b$ = 0−5 Vdc) MHW903/953 only (1)	—	—	−36	dBm
3.0 dB V_{cont} Bandwidth (P_{in} = 1.0 mW; P_{out} = 0.03−3.5 W) MHW903/953 only (1)	—	1.0	—	MHz
% AM In Output (P_{out} = 0.035−3.5 W; 135 kHz, 1% AM on Input) MHW954 only (2)	—	—	6	%
Load Mismatch Stress (P_{in} = 2.0 mW; P_{out} = 3.5 W; $V_{S1} = V_{S2} = V_{S3}$ = 9.0 Vdc) MHW903/953 (1) (P_{out} = 3.5 W; V_b = 4.75 Vdc; $V_{S1} = V_{S2}$ = 9.0 Vdc) MHW954 (2) (Load VSWR = 10:1, All Phase Angles at Frequency of Test)	ψ	No degradation in output power before and after test		
Stability (P_{in} = 0.5 to 2.0 mW; P_{out} = 0.03−3.5 W; $V_{S1} = V_{S2} = V_{S3}$ = 6.0 to 9.0 Vdc) MHW903/953 (1) (P_{out} = 0.03−3.5 W; $V_{S1} = V_{S2}$ = 6.0 to 9.0 Vdc) MHW954 (2) (Load VSWR = 6:1, Source VSWR = 3:1, All Phase Angles at Frequency of Test)	—	All spurious outputs more than 60 dB below desired signal		

NOTES:
1. Adjust V_{cont} for specified P_{out}; duty cycle = 12.5%, period = 4.6 ms
2. Adjust P_{in} for specified P_{out}; duty cycle = 12.5%, period = 4.6 ms



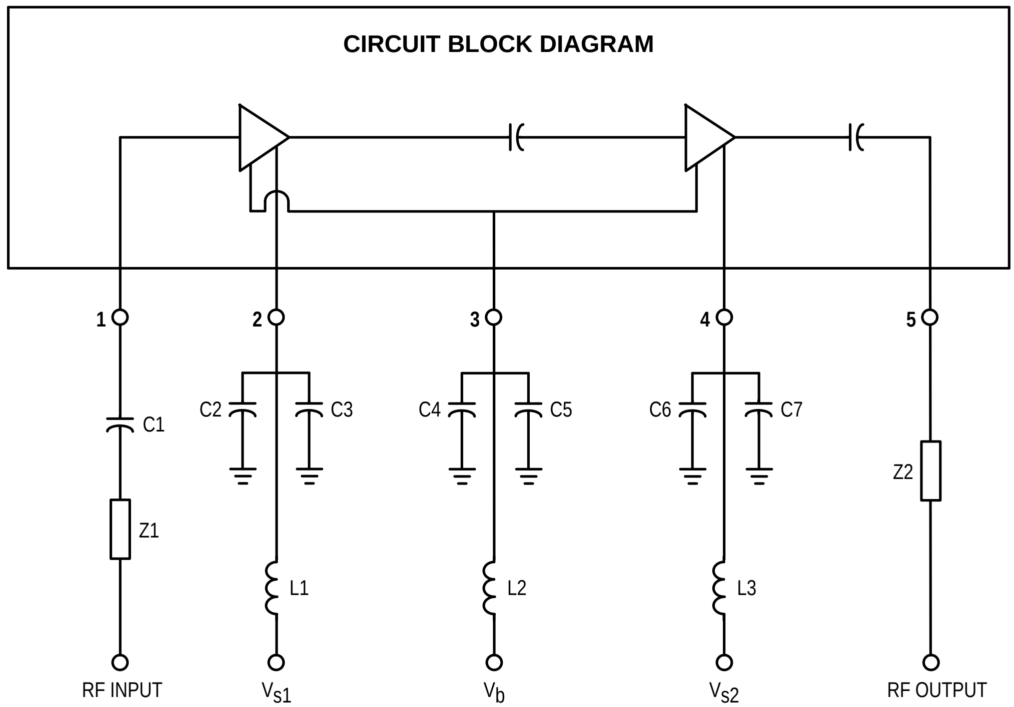
PIN DESIGNATIONS:

Pin 1 — RF Input Power @ 0 dBm and Control Voltage @ 0−3.0 Vdc
Pin 2 — First and Second Stage Collector Supply Voltage @ 7.2 Vdc
Pin 3 — Trickle Base Bias Voltage @ 5.0 Vdc
Pin 4 — Third Stage Collector Supply Voltage @ 7.2 Vdc
Pin 5 — Fourth Stage Collector Supply Voltage @ 7.2 Vdc
Pin 6 — RF Output Power @ 3.5 W

ELEMENT VALUES:

C1=C2= 0.018 µF
C4=C6=C8=C10= 0.1 µF
C3=C5=C7=C9 = 1.0 µF Tant.
L1−L3 = 0.29 µH Choke
L4, L5 = 0.15 µH Choke
Z1, Z2 = 50 Ohm Microstrip

Figure 1. Test Circuit Diagram — MHW903/953



PIN DESIGNATIONS:

Pin 1 — RF Input Power @ 20 dBm Max Adjust for Output Power
Pin 2 — First Stage Collector Voltage @ 7.2 Vdc
Pin 3 — Trickle Bias Voltage @ 4.5 Vdc
Pin 4 — Third Stage Collector Supply @ 7.2 Vdc
Pin 5 — RF Output Power @ 3.5 W Nominal

ELEMENT VALUES:

C1=C2=C4=C6= 0.018 µF
C3=C5=C7= 2.2 µF
L1, L2 = 0.29 µH
L3 = 0.2 µH
Z1, Z2 = 50 Ohm Microstrip

Figure 2. Test Circuit Diagram — MHW954

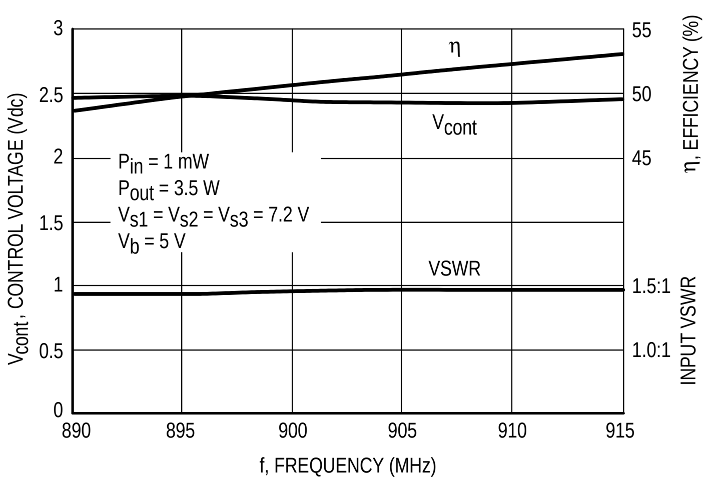


Figure 3. Control Voltage, Efficiency and Input VSWR versus Frequency

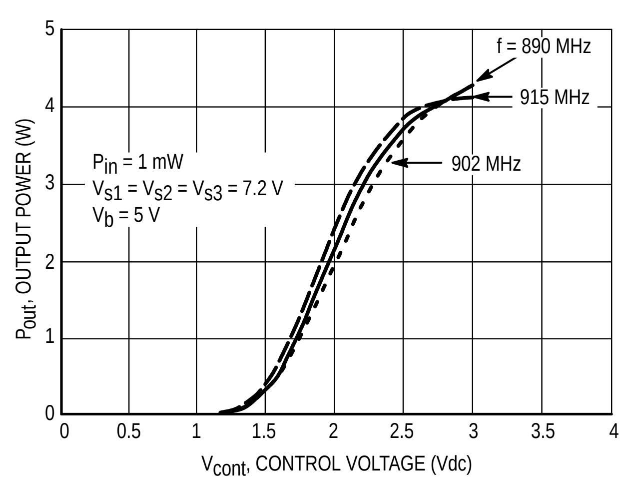


Figure 4. Output Power versus Control Voltage

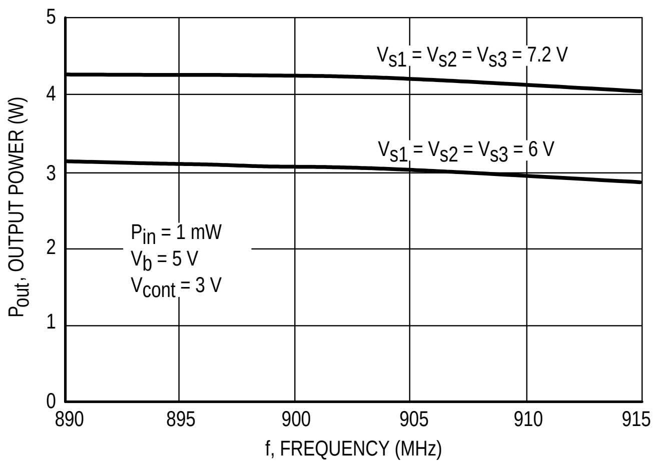


Figure 5. Output Power versus Frequency

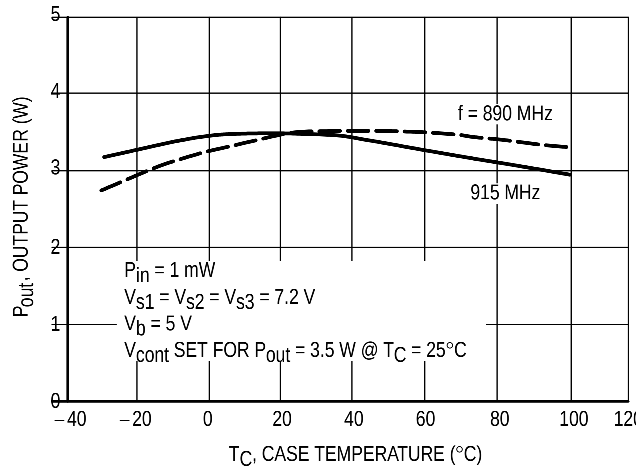


Figure 6. Output Power versus Case Temperature

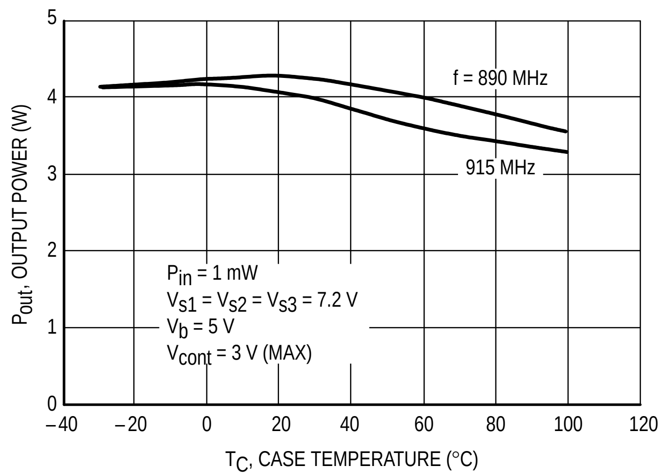


Figure 7. Output Power versus Case Temperature at Maximum Control Voltage

APPLICATIONS INFORMATION

NOMINAL OPERATION

All electrical specifications are based on the nominal conditions of $V_{S1} = V_{S2} = V_{S3} = 7.2$ Vdc (Pins 2, 4, 5) and $V_b = 5.0$ Vdc (Pin 3) for MHW903/953. Nominal conditions are $V_{S1} = V_{S2} = 7.2$ Vdc (Pins 2 and 4) and $V_b = 4.5$ Vdc (Pin 3) for MHW954. With these conditions, maximum current density on any device is 1.5×10^5 A/cm^2 and maximum die temperature is 165°C. While the modules are designed to have excess gain margin with ruggedness, operation of these units outside the published specifications is not recommended unless prior communications regarding intended use have been made with the factory representative.

GAIN CONTROL

The module output power should be limited to specified value. The preferred method of power control for the MHW903/953 is to fix $V_{S1} = V_{S2} = V_{S3} = 7.2$ Vdc, $V_b = 5.0$ Vdc, P_{in} (Pin 1) at 1.0 mW, and vary V_{cont} (Pin 1) voltage. For the MHW954, fix $V_{S1} = V_{S2} = 7.2$ Vdc and $V_b = 4.5$ Vdc; then vary P_{in} (Pin 1) to control P_{out} (Pin 5).

DECOUPLING

Due to the high gain of the four stages and the module size limitation, external decoupling networks require careful consideration, Pins 2, 3, 4 and 5 are internally bypassed with a 0.018 µF chip capacitor which is effective for frequencies from 5.0 MHz through 940 MHz. For bypassing frequencies below 5.0 MHz, networks equivalent to that shown in Figure 1 are recommended. Inadequate decoupling will result in spurious outputs at certain operating frequencies and certain phase angles of input and output VSWR.

MOUNTING CONSIDERATIONS

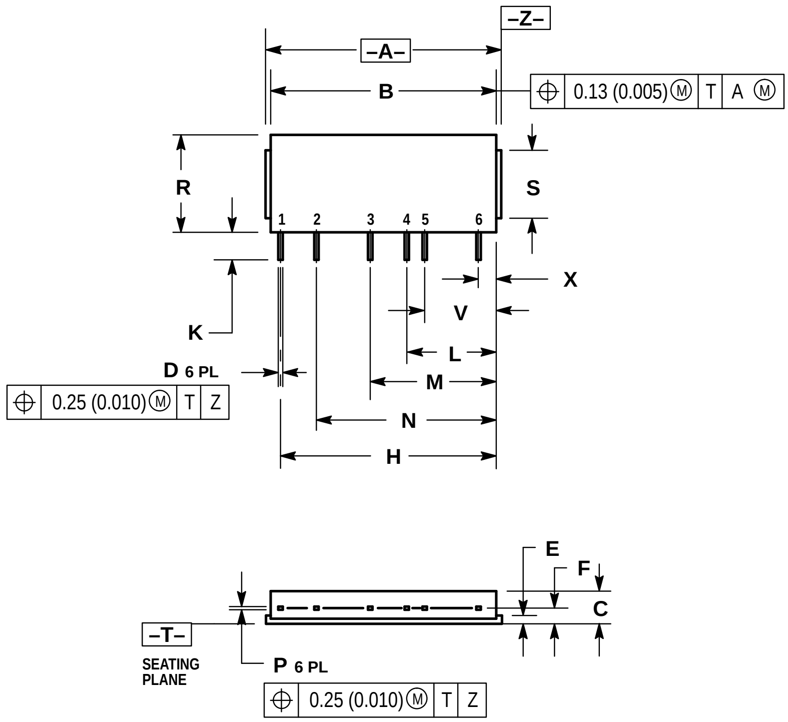
For the MHW903 Series module, mounting is generally accomplished by soldering the flange to a suitable heat sink. This can be done with a low temperature solder such as 52% In, 48% Sn and type “R” Flux which liquifies below 150°C. Under no circumstances should the MHW903 Series modules be heated to a temperature greater than ≈165°C. Internal construction of the module has been achieved using 36% Tin, 62% lead, 2% silver solder which liquifies at 179–180°C.

The modules are NOT hermetic. Do not immerse a module in a flux cleaning solution or other liquids under any circumstances.

LOAD MISMATCH

During final test each module is load mismatch tested in a fixture having the identical decoupling networks described in Figure 1. Electrical conditions are $V_{S1} = V_{S2} = V_{S3} = 9.0$ Vdc (Pins 2, 4, 5), and $V_b = 5.0$ Vdc (Pin 3), $P_{in} = 2.0$ mW (12.5% duty cycle, 4.6 ms period), VSWR equal to 10:1, and output power equal to 4.5 watts.

PACKAGE DIMENSIONS

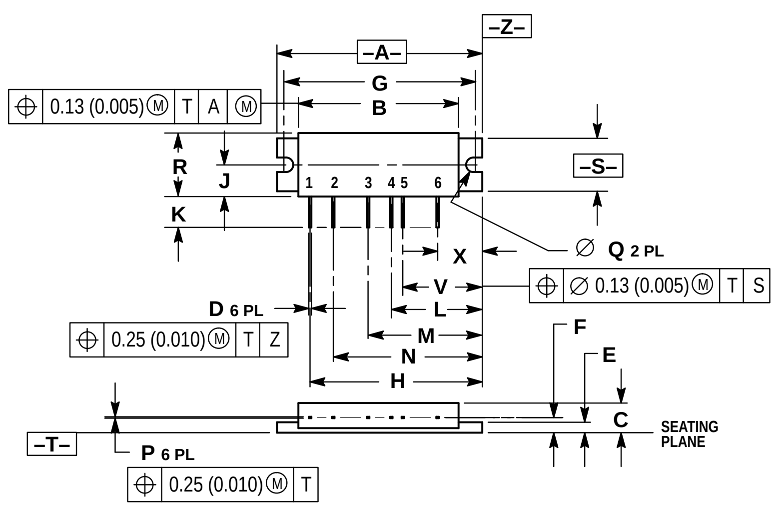


NOTES:
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
4. CONTROLLING DIMENSION: INCH.
5. DIMENSION F TO CENTER OF LEADS.
6. DIMENSIONS B AND R ARE MEASURED AT THE COVER CORNERS. SIZE REDUCTION BY INWARD BOWING OR BY DRAFT ANGLE ARE EXCLUDED.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.290	1.305	32.77	33.14
B	1.257	1.277	31.93	32.44
C	0.160	0.177	4.06	4.57
D	0.018	0.022	0.46	0.55
E	0.035	0.045	0.89	1.14
F	0.075	0.095	1.91	2.41
H	1.205 BSC		30.61 BSC	
K	0.100	—	2.54	—
L	0.505 BSC		12.83 BSC	
M	0.705 BSC		17.91 BSC	
N	1.005 BSC		25.53 BSC	
P	0.008	0.012	0.21	0.30
R	0.535	0.555	13.59	14.10
S	0.375	0.390	9.53	9.90
V	0.405 BSC		10.29 BSC	
X	0.105 BSC		2.67 BSC	

STYLE 1:
PIN 1. RF INPUT/V CONT
2. DC TERMINAL, VS1
3. DC TERMINAL, VB
4. DC TERMINAL, VS2
5. DC TERMINAL, VS3
6. RF OUTPUT
CASE: GROUND

CASE 413A–02
ISSUE D
MHW903

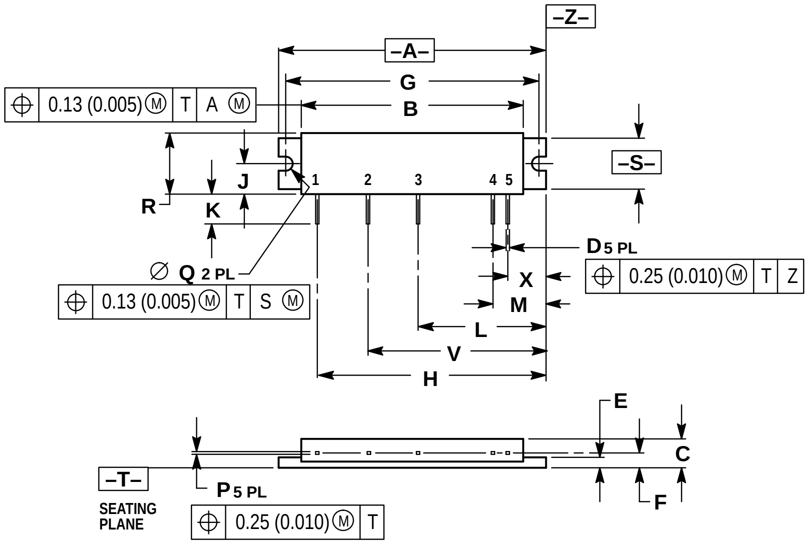


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION F TO CENTER OF LEADS.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.760	1.780	44.71	45.21
B	1.370	1.390	34.80	35.30
C	0.245	0.265	6.23	6.73
D	0.018	0.022	0.46	0.55
E	0.080	0.100	2.04	2.54
F	0.130 BSC		3.30 BSC	
G	1.650 BSC		41.91 BSC	
H	1.485 BSC		37.72 BSC	
J	0.267	0.278	6.79	7.09
K	0.177	0.217	4.50	5.51
L	0.785 BSC		19.94 BSC	
M	0.985 BSC		25.02 BSC	
N	1.285 BSC		32.64 BSC	
P	0.008	0.012	0.21	0.30
Q	0.120	0.130	3.05	3.30
R	0.535	0.555	13.59	14.09
S	0.445	0.465	11.31	11.81
V	0.685 BSC		17.40 BSC	
X	0.385 BSC		9.78 BSC	

STYLE 1:
PIN 1. RF INPUT/V CONT
2. VS1
3. Vb
4. VS2
5. VS3
6. RF OUTPUT
CASE: GROUND

CASE 301V–02
ISSUE D
MHW953



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	1.970	1.990	50.04	50.55
B	1.570	1.590	39.88	40.39
C	0.245	0.265	6.23	6.73
D	0.018	0.022	0.46	0.56
E	0.100	0.115	2.54	2.92
F	0.147 BSC		3.73 BSC	
G	1.860 BSC		47.24 BSC	
H	1.625 BSC		41.28 BSC	
J	0.267	0.278	6.78	7.06
K	0.177	0.217	4.50	5.51
L	0.825 BSC		20.96 BSC	
M	0.425 BSC		10.80 BSC	
P	0.008	0.012	0.20	0.30
Q	0.120	0.130	3.05	3.30
R	0.535	0.555	13.59	14.10
S	0.445	0.465	11.30	11.81
V	1.225 BSC		31.12 BSC	
X	0.325 BSC		8.26 BSC	

STYLE 1:
PIN 1. RF INPUT
2. DC TERMINAL, Vs1
3. DC TERMINAL, Vb
4. DC TERMINAL, Vs2
5. RF OUTPUT

CASE 301Y–02
ISSUE C
MHW954

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