



# Advance Information

## Dual-Band/Dual-Mode pHEMT GaAs IPA

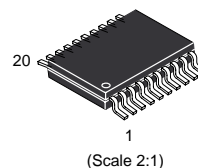
The MRFIC1856 is designed for dual-band subscriber equipment applications at 3.6 V in the cellular (800 MHz) and PCS (1900 MHz) bands. The device incorporates two pHEMT GaAs amplifier chains in one package, allowing the most flexibility and highest performance while reducing board space. Target applications include dual-band/dual-mode handsets for TDMA/AMPS and PCS TDMA cellular phones.

- Designed to Operate in Frequency Ranges of:  
824 to 849 MHz TDMA/AMPS  
1850 to 1910 MHz PCS TDMA
- 3.6 V Operation
- 30 dBm Output Power PCS TDMA
- 31 dBm Output Power TDMA Cellular
- 31 dBm Output Power AMPS

# MRFIC1856

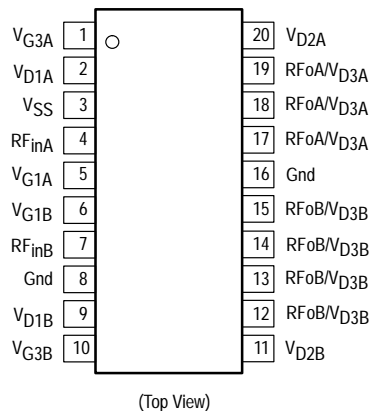
## DUAL-BAND/DUAL-MODE GaAs INTEGRATED POWER AMPLIFIER

### SEMICONDUCTOR TECHNICAL DATA

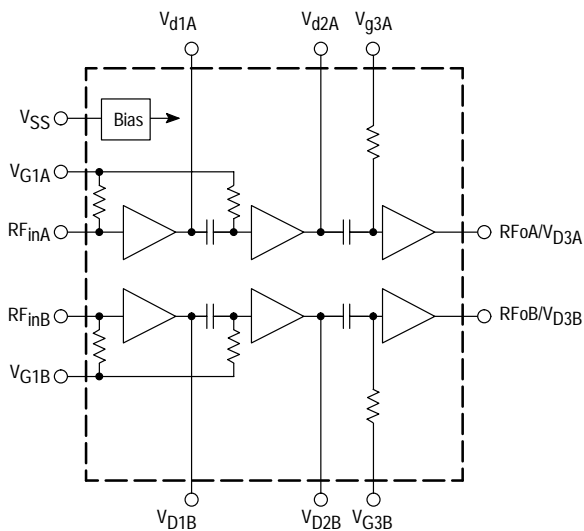


PLASTIC PACKAGE  
CASE 948M  
(TSSOP-20EP, Tape & Reel Only)

### PIN CONNECTIONS



### Simplified Block Diagram



This device contains 8 active transistors.

### ORDERING INFORMATION

Device	Operating Temp Range	Package
MRFIC1856R2	T <sub>C</sub> = -35 to 85°C	TSSOP-20EP

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## MAXIMUM RATINGS

Symbol	Value	Unit
Supply Voltage	V <sub>D</sub>	4.8 Vdc
RF Input Power	P <sub>in</sub>	15 dBm
Gate Voltage	V <sub>g</sub>	-6 to -0.3 Vdc
Storage Temperature Range	T <sub>stg</sub>	-65 to 150 °C
Operating Case Temperature	T <sub>C</sub>	-35 to 85 °C
Thermal Resistance, Junction to Case	R <sub>θJC</sub>	15 °C/W

- NOTES:** 1. Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the limits in the Electrical Characteristics tables.  
 2. ESD (electrostatic discharge) immunity meets Human Body Model (HBM) ≤100 V and Machine Model (MM) <50 V. Additional ESD data available upon request.

## RECOMMENDED OPERATING CONDITIONS

Characteristics	Symbol	Limit	Unit
Frequency Range – TDMA/AMPS	f <sub>RF</sub>	824 to 849	MHz
Frequency Range – PCS TDMA	f <sub>RF</sub>	1850 to 1910	MHz
Supply Voltage Range	V <sub>D1,2,3A</sub> , V <sub>D1,2,3B</sub>	3.0 to 4.8	Vdc
Negative Supply Voltage	V <sub>G</sub>	-4.5 to -2.5	Vdc

## ELECTRICAL CHARACTERISTICS (V<sub>D1,2,3A</sub> = 3.6 V, T<sub>A</sub> = 25°C, unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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### TDMA CELLULAR PERFORMANCE (P<sub>out</sub> = 31 dBm, f = 840 MHz)

Quiescent Supply Current	I <sub>DQ</sub>	-	-	300	mA
Negative Supply Current	I <sub>SS</sub>	-	-	3.0	mA
Efficiency	PAE	40	45	-	%
Gain	G <sub>P</sub>	29	-	-	
Adj Channel Power (±30 kHz)	ACP	-	-	-29	dBc
Alt Channel Power (±60 kHz)	ALT	-	-	-48	dBc
Rx Band Noise (30 kHz BW)	-	-	-92	-	dBm
Harmonic Output Power	-	-	-	-	dBc
2f <sub>o</sub>		-	-	-34	
3f <sub>o</sub>		-	-	-40	
Spurious Output, 10:1 VSWR, all angles on output	-	-	-	-60	dBc

### AMPS PERFORMANCE (P<sub>out</sub> = 31 dBm, f = 840 MHz)

Quiescent Supply Current	I <sub>DQ</sub>	-	-	300	mA
Negative Supply Current	I <sub>SS</sub>	-	-	3.0	mA
Efficiency (P <sub>out</sub> = 31 dBm)	PAE	-	48	-	%
Gain	G <sub>P</sub>	30	-	-	
Harmonic Output Power	-	-	-	-	dBc
2f <sub>o</sub>		-	-	-34	
3f <sub>o</sub>		-	-	-40	
Rx Band Noise (30 kHz BW)	-	-	-92	-	dBm
Spurious Output, 10:1 VSWR, all angles on output	-	-	-	-60	dBc

### PCS TDMA PERFORMANCE (P<sub>out</sub> = 30 dBm, f = 1.88 GHz)

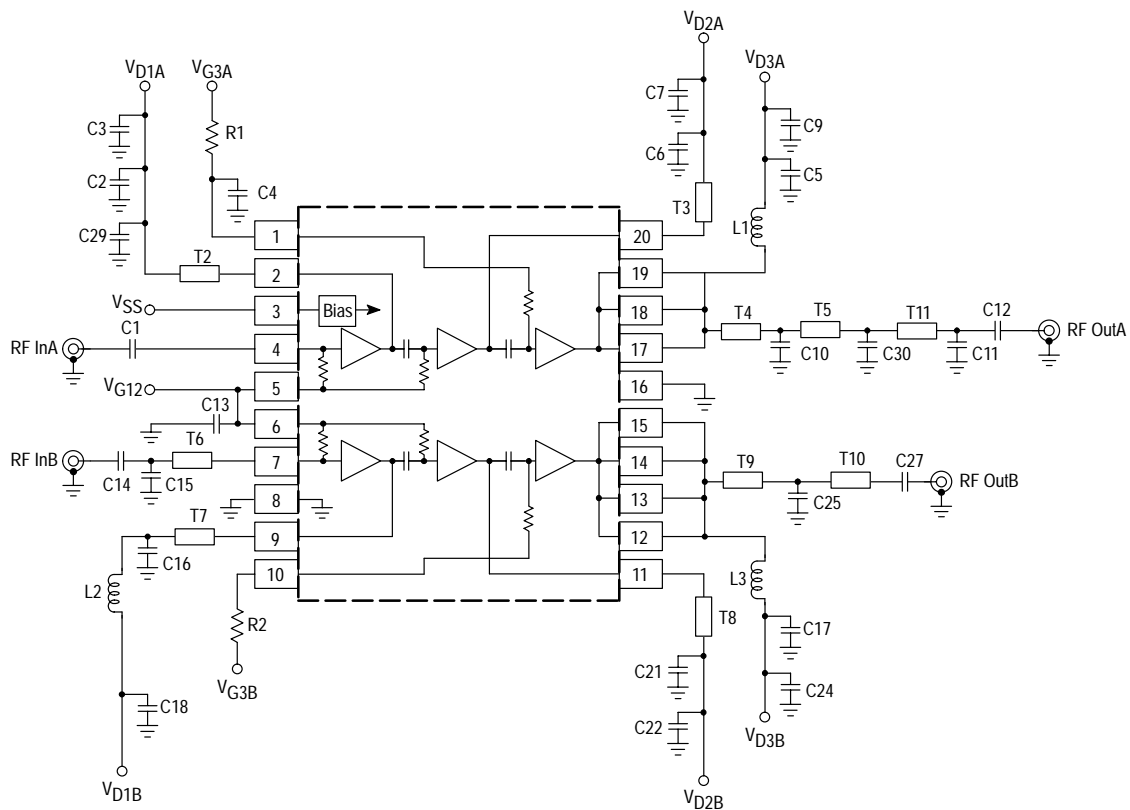
Quiescent Supply Current	-	-	-	300	mA
Negative Supply Current	-	-	-	3.0	mA
Efficiency	-	30	35	-	%
Gain	-	28	-	-	

## ELECTRICAL CHARACTERISTICS (continued) ( $V_{D1,2,3A} = 3.6\text{ V}$ , $T_A = 25^\circ\text{C}$ , unless otherwise noted)

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Characteristic	Symbol	Min	Typ	Max	Unit
<b>PCS TDMA PERFORMANCE (continued) (<math>P_{\text{out}} = 30\text{ dBm}</math>, <math>f = 1.88\text{ GHz}</math>)</b>					
Adj Channel Power ( $\pm 30\text{ kHz}$ )	-	-	-	-29	dBc
Alt Channel Power ( $\pm 60\text{ kHz}$ )	-	-	-	-48	dBc
Rx Band Noise (30 kHz BW)	-	-	-94	-	dBm
Harmonic Output Power	-	-	-	-	dBc
$2f_o$	-	-	-	-40	
$3f_o$	-	-	-	-40	
Spurious Output, 10:1 VSWR, all angles on output	-	-	-	-60	dBc

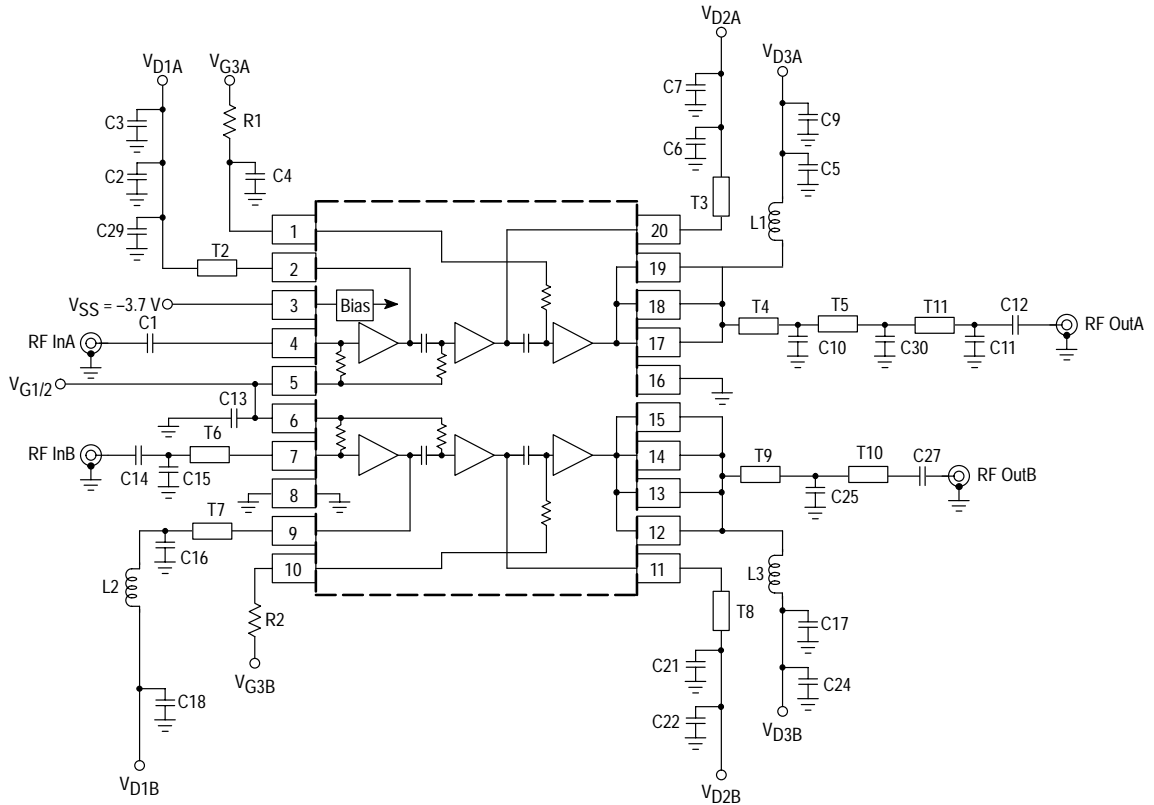
Figure 1. 3.6 V Applications Circuit



C1, C2, C5, C12, C17	100 pF	C16	6.2 pF	T2	50 $\Omega$ , Microstrip, L = 128 mils
C28	3.9 nF	C25	4.7 pF	T3	50 $\Omega$ , Microstrip, L = 50 mils
C3, C4, C6, C13, C21	1000 pF	C27	10 pF	T4	50 $\Omega$ , Microstrip, L = 60 mils
C7, C18	10 $\mu\text{F}$	C29	3.9 pF	T5	90 $\Omega$ , Microstrip, L = 88 mils
C9, C22, C24	20 $\mu\text{F}$	L1, L2, L3	15 nH	T6	90 $\Omega$ , Microstrip, L = 600 mils
C10	12 pF	R1	50 $\Omega$	T7	63 $\Omega$ , Microstrip, L = 133 mils
C11	5.1 pF	R2	100 $\Omega$	T8	50 $\Omega$ , Microstrip, L = 133 mils
C14	22 pF	NOTE: C29 added for 2nd harm trap.		T9	50 $\Omega$ , Microstrip, L = 10 mils
C15, C30	1.3 pF			T10	50 $\Omega$ , Microstrip, L = 330 mils
				T11	50 $\Omega$ , Microstrip, L = 145 mils

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Figure 2. 4.8 V Applications Circuit



C1,C2,C5,C12,C17, 100 pF	C16	6.8 pF	T2	50 Ω, Microstrip, L = 128 mils
C28 3.9 nF	C25	4.3 pF	T3	50 Ω, Microstrip, L = 50 mils
C3,C4,C6,C13,C21 1000 pF	C27	10 pF	T4	50 Ω, Microstrip, L = 60 mils
C7,C18 10 μF	C29	3.9 pF	T5	90 Ω, Microstrip, L = 88 mils
C9,C22,C24 20 μF	L1,L2,L3	15 nH	T6	90 Ω, Microstrip, L = 600 mils
C10 12 pF	R1	50 Ω	T7	63 Ω, Microstrip, L = 133 mils
C11 5.1 pF	R2	100 Ω	T8	50 Ω, Microstrip, L = 133 mils
C14 22 pF			T9	50 Ω, Microstrip, L = 10 mils
C15,C30 1.3 pF			T10	50 Ω, Microstrip, L = 330 mils
			T11	50 Ω, Microstrip, L = 145 mils

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TDMA PERFORMANCE

Figure 3. Gain versus Frequency

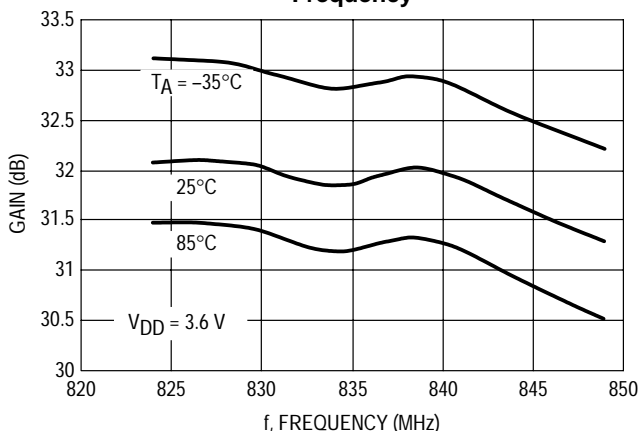


Figure 4. Gain versus Frequency

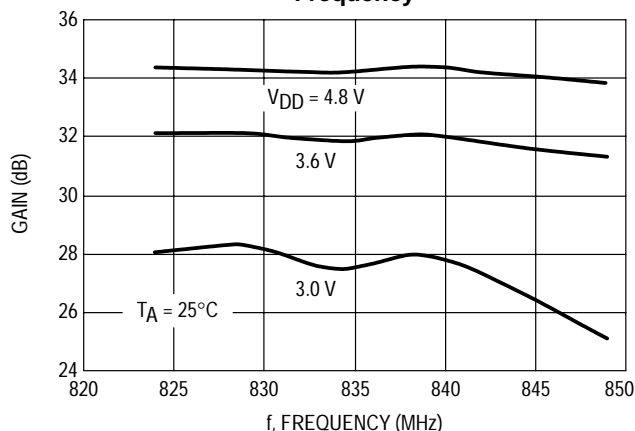


Figure 5. Output Power versus Input Power

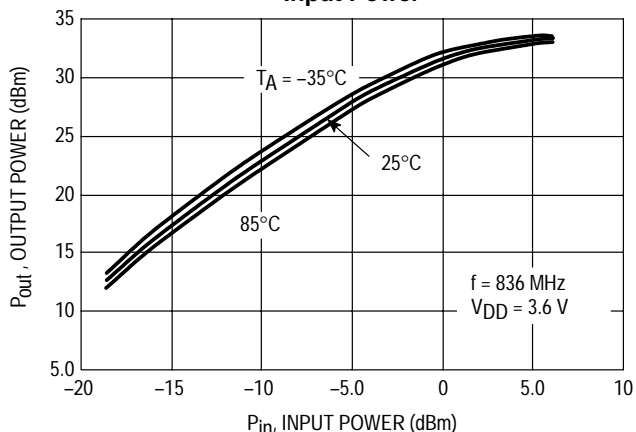


Figure 6. Output Power versus Input Power

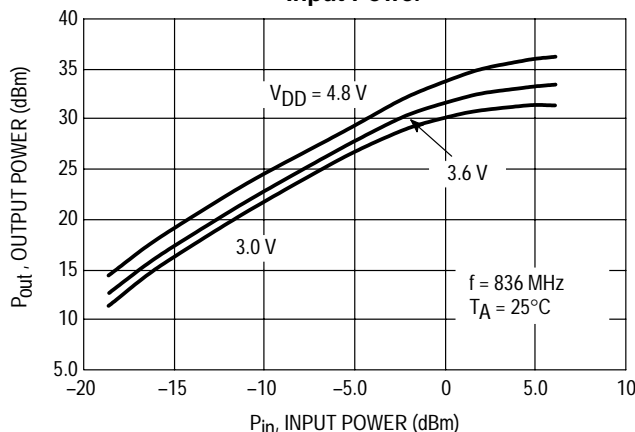


Figure 7. Adjacent Channel Power versus Output Power

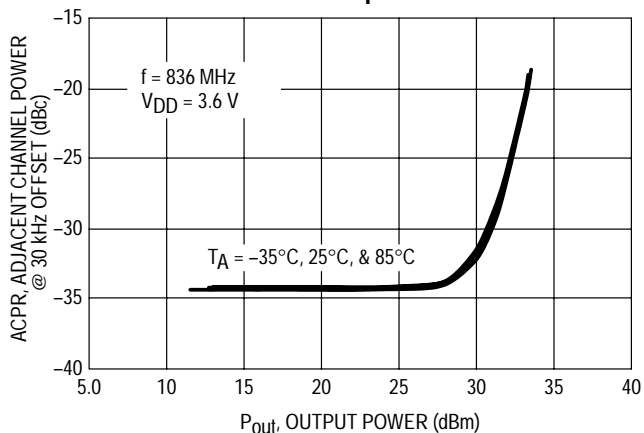
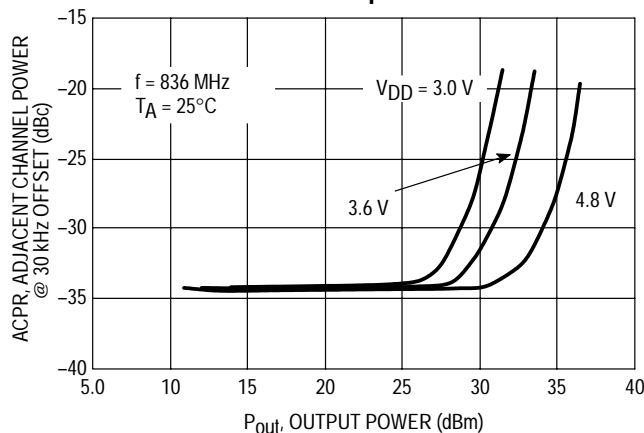


Figure 8. Adjacent Channel Power versus Output Power



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TDMA PERFORMANCE

Figure 9. Alternate Channel Power versus Output Power

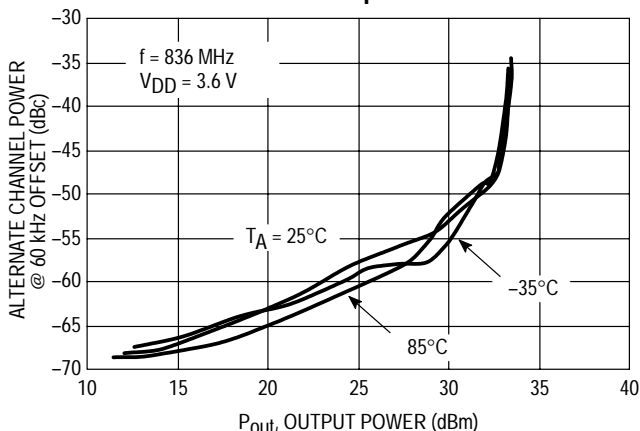


Figure 10. Alternate Channel Power versus Output Power

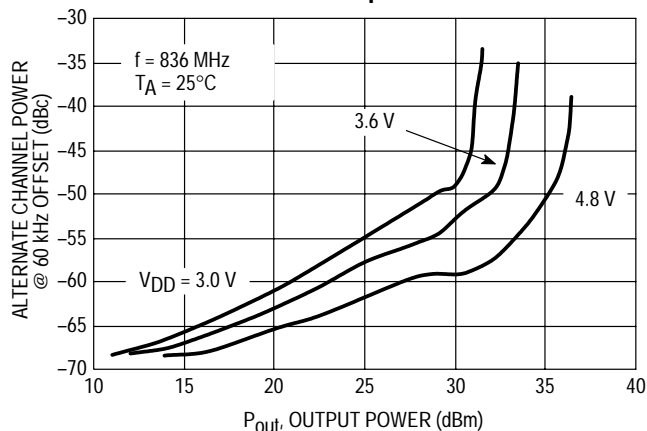


Figure 11. Gain versus Frequency

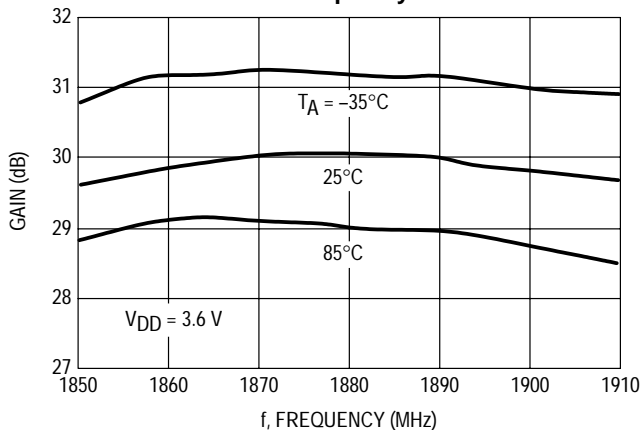


Figure 12. Gain versus Frequency

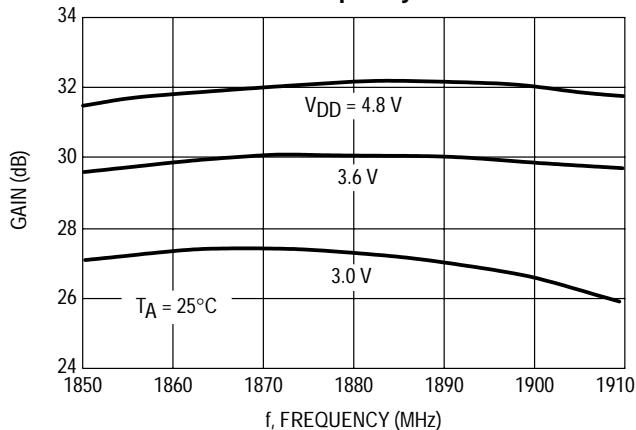


Figure 13. Output Power versus Input Power

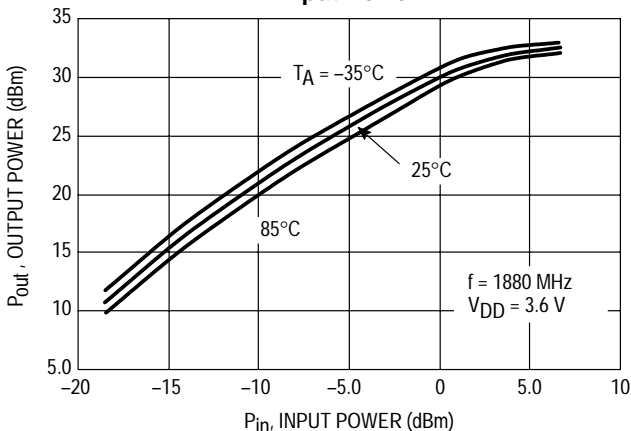
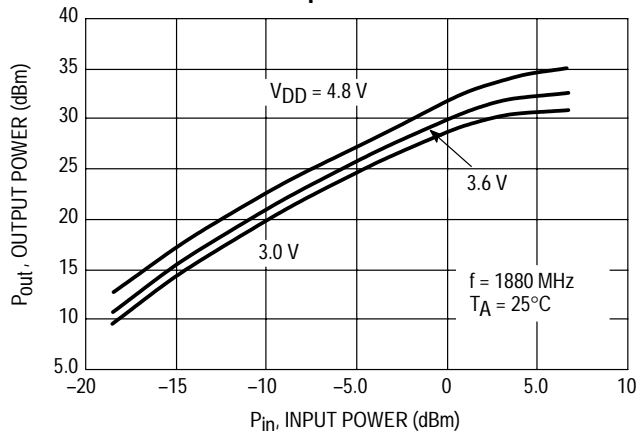


Figure 14. Output Power versus Input Power



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TDMA PERFORMANCE

Figure 15. Adjacent Channel Power versus Output Power

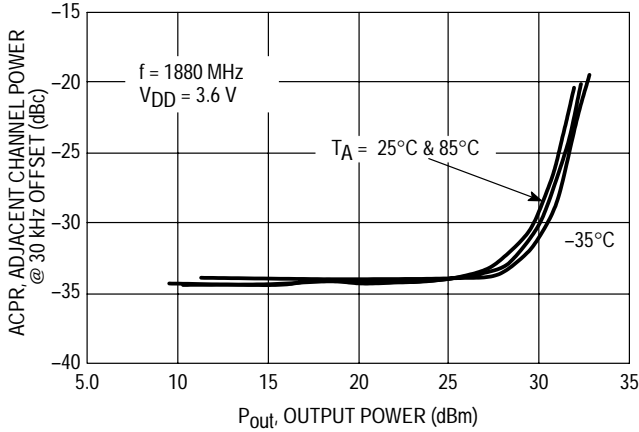


Figure 16. Adjacent Channel Power versus Output Power

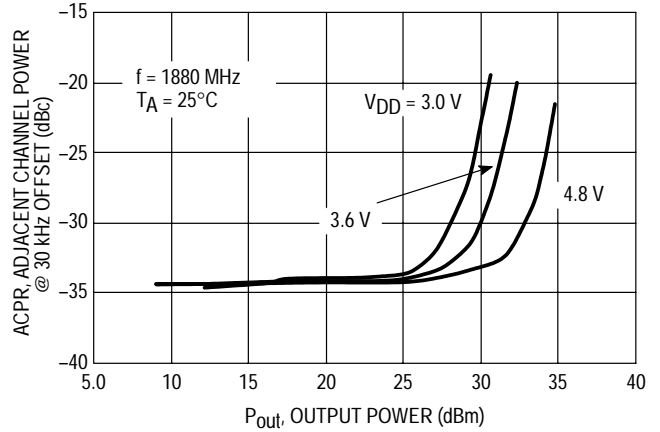


Figure 17. Alternate Channel Power versus Output Power

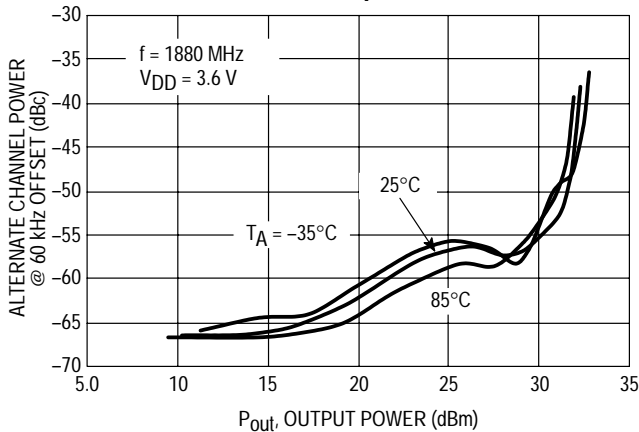
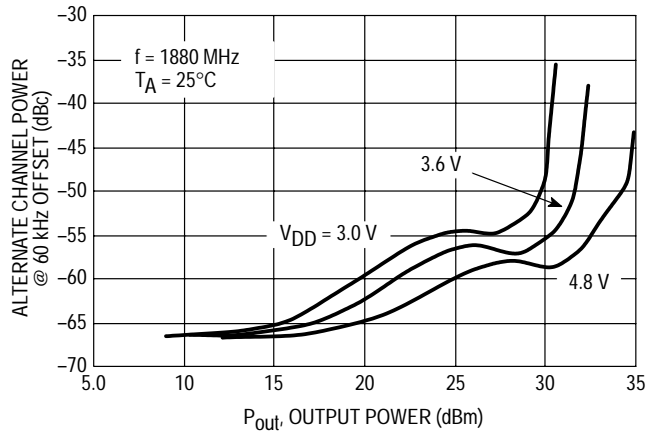


Figure 18. Alternate Channel Power versus Output Power



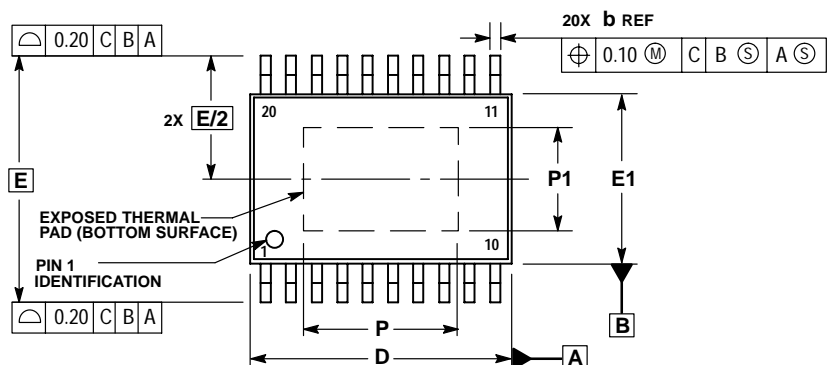
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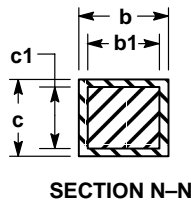
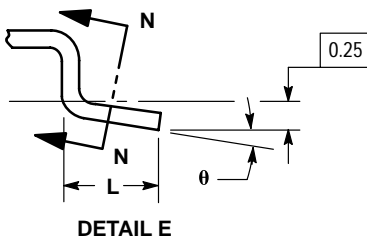
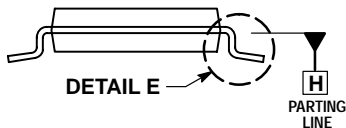
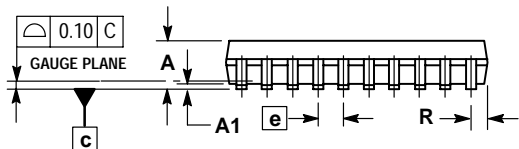
OUTLINE DIMENSIONS

PLASTIC PACKAGE  
CASE 948M-01  
(TSSOP-20EP)  
ISSUE O

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- 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.



DIM	MILLIMETERS	
	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°

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ASIA/PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbour Centre,  
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