T-33-11

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

TP5040

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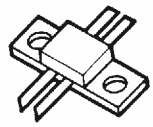
The RF Line

UHF Power Transistor

. . . designed for 24 Volt UHF large-signal common emitter amplifier applications in industrial and commercial FM equipment operating in the 380 to 512 MHz frequency range, i.e., cellular radio base stations.

- 380–512 MHz
- 40 W — P_{out}
- 24 V — V_{CC}
- High Gain — 9 dB Min, Class AB
- Gold Metallization for Reliability

40 W — 380 to 512 MHz UHF POWER TRANSISTOR NPN SILICON



CASE 395-01, STYLE 1
(BMA-2)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	28	Vdc
Collector-Base Voltage	V_{CBO}	45	Vdc
Emitter-Base Voltage	V_{EBO}	4	Vdc
Total Device Dissipation @ T_C = 70°C (Note 1) Derate above 70°C	P_D	65 0.5	Watts W/°C
Operating Junction Temperature	T_J	200	°C
Storage Temperature Range	T_{stg}	−65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (T_C = 70°C)	$R_{\theta JC}$	2	°C/W

Note 1. These devices are designed for RF operation. The total dissipation rating applies only when the device is operated in an RF push-pull amplifier

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (Note 1)					
Collector-Emitter Breakdown Voltage (I_C = 40 mA, I_B = 0)	$V_{(BR)CEO}$	28	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = 40 mA, I_E = 0)	$V_{(BR)CBO}$	45	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 6 mA, I_C = 0)	$V_{(BR)EBO}$	4	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 20 mA, R_{BE} = 47 Ω)	$V_{(BR)CER}$	40	—	—	Vdc
ON CHARACTERISTICS (Note 1)					
DC Current Gain (I_C = 500 mA, V_{CE} = 10 V)	h_{FE}	15	120	—	—
DYNAMIC CHARACTERISTICS (Note 1)					
Output Capacitance (V_{CB} = 28 V, I_E = 0, f = 1 MHz)	C_{ob}	—	—	40	pF

Note 1 Each transistor chip measured separately

(continued)

ELECTRICAL CHARACTERISTICS — continued

Characteristic	Symbol	Min	Typ	Max	Unit
FUNCTIONAL TESTS (Note 2)					
Common-Emitter Amplifier Power Gain (V_{CE} = 24 V, P_{out} = 40 W, f = 470 MHz, I_Q = 2 x 50 mA)	G_{PE}	9	—	—	dB
Collector Efficiency (V_{CE} = 24 V, P_{out} = 40 W, f = 470 MHz, I_Q = 2 x 50 mA)	η_C	45	50	—	%

Note 2 Both transistor chips operating in push-pull amplifier

TYPICAL CHARACTERISTICS

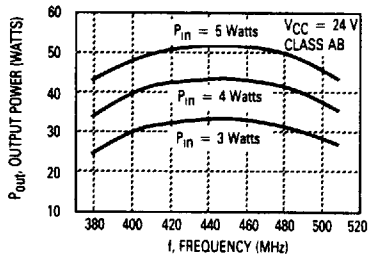


Figure 1. Output Power versus Frequency

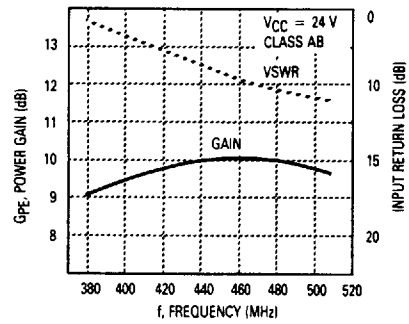


Figure 2. Gain versus Frequency

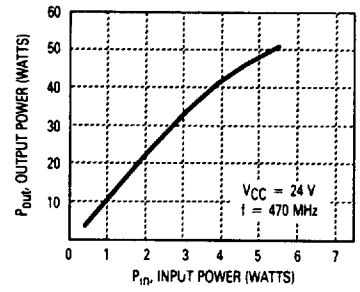
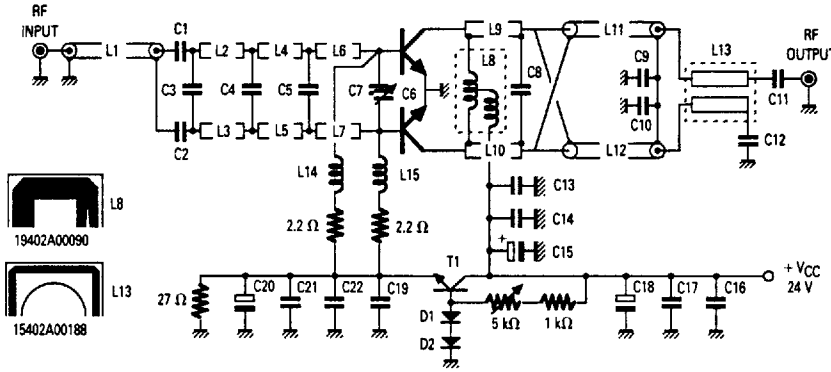


Figure 3. Output Power versus Input Power

F (MHz)	400	430	470	500
Input Impedance Ω	2.5 - j1.0	2.75 + j2.0	3.0 - j3.1	3.25 + j4.25
Output Impedance Ω	8.5 - j6.5	7 - j6.5	6.0 - j6.25	4.75 - j6.0

Figure 4. Series Equivalent Input/Output Impedances

CONDITIONS
V_{CE} = 24 V
I_Q = 2 x 50 mA — Class AB
P_{out} = 40 W
Collector-to-Collector



L1 — 50 Ω Coaxial Cable, 20% λg @ 470 MHz
L2, L3 — Wire Dia 0 5 mm, L = 5 mm
L4, L5 — Microstrip Line 7 5 mm 1679 Ω, 1.7% λg @ 470 MHz
L6, L7 — Microstrip Line 7 5 mm 39 Ω, 1 7% λg @ 470 MHz
L8 — Collector/Collector Inductor, 1/50" Teflon Glass
L9, L10 — Microstrip Line 7 mm 50 Ω, 1 7% λg @ 470 MHz
L11, L12 — 25 Ω Coaxial Cable, 56 mm
L13 — Balun 50 Ω, 12 5% λg @ 470 MHz
L14, L15 — 3 Turns ID 3 mm Wire 1 mm
C1, C2, C7 — 47 pF ATC100A470JP50 Capacitor
C3 — 4 7 pF ATC100A4R7DP50 Capacitor
C4 — 5.6 pF ATC100A5R6DP50 Capacitor
C5 — 15 pF ATC100A150DP50 Capacitor
C6 — Trimmer 1–4 pF Johanson 9401-4
C8 — 12 pF ATC100A120DP50 Capacitor
C9 — 1 nF Chip 0805 Sprague/Vitramon Capacitor
C10 — 15 nF Chip 0805 Sprague/Vitramon Capacitor
C11, C12 — 100 pF ATC100A101KP50 Capacitor
C13, C17, C21 — 100 pF ATC100A101KP50 Capacitor
C14, C16, C22 — 10 nF 0805 Sprague/Vitramon Capacitor
C19 — 0 1 nF 0805 Sprague/Vitramon Capacitor
C18, C20 — 100 μF 40 V Capacitor
C15 — 10 μF 63 V Capacitor
D1, D2 — 1N4007 Diode
T1 — BD135 Transistor

Board Material: 020 In , Teflon Glass

Figure 5. 380–512 MHz Broadband Test Circuit

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