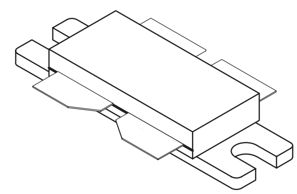
The RF MOSFET Line
RF Power Field-Effect Transistor
N–Channel Enhancement–Mode Lateral MOSFET

MRF377
MRF377R3
MRF377R5

Designed for broadband commercial and industrial applications with frequencies from 470 to 860 MHz. The high gain and broadband performance of this device make it ideal for large–signal, common source amplifier applications in 32 volt digital television transmitter equipment.

- Typical Broadband DVBT OFDM Performance @ 470–860 MHz, 32 Volts, I_{DQ} = 2.0 A, 8K Mode, 64 QAM
  Output Power — 45 Watts Avg.
  Power Gain ≥ 16.7 dB
  Efficiency ≥ 21%
  ACPR ≤ –58 dBc
- Typical Broadband ATSC 8VSB Performance @ 470–860 MHz, 32 Volts, I_{DQ} = 2.0 A
  Output Power — 80 Watts Avg.
  Power Gain ≥ 16.5 dB
  Efficiency ≥ 27.5%
  IMD ≤ –31.3 dBc
- Internally Input and Output Matched for Ease of Use
- Integrated ESD Protection
- Capable of Handling 10:1 VSWR, @ 32 Vdc, 860 MHz, 45 Watts DVBT OFDM Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large–Signal Impedance Parameters
- Available in Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel. R5 Suffix = 50 Units per 56 mm, 13 inch Reel.

470 – 860 MHz, 240 W, 32 V
LATERAL N–CHANNEL
RF POWER MOSFET



CASE 375G–04, STYLE 1
NI–860C3

MAXIMUM RATINGS (1)

Rating	Symbol	Value	Unit
Drain–Source Voltage	V_{DSS}	65	Vdc
Gate–Source Voltage	V_{GS}	– 0.5, +15	Vdc
Drain Current – Continuous	I_D	17	Adc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	486 2.78	W W/°C
Storage Temperature Range	T_{stg}	– 65 to +150	°C
Operating Junction Temperature	T_J	200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.36	°C/W

ESD PROTECTION CHARACTERISTICS

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M3 (Minimum)
Charge Device Model	7 (Minimum)

(1) Each side of device measured separately.

NOTE – **CAUTION** – MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

REV 0

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digital dna

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ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (1)					
Drain–Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D =10 μA)	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current (V_{DS} = 32 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	μAdc
Gate–Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
ON CHARACTERISTICS (1)					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 200 μA)	$V_{GS(th)}$	—	2.8	—	Vdc
Gate Quiescent Voltage (V_{DS} = 32 Vdc, I_D = 225 mA)	$V_{GS(Q)}$	—	3.5	—	Vdc
Drain–Source On–Voltage (V_{GS} = 10 Vdc, I_D = 3 A)	$V_{DS(on)}$	—	0.27	—	Vdc
DYNAMIC CHARACTERISTICS (1)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc, V_{GS} = 0, f = 1 MHz)	C_{rss}	—	3.2	—	pF
FUNCTIONAL CHARACTERISTICS (In DVBT OFDM Single–Channel, Narrowband Fixture, 50 ohm system)(2)					
Common Source Power Gain (V_{DD} = 32 Vdc, P_{out} = 45 W Avg., I_{DQ} = 2 x 1000 mA, f = 860 MHz)	G_{ps}	16.5	18.2	—	dB
Drain Efficiency (V_{DD} = 32 Vdc, P_{out} = 45 W Avg., I_{DQ} = 2 x 1000 mA, f = 860 MHz)	η	21	22.9	—	%
Adjacent Channel Power Ratio (V_{DD} = 32 Vdc, P_{out} = 45 W Avg., I_{DQ} = 2 x 1000 mA, f = 860 MHz)	ACPR	—	–59.2	–57	dBc
TYPICAL CHARACTERISTICS (In DVBT OFDM Single–Channel, Broadband Fixture, 50 ohm system)(2)					
Common Source Power Gain (V_{DD} = 32 Vdc, P_{out} = 45 W Avg., I_{DQ} = 2 x 1000 mA)	G_{ps}				dB
f = 470 MHz		—	17.6	—	
f = 560 MHz		—	17.6	—	
f = 660 MHz		—	17.4	—	
f = 760 MHz		—	17.4	—	
f = 860 MHz		—	16.8	—	
Drain Efficiency (V_{DD} = 32 Vdc, P_{out} = 45 W Avg., I_{DQ} = 2 x 1000 mA)	η				%
f = 470 MHz		—	23.5	—	
f = 560 MHz		—	25.8	—	
f = 660 MHz		—	23.0	—	
f = 760 MHz		—	22.7	—	
f = 860 MHz		—	21.3	—	
Adjacent Channel Power Ratio (V_{DD} = 32 Vdc, P_{out} = 45 W Avg., I_{DQ} = 2 x 1000 mA)	ACPR				dBc
f = 470 MHz		—	–59.3	—	
f = 560 MHz		—	–59.3	—	
f = 660 MHz		—	–58.7	—	
f = 760 MHz		—	–58.7	—	
f = 860 MHz		—	–58.1	—	

(1) Each side of device measured separately.
(2) Measured in push–pull configuration.

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TYPICAL CHARACTERISTICS (In ATSC 8VSB Single–Channel, Broadband Fixture, 50 ohm system)(2)

Characteristic	Symbol	Min	Typ	Max	Unit
Common Source Power Gain (V_{DD} = 32 Vdc, P_{out} = 80 W Avg., I_{DQ} = 2 x 1000 mA)	G_{ps}				dB
f = 470 MHz		—	17.5	—	
f = 560 MHz		—	17.5	—	
f = 660 MHz		—	17.2	—	
f = 760 MHz		—	17.2	—	
f = 860 MHz		—	16.6	—	
Drain Efficiency (V_{DD} = 32 Vdc, P_{out} = 80 W Avg., I_{DQ} = 2 x 1000 mA)	η				%
f = 470 MHz		—	31.0	—	
f = 560 MHz		—	34.3	—	
f = 660 MHz		—	30.1	—	
f = 760 MHz		—	29.6	—	
f = 860 MHz		—	27.8	—	
Intermodulation Distortion (V_{DD} = 32 Vdc, P_{out} = 80 W Avg., I_{DQ} = 2 x 1000 mA)	IMD				dBc
f = 470 MHz		—	31.7	—	
f = 560 MHz		—	32.7	—	
f = 660 MHz		—	32.9	—	
f = 760 MHz		—	34.2	—	
f = 860 MHz		—	35.4	—	

(2) Measured in push–pull configuration.

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Table 1. 845–875 MHz Narrowband Test Circuit Component Designations and Values

Part	Description	Value, P/N or DWG	Manufacturer
B1, B2	Ferrite Beads, Surface Mount, 11 Ω (0805)	2508051107Y0	Fair–Rite
Balun 1, Balun 2	0.8–1GHz Xinger Balun	3A412	Anaran
C1	33 pF Chip Capacitor (0805)	08055J330JBT	AVX / Kyocera
C2	2.7 pF Chip Capacitor (0603)	06035J2R7BBT	AVX / Kyocera
C3	12 pF Chip Capacitor (0805)	08051J120GBT	AVX / Kyocera
C4, C5	6.8 pF Chip Capacitors (0805)	08051J6R8BBT	AVX / Kyocera
C6	2.7 pF Chip Capacitor (0805)	0805J2R7BBT	AVX / Kyocera
C7, C8, C9, C10	3.3 pF Chip Capacitors (0805)	08051J3R3BBT	AVX / Kyocera
C11, C12	2.2 μF, 50 V Chip Capacitors	C1825C225J5RAC3810	Kemet
C13, C14, C15, C16	0.01 μF, 100 V Chip Capacitors	C1825C103J1GAC	Kemet
C17, C18	0.56 μF, 50 V Chip Capacitors	C1825C564J5RAC	Kemet
C19, C20	10 μF, 50 V Tantalum Chip Capacitors	522Z050/100MTRE	Tecate
C21, C22, C23, C24	47 μF, 16 V Tantalum Chip Capacitors	TPSD476K016R0150	AVX / Kyocera
C25, C26	470 μF, 63 V Electrolytic Capacitors	NACZF471M63V (18x22)	Nippon
L1	12 nH Inductor (0603)	0603HC–12NXJB	CoilCraft
L2	7.15 nH Inductor	1606–7	CoilCraft
L3, L4	10 nH Inductor (0603)	0603HC–10NXJB	CoilCraft
R1, R2	24 Ω, 1/8 W, 5% Chip Resistors (1206)		
WB1, WB2, WB3, WB4	Brass Wear Shims		
PCB	Arlon 30 mil, ε_r = 2.56	DS1152	DS Electronics

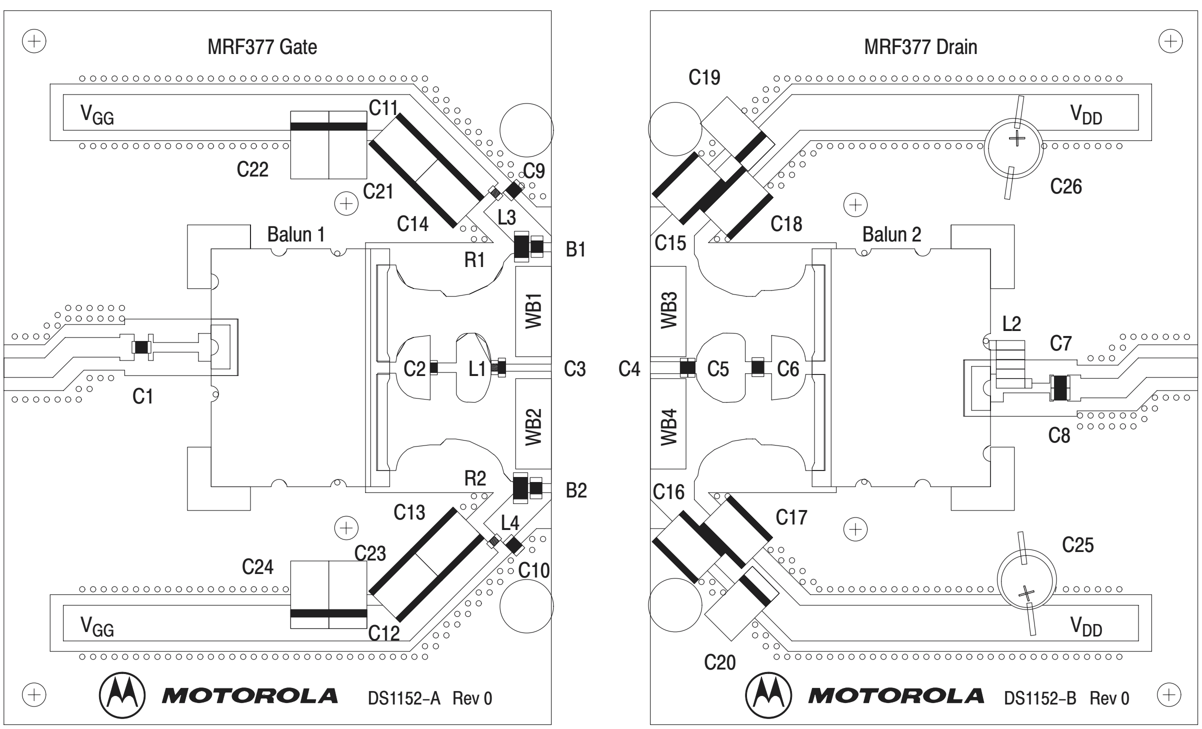

Figure 1. 845–875 MHz Narrowband Test Circuit Component Layout

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TYPICAL NARROWBAND CHARACTERISTICS

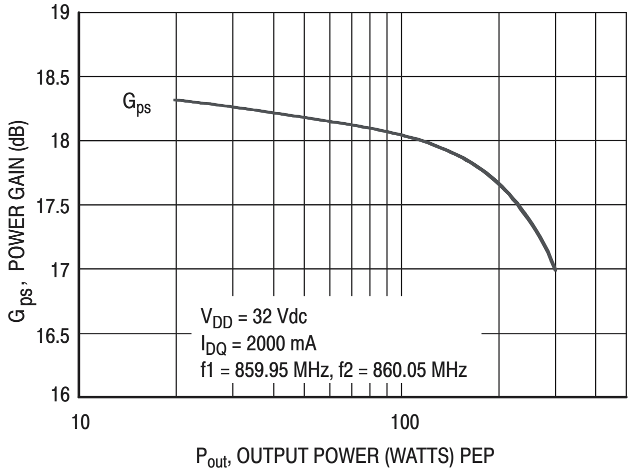

Figure 2. Two–Tone Power Gain versus Output Power

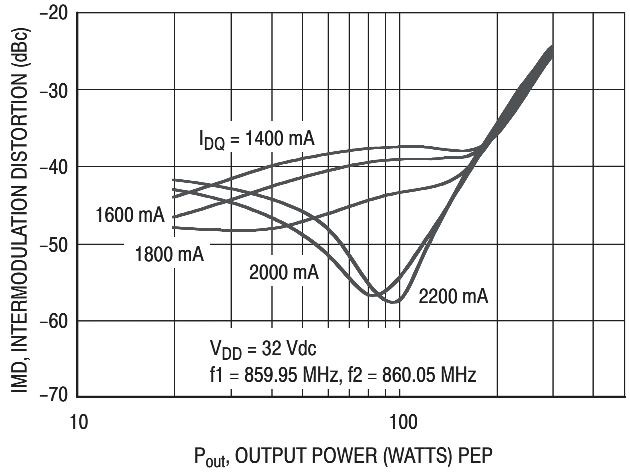

Figure 3. Third Order Intermodulation Distortion versus Output Power

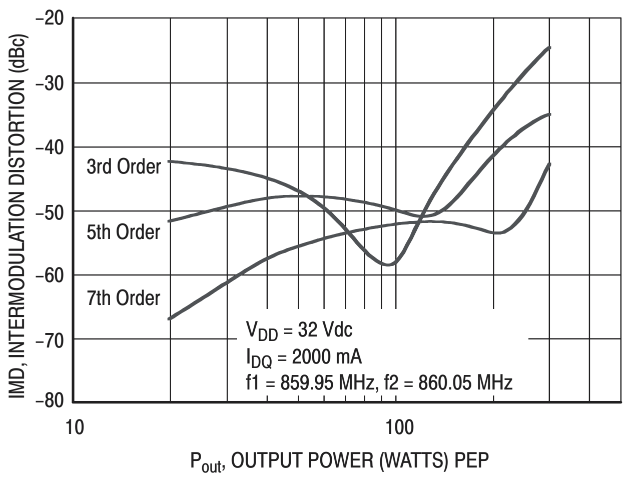

Figure 4. Intermodulation Distortion Products versus Output Power

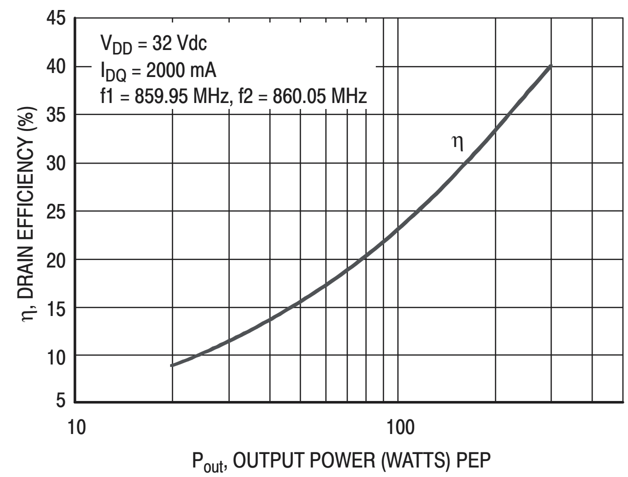

Figure 5. Two–Tone Drain Efficiency versus Output Power

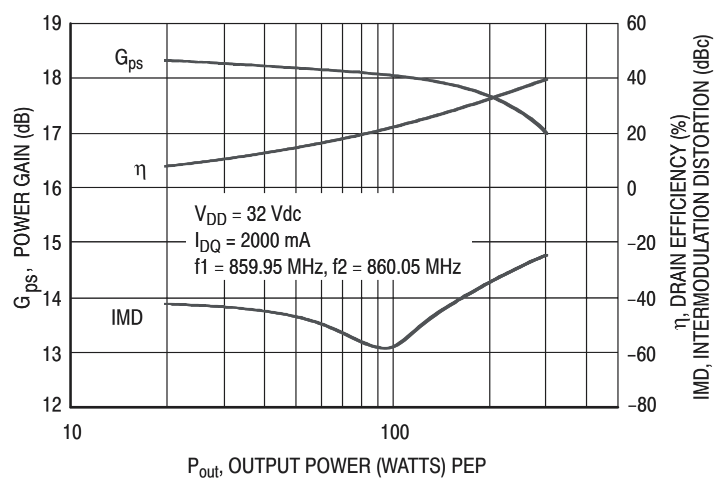

Figure 6. Power Gain, Efficiency and IMD versus Output Power

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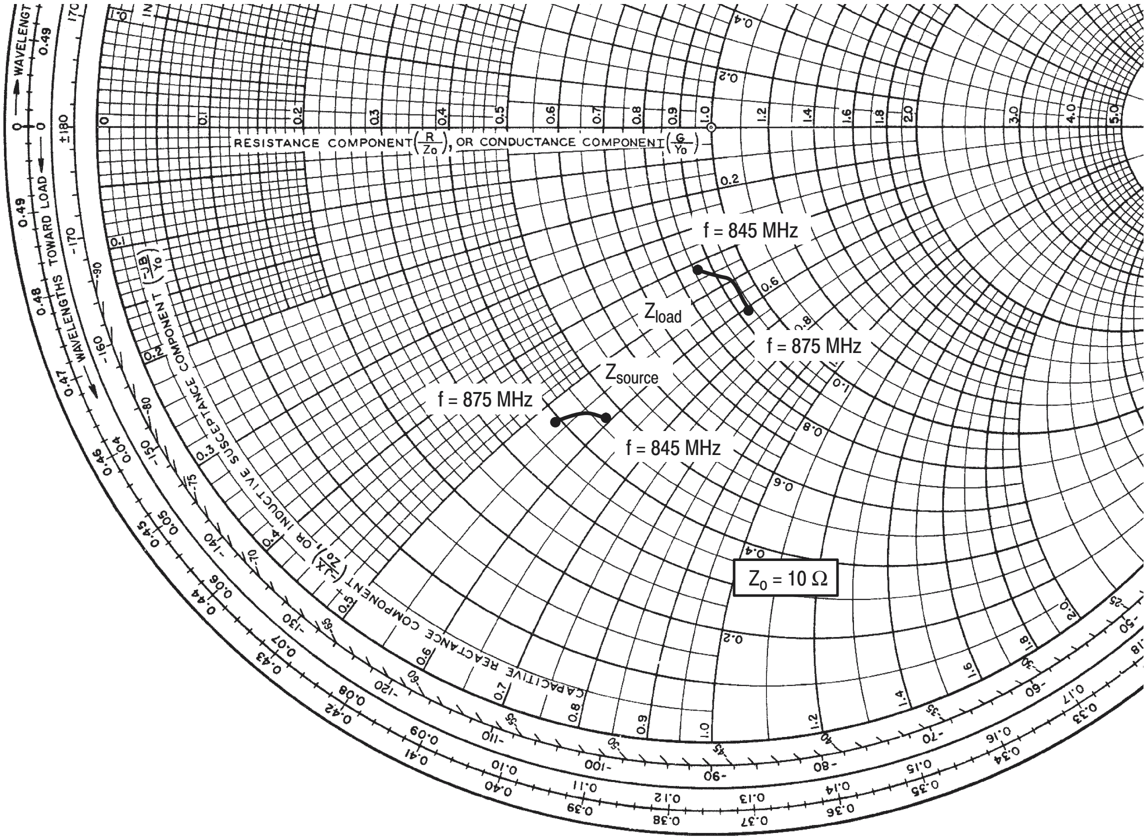

V_{DD} = 32 V, I_{DQ} = 2 x 1000 mA, P_{out} = 45 W Avg., DVBT OFDM

f MHz	Z_{source} Ω	Z_{load} Ω
845	4.66 – j5.90	8.59 – j4.22
860	4.38 – j5.64	9.36 – j4.95
875	3.93 – j5.33	9.39 – j6.06

Z_{source} = Test circuit impedance as measured from gate to gate, balanced configuration.

Z_{load} = Test circuit impedance as measured from drain to drain, balanced configuration.

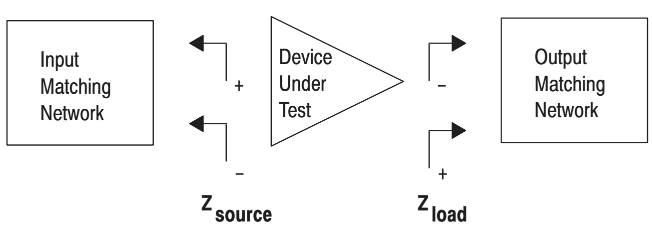

Figure 7. 845–875 MHz Narrowband Series Equivalent Input and Output Impedance

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Table 2. 470—860 MHz Broadband Test Circuit Component Designations and Values

Part	Description	Value, P/N or DWG	Manufacturer
B1, B2	Ferrite Beads, Surface Mount, 30 Ω (0603)	2506033007Y0	Fair–Rite
Balun 1, Balun 2	Rogers 3.006, ε_r = 6.06, 1 oz Cu	DS1046	DS Electronics
C1	12 pF Chip Capacitor (0603)	06035J120GBT	AVX / Kyocera
C2, C5	12 pF Chip Capacitors (0805)	08051J120GBT	AVX / Kyocera
C3	3.9 pF Chip Capacitor (0805)	08051J3R9BBT	AVX / Kyocera
C4, C7, C12, C15, C17	8.2 pF Chip Capacitors (0805)	08051J8R2BBT	AVX / Kyocera
C6	3.3 pF Chip Capacitor (0805)	08051J3R3BBT	AVX / Kyocera
C8	0.4–2.5 pF Variable Capacitor	27283PC	Gigatronics
C9, C10	3.3 pF Chip Capacitors (0603)	06035J3R3BBT	AVX / Kyocera
C11, C14	10 pF Chip Capacitor (0805)	08051J100GBT	AVX / Kyocera
C13	4.7 pF Chip Capacitor (0805)	08051J4R7BBT	AVX / Kyocera
C16	2.2 pF Chip Capacitor (0603)	06035J2R2BBT	AVX / Kyocera
C18	2.2 pF Chip Capacitor (0805)	08051J2R2BBT	AVX / Kyocera
C19, C20, C21, C22	47 µF, 16 V Tantalum Chip Capacitors	TPSD476K016R0150	AVX
C23, C26	2.2 µF, 50 V Ceramic Chip Capacitors	C1825C225J5RAC3810	Kemet
C24, C25, C27, C29	0.01 µF, 100 V Ceramic Chip Capacitors	C1825C103J1GAC	Kemet
C28, C30	0.56 µF, 50 V Ceramic Chip Capacitors	C1825C564J5GAC	Kemet
C31, C32	10 µF, 50 V Chip Capacitors	522Z–050/100MTRE	Tecate
C33, C34	470 µF, 63 V Electrolytic Capacitors	SME63VB471M12X25LL	United Chemi–Con
L1, L2	15 nH Inductors (0603)	L0603150GGW003	AVX
L3, L4	12 nH Inductors (0603)	0603HC–12NHJBU	CoilCraft
L5, L6	8 nH Coil Inductors	A03T–5	CoilCraft
L7	22 nH Coil Inductor	B07T–5	CoilCraft
L8	18.5 nH Coil Inductor	A05T–5	CoilCraft
R1, R2	12.1 Ω, 1/16 W, 1% Chip Resistors (0603)		
PCB Gate, PCB Drain	PCB Motherboard w/Integrated Daughterboard, Rogers 3003, ε_r = 3.03, 0.5 oz Cu	DS1047	DS Electronics

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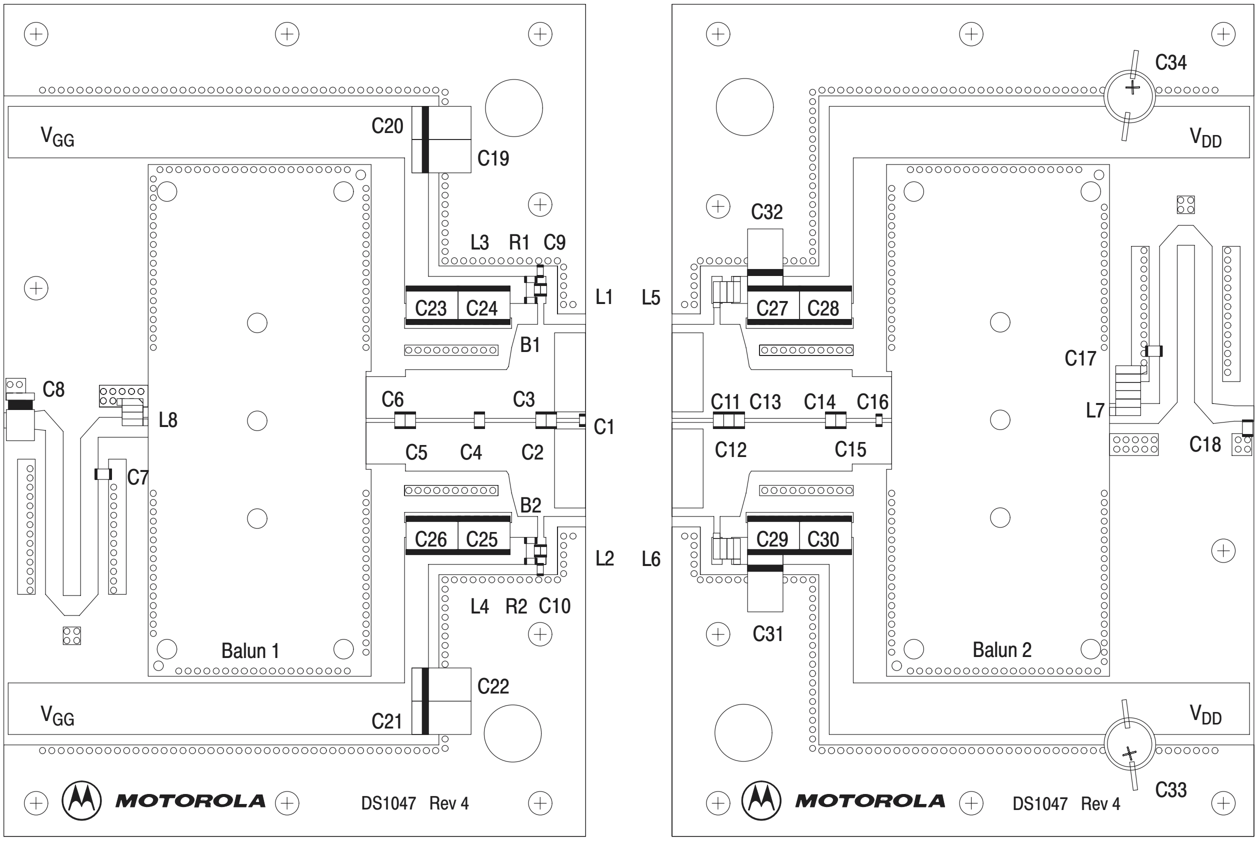

Multilayer Balun Mounting Detail

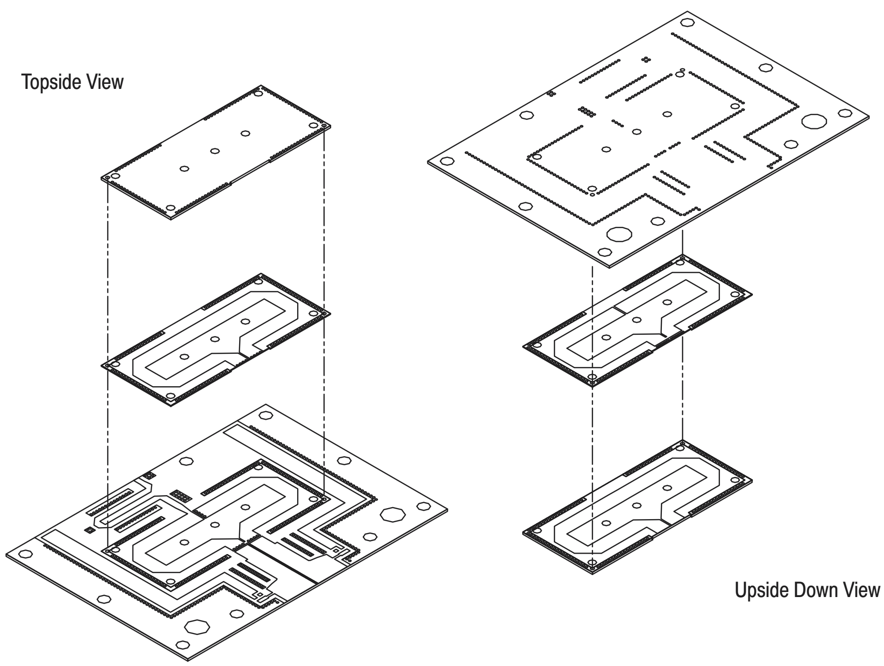

Figure 8. 470–860 MHz Broadband Test Circuit Component Layout

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TYPICAL DVBT OFDM BROADBAND CHARACTERISTICS

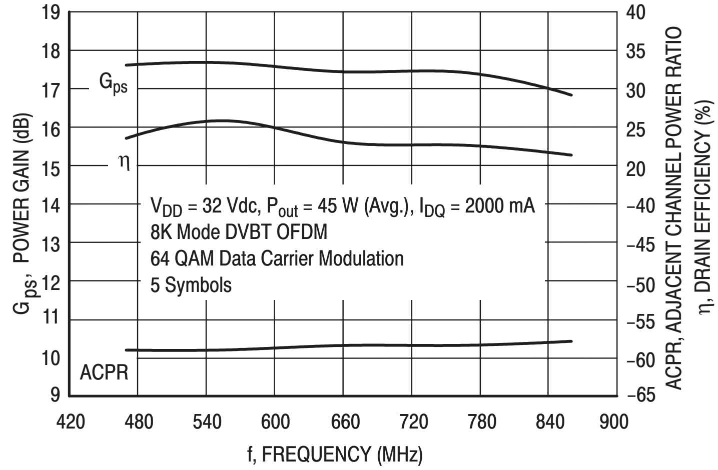

Figure 9. Single–Channel DVBT OFDM Broadband Performance

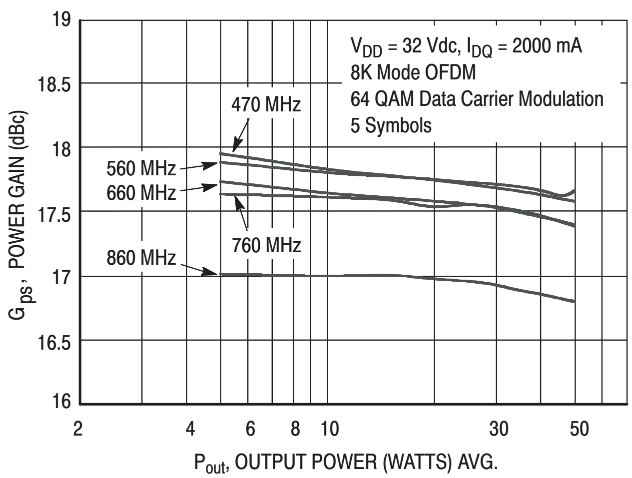

Figure 10. Single–Channel DVBT OFDM Broadband Performance Power Gain versus Output Power

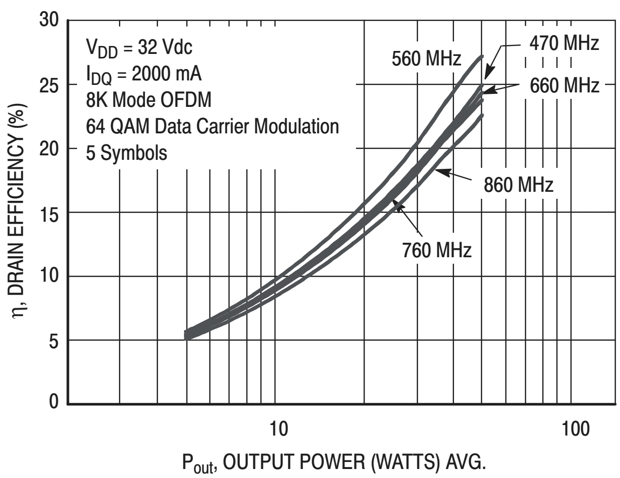

Figure 11. Single–Channel DVBT OFDM Broadband Performance Drain Efficiency versus Output Power

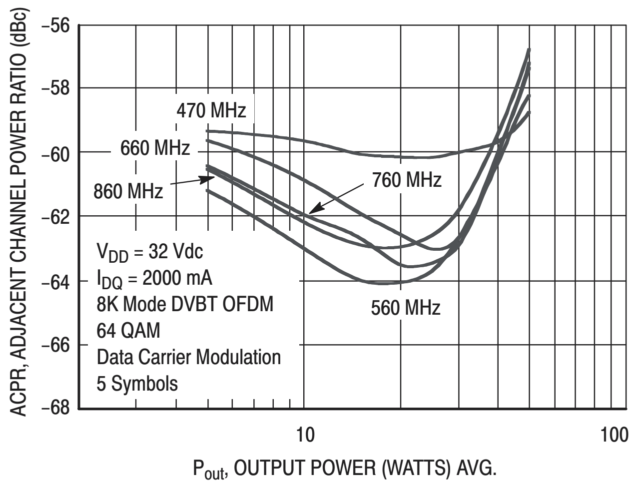

Figure 12. Single–Channel DVBT OFDM Broadband Performance Adjacent Channel Power Ratio versus Output Power

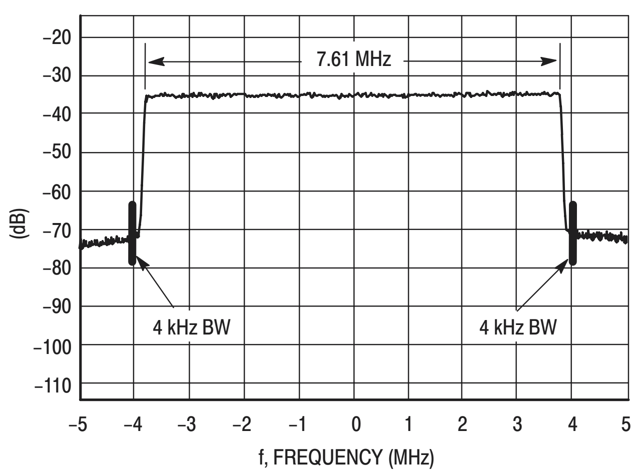

Figure 13. 8K Mode DVBT OFDM Spectrum

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TYPICAL ATSC 8VSB BROADBAND CHARACTERISTICS

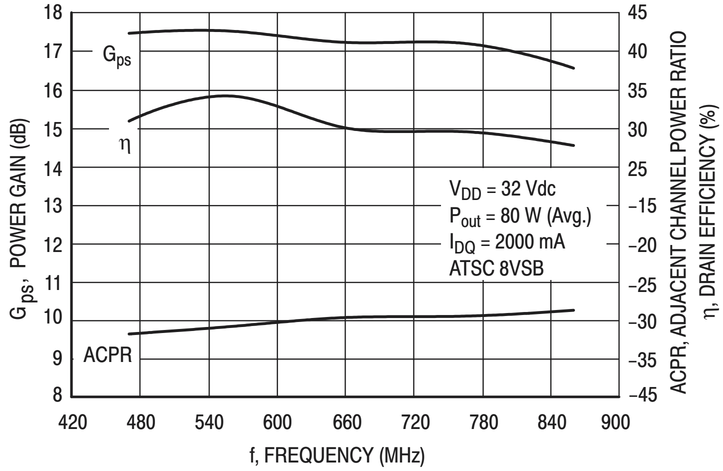

Figure 14. Single–Channel ATSC 8VSB Broadband Performance

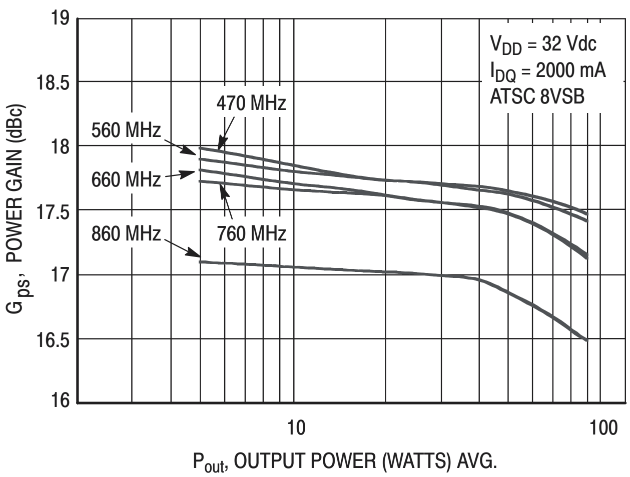

Figure 15. Single–Channel ATSC 8VSB Broadband Performance Power Gain versus Output Power

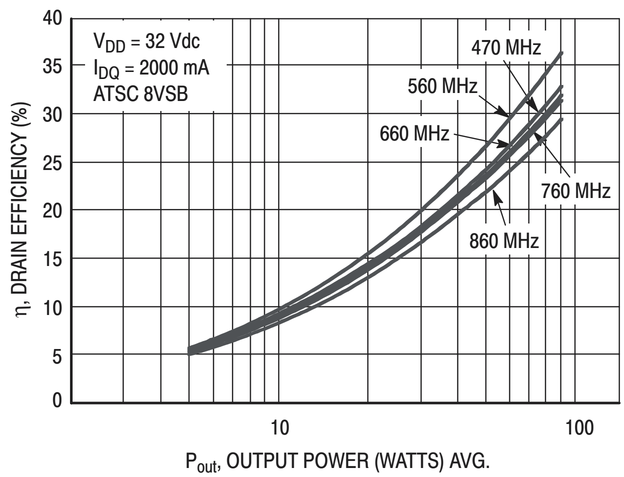

Figure 16. Single–Channel ATSC 8VSB Broadband Performance Drain Efficiency versus Output Power

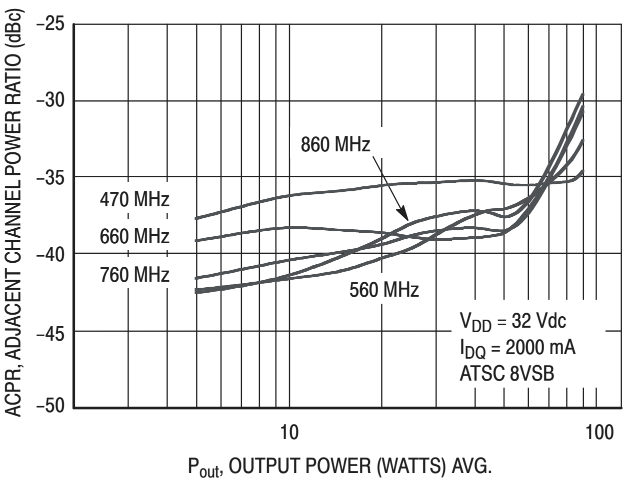

Figure 17. Single–Channel ATSC 8VSB Broadband Performance Adjacent Channel Power Ratio versus Output Power

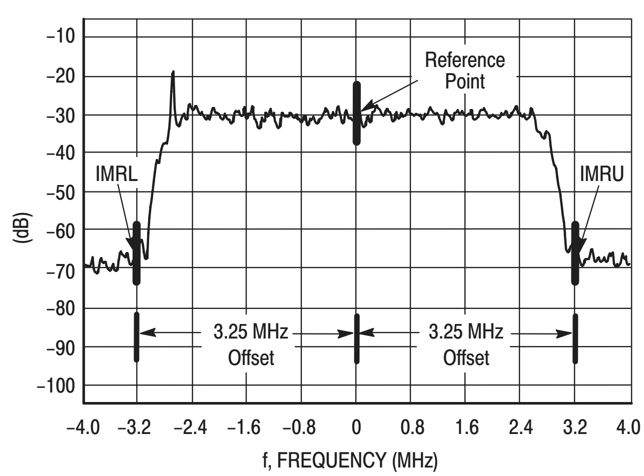

Figure 18. ATSC 8VSB Spectrum

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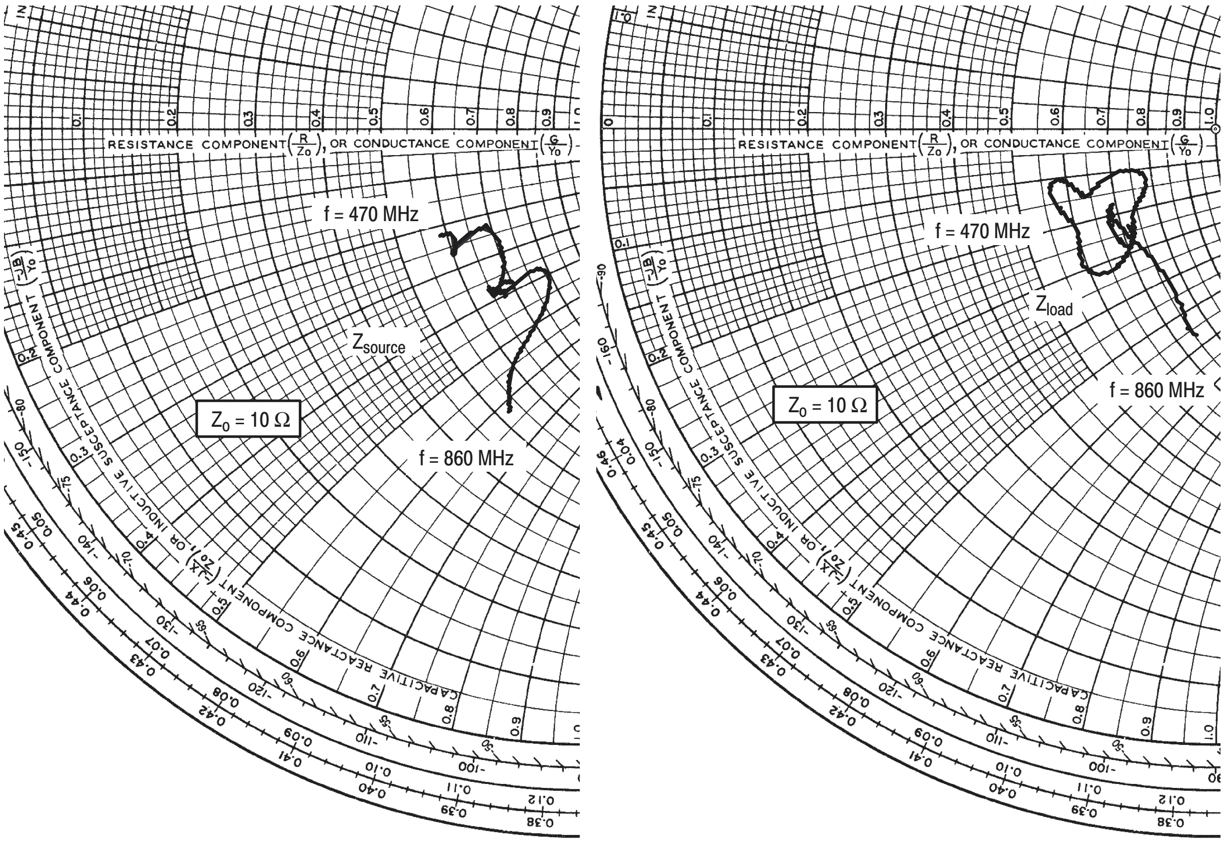

Optimized for V_{DD} = 32 V, I_{DQ} = 2 x 1000 mA, P_{out} = 45 W Avg., DVBT OFDM

f MHz	Z_{source} Ω	Z_{load} Ω
470	5.79 – j2.40	6.21 – j1.69
560	6.63 – j2.63	5.66 – j1.12
660	6.57 – j4.03	6.76 – j1.00
760	6.67 – j4.55	6.57 – j1.91
860	5.34 – j6.28	7.37 – j5.45

Z_{source} = Test circuit impedance as measured from gate to gate, balanced configuration.

Z_{load} = Test circuit impedance as measured from drain to drain, balanced configuration.

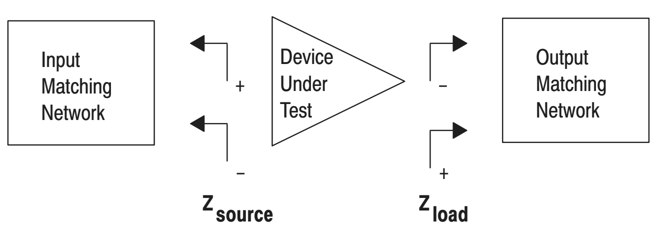

Figure 19. 470—860 MHz Broadband Series Equivalent Input and Output Impedance

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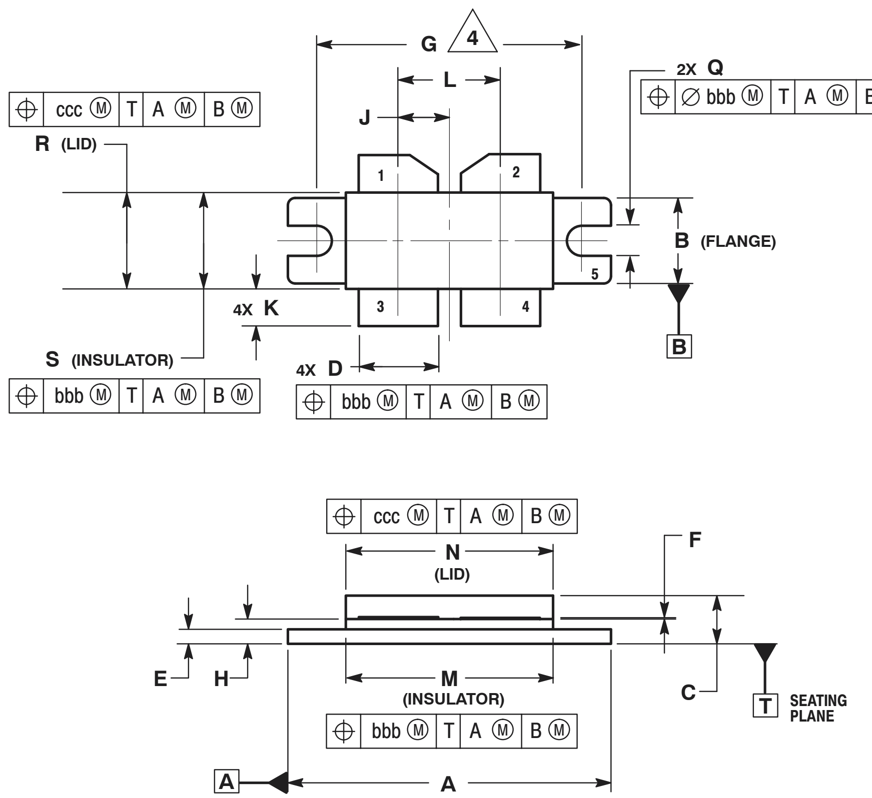
PACKAGE DIMENSIONS



NOTES:
1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DIMENSION H TO BE MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
4. RECOMMENDED BOLT CENTER DIMENSION OF 1.140 (28.96) BASED ON 3M SCREW.

	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	0.180	0.224	4.57	5.69
D	0.325	0.335	8.26	8.51
E	0.060	0.070	1.52	1.78
F	0.004	0.006	0.10	0.15
G	1.100 BSC		27.94 BSC	
H	0.097	0.107	2.46	2.72
J	0.2125 BSC		5.397 BSC	
K	0.135	0.165	3.43	4.19
L	0.425 BSC		10.8 BSC	
M	0.852	0.868	21.64	22.05
N	0.851	0.869	21.62	22.07
Q	0.118	0.138	3.00	3.30
R	0.395	0.405	10.03	10.29
S	0.394	0.406	10.01	10.31
bbb	0.010 REF		0.25 REF	
ccc	0.015 REF		0.38 REF	

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

CASE 375G–04
ISSUE E
NI–860C3

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