TriQuint SEMICONDUCTOR

AGR09090EF
90 W, 865 MHz—960 MHz, N-Channel E-Mode, Lateral MOSFET

Introduction

The AGR09090EF is a high-voltage, gold-metalized, laterally diffused metal oxide semiconductor (LDMOS) RF power transistor suitable for global system for mobile communication (GSM), enhanced data for global evolution (EDGE), cellular, and multicarrier class AB power amplifier applications. This device is manufactured on an advanced LDMOS technology, offering state-of-the-art performance and reliability. Packaged in an industry-standard package and capable of delivering a minimum output power of 90 W, it is ideally suited for today's wireless base station RF power amplifier applications.

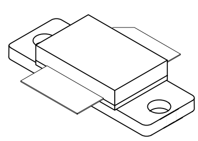


Figure 1. AGR09090EF (Flanged) Package

GSM Features

Typical performance ratings for GSM EDGE (f = 941 MHz, P_{OUT} = 40 W):
— Modulation spectrum:
 @ ±400 kHz = –60 dBc.
 @ ±600 kHz = –72 dBc.
— Error vector magnitude (EVM) = 2.3%.
Typical performance over entire GSM band:
— P1dB: 105 W typical.
— Power gain: @ P1dB = 17.8 dB.
— Efficiency @ P1dB = 60% typical.
— Return loss: –10 dB.

Cellular Features

Typical performance ratings (f = 880 MHz, P_{OUT} = 40 W):
— Modulation spectrum:
 @ ±400 kHz = –60 dBc.
 @ ±600 kHz = –72 dBc.
— Error vector magnitude (EVM) = 2.3%.
Typical performance over entire GSM band:
— P1dB: 105 W typical.
— Power gain: @ P1dB = 17.6 dB.
— Efficiency @ P1dB = 60% typical.
— Return loss: –10 dB.

GSM/Cellular Features

High-reliability, gold-metalization process.
Internally matched.
High gain, efficiency, and linearity.
Integrated ESD protection.
90 W minimum output power.

Table 1. Thermal Characteristics (921 MHz—960 MHz, and 865 MHz—895 MHz)

Parameter	Sym	Value	Unit
Thermal Resistance, Junction to Case: AGR09090EF	R JC	0.80	°C/W

Table 2. Absolute Maximum Ratings* (921 MHz—960 MHz, and 865 MHz—895 MHz)

Parameter	Sym	Value	Unit
Drain-source Voltage	V_{DSS}	65	Vdc
Gate-source Voltage	V_{GS}	–0.5, +15	Vdc
Drain Current—Continuous	I_D	8.5	Adc
Total Dissipation at T_C = 25 °C: AGR09090EF	P_D	219	W
Derate Above 25 C: AGR09090EF	—	1.25	W/°C
Operating Junction Temperature	T_J	200	°C
Storage Temperature Range	T_{STG}	–65, +150	°C

* Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Table 3. ESD Rating* (921 MHz—960 MHz, and 865 MHz—895 MHz)

AGR09090EF	Minimum (V)	Class
HBM	500	1B
MM	50	A
CDM	1500	4

* Although electrostatic discharge (ESD) protection circuitry has been designed into this device, proper precautions must be taken to avoid exposure to ESD and electrical overstress (EOS) during all handling, assembly, and test operations. PEAK Devices employs a human-body model (HBM), a machine model (MM), and a charged-device model (CDM) qualification requirement in order to determine ESD-susceptibility limits and protection design evaluation. ESD voltage thresholds are dependent on the circuit parameters used in each of the models, as defined by JEDEC's JESD22-A114B (HBM), JESD22-A115A (MM), and JESD22-C101A (CDM) standards.

Caution: MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

Electrical Characteristics

Recommended operating conditions apply unless otherwise specified: T_C = 30 °C.

Table 4. dc Characteristics (921 MHz—960 MHz, 865 MHz—895 MHz)

Parameter	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Drain-source Breakdown Voltage (V_{GS} = 0, I_D = 300 µA)	$V_{(BR)DSS}$	65	—	—	Vdc
Gate-source Leakage Current (V_{GS} = 5 V, V_{DS} = 0 V)	I_{GSS}	—	—	2.6	µAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 26 V, V_{GS} = 0 V)	I_{DSS}	—	—	150	µAdc
On Characteristics					
Forward Transconductance (V_{DS} = 10 V, I_D = 1.0 A)	G_{FS}	—	6	—	S
Gate Threshold Voltage (V_{DS} = 10 V, I_D = 400 µA)	$V_{GS(TH)}$	—	—	4.8	Vdc
Gate Quiescent Voltage (V_{DS} = 26 V, I_{DQ} = 700 mA)	$V_{GS(Q)}$	—	3.6	—	Vdc
Drain-source On-voltage (V_{GS} = 10 V, I_D = 1.0 A)	$V_{DS(ON)}$	—	0.12	—	Vdc

Table 5. RF Characteristics (921 MHz—960 MHz)

Parameter	Symbol	Min	Typ	Max	Unit
Dynamic Characteristics					
Output Capacitance (V_{DS} = 26 Vdc, V_{GS} = 0, f = 1 MHz)	C_{OSS}	—	48	—	pF
Reverse Capacitance (V_{DS} = 26 Vdc, V_{GS} = 0, f = 1 MHz)	C_{RSS}	—	2.3	—	pF
Functional Tests (in Supplied Test Fixture)					
Power Gain (V_{DS} = 26 V, P_{OUT} = 50 W, I_{DQ} = 700 mA)	G_L	17	17.8	—	dB
Drain Efficiency (V_{DS} = 26 V, P_{OUT} = P1dB, I_{DQ} = 700 mA)		50	60	—	%
EDGE Linearity Characterization[2] (P_{OUT} = 40 W, f = 941 MHz, V_{DS} = 26 V, I_{DQ} = 700 mA)					
Modulation Spectrum @ ±400 kHz	—	—	–60	—	dBc
Modulation Spectrum @ ±600 kHz	—	—	–72	—	dBc
Output Power (V_{DS} = 26 V, 1 dB gain compression, I_{DQ} = 700 mA)	P1dB	90	105	—	W
Input Return Loss	RL	—	–10	—	dB
Ruggedness (V_{DS} = 26 V, P_{OUT} = 90 W, I_{DQ} = 700 mA, VSWR = 10:1, all angles)		No degradation in output power.			

1. Across full GSM band, 921 MHz—960 MHz.
2. Measured according to 3GPP GSM 05.05.

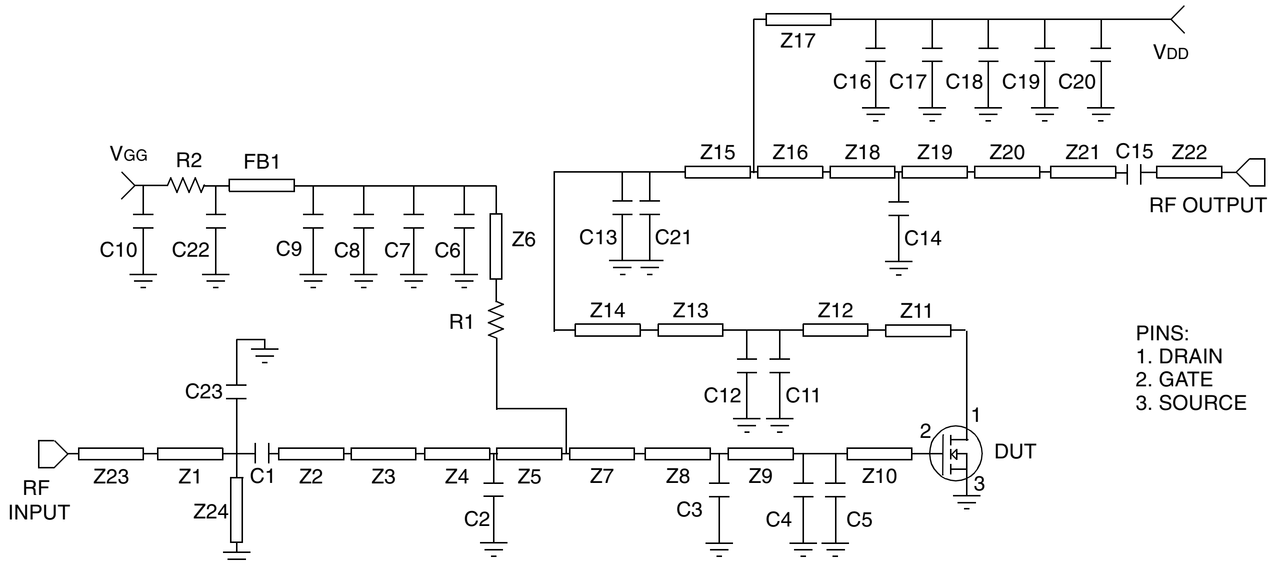
Electrical Characteristics (continued)

Table 6. RF Characteristics (865 MHz—895 MHz)

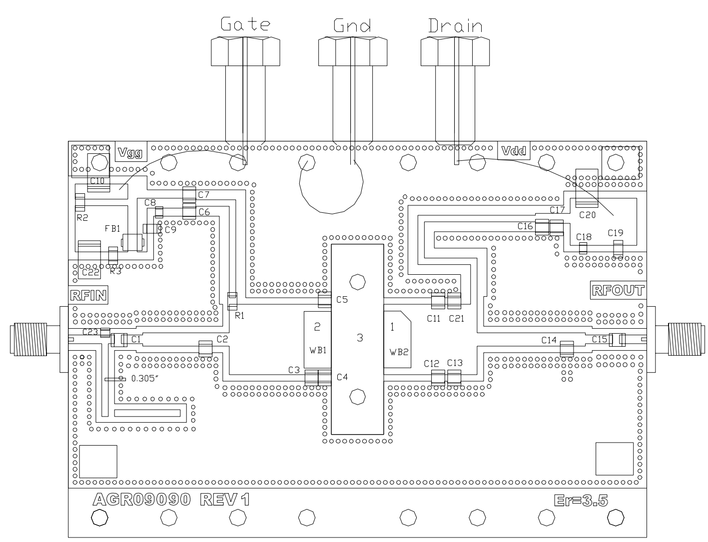
Parameter	Symbol	Min	Typ	Max	Unit
Dynamic Characteristics					
Output Capacitance (V_{DS} = 26 Vdc, V_{GS} = 0, f = 1 MHz)	C_{OSS}	—	48	—	pF
Reverse Capacitance (V_{DS} = 26 Vdc, V_{GS} = 0, f = 1 MHz)	C_{RSS}	—	2.3	—	pF
Functional Tests (in Agere Systems Supplied Test Fixture)[1]					
Power Gain (V_{DS} = 26 V, P_{OUT} = 50 W, I_{DQ} = 700 mA)	G_L	—	17.6	—	dB
Drain Efficiency (V_{DS} = 26 V, P_{OUT} = P1dB, I_{DQ} = 700 mA)		—	60	—	%
EDGE Linearity Characterization[2] (P_{OUT} = 40 W, f = 880 MHz, V_{DS} = 26 V, I_{DQ} = 700 mA)					
Modulation Spectrum @ ±400 kHz	—	—	–60	—	dBc
Modulation Spectrum @ ±600 kHz	—	—	–72	—	dBc
Output Power (V_{DS} = 26 V, 1 dB gain compression, I_{DQ} = 700 mA)	P1dB	—	105	—	W
Input Return Loss	RL	—	–10	—	dB
Ruggedness (V_{DS} = 26 V, P_{OUT} = 90 W, I_{DQ} = 700 mA, VSWR = 10:1, all angles)		No degradation in output power.			

1. Across full cellular band, 865 MHz—895 MHz.
2. Measured according to 3GPP GSM 05.05.

Test Circuit Illustrations for AGR09090EF, 921 MHz—960 MHz



A. Schematic, 921 MHz—960 MHz



Parts List:

Microstrip line: Z1 0.035 in. x 0.066 in.; Z2 0.120 in. x 0.066 in.; Z3 0.475 in. x 0.100 in.; Z4 0.050 in. x 0.100 in.; Z5 0.129 in. x 0.100 in.; Z6 0.958 in. x 0.050 in.; Z7 0.629 in. x 0.532 in.; Z8 0.050 in. x 0.532 in.; Z9 0.100 in. x 0.532 in.; Z10 0.050 in. x 0.532 in.; Z11 0.412 in. x 0.532 in.; Z12 0.050 in. x 0.532 in.; Z13 0.122 in. x 0.532 in.; Z15 0.050 in. x 0.532 in.; Z16 0.173 in. x 0.532 in.; Z17 1.916 in. x 0.050 in.; Z18 0.734 in. x 0.100 in.; Z19 0.050 in. x 0.100 in.; Z20 0.086 in. x 0.100 in.; Z21 0.208 in. x 0.066 in.; Z22 0.208 in. x 0.066 in.; Z23 0.278 in. x 0.066 in.; Z24 0.305 x 0.050

ATC® chip capacitor: C1, C6, C15, C16: 47 pF 100B470JW500X; C2: 2.7 pF 100B2R7JW500X; C3: 2.0 pF 100B2R0CW C4, C5, C11, C12: 12 pF 100B120JW500X; C7: 22 pF 100B220JW500X; C13, C21: 1 pF 100B1R0BW500X; C14: 4.7 pF 100B4R7CW; C17: 10 pF 100B100JW500X; C23: 8.2 pF 100A8R2CW.

Sprague® tantalum surface-mount chip capacitor: C10, C20 10 µF, 35 V; C22 22 µF, 35 V.

Murata® 0805 size chip capacitor: C8, C18: 0.01 µF GRM40X7R103K100AL.

Kemet® 1206 size chip capacitor: C9, C19: 0.1 µF C1206104K5RAC7800.

1206 size chip resistor: R1 51 RM73B2B510, R2 1 k RM73B2B130.

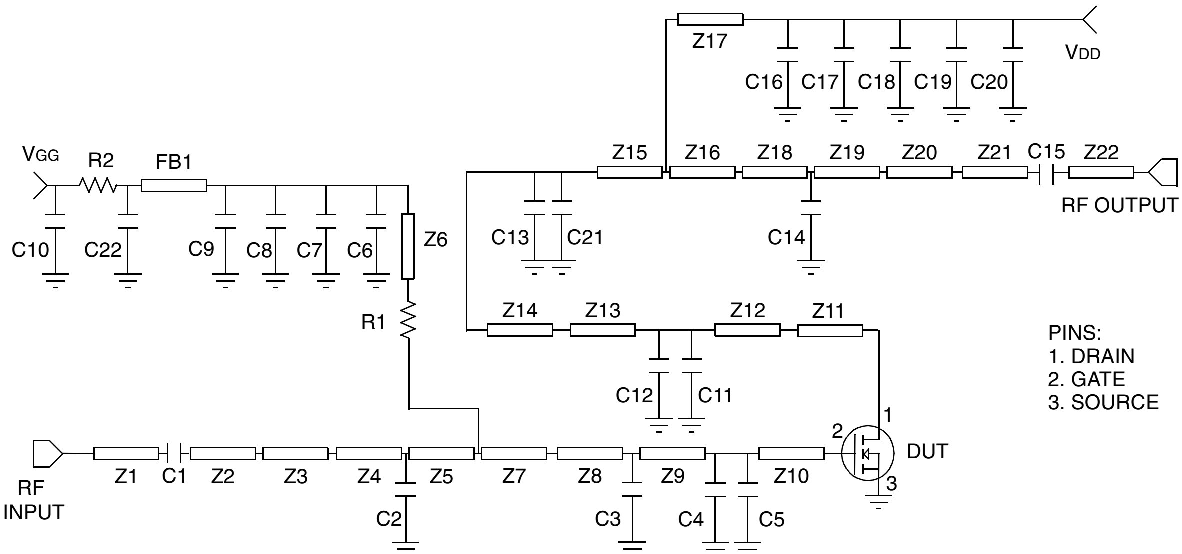
Kreger® ferrite bead: FB1 2743D19447.

Taconic® ORCER RF-35: board material, 1 oz. copper, 30 mil thickness, r = 3.5.

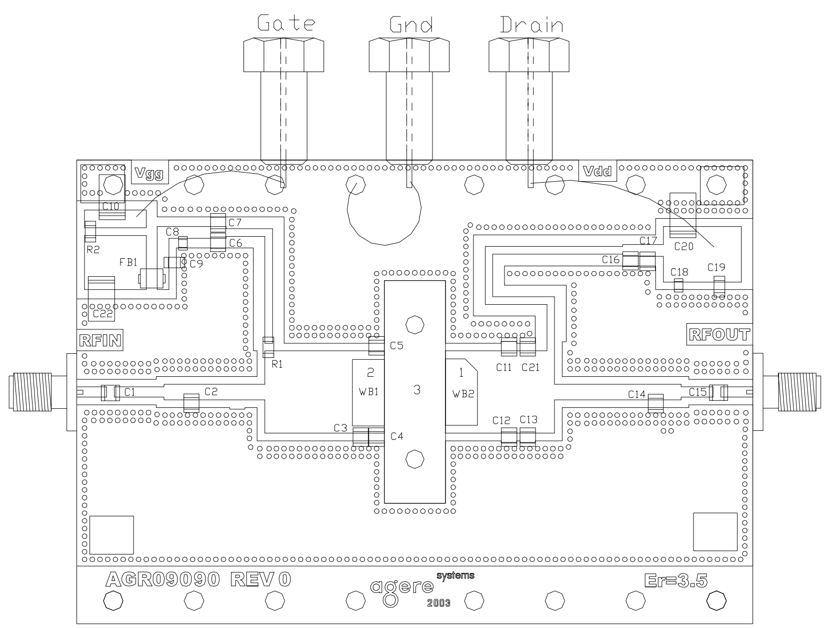
B. Component Layout, 921 MHz—960 MHz

Figure 2. AGR09090EF Test Circuit, 921 MHz—960 MHz

Test Circuit Illustrations for AGR09090EF, 865 MHz—895 MHz



A. Schematic, 865 MHz—895 MHz



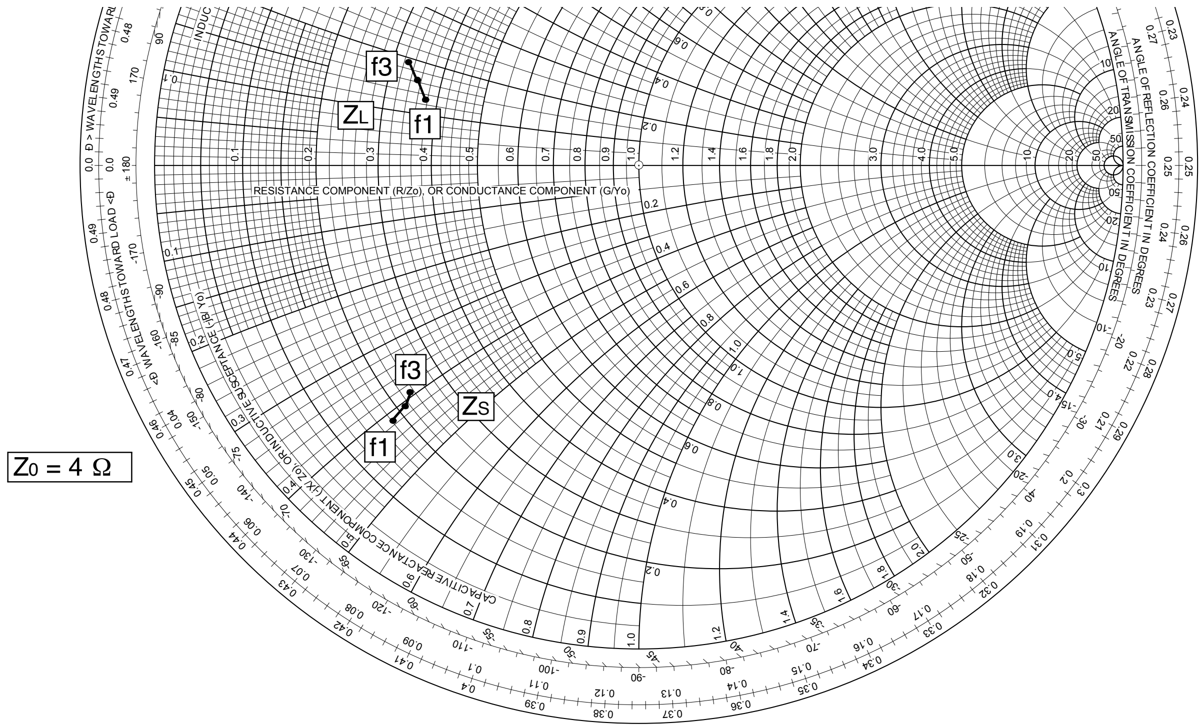
Parts List:

Microstrip line: Z1 0.193 in. x 0.066 in.; Z2 0.321 in. x 0.066 in.; Z3 0.179 in. x 0.100 in.; Z4 0.050 in. x 0.100 in.; Z5 0.425 in. x 0.100 in.; Z6 0.958 in. x 0.050 in.; Z7 0.629 in. x 0.532 in.; Z8 0.050 in. x 0.532 in.; Z9 0.100 in. x 0.532 in.; Z10 0.050 in. x 0.532 in.; Z11 0.412 in. x 0.532 in.; Z12 0.050 in. x 0.532 in.; Z13 0.122 in. x 0.532 in.; Z15 0.050 in. x 0.532 in.; Z16 0.173 in. x 0.532 in.; Z17 1.916 in. x 0.050 in.; Z18 0.656 in. x 0.100 in.; Z19 0.050 in. x 0.100 in.; Z20 0.114 in. x 0.100 in.; Z21 0.208 in. x 0.066 in.; Z22 0.208 in. x 0.066 in.
ATC® chip capacitor: C1, C6, C15, C16: 47 pF 100B470JW500X; C2, 2.7 pF 100B2R7JW500X; C3, C17, 10 pF 100B100JW500X; C4, C5, C11, C12: 12 pF 100B120JW500X; C7, 22 pF 100B220JW500X; C13, C21: 1 pF 100B1R0BW500X; C14, 4.7 pF 100B4R7JW500X.
Sprague® tantalum surface-mount chip capacitor: C10, C20 10 µF, 35 V; C22 22 µF, 35 V.
Kemet® 1206 size chip capacitor: C9, C19: 0.1 µF C1206104K5RAC7800.
Murata® 0805 size chip capacitor: C8, C18: 0.01 µF GRM40X7R103K100AL.
1206 size chip resistor: R1 51 RM73B2B510, R2 1 k RM73B2B130.
Kreger® ferrite bead: FB1 2743D19447.
Taconic® ORCER RF-35: board material, 1 oz. copper, 30 mil thickness, r = 3.5.

B. Component Layout, 865 MHz—895 MHz

Figure 3. AGR09090EF Test Circuit, 865 MHz—895 MHz

Typical Performance Characteristics



MHz (f)	ZS Ω (Complex Source Impedance)	ZL Ω (Complex Optimum Load Impedance)
921 (f1)	0.731 – j1.676	1.478 + j0.538
940.5	0.869 – j1.611	1.393 + j0.657
960 (f3)	0.912 – j1.569	1.300 + j0.761

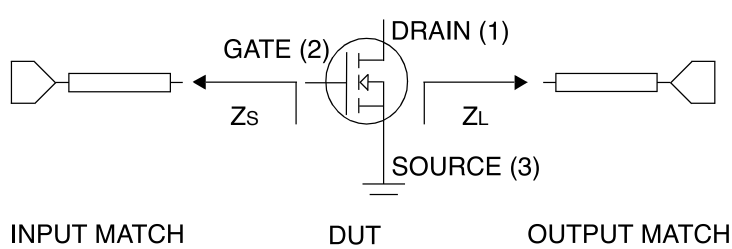
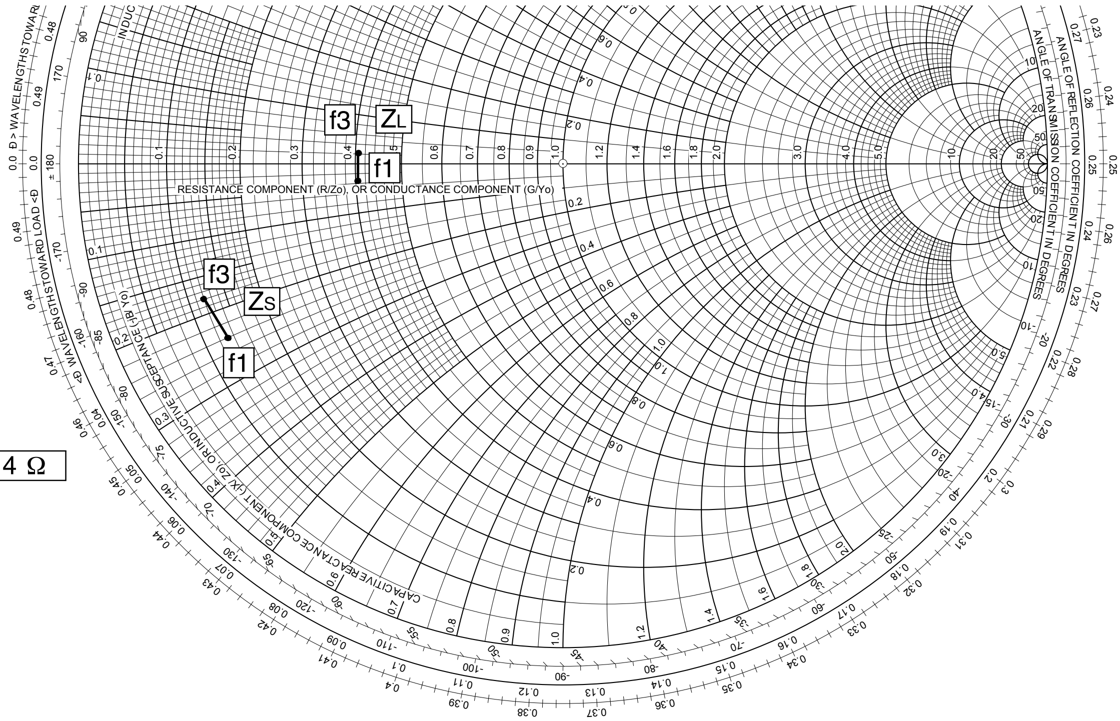


Figure 4. Series Equivalent Input and Output Impedances, 921 MHz—960 MHz

Typical Performance Characteristics (continued)



Z0 = 4 Ω

MHz (f)	ZS Ω (Complex Source Impedance)	ZL Ω (Complex Optimum Load Impedance)
865 (f1)	0.524 – j0.947	1.654 – j0.066
880	0.516 – j0.835	1.656 – j0.006
895 (f3)	0.477 – j0.738	1.639 + j0.043

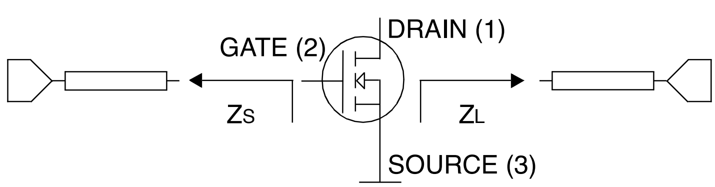
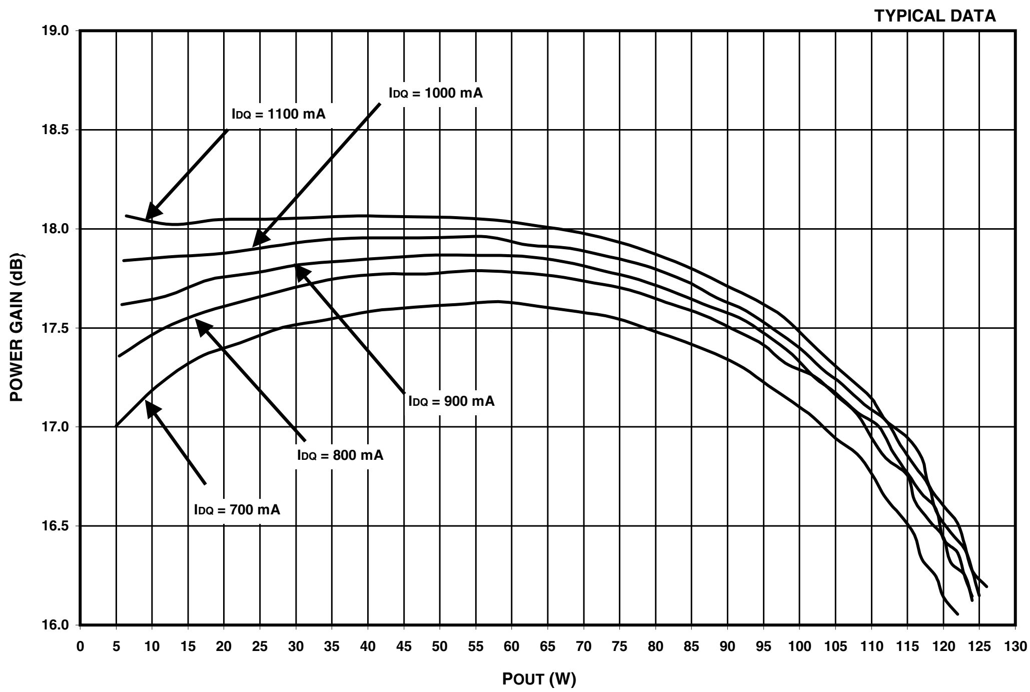


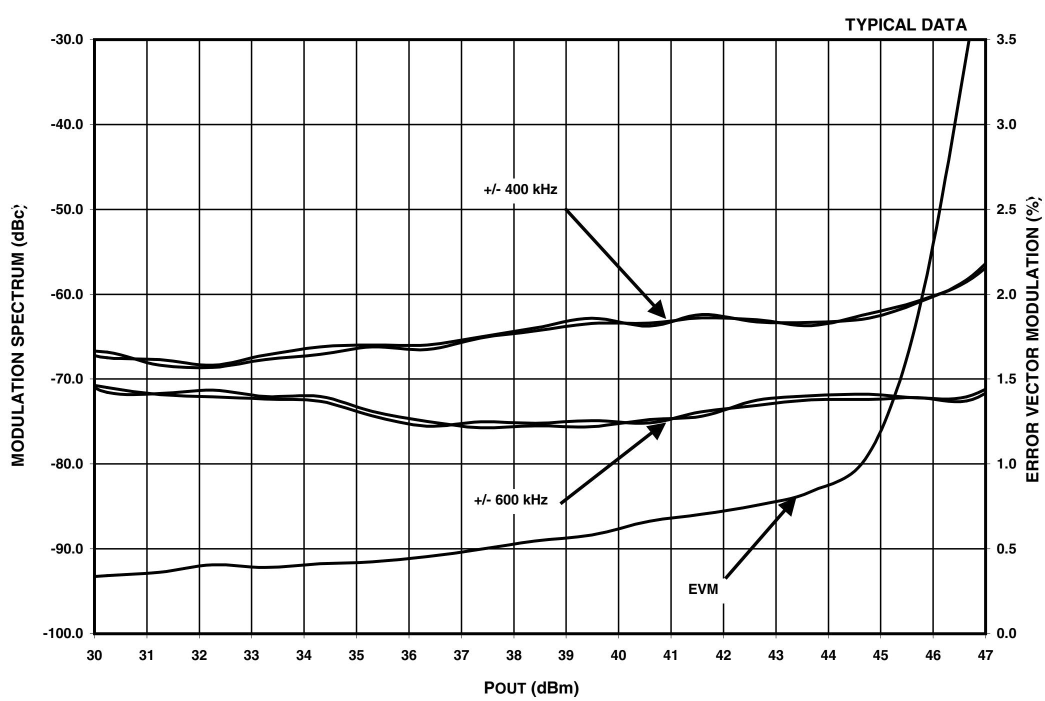
Figure 5. Series Equivalent Input and Output Impedances, 865 MHz—895 MHz

Typical Performance Characteristics (continued)



Test Conditions:
V_{DD} = 26 V, FREQUENCY = 940.5 MHz.

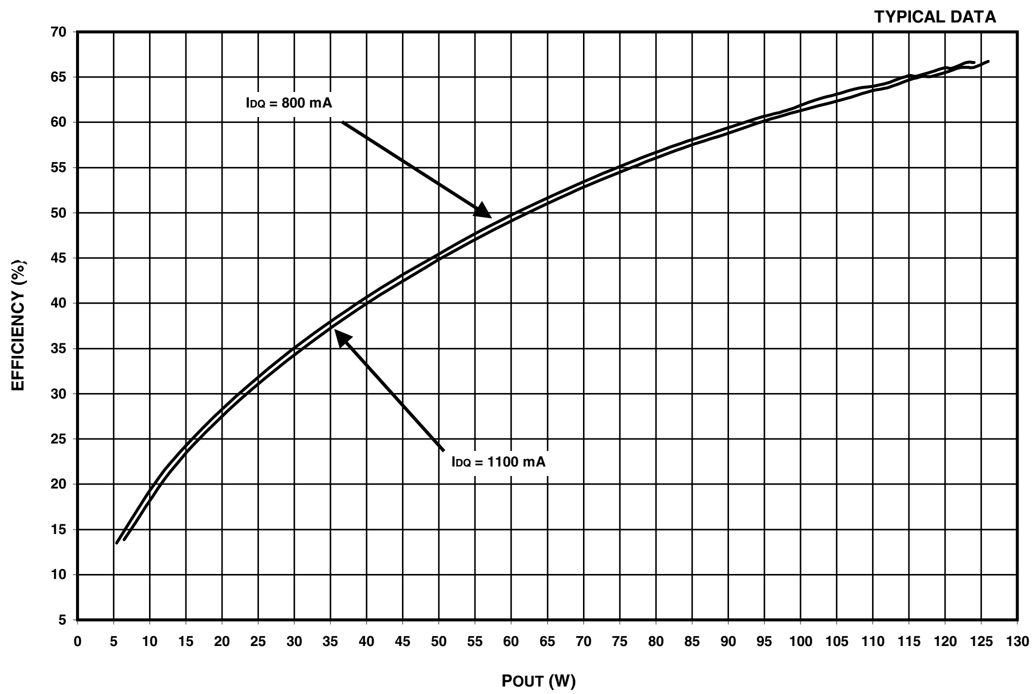
Figure 6. Power Gain vs. P_{OUT}, 921 MHz—960 MHz



Test Conditions:
V_{DD} = 26 V, FREQUENCY = 940.5 MHz, I_{DQ} = 700 mA.
RES BW: 30 kHz, VIDEO BW: 300 Hz, EDGE FORMAT = 3GPP GSM 05.05.

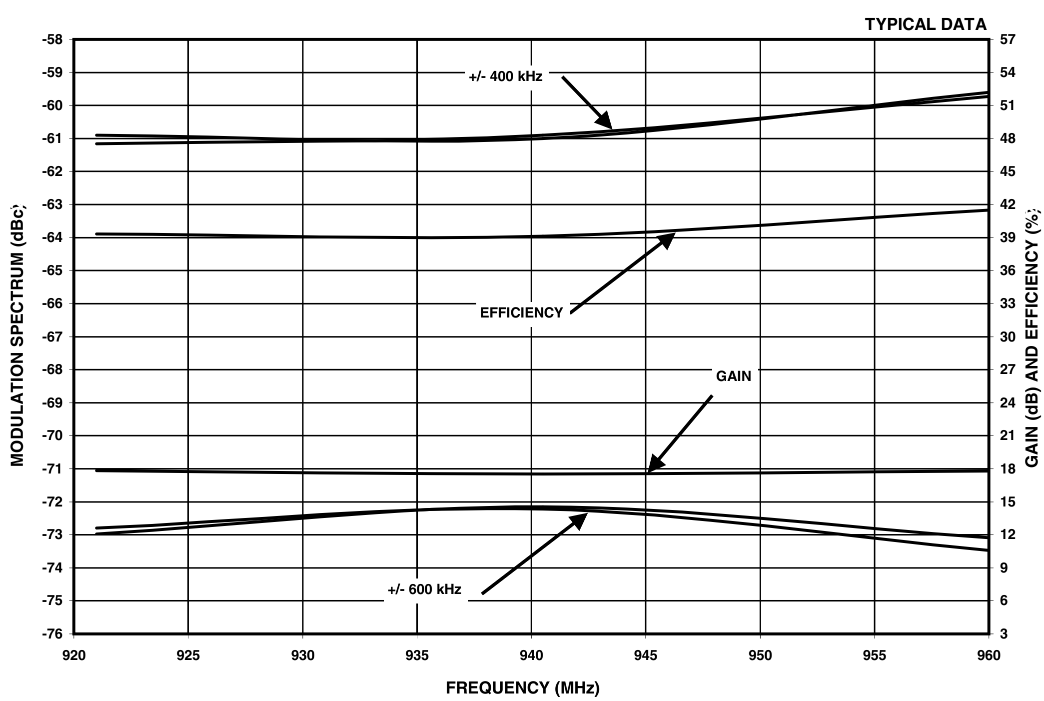
Figure 7. Modulation Spectrum and EVM vs. P_{OUT}, 921 MHz—960 MHz

Typical Performance Characteristics (continued)



Test Conditions:
V_{DD} = 26 V, FREQUENCY = 940.5 MHz.

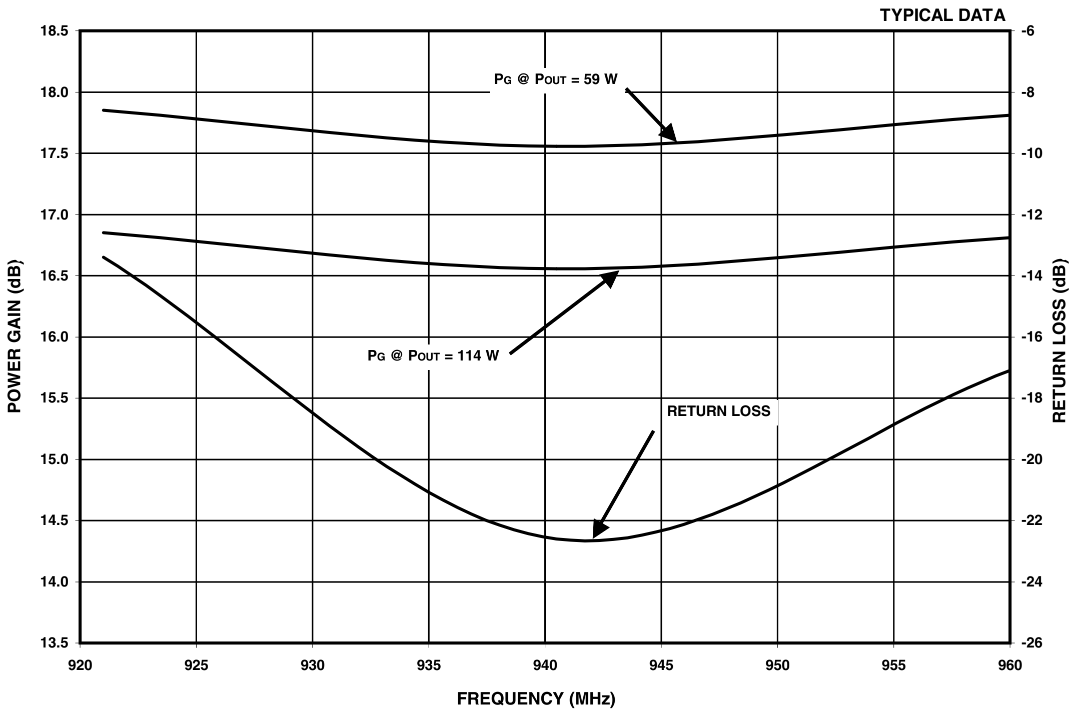
Figure 8. Efficiency vs. P_{OUT}, 921 MHz—960 MHz



Test Conditions:
V_{DD} = 26 V, EDGE FORMAT, I_{DQ} = 700 mA, P_{OUT} = 40 W.

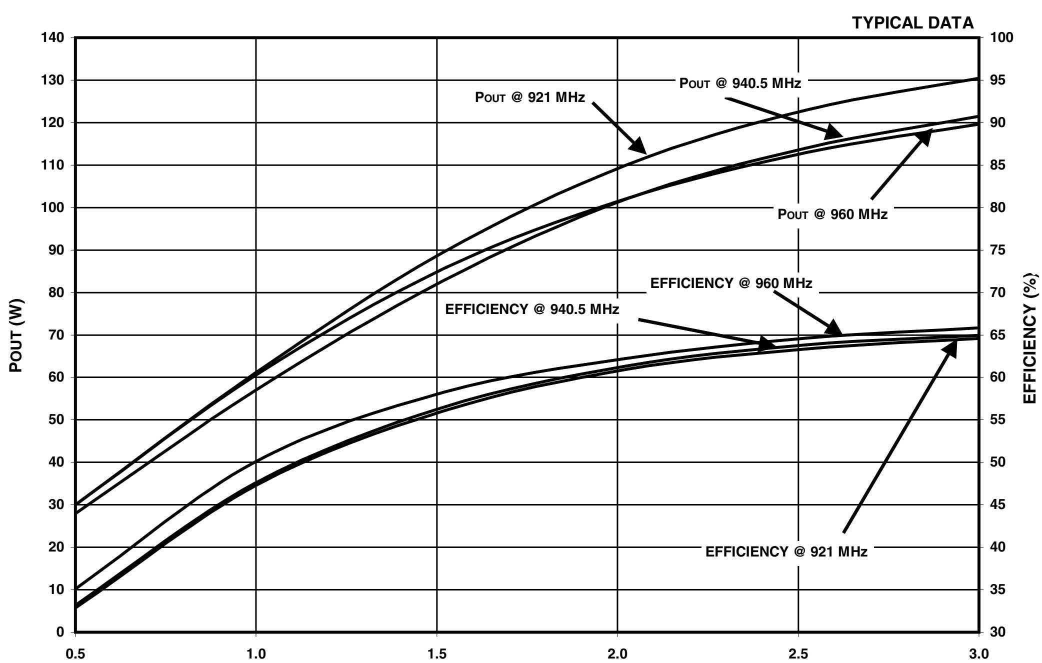
Figure 9. Modulation Spectrum, Gain, and Efficiency vs. Frequency, 921 MHz—960 MHz

Typical Performance Characteristics (continued)



Test Conditions:
VDD = 26 V.

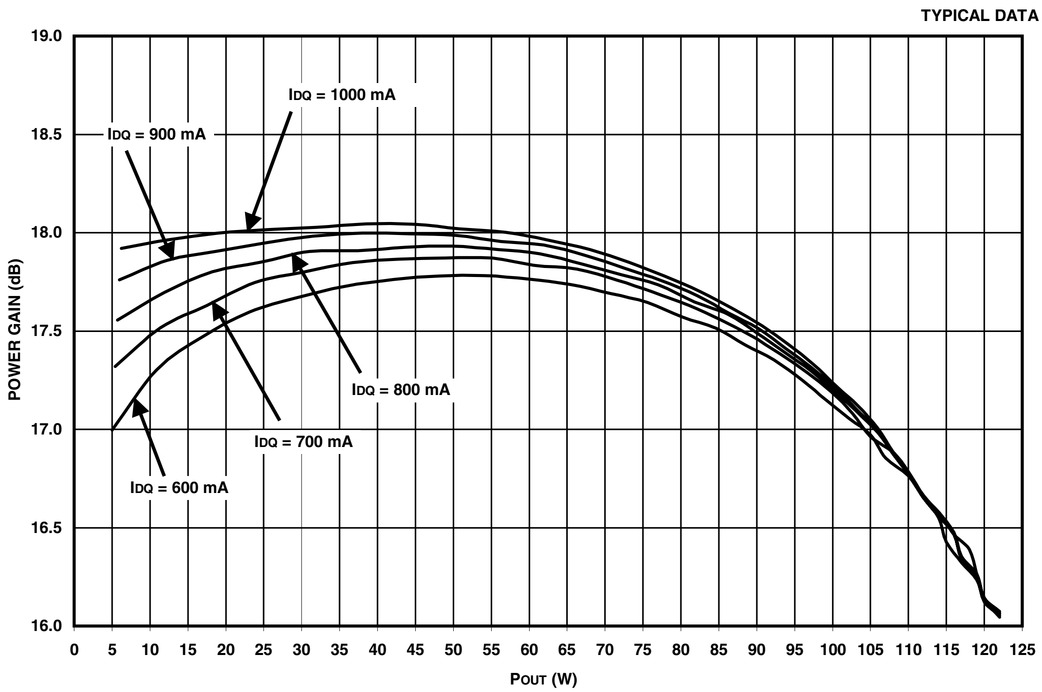
Figure 10. Power Gain and Return Loss vs. Frequency, 921 MHz—960 MHz



Test Conditions:
VDD = 26 V.

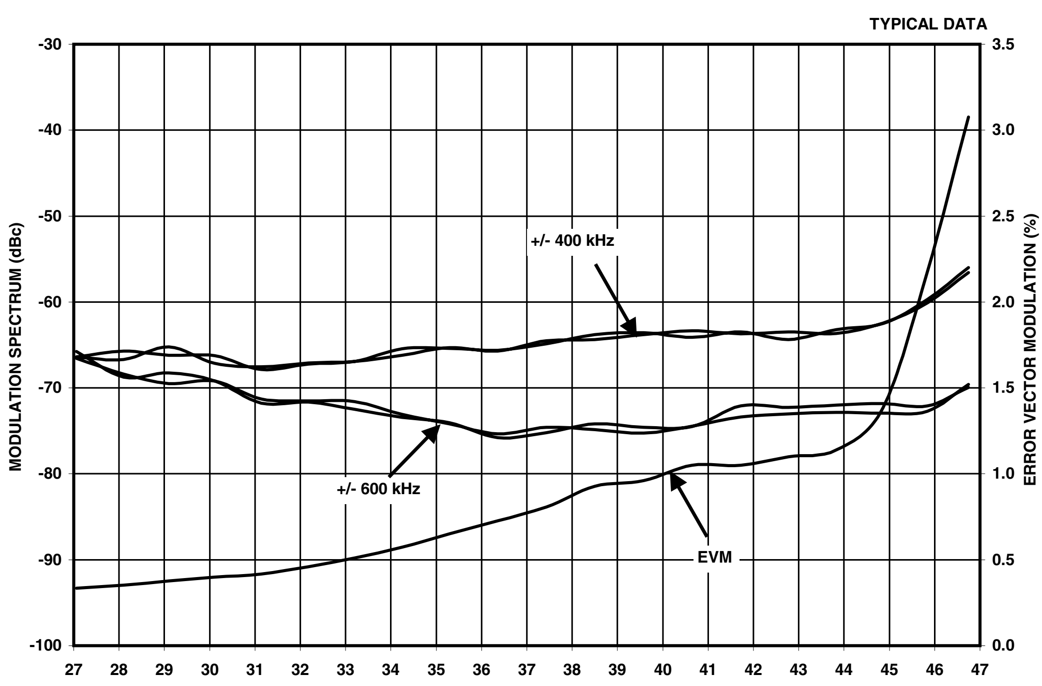
Figure 11. Power Out and Efficiency vs. Input Power, 921 MHz—960 MHz

Typical Performance Characteristics (continued)



Test Conditions:
V_{DD} = 26 V, FREQUENCY = 880 MHz.

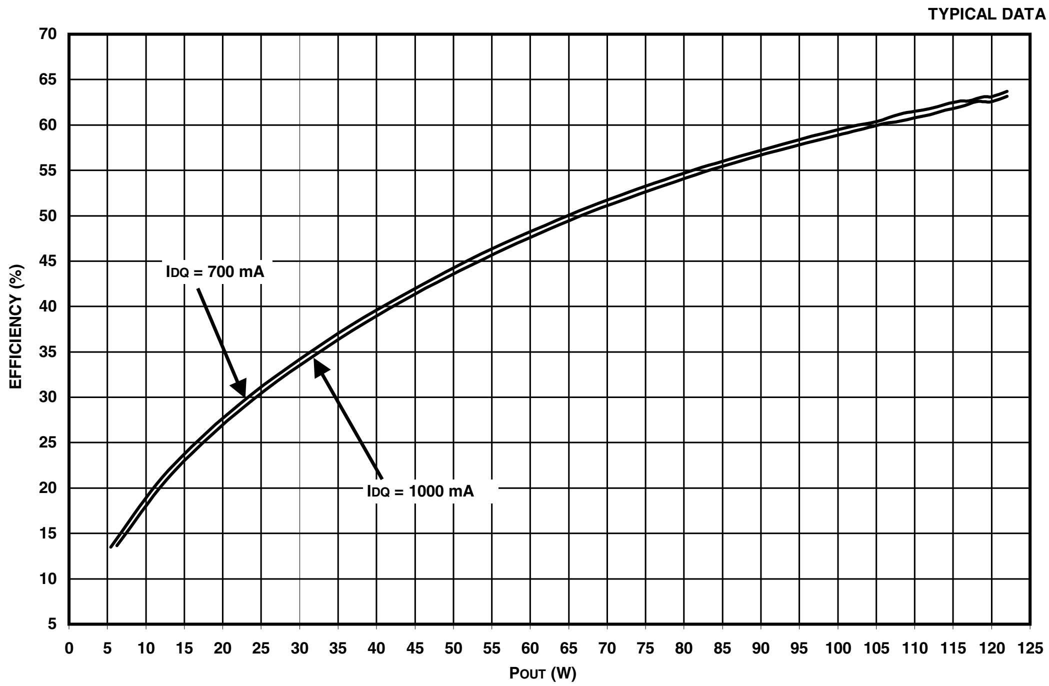
Figure 12. Power Gain vs. P_{OUT}, 865 MHz—895 MHz



Test Conditions:
V_{DD} = 26 V, FREQUENCY = 880 MHz, I_{DQ} = 700 mA.
RES BW: 30 kHz, VIDEO BW: 300 Hz, EDGE FORMAT = 3GPP GSM 05.05.

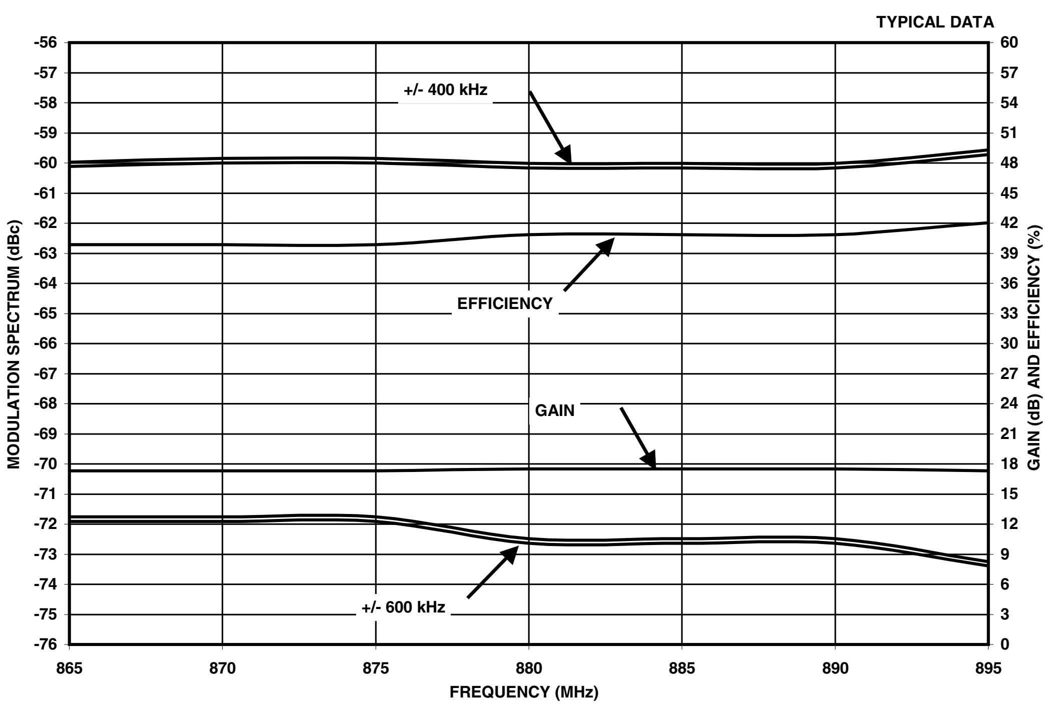
Figure 13. Modulation Spectrum and EVM vs. P_{OUT}, 865 MHz—895 MHz

Typical Performance Characteristics (continued)



Test Conditions:
V_{DD} = 26 V, FREQUENCY = 880 MHz.

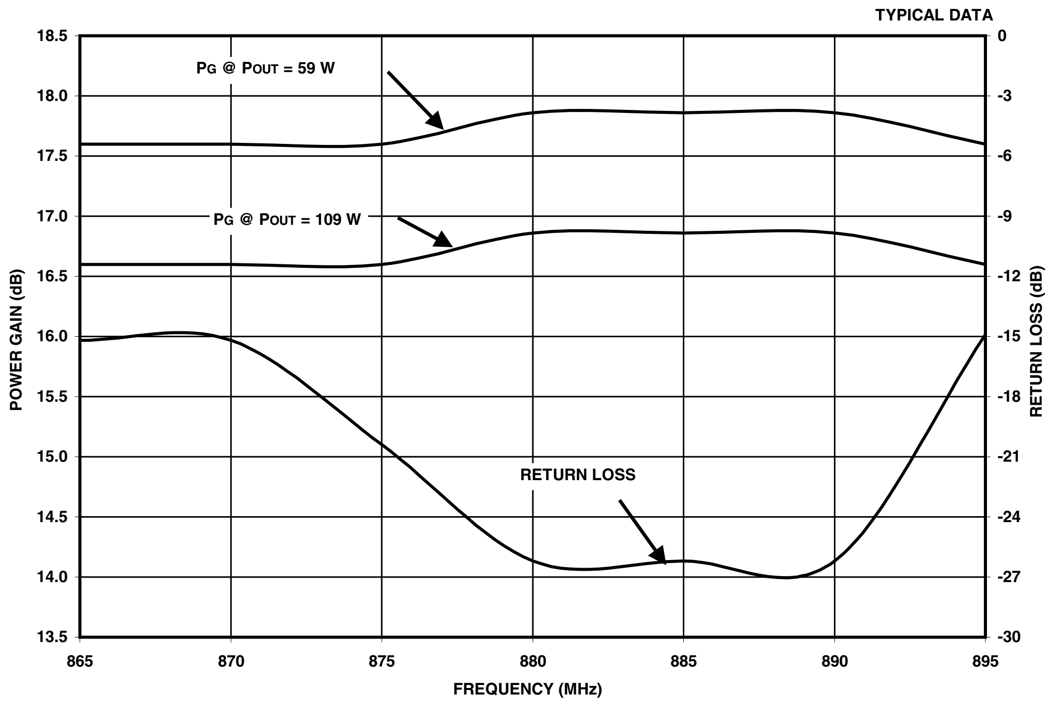
Figure 14. Efficiency vs. P_{OUT}, 865 MHz—895 MHz



Test Conditions:
V_{DD} = 26 V, EDGE FORMAT, I_{DQ} = 700 mA, P_{OUT} = 40 W.

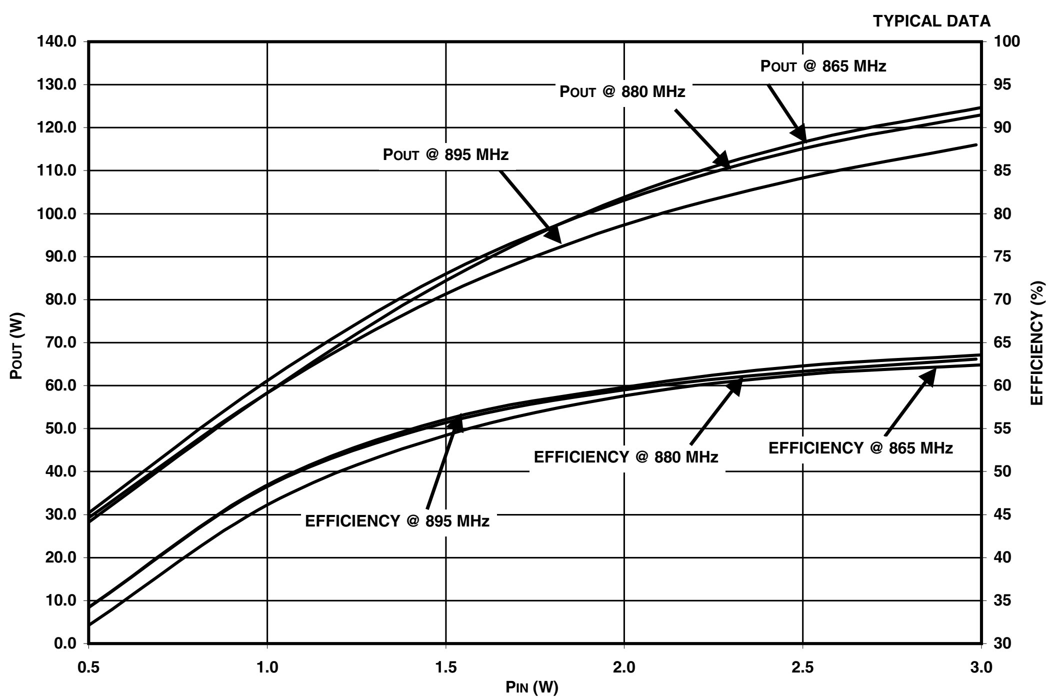
Figure 15. Modulation Spectrum, Gain, and Efficiency vs. Frequency, 865 MHz—895 MHz

Typical Performance Characteristics (continued)



Test Conditions:
V_{DD} = 26 V.

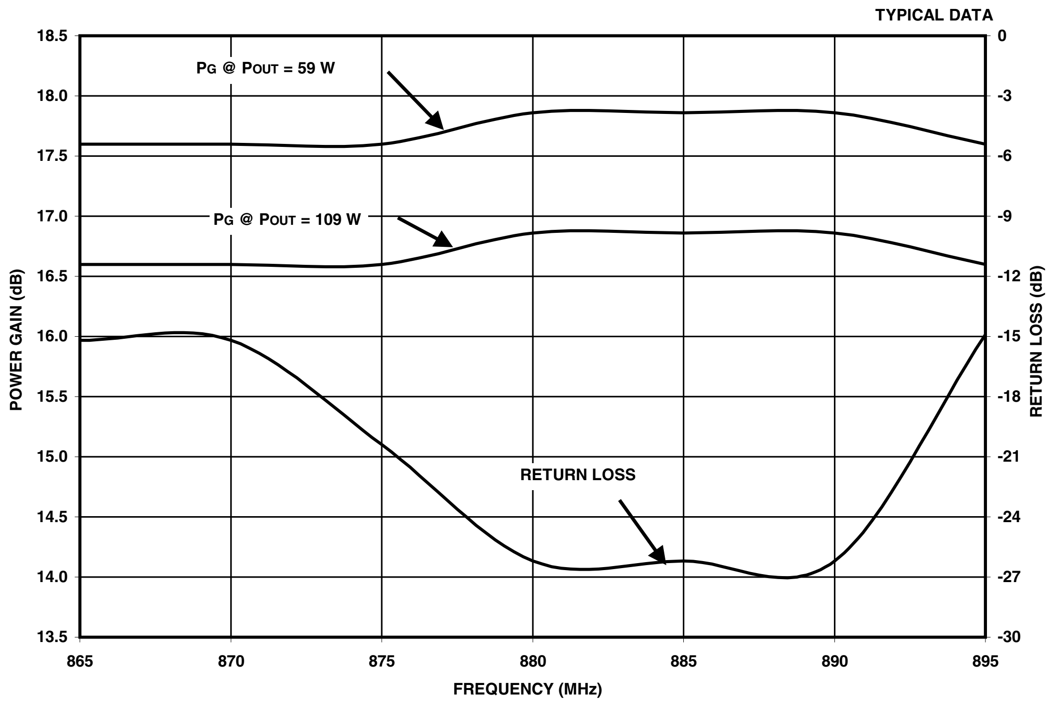
Figure 16. Power Gain and Return Loss vs. Frequency, 865 MHz—895 MHz



Test Conditions:
V_{DD} = 26 V.

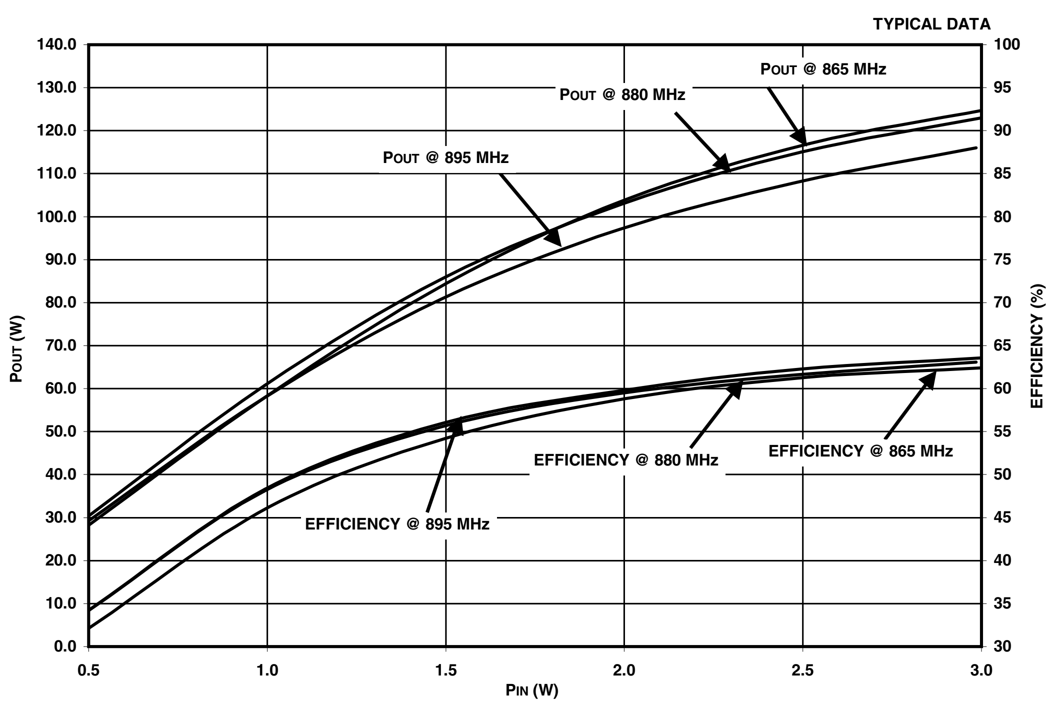
Figure 17. Power Out and Efficiency vs. Input Power, 865 MHz—895 MHz

Typical Performance Characteristics (continued)



Test Conditions:
V_{DD} = 26 V.

Figure 16. Power Gain and Return Loss vs. Frequency, 865 MHz—895 MHz



Test Conditions:
V_{DD} = 26 V.

Figure 17. Power Out and Efficiency vs. Input Power, 865 MHz—895 MHz