CGH40006S

6 W, RF Power GaN HEMT, Plastic

Cree's CGH40006S is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGH40006S, operating from a 28 volt rail, offers a general purpose, broadband solution to a variety of RF and microwave applications. GaN HEMTs offer high efficiency, high gain and wide bandwidth capabilities making the CGH40006S ideal for linear and compressed amplifier circuits. The transistor is available in 3mm x 3mm, surface mount, quad-flat-no-lead (QFN) packages.

Package Types: 440203
PN's: CGH40006S

FEATURES

- Up to 6 GHz Operation
- 13 dB Small Signal Gain at 2.0 GHz
- 11 dB Small Signal Gain at 6.0 GHz
- 8 W typical at P_{IN} = 32 dBm
- 65 % Efficiency at P_{IN} = 32 dBm
- 28 V Operation
- 3mm x 3mm Package

APPLICATIONS

- 2-Way Private Radio
- Broadband Amplifiers
- Cellular Infrastructure
- Test Instrumentation
- Class A, AB, Linear amplifiers suitable for OFDM, W-CDMA, EDGE, CDMA waveforms

PRELIMINARY
Rev 1.0 – May 2010

Large Signal Models Available for SiC & GaN

Absolute Maximum Ratings (not simultaneous) at 25˚C Case Temperature

Parameter	Symbol	Rating	Units
Drain-Source Voltage	V_{DSS}	84	Volts
Gate-to-Source Voltage	V_{GS}	-10, +2	Volts
Storage Temperature	T_{STG}	-65, +150	˚C
Operating Junction Temperature	T_J	225	˚C
Maximum Forward Gate Current	I_{GMAX}	2.1	mA
Soldering Temperature[1]	T_S	TBD	˚C
Thermal Resistance, Junction to Case[2]	$R_{\theta JC}$	10.1	˚C/W
Case Operating Temperature[2]	T_C	-40, +150	˚C

Note:
[1] Refer to the Application Note on soldering at www.cree.com/products/wireless_appnotes.asp
[2] Measured for the CGH40006S at P_{DISS} = 8 W.

Electrical Characteristics (T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.3	-2.3	V_{DC}	V_{DS} = 10 V, I_D = 2.1 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-3.0	–	V_{DC}	V_{DS} = 28 V, I_D = 100 mA
Saturated Drain Current	I_{DS}	1.7	2.1	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BR}	120	–	–	V_{DC}	V_{GS} = -8 V, I_D = 2.1 mA
RF Characteristics[2] (T_C = 25˚C, F_0 = 2.0 GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	–	12	–	dB	V_{DD} = 28 V, I_{DQ} = 100 mA
Power Output at P_{IN} = 32 dBm	P_{OUT}	–	8	–	W	V_{DD} = 28 V, I_{DQ} = 100 mA
Drain Efficiency[3]	η	–	65	–	%	V_{DD} = 28 V, I_{DQ} = 100 mA, P_{IN} = 32 dBm
Output Mismatch Stress	VSWR	–	–	TBD	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 100 mA, P_{IN} = 32 dBm
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	2.7	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	0.8	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.1	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz

Notes:
[1] Measured on wafer prior to packaging.
[2] Measured in CGH40006S-TB.
[3] Drain Efficiency = P_{OUT} / P_{DC}

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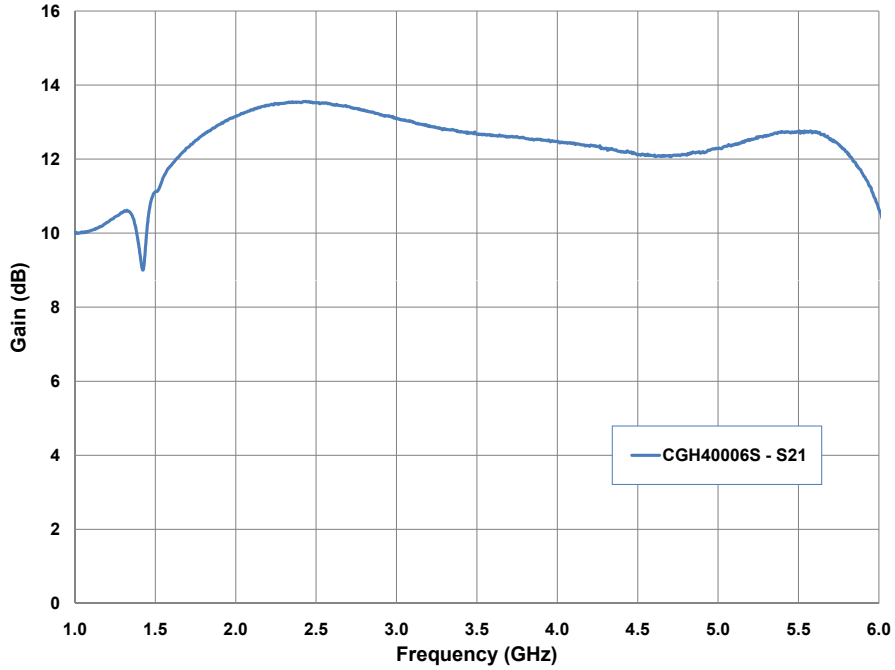
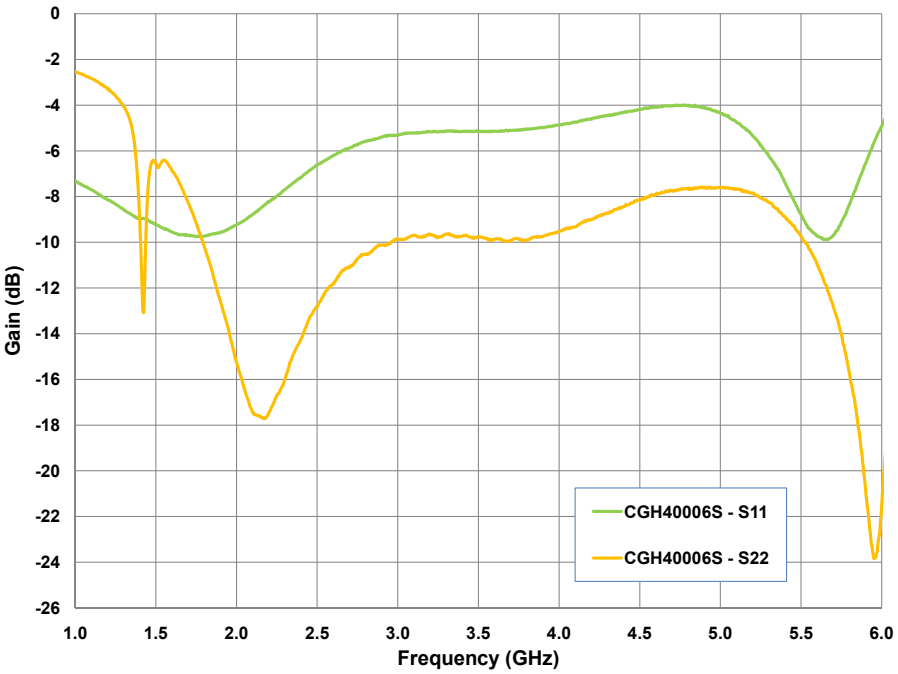
Typical Performance

Small Signal Gain vs Frequency at 28 V of the CGH40006S in the CGH40006S-TB



Input & Output Return Losses vs Frequency at 28 V of the CGH40006S in the CGH40006S-TB



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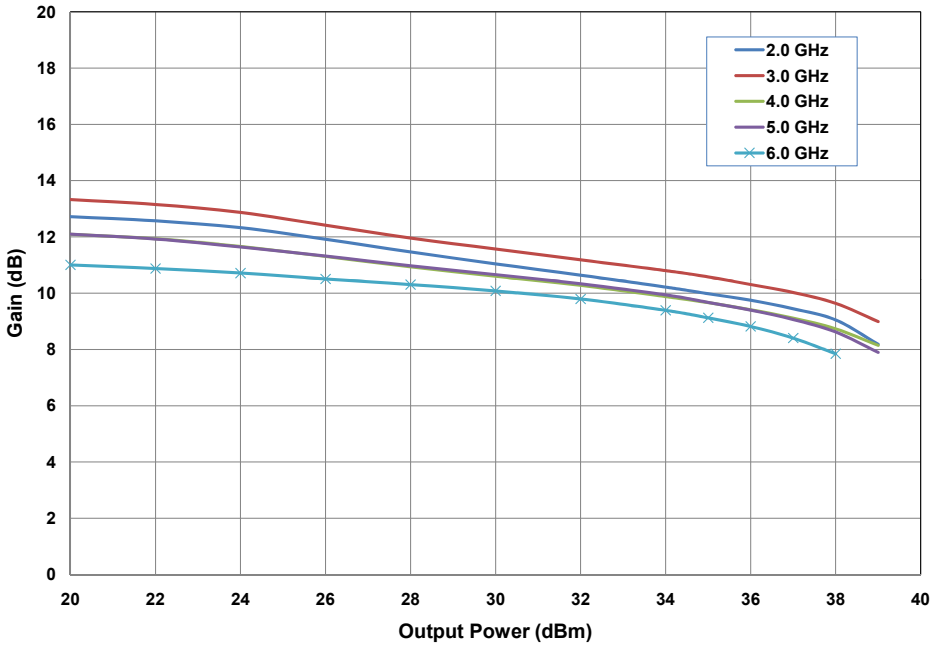
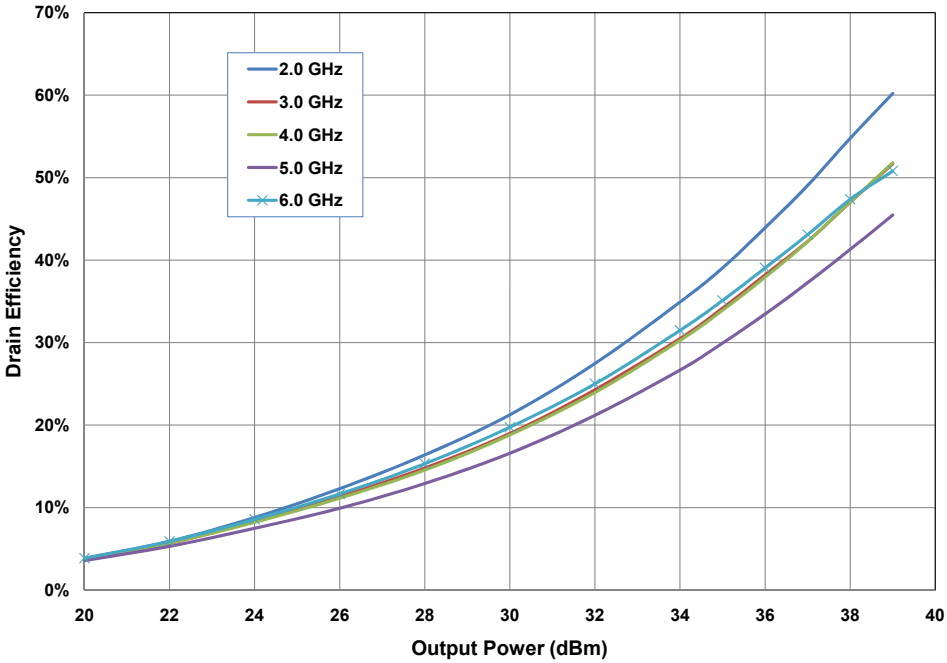
Typical Performance

Power Gain vs Output Power as a Function of Frequency of the CGH40006S in the CGH40006S-TB
V_{DD} = 28 V, I_{DQ} = 100 mA



Drain Efficiency vs Output Power as a Function of Frequency of the CGH40006S in the CGH40006S-TB
V_{DD} = 28 V, I_{DQ} = 100 mA



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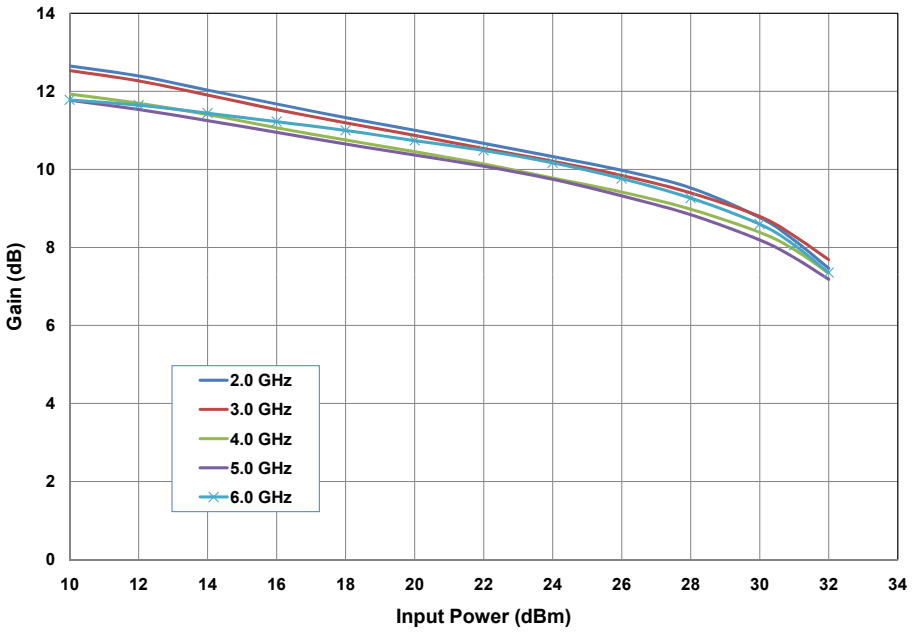
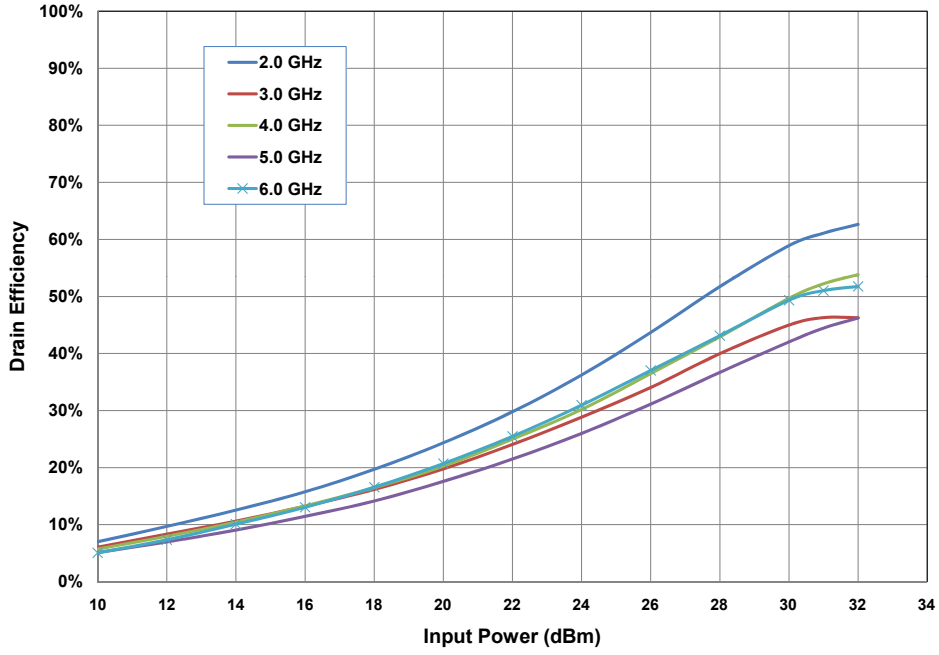
Typical Performance

Power Gain vs Input Power as a Function of Frequency of the CGH40006S in the CGH40006S-TB
V_{DD} = 28 V, I_{DQ} = 100 mA



Drain Efficiency vs Input Power as a Function of Frequency of the CGH40006S in the CGH40006S-TB
V_{DD} = 28 V, I_{DQ} = 100 mA



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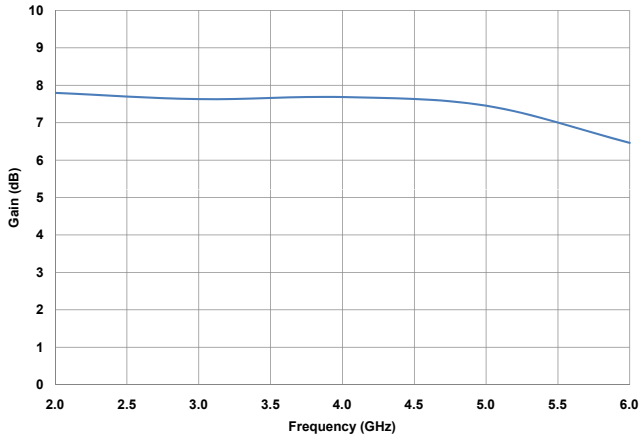
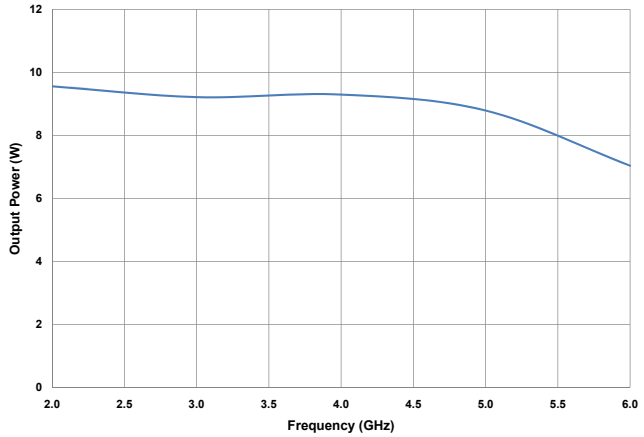
Typical Performance

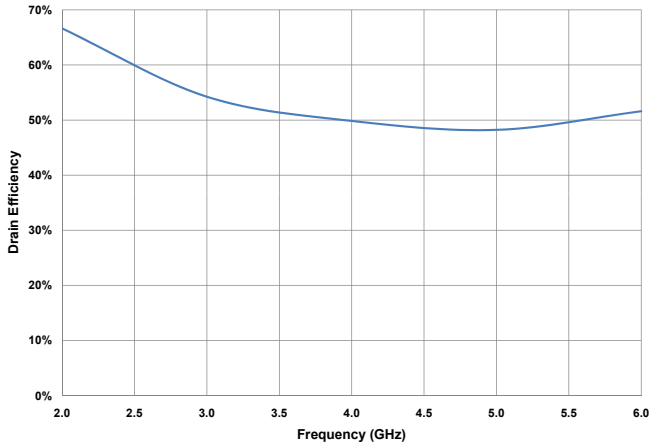
Power Gain vs Frequency of the CGH40006S in the CGH40006S-TB at P_{IN} = 32 dBm, V_{DD} = 28 V



Output Power vs Frequency of the CGH40006S in the CGH40006S-TB at P_{IN} = 32 dBm, V_{DD} = 28 V



Drain Efficiency vs Frequency of the CGH40006S in the CGH40006S-TB at P_{IN} = 32 dBm, V_{DD} = 28 V



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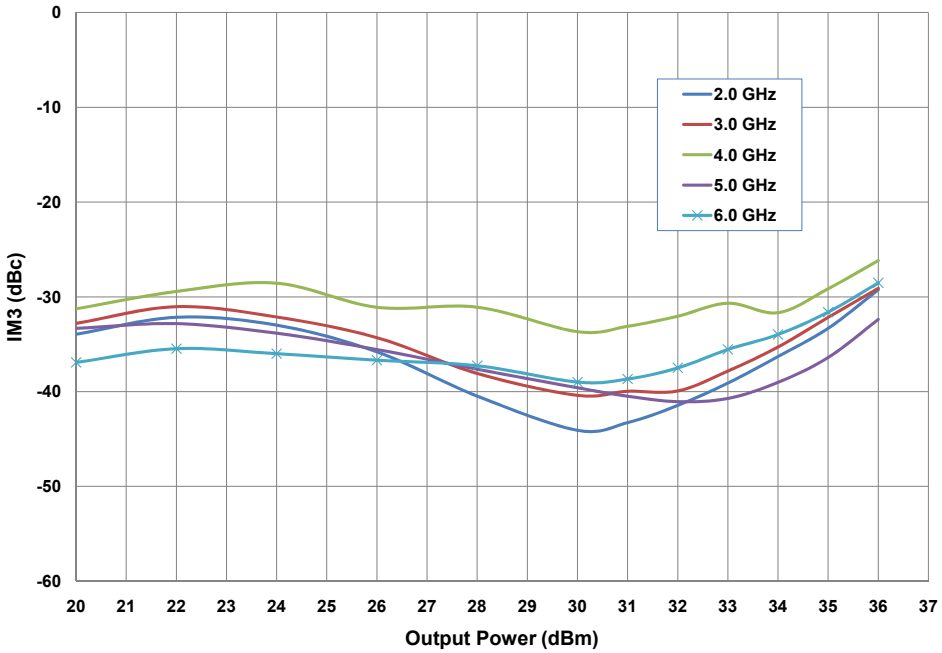
Typical Performance

Third Order Intermodulation Distortion vs Total Output Power as a Function of Frequency of the CGH40006S in the CGH40006S-TB
V_{DD} = 28 V, I_{DQ} = 60 mA



Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A > 250 V	JEDEC JESD22 A114-D
Charge Device Model	CDM	1 < 200 V	JEDEC JESD22 C101-C

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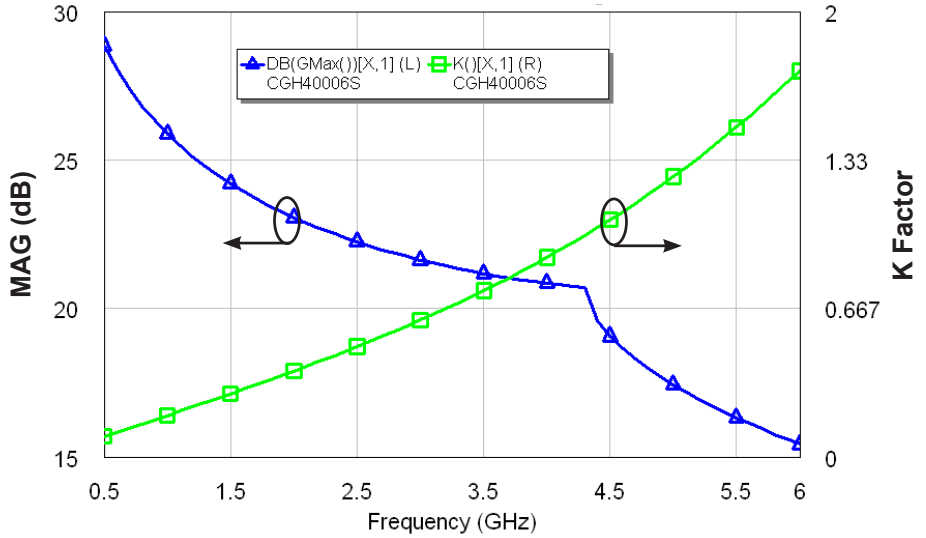
Typical Performance

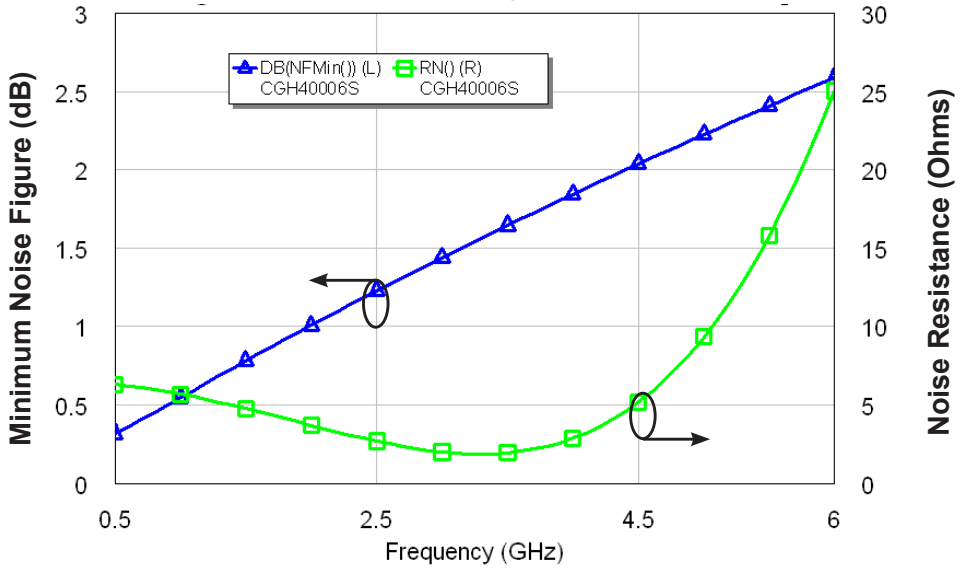
Simulated Maximum Available Gain and K Factor of the CGH40006S
V_{DD} = 28 V, I_{DQ} = 100 mA



Note 1. On a 20 mil thick PCB.

Typical Noise Performance

Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH40006S
V_{DD} = 28 V, I_{DQ} = 100 mA



Note 1. On a 20 mil thick PCB.

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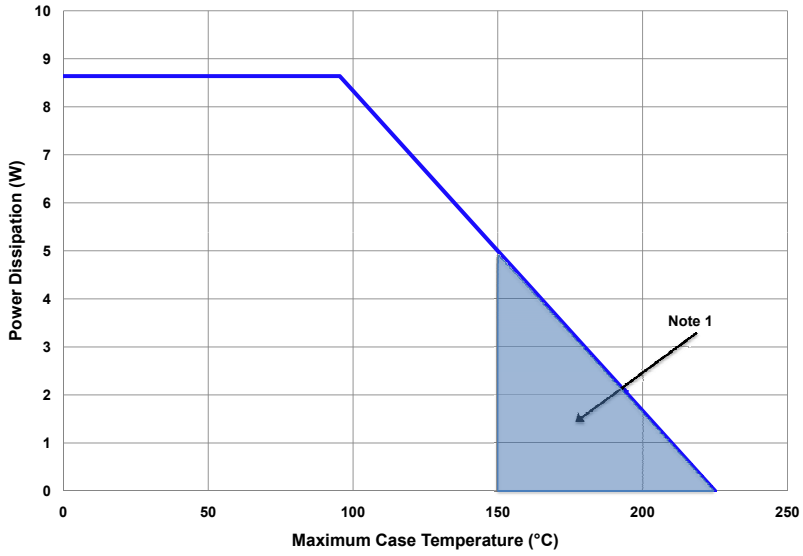
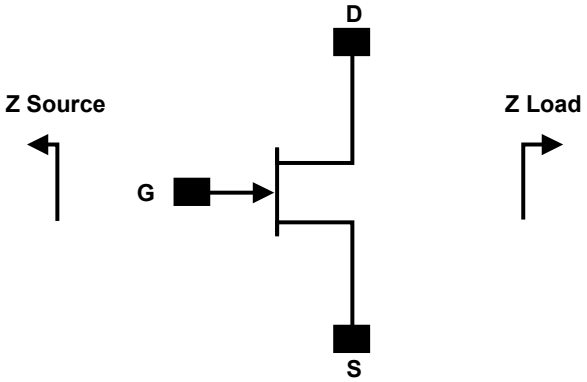
CGH40006S CW Power Dissipation De-rating Curve



Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).

Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
1000	12.7 + j20.2	62.3 + j42
2000	5.98 + j6.81	32.7 + j32.9
3000	3.32 - j2.89	19.2 + j29.8
4000	2.38 - j9.45	15.2 + j15.7
5000	2.62 - j15.6	9.98 + j9.6
6000	1.94 - j21.35	8.51 + j2.07

Note 1. V_{DD} = 28V, I_{DQ} = 100mA in the 440203 package.
Note 2. Optimized for power gain, P_{SAT} and PAE.
Note 3. When using this device at low frequency, series resistors should be used to maintain amplifier stability.
Note 4. 35 pH source inductance is assumed between the package and RF ground (20 mil thick PCB).

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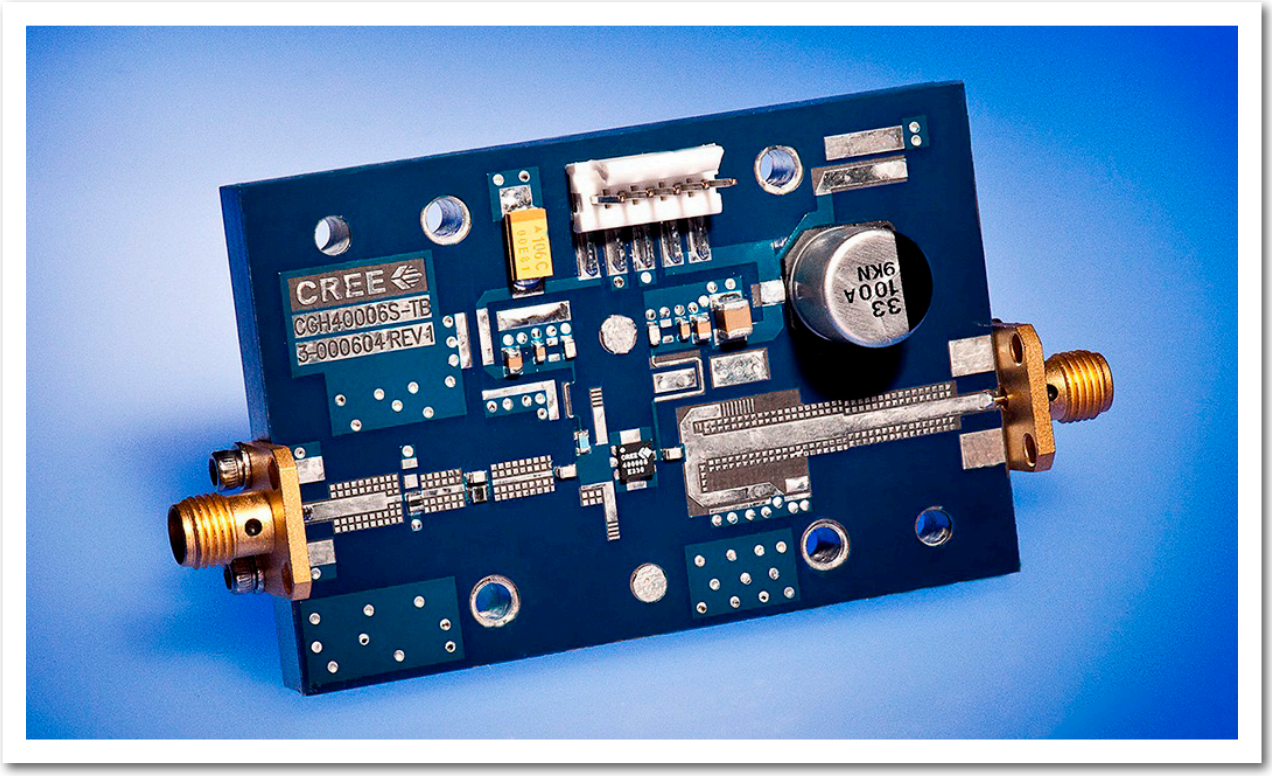
CGH40006S-TB Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, AIN, 0505, 470 Ohms (≤5% tolerance)	1
R2	RES, AIN, 0505, 50 Ohms (≤5% tolerance)	1
R3	RES, 0603, 348 Ohms (≤5% tolerance)	1
C1	CAP, 1.3 pF +/-0.1 pF, 0603, ATC 600S	1
C2	CAP, 2.7 pF +/-0.25 pF, 0603, ATC 600S	1
C10	CAP, 3.6 pF +/-0.1 pF, 0603, ATC 600S	1
C4,C11	CAP, 8.2 pF +/-0.25, 0603, ATC 600S	2
C6,C13	CAP, 470 pF +/-5%, 0603, 100 V	2
C7,C14	CAP, 33000 pF, CER, 100V, X7R, 0805	2
C8	CAP, 10 uf, 16V, SMT, TANTALUM	1
C15	CAP, 1.0 uF +/-10%, CER, 100V, X7R, 1210	1
C16	CAP, 33 uF, 100V, ELECT, FK, SMD	1
J3,J4	CONN, SMA, STR, PANEL, JACK, RECP	2
J1	HEADER RT>PLZ .1CEN LK 5POS	1
-	PCB, RO5880, 0.020" THK	1
Q1	CGH40006S	1

CGH40006S-TB Demonstration Amplifier Circuit



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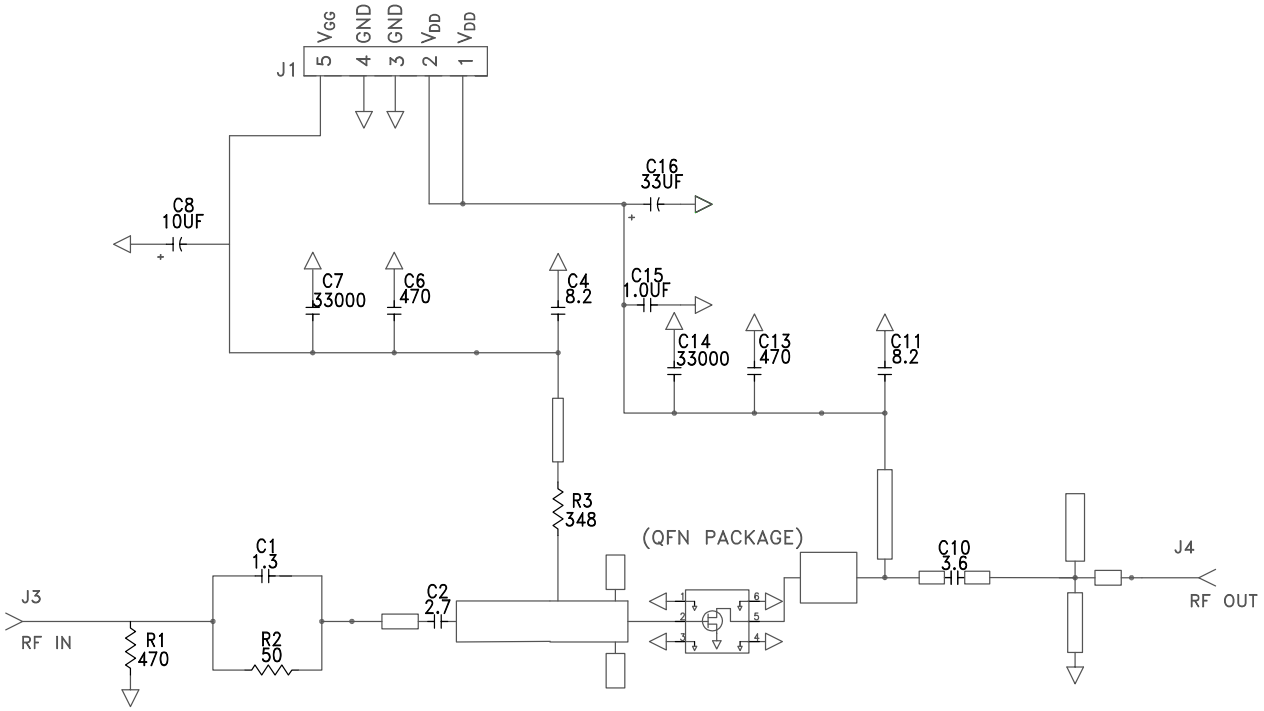
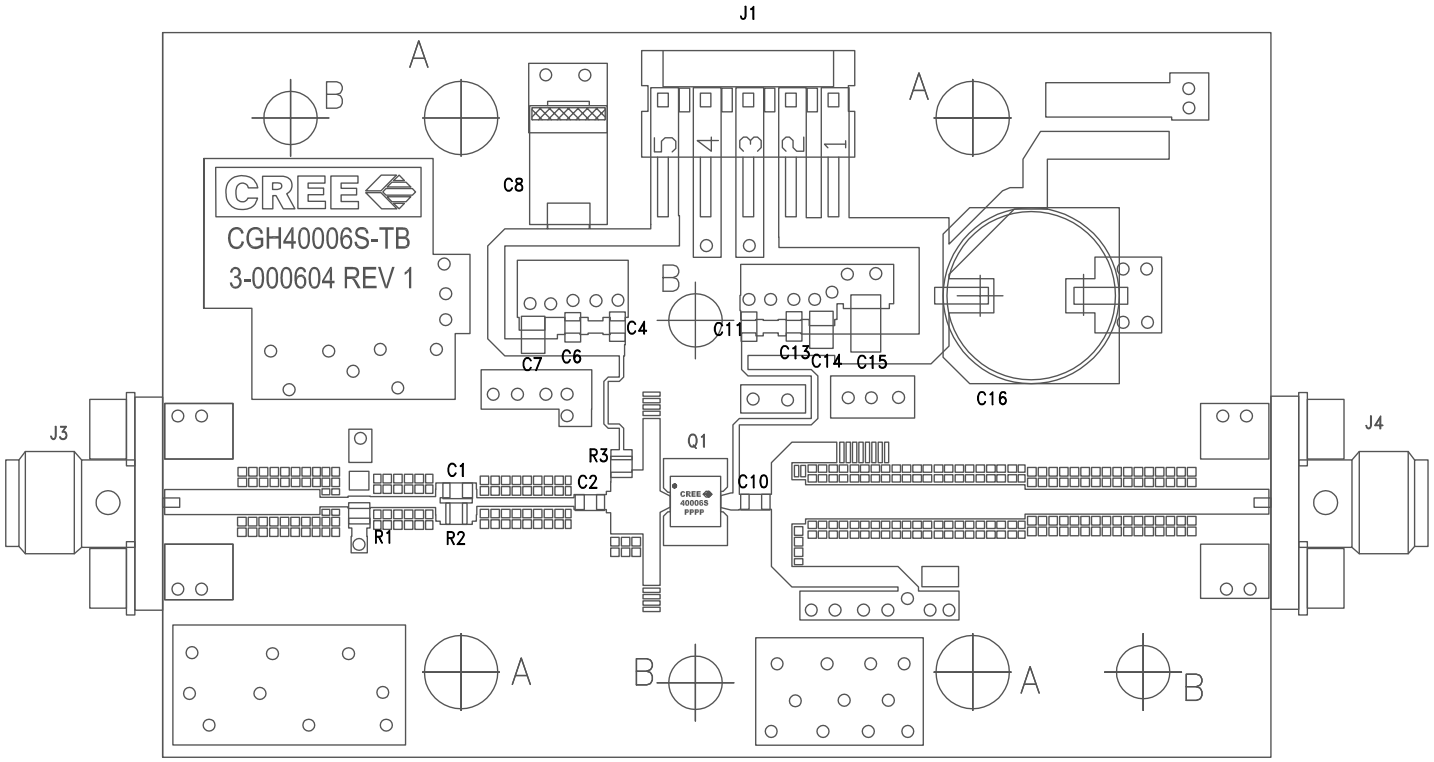
CGH40006S-TB Demonstration Amplifier Circuit Schematic



CGH40006S-TB Demonstration Amplifier Circuit Outline



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Typical Package S-Parameters for CGH40006S
(Small Signal, V_{DS} = 28 V, I_{DQ} = 100 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.933	-92.95	18.74	125.47	0.024	38.02	0.459	-48.87
600 MHz	0.922	-104.26	16.89	118.64	0.026	31.70	0.428	-54.78
700 MHz	0.912	-113.77	15.28	112.75	0.028	26.33	0.402	-59.82
800 MHz	0.905	-121.83	13.90	107.61	0.029	21.71	0.381	-64.21
900 MHz	0.899	-128.73	12.70	103.06	0.030	17.68	0.365	-68.10
1.0 GHz	0.894	-134.72	11.67	98.96	0.030	14.11	0.352	-71.62
1.1 GHz	0.891	-139.97	10.77	95.23	0.030	10.91	0.342	-74.86
1.2 GHz	0.888	-144.62	9.99	91.80	0.031	8.00	0.334	-77.87
1.3 GHz	0.886	-148.78	9.31	88.61	0.031	5.34	0.328	-80.72
1.4 GHz	0.884	-152.55	8.71	85.61	0.031	2.88	0.325	-83.43
1.5 GHz	0.883	-155.97	8.17	82.77	0.031	0.58	0.322	-86.03
1.6 GHz	0.881	-159.12	7.69	80.07	0.031	-1.57	0.321	-88.54
1.7 GHz	0.881	-162.04	7.26	77.49	0.031	-3.60	0.321	-90.98
1.8 GHz	0.880	-164.75	6.88	75.00	0.031	-5.53	0.321	-93.35
1.9 GHz	0.879	-167.29	6.53	72.60	0.031	-7.38	0.323	-95.67
2.0 GHz	0.879	-169.68	6.21	70.26	0.031	-9.14	0.325	-97.94
2.1 GHz	0.879	-171.94	5.92	68.00	0.030	-10.83	0.327	-100.17
2.2 GHz	0.879	-174.09	5.65	65.79	0.030	-12.46	0.330	-102.36
2.3 GHz	0.879	-176.14	5.40	63.62	0.030	-14.03	0.334	-104.51
2.4 GHz	0.879	-178.10	5.18	61.51	0.030	-15.55	0.338	-106.63
2.5 GHz	0.879	-179.98	4.97	59.43	0.030	-17.02	0.342	-108.71
2.6 GHz	0.879	178.20	4.77	57.38	0.029	-18.44	0.346	-110.77
2.7 GHz	0.879	176.44	4.59	55.37	0.029	-19.83	0.351	-112.81
2.8 GHz	0.879	174.74	4.42	53.39	0.029	-21.18	0.355	-114.82
2.9 GHz	0.879	173.09	4.26	51.43	0.029	-22.48	0.360	-116.80
3.0 GHz	0.880	171.49	4.11	49.50	0.028	-23.76	0.366	-118.76
3.2 GHz	0.880	168.39	3.84	45.70	0.028	-26.20	0.376	-122.63
3.4 GHz	0.881	165.43	3.60	41.97	0.027	-28.51	0.387	-126.41
3.6 GHz	0.882	162.57	3.38	38.31	0.026	-30.70	0.399	-130.13
3.8 GHz	0.883	159.81	3.19	34.71	0.025	-32.75	0.410	-133.78
4.0 GHz	0.884	157.13	3.01	31.16	0.025	-34.68	0.422	-137.38
4.2 GHz	0.885	154.52	2.85	27.65	0.024	-36.47	0.433	-140.91
4.4 GHz	0.887	151.96	2.71	24.19	0.023	-38.12	0.445	-144.40
4.6 GHz	0.888	149.45	2.57	20.77	0.022	-39.63	0.457	-147.84
4.8 GHz	0.889	146.98	2.45	17.38	0.022	-40.97	0.468	-151.24
5.0 GHz	0.890	144.55	2.33	14.03	0.021	-42.15	0.480	-154.60
5.2 GHz	0.892	142.15	2.23	10.71	0.020	-43.15	0.491	-157.92
5.4 GHz	0.893	139.78	2.13	7.41	0.019	-43.95	0.503	-161.20
5.6 GHz	0.894	137.43	2.04	4.15	0.018	-44.53	0.514	-164.45
5.8 GHz	0.896	135.11	1.95	0.91	0.018	-44.89	0.525	-167.66
6.0 GHz	0.897	132.80	1.87	-2.30	0.017	-45.00	0.535	-170.85

Note 1. Download this s-parameter file in ".s2p" format at http://www.cree.com/products/wireless_s-parameters.asp
Note 2. On a 20 mil thick PCB.

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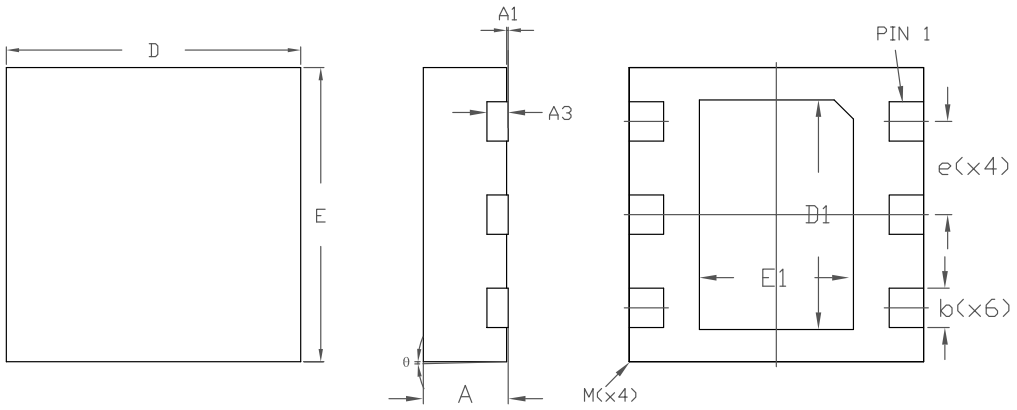
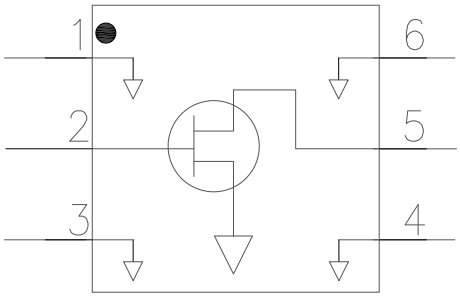
Product Dimensions CGH40006S (Package Type — 440203)



DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.80	0.90	1.00	0.032	0.035	0.039
A1	0	0.02	0.05	0	0.0008	0.002
A3	—	0.20REF.	—	—	0.008REF.	—
b	0.30	0.40	0.45	0.012	0.016	0.018
D	2.85	3.00	3.15	0.112	0.118	0.124
D1	—	2.34BSC	—	—	0.092BSC	—
E	2.85	3.00	3.15	0.112	0.118	0.124
E1	—	1.57BSC	—	—	0.062BSC	—
e	—	0.95BSC	—	—	0.037BSC	—
L	0.20	0.30	0.45	0.008	0.012	0.018
θ	0	—	12	0	—	12
M	—	—	0.05	—	—	0.002

Pin	Input/Output
1	GND
2	RF IN
3	GND
4	GND
5	RF OUT
6	GND



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