United Monolithic Semiconductors

CHK8101 - SYC

15W Power Packaged Transistor

GaN HEMT on SiC

Description

The CHK8101-SYC is an unmatched packaged Gallium Nitride High Electron Mobility Transistor. It offers general purpose and broadband solutions for a variety of RF power applications. It is well suited for multi-purpose applications such as space and telecommunication

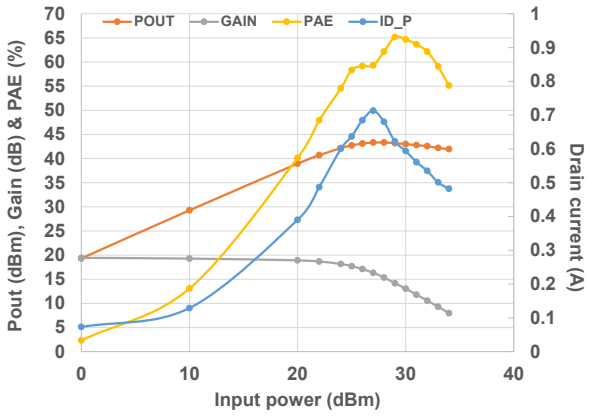
The CHK8101-SYC is developed on a 0.5µm gate length GaN on SiC HEMT process. It requires an external matching circuitry.

The CHK8101-SYC is supplied in a hermetic ceramic-metal flange power package, compliant with the RoHs N°2011/65 and REACH N°1907/2006 directives.

Main Features

- Wide band capability: up to 6GHz
- Pulsed and CW operating modes
- High power: > 15W
- High Efficiency: up to 65%
- DC bias: V_{DS} = 50V @ I_{D_Q} = 100mA
- MTF > 10^6 hours @ Tj = 200°C

V_{DS} = 50V, I_{D_Q} = 100mA, Freq = 1.3GHz, Pulsed mode



Main Electrical Characteristics

Tcase= +25°C, **Pulsed mode**, F = 1.3GHz, V_{DS}=50V, I_{D_Q}=100mA

Symbol	Parameter	Min	Typ	Max	Unit
G_{SS}	Small Signal Gain		19	-	dB
P_{SAT}	Saturated Output Power		15	-	W
PAE	Max Power Added Efficiency		65	-	%
G_{PAE_MAX}	Associated Gain at Max PAE		14	-	dB

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Recommended DC Operating Ratings

Tcase= +25°C

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
V_{DS}	Drain to Source Voltage		50		V	
V_{GS_Q}	Gate to Source Voltage		-1.85		V	V_D = 50V, I_{D_Q} = 100mA
I_{D_Q}	Quiescent Drain Current		0.1		A	V_D = 50V
I_{D_MAX}	Drain Current		0.7		A	V_D = 50V, Compressed mode
I_{G_MAX}	Gate Current (forward mode)		0	6	mA	Compressed mode
T_{j_MAX}	Junction temperature			200	°C	

(1) Limited by dissipated power

DC Characteristics

Tcase= +25°C

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
V_P	Pinch-Off Voltage	-3	-2	-1	V	V_D = 50V, I_D =I_{DSS}/100
I_{D_SAT}	Saturated Drain Current		2.7 (1)		A	V_D = 7V, V_G = 2V
I_{G_leak}	Gate Leakage Current (reverse mode)	-0.4			mA	V_D = 50V, V_G = -7V
V_{BDS}	Drain-Source Break-down Voltage		180		V	V_G = -7V, I_D = 20mA
R_{TH}	Thermal Resistance(2)		5.8		°C/W	

(1) For information, limited by I_{D_MAX}, see on Absolute Maximum Ratings
(2) CW mode, reference=package back-side

RF Characteristics

Tcase= +25°C, **Pulsed mode**, F = 1.3GHz, V_{DS}=50V, I_{D_Q}=100mA

Symbol	Parameter	Min	Typ	Max	Unit
G_{SS}	Small Signal Gain		19	-	dB
P_{SAT}	Saturated Output Power		20	-	W
PAE	Max Power Added Efficiency		64	-	%
G_{PAE_MAX}	Associated Gain at Max PAE		14	-	dB

These values represent typical performance on demonstration board. They are deduced from measurements and simulations. They are considered in the reference plane defined by the leads of the package, at the connection interface with the PCB.

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Absolute Maximum Ratings

Tcase= +25°C(1), (2), (3)

Symbol	Parameter	Rating	Unit	Note
V_{DS}	Drain source biasing voltage	60	V	
V_{GS}	Gate source biasing voltage (3)	-10 to +2	V	(5)
I_{G_MAX}	Maximum Gate Current in Forward Mode	+160	mA	
I_{G_MIN}	Maximum Gate Current in Reverse Mode	-2	mA	(4)
I_{D_MAX}	Maximum drain current (4)	3	mA	
Tj	Junction temperature	230	°C	
Ta	Operating temperature range	See note (4)	°C	(4)
Tstg	Storage temperature range	-55 to +150	°C	

(1) Operation of this device above anyone of these parameters may cause permanent damage.
(2) Duration < 1s.
(3) The given values must not be exceeded at the same time even momentarily for any parameter, since each parameter is independent from each other, otherwise deterioration or destruction of the device may occur.
(4) Max junction temperature must be considered
(5) V_{GS_Q} max limited by I_{D_MAX} and I_{G_MAX} values

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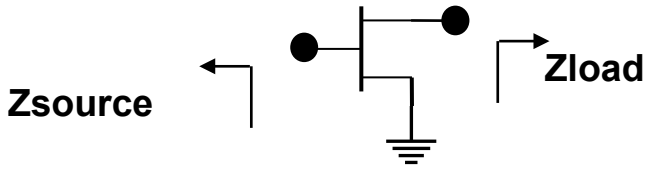
Simulated Source and Load Impedance for Pout & Pae

V_{DS} = 50V, I_{D_Q} = 100mA



Frequency (MHz)	Source H1	Source H2	Load H1	Load H2	Pout (dBm)	Pae (%)
1000	5.1+j*6.7	1+j*17.3	18.9+j*29	0.2+j*15.5	44.9	73
2000	5.1-j*6.9	0.3+j*21.8	6.2+j*12.6	7.6+j*10.8	45	62
3000	3.1-j*12.1	0.3+j*20.3	5.3+j*4.3	7.6+j*5.3	45.1	53
4000	7.6-j*24	0.1+j*1.2	3.4+j*0.2	1.2-j*26.3	44.5	46
5000	44.1-j*19.3	1.2-j*9.8	5.4-j*7.4	4+j*7.8	45.3	47
6000	30.1+j*34.3	0.2-j*18.4	8.3-j*12.6	1.6+j*114	44.6	38

These values are given in the reference plane defined by the connection between the package leads and the PCB.

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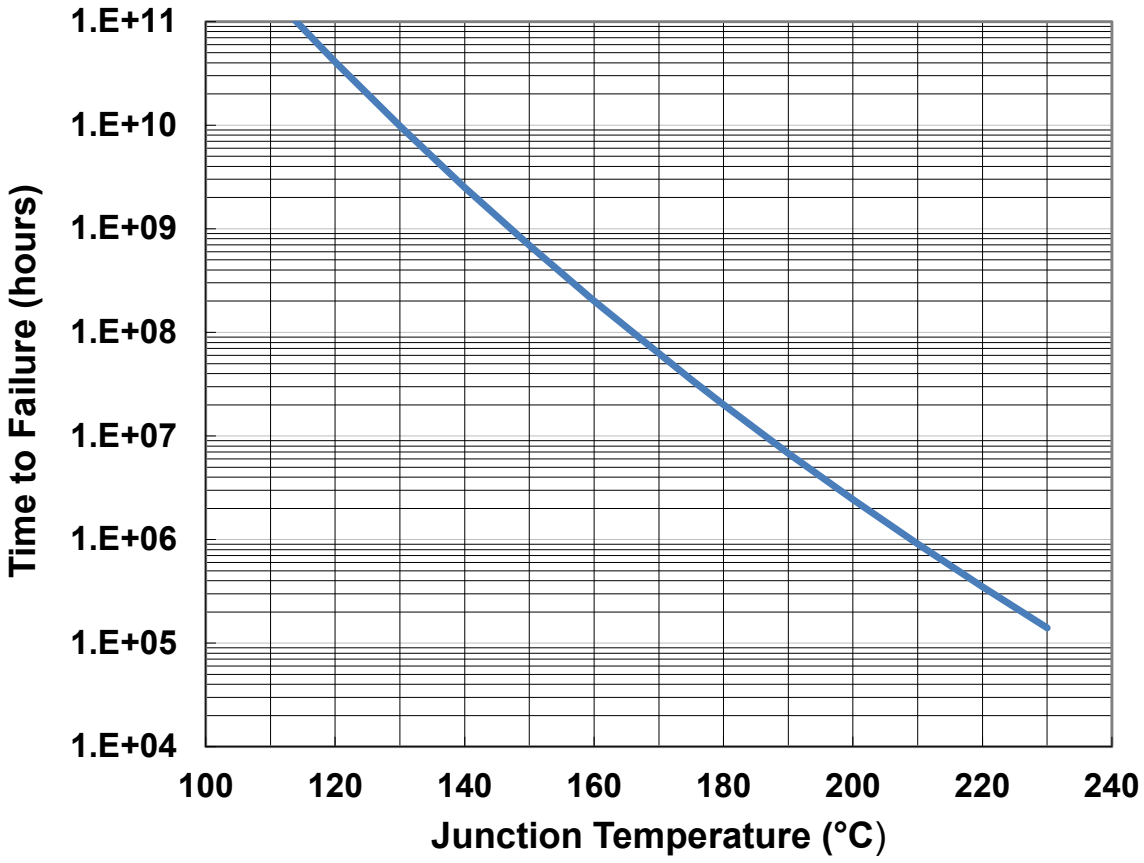
Device thermal performances

All the figures given in this section are obtained assuming that the package device is only cooled down by conduction through the package thermal pad.
The temperature is monitored at the package back-side interface (Tcase).
The system maximum temperature must be adjusted in order to guarantee that Tjunction remains below the maximum value specified in the Absolute Maximum Ratings table.
So, the system PCB must be designed to comply with this requirement.

Parameter	Biasing conditions	Tjunction (°C)	RTH (°C/W)	T50 (hours)
RTH [1] Thermal Resistance (Junction to Case)	**CW mode** Vd= 50V Id=650mA Pdiss= 14W	167	5,9	8,76E+07
RTH [1] Thermal Resistance (Junction to Case)	**Pulsed mode** Pulse length = 25µs, Duty cycle = 10% Vd= 50V Id=650mA Pdiss= 14W	126	3	1,72E+10

[1] Assuming 85°C Tcase



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Typical S-parameters

Tcase= +25°C, Pulsed mode, V_D=50V, I_{D_Q}=100mA, Phase S(i,j) in °

Freq (GHz)	dB S(1,1)	Phase S(1,1)	dB S(2,1)	Phase S(2,1)	dB S(1,2)	Phase S(1,2)	dB S(2,2)	Phase S(2,2)
0.25	-0,080	-54,7	-26,723	-170,2	-91,708	7,3	-0,027	-47,8
0.5	-0,153	-110,4	-3,535	-119,2	-65,595	161,3	-0,393	-110,3
0.75	-0,475	-170,1	7,880	24,8	-50,468	-61,0	-2,555	-136,2
1	-1,548	116,0	14,187	-94,9	-42,836	-178,7	-3,017	114,1
1.25	-14,481	142,4	20,521	72,4	-35,005	-5,1	-8,783	-85,6
1.5	-4,946	37,8	16,239	-107,5	-38,126	179,8	-5,546	44,6
1.75	-4,894	-122,3	5,554	83,4	-48,161	13,2	-0,821	-104,9
2	-1,454	104,4	-11,308	-34,8	-64,741	-124,7	-0,517	177,1
2.25	-0,718	38,5	-35,502	-98,7	-75,957	87,5	-0,517	118,4
2.5	-0,528	-7,7	-25,815	5,7	-73,638	-32,9	-0,494	66,6
2.75	-0,561	-47,1	-16,867	-55,0	-68,684	-89,0	-0,471	17,3
3	-1,359	-80,5	-4,527	-162,7	-60,441	163,7	-0,631	-33,6
3.25	-0,448	-110,9	-2,886	45,7	-61,032	24,0	-2,776	-94,6
3.5	-0,382	-146,5	-7,986	-103,9	-65,355	-132,8	-3,519	-104,5
3.75	-0,466	177,8	-13,638	170,3	-74,890	56,9	-2,186	-179,9
4	-0,607	140,7	-13,899	83,1	-70,269	-109,2	-2,437	85,5
4.25	-0,859	103,7	-14,101	-72,7	-76,615	-116,0	-1,849	-7,3
4.5	-0,700	63,3	-31,586	-179,7	-66,170	132,9	-1,922	-87,3
4.75	-0,705	22,5	-40,556	-131,6	-63,424	10,1	-1,204	-110,1
5	-0,707	-17,5	-30,819	170,3	-63,534	-83,1	-1,101	-166,6
5.25	-0,677	-55,4	-24,736	73,2	-63,276	173,3	-1,986	137,3
5.5	-0,628	-90,8	-21,161	-57,2	-60,455	44,6	-3,541	45,5
5.75	-0,580	-124,2	-25,946	145,6	-64,827	-112,7	-2,610	-116,2
6	-0,529	-156,1	-43,649	42,3	-80,305	82,7	-1,393	143,1
6.25	-0,528	173,0	-38,283	92,1	-63,033	-79,0	-3,622	33,4
6.5	-0,550	142,2	-38,074	-47,5	-56,275	159,9	-4,480	138,9
6.75	-0,606	110,5	-44,445	-113,5	-51,683	63,1	-4,319	39,4
7	-0,694	77,0	-45,523	-130,8	-51,082	-55,9	-8,863	-113,7
7.25	-0,848	41,0	-30,571	106,2	-51,768	-137,5	-3,865	103,5
7.5	-0,945	0,9	-36,378	-10,1	-54,589	123,1	-2,646	33,9
7.75	-1,084	-43,2	-43,035	-80,5	-58,827	36,2	-5,754	-9,4
8	-1,201	-90,6	-34,061	176,4	-56,452	-57,1	-2,796	-55,5
8.25	-1,249	-139,7	-37,181	55,1	-59,016	-160,6	-3,967	-131,8
8.5	-1,230	171,6	-41,752	-52,5	-62,168	86,0	-9,957	105,5
8.75	-1,199	125,1	-42,970	144,5	-61,100	-129,3	-19,101	-67,7
9	-1,197	81,5	-49,654	-10,6	-55,983	13,9	-9,367	19,6
9.25	-1,247	40,3	-48,035	-141,2	-53,701	-119,9	-4,043	-71,8
9.5	-1,393	1,2	-48,395	106,1	-55,559	126,0	-3,949	-151,4
9.75	-1,665	-38,1	-41,179	48,8	-44,015	108,6	-8,896	-115,6
10	-2,118	-79,2	-48,876	-56,3	-44,754	-22,1	-4,483	157,6
10.25	-2,790	-125,1	-53,483	-127,2	-50,171	-114,3	-6,629	87,2
10.5	-3,493	-177,7	-50,594	-122,9	-48,805	-126,2	-13,343	87,1
10.75	-3,674	125,6	-49,407	174,7	-48,717	165,1	-5,987	28,2
11	-3,201	73,3	-44,632	106,3	-44,573	103,1	-5,720	-64,5
11.25	-2,514	29,8	-45,707	2,0	-46,047	-0,3	-10,761	-132,4
11.5	-1,966	-5,6	-56,455	-38,4	-56,379	-38,3	-6,908	145,9
11.75	-1,600	-35,8	-50,912	-58,9	-50,872	-59,0	-4,941	73,5
12	-1,389	-62,9	-50,545	-128,6	-50,555	-130,0	-3,858	16,5
12.25	-1,293	-88,4	-51,697	-165,5	-51,745	-168,9	-4,707	-28,5
12.5	-1,267	-113,0	-49,803	116,1	-50,553	112,1	-2,922	-52,6
12.75	-1,342	-138,4	-55,371	55,4	-56,908	52,6	-2,018	-94,9
13	-1,525	-165,1	-55,375	22,0	-56,575	26,5	-2,195	-133,0
13.25	-1,895	165,1	-65,593	-14,5	-67,448	39,4	-2,238	-174,0
13.5	-2,675	130,2	-60,601	-134,8	-67,431	-83,1	-2,693	139,0
13.75	13.75	83,3	-48,133	-10,9	-47,933	-19,9	-3,118	84,7
14	-7,571	2,4	-47,672	-103,2	-47,217	-104,2	-3,322	21,7
14.25	-18,176	-36,8	-50,983	105,5	-46,491	127,1	-3,432	-40,3
14.5	-6,896	-109,0	-42,385	-167,4	-45,412	-157,4	-3,538	-86,7
14.75	-3,887	-164,4	-46,000	99,0	-47,909	109,1	-2,913	-128,1
15	-2,759	156,7	-47,075	63,5	-47,451	78,7	-3,155	-167,5

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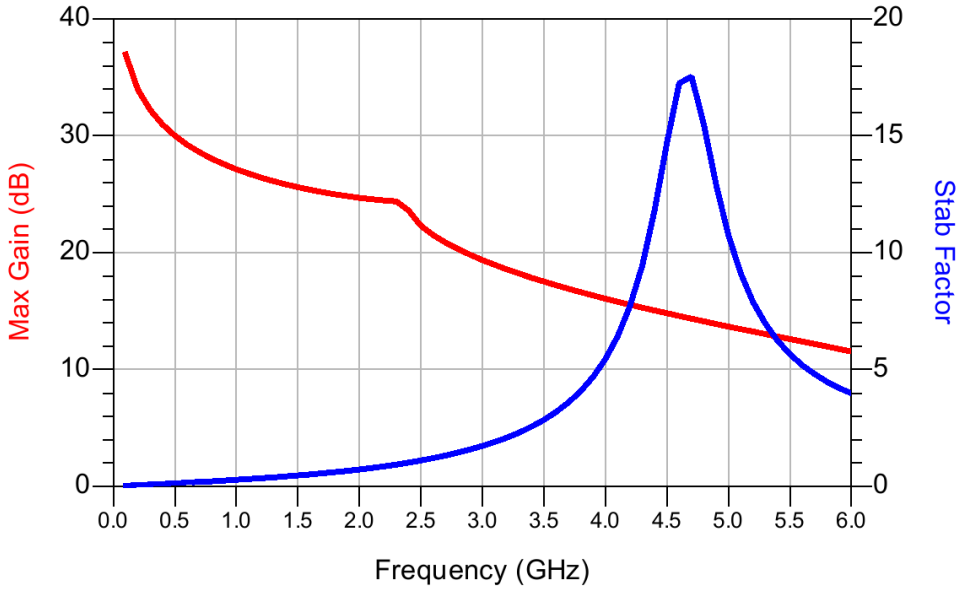
Maximum Gain & Stability Characteristics

Tcase= +25°C, V_D=50V, I_{D_Q}=100mA

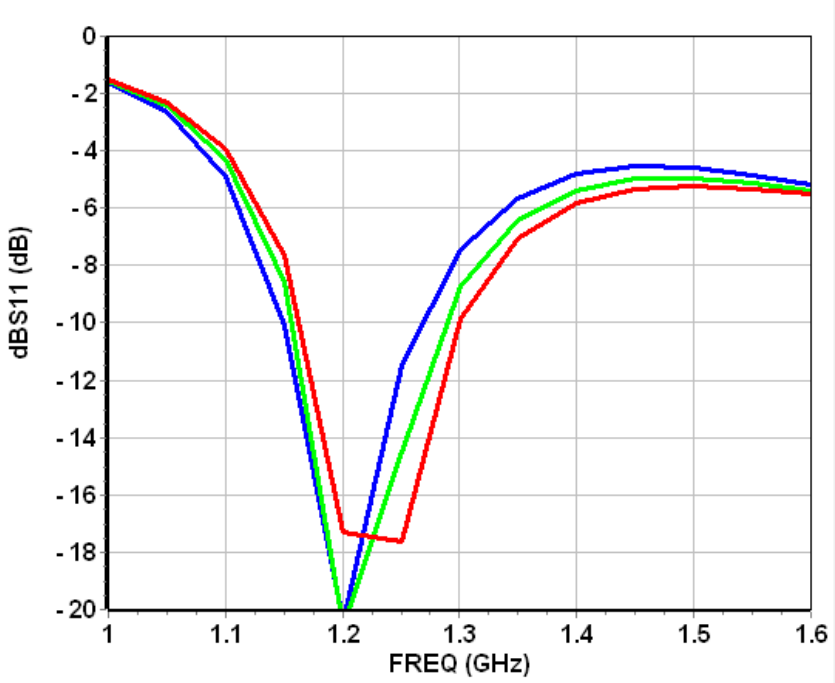


Typical Performance on Demonstration Board

Calibration and measurements are done on the connector reference accesses of the demonstration boards.

Tcase ≈ -40°, +25; +85°C, V_{DS} = 50V, I_{D_Q} = 100mA;

Input Return Loss vs Frequency and Temperature



Tcase ≈ -40°, +25; +85°C, V_{DS} = 50V, I_{D_Q} = 100mA

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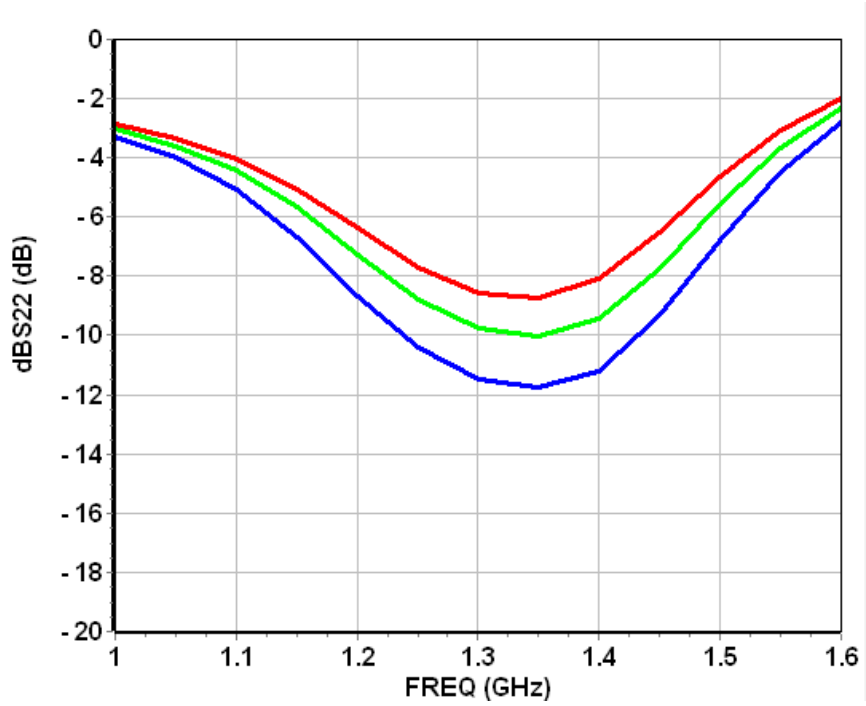
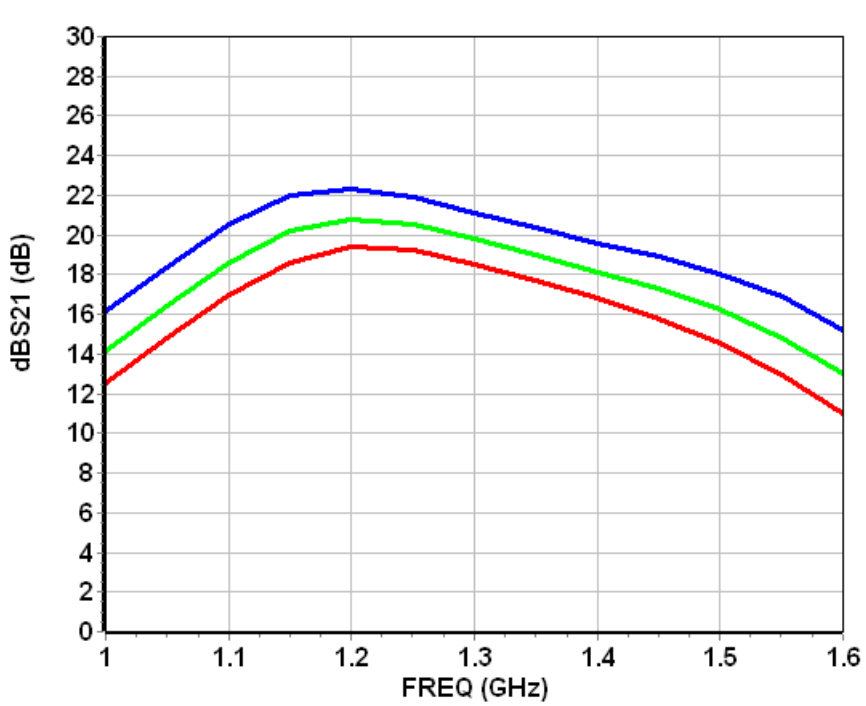
Output Return Loss vs Frequency and Temperature



Linear Gain vs Frequency and Temperature



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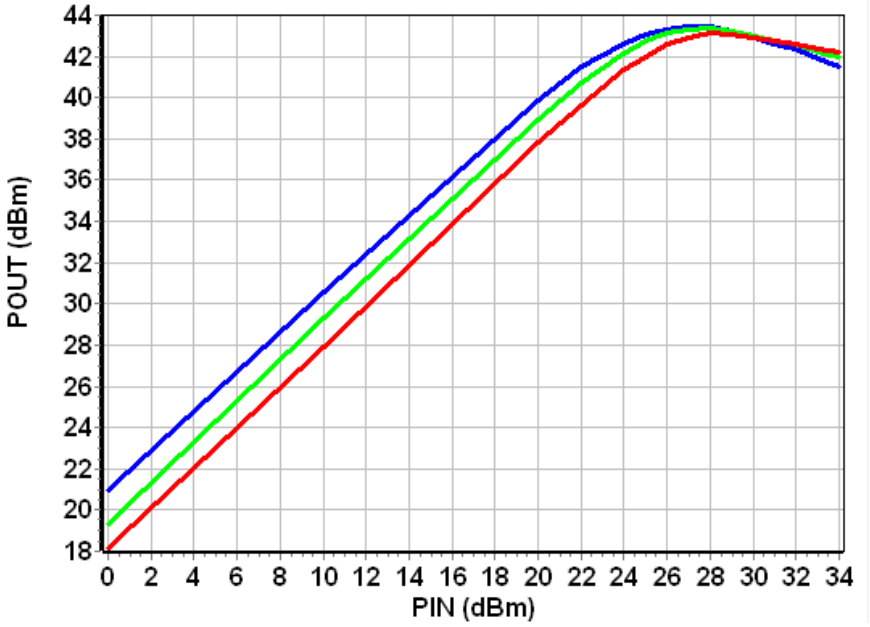
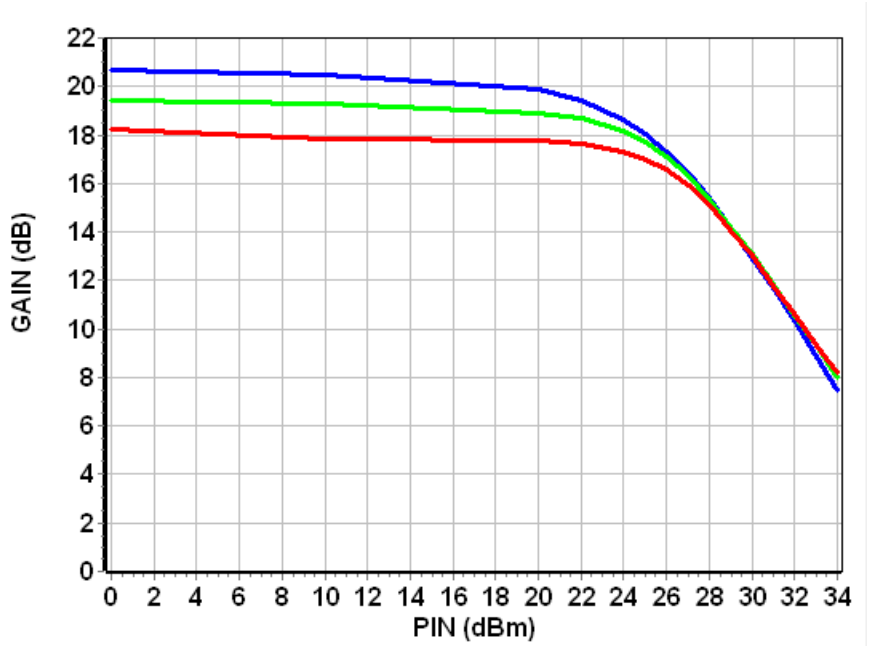
Tcase ≈ -40°, +25; +85°C, Pulsed mode V_{DS} = 50V, I_{D_Q} = 100mA; @Freq = 1.3GHz

Pout vs Pin



Gain vs Pin



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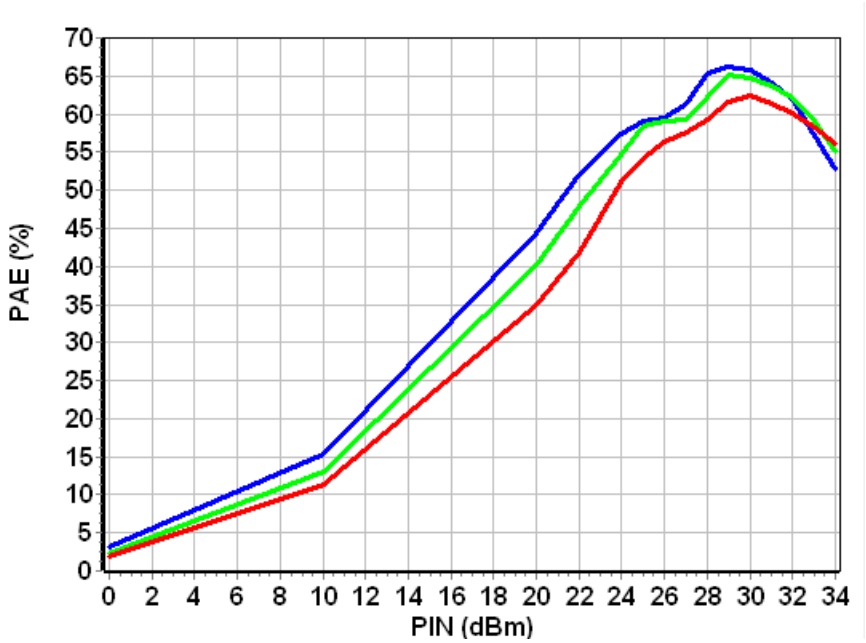
Tcase ≈ -40°, +25; +85°C, Pulsed mode V_{DS} = 50V, I_{D_Q} = 100mA; @Freq = 1.3GHz

Pae vs Pin



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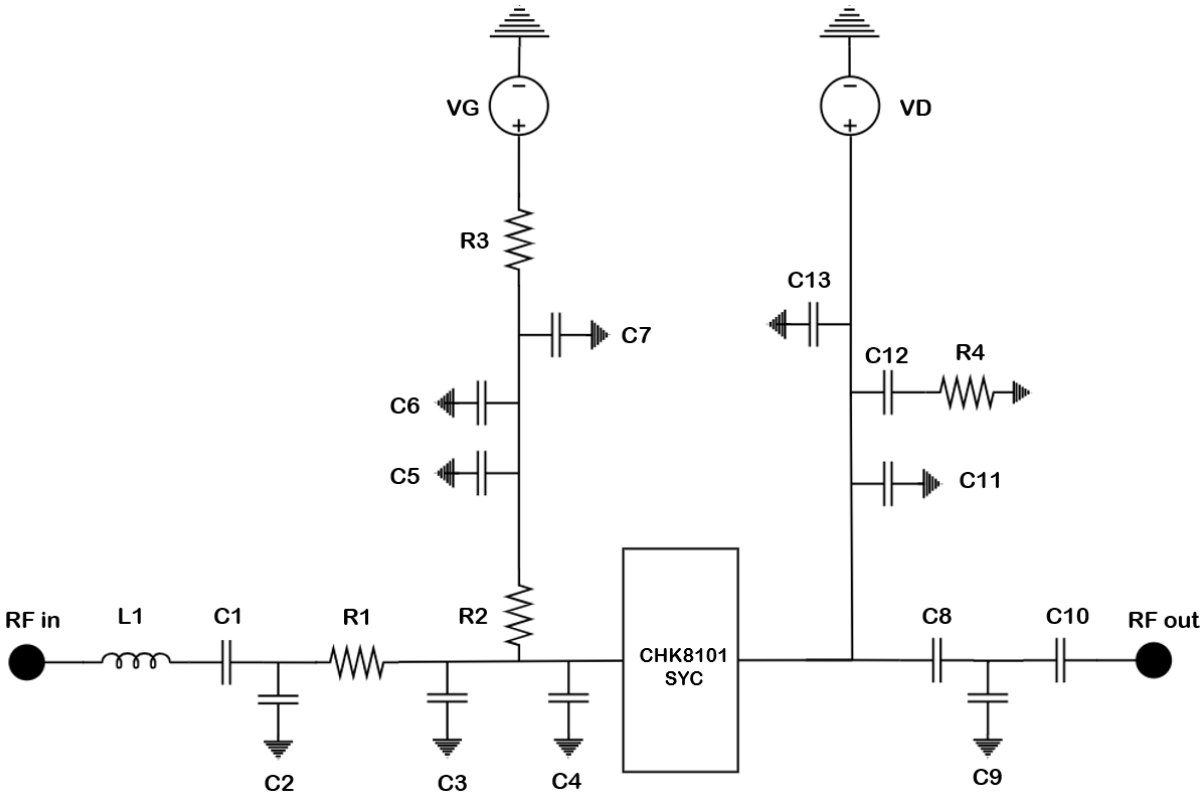
Demonstration Amplifier Low Frequency Equivalent Schematic



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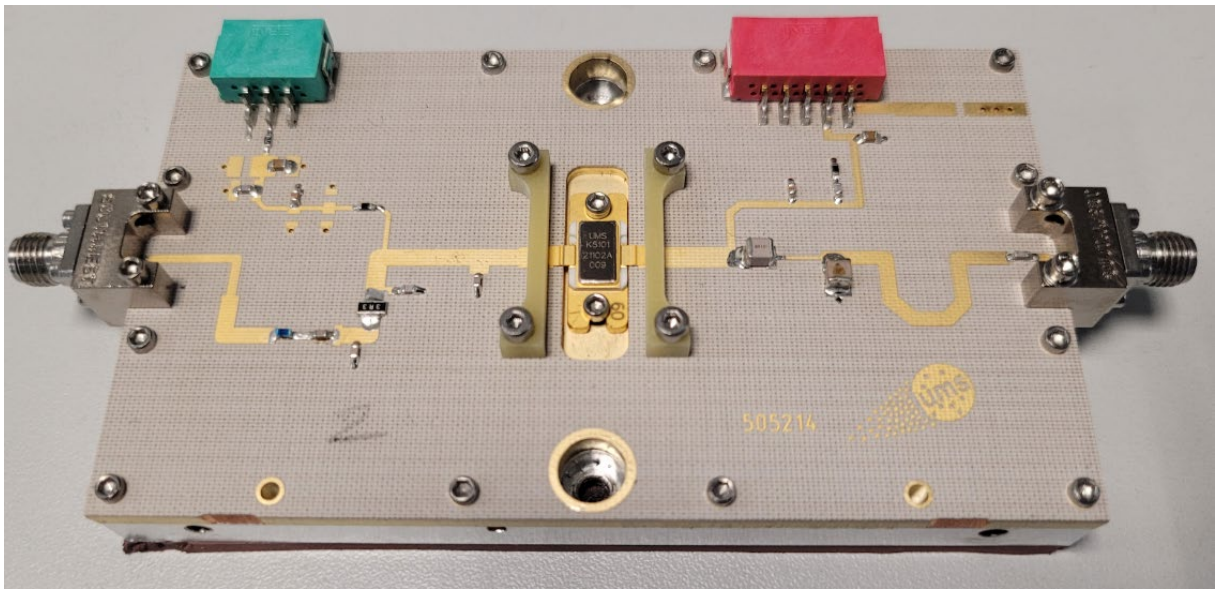
Demonstration Amplifier Circuit



Demonstration Amplifier / Bill of Materials			
Designator	**Type**	**Value - Description**	**Qty**
L1	Self inductance	11nH, +/- 5%, 0603	1
C1	Capacitor	0.9pF, +/- 0.1pF, 0603	1
C2, C3	Capacitor	0.2pF, +/- 0.1pF, 0603	2
C4	Capacitor	0.4pF, +/- 0.pF, 0603	1
C5, C11	Capacitor	100pF, +/- 5%, 0603	2
C6, C12	Capacitor	1nF, +/- 5%, 0603	2
C7, C13	Capacitor	10nF, +/- 5%, 0805	2
C8	Capacitor	9.1pF, +/- 0.25pF, 1111	1
C9	Capacitor	4.3pF, +/-0.25, 1111	1
C10	Capacitor	4.3pF, +/- 0.1, 0603	1
R1	Resistor	3.3Ω, +/- 1%, 1W 0612	1
R2, R4	Resistor	25Ω, +/- 1%, 1.5W 0603	2
R3	Resistor	220Ω, +/- 1%, 0.1W 0603	1
-	Connector	CMS 3cts	2
-	Connector	SMA (DC-18GHz)	2
-	Packaged Transistor	CHK8101- SYC	1
-	PCB	RF35P, Er=3.5, h=0.508mm	-

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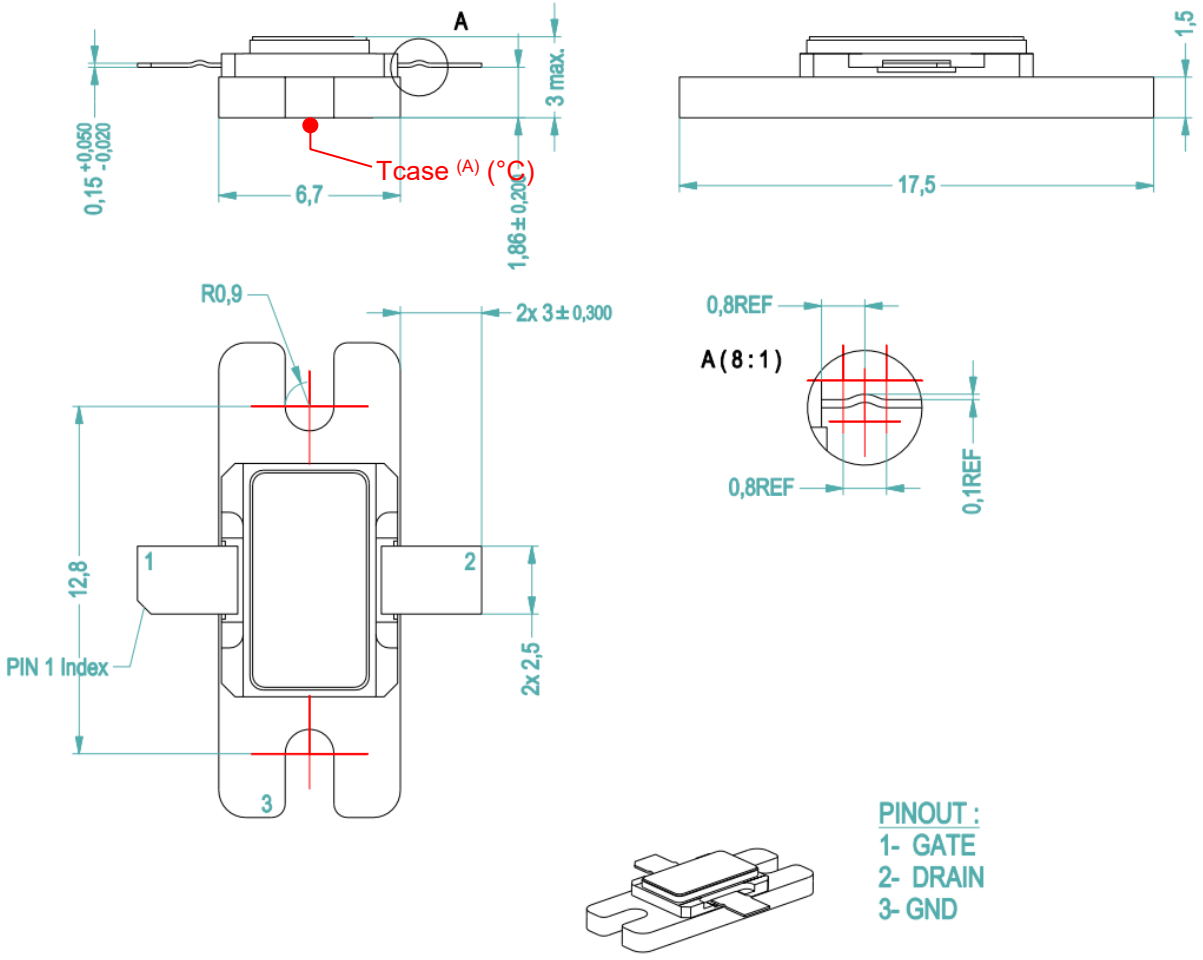
Package outline



(A) Tcase locates the reference point used to monitor the device temperature. This point has been taken at the device / system interface to ease system thermal design.

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Recommended environmental management

UMS products are compliant with the regulation in particular with the directives RoHS N°2011/65 and REACh N°1907/2006. More environmental data are available in the application note AN0019 also available at https://www.ums-rf.com.

Recommended ESD management

Refer to the application note AN0020 available at https://www.ums-rf.com for ESD sensitivity and handling recommendations for the UMS package products.

Qualification domain

The CHK8101-SYC is qualified according to ums rules, excluding humid environment as it is in an hermetic package.

Ordering Information

Package:	CHK8101-SYC/XY Tray: XY = 26

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