United Monolithic Semiconductors

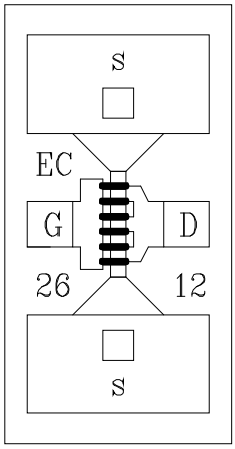
EC2612-99F

40GHz Super Low Noise pHEMT

Pseudomorphic High Electron Mobility Transistor

Description

The EC2612-99F is based on a 0.15µm gate pseudomorphic high electron mobility transistor (0.15µm pHEMT) technology.
Gate width is 120 µm and the 0.15µm T-shaped aluminium gate features low resistance and excellent reliability.
The device shows a very high transconductance which leads to very high frequency and low noise performances.
It is available in chip form with sources via holes connection. Only gate and drain wires bounding are required.



D: Drain
G: Gate
S: Source

Main Features

- 0.8dB minimum noise figure @ 18GHz
- 1.5dB minimum noise figure @ 40GHz
- 12dB associated gain @ 18GHz
- 9.5dB associated gain @ 40GHz
- Chip size: 0.63 x 0.37 x 0.1 mm

Main Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Idss	Saturated drain current	10	40	60	mA
NFmin	Minimum noise figure (F=40GHz)		1.5	1.9	dB
Ga	Associated gain (F=40GHz)	8	9.5		dB

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Specifications

Tamb.= +25°C

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
Idss	Saturated drain current	Vds = 2V Vgs = 0V	10	35	60	mA
Vp	Pinch off voltage	Vds = 2V Ids = 0.1mA	-1.0	-0.7	-0.3	V
G	Transconductance	Vds = 2V Ids = 25mA	50	70		mS
Igsd	Gate to source/drain leakage current	Vgsd = -2V			5	µA

Dynamic characteristics

Tamb.= +25°C

Symbol	Parameter	Test conditions		Min	Typ	Max	Unit
NF	Minimum noise figure	Vds=2V Ids=Idss/3	F= 12GHz		0.5	0.7	dB
			F= 30GHz		1.3	1.7	dB
			F= 40GHz		1.5	1.9	dB
Ga	Associated Gain		F= 12GHz	13	14		dB
			F= 30GHz	9	10		dB
			F= 40GHz	8	9.5		dB

Recommended Oprating ratings and Absolute Maximum ratings

Tamb.= +25°C

Symbol	Parameter	Conditions	ROR (1,2)	AMR (3,4)	Unit
Vds	Drain to source voltage	DC biasing area excluding RF signal	3.5	4	V
Vgs	Max. negative gate source voltage	at Vds=3.5V, DC biaising area excluding RF signal	-1.5	-1.75	V
		at Vds=0V, DC biaising area excluding RF signal	-2.5	-2.75	V
T_j	Peak Junction temperature	Under ROR conditions	175	N/A	°C

(1) Operation of this device above anyone of these parameters may cause permanent damage.
(2) Thermal Resistance channel to ground paddle
(3) Electrical performances are defined for specified test conditions
(4) Electrical performances are not guaranteed over all recommended operating conditions

Temperature Range

Tstg	Storage temperature range	-55 to +150	°C

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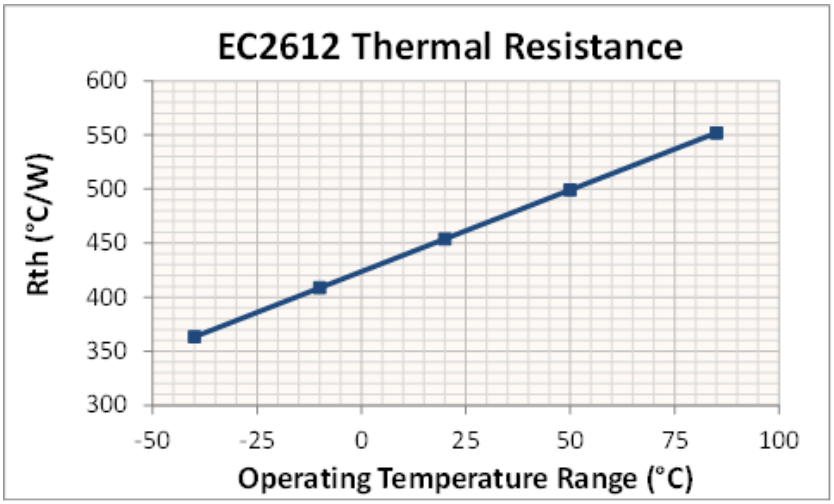
Device thermal information

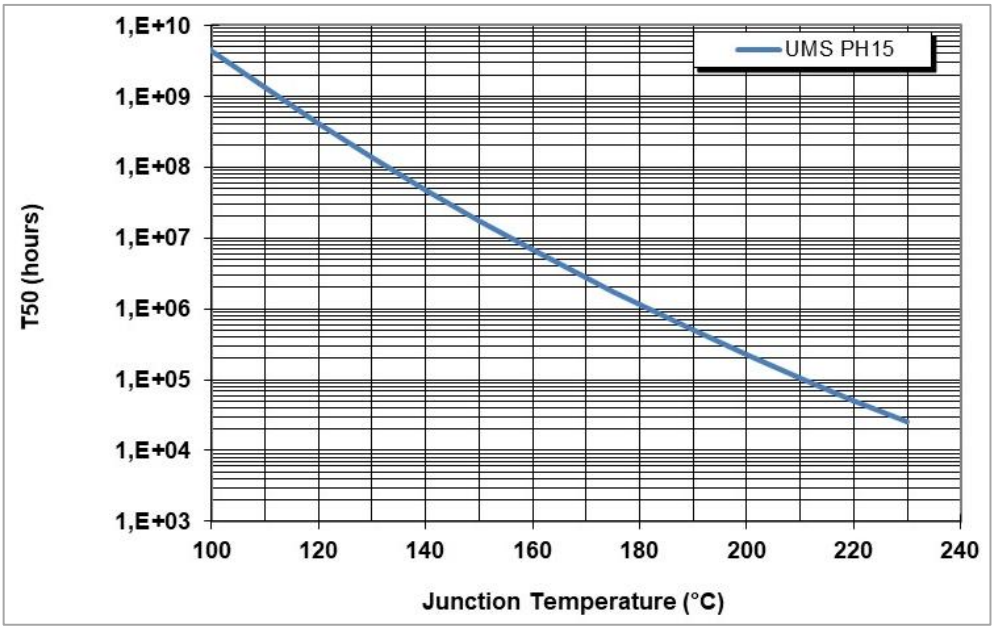
The following curve is extracted from thermal simulation on the 6x20µm transistor in the following conditions:

- A 0.5-W/mm dissipated power is applied in the channel between the gate and the drain.
- For the operating temperature range Ta from -40 °C to 85 °C



Power dissipation can be assessed from the following formula: Tj= Ta + Rth*Pdiss
The channel temperature Tj should not exceed the ROR value for reliable operation.

Median Life Time versus Junction Temperature



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Typical Scattering Parameters

Tamb.= +25°C, “S” Parameters including Lg=Ld~0.15nH, Vds = 3V, Ids = 30mA

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
1	-0,14	-11,0	-34,26	81,5	15,88	169,7	-4,78	-8,8
2	-0,19	-21,6	-28,41	76,1	15,69	162,2	-4,89	-18,3
3	-0,35	-32,3	-25,12	70,0	15,48	154,5	-5,11	-27,2
4	-0,62	-42,5	-22,92	64,0	15,20	146,7	-5,39	-36,0
5	-0,89	-52,5	-21,36	58,1	14,87	139,3	-5,80	-44,4
6	-1,12	-62,2	-20,14	52,2	14,53	132,3	-6,19	-53,5
7	-1,39	-71,9	-19,30	46,4	14,16	125,7	-6,67	-61,5
8	-1,70	-80,5	-18,69	42,0	13,74	119,5	-7,07	-68,5
9	-1,96	-88,2	-18,10	38,0	13,34	113,9	-7,38	-75,6
10	-2,15	-95,9	-17,61	33,5	12,96	108,3	-7,69	-83,2
11	-2,34	-104,1	-17,23	29,4	12,57	103,0	-8,04	-90,1
12	-2,47	-111,8	-16,88	25,8	12,23	97,6	-8,30	-96,9
13	-2,62	-118,7	-16,56	22,1	11,83	92,4	-8,55	-104,7
14	-2,78	-125,5	-16,35	18,7	11,40	87,4	-8,85	-111,9
15	-2,91	-132,8	-16,23	15,4	11,02	82,5	-9,03	-118,3
16	-3,00	-138,8	-16,11	12,9	10,60	78,1	-9,20	-123,8
17	-3,05	-144,2	-15,89	10,0	10,24	73,7	-9,29	-130,8
18	-3,08	-150,1	-15,79	6,7	9,86	69,5	-9,28	-137,3
19	-3,13	-156,5	-15,82	4,1	9,49	65,2	-9,34	-143,2
20	-3,17	-161,6	-15,77	1,5	9,14	61,2	-9,38	-148,9
21	-3,24	-166,5	-15,80	-2,0	8,75	57,2	-9,45	-155,9
22	-3,26	-171,9	-15,90	-4,8	8,40	53,3	-9,47	-160,6
23	-3,30	-176,7	-16,00	-6,9	8,02	50,0	-9,50	-164,8
24	-3,27	179,3	-15,96	-9,8	7,68	46,8	-9,43	-169,2
25	-3,26	175,8	-16,06	-12,6	7,39	43,6	-9,31	-174,6
26	-3,20	172,0	-16,12	-14,9	7,12	40,4	-9,20	-177,9
27	-3,17	167,4	-16,14	-17,2	6,86	37,1	-9,13	177,8
28	-3,15	163,5	-16,16	-20,0	6,62	33,4	-9,06	173,5
29	-3,19	159,2	-16,36	-22,2	6,28	29,7	-8,95	168,4
30	-3,15	155,1	-16,39	-23,1	5,98	26,5	-8,81	166,0
31	-3,10	151,2	-16,29	-24,9	5,70	23,1	-8,67	161,3
32	-3,03	147,7	-16,37	-27,5	5,40	19,5	-8,59	155,5
33	-2,99	144,1	-16,54	-28,8	5,12	16,7	-8,45	152,7
34	-2,98	139,8	-16,62	-30,6	4,89	13,4	-8,38	150,0
35	-2,97	136,5	-16,74	-32,6	4,68	10,1	-8,34	145,6
36	-2,89	132,3	-16,88	-34,5	4,51	6,4	-8,26	141,4
37	-2,85	128,2	-16,84	-36,4	4,24	3,0	-8,10	138,3
38	-2,83	124,9	-16,86	-39,7	4,04	-0,7	-7,89	133,7
39	-2,82	121,6	-17,04	-43,4	3,84	-4,4	-7,77	129,7
40	-2,83	116,9	-17,11	-46,0	3,47	-8,6	-7,71	127,3

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Typical Scattering Parameters

Tamb.= +25°C, “S” Parameters including Lg=Ld~0.15nH, Vds = 2V, Ids = 10mA

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
1	-0,11	-10,5	-33,67	82,3	13,52	170,6	-4,76	-7,4
2	-0,26	-20,7	-27,77	77,0	13,38	163,7	-4,81	-16,4
3	-0,45	-29,8	-24,45	71,2	13,22	156,4	-4,99	-24,5
4	-0,66	-38,4	-22,20	65,4	13,01	149,0	-5,21	-32,6
5	-0,85	-47,7	-20,57	59,6	12,74	141,8	-5,56	-40,5
6	-1,03	-56,5	-19,27	53,7	12,48	135,0	-5,88	-49,0
7	-1,20	-65,7	-18,36	47,9	12,19	128,5	-6,29	-56,6
8	-1,41	-73,9	-17,68	43,3	11,85	122,4	-6,65	-63,3
9	-1,64	-81,2	-17,04	39,2	11,51	116,7	-6,91	-70,0
10	-1,85	-88,7	-16,49	34,5	11,19	111,0	-7,19	-77,4
11	-2,04	-96,7	-16,08	30,1	10,85	105,6	-7,53	-84,0
12	-2,19	-104,2	-15,69	26,3	10,56	100,1	-7,78	-90,6
13	-2,35	-111,0	-15,33	22,3	10,22	94,7	-8,03	-98,0
14	-2,51	-117,8	-15,09	18,5	9,82	89,6	-8,34	-105,2
15	-2,66	-125,3	-14,94	14,9	9,49	84,5	-8,49	-111,6
16	-2,78	-131,4	-14,82	12,0	9,12	79,9	-8,67	-117,1
17	-2,86	-136,9	-14,57	8,9	8,78	75,2	-8,82	-124,0
18	-2,92	-142,9	-14,47	5,3	8,43	70,9	-8,91	-130,5
19	-3,00	-149,4	-14,48	2,3	8,08	66,4	-9,02	-136,3
20	-3,08	-154,6	-14,41	-0,5	7,76	62,2	-9,07	-141,9
21	-3,15	-159,8	-14,41	-4,3	7,40	58,0	-9,18	-149,1
22	-3,20	-165,3	-14,50	-7,5	7,07	54,0	-9,27	-154,0
23	-3,23	-170,4	-14,60	-9,8	6,72	50,4	-9,29	-158,4
24	-3,25	-174,7	-14,56	-12,9	6,38	47,1	-9,27	-162,8
25	-3,26	-178,3	-14,65	-16,0	6,10	43,6	-9,22	-168,4
26	-3,27	177,7	-14,71	-18,5	5,83	40,3	-9,16	-171,9
27	-3,27	173,0	-14,72	-21,1	5,57	36,8	-9,08	-176,3
28	-3,26	169,0	-14,74	-24,0	5,34	33,1	-9,05	179,2
29	-3,25	164,6	-14,93	-26,6	5,03	29,3	-8,91	174,0
30	-3,21	160,2	-15,00	-27,9	4,73	26,0	-8,80	171,5
31	-3,18	156,1	-14,93	-30,1	4,47	22,4	-8,67	166,5
32	-3,13	152,5	-15,01	-33,0	4,18	18,6	-8,58	160,6
33	-3,09	148,6	-15,21	-34,6	3,91	15,8	-8,49	157,5
34	-3,07	144,3	-15,27	-36,7	3,69	12,3	-8,39	154,9
35	-3,03	140,9	-15,31	-39,8	3,49	9,0	-8,30	151,3
36	-3,00	136,6	-15,48	-42,0	3,33	5,2	-8,20	146,8
37	-2,98	132,1	-15,49	-44,1	3,07	1,7	-8,08	143,3
38	-2,97	128,6	-15,53	-47,7	2,89	-2,2	-7,95	138,6
39	-2,94	125,3	-15,77	-50,7	2,67	-6,0	-7,86	133,6
40	-2,93	120,6	-15,86	-53,4	2,33	-10,2	-7,78	131,3

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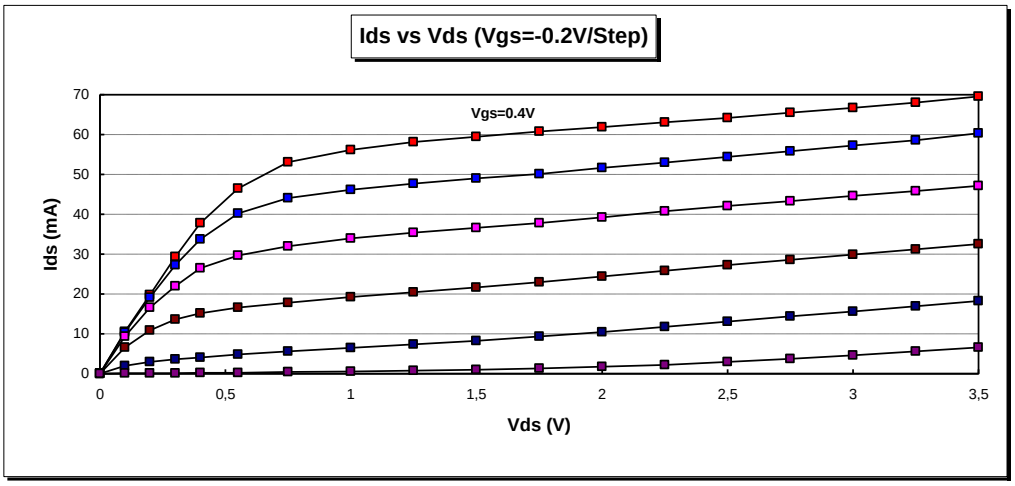
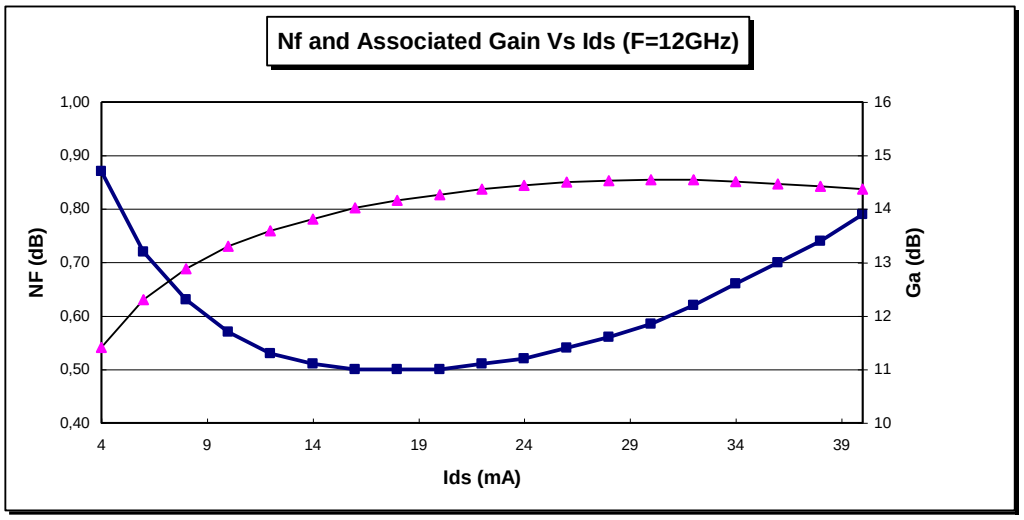
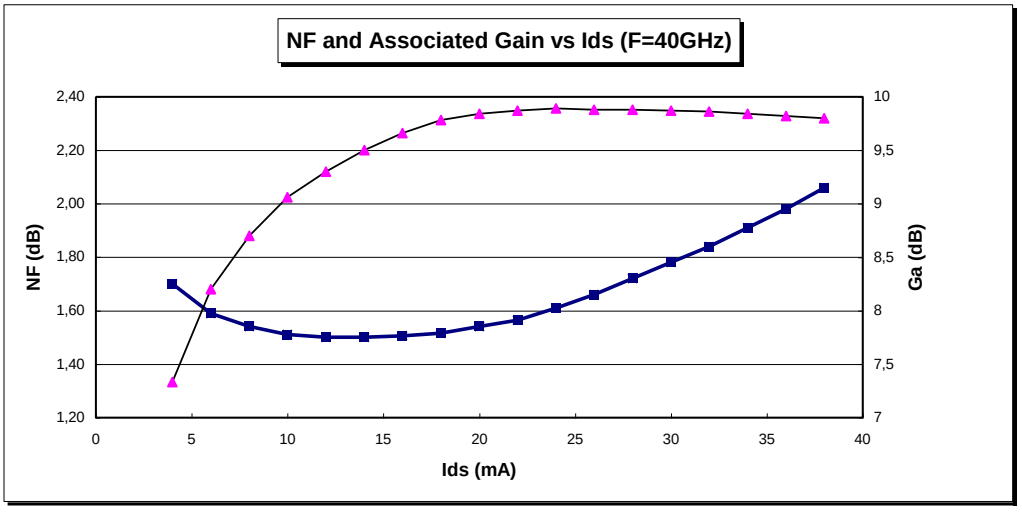
Typical results

Tamb.= +25°C





Vds=2V



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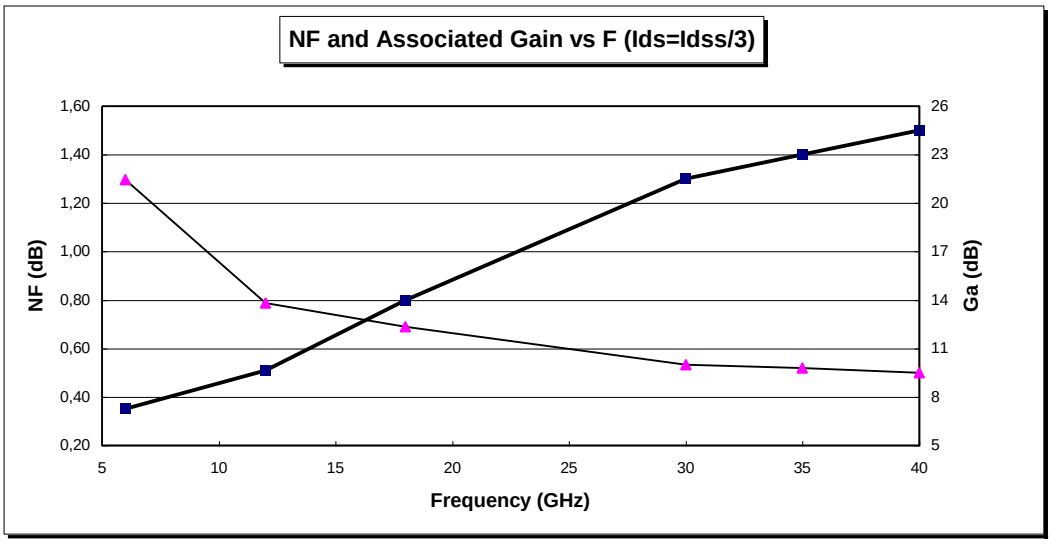
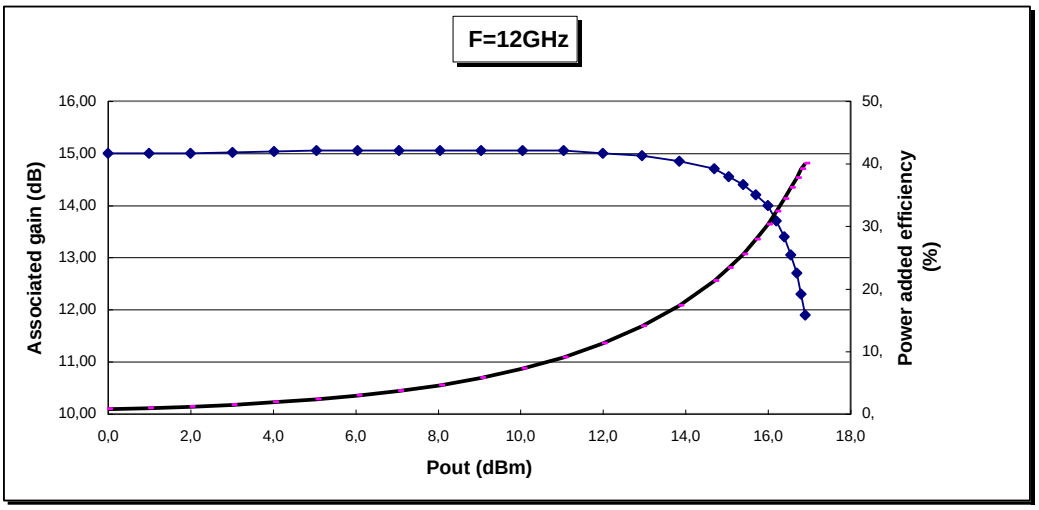


Vds=2V



Vds = 3V, Ids = 31mA

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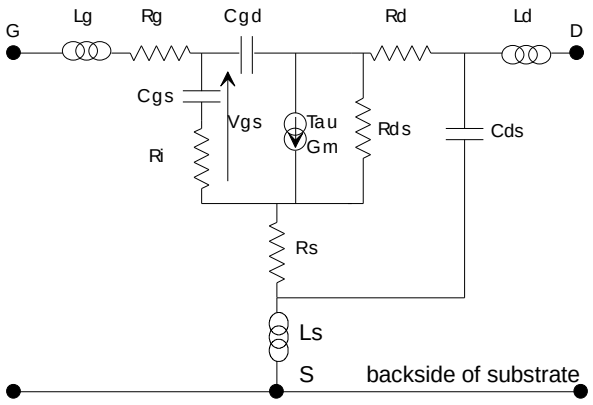
(CHIP) Equivalent Circuit model (Drain and Gate bond wires included)



Parameter	Unit	Value
Lg	pH	152.54
Rg	Ohms	0.13
Cgs	fF	142.6
Ri	Ohms	3.2
Cgd	fF	39.57
Rs	Ohms	2.83
Ls	pH	0.11
Gm	mS	98.14
Tau	ps	2.8
Cds	fF	46.84
Rds	Ohms	116.8
Rd	Ohms	2.83
Ld	pH	117.01

Typical Noise Parameters at Vds=2V, Ids=14mA
(Drain and Gate bond wires included)

FREQUENCY	NF min	Γopt		Rn
MHz	dB	MOD.	Ang.(°)	
5000	0.26	0.811	19.888	14.089
8000	0.356	0.746	32.28	13.33
12000	0.492	0.658	49.899	11.87
15000	0.595	0.598	64.263	10.51
20000	0.762	0.514	91.037	7.965
24000	0.892	0.473	114.916	5.923
28000	1.01	0.460	139.673	4.16
30000	1.07	0.465	151.723	3.473
32000	1.137	0.475	163.219	2.966
35000	1.223	0.5	179.087	2.63
38000	1.307	0.533	-166.857	2.923
40000	1.362	0.556	-158.467	3.538
42000	1.415	0.581	-150.795	4.536
45000	1.493	0.618	-140.488	6.843

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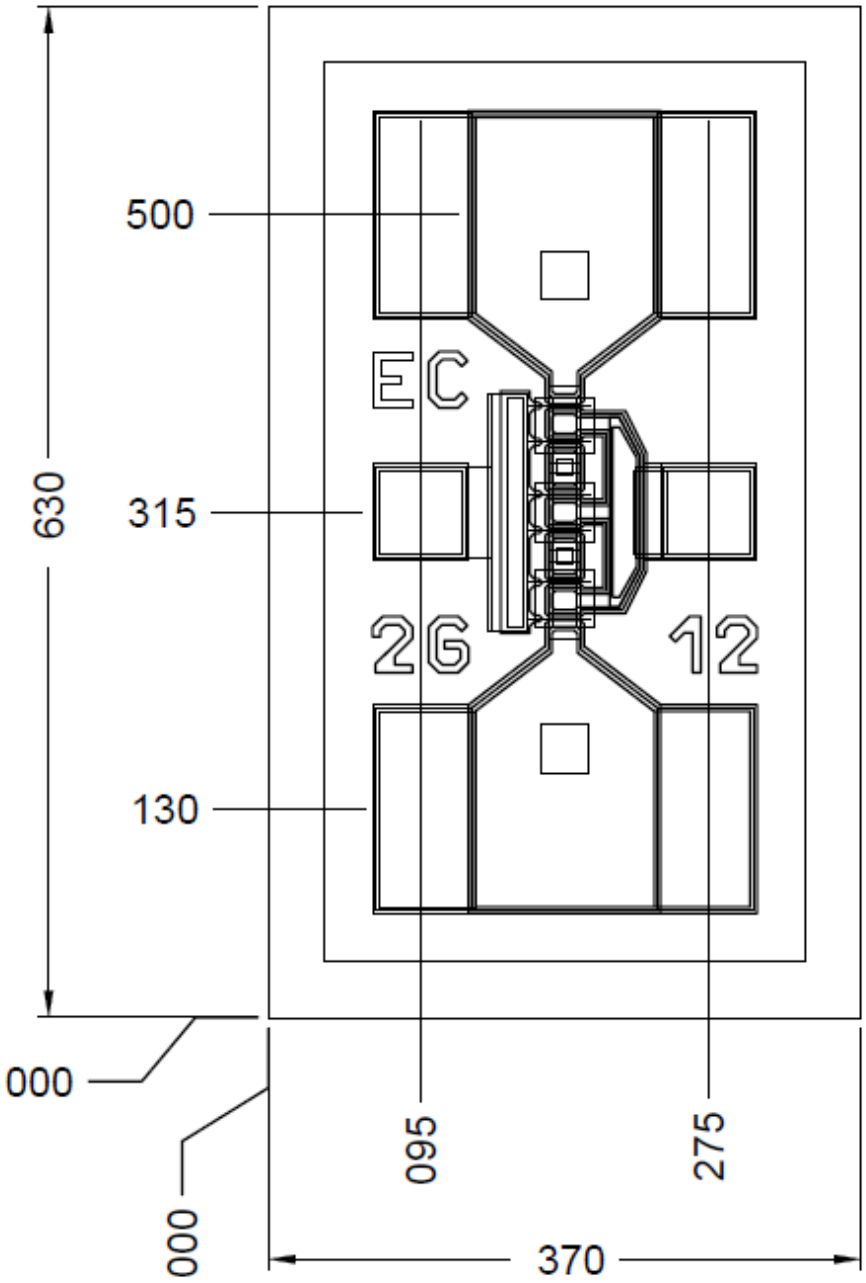
Mechanical data



Chip thickness: 100µm.
Chip size: 630x370 ±35µm
All dimensions are in micrometers

Drain area = 60x60 µm, Gate area = 60x60 µm
Recommended die attach : Stage temperature = 300°C (minimize temp. and time whenever possible)
Preforms = Au/Sn (80/20) Atmosphere: dry nitrogen or forming gas flow
Recommended bonding : ∅ 18 µm very pure gold wire (thermal compression)
The bonder should be properly grounded
Source pads are directly connected to back face metallization through the via holes

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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 products.

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.

Ordering Information

Chip form:	EC2612-99F/00

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