

## 40GHz Super Low Noise PHEMT

### Pseudomorphic High Electron Mobility Transistor

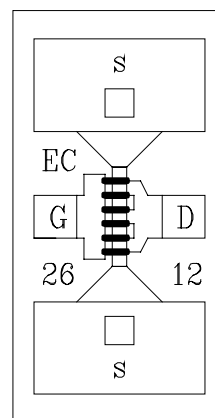
#### Description

Chip size : 0.63 x 0.37 x 0.1 mm

The EC2612 is based on a 0.15 $\mu$ m gate pseudomorphic high electron mobility transistor (0.15 $\mu$ m PHEMT) technology. Gate width is 120 $\mu$ m and the 0.15 $\mu$ m 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

#### Main 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   |

ESD Protections: Electrostatic discharge sensitive device observe handling precautions!

#### Electrical Characteristics

Tamb = +25°C

Ref. : DSEC26120077 -17-Marc-00

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Specifications subject to change without notice

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| Symbol | Parameter                            | Test Conditions         | Min  | Typ  | Max  | Unit |
|--------|--------------------------------------|-------------------------|------|------|------|------|
| Idss   | Saturated drain current              | Vds = 2V<br>Vgs = 0V    | 10   | 35   | 60   | mA   |
| Vp     | Pinch off voltage                    | Vds = 2V<br>Ids = 0.1mA | -1.0 | -0.7 | -0.3 | V    |
| Gm     | Transconductance                     | Vds = 2V<br>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          | F= 12GHz |      | 0.5 | 0.7  | dB |
|        |                      |                 | F= 30GHz |      | 1.3 | 1.7  |    |
|        |                      |                 | F= 40GHz |      | 1.5 | 1.9  | dB |
| Ga     | Associated Gain      | Ids=Idss/3      | F= 12GHz | 13   | 14  |      | dB |
|        |                      |                 | F= 30GHz | 9    | 10  |      |    |
|        |                      |                 | F= 40GHz | 8    | 9.5 |      | dB |

## Absolute Maximum Ratings (1)

Tamb = +25°C

| Symbol | Parameter                     | Values      | Units |
|--------|-------------------------------|-------------|-------|
| Vds    | Drain to source voltage       | 3.5         | V     |
| Vgs    | Gate to source voltage        | -2.5        | V     |
| Pt     | Total power dissipation       | 280         | mW    |
| Tch    | Operating channel temperature | +175        | °C    |
| Tstg   | Storage temperature range     | -55 to +175 | °C    |

(1) Operation of this device above any one of these parameters may cause permanent damage

**Typical Scattering Parameters**

Tamb = +25°C

"S" Parameters, including Lg=Ld-0.15nH

Vds = 3V, Ids = 30mA

| Freq.<br>GHz | S11<br>dB | S11<br>/° | S12<br>dB | S12<br>/° | S21<br>dB | S21<br>/° | S22<br>dB | S22<br>/° |
|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 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     |

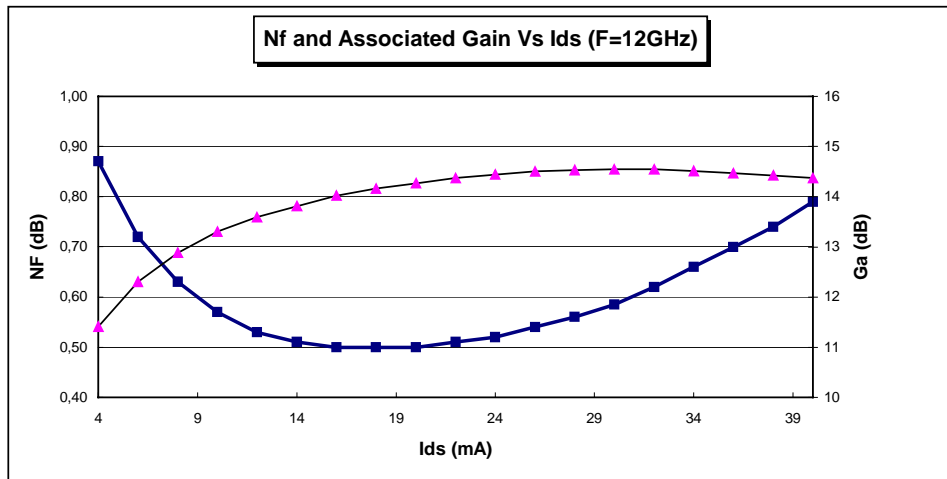
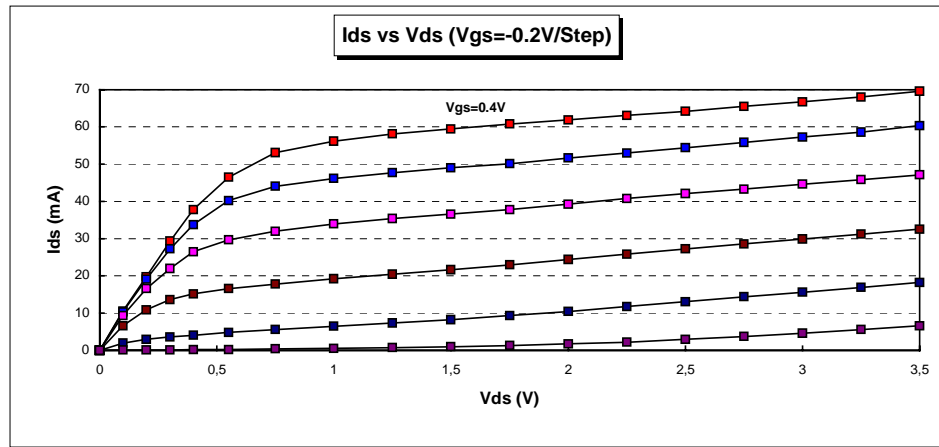
Tamb = +25°C

"S" Parameters, including  $L_g=L_d\sim 0.15nH$   
 $V_{ds} = 2V, I_{ds} = 10mA$

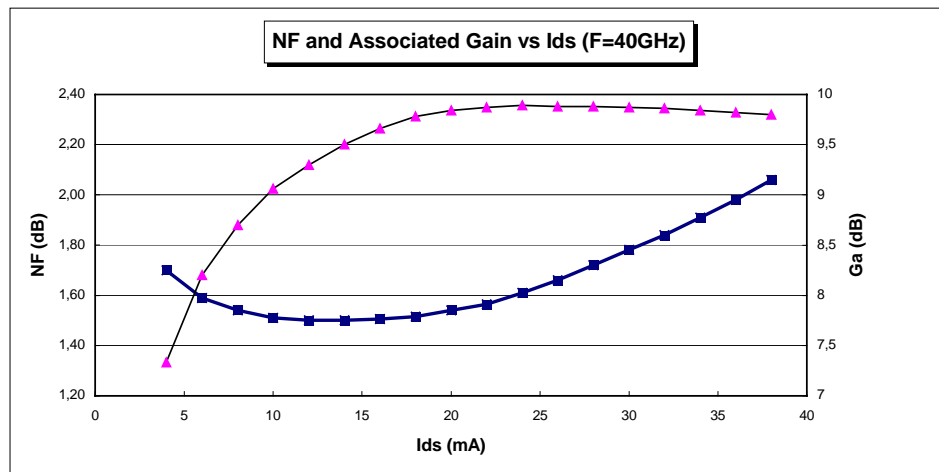
| Freq.<br>GHz | S11<br>dB | S11<br>/° | S12<br>dB | S12<br>/° | S21<br>dB | S21<br>/° | S22<br>dB | S22<br>/° |
|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1            | -0,11     | -10,5     | -33,67    | 82,3      | 13,52     | 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     |

**Typical results**

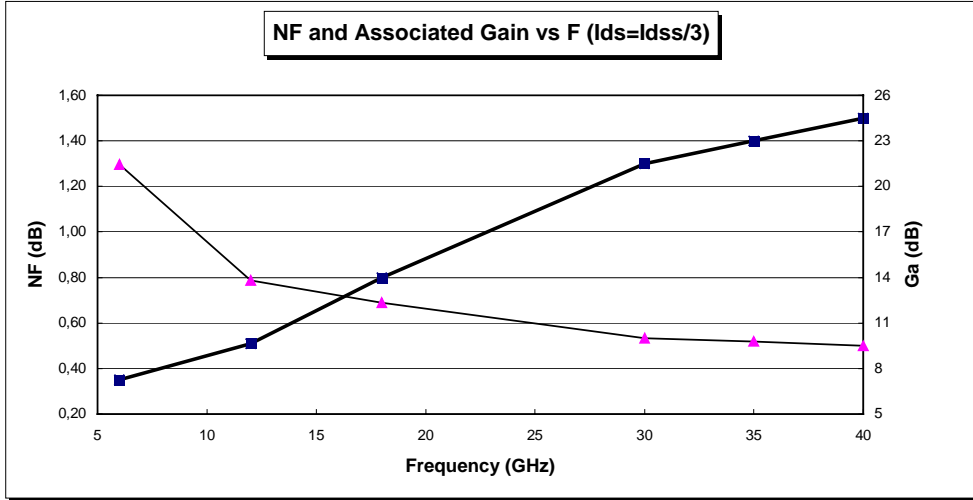
Tamb = +25°C



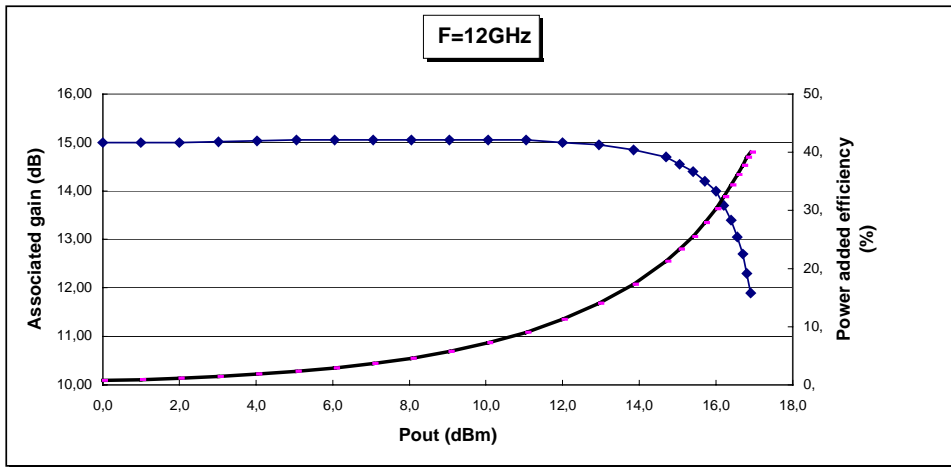
$V_{ds} = 2V$



$V_{ds}=2V$



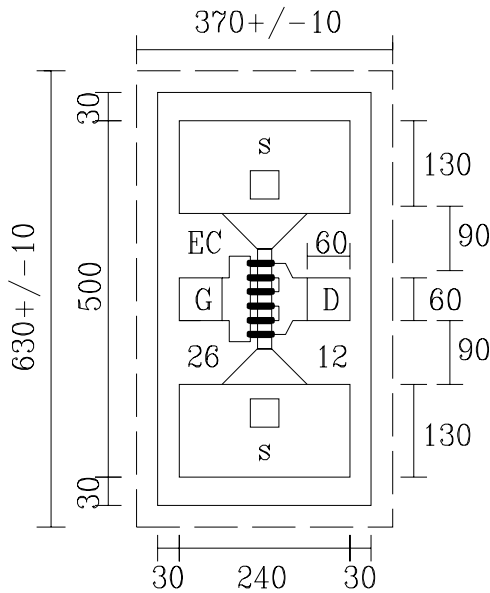
Vds=2V



Vds = 3V, Ids = 31mA



## Chip Mechanical Data



dimensions in  $\mu\text{m}$

Drain area =  $60 \times 60 \mu\text{m}$

Gate area =  $60 \times 60 \mu\text{m}$

Thickness =  $100 \mu\text{m}$

### Recommended die attach :

Stage temperature =  $300^\circ\text{C}$   
(minimize temp. and time whenever possible)

Preforms = Au/Sn (80/20)

Atmosphere : dry nitrogen or forming gas flow

### Recommended bonding :

$\varnothing 18 \mu\text{m}$  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

## Ordering Information

Chip form : EC2612-99F/00

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