# THE DATASHEET OF

# BFR843EL3E6327XTSA1

# BFR843EL3

## Low noise broadband pre-matched RF bipolar transistor

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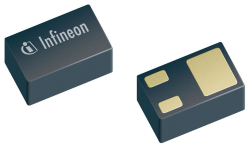
## Product description

The BFR843EL3 is a low noise dual band pre-matched transistor in a low profile package for high speed and low power consumption applications.




## Feature list

- Unique combination of high end RF performance and robustness: 20 dBm maximum RF input power and 1 kV HBM ESD hardness
- High transition frequency enables best in class noise performance at high frequencies: $NF_{min}$ = 1 dB at 2.4 GHz, 1.8 V, 8 mA and 1.15 dB at 5.5 GHz, 1.8 V, 8 mA
- High gain $G_{ms}$ = 24 dB at 2.4 GHz, 1.8 V, 15 mA and 21.5 dB at 5.5 GHz, 1.8 V, 15 mA
- $OIP_3$ = 20.5 dBm at 2.4 GHz, 1.8 V, 15 mA and 20.5 dBm at 5.5 GHz, 1.8 V, 15 mA
- Suitable for low voltage applications e.g. $V_{CC}$ = 1.2 V and 1.8 V (2.85 V, 3.3 V, 3.6 V require corresponding collector resistor)

## Product validation

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22.

## Potential applications

- Wireless communications: WLAN 2.4 GHz and 5-6 GHz bands, broadband LTE or WiMAX LNA
- Satellite navigation systems (e.g. GPS, GLONASS, BeiDou, Galileo...) and satellite C-band LNB (1st and 2nd stage LNA)

## Device information

**Table 1 Part information**

| Product name / Ordering code | Package | Pin configuration | | | Marking | Pieces / Reel |
|---|---|---|---|---|---|---|
| BFR843EL3 / BFR843EL3E6327XTSA1 | TSLP-3-10 | 1 = B | 2 = C | 3 = E | T2 | 15000 |

***Attention: ESD (Electrostatic discharge) sensitive device, observe handling precautions***

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# 1 Absolute maximum ratings

**Table 2 Absolute maximum ratings at $T_A$ = 25 °C (unless otherwise specified)**

| Parameter | Symbol | Values | | Unit | Note or test condition |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Collector emitter voltage | $V_{CEO}$ | – | 2.25 | V | Open base |
| | | | 2.0 | | $T_A$ = -55 °C, open base |
| Collector emitter voltage [1] | $V_{CES}$ | | 2.25 | | E-B short circuited |
| | | | 2.0 | | $T_A$ = -55 °C, E-B short circuited |
| Collector base voltage [2] | $V_{CBO}$ | | 2.9 | | Open emitter |
| | | | 2.6 | | $T_A$ = -55 °C, open emitter |
| Base current | $I_B$ | -1 | 5 | mA | |
| Collector current | $I_C$ | – | 55 | | |
| RF input power | $P_{RFin}$ | | 20 | dBm | $f$ = 1.9 GHz, matched to 50 Ω |
| ESD stress pulse | $V_{ESD}$ | -1 | 1 | kV | HBM, all pins, acc. to JESD22-A114 |
| Total power dissipation [3] | $P_{tot}$ | – | 125 | mW | $T_S \leq$ 103 °C |
| Junction temperature | $T_J$ | | 150 | °C | |
| Storage temperature | $T_{Stg}$ | -55 | | | |

***Attention**: **Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Exceeding only one of these values may cause irreversible damage to the integrated circuit.***

1 $V_{CES}$ is similar to $V_{CEO}$ due to design.
2 $V_{CBO}$ is similar to $V_{CEO}$ due to design.
3 $T_S$ is the soldering point temperature. $T_S$ is measured on the emitter lead at the soldering point of the PCB.

# 2 Thermal characteristics

**Table 3 Thermal resistance**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Junction - soldering point | $R_{thJS}$ | – | 375 | – | K/W | |

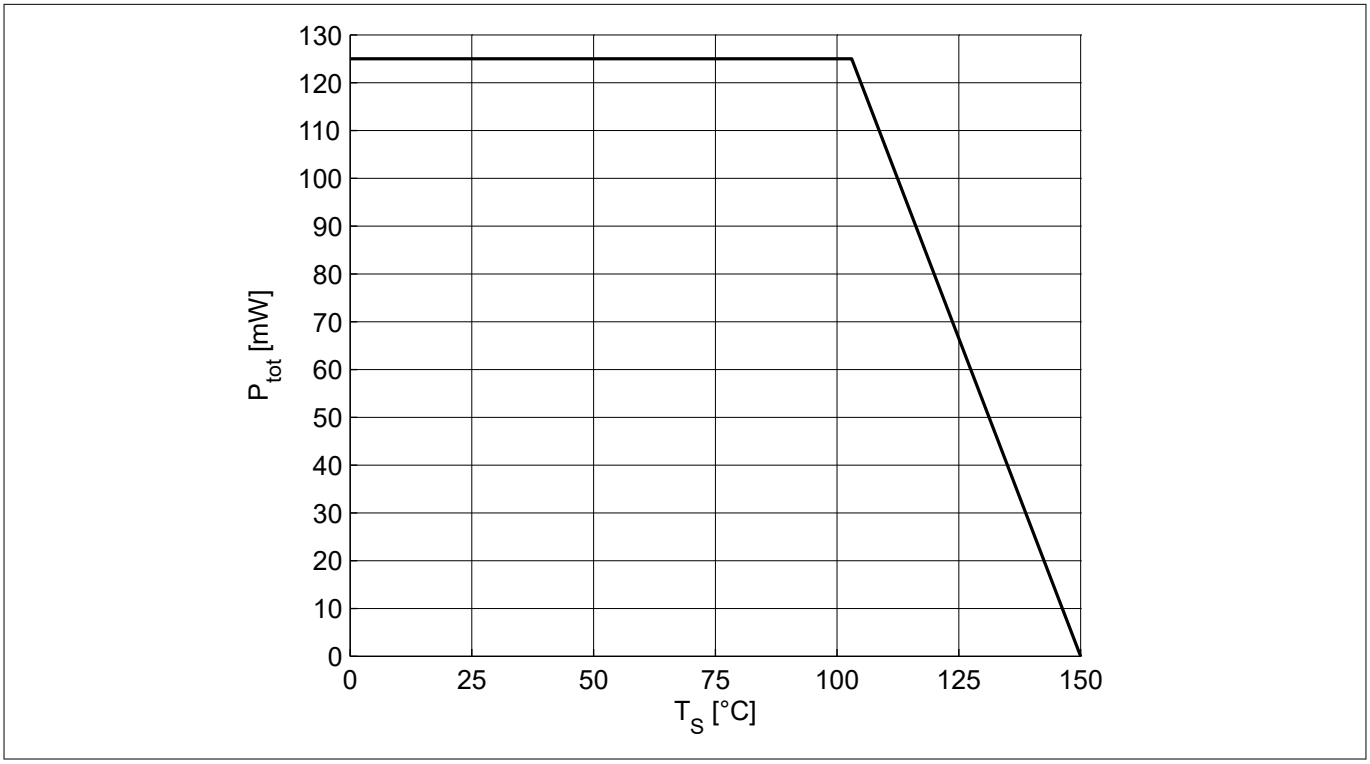


**Figure 1 Total power dissipation $P_{tot} = f(T_S)$**

# 3 Electrical characteristics

## 3.1 DC characteristics

**Table 4 DC characteristics at $T_A$ = 25 °C**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Collector emitter breakdown voltage | $V_{(BR)CEO}$ | 2.25 | 2.6 | – | V | $I_C$ = 1 mA, $I_B$ = 0, open base |
| Collector emitter leakage current | $I_{CES}$ | – | – | 400 [4] | nA | $V_{CE}$ = 1.5 V, $V_{BE}$ = 0, E-B short circuited |
| Collector base leakage current | $I_{CBO}$ | | | 400 [4] | | $V_{CB}$ = 1.5 V, $I_E$ = 0, open emitter |
| Emitter base leakage current | $I_{EBO}$ | | | 10 [4] | µA | $V_{EB}$ = 0.5 V, $I_C$ = 0, open collector |
| DC current gain | $h_{FE}$ | 230<br>– | 360<br>260 | 580<br>– | | $V_{CE}$ = 1.8 V, $I_C$ = 1 mA<br>$V_{CE}$ = 1.8 V, $I_C$ = 15 mA<br>Pulse measured |

## 3.2 General AC characteristics

**Table 5 General AC characteristics at $T_A$ = 25 °C**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Collector base capacitance [5] | $C_{CB}$ | – | 5.26<br>0.07 | – | pF | $f$ = 1 MHz<br>$f$ = 1 GHz<br>$V_{CB}$ = 1.8 V, $V_{BE}$ = 0, emitter grounded |
| Collector emitter capacitance | $C_{CE}$ | | 0.42 | | | $f$ = 1 MHz, $V_{CE}$ = 1.8 V, $V_{BE}$ = 0, base grounded |
| Emitter base capacitance | $C_{EB}$ | | 0.66 | | | $f$ = 1 MHz, $V_{EB}$ = 0.4 V, $V_{CB}$ = 0, collector grounded |

4 Maximum values not limited by the device but by the short cycle time of the 100% test.
5 Including integrated feedback capacitance

## 3.3 Frequency dependent AC characteristics

Measurement setup is a test fixture with Bias-T's in a 50 Ω system, $T_A$ = 25 °C.

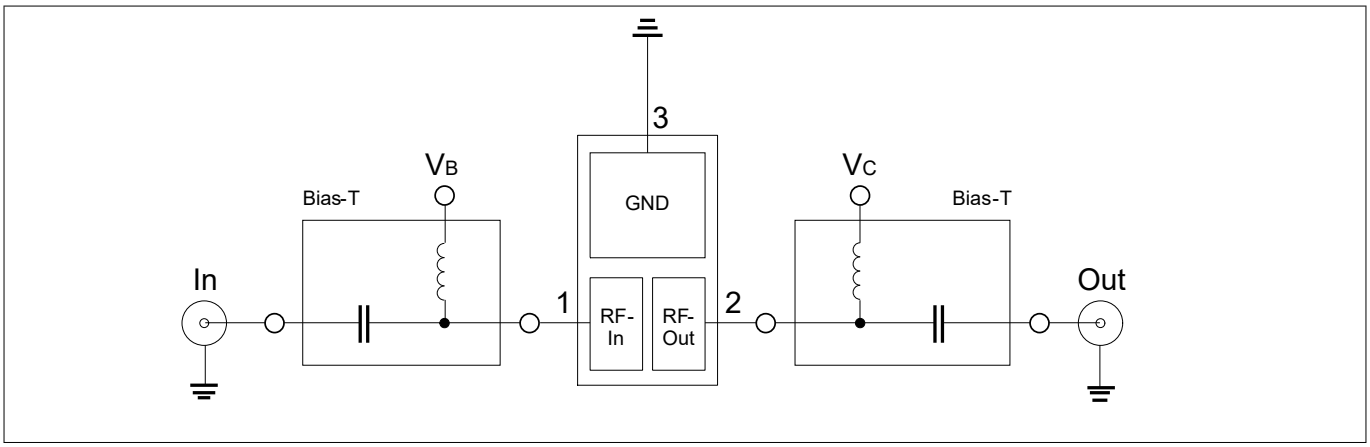


**Figure 2 Testing circuit**

**Table 6 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 450 MHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ms}$ | | 25.5 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 24.5 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 0.95 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 22.5 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 23 | | | $Z_S = Z_L$ = 50 Ω, $I_C$ = 15 mA |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 7.5 | | | |

**Table 7 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 900 MHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ms}$ | | 25 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 24 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 0.95 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 22 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 21.5 | | | $Z_S = Z_L$ = 50 Ω, $I_C$ = 15 mA |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 7 | | | |

**Table 8 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 1.5 GHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ms}$ | | 24.5 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 23 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 0.95 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 21.5 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 21.5 | | | $Z_S = Z_L$ = 50 Ω, $I_C$ = 15 mA |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 7 | | | |

**Table 9 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 1.9 GHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ms}$ | | 24.5 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 22.5 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 1 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 21 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 21 | | | $Z_S = Z_L$ = 50 Ω, $I_C$ = 15 mA |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 7 | | | |

**Table 10 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 2.4 GHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ms}$ | | 24 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 22 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 1 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 20 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 20.5 | | | $Z_S = Z_L$ = 50 Ω, $I_C$ = 15 mA |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 6 | | | |

**Table 11 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 3.5 GHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ms}$ | | 23 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 19.5 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 1.05 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 18.5 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 20.5 | | | $Z_S = Z_L$ = 50 Ω, $I_C$ = 15 mA |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 6 | | | |

**Table 12 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 5.5 GHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ms}$ | | 21.5 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 16.5 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 1.15 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 15.5 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 20.5 | | | $Z_S = Z_L$ = 50 Ω, $I_C$ = 15 mA |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 4.5 | | | |

**Table 13 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 10 GHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ma}$ | | 14.5 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 10.5 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 1.35 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 10.5 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 17 | | | $Z_S = Z_L$ = 50 Ω, $I_C$ = 15 mA |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 1.5 | | | |

***Note**: $G_{ms} = |S_{21} / S_{12}|$ for $k < 1$; $G_{ma} = |S_{21} / S_{12}| (k-(k^2-1)^{1/2})$ for $k > 1$. In order to get the $NF_{min}$ values stated in this chapter, the test fixture losses have been subtracted from all measured results. $OIP_3$ value depends on termination of all intermodulation frequency components. Termination used for this measurement is 50 Ω from 0.2 MHz to 12 GHz.*

## 3.4 Characteristic DC diagrams

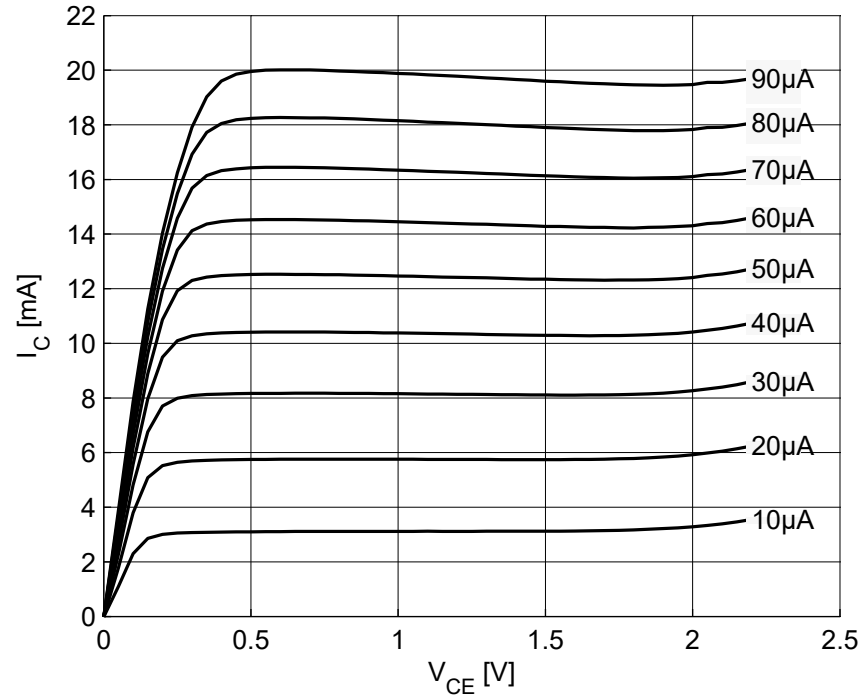


**Figure 3** **Collector current vs. collector emitter voltage $I_C = f(V_{CE})$, $I_B$ = parameter**

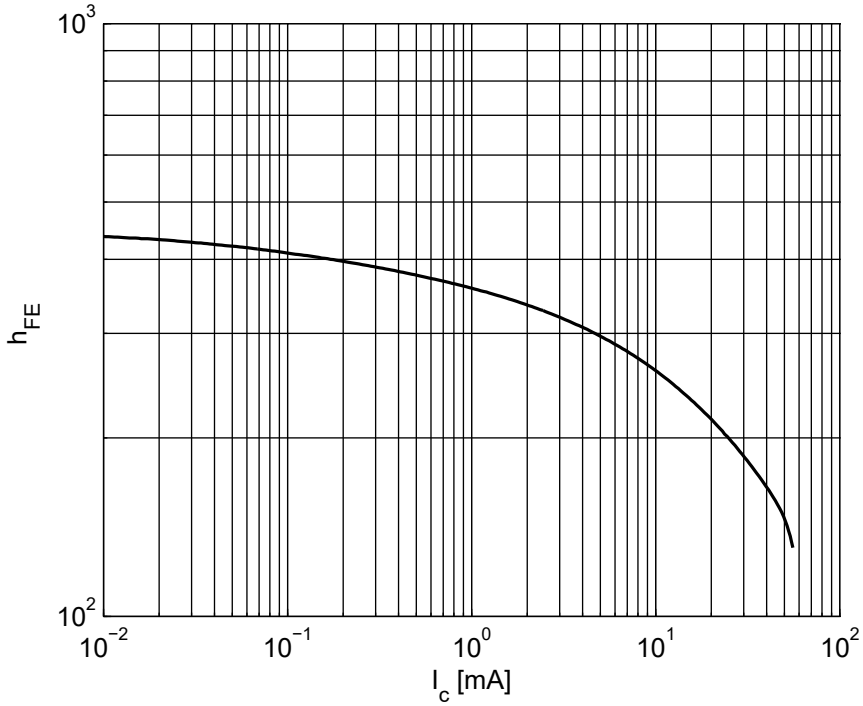


**Figure 4** **DC current gain $h_{FE} = f(I_C)$, $V_{CE}$ = 1.8 V**

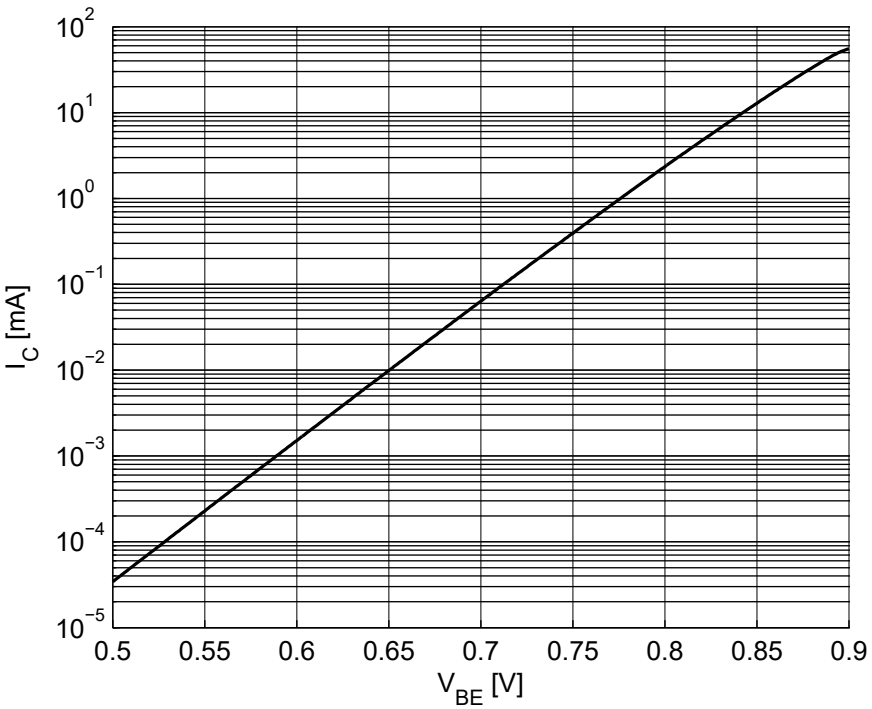


**Figure 5** **Collector current vs. base emitter forward voltage $I_C = f(V_{BE})$, $V_{CE} = 1.8$ V**

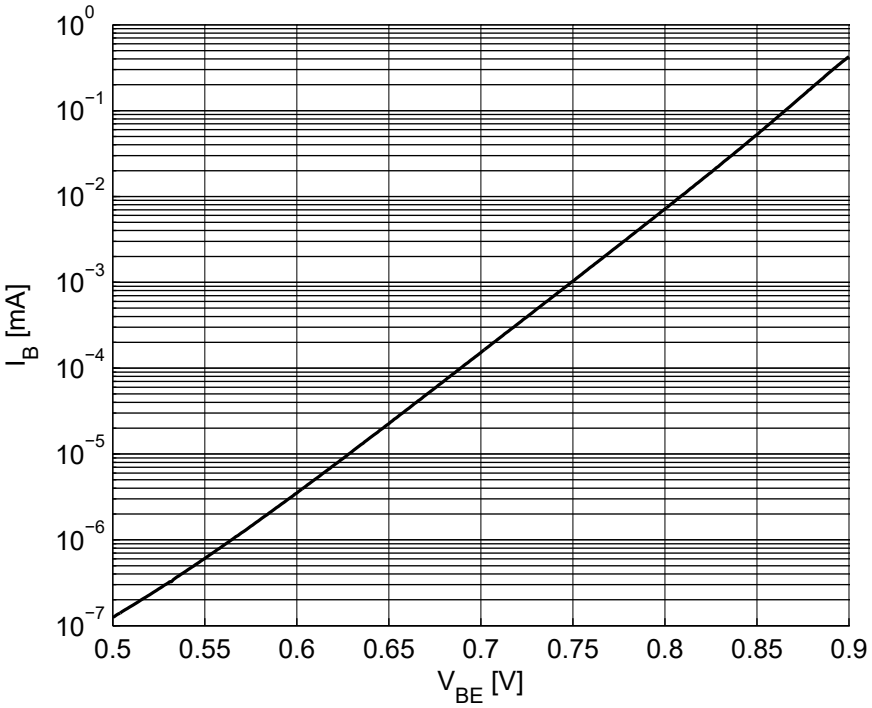


**Figure 6** **Base current vs. base emitter forward voltage $I_B = f(V_{BE})$, $V_{CE} = 1.8$ V**

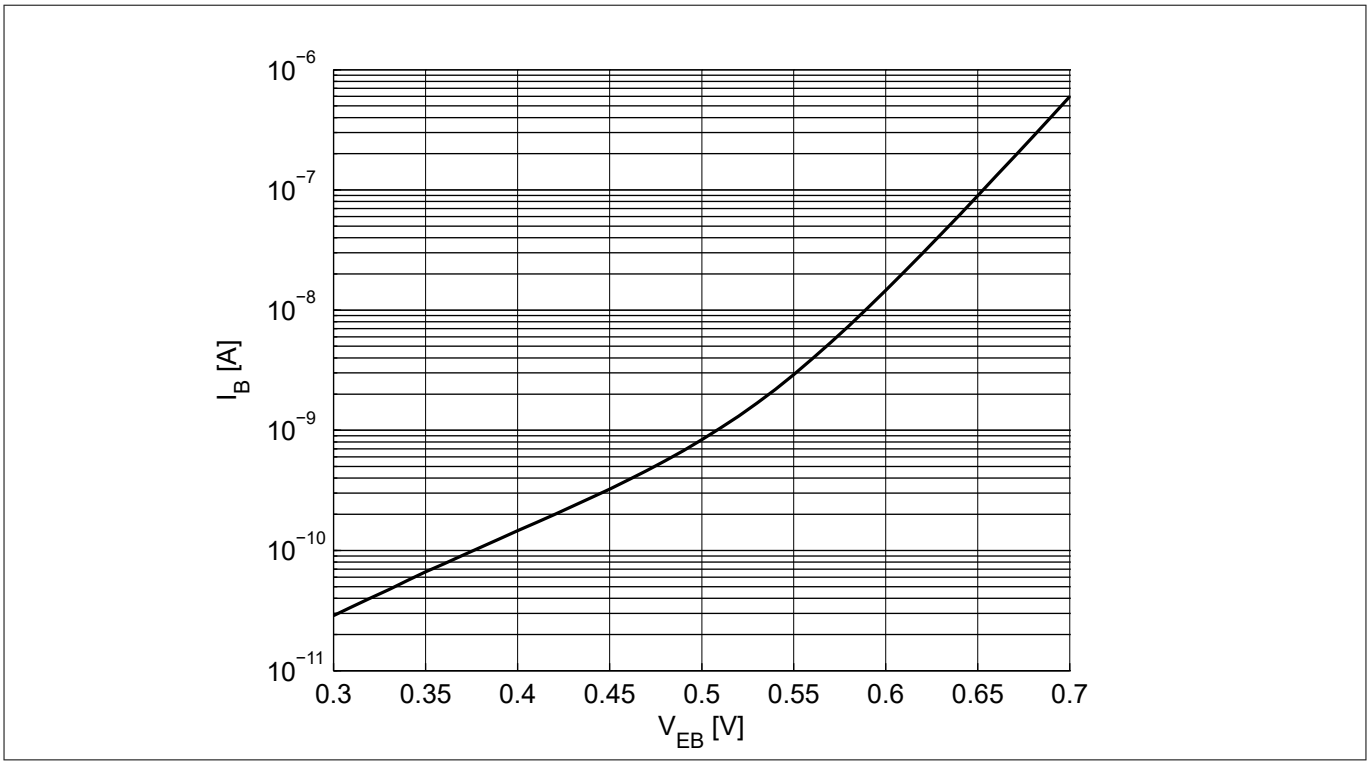


**Figure 7** **Base current vs. base emitter reverse voltage $I_B = f(V_{EB})$, $V_{CE} = 1.8$ V**

## 3.5 Characteristic AC diagrams

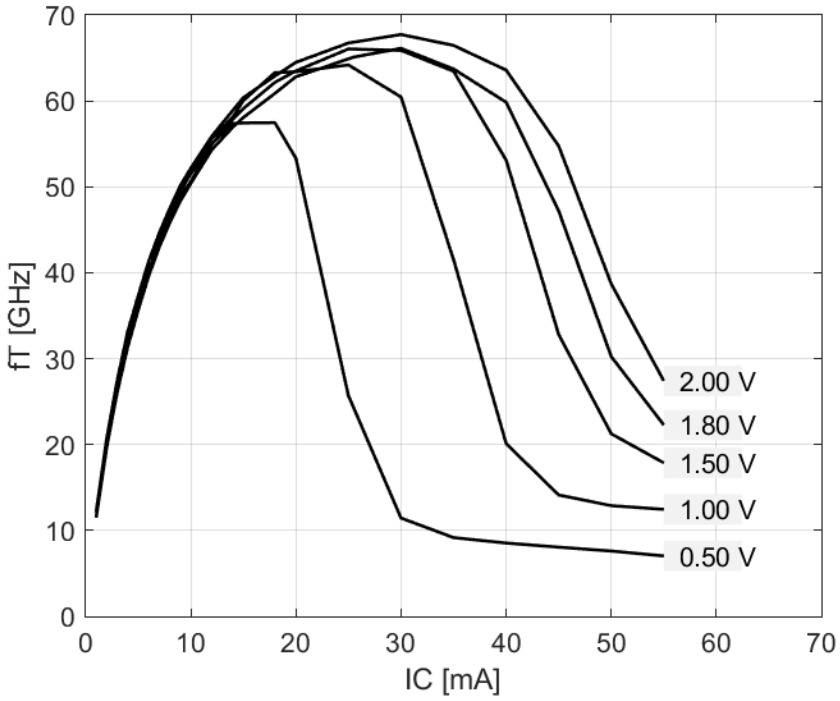


**Figure 8** **Transition frequency $f_T = f(I_C)$, $f = 2$ GHz, $V_{CE}$ = parameter**

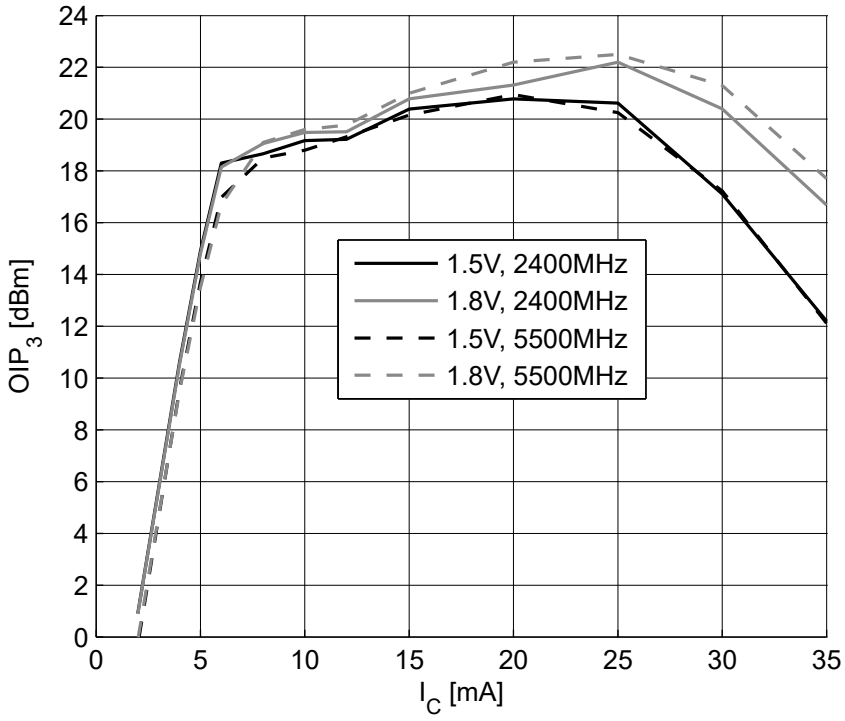


**Figure 9** **3rd order intercept point $OIP_3 = f(I_C)$, $Z_S = Z_L = 50\ \Omega$, $V_{CE}$, $f$ = parameter**

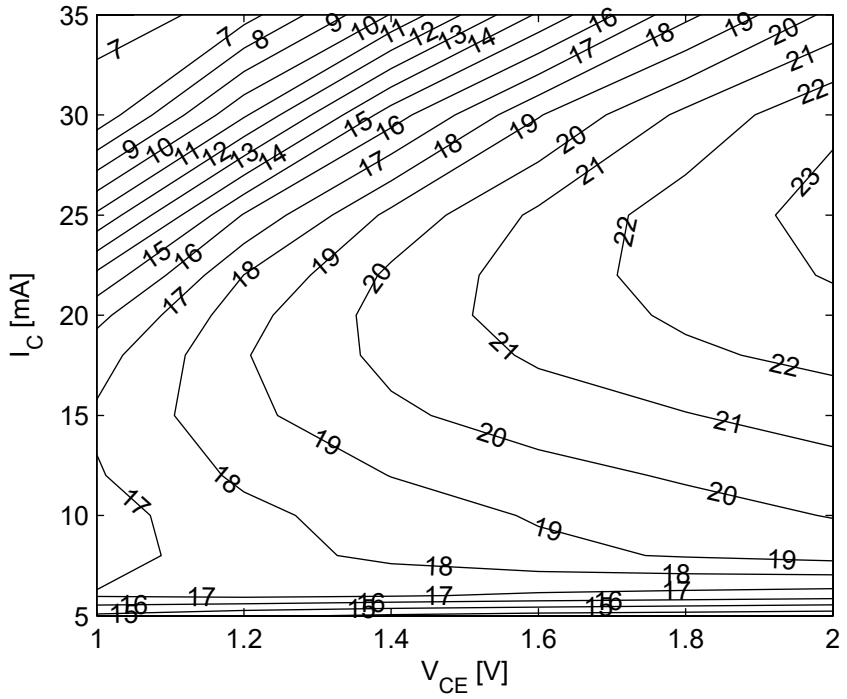


**Figure 10** **3rd order intercept point at output $OIP_3$ [dBm] = f($I_C$, $V_{CE}$), $Z_S$ = $Z_L$ = 50 Ω, $f$ = 5.5 GHz**

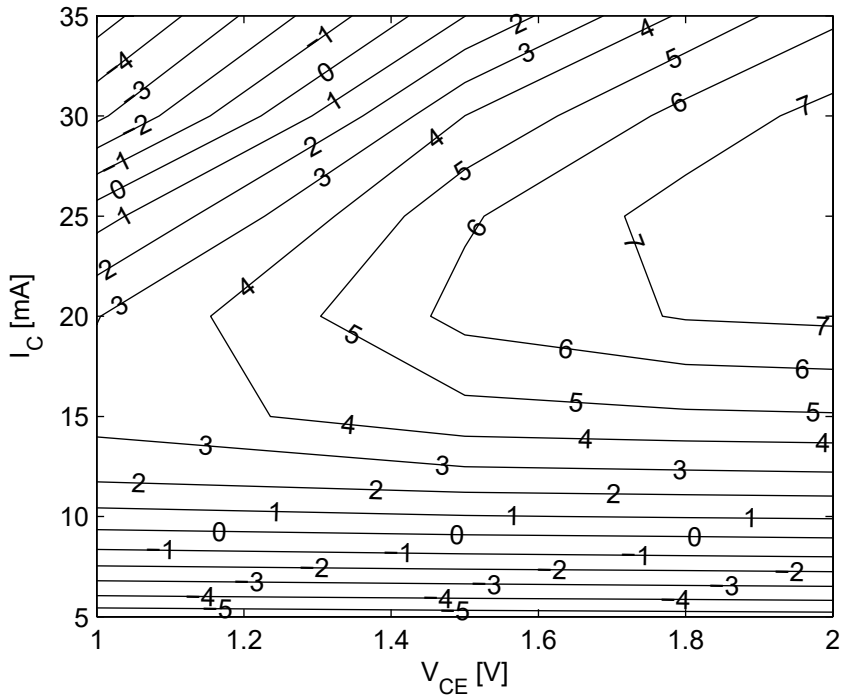


**Figure 11** **Compression point at output $OP_{1dB}$ [dBm] = f($I_C$, $V_{CE}$), $Z_S$ = $Z_L$ = 50 Ω, $f$ = 5.5 GHz**

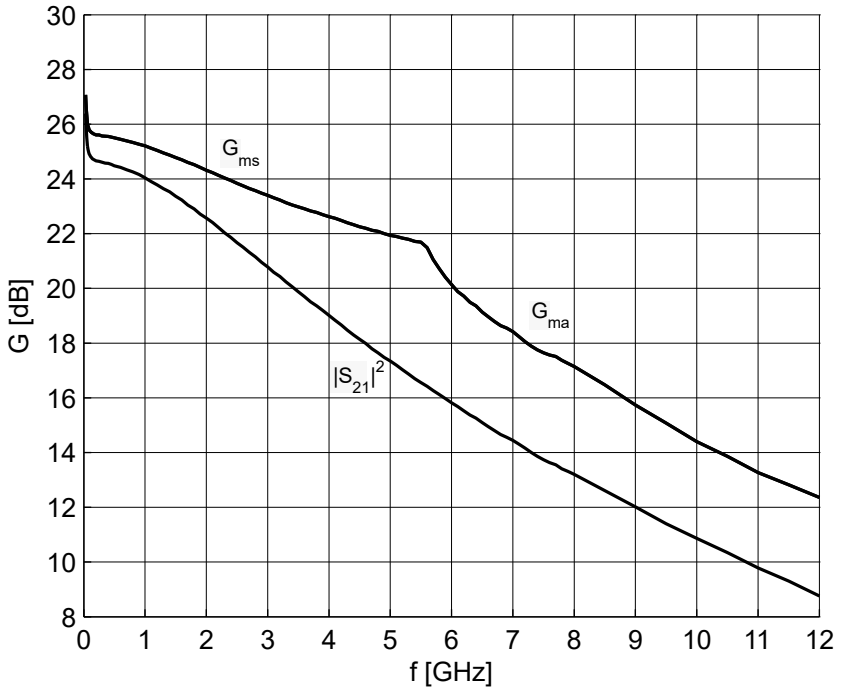


**Figure 12** **Gain $G_{ma}$, $G_{ms}$, $|S_{21}|^2$ = f($f$), $V_{CE}$ = 1.8 V, $I_C$ = 15 mA**

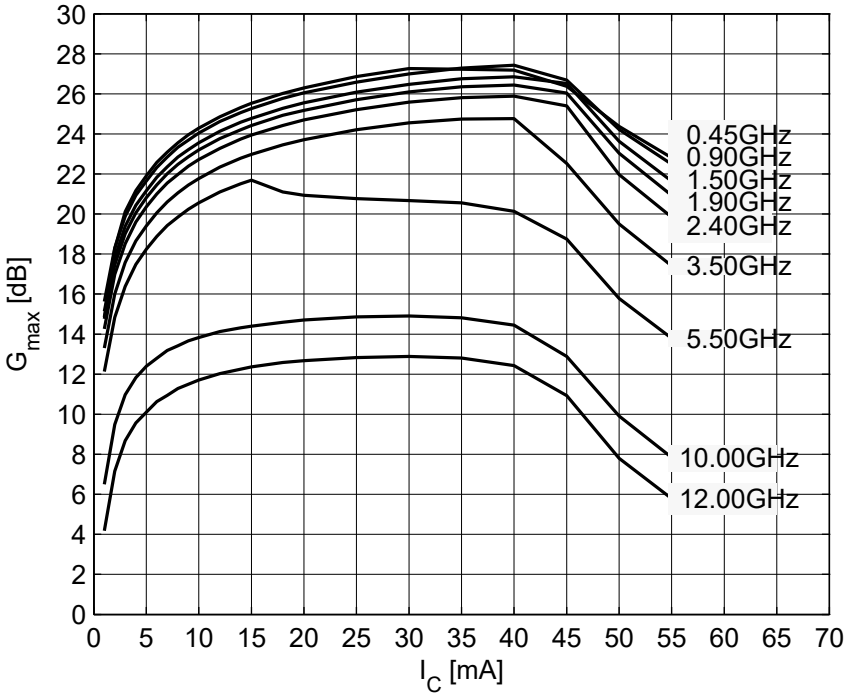


**Figure 13** **Maximum power gain $G_{max}$ = f($I_C$), $V_{CE}$ = 1.8 V, $f$ = parameter**

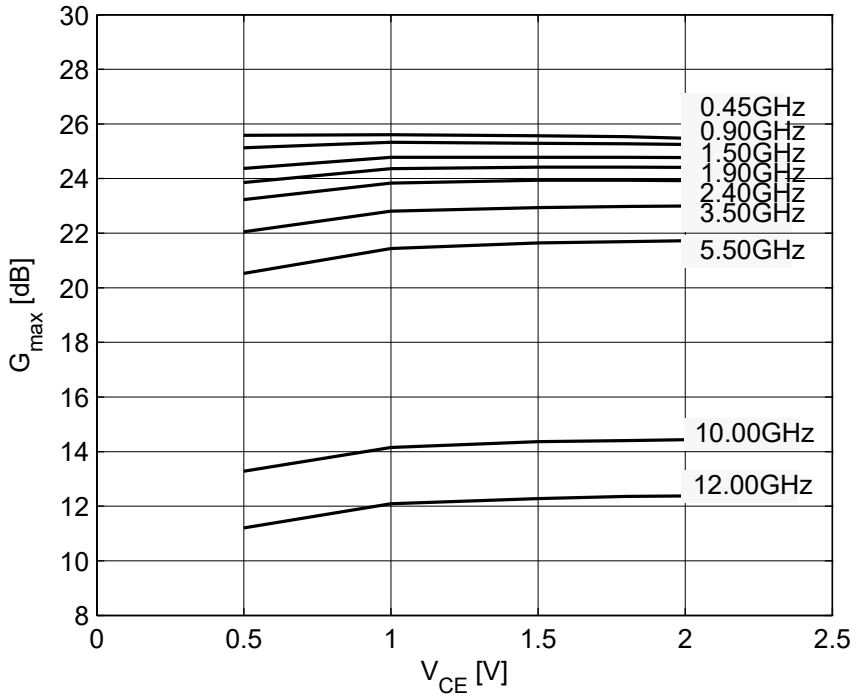


**Figure 14** **Maximum power gain $G_{max}$ = f($V_{CE}$), $I_C$ = 15 mA, $f$ = parameter**

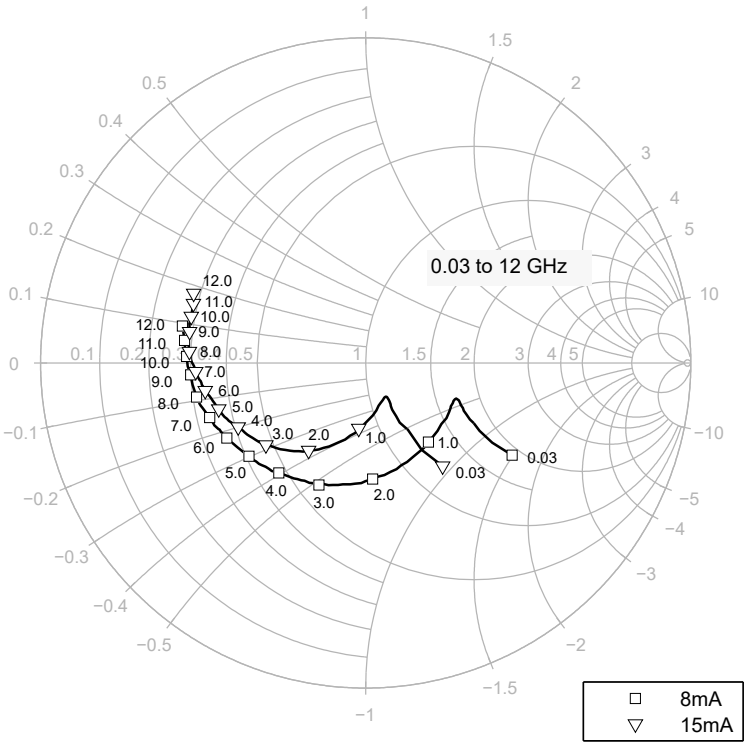


**Figure 15** **Input reflection coefficient $S_{11}$ = f($f$), $V_{CE}$ =1.8 V, $I_C$ = 8 / 15 mA**

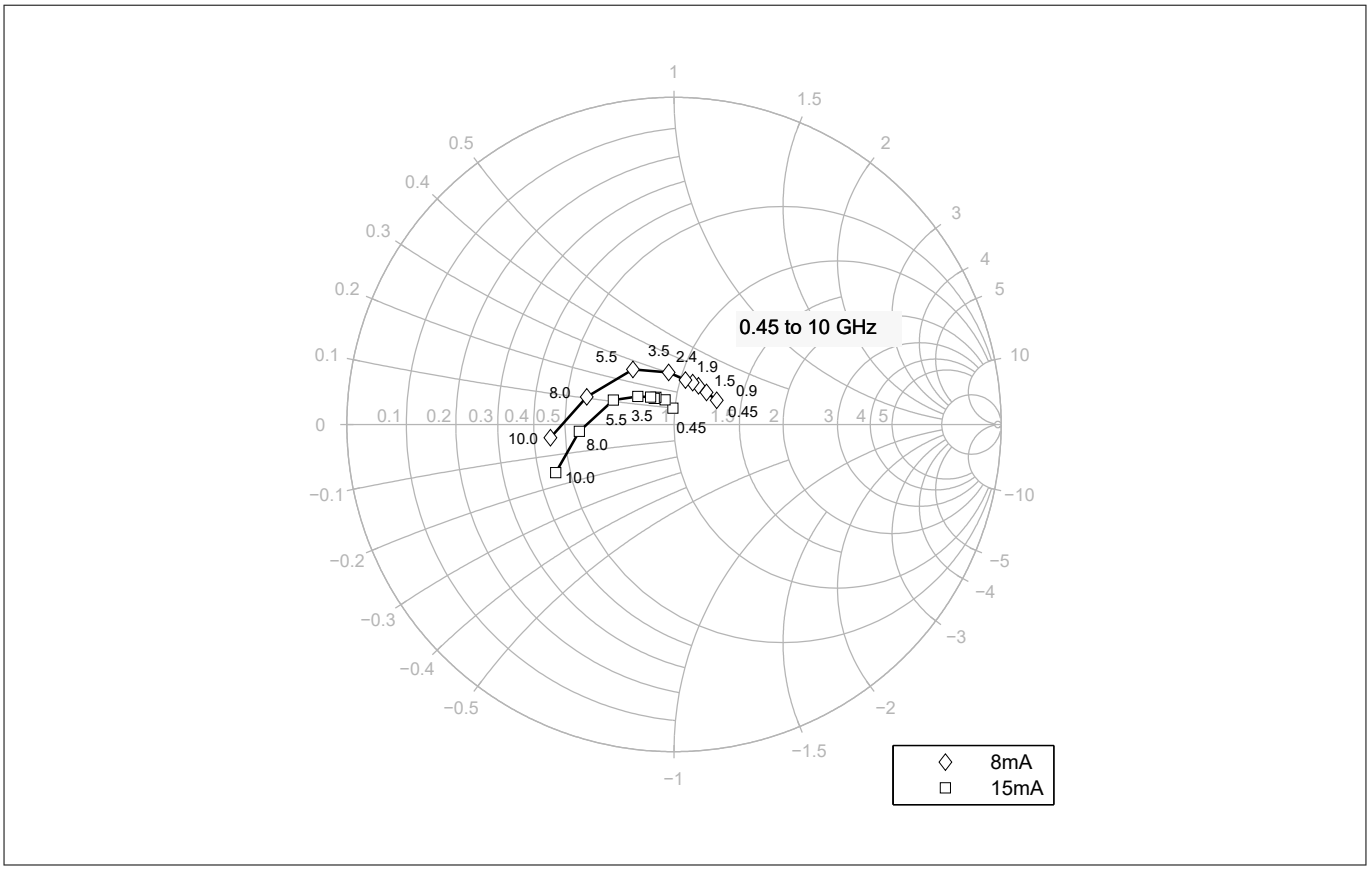


**Figure 16** **Source impedance for minimum noise figure $Z_{S,opt}$ = f($f$), $V_{CE}$ = 1.8 V, $I_C$ = 8 / 15 mA**

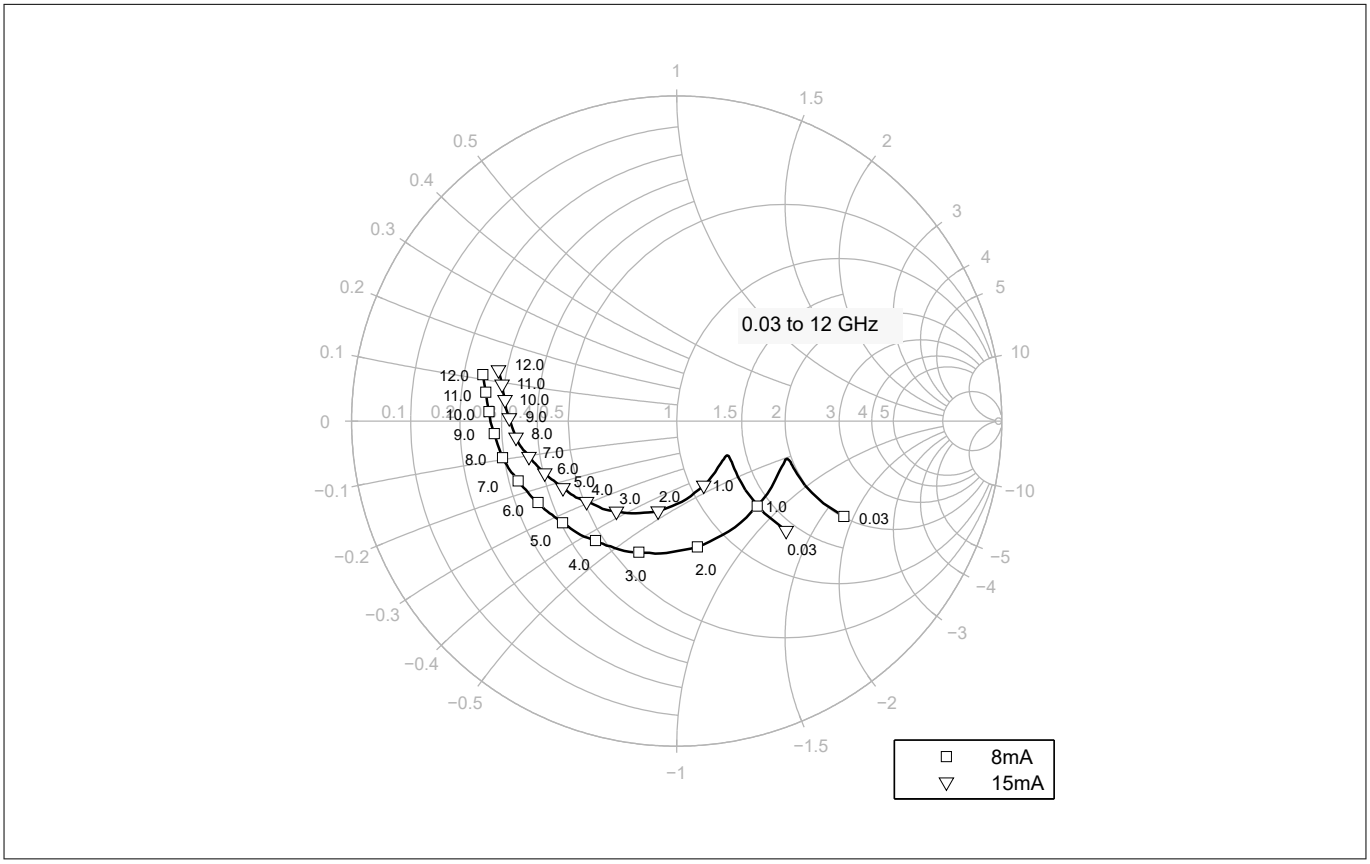


**Figure 17** **Output reflection coefficient $S_{22}$ = f($f$), $V_{CE}$ = 1.8 V, $I_C$ = 8 / 15 mA**

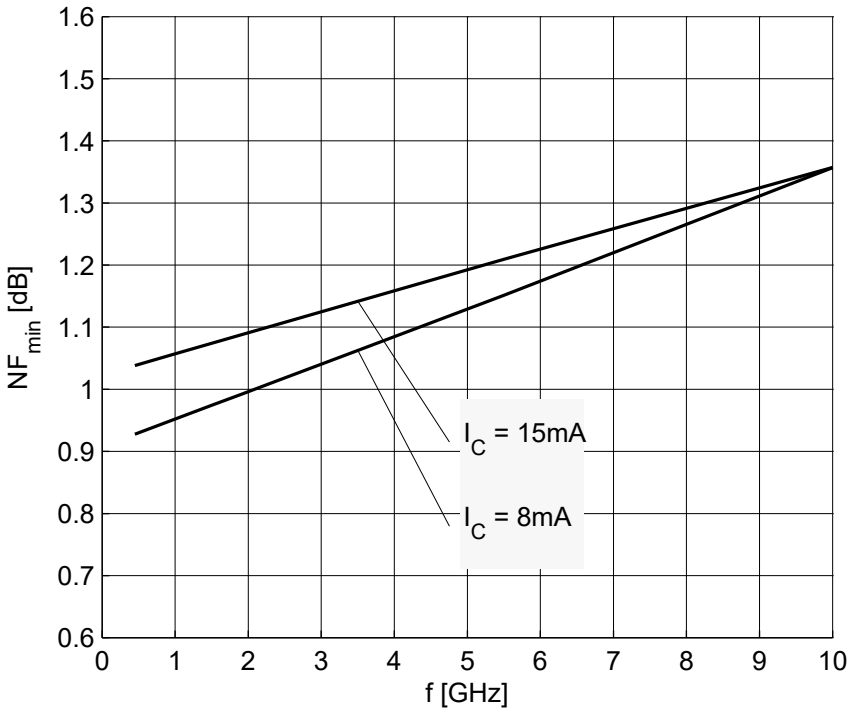


**Figure 18** **Noise figure $NF_{min}$ = f($f$), $V_{CE}$ = 1.8 V, $Z_S$ = $Z_{S,opt}$, $I_C$ = 8 / 15 mA**

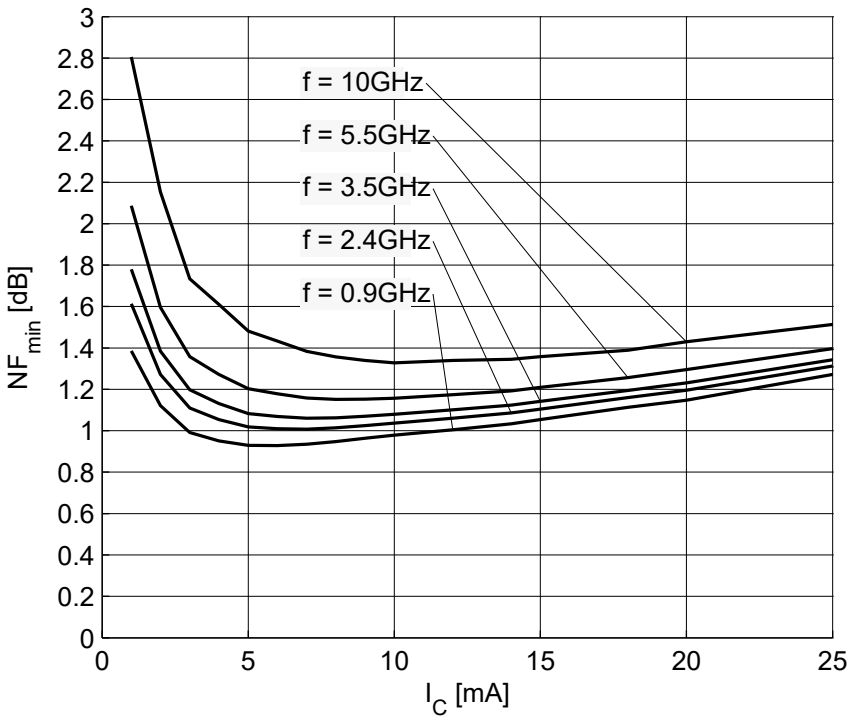


**Figure 19** **Noise figure $NF_{min}$ = f($I_C$), $V_{CE}$ = 1.8 V, $Z_S$ = $Z_{S,opt}$, $f$ = parameter**

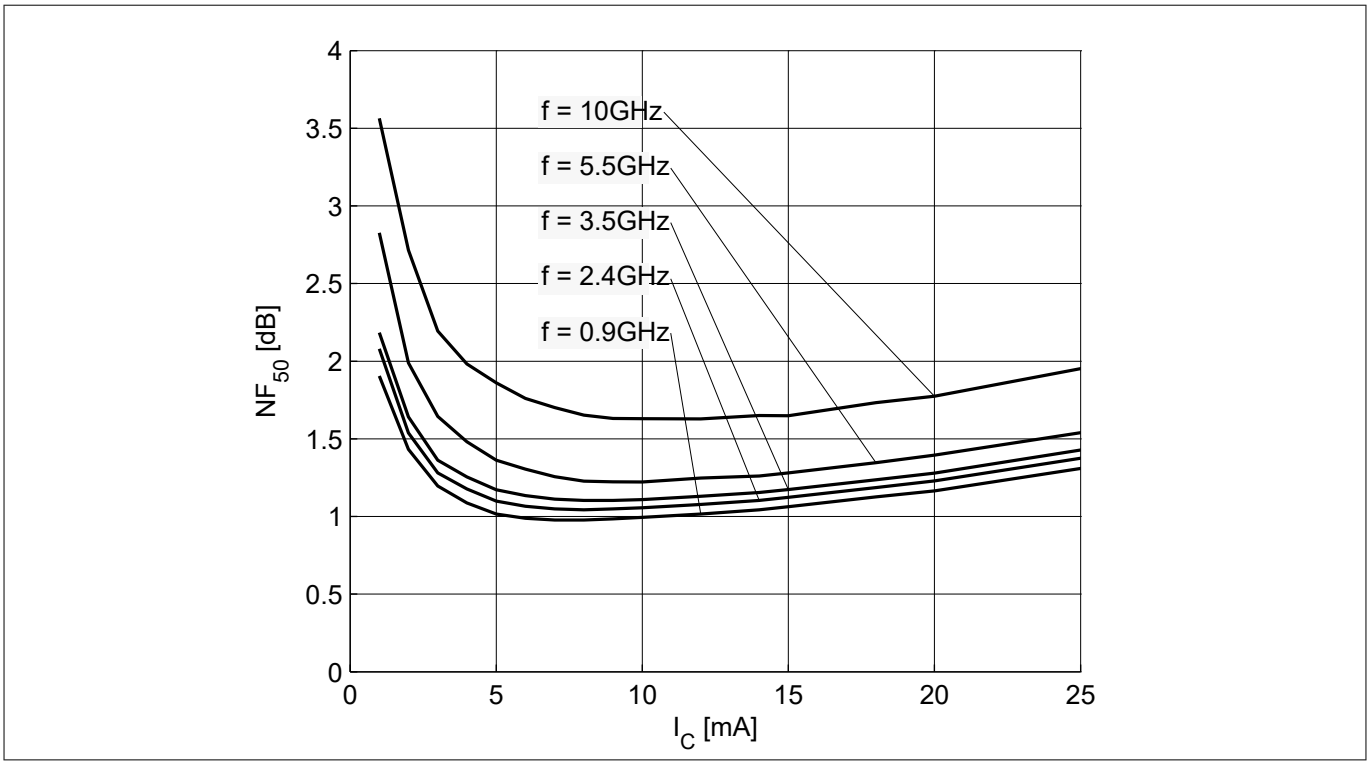


**Figure 20 Noise figure $NF_{50}$ = f($I_C$), $V_{CE}$ = 1.8 V, $Z_S$ = 50 Ω, $f$ = parameter**

***Note**: The curves shown in this chapter have been generated using typical devices but shall not be considered as a guarantee that all devices have identical characteristic curves. $T_A$ = 25 °C.*

# 4 Package information TSLP-3-10

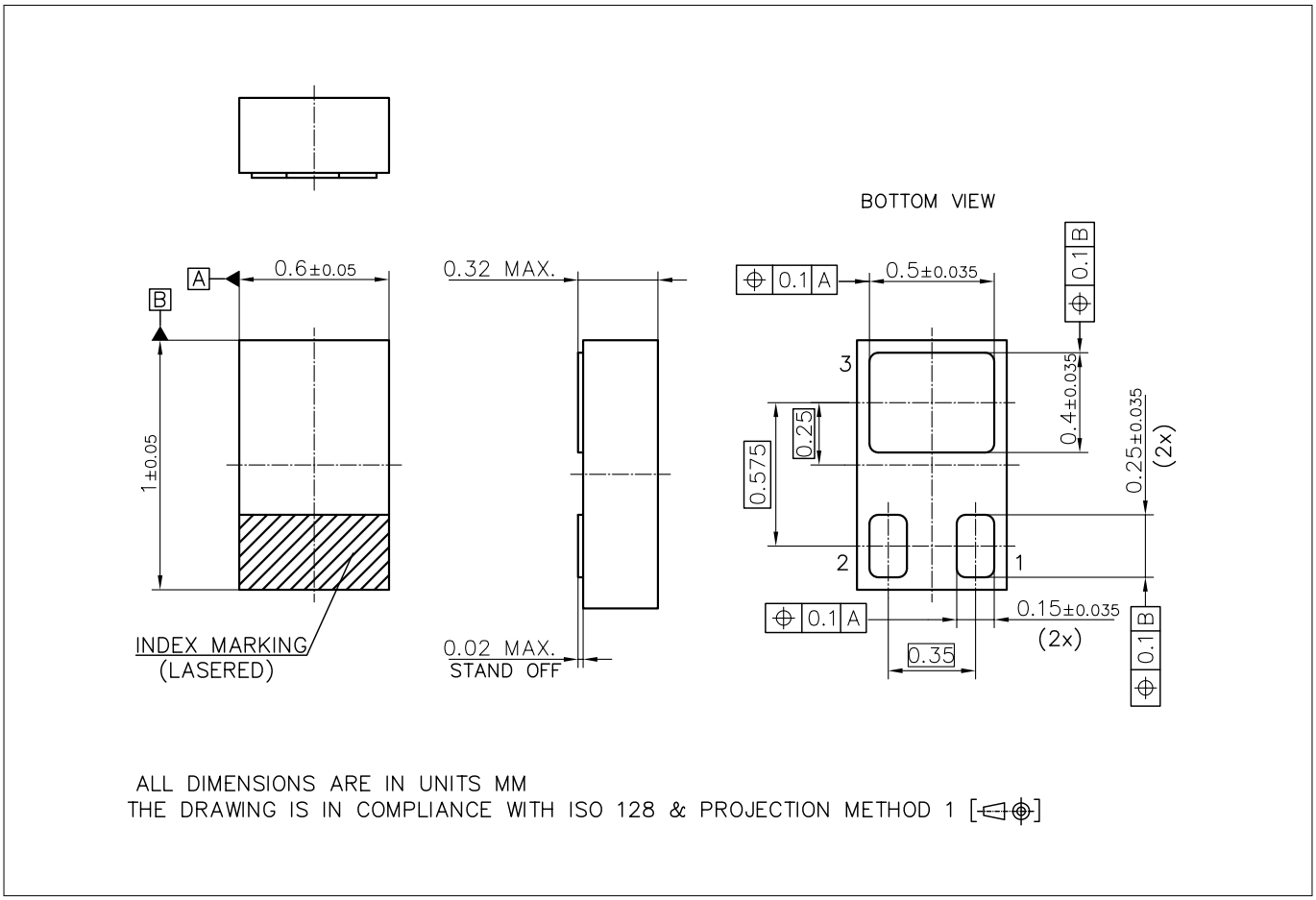


**Figure 21 Package outline**

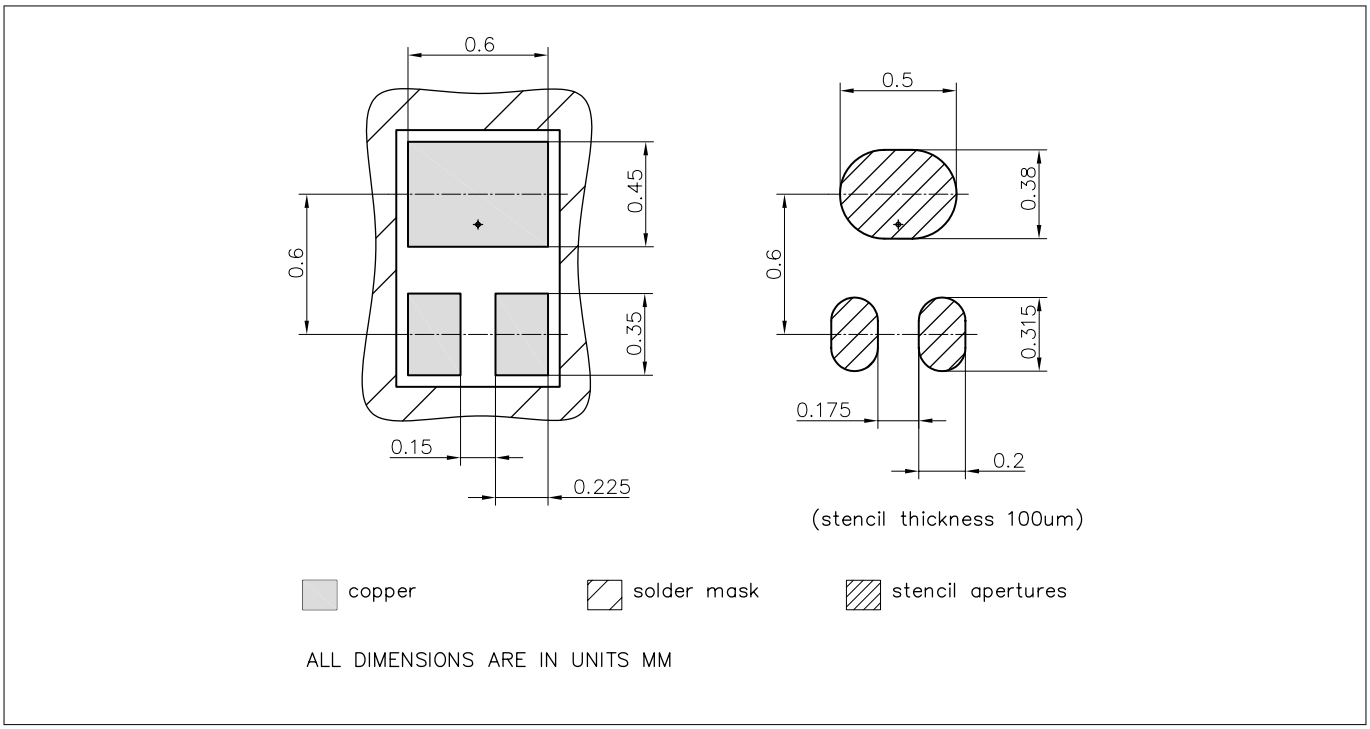


**Figure 22 Foot print**

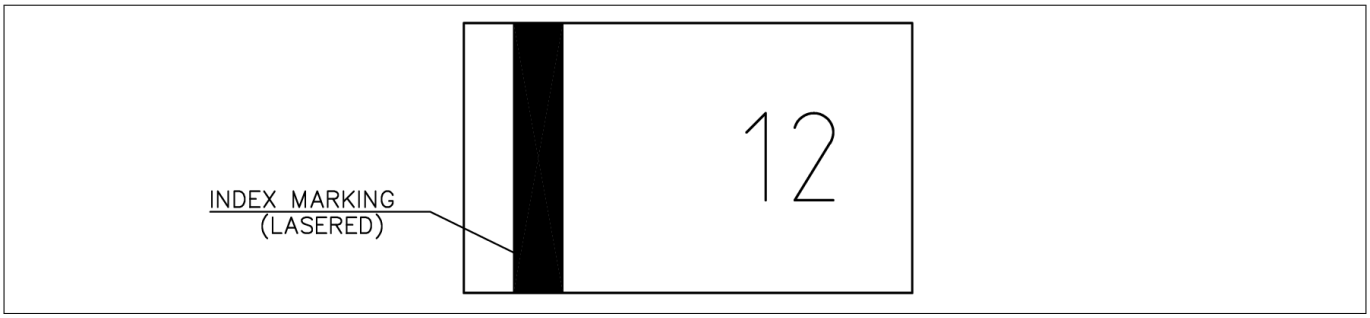


**Figure 23 Marking layout example**

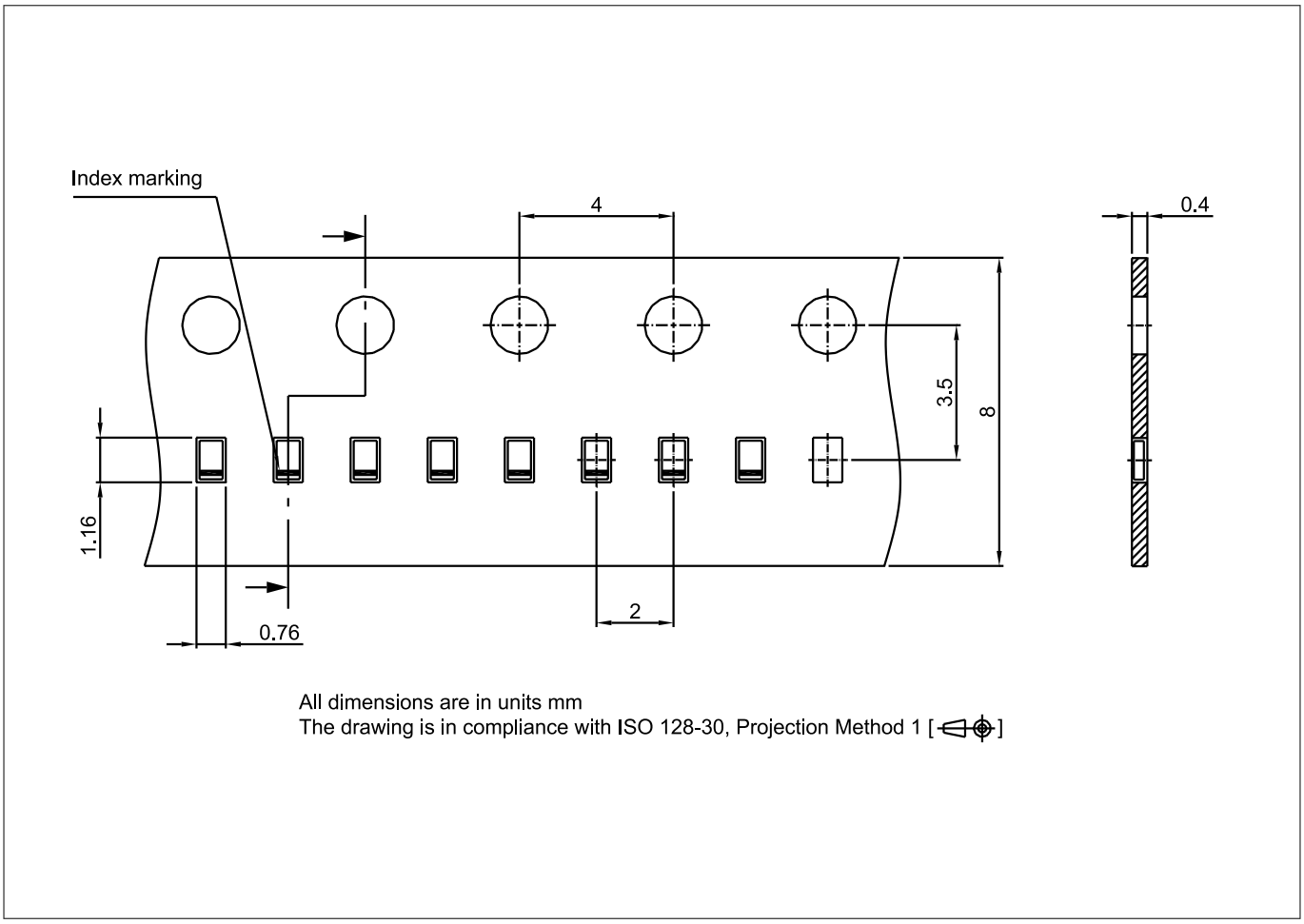


**Figure 24 Tape information**

***Note**: For recommendation on board assembly see the website of package PG-TSLP-3-10.*
*The marking layout is an example. For the real marking code refer to the device information on the first page. The number of characters shown in the layout example is not necessarily the real one. The marking layout can consist of less characters.*

# Revision history

| Document version | Date of release | Description of changes |
|---|---|---|
| 2.0 | 2018-09-26 | • New datasheet layout |
| 2.1 | 2023-12-12 | • Transition frequency curve added<br>• Tape change: New tape drawing |

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