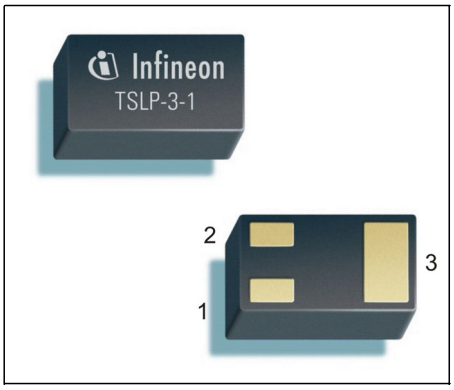
## Low Noise Silicon Bipolar RF Transistor




- Low voltage/ Low current operation
- For low noise amplifiers
- For Oscillators up to 3.5 GHz and Pout > 10 dBm
- Low noise figure: 1.0 dB at 1.8 GHz
- Pb-free (RoHS compliant) and halogen-free thin small leadless package
- Qualification report according to AEC-Q101 available

RoHS HAL

**ESD** (**E**lectro**s**tatic **d**ischarge) sensitive device, observe handling precaution!

| Type | Marking | Pin Configuration | | | Package |
|---|---|---|---|---|---|
| BFR360L3 | FB | 1 = B | 2 = E | 3 = C | TSLP-3-1 |

**Maximum Ratings** at $T_A$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-emitter voltage | $V_{CEO}$ | 6 | V |
| Collector-emitter voltage | $V_{CES}$ | 15 | |
| Collector-base voltage | $V_{CBO}$ | 15 | |
| Emitter-base voltage | $V_{EBO}$ | 2 | |
| Collector current | $I_C$ | 35 | mA |
| Base current | $I_B$ | 4 | |
| Total power dissipation[1)] $T_S \leq 104$°C | $P_{tot}$ | 210 | mW |
| Junction temperature | $T_J$ | 150 | °C |
| Storage temperature | $T_{Stg}$ | -55 ... 150 | |

**Thermal Resistance**

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Junction - soldering point[2)] | $R_{thJS}$ | 220 | K/W |

[1] $T_S$ is measured on the collector lead at the soldering point to the pcb

[2] For the definition of $R_{thJS}$ please refer to Application Note AN077 (Thermal Resistance Calculation)

**Electrical Characteristics** at $T_A$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| **DC Characteristics** | | | | | |
| Collector-emitter breakdown voltage<br>$I_C$ = 1 mA, $I_B$ = 0 | $V_{(BR)CEO}$ | 6 | 9 | - | V |
| Collector-emitter cutoff current<br>$V_{CE}$ = 15 V, $V_{BE}$ = 0 | $I_{CES}$ | - | - | 10 | µA |
| Collector-base cutoff current<br>$V_{CB}$ = 5 V, $I_E$ = 0 | $I_{CBO}$ | - | - | 100 | nA |
| Emitter-base cutoff current<br>$V_{EB}$ = 1 V, $I_C$ = 0 | $I_{EBO}$ | - | - | 1 | µA |
| DC current gain<br>$I_C$ = 15 mA, $V_{CE}$ = 3 V, pulse measured | $h_{FE}$ | 90 | 120 | 160 | - |

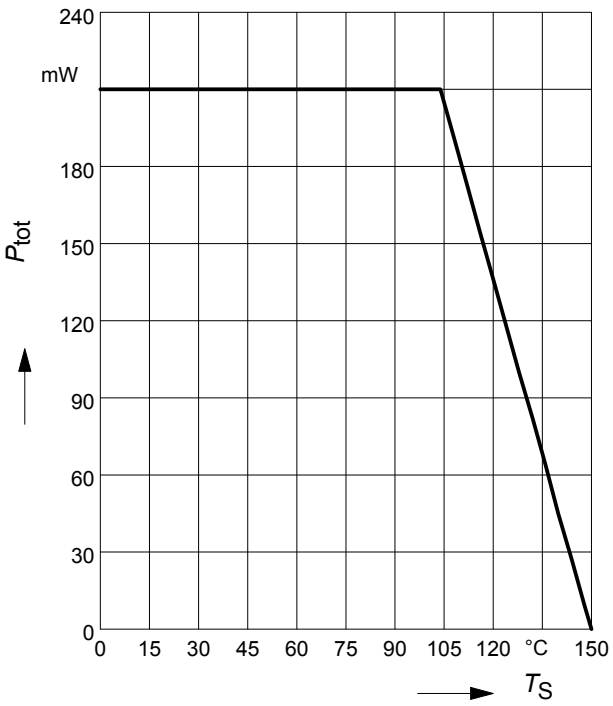
**Electrical Characteristics** at $T_A$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| **AC Characteristics** (verified by random sampling) | | | | | |
| Transition frequency<br>$I_C$ = 15 mA, $V_{CE}$ = 3 V, $f$ = 1 GHz | $f_T$ | 11 | 14 | - | GHz |
| Collector-base capacitance<br>$V_{CB}$ = 5 V, $f$ = 1 MHz, $V_{BE}$ = 0 ,<br>emitter grounded | $C_{cb}$ | - | 0.26 | 0.4 | pF |
| Collector emitter capacitance<br>$V_{CE}$ = 5 V, $f$ = 1 MHz, $V_{BE}$ = 0 ,<br>base grounded | $C_{ce}$ | - | 0.15 | - | |
| Emitter-base capacitance<br>$V_{EB}$ = 0.5 V, $f$ = 1 MHz, $V_{CB}$ = 0 ,<br>collector grounded | $C_{eb}$ | - | 0.42 | - | |
| Minimum noise figure | $NF_{min}$ | | | | dB |
| $I_C$ = 3 mA, $V_{CE}$ = 3 V, $Z_S$ = $Z_{Sopt}$, $f$ = 1.8 GHz | | - | 1 | - | |
| $I_C$ = 3 mA, $V_{CE}$ = 3 V, $Z_S$ = $Z_{Sopt}$, $f$ = 3 GHz | | - | 1.3 | - | |
| Power gain, maximum available[1)]<br>$I_C$ = 15 mA, $V_{CE}$ = 3 V, $Z_S$ = $Z_{Sopt}$ ,<br>$Z_L$ = $Z_{Lopt}$ , $f$ = 1.8 GHz | $G_{ma}$ | - | 16 | - | |
| $I_C$ = 15 mA, $V_{CE}$ = 3 V, $Z_S$ = $Z_{Sopt}$ ,<br>$Z_L$ = $Z_{Lopt}$ , $f$ = 3 GHz | | - | 11.5 | - | |
| Transducer gain<br>$I_C$ = 15 mA, $V_{CE}$ = 3 V, $Z_S$ = $Z_L$ = 50Ω ,<br>$f$ = 1.8 GHz | $\lvert S_{21e}\rvert^2$ | - | 13.5 | - | dB |
| $f$ = 3 GHz | | - | 9 | - | |
| Third order intercept point at output[2)]<br>$V_{CE}$ = 3 V, $I_C$ = 15 mA, $Z_S$=$Z_L$=50 Ω, $f$ = 1.8 GHz | $IP3$ | - | 24 | - | dBm |
| 1dB compression point at output<br>$I_C$ = 15 mA, $V_{CE}$ = 3 V, $Z_S$=$Z_L$=50 Ω, $f$ = 1.8 GHz | $P_{-1dB}$ | - | 9 | - | |

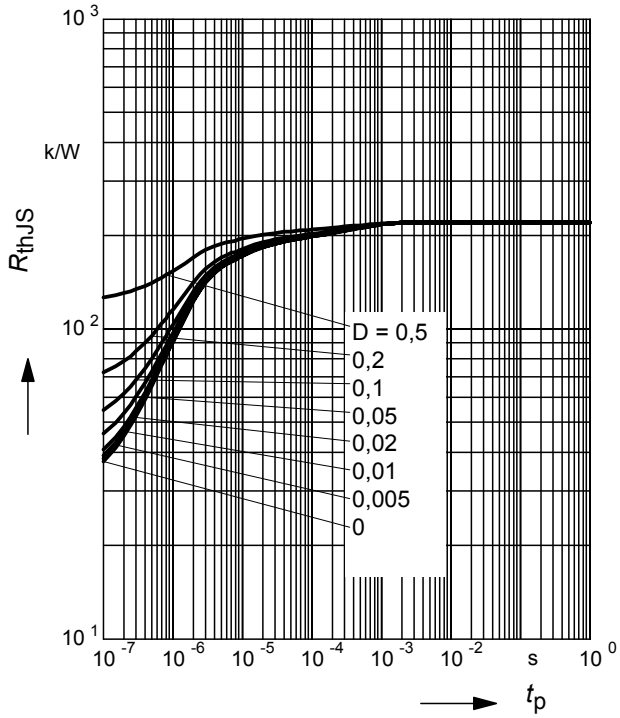
[1] $G_{ma} = |S_{21e} / S_{12e}| (k-(k^2-1)^{1/2})$

[2] IP3 value depends on termination of all intermodulation frequency components.
Termination used for this measurement is 50Ω from 0.1 MHz to 6 GHz

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

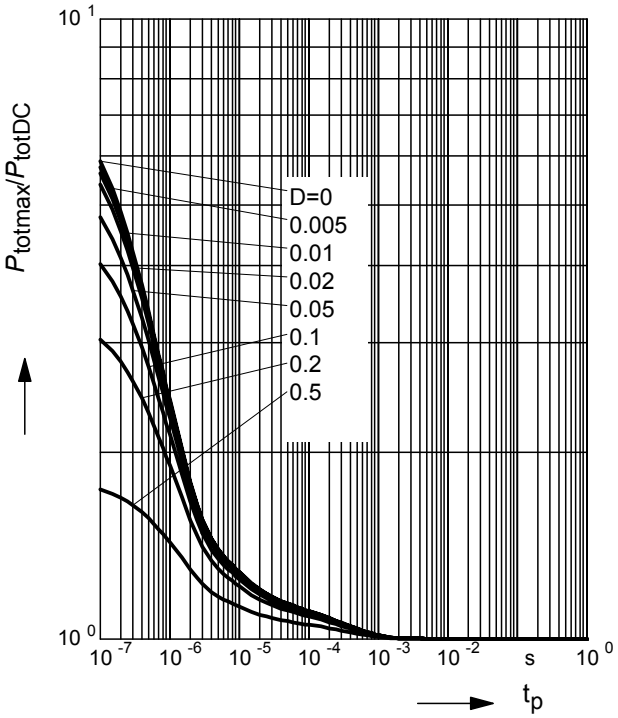



**Permissible Pulse Load $R_{thJS} = f(t_p)$**



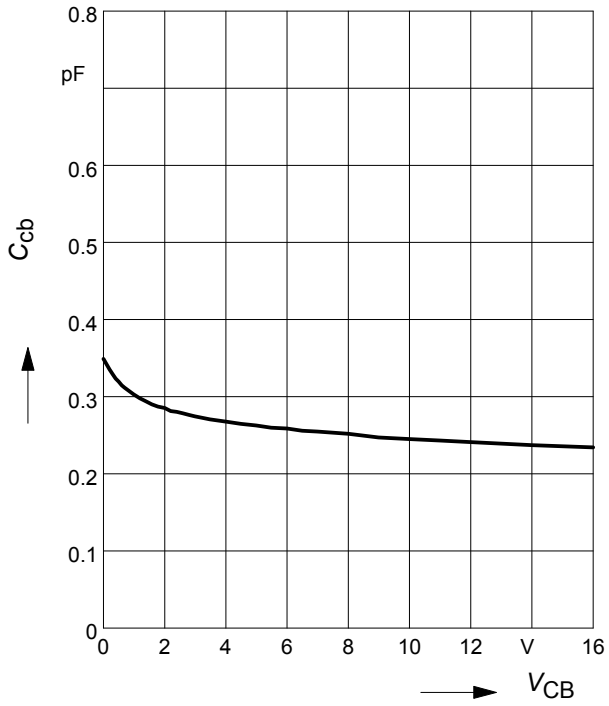

**Permissible Pulse Load**

**$P_{totmax}/P_{totDC} = f(t_p)$**




**Collector-base capacitance $C_{cb} = f(V_{CB})$**

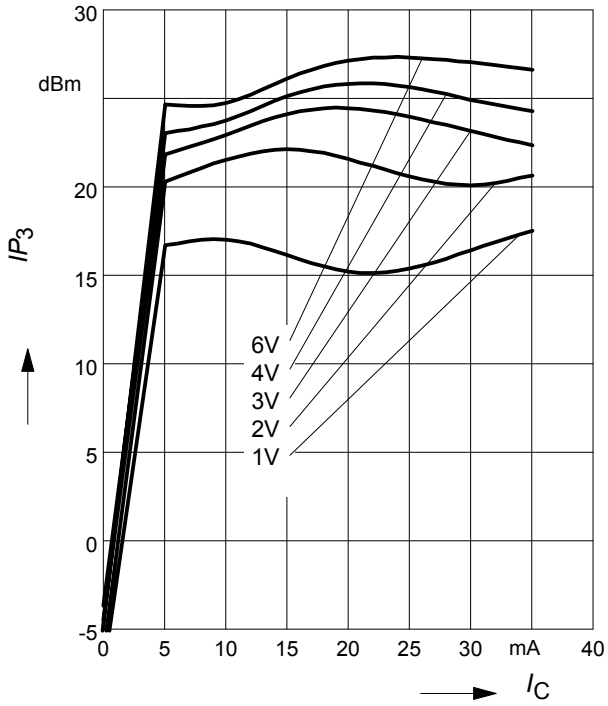
**$f$ = 1MHz**



**Third order Intercept Point** $IP_3=f(I_C)$

(Output, $Z_S=Z_L=50\Omega$)

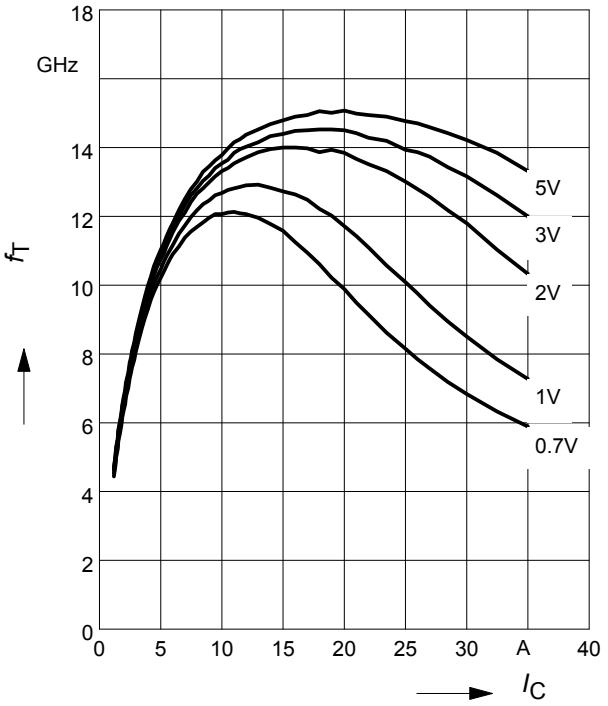
$V_{CE}$ = parameter, $f$ = 1.8 GHz




**Transition frequency** $f_T= f(I_C)$

$f$ = 1 GHz

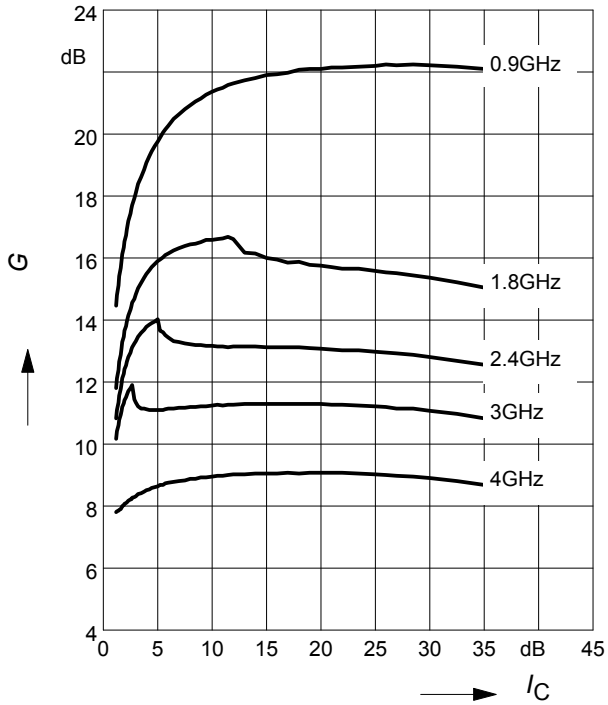
$V_{CE}$ = parameter




**Power gain** $G_{ma}$, $G_{ms}$ = $f(I_C)$

$V_{CE}$ = 3 V

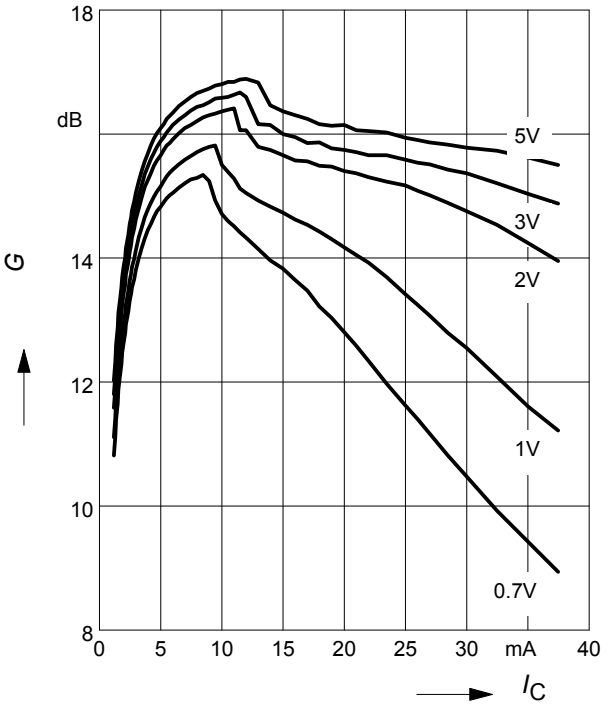
$f$ = parameter in GHz




**Power gain** $G_{ma}$, $G_{ms}$ = $f(I_C)$

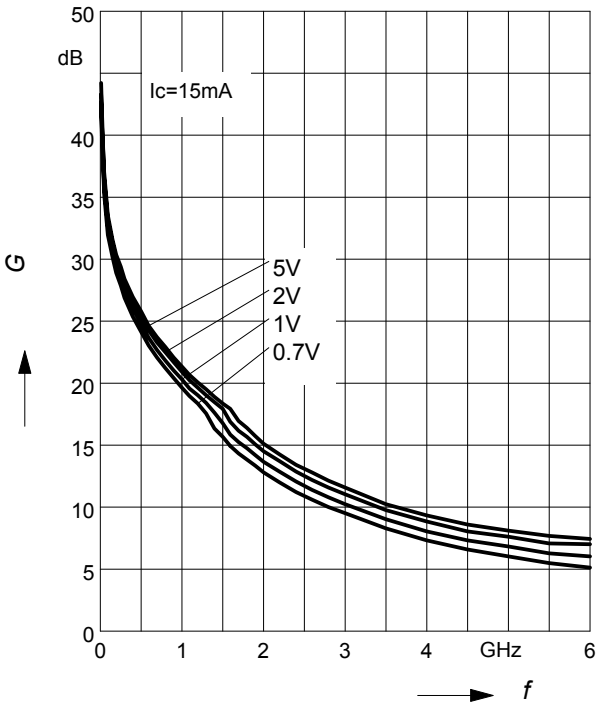
$f$ = 1.8GHz

$V_{CE}$ = parameter



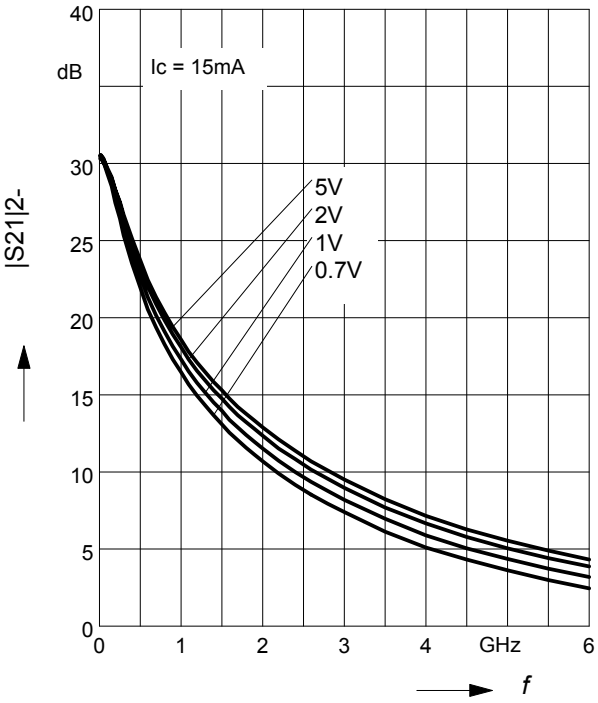
**Power Gain** $G_{ma}$, $G_{ms}$ = $f(f)$

$V_{CE}$ = parameter



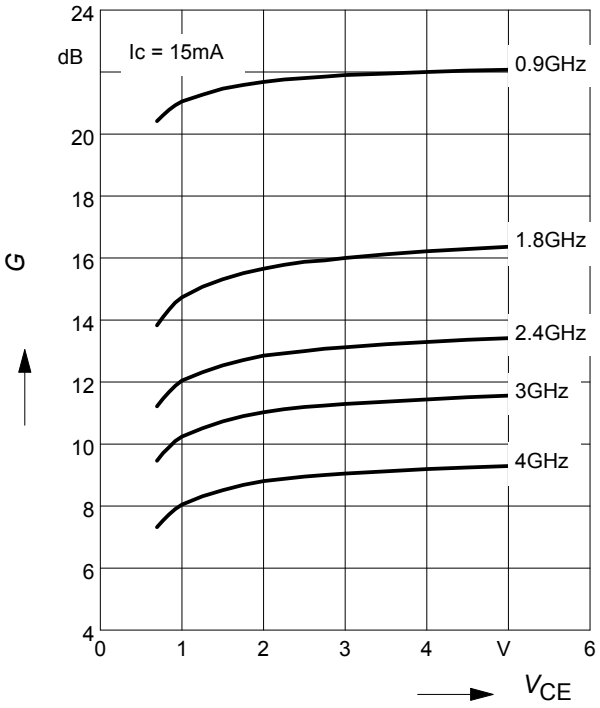

**Power Gain** $|S_{21}|^2$ = $f(f)$

$V_{CE}$ = parameter

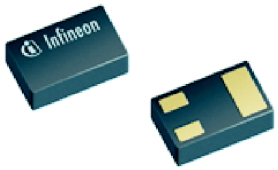


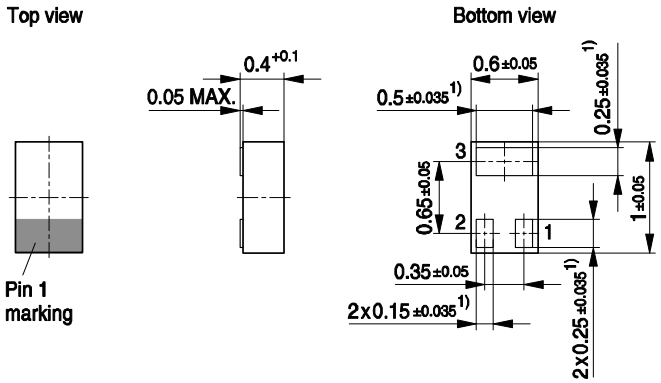

**Power Gain** $G_{ma}$, $G_{ms}$ = $f(V_{CE})$:

$f$ = parameter



## Package Outline

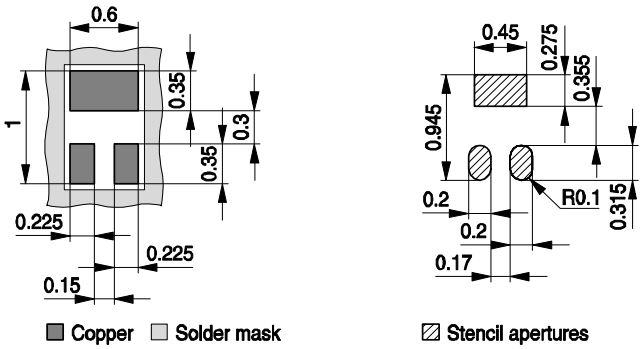





1) Dimension applies to plated terminal

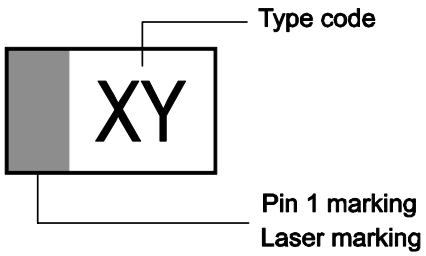
TSLP-3-1-PO V03

## Foot Print



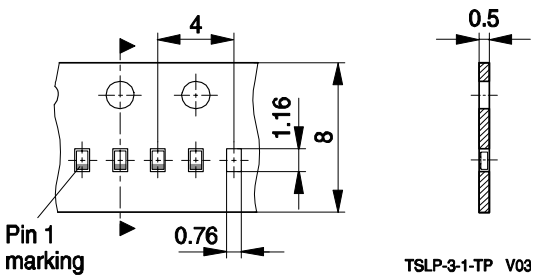

TSLP-3-1-FP V01

## Marking Layout (Example)




## Standard Packing

Reel Ø 330 mm: 15.000 Pieces/ Reel




TSLP-3-1-TP V03

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