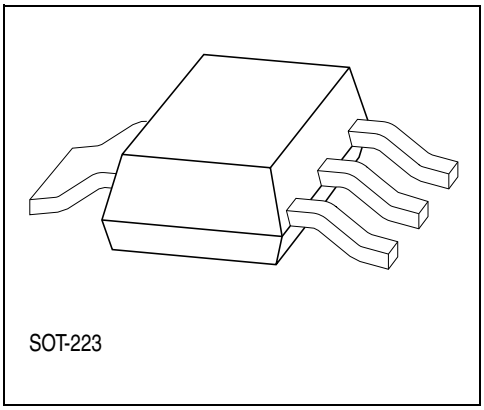
# GaAs FET

# CLY 5

*Data Sheet*

- Power amplifier for mobile phones
- For frequencies from 400 MHz to 2.5 GHz
- Wide operating voltage range: 2.7 to 6 V
- $P_{OUT}$ at $V_D$ = 3 V, $f$ = 1.8 GHz typ. 26.5 dBm
- High efficiency better 55%

**ESD**: **E**lectro**s**tatic **d**ischarge sensitive device, observe handling precautions!



SOT-223

| Type | Marking | Ordering Code (taped) | Pin Configuration | | | | Package |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | |
| CLY 5 | CLY 5 | Q62702-L90 | G | S | D | S | P-SOT223-4-2 |

**Maximum Ratings**

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain-source voltage | $V_{DS}$ | 9 | V |
| Drain-gate voltage | $V_{DG}$ | 12 | V |
| Gate-source voltage | $V_{GS}$ | – 6 | V |
| Drain current | $I_D$ | 1.2 | A |
| Channel temperature | $T_{Ch}$ | 150 | °C |
| Storage temperature | $T_{stg}$ | – 55 … + 150 | °C |
| Pulse peak power | $P_{Pulse}$ | 9 | W |
| Total power dissipation ($T_S \leq 80$ °C)<br>$T_S$: Temperature at soldering point | $P_{tot}$ | 2 | W |

**Thermal Resistance**

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Channel-soldering point | $R_{thChS}$ | ≤ 35 | K/W |

## Electrical Characteristics

$T_A$ = 25 °C, unless otherwise specified.

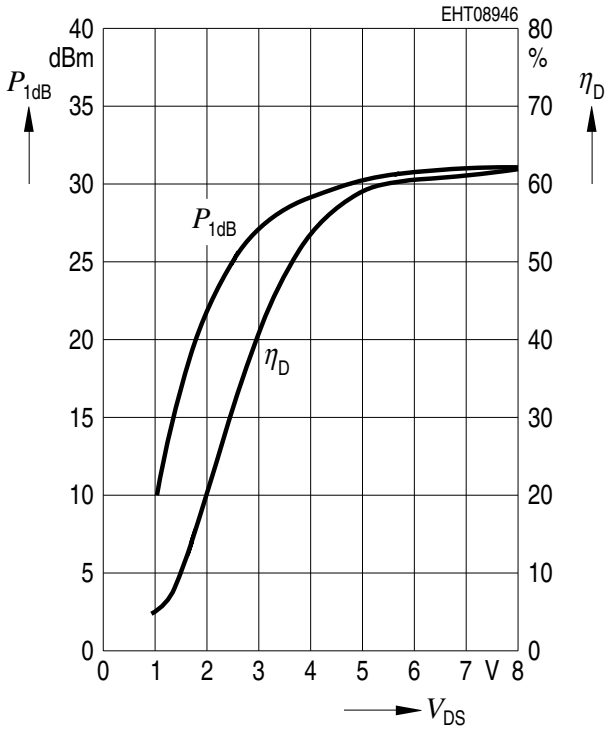
| Characteristics | Symbol | Limit Values | | | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| | | min. | typ. | max. | | |
| Drain-source saturation current | $I_{DSS}$ | 600 | 800 | 1200 | mA | $V_{DS}$ = 3 V<br>$V_{GS}$ = 0 V |
| Drain-source pinch-off current | $I_D$ | – | 10 | 100 | µA | $V_{DS}$ = 3 V<br>$V_{GS}$ = – 3.8 V |
| Gate pinch-off current | $I_G$ | – | 5 | 20 | µA | $V_{DS}$ = 3 V<br>$V_{GS}$ = – 3.8 V |
| Pinch-off Voltage | $V_{GS(p)}$ | – 3.8 | – 2.8 | – 1.8 | V | $V_{DS}$ = 3 V<br>$I_D$ = 100 µA |
| Small Signal Gain[1)] | $G$ | 10.5 | 11.0 | – | dB | $V_{DS}$ = 3 V<br>$I_D$ = 350 mA<br>$f$ = 1.8 GHz<br>$P_{IN}$ = 0 dBm |
| Small Signal Gain[1)] | $G$ | 11.5 | 12.0 | – | dB | $V_{DS}$ = 5 V<br>$I_D$ = 350 mA<br>$f$ = 1.8 GHz<br>$P_{IN}$ = 0 dBm |
| Small Signal Gain[2)] | $G_P$ | 9.0 | 9.5 | – | dB | $V_{DS}$ = 3 V<br>$I_D$ = 350 mA<br>$f$ = 1.8 GHz<br>$P_{IN}$ = 0 dBm |
| Output Power | $P_O$ | 26.5 | 27 | – | dBm | $V_{DS}$ = 3 V<br>$I_D$ = 350 mA<br>$f$ = 1.8 GHz<br>$P_{IN}$ = 19 dBm |
| Output Power | $P_O$ | 29.5 | 30 | – | dBm | $V_{DS}$ = 5 V<br>$I_D$ = 350 mA<br>$f$ = 1.8 GHz<br>$P_{IN}$ = 21 dBm |
| 1 dB-Compression Point | $P_{1\ dB}$ | – | 26.5 | – | dBm | $V_{DS}$ = 3 V<br>$I_D$ = 350 mA<br>$f$ = 1.8 GHz |

**Electrical Characteristics** (cont'd)
$T_A$ = 25 °C, unless otherwise specified.

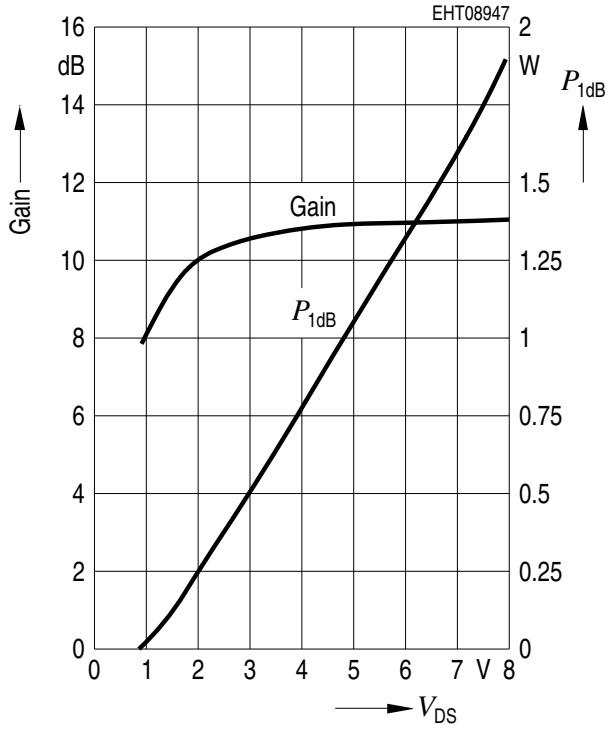
| Characteristics | Symbol | Limit Values | | | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| | | min. | typ. | max. | | |
| 1 dB-Compression Point | $P_{1dB}$ | – | 30 | – | dBm | $V_{DS}$ = 5 V<br>$I_D$ = 350 mA<br>$f$ = 1.8 GHz |
| Power Added Efficiency | PAE | 40 | 55 | – | % | $V_{DS}$ = 5 V<br>$I_D$ = 350 mA<br>$f$ = 1.8 GHz<br>$P_{IN}$ = 21 dBm |
| Noise figure | $NF$ | – | 1.72 | – | dB | $V_{DS}$ = 5 V<br>$I_D$ = 350 mA<br>$f$ = 1.8 GHz |

1) Matching conditions for maximum small signal gain (not identical with power matching conditions!).
2) Power matching conditions: $f$ = 1.8 GHz: Source Match: $G_{MS}$: MAG 0.58; ANG -143°; Load Match $G_{ML}$: MAG 0.76; ANG -116°

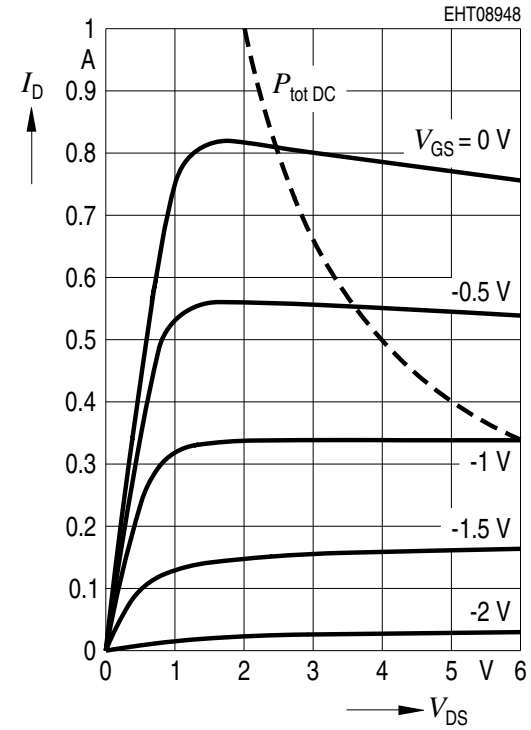
**Compression Power vs. Drain-Source Voltage** $f$ = 1.8 GHz; $I_{DS} = 0.5 \times I_{DSS}$




**Gain and $P_{1\,dB}$ vs. Drain Source Voltage,** $f$ = 1.8 GHz; $I_{DS} = 0.5 \times I_{DSS}$




**Output Characteristics**



## Typ. Common Source S-Parameters and Noise Data

$V_{DS}$ = 3 V, $I_D$ = 350 mA, $Z_0$ = 50 Ω

| $f$ | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| GHz | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 0.1 | 0.98 | – 26.6 | 11.52 | 160.7 | 0.01024 | 79 | 0.3 | – 171.8 |
| 0.15 | 0.96 | – 39.4 | 11.15 | 151.4 | 0.015 | 74.3 | 0.31 | – 169.3 |
| 0.2 | 0.93 | – 51.5 | 10.6 | 142.8 | 0.01942 | 69.9 | 0.33 | – 169.2 |
| 0.25 | 0.9 | – 63.1 | 10.06 | 134.9 | 0.02323 | 66.1 | 0.36 | – 169.4 |
| 0.3 | 0.87 | – 73.8 | 9.49 | 127.4 | 0.02665 | 62.3 | 0.38 | – 169.4 |
| 0.4 | 0.81 | – 93.3 | 8.34 | 114.1 | 0.03245 | 57 | 0.4 | – 172.7 |
| 0.5 | 0.77 | – 110.3 | 7.33 | 102.5 | 0.03711 | 52.8 | 0.43 | – 175.6 |
| 0.6 | 0.73 | – 125.3 | 6.47 | 92.4 | 0.04138 | 49.7 | 0.45 | – 179.4 |
| 0.7 | 0.71 | – 138.5 | 5.75 | 83.5 | 0.04528 | 47.3 | 0.47 | 177.5 |
| 0.8 | 0.7 | – 150.4 | 5.14 | 75.2 | 0.0489 | 45.2 | 0.49 | 174.2 |
| 0.9 | 0.69 | – 161.1 | 4.64 | 67.6 | 0.05271 | 43.3 | 0.5 | 170.8 |
| 1 | 0.68 | – 170.8 | 4.2 | 60.5 | 0.05646 | 41.6 | 0.51 | 168.1 |
| 1.2 | 0.69 | 172.1 | 3.51 | 47.2 | 0.06393 | 38 | 0.54 | 161.8 |
| 1.4 | 0.7 | 157.3 | 2.98 | 35.1 | 0.07181 | 34 | 0.57 | 155.6 |
| 1.5 | 0.71 | 150.5 | 2.76 | 29.2 | 0.07569 | 32 | 0.58 | 152.9 |
| 1.6 | 0.72 | 144.1 | 2.56 | 23.6 | 0.07941 | 29.7 | 0.59 | 149.4 |
| 1.8 | 0.74 | 132.2 | 2.22 | 12.6 | 0.08684 | 24.8 | 0.62 | 143.2 |
| 2 | 0.76 | 121.4 | 1.94 | 2.1 | 0.09377 | 19.7 | 0.65 | 137 |
| 2.2 | 0.78 | 111.5 | 1.7 | – 7.9 | 0.0998 | 14.6 | 0.68 | 130.9 |
| 2.4 | 0.8 | 102.5 | 1.49 | – 17.4 | 0.10532 | 9.4 | 0.7 | 124.7 |
| 2.5 | 0.81 | 98 | 1.39 | – 21.9 | 0.1076 | 6.7 | 0.71 | 121.1 |
| 3 | 0.85 | 79.2 | 1.01 | – 42.1 | 0.11638 | – 6 | 0.76 | 105.6 |
| 3.5 | 0.87 | 64 | 0.75 | – 58.1 | 0.12148 | – 17.2 | 0.8 | 91.4 |
| 4 | 0.89 | 51.4 | 0.59 | – 70.6 | 0.12571 | – 27.3 | 0.84 | 78.2 |
| 4.5 | 0.9 | 39.8 | 0.48 | – 82.2 | 0.12914 | – 37.2 | 0.86 | 65.6 |
| 5 | 0.92 | 29 | 0.41 | – 93.1 | 0.13429 | – 47 | 0.88 | 53.1 |

**Typ. Common Source S-Parameters and Noise Data** (cont'd)
$V_{DS}$ = 3 V, $I_D$ = 350 mA, $Z_0$ = 50 Ω

| $f$ | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| **GHz** | **MAG** | **ANG** | **MAG** | **ANG** | **MAG** | **ANG** | **MAG** | **ANG** |
| 5.5 | 0.92 | 18.4 | 0.35 | – 103.4 | 0.13892 | – 57 | 0.9 | 40.3 |
| 6 | 0.92 | 8.3 | 0.31 | – 112.4 | 0.14142 | – 66.8 | 0.91 | 27 |

| $f$ | $F_{min}$ | $\Gamma_{opt}$ | | $R_N$ | $r_N$ |
|---|---|---|---|---|---|
| **GHz** | **dB** | **MAG** | **ANG** | Ω | – |
| 0.9 | 0.92 | 0.408 | 142 | 3.9 | 0.79 |
| 1.8 | 1.72 | 0.664 | – 134 | 8.1 | 0.162 |

## Typ. Common Source S-Parameters and Noise Data

$V_{DS}$ = 5 V, $I_D$ = 350 mA, $Z_0$ = 50 Ω

| $f$ | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| GHz | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 0.1 | 0.98 | – 26.3 | 13.02 | 160.1 | 0.00906 | 79.1 | 0.15 | – 153.9 |
| 0.15 | 0.95 | – 38.8 | 12.58 | 150.7 | 0.01326 | 73.7 | 0.17 | – 148.4 |
| 0.2 | 0.92 | – 50.8 | 11.98 | 141.9 | 0.01702 | 69.3 | 0.2 | – 148.5 |
| 0.25 | 0.89 | – 62.1 | 11.34 | 133.7 | 0.02026 | 65.6 | 0.23 | – 149.9 |
| 0.3 | 0.86 | – 72.6 | 10.68 | 126.1 | 0.02304 | 61.8 | 0.26 | – 150.6 |
| 0.4 | 0.8 | – 91.7 | 9.39 | 112.4 | 0.02771 | 57 | 0.29 | – 155.5 |
| 0.5 | 0.76 | – 108.3 | 8.24 | 100.6 | 0.03151 | 53.4 | 0.33 | – 159.4 |
| 0.6 | 0.72 | – 122.9 | 7.27 | 90.2 | 0.0348 | 51.2 | 0.35 | – 164.1 |
| 0.7 | 0.7 | – 135.9 | 6.45 | 80.9 | 0.03798 | 49.7 | 0.37 | – 167.6 |
| 0.8 | 0.69 | – 147.6 | 5.77 | 72.4 | 0.04099 | 48.8 | 0.4 | – 171.3 |
| 0.9 | 0.68 | – 158.1 | 5.2 | 64.5 | 0.04435 | 47.9 | 0.41 | – 174.9 |
| 1 | 0.68 | – 167.7 | 4.7 | 57 | 0.04784 | 47.1 | 0.44 | – 177.8 |
| 1.2 | 0.68 | 175.3 | 3.92 | 43 | 0.05543 | 45.2 | 0.47 | 175.4 |
| 1.4 | 0.7 | 160.4 | 3.31 | 30.1 | 0.06413 | 42.2 | 0.51 | 168.7 |
| 1.5 | 0.71 | 153.6 | 3.06 | 24 | 0.06865 | 40.6 | 0.54 | 165.5 |
| 1.6 | 0.72 | 147.1 | 2.83 | 17.9 | 0.07318 | 38.5 | 0.55 | 161.7 |
| 1.8 | 0.75 | 135 | 2.43 | 6.2 | 0.08237 | 33.7 | 0.6 | 154.6 |
| 2 | 0.77 | 123.9 | 2.1 | – 5 | 0.09121 | 28.3 | 0.64 | 147.5 |
| 2.2 | 0.8 | 113.7 | 1.82 | – 15.6 | 0.09917 | 22.5 | 0.67 | 140.4 |
| 2.4 | 0.82 | 104.3 | 1.58 | – 25.7 | 0.10617 | 16.7 | 0.7 | 133.3 |
| 2.5 | 0.83 | 99.7 | 1.47 | – 30.4 | 0.10916 | 13.6 | 0.72 | 129.1 |
| 3 | 0.87 | 80.1 | 1.02 | – 51.4 | 0.12055 | – 0.8 | 0.78 | 111.6 |
| 3.5 | 0.89 | 64.4 | 0.74 | – 67.4 | 0.12631 | – 13.4 | 0.83 | 95.8 |
| 4 | 0.91 | 51.5 | 0.56 | – 79.4 | 0.13053 | – 24.5 | 0.86 | 81.3 |
| 4.5 | 0.92 | 39.6 | 0.45 | – 90.2 | 0.13384 | – 35 | 0.88 | 67.9 |
| 5 | 0.93 | 28.8 | 0.37 | – 100 | 0.13894 | – 45.2 | 0.91 | 54.9 |

**Typ. Common Source S-Parameters and Noise Data** (cont'd)
$V_{DS}$ = 5 V, $I_D$ = 350 mA, $Z_0$ = 50 Ω

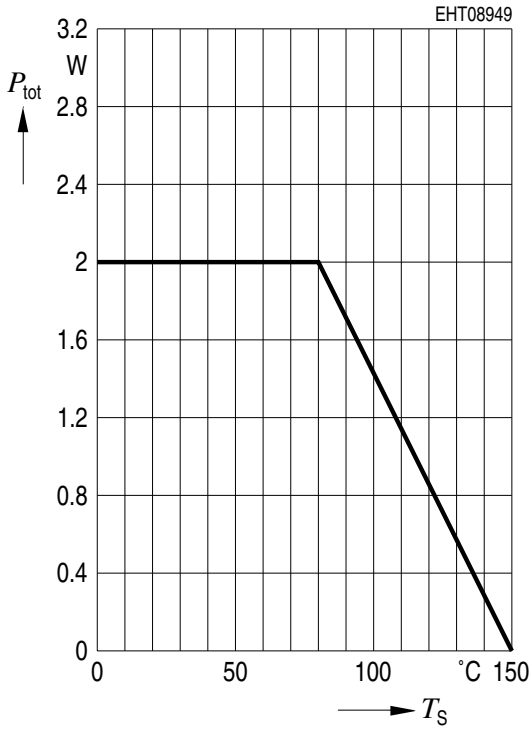
| $f$ | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| **GHz** | **MAG** | **ANG** | **MAG** | **ANG** | **MAG** | **ANG** | **MAG** | **ANG** |
| 5.5 | 0.93 | 18.1 | 0.31 | – 109.2 | 0.1434 | – 55.5 | 0.92 | 41.7 |
| 6 | 0.93 | 8 | 0.27 | – 117.1 | 0.14538 | – 65.6 | 0.92 | 28 |

| $f$ | $F_{min}$ | $\Gamma_{opt}$ | | $R_N$ | $r_N$ |
|---|---|---|---|---|---|
| **GHz** | **dB** | **MAG** | **ANG** | Ω | – |
| 0.9 | 1.05 | 0.369 | 139 | 4.9 | 0.097 |
| 1.8 | 1.94 | 0.603 | – 132 | 10.9 | 0.218 |

Additional S-Parameter available on data disc!

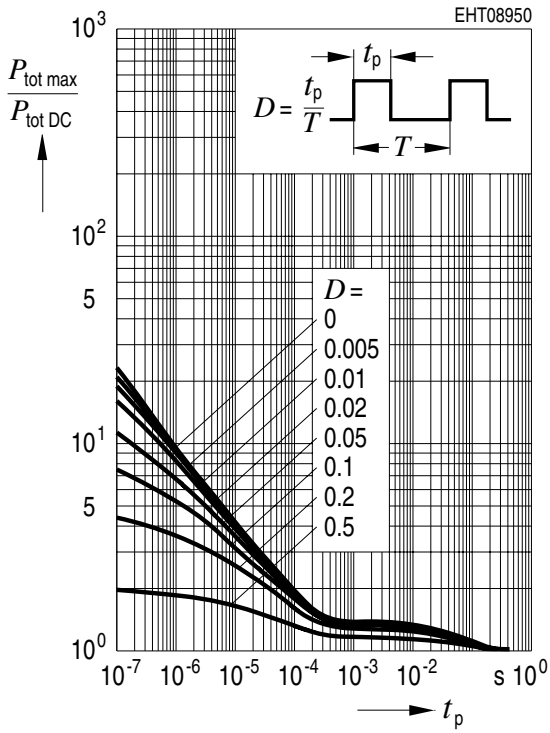
## Total Power Dissipation

$P_{tot} = f(T_S)$




## Permissible Pulse Load

$P_{tot\_max}/P_{tot\_DC} = f(t_P)$



## Increased Power Handling Capability Pulsed Applications

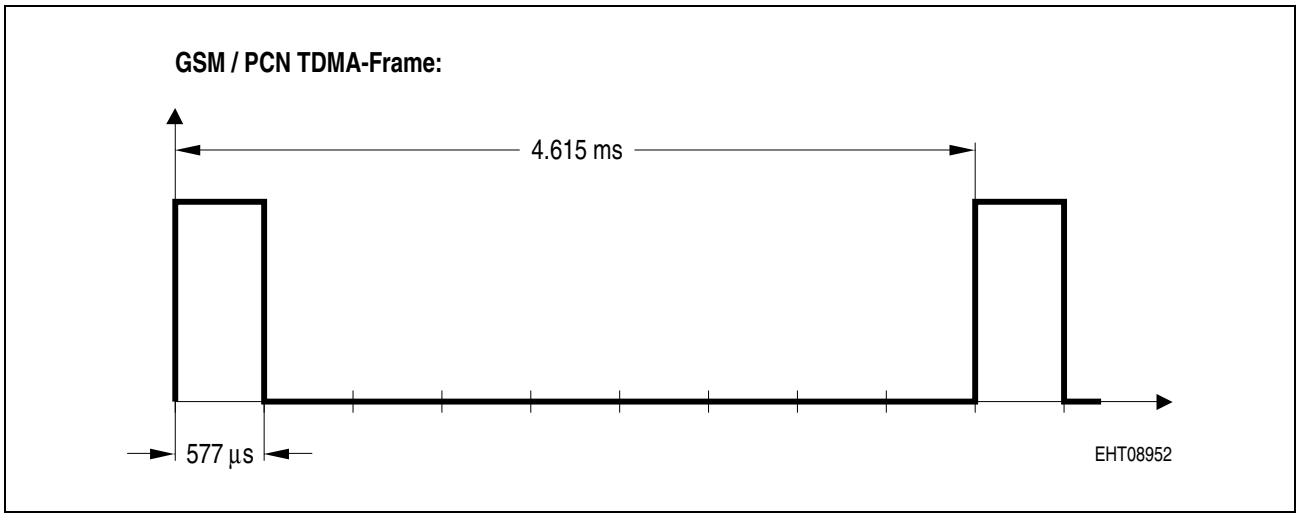



**Figure 1** **GSM/PCN TDMA-Frame** (D = $t_P/T$ = 0.577 ms/4.615 ms = 0.125)

Take value $P_{tot\ max}/P_{tot\ DC}$ from diagram permissible pulse load --> $P_{tot\ max}/P_{tot\ DC} \approx 1.4$

$P_{tot}$ = 2 W × 1.4 = 2.8 W

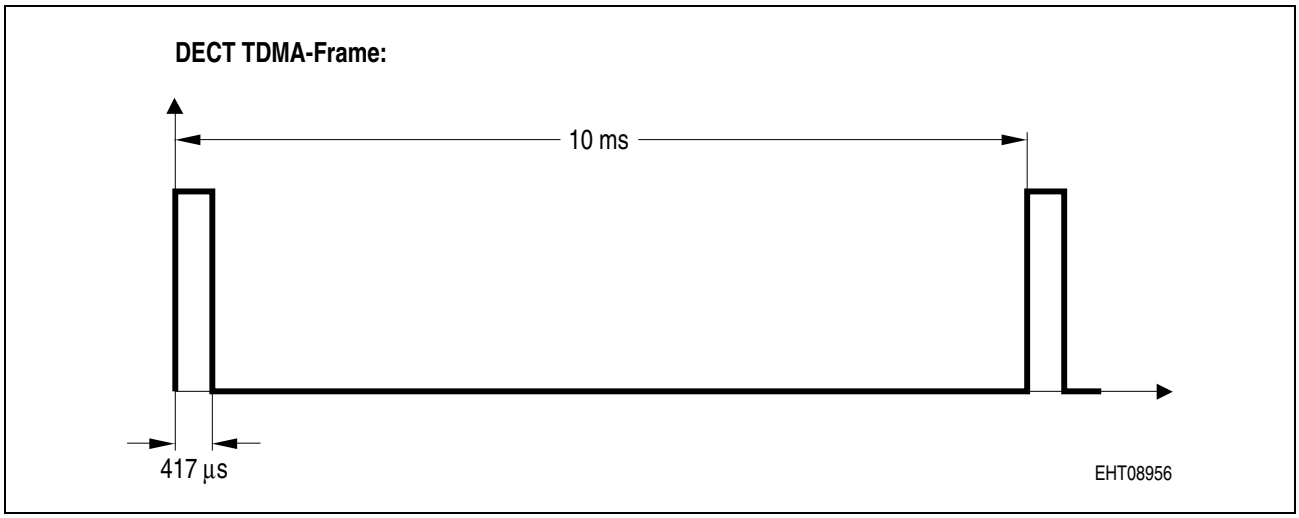


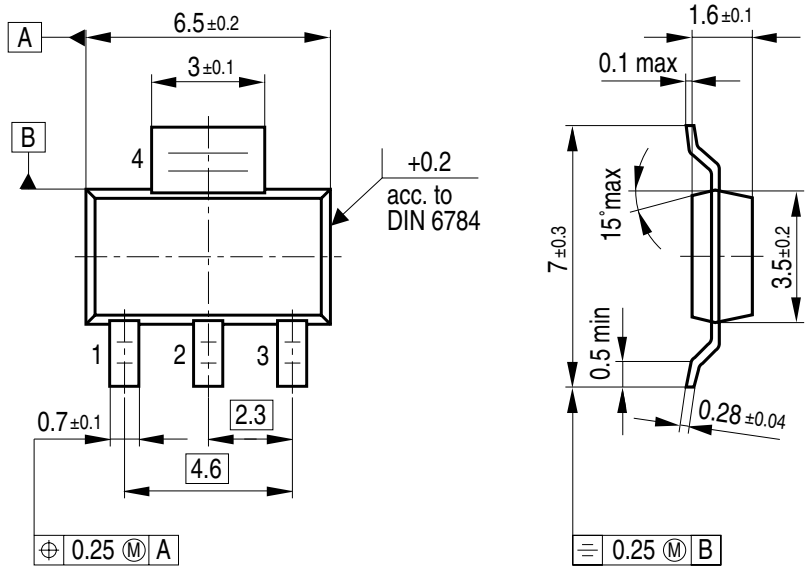

**Figure 2** **DECT TDMA-Frame** (D = $t_P/T$ = 0.417 ms/10 ms = 0.0417)

Take value $P_{tot\ max}/P_{tot\ DC}$ from diagram permissible pulse load --> $P_{tot\ max}/P_{tot\ DC} \approx 1.5$

$P_{tot}$ = 2 W × 1.5 = 3 W

## Package Outlines

**P-SOT223-4-2**
(Small Outline Transistor)




**Sorts of Packing**
Package outlines for tubes, trays etc. are contained in our Data Book “Package Information”.

SMD = Surface Mounted Device

Dimensions in mm