



# PD57045-E PD57045S-E

## RF POWER transistor, LdmoST plastic family N-channel enhancement-mode, lateral MOSFETs

### Features

- Excellent thermal stability
- Common source configuration
- $P_{OUT} = 45\text{ W}$  with 13dB gain @ 945 MHz / 28 V
- New RF plastic package

### Description

The device is a common source N-channel, enhancement-mode lateral field-effect RF power transistor. It is designed for high gain, broad band commercial and industrial applications. It operates at 28 V in common source mode at frequencies of up to 1 GHz. The device boasts the excellent gain, linearity and reliability of ST's latest LDMOS technology mounted in the first true SMD plastic RF power package, PowerSO-10RF. Device's superior linearity performance makes it an ideal solution for base station applications. The PowerSO-10 plastic package, designed to offer high reliability, is the first ST JEDEC approved, high power SMD package. It has been specially optimized for RF needs and offers excellent RF performances and ease of assembly. Mounting recommendations are available in [www.st.com/rf/](http://www.st.com/rf/) (look for application note AN1294).

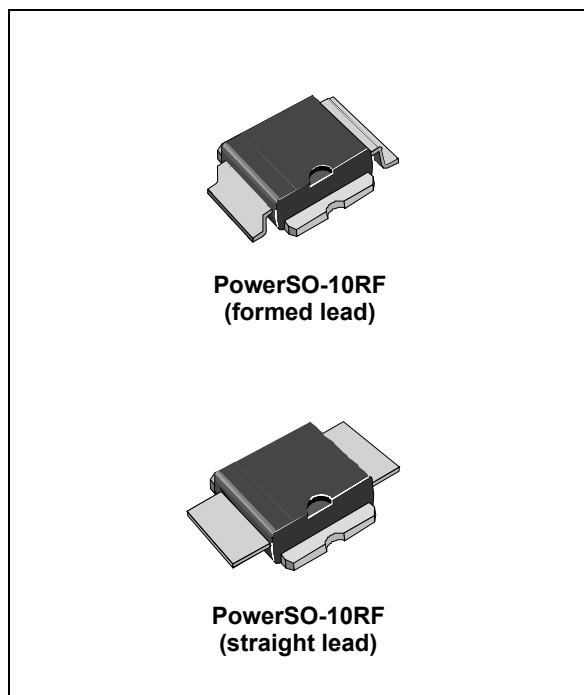


Figure 1. Pin connection

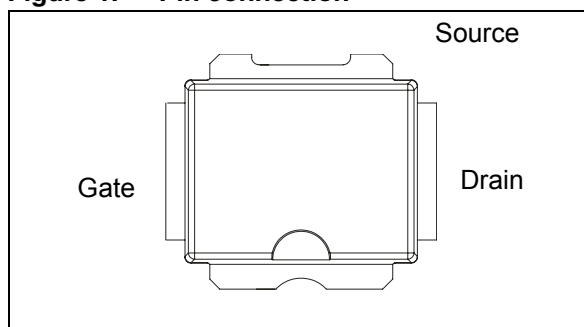


Table 1. Device summary

| Order code   | Package                      | Packing       |
|--------------|------------------------------|---------------|
| PD57045-E    | PowerSO-10RF (formed lead)   | Tube          |
| PD57045S-E   | PowerSO-10RF (straight lead) | Tube          |
| PD57045TR-E  | PowerSO-10RF (formed lead)   | Tape and reel |
| PD57045STR-E | PowerSO-10RF (straight lead) | Tape and reel |

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# 1 Electrical data

## 1.1 Maximum ratings

Table 2. Absolute maximum ratings ( $T_{CASE} = 25^{\circ}C$ )

| Symbol        | Parameter                                  | Value       | Unit        |
|---------------|--|-------------|-------------|
| $V_{(BR)DSS}$ | Drain-Source Voltage                       | 65          | V           |
| $V_{GS}$      | Gate-Source Voltage                        | $\pm 20$    | V           |
| $I_D$         | Drain Current                              | 5           | A           |
| $P_{DISS}$    | Power Dissipation (@ $T_c = 70^{\circ}C$ ) | 73          | W           |
| $T_J$         | Max. Operating Junction Temperature        | 165         | $^{\circ}C$ |
| $T_{STG}$     | Storage Temperature                        | -65 to +150 | $^{\circ}C$ |

## 1.2 Thermal data

Table 3. Thermal data

| Symbol     | Parameter                          | Value | Unit          |
|------------|------------------------------------|-------|---------------|
| $R_{thJC}$ | Junction - case thermal resistance | 1.2   | $^{\circ}C/W$ |

## 2 Electrical characteristics

$T_{CASE} = +25\text{ }^{\circ}\text{C}$

### 2.1 Static

**Table 4. Static**

| Symbol        | Test conditions        |                        | Min | Typ | Max | Unit          |
|---------------|------------------------|------------------------|-----|-----|-----|---------------|
| $V_{(BR)DSS}$ | $V_{GS} = 0$           | $I_{DS} = 1\text{ mA}$ | 65  |     |     | V             |
| $I_{DSS}$     | $V_{GS} = 0$           | $V_{DS} = 28\text{ V}$ |     |     | 1   | $\mu\text{A}$ |
| $I_{GSS}$     | $V_{GS} = 20\text{ V}$ | $V_{DS} = 0$           |     |     | 1   | $\mu\text{A}$ |
| $V_{GS(Q)}$   | $V_{DS} = 28\text{ V}$ | $I_D = 250\text{ mA}$  | 2.0 |     | 5.0 | V             |
| $V_{DS(ON)}$  | $V_{GS} = 10\text{ V}$ | $I_D = 3\text{ A}$     |     | 0.7 | 0.9 | V             |
| $g_{FS}$      | $V_{DS} = 10\text{ V}$ | $I_D = 4\text{ A}$     | 2.0 | 2.7 |     | mho           |
| $C_{ISS}$     | $V_{GS} = 0$           | $V_{DS} = 28\text{ V}$ |     | 86  |     | pF            |
| $C_{OSS}$     | $V_{GS} = 0$           | $V_{DS} = 28\text{ V}$ |     | 47  |     | pF            |
| $C_{RSS}$     | $V_{GS} = 0$           | $V_{DS} = 28\text{ V}$ |     | 3.6 |     | pF            |

### 2.2 Dynamic

**Table 5. Dynamic**

| Symbol        | Test conditions        |   | Min. | Typ. | Max. | Unit |
|---------------|------------------------|---|------|------|------|------|
| $P_{1dB}$     | $V_{DD} = 28\text{ V}$ | $I_{DQ} = 250\text{ mA}$ $f = 945\text{ MHz}$   | 45   |      |      | W    |
| $G_P$         | $V_{DD} = 28\text{ V}$ | $I_{DQ} = 250\text{ mA}$ $P_{OUT} = 45\text{ W}$ $f = 945\text{ MHz}$                     | 13   | 14.5 |      | dB   |
| $\eta_D$      | $V_{DD} = 28\text{ V}$ | $I_{DQ} = 250\text{ mA}$ $P_{OUT} = 45\text{ W}$ $f = 945\text{ MHz}$                     | 50   |      |      | %    |
| Load mismatch | $V_{DD} = 28\text{ V}$ | $I_{DQ} = 250\text{ mA}$ $P_{OUT} = 45\text{ W}$ $f = 945\text{ MHz}$<br>All phase angles | 10:1 |      |      | VSWR |

### 2.3 Moisture sensitivity level

**Table 6. Moisture sensitivity level**

| Test methodology | Rating |
|------------------|--------|
| J-STD-020B       | MSL 3  |

### 3 Impedance

Figure 2. Current conventions

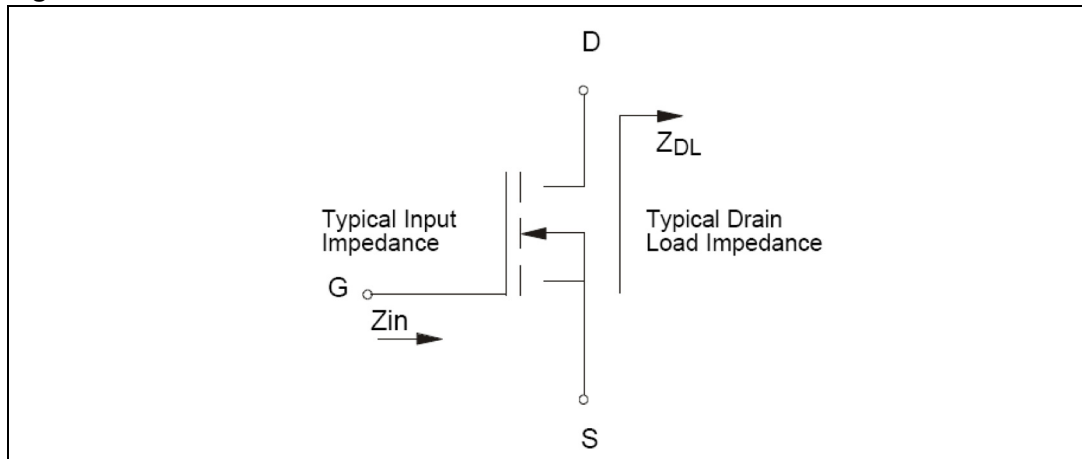


Table 7. Impedance data

| Freq. (MHz) | $Z_{IN}$ ( $\Omega$ ) | $Z_{DL}$ ( $\Omega$ ) |
|-------------|-----------------------|-----------------------|
| 925         | $.71 + j 2.32$        | $1.29 - j .35$        |
| 945         | $.69 + j 2.92$        | $1.25 - j .29$        |
| 960         | $.55 + j 2.78$        | $1.18 - j .83$        |

# 4 Typical performance

Figure 3. Capacitance vs drain voltage

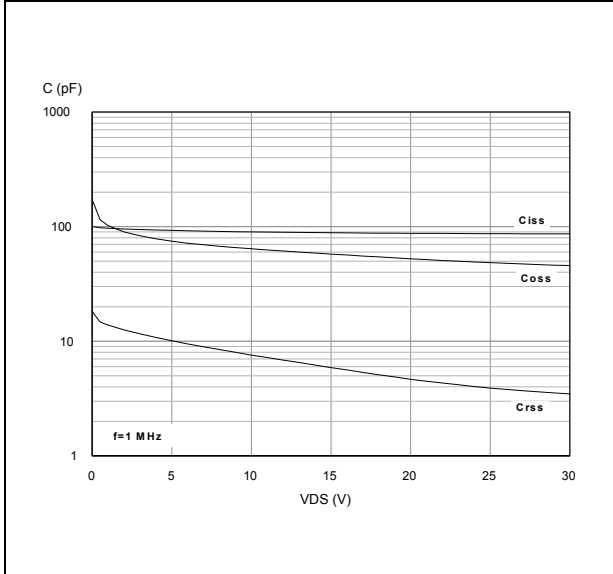


Figure 4. Drain current vs gate voltage

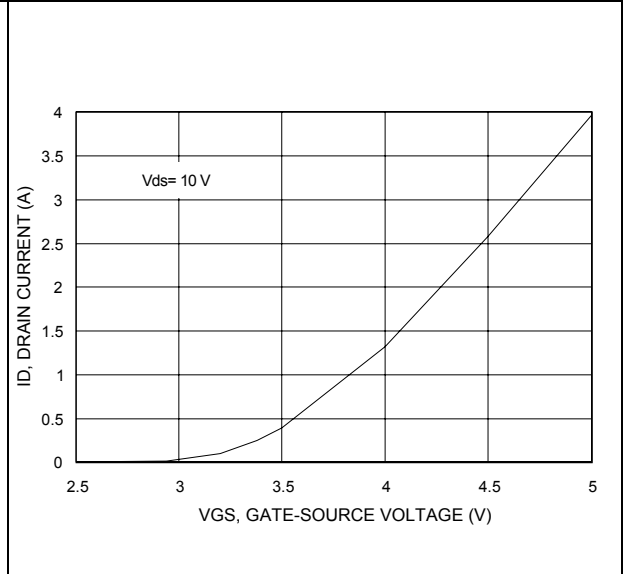


Figure 5. Gate-source voltage vs case temperature

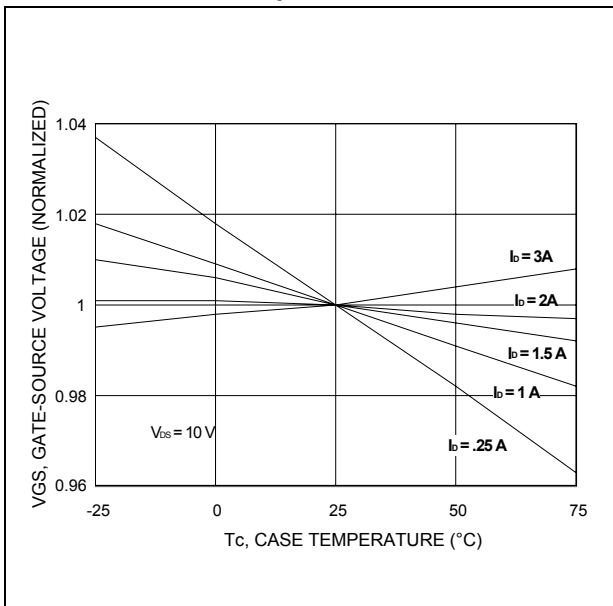
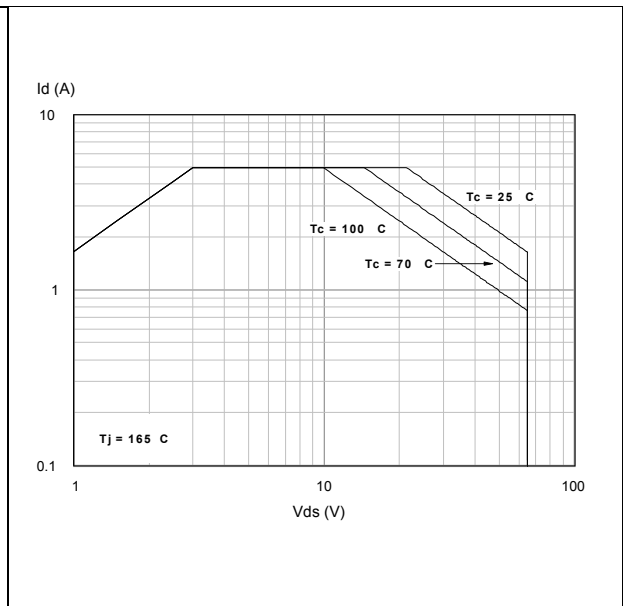


Figure 6. Safe operating area



### 4.1 PD57045S-E

Figure 7. Output power vs input power

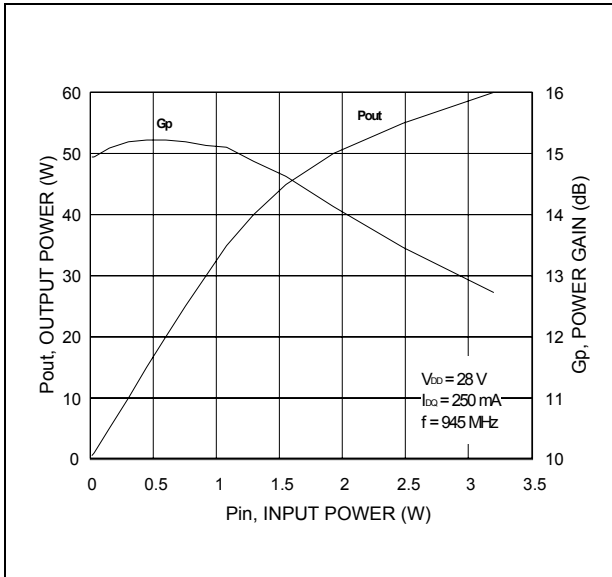


Figure 8. Input return loss vs output power

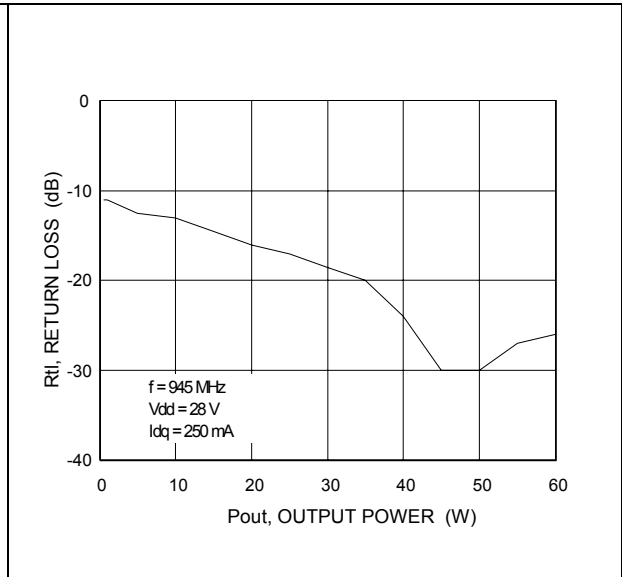


Figure 9. Power gain vs output power

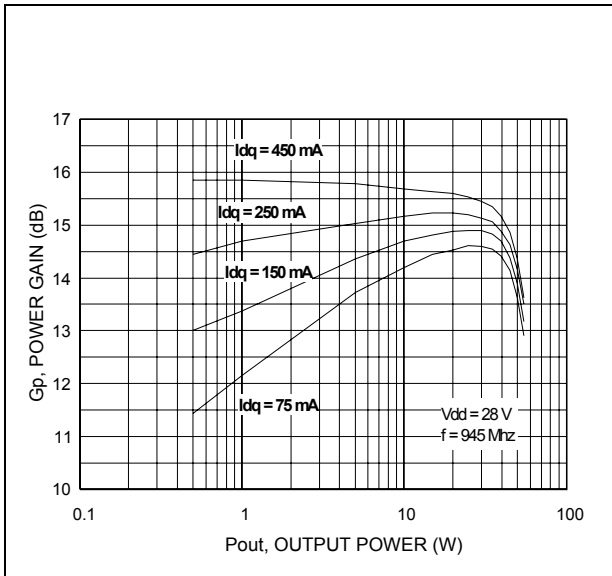


Figure 10. Drain efficiency vs output power

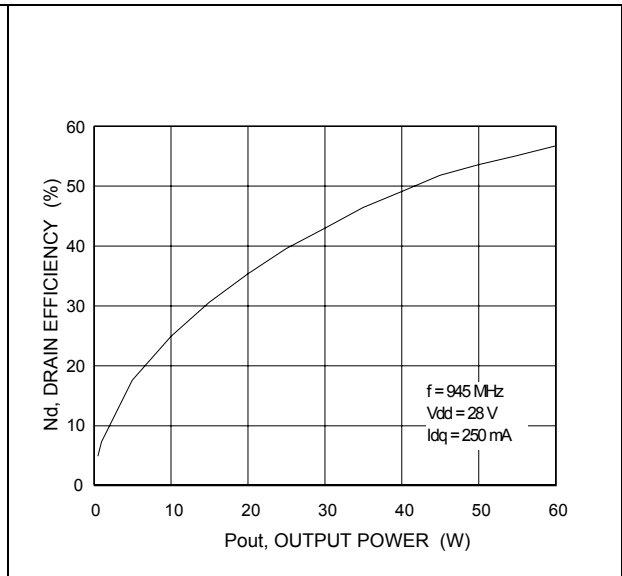


Figure 11. Output power vs bias current

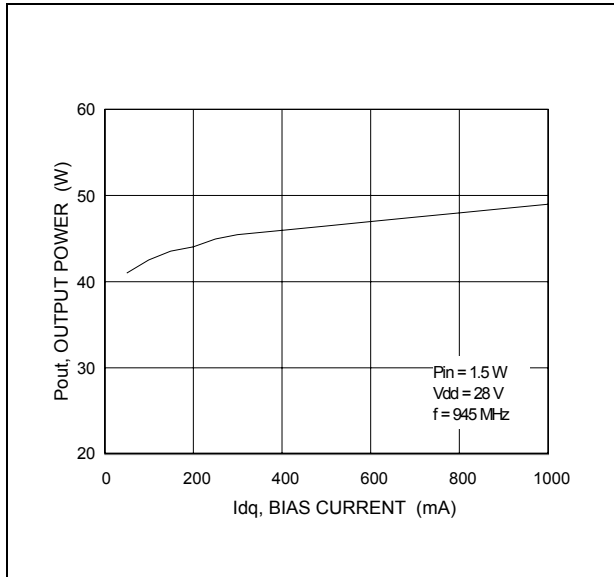


Figure 12. Drain efficiency vs bias current

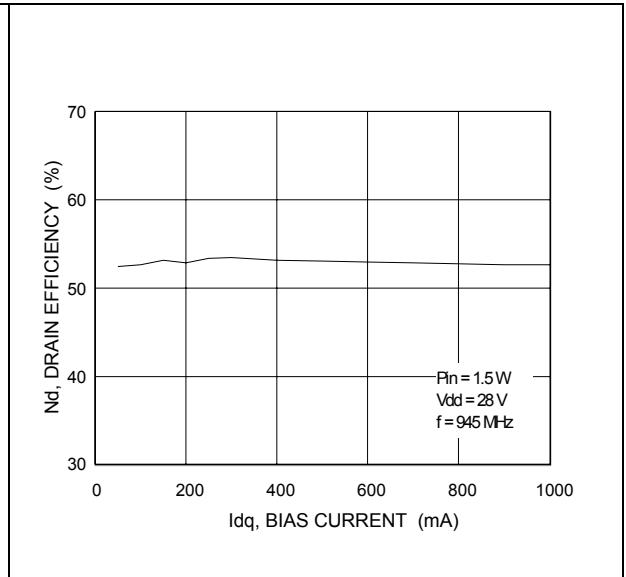


Figure 13. Output power vs drain voltage

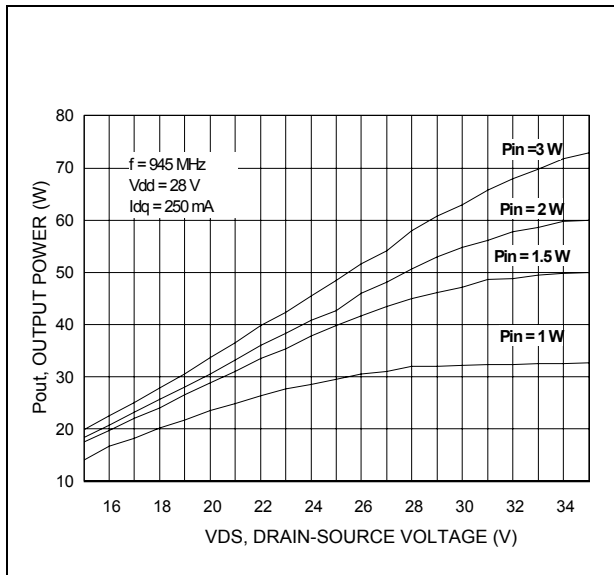
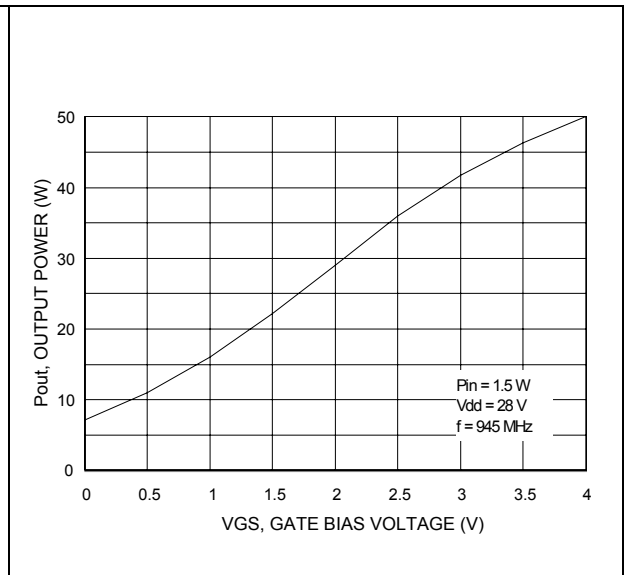


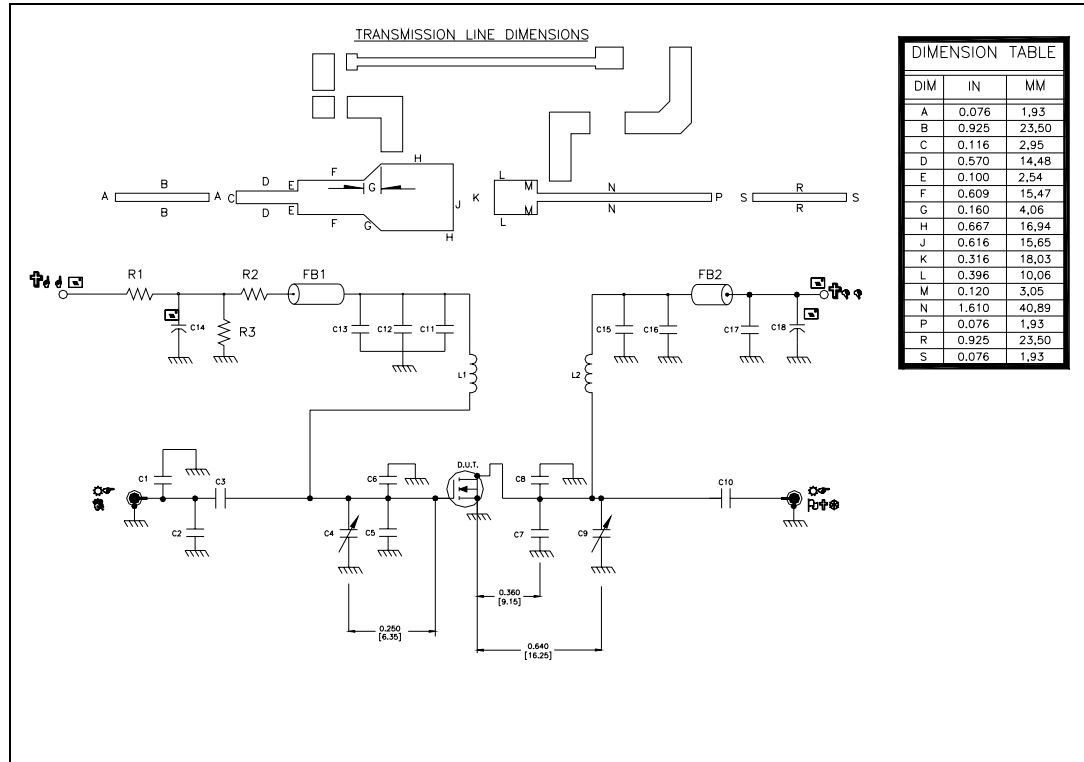
Figure 14. Output power vs gate bias voltage





# 5 Test circuit

Figure 15. Test circuit schematic



- Note:
- 1 Dimensions at component symbols are reference for component placement.
  - 2 Gap between ground & transmission line = 0.056 [1.42] +0.002 [0.05] -0.000 [0.00] typ.
  - 3 Dimensions of input and output component from edge of transmission lines.

**Table 8. Test circuit component part list**

| Component      | Description  |
|----------------|--|
| L1,L2          | Inductor, 5 turns air wound #22AWG, ID 0.059{1.49}, nylon coated magnet wire |
| FB1,FB2        | Shield bead surface mount EMI  |
| R1             | 18 kΩ, 1 W surface mount chip resistor                                       |
| R2             | 4.7 MΩ, 1 W surface mount chip resistor                                      |
| R3             | 120 Ω, 2 W surface mount chip resistor                                       |
| C1,C2          | 3 pF ATC 100B surface mount ceramic chip capacitor                           |
| C3,C10,C11,C15 | 47 pF ATC 100B surface mount ceramic chip capacitor                          |
| C4,C9          | 0.8-8.0 pF giga trim variable capacitor                                      |
| C5,C6,C7,C8    | 7.5 pF ATC 100B surface mount ceramic chip capacitor                         |
| C12            | 1000 pF ATC 700B surface mount ceramic chip capacitor                        |
| C13,C17        | 0.1 μF/500 V surface mount ceramic chip capacitor                            |
| C14            | 10 μF/50 V aluminum electrolytic radial lead capacitor                       |
| C16            | 100 pF ATC 100B surface mount ceramic chip capacitor                         |
| C18            | 220 μF/63 V aluminum electrolytic radial lead capacitor                      |
| Board          | Roger, ultra lam 2000, THK 0.030", εr = 2.55 2oz. ED cu 2 sides.             |

**Figure 16. Test circuit**

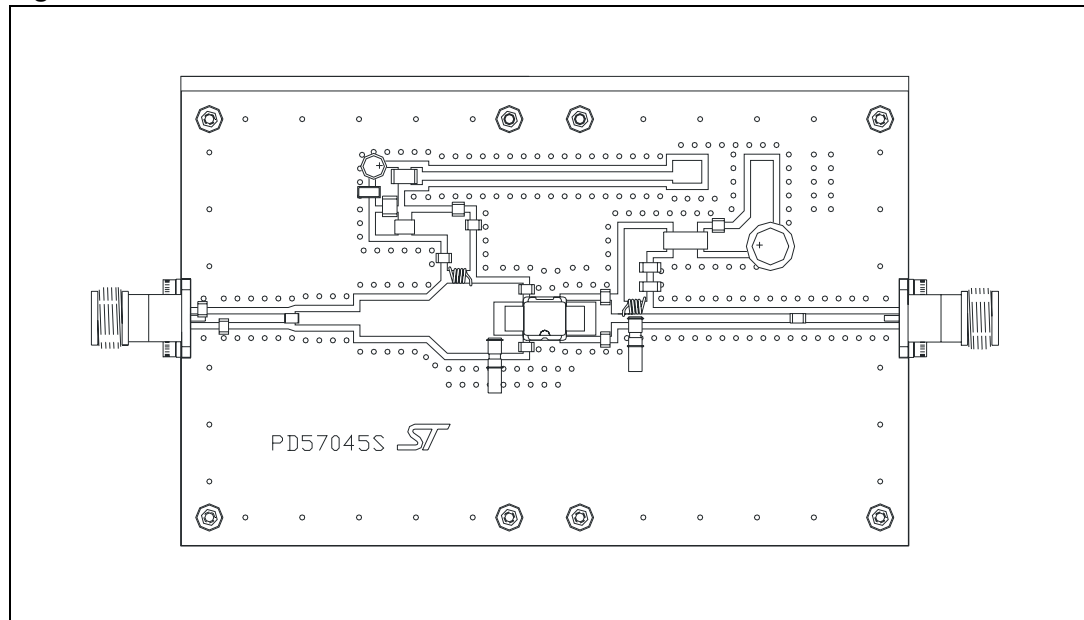
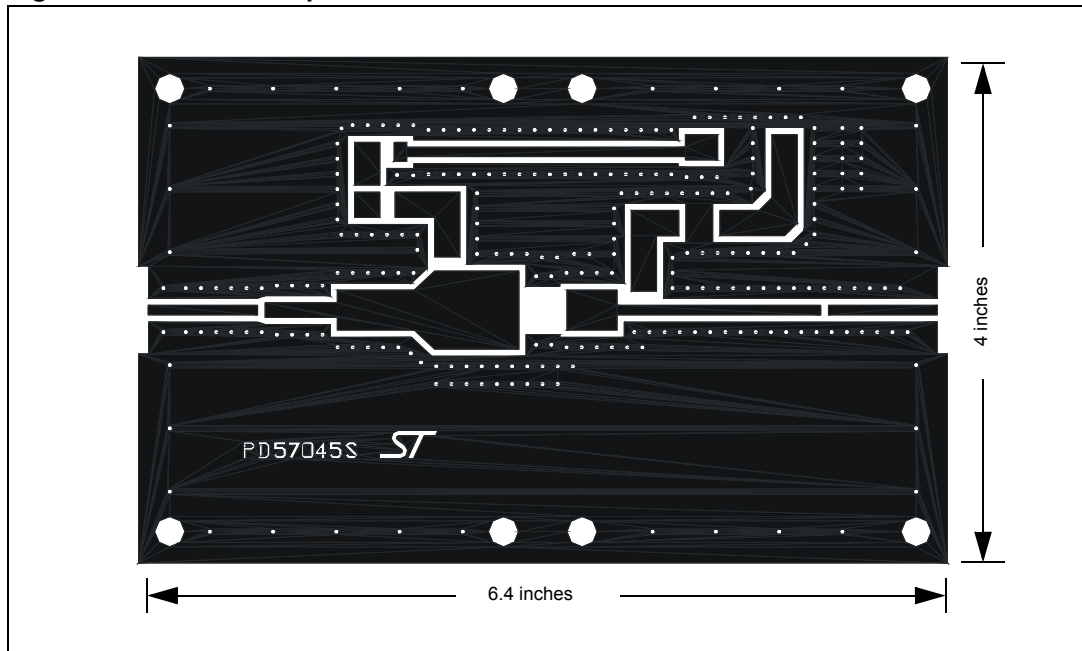


Figure 17. Test circuit photomaster



## 6 Common source s-parameter

Table 9. S-parameter for PD57045S-E ( $V_{DS} = 13.5\text{ V}$   $I_{DS} = 1.5\text{ A}$ )

| Freq (MHz) | $ S_{11} $ | $S_{11} < \Phi$ | $ S_{21} $ | $S_{21} < \Phi$ | $ S_{12} $ | $S_{12} < \Phi$ | $ S_{22} $ | $S_{22} < \Phi$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 50         | 0.825      | -170            | 14.34      | 85              | 0.014      | -1              | 0.819      | -171            |
| 100        | 0.875      | -173            | 6.94       | 79              | 0.013      | -6              | 0.824      | -175            |
| 150        | 0.895      | -175            | 4.67       | 75              | 0.013      | -10             | 0.828      | -175            |
| 200        | 0.908      | -176            | 3.44       | 70              | 0.013      | -14             | 0.837      | -176            |
| 250        | 0.910      | -177            | 2.70       | 65              | 0.012      | -16             | 0.842      | -176            |
| 300        | 0.916      | -178            | 2.20       | 60              | 0.012      | -18             | 0.854      | -176            |
| 350        | 0.922      | -178            | 1.82       | 55              | 0.011      | -23             | 0.864      | -176            |
| 400        | 0.926      | -179            | 1.55       | 51              | 0.010      | -25             | 0.874      | -176            |
| 450        | 0.933      | -179            | 1.32       | 47              | 0.010      | -25             | 0.883      | -177            |
| 500        | 0.937      | -179            | 1.14       | 44              | 0.008      | -25             | 0.893      | -177            |
| 550        | 0.942      | -180            | 1.00       | 40              | 0.008      | -24             | 0.901      | -177            |
| 600        | 0.946      | 180             | 0.88       | 37              | 0.007      | -25             | 0.912      | -177            |
| 650        | 0.949      | 180             | 0.79       | 34              | 0.007      | -25             | 0.915      | -178            |
| 700        | 0.951      | 179             | 0.70       | 32              | 0.006      | -20             | 0.922      | -178            |
| 750        | 0.954      | 179             | 0.63       | 29              | 0.005      | -23             | 0.926      | -179            |
| 800        | 0.958      | 178             | 0.57       | 27              | 0.005      | -14             | 0.932      | -179            |
| 850        | 0.961      | 178             | 0.52       | 24              | 0.004      | -6              | 0.932      | -180            |
| 900        | 0.963      | 178             | 0.47       | 22              | 0.004      | 3               | 0.942      | 179             |
| 950        | 0.964      | 177             | 0.44       | 20              | 0.004      | 1               | 0.942      | 180             |
| 1000       | 0.966      | 177             | 0.40       | 18              | 0.004      | 7               | 0.943      | 179             |
| 1050       | 0.967      | 176             | 0.37       | 16              | 0.003      | 26              | 0.946      | 179             |
| 1100       | 0.966      | 176             | 0.35       | 15              | 0.003      | 51              | 0.949      | 178             |
| 1150       | 0.969      | 176             | 0.32       | 13              | 0.003      | 56              | 0.950      | 179             |
| 1200       | 0.970      | 175             | 0.30       | 11              | 0.004      | 62              | 0.953      | 179             |
| 1250       | 0.970      | 175             | 0.29       | 9               | 0.004      | 55              | 0.967      | 178             |
| 1300       | 0.971      | 175             | 0.26       | 7               | 0.004      | 65              | 0.972      | 176             |
| 1350       | 0.972      | 174             | 0.25       | 6               | 0.004      | 71              | 0.958      | 176             |
| 1400       | 0.972      | 174             | 0.23       | 4               | 0.005      | 81              | 0.961      | 176             |
| 1450       | 0.970      | 174             | 0.22       | 3               | 0.006      | 91              | 0.958      | 175             |
| 1500       | 0.970      | 173             | 0.20       | 2               | 0.007      | 100             | 0.963      | 175             |

Table 10. S-parameter for PD57002S-E ( $V_{DS} = 28\text{ V}$   $I_{DS} = 1.5\text{ A}$ )

| Freq (MHz) | $ S_{11} $ | $S_{11} < \Phi$ | $ S_{21} $ | $S_{21} < \Phi$ | $ S_{12} $ | $S_{12} < \Phi$ | $ S_{22} $ | $S_{22} < \Phi$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 50         | 0.829      | -161            | 20.72      | 92              | 0.012      | 2               | 0.718      | -166            |
| 100        | 0.872      | -168            | 10.33      | 82              | 0.011      | -6              | 0.731      | -170            |
| 150        | 0.897      | -172            | 6.84       | 74              | 0.011      | -10             | 0.745      | -171            |
| 200        | 0.910      | -174            | 5.02       | 68              | 0.010      | -14             | 0.765      | -171            |
| 250        | 0.913      | -175            | 3.86       | 61              | 0.010      | -17             | 0.783      | -171            |
| 300        | 0.922      | -176            | 3.10       | 55              | 0.009      | -23             | 0.803      | -171            |
| 350        | 0.928      | -176            | 2.53       | 50              | 0.009      | -25             | 0.823      | -172            |
| 400        | 0.934      | -177            | 2.12       | 45              | 0.008      | -27             | 0.839      | -172            |
| 450        | 0.941      | -178            | 1.79       | 41              | 0.007      | -26             | 0.856      | -172            |
| 500        | 0.946      | -178            | 1.53       | 37              | 0.006      | -26             | 0.872      | -173            |
| 550        | 0.949      | -179            | 1.32       | 34              | 0.005      | -27             | 0.884      | -174            |
| 600        | 0.955      | -179            | 1.16       | 31              | 0.005      | -24             | 0.898      | -174            |
| 650        | 0.959      | -180            | 1.03       | 27              | 0.004      | -18             | 0.902      | -175            |
| 700        | 0.960      | 180             | 0.91       | 25              | 0.004      | -17             | 0.914      | -175            |
| 750        | 0.963      | 179             | 0.81       | 22              | 0.003      | -7              | 0.919      | -176            |
| 800        | 0.967      | 179             | 0.73       | 19              | 0.003      | -1              | 0.928      | -176            |
| 850        | 0.968      | 178             | 0.67       | 17              | 0.003      | 11              | 0.927      | -177            |
| 900        | 0.968      | 178             | 0.60       | 15              | 0.003      | 28              | 0.937      | -178            |
| 950        | 0.972      | 178             | 0.55       | 12              | 0.003      | 36              | 0.939      | -178            |
| 1000       | 0.972      | 177             | 0.50       | 11              | 0.003      | 56              | 0.94       | -179            |
| 1050       | 0.972      | 177             | 0.49       | 9               | 0.003      | 56              | 0.944      | -179            |
| 1100       | 0.972      | 176             | 0.43       | 7               | 0.004      | 63              | 0.950      | -180            |
| 1150       | 0.974      | 176             | 0.40       | 5               | 0.004      | 66              | 0.950      | -179            |
| 1200       | 0.975      | 176             | 0.37       | 4               | 0.005      | 72              | 0.950      | -180            |
| 1250       | 0.975      | 175             | 0.35       | 3               | 0.006      | 75              | 0.968      | 180             |
| 1300       | 0.976      | 175             | 0.32       | 0               | 0.006      | 77              | 0.973      | 178             |
| 1350       | 0.977      | 174             | 0.30       | -1              | 0.006      | 81              | 0.960      | 178             |
| 1400       | 0.976      | 174             | 0.28       | -2              | 0.006      | 84              | 0.960      | 177             |
| 1450       | 0.973      | 174             | 0.26       | -3              | 0.007      | 98              | 0.958      | 177             |
| 1500       | 0.973      | 174             | 0.25       | -4              | 0.008      | 102             | 0.963      | 176             |

## 7 Package mechanical data

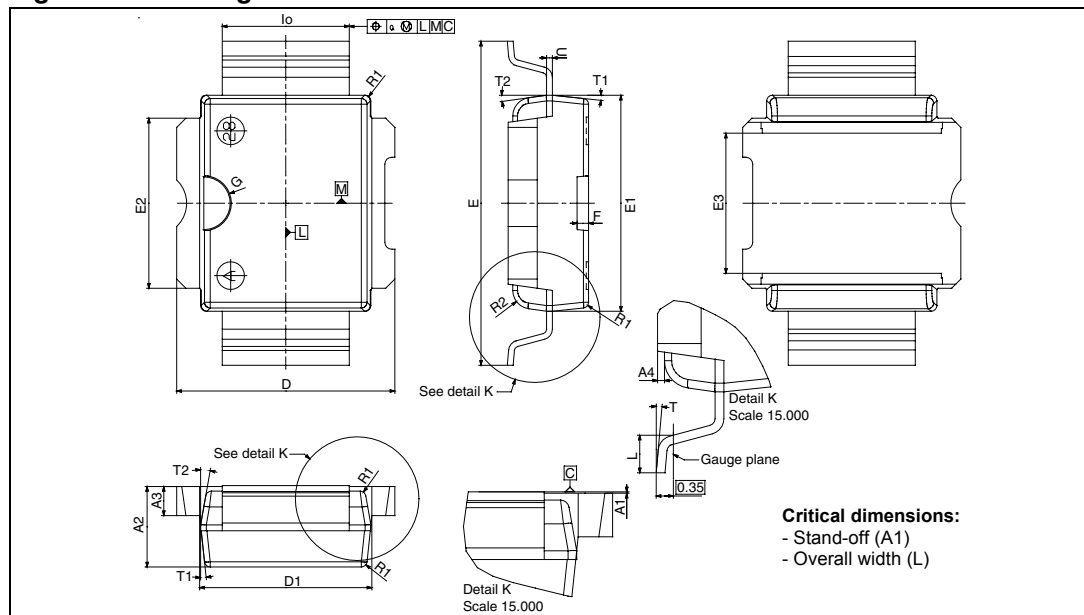
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

**Table 11. PowerSO-10RF formed lead (Gull Wing) mechanical data**

| Dim. | mm.   |        |       | Inch  |        |        |
|------|-------|--------|-------|-------|--------|--------|
|      | Min.  | Typ.   | Max.  | Min.  | Typ.   | Max.   |
| A1   | 0     | 0.05   | 0.1   | 0.    | 0.0019 | 0.0038 |
| A2   | 3.4   | 3.5    | 3.6   | 0.134 | 0.137  | 0.142  |
| A3   | 1.2   | 1.3    | 1.4   | 0.046 | 0.05   | 0.054  |
| A4   | 0.15  | 0.2    | 0.25  | 0.005 | 0.007  | 0.009  |
| a    |       | 0.2    |       |       | 0.007  |        |
| b    | 5.4   | 5.53   | 5.65  | 0.212 | 0.217  | 0.221  |
| c    | 0.23  | 0.27   | 0.32  | 0.008 | 0.01   | 0.012  |
| D    | 9.4   | 9.5    | 9.6   | 0.370 | 0.374  | 0.377  |
| D1   | 7.4   | 7.5    | 7.6   | 0.290 | 0.295  | 0.298  |
| E    | 13.85 | 14.1   | 14.35 | 0.544 | 0.555  | 0.565  |
| E1   | 9.3   | 9.4    | 9.5   | 0.365 | 0.37   | 0.375  |
| E2   | 7.3   | 7.4    | 7.5   | 0.286 | 0.292  | 0.294  |
| E3   | 5.9   | 6.1    | 6.3   | 0.231 | 0.24   | 0.247  |
| F    |       | 0.5    |       |       | 0.019  |        |
| G    |       | 1.2    |       |       | 0.047  |        |
| L    | 0.8   | 1      | 1.1   | 0.030 | 0.039  | 0.042  |
| R1   |       |        | 0.25  |       |        | 0.01   |
| R2   |       | 0.8    |       |       | 0.031  |        |
| T    | 2 deg | 5 deg  | 8 deg | 2 deg | 5 deg  | 8 deg  |
| T1   |       | 6 deg  |       |       | 6 deg  |        |
| T2   |       | 10 deg |       |       | 10 deg |        |

*Note:* Resin protrusions not included (max value: 0.15 mm per side)

**Figure 18. Package dimensions**



**Table 12. PowerSO-10RF straight lead mechanical data**

| Dim. | mm.   |        |       | Inch  |        |       |
|------|-------|--------|-------|-------|--------|-------|
|      | Min.  | Typ.   | Max.  | Min.  | Typ.   | Max.  |
| A1   | 1.62  | 1.67   | 1.72  | 0.064 | 0.065  | 0.068 |
| A2   | 3.4   | 3.5    | 3.6   | 0.134 | 0.137  | 0.142 |
| A3   | 1.2   | 1.3    | 1.4   | 0.046 | 0.05   | 0.054 |
| A4   | 0.15  | 0.2    | 0.25  | 0.005 | 0.007  | 0.009 |
| a    |       | 0.2    |       |       | 0.007  |       |
| b    | 5.4   | 5.53   | 5.65  | 0.212 | 0.217  | 0.221 |
| c    | 0.23  | 0.27   | 0.32  | 0.008 | 0.01   | 0.012 |
| D    | 9.4   | 9.5    | 9.6   | 0.370 | 0.374  | 0.377 |
| D1   | 7.4   | 7.5    | 7.6   | 0.290 | 0.295  | 0.298 |
| E    | 15.15 | 15.4   | 15.65 | 0.595 | 0.606  | 0.615 |
| E1   | 9.3   | 9.4    | 9.5   | 0.365 | 0.37   | 0.375 |
| E2   | 7.3   | 7.4    | 7.5   | 0.286 | 0.292  | 0.294 |
| E3   | 5.9   | 6.1    | 6.3   | 0.231 | 0.24   | 0.247 |
| F    |       | 0.5    |       |       | 0.019  |       |
| G    |       | 1.2    |       |       | 0.047  |       |
| R1   |       |        | 0.25  |       |        | 0.01  |
| R2   |       | 0.8    |       |       | 0.031  |       |
| T1   |       | 6 deg  |       |       | 6 deg  |       |
| T2   |       | 10 deg |       |       | 10 deg |       |

*Note: Resin protrusions not included (max value: 0.15 mm per side)*

**Figure 19. Package dimensions**

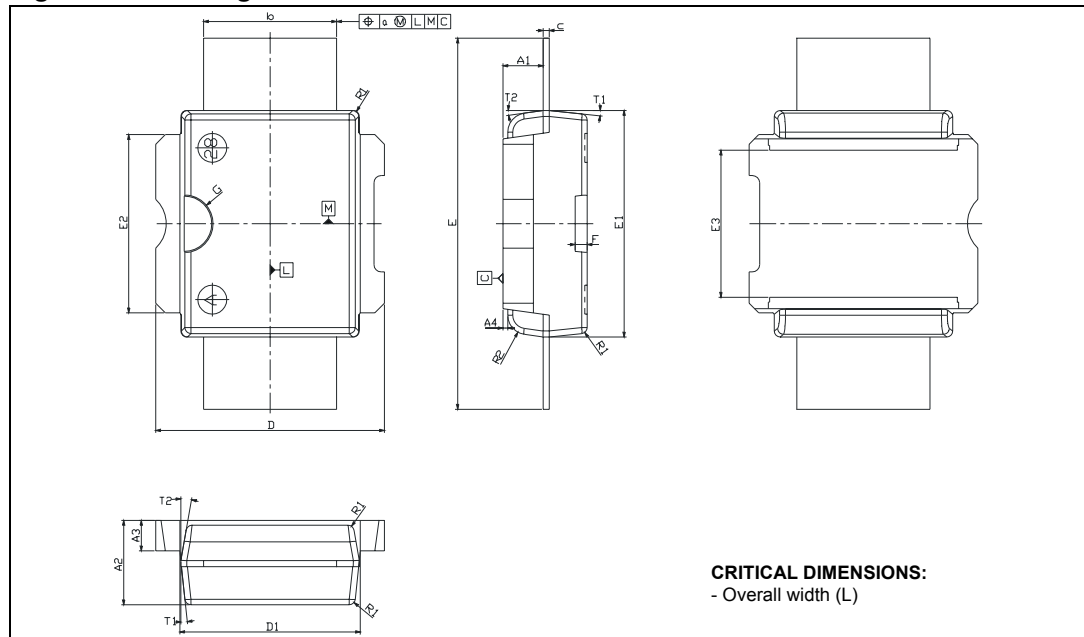




Figure 20. Tube information

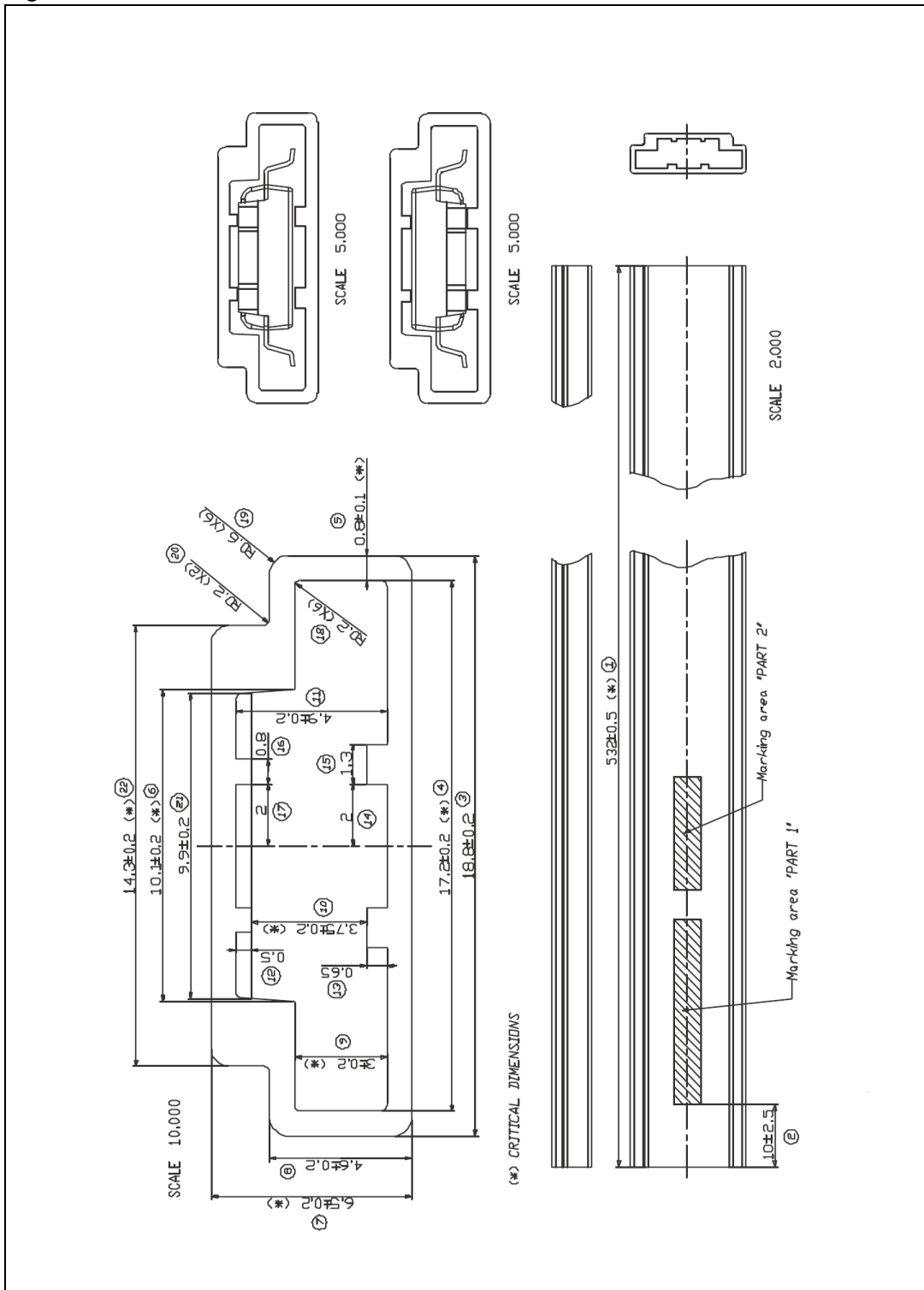
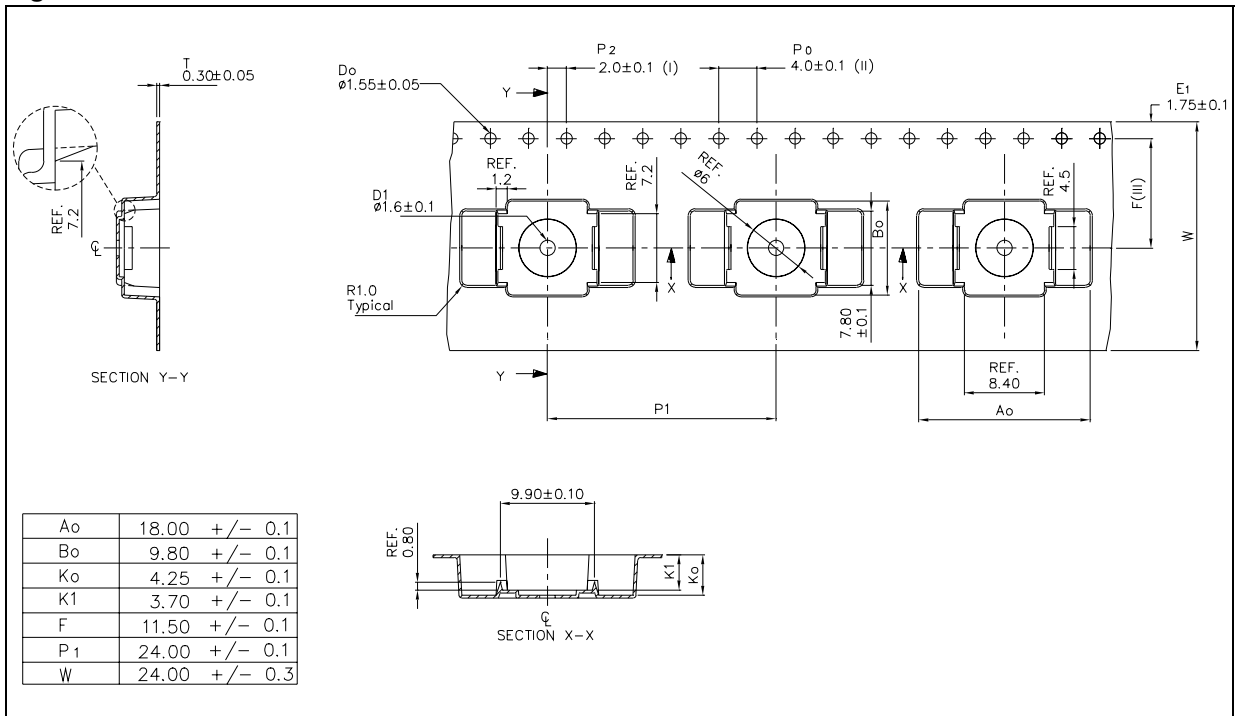


Figure 21. Reel information



## 8 Revision history

**Table 13. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 08-Aug-2006 | 1        | Initial release.   |
| 01-Jun-2010 | 2        | Added: <a href="#">Table 6: Moisture sensitivity level</a> . |

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