



PD57070-E PD57070S-E

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

Features

- Excellent thermal stability
- Common source configuration
- $P_{OUT} = 70\text{ W}$ with 14.7dB 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 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/ (look for application note AN1294).

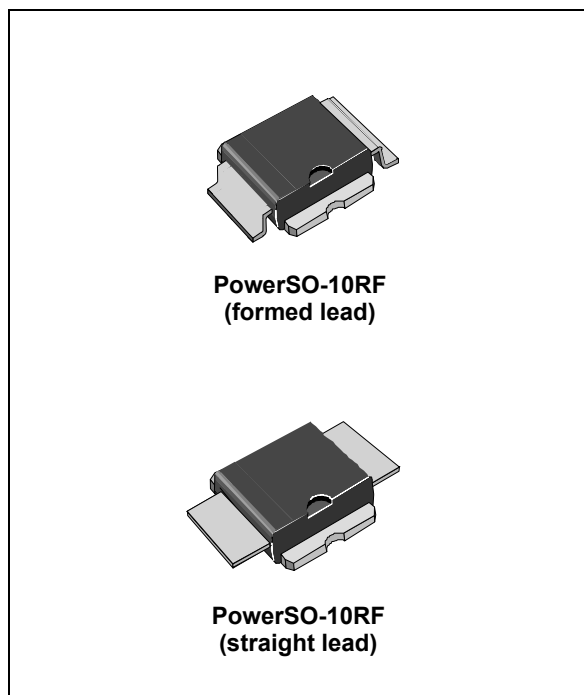


Figure 1. Pin connection

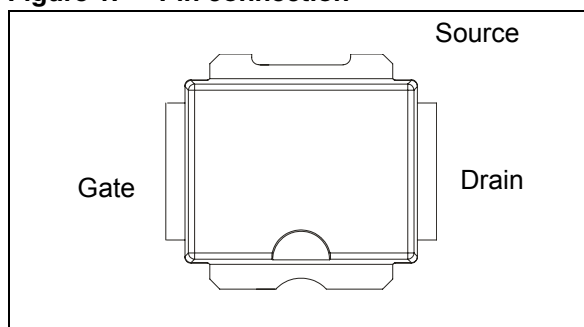


Table 1. Device summary

Order code	Package	Packing
PD57070-E	PowerSO-10RF (formed lead)	Tube
PD57070S-E	PowerSO-10RF (straight lead)	Tube
PD57070TR-E	PowerSO-10RF (formed lead)	Tape and reel
PD57070STR-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	± 20	V
I_D	Drain Current	7	A
P_{DISS}	Power Dissipation (@ $T_c = 70^{\circ}C$)	95	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	1.0	$^{\circ}C/W$

2 Electrical characteristics

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

2.1 Static

Table 4. Static

Symbol	Test conditions		Min	Typ	Max	Unit
$V_{DSS(BR)}$	$V_{GS} = 0$	$I_{DS} = 1\text{ mA}$	65			V
I_{DSS}	$V_{GS} = 0$	$V_{DS} = 28\text{ V}$			1	μA
I_{GSS}	$V_{GS} = 20\text{ V}$	$V_{DS} = 0\text{ V}$			1	μA
$V_{GS(Q)}$	$V_{DS} = 28\text{ V}$	$I_D = 100\text{ mA}$	2.0		5.0	V
$V_{DS(ON)}$	$V_{GS} = 10\text{ V}$	$I_D = 3\text{ A}$		0.8	0.95	V
G_{FS}	$V_{DS} = 10\text{ V}$	$I_D = 3\text{ A}$	2.5			mho
C_{ISS}	$V_{GS} = 0$	$V_{DS} = 28\text{ V}$		91		pF
C_{OSS}	$V_{GS} = 0$	$V_{DS} = 28\text{ V}$		58		pF
C_{RSS}	$V_{GS} = 0$	$V_{DS} = 28\text{ V}$		3.8		pF

2.2 Dynamic

Table 5. Dynamic

Symbol	Test conditions		Min	Typ	Max	Unit
P_{out}	$V_{DD} = 28\text{ V}$	$I_{DQ} = 250\text{ mA}$ $f = 945\text{ MHz}$	70			W
G_P	$V_{DD} = 28\text{ V}$	$I_{DQ} = 250\text{ mA}$ $P_{OUT} = 70\text{ W}$ $f = 945\text{ MHz}$	13	14.7		dB
h_D	$V_{DD} = 28\text{ V}$	$I_{DQ} = 250\text{ mA}$ $P_{OUT} = 70\text{ W}$ $f = 945\text{ MHz}$		50		%
Load mismatch	$V_{DD} = 28\text{ V}$	$I_{DQ} = 250\text{ mA}$ $P_{OUT} = 70\text{ W}$ $f = 945\text{ MHz}$ All phase angles	5:1			VSWR

2.3 Moisture sensitivity level

Table 6. Moisture sensitivity level

Test methodology	Rating
J-STD-020B	MSL 3

3 Impedances

Figure 2. Current conventions

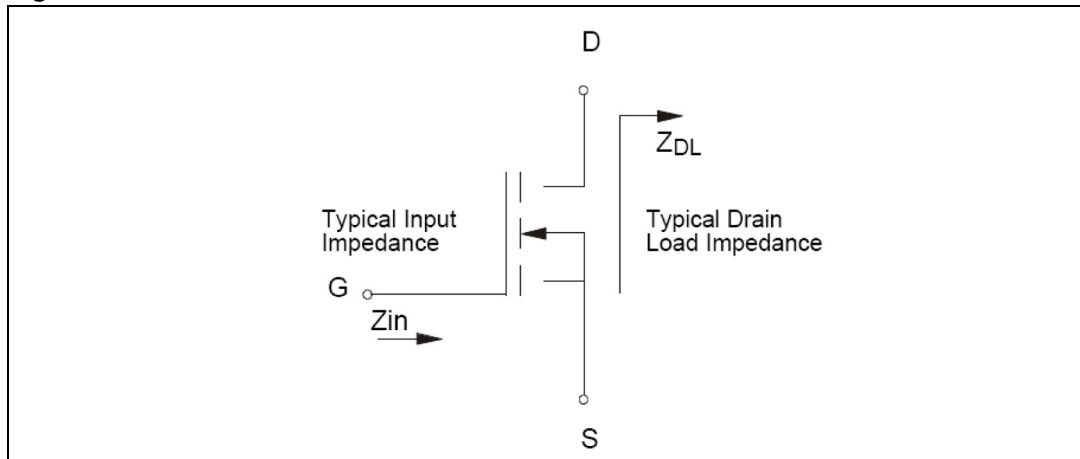


Table 7. Impedance data (PD57070S)

Freq. (MHz)	Z_{IN} (Ω)	Z_{DL} (Ω)
900	$0.37 + j 0.60$	$1.7 - j 0.50$
920	$0.35 + j 0.60$	$1.6 - j 0.30$
940	$0.55 + j 0.40$	$1.5 - j 0.21$
960	$0.42 + j 0.30$	$1.4 - j 0.18$
980	$0.20 + j 0.20$	$1.2 - j 0.15$

4 Typical performance

Figure 3. Capacitance vs supply voltage

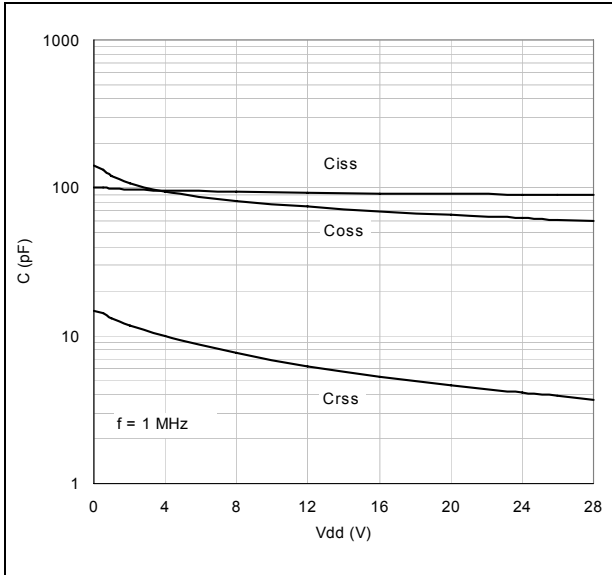


Figure 4. Drain current vs gate source voltage

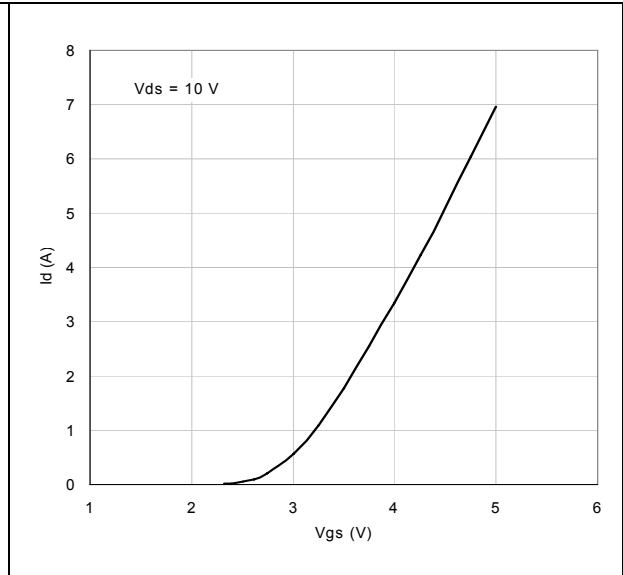


Figure 5. Gate-source voltage vs case temperature

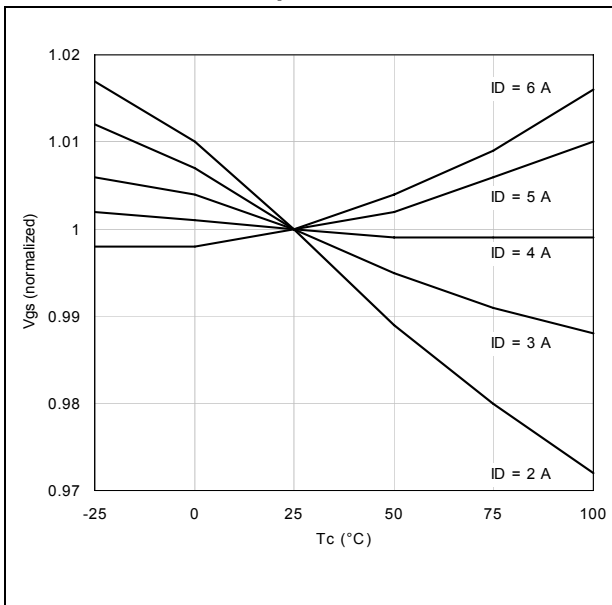


Figure 6. Output power vs input power

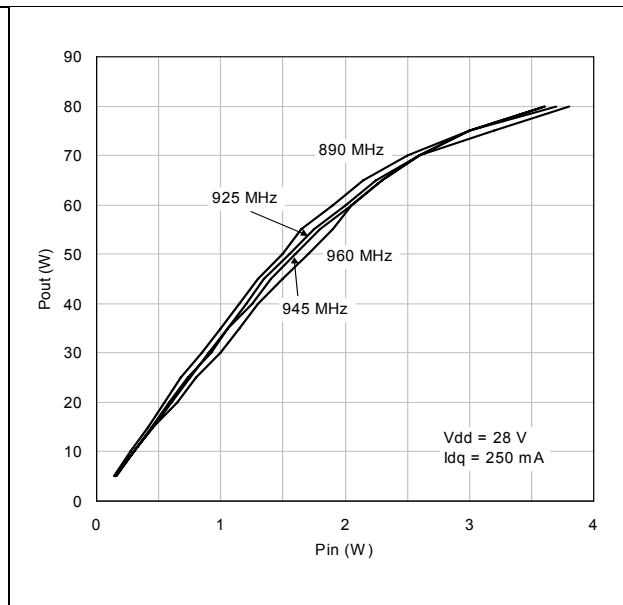


Figure 7. Power gain vs output power

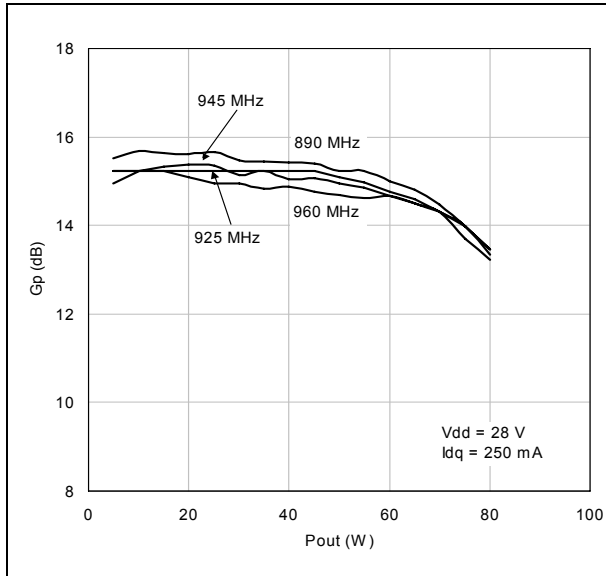


Figure 8. Efficiency vs output power

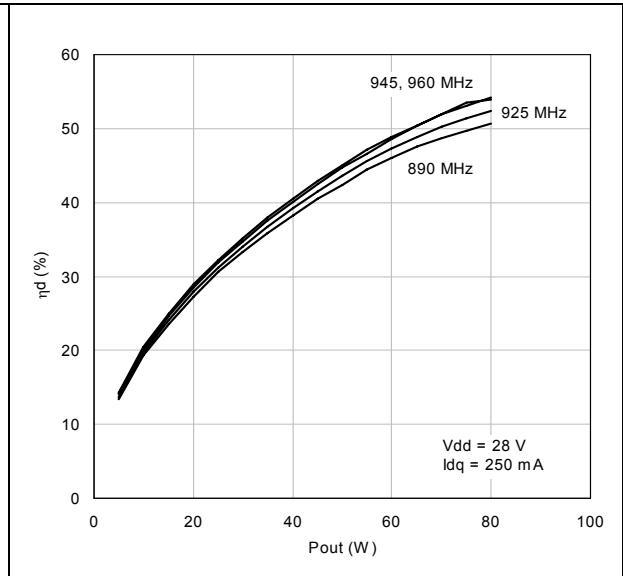


Figure 9. Input return loss vs output power

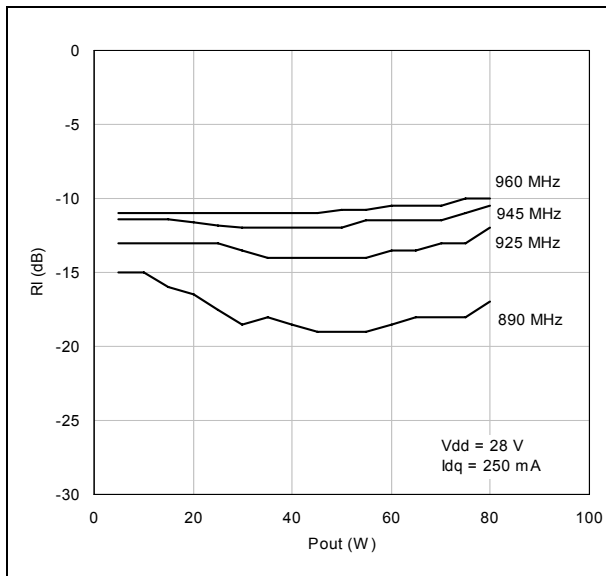


Figure 10. Output power vs gate-source voltage

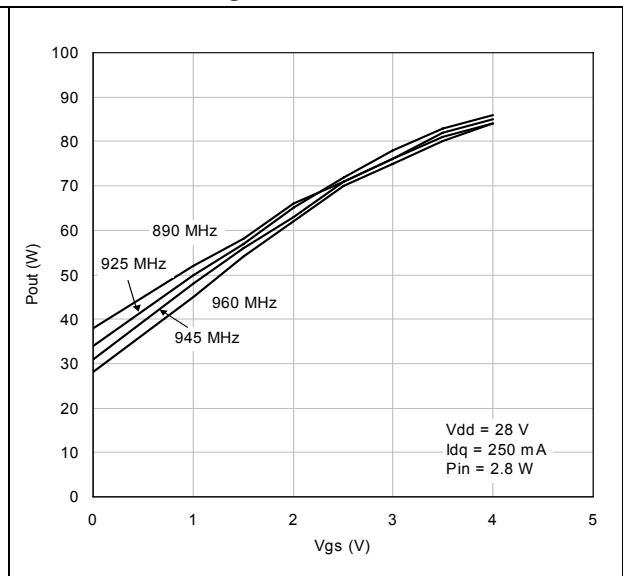


Figure 11. Output power vs bias current

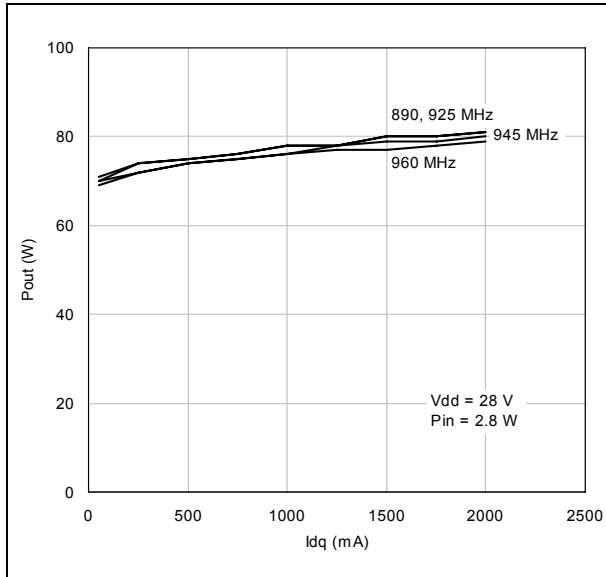


Figure 12. Efficiency vs bias current

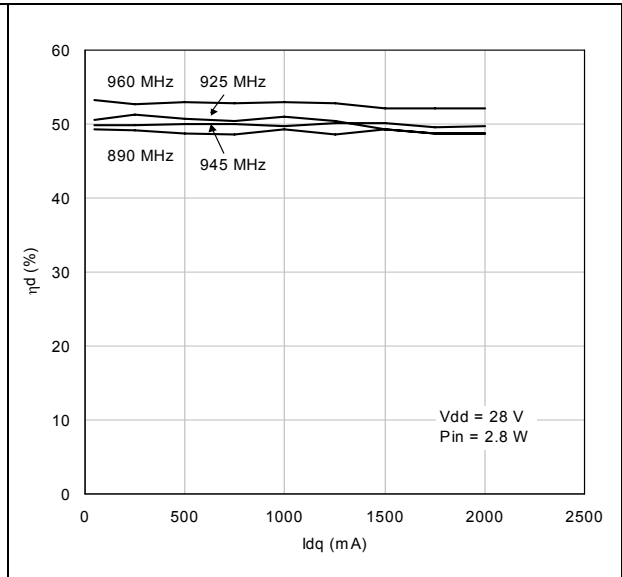


Figure 13. Output power vs supply voltage

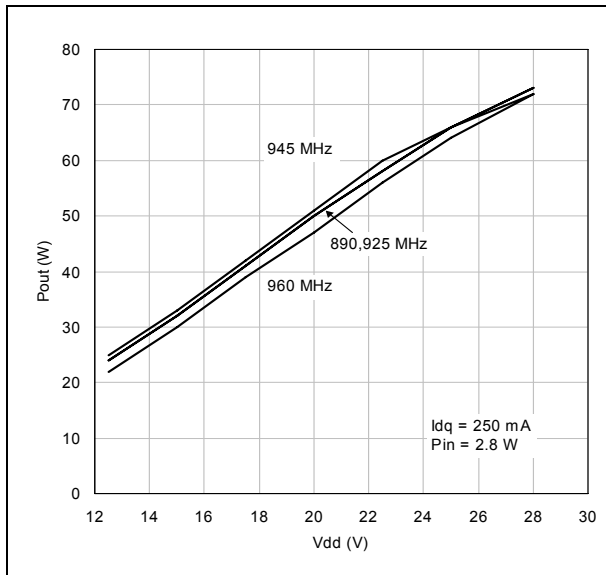
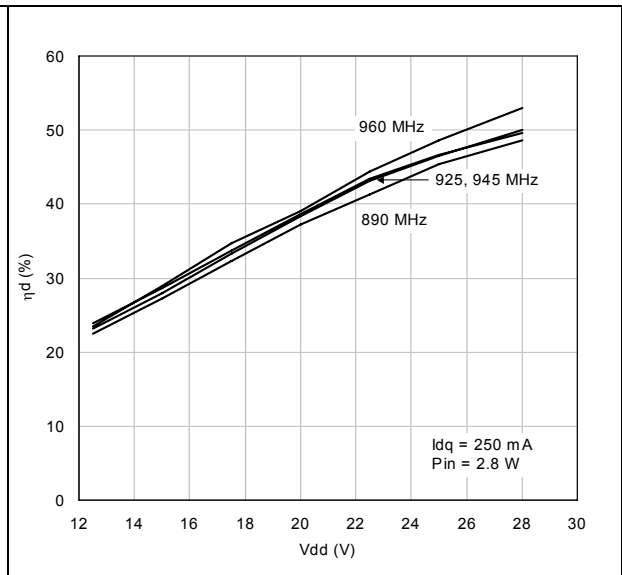
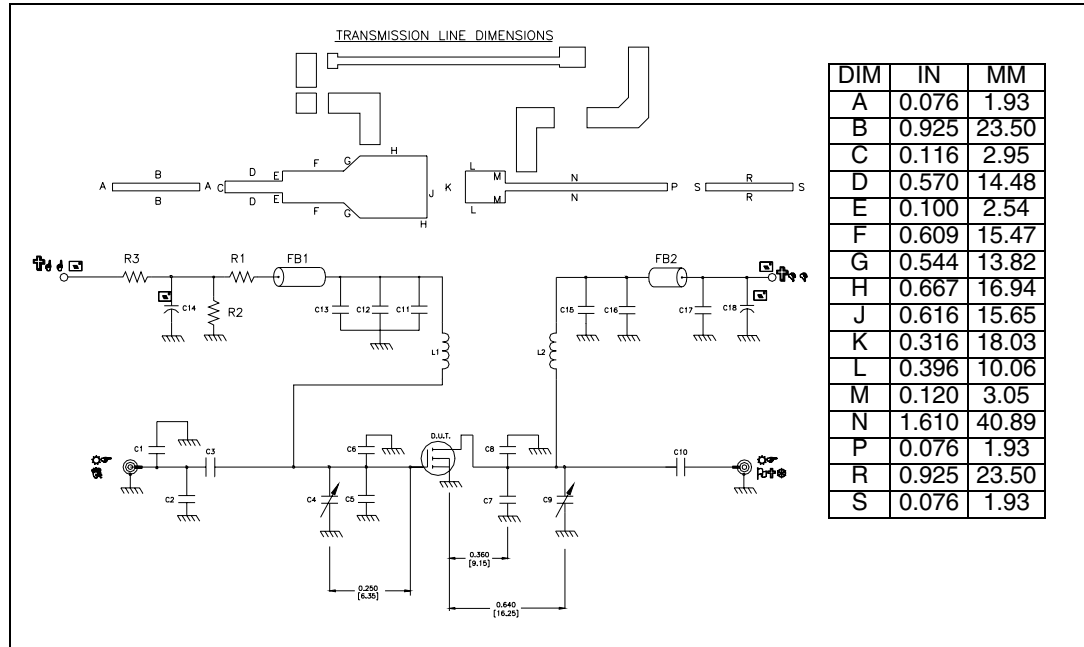


Figure 14. Efficiency vs supply voltage



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 k Ω , 1 W surface mount chip resistor
R2	4.7 M Ω , 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 μ F, 500 V surface mount ceramic chip capacitor
C14	10 μ F, 50 V aluminum electrolytic radial lead capacitor
C16	100 pF ATC 100B surface mount ceramic chip capacitor
C18	220 μ F, 63 V aluminum electrolytic radial lead capacitor
Board	Roger, ultra lam 2000, THK 0.030", $\epsilon_r = 2.55$ 2oz. ED Cu 2 sides.

Figure 16. Test circuit

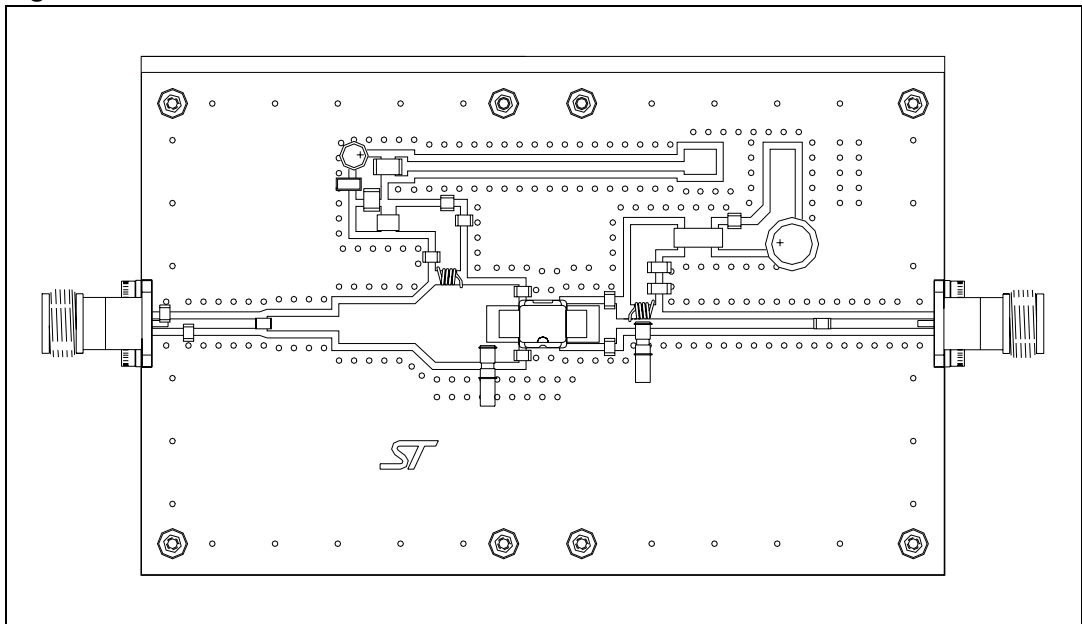
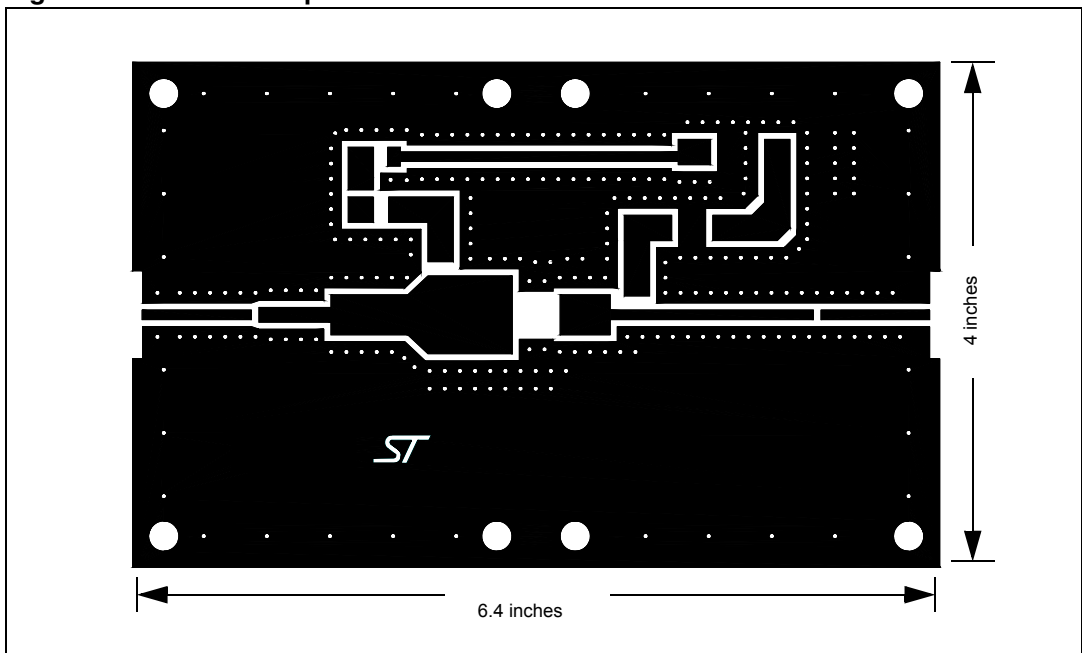


Figure 17. Test circuit photomaster



6 Common source s-parameter

Table 9. S-parameter for PD57070S-E ($V_{DS} = 28\text{ V}$ $I_{DS} = 500\text{ mA}$)

Freq (MHz)	$ S_{11} $	$S_{11} < \Phi$	$ S_{21} $	$S_{21} < \Phi$	$ S_{12} $	$S_{12} < \Phi$	$ S_{22} $	$S_{22} < \Phi$
50	0.834	-156	19.73	88	0.012	2	0.715	-164
100	0.868	-166	9.48	76	0.012	-9	0.741	-168
150	0.887	-170	6.18	67	0.011	-16	0.766	-169
200	0.901	-172	4.36	60	0.011	-23	0.793	-169
250	0.912	-173	3.32	52	0.009	-29	0.822	-169
300	0.924	-174	2.58	46	0.008	-29	0.848	-170
350	0.934	-175	2.07	40	0.007	-34	0.870	-171
400	0.941	-176	1.69	35	0.006	-37	0.889	-172
450	0.948	-177	1.40	31	0.005	-35	0.905	-172
500	0.954	-178	1.17	27	0.005	-38	0.916	-173
550	0.958	-179	1.00	24	0.004	-28	0.925	-174
600	0.962	-179	0.86	21	0.003	-23	0.937	-175
650	0.967	180	0.75	18	0.003	-10	0.942	-176
700	0.968	179	0.66	15	0.002	-5	0.949	-176
750	0.970	179	0.59	13	0.002	14	0.954	-177
800	0.973	178	0.52	11	0.002	32	0.960	-178
850	0.970	177	0.47	9	0.002	44	0.961	-178
900	0.977	177	0.43	7	0.002	58	0.967	-179
950	0.976	177	0.39	5	0.003	64	0.969	-180
1000	0.976	176	0.35	4	0.003	72	0.970	180
1050	0.976	175	0.32	2	0.004	70	0.974	179
1100	0.980	175	0.30	0	0.004	75	0.974	179
1150	0.978	175	0.27	-2	0.005	77	0.977	178
1200	0.975	174	0.25	-3	0.005	76	0.974	178
1250	0.977	174	0.23	-4	0.005	80	0.976	177
1300	0.979	173	0.22	-6	0.006	86	0.973	177
1350	0.975	173	0.20	-7	0.007	87	0.973	176
1400	0.976	172	0.19	-7	0.007	89	0.976	176
1450	0.977	172	0.17	-9	0.007	88	0.974	176
1500	0.974	172	0.16	-9	0.008	110	0.975	175

Table 10. S-parameter PD57070S-E ($V_{DS} = 28\text{ V}$ $I_{DS} = 1\text{ A}$)

Freq (MHz)	$ S_{11} $	$S_{11} < \Phi$	$ S_{21} $	$S_{21} < \Phi$	$ S_{12} $	$S_{12} < \Phi$	$ S_{22} $	$S_{22} < \Phi$
50	0.859	-157	19.99	90	0.009	3	0.756	-169
100	0.890	-167	9.70	79	0.009	-5	0.775	-172
150	0.906	-171	6.43	72	0.009	-10	0.788	-173
200	0.913	-173	4.61	65	0.008	-16	0.807	-173
250	0.921	-175	3.59	58	0.008	-19	0.824	-173
300	0.928	-176	2.83	52	0.007	-23	0.844	-173
350	0.933	-176	2.31	47	0.006	-23	0.862	-173
400	0.941	-177	1.92	42	0.005	-24	0.877	-173
450	0.946	-178	1.61	37	0.005	-22	0.892	-174
500	0.951	-179	1.37	33	0.004	-16	0.903	-175
550	0.956	-179	1.18	30	0.004	-10	0.913	-175
600	0.959	-180	1.02	26	0.003	-2	0.922	-176
650	0.961	180	0.90	23	0.003	3	0.929	-176
700	0.963	179	0.79	21	0.003	19	0.938	-177
750	0.966	178	0.71	18	0.003	36	0.944	-177
800	0.970	178	0.63	16	0.003	34	0.949	-178
850	0.968	177	0.57	14	0.003	49	0.953	-179
900	0.975	177	0.52	11	0.004	55	0.957	-179
950	0.972	176	0.47	9	0.004	56	0.960	-180
1000	0.972	176	0.43	8	0.004	68	0.962	180
1050	0.974	175	0.40	6	0.004	71	0.965	179
1100	0.975	175	0.37	4	0.004	76	0.967	179
1150	0.975	174	0.34	1	0.005	75	0.968	178
1200	0.971	174	0.31	0	0.005	72	0.968	178
1250	0.976	173	0.29	-2	0.006	80	0.969	177
1300	0.976	173	0.27	-3	0.006	79	0.969	177
1350	0.973	173	0.25	-4	0.007	87	0.968	176
1400	0.972	172	0.23	-5	0.007	87	0.969	176
1450	0.973	172	0.22	-6	0.007	89	0.970	175
1500	0.969	171	0.20	-7	0.008	108	0.972	175

Table 11. S-parameter for PD57070S-E ($V_{DS} = 28\text{ V}$ $I_{DS} = 2\text{ A}$)

Freq (MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
50	0.880	-156	19.15	92	0.008	5	0.780	-172
100	0.908	-166	9.35	81	0.008	-2	0.795	-174
150	0.923	-171	6.25	74	0.008	-4	0.803	-174
200	0.928	-173	4.52	68	0.007	-13	0.817	-174
250	0.933	-175	3.55	62	0.007	-14	0.831	-174
300	0.938	-176	2.84	56	0.006	-12	0.847	-174
350	0.941	-177	2.34	51	0.005	-14	0.863	-174
400	0.945	-178	1.95	46	0.005	-13	0.876	-175
450	0.949	-178	1.66	41	0.004	-10	0.888	-175
500	0.954	-179	1.42	37	0.004	-8	0.896	-176
550	0.958	-180	1.23	33	0.003	-2	0.906	-176
600	0.961	180	1.07	30	0.003	10	0.915	-176
650	0.963	179	0.94	27	0.003	21	0.923	-177
700	0.965	178	0.84	24	0.003	27	0.930	-177
750	0.968	178	0.75	22	0.003	35	0.937	-178
800	0.968	178	0.68	19	0.003	46	0.944	-178
850	0.966	177	0.61	17	0.003	46	0.947	-179
900	0.973	176	0.56	15	0.004	63	0.953	-180
950	0.973	176	0.51	12	0.004	58	0.953	180
1000	0.972	175	0.47	10	0.004	66	0.959	180
1050	0.974	175	0.43	8	0.004	71	0.960	179
1100	0.977	175	0.40	6	0.005	73	0.963	178
1150	0.974	174	0.37	4	0.005	71	0.965	178
1200	0.970	174	0.34	3	0.005	77	0.963	178
1250	0.975	173	0.31	1	0.006	77	0.963	177
1300	0.976	173	0.29	-1	0.007	82	0.965	177
1350	0.971	173	0.27	-2	0.007	80	0.968	176
1400	0.974	172	0.25	-3	0.007	85	0.968	176
1450	0.974	172	0.24	-4	0.008	88	0.965	175
1500	0.969	171	0.22	-5	0.008	107	0.967	175

Table 12. S-parameter for PD57070S-E ($V_{DS} = 28\text{ V}$ $I_{DS} = 3\text{ A}$)

Freq (MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
50	0.889	-154	18.31	92	0.008	8	0.783	-173
100	0.915	-166	8.98	82	0.007	-2	0.799	-174
150	0.928	-171	6.01	75	0.007	-4	0.807	-175
200	0.934	-173	4.35	69	0.007	-9	0.820	-175
250	0.939	-175	3.42	62	0.006	-12	0.833	-174
300	0.943	-176	2.74	57	0.006	-11	0.847	-174
350	0.946	-177	2.26	51	0.005	-13	0.860	-175
400	0.948	-178	1.89	47	0.005	-9	0.876	-175
450	0.954	-178	1.61	42	0.004	-6	0.887	-175
500	0.958	-179	1.37	38	0.004	-4	0.897	-176
550	0.961	-180	1.19	34	0.003	1	0.905	-176
600	0.965	180	1.05	31	0.003	12	0.914	-176
650	0.966	179	0.92	28	0.003	19	0.921	-177
700	0.968	178	0.82	25	0.003	38	0.929	-177
750	0.970	178	0.74	22	0.003	45	0.938	-178
800	0.971	177	0.66	19	0.003	45	0.942	-178
850	0.968	177	0.60	17	0.003	57	0.946	-179
900	0.973	176	0.55	15	0.004	58	0.952	-180
950	0.973	176	0.50	13	0.004	56	0.955	180
1000	0.973	175	0.46	11	0.005	59	0.958	179
1050	0.975	175	0.42	9	0.005	73	0.962	179
1100	0.977	174	0.39	6	0.005	71	0.965	178
1150	0.975	174	0.36	4	0.005	73	0.964	178
1200	0.972	174	0.33	3	0.006	74	0.963	178
1250	0.976	173	0.31	1	0.006	80	0.965	177
1300	0.977	173	0.29	-1	0.006	79	0.967	176
1350	0.974	172	0.26	-2	0.007	81	0.969	176
1400	0.976	172	0.25	-3	0.007	86	0.969	176
1450	0.974	172	0.23	-4	0.007	88	0.968	175
1500	0.971	171	0.22	-5	0.008	102	0.966	175

7 Package mechanical data

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

Table 13. 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 PowerSO-10RF formed lead

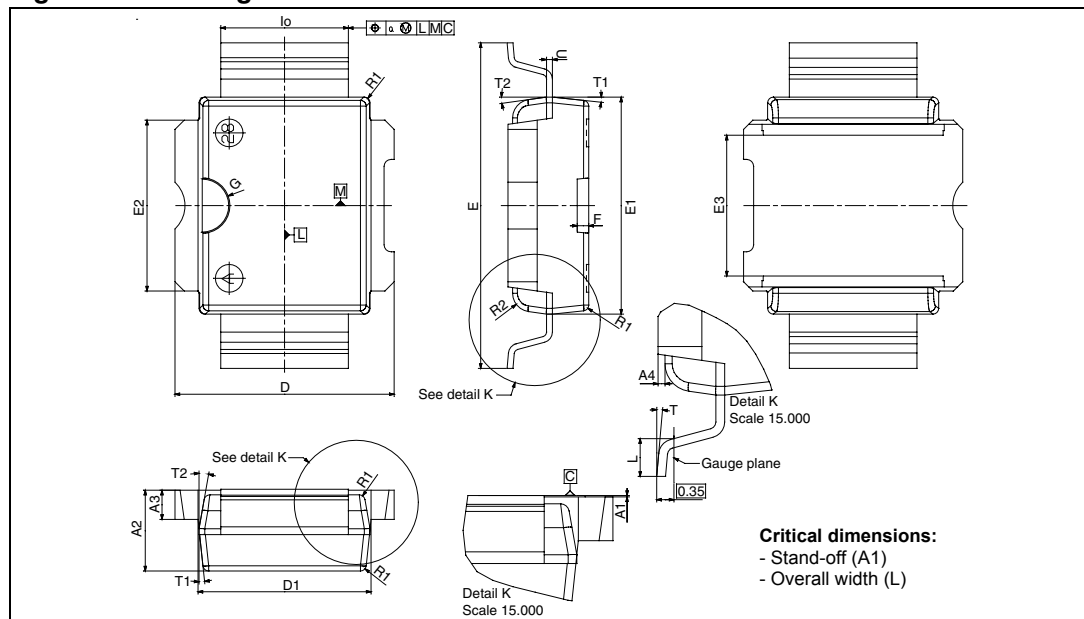


Table 14. PowerSO-10RF straight lead mechanical data

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 PowerSO-10RF straight lead

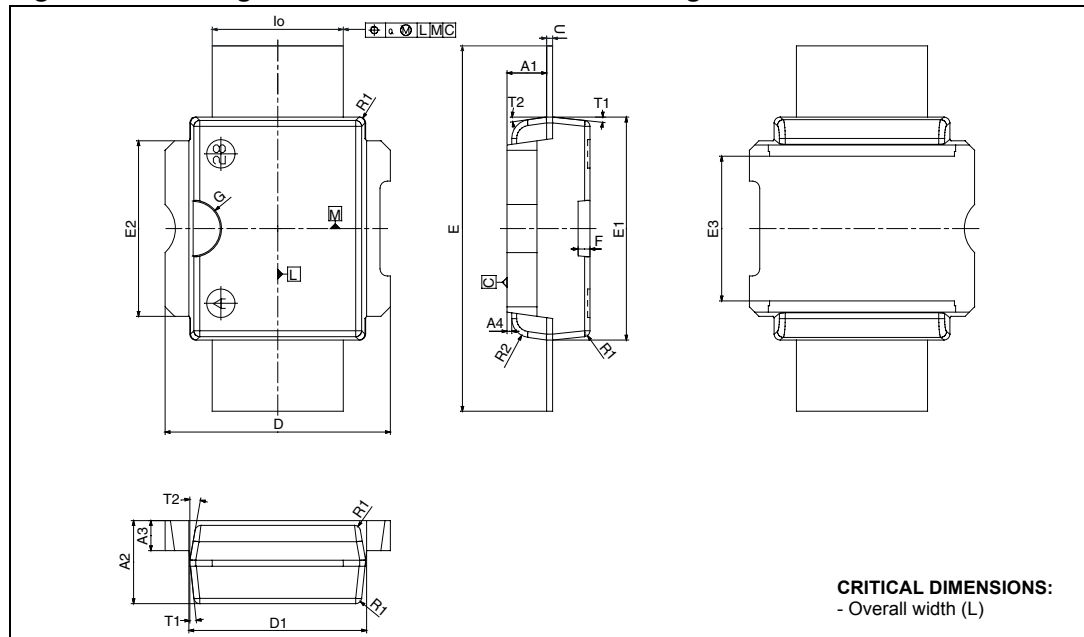


Figure 20. Tube information

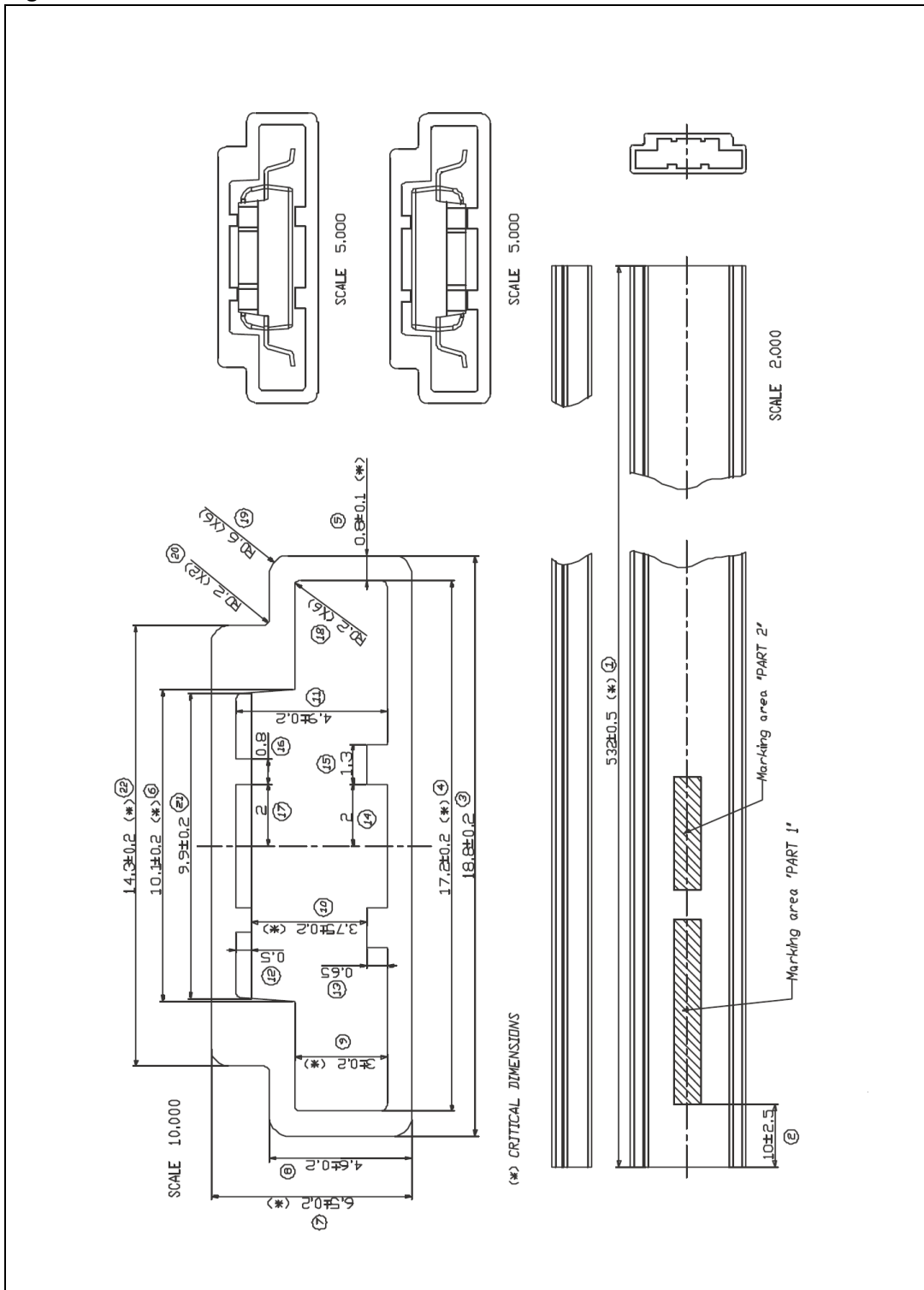
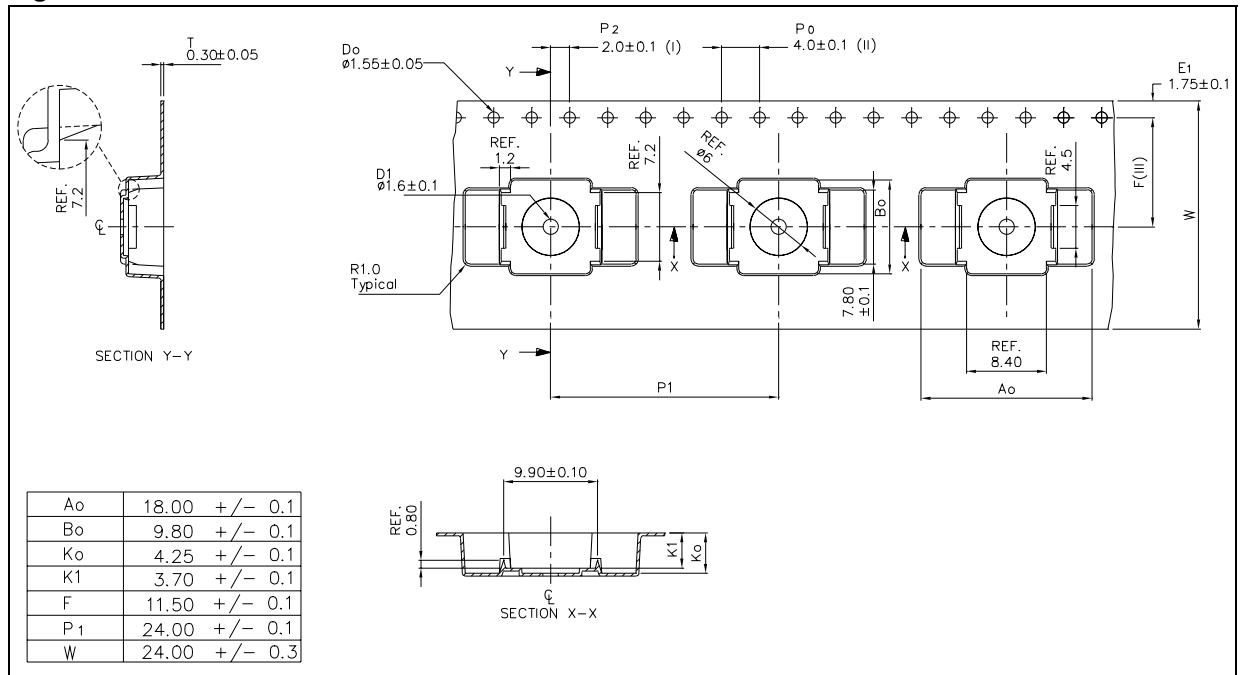


Figure 21. Reel information



8 Revision history

Table 15. Document revision history

Date	Revision	Changes
13-Jul-2006	1	Initial release.
03-Jun-2010	2	Added: Table 6: Moisture sensitivity level .

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