PD55025-E
PD55025S-E

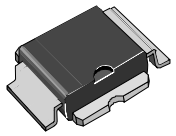
RF POWER transistor, LdmoST plastic family N-channel enhancement-mode, lateral MOSFETs

Features

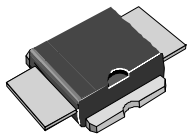
- Excellent thermal stability
- Common source configuration
- P_{OUT} = 25 W with 14.5dB gain @ 500 MHz / 12.5 V
- New RF plastic package

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 12 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. The device's superior linearity performance makes it an ideal solution for car mobile radio. 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 performance and ease of assembly. Mounting recommendations are available in www.st.com/rf/ (look for application note AN1294).



PowerSO-10RF (formed lead)



PowerSO-10RF (straight lead)

Figure 1. Pin connection

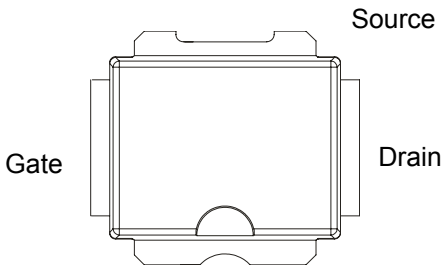


Table 1. Device summary

Order code	Package	Packing
PD55025-E	PowerSO-10RF (formed lead)	Tube
PD55025S-E	PowerSO-10RF (straight lead)	Tube
PD55015TR-E	PowerSO-10RF (formed lead)	Tape and reel
PD55015STR-E	PowerSO-10RF (straight lead)	Tape and reel

Contents

1 Electrical data

1.1 Maximum ratings

Table 2. Absolute maximum ratings (T_{CASE} = 25°C)

Symbol	Parameter	Value	Unit
$V_{(BR)DSS}$	Drain-source voltage	40	V
V_{GS}	Gate-source voltage	± 20	V
I_D	Drain current	7	A
P_{DISS}	Power dissipation (@ T_C = 70°C)	79	W
T_J	Max. operating junction temperature	165	°C
T_{STG}	Storage temperature	-65 to +150	°C

1.2 Thermal data

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Junction - case thermal resistance	1.2	°C/W

2 Electrical characteristics

T_{CASE} = +25 °C

2.1 Static

Table 4. Static

Symbol	Test conditions			Min.	Typ.	Max.	Unit
I_{DSS}	V_{GS} = 0	V_{DS} = 28 V				1	µA
I_{GSS}	V_{GS} = 20 V	V_{DS} = 0				1	µA
$V_{GS(Q)}$	V_{DS} = 28 V	I_D = 100 mA		2.0		5.0	V
$V_{DS(ON)}$	V_{GS} = 10 V	I_D = 3 A			0.7	0.8	V
G_{FS}	V_{DS} = 10 V	I_D = 3 A		2.5			mho
C_{ISS}	V_{GS} = 0	V_{DS} = 12.5 V	f = 1 MHz		86		pF
C_{OSS}	V_{GS} = 0	V_{DS} = 12.5 V	f = 1 MHz		76		pF
C_{RSS}	V_{GS} = 0	V_{DS} = 12.5 V	f = 1 MHz		5.8		pF

2.2 Dynamic

Table 5. Dynamic

Symbol	Test conditions		Min.	Typ.	Max.	Unit
P_{OUT}	V_{DD} = 12.5 V, I_{DQ} = 200 mA	f = 500 MHz	25			W
G_P	V_{DD} = 12.5 V, I_{DQ} = 200 mA, P_{OUT} = 25 W, f = 500 MHz			14.5		dB
h_D	V_{DD} = 12.5 V, I_{DQ} = 200 mA, P_{OUT} = 25 W, f = 500 MHz			50		%
Load mismatch	V_{DD} = 15.5 V, I_{DQ} = 200 mA, P_{OUT} = 25 W, f = 500 MHz All phase angles		20:1			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

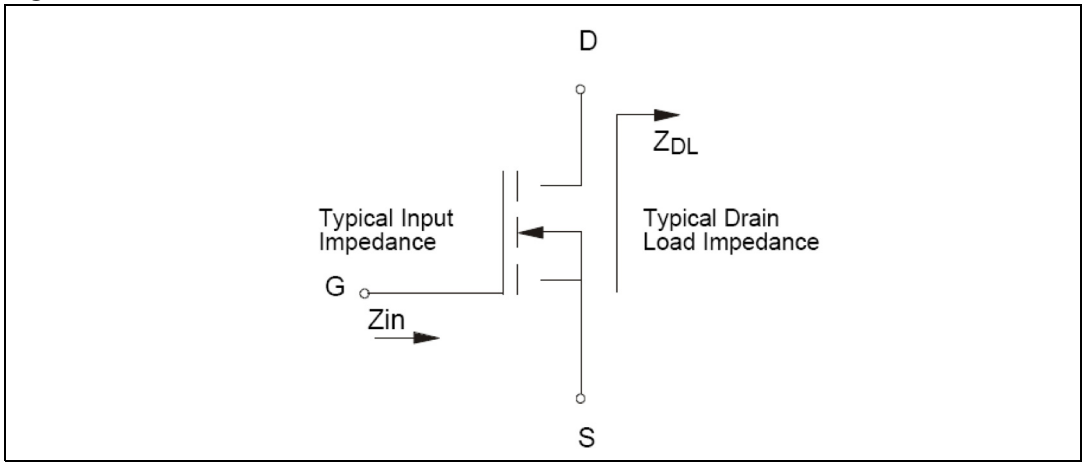


Table 7. Impedance data

Freq. (MHz)	Z_{IN} (Ω)	Z_{DL}(Ω)
175	3.20 - j 4.41	1.56 + j 2.14
480	1.01 - j 1.67	1.06 + j 0.22
500	0.93 - j 1.53	1.12 + j 0.20
520	0.88 - j 1.98	1.07 + j 0.83

4 Typical performance

Figure 3. Capacitance vs supply voltage

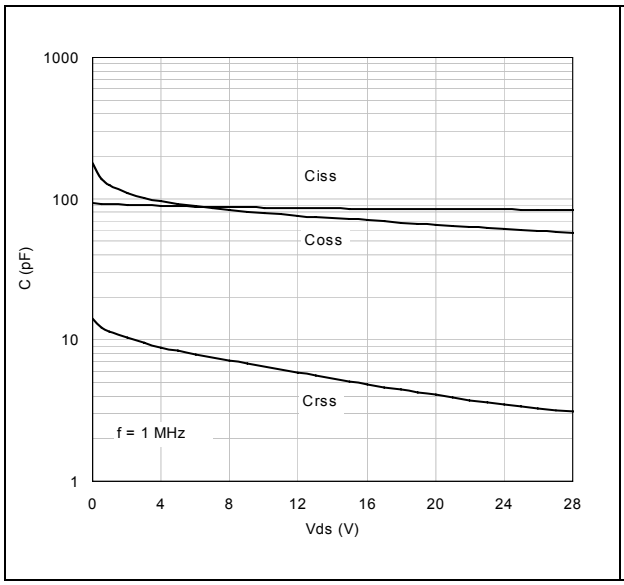


Figure 4. Drain current vs gate source voltage

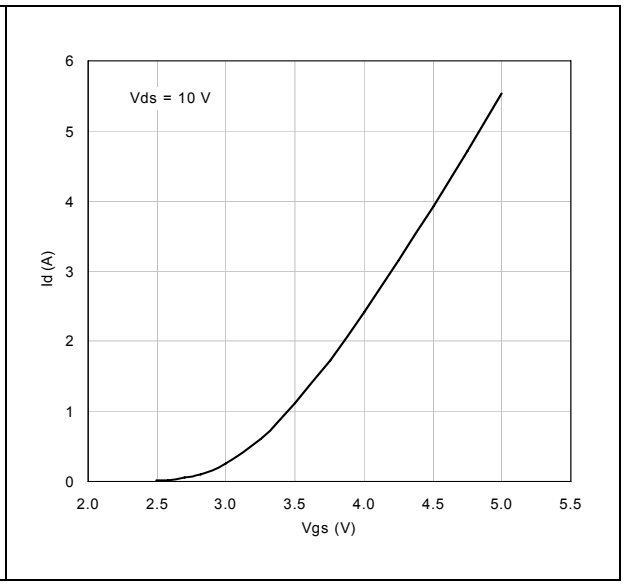


Figure 5. Gate-source voltage vs case temperature

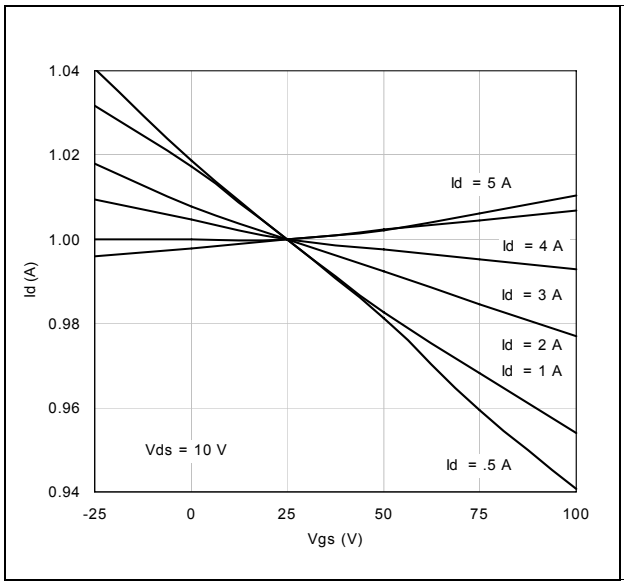


Figure 6. Output power vs input power

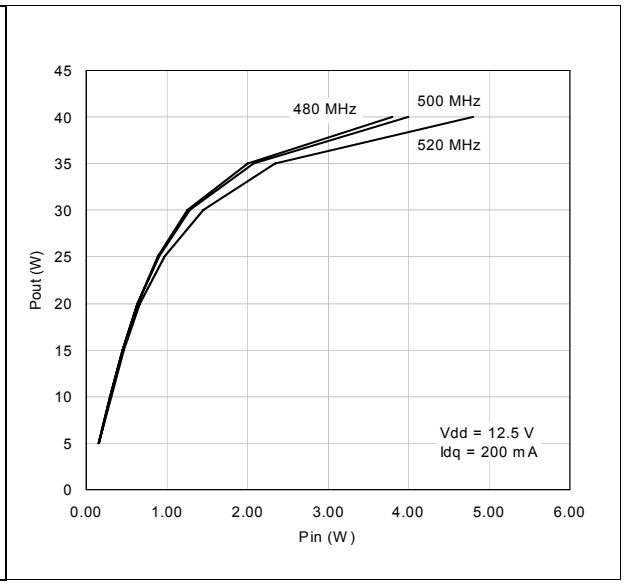


Figure 7. Output power vs input power

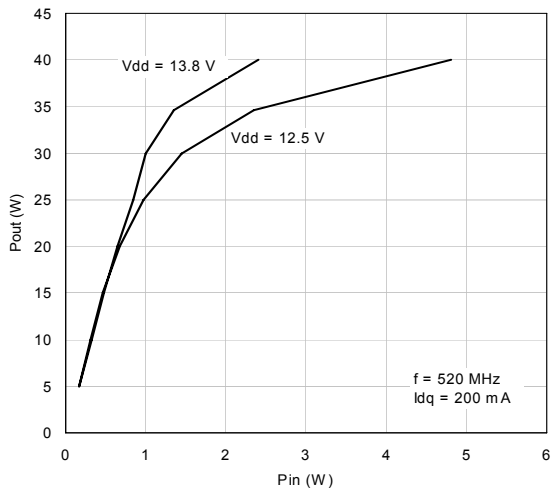


Figure 8. Power gain vs. output power

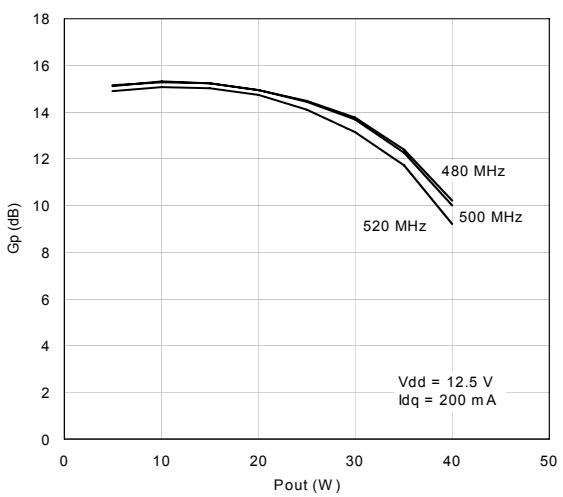


Figure 9. Drain efficiency vs output power

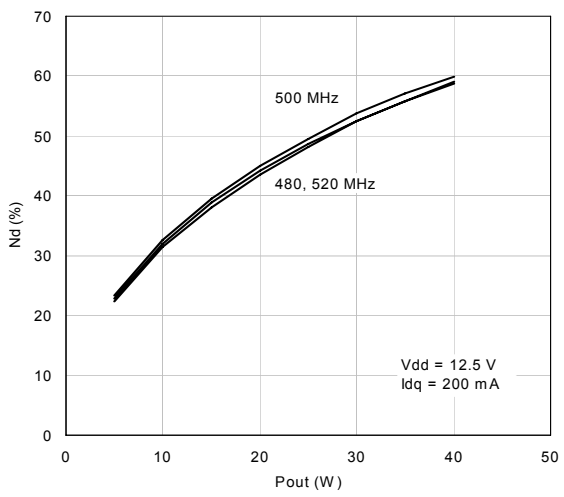


Figure 10. Input return loss vs output power

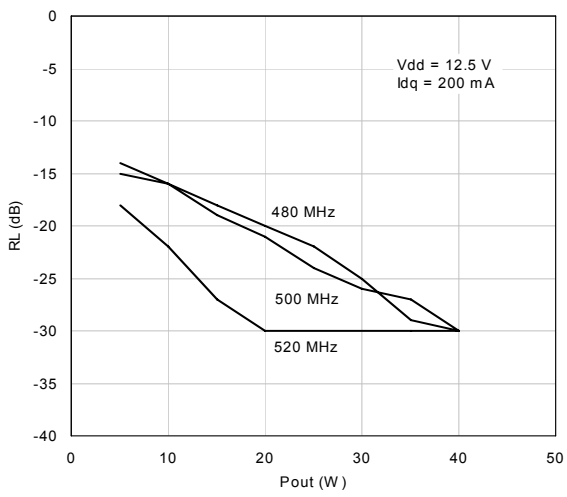


Figure 11. Output power vs bias current

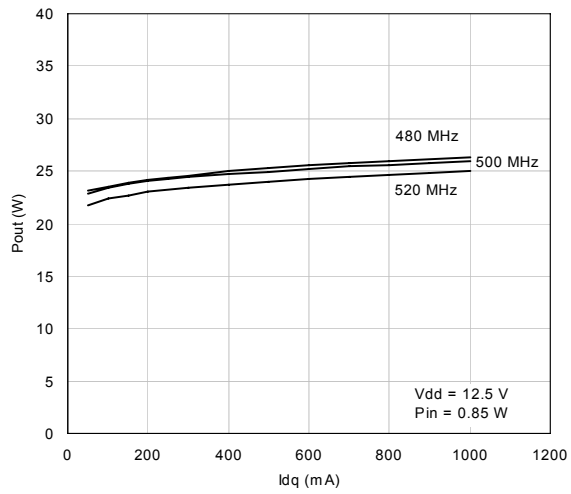


Figure 12. Drain efficiency vs bias current

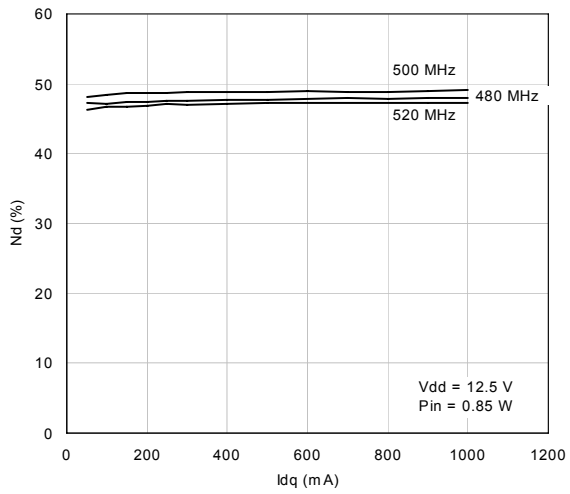


Figure 13. Output power vs supply voltage

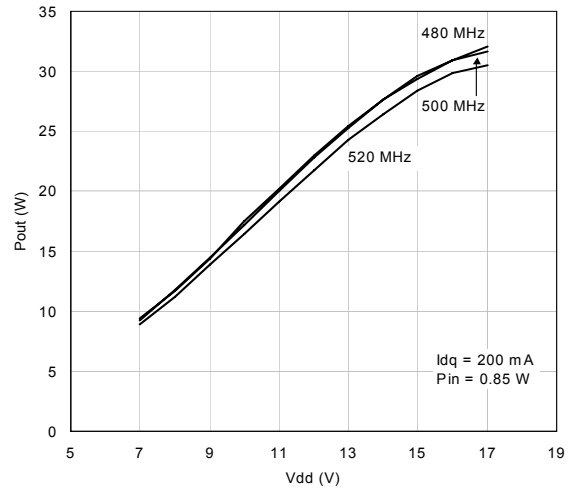


Figure 14. Drain efficiency vs supply voltage

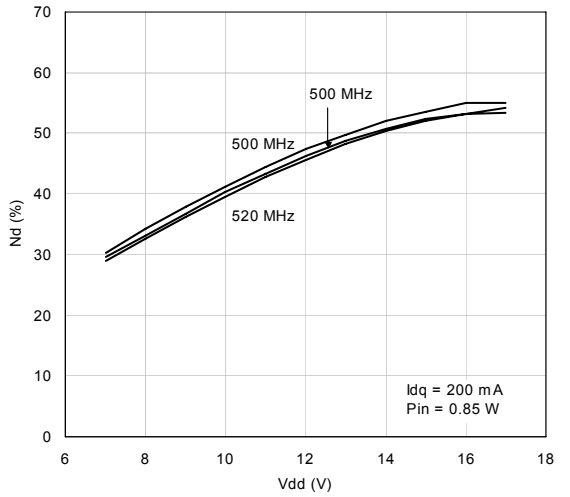


Figure 15. Output power vs gate bias voltage

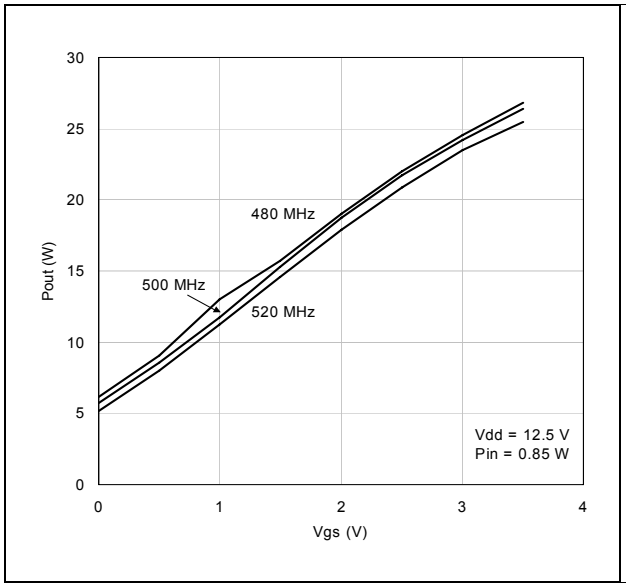


Figure 16. Output power vs input power (f = 175 MHz)

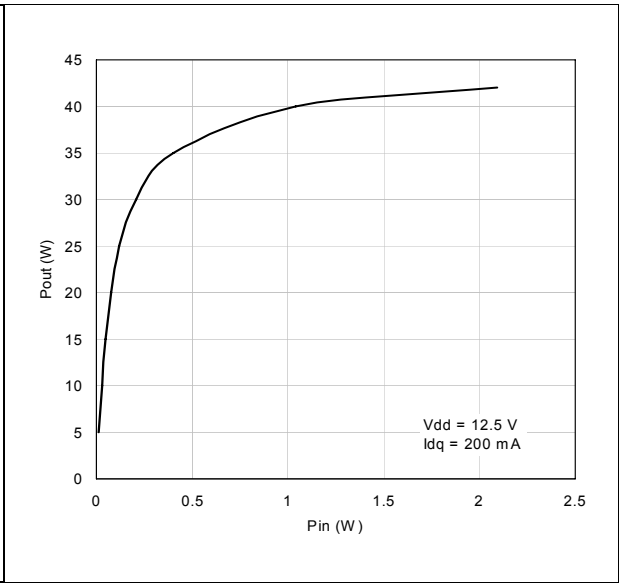


Figure 17. Power gain vs output power (f = 175 MHz)

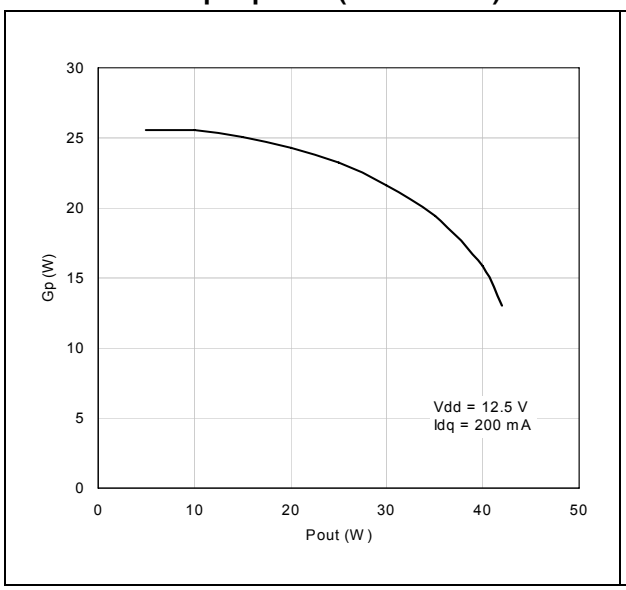


Figure 18. Drain efficiency vs output power (f = 175 MHz)

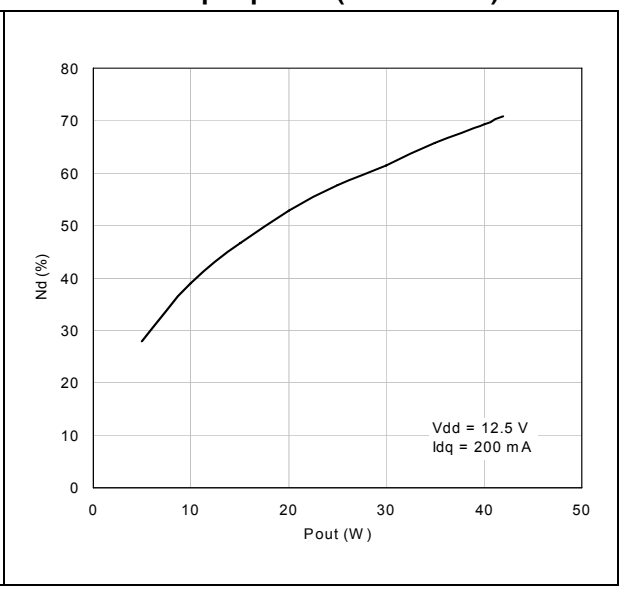
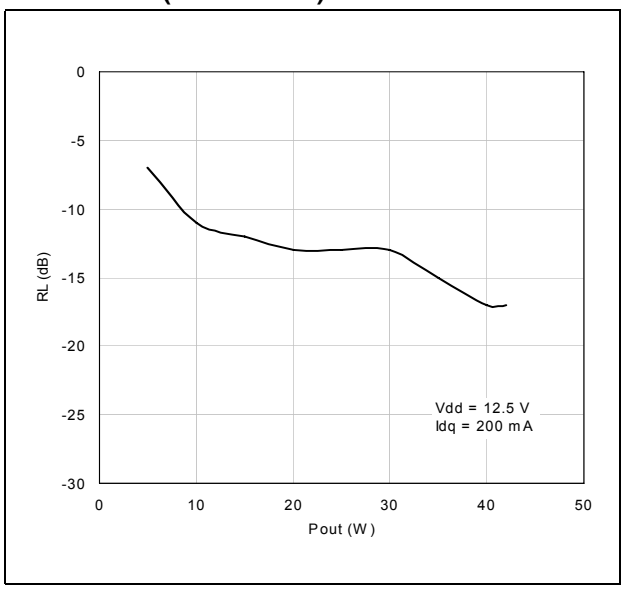


Figure 19. Input return loss vs output power (f = 175 MHz)



5 Test circuit

Figure 20. 500 MHz test circuit schematic (engineering)

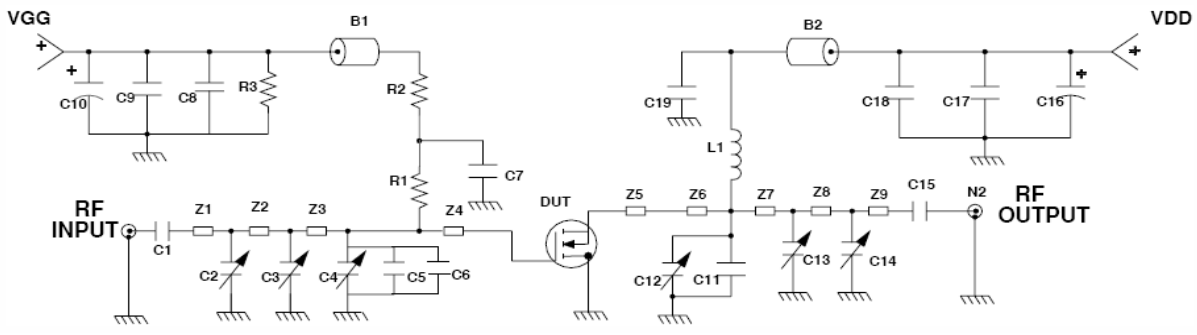


Table 8. Test circuit component part list

Component	Description
B1,B2	Ferrite bead
C1,C13	300 pF, 100 mil chip capacitor
C2,C3,C4,C12,C13,C14	1 to 20 pF trimmer capacitor
C6	39 pF ATC 100B surface mount ceramic chip capacitor
C7, C19	120 pF 100 mil chip capacitor
C10, C16	10 µF, 50 V electrolytic capacitor
C9, C17	0.1 mF, 100 mil chip cap
C8, C18	1.000 pF 100 mil chip cap
C5, C11	33 pF, 100 mil chip cap
L1	56 nH, 7 TURN, Coilcraft
N1, N2	Type N flange mount
R1	15 Ω, 1 W chip resistor
R2	1 kΩ, 1 W chip resistor
R3	33 kΩ, 1 W chip resistor
Z1	0.471” X 0.080” microstrip
Z2	1.082” X 0.080” microstrip
Z3	0.372” X 0.080” microstrip
Z4,Z5	0.260” X 0.223” microstrip
Z6	0.050” X 0.080” microstrip
Z7	0.551” X 0.080” microstrip
Z8	0.825” X 0.080” microstrip
Z9	0.489” X 0.080” microstrip
Board	Roger, ultra lam 2000 THK 0.030”, εr = 2.55 2oz. ED cu 2 Sides.

6 Circuit layout

Figure 21. 500 MHz test circuit

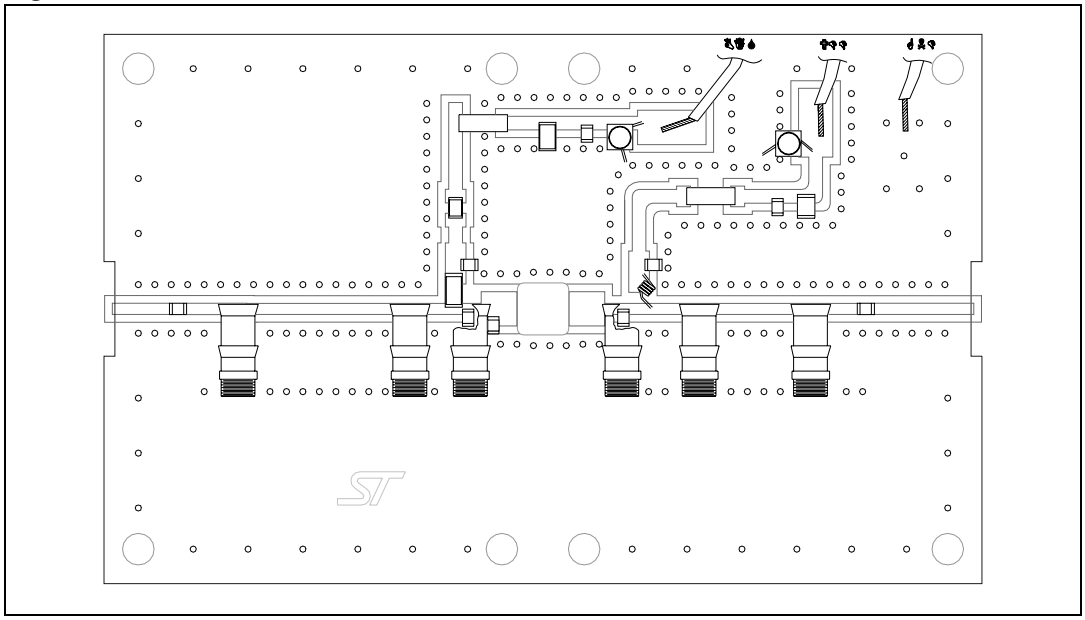


Figure 22. 500 MHz test circuit photomaster

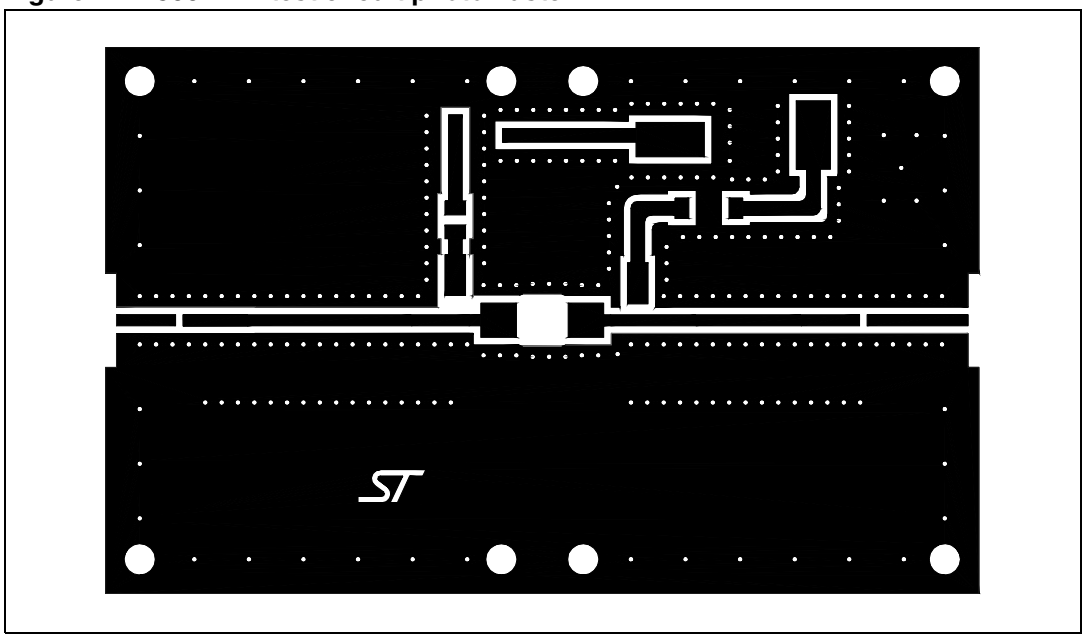


Figure 23. 175 MHz test circuit schematic (engineering)

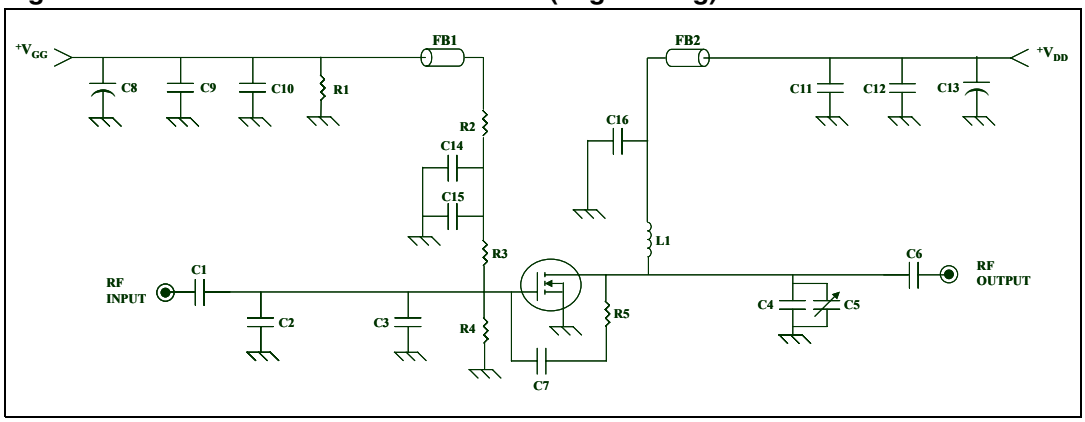


Table 9. 175 MHz test circuit component part list

Component	Description
C1, C6	300 pF chip capacitor
C2, C3	91 pF chip capacitor
C4, C14	75 pF chip capacitor
C5	1-20 pF trimmer capacitor
C7	.01 µF molded capacitor
C8, C13	10 µF electrolytic capacitor
C9, C12	.1 µF chip capacitor
C10, C11	1000 pF chip capacitor
C15, C16	1200 pF chip capacitor
FB1, FB2	Ferrite bead
R1	33 kΩ chip resistor
R2	17 Ω chip resistor
R3	15 Ω chip resistor
R4	47 Ω chip resistor
R5	220 Ω chip resistor
L1	5 turn, 16 AWG magnet wire, ID = .40” , inductor
Board	Roger, ultra lam 2000, THK 0.030”, εr = 2.55 2oz. ED cu 2 SIDES.

7 Common source s-parameter

Table 10. S-parameter for PD55025S-E (V_{DS} = 12.5 V I_D = 500 mA)

Freq (MHz)	$IS_{11}I$	S11 < Φ	$IS_{21}I$	S_{21}< Φ	$IS_{12}I$	S_{12}< Φ	$IS_{22}I$	S_{22}< Φ
50	0.837	-162	13.33	89	0.018	-1	0.780	-168
100	0.846	-169	6.51	76	0.017	-12	0.803	-172
150	0.862	-171	4.15	66	0.016	-19	0.831	-172
200	0.878	-173	2.93	58	0.015	-26	0.859	-172
250	0.895	-174	2.20	51	0.013	-31	0.874	-172
300	0.910	-174	1.71	45	0.012	-36	0.886	-173
350	0.921	-175	1.36	40	0.010	-40	0.892	-173
400	0.932	-176	1.11	35	0.009	-42	0.897	-175
450	0.941	-177	0.92	31	0.008	-43	0.915	-176
500	0.946	-178	0.78	27	0.007	-44	0.932	-177
550	0.953	-178	0.66	24	0.006	-43	0.946	-178
600	0.957	-179	0.57	21	0.005	-42	0.964	-179
650	0.960	-180	0.50	18	0.004	-39	0.975	-178
700	0.964	180	0.44	16	0.004	-34	0.976	-179
750	0.966	179	0.39	14	0.003	-29	0.981	-179
800	0.968	178	0.95	12	0.002	-15	0.979	-179
850	0.970	178	0.31	10	0.002	-2	0.964	-179
900	0.971	177	0.28	8	0.002	16	0.960	180
950	0.972	177	0.26	6	0.002	34	0.953	179
1000	0.972	176	0.23	5	0.003	45	0.940	178

Table 11. S-parameter PD55025S-E (V_{DS} = 12.5 V I_D = 1.5 A)

Freq (MHz)	$IS_{11}I$	S11 < Φ	$IS_{21}I$	S_{21}< Φ	$IS_{12}I$	S_{12}< Φ	$IS_{22}I$	S_{22}< Φ
50	0.876	-164	13.87	90	0.013	1	0.823	-172
100	0.880	-172	6.87	79	0.012	-7	0.838	-175
150	0.887	-174	4.46	71	0.012	-13	0.855	-176
200	0.895	-175	3.22	64	0.011	-18	0.873	-175
250	0.905	-176	2.47	58	0.010	-22	0.879	-175
300	0.915	-176	1.96	52	0.009	-25	0.885	-175
350	0.922	-177	1.60	47	0.009	-28	0.886	-175

Table 11. S-parameter PD55025S-E (V_{DS} = 12.5 V I_D = 1.5 A) (continued)

Freq (MHz)	$IS_{11}I$	S11 < Φ	$IS_{21}I$	S_{21}< Φ	$IS_{12}I$	S_{12}< Φ	$IS_{22}I$	S_{22}< Φ
400	0.931	-178	1.32	42	0.008	-30	0.889	-177
450	0.938	-178	1.11	38	0.007	-31	0.906	-178
500	0.942	-179	0.95	34	0.006	-31	0.923	-179
550	0.948	-179	0.82	31	0.005	-30	0.937	-179
600	0.952	-180	0.71	28	0.005	-27	0.956	-179
650	0.954	180	0.63	25	0.004	-22	0.967	-179
700	0.959	179	0.55	22	0.003	-16	0.969	-179
750	0.961	178	0.49	20	0.003	-6	0.973	-179
800	0.963	178	0.45	17	0.003	3	0.970	-179
850	0.966	177	0.40	15	0.003	17	0.956	-180
900	0.967	177	0.36	13	0.003	27	0.952	179
950	0.968	176	0.33	11	0.003	38	0.945	179
1000	0.968	176	0.30	9	0.003	45	0.933	177

Table 12. S-parameter for PD55025S-E (V_{DS} = 12.5 V I_D = 3 A)

Freq (MHz)	$IS_{11}I$	S11 < Φ	$IS_{21}I$	S_{21}< Φ	$IS_{12}I$	S_{12}< Φ	$IS_{22}I$	S_{22}< Φ
50	0.890	-165	13.19	91	0.012	2	0.837	-174
100	0.892	-172	6.55	81	0.011	-6	0.846	-176
150	0.898	-174	4.28	73	0.011	-12	0.865	-176
200	0.904	-175	3.11	66	0.010	-15	0.879	-176
250	0.913	-176	2.39	60	0.010	-20	0.883	-176
300	0.921	-177	1.91	54	0.009	-23	0.089	-176
350	0.926	-177	1.57	49	0.008	-25	0.887	-176
400	0.935	-178	1.31	44	0.007	-27	0.889	-177
450	0.941	-179	1.10	40	0.007	-28	0.905	-179
500	0.944	-179	0.94	36	0.006	-27	0.921	-179
550	0.949	-180	0.82	33	0.005	-25	0.936	-180
600	0.953	180	0.71	29	0.004	-21	0.954	180
650	0.955	179	0.63	26	0.004	-17	0.964	-180
700	0.959	179	0.56	24	0.003	-10	0.965	-180
750	0.961	178	0.50	21	0.003	-2	0.968	-180
800	0.963	177	0.45	19	0.003	10	0.966	-179
850	0.966	177	0.41	17	0.003	22	0.952	-180

Table 12. S-parameter for PD55025S-E (V_{DS} = 12.5 V I_D = 3 A) (continued)

Freq (MHz)	$IS_{11}I$	S11 < Φ	$IS_{21}I$	S_{21}< Φ	$IS_{12}I$	S_{12}< Φ	$IS_{22}I$	S_{22}< Φ
900	0.967	176	0.37	15	0.003	32	0.948	180
950	0.968	176	0.34	15	0.003	41	0.942	179
1000	0.969	175	0.31	11	0.004	49	0.930	177

Table 13. S-parameter for PD55025S-E (V_{DS} = 13.8 V I_D = 3 A)

Freq (MHz)	$IS_{11}I$	S11 < Φ	$IS_{21}I$	S_{21}< Φ	$IS_{12}I$	S_{12}< Φ	$IS_{22}I$	S_{22}< Φ
50	0.849	-164	13.99	91	0.012	2	0.833	-173
100	0.881	-171	6.94	80	0.011	-6	0.841	-175
150	0.895	-173	4.51	72	0.011	-12	0.857	-175
200	0.903	-175	3.27	65	0.010	-16	0.871	-175
250	0.912	-176	2.50	58	0.010	-21	0.877	-175
300	0.921	-176	1.99	52	0.009	-24	0.882	-175
350	0.927	-177	1.62	47	0.008	-27	0.883	-176
400	0.936	-178	1.35	42	0.007	-29	0.886	-177
450	0.943	-178	1.13	38	0.006	-29	0.904	-178
500	0.946	-179	0.97	34	0.006	-29	0.920	-179
550	0.952	-180	0.83	31	0.005	-26	0.935	-179
600	0.955	180	0.72	27	0.004	-23	0.955	-180
650	0.957	179	0.64	24	0.004	-17	0.965	-179
700	0.961	179	0.56	22	0.003	-8	0.967	-179
750	0.963	178	0.50	19	0.003	2	0.970	-179
800	0.965	178	0.45	17	0.003	14	0.968	-179
850	0.968	177	0.41	15	0.003	27	0.953	-179
900	0.969	176	0.37	13	0.003	36	0.949	180
950	0.970	176	0.34	11	0.003	45	0.943	179
1000	0.971	175	0.31	9	0.003	54	0.930	178

8 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 14. 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 24. Package dimensions PowerSO-10RF formed lead

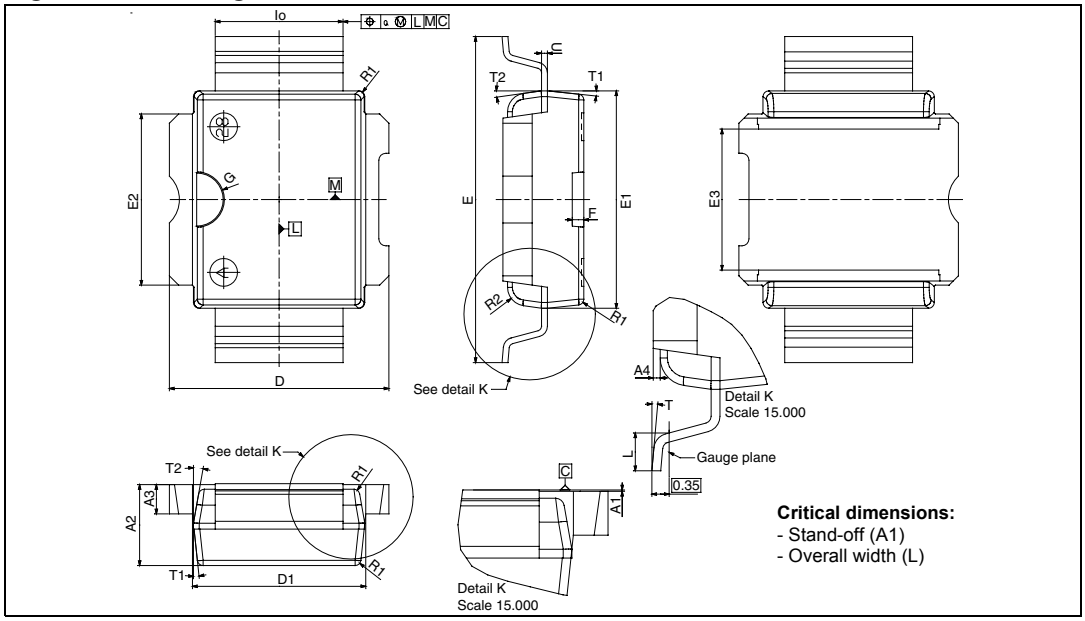


Table 15. PowerSO-10RF straight lead mechanical data

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 25. Package dimensions PowerSO-10RF straight lead

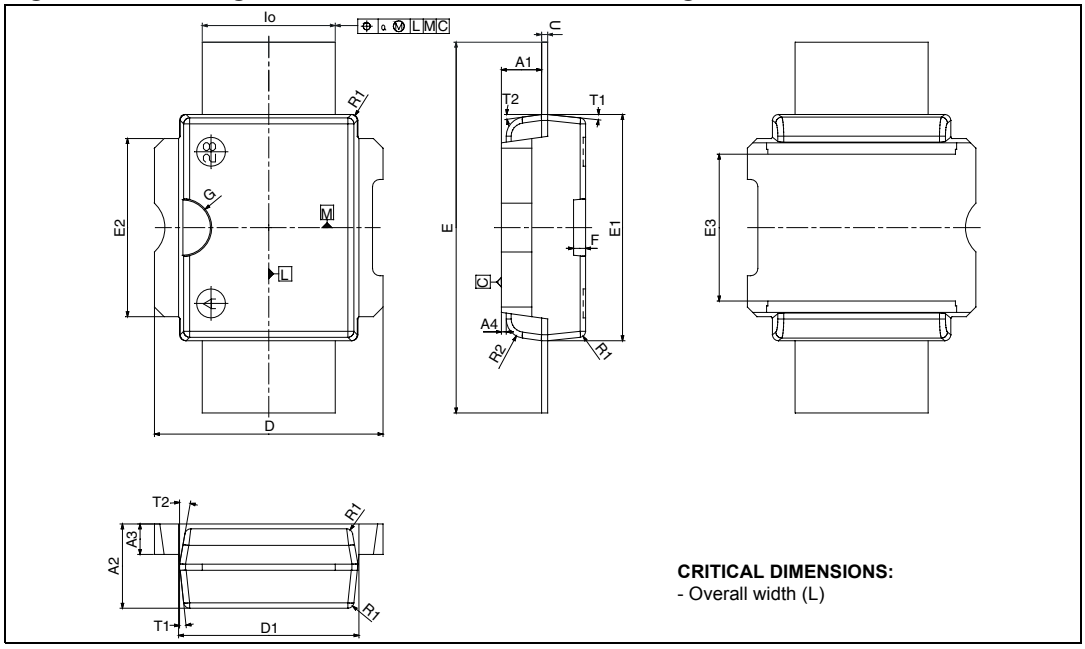


Figure 26. Tube information

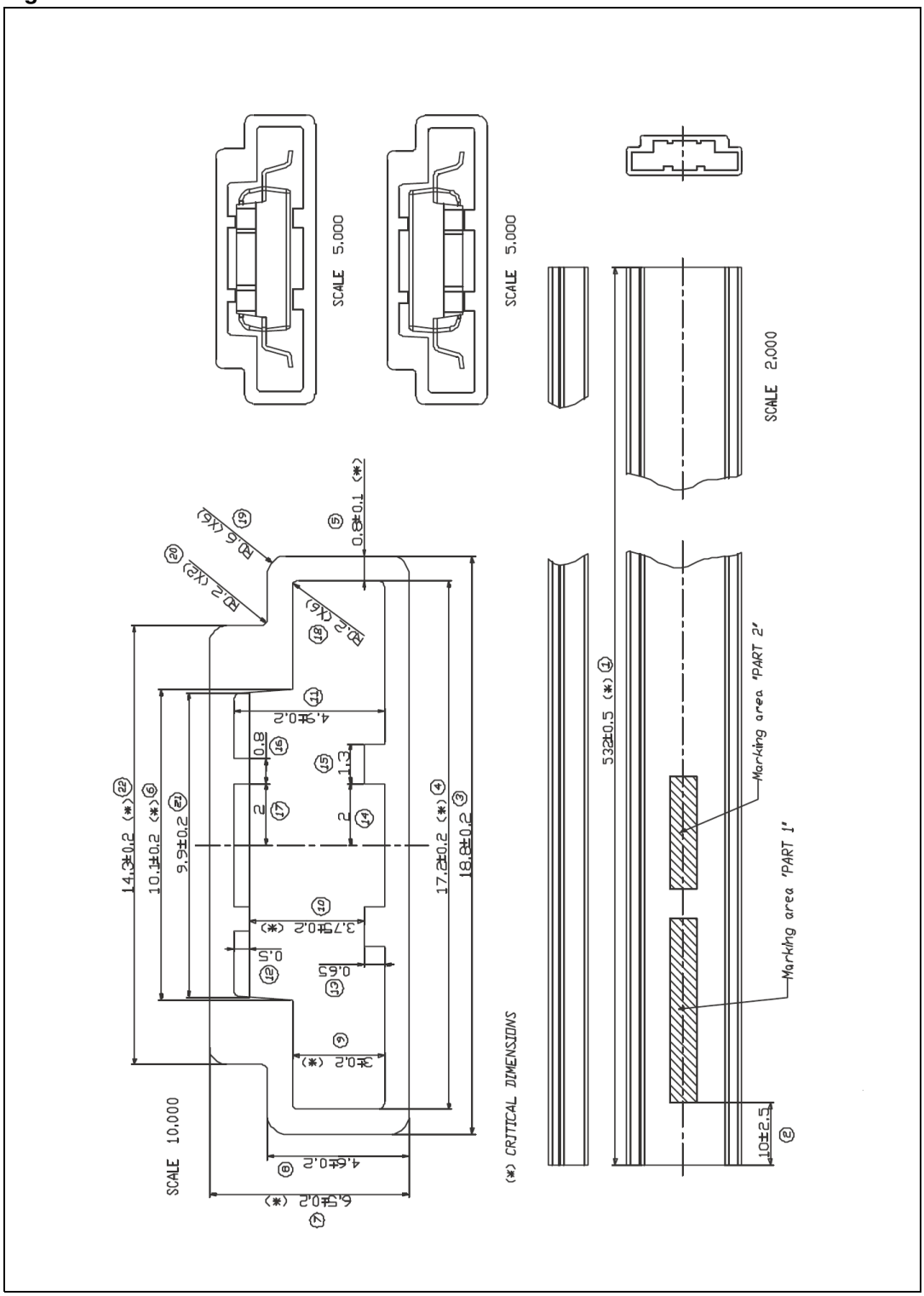
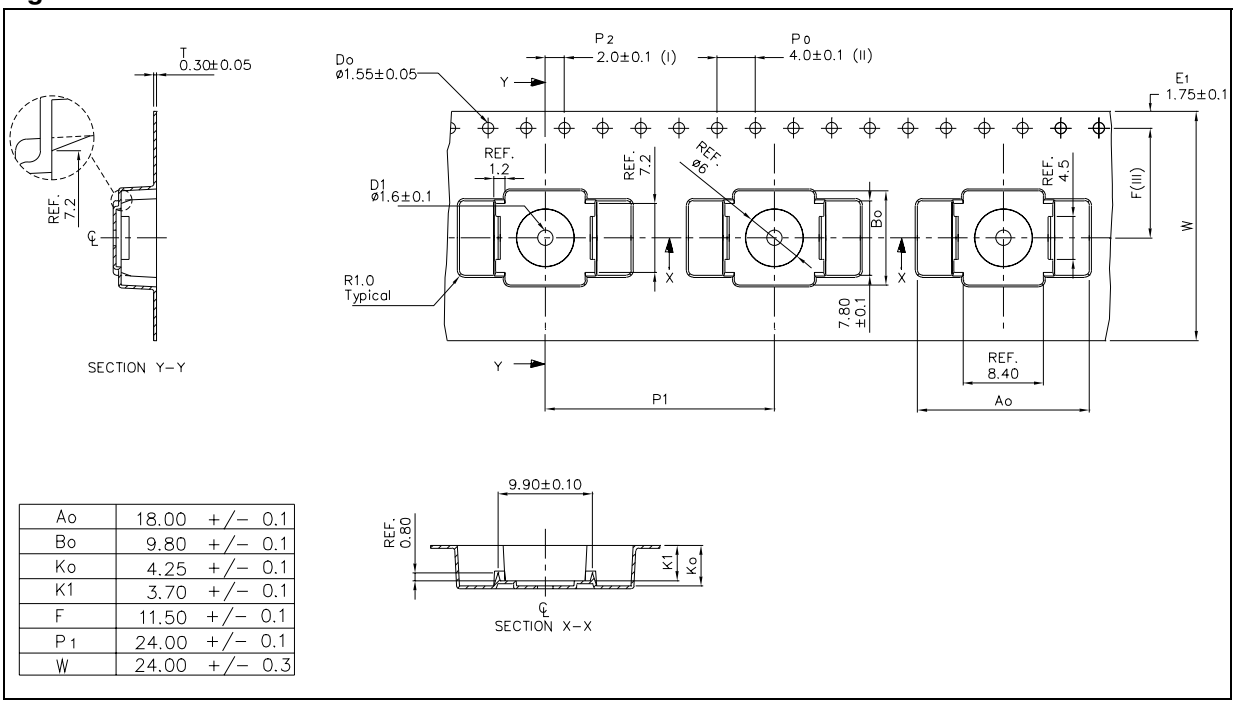


Figure 27. Reel information



Ao	18.00	+/–	0.1
Bo	9.80	+/–	0.1
Ko	4.25	+/–	0.1
K1	3.70	+/–	0.1
F	11.50	+/–	0.1
P1	24.00	+/–	0.1
W	24.00	+/–	0.3

9 Revision history

Table 16. Document revision history

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

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