Maximum Input Power Analysis of MMIC Amplifiers

1. Introduction

In many applications, amplifiers may be subjected to an unexpected abnormal operation by a various RF environment so that the amplifier can't work properly in a system. We made a test to provide a maximum input power level before our amplifier is damaged and fails to operate, which can be useful for user to achieve a safe system design.

2. Test Procedure

Tests were performed on 50 Ω / 75 Ω matched an evaluation board with a load condition (Z_L = 50 Ω / 75 Ω) as follows.

Step 1: I_d and S_{21} measurement on a device before test.

Step 2: Testing the device with static RF P_{IN} (20 dBm, CW) for 16 hours.

Step 3: I_d and S_{21} measurement on the device after test.

- Failure criterion: 10% change in I_d and 1 dB change in S_{21}.

Step 4: Measuring a burnout level of the device as P_{IN} increases from 20 dBm to 30 dBm.

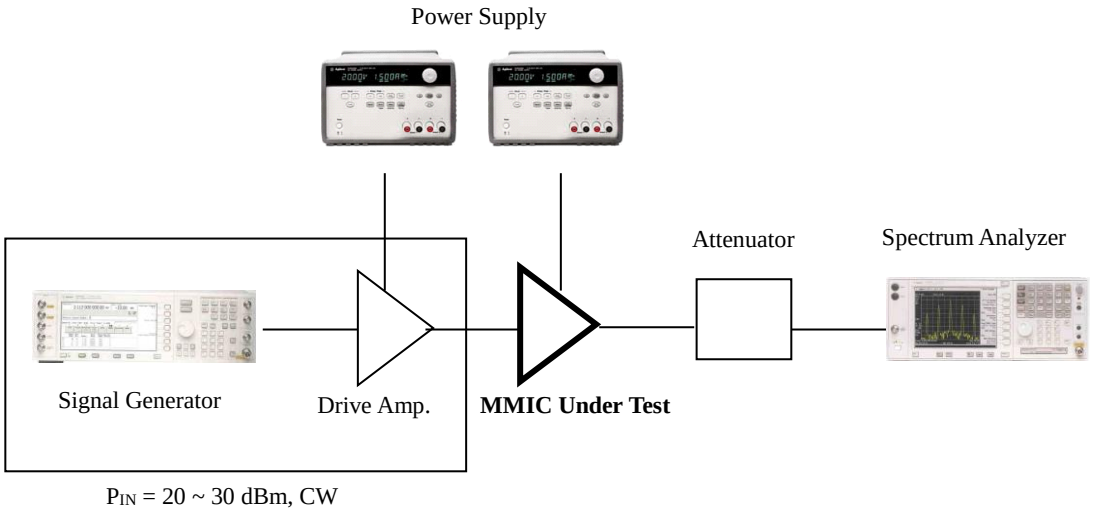

Fig 1. Test configuration (Step 4)

3.1 Test Results (50 Ω)

Part Number	Supply Voltage (V)	Test Freq. (MHz)	Before Test (Step 1)		After Test (Step 3)		Change		Burnout P_{IN} level (dBm) (Step 4)
			I_d (mA)	Gain (dB)	I_d (mA)	Gain (dB)	I_d (%)	Gain (dB)	
ABL5616U6	+5	5900	30	15.77	30	15.80	0	+0.03	26
AHB5614S9	+5	50	80	14.31	80	14.28	0.0	-0.03	30
AHB5614T8	+5	50	80	14.35	80	14.30	0.0	-0.05	30
AHL5216T8	+5	2000	65	17.35	65	17.28	0	-0.07	No Burnout
AHL5218T8	+5	2000	66	18.96	65	18.89	1.5	-0.07	No Burnout
AHL5220T8	+5	2000	65	20.61	65	20.52	0	-0.09	No Burnout
ASF130	+3	150	54	16.64	54	16.65	0.0	+0.01	No Burnout
ASF133	+3	150	56	21.95	56	21.93	0.0	-0.02	No Burnout
ASF140	+3.3	150	85	17.27	85	17.26	0.0	-0.01	No Burnout
ASF143	+3.3	150	88	22.82	88	22.81	0.0	-0.01	No Burnout
ASF150	+3.3	150	88	17.26	88	17.24	0.0	-0.02	No Burnout
ASF153	+3.3	150	89	22.73	89	22.72	0.0	-0.01	No Burnout
ASF240	+5	150	116	26.37	115	26.35	0.9	-0.02	25
ASF250	+5	150	98	16.92	98	16.93	0.0	+0.01	No Burnout
ASF255	+5	150	105	22.45	105	22.47	0.0	+0.02	No Burnout
ASL09C	+5	1950	50	12.91	50	12.90	0.0	-0.01	24
ASL13C	+5	2000	60	13.21	60	13.20	0.0	-0.01	26
ASL19C	+5	2000	67	13.11	67	13.13	0.0	+0.02	27
ASL226	+3	1575	8	28.96	8	28.92	0.0	-0.04	27
ASL30G	+3	1950	21	25.89	21	25.91	0.0	+0.02	24
ASL33C	+5	2000	33	13.25	33	13.24	0.0	-0.01	24
ASL52D6	+5	2000	54	21.07	54	21.05	0.0	-0.02	24
ASL210	+3.3	2000	68	12.87	68	12.84	0.0	-0.03	25
ASL41S9	+5	900	72	17.65	72	17.63	0.0	-0.02	25
ASL425	+5	1950	341	22.08	337	22.05	1.2	-0.03	25
ASL51S9	+3.3	2000	55	16.35	55	16.32	0.0	-0.03	25
ASL51T8	+5	900	57	18.1	57	18.09	0.0	-0.01	24
ASL54T8	+5	2000	45	16.55	45	16.54	0.0	-0.01	25
ASL5463	+5	2000	45	17.12	45	17.10	0.0	-0.02	25
ASL5543	+3.3	2000	54	16.40	54	16.38	0.0	-0.02	25
ASL5563	+3.3	2000	54	17.33	54	17.32	0.0	-0.01	25
AST20S	+5	1950	48	13.30	48	13.40	0.0	+0.10	24

AST54S	+5	2000	41	12.90	41	12.91	0.0	+0.01	25
ASW101	+3.3	2000	35	11.57	35	11.60	0.0	+0.03	No Burnout
ASW103	+3.3	2000	43	11.00	43	11.08	0.0	+0.08	No Burnout
ASW105	+3.3	2000	62	17.52	62	17.53	0.0	+0.01	29
ASW114	+3.2	2000	37	17.05	37	17.04	0.0	-0.01	28
ASW126	+3.3	2000	34	14.48	34	14.46	0.0	-0.02	28
ASW135	+3.3	2000	65	16.52	64	16.50	1.5	-0.02	24
ASW204	+5	2000	54	18.30	54	18.32	0.0	+0.02	24
ASW205	+5	2000	69	20.93	69	20.95	0.0	+0.02	No Burnout
ASW207	+5	2000	73	16.09	73	16.11	0.0	+0.02	26
ASW208	+5.5	2000	83	19.06	83	19.05	0.0	-0.01	25
ASW212	+5	2000	76	12.90	76	12.94	0.0	+0.04	No Burnout
ASW214	+5	2000	53	17.95	53	18.00	0.0	+0.05	No Burnout
ASW215	+5	2000	86	13.09	86	13.17	0.0	+0.08	No Burnout
ASW216	+5	2000	82	11.72	82	11.89	0.0	+0.17	No Burnout
ASW234	+5	2000	53	16.89	52	16.92	1.9	+0.03	23
ASW235	+5	2000	41	19.56	41	19.58	0.0	+0.02	No Burnout
ASW301	+5	2000	76	10.22	76	10.37	0.0	+0.15	No Burnout
ASW311	+5	2000	152	12.00	152	12.00	0.0	0.00	27
ASW313	+5	2000	103	16.33	103	16.30	0.0	+0.03	29
ASW314	+5	270	110	16.36	110	16.39	0.0	+0.03	21
	+5	900	115	16.24	115	16.35	0.0	+0.11	27
ASW316	+5	512	110	17.58	110	17.54	0.0	-0.04	22
	+5	1950	112	16.21	112	16.21	0.0	0.00	29
ASW318	+8	512	119	16.35	117	16.36	1.7	+0.01	20
	+8	2000	119	15.08	117	15.12	1.7	+0.04	28
ASW320	+5	900	123	22.10	123	22.09	0.0	-0.01	27
ASW335	+5	1950	119	15.08	117	15.12	1.7	+0.04	28
ASW338	+8	512	148	16.73	148	16.70	0.0	-0.03	21
	+8	1950	121	16.56	121	16.48	0.0	-0.08	26
ASX101	+3.5	2000	42	15.02	42	15.01	0.0	-0.01	No Burnout
ASX201	+5	2000	67	16.08	66	16.13	1.5	+0.05	No Burnout
ASX401	+5	2000	298	12.58	299	12.57	0.3	-0.01	No Burnout
ASX403	+3.3	2000	627	11.03	632	11.05	0.8	+0.02	29
ASX415	+5	2000	154	14.60	154	14.60	0.0	0.00	No Burnout
ASX501	+5	2000	578	10.99	580	11.16	0.3	+0.15	No Burnout

ASX601	+5	900	868	16.60	865	16.76	0.3	+0.16	29
ASX602	+5	1840	625	12.63	622	12.76	0.5	+0.13	No Burnout
ASX420	+5	2000	379	20.27	380	20.38	0.3	+0.11	29
ASX520	+5	900	650	32.09	636	32.15	2.2	+0.06	No Burnout
ASX620	+5	900	895	29.96	870	30.20	2.8	+0.24	No Burnout
ASX423	+5	2000	406	23.58	402	23.64	1.0	+0.06	30
ASX521	+5	2000	893	20.18	893	20.26	0.0	-0.11	No Burnout
ASX621	+5	2000	1161	19.35	1152	19.05	0.8	-0.20	No Burnout
AWB389	+5	2000	125	16.28	125	16.27	0.0	-0.01	26
AWB459	+5	512	128	24.65	128	24.62	0.0	-0.03	28
AWB478	+8	512	188	24.15	187	24.03	0.5	-0.12	28
AWB577	+9	380	180	13.0	179	12.9	0.6	-0.1	27
AWB578	+8	30	175	20.72	175	20.72	0.0	0.00	23
AWB589	+8	30	177	20.96	177	20.95	0.0	-0.04	23
AWB688	+10	30	307	22.59	307	22.57	0.0	0.09	27
AWG0015E	+3	2000	35	14.83	35	14.80	0.0	-0.03	No Burnout
AWG0020E	+3.3	2000	35	19.63	35	19.60	0.0	-0.03	No Burnout
AWG0023E	+3	2000	28	18.72	28	18.72	0.0	0.00	No Burnout
AWG0115E	+3	2000	57	14.35	57	14.30	0.0	-0.05	No Burnout
AWG0117E	+3	2000	51	16.16	51	16.10	0.0	-0.06	No Burnout
AWG0120E	+3	2000	45	18.01	45	17.95	0.0	-0.06	No Burnout
AWG0123E	+3	2000	45	20.55	45	20.48	0.0	-0.07	No Burnout
AWG1015E	+3.3	2000	75	14.58	75	14.58	0.0	0.00	No Burnout
AWG1017E	+3.3	2000	70	16.32	70	16.30	0.0	-0.02	No Burnout
AWG1020E	+3.3	2000	74	19.17	74	19.14	0.0	-0.03	No Burnout
AWG1023E	+3.3	2000	73	21.05	73	20.95	0.0	-0.10	No Burnout
AWG2015	+3.3	2000	95	14.91	95	14.81	0.0	-0.10	No Burnout
AWG2017	+3.3	2000	87	17.04	87	16.95	0.0	-0.09	No Burnout
AWG2020	+3.3	2000	85	19.63	85	19.54	0.0	-0.09	No Burnout
AWG2023	+3.3	2000	80	21.59	80	21.45	0.0	-0.14	No Burnout
AWG3015	+5	2000	105	14.91	105	14.82	0.0	-0.09	No Burnout
AWG3017	+5	2000	104	17.04	104	16.97	0.0	-0.07	No Burnout
AWG3020	+5	2000	107	19.85	107	19.74	0.0	-0.11	No Burnout
AWG3023	+5	2000	106	22.14	106	22.01	0.0	-0.13	No Burnout

3.2 Test Results (75 Ω)

Part Number	Supply Voltage (V)	Test Freq. (MHz)	Before Test (Step 1)		After Test (Step 3)		Change		Burnout P_{IN} level (dBm) (Step 4)
			I_d (mA)	Gain (dB)	I_d (mA)	Gain (dB)	I_d (%)	Gain (dB)	
ABB1513	+5	50	122	14.02	120	14.00	2.0	-0.02	28
ABB1516	+5	50	117	16.97	117	16.96	0.0	-0.01	29
ABB1519	+5	50	125	19.71	124	19.68	1.0	-0.03	30
ABB2513	+5	50	288	14.30	288	14.29	0.0	-0.01	No Burnout
ABB2516	+5	50	294	17.05	294	17.03	0.0	-0.02	No Burnout
ABB2518	+5	50	281	19.27	179	19.22	2.0	-0.05	No Burnout
ABU1513	+5	5	118	14.18	117	14.16	1.0	-0.02	27
ABU1516	+5	5	119	17.02	119	17.01	0.0	-0.01	No Burnout
ABU1519	+5	5	119	19.29	118	19.27	1.0	-0.02	30
ABU2513	+5	5	275	15.01	272	14.97	3.0	-0.04	No Burnout
ABU2516	+5	5	266	17.36	265	17.24	1.0	-0.02	No Burnout
ABU2518	+5	5	263	20.23	260	20.20	3.0	-0.03	29
ASA306B	+5	50	284	37.28	284	37.26	0.0	-0.02	28
ASA307	+5	50	252	29.77	255	29.89	1.2	+0.12	No Burnout
ASL31C	+5	50	107	23.58	105	23.55	1.9	-0.03	28
ASL330	+5	50	104	16.22	104	16.24	0.0	+0.02	23
ASL331	+5	50	231	19.53	232	19.59	0.4	+0.06	22
ASL360	+5	50	110	17.33	110	17.30	0.0	-0.03	22
ASL362	+5	50	224	10.72	224	10.75	0.0	+0.03	23
ASL380	+5	50	112	19.56	112	19.55	0.0	-0.01	21
ASL39D2	+5	50	315	19.85	314	19.85	0.3	0.00	No Burnout
ASL390	+3.3	50	65	23.46	65	23.48	0.0	+0.02	27
ASL550	+8	50	124	17.20	-	-	-	-	8
ASL551	+8	50	253	18.64	-	-	-	-	15
ASL552	+8	50	248	10.34	-	-	-	-	17
ASL560	+8	50	121	17.50	-	-	-	-	7
ASL580	+8	50	118	17.65	-	-	-	-	5
ASL59D4	+6.5	50	424	19.57	425	19.63	0.2	0.06	No Burnout
ASL590	+8	50	165	24.07	165	24.09	0.0	+0.02	28
ASL882	+12	50	531	21.39	535	21.38	0.8	-0.01	28
ASL912	+10	50	637	12.98	632	13.01	0.8	+0.03	28
ASL920	+10	50	652	20.02	658	20.07	0.9	+0.05	No Burn out
ASW220	+5	50	73	16.71	73	16.73	0.0	0.02	28

AWB31D1	+6	50	296	9.11	296	9.12	0.0	+0.01	No Burn out
AWB31D2	+5	50	221	12.24	220	12.27	0.5	+0.03	28
AWB31D7	+5	50	231	17.29	233	17.28	0.9	-0.01	28
AWB31D9	+5	50	233	20.11	233	20.15	0.0	+0.04	27
AWB51D2	+8	50	348	13.72	345	13.73	0.9	+0.01	28
AWB51D7	+8	50	352	18.13	351	18.15	0.3	+0.02	28
AWB51D9	+8	50	383	21.92	385	21.89	0.5	-0.03	27
AWB312	+5	50	112	12.92	113	12.92	0.9	0.0	28
AWB317	+5	50	115	18.07	115	18.05	0.0	-0.02	27
AWB319	+5	50	110	21.05	108	21.08	1.8	+0.03	28
AWB512	+8	50	119	12.93	121	12.94	1.7	+0.01	28
AWB517	+8	50	123	18.04	123	18.02	0.0	-0.02	27
AWB519	+8	50	130	21.00	131	21.02	0.8	+0.02	28

3.3 Test Results (Attenuator 75 Ω)

Part Number	Supply Voltage (V)	Test Freq. (MHz)	Before Test (Step 1)	After Test (Step 3)	Change	Burnout P_{IN} level (dBm) (Step 4)
			Insertion Loss (dB)	Insertion Loss (dB)	Insertion Loss (dB)	
AAT2073B2	+5	1200	0.58	0.59	+0.01	No Burnout
AAT2074B2	+5	1200	0.56	0.55	-0.01	No Burnout
AAT2075B2	+5	1200	0.51	0.50	-0.01	No Burnout
AAT2076B2	+5	1200	0.54	0.54	0	No Burnout
AAT2077B2	+5	1200	0.55	0.53	-0.02	No Burnout

3.4 Test Results (SPDT 50 Ω)

Part Number	Supply Voltage (V)	Test Freq. (MHz)	Before Test (Step 1)	After Test (Step 3)	Change	Burnout P_{IN} level (dBm) (Step 4)
			Insertion Loss (dB)	Insertion Loss (dB)	Insertion Loss (dB)	
AHX5406SS6	+3	2000	0.37	0.35	-0.02	No Burnout
AHX5406DS6	+3	2000	0.35	0.36	+0.01	No Burnout
AHX5607ST6	+3	2000	0.34	0.34	0	No Burnout
AHX5607DT6	+3	2000	0.34	0.35	+0.01	No Burnout