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1. SPDT, SP4T AND HIGH POWER SPDT SWITCH PERFORMANCE

1.1 S-parameter Characterization

S-parameter characterization is used to verify performance parameters such as insertion loss, isolation and delay differences between paths. The S-parameter measurements were made using an HP8510 network analyzer. Tables 1.1-1 and 1.1-2 provide worst case results, over the frequency band, for the SPDT and SP4T switches respectively.

Table 1.1-1: SPDT S-parameter Characterization

AMC P/N: SWN-RRA-2DT, S/N: 2MS70316

Path	Insertion Loss (dB)	[illegible]		Isolation (dB)	Delay (ps)
		Input	Output		
Specification	3.0	9.5	9.5	80	not specified
J1-J2	1.5	18.6	19.4	>85	222
J1-J3	1.4	16.5	18.8	>85	222

Table 1.1-2: SP4T S-parameter Characterization

AMC P/N: MSN-4DT, S/N: 2MS70305

Path	Insertion Loss (dB)	[illegible]		Isolation (dB)	Delay (ps)
		Input	Output		
Specification	3.5	9.5	9.5	80	not specified
J1-J3	1.6	21.7	21.1	>85	248
J1-J4	1.7	17.7	14.7	>85	247
J1-J6	1.5	24.2	22.9	>85	247
J1-J7	1.6	28.0	23.2	>85	246

1.2 Pulse Response

Pulse response measurements were performed to ensure the switch would not distort the input RF pulse. The test set-up is shown in Figure 1.2-1. Table 1.2-1 contains the results for the SPDT switch.

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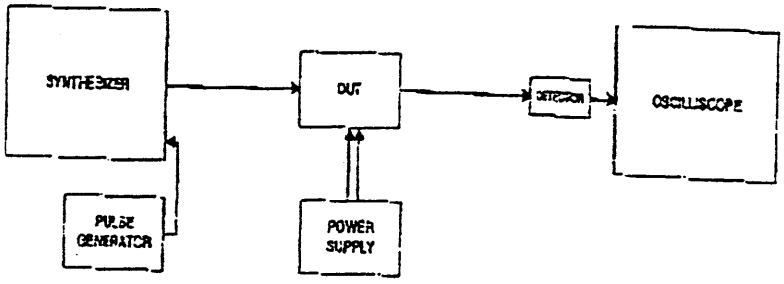

Figure 1.2-1: Pulse Response Test Set-up

Table 1.2-1: SPDT Switch Pulse Response

AMC P/N: SWN-RRA-2DT, S/N: 2MS703161

Specification	Pulse Width: 0.2 to 120 µs	Period: 0.8 to 120 ms PRF	Duty Cycle (%): 5 to 10	Rise Time (ns): < 20	Fall Time (ns): < 20	CW Incident Attenuation Difference (dB): 0
	120 µs	1.2 ms	10	9.0	11.1	-
	10 µs	100 µs	10	9.2	13.0	-
	1 µs	10 µs	10	9.2	12.2	-
	500 ns	5 µs	10	9.0	11.8	-
	200 ns	2 µs	10	8.9	12.1	-

1.3 Residual Amplitude and Phase Noise

All of the AM and PM noise measurements have been made using a HP3048A test set.

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Table 1.3-1: SPDT Residual Phase Noise

AMC P/N: SWN-RRA-2DT, S/N: 2MS703161

[illegible]	[illegible]	[illegible]
[illegible]	-132	-131
[illegible]	-142	-140
[illegible]	-150	-150
[illegible]	-160	-160
[illegible]	-167	-167
[illegible]	-170	-170
[illegible]	-170	-168
[illegible]	-167	-167

Table 1.3-2: SPDT Residual Amplitude Noise

COM DEV P/N: 123065-1

Offset Frequency	Measured Performance			
	Switch S/N: 2MS704186 (dBc/Hz)	Switch S/N: 2MS704187 (dBc/Hz)	Switch S/N: 2MS704188 (dBc/Hz)	Switch S/N: 2MS704189 (dBc/Hz)
10 Hz	-114	-110	-110	-110
[illegible]	-122	-120	-120	-118
[illegible]	-140	-140	-140	-135
[illegible]	-150	-152	-152	-147
[illegible]	-157	-157	-157	-155
[illegible]	-163	-164	-163	-162
[illegible]	-163	-163	-163	-163

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Table 1.3-3: High Power SPDT Residual Amplitude Noise

COM DEV P/N: 124043-1

[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]
[illegible]	-120	-120
[illegible]	-128	-127
[illegible]	-141	-142
[illegible]	-152	-153
[illegible]	-157	-157
[illegible]	-163	-163
[illegible]	-162	-162

1.4 Conducted Susceptibility

Conducted susceptibility measurements provide an indication of the components tolerance to noise on its supply or control lines. Performance is measured by monitoring the spurious levels with the AM/PM noise measurement test set for various frequencies and amplitudes of noise injected. The phase noise test set (HP3048A) is used (due to the dynamic range requirements of the specification) for all measurements up to 40 MHz offset from the carrier frequency. Above 40 MHz offset, measurements are made using a HP8563E spectrum analyzer. Two possible set ups can be used for measuring the spurious with the AM/PM test set: AM set up or PM set up. The AM set up will yield the worst case results since the PM set up provides some suppression of AM signals. The following tables provide results summaries.

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Table 1.4-1: SPDT Switch Conducted Susceptibility (PM Noise Set-up)

AMC P/N: SWN-RRA-2DT, S/N: 2MS703151

	-	-124	-
	-	-123	-
	-154	-	-
	-116	-	-118
	-	-	-170
	-165	-	-165
	-120	-	-166

The following results were obtained using input power levels of + 15 dBm into the switches. This was necessary to achieve a + 10 dBm level at the detector input. The specification calls for the measurements to be made at - 3 dBm for the low power SPDT, and + 29.5 dBm for the high power SPDT.

Table 1.4-2: SPDT Switch Conducted Susceptibility (AM Noise Set-up)

COM DEV P/N: 123065-1, S/N: 2MS704203

	< -115	-73	< -125
	-124	-74	-
	-123	-73	-
	-121	-80	< -150
	-121	-85	-
	-120	-89	< -150
	-126	-126	-
	-120	-123	-

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Table 1.4-3: High Power SPDT Switch Conducted Susceptibility (AM Noise Set-up)

COM DEV P/N: 124043-1, S/N: 2MS704240

	-73	-85	< -130
	-73	-85	-
	-74	-87	-
	-78	-102	-
	-82	-107	-
	-86	-110	< -150
	-118	-126	-
	< -125	< -125	-

1.5 Conducted Emissions

As discussed in the previous section, the conducted emissions are important in determining the effect that RF pulse reaction of a component will have on the overall unit performance. The conducted emissions output will generate noise on power supply and control lines and consequently could cause spurious outputs. By measuring the conducted emissions in the frequency and time domains for various input RF pulses, the effective noise level can be calculated. For the switches, only the frequency domain information is provided since there were no observable current spikes in the time domain monitoring. The conducted emissions are measured using a current probe and the HP8563E spectrum analyzer. The following tables provide a summary of the conducted emissions performance under pulsed RF operating conditions.

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Table 1.5-1: SPDT Conducted Emissions: Frequency Domain

COM DEV P/N: 124065-1, S/N: 2MS704203

Pulse Characteristics		Conducted Emissions +5V Supply Line	Conducted Emissions +12 V Supply Line
CRF (kHz)	Pulse Width (µs)		
100	2.9	15.7 kHz @ -86 dBm 102.9 kHz @ -100 dBm 714 kHz @ -82 dBm 13 MHz @ -100 dBm	15.9 kHz @ -89 dBm 102.9 kHz @ -99 dBm 714 kHz @ -82 dBm 13 MHz @ -99 dBm 14 MHz @ -103 dBm
100	1.0	15.9 kHz @ -90 dBm 31.8 kHz @ -96 dBm 714 kHz @ -82 dBm 13.1 MHz @ -99 dBm	16 kHz @ -87 dBm 32 kHz @ -95 dBm 100 kHz @ -106 dBm 714 kHz @ -80 dBm 13.2 MHz @ -101 dBm 14.6 MHz @ -103 dBm

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Table 1.5-1: High Power SPDT Conducted Emissions: Frequency Domain (Pulsed)

COM DEV P/N: 123043-1, S/N: 2MS704240

Pulse Characteristics		Conducted Emissions 5 V Supply Line	Conducted Emissions 12 V Supply Line
PRF (kHz)	Pulse Width (µs)		
0.5	1.0	500 Hz @ < -103 dBm 714 kHz @ -85 dBm 13 MHz @ -94 dBm 39.9 MHz @ -75 dBm	184 Hz @ -88 dBm 304 Hz @ -95 dBm 500 Hz @ -104 dBm 786 kHz @ -87 dBm 13 MHz @ -100 dBm 14.6 MHz @ -102 dBm 22 MHz @ -98 dBm
0.5	120	500 Hz @ -101 dBm 180 Hz @ -91 dBm 299 Hz @ -95 dBm	
100	2.9	100 kHz @ -87 dBm 786 kHz @ -82 dBm 13 MHz @ -96 dBm	100 kHz @ -96 dBm 786 kHz @ -85 dBm 1.79 MHz @ -77 dBm 13.3 MHz @ -101 dBm
100	1.0	100 kHz @ -94 dBm 429 kHz @ -76 dBm 13 MHz @ -94 dBm	

Additionally, the high power SPDT was monitored for conducted emissions output under CW conditions. The following table contains a summary of the results.

Table 1.5-1: High Power SPDT Conducted Emissions: Frequency Domain (CW)

COM DEV P/N: 123043-1, S/N: 2MS704240

Conducted Emissions 5 V Supply Line	Conducted Emissions 12 V Supply Line
786 kHz @ -89 dBm 13 MHz @ -96 dBm 30 MHz @ -92 dBm	857 kHz @ -91 dBm 1.86 MHz @ -87 dBm 13.1 MHz @ -99 dBm