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2. VARIABLE ATTENUATOR PERFORMANCE

2.1 S-Parameter Characterization

S-parameter characterization is used to verify performance parameters such as insertion loss, return loss and delay. The data is measured using the HP8510 network analyzer. Tables 2.5.1-1 provides the worst case results for the variable attenuator over the frequency band.

Table 2.1-1: Variable Attenuator S-parameter Characterization

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

	Insertion Loss (dB)	Return Loss (dB)		Delay (ps)
		Input	Output	
Specification	3.0	10.0	10.0	not specified
	3.0	20.7	19.0	377

An additional set of S-parameter measurements were made to determine the accuracy and frequency flatness performance of the attenuator. The flatness is calculated as the maximum attenuation less the minimum attenuation over the frequency band. The attenuation accuracy is calculated as the programmed attenuation setting less the nominal attenuation value, where the nominal attenuation value is the sum of the maximum and minimum attenuation (over the frequency band) divided by 2. The measurements were made using a HP8510 network analyzer. Since this unit was different from the unit previously tested, the return loss data was measured again. The insertion loss measurements were also repeated, however, that data forms part of the flatness and accuracy results. Tables 2.5.1-2 and 2.5.1-3 summarize the results. Note that the return loss measurements are worst case.

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Table 2.1-2: Variable Attenuator Return Loss

COM DEV P/N: 123469-1, S/N: DV70435

Attenuation Setting	Return Loss (dB)	
	Input	Output
0	17.4	21.0
33	20.3	20.0
63	18.4	18.0

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Table 2.1-3: Variable Attenuator Accuracy and Flatness

COM DEV P/N: 123469-1, S/N: DV70435

Attenuator Setting (dB)	Specification (dB)	Measured Attenuation @ 10 GHz (dB)	Calculated Accuracy from Nominal Attenuation (dB)	Pk - Pk Flatness Specification (dB)	Measured Flatness Pk-Pk (dB)
0.0		1.40[1]	-		0.28
0.5		0.92	0.34		0.33
1.0		0.05	0.95		0.30
1.5		0.05	1.48		0.29
2.0		0.10	1.94		0.36
2.5		0.27	2.26		0.28
3.0		0.60	2.41		0.30
3.5		1.22	2.31		0.33
4.0		1.95	2.02		0.20
4.5		2.71	1.75		0.20
5.0		3.51	1.49		0.20
5.5		4.20	1.27		0.11
6.0		4.89	1.11		0.07
6.5		5.57	0.91		0.32
7.0		6.23	0.91		0.35
7.5		6.86	0.81		0.48
8.0		7.45	0.49		0.61
8.5		8.02	0.44		0.63
9.0		8.59	0.34		0.85
9.5		9.17	0.35		0.66
10.0		9.67	0.29		0.70
10.5		10.2	0.27		0.85
11.0		10.76	0.24		0.82
11.5		11.22	0.26		0.96
12.0		11.72	0.23		0.99
12.5		12.17	0.20		1.05
13.0		12.63	0.32		1.12
13.5		13.10	0.39		1.09
14.0		13.54	0.40		1.13
14.5		14.03	0.48		1.17
15.0		14.45	0.54		1.12
21.0		21.24	0.07		1.73
27.0		27.68	0.58		2.14
33.0		33.36	0.21		2.28
39.0		39.43	0.34		2.51
45.0		44.87	0.62		2.29
51.0		51.83	0.47		2.46
57.0		57.70	0.30		2.85
63.0		65.39	1.15		4.01

[1] Insertion loss at 0 dB attenuation state.

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2.2 Pulse Response

Pulse response measurements were performed to ensure the attenuator would not distort the input RF pulse. The measurement set-up was shown previously in Figure 2.2-1. Table 2.2-1 contains the results for the SPDT switch.

Table 2.2-1: Variable Attenuator Pulse Response

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

	Pulse Width	Period	Duty Cycle (%)	Rise Time (ns)	Fall Time (ns)	CW/Pulsed Amplitude Difference (dB)
Specification	0.2 to 120 us	0.3 to 120 kHz PRF	< 25	< 20	< 20	± 1
	120 us	1.2 ms	10	9.3	11.0	-
	10 us	100 us	10	9.3	11.3	-
	1 us	10 us	10	9.5	11.3	-
	500 ns	5 us	10	9.0	11.3	-
	200 ns	2 us	10	9.3	11.5	-

The measured insertion loss / attenuation did not change when the input signal was changed from CW to pulse.

2.3 Residual Amplitude and Phase Noise

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

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Table 2.3-1: Variable Attenuator Residual Phase Noise

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

Offset Frequency	[illegible] Noise (dBc/Hz)	Attenuator (dBc/Hz)
[illegible]	-132	-131
[illegible]	-142	-139
[illegible]	-150	-149
[illegible]	-160	-158
[illegible]	-167	-166
[illegible]	-170	-169
[illegible]	-170	-167
[illegible]	-167	-167

Table 2.3-2: Variable Attenuator Amplitude Noise

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

Offset Frequency	[illegible] Noise (dBc/Hz)	Attenuator (dBc/Hz)
[illegible]	-114	-113
[illegible]	-123	-121
[illegible]	-132	-132
[illegible]	-143	-141
[illegible]	-152	-150
[illegible]	-158	-158
[illegible]	-162	-162
[illegible]	-162	-160

2.4 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

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for all measurements up to 40 MHz offset from the carrier frequency. Above 40 MHz offset, measurements are made using a HP8563E spectrum analyzer is used. 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. It was determined through measurement that the -15 V rail for the attenuator provided the worst case results. Consequently, all of the measurements were made for the -15 V rail. The following tables provide results summaries.

Table 2.4-1: Variable Attenuator Conducted Susceptibility (PM Noise Set-up)

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

	-128
	-113
	-113
	-113

Table 2.4-2: Variable Attenuator Conducted Susceptibility (AM Noise Set-up)

AMC P/N: AGH-0612-60DDSF, S/N: AH310303

	-120	-
	-116	-
	-91	-88