Broadsound Corporation

ProCheck SC5

Ultrasound Transducer Assembly Analysis Report

Device Under Test

Device Under Test (DUT)

Make	Model	No. of Elements	Type of Array	Radius of Curvature	Nominal Frequency	Serial Number
Philips	C5-1	160	Convex	R45	1 - 5 MHz	0336LN

Source File

Measurement Data File	C:\Users\Yi-Hsun\Desktop\New folder\Philips C5-1_20181022175454.PCMF

Extra Info. (Recurrent Test for Client)

Customer	Location		
Broadsound	Hsinchu		

Test Condition

Reference Drive Signal	-45 V, 0.4 uJ, DC-45 MHz unipolar pulse @ 50 ohm
Acoustic Mirror	Flat (Standard MAFS), Alum. & Concave R120, Alum.
Temperature of Water Bath	24.0 °C

ProCheck SC5 UTAS

	Model	Serial Number	Note
Ultrasound Transducer Analyzer	PCSC5TA	UFMEBJAAD	Lastest Calibration Date: 01-Jul-2018
Probe Adaptor	PH260C156CE	UA10BJAAC	Receptacle: iUE23 260-Cannon-F

Operator: YH Lin Date of Test: 22-Oct-2018

Ultrasound Transducer Assembly Analysis Report

Outline

1. ✓ Capacitance Measurement
   1) Statistics: mean, standard deviation (SD), maximum, minimum
   2) Excluded elements
      2.1) Auto exclusion
      2.2) Manual exclusion
   3) Uniformity of total capacitance C_T across elements being analyzed
      3.1) Coefficient of variation (*CV*) of total capacitance C_T
      3.2) Acceptance window of total capacitance C_T
      3.3) Bar chart of total capacitance C_T
   4) Data of measurement
2. ✓ Axial Characteristic Loop Sensitivity S_{LC} Measurement
   1) Curve of characteristic loop sensitivity S_{LC} along axial distance
   2) Data of measurement
3. ✓ Intrinsic Characteristics Measurement
   1) Statistics: mean, standard deviation (SD), maximum, minimum
   2) Excluded elements
      2.1) Auto exclusion
      2.2) Manual exclusion
   3) Uniformity of characteristic loop sensitivity S_{LC} across elements being analyzed
      3.1) Coefficient of variation (*CV*) of characteristic loop sensitivity S_{LC}
      3.2) Acceptance window of characteristic loop sensitivity S_{LC}
      3.3) Bar chart of characteristic loop sensitivity S_{LC}
   4) Relevant $X(t)$ and $S_L(f)$ of selected elements
   5) Typical optimum drive waveform signal $B(t)$
   6) Data of measurement
   7) Bar chart of measurement parameters
4. ✓ Transmission Crosstalk Measurement with Optimum Drive Waveform Signal $B(t)$
   1) Statistics: mean, standard deviation (SD), maximum, minimum
   2) Excluded elements
      2.1) Auto exclusion
      2.2) Manual exclusion
   3) Data of measurement
5. ✓ Echo Measurement with Optimum Drive Waveform Signal $B(t)$
   1) Statistics: mean, standard deviation (SD), maximum, minimum
   2) Excluded elements
      2.1) Auto exclusion
      2.2) Manual exclusion
   3) Uniformity of insertion gain of echo IG_e across elements being analyzed
      3.1) Coefficient of variation (*CV*) of insertion gain of echo IG_e
      3.2) Acceptance window of insertion gain of echo IG_e
      3.3) Bar chart of insertion gain of echo IG_e
   4) Relevant echo and relative energy spectrum of echo of selected elements
   5) Data of measurement
   6) Bar chart of measurement parameters

Ultrasound Transducer Assembly Analysis Report

1. Capacitance Measurement

1) Statistics

Parameter	C_T (pF)
Mean	649
SD (standard deviation)	11
Max.	675
Min.	570
Number of total elements	160
Number of elements being analyzed	160

C_T: Total capacitance including capacitance of coaxial cable C_{cable}, capacitance of transducer element $C_{element}$, and capacitance of HVSW (high voltage switch) ICs C_{HVSW} if existed, as given by: $C_T = C_{cable} + C_{element} + C_{HVSW}$

2) Excluded elements

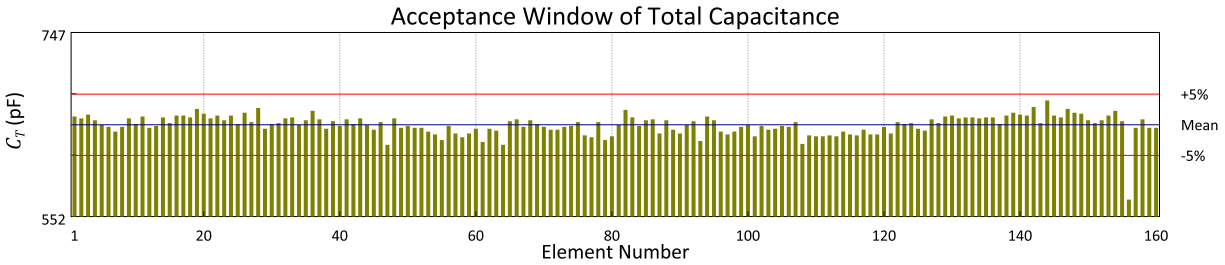
Total number of excluded elements	0		
Auto-excluded element number	---	subtotal	0
Manually excluded element number	---	subtotal	0

3) Uniformity of total capacitance C_T across elements being analyzed

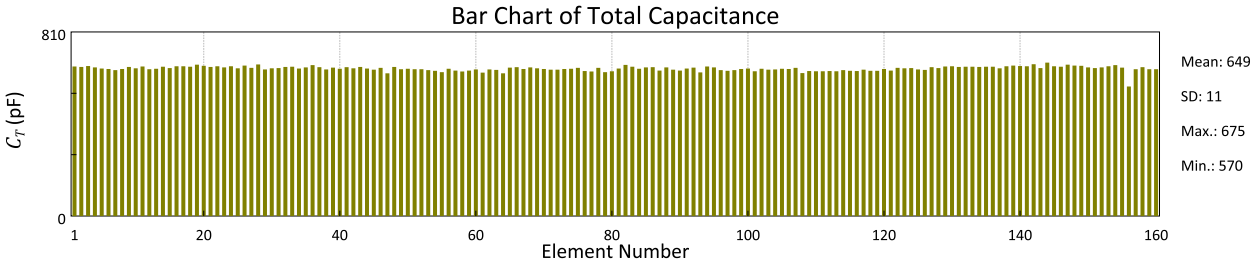
3.1) Coefficient of variation (*CV*) of total capacitance C_T

Coefficient of Variation (*CV*) of C_T	0.73 % (< 3 %)
① The *CV* (coefficient of variation) describes the SD as a percentage of the mean, as given by: *CV* = (SD / mean) X 100 (%) ② Note that the "0.0% of *CV*" means perfect uniformity across elements.	

3.2) Acceptance window of total capacitance C_T



3.3) Bar chart of total capacitance C_T



Device Under Test (DUT)

Make	Model	No. of Elements	Type of Array	Radius of Curvature	Nominal Frequency	Serial Number
Philips	C5-1	160	Convex	R45	1 - 5 MHz	0336LN

Ultrasound Transducer Assembly Analysis Report

1. Capacitance Measurement (cont'd)

4) Data of measurement

Element Number	C_T (pF)	Element Number	C_T (pF)	Element Number	C_T (pF)	Element Number	C_T (pF)	Element Number	C_T (pF)	Element Number	C_T (pF)
1	658	49	646	97	639	145	659	193	---	241	---
2	656	50	648	98	642	146	657	194	---	242	---
3	660	51	646	99	647	147	666	195	---	243	---
4	654	52	646	100	649	148	662	196	---	244	---
5	649	53	642	101	637	149	661	197	---	245	---
6	647	54	639	102	648	150	654	198	---	246	---
7	642	55	633	103	644	151	651	199	---	247	---
8	647	56	648	104	645	152	654	200	---	248	---
9	656	57	640	105	648	153	659	201	---	249	---
10	650	58	636	106	647	154	664	202	---	250	---
11	658	59	640	107	652	155	653	203	---	251	---
12	646	60	645	108	629	156	570	204	---	252	---
13	648	61	631	109	638	157	646	205	---	253	---
14	657	62	645	110	637	158	655	206	---	254	---
15	651	63	643	111	637	159	646	207	---	255	---
16	659	64	628	112	638	160	646	208	---	256	---
17	659	65	653	113	637	161	---	209	---	257	---
18	657	66	655	114	642	162	---	210	---	258	---
19	666	67	647	115	639	163	---	211	---	259	---
20	661	68	654	116	638	164	---	212	---	260	---
21	656	69	650	117	644	165	---	213	---	261	---
22	659	70	647	118	639	166	---	214	---	262	---
23	654	71	644	119	639	167	---	215	---	263	---
24	659	72	644	120	647	168	---	216	---	264	---
25	650	73	647	121	640	169	---	217	---	265	---
26	662	74	648	122	652	170	---	218	---	266	---
27	652	75	652	123	650	171	---	219	---	267	---
28	667	76	638	124	651	172	---	220	---	268	---
29	645	77	636	125	645	173	---	221	---	269	---
30	650	78	652	126	643	174	---	222	---	270	---
31	651	79	633	127	655	175	---	223	---	271	---
32	656	80	637	128	651	176	---	224	---	272	---
33	657	81	649	129	658	177	---	225	---	273	---
34	649	82	665	130	659	178	---	226	---	274	---
35	654	83	657	131	656	179	---	227	---	275	---
36	664	84	648	132	657	180	---	228	---	276	---
37	655	85	654	133	657	181	---	229	---	277	---
38	645	86	655	134	656	182	---	230	---	278	---
39	653	87	640	135	657	183	---	231	---	279	---
40	648	88	654	136	657	184	---	232	---	280	---
41	655	89	644	137	650	185	---	233	---	281	---
42	650	90	640	138	659	186	---	234	---	282	---
43	656	91	649	139	662	187	---	235	---	283	---
44	649	92	653	140	660	188	---	236	---	284	---
45	644	93	632	141	659	189	---	237	---	285	---
46	652	94	658	142	668	190	---	238	---	286	---
47	628	95	654	143	651	191	---	239	---	287	---
48	656	96	642	144	675	192	---	240	---	288	---
Element Number	C_T (pF)	Element Number	C_T (pF)	Element Number	C_T (pF)	Element Number	C_T (pF)	Element Number	C_T (pF)	Element Number	C_T (pF)

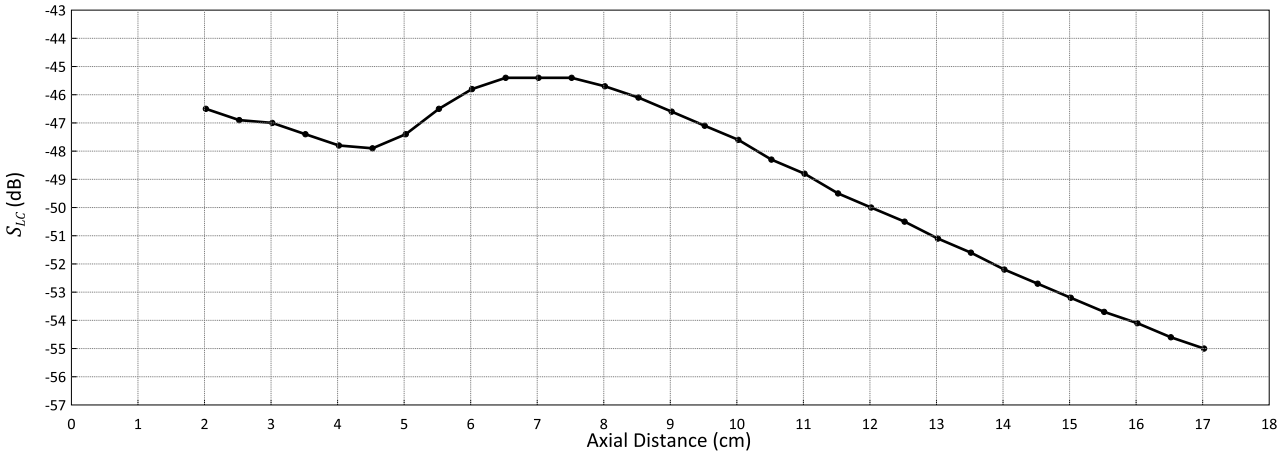
Device Under Test (DUT)

Make	Model	No. of Elements	Type of Array	Radius of Curvature	Nominal Frequency	Serial Number
Philips	C5-1	160	Convex	R45	1 - 5 MHz	0336LN

Ultrasound Transducer Assembly Analysis Report

2. Axial Characteristic Loop Sensitivity S_{LC} Measurement

1) Curve of characteristic loop sensitivity S_{LC} along axial distance



2) Data of measurement

Data Point	TF (μs)	L (cm)	S_{LC} (dB)	Data Point	TF (μs)	L (cm)	S_{LC} (dB)	Data Point	TF (μs)	L (cm)	S_{LC} (dB)
1	27.04	2.0	-46.5	16	127.36	9.5	-47.1	31	227.79	17.0	-55.0
2	33.75	2.5	-46.9	17	134.13	10.0	-47.6	32	---	---	---
3	40.40	3.0	-47.0	18	140.78	10.5	-48.3	33	---	---	---
4	47.06	3.5	-47.4	19	147.44	11.0	-48.8	34	---	---	---
5	53.80	4.0	-47.8	20	154.18	11.5	-49.5	35	---	---	---
6	60.55	4.5	-47.9	21	160.83	12.0	-50.0	36	---	---	---
7	67.24	5.0	-47.4	22	167.56	12.5	-50.5	37	---	---	---
8	73.91	5.5	-46.5	23	174.26	13.0	-51.1	38	---	---	---
9	80.56	6.0	-45.8	24	180.90	13.5	-51.6	39	---	---	---
10	87.33	6.5	-45.4	25	187.63	14.0	-52.2	40	---	---	---
11	93.94	7.0	-45.4	26	194.32	14.5	-52.7	41	---	---	---
12	100.60	7.5	-45.4	27	200.98	15.0	-53.2	42	---	---	---
13	107.28	8.0	-45.7	28	207.70	15.5	-53.7	43	---	---	---
14	114.04	8.5	-46.1	29	214.38	16.0	-54.1	44	---	---	---
15	120.72	9.0	-46.6	30	221.11	16.5	-54.6	45	---	---	---
Data Point	TF (μs)	L (cm)	S_{LC} (dB)	Data Point	TF (μs)	L (cm)	S_{LC} (dB)	Data Point	TF (μs)	L (cm)	S_{LC} (dB)

S_{LC}: Characteristic loop sensitivity;
TF: Time of flight or round-trip acoustic traveling time between acoustic transducer and acoustic mirror in degassed water bath
L: Axial distance between acoustic transducer and acoustic mirror in degassed water bath

Device Under Test (DUT)

Make	Model	No. of Elements	Type of Array	Radius of Curvature	Nominal Frequency	Serial Number
Philips	C5-1	160	Convex	R45	1 - 5 MHz	0336LN

Test Condition

Reference Drive Signal	-45 V, 0.4 uJ, DC-45 MHz unipolar pulse @ 50 ohm
Acoustic Mirror	Flat (Standard MAFS), Alum.; A-side Up
Selected Element Number	#79
Temperature of Water Bath	24.0°C

Ultrasound Transducer Assembly Analysis Report

3. Intrinsic Characteristics Measurement

1) Statistics

Group	Characteristic Loop Sensitivity S_{LC}		Normalized Loop Time Response $X(t)$				Wideband Loop Sensitivity $S_L(f)$							
Item	1	2	3	4	5①	6①	7	8	9	10	11	12	13①	14①
Parameter	S_{LC} (dB)	TF (μs)	t_d (μs)	t_{-12} (μs)	t_{-20} (μs)	t_{-26} (μs)	$f_{c\text{-}6}$ (MHz)	BW_{-6} (%)	$f_{c\text{-}10}$ (MHz)	BW_{-10} (%)	$f_{c\text{-}20}$ (MHz)	BW_{-20} (%)	$f_{c\text{-}30}$ (MHz)	BW_{-30} (%)
Mean	-41.4	102.0	0.39	0.55	1.09	1.50	3.1	86	3.1	97	3.3	118	3.3	137
SD	0.3	0.0	0.01	0.01	0.09	0.03	0.0	1	0.0	1	0.0	1	0.0	1
Max.	-40.9	102.1	0.41	0.60	1.42	1.67	3.2	88	3.2	99	3.3	119	3.4	140
Min.	-42.4	101.9	0.37	0.53	1.02	1.41	3.1	78	3.1	88	3.2	111	3.2	127
Number of total elements			160											
Number of elements being analyzed			160											

1. S_{LC}: Characteristic loop sensitivity
2. TF: Time of flight or round-trip acoustic traveling time between transducer and acoustic mirror in degassed water bath
3. t_d: Temporal duration of normalized loop time response $X(t)$
4. t_{-12}: Temporal length of -12 dB ring-down of $X(t)$
5. t_{-20}: Temporal length of -20 dB ring-down of $X(t)$
6. t_{-26}: Temporal length of -26 dB ring-down of $X(t)$
7. $f_{c\text{-}6}$: Center frequency of -6 dB limit of wideband loop sensitivity $S_L(f)$
8. BW_{-6}: Fractional bandwidth of -6 dB limit of $S_L(f)$
9. $f_{c\text{-}10}$: Center frequency of -10 dB limit of $S_L(f)$
10. BW_{-10}: Fractional bandwidth of -10 dB limit of $S_L(f)$
11. $f_{c\text{-}20}$: Center frequency of -20 dB limit of $S_L(f)$
12. BW_{-20}: Fractional bandwidth of -20 dB limit of $S_L(f)$
13. $f_{c\text{-}30}$: Center frequency of -30 dB limit of $S_L(f)$
14. BW_{-30}: Fractional bandwidth of -30 dB limit of $S_L(f)$

① Note that due to the nature of definition itself, the parameters t_{-20}, t_{-26}, $f_{c\text{-}30}$, and BW_{-30} may be prone to be contaminated by system noise; that is, the parameters t_{-20}, t_{-26}, $f_{c\text{-}30}$, and BW_{-30} would be more sensitive to system noises in the situation of low SNR (signal-to-noise ratio).

2) Excluded elements

Total number of excluded elements	0		
Auto-excluded element number	---	subtotal	0
Manually excluded element number	---	subtotal	0

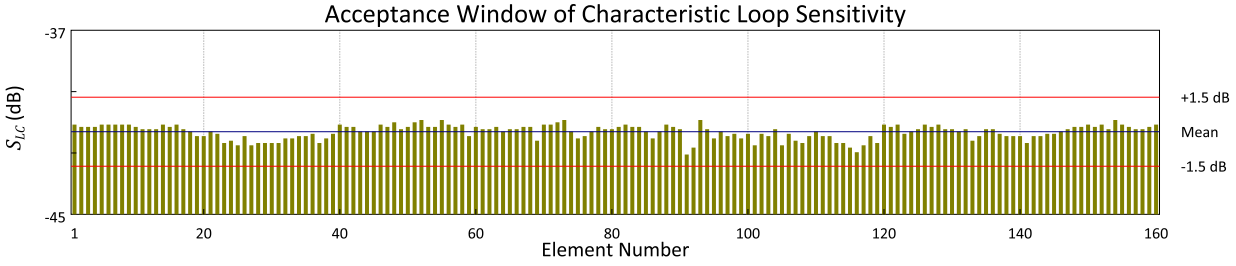
3) Uniformity of characteristic loop sensitivity S_{LC} across elements being analyzed

3.1) Coefficient of variation (*CV*) of characteristic loop sensitivity S_{LC}

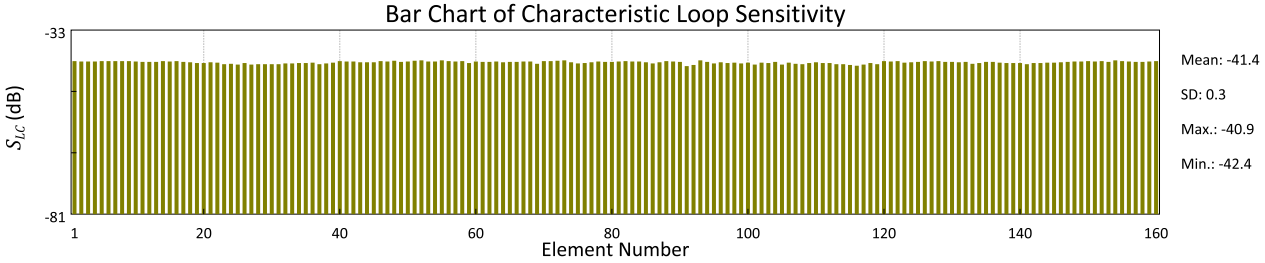
Coefficient of Variation (*CV*) of S_{LC}	0.73 % (< 3 %)

① The *CV* (coefficient of variation) describes the SD as a percentage of the mean, as given by: *CV* = (SD / mean) X 100 (%)
② Note that the "0.0% of *CV*" means perfect uniformity across elements.

3.2) Acceptance window of characteristic loop sensitivity S_{LC}



3.3) Bar chart of characteristic loop sensitivity S_{LC}



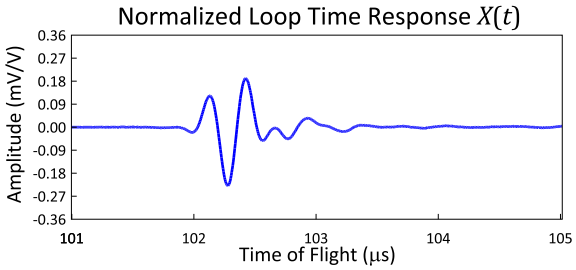
Device Under Test (DUT)

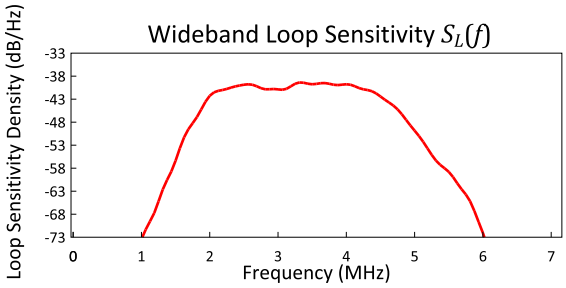
Make	Model	No. of Elements	Type of Array	Radius of Curvature	Nominal Frequency	Serial Number
Philips	C5-1	160	Convex	R45	1 - 5 MHz	0336LN

3. Intrinsic Characteristics Measurement (cont'd)

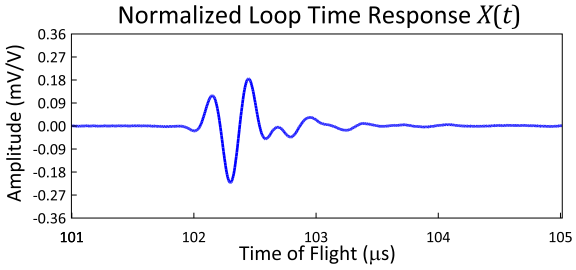
4) Relevant $X(t)$ and $S_L(f)$ of selected elements

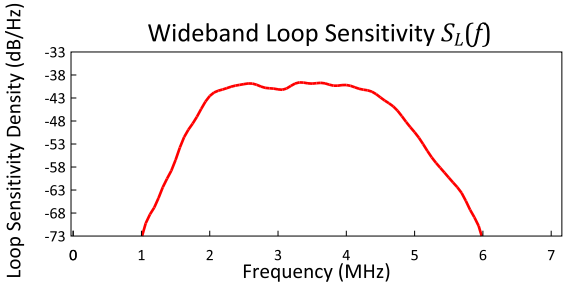
Element number: #10



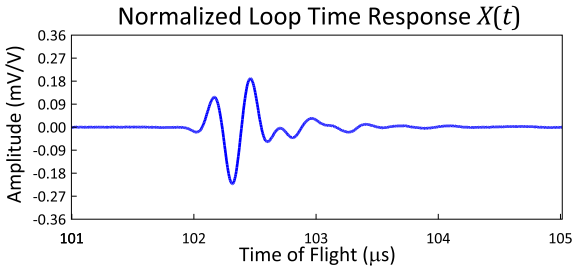


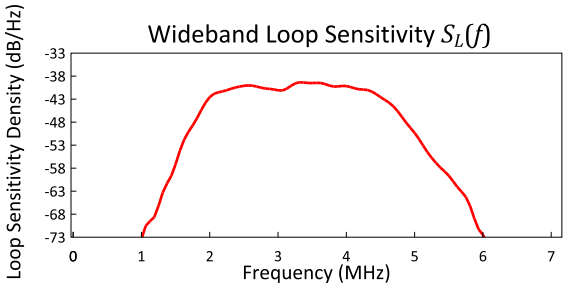
Element number: #45



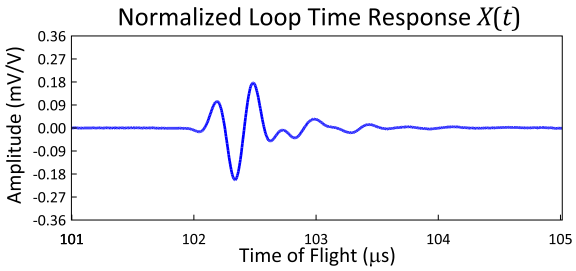


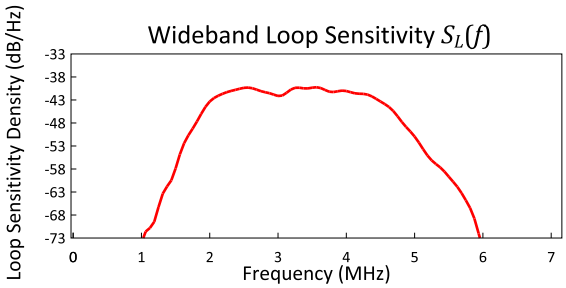
Element number: #80



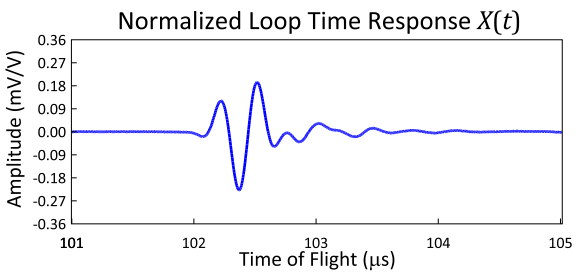


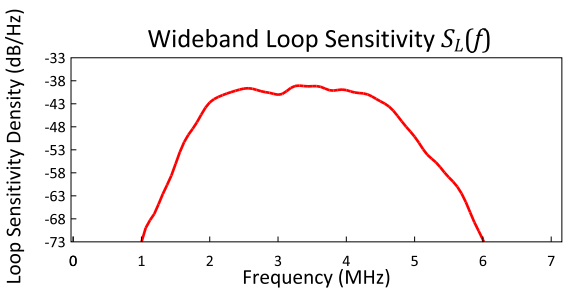
Element number: #115





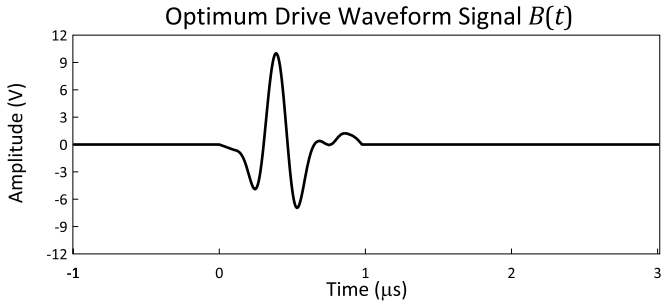
Element number: #150

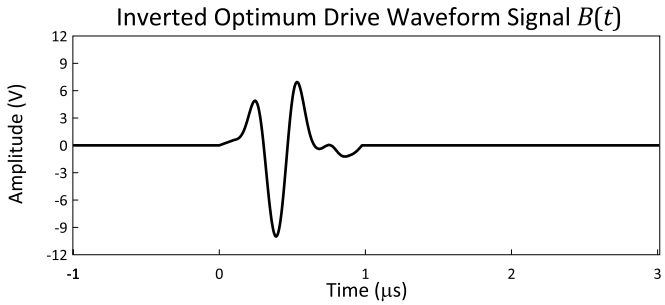


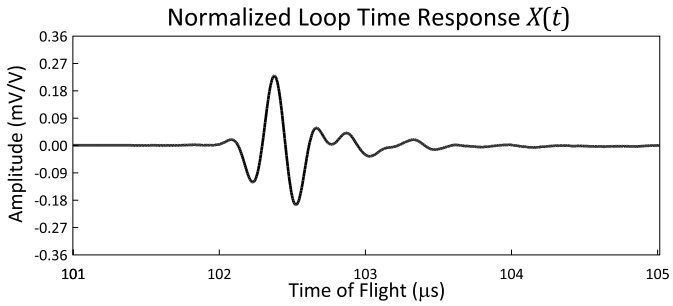


3. Intrinsic Characteristics Measurement (cont'd)

5) Typical optimum drive waveform signal $B(t)$







Device Under Test (DUT)

Make	Model	No. of Elements	Type of Array	Radius of Curvature	Nominal Frequency	Serial Number
Philips	C5-1	160	Convex	R45	1 - 5 MHz	0336LN

Ultrasound Transducer Assembly Analysis Report

3. Intrinsic Characteristics Measurement (cont'd)

6) Data of measurement

Item	Characteristic Loop Sensitivity S_{LC}		Normalized Loop Time Response $X(t)$				Wideband Loop Sensitivity $S_L(f)$							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Element Number	S_{LC} (dB)	TF (μs)	t_d (μs)	t_{-12} (μs)	t_{-20} (μs)	t_{-26} (μs)	$f_{c\text{-}6}$ (MHz)	BW_{-6} (%)	$f_{c\text{-}10}$ (MHz)	BW_{-10} (%)	$f_{c\text{-}20}$ (MHz)	BW_{-20} (%)	$f_{c\text{-}30}$ (MHz)	BW_{-30} (%)
1	-41.1	101.9	0.39	0.53	1.31	1.56	3.1	86	3.1	98	3.3	117	3.3	138
2	-41.2	101.9	0.38	0.53	1.06	1.50	3.1	87	3.1	97	3.3	119	3.3	138
3	-41.2	101.9	0.38	0.54	1.05	1.49	3.1	87	3.1	99	3.3	119	3.3	137
4	-41.2	101.9	0.38	0.54	1.04	1.50	3.1	87	3.1	98	3.2	119	3.3	139
5	-41.1	101.9	0.38	0.53	1.06	1.49	3.1	87	3.1	98	3.3	118	3.3	135
6	-41.1	101.9	0.38	0.53	1.05	1.48	3.1	87	3.1	98	3.3	119	3.3	138
7	-41.1	101.9	0.39	0.53	1.05	1.49	3.1	88	3.1	99	3.3	119	3.3	137
8	-41.1	101.9	0.39	0.53	1.06	1.48	3.1	88	3.1	99	3.3	119	3.3	137
9	-41.1	101.9	0.39	0.54	1.05	1.48	3.1	87	3.1	98	3.2	118	3.3	137
10	-41.2	101.9	0.38	0.54	1.05	1.42	3.1	87	3.1	98	3.3	119	3.3	136
11	-41.3	101.9	0.39	0.53	1.05	1.46	3.1	87	3.1	98	3.2	119	3.3	138
12	-41.3	101.9	0.39	0.54	1.06	1.47	3.1	87	3.1	99	3.3	118	3.3	136
13	-41.3	101.9	0.38	0.53	1.04	1.41	3.1	88	3.1	99	3.3	119	3.3	138
14	-41.1	101.9	0.39	0.54	1.05	1.47	3.1	88	3.1	98	3.3	118	3.3	136
15	-41.2	101.9	0.39	0.54	1.05	1.48	3.1	87	3.1	98	3.2	119	3.3	138
16	-41.1	101.9	0.39	0.53	1.06	1.48	3.1	87	3.1	98	3.3	119	3.3	138
17	-41.3	101.9	0.39	0.54	1.05	1.47	3.1	87	3.1	99	3.3	119	3.3	136
18	-41.4	101.9	0.39	0.55	1.06	1.48	3.1	86	3.1	97	3.2	118	3.3	137
19	-41.6	101.9	0.38	0.54	1.05	1.43	3.1	87	3.1	98	3.2	118	3.3	137
20	-41.6	101.9	0.38	0.54	1.05	1.46	3.1	86	3.1	98	3.2	118	3.3	138
21	-41.4	101.9	0.38	0.54	1.05	1.42	3.1	87	3.1	99	3.2	119	3.3	137
22	-41.5	101.9	0.38	0.53	1.05	1.42	3.1	88	3.1	99	3.2	119	3.3	136
23	-41.9	101.9	0.38	0.53	1.05	1.45	3.1	87	3.1	98	3.3	119	3.3	139
24	-41.8	101.9	0.38	0.53	1.05	1.42	3.1	87	3.1	99	3.2	119	3.3	139
25	-42.0	101.9	0.38	0.53	1.05	1.48	3.1	87	3.1	98	3.2	118	3.3	138
26	-41.6	101.9	0.39	0.54	1.05	1.42	3.1	87	3.1	98	3.2	118	3.3	137
27	-42.0	101.9	0.38	0.53	1.05	1.49	3.1	87	3.1	98	3.3	119	3.3	139
28	-41.9	101.9	0.38	0.53	1.05	1.43	3.1	88	3.1	99	3.3	119	3.3	137
29	-41.9	101.9	0.39	0.53	1.05	1.47	3.1	88	3.1	99	3.3	118	3.3	138
30	-41.9	101.9	0.39	0.53	1.05	1.46	3.1	87	3.1	98	3.2	118	3.3	137
31	-41.9	101.9	0.38	0.53	1.05	1.47	3.1	87	3.1	98	3.3	118	3.3	138
32	-41.7	101.9	0.38	0.54	1.05	1.46	3.1	87	3.1	98	3.3	118	3.3	137
33	-41.7	101.9	0.38	0.54	1.04	1.46	3.1	86	3.1	98	3.2	118	3.3	138
34	-41.6	101.9	0.39	0.54	1.05	1.48	3.1	87	3.1	97	3.3	118	3.3	137
35	-41.6	101.9	0.39	0.54	1.05	1.48	3.1	86	3.1	97	3.2	118	3.3	137
36	-41.5	101.9	0.39	0.54	1.06	1.48	3.1	87	3.1	97	3.3	118	3.3	135
37	-41.9	101.9	0.38	0.54	1.05	1.52	3.1	86	3.1	97	3.3	118	3.3	139
38	-41.7	101.9	0.38	0.53	1.05	1.49	3.1	88	3.1	99	3.3	118	3.3	137
39	-41.5	101.9	0.39	0.55	1.05	1.48	3.1	86	3.1	97	3.2	117	3.3	138
40	-41.1	101.9	0.38	0.54	1.05	1.47	3.1	87	3.1	98	3.3	118	3.3	137
41	-41.2	101.9	0.39	0.55	1.04	1.46	3.1	86	3.1	97	3.2	117	3.3	137
42	-41.2	101.9	0.39	0.54	1.04	1.48	3.1	87	3.1	98	3.3	118	3.3	137
43	-41.4	101.9	0.39	0.55	1.05	1.47	3.1	86	3.1	97	3.2	117	3.3	137
44	-41.4	101.9	0.39	0.55	1.05	1.46	3.1	86	3.1	97	3.2	118	3.3	137
45	-41.4	101.9	0.39	0.54	1.05	1.46	3.1	87	3.1	98	3.2	118	3.3	138
46	-41.1	101.9	0.39	0.54	1.05	1.45	3.1	87	3.1	98	3.2	119	3.3	136
47	-41.2	101.9	0.39	0.54	1.05	1.49	3.1	87	3.1	98	3.3	118	3.3	138
48	-41.0	101.9	0.39	0.54	1.05	1.50	3.1	86	3.1	97	3.2	118	3.3	138
49	-41.3	102.0	0.39	0.54	1.05	1.45	3.1	87	3.1	98	3.2	118	3.3	137
50	-41.2	102.0	0.40	0.56	1.05	1.50	3.1	85	3.1	96	3.2	116	3.3	137
51	-41.0	102.0	0.40	0.55	1.05	1.50	3.1	86	3.1	97	3.2	117	3.3	137
52	-40.9	102.0	0.39	0.55	1.05	1.50	3.1	86	3.1	97	3.2	117	3.3	137
53	-41.2	102.0	0.39	0.54	1.05	1.47	3.1	87	3.1	98	3.2	118	3.3	137
54	-41.2	102.0	0.39	0.54	1.05	1.49	3.1	87	3.1	98	3.3	118	3.3	138
55	-40.9	102.0	0.39	0.54	1.05	1.50	3.1	87	3.1	97	3.2	118	3.3	139
56	-41.1	102.0	0.39	0.54	1.05	1.48	3.1	87	3.1	98	3.2	118	3.3	137
57	-41.2	102.0	0.39	0.55	1.05	1.50	3.1	87	3.1	97	3.3	117	3.3	138
58	-41.1	102.0	0.39	0.55	1.05	1.50	3.1	86	3.1	96	3.2	117	3.3	138
59	-41.6	102.0	0.40	0.55	1.04	1.48	3.1	86	3.1	98	3.2	117	3.3	137
60	-41.2	102.0	0.40	0.56	1.04	1.50	3.1	85	3.1	95	3.2	116	3.3	137
61	-41.3	102.0	0.39	0.55	1.05	1.49	3.1	86	3.1	98	3.2	117	3.3	137
62	-41.3	102.0	0.40	0.54	1.26	1.49	3.1	87	3.1	98	3.3	118	3.3	137
63	-41.2	102.0	0.40	0.56	1.05	1.52	3.1	85	3.1	96	3.2	117	3.3	136
64	-41.4	102.0	0.40	0.55	1.29	1.51	3.1	87	3.1	98	3.3	117	3.3	137
Element Number	S_{LC} (dB)	TF (μs)	t_d (μs)	t_{-12} (μs)	t_{-20} (μs)	t_{-26} (μs)	$f_{c\text{-}6}$ (MHz)	BW_{-6} (%)	$f_{c\text{-}10}$ (MHz)	BW_{-10} (%)	$f_{c\text{-}20}$ (MHz)	BW_{-20} (%)	$f_{c\text{-}30}$ (MHz)	BW_{-30} (%)
Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Characteristic Loop Sensitivity S_{LC}		Normalized Loop Time Response $X(t)$				Wideband Loop Sensitivity $S_L(f)$							

Ultrasound Transducer Assembly Analysis Report

3. Intrinsic Characteristics Measurement (cont'd)

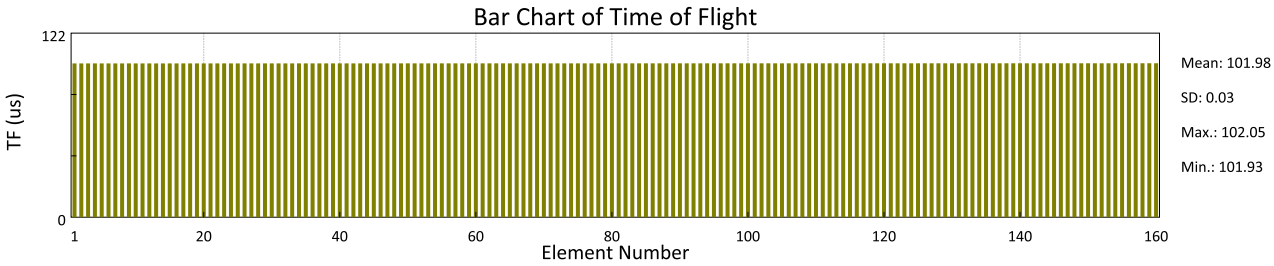
6) Data of measurement (cont'd)

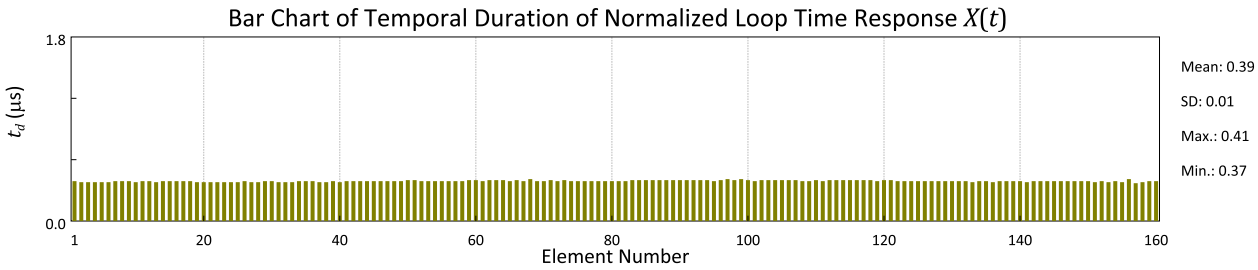
Item	Characteristic Loop Sensitivity S_{LC}		Normalized Loop Time Response $X(t)$				Wideband Loop Sensitivity $S_L(f)$							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Element Number	S_{LC} (dB)	TF (μs)	t_d (μs)	t_{-12} (μs)	t_{-20} (μs)	t_{-26} (μs)	$f_{c\text{-}6}$ (MHz)	BW_{-6} (%)	$f_{c\text{-}10}$ (MHz)	BW_{-10} (%)	$f_{c\text{-}20}$ (MHz)	BW_{-20} (%)	$f_{c\text{-}30}$ (MHz)	BW_{-30} (%)
65	-41.3	102.0	0.39	0.56	1.05	1.50	3.1	85	3.1	95	3.2	116	3.3	137
66	-41.3	102.0	0.40	0.57	1.27	1.52	3.1	84	3.1	95	3.2	116	3.3	136
67	-41.2	102.0	0.39	0.55	1.04	1.49	3.1	86	3.1	97	3.2	117	3.3	137
68	-41.2	102.0	0.41	0.57	1.27	1.52	3.1	85	3.1	95	3.2	116	3.3	135
69	-41.8	102.0	0.39	0.54	1.05	1.51	3.1	86	3.1	97	3.3	118	3.3	137
70	-41.1	102.0	0.39	0.55	1.04	1.50	3.1	85	3.1	96	3.2	117	3.3	137
71	-41.1	102.0	0.40	0.56	1.04	1.52	3.1	86	3.1	95	3.2	116	3.3	138
72	-41.0	102.0	0.39	0.55	1.05	1.49	3.1	86	3.1	97	3.2	117	3.3	136
73	-40.9	102.0	0.40	0.56	1.04	1.51	3.1	86	3.1	96	3.3	117	3.3	137
74	-41.4	102.0	0.39	0.55	1.04	1.48	3.1	86	3.1	97	3.3	117	3.3	136
75	-41.7	102.0	0.39	0.55	1.03	1.48	3.1	86	3.1	97	3.2	117	3.3	137
76	-41.6	102.0	0.39	0.55	1.03	1.50	3.1	86	3.1	97	3.3	117	3.3	137
77	-41.4	102.0	0.39	0.55	1.05	1.46	3.1	87	3.1	98	3.2	117	3.3	137
78	-41.2	102.0	0.39	0.55	1.06	1.50	3.1	86	3.1	97	3.2	117	3.3	136
79	-41.3	102.0	0.39	0.56	1.04	1.49	3.1	85	3.1	96	3.3	117	3.3	136
80	-41.3	102.0	0.39	0.55	1.06	1.48	3.1	86	3.1	97	3.2	117	3.3	135
81	-41.2	102.0	0.39	0.55	1.03	1.50	3.1	86	3.1	96	3.2	117	3.3	138
82	-41.1	102.0	0.39	0.55	1.05	1.46	3.1	86	3.1	97	3.2	117	3.3	136
83	-41.2	102.0	0.40	0.56	1.05	1.50	3.1	85	3.1	97	3.2	117	3.3	135
84	-41.2	102.0	0.40	0.56	1.05	1.52	3.1	85	3.1	96	3.2	117	3.3	138
85	-41.4	102.0	0.40	0.56	1.05	1.50	3.1	86	3.1	96	3.2	116	3.3	134
86	-41.7	102.0	0.40	0.57	1.04	1.53	3.1	84	3.1	95	3.2	117	3.3	135
87	-41.4	102.0	0.40	0.56	1.04	1.51	3.1	86	3.1	97	3.3	116	3.3	137
88	-41.1	102.0	0.40	0.56	1.05	1.52	3.1	85	3.1	95	3.2	117	3.2	139
89	-41.2	102.0	0.40	0.55	1.28	1.52	3.1	86	3.1	96	3.2	117	3.3	136
90	-41.3	102.0	0.40	0.58	1.26	1.51	3.1	85	3.1	94	3.3	115	3.3	133
91	-42.4	102.0	0.40	0.57	1.03	1.51	3.1	84	3.1	96	3.3	117	3.3	136
92	-42.1	102.0	0.40	0.56	1.04	1.52	3.1	86	3.1	96	3.3	117	3.3	134
93	-40.9	102.0	0.40	0.56	1.26	1.52	3.1	86	3.1	96	3.3	117	3.3	136
94	-41.3	102.0	0.40	0.55	1.28	1.51	3.1	86	3.1	98	3.2	118	3.3	136
95	-41.7	102.0	0.39	0.55	1.04	1.48	3.1	86	3.1	98	3.3	117	3.3	138
96	-41.4	102.0	0.40	0.57	1.04	1.50	3.1	85	3.1	96	3.3	117	3.3	136
97	-41.6	102.0	0.41	0.56	1.27	1.50	3.1	87	3.1	97	3.3	117	3.3	135
98	-41.5	102.0	0.40	0.56	1.04	1.50	3.1	85	3.1	96	3.3	117	3.3	136
99	-41.7	102.0	0.41	0.57	1.28	1.54	3.1	85	3.1	95	3.2	116	3.3	135
100	-41.5	102.0	0.40	0.55	1.03	1.49	3.1	87	3.1	97	3.3	117	3.3	135
101	-42.0	102.0	0.39	0.55	1.03	1.52	3.1	86	3.1	98	3.3	118	3.3	138
102	-41.5	102.0	0.40	0.56	1.04	1.50	3.1	86	3.1	97	3.3	117	3.3	137
103	-41.6	102.0	0.40	0.55	1.27	1.51	3.1	87	3.1	97	3.3	117	3.3	137
104	-41.3	102.0	0.40	0.56	1.04	1.50	3.1	86	3.1	96	3.3	117	3.3	134
105	-42.0	102.0	0.40	0.55	1.06	1.51	3.1	86	3.1	96	3.2	116	3.3	137
106	-41.5	102.0	0.40	0.56	1.05	1.52	3.1	85	3.1	96	3.2	116	3.3	136
107	-41.8	102.0	0.40	0.56	1.04	1.51	3.1	86	3.1	97	3.2	117	3.3	135
108	-41.9	102.0	0.39	0.54	1.27	1.52	3.1	87	3.1	98	3.3	119	3.3	137
109	-41.6	102.0	0.39	0.55	1.04	1.51	3.1	86	3.2	96	3.3	117	3.3	136
110	-41.4	102.0	0.40	0.55	1.28	1.52	3.1	86	3.1	97	3.2	117	3.3	134
111	-41.6	102.0	0.39	0.56	1.04	1.48	3.1	86	3.1	97	3.3	117	3.3	136
112	-41.6	102.0	0.40	0.56	1.26	1.51	3.1	86	3.1	96	3.3	117	3.3	137
113	-41.9	102.0	0.40	0.55	1.05	1.52	3.1	87	3.1	98	3.3	118	3.3	135
114	-41.9	102.0	0.40	0.56	1.26	1.52	3.1	86	3.1	97	3.3	118	3.3	136
115	-42.1	102.0	0.40	0.55	1.26	1.52	3.1	87	3.1	98	3.3	117	3.3	135
116	-42.3	102.0	0.40	0.55	1.26	1.52	3.1	86	3.1	97	3.3	118	3.3	137
117	-42.0	102.0	0.40	0.55	1.27	1.54	3.1	86	3.2	96	3.3	118	3.3	140
118	-41.6	102.0	0.40	0.55	1.25	1.53	3.1	86	3.1	97	3.3	117	3.3	135
119	-41.9	102.0	0.39	0.54	1.28	1.54	3.1	87	3.1	98	3.3	119	3.3	137
120	-41.1	102.0	0.40	0.56	1.29	1.56	3.1	85	3.1	95	3.3	116	3.3	136
121	-41.2	102.0	0.40	0.55	1.27	1.53	3.1	87	3.1	97	3.3	118	3.3	138
122	-41.1	102.0	0.39	0.55	1.06	1.53	3.1	86	3.1	97	3.3	118	3.3	137
123	-41.5	102.0	0.39	0.55	1.27	1.54	3.1	85	3.1	96	3.2	117	3.3	139
124	-41.4	102.0	0.39	0.55	1.27	1.54	3.1	85	3.1	96	3.3	117	3.3	135
125	-41.3	102.0	0.39	0.55	1.05	1.53	3.1	86	3.1	96	3.3	117	3.3	138
126	-41.1	102.0	0.39	0.55	1.05	1.53	3.1	86	3.1	97	3.3	118	3.3	137
127	-41.2	102.0	0.39	0.55	1.27	1.54	3.1	86	3.1	96	3.3	117	3.3	136
128	-41.1	102.0	0.39	0.55	1.03	1.51	3.1	86	3.1	97	3.3	118	3.3	138
Element Number	S_{LC} (dB)	TF (μs)	t_d (μs)	t_{-12} (μs)	t_{-20} (μs)	t_{-26} (μs)	$f_{c\text{-}6}$ (MHz)	BW_{-6} (%)	$f_{c\text{-}10}$ (MHz)	BW_{-10} (%)	$f_{c\text{-}20}$ (MHz)	BW_{-20} (%)	$f_{c\text{-}30}$ (MHz)	BW_{-30} (%)
Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Characteristic Loop Sensitivity S_{LC}		Normalized Loop Time Response $X(t)$				Wideband Loop Sensitivity $S_L(f)$							

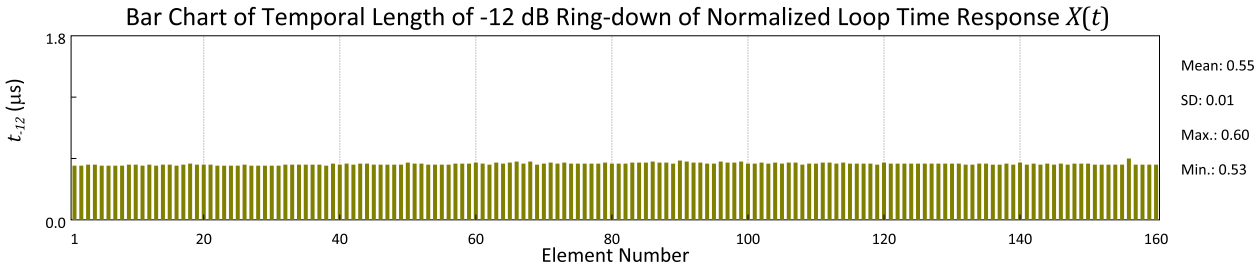
6) Data of measurement (cont'd)

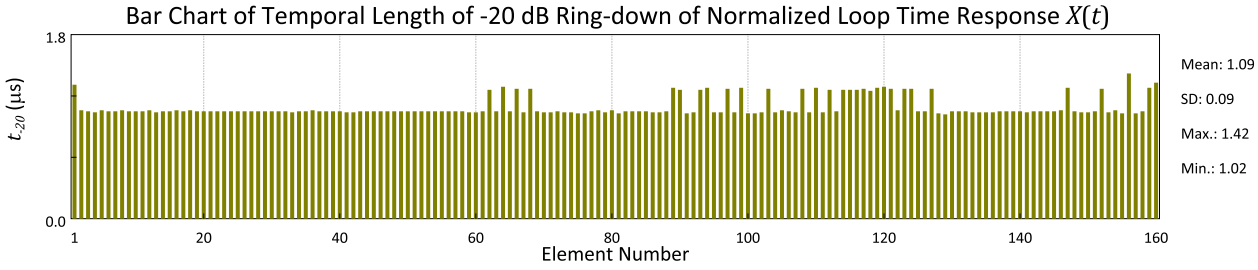
Item	Characteristic Loop Sensitivity S_{LC}		Normalized Loop Time Response $X(t)$				Wideband Loop Sensitivity $S_L(f)$							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Element Number	S_{LC} (dB)	TF (μs)	t_d (μs)	t_{-12} (μs)	t_{-20} (μs)	t_{-26} (μs)	$f_{c\text{-}6}$ (MHz)	BW_{-6} (%)	$f_{c\text{-}10}$ (MHz)	BW_{-10} (%)	$f_{c\text{-}20}$ (MHz)	BW_{-20} (%)	$f_{c\text{-}30}$ (MHz)	BW_{-30} (%)
129	-41.3	102.0	0.39	0.55	1.02	1.51	3.1	86	3.1	98	3.2	118	3.3	138
130	-41.3	102.0	0.39	0.55	1.05	1.53	3.1	86	3.1	97	3.3	117	3.3	136
131	-41.4	102.0	0.39	0.55	1.05	1.51	3.1	86	3.1	97	3.3	117	3.3	137
132	-41.3	102.0	0.39	0.54	1.05	1.52	3.1	87	3.1	98	3.2	118	3.3	137
133	-41.8	102.0	0.38	0.54	1.04	1.52	3.1	86	3.1	97	3.3	118	3.3	139
134	-41.6	102.0	0.39	0.55	1.04	1.53	3.1	85	3.1	96	3.2	117	3.3	137
135	-41.3	102.0	0.39	0.55	1.04	1.52	3.1	86	3.1	97	3.2	117	3.3	137
136	-41.3	102.0	0.38	0.54	1.04	1.51	3.1	87	3.1	98	3.3	118	3.3	137
137	-41.5	102.0	0.39	0.54	1.05	1.50	3.1	86	3.1	97	3.3	118	3.3	137
138	-41.6	102.0	0.39	0.55	1.05	1.50	3.1	86	3.1	97	3.2	117	3.3	136
139	-41.6	102.0	0.39	0.54	1.05	1.51	3.1	86	3.1	97	3.3	118	3.3	138
140	-41.6	102.0	0.39	0.56	1.05	1.51	3.1	86	3.1	96	3.2	117	3.3	137
141	-41.9	102.0	0.38	0.54	1.04	1.50	3.1	86	3.1	97	3.3	118	3.3	138
142	-41.6	102.0	0.39	0.55	1.05	1.50	3.1	86	3.1	97	3.3	117	3.3	136
143	-41.6	102.0	0.39	0.54	1.05	1.52	3.1	87	3.1	98	3.3	118	3.3	136
144	-41.5	102.0	0.39	0.55	1.05	1.52	3.1	86	3.1	97	3.3	118	3.3	138
145	-41.5	102.0	0.39	0.54	1.05	1.51	3.1	86	3.1	97	3.2	118	3.3	137
146	-41.4	102.0	0.39	0.55	1.06	1.52	3.1	86	3.1	96	3.2	117	3.3	137
147	-41.3	102.0	0.39	0.54	1.28	1.53	3.1	86	3.1	97	3.3	117	3.3	137
148	-41.2	102.0	0.39	0.55	1.05	1.52	3.1	86	3.1	97	3.3	118	3.3	135
149	-41.2	102.0	0.39	0.55	1.04	1.52	3.1	86	3.1	97	3.3	118	3.3	137
150	-41.1	102.0	0.39	0.55	1.04	1.52	3.1	86	3.1	97	3.2	118	3.3	137
151	-41.2	102.0	0.38	0.54	1.05	1.54	3.1	86	3.1	97	3.3	118	3.3	136
152	-41.1	102.0	0.39	0.54	1.27	1.53	3.1	87	3.1	98	3.3	118	3.3	135
153	-41.3	102.0	0.38	0.54	1.04	1.52	3.1	87	3.1	98	3.3	119	3.3	138
154	-40.9	102.0	0.39	0.54	1.06	1.52	3.1	87	3.1	98	3.2	118	3.3	136
155	-41.1	102.0	0.38	0.54	1.03	1.49	3.1	87	3.1	99	3.3	119	3.3	136
156	-41.2	102.1	0.41	0.60	1.42	1.67	3.2	78	3.2	88	3.3	111	3.4	127
157	-41.3	102.0	0.37	0.54	1.03	1.50	3.1	87	3.1	98	3.3	119	3.3	139
158	-41.3	102.0	0.38	0.54	1.05	1.54	3.1	86	3.1	97	3.3	118	3.3	137
159	-41.2	102.0	0.39	0.54	1.28	1.54	3.1	86	3.1	97	3.3	118	3.3	136
160	-41.1	102.0	0.39	0.54	1.33	1.58	3.1	87	3.1	97	3.3	118	3.3	137
Element Number	S_{LC} (dB)	TF (μs)	t_d (μs)	t_{-12} (μs)	t_{-20} (μs)	t_{-26} (μs)	$f_{c\text{-}6}$ (MHz)	BW_{-6} (%)	$f_{c\text{-}10}$ (MHz)	BW_{-10} (%)	$f_{c\text{-}20}$ (MHz)	BW_{-20} (%)	$f_{c\text{-}30}$ (MHz)	BW_{-30} (%)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Item	Characteristic Loop Sensitivity S_{LC}		Normalized Loop Time Response $X(t)$				Wideband Loop Sensitivity $S_L(f)$							

7) Bar chart of measurement parameters

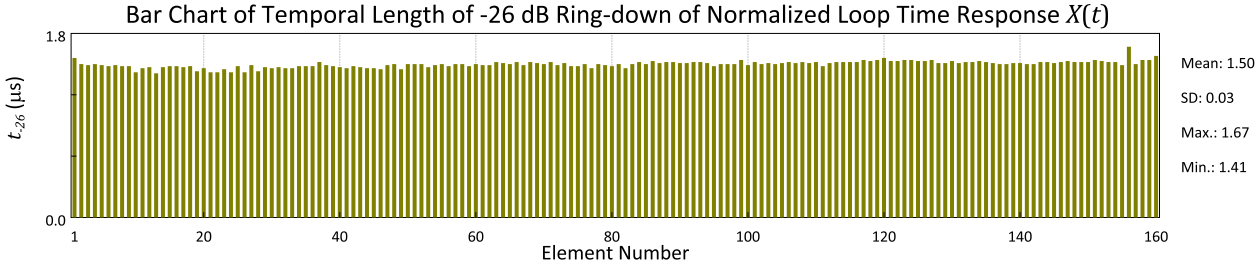








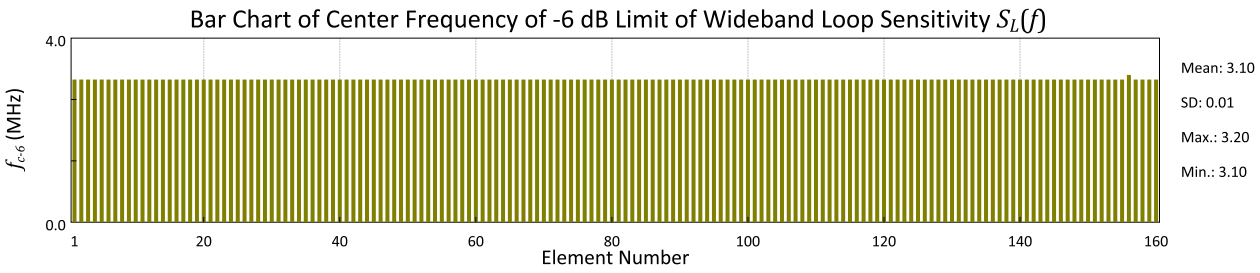
Note: t_{-20} would be more sensitive to system noises especially in the situation of low SNR

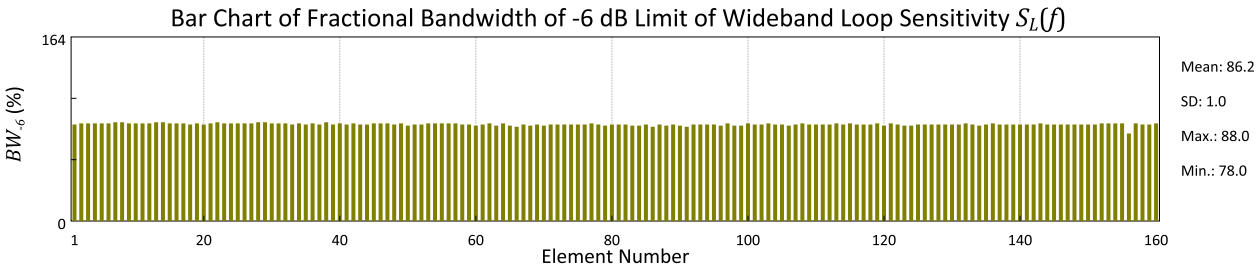


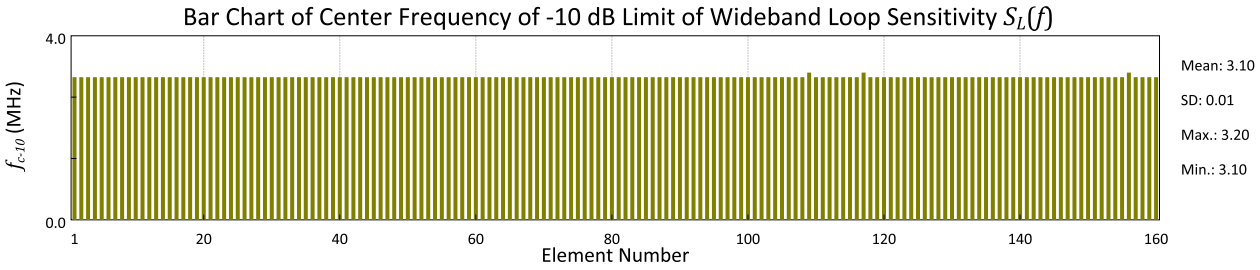
Note: t_{-26} would be more sensitive to system noises especially in the situation of low SNR

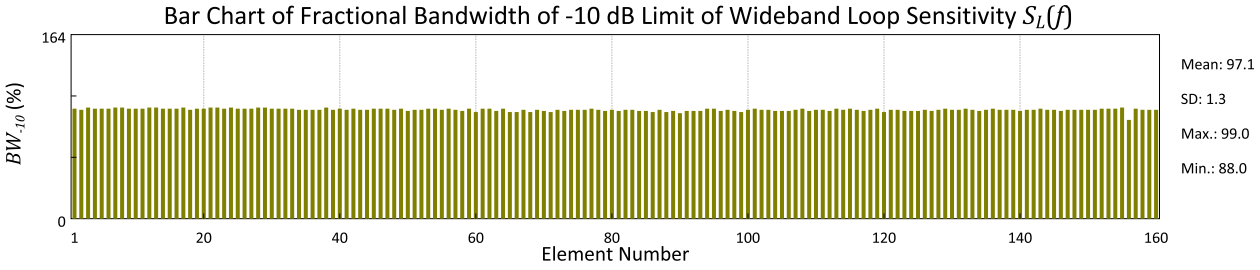
3. Intrinsic Characteristics Measurement (cont'd)

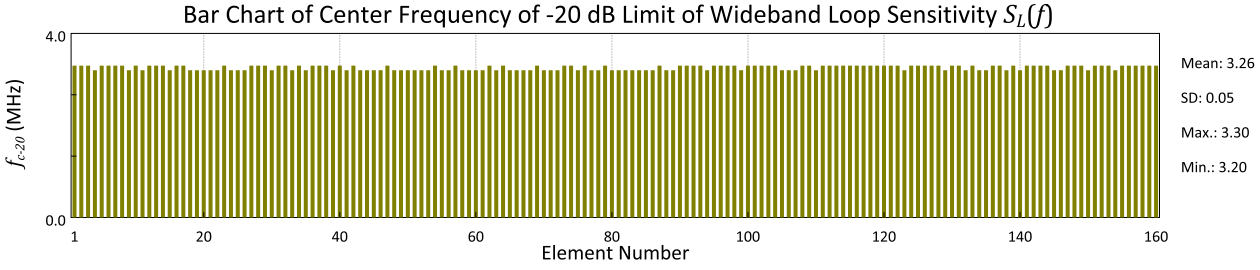
7) Bar chart of measurement parameters (cont'd)



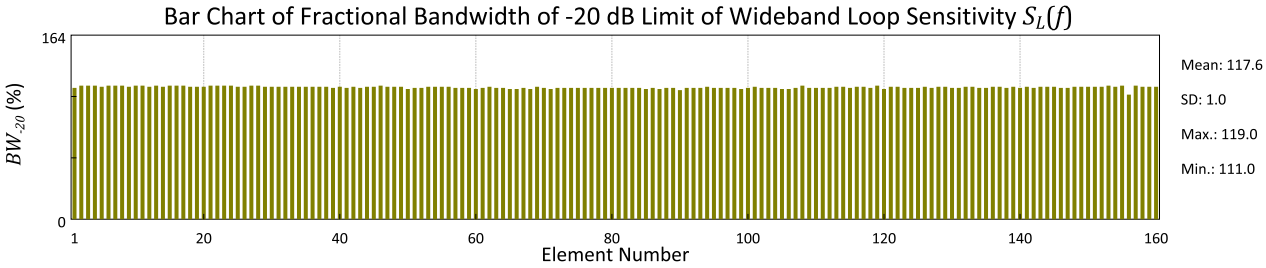


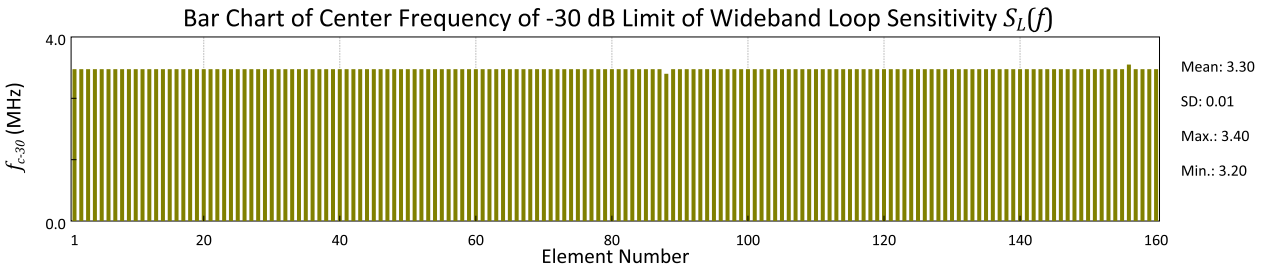




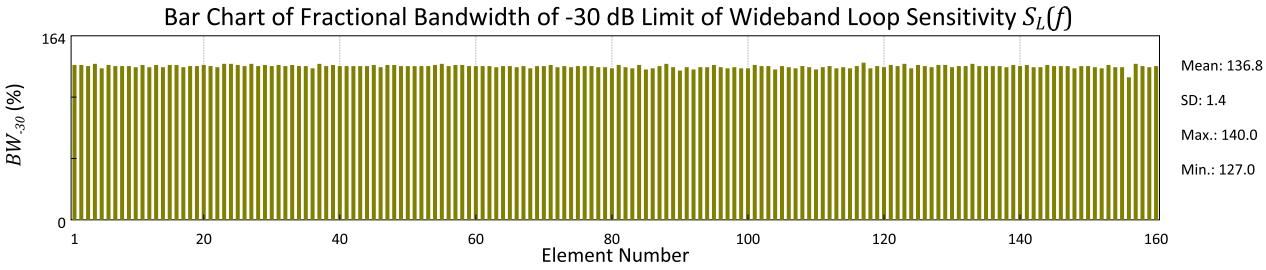


7) Bar chart of measurement parameters (cont'd)





Note: f_{c-30} would be more sensitive to system noises especially in the situation of low SNR



Note: BW_{-30} would be more sensitive to system noises especially in the situation of low SNR

4. Transmission Crosstalk Measurement with Optimum Drive Waveform Signal $B(t)$

1) Statistics

Parameter	XT (dB) ①									
	# - 5	# - 4	# - 3	# - 2	# - 1	# + 1	# + 2	# + 3	# + 4	# + 5
Mean	n/a	n/a	-50.1	-46.2	-37.1	-37.1	-46.3	-50.1	n/a	n/a
SD	n/a	n/a	0.8	0.4	0.2	0.2	0.4	0.8	n/a	n/a
Max.	n/a	n/a	-47.4	-44.9	-36.4	-36.4	-45.0	-47.3	n/a	n/a
Min.	n/a	n/a	-51.1	-47.2	-37.7	-37.7	-47.2	-51.1	n/a	n/a
Number of total elements	160									
Number of elements being analyzed	160									
XT : Transmission crosstalk across adjacent element										
① For the ultrasound probes with high voltage switch IC chips, the transmission crosstalk may be not obtainable on some elements.										

2) Excluded elements

Total number of excluded elements	0		
Auto-excluded element number	---	subtotal	0
Manually excluded element number	---	subtotal	0

Device Under Test (DUT)

Make	Model	No. of Elements	Type of Array	Radius of Curvature	Nominal Frequency	Serial Number
Philips	C5-1	160	Convex	R45	1 - 5 MHz	0336LN

4. Transmission Crosstalk Measurement with Optimum Drive Waveform Signal $B(t)$ (cont'd)

3) Data of measurement

Transmission Crosstalk Across Adjacent Element XT (dB)										
# - 5	# - 4	# - 3	# - 2	# - 1	Element Number #	# + 1	# + 2	# + 3	# + 4	# + 5
n/a	n/a	n/a	n/a	n/a	1	-36.6	-45.8	-50.5	n/a	n/a
n/a	n/a	n/a	n/a	-36.6	2	-37.3	-46.3	-50.5	n/a	n/a
n/a	n/a	n/a	-45.9	-37.2	3	-37.1	-46.4	-50.7	n/a	n/a
n/a	n/a	-50.5	-46.3	-37.1	4	-37.0	-46.7	-50.6	n/a	n/a
n/a	n/a	-50.5	-46.5	-37.0	5	-37.2	-45.7	-50.6	n/a	n/a
n/a	n/a	-50.6	-46.7	-37.2	6	-37.1	-46.4	-50.6	n/a	n/a
n/a	n/a	-50.6	-45.6	-37.1	7	-37.2	-45.5	-50.6	n/a	n/a
n/a	n/a	-50.6	-46.4	-37.2	8	-37.1	-47.1	-50.9	n/a	n/a
n/a	n/a	-50.6	-45.4	-37.1	9	-37.3	-46.7	-51.0	n/a	n/a
n/a	n/a	-50.6	-47.1	-37.3	10	-37.7	-46.8	-50.2	n/a	n/a
n/a	n/a	-50.9	-46.7	-37.7	11	-37.5	-47.2	-50.8	n/a	n/a
n/a	n/a	-50.9	-46.8	-37.5	12	-37.6	-47.0	-51.0	n/a	n/a
n/a	n/a	-50.3	-47.2	-37.6	13	-37.3	-46.5	-50.8	n/a	n/a
n/a	n/a	-50.8	-47.0	-37.3	14	-37.5	-45.8	-51.1	n/a	n/a
n/a	n/a	-51.1	-46.5	-37.5	15	-37.6	-47.2	-50.4	n/a	n/a
n/a	n/a	-50.9	-45.8	-37.6	16	-37.4	-46.8	-50.6	n/a	n/a
n/a	n/a	-51.0	-47.2	-37.3	17	-37.5	-46.6	-51.0	n/a	n/a
n/a	n/a	-50.2	-46.7	-37.5	18	-37.4	-46.5	-48.0	n/a	n/a
n/a	n/a	-50.4	-46.7	-37.4	19	-37.5	-46.8	-50.5	n/a	n/a
n/a	n/a	-51.1	-46.5	-37.5	20	-37.5	-46.9	-50.9	n/a	n/a
n/a	n/a	-48.2	-46.9	-37.5	21	-37.2	-46.7	-50.3	n/a	n/a
n/a	n/a	-50.7	-46.8	-37.2	22	-37.3	-46.4	-50.7	n/a	n/a
n/a	n/a	-50.8	-46.7	-37.3	23	-37.2	-47.0	-50.7	n/a	n/a
n/a	n/a	-50.2	-46.4	-37.2	24	-37.1	-46.5	-49.7	n/a	n/a
n/a	n/a	-50.5	-47.0	-37.1	25	-37.2	-46.4	-50.5	n/a	n/a
n/a	n/a	-50.7	-46.5	-37.3	26	-37.1	-46.3	-50.6	n/a	n/a
n/a	n/a	-49.8	-46.4	-37.1	27	-37.3	-46.8	-50.4	n/a	n/a
n/a	n/a	-50.6	-46.3	-37.3	28	-37.1	-46.5	-50.5	n/a	n/a
n/a	n/a	-50.5	-46.7	-37.1	29	-37.1	-46.2	-50.6	n/a	n/a
n/a	n/a	-50.3	-46.5	-37.1	30	-37.2	-46.2	-50.5	n/a	n/a
n/a	n/a	-50.6	-46.2	-37.2	31	-37.2	-46.8	-50.2	n/a	n/a
n/a	n/a	-50.5	-46.2	-37.2	32	-37.1	-46.3	-47.8	n/a	n/a
n/a	n/a	-50.4	-46.8	-37.1	33	-36.9	-46.1	-50.3	n/a	n/a
n/a	n/a	-50.2	-46.4	-36.9	34	-36.9	-46.4	-50.5	n/a	n/a
n/a	n/a	-48.0	-46.1	-37.0	35	-37.1	-46.5	-50.5	n/a	n/a
n/a	n/a	-50.4	-46.4	-37.2	36	-37.5	-46.7	-50.4	n/a	n/a
n/a	n/a	-50.5	-46.5	-37.4	37	-37.5	-46.5	-50.9	n/a	n/a
n/a	n/a	-50.3	-46.7	-37.5	38	-37.1	-46.5	-50.6	n/a	n/a
n/a	n/a	-50.4	-46.5	-37.1	39	-36.9	-46.6	-50.8	n/a	n/a
n/a	n/a	-51.0	-46.6	-36.9	40	-37.2	-46.7	-50.7	n/a	n/a
n/a	n/a	-50.8	-46.7	-37.2	41	-37.3	-46.5	-50.2	n/a	n/a
n/a	n/a	-50.9	-46.7	-37.3	42	-37.6	-46.5	-50.7	n/a	n/a
n/a	n/a	-50.6	-46.5	-37.6	43	-37.5	-46.8	-50.5	n/a	n/a
n/a	n/a	-50.2	-46.5	-37.5	44	-37.5	-46.4	-47.9	n/a	n/a
n/a	n/a	-50.6	-46.7	-37.5	45	-37.2	-46.2	-50.5	n/a	n/a
n/a	n/a	-50.6	-46.5	-37.3	46	-37.1	-46.1	-50.6	n/a	n/a
n/a	n/a	-48.0	-46.2	-37.0	47	-37.3	-47.0	-50.6	n/a	n/a
n/a	n/a	-50.7	-46.0	-37.3	48	-37.3	-47.0	-50.5	n/a	n/a
n/a	n/a	-50.5	-47.0	-37.3	49	-37.4	-45.8	-50.1	n/a	n/a
n/a	n/a	-50.5	-46.9	-37.4	50	-37.2	-46.4	-50.0	n/a	n/a
n/a	n/a	-50.4	-45.8	-37.2	51	-37.1	-46.8	-50.6	n/a	n/a
n/a	n/a	-50.2	-46.4	-37.1	52	-37.1	-46.7	-49.2	n/a	n/a
n/a	n/a	-50.1	-46.8	-37.1	53	-37.4	-46.0	-50.7	n/a	n/a
n/a	n/a	-50.7	-46.7	-37.5	54	-37.2	-46.3	-50.4	n/a	n/a
n/a	n/a	-49.0	-46.0	-37.2	55	-37.2	-46.6	-50.4	n/a	n/a
n/a	n/a	-50.7	-46.4	-37.2	56	-37.1	-46.1	-48.4	n/a	n/a
n/a	n/a	-50.4	-46.6	-37.1	57	-37.2	-46.2	-50.4	n/a	n/a
n/a	n/a	-50.3	-46.2	-37.3	58	-36.9	-46.2	-48.5	n/a	n/a
n/a	n/a	-48.4	-46.3	-36.9	59	-37.3	-46.5	-50.5	n/a	n/a
n/a	n/a	-50.6	-46.2	-37.3	60	-37.2	-46.3	-50.6	n/a	n/a
n/a	n/a	-48.6	-46.5	-37.2	61	-37.1	-46.1	-50.5	n/a	n/a
n/a	n/a	-50.5	-46.2	-37.1	62	-37.1	-45.9	-50.8	n/a	n/a
n/a	n/a	-50.5	-46.1	-37.0	63	-37.2	-46.2	-50.4	n/a	n/a
n/a	n/a	-50.3	-45.9	-37.2	64	-37.1	-46.4	-48.6	n/a	n/a
# - 5	# - 4	# - 3	# - 2	# - 1	Element Number #	# + 1	# + 2	# + 3	# + 4	# + 5
Transmission Crosstalk Across Adjacent Element XT (dB)										

4. Transmission Crosstalk Measurement with Optimum Drive Waveform Signal $B(t)$ (cont'd)

3) Data of measurement (cont'd)

Transmission Crosstalk Across Adjacent Element XT (dB)										
# - 5	# - 4	# - 3	# - 2	# - 1	Element Number #	# + 1	# + 2	# + 3	# + 4	# + 5
n/a	n/a	-50.7	-46.1	-37.1	65	-37.1	-45.6	-50.2	n/a	n/a
n/a	n/a	-50.5	-46.5	-37.0	66	-37.1	-45.9	-49.1	n/a	n/a
n/a	n/a	-48.7	-45.5	-37.1	67	-37.1	-46.5	-50.2	n/a	n/a
n/a	n/a	-50.3	-45.9	-37.1	68	-37.4	-46.3	-49.9	n/a	n/a
n/a	n/a	-49.0	-46.5	-37.3	69	-37.2	-45.3	-50.0	n/a	n/a
n/a	n/a	-50.1	-46.2	-37.3	70	-36.7	-45.8	-47.7	n/a	n/a
n/a	n/a	-49.8	-45.2	-36.7	71	-36.9	-46.4	-49.9	n/a	n/a
n/a	n/a	-50.1	-45.8	-36.9	72	-36.8	-46.1	-47.9	n/a	n/a
n/a	n/a	-47.9	-46.4	-36.8	73	-37.2	-45.6	-50.2	n/a	n/a
n/a	n/a	-50.1	-46.1	-37.3	74	-37.0	-45.9	-50.6	n/a	n/a
n/a	n/a	-47.9	-45.6	-37.0	75	-37.3	-46.3	-49.8	n/a	n/a
n/a	n/a	-50.1	-45.8	-37.2	76	-37.1	-45.3	-49.2	n/a	n/a
n/a	n/a	-50.4	-46.3	-37.1	77	-37.3	-45.5	-50.6	n/a	n/a
n/a	n/a	-49.7	-45.2	-37.3	78	-37.1	-46.1	-48.0	n/a	n/a
n/a	n/a	-48.9	-45.4	-37.1	79	-37.1	-46.5	-50.4	n/a	n/a
n/a	n/a	-50.7	-46.1	-37.1	80	-37.1	-46.3	-49.8	n/a	n/a
n/a	n/a	-48.1	-46.5	-37.1	81	-37.0	-46.0	-49.8	n/a	n/a
n/a	n/a	-50.4	-46.3	-37.0	82	-37.1	-45.7	-50.3	n/a	n/a
n/a	n/a	-49.7	-45.9	-37.1	83	-37.2	-46.4	-50.3	n/a	n/a
n/a	n/a	-49.6	-45.7	-37.2	84	-37.1	-46.2	-49.0	n/a	n/a
n/a	n/a	-50.2	-46.4	-37.1	85	-36.8	-46.3	-49.9	n/a	n/a
n/a	n/a	-50.3	-46.2	-36.8	86	-37.1	-45.9	-50.1	n/a	n/a
n/a	n/a	-49.0	-46.3	-37.1	87	-37.0	-45.0	-50.0	n/a	n/a
n/a	n/a	-50.0	-45.9	-37.1	88	-37.2	-46.4	-49.5	n/a	n/a
n/a	n/a	-50.1	-44.9	-37.1	89	-36.9	-46.0	-50.3	n/a	n/a
n/a	n/a	-49.9	-46.4	-36.9	90	-36.9	-45.7	-47.3	n/a	n/a
n/a	n/a	-49.4	-46.1	-36.9	91	-37.2	-46.5	-50.4	n/a	n/a
n/a	n/a	-50.4	-45.7	-37.2	92	-37.0	-45.9	-49.8	n/a	n/a
n/a	n/a	-47.4	-46.4	-37.0	93	-36.9	-46.1	-50.2	n/a	n/a
n/a	n/a	-50.5	-45.9	-37.0	94	-36.9	-45.7	-49.7	n/a	n/a
n/a	n/a	-49.8	-46.1	-36.9	95	-37.1	-46.5	-50.2	n/a	n/a
n/a	n/a	-50.1	-45.6	-37.0	96	-37.0	-46.8	-50.3	n/a	n/a
n/a	n/a	-49.6	-46.3	-36.9	97	-37.5	-46.2	-49.5	n/a	n/a
n/a	n/a	-50.1	-46.8	-37.5	98	-36.9	-45.5	-47.6	n/a	n/a
n/a	n/a	-50.3	-46.3	-36.9	99	-36.9	-46.1	-49.0	n/a	n/a
n/a	n/a	-49.7	-45.6	-36.9	100	-36.8	-46.1	-49.9	n/a	n/a
n/a	n/a	-47.6	-46.1	-36.8	101	-37.2	-45.9	-50.2	n/a	n/a
n/a	n/a	-49.1	-46.1	-37.2	102	-37.2	-46.1	-50.4	n/a	n/a
n/a	n/a	-49.7	-45.9	-37.2	103	-36.9	-46.2	-50.1	n/a	n/a
n/a	n/a	-50.2	-46.0	-36.9	104	-37.3	-46.8	-47.8	n/a	n/a
n/a	n/a	-50.4	-46.3	-37.4	105	-37.0	-46.3	-50.5	n/a	n/a
n/a	n/a	-50.2	-46.8	-37.0	106	-37.1	-46.1	-50.1	n/a	n/a
n/a	n/a	-47.9	-46.3	-37.1	107	-37.3	-46.7	-49.9	n/a	n/a
n/a	n/a	-50.6	-46.1	-37.3	108	-37.4	-46.5	-50.4	n/a	n/a
n/a	n/a	-50.0	-46.7	-37.3	109	-37.1	-46.3	-50.5	n/a	n/a
n/a	n/a	-49.9	-46.5	-37.2	110	-36.8	-45.7	-48.4	n/a	n/a
n/a	n/a	-50.3	-46.3	-36.8	111	-37.0	-46.4	-50.0	n/a	n/a
n/a	n/a	-50.6	-45.7	-37.1	112	-36.7	-46.2	-50.3	n/a	n/a
n/a	n/a	-48.4	-46.5	-36.7	113	-36.9	-46.3	-50.3	n/a	n/a
n/a	n/a	-50.1	-46.1	-36.9	114	-36.8	-46.4	-50.7	n/a	n/a
n/a	n/a	-50.3	-46.3	-36.8	115	-37.1	-46.5	-50.2	n/a	n/a
n/a	n/a	-50.2	-46.3	-37.0	116	-37.1	-45.9	-50.0	n/a	n/a
n/a	n/a	-50.6	-46.4	-37.1	117	-37.2	-46.2	-50.4	n/a	n/a
n/a	n/a	-50.0	-46.0	-37.2	118	-36.9	-45.6	-48.4	n/a	n/a
n/a	n/a	-50.0	-46.2	-36.8	119	-36.9	-46.1	-50.1	n/a	n/a
n/a	n/a	-50.6	-45.7	-37.0	120	-37.0	-46.0	-50.5	n/a	n/a
n/a	n/a	-48.4	-46.1	-36.9	121	-36.9	-46.2	-49.7	n/a	n/a
n/a	n/a	-50.3	-46.0	-37.0	122	-37.1	-45.9	-50.2	n/a	n/a
n/a	n/a	-50.3	-46.2	-37.1	123	-37.0	-45.9	-50.3	n/a	n/a
n/a	n/a	-49.5	-45.9	-37.0	124	-36.9	-46.3	-50.2	n/a	n/a
n/a	n/a	-50.1	-45.9	-36.9	125	-36.9	-46.2	-50.2	n/a	n/a
n/a	n/a	-50.3	-46.3	-36.9	126	-36.9	-45.9	---	n/a	n/a
n/a	n/a	-50.3	-46.2	-36.9	127	-36.7	---	---	n/a	n/a
n/a	n/a	-50.4	-45.9	-36.7	128	---	---	---	n/a	n/a
# - 5	# - 4	# - 3	# - 2	# - 1	Element Number #	# + 1	# + 2	# + 3	# + 4	# + 5
Transmission Crosstalk Across Adjacent Element XT (dB)										

4. Transmission Crosstalk Measurement with Optimum Drive Waveform Signal $B(t)$ (cont'd)

3) Data of measurement (cont'd)

Transmission Crosstalk Across Adjacent Element XT (dB)										
# - 5	# - 4	# - 3	# - 2	# - 1	Element Number #	# + 1	# + 2	# + 3	# + 4	# + 5
n/a	n/a	---	---	---	129	-36.5	-45.8	-50.5	n/a	n/a
n/a	n/a	---	---	-36.5	130	-37.0	-46.2	-50.7	n/a	n/a
n/a	n/a	---	-45.9	-37.0	131	-36.7	-46.5	-50.2	n/a	n/a
n/a	n/a	-50.5	-46.2	-36.7	132	-37.1	-46.5	-50.6	n/a	n/a
n/a	n/a	-50.7	-46.5	-37.1	133	-37.2	-46.1	-50.5	n/a	n/a
n/a	n/a	-50.3	-46.4	-37.2	134	-37.0	-46.0	-50.5	n/a	n/a
n/a	n/a	-50.6	-46.0	-37.0	135	-36.8	-45.1	-50.6	n/a	n/a
n/a	n/a	-50.4	-46.0	-36.8	136	-36.7	-46.8	-50.6	n/a	n/a
n/a	n/a	-50.5	-45.1	-36.7	137	-37.0	-46.3	-50.7	n/a	n/a
n/a	n/a	-50.6	-46.8	-37.0	138	-37.2	-46.5	-50.2	n/a	n/a
n/a	n/a	-50.6	-46.3	-37.2	139	-37.1	-46.8	-50.5	n/a	n/a
n/a	n/a	-50.6	-46.5	-37.1	140	-37.3	-46.5	-50.5	n/a	n/a
n/a	n/a	-50.2	-46.8	-37.3	141	-37.1	-46.3	-50.6	n/a	n/a
n/a	n/a	-50.5	-46.6	-37.1	142	-37.2	-45.4	-50.7	n/a	n/a
n/a	n/a	-50.6	-46.3	-37.2	143	-36.9	-46.8	-50.1	n/a	n/a
n/a	n/a	-50.6	-45.4	-36.9	144	-37.1	-46.4	-50.2	n/a	n/a
n/a	n/a	-50.7	-46.7	-37.1	145	-36.8	-46.3	-50.5	n/a	n/a
n/a	n/a	-50.0	-46.4	-36.8	146	-36.9	-45.9	-48.0	n/a	n/a
n/a	n/a	-50.0	-46.3	-36.9	147	-36.7	-46.3	-50.3	n/a	n/a
n/a	n/a	-50.6	-45.9	-36.7	148	-36.8	-46.3	-50.6	n/a	n/a
n/a	n/a	-48.1	-46.4	-36.8	149	-36.9	-46.1	-50.2	n/a	n/a
n/a	n/a	-50.5	-46.3	-36.9	150	-36.9	-45.8	-50.5	n/a	n/a
n/a	n/a	-50.5	-46.1	-36.9	151	-36.7	-46.5	-50.4	n/a	n/a
n/a	n/a	-50.1	-45.7	-36.7	152	-36.6	-46.0	-49.4	n/a	n/a
n/a	n/a	-50.3	-46.5	-36.6	153	-36.7	-46.1	-50.5	n/a	n/a
n/a	n/a	-50.5	-46.1	-36.8	154	-36.5	-46.5	-50.5	n/a	n/a
n/a	n/a	-49.6	-46.1	-36.4	155	-37.1	-45.1	-50.2	n/a	n/a
n/a	n/a	-50.4	-46.5	-37.1	156	-37.4	-46.3	-49.8	n/a	n/a
n/a	n/a	-50.4	-45.1	-37.4	157	-36.6	-45.7	-49.9	n/a	n/a
n/a	n/a	-50.1	-46.4	-36.6	158	-36.5	-45.7	n/a	n/a	n/a
n/a	n/a	-49.9	-45.7	-36.5	159	-36.4	n/a	n/a	n/a	n/a
n/a	n/a	-49.9	-45.7	-36.4	160	n/a	n/a	n/a	n/a	n/a
# - 5	# - 4	# - 3	# - 2	# - 1	Element Number #	# + 1	# + 2	# + 3	# + 4	# + 5
Transmission Crosstalk Across Adjacent Element XT (dB)										

Ultrasound Transducer Assembly Analysis Report

5. Echo Measurement with Optimum Drive Waveform Signal $B(t)$

1) Statistics

Group	Insertion Gain of Echo IG_e		Echo Signal $V_e(t)$				Relative Energy Spectrum of Echo							
Item	1	2	3	4	5①	6①	7	8	9	10	11	12	13①	14①
Parameter	IG_e (dB)	TF (μs)	t_{de} (μs)	$t_{\text{-}12e}$ (μs)	$t_{\text{-}20e}$ (μs)	$t_{\text{-}26e}$ (μs)	$f_{c\text{-}6e}$ (MHz)	$BW_{\text{-}6e}$ (%)	$f_{c\text{-}10e}$ (MHz)	$BW_{\text{-}10e}$ (%)	$f_{c\text{-}20e}$ (MHz)	$BW_{\text{-}20e}$ (%)	$f_{c\text{-}30e}$ (MHz)	$BW_{\text{-}30e}$ (%)
Mean	-40.8	102.4	0.50	0.65	1.29	1.59	3.0	77	3.0	88	3.1	107	3.1	122
SD	0.3	0.0	0.01	0.00	0.06	0.06	0.0	1	0.0	1	0.0	1	0.0	1
Max.	-40.3	102.4	0.51	0.66	1.40	1.76	3.1	79	3.1	89	3.2	108	3.2	124
Min.	-41.4	102.3	0.45	0.64	1.11	1.45	3.0	70	3.0	82	3.1	100	3.1	115
Number of total elements			160											
Number of elements being analyzed			160											

1. IG_e: Insertion gain of echo
2. TF: Time of flight or round-trip acoustic traveling time between transducer and acoustic mirror in degassed water bath
3. t_{de}: Temporal duration of echo signal $V_e(t)$
4. $t_{\text{-}12e}$:Temporal length of -12 dB ring-down of echo signal $V_e(t)$
5. $t_{\text{-}20e}$:Temporal length of -20 dB ring-down of echo signal $V_e(t)$
6. $t_{\text{-}26e}$:Temporal length of -26 dB ring-down of echo signal $V_e(t)$
7. $f_{c\text{-}6e}$: Center frequency of -6 dB limit for relative energy spectrum of echo
8. $BW_{\text{-}6e}$: Fractional bandwidth of -6 dB limit for relative energy spectrum of echo
9. $f_{c\text{-}10e}$: Center frequency of -10 dB limit for relative energy spectrum of echo
10. $BW_{\text{-}10e}$:Fractional bandwidth of -10 dB limit for relative energy spectrum of echo
11. $f_{c\text{-}20e}$: Center frequency of -20 dB limit for relative energy spectrum of echo
12. $BW_{\text{-}20e}$:Fractional bandwidth of -20 dB limit for relative energy spectrum of echo
13. $f_{c\text{-}30e}$: Center frequency of -30 dB limit for relative energy spectrum of echo
14. $BW_{\text{-}30e}$:Fractional bandwidth of -30 dB limit for relative energy spectrum of echo

① Note that due to the nature of definition itself, the parameters $t_{\text{-}20e}$, $t_{\text{-}26e}$, $f_{c\text{-}30e}$, and $BW_{\text{-}30e}$ may be prone to be contaminated by system noise; that is, the parameters $t_{\text{-}20e}$, $t_{\text{-}26e}$, $f_{c\text{-}30e}$, and $BW_{\text{-}30e}$ would be more sensitive to system noises in the situation of low SNR (signal-to-noise ratio).

2) Excluded elements

Total number of excluded elements	0		
Auto-excluded element number	---	subtotal	0
Manually excluded element number	---	subtotal	0

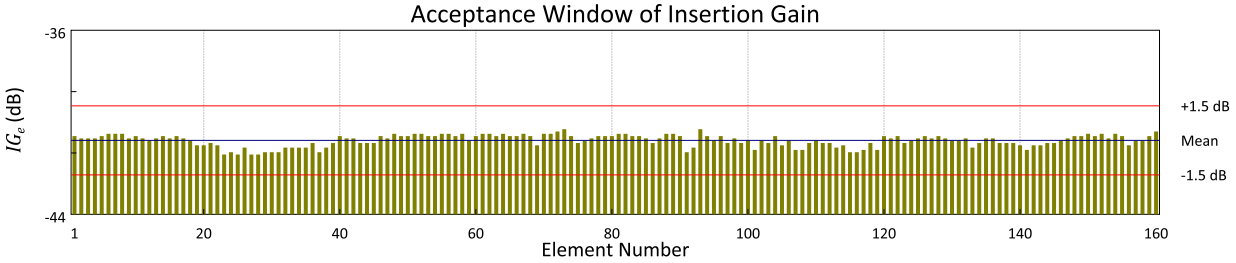
3) Uniformity of insertion gain IG_e across elements being analyzed

3.1) Coefficient of variation (*CV*) of insertion gain of echo IG_e

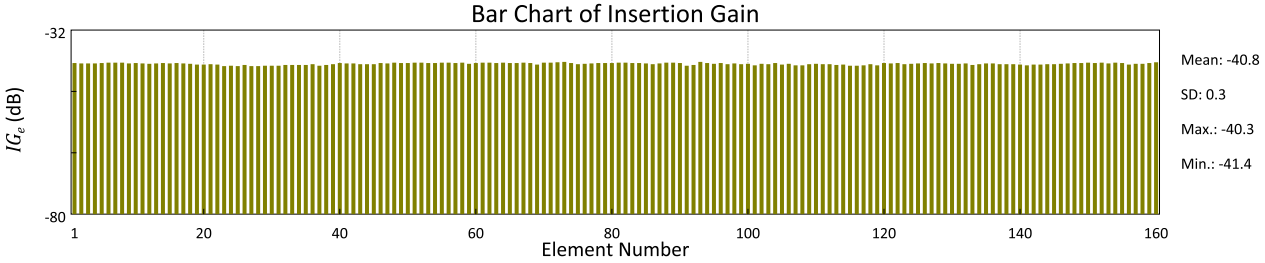
Coefficient of Variation (*CV*) of IG_e	0.62 % (< 3 %)

① The *CV* (coefficient of variation) describes the SD as a percentage of the mean, as given by: *CV* = (SD / mean) X 100 (%)
② Note that the "0.0% of *CV*" means perfect uniformity across elements.

3.2) Acceptance window of insertion gain of echo IG_e



3.3) Bar chart of insertion gain of echo IG_e



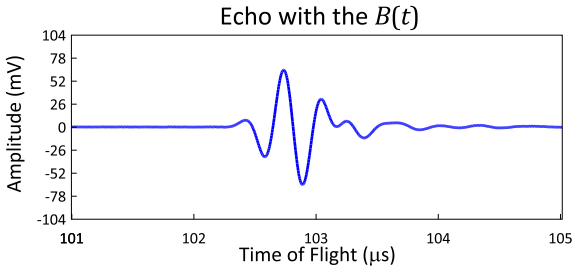
Device Under Test (DUT)

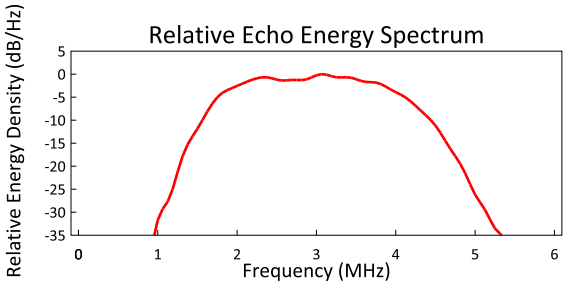
Make	Model	No. of Elements	Type of Array	Radius of Curvature	Nominal Frequency	Serial Number
Philips	C5-1	160	Convex	R45	1 - 5 MHz	0336LN

5. Echo Measurement with Optimum Drive Waveform Signal $B(t)$ (cont'd)

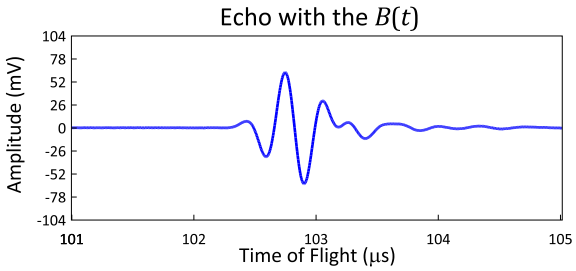
4) Relevant echo and relative energy spectrum of echo of selected elements

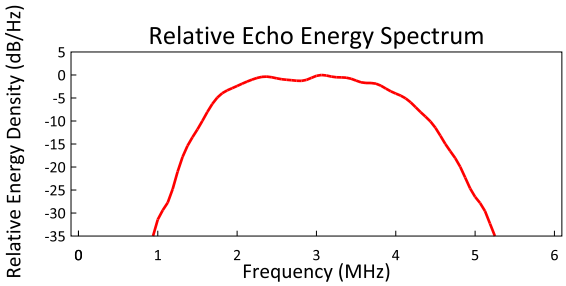
Element number: #10



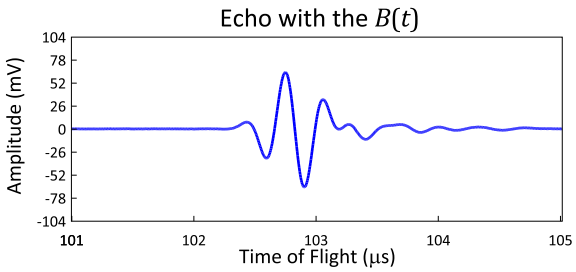


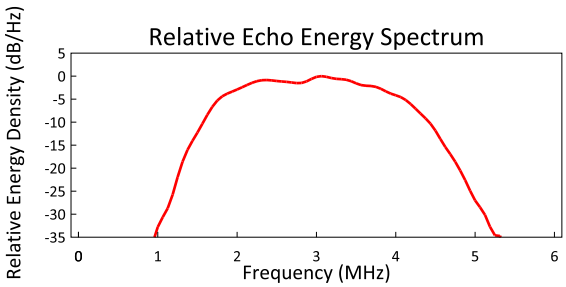
Element number: #45



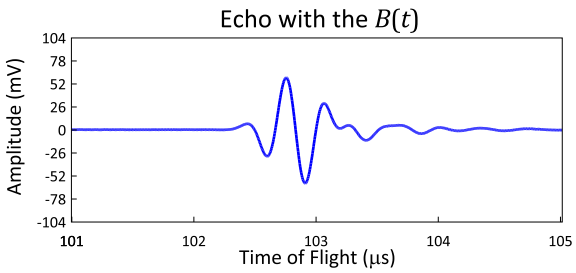


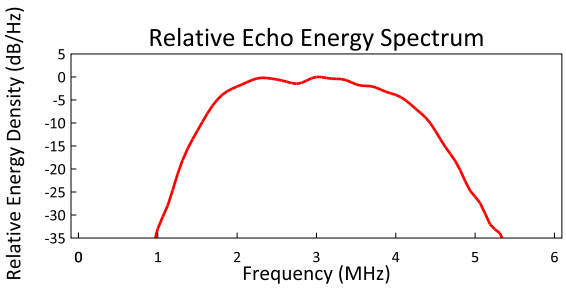
Element number: #80



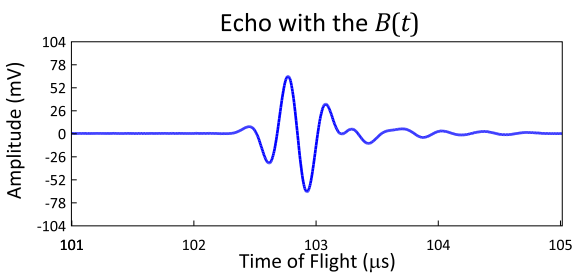


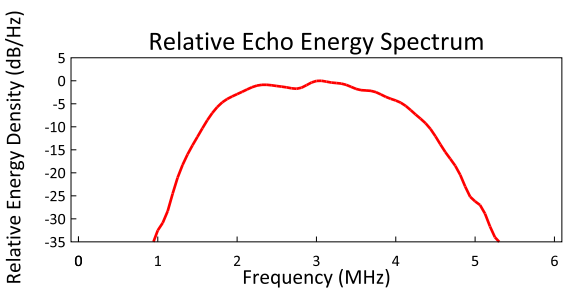
Element number: #115





Element number: #150





5. Echo Measurement with Optimum Drive Waveform Signal $B(t)$ (cont'd)

5) Data of measurement

Item	Insertion Gain of Echo IG_e		Echo Signal $V_e(t)$				Relative Echo Energy Spectrum							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Element Number	IG_e (dB)	TF (μs)	t_{de} (μs)	t_{-12e} (μs)	t_{-20e} (μs)	t_{-26e} (μs)	$f_{c\text{-}6e}$ (MHz)	BW_{-6e} (%)	$f_{c\text{-}10e}$ (MHz)	BW_{-10e} (%)	$f_{c\text{-}20e}$ (MHz)	BW_{-20e} (%)	$f_{c\text{-}30e}$ (MHz)	BW_{-30e} (%)
1	-40.6	102.4	0.51	0.64	1.37	1.65	3.0	77	3.0	88	3.1	107	3.1	123
2	-40.7	102.4	0.50	0.65	1.33	1.59	3.0	78	3.0	88	3.1	108	3.1	121
3	-40.7	102.4	0.50	0.64	1.30	1.58	3.0	77	3.1	88	3.1	108	3.1	123
4	-40.7	102.4	0.50	0.65	1.29	1.60	3.0	78	3.1	88	3.1	107	3.1	122
5	-40.6	102.4	0.50	0.64	1.31	1.57	3.0	77	3.0	88	3.1	108	3.1	123
6	-40.5	102.4	0.50	0.64	1.29	1.56	3.0	78	3.1	88	3.1	108	3.1	123
7	-40.5	102.4	0.50	0.64	1.30	1.57	3.0	79	3.1	89	3.1	108	3.1	123
8	-40.5	102.4	0.50	0.65	1.31	1.55	3.0	78	3.1	89	3.1	108	3.1	123
9	-40.7	102.4	0.50	0.65	1.28	1.55	3.0	78	3.0	88	3.1	108	3.1	123
10	-40.6	102.4	0.50	0.65	1.28	1.47	3.0	78	3.0	89	3.1	108	3.1	123
11	-40.7	102.4	0.50	0.65	1.28	1.51	3.0	78	3.1	89	3.1	108	3.1	123
12	-40.8	102.4	0.50	0.65	1.27	1.47	3.0	77	3.1	88	3.1	108	3.1	123
13	-40.7	102.3	0.50	0.64	1.12	1.45	3.0	78	3.1	89	3.1	108	3.1	123
14	-40.6	102.4	0.50	0.65	1.30	1.55	3.0	78	3.1	88	3.1	108	3.1	122
15	-40.7	102.3	0.50	0.64	1.30	1.56	3.0	78	3.1	88	3.1	108	3.1	123
16	-40.6	102.4	0.50	0.64	1.32	1.56	3.0	78	3.1	89	3.1	108	3.1	123
17	-40.7	102.4	0.50	0.65	1.29	1.55	3.0	78	3.1	89	3.1	108	3.1	123
18	-40.8	102.4	0.51	0.65	1.29	1.46	3.0	77	3.0	88	3.1	107	3.1	123
19	-41.0	102.4	0.50	0.65	1.28	1.47	3.0	77	3.0	88	3.1	107	3.1	123
20	-41.0	102.4	0.50	0.65	1.27	1.52	3.0	77	3.1	88	3.1	107	3.1	123
21	-40.9	102.4	0.50	0.65	1.13	1.45	3.0	78	3.0	89	3.1	108	3.1	123
22	-41.0	102.4	0.50	0.65	1.13	1.46	3.0	78	3.0	89	3.1	108	3.1	123
23	-41.4	102.4	0.50	0.65	1.30	1.56	3.0	78	3.0	89	3.1	108	3.1	124
24	-41.3	102.4	0.50	0.65	1.12	1.52	3.0	78	3.0	89	3.1	108	3.1	123
25	-41.4	102.4	0.50	0.65	1.28	1.48	3.0	78	3.0	88	3.1	108	3.1	123
26	-41.1	102.4	0.50	0.65	1.27	1.46	3.0	78	3.0	88	3.1	107	3.1	122
27	-41.4	102.4	0.50	0.65	1.29	1.57	3.0	78	3.1	88	3.1	108	3.1	124
28	-41.4	102.4	0.50	0.65	1.31	1.52	3.0	78	3.0	89	3.1	108	3.1	123
29	-41.3	102.4	0.50	0.64	1.31	1.59	3.0	79	3.1	89	3.1	108	3.1	123
30	-41.3	102.4	0.50	0.65	1.30	1.57	3.0	78	3.0	89	3.1	108	3.1	123
31	-41.3	102.4	0.50	0.65	1.31	1.56	3.0	78	3.0	88	3.1	108	3.1	123
32	-41.1	102.4	0.50	0.65	1.29	1.57	3.0	77	3.1	88	3.1	108	3.1	123
33	-41.1	102.4	0.50	0.65	1.13	1.49	3.0	77	3.0	88	3.1	108	3.1	123
34	-41.1	102.4	0.50	0.64	1.29	1.58	3.0	77	3.1	88	3.1	107	3.1	122
35	-41.1	102.4	0.50	0.65	1.31	1.57	3.0	77	3.0	88	3.1	107	3.1	122
36	-40.9	102.4	0.50	0.65	1.31	1.57	3.0	77	3.0	88	3.1	107	3.1	122
37	-41.3	102.4	0.50	0.65	1.31	1.59	3.0	77	3.1	87	3.1	107	3.1	123
38	-41.1	102.4	0.50	0.65	1.31	1.59	3.0	78	3.1	89	3.1	108	3.2	122
39	-40.9	102.4	0.51	0.65	1.30	1.58	3.0	77	3.0	87	3.1	107	3.1	123
40	-40.6	102.4	0.50	0.65	1.31	1.56	3.0	77	3.0	88	3.1	107	3.1	122
41	-40.7	102.4	0.50	0.65	1.25	1.51	3.0	77	3.0	88	3.1	107	3.1	122
42	-40.7	102.4	0.50	0.64	1.30	1.57	3.0	78	3.1	88	3.1	107	3.1	123
43	-40.9	102.4	0.51	0.65	1.30	1.55	3.0	76	3.0	87	3.1	107	3.1	122
44	-40.9	102.4	0.50	0.65	1.12	1.51	3.0	77	3.0	88	3.1	107	3.1	122
45	-40.9	102.4	0.50	0.65	1.28	1.47	3.0	78	3.0	88	3.1	108	3.1	123
46	-40.6	102.4	0.50	0.65	1.30	1.50	3.0	77	3.0	88	3.1	107	3.1	122
47	-40.7	102.4	0.50	0.65	1.31	1.56	3.0	78	3.1	88	3.1	107	3.1	123
48	-40.5	102.4	0.50	0.65	1.29	1.56	3.0	77	3.0	88	3.1	107	3.1	123
49	-40.6	102.4	0.50	0.65	1.29	1.55	3.0	77	3.0	88	3.1	108	3.1	122
50	-40.6	102.4	0.51	0.65	1.29	1.57	3.0	76	3.0	87	3.1	107	3.1	121
51	-40.5	102.4	0.51	0.65	1.30	1.57	3.0	77	3.0	88	3.1	107	3.1	122
52	-40.5	102.4	0.51	0.65	1.30	1.58	3.0	76	3.0	87	3.1	107	3.1	121
53	-40.6	102.4	0.50	0.65	1.30	1.55	3.0	77	3.1	88	3.1	107	3.1	122
54	-40.6	102.4	0.51	0.65	1.31	1.58	3.0	77	3.0	88	3.1	107	3.1	122
55	-40.5	102.4	0.50	0.65	1.30	1.58	3.0	77	3.1	88	3.1	107	3.1	122
56	-40.5	102.4	0.50	0.65	1.30	1.55	3.0	77	3.0	88	3.1	107	3.1	122
57	-40.6	102.4	0.50	0.65	1.29	1.57	3.0	77	3.1	88	3.1	107	3.1	122
58	-40.5	102.4	0.50	0.65	1.31	1.58	3.0	77	3.0	88	3.1	107	3.1	122
59	-40.8	102.4	0.50	0.65	1.29	1.55	3.0	77	3.0	88	3.1	107	3.1	122
60	-40.6	102.4	0.50	0.65	1.29	1.59	3.0	76	3.0	87	3.1	107	3.1	121
61	-40.5	102.4	0.50	0.65	1.31	1.59	3.0	77	3.0	88	3.1	107	3.1	122
62	-40.5	102.4	0.50	0.65	1.31	1.58	3.0	78	3.0	88	3.1	107	3.1	122
63	-40.6	102.4	0.51	0.65	1.32	1.62	3.0	76	3.0	87	3.1	107	3.1	121
64	-40.5	102.4	0.50	0.65	1.32	1.60	3.0	77	3.1	88	3.1	107	3.1	122
Element Number	IG_e (dB)	TF (μs)	t_{de} (μs)	t_{-12e} (μs)	t_{-20e} (μs)	t_{-26e} (μs)	$f_{c\text{-}6e}$ (MHz)	BW_{-6e} (%)	$f_{c\text{-}10e}$ (MHz)	BW_{-10e} (%)	$f_{c\text{-}20e}$ (MHz)	BW_{-20e} (%)	$f_{c\text{-}30e}$ (MHz)	BW_{-30e} (%)
Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Insertion Gain of Echo IG_e		Echo Signal $V_e(t)$				Relative Echo Energy Spectrum							

5. Echo Measurement with Optimum Drive Waveform Signal $B(t)$ (cont'd)

5) Data of measurement (cont'd)

Item	Insertion Gain of Echo IG_e		Echo Signal $V_e(t)$				Relative Echo Energy Spectrum							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Element Number	IG_e (dB)	TF (μs)	t_{de} (μs)	t_{-12e} (μs)	t_{-20e} (μs)	t_{-26e} (μs)	$f_{c\text{-}6e}$ (MHz)	BW_{-6e} (%)	$f_{c\text{-}10e}$ (MHz)	BW_{-10e} (%)	$f_{c\text{-}20e}$ (MHz)	BW_{-20e} (%)	$f_{c\text{-}30e}$ (MHz)	BW_{-30e} (%)
65	-40.6	102.4	0.51	0.65	1.31	1.61	3.0	76	3.0	87	3.1	106	3.1	121
66	-40.6	102.4	0.50	0.65	1.31	1.62	3.0	75	3.0	87	3.1	106	3.1	121
67	-40.5	102.4	0.50	0.65	1.29	1.58	3.0	77	3.0	88	3.1	107	3.1	123
68	-40.6	102.4	0.46	0.65	1.32	1.64	3.0	76	3.0	87	3.1	106	3.1	121
69	-41.0	102.4	0.51	0.66	1.32	1.64	3.0	77	3.0	87	3.1	107	3.1	122
70	-40.5	102.4	0.50	0.65	1.30	1.59	3.0	76	3.0	87	3.1	107	3.1	121
71	-40.5	102.4	0.50	0.65	1.29	1.61	3.0	76	3.0	87	3.1	106	3.1	122
72	-40.4	102.4	0.50	0.65	1.12	1.57	3.0	76	3.0	88	3.1	107	3.1	122
73	-40.3	102.4	0.50	0.65	1.12	1.59	3.0	77	3.0	88	3.1	107	3.1	122
74	-40.6	102.4	0.50	0.65	1.28	1.57	3.0	77	3.0	88	3.1	107	3.1	122
75	-40.9	102.4	0.50	0.65	1.12	1.58	3.0	77	3.0	88	3.1	107	3.1	122
76	-40.8	102.4	0.50	0.65	1.28	1.59	3.0	77	3.1	88	3.1	107	3.1	122
77	-40.7	102.4	0.50	0.65	1.29	1.57	3.0	77	3.0	88	3.1	107	3.1	122
78	-40.6	102.4	0.50	0.65	1.30	1.57	3.0	77	3.0	87	3.1	107	3.1	122
79	-40.6	102.4	0.50	0.65	1.12	1.58	3.0	76	3.1	88	3.1	107	3.1	122
80	-40.6	102.4	0.50	0.65	1.30	1.56	3.0	77	3.0	88	3.1	107	3.1	120
81	-40.5	102.4	0.50	0.65	1.11	1.58	3.0	77	3.1	88	3.1	107	3.1	122
82	-40.5	102.4	0.50	0.65	1.29	1.54	3.0	77	3.0	88	3.1	107	3.1	122
83	-40.6	102.4	0.50	0.65	1.30	1.57	3.0	76	3.0	87	3.1	107	3.1	121
84	-40.6	102.4	0.50	0.65	1.12	1.62	3.0	76	3.0	87	3.1	107	3.1	121
85	-40.7	102.4	0.47	0.65	1.29	1.60	3.0	76	3.0	87	3.1	107	3.1	121
86	-40.9	102.4	0.50	0.65	1.12	1.59	3.0	75	3.0	86	3.1	106	3.1	121
87	-40.7	102.4	0.50	0.65	1.29	1.60	3.0	77	3.0	88	3.1	107	3.1	122
88	-40.5	102.4	0.49	0.65	1.31	1.64	3.0	76	3.0	87	3.1	106	3.1	122
89	-40.5	102.4	0.49	0.65	1.33	1.60	3.0	76	3.0	87	3.1	107	3.1	121
90	-40.6	102.4	0.45	0.65	1.31	1.62	3.0	75	3.0	86	3.1	106	3.2	119
91	-41.3	102.4	0.46	0.65	1.27	1.67	3.0	75	3.0	87	3.1	106	3.2	121
92	-41.1	102.4	0.45	0.65	1.29	1.60	3.0	76	3.0	87	3.1	107	3.2	121
93	-40.3	102.4	0.45	0.65	1.32	1.62	3.0	77	3.1	88	3.1	107	3.2	120
94	-40.6	102.4	0.49	0.65	1.29	1.59	3.0	77	3.0	88	3.1	107	3.1	123
95	-40.8	102.4	0.49	0.65	1.30	1.60	3.0	77	3.0	88	3.1	107	3.1	123
96	-40.6	102.4	0.46	0.65	1.29	1.63	3.0	76	3.0	87	3.1	107	3.2	120
97	-40.9	102.4	0.46	0.65	1.32	1.61	3.0	78	3.0	88	3.1	108	3.1	122
98	-40.7	102.4	0.45	0.65	1.32	1.60	3.0	76	3.0	87	3.1	107	3.1	121
99	-40.9	102.4	0.46	0.65	1.30	1.62	3.0	77	3.0	87	3.1	107	3.1	122
100	-40.8	102.4	0.46	0.65	1.28	1.59	3.0	77	3.1	88	3.1	107	3.1	123
101	-41.2	102.4	0.49	0.65	1.27	1.59	3.0	76	3.1	87	3.1	107	3.1	123
102	-40.8	102.4	0.46	0.65	1.30	1.59	3.0	77	3.0	88	3.1	107	3.2	121
103	-40.9	102.4	0.47	0.65	1.34	1.63	3.0	77	3.0	88	3.1	107	3.1	121
104	-40.6	102.4	0.46	0.65	1.32	1.60	3.0	77	3.0	88	3.1	107	3.1	122
105	-41.0	102.4	0.50	0.65	1.32	1.57	3.0	76	3.0	88	3.1	107	3.1	121
106	-40.8	102.4	0.50	0.65	1.32	1.63	3.0	76	3.1	87	3.1	107	3.1	121
107	-41.2	102.4	0.49	0.65	1.27	1.58	3.0	76	3.0	88	3.1	107	3.1	122
108	-41.2	102.4	0.50	0.65	1.33	1.60	3.0	79	3.1	89	3.1	108	3.1	123
109	-40.9	102.4	0.50	0.65	1.32	1.68	3.0	76	3.1	88	3.1	107	3.2	121
110	-40.8	102.4	0.51	0.66	1.34	1.62	3.0	77	3.0	88	3.1	107	3.1	122
111	-40.9	102.4	0.50	0.65	1.27	1.56	3.0	77	3.0	88	3.1	107	3.1	121
112	-40.9	102.4	0.47	0.65	1.32	1.63	3.0	77	3.0	88	3.1	107	3.1	122
113	-41.1	102.4	0.50	0.65	1.31	1.60	3.0	78	3.0	89	3.1	108	3.1	123
114	-41.0	102.4	0.46	0.65	1.31	1.60	3.0	77	3.0	88	3.1	107	3.1	122
115	-41.3	102.4	0.47	0.65	1.33	1.64	3.0	78	3.0	89	3.1	107	3.1	121
116	-41.3	102.4	0.47	0.65	1.33	1.63	3.0	77	3.0	88	3.1	107	3.1	122
117	-41.2	102.4	0.50	0.65	1.33	1.63	3.0	78	3.1	88	3.1	107	3.2	123
118	-40.9	102.4	0.49	0.65	1.34	1.61	3.0	76	3.0	88	3.1	107	3.2	121
119	-41.2	102.4	0.50	0.65	1.34	1.63	3.0	78	3.1	88	3.1	107	3.1	123
120	-40.6	102.4	0.50	0.65	1.36	1.75	3.0	75	3.0	87	3.1	106	3.1	121
121	-40.7	102.4	0.50	0.65	1.33	1.62	3.0	78	3.0	88	3.1	107	3.2	121
122	-40.6	102.4	0.50	0.65	1.35	1.62	3.0	76	3.0	87	3.1	107	3.2	121
123	-40.9	102.4	0.51	0.65	1.33	1.74	3.0	76	3.0	87	3.1	107	3.1	120
124	-40.8	102.4	0.51	0.65	1.33	1.71	3.0	76	3.0	87	3.1	107	3.2	121
125	-40.7	102.4	0.50	0.65	1.34	1.64	3.0	77	3.0	87	3.1	107	3.1	121
126	-40.6	102.4	0.50	0.65	1.34	1.67	3.0	77	3.0	88	3.1	107	3.2	121
127	-40.7	102.4	0.50	0.65	1.34	1.64	3.0	76	3.0	88	3.1	107	3.1	122
128	-40.6	102.4	0.50	0.65	1.11	1.60	3.0	77	3.1	88	3.1	107	3.2	121
Element Number	IG_e (dB)	TF (μs)	t_{de} (μs)	t_{-12e} (μs)	t_{-20e} (μs)	t_{-26e} (μs)	$f_{c\text{-}6e}$ (MHz)	BW_{-6e} (%)	$f_{c\text{-}10e}$ (MHz)	BW_{-10e} (%)	$f_{c\text{-}20e}$ (MHz)	BW_{-20e} (%)	$f_{c\text{-}30e}$ (MHz)	BW_{-30e} (%)
Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Insertion Gain of Echo IG_e		Echo Signal $V_e(t)$				Relative Echo Energy Spectrum							

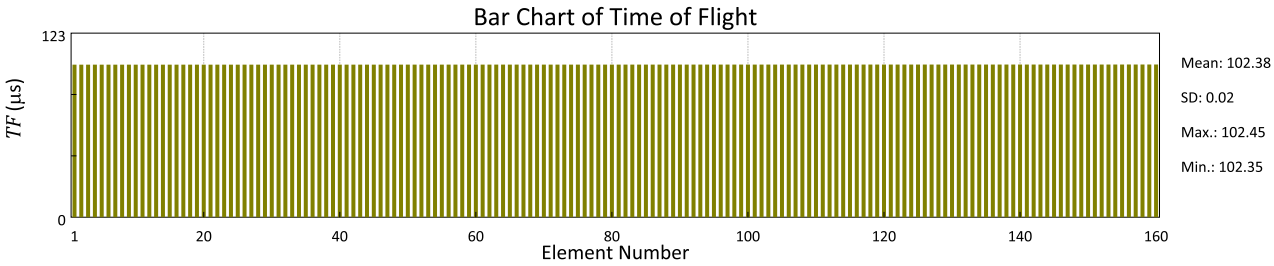
5. Echo Measurement with Optimum Drive Waveform Signal $B(t)$ (cont'd)

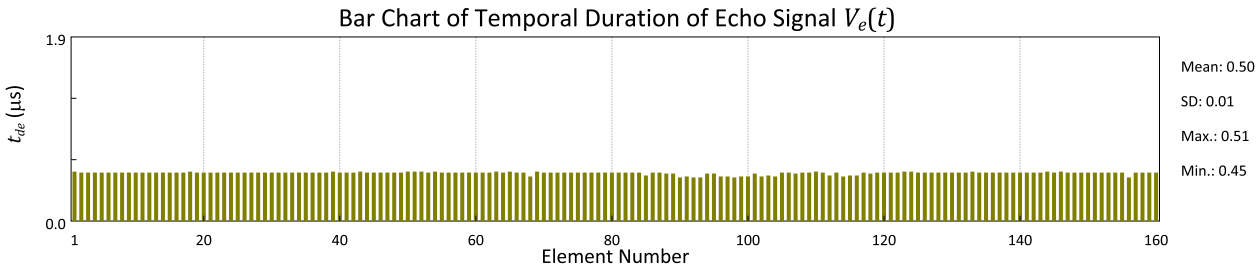
5) Data of measurement (cont'd)

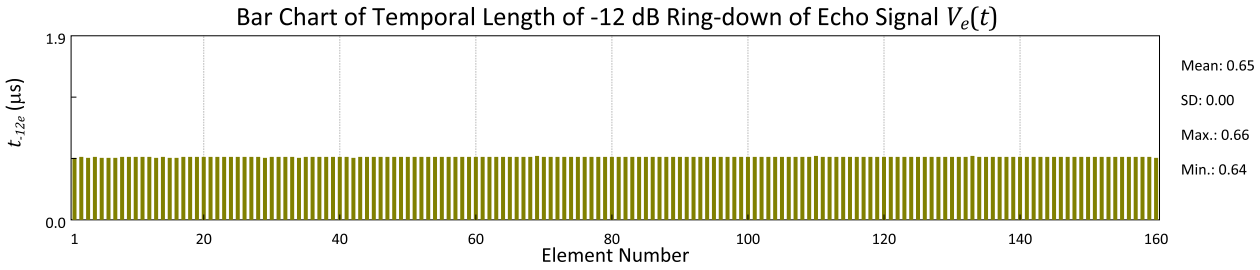
Item	Insertion Gain of Echo IG_e		Echo Signal $V_e(t)$				Relative Echo Energy Spectrum							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Element Number	IG_e (dB)	TF (μs)	t_{de} (μs)	t_{-12e} (μs)	t_{-20e} (μs)	t_{-26e} (μs)	$f_{c\text{-}6e}$ (MHz)	BW_{-6e} (%)	$f_{c\text{-}10e}$ (MHz)	BW_{-10e} (%)	$f_{c\text{-}20e}$ (MHz)	BW_{-20e} (%)	$f_{c\text{-}30e}$ (MHz)	BW_{-30e} (%)
129	-40.7	102.4	0.50	0.65	1.11	1.60	3.0	77	3.0	88	3.1	108	3.1	122
130	-40.8	102.4	0.50	0.65	1.32	1.68	3.0	76	3.0	88	3.1	107	3.2	121
131	-40.8	102.4	0.50	0.65	1.33	1.61	3.0	77	3.0	88	3.1	107	3.1	121
132	-40.7	102.4	0.50	0.65	1.33	1.62	3.0	78	3.0	89	3.1	108	3.2	121
133	-41.1	102.4	0.51	0.66	1.34	1.71	3.0	76	3.0	88	3.1	107	3.2	121
134	-40.9	102.4	0.50	0.65	1.32	1.72	3.0	76	3.0	87	3.1	107	3.1	121
135	-40.7	102.4	0.50	0.65	1.30	1.62	3.0	76	3.0	88	3.1	107	3.1	121
136	-40.7	102.4	0.50	0.65	1.33	1.61	3.0	77	3.0	89	3.1	108	3.2	121
137	-40.9	102.4	0.50	0.65	1.33	1.61	3.0	77	3.0	88	3.1	107	3.2	121
138	-40.9	102.4	0.50	0.65	1.33	1.59	3.0	76	3.0	88	3.1	107	3.1	122
139	-40.9	102.4	0.50	0.65	1.33	1.64	3.0	76	3.0	88	3.1	107	3.2	121
140	-41.0	102.4	0.50	0.65	1.32	1.61	3.0	76	3.0	88	3.1	107	3.1	122
141	-41.2	102.4	0.50	0.65	1.33	1.68	3.0	76	3.0	88	3.1	107	3.2	121
142	-41.0	102.4	0.50	0.65	1.33	1.59	3.0	76	3.0	88	3.1	107	3.1	121
143	-41.0	102.4	0.50	0.65	1.34	1.69	3.0	77	3.0	88	3.1	108	3.2	121
144	-40.9	102.4	0.51	0.65	1.33	1.62	3.0	77	3.0	88	3.1	107	3.1	122
145	-40.9	102.4	0.50	0.65	1.33	1.64	3.0	77	3.0	88	3.1	108	3.2	120
146	-40.8	102.4	0.51	0.65	1.34	1.62	3.0	76	3.0	87	3.1	107	3.1	121
147	-40.7	102.4	0.50	0.65	1.34	1.69	3.0	76	3.0	88	3.1	107	3.1	121
148	-40.6	102.4	0.50	0.65	1.32	1.61	3.0	76	3.0	88	3.1	107	3.1	121
149	-40.6	102.4	0.50	0.65	1.32	1.61	3.0	76	3.0	88	3.1	107	3.2	121
150	-40.5	102.4	0.50	0.65	1.33	1.67	3.0	76	3.0	88	3.1	107	3.2	121
151	-40.6	102.4	0.50	0.65	1.34	1.70	3.0	77	3.0	88	3.1	108	3.2	121
152	-40.5	102.4	0.50	0.65	1.34	1.64	3.0	77	3.0	88	3.1	108	3.1	122
153	-40.7	102.4	0.50	0.65	1.34	1.60	3.0	77	3.0	89	3.1	108	3.2	121
154	-40.5	102.4	0.50	0.65	1.34	1.60	3.0	77	3.0	88	3.1	108	3.1	121
155	-40.6	102.4	0.50	0.65	1.11	1.54	3.0	78	3.0	89	3.1	108	3.2	122
156	-41.0	102.4	0.45	0.65	1.21	1.76	3.1	70	3.1	82	3.2	100	3.2	115
157	-40.8	102.4	0.50	0.65	1.11	1.57	3.0	78	3.1	89	3.1	108	3.2	121
158	-40.8	102.4	0.50	0.65	1.32	1.72	3.0	76	3.0	88	3.1	108	3.2	122
159	-40.6	102.4	0.50	0.65	1.37	1.71	3.0	77	3.0	88	3.1	108	3.2	121
160	-40.4	102.4	0.50	0.64	1.40	1.73	3.0	77	3.0	88	3.1	107	3.2	121
Element Number	IG_e (dB)	TF (μs)	t_{de} (μs)	t_{-12e} (μs)	t_{-20e} (μs)	t_{-26e} (μs)	$f_{c\text{-}6e}$ (MHz)	BW_{-6e} (%)	$f_{c\text{-}10e}$ (MHz)	BW_{-10e} (%)	$f_{c\text{-}20e}$ (MHz)	BW_{-20e} (%)	$f_{c\text{-}30e}$ (MHz)	BW_{-30e} (%)
Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Insertion Gain of Echo IG_e		Echo Signal $V_e(t)$				Relative Echo Energy Spectrum							

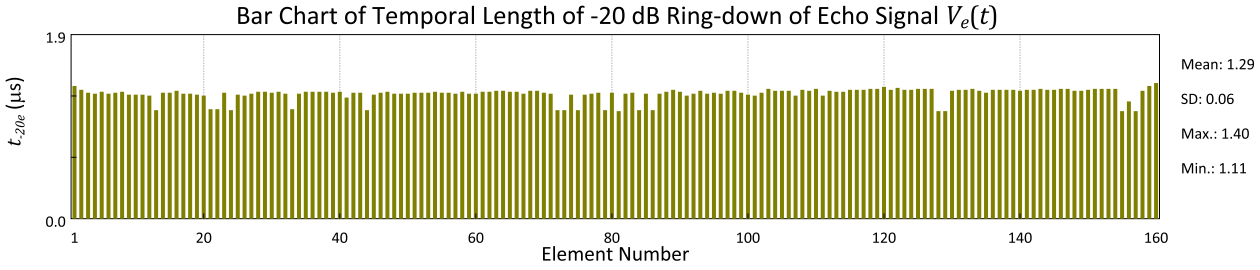
5. Echo Measurement with Optimum Drive Waveform Signal $B(t)$ (cont'd)

6) Bar chart of measurement parameters

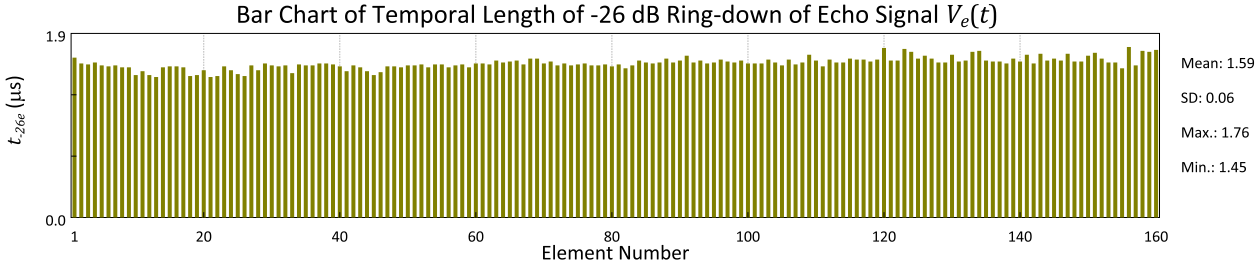








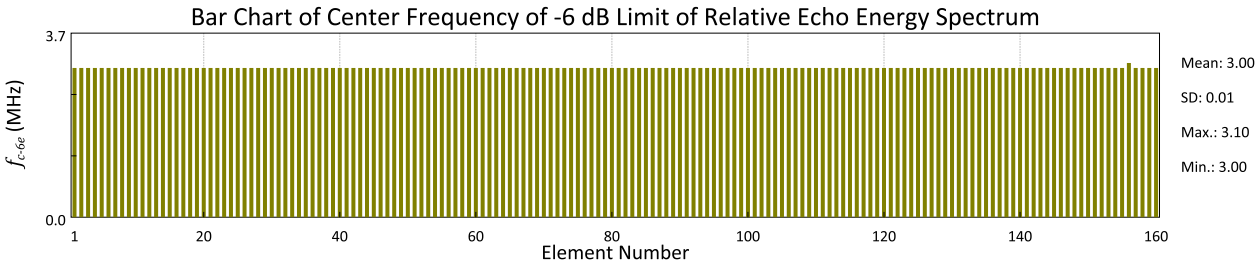
Note: t_{-20e} would be more sensitive to system noises especially in the situation of low SNR

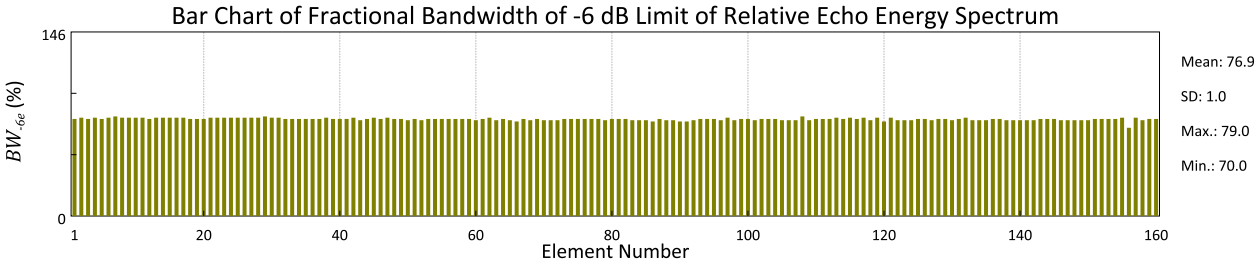


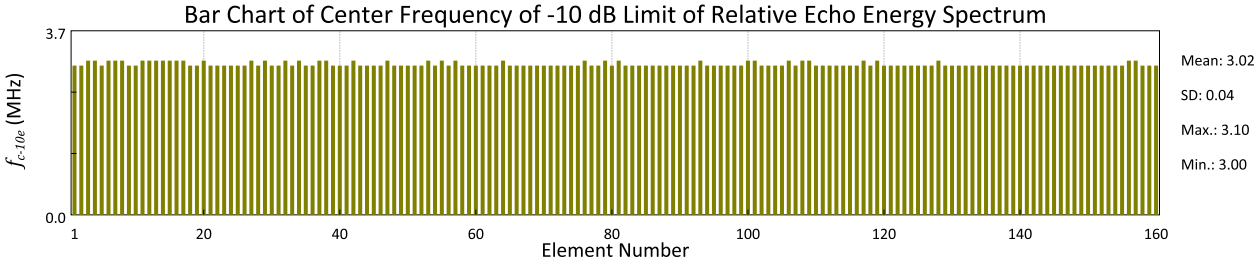
Note: t_{-26e} would be more sensitive to system noises especially in the situation of low SNR

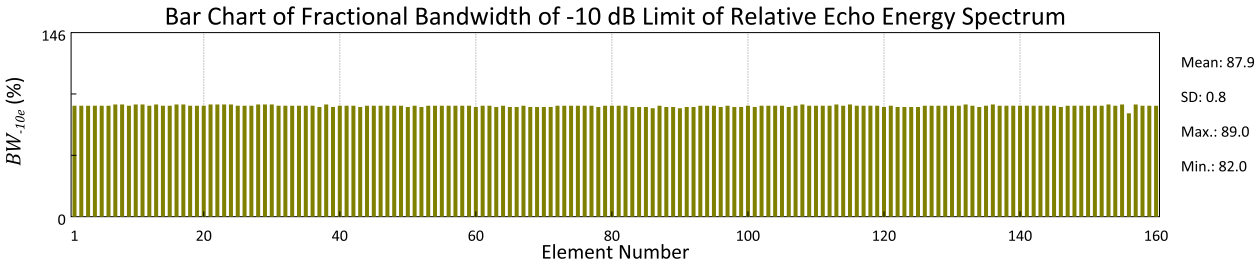
5. Echo Measurement with Optimum Drive Waveform Signal $B(t)$ (cont'd)

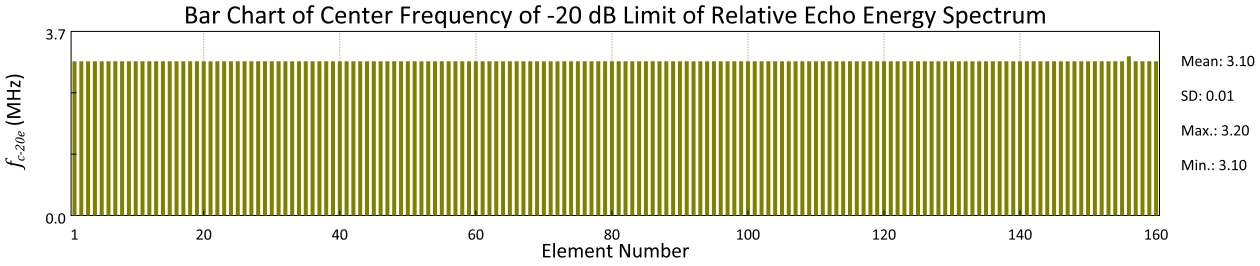
6) Bar chart of measurement parameters (cont'd)





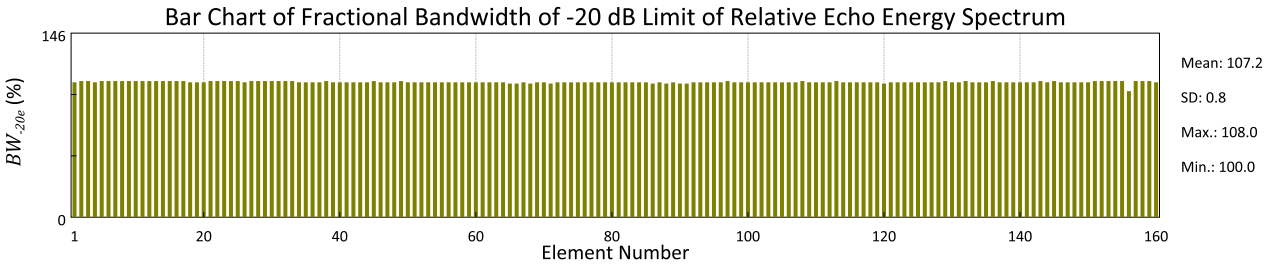


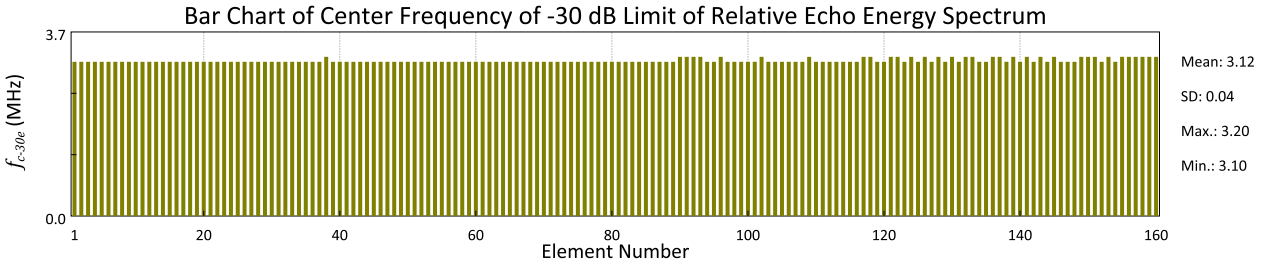




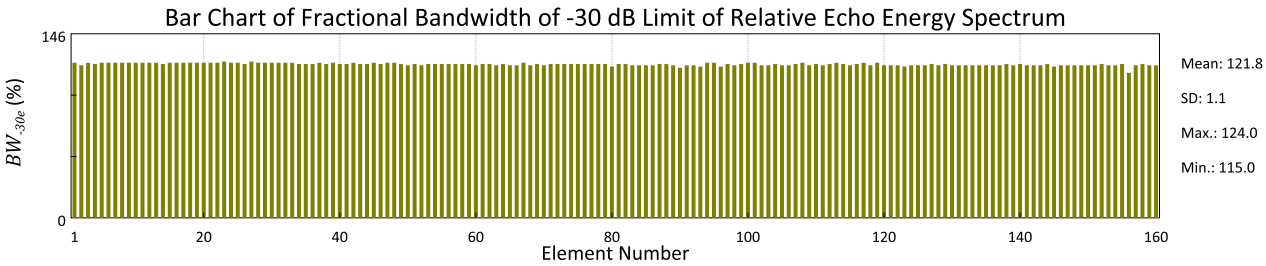
5. Echo Measurement with Optimum Drive Waveform Signal $B(t)$ (cont'd)

6) Bar chart of measurement parameters (cont'd)





Note: $f_{c\text{-}30e}$ would be more sensitive to system noises especially in the situation of low SNR



Note: BW_{-30e} would be more sensitive to system noises especially in the situation of low SNR

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