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TRACOR INC AUSTIN TEX

ANALYSIS OF TAPES RECORDED DURING SQS-26CX R/M BASELINE TEST.(U)

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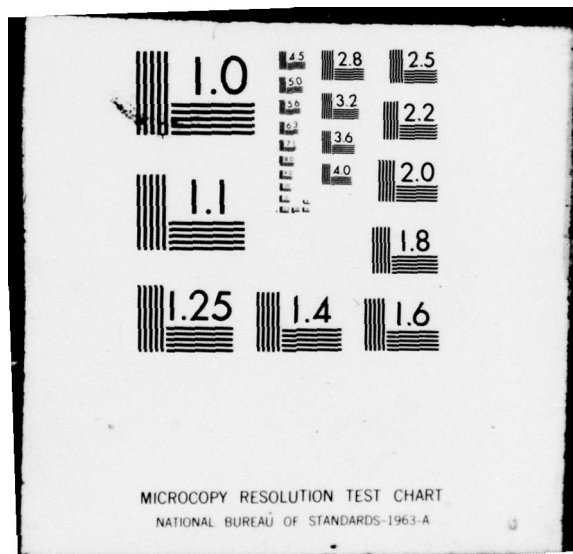
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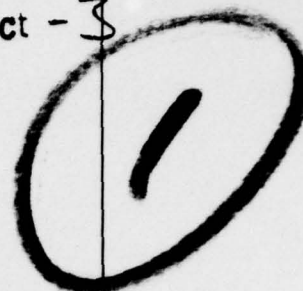
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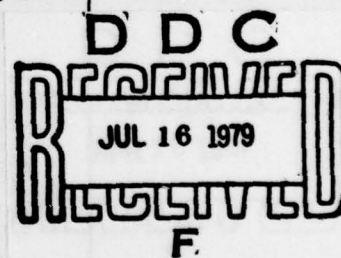


Technical Note

ANALYSIS OF TAPES RECORDED DURING
SQS-26CX R/M BASELINE TEST
(U)

Commander
Naval Ship Systems Command
Department of the Navy
Washington, D.C. 20360
Attention: J.D. Hodges, PMS-87

July 7, 1967



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INTRODUCTION

✓ The baseline tapes for the R/M test have been processed and analyzed by TRACOR, inc. to determine

1. ✓ Signal-to-noise ratios for the input records and
2. ✓ Signal-to-noise ratios at the output of the CW, CP, and ODT processors. ✓

The analog tapes were recorded with formats described in Data Acquisition and Analysis Notes For CX R/M Test, General Electric Technical Information Series No. R67EMH12. The format for the three modes are slightly different and will be described briefly below.

An initial and final input record are recorded at the beginning and end of each mode test. The input record consists of a series of recordings of signal only and then noise only which document the input SNR conditions to the CX system prior to and immediately following a test. For this purpose the 24 inputs to the beamformer are selected in four groups of six each for recording. Prior to recording, the inputs are passed through attenuators to shade for beamforming. The shading factors are presented in dB in the input record tables to follow.

In the CW mode test the input signal consists of a CW tone of 0.5 second duration repeated every three seconds. Two minutes of noise only and then two minutes of signal plus noise are recorded for each of the twelve CW variable depression beams.

The coded pulse (CP) mode test has an input signal which is a 100 Hz, 0.5 second duration, FM slide. This input signal also has a repetition rate of one per three seconds. Two minutes of signal plus noise are recorded for twelve beam outputs. No noise-only interval is provided for in the CP mode



since there is ample opportunity to obtain the required data on the noise statistics during the interpulse periods.

In the surface duct (ODT) mode test the input signal is a 100 ms CW tone with three-second repetition periods. One minute of noise only and two minutes of signal plus noise are recorded for each of the 72 beam outputs for the ODT test.

TRACOR, Inc. sampled the analog baseline test tapes and determined the signal-to-noise ratios from the digital data. For the mode tests the output signal-to-noise ratios, SNR_O , are defined by

$$SNR_O = 20 \log_{10} \left[\frac{\overline{P} - \overline{X}_N}{\sigma_N} \right],$$

where

$\overline{P}$ = average output at target response time, signal plus noise input,

$\overline{X}_N$ = average (dc) output, noise input only,

σ_N = rms deviation of output about $\overline{X}_N$, noise input only.

The signal-to-noise ratios for the input records were determined from

$$SNR_I = 20 \log_{10} \left[\frac{\sigma_S}{\sigma_N} \right],$$

where

σ_S = rms deviation about mean, signal only,

σ_N = rms deviation about mean, noise only.

The results of the analysis are presented in a tabular form in the technical note for

- | | |
|----------------|--------------------|
| 1. CW Run 106 | (Tables I, II) |
| 2. CP Run 212 | (Tables III, IV) |
| 3. CP Run 213 | (Tables V, VI) |
| 4. ODT Run 308 | (Tables VII, VIII) |
| 5. ODT Run 309 | (Tables VII, IX) |



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TABLE I. OUTPUT SIGNAL-TO-NOISE RATIOS
FOR CW RUN 106

Beam No.	S/N (dB)
1	22.7
5	22.1
9	22.2
2	21.1
6	22.8
10	21.9
3	20.7
7	23.5
11	21.9
4	23.1
8	22.9
12	21.6

(Average S/N is 22.1 dB)



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TABLE II. INPUT SIGNAL RECORD AND SHADING FACTORS FOR
CW RUN 106

	Initial Input Record (dB)	Final Input Record (dB)	Shading Factor (dB)
Line Group No. 1			
1	-4.43	-3.99	-4.70
2	-3.87	-3.63	-4.01
3	-3.14	-2.89	-3.30
4	-2.51	-2.03	-2.70
5	-1.54	-1.68	-2.10
6	-1.18	-1.41	-1.50
Line Group No. 2			
7	-0.47	-0.18	-1.00
8	-0.45	0.16	-0.60
9	-0.08	0.13	-0.24
10	0.35	0.40	0.0
11	0.18	0.60	0.0
12	0.24	0.59	0.0
Line Group No. 3			
13	0.28	0.71	0.0
14	0.27	0.51	0.0
15	0.38	0.53	0.0
16	-0.05	0.28	-0.24
17	-0.21	0.05	-0.60
18	-0.76	-0.33	-1.00
Line Group No. 4			
19	-1.30	-1.22	-1.50
20	-1.72	-1.59	-2.10
21	-2.21	-2.12	-2.70
22	-2.86	-3.07	-3.30
23	-3.85	-3.61	-4.01
24	-4.77	-4.22	-4.70



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TABLE III. OUTPUT SIGNAL-TO-NOISE RATIOS
FOR CP RUN 212

Beam No.	S/N (dB)
1	22.6
5	22.6
9	22.5
2	22.3
6	23.1
10	22.5
3	22.8
7	22.5
11	21.5
4	23.0
8	21.9
12	23.1

(Average S/N is 22.5 dB)



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TABLE IV. INPUT SIGNAL RECORD AND SHADING
FACTORS FOR CP RUN 212

	Initial Input Record (dB)	Final Input Record (dB)	Shading Factor (dB)
Line Group No. 1			
1	-4.28	-4.07	-4.70
2	-3.53	-3.81	-4.01
3	-2.81	-2.78	-3.30
4	-2.11	-1.95	-2.70
5	-1.74	-1.37	-2.10
6	-0.95	-1.61	-1.50
Line Group No. 2			
7	-0.60	-0.24	-1.00
8	-0.20	-0.05	-0.60
9	0.41	0.36	-0.24
10	0.43	0.61	0.0
11	0.63	0.79	0.0
12	0.40	0.56	0.0
Line Group No. 3			
13	0.38	0.28	0.0
14	0.57	0.47	0.0
15	0.53	0.37	0.0
16	0.15	0.18	-0.24
17	-0.33	-0.21	-0.60
18	-0.47	-0.69	-1.00
Line Group No. 4			
19	-1.17	-1.02	-1.50
20	-1.78	-1.87	-2.10
21	-2.14	-2.21	-2.70
22	-2.89	-2.99	-3.30
23	-3.82	-3.90	-4.01
24	-4.44	-4.38	-4.70



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TABLE V. OUTPUT SIGNAL-TO-NOISE RATIOS
FOR CP RUN 213

Beam No.	S/N (dB)
1	17.5
5	16.8
9	17.4
2	16.5
6	17.9
10	17.5
3	16.6
7	17.0
11	17.7
4	17.4
8	16.8
12	17.3

(Average S/N is 17.2 dB)



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TABLE VI. INPUT RECORD AND SHADING FACTORS
FOR CP RUN 213

	Initial Input Record (dB)	Final Input Record (dB)	Shading Factor (dB)
Line Group No. 1			
1	-4.40	-4.22	-4.70
2	-3.75	-3.61	-4.01
3	-2.97	-2.80	-3.30
4	-2.45	-2.28	-2.70
5	-1.66	-1.69	-2.10
6	-0.70	-0.40	-1.50
Line Group No. 2			
7	-0.73	-0.31	-1.00
8	-0.25	-0.07	-0.60
9	0.05	0.22	-0.24
10	0.46	0.52	0.0
11	0.32	0.70	0.0
12	0.33	0.49	0.0
Line Group No. 3			
13	0.38	0.58	0.0
14	0.42	0.59	0.0
15	0.32	0.66	0.0
16	-0.06	0.06	-0.24
17	-0.65	-0.38	-0.60
18	0.17	0.38	-1.00
Line Group No. 4			
19	-1.10	-0.94	-1.50
20	-1.71	-1.59	-2.10
21	-2.60	-2.14	-2.70
22	-3.16	-3.11	-3.30
23	-3.89	-3.53	-4.01
24	-4.77	-4.35	-4.70



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TABLE VII. OUTPUT SIGNAL-TO-NOISE RATIOS FOR
ODT RUNS 308 AND 309

Beam No.	S/N (dB)
1	24.6
2	25.3
3	24.9
4	25.0
5	25.2
6	25.1
7	25.4
8	25.3
9	24.7
10	25.2
11	25.4
12	25.3
13	25.8
14	25.2
15	25.0
16	25.1
17	25.7
18	24.9
19	24.8
20	24.7
21	26.0
22	25.0
23	26.4
24	25.7
25	24.8
26	24.6
27	25.4
28	25.5
29	25.5
30	25.2
31	26.1
32	25.2
33	26.0



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Continuation of Table VII

Beam No.	S/N (dB)
34	25.5
35	25.4
36	26.0
37	26.0
38	25.8
39	25.8
40	25.9
41	26.3
42	25.0
43	26.2
44	24.5
45	25.4
46	24.6
47	25.1
48	25.3
49	25.5
50	25.3
51	25.2
52	25.6
53	25.7
54	25.2
55	25.5
56	26.0
57	25.1
58	24.8
59	25.0
60	25.9
61	25.5
62	24.9
63	25.2
64	24.9
65	25.6
66	25.8
67	26.0



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Continuation of Table VII.

Beam No.	S/N (dB)
68	25.7
69	26.6
70	25.8
71	25.1
72	25.3

(Average S/N is 25.4 dB).



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TABLE VIII. INPUT SIGNAL RECORD FOR ODT RUN 308

	Initial Input Record (dB)	Final Input Record (dB)	Shading Factor (dB)
Line Group No. 1			
1	-4.40	-4.43	-4.70
2	-3.79	-3.84	-4.01
3	-3.19	-3.10	-3.30
4	-2.57	-2.49	-2.70
5	-1.92	-1.63	-2.10
6	-1.02	-0.53	-1.50
Line Group No. 2			
7	-0.59	-0.84	-1.00
8	-0.35	-0.30	-0.60
9	-0.05	0.30	-0.24
10	0.21	0.44	0.0
11	0.13	0.26	0.0
12	0.21	0.12	0.0
Line Group No. 3			
13	0.25	-0.01	0.0
14	0.20	0.50	0.0
15	0.41	0.50	0.0
16	-0.12	-0.19	-0.24
17	1.03	-0.61	-0.60
18	-0.26	-0.91	-1.00
Line Group No. 4			
19	-1.19	-1.26	-1.50
20	-2.05	-2.18	-2.10
21	-2.31	-2.02	-2.70
22	-3.36	-2.89	-3.30
23	-1.57	-3.84	-4.01
24	-4.66	-4.47	-4.70



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TABLE IX. INPUT SIGNAL RECORD FOR ODT RUN 309

	Initial Input Record (dB)	Final Input Record (dB)	Shading Factor (dB)
Line Group No. 1			
1	-4.35	-4.04	-4.70
2	-3.66	-3.56	-4.01
3	-2.88	-2.77	-3.30
4	-2.50	-2.02	-2.70
5	-1.76	-1.28	-2.10
6	-1.37	-1.43	-1.50
Line Group No. 2			
7	-0.79	-0.27	-0.60
8	-0.44	0.18	-0.24
9	-0.13	0.08	0.0
10	0.30	0.68	0.0
11	0.25	0.73	0.0
12	0.18	0.62	0.0
Line Group No. 3			
13	0.13	0.39	0.0
14	0.26	0.49	0.0
15	0.15	0.70	0.0
16	-0.17	0.30	-0.24
17	-1.56	-0.04	-0.60
18	-0.59	-0.51	-1.00
Line Group No. 4			
19	-1.33	-1.13	-1.50
20	-2.00	-2.13	-2.10
21	-2.66	-1.82	-2.70
22	-3.30	-2.62	-3.30
23	-3.97	-3.44	-4.01
24	-4.63	-3.97	-4.70