

INSTRUCTIONS: LUBELL LABS VC2C UNDERWATER SPEAKER



WARNING: FOR USE BY QUALIFIED OCEAN ENGINEER ONLY!

The Lubell Labs VC2C is an underwater acoustic transducer covering the frequency range of 50 Hz to 1500 Hz at a maximum sound pressure level of 174dB/uPa/m @ 115 Hz. Sales of the VC2C are limited to marine scientists and laboratories, ocean engineers, and the military.

- **Description:** Axial symmetric dual-piston radiator with spring copper diaphragms and external stops
- **Materials:** End plate assm - 316 stainless steel; Pistons/housing - Hardcoat anodized 6061 aluminum
- **Finish:** Safety yellow TGIC polyester powder coat
- **Frequency Range:** 50 Hz to 1.5 kHz
- **Resonant Frequency:** 115 Hz +/- 5 Hz
- **Impedance:** Varies with frequency (4 ohms min @ 50 Hz; 17 ohms @ 1500 Hz)
- **Maximum Output Level:** 174dB/uPa/m
- **Maximum Voltage/Current:** 20 Vrms/3A (100% duty cycle)
- **Q Parameters:** $Q_{tco} \sim 2.5$ $Q_{mc} \sim 5$
- **Directivity:** Omnidirectional to 1.5 kHz
- **Bulkhead Connector:** Subconn MCBH3MSS (Coding: Pin 2 hot, Pin 1 return, Pin 3 ground)
- **Mating Cable:** Subconn MCIL3F // MCDLS-F on 50 feet (15.24m) 18/3 SOOW cable
- **Minimum / Maximum Depth:** 10 feet (3.05 meters) - 50 feet (15.24 meters)
- **Maximum Pressure:** 23 psi (WARNING: use provided hand air pump only!)
- **Piston Stop Gap:** 0.016 inches (Schrader valve pin depressed to equalize internal/external pressure)
- **Dimensions (LWH):** 9.5 IN (241.3mm) x 8.5 IN (215.9mm) x 8.5 IN (215.9mm)
- **Weight:** 23.25 lbs (10.55 kg)
- **Includes:** Lubell VC2C underwater speaker, Subconn MCIL3F/MCDLS-F on 50' SOOW cable, Blackburn 2038415 hand pump, Accutire MS-4021B pressure gauge. P19-4130-A case optional.
- **Warranty:** 90 days parts & labor against manufacturing defects.

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The Lubell VC2C is for sale to marine scientists and laboratories, ocean engineers, and the military. Set-up and operation of the VC2C must be supervised by an engineer having a background in ocean engineering, due to careful pressure compensation procedures and potentially harmful sound levels.

WARNING:

- **MUST BE GROUNDED**
 - **VC2C MUST BE PRESSURIZED TOPSIDE BEFORE DEPLOYMENT AT FIXED OPERATING DEPTH PER ATTACHED INFLATION SCHEDULE**
 - **DO NOT DEPRESS THE SCHRADER VALVE CORE PIN IN THE WATER**
1. Equipment operator should wear dry rubber-soled shoes while setting up and operating equipment.
 2. Inspect all equipment and cordage before use. Do not use equipment if cords are damaged.
 3. Set up a wood or plastic insulated equipment table in a dry sheltered area keeping a minimum distance of 10' from the water. Keep equipment securely fastened in place if using on a boat or ship.
 4. Attach a sturdy 3/8 inch three-strand polypropylene rope of sufficient length to the attachment eyelet on the VC2C underwater acoustic transducer. Depth markers should be placed on the rope in 1 foot intervals to determine the operating depth of the VC2C when deployed from vessel.
 5. After lightly lubricating the pins with silicone grease, attach the Seaconn MCIL3F//MCDLS-F 50' SOOW cable to the mating SUBCONN MCBH3MSS bulkhead connector fitted on the VC2C underwater speaker. **IMPORTANT: Strain relief a loop in the SO cable using HD nylon cable ties so as to prevent any strain on the bulkhead connector. Failure to follow this procedure may result in damage to the bulkhead connector, which will require factory replacement.**
 6. **GROUNDING:** Ground the VC2C to an approved pool, ship, or tank ground via the green conductor in the SOOW cable.
 7. **IMPORTANT:** Before lowering the VC2C underwater speaker into the water (from dry deployment area), depress the Schrader valve core pin to equalize (zero out) the internal air pressure of the VC2C with that of the surrounding atmospheric pressure.
 8. **IMPORTANT:** Verify that both of the VC2C's piston-stop gaps are precisely set to 0.016 inches, and that the set-screw lock-nut is securely tightened.
 9. Determine and record the proposed operating depth for the VC2C tests.
 10. The VC2C must then be precisely inflated with the supplied hand pump to the correct pressure corresponding to the intended depth of operation per following schedule: **Freshwater:** 0.433 psi x depth of operation in feet; **Saltwater:** 0.444 psi x depth of operation in feet. When pressurized, the piston-stop gaps will close while on the platform, but will then return to the preset 0.016 inch gap once the VC2C is deployed to the prescribed depth of operation. (Practice measuring the pressure with the included Accutire MS-4021B digital pressure gauge, as each time you check the pressure, you release a small amount of air...pressure must be accurate!) **WARNING: Disconnect the VC2C from amplifier if diver is verifying the 0.016 inch piston-stop gap at depth.**
 11. Tether the VC2C at the test depth determined in step 9, and compensated for in step 10.
 12. Connect VC2C to public address (PA) amplifier rated between 80 watt to 120 watts @ 4 ohms (20 Vrms nominal). Suitable amps would include: InterM A120, Bogen C100, Bosch PLE-1ME120-US, TOA BG-2120. Connect VC2C cable to amplifier speaker terminals as follows: white to 4 OHM, black to COMMON, and GREEN to tank, pool, or boat GROUND. To help protect the VC2C against burnout, replace fuse in white wire HFB fuseholder with Bussman AGC-3-R or AGC-4-R FB fuse.
 13. Connect amplifier to GFCI protected AC outlet in dry area only.
 14. Monitor output of VC2C with hydrophone and scope, and avoid any distortion.

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DEPLOYMENT DEPTH VS REQUIRED INFLATION PRESSURE VC2C

FRESHWATER	SALTWATER
10 FEET = 4.330 PSI	10 FEET = 4.440 PSI
11 FEET = 4.763 PSI	11 FEET = 4.884 PSI
12 FEET = 5.196 PSI	12 FEET = 5.328 PSI
13 FEET = 5.629 PSI	13 FEET = 5.772 PSI
14 FEET = 6.062 PSI	14 FEET = 6.216 PSI
15 FEET = 6.495 PSI	15 FEET = 6.660 PSI
16 FEET = 6.928 PSI	16 FEET = 7.104 PSI
17 FEET = 7.361 PSI	17 FEET = 7.548 PSI
18 FEET = 7.794 PSI	18 FEET = 7.992 PSI
19 FEET = 8.227 PSI	19 FEET = 8.436 PSI
20 FEET = 8.660 PSI	20 FEET = 8.880 PSI
21 FEET = 9.093 PSI	21 FEET = 9.324 PSI
22 FEET = 9.526 PSI	22 FEET = 9.768 PSI
23 FEET = 9.959 PSI	23 FEET = 10.212 PSI
24 FEET = 10.392 PSI	24 FEET = 10.656 PSI
25 FEET = 10.825 PSI	25 FEET = 11.100 PSI
26 FEET = 11.258 PSI	26 FEET = 11.544 PSI
27 FEET = 11.691 PSI	27 FEET = 11.988 PSI
28 FEET = 12.124 PSI	28 FEET = 12.432 PSI
29 FEET = 12.557 PSI	29 FEET = 12.876 PSI
30 FEET = 12.990 PSI	30 FEET = 13.320 PSI
31 FEET = 13.423 PSI	31 FEET = 13.764 PSI
32 FEET = 13.856 PSI	32 FEET = 14.208 PSI
33 FEET = 14.289 PSI	33 FEET = 14.652 PSI
34 FEET = 14.722 PSI	34 FEET = 15.096 PSI
35 FEET = 15.155 PSI	35 FEET = 15.540 PSI
36 FEET = 15.588 PSI	36 FEET = 15.984 PSI
37 FEET = 16.021 PSI	37 FEET = 16.428 PSI
38 FEET = 16.454 PSI	38 FEET = 16.872 PSI
39 FEET = 16.887 PSI	39 FEET = 17.316 PSI
40 FEET = 17.320 PSI	40 FEET = 17.760 PSI
41 FEET = 17.753 PSI	41 FEET = 18.200 PSI
42 FEET = 18.186 PSI	42 FEET = 18.648 PSI
43 FEET = 18.619 PSI	43 FEET = 19.092 PSI
44 FEET = 19.052 PSI	44 FEET = 19.536 PSI
45 FEET = 19.485 PSI	45 FEET = 19.980 PSI
46 FEET = 19.918 PSI	46 FEET = 20.424 PSI
47 FEET = 20.351 PSI	47 FEET = 20.868 PSI
48 FEET = 20.784 PSI	48 FEET = 21.312 PSI
49 FEET = 21.217 PSI	49 FEET = 21.756 PSI
50 FEET = 21.650 PSI	50 FEET = 22.220 PSI

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CALIBRATION OF LUBELL VC2C AT NUWC DODGE POND TUESDAY FEBRUARY 10 2009 10:03:40 AM Lubell VC2C Se 50 Hz to 2 kHz 12_5 psi 28 ft depth 20 V drive

Frequency kHz	Transmit Voltage volts	Transmit Current amps	Real Power watts	Z Magnitude ohms	Phase (Z) deg	TVR dB// uPa/volt	TCR dB// uPa/amp	SPL dB//uPa
0.050	20.04	4.60	84.49	4.36	23.44	128.83	141.62	154.87
0.055	20.05	4.71	85.98	4.26	24.40	131.22	143.80	157.26
0.060	20.04	4.58	82.80	4.37	25.57	132.04	144.86	158.08
0.065	20.03	4.51	79.96	4.44	27.69	132.85	145.80	158.88
0.070	19.94	4.20	73.61	4.75	28.36	134.51	148.05	160.50
0.075	20.03	4.44	75.77	4.51	31.61	135.29	148.37	161.32
0.080	19.97	4.02	67.84	4.96	32.45	136.10	150.01	162.10
0.085	20.04	4.45	75.38	4.50	32.33	136.64	149.71	162.68
0.090	19.96	3.56	55.08	5.60	39.24	140.16	155.13	166.17
0.095	19.95	3.30	53.34	6.05	35.82	142.57	158.21	168.57
0.100	20.05	3.04	54.68	6.61	26.08	143.39	159.79	169.43
0.105	20.06	2.83	51.17	7.08	25.85	145.00	162.00	171.05
0.110	20.05	2.60	49.25	7.70	19.44	145.78	163.51	171.83
0.115	19.96	2.56	48.75	7.79	17.55	147.33	165.17	173.34
0.120	19.94	2.80	54.90	7.11	10.76	147.13	164.17	173.12
0.125	20.05	2.40	47.38	8.36	10.11	145.06	163.50	171.11
0.130	20.06	3.32	66.31	6.04	5.63	146.60	162.22	172.65
0.135	20.05	3.07	60.38	6.53	11.32	148.18	164.48	174.23
0.140	19.97	3.62	71.08	5.51	10.67	146.44	161.27	172.45
0.145	19.98	3.85	75.36	5.20	11.38	146.51	160.82	172.52
0.150	20.06	4.08	78.54	4.92	16.21	145.84	159.67	171.88
0.155	20.05	3.91	77.25	5.13	9.88	145.66	159.86	171.71
0.160	19.96	4.27	79.04	4.68	21.83	145.06	158.46	171.06
0.165	19.95	4.44	83.47	4.49	19.67	143.16	156.21	169.16
0.170	20.03	3.88	71.56	5.16	23.09	143.98	158.24	170.02
0.175	19.95	4.08	73.84	4.89	25.02	142.05	155.83	168.05
0.180	20.01	3.99	75.59	5.02	18.68	141.47	155.49	167.50
0.185	19.94	3.70	67.13	5.39	24.54	142.04	156.68	168.04
0.190	18.52	3.53	65.34	5.25	0.21	142.69	157.09	168.04
0.195	20.03	3.88	67.18	5.16	30.26	140.80	155.05	166.83
0.200	20.05	3.85	65.95	5.21	31.29	140.21	154.55	166.26
0.200	19.98	3.44	57.73	5.80	32.88	140.94	156.21	166.95
0.220	19.94	3.33	57.64	5.98	29.87	137.90	153.44	163.90
0.240	19.97	3.38	52.77	5.92	38.48	139.13	154.57	165.14
0.260	19.94	3.12	50.62	6.38	35.67	134.84	150.94	160.84
0.280	20.07	3.27	53.23	6.14	35.81	136.50	152.26	162.55
0.300	19.92	2.81	43.65	7.10	38.68	135.65	152.67	161.63
0.320	20.05	2.88	45.95	6.97	37.26	136.85	153.71	162.89
0.340	20.03	2.74	43.56	7.31	37.53	135.82	153.09	161.86
0.360	20.06	2.71	44.38	7.41	35.16	134.86	152.26	160.91
0.380	19.99	2.59	39.16	7.71	40.91	134.13	151.87	160.14
0.400	20.07	2.59	41.25	7.75	37.48	133.86	151.64	159.91
0.420	20.01	2.48	36.29	8.07	42.98	134.21	152.35	160.23

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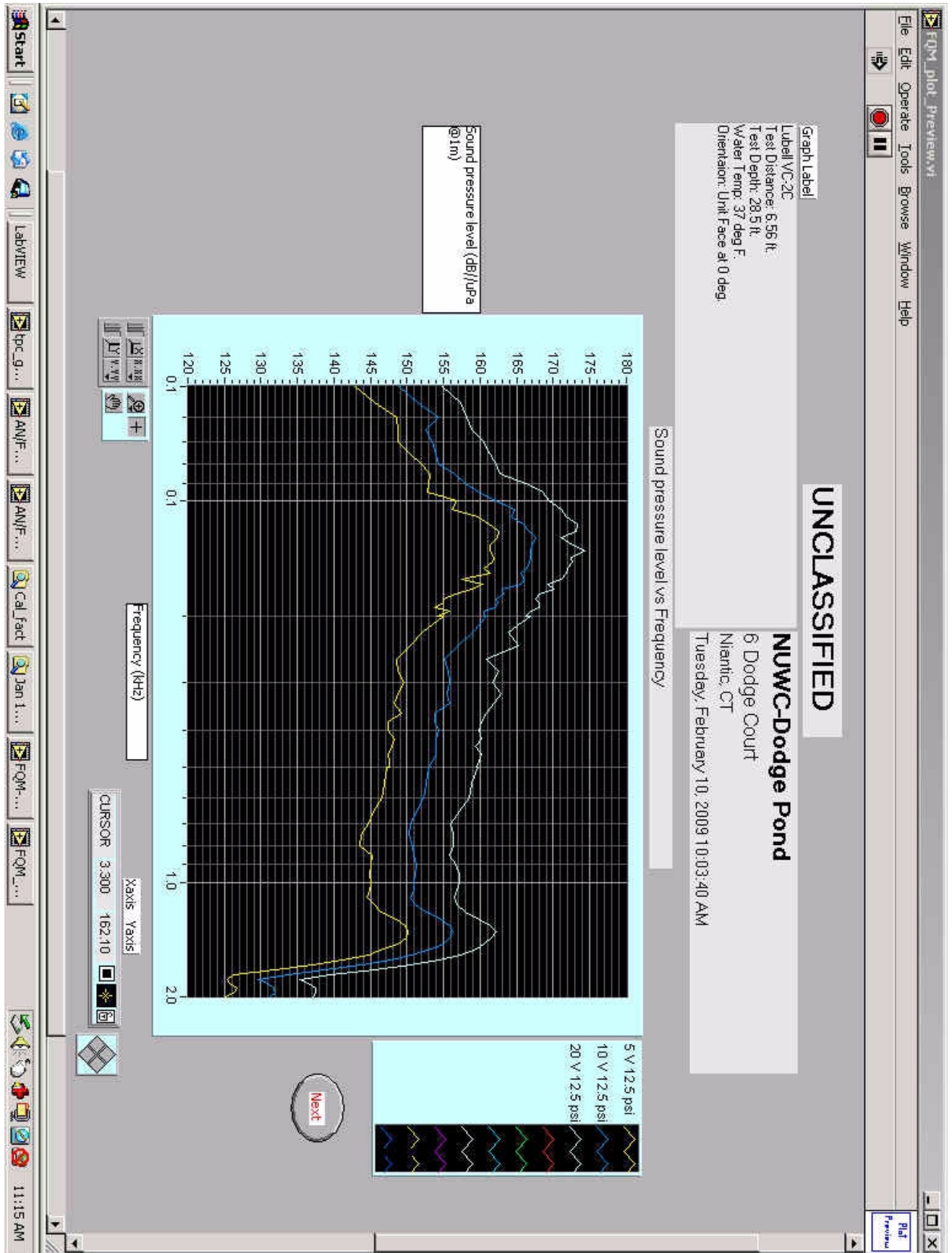
0.440 19.99 2.53 38.04 7.90 41.28 133.24 151.19 159.26

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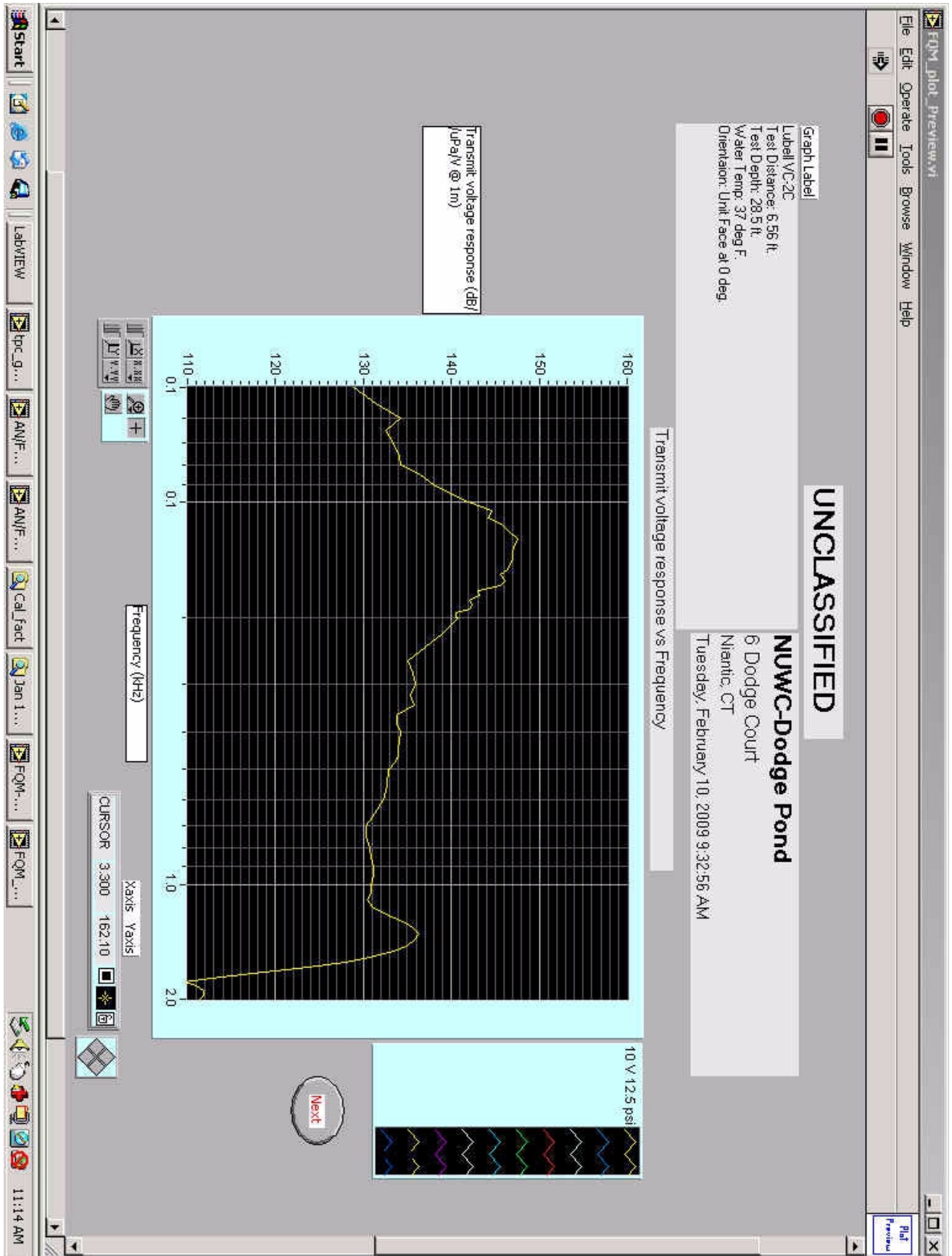
CALIBRATION OF LUBELL VC2C AT NUWC DODGE POND TUESDAY FEBRUARY 10 2009 10:03:40 AM
Lubell VC2C Se 50 Hz to 2 kHz 12_5 psi 28 ft depth 20 V drive

Frequency kHz	Transmit Voltage volts	Transmit Current amps	Real Power watts	Z Magnitude ohms	Phase (Z) deg	TVR dB// uPa/volt	TCR dB// uPa/amp	SPL dB//uPa
0.460	20.03	2.33	33.82	8.61	43.50	134.15	152.84	160.18
0.480	20.06	2.24	32.74	8.94	43.36	133.75	152.78	159.80
0.500	19.94	2.10	28.01	9.50	48.03	133.46	153.01	159.46
0.500	20.04	2.31	33.08	8.66	44.46	133.56	152.31	159.59
0.550	19.94	1.93	26.21	10.36	46.95	132.91	153.21	158.90
0.600	19.97	2.01	28.20	9.93	45.36	132.43	152.37	158.43
0.650	19.98	1.93	26.79	10.38	45.86	131.18	151.51	157.20
0.700	20.06	1.80	26.39	11.12	43.17	129.87	150.79	155.91
0.750	19.97	1.82	22.89	10.98	50.92	130.35	151.16	156.36
0.800	20.08	1.70	22.71	11.84	48.16	130.25	151.72	156.31
0.850	19.96	1.59	21.58	12.58	47.05	129.87	151.87	155.88
0.900	19.99	1.57	20.95	12.72	48.16	130.58	152.67	156.59
0.950	19.96	1.56	20.61	12.76	48.68	131.17	153.29	157.17
1.000	20.01	1.50	19.36	13.34	49.82	131.14	153.65	157.17
1.050	20.04	1.48	20.21	13.57	46.93	130.77	153.42	156.80
1.100	19.95	1.40	18.98	14.24	47.21	130.45	153.52	156.45
1.150	20.02	1.40	18.89	14.31	47.61	130.85	153.96	156.87
1.200	19.96	1.32	17.55	15.17	48.10	131.97	155.59	157.98
1.250	19.95	1.28	17.19	15.55	47.81	133.87	157.70	159.86
1.300	20.00	1.24	16.79	16.18	47.22	135.25	159.44	161.27
1.350	19.95	1.25	16.72	16.00	47.76	136.23	160.31	162.23
1.400	19.97	1.20	16.34	16.58	47.20	135.44	159.84	161.45
1.450	19.97	1.18	16.16	16.89	46.81	134.56	159.12	160.57
1.500	19.99	1.17	16.25	17.07	46.02	133.43	158.08	159.45
1.550	20.05	1.15	15.48	17.41	47.90	131.27	156.09	157.31
1.600	20.03	1.13	14.83	17.78	48.91	128.19	153.19	154.22
1.650	20.02	1.12	15.24	17.81	47.39	124.33	149.35	150.36
1.700	20.02	1.10	14.95	18.25	47.11	119.52	144.75	145.55
1.750	20.00	1.08	14.63	18.54	47.32	113.42	138.78	139.44
1.800	19.99	1.06	14.44	18.83	47.12	109.34	134.84	135.35
1.850	19.98	1.03	14.03	19.31	47.30	110.54	136.25	136.55
1.900	19.92	1.03	13.71	19.30	48.19	111.51	137.22	137.49
1.950	20.02	1.01	13.72	19.77	47.44	111.53	137.45	137.56
2.000	20.02	1.00	13.44	20.08	47.66	111.11	137.16	137.14

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