4.3 Ocean Bottom Seismometer

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4.3.1 Specifications of JAMSTEC OBS

Figure 4.3.0 shows outline of JAMSTEC OBS. The JAMSTEC-OBS houses recorder, Li-Ion rechargeable batteries and geophones in a 17" Benthos glass sphere. The glass sphere is covered by a hard hat (yellow plastic), which is mounted at two points to anchor weight that appears red in the photograph. The mounting points function as a release mechanism by forced electrical corrosion controlled by an acoustic transponder mounted to one side of the mounting points. Strobe, radio beacon, and hydrophone is also mounted on the hard hat to protect the glass sphere.

Geophone sensors are orthogonal three component leveled by a gimbal mechanism dumped by silicone oil. Sensor signal is recorded by 4 channel hard disc recorder at 100 samples per second in 16bit resolution. Polarity of sensors are upward positive for channel 1, east to west positive for channel 2, and south to north positive for channel 3. The fourth channel records hydrophone signal in that positive pressure is recorded negative. In this experiment, preamplifier for the recorder has a setting that vertical channel 40dB gain (M-position), horizontal components 20dB (L-position), and hydrophone 40dB (H-position).

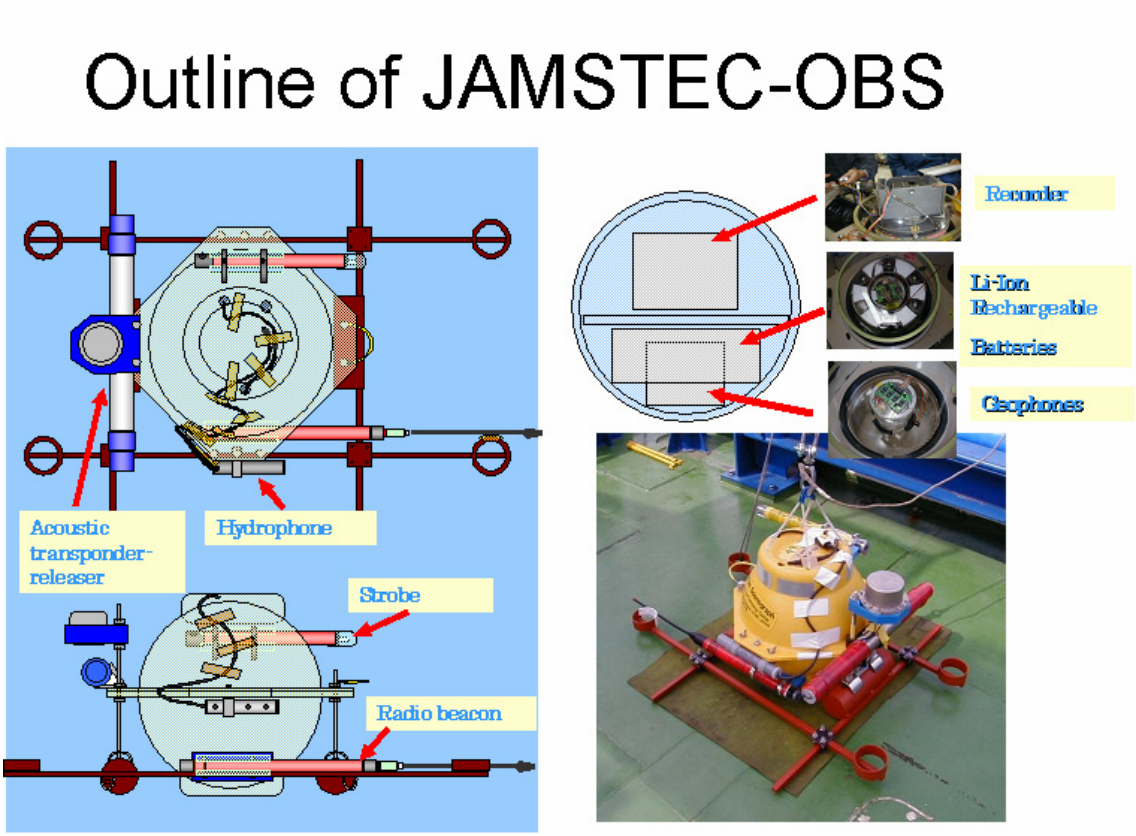


Fig4.3.0: Outline of JAMSTEC Ocean Bottom Seismometer

The following is the list of figures showing the specification of JAMSTEC OBS system (including Japanese).

Fig4.3.1. OBS block diagram

Fig4.3.2. Frequency response curve of sensor (Geophone)

Fig4.3.3. Frequency response curve of analog filter

Fig4.3.4. DAT-II(recorder) calibration sheet

Fig4.3.5. Specification of hydrophone preamplifiers, Molded assembles

4.3.2 Specifications for ERI OBS (Earthquake Research Institute, the Univ. of Tokyo)

The sensors of the SP-OBS and the LT-OBS are all 4.5Hz three component geophones (vertical, two orthogonal horizontal sensors). The signal from geophones was sampled at 200Hz in 24bit resolution. Recording is started after deployment on the seafloor by a recorder timer as shown by Table 5.3.3.

For all ERI OBSs, the preamplifier gain was set to 1.1 for the horizontal components and 2.0 for the vertical component. The hexadecimal ID number written in the data represents the recorder ID as shown by Table 5.3.3.

To help possible recovery by the ROV Hyper Dolphin onboard R/V Natsushima, all OBS have light reflecting tape strips stuck on the surface of the hard hat of the Benthos spheres and the titanium spheres. We took care to stick some of the strips also on the bottom side of the sphere to help identification when surfaced in the darkness

4.3.2.1. Short-term observation Ocean Bottom Seismometer (OBS)

The ERI OBS has similar specifications as that of JAMSTEC OBS. The sensors are three component geophones of 4.5Hz corner frequency. The signal from the geophones is digitized at 200 samples per second in 24bit resolution by the recorder (HDDR-2). The recorder has two-or-more hard disc drives to store data. For this experiment less than one month, one disc is more than enough to store data, but many discs were installed for redundancy. The accuracy of clock in the recorder has similar accuracy to that of the JAMSTEC OBS. Before deployment and after recovery, the timing of the clock signal of 10 seconds interval was measured by a reference GPS clock (Truetime XL-AK) for calibration. We set the clock within a second or two (in a worst case) from the reference at the beginning of the observation, so the time offset of OBS clock is the offset from the measured time rounded to each 10 seconds.

4.3.2.2 Long-term observation Ocean Bottom Seismometer (LT-OBS)

The ERI LT-OBS houses geophones, a HDD data recorder, Lithium batteries, and acoustic transponder electronics in a titanium sphere of 500mm diameter. The outside of the OBS looks as shown by Figure 5.3.9. The HDD data recorder (HDDR3) has two 20GB hard disc drives. The clock in the HDDR3 recorder has a accuracy of 1ms drift per day or so. The

maximum recording time is determined by the capacity of battery rather than the capacity of the hard disc drives. Even after the battery run out, the clock is backed up by separate Lithium batteries so that we can keep track of timing for more than 1 year after the end of observation.

One of the two LT-OBS (ID 609) has a strong motion accelerometer from Akashi (Model V407-3-A Code No. 825-342 S/N SIG0001) and the signal is recorded separately in a 2GB compact flash memory. Clock for the accelerometer recorder was set long before deployments in January 2005. Therefore, recorded signal should be correlated with geophone data to correct clock accuracy.

4.3.3. JAMSTEC OBS deployment operation

Ten JAMSTEC's Ocean Bottom Seismometers (OBS) were fully assembled before the cruise starts. Onboard, before these deployments, the OBS recorder clock was synchronized to GPS time, and also the time of OBSs recorder wake-up was set to 17:00, 21st of February 2005 (UTC). It was done communicating with Master Clock (device for set up JAMSTEC OBSs) on 17th February. OBS were scheduled to wake up and start recording after deployment on the seafloor. The recorder battery life (approx. 3 weeks) was also taken into account.

About an hour before each OBS deployment, instruments attached to each OBS such as transponder, ballast release mechanism, hydrophone, radio beacon and flasher, were visually inspected and also response of its transponder was tested. And then electrical components for anchor release mechanism was checked. Twenty minutes before the deployment, OBS recorder clock time were logged using the Master Crock in comparing it with GPS time and to check its drift.

To avoid having OBS land on steep topographic region, the bathymetric data acquired by multi narrow beam echo-sounder (Seabat8160) were carefully inspected around the planed deployment point before releasing the OBS in the water. The OBS was released from starboard side of R/V Natsushima if the sea bottom condition seemed to be no problem.

The OBS position was tracked by SSBL (Super Short-base Line) acoustic positioning system while OBS was subsiding right after the release until the landing on the seafloor. Acoustic positioning was continued for few minutes after the landing was confirmed until measured OBS positions converge. The OBS landing position was determined as approximate center positions of scattered SSBL positions after the landing.

海底地震計ブロックダイアグラム

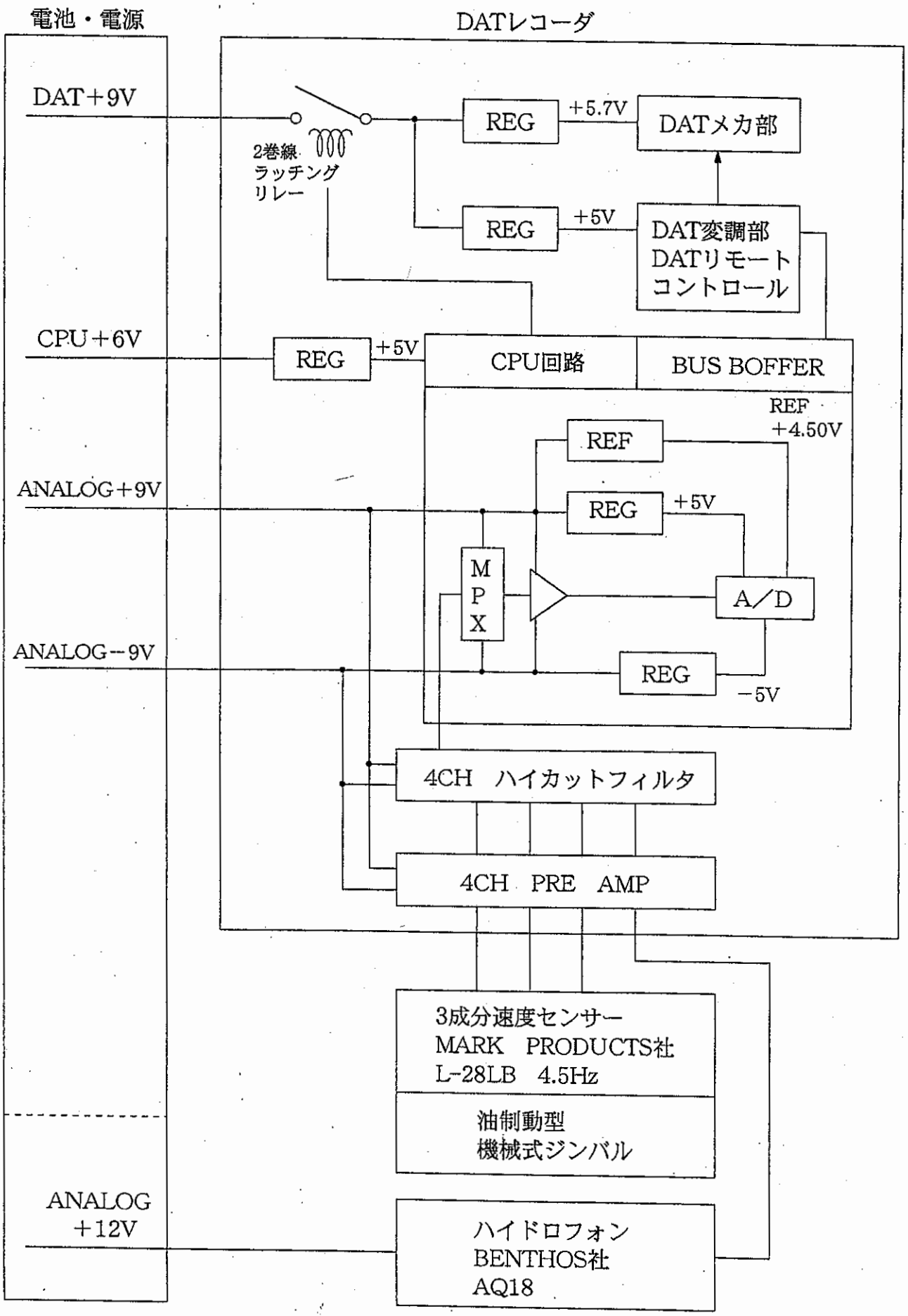


Fig1.

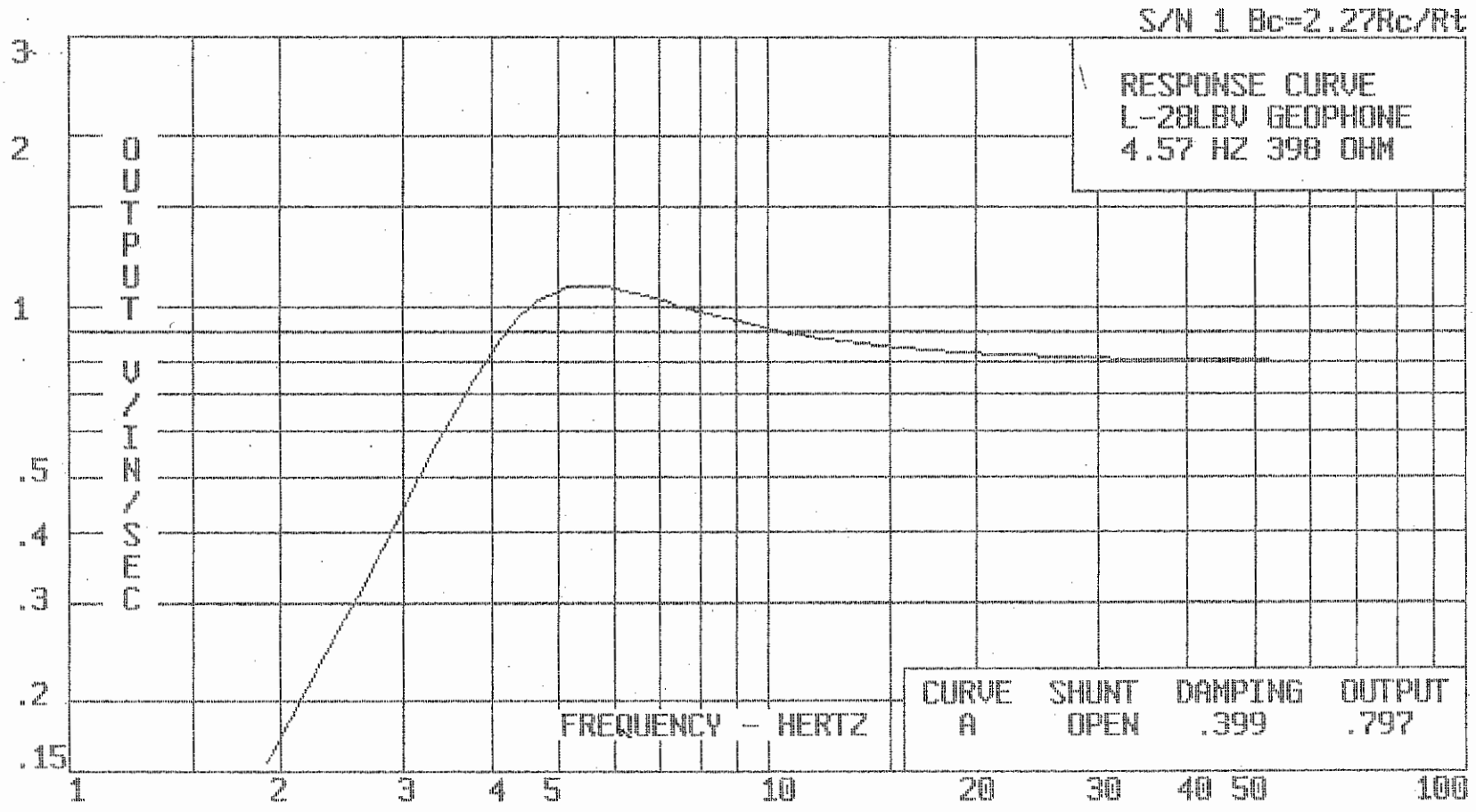

S/N 1 Bc=2.27Rc/Rt
RESPONSE CURVE
L-28LBV GEOPHONE
4.57 HZ 398 OHM
OUTPUT V/IN/SEC
FREQUENCY - HERTZ
CURVE SHUNT DAMPING OUTPUT
A OPEN .399 .797
3
2
1
.5
.4
.3
.2
.15
1
2
3
4
5
10
20
30
40
50
100

Fig2.

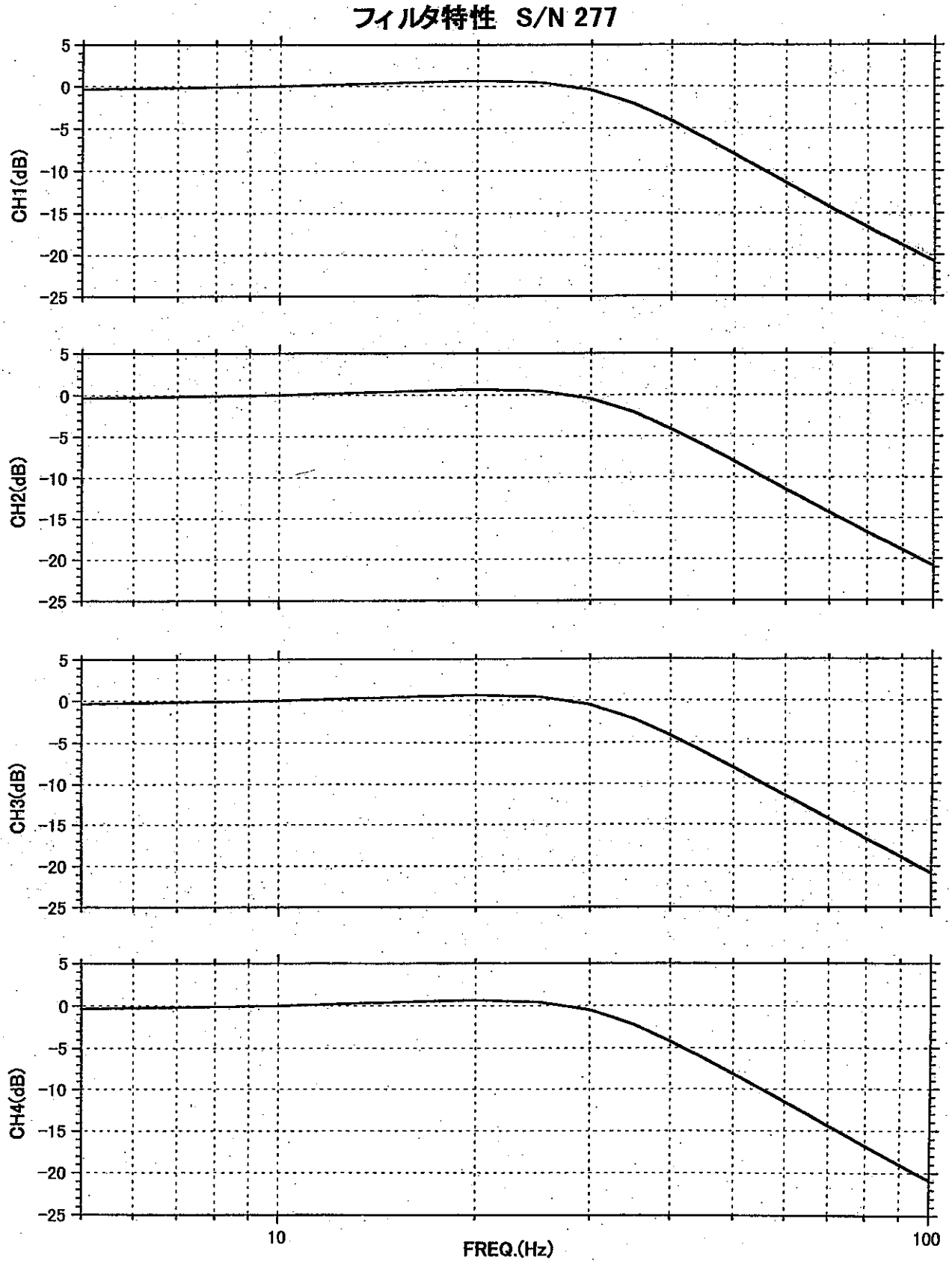

フィルタ特性 S/N 277
CH1(dB)
CH2(dB)
CH3(dB)
CH4(dB)
5
0
-5
-10
-15
-20
-25
10
100
FREQ.(Hz)

Fig3.

DAT－II 試験成績書

クローバテック株式会社

試験年月日　1999 年　3 月　2 日

形　　式　DAT－II C

シリアル No.　99031750277

プリアンプ利得　　10 Hz 正弦波入力時

	CH 1	CH 2	CH 3	CH 4 (ﾊｲﾄﾞﾛﾌｫﾝ用)
L	19.2 dB	19.2 dB	19.1 dB	0.0 dB
M	39.3 dB	39.4 dB	39.3 dB	20.1 dB
H	59.3 dB	59.2 dB	59.2 dB	40.1 dB

フィルタ特性

グラフ添付

機能試験

項　目	内　　容	合否
外部入出力	外部電源制御	合
	10 秒パルス出力	合
記録試験	データ記録・再生装置による記録データ再生	合

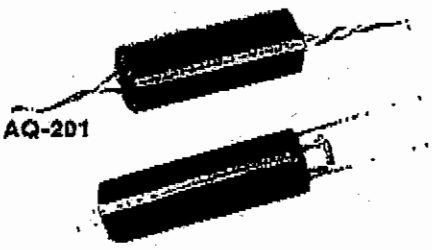
Fig4.

Hydrophone Preamplifiers

These Preamplifiers have been specifically designed for small diameter arrays used to extreme depth ratings. High input impedance, low current, and high drive capability make them suitable for long cable lengths.

The AQ-201 and AQ-202 are single ended units with complimentary direct-coupled output drivers. The AQ-202 Model has higher current with lower noise.

The AQ-300 and AQ-302 have the same features as the AQ-201 with the exception of differential input and output circuits.



AQ-201

AQ-300

	AQ-201	AQ-202	AQ-300	AQ-302
Gain dB	26 dB	26 dB	20.8 dB	20.8 dB
Input Impedance	15 MΩ	15 MΩ	30 MΩ	30 MΩ
Current Quiescent mA 12VDC	<0.3 mA	<4.0 mA	<0.6 mA	<6 mA
Noise ref. input nv/√ Hz	<100 nv	<20 nv	<100 nv	<20 nv
High Pass -3 dB	1 Hz	1 Hz	.3 Hz	.3 Hz
Low Pass -3 dB	12 kHz	12 kHz	14 kHz	14 kHz
Depth in meters	1732	1732	1732	.1732
Size in cm O.D./length	1.74/4.45	1.74/4.45	1.65/5.7	1.65/5.7
Weight in grams	17.4	17.4	17.1	17.1

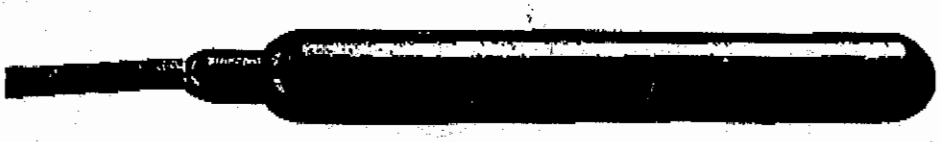
Molded Assemblies

For general purpose applications, these rugged, polyurethane-molded assemblies are molded to a signal cable. They may be used as signature phones under very high signal conditions or in applications requiring extreme depth ratings. Cable capacity determines sensitivity unless a charge-coupled preamplifier is used.

The AQ-17 and AQ-16 assemblies are general purpose, broadband hydrophones with preamplifiers for extended frequency response and cable driving needs. Rated to over 1800 meters, they are well suited for applications where signal preamplification is desired. Signal decoupling and power are provided by an optional MESH-BU battery box.

The AQ-21A is a pinger locater, two-channel molded array. A specially designed Kevlar-reinforced, polyurethane-shielded tow cable is molded directly to the hydrophone for ease of deployment.

	AQ-11/AQ-12	AQ-17/AQ-16	AQ-21
Sensitivity	-202.5dB/-197dB	-174.5dB/-169dB	-174.5 dB
Capacity — pfd ± 10%	14,500/3500	N/A	N/A
Depth in meters	1732/13860	1732	2500



AQ-11

Specifications subject to change without notice

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Fig5.