Data Report No. 99-003

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1984 Campi Flegrei, Italy, Experiment

A "seismic crisis" occurred in the Campi Flegrei caldera area of southern Italy in 1983-1984, when rapid uplift was detected and microearthquake activity increased dramatically. A temporary network of University of Wisconsin-Madison portable digital seismic recorders with 3-component sensors was deployed in the vicinity of the Campi Flegrei caldera (Figure 1) in mid-March, 1984, for a period of about one month [Aster and Meyer, 1988, 1989]. The event data collected by the temporary network are being made publicly available through the IRIS DMC as part of an NSF-supported project to archive historic UW-Madison digital seismic datasets collected by the research group of Prof. R. P. Meyer.

Data Collection and Processing

Data were recorded in triggered mode for all stations. Table 1 presents the station coordinates. Table 2 contains the SEGY headers set during the UW-to-SEGY format conversion process. Clock corrections are incorporated into the data. The data have been assembled in the form of a SEGY event volume. Table 3 lists the events - those with known location are listed with their coordinates, unknown events are listed with coordinates 00 00.00, 00 00.00.

Tape Provided

The data archive consists of one DAT tape with the event-volume data, this report in postscript and RTF formats, and miscellaneous information.

UW Seismic Recorders

The University of Wisconsin-Madison portable digital seismic recorders are wide-dynamic-range instruments (106 dB) designed for recording seismic waves from earthquakes or explosions (Table 4) [Powell, 1983]. Data from 1-Hz Geotech S-13 and Hall-Sears HS-10-1 geophones were recorded at 100- or 200-Hz sampling rates, with a 4-pole Butterworth anti-aliasing filter at 24 and 48 Hz, respectively. A 13.6 k Hz Omega receiver incorporated in each seismograph recorded data from the worldwide Omega network concurrently with seismic signals. A timing-correction process developed for application to the UW seismic recorders provides 1/4 sample RMS time error relative to Universal Time [Schneider et al., 1987]. Ground motion may be estimated from an average value for voltage sensitivity of 150 V/m/s for the UW Hall-Sears geophones (1000 ohm). S-13 geophones were deployed at stations W11 and W13 (200 Hz).

Related publications:

Aster, R. C., and R. P. Meyer, Three-dimensional velocity structure and hypocenter distribution in the Campi Flegrei caldera, Italy, *Tectonophysics, 149*, 195-218, 1988.

Aster, R. C., and R. P. Meyer, Determination of shear- and compressional-wave velocity variations and hypocenter locations in a rapidly inflating caldera: the Campi Flegrei, *Phys. Earth Planet. Inter.*, *55*, 313-325, 1989.

Powell, L.A., Engineering Description of the U.W. Portable Digital Seismograph, Proceedings of the Committee on Controlled Source Seismology (CCSS), Workshop on Portable Digital Seismograph Development, Los Altos, California, 121-122, 1983.

Schneider, J.F., R.C. Aster, L.A. Powell, and R.P. Meyer, Timing of portable seismographs from Omega navigation signals, *Bull. Seismo. Soc. Am.*, *77*, 1457-1478, 1987.

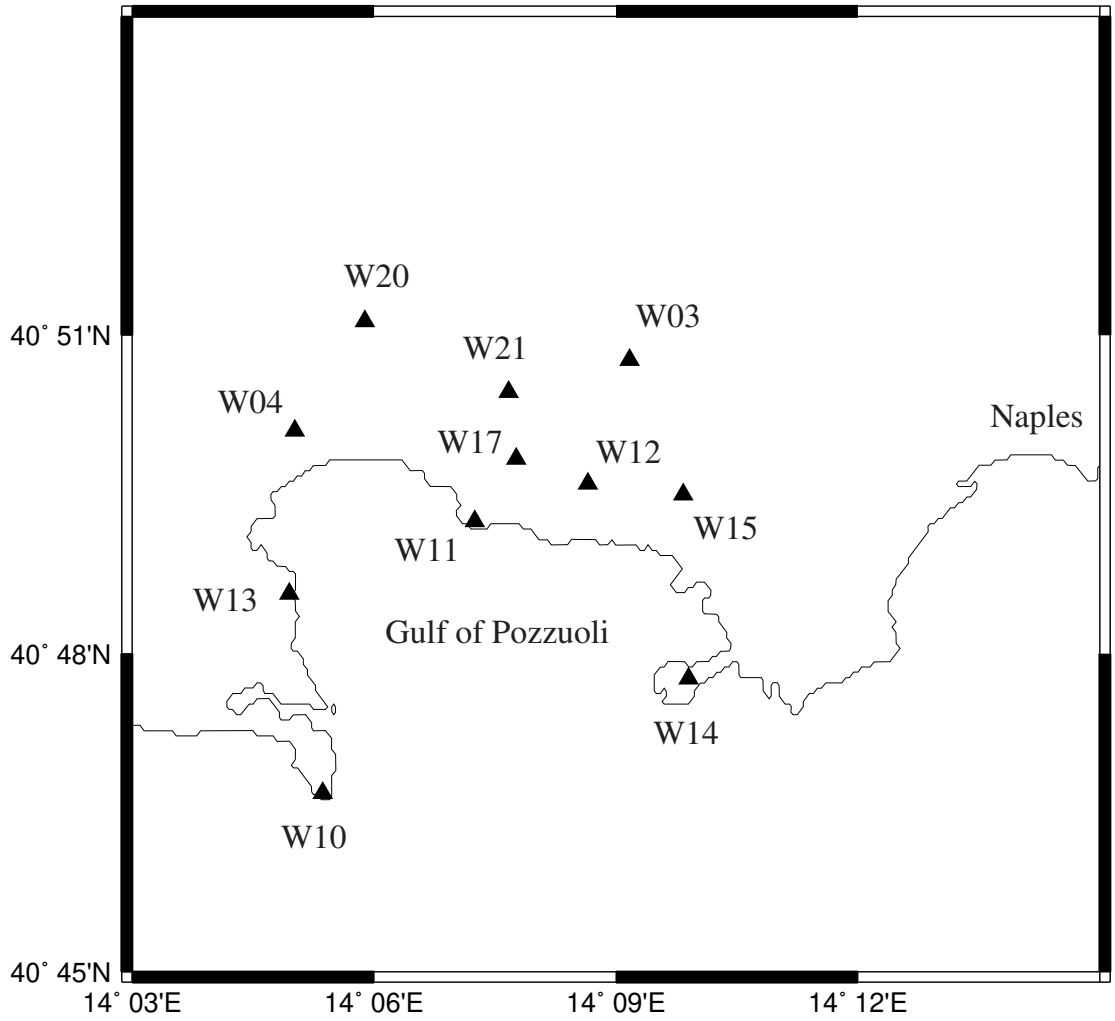

Figure 1. Map of UW station locations for the Campi Flegrei caldera array, 1984.

Table 1. Locations of UW stations deployed in the Campi Flegrei caldera array, 1984.

University of Wisconsin Station List – Campi Flegrei Experiment, 1984						
ID	Latitude N		Longitude E		Elevation	Name
W03	40	50.77	14	9.17	35	ASTRONI
W04	40	50.11	14	5.03	70	MT.NUOVO
W10	40	46.69	14	5.37	50	CAPO
W11	40	49.26	14	7.25	82	DARSENA
W12	40	49.60	14	8.66	180	SOLFATARA
W13	40	48.58	14	4.96	20	BAIA
W14	40	47.78	14	9.90	40	NISIDA
W15	40	49.51	14	9.84	150	MT.SPINA
W17	40	49.84	14	7.78	84	DA
W20	40	51.14	14	5.89	306	MT.S.ANGELO
W21	40	50.47	14	7.67	175	FONDI

Table 2. Portions of the PASSCAL SEGY headers used and instrument parameters

SEGY Headers set via UW data archiving	Comments (standard usages followed)
lineSeq	UW Instrument event# + channel
reelSeq	UW Instrument event# + channel
event_number	Experiment Event Number
channel_number	standard (1-3:V,N,E)
traceID	standard (1)
elevationScale	standard (1)
coordScale	standard (1)
coordUnits	standard (2 for lat and lon)
sampleLength	standard
num_samps*	standard
deltaSample	microseconds
samp_rate	microseconds
gainType	standard
gainConst	standard
scale_fac	Scale to volts
year	Trace start time
day	
hour	
minute	
second	
m_secs	
timeBasisCode	standard usage (2 is GMT)
trigyear	UW instrument trigger time
trigday	
trighour	
trigminute	
trigsecond	
trigmills	
data_form	standard usage (1 is 32-bit)
inst_no	UW instrument number
station_name	W## with number from 1 to 21
recLongOrX	receiver longitude*3600
recLatOrY	receiver longitude*3600
sourceLongOrX	source longitude*3600
sourceLatOrY	source latitude*3600
sourceDepth	source depth (m)
phoneRollPos1	for SAC O-header

Table 3. Event list based on information provided by Osservatorio Vesuviano, Naples.

Campi Flegrei Experiment Event List from 3/15/84 to 4/15/84												
Ev#	Year	Mon	Day	Hour	Min	Sec	Latitude N		Longitude E		Depth	Mag
1	84	3	15	21	24	39.69	40	48.53	14	6.66	10.41	3.4
2	84	3	15	23	5	59.17	40	50.64	14	8.45	3.80	1.0
3	84	3	16	8	8	57.65	40	50.09	14	4.47	1.96	4.2
4	84	3	16	18	33	10.44	40	49.93	14	6.62	3.98	1.5
5	84	3	17	0	6	29.99	40	50.59	14	8.07	2.55	0.7
6	84	3	18	3	57	35.23	40	49.89	14	8.69	3.10	0.6
7	84	3	18	10	33	27.20	40	49.67	14	8.14	3.30	0.7
8	84	3	18	17	46	42.92	40	48.26	14	6.50	6.70	2.2
9	84	3	18	17	54	22.45	40	48.35	14	5.83	4.65	2.6
10	84	3	18	19	54	48.96	40	50.49	14	6.45	3.18	1.5
11	84	3	18	20	29	34.82	40	48.34	14	6.29	4.64	2.2
12	84	3	19	0	17	23.38	40	50.25	14	8.94	4.11	1.0
13	84	3	19	0	32	42.44	40	50.61	14	8.80	3.35	0.6
14	84	3	19	1	10	57.19	40	49.68	14	7.17	3.42	0.8
15	84	3	19	1	12	9.42	40	49.69	14	6.79	3.58	1.0
16	84	3	19	1	31	53.48	40	48.40	14	5.96	4.59	2.4
17	84	3	19	10	39	59.87	40	50.07	14	7.85	3.46	0.8
18	84	3	19	13	47	48.02	40	49.86	14	8.94	2.67	0.7
19	84	3	19	16	46	22.74	40	49.97	14	8.76	3.50	0.7
20	84	3	19	16	48	30.40	40	49.97	14	8.60	3.69	0.7
21	84	3	19	17	19	27.94	40	50.42	14	9.12	3.72	0.7
22	84	3	19	21	57	15.13	40	49.56	14	9.11	1.50	0.7
23	84	3	19	22	45	35.06	40	50.02	14	8.32	3.73	0.9
24	84	3	19	22	51	57.00	40	49.99	14	8.32	3.54	0.9
25	84	3	19	22	56	45.27	40	50.07	14	7.91	2.99	0.8
26	84	3	19	23	52	5.67	40	50.76	14	8.59	3.21	0.8
27	84	3	20	0	32	43.51	40	50.09	14	8.05	3.35	0.9
28	84	3	20	9	11	11.25	40	50.01	14	8.39	4.03	0.9
29	84	3	20	11	47	26.95	40	49.09	14	7.31	2.31	0.3
30	84	3	20	21	21	33.89	40	49.18	14	4.72	3.42	1.8
31	84	3	20	23	42	44.52	40	48.32	14	5.74	3.59	2.8
32	84	3	21	0	0	14.28	40	49.48	14	8.00	3.02	0.9
33	84	3	21	5	45	38.13	40	48.77	14	5.20	3.94	2.5
34	84	3	21	14	7	52.29	40	49.75	14	7.65	2.85	1.1
35	84	3	21	16	8	25.66	40	49.55	14	7.31	4.18	0.6
36	84	3	21	16	27	40.78	40	49.47	14	7.94	3.16	1.0
37	84	3	21	16	34	57.90	40	49.65	14	8.37	4.15	1.8
38	84	3	21	16	48	41.19	40	49.87	14	7.80	2.90	1.1
39	84	3	21	16	53	51.30	40	49.82	14	8.33	3.81	0.6
40	84	3	21	23	19	42.26	40	49.43	14	8.39	3.40	0.5
41	84	3	21	23	23	49.18	40	49.93	14	6.26	3.11	1.7
42	84	3	21	23	59	5.69	40	49.34	14	7.88	3.54	0.9
43	84	3	22	1	2	59.06	40	49.94	14	8.24	3.88	0.9
44	84	3	22	2	22	35.63	40	46.49	14	9.55	3.68	5.6
45	84	3	22	4	30	7.63	40	50.22	14	5.48	2.97	0.7
46	84	3	22	5	26	55.32	40	50.17	14	8.33	2.99	1.1
47	84	3	22	19	31	29.40	40	50.72	14	8.28	3.33	1.0
48	84	3	22	23	38	45.99	40	50.24	14	6.56	3.64	1.6
49	84	3	22	23	40	28.42	40	50.23	14	6.47	3.62	1.7
50	84	3	23	0	48	44.85	40	50.12	14	6.47	2.99	1.8

51	84	3	23	1	55	48.88	40	50.37	14	8.60	3.55	1.1
52	84	3	23	2	21	17.04	40	48.86	14	4.79	3.33	0.6
53	84	3	23	2	29	26.49	40	48.68	14	5.03	3.68	0.2
54	84	3	23	2	59	15.16	40	48.89	14	9.77	2.95	1.1
55	84	3	23	5	49	41.88	40	48.38	14	9.26	4.88	1.4
56	84	3	23	10	37	7.71	40	50.60	14	7.18	3.70	0.7
57	84	3	23	11	6	21.18	40	50.30	14	6.77	3.35	1.3
58	84	3	23	15	41	15.86	40	49.50	14	8.48	1.05	0.3
59	84	3	23	5	49	41.85	40	48.37	14	9.26	4.96	1.4
60	84	3	23	10	37	7.28	40	49.66	14	7.16	5.07	0.8
61	84	3	23	11	6	21.19	40	50.30	14	6.78	3.34	1.3
62	84	3	23	15	41	15.29	40	49.78	14	8.69	3.25	0.3
63	84	3	23	23	33	39.00	40	49.47	14	7.41	3.27	0.5
64	84	3	24	0	46	41.72	40	47.31	14	6.84	4.49	2.3
65	84	3	24	1	8	12.32	40	50.18	14	8.28	4.10	0.9
66	84	3	24	1	35	13.96	40	50.47	14	7.69	3.04	0.1
67	84	3	24	4	35	55.83	40	50.67	14	9.01	1.80	0.3
68	84	3	24	5	7	54.97	40	48.49	14	5.54	4.11	0.8
69	84	3	24	5	27	51.57	40	49.98	14	6.15	3.15	1.6
70	84	3	24	12	14	15.12	40	47.62	14	8.88	3.96	1.5
71	84	3	24	17	0	30.82	40	47.67	14	10.73	1.74	1.2
72	84	3	24	17	10	12.45	40	47.65	14	11.06	2.40	1.6
73	84	3	24	20	27	12.17	40	49.62	14	5.31	3.40	0.9
74	84	3	24	21	43	14.83	40	50.59	14	8.01	2.84	0.6
75	84	3	24	22	24	1.57	40	50.42	14	8.37	2.90	1.0
76	84	3	26	11	28	0.14	40	50.03	14	7.84	4.29	0.4
77	84	3	26	20	53	41.88	40	48.08	14	6.48	4.12	2.3
78	84	4	1	1	4	37.84	40	49.94	14	6.90	3.17	1.3
79	84	4	1	1	7	31.14	40	50.07	14	7.45	3.18	0.7
80	84	4	1	1	11	11.23	40	49.88	14	7.18	3.37	1.1
81	84	4	1	1	21	0.35	40	49.97	14	7.17	3.30	0.9
82	84	4	1	1	27	4.01	40	49.87	14	7.19	3.04	0.8
83	84	4	1	1	28	30.72	40	49.71	14	7.28	3.19	0.7
84	84	4	1	1	35	44.66	40	49.83	14	7.47	3.43	0.4
85	84	4	1	1	37	20.87	40	49.93	14	7.35	3.22	0.7
86	84	4	1	1	42	16.98	40	49.99	14	7.34	3.19	0.7
87	84	4	1	1	47	0.02	40	49.76	14	7.54	3.33	0.3
88	84	4	1	1	50	50.57	40	49.78	14	7.68	3.35	0.2
89	84	4	1	2	3	11.25	40	49.78	14	7.48	3.27	0.4
90	84	4	1	2	4	53.76	40	49.36	14	6.72	3.82	0.8
91	84	4	1	2	6	52.74	40	49.92	14	7.59	3.25	0.3
92	84	4	1	2	10	13.49	40	49.92	14	7.74	3.08	0.2
93	84	4	1	2	11	33.22	40	49.84	14	7.65	3.39	0.2
94	84	4	1	2	16	55.57	40	49.90	14	7.46	3.03	0.5
95	84	4	1	2	18	32.86	40	49.94	14	7.41	3.32	0.6
96	84	4	1	2	25	58.48	40	49.87	14	7.38	3.33	0.6
97	84	4	1	2	34	9.16	40	49.89	14	7.91	3.25	1.1
98	84	4	1	2	37	44.80	40	49.89	14	7.79	3.27	1.1
99	84	4	1	2	43	13.10	40	49.67	14	7.26	3.66	0.8
100	84	4	1	2	45	39.50	40	50.07	14	7.13	2.88	1.0
101	84	4	1	2	49	4.76	40	50.08	14	7.23	2.96	0.9
102	84	4	1	2	52	59.46	40	49.78	14	7.67	3.60	1.1
103	84	4	1	3	3	3.82	40	50.88	14	7.00	6.80	1.2
104	84	4	1	3	6	22.03	40	49.91	14	7.32	3.21	0.7
105	84	4	1	3	12	21.16	40	49.85	14	7.38	3.51	1.1
106	84	4	1	3	21	41.16	40	49.97	14	7.64	3.28	0.3

107	84	4	1	3	25	9.09	40	49.96	14	7.38	3.11	0.6
108	84	4	1	3	27	52.26	40	50.09	14	7.51	2.97	0.6
109	84	4	1	3	31	44.71	40	49.71	14	7.56	3.38	1.4
110	84	4	1	3	34	27.37	40	49.95	14	8.01	3.07	1.1
111	84	4	1	4	0	58.12	40	50.07	14	7.28	3.14	0.8
112	84	4	1	4	16	51.12	40	49.97	14	6.90	6.43	1.3
113	84	4	1	4	18	38.72	40	49.90	14	7.57	3.33	1.1
114	84	4	1	4	28	15.04	40	50.03	14	7.52	2.93	0.5
115	84	4	1	5	21	51.18	40	49.93	14	7.60	2.89	0.3
116	84	4	1	5	28	4.23	40	49.99	14	7.70	3.01	0.3
117	84	4	1	12	8	57.74	40	49.97	14	7.84	2.94	0.3
118	84	3	19	10	18	40.00	00	00.00	00	0.00	0.00	0.0
119	84	3	21	1	13	22.70	00	00.00	00	0.00	0.00	0.0
120	84	4	1	3	8	32.00	00	00.00	00	0.00	0.00	0.0
121	84	4	1	3	20	24.00	00	00.00	00	0.00	0.00	0.0
122	84	4	3	14	34	53.22	00	00.00	00	0.00	0.00	0.0
123	84	4	5	16	12	1.13	00	00.00	00	0.00	0.00	0.0
124	84	4	5	17	45	35.23	00	00.00	00	0.00	0.00	0.0
125	84	4	7	01	11	23.54	00	00.00	00	0.00	0.00	0.0
126	84	4	7	17	24	13.67	00	00.00	00	0.00	0.00	0.0
127	84	4	7	22	51	23.62	00	00.00	00	0.00	0.00	0.0
128	84	4	8	04	52	4.07	00	00.00	00	0.00	0.00	0.0
129	84	4	8	05	04	28.57	00	00.00	00	0.00	0.00	0.0
130	84	4	8	09	04	55.00	00	00.00	00	0.00	0.00	0.0
131	84	4	8	22	11	7.56	00	00.00	00	0.00	0.00	0.0
132	84	4	9	08	28	28.81	00	00.00	00	0.00	0.00	0.0
133	84	4	10	21	43	10.98	00	00.00	00	0.00	0.00	0.0
134	84	4	11	17	58	1.21	00	00.00	00	0.00	0.00	0.0
135	84	4	11	17	59	6.78	00	00.00	00	0.00	0.00	0.0
136	84	4	12	02	52	40.91	00	00.00	00	0.00	0.00	0.0
137	84	4	12	16	52	58.85	00	00.00	00	0.00	0.00	0.0
138	84	4	13	14	28	44.57	00	00.00	00	0.00	0.00	0.0
139	84	4	13	19	08	13.65	00	00.00	00	0.00	0.00	0.0
140	84	4	13	20	46	58.74	00	00.00	00	0.00	0.00	0.0
141	84	4	13	20	51	2.26	00	00.00	00	0.00	0.00	0.0
142	84	4	13	20	57	6.86	00	00.00	00	0.00	0.00	0.0
143	84	4	13	21	21	15.44	00	00.00	00	0.00	0.00	0.0
144	84	4	14	02	07	27.25	00	00.00	00	0.00	0.00	0.0
145	84	4	14	02	09	52.82	00	00.00	00	0.00	0.00	0.0
146	84	4	14	02	12	12.10	00	00.00	00	0.00	0.00	0.0
147	84	4	14	02	19	33.50	00	00.00	00	0.00	0.00	0.0
148	84	4	14	03	07	31.68	00	00.00	00	0.00	0.00	0.0
149	84	4	14	03	39	9.52	00	00.00	00	0.00	0.00	0.0
150	84	4	14	07	30	1.34	00	00.00	00	0.00	0.00	0.0
151	84	4	14	08	11	17.24	00	00.00	00	0.00	0.00	0.0
152	84	4	14	18	11	10.79	00	00.00	00	0.00	0.00	0.0
153	84	4	14	18	26	10.46	00	00.00	00	0.00	0.00	0.0
154	84	4	14	21	45	37.83	00	00.00	00	0.00	0.00	0.0
155	84	4	14	22	14	0.14	00	00.00	00	0.00	0.00	0.0
156	84	4	14	22	36	13.21	00	00.00	00	0.00	0.00	0.0
157	84	4	14	23	10	10.09	00	00.00	00	0.00	0.00	0.0
158	84	4	14	23	43	52.20	00	00.00	00	0.00	0.00	0.0
159	84	4	15	00	33	4.32	00	00.00	00	0.00	0.00	0.0
160	84	4	15	02	59	18.10	00	00.00	00	0.00	0.00	0.0

Table 4. General specifications, University of Wisconsin-Madison digital 3-component recorders

DATA STORAGE:	5" reel 1/4" tape, 1800 feet	or	SCSI 3-1/2" disk
CAPACITY:	20 Mbyte		210 Mbyte
FORMAT:	4-track; 3-channel + error correction		multi-stream packet
DYNAMIC RANGE:	106 dB	Noise = 0.25 μV P-P	Clipping = 0.05 V P-P
CALIBRATION:	Random binary sequence and step current applied to seismometer coils through a bridge (at programmed start times)		
PASSBAND:	Low end: 2 poles at 0.09 Hz High end: 4-pole Butterworth at (0.25 * sample rate)		
SAMPLE RATE:	25, 50, 100, 200, 400 samples/second		
PRE-EVENT DELAY:	512, 1024, 2048 samples/channel		
MODES:	Programmed and/or multiple-mode triggered		
PROGRAMMING:	Time (ddd – hr:mn:sc), repeat interval and count for run, calibrate, trigger arm and disarm (24 entries)		
RUN TIMES:	Programmable to 1000 minutes in 1 sec steps with optional programmed limits on total recording time for each mode		
TRIGGER HARDWARE:	STA/delayed LTA ratio; broadband or teleseismic filtered		
TRIGGER SOFTWARE:	Three frequency band Walsh transform filter to discriminate teleseismic, regional, and noise; with independent run times		
STATUS REVIEW:	Omega signal, time, configuration, schedules, number of events recorded and time used for each mode, times of last 500 events, seismometer period and damping		
TIMING INTERNAL:	1 mHz TCXO, +/- 1 x 10^{-6} over temperature range		
EXTERNAL:	13.6 kHz Omega VLF phase recorded with seismic data;		
worldwide	coverage (except Antarctica and central Greenland) Post-processing time corrections: +/- 1 x 10^{-8} oscillator error; 1/4 sample RMS time error relative to U.T.		
POWER:	12.5 V DC +/- 20% 40 ma average current waiting for trigger 400 ma average current recording to tape 50 ma average current recording to disk		
DIMENSIONS:	56 x 33 x 40 cm		
WEIGHT:	22 kg		
TEMPERATURE:	0 deg to 50 deg C normal range (tape operates to 0 deg C) -20 deg to 70 dec C reduced spec. (disk operates to –20 deg C) -40 deg to 80 deg C storage		