A Single Shot BPM System for The SPring-8 Linac

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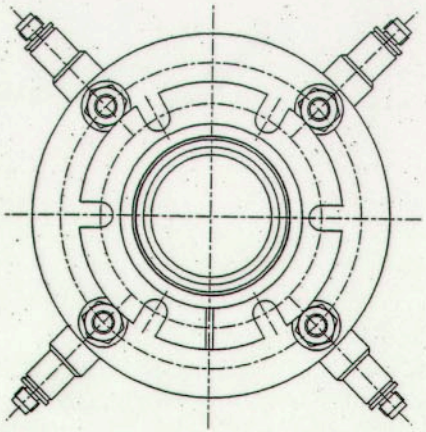
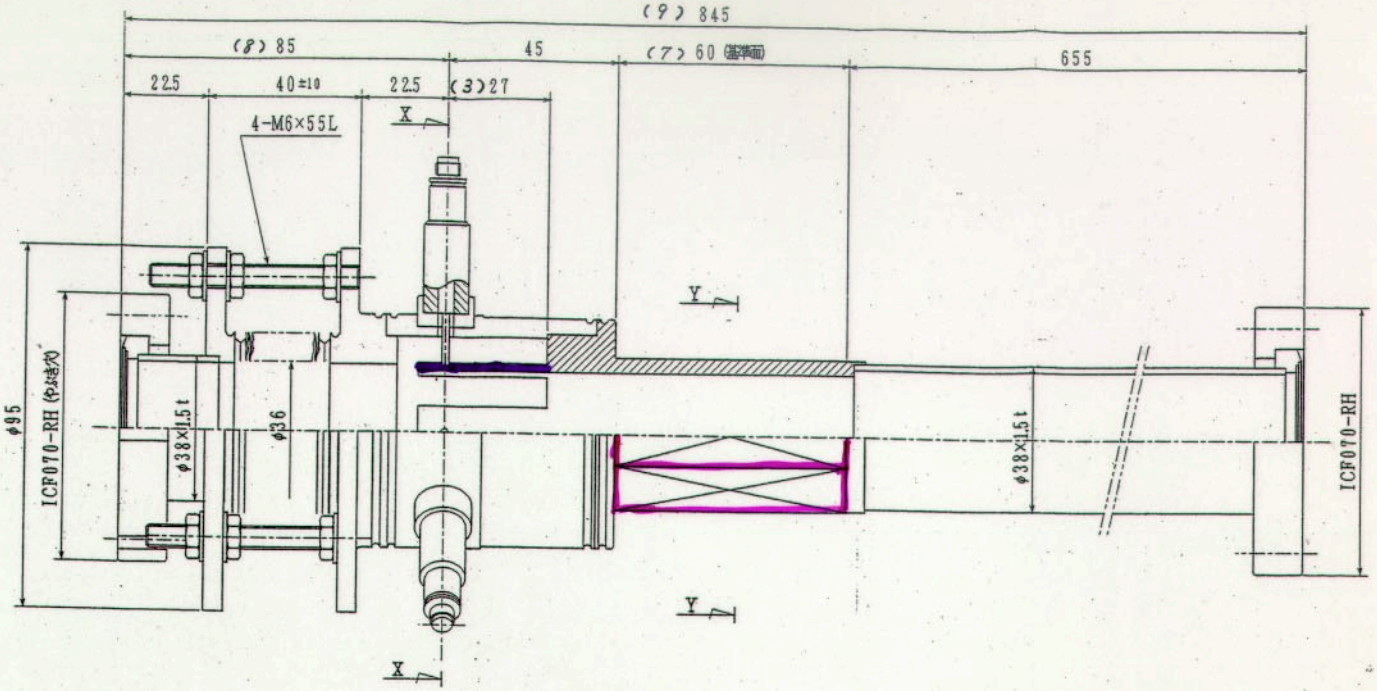
Contents

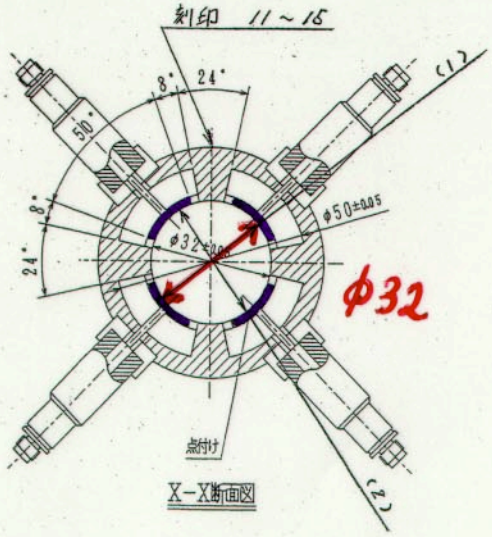
- Motivation, condition, target, ... for designing BPM system
- Design of BPM and signal processor
  - Detection frequency
  - What is the pick up? Strip line? TM_{110} Cavity?
  - Signal processor with an analog-to-digital converter
- Data Acquisition

The guidelines for designing the BPM system

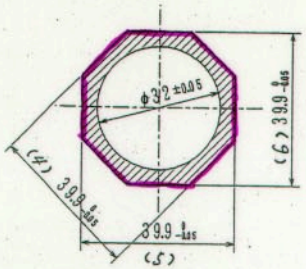
- A bunch separation is short as 350 ps (2.856 GHz).
- A dynamic range of macropulse width is wide i. e. from 1 ns (including single bunch) beam to 1 μs beam.
- A dynamic range of beam power is also wide i. e. from 1 ns - 10 mA (for the positron) beam to 1 μs - 100 mA beam.
- A total resolution under machine operating condition is needed less than 10^{-3} (1σ), e.g. σ=16μm@R=16mm .
- A high acquisition rate is needed more than 60 Hz (~1,000Hz at the future system?)
- A simple design and a low cost manufacturing are needed.
- Maintenance free.



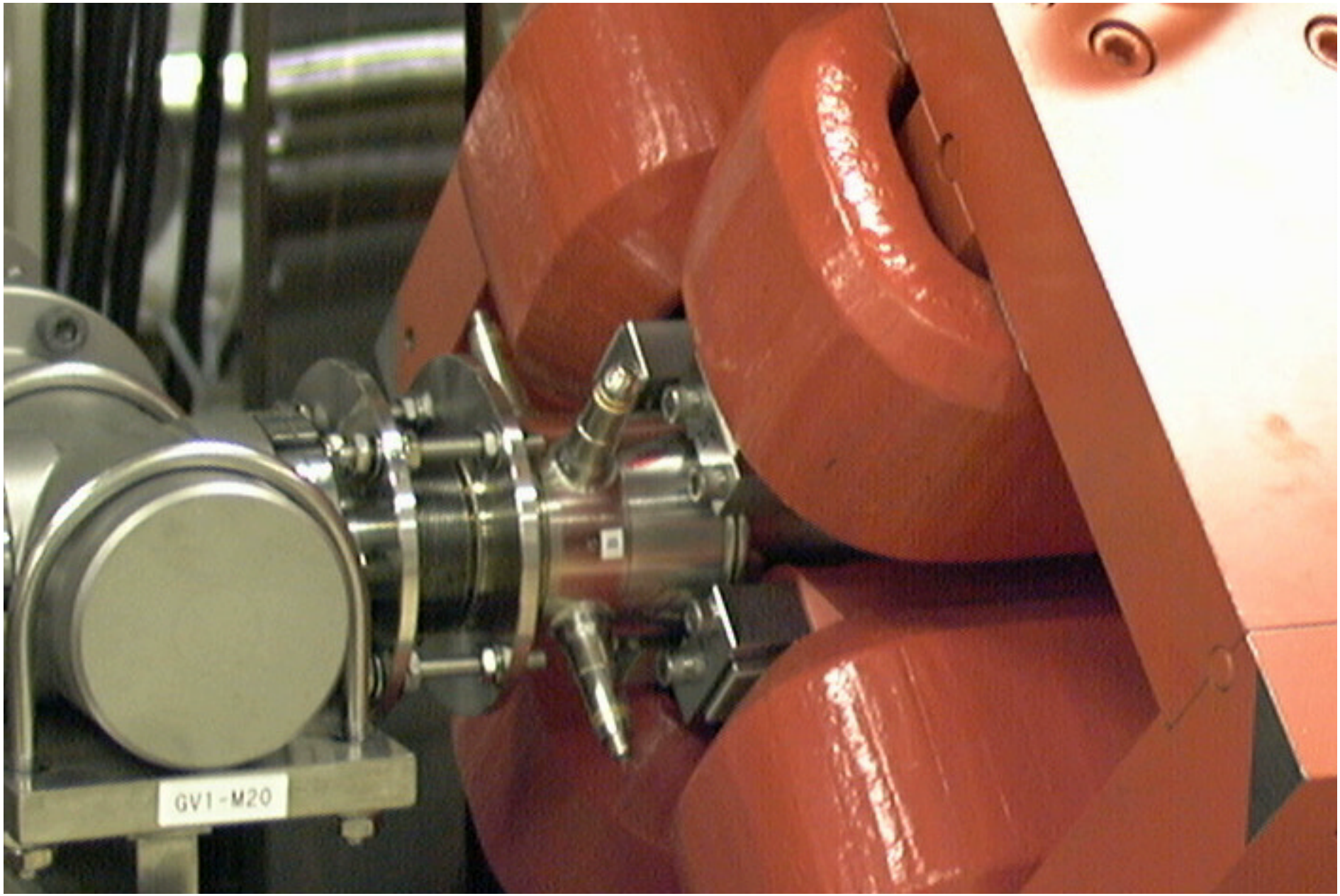

(9) 845
(8) 85
45
(7) 60 基準面
655
22.5
40±10
22.5
(3) 27
4-M6×55L
X
Y
φ95
ICF070-RH (内径穴)
φ38×1.5 t
φ36
φ38×1.5 t
ICF070-RH


刻印 11～18
8°
24°
(1)
5印
8°
24°
φ50±0.05
φ32±0.05
φ32
点付け
(2)

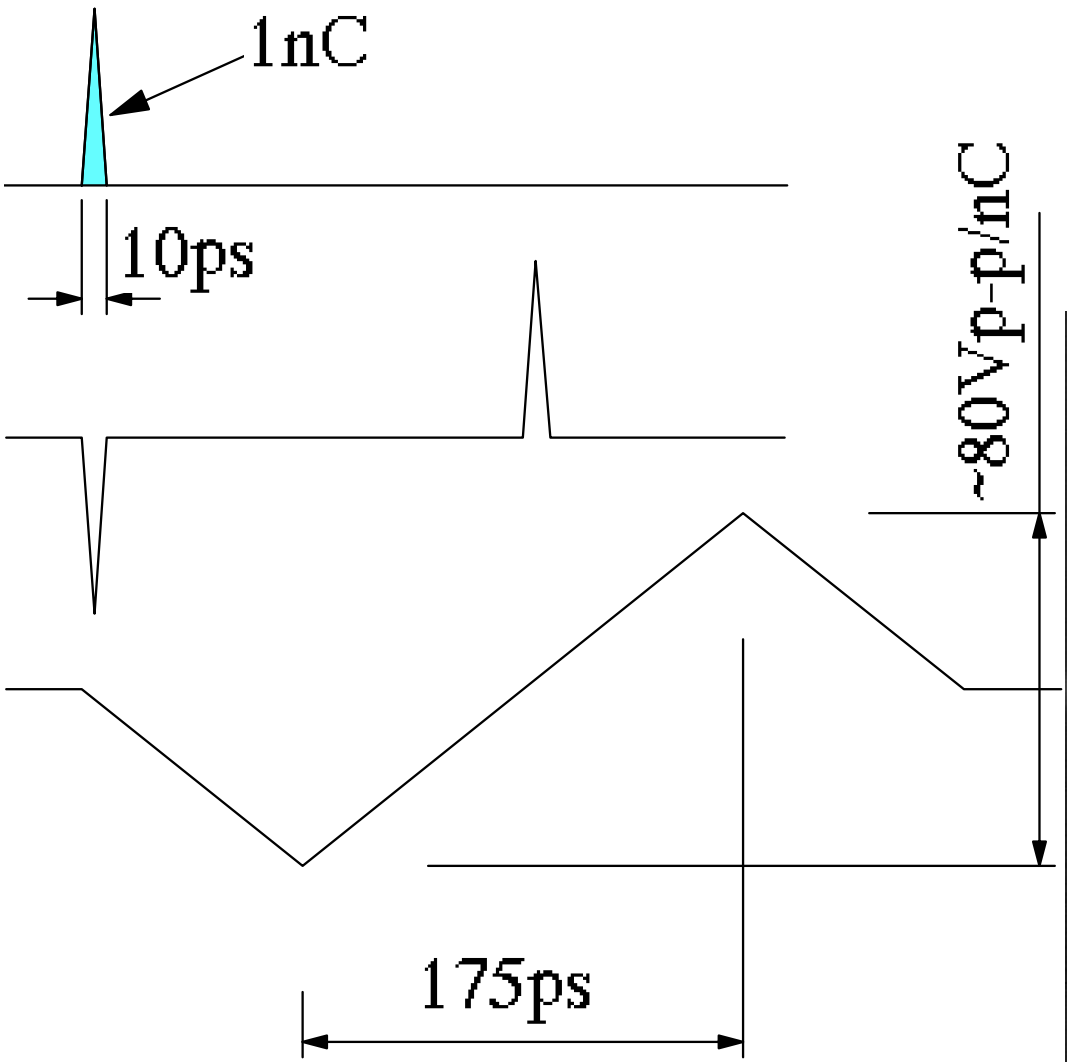
X-X断面図

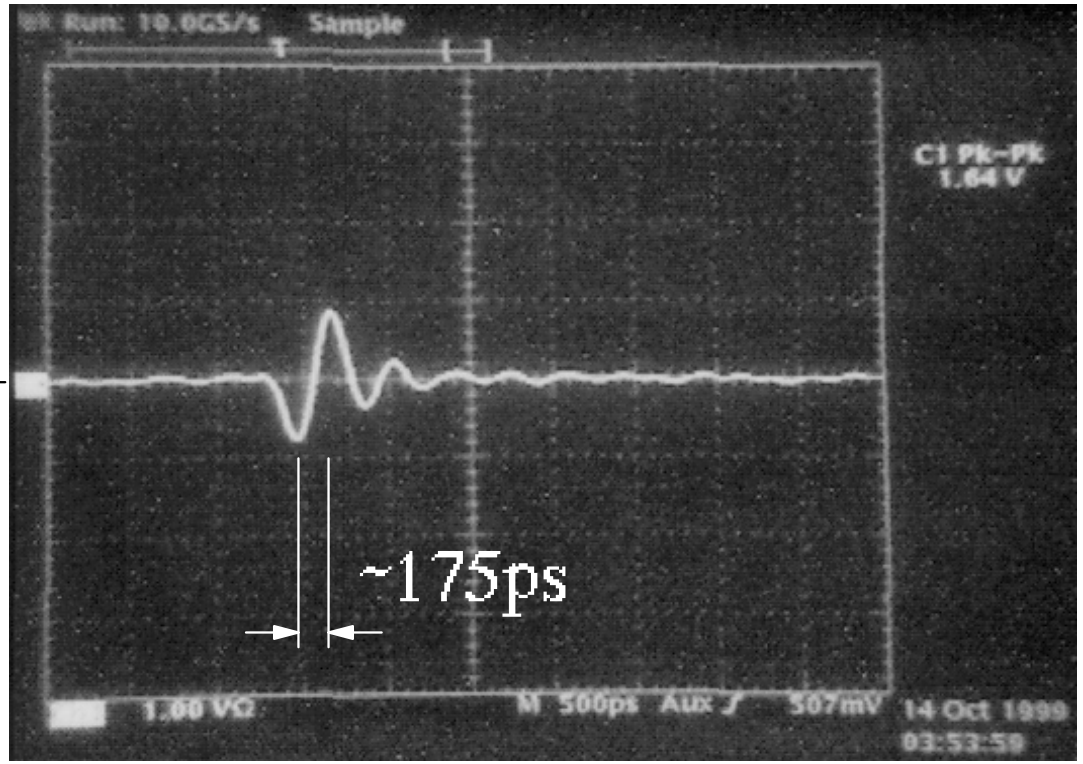

φ32±0.05
(6) 39.9 -0.05
(4) 39.9 -0.05
39.9 -0.05
(5)

Y-Y断面図

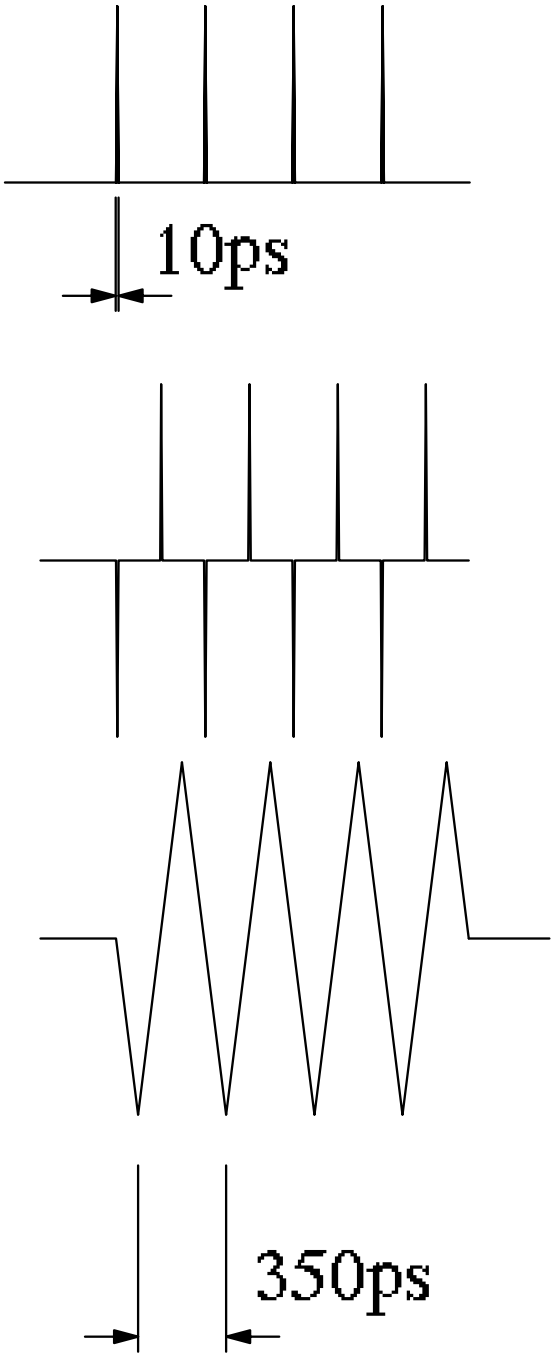


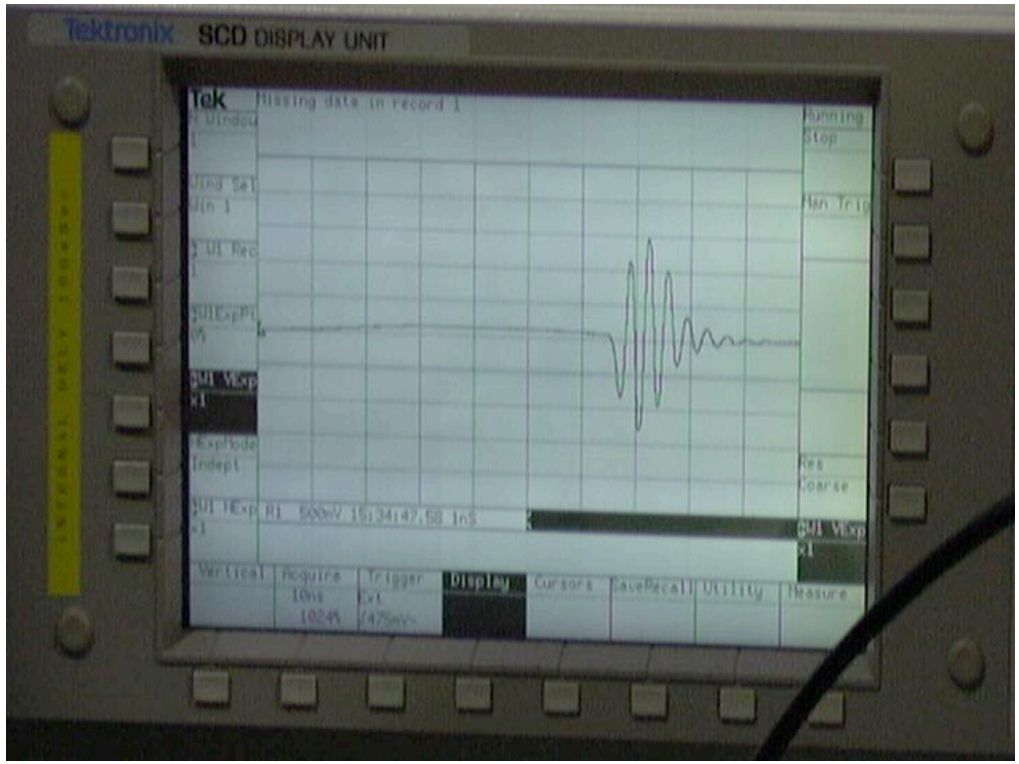
Photograph of the BPM inserted in quadrupole magnet

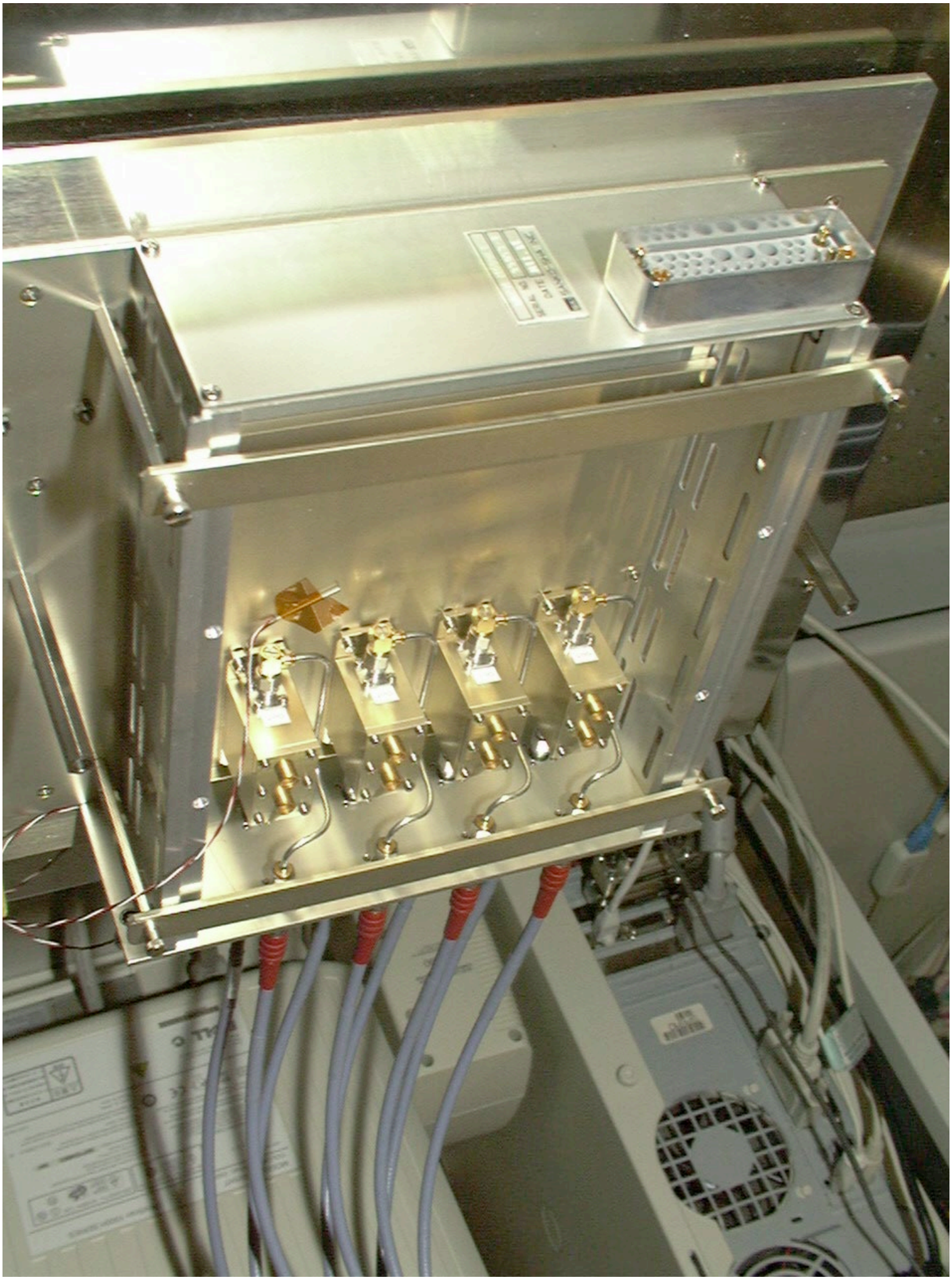


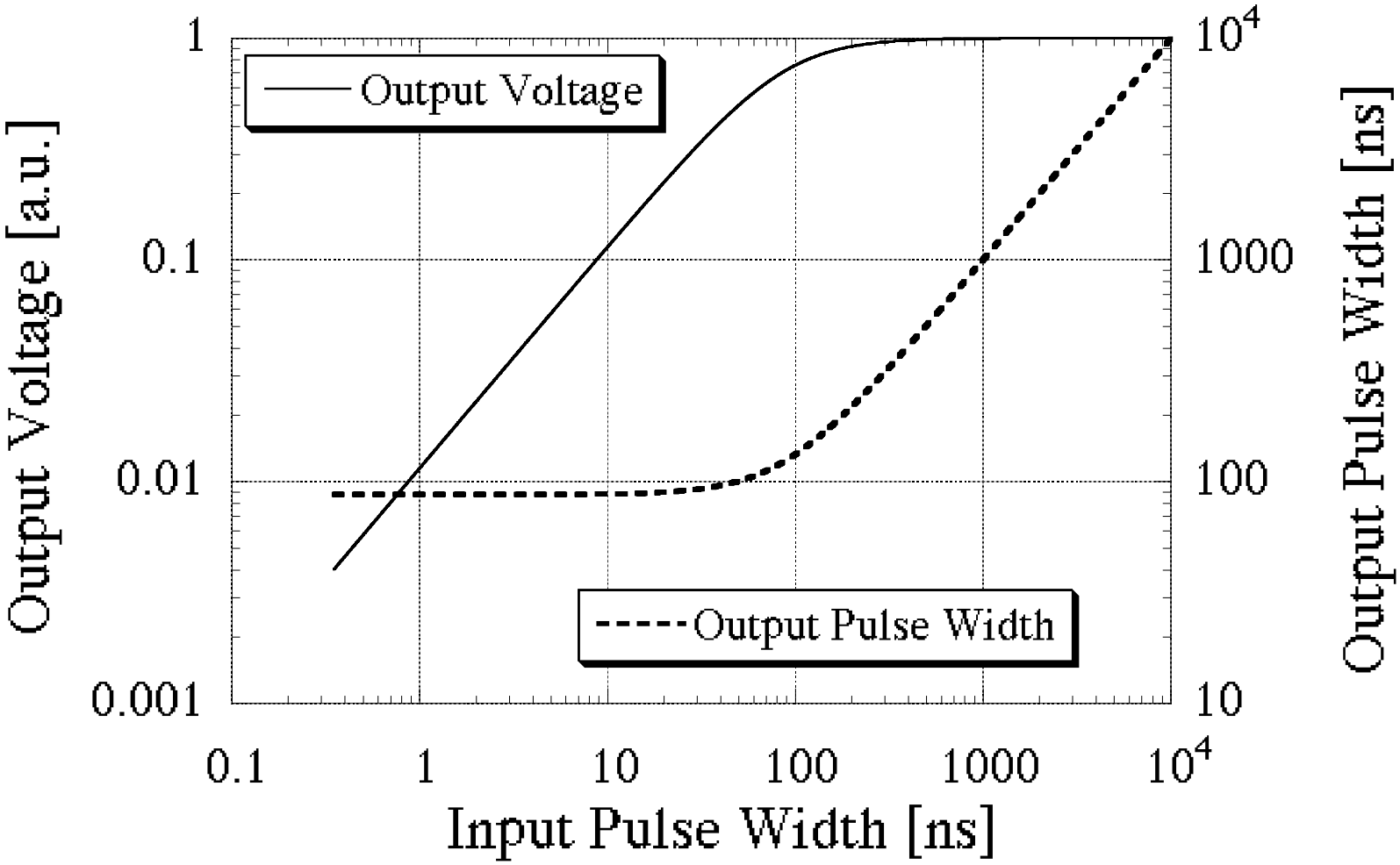


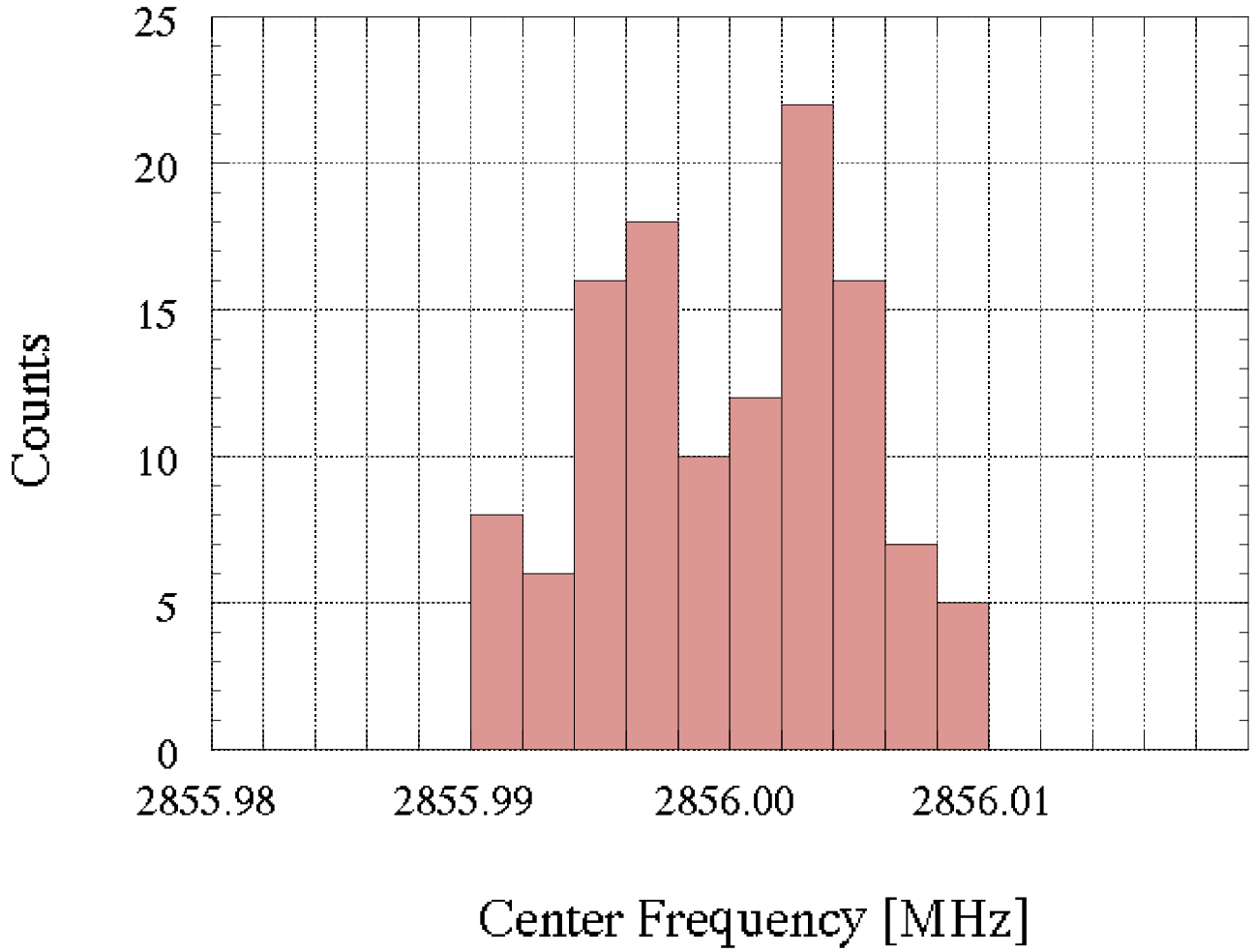
Output of the BPM. This is a waveform of single bunch beam (500 ps/div., 1 V/div.).

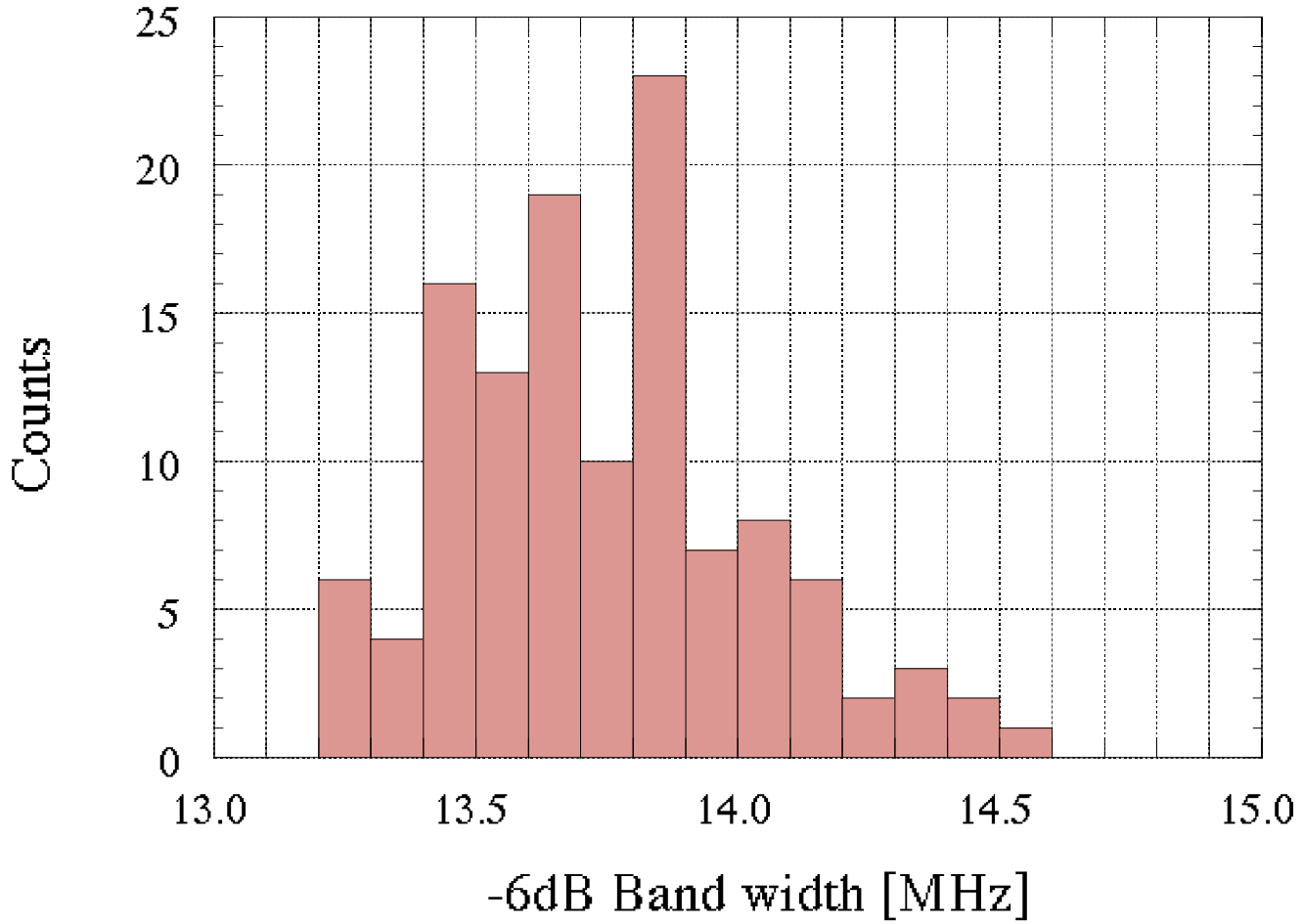

10ps
350ps

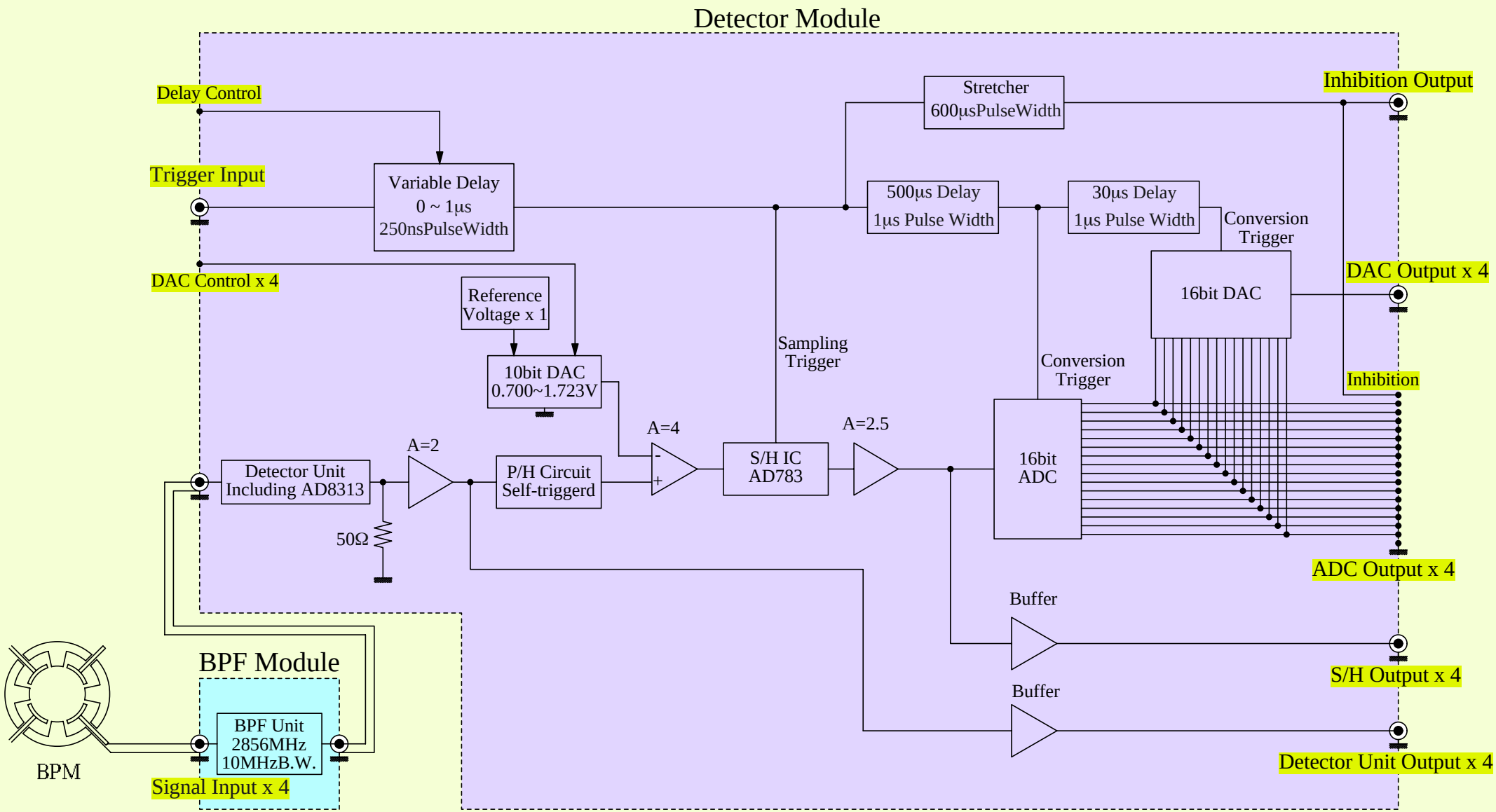

Tektronix
SCD DISPLAY UNIT
Tek
Missing data in record 1
Running
Stop
Man Trig
Res
Coarse
Vertical
Acquire
Trigger
Display
Cursors
Save/Recall
Utility
Measure



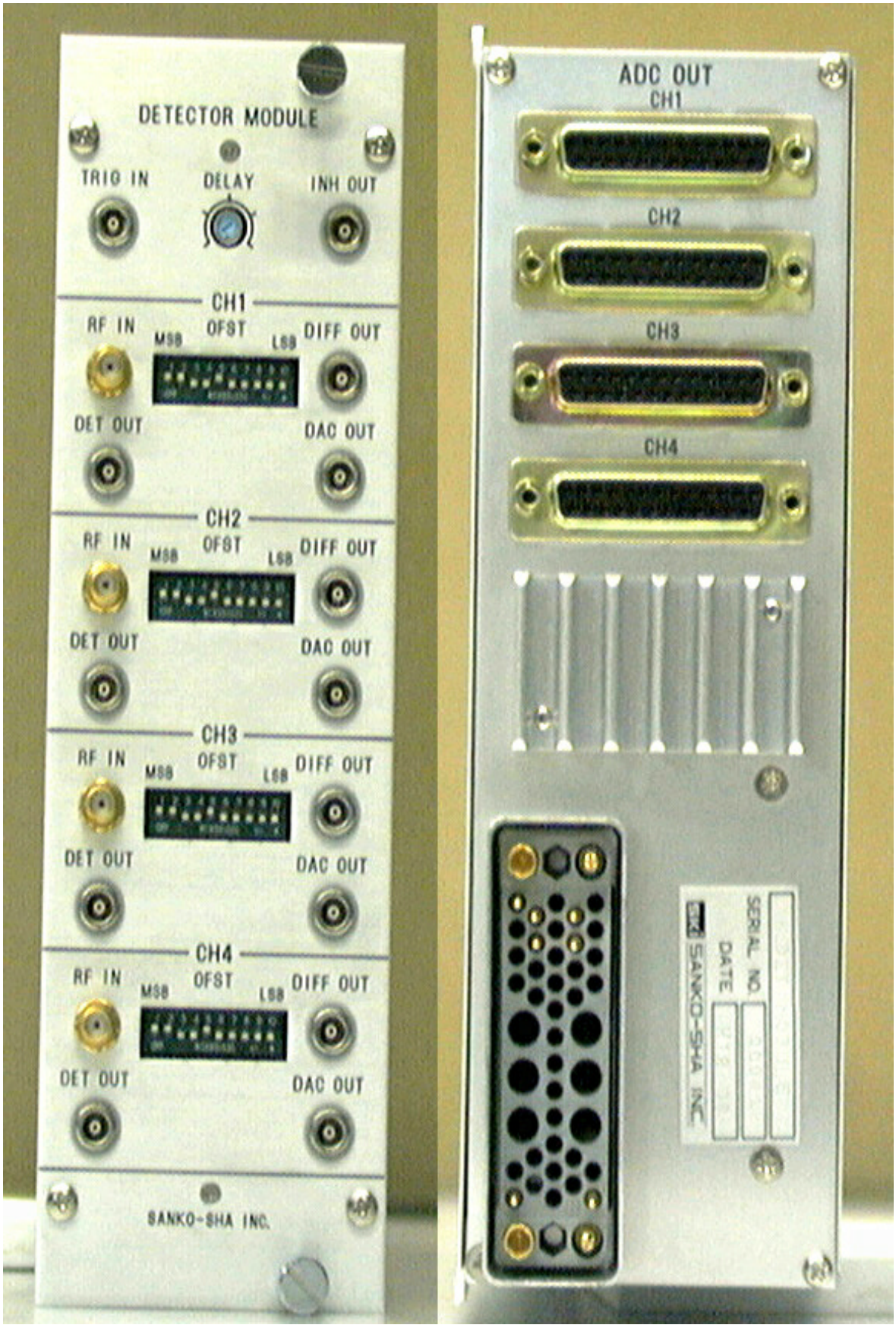

Output Voltage
Output Pulse Width
Output Voltage [a.u.]
Output Pulse Width [ns]
Input Pulse Width [ns]
1
0.1
0.01
0.001
10^4
1000
100
10
0.1
1
10
100
1000
10^4


25
20
15
10
5
0
Counts
2855.98
2855.99
2856.00
2856.01
Center Frequency [MHz]


25
20
15
10
5
0
Counts
13.0
13.5
14.0
14.5
15.0
-6dB Band width [MHz]



Block Diagram of the Signal Processor



Photograph of the detector module

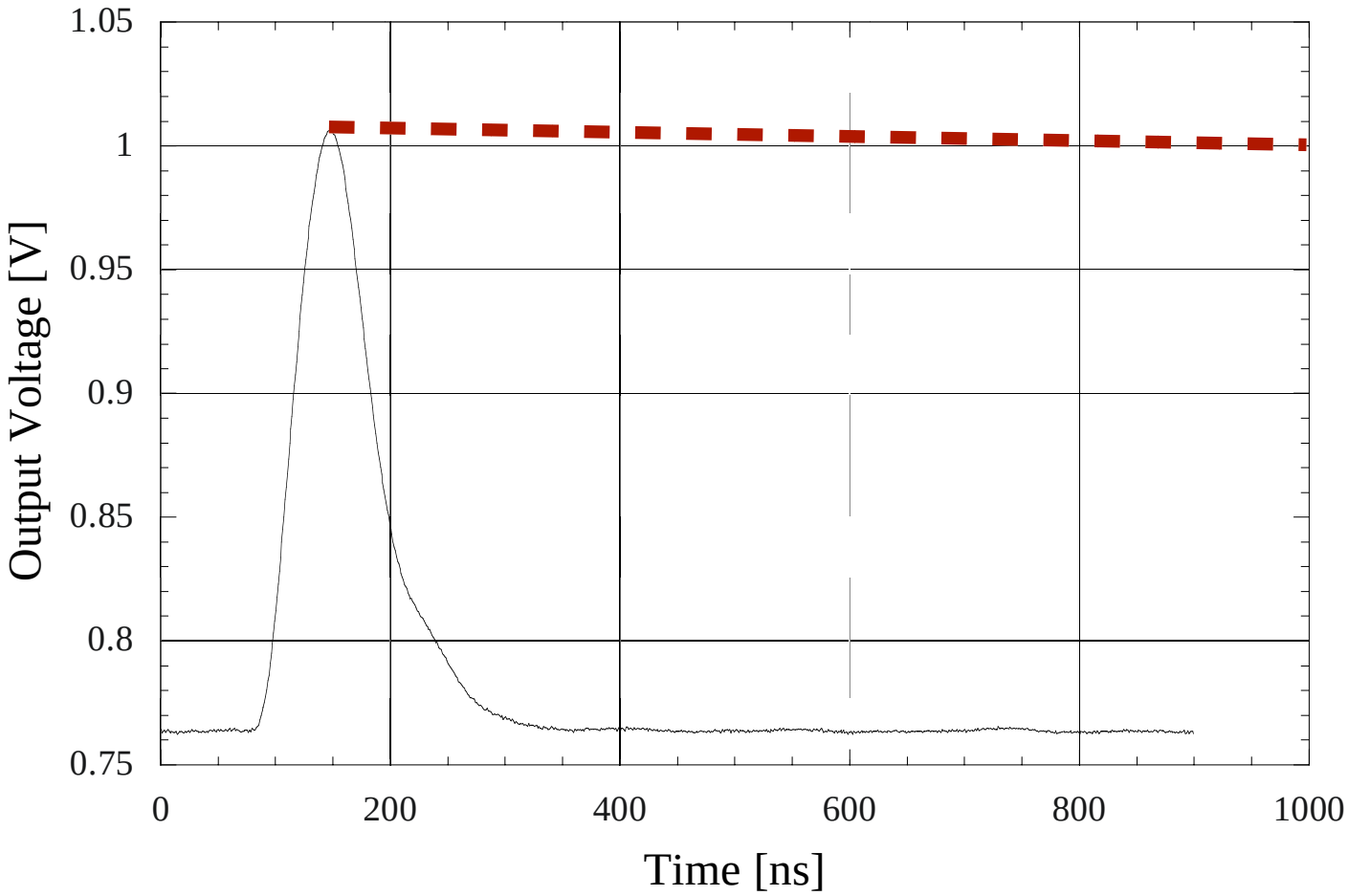


図　LOG増幅器ユニットの出力信号波形。
シングルパルス（パルス幅175ps）入力時

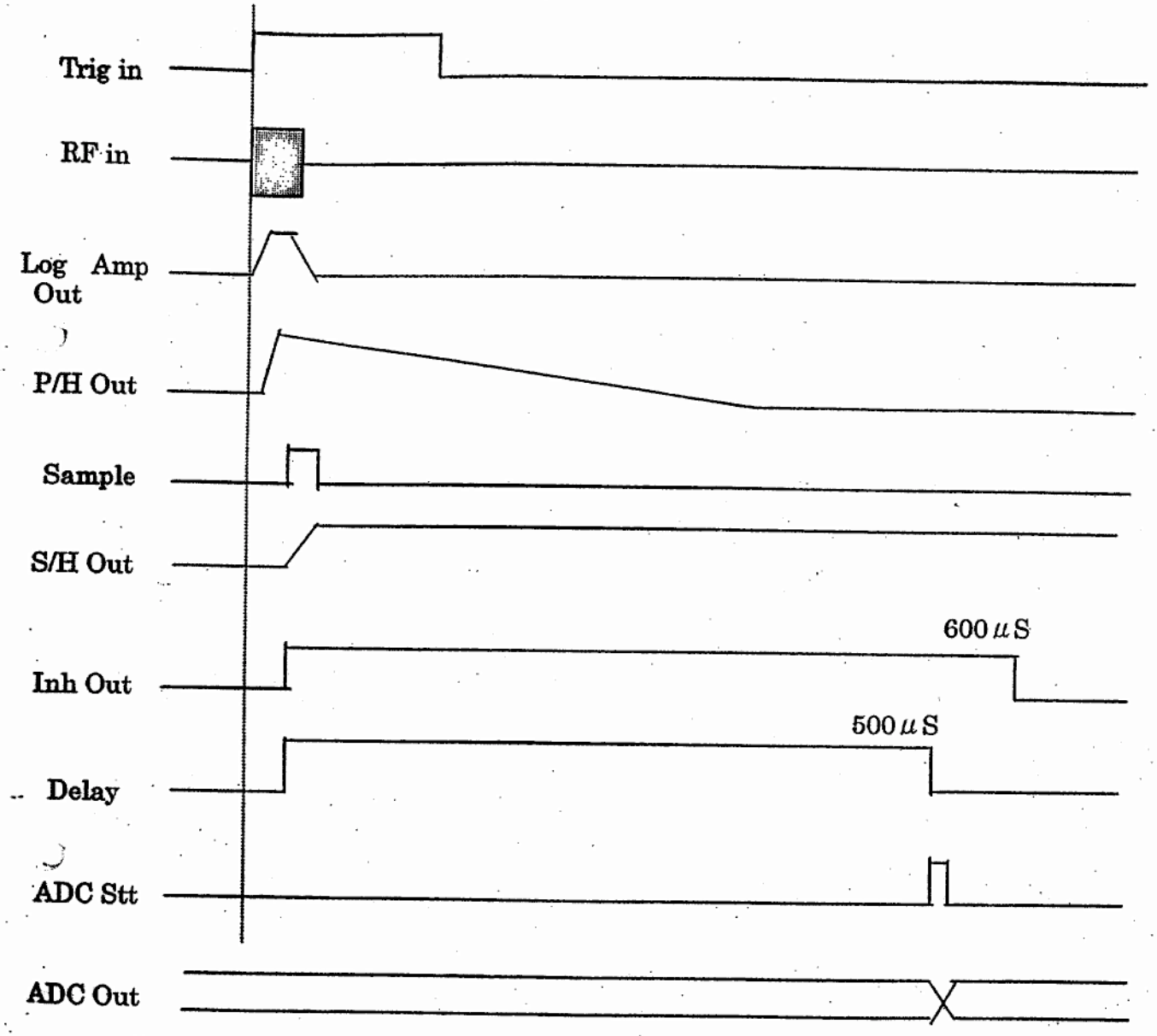
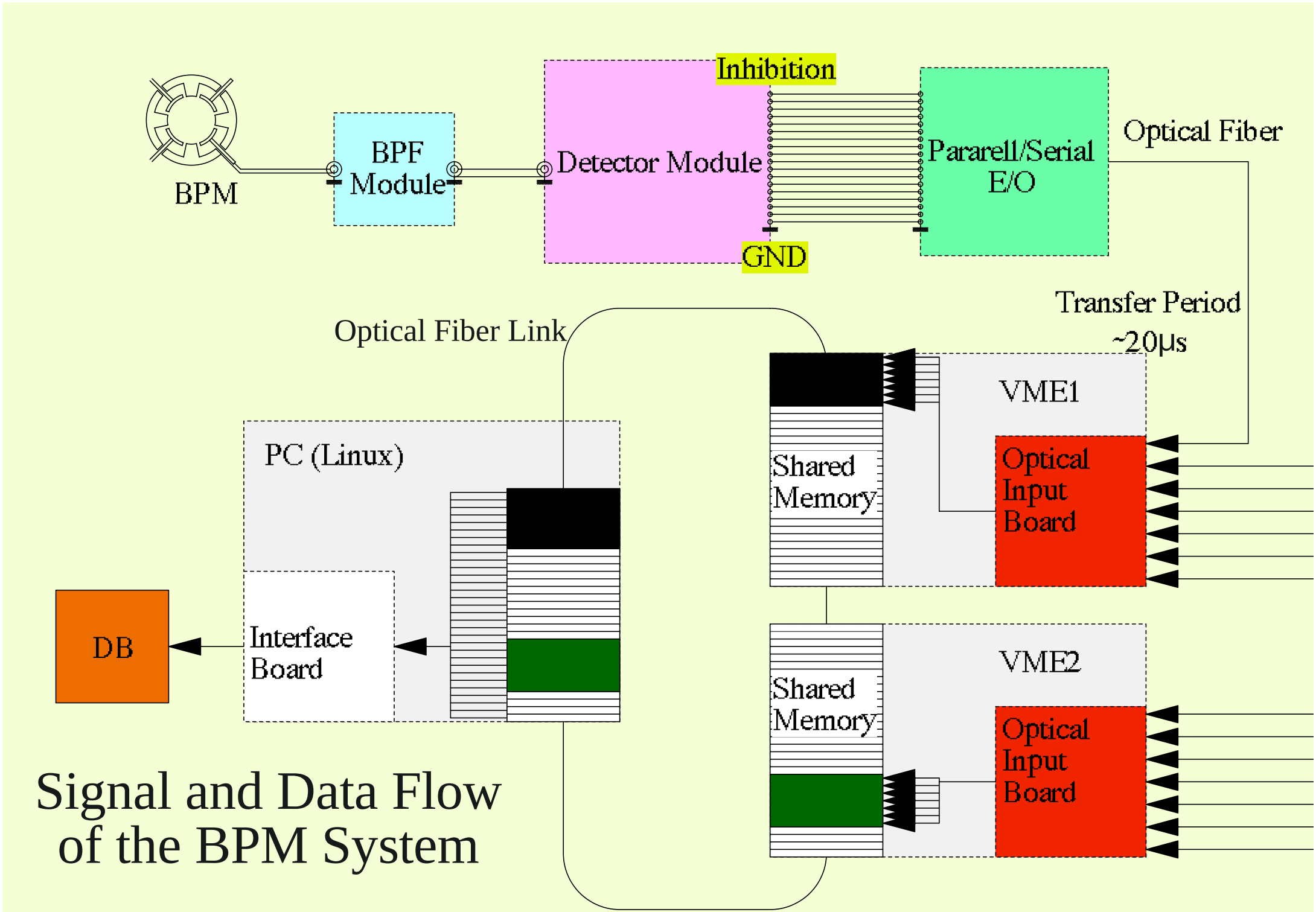
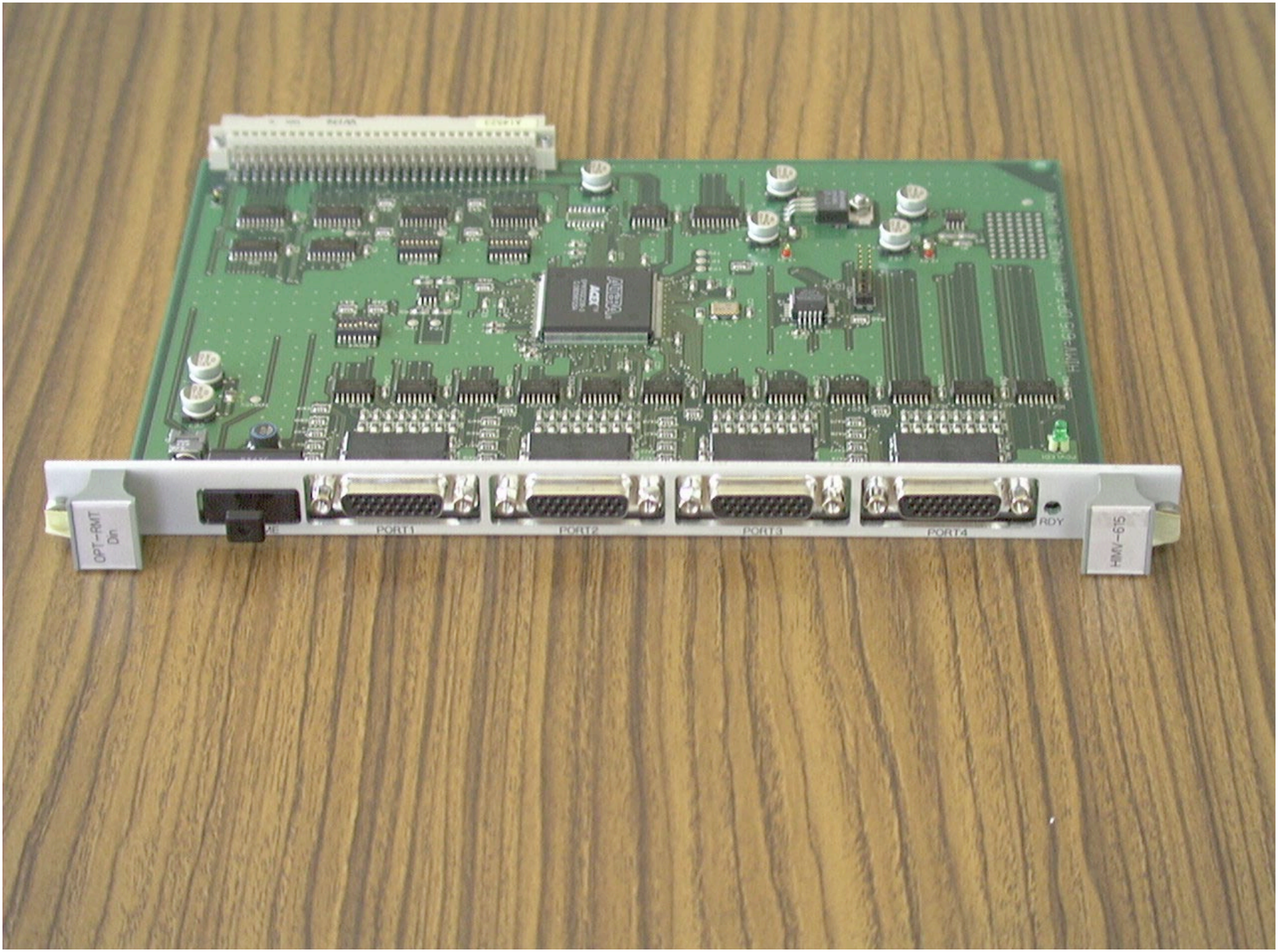
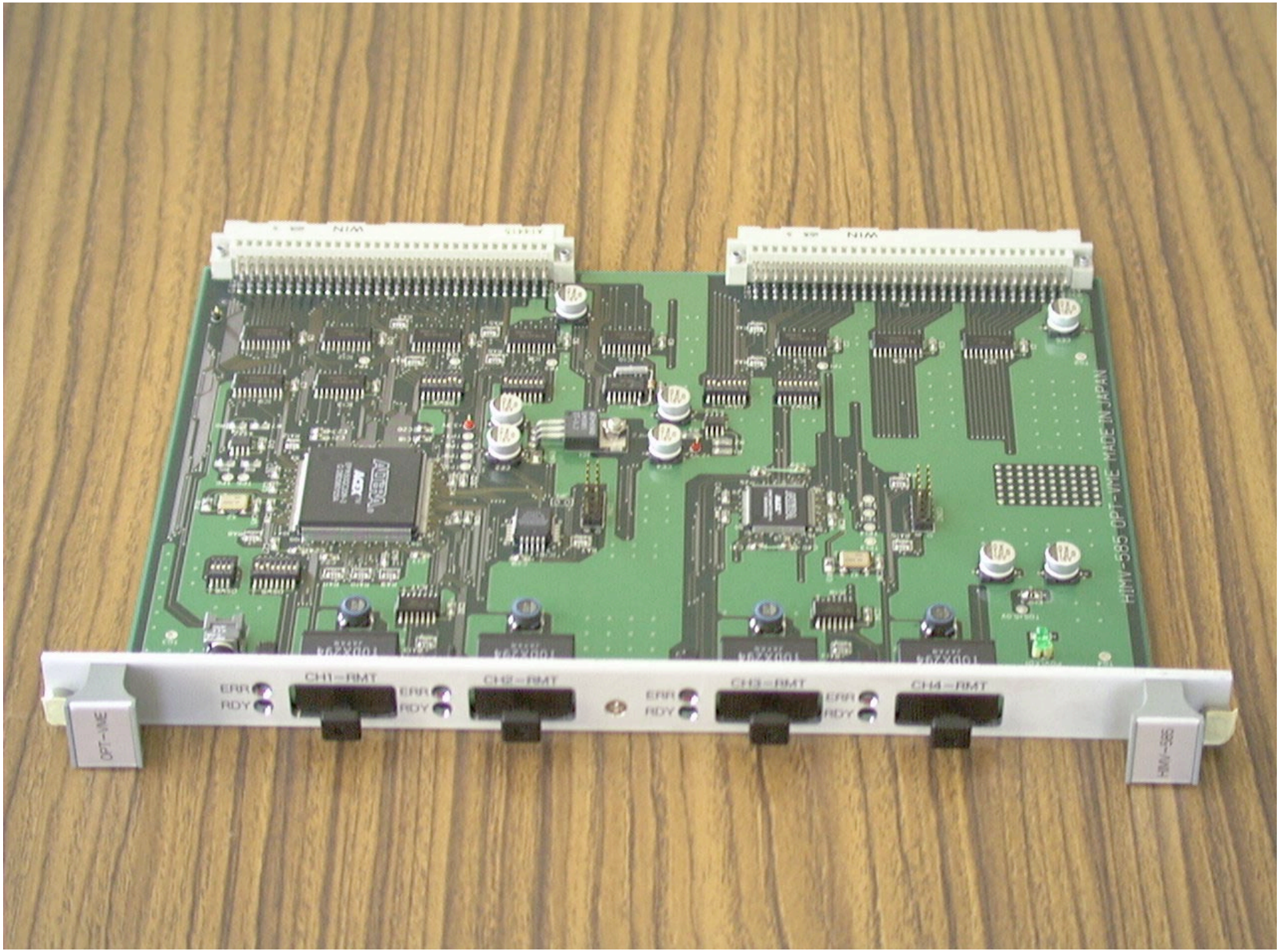


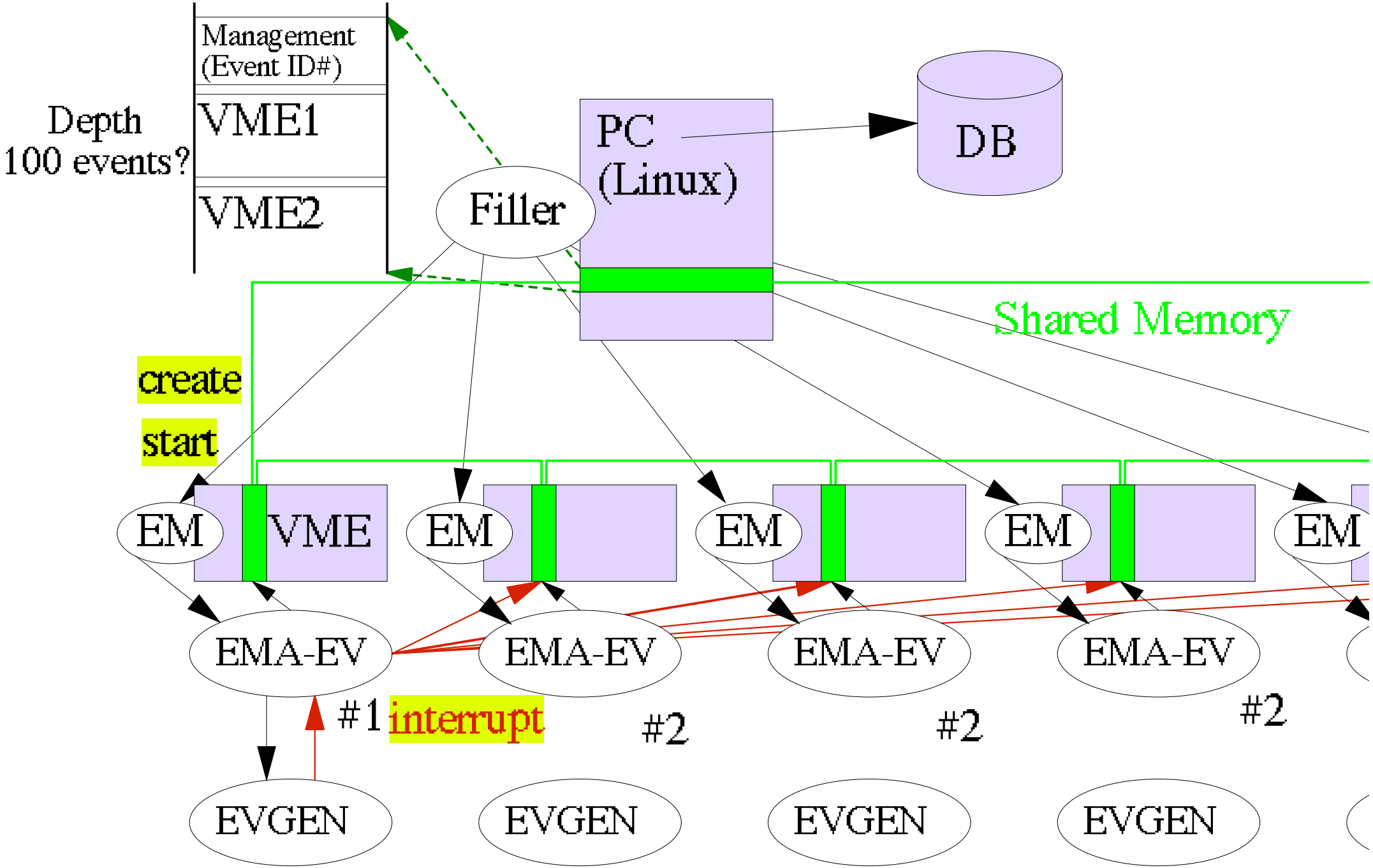
図２　タイミング・チャート

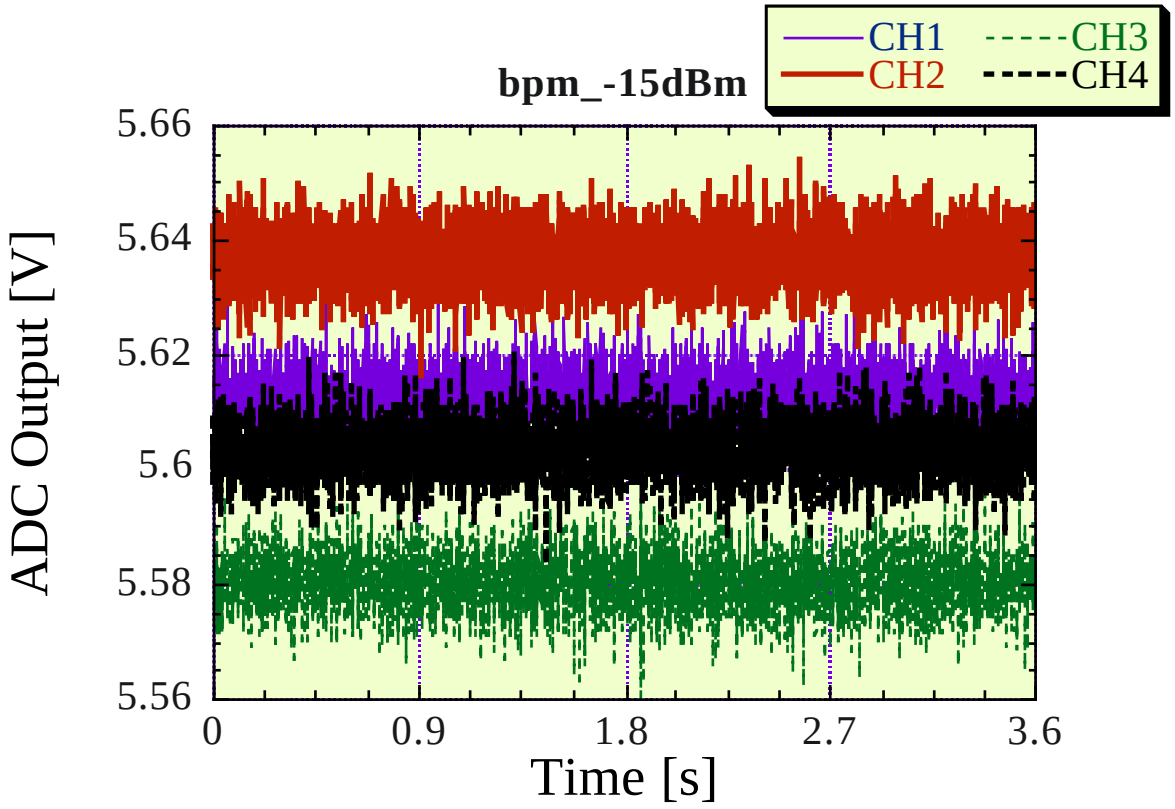


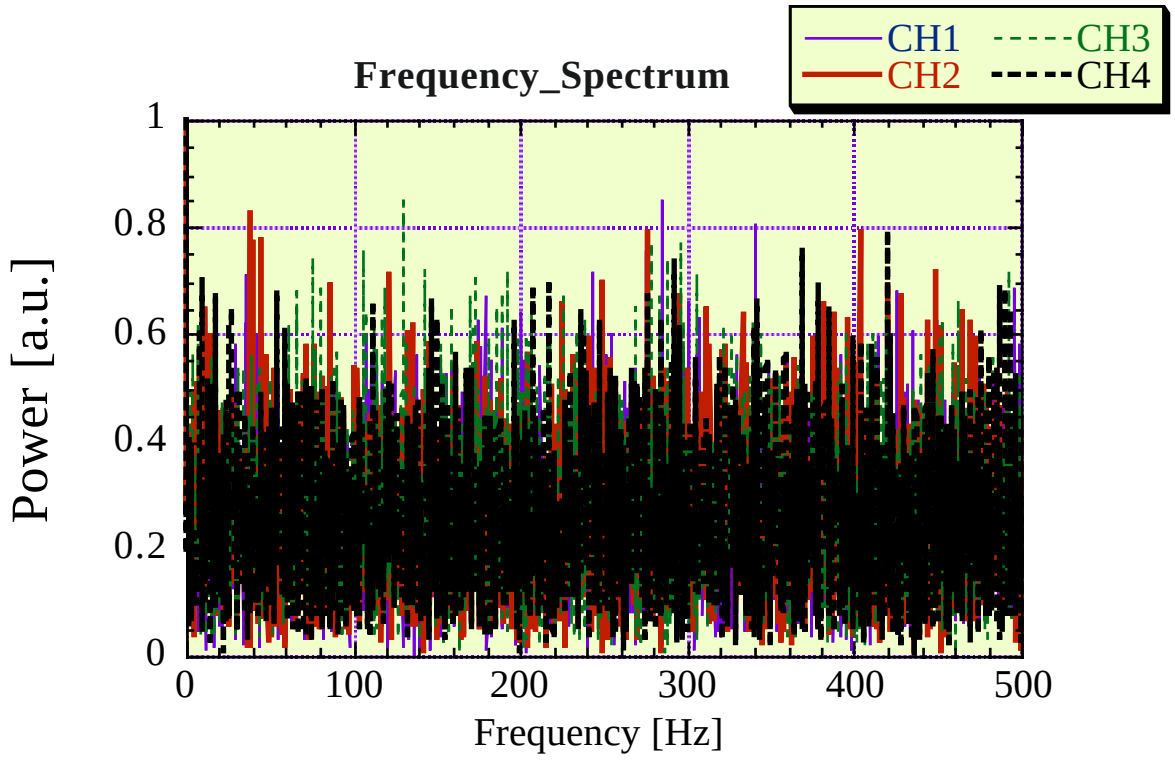
Signal and Data Flow of the BPM System


OPT-RMT
Din
PORT1
PORT2
PORT3
PORT4
RDY
HMV-615


ERR
RDY
CH1-RMT
CH2-RMT
CH3-RMT
CH4-RMT
OPT-VME
HMV-5555 OPT-VME MADE IN JAPAN


Management
(Event ID#)
VME1
VME2
Depth
100 events?
Filler
PC
(Linux)
DB
Shared Memory
create
start
EM
VME
EM
EM
EM
EM
EMA-EV
EMA-EV
EMA-EV
EMA-EV
#1
interrupt
#2
#2
#2
EVGEN
EVGEN
EVGEN
EVGEN


bpm_-15dBm
CH1
CH2
CH3
CH4
ADC Output [V]
5.66
5.64
5.62
5.6
5.58
5.56
0
0.9
1.8
2.7
3.6
Time [s]


Frequency_Spectrum
CH1
CH2
CH3
CH4
Power [a.u.]
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
500
Frequency [Hz]

Summary

- Non-Dispersive Section BPM → O.K.
- Dispersive Section BPM → Under Study
- 10MHz BPF → O.K.
- Log-Amp. Signal Processor → O.K.
- Fast Data Acquisition (1kHz) by VME → O.K.
- Data Acquisition System (60Hz) → Under Development