

Progress Report of Electronics for Fast Luminosity Monitor

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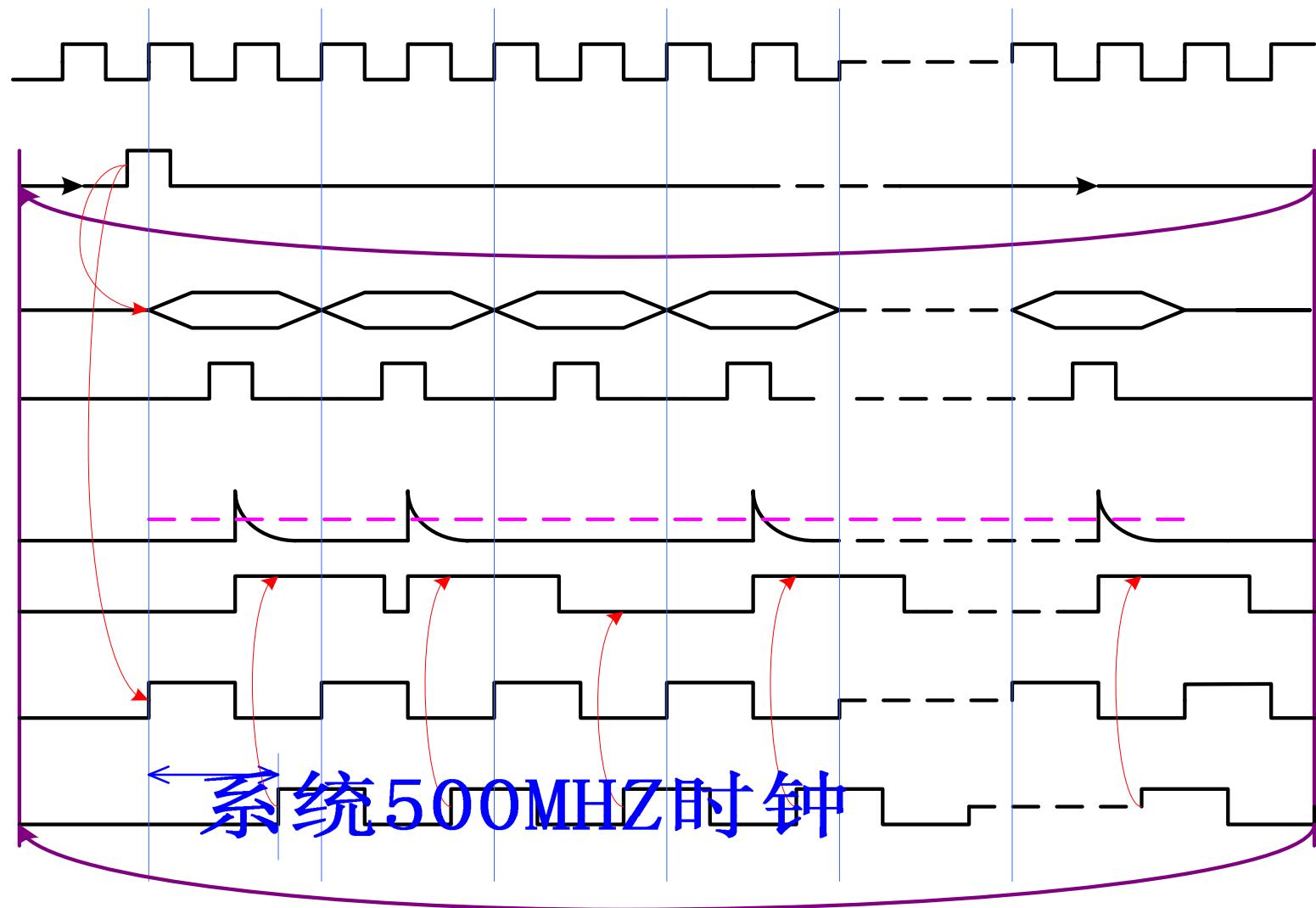
Fast Luminosity Monitor for BEPCII(1)

- Target of Fast Luminosity Monitor :
 - Luminosity for each bunch
 - Fast updating speed for beam adjusting, e.g. once per second.
 - Luminosity range: $10^{28} - 10^{31} \text{ cm}^{-2} \text{ s}^{-1}$ / bunch
- Fast Monitoring is based on
 - Radiation Bhabha process: $e^+ e^- \rightarrow e^+ e^- \gamma$, counting γ rate for luminosity
 - 0 degree detecting: $1/\gamma \sim 0.3 \text{ mrad}$ @ 1.89 GeV
 - Bigger reaction section for fast updating
 $\sim 400 \text{ mb}$ when $k_{\min} = 0.001 E_b$

Fast Luminosity Monitor for BEPCII(2)

- The number of bunches per circle: $93 \times 2 = 186$,
the time between bunches is $8\text{ns}/2 = 4\text{ns}$
- The energy range of γ : $0.05\sim 1.89\text{GeV}$, the
dynamic range of the output of detector signal:40
 - Demand fast response PMT
 - Fast front-end electronics, fast Bunch-by-Bunch counter
and land distance signal transmission.
- Limited space for installation, radiation shielding...

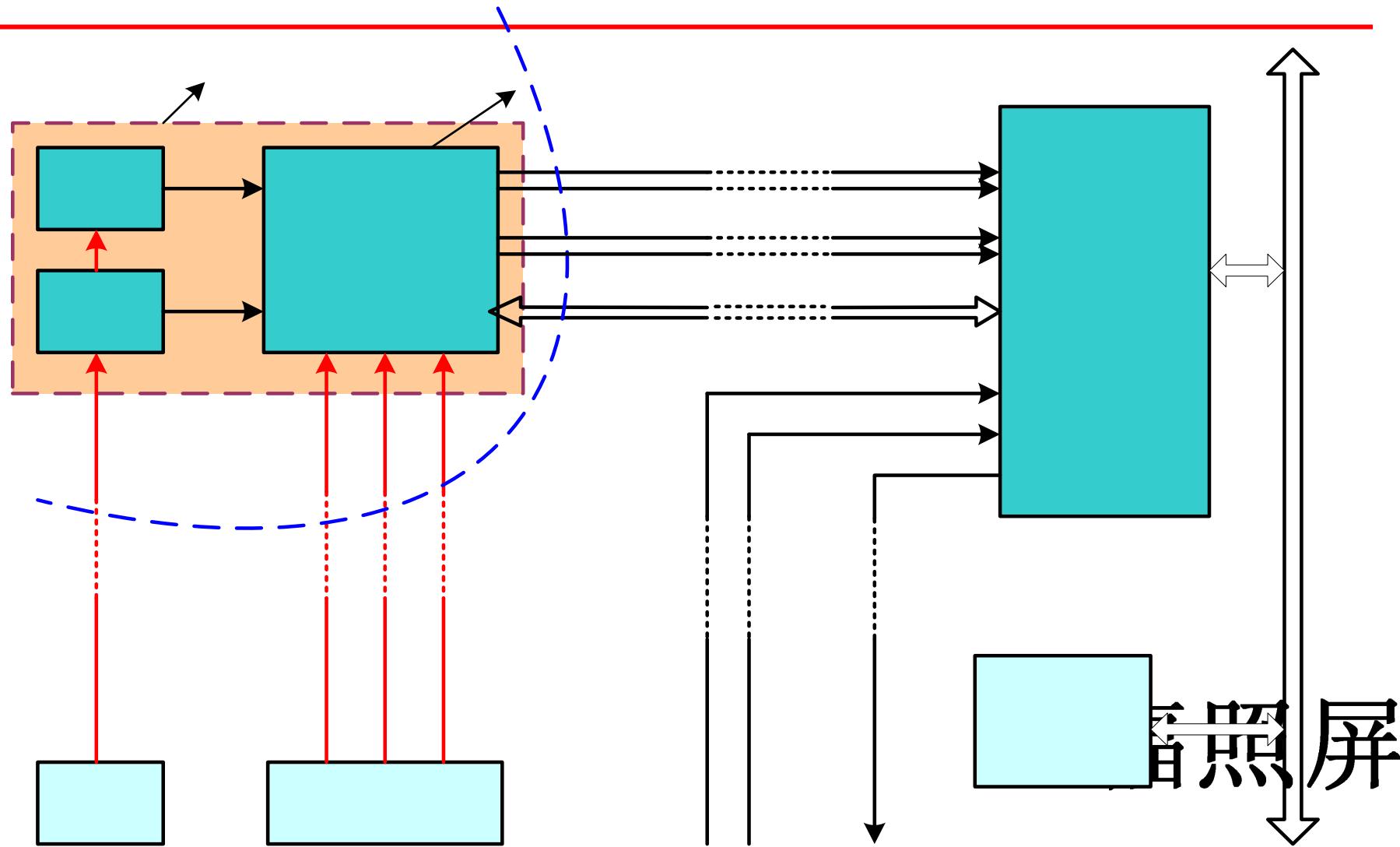
Fast Luminosity Monitor for BEPCII(3)

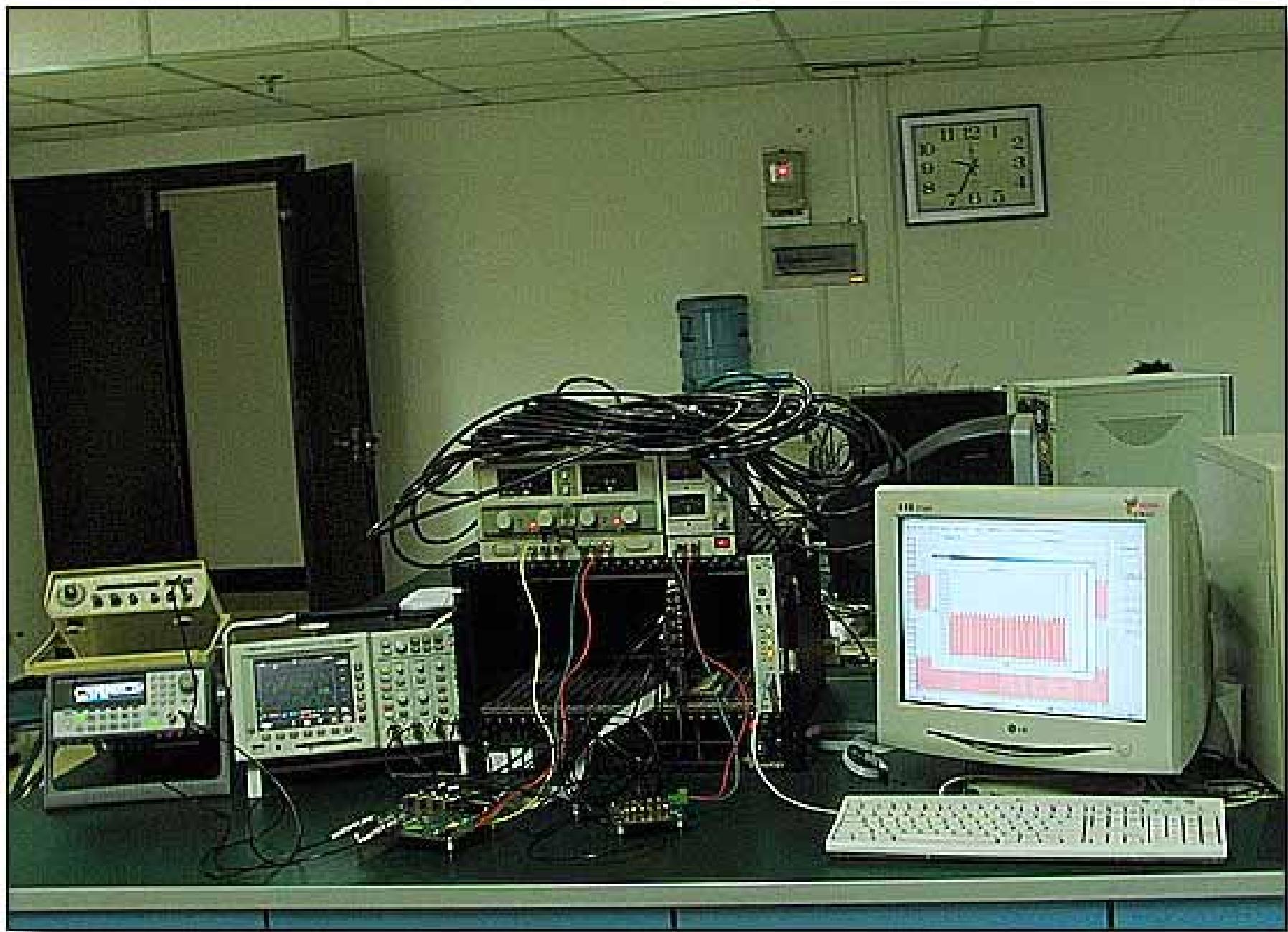


LM Electronics System(1)

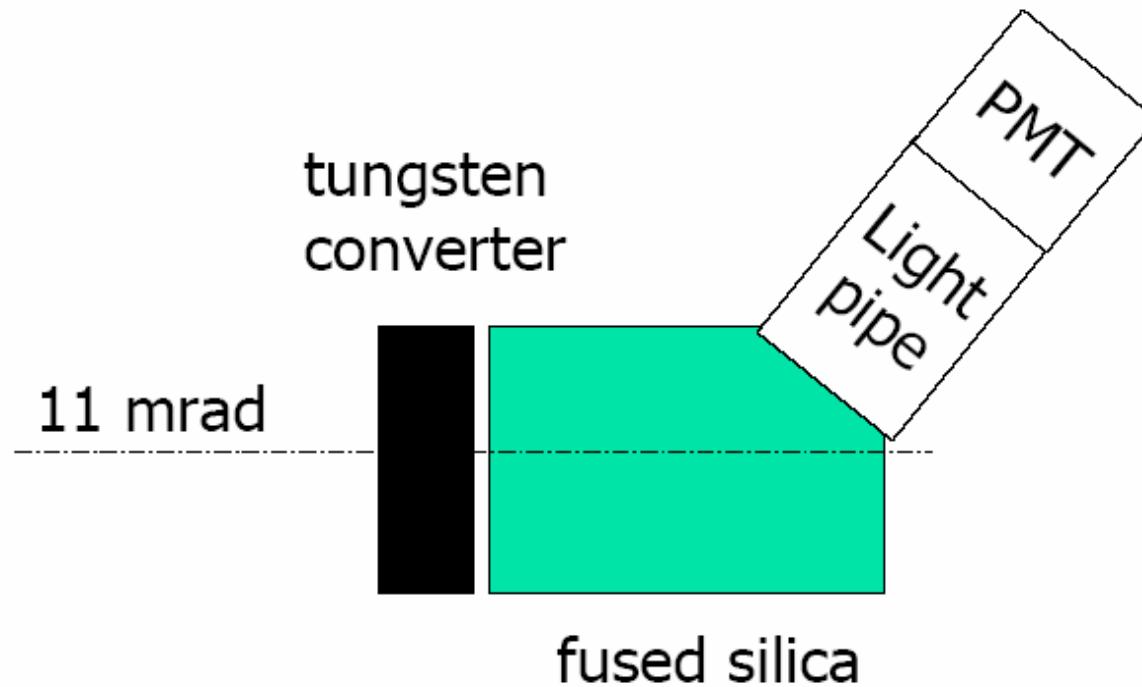
- Front-end electronics:
 - Amplifier for PMT output signal: Bandwidth >250MHz
 - Programmable threshold-controlled comparator
 - Two channels
 - Interface for long-distance signal transmission
- Bunch-by-bunch counter (CAMAC module and PC)
 - Anti-coincidence
 - Luminosity signal sampling within a time-window
 - Bunch-by-Bunch fast counter
 - output of luminosity signals integration
 - Digital signals output to control the threshold of comparator
 - Software on PC, human interface (Bunch luminosity display, parameters setting ...)
- Long-distance signals transmission
 - LVDS digital signal transmission
 - Luminosity signal, anti-coincidence signal transmission

LM Electronics System(2)



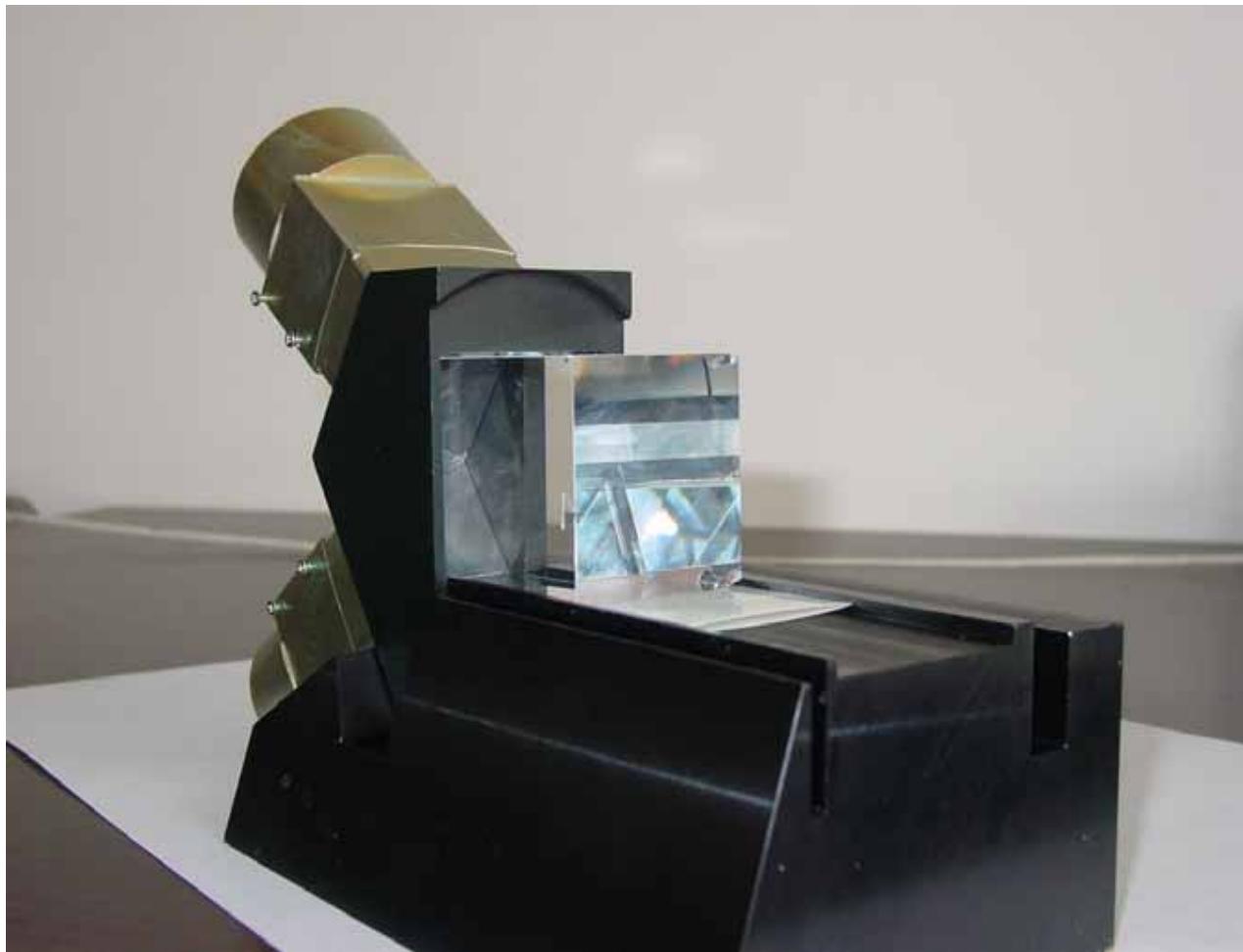


Detector

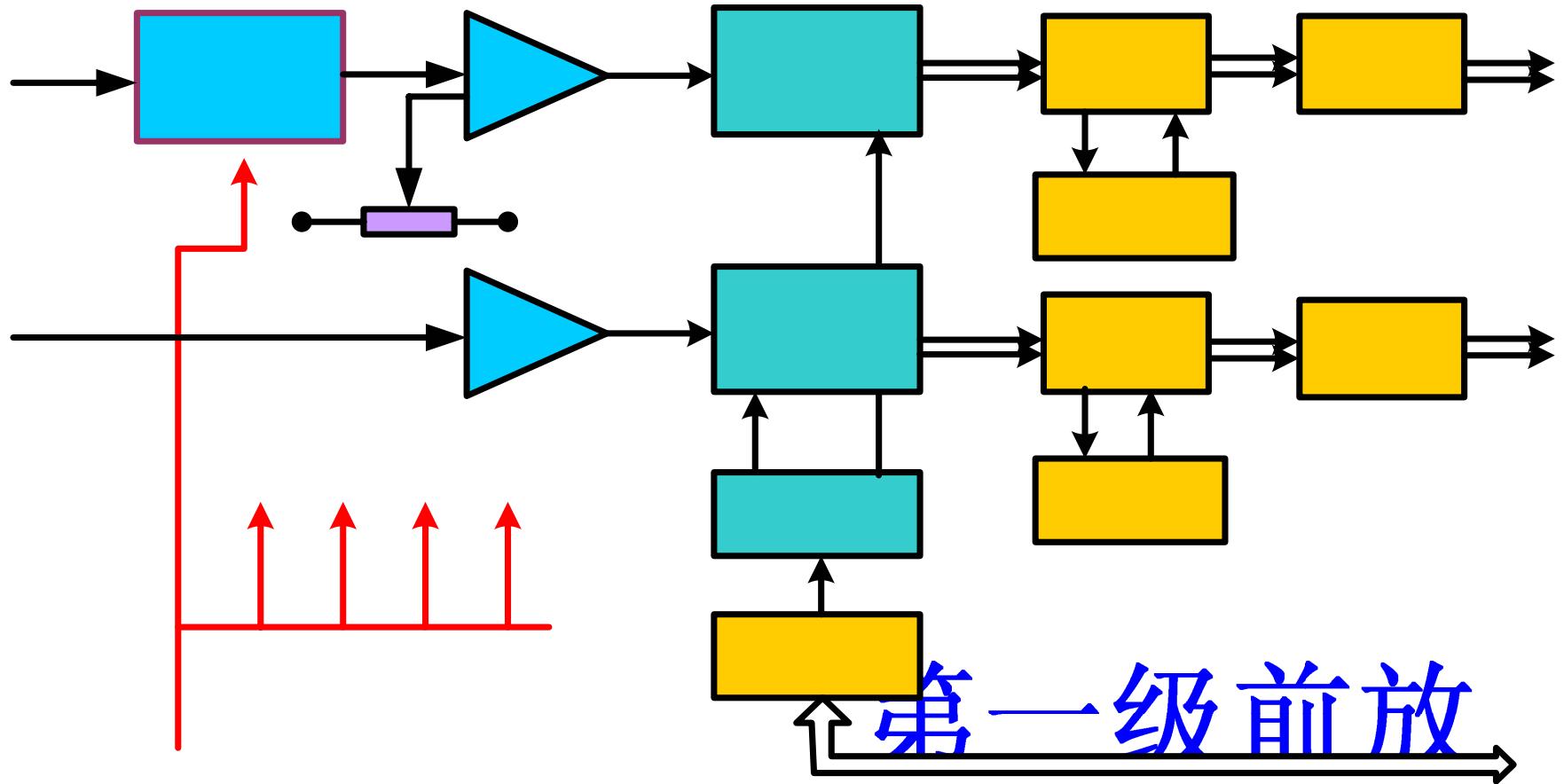


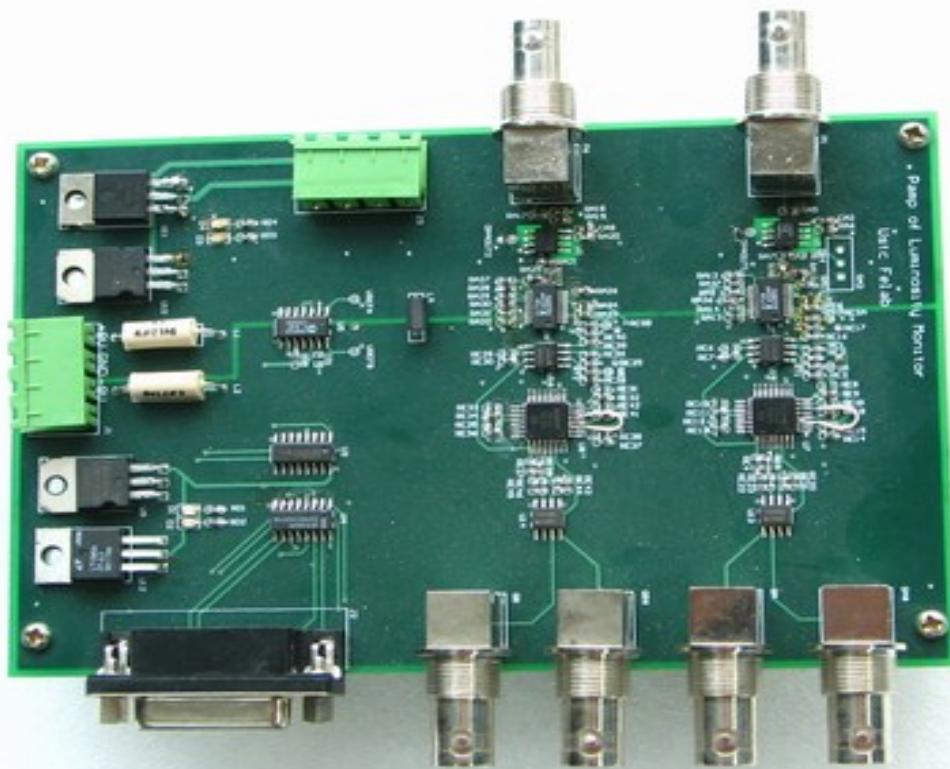
Will be surrounded by lead shielding

Detector

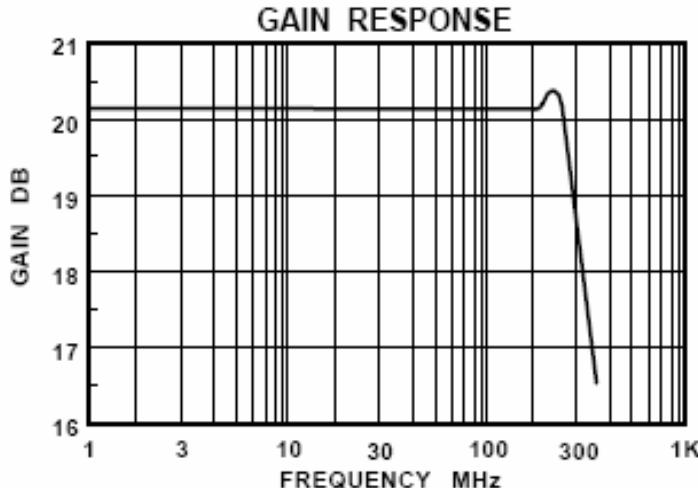


Front-end Electronics





Pre-Amplifier: model 6950



- Bipolar amplifier: Voltage Gain=10, Non-inverting
- Bandwidth: DC~300MHz
- 1 input, 50 ohms DC coupled
- 2 outputs; $\pm 2V@50$ Load
- DC offset control
- Inputs and outputs protection
- Powers: ± 8 volts to ± 28 Vs

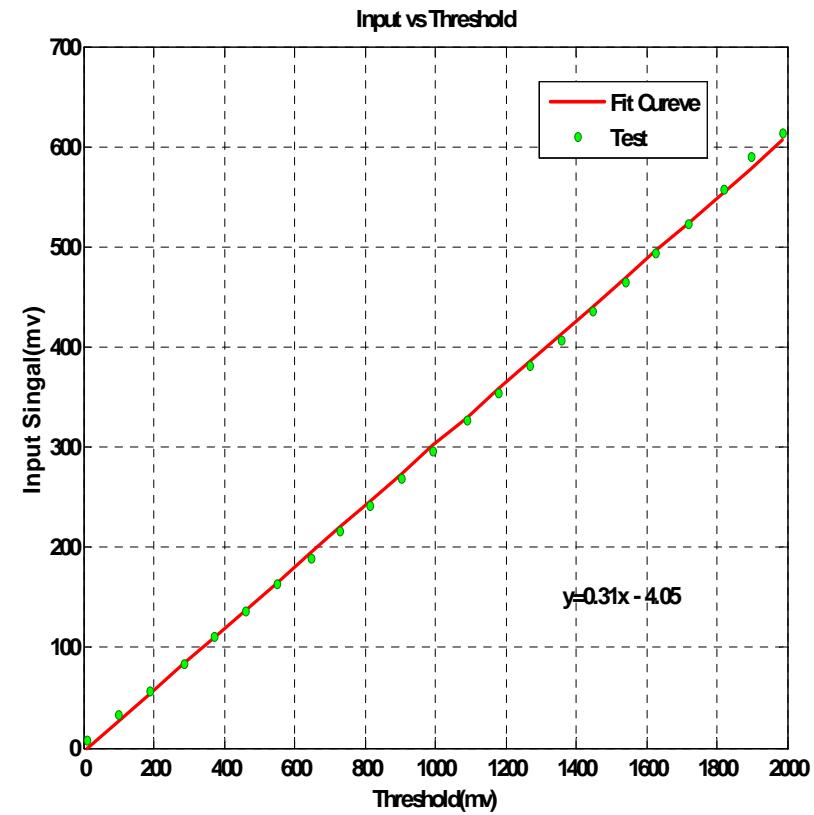
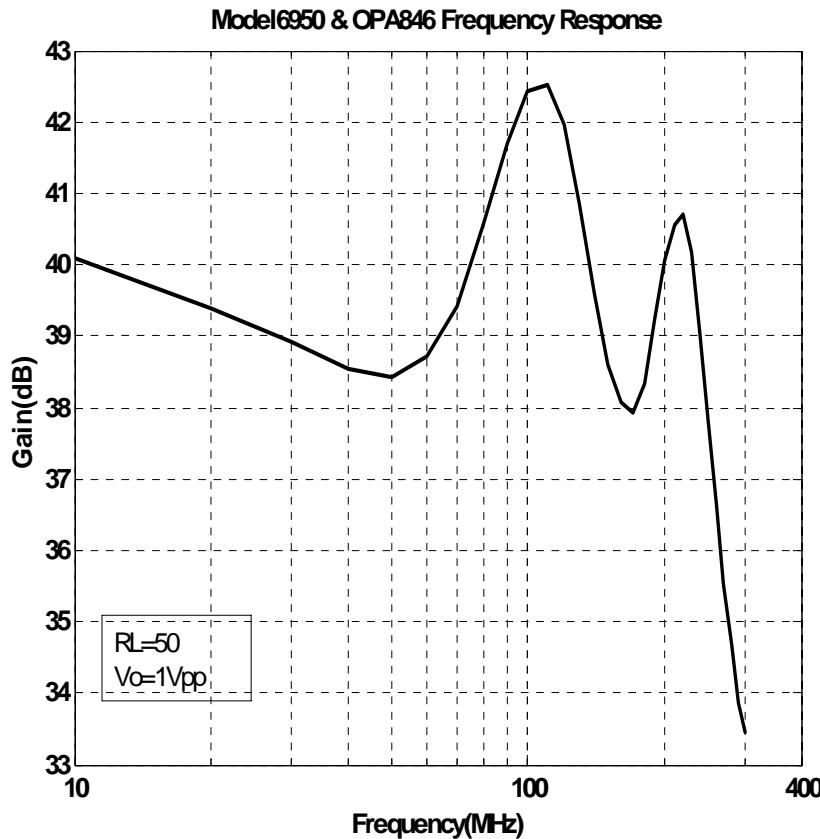
Main components of Front-end

- The second amplification: Gain= 10
 - OPA846:VFB, GBP=1.7GHz, 400MHz@G=+10, Acl=7.
 - OPA847:VFB, GBP=3.9GHz, Acl=12, 500MHz@G=-20.
 - OPA695:IFB, 1.7GHz@G=1, 1.4GHz@G=2, 450MHz@G=8
 - AD8000:IFB, 1.5GHz@G=1, 650MHz@G=2, 350MHz@G=10
- Comparator: ADCMP562(dual comps)
 - LVPECL output , 700ps minimum input pulse width , Bandwidth 1.5GHz, output rise/fall time 500ps , programmable Hysteresis.
- Threshold controlled by : AD8522 (DAC)
 - Dual 12bits DAC, output voltage range:0-4.095V
- LVDS digital format for control signals transmission
 - DS90C031B : 4 LVDS transmitter,155Mbps
 - DS90C032B : 4LVDS receiver , 155Mbps

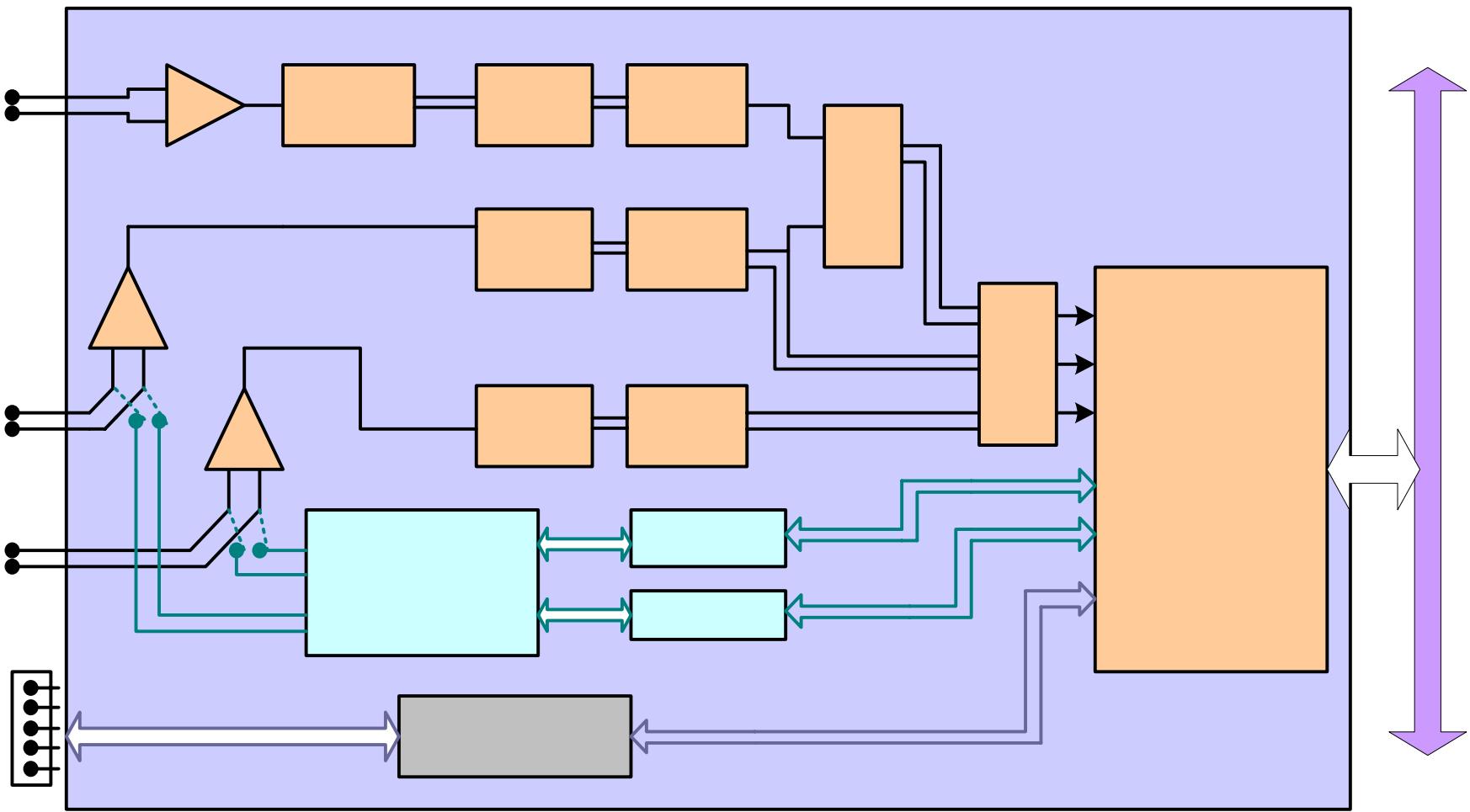
Performance of Front-end

- One channel for luminosity signal, One channel for anti-coincidence
 - Two stages amplification: PHLIPS MODEL6950 and OPA846 , the maximum amplification 100.
 - Anti-coincidence signal amplified by AD8000 (only one stage)
- Testing of luminosity :
 - **Bandwidth : >250MHz (> 300MHz if we use AD847) , PP value of noise < 5mV**
 - **Linearity of comparator (see drawing below) , dynamic range 10mV—2V**
 - **LVPECL luminosity signal transmission : 30m with the differential LVPECL signals**
 - **LVDS threshold-controlled signals testing : 30m by unshielded twist-pair.**
 - **The bandwidth of anti-coincidence channel >450MHz**

Bandwidth & linearity

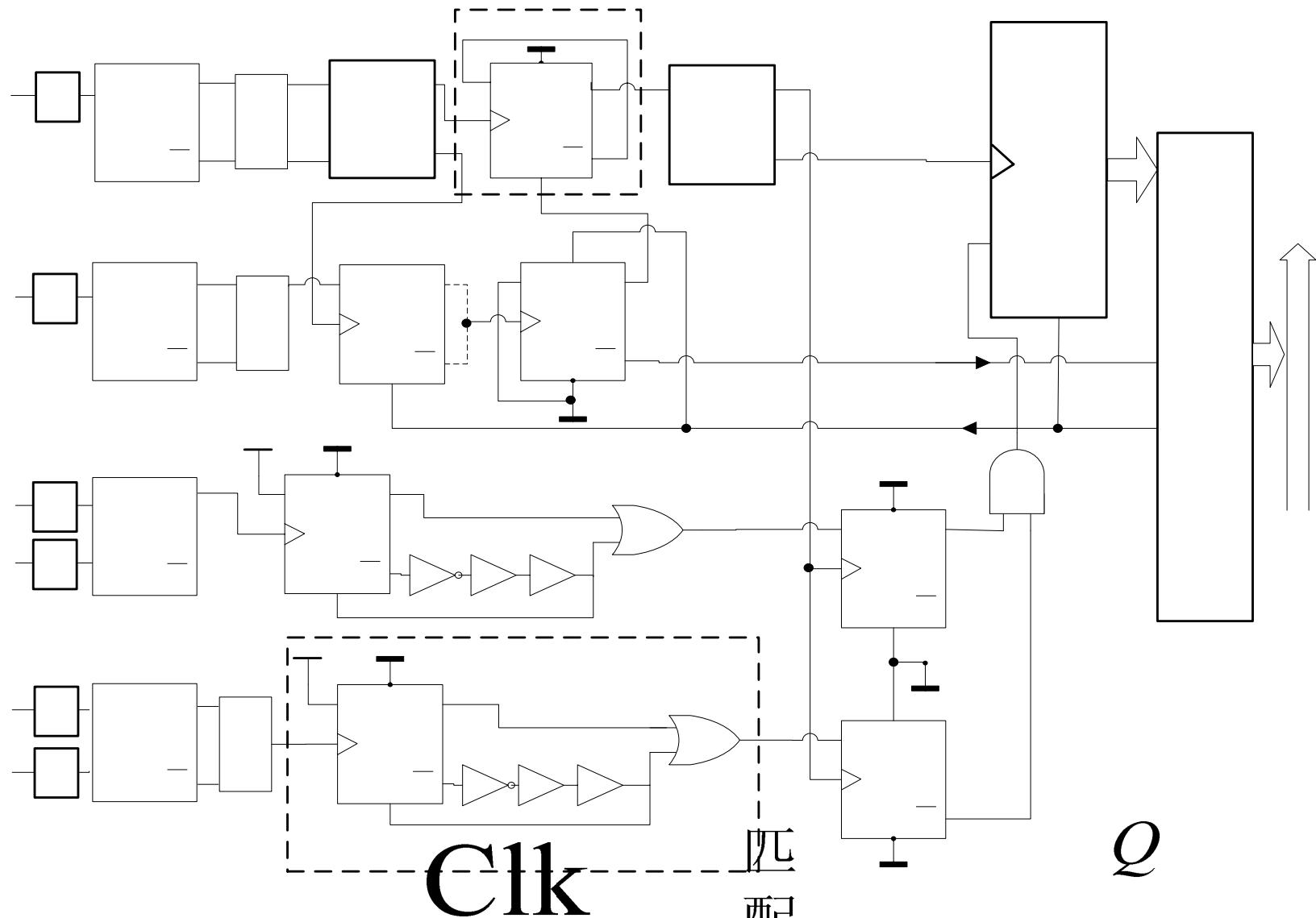


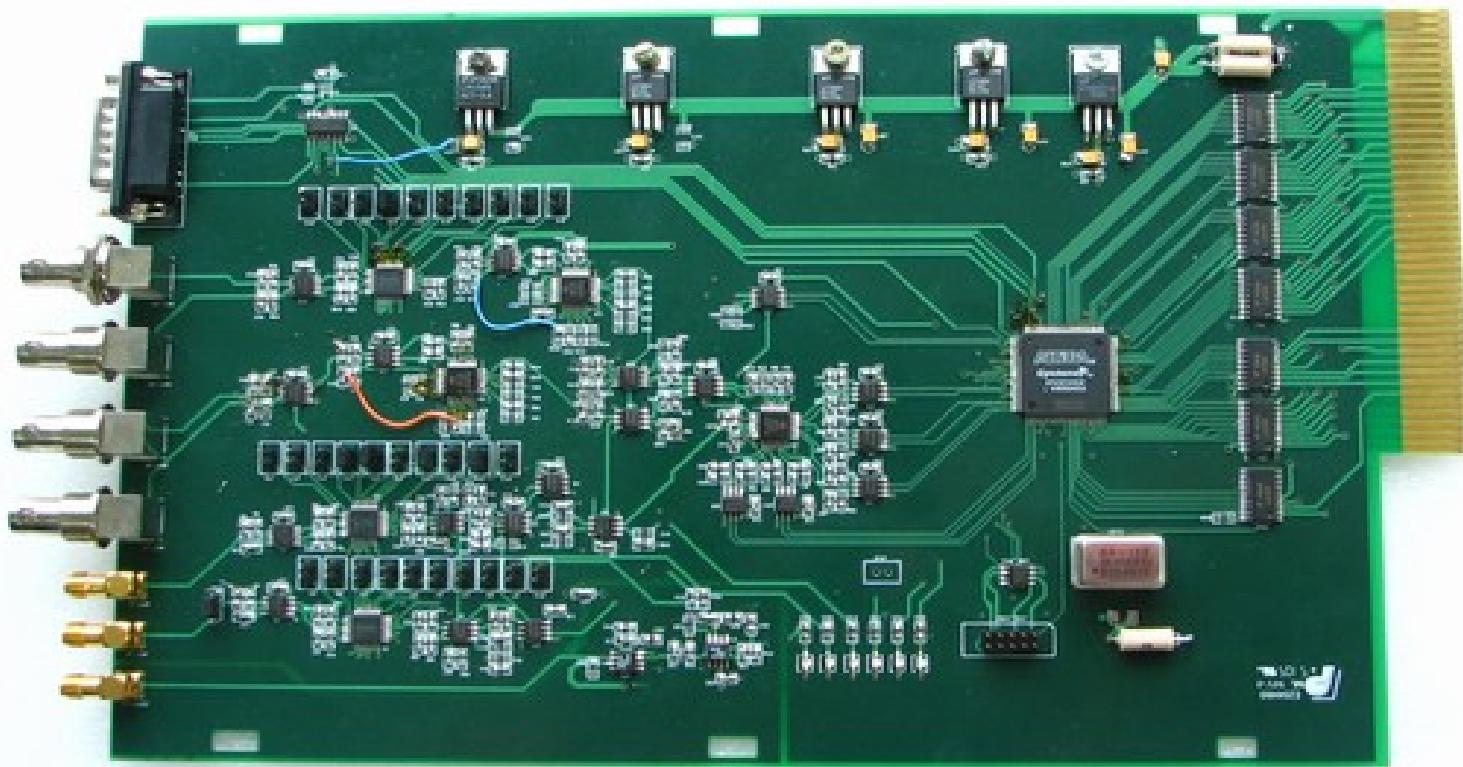
Bunch-by-bunch Counter:8ns



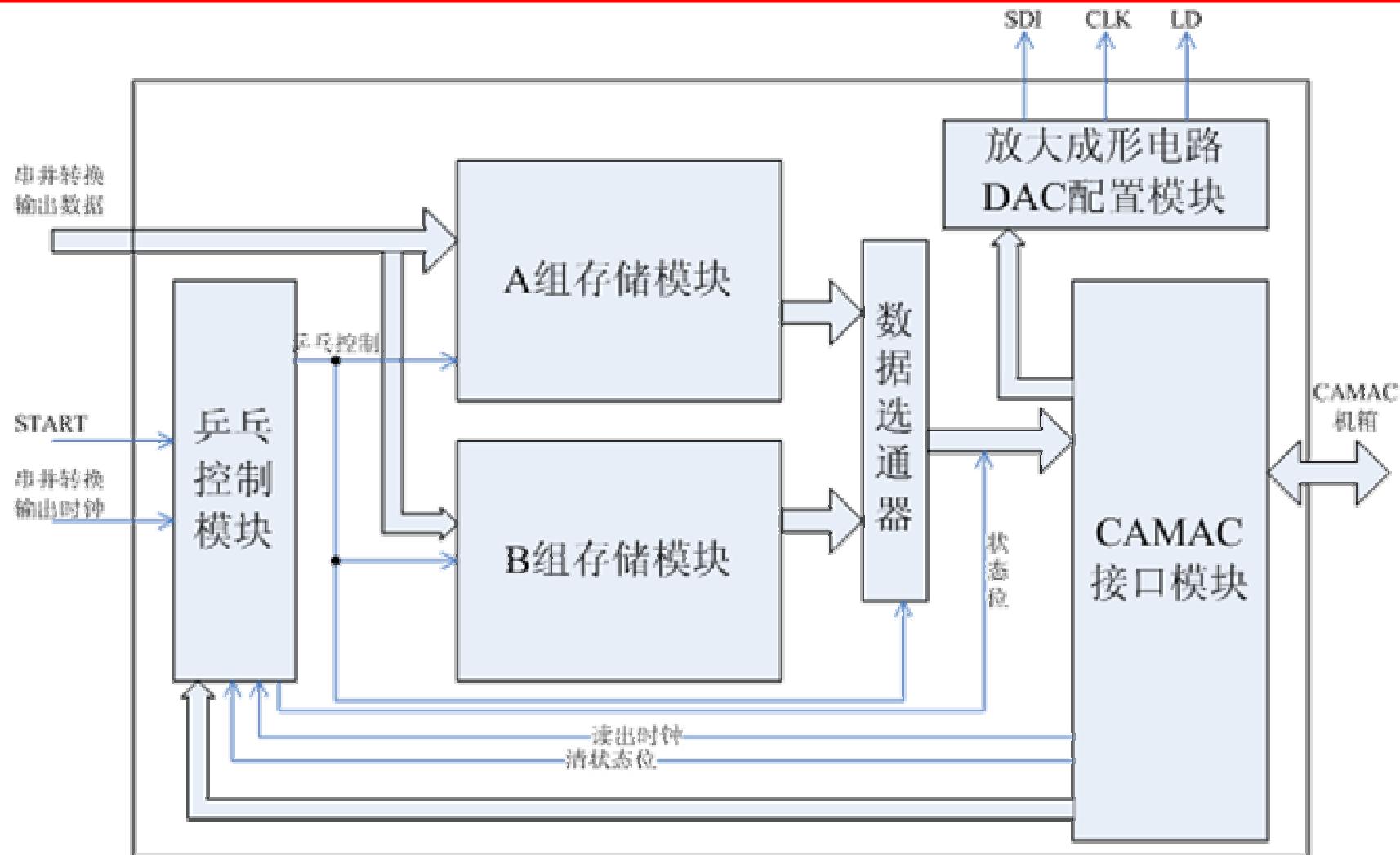
LUM Sig

Bunch-by-Bunch counter:4ns

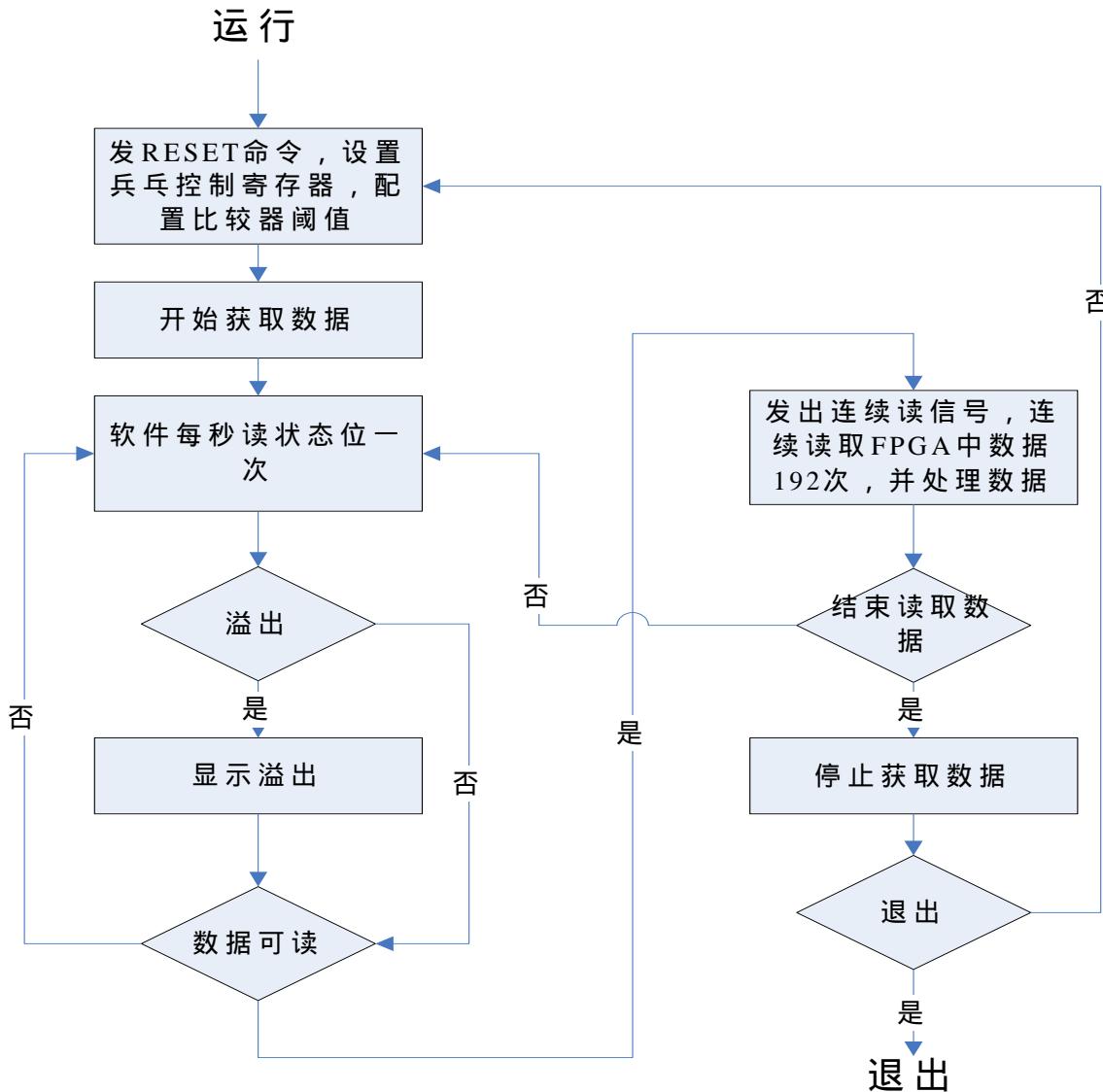




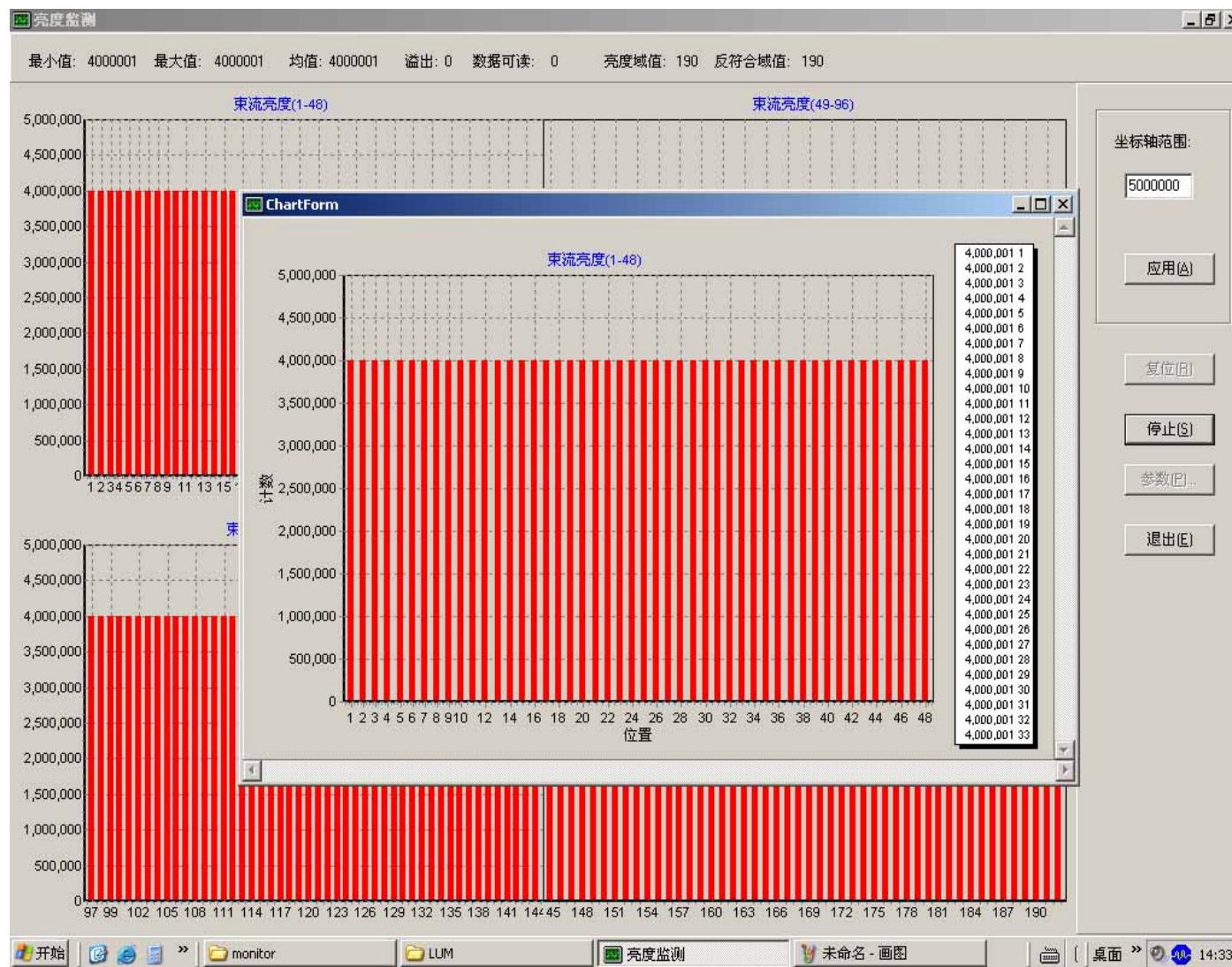
Functions in FPGA



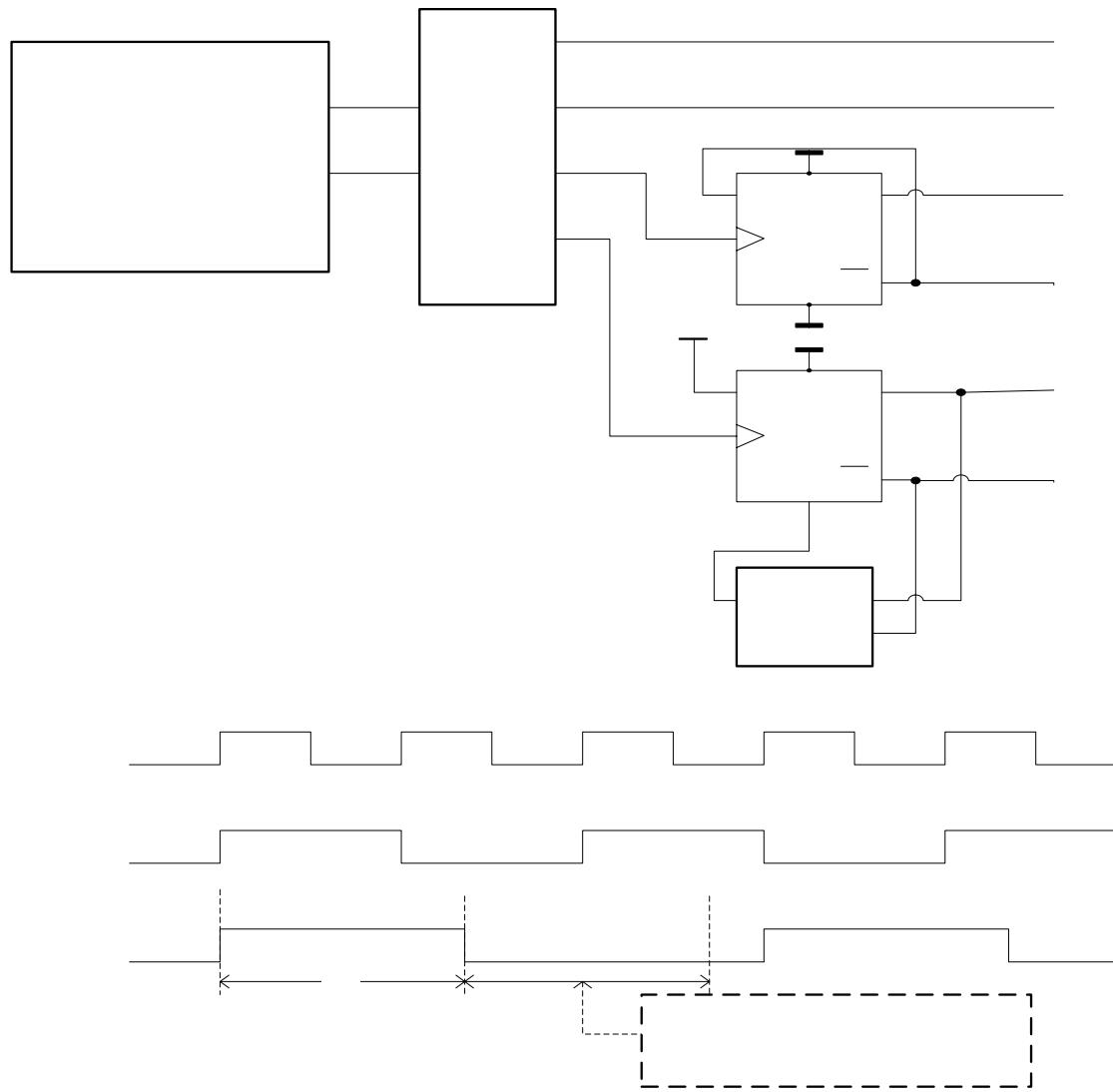
Software in PC

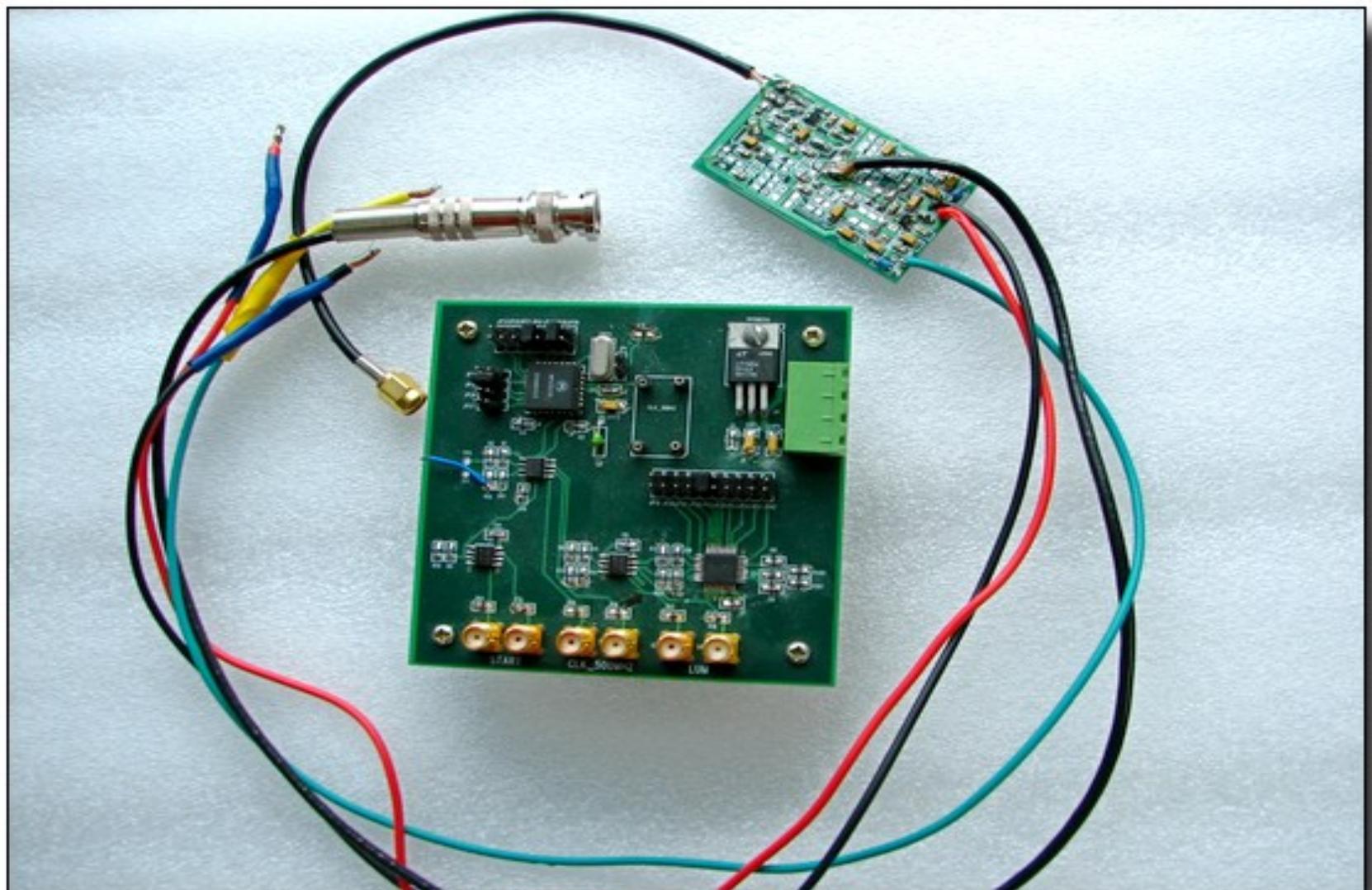


Interface of Software

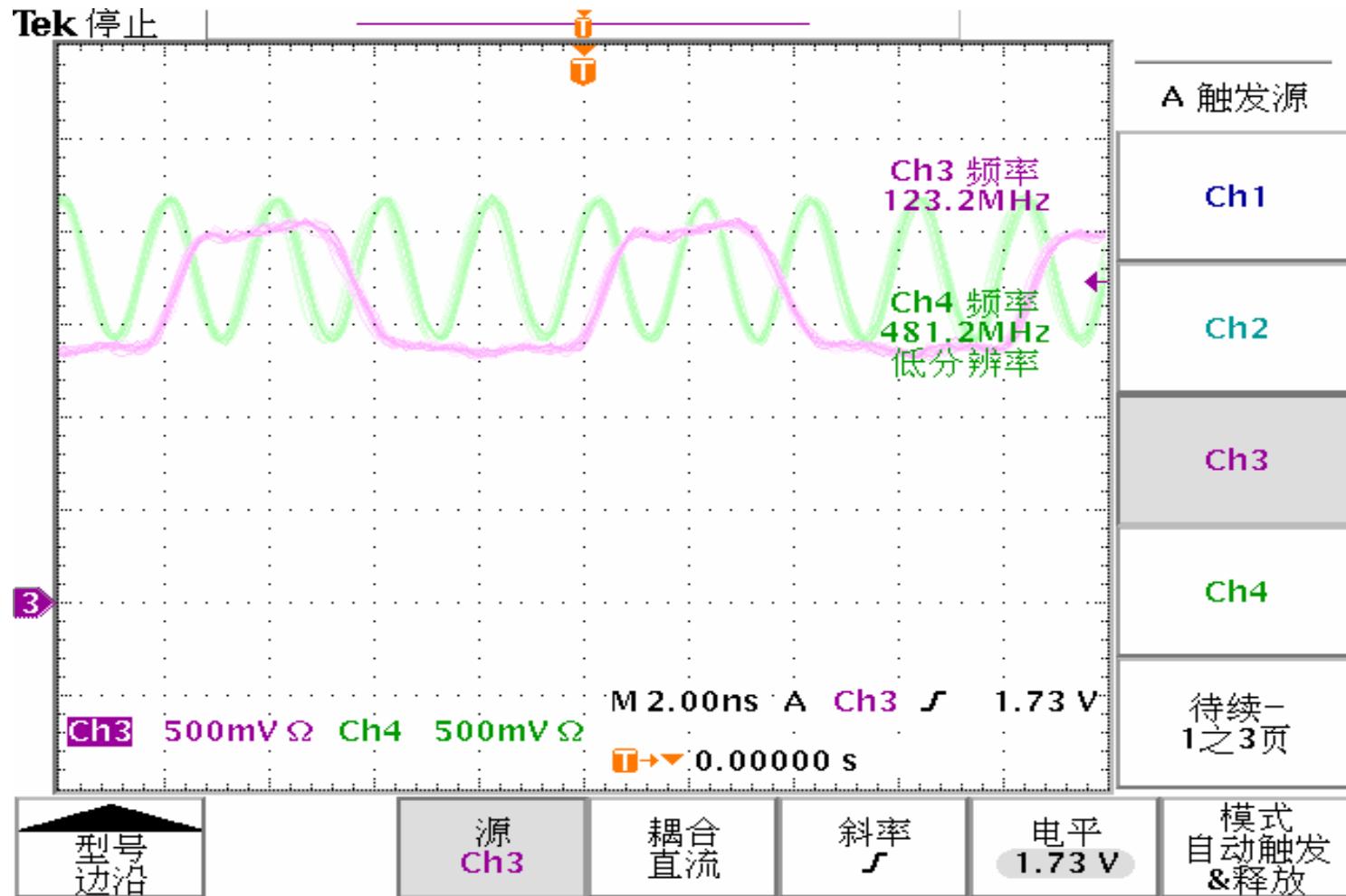


500MHz Signals generator





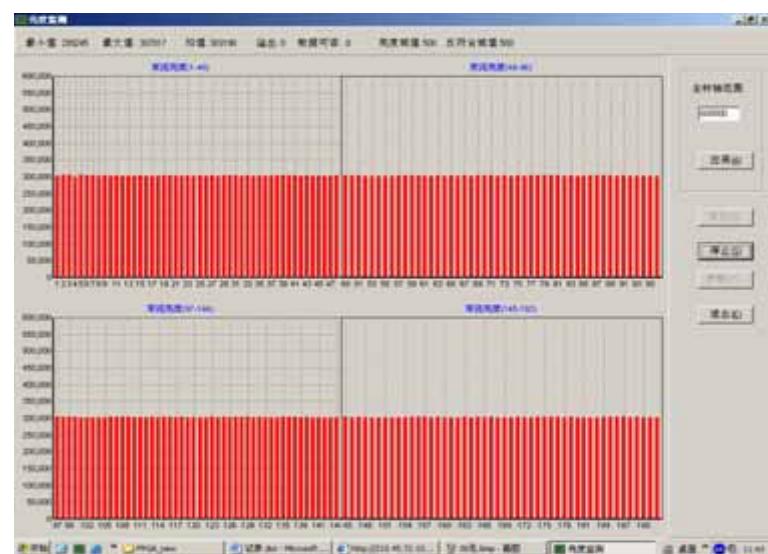
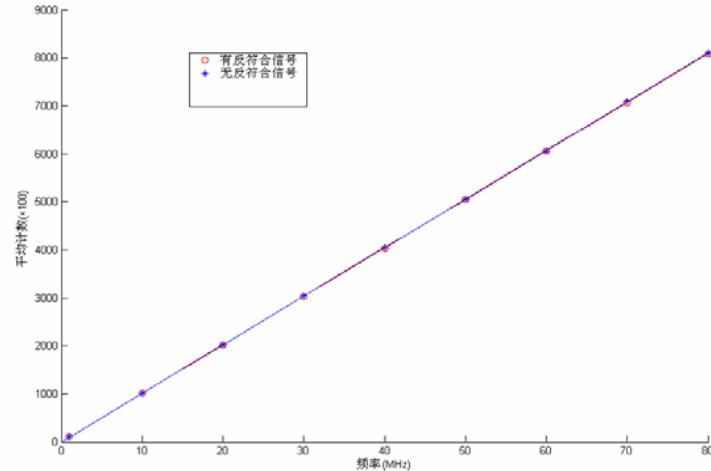
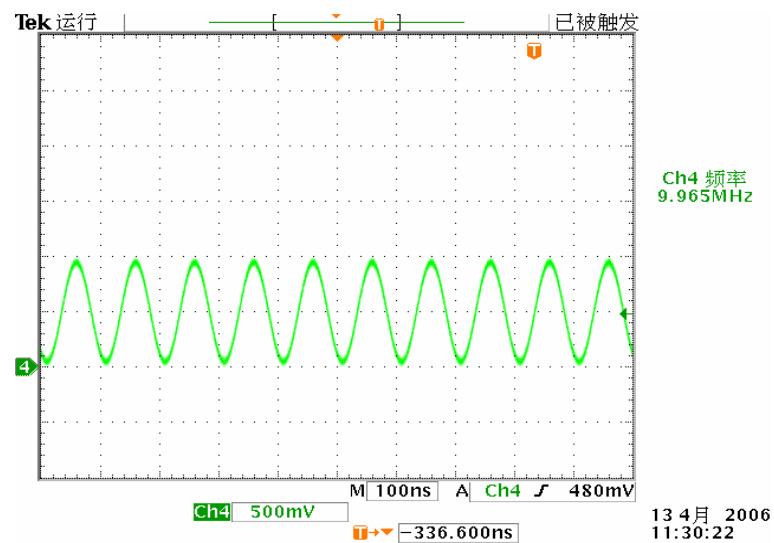
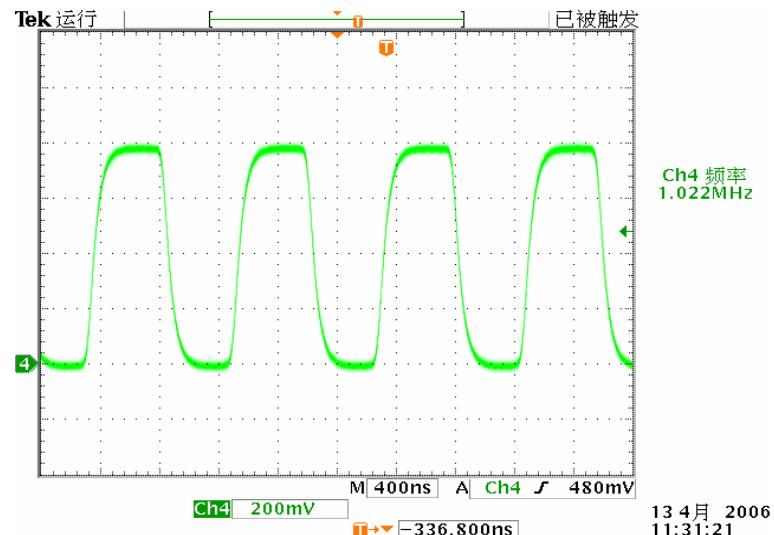
500MHz generated waveforms



Testing for Bunch-by-Bunch counter

- Testing of anti-coincidence function
- Achieving 250MHz counting rate
- Testing of programmable controlling of threshold in comparator
- Testing of parameters setting
- Testing of luminosity integrating signal output

Random sampling test



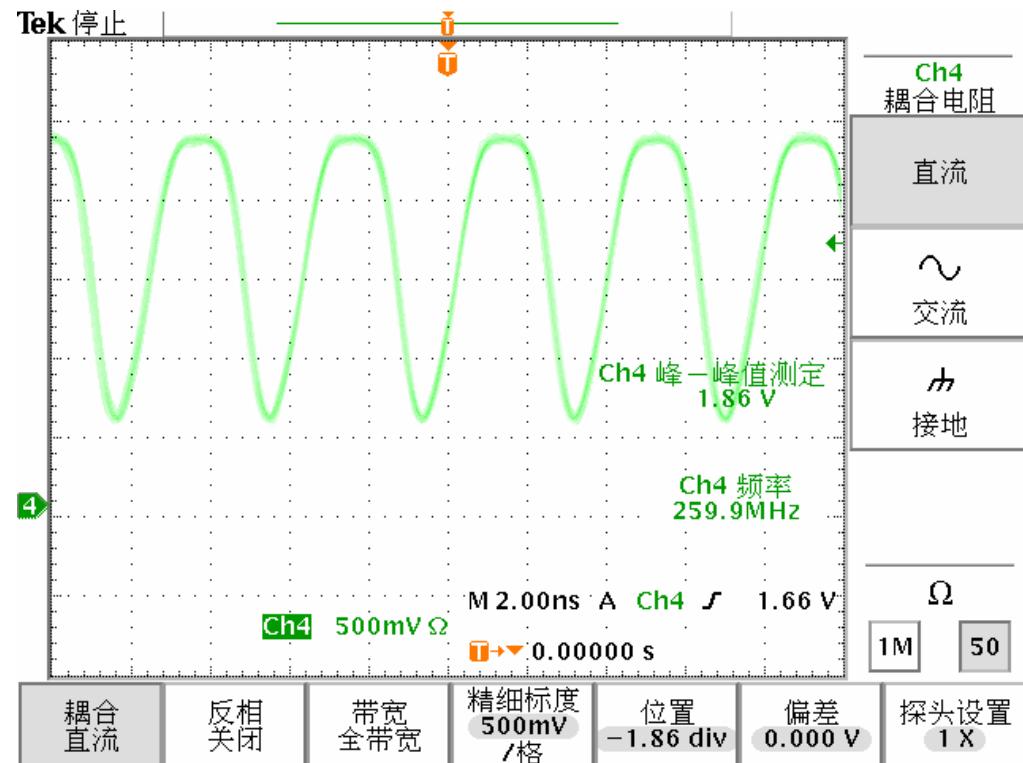
Cable selection for transmission

Attenuation (dB per 100 feet)										
	MHz:	30	50	100	146	150	440	450	1000	2400
#2632	RG-174	5.5	6.6	8.8	13.0		25.0		30.0	75.0
#0985	LMR-100A	3.9	5.1		8.8	8.9	15.6	15.8		
#2619	RG-58A/U	2.5	4.1	5.3	6.1	6.1	10.4	10.6	24.0	38.9
#3603	LMR-200	1.8	2.3		3.9	4.0	6.9	7.0		16.5
#2910	RG-59		2.4	3.5			7.6		12.0	
#2247	RG-8X	2.0	2.1	3.0	4.5	4.7	8.1	8.6		21.6
#3604	LMR-240	1.3	1.7		3.0	3.0	5.2	5.3		12.7
#3605	LMR-240 Ultra	1.3	1.7		3.0	3.0	5.2	5.3		12.7
#2929	RG-213	1.2	1.6	1.9	2.8	2.8	5.1	5.1	8.0	13.7
#0390	RG-214	1.2	1.6	1.9	2.8	2.8	5.1	5.1	8.0	13.7
#3606	LMR-400	0.7	0.9		1.5	1.5	2.7	2.7		6.6
#3607	LMR-400 Ultra	0.7	0.9		1.5	1.5	2.7	2.7		6.6
#0812	9086			1.4			2.8	2.8		
#0075	9913	0.8			1.5		2.8			7.5
Values indicated are approximate and for comparison purposes only.										

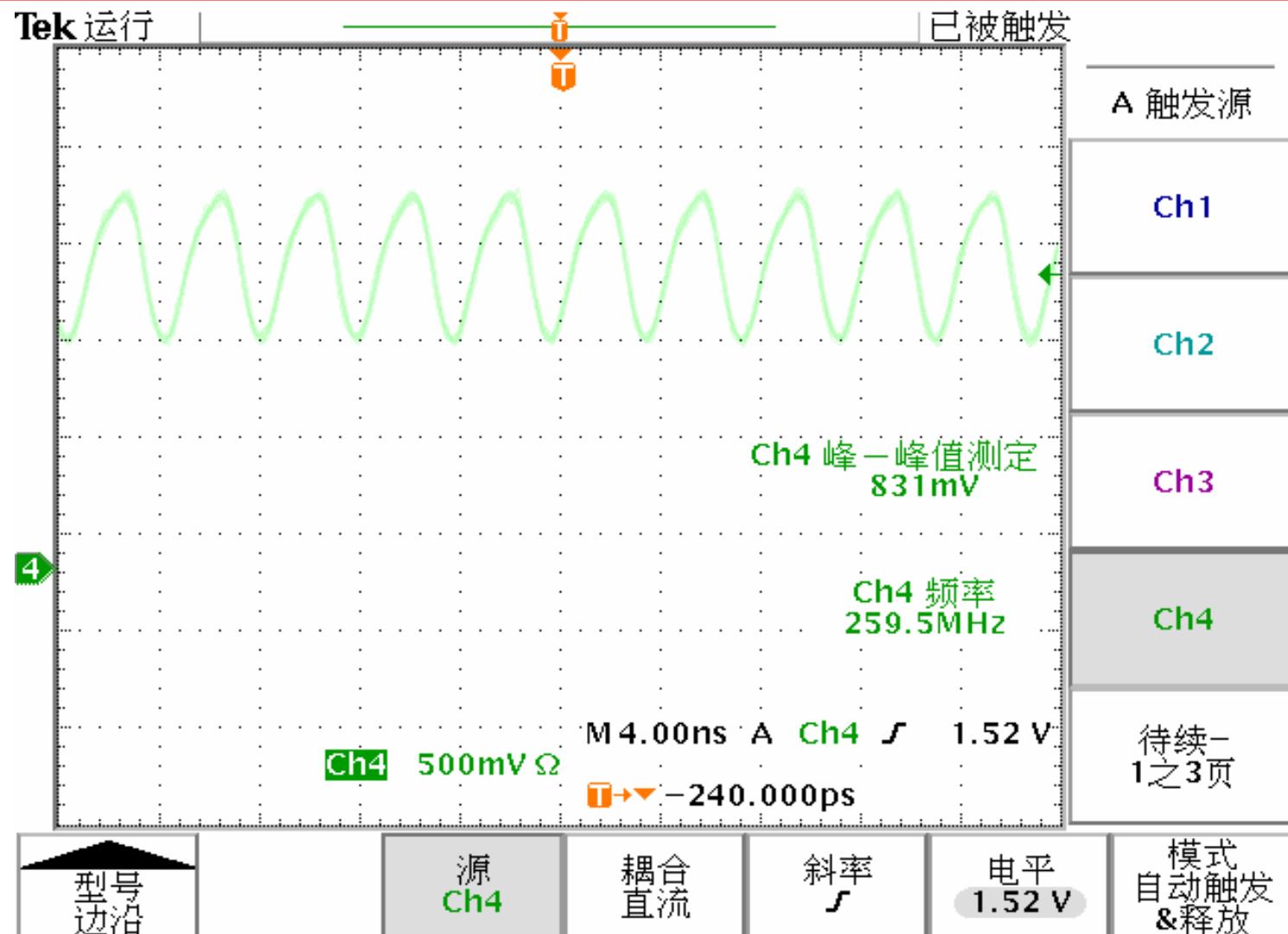


Shaping for transmission

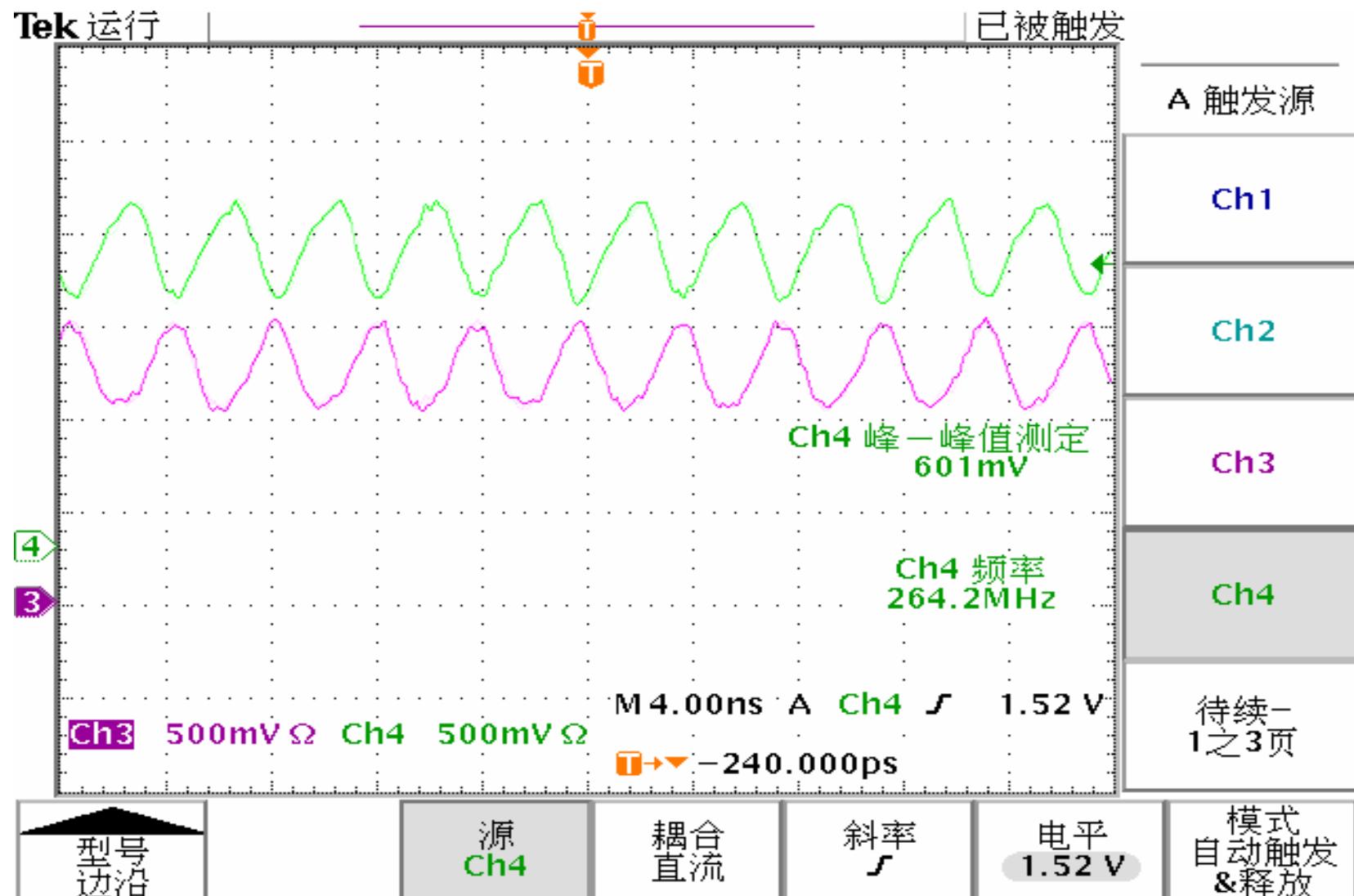
- Input: 260MHz sine waves
- Threshold is 20mv
- Scope is 50 ohm terminated



LVPECL transmission : 30mRG58

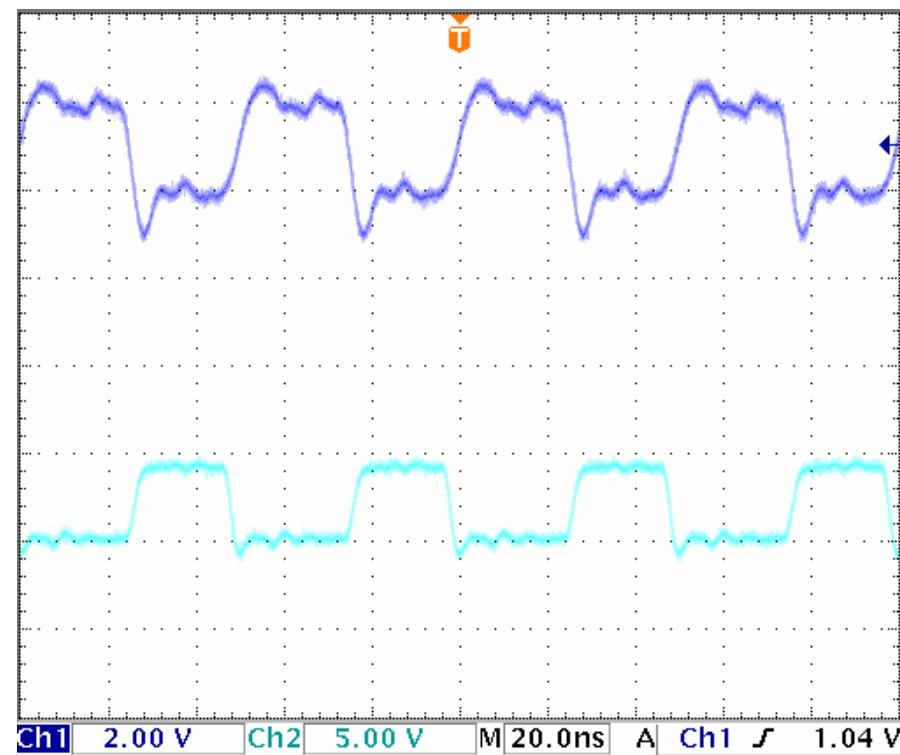


30M differential cables (Tianjin)



LVDS digital signals transmission

- Input to LVDS driver DS90C31B: TTL with 5ns rising time
- Cable: 30m unshielded twist-pairs
- Receivers DS90C32B change LVDS signal into TTL signals
- Comparing input with output TTL signals.



Thanks!

