

Investigating and Decreasing the Interference from BES SC to MDC

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Introduction

● The hot channels in trigger MDC tracking

There were always some hot channels in trigger MDC Tracking outputs.

It was found that it was MDC wire signals that caused these hot channels.

The positions of these hot channels were often changed. The trigger rate

could be increased 2-3 Hz some time due to these hot channels.

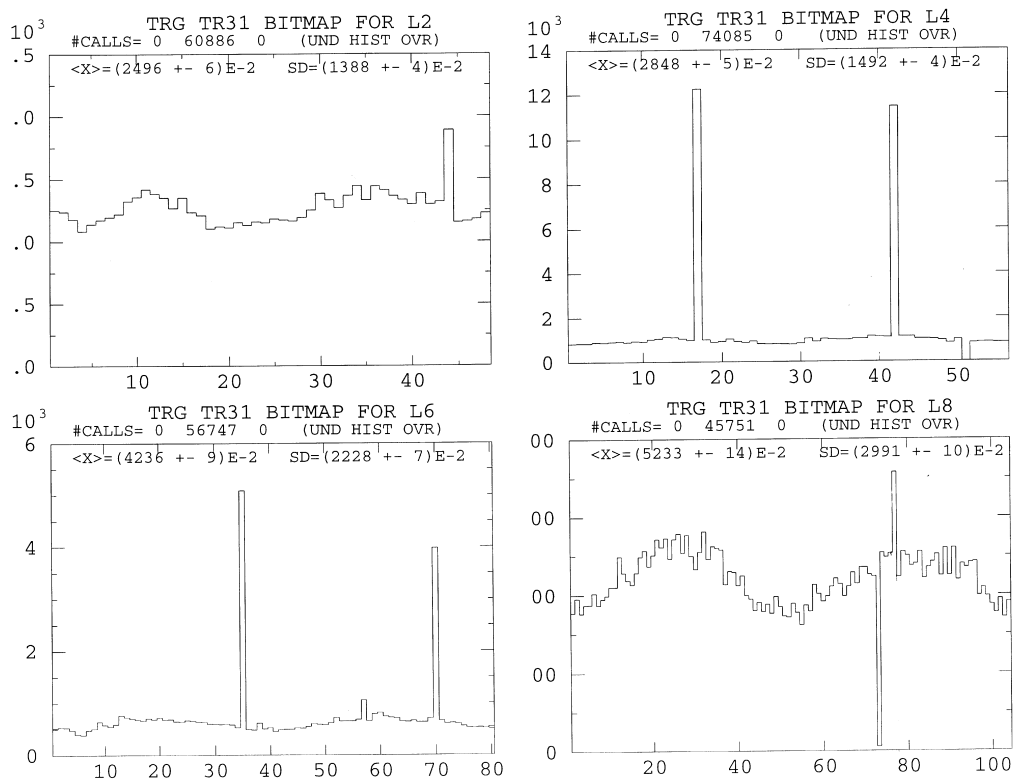


Fig.1 Three out of four for trigger MDC tracking

- The timing relations of MDC Tracking Gate and SC Reset

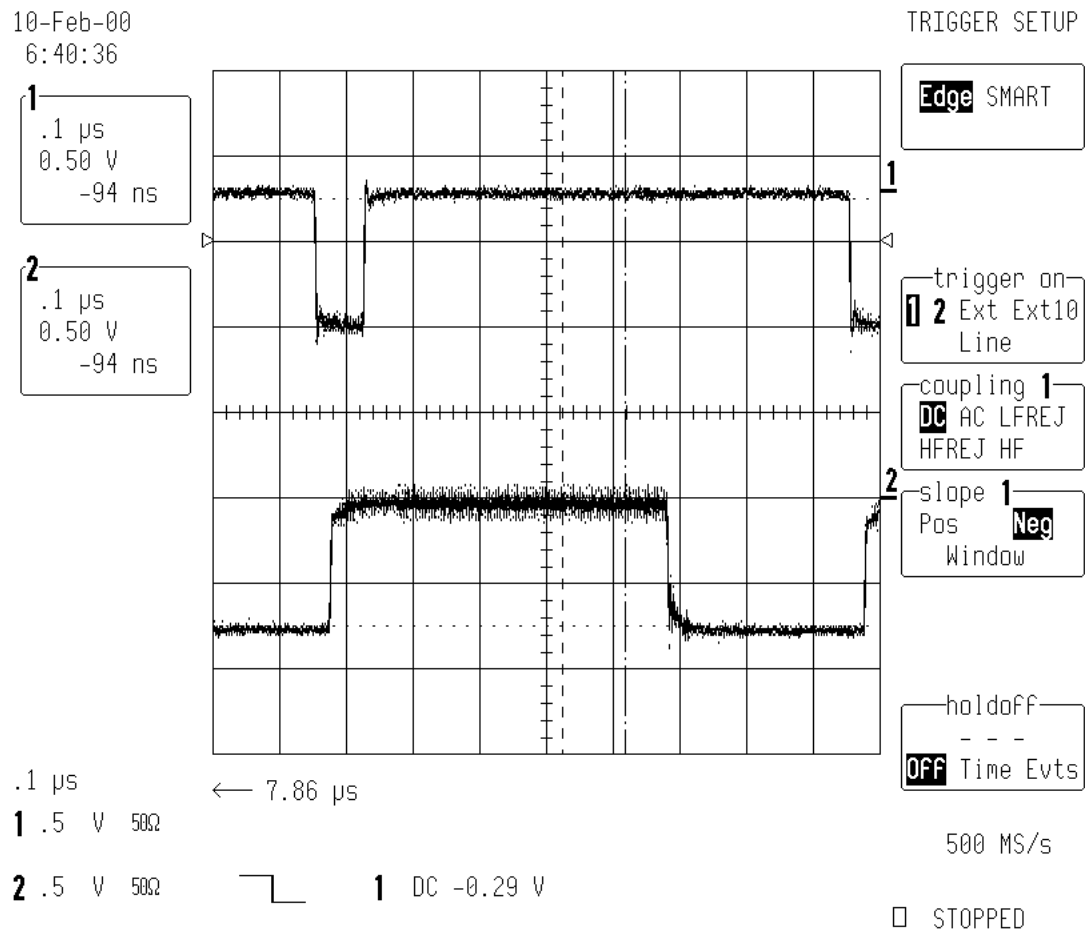


Fig. 2 CH1: Reset SC from Trigger

Ch2: MDC Tracking Gate

Considering the timing relation of SC reset and MDC tracking gate, the MDC tracking should not be interfered by SC reset.

- The unusual SC Reset waveforms were observed

The problem was studied systematically from Feb. 2, 2000 (when the accelerator machine study was performed). On Feb. 3, the first type unusual SC reset waveforms were observed by De Li.

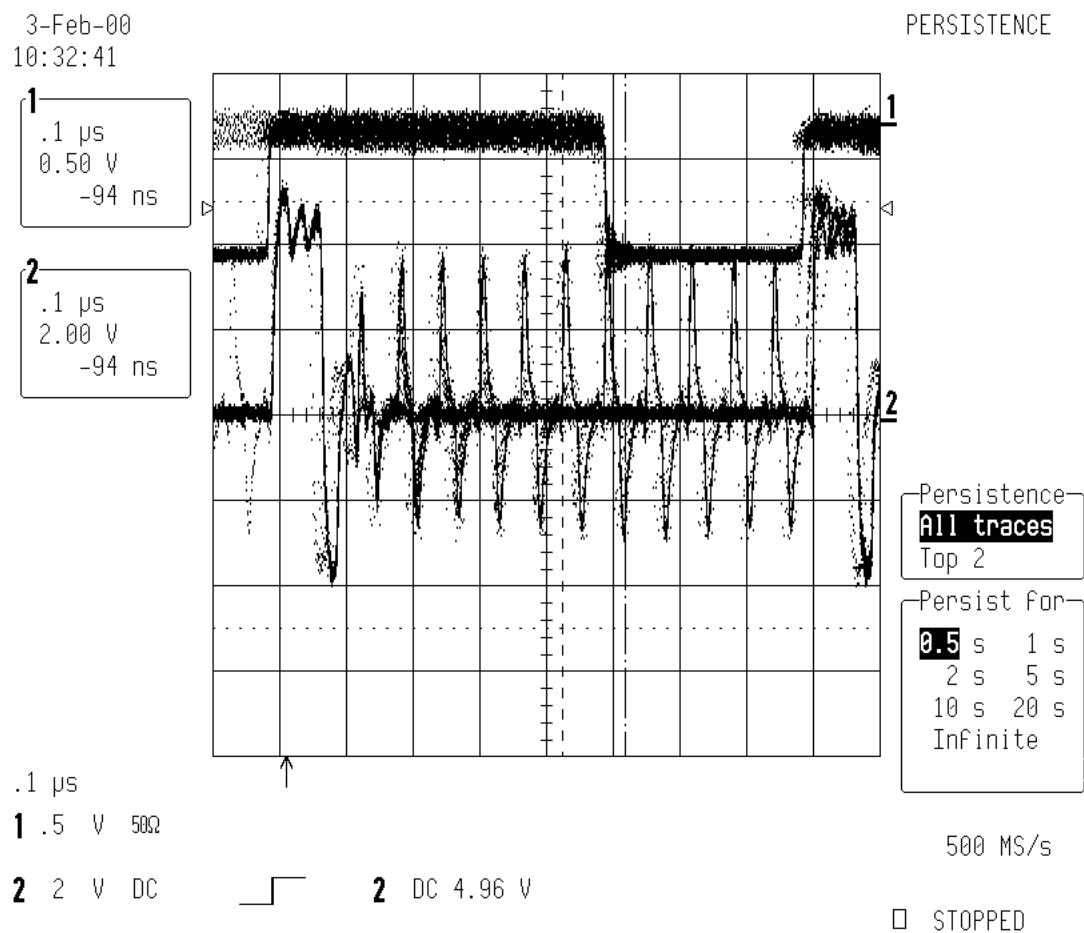


Fig. 3 False trigger, Test RUN; Channel 1: Trigger MDC tracking gate;

Channel 2: Reset SC from SC reset NIM to TTL Fan-out

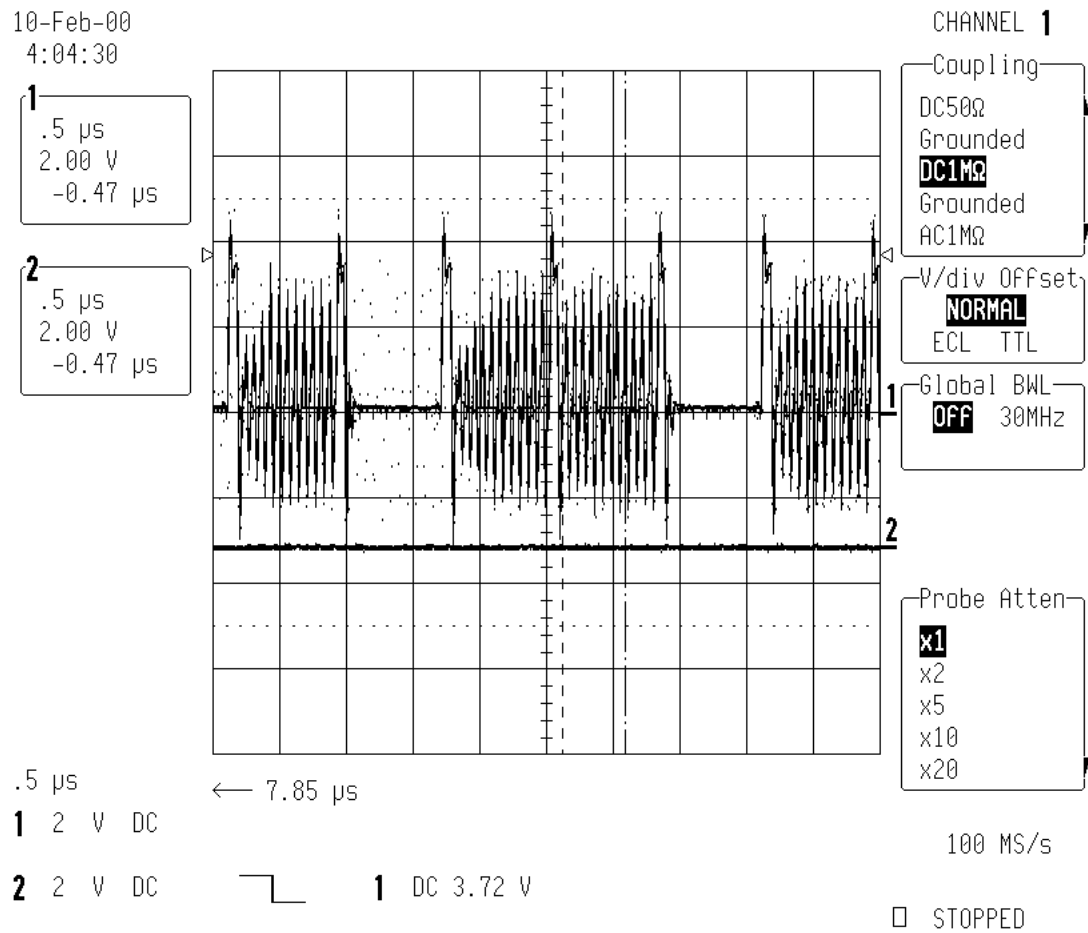


Fig.4 Channel 1: Reset SC from SC reset NIM to TTL Fan-out

At 5:00 am on 10 Feb., De Li observed the second type of the unusual SC reset waveforms.

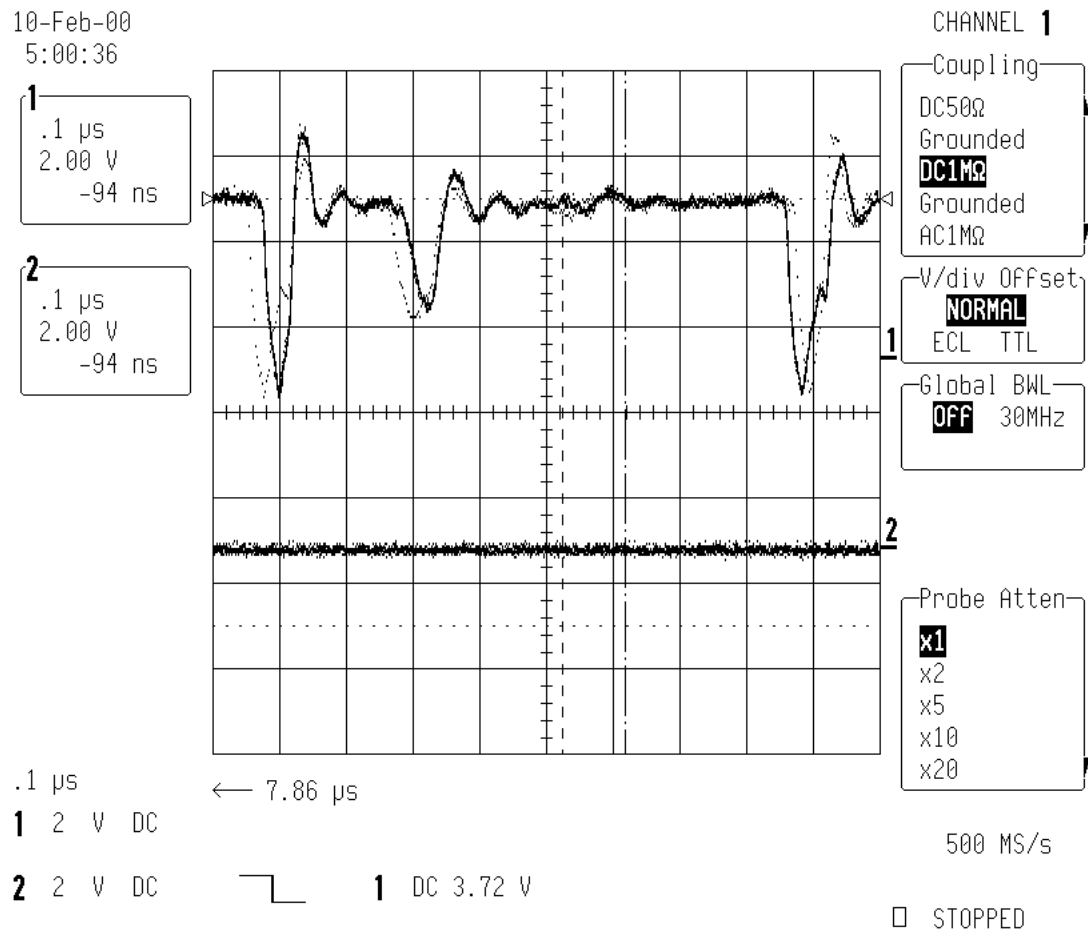


Fig. 5 Channel 1: Sport-C RSO

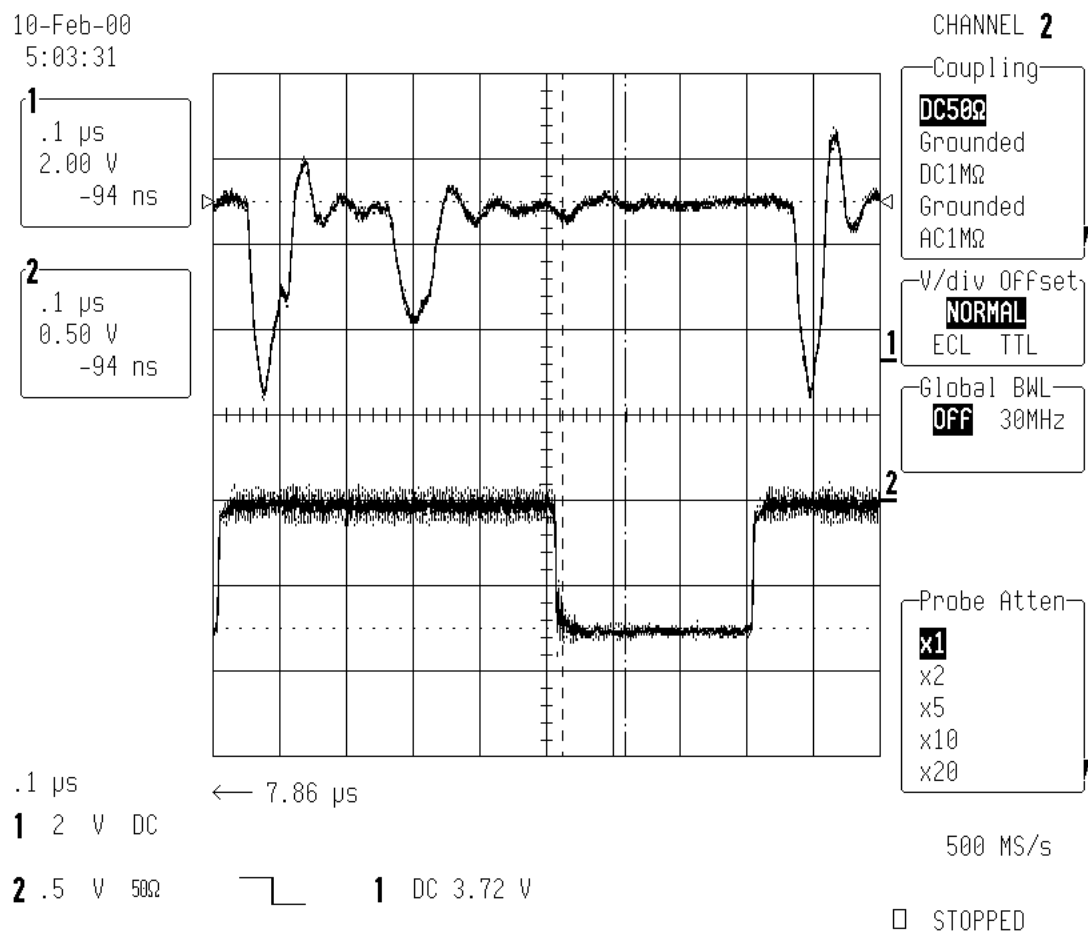


Fig. 6 Channel1: Sport-C RSO
Channel 2: Trigger MDC Tracking Gate

The second pulse could interfere trigger MDC tracking.

Studying the reasons for the unusual SC reset waveforms

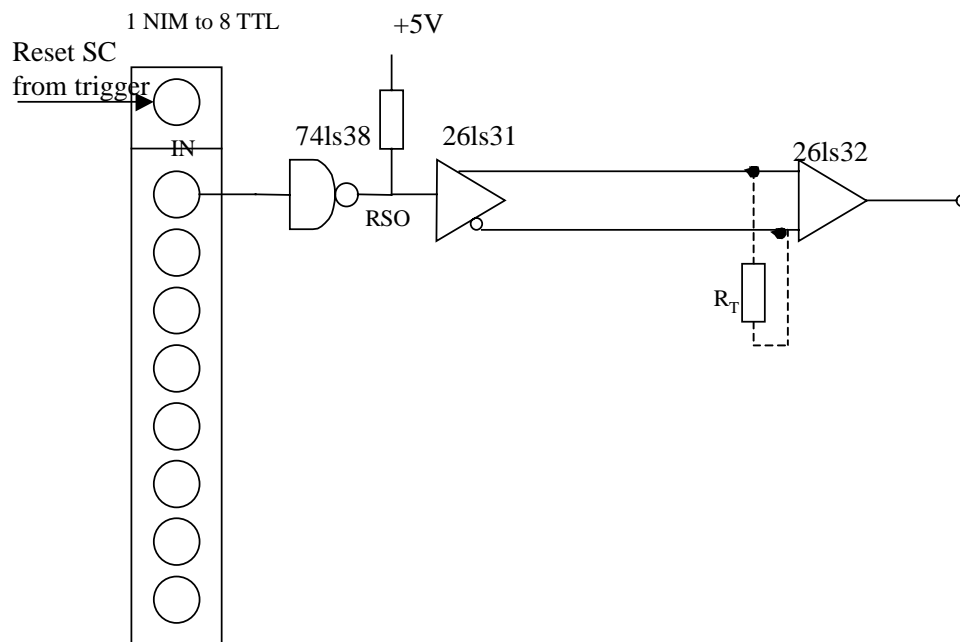


Fig. 7 The diagram for SC reset

After carefully analyzing and testing, the reasons for the unusual SC reset waveforms were found.

- The reason for the first type unusual SC reset waveforms was the oscillation of the Fan-out module.
- The reason for the second type unusual waveforms was the reflection at the end of transmission line. After adding the matched termination resistors the reflection could be removed.

Investigating the interference from SC to MDC

False trigger; Safe high voltage for all detectors; Connecting all

SC gates and resets, $R_T = \infty$

Note: Tr31 is the module of the 3 out of 4 for MDC tracking.

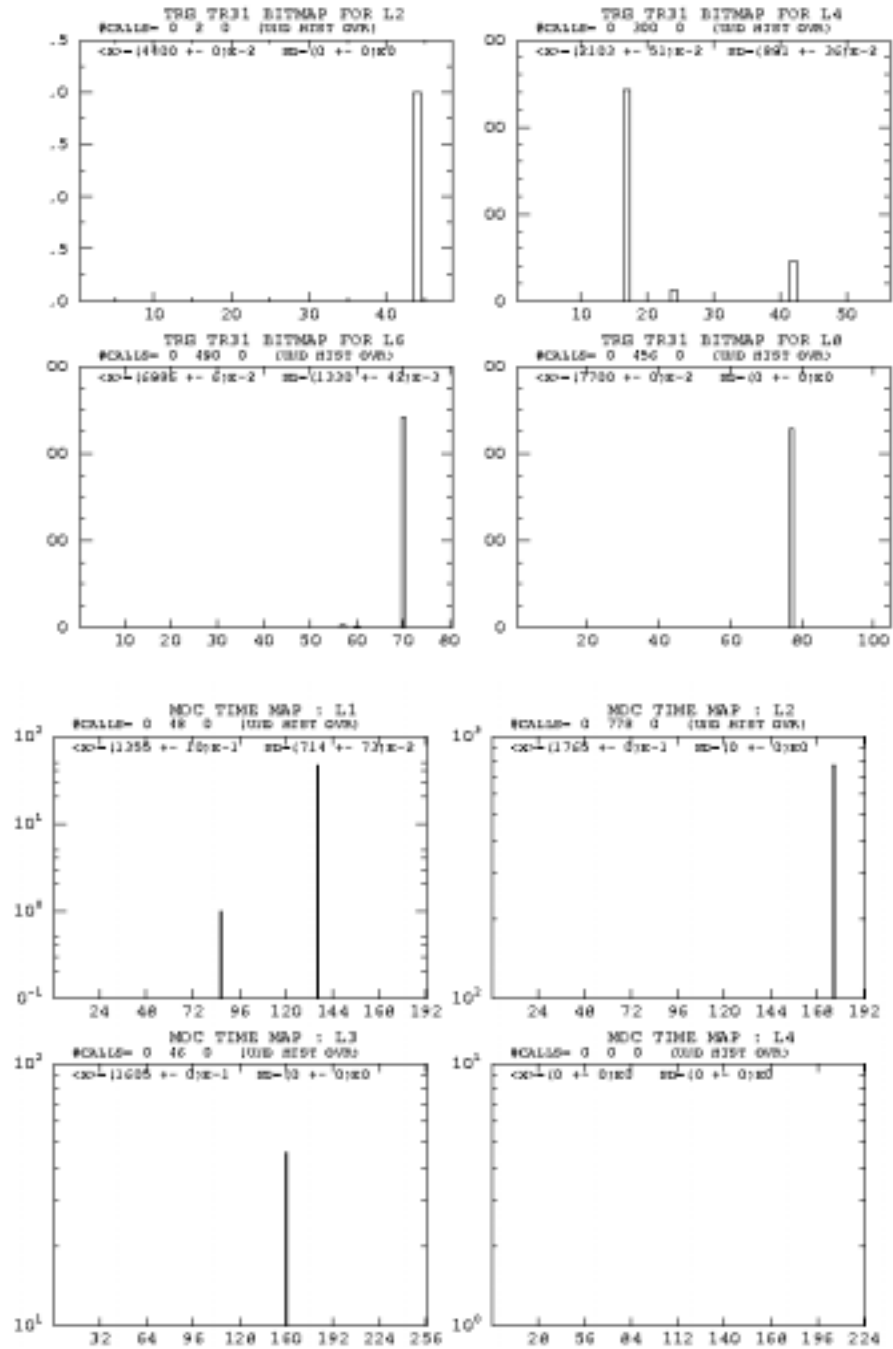


Fig. 8

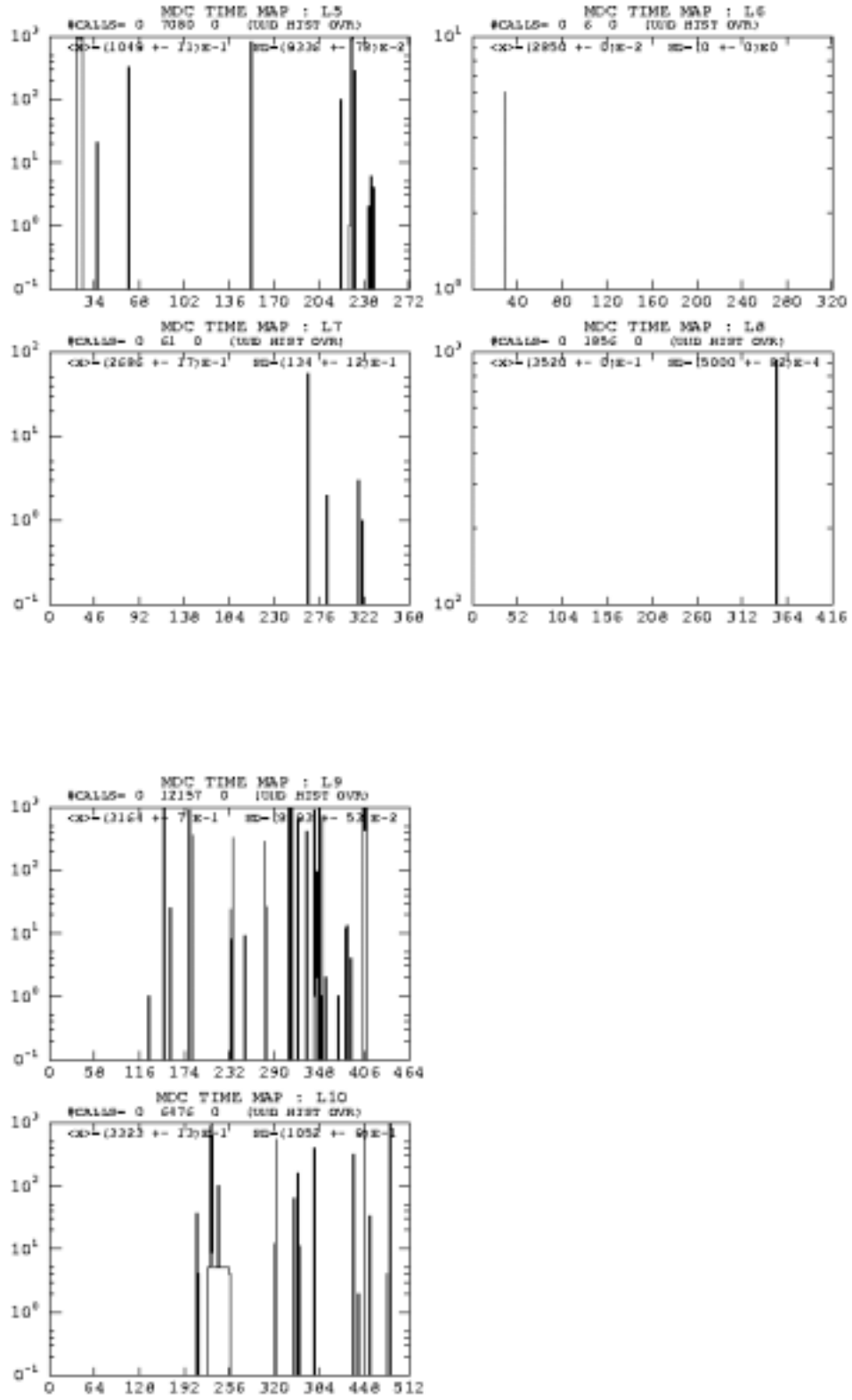


Fig. 9

Disconnecting all the SC gates and resets

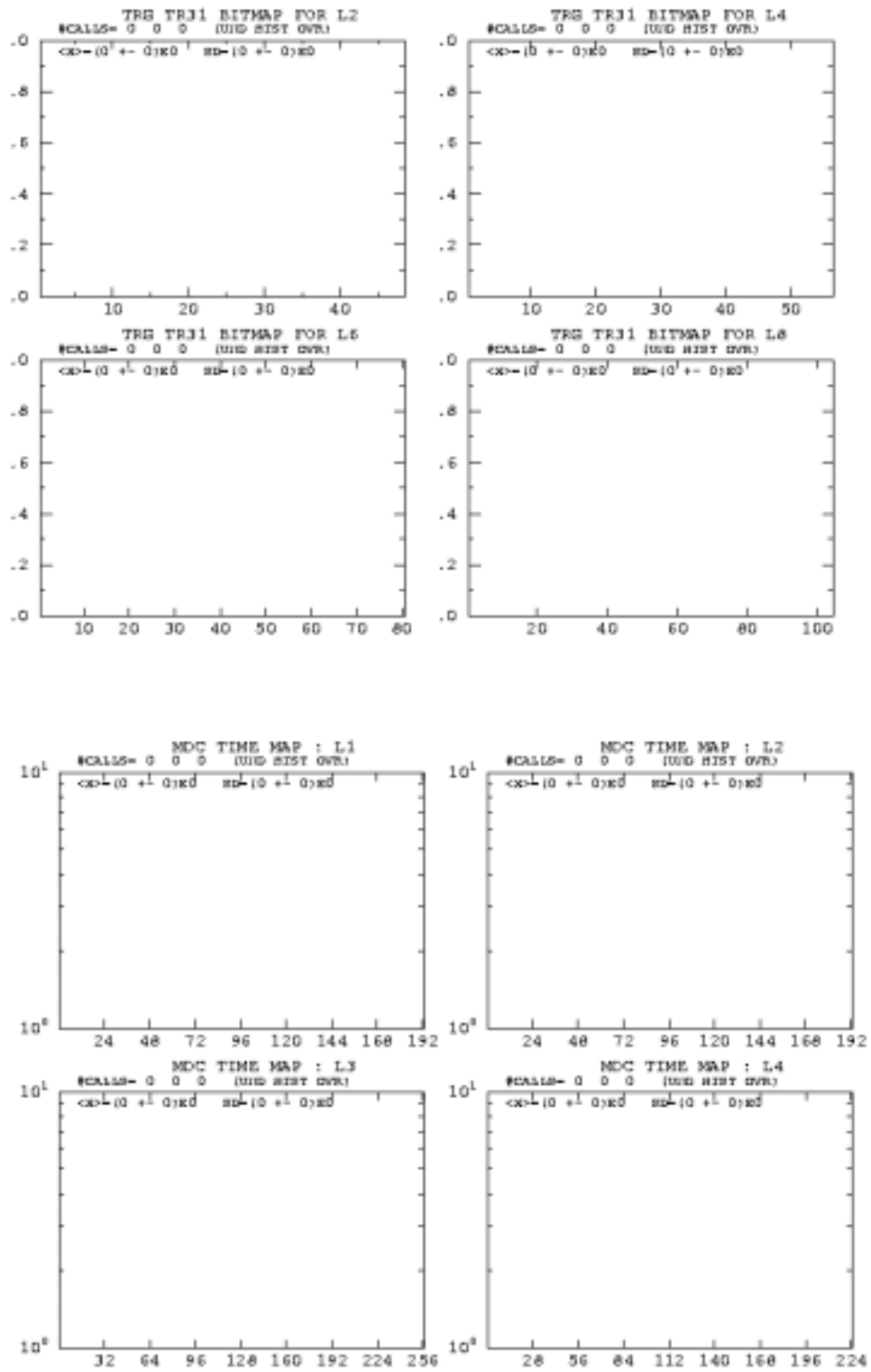


Fig. 10

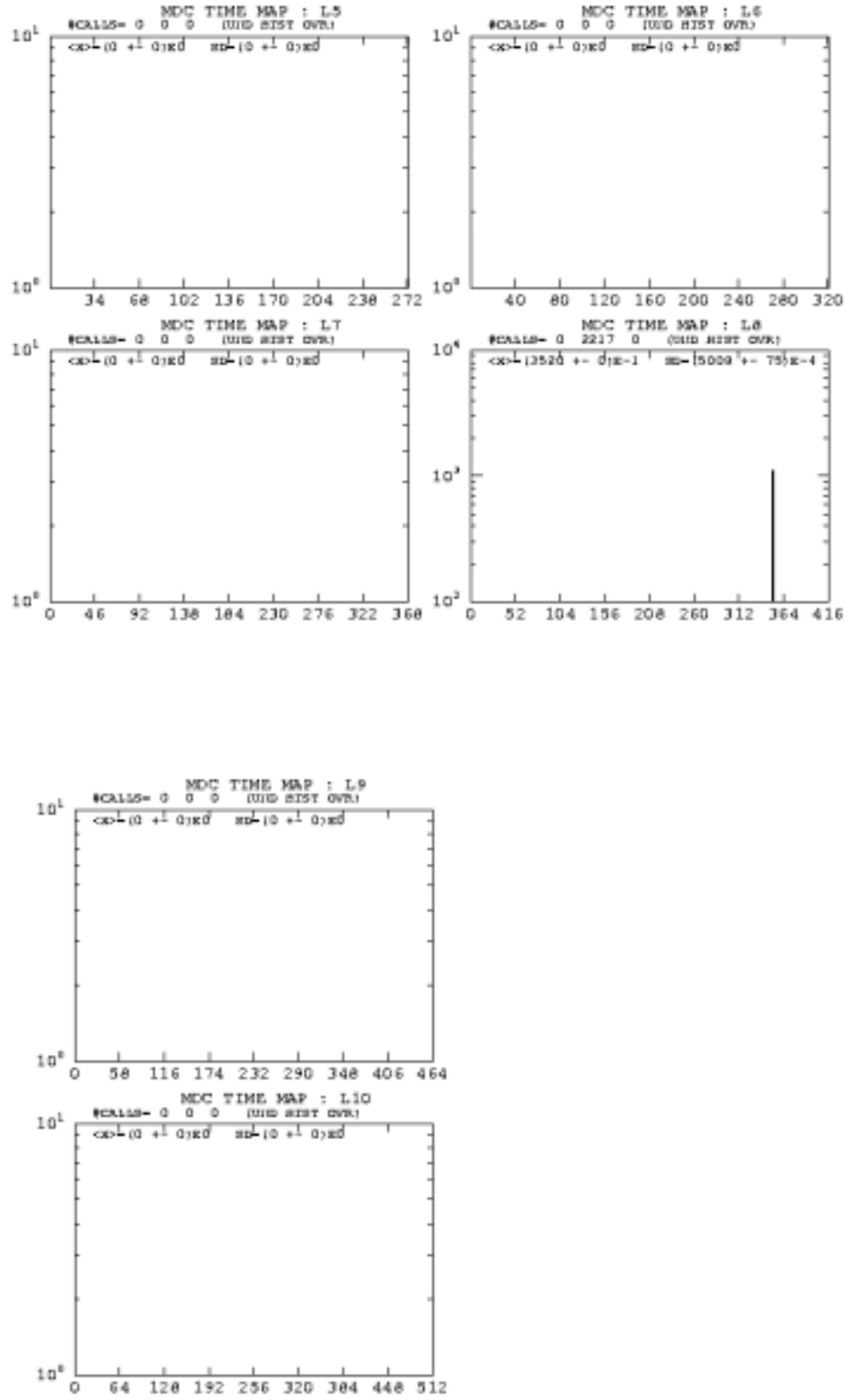


Fig. 11

Summary of the investigation for the interference from SC to MDC

1. The interference from SC resets and gates to MDC is the reasons for MDC hot channels. The strength of the interference is different for different SC read-out CAMAC sub-branches. The interference is stronger for the CAMAC sub-branches that the corresponding sampling-keeping crates close to the MDC electronic crates in BES hall.
2. The interference mainly comes from state transition in the sampling-keeping crates (for every crate there are 420 channels of the sampling-keeping circuit) in BES hall. The interference of the transmission line from the Counting Room to BES hall was not observed (when the sampling-keeping crate was turn off the interference was not observed).
3. Changing the timing relations between SC reset, gate and the MDC gate, the strength of the interference was changed.
4. Bad connections of the transmission lines with the sport-c in the Counting Room and/or the sampling-keeping crates in BES hall could make the reset in the sampling-keeping crates become wider. The wider reset pulse could change the time relations. The strength of the interference could be increased.

Decreasing the interference

- Adding the termination resistors

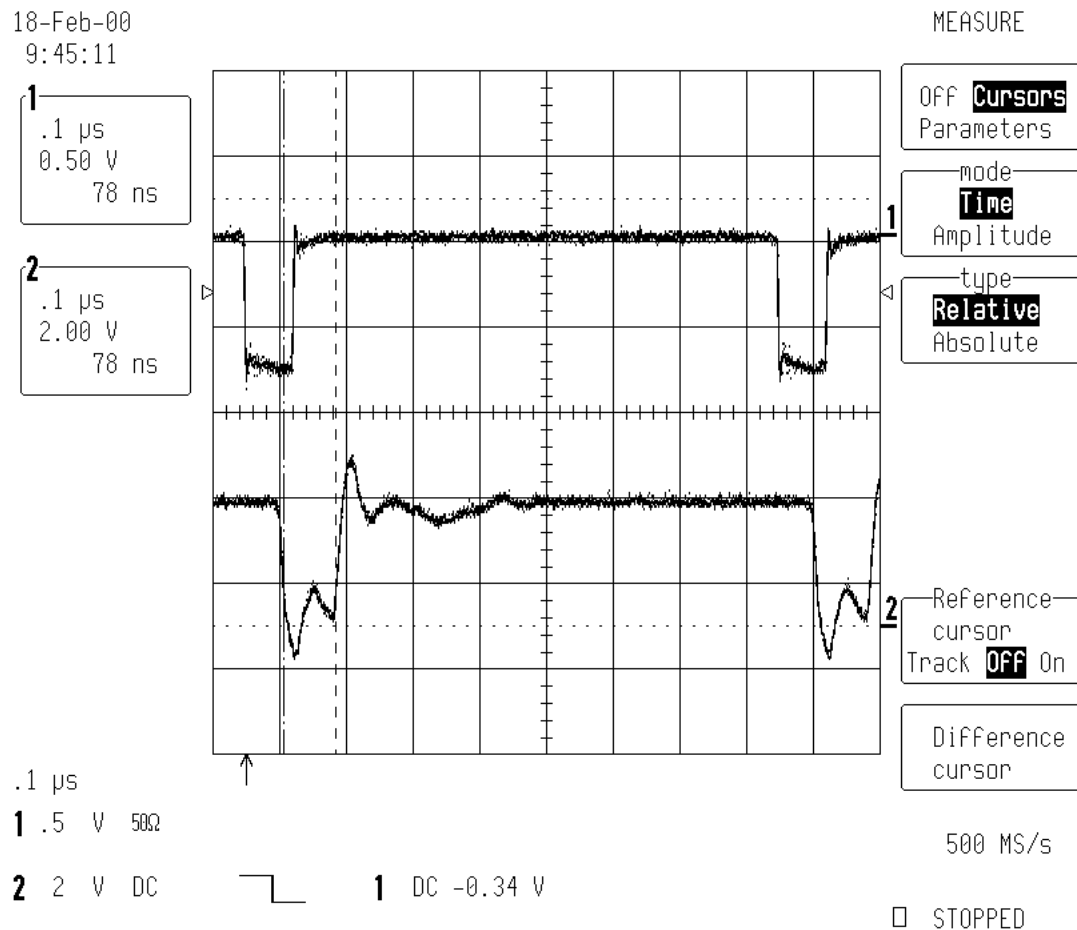


Fig. 12 Channel 1: Reset SC from trigger

Channel 2: RSO on Sport-c ($R_T = 100\Omega$)

It was proved by the experiments that after adding the termination resistors at the end of the transmission lines, the performance of the sampling-keep circuit should not be changed.

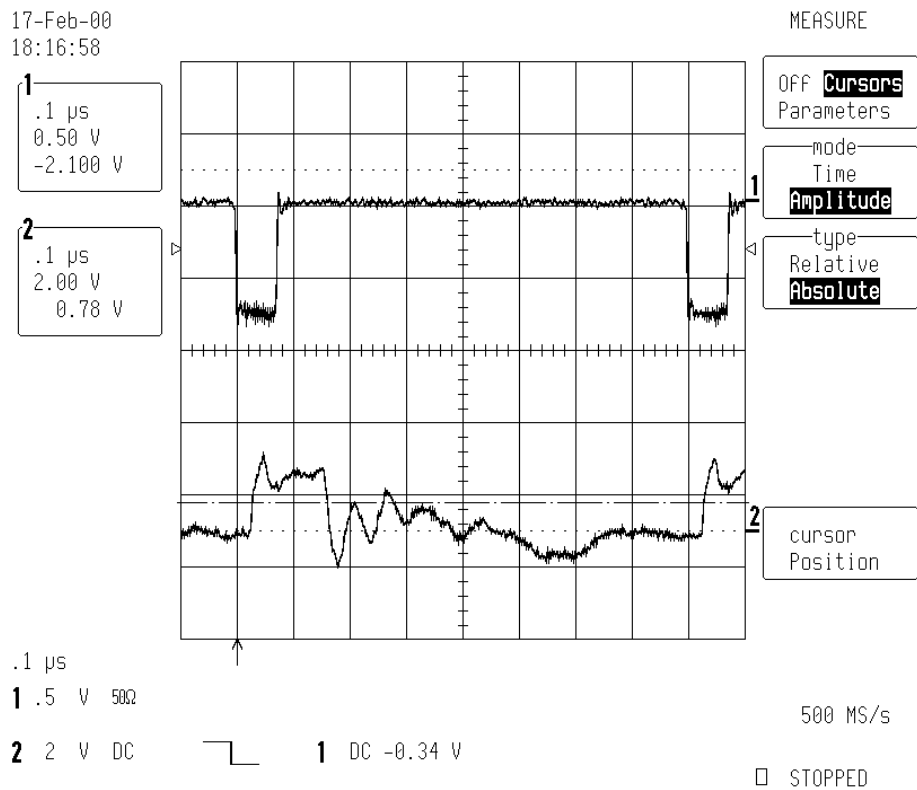


Fig. 13 Channel 1: Reset SC from trigger

Channel 2: RGO on Sport-c ($R_T = \infty$)

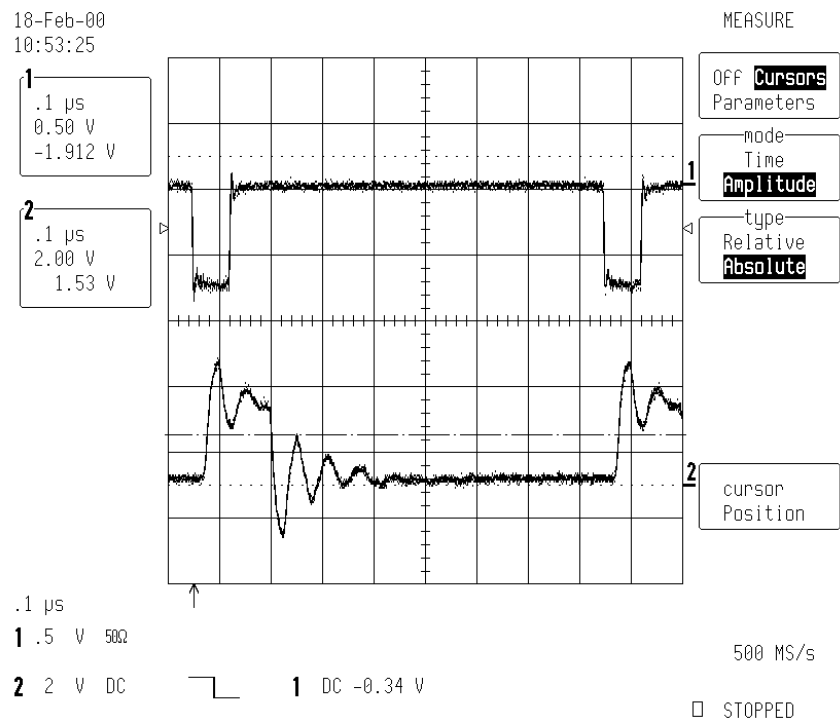


Fig. 14 ($R_T = 100\Omega$)

● Changing the time relations

Timing Diagram for SC

Drawn by Li De, Feb., 2000

Units of time: ns

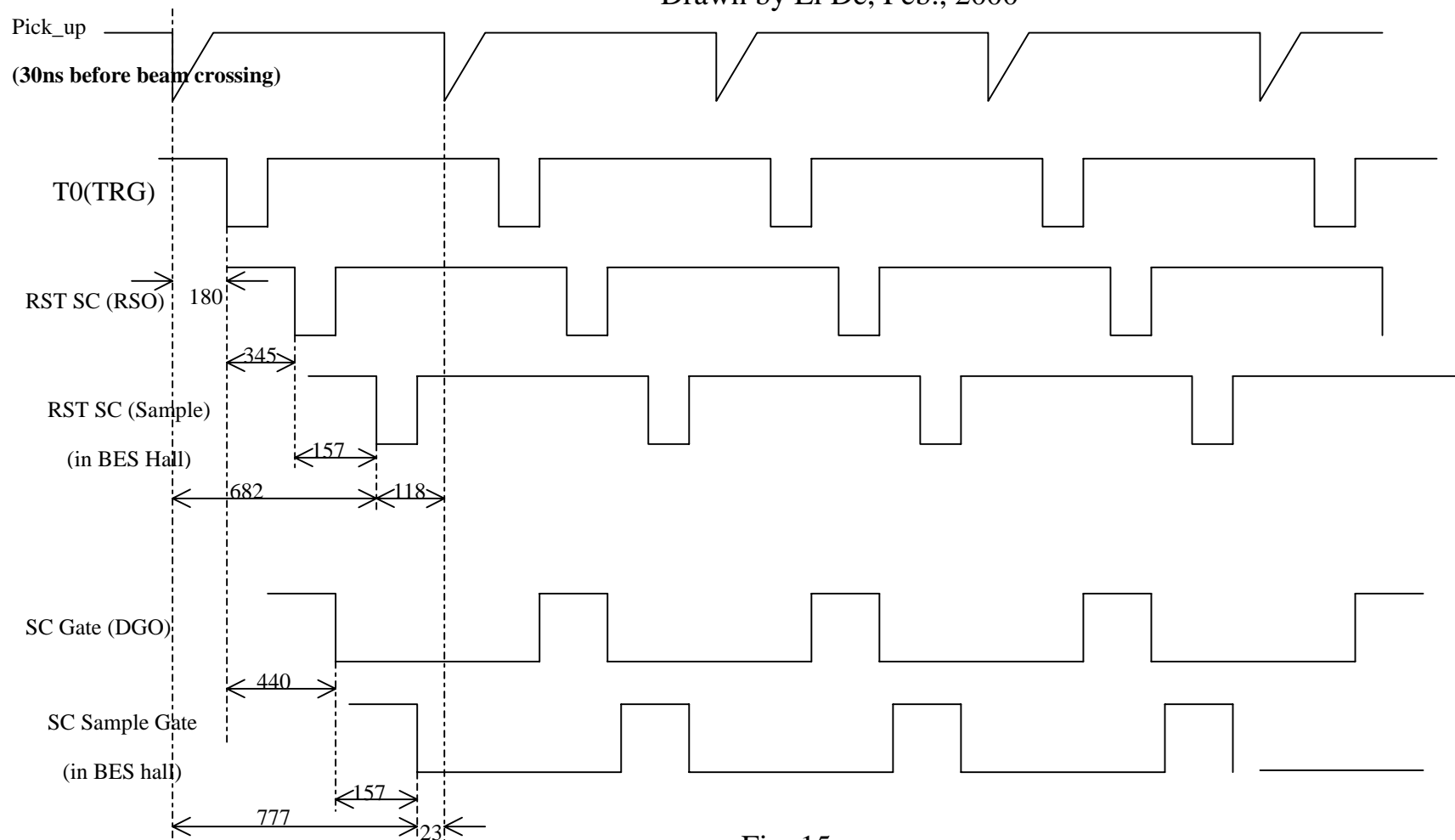
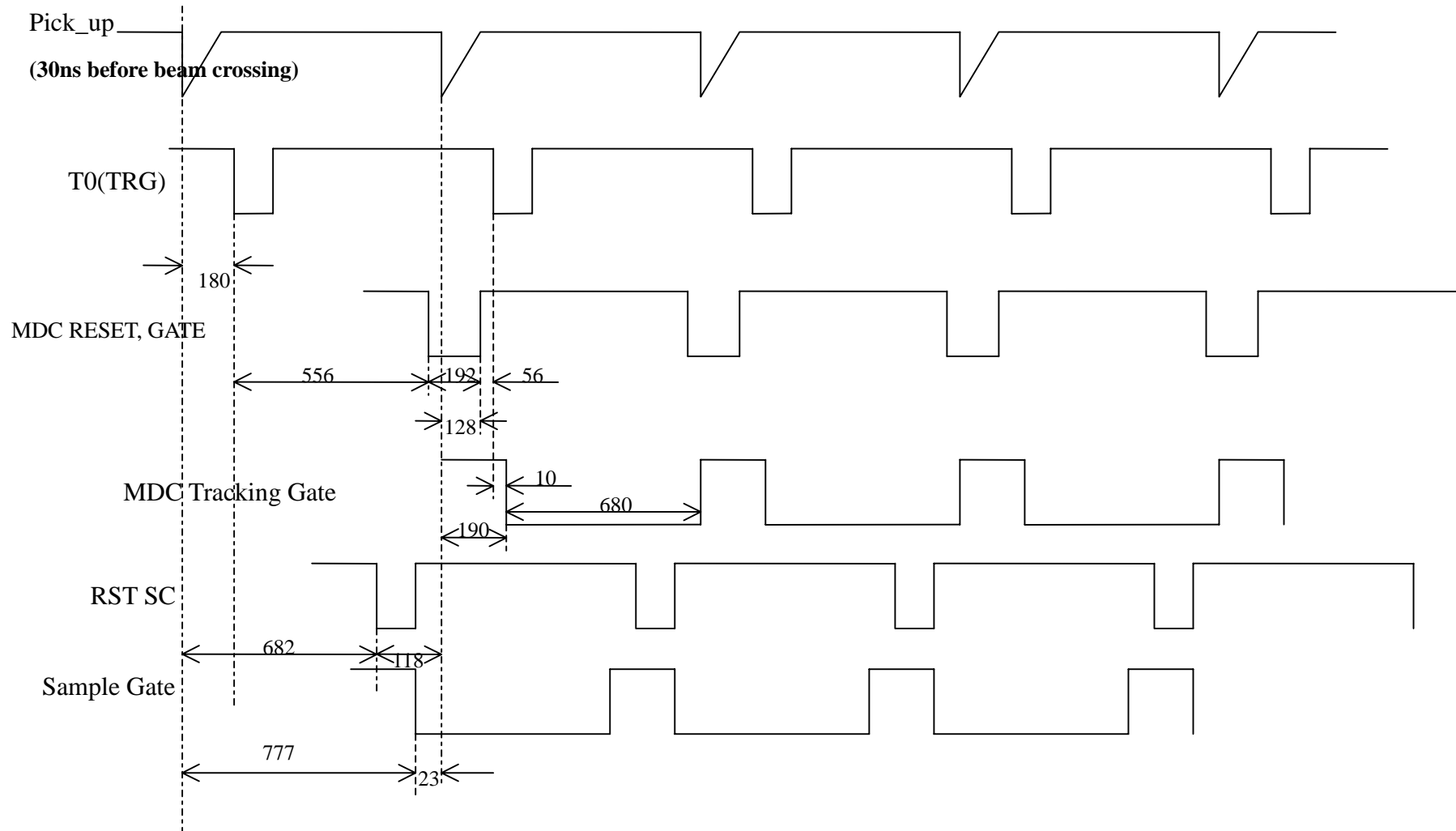


Fig. 15

Timing Diagram for MDC and SC

Drawn by Li De, Feb., 2000

Units of time: ns



- Improving the bad connections

The width of the SC reset at the receiver outputs (26ls32) could become wider if connections between the transmission lines and SPORT-Cs or sampling-keeping crates are not good. The falling edge of the reset may go into the MDC gate. This edge will create interference to MDC.

Comparing the interference before the methods for decreasing interference were used with that after the methods were used

● MDC tracking

Table 1 The number of the output from MDC tracking ($N_{\text{track}} \geq 1$, $N_{\text{track}} \geq 2$) before the decreasing interference methods were used.

Date		Feb.,15	Feb.,15	Feb.,15	Feb.,15	Feb.,15
RUN No.		Run14831	Run14835	Run14839	Run14847	Run14854
Ibeam (mA)		37.3	37.0	36.7	37.9	39.1
$N_{\text{track}} \geq 1$	Number for 10S	24339	25108	21725	22480	24025
	Number for per mA	652.5	678.6	592.0	593.1	614.5
	The average number for per mA	626.1				
$N_{\text{track}} \geq 2$	Number for 10S	21096	21642	19795	20484	21815
	Number for per mA	565.6	584.9	539.4	540.5	557.9
	The average number for per mA	557.7				

Table 2 The number of the output from MDC tracking ($N_{\text{track}} \geq 1$, $N_{\text{track}} \geq 2$) after the decreasing interference methods were used.

Date		Feb.,21	Feb.,21	Feb.,21	Feb.,22	Feb.,22
RUN No.		Run14994	Run15001	Run15006	Run15013	Run15021
Ibeam (mA)		37.2	35.4	40.1	39.3	39.2
$N_{\text{track}} \geq 1$	Number for 10S	18030	20682	20769	19673	20404
	Number for per mA	484.7	584.2	517.9	500.2	520.5
	The average number for per mA	521.6				
$N_{\text{track}} \geq 2$	Number for 10S	15786	18006	18312	17186	17811
	Number for per mA	424.4	508.6	456.7	437.3	454.4
	The average number for per mA	456.3				

The number decreased 17% for $N_{\text{track}} \geq 1$ and 18% for $N_{\text{track}} \geq 2$ after the decreasing interference methods were used

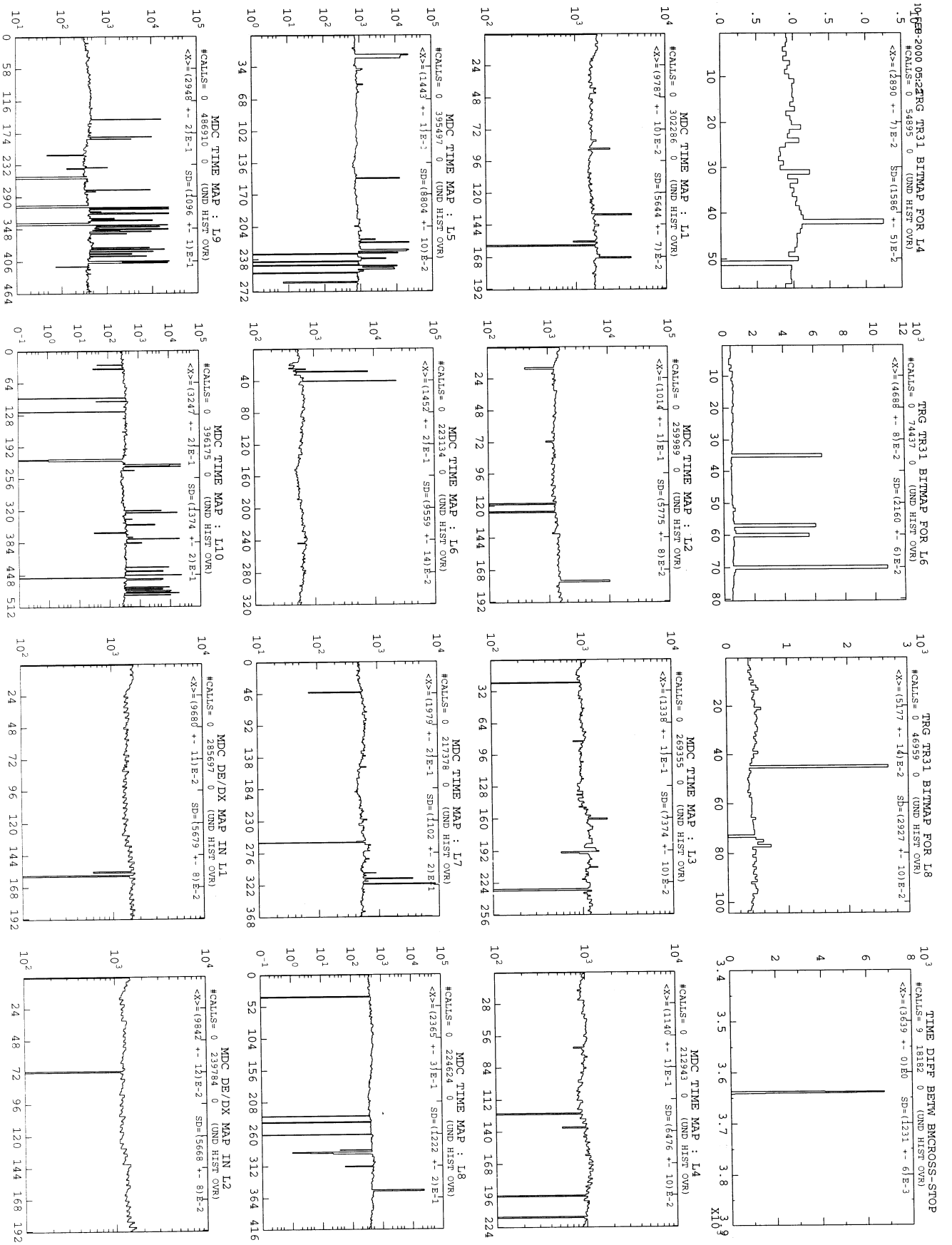


Fig. 17 Before the decreasing interference methods were used

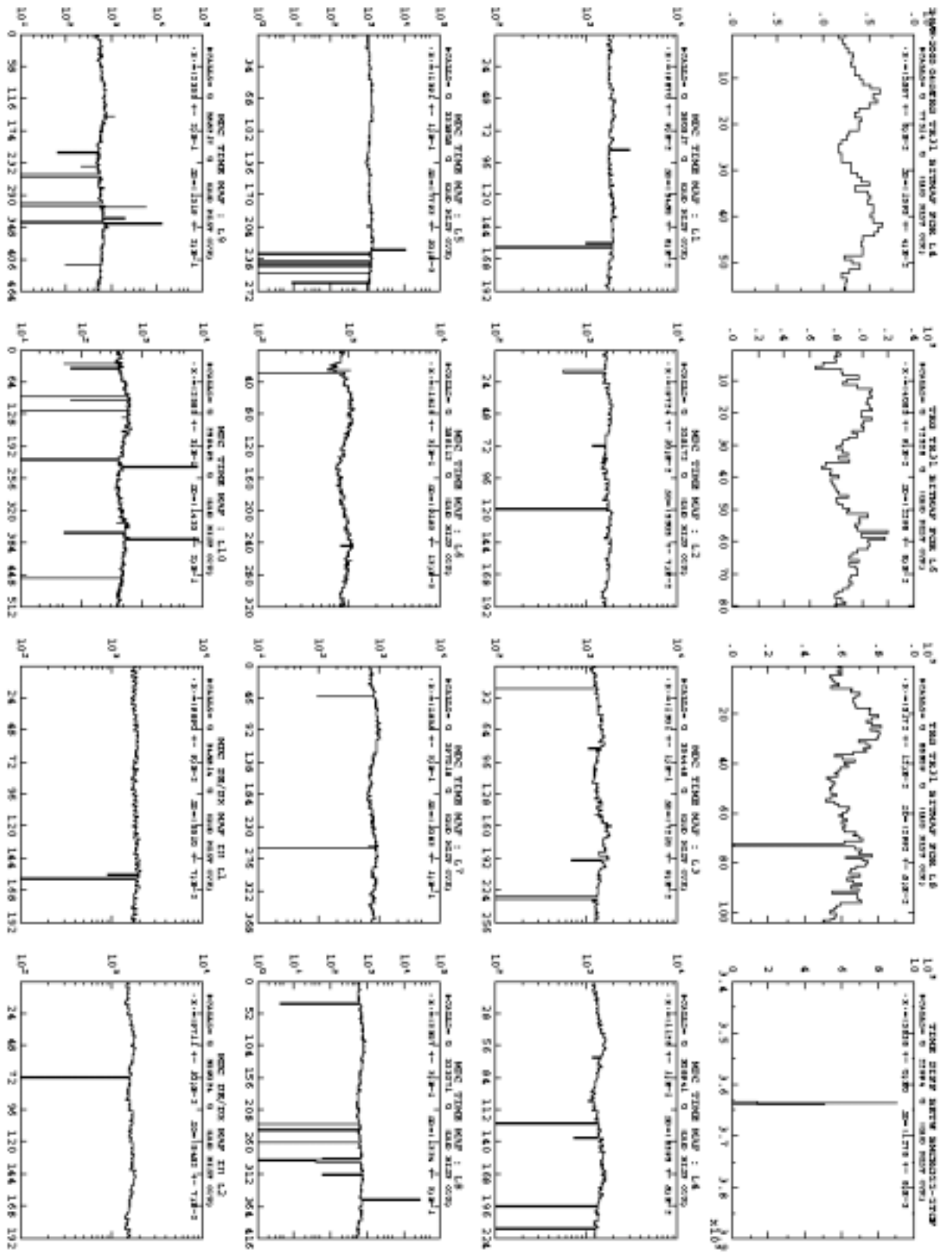


Fig. 18 After the decreasing interference methods were used

Summary

- After using the methods for decreasing the interference, the interference from SC to MDC was decreased significantly. The hot channels in trigger MDC tracking were removed. The MDC tracking outputs decreased about 17%-18%. Most hot channels in MDC time channels were removed. After decreasing the interference, the ratio of the background in BES events was decreased. The quality of the BES data was increased (especially the data from MDC).
- Carefully using the methods for decreasing the interference (good matching at the end at the transmission line, tuning the time relations of the MDC gate with the SC reset and gate, improving the bad connections, limiting the interference transferring path, ...), the strength of the interference could be controlled to the lower level compared than the noise coming from MDC electronics.
- When MDC 3 is installed, the interference from SC should be tested carefully.