Hardware Analysis of the Prescaling Scheme Of the Hall-B Photon Tagger

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1 Introduction

The following document describes the results of the analysis of the signals related to the prescaling scheme for the Hall-B photon spectrometer. This was performed in answer to the apparent failure the system to prescale correctly T-counters: 16, 17, 18, 22, 23, 24, and 25.

This document also describes the modifications brought to the prescaling scheme after the above measurements were performed.

2 Effects of the Prescale Veto

Fig 1 shows the basic processing of signals from the photon tagger. The prescaler is essentially a gate of definite width and periodicity applied as a veto to the Left-Right-E counters coincidence. The prescale signals are generated by VME modules and are remotely programmable. Presently, three prescale factors- x2, x4, and x8 - are readily available, where the x2 signifies that the gate is opened for half the time, x4 for a quarter of the time, and x8 for an eighth of the time. The prescaling factors are, furthermore, applied to the T-counter signals in the following manner:

- x2: T-16 to T-29
- x4: T-30 to T-45
- x8: T-46 to T-61

In order to ascertain that the electronics were performing as per the specifications, the following test was performed.

- The Phillips 754 coincidence unit was switched from level 3 to level 1
- A 100 MHz square wave was supplied to the Phillips 754 coincidence unit insuring constant triggering. The 754s are rated at 300MHz and have no difficulty handling such input rates. The input signal is shown on Fig 2.
- The Prescaling gates were enabled.
- The output for each coincidence units corresponding to T-counters 16 through 61 were recorded.

Prescale Factor	Full Period in msec	Gate Enable in msec
x2	66	33
x4	130	30
x8	270	33

Table 1: Parameters of the veto signals.

The results from these measurements are shown of figs 3 to 10. The signals desplayed were recorded at the output of the Phillips 754 coincidence units. The desplayed output from T-counter 16 differs from the others in that it was recorded in single shot mode. The short time scale structures shown are artifacts from the digital oscilloscope due to the difference in time scales between the test signal (100 MHz) and the veto (15 Hz). To compensate for this, all the other signals were recorded in integration mode. Nevertheless, it is clear from all the traces that the prescaling scheme is working as expected.

Table 1 lists the average characteristics of the veto signals.

3 Measurement of the Relative Phases of the Veto Signals

We have also measured the relative phases of all of the veto signals. These signals are essentially broken down into three groups corresponding to the x2, x4 and x8 prescale factors.

3.1 The x2 Prescale Factor

The signals defining the x2 prescale factors are square waves whose period is 66 msec. They are 180 degrees out of phase. These signals are shown clearly on Fig 11. We found during our measurements that, if one calls the first of these signals α and that which is 180 degree out of phase β, the order of T-counters they affect is not intuitively obvious. The association of T-counters to a phase, prior to may 19, was as follow:

- veto α: T-19, 20, 21, 26, 27, 28, and 29
- veto β: T-16, 17, 18, 22, 23, 24, and 25

NB: It has been noted that the T-counters which are not prescaled correctly are associated with the so-called phase β. We have checked the corresponding signals and find that they are working correctly. Our suspicion is that the cable from the VME crate to the fan-out may be deffective, but we have not really been able to prove this assertion.

3.2 The x4 Prescale Factor

The signals defining the x4 prescale factors have a period of about 130 msec. They are on (NIM level high) for 100 msec, and off for the remaining time. There are four such signals, and they are out of phase by 90 degrees. The corresponding signals are shown on Fig 11. The association of T-counters to a phase, prior to may 19, was as follow:

- veto 'phase 0 degrees': T-30, 31, 32, and 33

- veto 'phase 90 degrees': T-34, 35, 36, and 37
- veto 'phase 180 degrees': T-38, 39, 40, and 41
- veto 'phase 270 degrees': T-42, 43, 44, and 45

3.3 The x8 Prescale Factor

The signals defining the x8 prescale factors have a period of about 270 msec. They are on (NIM level high) for 240 msec, and off for the remaining time. There are four such signals, and they are out of phase by 45 degrees. The corresponding signals are shown on Figs 11 and 12. The association of T-counters to a phase, prior to may 19, was as follow:

- veto 'phase 0 degrees': T-46, and 47
- veto 'phase 45 degrees': T-48, and 49
- veto 'phase 90 degrees': T-50, and 51
- veto 'phase 135 degrees': T-52, and 53
- veto 'phase 180 degrees': T-54, and 55
- veto 'phase 225 degrees': T-56, and 57
- veto 'phase 270 degrees': T-58, and 59
- veto 'phase 315 degrees': T-60, and 61

4 New correspondence between T-counters and vetos after may 19

In order to reduce the number of special tagger configurations and thereby ease the analysis of the tagger events, a new scheme has been adopted for the correspondence between T-counters and vetos.

4.1 The x2 Prescale Factor

- veto α: T-16, 18, 20, 22, 24, 26, and 28
- veto β: T-17, 19, 21, 23, 25, 27, and 29

4.2 The x4 Prescale Factor

- veto 'phase 0 degrees': T-30, 34, 38, and 42
- veto 'phase 90 degrees': T-31, 35, 39, and 43
- veto 'phase 180 degrees': T-32, 36, 40, and 44
- veto 'phase 270 degrees': T-33, 37, 41, and 45

4.3 The x8 Prescale Factor

- veto 'phase 0 degrees': T-46, and 54
- veto 'phase 45 degrees': T-47, and 55
- veto 'phase 90 degrees': T-48, and 56
- veto 'phase 135 degrees': T-49, and 57
- veto 'phase 180 degrees': T-50, and 58
- veto 'phase 225 degrees': T-51, and 59
- veto 'phase 270 degrees': T-52, and 60
- veto 'phase 315 degrees': T-53, and 61

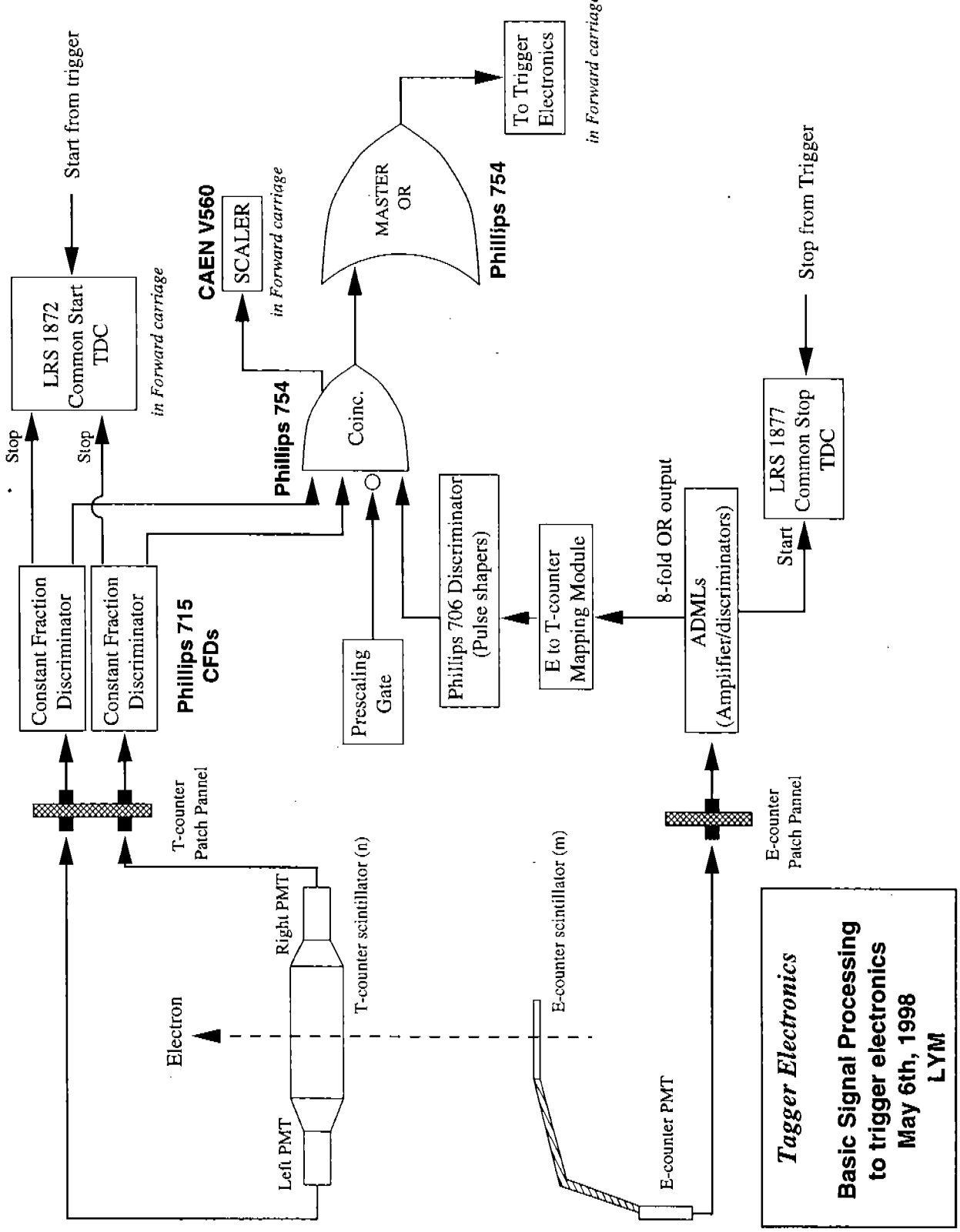


Figure 1: Tagging Spectrometer Signal Processing

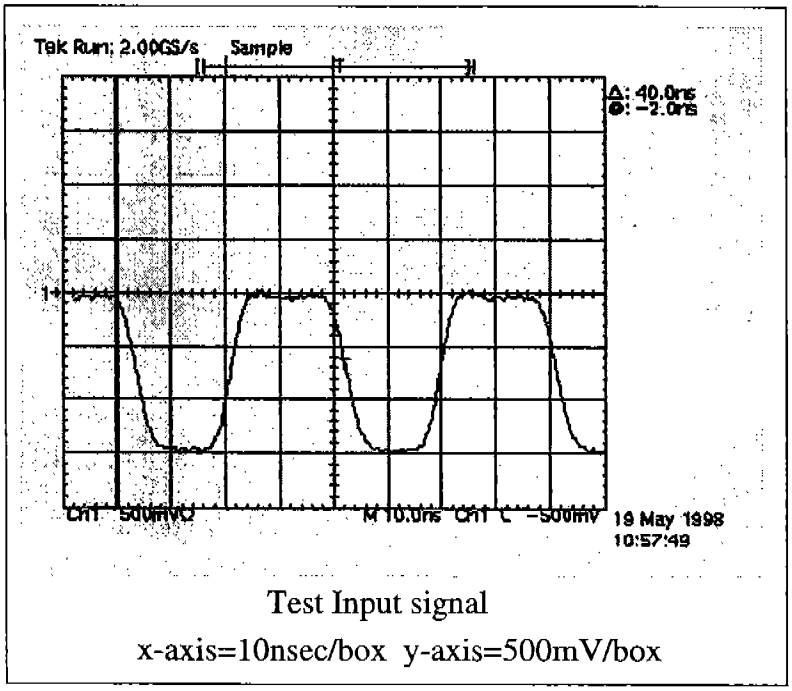
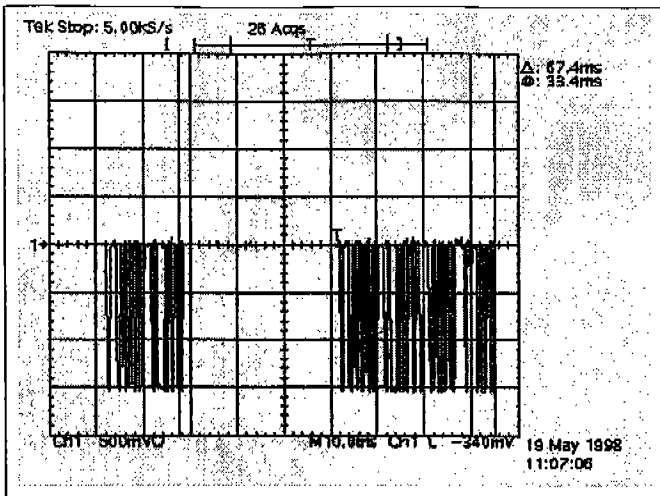
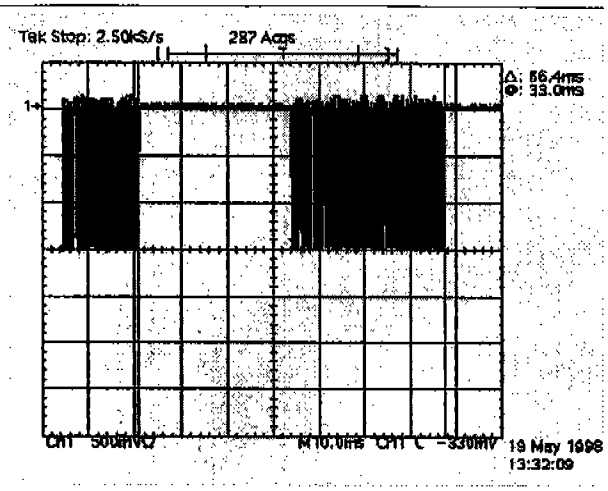


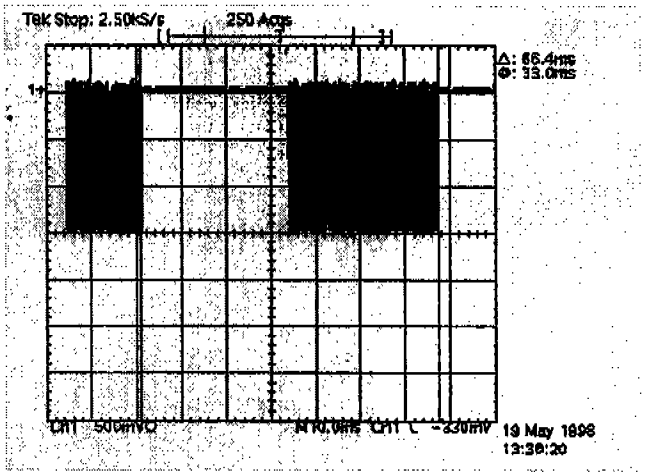
Figure 2: Oscilloscope Trace of the 100MHz test input signal



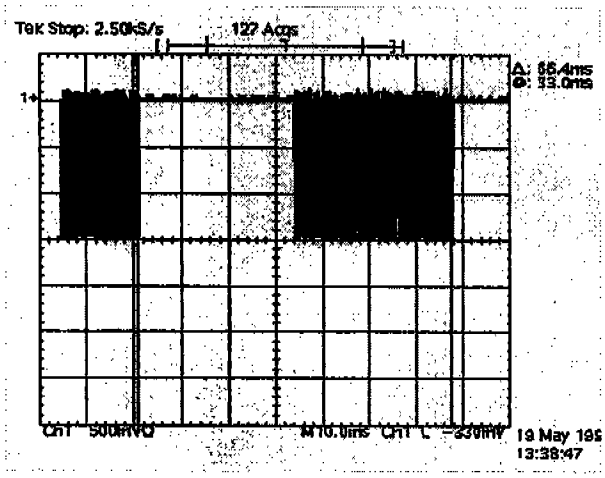
T-16 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box



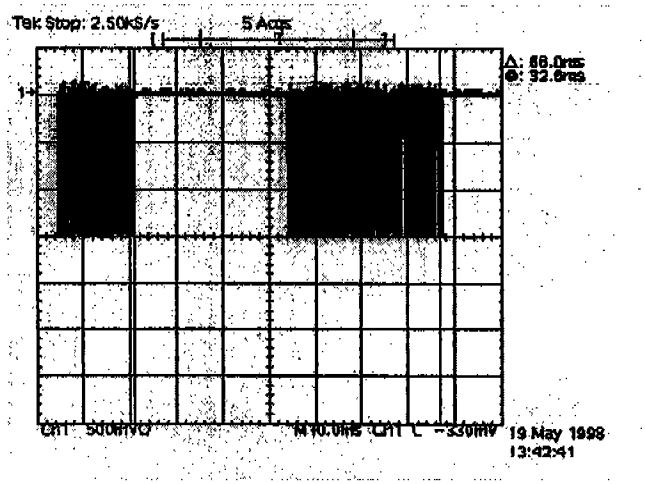
T-17 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box



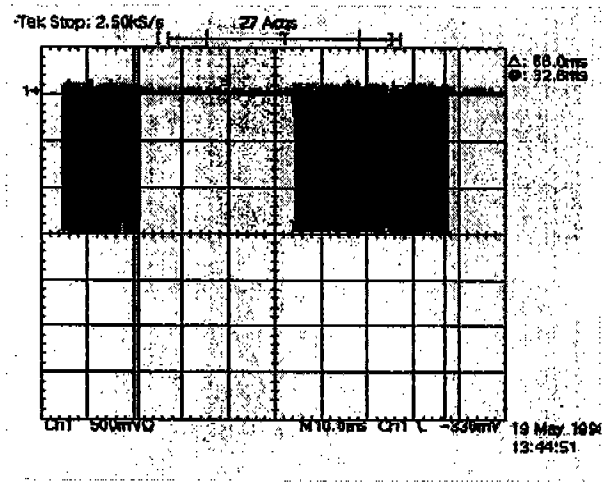
T-18 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box



T-19 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box

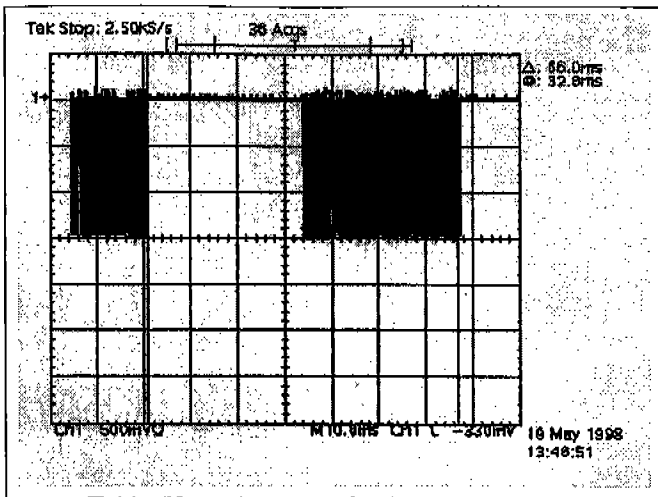


T-20 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box

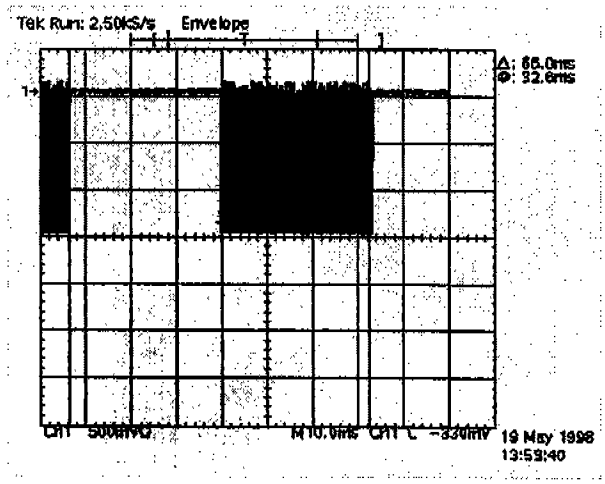


T-21 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box

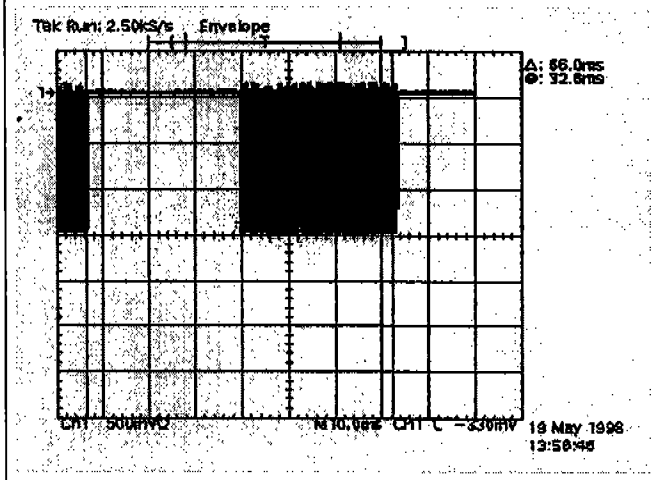
Figure 3: Traces for T-counters 16-21



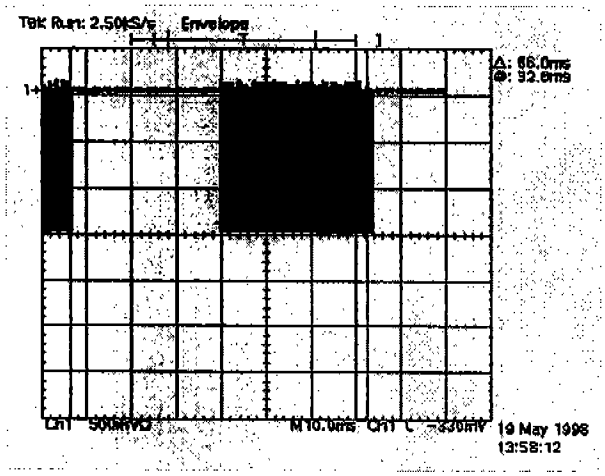
T-22 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box



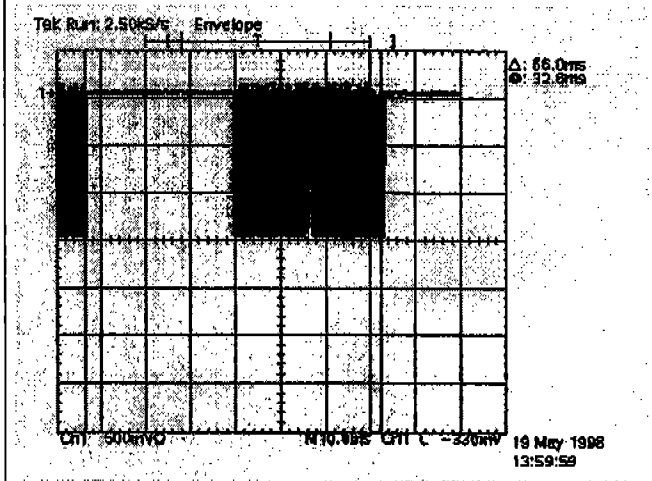
T-23 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box



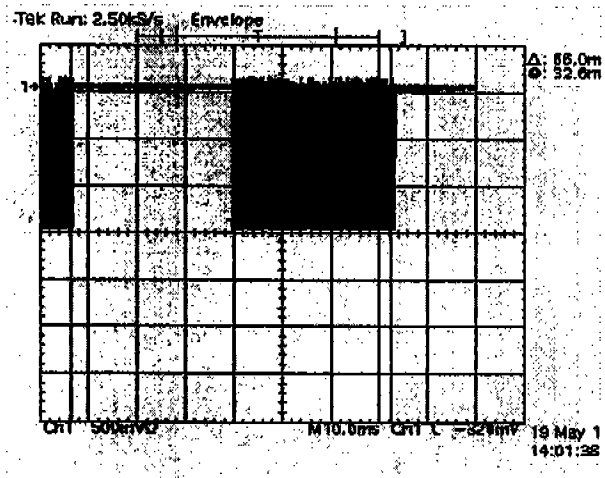
T-24 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box



T-25 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box

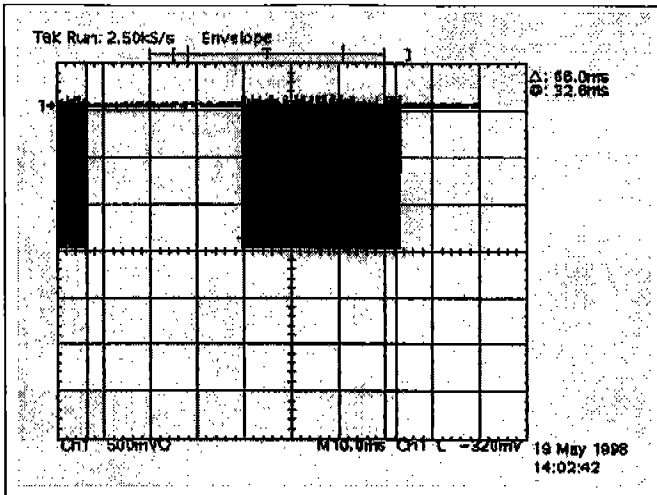


T-26 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box

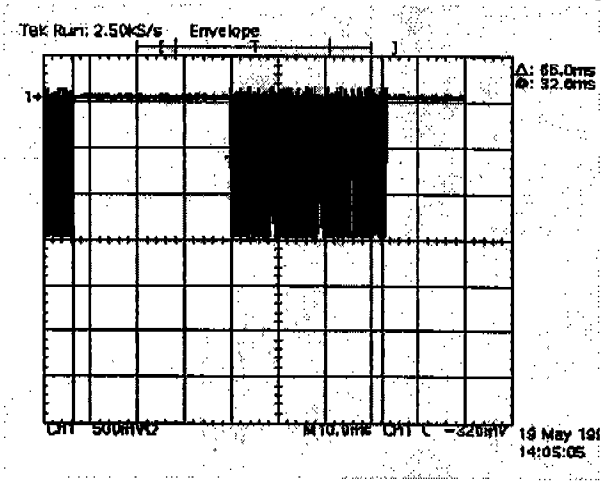


T-27 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box

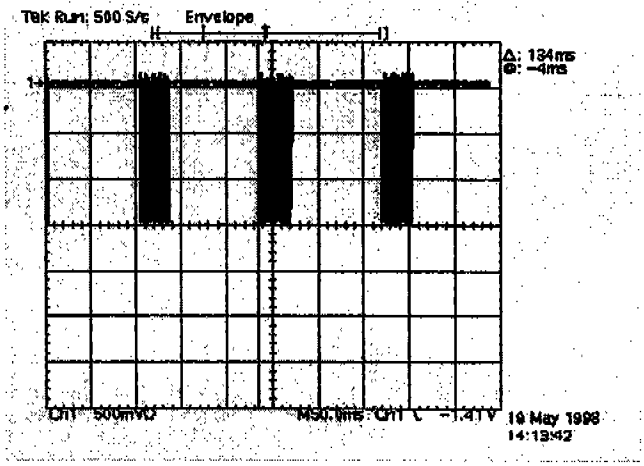
Figure 4: Traces for T-counters 22-27



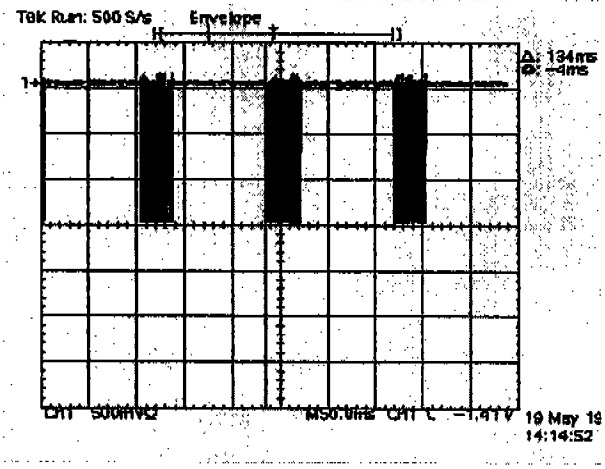
T-28 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box



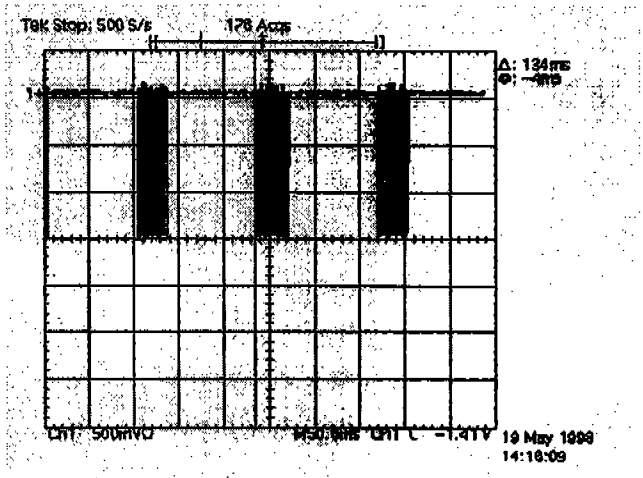
T-29 : Vetoed output of coincidence unit
x-axis=10msec/box y-axis=500mV/box



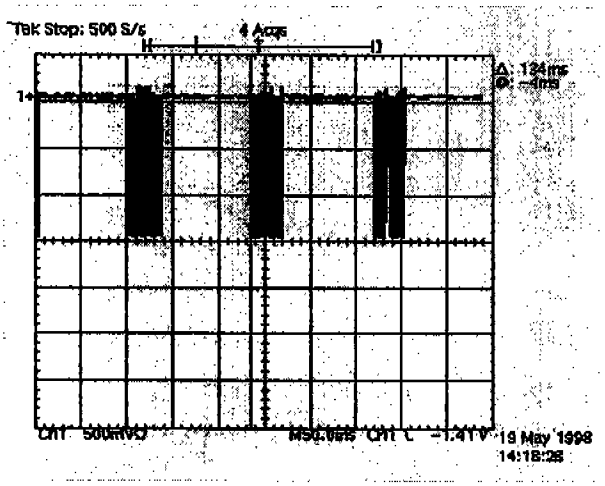
T-30 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box



T-31 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box

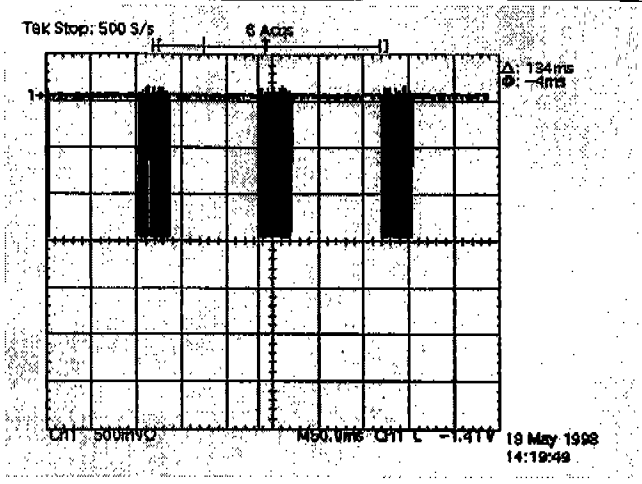


T-32 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box

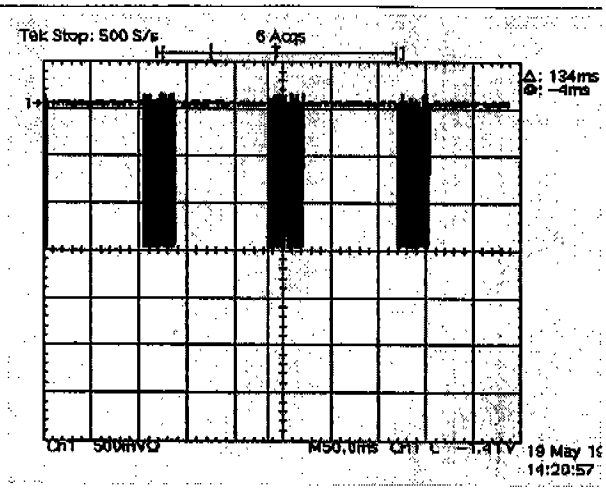


T-33 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box

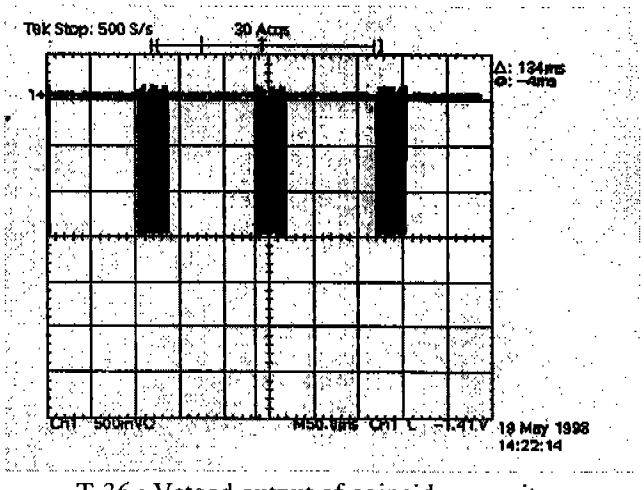
Figure 5: Traces for T-counters 28-33



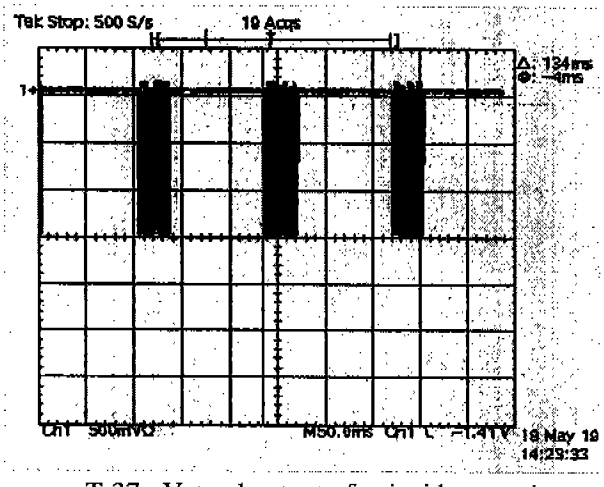
T-34 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box



T-35 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box



T-36 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box



T-37 : Vetoed output of coincidence unit
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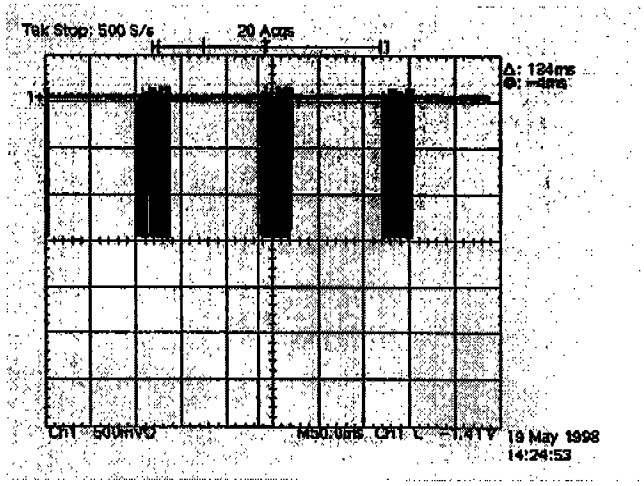

T-38 : Vetoed output of coincidence unit
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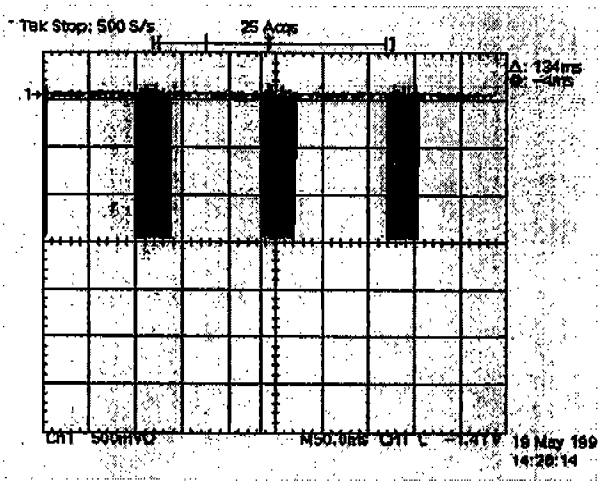
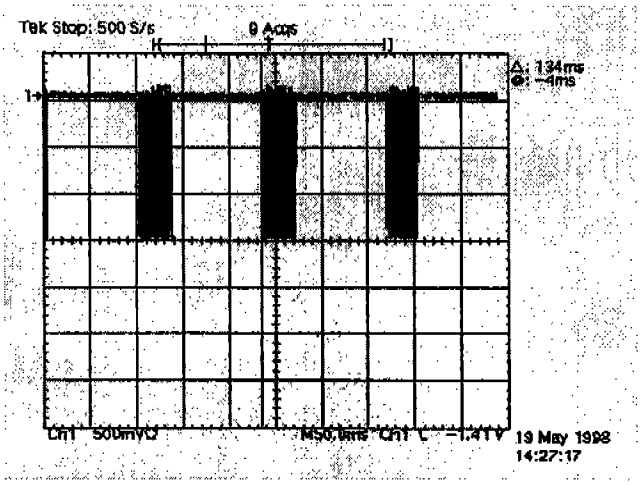
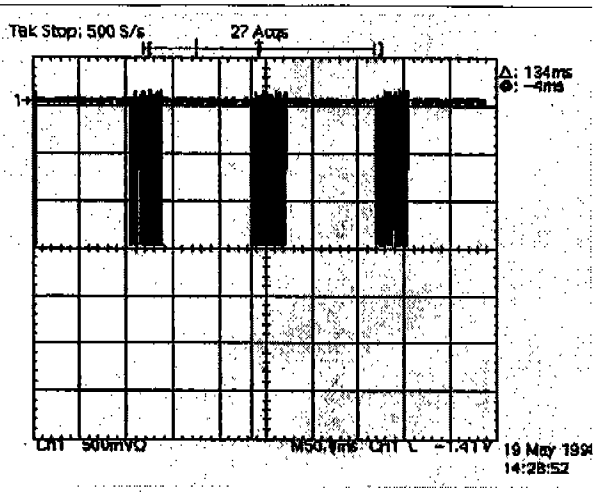


T-39 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box

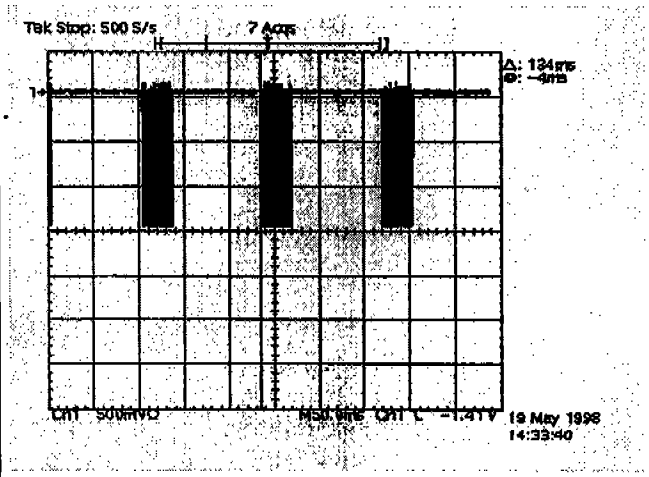
Figure 6: Traces for T-counters 34-39



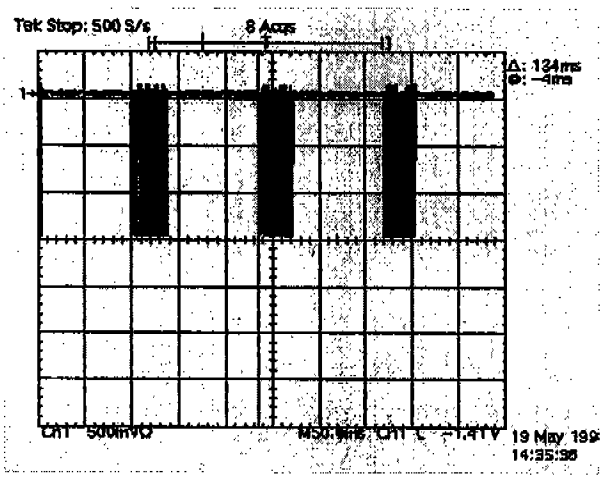
T-40 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box



T-41 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box



T-42 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box



T-43 : Vetoed output of coincidence unit
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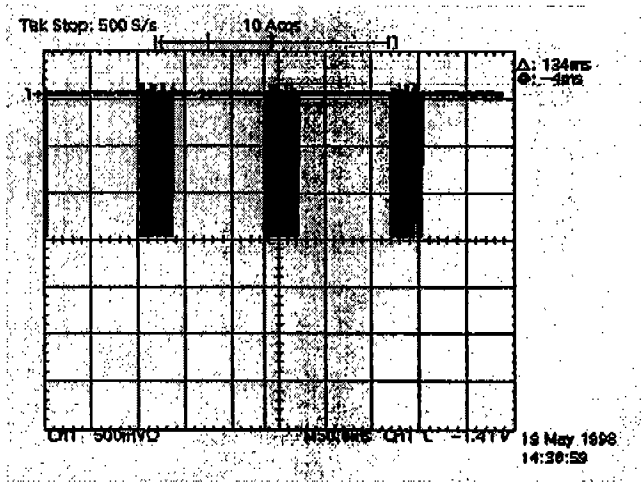
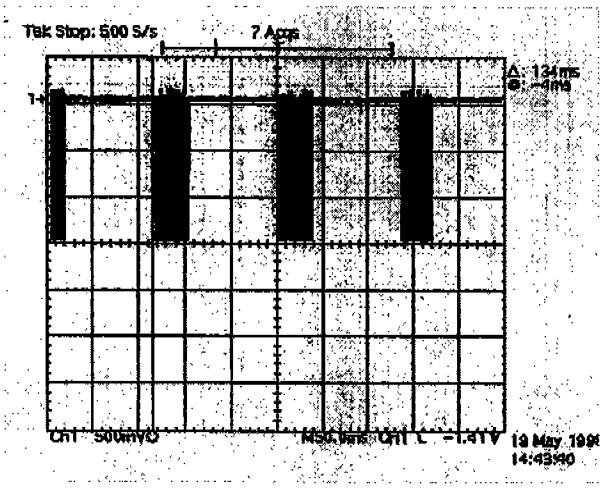
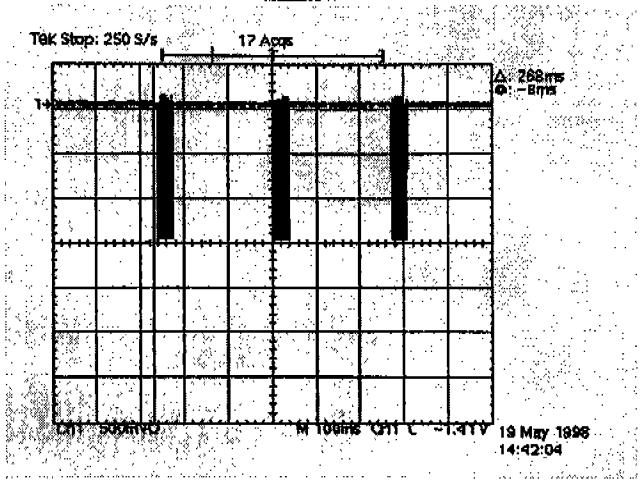


T-44 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box

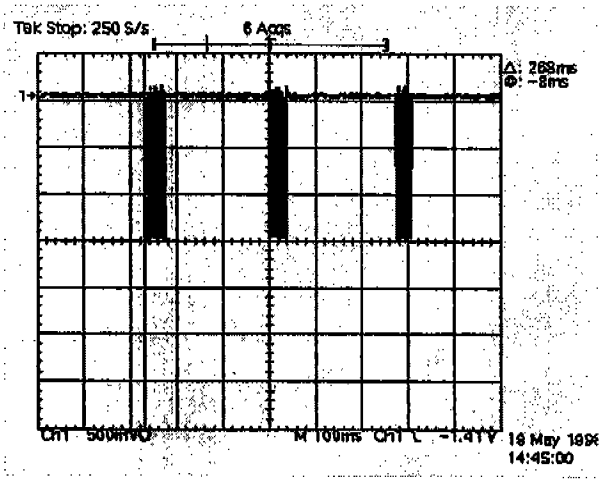


T-45 : Vetoed output of coincidence unit
x-axis=50msec/box y-axis=500mV/box

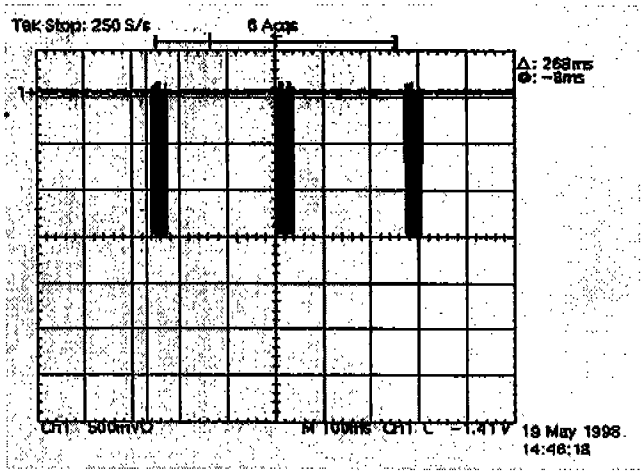
Figure 7: Traces for T-counters 40-45



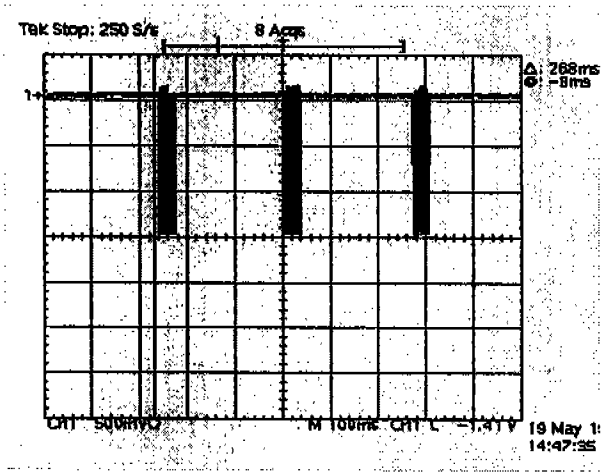
T-46 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box



T-47 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box



T-48 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box



T-49 : Vetoed output of coincidence unit
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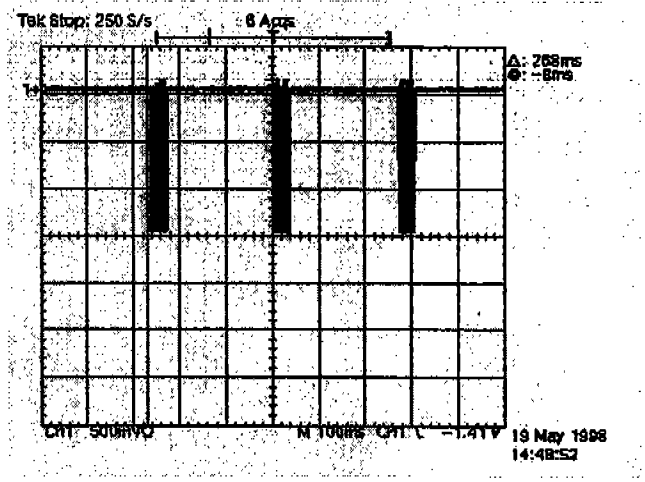

T-50 : Vetoed output of coincidence unit
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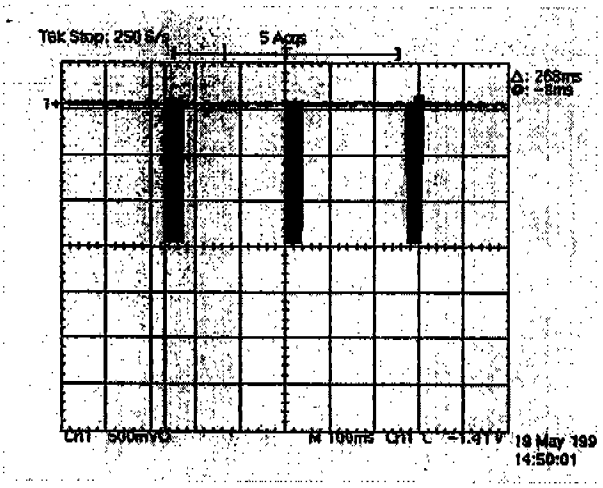
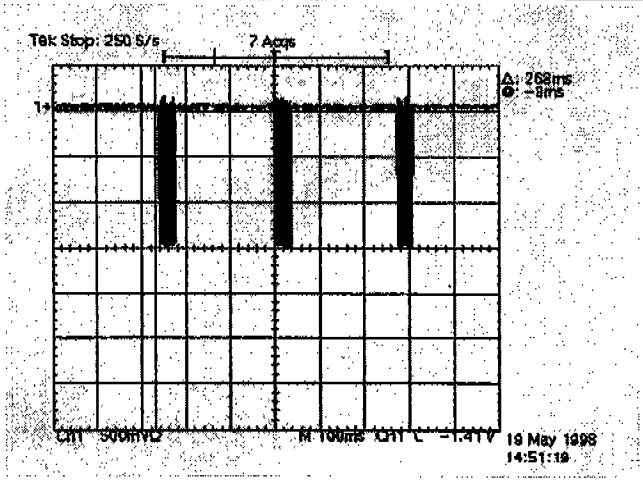
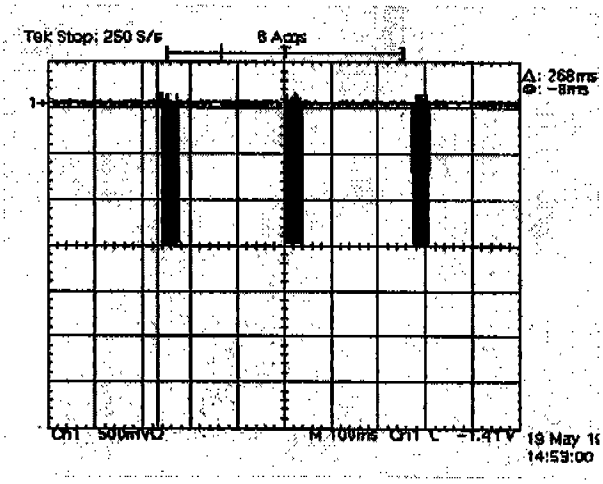


T-51 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box

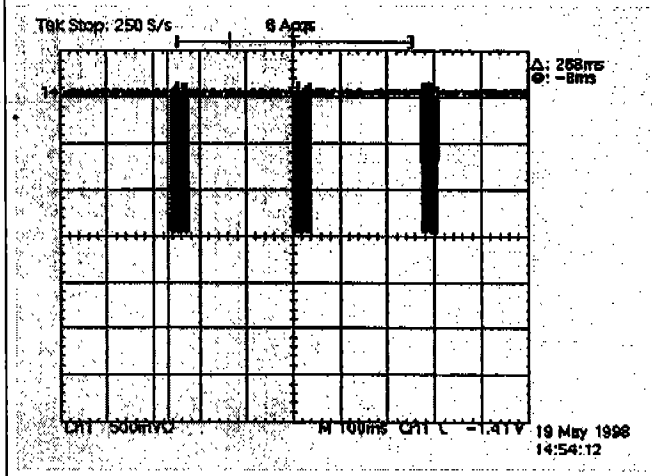
Figure 8: Traces for T-counters 46-51



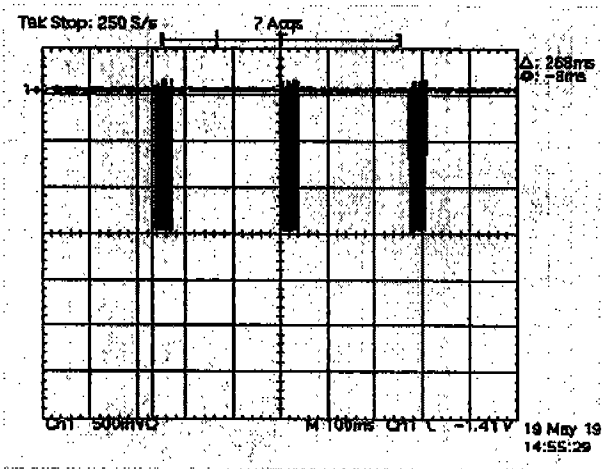
T-52 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box



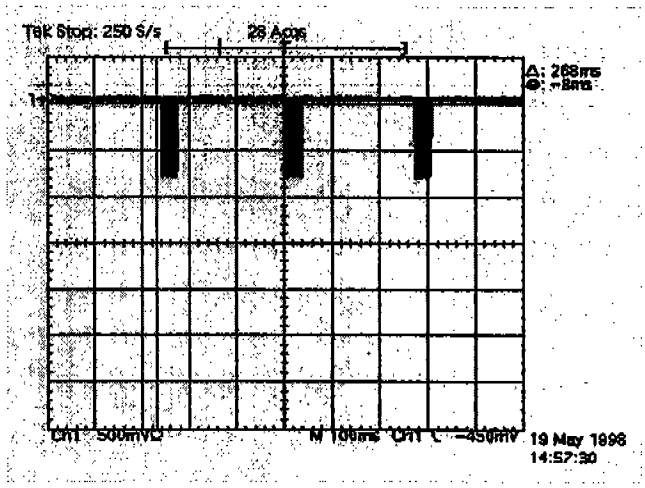
T-53 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box



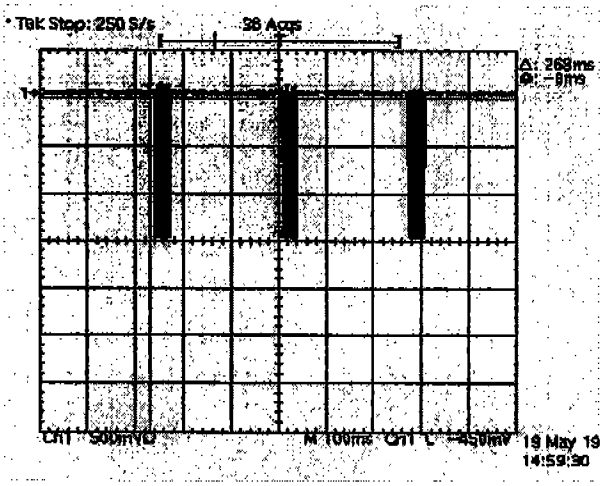
T-54 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box



T-555 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box

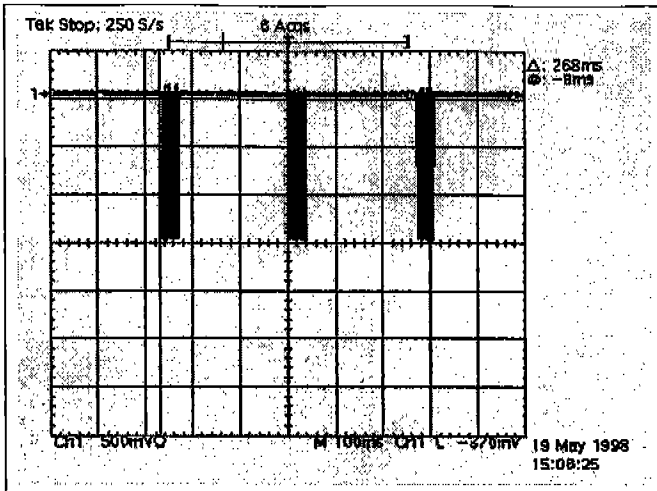


T-56 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box

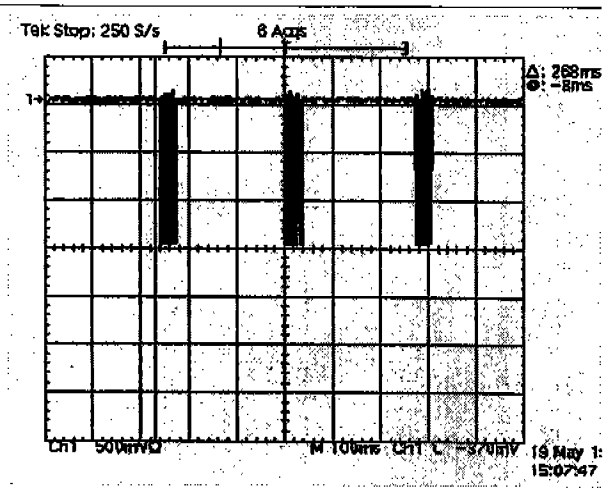


T-57 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box

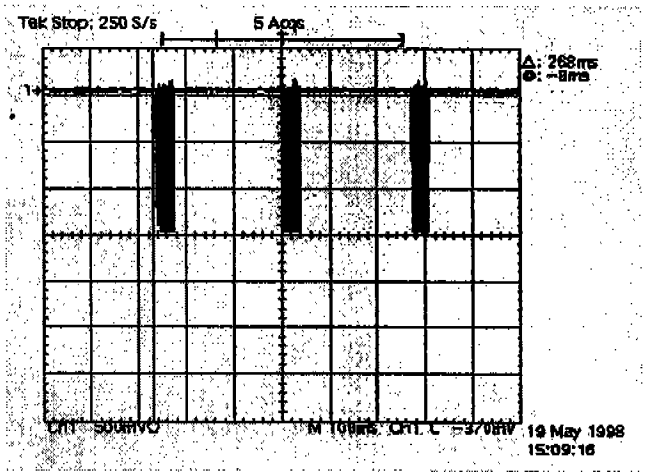
Figure 9: Traces for T-counters 52-57



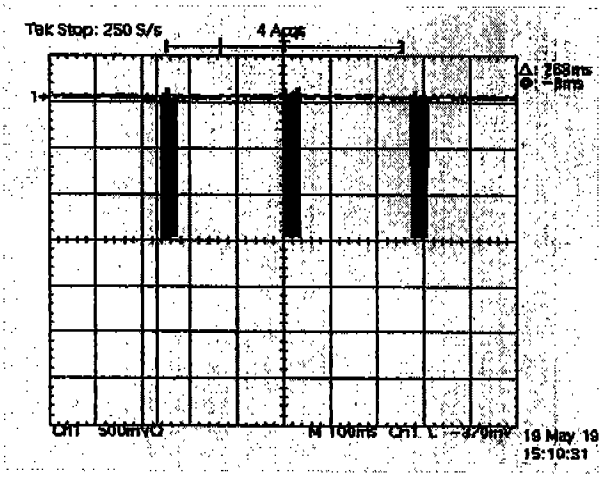
T-58 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box



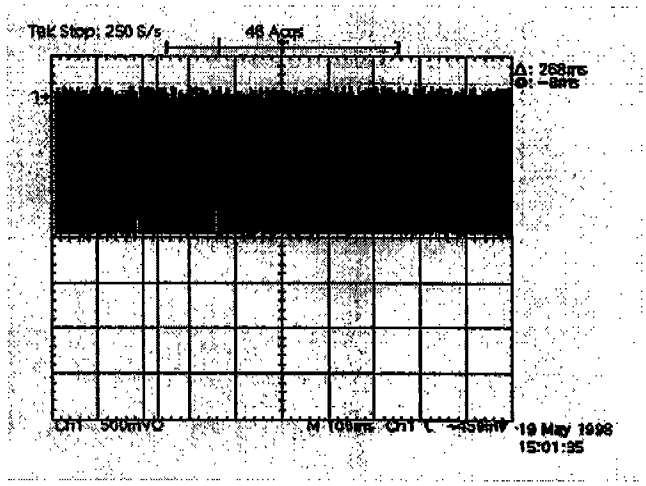
T-59 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box



T-60 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box

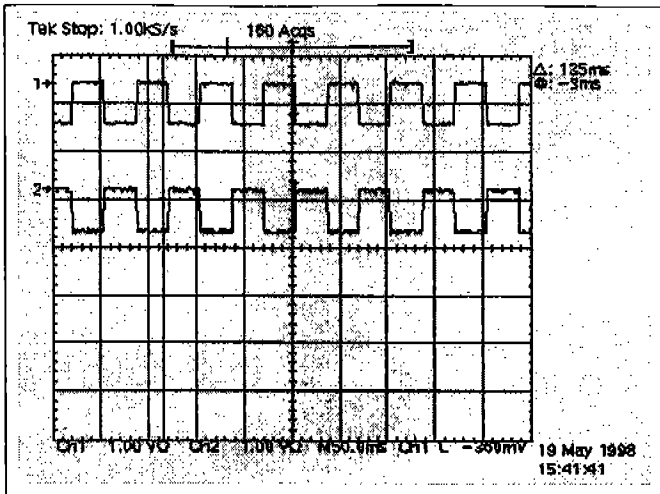


T-61 : Vetoed output of coincidence unit
x-axis=100msec/box y-axis=500mV/box

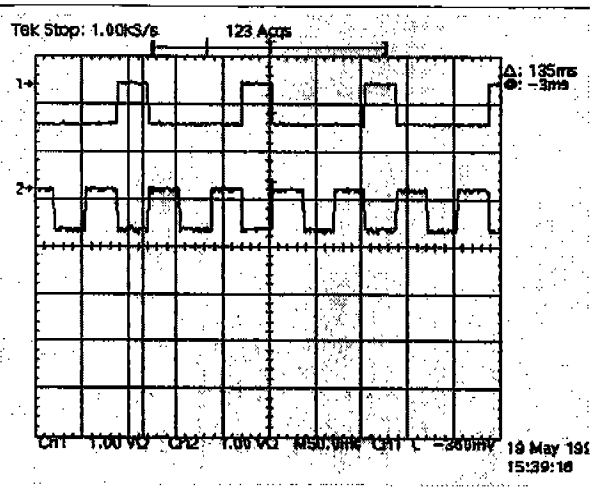


T-58 : Vetoed output of coincidence unit
Veto signal turned off

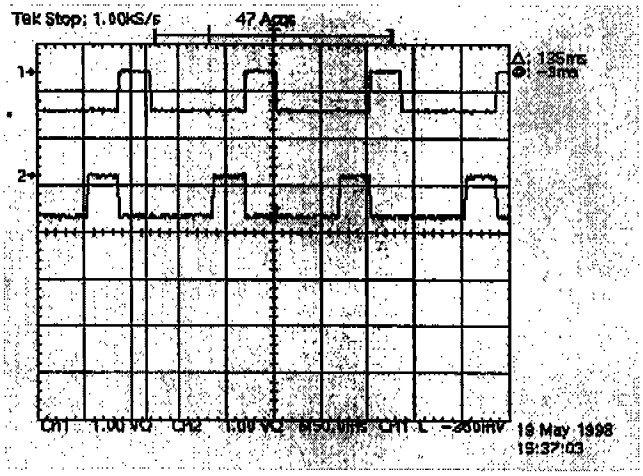
Figure 10: Traces for T-counters 58-61



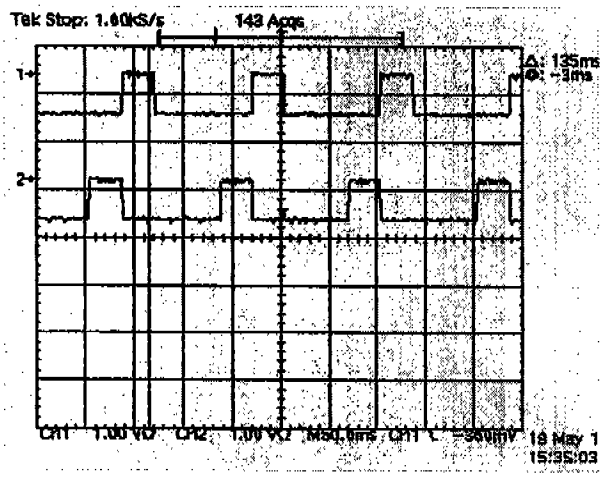
relative timing of veto signals
chan1 T-29 - chan2 T-25



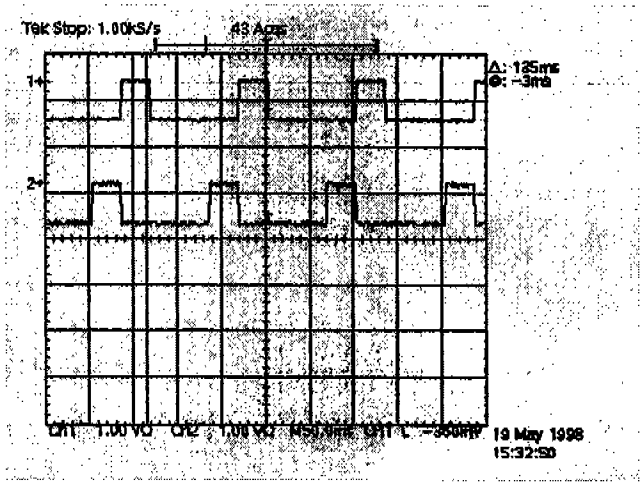
relative timing of veto signals
chan1 T-30 - chan2 T-29



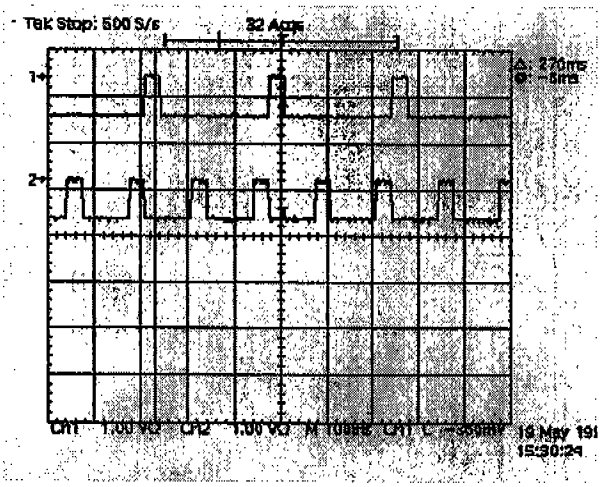
relative timing of veto signals
chan1 T-34 - chan2 T-33



relative timing of veto signals
chan1 T-38 - chan2 T-37

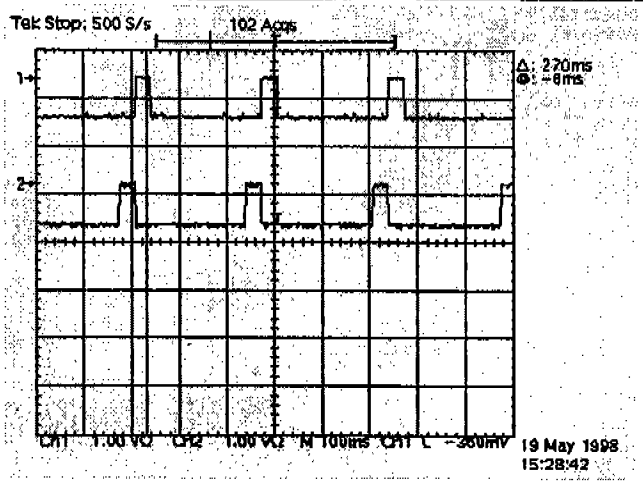


relative timing of veto signals
chan1 T-42 - chan2 T-41

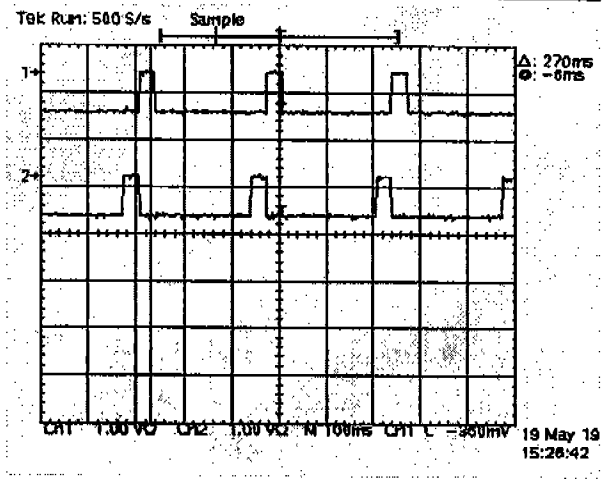


relative timing of veto signals
chan1 T-46 - chan2 T-45

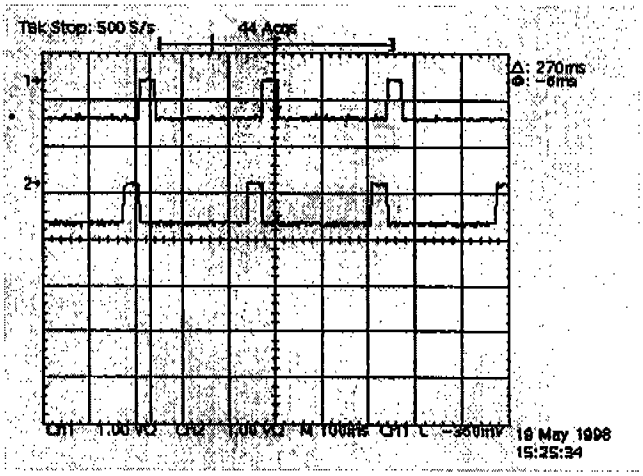
Figure 11: Relative Timing of the Vetos for T-25 through 46



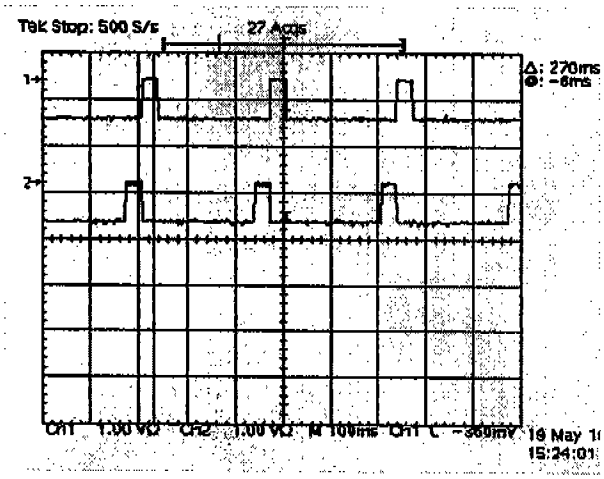
relative timing of veto signals
chan1 T-48 - chan2 T-47



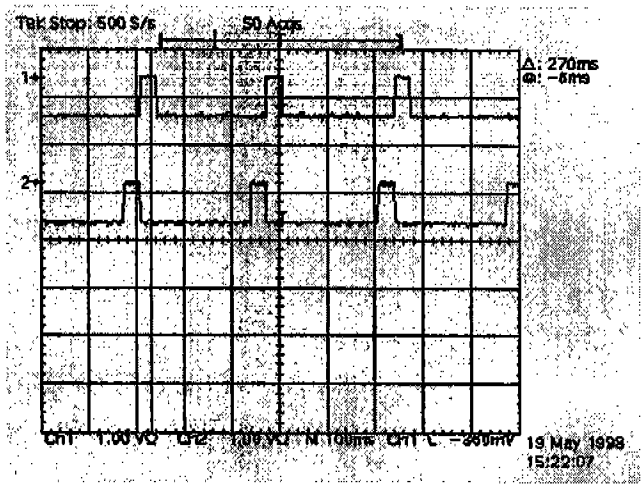
relative timing of veto signals
chan1 T-50 - chan2 T-49



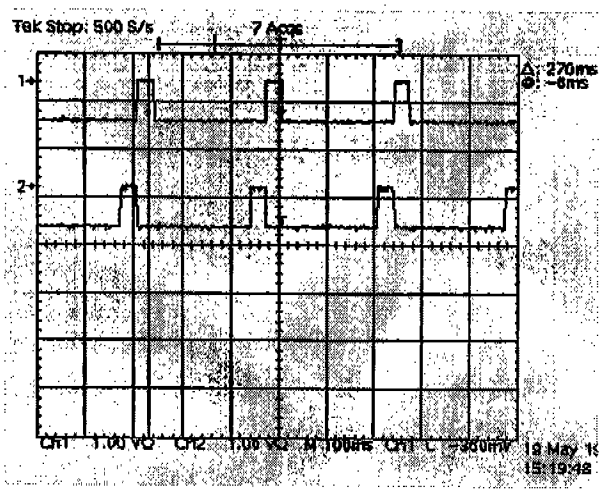
relative timing of veto signals
chan1 T-52 - chan2 T-51



relative timing of veto signals
chan1 T-54 - chan2 T-53



relative timing of veto signals
chan1 T-56 - chan2 T-55



relative timing of veto signals
chan1 T-58 - chan2 T-57

Figure 12: Relative Timing of the Vetos for T-48 through 57