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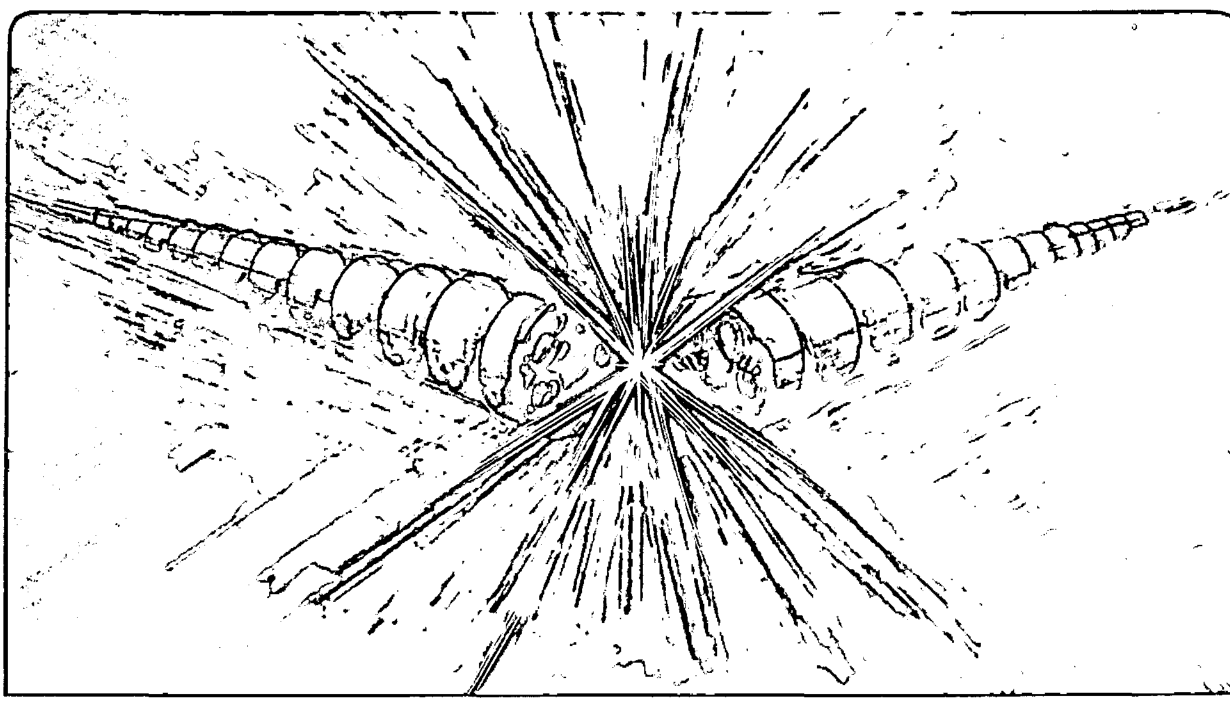

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Four Channel 250MHz Visual Counter

(LBL 14Y5104)

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Abstract

A visual counter rated at 250 MHz. with a pulse-pair resolution of 2.6 nanoseconds for NIM signals has been designed. Pulse widths for NIM signals must be equal to or greater than 2 ns. The counter has a separate input for TTL signals and for this logic level it operates at rates equal to or less than 190 MHz. TTL pulses must be greater than 4 ns. The design was implemented on a printed circuit card. Four of these cards were packaged into a single unit resulting in a four channel device that can be mounted into a 19 inch rack. Seven units were built; they are presently used in the experimental area and in the Main Control Room of the Bevalac. The counter accepts well defined NIM or TTL signals internally terminated with 50 ohms. All the controls and the signal input connectors are located on the front panel. An Overflow output, Gate, and Reset inputs are located on the back panel. The counters have 8 Light Emitting Diode digit displays which are 20.3 mm high with a viewing distance rating of 10 meters. Light filters are used for the LED displays greatly enhancing their visibility.

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Documentation

There are two documents pertinent to this device. The "Four Channel 250 MHz Visual Counter" (PUB-3097) refers to the 19" 4-channel chassis, 14Y5104; it is intended for the user and contains sufficient information to make effective use of the device. The "250 MHz Visual Counter" (PUB-3099) refers to the printed circuit card and contains detailed information on the circuitry design that is useful for maintenance and trouble-shooting.

Description.

The unit contains four quasi-independent channels with separate signal inputs and controls, housed in a 19" x 8.5" x 14" chassis. Each counter has eight large (20.3 mm) LED displays. The counters operate with leading zero suppression except the least significant digit. This means that upon turn-on and after reset, either manual or electrical reset, the least significant digit will display a zero while the other displays will be blanked-out in the absence of a signal input. See Fig. 1, Four Channel Counter, 14Y5104.

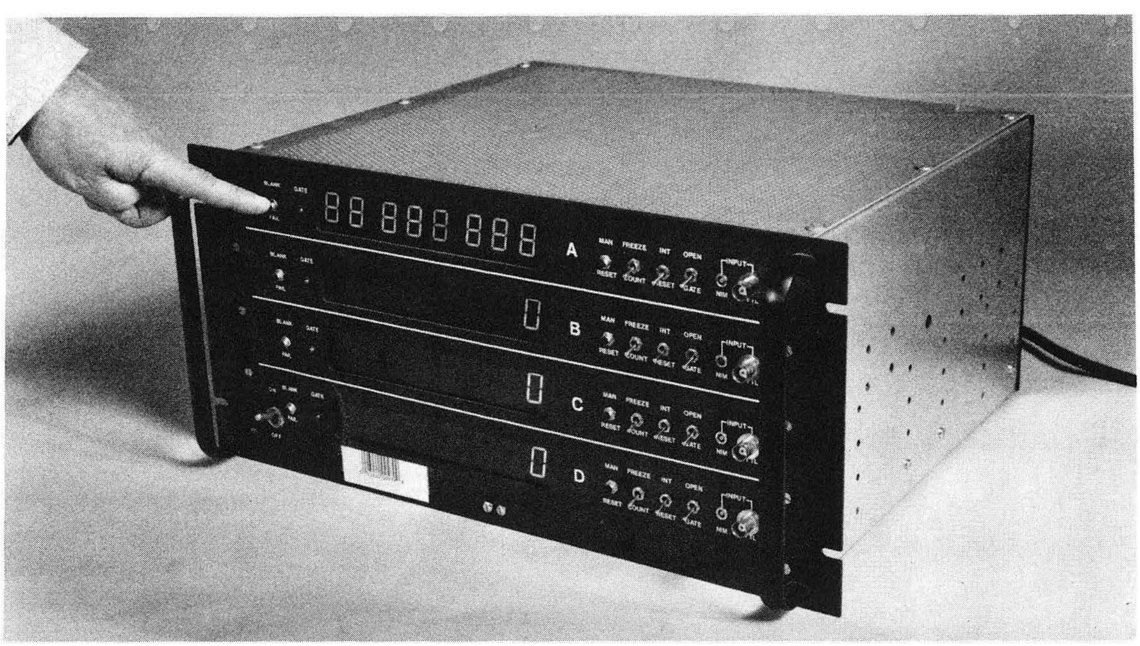

Fig. 1, Four Channel Visual Counter. (14Y5104)

The counters are not independent since they share the same power supply and the same RESET and GATE control signals. The manual controls for each channel enable or disable these signals, which are wired in the back through common input connectors. Thus, the individual counters cannot be operated with separate GATE or RESET signals. There is an overflow TTL output signal with 50 ohm drive capability from each channel . This output is available on the back panel through a BNC connector. The input and output signals and other parameters are summarized below.

Signal Inputs:
Standard NIM signals having a width equal to or greater than 2 ns at a rate equal to or less than 250 MHz. Pulse-pair resolution is 2.6 ns. Internal 50 ohms termination. NIM connector on the front panel. See Fig. 2, Front Panel.

TTL level input signals having a width equal to or greater than 4 ns and at a rate less than 190 MHz. Internal 50 ohms termination. BNC connector on the front panel. *Input should be either NIM or TTL at one time, not both.*

Control inputs:
TTL signal for the GATE function. A "high" level enables the counter. Notice that in the absence of a signal to this input, the internal TTL circuitry assumes a "high" and the counter is enabled. BNC connector in the back panel. See Fig. 3, Back Panel.

TTL control signal for the RESET function. A "high" level resets the counter and prevents it from counting. External circuitry must "pull" this input "low" to enable the counter. In absence of outside circuitry, the counter can be enabled by setting the INT-RESET switch in the INT (integrate) position. RESET can be performed at any time by pressing the MAN(nual)-RESET switch.

Outputs:
One TTL per channel. The output is the overflow count; there is a pulse any time there is a carry from the most significant digit of the counter. This output can drive a 50 Ohm load.

Visual Range:
Visual range is rated at 10 meters in daylight. Light filters are used to increase display contrast.

Manual Controls:

The counters are stacked vertically and the displays and control switches are similar for all the counters, thus the description of one set will suffice for the rest of the counters. From left to right the following items are found: (See FIG 2. Front Panel)

<u>BLANK-FAIL</u> Push-button switch. It tests the large LED displays for element or total failure. Pressing of the switch turns **on** all the elements of the LED displays which will show an "8".

<u>GATE</u> Light emitting diode. It indicates the presence of the gate control signal and that the counter is enabled to count. This lamp should go **on** with the OPEN-GATE switch in the OPEN position. With no connection to the GATE input, the circuitry assumes a "high" input, and the lamp turns **on**. (Provided that the FREEZE-COUNT toggle switch is not in the FREEZE position.)

<u>MAN-RESET</u> Push-button switch. The MAN(nual)-RESET switch allows the operator to manually reset the counter at any time

<u>FREEZE-COUNT</u> Toggle switch. The COUNT position enables the RESET and GATE functions. The FREEZE position disables both the RESET and GATE functions, and the counter neither counts nor resets thereby "freezing" the displayed value.

<u>INT-RESET</u> Toggle switch. The INT(egrate)-RESET switch operates on the RESET function. The RESET position allows the RESET control signal to reset the counter. The INT(egrate) position disables the RESET control signal and the counter integrates the incoming counts from the next gate period with the existing count.

<u>OPEN-GATE</u> Toggle switch. The OPEN position allows the counter to count all the time. (The GATE LED should go **on**.) The GATE position allows counting only during the positive periods of the GATE control signal.

<u>INPUT-NIM-TTL</u> NIM and BNC connectors. The NIM connector is for NIM signals. The BNC connector is for TTL signals.

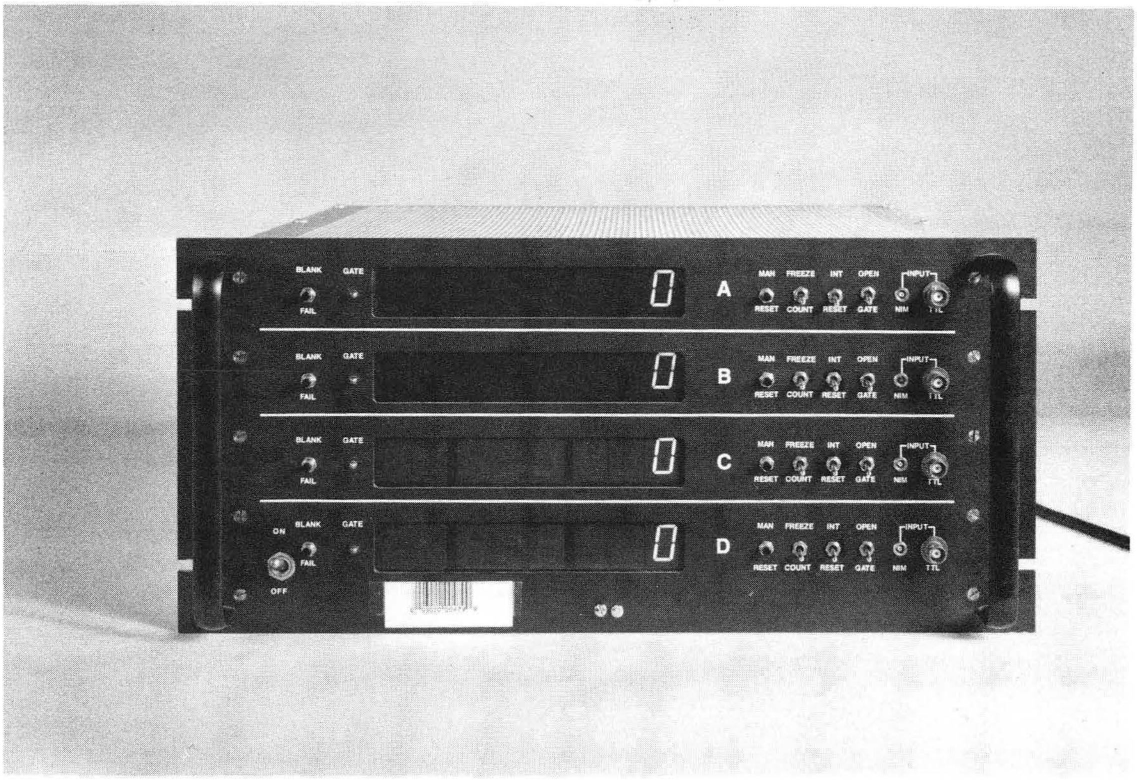

Fig. 2, Front Panel

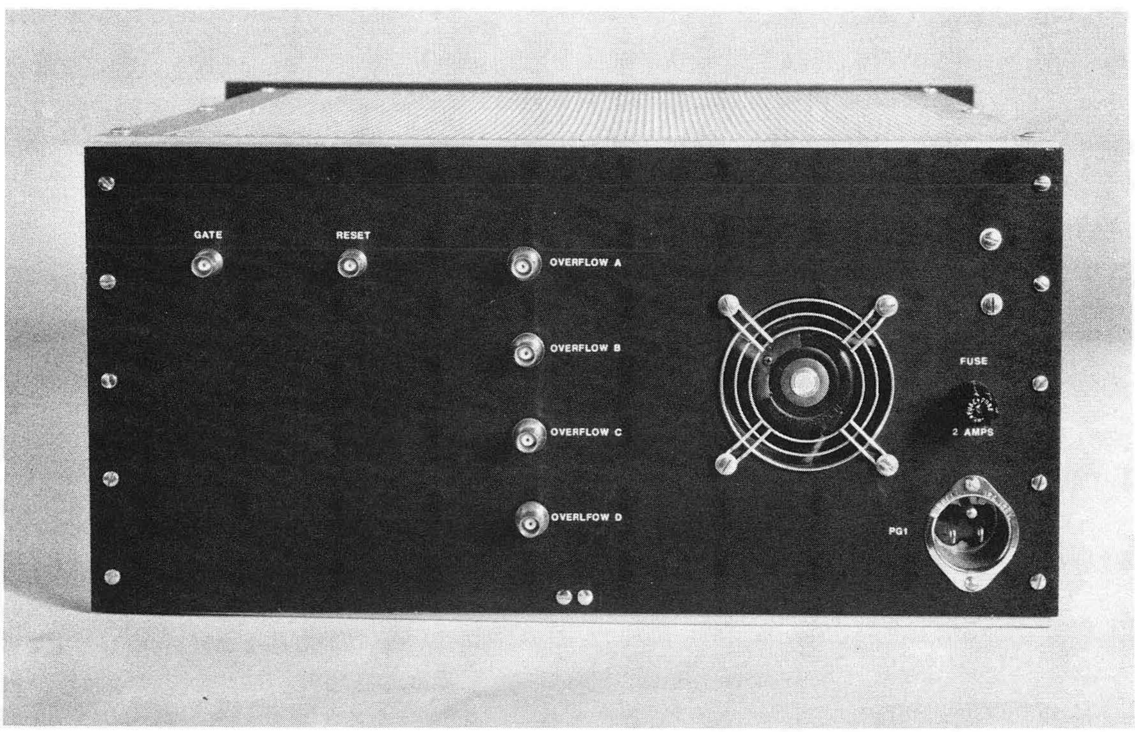

Fig. 3, Back Panel

Notes on packaging.

A single channel counter was implemented on a single Printed Circuit Board assembly. Four of these PCBs rest on top of each other. Fig 4, Packaging, shows the unit with the top cover removed. The arrangement necessitates ease of assembly and disassembly both for manufacturing and trouble-shooting. The signal cables to the PCB assemblies are mated to the outside world using feed through connectors; the front panel circuitry is mated through dual-in-line headers. Thus there are four major sub-assemblies, all of which are easily detachable; these sub-assemblies are:

Front Panel Assembly
Back Panel Assembly
Printed Circuit Board Assemblies (4 ea.)
Power Supply Assembly.

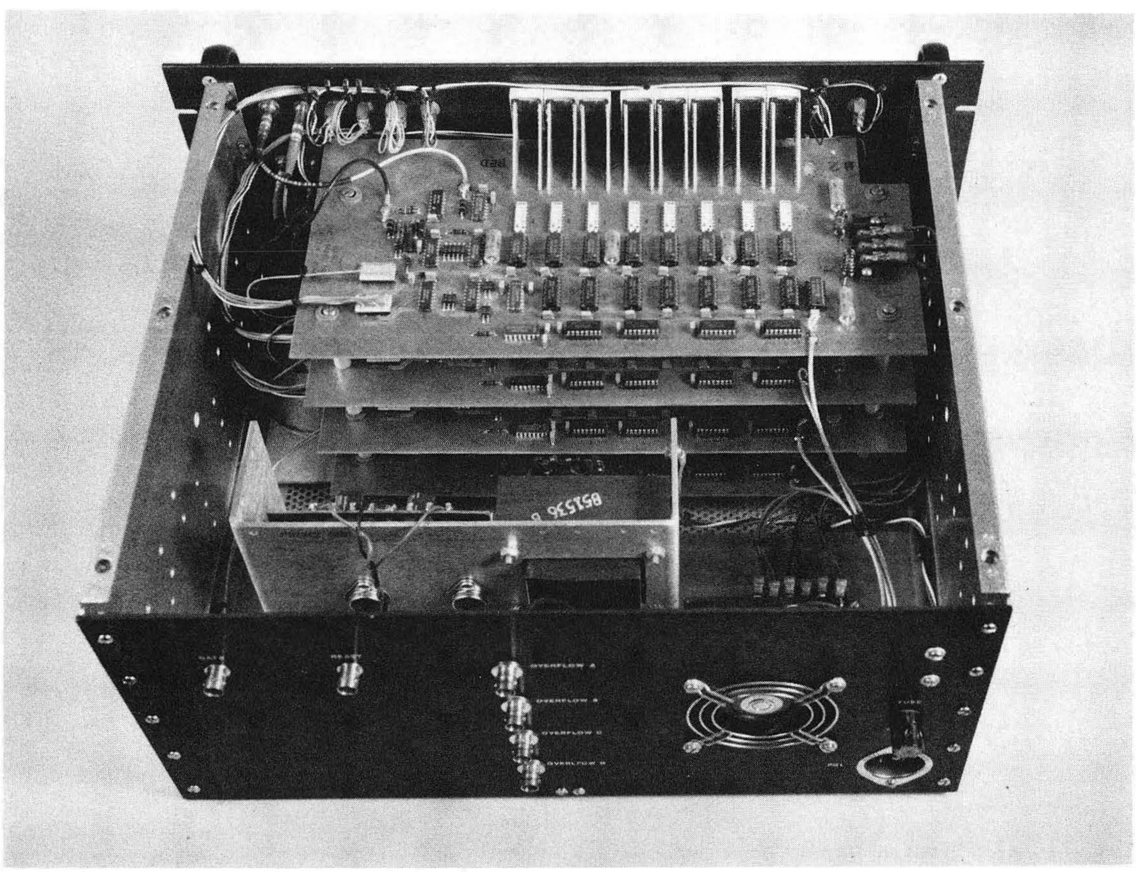

Fig. 4, Packaging

Notes on Design and Performance.

This counter was designed with simplicity in mind. Functions which were not considered essential were not implemented. For instance, there is no amplification and no wide range discrimination in the input circuitry. (There is an internal adjustment for input threshold.) The rationale for that decision is that this counter is intended for use in experiment counting houses. In this environment, well defined signals are not only expected but demanded; these signals are logical, discrete level, signals that do not require amplification. The goal was to implement a 250 MHz counter with a short pulse-pair resolution for NIM signals. It was felt that if amplification and discrimination was required in certain applications, readily available separate units could be used to perform those functions.

It should also be noted that because of the wide bandwidth of these counters, there could be instances in which it may appear that a counter is "double-counting" when in fact a "double-pulsing" condition exists -i.e. pulses are real.- Overshoots or undershoots from "ringing" signals could be counted as legitimate pulses. This condition arises because of two deliberate design decisions. First was the desire to obtain a narrow pulse-pair resolution. Obviously, guarding against "ringing" may result in degradation of the pulse-pair resolution. The second reason is rather philosophical as opposed to technical in nature. It was not the intent to build a "forgiving" device. The desire was to have a counter that could "flag" potential problems by being sensitive to the integrity of the signals.

Acknowledgments

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