

# AN ELECTRONIC TOTALIZER FOR CURRENT METERS

by  
John R. Glover

Sponsored by  
U.S. Army Corps of Engineers  
Missouri River Division, Omaha District  
Contract DACW45-68-C-0055



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IIHR Report No. 115

Iowa Institute of Hydraulic Research  
The University of Iowa  
Iowa City, Iowa

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## An Electronic Totalizer for Current Meters

Current meters of the Price (cup) and propeller types will continue in the foreseeable future to be the most widely used instrument for measurement of velocities in natural streams and rivers. To provide better resolution and reliability of the meter output, magnetic dry-reed switches are now frequently being used as the contact closing device in these current meters. However, the counting rates at high velocities cannot be audibly discriminated and accurately totalized by the operator; thus, an electronic totalizer was required in order to realize the full potential of these improved switches. The totalizer described herein and depicted in Figure 1 consists of a pulse shaping network, three decade-decoder-display units, and switches for testing and operating. Integrated circuits are employed to minimize size, and the display intensity has been adjusted to be visible in indirect sunlight.

The pulse shaping network (Figure 2) utilizes integrated circuits, types SN15-830N and SN15-851N, the former being a dual four-input NAND/NOR gate, and the latter a monostable multivibrator. The requirements imposed on the pulse-shaping network were elimination of the influence of contact bouncing of the dry-reed contactor in the current meter, and provision of pulses of proper shape for the counting circuits. In addition, the COUNT switch is interfaced in a manner that the contact bounce associated with its operation does not generate extraneous pulses.

Influence of contact bouncing of the contactor in the current meter is eliminated by generating a pulse of time interval greater than the time duration of contactor bouncing, and feeding it to the gate responding to the bouncing contactor. The output of this gate, which represents the current-meter contactor opening and closing is then free of spurious signals which can cause erroneous counting. The pulse driving the gate during the period of contact bouncing is generated by the monostable multivibrator, and has a duration of approximately five milliseconds. It is initiated by the first detectable closing of the contactor, and is also the signal which drives the first decade unit.

Contact bounce of the COUNT switch is eliminated in a different manner because it is a single-pole two-position switch. Functioning in conjunction with two gates (SN15-830N-2), which are connected as a set-reset flip-flop, the COUNT switch produces a bounce-free response for controlling the gate driving the monostable multivibrator. When the COUNT switch is not depressed, pulses from the current-meter contactor are inhibited by the gate driving the monostable multivibrator. Pressing the COUNT switch opens the gate and the monostable multivibrator responds to the current-meter contactor.

An operating description of the decade-decoder-display units is not included, since these are commercially available units and are described adequately by the manufacturer, [1]. The wiring diagram showing how they are incorporated into the instrument is presented in Figure 3.

### Operation

In addition to the OFF-ON switch, there are three push-button switches located on the instrument panel. The RESET switch must be pushed and released to set the decade units to zero before counting. To register the contact closures of the current meter, the COUNT switch is depressed while a velocity measurement is being taken. Because there are two contact closures per revolution of the current meter, the display must be divided by two to determine the number of meter revolution. Releasing the COUNT switch at the end of the measured time interval disconnects the current-meter signal from the decade units. The totalized number is displayed until the RESET switch is pushed or until the instrument is turned off. Testing of all seven illumination elements in each display module is accomplished by pressing the TEST switch. Failure of an element is indicated when the number 8 does not appear while the TEST switch is depressed. Pushing the TEST switch does not change the displayed count.

A step-by-step operation sequence proceeds as follows:

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[1] See Maintenance Section for supplier.

1. Connect a current meter which has a magnetic dry-reed contactor to the terminals on the instrument panel.
2. Turn the OFF-ON switch to ON.
3. Press and release the RESET switch.
4. Check the display elements by pushing the TEST switch.
5. Depress the COUNT switch during the time interval the velocity measurement is being accomplished. A stop watch is used to indicate the time interval during which the counts are totalized.
6. Reset the counter or turn the instrument off after recording the display.

#### Maintenance

There are no internal or external adjustments to be made on the instrument. Periodic replacement of the batteries will be necessary and is indicated by the display intensity becoming too low to be observed and/or by improper counting. Replacement batteries must be rated at 1.35 volts. Recommended replacement batteries are Mallory RM42R. Standard 1.5-volt batteries should not be used since they will shorten the life of the display units, which have an expectancy inversely proportional to the applied voltage raised to the 12th power. Access to the batteries is gained by removing the bottom and back cover plates.

The life expectancy of the display units is 100,000 hours. Replacement of these units is accomplished by removing the front panel and disconnecting the numeric readout module. Replacement modules are Model M6-30 and are available from Pinlites Inc., 1275 Bloomfield Avenue, Fairfield, New Jersey, 07006.

### Acknowledgments

Development of this instrument has been carried out under the general supervision of Mr. Donald C. Bondurant, Missouri River Division of the U. S. Army Corps of Engineers, and Dr. John F. Kennedy of the Institute of Hydraulic Research.

Grateful acknowledgment is extended to Mr. Ernest E. Schwab of the Institute Electronics Staff for instrument construction. Financial support for design and construction of this unit was provided by the Corps of Engineers, Omaha District, under contract DACW45-68-C-0055.



Figure 1. Electronic Current-Meter Totalizer

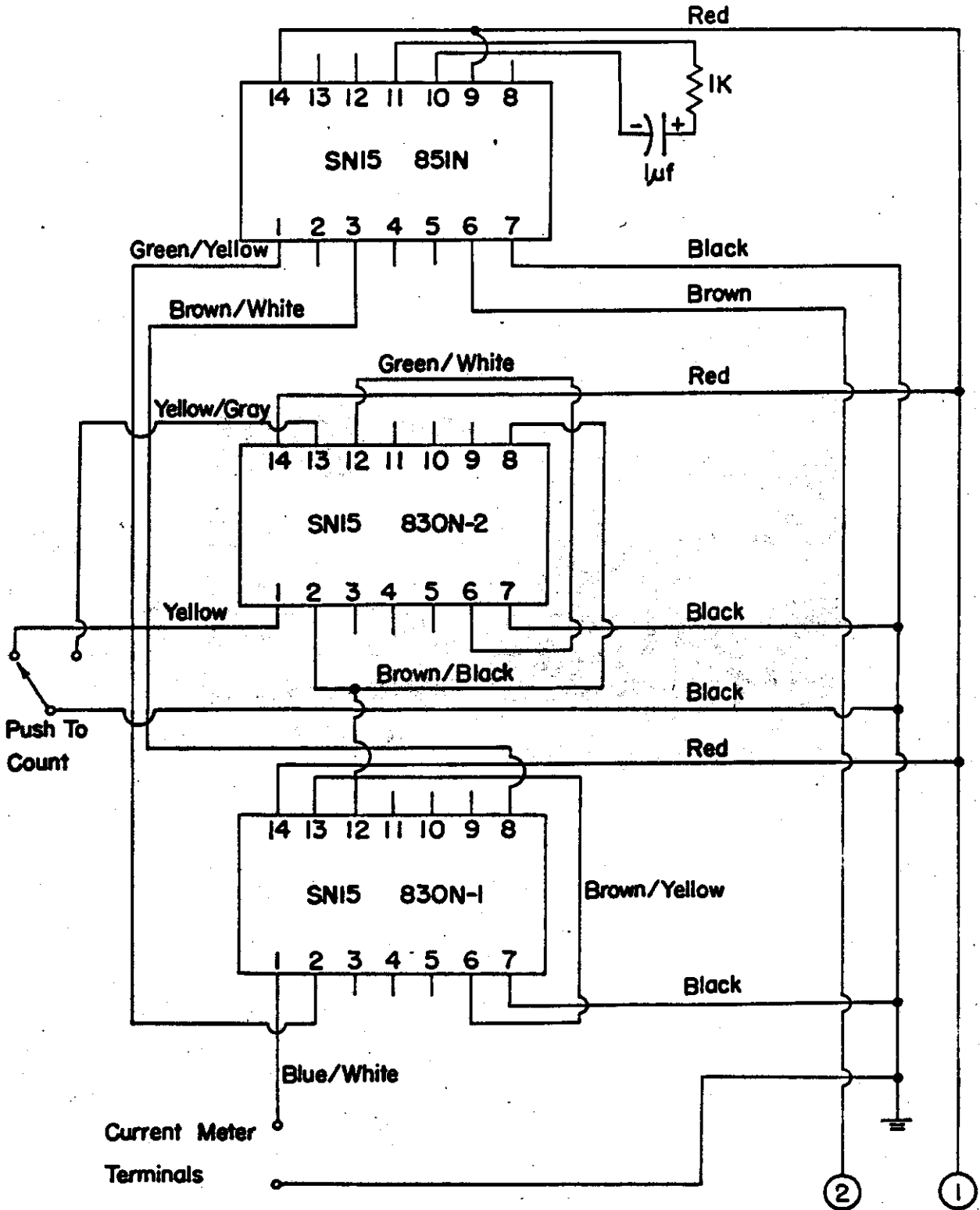


Figure 2. Pulse Shaping Network.



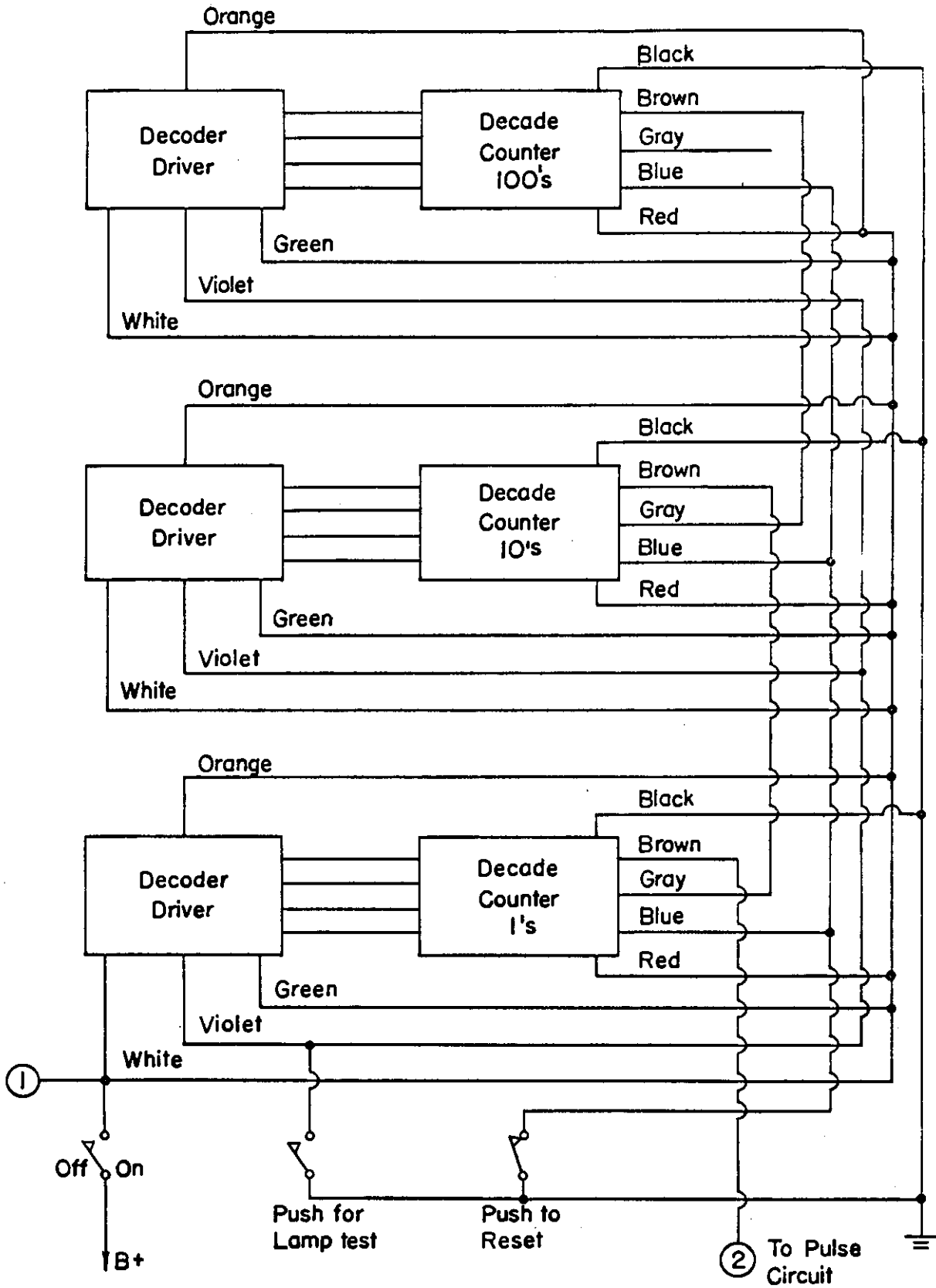


Figure 3. Wiring Diagram of Decade-Decoder-Display Units.

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