KS-15947

TOTALIZER CIRCUIT, SD-95965-01

GENERAL DESCRIPTIVE INFORMATION

INTRODUCTION

The totalizer is an electronic counting device which provides on one traffic register the total count accumulated by up to 120 individual traffic registers. It may also be used to count the calls handled on groups of maximum 120 trunks which have not previously provided a peg count. It is intended to provide a means for obtaining summaries of important call counts frequently and economically. As an aid to traffic engineering it will supplement the TUR, when peg counts summaries are required daily. It is expected to be particularly valuable in the field of dial office administration because through its use all important traffic counts of calls, overflows, etc., can be obtained quickly by reading a few traffic registers.

GENERAL DESCRIPTION

The totalizer receives counts in the form of pulses from existing traffic register leads. Its input circuits electronically shape and shorten these input pulses in order to accumulate on one traffic register, without significant loss, the total count ordinarily read from any individual registers. The total count then received is divided by ten to enable a single traffic register to handle a large count. Output circuits amplify and stretch the signal to match the signal requirements of a 14-type or KS-16493 traffic register.

GENERAL APPLICATION

In general, the totalizer may be connected to any circuit which will supply a relay contact closure to ground per event to be counted of 15 milliseconds duration or longer. It may be bridged to existing traffic register leads with or without

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the individual traffic register remaining in service. In addition, the totalizer may be given input characteristics which will permit it to be connected to the sleeve leads of many types of trunk circuits from which peg counts are not now available.

The totalizer is an electronic device to be installed in an electromechanical environment. For satisfactory operation a few simple restrictions and requirements must be considered to insure compatibility between the totalizer and its connecting circuits. These are discussed under Connecting Circuit Considerations.

SPECIFIC APPLICATIONS

The totalizer is intended for broad application in various Bell System standard central office systems. Typical applications are as indicated below:

Step-by-Step Offices

Line Finders P.C.
Selectors P.C.
Connectors P.C.
Outgoing Trunks P.C.

No. 1 Crossbar

Markers P.C.
Incoming Link Frames P.C.
Office Link Frames P.C.
Trunks P.C.

No. 5 Crossbar

Markers P.C.
Transverters P.C.
Trunk Link Frames P.C. (Older Offices)
Trunks P.C.

Crossbar Tandem

Markers P.C.
Transverters P.C.
Trunk Link Frames P.C.
Office Link Frames P.C.
Final Trunk Groups - Overflow
Trunks P.C.
Toll Connecting Trunks - Overflows

No. 4 Toll Crossbar

Trunk Link Frame P.C.
Senders P.C.
Decoders P.C.
Markers P.C.
Recorder Trunks P.C.
Decoder Pre-Translator P.C.
Traffic Separations P.C.
NCA Trunks P.C.
FRA Trunks P.C.
Through Traffic P.C.
Overflows to a Particular Alternate Route (H.U. or Final)
Toll Connecting Trunks - Overflows
Final Trunk Groups - Overflows

Panel

Present totalizer design not yet approved for panel offices.

CONNECTING CIRCUIT CONSIDERATIONS

For straightforward application of the totalizer to circuits which now connect to traffic registers, compatibility between the totalizer and its connecting circuits is assured merely by selection of proper circuit options obtained from the circuit and equipment notes in drawing SD-95965-01, and adjustment of totalizer sensitivity as covered in the circuit description CD-95965-01. The totalizer is also suitable for original applications which may be suggested by traffic situations peculiar to a given locality, but in order to take advantage of its abilities, certain simple requirements of the connecting circuits should be considered. It is necessary, therefore, as part of the general description of the totalizer to mention its input abilities and requirements, particularly as these influence its ability to accept connecting circuits of various kinds.

It may be expected that very accurate totalizer operation is assured when count signals to it from connecting circuits are generated by relay contacts in reasonably good adjustment as to spring tension, contact follow, etc., and in reasonably good conditions as to pitting and contamination.

Count signals from relay contacts in poor adjustment (producing excessive chatter) or in bad condition (making imperfect contact) may operate the totalizer successfully, but at some increased likelihood that an occasional count will be missed. The design of the totalizer is such as to cause signals from excessively faulty sources to be "seen" at reduced amplitudes; however, input tolerances are broad enough so that any relay contact which does not operate the totalizer with adequate margin will be found to be well outside its limits as to adjustment or condition.

Where the totalizer is connected to leads other than trunk sleeve leads, the count signals are well below the minimum duration of count signals required by other peg count arrangements ordinarily used, and thus does not present any particular restriction as to connecting circuits which may be used.

Where the totalizer is connected to trunk sleeve leads, circuit options are selected so that relatively long signals are required to operate the totalizer so as to guard against counting momentary trunk circuit sleeve grounds caused by "bridging" of trunk sleeves due to the action of various associated switches, caused by partially dialed abandoned calls, and the like.

Furthermore, the minimum signal duration of a signal which will just operate the totalizer depends somewhat upon how sensitive the totalizer is adjusted. Generally, it may be assumed, however, that when the totalizer is used on trunk sleeves, input signals shorter than 100 milliseconds will not be counted. Since trunk sleeve circuit "count" signals have a duration equal to that of the conversation time, this minimum duration does not represent any significant restriction.

It should be noted that the totalizer will guard itself against operation on momentary sleeve lead "hits" to a greater degree than will the other peg count arrangements commonly used on trunk

circuits, and its count will be correspondingly more accurate than that of other arrangements. Thus, in checking a totalizer trunk peg count against that shown by older arrangements, the older arrangements may be found to over count by one per cent or more in some cases.

The polarity and type of signals which the totalizer is designed to accept are those generated by a relay contact closure which connects ground to the input of the totalizer. The totalizer alone, or in conjunction with other loads served by the relay contact, feeds battery toward the contact. Thus, with the contact open, -48 volt battery appears on the input lead to the totalizer. When the contact closes to indicate start of a count signal, the totalizer input moves quickly to almost 0 volts. When the contact opens to indicate the end of a count signal, the totalizer input returns to -48 volts [perhaps with an inductive "kick" if inductive loads (traffic registers) are also being served by the contacts]. The totalizer is designed to guard against false counts due to relay contact chatter of any duration at the beginning of a signal (e.g., when one of its inputs changes from -48 volts to ground). At the end of a count signal (e.g., when the grounded input returns to -48 volts) the totalizer guards itself only long enough to avoid false operation on "split" trailing edge signals caused by severely pitted relay contacts. In order to keep the totalizer's counting speed as high as possible, the "trailing" edge guard time must be kept to a minimum. It is important therefore that the totalizer never be connected to a relay contact which supplies battery when it closes; the chatter protection would be applied to the wrong end of the signal and severe over-counting could result.

So long as closure of the contact supplies ground to the totalizer, it makes no difference whether the contact is a "front" or a "back" contact, nor does it matter whether the relay is normally released or normally operated.

Under any operating condition, the totalizer counts at the instant of release of the contact closure.

EQUIPMENT DESCRIPTION

The totalizer consists of a 4-inch by 23-inch steel mounting plate, drilled for mounting on standard 23-inch equipment racks, upon which are mounted six or more cube-shaped epoxy encapsulated, apparatus packages each 2-inches long, 1-inch high, and 3/4-inch deep, together with associated miscellaneous external resistances and capacitors. The packages are bolted to the steel mounting plate and are equipped with standard wire-wrapped terminals which extend through the plate to the "wiring" side of the equipment. Each package contains a number of electronic circuit components. Six different type packages are used designated as A, SA, RPA, DS, PS and DA.

PACKAGE DESCRIPTION

(A) Input package - basically a ten-input resistance "OR" circuit incorporating some high-frequency filtering, followed by an R-C "differentiator" incorporating a diode so that it has a long time constant for positive going input voltage steps and a short time constant for negative going input voltage steps. The number of (A) packages furnished in each application is determined as indicated under ENGINEERING CONSIDERATIONS. The (A) packages:

(a) collect count signals from a number of separate points in a switching system,

(b) reduce the duration of each count signal in order to minimize the likelihood that when all count signals are placed on a single lead, two counts will occur so close together as to appear as a single count,

(c) Protect itself against the effects of relay contact chatter and bounce which may appear at its inputs,

(SA) Slicer Amplifier Package - a three-transistor amplifier adjusted to amplify a narrow "slice", generally taken at about one third of the peak amplitude, of negative-going (count signal) pulses which it receives from the (A) packages. This

amplifier also has specific low-frequency and high-frequency cut-off characteristics to optimize signal-to-noise ratios under the various operating conditions. Thus, the (SA) package:

(d) amplifies selected portions of the shortened count signal wave form.

(RPA) Regenerative Pulse Amplifier Package - a monostable multivibrator turned "ON" by each signal from the (SA) package and remaining "ON" for either about 1 millisecond (applications of other than trunk sleeve leads) or about 10 milliseconds (applications involving trunk sleeve leads) to prevent double counting on "split" count signals from badly pitted relay contacts. The (RPA) package thus:

(e) regenerates the shortened count signals, making them uniform as to amplitude, wave shape, and duration,

(DS) Decade Scaler Package - an inductance "dipper-and-bucket" circuit incorporating nonlinear core circuitry which:

(f) divides the total count by 10, generating one output pulse for each 10 counts received,

(PS) Pulse Stretcher Package - a monostable multivibrator identical to the (RPA) multivibrator except for added optional apparatus which cause it to remain "ON" for about 30 milliseconds each time it receives a pulse from the (DS) package. Thus the (PS) package:

(g) stretches the divided count signal so that it is of long enough duration to operate an electromechanical traffic register, and finally,

(DA) Driver Amplifier Package - a power amplifier capable of operating up to three 14-type or KS-16493 traffic registers which:

(h) amplifies the stretched signal and applies it to operate traffic registers.

ENGINEERING CONSIDERATIONS

Circuit Options

Design of the totalizer is such that, insofar as possible, the same combination of encapsulated packages is used for all applications. Circuit options required to adapt the circuit to various operating conditions are applied to the outside of the encapsulated packages. Details of these options are covered on the circuit and equipment notes of drawing SD-95965-01. The following situations require separate options:

(A) Connection of the totalizer to leads other than trunk sleeve leads which also operate inductive apparatus such as registers or relays:

(a) Without contact protection associated with the registers or relays or with contact protection of the resistance - capacity type associated with the registers or relays,

(b) with contact protection of the resistance shunt type associated with the registers or relays.

(B) Connection of the totalizer to leads which do not also operate inductive apparatus such as registers or relays.

(C) Connection of the totalizer to trunk sleeve leads.

Provision of Input (A) Packages

The options which are required under various operating conditions have an effect on the holding times of the totalizer packages. This, in turn, affects the number of calls which each package can handle and still maintain the low package occupancies required to permit high counting accuracy.

Input connections are cabled directly to wire-wrapped terminals on the input (A) packages of the totalizer, up to 10 input leads being connected to each input (A) package. (A) packages are furnished as required to provide for up to 120 inputs to the totalizer within the following limitations which assure that the totalizer peg count will be more than 99 per cent accurate under the various conditions of operation:

(a) Where the totalizer is connected to leads which also serve to operate inductive apparatus (e.g. 12-type, 14-type or other electromechanical traffic registers; U-type, Y-type, wire spring, or other electromechanical relays, etc.), but not including connection to trunk circuit sleeve leads, input connections are limited as required so that busy-hour counts to the totalizer do not exceed 10,000 counts per (A) package, nor more than 30,000 counts per totalizer.

(b) Where the totalizer is connected to leads which serve only the totalizer, or to leads which serve only resistive loads (lamps, etc.), input connections are limited as required so that busy-hour counts to the totalizer do not exceed 3,000 counts per (A) package nor more than 30,000 counts per totalizer.

(c) Where the totalizer is connected to leads which connect to trunk sleeve leads, input connections are limited so that busy-hour counts to the totalizer do not exceed 1,000 counts per (A) package nor more than 3,000 per totalizer.

Location of Totalizer

The totalizer should be located as close as is convenient to the circuits whose relay contacts produce the pulses to be counted. Generally, connections are conveniently made at a distributing frame where the punchings to which connections are to be made are found grouped together, and if the leads pass via more than one such distributing frame, the one nearest the relay contacts should be used. Avoiding unnecessary length of input leads reduces installation cost and results in a cleaner, more easily counted, signal.

Location of Totalizer Traffic Registers

The totalizer will operate up to three 14E traffic registers or up to two KS-16493 traffic registers. All registers operated by a totalizer must be controlled by the same battery supply key. The registers will normally be installed in the regular traffic register racks located at any convenient points within the building subject only to the operating limit restrictions which apply to all such traffic register installations.

Power Requirements

The totalizer requires two -48 volt battery connections, each fused for 1-1/3 amperes. One supplies the (A) package(s). The other provides all remaining packages with -20 volts necessary to power the transistor circuitry, by means of a dropping resistor, 20-volt zener regulator, and filter capacitor which are furnished as part of the totalizer assembly.

Maintenance Requirements

A small, well protected, solid-state circuit such as the totalizer, may be expected to average many years of operation between troubles. When troubles do occur, it is merely necessary to determine which package is in trouble and replace it using only standard wire-wrap tools. In order to simplify locating a defective package, test jacks connecting to each package input and output are provided on the front of the mounting plate. A totalizer test set, KS-15946, may be used, together with a simple test procedure, to locate any defective package. This test set is a small portable unit which may be connected to the totalizer by cords. It will generate pulses of controlled amplitude and polarity so that the input sensitivity of the totalizer may be checked. It also provides a means of by-passing the decade scaler to permit individual counts to be observed at the output. A visual indication of an output pulse can be obtained from a lamp furnished in the test set, in the event that the associated traffic register is remotely located.

A sensitivity potentiometer adjustment is made, using a screwdriver, at the time the totalizer is installed, following the procedures specified in the circuit description. Sensitivity requirements are not critical and a totalizer may be expected to operate for extended periods without readjustment. Any readjustments which may be required to compensate for gradual drift in the characteristics of components may be made very simply, by use of the totalizer test set.