US005754644A

United States Patent [19]

Akhteruzzaman

[11] Patent Number: 5,754,644

[45] Date of Patent: May 19, 1998

[54] **METHOD FOR CUSTOMIZING OPERATION OF A BATTERY FEED CIRCUIT IN A TELECOMMUNICATIONS NETWORK**

[75] Inventor: **Akhteruzzaman**, Naperville, Ill.

[73] Assignee: **Lucent Technologies Inc.**, Murray Hill, N.J.

[21] Appl. No.: **672,189**

[22] Filed: **Jun. 27, 1996**

[51] **Int. Cl.**[6] **H04M 19/00**

[52] **U.S. Cl.** **379/413**; 379/399; 379/324

[58] **Field of Search** 379/413, 399, 379/377, 379, 382, 324, 340, 383, 387

[56] **References Cited**

U.S. PATENT DOCUMENTS

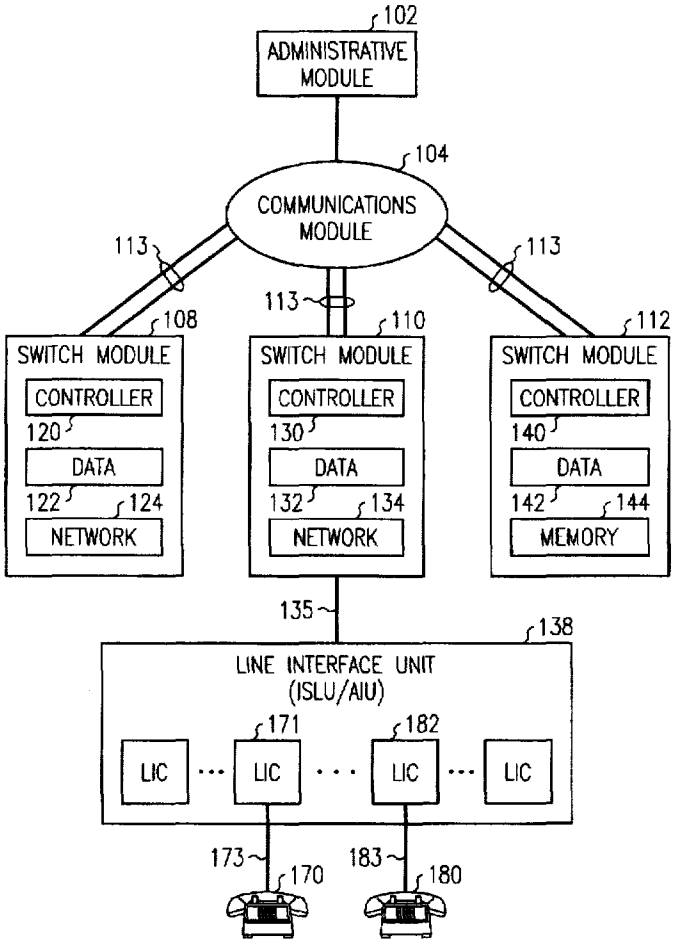
4,490,580	12/1984	Nagashima	379/379
4,511,763	4/1985	Skidanenko et al.	379/413
4,652,701	3/1987	Cubbison, Jr.	379/373
5,596,637	1/1997	Pasetti et al.	379/399
5,636,273	6/1997	Schopfer et al.	379/377
5,640,451	6/1997	Schopfer	379/413

Primary Examiner—Krista Zele
Assistant Examiner—Jacques M. Saint-Surin
Attorney, Agent, or Firm—Mony R. Ghose

[57] **ABSTRACT**

A method for controlling power losses associated with the operation of line interface circuits in telecommunications networks comprises detecting a loop current of at least one subscriber loop interconnected to at least one line interface circuit. The detected loop current is used to access a threshold voltage value from a line interface circuit database. A threshold voltage based on the threshold voltage value retrieved from the database is compared to a feedback voltage to control a duty cycle of a switching converter circuit in the line interface circuit. Controlling the duty cycle of the switching converter circuit enables control of battery voltages based on the comparison of the threshold voltage and the feedback voltage. In the preferred embodiment, the battery voltage is controlled to be a minimum voltage needed to provide a predetermined magnitude of the minimum loop current.

7 Claims, 3 Drawing Sheets



100

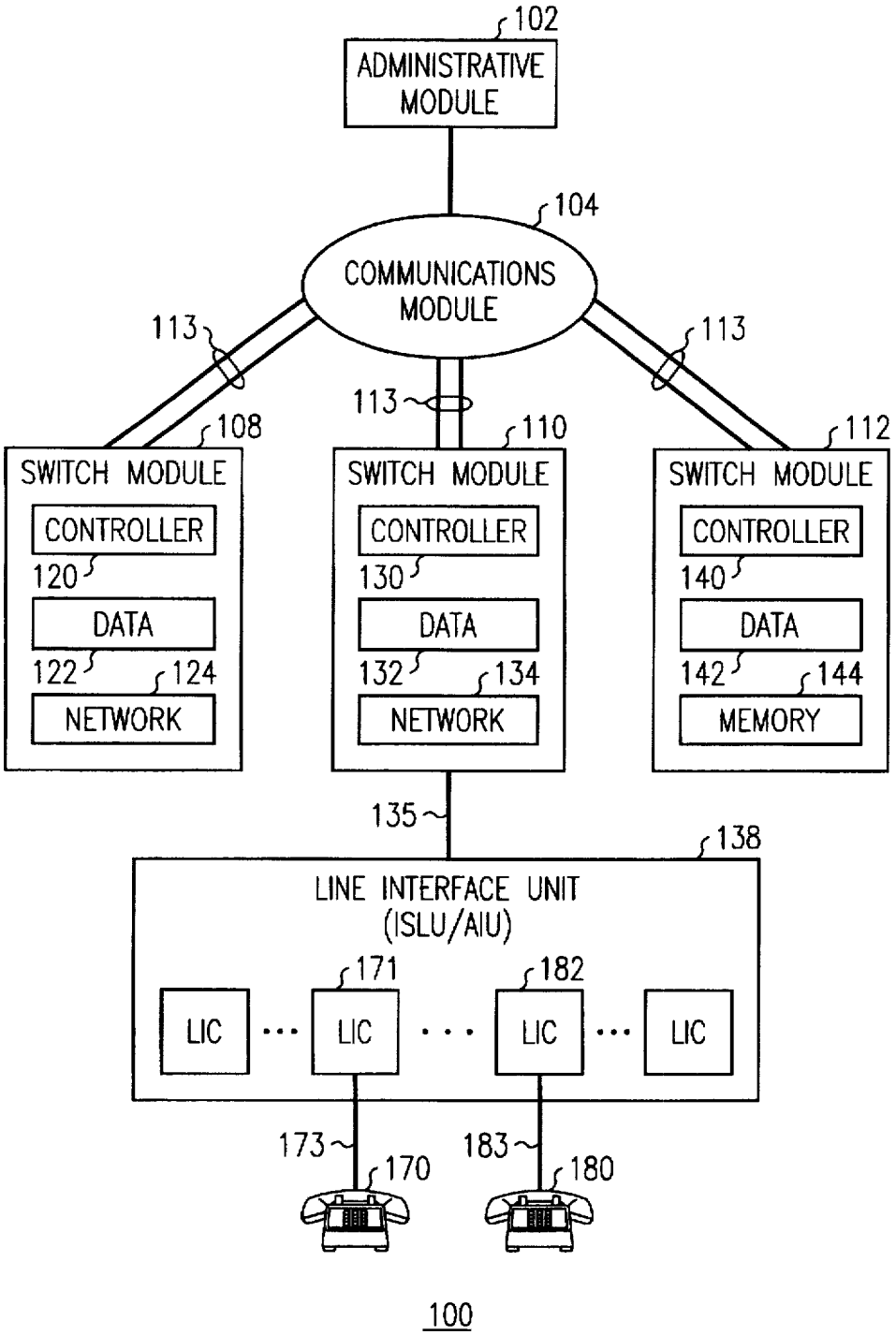


FIG. 1

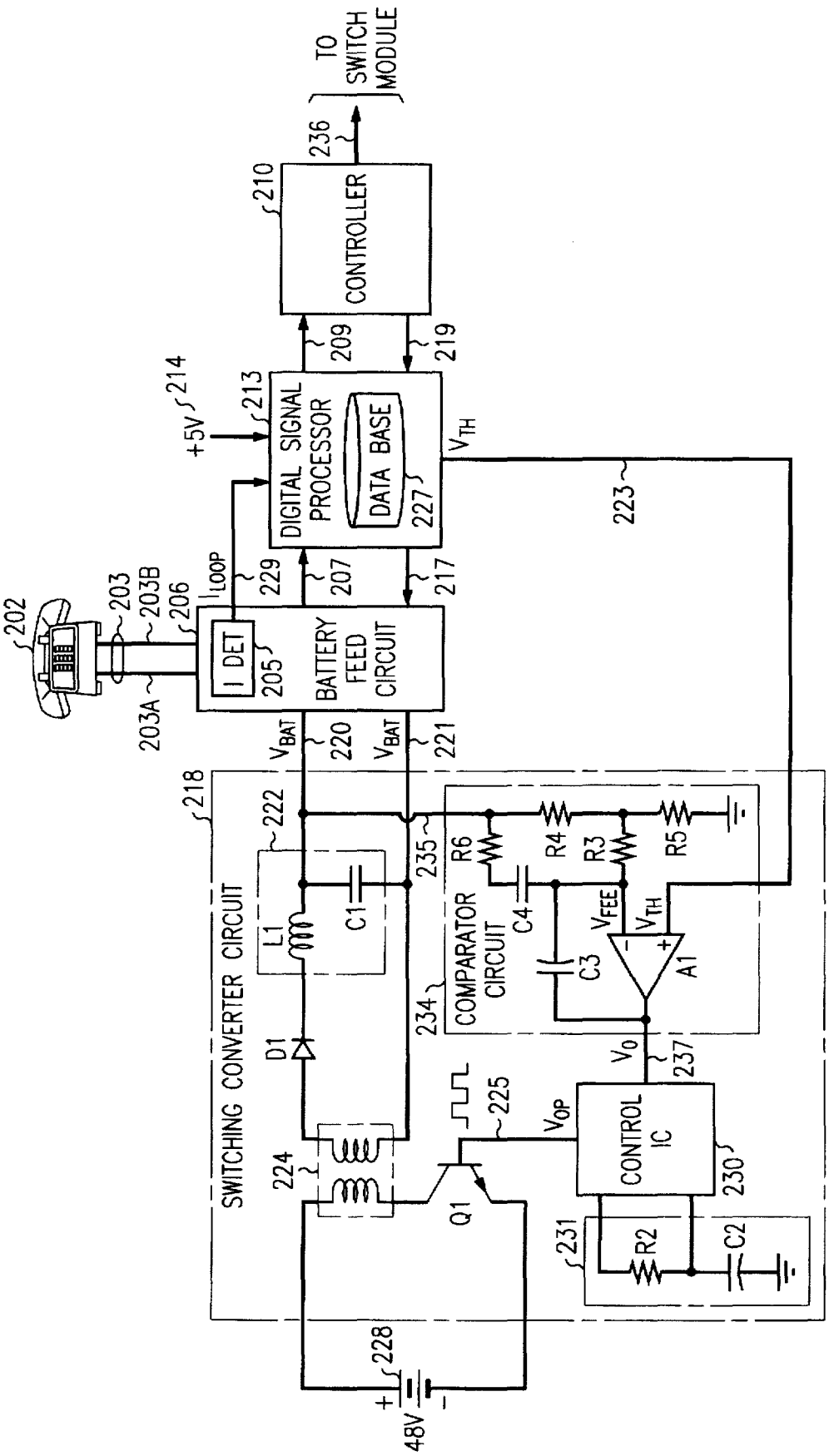
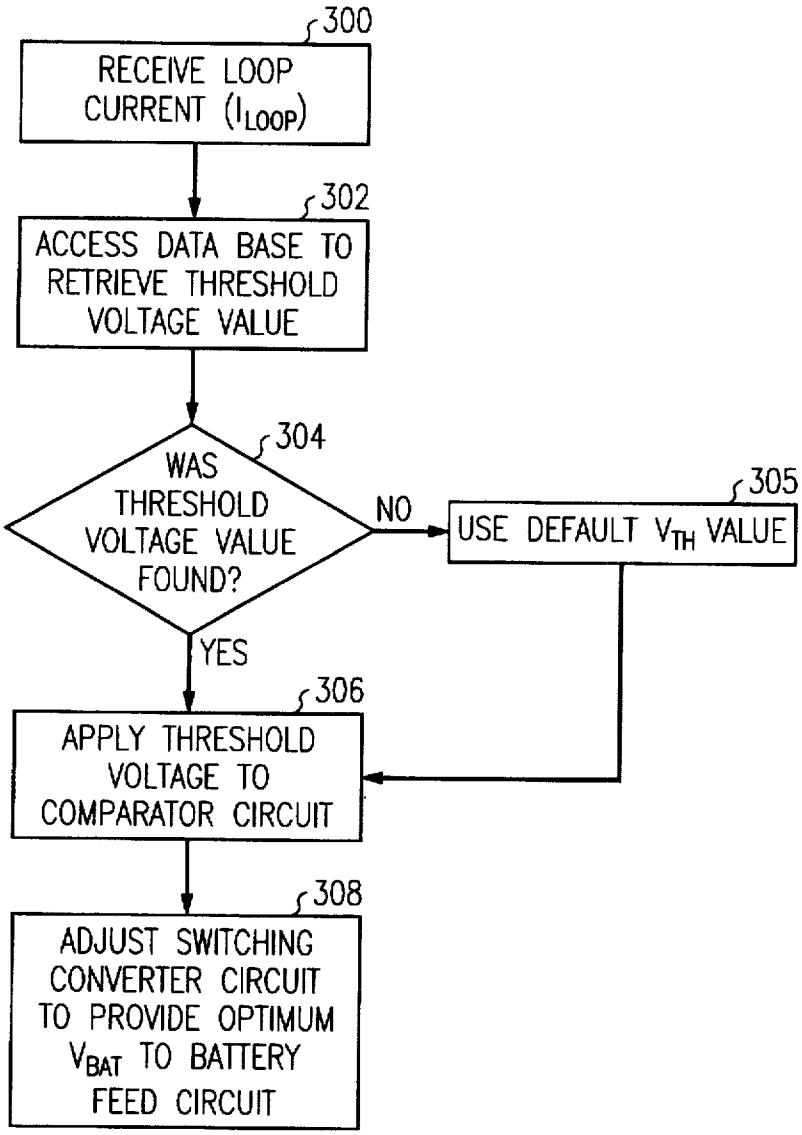


FIG. 2

FIG. 3



METHOD FOR CUSTOMIZING OPERATION OF A BATTERY FEED CIRCUIT IN A TELECOMMUNICATIONS NETWORK

CROSS-REFERENCE TO RELATED APPLICATION

This application is related to the applications of Akhteruzzaman entitled "Method For Controlling Power Losses Associated With Line Interface Circuits In Telecommunications Networks" and "Method For Customizing Operation Of A Line Interface Circuit In A Telecommunications Network", which applications are assigned to the assignee of the present application, and are being filed concurrently herewith.

TECHNICAL FIELD

This invention relates to line interface circuits and, more particularly, to supplying power to battery feed circuits in such line interface circuits deployed in telecommunications networks.

BACKGROUND OF THE INVENTION

Line interface circuits (LIC) interconnect customer premises equipment to central office switches by subscriber lines (commonly referred to as "subscriber loops"). For administrative purposes, a plurality of LICs are grouped in an integrated line services unit (ISLU). A LIC includes means for delivering current to a subscriber loop, and an external power source. In modern LICs, the means for delivering current to the subscriber loop is a battery feed circuit comprising a complex set of integrated circuits. Voltage generated by the external power source, is processed by a LIC switching converter circuit before delivery to the battery feed circuit. The power delivered to the subscriber loop by the battery feed circuit enables a serving central switch to detect the presence, and status, of customer premises equipment served by the loop. The battery feed circuit also couples audio signals transmitted by the central office switch to the customer premises equipment, and vice versa. Power supplied to the switching converter circuit is processed by a transformer which produces a predetermined battery voltage (V_{bat}). The predetermined voltage is established to provide adequate current to interconnect customer premises equipment to a central office switch when appropriate, and to provide high quality voice transmission to the subscriber loop.

It is well known that normal LIC operation results in the dissipation of power due to losses associated with internal LIC components. Particularly, a substantial amount of power is lost at the battery feed circuit. Although losses associated with individual LICs might be tolerable, the accumulation of LIC losses (due to the large number of LICs deployed in a single ISLU) significantly impacts the overall efficiency of a central office switch. For this reason, controlling LIC power losses is of critical importance to telecommunications service providers. Although cooling devices are frequently employed to control power losses, these devices are expensive to operate, and require a non-trivial amount of space.

Therefore, there is a need in the art for controlling power losses associated with the operation of LICs in telecommunications networks.

SUMMARY OF THE INVENTION

This need is addressed and technological advance is achieved in the art by substantially controlling the battery voltage supplied to a battery feed circuit in a LIC according to subscriber loop length.

The electrical resistance of a subscriber loop is directly proportional to the geographical distance of its associated customer premises equipment from a serving central office switch. Customer premises equipment located relatively near the serving central office switch has a shorter subscriber loop (and hence, lower resistance) than customer premises equipment located a great distance (higher resistance) from the switch. Due to a smaller total resistance, short subscriber loops do not require as much voltage to generate the needed amount of current as do longer subscriber loops to interconnect customer premises equipment to the serving central office switch.

In accordance with the preferred embodiment of the present invention, each LIC detects a loop current (I_{loop}) of its associated subscriber loop, and uses the detected loop current to determine a threshold voltage (V_{th}). The threshold voltage affects the value of the customized battery feed voltage (V_{bat}) supplied to the battery feed circuit of the LIC. More particularly, the loop current is detected by a current detector in the battery feed circuit, and is detected by a digital signal processor (DSP). The DSP uses the loop current as an index to access a threshold voltage database. The threshold voltage affects a duty cycle of the LIC switching converter circuit to produce an optimum battery feed voltage to be supplied to the battery feed circuit. The optimum battery feed voltage is just sufficient to produce the correct amount of current necessary to interconnect the customer premises equipment to the central office switch, and provide telecommunications service. By providing the optimum battery feed voltage, the dissipation of power is minimized for short subscriber loops, and the overall efficiency of the serving central office switch is enhanced.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a central office switch in which the present invention may be practiced;

FIG. **2** is a block diagram of a LIC in accordance with a preferred embodiment of the present invention; and

FIG. **3** is a flow diagram of the steps performed in a LIC in accordance with the preferred embodiment of the method of the present invention.

DETAILED DESCRIPTION

FIG. **1** shows a simplified block diagram of a central office telecommunications switch **100** (hereinafter, switch **100**). In the preferred embodiment, switch **100** is the 5ESS® manufactured, and sold, by Lucent Technologies. Although a central office switch is shown, any system in which power is supplied to subscriber loops may be utilized.

Switch **100** includes three major components: administrative module **102** for providing system-wide administration, maintenance, and resource allocation; communications module **104** for serving as a distribution hub in switching voice, control information, and synchronization signals; and a plurality of switching modules (SM) **108**, **110** and **112** for performing local switching and control functions. Communication among the elements of central office switch **100** is accomplished over network control and timing (NCT) links **113**. As required by convention, dual NCT links are shown for the interconnection of each SM to communications module **104**.

SMs **108**, **110** and **112** include controllers for coordinating switching functions, memory for retaining specific sub-

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.