Programmable Central Office and Private Branch Exchange Linecards

National Semiconductor
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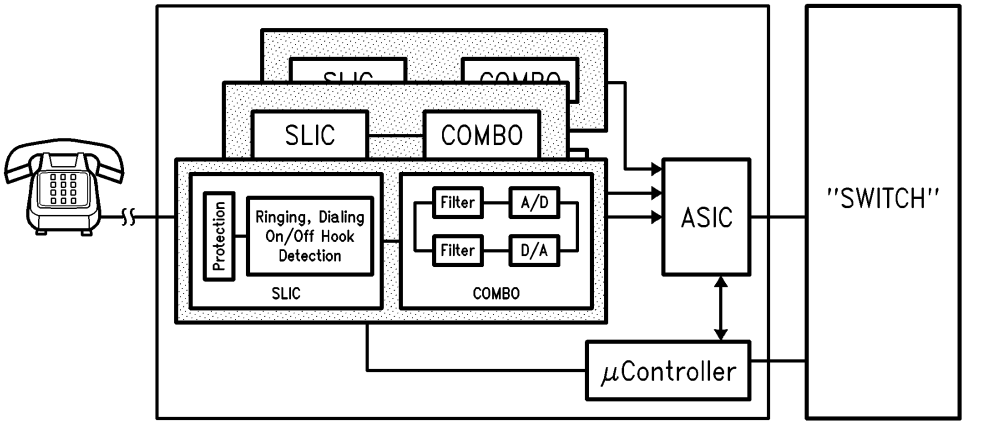

TL/F/10855–1

SYSTEM DESCRIPTION

In a Central Office (CO) or Private Branch Exchange (PBX), each subscriber's telephone line is interfaced to the switching equipment through electronics on linecards in the switch. These electronics are required to provide the basic BORSCHT functions as described below.

B – Battery feed to power the subscriber's telephone in the local loop

O – Overvoltage protection from lightning surges and induced or short circuit voltages from utility power lines

R – Ringing signal to the subscribers telephone

S – Supervision to detect caller off-hook, calls in progress, calls terminated

C – Coding of voice (analog) signals into serial digital codes that are placed into PCM timeslots for digital transmission. Encoding is performed at the sending end; signal recovery and decoding is performed at the receiving end

H – Hybrid transformer for conversion from two-wire to four-wire, and filtering to provide impedance match to remove or minimize echoes.

T – Testing of the local loop and circuits of the switching equipment to detect faults and provide maintenance

On the linecard, SLICs and CODEC/filters are the main devices which are used to provide the above functions. SLIC is an acronym for Subscriber Line Interface Circuit, and may be transformer-based, electronic, or some combination of the two technologies. CODEC is an acronym for CODer/DECoder. CODECs and filters may be used as separate devices, or may be combined into devices such as National's COMBO® series of combined CODEC/filter systems.

A microcontroller or microprocessor may also be on a linecard, but is not shown in the block diagram since there is typically one micro for a whole shelf or frame of linecards. Additional circuitry is also required to interface between the complex backplane and the electronics on the linecard. Each manufacturer implements this interface in a unique way, and typically this logic is contained in a custom ASIC device.

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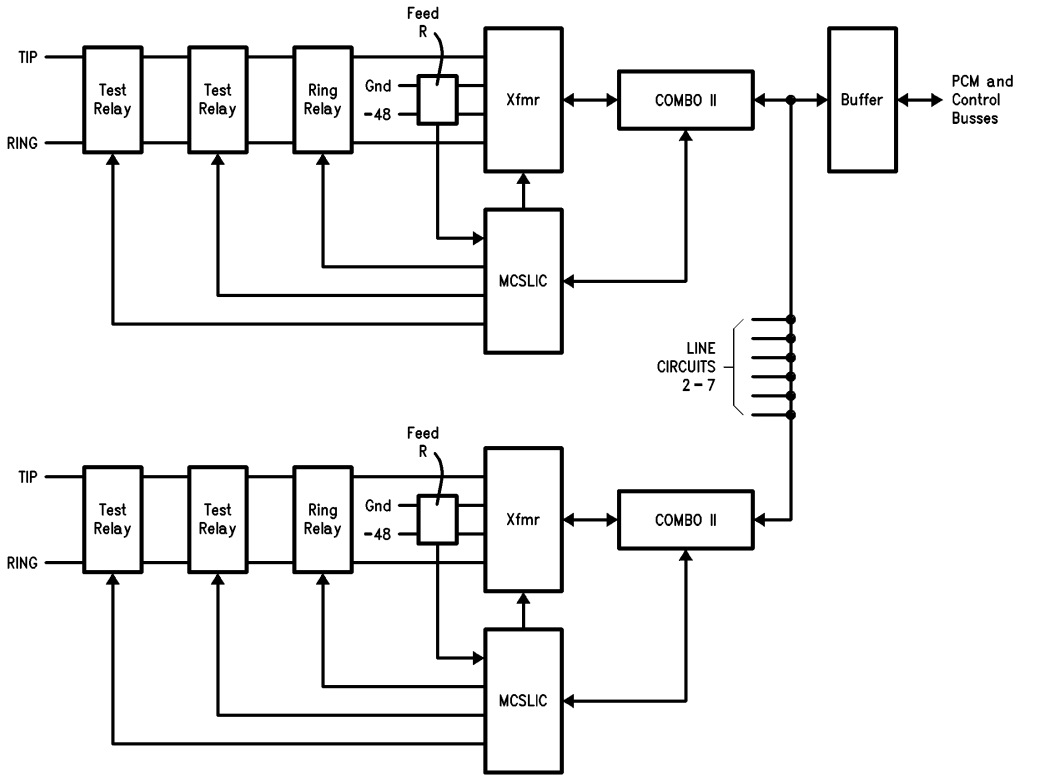
Typical Block Diagram for an 8-Line COMBO II Based Line Card



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Key Design Challenges

PERFORMANCE

Telephone switch linecards are required to meet a variety of specifications, depending on the country in which they are to be installed. Among the specifications are the Comite Consultatif International Telegraphique et Telephonique CCITT International specifications and Bell Communications Research (Bellcore) Lata Switching System General Requirements (LSSGR). Bellcore is an independent research lab upon which the Regional Bell Operating companies in the U.S. depend for specifications. Each country will have its own requirements from the local telecommunications authority. Use of circuits which do not meet these specifications requires the switch maker to obtain waivers from their customers (and the Telecom authorities) before the customer is allowed to put the equipment into service.

PROGRAMMABILITY

Several functions on a linecard are programmed. Chief among them is the hybrid balance filter, for the cancellation of echo from the 4-wire receive path towards the 4-wire transmit path introduced by the 2- to 4-wire conversion via the subscriber line interface transformer and circuitry. Hybrid balance needs to be adjusted to suit a wide range of local loop conditions. An additional programmable area is the transmit and receive gain. It is also useful to have one device which is selectable between A-law and μ-law coding if the switch is to be sold in many different countries.

COST

The market for telephone switching equipment is very competitive and continues to be so with increasing deregulation. Linecards can typically represent 65% of the cost of a switch and as a result, manufacturers take special care in designing the linecard to optimally meet the market requirements, and in the selection of linecard components to optimally implement the design. Tradeoffs include use of separate CODEC/filters versus a combined device such as the COMBO, use of a highly programmable device such as COMBO II versus implementing the functions off-chip with external components, use of an electronic versus a transformer-based subscriber line interface circuit, or some combination of the two. Consideration is given to flexibility, manufacturing costs, availability of alternate sources, and basic volume availability of the critical components.

Key Components

TP3070/71 COMBO II CODEC/FILTER

The COMBO II meets or exceeds Bellcore and CCITT requirements. It is a complete CODEC and filtering system, including high-pass and low-pass filtering and A-law or μ-law compatible coder and decoder. Channel gains are programmable over a 25.4 dB range, in 0.1 dB steps, in both the transmit and receive directions. A programmable filter is included for Hybrid Balancing. Up to 65,536 filter combinations can be programmed for impedance match.

TP3200/3204 MAGNETIC COMPENSATION SLICs

This series of devices meet or exceed Bellcore and CCITT requirements. They provide hook-switch detect, ringing detect and dial a pulse replication. Use of the TP32XX SLIC allows use of a ferrite core transformer which is smaller and cheaper than a conventional transformer. This also allows higher density, lower profile cards which can be closer together in the switch.

Typical Bill of Materials for an 8-Line COMBO II™ Based Line Card

Function	Description	NSC Part	Other Mfg.	Qty.
A/D, D/A	COMBO II™	TP3070		8
Line Interface	MCSLIC	TP3204		8
	Line Transformer		✓	8
	Line Coupling Capacitor		✓	8
	Battery Feed Resistors		✓	32
	Ring and Test Relays		✓	24
	Speech Filter Capacitor		✓	8
	Compensation Current Set Resistor		✓	8
	Transformer Matching Resistor		✓	8
Backplane I/F	TRI-STATE® Quad Buffer	DM74LS125A		5
Protection	Relay Clamp Diode		✓	24
	Compensation Winding Clamp—62V Zener Diode		✓	8
	Line Transient Clamp—3.9V Zener Diode	1N4730A		16
	Line Current Limiting Resistor		✓	16
	Transient Suppressor		✓	16
	Schottky Diode		✓	1
Supply Decoupling	Ceramic Capacitor		✓	42
	Elecrolytic Capacitor		✓	2
	Resistor		✓	8

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