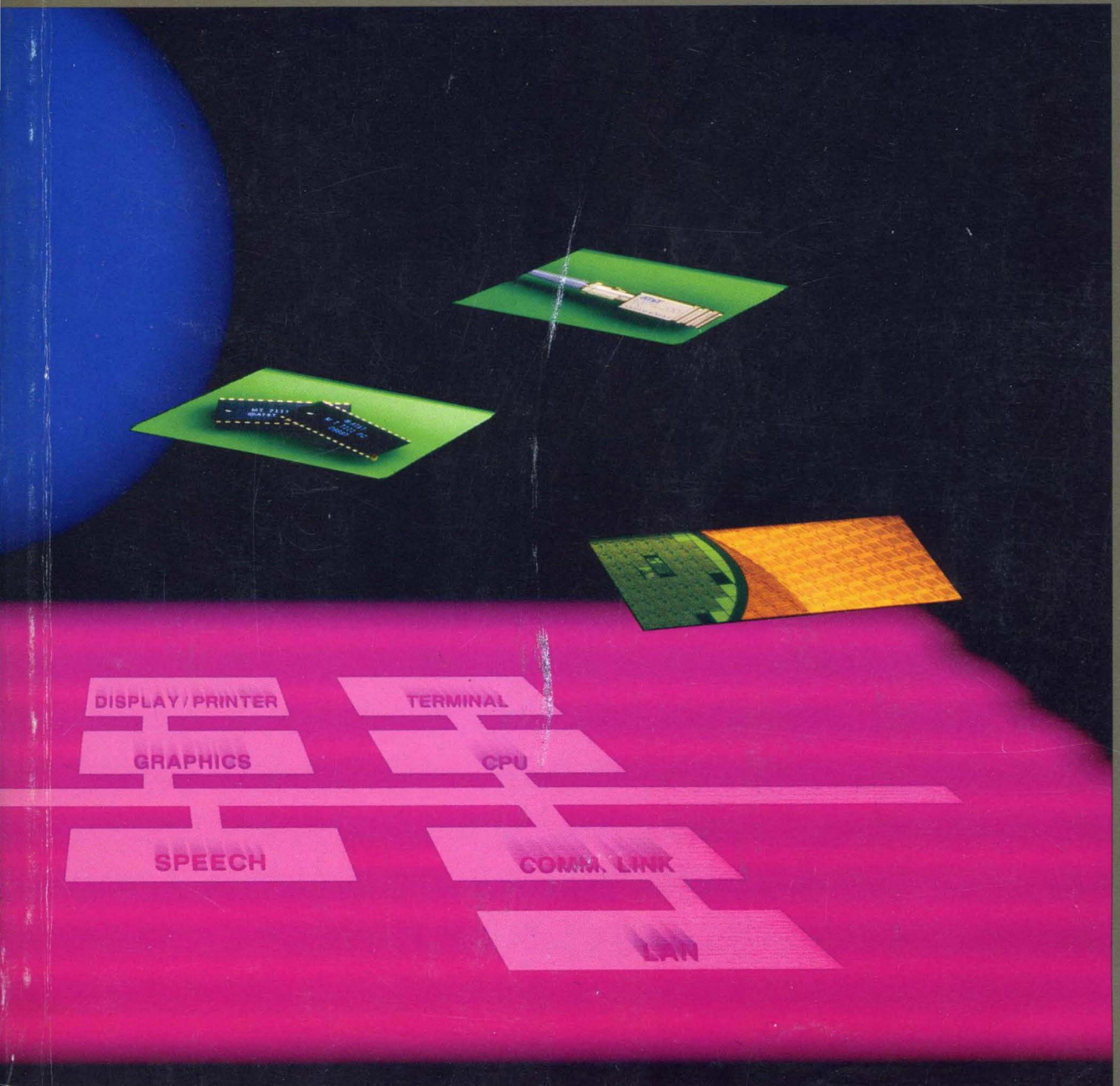


Spring 1988  
Selection Guide



## Microelectronic Products



**Spring 1988**

# **Microelectronic Products Selection Guide**

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## **A Word About Trademarks**

The following AT&T trademarks are used in the Product Selection Guide:  
*ASTROTEC*®, *5ESS*®, *FASTECH*®, *LGX*™, *LIGHTPACK*®, *LINEAGE*®, *ODL*®, *SLC*®,  
*ST*®, *UNITE*™, *UNIX*®, *WE*®.

The following trademarks, owned by entities other than AT&T, are also used in the Product Selection Guide: *C EXECUTIVE*®, *CSX*™, *ENP-10*™, *HALAR*®, *MS-DOS*®,  
*TEFLON*®, *VAX*®, *VMS*®.

## How To Use This Guide

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AT&T Microelectronics is a major manufacturer of components and electronic systems. The entire family of integrated products is designed by AT&T Bell Laboratories and supported by a broad-based network of field applications specialists and sales engineers. As a world-class supplier, we dedicate these support resources to providing you with total solutions...not just components.

We invite you to review our components in the product information section. The product families are arranged alphabetically, in subsections, as outlined in the Table of Contents on the previous page. Each product subsection also carries a product family Table of Contents, identifying those products that were not included in the previous edition.

The Typical Applications Section offers examples of suggested uses for specific AT&T components within selected electronic applications.

The Customer Support Section shows the locations of our domestic sales offices, design centers, and manufacturing plants, and contains literature ordering information.

The last section carries an alphabetized list of all products included in the Selection Guide.

In addition to the information offered in the Guide, complete technical specifications are available upon request. Contact the sales office nearest you, return one of the inquiry cards found in the back of the guide, or call our toll-free number:  
**1-800-372-2447.**

We invite you to learn more about our components.....and discover how partners in technology become partners in success.



# **Product Information**



## Analog ICs

More than 600 devices comprise AT&T's analog integrated circuit family, including a variety of voltage references, relay drivers, solid-state relays, analog switches, line drivers and receivers, special-purpose amplifiers, telephone circuits, and linear arrays. The devices include, in many cases, an internal full-wave bridge rectifier for surge protection. On many circuits, this provides lightning protection to 1500 V.

The new line of AT&T semi-custom linear arrays are the cost-effective alternative to custom design. The arrays can tolerate working voltages up to 90 V with blocking voltages as high as 1000 V. They have the sophistication to perform a host of electronic functions, while interfacing with a wide variety of circuits.

**For additional information contact your nearest sales office or call:**  
**1-800-372-2447.**

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\* Did not appear in the previous edition of the Product Selection Guide.



## **Analog ICs**

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\* Did not appear in the previous edition of the Product Selection Guide.

# High-Speed Dual Analog Switch — LB1017AC

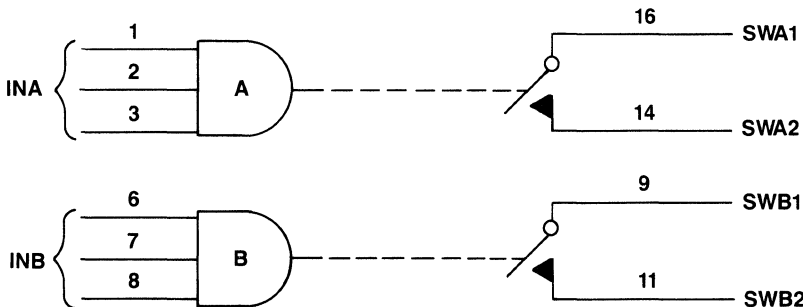
## Description

The LB1017AC High-Speed Dual Analog Switch integrated circuit contains two channels in one package. Each channel consists of a driver circuit controlling a SPST switch. The drivers interface with TTL-logic input signals for applications such as multiplexing, commutating, and D/A converter applications. These drivers enable a low-level input (0.8 to 2.0 volts) to control the ON/OFF condition of each switch. In the ON-state, each switch will conduct equally well in either direction. In the OFF-state, each switch will block voltages up to  $\pm 5$  volts. Positive Logic 1 will turn each switch ON and Logic 0 will turn each switch OFF.

## Features

- Low ON resistance (9 to 15 ohms) for signals up to  $\pm 4$  V and 100 kHz
- Characterized for audio range; capable of handling small-signal analog inputs to the MHz range
- Switching times  $< 50$  ns
- $\pm 4$  volt common-mode range
- Low injected charge ( $< 50$  pC)
- High open-switch isolation ( $-70$  dB) at 1.0 kHz
- Low leakage current ( $< 100$  nA) in the OFF-state
- Low crosstalk ( $-50$  dB) between switches
- Low harmonic distortion
- Switches have sink/source current capabilities  $> 16$  mA
- Low feedthrough capacitance ( $< 0.3$  pF)

## Functional Diagram



LOGIC	SWITCH
1 1 1	ON
0 0 0	OFF
0 0 1	
0 1 0	
0 1 1	
1 0 0	
1 0 1	
1 1 0	

## Analog ICs Battery Feeds

# Battery Feed — LB1011AB

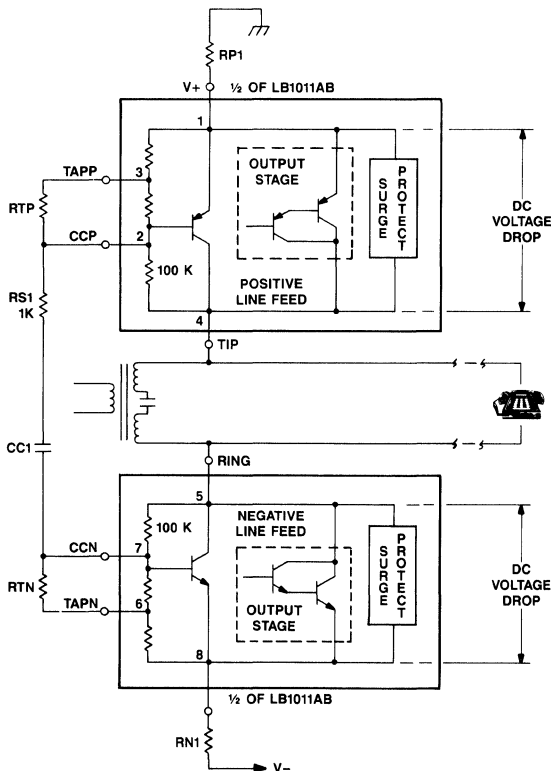
### Description

The LB1011AB integrated circuit is an electronic battery feed circuit which supplies dc currents to a telephone line with minimal loading on the ac signals. The device is integrated as two complementary chips to supply dc currents of both negative and positive polarities to either unbalanced or balanced lines. In the balanced-line application, this device helps suppress undesirable common-mode signals.

### Features

- Basic battery feed functions at a low cost
- High ac impedance characteristics for balanced-line, differential-mode, and voice-band signals
- Full internal lightning surge protection
- dc voltage drops can be adjusted to accommodate different peak signal levels
- 8-pin plastic DIP

### Functional Diagram



## Analog ICs Battery Feeds

# Battery Feed — LB1012AD

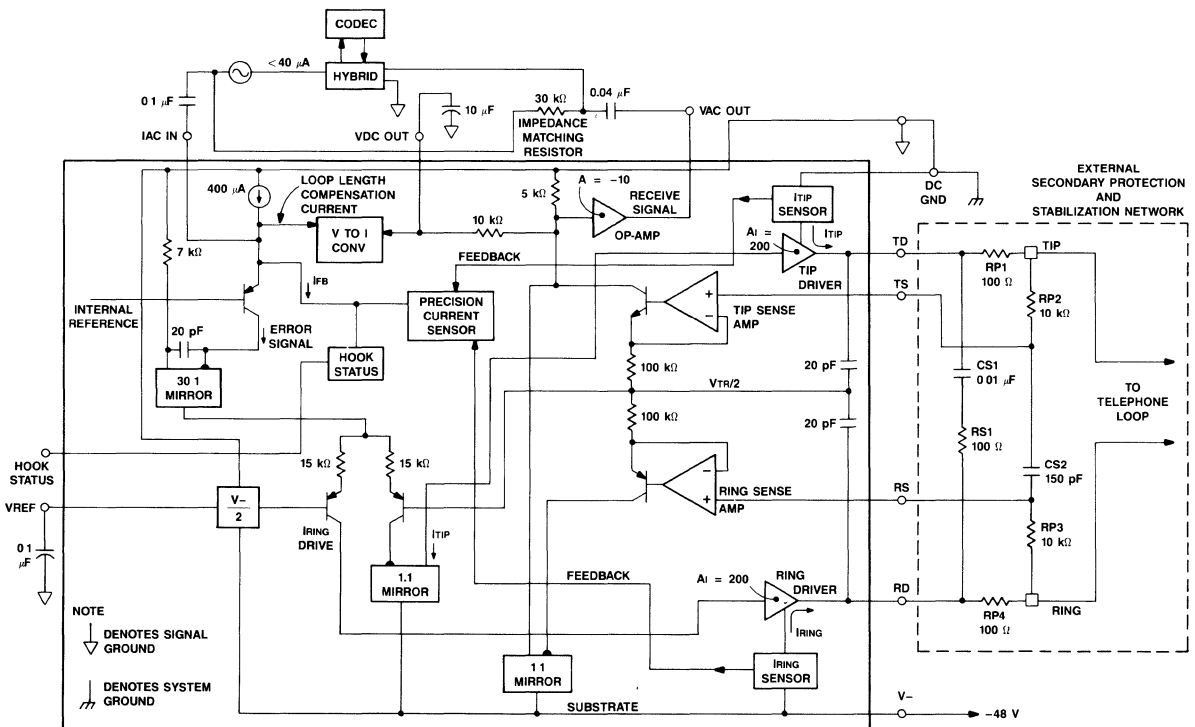
### Description

The LB1012AD integrated circuit is an electronic battery feed circuit which supplies a controlled dc current to the Tip-Ring pair of a telephone system. The battery feed circuitry presents a low impedance to dc current, while presenting a high impedance to the ac signal. The LB1012AD device contains input and output ports for voice-frequency signals and a hook status output signal.

### Features

- Loop lengths up to 1300 ohms can be driven
- Common-mode rejection (longitudinal balance) better than 60 dB
- Well-controlled receive and transmit gains
- TTL-compatible "Hook Status" indicator
- Proper line matching can be provided with a 50:1 scaled network; 30 k $\Omega$  provide a 600  $\Omega$  termination
- 18-pin plastic power DIP

### Functional Diagram



## Quad Line Driver — AM26LS31CC

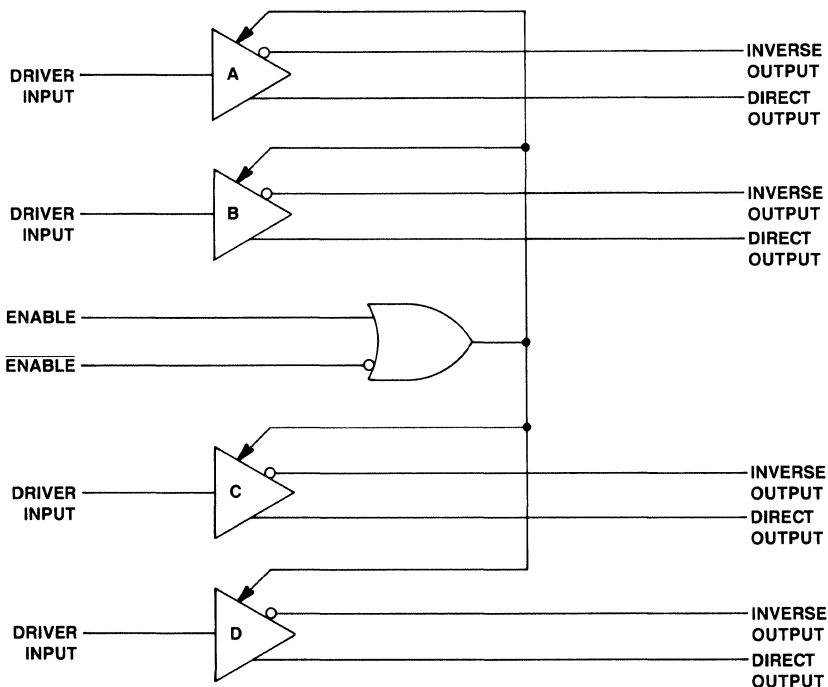
### Description

This device consists of four independent line drivers with a common ENABLE,  $\overline{\text{ENABLE}}$  control. It provides high-speed differential drive to transmission lines having an impedance of at least 100 ohms. Each of the four drivers has complementary 3-state outputs. This device requires only a 5 volt supply ( $\pm 10\%$ ) for operation.

### Features

- Direct replacement for industry-standard differential line drivers
- Meets EIA RS-422A requirements
- Input/output propagation delay is less than 20 ns
- ENABLE,  $\overline{\text{ENABLE}}$  to output delay is less than 40 ns
- Reduced power supply current (less than 40 mA) when device is disabled
- Output skew (time delay between direct output and inverse output) typically 2 ns
- TTL-compatible ENABLE,  $\overline{\text{ENABLE}}$  inputs
- 16-pin plastic DIP

### Functional Diagram



# Quad Line Receivers — AM26LS32CC, AM26LS33CC

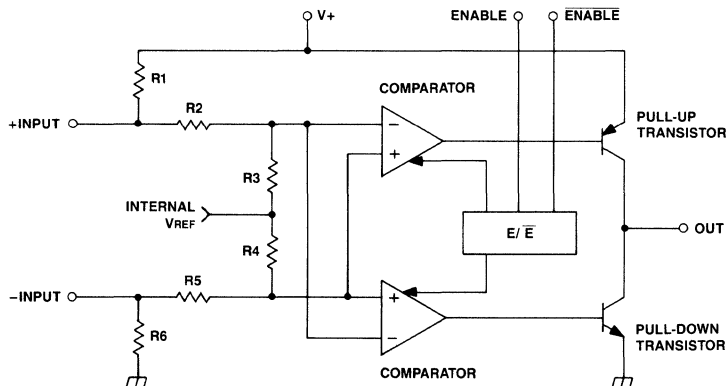
## Description

The AM26LS32CC and AM26LS33CC integrated circuits are general-purpose, line receiver circuits for use in either balanced or unbalanced data transmission systems. A TTL-compatible ENABLE,  $\overline{\text{ENABLE}}$  is common to all four receivers in each package. The ENABLE,  $\overline{\text{ENABLE}}$  allows the output to be put into a high-impedance state for output busing.

## Features

- Direct replacement for industry-standard line receivers
- Meets EIA RS-422A/423A specifications
- Four independent receivers with common strobe TTL-compatible input
- Electrostatic discharge protection on receiver inputs
- Requires only a single 5 V ( $\pm 10\%$ ) power supply
- Input sensitivity:  $\pm 200$  mV (AM26LS32CC),  
 $\pm 500$  mV (AM26LS33CC)
- Guaranteed minimum input hysteresis: 15 mV (AM26LS32CC),  
 30 mV (AM26LS33CC)
- Internal fail-safe forces the output high for an open input condition
- Typical propagation delay of 17 ns
- 16-pin plastic DIP, with industry-standard pinout

## Simplified Diagram



### Notes:

R1 and R6 are fail-safe resistors.

R2, R3, R4 and R5 form an Input Divider. With the internal reference ( $V_{REF}$ ), these components set the input characteristics.

One of four identical circuits shown.

# Quad Bus Transceiver — LB1025AC

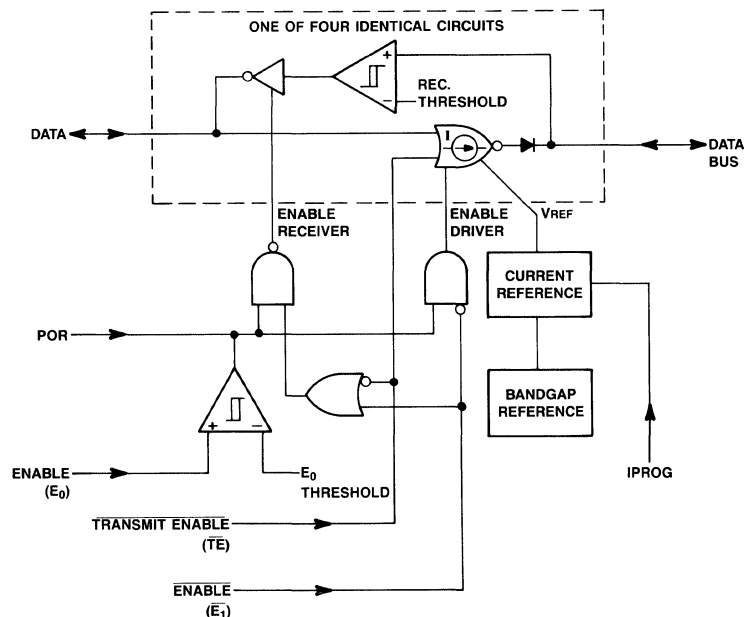
## Description

The LB1025AC device contains four bus transceivers. Each transceiver will interface a 3-state bus with a large, low-impedance party-line bus. It has current-source drive to the party-line bus and maintains a high-impedance load to this bus under all conditions. All receivers have 3-state outputs and their inputs have built-in hysteresis to improve noise control. Fail-safe design ensures that transmit is disabled when the enable pins are open.

## Features

- Four independent transceivers
- Low output capacitance (<6 pF to bus)
- Simultaneous receive/transmit enabling of all transceivers
- TTL-compatible inputs
- 3-state receiver outputs
- Receiver input hysteresis
- Driver output high is 75 mA
- 4.75 V to 5.25 V supply voltage range
- 16-pin plastic DIP

## Functional Diagram



**Analog ICs**  
**High-Voltage Gate Arrays**

**Octal High-Voltage N-Channel  
MOSFET Array — AN0130NA**  
**Monolithic N-Channel Enhancement-Mode**

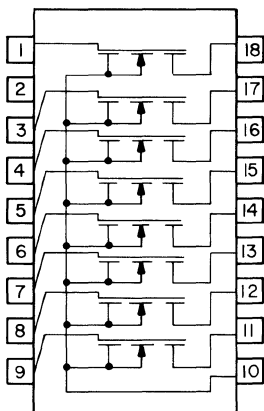
**Description**

The AT&T MOSFET Arrays contain eight N-channel DMOS drivers configured with common-source, open drain, and ESD protection gates. The device interfaces MOS logic inputs to outputs capable of withstanding 300 V and sinking 30 mA. The devices are fabricated in AT&T's proprietary bipolar-CMOS-DMOS (BCDMOS) technology with dielectric isolation. This process offers unprecedented freedom from latchup and parasitic device interaction. A most important feature is the ESD protection provided on-chip. This is a feature not provided by similar arrays presently available in the industry.

**Features**

- On-chip ESD protection
- Operating voltage up to 300 V
- Processed with BCDMOS technology
- Freedom from secondary breakdown
- Interfaces directly to CMOS logic
- Pin-compatible with industry-standard driver arrays
- Low crosstalk between channels

**Pin Configuration and  
Functional Diagram**



*Advanced information — Sample devices are not necessarily available at this time.*

**(Refer to Section 19 for typical applications of this product.)**



**Analog ICs**  
**High-Voltage Gate Arrays**

**Octal High-Voltage P-Channel  
MOSFET Array — AP0130NA**  
**Monolithic P-Channel Enhancement-Mode**

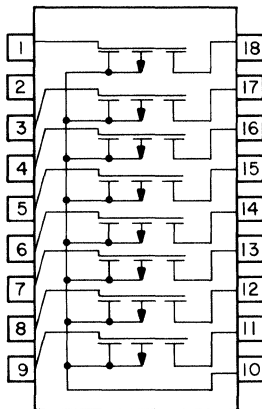
**Description**

The AT&T MOSFET Arrays contain eight P-channel DMOS drivers configured with common-source, open drain, and ESD protection gates. The device interfaces MOS logic inputs to outputs capable of withstanding 300 V and sinking 15 mA. The devices are fabricated in AT&T's proprietary bipolar-CMOS-DMOS (BCDMOS) technology with dielectric isolation. This process offers unprecedented freedom from latchup and parasitic device interaction. A most important feature is the ESD protection provided on-chip. This is a feature not provided by similar arrays presently available in the industry.

**Features**

- On-chip ESD protection
- Operating voltage up to 300 V
- Processed with BCDMOS technology
- Freedom from secondary breakdown
- Interfaces directly to CMOS logic
- Pin-compatible with industry-standard driver arrays
- Low crosstalk between channels

**Pin Configuration and  
Functional Diagram**



*Advanced information — Sample devices are not necessarily available at this time.*

## Analog ICs High-Voltage Level Translator

# 8-Channel Logic to High-Voltage Level Translator — HT0130P

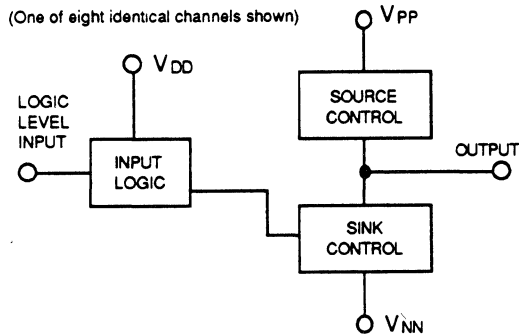
### Description

The AT&T Level Translator converts  $V_{DD}$  referenced logic inputs to  $V_{PP}$  referenced outputs ranging from  $-3$  to  $+300$  volts. The device can be used to drive the AT&T AP0130NA P-Channel MOSFET Array. The HT0130P Level Translator features low power supply drain current under quiescent conditions and provides on-chip ESD protection of inputs. These are features not always provided by similar types of arrays presently available in the industry.

### Features

- On-chip ESD protection
- Operating voltage up to 300 V
- Processed with BCDMOS technology
- Provides logic to high-voltage translation for controlling P-channel MOS gates
- Accommodates 5 to 15 volt logic inputs
- Accommodates output voltage swings below ground
- Eliminates need for floating logic

### Functional Diagram



Advanced information — Sample devices are not necessarily available at this time.

**(Refer to Section 19 for typical applications of this product.)**

Spring 1988

2-11

# SPST High-Voltage Solid-State Relays — LH1056-Type

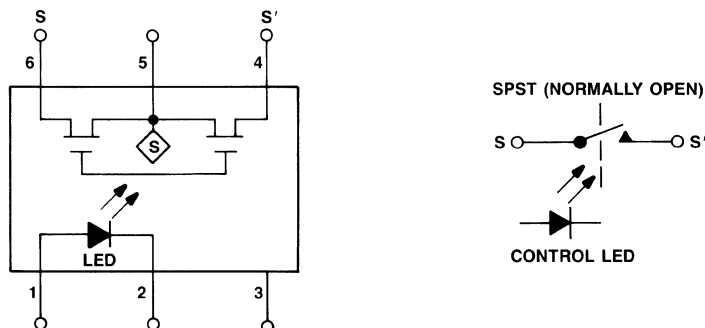
## Description

The LH1056AT Multipurpose Solid-State Relays (MSR) are low-cost, bidirectional, SPST switches which can replace mechanical relays in many applications. Output is rated at 350 volts and can handle loads up to 100 mA. The MSR is available in a 6-pin plastic DIP or a surface-mount package. The MSR will switch both dc and ac loads and is UL listed for 1500 Vrms of input/output isolation. The circuit consists of one GaAlAs LED to optically couple the control signal to a dielectrically isolated high-voltage integrated circuit. The typical ON-resistance is 30 ohms at 25 mA, and is exceptionally linear up to 50 mA. Beyond 50 mA, the incremental resistance becomes even less, thereby minimizing internal power dissipation. The MSR also has internal current limiting, which clamps the load current to 150 mA to insure that the device survives during power surges. The MSR will survive FCC lightning test number 68-302 when it is properly protected.

## Features

- Low ON-resistance
- Clean, bounce-free switching
- 1500 Vrms input/output isolation (optically coupled)
- High solid-state reliability
- $dv/dt$  typically better than 500 V/ $\mu$ s
- High surge capability
- Low power consumption
- Noise-free operation
- No electromagnetic interference
- High-voltage monolithic IC fabricated in a dielectric isolation process

## Functional Diagram



*This information is preliminary and subject to change.*

## Analog ICs High-Voltage Solid-State Relays

# DPST High-Voltage Solid-State Relay — LH1061AB

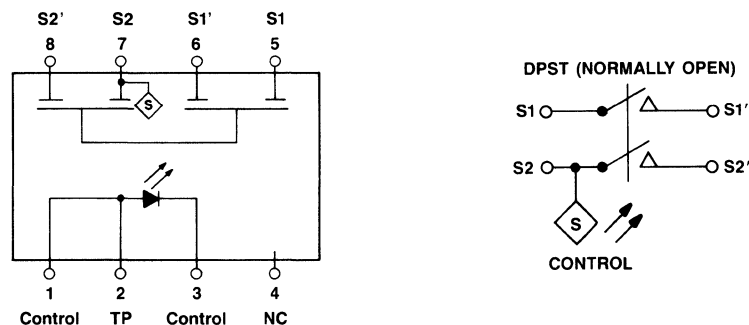
### Description

The LH1061AB High-Voltage Solid-State Relay is a low-cost, multipurpose, bi-directional, double-pole, single-throw (DPST) switch which can replace mechanical relays in many applications. Its output is rated at 200 volts per pole and can handle loads up to 200 mA. It provides up to 1500 Vrms of input/output isolation and will switch both ac and dc loads. The device is packaged in an 8-pin plastic DIP. The LH1061AB solid-state relay consists of a single IRED to optically couple the control signal to a dielectrically isolated high-voltage integrated circuit. The typical ON-resistance is 12 ohms per pole at 50 mA, and is exceptionally linear to 100 mA. Beyond 100 mA, the incremental ON-resistance becomes even less, thereby minimizing internal power dissipation. The LH1061AB unit also has internal current limiting which clamps the load current to 250 mA to ensure that the device survives during power surges.

### Features

- Low ON-resistance
- Clean, bounce-free switching
- 1500 V input/output isolation (optically isolated)
- High solid-state reliability
- $dv/dt$  typically better than 500 V/ $\mu$ s
- High surge capability
- Low power consumption
- Noise-free operation
- No electromagnetic interference
- High-voltage monolithic IC fabricated in a dielectric isolation process
- Surface mount version available

### Functional Diagram



*This information is preliminary and subject to change.*

**(Refer to Section 19 for typical applications of this product.)**

## **SPST High-Voltage Solid-State Relay (High mA) — LH1085AT**

### **Description**

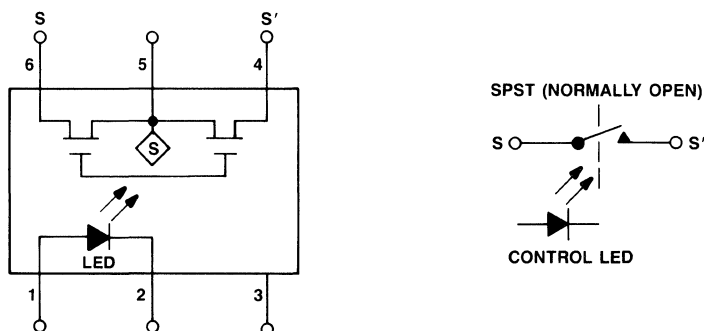
The LH1085AT High-Voltage Solid-State Relay is a low-cost, bidirectional, SPST switch which can replace mechanical relays in many applications. The output is rated for 350 volts and is similar to the LH1056AT (MSR) except that the typical value of internal current limiting has been increased from 150 mA to 300 mA. The LH1085AT is available in a 6-pin plastic DIP. The LH1085AT will switch both dc and ac loads and is UL approved for 1500 Vrms of input-to-output isolation.

This device uses one GaAlAs LED to optically couple the control signal to a dielectrically isolated high-voltage integrated circuit. The typical ON-resistance is 30 ohms at 25 mA and is exceptionally linear up to 50 mA. Beyond 50 mA, the incremental resistance becomes even less, thereby minimizing internal power dissipation. The LH1085AT is rated for dc load (operating) currents up to 150 mA and peak currents up to 225 mA. Internal current limiting will protect the device in many applications.

### **Features**

- Low ON-resistance
- Clean, bounce-free switching
- 1500 Vrms input/output isolation (optically coupled)
- High solid-state reliability
- $dv/dt$  typically better than 500 V/ $\mu$ s
- High surge capability
- Low power consumption
- Noise-free operation
- No electromagnetic interference
- High-voltage monolithic IC fabricated in a dielectric isolation process

### **Functional Diagram**



*This information is preliminary and subject to change.*

## Analog ICs Operational Amplifiers

# Dual Programmable Micropower Op Amp — LB1035AC

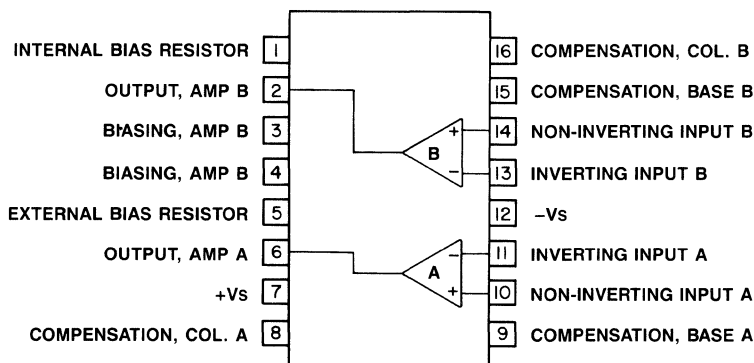
### Description

The LB1035AC device is a dual micropower operational amplifier intended for applications requiring minimum quiescent power dissipation. It is bias-programmable, permitting simultaneous adjustment of supply current ( $I_{PS}$ ) and gain-bandwidth product ( $f_T$ ) over about three orders of magnitude. A nominal  $I_{PS} \cong 100 \mu\text{A}$  per amplifier provides  $f_T \cong 1.5 \text{ MHz}$  internally compensated for closed-loop gains down to unity.

### Features

- 130  $\mu\text{A}$  per amplifier, maximum supply current at  $\pm 6.2 \text{ V}$  power supplies
- Low-voltage operation
- Internal compensation
- Guaranteed minimum unity-gain frequency of 750 kHz
- 0.53  $\text{V}/\mu\text{s}$  typical slew rate
- Bias programmable for adjustment of bandwidth and supply current
- Static discharge protection
- 16-pin DIP
- Storage temperature range:  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$
- Supply voltage range:  $\pm 1.0$  to  $\pm 10 \text{ V}$
- Differential-mode voltage range:  $\pm 6.0 \text{ V}$

### Pin Connections and Functional Diagram



# High-Voltage Dual Op Amp — LB1013AD

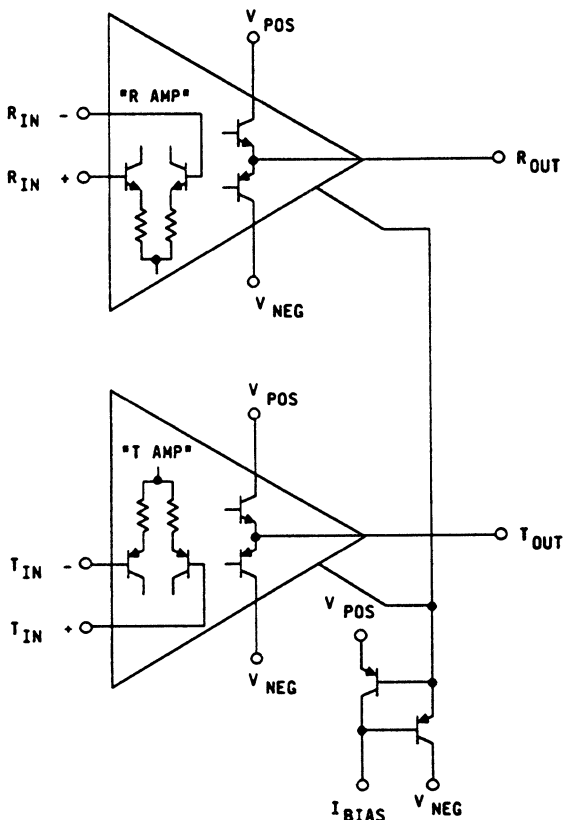
## Description

The LB1013AD High-Voltage Dual Op Amp integrated circuit operates off a single power supply from 5 to 85 volts, or a dual power supply from  $\pm 2.5$  to  $\pm 42.5$  volts. The amplifiers are internally compensated and are designed to operate in the audio band. This device is powered up with a current supplied to the IBIAS pin (typically  $40\ \mu\text{A}$  to  $80\ \mu\text{A}$ ). External circuitry is required to provide short-circuit protection.

## Features

- Typical  $f_r = 1\ \text{MHz}$
- Open loop gain;  $50\ \text{dB @ } 3\ \text{kHz}$
- Provides output currents  $\pm 40\ \text{mA}$  to  $\pm 80\ \text{mA}$  (depending upon the IBIAS value)
- Operating temperature range ( $-25$  to  $+100^\circ\text{C}$ )

## Functional Diagram



## Analog ICs Operational Amplifiers

# High-Voltage Dual Op Amp — LB1108A-Type

### Description

The LB1108A-Type silicon integrated circuit is an internally compensated, high-voltage dual operational amplifier. It has internal current-limiting and thermal shut-down features. Provisions are provided to accommodate separate positive supply voltages for the input stages ( $V_{S1}$ ) and the output stages ( $V_{S2}$ ). This connection configuration allows for higher common-mode input voltage swing and provides higher output currents for telephone line applications.

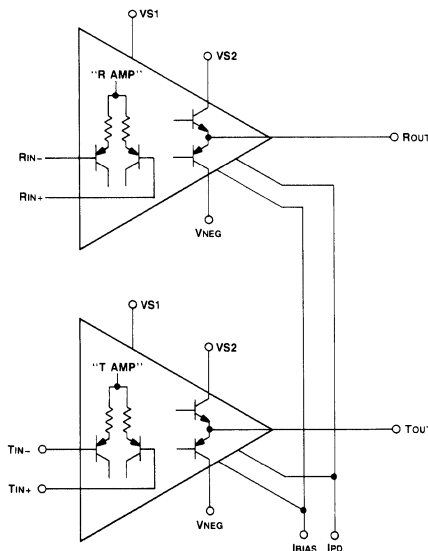
Each amplifier output can sink or source up to 60 mA, and will operate in the temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . The output voltage swing is typically 2.0 volts from the power-supply voltage.

An optional powerdown feature is available for applications requiring minimum standby power.

### Features

- Audio band operation: typically  $f_T = 3\text{ MHz}$ ; Gain = 70 dB @ 1.0 kHz
- Single-supply operation: 5.0 to 85 V;  
Dual-supply operation:  $\pm 2.5$  to  $\pm 42.5\text{ V}$
- Output voltage swing to within 2.0 V of supply voltage rails
- Internal circuitry provides output overload protection @ 70 mA
- Thermal shutdown protection in-chip temperature range of 150 to 160°C

### Functional Diagram



Advanced information — Sample devices are not necessarily available at this time.

**(Refer to Section 19 for typical applications of this product.)**



## Analog ICs Operational Amplifiers

# Programmable Medium-Power Output Op Amp — LB1032BC

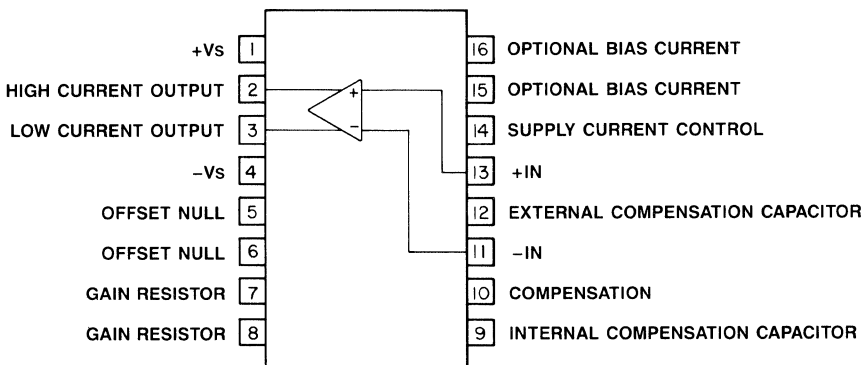
### Description

The LB1032BC device is a programmable internally compensated, medium-power operational amplifier. Maximum supply voltage is  $\pm 9.0$  V and output current is  $\pm 140$  mA into a  $45 \Omega$  load. Optional bias control, external compensation, offset nulling, and a low-current, higher frequency output are also provided.

### Features

- 140 mA minimum output current capability
- Guaranteed minimum unity-gain frequency of 2.5 MHz
- Offset voltage null capability
- 1.5 V/ $\mu$ s typical slew rate
- Optional internal or external compensation
- 16-pin DIP; 500 mW
- Supply voltage range:  $\pm 3.0$  to  $\pm 9.0$  V
- Differential-mode voltage range:  $\pm 6.5$  V

### Pin Connections and Functional Diagram



## **Programmable Wideband Op-Amp — LB1034AC**

---

### **Description**

The LB1034AC device is a bias-programmable, wideband, high-output current operational amplifier. It features low-quiescent current, high-output voltage swing, and a high gain-bandwidth product. Power-supply voltages of  $\pm 2.0$  to  $\pm 15$  volts are usable. Internal "T" and feedback compensations are available for closed-loop gains exceeding 20 dB.

This device can also be used as a micropower operational amplifier, with power-supply currents as low as  $5.0 \mu\text{A}$ , and greatly reduced input bias and offset currents. The gain-bandwidth product of the amplifier (ft) is adjustable with bias current.

### **Features**

- Capable of sinking or sourcing a minimum 150 mA output current
- 2.1 mA maximum quiescent supply current
- Static discharge protection
- Internal "T" compensation
- 80 dB open-loop gain to 100 kHz
- Wideband performance optimized for closed-loop gains  $> 20$  dB
- Bias programmable for wide adjustment of bandwidth and supply current
- Typical minimum unity-gain frequency of 1.0 MHz
- Operation to  $+85^\circ\text{C}$



## Analog ICs Operational Amplifiers

# Single General-Purpose Medium-Power Output Op Amp — LB1032AC

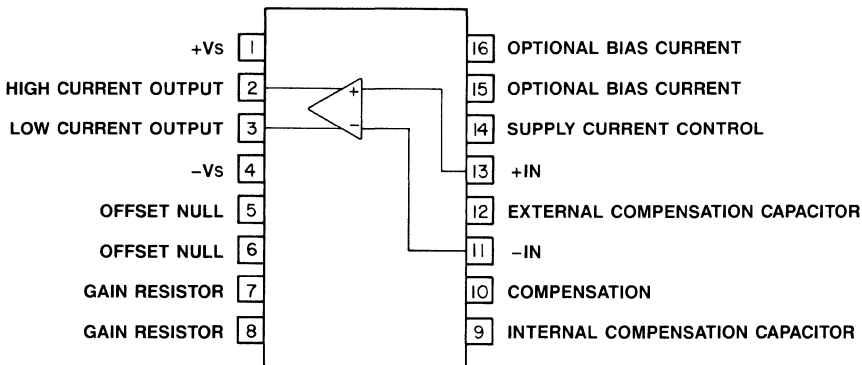
### Description

The LB1032AC device is an internally compensated, medium-power operational amplifier. Maximum supply voltage is  $\pm 70$  V and output current is  $\pm 77$  mA into a  $45 \Omega$  load. Optional bias control, external compensation, offset nulling, and a low-current, higher frequency output are also provided.

### Features

- 80 mA minimum output current capability
- Guaranteed minimum unity-gain frequency of 2.5 MHz
- Offset voltage null capability
- 1.5 V/ $\mu$ s typical slew rate
- Optional internal or external compensation
- 16-pin plastic DIP
- Supply voltage range:  $\pm 3.0$  to  $\pm 7.0$  V
- Differential-mode voltage range:  $\pm 6.5$  V

### Pin Connections and Functional Diagram



## **Power Controller — LB1019AB**

---

### **Description**

The LB1019AB Power Controller is used to switch the unregulated  $-48$  volt supply to multibutton telephone station sets or other loads. It is digitally controlled and has a 300 mA capability. This device can drive higher instantaneous currents and has a built-in thermal shutdown to prevent destruction in the event of a fault condition.

This device provides logic output states for three different load conditions:

Load currents  $\leq 3$  mA — open circuit.

Load currents  $\geq 300$  mA — overload.

Load currents  $\geq 3$  mA and  $\leq 300$  mA — normal load conditions.

The power controller will not provide current to the load if the  $V-$  supply voltage is more positive than a nominal  $-30$  volts. This prevents hazardous high-current conditions from occurring in a switching regulator located in the telephone station sets.

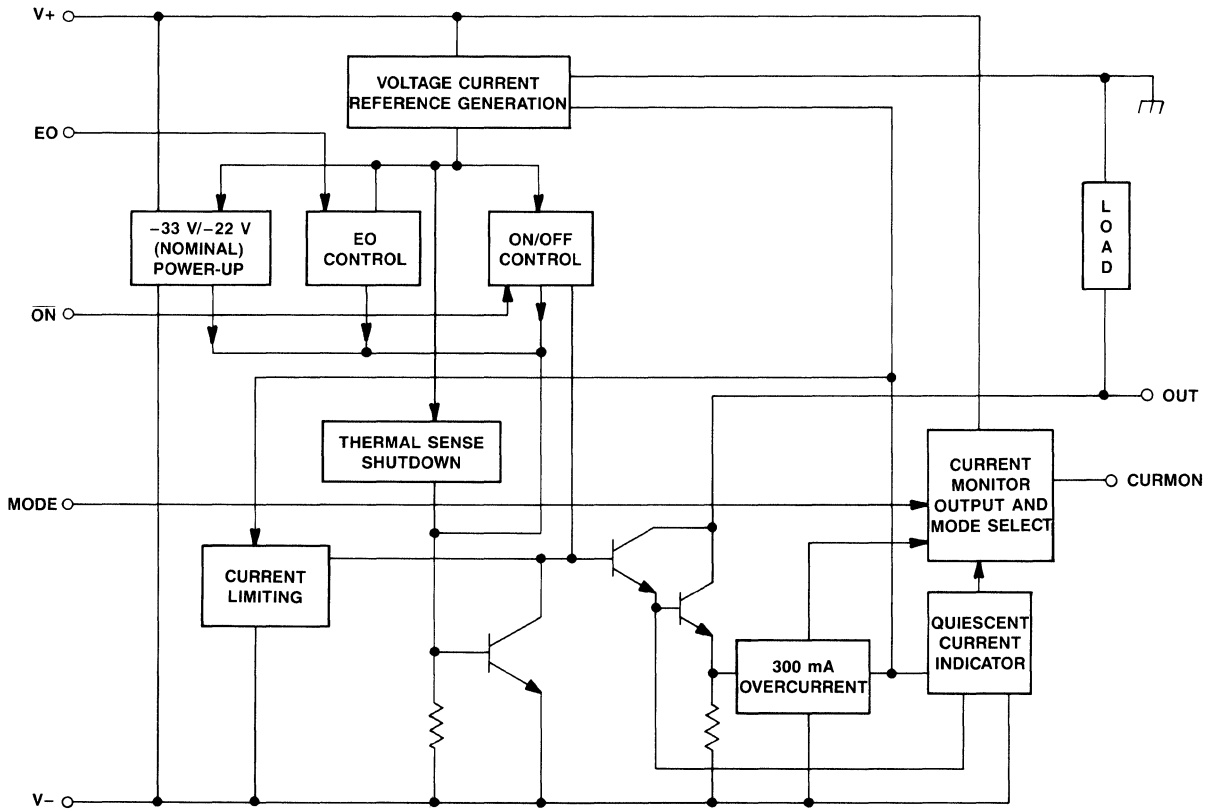
### **Features**

- Digital controlled power switch
- Power can be turned on and off using the  $\overline{ON}$  input
- Current limiting during a fault condition
- Thermal shutdown during extended fault conditions
- Indicates quiescent current flow to confirm output-to-load continuity
- EO input allows smooth power-up sequence
- Indicates overcurrent condition when the load current exceeds 300 mA (typically)
- 8-pin plastic DIP
- Inquire about the availability of devices with overcurrent threshold settings of 200 mA, 400 mA, and 600 mA ( $\pm 15\%$ )

# Analog ICs

## Power and Control Devices

### LB1019AB Power Controller Functional Diagram



# Pulse-Width Modulator — LB1048-Type

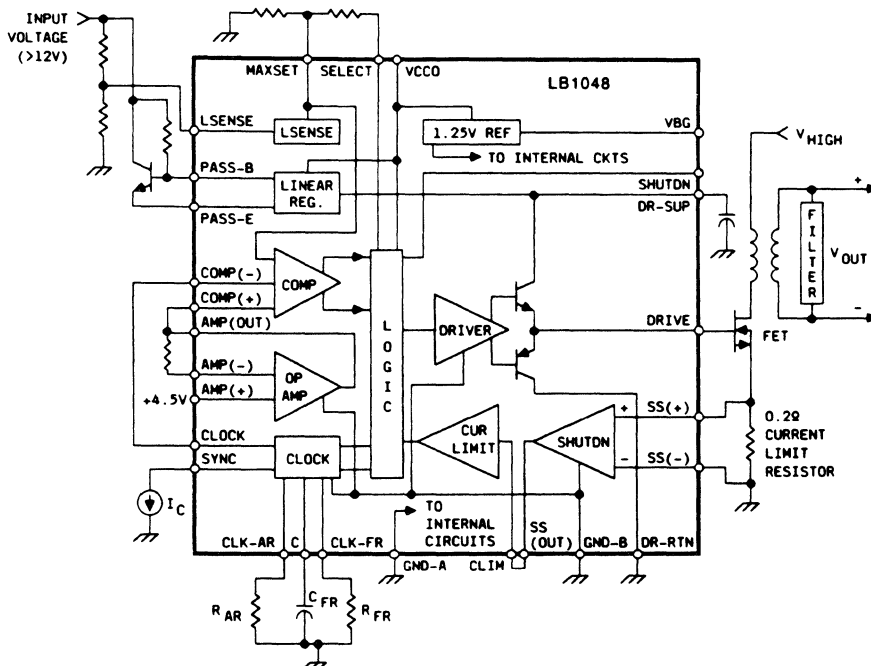
## Description

The LB1048AAJ and LB1048AG Pulse-Width Modulators are silicon integrated circuits offering a single-ended output which can either sink or source currents up to 200 mA. Each device is suitable for performing the basic pulse-width modulation function in switching power supplies. The logic section provides noise immunity by having an edge-triggered input which allows only one transition per clock cycle. This device includes a 1.25 V temperature-compensated reference capable of supplying up to 1 mA to external circuitry. It also features circuitry for current limiting, maximum duty-cycle limiting, shutdown and adaptive startup. An internal triangular wave shape oscillator (providing equal rise and fall times) is controlled by external components.

## Features

- Single source/sink output:  $\pm 200$  mA
- Frequency adjustable to 500 kHz
- Noise-immunity logic
- External oscillator synchronization
- Adaptive startup and shutdown control
- Double pulse suppression
- Current limit control of external FET
- Quiescent current less than 7.0 mA
- Maximum duty cycle control
- FET driver

## Functional Diagram



# Regulation Control Circuit LBR Family

## Description

The Regulation Control Circuit LBR Family consists of integrated circuits which provide three main functions in the same package; a voltage regulator, a precision 1.25 V reference, and a high-speed comparator. Each device accepts an unregulated dc supply voltage ranging from 4 to 26 V and provides two fixed outputs: a 1.25 V reference voltage, common to each device code in this family; and a customer-specified regulation voltage, ranging from 2 to 24 V, fixed at time of manufacture. These devices are available in 8-pin (fixed configuration, see Functional Diagram) and 16-pin (flexible configuration) packages.

## Features

### *Voltage Regulator*

- Fixed values between 2 and 24 V ( $\pm 1\%$ )
- Low temperature fluctuation

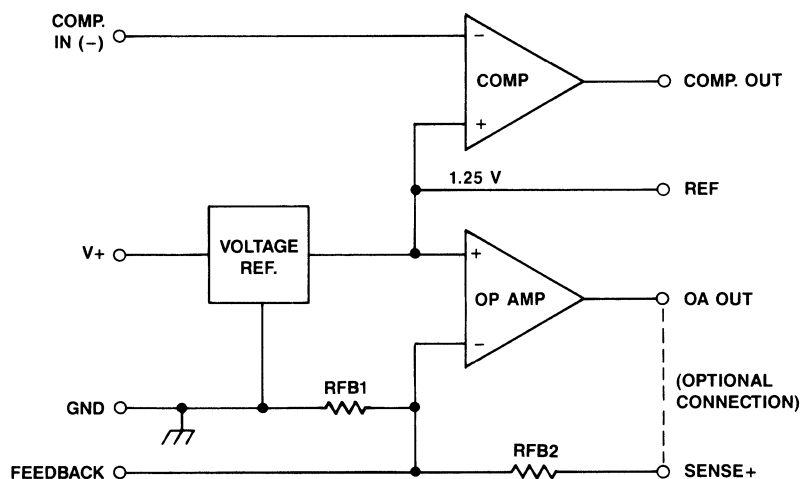
### *High-Speed Comparator*

- Propagation delay  $< 150$  ns
- Output loading to 10 mA maximum

### *Precision Low-Voltage Reference*

- 1.25 V ( $\pm 1\%$ ) from 4- to 26-volt supply
- 4-volt minimum  $V+$  operation ( $-40$  to  $+100^\circ\text{C}$ )
- Capacitive operation to 100 pF maximum
- Current loading to  $\leq 10$  mA

## Functional Diagram





# Voltage Reference Family — LB1081-Type

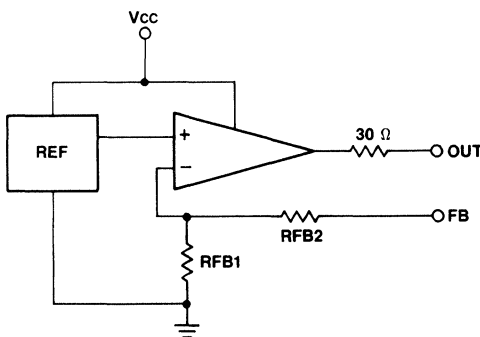
## Description

The LB1081-Type Voltage References represent a family of low-power control devices, each designed to provide a specific output within the range of 4 to 8 volts. Offering multipurpose applications, all circuits are characterized by low noise, medium current, and a predetermined output voltage. As a special design consideration, the reference voltage is set during manufacture by applying a voltage waveform to fusible, on-chip resistors. When used with the appropriate external components, the devices function as negative voltage regulators and high-output voltage regulators, and are suitable in environments requiring high current with low-impedance capabilities. Additionally, they are ideal for use in instrumentation equipment, measurement devices, and monitoring systems.

## Features

- Five preset output options.  
 4 V (LB1081AC)  
 5 V (LB1081BC)  
 6 V (LB1081CC)  
 7 V (LB1081DC)  
 8 V (LB1081EC, LB1081FC)
- Factory-programmable reference voltages
- Negative-voltage and high-voltage capabilities
- Medium-current and high-current capabilities
- Output current limiting, 30 mA
- Packaged in a 16-pin plastic DIP

## Functional Diagram



**Note:** The value of RFB2 and corresponding codes are shown in the table.

Code	RFB2*	TC V <sub>OUT</sub> **
LB1081AC	5.5 kΩ	±.0075%/°C
LB1081BC	7.5 kΩ	±.0075%/°C
LB1081CC	9.5 kΩ	±.0075%/°C
LB1081DC	11.5 kΩ	±.0075%/°C
LB1081EC	13.5 kΩ	±.0075%/°C
LB1081FC†	13.5 kΩ	±.0045%/°C

\* RFB1 = 2.48 kΩ and may be trimmed via meltback path to achieve precision output voltage.

\*\* TC V<sub>OUT</sub> denotes temperature coefficient of output voltage

† The LB1081EC and FC are electrically similar except for the noted difference in TC V<sub>OUT</sub>.

## Analog ICs Protection

# Octal Line Protector — LB1010AD

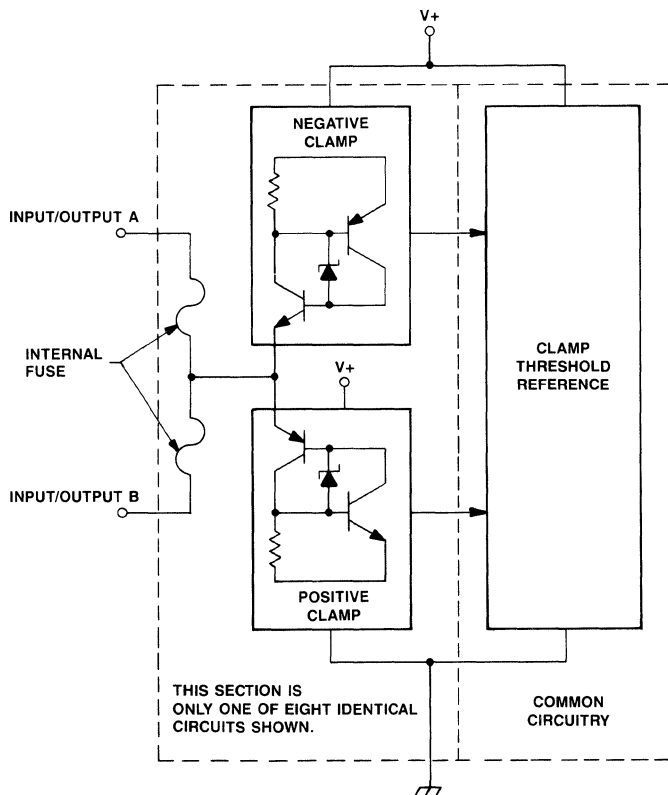
### Description

The LB1010AD integrated circuit is a bidirectional overvoltage/overcurrent limiting device that protects up to eight digital lines. This circuit contains 16 on-chip fuses, 8 voltage/current clamps, and a clamp threshold reference which tracks the power supply. In operation, transient on-line surges (within specified limits) are clamped to a safe level. However, if an extraordinarily high-current fault is detected (on the order of 1 amp), an on-chip fusing component will open, protecting your electronic circuits.

### Features

- Bidirectional clamping
- Clamp threshold tracks supply voltage to 7.0 V
- Protects 8 lines
- 18-pin plastic DIP

### Functional Diagram



## **High-Voltage Isolation Amplifier — LB1109AB**

### **Description**

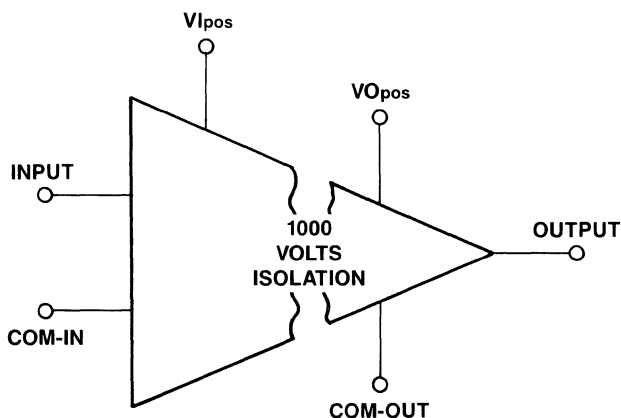
The LB1109AB High-Voltage Isolation Amplifier integrated circuit is a linear, two-port device designed to pass information across an isolated boundary. This device can transmit signals of up to 1.0 MHz bandwidth with less than one percent signal error at unity gain, while isolating input-to-output differential voltages of up to 1000 volts. The device is packaged in an 8-pin plastic DIP.

This device can replace opto-isolators in many applications. The advantage of the LB1109AB High-Voltage Isolation Amplifier is that it is a stand-alone unit (i.e., it is not dependent upon ancillary input and output circuitry). In addition, it has good temperature coefficients and well-controlled transfer characteristics.

### **Features**

- 1.0 MHz bandwidth
- Emitter follower output stage (1.5 mA source, 100  $\mu$ A sink)
- Temperature coefficient < 200 ppm/ $^{\circ}$ C
- Input currents  $\leq 1.3$  mA @ 5.0 V
- Signal-to-noise ratio > 60 dB
- 1000 volt transient input/output isolation
- Standby supply current < 3.0 mA
- Less than 0.5% signal error with a  $dv/dt$  of 100 V/ $\mu$ s
- Signal error at set point is less than  $\pm 1.0\%$

### **Functional Diagram**



# Integrated Secondary Protectors — LH1150-Type

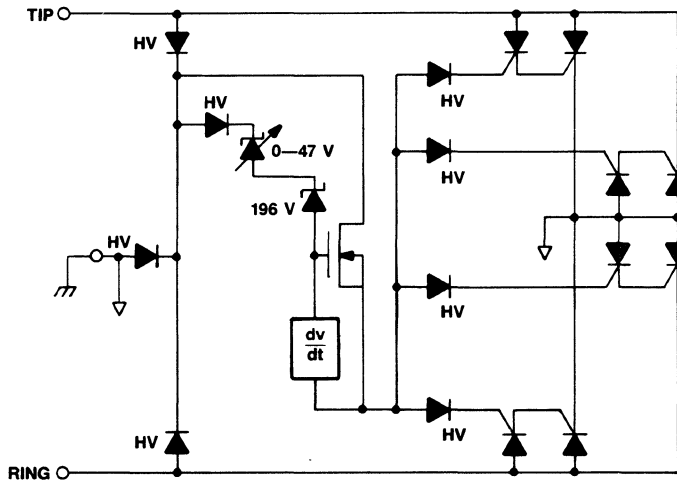
## Description

The LH1150-Type Integrated Secondary Protectors (ISP) are two-wire overvoltage devices for secondary protection of electronic switch line units. Each circuit contains four thyristor devices with associated threshold sensing. The fabrication technology utilizes a high-voltage, bipolar, DMOS, dielectrically isolated, silicon, integrated circuit chip, available in a rugged plastic package. In many applications this device is interchangeable with Texas Instruments voltage suppressor part TISP229A and TECCOR Electronics surge protector part P101.

## Features

- Bidirectional overvoltage protection
- Crowbars surge waves and power cross faults
- Internal voltage trim capability to meet threshold voltage requirements
- Symmetrical pinout
- No heat sink required

## Functional Diagram



# 60-Volt Dual Relay Driver — LS1014AB

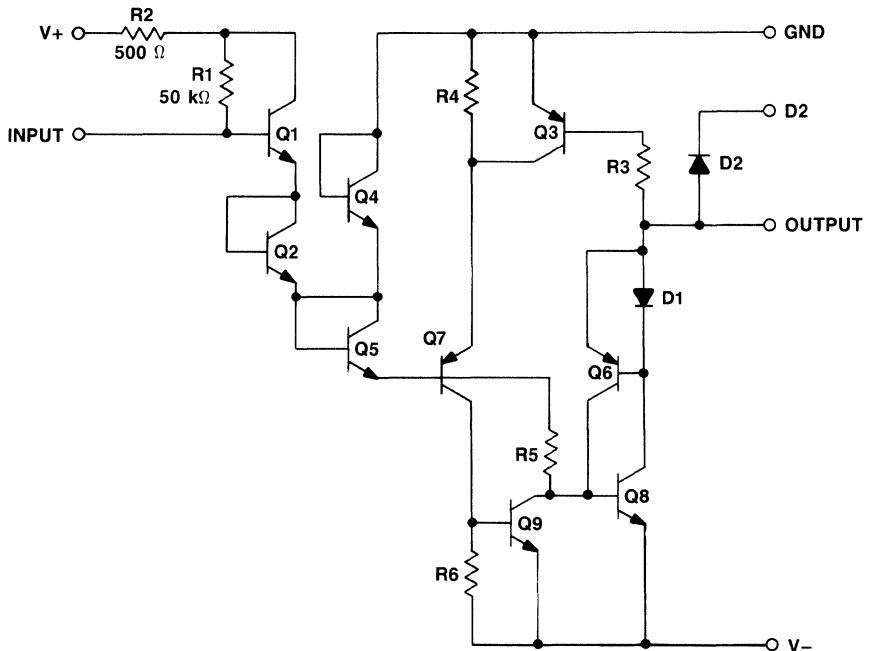
## Description

The LS1014AB integrated circuit consists of two independent relay drivers and is intended for use in high-voltage relay applications. Each relay circuit is designed to operate from positive TTL logic.

## Features

- Flyback protection diode at each output for optional connection
- Each output can handle any load from 2 to 30 mA
- Designed to operate from 5 V (V+) and -48 V (V-)
- Tested for 60 V operation
- 8-pin plastic DIP

## Basic Schematic



NOTE: This device consists of two identical drivers. Only one driver schematic is shown.

# Quad Negative-Voltage Relay Driver — LS1098AAF

## Description

The LS1088AAF integrated circuit consists of four independent 60-volt relay drivers designed to operate over wide ranges of supply voltage, common-mode voltage, and ambient temperature, with 50 mA source capability. These drivers are intended for switching the ground side of loads which are directly connected to a negative supply, such as in telephone relay systems.

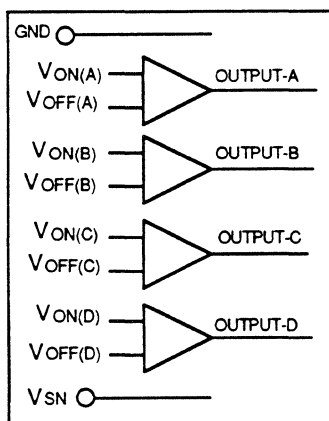
Noise and IR drop between logic ground and negative supply ground are problems which must always be considered in telephone relay systems. Therefore, these relay drivers are designed to operate with a high common-mode range.

These drivers are compatible with TTL, LS, and CMOS logic, since the differential input current requirements are low. Differential inputs permit either inverting or noninverting operation. The driver outputs incorporate transient suppression clamp networks which eliminate the need for external suppression circuitry when used in applications for switching inductive loads. A fail-safe feature is incorporated to ensure that, if the VON input or both inputs (VON and VOFF) are open, the driver will be off.

## Features

- 50 mA source capability (each driver)
- Low propagation delays ( $\leq 10 \mu\text{s}$ )
- TTL, LS, or CMOS compatible inputs
- Fail-safe disconnect protection
- High input common-mode voltage range ( $\pm 20 \text{ V}$ )
- Negative supply operating voltage ( $-10 \text{ V}$  to  $-60 \text{ V}$ )
- Built-in output clamp diodes

## Functional Diagram



# Analog ICs

## Semi-Custom Linear Arrays

# Semi-Custom Linear Arrays

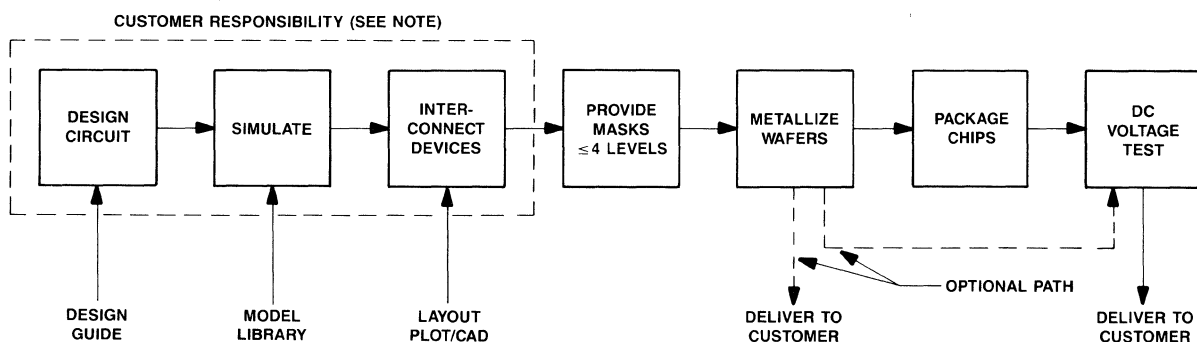
### Description

AT&T's family of CBIC linear arrays has been designed to fulfill a wide range of applications using a complementary vertical NPN and PNP transistor technology. Our linear arrays satisfy circuit design requirements ranging from dc to VHF, and 5 to 90 volt applications. In addition, some linear arrays combine analog and digital circuitry on the same chip. Design kits are available that consist of instruction manuals, building block parts kits, macrocell libraries, and grid plot arrays.

### Features

- Two-level metal interconnect
- All I/O ESD protected
- Low development costs
- Quick design turnaround, typically six to eight weeks from design approval
- Design proprietorship
- Available in chip form and a variety of JEDEC standard packages

### Design Manufacturing Sequence



NOTE: AT&T will provide these services if requested by customer at an additional charge.

### Product Matrix

Series	Technology	Characteristics
ALA201/202	CBIC	UHF; complementary vertical NPN and PNP transistors
ALA300/301	CBIC	90 V; complementary vertical NPN and PNP transistors
ALA400/401	CBIC	33 V; complementary vertical NPN and PNP transistors

## Analog ICs Speakerphone Device Set

# Voice Path Switch — LB1020AF

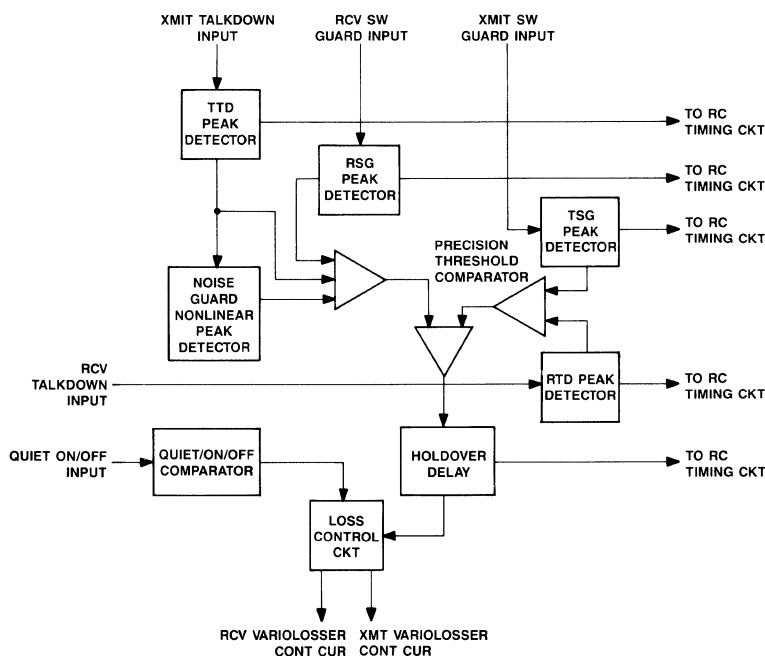
### Description

These speakerphone ICs are designed specifically for PBX and other office applications. The voice path switch, combined with the LB1021AD Power Conditioner/Amplifier, provides superior voice quality and low noise characteristics not offered by competitive line-powered devices. The LB1020AF performs the switching functions needed for speakerphone operation, accepting transmit and receive signals as input, and providing transmit and receive varioloss control signals as output. Timing of switching functions is selectable using external RC combinations. There is a noise-guard feature which permits steady background noise to be ignored in making the transmit/receive switching decision.

### Features

- Switching unaffected by background noise
- Single power supply
- Half-duplex operation; receive in default
- All timing, including fallback to default, controllable with external components
- Provides complete speakerphone operation when used with the LB1021AD device
- 24-pin plastic DIP

### Functional Diagram





## Analog ICs Speakerphone Device Set

# Power Conditioner/Amplifier — LB1021AD

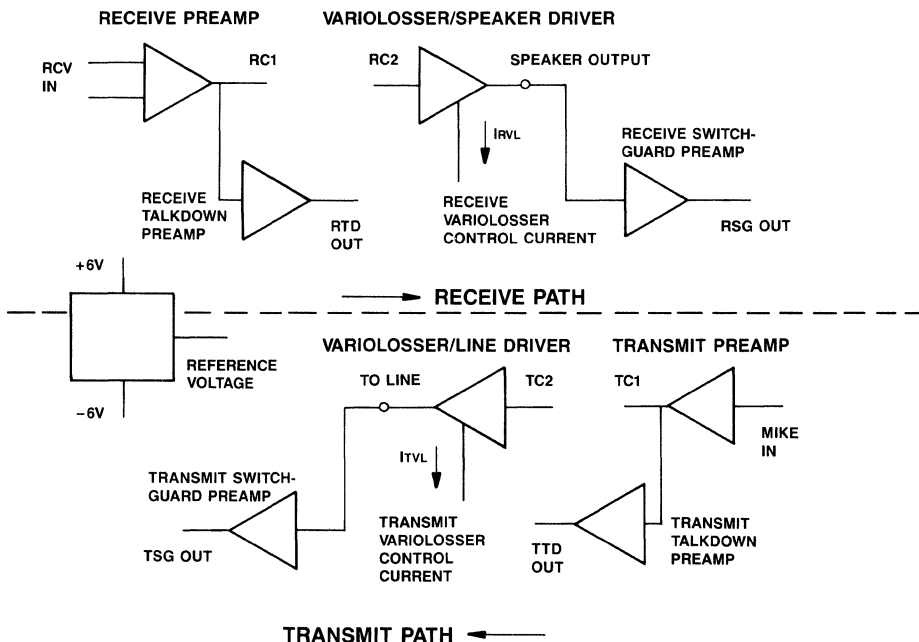
### Description

This device provides the linear amplification for a full-feature speakerphone system, including switchable, controllable gain for the transmit and receive voice paths, speaker and line drive capabilities, and switchguard/talkdown gain. In addition, it provides a stable, low-noise signal reference from the single 12 volt supply needed to power the circuit.

### Features

- High-gain receive preamplifier accommodates variety of microphones
- 700 mA speaker drive capability
- Gains and switching controllable by 0—100  $\mu$ A control currents
- Provides complete speakerphone operation when used with the LB1020AF device
- 18-pin plastic DIP

### Functional Diagram



# Electret Preamplifier — LB1027AB

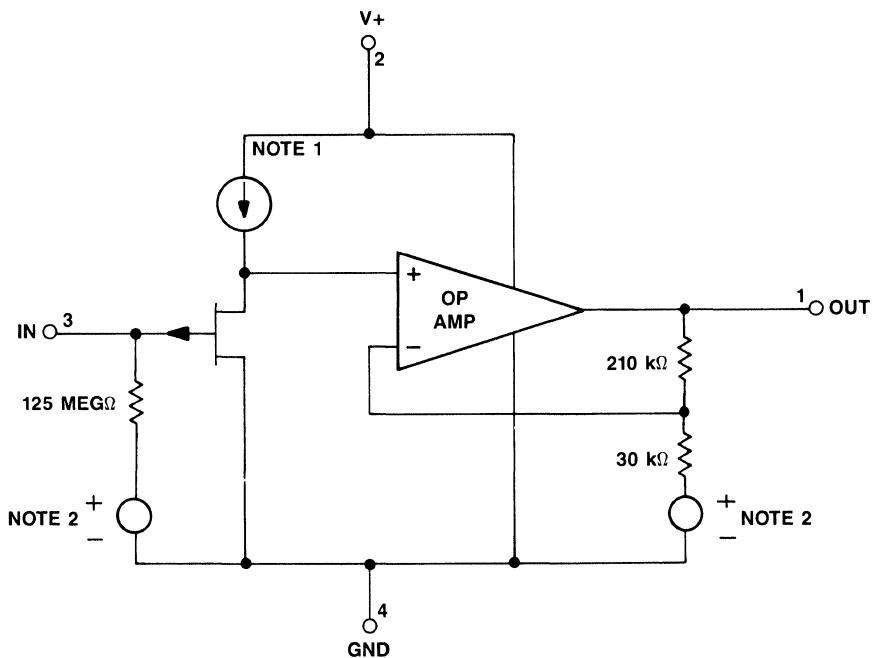
## Description

The LB1027AB is a voice-frequency preamplifier specifically designed for electret microphone applications. This device operates from a supply voltage of 15 volts down to 1.1 volts (with some performance degradation below 1.6 volts).

## Features

- Input impedance of 125 M $\Omega$  (in parallel with 2.5 pF)
- Low power drain (<327  $\mu$ A at 4 V)
- ac voltage gain of 18 dB
- 600 mV peak-to-peak output voltage swing
- Typical output resistance of 50  $\Omega$
- Available in wafer form or as an 8-pin DIP

## Functional Diagram



Notes:

1. Internal Current Source
2. Effective Internal Voltage Source

## **Full-Feature Tone Ringer/Ringing Detector — LB1004AC**

---

### **Description**

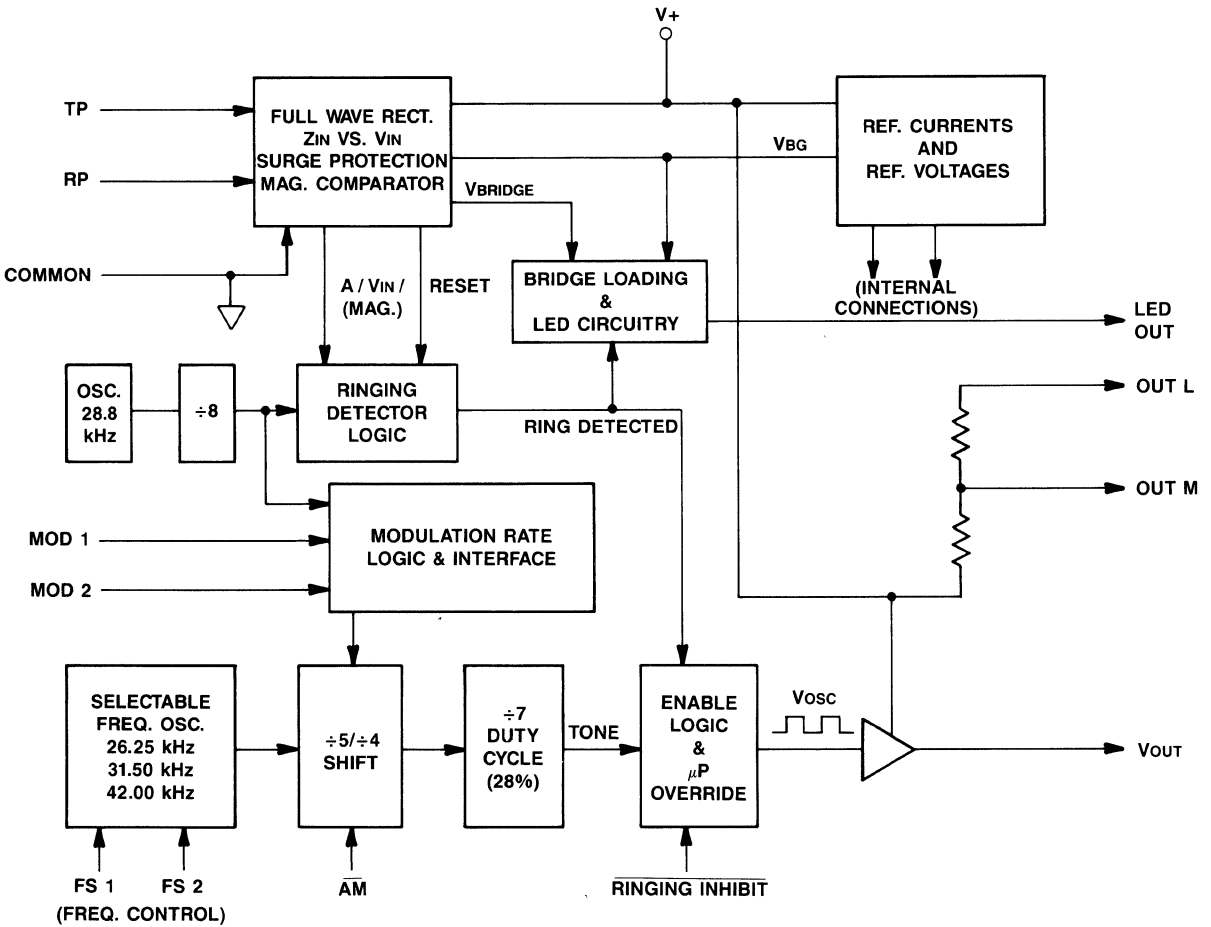
The LB1004AC integrated circuit is a Full Feature Tone Ringer/Ringing Detector which simultaneously provides a ringer-output tone and a "ringing-detected" output signal. The tone ringer portion of the device provides switch-selectable output frequencies of 750, 900, 940, and 1200 Hz at independently selectable modulation rates of 7.5, 10, 15, and 20 Hz. Amplitude or frequency modulation may also be independently selected. These TTL/CMOS logic or switch-selectable features, controlling both the type of sound and its duration, provide distinctive ringing capabilities which are useful for a multiphone office environment. The ringer can be prevented from providing a tone output with a "Ringing Inhibit" function. These functions can be controlled by a microprocessor, allowing various alerting tasks to be performed by appropriate programming. The ringing detector portion of the device provides an output (LED OUT) which can interface with a microprocessor or an opto-isolator.

### **Features**

- Complete telephone bell replacement with distinctive ringing capability
- Tight output frequency control ( $\pm 3\%$ ) for maximum acoustic output
- External components: only two capacitors and one resistor required
- Independently selectable AM or FM modulation
- On-chip volume control resistors provided
- Immune to rotary dial pulsing (bell tap)
- Meets both type A and B ringing requirements ( $40 V_{RMS} \leq V_{IN} \leq 150 V_{RMS}$ ,  $15 \text{ Hz} \leq f_{IN} \leq 68 \text{ Hz}$ ) as specified by EIA RS-470 and FCC Part 68
- Meets input impedance criteria specified by EIA RS-470 and AT&T Technical Publication 47001
- Logic- or switch-selectable output frequency and modulation rate options
- Internal polarity guard and 1500 V lightning surge protection provided
- Ringer equivalency: 1.0 B

# Analog ICs Telephony Devices

## LB1004AC Tone Ringer/Ringing Detector Functional Diagram



## **General-Purpose Tone Ringers — LB1005-Type**

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### **Description**

These integrated circuits provide a low-cost telephone alerter function with an output tone warbling between the base frequency and 1.25 times that of the base frequency, at a 15 or 20 Hz modulation rate. These devices meet all known standard criteria for telephone alerters, and also drive piezoelectric transducers directly. The LB1005AB is a tone ringer having an 1800 Hz base frequency, and is particularly suited for applications where space for the alerter is at a premium. The LB1005BB is a tone ringer having a 1200 Hz base frequency. This device produces a pleasant tone where required space is available for the alerter. The LB1005CB has a base frequency of 900 Hz.

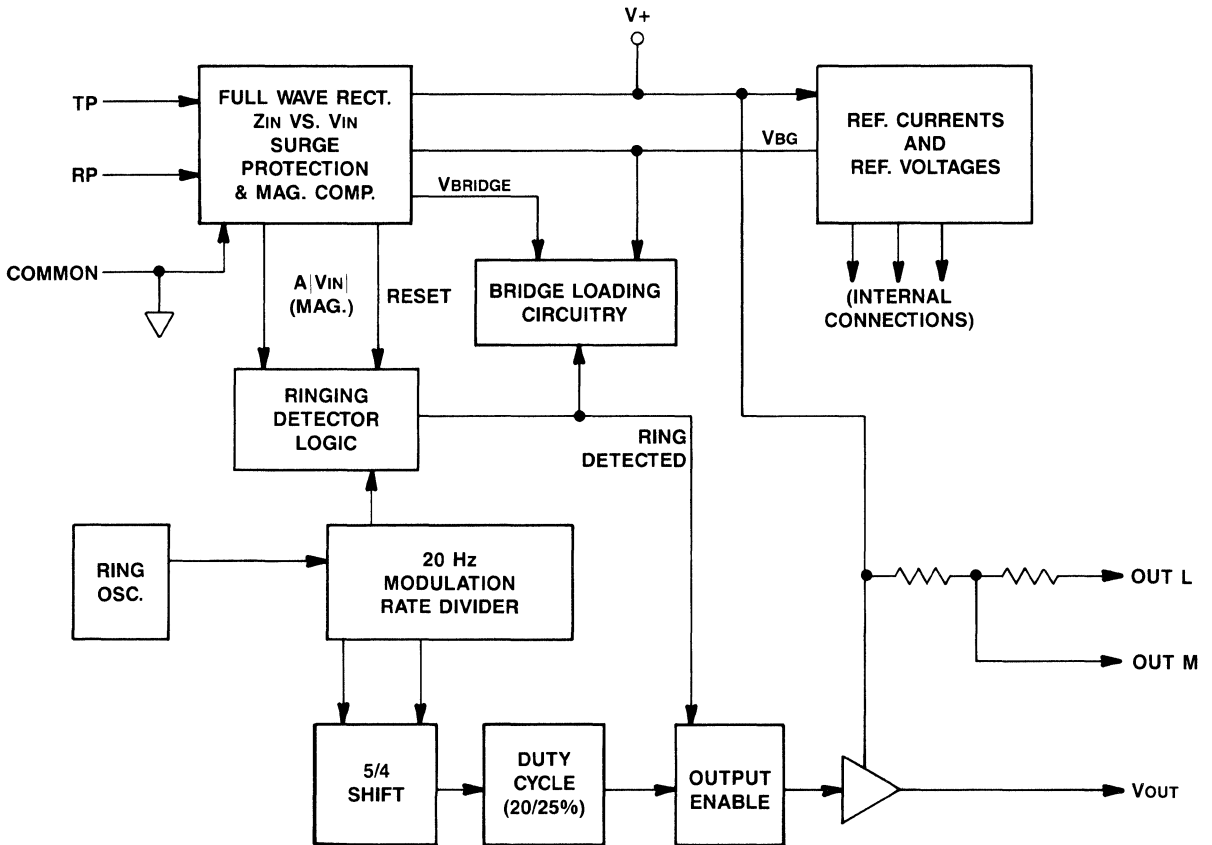
### **Features**

- Provides an inexpensive and more compact alerter than an electromechanical bell
- Tight output frequency control ( $\pm 3\%$ ) for maximum acoustic output
- External components required are two capacitors, one resistor, and an alerter
- Meets both Type A and B ringing requirements ( $40 \text{ V}_{\text{RMS}} \leq V_{\text{IN}} \leq 150 \text{ V}_{\text{RMS}}$ ,  $15 \text{ Hz} \leq f_{\text{IN}} \leq 68 \text{ Hz}$ ) as specified by EIA RS-470 on FCC Part 68
- Immune to rotary dial pulsing (bell tap)
- Meets input impedance criteria specified by EIA RS-470 and AT&T Technical Publication 47001
- Polarity guard and 2000 V lightning surge protection provided
- On-chip volume control resistors provided
- Provides essentially no loading under non-ringing conditions

# Analog ICs

## Telephony Devices

### LB1005-Type General-Purpose Tone Ringer Functional Diagram



# Ringing Detector — LB1006AB

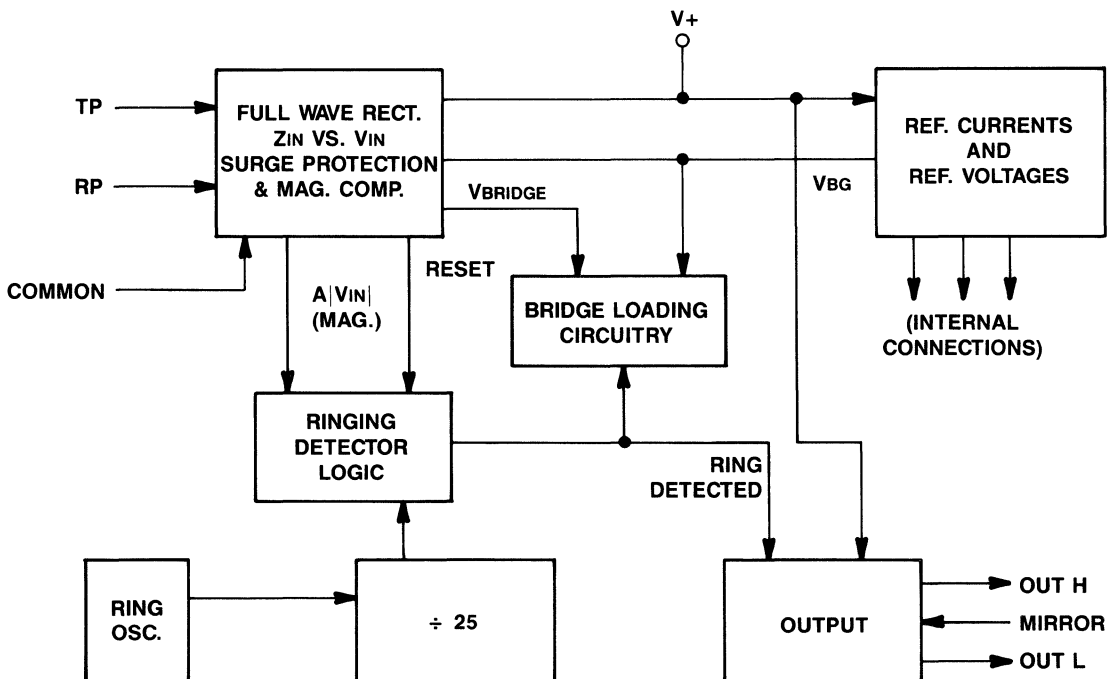
## Description

The LB1006AB Ringing Detector provides ringing detection functions from the Tip-Ring pair of a telephone loop. This device provides a nominal output current (up to approximately 1 mA) for two types of output drives. The output can be connected to either an opto-isolator device or to a logic interface with a microprocessor.

## Features

- Provides an inexpensive means of ringing detection
- Operates on less than 1.0 mA from the telephone loop
- Internal polarity guard and 2000 V lightning surge protection
- Immune to rotary dial pulsing (bell tap)
- Meets both Type A and B ringing requirements ( $40 V_{RMS} \leq V_{IN} \leq 150 V_{RMS}$ ,  $15 \text{ Hz} \leq f_{IN} \leq 68 \text{ Hz}$ ) as specified by EIA RS-470 and FCC Part 68
- Ringer equivalency: 0.8 B

## Functional Diagram



# Keypad-Controlled, Touch-Tone Single-Chip Telephone Integrated Circuit — LB1008AE

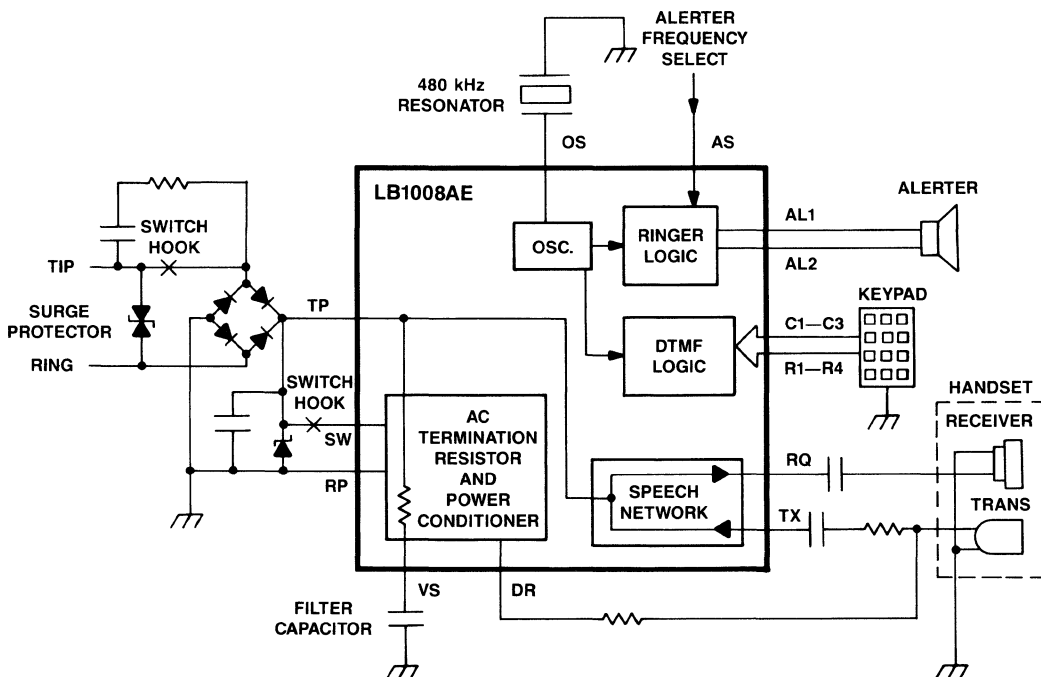
## Description

The LB1008AE integrated circuit requires only a few external components to provide all of the touch-tone electronic functions. This integrated circuit furnishes ac and dc loop termination for both switchhook states, transmits and receives voice signals to and from the Central Office, provides dual-tone multi-frequency (DTMF) signals to the Central Office, and properly distinguishes between spurious noise and genuine ringing signals, providing a distinctive audible alerter output.

## Features

- An alerter select function of 1200/1500 Hz or 1800/2250 Hz
- Capable of speech transmission down to 3.0 mA loop current
- Compatible with electret and carbon microphones
- Signal ground pin eliminates external capacitor for dial-in-handset designs
- 700  $\Omega$  line-matching impedance, 600  $\Omega$  receiver impedance
- Provides a power port for driving an LED

## Functional Diagram (4-Wire Handset Interface)



Advanced information — Sample devices are not necessarily available at this time.

**(Refer to Section 19 for typical applications of this product.)**



## Analog ICs Telephony Devices

# Microprocessor Controlled, Single-Chip Telephone Integrated Circuit — LB1009AE

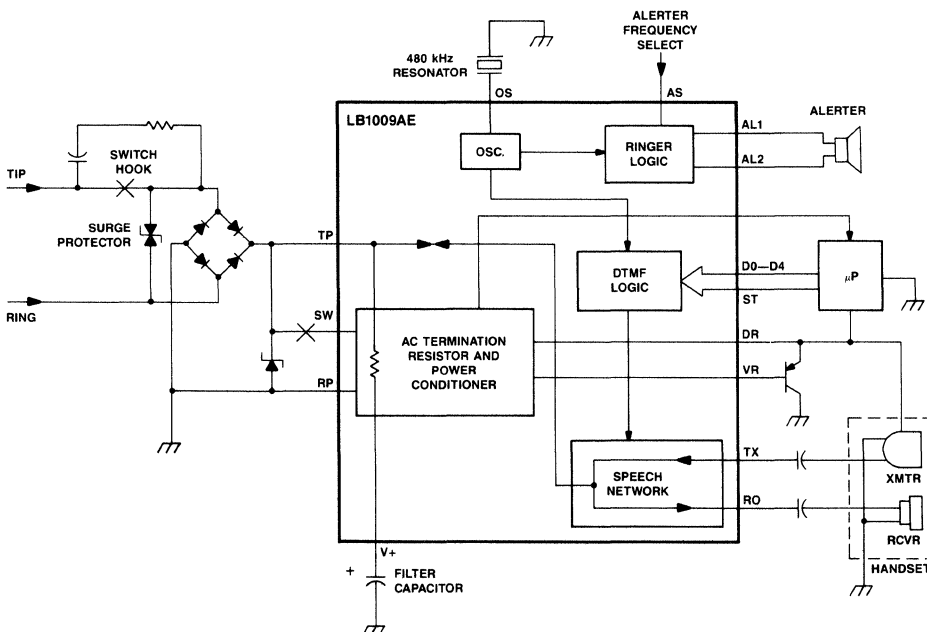
### Description

The LB1009AE single-chip touch-tone telephone integrated circuit interfaces with a 4-bit microprocessor for applications requiring enhanced features such as repertory dialing. Four basic telephone functions are integrated on-chip: furnishes ac and dc loop termination for both switchhook states; transmits and receives voice signals within performance guidelines (including transducer variations); provides dual-tone multifrequency (DTMF) signals to the Central Office; properly distinguishes between spurious noise and genuine ringing signals, providing a distinctive audible alerter output.

### Features

- Signal Ground pin eliminates an external capacitor for dial-in-handset designs
- Requires only a 2-contact switchhook
- Capable of speech transmission down to 3 mA loop current
- Operates from power supplied by the Central Office
- Alerter select options: 1200/1500 Hz, 1800/2250 Hz
- Compatible with electret microphones
- Provides a power port for driving an LED or microprocessor

### Functional Diagram



# Telephone Interface Circuit — LH1028BB

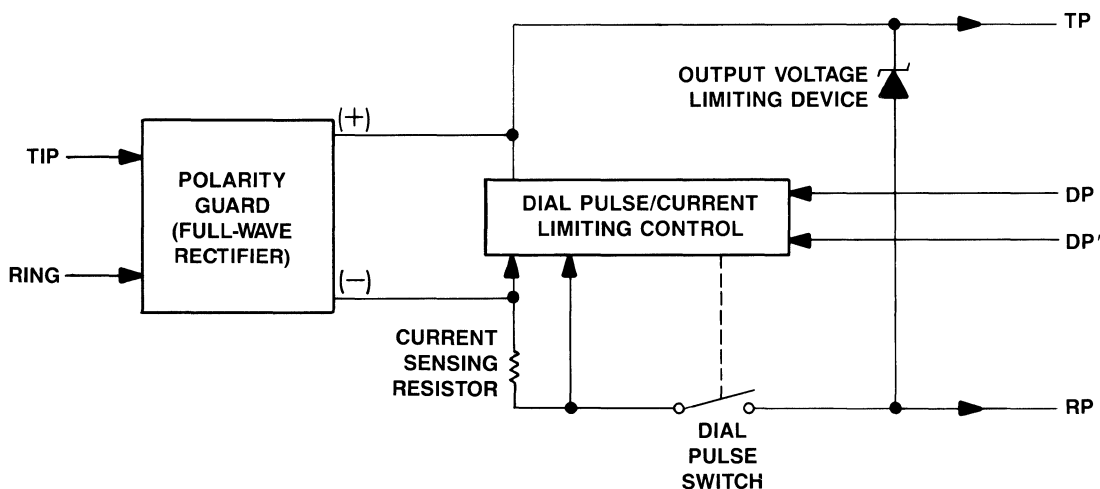
## Description

The LH1028BB Telephone Interface Circuit (TIC) is a product fabrication of monolithic high-voltage DMOS technology and dielectric isolation. This integrated circuit performs the following basic functions: high-voltage dial pulse switching, protection against reversal of Tip-Ring polarity from the Central Office, and over-voltage/overcurrent protection of telephone circuits.

## Features

- Withstands telephone loop voltages to 155 V
- Operates at low Tip-Ring voltages (typically as low as 2.7 V)
- Minimal internal voltage drop across polarity guard
- Monolithic solid-state construction allows for greater reliability and physical area conservation

## Functional Diagram



# **Universal Voice-Signal Conditioner — LB1068AW**

---

## **Description**

The LB1068AW silicon integrated circuit is intended for use as a conditioner of voice signals in telephone handset and speech applications. The device provides the following five functions:

1. High PSRR electret microphone biasing — low noise output in the presence of power-supply modulation.
2. Microphone preamplification with adjustable gain—provides flexibility for different microphone and acoustic applications.
3. Gain expansion of the microphone signal — reduces the effects of background noise during periods when the talker is silent.
4. Adjustable gain receiver amplification with a choice of 300  $\Omega$  or 600  $\Omega$  output impedance; active receiver driver for noisy environments or hearing-impaired applications.
5. Receiver clamping — limits high transient signals from overdriving the receiver.

## **Features**

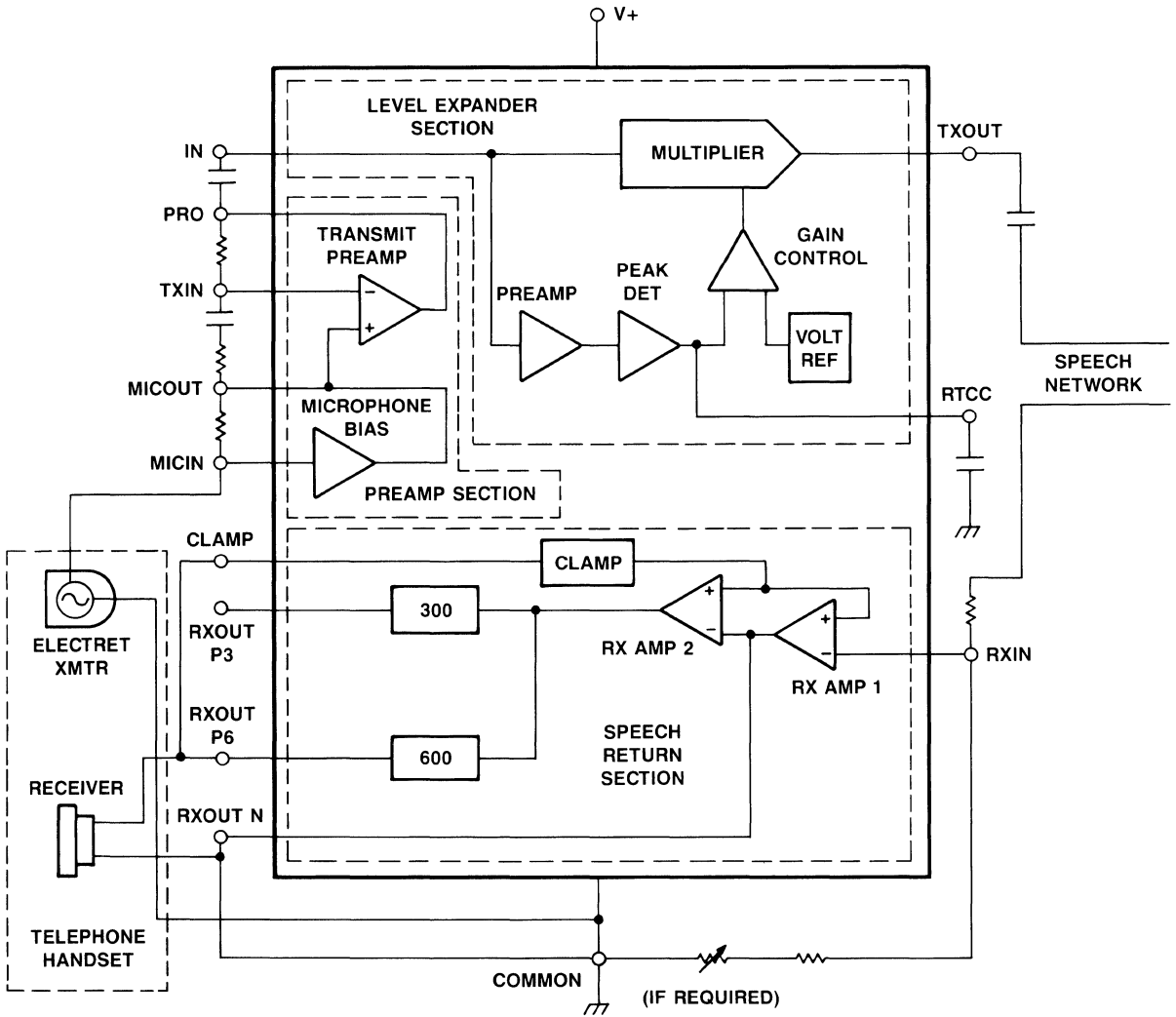
- Supply-voltage range from 2.6 to 10 V (suitable for line-powered applications)
- High PSRR electret microphone biasing (typically >50 dB)
- User-selectable microphone and receiver gain
- Usable with other types of microphones (ceramic, dynamic, etc.)
- Internally supplied signal ground
- Built-in receiver equalizing resistors for 300  $\Omega$  or 600  $\Omega$  applications

*This information is preliminary and subject to change.*

**(Refer to Section 19 for typical applications of this product.)**

# Analog ICs Telephony Devices

**LB1068AW Universal  
Voice-Signal Con-  
ditioner Functional  
Diagram**



# Voice Frequency Level Expander — LB1026AB

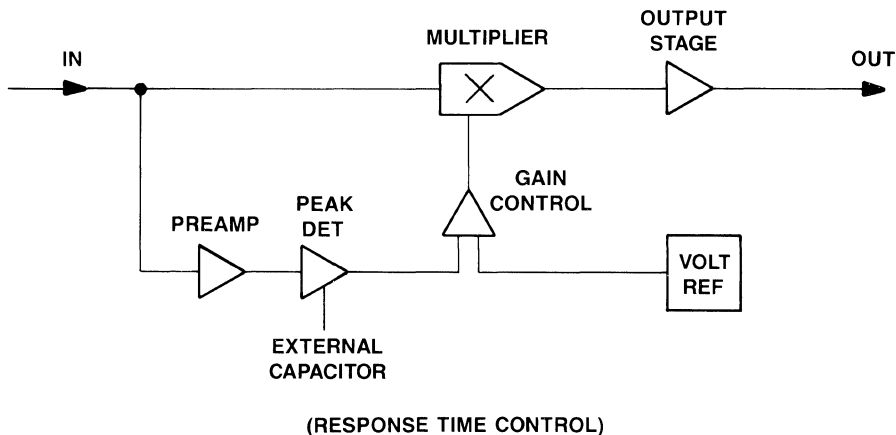
## Description

The LB1026AB integrated circuit is a voice frequency level expander used to condition amplified signals from electret-type microphones. A characteristic of the device is to attenuate low-level signals that typically originate from background noise, and to pass normal amplitude speech signals at unity gain. The end result of using the device is that the quality of conversation is enhanced for both the speaker, by way of receiver sidetones, and the listener, by reducing background sounds that might be heard during the speaker's silence. The device is particularly suited for office telephone applications where the suppression of undesirable background noise during lulls in conversation is desired. A 1.0  $\mu\text{F}$  response-time control capacitor must be provided by the user if the specified attack and decay times are to be obtained.

## Features

- Reduces transmitted background noise during pauses in conversation
- Provides unity-gain transmission of normal amplitude voice signals
- Operates from 2- to 15-volt power supply
- Available in water form (LB1026AA) and 8-pin plastic DIP (LB1026AB)

## Functional Diagram



# Loop Termination Switch with Surge Protection — LB1060AB

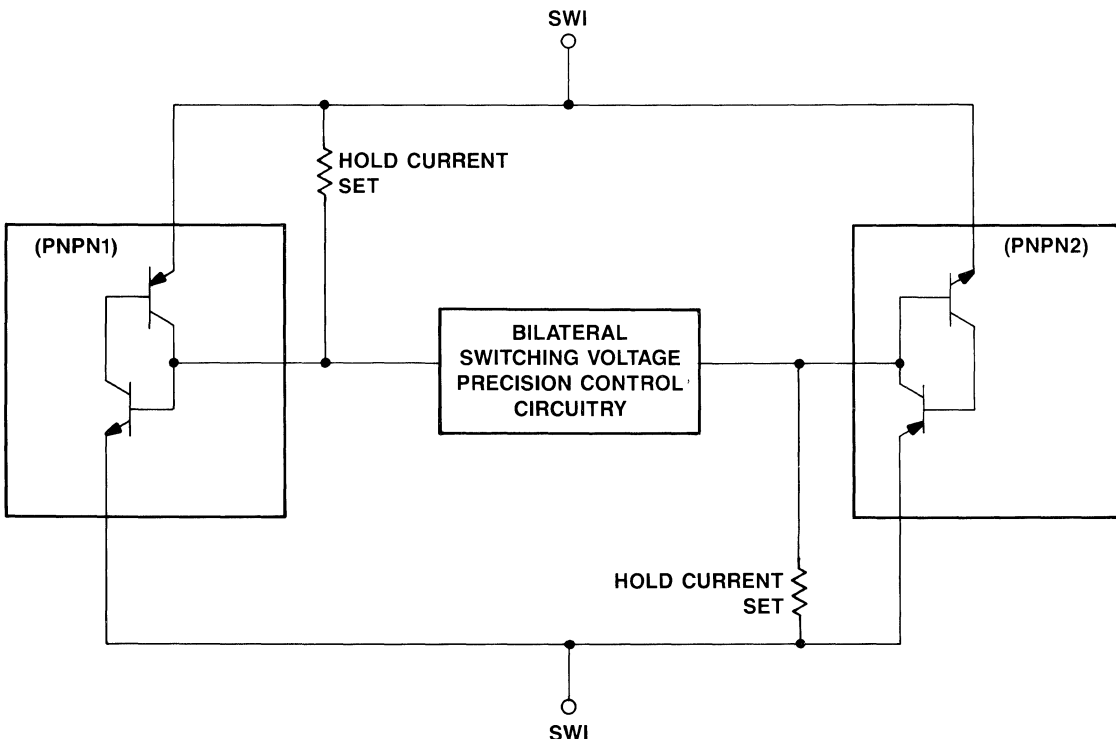
## Description

The LB1060AB Dual Bilateral Switch is an application specific integrated circuit. It consists of two (dual) isolated, polarity-insensitive (bilateral) voltage/current controlled switches. Each independent switch has only two terminals. A switch will normally be open until the voltage across these two terminals rises to a nominal 17.3 volts, at which point it will close (customers desiring a different activating voltage should inquire about factory trimmed options). The switch will remain closed until the current flowing through the switch drops to a nominal 30 mA. Each switch has PNP protector devices to guard against lightning surges.

## Features

- Survives  $\pm 10$  A lightning surges
- Some PNP protector devices will become a permanent short circuit when subjected to lightning surge currents between  $\pm 10$  A and  $\pm 30$  A (some devices may survive)
- Temperature coefficient of switching voltage is typically  $\pm 0.5$  mV/°C

## Functional Diagram





## Application Specific Integrated Circuits (ASICs)

---

As one of the largest CMOS standard cell suppliers, AT&T has an ASIC design capability which provides the performance, complexity, and flexibility of full custom circuits, while achieving a rapid development cycle approaching that of gate arrays.

We offer a wide range of capabilities: from simple standard library cells, to synthesized combinations of cells, to automatically compiled macroblocks. All of these capabilities are compatible with each other and are supported by the same CAD tools and production facilities.

**For additional information contact your nearest sales office or call:**

**1-800-372-2447.**

### **ASIC Standard Cells**

**Page**

**3-2**



## Application Specific ICs

# ASIC Standard Cells

---

### Standard Cell Custom Circuits

Our current VLSI technology offerings include 1.25  $\mu\text{m}$  single- and double-level metal CMOS Standard Cell Libraries. To exploit the VLSI capabilities of custom circuits, AT&T has developed a comprehensive computer-based standard cell custom design system that offers the benefits of full-custom circuits at significantly reduced development time and cost. This system has enabled us to achieve exceptionally high first-model success rates.

If you are a system or IC design house representative, consider the complete range of services available to you from AT&T.

- State-of-the-art CMOS technology
- Extensive standard cell libraries
- Industry-leading CAD tools that carry your design ideas from schematic capture to layout
- Regional design centers, staffed with experienced AT&T engineers and equipped with the latest hardware
- Complete photomask and wafer production capabilities in our own manufacturing plants
- Fast turnaround of fully assembled and tested chips in both model and production quantities

From concept to the final review, our design cycle offers a variety of entry points. The typical transfer of responsibility to AT&T is the prelayout review. But the choice of where we take over the job is up to you.

Several reviews during the design cycle help assure you of first-time success by identifying and correcting potential problems.

You can use AT&T's powerful CAD system and do the entire design at an AT&T design center. Or, if you prefer to work at your own site, AT&T can help. Our standard cell library is supported on commercially available CAD systems. You can also use AT&T CAD tools through a licensing agreement or through a dial-up link to an AT&T design center.

To help ensure the manufacturability of all of your designs, we process your initial prototypes on the same fabrication line that will supply your production requirements.

Our high-volume CMOS processes utilize twin-tub epitaxial structures, which enables us to optimize both NMOS and PMOS transistor characteristics for superior circuit performance.

The use of the epitaxial layer, together with refined layout techniques, eliminates latchup problems. We also incorporate advanced electrostatic discharge (ESD) protection circuitry that exceeds industry standards for class II ESD protection.

## **Application Specific ICs ASIC Standard Cells**

### **Extensive Standard Cell Libraries**

AT&T's standard cells are predesigned and precharacterized logic elements that let you design complex VLSI circuits without expertise in IC design. Each library provides an extensive choice of logic functions as well as speed or area-optimized cells to accommodate a wide range of requirements. Each library includes

- combinational cells
- sequential elements
- linear functions
- input/output buffers and level shifters

### **Functional Design System**

Complex circuits are made up of more than just simple logic elements. The capability to easily create complex functions out of simple library logic elements is essential to the fast development of any design. AT&T's Functional Design System (FDS) meets this need. Following simple interactive procedures, a customer can quickly create optimized complex functions from simple functional specifications. The functionally synthesized elements available include:

- Adders
- Counters
- Comparators
- Decoders
- Multipliers
- Parity generators
- Universal registers
- Combinational blocks
- State machines

### **Parameterized Macroblock Compilers**

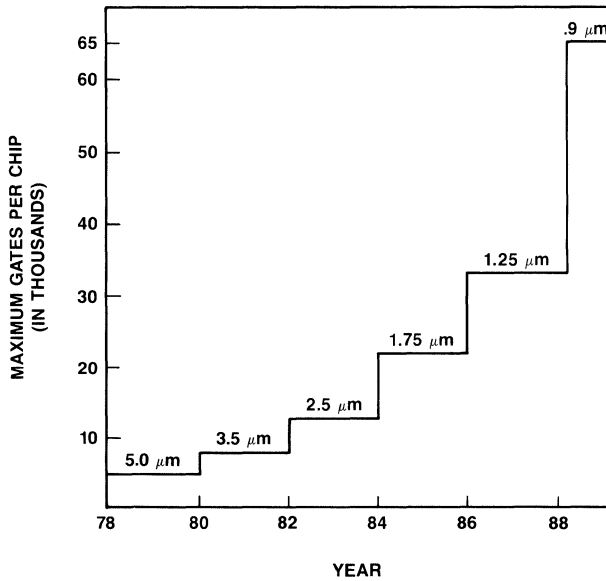
Just as the need for complex functional synthesis is achieved by our Functional Design System, our Parameterized Macroblock Compilers can create special custom blocks to solve your needs. Using these compilers, memory and other special blocks are automatically synthesized from a library of primitives. This way you get exactly the capability and configuration you need. And, you also get full CAD support, including automatic simulation modeling and layout generation. This gives you the advantage of fast development with accuracy and performance on minimum silicon area.

The Parameterized Macroblock Compilers include:

- RAM (up to 32 kbit static)
- ROM (up to 32 kbit)
- Shift Register (limited only by chip size constraints)
- PLA (up to 200 product terms)

## Application Specific ICs ASIC Standard Cells

### AT&T CMOS Technology Complexity Progression



### CMOS Speed Performance

Gate	Average Gate Delay (ns)	
	1.75 μm (1.3 μL')	1.25 μm (1.0 μL')
inverter	1.0	0.8
2-input NAND	1.4	1.0
f-f setup	2.5	0.7
f-f clk to out	4.5	1.6
input buffer	1.5	1.0
output buffer (50 pF load)	5.9	3.5

(Nominal process, 5 V power supply, 25°C, fanout = 3, 2.5 mm wire.)

### AT&T Future CMOS Technologies

Process	Routine Design Starts
Double Metal Layer 0.9 μm Average Feature Size 0.75 μm Effective Channel Length	4Q 1988

# Application Specific ICs

## ASIC Standard Cells

### 1.25 $\mu\text{m}$ CMOS Characteristics

- Input Protection:
  - Latchup  $>1$  A
  - ESD  $>2.5$  kV (HBM)
- Polysilicide Resistance:  $2.5 \Omega/\square$
- Effective Channel Length:  $1.0 \mu\text{m}$
- Speed Performance (SLM):  $t_{PLH} = t_{PHL} = 0.7$  ns  
(typical process parameters: 2-input NAND, fanout = 2.2 mm metal track,  $V_{DD} = 5$  V,  $T = 25^\circ\text{C}$ )

### 1.75 and 1.25 $\mu\text{m}$ CMOS Standard Cell Libraries

Total of over 400 different functions available.

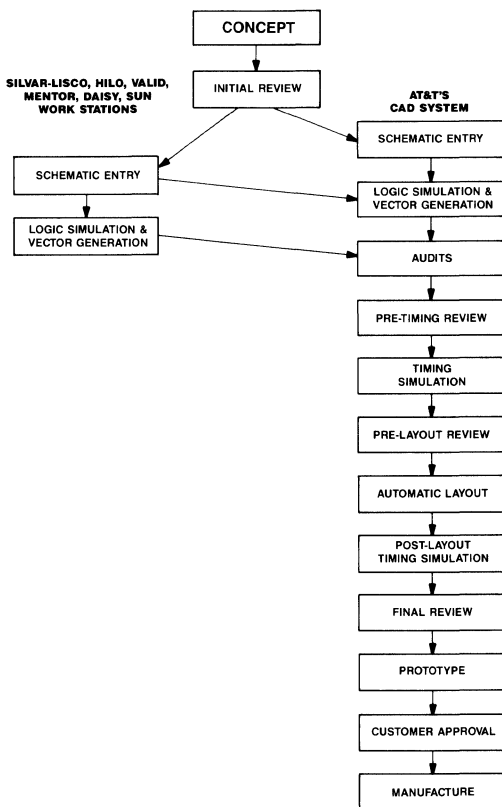
1. Logic Functions:
  - Logic Cells
  - Latches/Flip-Flops
2. I/O Functions:
  - I/O Drivers
  - I/O Buffers
3. MSI/LSI Digital Functions:
  - Arithmetic Logic Units
  - 4-Phase Clock Generator
  - Divide-by Counters
  - 4-Bit Fast Adder
  - 4-Bit Look-ahead Carry Generator
  - Microprocessor Interface
  - Majority Vote
  - Programmable Counter/Timers
  - Fast-Locking Data-Rate PLL
4. Complex Macrocells:
  - Functional Block Compilers
    - Adder
    - Comparator
    - Counter
    - Decoder
    - Multiplexer
    - Parity Generator
    - Universal Register
    - Combinational Block
    - Finite State Machine
  - Parameterized Macroblock Compilers
    - ROM
    - RAM
    - PLA
    - Shift Register
5. Selected Analog Functions:
  - Oscillators
  - Power-up Reset
  - Resistors and Capacitors
  - Transmitter/Receiver Interfaces

## Application Specific ICs ASIC Standard Cells

### CAD System

- SCHEMA — allows schematic entry and automated netlist generation
- FDS — synthesizes complex functions from standard cells
- SCOAP — estimates the testability of digital circuits
- MOTIS — provides logic, timing, and fault analysis for complete chip design
- MISL — generates test vectors from high-level language
- Design Audits — detect certain design flaws, such as: races, glitches, asynchronous loops, etc.
- Synchronous Delay Audits — analyze speed performance of individual circuit paths
- ADVICE — circuit simulator, provides transistor-level simulations
- LTX2 — produces optimum chip layout with respect to chip size and performance
- HCAP — extracts layout connectivity and node capacitances
- GRED — allows interactive layout editing
- LARC — provides layout design rule checking
- Vector Audits — detect potential hazards in test vectors
- TPG2 — program for automatic test program generation

### Design Cycle



## Capacitors

---

AT&T's metallized film capacitor line includes axial, radial, and 2-pin DIP configurations. These capacitors are highly reliable due to their self-healing property. The benign failure mode, characteristic of metallized film capacitors (they fail open rather than short), makes them suitable for a broad range of electronic system applications.

Our 2-pin DIP capacitor is epoxy-molded and machine-insertable. It is particularly well-suited for bypass applications where high component packing densities are required.

**For additional information contact your nearest sales office or call:**

**1-800-372-2447.**

### **Miniature Metallized Film Capacitors**

**Page**

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### **Standard Metallized Film Capacitors**

**4-3**

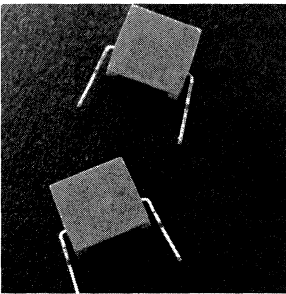
### **Other Products**

**4-4**

## Capacitors

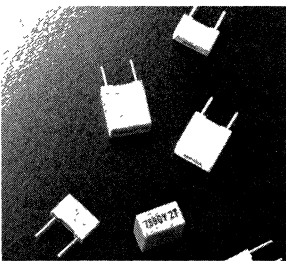
# Miniature Metallized Film

Our smallest size capacitors utilize micro-thin metallized polyester films for a higher capacitance per volume ratio. These capacitors are self-healing, resulting in high reliability, and are specially sealed for added moisture resistance. Mini-box and mini-tubular type configurations are designed to operate from  $-40$  to  $+85^{\circ}\text{C}$  without derating. The 2-pin DIP type configuration is designed to operate from  $-40$  to  $+100^{\circ}\text{C}$  without derating. Capacitors with rated voltages of 50, 100, or 200 Vdc are available, depending on capacitor size and value. They are machine-insertable and well-suited for general-purpose applications. These miniature capacitors are also designed for soldering methods employing water-soluble flux.



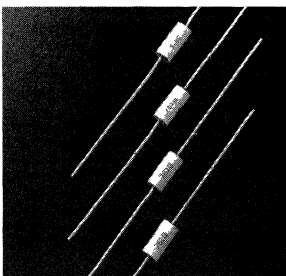
### 2-Pin DIP Type

- Capacitance range: 0.01 to 0.12  $\mu\text{F}$
- Encased in flame-retardant epoxy molding compound
- Full hard Olin 194 brass, solder-plated leads
- Ideal for PC board bypass applications (fails open — not short)
- Designed for long-term reliability, even in hostile (elevated temperature and high humidity) environments
- Packed in plastic tubes for automatic insertion



### Mini-Box Type

- Capacitance range: 0.01 to 2.2  $\mu\text{F}$
- Encapsulated in flame-retardant rectangular insulated case and sealed with flame-retardant epoxy
- Radial solder-coated wire leads
- Supplied in standard lead spacings
- Volumetrically efficient unit requiring minimum PC board real estate
- Available on reels or in plastic tubes for automatic insertion



### Mini-Tubular Type

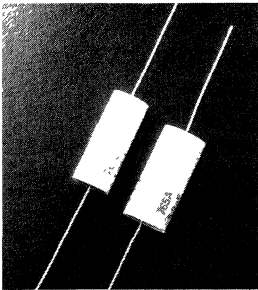
- Capacitance range: 0.0022 to 1.2  $\mu\text{F}$
- Flame-retardant tape encapsulation and epoxy-filled ends
- Axial solder-coated wire leads
- Cost-effective mini-axial design
- Available on reels for automatic insertion
- Polypropylene film version available

## Capacitors

### Standard Metallized Film

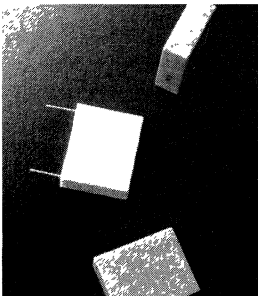
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Our standard size family of metallized polyester film capacitors is available in a wide range of sizes and values. These capacitors are designed to operate at temperatures ranging from  $-40$  to  $+85^{\circ}\text{C}$  and can be used with water-soluble flux. They have superior moisture resistance. Their self-healing property and stable electrical characteristics make them an excellent choice for general-purpose applications, such as coupling, bypassing, filtering, timing, and noise suppression.



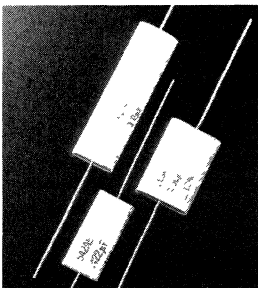
#### Tubular Type

- Capacitance range: 0.020 to 5.1  $\mu\text{F}$
- Rated voltages: 80, 100, 150, and 200 Vdc
- High volumetric efficiency
- Flame-retardant tape encapsulation and epoxy-filled ends
- Axial solder-coated wire leads
- Available on reels for automatic insertion



#### Box Type

- Capacitance range: 0.147 to 2.2  $\mu\text{F}$
- Rated voltages: 100 and 250 Vdc
- High volumetric efficiency
- Encapsulated in flame-retardant rectangular insulated case and sealed with flame-retardant epoxy
- Radial solder-coated wire leads
- Available in plastic tubes for automatic insertion



#### Flat Type

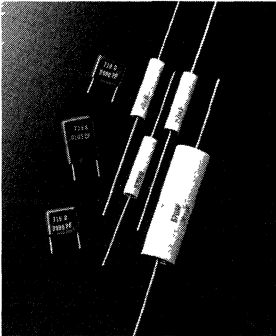
- Capacitance range: 0.004 to 10.0  $\mu\text{F}$
- Rated voltages: 100, 150, 200, 250, 300, 350, and 500 Vdc; 220 Vac
- Flat oval form saves PC board space
- Flame-retardant tape encapsulation and epoxy-filled ends
- Axial solder-coated wire leads
- Tolerances down to  $\pm 1\%$  available



## Capacitors

### Other Products

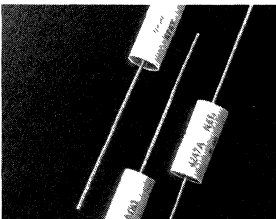
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#### Film-Foil Type

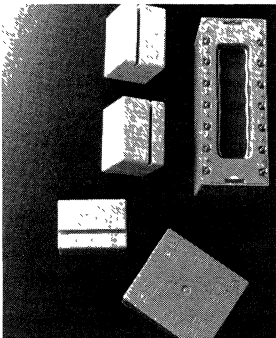
AT&T Film-Foil capacitors use polystyrene, polypropylene, or polyester film as a dielectric and tin/lead metal foil as an electrode. They operate in a temperature range of  $-40$  to  $+85^{\circ}\text{C}$ . All of these capacitors are encapsulated with flame-retardant tape and epoxy-filled ends. Both polystyrene and polypropylene capacitors are preferred for applications requiring exceptional capacitance stability, low losses, or negative temperature-coefficient characteristics. Polystyrene capacitors are particularly well-suited for quick discharge applications and can withstand lightning surges of up to 850 volts.

- Polystyrene dielectric: 0.000301 to 0.768  $\mu\text{F}$ , 50, 100, 200 Vdc
- Polypropylene dielectric: 0.000301 to 0.787  $\mu\text{F}$ , 125 Vdc
- Polyester dielectric: 0.001 to 0.0196  $\mu\text{F}$ , 125 Vdc



#### Networks

Networks are unique laser-generated series capacitor-resistor elements of metalized film construction which offer self-healing properties. They are compact, space-saving components, specifically designed for contact protection applications. Two types ( $0.13 \mu\text{F}/470 \Omega$  and  $0.05 \mu\text{F}/75 \Omega$ ) are available, both with 350 V and  $10^9$  pulse rating. These axial-lead, flame-retardant, tape-wrapped, and epoxy end-filled networks can be supplied on reels for automatic insertion.



#### CAP-PAKs

CAP-PAKs are combinations of individual wound film capacitors, housed in a rugged, modular, radial-leaded, flame-retardant package. They can be tailored for almost any multi-capacitor requirement. The installation of a single CAP-PAK reduces assembly time and cost, especially when using higher volume units. In addition, insertion errors and inventory problems are minimized.

## Communication Integrated Circuits

Included in AT&T's comprehensive line of communication ICs are a complete line of ISDN basic-rate and primary-rate devices, DS1 interface solutions, encryption devices, data formatters, codecs, and clock recovery circuits.

Our digital loop controller circuits spearhead the industry's move to integrated services digital networks (ISDN), soon to be the backbone of digital communications, combining both voice and data signals.

The DS1 chip set performs the various multiplexing and framing functions required by the physical interface to a T1 facility.

**For additional information contact your nearest sales office or call:  
1-800-372-2447.**

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(Continued on next page)

\* Did not appear in the previous edition of the Product Selection Guide.

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\* Did not appear in the previous edition of the Product Selection Guide.

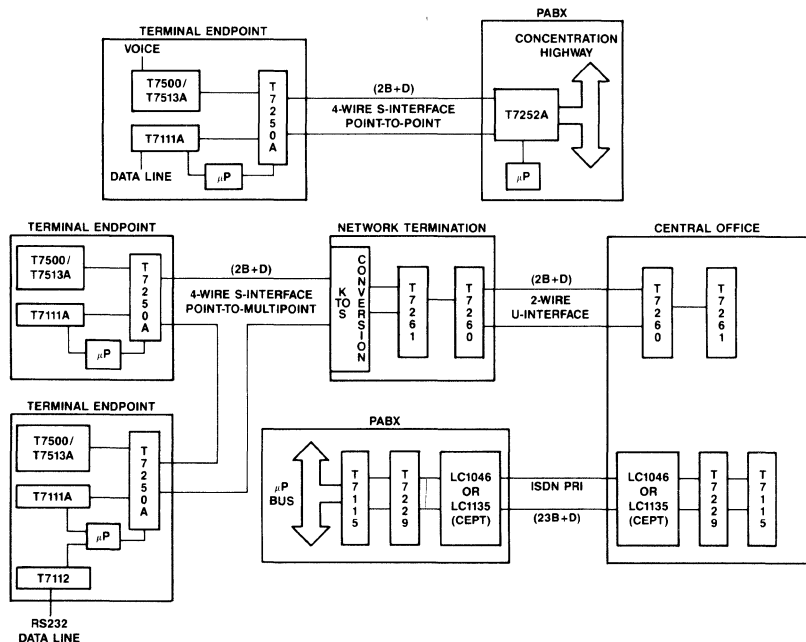
## ISDN — Integrated Services Digital Network

The major purpose of ISDN is the definition and worldwide agreement for both user-to-network and network-to-network interfaces. A user who has a system connected to an ISDN interface has access to network services through one interface structure. The ISDN network will provide all of these services at faster speeds and larger capacity while incorporating advanced digital switching and transmission systems that all speak the same language, regardless of manufacturer or location.

Two interfaces are defined to govern interactions between the network and customer equipment. The two CCITT-approved interfaces are called basic rate and primary rate. Both interfaces can provide data or voice service simultaneously and circuit-switched or packet-switched connections on the same transmission channel.

**Basic Rate Interface** consists of two 64 kb/s information channels (B channels) used for voice and data, and one 16 kb/s packet-switched data channel (D-channel) used for signaling and data. The B and D channels are full duplex bit streams. They are time-division multiplexed into a common stream containing both user information and signaling. The basic rate interface serves small end-systems such as voice/data workstations and terminal adapters for non-ISDN devices.

**Primary Rate Interface** consists of twenty-three 64 kb/s B-channels for voice and data plus one 64 kb/s D-channel for signaling. This interface is based on the DS1 transmission rate of 1.544 Mb/s. The signaling is performed on the D-channel, allowing the user a full 64 kb/s range on the B-channels. Typical applications are connecting a PBX or mainframe computer to an ISDN.



## **Four-Wire Interfaces**

# **User Network Interface for Terminal Equipment — T7250A**

---

### **Description**

The T7250A User Network Interface for Terminal Equipment circuit provides the line interface used for basic access service offered by the Integrated Services Digital Network (ISDN). The device conforms to all CCITT I.430 recommendations for point-to-point and point-to-multipoint configuration. Priority, contention resolution, multiframing, and activation/deactivation processes are fully supported. With a simple transformer circuit, I.430 impedance and voltage requirements can be met. An HDLC formatter and a sophisticated queue manager are provided to simplify the D channel interface.

This device is manufactured using CMOS technology, and is available in either a 40-pin plastic DIP or 44-pin plastic leaded chip carrier (PLCC). The 44-pin chip carrier provides additional 16/8 kHz and 6.144 MHz/192 kHz clocks that the 40-pin DIP does not have. The T7250A device uses a nominal 5 volt supply and has a maximum power consumption of 55 mW.

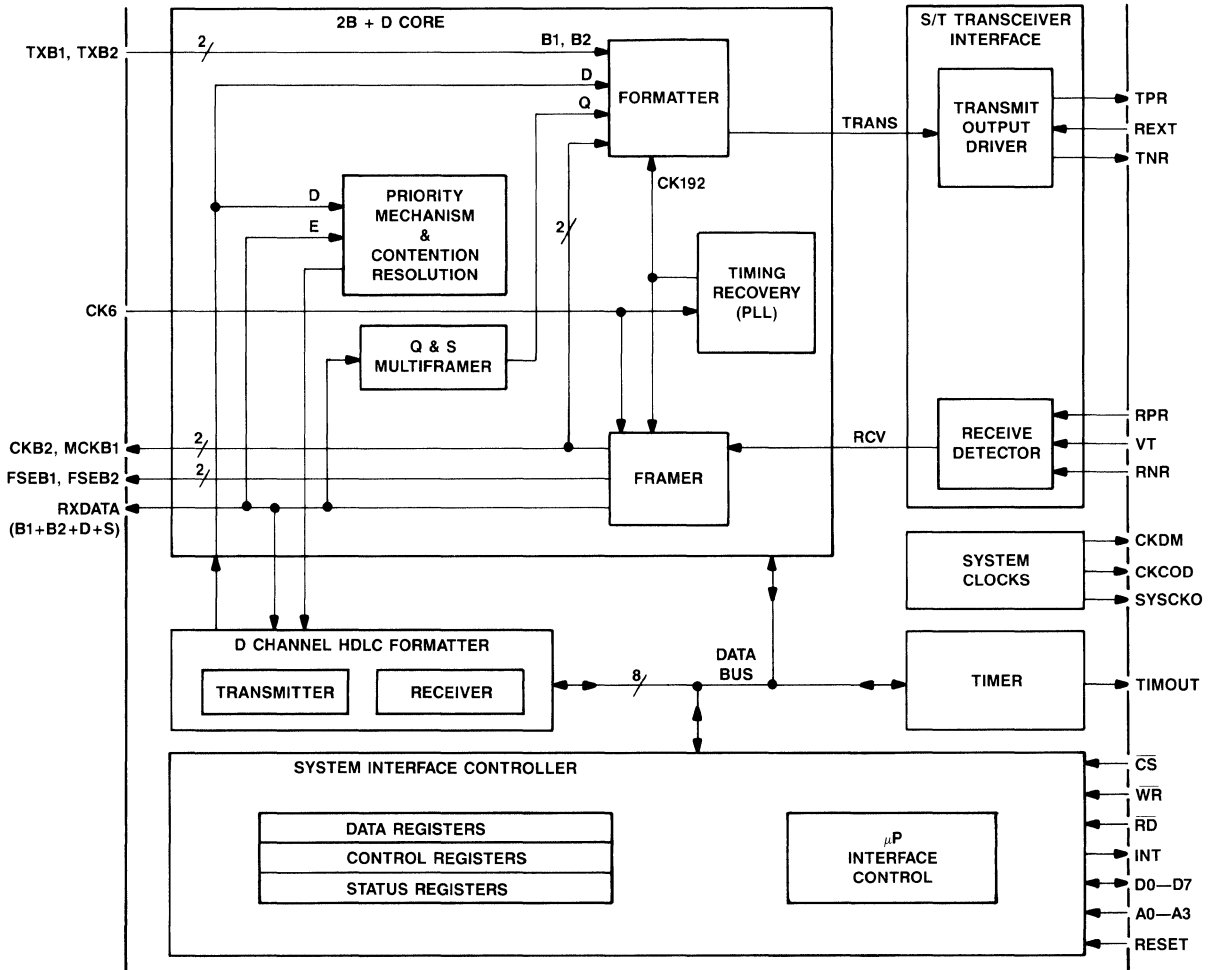
### **Features**

- Built-in HDLC formatter for the D channel
- Programmable synchronization signal for codecs
- Power-up reset with a programmable timer for system interface control
- Interchangeable B channels for voice or data
- 16 bytes of transmit and receive buffers for the D channel
- Local and remote loopback test modes
- Passive bus support

# Communication ICs

## UNITE ISDN Family of Basic-Rate Devices

### T7250A User Network Interface for Terminal Equipment Block Diagram



## **Communication ICs**

### **UNITE ISDN Family of Basic-Rate Devices**

# **Four-Wire Interfaces**

## **User Network Interface Termination for Switches (UNITS) — T7252A**

---

### **Description**

The T7252A User Network Interface Termination for Switches is a silicon integrated circuit that provides the user with level 1 network termination (NT) functions for ISDN. The T7252A UNITS provides full-duplex 2B+D communication at 192 kb/s over a four-wire digital subscriber loop. Channels B1 and B2 are 64 kb/s voice or data channels, and the D channel is a 16 kb/s control or data channel. All point-to-point and point-to-multipoint (passive bus) configurations are supported as defined in the 1986 version of CCITT Recommendation I.430 and the November, 1986 Draft US Specification. The T7252A UNITS communicates with a switching network over a user-configured time-division multiplexed highway. A generic microprocessor interface is also provided. The T7252A UNITS is manufactured in low-power 1.25 micron CMOS technology, and is available in either a 44-pin plastic leaded chip carrier or a 40-pin DIP. It operates on a 5 V power supply and has a maximum power consumption of less than 100 mW.

### **Features**

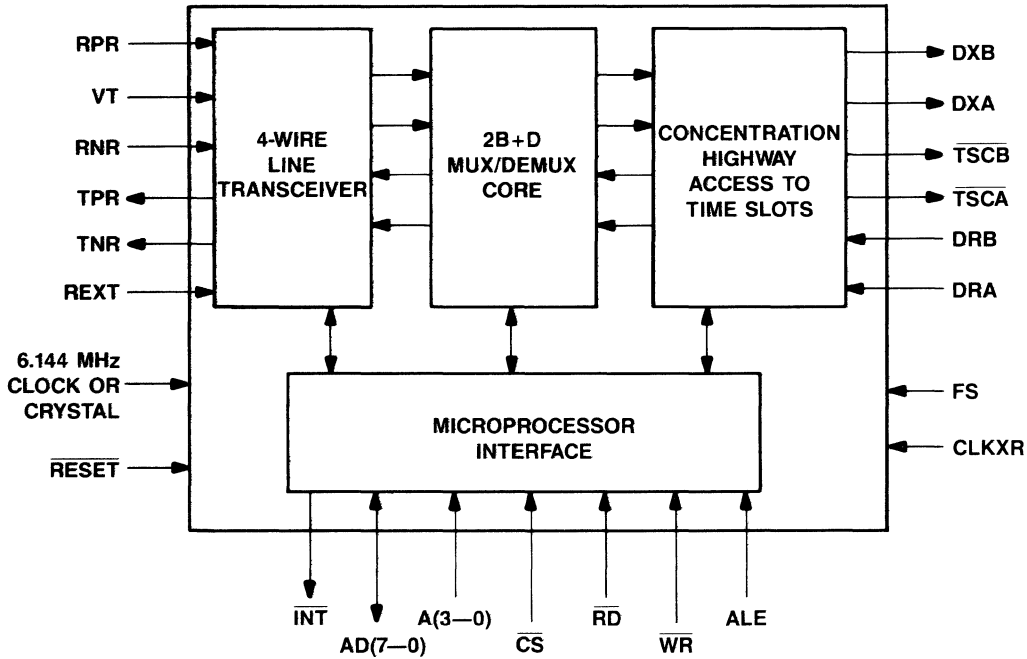
- Full-duplex 2B+D interface for point-to-point and point-to-multipoint (passive bus) configurations with automatic threshold adjustment
- B1, B2, and D channels separated from and combined into a 192 kb/s stream
- Two independent transmit/receive serial highways, with assignable time slots for voice/data transfer
- Generic parallel microprocessor interface, with either multiplexed or demultiplexed address/data lines and maskable interrupts
- Capability of direct microprocessor control of B1, B2, or D channel through the microprocessor interface
- Multiframe support, with access to the S (NT-to-TE) and Q (TE-to-NT) channels through microprocessor registers
- Provides I.430 interface for 2B+D applications in digital switches (PBXs, etc.)
- Selectable speeds on serial highway: 256 kHz (4 time slots) to 4.096 MHz (64 time slots)

*This information is preliminary and subject to change.*

# Communication ICs

## UNITE ISDN Family of Basic-Rate Devices

### T7252A UNITS Block Diagram





**Communication ICs**  
**UNITE ISDN Family of Basic-Rate Devices**

**Two-Wire Interface**  
**ISDN U-Interface Basic Access**  
**Transceiver Chip Set —**  
**T7260 and T7261**

---

**Description**

The AT&T T7260 and T7261 ISDN U-Interface Basic Access Transceiver (U-BAT) chip set is a pair of silicon integrated circuits providing full-duplex 2B+D communication on a 2-wire digital subscriber loop. The T7260 and T7261 devices perform line transceiver functions at either the Central Office switch or at the network termination and operate at a data transfer rate of 144 kb/s. Adaptive echo cancellation and equalization techniques provide a loss budget of 38 dB. The T7260 requires both a +5 V and -5 V supply; the T7261 requires only a 5 V supply. Both are manufactured in CMOS technology and are packaged in a 44-pin plastic leaded chip carrier (PLCC).

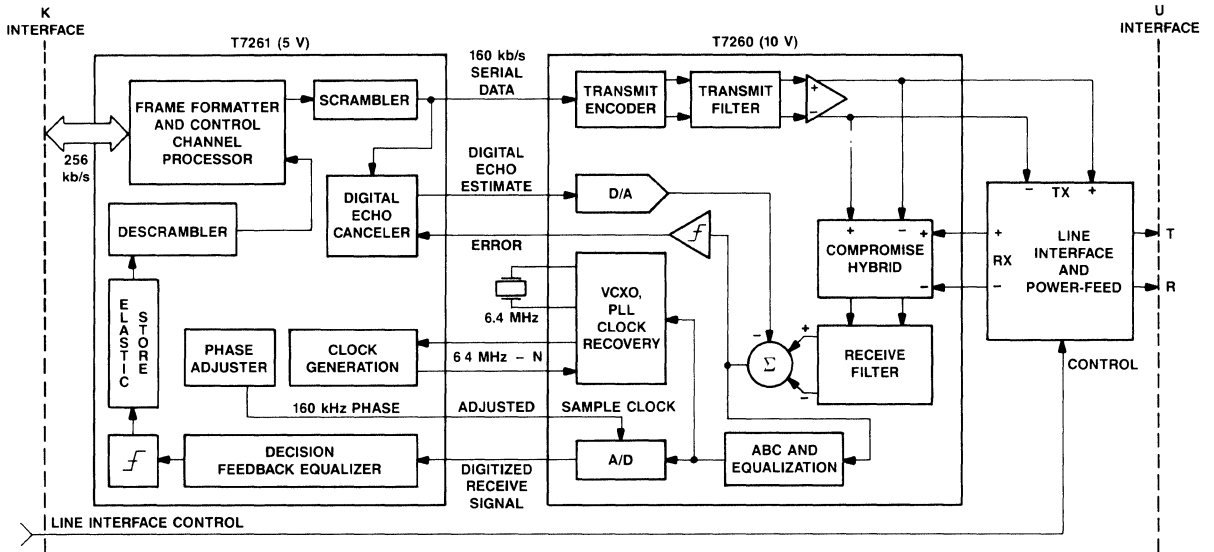
**Features**

- U-interface for 2-wire operation. Pin-selectable for Central Office switch and network termination applications
- 144 kb/s full duplex using echo cancellation (EC)
- Alternate mark inversion line code as used in AT&T 5ESS® Central Office Switch
- Digital I/O via the AT&T K-interface
- On-chip balanced line driver
- Balanced continuous time filters
- Adaptive equalization and automatic gain control
- Power-down option
- LED driver to signal loss of framing
- Decision feedback equalizer (DFE) for increased tolerance to bridged taps
- EC and DFE reset pins for external power-up reset
- Selectable on-chip or external VCXO

# Communication ICs

## UNITE ISDN Family of Basic-Rate Devices

### T7260 and T7261 Block Diagram



## **Synchronous Packet Data Formatter — T7111A**

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### **Description**

The T7111A Synchronous Packet Data Formatter (ANT) integrated circuit is used to interface physical link level lines using bit-synchronous HDLC/SDLC protocols to 8-bit microprocessor or microcontroller systems. All inputs and outputs of the T7111A ANT are TTL-compatible. It is implemented using CMOS technology and requires a single +5 V supply. The device is available in a 28-pin plastic DIP for standard through-hole mounting, or in a 28-pin plastic small-outline J-lead (SOJ) package for surface mounting.

### **Features**

#### **Host Interface**

- Compatible with 8088 and 80188 Microprocessor-Based Systems and 8051 Microcontroller
- Compatible with 8237 and 8257 DMA Controllers in extended write mode
- Programmable receive and transmit queue interrupts with variable fill levels
- Programmable receive and transmit DMA requests with variable fill levels

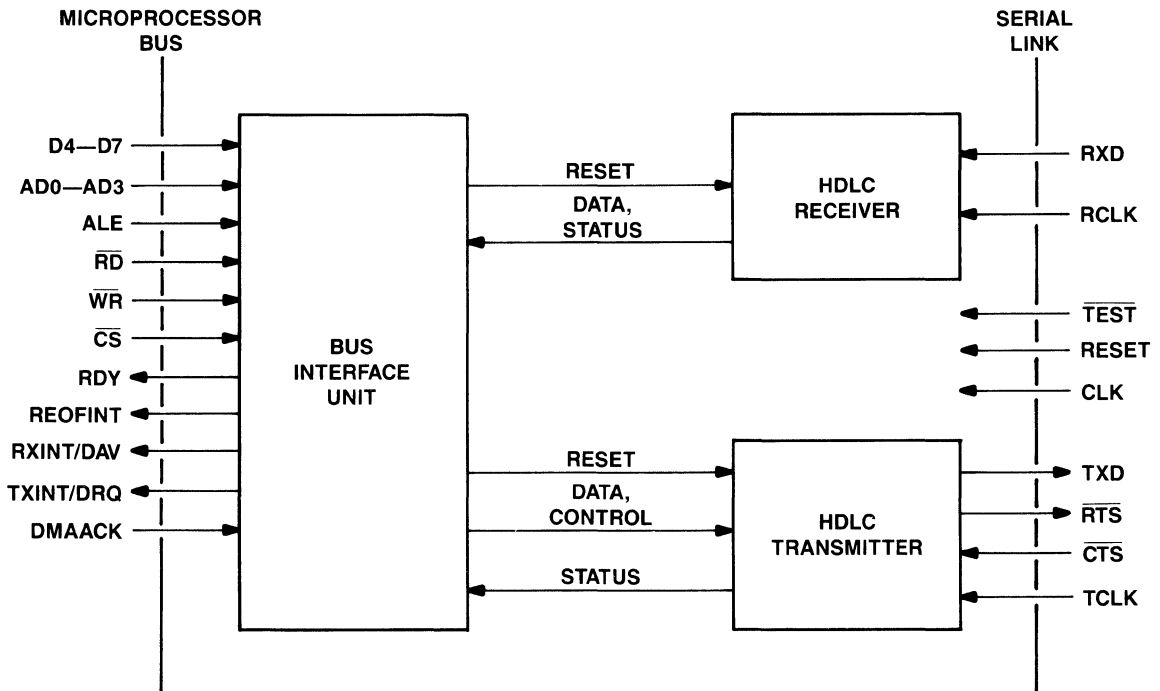
#### **Serial Link Interface**

- Separate receive and transmit clocks
- 4 Mb/s maximum data rate
- 6-byte receive queue and 4-byte transmit queue
- Automatic flag transmission and detection
- Zero bit insertion and deletion for data transparency
- CRC-CCITT 16-bit polynomial generation and check with inhibit option

# Communication ICs

## UNITE ISDN Family of Basic-Rate Devices

**T7111A ANT Block Diagram**



# **Asynchronous Receiver/ Transmitter Interface — T7112**

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## **Description**

The T7112 ARTI is an asynchronous, single-channel, full-duplex receiver/transmitter interface for terminals and modems. The ARTI is compatible with the bus protocol and timing specifications of both the 8051 Microcontroller and the 8088 Microprocessor. The device may be used in a polled or interrupt driven system. The transmitter has four buffers and the receiver has six buffers to reduce the interrupt overhead and the potential for overruns. The device is implemented in low-power, CMOS technology and is available in a 24-pin plastic DIP or 28-pin plastic SOJ surface-mount package.

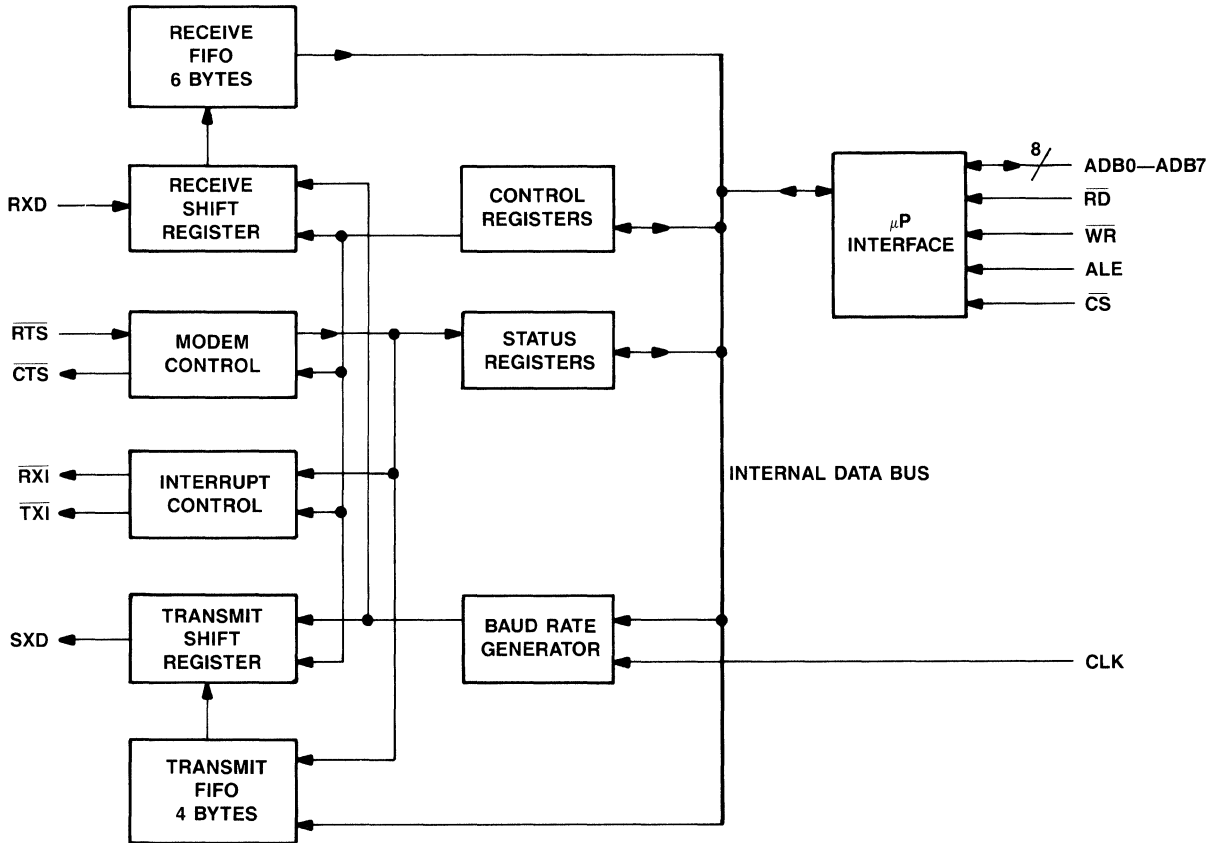
## **Features**

- Programmable data format:
  - Seven data bits plus parity
  - Odd, even, no parity
  - One or two stop bits
- 6-byte receive and 4-byte transmit data buffers
- 8088 (8 MHz) and 8051 (16 MHz) microprocessor interface without wait states
- Clear-to-send/request-to-send selectable signals for DTE or DCE modes and flow control
- Programmable interrupt systems:
  - Full level interrupt of receive FIFOs (first-in, first-out)
  - Receive break detection and error interrupt
  - Empty level of transmit FIFO and error interrupt
- Transmit/receive FIFO status bits indicate FIFO levels
- Flexible polling capabilities
- On-chip baud rate generator
- Speedmatching (autobaud capability)

# Communication ICs

## UNITE ISDN Family of Basic-Rate Devices

**T7112 ARTI Block Diagram**



# Communication ICs

## UNITE ISDN Family of Primary-Rate Devices

# DS1/DS1C Digital Signaling Interface — LC1046A

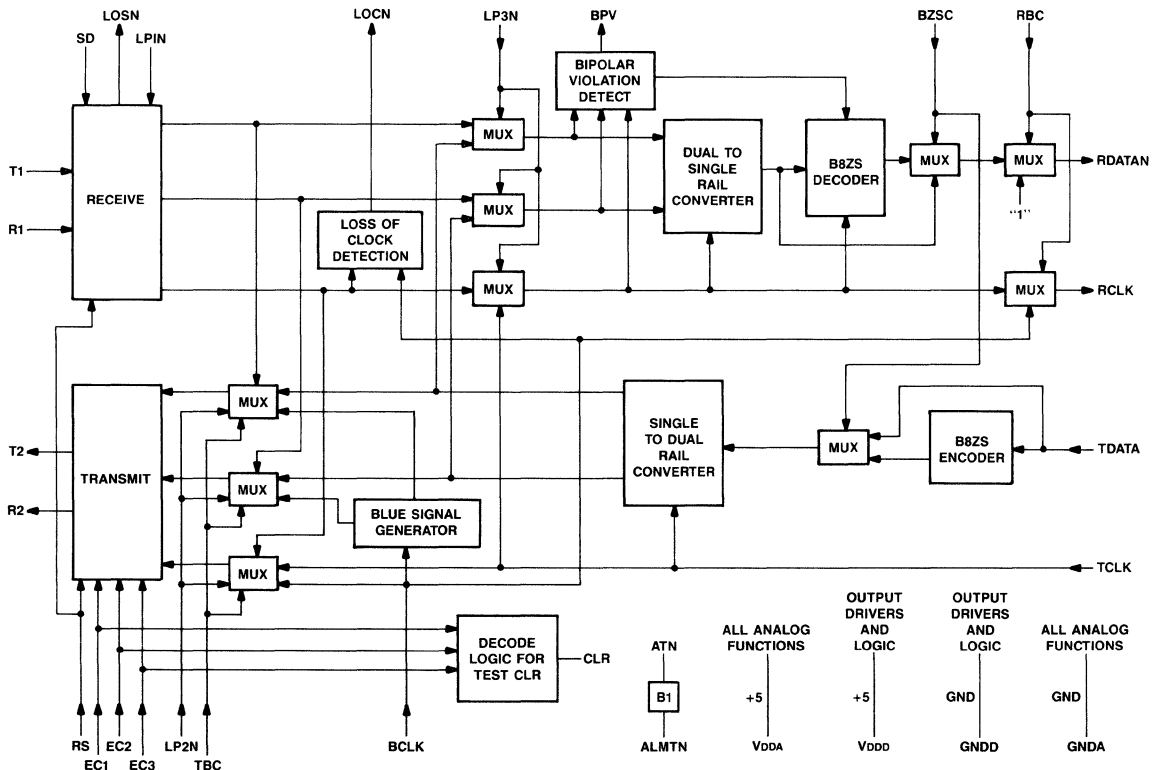
### Description

The LC1046A Digital Signaling Interface (DSI) is an integrated circuit that provides a line interface between the DS1 or DS1C cross-connect and terminal equipment circuits for cable distances of up to 655 feet for 22-gauge plastic insulated cable. The device performs receive pulse regeneration, timing recovery, and transmit pulse shaping and equalization functions. The LC1046A DSI device is manufactured using 1.75 micron CMOS technology and is available in a 28-pin plastic DIP or 28-pin plastic small-outline J-leaded (SOJ) package for surface mounting.

### Features

- Fully integrated DS1/DS1C line interface
- Compatible with Technical Advisory #34 (TA34) and PUB 43802 specifications
- On-chip transmit equalization
- Monolithic clock recovery
- Pin-selectable B8ZS encoder and decoder
- Loopback modes for fault isolation
- Multiple link-status and alarm features
- Minimal external circuitry required

### Block Diagram



# Communication ICs

## UNITE ISDN Family of Primary-Rate Devices

# DS1 Digital Signaling Interface — LC1046C

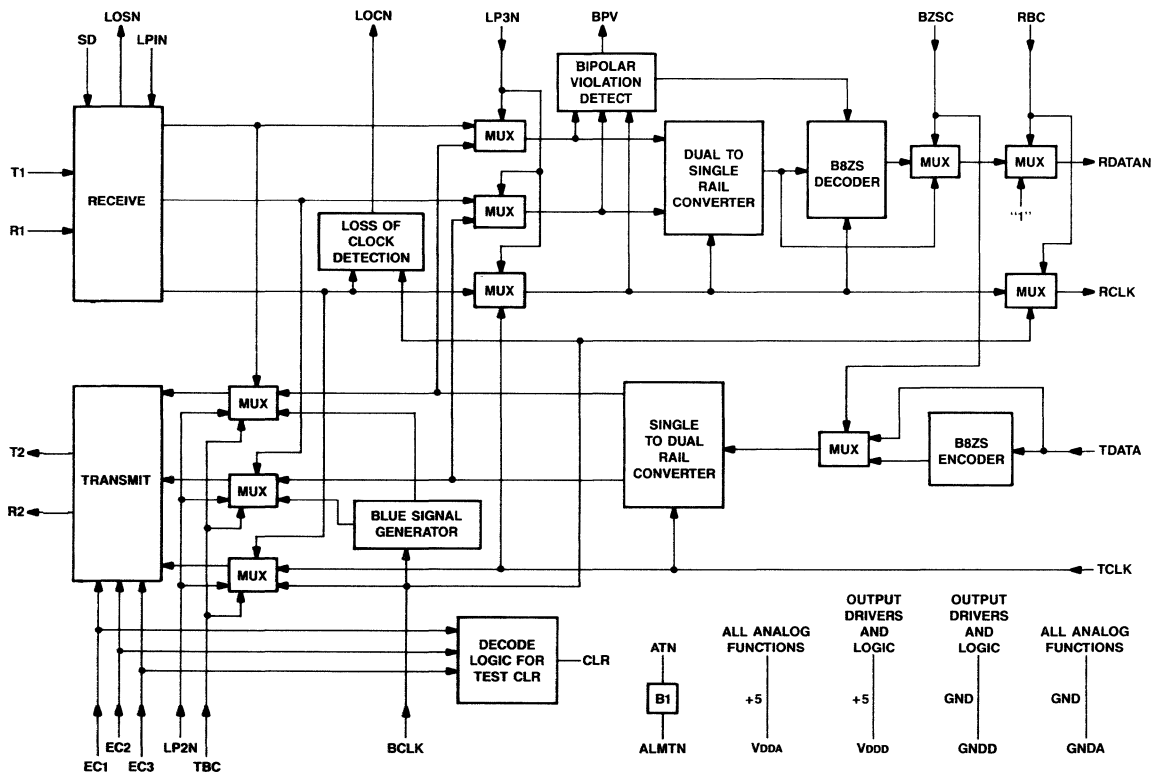
### Description

The LC1046C Digital Signaling Interface (DSI) is an integrated circuit that provides a line interface between the DS1 cross-connect and terminal equipment circuits for cable distances of up to 655 feet for 22-gauge plastic insulated cable. The device performs receive pulse regeneration, timing recovery, and transmit pulse shaping and equalization functions. The LC1046C DSI device is manufactured using 1.75 micron CMOS technology and is available in a 28-pin plastic DIP or 28-pin plastic small-outline J-leaded (SOJ) package for surface mounting.

### Features

- Fully integrated DS1 line interface
- Compatible with Technical Advisory #34 (TA34) and PUB 43802 specifications
- On-chip transmit equalization
- Monolithic clock recovery
- Pin-selectable B8ZS encoder and decoder
- Loopback modes for fault isolation
- Multiple link-status and alarm features
- Minimal external circuitry required

### Block Diagram









**Communication ICs**  
**UNITE ISDN Family of Primary-Rate Devices**

**DS1/CEPT Support Circuits**  
**Primary Access Framer — T7229**

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**Description**

The T7229 Framer integrated circuit provides the line-format and frame-format interfaces for DS1 (1.544 Mb/s) and CEPT (2.048 Mb/s) digital carrier systems. It performs in-line and off-line frame-oriented functions in both the receive and transmit directions. The T7229 Framer is TTL-compatible, manufactured using CMOS technology, and is packaged in a 40-pin plastic DIP.

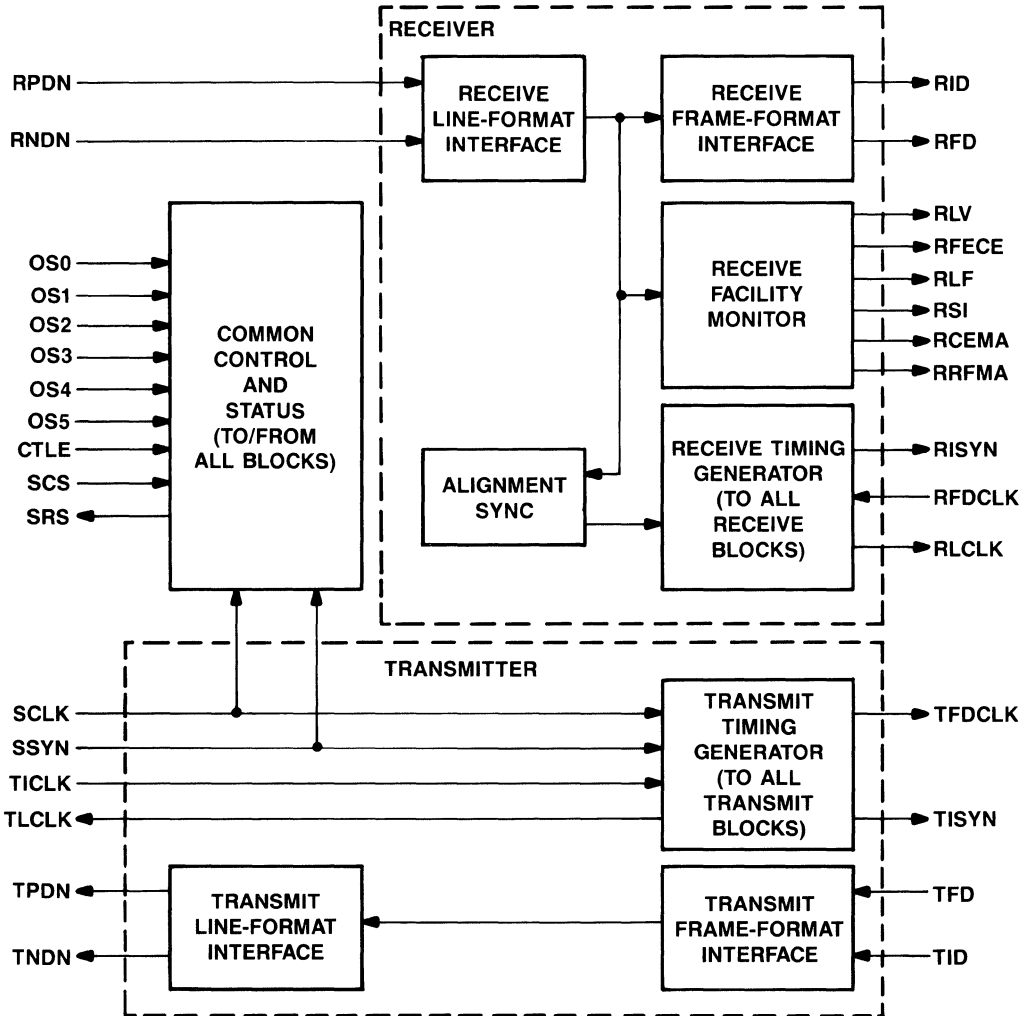
**Features**

- Multiple line-format capability
  - AMI and HDB3 (CEPT)
  - Bipolar and B8ZS
- Multiple TDM frame formats
  - Independent formats — D4, *SLC*<sup>®</sup> Carrier, ESF, and DDS T1DM (DS1)
  - CCITT 30-channel format, with optional TS-16 signaling (CEPT)
- Off-line, defensive, and fast-frame synchronization
- *SLC* Carrier, ESF, and DDS T1DM facility data-link insertion and extraction
- Remote frame/multiframe alarm activation and detection
- AIS detection
- Transmission performance monitoring capability:
  - Bipolar, B8ZS, AMI, and HDB3 violations
  - Frame-alignment signal (frame bit) errors
  - Loss-of-frame/loss-of-multiframe alignment
  - CRC-6 errors (ESF mode)
  - Change-of-frame alignment

# Communication ICs

## UNITE ISDN Family of Primary-Rate Devices

**T7229 Primary  
Access Framer Block  
Diagram**



## Communication ICs UNITE ISDN Family of Primary-Rate Devices

# DS1/CEPT Support Circuits Maintenance Buffer — 229FB

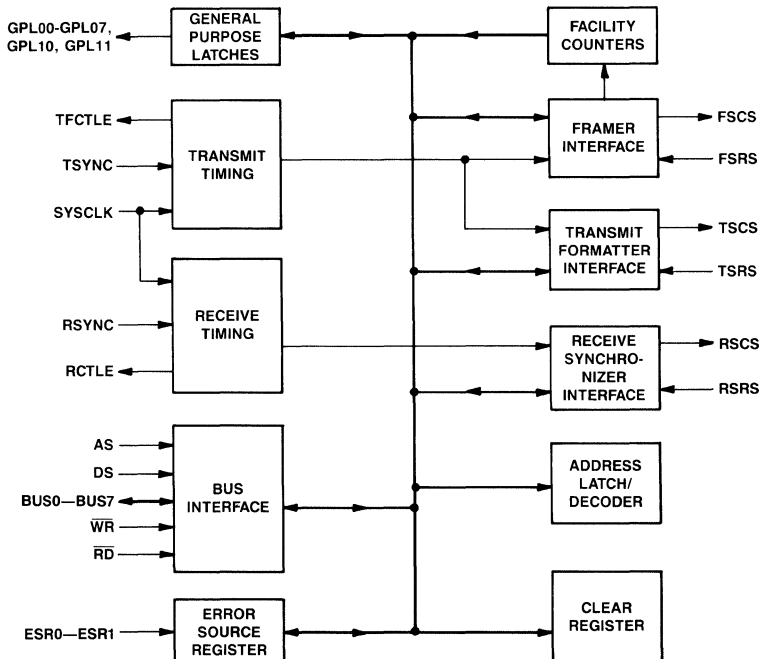
### Description

The 229FB Maintenance Buffer integrated circuit provides the microprocessor interface for the serial report and control streams of the T7229 Framer, 257AU Receive Synchronizer, and 257AL Transmit Formatter. The device also processes facility alarms received from the framer and provides additional latched inputs and outputs for microprocessor use. The maintenance buffer is manufactured using depletion-mode NMOS technology, requires a single +5 V supply, and is available in a 40-pin plastic DIP.

### Features

- 8-bit interface bus
- Microprocessor access to control/report streams
- Ten general-purpose latched outputs
- Two error-source latched inputs
- Preprocessing counters for facility error conditions updated by the framer
- Built-in operational testing capability
- TTL-compatible

### Block Diagram



**Communication ICs**  
**UNITE ISDN Family of Primary-Rate Devices**

# DS1/CEPT Support Circuits Transmit Formatter — 257AL

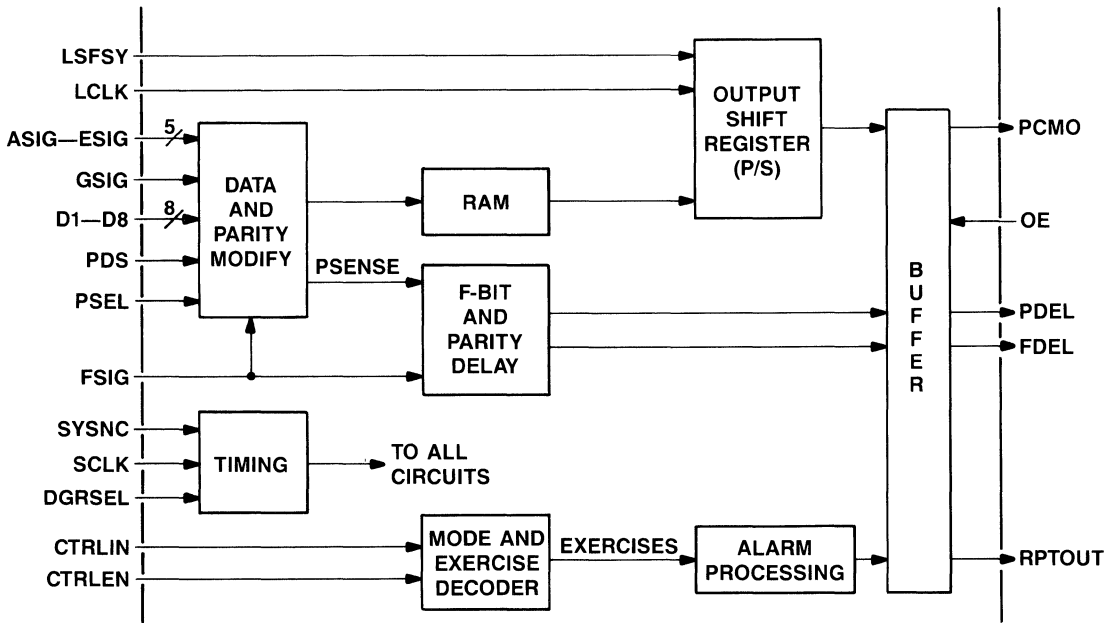
## Description

The 257AL Transmit Formatter integrated circuit converts 14 bits of parallel data (8 traffic bits, 5 signaling bits, 1 parity bit), received from a time slot interchanger, into a serial stream. The device is manufactured using NMOS technology, requires a single +5 volt supply, and is available in a 32-pin plastic DIP.

## Features

- Selectable DS1 (1.544 Mb/s) or CEPT (2.048 Mb/s) formats
- 2-, 4-, 16-state signaling or inhibit signaling insertion
- TTL-compatible

## Block Diagram



# Communication ICs

## UNITE ISDN Family of Primary-Rate Devices

### DS1/CEPT Support Circuits

# Receive Synchronizer — 257AU

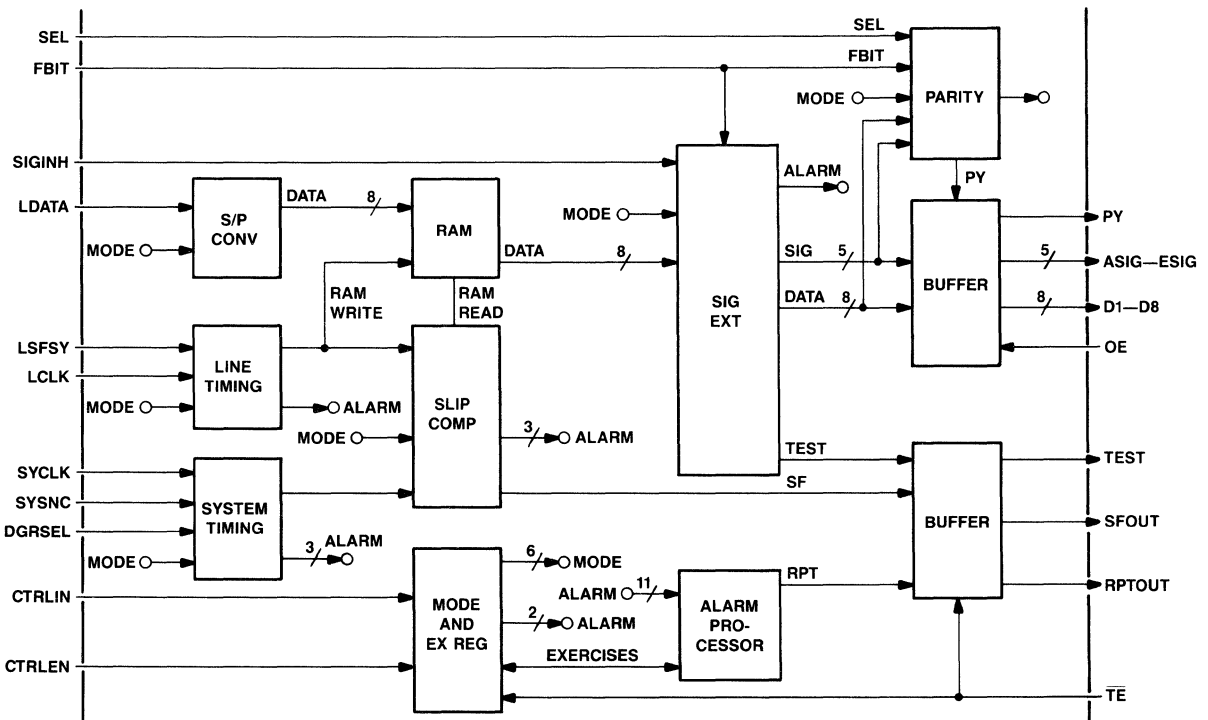
#### Description

The 257AU Receive Synchronizer performs serial-to-parallel conversion, slip compensation, and signaling extraction on the serial data received from the framer. The receive synchronizer is a part of an LSI digital facility interface chip set that also includes the 257AL Transmit Formatter, the T7229 Framer, and the 229FB Maintenance Buffer. The receive synchronizer is manufactured using NMOS technology and is available in a 32-pin plastic DIP.

#### Features

- Selectable DS1 (1.544 Mb/s) or CEPT (2.048 Mb/s) formats
- 4- or 16-state, RSM signal extraction
- Internal maintenance circuits
- Single +5 V supply
- TTL-compatible inputs and outputs

#### Block Diagram



**Communication ICs**  
**UNITE ISDN Family of Primary-Rate Devices**

**DS1 Support Circuits**  
**Loop Divider — 41KW**

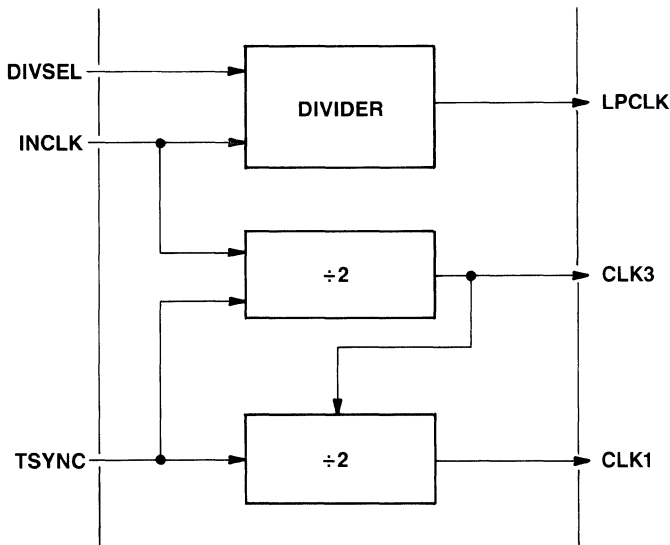
**Description**

The 41KW Loop Divider integrated circuit is an LSTTL-compatible gate array used in a phase-locked loop (PLL) to derive, from a system clock, the 1.544 MHz or 3.152 MHz square-wave clock signal for the DS1 or DS1C chip set. The divisor is set by logic for either DS1 or DS1C operation. A 32 kHz clock output provides the required PLL signal. The loop divider requires a single 5 V supply and is available in a 16-pin plastic DIP.

**Features**

- 2-bit and 8-bit counters
- Either 1.544 or 3.152 MHz square-wave clock output
- 32 kHz clock output
- Standard LSTTL-compatible inputs and outputs

**Block Diagram**





**Communication ICs**  
**UNITE ISDN Family of Primary-Rate Devices**

# DS1 Support Circuits Timing Generator — 129EC

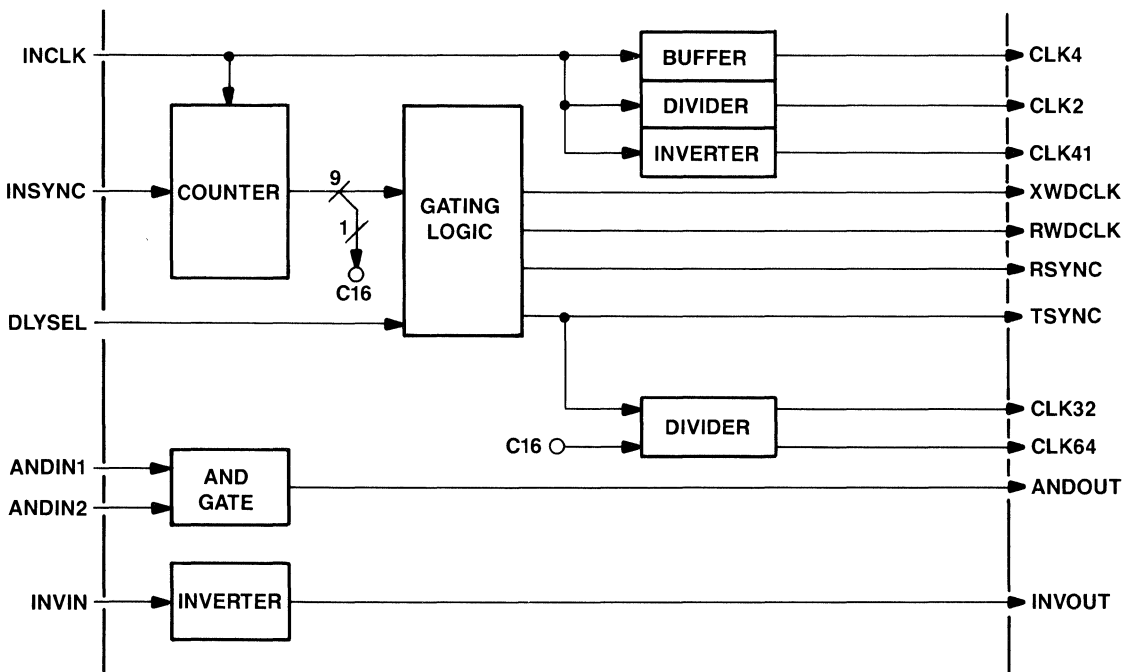
### Description

The 129EC Timing Generator integrated circuit is an LSTTL-compatible gate array that provides the synchronization (sync) and latch pulses required to interface a DS1 chip set to a PBX or host computer. The timing generator requires a single 5 V supply and is available in a 24-pin plastic DIP.

### Features

- Provides clock and sync signals needed to interface the DS1 chip set to a PBX or host computer
- 9-bit binary counter
- Standard LSTTL-compatible inputs and outputs
- Two separate 8 kHz sync outputs
- Two separate 256 kHz clock outputs
- 4.096 MHz clock output and its inversion
- 32 and 64 kHz clock outputs for phase-locked loop (PLL) circuit
- 2.048 MHz clock output

### Block Diagram



**Communication ICs**  
**UNITE ISDN Family of Primary-Rate Devices**

# Synchronous Protocol Data Formatter with Serial Interface — T7110

## Description

The T7110 Synchronous Protocol Data Formatter with Serial Interface (SPYDER-S) is a synchronous packet data communications controller. It is used to interface data link level lines using bit-synchronous (HDLC/SDLC) protocols to 16-bit and 32-bit microprocessor systems. All inputs and outputs are TTL-compatible. The device is fabricated using CMOS technology, requires a single +5 volt power supply, and is packaged in a 68-pin plastic leaded chip carrier (PLCC).

## Features

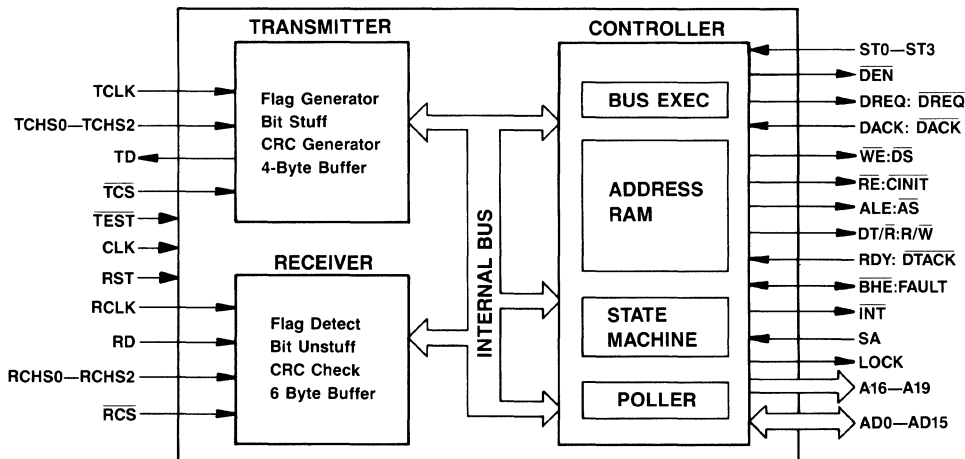
### Host Interface Features

- Compatible with iAPX86, MC68000, or WE® 32100 Microprocessor systems
- On-chip 16-channel DMA memory address generator and buffer management with a 4 Mbyte/s maximum transfer rate
- Transmit and receive buffers accessible through memory-mapped look-up elements

### Serial Interface Features

- 8-channel multiplexed serial input/output
- Automatic flag transmission and detection
- Zero bit insertion and deletion
- CRC generation and checking
- 2 Mb/s continuous serial data rate, 4 Mb/s instantaneous data rate

## Block Diagram



# **Synchronous Protocol Data Formatter — T7115**

## **Description**

The T7115 Synchronous Protocol Data Formatter (SPYDER-T) integrated circuit is a synchronous packet data communications controller device. All inputs and outputs of the T7115 SPYDER-T are TTL-compatible. The device is fabricated using CMOS technology, requires a single 5 V supply, and is available in a 68-pin plastic leaded chip carrier.

## **Features**

### **Serial Port Interface**

- 32-channel (full-duplex) multiplexed serial input/output supports the T1/DS1 24-channel and the CEPT 32-channel modes
- Automatic flag transmission and detection
- Flag stuffing up to 2047 flags
- Flag adjustment for the synchronous rate adaption
- Full, partial, or no CRC generation and checking
- Zero-bit insertion and deletion
- Abort/idle detection and transmission
- Short- and long-frame detection
- 2-Mb/s continuous serial data rate
- Dynamic channel allocation (or channel concatenation) supports DS0, H0, H11, and H12 channels
- Bit rate control on each channel
- Channel inversion
- Transparent mode (no protocol) supports ECMA 102 and CCITT I.463 RA2 rate adaption standards
- Loopback mode
- DMA CRC for relay mode

### **Microprocessor Interface**

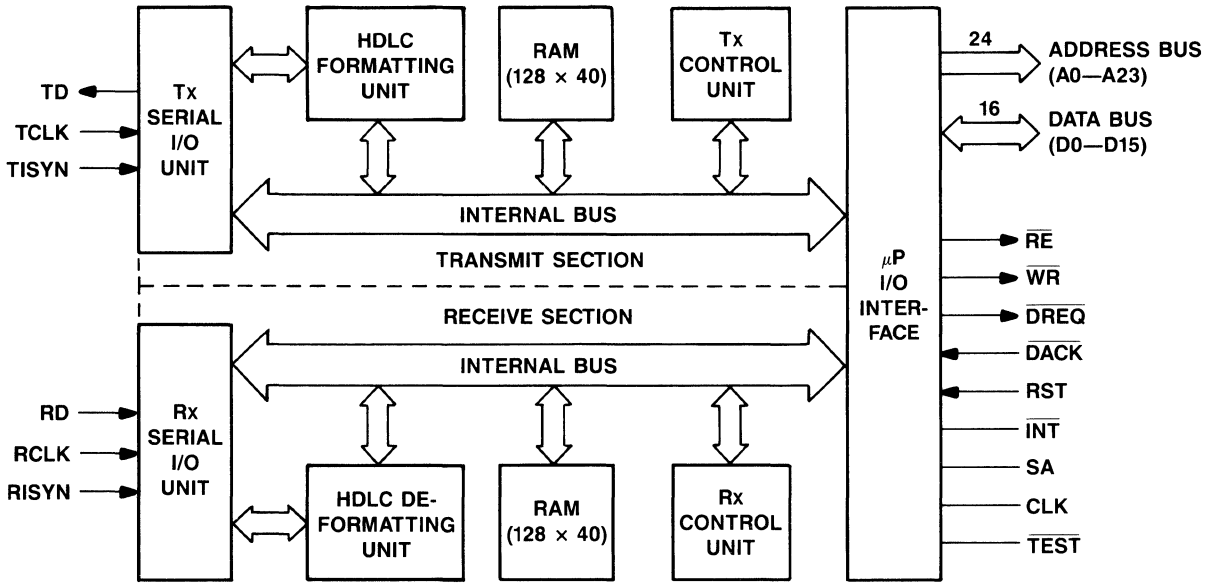
- Compatible with 16-bit or 32-bit microprocessor systems
- On-chip 64-channel DMA memory address generator and buffer manager
- Nonmultiplexed 16-bit data and 24-bit address (16 Mbytes) buses
- Transmit and receive buffers accessible through memory-mapped look-up tables
- Interrupt queue (up to 4096 interrupts)

*Advanced information — Sample devices are not necessarily available at this time.*

# Communication ICs

## UNITE ISDN Family of Primary-Rate Devices

**SPYDER-T Block Diagram**



## Communication ICs Data Protocol

# Digital Encryption Processor — T7000A

### Description

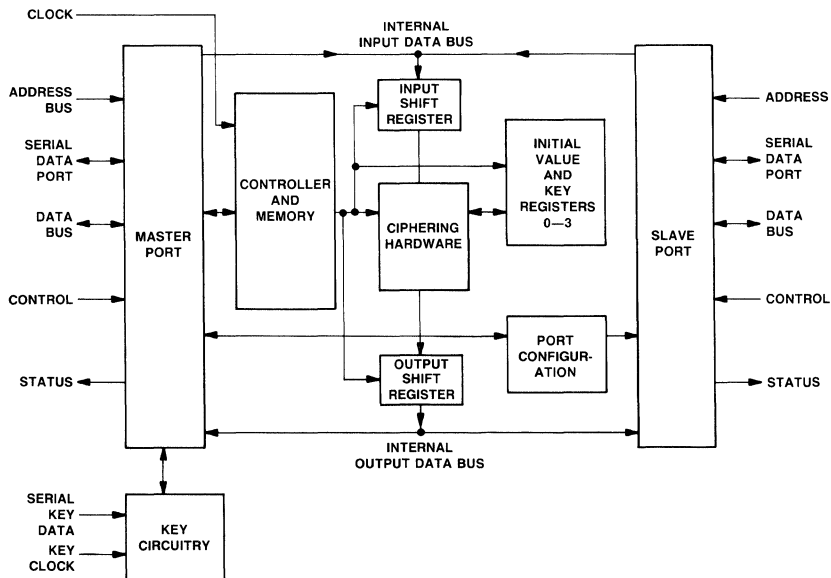
The Digital Encryption Processor (DEP) provides a low-cost, high security cryptographic system for encrypting and decrypting digital signals. It implements the four data encryption standard (DES) modes specified by the National Bureau of Standards (NBS) and is capable of performing multiple encryption operations or multiplexed key and initial value ciphering.

This programmable device provides a maximum ciphering rate of 235,000 operations/second for any of the DES modes. The DEP is manufactured using CMOS technology, requires a single +5 volt supply, and is packaged in a 40-pin plastic DIP.

### Features

- Programmable DES ciphering modes
- Programmable multiple or multiplexed ciphering
- On-chip RAM and ROM
- Separate parallel and/or serial plain-text and cipher-text ports
- Separate serial key input port
- Data throughput of 1.882 Mbytes/s using the entire DES output block
- Validated by the NBS

### Block Diagram



# Random Number Generator — T7001

## Description

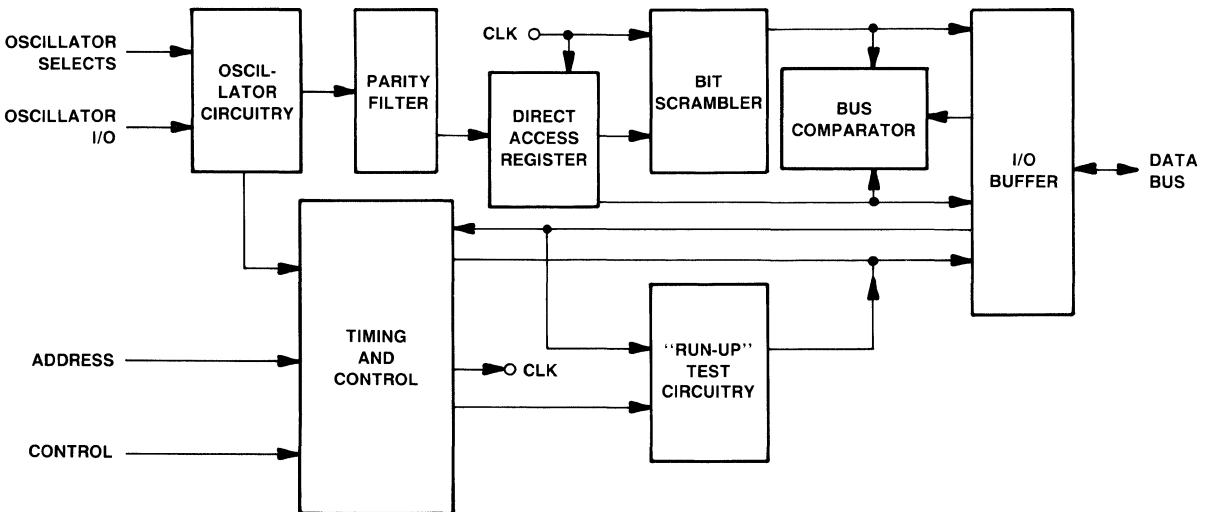
The Random Number Generator (RNG) produces random bits based on the phase jitter of a free-running oscillator. The output data stream of this device is truly random (not pseudorandom). In the data encryption unit, the RNG generates a random number that can be used as a session key.

This device is fabricated in CMOS technology, requires a single +5 volt supply, and is available in a 32-pin plastic DIP.

## Features

- On-chip or external HF oscillator source option
- On-chip or external jitter oscillator source option
- Generation of a 536-bit random number available in 8-bit bytes
- Internal elementary randomness check with external access to generated statistics

## Block Diagram



## Communication ICs Data Protocol

# Bit Slice Multiplier and Extender — T7002 and T7003

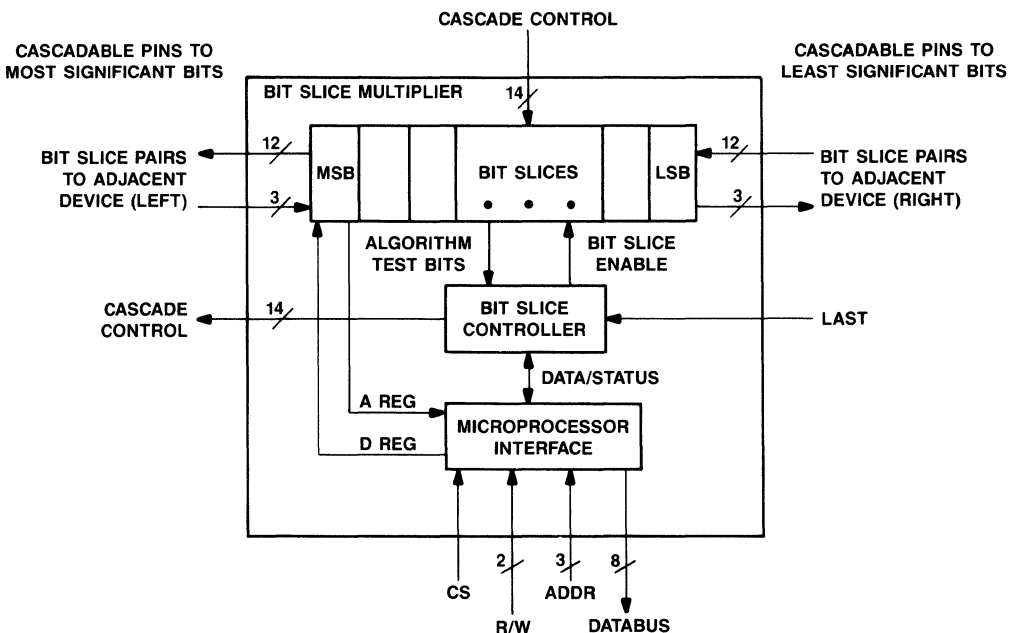
### Description

The T7002 Bit Slice Multiplier (BSM), designed to be a microprocessor peripheral, is a cascadable integrated circuit useful in cryptosystem applications. When cascaded with one or more T7003 BSM Extenders, only the T7002 device interfaces with the host processor. The T7002 BSM can handle 292 multiplication bits while each cascaded T7003 device increases the bit length by 298 bits. The T7002 device generates the cascade control signals that drive the T7003 device control inputs. Each device is manufactured using 1.5 micron CMOS technology, requires a +5 V supply, and is packaged in a 68-pin plastic leaded chip carrier (PLCC).

### Features

- Useful in public-key cryptosystem applications
- Microprocessor-compatible interface
- Calculates  $Y = [X \times Y] \pmod{N}$  and under control of a host processor exponentiates:  $Y = [B^{\text{exp}}] \pmod{N}$
- Exponentiation rate: 27 ms for 512-bit operation
- Cascadable device design with 292 bits on a T7002 and 298 bits on a T7003
- 1.5 micron CMOS design

### Block Diagram



# Communication ICs

## Data Protocol

# X.25 Protocol Controller — T7100A

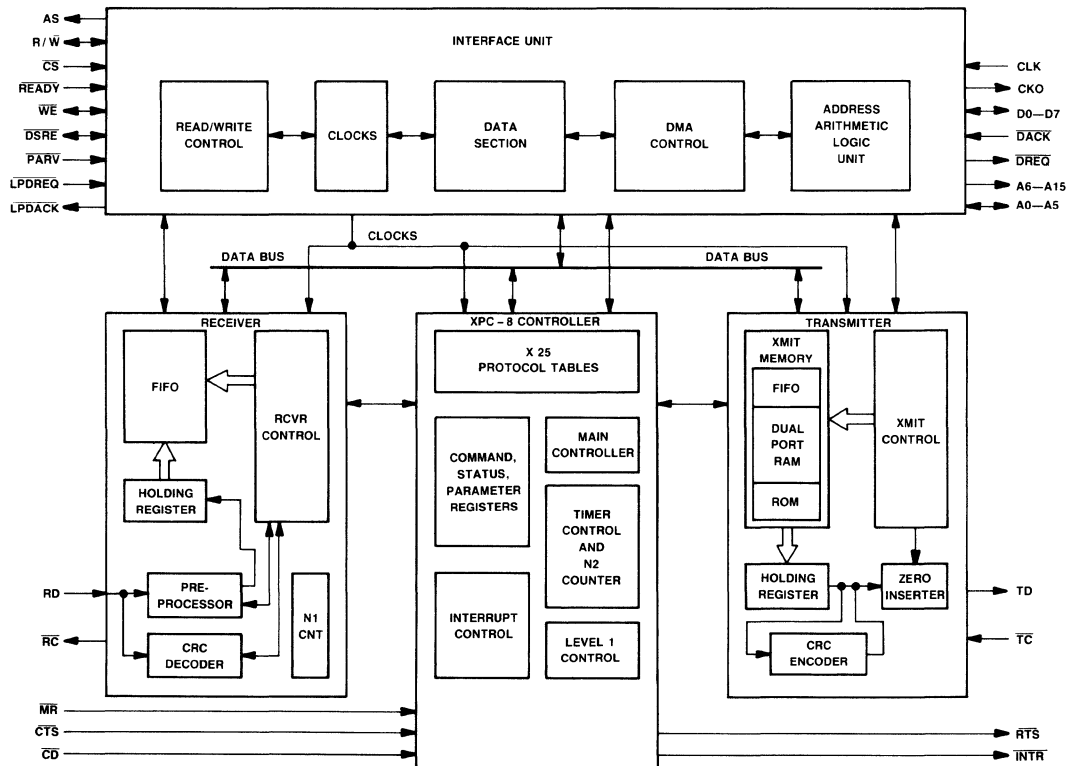
### Description

The T7100A X.25 Protocol Controller, also known as XPC-8, implements the data link control functions defined in the X.25 packet switching communication standard for an 8-bit data bus. This level 2 protocol controller is fabricated using NMOS silicon gate technology, is TTL-compatible, and may be interfaced with an 8-bit microprocessor. The device is available in a 48-pin nonhermetic ceramic DIP.

### Features

- DMA with standard interface including DMS request, DMA acknowledge, DMA read, and DMA write
- Programmable timers and window size
- Serial data rate of 250 kb/s
- Wait-state generator (on DMA side) for slow memory
- Two independent test modes to verify the XPC-8 and its link

### Block Diagram







## Communication ICs Data Protocol

# X.25/X.75 Protocol Controller — T7102A

### Description

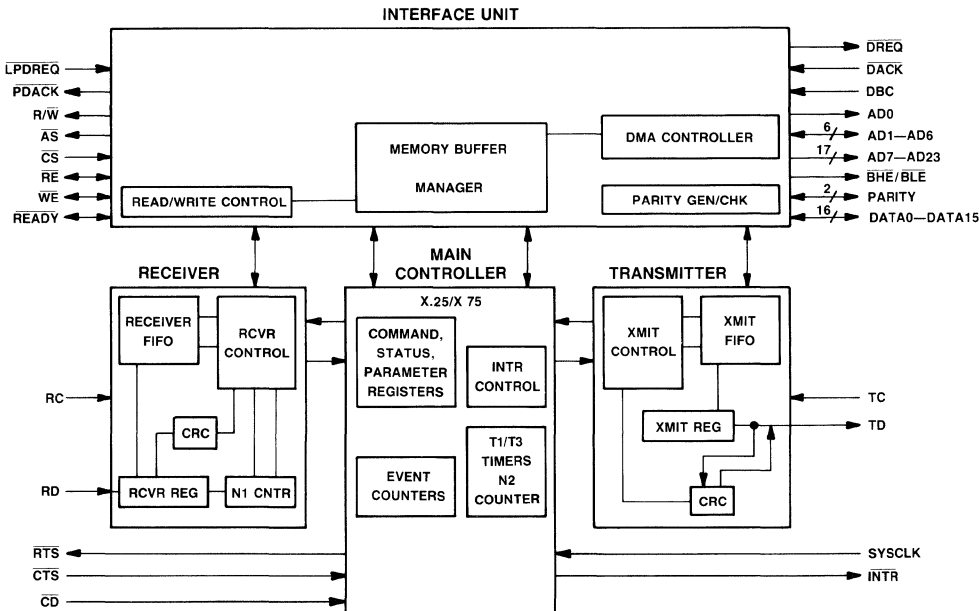
The T7102A XPC device satisfies the X.25 link layer (level 2) requirements for a balanced link access procedure (LAPB) for data interchange over a synchronous full-duplex, serial data link. This device also implements X.75 level 2 protocol used in inter-network applications. The protocol controller is bit-oriented with a maximum transmit and receive speed of 333 kb/s. A set of programmable registers control and record vital events during data transmission.

This single-chip LSI device is available in a 70-pin, pin-grid array package and is fabricated using NMOS silicon gate technology.

### Features

- 24-bit address bus to address 16-Mbyte address space
- Dual-channel DMA with standard interface including DMA request, DMA acknowledge, DMA read, and DMA write
- Independently programmable timers, retransmission counter, window size (transmit and receive), and Modulo 8 or 128 frame sequence numbering
- Daisy chain DMA for priority-controlled CPU interface
- Event counters and registers
- Supports 8-bit or 16-bit data buses

### Block Diagram



## **PCM Codec With Filters — T7500**

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### **Description**

The T7500 PCM Codec with Filters integrated circuit performs the analog-to-digital and digital-to-analog translation functions in a circuit. It incorporates transmit and receive filtering of voice information for transmission via a digital network. The device is a full-duplex, 8-bit codec that operates from a  $\pm 5$  volt power supply and provides A-law and/or  $\mu$ -law conversion algorithms.

The T7500 codec is synchronized off the positive-going edge and has separate power-down for the transmitter and receiver. The device is manufactured using CMOS technology and is available in an 18-pin plastic DIP or in a 20-pin plastic SOJ. Custom configurations and/or special packages may be available on request.

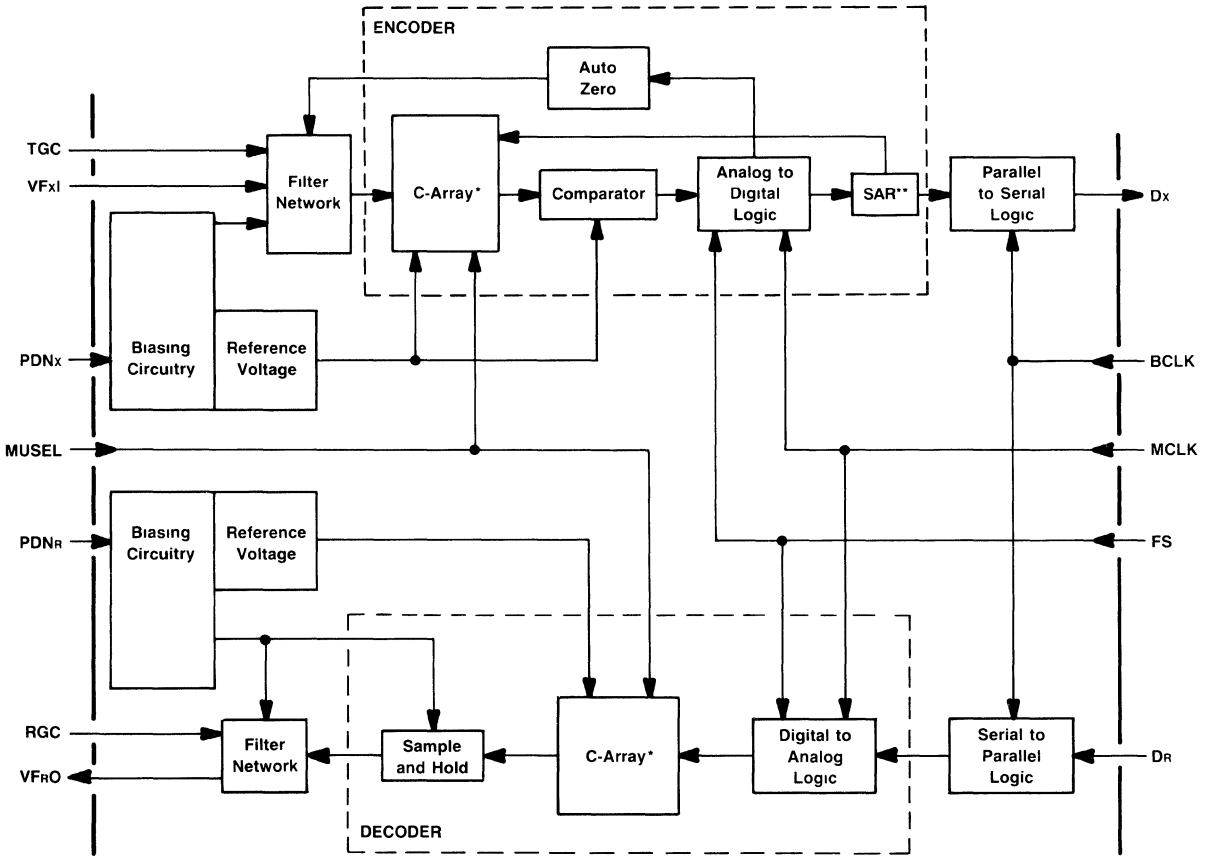
### **Features**

- AT&T/CCITT compatible
- Pin selectable  $\mu$ -law or A-law operation
- Pin selectable transmit and receive gain
- Variable data rate (128 kHz to 4.096 MHz)
- On-chip voltage reference
- Low power dissipation
- TTL-compatible inputs and outputs
- AT&T interface timing

# Communication ICs

## Codec Products ( $\mu$ -Law, A-Law, $\pm 5$ Volts)

### T7500 PCM Codec Block Diagram



**Communication ICs**  
**Codec Products ( $\mu$ -Law, A-Law,  $\pm 5$  Volts)**

## **PCM Codec With Filters — T7513A**

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### **Description**

The T7513A PCM Codec with Filters is a single-chip integrated circuit that provides analog-to-digital and digital-to-analog conversion. In addition, it provides the transmit and receive filtering necessary to interface a voice telephone circuit to a time-division multiplexed system. The T7513A Codec is a direct replacement for the T7513 Codec, offering enhanced functionality and significantly reduced power consumption. The T7513A device is available in a 20-pin plastic DIP or small outline J-lead (SOJ) package for surface mounting.

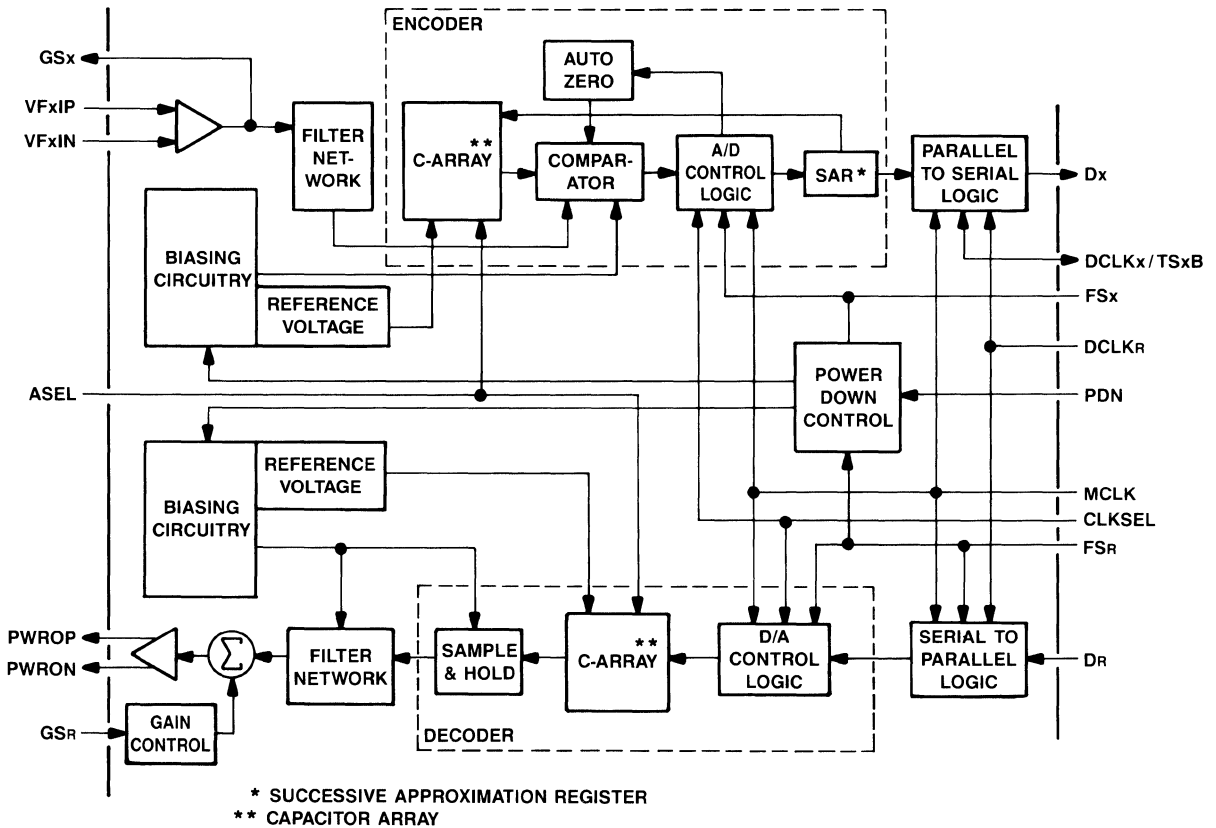
### **Features**

- Direct replacement for the industry-standard 2913 and 29C13 Codecs
- Low-power, latchup-free CMOS technology
  - 65-mW typical operating power dissipation
  - 5-mW typical power-down dissipation
- Differential architecture for high noise immunity and PSRR
- Pin-selectable master clock rates of 2.048, 1.544, or 1.536 MHz
- Two timing modes
  - Fixed data rate: 2.048, 1.544, or 1.536 MHz
  - Variable data rate: 64 kHz to 2.048 MHz
- On-chip sample and hold, autozero, and precision voltage reference — no external components required
- Excellent noise performance
- Pin-selectable  $\mu$ -law or A-law operation

*This information is preliminary and subject to change.*

## Communication ICs Codec Products ( $\mu$ -Law, A-Law, $\pm 5$ Volts)

**T7513A PCM Codec  
Block Diagram**



## **Dual PCM Codec With Filters — T7512**

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### **Description**

The AT&T T7512 Dual PCM Codec With Filters integrated circuit provides two channels of analog-to-digital and digital-to-analog conversion as well as the transmit and receive filtering necessary to interface two voice telephone circuits to a time-division multiplexed system. The device is fabricated using low-power CMOS technology and requires a single +5 volt supply. It is available in either a 28-pin plastic DIP or 28-pin plastic SOJ package for surface mounting.

### **Features**

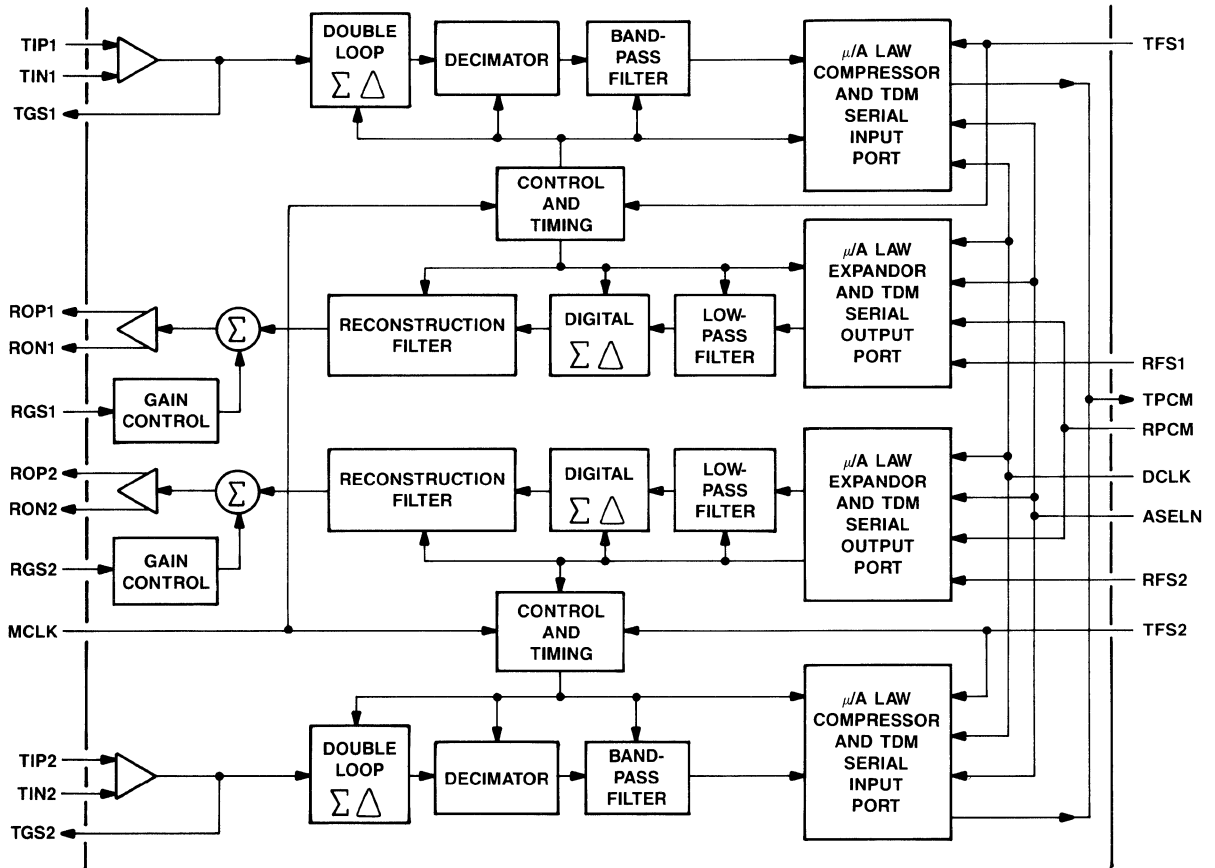
- AT&T/CCITT-compatible
- Pin selectable  $\mu$ -law or A-law operation
- Transmit and receive gain control with external resistors
- Two timing modes
  - Fixed data rate mode at 2.048 MHz
  - Variable data rate mode — 128 kHz to 2.048 MHz
- On-chip voltage reference
- Differential output amplifier
- TTL-compatible I/O

*This information is preliminary and subject to change.*

## Communication ICs

### Codec Products ( $\mu$ -Law, A-Law, 5 Volts)

#### T7512 Dual PCM Codec Block Diagram



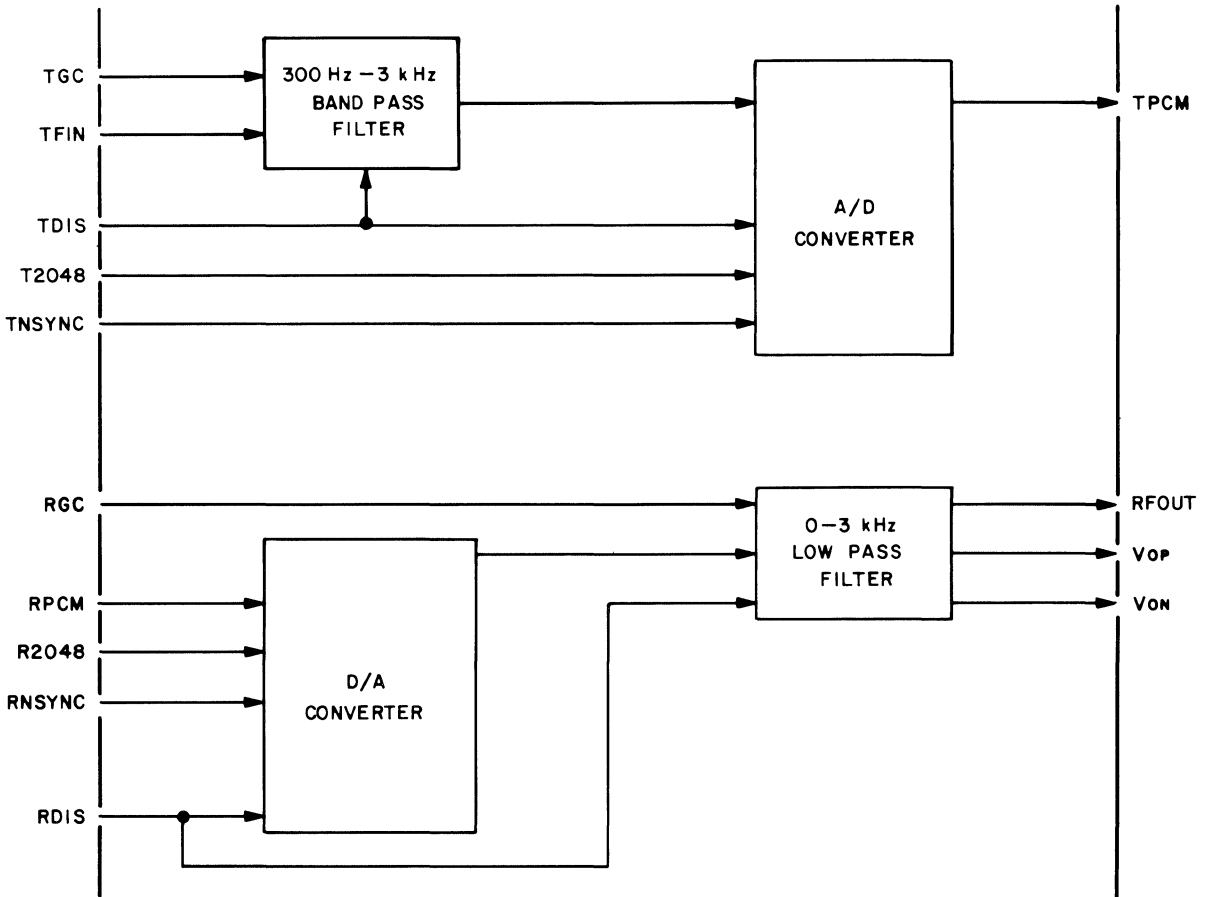




# Communication ICs

## Codec Products (Linear, High-Precision, $\pm 5$ Volts)

### T7520A PCM Codec Block Diagram



## **High-Precision PCM Codec — T7521A**

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### **Description**

The T7521A High-Precision PCM Codec integrated circuit performs A/D and D/A conversion with 15-bit resolution and 10-bit linearity. The device provides an on-chip reconstruction filter and a precision voltage reference. The device is designed for use in signal-processing applications that require PCM data with a higher resolution than PCM  $\mu$ -law data. The T7521A Codec is a linear device with 16-bit PCM I/O data in 2's complement binary format. Typical applications include the use of this codec with echo cancelers, digital signal processors, and in data sets. An optional transmit filter may be supplied by the user for this device. The T7521A Codec is manufactured using CMOS technology and is available in a 24-pin hermetic, ceramic DIP.

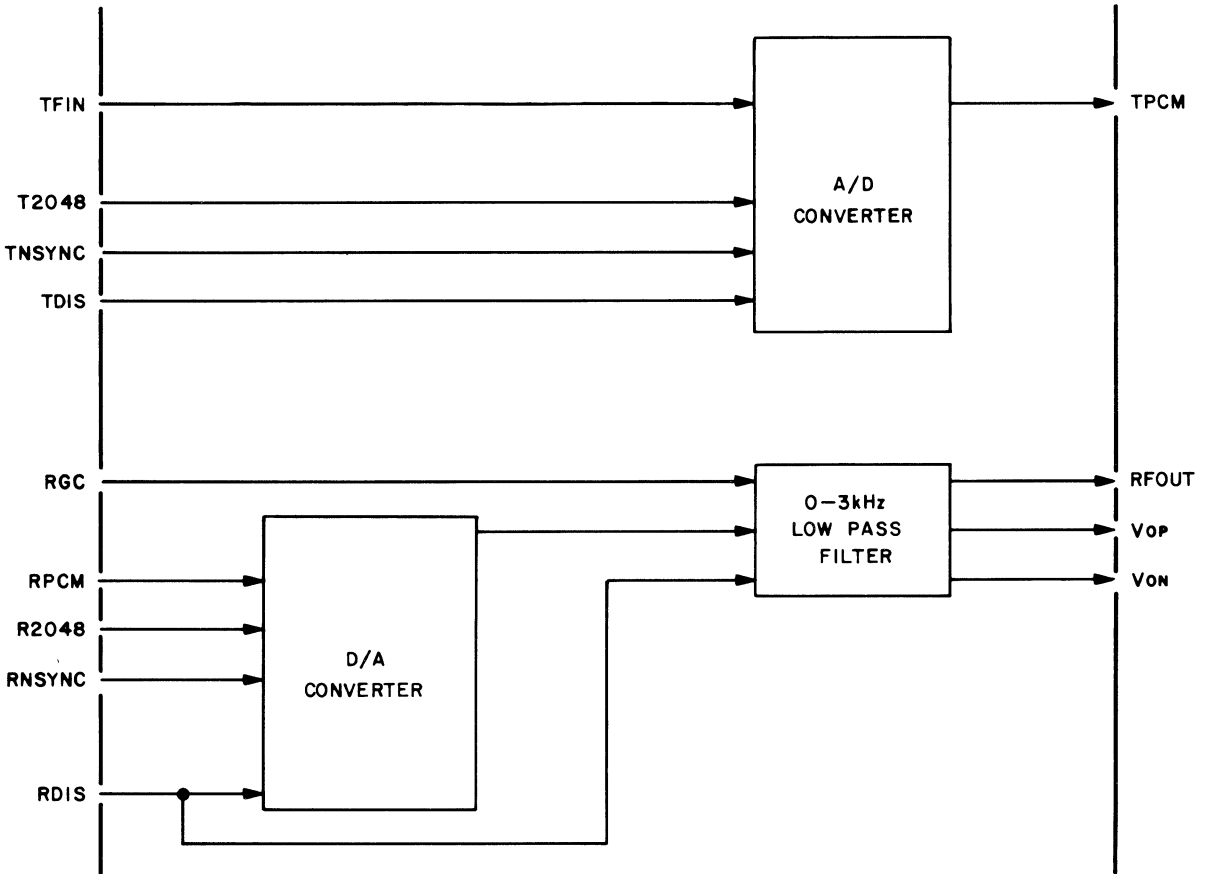
### **Features**

- A/D and D/A with on-chip D/A filters
- On-chip precision-trimmed reference voltages
- Charge redistribution and switched capacitor techniques
- $\pm 5$  V power supplies, with 100 mW nominal power
- Independent transmit and receive power-down
- Easy interface to a DSP device
- Sync deglitching circuitry on-chip
- 3-state TTL-output bus
- Data format: 16-bit PCM in 2's complement binary (LSB first)
- Gain selection — receive: +3 or 0 dB
- Guaranteed monotonic to 15 bits
- Balanced filters for improved PSRR
- A/D filters can be bypassed; A/D has sample and hold built in

# Communication ICs

## Codec Products (Linear, High-Precision, $\pm 5$ Volts)

### T7521A High-Precision PCM Codec Block Diagram



## **High-Precision PCM Codecs With Filters — T7522 and T7523**

### **Description**

The T7522 and T7523 High-Precision PCM Codecs With Filters integrated circuits perform A/D and D/A conversion with 15-bit resolution and 10-bit linearity. The devices are designed for use in signal-processing applications that require PCM data with a higher resolution than PCM  $\mu$ -law data. Each codec is a linear device with 16-bit PCM I/O data in 2's complement binary format. Typical applications include the use of the codec with echo cancelers, digital signal processors, and in data sets. Each codec is manufactured using CMOS technology and is available in a 24-pin, hermetic ceramic DIP.

The T7522 Codec provides anti-aliasing and reconstruction filters and a precision voltage reference. The chip has selectable LSB or MSB first I/O. The T7522 device can directly replace the T7520A and T7521A Codecs in applications not requiring independent A/D and D/A power-down options, and is recommended for all new designs.

Designs requiring the independent A/D and D/A power-down option should use the T7523 Codec. The T7523 device is a pin-for-pin replacement and upgrade for the T7520A and T7521A Codecs, and is recommended as their replacement for all new designs. However, applications requiring MSB first PCM I/O should use the T7522 Codec.

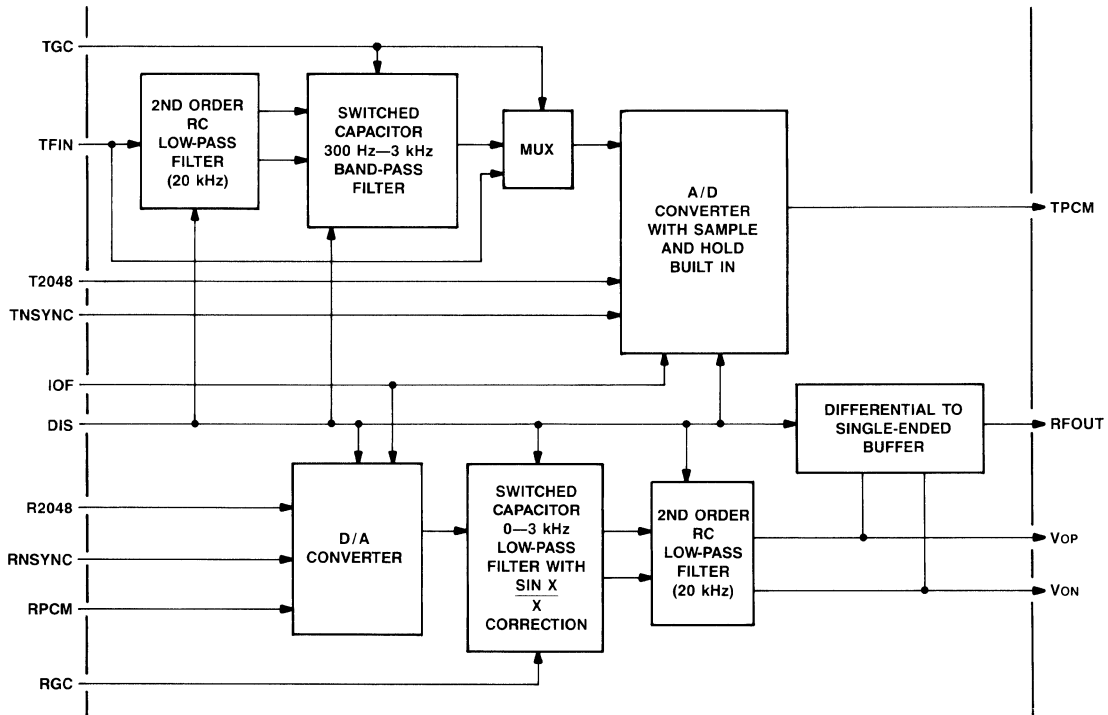
### **Features**

- Encoder and decoder with on-chip filters
- On-chip precision-trimmed reference voltages
- Charge redistribution and switched capacitor techniques
- $\pm 5$  V power supplies, with 120 mW nominal power
- Easy interface to industry-standard DSP devices
- Independent transmit and receive power-down (T7523)
- Sync deglitching circuitry on-chip
- 3-state TTL-output bus
- Data format 16-bit PCM in 2's complement binary LSB first I/O (T7523)
- Selectable LSB or MSB first I/O (T7522)
- Gain selection: transmit: 0 or  $-3$  dB  
receive:  $+3$  or 0 dB
- Guaranteed monotonic to 15 bits
- Balanced filters for improved power supply rejection ratio (PSRR)
- A/D has sample and hold built-in
- A/D filters can be bypassed

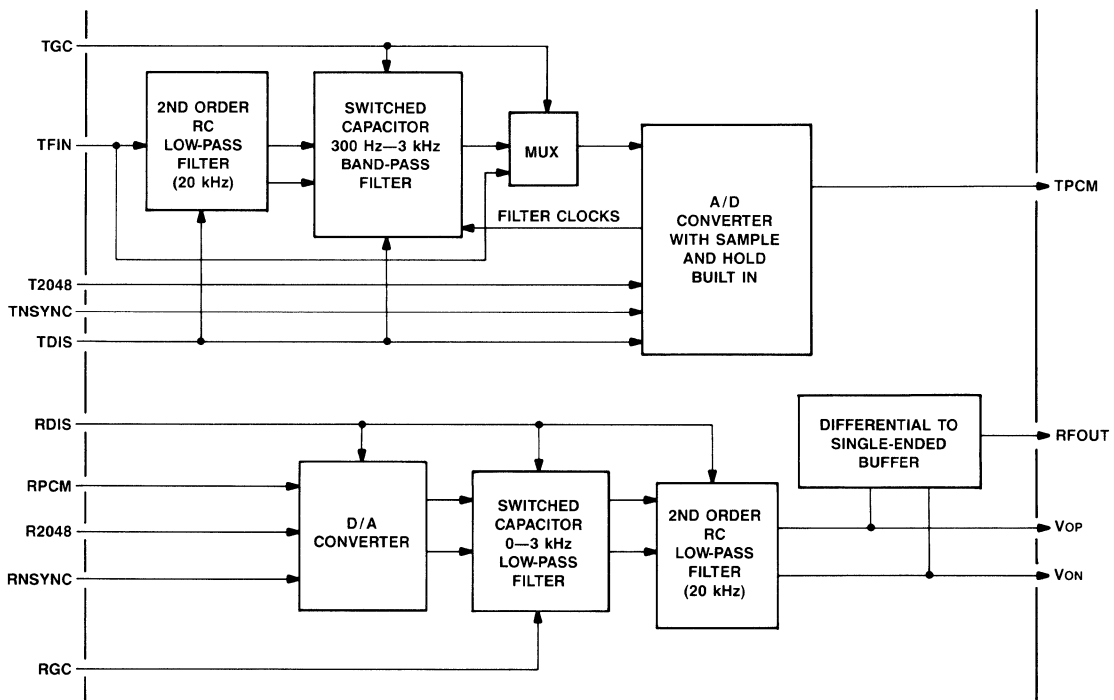
# Communication ICs

## Codec Products (Linear, High-Precision, $\pm 5$ Volts)

**T7522 Block Diagram**



**T7523 Block Diagram**



## **High-Precision PCM Codec With Filters — T7525**

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### **Description**

The AT&T T7525 integrated circuit is a high-precision voiceband sigma-delta PCM codec with transmit and receive filters. It provides 15-bit resolution and 10-bit linearity. The serial PCM input/output uses a linear 16-bit 2's complement data format. The device can input or output 16-bit data 16 bits at a time (word mode), or optionally 8 bits at a time (byte mode) to allow easy interfacing to digital signal processor devices with 8-bit input/output. The transmit and receive digital filters can be bypassed, which is useful for echo canceling applications. The T7525 Codec is fabricated using a low-power CMOS technology, operates from a single +5 volt supply, and is available in either a 24-pin plastic DIP package or in a 28-pin plastic SOJ package.

### **Features**

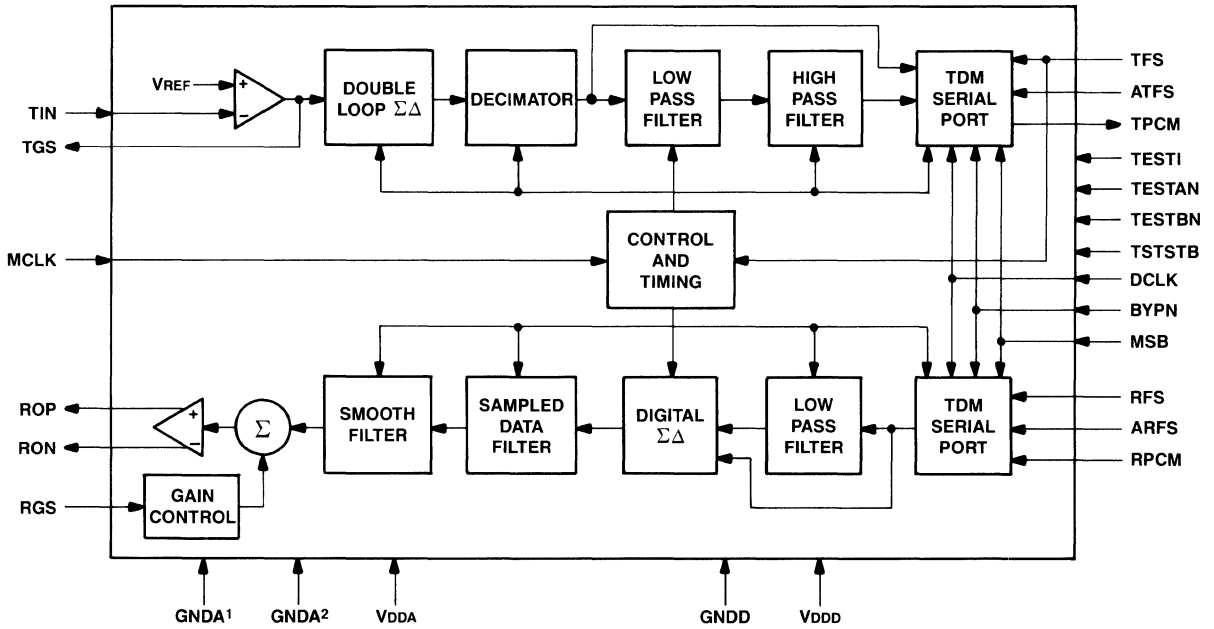
- Easy interface to AT&T and TI family DSPs
- Pin-selectable MSB/LSB first
- Transmit/receive gain control with external resistors
- Two timing modes
  - fixed data rate mode: 2.048 MHz
  - variable data rate mode: 128 kHz to 2.048 MHz
- Filters may be optionally bypassed
- On-chip voltage reference
- Differential output amplifier
- TTL-compatible digital I/O
- Two input/output modes — byte and word

*This information is preliminary and subject to change.*

# Communication ICs

## Codec Products (Linear, High-Precision, $\pm 5$ Volts)

### T7525 High-Precision PCM Codec With Filters Block Diagram





# Clock Recovery Circuit — T7032

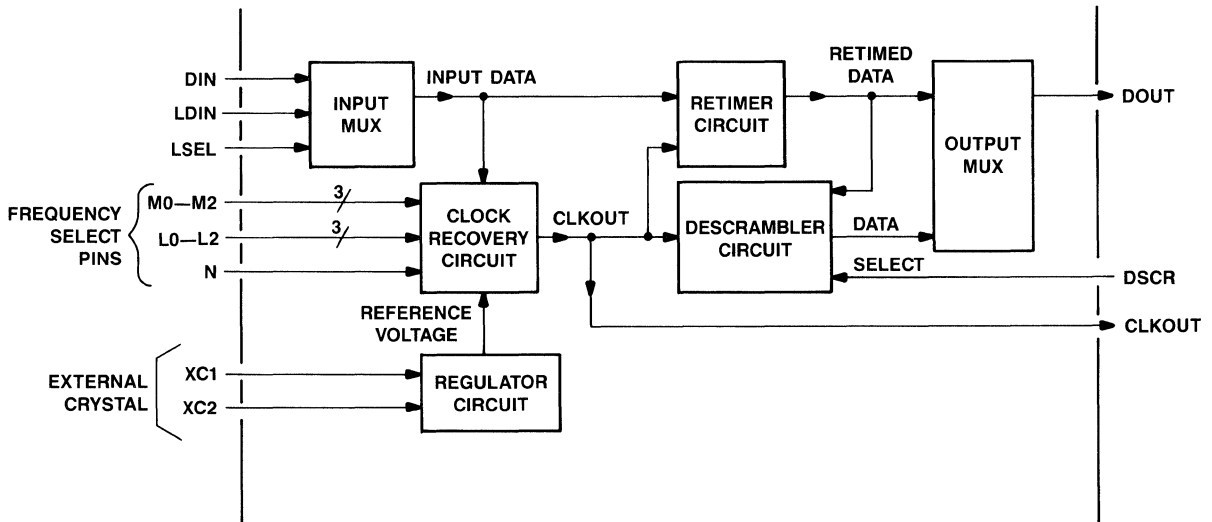
## Description

The T7032 Clock Recovery Circuit integrated circuit operates over a 1 to 50 MHz frequency range and provides clock recovery, data retiming, and a polynomial-based descrambler. The descrambler may be disabled for those applications where no data scrambler is used. The device accepts TTL nonreturn-to-zero (NRZ) data from a receiver (optical or electrical), recovers the clock, and retimes the data to the recovered clock. The inputs and outputs are TTL-compatible, and the circuit requires a single +5 V supply. The T7032 Clock Recovery Circuit is manufactured using CMOS technology and is available in a 300 mil, 20-pin plastic DIP.

## Features

- Pin-programmable for 1 to 50 MHz operation
- Fiber and wire applications
- Compatible with the ODL® 50 Lightwave Data Link
- Single-chip CMOS design
- Single +5 V supply

## Block Diagram



# Clock Recovery Circuit — T7033

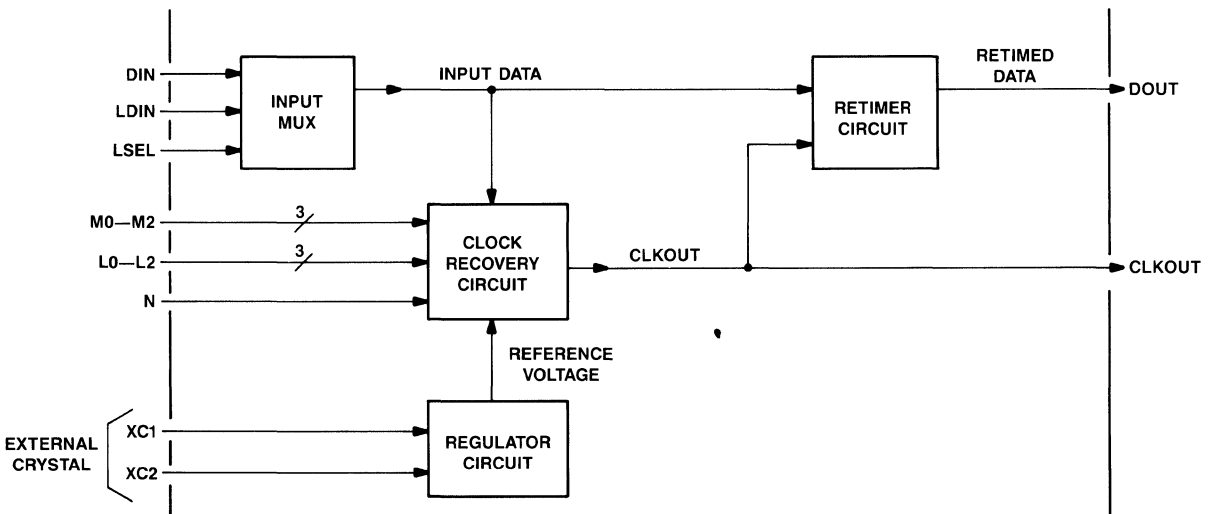
### Description

The T7033 Clock Recovery Circuit integrated circuit operates over a 1 to 50 MHz frequency range and provides clock recovery and data retiming. The device accepts TTL-NRZ data from a receiver (optical or electrical), recovers the clock, and retimes the data to the recovered clock. The inputs and outputs are TTL-compatible, and the circuit requires a single +5 V supply. The T7033 Clock Recovery Circuit is manufactured using CMOS technology and is available in a 300 mil, 20-pin plastic DIP. This circuit may be used for many general-purpose clock recovery and retiming applications. The device is intended for applications where a data scrambler is not used.

### Features

- Pin-programmable for 1 to 50 MHz operation
- Fiber and wire applications
- Single +5 V supply
- Only one external component required: 3.58 MHz crystal

### Block Diagram



# Clock Recovery Circuit — T7034

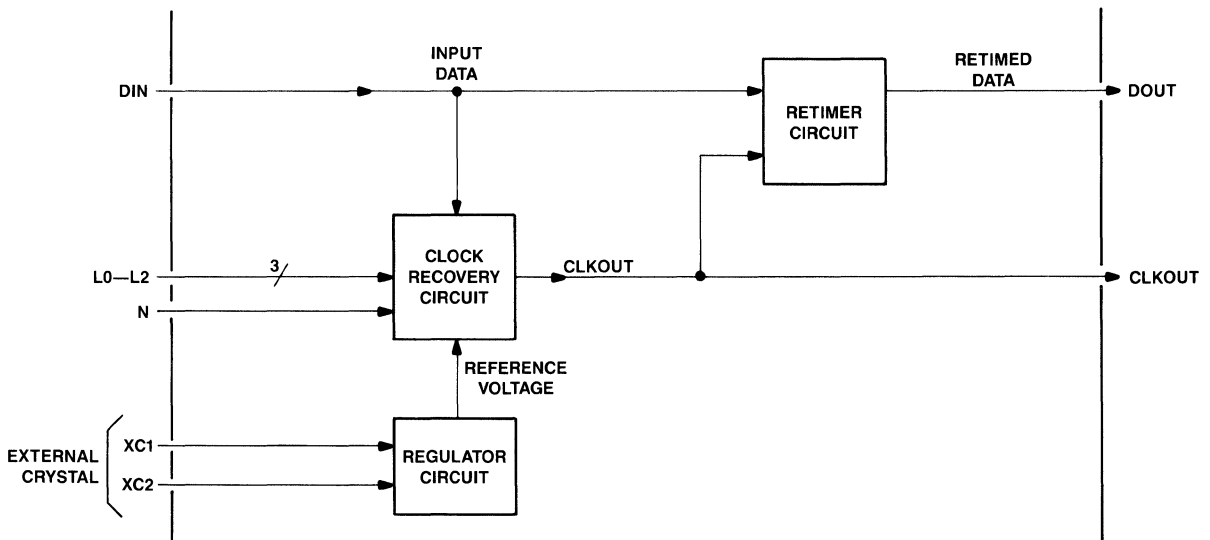
### Description

The T7034 Clock Recovery Circuit integrated circuit operates over a 25 MHz to 50 MHz frequency range and provides clock recovery and data retiming. The device accepts TTL-NRZ data from a receiver (optical or electrical), recovers the clock, and retimes the data to the recovered clock. The inputs and outputs are TTL-compatible and the circuit requires a single +5 V supply. The T7034 Clock Recovery Circuit is manufactured using CMOS technology and is available in a 300 mil, 20-pin plastic DIP. The device is designed for general-purpose clock recovery and retiming applications.

### Features

- Pin-programmable for 25 MHz to 50 MHz operation
- Fiber and wire applications
- Single +5 V supply
- Only one external component required: 3.58 MHz crystal

### Block Diagram



*This information is preliminary and subject to change.*

## Digital Bipolar Integrated Circuits

The Digital Bipolar product family is made up of four basic process technologies: Guardring Isolated Monolithic Integrated Circuits (GIMIC), Standard Buried Collector (SBC), Oxide-Isolated Logic (OXIL), and Scaled-Fast Oxide-Isolated Logic (SFOXIL).

There are three major product offerings available in the Digital Bipolar product family. These are custom, semi-custom, and catalog logic devices. Custom logic devices include all devices designed to satisfy a unique systems application. They are designed from the gate level to minimize chip size and maximize performance. Semi-custom designs include gate arrays and functional logic array circuits that are designed and manufactured to provide fast turnaround, low risk, and low development expense. Catalog logic devices are used as building blocks in the design of digital systems.

**For additional information contact your nearest sales office or call:**

**1-800-372-2447.**

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<b>Quad Differential Line Receiver — 41LF</b>	<b>6-2</b>
<b>Quad Differential Line Driver — 41LG</b>	<b>6-3</b>
<b>* Dual Differential Line Driver-Receiver Pairs — 41LK, 41LL, 41LM</b>	<b>6-4</b>
<b>8×8 Bipolar Bilateral Crosspoint Array — 129EH-P</b>	<b>6-6</b>
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\* Did not appear in the previous edition of the Product Selection Guide.

## Digital Bipolar ICs

# Quad Differential Line Receiver — 41LF

### Description

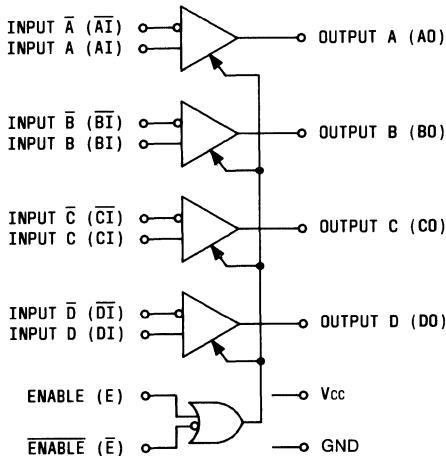
The 41LF Quad Differential Line Receiver integrated circuit is a quad differential input to TTL output line receiver. This OXIL technology device contains four receiver clusters and enable circuitry. The average propagation delay is 4 ns, and the common mode operating range is  $\pm 4$  V. The 41LF line receiver is pin-equivalent to the general-trade AM26LS32 device, but has improved speed and decreased power consumption.

The quad differential line receiver is available in a 16-pin plastic DIP (41LF), a 16-pin SOJ (1041LF), and a 16-pin SOIC-GW (1141LF).

### Features

- Single +5 V supply
- 0 to 85°C operating temperature
- Four line receivers per package
- Complementary inputs for each line receiver
- 250 mW maximum power dissipation
- 7 ns maximum propagation delay
- 0.20 V input sensitivity
- $\pm 4$  V common mode rejection

### Logic Diagram



## Digital Bipolar ICs

# Quad Differential Line Driver — 41LG

### Description

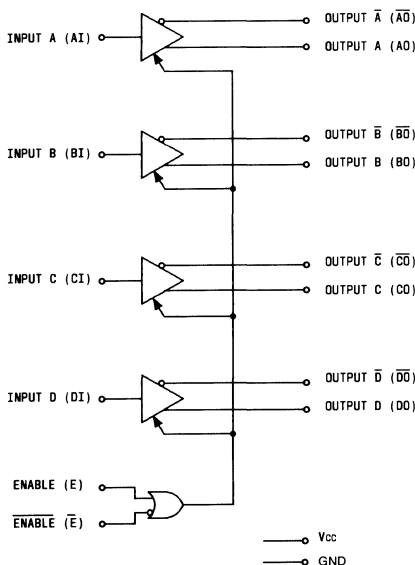
The 41LG Quad Differential Line Driver integrated circuit transmits digital data over balanced transmission lines. It translates input TTL logic levels to ECL-like output levels that directly drive the line. This OXIL technology device is pin-equivalent to the general-trade 26LS31 device; however, it has decreased power consumption and generates lower levels of electromagnetic interference (EMI). By having four drivers in one 41LG device, circuit board package count is reduced. All four line drivers in the device have common enable and disable functions. The 41LG line driver is compatible with many line receivers including the AT&T 41LF and 858B HIC (built-in terminations) devices, and the general-trade AM26LS32 device.

The quad differential line driver is available in a 16-pin plastic DIP (41LG), a 16-pin SOJ (1041LG), and a 16-pin SOIC-GW (1141LG).

### Features

- Single +5 V supply
- Four line drivers per package
- Complementary outputs from each line driver
- No line loading when  $V_{CC} = 0$
- 40 mA drive capability
- High output drive for 50  $\Omega$  lines
- 100 mA minimum output short-circuit current
- 300 mW maximum power dissipation
- 6 ns maximum propagation delay
- 0.2 ns output skew, typical
- 0 to 85°C operating temperature

### Logic Diagram



## Digital Bipolar ICs

# Dual Differential Line Driver-Receiver Pairs — 41LK, 41LL, and 41LM

### Description

The 41LK, 41LL, and 41LM devices are dual differential line driver-receiver pairs that are compatible with the 41LF Receiver and 41LG Driver devices. These dual pair devices consist of two line receivers with differential ECL-to-TTL converters, two line drivers with TTL-to-differential ECL converters, and individual 3-state enabling circuitry for the driver and receiver pairs. This allows serial data and a control clock to be transmitted and received on a single integrated circuit. The typical propagation delays for the driver and receiver of these OXIL-technology devices are 3.0 ns and 4.0 ns, respectively.

The 41LK device is intended for use where the minimization of electromagnetic interference is required, and it has characteristics similar to those of the 41LG and 41LF devices. The 41LL device has internal 200  $\Omega$  discharge resistors added on each driver output and is equivalent to the NSC DS8923A. The 41LM device has internal resistor terminations for both the driver (200  $\Omega$ ) and receiver (100  $\Omega$ ), eliminating the need for external resistors, and is intended for use with 100  $\Omega$  impedance (Z) twisted-pair or flat cable.

The dual differential line driver-receiver pairs are available in a 16-pin plastic DIP (41LK, 41LL, and 41LM), SOJ (1041LK, 1041LL, and 1041LM), or SOIC-GW (1141LK, 1141LL, and 1141LM).

### Driver Features

- Two line drivers per package
- Complementary outputs from each line driver
- Maximum propagation delay 6 ns
- No line loading when  $V_{CC} = 0$  V
- Minimum output short-circuit current 100 mA
- Output skew 0.2 ns, typical
- Single 5 V supply
- 0 to 85°C operating temperature

### Receiver Features

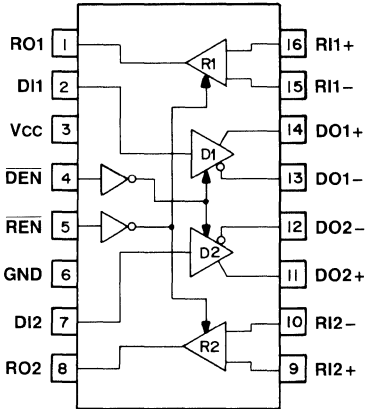
- Two line receivers per package
- Complementary inputs for each line receiver
- Maximum propagation delay 7 ns
- 0.20 V input sensitivity
- Common mode rejection  $\pm 4$  V
- Single 5 V supply
- 0 to 85°C operating temperature

*This information is preliminary and subject to change.*

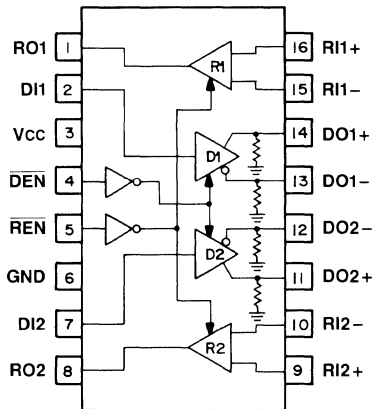
## Digital Bipolar ICs

### Dual Differential Line Driver-Receiver Pairs — 41LK, 41LL, and 41LM

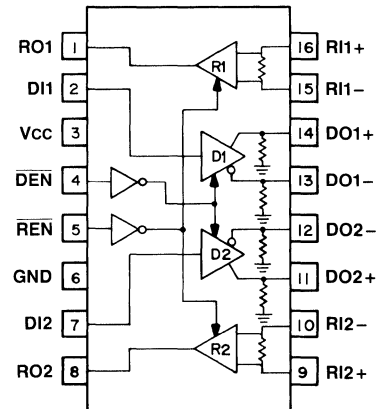
#### Pin Function Diagrams



**41LK**  
**1041LK**  
**1141LK**



**41LL**  
**1041LL**  
**1141LL**



**41LM**  
**1041LM**  
**1141LM**



## Digital Bipolar ICs

# 8 × 8 Bipolar Bilateral Crosspoint Array — 129EH-P

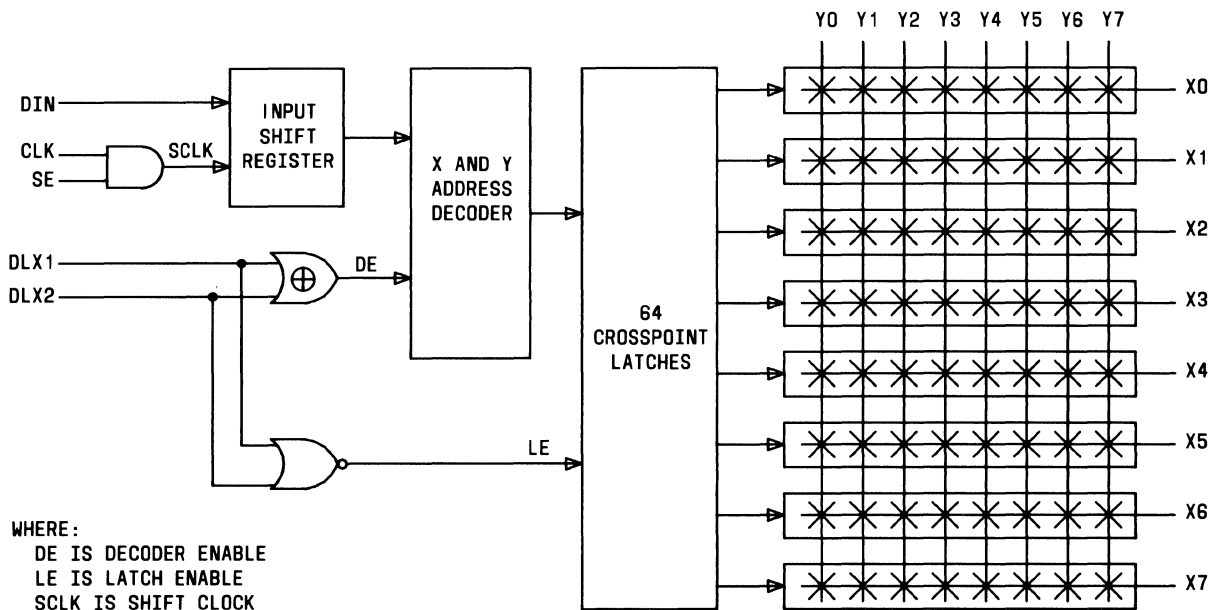
### Description

The 129EH-P 8 × 8 Bipolar Bilateral Crosspoint (B<sup>2</sup>X) Array integrated circuit is a high-density, high-performance, bipolar space division switch. It is organized as an 8 × 8 crosspoint array, with crosspoints consisting of 64 symmetrical, lateral P<sup>+</sup>NP<sup>+</sup> transistors. Each crosspoint is a nearly ideal switch, capable of conducting current in both directions with an insertion impedance of less than 20 Ω. The on-board I<sup>2</sup>L control and interface logic is TTL-compatible. The 129EH-P B<sup>2</sup>X device is available in a 24-pin molded plastic DIP.

### Features

- Crosstalk < -90 dB @ 3 kHz, 900 Ω
- Off isolation < -90 dB @ 3 kHz, 900 Ω
- Crosspoint-on resistance: 7 Ω ≤ RON ≤ 20 Ω
- Crosspoint signal bandwidth > 5 MHz
- Power dissipation < 100 mW, all crosspoints off
- TTL-compatible

### Simplified Block Diagram



## Digital Bipolar ICs

# Bipolar OXIL Gate Arrays — LS2000

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### Description

The LS2000 high-speed gate array is designed using advanced oxide-isolated (OXIL) bipolar technology. It is compatible with the TTL-ECL series of customized gate arrays. The internal logic gates are built of stacked ECL/EFL gates, and the buffers are LS240 compatible.

### Product Features

- Internal clock frequency of 200 MHz
- Internal gate delay of 0.9 ns, typical
- Fast turnaround time: 8 weeks from T = 0
- Schottky-compatible I/O
- Highly integrated SSI/MSI macro library

### CAD Features

- Schematic capture
- Multiple delay logic simulation
- Automatic placement and routing
- Design verification
- Test program generation

### Product Matrix

---

Series	Maximum No. of Equivalent Gates	Total No. Inputs, Outputs, Input/Outputs	Package Type
LS2000	2000	84 (84 outputs)	68-pin surface-mount chip carrier; 70-pin PGA; 104-pin PGA

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## Digital Bipolar ICs

# Bipolar OXIL Gate Arrays — TE1000, TE2000, TE3000

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### Description

The customized high-speed TTL-ECL gate array family is designed using advanced oxide-isolated (OXIL) bipolar technology. The internal logic gates are built of stacked ECL/EFL gates, and the buffers are a mixture of ECL and TTL for optimum speed/power combinations. The ECL outputs are capable of driving 50-ohm loads. The array is ECL 10K, ECL 10KH, and Schottky TTL compatible.

### Product Features

- Internal clock frequency of 200 MHz
- Internal gate delay of 0.9 ns, typical
- All ECL outputs drive 50-ohm loads
- Fast turnaround time: 8 weeks from T = 0
- Available mixture of ECL and TTL I/O
- Highly integrated SSI/MSI macro library

### CAD Features

- Schematic capture
- Multiple delay logic simulation
- Automatic placement and routing
- Design verification
- Test program generation

### Product Matrix

---

Series	Maximum No. of Equivalent Gates	Total No. Inputs, Outputs, Input/Outputs	Package Type
TE1000	1000	96 (48 outputs)	68-pin chip carrier; 68-pin plastic multilayer chip carrier
TE2000	2000	84 (84 outputs)	100-pin surface-mount leaded ceramic chip carrier; 104-pin PGA
TE3000	3000	168 (84 outputs)	149-pin PGA

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## Digital Bipolar ICs

# ATE-Series Digital Bipolar Gate Arrays

### Description

AT&T's advanced high-speed TTL-ECL gate arrays are designed using Scaled-Fast Oxide-Isolated Logic (SFOXIL) bipolar technology which offers higher operating speeds. The new gate arrays are the ATE6000, ATE3000, and ATE1000 and will be available in the 2Q88, 3Q88, and 3Q88, respectively.

### Product Features

- Several internal speed and power options available:

<i>Speed</i>	<i>Power</i>
500 ps	1.25 mW/gate
300 ps	2.5 mW/gate
200 ps	5.0 mW/gate

- Internal clock frequency of 500—800 MHz
- ECL and TTL buffers for optimum speed/power combinations:
  - ECL buffer input: 300 ps
  - ECL buffer output: 600 ps
  - TTL buffer input: 500 ps
  - TTL buffer output: 2400 ps

- ECL outputs that drive 50  $\Omega$  loads
- Fast turnaround time of 6 weeks from  $t = 0$
- ECL and TTL input/outputs available
- Highly integrated SSI/MSI macro library available

### CAD Features

- Schematic capture
- Multiple-delay logic simulation
- Automatic placement and routing
- Design verification
- Test program generation

### Product Matrix

<b>Gate Array Code</b>	<b>Maximum No. of Equivalent Gates</b>	<b>Total No. of Inputs, Outputs, and Input/Outputs</b>	<b>Package Type</b>
ATE1000	1000	To be determined	To be determined
ATE3000	3000	To be determined	To be determined
ATE6000	6000	120	149-pin PGA

*This information is preliminary and subject to change.*

**(Refer to Section 19 for typical applications of this product.)**

Spring 1988

**6-9**



## Digital Signal Processors (DSPs)

With both fixed-point and floating-point DSPs, AT&T has the single-chip solution. Each digital signal processor is fully supported with software and hardware development tools.

The DSP16 and DSP16A are 16-bit fixed-point processors that perform a 16×16 bit multiplication and 36-bit accumulation in a single instruction cycle. Executing 30 million instructions per second, the new DSP16A has nearly twice the throughput of the DSP16 and twice the ROM, and four times the RAM on-chip.

The DSP32 and DSP32C are 32-bit floating-point processors targeted for high-end applications. Performing up to 25 million floating-point operations per second, the new DSP32C offers full upward compatibility with the DSP32 and can address up to 16 Mbytes of external memory. An optimizing C language compiler for the DSP32 and DSP32C is available.

**For additional information contact your nearest sales office or call:**

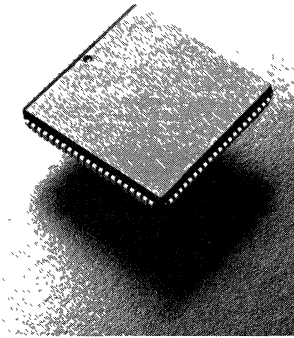
**1-800-372-2447.**

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<b>WE<sup>®</sup> DSP16 Digital Signal Processor</b> (Fixed Point)	<b>7-2</b>
* <b>WE DSP16A Digital Signal Processor</b> (Fixed Point)	<b>7-5</b>
<b>WE DSP32 Digital Signal Processor</b> (Floating Point)	<b>7-8</b>
<b>WE DSP32C Digital Signal Processor</b> (Floating Point)	<b>7-11</b>

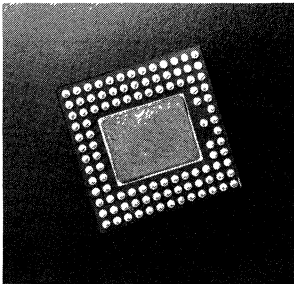
\* Did not appear in the previous edition of the Product Selection Guide.

## Digital Signal Processors

# WE DSP16 Digital Signal Processor (Fixed Point)



**WE DSP16 Digital Signal Processor 84-pin Plastic Leaded Chip Carrier**



**WE DSP16 Digital Signal Processor 13 x 13 Ceramic PGA Package**

### Description

The WE DSP16 Digital Signal Processor is a 16-bit fixed-point, high-performance, low-power CMOS integrated circuit. It can be programmed for a variety of fixed-point/integer applications.

There are three internal processing units, two for memory addressing and one for data operations. The addressing units support high-speed register-indirect memory addressing with post-modification of the register using associated increment registers or fixed increments. The data arithmetic unit (DAU) contains a  $16 \times 16$ -bit multiplier, whose product can be accumulated into one of two 36-bit accumulators. 16- or 32-bit ALU instructions are supported along with conditional branches and subroutine calls. The DSP16 also features a 15-word instruction cache for high-speed, ROM-efficient vector operations.

On-chip memory includes 2048 words of mask-programmable ROM and 512 words of RAM. Up to 64K words of external ROM may be used in place of the internal ROM.

Interfacing is supported with serial/parallel I/O ports and interrupts. The serial port is compatible with a wide variety of serial devices including TDM codecs and other DSP16 chips for multiprocessing. The parallel I/O port uses a 16-bit bus, interfacing to other DSP16 devices or peripheral devices, with data rates of up to 18.2 Mbytes/s. A mixture of hardware and software interrupts gives a high degree of interface flexibility.

### Features

- Low-power  $1 \mu\text{m}$  2-level metal CMOS technology
- 16-bit fixed-point arithmetic
- 55 and 75 ns versions available
- Military version (MIL-STD-883C) in  $13 \times 13$  ceramic PGA package available 3Q88
- Single cycle multiply/accumulate
- Two 36-bit accumulators
- 15-word instruction cache
- 2K-word on-chip ROM
- 512-word on-chip RAM
- 64K-word off-chip ROM expansion
- Serial and parallel I/O ports
- Multiprocessor capability
- Maskable interrupts
- *UNIX*<sup>®</sup> Systems, *MS-DOS*<sup>\*</sup>, and *VMS*<sup>\*\*</sup> Software support
- Development system

\* Registered trademark of Microsoft Corporation

\*\* Registered trademark of Digital Equipment Corporation

# Digital Signal Processors

## WE DSP16 Digital Signal Processor

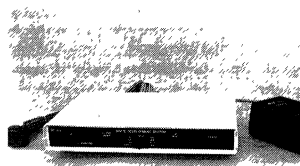
### Software Development

Software development tools to create, test, and debug DSP16 application programs are available to run under the *UNIX* Operating System, and *MS-DOS* and *VMS* Operating Systems.

The assembler source is similar to the C language, with the usual features of labels, symbols, comments, etc. The DSP16 simulator provides full program debugging by allowing access to all registers and memory. Conditional breakpoints are supported along with user-defined functions and variables.

### Hardware Development

Application system hardware development and real-time software testing is supported by the *WE DSP16-DS* Digital Signal Processor Development System. In-circuit emulation is provided and up to 16 development systems can be cascaded for multiprocessor applications.



**WE DSP16-DS Digital Signal Processor Development System**

### Product Matrix

Type	Description
Devices	
WE-DSP16-M02-075	84-Pin PLCC (Plastic, Leaded), 75 ns <sup>1,2</sup>
WE-DSP16-M02-055	84-Pin PLCC, 55 ns <sup>1,2</sup>
WE-DSP16-R02-075	13 × 13 PGA (Pin Grid Array), 75 ns <sup>1,2</sup>
WE-DSP16-R02-055	13 × 13 PGA, 55 ns <sup>1,2</sup>
Software Library Versions	
WE-DSP16-SL-UN5VX-T	<i>UNIX</i> System V ( <i>VAX</i> 11/780 Series)
WE-DSP16-SL-UN5B2-F	<i>UNIX</i> System V (3B2 Series)
WE-DSP16-SL-MSDOS-F	<i>MS-DOS</i> (AT&T PC6300 and Compatibles)
WE-DSP16-SL-VMS-T	<i>VMS</i> ( <i>VAX</i> 11/780 Series)
WE-DSP16-SL-BKSUN-C	<i>UNIX</i> System Berkeley 4.2 (Sun Series)
WE-DSP16-SL-UNB42-T	<i>UNIX</i> System Berkeley 4.2 ( <i>VAX</i> 11/780 Series)
Development Systems	
WE-DSP16-DS	Development System, 75 ns
WE-DSP16-DS-055	Development System, 55 ns

<sup>1</sup> Custom ROM versions are available.

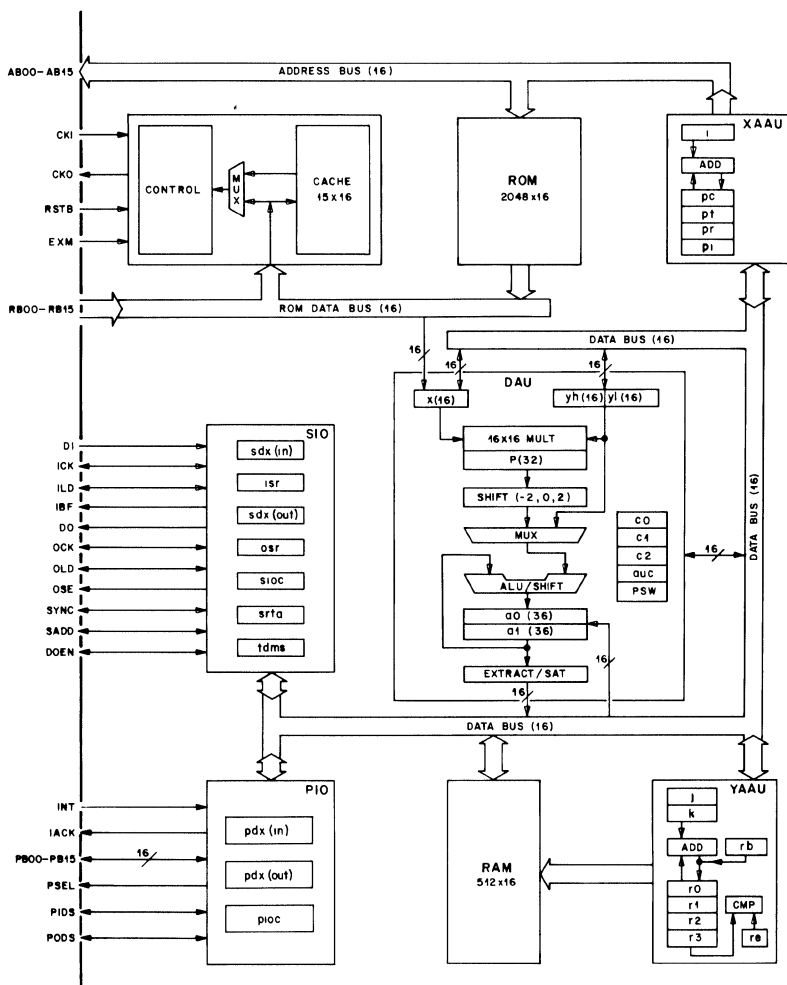
<sup>2</sup> Secure ROM versions are available.



# Digital Signal Processors

## WE DSP16 Digital Signal Processor

### Block Diagram

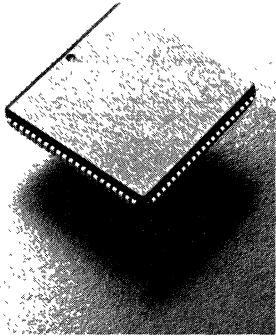


### LEGEND:

<b>16 x 16 Mult</b>	16-bit by 16-bit Multiplier
<b>a0—a1</b>	Accumulators 0—1
<b>ADD</b>	Adder
<b>ALU/SHIFT</b>	Arithmetic Logic Unit Shift
<b>auc</b>	Arithmetic Unit Control
<b>c0—c2</b>	Counters 0—2
<b>CMP</b>	Comparator
<b>DAU</b>	Data Arithmetic Unit
<b>i</b>	Increment Register
<b>isr</b>	Input Shift Register
<b>j</b>	Increment Register
<b>k</b>	Increment Register
<b>MUX</b>	Multiplexer
<b>osr</b>	Output Shift Register
<b>p</b>	Product Register
<b>pc</b>	Program Counter
<b>pdx(in)</b>	Parallel I/O Data Transmit Input Register
<b>pdx(out)</b>	Parallel I/O Data Transmit Output Register
<b>pi</b>	Program Interrupt Register
<b>PIO</b>	Parallel I/O Unit
<b>pioc</b>	Parallel I/O Control Register
<b>pr</b>	Program Return Register
<b>psw</b>	Processor Status Word
<b>pt</b>	ROM Table Pointer
<b>r0—r3</b>	RAM Pointer Registers 0—3
<b>RAM</b>	Read/Write Memory
<b>rb</b>	Modulo Addressing Register
<b>re</b>	Modulo Addressing Register
<b>ROM</b>	Read Only Memory
<b>sdx(in)</b>	Serial Data Transmit Input Register
<b>sdx(out)</b>	Serial Data Transmit Output Register
<b>SIO</b>	Serial I/O Unit
<b>sioc</b>	Serial I/O Control Register
<b>srta</b>	Serial Receive Transmit Address Register
<b>tdms</b>	Serial I/O Time Division Multiplex Signal Control Register
<b>x</b>	Multiplier Input Register
<b>XAAU</b>	ROM Address Arithmetic Unit
<b>YAAU</b>	RAM Address Arithmetic Unit
<b>yh</b>	y(high) DAU Register
<b>yl</b>	y(low) DAU Register

## Digital Signal Processors

# WE DSP16A Digital Signal Processor (Fixed Point)



**WE DSP16A Digital Signal Processor 84-pin Plastic Leaded Chip Carrier**

### Description

The WE DSP16A Digital Signal Processor is a 16-bit fixed-point, high-performance, low-power CMOS integrated circuit with nearly twice the throughput of the DSP16 device. It can be programmed for a variety of applications.

There are three internal processing units, two for memory addressing and one for data operations. The addressing units support high-speed register-indirect memory addressing with post-modification of the register using associated increment registers or fixed increments. The data arithmetic unit (DAU) contains a  $16 \times 16$ -bit multiplier, whose product can be accumulated into one of two 36-bit accumulators. 16- or 32-bit ALU instructions are supported. The DSP16 also features a 15-word instruction cache for high-speed, ROM-efficient vector operations.

On-chip memory includes 4096 words of mask-programmable ROM and 2048 words of RAM. The on-chip ROM can be augmented with up to 60K words of external memory or can be replaced with up to 64K words of external memory.

Interfacing is supported with serial/parallel I/O ports and interrupts. The serial port is compatible with a wide variety of serial devices including TDM codecs and other DSP16 or DSP16A chips for multiprocessing. The parallel I/O port uses a 16-bit bus, interfacing to other DSP16 or DSP16A devices or peripheral devices, with data rates of up to 30 Mbytes/s. A mixture of hardware and software interrupts gives a high degree of interface flexibility.

### Features

- Low-power  $.75 \mu\text{m}$  2-level metal CMOS technology
- 16-bit fixed-point arithmetic
- 33 ns instruction time
- Single cycle multiply/accumulate
- Two 36-bit accumulators
- 15-word instruction cache
- 4K-word on-chip ROM
- 2K-word on-chip RAM
- 64K-word off-chip ROM expansion
- Serial and parallel I/O ports
- Multiprocessor capability
- Maskable interrupts
- UNIX<sup>®</sup> Systems, MS-DOS, and VMS Software support
- Development system

# Digital Signal Processors

## WE DSP16A Digital Signal Processor

### Software Development

Software development tools to create, test, and debug DSP16A application programs are available to run under the *UNIX* Operating System, and *MS-DOS* and *VMS* operating systems.

The assembler source is similar to the C language, with the usual features of labels, symbols, comments, etc. The DSP16A simulator provides full program debugging by allowing access to all registers and memory, and provides precise simulations. Conditional breakpoints are supported along with user-defined functions and variables.

### Hardware Development

Application system hardware development and real-time software testing is supported by the *WE DSP16A-DS* Digital Signal Processor Development System. In-circuit emulation is provided and up to 16 development systems can be cascaded for multiprocessor applications.

### Product Matrix

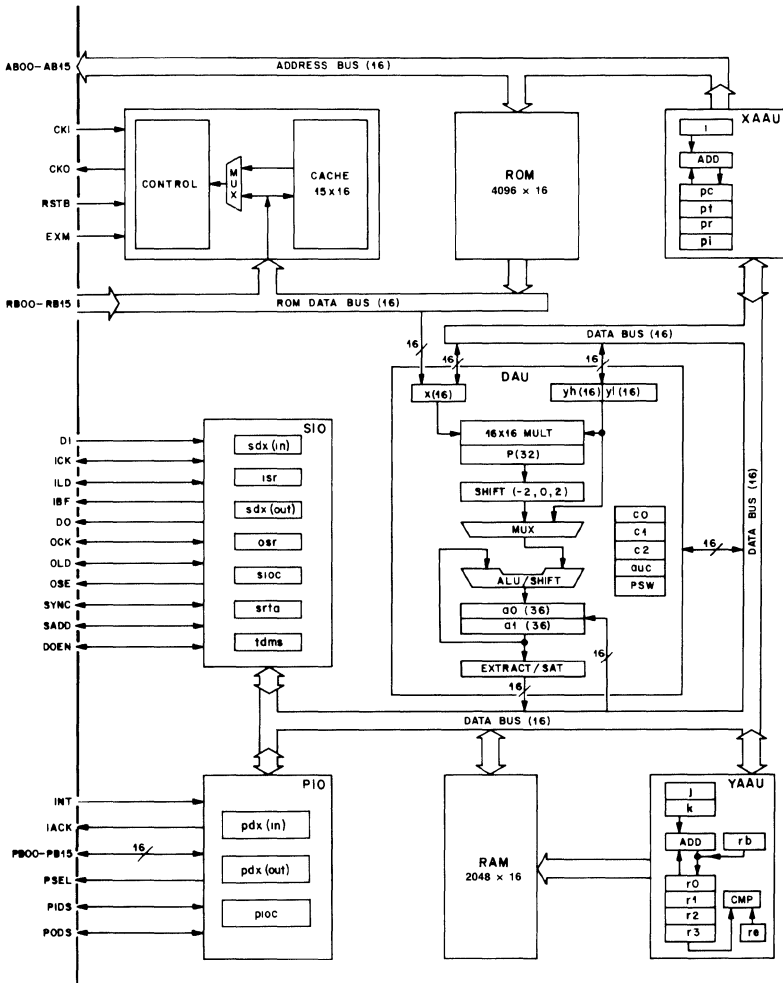
Type	Description
Devices	
WE-DSP16A-M11-033	84-Pin PLCC (Plastic Leaded), 33 ns*
Software Library Versions	
WE-DSP16A-SL-UN5VX-T	<i>UNIX</i> System V ( <i>VAX</i> 11/780 Series)
WE-DSP16A-SL-UN5B2-F	<i>UNIX</i> System V (3B2 Series)
WE-DSP16A-SL-UNB42-T	<i>UNIX</i> System Berkeley 4.2 ( <i>VAX</i> 11/780 Series)
WE-DSP16A-SL-BKSUN-C	<i>UNIX</i> System Berkeley 4.2 (Sun Series)
WE-DSP16A-SL-VMS-T	<i>VMS</i> ( <i>VAX</i> 11/780 Series)
WE-DSP16A-SL-MSDOS-F	<i>MS-DOS</i> (AT&T PC6300 and Compatibles)

\* Custom ROM versions are available.

# Digital Signal Processors

## WE DSP16A Digital Signal Processor

### Block Diagram

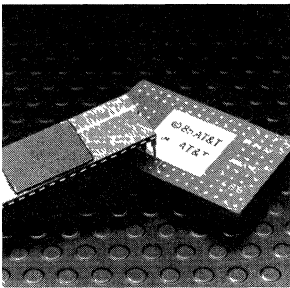


### LEGEND:

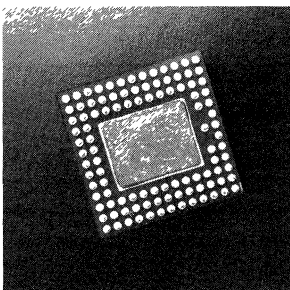
<b>16 x 16 Mult</b>	16-bit by 16-bit Multiplier
<b>a0—a1</b>	Accumulators 0—1
<b>ADD</b>	Adder
<b>ALU/SHIFT</b>	Arithmetic Logic Unit Shifter
<b>auc</b>	Arithmetic Unit Control
<b>c0—c2</b>	Counters 0—2
<b>CMP</b>	Comparator
<b>DAU</b>	Data Arithmetic Unit
<b>i</b>	Increment Register
<b>isr</b>	Input Shift Register
<b>j</b>	Increment Register
<b>k</b>	Increment Register
<b>MUX</b>	Multiplexer
<b>osr</b>	Output Shift Register
<b>p</b>	Product Register
<b>pc</b>	Program Counter
<b>pdx(in)</b>	Parallel I/O Data Transmit Input Register
<b>pdx(out)</b>	Parallel I/O Data Transmit Output Register
<b>pi</b>	Program Interrupt Register
<b>PIO</b>	Parallel I/O Unit
<b>pioc</b>	Parallel I/O Control Register
<b>pr</b>	Program Return Register
<b>psw</b>	Processor Status Word
<b>pt</b>	ROM Table Pointer
<b>r0—r3</b>	RAM Pointer Registers 0—3
<b>RAM</b>	Read/Write Memory
<b>rb</b>	Modulo Addressing Register
<b>re</b>	Modulo Addressing Register
<b>ROM</b>	Read Only Memory
<b>sdx(in)</b>	Serial Data Transmit Input Register
<b>sdx(out)</b>	Serial Data Transmit Output Register
<b>SIO</b>	Serial I/O Unit
<b>sioc</b>	Serial I/O Control Register
<b>srta</b>	Serial Receive Transmit Address Register
<b>tdms</b>	Serial I/O Time Division Multiplex Signal Control Register
<b>x</b>	Multiplier Input Register
<b>XAAU</b>	ROM Address Arithmetic Unit
<b>YAAU</b>	RAM Address Arithmetic Unit
<b>yh</b>	y(high) DAU Register
<b>yl</b>	y(low) DAU Register

## Digital Signal Processors

# WE DSP32 Digital Signal Processor (Floating Point)



**WE DSP32 Digital Signal Processor 40-pin DIP and 100-pin PGA**



**WE DSP32 Digital Signal Processor 13 x 13 PGA**

### Description

The WE DSP32 Digital Signal Processor is a 32-bit floating-point integrated circuit. Its architecture has been optimized for applications such as speech processing, telecommunications, image processing, and numerical control.

There are two internal arithmetic units available to the designer, the control arithmetic unit (CAU) for 16-bit integer operations as well as memory and program control, and the data arithmetic unit (DAU) for 32-bit floating-point operations. The CAU features a 16-bit adder, program counter, and 21 general-purpose registers. The DAU has a single-instruction floating-point multiply/accumulate, auto post-normalization, and single-instruction format conversions.

Two banks of 512 (32-bit) words of internal RAM are provided, along with 512 words of mask-programmable ROM. 56 Kbytes of external memory (ROM or RAM) may be added to the 100-pin or 13 x 13 PGA version with no loss in execution speed.

There are extremely flexible serial and parallel input/output ports with associated on-chip DMA controllers for multiprocessor and peripheral interfacing.

The DSP32 device is available in 16 and 25 MHz versions, achieving instruction cycle times of 250 and 160 ns, respectively. The 13 x 13 PGA package provides pin compatibility with the new DSP32C device.

### Features

- 160 and 250 ns versions available
- 32-bit floating-point arithmetic
- All instructions are single cycle
- Up to 4 memory accesses per instruction
- Four 40-bit accumulators
- 16-bit integer operations
- 512 words on-chip ROM; 1024 words on-chip RAM
- External memory expansion (100-pin or 13 x 13 PGA)
- Serial and parallel I/O ports
- On-chip DMA
- UNIX Systems and MS-DOS Software support
- Full C compiler
- Extensive application software library
- Development system
- Third party support

# Digital Signal Processors

## WE DSP32 Digital Signal Processor

### Software Development

The DSP32 software development tools include an optimizing C compiler, an assembler/linker, a simulator operating under the *UNIX* Operating System, and *MS-DOS* Operating Systems

The compiler is a full implementation of standard AT&T C language and uses pipeline optimization to achieve the efficiency required in real-time applications. Several libraries of functions allow easy porting of C programs from other systems.

The DSP32 simulator is a powerful debugging facility that allows access to all registers and memory. Precise timing simulations are possible for code optimization. High-level features, such as user defined functions, variables, and if/while constructs equip the designer for rapid program development. Data files may also be interfaced with simulated I/O so that real data may be processed by the simulator in non-real time

### Hardware Development

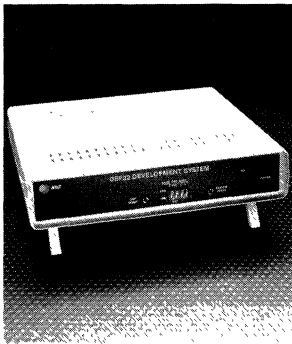
The DSP32 development system allows real-time evaluation of programs which are loaded via an RS232 interface. The development system commands are a subset of the simulator and include register/memory display and software breakpoints. Buffered input/output in-circuit emulation is possible, and up to 7 development systems may be used together for multiprocessor applications.

### Product Matrix

Type	Description
Devices	
WE-DSP32-C08-250	40-Pin Ceramic DIP, 250 ns*
WE-DSP32-G08-250	100-Pin PGA, 250 ns*
WE-DSP32-C08-160	40-Pin Ceramic DIP, 160 ns*
WE-DSP32-G08-160	100-Pin PGA, 160 ns*
WE-DSP32-R08-250	13 x 13 PGA, 250 ns*
WE-DSP32-R08-160	13 x 13 PGA, 160 ns*
Software Library Versions	
WE-DSP32-SL-UN5VX-T	<i>UNIX</i> System V ( <i>VAX</i> 11/780 Series)
WE-DSP32-SL-UNB42-T	<i>UNIX</i> System, Berkeley 4.2 ( <i>VAX</i> 11/780 Series)
WE-DSP32-SL-UN5B2-F	<i>UNIX</i> System V (3B2 Series)
WE-DSP32-SL-MSDOS-F	<i>MS-DOS</i> (AT&T PC6300 and Compatibles)
WE-DSP32-SL-BKSUN-C	<i>UNIX</i> System, Berkeley 4.2 (Sun Series)
Application Library Versions**	
WE-DSP32-AL-MSDOS-F	<i>MS-DOS</i> (AT&T PC6300 and compatibles)
Development Systems	
WE-DSP32-DS	Development System (Host Independent), 250 ns
WE-DSP32-DS-160	Development System (Host Independent), 160 ns
C-Compiler Versions	
WE-DSP32-CC-UN5VX-T	<i>UNIX</i> System V ( <i>VAX</i> 11/780 Series)
WE-DSP32-CC-UNB42-T	<i>UNIX</i> System, Berkeley 4.2 ( <i>VAX</i> 11/780 Series)
WE-DSP32-CC-BKSUN-C	<i>UNIX</i> System, Berkeley 4.2 (Sun Series)
WE-DSP32-CC-UN5B2-F	<i>UNIX</i> System V (3B2 Series)
WE-DSP32-CC-MSDOS-F	<i>MS-DOS</i> (AT&T PC6300 and Compatibles)

\* Custom ROM versions are available.

\*\* Supported for same hosts as Software Library and C Compiler.

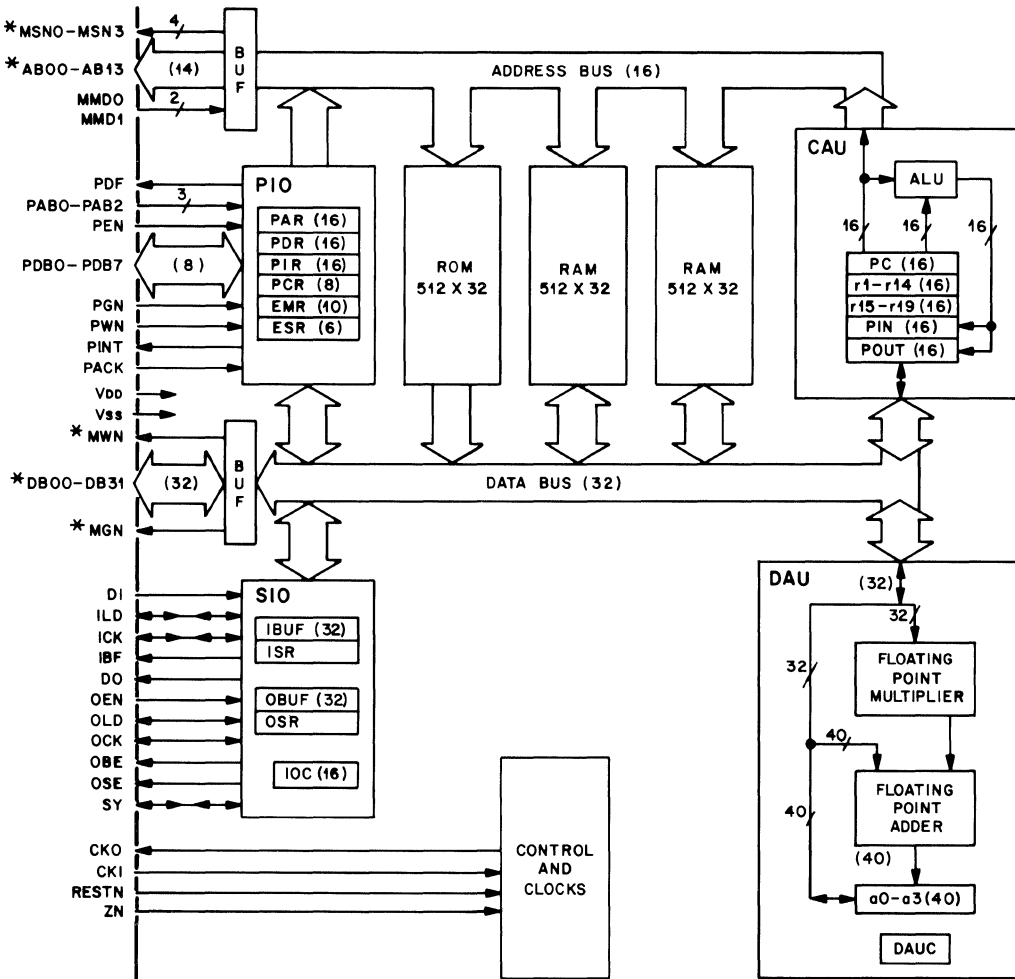


**WE DSP32-DS Digital Signal Processor Development System**

# Digital Signal Processors

## WE DSP32 Digital Signal Processor

### Block Diagram



\*AVAILABLE ON 100-PIN PGA PACKAGE ONLY

#### LEGEND:

<b>a0—a3</b>	Accumulators 0—3	<b>IOC</b>	Input/Output Control Register	<b>PIO</b>	Parallel I/O Unit
<b>ALU</b>	Arithmetic Logic Unit	<b>ISR</b>	Input Shift Register	<b>PIR</b>	PIO Interrupt Register
<b>CAU</b>	Control Arithmetic Unit	<b>OBUF</b>	Output Buffer	<b>R1—r19</b>	Registers 1—19
<b>DAU</b>	Data Arithmetic Unit	<b>OSR</b>	Output Shift Register	<b>PIN</b>	Pointer for Serial DMA Input
<b>DAUC</b>	Data Arithmetic Unit Control Register	<b>PAR</b>	PIO Address Register	<b>POUT</b>	Pointer for Serial DMA Output
<b>EMR</b>	Error Mask Register	<b>PC</b>	Program Counter	<b>RAM</b>	Read Write Memory
<b>ESR</b>	Error Source Register	<b>PCR</b>	PIO Control Register	<b>ROM</b>	Read-Only Memory
<b>IBUF</b>	Input Buffer	<b>PDR</b>	PIO Data Register	<b>SIO</b>	Serial I/O Unit

## Digital Signal Processors

# WE DSP32C Digital Signal Processor (Floating Point)

### Description

Targeted at high-performance applications, the WE DSP32C Digital Signal Processor brings an unprecedented level of performance to the systems designer. Upward compatibility has been preserved with the DSP32, so current DSP32 users can easily upgrade to the DSP32C if greater performance is desired. The DSP32C features a 16 Mbyte address space, vectored interrupts, a full C compiler, enhanced instruction set, and powerful format conversions.

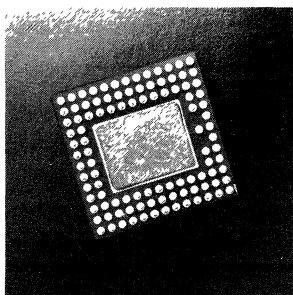
The DSP32C uses two execution units to achieve its high throughput. An integer processing unit (CAU) is used as a 16- or 24-bit microprocessor, or it may be used to generate and modify addresses for the data arithmetic unit (DAU). The CAU supports conditional and unconditional ALU and branch operations as well as data move instructions. When used to generate addresses for the DAU, the CAU can generate and post-modify four addresses in a single instruction cycle.

The DAU employs a straightforward 3-stage fetch/multiply/accumulate pipeline for 32-bit floating-point operands. Results are automatically normalized without additional instructions or pipeline stages.

On-chip memory consists of three banks of RAM, each with 512 words. A ROM-coded version is also available which substitutes a 2048-word ROM for one 512-word RAM bank. External memory is expandable to 16 Mbytes (directly addressable). A flexible wait-state generator allows efficient use of slower memories and memory-mapped peripherals.

### Features

- 80 and 100 ns versions available
- .75  $\mu\text{m}$  double-metal CMOS technology
- Object code compatible with DSP32 (pin compatible with 13  $\times$  13 PGA package)
- Twenty-two 24-bit general-purpose registers
- 32-bit floating-point arithmetic
- Full C compiler
- 24-bit and 16-bit integer microprocessor operations for logic and control
- Data addressable as 8-, 16-, or 32-bit words
- 2048 words of ROM and 2 banks (512 words each) of RAM, or 3 banks (512 words each) of RAM
- 16 Mbytes of directly addressable off-chip memory
- Wait states for slow external memories



**WE DSP32C Digital Signal Processor 13  $\times$  13 Ceramic PGA Package**



## Digital Signal Processors

### WE DSP32C Digital Signal Processor

- Powerful single-cycle data format conversions
  - IEEE 754 floating point
  - 24-bit and 16-bit integer
  - 8-bit linear byte
  - 8-bit  $\mu$ -law and A-law
- Serial and parallel ports with DMA
- Interfaces to a microprocessor without glue logic
- 6 vectored interrupts
- 133-pin PGA package

#### Product Matrix

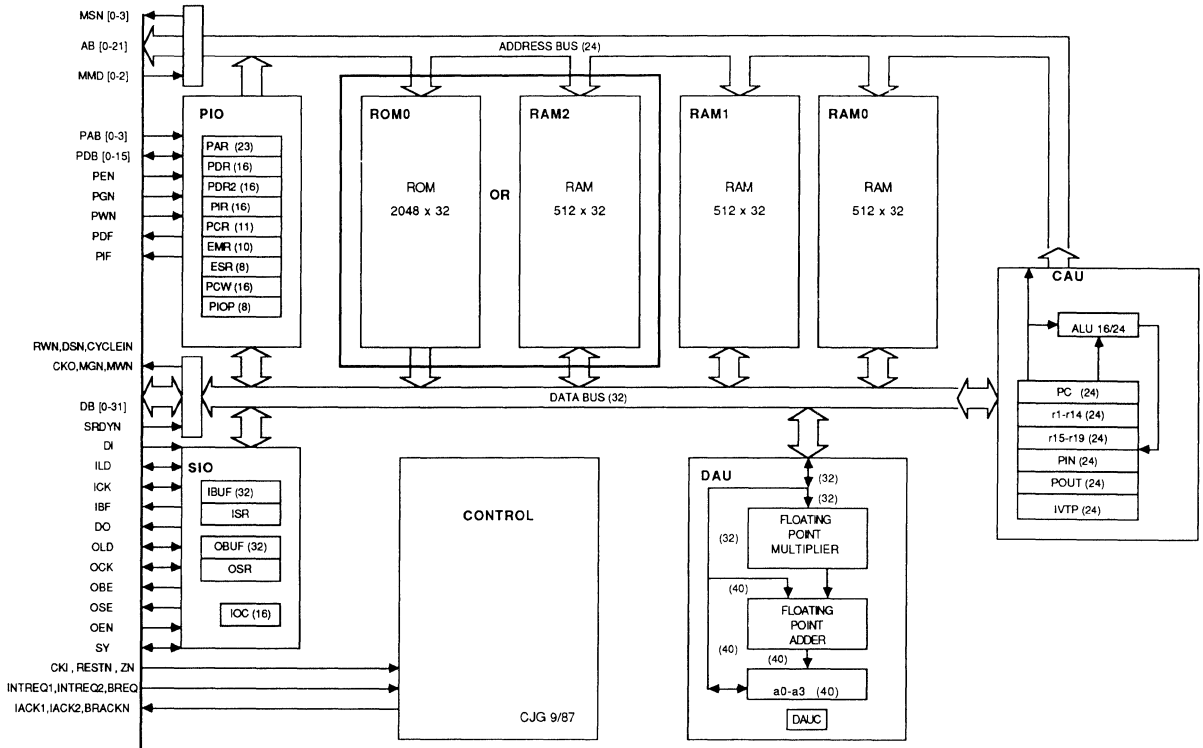
Type	Description
Devices	
WE-DSP32C-R31-100	133-Pin PGA, 100 ns
WE-DSP32C-R31-080	133-Pin PGA, 80 ns
WE-DSP32C-R21-XX-100	133-Pin PGA, 100 ns, Custom ROM
WE-DSP32C-R21-XX-080	133-Pin PGA, 80 ns, Custom ROM
Software Library Versions	
WE-DSP32C-SL-UN5VX	UNIX System V (VAX 11/780 Series)
WE-DSP32C-SL-UNB42	UNIX System, Berkeley 4.2 (VAX 11/780 Series)
WE-DSP32C-SL-UN5B2	UNIX System V (3B2 Series)
WE-DSP32C-SL-MSDOS	MS-DOS (AT&T PC6300 and Compatibles)
WE-DSP32C-SL-BKSUN	UNIX Berkeley 4.2 (Sun Series)
Application Library Versions*	
WE-DSP32C-AL-MSDOS	MS-DOS (AT&T PC6300 and Compatibles)
C-Compiler Versions	
WE-DSP32C-CC-UN5VX-T	UNIX System V (VAX 11/780 Series)
WE-DSP32C-CC-UNB42-T	UNIX System, Berkeley 4.2 (VAX 11/780 Series)
WE-DSP32C-CC-BKSUN-C	UNIX System, Berkeley 4.2 (Sun Series)
WE-DSP32C-CC-UN5B2-F	UNIX System V (3B2 Series)
WE-DSP32C-CC-MSDOS-F	MS-DOS (AT&T PC6300 and Compatibles)
Development Systems (AT&T PC6300 and Compatibles)	
WE-DSP32C-DS-DEV-16	Development Card, 16K Words $\times$ 32 Memory
WE-DSP32C-DS-DEV-64	Development Card, 64K Words $\times$ 32 Memory
WE-DSP32C-DS-ICE	In-Circuit Emulator Board
WE-DSP32C-DS-PBS	PC Bus Card
WE-DSP32C-DS-EXM	Extended Memory Board

\* Supported for same hosts as Software Library and C Compiler.

# Digital Signal Processors

## WE DSP32C Digital Signal Processor

### Block Diagram



### LEGEND:

<b>a0—a3</b>	Accumulators 0—3	<b>ISR</b>	Input Shift Register	<b>PDR2</b>	PIO Data Register 2
<b>ALU</b>	Arithmetic Logic Unit	<b>IVTP</b>	Interrupt Vector Table Pointer	<b>PIN</b>	Parallel Input Register
<b>CAU</b>	Control Arithmetic Unit	<b>OBUF</b>	Output Buffer	<b>PIO</b>	Parallel I/O Unit
<b>DAU</b>	Data Arithmetic Unit	<b>OSR</b>	Output Shift Register	<b>PIOP</b>	Parallel I/O Ports
<b>DAUC</b>	DAU Control Register	<b>PAR</b>	PIO Address Register	<b>PIR</b>	PIO Interrupt Register
<b>EMR</b>	Error Mask Register	<b>PCW</b>	Processor Control Word	<b>POUT</b>	Parallel Output Register
<b>ESR</b>	Error Source Register	<b>PC</b>	Program Counter	<b>r1—r19</b>	Registers 1—19
<b>IBUF</b>	Input Buffer	<b>PCR</b>	PIO Control Register	<b>RAM</b>	Read/Write Memory
<b>IOC</b>	Input/Output Control Register	<b>PCW</b>	Processor Control Word	<b>ROM</b>	Read-Only Memory
		<b>PDR</b>	PIO Data Register	<b>SIO</b>	Serial I/O Unit



## Fiber Optics

AT&T's active and passive fiber optic product family offers reliability, security, and interference immunity in communication networks.

*ODL*® Lightwave Data Links can handle large amounts of information because of their broad bandwidth. Fiber optic modems, an extension of the data links, can be inserted into standard applications. *ASTROTEC*® Laser Modules and Laser Transmitters, designed for long haul applications, are thermoelectrically cooled for wavelength stability and long life. *ASTROTEC* Receivers provide highly sensitive PIN and APD options.

AT&T's line of connectors include *ST*® Lightguide Cable Connectors; single-mode biconic connectors; and the multifiber array connector (MAC).

Cable and apparatus includes numerous types of cables, jumpers, cabinets, splices, and test sets.

**For additional information contact your nearest sales office or call:**  
**1-800-372-2447.**

### Lightwave Data Links, Retimers, and Interfaces

<i>ODL</i> 200 Lightwave Data Link	<b>8-2</b>
Clock Recovery and Data Retiming Module — TRU-200A	<b>8-3</b>
<i>ODL</i> 50 Lightwave Data Link	<b>8-4</b>
<i>ODL</i> RS232-1 Fiber Optic Modem/Multiplexer	<b>8-5</b>
* <i>ODL</i> RS232-1M Fiber Optic Multiplexer/Module	<b>8-6</b>
<i>ODL</i> RS232-2 Fiber Optic Modem	<b>8-7</b>
<i>ODL</i> 02X Lightwave Transceiver	<b>8-8</b>

### Laser Products

<i>ASTROTEC</i> Lightwave Transmitters	<b>8-9</b>
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<i>LIGHTPACK</i> ® Cable	<b>8-14</b>
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Ribbon Cable	<b>8-18</b>
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### Cabinets/*LGX*™ Lightguide Cross-Connect Frame **8-28**

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\* Did not appear in the previous edition of the Product Selection Guide.

## Fiber Optics

### Lightwave Data Links, Retimers, and Interfaces

# ODL 200 Lightwave Data Link



### Description

The *ODL 200* Lightwave Data Link is a high-performance link that consists of a 1252 Series Transmitter and 1352 Series Receiver. It is designed for data rates from 40 to 220 Mb/s (NRZ) and will transmit over distances up to 3 km. The transmitter and receiver are single-chip, microwave complementary bipolar integrated circuit (MCBIC) designs and are housed in well-shielded, compact, connectorized 16-pin DIPs. The *ODL 200* Lightwave Data Link is designed to be used with 62.5/125  $\mu\text{m}$  optical fiber and an *ST*<sup>®</sup> Lightguide Cable Connector. The data link may be used with other fibers as well.

### Features

- 100K ECL-compatible
- Single power supply
- Single-chip, MCBIC design
- 18.3 dB typical power budget
- 3 km link
- 1.3  $\mu\text{m}$  LED and PIN diode
- Link status indicator
- Optional TRU-200A Clock Recovery and Data Retiming Module (see page 8-3)

### Product Matrix

Code	Product Description	Features
1252J	Transmitter	Data rates 40—220 Mb/s; long wavelength; 1.3 $\mu\text{m}$ LED; optical power $-19$ dB; $\pm 4.5$ V; 16-pin DIP; <i>ST</i> Connector
1252N	Transmitter	Same as 1252J Transmitter, with $\pm 5.0$ V
1352J	Receiver	Data rates 40—220 Mb/s; long wavelength; PIN diode; sensitivity $-30$ dBm; $-4.2$ to $-5.46$ V; 16-pin DIP; <i>ST</i> Connector
1352N	Receiver	Same as 1352J Receiver, with $+4.2$ to $+5.46$ V
(Kit)	<i>ODL 200</i> Lightwave Data Link Models Kit	1252J/N Tx; 1352J/N Rx; 50-foot, 62.5 $\mu\text{m}$ fiber cable
TRU-200A	Clock Recovery and Retiming Module	Optional for use with <i>ODL 200</i> Lightwave Data Link

# Clock Recovery and Data Retiming Module — TRU-200A

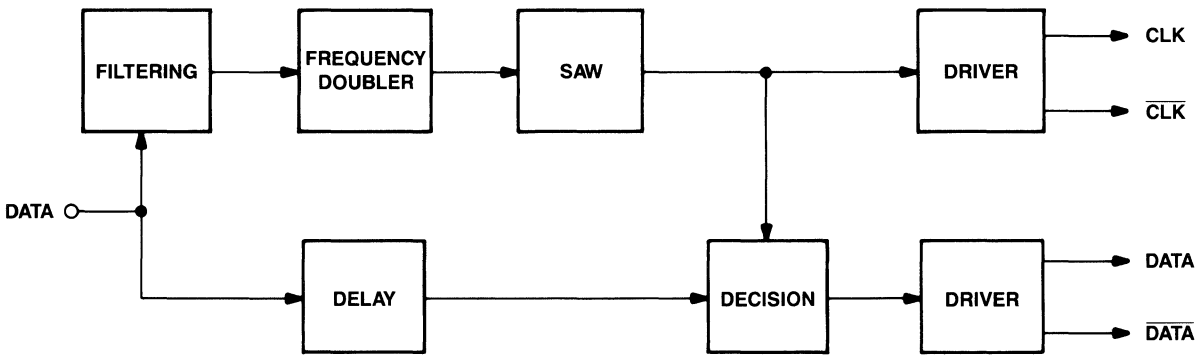
## Description

The TRU-200A Clock Recovery and Data Retiming Module is a high-performance device for extracting the clock signal from a transmitted digital data stream and retiming the data to yield bit error ratios below  $10^{-9}$  and phase noise reduction from as much as 70% at the input to below 10% at the output. When used with the ODL 200 Lightwave Receiver, this function can be performed with less than a 1 dB optical power allowance at the maximum data rate. The hermetically sealed 28-pin DIP contains a single Microwave Complementary Bipolar Integrated Circuit (MCBIC) and Surface Acoustic Wave (SAW) filter to achieve exceptional performance and high reliability.

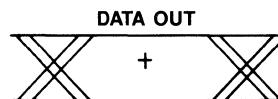
## Features

- Choice of data rates from 125 to 250 Mb/s
- Output jitter less than  $3^\circ$  rms
- Compatible with ODL 200 Lightwave Data Link
- 100K ECL-compatible inputs and outputs
- Single supply voltage (negative or positive)
- Complementary DATA and CLOCK outputs
- Hermetically sealed 28-pin ceramic dual in-line package (DIP)

## Block Diagram



30% MIN  
EYE OPENING

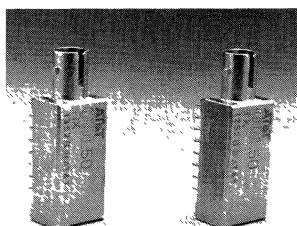


90% MIN  
EYE OPENING

## Fiber Optics

### Lightwave Data Links, Retimers, and Interfaces

# ODL 50 Lightwave Data Link



### Description

The *ODL 50* Lightwave Data Link is a high-performance link consisting of a 1252 Series Transmitter and 1352 Series Receiver. It is designed for data rates from 1 to 50 Mb/s (NRZ) at distances up to 3 km (0.87  $\mu\text{m}$ ) or 11 km (1.3  $\mu\text{m}$ ). The transmitter and receiver are single-chip, CMOS designs housed in well-shielded, compact connectorized 16-pin DIPs. The *ODL 50* Lightwave Data Link is designed for use with 62.5/125  $\mu\text{m}$  optical fiber and an *ST* Connector. The data link may be used with other fibers as well.

In addition to the LED driver and GaAlAs high-radiance LED, the *ODL 50* Transmitter also includes a seven-stage data scrambler circuit. The *ODL 50* Receiver consists of a PIN photodiode, preamplifiers and post-amplifiers, and a decision circuit. The 0.87  $\mu\text{m}$  version and 1.3  $\mu\text{m}$  version are pin-for-pin compatible.

### Features

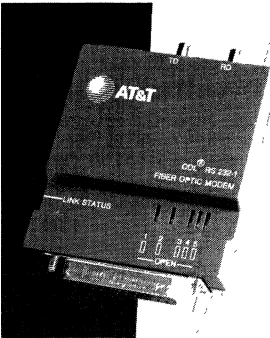
- TTL-compatible
- Single 5 V power supply
- Single-chip, CMOS design
- 20 dB typical power budget for 0.87  $\mu\text{m}$ ; 23 dB typical power budget for 1.3  $\mu\text{m}$
- 0.87  $\mu\text{m}$  or 1.3  $\mu\text{m}$  LED and PIN diode
- 3 km link (0.87  $\mu\text{m}$ ) or 11 km link (1.3  $\mu\text{m}$ )
- Link status indicator
- Optional T7032 Clock Recovery Circuit (see page 5-47)

### Product Matrix

Code	Product Description	Features
1252P	Transmitter	Data rates 1—50 Mb/s; short wavelength; 0.87 $\mu\text{m}$ LED; optical power $-15$ dBm; 5 V; 16-pin DIP; <i>ST</i> Connector
1252E	Transmitter	Data rates 1—50 Mb/s; long wavelength; 1.3 $\mu\text{m}$ LED; optical power $-19$ dBm; 5 V; 16-pin DIP; <i>ST</i> Connector
1352P	Receiver	Data rates 1—50 Mb/s; 3 km link, short wavelength; PIN diode; sensitivity $-29$ dBm; 5 V; 16-pin DIP; <i>ST</i> Connector
1352E	Receiver	Data rates 1—50 Mb/s; 11 km link, long wavelength; PIN diode; sensitivity $-32$ dBm; 5 V; 16-pin DIP; <i>ST</i> Connector
(Kit)	<i>ODL 50</i> Lightwave Data Link Models Kit	1252P/E Tx; 1352P/E Rx; 50-foot, 62.5 $\mu\text{m}$ fiber cable
T7032	Clock Recovery IC	Optional for use with <i>ODL 50</i> Lightwave Data Link

## Fiber Optics Lightwave Data Links, Retimers, and Interfaces

# ODL RS232-1 Fiber Optic Modem/Multiplexer



### Description

The ODL RS232-1 Fiber Optic Modem/Multiplexer is a high-performance data interface designed to interface with DTE equipment. It operates at data rates ranging from 1.2 to 64 kb/s synchronous, or dc to 100 kb/s asynchronous. In the synchronous mode, the clock may be supplied by the modem or by the attached DTE.

Two ODL RS232-1 modules and a pair of fiber optic cables provide a full-duplex transmission link of up to 3 km (with a bit-error-rate not exceeding  $10^{-9}$ ), when used with the recommended 62.5/125  $\mu\text{m}$  fiber and ST Fiber Optic Connectors. The modem combines time-division multiplexing with an asynchronous sampling scheme to multiplex data, clock, and four control channels (or as many as six input lines) for fiber optic communication. The ODL RS232-1M Fiber Optic Multiplexer/Module provides a board-level equivalent of this device.

### Features

- EIA RS-232C and CCITT V.24 compatible
- Meets FCC Class B EMI requirements
- Switch-selectable DCE clock (frequency to line configuration)
- LED status indicator
- External  $\pm 12$  V power source

### Product Matrix

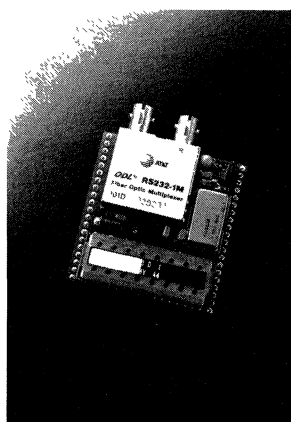
Code	Product Description	Features
100A	ODL RS232-1 Fiber Optic Modem/Multiplexer	Male RS232 connector: Data rates 1.2—64 kb/s syn., dc — 100 kb/s asyn.; full-duplex 3 km link; 62.5 $\mu\text{m}$ fiber cable; multiplexer for up to 6 channels
100D	ODL RS232-1 Fiber Optic Modem/Multiplexer	Female RS232 connector: Data rates 1.2—64 kb/s syn., dc — 100 kb/s asyn.; full-duplex 3 km link; 62.5 $\mu\text{m}$ fiber cable; multiplexer for up to 6 channels
(Kit)	ODL RS232-1 Fiber Optic Modem/Multiplexer	2 modems with male or female connectors, or combination; 50-foot jumper cable; accessories



## Fiber Optics

### Lightwave Data Links, Retimers, and Interfaces

# ODL RS232-1M Fiber Optic Multiplexer/Module



### Description

The ODL RS232-1M Fiber Optic Multiplexer/Module is a high-performance, board-mountable data interface serving as an RS-232C to fiber-optics converter for as many as six full-duplex I/O channels. It operates at data rates ranging from 1.2 to 64 kb/s synchronous, or dc to 100 kb/s asynchronous. In the synchronous mode, the clock may be supplied by the module or by the host equipment. The RS232-1M Module is the board-level equivalent of the RS232-1 Modem.

Two ODL RS232-1M modules and a pair of fiber optic cables provide a full-duplex transmission link of 3 km (with a bit-error-rate not exceeding  $10^{-9}$ ), when used with the recommended 62.5/125  $\mu\text{m}$  fiber and ST Fiber Optic Connectors. The module combines time-division multiplexing with an asynchronous sampling scheme to multiplex data, clock, and four control channels (or as many as six input lines) for fiber optic communication.

### Features

- EIA RS-232C and CCITT V.24 compatible
- 40-pin dual in-line module
- Typical link budget of 15 dB
- Link status indicators (flag output and LED) on module

### Product Matrix

Code	Product Description	Features
101D	ODL RS232-1M Module	40-pin board-mountable module; data rates 1.2—64 kb/s syn., dc—100 kb/s asyn.; full-duplex 3 km link; multiplexer for up to six channels
(Kit)	ODL RS232-1M Fiber Optic Modem/Multiplexer	2 modules; 50-foot duplex jumper cable

## Fiber Optics Lightwave Data Links, Retimers, and Interfaces

# ODL RS232-2 Fiber Optic Modem



### Description

The *ODL RS232-2* Fiber Optic Modem is a high-performance data link designed to interface with data terminal equipment (DTE) systems. Two modules and a single-fiber cable provide for simplex, half-duplex, or full-duplex data communication between any two DTE devices, including computers, terminals, and printers. The modem operates at data rates from dc to 19.2 kb/s asynchronous and features a secondary control channel which may be used independently of the data channel. The unit provides loopback diagnostics. The *ODL 02X* Lightwave Transceiver provides a board-level companion to this device.

### Features

- EIA RS-232C and CCITT V.24 compatible
- Meets FCC Class B EMI requirements
- Switch-selectable (loopback configuration)
- LED status indicator
- Internal or external power source

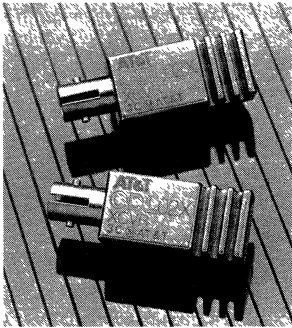
### Product Matrix

Code	Product Description	Features
100H	<i>ODL RS232-2</i> Fiber Optic Modem	Male RS232 connector; $\pm 12$ V; Data rates dc — 19.2 kb/s; bidirectional full-duplex over single fiber cable with <i>ST</i> Connector; 1 km link; EIA RS-232C compatible
100J	<i>ODL RS232-2</i> Fiber Optic Modem	Female RS232 connector; $\pm 12$ V; Data rates dc — 19.2 kb/s; bidirectional full-duplex over single fiber cable with <i>ST</i> Connector; 1 km link; EIA RS-232C compatible
100K	<i>ODL RS232-2</i> Fiber Optic Modem	Male RS232 connector; +5 V; Data rates dc — 19.2 kb/s; bidirectional full-duplex over single fiber cable with <i>ST</i> Connector; 1 km link; EIA RS-232C compatible
100L	<i>ODL RS232-2</i> Fiber Optic Modem	Female RS232 connector; +5 V; Data rates dc — 19.2 kb/s; bidirectional full-duplex over single fiber cable with <i>ST</i> Connector; 1 km link; EIA RS-232C compatible
(Kit)	<i>ODL RS232-2</i> Fiber Optic Modem	2 modems with male or female connectors, $\pm 12$ V or +5 V, or combination; 50-foot jumper cable; accessories

## Fiber Optics

### Lightwave Data Links, Retimers, and Interfaces

# ODL 02X Lightwave Transceiver



### Description

The *ODL 02X* Lightwave Transceiver is a fully integrated data transceiver combining all functions of an optical transmitter and optical receiver within a single unit. The transceiver is a high-performance unit designed for transmission of data at rates from dc to 19.2 kb/s (NRZ). Under typical operating conditions, it provides an optical power budget of 12 dB. The unit is designed for a maximum link distance of 1 km, and a bit-error-rate (BER) not exceeding  $10^{-9}$ . The *ODL 02X* Lightwave Transceiver is the board-level companion of the *ODL RS232-2* Modem.

The various data-handling and protocol functions are performed by a  $1.75 \mu\text{m}$  CMOS integrated circuit designed to operate with a 5 volt power supply. Available in a 16-pin DIP, the device is equipped with an integral lens-coupled optical connector that mates with the *ST* Lightguide Cable Connector. The transceiver is designed to operate with  $62.5/125 \mu\text{m}$  optical fiber, but may be used with other fiber as well. As a key cost benefit, the device achieves bidirectional, full-duplex communication using a single-fiber cable. Additionally, there is one control line or secondary data line in each direction.

### Features

- TTL-compatible
- Single 5 V supply
- Single-chip, CMOS design
- 12 dB power budget
- Remote loopback diagnostics
- Link status indicator

### Product Matrix

Code	Product Description	Features
3C	Transceiver	Data rates dc — 19.2 kb/s; bidirectional, full-duplex transmission over single-fiber cable with <i>ST</i> Connector; 16-pin DIP
(Kit)	<i>ODL 02X</i> Lightwave Transceiver	2 transceivers; 50-foot connectorized cable

## **ASTROTEC Lightwave Transmitters**



**A 1218-Type Lightwave Transmitter**

### **Description**

The 1218-Type *ASTROTEC* Lightwave Transmitters are highly reliable, 1.3  $\mu\text{m}$  laser transmitters for high-speed digital applications. To meet specific application requirements, each transmitter has a profile of output power, bit rate, and wavelength. The transmitters require only a single  $-5\text{ V}$  power supply and are designed to operate over a wide bit rate range (1 kb/s, 1010 pattern to 1 Gb/s, pseudorandom pattern, NRZ format) and a wide flange temperature range.

Each transmitter consists of a 1.3  $\mu\text{m}$  multifrequency laser, thermoelectric heat pump, and circuitry for modulation, automatic power control, laser protection, and heat/cool temperature control. In the standard configuration, the laser is optically coupled to a Type 5D, 8  $\mu\text{m}$  core, single-mode fiber pigtail terminated with an AT&T 2016 threaded biconic connector. All key transmitter elements are enclosed in a hermetic ceramic package. This package, attached to an aluminum heat transfer flange equipped with integral cooling fins, optimizes the convective heat transfer with the local ambient. The heat transfer flange is easily attached to an optional customer-provided heat sink for enhanced thermal performance. For convenient transmitter monitoring, the laser dc bias and laser temperature are electrically accessible.

### **Features**

- High performance over wide temperature range
- Rugged, compact, hermetic package
- Single  $-5\text{ V}$  power supply
- ac coupled input signal
- Data rates to 1.0 Gb/s
- Optional power level to 0 dBm
- 100% burned-in

### **1218-Type Laser Transmitter Device Options\***

<b>Average Optical Output Power (dBm)</b>	<b>Bit Rate (Mb/s)</b>	<b>Wavelength (<math>\mu\text{m}</math>)**</b>
0 $\pm$ 0.5	$\leq 200$	1.308 $\pm$ 0.005
-2 $\pm$ 0.5	$\leq 565$	1.308 $\pm$ 0.015
-4 $\pm$ 0.5	$\leq 880$	1.308 $\pm$ 0.020
-6 $\pm$ 0.5	$\leq 1000$	1.308 $\pm$ 0.050
-10 $\pm$ 0.5		

\* Certain codes are considered to be standard product and are stocked for immediate delivery (4 to 6 weeks). These codes represent parameter mixes suitable for modeling, demonstration/evaluation systems, and characterization. The remainder of the codes are considered nonstandard products and are subject to significantly longer delivery intervals and prices. Other special options are negotiable upon request (e.g., connectors, fiber type, and wavelength).

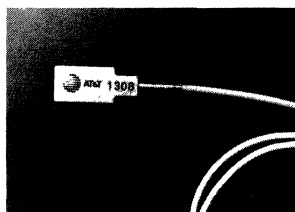
\*\* The 1218-Type Transmitters are available with an operating wavelength of 1.55  $\mu\text{m}$  through a models program. Please contact your AT&T Account Manager for more information.



## Fiber Optics Laser Products

# ASTROTEC Lightwave Receivers

### Description



**The 1308-Type Lightwave Receiver**

ASTROTEC Lightwave Receivers are wide-band, linear devices useful with data rates as high as 1.7 Gb/s, NRZ (Non-Return to Zero) format. They are designed for use in single-mode lightwave communication systems requiring 1.3 or 1.55  $\mu\text{m}$  wavelengths. At the maximum bit rate and 23°C ambient, the receivers are characterized by high sensitivities (–45 to –21 dBm) and a wide dynamic range.

The devices are manufactured in hermetic and nonhermetic corrosion-resistant packages. The PIN-based receivers are equipped with a multimode, graded-index fiber pigtail, terminated with an AT&T 2016 Connector. The APD-based receivers (1306-Type) are equipped with an 8  $\mu\text{m}$  single-mode fiber pigtail also terminated with a 2016 Connector. The 1308-Type Receivers are packaged in a 14-pin dual in-line package.

### Features

- Wide bandwidth
- Wide dynamic range
- High sensitivity
- EMI-shielded, rugged package

### Product Matrix

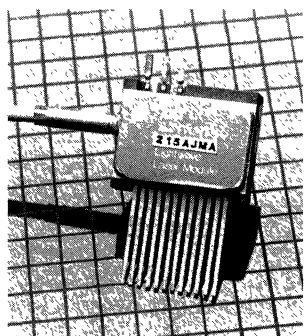
Code	Product Description	Features
1308-Type	1.3—1.55 $\mu\text{m}$ Receiver	(See Device Options, below)
1306AA	1.3 $\mu\text{m}$ Receiver	Sensitivity –32 dBm at 1.7 Gb/s

### 1308-Type Receiver Device Options\*

Bit Rate (Mb/s)	Photodetector	Hermeticity
45	PIN	Hermetic
90		Nonhermetic
180		
417		
565		
880		
1700		

\* Certain codes are considered to be standard product and are stocked for immediate delivery (4 to 6 weeks). These codes represent parameter mixes suitable for modeling, demonstration/evaluation systems, and characterization. The remainder of the codes are considered nonstandard products and are subject to significantly longer delivery intervals and prices. Other special options are negotiable upon request (e.g., connectors, fiber type, and adjustable transimpedance). Please contact your AT&T Account Manager for more information.

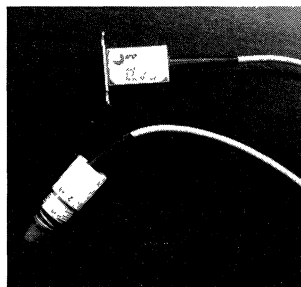
## **ASTROTEC Laser Modules**



**The 215-Type Laser Module**

### **Description**

The AT&T 213- and 215-Type *ASTROTEC* Laser Modules represent a family of custom-manufactured laser modules, each with its own profile of operating speed, output power, wavelength, and lead configuration. Collectively, they are internally-cooled InGaAsP injection lasers designed for 1.3  $\mu\text{m}$  wavelength applications. Devices with an operating wavelength of 1.55  $\mu\text{m}$  are available in a models program. The 213-Type Laser offers data rate capabilities from 45 to 400 Mb/s. The 215-Type Laser offers data rate capabilities from 417 Mb/s through 1700 Mb/s with typical launched optical power up to +4 dBm when dc-biased at 25°C. Each module is manufactured in a 12-pin, hermetic ceramic, single in-line package (SIP) with a separate input for high bit rate modulation signals. The high-frequency input port is specially designed to have a nominal 25  $\Omega$  input impedance. An integral thermoelectric cooler (TEC) provides stable thermal characteristics and high reliability. The package is equipped with a Type 5D, 8  $\mu\text{m}$  core, single-mode fiber that is terminated with an AT&T 2016A Biconic Connector.



**The 227-Type Laser Module**

The AT&T 227-Type *ASTROTEC* Laser Modules offer data rates through 565 Mb/s with power levels up to 0 dBm. Each 227-Type Module is manufactured in an industry-standard, 14-pin, dual in-line hermetic package. An integral thermoelectric cooler provides a stable thermal environment for the InGaAsP laser.

### **Features**

- Wide bandwidth
- High alignment stability
- Wide temperature range
- Custom features

## Fiber Optics Laser Products

### Product Matrix

Code	Product Description	Features
213	1.3 $\mu\text{m}$ Laser Module	(See Device Options below)
215	1.3 $\mu\text{m}$ Laser Module	(See Device Options below)
227A	1.3 $\mu\text{m}$ Laser Module	Rated optical power of 1.0 mW (0 dBm)
227B	1.3 $\mu\text{m}$ Laser Module	Rated optical power of 0.5 mW (-3.0 dBm)
227C	1.3 $\mu\text{m}$ Laser Module	Rated optical power of 0.25 mW (-6.0 dBm)

### 213/215 Laser Module Device Options\*

Code	Typical Optical Peak Power Level (dBm)	Data Rate (Mb/s)	Wavelength** ( $\mu\text{m}$ )
213	+4	$\leq 45$	1.308 $\pm$ .005
	+3	90	1.308 $\pm$ .015
	+2	180	1.308 $\pm$ .020
	+1	400	1.308 $\pm$ .050
	0		
	-1		
	-2		
	-4		
	-7		
	-10		
215	+4	417	1.308 $\pm$ .005
	+3	565	1.308 $\pm$ .015
	+2	880	1.308 $\pm$ .020
	+1	1700	1.308 $\pm$ .050
	0		
	-1		
	-2		
	-4		
	-7		
	-10		

\* Certain codes are considered to be standard product and are stocked for immediate delivery (4 to 6 weeks). These codes represent parameter mixes suitable for modeling, demonstration/evaluation systems, and characterization. The remainder of the codes are considered nonstandard products and are subject to significantly longer delivery intervals and prices. Other special options are negotiable upon request (e.g., connectors, fiber types, and lead configurations).

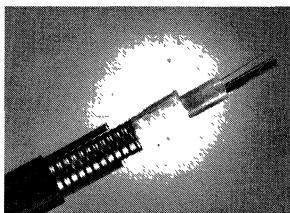
\*\* The 213- and 215-Type Laser Modules are available with an operating wavelength of 1.55  $\mu\text{m}$  through a models program. Please contact your AT&T Account Manager for more information.



## **Fiber Optics Cable**

# **LIGHTPACK Cable**

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### **Description**

*LIGHTPACK* Cable is a revolutionary lightguide cable design — one that combines optical and environmental excellence in a new compact size and helps to greatly reduce installation time.

#### ***Design***

Each *LIGHTPACK* Cable core consists of “bundles” of fibers held together with color-coded yarn binders. Unit tubes are no longer required, so *LIGHTPACK* Cable can hold up to 96 fibers and still maintain a large clearance in the core tube.

The core is filled with a water-blocking compound, which, along with the large clearance in the core tube, offers excellent installation and environmental performance — virtually eliminating microbending losses.

#### ***Fiber Identification***

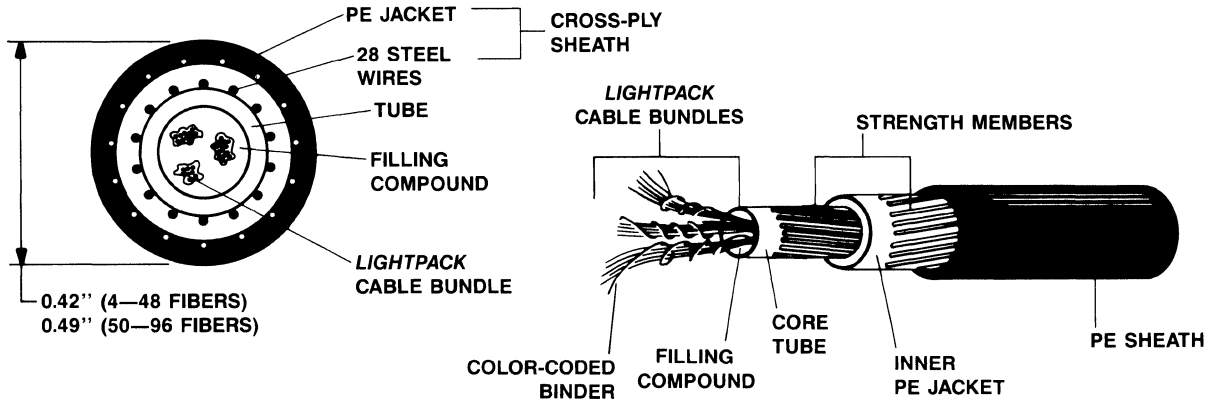
Color-coded “binders” are designed to provide easy unit identification. The standard fiber counts for *LIGHTPACK* Cable are 4, 6, 8, 12, 16, 20, 24, 36, 48, 60, 72, 84, and 96. These offer a more economical solution to most applications. Intermediate counts are also available from a range of 4 to 94.

#### ***Sheath Options***

AT&T has designed cable sheaths that maximize fiber protection and installation productivity. Long runs can be easily installed due to the low coefficient of friction of the high-density polyethylene (HDPE) jacketing. HDPE also provides protection in harsh environments or acidic soils. AT&T sheaths feature strength members in the cable sheath rather than in the cable core, providing protection against unanticipated installation practices by isolating the fibers from the load-bearing members. This feature also provides excellent environmental performance, since there are no dissimilar materials in the cable core. The AT&T rodent-lightning protected sheath provides sustained protection against rodent attacks through the use of stainless steel. Stainless steel does not corrode, so the fibers are protected against rodent attacks for the lifetime of the cable. AT&T sheaths, due to their small size and light weight, have the highest strength to weight ratio in the lightguide industry. These sheaths have been designed with the user in mind.

# Fiber Optics Cable

LIGHTPACK Cable

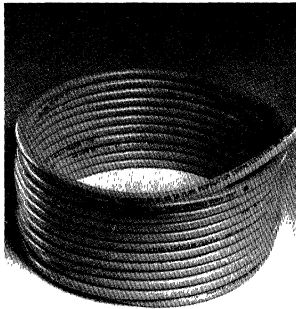


## Product Matrix — LIGHTPACK Cable

Code	Product Description
1DAX	Cable with steel reinforced crossply sheath, 4-96 fibers, 50/125 $\mu\text{m}$
1DFX	Cable with nonmetallic crossply, 4-96 fibers, 50/125 $\mu\text{m}$
1DHX	Cable with rodent-lightning protected crossply, 4-96 fibers, 50/125 $\mu\text{m}$
3DAX	Cable with steel reinforced crossply, 4-96 fibers, 62.5/125 $\mu\text{m}$
3DFX	Cable with nonmetallic crossply, 4-96 fibers, 62.5/125 $\mu\text{m}$
3DHX	Cable with rodent-lightning protected crossply, 4-96 fibers, 62.5/125 $\mu\text{m}$
4DAX	Cable with steel reinforced crossply, 4-96 fibers, 8.3/125 $\mu\text{m}$
4DFX	Cable with nonmetallic crossply, 4-96 fibers, 8.3/125 $\mu\text{m}$
4DHX	Cable with rodent-lightning protected crossply, 4-96 fibers, 8.3/125 $\mu\text{m}$

## Fiber Optics Cable

# Lightguide Building Cable



**Building Cables are designed for all optical telecommunications within buildings.**

### Description

All Lightguide Building Cables are manufactured with AT&T high-quality fibers which are buffered with PVC. These cables are reinforced with aramid yarn to provide superior strength. No metallic elements are present in any of these cables.

- PVC jacketed cables are for riser applications.
- Fluoropolymer jacketed cables are for plenum and riser applications.

Riser and Plenum Lightguide Building Cables are available in fiber counts of 2, 4, 6, and 12. All of these cables are available with either multimode (50/125  $\mu\text{m}$  or 62.5/125  $\mu\text{m}$ ) or single mode (8.3/125  $\mu\text{m}$ ) fibers.

Riser applications — in accordance with section 770-6(b) of the 1987 National Electrical Code and Plenum applications — in accordance with section 770-6(c) of the 1987 National Electrical Code.

### Technical Specifications

Buffered Fiber	50/125 $\mu\text{m}$ , 62.5/125 $\mu\text{m}$ , or single mode
Fiber Identification	Individually color-coded PVC buffer
Buffer Material	Polyvinyl chloride
Jacket Material	Polyvinyl chloride or fluoropolymer
Strength Material	Aramid yarn
Operating Temperature	+14 to +131°F (−10 to +55°C)
Storage Temperature	−40 to +131°F (−40 to +55°C)

### Transmission Characteristics

Fiber Type	Operating Wavelength	Individual Fiber	
		Maximum Attenuation	Minimum Bandwidth
50/125 $\mu\text{m}$	850 nm	4.0 dB/km	500 MHz/km
50/125 $\mu\text{m}$	1300 nm	1.5 dB/km	500 MHz/km
62.5/125 $\mu\text{m}$	850 nm	4.0 dB/km	160 MHz/km
62.5/125 $\mu\text{m}$	1300 nm	1.0 dB/km	500 MHz/km
Single Mode	1310 nm	0.5 dB/km	N/A
Single Mode	1550 nm	0.5 dB/km	N/A

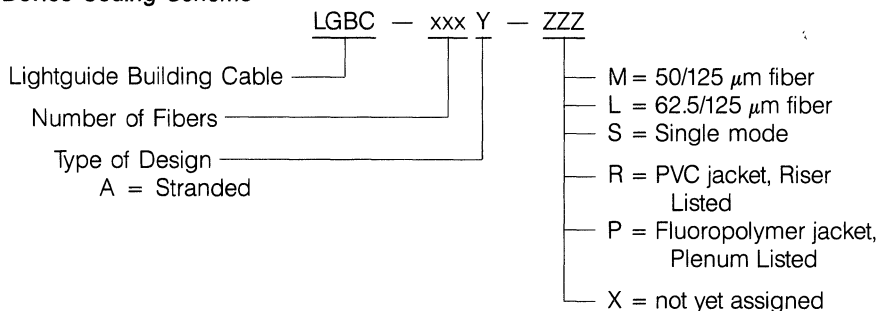
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# Fiber Optics Cable

## Product Matrix — Building Cable

Code*	Maximum Length** (ft./reel)	Cable O.D. (inches)	Cable Wt./100' (lb.)	Maximum Pulling Tension (lb.)	
<i>UL "Listed" Plenum Cable [1987 NEC 770-6(c)] Single Mode &amp; Multimode LGBC Specific Lengths</i>					
	C	D			
LGBC-002A-MPX	3,280	7,000	0.195	1.4	100
LGBC-004A-MPX	3,280	7,000	0.195	1.4	100
LGBC-006A-MPX	1,500	6,500	0.245	2.2	125
LGBC-012A-MPX	1,000	4,000	0.320	3.3	150
LGBC-002A-LPX	3,280	7,000	0.195	1.4	100
LGBC-004A-LPX	3,280	7,000	0.195	1.4	100
LGBC-006A-LPX	1,500	6,500	0.245	2.2	125
LGBC-012A-LPX	1,000	4,000	0.320	3.3	150
LGBC-002A-SPX	3,280	7,000	0.195	1.4	100
LGBC-004A-SPX	3,280	7,000	0.195	1.4	100
LGBC-006A-SPX	1,500	6,500	0.245	2.2	125
LGBC-012A-SPX	1,000	4,000	0.320	3.3	150
<i>UL "Listed" Riser Cable [1987 NEC 770-6(b)] Single Mode &amp; Multimode LGBC Specific Lengths</i>					
LGBC-002A-MRX	4,000	7,000	0.175	1.2	100
LGBC-004A-MRX	4,000	7,000	0.175	1.2	100
LGBC-006A-MRX	2,500	7,000	0.210	1.6	125
LGBC-012A-MRX	1,500	5,000	0.275	2.8	150
LGBC-002A-LRX	4,000	7,000	0.175	1.2	100
LGBC-004A-LRX	4,000	7,000	0.175	1.2	100
LGBC-006A-LRX	2,500	7,000	0.210	1.6	125
LGBC-012A-LRX	1,500	5,000	0.275	2.8	150
LGBC-002A-SRX	4,000	7,000	0.175	1.2	100
LGBC-004A-SRX	4,000	7,000	0.175	1.2	100
LGBC-006A-SRX	2,500	7,000	0.210	1.6	125
LGBC-012A-SRX	1,500	5,000	0.275	2.8	150

### \* Device Coding Scheme

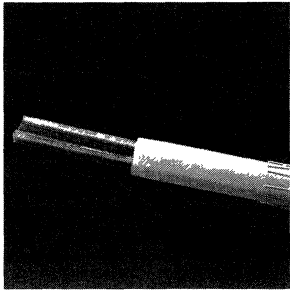


### \*\* Reel Characteristics

- C — width = 13"; diameter = 18"; weight = 10 lb.
- D — width = 16"; diameter = 32"; weight = 65 lb.

## Fiber Optics Cable

# Ribbon Cable



### Description

#### *Design*

Ribbon designs are available with or without connectors. Ribbons provide large fiber counts within a small cable diameter, installation cost savings, and individual fiber add/drop access. The ribbon design consists of 12 fibers arranged in a planar array and laminated between pressure-sensitive adhesive tapes. Requirements for fewer than 12 guaranteed fibers in a ribbon are accommodated by placing filler fibers in the remaining positions. The use of filler fibers maintains the basic ribbon and array connector structure, thus allowing the use of existing field tools, test sets, and interconnect hardware. Fiber counts are available from 4 to 144 fibers in increments of two fibers.

#### *Ribbon and Fiber Identification*

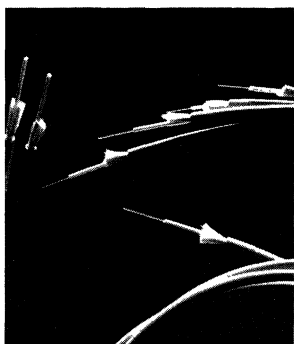
The fibers within each ribbon are uniquely identified with a fiber color code. Each ribbon is assigned a unique ribbon number that is printed every 4 inches along its length, on the inside of the clear laminating tape, so that it does not fade with time or use. In addition, in factory connectorized cables, each ribbon is given a position marker, 1 through 12, behind the splice array at each end. For mid-span identification, the ribbon number is used to identify a ribbon.

### Product Matrix

Code	Product Description
1ALX	Cable with air core PVC riser nonmetallic crossply, 4—144 fibers, 50/125 $\mu\text{m}$
1BAX	Cable with steel reinforced crossply, 4—144 fibers, 50/125 $\mu\text{m}$
1BFX	Cable with nonmetallic crossply, 4—144 fibers, 50/125 $\mu\text{m}$
1BHX	Cable with rodent-lightning protected crossply, 4—144 fibers, 50/125 $\mu\text{m}$
3ALX	Cable with air core PVC riser nonmetallic crossply, 4—144 fibers, 62.5/125 $\mu\text{m}$
3BAX	Cable with steel reinforced crossply, 4—144 fibers, 62.5/125 $\mu\text{m}$
3BFX	Cable with nonmetallic crossply, 4—144 fibers, 62.5/125 $\mu\text{m}$
3BHX	Cable with rodent-lightning protected crossply, 4—144 fibers, 62.5/125 $\mu\text{m}$
4ALX	Cable with air core PVC riser nonmetallic crossply, 4—144 fibers, 8.3/125 $\mu\text{m}$
4BAX	Cable with steel reinforced crossply, 4—144 fibers, 8.3/125 $\mu\text{m}$
4BFX	Cable with nonmetallic crossply, 4—144 fibers, 8.3/125 $\mu\text{m}$
4BHX	Cable with rodent-lightning protected crossply, 4—144 fibers, 8.3/125 $\mu\text{m}$

## Fiber Optics Cable

# Jumper Cable



**Multimode Fiber Optic  
Jumper Cable**

### Description

The AT&T 1800, 1860, and 2000 Series Cable is designed to be used for inter-equipment connections that are indoors or in controlled environments. This cable is rugged but flexible. It is ideal for connections that may require repeated handling, such as in offices or other areas requiring rearrangement of facilities. Jumper Cable may be pulled through ducts or conduit. Jumper Cable and its associated family of products are highly dimensionally controlled such that connection losses associated with fiber are kept to a minimum. The properties of the jackets facilitate the sure and easy mounting of connectors. All codes are UL Listed (OFN) and available in either 2.4 or 3.0 mm diameter to accommodate a wide assortment of connectors.

### Product Matrix

#### Multimode — 50 $\mu\text{m}$ core

Code	Fiber Count	Jacket Color	850 nm		1300 nm	
			Max. Loss (dB/km)	Min. Bandwidth (MHz/km)	Max. Loss (dB/km)	Min. Bandwidth (MHz/km)
1800A	single	orange	4.0	500	1.5	500
1801A	duplex	orange	4.3	500	1.8	500

#### Multimode — 62.5 $\mu\text{m}$ core

Code	Fiber Count	Jacket Color	850 nm		1300 nm	
			Max. Loss (dB/km)	Min. Bandwidth (MHz/km)	Max. Loss (dB/km)	Min. Bandwidth (MHz/km)
1860A	single	slate	4.0	160	1.0	500
1861A	duplex	orange	4.3	160	1.3	500

#### Single Mode — 8.3 $\mu\text{m}$ core

Code	Fiber Count	Jacket Color	1310 nm		1550 nm	
			Max. Loss (dB/km)	Min. Bandwidth (MHz/km)	Max. Loss (dB/km)	Min. Bandwidth (MHz/km)
2000A	single	yellow	0.5	1220	0.5	1220
2001A	duplex	yellow	0.8	1220	0.8	1220

## Fiber Optics Cable

# Interconnection Cable

### Description

Lightguide Interconnection cables are used to link cross-connection or interconnection modules with optical/electronic equipment or to link cross-connection modules. These cables are equipped with appropriate connectors as ordered from the factory. They are available as single fiber or duplex cables.

Factory-terminated biconic interconnection cables are connectorized cable assemblies used for most inter-equipment connection of multimode or single-mode transmission systems. These interconnection cables are designed for repeated connections where rearrangement of facilities is often desired. They are available in standard lengths or may be ordered in special lengths. The cables are connectorized with either the same type of connector or two different types of connectors on each end.

ST Connector Lightguide Interconnection Cables are used to link cross-connection or interconnection modules with optical or electronics equipment. They also may be used as the jumper cable or patch cord between cross-connection modules. These interconnection cables are available in single fiber or duplex fiber options in a wide selection of standard lengths. The cables are connectorized with either the same type of connector or two different types of connectors on each end.

Pigtails are single-ended interconnection cables that are spliced to outside plant cables to provide connection to a wide variety of termination equipment.

### Product Matrix

#### *Biconic Interconnection Cable*

Code	Product Description
LA1A-A-xx	Cable with one biconic connector — 50 $\mu\text{m}$ core
LA2A-A-xx	Cable with two biconic connectors — 50 $\mu\text{m}$ core
LL1A-A-xx	Cable with one biconic connector — 62.5 $\mu\text{m}$ core
LB2B-B-xx	Cable with two data links — 50 $\mu\text{m}$ core
LL1B-B-xx	Cable with one data link — 62.5 $\mu\text{m}$ core
LL2B-B-xx	Cable with two data links — 62.5 $\mu\text{m}$ core
LL2A-A-xx	Cable with two biconic connectors — 62.5 $\mu\text{m}$ core
LL1A-B-xx	Cable with one biconic and one data link — 62.5 $\mu\text{m}$ core
LL2A-B-xx	Cable with two biconic connectors and two data link connectors — 62.5 $\mu\text{m}$ core

## **Fiber Optics Cable**

### **Product Matrix (continued)**

#### *ST Interconnection Cable*

<b>Code</b>	<b>Product Description</b>
FL1P-P-xx	Cable with one <i>ST</i> Connector — 62.5 $\mu\text{m}$ core
FL2P-P-xx	Cable with two <i>ST</i> Connectors — 62.5 $\mu\text{m}$ core
FL1P-B-xx	Cable with one <i>ST</i> Connector and one data link connector — 62.5 $\mu\text{m}$ core
FL2P-B-xx	Cable with two <i>ST</i> Connectors and two data link connectors — 62.5 $\mu\text{m}$ core
FL1P-A-xx	Cable with one <i>ST</i> Connector and one biconic connector — 62.5 $\mu\text{m}$ core
FL2P-A-xx	Cable with two <i>ST</i> Connectors and two biconic connectors — 62.5 $\mu\text{m}$ core

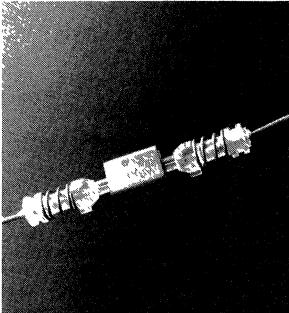
#### *Pigtails*

<b>Code</b>	<b>Product Description</b>
1B-xx	Buffered Cable — 8.3 $\mu\text{m}$ core
2B-xx	Buffered Cable — 50 $\mu\text{m}$ core
3B-xx	Buffered Cable — 62.5 $\mu\text{m}$ core



## Fiber Optics Splices

# Rotary Mechanical Splice



### Description

The enhanced Rotary Mechanical Splice (RMS) is an inexpensive, reliable, easy-to-use method for splicing individual single-mode or multimode fiber. Mated glass plug assemblies (termini) are installed on each end of a fiber. These plugs are then joined together through an alignment sleeve while index-matching gel is used between the two connectors to minimize splice loss. The plugs are rotated in the alignment sleeve and the tabs are aligned to obtain minimum loss (passive alignment). If extremely low loss is required, the splice can be tuned (active alignment). Single-mode splice losses range from 0.20 dB (passive alignment) down to 0.05 dB (active alignment). Multimode losses vary 0.25 dB to 0.10 dB for passive and active alignment, respectively. The losses are maintained over a wide variation in ambient temperature. The enhanced RMS is fully compatible with the splice storage capability of the entire line of AT&T fiber optic closures and cabinets.

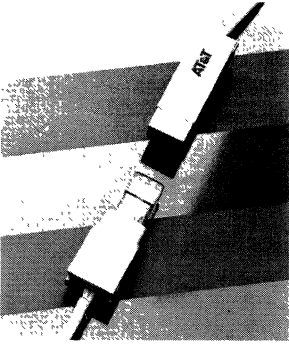
### Product Matrix

Code	Product Description
D-181617	Kit of parts — all materials required for 12 splices
D-181595	Kit of parts — all materials required for 60 splices

## Fiber Optics Connectors and Couplings

# Multifiber Array Connector

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### Description

The Multifiber Array Connector (MAC) is compact, with a maximum envelope of  $0.5 \times 0.6 \times 2.26$  inches, and requires minimum circuit-pack spacing of 0.75 inch.

This connector allows designers to interconnect from 2 to 18 optical fibers through the backplane and can be mounted along with commercially available circuit-pack connectors.

The MAC can be used to interconnect  $50/125 \mu\text{m}$  or  $62.5/125 \mu\text{m}$  multimode fiber. When  $50/125 \mu\text{m}$  multimode fiber is used with  $0.87 \mu\text{m}$  wavelength and short launch and receive conditions, an average loss of  $< 1$  dB will be experienced over all fibers in the array with no fiber in excess of 1.5 dB. Based on limited test data, typical average loss will be 0.5 dB. A single-mode version of this connector is now under development, with a projected average loss of 1 dB.

The 9630-Type Lightguide Connector Family can be used with either ribbon cable or discrete fibers.

## Fiber Optics Connectors and Couplings

# Biconic Connectors (Field Mountable)



### Description

The Field Mountable Biconic Connector is a high-performance, low-cost, fiber optic connector. It is based on the well-known, time-proven biconic design. It incorporates the latest in precision moulding techniques to yield fractional dB insertion loss when mated with any of AT&T's single fiber couplings or when used with the 1000, 1001, or 1003 type build-out blocks and the appropriate build-out.

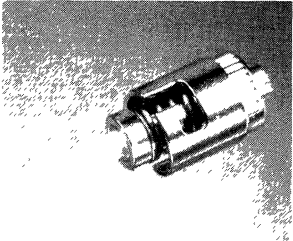
The connector performs best when used with AT&T single-fiber cable. However, it may be used with cable of similar construction having a 2.4 or 3.0 mm jacket O.D. and which uses 125 or 140  $\mu\text{m}$  O.D. fiber. Adapter kits are available to mount the connectors on buffered and/or coated fibers.

### Product Matrix

Code	Product Description
1006A	MM-Biconic Connector for 125 $\mu\text{m}$ fiber, 2.4 mm O.D. cable, loss 0.6 dB
1006C	MM-Biconic Connector for 125 $\mu\text{m}$ fiber, 3.0 mm O.D. cable, loss 0.6 dB
1006C-140	MM-Biconic Connector for 140 $\mu\text{m}$ fiber, 3.0 mm O.D. cable, loss 0.6 dB
1006A-140	MM-Biconic Connector for 140 $\mu\text{m}$ fiber, 2.4 mm O.D. cable, loss 0.6 dB
1000A	Coupling for MM-Biconic Connector
1002A	Coupling for MM-Biconic Connector
1003A	Coupling for MM-Biconic Connector
2016A	SM-Biconic Connector for 125 $\mu\text{m}$ fiber, 2.4 mm O.D. cable, loss 0.6 dB
2016A1	SM-Biconic Connector for 127 $\mu\text{m}$ fiber, 2.4 mm O.D. cable, loss 0.6 dB
2016C	SM-Biconic Connector for 125 $\mu\text{m}$ fiber, 3.0 mm O.D. cable, loss 0.6 dB
2016C1	SM-Biconic Connector for 127 $\mu\text{m}$ fiber, 3.0 mm O.D. cable, loss 0.6 dB
1011A	Coupling for SM-Biconic Connector
1012A	Coupling for SM-Biconic Connector
1013A	Coupling for SM-Biconic Connector

## Fiber Optics Connectors and Couplings

# ST Lightguide Cable Connector



### Description

The *ST* Series family of fiber optic connectors incorporates the AT&T patented flexible sleeve coupling and precision ceramic plug. The flexible split-sleeve coupling assures evenly distributed force to hold the connector plugs. The ceramic plug tip accurately positions the fiber, while maintaining its shape over a wide range of temperatures and humidity. This combination yields a rugged, low-loss connection with stable, repeatable performance at low cost.

The *ST* Series Connectors are available factory-mounted on 1860 Series Cable (62.5/125  $\mu\text{m}$ ) or may be field mounted.

### Product Matrix

Code	Product Description
P2020AC125	<i>ST</i> Connector for 125 $\mu\text{m}$ fiber, loss 0.5 dB
P2020AA125	<i>ST</i> Connector for 125 $\mu\text{m}$ fiber (plastic tip), loss 0.9 dB
C2000A-1	Coupling for <i>ST</i> Connector
C2000A-2	Coupling for <i>ST</i> Connector
C2000A-3	Coupling for <i>ST</i> Connector

## Fiber Optics

# Tool Kits and Test Sets

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### Description

The 1031A1 Tool Kit contains all the tools needed to mount the 1006-type multimode and the 2016-type single-mode field-mountable biconic connectors on the appropriate fiber optic cable. It can be used in any service or installation environment having 110 Vac power. Consumables and connectors must be ordered separately.

The 1032A Tool Kit contains all the tools needed to mount the *ST* Series Connectors on 1800 series fiber optic cable. It also can be used in any service or installation environment where 110 Vac power is available. The kit contains enough consumables to mount about 100 connectors.

The 1040A Tool Kit contains all the tools and accessories necessary to assemble multimode mechanical or single-mode Rotary Mechanical Splices in any environment where 110 Vac is available.

The 935A Local Splice Alignment and Measurement (LSAM) Test Set is used to align and optimize the single-mode or multimode RMS. The splice loss is read directly from the panel-mounted meter. This set, which is not temperature or humidity sensitive, operates on rechargeable batteries or ac power.

The 945A Local Splice Injection Module (LSIM) is used in conjunction with the 935A LSAM to allow one-man splicing of RMS. This set injects a 2 kHz modulated 1300 nm signal into the core of the fiber without access to the butt end of a fiber. It operates on 110 Vac power.

The 936A (Fiber Identifier) Test Set identifies nonworking fibers at any point without having to interrupt service. The set consists of a 736A Transmitter, which injects a 2 kHz modulated 1300 nm signal; the 94A Detector, which detects the signal when clamped on the fiber; and the 836A Receiver.

The 938A Optical Loss Test Set is a modular, hand-held instrument designed for testing active and passive lightwave components, installations, and systems. The test set can operate as an optical power meter and a stabilized LED optical source.

### Product Matrix

Code	Product Description
1031A1	Field Mounting Biconic Connectors Tool Kit
1032A	Field Mounting <i>ST</i> Connectors Tool Kit
1040A	Rotary Mechanical Splicing Tool Kit
935A	Local Splice Alignment and Measurement (LSAM) Test Set
945A	Local Splice Injection Module (LSIM)
936A	Fiber Identifier Test Set
938A	Optical Loss Test Set

## Fiber Optics

# Closures

### Description

The Universal Fiber Optic Closure is designed to offer environment protection and mechanical support for splice connections. The closure is a cast-metallic housing which holds a number of components, each of which is designed to meet a specific need. Components are ordered separately, allowing the user to design a closure for each splicing configuration. The closure is easily assembled, quickly re-enterable, and provides a method of storing spare fiber neatly.

The Universal Closure is designed to meet the needs of all lightguide splicing applications — aerial, vault, and building environments.

UC-Type Lightguide Organizers, which fit inside the closure housing, organize and store various lightguide splices. There are five organizers, each identified by its application.

Grommet and Grip Kits are available to facilitate the sealing, bonding, and anchoring of cables at the closure entrance points. A separate kit is required for each sheath entering the closure. Different kits are available for different types of cable.

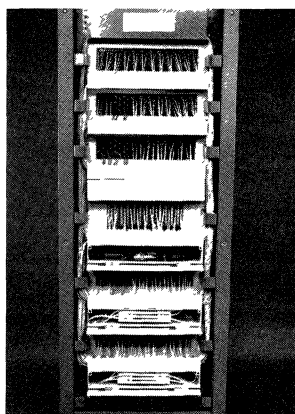
The Universal Fiber Optic Closure can stand alone in a non-corrosive environment. Teamed with the 2000 LG Lightguide Closure or the 51D3/LG-2 Closure, the universal closure provides organization and protection for splices in those environments which demand more protection — buried, underground, and corrosive aerial. An outer plastic closure is installed around the UCB1 and encapsulated for additional protection. Both closures provide a water-tight encapsulated splice. Local practice should dictate which closure to use

### Product Matrix

Product	Description
UCB1 Closure	Base closure kit. Designed for splicing applications. Normally enclosed in an outer closure, but may stand alone in an aerial non-corrosive environment.
2000 LG	Latchable closure which surrounds the UCB1 and allows for encapsulation.
51D3-LG2	Bolted plastic outer closure which surrounds the UCB1 and allows for encapsulation.
Organizers	Contain some combination of the following storage leaves: Ribbon (R): Ribbon array splices Mechanical (M1): Mechanical splices Fusion (F1): Fusion splices
Grommet and Grip Kits	Assembly to seal, bond, and anchor cables to the inner and the outer closures.

## Fiber Optics

# Cabinets/LGX Lightguide Cross-Connect Frame



### Description

AT&T LS- and LC-type interconnection cabinets accommodate ribbon or stranded outside plant cable and have up to a 144-fiber capacity, depending on the type of cable. The modular cabinets provide a convenient, centralized point for optical fiber access and outside plant cable termination, as well as fiber organization, storage, and accommodation of splices and connectors. They may be used in controlled environments such as Central Offices, mini-huts, remote terminals, customer premises, and 80-type cabinets, etc.

The Lightguide Systems Interconnection/Cross-Connection Apparatus for Customer Premises (LIU) is a modular cabinet intended to provide cross-connect and/or interconnect splicing and terminating capability for Lightguide Building Cables (LGBC), or ribbon or *LIGHTPACK* Cables in buildings. The 100A LIU terminates 12 fibers, splices up to 12 fibers with mechanical splice as well as 16 fusion splices, and is 7.5" wide, 8.75" high, and 3.0" deep.

The *LGX* Lightguide Cross-Connect Frame is a terminating and cross-connection point for fiber optic circuits. Its modular design allows the flexibility to connect a network circuit directly to an equipment circuit, or to connect these two circuits with a jumper. The *LGX* Frame is also designed for cable termination and grounding, ribbon or individual fiber splicing, and fiber and jumper storage. In addition to terminating, splice-only and express-through situations are easily accommodated. The *LGX* Frame is ideal where a large number of fibers must be terminated and the flexibility of reassigning circuits is desirable, such as in central offices and as the hub for a local area network. The *LGX* Frame has the capacity for 644 fiber terminations in a single bay, and growth capability of up to 20 bays in a lineup. The *LGX* Frame is designed with ample jumper routing capacity to allow easy administration of reassignments and avoidance of congestion.

### Product Matrix

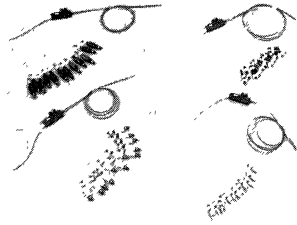
Name	Order Code	Fiber Capacity	Description
LCIE	ED8C006-50	144	Ribbon Cabinet
LCIT	ED8C005-50	72	Ribbon Cabinet
LCIM	ED8C009-50	24	Ribbon Cabinet
LSCIE	ED8C008-50	312	Stranded Cabinet
LSCIT	ED8C007-50	156	Stranded Cabinet
LSCIM	ED8C010-50	78	Stranded Cabinet
LCIU	ED8C011-50	72	Portable Cabinet
LCSE	ED8C013-50	—	Storage Cabinet
100A LIU		12	Modular Cabinet
LGX	ED6C321-50	644	Terminate & Cross-Connect Frame

## Fiber Optics

# Fanouts

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### Description



Fanouts are used to provide a transition from ribbon fibers to individual fiber connection ports. Fanouts can be mounted in cabinets or used simply to access individual fibers in a ribbon.

AT&T manufactures and provides three types of fanouts: modular fanouts, mini fanouts, and test fanouts.

Modular fanouts provide the transition from ribbon fibers to individual single-fiber connection ports. One fanout connects to one ribbon of an outside plant/riser ribbon cable. All fanouts are terminated with a 30-mil chip array connector. The 1009C Connector is not included. These fanouts are intended to be mounted in LC and LGX cabinets.

Mini fanouts consist of a 30-mil chip array connector on a 48-inch-long ribbon, a transition assembly, and 24- or 48-inch-long distributing buffered fibers with connectors. The 1009C Connector is not included. These fanouts are intended to be mounted in the LGX and 100A LIU Cabinets.

Test fanouts consist of a pre-tested 3-type fanout with an aluminum base to provide free-standing capability, and a clamp to attach to the 26A Workshelf. The fanout is equipped with non-attenuated build-outs and is shipped in a rugged, foam-lined carrying case.



## Fiber Optics

# Attenuators, Build-Outs, Build-Out Blocks, and Connector Panels

### Description

Cable attenuators are used for the interconnection and attenuation of optical signals for both single-mode (SM) and multimode (MM) applications. They consist of a short jumper fastened to a special lightguide connector coupling containing a carbon-coated mylar filter. Cable build-outs are usually inserted into circuits at system interfaces such as interconnection equipment.

Barrel-Type Build-Outs are also used for the interconnection and attenuation of optical signals for both single-mode and multimode applications. They consist of a sleeve, with or without attenuation, housed in a plastic barrel that snaps into a build-out block.

Build-Out Blocks are molded black plastic adapters that accept any barrel-type build-out for single-mode and multimode applications. They are equipped with either dual or round flanges for panel mounting.

Connector panels mount up to six biconic, data link, *ST* Connector, FC, or SMA couplings. Two connector panels can be mounted in a 100A LIU Modular Enclosure. Adapter plates are necessary in the mounting of 1000C Build-Out Blocks or *ST* Connector couplings into LC-Type Cabinets.

### Product Matrix

#### *Cable Build-Outs*

Code	Product Description
400x Series	Referenced at 825/875 nm wavelength, MM to MM type connections
500x Series	Referenced at 1300 nm wavelength, MM to MM type connections
600x Series	Referenced at 1300 and 1550 nm wavelength, SM to MM type connections

#### *Barrel Build-Outs*

Code	Product Description
401xx Series	Referenced at 825 nm wavelength, MM to MM type connections
501xx Series	Referenced at 1300 nm wavelength, MM to MM type connections
601xx Series	Referenced at 1300 and 1550 nm wavelength, SM to MM type connections
701xx Series	Referenced at 1300 nm and 1550 nm wavelength, SM to SM type connections

## Fiber Optics Attenuators, Build-Outs, Build-Out Blocks, and Connector Panels

### Product Matrix (continued)

#### *In-Line Attenuators*

Code	Product Description
602x Series	Connector coupling equipped with a biconic sleeve attenuator

#### *Build-Out Blocks*

Code	Product Description
1000C	Threaded, split "six-pack" design
1001C	Electronic equipment plug-in, round flange type
1001E	Electronic equipment plug-in, dual flange type
1003E	Threaded, dual flange type

#### *Connector Panels*

Code	Product Description
10A	Mounts six <i>ST</i> C2000A-2 Connector Couplings, for 100A LIU Modular Cabinets
11A	Mounts six 1007A Biconic data link connector couplings, for 100A LIU Modular Cabinets
12A	Accepts six of the 401, 501, 601, or 701 Series Attenuators or non-attenuated barrel build-outs for interconnecting 1006 or 2016 type connectors, for 100A LIU Modular Cabinets
F86AK8606	Mounts 1000C Build-Out Blocks into LCIT, LCIE, or LCIM Cabinets
F85AK8518	Mounts <i>ST</i> Connector couplings into LSCX-Type Cabinets



## Frequency Control Products (Oscillators and Timing Recovery Units)

AT&T's line of oscillators are quartz crystal stabilized frequency generators. A variety of packages, outputs, and features are available; not all are listed here.

AT&T's line of clock recovery and data retiming modules extract the clock signal from a digital data stream and retime the data to reduce phase noise and yield low bit error rates.

**For additional information contact your nearest sales office or call:  
1-800-372-2447.**

	<b>Page</b>
<b>Voltage-Controlled Crystal Oscillators</b>	<b>9-2</b>
<b>Multiplexed Output Oscillators</b>	<b>9-3</b>
<b>Standard Oscillators</b>	<b>9-3</b>
<b>* S-Type Crystal Oscillators</b>	<b>9-4</b>
<b>* Clock Recovery and Data Retiming Module — TRU050</b>	<b>9-6</b>
<b>Clock Recovery and Data Retiming Module — TRU200</b> (see page 8-3)	

\* Did not appear in the previous edition of the Product Selection Guide.

## Frequency Control Products

# Voltage-Controlled Crystal Oscillators — 127-Type

### Description

The 127-type Voltage-Controlled Crystal Oscillators are quartz crystal stabilized, TTL-compatible frequency generators. The oscillator components are housed within a metal, hermetically sealed, dual in-line package (DIP). The oscillator circuit may include a buffer gate or frequency divider.

### Features

- TTL-compatible output
- Frequencies from 0.5 MHz to 33 MHz
- Frequency stability to  $\pm 32$  parts per million (ppm)
- Choice of temperature ranges
- Wide frequency pull range
- Phase jitter less than 200 ps
- High reliability

### Product Matrix

Code	Frequency Range (MHz)	Frequency Stability* ( $\pm$ ppm)	Temperature Range** ( $^{\circ}$ C)	Symmetry (%)	Power Supply Current (Max.) (mA, $V_{CC} = 5.50$ V)
127W	0.5 to 8.0	50	0 to 70	45/55	50
127AA	0.5 to 8.0	50	0 to 95	45/55	50
127S	0.5 to 8.0	50	-40 to +85	45/55	50
127AC	0.5 to 8.0†	50	0 to 70	45/55	50
127U	8.0 to 22.0	50	0 to 70	45/55	25
127AH	8.0 to 22.0	50	0 to 85	45/55	25
127AJ	8.0 to 22.0	32	0 to 85	45/55	25
127AB	22.0 to 33.0†	50	0 to 70	40/60	40

\* Frequency stability is the frequency deviation from  $f_0$  due to the combined effects of aging power supply variations, temperature range, and electrical load.

\*\* The temperature range is the ambient temperature over which the frequency stability is guaranteed.

† The 127-type voltage-controlled crystal oscillator has a minimum frequency deviation of  $-110$  ppm @  $V_C = 1.0$  volt and  $+110$  ppm @  $V_C = 4.0$  volts.

## Frequency Control Products

# Multiplexed Output Oscillators — 134-Type and Standard Oscillators — 126-Type

### Description

The 134-type oscillators are quartz crystal stabilized frequency generators with a multiplexed output. The oscillator components are housed within a metal, hermetically-sealed DIP. A logic low on the multiplex enable pin switches the input to the final buffer stage from the internal oscillator/divider to the external frequency input pin. The external frequency will then appear at the oscillator output uninverted. This feature can be used for margin testing or to provide an oscillator override capability.

The 126-type oscillators have the same electrical characteristics as the 134-type, but without the multiplex feature and having only the four corner pins.

### Features

- Frequencies from 244 Hz to 40 MHz
- Frequency stability to  $\pm 100$  parts per million (ppm)
- TTL- or CMOS-compatible output
- External frequency select for in-circuit testing (134-Type)

### Product Matrix

Code	Output Compatible	Frequency Range (MHz)	Frequency Stability* ( $\pm$ ppm)	Temperature Range** ( $^{\circ}$ C)	Symmetry (%)	Power Supply Current (Max.) (mA, $V_{cc} = 5.50$ V)	Multiplex/Standard
134B	CMOS	8.0 to 30.0	100	0 to 90	45/55	30	MPX
134C	CMOS	30.0 to 40.0	100	0 to 90	40/60	30	MPX
134D	TTL	244 Hz to 8.0	100	0 to 90	45/55	15	MPX
134E	TTL	8.0 to 30.0	100	0 to 90	45/55	30	MPX
134F	TTL	30.0 to 40.0	100	0 to 90	40/60	30	MPX
126H	CMOS	8.0 to 30.0	100	0 to 90	45/55	30	STD
126J	CMOS	30.0 to 40.0	100	0 to 90	40/60	30	STD
126K	TTL	244 Hz to 8.0	100	0 to 90	45/55	15	STD
126L	TTL	8.0 to 30.0	100	0 to 90	45/55	30	STD
126M	TTL	30.0 to 40.0	100	0 to 90	40/60	30	STD
126N	TTL	244 Hz to 8.0	100	-40 to +85	45/55	15	STD

\* Frequency stability is the frequency deviation from the specified oscillator output frequency due to the combined effects of aging, power supply variation, temperature range, and electrical load.

\*\* The temperature range is the ambient temperature over which the frequency stability is guaranteed.

## Frequency Control Products

# S-Type Crystal Oscillators

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### Description

The S-Type Crystal Oscillators are quartz-stabilized, TTL/CMOS compatible square-wave generators. They are hermetically packaged in low-profile, ceramic 6-pin DIPs. Long-term reliability is expected to be better than 20 million hours MTBF.

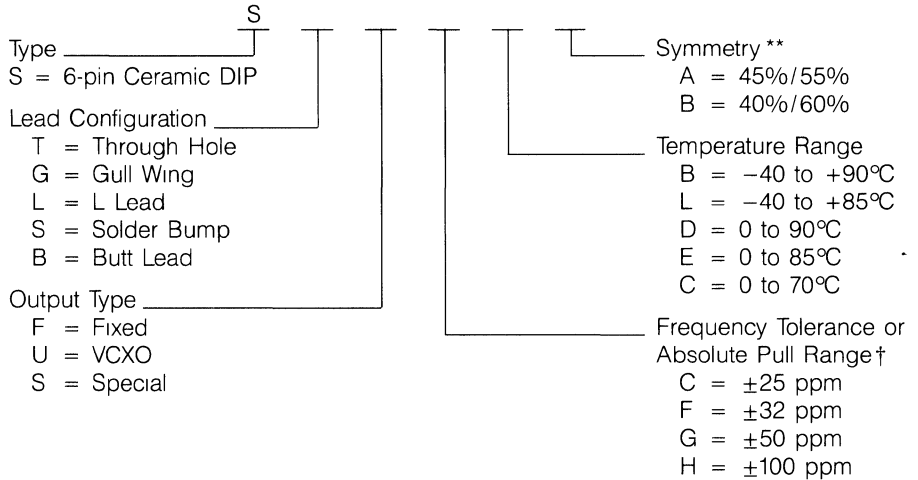
### Features

- Small package — 6-pin DIP
- Choice of lead configurations
- VCXO or fixed frequency
- Stability to 25 ppm
- Frequencies to 35 MHz
- TTL or CMOS compatible
- 3-stateable
- High reliability
- Phase jitter <200 ps
- Choice of temperature ranges
- Machine insertable

# Frequency Control Products

## S-Type Crystal Oscillators

### Product Matrix and Coding Scheme \*



\* For example, an S T U G L A oscillator would be an S-Type with a through-hole lead configuration, a VCXO output type with an absolute pull range of ±50 ppm, a temperature range of -40 to +85°C, and symmetry of 45/55%.

\*\* Symmetry (%) = ON TIME/PERIOD with  $V_s = 1.4$  for TTL or  $V_s = 2.5$  for CMOS.

† Frequency tolerance or absolute pull range:

For codes S F        , non-VCXO, the frequency tolerance is the maximum frequency deviation, in ppm, from the specified output frequency,  $f_0$ , including variations due to temperature, power supply, load, and aging.

For codes S U        , VCXO, the absolute pull range is the minimum guaranteed output frequency shift for  $f_0$ , including variations due to temperature, power supply, load, and aging.



## Frequency Control Products

# Clock Recovery and Data Retiming Module — TRU050

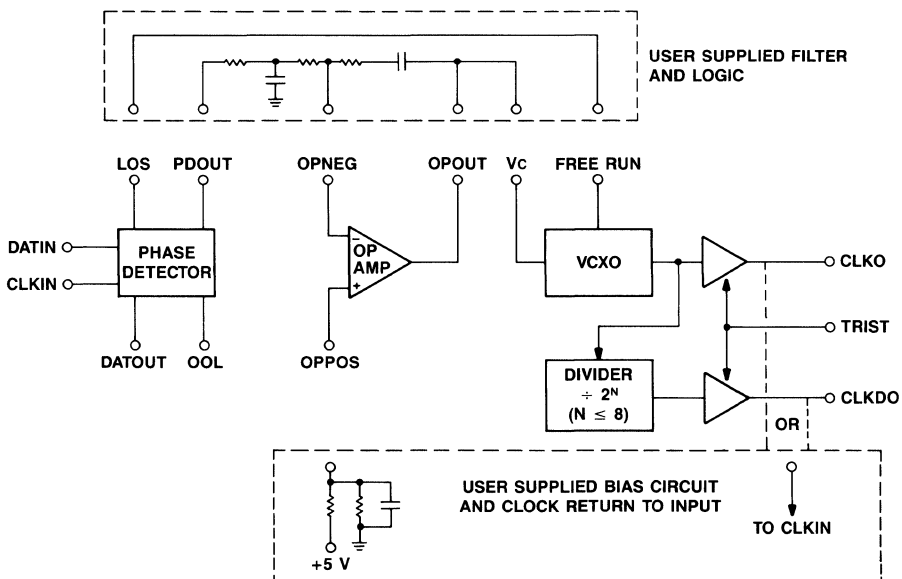
### Description

The TRU050 Clock Recovery and Data Retiming Module is a crystal-stabilized, phase-locked loop design that extracts the clock signal from a digital data stream and regenerates the data with a bit error rate less than  $10^{-9}$  and output jitter less than  $3^\circ$  rms. Incoming data should originate with a crystal-stabilized clock source and in NRZ format at TTL or CMOS logic levels. The module contains a voltage-controlled crystal oscillator, phase detector, and operational amplifier. With the addition of an RC network, loop dynamics may be tailored to the application.

### Features

- Selectable data rates to 50 Mb/s
- Output jitter less than  $3^\circ$  rms
- TTL-compatible
- Hermetically-sealed, 16-pin DIP
- Single positive supply voltage
- Low transition density required: 15%
- 3-stateable
- A return-to-zero TRU will be available 4Q88

### Block Diagram



Advanced information — Sample devices are not necessarily available at this time.

## Gallium Arsenide Integrated Circuits

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The intrinsic advantages of Gallium Arsenide include high speed, low power, and radiation hardness.

AT&T's initial product offering in this technology is a decision circuit. It performs retiming and regeneration of noisy digital input data. The device features a high-gain/bandwidth amplifier, D-type flip-flop, and complementary 50 ohm output buffers. The decision and clock threshold voltages are provided as dc outputs from the chip.

**For additional information contact your nearest sales office or call:  
1-800-372-2447.**

**Decision Circuit: 1.7 Gb/s**

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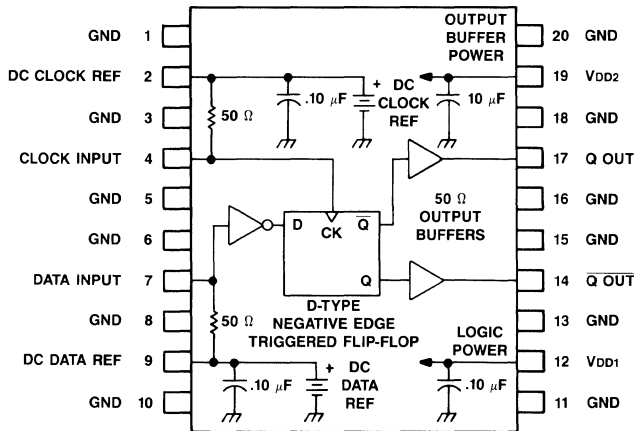
## Gallium Arsenide ICs

# Decision Circuit: 1.7 Gb/s — LG1088AX

### Description

The LG1088AX Decision Circuit is designed for high-performance, high-speed applications in digital terminals, repeaters, synchronizers, and data samplers and can be interconnected to create higher-level circuit functions. The unit retimes and regenerates a digital data stream, determining actual data states from weak input signals through a threshold voltage reference. A high-gain/bandwidth amplifier and D-type flip-flop with output buffers produce complementary outputs. The LG1088AX Decision Circuit is supplied in a 20-pin, surface-mountable ceramic package with nominal dimensions of 0.580" × 0.488" × 0.084".

### Functional Diagram



### Nominal Specifications ( $T_A = 25^\circ\text{C}$ , $V_{DD1} = 2.0\text{ V}$ )

Parameter	Symbol	Min	Typ	Max	Unit
Maximum Clock Frequency	$f_{\text{max}}$	1.7	—	—	GHz
Clock Input Voltage	$V_{\text{CLK}}$	—	600	—	mV p-p
Data Input Voltage	$V_{\text{IN}}$	150	—	600	mV p-p
Data Output Voltage*	$V_{\text{Q OUT}}$	250	—	—	mV p-p
Propagation Delay, Low to High	$t_{\text{PLH}}$	—	400	—	ps
High to Low	$t_{\text{PHL}}$	—	350	—	ps
Setup + Hold Time	$t_{\text{s+H}}$	—	400	—	ps
Data Output Transition Time (20% to 80%)*		—	—	150	ps
Power Supply Currents: Pin 12	$I_{\text{DD1}}$	—	25	—	mA
Pin 19	$I_{\text{DD2}}$	—	35	—	mA

\* ac-coupled into 50 ohms

## Hybrid Integrated Circuits

AT&T's hybrid IC offering features both thin- and thick-film technologies. In thin film, a tantalum resistor/capacitor (RC) process allows for precisely matched and temperature-stable components. A combination of both technologies is used to form reliable and inexpensive crossovers, with the inherent advantages of thin film: high precision and space compaction.

AT&T also provides a patented copper thin-film technology that produces high conductivity paths for use in high-frequency applications. This combination of highly stable tantalum thin-film resistors and the copper conductor system allows increased power densities without degrading reliability.

Packaging options include not only standard SIPs and DIPs but also surface mount and a variety of leaded and leadless packages.

**For additional information contact your nearest sales office or call:**

**1-800-372-2447.**

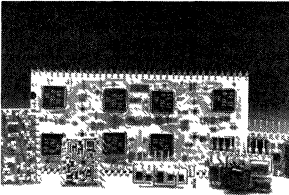
### Custom Hybrid Integrated Circuits

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## Hybrid ICs

# Custom Hybrid Integrated Circuits



### Description

AT&T's custom hybrid integrated circuits are produced by depositing thin and/or thick film metallization on a ceramic base. Active or passive components are attached to the circuit, producing a very efficient, integrated package. These packages are available in standard or special configurations.

### Performance

- High-stability resistor and capacitor technology with extremely tight component tolerances, ratios, and tracking capabilities
- Low parasitics and controlled impedances
- Excellent thermal performance
- High conductivity with copper or noble metal conductor systems
- Minimum propagation delay

### Flexibility

- Efficient electronic packaging by interconnecting different silicon IC technologies, such as MOS and Bipolar, on one hybrid
- Quick modifications to a design late in the development stage

### Modularity

- Pre-tuned and tested modules to meet critical functional requirements
- Pre-tested hybrid ICs improve system yields and reduce diagnostic and repair costs

### Custom Design

Bell Laboratories can design a custom hybrid IC from your circuit specifications. Our experienced application and design engineers can work with you to partition and develop a hybrid implementation of your circuit design. Early involvement with our engineers permits maximum utilization of the benefits of hybrids.

### Hybrid Technology

AT&T will recommend the most appropriate technology for your hybrid circuit. Our selection of hybrid technologies includes thin and thick film, multilayer thin and thick film, and PCB-based modules.

# Hybrid ICs

## Custom Hybrid Integrated Circuits

### Components

AT&T makes available a wide variety of components that can be placed on a hybrid IC. In addition to thin- and thick-film resistors and capacitors, a full line of AT&T silicon integrated circuits is available for your hybrid application. Commercially available active and passive components in packaged or unpackaged configurations are also used. These include: flat packs, chip resistors, chip capacitors, chip inductors, SOTs, SOICs, chip carriers, and optical components.

### Hybrid Packaging

AT&T hybrids are available in a variety of physical packages. Standard SIPs and DIPs often provide the most cost-effective design solution, but we also offer surface mount packages and a variety of leaded and unleaded packaging options. AT&T can also supply specially designed microwave hybrids.

### End-Point Specifications

#### Thin Film Components

Resistors	Sheet Resistance	300 & 100 $\Omega$ /Sq. (75, 50, & 25 $\Omega$ /Sq.)*
	Laser Trimmed (Abs)	$\pm 0.5\%$ ( $\pm 0.1\%$ )*
	Laser Trimmed (Ratio)	$\pm 0.25\%$ ( $\pm 0.05\%$ )*
	Stability (20 Yrs., 65°C)	+0.1% max.
	Temp. Coef. of Res. (TCR)	-145 $\pm 20$ ppm/°C
	TCR Tracking	< 4.0 ppm/°C
Capacitors	Resistor Density	5 $\Omega$ /Res. to 3 M $\Omega$ /Crt.
	Capacitance Density	500 — 56000 pF/Crt. (100 — 56000 pF/Crt.)*
	Dissipation Factor	$\leq 0.0024$ (1 kHz at 25°C)
	Temp. Coef. of Cap. (TCC)	+145 $\pm 15$ ppm/°C
	Tolerance	$\pm 5.0\%$
RC Product	Stability (20 Yrs., 65°C)	-0.1% max.
	Tolerance	$\pm 0.3\%$ ( $\pm 0.1\%$ )*
	Temp. Coef. of Freq. (TCF)	0.0 $\pm 25$ ppm/°C
Conductors	Sheet Resistance (Au)	50.0 m $\Omega$ /Sq. (5.0 m $\Omega$ /Sq.)*
	Sheet Resistance (Cu)	(< 2.0 m $\Omega$ /Sq.)*

#### Thick Film Components

Resistors	Sheet Resistance	0.1 $\Omega$ /Sq. to 10 M $\Omega$ /Sq.
	Laser Trimmed (Abs)	$\pm 1.0\%$ ( $\pm 0.5\%$ )*
	Laser Trimmed (Ratio)	$\pm 0.5\%$ ( $\pm 0.25\%$ )*
	Stability (20 Yrs., 65°C)	+0.1%
	Temp. Coef. of Res. (TCR)	+100 ppm/°C
Conductors	TCR Tracking	< 50 ppm/°C
	Sheet Resistance	25 — 45 m $\Omega$ /Sq. (2 — 3 m $\Omega$ /Sq.)*

\* Components with these tighter specifications are also available.



## Microprocessors and Peripherals

AT&T advanced microprocessors and peripherals offer you all the building blocks necessary for high-performance, 32-bit system designs. Ranging from 10—24 MHz, these chips are upward compatible and optimized for supporting *UNIX*® System V software for multitasking/multiuser systems.

The 32200 Microprocessor and peripherals chip set includes an advanced CPU, an integrated Memory Management Unit (MMU) and Data Cache, and a floating-point Math Acceleration Unit (MAU). The Direct Memory Access Controller (DMAC) and Dynamic RAM Controller (DRAMC) round out the chip set family.

AT&T also offers a design and development system which incorporates in-circuit emulation of the CPU and MMU with no wait states.

**For additional information contact your nearest sales office or call:  
1-800-372-2447.**

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# WE 32100 Microprocessor

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### Description

The WE 32100 Microprocessor is a second-generation, high-performance, single-chip, 32-bit central processing unit (CPU). It is optimized to support modern process-oriented operating systems and efficiently execute high-level language programs. It performs all of the system address generation, control, memory access, and processing functions required in a 32-bit microcomputer system. The CPU provides special instructions to allow the use of coprocessors and the necessary signals for interfacing with the WE 32101 Memory Management Unit. Separate 32-bit address and data buses are provided. The system memory space is addressed over the 32-bit address bus using either physical or virtual addresses. Data is written over the 32-bit bidirectional data bus in word (32-bit), halfword (16-bit), or byte (8-bit) lengths. Extensive addressing modes result in a symmetric, powerful, and extensive instruction set. The WE 32100 Microprocessor is available in 10-, 14-, and 18-MHz frequency versions. It is available in a 125-pin square, hermetic, ceramic pin grid array package and requires a single +5 V supply.

### Features

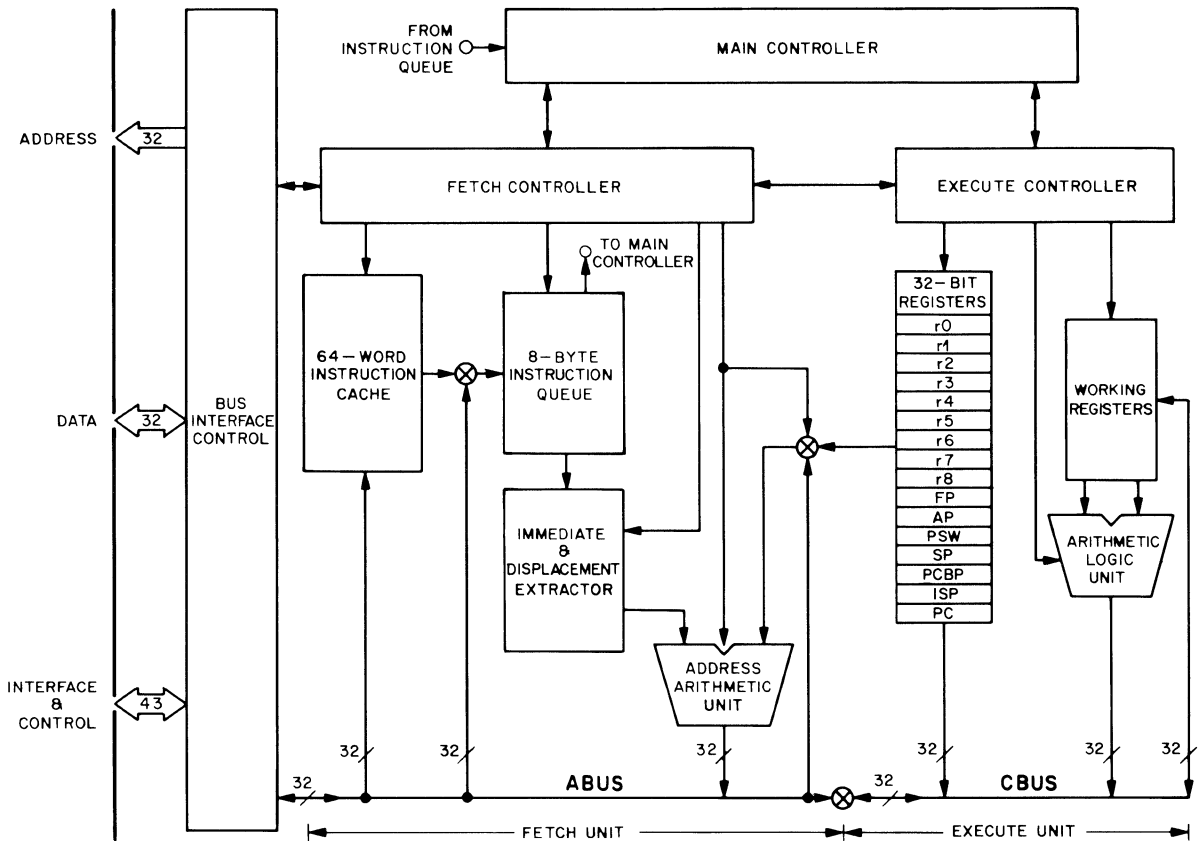
- 2 to 4 MIPS processing power
- Efficient execution of high-level language programs
- Extensive and orthogonal instruction set
- Direct support for process-oriented operating systems, such as *UNIX* System V, and process-handling instructions and executions
- Demand-paged virtual memory support provides mainframe computer capabilities
- Full 32-bit paths, address and data buses, and data manipulations
- Sixteen 32-bit on-chip registers; nine general-purpose and seven special-purpose
- On-chip 64 × 32 bit instruction cache and 8 × 8 bit instruction queue provide better system performance
- 4 Gbytes (2<sup>32</sup>) of direct memory addressing
- Physical and virtual addressing
- General-purpose coprocessor interface
- Four levels of execution privilege: kernel, executive, supervisor, and user
- Fifteen interrupt levels
- Memory-mapped I/O

# Microprocessors and Peripherals

## WE 32100 Microprocessor

- Triadic instructions
- Instructions start on 8-bit byte boundaries
- Synchronous or asynchronous interfacing to external devices
- Complete floating-point support via the WE 32106 Math Acceleration Unit
- 10-, 14-, and 18-MHz versions
- Single +5 V supply
- Low-power CMOS technology

### Block Diagram



# WE 32200 Microprocessor

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### Description

The WE 32200 Microprocessor (CPU) is the next generation of the single-chip, 32-bit WE 32100 Microprocessor. It is protocol and upward object code compatible with the WE 32100 Microprocessor. Application object code for the WE 32100 CPU will run without modification on the WE 32200 CPU. The new features of the WE 32200 Microprocessor include:

1. Arbitrary byte alignment for data and instructions
2. New addressing modes to support array access
3. Additional kernel and user registers
4. Loop control
5. BCD arithmetic instructions
6. Additional semaphore support
7. Dynamic bus sizing
8. Byte replication

### Features

- Performance at 6—8 MIPS
- 32 on-chip 32-bit registers (16 registers are utilized by the WE 321SG Software Generation Programs)
- 16/32-bit dynamic bus sizing allows transfers to/from 16- and 32-bit memories and peripherals by dynamically determining data width during an access
- Arbitrary byte alignment enables the CPU to handle nonaligned memory accesses for both reads and writes
- 15-level interrupt hierarchy for higher speed and improved security in interrupt handling
- Direct support for operating systems and high-level languages including C, PASCAL, FORTRAN, and COBOL
- A 256 byte on-chip instruction cache
- Start of instruction and stop pins, allowing you to control and monitor instruction execution and providing simplified synchronization of processors for fault tolerant applications
- Hardware support for process switching, minimizing the need for additional assembly code
- 24 MHz clock operation
- Low-power, 1  $\mu\text{m}$ , CMOS technology

# WE 32101 Memory Management Unit

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### Description

The WE 32101 Memory Management Unit (MMU) is a 32-bit, bus-structured device that provides logical-to-physical address translation, memory organization, control, and access protection for the WE 32100 Microprocessor. The MMU performs address translation by mapping virtual memory addresses to physical memory addresses. It supports both demand paged and demand segmented virtual memory systems, allowing 4 Gbytes of virtual memory and up to 4 Gbytes of physical memory per process. The MMU also allows the use of shared segments for intertask communication. Access privileges for each segment provide system protection. The WE 32101 Memory Management Unit is available in 10-, 14-, and 18-MHz versions; is available in a 125-pin square, hermetic, ceramic pin grid array package and requires a single +5 V supply.

The 4 Gbyte virtual address space is subdivided into four sections with as many as 8K segments per section. Segments may be as large as 128 Kbytes of contiguous space, or may be further subdivided into as many as sixty-four 2 Kbyte pages. The segments are mapped by the MMU into the physical address space. For each of the four execution levels, there are four access permissions associated with segments — execute only, read/execute, read/write/execute, no access.

The MMU contains descriptor caches, section RAMs, and MMU registers; all are addressable as memory locations. Each virtual memory section has a segment descriptor cache, page descriptor cache, base address register, and section length register associated with it. The four MMU registers are dedicated to decoding and reporting the status of the currently active virtual address.

### Features

- Extended temperature available now; MIL-STD-883C (10 MHz Version) planned availability 1988
- Manages 4 Gbytes ( $2^{32}$ ) of virtual address and up to 4 Gbytes of physical address space
- Paged and nonpaged segmentation support
- On-chip, segment descriptor cache; 2-way set-associative page descriptor cache
- On-chip cache miss-processing
- Four types of access protection at four execution levels
- Hardware support for *UNIX* System demand paging with automatic referenced/modified bit update
- Shared segments managed by indirect segment descriptors
- Extensive fault detection and resolution capability
- Multiple MMU configuration support; low-power CMOS technology
- 10-, 14-, and 18-MHz versions

# WE 32201 Memory Management Unit/Cache

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### Description

The WE 32201 Memory Management Unit (MMU) provides high-performance memory management for WE 32200 Microprocessor based systems. This VLSI device provides logical-to-physical address translation and access protection. It has 32-bit data and address buses and is upward compatible with the WE 32101 MMU. The MMU can map  $2^{32}$  bytes of virtual memory into a maximum of  $2^{32}$  bytes of physical memory. Paged segments are supported with access rights checking for system protection. A 64-entry, fully associative page descriptor cache provides a high hit rate. Transparent multiple contexts are supported for faster context switching. The MMU also allows the use of shared segments for interprocess communication.

The on-chip, 4-Kbyte, two-way, set-associative instruction/data cache returns data with zero wait states on WE 32200 CPU virtual and physical memory accesses. Transparent data cache miss-processing and zero wait-state hits significantly reduce overall system access wait states. The physical cache stores multiple contexts and performs bus monitoring to maintain cache integrity.

### Features

- Manages mapping of up to 4 Gbytes ( $2^{32}$ ) of virtual address space and up to 4 Gbytes ( $2^{32}$ ) of physical address space
- One and a half cycle virtual-to-physical address translation for instruction/data cache misses
- Fully associative, CAM based, 64-entry page descriptor cache
- On-chip zero wait-state, 4-Kbyte physical data cache
- Multiple configurations for up to 16-Kbyte physical cache
- Support for paged and contiguous segments
- Transparent multiple context support, with internal management of context identification
- Multiple page sizes: 2, 4, or 8 Kbytes
- Four execution levels with access rights checking
- On-chip miss-processing
- Bus watching maintains data integrity
- Hardware support for UNIX System demand paging, with automatic referenced/modified bit update
- Indirect segment descriptors in support of shared segments
- 22 MHz clock operation
- Low-power, 1  $\mu\text{m}$ , CMOS technology

# WE 32102 Clock

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### Description

The WE 32102 Clock supplies the two-phase, CMOS-level, frequency source required by the WE 32100 and WE 32200 Microprocessor chip sets. The WE 32102 Clock generates three outputs from an internal crystal controlled encoder. Two of the outputs are of the same basic frequency, but 90° out-of-phase. A third output is twice the frequency. Other features include an external frequency source input which provides control for testing of the clock's output. The clock is housed in a hermetically-sealed metal can (double-width, dual in-line package) and requires a single +5 V supply for operation. It is available in 10-, 14-, 18-, 22-, and 24-MHz versions.

The WE 32102 Clock can be controlled by an internal crystal or by an external frequency source for testing purposes. A clock enable input determines whether control is internal (enable high) or external (enable low).

### Features

- Extended temperature
- Available in 10-, 14-, 18-, 22-, and 24-MHz versions
- Two outputs 90° out-of-phase
- Each output drives up to 130 pF of capacitive loading
- Input for external frequency source
- Input and output at CMOS levels
- Single +5 V supply

# WE 32103 DRAM Controller

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### Description

The WE 32103 DRAM Controller provides address multiplexing, access and cycle time management, and refresh control for DRAM devices. In a single chip, it provides the interface for high-performance, high reliability, 16- and 32-bit wide, dynamic memory subsystems. Its general-purpose interface is programmable, optimizing system performance for a wide range of memory configurations. The DRAM controller is capable of addressing up to 16 Mbytes of memory. The WE 32103 DRAM Controller is available in a 125-pin, square, hermetic, ceramic pin grid array package; is available in 10-, 14-, and 18-MHz versions; and requires a single +5 V supply.

The important features of the WE 32103 DRAM Controller are:

#### *Memory Access/Address Translation Overlap*

To provide an overlap of memory accesses with address translation, the DRAM controller uses a pretranslation technique. This feature can be used in virtual memory systems that use paged segments. In such systems, the lower order bits of the virtual address do not change during translation. The DRAM controller can use these low-order bits to drive the row address and assert the row address strobe while the WE 32101 Memory Management Unit is translating the remaining portion of the address.

#### *Multiword Memory Transfers*

Byte, half-word, 3-byte, 4-byte, 2-word, 3-word, and 4-word read and write operations are supported. For I/O bound user applications, use of multiword bus transactions can double the rate of block data transfer over the system data bus. Multiword access reduces the overhead latencies associated with bus arbitration, successive address transmission, and subsequent address translation. The DRAM controller provides 2-word reads to the WE 32100 CPU, as well as 4-word reads and writes to the WE 32104 DMA Controller. The DRAM controller provides multiword access by receiving an access size request, supplying a handshake, and manipulating DRAM strobes for page, nibble, or cycling RAS.

#### *Error Detection and Correction*

All of the signals needed to interface with an error detection and correction unit are provided. The DRAM controller turns partial-word write operations and read operations with correctable errors into a user-transparent read-modify-write memory cycle. For high reliability applications, programmable support is provided for periodic error scrubbing and automatic check-bit initialization.

# **Microprocessors and Peripherals**

## **WE 32103 DRAM Controller**

### *Dual-Port Configuration*

A dual-ported memory can be controlled using two DRAM controllers. One is configured as a master, while the other is configured as a slave. Along with its normal tasks, the master performs memory arbitration and refreshes. The slave normally 3-states its memory outputs until it is granted ownership of the shared memory outputs by the master DRAM controller.

### *Refresh Configurations*

The DRAM controller can be programmed to provide a wide variety of refresh schemes. It has both a programmable, internal refresh timer and an external refresh request input. The refresh mode can be programmed for distributed refresh. Combinations of internal, external, and distributed refresh modes allow many different applications. An explicit refresh interval timer is accessible to the programmer.

### *Configuration Registers*

Configuration registers are provided to optimize the controller for a wide range of DRAM configurations.

## **Features**

- Can overlap memory access with MMU address translation and chip select decoding functions
- Provides 5 cycle access mechanism for CPU, CPU/MMU, CPU/MMU/DMAC systems
- Supports double-, triple-, and quad-word memory reads and writes
- Full support for error detection and correction devices
- Drives up to 88 DRAM devices without external buffers
- Controls a variety of DRAM configurations including 1-Mbit DRAM devices
- Internal refresh timer and refresh address counter to reduce board-level device count
- Programmable DRAM access times
- Programmable support for page and nibble mode DRAM
- Dual-ported memory configurations using two DRAM controllers
- General-purpose asynchronous operation and synchronous operation with the WE 32100 Microprocessor chip set



# WE 32104 DMA Controller

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### Description

Direct memory access (DMA) is a mechanism for servicing I/O device data transfer requests. It is driven by an I/O device to provide direct access to system memory. The WE 32104 Direct Memory Access Controller (DMAC) provides DMA capabilities while taking advantage of the full 32-bit data and address of the WE 32100 Microprocessor. The DMAC contains specialized hardware that permits transfers at a much faster rate than possible under microprocessor control.

The DMAC is a memory-mapped peripheral device that performs memory-to-memory, memory-to-peripheral, and peripheral-to-memory data transfers quickly and efficiently. When used with the WE 32100 Microprocessor, the DMAC permits the full 32-bit width of the system bus to be utilized without external interfacing logic. In addition, a peripheral bus is provided to couple 8-bit input/output devices to the system bus. The DMAC is implemented in CMOS technology, is available in a 133-pin, square, hermetic, ceramic pin grid array, and requires a single +5 V supply. The DMAC is available in 10-, 14-, and 18-MHz versions.

### Architectural Summary

The DMAC has four independent channels that allow it to serve four unrelated transfer requests simultaneously. Each channel has a set of registers that configures and controls its operation. In addition, there is one mask register which is shared between the four channels. When the DMAC is in peripheral mode, registers within the DMAC and registers within devices connected to the peripheral bus are accessed by the CPU. This provides the CPU an access path to the peripheral bus.

The seven functional elements of the DMAC are:

**System Bus Interface** - provides address, data, and control signals needed to interface the DMAC to the WE 32100 Microprocessor.

**Data Buffers** - each of the four channels has a 32-byte data buffer. The lowest address data buffer is used as the memory fill data register (MFDR). This register contains the data which is written to consecutive locations during memory fill operations.

**Register File** - contains eight control registers for each DMA channel and one global register. The control registers consist of source address, destination address, transfer count, base address, mode, device control, interrupt vector, and status and control registers. The global register is a mask register used to disable particular channel activity.

**Address Arithmetic Unit (AAU)** - calculates addresses of source and destination using information from the per channel registers and the data size and request generator.

## **Microprocessors and Peripherals**

### **WE 32104 DMA Controller**

*Count Arithmetic Unit (CAU)* - calculates number of bytes to be transferred using information from the per channel registers and the data size and request generator.

*Packing Registers* - used to pack bytes into larger operands when transferring from the peripheral bus to the system bus. Also used to unpack large system bus operands to bytes when transferring to the peripheral bus.

*Peripheral Bus* - used to communicate with 8-bit I/O devices.

#### **Features**

- Extended temperature, Mil spec
- Full 32-bit address and data buses
- 8-bit peripheral bus for coupling I/O devices to the system bus
- Double- and quad-word bus cycles available for high system throughput
- Internal data buffers to support burst data peripherals
- Four independent prioritized DMA channels
- Two programmable interrupt vectors per channel
- Memory-to-memory transfers at rates up to 14.4 Mbytes/s at 18 MHz
- Memory-to-peripheral transfers at rates up to 9 Mbytes/s at 18 MHz (with burst mode)
- Memory fill operations at rates up to 26.2 Mbytes/s are available for writing an arbitrary constant to a block of memory

# WE 32204 DMA Controller

---

### Description

Direct memory access (DMA) is a mechanism for servicing I/O device data transfer requests. It is driven by an I/O device to provide direct access to system memory. The WE 32204 Direct Memory Access Controller (DMAC) provides DMA capabilities while taking advantage of the full 32-bit data and address of the WE 32200 Microprocessor. The DMAC contains specialized hardware that permits transfers at a much faster rate than possible under microprocessor control.

The DMAC is a memory-mapped peripheral device that performs memory-to-memory, memory-to-peripheral, and peripheral-to-memory data transfers quickly and efficiently. When used with the WE 32200 Microprocessor, the DMAC permits the full 32-bit width of the system bus to be used without external interfacing logic. In addition, a peripheral bus is provided to couple 8-bit input/output devices to the system bus. The DMAC is implemented in CMOS technology, is available in a 145-pin, square, hermetic, ceramic pin grid array, and requires a single 5 V supply. The DMAC is available in a 24 MHz version.

### Architectural Summary

The DMAC has four independent channels, which allow it to serve four unrelated transfer requests simultaneously. Each channel has a set of registers that configures and controls its operation. In addition, there is one mask register that is shared between the four channels. When the DMAC is in peripheral mode, registers within the DMAC and registers within devices connected to the peripheral bus are accessed by the CPU. This procedure provides the CPU an access path to the peripheral bus.

The seven functional elements of the DMAC are:

**System Bus Interface** - provides the address, data, and control signals needed to interface the DMAC to the WE 32200 Microprocessor.

**Data Buffers** - each of the four channels has a 32-byte data buffer. The lowest address data buffer is used as the memory fill data register (MFDR). This register contains the data that is written to consecutive locations during memory fill operations.

**Register File** - contains eight control registers for each DMA channel and one global register. The control registers consist of source address, destination address, transfer count, base address, mode, device control, interrupt vector, and status and control registers. The global register is a mask register used to disable particular channel activity.

**Address Arithmetic Unit (AAU)** - calculates addresses of source and destination using information from the per channel registers and the data size and request generator.

## **Microprocessors and Peripherals**

### **WE 32204 DMA Controller**

*Count Arithmetic Unit (CAU)* - calculates the number of bytes to be transferred using information from the per channel registers and the data size and request generator.

*Packing Registers* - used to pack bytes into larger operands when transferring from the peripheral bus to the system bus. Also, it is used to unpack large system bus operands to bytes when transferring to the peripheral bus.

*Peripheral Bus* - used to communicate with 8-bit I/O devices.

#### **Features**

- Full 32-bit address and data buses
- 8-bit peripheral bus for coupling I/O devices to the system bus
- Double- and quad-word bus cycles available for high system throughput
- Internal data buffers to support burst data peripherals
- Four independent prioritized DMA channels
- Two programmable interrupt vectors per channel
- Memory-to-memory transfers at rates of up to 19.2 Mbytes/s at 24 MHz
- Memory-to-peripheral transfers at rates of up to 12 Mbytes/s at 24 MHz (with burst mode)
- Memory fill operations available for writing an arbitrary constant to a block of memory

# **WE 32106 Math Acceleration Unit (Floating Point)**

---

### **Description**

The WE 32106 Math Acceleration Unit (MAU) provides floating-point capability for the WE 32100 Microprocessor and is fully compatible with the IEEE standard for binary floating-point arithmetic.

The MAU can operate in peripheral mode with general-trade microprocessors or as a coprocessor for the WE 32100 Microprocessor. It provides single (32-bit), double (64-bit), and double-extended (80-bit) precision for add, subtract, multiply, divide, remainder, square root, and compare operations. The operand, result, status, and command information transfers take place over a 32-bit bidirectional data bus that provides the interface to the host microprocessor. The MAU is implemented in CMOS technology; is available in a 125-pin, square, hermetic, ceramic pin grid array package; and requires a single +5 V supply.

### **Features**

- Extended temperature available now; MIL-STD-883C (10 MHz Version) planned availability 1988
- Compatible with ANSI/IEEE Standard 754-1985 for Binary Floating-Point Arithmetic
- Single (32-bit), double (64-bit), and double-extended (80-bit) precision capability
- Add, subtract, multiply, divide, remainder, negate, absolute value, and square root functions
- Compare, move, and rounding to integral value functions
- Coprocessor and peripheral mode interfaces available
- Up to 1.4 million Whetstones/second
- Symmetric integer, decimal, and floating-point conversions
- 32-bit I/O interface
- Support of transcendental functions via the WE 321SG Software Generation Programs
- Available in 10-, 14-, and 18-MHz versions

# **WE 32206 Math Acceleration Unit (Floating Point)**

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### **Description**

The WE 32206 Math Acceleration Unit (MAU) is an enhanced coprocessor that provides high-speed, IEEE floating-point processing support for the WE 32200 Microprocessor. The MAU can operate in peripheral mode, allowing operation with general-trade microprocessors, or as a coprocessor for the WE 32200 Microprocessor. Systems using the WE 32206 MAU have a two-times performance improvement over its predecessor, the WE 32106 MAU. The WE 32206 MAU is footprint, protocol, and upward object code compatible with the WE 32106 MAU.

### **Features**

- Full compliance with ANSI/IEEE Standard 754-1985 for Binary Floating-Point Arithmetic
- Single (32-bit), double (64-bit), and double-extended (80-bit) precision capability
- Eight 80-bit user registers
- Add, subtract, multiply, divide, remainder, negate, absolute value, square root, sine, cosine, arctan, and pi operations
- Compare, move, and rounding to integral value functions
- On-chip trigonometric functions
- Coprocessor and peripheral mode interfaces available
- Symmetric integer, decimal, and floating-point conversions
- 32-bit I/O interface
- Up to three memory-based operands for each coprocessor instruction
- 24 MHz clock operation
- 3.1 million Whetstones/second
- Single +5 V supply
- Low-power, 1 micron, CMOS technology

# **WE 321DM/WE 322DM CPU and MMU Device Monitors**

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### **Description**

The WE 321DM/WE 322DM CPU and MMU Device Monitors provide low-cost solutions for debugging WE 32100/WE 32200 Microprocessors and the WE 32101/WE 32201 Memory Management Units.

The device monitor allows signal observation of high-speed target systems with a logic analyzer that has 10 MHz sampling rates by:

- Generating logic analyzer sample points based on bus cycle activity, and guaranteeing a minimum of 100 ns between sample points at target system operating frequencies as high as 24 MHz.
- Sampling and holding signals as necessary to assure 30 ns signal set-up and 0 ns signal hold times with respect to selected sampling points in a target system operating frequency up to 24 MHz.
- Providing the flexibility of observing a narrow window of bus activity in detail, or observing a larger window of bus activity with reduced detail but with a greater perspective of system bus activity.

These device monitors support zero wait-state block fetch accesses at frequencies of 18 MHz and 24 MHz, respectively.

# WE 321DS Microprocessor Development System

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### Description

The WE 321DS Microprocessor Development System is an integrated hardware and software system used to develop, test, and debug WE 32100 Microprocessor based applications. It consists of items that can be ordered individually. The main component of the development system is the WE 321AP Microprocessor Analysis Pod. The analysis pod emulates the WE 32100 Microprocessor, WE 32101 Memory Management Unit, and WE 32102 Clock functions in the target system under development and is essential for diagnosing target hardware and software problems. The analysis pod includes an interactive monitor program (IMP) for assembly-level debugging. The development system also includes the WE 321SD Development Software Programs, a package of *UNIX* System based software which runs on either an AT&T 3B2/300 or 400 Computer, or a VAX\* 11/780 Computer. This package includes utility programs for downloading the host computer. An optional software package includes Ferret, a C-level symbolic debugger. An additional software package is available that supports logic analysis with the Hewlett-Packard 64000 Logic Development System.

The WE 321DS Microprocessor Development System can operate in any of four configurations. All four configurations require a terminal (system console) for user interaction with the debuggers and a +5 V power supply for the analysis pod.

These configurations are:

- Microprocessor Analysis Pod Stand-Alone
- Hardware Development Workstation
- Software Development Workstation
- Hardware and Software Integrated Workstation

\* Registered trademark of Digital Equipment Corporation



# WE 321EB Microprocessor Evaluation Board

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### Description

The WE 321EB Microprocessor Evaluation Board is a WE 32100 Microprocessor based single-board microcomputer evaluation system. It allows evaluation of the hardware and software capabilities and performance of the WE 32100 Microprocessor, the WE 32101 Memory Management Unit (MMU), and the WE 32106 Math Acceleration Unit (MAU) in an application environment. The evaluation board contains a WE 32100 Microprocessor, a WE 32101 Memory Management Unit, a WE 32106 Math Acceleration Unit, a WE 32102 Clock, a ROM-based interactive monitor program (IMP) and system self-test, 96 Kbytes of RAM, and I/O circuitry. The evaluation board requires a single +5 V, 3 A power source for operation and operates at 18 MHz.

### Features

- WE 32100 Microprocessor
- WE 32101 Memory Management Unit
- WE 32106 Math Acceleration Unit
- WE 32102 Clock (18 MHz)
- 64 Kbytes of high-speed static RAM
- 32 Kbytes of additional RAM
- 64-Kbyte ROM-resident interactive monitor program (IMP) and system self-test program
- Program trace and breakpoint capability
- Seven individually maskable interrupts
- Twenty-four programmable parallel I/O lines
- Two RS-232C serial I/O ports with selectable baud rate (300—9600)
- Communication with terminal and with *UNIX* System host
- Three programmable 16-bit interval timers
- Eight-character LED display (17-segment)
- Push-button reset and abort switches

# WE 321SG C-Software Generation Programs (CPLU Release 4.2)

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### Description

The WE 321SG C-Software Generation Programs facilitate using a host *UNIX* System V for creating software for the WE 32100 Microprocessor. This support software provides utility programs that enable the user to write applications software in C language or assembly language.

The C-Software Generation Programs are binary products that satisfy a native programming environment. The WE 321SG C-Software Generation Programs replace any other Native C compiler already installed in an AT&T 3B2 Computer System running *UNIX* System V Release 2.0.5/2.1/3.0/3.1/3.1.1 or *UNIX* System V/VME Release 2.1/3.1.

An additional software package that is available with the C-Software Generation Programs, Advanced Programming Utilities Environment (APU), contains commands such as *ctrace*, *lex*, and *yacc*. These and other commands provide the user with a set of programming tools that allow the programmer to do advanced programming and debugging, create shared libraries, and work in an environment where it may be necessary to track and maintain versions of files and programs.

The software generation programs can generate code in either of two floating-point modes, MAU or FPE. The MAU mode provides enhanced floating-point performance through the use of in-line code generation for the WE 32106 Math Acceleration Unit (MAU). Alternatively, at the cost of lower performance, the FPE mode supports target systems operating both with and without a math acceleration unit. The FPE mode compiles floating-point operations as calls to library routines that either execute MIS or emulate the operations, depending on whether a math acceleration unit has been determined to be present at process start-up.

The software generation programs also provide high-performance math libraries, integer and floating-point optimizations, and floating-point support that conforms to the IEEE Standard for Binary Floating-Point Arithmetic (ANSI/IEEE Std. 754-1985). The C-Software Generation Programs comply completely with the *UNIX* System V Interface Definition (SVID) (i.e., passes the *UNIX* System V Verification Suite).

### Features for the WE 321SG Software Generation Programs

#### *Utilities*

- C compiler
- Assembler
- Link editor
- Disassembler
- Object code optimizer
- Archiver and library maintainer
- Object file host converter
- Object file compressor
- Object and archive file converter
- Object file dumper
- Source code lister
- Object file orderer
- Symbol table printer
- Object file stripper

## Microprocessors and Peripherals

# UNIX System V Release 2.1/3.1

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### Description

UNIX System V Release 2.1/3.1 provides the operating system and user interface for the 32-bit WE 32100/32200 Microprocessor chip set. Optionally, this software may be integrated by the user with an optimized version of the WE 321SG C-Software Generation Programs for the WE 32100 Microprocessor chip set. The operating system has been tested and certified with these optimized programs.

They provide several levels of optimization and different types of floating-point support as run-time options.

### Features

- Multi-user/multi-tasking
- Enhanced C software generation system with symbolic debugging includes shared library support
- Demand-paged virtual memory gives at least 16 Mbytes of linear address space per process; includes U page
- File and record locking system calls provide user data protection
- Self-configuration allows installation of new drivers without regenerating the system
- Simplified system administration eliminates the need for a full-time, on-site systems expert
- Job control language
- Cross-compilers allow program development in a large computer environment
- Exploits UNIX System oriented features of the WE 32100 Microprocessor chip set, such as full 32-bit architecture, efficient process switching, memory management, and optional hardware floating-point capability
- Facilitates personalization to user-developed hardware configurations
- Easy to use documentation
- Remote file sharing using Ethernet local area network
- Improved signal mechanisms
- Incremental back-up of nested files systems

## **Microprocessors and Peripherals**

### ***UNIX System V Release 2.1/3.1***

#### **Additional Features for *UNIX System V Release 3.1***

- Internationalization, includes support for 8-bit code set, alternate date/time formats, and character class/conversion rules
- Assists menu/forms interface
- Faster Curses/Terminfo support the writing of terminal-independent applications
- Remote file sharing (RFS)
- STREAMS Mechanism and Tools
- AT&T Transport Interface
- Media-independent uucp
- Executable shared libraries
- ASSIST Interface
- Performance improvements, including paging the user area, remote file sharing client caching, and smaller and faster curses
- Complies completely with the *UNIX System V Interface Definition Issue 2 (SVID)* (i.e., passes the *UNIX System V Verification Suite Release 3*)



## Opto-isolators

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AT&T's complete line of high-performance opto-isolators features a high minimum transfer ratio and significantly low drive current that result in minimal power consumption. They transmit both ac and dc signals and can be used in analog or digital systems. Moreover, opto-isolators protect against transient surges and provide ground loop isolation.

**For additional information contact your nearest sales office or call:  
1-800-372-2447.**

### **Autopolarity IRED Input**

Darlington Output  
Transistor Output

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### **Unipolarity IRED Input**

Darlington Output  
Transistor Output  
SCR Output  
Dual Transistor Output  
Dual Photodiode Output

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**13-5**  
**13-6**  
**13-7**  
**13-8**

## Opto-isolators Autopolarity IRED Input

# Darlington Output

### Single Channel

Base Lead to No. 6 Pin	Specified Input Current (I <sub>F</sub> ) mA	Current Transfer Ratio (CTR) min	Sustained Voltage		Isolation Current** (I <sub>ISO</sub> ) nA max	Pulse Time (T <sub>r</sub> , T <sub>f</sub> ) μs max	Device Code Number
			[V <sub>CE(SUS)</sub> ] V min	(I <sub>CEO</sub> )* nA max			
yes	2.0	7.5	60	100	100	100	4E †
yes	0.1	2.0	12	100	100	200	4N
none	0.2	1.8	12	100	100	200	4H
none	1.0	4.0	30	200	100	—	9E †

### Dual Channel

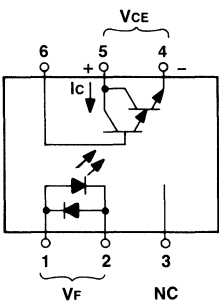
Specified Input Current (I <sub>F</sub> ) mA	Current Transfer Ratio (CTR) min	Sustained Voltage [V <sub>CE(SUS)</sub> ] V min	(I <sub>CEO</sub> )* nA max	Isolation Current** (I <sub>ISO</sub> ) nA max	Pulse Time (T <sub>r</sub> , T <sub>f</sub> ) μs max	Device Code Number
2.0	7.5	60	100	100	100	2A

\* Collector-Emitter Leakage Current

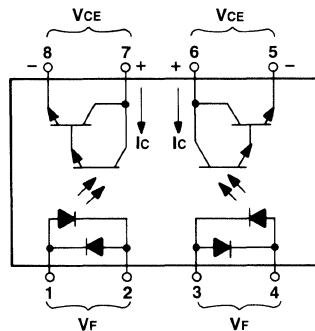
\*\* Specified at (V<sub>ISO</sub>) = 2500 V

† UL recognized (File No. E86340). Approvals can be obtained for other devices.

#### Single Channel



#### Dual Channel



# Opto-isolators Autopolarity IRED Input

## Transistor Output

### Single Channel

Specified Input Current (IF) mA	Current Transfer Ratio (CTR) min	Sustained Voltage		Isolation Current**		Pulse Time (Tr,Tr) μs max	Device Code Number
		[VCE(SUS)] V min	(ICEO)* nA max	(Iiso) nA max			
2.0	0.6	60	100	100	5.0	4D	

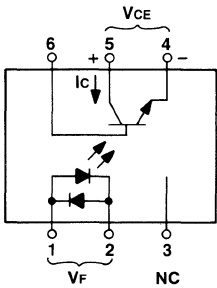
### Dual Channel

Specified Input Current (IF) mA	Current Transfer Ratio (CTR) min	Sustained Voltage		Isolation Current**		Pulse Time (Tr,Tr) μs max	Device Code Number
		[VCE(SUS)] V min	(ICEO)* nA max	(Iiso) nA max			
2.0	0.6	60	100	100	5.0	2E	

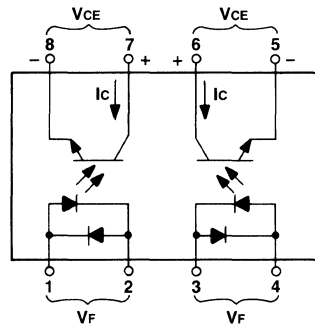
\* Collector-Emitter Leakage Current

\*\* Specified at (VISO) = 2500 V

#### Single Channel



#### Dual Channel





## Opto-isolators Unipolarity IRED Input

# Darlington Output

### Single Channel

Base Lead to No. 6 Pin	Specified Input Current (I <sub>F</sub> ) mA	Current Transfer Ratio (CTR) min	Sustained Voltage		Isolation Current**		Pulse Time (T <sub>r</sub> , T <sub>f</sub> ) μs max	Device Code Number
			[V <sub>CE(SUS)</sub> ] V min	(I <sub>CEO</sub> )* nA max	(I <sub>iso</sub> ) nA max			
yes	2.0	7.5	60	100	100	100	4B	
yes	0.7	4.0	60	100	100	100	4C	
none	0.2	2.0	60	100	100	100	4G	
none	2.0	7.5	60	100	100	100	4K	

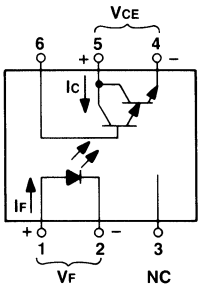
### Dual Channel

Specified Input Current (I <sub>F</sub> ) mA	Current Transfer Ratio (CTR) min	Sustained Voltage		Isolation Current**		Pulse Time (T <sub>r</sub> , T <sub>f</sub> ) μs max	Device Code Number
		[V <sub>CE(SUS)</sub> ] V min	(I <sub>CEO</sub> )* nA max	(I <sub>iso</sub> ) nA max			
2.0	7.5	60	100	100	100	2B	
0.2	1.8	12	100	100	200	2H	

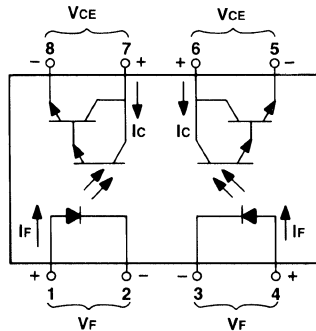
\* Collector-Emitter Leakage Current

\*\* Specified at (V<sub>iso</sub>) = 2500 V

#### Single Channel



#### Dual Channel



# Opto-isolators

## Unipolarity IRED Input

# Transistor Output

### Single Channel

Base Lead to No. 6 Pin	Specified Input Current (IF) mA	Current Transfer Ratio (CTR) min	Sustained Voltage		Isolation Current** (Iiso) nA max	Pulse Time (Tr, Tf) max	Device Code Number
			[VCE(SUS)] V min	(ICEO)* nA max			
none	1.0	1.0	17	100	100	5.0 μs	4W
none	1.0	1.0	17	100	100	5.0 μs	4L
yes	2.0	0.6	60	100	100	5.0 μs	4A
none	2.0	0.6	12	100	100	5.0 μs	4J
yes	1.0	0.3	60	100	100	5.0 μs	4F
none	0.5	0.3	12	100	100	5.0 μs	4M
none	0.16	—	30	100	100	20 ms	4U †

### Dual Channel

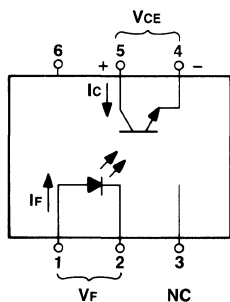
Specified Input Current (IF) mA	Current Transfer Ratio (CTR) min	Sustained Voltage		Isolation Current** (Iiso) nA max	Pulse Time (Tr, Tf) μs max	Propagation Delay μs max	Device Code Number
		[VCE(SUS)] V min	(ICEO)* nA max				
2.0	0.6	60	100	100	50	—	2C
2.0	1.8	60	100	100	—	50	2K
1.0	1.0	60	100	100	5.0	—	2J

\* Collector-Emitter Leakage Current

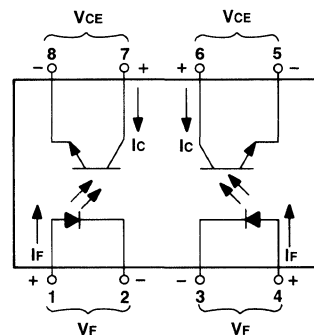
\*\* Specified at (VISO) = 2500 V

† UL recognized (File No. E86340). Approvals can be obtained for other devices.

#### Single Channel



#### Dual Channel



(Refer to Section 19 for typical applications of this product.)

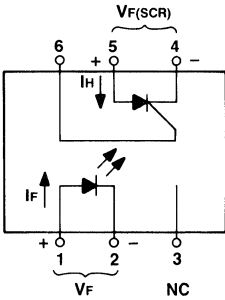
## Opto-isolators Unipolarity IRED Input

# SCR Output

### SCR Output

Input Current to Trigger (I <sub>F</sub> ) mA		Holding Current (I <sub>H</sub> ) mA		Forward On-State Voltage [V <sub>F(SCR)</sub> ] V	Reverse Breakdown Voltage [V <sub>BR(R)</sub> ] V	Forward Breakover Voltage [V <sub>BR(F)</sub> ] V	Isolation Current* (I <sub>iso</sub> ) nA	Device Code Number
min	max	min	max	max	min	min	max	
2.0	15	0.02	2.0	1.5	250	250	100	5A

\* Specified at (V<sub>iso</sub>) = 2500 V



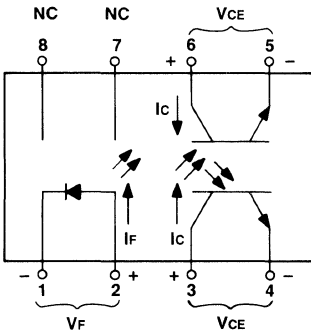
# Opto-isolators Unipolarity IRED Input

## Dual Transistor Output

### Dual Transistor Output

dc Contrast	Specified Input Current	Current Transfer Ratio	Sustained Voltage		Isolation Current (V <sub>iso</sub> )= 1500 V	Pulse Time	Device Code Number
(K)	(I <sub>F</sub> ) mA	(CTR) min	[V <sub>CE(SUS)</sub> ] V min	(I <sub>CEO</sub> )* nA max	(I <sub>iso</sub> ) nA max	(T <sub>r</sub> , T <sub>f</sub> ) μs max	
±100%	1.0	0.6	60	100	100	5	2L

\* Collector-Emitter Leakage Current



## Opto-isolators Unipolarity IRED Input

# Dual Photodiode Output

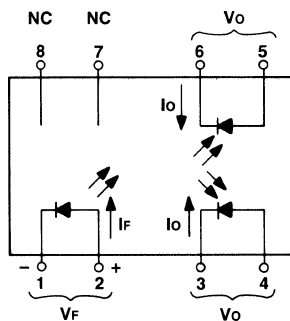
### Dual Photodiode Output

dc Contrast		Breakdown Voltage	Diode Leakage Current	Isolation Current*	Cutoff Frequency	Device Code Number
(K)		(VBR) V	(I <sub>D</sub> ) nA	(I <sub>iso</sub> ) nA	(F <sub>c</sub> ) kHz	
min	max	min	max	max	min	
0.80%	1.20%	60	25	100	70	2D

\* Specified at (V<sub>iso</sub>) = 2500 V

The 2D opto-isolator is designed for an in-circuit configuration that utilizes one of the photodiodes of the 2D as a feedback element for stabilization. When applied in this manner, the 2D is optimized to monitor situations where complete isolation is necessary, and low frequency linear or dc transmission is desirable. The ratio of one output detector to another only varies by  $\pm 0.50\%$  when comparing ac and dc operation over the full temperature range.

The linear opto-isolator not only replaces an isolation transformer, but it allows a new approach by providing a means for an optically-coupled, isolated circuit.



## Power Products

AT&T offers a broad spectrum of power products.

Board mounted power modules, ranging from 2.5 to 100 watts, have a small footprint, high power density, and high efficiency. The OLS Power Supplies range in size from 25 to 2000 watts and offer a wide variety of output features.

DC-DC Converters are available in a wide range of outputs, or custom designed for your particular needs.

AT&T Uninterruptible Power Systems (UPS) are on-line, microprocessor-controlled units that regulate ac power in normal use and provide continuous backup in emergencies.

The *LINEAGE 2000* Energy Systems include rectifiers, round cell batteries, and either a conventional or microprocessor-based system controller.

A power systems design staff is available to assist you in the selection of power architectures that meet your needs.

**For additional information contact your nearest sales office or call:  
1-800-372-2447.**

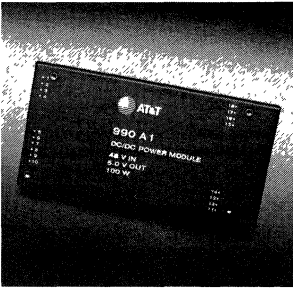
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\* Did not appear in the previous edition of the Product Selection Guide.

## Power Products

# Board Mounted Power Modules

### Description



**The 990A1 Board Mounted Power Module**

AT&T Board Mounted Power Modules offer low profiles, small footprints, and high power densities. These miniature dc-dc converters range in output power from 2.5 to 100 watts. The 900 Series is designed with both surface mount and through-hole technology on printed circuit boards. Some models have a thick-film ceramic substrate control circuit while others have a separate PCB surface mount control circuit. Only the 990A1, 100 watt model, requires an external heat sink. All other 900-Series modules are entirely self-contained and do not require additional components such as external filters or heat sinks.

A system powered by Board Mounted Power Modules offers benefits to the user. In addition to the capability for developing non-standard voltages, the power modules can reduce the cost of power distribution by decreasing distances traveled by low voltages. Moreover, they can power a system on a field-replaceable basis, thereby yielding improved system reliability.

### Features

- Low profile (as low as 1/2 inch)
- Efficiencies to 89%
- 2.5 to 100 watts
- High power densities
- Small footprint
- Remote on/off capability
- Remote sense
- Output current limiting/overcurrent protection
- Overvoltage protection
- Input/output isolation
- Input/output filtering
- External synchronization
- Constant voltage/constant current models
- Regulated output voltage/current
- Operating temperatures range as wide as -40 to +70°C

## Power Products

### Board Mounted Power Modules

#### Product Matrix — 900 Series Printed Circuit Board-Based

##### *Isolated Input/Output*

Input/Output Characteristics	Output			Dim.*	Code
	V (volts)	I (amps)	P (watts)		
<b>24 Volt Input</b>					
Single Output	100	3.5	35.0	G	984G
<b>48 Volt Input</b>					
Single Output	2.2	4.2	9.0	F	920D
	5.0	2.0	10.0	B	910A
	5.0	2.0	10.0	K	910AP1
	12.0	0.833	10.0	K	910BP
	12.0	1.0	12.0	E	912A
	5.0	3.0	15.0	D	915A
	2.1	8.0	17.0	G	984C
	2.2	8.0	17.6	G	984L
	4.6	4.1	19.0	F	920E
	5.0	4.0	20.0	F	920A
	5.2	3.8	20.0	F	920F
	12.0	1.7	20.0	F	920B
	15.0	1.3	20.0	F	920C
	5.0	6.0	30.0	G	984A
	12.0	2.5	30.0	G	984D
	5.2	6.0	31.2	G	984B
	5.0	20.0	100.0	H	990A1

#### Product Matrix — Ceramic

##### *Non-Isolated Input/Output*

Input/Output Characteristics	Output			Dim.*	Code
	V (volts)	I (amps)	P (watts)		
<b>5 Volt Input</b>					
Single Output	-130	0.005	0.10	I	113E
	-15	0.050	0.75	I	113C
	-5	0.300	1.50	I	113G
	15	0.100	1.50	I	112C
	12	0.125	1.50	I	112E
<b>15-60 Volt Input</b>					
Single Output	12	0.084	1.00	I	117A

\* See Physical Dimensions chart, page 14-4.



## Power Products

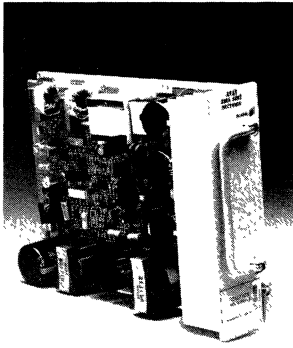
### Board Mounted Power Modules

#### Physical Dimensions

Size Key	Nominal Dimensions (inches)			Pins
	Length	Width	Height	
A	1.75	1.75	0.50	4
B	2.50	1.50	0.50	4
C	2.50	2.50	1.04	6
D	2.68	2.10	0.61	5
E	3.00	2.20	0.68	5
F	3.60	1.85	0.50	13
G	3.60	2.00	0.75	6
H	6.25	3.70	0.60	18
I	1.00	0.70	0.46	16
J	2.20	1.30	0.49	40
K	2.68	1.70	0.61	4

## Power Products

# Off-Line Switching (OLS) Power Supplies



### Description

OLS Power Supplies are high-quality, custom units designed for use in business communication systems and computer networking and peripheral applications. They range in size from 25 to 2000 watts and offer a wide variety of features such as remote on-off control, remote sense, overload and thermal protection, and various alarms and indicators. Single- or multiple-voltage outputs are available, with input voltages consistent with domestic and foreign applications.

### Features

- Meet world regulatory agency requirements, such as UL and CSA
- Meet FCC and Class A or B EMI requirements for conducted and radiated emission
- Isolated input/outputs
- Inputs are surge-protected for common line transient conditions
- Outputs are overvoltage protected
- Manual or auto-ranging for worldwide input voltage ranges
- Power factor correction
- Demonstrated high reliability, designed to meet a system's need

**The 336A OLS Power Supply**

### Product Matrix

Code	Input Voltage	Output Voltage(s) (Vdc)	Power at Full Load (Watts)	Switching Frequency (kHz)	Full Load Efficiency (%)	Outline Dimensions (in.)
332C	117 Vac	5 12 -4 -48	60	45	75	7.77L × 6.0W × 2.95H
336A	117 Vac	-52	300	80	83	10.218L × 2.06W × 7.15H
631DA1	120 Vac 144 Vdc	-48	300	—	68	14.42L × 3.02W × 7.67H
631DB1	120 Vac 144 Vdc	-5, -48	384	—	75	14.42L × 3.02W × 7.67H

## Power Products

# DC-DC Converters

---

### Description

AT&T's dc-dc converters are recommended to power electronic systems where highly reliable and stable power is needed, and where small size, light weight, and high efficiency are important. Some typical applications include digital switching systems, PBXs, and the AT&T 3B20 Computer. You can select a power unit to meet your specific needs, or the Bell Laboratories power system engineers can design a power system for your application or help integrate an AT&T power unit into your system design.

### Features (available on many codes)

- Power levels from 50 to 670 W
- Independent programmable output voltages for many codes
- Remote sensing with compensation for distribution voltage drops
- Overvoltage shutdown
- Low-voltage alarm
- Output current- and power-limiting
- Meet FCC class A conducted and radiated EMI

## Power Products DC-DC Converters

### Product Matrix

Input Voltage	Output Voltage and Amps	Watts	Size (in.)	Notes	Code
<i>FASTECH® Power Unit Packaging</i>					
48	5 V at 13 A, 5 V at 1 A	70	8×13×1		412AA
48	5 V at 10 A, 17 V at 1 A, -17 V at 1 A	84	8×8×1.5		474EA
48	5 V at 15 A, -5 V at 2 A	85	8×13×1	UL	494GB
48	5 V at 50 A	250	8×13×2	UL	495FB
<i>TRANSPAC Packaging</i>					
24	5 V at 25 A, -5 V at 13 A	200	7.5×10×2.5		547B
48	5 V at 10 A	50	3.5×10×2.25		323A
48	5 V at 10 A	50	3.5×10×1.5		323C
48	12 V at 4 A	48	3.5×10×1.5		323D
48	5 V at 30 A	150	7.5×10×2		333A
48	5 V at 25 A, -5 at 13 A	200	7.5×10×2.5		547A
48	5 V at 40 A, 5 V at 13 A	265	7.5×10×3		549A
48	5 V at 22 A	110	7.5×10×1		550A
<i>Custom Packaging</i>					
24	5 V at 74 A, -5 V at 1.4 A, 12 V at 8.5 A, -12 V at 3.4 A	520	5×8×14		CS785
48	5 V at 3 A, 12 V at 2 A, -12 V at 2 A	60	4×10×1.5		325A
48	5 V at 4 A, -5 V at 2 A	30	7.4×2.6×.75		553A
48	5 V at 25 A, -5 V at 7 A	160	8×10×2.5		555A
48	5 V at 8 A, -5 V at 1.5 A, 12 V at 1 A, -12 V at 1 A	50	3×8×2.2		CS702A
48	5 V at 4.4 A, 5 V at 3.9 A, -5.2 A at .5 A	60	3×8×1.5		CS703A
48	5 V at 10.5 A, 5 V at 2 A, -5.2 V at 1.3 A, -4.5 V at 8.5 A, 12 V at 1.3 A	123	3×8×4		CS731
48	5 V at 92 A, 12 V at 10 A, -12 V at 3 A	660	5×7×15		CS783A

## Power Products

# Uninterruptible Power Systems (1, 3, 5, 10 KVA Single-Phase UPS)

---

### Description

Uninterruptible Power Systems (UPS) protect you from contaminated power and power interruptions. An uninterruptible power system filters and regulates commercial ac, helping to insure that sensitive electronic components will not be prematurely stressed into downtime. In the event commercial ac becomes temporarily unstable or disappears completely, the UPS will automatically use its battery-powered backup system to supply clean, stable ac.

### Features

- Cleaned, regulated, stable ac
- Reliable, competitively priced, state-of-the-art technology
- Typically 86% efficient (3, 5, and 10 KVA); 92% efficient (1 KVA)
- No need to oversize the UPS to compensate for load startup
- Microprocessor control providing automatic on-line power management
- Solid-state components
- For longer-term outages beyond the UPS reserve time, the UPS automatically shuts down and restarts internal software when power returns
- Multiple distribution panel options
- External computer interface provided. Allows your computer to sense on-battery, low-battery, UPS-fail, and UPS-overload conditions.
- External battery reserve available in incremental sizes (see individual data sheets for details)
- UL listed, file 1012; IEEE C62.41 — 1980 Category B
- FCC conformance, 47 CFR, Part 15, Subpart II, Class A
- NEC conformance
- Provides for all linear and nonlinear computer power supplies over the full power range of the UPS power

## Power Products

# Uninterruptible Power Systems (10, 20 KVA Three-Phase UPS)

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### Description

The AT&T Uninterruptible Power System (UPS) is an on-line unit, using ferroresonant, parallel-processing architecture. Three modes of operation — normal, inverter, and electronic bypass — are electronically controlled to provide continuous, regulated, transient-free power. AT&T Uninterruptible Power Systems protect sensitive electronics from natural and man-made causes of contaminated power.

### Features

- Independent operation
  - Operator-free, cleaned, regulated, stable ac power
  - Reliable, proven, innovative parallel-processing design
  - Electronic control providing automatic transient power management without user intervention
- Cost-effective design
- On-line UPS operations in forward and reverse transfer mode. Maintains continuous sine wave output. Critical loads will not sense mode power transfer when utility power fails.
- Typically greater than 85% efficient
- Provides 10 or 20 KVA, respectively, at full load, regardless of the type of loads supported, thus providing lower distortion of output power
- Line filtering in all modes of operation
- UPS automatically restarts itself after an extended power outage for greater independent operations
- External UPS interface provided to facilitate load sensing of On-battery, Low-battery, UPS-fail, and UPS-overload conditions, for greater protection of your data
- Battery reserve in incremental sizes
- UL listed
- FCC conformance, 47CFR Part 15, Subpart II, Class A

## Power Products

# LINEAGE 2000 Energy Systems

---

The *LINEAGE 2000* Energy Systems Product Family is based on a line of state-of-the-art dc battery plants that supply continuous power to telecommunication-type systems.

The dc battery plants are offered in various output capacities and configurations to allow the customer to optimize the equipment for specific applications.

Rounding out the *LINEAGE 2000* Energy Systems product line are plant controllers, batteries and stands, and a microprocessor-based monitoring system that provides for remote access of various telecommunication equipment.

### **LINEAGE 2000 Battery Plants, 500A Series (MCS/CCS)**

#### *Description*

The *LINEAGE 2000*, 500A Series Battery Plant, when equipped with the Microprocessor Controlled System (MCS) or Conventional Controlled System (CCS), is designed to provide dc power to loads of up to 6400 amps charge capacity. The MCS Battery Plant gives you a total systems solution for reducing energy, maintenance, training, engineering, and capital expenses by combining a state-of-the-art, microprocessor-based controller with a flexible, modular hardware design.

The MCS Battery Plant is an intelligent and fully integrated system. The controller, distribution system, rectifiers, and batteries are modularly packaged to ensure easy installation and maintenance while accommodating a wide range of current capacities and configurations. This enables your plant to begin small and expand capacity, hardware, and software features incrementally as demands require. This add-on capability — and the MCS controller's ability to remotely access plant operating data — eliminates the guesswork that can lead to excess capacity and reduced operating efficiency.

The MCS Plant is also available in a lower cost, CCS version that can be upgraded at a later date to a microprocessor controlled system. The CCS Battery Plant, while providing more basic control and monitor features, does offer the same integrated physical design as the MCS version.

#### *Features*

- Designed as a totally integrated energy system
- Up to 5200 amp discharge capacity, 6400 amp charge capacity,  $-48$  V or  $\pm 24$  V output voltages
- Long-life *LINEAGE 2000* Round Cells or conventional rectangular cells available in wide range of configurations
- AT&T *LINEAGE 2000* MCS or CCS Controllers can be used

## **Power Products**

### **LINEAGE 2000 Energy Systems**

- Utilizes AT&T 855 Series 25, 50, 100, 125, 200, and 400 amp rectifiers or 874 Series 35, 100, and 200 amp rectifiers
- 856 Series and 874 Series 50 Hz rectifiers are also compatible
- dc circuit breakers and fuses of up to 600 amp capacity are available for distribution
- Improved distribution capacity using center battery distribution busbar in bays
- Interfaces with standard office alarm systems
- Circuit breaker and fuse alarm monitoring
- Connectorized rectifier interface facilitates modular growth
- Plant shunt and charge busbars are mounted external to the bay which facilitates growth and a reduction of cable congestion

#### ***Optional Features***

- Low-voltage disconnect
- Capacitor precharge feature
- Supplementary rectifier bay and/or distribution bay available

### **LINEAGE 2000 Battery Plants, 500B Series (MCS/CCS/XCS)**

#### ***Description***

The *LINEAGE 2000*, 500B Series Battery Plant makes optimal use of limited floor space. The compact design takes up less room. Front access lets you position the battery plant in almost any available space, with easy maintenance. To add to its flexibility, the 500B can be configured using batteries that are either bay mounted or in stands. The 500B Series is designed for use with *SLC Carrier Systems*.

All plant busbars and shunts are incorporated into a compact arrangement that provides up to 400 amps of charge capacity.

#### ***Features***

- Front access
- Up to 400 amp discharge capacity;  $\pm 24$  V or  $-48$  V outputs
- Up to 200 amp charge capacity in single bay arrangement
- Up to 36 dc circuit breakers arranged for front access
- Plant shunt and charge/discharge busbars inside bay
- AT&T *LINEAGE 2000* MCS, CCS, or XCS Controllers can be used
- Connectorized rectifier control-cable interface
- Uses AT&T *LINEAGE 2000*, 855 Series 25, 50, 100, 125, 200, and 400 amp energy-efficient rectifiers
- Optional capacitor precharge feature
- Optional supplementary rectifier bay and/or distribution bay available
- Low-voltage disconnect feature available



## **Power Products**

### **LINEAGE 2000 Energy Systems**

#### **LINEAGE 2000 Battery Plants, 500C Series**

##### *Description*

Because the *LINEAGE 2000*, 500C Series Battery Plant has no dedicated frame space and utilizes the XCS Controller, its flexibility provides a cost-effective solution for applications such as microwave, remote switching, and lightwave radio systems. It makes the optimum use of space, which makes it especially useful for telecommunication equipment in a remote environment. The seven-foot frame gives you ample room for all components.

Front access, with no-hinged panels, makes the equipment easier to get to. It opens up areas in which to put wiring and connectors for a neater, uncluttered job with easier accessibility for changes and maintenance. It adds up to less time spent for installation, upgrades, and service.

The future addition of a microprocessor option board will furnish you with some of the more important remote information furnished by the MCS Controller, as well as provide a remote start capability. The information includes voltage, current, load statistics, alarms, average load, and elapsed time of battery discharge.

##### *Features*

- Front access
- 400 amp capacity;  $\pm 24$  V or  $-48$  V outputs
- Plug-in circuit packs
- Monitor and control of up to six *LINEAGE 2000* Rectifiers
- Connectorized rectifier control-cable interface
- Selective high-voltage shutdown of rectifiers
- Automatic restart
- LED alarm indicators
- Adjustable BD alarm (five settings)
- Adjustable HV alarm
- Single alarm and control PCB for 24 and 48 V
- Visually verifiable alarm settings (DIP switches)
- Circuit-breaker distribution up to 225 amps
- Fuse distribution up to 60 amps
- Batteries can be mounted in the primary bay (inboard) or in a supplementary bay (outboard)
- Low-voltage disconnect option
- Optional capacitor precharge feature
- Optional supplementary rectifier bay and/or distribution bay available

## **Power Products**

### **LINEAGE 2000 Energy Systems**

#### **LINEAGE 2000 Microprocessor-Controlled System (MCS) Controller**

##### *Description*

Unattended offices, escalating energy and maintenance expenses, and fewer expert operating personnel have made the provision of high-reliability power systems more important than ever. The *LINEAGE 2000* MCS Controller was designed with this environment in mind.

The MCS Controller is a firmware-based system which uses state-of-the-art technology to continuously monitor load requirements and operation of components in a battery plant. It ensures optimal efficiency and the highest reliability in all *LINEAGE 2000* Battery Plants.

##### *Features*

- AT&T Bell Laboratories patented energy efficiency algorithm
- To maintain rectifier reliability, the MCS Controller ensures that all rectifiers have been on and delivering current for at least 24 hours during a 30-day period
- Detailed diagnostics instruct less experienced craft people and enable them to respond to and clear an alarm condition quickly and easily
- Plant status and diagnostics can be displayed both on the controller front panel and on a remote terminal
- Controls up to sixteen *LINEAGE 2000* Rectifiers
- Plug-in circuit packs simplify the addition of optional features and new design developments
- Plant alarm history stores events in memory, along with the date and time of each event
- Plant drain statistics store three highest hourly average discharge currents, three highest peaks, and three minimums, along with date and time
- Automatic high-voltage shutdown; checks individual rectifiers for status, alarms, output current, and malfunctions, and shuts down any rectifiers that drive the plant voltage above specified levels
- Automatic restart of rectifiers
- Help key for technical assistance
- Back up conventional control system
- Physical dimensions: 9" high × 26" wide × 12" deep

##### *Major Alarms*

- Battery on discharge
- High battery voltage
- Discharge-fuse/circuit-breaker failure
- Major control-unit fuse failure

## **Power Products**

### ***LINEAGE 2000 Energy Systems***

#### ***Minor Alarms***

- Plant efficiency algorithm disabled
- Limited recharge capacity
- Excess plant load
- Control panel fuse failure
- Rectifier regulation fuse failure
- ac input failure
- Rectifier failure
- Rectifier circuit breaker tripped
- Rectifier manually turned off
- Microprocessor failure
- Minor-fuse failure
- Excess rectifier load
- Plant drain inconsistency

#### ***Optional Enhancements***

- Remote access
- Universal shunt monitoring
- Data switch
- 300/1200 baud transmission rate

### ***LINEAGE 2000 CCS Controller***

#### ***Description***

The *LINEAGE 2000* Conventional Control System (CCS) Controller is ideal for monitoring and controlling conventional battery plants, at either  $\pm 24$  V or  $-48$  V, with up to 16 rectifiers. It provides dependable power control and alarm monitoring at low cost.

The *LINEAGE 2000* CCS Controller has an MCS-compatible card cage, which permits upgrading when the microprocessor capabilities of the MCS Controller are needed.

#### ***Features***

- Monitors and controls up to sixteen *LINEAGE 2000* Rectifiers
- Connectorized rectifier control cable interface
- Selective high-voltage shutdown
- LED alarm indicators
- Plug-in circuit packs
- Dimensions: 9" high  $\times$  26" wide  $\times$  12" deep

## **Power Products**

### **LINEAGE 2000 Energy Systems**

#### *Major Alarms*

- Battery-on discharge
- High battery voltage
- Major-fuse/circuit-breaker failure

#### *Minor Alarms*

- Rectifier failure
- Minor-fuse failure

### **LINEAGE 2000 XCS Controller**

#### *Description*

The *LINEAGE 2000* Expandable Control Systems (XCS) Controller is ideal for monitoring and controlling battery plants, at either  $\pm 24$  V or  $-48$  V, with provision to control up to six *LINEAGE 2000* Rectifiers.

The *LINEAGE 2000* XCS Controller is designed to handle a variety of small load applications, regardless of their distribution requirements. Its built-in flexibility enables the power engineer to customize the distribution arrangement to best suit the needs of the application.

#### *Features*

- The XCS Controller is available in four basic configurations, as follows:
  - Basic Controller — external distribution required
  - Basic Controller — six regulation fuses and external distribution required
  - Basic Controller — internal busbars/shunt (200 amp capacity) with eight distribution fuses and external distribution capability
  - Basic Controller — internal busbars/shunt (200 amp capacity) with six regulation fuses and external distribution required
- LED indicators make alarm conditions easy to read, while plug-in circuit packs make service quick and simple
- Dimensions: 9" high  $\times$  26" wide  $\times$  12" deep
- Front access
- Monitor and control of up to six *LINEAGE 2000* Rectifiers
- Connectorized rectifier control-cable interface
- Selective high-voltage shutdown of rectifiers
- Automatic restart
- Adjustable BD alarm (five settings)
- Adjustable HV alarm (five settings)
- Single alarm and control PCB for 24 and 48 V
- Visually verifiable alarm settings (DIP switches)
- Optional meters: voltage and current (analog)

## **Power Products**

### **LINEAGE 2000 Energy Systems**

#### *Features of Microprocessor Option Board*

- Voltage
- Current
- Load statistics
- Plant alarms/history
- Battery discharge — average load and elapsed time
- Real-time clock
- Remote restart of rectifiers
- Battery backup of memory
- User-programmable descriptors
- Plant inventory — listing of equipment/options

#### **LINEAGE 2000 Rectifiers, 855 Series, 60 Hz**

##### *Description*

The 855 Series Rectifier product line is designed to convert commercial 60 Hz ac input power into highly regulated and filtered low-noise, 24 or 48 volt dc output power for telecommunications-type equipment loads. Since Central Offices usually obtain their electrical power from potentially noisy commercial ac lines (and emergency generators during commercial power failures), and since high quality dc power is required in order for the equipment to operate correctly, the 855 Series Rectifier product line is an excellent choice for any telecommunications battery plant.

The 855 Series Rectifier product line offers a variety of input ac volts. The rectifier output dc current capacities are 25, 50, 100, 125, 200, or 400 amps.

All of the 855 Series Rectifiers are both UL listed and CSA certified, with the exception of the J85503C (400 amp) rectifier. They are also compatible with all *LINEAGE* Energy System products, previous AT&T plants, and most other commercial battery plants and controller systems.

##### *Features*

- Selective high-voltage shutdown
- Backup high-voltage shutdown
- Output current "walk-in" circuit
- Adjustable output current limit
- Automatic restart
- Output circuit breaker
- MCS/CCS/XCS Controller capability
- Back-up current limit
- Digital ammeter/voltmeter option
- Interchangeable circuit boards
- dc output circuit breakers
- Connectorized control cable interface
- UL/CSA listing
- 32 dBrnC
- Safety interlocks

## Power Products

### LINEAGE 2000 Energy Systems

#### Rectifier Input Specifications

Phase	Capacity (amps)	Rectifier J-code	Input ac (volts)	Output dc (volts)
Single	25	J85502A-1	208	24 48
			240	24 48
	50	J85502B-1	208	24 48
			240	24 48
	125	J85502C-1	208	24 48
			240	24 48
Three	100	J85503A-1	208	24 48
			240	24 48
			480	24 48
	200	J85503B-1	208	24 48
			240	24 48
			480	24 48
400	J85503C-1	208	48	
		240	48	
		480	48	

## Power Products

### LINEAGE 2000 Energy Systems

#### LINEAGE 2000 Round Cell Batteries

##### *Description*

The LINEAGE 2000 Round Cell Battery has a revolutionary cylindrical design that provides longer life and actually helps increase the capacity over time. Round cell batteries deliver reliable, cost-effective backup power and are easier to handle, install, and maintain than conventional lead-acid flooded cells.

##### *Features*

- Pure lead grids
- Polyvinyl chloride polymer jar and cover
- Oxygen index of 33, which means an exceptionally high flashpoint
- Heat-sealed bond (over 1,500 pounds per linear inch)
- Corrosion path five times longer than in conventional cells, thanks to specially designed post-cover seals
- Post-cover seals whose tests indicate a leakage-free integrity in excess of 60 years
- Conically shaped grids stacked horizontally for maximum strength and material retention
- Specific gravity of 1.215
- Recommended float voltage of 2.17 to 2.22 volts per cell

##### *Round Cell Specifications*

Specifications	List 1S	List 2S	List 3S	List 4S
Ampere hour capacity; 8-hour rate 77°F	1600	854	488	296
Change in ampere hour capacity with time	Greater than 100% at end of life			
Predicted life expectancy (based on positive plate growth)	77°F	70 years		
	90°F	40 years		
Size (height x diameter)	26-3/4" x 13-4/5"	18-7/8" x 13-4/5"	15-3/8" x 13-4/5"	13-5/8" x 13-4/5"
Weight (lbs.)	346	198	133	100
Time required for recharge to 90% capacity following discharge of any fraction of cell capacity	Less than 24 hours			
Initial capacity	90—95%			

## **Power Products**

### **LINEAGE 2000 Energy Systems**

#### **LINEAGE 2000 Battery Stands**

##### **Description**

The *LINEAGE 2000* Battery Stand, made of a polyester-glass material, is stronger, easier to install, and more compact than metal stands. It offers greater safety and is the best choice for soft sites as well as earthquake and 10 or 50 psi hardened sites where it requires only minor additional bracing and supporting hardware.

##### **Features**

- Outstanding safety

The battery stand is made of white polyester-glass composite that is highly resistant to acids. It is also an electrical insulator and fire retardant. Any battery electrolyte that is spilled has virtually no path to ground, so fire hazards are greatly reduced.

- Substantial space savings

The slimmer design of battery stands assembled in two-tier, two-row stands requires 20 percent less floor space than metal stands.

#### **LINEAGE 2000 Remote Access System**

##### **Description**

The *LINEAGE 2000* Remote Access System (RAS) is a flexible, user-configured, data-logging, and data-acquisition system designed to monitor all types of power equipment regardless of age, vintage, or manufacturer. The sophisticated microprocessor-based monitoring system provides accurate, up-to-the-minute operational information, detailed alarms, diagnostics, and load statistics.

##### **Features**

- Distributed architecture minimizes installed cost, facilitates system expansion, and ensures greater reliability with lower lead lengths
- Powerful microprocessor and generic program enables you to tailor the RAS to your office power requirements
- Command language compatible with *LINEAGE 2000* MCS Battery Plant commands
- Both binary and analog sensing, with provisions for out-of-limits alarms that can be tied to your existing alarm system (enhancing your alarm capability)
- Historical data on individual channels — load statistics and alarms
- Prints three highest, three lowest, and three highest hourly averages on all channels
- Prints active and ten most recently retired alarms
- Plenty of capacity. a total of 32 channels per unit — 16 binary (for on/off indicators) and 16 analog (for continuous readings of voltage and current values)
- Optical isolation of binary channels prevents electrical interference between channels so that only accurate information is received at the monitor from the sensor
- Binary channels can also directly sense dc voltages from 20 to 150 V and ac voltages from 60 to 150 V at 20 Hz and 20 to 150 V at 60 to 400 Hz. Other voltages can be sensed with minor conditioning. For analog channels, the measurable differential voltage ranges up to 150 V ac and dc, with channel accuracy of  $\pm 0.1\%$  dc and  $\pm 0.7\%$  ac, at 60 to 400 Hz.



## **Power Products**

### **LINEAGE 2000 Energy Systems**

- Continuous monitoring — binary and analog channel measurement speed of greater than 16 channels every 15 seconds
- Three alarms — major, minor, and watchdog. The watchdog alarm is generated if the system executes improperly or if intermonitor communications are lost.
- Reports on all channels, selected channels, or one channel, depending on your need
- Hourly and daily trend studies for 10-day periods on any one channel
- Operates on dc power ( $\pm 24$  or  $\pm 48$  volts) to maximize reliability — even during commercial power outages — when status and alarm data are most important
- Units can be cascaded to modularly increase system capacity
- Switchable 300/1200 baud rate modem
- System can directly interface with PEERS (AT&T's Power Equipment Engineering Record System)
- Call out on alarm, when used in conjunction with *LINEAGE 2000* MCS Controller Data Switch Option
- HELP routine with summary of commands and AT&T toll-free help number

### **LINEAGE 2000 Secondary dc Distribution Battery Distribution Fuse Board (BDFB)**

#### *Description*

The J85568A-1 is a general-purpose Battery Distribution Fuse Board (BDFB). It is used when dc power is obtained from a central battery plant and must be distributed to the equipment to be served. The BDFB is designed to distribute  $\pm 24$  or  $-48$  volt power.

It has a 1200 amp discharge capacity that is divided equally among two separate input battery buses. Each 600 amp bus provides five panel positions that will accommodate cartridge- or instrument-type fuses. An alarm panel is provided to annunciate alarms. The standard digital meter allows for current measurement of each bus load.

#### *Features*

- 1200 amp discharge capacity
- Two load buses
- Standard digital ammeter
- Input power feed from top or bottom
- Maximum to 96 fuse positions
- Accommodates fuse sizes 1 to 60 amps
- Frame alarm indicator lamp
- Individual fuse alarm indicator
- Alarm circuit module for remote sending
- Individual standard shunts
- In-frame cabling guide
- Floor mounted
- Transparent protective back panels
- Optional appearance package
- Optional extension to accommodate 11'6" environment

## Power Products

### LINEAGE 2000 Energy Systems

#### LINEAGE 2000 Secondary dc Distribution Battery Distribution Circuit Breaker Bay (BDCBB)

##### Description

The J86335 BDCBB is used where battery is obtained from large fuses on the battery control board and divided into smaller circuits from a location near the area to be served.

The BDCBB is designed to distribute +130, -130, +24, -24, +48, or -48 volts. The ground bar is arranged in 1200 amp "add on" sections and the unit may be equipped with prewired blank panels to allow the addition of capacity for tomorrow's expansion.

The basic units are available in 7'0", 9'0", and 11'6" frames. Three different circuit-breaker panels are available to accommodate twelve 1-100 amp, and six 100-225 amp, or four 300-400 or two 500-600 amp breakers. An alarm control panel is provided with an indicator lamp and relays for remote alarm sending.

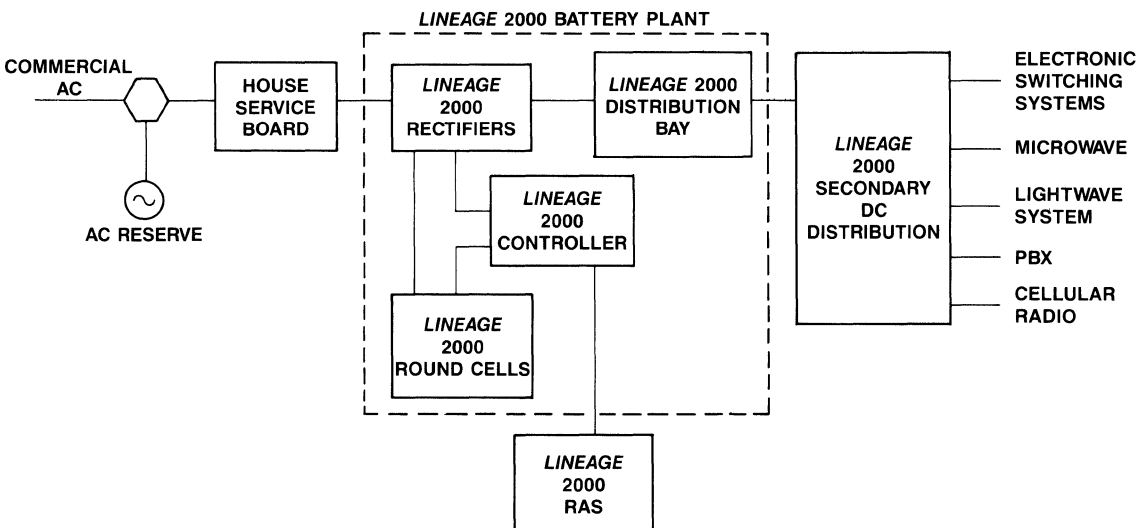
##### Features

- Floor mounted
- Individual input feed for circuit-breaker panels allow for multiple load arrangements
- 1200 amp "add on" ground bar sections
- Power feeders enter through top or bottom
- Distribution feeders exit through top or bottom
- Circuit breakers available from 1 to 600 amps
- Fuse alarm indicator lamp
- Alarm circuit module for remote sending

##### Typical Application

AT&T LINEAGE 2000 Energy Systems are used for supplying highly regulated and filtered, low-noise, 24 or 48 volt dc output power for telecommunications-type equipment loads in telephone Central Offices or customer premise locations.

##### Application Diagram





## Printed Circuit Boards

AT&T's high-density multilayer Printed Circuit Boards (PCBs) bring new levels of precision and performance for your complex board requirements. For applications to 22+ layers, AT&T provides standard line widths and spaces down to 6 mils, and below for special requirements.

In addition to conventional plated holes and vias, buried microvia processing is available for designs that utilize this feature in high-density applications, such as surface mount technology. AT&T offers boards that are UL approved and meet MIL-P-55110D. Each board is visually inspected and electrically tested before it leaves the plant.

**For additional information contact your nearest sales office or call:  
1-800-372-2447.**

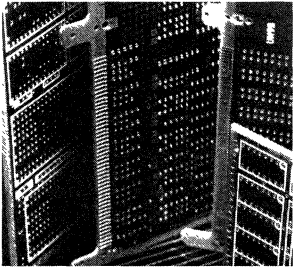
### **Multilayer Printed Circuit Boards**

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## Printed Circuit Boards

# Multilayer Printed Circuit Boards



### Description

Custom multilayer Printed Circuit Boards (PCBs) are available in FR-4, bismaleimide triazine, and other special materials. Surface finishes include reflowed solder, solder mask over bare copper with hot air solder leveling, and gold over nickel.

A standard via may be as small as .0135 inch, and a buried microvia as small as .008 inch.

Standard high-density capabilities include line width and line spacing to .006 inch, and hole sizes to .0135 inch with .025 inch lands on external layers. Three tracks may be routed between lands on .100 inch centers on external layers as well as innerlayers.

The Richmond Works includes a separate shop for prototypes and utilizes SQC and SPC quality programs to ensure electrically tested, defect-free boards. All of our customers receive personalized service, with application engineering support available from prototypes through volume production.

### Features

- Up to 22+ layers for interconnection density
- Surface mount technology
- Standard via, blind via, and buried microvia technologies
- High-density circuitry
- Variety of materials and surface finishes
- High-aspect ratio drilling/plating
- Controlled impedance
- MIL-P-55110D qualification
- UL Approved

### Processing Capabilities

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No. of Layers	6+
Board Sizes	To 16.5" × 23"
Line Widths	To 6 mils
Line Spaces	To 6 mils
Hole Sizes	
External Layers	13 mils
Internal Layers (Buried Microvias)	8 mils

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## Single Board Computer

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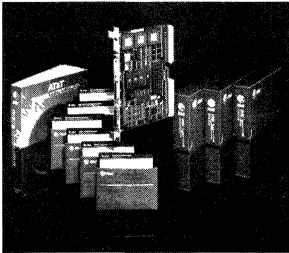
The *WE*® 321SB VMEbus Single Board Computer is an open architecture single board computer that allows you to mix and match peripheral and memory boards from different suppliers to configure high performance, demand-paged *UNIX* Computer Systems. This single board computer features chips from the AT&T Microprocessor family — the *WE* 32100 Microprocessor, *WE* 32101 Memory Management Unit, and *WE* 32106 Math Acceleration Unit (see Microprocessors and Peripherals, section 12).

**For additional information contact your nearest sales office or call:  
1-800-372-2447.**

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<b><i>WE</i> 321SB VMEbus Single Board Computer</b>	<b>16-2</b>

## Single Board Computer

# WE 321SB VMEbus Single Board Computer



### Description

The WE 321SB VMEbus Single Board Computer (SBC) is a high-performance, 32-bit, single board computer that facilitates the rapid configuration of user-defined VMEbus computer systems. Using the SBC with AT&T *UNIX* System V/VME, users can design and assemble open-architecture, demand-paged *UNIX* Systems that are object file and floppy disk format compatible with the AT&T 3B Computer family. Thus, many hundreds of applications and language packages available for the 3B Computers will execute directly on a VMEbus computer built using this SBC and *UNIX* System V/VME. This compatibility gives SBC users immediate access to one of the largest collections of off-the-shelf *UNIX* System software available today.

The VMEbus standard has many supporters and there are over 1000 commercially available bus-compatible products. *UNIX* System V/VME aids users who need to add VMEbus boards to their systems. AT&T and others have developed *UNIX* System V/VME Device Drivers for a number of third-party VMEbus boards. AT&T has also released driver design documentation to help users develop their own device drivers.

### Hardware

The WE 321SB VMEbus Single Board Computer provides full 32-bit (A32/D32) master and slave interfaces to the VMEbus. The SBC operates with an on-board system clock. On-board memory is divided into one bank of EPROM/ROM byte-wide sockets and one bank of DRAM. The EPROM/ROM bank can be populated with 2764-, 27128-, 27256-, or 27512-type EPROMs for a total of 32-, 64-, 128-, or 256-Kbytes of EPROM, respectively. On-board is 1 Mbyte of DRAM with byte parity. Byte, halfword (16-bit), word (32-bit), and read/modify/write accesses of memory are supported. Refresh of the DRAM bank is handled automatically on-board.

On-board memory management supports a full 32-bit wide virtual and physical address space. The result is a linear 32-bit wide address space, as seen by the programmer. The WE 32101 MMU also includes on-chip logic that supports automatic miss-processing. The WE 32106 MAU provides both IEEE-standard floating-point and decimal high-speed arithmetic capabilities. Operating as a coprocessor to the WE 32100 CPU, the MAU works to off-load mathematically intensive operations from the CPU.

The WE 321SB VMEbus Single Board Computer is manufactured using AT&T advanced surface-mount technology to provide a product with an extraordinary size-to-function ratio. With all of its features, the SBC measures just 160 by 233 mm (6.3 by 9.2 inches), the standard double-height Eurocard size.

# Single Board Computer

## WE 321SB VMEbus Single Board Computer

### *Firmware*

A debugger/monitor program is included in on-board EPROM. EPROM contents include power-up board self-test and initialization. Also provided are low-level observation and control capabilities, including program tracing, single-stepping, register and memory examination and modification, exception and interrupt handling, and breakpointing. Software can be cross-developed and downloaded for stand-alone execution and development. A floppy and hard disk boot facility for *UNIX* System *V/VME* is also included.

The on-board EPROMs can be replaced by the user, thereby facilitating the use of user-developed firmware.

### *Operating Systems*

AT&T is offering a highly-tuned release of *UNIX* System V for the WE 321SB VMEbus Single Board Computer. *UNIX* System V, developed by AT&T Bell Laboratories and available since 1982, has received worldwide acceptance as a standardized product. *UNIX* System *V/VME* includes the most recent enhancements from AT&T, such as demand paging, record/file locking, simplified system administration, and remote file sharing.

*UNIX* System *V/VME* also includes device drivers for third-party system controller, floppy/hard disk controller, and Ethernet boards. Additional device drivers are available from AT&T and others, including an SCSI disk and intelligent serial I/O. Drivers may also be developed by users, following the guidelines provided within the *UNIX System V/VME System Builders Reference Guide*.

*UNIX* System *V/VME* users who want to develop software can use the WE 321SG Software Generation Programs, which include an AT&T enhanced C compiler, utilities, and optimizer. The WE 321SG Software Generation Programs are supported either in a stand-alone or cross development environment. Compilers for other languages are available as well.

For those who require real-time operating system support, there are currently two choices:

- *C EXECUTIVE* \* from JMI Software Consultants
- *CSX* \*\* from Cytec Systems, Inc.

### *Documentation*

Complete and thorough documentation is available from AT&T for the WE 321SB VMEbus Single Board Computer and *UNIX* System *V/VME*. In addition to the numerous documents available from AT&T addressing the *UNIX* Operating System in general, over twenty product-specific documents for the SBC and *UNIX* System *V/VME* are also available. These cover all aspects of configuration, operations, and programming, including such areas as VMEbus system assembly, using *UNIX* System *V/VME*, OEM modifications to System *V/VME*, and device driver design. Call **1-800-372-2447** for the *UNIX System V/VME Documentation Roadmap*.

\* Registered trademark of JMI Software Consultants, Inc.

\*\* Trademark of Cytec Systems, Inc.





## Transformers and Inductors

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AT&T designs and manufactures over 6000 different transformers and inductors for your electronic and power applications. Our product line includes a broad range of both custom- and standard-designed components and uses a wide variety of physical structures, core materials, configurations, and winding technologies. After the components are designed and tested for both quality and reliability, they are coded for your selection.

AT&T supports its transformer and inductor product line with full customer service and applications engineering.

**For additional information contact your nearest sales office or call:**

**1-800-372-2447.**

### **Electronic Circuit Transformers and Inductors**

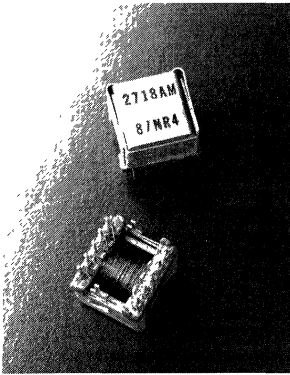
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### **Power Transformers and Inductors**

**17-5**

# Electronic Circuit Transformers and Inductors



**The 2718AM Transformer was designed for the ISDN S/T Interface.**

Electronic circuit transformers and inductors are used in telecommunication and other small signal applications for:

- Voltage or current conversion
- Impedance matching
- Direct current (dc) isolation
- Signal splitting or combining
- Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) suppression
- Signal filtering

Our product line offers a wide range of standard- and custom-designed transformers and inductors.

### Transformer Types

- **Audio/Voice Frequency** — for use where the supplied frequency is in the 20 Hz to 20 kHz range with or without superimposed direct current.

Some of the application-related transformers in this category are:

- Input
- Output
- Interstage
- Driver
- Line
- Modem
- Telephone interconnect
- Voice/data coupling

- **Wide Band** — for carrier frequencies (40 kHz to 30 MHz), radio frequencies, video and microwave intermediate frequencies up to 500 MHz.
- **Low-Power Pulse** — pulse duration from microseconds to milliseconds, rise time from nanoseconds to microseconds, and ET constants (pulse amplitude multiplied by duration in microseconds) up to 4500.

Some digital transmission applications are:

- DS0
- DS1
- DS1C
- DS3
- ISDN S/T Interface
- ISDN U Interface
- LAN

- **Hybrid** — for signal combining and splitting with the ability to electrically isolate ac signals from one port while transmitting them to other ports.

# Transformers and Inductors

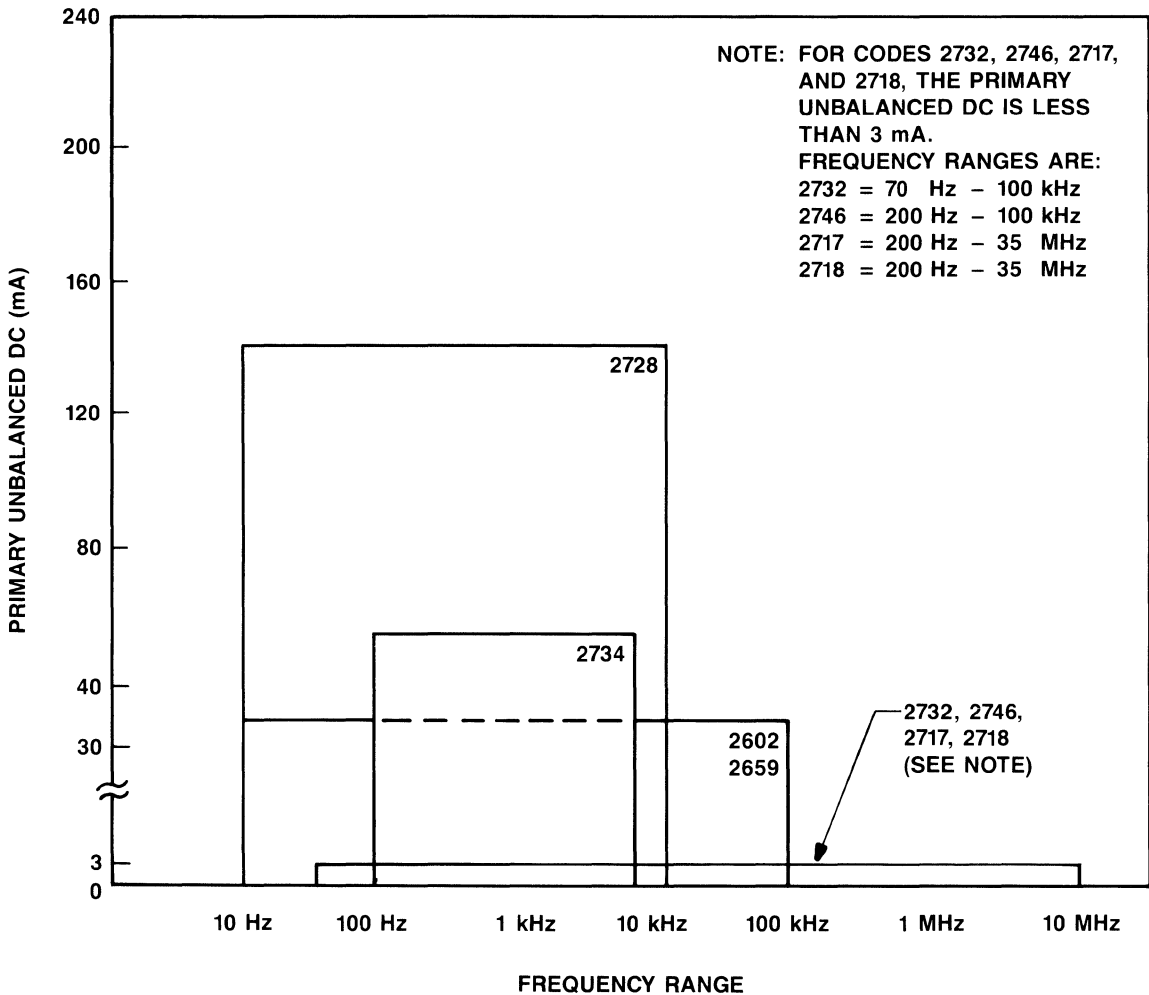
## Electronic Circuit Transformers and Inductors

### Inductor Types

- *Audio/Voice Frequency* — fixed toroidal type.
- *High Frequency, High Q* — adjustable and fixed types, pot core
- *Choke Coil* — fixed type, variety of cores.

Based on your circuit criteria, the Product Matrices on the following two pages will help you determine the AT&T transformer structure that best suits your needs.

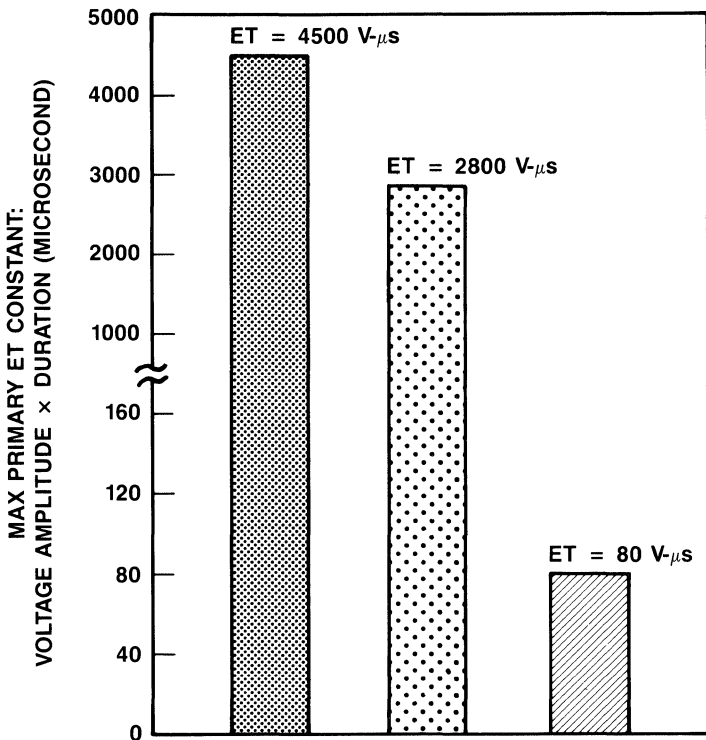
### Product Matrix — Audio/Voice and Wideband Transformers



# Transformers and Inductors

## Electronic Circuit Transformers and Inductors

### Product Matrix — Pulse Transformers



#### PULSE TRANSFORMER STRUCTURES

- 2732
- 2718
- 2661, 2662, 2664, 2745

## Transformers and Inductors

# Power Transformers and Inductors

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The power transformers and inductors product line offers you a broad selection of embedded and common power magnetic structure components. The listing below shows examples of our broad range of standard- and custom-designed transformers and inductors, followed by a brief description of their applications. The magnetics are organized in two categories — high and low frequency.

### *High-Frequency Applications*

- Inductors
  - Common Mode — used in switch-mode power supplies to reduce ac line conducted interference.
  - Output Coupled Power — used in the output inductor capacitor (LC) sections of multiple output switch-mode power supplies.
  - Output Power — used in the output LC filter section of switch-mode power supplies.
  - Snubber — used in switch-mode power supplies to limit peak currents that are generated due to parasitics.
- Transformers
  - Current Sense — used to change the input current to an output current at another level.
  - Driver — used to trigger the base of a bipolar transistor or the gate of a field-effect transistor (FET).
  - Flyback — used to store and transfer energy.
  - Unipolar and Bipolar Waveform — used to convert dc power at one voltage and impedance level to a different level.

### *Low-Frequency Applications*

- Inductors
  - Alternating Current (ac) Power — used in power circuits.
  - Commutating Power — used in a semiconductor circuit to limit the rate of change of current during the on-time and off-time of the excitation cycle.
  - Direct Current (dc) Power — a basic component of the filter section of a regulated rectifier.

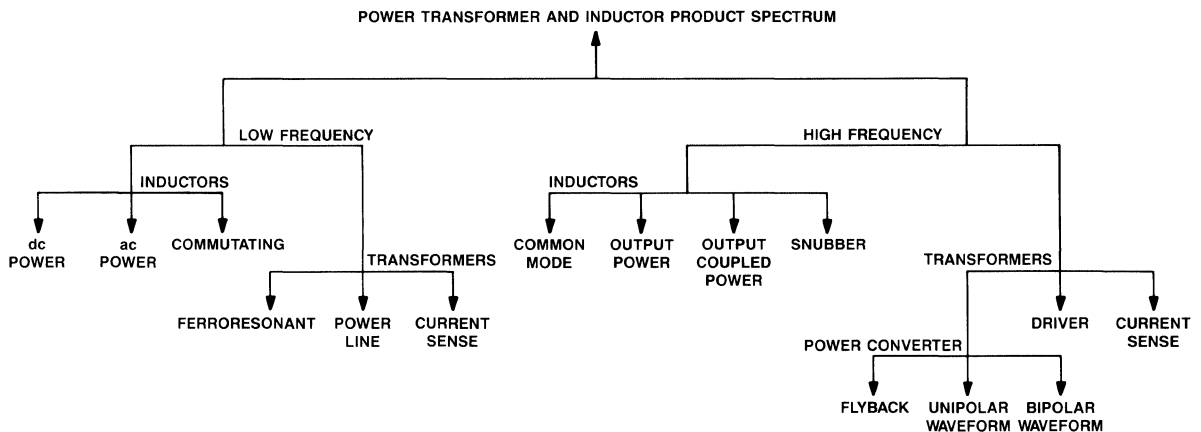
# Transformers and Inductors

## Power Transformers and Inductors

- Transformers
  - Current Sense — used to change the input current to an output current at another level.
  - Ferroresonant — used in battery charging systems and in uninterruptible power supplies.
  - Power Line — converts power at one input voltage level to a different output voltage level.

### Product Matrix

Based on your circuit criteria, the Product Matrix will help you determine the AT&T magnetic component structure that best suits your needs.



## Wire & Cable (Electronic)

---

AT&T's extensive line of copper-based, electronic wire and cable is specially designed for digital data transmission. The products include conventional, enhanced performance, and specialized performance cable families, all utilizing twisted-pair construction.

The conventional cables are interchangeable with industry-standard commercial cables. The enhanced-performance cables incorporate foam skin insulation for lower capacitance and smaller diameters. The specialized-performance cables are small-pair-size, shielded cables designed for high-performance applications.

**For additional information contact your nearest sales office or call:**

**1-800-372-2447.**

### **Conventional Cables**

### **Enhanced Performance Cables**

### **Specialized Performance Cables**

### **Color Codes**

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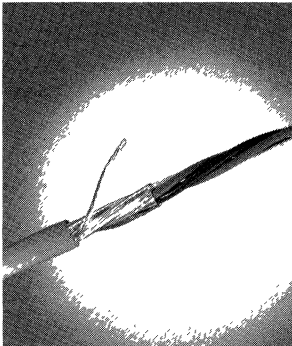
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**18-15**



## Wire & Cable (Electronic)

# Conventional Cables



1705 Conventional Cable

### Description

AT&T offers a full line of conventional cables that are interchangeable with industry-standard commercial cables. These cables are either unshielded or shielded multipair cables, and utilize twisted-pair construction. This construction involves twisting individual conductors and grouping these pairs to form a core or unit for a larger cable. Twisted-pair construction provides greater separation between pairs, minimizing crosstalk between adjacent pairs.

Shielded cables are used in electronically sensitive locations, where it is desirable to control interference.

### Features

- High error-free transmission rates
- UL approved
- High maximum operating temperature — up to 90°C

### 22 AWG (7×30) Stranded Conductors, Twisted Pairs — 1003

Number of Pairs: 1, 2, 3, 4, 6, 9, 12

UL Recognized — 20399: 90°C, 150 V and

UL Listed Type CM: 60°C, 300 V

#### *Nominal Parameters:*

Mutual Capacitance: 15.9 pF/ft.

DC Resistance: 15.3  $\Omega$ /1000 ft.

Impedance  $Z_0$ : 113  $\Omega$  @ 1 MHz

#### *Error-Free Transmission Rates:*

1.54 Mb/s up to 3200 ft.

3.1 Mb/s up to 1700 ft.

6.3 Mb/s up to 1400 ft.

Conductors: Tinned Copper

Insulation: Semirigid PVC

Jacket: Gray PVC

Color Code: #3

## **Wire & Cable (Electronic) Conventional Cables**

### **20 AWG (7×28) Stranded Conductors, Mixed Pairs — 1144**

Number of Pairs: 2

UL Recognized — 20399: 90°C, 150 V and

UL Listed Type CM: 60°C, 300 V

#### *Nominal Parameters:*

Mutual Capacitance: 55 pF/ft.

DC Resistance: 9.8  $\Omega$ /1000 ft

Impedance  $Z_0$ : 38  $\Omega$  @ 1 MHz

#### *Error-Free Transmission Rates:*

1.54 Mb/s up to 900 ft.

3.1 Mb/s up to 500 ft.

6.3 Mb/s up to 300 ft.

Conductors: Tinned Copper

Insulation: Semirigid PVC

Jacket: Gray PVC

Color Code: Red/Black

Green/White

Shield: Red/Black pair has longitudinal foil shield

Drain Wire: 22 AWG stranded tinned copper

### **22 AWG (7×30) Stranded Conductors, Shielded Pair — 1201**

Number of Pairs: 1

Maximum Operating Temperature 90°C

UL Listed Type CM: 60°C, 300 V

#### *Nominal Parameters:*

Mutual Capacitance: 31.6 pF/ft.

DC Resistance: 15.3  $\Omega$ /1000 ft.

Impedance  $Z_0$ : 61  $\Omega$  @ 1 MHz

#### *Error-Free Transmission Rates:*

1.54 Mb/s up to 800 ft.

3.1 Mb/s up to 400 ft.

6.3 Mb/s up to 200 ft.

Conductors: Tinned Copper

Insulation: PP

Jacket: Gray PVC

Color Code: Black and Red

Shield: Longitudinal polyester-aluminum foil overshield

Drain Wire: 22 AWG stranded tinned copper

## **Wire & Cable (Electronic) Conventional Cables**

### **22 AWG Solid Conductors, Shielded Pair — 1202**

Number of Pairs: 1

Maximum Operating Temperature 90°C

UL Listed Type CM: 60°C, 300 V

*Nominal Parameters:*

Mutual Capacitance: 33.1 pF/ft.

DC Resistance: 16.4  $\Omega$ /1000 ft.

Impedance  $Z_0$ : 57  $\Omega$  @ 1 MHz

*Error-Free Transmission Rates:*

1.54 Mb/s up to 700 ft.

3.1 Mb/s up to 400 ft.

6.3 Mb/s up to 250 ft.

Conductors: Tinned Copper

Insulation: PP

Jacket: Gray PVC

Color Code: Black and Red

Shield: Longitudinal polyester-aluminum foil overshield

Drain Wire: 22 AWG solid tinned copper

### **22 AWG (7×30) Stranded Conductors, Shielded Pairs — 1221**

Number of Pairs: 2

Maximum Operating Temperature 90°C

UL Listed Type CM: 60°C, 300 V

*Nominal Parameters:*

Mutual Capacitance: 31.6 pF/ft.

DC Resistance: 15.3  $\Omega$ /1000 ft.

Impedance  $Z_0$ : 61  $\Omega$  @ 1 MHz

*Error-Free Transmission Rates:*

1.54 Mb/s up to 800 ft.

3.1 Mb/s up to 400 ft.

6.3 Mb/s up to 200 ft.

Conductors: Tinned Copper

Insulation: PP

Jacket: Gray PVC

Color Code: Red/Black

Green/White

Shield: Each pair individually shielded with longitudinal polyester-aluminum foil

Drain Wire: 24 AWG stranded tinned copper

## **Wire & Cable (Electronic) Conventional Cables**

### **22 AWG (7×30) Stranded Conductors, Shielded Pairs — 1222**

(Low-Voltage Computer Cable)

Number of Pairs: 3, 4, 6

UL Recognized — 2919: 80°C, 30 V and

UL Listed Type CM: 60°C, 300 V

*Nominal Parameters:*

Mutual Capacitance: 32.0 pF/ft.

DC Resistance: 15.3  $\Omega$ /1000 ft.

Impedance  $Z_0$ : 58  $\Omega$  @ 1 MHz

*Error-Free Transmission Rates:*

1.54 Mb/s up to 800 ft.

3.1 Mb/s up to 500 ft.

6.3 Mb/s up to 300 ft.

Conductors: Tinned Copper

Insulation: PP

Jacket: Gray PVC

Color Code: #3

Shield: Each pair individually shielded with longitudinal polyester-aluminum foil

Drain Wire: 22 AWG stranded tinned copper, one each pair

### **22 AWG (7×30) Stranded Conductors, Cabled — 1603**

Number of Conductors: 3, 4, 5, 10, 12

UL Recognized — 20399: 90°C, 150 V and

UL Listed Type CM: 60°C, 300 V

*Nominal Parameters:*

Capacitance:  $C_1$ : 15.4 pF/ft.

$C_2$ : 28.4 pF/ft.

DC Resistance: 16.2  $\Omega$ /1000 ft.

Conductors: Tinned Copper

Insulation: Semirigid PVC

Jacket: Gray PVC

Color Code: #1

### **18 AWG (19×30) Stranded Conductors, Cabled — 1705**

Number of Conductors: 4

UL Recognized — 20399: 90°C, 150 V and

UL Listed Type CM: 60°C, 300 V

*Nominal Parameters:*

Capacitance:  $C_1$ : 46.6 pF/ft.

$C_2$ : 93.3 pF/ft.

DC Resistance: 6.4  $\Omega$ /1000 ft.

Conductors: Tinned Copper

Insulation: Semirigid PVC

Jacket: Gray PVC

Color Code: Black, Red, White, Green

Shield: Longitudinal polyester-aluminum foil overshield

Drain Wire: 20 AWG stranded tinned copper

## **Wire & Cable (Electronic) Conventional Cables**

### **22 AWG (7×30) Stranded Conductors, Cabled — 1764**

Number of Conductors: 2  
UL Recognized — 2092: 60°C, 300 V and  
UL Listed Type CM: 60°C, 300 V

*Nominal Parameters:*

Capacitance. C<sub>1</sub>: 24.0 pF/ft.  
C<sub>2</sub>: 47.0 pF/ft.  
DC Resistance: 16.2 Ω/1000 ft.  
Conductors: Tinned Copper  
Insulation: PE  
Jacket: Gray PVC  
Color Code: Black and Clear  
Shield: Longitudinal polyester-aluminum foil overshield  
Drain Wire: 22 AWG stranded tinned copper

### **24 AWG (7×32) Stranded Conductors, Twisted Pairs, Shielded**

(Low-Voltage Computer Cable;  
RS-232 Application)  
Number of Pairs: 2, 4½, 9, 12½, 18½  
UL Recognized — 2448

*Nominal Parameters:*

Mutual Capacitance: 13.2 pF/ft.  
DC Resistance: 24.2 Ω/1000 ft.  
Impedance: 120 Ω (±10%) at 1 MHz  
Conductors: Tinned Copper  
Insulation: Polyethelene  
Jacket: Black PVC  
Color Code: Combination of #1 and #4  
Shield: Longitudinal polyester-aluminum foil overshield  
Drain Wire: 24 AWG stranded tinned copper

## **Wire & Cable (Electronic) Conventional Cables**

### **DIW 4 Pair**

Number of Pairs: 4—600  
UL Listed Type CMR (24 AWG)  
and Type CM (22 AWG): 60°C, 300 V

#### *Representative Electrical and Transmission Characteristics:*

Error-Free Bit Rates (24 gauge)  
1.6 Mb/s (T1 Rate) up to 2600 ft.  
3.15 Mb/s (T1C Rate) up to 1600 ft.  
6.3 Mb/s (T2 Rate) up to 1000 ft.

Conductor Resistance.  
24 gauge: 25.7  $\Omega$ /1000 ft.  
22 gauge: 16.2  $\Omega$ /1000 ft.

Mutual Capacitance: 15—20 pF/ft.

Color Code — 4 Pair Cable:

Pair No.	Color
1	Bl/W-Bl
2	O/W-O
3	G/W-G
4	Br/W-Br

### **22 and 24 AWG Halar\* /Halar Plenum Cable — 2601D, 2001D, 2602D**

Number of Conductors and Pairs: 2 Cond, Triple, Quad, Pairs 1 Thru 100  
Temperature Range to 150°C  
UL Listed — Type CMP

#### *Nominal Parameters:*

Mutual Capacitance: 16 pF/ft. (pairs)  
DC Resistance: 25.8  $\Omega$ /1000 ft. (24 gauge)  
16.5  $\Omega$ /1000 ft. (22 gauge)  
Impedance: 100 ( $\pm$ 10%)  $\Omega$  @ 1 MHz  
Attenuation: @ 1 kHz = 0.55 dB/1000 ft.  
@ 1 MHz = 6.06 dB/1000 ft.

#### *Error-Free Transmission Rates\*\*:* (2001D)

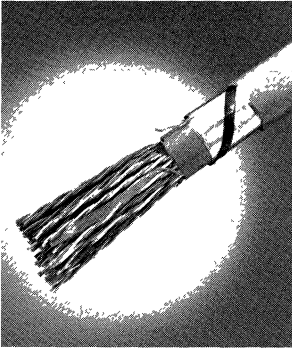
2800 ft. @ 1.54 Mb/s  
1600 ft. @ 3.1 Mb/s  
1400 ft. @ 6.3 Mb/s

Conductors: Solid, Annealed Copper  
Insulation: ECTFE  
Jacket: ECTFE

\* Registered trademark of the Ausimont Corporation

\*\* Bipolar, one-way transmission

# Enhanced Performance Cables



**1249 Enhanced Performance Cable**

### Description

AT&T's line of enhanced performance cables use foam/skin insulation, which allows lower capacitance values and smaller diameters. Data rates and transmission distances, before amplification or regeneration is required, are also enhanced.

Most of the applications for these cables are at the system interconnect level, including computers, mass storage devices, peripherals, and terminals. The cables are also used for business machines, data communication equipment, data recording equipment, and programmable controllers.

All of these enhanced performance cables are shielded, multipair cables that utilize twisted-pair construction. This provides greater separation between pairs, thereby minimizing crosstalk between adjacent pairs.

### Features

- High data rates
- Error-free transmission
- Longer transmission distances

### 26 AWG (7×34) Stranded Conductors, Twisted Pairs — 1241

Number of Pairs: 2, 3, 4, 6, 9, 12  
UL Listed Type CL2

#### *Nominal Parameters:*

Mutual Capacitance: 11 pF/ft.  
DC Resistance: 41  $\Omega$ /1000 ft.  
Impedance  $Z_0$ : 138  $\Omega$  @ 1 MHz

#### *Error-Free Transmission Rates:*

1.54 Mb/s up to 1000 ft.  
3.1 Mb/s up to 500 ft.  
6.3 Mb/s up to 400 ft.

Conductors: Tinned Copper  
Insulation: Dual, semirigid PVC skin over foamed PE  
Jacket: Gray PVC  
Color Code: #4  
Shield: Longitudinal polyester-aluminum foil overshield  
Drain Wire: 26 AWG stranded tinned copper

## **Wire & Cable (Electronic) Enhanced Performance Cables**

### **24 AWG (7×32) Stranded Conductors, Twisted Pairs — 1242**

Number of Pairs: 2, 3, 4, 6, 9, 12½, 18½  
UL Listed Type CL2

*Nominal Parameters:*

Mutual Capacitance: 13 pF/ft.  
DC Resistance: 25.7  $\Omega$ /1000 ft.  
Impedance  $Z_0$ : 138  $\Omega$  @ 1 MHz

*Error-Free Transmission Rates:*

1.54 Mb/s up to 1200 ft.  
3.1 Mb/s up to 700 ft.  
6.3 Mb/s up to 600 ft.

Conductors: Tinned Copper  
Insulation: Dual, semirigid PVC skin over foamed PE  
Jacket: Gray PVC  
Color Code: #4  
Shield: Longitudinal polyester-aluminum foil overshield  
Drain Wire: 24 AWG stranded tinned copper

### **24 AWG Solid Conductors, Twisted Pairs — 1245**

Number of Pairs: 2, 3, 4, 6, 9, 12  
UL Listed Type CL2

*Nominal Parameters:*

Mutual Capacitance: 11 pF/ft.  
DC Resistance: 26.5  $\Omega$ /1000 ft.  
Impedance  $Z_0$ : 138  $\Omega$  @ 1 MHz

*Error-Free Transmission Rates:*

1.54 Mb/s up to 2200 ft.  
3.1 Mb/s up to 1400 ft.  
6.3 Mb/s up to 1200 ft.

Conductors: Tinned Copper  
Insulation: Dual, semirigid PVC skin over foamed PE  
Jacket: Gray PVC  
Color Code: #4  
Shield: Longitudinal polyester-aluminum foil overshield  
Drain Wire: 24 AWG solid tinned copper



## **Wire & Cable (Electronic) Enhanced Performance Cables**

### **26 AWG Solid Conductors, Twisted Pairs — 1247 (Coax Replacement)**

Number of Pairs: 18  
UL Listed Type CL2 and CSA Certified

*Nominal Parameters:*

Mutual Capacitance: 12.7 pF/ft.  
DC Resistance: 41  $\Omega$ /1000 ft.  
Impedance  $Z_0$ : 118  $\Omega$  @ 1 MHz

*Error-Free Transmission Rates:*

3 Mb/s up to 200 ft. (unbalanced mode)  
3 Mb/s up to 900 ft. (balanced mode)

Conductors: Tinned Copper  
Insulation: Dual, semirigid PVC skin over foamed PE  
Jacket: Beige PVC, inner and outer  
Color Code: #2  
Core Wrap: Polyester film  
Shield: Longitudinal polyester-aluminum foil overshield  
Drain Wire: 24 AWG stranded tinned copper

### **26 AWG Solid Conductors, Twisted Pairs — 1249**

Number of Pairs: 4, 6, 12, 16, 20, 25, 32, 50  
UL Listed Type CL2

*Nominal Parameters:*

Mutual Capacitance: 12.5 pF/ft.  
DC Resistance: 41  $\Omega$ /1000 ft.  
Impedance  $Z_0$ : 120  $\Omega$  @ 1 MHz

*Error-Free Transmission Rates:*

1.54 Mb/s up to 2700 ft.  
3.1 Mb/s up to 1400 ft.  
6.3 Mb/s up to 1100 ft.

Conductors: Tinned Copper  
Insulation: Dual, semirigid PVC skin over foamed PE  
Jacket: Gray PVC  
Color Code: #2  
Shield: Dual longitudinal polyester-aluminum foil overshield  
Drain Wire: 26 AWG solid tinned copper

## **Wire & Cable (Electronic) Enhanced Performance Cables**

### **24 AWG Solid Conductors, Twisted Pairs — 1251**

Number of Pairs: 2, 3, 4, 6, 9, 12  
UL Listed Type CL2

*Nominal Parameters:*

Mutual Capacitance: 18 pF/ft.  
DC Resistance: 25.7  $\Omega$ /1000 ft.  
Impedance  $Z_0$ : 92  $\Omega$  @ 1 MHz

*Error-Free Transmission Rates:*

1.54 Mb/s up to 1900 ft.  
3.1 Mb/s up to 1100 ft.  
6.3 Mb/s up to 700 ft.

Conductors: Tinned Copper  
Insulation: Dual, semirigid PVC skin over foamed PE  
Jacket: Gray PVC  
Color Code: #4  
Shield: Longitudinal polyester-aluminum foil overshield  
Drain Wire: 24 AWG stranded tinned copper

### **24 AWG (7×32) Stranded Conductors, Twisted Pairs — 1254**

Number of Pairs: 2, 3, 4, 6, 9, 12, 12½, 18½  
UL Listed Type CL2

*Nominal Parameters:*

Mutual Capacitance: 18 pF/ft.  
DC Resistance: 25.7  $\Omega$ /1000 ft.  
Impedance  $Z_0$ : 92  $\Omega$  @ 1 MHz

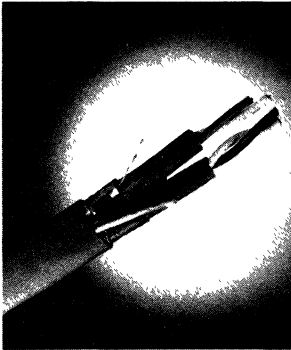
*Error-Free Transmission Rates:*

1.54 Mb/s up to 1100 ft.  
3.1 Mb/s up to 600 ft.  
6.3 Mb/s up to 400 ft.

Conductors: Tinned Copper  
Insulation: Dual, semirigid PVC skin over foamed PE  
Jacket: Gray PVC  
Color Code: #4  
Shield: Longitudinal polyester-aluminum foil overshield  
Drain Wire: 24 AWG stranded tinned copper

## Wire & Cable (Electronic)

# Specialized Performance Cables



**1281 Specialized Performance Cable**

### Description

AT&T's specialized performance cables are small-pair-size shielded data communication cables, using a pair twist scheme that minimizes crosstalk in the balanced pair mode. They are designed for use in digital channel banks, local area networks, and applications where joint voice and data communications within the same jacket are required. Specialized performance cables can be used to interconnect data processing equipment, terminals, and digital switching networks.

### Features

- Specialized designs
- Minimized crosstalk
- Voice/data applications

### Local Area Network (LAN) Cable — 1283

Number of Pairs: 2, 4

UL Listed Type CM: 60°C, 300 V

<i>Nominal Parameters:</i>	<u>Voice Pairs</u>	<u>Data Pairs</u>
Mutual Capacitance (pF/ft.):	19	12
DC Resistance ( $\Omega$ /1000 ft.):	28	43
Impedance $Z_0$ ( $\Omega$ @ 4 MHz):	95	122

#### *Error-Free Transmission Rates:*

1.54 Mb/s up to 2700 ft.

3.15 Mb/s up to 1700 ft.

6.3 Mb/s up to 1500 ft.

	<u>Voice Pairs</u>	<u>Data Pairs</u>
Conductors:	24 AWG Bare Copper	26 AWG Tinned Copper
Insulation:	Semirigid PVC	Dual, Semirigid PVC skin over foamed PE
Jacket:	Outside Gray PVC	Individual Gray PVC
Color Code:	#4	Red/Green Black/Orange
Shield:	None	Longitudinal polyester-aluminum foil
Drain Wire:	None	24 AWG solid tinned copper

## **Wire & Cable (Electronic) Specialized Performance Cables**

### **Local Area Network (LAN) Cable — 2281**

Number of Pairs: 2, 4  
UL Listed Type CMP

<i>Nominal Parameters:</i>	<u>Voice Pairs</u>	<u>Data Pairs</u>
Mutual Capacitance (pF/ft.):	19	10.3
DC Resistance ( $\Omega$ /1000 ft.):	28	41
Impedance $Z_0$ ( $\Omega$ @ 4 MHz):	95	132

***Error-Free Transmission Rates:***

1.54 Mb/s up to 2900 ft.  
3.1 Mb/s up to 1800 ft.  
6.3 Mb/s up to 1600 ft.

	<u>Voice Pairs</u>	<u>Data Pairs</u>
Conductors:	24 AWG Bare Copper	26 AWG Tinned Copper
Insulation:	Semirigid PVC	Dual, Semirigid PVC skin over foamed PE
Jacket:	Outside Transparent PVDF	Individual Transparent ECTFE
Color Code:	#4	Red/Green Black/Orange
Shield:	None	Longitudinal polyester-aluminum foil
Drain Wire:	None	24 AWG solid tinned copper
Thermal Barrier:	None	TEFLON * tape

### **26 AWG Solid Conductors, Twisted Pairs — 1205**

Number of Pairs: 2, 5  
Maximum Operating Temperature 90°C  
UL Listed Type CM: 60°C, 300 V

***Nominal Parameters:***

Mutual Capacitance: 14.5 pF/ft.  
DC Resistance: 41  $\Omega$ /1000 ft.  
Impedance  $Z_0$ : 100  $\Omega$  @ 1 MHz

***Error-Free Transmission Rates:***

1.6 Mb/s up to 2600 ft.  
3.15 Mb/s up to 1700 ft.  
6.3 Mb/s up to 1100 ft.

Conductors: Tinned Copper  
Insulation: PP  
Jacket: Gray PVC  
Color Code: #5  
Core Wrap: Polyester Film  
Shield: Longitudinal polyester-aluminum foil overshield  
Drain Wire: 26 AWG solid tinned copper

\* Registered trademark of the DuPont Company

## **Wire & Cable (Electronic) Specialized Performance Cables**

### **Local Area Network (LAN) Cable — 1281**

Number of Pairs: 2

UL Listed Type CM: 60°C, 300 V

<i>Nominal Parameters:</i>	<u>Voice Pairs</u>	<u>Data Pairs</u>
Mutual Capacitance: (pF/ft.)	13	9.6
DC Resistance: ( $\Omega$ /1000 ft.)	18	16.4
Impedance $Z_0$ : ( $\Omega$ @ 1 MHz)	118	146

*Error-Free Transmission Rates:*

1.54 Mb/s up to 3500 ft.

3.1 Mb/s up to 2300 ft.

6.3 Mb/s up to 2000 ft.

	<u>Voice Pairs</u>	<u>Data Pairs</u>
Conductors:	22 AWG Tinned Copper	26 AWG Tinned Copper
Insulation:	Dual, Semirigid PVC skin over PE	Dual, Semirigid PVC skin over foamed PE
Jacket:	Outside Gray PVC	Individual Gray PVC
Color Code:	Blue-White/White-Blue Green-White/White-Green	Orange/White Brown/White
Shield:	None	Longitudinal polyester-aluminum foil
Drain Wire:	None	24 AWG solid tinned copper

## Wire & Cable (Electronic)

### Color Codes

#### Color Code #1

Cond. No.	Color
1	Black
2	White
3	Red
4	Green
5	Brown
6	Blue
7	Orange
8	Yellow
9	Violet
10	Slate
11	Pink
12	Tan

#### Color Code #3

Pair No.	Colors
1	Black/Red
2	Black/White
3	Black/Green
4	Black/Blue
5	Black/Yellow
6	Black/Brown
7	Black/Orange
8	Red/White
9	Red/Green
10	Red/Blue
11	Red/Yellow
12	Red/Brown
13	Red/Orange
14	Green/White
15	Green/Blue
16	Green/Yellow
17	Green/Brown
18	Green/Orange
19	White/Blue
20	White/Yellow

#### Color Code #2

Pair No.	Colors
1	Blue/White
2	Orange/White
3	Green/White
4	Brown/White
5	Slate/White
6	Blue/Red
7	Orange/Red
8	Green/Red
9	Brown/Red
10	Slate/Red
11	Blue/Black
12	Orange/Black
13	Green/Black
14	Brown/Black
15	Slate/Black
16	Blue/Yellow
17	Orange/Yellow
18	Green/Yellow
19	Brown/Yellow
20	Slate/Yellow
21	Blue/Violet
22	Orange/Violet
23	Green/Violet
24	Brown/Violet
25	Slate/Violet

## Wire & Cable (Electronic) Color Codes

### Color Code #4

Pair No.	Color
1	White-Blue/Blue
2	White-Orange/Orange
3	White-Green/Green
4	White-Brown/Brown
5	White-Slate/Slate
6	Red-Blue/Blue-Red
7	Red-Orange/Orange-Red
8	Red-Green/Green-Red
9	Red-Brown/Brown-Red
10	Red-Slate/Slate-Red
11	Black-Blue/Blue-Black
12	Black-Orange/Orange-Black
13	Black-Green/Green-Black
14	Black-Brown/Brown-Black
15	Black-Slate/Slate-Black
16	Yellow-Blue/Blue-Yellow
17	Yellow-Orange/Orange-Yellow
18	Yellow-Green/Green-Yellow
19	Yellow-Brown/Brown-Yellow
20	Yellow-Slate/Slate-Yellow
21	Violet-Blue/Blue-Violet
22	Violet-Orange/Orange-Violet
23	Violet-Green/Green-Violet
24	Violet-Brown/Brown-Violet
25	Violet-Slate/Slate-Violet

### Color Code #5

Pair No.	Colors
1	Blue/White-Blue
2	Orange/White-Orange
3	Green/White-Green
4	Brown/White-Brown
5	Slate/White-Slate

## **Typical Applications**





## Typical Applications

The following pages describe selected industry applications that require sophisticated electronic components. Each is characterized by a system diagram that illustrates the functional elements of the application. Accompanying each element is a list of specific AT&T devices, identified by product line, that can be utilized. Devices which are generally applicable to any element are listed at the top of each diagram. A ( ) reference after a device indicates the page where the device is fully described.

The applications presented are suggestions that can be adapted for your specific needs. When you see the versatility of AT&T's Component Products, we think you will agree that whatever your application, we can become partners in technology...and in success.

**For additional information contact your nearest sales office or call:  
1-800-372-2447.**

### Computers

Multiuser Microsystems  
Workstations  
Storage Products

### Data Communications

Local Area Networks (LANs)

### Telecommunications

Loop Carrier Systems  
Private Branch Exchanges (PBXs)  
Digital Cross-Connect Systems

### Industrial

Manufacturing Automation Protocol (MAP) LANs  
Cell Controllers

### Page

**19-2**  
**19-4**  
**19-6**

**19-8**

**19-10**  
**19-12**  
**19-14**

**19-16**  
**19-18**

### AT&T's product lines are identified as follows:

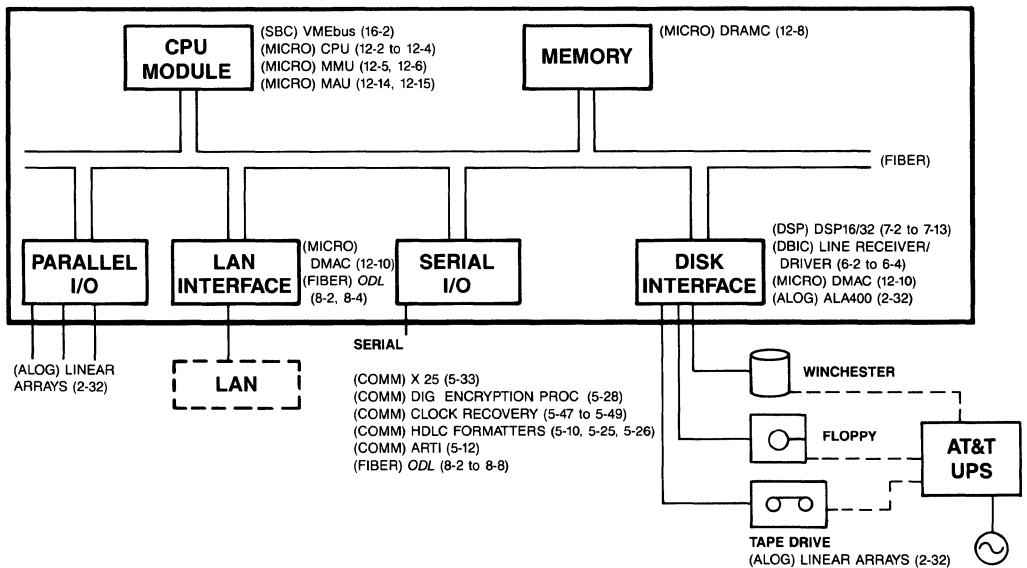
<b>(ALOG)</b>	Analog Integrated Circuits
<b>(ASIC)</b>	Application Specific Integrated Circuits
<b>(CAP)</b>	Capacitors
<b>(COMM)</b>	Communication Integrated Circuits
<b>(DBIC)</b>	Digital Bipolar Integrated Circuits
<b>(DSP)</b>	Digital Signal Processors
<b>(FIBER)</b>	Fiber Optics
<b>(FREQ)</b>	Frequency Control Products
<b>(GaAs)</b>	Gallium Arsenide Integrated Circuits
<b>(HYBRID)</b>	Hybrid Integrated Circuits
<b>(MICRO)</b>	Microprocessors and Peripherals
<b>(PCB)</b>	Printed Circuit Boards
<b>(POW)</b>	Power Products
<b>(SBC)</b>	Single Board Computer
<b>(T&amp;I)</b>	Transformers and Inductors
<b>(W&amp;C)</b>	Wire and Cable (Electronic)

# Typical Applications Computers

## Multuser Microsystems

### Application Description

Multuser microsystems are used as file servers, print servers, and communication servers, as well as a central CPU for dumb terminals.



### Generally Applicable Product Lines

ASIC	HYBRID
CAP	PCB
DBIC	POW
FIBER	T&I
FREQ	W&C

## Typical Applications Computers

### Multuser Microsystems

#### AT&T Advantages

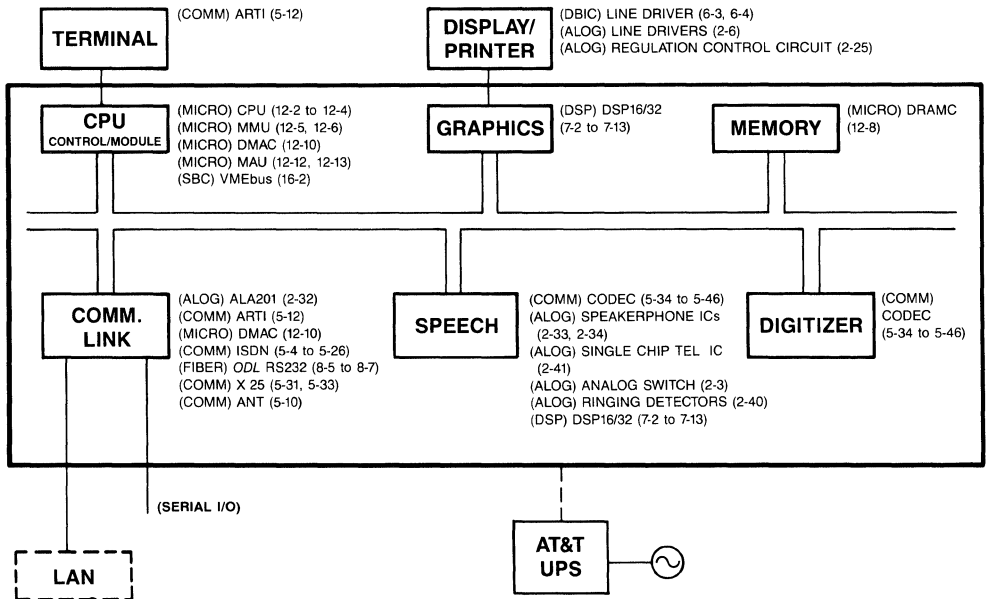
- (ALOG)** *Semi-Custom Linear Arrays (ALA201, ALA400)*: High speed; high performance; integration of analog and digital functions
- (ASIC)** Interfaces with peripherals; special block capability
- (COMM)** *ARTI*: Automatic speed matching  
*Clock Recovery Circuit*: No tuning necessary; 1-5 MHz  
*Digital Encryption Processor*: Does all four DES modes  
*HDLC Formatters*: Multichannel; high speed; on-chip buffers  
*X.25 Protocol Controller*: Full X.25 LAPB protocol for level 2; no software needed
- (DBIC)** High-speed designs with reasonable schedule and cost  
*Line Receivers and Drivers*: High speed; low power; low EMI
- (DSP)** *DSP16 Family (16-bit fixed point)*: High speed; cost effective  
*DSP32 Family (32-bit floating point)*: High precision; flexible architecture
- (FIBER)** *ODL 50 and ODL 200 Lightwave Data Links*: Long transmission; small size and weight  
*ODL RS232 Modem/Multiplexer and O2X Transceiver*: EMI/ESD noninductive noise immunity; plug-compatible; electrical isolation of equipment
- (FREQ)** Small, stable, switchable clock oscillators to drive logic; high-performance TRUs to recover data and clock
- (HYBRID)** Custom hybrid thin- or thick-film IC combining different technologies in dense packaging functional subassembly
- (MICRO)** *CPU*: Full 32-bit architecture enables complex instructions; high speed  
*DMAC*: Dual bus architecture eliminates bus contention bottleneck  
*DRAMC*: Built-in programmability to change and match memory speed  
*MAU*: Floating-point arithmetic intensive; reduces CPU overhead  
*MMU*: 4 Kbyte, two-way set-associative MMU/Cache with 85% data cache hit rate
- (PCB)** Complex, high-density for small size; EMI shielding; surface mount technology
- (POW)** *UPS*: Will reliably power combinations of computer (OLS), printer/disk (inductive), and modem (linear) power supplies; parallel processing design allows momentary overloads due to load startup or normal load operating characteristics
- (SBC)** *VMEbus*: Shortens design cycle by pre-engineering critical elements onto standard VMEbus hardware in an open architecture; complete software availability. Complementary UNIX System V/VME facilitates implementation of robust file systems.
- (W&C)** Digital transmission cables with solid or stranded copper conductors featuring shielding for EMI protection, twisted pairs to minimize crosstalk, and foam/skin insulations for low capacitance

# Typical Applications Computers

## Workstations

### Application Description

A technical workstation, often described as a single-purpose engineering workstation or graphics workstation, has its own processing capability that is greater than that of a personal computer. It can function as either a stand-alone or as a distributed processor linked by a network to other workstations. A workstation is generally designed with one or more 32-bit microprocessor sets, auxiliary storage, very high resolution CRT, 70-167 MB Winchester disk, and virtual memory management. The graphics capabilities of a technical workstation are sophisticated in terms of complexity, precision, and computational speed, and separate graphics processors are often used with floating-point units. Multitasking and LAN capabilities are also offered on some units.



### Generally Applicable Product Lines

- |       |        |
|-------|--------|
| ASIC  | HYBRID |
| CAP   | PCB    |
| DBIC  | POW    |
| FIBER | T&I    |
| FREQ  | W&C    |

# Typical Applications

## Computers

### Workstations

#### AT&T Advantages

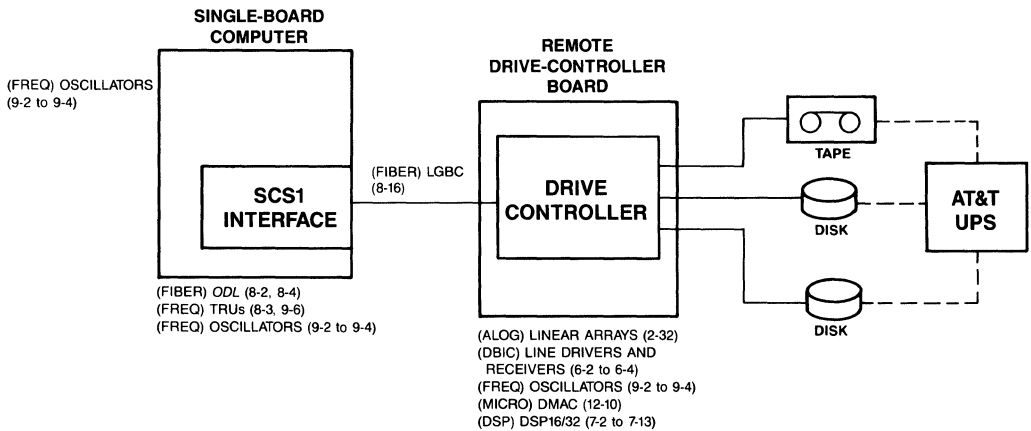
- (ALOG)** *Semi-Custom Linear Arrays (ALA201)*: High speed; high performance, integration of analog and digital functions  
*Ringing Detector*: Immune to false detection (bell tap immune)  
*Speakerphone ICs*: Low background noise and soft switch capability  
*Other*: LSI of high-voltage circuitry
- (ASIC)** Interfaces with peripherals; special block capability
- (COMM)** *ISDN*: Low cost; easy access to channel peripheral devices; 2- and 4-wire interfaces  
*ANT*: High speed; additional buffering capability; DMA handshaking functions  
*ARTI*: Automatic speed matching  
*Codec*: Low-cost,  $\mu$ -law, A-law devices with superior noise performance; high-precision devices provide excellent linearity and easy interface to DSP
- (DBIC)** High-speed design with reasonable schedule and cost  
*Line Driver*: High speed; low power; low EMI
- (DSP)** *DSP16 Family (16-bit fixed point)*: High speed; cost effective  
*DSP32 Family (32-bit floating point)*: High precision; flexible architecture
- (FIBER)** *ODL RS232 Modem/Multiplexer and 02X Transceiver*: EMI/ESD noninductive noise immunity; plug-compatible with terminal equipment
- (FREQ)** Small, stable, switchable clock oscillators to drive logic; 3-stateable, small VCXOs to sync graphics display
- (HYBRID)** Custom hybrid thin- or thick-film IC combining different technologies in dense packaging functional subassembly
- (MICRO)** *CPU*: Multitasking 32-bit architecture with full set of peripherals  
*DMAC*: Dual bus architecture eliminates bus contention bottleneck  
*DRAMC*: Eliminates costly discrete designs; built-in programmability  
*MAU*: Enhanced floating-point unit improves performance  
*MMU*: MMU/Cache frees CPU to run at zero wait states at 24 MHz
- (PCB)** Complex, high-density for small size; EMI shielding; surface mount technology
- (POW)** *UPS*: Will reliably power combinations of computer (OLS), printer/disk (inductive), and modem (linear) power supplies; parallel processing design allows momentary overloads due to load startup or normal load operating characteristics
- (W&C)** Digital transmission cables with solid or stranded copper conductors featuring shielding for EMI protection, twisted pairs to minimize crosstalk, and foam/skin insulations for low capacitance. Specialized performance cables feature data and voice pairs in a common outer jacket.

# Typical Applications Computers

## Storage Products

### Application Description

Mass storage products encompass rigid (hard) disk drives, flexible (floppy) disks, tape drives, and optical disk drives and are used for data collection and retrieval. They are comprised of a disk drive and a disk controller. Disk drive controllers provide the electronics that allow the drive to interface with the host system. The drive may or may not contain the controller. If contained in the drive, the controller may be a single chip, chip set, or board. If not contained, the controller may be a plug-in board or a stand-alone unit containing many boards.



### Generally Applicable Product Lines

ASIC	PCB
CAP	POW
DBIC	T&I
FIBER	W&C
HYBRID	

## Typical Applications Computers

### Storage Products

#### AT&T Advantages

- (ALOG)** *Line Drivers and Receivers*: Industry standard  
*Semi-Custom Linear Arrays*: High speed; high performance; integration of analog and digital functions
- (ASIC)** Higher level of component integration to save board space
- (DBIC)** High speed designs with reasonable schedule and cost  
*Line Drivers and Receivers*: High speed; low power; low EMI
- (DSP)** Servo-control mechanism in the controller  
*DSP16 Family (16-bit fixed point)*: High speed; cost effective  
*DSP32 Family (32-bit floating point)*: High precision; flexible architecture
- (FIBER)** *ODL Lightwave Components*: EMI/ESD noninductive noise immunity; small size and weight; transmits long distances without repeaters; high bandwidth  
*MAC*: Links hosts to modules  
*LGBC (Lightguide Building Cable)*: Secure transmission media; immune to EMI; longer system runs; capability to upgrade to 200 Mb/s; UL listed for riser and plenum applications
- (FREQ)** *Oscillators*: Small, stable, switchable clock oscillators to drive logic  
*TRUs*: High performance; recover data and clock
- (HYBRID)** Custom hybrid thin- or thick-film IC combining different technologies in dense packaging functional subassembly
- (MICRO)** *DMAC*: Off-loads work from main processor and increases overall system throughput
- (PCB)** Complex, high-density for small size; EMI shielding; surface mount technology
- (W&C)** Digital transmission cables with solid or stranded copper conductors featuring shielding for EMI protection, twisted pairs to minimize crosstalk, and foam/skin insulations for low capacitance

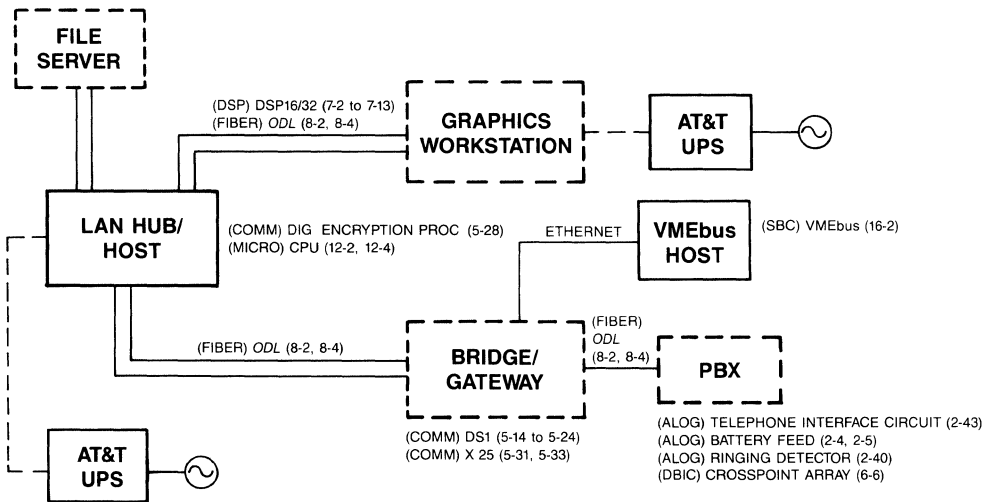


## Typical Applications Data Communications

# Local Area Networks (LANs)

### Application Description

LANs provide a communications facility for data systems contained in a small geographic area. LAN characteristics include high bandwidth interconnection media and relatively simple hosts or control hubs, although more sophisticated systems perform extensive protocol conversion, priority, and congestion control as well as multiplexing functions. Hosts can be either stand-alone systems or embedded PBX functions.



### Generally Applicable Product Lines

ASIC	HYBRID
CAP	PCB
DBIC	POW
FIBER(MAC)	T&I
FIBER	W&C
FREQ	

# Typical Applications

## Data Communications

### Local Area Networks (LANs)

#### AT&T Advantages

- (ALOG)** *Battery Feed*: Low cost, single-chip solution  
*Ringling Detector*: Immune to false detection (bell tap immune)  
*Telephone Interface Circuit*: Directs line interface with high-voltage protection functionality
- (ASIC)** Allows high-complexity designs with reasonable schedule and cost
- (COMM)** *DS1 Chip Set*: Supports multiple frame formats; complete DS1 and CEPT solutions  
*Digital Encryption Processor*: Programmable; does all four DES modes  
*X.25 Protocol Controller*: Full X.25 LAPB protocol for level 2; no software needed
- (DBIC)** High-speed designs with reasonable schedule and cost  
*Crosspoint Array*: High density; high performance; insertion impedance  $< 20 \Omega$
- (DSP)** *DSP16 Family (16-bit fixed point)*: High speed; cost effective  
*DSP32 Family (32-bit floating point)*: High precision; flexible architecture
- (FIBER)** *ODL 50 and 200 Lightwave Data Links*: EMI/ESD noninductive noise immunity; small size and weight; transmits long distances without repeaters; high bandwidth  
*MAC*: Compact backplane to circuit pack multiple fiber optic connector
- (FREQ)** Small, stable, switchable clock oscillators to drive logic; 3-stateable VCXOs to sync graphics display; high-performance TRUs to recover data and clock
- (HYBRID)** Custom hybrid thin- or thick-film IC combining different technologies in dense packaging functional subassembly
- (MICRO)** *CPU*: Handles full 32-bit word length instructions and increases speed and functionality
- (PCB)** Complex, high-density for small size; EMI shielding; surface mount technology
- (POW)** *UPS*: Will reliably power combinations of computer (OLS), printer/disk (inductive), and modem (linear) power supplies; parallel processing design allows momentary overloads due to load startup or normal load operating characteristics
- (SBC)** *VMEbus*: *UNIX* System V/VME includes device driver software for the CMC ENP-10\* Plus Ethernet Node Processor
- (W&C)** Digital transmission cables with solid or stranded copper conductors featuring shielding for EMI protection, twisted pairs to minimize crosstalk, and foam/skin insulations for low capacitance. Specialized performance cables feature data and voice pairs in a common outer jacket.

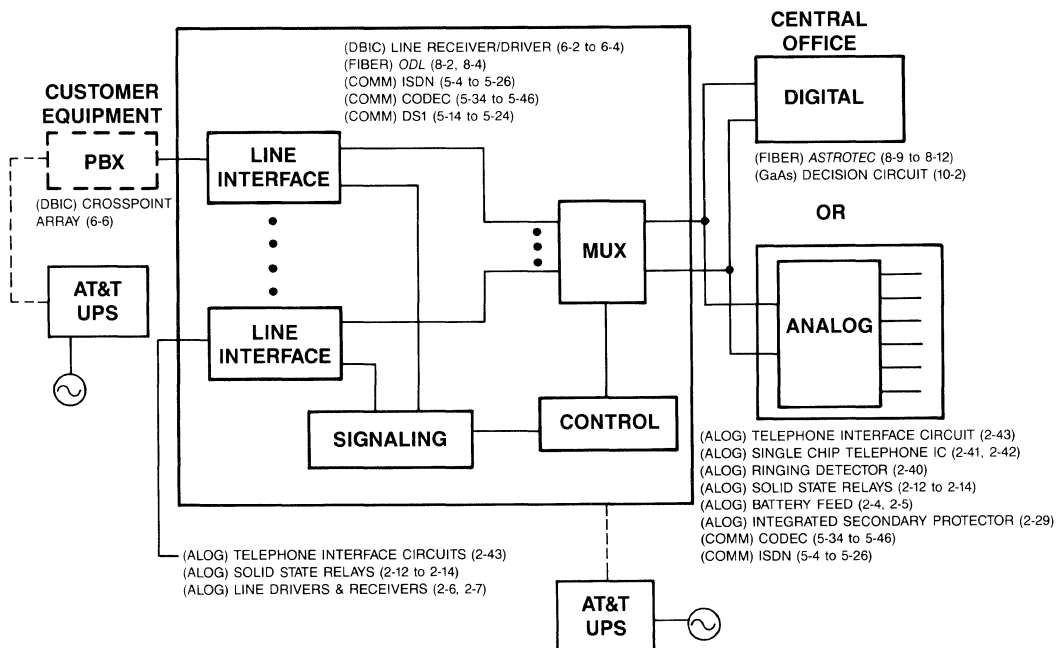
\* Trademark of the Communication Machinery Corporation

## Typical Applications Telecommunications

# Loop Carrier Systems

### Application Description

Digital loop carrier systems are used to deploy digital connectivity into the loop efficiently and economically. These systems consolidate (multiplex) message channels onto high bandwidth transmission media, essentially creating interoffice trunk systems that have the special features required for operation in the loop environment such as A/D and D/A conversion operational functions.



### Generally Applicable Product Lines

ASIC	HYBRID
CAP	PCB
DBIC	POW
DSP	T&I
FIBER	W&C
FREQ	

# Typical Applications

## Telecommunications

### Loop Carrier Systems

#### AT&T Advantages

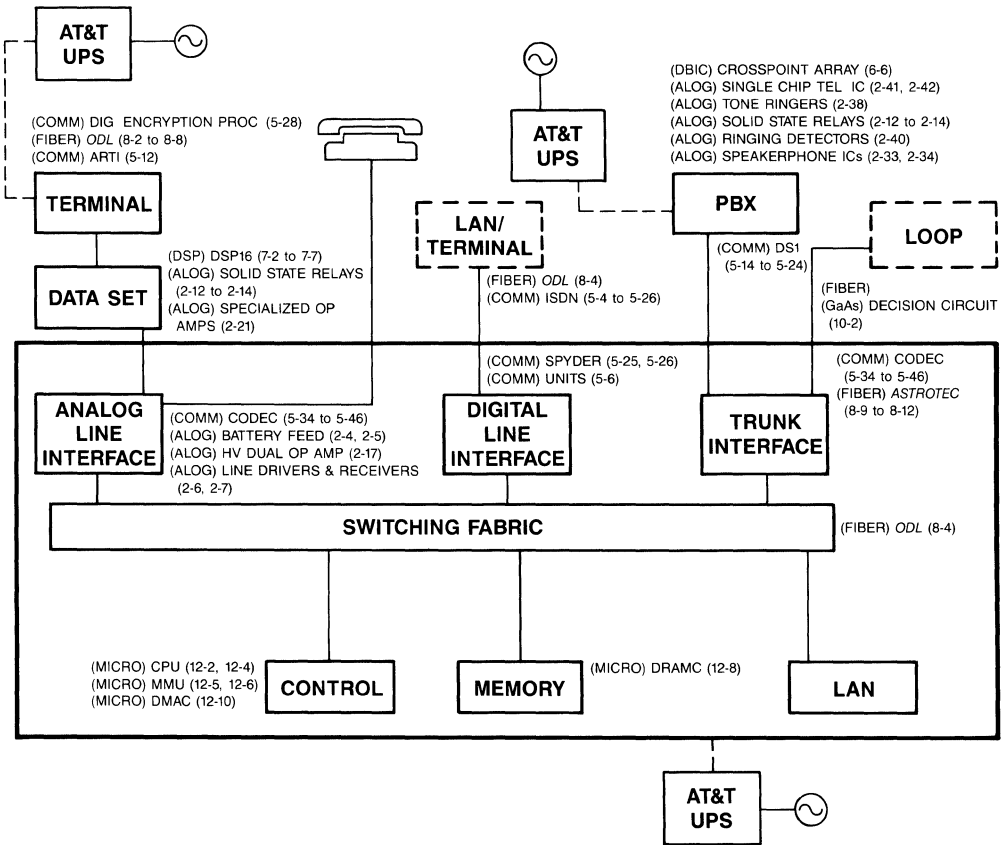
- (ALOG)** *Battery Feed:* Low cost, single-chip solution  
*Integrated Secondary Protector:* Complete 2-wire protection  
*Line Drivers and Receivers:* Industry standard  
*Ringing Detector:* No false detection (bell tap immune)  
*Single Chip Telephone IC:* Minimum external components  
*Solid State Relays:* Low cost; high reliability  
*Telephone Interface Circuits:* Line interface and dial pulse switch in one package
- (ASIC)** Interfaces with peripherals; special block capability
- (COMM)** *ISDN:* Low cost; easy access to channel peripheral devices; 2- and 4-wire interfaces  
*DS1 Chip Set:* Supports multiple frame and signaling formats; complete DS1 and CEPT solutions  
*Codec:* Low-cost,  $\mu$ -law, A-law devices with superior noise performance; high-precision devices provide excellent linearity and easy interface to DSP
- (DBIC)** High-speed designs with reasonable schedule and cost  
*Line Drivers/Receivers:* High speed; low power; low EMI  
*Crosspoint Array:* High density; high performance; insertion impedance  $< 20 \Omega$
- (DSP)** *DSP16 Family (16-bit fixed point):* High speed; cost effective  
*DSP32 Family (32-bit floating point):* High precision; flexible architecture
- (FIBER)** *ASTROTEC Laser Modules, Transmitters, Receivers:* Compact; high reliability; board mountable; many different speeds; ESD/EMI noninductive noise immunity; high bandwidth  
*ODL 50 and ODL 200 Lightwave Data Links:* Long transmission; small size and weight; EMI/ESD noninductive noise immunity; high bandwidth  
*Lightguide Cable:* Low loss; high bandwidth; robust; easy to install  
*ST Lightguide Cable Connectors:* Low loss; low cost; widely used; easy to install; stable  
*Lightguide Rotary Splice:* Low loss; rearrangeable; stable; easy and quick to install  
*MAC:* Compact backplane to circuit pack multiple fiber optic connector
- (FREQ)** Small, stable, switchable clock oscillators to drive logic; 3-stateable, small VCXOs for clock recovery
- (GaAs)** *Decision Circuit:* High speed; low power
- (HYBRID)** Custom hybrid thin- or thick-film IC combining different technologies in dense packaging functional subassembly
- (PCB)** Complex; high-density for small size; EMI shielding; surface mount technology
- (POW)** *UPS:* Will reliably power combinations of computer (OLS), printer/disk (inductive), and modem (linear) power supplies; parallel processing design allows momentary overloads due to load startup or normal load operating characteristics
- (T&I)** Electronic circuit transformers designed for analog or digital applications on high-density line cards; optimal combinations of size, performance, and price
- (W&C)** Digital transmission cables with solid or stranded copper conductors featuring shielding for EMI protection, twisted pairs to minimize crosstalk, and foam/skin insulations for low capacitance

# Typical Applications Telecommunications

## Private Branch Exchanges (PBXs)

### Application Description

A PBX is a customer premise switch that routes voice and data traffic both intra-premise and to the loop. The application package focuses on PBXs which support 100 to 10,000 lines.



### Generally Applicable Product Lines

ASIC	HYBRID
CAP	PCB
DBIC	POW
FIBER	T&I
FREQ	W&C

## Typical Applications Telecommunications

### Private Branch Exchanges (PBXs)

#### AT&T Advantages

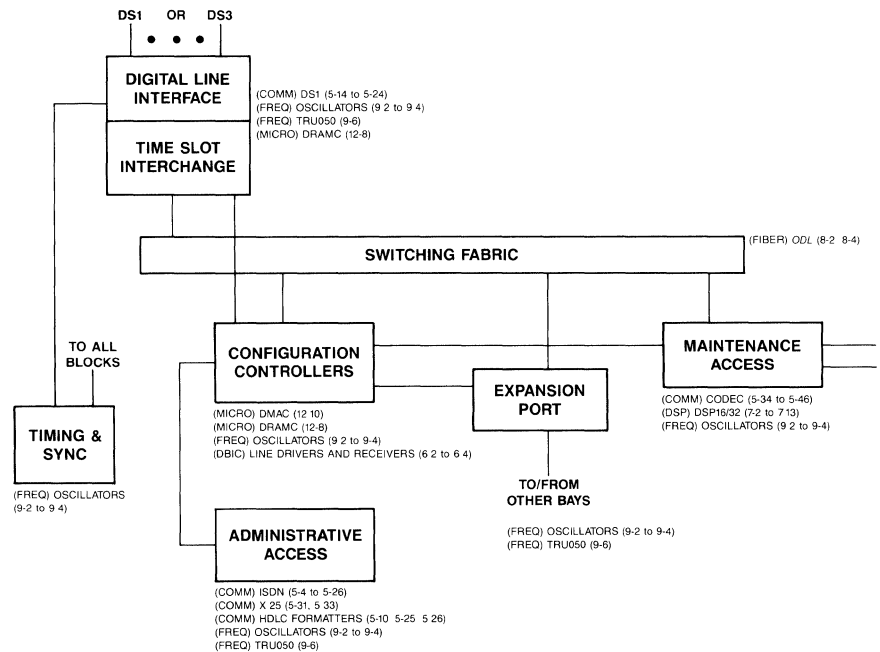
- (ALOG)** *HV Dual Op Amp:* High-voltage operation; fail-safe thermal shutdown; constant supply voltage  
*Solid-State Relays:* Low cost; high reliability  
*Ringling Detectors:* No false detection (bell tap immune)  
*Speakerphone ICs:* High performance, low background noise  
*Single Chip Telephone IC:* All telephone functions on one chip; few external components required  
*Line Drivers and Receivers:* Industry standard  
*Tone Ringers:* Low cost  
*Specialized Op Amps:* Low power; wide bandwidth; programmable
- (ASIC)** Allows high-complexity designs with reasonable schedule and cost
- (COMM)** *ISDN:* Low cost; easy access to channel peripherals; 2- and 4-wire interfaces  
*UNITS:* Low cost; high-speed TDM system interface; pass D-channel information to central controller  
*DS1 Chip Set:* Supports multiple frame formats; complete DS1 and CEPT solutions  
*ARTI:* Automatic speed matching  
*Codec:* Low cost,  $\mu$ -law, A-law devices with superior noise performance; high-precision devices provide excellent linearity and easy interface to DSP  
*Digital Encryption Processor:* Programmable, four DES modes  
*SPYDER:* Extremely compact multichannel formatter with buffers and DMA on chip
- (DBIC)** High-speed designs with reasonable schedule and cost  
*Crosspoint Array:* High density; high performance; insertion impedance  $< 20 \Omega$
- (DSP)** *DSP16 Family (16-bit fixed point):* High speed; cost effective  
*DSP32 Family (32-bit floating point):* High precision; flexible architecture
- (FIBER)** *ASTROTEC Laser Modules, Transmitters, Receivers:* High reliability; longer transmission distance; immunity to EMI, corrosion  
*ODL 50 Lightwave Data Link:* EMI/ESD noninductive noise immunity; high bandwidth; small size and weight; long distance without repeater  
*ODL RS232 Modem/Multiplexer:* EMI/ESD noninductive; plug-compatible with existing equipment  
*MAC:* Compact backplane to circuit pack multiple fiber optic connector
- (FREQ)** Small, stable, switchable clock oscillators to drive logic; high-performance TRUs to recover data and clock
- (GaAs)** *Decision Circuit:* High speed, low power
- (HYBRID)** Custom hybrid thin- or thick-film IC combining different technologies in dense packaging functional subassembly
- (MICRO) &(DSP)** Fully integrated 32-bit microprocessors, peripherals, and DSPs to control PBX functions
- (PCB)** Complex, high-density for small size; EMI shielding; surface mount technology
- (POW)** *UPS:* Will reliably power combinations of computer (OLS), printer/disk (inductive), and modem (linear) power supplies; parallel processing design allows momentary overloads due to load startup or normal load operating characteristics
- (T&I)** Electronic circuit transformers designed for analog or digital applications on high-density line cards; optional combinations of size, performance, and price
- (W&C)** Digital transmission cables with solid or stranded copper conductors featuring shielding for EMI protection, twisted pairs to minimize crosstalk, and foam/skin insulations for low capacitance

## Typical Applications Telecommunications

# Digital Cross-Connect Systems

### Application Description

A Digital Cross-Connect System (DCS or DACS) makes direct connections between channels of incoming and outgoing digital lines and provides access to any channel for remote digital testing. The cross-connect capability permits the assignment and redistribution of lower speed channels among higher rate systems (e.g., 64 kb/s DS0 channels among 1.544 Mb/s DS1 systems or 1.544 Mb/s DS1 channels among 45 Mb/s DS3 systems). The capability is used to collect incoming channels with common destinations and thus increase the fill on outgoing systems and/or on terminal transmission equipment. The cross-connect capability can also be used to segregate channels by type (e.g., message/special service; 2-wire/4-wire) to simplify Central Office interconnection.



### Generally Applicable Product Lines

ASIC	PCB
CAP	POW
DBIC	T&I
FIBER	W&C
HYBRID	

# Typical Applications

## Telecommunications

### Digital Cross-Connect Systems

#### AT&T Advantages

- (ASIC)** Interfaces with peripherals; special block capability
- (COMM)** *ISDN*: Low cost; easy access to channel peripheral devices; 2- and 4-wire devices  
*DS1 Chip Set*: Supports multiple frame and signaling formats; complete DS1 and CEPT solutions  
*Codec*: Low cost,  $\mu$ -law, A-law devices with superior noise performance; high-precision devices provide excellent linearity and easy interface to DSP  
*HDLC Formatters*: Multichannel; high speed; on-chip buffers  
*X.25 Protocol Controller*: Full X.25 LAPB protocol for level 2; no software necessary
- (DBIC)** High-speed designs with reasonable schedule and cost  
*Line Drivers and Receivers*: High speed, low power, low EMI
- (DSP)** *DSP16 Family (16-bit fixed point)*: High speed; cost effective  
*DSP32 Family (32-bit floating point)*: High precision; flexible architecture
- (FIBER)** *ODL 50 and ODL 200 Lightwave Data Links*: Long transmission; small cable size and weight
- (FREQ)** Clock recovery and data retiming via TRU050 or VCXO in phase-locked loop; clock oscillators to drive logic
- (HYBRID)** Custom hybrid thin- or thick-film IC combining different technologies in dense packaging functional subassembly
- (MICRO)** *DMAC*: Provides high-speed interface between system memory and administrative access peripheral (e.g., ISDN, XPC)  
*DRAMC*: Provides control necessary for large banks of dynamic RAM; can be used in dual port mode for simultaneous access by multiple processors
- (PCB)** Complex, high-density for small size; EMI shielding; surface mount technology
- (W&C)** Digital transmission cables with solid or stranded copper conductors featuring shielding for EMI protection, twisted pairs to minimize crosstalk, and foam/skin insulations for low capacitance

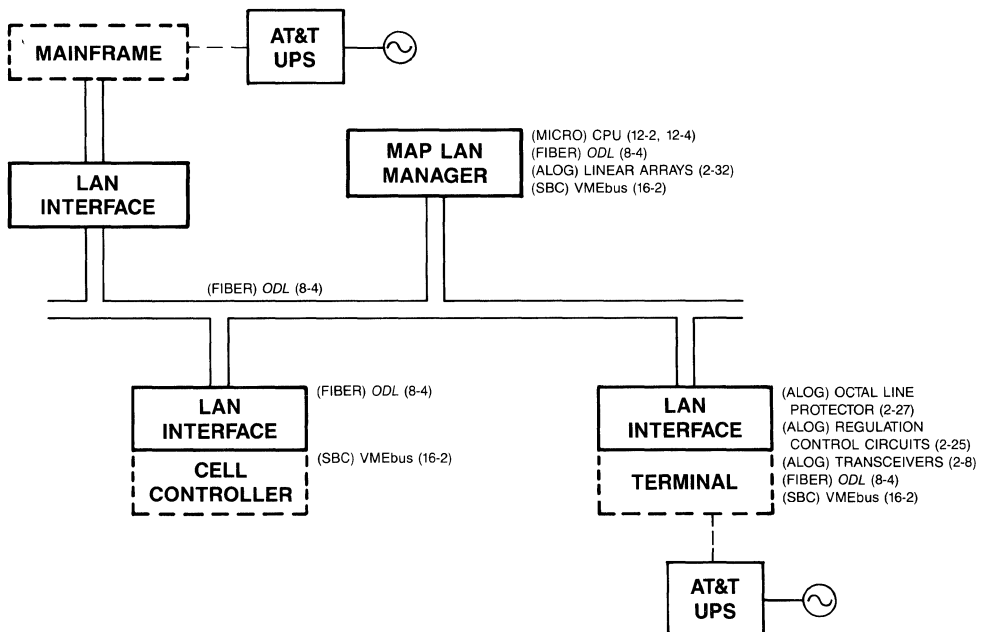


## Typical Applications Industrial

# Manufacturing Automation Protocol (MAP) LANs

### Application Description

The MAP LAN is a specialized LAN adhering to the MAP standard. It provides a high bandwidth communication link between intelligent controllers, computers, and terminals in the factory environment. The LAN consists of the transmission media, interface units, and the network manager. The latter performs maintenance, monitoring, performance, and status functions.



### Generally Applicable Product Lines

ASIC	FREQ
CAP	HYBRID
DBIC	PCB
DSP	POW
FIBER(MAC)	T&I
FIBER	W&C

## Typical Applications Industrial

### Manufacturing Automation Protocol (MAP) LANs

#### AT&T Advantages

- (ALOG)** *Octal Line Protector*: Electronic fusing for bus protection  
*Regulation Control Circuits*: High-speed comparator and precision reference in one package  
*Transceivers*: TTL- and CMOS-compatible
- (ASIC)** Allows high-complexity designs with reasonable schedule and cost
- (DBIC)** High-speed designs with reasonable schedule and cost
- (DSP)** *DSP16 Family (16-bit fixed point)*: High speed; cost effective  
*DSP32 Family (32-bit floating point)*: High precision; flexible architecture
- (FIBER)** *ODL Lightwave Components*: EMI/ESD noninductive noise immunity; small size and weight; transmits long distances without repeaters; high bandwidth  
*MAC*: Compact backplane to circuit pack multiple fiber optic connector
- (FREQ)** Small, stable, switchable clock oscillators to drive logic; high-performance TRUs to recover data and clock
- (HYBRID)** Custom hybrid thin- or thick-film IC combining different technologies in dense packaging functional subassembly
- (MICRO)** *CPU*: Full 32-bit instruction set; high performance, multitasking capability
- (PCB)** Complex, high-density for small size; EMI shielding; surface mount technology
- (POW)** *UPS*: Will reliably power combinations of computer (OLS), printer/disk (inductive), and modem (linear) power supplies; parallel processing design allows momentary overloads due to load startup or normal load operating characteristics
- (SBC)** *VMEbus*: Shortens design cycle by pre-engineering critical elements onto standard VMEbus hardware in an open architecture; complete software availability. Open architecture of *UNIX System V/VME* allows for easy integration of other VMEbus boards, many of which are available for factory applications.
- (W&C)** Digital transmission cables with solid or stranded copper conductors featuring shielding for EMI protection, twisted pairs to minimize crosstalk, and foam/skin insulations for low capacitance

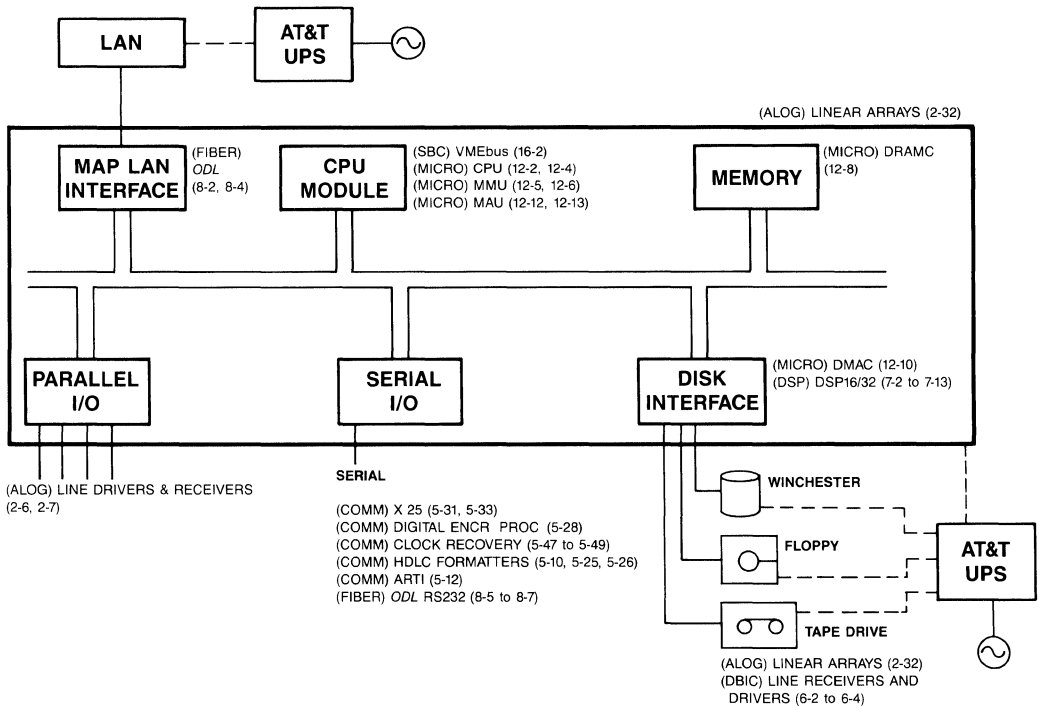
# Typical Applications

## Industrial

# Cell Controllers

### Application Description

A cell controller is usually a multiprocessing minicomputer controlling an area of the factory floor concerned with a particular segment of the manufacturing process (i.e., cell). A real-time operating system is important to service the lower-level controllers which manage the manufacturing tools in the cell. Communication to the lower-level controllers may occur through a LAN, MAP LAN, or dedicated I/O channels (serial or parallel).



### Generally Applicable Product Lines

ASIC	HYBRID
CAP	PCB
DBIC	POW
FIBER	T&I
FREQ	

# Typical Applications

## Industrial

### Cell Controllers

#### AT&T Advantages

- (ALOG)** *Line Drivers and Receivers:* Industry standard  
*Semi-Custom Linear Arrays (ALA201, ALA400):* High speed; high performance; integration of analog and digital functions
- (ASIC)** Interfaces with peripherals; special block capability
- (COMM)** *ARTI:* Automatic speed matching  
*Clock Recovery Circuit:* No tuning necessary; 1—5 MHz  
*Digital Encryption Processor:* Programmer; does all four DES modes  
*HDLC Formatters:* Multichannel; high speed; on-chip buffers  
*X.25 Protocol Controller:* Full X.25 LAPB protocol for level 2; no software necessary
- (DBIC)** High-speed designs with reasonable schedule and cost  
*Line Receivers and Drivers:* High speed; low power; low EMI
- (DSP)** *DSP16 Family (16-bit fixed point):* High speed; cost effective  
*DSP32 Family (32-bit floating point):* High precision; flexible architecture
- (FIBER)** *ODL Lightwave Components:* EMI/ESD noninductive noise immunity; small size and weight; transmits long distances without repeaters; high bandwidth  
*MAC:* Compact backplane to circuit pack multiple fiber optic connector
- (FREQ)** Small, stable, switchable clock oscillators to drive logic; high-performance TRUs to recover data and clock
- (HYBRID)** Custom hybrid thin- or thick-film IC combining different technologies in dense packaging functional subassembly
- (MICRO)** *CPU:* Handles full 32-bit word length instructions and increases functionality  
*DMAC:* Dual bus architecture eliminates bus contention bottleneck  
*DRAMC:* Built-in programmability to change and match memory speed  
*MAU:* Extremely fast math co-processor  
*MMU:* Eliminates overhead by handling process switching
- (PCB)** Complex, high-density for small size; EMI shielding; surface mount technology
- (POW)** *UPS:* Will reliably power combinations of computer (OLS), printer/disk (inductive), and modem (linear) power supplies; parallel processing design allows momentary overloads due to load startup or normal load operating characteristics
- (SBC)** *VMEbus:* Shortens design cycle by pre-engineering critical elements onto standard VMEbus hardware in an open architecture; complete software availability. Open architecture of UNIX System V/VME allows for easy integration of other VMEbus boards, many of which are available for factory applications.



# **Customer Support**



## Customer Support

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For additional information contact your nearest sales office or call:

**1-800-372-2447.**

**Domestic Sales Offices**

**Worldwide Design Centers and Manufacturing Plants**

**Technical Literature**

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# Customer Support

## Domestic Sales Offices

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### Sales Headquarters

1 Oak Way  
Berkeley Heights, NJ 07922

### Alabama

Huntsville Sales Office  
4717 University Drive, #104  
Huntsville, AL 35816  
205-837-6062

### (S. Los Angeles, San Diego)

Los Angeles Sales Office  
6300 Gateway Drive  
Cypress, CA 90630  
714-220-6228  
Telecopier: 714-220-6193

### Alaska

Portland Sales Office  
2 Lincoln Center #520  
10220 SW Greenburg Rd.  
Portland, OR 97223  
503-244-3883  
Telecopier: 503-244-2315

### Colorado

Denver Sales Office  
6160 S. Syracuse Way, Floor 3  
Englewood, CO 80111  
303-850-2935  
Telecopier: 303-850-2904

### Arizona

Phoenix Sales Office  
432 N. 44th St. #430  
Phoenix, AZ 85008  
602-244-1100  
Telecopier: 602-231-8758

### Connecticut

Boston Sales Office  
111 Speen Street  
Framingham, MA 01701  
617-626-2161  
Telecopier: 617-626-3710

### Arkansas

Chicago Sales Office  
500 Park Blvd. #270  
Itasca, IL 60143  
312-250-9777  
Telecopier: 312-250-8170

### Delaware

Philadelphia Sales Office  
601 Allendale Road  
King of Prussia, PA 19406  
215-768-2626  
Telecopier: 215-768-2992

### California

**(N. California)**  
San Francisco Sales Office  
1090 E. Duane Ave.  
Sunnyvale, CA 94086  
408-522-5555  
Telecopier: 408-522-4219

### District of Columbia

Philadelphia Sales Office  
601 Allendale Road  
King of Prussia, PA 19406  
215-768-2626  
Telecopier: 215-768-2992

### **(N. Los Angeles)**

Los Angeles Sales Office  
15350 Sherman Way #226  
Van Nuys, CA 91406  
818-376-6501  
Telecopier: 818-376-6523

### Florida

Orlando Sales Office  
9333 S. John Young Parkway  
Orlando, FL 32819  
305-345-7296  
Telecopier: 305-345-6900

## **Customer Support Domestic Sales Offices**

### **(NW Florida)**

Atlanta Sales Office  
3295 River Exchange Drive #350  
Norcross, GA 30092  
404-446-4710  
Telecopier: 404-446-4726

### **Kentucky**

Philadelphia Sales Office  
601 Allendale Road  
King of Prussia, PA 19406  
215-768-2626  
Telecopier: 215-768-2992

### **Georgia**

Atlanta Sales Office  
3295 River Exchange Drive #350  
Norcross, GA 30092  
404-446-4710  
Telecopier: 404-446-4726

### **Louisiana**

Dallas Sales Office  
4001 Airport Freeway #370  
Bedford, TX 76021  
817-354-9798  
Telecopier: 817-283-0108

### **Hawaii**

San Francisco Sales Office  
1090 E. Duane Ave.  
Sunnyvale, CA 94086  
408-522-5555  
Telecopier: 408-522-4219

### **Maine**

Boston Sales Office  
111 Speen Street  
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617-626-2161  
Telecopier: 617-626-3710

### **Idaho**

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2 Lincoln Center #520  
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Telecopier: 503-244-2315

### **Maryland**

Philadelphia Sales Office  
601 Allendale Road  
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215-768-2626  
Telecopier: 215-768-2992

### **Illinois**

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500 Park Blvd. #270  
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312-250-9777  
Telecopier: 312-250-8170

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Telecopier: 617-626-3710

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Philadelphia Sales Office  
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215-768-2626  
Telecopier: 215-768-2992

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Philadelphia Sales Office  
601 Allendale Road  
King of Prussia, PA 19406  
215-768-2626  
Telecopier: 215-768-2992

### **Iowa**

Chicago Sales Office  
500 Park Blvd. #270  
Itasca, IL 60143  
312-250-9777  
Telecopier: 312-250-8170

### **Minnesota**

Minneapolis Sales Office  
1650 W. 82nd St. #700  
Bloomington, MN 55431  
612-885-4322  
Telecopier: 612-885-4300

### **Kansas**

Kansas City Sales Office  
777 N. Blue Parkway  
Lee's Summit, MO 64063  
816-251-5801  
Telecopier: 816-251-5272

### **Mississippi**

Huntsville Sales Office  
165 Old Wood Road  
Huntsville, AL 35811  
205-837-6062

# Customer Support

## Domestic Sales Offices

### Missouri

Kansas City Sales Office  
777 N. Blue Parkway  
Lee's Summit, MO 64063  
816-251-5801  
Telecopier: 816-251-5272

### Montana

Portland Sales Office  
2 Lincoln Center #520  
10220 SW Greenburg Rd.  
Portland, OR 97223  
503-244-3883  
Telecopier: 503-244-2315

### Nebraska

Minneapolis Sales Office  
1650 W. 82nd St. #700  
Bloomington, MN 55431  
612-885-4322  
Telecopier: 612-885-4300

### Nevada

San Francisco Sales Office  
1090 E. Duane Ave.  
Sunnyvale, CA 94086  
408-522-5555  
Telecopier: 408-522-4219

### New Hampshire

Boston Sales Office  
111 Speen Street  
Framingham, MA 01701  
617-626-2161  
Telecopier: 617-626-3710

### New Jersey

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601 Allendale Road  
King of Prussia, PA 19406  
215-768-2626  
Telecopier: 215-768-2992

### New Mexico

Phoenix Sales Office  
432 N. 44th St. #430  
Phoenix, AZ 85008  
602-244-1100  
Telecopier: 602-231-8758

### New York

Philadelphia Sales Office  
601 Allendale Road  
King of Prussia, PA 19406  
215-768-2626  
Telecopier: 215-768-2992

### North Carolina

Raleigh Sales Office  
4805 Green Road #120  
Raleigh, NC 27604  
919-790-9001  
Telecopier: 919-790-9007

### North Dakota

Minneapolis Sales Office  
1650 W. 82nd St. #700  
Bloomington, MN 55431  
612-885-4322  
Telecopier: 612-885-4300

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Telecopier: 215-768-2992

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4001 Airport Freeway #370  
Bedford, TX 76021  
817-354-9798  
Telecopier: 817-283-0108

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Telecopier: 503-244-2315

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Telecopier: 215-768-2992

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### Rhode Island

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Framingham, MA 01701  
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Telecopier: 617-626-3710

## **Customer Support Domestic Sales Offices**

### **South Carolina**

Raleigh Sales Office  
4805 Green Road #120  
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919-790-9001  
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### **South Dakota**

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1650 W. 82nd St. #700  
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### **Tennessee**

#### **(E. Tennessee)**

Atlanta Sales Office  
3295 River Exchange Drive #350  
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Telecopier: 404-446-4726

#### **(W. Tennessee)**

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165 Old Wood Road  
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205-837-6062

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Telecopier: 817-283-0108

Austin Sales Office  
4412 Spicewood Springs Road, #600  
Austin, TX 78759  
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Telecopier: 512-343-0351

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Denver Sales Office  
6160 S. Syracuse Way, Floor 3  
Englewood, CO 80111  
303-850-2935  
Telecopier: 303-850-2904

### **Vermont**

Boston Sales Office  
111 Speen Street  
Framingham, MA 01701  
617-626-2161  
Telecopier: 617-626-3710

### **Virginia**

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601 Allendale Road  
King of Prussia, PA 19406  
215-768-2626  
Telecopier: 215-768-2992

### **Washington**

Seattle Sales Office  
3460 161st Ave. SE, #100  
Bellevue, WA 98008  
206-644-3632

### **West Virginia**

Philadelphia Sales Office  
601 Allendale Road  
King of Prussia, PA 19406  
215-768-2626  
Telecopier: 215-768-2992

### **Wisconsin**

#### **(E. Wisconsin)**

Chicago Sales Office  
500 Park Blvd. #270  
Itasca, IL 60143  
312-250-9777  
Telecopier: 312-250-8170

#### **(W. Wisconsin)**

Minneapolis Sales Office  
1650 W. 82nd St. #700  
Bloomington, MN 55431  
612-885-4322  
Telecopier: 612-885-4300

### **Wyoming**

Minneapolis Sales Office  
1650 W. 82nd St. #700  
Bloomington, MN 55431  
612-885-4322  
Telecopier: 612-885-4300

## **Customer Support**

# **Worldwide Design Centers and Manufacturing Plants**

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### **Design Centers**

Allentown, PA  
Sunnyvale, CA  
London, England  
Madrid, Spain  
Munich, W. Germany  
Singapore

### **Manufacturing Plants**

Allentown, PA  
Atlanta, GA  
Kansas City, MO  
Orlando, FL  
Reading, PA  
Bangkok, Thailand  
Madrid, Spain  
Singapore

# AT&T Microelectronics Technical Literature

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For additional information, contact  
your AT&T Account Manager, or call:

- AT&T Microelectronics  
Dept. 51AL230230  
555 Union Boulevard  
Allentown, PA 18103  
**1-800-372-2447**

In Canada, call:  
**1-800-553-2448**

- AT&T Microelectronics GmbH  
Freischützstrasse 92  
D-8000 Munich 81  
West Germany  
**Tel. 0 89/95 97 0**  
**Telex 5 216 884**
- AT&T Microelectronics Pte. Ltd.  
745 Lorong 5 Toa Payoh  
Singapore 1231  
**Tel. 259-6622**  
**Telex RS42898**  
**FAX 259-2244**
- AT&T Japan  
7F, Fukoku Seimei Bldg.,  
2-2-2, Uchisaiwai-cho,  
Chiyoda-ku, Tokyo 100 Japan  
**Tel. (03) 502-3055**  
**Telex J32562 ATTIJ**  
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