

December 1995



# Product Selection Guide



# AT&T Microelectronics Product Selection Guide January 1996

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## USING THIS GUIDE/INTRODUCTION

### Using This Guide

This guide is an overview of our component offerings. It is organized to help you quickly determine what additional documentation you need to apply AT&T Microelectronics' components and capabilities in your product design.

The Product Listings describe standard products, semicustom components, and custom capabilities—quick reference charts for ordering appropriate data sheets by part number; descriptions of our capabilities in standard-cell ASICs and FPGAs; and an overview of how we can work with you to develop semicustom and custom products.

#### Literature Code Legend:

AP — Application Note  
BC — Brochure  
CA — Catalog  
DB — Data Book  
DS — Data Sheet  
IM — Information Manual  
MN — Manual  
PN — Product Brief  
TN — Technical Note

**To order literature or request additional information, call your AT&T Account Manager or call 1-800-372-2447.**

### Introduction

#### Expanding People's Capabilities Through Innovation . . .

For over a hundred years people have been communicating by voice-only telephony made significantly possible by the technology and products of AT&T Microelectronics. Through the 1990s advanced technology will be expanding people's communication possibilities through innovative methods. People have the opportunities to exchange thoughts, messages, and information via speech, signals, and writing. Visual images and pictures will enhance people's communication between one another and the world around them, while stretching beyond the limits of strictly words. As technology advances, people will understand their need to communicate is no longer determined by their location, by the time zone in which they live, or by the communication instrument available to them at a given time. Today, their ability to communicate or access information is aided by a wider choice of media and a greater accessibility range. People now have the opportunity to com-

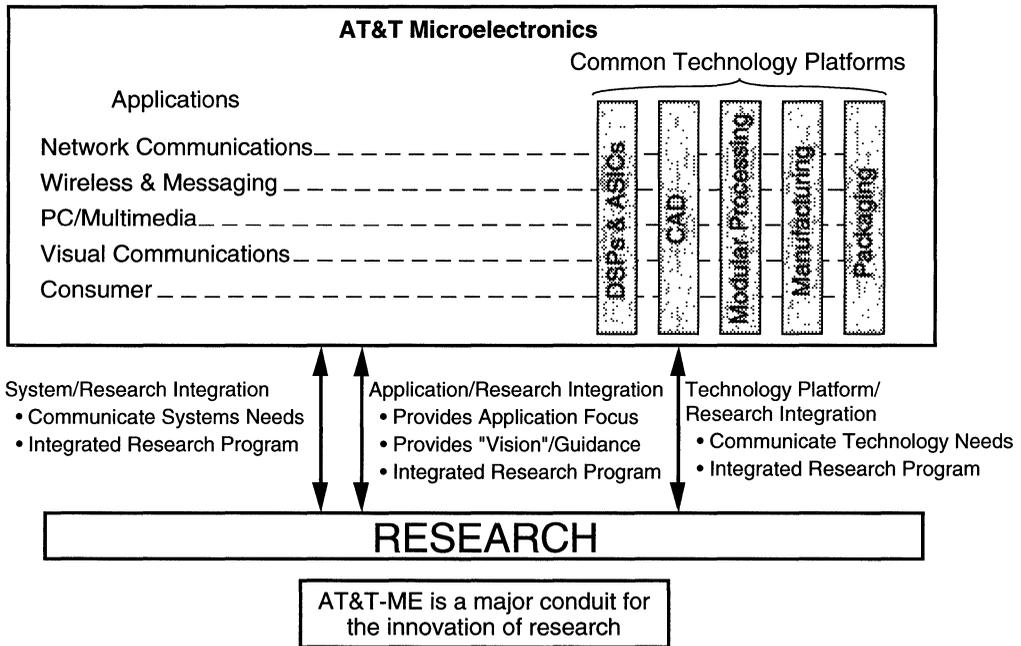
municate sitting at a desk, traveling in an airplane or car, or even lounging on the beach. These communication capabilities are emerging from a convergence of the traditional communication, computing, and entertainment markets. From this merger come opportunities in new markets, with new products, and between new customers. AT&T Microelectronics, working together with the key players in these markets, is creating the vision of anytime, anywhere communications.

# INTRODUCTION

## Customer-Driven Solutions

AT&T Microelectronics applies the world-renowned research of AT&T Bell Laboratories, our integrated technology platforms, and our customers' needs and insights to create focused applications in line with our vision. Our efforts result in leading products and application solutions which give our customers an advantage and bring an added value to their own customers (see Figure 1). Today we're delivering industry-

leading solutions for networked computing, wireless communications, telecommunications, and desktop videoconferencing. Soon we'll deliver solutions for advanced consumer electronic products like HDTV. And with our state-of-the-art production facilities and design centers located throughout North America, Europe, and Asia, we can deliver these solutions on a world-wide scale.



**Figure 1. Focusing AT&T Microelectronic's Resources on Meeting the Critical Needs of Customers**

AT&T Microelectronics  
Integrated Circuits Group

# Lifetime Warranty

We deliver customer delight by guaranteeing our IC Products for Life.



Warranty – Effective January 1, 1995, Seller warrants to Buyer that products of its manufacture will be, on the date of shipment of the product, free from defects in material and workmanship and will substantially conform to Seller's written specifications provided to Buyer or to the specifications, if any, identified in an order and agreed to in writing by Seller. If any defect in material or workmanship or failure to meet such specifications (a "defect") appears in the product, Seller will, at its option, either credit or refund the purchase price, repair, or replace the defective product with the same or equivalent product without charge at Seller's manufacturing or repair facility provided (i) Buyer notifies Seller in writing of the claimed defect within thirty (30) days after Buyer knows or reasonably should know of the claimed defect, and (ii) Seller's examination of the product discloses that the claimed defect actually exists and (iii) in the case of optically coupled MOSFET drivers, optically coupled solid-state relays, or any product other than packaged monolithic integrated circuits, the defect appears within twelve (12) months from the date of shipment of the product.

Buyer shall follow Seller's instructions regarding return of defective product, and no product will be accepted for repair, replacement, credit, or refund without the written authorization of and in accordance with Seller's instructions. This warranty only extends to Buyer. Seller will not accept returns directly from Buyer's customers or users of Buyer's products. Replaced products shall become Seller's property. In no event shall Seller be responsible for deinstallation or reinstallation of defective products or for the expenses thereof. If Seller determines that the returned products are not defective, Buyer shall pay Seller all costs of handling, inspection, repairs, and transportation at Seller's then prevailing rates. Repairs and replacements covered by the above warranty are warranted to be free from defects as set forth above.

The above warranty does not apply to, and Seller makes no warranties with respect to, products that:

- are software programs, experimental or prototypes (all of which are provided "AS IS"), or
- have been subjected to misuse, neglect, accident, abuse, or operating or environmental conditions that deviate from the parameters established in applicable specifications; or
- have been improperly installed, stored, maintained, repaired, or altered by anyone other than Seller; or
- have had their serial numbers or month and year of manufacture or shipment removed, defaced, or altered.

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# DIGITAL SIGNAL PROCESSORS

## Floating-Point DSP Products – Product Matrix

Part Number	Description	Package Type	Speed (ns)	Temp. Ranges	Literature
DSP32C	32-bit CMOS Digital Signal Processor 1.5K RAM/0 ROM	133-pin, ceramic PGA 164-pin BQFP	50, 60, 80	0 °C to +70 °C –40 °C to +85 °C* (I)	AP, DS, IM
DSP32C w/o External Memory Interface	2K RAM/0 ROM	68-pin PLCC	80	0 °C to +70 °C	AP, DS, IM

\*Industrial temperature only available at 100 ns.

## DSP32C Development Tools - Product Matrix\*

Part Number	Description
DSP32C-SL-XXXX	Software Library containing Software Generation System (SGS) and a device simulator
DSP32C-AL-XXXX	Application Software Library
DSP32C-CC-XXXX	C Language Compiler including a Software Library and C-Callable Version of the Application Software Library
DSP32C-DS-DEV-16	Development Board with 16 Kword SRAM
DSP32C-DS-DEV-64	Development Board with 64 Kword SRAM
DSP32C-DS-ICE	PC Board — In-Circuit Emulator POD
DSP32C -DS-PBS	PC Board — PC Bus Interface Half-Card
DSP32C-DS-MII	Multi-ICE Interface Box
SIG32C-8	ISA Bus board which supports 32C 50 ns devices. Contact SignaLogic at (214) 343-0069 for details.

\*Technical/Sales support is now being handled by a third party, Valley Technologies, Contact No. 1-800-370-6661 for all issues.

## Fixed-Point DSP Products – Product Matrix

Part Number	Description	Package Type	Speed (ns)	Power Supply (V)	Temp. Ranges	Literature
DSP16A	2K RAM/12K ROM	84-pin PLCC	25, 33, 55	5	0 °C to 70 °C	AP, DS, IM
	16-bit CMOS Digital Signal Processor	84-pin PQFP			–40 °C to +85 °C*	
	1K RAM/8K ROM	84-pin PLCC	33, 55	5	0 °C to 70 °C	
DSP1610	16-bit CMOS Digital Signal Processor	84-pin PLCC	25, 33, 55	5	0 °C to 70 °C	AP, DS, IM
	2K RAM/24K ROM	84-pin PQFP			–40 °C to +85 °C*	
	6-bit CMOS Digital Signal Processor	100-pin TQFP				
DSP1610	16-bit CMOS DSP with 8K Downloadable Dual-Port RAM and 512K Boot ROM or 4K RAM and 512K Boot ROM	132-pin PQFP	25, 33	5	0 °C to 70 °C –40 °C to +85 °C	AP, BC, DS, IM, DB
DSP1611	16-bit CMOS DSP with 12K Dual-Port RAM and 1K Boot ROM	100-pin TQFP	20, 25, 30 33 38	5 3 2.7	–40 °C to +85 °C	DS, DB

## Fixed-Point DSP Products – Product Matrix (continued)

Part Number	Description	Package Type	Speed (ns)	Power		Temp. Ranges	Literature
				Supply (V)			
DSP1615	16-bit CMOS DSP with 1K SRAM & 24K ROM	100-pin TQFP	100	3	-10 °C to +60 °C	DS, IM	
		100-pin BQFP	125	3			
DSP1616 x 11	16-bit CMOS DSP with 2K Dual-Port RAM and 12K ROM	100-pin BQFP 100-pin TQFP	33, 38	5	-40 °C to +85 °C	AP, BC, DS, DB	
DSP1616 x 30	16-bit CMOS DSP with 2K Dual-Port RAM and 12K ROM	100-pin BQFP	20, 25, 30	5	-40 °C to +85 °C	BC, DS, IM, DB	
		100-pin TQFP	33	3			
			38	2.7			
DSP1617	16-bit CMOS DSP with 4K Dual-Port RAM and 24K ROM	100-pin BQFP	20, 25, 30	5	-40 °C to +85 °C	BC, DS, DB	
		100-pin TQFP	33	3			
			38	2.7			
DSP1618	16-bit CMOS DSP with 3K Dual-Port RAM and 16K ROM	100-pin BQFP	20, 25, 30	5	-40 °C to +85 °C	BC, DS, DB	
		100-pin TQFP	33	3			
			38	2.7			
DSP1627 x 32	16-bit CMOS DSP with 6K Dual-Port RAM and 32K ROM	100-pin TQFP	14	5	-40 °C to +85 °C	DS, DB	
		100-pin BQFP	20	2.7			
DSP1627 x 36	16-bit CMOS DSP with 6K Dual-Port RAM and 36K ROM	100-pin BQFP	14	5	-40 °C to +85 °C	DS, DB	
		100-pin TQFP	20	2.7			

\* Industrial temperature for 25, 33, 55 ns in 84 PLCC and 33, 55 ns in 84 PQFP only.

## DSP16A and DSP161X Development Tools – Product Matrix

Part Number	Description
DSP16A-SL-XXXX	Software Library containing Software Generation System (SGS) and a device simulator
DSP16A-AL-XXXX	Application Software Library
DSP16A-DS	Stand-Alone Development System
DSP16A-BD-EVAL	Development Board with <i>PC/XT/AT</i> Plug-in Board
DSP16A-BD-EV/25	Evaluation Board with <i>PC/XT/AT</i> Plug-in Board
DSP1610-ST-XXXX	Software Library containing Software Generation System (SGS) and an Integrated Development Environment (IDE)
<i>FlashDSP</i> ™ 1600-HDS	<i>FlashDSP</i> 1600 Hardware Development System
DSP1610-HDS	Hardware Development System
DSP1610-EVAL2	PC Board — DSP1610 Evaluation Board
CSP1027-AC	Adds CSP1027 Functionality to DSP1602/04-DEMO, DSP1610-EVAL2, DSP161X-EVAL
T7525-AC	T7525 Codec Add-On Card. Adds functionality to DSP1610-EVAL2, DSP161X-EVAL
DSP1611-ST-XXXX	Software Library containing Software Generation System (SGS) and an Integrated Development Environment (IDE)
DSP1611-EVAL	DSP1611 Evaluation Board
DSP1616-ST-XXXX	Software Library containing Software Generation System (SGS) and an Integrated Development Environment (IDE)
DSP1616-POD	DSP1616 In-Circuit Emulation POD
DSP1616/27-DEMO	Demonstration Board. Provides Software and Hardware Evaluation Platform for the DSP1616 and CSP1027

## DIGITAL SIGNAL PROCESSORS

### DSP16A and DSP161X Development Tools – Product Matrix (continued)

Part Number	Description
DSP1616/84-DEMO	Demonstration Board. Provides Software and Hardware Evaluation Platform for the DSP1616 and CSP1084
DSP1616-EVAL	DSP1616 Evaluation Board with PC/AT Plug-in Board
FlashDSP 1616X-KIT	FlashDSP 1616 KIT. Program and Erase Flash Memory on FlashDSP 1616 through JTAG/HDS Port
DSP1617-ST-XXXX	Software Library containing Software Generation System (SGS) and an Integrated Development Environment (IDE)
DSP1617-EVAL	DSP1617 Evaluation Board
DSP1618-ST-XXXX	Software Library containing Software Generation System (SGS) and an Integrated Development Environment (IDE)
DSP1618-EVAL	DSP1618 Evaluation Board
FlashDSP 1618X-KIT	FlashDSP 1618 KIT. Program and Erase Flash Memory on FlashDSP 1618 through JTAG/HDS Port

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

### Fixed-Point DSP Products – Product Matrix

Part Number	Description	Package	Speed	Temperature Range	Literature
<b>Consumer DSP Products</b>					
DSP1603	Development Device for DSP1604/06 with on-board Flash ROM and Dual-Port RAM, 3.3 V and 5 V	80-pin MQFP 84-pin PLCC 100-pin TQFP	30 ns	0 °C to +70 °C	DS
DSP1604/06	Low-Cost DSP with on-board ROM and RAM, 3.3 V & 5 V, and IOP Ports	80-pin MQFP 84-pin PLCC 100-pin TQFP	30 ns	0 °C to +70 °C	DS
DSP1605	Low-Cost DSP with on-board ROM and RAM, 3.3 V and 5 V, and HIF	80-pin MQFP 68-pin PLCC	30 ns	0 °C to +70 °C	DS
DSP1605F	Development Device for DSP1605 with Flash ROM and on-board RAM, 3.3 V and 5 V	80-pin MQFP 68-pin PLCC	30 ns	0 °C to +70 °C	DS
<b>Enhanced Telephone Answering Devices</b>					
LC30	Low-Cost, High-Performance TAD with ARAM Support using the DSP1605	68-pin PLCC 80-pin QFP	30 ns	0 °C to +70 °C	PN
LD30	Low-Cost, High-Performance TAD with ARAM Support using the DSP1605 with Echo Cancelling Speakerphone	68-pin PLCC 80-pin QFP	30 ns	0 °C to +70 °C	PN
LE30	Low-Cost, High-Performance TAD with NOR Flash Support (FTAD) using the DSP1605	68-pin PLCC 80-pin MQFP	30 ns	0 °C to +70 °C	PN

## Fixed-Point DSP Products – Product Matrix (continued)

Part Number	Description	Package	Speed	Temperature Range	Literature
<b>Enhanced Telephone Answering Devices (continued)</b>					
LJ30	Low-Cost, High-Performance TAD with ANAND Flash Support (FTAD) using the DSP1605	68-pin PLCC 80-pin MQFP	30 ns	0 °C to +70 °C	PN
LH30	Low-Cost, High-Performance TAD with ANAND Support using the DSP1605 with Echo Cancelling Speakerphone	68-pin PLCC 80-pin QFP	30 ns	0 °C to +70 °C	PN
LF30	Low-Cost, High-Performance TAD with ANAND Support using the DSP1605 with Acoustic Echo Cancelling Speakerphone	68-pin PLCC 80-pin QFP	30 ns	0 °C to +70 °C	PN

## Consumer Development Tools – Product Matrix

Part Number	Description
DSP160X-ST-MSDOS	Software Library containing Software Generation System (SGS) and an Integrated Development Environment (IDE) that supports 1602, 1605, 1606 (includes 1603F, 1605F, 1604) devices
DSP1603-FP0-POD	In Circuit Emulation Board that supports Pin 0 option
DSP1603-FP1-POD	In Circuit Emulation Board that supports Pin 1 option
FLASHDSP1603-KIT	<i>Flash DSP1600-HDS, DSP160X-DEV, DSP160X-ST-MSD</i>
DSP160X-DEV	Flash Target System supporting all 1604/06 devices
DSP1605-DEV-2	Flash Target System supporting all 1605 devices
DSP1605-UPDATE	2 FDMs (MQFP & PLCC) which give the DSP160X-DEV board 1605 functionality
DSP160X-TAD	5 TAD Application-Specific Modules
DSP160X-ST-MSDOS	DSP160X Software Tools
FLASHDSP1600-HDS	Flash DSP1600 Hardware Development System
LC30, LJ30, or LE30 Evaluation Board	Low-Cost Platform for Evaluating and Developing Products Based on the ETAD; Stand-alone Digital Answering Machine
LD30, LH30, or LF30 Evaluation Board	Low-Cost Platform for Evaluating and Developing Products Based on the ETAD-ECS; Fully Operational Digital Answering Machine with Integrated Echo Cancelling Speakerphone or Acoustic Echo Cancelling Speakerphone
SWPCUP	<i>Windows-based Development Tool for TAD Host Interface development using a PC's serial port</i>

## Codecs

Part Number	Description	Package Type	Temp. Ranges	Literature
T7582	Baseband Codec for Digital Cellular Applications	44-pin PLCC	-40 °C to +85 °C	DS
CSP1027	Voiceband Codec for Cellular Handset and Modem Applications	44-pin EIAJ QFP 48-pin TQFP	-40 °C to +120 °C	DS
CSP1084	Baseband Radio Interface for IS-54 Dual-Mode Cellular Telephone Applications	80-pin EIAJ QFP 100-pin TQFP	-40 °C to +85 °C	DS

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

# DIGITAL SIGNAL PROCESSORS

## Modem Products

In an era that demands greater amounts of real-time voice, data, and FAX over phone lines and wireless communications channels, AT&T Microelectronics responds with a range of solutions for modem applications.

At the heart of every modem is a modem chip set. At the highest level there are two types of modem chip sets. They are data pump chip sets and complete modem chip sets.

## Data Pump Chip Sets

A data pump chip set is the portion of the modem that pumps bits of data onto a telephone line or a wireless (cellular) communication channel. Data pump chip sets are for customers who have their own controller hardware and software. There are three form factors in the family of data pump chip sets:

- Desktop data pump chip sets
  - Laptop data pump chip sets
  - PCMCIA data pump chip sets
- Desktop data pump chip sets are low-cost solutions ideal for applications such as stand-alone modems, desktop PC plug-in modems, and integral desktop PC modems. The laptop data pump chip sets are intended for low-power applications and/or applications where space saving is essential; examples include notebook and laptop PCs and pocket modems. Most of today's laptop and desktop modem designs use components in Bumper Quad Flat Packs (BQFP), formerly known as Plastic Quad Flat Pack (PQFP). The PCMCIA data pump chip sets require even less board space than the Laptop versions, and are thin enough to allow double-sided placement on Type II PCMCIA plug-in cards.

Table 1 shows the AT&T modem data pump chip sets that are available. The table includes the chip set name along with the highest speed it can operate at, and the packages and devices that constitute the chip set. For example, the HSM288PD+D is the name for a DSVD data pump chip set in a PCMCIA form factor. It can operate at 28.8 Kbits/s, has a DSP in a TQFP package called the 16345-AD, an interface chip in a 100TQFP called the VALV 34, an audio codec in a 100TQFP called the CSP1635, and an optional device which is an optical DAA in a 14-pin SSOP called the 2560ABL.

Table 2 offers a more in-depth view of the features available in each product family. For instance, the HSM288xD supports all features on the list except 3.3 V, Cellular, DSVD, and PLCC packaging.

**Table 1. 16-bit Fixed Point High-Speed Modem – Data Pump Chip Sets**

Chip Set Name*	Highest Speeds	Standard Features	DSP	Interface	Codec	Audio Codec	Optional Device	Comments
<b>Desktop</b>								
HSM192DD	19,200	V.32 bis – MJ Data/FAX	84 PLCC 16A32-MJ	68 PLCC V.32 Intfc.	28 SOJ T7525			
HSM288DD	28,800	V.34 – AC Data/FAX	100 BQFP 16345-AC	84 BQFP VALV 34				
HSM288DD+D	28,800	V.34 – AD Data/FAX/ DSVD	100 BQFP 16345-AD	84 BQFP VALV 34		100 BQFP CSP 1635		Catamaran™ Data Pump
<b>Laptop</b>								
HSM192LD	19,200	V.32 bis – MJ Data/FAX	84 BQFP 16A32-MJ	84 BQFP V.32 Intfc.	44 MQFP CSP1027			
HSM192LD+3	19,200	V.32 bis – MJ Data/FAX	84 BQFP 16A32-MJ	84 BQFP V.32 Intfc.	44 MQFP CSP1027			3.3 V chip set
HSM192LD+C	19,200	V.32 bis – MJ Data/ FAX/Cellular	84 BQFP 16A32-MJ	84 BQFP V.32 Intfc.	44 MQFP CSP1027			+C = Cellular
HSM192LD+C3	19,200	V.32 bis – MJ Data/ FAX/Cellular	84 BQFP 16A32-MJ	84 BQFP V.32 Intfc.	44 MQFP CSP1027			+C = Cellular 3.3 V chip set

\*Chip Set Name – The letters D, L, P refer to the package option: D = desktop, L = laptop, P = PCMCIA

Note: Part numbers are not complete, please contact customer service for complete part numbers when placing orders.

**Table 1. 16-bit Fixed Point High-Speed Modem – Data Pump Chip Sets (continued)**

Chip Set Name*	Highest Speeds	Standard Features	DSP	Interface	Codec	Audio Codec	Optional Device	Comments
<b>PCMCIA</b>								
HSM192PD	19,200	V.32 bis – MJ Data/FAX	100 TQFP 16A32-MJ	100 TQFP V.32 Intfc.	48 TQFP CSP1027			
HSM192PD+3	19,200	V.32 bis – MJ Data/FAX	100 TQFP 16A32-MJ	100 TQFP V.32 Intfc.	48 TQFP CSP1027			3.3 V chip set
HSM192PD+C	19,200	V.32 bis – MJ Data/ FAX/Cellular	100 TQFP 16A32-MJ	100 TQFP V.32 Intfc.	48 TQFP CSP1027			+C = Cellular
HSM192PD+C3	19,200	V.32 bis – MJ Data/ FAX/Cellular	100 TQFP 16A32-MJ	100 TQFP V.32 Intfc.	48 TQFP CSP1027			+C = Cellular 3.3 V chip set
HSM288PD	28,800	V 34 – AC Data/FAX	100 TQFP 16345-AC	100 TQFP VALV 34			14SSOP 2560ABL	
HSM288PD+C	28,800	V.34 – AC Data/FAX/ Cellular	100 TQFP 16345-AC	100 TQFP VALV 34			14SSOP 2560ABL	+C = Cellular
HSM288PD+D	28,800	V.34 – AD Data/FAX/ DSVD	100 TQFP 16345-AD	100 TQFP VALV 34		100 TQFP CSP1635	14SSOP 2560ABL	<i>Catamaran</i> Data Pump

\*Chip Set Name – The letters D, L, P refer to the package option: D = desktop, L = laptop, P = PCMCIA

Note: Part numbers are not complete, please contact customer service for complete part numbers when placing orders

**Table 2. Data Pump Chip Sets; Features by Product Family**

Features	Product				
	HSM192xD	HSM192xD+C	HSM288xD	HSM288xD+C	HSM288xD+D
V.34 – 28.8			✓	✓	✓
V.32 Terbo and Fallback	✓	✓	✓	✓	✓
V.17 Fallback	✓	✓	✓	✓	✓
Voice thru' mode (μ-Law & A-Law)	✓	✓	✓	✓	✓
3.3 V chip set version available	✓	✓			
Cellular		✓		✓	
DSVD					✓
PLCC Package	x = D				
BQFP Package	x = L	x = L	x = D		x = D
TQFP Package	x = P	x = P	x = P	x = P	x = P

# DIGITAL SIGNAL PROCESSORS

## Complete Modem Chip Sets

A complete modem chip set is just what it says, it is a complete modem chip set for customers who do not have their own controller hardware and software. It contains a data pump plus a microcontroller, which when working together, in addition to pumping bits of data over a telephone line or cellular channel, can also perform error correction, data compression, and AT command processing. There are two form factors in the family of complete modem

chip sets, plus a special version of a complete modem chip set called the controllerless modem chip set. The family of complete chip sets consists of:

- Desktop complete modem chip sets (since this uses BQFP packaging, it satisfies the laptop needs as well)
- PCMCIA complete modem chip sets
- Controllerless modem chip sets

Desktop complete modem chip sets are low-cost solutions for stand-alone modems, desktop PC plug-in modems, integral desktop PC modems, laptop and notebook PCs, and pocket modems. They are available in BQFP packages. The PCMCIA complete modem chip sets are used in Type II PCMCIA plug-in modem cards where less board space is needed; they are supplied in TQFP packages. They are being used more increasingly in PC plug-in cards, laptop and notebook PCs, and pocket modems.

**Table 3. 16-bit Fixed Point High-Speed Modem – Complete Modem Chip Sets**

Chip Set Name*	Highest Speeds	Standard Features or Description	Controller	DSP
<b>Desktop</b>				
HSM288DC	28,800	V.34 – AC Data/FAX	100 BQFP. C882-29Q	100 BQFP 16345-AC
HSM288DC+Si	28,800	V.34 – AC Data/FAX/FDSP	100 BQFP C889-29Q	100 BQFP 16345-AC
HSM288DC+Vi	28,800	V.34 – AC TAM	100 BQFP C882-29Q	100 BQFP 16345-AC
HSM288DC+Se	28,800	V.34 – AC Data/FAX/FDSP	100 BQFP C882-29Q	100 BQFP 16345-AC
HSM288DC+Ve	28,800	V.34 – AC TAM	100 BQFP C882-29Q	100 BQFP 16345-AC
HSM288DC+D	28,800	V.34 – AD Data/FAX/DSVD	100 BQFP C882-29Q	100 BQFP 16345-AD
<b>PCMCIA</b>				
HSM288PC	28,800	V.34 – AC Data/FAX	100 VQFP C882-29V	100 TQFP 16345-AC
HSM288PC+C	28,800	V.34 – AC Data/FAX/Cellular	100 VQFP C882-29V	100 TQFP 16345-AC

## 16-bit Fixed Point High-Speed Modem – Controllerless Modem Chip Sets

Chip Set Name*	Highest Speeds	Standard Features or Description	DSP16
<b>Desktop</b>			
HSM192DW+S	19,200	V.32 bis – MS Data/ FAX/FDSP	84 PLCC 1632-MS
HSM288DW+S	28,800	V.34 – AC Data/ FAX/FDSP	100 QFP 16345-AC

\*Chip Set Name – The letters D, L, P refer to the package option: D = desktop, L = laptop, P = PCMCIA.

Note: Part numbers are not complete, please contact customer service for complete part numbers when placing orders.

Included in the family of complete modem chip sets are the controllerless modem chip sets. Though they are supplied without a controller, they still use the host processor (*Pentium* 486, 386, etc.) of the PC along with a software driver to perform traditional Microcontroller functions. Because the controllerless modem chip sets utilize a host CPU, they allow designers to achieve the lowest cost of bill of materials and reduce the power requirements, because the need for a microcontroller chip and its RAM and ROM are eliminated.

A controllerless modem chip set is targeted for PC internal cards which utilize a *Pentium*-based windows operating system.

Table 3 shows the AT&T complete modem sets that are available. The table includes the chip set name along with the highest speed it can operate at, and the packages and devices that constitute the chip set. For example, the HSM288PC+C can operate at 28.8 Kbits/s, has a controller in a TQFP called the C882, a DSP in a TQFP package called the 16345-AD, an interface chip in a

100TQFP called the VALV 34, an audio codec in a 100TQFP called the CSP1635, and optional bus interface device in a 48TQFP called the PID2, and an optional device which is an optical DAA in a 14-pin SSOP called the 2560ABL.

Table 4 offers a more in-depth view of the features available in each product family. For instance, the HSMzzzDW (controllerless 19.2 and 28.8 Kbits/s modem chip sets) do not support ETC, autosync, DSVD and TQFP packages.

Interface	Codec	Audio Codec	Optional Bus Interface Device	Optional Device	Comments
84 BQFP VALV 34					TAS (Controller)
84 BQFP VALV 34		28 SOJ T7525	PNP 100 MQFP		Half card (MTC) +S = FDSP, VV, TAM
84 BQFP VALV 34		28SOJ T7525	PNP 100 MQFP		+V = TAM
84 BQFP VALV 34		28SOJ T7525			Box modem, +S = FDSP, VV, TAM (MTC)
84 BQFP VALV 34		28SOJ T7525			+V = TAM (MTC)
84 BQFP VALV 34		100 BQFP CSP1635	PNP 100 MQFP		<i>Catamaran</i> TAS (Controller)
100 TQFP VALV 34			48 TQFP PID2	14SSOP 2560ABL	TAS (Controller)
100 TQFP VALV 34			48 TQFP PID2	14SSOP 2560ABL	+C = Cellular TAS (Controller)

Interface	Codec	Audio Codec	Comments
68 PLCC V.32 Intfc.	28 SOJ T7525	28 SOJ T7525	win32 +S = FDSP, VV, TAM (MTC)
84 QFP VALV 34		28 SOJ T7525	win34 +S = FDSP, VV, TAM (MTC)

# DIGITAL SIGNAL PROCESSORS

**Table 4. Complete Modem Chip Sets; Features by Product Family**

Features	Product					
	HSM288xC	HSM192xC+S	HSM288CxV	HSM288xC+C	HSM288xC+D	HSMzzzDW
V.34 – 28.8	✓	✓	✓	✓	✓	✓
V.32 Terbo and Fallback	✓	✓	✓	✓	✓	✓
V.42 Bis	✓	✓	✓	✓	✓	✓
<i>ETC™</i>				✓		
FAX Class 1	✓	✓	✓	✓	✓	✓
FAX Class 2	✓	✓	✓	✓	✓	✓
Auto Sync						
TAM		✓	✓			✓
FDSP		✓				✓
DSVD						
<i>VoiceView</i>		✓			✓	✓
Serial (external)	✓	✓	✓			
Parallel (internal)	✓	✓	✓		✓	✓
PCMCIA	✓			✓	✓	
PLCC Package						zzz = 192
BQFP Package	x = D	x = D	x = D		x = D	zzz = 288
TQFP Package	x = P			x = P		

# WIRELESS RF PRODUCTS

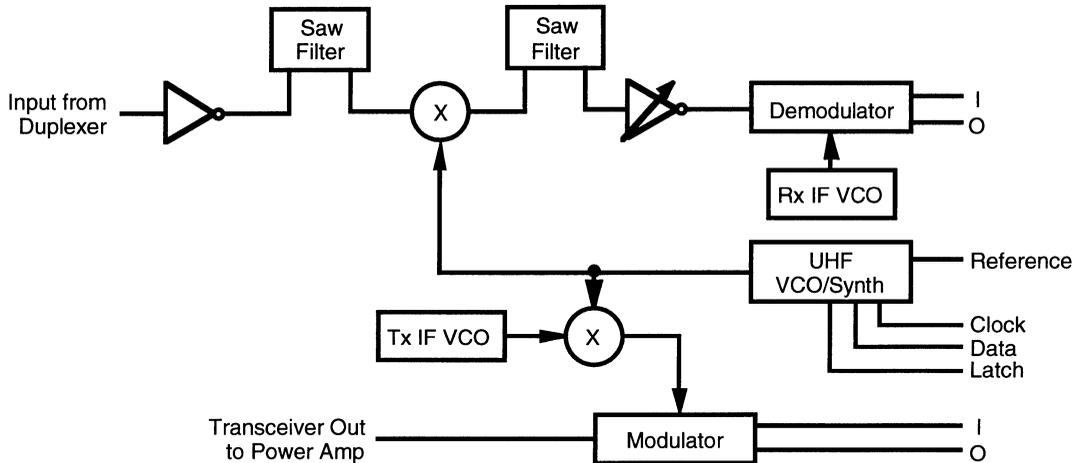
## Wireless RF Products

AT&T Microelectronics RF products are developed specifically for digital cellular and digital cordless applications, according to standards generated in the geographic region in which the application is primarily targeted. The following applications are presently being targeted:

- Global System for Mobile, with a GSM standard, for Europe.
- Personal Digital Cellular, with a RCR-27 (PDC) standard, for Japan.

- American Digital Cellular, with a IS136 (TDMA) standard, for the U.S.A.
- Japan Digital Cordless (Personal Handyphone), with a RCR-28 (PHS) standard, for Japan.

All AT&T Microelectronics RF products target the transceiver functionality of a radio system. A transceiver is comprised of three functions: receiver, modulator, and frequency synthesizer(s). A generic radio block diagram is shown below.



Product	Description	Target Application	Supply Voltage
W1452	45 MHz—86 MHz, IF Amplifier/Quadrature Demodulator	All	5 V
W2005	1 GHz, Dual-Mode Cellular Receiver	IS136	5 V
W2012	1.9 GHz, Indirect-up Quadrature Modulator	PHS	3 V
W2020	GSM Transceiver	GSM	3 V

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

## MPEG-2 System-Layer Demultiplexers

AT&T's single-chip MPEG-2 System-Layer Demultiplexer (MSLD) provides a standards-based easy-to-use solution for the design of systems for MPEG-2 applications.

### Applications

- Integrated receiver decoders (IRD); set-top box
  - Cable TV
  - Direct broadcast satellite (DBS)
  - Video-on-demand
  - Interactive TV
- Headend uplink facilities
- CD-ROM video entertainment solutions
- PC multimedia solutions
- Telephone network set-top box

AT&T's AV6220A MPEG-2 System-Layer Demultiplexer (MSLD) provides users with efficient, cost-effective MPEG-2 transport layer demultiplexing. This device complies with the MPEG-2 and DVB

specifications and provides a comprehensive feature set. It demultiplexes transport stream (TS) packets into packetized elementary streams (PES), elementary streams (ES), PSI, SI, systems, and private data.

The AV6220A works seamlessly with multiple MPEG-2 video, audio, and combined video/audio decoders, as well as a variety of processors. It accepts either serial or byte wide TS inputs and may also receive TS data through the host interface for CD-ROM applications. The MSLD provides clock recovery for the system 27 MHz clock and assists in the synchronization of video and audio streams.

The AV6220A is available in a low-cost, 160-pin plastic metric quad flat pack (MQFP) and uses advanced 0.55  $\mu\text{m}$ , 5.0 V, CMOS Technology that provides low power consumption of less than 1 W.

### Features

- DVB, MPEG-2 standard compliant
  - 32 PIDs and 8 service information filters
  - Compatible with DVB and other conditional access interfaces
- High performance
  - Supports high transport rate of 96 Mbits/s
  - Allows flexible algorithm and system configuration
  - Off-loads the processor and allows better bandwidth
- Cost-effective solution
  - Eliminates the need for micro-code development
  - Achieves small chip area and low power
  - Allows easy configuration by users

Part Number	Description	Package Type	Temp. Ranges	Literature
AV6220A	MPEG-2 System-Layer Demultiplexer	160-pin PQFP	0 °C to +70 °C	PN,DS

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

## CMOS STANDARD-CELL ASICs

AT&T has an uncommon mix of products, technology, and support to provide powerful, cost-effective ASIC solutions in silicon. We've extended the possibilities of ASICs with higher densities, increased speed capabilities, and lower power consumption. Our rich selection of libraries and design tools make design easier, faster, and more reliable. Our ASIC libraries are comprehensive, allowing you to optimize your design and provide efficient, cost-effective functionality.

### Design Flexibility and Library Richness

AT&T's product focus provides you with a rich set of library elements that range from simple logic functions to complex digital and analog macrocells. AT&T's libraries are optimized to take advantage of today's sophisticated design and test methodologies, such as behavioral modeling/synthesis, and full and partial scan insertion. AT&T provides ASIC design kits for many popular commercial CAD platform options including: *Mentor Graphics*, *Verilog*, *Viewlogic*, *IKOS*, *Synopsys*, *Quad Motive*, *HSPICE*, *Sunrise*, and *ZyCAD*.

We have a broad selection of flip-flops, registers, and adders, as well as full memory compilers. Our macrocells offer you system-level integration of microprocessors, DSPs, and peripheral and communications controllers. These building blocks can dramatically slash design time by giving you ready-made solutions to your specific needs. Our extensive expertise in mixed analog/digital designs makes our ASICs the ideal solution for data recovery, data acquisition, and clock skew/synchronization.

Today's performance-driven designs demand both high speeds and low power consumption—without the tradeoffs associated with achieving one at the expense of the other. AT&T offers high performance in 2.5 V, 3 V, and 5 V libraries to meet these demands.

### Integrated Capability

AT&T is your source for global ASIC solutions. We have design centers and manufacturing facilities located worldwide. This gives you a full multiple-source approach for flexible manufacture from a single vendor. And because we are an inte-

grated manufacturer from silicon material through wafer fabrication and final device assembly/test, we maintain full and rigorous control over every step of the process. With AT&T, you have a clear path from concept to production and from today's state of the art to tomorrow's.

### 0.35 $\mu$ m CMOS Standard-Cell ASIC Libraries

ASIC Libraries	HL350C	HS350C	LV350C <sup>1</sup>
Process Technology	0.35 $\mu$ m 3 V CMOS	0.35 $\mu$ m 3 V CMOS	0.35 $\mu$ m 3 V CMOS
Operating Voltages	2.7 V—3.6 V	4.5 V—5.5 V	2.3 V—2.7 V
Leff	0.32 $\mu$ m	0.46 $\mu$ m	0.32 $\mu$ m
TOX	65 Å	115 Å	50 Å
Metal Interconnect Levels	3—4 <sup>2</sup>	3—4 <sup>2</sup>	3—4 <sup>2</sup>
Usable Gates	2.5 M	2.5 M	2.5 M
Compilable Memory			
SRAM	1 Mbit	1 Mbit	1 Mbit
ROM	4 Mbits	4 Mbits	4 Mbits
Gate Speed (Internal, Typical, Unloaded)	54 ps	78 ps	59 ps
Max. Toggle Rate	940 MHz	755 MHz	850 MHz
ASIC & EDA Benchmark <sup>3</sup>			
Benchmark #1 (Path Delay)	5.00 ns	5.78 ns	5.50 ns
Benchmark #2 (Counter Max. Freq.)	860 MHz	755 MHz	775 MHz
Power ( $\mu$ W/MHz/Gate, FO = 1)	0.8	1.7	0.5
Buffer Drive	40 mA	40 mA	40 mA
I/O Interfaces	TTL/CMOS 3 V/5 V <sup>4</sup> PCI SCSI PECL Bal. CMOS GTL/HSTL/LVDS	TTL/CMOS 3 V/5 V <sup>5</sup> PCI SCSI PECL Bal. CMOS GTL/HSTL/LVDS	TTL/CMOS 2.5 V/3 V <sup>6</sup> PCI SCSI PECL Bal. CMOS GTL/HSTL/LVDS
I/O Capability			
QFP	304	304	304
E-PBGA	640	640	640
Flip-chip PBGA	>700	>700	>700
Pad Pitch	<3 mil	<3 mil	<3 mil

1. Planned 1996 introduction, preliminary information.

2. Flip-chip, DRAM applications.

3. Worst-case slow process, temperature, voltage

4. 3 V technology with 5 V tolerant I/O capability.

5. 5 V technology with 3 V tolerant I/O capability.

6. 2.5 V technology with 3 V tolerant I/O capability.

## CMOS STANDARD-CELL ASICs

### 0.5 $\mu\text{m}$ —0.9 $\mu\text{m}$ CMOS Standard-Cell ASIC Libraries

ASIC Libraries	HL400C HL400P <sup>1</sup>	HS500C HS500P <sup>2</sup>	HS600C	LP600C	HS900C
Process Technology	0.5 $\mu\text{m}$ CMOS	0.5 $\mu\text{m}$ CMOS	0.6 $\mu\text{m}$ CMOS	0.6 $\mu\text{m}$ CMOS	0.9 $\mu\text{m}$ CMOS
Operating Voltages	2.7 V—3.6 V	4.5 V—5.5 V	2.7 V—5.5 V	4.5 V—5.5 V	2.7 V—5.5 V
Metal Interconnect Levels	3	3	2	2	2
Total Gates	>500K	>500K	150K	>150K	150K
Gate Speed (Internal, Typical, Unloaded)	90 ps	90 ps	120 ps	180 ps	150 ps
Max. Toggle Rate	600 MHz	650 MHz	470 MHz	285 MHz	350 MHz
ASIC & EDA 1994 Benchmark <sup>2</sup>					
Benchmark #1 (Path Delay)	6.34 ns	6.11 ns	9.27 ns	15.38 ns	12.41 ns
Benchmark #2 (Counter Max. Freq.)	580 MHz	650 MHz	470 MHz	260 MHz	350 MHz
Power ( $\mu\text{W}/\text{MHz}/\text{Gate}$ , FO = 1)	0.8	1.7	3.5	1.5	3.3
Buffer Drive	40 mA	64 mA	64 mA	64 mA	64 mA
I/O Capability	TTL/CMOS 3 V/5 V <sup>3</sup> PCI SCSI PECL Bal. CMOS GTL/HSTL	TTL/CMOS 5 V PCI SCSI PECL Bal. CMOS	TTL/CMOS 3 V/5 V PCI SCSI PECL Bal. CMOS GTL	TTL/CMOS 3 V/5 V PCI SCSI Bal. CMOS	TTL/CMOS 3 V/5 V PCI SCSI PECL Bal. CMOS
Pad Pitch	<4 mil	<4 mil	4—5 mil	4—5 mil	5 mil
Compatible Memory					
SRAM	700 kbits	700 kbits	250 kbits	250 kbits	250 kbits
ROM	2.8 Mbits	2.8 Mbits	1 Mbit	1 Mbit	1 Mbit

1 Metal programmable option.

2 Worst-case slow process, temperature, voltage.

3 3 V technology with 5 V tolerant I/O capability.

<b>Name</b>	<b>Description</b>
<b>Digital ASIC Macrocells</b>	
196KC/KB	16-bit Microcontroller
80C31/32/51/52	8-bit Microcontroller
960JX	Embedded 32-bit Risc Processor
Z80	8-bit Microprocessor
C10/15	16-bit Fixed-point DSP
C25	16-bit Fixed-point DSP
C2XLP	16-bit Fixed-point DSP
C5X	16-bit Fixed-point DSP
16C450	Universal Asynchronous Receiver/Transmitter (UART)
16C550A	Universal Asynchronous Receiver/Transmitter (UART)
85C30	Serial Communications Controller
53C94/95/96	SCSI Bus Controller
61602*	LCD Controller
83C90	AT&T Controller for Ethernet (ACE)
74LS612	Memory Mapper
82077*	Floppy Disk Controller
82365	PCMCIA Host Controller
146818A	Real-time Clock
82C37A	Programmable DMA Controller
82C54	Programmable Interval Timer
82C55A	Programmable Peripheral Interface
82C59A	Programmable Interrupt Controller
7186*	Video Scaler
PCIU	PCMCIA Card Interface Unit
PCI	Bus Interface
MPEG-1*	Video/Audio Decoder
T7901*	Single-Port ISDN Transceiver
<b>Analog ASIC Macrocells</b>	
FADC [5:8]	Flash Analog-to-Digital Converters (ADC) with Resolution of 5 to 8 Bits
F2ADC8	2-Step Flash ADC with 8-bit Resolution
SAR8	Successive Approximation ADC with 8-bit Resolution
SAR10	Successive Approximation ADC with 10-bit Resolution
SAR12*	Successive Approximation ADC with 12-bit Resolution
RDAC [5:8]	Resistor Ladder Digital-to-Analog Converters (ADC) with Resolution of 5 to 8 Bits
RDAC10	10-bit Resistor Ladder DAC
RDAC12*	12-bit Resistor Ladder DAC
IDAC8	8-bit Current (Video) DAC
IDAC10*	10-bit Current (Video) DAC
PLL	Phase-locked Loops with Output Frequencies to 1X, 2X, and 4X the Input Frequency
FREQSYNTH	Frequency Synthesizers

\* Planned development.

# FIELD-PROGRAMMABLE GATE ARRAYS

## ATT3000 Series Field-Programmable Gate Arrays (FPGAs)

### Description

The high-speed ATT3000 Series of FPGAs provides the benefits of high-speed, high-density, digital logic while avoiding the NRE, time delay, and risk of traditional masked gate arrays. The series is pin-for-pin and specification compatible with the *Xilinx XC3100* family and the *Xilinx XC3000* family.

The ATT3000 Series FPGAs are supported by the *ORCA™* Foundry Development System, which provides automatic place-and-route of netlists from user-created schematics or text-based design entry tools.

The ATT3000 regular, flexible, reprogrammable array architecture is composed of a configuration program store with three types of configurable or programmable elements: a perimeter of input/output blocks (IOBs), a core array of

configurable logic blocks (CLBs), and routing resources for interconnection.

The CLB implements logic functions by using programmed look-up tables (LUTs). Functional options are implemented by user-programmable multiplexers. Interconnecting networks are implemented with metal routing lines joined by user-programmable pass transistors. Registers or flip-flops are found in CLBs and IOBs.

The devices are customized by a configuration program stored in internal SRAM-based memory cells. The program data resides externally from the FPGAs in an EEPROM, EPROM, or ROM on the circuit board, or on a floppy or hard disk.

### Features

- High performance:
  - Up to 270 MHz toggle rates
  - 4-input LUT delays < 3 ns

- Flexible array architecture:
  - 2000 to 9000 gate logic complexity
  - Extensive register and I/O capabilities
  - Low-skew clock nets
  - High fan-out signal distribution
  - Internal 3-state bus capabilities
  - TTL or CMOS input thresholds
  - On-chip oscillator amplifier
- Standard product availability:
  - Low-power 0.6 μm CMOS technology
  - Pin-for-pin compatible with *Xilinx XC3000* and *XC3100* family
  - Cost-effective, high-speed FPGAs
  - 100% factory pretested
  - Selectable configuration modes
- *ORCA* Foundry for ATT3000 Development System support
- All FPGAs processed on a QML-certified line

## ATT3000 Series FPGAs

FPGA	Logic Capacity (Available Gates)	Configurable Logic Blocks	User I/Os	Program Data (Bits)
ATT3020	2000	64	64	14779
ATT3030	3000	100	80	22176
ATT3042	4200	144	96	30784
ATT3064	6400	224	120	46064
ATT3090	9000	320	144	64160

## Comparison Table

Series	Equivalent <i>Xilinx</i> Family	Speed Grade	LUT Delay (ns)	Toggle Rate (MHz)
ATT3000	<i>XC3100</i>	-3	2.7	270
		-4	3.3	230
		-5	4.1	190
ATT3000	<i>XC3000</i>	-125	5.5	125
		-100	7.0	100
		-70	9.0	70

## ATT3000 Series FPGA Device Matrix

Device & Speed	44-pin	68-pin	84-pin	100-pin		132-pin	144-pin	160-pin	175-pin	208-pin	Lit.
	PLCC	PLCC	PLCC	QFP	TQFP	Plast. PGA	TQFP	QFP	Plast. PGA	Plast. SQFP	
	M44	M68	M84	J100	T100	H132	T144	J160	H175	Q208	
ATT3020											
-70, -100, -125	—	CI	CI	CI	—	—	—	—	—	—	DS
-5	—	CI	CI	CI	—	—	—	—	—	—	DS
-4, -3	—	C	C	C	—	—	—	—	—	—	DS
ATT3030											
-70, -100, -125	CI	CI	CI	CI	CI	—	—	—	—	—	DS
-5	CI	CI	CI	CI	CI	—	—	—	—	—	DS
-4, -3	C	C	C	C	C	—	—	—	—	—	DS
ATT3042											
-70, -100, -125	—	—	CI	CI	CI	CI	CI	—	—	—	DS
-5	—	—	CI	CI	CI	CI	CI	—	—	—	DS
-4, -3	—	—	C	C	C	C	C	—	—	—	DS
ATT3064											
-70, -100, -125	—	—	CI	—	CI	CI	CI	CI	—	—	DS
-5	—	—	CI	—	CI	CI	CI	CI	—	—	DS
-4, -3	—	—	C	—	C	C	C	C	—	—	DS
ATT3090											
-70, -100, -125	—	—	CI	—	—	—	—	CI	CI	CI	DS
-5	—	—	CI	—	—	—	—	CI	CI	CI	DS
-4, -3	—	—	C	—	—	—	—	C	C	C	DS

Key: C = commercial temperature option, I = industrial temperature option.

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

### AT&T Optimized Reconfigurable Cell Array (ORCA) Series FPGAs

#### Description

The AT&T Optimized Reconfigurable Cell Array (ORCA) series of SRAM-based field-programmable gate arrays (FPGAs) from AT&T Microelectronics provides a family of high-performance, high-density, low-power, user-programmable logic circuits.

The ORCA architecture is comprised of two major programmable blocks: programmable I/O cells (PICs) and programmable logic cells (PLCs) organized in a homogeneous array structure. These programmable cells are interconnected by abundant routing resources, which are placed symmetrically within the device.

#### Programmable Logic Cells

A PLC consists of a programmable function unit (PFU) and programmable routing resources. The PFU has a look-up table (LUT) section and a latch section. The 64-bit (four 16 x 1) LUT is used for the combinatorial logic of a design. The four latches implement the sequential logic in a design. These latches can be programmed to be active on either level, or they can be used as flip-flops.

The LUTs can also be programmed to operate in one of three modes: combinatorial, ripple, or memory. In combinatorial mode, the LUTs can be programmed to realize any 4-, 5-, or 6-input logic functions. In ripple mode, the high-speed carry logic is used for arithmetic circuits. In memory mode, the LUTs can be used as two 16 x 2 or a 16 x 4 read/write or read-only memory.

The programmable routing resources within each PLC are made from metal segments called routing nodes (R-nodes) connected together at configurable interconnect points (CIPs) to form user-defined nets.

#### Programmable I/O Cells

PICs are located along the perimeter of the device. Each PIC is comprised of I/O drivers, I/O pads, and routing resources. Each PIC can be programmed to be an input, output, or both; to have either TTL or CMOS input thresholds; or to have the input signal delayed. Other options include variable output slew rates; output current drive capabilities; 3-state output (either active-high or active-low); inverting the output, if desired; and/or floating (unused) pins using pull-up or pull-down resistors.

## FIELD-PROGRAMMABLE GATE ARRAYS

### Features

- High-performance, cost-effective 0.5  $\mu\text{m}$  technology (4-input look-up table delay less than 3.6 ns)
- High density (up to 40,000 usable gates)
- Up to 480 user I/Os
- Fast on-chip user SRAM; 64 bits/logic block
- Nibble-oriented architecture for implementing 4-, 8-, 16-, 32-bit (or wider) bus structures
- Innovative, abundant, and hierarchical nibble-oriented routing resources that allow automatic use of internal gates for all device densities without sacrificing performance
- Four 16-bit look-up tables and four latches/flip-flops per PLC
- Internal fast carry for arithmetic functions
- TTL or CMOS input thresholds programmable per pin
- Individually programmable drive capability: 12 mA sink/6 mA source or 6 mA sink/3 mA source
- Built-in boundary scan (*IEEE 1149.1*)
- Low power consumption from submicron CMOS process
- Full PCI-bus compliance
- Supported by industry-standard CAE tools for design entry, synthesis, and simulation
- *ORCA* Foundry Development System

### ORCA Series FPGAs – Product Matrix

Part Number	Usable Gates	Registers	Max User RAM Bits	User I/Os	Array Size	Literature
ATT2C04	3,500—4,300	400	6,400	160	10 x 10	DS, MN
ATT2C06	5,000—6,200	576	9,216	192	12 x 12	DS, MN
ATT2C08	7,000—8,800	784	12,544	224	14 x 14	DS, MN
ATT2C10	9,000—11,400	1024	16,384	256	16 x 16	DS, MN
ATT2C12	12,000—14,600	1296	20,736	288	18 x 18	DS, MN
ATT2C15	15,000—18,000	1600	25,600	320	20 x 20	DS, MN
ATT2C26	22,000—26,000	2304	36,864	384	24 x 24	DS, MN
ATT2C40	35,000—40,000	3600	57,600	480	30 x 30	DS, MN

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

### ORCA Series FPGA – Product Matrix

Device	84-pin	100-pin	144-pin	160-pin	208-pin	240-pin	256-pin	304-pin	364-pin	428-pin	Lit.
	PLCC	TQFP	TQFP	QFP	EIAJ SQFP	EIAJ SQFP	Ball Grid Array	EIAJ SQFP	Cer. PGA	Cer. PGA	
	M84	T100	T144	J160	S208 PS208	S240 PS240	B256	S304 PS304	R364	R429	
ATT2C04	CI	CI	CI	CI	CI	—	—	—	—	—	DS
ATT2C06	CI	CI	CI	CI	CI	CI	—	—	—	—	DS
ATT2C08	CI	—	—	CI	CI	CI	CI	CI	—	—	DS
ATT2C10	CI	—	—	CI	CI	CI	CI	CI	—	—	DS
ATT2C12	—	—	—	—	CI	CI	CI	CI	CI	—	DS
ATT2C15	—	—	—	—	CI	CI	—	CI	CI	—	DS
ATT2C26	—	—	—	—	CI	CI	—	CI	—	CI	DS
ATT2C40	—	—	—	—	CI	CI	—	CI	—	CI	DS

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

Key: C = commercial, I = industrial.

Note: The package options with the SQFP/SQFP-PQ2 designation in the table above, use the SQFP package for all densities up to and including the ATT2C15, while the ATT2C26 and ATT2C40 use the SQFP-PQ2 package.

## Optimized Reconfigurable Cell Array (ORCA) ATT2T15 (3.3 V) Field-Programmable Gate Array

The ATT2T15 is the first device in this family optimized to provide logic solutions in 3.3 V systems. This device contains approximately 15,000—18,000 usable gates and is offered in a variety of packages, speed grades, and temperature ranges.

The ORCA series FPGA consists of two basic elements: programmable logic cells (PLCs) and programmable input/output cells (PICs). An array of programmable logic cells (PLCs) is surrounded by programmable input/output cells (PICs). Each PLC contains a programmable function unit (PFU). The PLCs and PICs also contain routing resources and configuration RAM. All logic is done in the PFU. Each PFU contains four 16-bit look-up tables (LUTs) and four latches/flip-flops (FFs).

The LUTs can be programmed to operate in one of three modes: combinatorial, ripple, or memory. In combinatorial mode, the LUTs can be programmed to realize any 4, 5, or 6 input logic functions. In ripple mode, the high-speed carry logic is used for arithmetic functions. In memory mode, the LUTs can be used as a 16 x 4 read/write or read-only memory.

The PLC architecture provides a balanced mix of logic and routing that allows a higher utilized gate/PFU than alternative architectures. The routing resources carry logic signals between PFUs and I/O pads. The routing in the PLC is symmetrical about the horizontal and vertical axes. This improves routability by allowing a signal to be routed into the PLC from any direction.

Each PIC is comprised of I/O drivers, I/O pads, and routing resources. Each I/O can be programmed to be either an input, output, or bidirectional signal. The ATT2T15 is also capable of interfacing to 5 V devices because the I/O pads can be driven by signals of up to 6 V. Other options include variable output slew rates and pull-up or pull-down resistors.

The ORCA Foundry Development System is used to process a design from a netlist to a configured FPGA. AT&T provides interfaces and libraries to popular CAE tools for design entry and simulation.

The FPGA's functionality is determined by internal configuration RAM. The FPGA's internal initialization/configuration circuitry loads the configuration data at powerup or under system control. The RAM is loaded by using one of several configuration modes. The configuration data resides externally in an EEPROM, EPROM, or ROM on the circuit board, or any other storage media. Serial ROMs provide a simple, low pin count method for configuring FPGAs.

## Features

- High-performance, cost-effective 0.5  $\mu\text{m}$  technology optimized for 3.3 V operation
- 5 V-tolerant I/O buffers can be connected to external signals up to 6 V, allowing interconnection to both 3.3 V and 5 V devices (selectable on a per-pin basis)
- High density (15,000 usable gates)
- 308 user I/Os (all 5 V-tolerant)
- 1600 latches/flip-flops
- Maximum 25,600 user RAM bits
- Fast on-chip user SRAM: 64 bits/logic block
- Nibble-oriented architecture for implementing 4-, 8-, 16-, 32-bit, or wider bus structures
- Innovative, abundant, and hierarchical nibble-oriented routing resources that allow automatic use of internal gates for all device densities without sacrificing performance
- Four 16-bit look-up tables and four latches/flip-flops per logic block
- Internal fast carry for arithmetic functions
- Individually programmable drive capability: 12 mA sink/6 mA source or 6 mA sink/3 mA source
- Built-in boundary scan (IEEE 1149.1)
- Low power consumption from submicron CMOS process optimized for 3.3 V operation
- Architecture-compatible to the ORCA 2C series of 5 V devices
- Supported by industry-standard CAE tools for design entry, synthesis, and simulation
- ORCA Foundry Development System support

# FIELD-PROGRAMMABLE GATE ARRAYS

## ORCA Foundry Development System

FPGA devices are growing in size and complexity—straining the capabilities of both designers and early-generation tool sets. High-performance tools are critical to realizing the full potential of today's larger, more complicated devices. Such tools not only significantly shorten your design cycles, but also produce chip designs with higher device utilization and faster operating frequencies. *ORCA Foundry* is such a tool set.

### Capture, Mapping, and Optimization

*ORCA Foundry* allows designs to be captured using device-specific libraries, vendor-independent libraries, or a combination of both. No other design tool set lets you designate the specific design capture method that best supports your requirements. As a result, vendor-independent libraries and industry-standard netlists can be easily implemented in either *ORCA* or ATT3000 devices.

*ORCA Foundry's* device- and architecture-specific optimization, combined with superior place and route capabilities, produces consistently high gate utilization. Of course, *ORCA Foundry* fully supports device-specific features, such as hard macros, RAM, and automatic routing of clocks.

With complete back-annotation, incremental mapping, and the ability to preserve hierarchy throughout the design process, *ORCA Foundry* gives you as much help in updating and debugging your design as it does in implementing it.

### Advanced Place and Route Capabilities (PAR)

Using the most powerful combination of algorithms available, *ORCA Foundry's* place and route (PAR) program consistently completes designs with the fewest iterations and

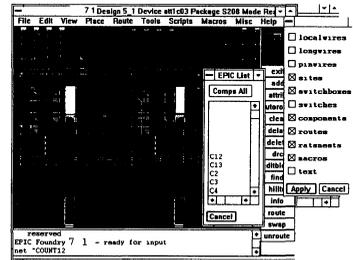
with no manual intervention. PAR's fast execution time and built-in incremental change capability result in the shortest possible design cycle.

With the addition of *ORCA Foundry's* AT&T *Timing Wizard* module, designers can specify frequency and timing requirements up front. AT&T *Timing Wizard* then drives PAR to meet those requirements, delivering higher-performance devices with the fastest possible operating frequencies while shortening design cycles even further.

### Powerful Interactive Layout Editor (EPIC)

The AT&T Editor for Programmable ICs (AT&T EPIC) is a powerful, interactive layout editor found in *ORCA Foundry* that streamlines the debugging and tuning of FPGA designs. AT&T EPIC's easy-to-use graphical interface provides a choice of push button, menu-driven, or command-line editing capabilities that can be customized to suit any set of requirements. In addition, AT&T EPIC has been tuned to guarantee the fastest graphics response, eliminating the unproductive waiting while a large design is panning, zooming, or simply highlighting a net.

Many advanced features have been designed into AT&T EPIC to make working with complex devices easier. Among these are manual placement and routing, auto placement, auto routing, and integration of *ORCA Foundry's* powerful timing analyzer. AT&T EPIC's on-line design rule checks (DRC) can be used in logical mode (allowing changes to placement and routing, but preventing any changes to the logic during the editing session) or in physical mode (allowing logic and signals to be added and deleted while guaranteeing that changes are valid within the physical constraints of the specified FPGA).

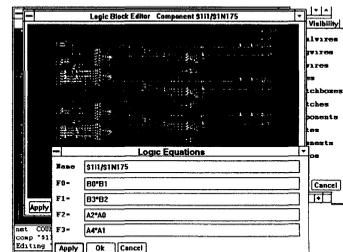


*ORCA Foundry's* powerful editing and debugging environment, AT&T EPIC, also features tracking of hierarchical design data...

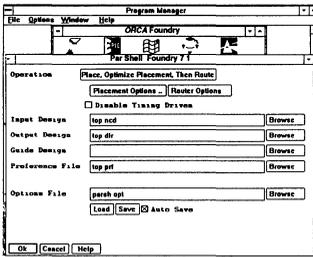
### FPGA-Specific Timing Analyzer (TRACE)

AT&T TRACE provides complete analysis of a circuit's timing characteristics. Using actual component and interconnect delays, AT&T TRACE exhaustively examines every signal path and automatically evaluates the circuit for set up and hold violations, race conditions, and adherence to specified timing preferences.

AT&T TRACE runs its analysis using user-specified timing preferences (such as desired operating frequency) and feeds back detailed results that identify specifically where the design fails to meet those requirements, thereby eliminating the need to read through reams of paper to pinpoint potential timing problems.



*ORCA Foundry's* capabilities enable a designer to use all device-specific features.



Using industry standards, *ORCA Foundry* allows a designer to take full advantage of powerful *Windows* applications.

### Supports Industry-Standard Platforms

#### PC-Based:

- IBM PC or compatible 486SX, 486, or Pentium
- MS-DOS 5.0 (or higher)
- Microsoft Windows 3.1 (or higher)
- RAM: 16 Mbytes minimum
- Disk: 30 Mbytes for first family, 10 Mbytes for each additional family
- Swap: 5 Mbytes permanent *Microsoft Windows* swap file
- Color VGA
- 2- or 3-button *Microsoft Windows* compatible mouse
- One parallel port for security device

#### Workstation-Based:

- Sun SPARCstation compatible running SunOS 4.1.3 (or higher) or running Solaris 5.3 (or higher)
- HP 9000 Series 400/700 running HP-UX 9.0.3 (or higher)
- X-*Windows* version X11R4 (or higher) and OSF/MOTIF 1.1
- RAM: 32 Mbytes
- Disk: 45 Mbytes for first family, 10 Mbytes for each additional family
- Swap: 32 Mbytes
- Color monitor
- 3-button mouse
- One serial port for security device

### Features

- Complete, fully integrated tool set
- Supports *ORCA* 1C, 2C, 2T, and ATT3000 Series FPGAs
- Integrates into existing CAE environments
- True timing- and frequency-driven design
- Performs device-specific optimization and technology mapping
- Performs both automatic and manual place and route

- Performs static timing analysis
- Allows for back-annotated timing simulation

### ORCA Foundry Benefits

- Automatic completion of difficult designs
- Maximum device utilization
- Faster clock speeds
- Ease of use means fast time-to-market benefits

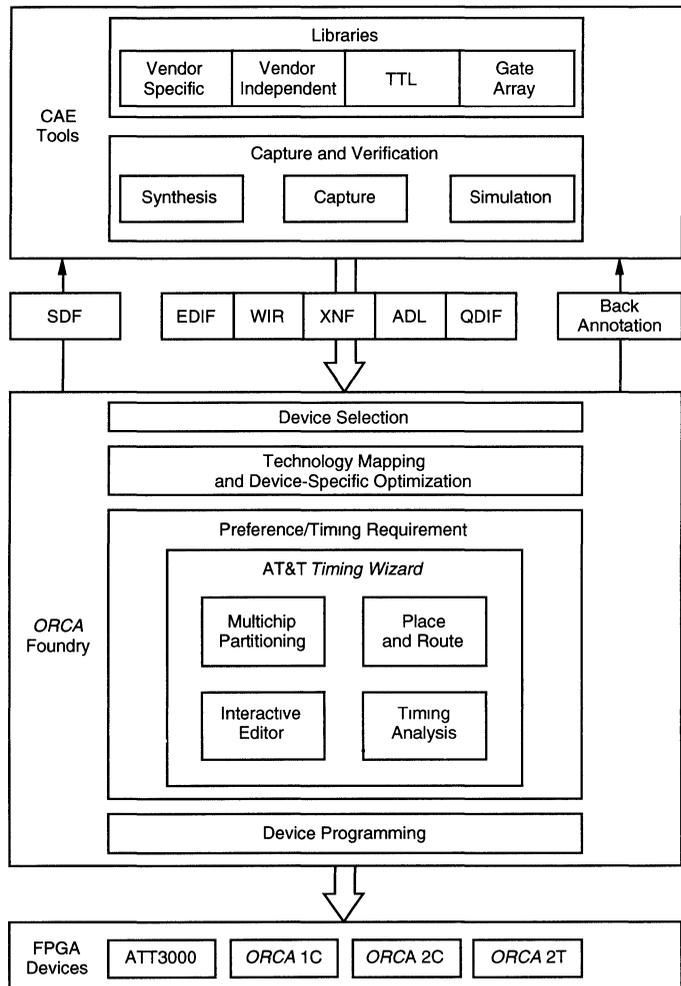


Figure 1. ORCA Foundry Environment

# FIELD-PROGRAMMABLE GATE ARRAYS

## Development Systems for ORCA Series FPGAs

Part Number	Version	Description
<b>ORCA Foundry Software Licenses</b>		
<b>PC Solutions:</b>		
ATT-ORCAVISTA-PC	7.1	Low-density starter system for AT&T FPGAs. Supports ATT3000, ATT1Cxx, ATT2C04, ATT2C06, ATT2C08, and ATT2C10 devices. Includes AT&T <i>Timing Wizard</i> and choice of CAE Vendor Kits.
ATT-ORCAAPEX-PC	7.1	Complete support package for all ATT3000 and all ORCA 1Cxx and 2Cxx FPGAs. Includes AT&T <i>Timing Wizard</i> and choice of one CAE Vendor Kits.
ATT-ORCAEVAL-PC	7.1	Evaluation version of complete software suite. No bit stream generation capability or download cable.
ATT-ORCAVISAP-PC	7.1	Upgrade Vista package to Apex package.
<b>Workstation Solutions (Sun and HP700):</b>		
ATT-ORCAVISTA-WS	7.1	Low-density starter system for AT&T FPGAs. Supports ATT3000, ATT1Cxx, ATT2C04, ATT2C06, ATT2C08, and ATT2C10 devices. Includes AT&T <i>Timing Wizard</i> and choice of CAE Vendor Kits.
ATT-ORCAAPEX-WS	7.1	Complete support package for all ATT3000 and all ORCA 1Cxx and 2Cxx FPGAs. Includes AT&T <i>Timing Wizard</i> and choice of one CAE Vendor Kits.
ATT-ORCAEVAL-WS	7.1	Evaluation version of complete software suite. No bit stream generation capability or download cable.
ATT-ORCAVISAP-WS	7.1	Upgrade Vista package to Apex package.
<b>PC Solutions</b>		
ATT-PROCAPTURE-PC	6.1	<i>VIEWlogic PROSeries</i> Schematic Capture (DOS/Windows).
ATT-PROSIM-PC	6.1	<i>VIEWlogic PROSeries</i> non-VHDL Simulation. <i>PROWave</i> and <i>PROGen</i> for simulation through ATT2C26. Requires ATT-PROCAPTURE-PC.
ATT-PROSIMHD-PC	6.1	<i>VIEWlogic PROSeries</i> non-VHDL unlimited gates simulation upgrade. Requires ATT-PROSIM-PC.
<b>Workstation Solutions (SPARC only)</b>		
ATT-PCDESIGN-SN	5.3.2	<i>VIEWlogic</i> Powerview Series non-VHDL <i>ViewDraw</i> schematic capture and <i>ViewSim</i> simulation through ATT2C26, including <i>ViewWave</i> and <i>ViewGen</i> .
ATT-PVDESIGNHD-SN	5.3.2	<i>VIEWlogic</i> Powerview Series non-VHDL unlimited gates simulation upgrade. Requires ATT-PVDESIGN-SN.
<b>ORCA Software Libraries (PC)</b>		
See Note Below	3.1	<i>VIEWlogic</i> schematic entry, synthesis, prelayout simulation library, and interface. Required when using ATT-PROCAPTURE-PC for schematic entry, <i>PROSyn</i> (available from <i>VIEWlogic</i> ) for synthesis, or ATT-PROSIM-PC for prelayout unit delay simulation or for postlayout back-annotated timing simulation.

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

Note: The ORCA libraries for *Synopsys* and *VIEWlogic* are included on the ORCA Foundry 7.1 CD

## Development Systems for ORCA Series FPGAs (continued)

Part Number	Version	Description
<b>ORCA Software Libraries (Sun/HP)</b>		
See Note Below	3.1	<i>VIEWlogic</i> schematic entry, synthesis, prelayout simulation library, and interface. Required when using ATT-PVDESIGN-SN (or the <i>HP</i> equivalent available from <i>VIEWlogic</i> ) for schematic entry, prelayout unit delay simulation, postlayout back-annotated timing simulation, or <i>VIEWSyn</i> (available from <i>VIEWlogic</i> ) for synthesis.
ATT-LIBVRG-WS	3.0	Interface and library for <i>Verilog</i> . Required when performing prelayout simulation using <i>Verilog</i> after performing <i>ORCA</i> -specific synthesis or when performing postlayout timing simulation using <i>Verilog</i> .
ATT-LIBMN-WS	3.0	Interface and library for <i>Mentor Graphics</i> . Required when using Design Architect for schematic capture or <i>QuickSim II</i> for prelayout unit delay simulation or for postlayout back-annotated timing simulation.
ATT-LIBDA-WS	3.1	ATT-Design Automation interface and library. Required when using either ATT-Schema for schematic capture or ATTSIM for prelayout unit delay simulation or for postlayout back-annotated timing simulation.
See Note Below	3.1	High-level design link, interface, and synthesis library for <i>Synopsys</i> .
<i>MOTIVE</i> Libraries	None	<i>MOTIVE</i> Integration kit (available from Quad Design Technologies Group of Viewlogic, Inc.)
LMG Libraries	None	LMG Models (available from the Logic Modeling Group of <i>Synopsys</i> , Inc.)

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447

Note: The *ORCA* libraries for *Synopsys* and *VIEWlogic* are included on the *ORCA* Foundry 7 1 CD

## Intelligent Ethernet Hub Products

The T7202 Smart Hub Controller (SHC) and T7241 Multiple Ethernet Transmitter (METRX) represent AT&T's third-generation multiport repeater controller ICs for use in *IEEE* 802.3 10Base-T networks. The chip set provides a two-chip solution for implementation of a central network hub with extensive network management capabilities. This chip set also provides a low-cost, easy-to-design, feature-rich solution for PC-based 10Base-T repeaters.

### Features

- High level of integration
  - Twelve 10Base-T ports
  - Two AUI ports
  - Dedicated MAC port
  - Dedicated expansion port
  - Security
- Preprocessed network management statistics
- Per-port statistics
- Per-port collision counters
- Dedicated management report FIFO

### Benefits

- Reduce system cost and improve reliability
- Address size-sensitive markets such as PC hubs
- Provide superior system performance
- Provide superior network management features in your system

Part No.	Description	Package Type	Temp. Ranges	Applications	Literature
T7202	Smart Hub Controller	132-pin PQF	0 °C to +70 °C	TP Ethernet	DS, AP, TN, PN
T7241	Multiple Ethernet Transmitter	84-pin PLCC	0 °C to +70 °C	TP Ethernet	DS, PN

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

## Ethernet Switching Hub Products

The ATT1RX04 promotes cost-effective Ethernet circuit-switched hubs where each port can be independently assigned to a LAN network or segment. Circuit switching is used to provide network administrators with the ability to optimize network performance by making it easy to move any port on the network to a new LAN segment as the load or traffic patterns dictate.

The AT&T1S04 provides the circuit switch and collision handling logic for implementing a 12-port, four-segment circuit switch when used in conjunction with the ATT1RX04. In addition, it provides all the miscellaneous board-level circuitry, including the reset circuitry, and board-level address decoding. The SEABREEZE also provides a board-level reset to the ATT1RX04s that can be controlled by software or hardware. The design allows for a 4-bit hardware configured board ID.

The ATT1MX10 provides four *IEEE* 802.3 10 Mbits/s standard MACs and TP/AUI transceivers in a single 208-pin SQFP package. With deep inter-

nal FIFOs and a high speed system interface, the ATT1MX10 is intended for Ethernet frame switching and multiport bridging and routing applications.

The ATT1MX10 allows single-cycle DMA transfers directly to and from its internal transmit and receive FIFOs. The deep FIFOs enable storing multiple packets on-chip, retransmitting a packet after a collision, and rejecting runs before any DMA activity.

The ATT1MX10 also contains extensive on-chip counters and registers. This enable system designers to easily keep track of network statistics required by network management standards.

### Features of the ATT1RX04

- High level of integration
  - Four independent repeaters
  - Four AUI/TP transceivers
  - Network management and security
- Comprehensive network management
  - 32-bit counters
  - 802.3K and RMON support

- Security
  - Eavesdropping
  - Intrusion protection
  - Customizable security implementation
- Demonstration hardware/software available

### Benefits of the ATT1RX04

- Reduce system cost and improve reliability
- Provide superior system performance
- Provide superior network management features in your system

### Features of the ATT1S04

- A circuit switch supporting 12 ports and providing independent connection to 1 of 4 segmented Ethernet segments
- Supports an unlimited number of configurations
- Integrates miscellaneous board-level circuitry to minimize other components

### Benefits of the ATT1S04

- Makes Switched Ethernet A BREEZE (SEABREEZE) and reduces time to market.

### Features and Benefits of the ATT1MX10

- Four 10 Mbit/s Ethernet transceivers and MACs integrated together with separate transmit and receive channel FIFOs and a DMA interface simplify the design of a frame-switching hub
- Provides extensive network management capabilities that network administrators demand in today's hub equipment
  - There are nine per-channel transmit event counters and 19 per-channel receive event counters
  - The status of each packet received is appended to the packet for custom management implementations
- A high-speed 32-bit system interface maximizes throughput on the system bus
  - Direct system interface to FIFOs allows single-cycle DMA operations at 25 MHz
  - Each channel provides separate status and control leads for efficient memory management
- Separate 128-byte deep transmit and receive FIFOs are provided on a per-channel basis
- The chip complies with 802.3 by default, but also can be configured for optimal frame switching performance
  - Short preamble generation
  - Ignore transmit deferred
  - Immediate retransmission after collision
- Selectable number of collision retries
- Ignore SQE test after transmission
- The CRC generator can be enable or disabled on a per-packet basis with hardware control. This allows passing preformatted packets at high speed
- The ATT1MX10 can also be configured for full-duplex operation

Part No.	Description	Package Type	Temp. Ranges	Applications	Literature
ATT1RX04	Four Managed Repeaters for Circuit-Switched Ethernet	132-pin BQFP	0 °C to +70 °C	TP Ethernet	PN, DS
ATT1S04	Circuit Switch and Collision Handling Logic for 12-Port, 4-Segment Ethernet Circuit Switching	132-pin BQFP	0 °C to +70 °C	TP Ethernet	PN, DS
ATT1MX10	QuadMAC and Transceiver for Ethernet Frame Switching	208-pin SQFP	0 °C to +70 °C	TP Ethernet	PN, DS

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447

### Ethernet Network Interface Card (NIC) Products

The T7231 Local Area Network Protocol Assist Communications Engine with ROM Controller (*LANPACER* Controller) and the T7213 Dual Interface Station Chip (DISC) provide a two-chip solution for the implementation of *IEEE* 802.3 for an Ethernet attachment unit interface (AUI) and twisted-pair wire (10Base-T) media. These two devices provide the complete solution for the *PC/XT/AT* bus interface to the network media.

#### Features

- High level of integration
  - Integrated bus interface
  - Software medium selection
  - Software link-integrity control
- 82586 software compatibility
- Certified *Novell* and NDIS drivers
- Flexible data structure
- Support EEPROM/Flash
- Printer error monitor

#### Benefits

- Minimal component count
- High reliability
- Low manufacturing cost
- Small card applications
- Laptop applications
- Early to market

- Low development cost
- Easy to upgrade

The T7220A Twisted-Pair Medium Attachment Unit (TPMAU2) simplifies the design and implementation of a minimal-part-count, cost-effective medium attachment unit (MAU) between an Ethernet attachment unit interface (AUI) and the twisted-pair wire media. The T7220A TPMAU2 can also be used to implement the twisted-pair wire interface on an Ethernet computer network interface card.

The T7220A TPMAU2 device requires a standard 5 V supply and consumes a maximum of 600 mW.

## LAN ICs

### Features

- Integrated TP and AUI drivers and receivers
- All functions integrated on a single device
- Integrated LED drivers
- Autopolarity detection/correction extended wire length

- Low jitter robust smart squelch accurate predistortion

### Benefits

- Small adapter and transceiver applications
- Early to market
- Low development cost

- Special features for product differentiation
- Proven performance, early to market
- Superior network performance

Part No.	Description	Package Type	Temp. Ranges	Application	Literature
T7220A	Twisted-Pair Medium Attachment Unit	28-pin SOJ 28-pin DIP	0 °C to +70 °C	TP Ethernet	DS
T7213	Dual Interface Station Chip	28-pin, plastic DIP 28-pin, plastic SOJ	0 °C to +70 °C	TP Ethernet	DS, PN
T7231	IEEE 802.3 LANPACER Controller	132-pin, PQFP	0 °C to +70 °C	TP Ethernet	DS, MN, PN

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

### FDDI Products

The T7352 TPDDI Physical Layer Device (PHY) is a single-chip CMOS VLSI component that implements cipher scramble/descramble functions of the FDDI twisted-pair PMD as defined by the ANSI X3T9.5, the complete fiber-distributed data interface (FDDI) physical layer protocol, as well as the stream FDDI Committee.

In the TPDDI mode, the T7352 inserts the stream cipher scramble/descramble function into the serial

bit stream on the NRZ side of the NRZ  $\longleftrightarrow$  NRZI converters.

In the FDDI mode, the T7352 provides the connection to the FDDI physical media dependent (PMD) interface, the media access controller (MAC), and the station management (SMT) ports. It monitors and controls the media line state, exchanging this information with the SMT layer.

### Features

- Single-chip device
- Low power
- Extended CMT support

### Benefits

- Board space saving
- Board cost saving
- No need to run 125 MHz clock on the board
- Reduced cooling requirements
- Multiport concentrator possible
- No external logic
- No additional components
- Provides additional ring management features

Part No.	Description	Package Type	Temp. Ranges	Application	Literature
T7352	FDDI/TPDDI Physical Layer Device	84-pin PQFP	0 °C to +70 °C	FDDI	DS, PN

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

## 100 VG/10Base-T MAC and System Interface

The ATT2MD01 is a CMOS Integrated Circuit containing all of the media access control (MAC), memory management, and EISA/ISA system interface logic required for numerous 100VG-AnyLAN/10Base-T adapter card applications. The ATT2MD11 and ATT2MD12 are CMOS Integrated Circuits containing all of the media access control (MAC), memory management, and PCI system interface logic required for numerous 100VG-AnyLAN/10Base-T adapter card applications.

Both the ATT2MD01 and ATT2MD11 can be used in the following applications:

- Adapter cards for PC applications
- Workstations and file servers

- Network ready motherboards
- Network analyzers and test equipment
- Bridges and routers
- Remotely managed hubs

### Features

- Supports *IEEE* 802.12 100VG-AnyLAN specification
- EEPROM interface enables easy implementation of jumperless products
- Complete hardware/software demonstration kit available
- ATT2MD01 supports software data structures that can be maintained across EISA slave, ISA slave, and EISA bus master implementations for both 10Base-T and 100VG-AnyLAN
- ATT2MD01 provides EISA bus compatibility for high performance

- ATT2MD01 ISA bus compatibility addresses the embedded base
- ATT2MD01 BootROM interface supports Remote Program Load (RPL) for EISA/ISA diskless workstations
- ATT2MD11 dual media access controllers (MACs) support 10/100 applications that allow for easy migration.
- ATT2MD11 provides PCI bus compatibility for high performance

### Benefits

- Minimal component count
- Low manufacturing cost
- Early to market
- Easy migration from 10 to 100 Mbits/s
- High performance

Part No.	Description	Package Type	Temp. Ranges	Application	Literature
ATT2MD01	100VG/10Base-T MAC and EISA/ISA System Interface	208-pin BQFP	0 °C to +70 °C	100VG-AnyLAN	DS, PN
ATT2MD11	100VG/10Base-T MAC and PCI System Interface	160-pin QFP	0 °C to +70 °C	100VG-AnyLAN	DS, PN
ATT2MD12	100VG/10Base-T MAC and PCI System Interface	160-pin QFP	0 °C to +70 °C	100VG-AnyLAN	DS, PN

## 100 VG/10Base-T Multiport Managed Repeater

The ATT2R01 and ATT2R02 are CMOS integrated circuits that contain all the functionality necessary to implement a six-port managed 100VG-AnyLAN repeater with an optional uplink port. The ATT2R01 is designed to provide all the hub management and security features that have evolved with over four generations of 10Base-T devices. In addition, the ATT2R01 provides two levels of priority for time-sensitive applications like multimedia.

Everything is built in so the system designer can get to market very quickly with a secure, managed 100 Mbit 100VG-AnyLAN hub product. The ATT2R01 supports a wide variety of product offerings through the topologies supported, number of ports supported, style of hub, remote management capabilities, etc.

### Features

- Supports *IEEE* 802.12 specifications
- High level of integration allows for expansion with minimal external components
- Supports many network configurations

- Provides extensive network management capability
- Extensive built-in security
- Promiscuous mode supports network analyzers
- Board-level diagnostics simplify manufacturing tests
- Complete hardware/software demonstration kit available

### Benefits

- Minimal component count
- Reduce system cost and improve reliability
- Early to market

Part No.	Description	Package Type	Temp. Ranges	Application	Literature
ATT2R01	100VG Multiport Managed Repeater	208-pin BQFP	0 °C to +70 °C	100VG-AnyLAN	DS, PN
ATT2R02	100VG Multiport Managed Repeater	208-pin BQFP	0 °C to +70 °C	100VG-AnyLAN	DS, PN

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

## 100 VG Quartet Signaling Transceiver

The ATT2X01 and ATT2X02 are CMOS integrated circuits implementing the physical layer function of the proposed *IEEE* 802.12 standard for 100 Mb/s data transmission in local area networks (LAN). The ATT2X01 implements the Quartet Signaling technology in a single integrated circuit, enabling reliable data transmission at 100 Mb/s over voice-grade twisted-pair cabling.

The ATT2X01 is a versatile building block for 100VG-AnyLAN systems.

### Features

- Supports *IEEE* 802.12 100VG-AnyLAN specifications
- Enables 100 Mb/s transmission over 10Base-T wiring
- Complete implementation of the 100VG-AnyLAN Quartet Signaling Physical Layer function

### Benefits

- Early to market
- Minimal component count

Part No.	Description	Package Type	Temp. Ranges	Application	Literature
ATT2X01	100VG Quartet Signaling Transceiver	44-pin PLCC	0 °C to +70 °C	100VG-AnyLAN	DS, PN
ATT2X02	100VG Quartet Signaling Transceiver	44-pin PLCC	0 °C to +70 °C	100VG-AnyLAN	DS, PN

## Clock Recovery Circuits

When transmitting digital signals, it is very important to determine the beginning and end of each bit position. One rather expensive approach is to provide a separate clock lead to synchronize transmitter and receiver. A more cost-effective approach is to provide synchronization by recovering the clock from the suitability encoded transmitted signal itself. The data is then synchronized to this recovered clock. The T7032 and T7035 perform this clock recovery and data retiming function.

These two devices offer a broad range of application flexibility, with the T7032 up to 52 MHz, and the T7035 between 47.7 MHz and 210.5 MHz.

### Features

- Pin-programmable for 1 MHz to 210.5 MHz
- Only one inexpensive 3.58 MHz crystal needed
- Programmable frequency
- Single 5 V supply
- 100K ECL compatible

- Extended temperature range available. -40 °C to +85 °C

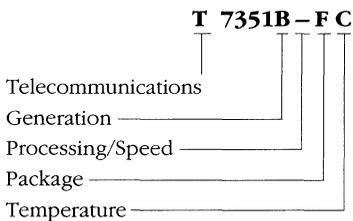
### Benefits

- Flexibility, suitable for numerous applications
  - SONET
  - ATM
  - Fiber channel
  - ESCON
  - FDDI
  - Fiber or copper wire
- Ease of design
- Rugged

Part No.	Description	Package Type	Temp. Ranges	Application	Literature
<b>Clock Recovery</b>					
T7032	Clock Recovery and Data Retiming Circuit (1 MHz to 52 MHz)	20-pin, plastic DIP	-40 °C to +85 °C	Transmission	DS, AP, TN
T7035	Clock Recovery and Data Retiming Circuit (47.7 MHz to 210.5 MHz)	44-pin PLCC	-40 °C to +85 °C	Transmission	DS, PN, TN

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

### Coding Information



### Generation

- A** Second
- B** Third, etc.

### Package Options

- B** Nonhermetic, ceramic DIP
- C** Hermetic, ceramic DIP
- D** Cerdip
- E** Small-outline J-lead
- F** Plastic quad flat pack (PQFP)
- G** Small-outline gull wing
- J** Nonhermetic, leadless chip carrier
- K** Hermetic, leadless chip carrier
- L** Hermetic, ceramic leaded chip carrier
- M** Plastic, leaded chip carrier
- N** Nonhermetic, ceramic pin array
- P** Plastic DIP
- R** Hermetic, ceramic pin array

- S** Plastic pin array
- T** Plastic, leadless chip carrier
- U** Nonhermetic, ceramic, leaded chip carrier
- W** Chip in wafer form

### Temperature Options

- C** 0 °C to 70 °C
- E** 0 °C to 85 °C
- M** Military
- L** -40 °C to +85 °C

## WIDE AREA NETWORK ICs

### ISDN Desktop ICs

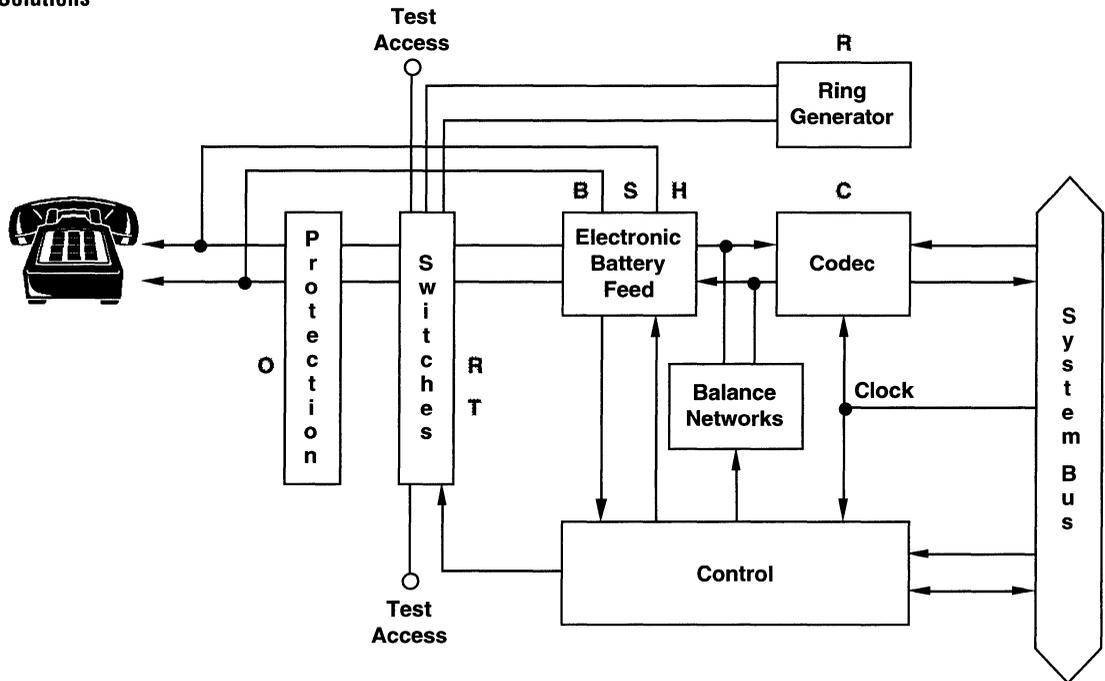
The ISDN market is currently experiencing dramatic growth. This expansion is fueled by end-users'

desire to obtain high-speed interconnectivity to other remote users and to services such as *Prodigy*, *Compuserve*, and the Internet.

AT&T-ME offers both two-wire U and four-wire S/T interface devices to support digital services.

Part No.	Description	Package Type	Temp. Ranges	Literature
LH1465	ISDN dc Terminator	8-pin DIP 16-pin SOG	-40 °C to +85 °C	DS
T7121	HDLC Interface for ISDN	28-pin SOJ 28-pin DIP	-40 °C to +85 °C	DS, TN, BC, AP
T7237	U-Interface Transceiver	44-pin, PLCC	-40 °C to +85 °C	DS, PN
T7250C	Enhanced user-network interface for ISDN and proprietary terminal endpoints	44-pin PLCC	0 °C to 70 °C	DS, PN, TN, BC, AP
T7254	Quad S/T Transceiver	68-pin PLCC	0 °C to 70 °C	AP, DS, BC
T7256	Single-Chip NT1	44-pin PLCC	-40 °C to +85 °C	DS, PN, MN, BC
T7259	SBus Dual Basic Rate (DBRI) Transceiver	132-pin, JEDEC PQFP	0 °C to 70 °C	DS, BC
T7264	U-Interface 2BIQ Transceiver	44-pin PLCC	-40 °C to +85 °C	DS, TN, BC
T7270	Time-slot Interchanger	48-pin PLCC	-40 °C to +85 °C	DS, TN, AP
T7501	PCM CODEC	18-pin DIP 20-pin SOJ	0 °C to 70 °C	DS
T7540	Speaker Phone CODEC	40-pin DIP 44-pin PLCC	0 °C to 70 °C	DS
T7901	ISA Single-Port Wide Area Connection (ISA-SWAC) Device	132-pin BQFP	0 °C to 70 °C	DS, PN
T7903	ISA Multiport Wide Area Connection (ISA-MWAC) Device	132-pin BQFP	0 °C to 70 °C	PN, DS, MN

## Analog Line Card (Line Interface) Solutions



Analog Line Card products provide all of the functions to provide Plain Old Telephone Service (POTS) in applications such as:

- ISDN + POTS
- Modem + POTS
- FITL (Fiber-In-The-Loop)
- HFC (Hybrid-Fiber/Coax)
- DAML (Digitally Added Main Line)
- PBX (Private Branch Exchange)
- Central Office

These products provide the functions required by POTS, called BORSCHT, which stands for:

- B = Battery Feed
- O = Overvoltage Protection
- R = Ringing
- S = Supervision
- C = Codec
- H = Hybrid
- T = Testing

If you look at the preceding diagram, you will see which products provide which function.

And now, the products . . .

### Protection

- Protect the SLIC (Subscriber Loop Interface Chip) from lightning or power crosses.

Part No.	Package	Lightning	Power Cross
LB1201A	8-Pin DIP	$\pm 12.5$ A, $10\mu\text{s} \times 100\mu\text{s}$	1 Arms, 60 Hz, 25 ms
	8-Pin SONB	$\pm 18.5$ A, $10\mu\text{s} \times 160\mu\text{s}$	6 Arms, 60 Hz, 25 ms
ATTL7591	8-Pin DIP or	$\pm 30$ A, $10\mu\text{s} \times 1000\mu\text{s}$	3.5 Apeak, 50 to 60 Hz, 15 ms
		$\pm 40$ A, $5\mu\text{s} \times 320\mu\text{s}$	5.0 Apeak, 50 to 60 Hz, 10 ms
	8-Pin SONB	$\pm 80$ A, $2\mu\text{s} \times 10\mu\text{s}$	

### Application Note:

1. Overvoltage Protection of Solid-State Subscriber Loop Circuits.

## WIDE AREA NETWORK ICs

### SLIC (Subscriber Line Interface Circuit)

- Short loop to long loop capability!
- Low power—cuts power to the phone!
- Thermal protection
- Select from low cost to high balance to low power



### Selection Guide

Feature or Specification	Low Cost	High Balance		Low Power						
	LB1011	LB1276	LB1356	ATT L7551	ATT L7553	ATT L7554	ATT L7556	ATT L7557	ATT L7561	ATT L7564
Quiet Polarity Reversal			*		*	*				*
Switching Regulator								*	*	*
Auxiliary Battery Input with Switching							µP Control	Auto Control		
On-hook Transmission (mW) Pdiss at VBAT = -48 V		217	260	115	175	165	125	125	135	182
Pdiss Low-Power Scan State (mW)	NA	150	155	NA	NA	76	NA	NA	NA	76
Tip Open (Ground Start) State						*				*
Feedback Guaranteed Balance (58 dB)		*	*							
Spare Op Amp				*		*	*	*	*	*
Package	8 DIP	44 PLCC 24 DIP	24 DIP	44 PLCC 24 DIP	44 PLCC	44 PLCC	32 PLCC	32 PLCC	44 PLCC	44 PLCC
Demo Board	*	*	*	*		*	*	*	*	*
Design Software				*		*	*	*	*	*

\*Availability.

### Application Notes:

1. Using the LB1276 SLIC
2. Using the LB1356 High-Balance SLIC
3. Ground-Start Applications Using the LB1356 SLIC
4. Using the Low-Power SLIC Evaluation Board
5. Low-Power SLIC Application Examples

## Switching

### Line Card Access Switches (LCAS)

- Replace electromechanical relays on line cards (POTS Cards)
- No impulse noise
- No "Zero Cross" circuitry required
- Small packages



Part No.	Form	Package	Function	Power Supplies Required	Power Dissipation
ATTL7580	1-2 Form C	16 SOG	Power Ringing Access	+5 V	3 mW
ATTL7581	1 ~ 2 Form C	16 DIP/SOG	Power Ringing Access	+5 V	3 mW
ATTL7582	2 ~ 2 Form C	16 DIP/SOG	Power Ringing Access Line Access	+5 V	3 mW
ATTL7583A/B	3 ~ 2 Form C	24 DIP/28 SOG	Power Ringing Access, Test in Access	+5 V	3 mW
ATTL7583C/D	3 ~ 2 Form C	28 SOG	(Independent Logic Inputs)	+5 V	3 mW

A Version – Includes diode bridge/SER clamping circuit for fault protection.

B Version – Includes diode bridge protection only.

C Version – Same as A above, but includes an additional logic state.

D Version – Same as B above, but includes an additional logic state.

### Application Notes:

1. Introduction to AT&T Line Card Access Switches
2. Switching Behavior of AT&T Line Card Access Switches
3. Impulse Noise and the AT&T ATTL758X Series of Line Card Access Switches

### Reference Designs for POTS Applications

Design 1:

Contains: ATTL7551 SLIC  
T7504 Quad CODEC  
ATTL7581 Switch

For good resistive termination

Design 2:

Contains: ATTL7554 SLIC  
T7504 Quad CODEC  
ATTL7583 Switch

For complex termination

Design 3:

Contains: ATTL7590 Ring  
Generator

Design 4:

Contains: ATTL7551 SLIC  
T7504 Quad CODEC  
ATTL7582 Switch

For complex termination

### Ringing Circuits

#### ATTL7590 Ring Generator

- Applies a battery-backed, single-ended, sinusoidal ringing signal to the telephone loop
- Ringing capability:
  - 40 Vrms into 5 North American REN
  - 30 mApeak into 4 German REN
- Built-in current limiting
- Low power dissipation in idle and ringing modes
- Needs only +5 V, a high-value negative dc supply, and a digital input sequence

#### ATTL7596A Integrated SLIC/Ring Generator

- Ultralow-power short-loop line interface
- Integrated constant current battery feed plus ring generator
- +5 V and –48 V battery operation
- Supervision function included
- Transformer-based
- No ring relay required
- Battery switch included

# WIDE AREA NETWORK ICs

## CODEC (Coder/Decoder)

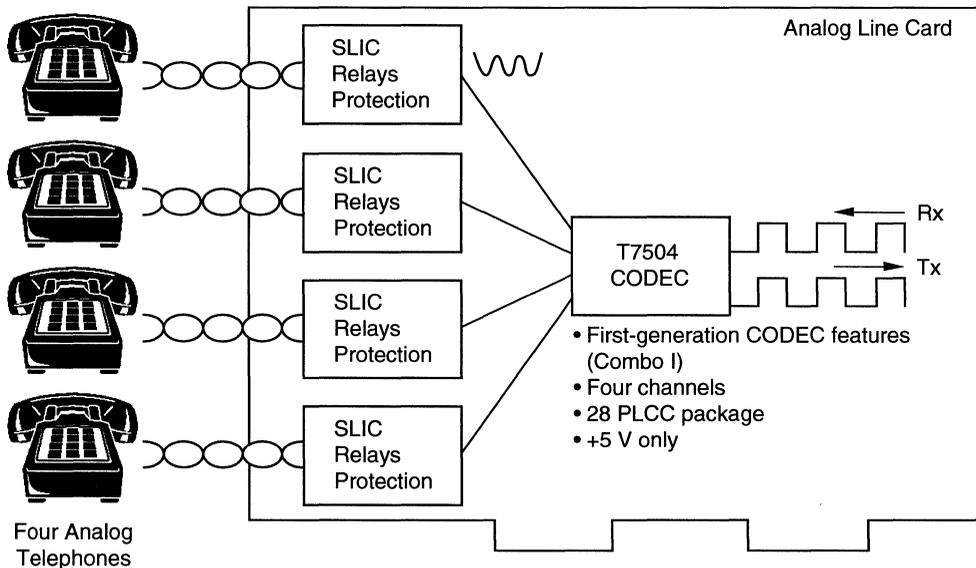
- 1, 2, or 4 channels per device
- Single +5 V supply
- High immunity to latch-up

	T7502	T7503	T7504	T7548	T7570
No. of Channels	2	2	4	1	1
Package Size	20 SOJ	20 SOJ	20 DIP/PLCC	20 PLCC	20 PLCC
Power Supply	+5 V	+5 V	+5 V	±5 V	+5 V
Clock Frequency (MHz)	2 or 4	2 or 4	2 or 4	0.512	2 or 4
Temp. Range (°C)	-40 to +85	-40 to +85	-40 to +85	0 to +85	-40 to +85
Companding (μ/A-law)	A-law	μ-law	Selectable	Selectable	Selectable
Programmable Gain	Ext. Restr.	Ext. Restr.	Ext. Restr.	Yes	Yes
Programmable Hybrid Balance	No	No	No	Switches	Yes
Latches	No	No	No	No	6
Second Source	No	No	No	Yes	Yes
Demo Board	Yes	Yes	Yes	No	No
Typ Active Power (9 mW)	37	37	65	72	

### Application Notes:

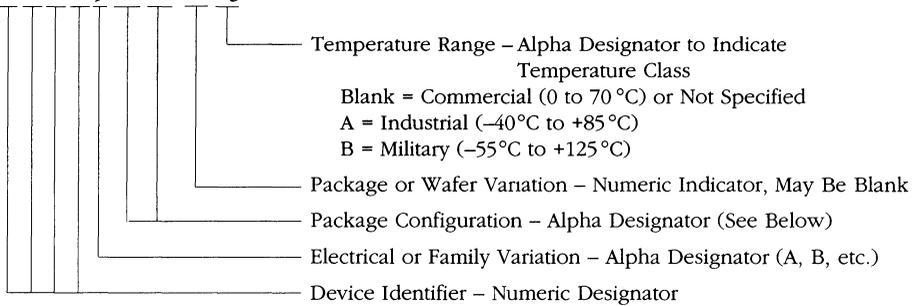
1. Using the T7570 Single-Supply CODEC
2. T7570 Coefficient Selection Software

### T7504 – Quad CODEC



**Part Number System for Protector/LCAS/SLIC Products**

**A T T L X X X X 9 10 11 12 13**



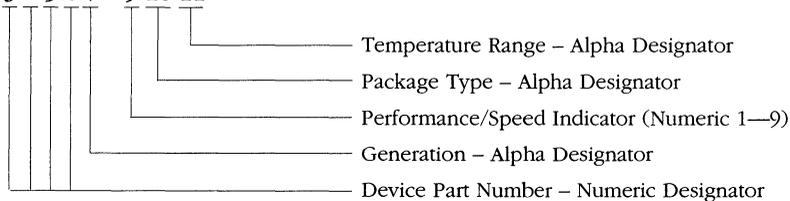
**Package Configuration (position 10, 11 above)**

Alpha designators for package variations.

- B** = 8-Pin DIP
- C** = 16-Pin DIP
- F** = 24-Pin DIP
- P** = 44-Pin PLCC
- S** = 8-Pin SONB
  
- AE** = 16-Pin SOG
- AJ** = 28-Pin SOG
- AU** = 32-Pin PLCC

**Part Number System for CODECs**

**T – 3 4 5 6 7 – 9 10 11**



**Temperature Ranges**

- C** = 0 °C to 70 °C (Commercial)
- E** = 0 °C to 85 °C (Extended)
- L** = –40 °C to +85 °C (Outside Plant/Loop)

**Package Types**

- E** = SOJ
- M** = Plastic, Leaded Chip Carrier
- P** = Plastic DIP

## WIDE AREA NETWORK ICs

### Transmission ICs

AT&T-ME's Transmission ICs group designs and manufactures integrated circuit solutions for copper-based data and voice transmission in the range of 1,544,000 bits per second (1.5 Mbits/s) to 51,840,000 bits per second (51.84 Mbits/s). AT&T Microelectronics' transmission IC solutions target SONET/SDH, DS3/E3, and DS1/E1 applications, which include multiplexers, digital access cross-connect systems (DACS), channel service unit (CSU) and digital service unit (DSU) equipment, channel banks, remote wireless modules, and PBX interfaces.

Wide area network routing and signaling via X.25 or LAPD protocol applications are facilitated by AT&T-ME's high-level data link control (HDLC) devices. Providing 24 or 32 channels, these devices perform HDLC functionality for both domestic and international applications. For those applications requiring data compression, AT&T-ME's adaptive delta pulse code modulation (ADPCM) transcoders provide variable bit rates and are compliant with ANSI T1.301-1987 and ITU-T Recommendations G.721 and G.726.

Interdevice communication in the AT&T solution is accomplished via a full-duplex, serial time-division-multiplexed (TDM) concentration high-way interface (CHI). AT&T-ME manufactures a single-chip solution that interfaces four TDM-CHIs able to switch data in both the time and space domain over any CHI, while maintaining frame integrity for wideband data/video applications or reducing the data latency for voice applications. Applications requiring cross-connect functionality can interconnect these CHI controllers to produce switching matrixes of varying sizes.

Part No.	Description	Package Type	Temp. Ranges	Literature
T7115A	32/34 Channel Synchronous Protocol Data Formatter	64-pin PLCC	-40 °C to +85 °C	DS, AP
T7230	Primary Access Framers/Controller	68-pin PLCC	-40 °C to +85 °C	DS, PN
T7274B	Quad Differential Line Driver	16-pin DIP 16-pin SOJ	-40 °C to +85 °C	DS
T7275C	Quad Differential Line Receiver	16-pin DIP 16-pin SOJ	-40 °C to +85 °C	DS
T7281	16-Channel ADPCM	44-pin PLCC, 24-pin DIP	0 °C to 70°C	DS, AP
T7288	CEPT Line Interface	28-pin DIP, 28-pin SOJ	-40 °C to +85 °C	DS
T7289A	DS1 Line Interface	28-pin DIP, 28-pin SOJ	-40 °C to +85 °C	DS
T7290A	DS1/T1/CEPT	28-pin DIP, 28-pin SOJ	-40 °C to +85 °C	DS
T7295-1	E3 Integrated Line Receiver	20-pin DIP, 20-pin SOJ	-40 °C to +85 °C	DS
T7295-6	DS3/SONET STS-1 Line Receiver	20-pin DIP, 20-pin SOJ	-40 °C to +85 °C	DS
T7296	DS3/E3 SONET STS-1 Transmitter	28-pin DIP, 28-pin SOJ	-40 °C to +85 °C	DS
T7630	Dual T1/E1 Line Interface and Framers plus HDLC Data Line Access	84-pin PQFP	-40 °C to +85 °C	PN
T7632	Dual CEPT Primary Access Framers	84-pin PQFP	-40 °C to +85 °C	DS, PN
T7690/93	3 V Quad DS1/E1 Line Interface	100-pin BQFP	-40 °C to +85 °C	DS, PN, MN

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

## Access ICs

Broadband access integrated circuits create the communications link between the optical network unit (ONU) and the terminal device within a customer's premises [commonly referred to as customer premises equipment (CPE)] found in a fiber-to-the-curb (FTTC)/switched-digital video (SDV) system. AT&T-ME's switched-digital video solution

provides a quantum leap forward in supplying cost-effective broadband access to the home and office.

AT&T-ME's circuits in these systems provide the following functions:

- ONU
  - Framing
  - Line interface
  - Line driving

- Set-top functions
  - Line driving
  - Line interface
  - Transmission convergence
  - Segmentation and Reassembly (SAR)
  - ATM Adaptation Layer 5 (AAL5)

Part No.	Description	Package Type	Temp. Ranges	Literature
T7660	16-CAP Receiver	84-pin PLCC	0 °C to +70 °C	DS, PN
T7661	Analog Front-end and QPSK Transmitter	84-pin PLCC	0 °C to +70 °C	DS, PN
T7662	Transmission Convergence plus SAR/AAL Framer	100-pin MQFP	0 °C to +70 °C	DS, PN
T7664	Quad 16-CAP Transmitter	84-pin PLCC	–40 °C to +85 °C	DS, PN
T7665	Quad QPSK Receiver	84-pin PLCC	–40 °C to +85 °C	DS, PN
T7666	Transmission Convergence Framer	128-pin PQFP	–40 °C to +85 °C	DS, PN

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

## Video RF Components

Video RF components are broadband RF communication interface ICs for voice/data/video transmission over fiber, coax, and satellite.

### ATTV4910 RF Transmitter

#### Applications

- Hybrid fiber/coax network interface device (NID)

#### Description

The ATTV4910 is a silicon integrated transmitter. It consists of a five-stage AGC amplifier section followed by a differential line driver. The AGC has 26 dB of gain control in 1 dB steps. The gain is controlled by 5 TTL/CMOS compatible inputs. The line driver can provide up to 200 mA of current from a 5 V supply. The ATTV4910 is designed to operate from –40 °C to +85 °C and is available in a 24-pin SOJ package.

#### Features

- Minimum Pout = 17.5 dB, 5 MHz to 40 MHz, @ R(A + B – C) ≥ 24 dBc
- 5 MHz to 60 MHz small signal bandwidth, Pout ≤ 11 dBm, R(A + B – C) ≥ 38 dBc
- Typical dc power consumption:
  - Active mode 385 mW
  - Sleep mode 15 mW
- Very fast switching times between active and sleep mode: <300 ns
- 26 dB gain range, TTL or CMOS controlled

### ATTV5002 Dual Video Cable Driver

#### Applications

- Driving unshielded twisted pairs
  - ATM LAN UTP
  - FTTC UTP
- 50 Ω or 75 Ω cable driver

#### Description

The ATTV5002 is a 150 mA, 240 MHz, unity gain stable (up to 10 pF capacitive load over process and temperature variations at Av = +1 and stable for any CL at Av = +3/–2), dual operational amplifier designed specifically for those applications where stable, high-speed, large current driving capabilities are essential.

The ATTV5002 utilizes a voltage feedback architecture to achieve input biasing currents of 300 nA and a high input impedance of 8 MΩ. In addition, the ATTV5002 is set to a modest gain of 50 dB for a maximum range of stable operation, and gain flatness of less than 1 dB up to 30 MHz while maintaining a slew rate of 500 V/μs. These features give the ATTV5002 the ability to drive over 150 mA (6 V peak to peak) into a transmission line with minimum distortion for pure mono-

tone signals and less than 10% ringing for pulse signals. Also, with a standby flow-through current in excess of 1 mA in its output stage, the ATTV5002 provides linear amplification of less than 1% from 6 mV to 6 V. The dual amplifiers are exact mirrors of each other with individual power supply bonding pads that provide optimized matching and isolation. The ATTV5002 can operate on either single or dual power supplies with a range of 5 V to 12 V, requiring 2 V of head room in each direction.

### Features

The ATTV5002 is a low-cost dual video operational amplifier optimized for applications requiring high output drive capability, such as unshielded twisted pairs in a telephony or data communications environment from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

- Output peak current in excess of 150 mA
- Can drive any capacitive load for  $A_v = +3/-2$
- Unity gain stable up to 10 pF loads
- Output swing to within 2 V of either supply
- Gain flatness  $<1$  dB, dc to 30 MHz ( $A_v = +3$ )
- Slew rate of 500 V/ $\mu\text{s}$
- Dual or single power supply up to 12 V
- Quiescent current varies by  $<2\%$  from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

### ATTV5006 Dual Video Cable Driver

#### Applications

- Driving unshielded twisted pairs
  - ATM LAN UTP
  - FTTC UTP
- 50  $\Omega$  to 75  $\Omega$  cable driver

#### Description

The ATTV5006 is a 150 mA, 340 MHz, dual operational amplifier designed specifically for those applications where stable, high-speed, large current driving capabilities are essential.

The ATTV5006 utilizes a voltage feedback architecture to achieve input biasing currents of 300 nA and a high input impedance of 8 M $\Omega$ . In addition, the ATTV5006 is set to a modest gain of 60 dB for a maximum range of stable operation, and gain flatness of less than 1 dB up to 30 MHz while maintaining a slew rate of 500 V/ $\mu\text{s}$ . These features give the ATTV5006 the ability to drive over 150 mA (6 V peak to peak) into a transmission line with minimum distortion for pure monotone signals and less than 10% ringing for pulse signals. Also, with a standby flow-through current in excess of 1 mA in its output stage, the ATTV5006 provides linear amplification of less than 1% from 6 mV to 6 V. The dual amplifiers are exact mirrors of each

other with individual power supply bonding pads that provide optimized matching and isolation. The ATTV5006 can operate on either single or dual power supplies with a range of 5 V to 12 V, requiring 2 V of head room in each direction.

#### Features

The ATTV5006 is a low-cost dual video operational amplifier optimized for applications requiring high output drive capability, such as unshielded twisted pairs in a telephony or data communications environment from  $0^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ .

- Output peak current in excess of 150 mA
- Can drive any capacitive load for  $A_v = +7/-6$
- Output swing to within 2 V of either supply
- Gain flatness  $<1$  dB, dc to 30 MHz ( $A_v = +7$ )
- Slew rate of 500 V/ $\mu\text{s}$
- Dual or single power supply up to 12 V
- Quiescent current varies by  $<2\%$  from  $0^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$

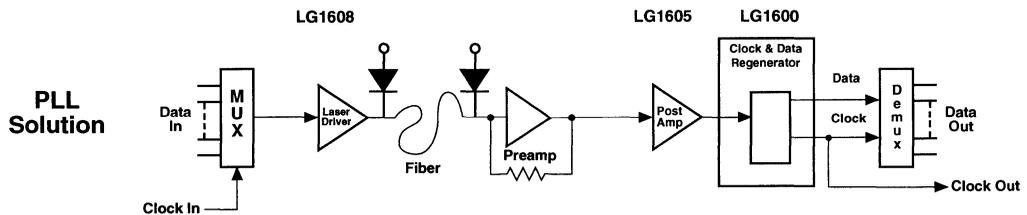
## High-Frequency Gallium Arsenide (GaAs)

The High-Frequency GaAs ICs listed here with the associated evaluation fixtures, were introduced in 1990. They were designed for SONET compatibility at the OC-48 data rate of 2.488 Gbits/s. These devices have

now been in production for over five years. Our clock and data regenerator at the OC-96 data rate of 4.977 Gbits/s has been in production for two years. Customer requests have resulted in clock and data regenerators in production that are at non standard OC rates. Our

clock and data regenerator can be factory tuned to any data rate from 450 Mbits/s to 5.5 Gbits/s, for those special needs. New products for 1996, at 10 Gbits/s, are now in development. Samples will be available at the beginning of 1996.

### Block Diagram of a Fiber-Optic Regenerator



## High-Frequency Products

Part No.	Description	Type	Data Rate	Literature
LG1600FXH (any data rate)	Clock and Data Regenerator	68-lead package	up to 5.5 Gbits/s	DS
LG1600FXH5332	Clock and Data Regenerator	68-lead package	5332 Mbits/s	DS
LG1600FXH4977	Clock and Data Regenerator	68-lead package	4977 Mbits/s	DS
LG1600FXH2488	Clock and Data Regenerator	68-lead package	2488 Mbits/s	DS
LG1600FXH1244	Clock and Data Regenerator	68-lead package	1244 Mbits/s	DS
LG1600FXH1062	Clock and Data Regenerator	68-lead package	1062 Mbits/s	DS
LG1600FXH0622	Clock and Data Regenerator	68-lead package	622 Mbits/s	DS
LG1605DXB	Limiting Amplifier	16-lead package	2488 Mbits/s	DS
LG1605DXB-TR16	Limiting Amplifier	16-lead package on tape and reel	2488 Mbits/s	DS
LX1608DXF	Laser Driver	24-lead package	2488 Mbits/s	DS
TF1003C	Evaluation Fixture for LG1605DXB			DS
TF1004A	Evaluation Fixture for LG1600FXH			DS
TF1006A	Evaluation Fixture for LG1608DXF			DS

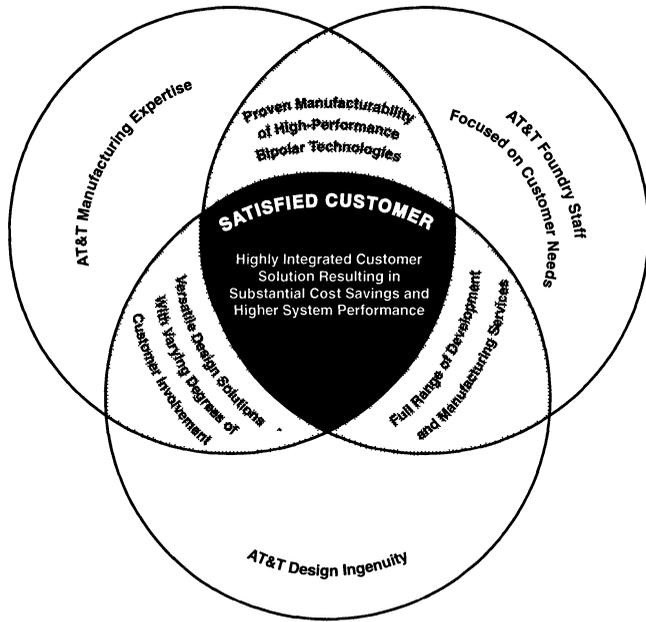
# FOUNDRY

## AT&T Bipolar Foundry

The AT&T Bipolar Foundry organization is one in which customer input can be anything from an idea to ready masks. Our foundry is a recognized major supplier of a wide variety of high-performance bipolar technologies that span a broad analog/mixed-signal application base including products designed for interface circuitry, network computing, telecom, instrumentation/ATE, and video/RF. The proven manufacturability of our foundry technologies is complemented nicely with a full range of development and manufacturing services (summarized in table at right) performed by our technical and management staff. Additionally, AT&T utilizes their design ingenuity to offer versatile design solutions that result in highly integrated customer solutions leading to substantial cost savings and higher system performance. Also, we support commercially available PC and workstation based design tools.

### Technology Offerings

AT&T provides a diverse offering of high-performance bipolar technologies that can be utilized to provide system solutions to our customers. Several of AT&T's bipolar technologies are offered in both custom or semicustom design options in which either the customer or AT&T can provide the design and layout. The foundry technologies, manufactured in world-class cleanroom facilities, fall into two major groups. First, there is the Complementary Bipolar Integrated Circuit (CBIC) consisting of CBIC-R, CBIC-U2, and CBIC-V2 technologies. They provide vertical PNPs as well as vertical NPNs having  $f_T/BV_{ce0}$ s ranging from 250 MHz/33 V to 10 GHz/10 V, respectively.



## Bipolar Foundry Services

### Development Services

Customer Training  
 IC Electrical Design  
 Test Development  
 IC Layout and Mask Tooling  
 Prototype Wafer Fabrication  
 Prototype Packaging and Test  
 Prototype Evaluation

### Production Services

Wafer Fabrication  
 Wafer Probe  
 Product Packaging and Test  
 Product Engineering

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

The second group of foundry technologies, ideal for data conversion products, was designed for ultrafast NPN, ECL-type digital and analog UHF/VHF communications. This is our Bipolar Enhanced Super Self-

Aligned Technology (BEST1) which offers a typical  $f_T$  of 14 GHz and a minimum  $BV_{ce0}$  of 5.5 V. A technology overview and a summary of dc and ac device characteristics are shown on page 2-41.

## Analog/Mixed-Signal Bipolar Technology Overview

Technology	Overview
<b>CBIC-R</b>	General-purpose 33 V, 250 MHz, moderate-speed complementary bipolar technology for analog/mixed-signal applications. CBIC-R is the most mature junction-isolated complementary bipolar technology available with over 15 years of manufacturing experience. CBIC-R technology is also offered through the ALA-400 family of semicustom linear arrays.
<b>CBIC-U/U2</b>	High-performance 12 V, 4 GHz, high-speed complementary bipolar technologies for wideband or low-power analog/mixed-signal applications. Since CBIC-U's introduction to the marketplace and CBIC-U2's introduction in 1992, many customers have used these technologies to introduce leading-edge products targeted in video/consumer, industrial, instrumentation, and data/telecommunications markets. CBIC-U's semicustom products are available in the ALA-200 family of arrays.
<b>CBIC/V2</b>	Very high-performance 10 V, 10.2 GHz, complementary bipolar technologies that can be utilized for very high-speed or ultralow-power analog/mixed-signal applications. CBIC/V2 is the highest-speed side wall oxide isolated complementary bipolar technologies in manufacture. CBIC-V2 was introduced into manufacture in 1989. The ALA-110 family supports semicustom designs in CBIC-V2.
<b>BEST-1</b>	Offers a nonoverlapping, super self-aligned, oxide isolated NPN transistor capable of a 5.5 V minimum BV <sub>ceo</sub> , and a typical f <sub>r</sub> of 14 GHz. BEST-1 has been in production since 1989, and is ideal for ultrahigh-speed lower power consumption mixed-signal applications. BEST-1 is utilized for applications such as video driver distribution circuitry, high-speed data communications, and high-speed data conversion. ECL prop delays of 87 ps at a power level of 2 mW per gate have been obtained. BEST-1 semicustom solutions are available in the BE1000, BE2000, and BE4000 gate arrays.

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

## Technology Characteristics

Parameter	CBIC-R	CBIC-U2	CBIC-V2	BEST-1	Unit
BV <sub>ceo</sub> (min)					
NPN	33	12	10	5.5	V
PNP	33	11	10	6*	V
f <sub>r</sub> (typ)					
NPN	250 MHz	3.5 GHz	10.2 GHz	14 GHz	—
PNP	250 MHz	2.7 GHz	4.3 GHz	—	—
hFE (typ)					
NPN	85	125	70	100	—
PNP	110	35	40	4*	—
CJC (1 x typ)					
NPN	220	40	30	9	fF
PNP	340	60	50	—	fF
Interconnect	2 LM Ti-Pt Ti-Pt-Au	2 LM Ti-Pt-Au Ti-Pt-Au	2 LM Ti-Pt-Au Ti-Pt-Au	3 LM + Poly Ti-TiN-Al-TiN —	— — —
Resistors	200 & 2000 (implanted)	50 & 1080 (implanted)	80 & 1880 (implanted)	565 (Poly)	Ω/sq.
Trimmed Resistors	300	300	300	—	Ω/sq.
Capacitors	0.4	0.34	0.22	1.62 (MOS)	fF/μm <sup>2</sup> (MNOS)
Min. Feature Size	5.0	1.5	1.5	1.5	μm

\*Lateral PNP.

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447

## Flexible Design Options

Table at the right covers the range of customer/AT&T partnership arrangements that might be followed once masks and wafers have been produced. Development begins, given customer-specified product performance requirements, with AT&T serving as technology consultants. As development commences, the division of customer/AT&T responsibility depends upon customer choice. For example, the customer might finish design through layout and finish with option 1 in table at the right, leaving AT&T only responsible for mask and wafer fabrication. Or the customer may require a turn-key solution, finished as option 6. Deliverables in options 1, 2, and 3 are either wafers or die.

Furthermore, the product may be either a custom or semicustom IC. The semicustom product offerings and component summaries are summarized in the following three tables. The essential feature of this supported IC development procedure is that it is flexible in meeting customer needs.

## Customer/AT&T IC Product Development (Custom or Semicustom)

### Foundry Options

Manufacturing Steps	Customer Options*					
	1	2	3	4	5	6
Mask Fab						
Wafer Fab	A	A	A	A	A	A
Visual Inspection						
Wafer Probe	C	A	A	A	A	A
Dicing	C	C	A	A	A	A
Package Assembly	C	C	C	A	A	A
Package Test	C	C	C	C	A	A
Qualification	C	C	C	C	C	A

\* Symbol key: C: Customer  
A: AT&T

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

### Analog/Mixed-Signal Design Options

AT&T design capabilities offer highly integrated solutions resulting in substantial savings in costs along with higher system performance. This is achieved by utilizing either AT&T full-custom or semicustom design alternatives.

#### Full Custom

Full custom is the customizing of component types, values placement, and interconnect and requires a complete mask set. An extensive, characterized library of transistors,

resistors, and capacitors is provided, which enables the designer to optimize the performance for a given application at minimal risk.

#### Semicustom

Semicustom is dies consisting of a standardized set of prepositioned components. Wafers are held in inventory prior to metallization. The interconnection is customized for each design, resulting in fewer masks, lower NRE, and a shorter processing interval than a full-custom design. Deliverables can be either tested or untested die, packages, or wafers.

## Analog/Mixed-Signal Product Offering

Product	Technology				
	CBIC-R	CBIC-U	CBIC-U2	CBIC-V2	BEST-1
Semicustom	ALA-401	ALA-201	—	ALA-110	BE1000
	ALA-402	ALA-202	—	—	BE2000
		ALA-210	—		BE4000
Full Custom	✓		✓	✓	✓

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

The following is a general summary of the number and type of components available on the various linear array products. For more detailed information, please request the appropriate data sheet.

### Semicustom Product Component Summary

Product	Voltage (V)	Complementary Transistors		Resistors	Capacitors	Bonding Pads
		NPN	PNP			
ALA-110	10	51	41	282	14	16
ALA-201	12	68	43	480	21	36
ALA-202	12	136	86	960	38	48
ALA-210	12	37	37	104	6	16
ALA-401	33	61	61	434	7	38
ALA-402	33	104	104	744	12	46

The following is a summary of the BEST-1 gate-array complexities available. The number of equivalent gates is calculated based on a gate multiplier of four transistors per gate.

### Semicustom Gate-Array Complexity Options

Product	Voltage	Equivalent Gates	Internal Cells	I/O Buffer Cells	Fixed Power & GND Pads	Equivalent Gates (D Flip-Flop with Clear)	Equivalent Gates (1-Bit Full Adder)
BE1000	5.5 V	1048	182	48	32	728	1001
BE2000	5.5 V	2780	484	92	38	1936	2660
BE4000	5.5 V	4196	728	108	38	2912	4004

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447

### CAD Support

As circuits become more complex, computer-aided design (CAD) tools become more important to the successful completion of a design. AT&T Microelectronics supports a variety of commercially available PC and workstation based design tools. A description of the supported tools is offered below.

Training in the use of any of these tools will be provided at a nominal fee.

### Schematic Capture

AT&T Microelectronics provides a library and software support for *Viewdraw* from Viewlogic Corporation and the schematic capture tool in the Cadence Design Systems' Analog Artist environment.

### Circuit Simulation

#### SPICE

SPICE is the primary circuit analysis tool used by analog designers. There are several versions available. AT&T Microelectronics provides transistor models compatible with SPICE 2G6. The resistor and capacitor models supplied are compatible with any simulator that allows models to be specified. In addition, some enhanced subcircuit models are available for use with MicroSim's *PSPICE*, version 4.01 or later.

#### ADVICE<sup>®</sup>

AT&T's own circuit simulator, *ADVICE* (a SPICE derivative), is available for use on *Sun Workstation*. It features an extended four-terminal bipolar transistors model that covers parasitic transistor behavior, operation in the quasi-saturation region, both interactive and batch execution, parameterized subcircuits, design centering, user-definable models, and procedural simulation. AT&T Microelectronics licenses the *ADVICE* simulation tool and will provide training for a fee.

## Layout

AT&T Microelectronics supports cell-based layout libraries for a number of layout editors available for both PC and *Sun Workstation* platforms. A library of CBIC primitive cells is available in *GDS II Stream* format.

## Analog Artist Layout

The polygon layout editor in Analog Artist is supported with CBIC cell libraries written in Analog Artist database format. Also supplied are parameterized cells for generating valid resistor cells with desired values.

## Verification

Layout verification using both AT&T and other commercial tools is supported on PC and *Sun Workstation* platforms.

## Analog Artist

The verification tools PDcheck, PDextract, ERC, and PDcompare are fully supported for design rule checking, layout connectivity and parasitic capacitor extraction, electrical rule checking, and layout versus schematic checking, respectively.

## Dracula

A library of command files for Cadence Design Systems' *Dracula* is available to enable design rule checking, layout connectivity and parasitic capacitor extraction, electrical rule checking, and layout versus schematic checking for layouts.

## Dielectrically Isolated Wafers

AT&T also provides an application-specific wafer service wherein we prepare dielectrically isolated (DI) wafers for customers to finish processing in their own fab lines. In this mode, we are currently fabricating DI wafers for a variety of high-voltage and high-performance bipolar technologies.

## Bonded Silicon on Insulator (SOI) Wafer

### Features

- Handles like bulk silicon
- High bond strength

### Specifications

- Diameter:
  - 100 mm and 125 mm
  - 150 mm
- Orientation: <100> or <111>

### Description

AT&T Microelectronics provides high-performance silicon materials to OEM customers. Process enhancements are made possible by the substrate properties which can

be achieved through wafer bonding. High-volume processes are used to meet your production needs. AT&T-ME's bonding process was developed in conjunction with AT&T Bell Laboratories.

## Customized Bonded Wafer Process

Silicon wafer bonding enables two wafers with different properties to be united by an attractive force. Sophisticated substrates are created with specific properties for a given process.

The bonded wafer process consists of the following steps:

1. Two wafers are welded together at room temperature.
2. Bond integrity is verified by infrared interference inspection. This step ensures that no voids are present following the initial bonding process.
3. The bonded wafers are annealed at high temperature to increase bonding strength.
4. The device layer is thinned to the appropriate thickness by grinding and polishing.

## SOI Wafer Physical Characteristics

Wafer Type	Device Layer Thickness	Device Layer Thickness Variation	Insulating Oxide Thickness	Total Wafer TTV
Thick SOI	10 $\mu\text{m}$ —150 $\mu\text{m}$	$\pm 15\%$	0.4 $\mu\text{m}$ —4 $\mu\text{m}$	<10 $\mu\text{m}$
Thin SOI	2 $\mu\text{m}$ —10 $\mu\text{m}$	$\pm 0.5 \mu\text{m}$	0.4 $\mu\text{m}$ —4 $\mu\text{m}$	3 $\mu\text{m}$
Ultrathin SOI	0.07 $\mu\text{m}$ —2 $\mu\text{m}$	$\pm 0.02 \mu\text{m}$	0.1 $\mu\text{m}$ —2 $\mu\text{m}$	3 $\mu\text{m}$

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.



## CUSTOM PRINTED-CIRCUIT BOARDS AND BACKPLANES

AT&T Microelectronics' high-density, multilayer printed-circuit boards (PC boards) offer high levels of precision and performance for applications up to 22 layers and standard line widths and spaces down to 5 mils.

Choose from conventional plated holes, or select buried microvias to conserve surface area when using surface-mount components extensively. All PC boards are *UL*-approved, and meet both Bellcore and IPC specifications. In addition, they're thoroughly electrically tested and inspected before being shipped to you.

AT&T Microelectronics' PC boards are custom double-sided rigid and multilayer and are available in these substrates:

- FR4
- BT (bismaleimide triazine)
- Materials for lower dielectric constant applications

Surface finishes include solder mask over bare copper with hot-air solder leveling, plus several alternative solder masks.

Standard high-density capabilities include line width and spacing to 0.005 inches and drilled hole size to 0.0135 inches with 0.025-inch lands on external layers. Most models are available in five days—quality-tested and ready for your system testing.

AT&T's backplanes are available with your choice of components. We will assemble your backplane design with connectors on standard or metric grids, with *Fastech*® or other pins, and with passive and/or active components. Large sizes up to 24 inches x 24 inches are available. All backplanes are electrically tested, including level III testing when active components are part of your design.

Total quality control (TQC) and statistical process control (SPC) programs are combined with full electrical testing to help produce reliable, defect-free boards.

Personalized service from dedicated field engineers is available to all customers who wish support in the early design phases through volume production.

Additional features include:

- Up to 22 layers for interconnection density
- Surface-mount technology
- Standard via, blind via, and buried microvia technologies

For additional information, call your AT&T Account Manager, or call 1-800-372-2447.



## OPTOELECTRONICS

AT&T Microelectronics is the world's largest supplier of components and subsystems for fiber-optic communications. AT&T Optoelectronics SBU addresses the telecommunications and network computing markets.

We have a long history of supplying state-of-the-art products for the telecommunications market. Applications range from Fiber-to-the-Home (FTTH), to SONET, to 2.5 Gbits/s long-haul transmission, to undersea.

For these applications, AT&T is offering laser and detector components, transmitters, receivers, lithium niobate modulators, and advanced technology erbium-doped fiber amplifiers.

AT&T is also a leading player in the CATV and emerging microcellular markets. AT&T's systems-level testing allows customers to repurchase fully characterized devices. Testing includes NTSC, PAL, and cellular frequency plans.

In addition to leading-edge products, AT&T Optoelectronics SBU brings years of experience to the photonics industry. Drawing on the strength of Bell Laboratories, we offer outstanding technical support. With our large commitment to fiber optics, AT&T will enable you to take advantage of leading-edge products that enable you to get to the market sooner.

### Components

Device Type	Part No.	Description	Application	Features	Lit.
Modulators	2612AA	1.3 $\mu\text{m}$ 4 GHz Bandwidth	High-speed telecommunications, analog CATV, SONET OC-64	Uses LiNbO <sub>3</sub> technology (Z-cut), Excellent linearity for analog applications,	DS
	2613AA	1.3 $\mu\text{m}$ 8 GHz Bandwidth			DS
	2622AA	1.55 $\mu\text{m}$ 4 GHz Bandwidth	Analog & digital cellular communications	configurable to customer specifications	DS
	2623AA	1.55 $\mu\text{m}$ 8 GHz Bandwidth			DS
	2624AA	1.55 $\mu\text{m}$ 16 GHz Bandwidth			DS
	2410C	Dual Output, 1.3 $\mu\text{m}$			DS
	2420C	Dual Output, 1.55 $\mu\text{m}$			DS

### Photodetectors

InGaAs APDs	126A	Ceramic Carrier 1.5 Gbits/s 1.5 GHz Typical Bandwidth	High-speed communications, high-speed analog transmissions Submarine cable communication systems	Compatible with industry-standard ceramic carriers	DS
	126B	Ceramic Carrier 2.5 Gbits/s 2.0 GHz Typical Bandwidth			DS
	126C	Ceramic Carrier 2.5 Gbits/s 3.0 GHz Typical Bandwidth			DS
	127A	Industry-Std. Pkg. 1.5 Gbits/s 1.5 GHz Biconic Connector	High-speed communications, high-speed analog transmissions Submarine cable communication systems	Suitable for use in harsh environments High coupling stability	DS
	127A1	Industry-Std. Pkg. 1.5 Gbits/s 1.5 GHz FC-PC Connector			DS
	127B	Industry-Std. Pkg. 2.5 Gbits/s 2.0 GHz Biconic Connector			DS
	127B1	Industry-Std. Pkg. 2.5 Gbits/s 2.0 GHz FC-PC Connector			DS
	127C	Industry-Std. Pkg. 2.5 Gbits/s 2.0 GHz Biconic Connector			DS
	127C1	Industry-Std. Pkg. 2.5 Gbits/s 3.0 GHz FC-PC Connector			DS

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## Components (continued)

Device Type	Part No.	Description	Application	Features	Lit.
<b>Photodetectors (continued)</b>					
PINs	131A	Digital 8-lead DIP SM Pigtail	FITL, Analog CATV	Low-cost, wide operating temperature range Wide bandwidth: >1 GHz High optical coupling stability	DS
	131B	Digital 8-lead DIP MM Pigtail			DS
	131D	Analog 8-lead DIP SM Rotary Mechanical Splice			DS
	131E	Analog 8-lead DIP No Connector			DS
	131G	Analog 8-lead DIP SM Rotary Mechanical Splice			DS
	131H	Analog 3-lead pkg. SM Connector			DS
	131J	Analog 3-lead pkg. SM Connector			DS
	131K	Digital 3-lead pkg. SM Rotary Mechanical Splice			DS
	131L	Analog 8-lead DIP SM Rotary Mechanical Splice			DS
	131N	Digital 8-lead DIP SM Rotary Mechanical Splice			DS
	131P	Analog 8-lead DIP SM FC/APC Connector			DS
	131R	Analog 8-lead DIP SM FC/PC Connector			DS
	131S	Analog 8-lead DIP SM FC/APC Connector			DS
	131T	Analog 8-lead DIP SM FC/PC Connector			DS
		M128C			Analog, 1.1 $\mu\text{m}$ to 1.6 $\mu\text{m}$ , Planar Structure
<b>Laser Modules</b>					
High-Speed Digital Distributed Feedback	246M	1.3 $\mu\text{m}$ 14-pin Butterfly Package, 2.5 Gbits/s	SONET OC-12/48, long-haul hermetic package	Internal isolator, compact & lightweight, epoxy-free,	DS
	246N	1.55 $\mu\text{m}$ 14-pin Butterfly Package, 2.5 Gbits/s			DS
	246PF	Digital 1.5 DFB CW laser with polarization maintaining fiber			DS
Analog Isolated DFB	257CH	1.3 $\mu\text{m}$ 14-pin Butterfly Package, Multiquantum well DFB laser	CATV, video surveillance, wireless and personal communication networks	Laser module with transformer coupling, internal isolator, 1000 MHz performance, 77 NTSC channel load	DS
	257CP	1.3 $\mu\text{m}$ 14-pin Butterfly Package, Multiquantum well DFB laser	CATV, video surveillance, wireless, and personal communication networks	Laser module with predistortion board, internal isolator, 750 MHz performance, 77 NTSC channel load	DS

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

## Laser Subsystems

Device Type	Part No.	Description	Application	Features	Lit.
<b>Laser Modules</b> (continued)					
Fabry-Perot	270A-Type	1.3 $\mu\text{m}$ , single-mode fiber pigtail, multiquantum well Fabry Perot laser	Telecommunications, Local loops, MANS, data communications	Wide operating temperature range, no TEC required, high output power, internal backface monitor.	DS
	270F-Type	1.3 $\mu\text{m}$ , single-mode fiber pigtail, multiquantum well Fabry Perot laser	Narrowband video, return path systems, mixed analog and digital systems, telecommunications	Wide operating temperature range, no TEC required, high output power, internal backface monitor	DS
<b>Bidirectional Laser Module</b>					
	1420-Type	1.3 $\mu\text{m}$ Bidirectional Laser Module	LANs, MANs, Fiber-in-the-Loop Systems, Telecommunication	1.3 $\mu\text{m}$ Fabry-Perot laser, InGaAsP photodetector with integral splitter, wide operating temperature range, SM fiber pigtail, high output power	DS
<b>Transmitters</b>					
1.3 $\mu\text{m}$ Fabry-Perot	1227C	200 Mbits/s, -5 dBm, FC-PC Connector	SONET OC-3 or OC-12 single-mode FDDI	20-pin DIP package with pigtail, no thermoelectric cooler required	DS
	1227D	650 Mbits/s, -5 dBm, FC-PC Connector			DS
	1227E	200 Mbits/s, -8 dBm, FC-PC Connector			DS
	1227F	200 Mbits/s, -8 dBm, FC-PC Connector			DS
	1227G	650 Mbits/s, -8 dBm, FC-PC Connector			DS
	1227H	200 Mbits/s, -11 dBm, FC-PC Connector			DS
	1227J	200 Mbits/s, -5 dBm, <i>ST</i> <sup>®</sup> Connector			DS
	1227K	650 Mbits/s, -5 dBm, <i>ST</i> Connector			DS
	1227L	200 Mbits/s, -8 dBm, <i>ST</i> Connector			DS
	1227M	200 Mbits/s, -8 dBm, <i>ST</i> Connector			DS
	1227N	650 Mbits/s, -8 dBm, <i>ST</i> Connector			DS
	1227P	200 Mbits/s, -11 dBm, <i>ST</i>			DS
	1227EB	Evaluation Board for 1227 Transmitter			DS
	1229-Type	650 Mbits/s, Pigtailed with FC-PC, SC, or <i>ST</i> connector			SONET OC-12
High-Speed 1.3 $\mu\text{m}$ Fabry-Perot	1238B	1062.5 Mbits/s, -8 dBm, SM-Pigtail	Fibre channel, SONET, Serial HIPPI	Space-saving, self-contained 20-pin DIP, no thermoelectric cooler required	DS
	1238C	Meets Sonet Mask Only, Not Fibre Channel Mask			DS
	1238EB	Eval. Board for 1238 Transmitter			DS

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### Laser Subsystems (continued)

Device Type	Part No.	Description	Application	Features	Lit.		
<b>Receivers</b>							
InGaAs PIN	1310C	InGaAs PIN, 155 Mbits/s, MM FC-PC Connector	SONET OC-3, medium to high-speed data communications	Pigtailed, 20-pin DIP, compact hermetic package	DS		
	1310D	InGaAs PIN, 622 Mbits/s, MM FC-PC Connector			DS		
	1310E	InGaAs PIN, 155 Mbits/s, MM FC-PC Connector			DS		
	1310F	InGaAs PIN, 622 Mbits/s, MM FC-PC Connector			DS		
	1310J	InGaAs PIN, 52 Mbits/s, MM FC-PC Connector			DS		
	1310K	InGaAs PIN, 52 Mbits/s, MM FC-PC Connector			DS		
	1310L	InGaAs PIN, 155 Mbits/s, MM FC-PC Connector			DS		
	1310M	InGaAs PIN, 622 Mbits/s, MM FC-PC Connector			DS		
	1310N	InGaAs PIN, 266 Mbits/s, MM FC-PC Connector			DS		
	1310P	InGaAs PIN, 155 Mbits/s, MM FC-PC Connector			DS		
	1310R	InGaAs PIN, 52 Mbits/s, MM FC-PC Connector			DS		
	1310S	InGaAs PIN, 52 Mbits/s, MM <i>ST</i> Connector			DS		
	1310EB	Evaluation Board for 1310 Receiver			DS		
	1330-Type	155 Mbits/s FC-PC Connector			SONET OC-3	Clock recovery and data regeneration 20-pin DIP, TTL compatible, phase-locked loop, low power	DS
High-Speed InGaAs PIN	1318A	1062.5 Mbits/s Multimode Pigtail	Fibre channel, SONET	Connectorized, 20-pin DIP	DS		
InGaAs APD	1319B	2.5 Gbits/s, SM FC-PC Connector	SONET OC-48, line terminal equipment, high-speed networks	GaAs preamplifier, compact butterfly package	DS		
	1319C	2.5 Gbits/s, SM <i>ST</i> Connector			DS		
	1320A	155 Mbits/s, FC-PC Connector			SONET OC-3	Space-saving, self-contained 24-pin package	DS
	1320B	155 Mbits/s, SC Connector			SONET OC-3	DS	
	1320C	622 Mbits/s, FC-PC Connector			SONET OC-12	DS	
1320D	622 Mbits/s, SC Connector	SONECT OC-12	DS				

## Laser Subsystems (continued)

Device Type	Part No.	Description	Application	Features	Lit.
<b>Optical Amplifiers and Components</b>					
Fiber	1712A	Pout, 11 dBm, <i>ST</i> Connector	Amplifiers for repeaters, power boosters, preamps, CATV networks, LANs, and MANs	980 nm pump, TTL	DS
	1712B	Pout, 11 dBm, FC-PC Connector		compatible alarm outputs,	DS
	1712C	Pout, 11 dBm, SC Connector		wide operating tempera-	DS
	1712D	Pout, 14 dBm, <i>ST</i> Connector		ture range, optical input	DS
	1712E	Pout, 14 dBm, FC-PC Connector		and output taps, low	DS
	1712F	Pout, 11 dBm, SC Connector		power consumption	DS
	1713A	Pout, 8.5 dBm, <i>ST</i> Connector		1480 nm pump, TTL	DS
	1713B	Pout, 8.5 dBm, FC-PC Connector		compatible alarm outputs,	DS
	1713C	Pout, 8.5 dBm, SC Connector		wide operating tempera-	DS
	1713D	Pout, 11.5 dBm, <i>ST</i> Connector		ture range, optical input	DS
	1713E	Pout, 11.5 dBm, FC-PC Connector	and output taps, low	DS	
	1713F	Pout, 11.5 dBm, SC Connector	power consumption	DS	
	1713G	Pout, 15.5 dBm, <i>ST</i> Connector		DS	
	1713H	Pout, 15.5 dBm, FC-PC Connector		DS	
	1713H	Pout, 15.5 dBm, SC Connector		DS	
	1720ABC	Pout, 13 dBm, SC Connector		DS	
	1720BBC	Pout, 16 dBm, SC Connector		DS	
	1720CBC	Pout, 16 dBm, SC Connector		DS	
	1714ABC	Pout, 11 dBm, SC Connector	Amplifier gain	980 nm pump, optical	DS
	1714BBC	Pout, 13 dBm, SC Connector	blocks for repeaters,	input and output taps,	DS
1714CBC	Pout, 15 dBm, SC Connector	power boosters, line	wide input signal band-	DS	
1715ABC	Pout, 12 dBm, SC Connector	amplifiers, CATV,	width 1480 nm pump for	DS	
1715BBC	Pout, 14 dBm, SC Connector	networks, LANS	greater reliability optical	DS	
1715CBC	Pout, 16 dBm, SC Connector	and MANs.	input and output taps,	DS	
1718ABC	Pout, 11 dBm, SC Connector		wide input signal	DS	
1718BBC	Pout, 13 dBm, SC Connector		bandwidth	DS	
1718CBC	Pout, 15 dBm, SC Connector			DS	
<b>Pump Lasers</b>					
	263C	60 mW output power	Erbium-doped fiber amplifier systems	Field-proven packaging	DS
	263D	70 mW output power		technology, compact	DS
	263E	80 mW output power		14-pin butterfly package,	DS
	263F	90 mW output power		InGaAs/GaAlAs high-	DS
	263G	100 mW output power		power quantum well	DS
	263H	110 mW output power		chip design	DS

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447



## POWER PRODUCTS

AT&T Microelectronics offers a broad line of power conversion products and power protection systems to fulfill the needs of the telecommunications and electronic data processing markets.

AT&T board-mounted power modules, ranging from 0.5 W to 300 W, have small footprints, high efficiencies, and high-power densities. Our dc-dc converters range from 15 W to 1500 W, and the off-line switchers range from 50 W to 2,000 W. See details on the new line of DiskPower converters, Front Ends, and Power Shelves.

Our power systems design staff in Dallas is available to assist you in the selection of power architectures that meet your needs. Dallas is an ISO 9001 registered facility and 1994 Deming Prize winner.

### Board-Mounted Power Modules

AT&T board-mounted power modules offer low profiles, high-power density, off-the-shelf, dc-dc power conversions in module sizes of 0.5 W to 300 W. Known for reliability, AT&T board-mounted power modules feature a variety of design options with typical power efficiencies in excess of 80%. State-of-the-art surface-mount technology is used to achieve high performance in a small package. MTBFs of over one million hours and a three-year warranty are standard.

A system powered by board-mounted power modules offers many user benefits. 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 profiles
- High efficiencies
- 0.5 W to 300 W
- High-power densities
- Small footprints
- Remote on/off capability
- Remote sense
- Output current limiting
- Overvoltage protection
- Isolated and nonisolated models
- Input/output filtering
- External synchronization
- Parallel operation with forced load sharing
- Regulated output voltage
- -40 °C to +100 °C operating case temperature
- *UL* recognized
- 3-year warranty

# POWER PRODUCTS

## Board-Mounted Power Modules Low-Power Product Matrix (0.5 W to 50 W)

Part Number	Nominal Input (Vdc)	Input Range (Vdc)	Output Voltage (Vdc)*	Output Current (IA)	Power, Watts (W)	Length (in.)	Width (in.)	Height (in.)	Temp. (°C)	Literature
112A2	5	4.5—5.5	12	0.041	0.5	0.96	0.70	0.44	0 to +70	DS
112C2	5	4.5—5.5	15	0.100	1.5	0.96	0.70	0.44	0 to +70	DS
112D2	5	4.5—5.5	25	0.030	0.75	0.96	0.70	0.44	0 to +70	DS
112E2	5	4.5—5.5	12	0.125	1.5	0.96	0.70	0.44	0 to +70	DS
113A2	5	4.5—5.5	-5	0.100	0.5	0.96	0.70	0.44	0 to +70	DS
113AA2	5	4.5—5.5	-5	0.100	0.500	0.96	0.70	0.44	0 to +70	DS
113B2	5	4.5—5.5	-12	0.063	0.75	0.96	0.70	0.44	0 to +70	DS
113B3	5	4.5—5.5	-12	0.063	0.75	0.96	0.70	0.44	0 to +70	DS
113C2	5	4.5—5.5	-15	0.050	0.75	0.96	0.70	0.44	0 to +70	DS
113E2	5	4.5—5.5	-130	0.0005	0.065	0.96	0.70	0.44	0 to +70	DS
113F2	5	4.5—5.5	-5	0.300	1.5	0.96	0.70	0.44	0 to +70	DS
113F3	5	4.5—5.5	-5	0.300	1.5	0.96	0.70	0.44	0 to +70	DS
113G2	5	4.5—5.5	-12	0.125	1.5	0.96	0.70	0.44	0 to +70	DS
RA003A	12	8.0—16.5	5	0.6	3	1.75	0.43	0.81	-10 to +50	DS
RA003B	12	8.0—16.5	12	0.25	3	1.75	0.43	0.81	-10 to +50	DS
RA003C	12	8.0—16.5	15	0.2	3	1.75	0.43	0.81	-10 to +50	DS
RA003BK	12	8.0—16.5	±12	±0.125	3	1.75	0.43	0.81	-10 to +50	DS
RA003CL	12	8.0—16.5	±15	±0.1	3	1.75	0.43	0.81	-10 to +50	DS
RC003A	28	16—32	5	0.6	3	1.75	0.43	0.81	-10 to +50	DS
RC003B	28	16—32	12	0.25	3	1.75	0.43	0.81	-10 to +50	DS
RC003C	28	16—32	15	0.2	3	1.75	0.43	0.81	-10 to +50	DS
RC003BK	28	16—32	±12	±0.125	3	1.75	0.43	0.81	-10 to +50	DS
RC003CL	28	16—32	±15	±0.1	3	1.75	0.43	0.81	-10 to +50	DS
RE003A	48	28—60	5	0.6	3	1.75	0.43	0.81	-10 to +50	DS
RE003B	48	28—60	12	0.25	3	1.75	0.43	0.81	-10 to +50	DS
RE003C	48	28—60	15	0.2	3	1.75	0.43	0.81	-10 to +50	DS
RE003BK	48	28—60	±12	±0.125	3	1.75	0.43	0.81	-10 to +50	DS
RE003CL	48	28—60	±15	±0.1	3	1.75	0.43	0.81	-10 to +50	DS
RH003A	5	4.0—7.2	5	0.6	3	1.75	0.43	0.81	-10 to +50	DS
RH003B	5	4.0—7.2	12	0.25	3	1.75	0.43	0.81	-10 to +50	DS
RH003C	5	4.0—7.2	15	0.2	3	1.75	0.43	0.81	-10 to +50	DS
RH003BK	5	4.0—7.2	±12	±0.125	3	1.75	0.43	0.81	-10 to +50	DS
RH003CL	5	4.0—7.2	±15	±0.1	3	1.75	0.43	0.81	-10 to +50	DS
MA005A	12	10—15	5	1.00	5	2.00	1.10	0.46	-10 to +70	DS
MA005B	12	10—15	12	0.42	5	2.00	1.10	0.46	-10 to +70	DS
MA005C	12	10—15	15	0.33	5	2.00	1.10	0.46	-10 to +70	DS
MA005BK	12	10—15	±12	±0.21	5	2.00	1.10	0.46	-10 to +70	DS
MA005CL	12	10—15	±15	±0.17	5	2.00	1.10	0.46	-10 to +70	DS

\*Other voltages available.

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447

**Board-Mounted Power Modules (continued)**  
**Low-Power Product Matrix (0.5 W to 50 W)**

Part Number	Nominal Input (Vdc)	Input Range (Vdc)	Output Voltage (Vdc)*	Output Current (IA)	Power, Watts (W)	Length (in.)	Width (in.)	Height (in.)	Temp. (°C)	Literature
MC005A	28	18—36	5	1.0	5	2.00	1.10	0.46	-40 to +85	DS
MC005B	28	18—36	12	0.42	5	2.00	1.10	0.46	-40 to +85	DS
MC005C	28	18—36	15	0.33	5	2.00	1.10	0.46	-40 to +85	DS
MC005BK	28	18—36	±12	±0.21	5	2.00	1.10	0.46	-40 to +85	DS
MC005CL	28	18—36	±15	±0.17	5	2.00	1.10	0.46	-40 to +85	DS
ME005A	48	39.5—60	5	1.0	5	2.00	1.10	0.46	-40 to +85	DS
ME005B	48	39.5—60	12	0.42	5	2.00	1.10	0.46	-40 to +85	DS
ME005C	48	39.5—60	15	0.33	5	2.00	1.10	0.46	-40 to +85	DS
ME005N	48	39.5—60	5.2	0.96	5	2.00	1.10	0.46	-40 to +85	—
ME005BK	48	39.5—60	±12	±0.21	5	2.00	1.10	0.46	-40 to +85	DS
ME005CL	48	39.5—60	±15	0.17	5	2.00	1.10	0.46	-40 to +85	DS
MH005A	5	4.5—5.5	5	1.00	5	2.00	1.10	0.46	-10 to +70	DS
MH005B	5	4.5—5.5	12	0.42	5	2.00	1.10	0.46	-10 to +70	DS
MH005C	5	4.5—5.5	15	0.33	5	2.00	1.10	0.46	-10 to +70	DS
MH005BK	5	4.5—5.5	±12	±0.21	5	2.00	1.10	0.46	-10 to +70	DS
MH005CL	5	4.5—5.5	±15	±0.17	5	2.00	1.10	0.46	-10 to +70	DS
MK005CL5	48	38—72	20	120	5	2.00	1.19	0.46	-40 to +85	DS
MW005A	48	36—72	5	1.0	5	2.00	1.10	0.46	-40 to +85	DS
MW005B	48	36—72	12	0.42	5	2.00	1.10	0.46	-40 to +85	DS
MW005C	48	36—72	15	0.33	5	2.00	1.10	0.46	-40 to +85	DS
MW005AJ	48	36—72	±5	±0.5	5	2.00	1.10	0.46	-40 to +85	DS
MW005BK	48	36—72	±12	0.21	5	2.00	1.10	0.46	-40 to +85	DS
MW005CL	48	36—72	±15	0.17	5	2.00	1.10	0.46	-40 to +85	DS
FE008AJ4	48	39.5—60	±5	1.2	8	2.00	2.00	0.50	-40 to +85	DS
FE008AJ3	48	39.5—60	±5	2.0, -0.4	8	2.00	2.00	0.50	0 to +70	DS
MA010A	12	10—15	5	2.00	10	2.00	1.60	0.50	-10 to +50	DS
MA010B	12	10—15	12	0.83	10	2.00	1.60	0.50	-10 to +50	DS
MA010C	12	10—15	15	0.67	10	2.00	1.60	0.50	-10 to +50	DS
MA010BK	12	10—15	±12	±0.42	10	2.00	1.60	0.50	-10 to +50	DS
MA010CL	12	10—15	±15	±0.33	10	2.00	1.60	0.50	-10 to +50	DS
MC010A	28	18—36	5	2.0	10	2.00	1.60	0.50	-40 to +85	DS
MC010B	28	18—36	12	0.83	10	2.00	1.60	0.50	-40 to +85	DS
MC010C	28	18—36	15	0.67	10	2.00	1.60	0.50	-40 to +85	DS
MC010BK	28	18—36	±12	0.43	10	2.00	1.60	0.50	-40 to +85	DS
MC010CL	28	18—36	±15	0.33	10	2.00	1.60	0.50	-40 to +85	DS
MH010A	5	4.5—5.5	5	2.00	10	2.00	1.60	0.50	-10 to +50	DS
MH010B	5	4.5—5.5	12	0.83	10	2.00	1.60	0.50	-10 to +50	DS
MH010C	5	4.5—5.5	15	0.67	10	2.00	1.60	0.50	-10 to +50	DS

\*Other voltages available.

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

# POWER PRODUCTS

## Board-Mounted Power Modules (continued) Low-Power Product Matrix (0.5 W to 50 W)

Part Number	Nominal Input (Vdc)	Input Range (Vdc)	Output Voltage (Vdc)*	Output Current (IA)	Power, Watts (W)	Length (in.)	Width (in.)	Height (in.)	Temp. (°C)	Literature
MH010BK	5	4.5—5.5	±12	±0.42	10	2.00	1.60	0.50	-10 to +50	DS
MH010CL	5	4.5—5.5	±15	±0.33	10	2.00	1.60	0.50	-10 to +50	DS
MW010A	48	36—72	5	2.0	10	2.00	1.60	0.50	-40 to +85	DS
MW010B	48	36—72	12	0.83	10	2.00	1.60	0.50	-40 to +85	DS
MW010C	48	36—72	15	0.67	10	2.00	1.60	0.50	-40 to +85	DS
MW010BK	48	36—72	±12	0.43	10	2.00	1.60	0.50	-40 to +85	DS
MW010CL	48	36—72	±15	0.33	10	2.00	1.60	0.50	-40 to +85	DS
SE014S110	48	40—60	110	130	14	2.00	2.00	0.50	-40 to +85	DS
LW016AJ	48	36—75	±5	±16	16	2.00	2.00	0.375	-25 to +71	—
LW020A	48	36—75	5	4	20	2.00	2.00	0.375	-25 to +71	—
NH020F	5	4.5—5.5	3.3	6	20	2.50	0.24	0.55	0 to +55	DS
CC025AJ	28	18—36	±5	2.50	25	2.80	2.40	0.50	-40 to +95	DS
CC025BK	28	18—36	±12	1.04	25	2.80	2.40	0.50	-40 to +95	DS
CC025CL	28	18—36	±15	0.83	25	2.80	2.40	0.50	-40 to +95	DS
CC025ABK	28	18—36	5, ±12	5, ±1	25	2.80	2.40	0.50	-40 to +95	—
CC025ACL	28	18—36	5, ±15	5, ±0.8	25	2.80	2.40	0.50	-40 to +95	—
CW025AJ	48	36—72	±5	±2.50	25	2.80	2.40	0.50	-40 to +95	DS
CW025BK	48	36—72	±12	±1.04	25	2.80	2.40	0.50	-40 to +95	DS
CW025CL	48	36—72	±15	±0.83	25	2.80	2.40	0.50	-40 to +95	DS
CW025ABK	48	36—72	5, ±12	5, ±1	25	2.80	2.40	0.50	-40 to +95	—
CW025ACL	48	36—72	5, ±15	5, ±0.8	25	2.80	2.40	0.50	-40 to +95	—
DC025AA	28	18—36	5, 5	2.5, 2.5	25	2.80	2.40	0.50	-40 to +95	DS
DC025AF	28	18—36	5, 3.3	2.50, 2.50	25	2.80	2.40	0.50	-40 to +95	DS
DC025AJ	28	18—36	±5	±2.50	25	2.80	2.40	0.50	-40 to +95	DS
DC025BB	28	18—36	12, 12	1.04, 1.04	25	2.80	2.40	0.50	-40 to +95	DS
DC025BK	28	18—36	±12	±1.04	25	2.80	2.40	0.50	-40 to +95	DS
DC025CC	28	18—36	15, 15	0.83, 0.83	25	2.80	2.40	0.50	-40 to +95	DS
DC025CL	28	18—36	±15	±0.83	25	2.80	2.40	0.50	-40 to +95	DS
DC025ABK	28	18—36	5, ±12	5, ±1	25	2.80	2.40	0.50	-40 to +95	—
DC025ACL	28	18—36	5, ±15	5, ±0.8	25	2.80	2.40	0.50	-40 to +95	—
DW025AA	48	36—72	5, 5	2.50, 2.50	25	2.80	2.40	0.50	-40 to +95	DS
DW025AB	48	36—72	5, 12	5, 1	25	2.80	2.40	0.50	-40 to +95	DS
DW025AF	48	36—72	5, 3.3	2.50, 2.50	25	2.80	2.40	0.50	-40 to +95	DS
DW025AJ	48	36—72	±5	±2.50	25	2.80	2.40	0.50	-40 to +95	DS
DW025BB	48	36—72	12, 12	1.04, 1.04	25	2.80	2.40	0.50	-40 to +95	DS
DW025BK	48	36—72	±12	±1.04	25	2.80	2.40	0.50	-40 to +95	DS
DW025CC	48	36—72	15, 15	0.83, 0.83	25	2.80	2.40	0.50	-40 to +95	DS
DW025CL	48	36—72	±15	±0.83	25	2.80	2.40	0.50	-40 to +95	DS
DW025ABK	48	36—72	5, ±12	5, ±1	25	2.80	2.40	0.50	-40 to +95	—

\*Other voltages available.

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447

**Board-Mounted Power Modules (continued)**  
**Low-Power Product Matrix (0.5 W to 50 W)**

Part Number	Nominal Input (Vdc)	Input Range (Vdc)	Output Voltage (Vdc)*	Output Current (IA)	Power, Watts (W)	Length (in.)	Width (in.)	Height (in.)	Temp. (°C)	Literature
DW025ACL	48	36—72	5, ±15	5, ±0.8	25	2.80	2.40	0.50	-40 to +95	—
CC030A	28	18—36	5	6.0	30	2.80	2.40	0.50	-40 to +100	DS
CC030B	28	18—36	12	2.5	30	2.80	2.40	0.50	-40 to +100	DS
CC030C	28	18—36	15	2.0	30	2.80	2.40	0.50	-40 to +100	DS
CW030A	48	36—72	5	6.0	30	2.80	2.40	0.50	-40 to +95	DS
CW030B	48	36—72	12	2.5	30	2.80	2.40	0.50	-40 to +95	DS
CW030C	48	36—72	15	2.0	30	2.80	2.40	0.50	-40 to +95	DS
LW030A	48	36—75	5	6	30	2.40	2.80	0.375	-30 to +75	DS
JC030A	24	18—36	5	6.0	30	2.40	2.28	0.50	-40 to +100	DS
JC030B	24	18—36	12	2.5	30	2.40	2.28	0.50	-40 to +100	DS
JC030C	24	18—36	15	2.0	30	2.40	2.28	0.50	-40 to +100	DS
JW030A	48	36—72	5	6.0	30	2.40	2.28	0.50	-40 to +100	DS
JW030B	48	36—72	12	2.5	30	2.40	2.28	0.50	-40 to +100	DS
JW030C	48	36—72	15	2.0	30	2.40	2.28	0.50	-40 to +100	DS
JW030D	48	36—72	2	6.5	13	2.40	2.28	0.50	-40 to +100	DS

\*Other voltages available.

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447

# POWER PRODUCTS

## High-Power Product Matrix (50 W to 300 W)

Part Number	Nominal Input (Vdc)	Input Range (Vdc)	Output Voltage (Vdc)*	Output Current (IA)	Power, Watts (W)	Length (in.)	Width (in.)	Height (in.)	Temp. (°C)	Literature
JC050A1	28	18—36	5	10	50	2.40	2.28	0.50	-40 to +100	DS
JC050B1	28	18—36	12	4.2	50	2.40	2.28	0.50	-40 to +100	DS
JC050C1	28	18—36	15	3.3	50	2.40	2.28	0.50	-40 to +100	DS
JC050F1	28	18—36	3.3	10	50	2.40	2.28	0.50	-40 to +100	DS
JC075A1	28	18—36	5	15	75	2.40	2.28	0.50	-40 to +100	DS
JC075B1	28	18—36	12	6.3	75	2.40	2.28	0.50	-40 to +100	DS
JC100A1	28	18—36	5	20	100	2.40	2.28	0.50	-40 to +100	DS
JC100B1	28	18—36	12	8.3	100	2.40	2.28	0.50	-40 to +100	DS
JC100C1	28	18—36	15	6.7	100	2.40	2.28	0.50	-40 to +100	DS
JC100F1	28	18—36	3.3	20	100	2.40	2.28	0.50	-40 to +100	DS
JW050A	48	36—72	5	10	50	2.40	2.28	0.50	-40 to +100	DS
JW050B	48	36—72	12	4.2	50	2.40	2.28	0.50	-40 to +100	DS
JW050C	48	36—72	15	3.3	50	2.40	2.28	0.50	-40 to +100	DS
JW050F	48	36—72	3.3	10	33	2.40	2.28	0.50	-40 to +100	DS
JW075A1	48	36—72	5	15	75	2.40	2.28	0.50	-40 to +100	DS
JW075B1	48	36—72	12	6.3	75	2.40	2.28	0.50	-40 to +100	DS
JW075D1	48	36—72	2	15	75	2.40	2.28	0.50	-40 to +100	DS
JW100A	48	36—72	5	20.0	100	2.40	2.28	0.50	-40 to +100	DS
JW100B	48	36—72	12	8.3	100	2.40	2.28	0.50	-40 to +100	DS
JW100C	48	36—72	15	6.7	100	2.40	2.28	0.50	-40 to +100	DS
JW100F	48	36—72	3.3	20.0	66	2.40	2.28	0.50	-40 to +100	DS
JW150A	48	36—72	5	30	150	2.40	2.28	0.50	-40 to +100	DS
JW150B	48	36—72	12	12.5	150	2.40	2.28	0.50	-40 to +100	DS
JW150C	48	36—72	15	10.0	150	2.40	2.28	0.50	-40 to +100	DS
JW150F	48	36—72	3.3	30	99	2.40	2.28	0.50	-40 to +100	DS
FC050A	28	18—36	5	10.0	50	4.80	2.50	0.50	0 to +90	DS
FC050B	28	18—36	12	4.2	50	4.80	2.50	0.50	0 to +90	DS
FC050C	28	18—36	15	3.3	50	4.80	2.50	0.50	0 to +90	DS
FC050D	28	18—36	2	10	20	4.80	2.50	0.50	0 to +90	—
FC050F	28	18—36	3.3	10.0	33	4.80	2.50	0.50	0 to +90	DS
FC100A	28	18—36	5	20.0	100	4.80	2.50	0.50	0 to +90	DS
FC100B	28	18—36	12	8.3	100	4.80	2.50	0.50	0 to +90	DS
FC100C	28	18—36	15	6.7	100	4.80	2.50	0.50	0 to +90	DS
FC100D	28	18—36	2	20.0	40	4.80	2.50	0.50	0 to +90	—
FC100F	28	18—36	3.3	20.0	66	4.80	2.50	0.50	0 to +90	DS
FC150A	28	18—36	5	30.0	150	4.80	2.50	0.50	0 to +90	DS
FC150C	28	18—36	15	10.0	150	4.80	2.50	0.50	0 to +90	DS
FC150D	28	18—36	2	30.0	60	4.80	2.50	0.50	0 to +90	DS
FC150F	28	18—36	3.3	30.0	100	4.80	2.50	0.50	0 to +90	DS

\*Other voltages available.

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

### High-Power Product Matrix (50 W to 300 W) (continued)

Part Number	Nominal Input (Vdc)	Input Range (Vdc)	Output Voltage (Vdc)*	Output Current (IA)	Power, Watts (W)	Length (in.)	Width (in.)	Height (in.)	Temp. (°C)	Literature
FC250A1	28	18—36	5	50	250	2.40	4.60	0.50	-40 to +100	DS
FC250B1	28	18—36	12	20.8	250	2.40	4.60	0.50	-40 to +100	DS
FC250C1	28	18—36	15	16.7	250	2.40	4.60	0.50	-40 to +100	DS
FC250F1	28	18—36	3.3	50	250	2.40	4.60	0.50	-40 to +100	DS
FE050A	48	38—60	5	10.0	50	4.80	2.50	0.50	0 to +90	DS
FE050B	48	38—60	12	4.2	50	4.80	2.50	0.50	0 to +90	DS
FE050C	48	38—60	15	3.33	50	4.80	2.50	0.50	0 to +90	—
FE050D	48	38—60	2.0	10.0	20	4.80	2.50	0.50	0 to +90	DS
FE050F	48	38—60	3.3	10.0	33	4.80	2.50	0.50	0 to +90	DS
FE050H	48	38—60	24	2.1	50	4.80	2.50	0.50	0 to +90	DS
FE100A	48	38—60	5	20.0	100	4.80	2.50	0.50	0 to +90	DS
FE100B	48	38—60	12	8.3	100	4.80	2.50	0.50	0 to +90	DS
FE100C	48	38—60	15	6.7	100	4.80	2.50	0.50	0 to +90	—
FE100D	48	38—60	2.0	20.0	40	4.80	2.50	0.50	0 to +90	DS
FE100F	48	38—60	3.3	20.0	66	4.80	2.50	0.50	0 to +90	DS
FE100H	48	38—60	24	4.2	100	4.80	2.50	0.50	0 to +90	DS
FE150A	48	38—60	5	30.0	150	4.80	2.50	0.50	0 to +90	DS
FE150B	48	38—60	12	12.5	150	4.80	2.50	0.50	0 to +90	DS
FE150C	48	38—60	15	10.0	150	4.80	2.50	0.50	0 to +90	—
FE150D	48	38—60	2	30.0	60	4.80	2.50	0.50	0 to +90	DS
FE150F	48	38—60	3.3	30.0	100	4.80	2.50	0.50	0 to +90	DS
FE150H	48	38—60	24	6.25	150	4.80	2.50	0.50	0 to +90	DS
FE200A9	48	38—60	5	40	200	4.80	2.50	0.50	0 to +80	DS
FE200B9	48	38—60	12	16.6	200	4.80	2.50	0.50	0 to +80	DS
FE200F9	48	38—60	3.3	40	132	4.80	2.50	0.50	0 to +80	DS
FW050A	48	36—72	5.0	10.0	50	4.80	2.50	0.50	0 to +90	DS
FW050B	48	36—72	12	4.2	50	4.80	2.50	0.50	0 to +90	DS
FW050C	48	36—72	15	3.33	50	4.80	2.50	0.50	0 to +90	DS
FW050D	48	36—72	2	10	20	4.80	2.50	0.50	0 to +90	—
FW050F	48	36—72	3.3	10	33	4.80	2.50	0.50	0 to +90	DS
FW100A	48	36—72	5.0	20.0	100	4.80	2.50	0.50	0 to +90	DS
FW100B	48	36—72	12	8.4	100	4.80	2.50	0.50	0 to +90	DS
FW100C	48	36—72	15	6.7	100	4.80	2.50	0.50	0 to +90	DS
FW100D	48	36—72	2	20	40	4.80	2.50	0.50	0 to +90	—
FW100F	48	36—72	3.3	20	66	4.80	2.50	0.50	0 to +90	—

\*Other voltages available.

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447.

## POWER PRODUCTS

### High-Power Product Matrix (50 W to 300 W) (continued)

Part Number	Nominal Input (Vdc)	Input Range (Vdc)	Output Voltage (Vdc)*	Output Current (IA)	Power, Watts (W)	Length (in.)	Width (in.)	Height (in.)	Temp. (°C)	Literature
FW150A	48	36—72	5.0	30.0	150	4.80	2.50	0.50	0 to +90	DS
FW150B	48	36—72	12	12.6	150	4.80	2.50	0.50	0 to +90	DS
FW150C	48	36—72	15	10.0	150	4.80	2.50	0.50	0 to +90	DS
FW150D	48	36—72	2	30	60	4.80	2.50	0.50	0 to +90	—
FW150F	48	36—72	3.3	30	99	4.80	2.50	0.50	0 to +90	DS
FW250A1	48	36—75	5	50	250	2.40	4.60	0.50	-40 to +100	DS
FW250B1	48	36—75	12	20.8	250	2.40	4.60	0.50	-40 to +100	DS
FW250F1	48	36—75	3.3	50	250	2.40	4.60	0.50	-40 to +100	DS
FW300A1	48	36—75	5	60	300	2.40	4.60	0.50	-40 to +100	DS
FW300B1	48	36—75	12	25	300	2.40	4.60	0.50	-40 to +100	DS
FW300F1	48	36—75	3.3	60	300	2.40	4.60	0.50	-40 to +100	DS

\*Other voltages available

For additional information, call your AT&T Account Manager, your local distributor, or 1-800-372-2447

### DiskPower Modules

The TW050AB and TW070AB DiskPower Converters are designed to power large-capacity disk drives and other mass storage devices. They are ideal for implementing distributed power systems in disk array systems.

The modules operate with input voltages from 36 Vdc to 72 Vdc and provide two outputs: 5 Vdc and 12 Vdc. Each output is independently regulated. The output ripple and noise are very low. The 12 V output supports surge currents up to 3.5 A for the TW050AB and up to 5 A for the TW070AB in order to spin-up large disk drives.

Other features include overvoltage protection and current limiting on each output and a remote on/off input. The modules offer a very low failure rate and reliability ten times better than the disk drives being powered.

- Input and outputs are electrically isolated
- 2:1 input voltage range
- Remote on/off
- Overtemperature protection
- UL 1950, CSA 22.2—950, and EN60950 approvals are pending

#### Features

- Small—Business Card Size  
2.0 in. x 3.5 in. x 0.625 in.  
50.8 mm x 88.9 mm x 15.9 mm
- Low output noise
- Economical open-frame construction
- Automated assembly with all surface-mount construction offers high reliability and consistency

### DiskPower Modules

Part Number	Nominal Input (Vdc)	Input Range (Vdc)	Output Voltage (Vdc)*	Output Current (IA)	Power, Watts (W)	Length (in.)	Width (in.)	Height (in.)	Temp. (°C)	Literature
TW050AB	48	36—72	5.12	1.5, 2.5 (3.5)	37.5	2.0	3.5	0.625	0 to +50	DS
TW070AB	48	36—72	5.12	2.2, 2.5 (5.0)	41	2.0	3.5	0.625	0 to +50	DS

## Enhanced Distributed Power Architecture (EDPA)

### RM Series Front Ends

AT&T front-end power supplies convert ac input power to a regulated, SELV dc bus voltage. They are parallelable, are power factor corrected, and can be used redundantly. AT&T's front-end power supplies feature a full complement of alarm and control functions to ease diagnostics and are available in power levels up to 2000 W.

### Features

- Recognized by *Underwriters Laboratories* to UL 1950, certified by CSA to CSA 22.2 and also licensed to IEC950
- Meets FCC Class A EMI requirements for conducted and radiated emissions
- Autoranging for worldwide input voltage ranges
- Power factor corrected
- Outputs are overvoltage protected
- Overtemperature protection
- Redundant parallel operation
- Remote ON/OFF
- Current sharing
- Hot insertion/removal (hot plug)
- Power fail and fault alarms
- Margining

### RM Series Front Ends

Watts (W)	Input (Vac)	Output (Vdc, A)	L	Dimensions			Part Number
				W	H		
750	85—264	48, 15.6	12	3	5		RM0750A
750	85—264	54.5, 13.7	12	3	5		RM0750H
750	85—264	56.25, 13.3	12	3	5		RM0750L
1000	85—264	48, 20.8	12	4	5		RM1000A
1000	85—264	54.5, 18.3	12	4	5		RM1000H
1000	85—264	56.25, 17.7	12	4	5		RM1000L
1500	102—264	48, 31.2	12	6	5		RM1500A
1500	102—264	54.5, 27.5	12	6	5		RM1500H
1500	102—264	56.25, 26.6	12	6	5		RM1500L
2000	170—264	48, 41.6	12	6	5		RM2000A
2000	170—264	54.5, 36.7	12	6	5		RM2000H
2000	170—264	56.25, 35.5	12	6	5		RM2000L

## POWER PRODUCTS

### Power Shelves

AT&T Power Shelves mount in a standard 19 in. rack and provide all of the wiring and control signals for the front-end power supplies and battery interface units.

### Features

- Rack mount sheet metal chassis (3U height, 19 in. rack)
- ac input module with line filtering, circuit breaker, and ac present LED
- Power system controller

### Power Shelves

Number of Power Slots	Units Accomodated	Part Number
4	750 W	PS3000A4
3	1000 W	PS3000A3
2	1500 W/2000 W	PS3000A2

### dc-dc Converters

#### Capabilities

- AT&T has more than 50 years experience in designing and manufacturing custom dc-dc converters typically ranging from 15 W to 1500 W with a wide variety of optional features.
- Custom design capabilities to address both United States and European requirements and standards.
- Manufacturing capabilities are available in the United States (Dallas, TX), Europe (Malmesbury, UK), and Mexico (Matamoros).
- AT&T's Dallas manufacturing site includes fully equipped product qualification facilities to meet FCC, *UL*, *CSA*, and other world regulatory and safety agency requirements.

- Surface-mount technology is available to provide high-power densities, modular packaging flexibility, and high quality.

#### Features

- Wide input voltage range
- Low-profile designs
- Wide operating temperature range
- Input-to-output isolation
- Inrush protection to provide hot plug-in capability
- Meets CISPR and FCC EMI and susceptibility requirements
- Externally synchronized switching frequency
- Customized alarms for input/output conditions
- Load sharing with redundancy and fault tolerance
- Programmable overcurrent shutdown
- Remote sensing

- Output current limiting/shutdown
- AT&T can provide a fully customized dc-dc converter solution using customer-specified hardware.
- AT&T offers a standard family of proven high-reliability *Fastech* and *TRANSPAC* dc-dc converters that can be modified if necessary to meet specific application requirements. *Fastech* and *TRANSPAC* dc-dc converters use AT&T connector systems and are plug-in type circuit card modules which have standardized feature sets.

The following is a representative listing of AT&T *Fastech*, *TRANSPAC*, and custom dc-dc converter products.

## TRANSFORMERS AND INDUCTORS

AT&T manufactures more than 3000 different transformers for telecommunications and power applications. This guide includes those transformers designed to meet the need for modem, ISDN, and high-frequency applications. In addition, AT&T manufactures custom power magnetics for both linear and switched-mode power supplies.

AT&T manages its transformer division from the Power Systems location in Mesquite, Texas. Each of our manufacturing locations has been ISO and BABT Certified, and AT&T Microelectronics Power Systems is the first American manufacturer to be awarded the Deming Prize for quality.

Along with the expertise that goes with 30 years of magnetics design and manufacturing experience, AT&T offers the following features and benefits:

- Low-profile packaging
- Compatibility with ITU-T, ANSI, and *IEEE* standards
- Compliance with Bellcore TR-NWT-00357 Component Reliability Requirements
- Compliance with AT&T X-74550 Assembly Process Qualification Requirements
- WSF/TIC compatibility
- International safety requirement compliance
- Surface-mount designs

### Attractive Quality

When you order AT&T transformers, you receive not only reliable, high-quality products, but also our value-added commitment, which includes:

- **Preorder support** - Our experienced Bell Laboratories magnetics designers provide the technical support required to incorporate our components into your design/production needs. In many cases, our magnetics designers have identified circuit or interface related problems which would have otherwise remained unresolved.
- **Product quality** - Reliability and quality are built into our products and are ensured through validated design practices, qualification of new designs, annual requalification of manufactured products, and strict control of materials and manufacturing processes.
- **Custom design** - AT&T offers both catalog and custom solutions to meet its customer's needs. Our designers work with each customer to ensure that the design objectives and specifications are understood. The specifications, initially expressed in terms of circuit performance, are analyzed and translated into magnetic parameters. Engineering samples are made and provided to customers for in-circuit evaluation. After customer approval of engineering samples and agreement on requirements, the custom product is developed for production.

### Product Availability

All transformers listed in this guide are available. Call 1-800-372-2447 to request our Transformers Selection Guide and for sales information. For technical assistance, call the Power Systems hot line 1-800-526-7819.

# TRANSFORMERS

## Modem Transformers

AT&T has an expanding portfolio of transformers designed to serve all segments of the high-speed modem market. All transformers meet appropriate industry and safety standards.

Part No.	Comcode	Agency Approvals	Maximum Insertion Loss @ 1 kHz (dB)	Maximum Return Loss 300 Hz—3 kHz (dB)	Minimum Frequency Response 0.2 dB Shaping Relative to 1 kHz
2746J <b>V.32bis</b>	107265860	UL, CSA	1.8	23	200 Hz—5 kHz
2769A <b>V.32bis</b>	106684939	UL, CSA	1.2	24	200 Hz—6 kHz
2770A <b>V.32bis</b>	1066684947	UL, CSA	1.2	24	200 Hz—6 kHz
2778A <b>V.32bis BAPT</b>	107240186	UL, CSA, BAPT	1.2	15	200 Hz—3 kHz
2780A <b>V.32bis SMT</b>	107244246	UL, CSA	1.6	24	200 Hz—6 kHz
2791A <b>V.32bis</b>	107538092	UL, CSA	2.0	24	100 Hz—4 kHz
2794J <b>V.32bis</b>	107643868	UL, CSA Pending	1.8	23	200 Hz—5 kHz
2746K <b>V.34</b>	107314338	UL, CSA	2.1	22	200 Hz—4 kHz
2781A <b>V.34 BAPT</b>	107244253	UL, CSA, BAPT	2.0	20	200 Hz—4 kHz
2783A <b>V.34 SMT</b>	107244287	UL, CSA	1.8	21	200 Hz—5 kHz
2789A <b>V.34</b>	107434086	UL, CSA	2.4	25	100 Hz—5 kHz
2791B <b>V.34</b>	107538415	UL, CSA	2.6	20	100 Hz—4 kHz
2793A <b>V.34 BAPT</b>	107593535	UL, CSA, BAPT	2.0	20	100 Hz—2 kHz
2784A <b>V.32bis PCMCIA*</b>	107390114	UL, CSA	2.7	25	200 Hz—6 kHz
2792A <b>V.34 PCMCIA</b>	107565426	UL, CSA	2.7	25	100 Hz—4 kHz
2792B <b>V.34 BAPT PCMCIA</b>	107565434	UL, CSA, BAPT Pending	2.8	20	100 Hz—4 kHz
2786A <b>V.34 PCMCIA</b>	107451358	UL, CSA	2.9	30	200 Hz—5 kHz
2796A <b>V.34 PCMCIA</b>	1076768253	UL, CSA Pending	2.7	30	200 Hz—5 kHz

\* Available with multiple terminal configurations. AT&T is developing additional PCMCIA transformers for applications requiring lower profile or lower distortion

## ISDN Transformers

AT&T offers ISDN S/T- and U-Interface transformers compatible with various ISDN transceivers.

Part No.	Comcode	Associated AT&T Transceiver IC	Turns Ratio (PRI:SEC)	Maximum Primary Inductance (mH)	Maximum Primary Leakage Inductance (μH)
2754G2 <b>U Interface</b>	106376759	T7262/T7263	1:2.5	12.0	25.6
2754H2 <sup>1</sup> <b>U Interface</b>	106559990	T7264, T7256 & T7237	1:1.5	34.2	76.4
2754J2 <sup>2</sup> <b>U Interface</b>	107155426	T7264, T7256 & T7237	1:1.5	34.2	76.4
2754K2 <sup>3</sup> <b>U Interface</b>	107306946	T7264, T7256 & T7237	1:1.5	34.2	76.4
2768A <sup>4</sup> <b>Dual PKG S/T Interface</b>	106546575	T7250C, T7256	1:2.5	22.0	4.0
2776A <sup>5</sup> <b>S/T Interface</b>	107049942	T7250C, T7256	1:2.5	22.0	5.0

In Development: Dual-Package Surface-Mount S/T-Interface Unit, Dual-Package PCMCIA S/T-Interface Unit

- 1 For North American use only.
- 2 For Far East applications
- 3 For European, North American, and Far East applications.
4. Transmit and receive transformer in single package
- 5 Meets European safety agency requirements



<b>Total Harmonic Distortion</b>	<b>Maximum dc Resistance Primary (<math>\Omega</math>)</b>	<b>Maximum dc Resistance Secondary (<math>\Omega</math>)</b>	<b>Minimum Breakdown Voltage (Vrms)</b>	<b>Maximum Length x Width x Height (Inches)</b>
-76.5 dB Max @ -10 dBm, 600 Hz	90	120	1500	0.72 x 0.63 x 0.56
-78 dB Max @ -10 dBm, 600 Hz	71	93	1500	0.62 x 0.70 x 0.35
-78 dB Max @ -10 dBm, 600 Hz	71	93	1500	0.62 x 0.80 x 0.35
-86 dB Max @ -9 dBm, 380 Hz	69	69	3000	0.71 x 0.71 x 0.565
-76 dB Max @ -10 dBm, 600 Hz	88	117	1500	0.62 x 0.80 x 0.295
-76 dB Max @ -10 dBm, 600 Hz	118	126	1000	0.69 x 0.71 x 0.472
-76.5 dB Max @ -10 dBm, 600 Hz	90	120	1000	0.66 x 0.56 x 0.481
-81 dB Max @ -9 dBm, 600 Hz	118	155	1500	0.72 x 0.63 x 0.56
-86 dB Max @ -3 dBm, 600 Hz	109	135	3000	0.71 x 0.71 x 0.495
-81 dB Max @ -9 dBm, 600 Hz	88	118	1500	0.62 x 0.80 x 0.393
-90 dB Max @ -9 dBm, 600 Hz	140	165	1000	1.145 x 0.95 x 0.50
-86 dB Max @ -10 dBm, 600 Hz	152	165	1000	0.69 x 0.71 x 0.472
-82 dB Max @ -3 dBm, 300 Hz	120	120	3000	0.71 x 0.71 x 0.42
-77 dB Max @ -10 dBm, 600 Hz	140	170	1000	0.60 x 0.33 x 0.170
-80 dB Max @ -10 dBm, 600 Hz	180	156	1000	0.66 x 0.66 x 0.172
-80 dB Max @ -10 dBm, 600 Hz	160	183	1500	0.66 x 0.66 x 0.172
-85 dB Max @ -10 dBm, 600 Hz	165	200	1000	0.75 x 0.33 x 0.172
-80 dB Max @ -10 dBm, 600 Hz	165	165	1000	0.60 x 0.33 x 0.170



<b>Maximum Interwinding Capacitance (pF)</b>	<b>Maximum dc Resistance Primary (<math>\Omega</math>)</b>	<b>Maximum dc Resistance Secondary (<math>\Omega</math>)</b>	<b>Minimum Breakdown Voltage (Vrms)</b>	<b>Maximum Length x Width x Height (Inches)</b>
—	2.5	12.2	1000	1.03 x 1.04 x 0.48
—	5.6	13.05	1000	1.03 x 1.04 x 0.48
—	7.35	13.65	1000	1.03 x 1.04 x 0.48
—	7.4	17.4	1500	1.03 x 1.04 x 0.48
100	2.3	5.8	2400	0.93 x 0.48 x 0.50
100	1.55	8.75	3000	0.68 x 1.15 x 0.51

# TRANSFORMERS

## DS1/T1/CEPT Line Interface Transformers

Products listed in order by turns ratio.

Apparatus Code	Ordering Comcode	Turns Ratio (PRI:SEC)	Minimum Primary Inductance (mH)	Maximum Primary Leakage Inductance ( $\mu$ H)	Maximum Interwinding Capacitance (pF)	Maximum dc Resistance Primary ( $\Omega$ )	Maximum dc Resistance Secondary ( $\Omega$ )	Minimum ac Breakdown (Vac)
2745AG2	106186430	1:1 CT	2.30	2	25	1.0	1.2	500
2664AM <sup>1, 4, 7</sup>	107620130	1:1 CT	1.50	3.5	5	1.0	0.5	1000
2745AJ2	106727605	1:1.07 CT	1.00	0.8	75 (TYP)	0.5	1.0	1000
2745G3	106696297	1:1.14 CT	1.75	1.4	90	1.0	1.1	850
2745AK2 <sup>1</sup>	107154676	1:1.14 CT	1.25	2	5	0.9	0.8	1000
2745AL2 <sup>4</sup>	107194326	1:1.14 CT	1.25	1.8	14	0.9	0.4	1000
2741H2 <sup>1</sup>	106003999	1:1.36 CT	0.92	2.5	5	0.9	1.5	850
2745CA	106445711	1:1.36 CT	0.92	0.7	20	0.9	1.2	850
2741J <sup>1</sup>	105668727	1CT:1.37	0.92	2	8	0.9	1.3	850
2745C2	106004013	1:1.37 CT	0.68	1.2	85 (TYP)	1.0	1.4	850
2745AE	104450697	1:1.43 CT	1.30	1.2	90	0.6	0.9	850
2741G2 <sup>1</sup>	106003973	1 CT:2 CT	3.15	6.5	5	1.9	4.4	850
2745AF2	106004047	1 CT:2 CT	3.15	3	23	1.6	3.2	850
2741R2	107213860	1 CT:1.3 CT	0.93	0.5	65	1.0	3.3	850
2745AH	105710461	1:3.76 CT	0.43	0.7	45	0.4	1.5	850
2771B (SMT)	107084352	1:1.14 CT	1.75	2	80	0.8	0.8	850
2771D (SMT) <sup>1</sup>	107310500	1:1.14 CT	1.30	1.5	5	0.6	0.7	1500
2771G (SMT)	107089906	1:1.37 CT	0.70	1.2	50 (TYP)	0.4	0.5	850
2771C (SMT)	107089880	1 CT:2 CT	3.15	3	30	1.1	2.3	1500
2664AK	107594988	1:1.91CT	0.78	0.5	20 (TYP)	0.7	1.3	1500
2664AL	107591851	1:2.1CT	0.78	0.55	20 (TYP)	0.9	2.0	1500
2664AJ	107542565	1:2.43CT	0.97	0.45	20 (TYP)	1.4	3.4	1500
2771E (SMT) <sup>1</sup>	107310518	1:2 CT	3.15	3.2	5	1.0	3.4	1500
2771H (SMT)	107436495	See Note 6	1.85	1.3	23	0.74	0.97	1500
2779C (SMT)	107637815	1:1.36 CT	1.00	0.7	25	0.85	1.3	1500
2779H (SMT)	107728594	1:1.07 CT	1.65	0.53	15	1.1	1.1	1500
		1:1.37 CT	1.65	0.50	22	1.1	1.45	1500
2779J (SMT)	107714057	1:1.07 CT	1.3	0.8	—	0.6	1.1	1500
2779L (SMT)	107714842	1:1.14 CT	1.25	1.8	14	0.9	0.48	1500

## DS3/STS-1/E3 Transformer

2745AM2 <sup>3</sup>	107253056	1:1:1	0.07	0.1	15 (TYP)	0.20	0.40	1500
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## Wide-Band Hybrid Transformer

2689J2	106648009	3 dB	75 $\Omega$ : 75 $\Omega$ + 75 $\Omega$	20 kHz—800 MHz
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1. CT = center tap.

2. An electrostatic shield is included between the primary and secondary.

3. Can be configured for both 1:1 and 1:4 impedance ratios.

4. "Hardened" to withstand a 6 A current for 1 second with no damage.

5. Precision adjustable tuned transformer used in LC tank circuit for T1 timing recovery. Minimum Q = 160 at 1.544 MHz.

6. Transformer has a dual turns ratio (1:1.0 Band 1:1.36).

7. Designed for EMI suppression in T1 circuits.

## Through-Hole Transformers for DSI Devices

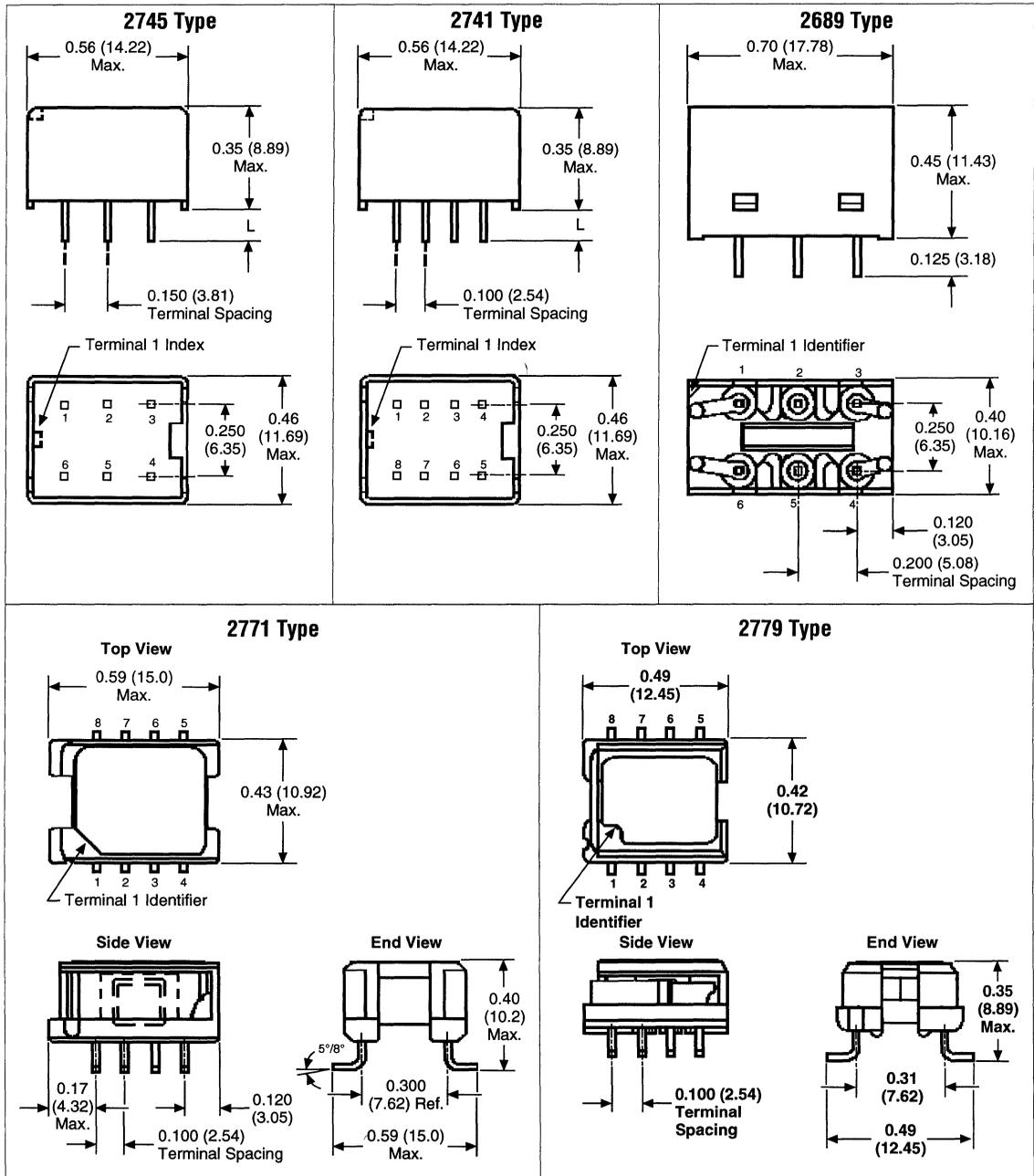
Communication Device	Application	Transmit Transformers			Receive Transformers		
		Code	Comcode	Note	Code	Comcode	Note
T7288	CEPT	2745CA	106445711	1	2745AF2	106004047	1
		2741H2	106003999	2	2741G2	106003973	2
T7289, T7289A	DS1	2745G3	106696297		2745AF2	106004047	1
		2745AK2	107154676	2	2741G2	106003973	2
		2745AL2	107194326	3			
T7290A	T1	2745C2	106004013		2745AF2	106004047	1
		2745CA	106445711	1	2741G2	106003973	2
		2741H2	106003999	2			
	DS1	2745AJ2	106727605		2745AF2	106004047	1
					2741G2	106003973	2
T7690	DS1	2745G3	106696297		2745G3	106696297	
	CEPT 75.1	2745AJ2	106727605		2745AJ2	106727605	
	CEPT 75.2	2745CA	106445711	1	2745CA	106445711	1
	CEPT 120	2745CA	106445711	1	2745CA	106445711	1
T7693	DS1	2664AL	107591851	1	2664AL	107591851	1
	CEPT 75 1	2664AK	107594988	1	2664AK	107594988	1
	CEPT 75 2	2664AJ	107542565	1	2664AJ	107542565	1
	CEPT 120	2664AJ	107542565	1	2664AJ	107542565	1
T7296	DS3, E3, STS-1	2745AM2	107253056		2745AM2	107253056	

## Surface-Mount Transformers for DSI Devices

Communication Device	Application	Transmit Transformers			Receive Transformers		
		Code	Comcode	Note	Code	Comcode	Note
T7288	CEPT	2779C	107697815		2779B	107554701	
T7289, T7289A	DS1	2779G	107554693		2779B	107554701	
T7290A	T1	2779H	107728594		2779B	107554701	
	DS1	2779H	107728594	4	2779B	107554701	
	CEPT	2779H	107728594	4	2779B	107554701	
T7690	DS1	2779G	107728594	4	2779G	107554693	
	CEPT 75.1	2779H	107728594	4	2779H	107728594	4
	CEPT 75.2	2779H	107728594	4	2779H	107728594	4
	CEPT 120	2779H	107728594	4	2779H	107728594	4

1. Transformer with extra interwinding insulation for low capacitance.
2. Transformer with electrostatic shield for maximum circuit EMI suppression.
3. Hardened transformer. Center-tapped winding can handle 6 Amps for 1 second.
4. Transformer has a dual turns ration (1:1.36 and 1:1.08) to accommodate all three applications of T7290A and all three CEPT applications the T7690.

# TRANSFORMERS



**General Notes:** Dimensions in inches (millimeters)  
 TH Standard Terminal Lengths: L = 0.110 (2.79), 0.155 (3.94)  
 Terminals: Solder Coated Phosphor Bronze, 0.023 (0.584) Sq Typ

# AT&T CUSTOM MANUFACTURING SERVICES

## Full-Service, Box-Build Solutions

AT&T Custom Manufacturing Services (CMS) is a full-service, electronics manufacturing services industry (EMSD) provider specializing in turnkey, final-system build solutions for communications products. Through its alliance with AT&T Microelectronics, AT&T CMS offers customers a one-stop product realization source.

## Total Life-Cycle Solutions

For OEMs requiring a complete solution to their manufacturing outsourcing needs, AT&T Custom Manufacturing Services offers total life-cycle solutions unlike traditional contractors with "enhanced" assembly services. We have integrated, end-to-end capabilities and resources to take a product at the de-

sign stage and deliver finished units to your end customers. We can even provide repair, upgrade, and warranty services, all with the value you would expect from AT&T—the value of high quality and reliability backed by leading technology and standard-setting customer service

Service	Primary Partner Benefit(s)	Other Benefits
<b>Concurrent Design and Engineering</b>	– <b>Reduced risk and cost</b>	<ul style="list-style-type: none"> <li>– On-site Bell Labs Design Engineering Services – PWB layout, DFX</li> <li>– Component engineering – vendor qualification, approved vendor list</li> <li>– Co-location support available for design transition</li> <li>– Bell Labs Engineering Research Center support</li> </ul>
<b>New Product Introduction</b>	– <b>Enhanced time to market</b>	<ul style="list-style-type: none"> <li>– Product design evaluation and proposals for cost reduction and reliability improvements</li> <li>– Prototype builds, evaluation and testing to prove-in manufacturing processes</li> <li>– Design For Manufacturability (DFM) reviews following the prototype build</li> <li>– Each program assigned a dedicated project manager who leads a cross-functional project team throughout the life of the program</li> <li>– Concurrent approach provides smooth transition to production</li> </ul>
<b>Supply Line Management</b>	<ul style="list-style-type: none"> <li>– <b>Lower total cost of ownership</b></li> <li>– <b>Enhanced flexibility</b></li> </ul>	<ul style="list-style-type: none"> <li>– Component and supplier evaluation for passive, active, PWB, and custom parts</li> <li>– Material planning and procurement leverages approved vendors and corporate contracts to improve delivery, quality, and cost performance.</li> <li>– Customized scheduling and production planning to meet customer order fulfillment needs (MRP II-based)</li> <li>– EDI support</li> <li>– Global purchasing support</li> </ul>
<b>Manufacturing</b>	<ul style="list-style-type: none"> <li>– <b>Improved quality and reliability</b></li> <li>– <b>Technology leverage</b></li> </ul>	<ul style="list-style-type: none"> <li>– Flexible, state-of-the-art facilities operated by a highly skilled, experienced work force.</li> <li>– Wide range of printed-circuit assembly capabilities—from 12-mil pitch surface mount to large discrete through-hole devices</li> <li>– Ball grid array (BGA) and 0402 passive assembly</li> <li>– Dedicated final-system assembly areas and processes utilizing progressive assembly and material buffering</li> <li>– Jointly developed test strategies identify the appropriate combination of cost-effective tests</li> </ul>
<b>Quality</b>	<ul style="list-style-type: none"> <li>– <b>Improved quality and reliability</b></li> <li>– <b>Lower total cost of ownership</b></li> </ul>	<ul style="list-style-type: none"> <li>– Total Quality Management (TQM) approach</li> <li>– ISO 9002-certified manufacturing facilities</li> <li>– BellCore-compliant</li> <li>– EPA, UL, CSA, FCC, VDE product-specific certification support (BABT in 1995)</li> </ul>

# AT&T CUSTOM MANUFACTURING SERVICES

## Partnering in Product Realization

The motivation and benefits of outsourcing are clear—from reduced costs associated with capital investments, inventory, and operating overhead to enhanced time to market, market flexibility, and financial performance. AT&T CMS partners enjoy these benefits and more. They leverage the strengths of a leading EMSI provider backed by the resources of AT&T:

- Total life-cycle solutions backed by AT&T's extensive resources
- Unmatched experience, expertise and vision in communications markets
- Access to world-class technology and process development
- Global purchasing power and supply line management resources
- Legendary quality and reliability
- AT&T's global brand recognition and market leverage

## Markets/Applications Served

### Networked Communications

- Internetworking LAN/WAN hubs and routers
- Broadband switches

### Wireless Communications

- Secure voice/data equipment
- Cellular/PCS base stations and terminals
- WLAN, WPBX
- Air-to-ground communications equipment

### Multimedia Communications

- Videoconferencing equipment
- Video servers
- Computer Telephony Integrated (CTI) Terminals

## Custom Manufacturing Centers

- *Greensboro, North Carolina, U.S.A.:*
  - Dedicated EMSI facility built in 1992
  - Full-service facility
  - SM, PTH, system assembly (including BGA, 12-mil pitch, 0402 assembly in 1995)
  - 210,000 square feet
  - 400 employees
  - ISO 9002-certified (DnV Industry)
  - 1994 NC Quality Leadership Honor Roll recipient
- *Little Rock, Arkansas, U.S.A.:*
  - Wireless Center of Excellence (RF-specific capabilities and resources)
  - Full-service facility
  - SM, PTH, system assembly
  - 288,000 square feet
  - 300 employees
  - ISO 9002-certified (Lloyd's Register)

Together we can leverage our combined core competencies to deliver winning products to the market. Let us show you how *"Partnering In Product Realization"* can work for you.

For more information about AT&T Custom Manufacturing Services, call your AT&T Account Manager, or call 1-800-447-2925.

# CUSTOMER SUPPORT

## AT&T Worldwide Support

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Allentown, PA  
London, England  
Madrid, Spain  
Munich, Germany  
Singapore  
Taipei, Taiwan  
Tokyo, Japan

### ◆ Manufacturing Plants

Allentown, PA  
Bangkok, Thailand  
Dallas, TX  
Madrid, Spain  
Malmesbury, England  
Matamoros, Mexico  
Merrimack Valley, MA  
Orlando, FL  
Reading, PA  
Richmond, VA  
Singapore

### Sales Offices

Located worldwide. For  
the nearest location,  
please call:  
**1-800-372-2447.**



## CUSTOMER SUPPORT

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Berkeley Heights, NJ 07922-2727  
(908) 771-2000

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555 Union Boulevard  
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Suite 350  
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#### **Dallas**

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(905) 672-2030

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San Juan, Puerto Rico 00922  
(809) 798-1300

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Huntsville, AL 35816  
(205) 837-9668

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###### **Electramark**

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Hot Springs Village, AR 71909  
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###### **Electec SoCal, Inc.**

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### Anthem Electronics, Inc.

9369 Carroll Park Drive  
San Diego, CA 92121  
(619) 453-9005

### Anthem Electronics, Inc.

9131 Oakdale Avenue  
Chatsworth, CA 91311  
(818) 775-1333

### Anthem Electronics, Inc.

580 Menlo Drive  
Suite 8  
Rocklin, CA 95677  
(916) 624-9744

### Arrow/Schweber Electronics

6 Cromwell Street, Suite 100  
Irvine, CA 92718  
(714) 454-4303

### Arrow/Schweber Electronics

1180 Murphy Avenue  
San Jose, CA 95131  
(408) 441-9700

### Arrow/Schweber Electronics

9511 Ridgehaven Court  
San Diego, CA 92123  
(619) 565-4800

### Arrow/Schweber Electronics

27607 W Agoura Road  
Malibu Canyon Business Park  
Calabasas, CA 91302  
(818) 880-9686

### Capstone Electronics

6 Cromwell St., #100  
Irvine, CA 92718  
(714) 454-4245

### Capstone Electronics – San Jose Hub

1180 Murphy Avenue  
San Jose, CA 95131  
(408) 453-9804

### Zeus Electronics, Inc.

6276 San Ignacio Ave., Suite E  
San Jose, CA 95119  
(408) 629-4789

## CUSTOMER SUPPORT

### **Zeus Electronics, Inc.**

6 Cromwell St. #100  
Irvine, CA 92718-1816  
(714) 581-4622

### **Pioneer Technologies Group**

333 River Oaks Parkway  
San Jose, CA 95134  
(408) 954-9100

Power Products Only

### **Compumeck**

726 S. Hillview Dr.  
Milpitar, CA 95035  
(408) 945-9100

Power Products Only

### **Foresight Electronics**

318 Martin Avenue  
Santa Clara, CA 95050  
(408) 980-9700

Power Products Only

### **Pioneer Standard**

217 Technology Dr. #110  
Irvine, CA 92718  
(714) 753-5090

Power Products Only

### **Pioneer Standard**

9449 Balboa Ave #114  
San Diego, CA 92123  
(619) 514-7700

### **Colorado**

#### **Anthem Electronics, Inc.**

373 Inverness Drive South  
Englewood, CO 80112  
(303) 790-4500

#### **Arrow/Schweber Electronics**

101 Inverness Drive East  
Suite 105  
Englewood, CO 80112  
(303) 799-0258

#### **Capstone Electronics**

##### **(Headquarters)**

3254 Fraser Street  
Aurora, CO 80011  
(303) 375-1300

### **Connecticut**

#### **Anthem Electronics, Inc.**

61 Mattatuck Heights Road  
Waterbury, CT 06705  
(203) 575-1575

#### **Arrow/Schweber Electronics**

860 N Main St Ext  
Wallingford, CT 06492  
(203) 265-7741

Power Products Only

### **Sager**

108 N. Plains Industrial Rd.  
Wallingford, CT 06492  
(203) 265-4600

### **Florida**

#### **Arrow/Schweber Electronics**

400 Fairway Drive  
Deerfield Beach, FL 33441  
(305) 429-8200

#### **Arrow/Schweber Electronics**

37 Skyline Drive  
Building D  
Suites 3101, 3102, & 3103  
Lake Mary, FL 32746  
(407) 333-9300

#### **Anthem Electronics, Inc.**

598 South Northlake Blvd.  
Suite #1024  
Altamonte Springs, FL 32701  
(407) 831-0007

#### **Anthem Electronics, Inc.**

5200 Northwest 33rd Ave.  
Suite 206  
Ft. Lauderdale, FL 33309  
(305) 484-0990

#### **Zeus Electronics, Inc.**

37 Skyline Dr.  
Building D, Suites 1301-3  
Lake Mary, FL 32746  
(407) 333-3055

#### **Pioneer Technologies Group**

337 South-North Lake, #1000  
Altamonte Springs, FL 32701  
(407) 834-9090

#### **Pioneer Technologies Group**

674 South Military Trail  
Deerfield Beach, FL 33442  
(305) 428-8877

Power Products Only

### **Sager**

7699 Commerce Center Drive  
Orlando, FL 32819  
(407) 354-1130

### **Georgia**

#### **Arrow/Schweber Electronics**

4250 E. River Green Parkway  
Duluth, GA 30136  
(404) 497-1300

#### **Pioneer Technologies Group**

4250 C Rivergreen Parkway  
Duluth, GA 30136  
(404) 623-1003

#### **Anthem Electronics, Inc.**

3305 Breckenridge Blvd.  
Suite 108  
Duluth, GA 30136  
(404) 813-0023

Power Products Only

### **Sager**

3000 Northwoods Parkway #170  
Norcross, GA 30071  
(404) 446-0085

### **Illinois**

#### **Anthem Electronics, Inc.**

1300 Remington Road  
Suite A  
Schaumburg, IL 60173  
(708) 884-0200

#### **Arrow/Schweber Electronics**

1140 W Thorndale Avenue  
Itasca, IL 60143  
(708) 250-0500

#### **Capstone Electronics – Chicago Regional Center**

1100 W. Thorndale Avenue  
Itasca, IL 60143  
(708) 250-0300

Power Products Only

### **Sager**

1105 Remington Rd.  
Schaumburg, IL 60173  
(708) 882-9790

### **Indiana**

#### **Arrow/Schweber Electronics**

7108 Lakeview Parkway, West Drive  
Indianapolis, IN 46268  
(317) 299-2071

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### **Pioneer Standard**

9350 N Priority Way W Dr  
Indianapolis, IN 46240  
(317) 573-0880

### **Kansas**

#### **Arrow/Schweber Electronics- Capstone**

9801 Legler Road  
Lenexa, KS 66214  
(913) 541-9542

### **Maryland**

#### **Anthem Electronics, Inc.**

7168 Columbia Gateway Drive  
Suite A  
Columbia, MD 21046  
(410) 995-6640

#### **Arrow/Schweber Electronics**

9800J Patuxent Woods Drive  
Columbia, MD 21046  
(301) 596-7800

#### **Pioneer Technologies Group**

15810 Gaither Drive  
Gaithersburg, MD 20877  
(301) 921-8407

**Pioneer Technologies Group**

9100 Gaither Road  
Gaithersburg, MD 20877  
(301) 921-0660

Power Products Only

**Sager**

9051 K Red Branch Road  
Columbia, MD 21045  
(410) 995-4900

**Massachusetts**

Power Products Only

**Sager (N. Branch)**

100 Research Dr  
Wilmington, MA  
(508) 657-5155

**Anthem Electronics, Inc.**

200 Research Dr  
Wilmington, MA 01887  
(508) 657-5170

**Arrow/Schweber Electronics**

25 Upton Drive  
Wilmington, MA 01887  
(508) 658-0900

**Capstone Electronics – Boston Regional Center**

25 Upton Drive  
Wilmington, MA 01887  
(508) 657-5874

**Zeus Electronics, Inc.**

25 Upton Dr  
Wilmington, MA 01887  
(508) 658-4776

Power Products Only  
**Sager**

60 Research Rd  
Hingham, MA 02043  
(617) 749-6700

Power Products Only

**Pioneer Standard**

44 Hartwell Ave  
Lexington, MA 02173  
(617) 861-9200

**Michigan****Arrow/Schweber Electronics**

44720 Helm St  
Plymouth, MI 48172  
(313) 462-2290

Power Products Only

**Pioneer Standard**

4595 Broadmoor SE, Suite 235  
Grand Rapids, MI 49512  
(616) 534-0500

Power Products Only

**Pioneer Standard**

44190 Plymouth Oaks Dr  
Plymouth, MI 48170  
(313) 416-2157

**Minnesota****Anthem Electronics, Inc.**

7690 Golden Triangle Drive  
Eden Prairie, MN 55344  
(612) 944-5454

**Arrow/Schweber Electronics**

10120A West 76th St  
Eden Prairie, MN 55344  
(612) 946-4800

**Arrow/Schweber Electronics**

10100 Viking Drive, Suite 100  
Eden Prairie, MN 55344  
(612) 941-5280

**New Hampshire**

Power Products Only

**Sager**

2 Industrial Way  
Salem, NH 03079  
(603) 898-1348

**New Jersey****Anthem Electronics, Inc.**

26 Chapin Road, Unit K  
Pine Brook, NJ 07058  
(201) 227-7960

**Arrow/Schweber Electronics**

4 E Stow Road, Unit 11  
Marlton, NJ 08053  
(609) 596-8000

**Arrow/Schweber Electronics**

43 Route 46 East  
Pine Brook, NJ 07058  
(201) 227-7889

**Arrow/Schweber Electronics**

101 Crawfords Corner Road  
Room 1M511  
Holmdel, NJ 07733-3030  
(908) 949-4700

**Capstone Electronics – Philadelphia Regional Center**

4 E Stow Road, #12  
Marlton, NJ 08053  
(609) 596-7500

Power Products Only

**Pioneer Standard**

14A Madison Rd.  
Fairfield, NJ 07006  
(201) 575-3510

**New York****Anthem Electronics, Inc.**

47 Mall Drive  
Commack, NY 11725  
(516) 864-6600

**Arrow/Schweber Electronics**

20 Oser Avenue  
Hauppauge, NY 11788  
(516) 231-1000

**Arrow/Schweber Electronics**

3375 Brighton-Hennetta  
Townline Road  
Rochester, NY 14623  
(716) 427-0300

**Arrow/Schweber Electronics**

25 Hub Drive  
Melville, NY 11747  
(516) 391-1300

**Zeus Electronics, Inc.**

100 Midland Ave  
Port Chester, NY 10573  
(914) 933-4200

Power Products Only

**Sager**

800 Prime Place  
Hauppauge, NY 11788  
(516) 348-1300

Power Products Only

**Pioneer Standard**

840 Fairport Park  
Fairport, NY 14450  
(716) 381-7070

Power Products Only

**Pioneer Standard**

60 Crossways Park West  
Woodbury, NY 11797  
(516) 921-8700

**North Carolina****Arrow/Schweber Electronics**

5240 Greens Dairy Road  
Raleigh, NC 27604  
(919) 876-3132

**Capstone Electronics – Raleigh Hub**

5230 Greens Dairy Road  
Raleigh, NC 27604  
(919) 954-0600

**Pioneer Technologies Group**

2200 Gateway Centre Boulevard  
Suite 215  
Morrisville, NC 27560  
(919) 460-1530

Power Products Only

**Sager**

5249 Capital Blvd  
Raleigh, NC 27604  
(919) 850-9550

**Ohio****Arrow/Schweber Electronics**

6573 E Cochran Road  
Solon, OH 44139  
(216) 248-3990

## CUSTOMER SUPPORT

### **Arrow/Schweber Electronics**

8200 Washington Village Drive  
Suite A  
Centerville, OH 45458  
(513) 435-5563

### Power Products Only

**Sager**  
2608 E. River Road  
Dayton, OH 45439  
(513) 298-5555

### Power Products Only

**Sager**  
1755 Merriman Rd., Suite 150  
Akron, OH 44313  
(216) 864-2111

### Power Products Only

**Pioneer Standard**  
4800 E 131st St.  
Cleveland, OH 44105  
(216) 498-6993

### **Oklahoma**

#### **Arrow/Schweber Electronics**

12111 E 51st Street  
Suite 101  
Tulsa, OK 74146  
(918) 252-7537

### Power Products Only

**Pioneer Standard**  
9717 E. 42nd St., Suite 105  
Tulsa, OK 74146  
(918) 665-7840

### **Oregon**

#### **Anthem Electronics, Inc.**

9090 S W Gemini Drive  
Beaverton, OR 97005  
(503) 643-1114

#### **Almac/Arrow Electronics Corp.**

1885 N.W 169th Place  
Beaverton, OR 97006-7312  
(503) 629-8090

### **Pennsylvania**

#### **Anthem Electronics, Inc.**

355 Business Center Drive  
Suite C  
Horsham, PA 19044  
(215) 443-5150

#### **Arrow/Schweber Electronics**

2681 Mosside Blvd  
Suite 204  
Monroeville, PA 15146  
(412) 856-9490

#### **Pioneer Technologies Group**

500 Enterprise Rd  
Horsham, PA 19044  
(215) 674-4000

### Power Products Only

**Sager**  
705 Thomson Park Drive  
Mars, PA 16046  
(412) 772-2233

### Power Products Only

**Sager**  
2270 Cabot Blvd. W.  
Suite 2  
Langhorne, PA 19047  
(215) 750-7778

### Power Products Only

**Pioneer Standard**  
259 Kappa Drive  
Pittsburgh, PA 15238  
(412) 782-2300

### **Texas**

#### **Anthem Electronics, Inc.**

651 N. Plano Road  
Suite 429  
Richardson, TX 75081  
(214) 238-7100

#### **Arrow/Schweber Electronics**

3220 Commander Drive  
Carrollton, TX 75006  
(214) 380-6464

#### **Arrow/Schweber Electronics**

19416 Park Row, Suite 190  
Houston, TX 77084  
(713) 530-4700

#### **Arrow/Schweber Electronics**

11500 Metric Blvd., Suite 160  
Austin, TX 78758  
(512) 835-4180

#### **Capstone Electronics – Dallas Regional Center**

3220 Commander Drive  
Carrollton, TX 75006  
(214) 380-9049

#### **Anthem Electronics, Inc.**

14050 Summit Drive, Suite 119  
Austin, TX 78728  
(512) 388-0049

#### **Zeus Electronics, Inc.**

3220 Commander Dr.  
Carrollton, TX 75006  
(214) 380-4330

### Power Products Only

**Sager**  
1122 Commerce Dr  
Richardson, TX 75081  
(214) 783-1133

### Power Products Only

**Pioneer Standard**  
10530 Rockley Rd.  
Houston, TX 77099  
(713) 495-4700

### Power Products Only

**Pioneer Standard**  
8200 Interstate 10W #705  
San Antonio, TX 78230  
(210) 377-3440

### **Utah**

#### **Anthem Electronics, Inc.**

1279 W 2200 South  
Salt Lake City, UT 84119  
(801) 973-8555

#### **Arrow/Schweber Electronics**

1946 W Parkway Boulevard  
Salt Lake City, UT 84119  
(801) 973-6913

### **Washington**

#### **Almac Electronics Corporation (Headquarters)**

14360 S.E. Eastgate Way  
Bellevue, WA 98007  
(206) 643-9992

#### **Anthem Electronics, Inc.**

19107 120th Avenue, N.E  
Suite 102  
Bothell, WA 98011  
(206) 483-1700

#### **Pioneer Technologies, Inc.**

2800 156th Ave S E Group  
Suite 100  
Bellevue, WA 98007  
(206) 644-7500

### **Wisconsin**

#### **Arrow/Schweber Electronics**

200 N. Patrick Boulevard, Suite 100  
Brookfield, WI 53045  
(414) 792-0150

### Power Products Only

**Pioneer Standard**  
120 Bishops Way #163  
Brookfield, WI 53005  
(414) 784-3480

### **International Distributors**

#### **Australia**

**Zatek Australia Pty. Ltd.**  
Suite 8, 1059 Victoria Road  
West Ryde NSW 2214  
Sydney, Australia  
Int'l: +61-2-8740122  
FAX: +61-2-8746171

#### **Austria**

##### **Steiner Electronic Vertrieb GmbH**

Egererstrasse 18  
A-3013 Tullnerbach  
Austria  
Tel: 02233-55366-0  
Int'l: +43-2233-55366-0  
FAX: 02233-55360  
Int'l: +43-2233-55360

## Belgium

**Eurodis Inelco**  
Avenue Des Croix de Guerre 116  
B-1120 Brussels  
Belgium  
Tel: 02-2474969  
Int'l: +32-2-2474969  
FAX: 02-2-2158102  
Int'l: +32-2-2158102

## Brazil

Optoelectronics Products Only  
**AsGa Microelectronica**  
Dr Roberto Moreira Rod,  
KM4-CEP 1314  
Cx P. 132  
Paulina-SP  
Brazil  
Tel: (55192) 74-3210

## Denmark

FPGAs Only  
**Berendsen Electronics**  
Telefonvej 8  
Dk-2860 Soeborg  
Denmark  
Int'l: +45-3457-7110

## C-88 AS

101 Kokkedal Industrypark  
Dk-2980 Kokkedal  
Denmark  
Tel: 042-244888  
Int'l: +45-42-244-888  
FAX: 042-244-889  
Int'l: +45-42-244-889

## England

**Bytech Components LTD**  
12A Cedarwood  
Chineham Business Park  
Crockford Lane  
Basingstoke  
Hampshire, RG24 OWD  
England  
Tel: 0256-707107  
Int'l: +44-256-707107  
FAX: 0256-707162  
Int'l: +44-256-707162

## Macro

Burnham Lane  
Slough  
SL1 6LN  
England  
Tel: 0628-604383  
Int'l: +44-628-604383  
FAX: 0628-666873  
Int'l: +44-628-666873

Lightwave Products Only  
**Lambda Photometrics Ltd.**  
Lambda House  
Batford Mill  
Harpenden, Herts  
AL5 5BZ England  
Tel: 05827-64334  
Int'l: +44-5827-64334  
FAX: 05827-12084  
Int'l: +44-5827-12084

## Finland

ICs & Optoelectronics Only  
**Berendsen Electronics**  
Ralssintie 6  
FIN-00720 Helsinki  
Finland  
Int'l: +35-8-0351-5100

## Nordcomp Finland OY

Asemakuja 2  
SF-02770 ESPOO  
Finland  
Int'l: +35-8-0859-3699  
FAX: +35-8-0859-3644

## France

**Compress**  
30, Rue Du Morvan  
94633 RUNGIS CEDEX  
France  
Int'l: +33-1-46878020  
FAX: +33-1-46866763

Lightwave Products Only  
**Microscience SA**  
10 Rue Degas  
75016 Paris  
France  
Int'l: +33-1-4224-6599  
FAX: +33-1-4224-6576

## Germany

**Jermyn GmbH**  
Im Dachsstock 9  
D-65549 Limburg  
Germany  
Tel. 06431-5080  
Int'l: +49-6431-5080  
FAX: 06431-508289  
Int'l: +49-6431-508289

## Hong Kong

**Tektron Electronics (HK) Ltd.**  
1702 Bank Centre  
636 Nathan Road  
Kowloon, Hong Kong  
Int'l: +852-3880629  
FAX: +852-7805871

## Italy

**Lasi Elettronica SPA**  
Viale Fulvio Testi, 280  
I-20126 Milan  
Italy  
Tel: 02-661431  
Int'l: +39-2-661431  
FAX: 02-66101385  
Int'l: +399-2-6610385

Lightwave Products Only  
**Farnell Italia Srl**  
Via F. Ili Cernuschi  
22-22055 Merate (Como)  
Italy  
Tel: 039-9907612  
Int'l: +39-39-9907612  
FAX: 039-599213  
Int'l: +39-39-599213

## Japan

**AT&T Japan Semiconductor Marketing Ltd.**  
7-18, Higashi-Gotanda 2-chome  
Shinagawa-ku, Tokyo 141  
Japan  
Tel: 03-5421-1777  
Int'l: 81-3-5421-1777  
FAX: 03-5421-1785  
Int'l: 81-3-5421-1785

## Kanematsu Electronics Components Corp.

Shin-Ohsaki Kangyo Bldg 11F  
6-4 Ohsaki 1-chome  
Shinagawa-ku, Tokyo 141  
Japan  
Tel 03-3779-7811  
Int'l: +81-3-3779-7811  
FAX: 03-3779-7800  
Int'l: +81-3-3779-7800

## Mitsui & Co., Ltd.

2-1 Ohtemachi 1-chome  
Chiyoda-ku, Tokyo 100  
Japan  
Tel: 03-3285-4067  
Int'l: 81-3-3285-4067  
FAX: 03-3285-9868  
Int'l: 81-3-3285-9868

## Sumisho Electronic Devices Corp. Eisenwamotocho Bldg.

2-8-8 Iwamotocho  
Chiyoda-ku, Tokyo 101  
Japan  
Tel. 03-3863-8200  
Int'l: +81-3-3863-8200  
FAX: 03-3863-8211  
Int'l: +81-3-3863-8211

## TOMEN Electronics Corp.

1- 1, Uchisaiwaicho 2-chome  
Chiyoda-ku, Tokyo 100  
Japan  
Tel 03-3506-3650  
Int'l: +81-3-3506-3650  
FAX: 03-3506-3497  
Int'l: +81-3-3506-3497

## Korea

**Douil Inc.**  
1301 KMIC Building  
168-9 Yeomli-Dong  
Mapo-Gu Seoul 121-090  
Korea  
Int'l: +82-2-7127071  
FAX: +82-2-7180817

## CUSTOMER SUPPORT

### **Excel Tech**

2nd Floor Samma Building  
#403-16 Seokyo-Dong  
Mapo-Gu Seoul  
Korea 121-210  
Int'l: +82-2-3357823/4  
FAX: +82-2-3357825

### **Norway**

#### **Berendsen Technology**

Konowsgt. 8  
P.O. Box 9376  
0135 Oslo  
Norway  
Int'l: +47-22-67-6800  
FAX: +47-22-67-7380

### **Portugal**

#### **ATD Electronica LDA**

Quinta Grande  
Lote 20-R/C DTO.  
Alfragide (Norte)  
2700 Amadora  
Portugal  
Int'l: +351-1-4714-182/575  
FAX: +351-1-4715-886

### **Singapore**

#### **Serial System Pte. Ltd.**

11 Jalan Mesin #06-00  
Standard Industrial Building  
Singapore 1336  
Int'l: +65-2800200  
FAX: +65-2861812

### **Slovenia**

#### **I&R Electronic**

Ziherlova Ulica 2  
61000 Ljubljana  
Slovenia  
Int'l: +38-661-222-007  
FAX: +38-661-224-111

### **Spain**

#### **ATD Electronica SA**

Albasans, 75  
28037 Madrid  
Spain  
Int'l: +34-1304-1534  
FAX: +34-1327-2778

Lightwave Products Only

#### **Optilas Iberica, SA**

Maria Tubagy 5  
Edificio Auge VI  
28050 Madrid  
Spain  
Int'l: +34-1358-8611  
FAX: +34-1358-8271

FPGA Products Only

#### **Semiconductores Investigacion y**

#### **Diseno SA**

Edificio "Centro de Encuentros"  
Issac Newton, s/n  
28760 Tres Cantos  
Madrid  
Spain  
Int'l: +34-18035052  
FAX: +34-18039557

### **Sweden**

ICs & Optoelectronics Only

#### **Berendsen Technology**

Hammarby Kajvag 14  
S-12006 Stockholm  
Sweden  
Int'l: +46-08615-7402

#### **NC Nordcomp Sweden AB**

P.O. Box 4115, Hemvärnsgaten 11  
S-171 04 Solna  
Sweden  
Tel: 08-985140  
Int'l: +46-8-985140  
FAX: 08-7645451  
Int'l: +46-8-7645451

### **Switzerland**

#### **Datacomp AG**

Silbernstrasse 10  
CH-8953 Dietikon  
Switzerland  
Tel: 01-7405140  
Int'l: +41-1-7405140  
FAX: 01-7413423  
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### **Taiwan**

#### **Jedcom Ltd.**

7F B.267 Sec. 3  
Cheng-Teh Road  
Taipai, Taiwan  
Int'l: +886-2-5856661  
FAX: +886-2-5864736

#### **Seraphim Engineering Co., LTD.**

6th Floor, No. 34-1  
Chiu Chuan Street  
Taipei, Taiwan, R.O.C.  
Tel: 2-593-5195  
Int'l: +886-2-593-5195  
FAX: 2-594-9424  
Int'l: +886-2-594-9424

#### **Maxtek Technology Co. Ltd.**

3rd Floor No. 197 Sec. 4  
Nanking E. Road  
Taipei, Taiwan  
Int'l: +886-2-7130209  
FAX: +886-2-7126780

### **EURODIS TME Components BV**

Heltheuvelpassage 14  
NL-5224 AP's-Hertogenbosch  
The Netherlands  
Int'l: +31-73-221010  
FAX: +31-73-220330

### **Turkey**

#### **Inter Muchendislik**

Kadikoev Hasircibasi  
CAD. No. 55  
TR-81310 Istanbul  
Turkey  
Tel: 013499400  
Int'l: +90-216-3499400  
FAX: 013382823  
Int'l: +90-216-3382823

### **The Netherlands**

# AT&T MICROELECTRONICS TERMS AND CONDITIONS

## TERMS AND CONDITIONS

THE TERMS AND CONDITIONS OF SALE CONTAINED HEREIN ("THIS AGREEMENT") SHALL APPLY TO ALL QUOTATIONS AND OFFERS MADE AND PURCHASE ORDERS ACCEPTED BY SELLER. IF THESE TERMS AND CONDITIONS CONFLICT WITH TERMS AND CONDITIONS OF A PURCHASE ORDER OR PROCUREMENT DOCUMENT ISSUED BY BUYER, THE TERMS AND CONDITIONS CONTAINED HEREIN SHALL GOVERN. SELLER'S ACCEPTANCE OF BUYER'S ORDER IS CONDITIONED UPON BUYER'S ACCEPTANCE OF THESE TERMS AND CONDITIONS IRRESPECTIVE OF WHETHER THE BUYER ACCEPTS THEM IN WRITING, BY IMPLICATION, OR BY ACCEPTANCE OF AND PAYMENT FOR PRODUCT SOLD HEREUNDER, AND IRRESPECTIVE OF WHEN BUYER'S PURCHASE ORDER OR PROCUREMENT DOCUMENT IS ISSUED OR WHETHER IT PRECEDES OR FOLLOWS ISSUANCE OF THIS AGREEMENT. SELLER'S FAILURE TO OBJECT TO PROVISIONS CONTAINED IN ANY COMMUNICATION FROM BUYER SHALL NOT BE DEEMED A WAIVER OF THE PROVISIONS HEREIN.

**1. DELIVERY, TITLE, AND RISK OF LOSS** — Shipment will be made in a manner determined by Seller. Title (except as provided in Section 8, "RIGHTS IN INTELLECTUAL PROPERTY") and risk of loss or damage to the product shall pass to Buyer at the time Seller delivers possession of the product to a carrier at Seller's plant or warehouse or other facility without regard to notification of shipment or selection of carrier. Product held by Seller at Buyer's request beyond the scheduled delivery date shall be at Buyer's risk and expense. Freight shall be prepaid by Seller and invoiced back to Buyer. Buyer shall be responsible for expenses incurred by Seller where, at Buyer's request, Seller ships or packs product in other than its normal manner for domestic shipment.

**2. LICENSED PRODUCTS** — No title or other ownership rights in any licensed products or any copies thereof shall pass to Buyer under this Agreement or any performance hereunder. Buyer agrees that it will not alter any notices on, prepare derivative works based on, or reproduce, reverse engineer, disassemble, or decompile any software embodied in licensed products or recorded in the purchased products furnished under this Agreement.

**3. TERMINATION OR CHANGE** — Buyer shall not terminate, suspend performance, reschedule or cancel delivery, or issue a "hold" order under this Agreement, in whole or in part, without Seller's prior written consent and upon terms that will compensate Seller for any loss or damage resulting from such action. Buyer's liability shall include, but not be limited to, the price of product delivered or held for disposition and the price of services already performed, plus Seller's loss of profits thereon, incurred costs, and a reasonable allocation of general and administrative expenses. Any such termination shall be subject to a minimum termination charge of fifteen percent (15%) of the dollar amount of the sales terminated.

**4. TERMS OF PAYMENT** — Buyer shall pay the invoiced amount within thirty (30) days from the date of Seller's invoice. Delinquent payments are subject to an interest charge at the rate of one and one-half percent (1-1/2%) per month, or portion thereof (but not to exceed the maximum lawful rate). Buyer hereby grants to Seller a purchase money security interest in the product to secure the purchase price of the product until the purchase price is paid in full. Buyer agrees to execute and deliver all documents requested by Seller to perfect and maintain Seller's security interest. Orders are subject to a maximum outstanding credit limit (measured counting all outstanding invoices, whether or not past due, combined with the value of all accepted orders) as reasonably determined by Seller. Seller may refuse to accept purchase orders, if such acceptance would result in Buyer exceeding such credit limit. The amount of credit or terms of payment may be changed or credit withdrawn by Seller at any time. Each shipment shall constitute an independent transaction, and Buyer shall pay for same in accordance with the specified payment terms. If shipments are delayed by Buyer, Seller may invoice Buyer when Seller is prepared to ship.

**5. TAXES** — Any tax or related charge that Seller shall be required to pay to or collect for any government upon or with respect to services rendered or the sale, use, or delivery of products shall be billed to Buyer as a separate item and paid by Buyer, unless a valid exemption certificate is furnished by Buyer to Seller.

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**6. PRODUCT CHANGES** — Seller may at any time (i) make changes in the products that do not materially affect physical or functional interchangeability or performance or (ii) make more substantial changes or discontinue delivery of the product when required for purposes of safety.

**7. WARRANTY** — Seller warrants to Buyer that products of its manufacture will be, on the date of shipment of the product, free from defects in material and workmanship and will substantially conform to Seller's written specifications provided to Buyer or to the specifications, if any, identified in an order and agreed to in writing by Seller, other than specifications specifying performance for a period of time. If any defect in material or workmanship or failure to meet said published specifications (a "defect") appears in the product, Seller will, at its option, either repair or replace the defective product without charge at Seller's manufacturing or repair facility or credit or refund the purchase price of the defective product provided: (i) the defect appears within twelve (12) months from the date of shipment of the product, (ii) Buyer notifies Seller in writing of the claimed defect within thirty (30) days after Buyer knows or reasonably should know of the claimed defect, and (iii) Seller's examination of the product discloses that the claimed defect actually exists.

Buyer shall follow Seller's instructions regarding return of defective product, and no product will be accepted for repair, replacement, credit, or refund without the written authorization of and in accordance with Seller's instructions. Replaced products shall become Seller's property. In no event shall Seller be responsible for deinstallation or reinstallation of defective products or for the expenses thereof. If Seller determines that the returned products are not defective, Buyer shall pay Seller all costs of handling, inspection, repairs, and transportation at Seller's then prevailing rates. Repairs and replacements covered by the above warranty are warranted to be free from defects as set forth above except that the defect must appear (i) within three (3) months from the date of repair or replacement or (ii) prior to the expiration of the above twelve (12) month period, whichever is later.

With respect to products not manufactured by Seller, Seller, to the extent permitted, extends the warranties and affords the remedies to Buyer given to Seller by its vendor of said products. Seller makes no warranties with respect to experimental products or prototypes or to products which have been subjected to misuse, neglect, accident, or abuse or have been improperly installed, stored, maintained, repaired, or altered by anyone other than Seller, or had their serial numbers or month and year of manufacture or shipment removed, defaced, or altered.

EXCEPT AS STATED IN THIS SECTION 7, SELLER, ITS SUBSIDIARIES AND AFFILIATES, SUBCONTRACTORS, AND SUPPLIERS MAKE NO WARRANTIES EXPRESS OR IMPLIED, AND SPECIFICALLY DISCLAIM ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AS WELL AS OTHER IMPLIED WARRANTIES, IN LAW OR EQUITY. BUYER'S SOLE AND EXCLUSIVE REMEDY SHALL BE SELLER'S OBLIGATION TO REPAIR OR REPLACE OR CREDIT OR REFUND AS SET FORTH ABOVE.

**8. RIGHTS IN INTELLECTUAL PROPERTY** — Seller exclusively shall own all right, title, and interest in and to any inventions, discoveries, improvements, methods, ideas, computer and other apparatus programs and related documentation, other works of authorship fixed in any tangible medium of expression, mask works or other forms of intellectual property, whether or not patentable, copyrightable or subject to mask work rights or other forms of protection, which are made, created, developed, written, conceived or first reduced to practice by Seller solely, jointly or on its behalf, in the course of, arising out of or as a result of work done under this Agreement.

**9. INTELLECTUAL PROPERTY INDEMNITY** — Seller shall: (i) defend or settle, at its option and expense, any claim against Buyer alleging that any product furnished under this Agreement directly infringes any patent, copyright, or trademark; (ii) reimburse Buyer for any costs incurred at Seller's written request relating to such request; and (iii) pay damages and costs assessed by final judgment against Buyer and attributable to such claim, provided that in no event shall Seller's total liability under this Section 9 exceed the amount of the purchase price actually paid to Seller.

In addition, Seller will have the right, at any time and at its option and expense to: (i) procure for Buyer the right to continue using such Product; (ii) replace or modify any such Product provided or to be provided to be free of the infringement; or (iii) require return of such Product and refund the purchase price.

Seller's obligations hereunder are conditioned upon: (i) Buyer giving Seller written notice within thirty days of any such claim; (ii) Seller having complete control of the defense and settlement thereof, (iii) Buyer cooperating fully with Seller to facilitate the defense or settlement of such claim; and (iv) Buyer's full compliance with this Agreement.

Notwithstanding the foregoing, Seller shall have no obligation to defend or settle any claim, and Buyer shall indemnify and save harmless Seller and its suppliers and affiliated companies from all costs, expenses, liabilities, and claims, for any such claim: (i) arising from Seller's compliance with Buyer's specifications, designs, or instructions; or (ii) relating to any Product furnished hereunder in combination with item(s), whether or not furnished by Seller, even if such combination results from the Product's necessary or inherent use or the use for which the Product is purchased.

The sale of any Product by Seller shall not in any way confer upon Buyer, or upon anyone claiming under Buyer, any license (expressly, by implication, by estoppel or otherwise) under any patent claim of Seller or others covering or relating to any combination, machine, or process in which such Product is or might be used, or to any process or method of making such Product.

THE FOREGOING STATES THE SOLE AND EXCLUSIVE REMEDY AND OBLIGATION OF THE PARTIES HERETO FOR INFRINGEMENT OR OTHER VIOLATION OF ANY INTELLECTUAL PROPERTY RIGHTS ARISING OUT OF THIS AGREEMENT AND IS IN LIEU OF ALL WARRANTIES, EXPRESS, IMPLIED, OR STATUTORY, IN REGARD THERETO.

**10. EXPORT CONTROL** — Buyer acknowledges that the products sold under this Agreement and technical information transmitted in connection therewith may be subject to export restrictions under applicable law, including the U.S. Department of Commerce Export Administration Regulations ("Regulations"), and Buyer agrees to comply fully with same. Buyer assures Seller that it will not transmit, sell, transfer, or convey any such products, technical information or software, or goods produced through the use of same, to any country, or citizen or resident of a country, other than the United States without first securing the written consent, if required, of the U.S. Department of Commerce.

#### **11. EXCLUSIVE REMEDIES AND LIMITATIONS OF LIABILITY**

A. FOR PURPOSES OF THE EXCLUSIVE REMEDIES AND LIMITATIONS OF LIABILITY SET FORTH IN THIS SECTION 11, SELLER SHALL BE DEEMED TO INCLUDE AMERICAN TELEPHONE AND TELEGRAPH COMPANY, ITS SUBSIDIARIES AND AFFILIATES AND THE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS, REPRESENTATIVES, SUBCONTRACTORS, AND SUPPLIERS OF EACH OF THEM; AND "DAMAGES" SHALL BE DEEMED TO REFER COLLECTIVELY TO ALL INJURY, DAMAGE, LOSS, OR EXPENSE INCURRED.

B. SELLER'S ENTIRE LIABILITY AND BUYERS' EXCLUSIVE REMEDIES AGAINST SELLER FOR ANY DAMAGES CAUSED BY ANY PRODUCT DEFECT OR FAILURE, OR ARISING FROM THE PERFORMANCE OR NONPERFORMANCE OF ANY WORK, REGARDLESS OF THE FORM OF ACTION, WHETHER IN CONTRACT, TORT INCLUDING NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE SHALL BE:

1. FOR INFRINGEMENT, THE REMEDIES SET FORTH IN SECTION 9.
2. FOR FAILURE OF PRODUCT OR WORK PERFORMED, THE REMEDIES STATED IN SECTION 7.
3. FOR DELAYS IN DELIVERY, NONE UNLESS THE DELIVERY IS DELAYED BY MORE THAN THIRTY (30) DAYS BY CAUSES NOT ATTRIBUTABLE EITHER TO BUYER OR TO FORCE MAJEURE CONDITIONS, IN WHICH CASE BUYER SHALL HAVE THE RIGHT, AS ITS SOLE REMEDY, TO CANCEL THE ORDER WITHOUT INCURRING TERMINATION CHARGES.
4. FOR DAMAGES TO REAL OR TANGIBLE PERSONAL PROPERTY OR FOR BODILY INJURY OR DEATH TO ANY PERSON PROXIMATELY CAUSED BY SELLER, BUYER'S RIGHT TO PROVEN DIRECT DAMAGES.
5. FOR CLAIMS OTHER THAN SET FORTH ABOVE, SELLER'S LIABILITY SHALL BE LIMITED TO DIRECT DAMAGES THAT ARE PROVEN, IN AN AMOUNT NOT TO EXCEED \$100,000.

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C. NOTWITHSTANDING ANY OTHER PROVISION OF THIS AGREEMENT, SELLER SHALL NOT BE LIABLE FOR INCIDENTAL, INDIRECT, SPECIAL, OR CONSEQUENTIAL DAMAGES OR FOR LOST PROFITS, SAVINGS, OR REVENUES OF ANY KIND, WHETHER OR NOT SELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THIS PROVISION SHALL SURVIVE FAILURE OF AN EXCLUSIVE REMEDY.

**12. MEDICAL AND LIFE SUPPORT APPLICATIONS** — Seller does not recommend the use of any products for medical or life support applications wherein a failure or malfunction of the product may directly threaten life or cause injury and Seller will not knowingly sell its products for such use except pursuant to a written exception to this policy granted on a case-by-case basis. No warranty is made with respect to any such medical or life support use of any product.

**13. ASSIGNMENT** — Buyer shall not assign this Agreement or any rights or obligations hereunder without the prior written consent of the Seller. Any attempted assignment without the Seller's consent shall be void and ineffective.

**14. NON-WAIVER** — No course of dealing or failure of either party to strictly enforce any term, right, or condition of this Agreement shall be construed as a waiver of such term, right or condition.

**15. FORCE MAJEURE** — Except with respect to Buyer's obligation to make timely payments when due, neither party shall be held responsible for any delay or failure in performance of any part of this Agreement to the extent such delay or failure is caused by fire, flood, explosion, war, strike, embargo, government requirement, civil or military authority, act of God, nature or the public enemy, inability to secure material or transportation facilities, inadequate yield of products despite Seller's reasonable efforts, act or omission of carriers or any other causes beyond its reasonable control. Seller may, in the event of any such circumstance, allocate at its sole discretion its available production output among itself and its other customers, including at Seller's option those not under contract.

**16. CHOICE OF LAW** — The construction, interpretation, and performance of this Agreement shall be governed by the substantive laws, but not the conflicts of law, of the State of New York. The U.N. Convention on Contracts for the International Sales of Goods shall not apply to the sale of product hereunder.

**17. ENTIRE AGREEMENT** — Except for any written agreement between the parties relating to confidentiality of proprietary information, the terms and conditions contained in this Agreement supersede all prior oral or written understandings between the parties and shall constitute the entire Agreement between the parties with respect to the subject matter of this Agreement. This Agreement shall not be modified or amended except by a writing signed by Buyer and Seller.

For additional information, contact your  
AT&T Account Manager or the following:

- AT&T Microelectronics  
555 Union Boulevard  
Room 21Q-133BA  
Allentown, PA 18103  
1-800-372-2447  
FAX 610-712-4106

In Canada, call:  
1-800-553-2448  
FAX 610-712-4106

- AT&T Microelectronics Asia/Pacific  
14 Science Park Drive  
#03-02A/04 The Maxwell  
Singapore 0511  
Tel. (65) 778-8833  
FAX (65) 777-7495

- AT&T Microelectronics  
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For data requests in Europe:

- AT&T Dataline  
Tel. (44) 1734 324 299  
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For technical inquiries in Europe:

- Central Europe: (49) 89 95086 0 (Munich)
- Northern Europe: (44) 1344 865 900 (Bracknell UK)
- France: (33) 1 47 67 47 67 (Paris)
- Southern Europe: (39) 2 6601 1800 (Milan)
- (34) 1 807 1700 (Madrid)

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