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Master Selection Guide

1983

Catalog of Semiconductor Products

TEXAS INSTRUMENTS

Texas Instruments Semiconductor Products Master Selection Guide

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This product selection guide has been designed to provide engineers, buyers, and managers with a convenient reference to the Texas Instruments semiconductor product line. The basic product features and descriptions are presented to aid in the selection of the best product for a particular application. Complete specifications are available from the appropriate TI data sheet or data book. In the event of conflict with this selection guide, the data sheet specifications shall govern. TI reserves the right to make changes at any time in order to improve design and to supply the best product possible.

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QUALITY AND RELIABILITY

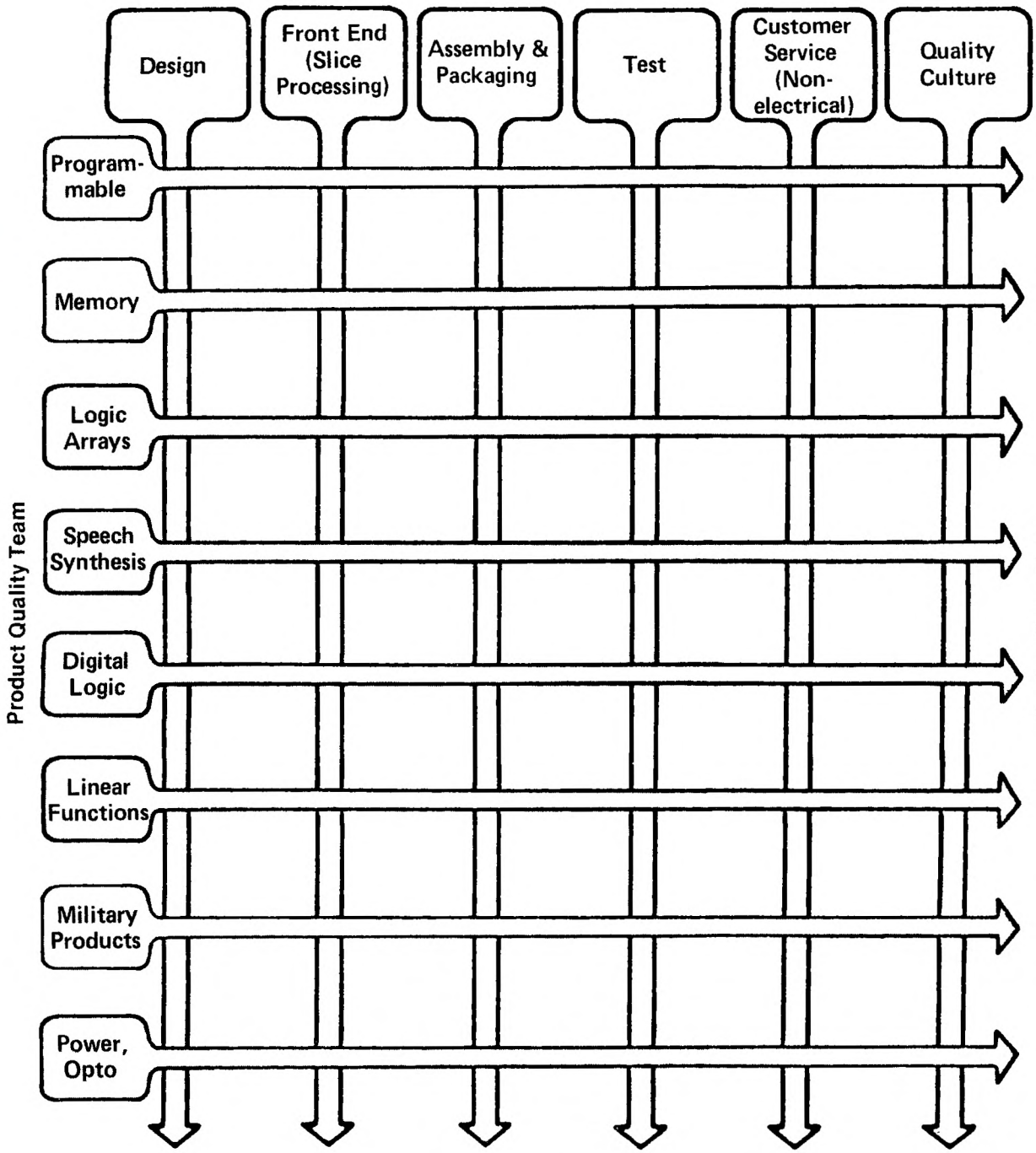
The goal of Texas Instruments is to offer the highest quality and reliability in the industry. Product managers specify goals to be achieved by design, engineering and manufacturing functions to meet the quality and reliability requirements of the marketplace. Quality and reliability teams for product technologies and functions are major factors in achieving leadership quality and reliability. Significant improvements have been achieved during the past several years. TI has plans and programs in place to assure continuing product improvement.

Performance of product managers in achieving quality and reliability goals is routinely reviewed to assure that resources and actions are effective in establishing and maintaining quality and reliability leadership of TI products.

TI realizes that the customer's results are the final measure of quality and reliability. Therefore, developing and maintaining close working relationships with individual customers to fully understand and meet their quality and reliability requirements is an essential element in TI's programs and plans.

TI stresses the concept of Product Quality and Reliability teams for product technologies, and Functional Quality and Reliability teams for design, manufacturing and test disciplines. These teams interact to focus resources and actions on the quality and reliability requirements derived from the marketplace. The management of these teams is the responsibility of the operating managers. Figure 1 shows an example of how these teams—involving all functions—interact to impact quality and reliability improvement.

Functional Quality/Reliability Teams



Functional Team Focus

• Product independent, manufacturing processes, Q&R predictors, process controls
• Data systems & feedback • Training and education

Figure 1

Quality Improvement

Through product redesigns, modified assembly methods, better test programs and improved device external characteristics, significant improvement in product quality as measured by our customers has been achieved. As shown in Figure 2, the defect rate at customers' Incoming Quality Control improved about 90% since 1979, with significant reductions in both electrical and non-electrical discrepancies during 1982.

Figure 2 also indicates the job still to be done for improved quality levels. In addition to ongoing emphasis on reduction of electrical defects, TI is developing a "zero defect" quality system for eliminating paperwork errors which result in shipment of wrong devices or parts with incorrect marking. This program is essential to achieving the improvements in customer quality projected for 1983 and later years.

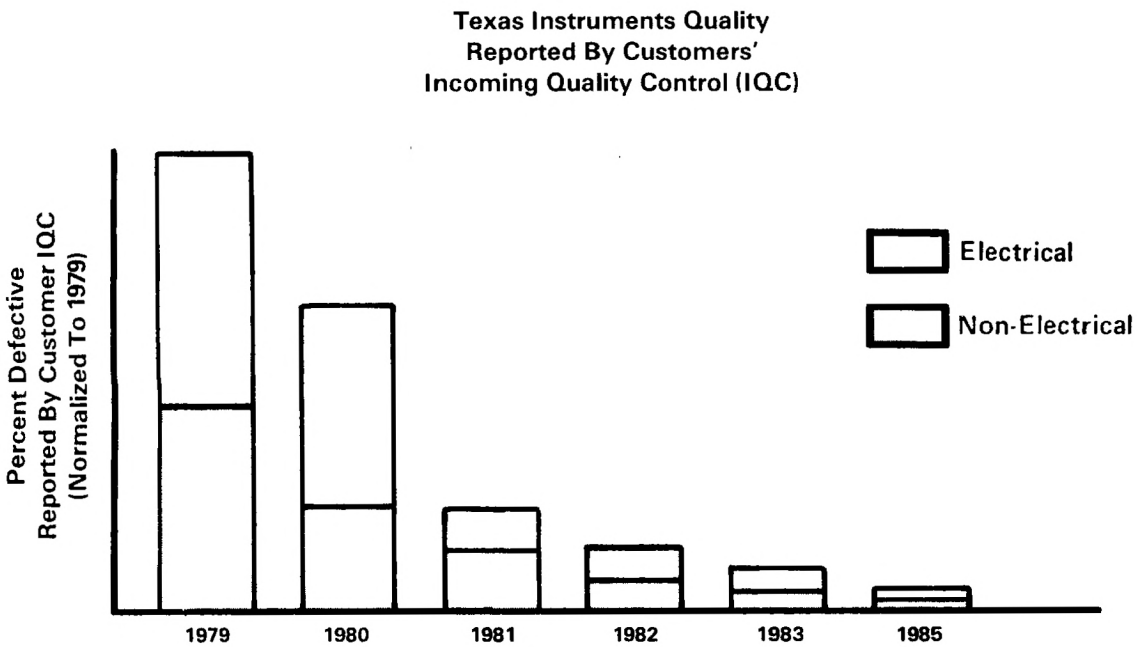


Figure 2

Reliability Improvement

TI assures a reliable product prior to market introduction. Thereafter product is routinely monitored to determine design, material and process changes for continuing reliability improvement. This procedure has resulted in TI products typically following a 50-70% learning curve (failure rate reduces to 50 to 70% of its previous value each time cumulative production volume doubles). Figure 3 shows examples of reliability improvement in learning curve format. These reliability improvements resulted from specific programs for eliminating failure modes discovered in reliability life testing. Since reliability is a major factor in minimizing the "total cost of ownership" of products by customers, TI emphasizes the continuation of improvements in product reliability.

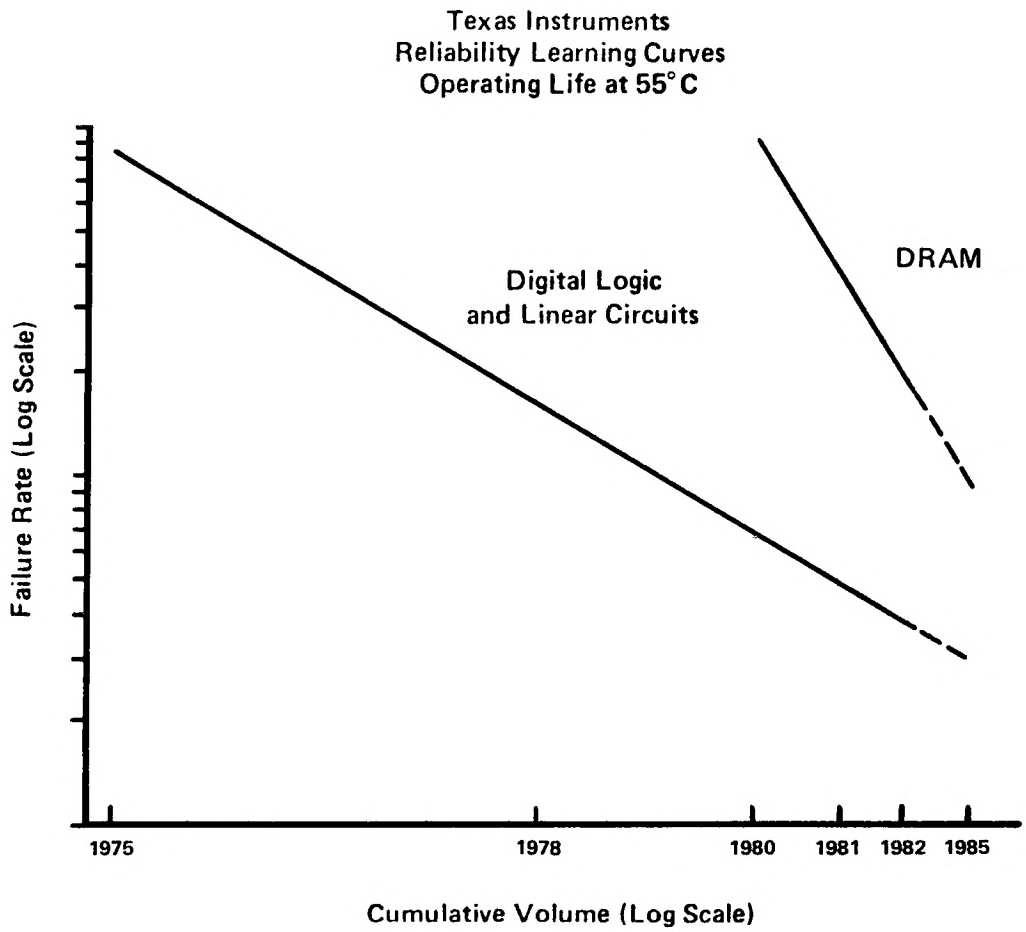


Figure 3

TI is dedicated to achieving product quality and reliability leadership in the worldwide semiconductor market. Plans and programs for continual quality and reliability improvements are working to satisfy the needs of TI's customers in meeting the exacting challenges of the electronics equipment industry.

PROGRAMMABLE PRODUCTS

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Overview

Texas Instruments is the only manufacturer to offer 4-, 8-, 16-, and 32-bit single-chip microcomputers, meeting a broad range of customer applications and requirements. To date, TI has shipped ove 100 million microcomputers, making Texas Instruments the world's leding suplier of microcomputer products.

The new TMS320 family of 16/32-Bit Digital Signal Processors is rapidly being accepted as the new industry standard for high performance signal processing applications. Through its five million instructions per-second, hardware multiply, barrel shifter, and digital signal processing instructions, the TMS320 family opens new areas in microcomputer applications. Applications such as speech recognition are now solved with low-cost microcomputers.

The 16-bit TMS99000 family provides a choice of high-performance microprocessors, single-chip microcomputers, and peripherals. Features include advanced architecture, bus structure, and an instruction set that is compatible throughout the family.

The 8-bit TMS7000 family is the newest, most cost-effective system solution for 8-bit microcomputer applications, such as computer peripherals, telecommunications, industrial control, and automotive. It has unique features that significantly enhance performance and flexibility.

The 4-bit TMS1000 family is targeted for high-volume applications where the most cost-effective microcomputer intelligence is required. Typical applications of the 40-device TMS1000 family include appliance controllers, toys and games, instrumentation, and other simple controller operations.

The Advanced Microprocessor Peripheral Family provides a cost effective, high-performance solution to many of the common I/O and control functions. Advanced peripherals are available for MODEM, Video Display Controllers and many other functions within a single chip. Advanced peripherals will interface with most microprocessors.

XDS and AMPL development systems consist of an extensive set of hardware and software development support tools for TI's programmable products. System configurations range from a single user XDS debug system through multi-user hard-disk systems. The Multi-AMPL systems support up to eight program designers at the same time, thereby providing increased productivity and reduced cost per user.

System support includes real-time in-circuit emulation, friendly menu-driven operator interface, and a variety of high-level languages such as BASIC and PASCAL. These high level languages plus component software products provide an unexcelled ease of program development for TI's TMS99000/TM990 16-bit microcomputer components and modules. Including system support for the TMS7000 8-bit and TMS1000 4-bit microcomputer families, completes a comprehensive line of support tools needed to capitalize on TI's broad range of microcomputer products and technologies.

The TM990 series of microcomputer modules provides an extensive choice of pre-assembled 16-bit microcomputer modules. Each is a single, pretested, ready-to-plug-in board, and is compatible with other members of the TMS99000 family of microcomputers and microprocessors. In addition, add-in memory boards are available for DEC and Intel mini/microcomputers. These boards offer improved system performance and increased reliability through use of 64K DRAMs and VLSI error detect and correct (EDAC) components. Density extends up to 1M bytes per board.

Quality and Reliability

Texas Instruments recognizes the need not only to provide state-of-the-art functional features that ensure competitive functional capability, but to market products without initial defects and with high field reliability. We are also keenly aware that quality and reliability leadership is a critical ingredient in a market with increasing international competition and that quality, reliability, and cost economy are interdependent.

Microcomputer Components

The firm TI commitment to excellence in microcomputer device quality and reliability is illustrated by the following detailed testing:

- After 100% electrical screen by manufacturing, each lot is sampled by QC at worst-case bias, temperature, load, and timing conditions. Full instruction set exercises are performed. Failed lots are rejected and rescreened prior to shipment.
- New designs and major process/material changes are qualified by extensive environmental and life testing prior to production startup.
- Accelerated environmental monitor testing of representative products ensure that manufacturing controls are effective and that capability demonstrated by original qualification test has been maintained.
- Failures from accelerated reliability tests are analyzed to identify cause and corrective action on a systematic basis. This product improvement program is targeted to drive failure rate to less than 100 FITS.

Microcomputer Modules

All Texas Instruments TM990 modules are dynamically burned-in at 70°C for at least eight hours, error free. All are monitored by automatic error monitoring equipment to immediately catch any failed units. Further, TI puts representative modules, selected from regular production, on long-term life test. Presently, over 370,000 module-hours of testing at 65°C has resulted in a demonstrated MTBF of over four years per module. Analysis of published data from other manufacturers indicates this to be leadership reliability.

TMS320 Family of Digital Signal Processors

The TMS32010 is the first member of the new TMS320 digital signal processing family, designed to support a wide range of high-speed or numeric-intensive applications. This 16/32-bit single-chip microcomputer combines the flexibility of a high-speed controller with the numerical capability of an array processor, thereby offering an inexpensive alternative to multichip bit-slice processors.

The TMS320 family contains the first MOS microcomputers capable of executing five million instructions per second. This high throughput is the result of the comprehensive, efficient, and easily programmed instruction set and of the highly pipelined architecture. Special instructions have been incorporated to speed up the execution of digital signal processing (DSP) algorithms.

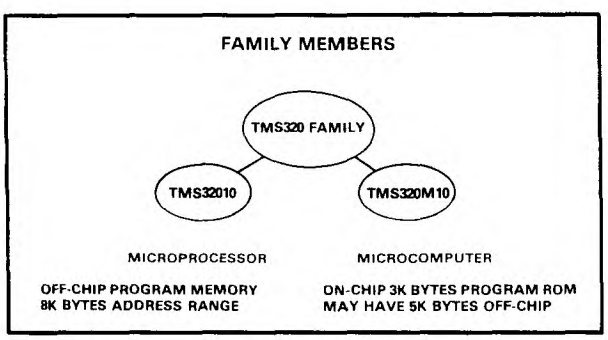
Development support is available for a variety of host computers. This includes a macro assembler, linker, simulator, emulator, and evaluation module.

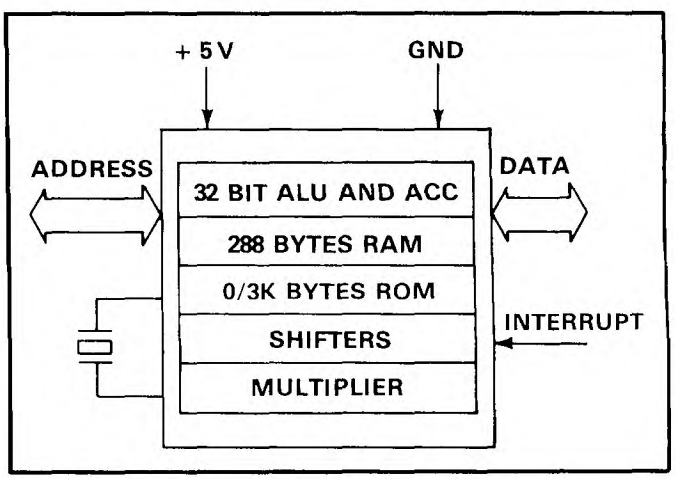
KEY FEATURES

With an excellent combination of features, the TMS320 family of high-performance digital signal processors is a cost-effective alternative to custom VLSI devices and bit-slice systems.

- 200-ns instruction cycle
- 288-byte on-chip data RAM
- ROMless version - TMS32010
- 3K-byte on-chip program ROM - TMS320M10
- External memory expansion to a total of 8K bytes at full speed
- 16-bit instruction/data word
- 32-bit ALU/accumulator
- 16 x 16-bit multiply in 200 ns
- 0 to 15-bit barrel shifter
- Eight input and eight output channels
- 16-bit bidirectional data bus with 40-megabits-per-second transfer rate
- Interrupt with full context save
- Signed two's complement fixed-point arithmetic
- 2.7-micron NMOS technology
- Single 5-V supply
- 40-pin DIP

The TMS320M10 and the TMS32010 are exactly the same with one exception: the TMS320M10 contains an on-chip masked ROM while the TMS32010 utilizes off-chip program memory.





TMS320 Family of Digital Signal Processors

The TMS320 family's unique versatility and power give the design engineer a new approach to a variety of complicated applications. In addition, these microcomputers are capable of providing the multiple functions often required for a single application. For example, the TMS320 family can enable an industrial robot to synthesize and recognize speech, sense objects with radar or optical intelligence, and perform mechanical operations through digital servo loop computations.

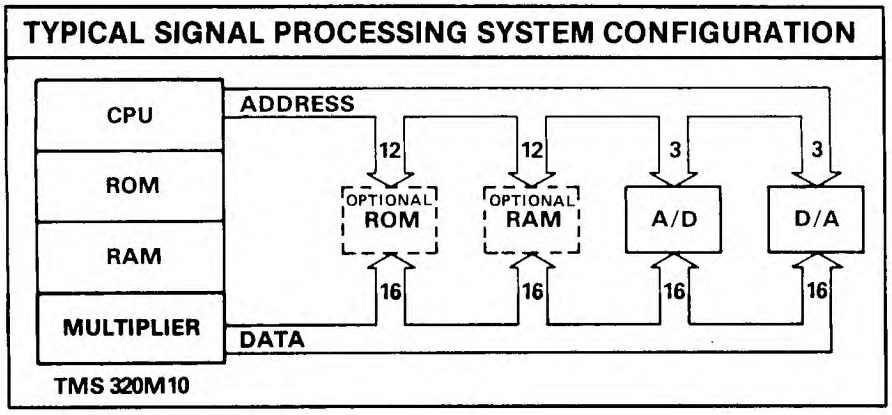
Some typical applications of the TMS320 family are listed below.

TYPICAL APPLICATIONS OF THE TMS320 FAMILY

SIGNAL PROCESSING	TELECOMMUNICATIONS	IMAGE PROCESSING
• Digital filtering • Correlation • Hilbert transforms • Windowing • Fast Fourier transforms • Adaptive filtering • Waveform generation • Speech processing • Radar and sonar processing • Electronic counter measures • Seismic processing	• Adaptive equalizers • μ/A law conversion • Tone generators • High-speed modems • Multiple-bit-rate modems • Amplitude, frequency, and phase modulation/demodulation • Data encryption • Data scrambling • Digital filtering • Data compression • Spread-spectrum communications	• Pattern recognition • Image enhancement • Image compression • Homomorphic processing • Radar and sonar processing
		HIGH-SPEED CONTROL
		• Servo links • Position and rate control • Motor control • Missile guidance • Remote feedback control • Robotics
INSTRUMENTATION	**NUMERIC PROCESSING**	**SPEECH PROCESSING**
• Spectrum analysis • Digital filtering • Phase-locked loops • Averaging • Arbitrary waveform generation • Transient analysis	• Fast multiple/divide • Double-precision operations • Fast scaling • Non-linear function computation (i.e., sin x, e^x)	• Speech analysis • Speech synthesis • Speech recognition • Voice store and forward • Vocoders • Speaker authentification

TMS320 SIGNAL PROCESSING MICROCOMPUTERS

FEATURES	DEVICE NUMBER	
	TMS32010	TMS320M10
Accumulator Width (bits)	32	32
Data Word (bits)	16	16
Clock Rate (MHz)	20	20
Instruction Rate (MIPS)	5	5
Memory On-Chip RAM (bytes)	288	288
ROM (bytes)	0	3 K
16 X 16 Multiply - 200 ns	✓	✓
Barrel Shifter	✓	✓
Power Supply	5 V	5 V
Development System	✓-XDS	✓-XDS



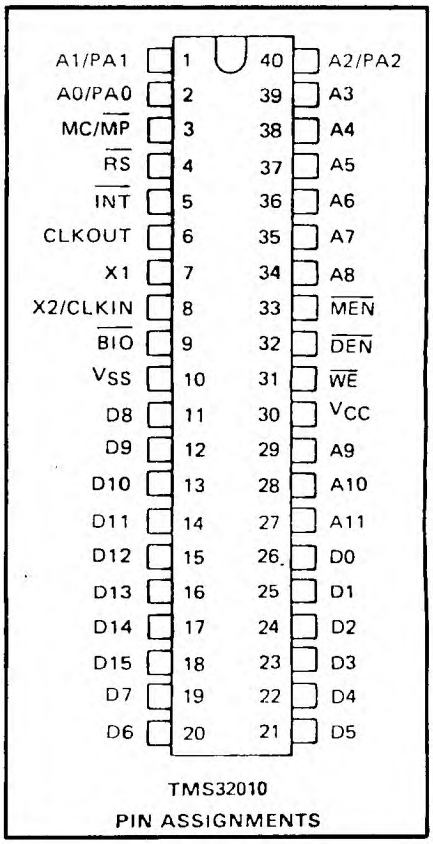
ARCHITECTURE

The TMS320 family utilizes a modified Harvard architecture for speed and flexibility. In a strict Harvard architecture, program and data memory lie in two separate spaces, permitting a full overlap of the instruction fetch and execution. The TMS320 family's modification of the Harvard architecture allows transfers between program and data spaces, thereby increasing the flexibility of the device. This modification permits coefficients stored in program memory to be read into the RAM, eliminating the need for a separate coefficient ROM. It also makes available immediate instructions and subroutines based on computed values.

The TMS32010 utilizes hardware to implement functions that other processors typically perform in software. For example, this device contains a hardware multiplier to perform a multiplication in a single 200-ns cycle. There is also a hardware barrel shifter for shifting data on its way into the ALU. Finally, extra hardware has been included so that auxiliary registers, which provide indirect data RAM addresses, can be configured in an autoincrement/decrement mode for single-cycle manipulation of data tables. This hardware-intensive approach gives the design engineer the type of power previously unavailable on a single chip.

TMS32010 PIN DEFINITIONS

SIGNAL	I/O	DEFINITION
V_{CC}, V_{SS}	IN	Power and ground
X1	IN	Crystal input
X2/CLKIN	IN	Crystal input or external clock input
CLKOUT	OUT	System clock output, 1/4 crystal/CLKIN frequency
$\overline{WE}$	OUT	Write enable indicates valid data on D15-D0.
$\overline{DEN}$	OUT	Data enable indicates the processor accepting input data on D15-D0.
$\overline{MEN}$	OUT	Memory enable indicates that D15-D0 will accept external memory instruction.
$\overline{RS}$	IN	Reset used to initialize the device
$\overline{INT}$	IN	Interrupt
$\overline{BIO}$	IN	External polling input for bit test and jump operations
MC/$\overline{MP}$	IN	Memory mode select pin. High selects microcomputer mode. Low selects microprocessor mode.
D15-D0	I/O	16-bit data bus
A11-A0/ PA2-PA0	OUT	External address bus. I/O port address multiplexed over PA2-PA0.



TMS32010
PIN ASSIGNMENTS

TMS99000 16-Bit Microprocessor/Microcomputer Family

The TI 99000 Family provides a choice of high-performance, and single-chip microprocessors and microcomputers. Each is unique. An advanced architecture, bus structure, and instruction set common to the entire Family provide design ease and flexibility, high performance, economy, and other benefits for both designer and user. Fully supported by software, software development systems, and TI's technical assistance, these circuits are available now. The key microprocessors of the 99000 Family include:

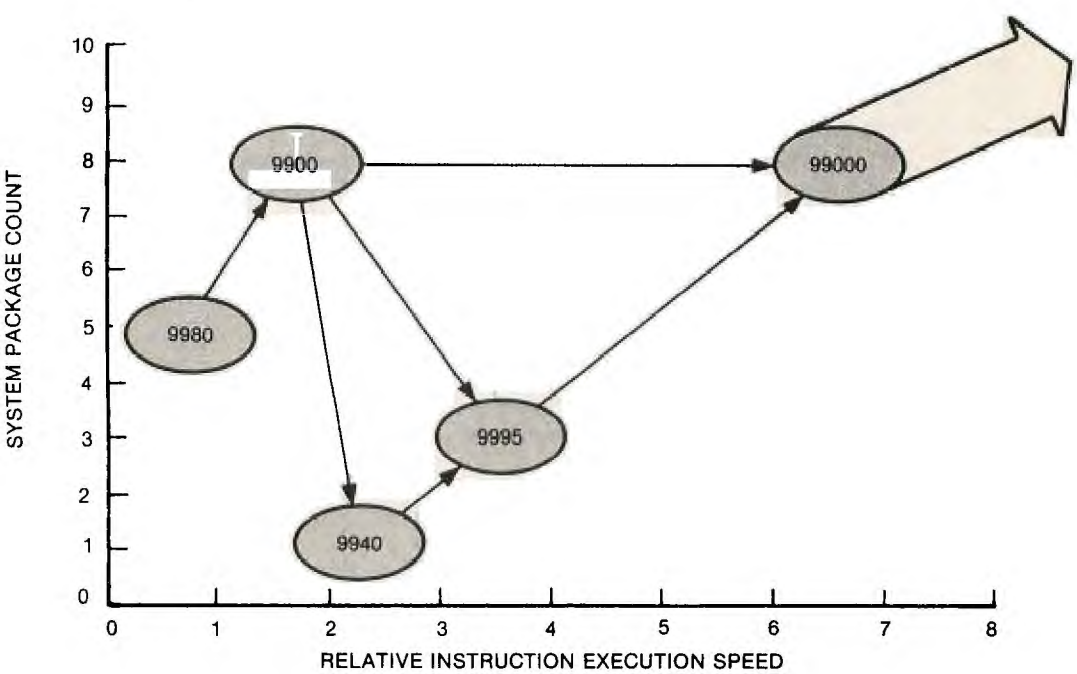
TMS9900 MICROPROCESSOR. The TMS9900, introduced in 1977, is the world's first 16-bit microprocessor. The TMS9900 is backed by an established base of software, design support, and AMPL development systems. Key features include: 16-bit instruction word; 8- and 16-bit data format; bidirectional parallel data bus; direct addressing of up to 64K bytes; 69 instructions, including multiply and divide; 7 addressing modes; 17 prioritized interrupts; and a unique bit serial I/O is addition to general memory-mapped I/O. For military applications, the SBP9989 provides the operating temperature range and radiation tolerance of the SBP9900A with the added feature of twice the throughput of the SBP9900A.

TMS9980A AND TMS9981 MICROPROCESSORS. Lower-cost versions of the TMS9900 featuring an 8-bit memory data bus for smaller systems needing 9900 16-bit capabilities. TMS9980A and TMS9981 are similar, except for minor differences in supply voltages and clock-drive requirements.

TMS9940 MICROCOMPUTER. The TMS9940 is the world's first single-chip 16-bit microcomputer featuring 2048 bytes of ROM and 256 bytes of RAM on-chip. Key features include: 9900 CPU architecture and instruction set; 4 prioritized interrupts; on-chip timer/event counter; and 32 general purpose I/O ports.

TMS9995 MICROPROCESSOR. Contains a performance enhanced CPU, on-chip 256 bytes of RAM, and external memory and I/O bus to bring speed and low chip count for systems requiring both high performance and low system cost. Key Features include 9900 instruction set including signed multiply and divide; 256 bytes of on-chip RAM; on-chip 16-bit interval timer/event counter; on-chip I/O mapped flag register; 7 prioritized interrupts; 64K bytes memory addressability; and an on-chip 12-MHz clock generator.

TMS99000 MICROPROCESSORS. The 99000 Family is the third and newest family of advanced 16-bit microprocessors from TI. With performance 5 to 7 times that of the TMS9900, the 99000 Family features 84 powerful instructions that are a direct superset of the 9900. With a fast, 167 nanosecond cycle time, the 99000 family of processors can perform a memory-to-memory move in just 0.8 microseconds. Also new for the 99000 Family is both parallel and serial I/O address space for flexibility in configuring input/output devices. The first member of the 99000 Family is the TMS99105 Advanced 16-bit Microprocessor. The TMS99105 supports all the features of the 99000 Family. The TMS99110 Advanced 16-bit Microprocessor includes all the features of the TMS99105 with the addition of the 12 single-precision floating point instructions.



TMS99000 16-Bit Microprocessor/Microcomputer Family

FEATURES	DEVICE NUMBER							
	TMS99110A	TMS99105A	TMS9995*	TMS9940M	SBP9989	TMS9981	TMS9980A	TMS9900-40*
Minimal System Chip Count	5	5	3	1	5	3	3	6
Clock Rate (MHz)	24	24	12	4	4.4	2.5	2.5	3, 4
Max Memory Reach (Bytes)								
Stand-Alone	256K	256K	64K	2K	128K	16K	16K	64K
Memory Mapper	16M	16M	16M	NA	16M	4M	4M	16M
On-chip Memory (Bytes)								
ROM	1024	1024	0	2048	NA	NA	NA	NA
RAM	32	32	256	128	NA	NA	NA	NA
Addressing Modes	7	–	7	7	7	7	7	7
Number of Instructions	96	84	73	73	73	69	69	69
Development System	AMPL	AMPL	AMPL	AMPL	AMPL	AMPL	AMPL	AMPL
Power Supply	+5 V	+5 V	+5 V	+5 V	400 mA	+5, +12 V	±5, +12 V	±5, +12 V
Temperature Range	0°C to 70°C				−55°C to 125°C	0°C to 70°C		
On-chip Clock	Yes	Yes	Yes	Yes	No	Yes	No	No
CRU Address Reach	[illegible]	32K	32K	256	32K	4K	4K	4K
Package								
Pins	40	40	40	40	64	40	40	64
Type	N,J	N,J	N,J	N,J	J	N,J	N,J	N,J

* Available in Industrial Temperature Range (−40°C to +85°C)

TMS99000 Family Instruction Set

MNEMONIC	DESCRIPTION
A	Add Word (16-bit)
AB	Add Byte (8-bit)
ABS	Absolute Value
AI	Add Immediate
AM	Add Multiple (32-bit)
ANDI	AND Immediate
B	Branch
BIND	Branch Indirect
BL	Branch and Link
BLWP	Branch and Load Workspace Pointer
BLSK	Branch Immediate and Push Link to Stack
C	Compare Word
CB	Compare Byte
CI	Compare Immediate
CKOF	External Clock Off
CKON	External Clock On
CLR	Clear Word
COC	Compare Ones Corresponding
CZC	Compare Zeros Corresponding
DCA**	Decimal Correct Add
DCS**	Decimal Correct Subtract
DEC	Decrement
DECT	Decrement By Two
DIV	Unsigned Divide
DIVS	Signed Divide
IDLE	Idle Processor
INC	Increment
INCT	Increment By Two
INV	Invert
JXX	Jump (1-unconditional, 12-conditional)
LDD*	Long Distance Destination (Memory Mapper Control)
LDCR	Load Communications Register Unit (I/O)
LDS*	Long Distance Source (Memory Mapper Control)
LI	Load Workspace Register Immediate
LIMI	Load Interrupt Mask Immediate
LREX	Load External
LST	Load Status Register
LWP	Load Workspace Pointer

MNEMONIC	DESCRIPTION
LWPI	Load Workspace Pointer Immediate
MOV	Move Word
MOVB	Move Byte
MPY	Multiply
MPYS	Signed Multiply
NEG	Negate
ORI	OR Immediate
RSET	External Reset
RTWP	Return to Workspace Pointer
S	Subtract (16-Bit)
SB	Subtract Byte (8-Bit)
SBO	Set Bit to One (I/O)
SBZ	Set Bit to Zero (I/O)
SETO	Set Word to Ones
SLA	Shift Left Arithmetic
SLAM	Shift Left Arithmetic Multiple (32-Bit)
SM	Subtract Multiple (32-Bit)
SRA	Shift Right Arithmetic
SRAM	Shift Right Arithmetic Multiple (32-Bit)
SRC	Shift Right with Carry
SRL	Shift Right Logical
SOC	Set Ones Corresponding Word
SOCB	Set Ones Corresponding Byte
STCR	Store Communication Register Unit (I/O)
STST	Store Status
STWP	Store Workspace Pointer
SWPB	Swap Bytes
SZC	Set Zeros Corresponding Word
SZCB	Set Zeros Corresponding Byte
TB	Test Bit (I/O)
TCMB	Test and Clear Memory Bit
TMB	Test Memory Bit
TSMB	Test and Set Memory Bit
X	Execute
XOP	Extended Operation (Software Context Switch-16 XOP's)
XOR	Exclusive-OR

*Implemented in TMS99110A only.

**TMS9940 only.

TMS99110 FLOATING POINT FUNCTIONS

AR	Add Real	CR	Compare Reals
SR	Subtract Real	CIR	Convert Integer to Real
MR	Multiply Real	CER	Convert Extended Integer to Real
DR	Divide Real	CRI	Convert Real to Integer
LR	Load Real	CRE	Convert Real to Extended Integer
STR	Store Real	MM	Multiply Multiple (32 bit integer × 32 bit integer = >64 bit general source/destination)
NEGR	Negate Real		

TMS7000 8-Bit Microcomputer Family

The first microprogrammable 8-bit microcomputer

Setting new VLSI standards in cost, performance, and flexibility with unique chip design and rich instruction set...

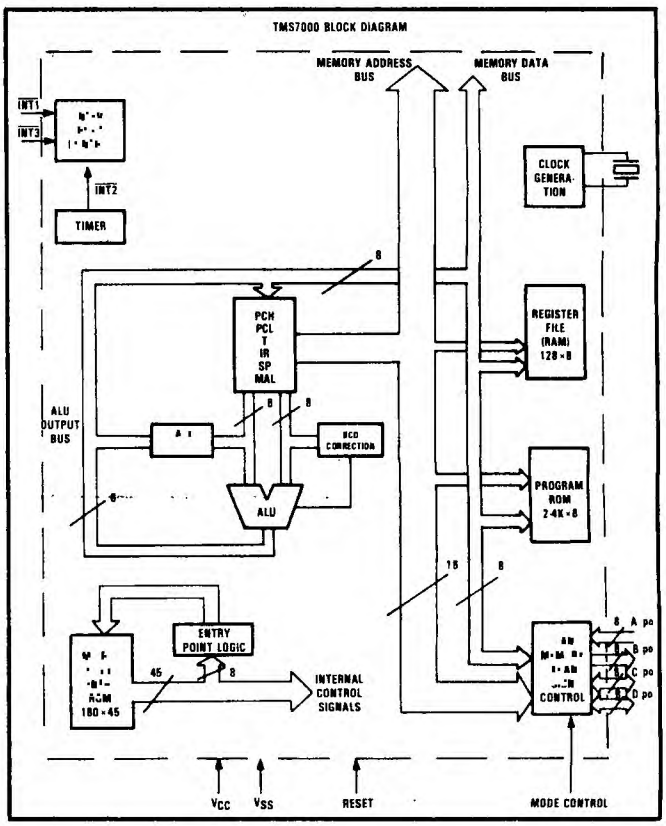
The TMS7000 is the newest, most cost-effective system solution for 8-bit microcomputer applications, such as computer peripherals, telecommunications, industrial control, automotive, appliances, toys, and games. The significantly smaller chip size of the TMS7000 means lower cost. The singular VLSI design concept provides the ability to add family members quickly and easily by simply inserting new areas on the chip for additional memory capacity or functions.

The TMS7000 instruction set, variety of addressing modes, and unequaled architecture maximize throughput while minimizing memory requirements. The instruction set contains the usual byte-oriented instructions, and in addition offers multiplication, double precision arithmetic, and single- and multiple-bit testing, as well as BCD arithmetic.

At the heart of the TMS7000 family is TI's newly developed STRIPCHIP ARCHITECTURE TOPOLOGY (SCAT). The TMS7000 is a unique memory-like array-structured chip, resulting in a significant size reduction. Smaller chips equate to lower prices.

Another feature of SCAT is the control ROM used to define the instruction set. This feature allows customizing of the TMS7000 instruction set.

Five memory expansion modes allow trade off of I/O pins for easy interface to a wide range of external memory and peripheral devices. Up to 64K may be addressed for increased configuration flexibility.



FEATURES	DEVICE NUMBER					
	TMS7000	TMS7020	TMS7040	TMS70120*	TMS7041*	TMS70C20
ROM (Bytes)	0	2K	4K	12 K	4K	2K
RAM (Bytes)	128	128	128	128	128	128
I/O BITS	32	32	32	32	32	32
SERIAL I [illegible]	NO	NO	NO	NO	YES**	NO
NO. OF [illegible] RY EXPANSION MODES	5	5	5	5	4	5
NO. OF INTERRUPTS	3	3	3	3	3	3
8-BIT TIMER/EVENT COUNTER	YES	YES	YES	YES	YES (2)	YES
INTERNAL CLOCK FREQ (MHz)	2.5/4.0	2.5	2.5	2.5	2.5/4.0	1.5
EXTERNAL CRYSTAL FREQ	5.0/8.0	5.0	5.0	5.0	5.0/8.0	3
OPERATING VOLTAGE	5	5	5	5	5	5
POWER CONSUMPTION (mW) @ 5 VOLTS	500/600	500	500	500	650/750	30
POWER DOWN CURRENT	–	–	–	–	–	5 μA
TECHNOLOGY	SMOS	SMOS	SMOS	SMOS	SMOS	Si Gate CMOS
DIP PACKAGE TYPE	40-pin	40-pin	40-pin	40-pin	40-pin	40-pin

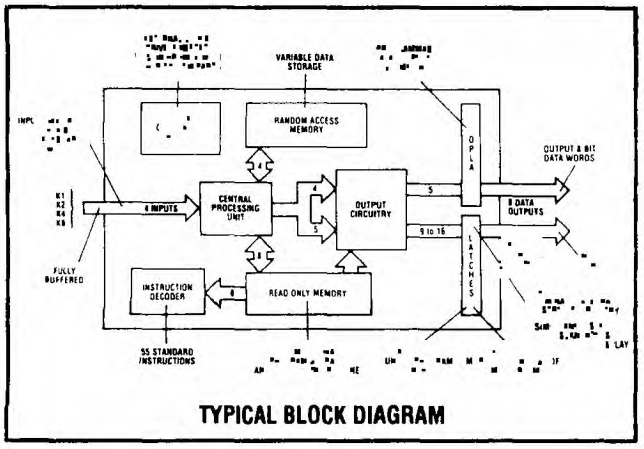
* Planned new product
** On-Chip UART

TMS1000 4-Bit Microcomputer Family

For high-volume low-cost applications, no other microcomputer family has enjoyed the continued popularity of the TMS1000 family of 4-bit single-chip microcomputers. Since its introduction in 1974, the TMS1000 family has become the world's most widely used microcomputer, with over 100 million units shipped for applications as diverse as microwave ovens, electronic toys and games, television tuners, dishwashers, radios, scanners, and security systems.

Available in PMOS, CMOS, and LMOS (Low-power PMOS) processes with wide variations of ROM/RAM, package sizes, I/O, output drive capability, and clock speeds, the family offers well over 40 base-sets to fit into various end-equipment applications at the lowest system cost. The unique functionality of the microcomputer is determined by the customer-specified software that is mask-programmed into the ROM at the factory.

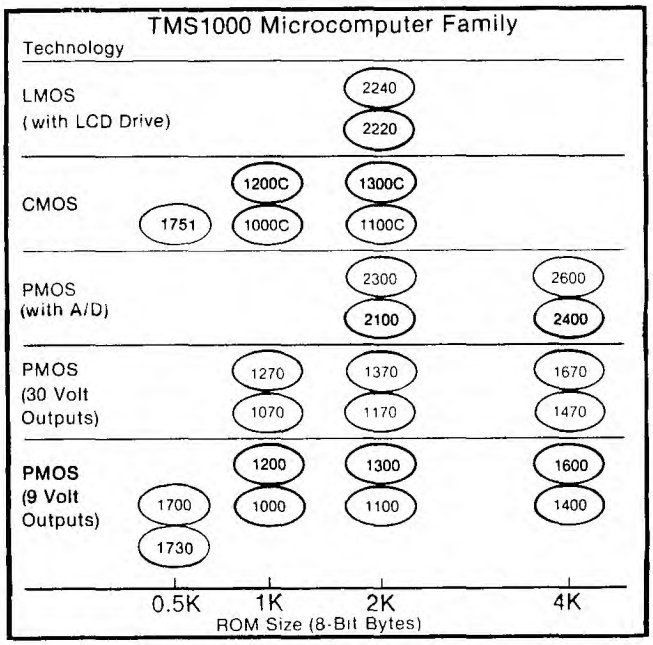
Several preprogrammed versions are available to evaluate features of the TMS1000 family. Contact local field sales offices for further information.



TYPICAL BLOCK DIAGRAM

The TMS1000 family is well supported with extensive design, test and application support. A complete *line of* development tools in the form of ROMless evaluator chips, System Evaluator boards, and AMPL 1000 systems (consisting of Editor, Assembler, In-Circuit Emulators, and diagnostics) are available to the user to develop his custom software.

Texas Instruments continues to lead the industry in bringing 4-bit microcomputer power to within the practical (cost effective) reach of more and more applications every year. Cost effectiveness at the chip level through volume learning curve experience and at the system level through on-board interface circuitry have been the banners of the TMS1000 family's success. This, coupled with field proven reliable performance, will continue to serve the future needs of the market place . . . a marketplace limited only by entrepreneuric qualities of the human mind!



TMS1000 PMOS Series

FEATURES		DEVICE NUMBER													
		TMS1730	TMS1700	TMS1000	TMS1070	TMS1200	TMS1270	TMS1100	TMS1170	TMS1300	TMS1370	TMS1400	TMS1470	TMS1600	TMS1670
Supply Voltage (V)		9/15	9/15	9/15	9/15	9/15	9/15	9/15	9/15	9/15	9/15	9	9	9	9
ROM (8-Bit Bytes)		0.5 K	0.5 K	1 K	1 K	1 K	1 K	2 K	2 K	2 K	2 K	4 K	4 K	4 K	4 K
Data RAM (Bits)		32.4	32X4	64X4	64X4	64X4	64X4	128X4	128X4	128X4	128X4	128X4	128X4	128X4	128X4
I/O	K/L Inputs	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/4	4/4
	'R' Individually Addressed Outputs	6	9	11	11	13	13	11	11	16	16	11	10	16	16
	'O' Parallel Latched Data Outputs	5	8	8	8	8	10	8	8	8	8	8	8	8	8
Subroutine Levels		1	1	1	1	1	1	1	1	1	1	3	3	3	3
Instruction Cycle (μSEC)		10	10	10	15	15	15	10	15	15	15	11	11	11	11
Output Voltage (V)		-15/-20	-9/-15	-9/-15	-30/-35	-9/-15	-30/-35	-9/-15	-30/-35	-9/-15	-30/-35	-9	-30	-9	-30
Package Pin Count		20	28	28	28	40	40	28	28	40	40	28	28	40	40
Power Dissipation (mW)		36/68	36/68	36/68	45/105	36/68	45/105	45/105	45/105	45/105	45/105	63	63	63	63
Evaluator (ROMless Chip)		SE1000P						SE1100P				SE1400P			
Emulator Support		AMPL1000										AMPL1400			

TMS1000 CMOS Series

FEATURES		TMS1751**	TMS1000C	TMS1200C	TMS1100C	TMS1300C	TMS1004C**	TMS1304**
Supply Voltage Range (V)		3 - 6	3 - 6	3 - 6	3 - 6	3 - 6	3 - 6	3 - 6
ROM (8-Bit Bytes)		0.5 K	1 K	1 K	2 K	2 K	2 K	2 K
Data RAM (Bits)		32 X 4	64 X 4	64 X 4	128 X 4	128 X 4	256 X 4	256 X 4
I/O	K/L Inputs	4/0	4/0	4/4	4/0	4/4	4/0	4/0
I/O	'R' Individually Addressed Output Latches	7	10	16	10	16	10	10
I/O	'O' Parallel Latched Data Outputs	4	8	8	8	8	8	8
Subroutine Levels		3	3	3	3	3	3	3
Instruction Cycle (μSEC)		6	6	6	6	6	6	6
Output Levels (V)		5	5	5	5	5	5	5
Package Pin Count		16	28	40	28	40	28	40
Power Dissipation	Operating Mode (mW @ 5 V)	3	3.5	3.5	5	5	5	5
Power Dissipation	Halt Mode (μW @ 5 V)	—	0.5	0.5	1	1	1	1
Evaluator (ROMless Chip)		SE1000C			SE1100C		SE1004C**	
Emulator Support		AMPL1000C					AMPL1004C**	

TMS2100 Series (Expanded I/O with A/D Converters)

FEATURES		TMS2100	TMS2170	TMS2300	TMS2370	TMS2400**	TMS2470**	TMS2600**	TMS2670**
Supply Voltage Range (V)		9	9	9	9	9	9	9	9
ROM (8-Bit Bytes)		2 K	2 K	2 K	2 K	4 K	4 K	4 K	4 K
Data RAM (Bits)		128 X 4	128 X 4	128 X 4	128 X 4	256 X 4	256 X 4	256 X 4	256 X 4
I/O	'K' and 'J' Inputs	4	4	8	8	4	4	8	8
I/O	'R' Bi-Directional	4	4	4	4	4	4	4	4
I/O	'R' Individually Addressed Output	7	6	15	14	7	6	15	14
I/O	'O' Parallel Latched Data Outputs	8	8	8	8	8	8	8	8
I/O	Interrupts	1	1	1	1	1	1	1	1
I/O	Timer/ECI	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
I/O	8-Bit A/D	1	1	2	2	1	1	4	4
I/O	Zero-cross Detector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Subrouting Levels		4	4	4	4	4	4	4	4
Instruction Cycle (μSEC)		12	12	12	12	12	12	12	12
Output Levels (V)		- 15	- 35	- 15	- 35	- 15	- 35	- 15	- 35
Package Pin Count		28	28	40	40	28	28	40	40
Power Dissipation (mW)		90	90	90	90	105	105	105	105
Evaluator (ROMless Chip)		SE2100				SE2400			
Emulator Support		AMPL2100				AMPL2400**			

TMS2200 LMOS Series (Low Power)

FEATURES		TMS2220L	TMS2240L
Supply Voltage Range (V)		3	3
ROM (8-Bit Bytes)		2 K	2 K
Data RAM (Bits)		128 X 4	128 X 4
I/O	K/L Inputs	4/0	4/0
I/O	'R' Lines	4 - 8	8 - 13
LCD Drive	Duty Cycle	1/4	1/4
LCD Drive	Select Lines	8 - 12	15 - 20
LCD Drive	Display Digits	4 - 6	7.5 - 10
LCD Drive	Segments	32 - 48	60 - 80
Subrouting Levels		3	3
Instruction Cycle (μSEC)		18	18
Output Levels (V)		6	6
Package Pin Count		28	40
Power Dissipation	Slow Mode (μW)	180	180
Power Dissipation	Fast Mode (μW)	1200	1200
Evaluator (ROMless Chip)		SE2240L	
Emulator Support		AMPL2240**	

TMS2132 Microcomputer With On-Board Complex Sound Generator

FEATURES		TMS2132**
Supply Voltage Range (V)		9
ROM (8-Bit Bytes)		2 K
Data RAM (Bits)		128 X 4
I/O	K/L Inputs	4/0
I/O	LED Digit Outputs	9
I/O	LED Segment Outputs	8
I/O	*Complex Sound Generator Outputs (T, $\overline{T}$)	2
Subrouting Levels		3
Instruction Cycle (μSEC)		12
Output Levels (V)		- 9
Package Pin Count		28
Power Dissipation (mW)		100
Power On/Off		YES
Evaluator (ROMless Chip)		SE2130
Emulator Support		AMPL2130

* Complex Sound Generator Consists of 2-Tone Generators and 1 White Noise Generator With Individual Attenuators for Each Generator.

** Planned new product

TMS1000 Family Development Systems

The TMS1000 family of microcomputers are supported by the AMPL1000 line of development systems. The AMPL1000 system can be broken into software and hardware components. The hardware consists of an emulator buffer with specific SE emulator boards, while the software consists of a completely self-contained editor, assembler, emulator control, and diagnostics.

TMS1000 AMPL Development Systems

EMULATOR KITS	DEVICES SUPPORTED
TMAM6075	TMS1000/1070/1100/1170/1200/1270/1300/1370/1700 PMOS Family Members
TMAM6071	TMS1000/1070/1100/1170/1200/1300 CMOS Family Members
TMAM6073	TMS1400/1470/1600/1670 PMOS Family Members
TMAM6081	TMS2100/2170/2300/2370 PMOS Family Members
TMAM6082	TMS2220/2240 LMOS Family Members

The Following Texas Instruments Host Computers Support the AMPL1000 Development Systems

FEATURES	TMS1000 FAMILY HOST COMPUTERS			
	TMAM9000*	TMAM9010*	TMAM9021	TMAM9041
RAM Main Memory (Bytes)	64K	256K	256K	320K
Hard Disk Drives		1 (Dual)	2 (Dual)	2
Floppy Disk Drives	2 DSDD			
Total Disk Storage (Bytes)	2.2M	9.4M	18.8M	89.4M
Number of Terminals Included	1	1–2	2–4	4–8
CPU Clockspeed (MHz)	4	10	10	10
Operating System	TX5	DX	DX	DX

DSDD: Double-sided, Double-Density Floppy Disk

The following is a list of ROMless Microcomputers to aid the user in ensuring that his algorithm in EPROM is functionally correct before he commits it to a MASK-ROM device.

System Evaluators

SYSTEM EVALUATOR	DEVICES SUPPORTED
SE1000P	TMS1000/1070/1200/1270/1700 PMOS Family Members
SE1100P	TMS1100/1170/1300/1370 PMOS Family Members
SE1000C	TMS1000/1200/ CMOS Family Members
SE1004C**	TMS1104/1304/ CMOS Family Members
SE1100C	TMS1100/1300 CMOS Family Members
SE1400P	TMS1400/1470/1600/1670 PMOS Family members
SE2100P	TMS2100/2170/2300/2370 PMOS Family Members
SE2400P**	TMS2400/2470/2600/2670 PMOS Family members
SE2130P	TMS2132 PMOS Family Members
SE2220L	TMS2220/2240 LMOS Family Members

Texas Instruments also offers the ROMless microcomputers listed above with the following fully assembled and tested evaluation boards.

System Evaluator Boards

EVALUATOR BOARDS	BOARD CONTENTS
SEB1000P	PCB Assembly With SE1000P, EPROM Program memory and 0-PLA PROM
SEB1100P	PCB Assembly With SE1100P, EPROM Program memory and 0-PLA PROM
SEB1000C	PCB Assembly With SE1000C, EPROM Program memory and 0-PLA PROM
SEB1004C**	PCB Assembly With SE1004C, EPROM Program memory and 0-PLA PROM
SEB1100C	PCB Assembly With SE1100C, EPROM Program memory and 0-PLA PROM
SEB1400P	PCB Assembly With SE1400P, EPROM Program memory and 0-PLA PROM
SEB2100P	PCB Assembly With SE2100P, EPROM Program memory and 0-PLA PROM
SEB2400P**	PCB Assembly With SE2400P, EPROM Program memory and 0-PLA PROM
SEB2130P**	PCB Assembly With SE2130P, EPROM Program memory and 0-PLA PROM
SEB2220L	PCB Assembly With SE2220L, EPROM Program memory and 0-PLA PROM

** Planned new product

Advanced Microprocessor Peripherals

The TI Advanced Peripheral Family contains a wide selection of system support circuits which easily and cost effectively perform peripheral and interface functions, such as data communications, memory functions, special signal processing, and display. Included are controllers, latches, encoders, and others. The bus structure, architecture, I/O features, and other characteristics of these peripheral and interface circuits are compatible with members of the 99000 Family as well as most common microprocessors.

TI's general purpose peripherals work with any microprocessor and any microcomputer with a memory mapped I/O port. TI microprocessors and other popular microprocessor systems are achieving reduced parts counts, lower cost, and improved reliability through these powerful peripheral components.

Peripheral and Interface Circuits

Digital I/O

FUNCTION	DEVICE NUMBER	TECHNOLOGY	INTERFACE TO CPU	DATA TRANSFER RATE (max)	NO. OF PINS	PACKAGE	GENERAL PURPOSE PERIPHERAL
PROGRAM SYSTEM INTERFACE	TMS9901	NMOS	Serial, CRU	NA	40	N,J	NO
Octal I/O and Priority Encoders	TIM9905 TIM9906 TIM9907 TIM9908	LS TTL	Serial	NA	16	N,J	Yes

Clock Circuit

Clock Driver for 9900	TIM9904	LS TTL	Parallel	4MHz	16	N	NO

Communications Interface

Async. Comm. Controller Sync. Comm. Controller	TMS9902A TMS9903	NMOS	Serial, CRU Serial, CRU	19.2 K Baud 19.2 K Baud	18 20	N,J	NO
IEEEE 488 Interface FSK Modem-Bell 103 Comp FSK Modem-CCITT Pulse, Dual Tone Dialer Data Encryption Unit	TMS9914A TMS99532 TMS99534** TMS99531** TMS99541**	NMOS	Parallel Parallel Parallel Parallel Parallel	1 M Bytes/S 300 Bits/S 300 Bits/S N/A 5.1 K/Baud	40 18 18 14 40	N,J	Yes

Memory Interface

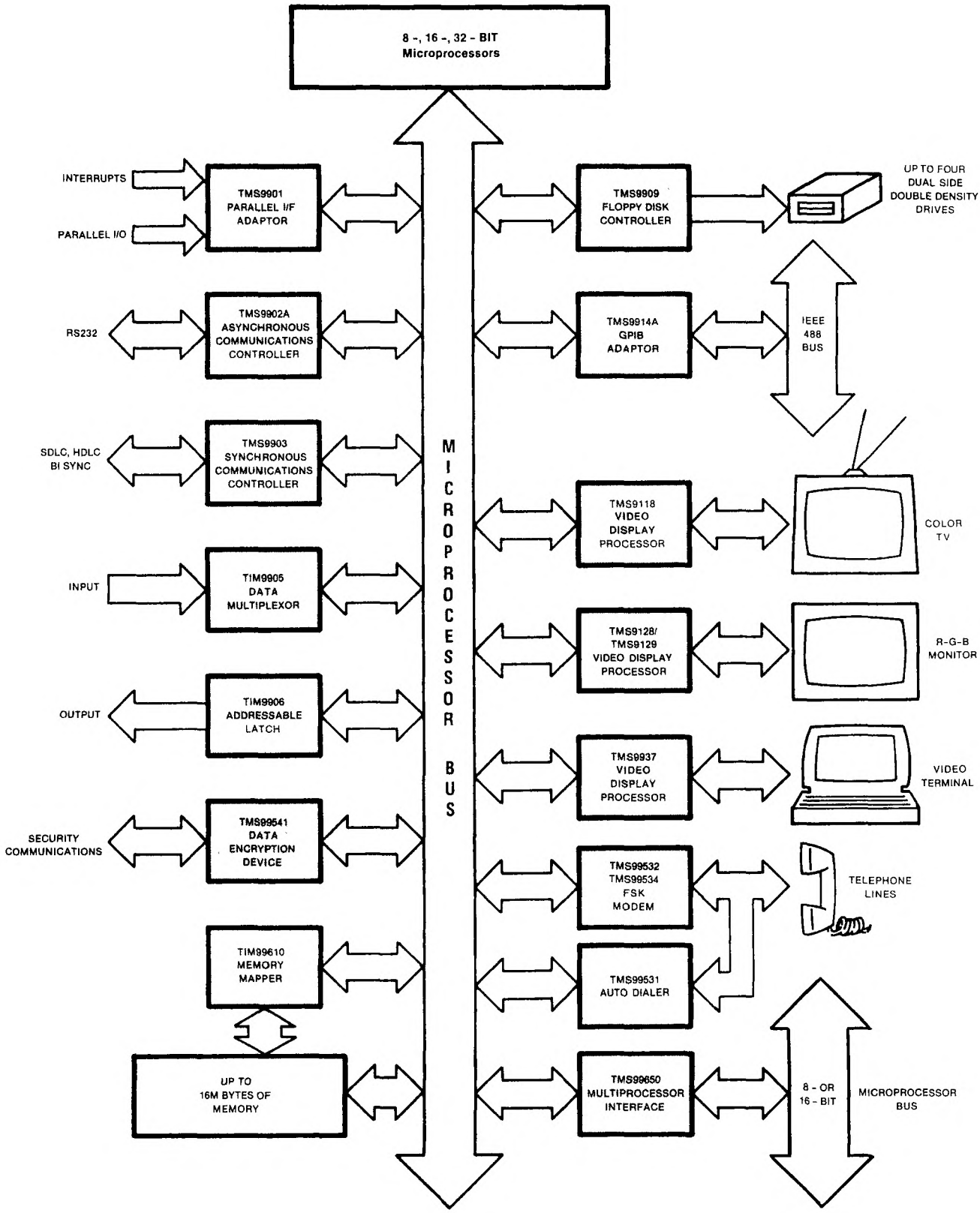
Floppy Disc Controller Multi-Processor Interface	TMS9909 TMS99650**	NMOS	Parallel	2 M Bits/S NA	40	N,J	Yes

Video Interface

Video Display Processor	Composite Video	TMS9118†	NMOS	Parallel	NTSC Composite Video	40	N,J	Yes
	Color difference output	TMS9128†			525 Line			
	Color difference output	TMS9129†			625 Line			
CRT Controller		TMS9937/5037*	NMOS	Parallel	NA	40	N,J	Yes

*SMC second source
**Planned new products
†Uses TMS4416 or TMS4116 VRAM
NA = Not Applicable
All Power Supplies are rated at +5 V

Advanced Microprocessor Peripherals

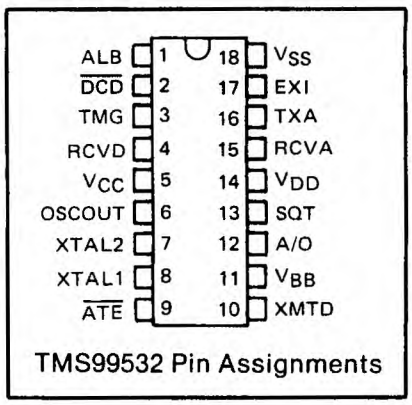


TMS99532, TMS99534* Single chip MODEMs

The TMS99532 modem is a telecommunications device that transmits and receives serial, binary data over the switched telephone network using frequency-shift-keyed (FSK) modulation. It is compatible with the Bell 103 series data sets and will communicate at up to 300 bits per second. The TMS99532 provides all the necessary modulation, demodulation and filtering required to implement a serial, asynchronous communications link. It is designed for users not expert in the telecommunications field and is an easily implemented cost-effective alternative to standard discrete modem design. Large scale integration NMOS technology provides the advantages of small size, low power and increased reliability. The TMS99532 modem design assures compatibility with a broad installed base of low-speed modems and acoustic couplers. Applications include interactive terminals, desk-top computers, point-of-sale (POS) terminals and credit verification systems.

KEY FEATURES

- Bell 103 compatible
- Single LSI chip solution requiring only 1 dual op-amp and 13 discretes
- All filtering, modulation and demodulation on chip
- Simplex, half duplex and full duplex capability
- Originate and answer modes
- Data rates from zero to 300 BPS
- Adjustable carrier detect timing
- Crystal controlled oscillator on chip
- CCITT V.25 compatible answer tone
- Analog loopback test mode
- TTL- compatible digital interface
- N- Channel silicon gate process (NSAG)
- Switched capacitor technology
- Housed in space-saving 18-pin DIP



TMS99532 Pin Assignments

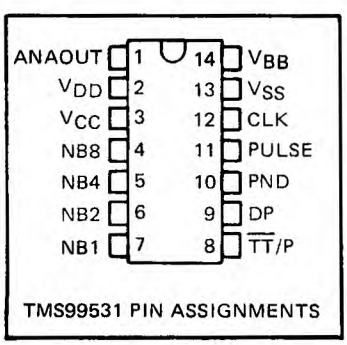
*The TMS99534 single chip modem has all of the same features as the TMS99533 except that it is CCITT V.21 compatible for use in Western Europe. The software and hardware interface is identical. The bandpass frequencies in European MODEMS are altered to be optimum for the equipment already in place in Europe.

TMS99531 Dual-Tone and Pulse Dialer

The TMS99531 Dialer is a telecommunications device compatible with the Bell telephone switching network. It provides both dual-tone multiple-frequency (DTMF) and pulse dialing. In addition to the usual common telephone usage, the dialer can be employed with transaction (POS and/or credit) terminals, digital voice messagers, radio and mobile telephones and remote/process control. Cost/Performance advantages make the dialer highly competitive with other dual tone/pulse dialers currently available.

In the pulse mode the TMS99531 can dial all 10 digits (0-9). In the dual-tone mode it can dial the 12 dual-tone combinations (0-9, *, #) on the standard pushbutton telephone keypad. Both fixed and interdigit timing in either mode is available.

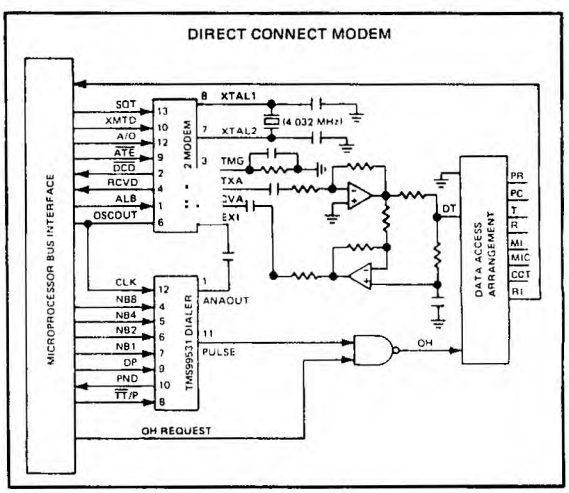
External circuits required by the TMS99531 are conveniently provided by the TMS99532 frequency-shift keyed modem (300 BPS). If the user chooses not to use the TMS99532, he will need a 4.032 MHz oscillator and a low-pass filter to remove higher harmonics.



TMS99531 PIN ASSIGNMENTS

KEY FEATURES

- Standard N-channel silicon gate processing using switched cap technology
- Identical 4-Bit addressing for both pulse and DTMF dialing
- Fixed digit and interdigit timing for both pulse and DTMF dialing
- No limit to number of digits that can be sent
- Accelerated pulse rate for minimum checkout
- Standard 12 frequency-pair combinations, plus single tone capability
- Stable frequencies and amplitudes
- Less than 5 percent total harmonic distortion in voice band
- High group tone pre-emphasis
- TTL-compatible input-output interface
- Subsystem complement to the TMS99532 FSK modem



Advanced Microprocessor Peripherals

Video Display Processors (VDP)

The control of color television and color monitor graphics with mixtures of text, animated pictorials, and a variety of color patterns is easily achieved in a low-cost system by selecting the TI VDP family. This VDP family has the ability to send out composite video or color difference and luminance outputs. The picture storage is highly compressed into dynamic RAMs which are refreshed transparently — no extra refresh hardware. The video memory space consists of two TMS4416 (16 K X 4) or eight TMS4116 (16 K X 1) when using the TMS9118, TMS9128 or TMS9129.

The VDP Family contains the following devices:

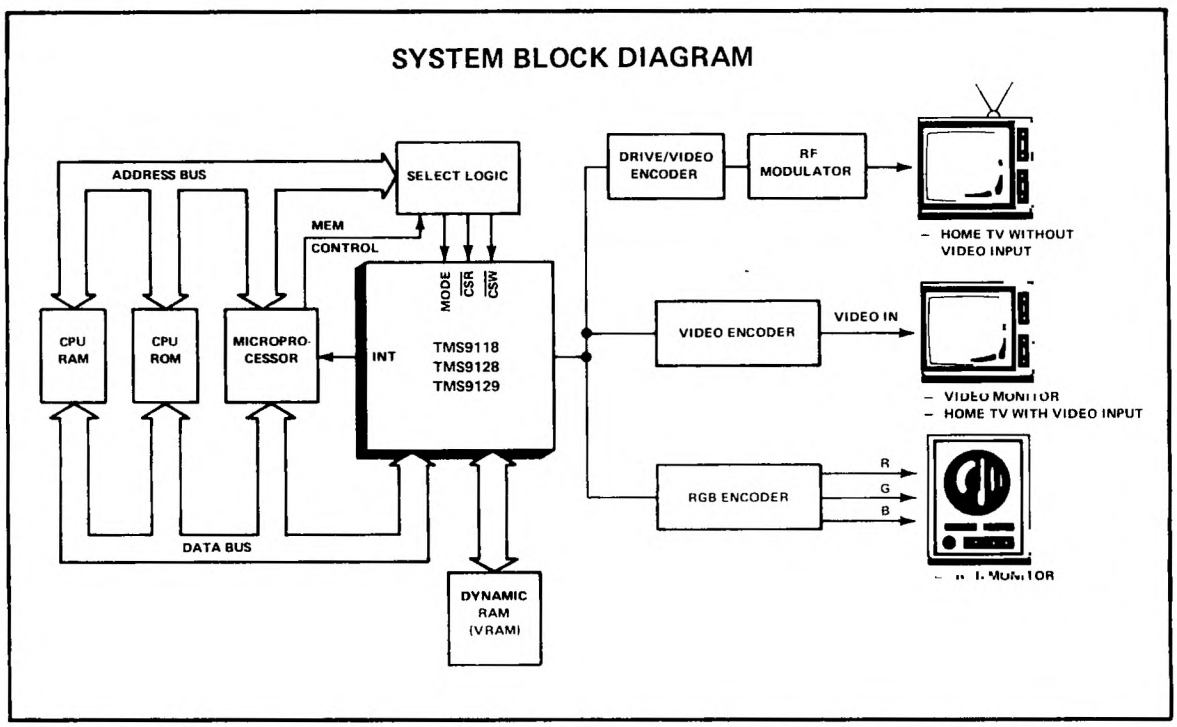
DEVICE	OUTPUT COMPATIBILITY	VRAM COMPATIBILITY
TMS9118	• Composite Video • 525 Line Format • NTSC-N. American	TMS4416 16 K X 4 or TMS4116 16 K X 1
TMS9128	• R-Y • B-Y Color Difference • Y Luminance Outputs • 525 Line Format • NTSC - N. American	TMS4416 16 K X 4 or TMS4116 16 K X 1
TMS9129	• R-Y • B-Y Color Difference • Y Luminance Outputs • 625 Line Format • PAL - European	TMS4416 16 K X 4 or TMS4116 16 K X 1

Standard VDP Family Features

- Single-chip graphics controller solution
- 256 X 192 color pixel resolution
- 32 animated sprites
  - — easily moved objects
  - — 1 pixel resolution
  - — 4 sprite sizes up to 32 X 32 pixels
  - — 32 overlapping planes, 3-D simulation
- 15 unique colors (plus transparent)
- 40 character X 24 line text display
- 3 optional background pattern modes:

GRAPHICS MODE	SCREEN (HOR. X V.)	PATTERN SIZE (PIXELS)	# COLORS
I II Multi-Color	32 X 24 32 X 24 64 X 48	8 X 8 8 X 8 4 X 4	2/Pattern 2/Line 15

- Direct wiring to video RAMs
- General 8-Bit CPU interface
- 40-pin plastic DIP
- N-channel MOS, single 5 V supply



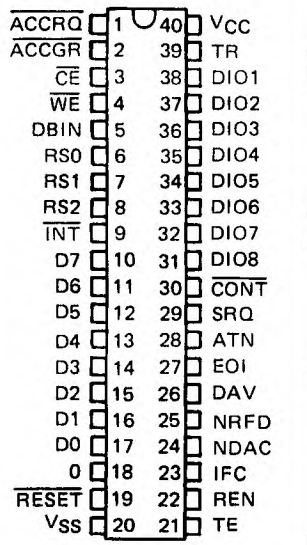
Advanced Microprocessor Peripherals

TMS9914A GPIB Adapter

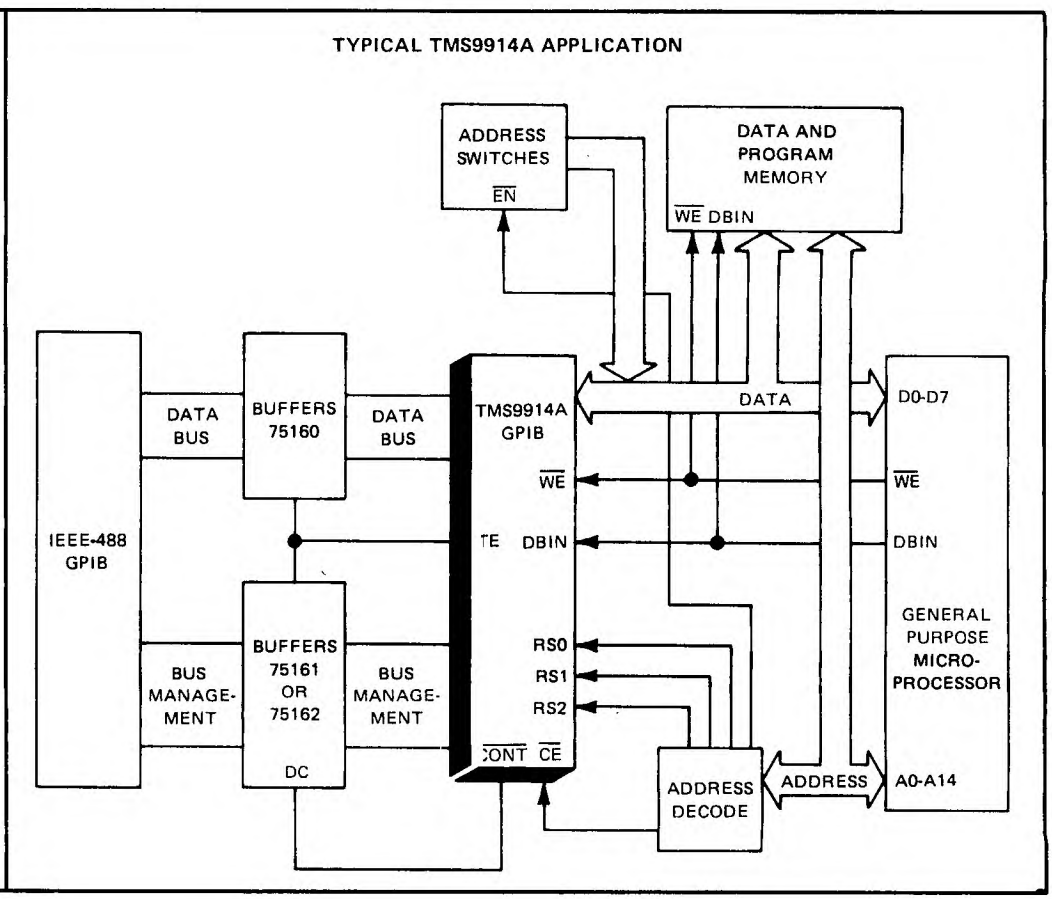
The TMS9914A provides an interface between a Microprocessor System and the General Purpose Interface Bus (GPIB) specified in the IEEE-488 1975-78 standards and the IEEE-488A 1980 supplement. The device is controlled and configured through 8-bit memory mapped registers and enables all aspects of the standards to be implemented, including talker, listener and controller. The TMS9914A is used when an intelligent instrument is required to communicate with an IEEE-488 GPIB. It performs the interface function between the microprocessor and bus and relieves the processor of the task of maintaining the IEEE protocol. By utilizing the interrupt capabilities of the device, the bus does not have to be continually polled, and fast responses to changes in the interface configuration can be achieved.

KEY FEATURES

- Handles all IEEE-488 1975/78 functions
- Compatible with IEEE-488A 1980 supplement
- Talker and listener function (T,TE, L, LE)
- Automatic source and acceptor handshakes (SH, AH)
- Controller with pass control
- System controller capabilities
- Device trigger and device clear capabilities (DT, DC)
- Optional automatically cleared "request service bit"
- Parallel and serial poll facilities (PP)
- Remote/local function with local lockout (RL)
- Single or dual primary addressing
- Secondary address capabilities
- Direct interface to SN75160/161/162 bus transceivers with no additional logic
- Compatible with most microprocessors
- Direct memory access facilities
- Memory-mapped microprocessor interface



TMS9914A PIN ASSIGNMENTS



XDS Development System

XDS is a new concept in microprocessor development, featuring host-independence and a consistent tool set for the different TI microprocessor families.

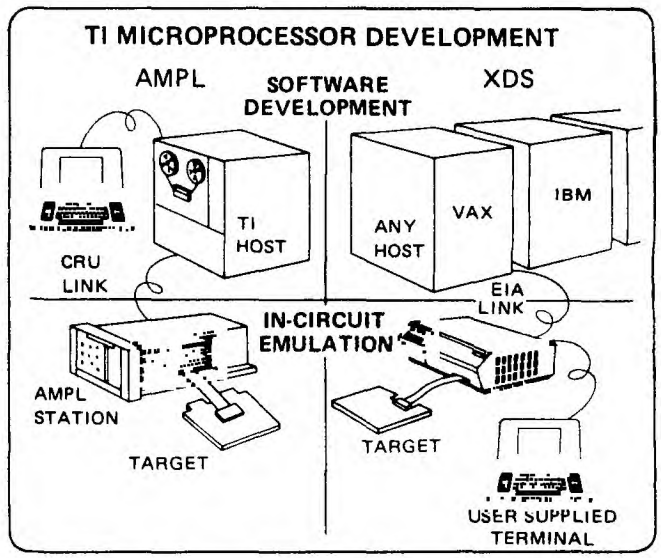
The host-independent configuration of the XDS, coupled with a transportable set of development and debug tools lets the user select the TI processor best suited for solving his problem. Having a common set of tools available means the basic development format has to be learned only one time and then can be used with any TI TMS320, TMS7000, TMS9995, and TMS99000 family microprocessor as desired.

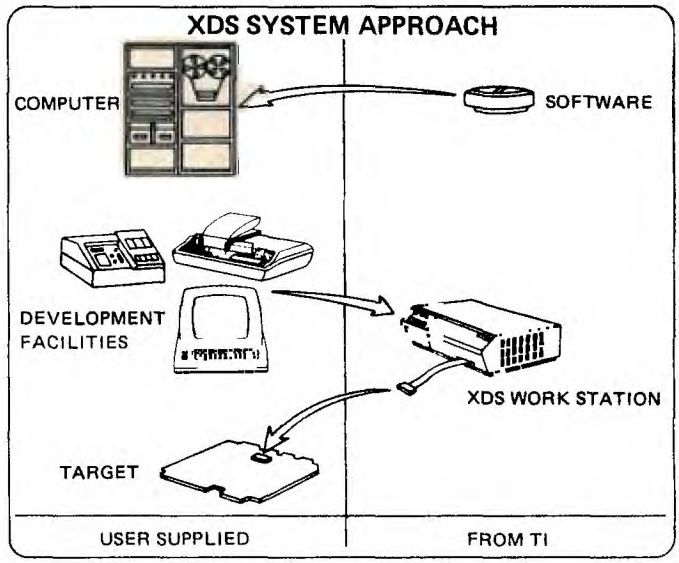
XDS cross-assemblers and host interfaces are available for *running under* IBM370 MVS operating system, DEC VAX VMS operating system and TI operating systems TX4, TX5, and DX10. This broad range of systems capability permits the development of software systems using pre-installed equipment familiar to the user.

Emulation of a TI microprocessor is provided by the XDS unit, using a RS232 link for interface with a variety of host systems. User supplied peripherals are also connected through similar RS232 links, thus creating a low-cost high-performance hardware/software development system. The XDS family of products supports RS232 downlink capabilities, in-circuit emulation, and target system debugging with breakpoint and trace capabilities, thus enhancing software development while executing real-time target system debugging. As an option intelligence can be added to provide High-Level Debug Language (XMPL) for increased target control.**

Features

- Host independent
- Total support for all TI microprocessor families
- Real-Time in-circuit emulation capability
- Break point/trace capability
  - 2 hardware breakpoints
- Easily expandable
- Convenient desk-top size
- User-friendly hardware and software
- High performance at low cost





SUPPORTS	HARDWARE	PART NUMBER
TM[illegible]	XDS Model 22	TMDS3262210
TM[illegible] & 7040**	XDS Model 22	TMDS7062210
TMS7041**	XDS Model 22	TMDS7062241
TM[illegible]**	XDS Model 22	TMDS9562210
TM[illegible]0**	XDS Model 22	TMDS9962210

SUPPORTS	SOFTWARE†	PART NUMBER
TMS320	TMAM9000 X-SUPPORT	TMDS3240110
	Multi-Ampl X-SUPPORT	TMDS3240120
	FS990 X-SUPPORT	TMD[illegible]40130
	VAX VMS X-Support	TMD[illegible]40210
	SIMULATOR ON VAX	TMD[illegible]40211
	IBM370 MVS X-SUPPORT	TMD[illegible]40310
TMS7000	TMAM9000 X-SUPPORT	TMDS7040113
	MULTI-AMPL X-SUPPORT	TMDS7040123
	FS990 X-SUPPORT	TMDS7040133
	VAX VMS X-SUPPORT	TMDS7040210
	IBM370 MVS X-SUPPORT	TMDS7040310
TMS9995 TMS99000	TMAM9000 X-SUPPORT	TMDS9940110
	M[illegible] TI-AMPL X-SUPPORT	[illegible]
	F[illegible]0 X-SUPP[illegible]	IM[illegible]
	VAX VMS X-SUPPORT	TMDS9940210
	MPP ON VAX	TMDS9940220
	IBM370 MVS X-Support	TMDS9940310
For INTEL* Based Cross Support Contact Factory		

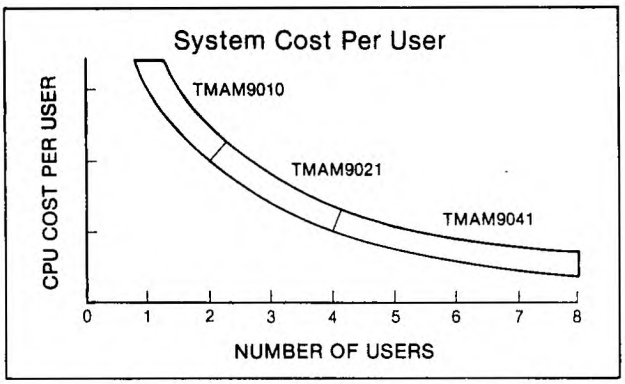
* Intel is a trademark of the Intel Corporation
** Planned new product
† Contact factory for desired software media

PROGRAMMABLE PRODUCTS

Multi-AMPL Development Systems

An entire team can now develop software and hardware simultaneously using a single system. The hard-disk Multi-AMPL Systems from Texas Instruments allow as many as eight program designers to work at the same time. You reduce software investment per user by maintaining a single data base. You cut program development time drastically and achieve the lowest possible cost per user.

Each Multi-AMPL System—there are three configurations from which to meet your particular needs—is a complete set of software and hardware development tools. Providing multiple processor emulation. And concurrent multi-task operation: compile, assemble, debug, edit, printing. Also included: data and address trace. Data and address breakpoints. A high-level debug and test procedure language. EPROM and PROM programming. Microprocessor Pascal, Component Software, and Fortran languages supported.



Hardware

DESCRIPTION	TMAM9010	TMAM9021	TMAM9041
Maximum Number of Users	2	4	8
Terminal Expansion for Maximum Number of Users	(1) TMAM7003	(1) TMAM7005	TMAM7005
Printers	(1) TMAM7001	(1) TMAM7001 or (1) TMAM7002	(1) TMAM7002 or (2) TMAM7001
AMPL Station for:	Choose 1:	Choose 1-2:	Choose 1-4:
TMS9900, 9900-40	TMAM6001	TMAM6001	TMAM6001
TMS9980/9981	TMAM6002	TMAM6002	TMAM6002
SBP9900	TMAM6003	TMAM6003	TMAM6003
TMS9940	TMAM6004	TMAM6004	TMAM6004
TMS7000	TMAM6059	TMAM6059	TMAM6059
EPROM Programmer Kit	TMAM6058	TMAM6058	TMAM6058

Software

Multi-AMPLUS	TMAM4004-10	TMAM4004-22	TMAM4004-22
Microprocessor Pascal	TMSW754P-10	TMSW754P-22	TMSW754P-22
Memory Mapped Pascal 2MB	TMAM757-22	TMAM757-22	TMAM757-22
Component Software:			
Realtime Executive	TMSW33OR-10	TMSW33OR-22	TMSW33OR-22
File Manager	TMSW34OR-10	TMSW34OR-22	TMSW34OR-22

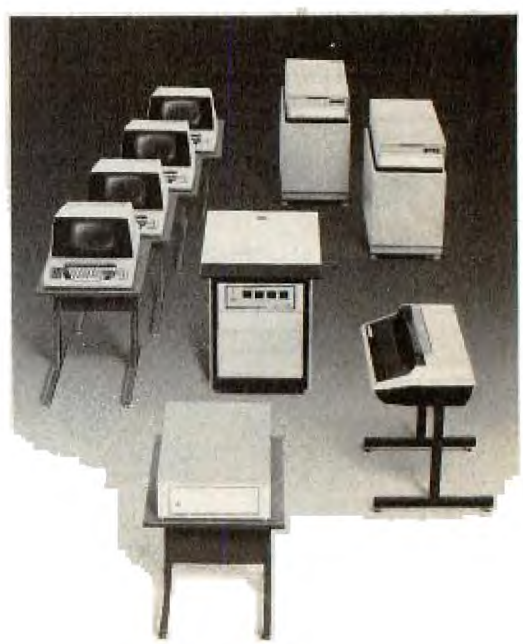
Contact factory for other language support

The modular AMPL Station is the key to system capability and flexibility. Each user can have his own station with access to the computer via video terminals (VDTs). The trace module with 10-MHz capability is the invaluable companion for faster, easier design.

The Multi-AMPL Systems supports a variety of programmable-function devices: the TMS99000 16-bit microprocessors, the microcomputer modules and the TMS7000 8-bit microcomputers.

Multi-AMPL Packaged Systems

DESCRIPTION	TMAM9010	TMAM9021	TMAM9041
Main Memory (Bytes)	256K	256K	320K
Total Disk Storage (Formatted Bytes)	9.4M	32M	96M
No. of Disk Drives	1 (DUAL)	2	2
Fixed Disk Storage (Bytes)	1-4.7M	16M	80M
Removable Disk Storage (Bytes)	4.7M	16M	16M
No. Terminals Included	1	2	4
AMPL Station Link	YES	YES	YES
Software Included	Multi-Amplus OS Macro Assembler AMPL Utility Diagnostic Text Editor Link Editor PROM Programming Utility		
Included in all systems: (1) Installation; (2) System generation; (3) Tuition for RTC training; (4) 90-day warranty on parts and labor			



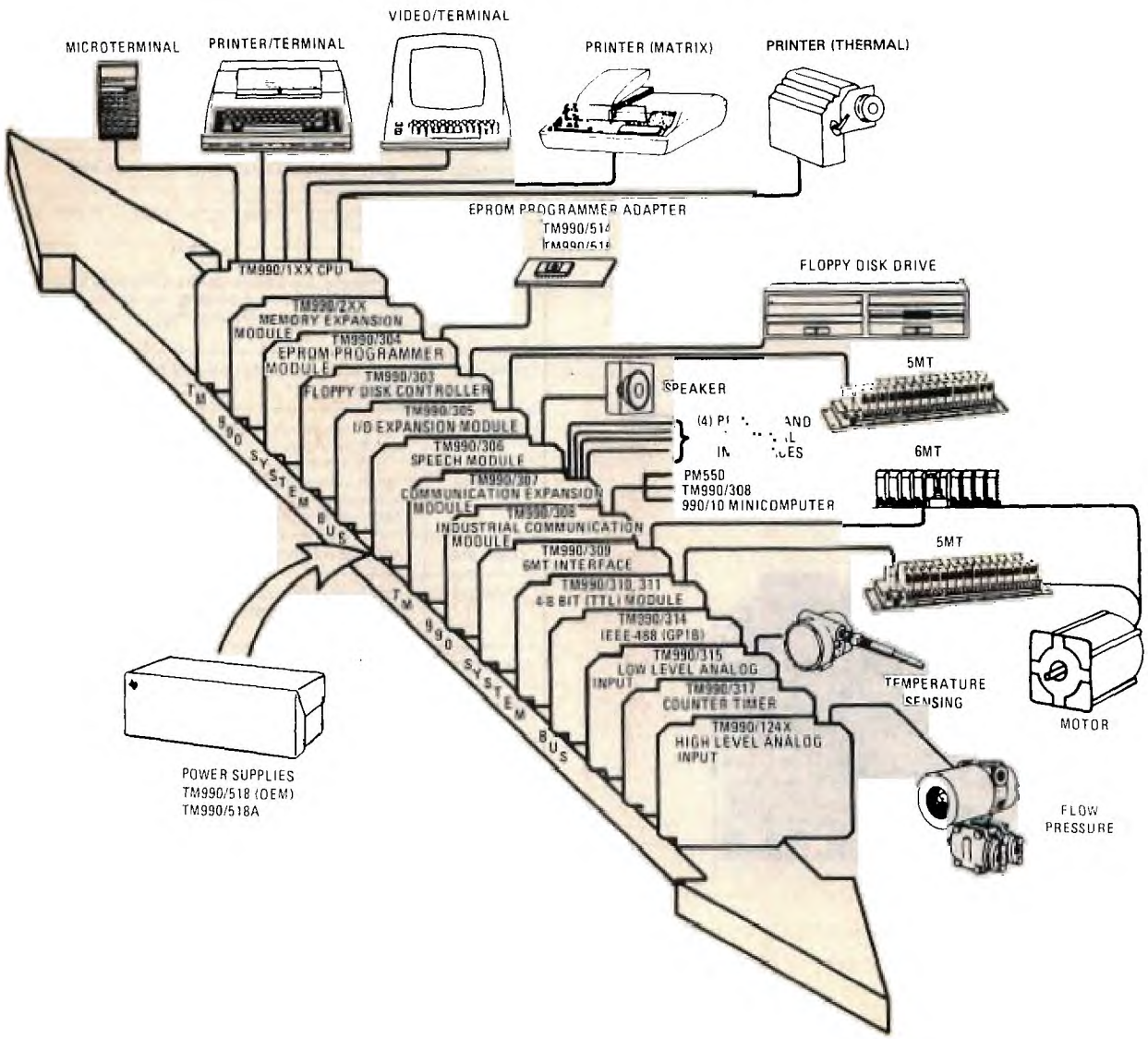
TM990 Family of Microcomputer Modules

The TM990 Series provides an extensive choice of preassembled, high-performance, 16 bit microcomputer modules that save design and development time, cut the number of system components, reduce costs, and improve reliability. Each module is a single, pretested, ready-to-plug-in board. The series includes: complete CPU modules with on-board memory and I/O interface; memory and I/O expansion modules; data entry and display modules; software development modules, industrial AC and DC I/O modules; A/D and D/A interface modules; a floppy disk controller; a speech module; and industrial communication modules. In addition, OEM card cages, cables, connectors, extender, and prototyping boards are available.

All TM990 modules are compatible with other members of TI's 9900 Family of microprocessors and microcomputers, which allows easy conversion to a dedicated-component solution if your application warrants.

Reliability for Harsh Industrial Environments—All components used in TM990 module construction are subjected to TI's strict quality assurance criteria. All assembled modules go through a computer-controlled test station providing verification of product compliance with specifications. All modules are dynamically exercised in a severe environment chamber that cycles products through a 25-70°C temperature range; burn-in time varies from eight hours to four days. Prior to shipping, all modules are system tested for strict compliance to system specifications and quality assurance criteria. TM990 modules are guaranteed over the industrial 0°C to 70°C operating temperature range.

Hardware Product Overview



TM990 Family of Microcomputer Modules

Microcomputer Modules

TI has a wide choice of CPU modules; the TM990/100MA, which has a perforated area on the PC board for customer circuit breadboarding; the TM990/102, which extends the address reach to 1MB providing 128K bytes on board DRAM, and the TM990/103* high performance CPU, which provides single precision floating point arithmetic, in addition to a 16 MB address reach. All the CPUs provide prioritized vectored interrupts.

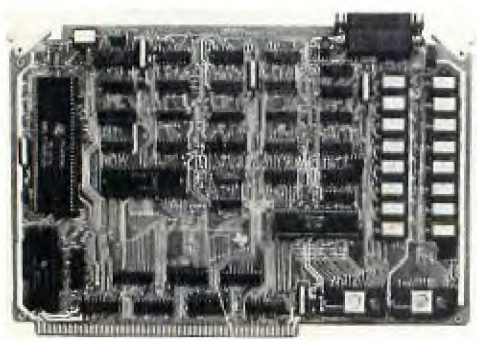
MODULE	CPU	TIMER	MEMORY (BYTES)			I/O		FLOATING POINT ARITHMETIC
			EPROM	RAM	OFF BOARD	PARALLEL	SERIAL	
TM990/100MA	TMS9900	2	8K	4K	64K	16	1 RS232	NO
TM990/101MA	TMS9900	3	8K	4K	64K	16	2 RS232	NO
TM990/102	TMS9900	1	16K SOCKETS	128K	1M	0	1 RS232	NO
TM990/103	TMS 99110	3	32K SOCKETS	80K SOCKETS	16M	16	2 RS232	YES

*The TM990/103 can accept industry standard IEEE (iSBX)† cost - effective peripheral interface modules.

Memory Modules

MODULE	DESCRIPTION
TM990/201	Combination RAM/EPROM — Up to 8 KB EPROM — Up to 32 KB Static RAM
TM990/202	RAM/EPROM/CMOS/RAM Module Sockets for up to 128 KB EPROM up to 32 KB Static RAM — Up to 32 KB CMOS RAM — On board battery back up
TM990/203A	Up to 256 KB DRAM with error detection Up to 16 KB EPROM
TM990/204	Battery backed up CMOS RAM Module — 16 KB max — days max data retention.

†Trademark of Intel Coproration



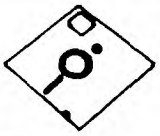
TM990/102

I/O Modules

MODULE	DESCRIPTION
TM990/303B	Floppy disk drive controller
TM990/304	EPROM Programmer Module
TM990/306	Speech output module with 179 word vocabulary
TM990/307	Communication Expansion Modules — Provides 4 RS232/RS422
TM990/308	X.25/HDLC Communication Module permits implementation of distributed industrial processing network. Provides an X.25/HDLC communication protocol for packet switching network.
TM990/309	High Power (AC and DC) interface via 6MT industrial I/O modules
TM990/310	48 TTL compatible I/O lines with 3 programmable timers and 6 interrupts.
TM990/311	48 TTL compatible I/O lines interface with 24-mA sink current and on-board voltage regulator for operation with 5MT industrial I/O modules.
TM990/314	IEEE 488 controller
TM990/315	Low-level analog input module supports the thermocouple, RTD, strain gauge, and pressure transducer interface
TM990/317	Pulse timer/event counter module
TM990/320	IEEE page 59 (iSBX) interface module
TM990/1241	Analog I/O module 16 inputs, 2 outputs
TM990/56X	Digital and Analog I/O termination panel with • Barrier strip for field wire termination • Optical isolation • Transfomer isolation • Sockets for installing — Current loop inputs — Voltage dividers — Noise filtering — Decoupling capacitor etc.

TM990 Family of Microcomputer Software Products

PDOS — PDOS-01,02



Easy to Use Capture Mechanisms

- Utilities — the popular Basic Language for program development
- Detailed knowlege of specific hardware requirements minimized
- Well documented
- Availability and size

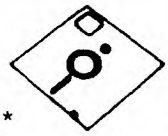
Features:

- Full range of development tools -
  - Screen Editor
  - Basic Language
  - TMS 9900 Assy Language
  - Linker
  - Debugger
  - EPROM Programmer (Supports/302)
- Application Program — ROMable (Burned into RPROM)
- Supports — Floating point arithmetic
- Multi-Tasking (Target)
- Multi-User (Host)
- Support file management
- 75 System Primitives — minimizes programming time (Host)
- Floppy disk based

Development Hardware (User Supplied):

- EIA terminal (screen & keyboard)
- 8" Floppy disk drives (DSDD capability) recommended
- Printer (opt)
- Power Supply (not required with/602 kit)

UCSD-p-System* — TMSW600P



Transportable:

- Supports CPU independent, easy to learn, high level language (UCSD/Pascal)
- 100% Transportable CPU based systems (application software)

Features:

- Full range standard development tools -
  - Screen Editor
  - Pascal Compiler
  - TMS9900 Assembler
  - Linker
  - Pascal Debugger
- Menu driver format (operator prompts)
- Utility package — Communications (EIA, Modem) — EPROM program (supports/302) — Host-to-Target down load — TX4 to UCSD file conversion (DSG user's) — TI assembler directives to UCSD assembler directives conversion capability (DSG user's)
- Supports — file management
- Floppy disk based — 8" SSSD
- Supported by — international user's group (USUS)
- Automatic terminal configuration (menu driven)

Development Hardware (User supplied):

- EIA terminal (screen & keyboard)
- 8" Floppy disk drives (SSSD capability adequate)
- Printer (opt)

* Trademark of the Regents of the University of California

MPP PASCAL — TMSW754P

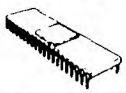
Complex/Hi-Performance Applications:

- Supports full concurrency
- User configurable real time executive
- Provides capability for using TI component software

Features:

- Complete PASCAL software development capability
- Syntax checking editor
- Full screen editor
- PASCAL compiler generates p-Codes
- Full PASCAL debugger
- Link editor
- Code generator creates TMS9900 object code
- Run time support resource management at target level, supports extended addressing.
- TMS9900 assembler capabilities
- Applications program — ROMable (EPROM based)
- Multi-user
- Hard disk based — TMAM 9021,9041

SOFTWARE SUMMARY

SOFTWARE SUMMARY	STORAGE MEDIA		
	HARD DISK	FLOPPY DISK	FIRMWARE 
OPERATING SYSTEMS			
• UCSD P-SYSTEM • PDOS		TMSW600P PDOS-01, 02	
LANGUAGES			
• BASIC - PDOS BASIC - UNIV. BASIC • PASCAL - UCSD PASCAL - MPP PASCAL • A [illegible]BLY - [illegible] - LINE-BY-LINE - PDOS ASSBLR - ADAPTIVE ASSBLR	TMSW754P	PDOS-01,02 TMSW600P PDOS01, 02 TMSW600P	TM990/469 TM990/468 TM990/402
MONITORS			
• TIBUG (100, 101) • UNIBUG (U89) • TIBUG (102, 103)			TM990/401-3 TM990/468 TM990/404, 405

Add-In Memory Boards

TI high-density memory boards feature 64K DRAM technology, increased board densities, single 5-volt-only power supply, low power consumption, lower cost per bit, optional battery backup, and a full **two-year** warranty.

TI memory components and boards also improve system performance by enhancing system reliability, VLSI error detection and correction increase system reliability by making errors transparent to the user.

All TI boards are 100% tested and burned in.

TI Memory Boards for DEC† and Intel Mini/Micro Computers

SYSTEM	TI SERIES	BOARD DASH NUMBER				
LSI-11†	TMM10010*	- 01/ - 02	- 03/ - 04	- 05/ - 06		
PDP-11†	TMM20000**		- 03	- 02	- 01	- 04
MULTIBUS ™ ‡	TMM40010A**	- 08		- 05	- 04	
MULTIBUS ™ ‡	TMM40020**	- 08		- 05	- 04	
CAPACITY	Bytes	128 K	192 K	256 K	512 K	
	Words	64 K	96 K	128 K	256 K	1M 512 K

* Parity optional ** EDAC standard † DEC compatible (trademark of Digital Equipment Corporation) ‡ INTEL compatible (trademark of Intel Corporation).

PROGRAMMABLE PRODUCTS

TMM10010 Series For LSI-11 Systems

Features

- High density: 128KB thru 256KB on a single "dual" board.
- High speed (See specifications)
- Completely compatible with DEC LSI-11/23 (¼ MB) and LSI-11/23 PLUS (4MB)
- Starting Address DIP Selectable on 4K word boundaries
- Address Space DIP Selectable from 256KB to 4MB (18 to 22 address lines).
- On-Board Parity Controller with Control and Status Register.
- Full Two Year Warranty.

Specifications

- Memory Size: 65,536 to 131,072 words; 18 bits/word (16 + 2 parity); 16 bits/word (No Parity).
- Speed: Write Access — 95 ns; Read Access — 195 ns; Cycle — 360 ns (typical)
- Power (operating): +5 VDC (100% duty) 2.2A with parity controller option.
- Temperature (operating): Up to 95% RH (non-condensing), 0°C to 50°C.
- Dimensions: 52" X 8.9"
- Weight: 1 lb.

TMM20000 Series For PDP-11 Systems

Features

- High density: 128KB thru 1MB on a single hex board.
- Error Detection and Correction (EDAC) is standard on all 20000 series boards.
- Compatible with DEC modified and extended unibus systems.
- Starting Address DIP Selectable on 16K word boundaries.
- Modified or extended unibus is DIP switch selectable.
- Configurable for two way interleave.
- Full Two Year Warranty.

Specifications

- Memory Size: 65,536 thru 524,288 words; 22 bits/word (16 + 6 EDAC)
- Speed: Write Access (Memory) — 40 ns; Read Access (Memory) — 400 ns; Read Access (Register) — 125ns (typical).
- Power (operating): + 5 VDC (100% duty) 4.2A
- Temperature (operating: 5°C to 50°C up to 95% RH non-condensing).
- Dimensions: 8.88" X 15.68"
- Weight: 2 lb.

TMM40010A Series For MULTIBUS Systems

Features

- High density: 128KB thru 512KB on a single board.
- Compatible with INTEL iSBC 80 and iSBC 86 (MULTIBUS) Systems.
- Lower and Upper Memory Address are independently selectable on 4K — Byte boundaries.
- Error Detection/Correction (EDAC) standard on all boards.
- Jumper selectable 20 or 24 bit addressing bus.
- Operates in 64KB (Standard), 1MB (extended) or 16MB (IEEE-P796) address spaces.
- Battery back-up and ROM overlay capability
- Full Two Year Warranty

Specifications

- Memory size 65,536 thru 262,144 words; 22 bits/words (16 + 6 EDAC)
- Speed: Read Access — 325 ns; Write Access — 90 ns; Cycle — 700 ns (typical)
- Power (operating): +5VDC (100% duty) 3.2A.
- Temperature (operating): 0°C to 70°C up to 95% RH (non-condensing).
- Dimensions: 6.75" X 12.0"
- Weight: 1.5 lb.

TMM40020 Series For MULTIBUS Systems

Features

- High density: 128K Bytes to 512K Bytes on one board.
- High speed (see specifications).
- Compatible with INTEL MULTIBUS protocol.
- Lower and Upper Memory Address are independently selectable on 4K Byte boundaries.
- Jumper selectable 20 or 24 Bit Addressing Bus.
- Full Two Year Warranty.

Specifications

- Memory size: 65,520 thru 262,144 words, 18 bits/words (16 + 2 parity)
- Speed: Read Access — 197 ns; Write Access — 160 ns; Cycle time — 303 ns (typical).
- Power (operating): +5VDC (100% duty) 3.3A.
- Temperature (operating): 0°C to 70°C up to 95% RH (non-condensing).
- Dimensions: 6.75" X 12.0"
- Weight: 1.5 lb.

LOGIC ARRAY PRODUCTS

Texas Instruments provides several distinct families of VLSI Logic Arrays. Master bars are processed using low-power Schottky TTL Logic (LPSTTL) with double-level-metal (DLM) routing interconnect, high performance Schottky Transistor-Logic (STL) with triple-level metal (TLM) interconnect and low power, reverse silicon CMOS with DLM interconnect. These arrays are mask configured to satisfy unique logic requirements, allowing efficient implementation of custom IC functions, SSI/MSI logic replacement, and in many cases complete board replacement.

The Low-Power Schottky TTL (LPSTTL) master arrays employ a cellular organization of NAND gates. Array interiors consist of low-power Schottky TTL gates with LPSTTL input/output buffers surrounding the periphery. Schottky Transistor Logic (STL) master arrays likewise employ a cellular organization of interior gates. Each interior gate performs the INVERT function and is processed using high-performance STL technology. Input/output buffers on the TAT004/TAT008 are compatible with low-power Schottky TTL Logic. The CMOS master arrays employ an interior organization of basic NAND/NOR functional cells arranged into column structures. This array interior interfaces directly to low-power Schottky TTL logic via the periphery buffer organization.

All Texas Instruments Master Arrays employ both vertical and horizontal routing channels dedicated to signal interconnect. The LPSTTL arrays require manual interconnect routing, with predesigned/prerouted buffer logic functions referenced for ease of interconnect. All STL and CMOS arrays are supported by a fully integrated software design utility, assisting the user in specifying his logic design and test pattern set. This offers the capability for verification and analysis of the design prior to automated mask patterning of the specific logic function. This automated layout system is typically able to achieve an 80% utilization of internal logic gates.

Packaging Options

PACKAGE DESCRIPTION	PIN COUNT					
	28	40	64	68	84	108
Plastic Dual-In-Line	TAL002 TAL004	TAL002 TAL004 TAL004 TAC010A	TAT004 TAT008			
Plastic Chip Carrier				TAT008 TAC010A		
Ceramic Chip Carrier					TAT008	
Ceramic Pin Grid Array					TAT008 TAC010A	TAT008

Logic Array Master Bars

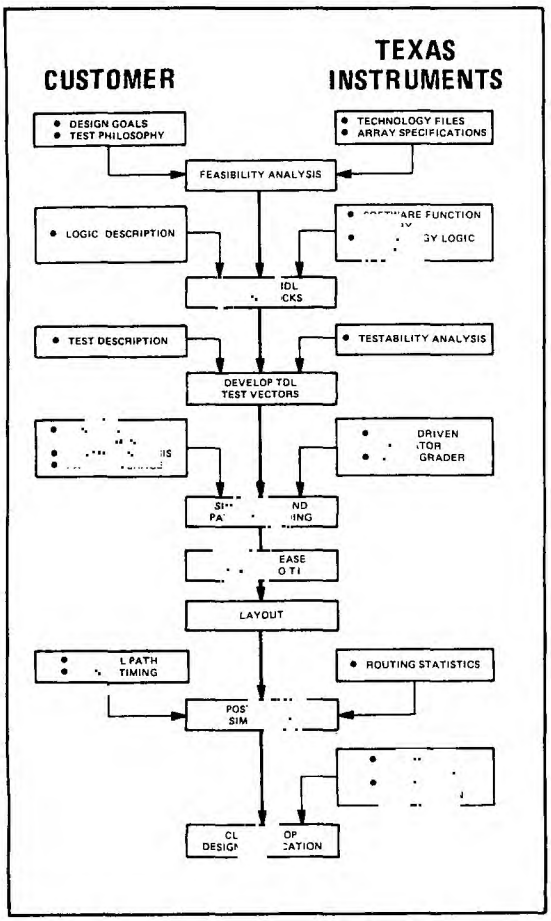
DEVICE NUMBER	GATE TECHNOLOGY	MINIMUM PROCESSING GEOMETRY (MICRONS)	INTER-CONNECT	ROUTIBLE GATE COUNT	INTERNAL GATE PROPAGATION DELAY (TYP)	INTERNAL GATE POWER DISSIPATION (TYP)	TOTAL ARRAY STATIC POWER DISSIPATION	NO. SIGNAL PADS
TAL002	JUNCTION ISOLATED LPSTTL	4.5	DLM	200	5.0ns	1.25 mW	500 mW	28
TAL004	JUNCTION ISOLATED LPSTTL	4.5	DLM	400	5.0ns	1.25 mW	900 mW	42
TAT004	JUNCTION ISOLATED STL	4.5	TLM	400*	2.5ns	600 μW	1.4 W	76
TAT008	JUNCTION ISOLATED STL	4.5	TLM	800*	2.5ns	600 μW	2.0 W	104
TAC010A	REVERSE SILICON CMOS	3.6	DLM	1000*	6.0ns	150 μW AT 5MHZ	10 μW	64

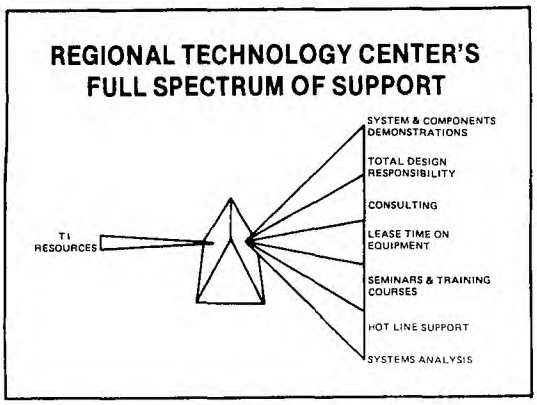
* FULLY AUTOROUTIBLE

DEVICE NUMBER	INPUT BUFFERS (MAX)	OUTPUT BUFFERS (MAX)	OPERATING FREE AIR TEMPERATURE RANGE	POWER SUPPLY ±10% (VOLTS)	I/O BUFFER COMPATIBILITY	MAX TOGGLE FREQUENCY (D FLIP-FLOP)	BASIC GATE LOGIC FUNCTION
TAL002	28	28	0°C - 70°C	+5	LSTTL	25 MHZ	4-INPUT NAND GATES
TAL004	42	42	0°C - 70°C	+5	LSTTL	25 MHZ	4-INPUT NAND GATES
TAT004	76	38	0°C - 70°C	+5, +2	LSTTL	80 MHZ	WIRE-AND INVERTER
TAT008	104	52	0°C - 70°C	+5, +2	LSTTL	80 MHZ	WIRE-AND INVERTER
TAC010A	64	64	0°C - 70°C**	+5	CMOS LSTTL	25 MHZ	2-INPUT NAND

**TAC010A FREE-AIR OPERATING TEMPERATURE RANGE UNQUALIFIED AT PUBLICATION TIME. QUALIFICATION WILL EXTEND BEYOND STANDARD COMMERCIAL RANGE.

Logic Array Products Design Support





Designing logic arrays requires two parties: Texas Instruments and you. TI provides design automation facilities staffed by experts and you provide the requirements of your logic design. To make this process more convenient, TI is enlarging its computer and engineering support resources. Assistance is available at Regional Technology Centers (RTC's) located in Boston, Chicago, Los Angeles, Santa Clara, Dallas and Atlanta. Design automation software may be accessed through these facilities or via dial-up communications links tied directly to TIs computing network in Dallas.

This network provides closed-loop customer support throughout the entire logic array design cycle: From initial training and documentation; through actual design, analysis and consulting services; to computer interfacing for communications and remote entry of batch jobs. TI concentrates resources in areas of greatest customer need to assure cost-effective support and effective communications.

Texas Instruments technology centers are staffed with experienced systems analysts and design engineers who examine your circuit applications and determine design feasibility for TI Logic Arrays. They compare specific logic design requirements with the capabilities of the various array products in order to determine which master array best satisfies your design. Next, I/O requirements are considered in order to specify packaging needs. Special requirements and design advice may then be discussed in order to reduce potential test or environmental difficulties.

The results of these analyses are product/package recommendations which capitalize on the technical capabilities of TIs Logic Array families to provide the most cost-effective solution to your design requirements. This service is extended at no charge for logic array applications. Full system feasibility analysis is also available whenever full system partitioning will be the initial procedure.

For more information on TIs Logic Array family, please contact the RTC in your region.

ATLANTA TECHNOLOGY CENTER	404/452-4682
BOSTON TECHNOLOGY CENTER	617/890-6671
CHICAGO TECHNOLOGY CENTER	312/228-6008
DALLAS TECHNOLOGY CENTER	214/680-5066
NORTHERN CALIFORNIA TECHNOLOGY CENTER	408/748-2220
SOUTHERN CALIFORNIA TECHNOLOGY CENTER	714/660-8140

SPEECH PRODUCTS

Let Your Product Speak For Itself

Whether it's appliances, automotive consoles, transaction terminals, office systems, telecommunications, robotics, or electronic toys and games, TI's Solid State Speech™ technology promises to have a dramatic impact on design, now, and for generations to come.

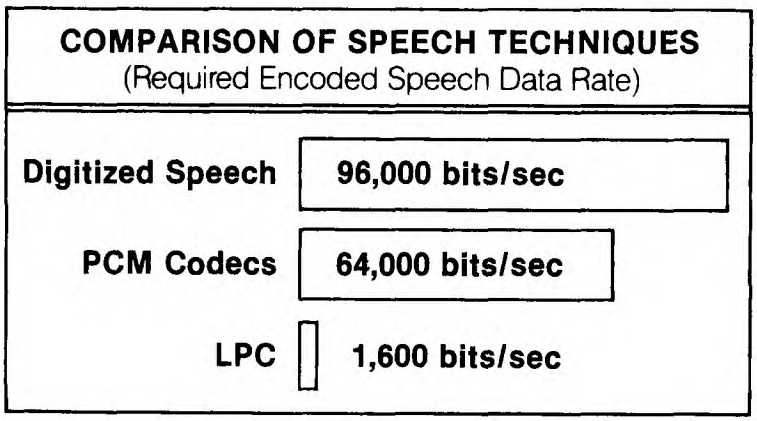
TI's Solid State Speech technology provides a revolutionary approach to the design of man-machine interfaces. A wide variety of applications can benefit from this technology due to the high intelligibility, reliability, and low cost of Solid State Speech reproduction.

The development of Solid State Speech technology at Texas Instruments began with the analysis of the human mechanisms for production and perception of speech. Based on the mechanisms of natural speech production, a model of the speech production process was implemented using digital signal processing techniques. This model is the basis for TI's Solid State Speech products.

The speech recording/processing begins by recording actual human speech, extracting energy and pitch information, and then using Linear Predictive Coding (LPC) analysis to produce data suitable for the digital speech model. These techniques faithfully preserve the character of the speaker's voice, including intonation, accent, dialect, and pitch in any language. Whole phrases and sentences, as well as single words and sounds, can be reproduced, preserving authentic human inflections. The result is more lifelike, natural sounding speech.

Value to the user of TI's LPC technique is its modest memory requirement compared to other approaches. Brute-force storage of speech signals can be accomplished by sampling and converting speech at an 8 to 10-kilohertz clock rate. This results in a digital data rate of 100,000 bits per second of speech. Pulse-coded modulation (PCM) codecs and companding techniques have found acceptance in new, all-digital telecommunications systems. However, their data rate of 64,000 bits per second is still too high for many applications.

Linear Predictive Coding provides speech quality comparable to other techniques, yet it only requires an average data rate of about 1,600 bits per second. With the advent of 128K-bit and larger storage devices, LPC packs minutes of high-quality speech into memories that would hold only one or two seconds of speech using other techniques. To illustrate, a speech reproduction of the words "Texas Instruments" requires approximately 90 times as many bits using digitized speech techniques as it requires with LPC. Using these techniques a single 128K-bit ROM can hold as many as 200 words.



Voice Synthesis Processors (VSP)

Speech encoding on TI Voice Synthesis Processors is achieved through LPC coding. Codes for twelve synthesis parameters (pitch, energy, and 10 filter coefficients) serve as inputs to the VSP. After being decoded by the VSP, these codes represent a time-varying description of the LPC model of the original voice.

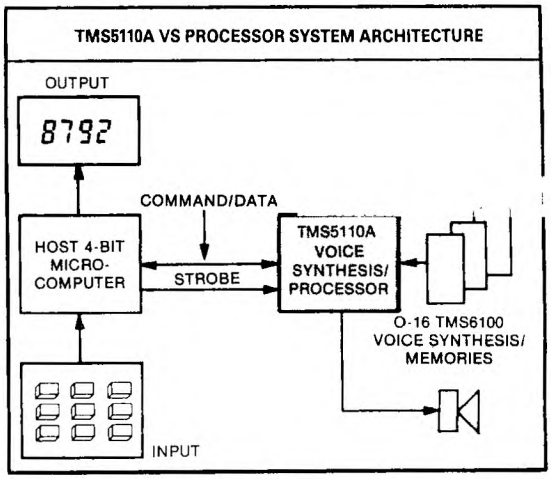
Inputs to the VSP's digital filter takes two forms: periodic and random. The periodic inputs are used to reproduce voiced sounds which have a definite pitch, such as vowel sounds or voiced fricatives (Z,B,D). A random input models unvoiced sounds such as S, F, T, and SH. Separate models generate the voiced and unvoiced excitations. Output from the digital filter drives a digital-to-analog converter, which in turn drives a speaker.

With one TMS6100 128K-bit ROM a TMS5000 Series VSP can produce more than 100 seconds of speech, or about 200 synthesized words. A single TMS5110A or TMS5220A VSP can support up to 16 128K-bit VS Memories, or approximately 3200 words of speech. In addition, the TMS5220A is capable of tapping host storage or off-line storage to produce virtually unlimited vocabularies.

TMS5110A Voice Synthesis Processor

Features

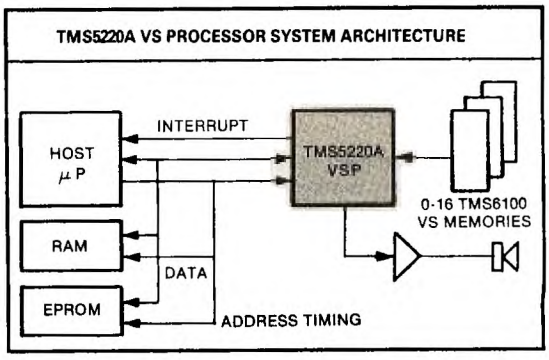
- Interfaces easily to 4-bit microprocessors, such as TI's TMS1000 Family of microcomputers
- A complete voice synthesis system can be designed with 3 chips: TMS5110A VSP, TMS6100 VSM and a TMS1000 microcomputer
- Directly addresses up to 16 TMS6100 VS Memories (128K bits each) for up to 3200 words of speech
- Ideal for high-volume, low-cost applications
- Low average data rate: 1600 bits/second
- TMS5110A can process male and female voices, plus tones, chimes and sound effects.



TMS5220A Voice Synthesis Processor

Features

- High-quality voice synthesis for microprocessor-based system
- Low average data rate: 1600 bits/second
- Compatible with 8 and 16-bit microprocessors
- Commands supplied over standard 8-bit data bus
- Speech data can be stored in up to 16 TMS6100 Series VS Memories, in host system storage, or off-line in disk
- Interrupt-driven service request capability
- On-chip FIFO (16-byte) buffers two frames of speech data when coming from host processor
- Can process male and female voices plus tones, chimes and sound effects
- Capable of stringing basic 'allophone' sounds together to form words and phrases



Voice Synthesis Processors Summary

FEATURES	DEVICE NUMBER	
	TMS5110A	TMS5220A
Microprocessors interface (bits)	4	8
Data from ROM	Yes	Yes
Data from microprocessor	No	Yes
Operating Voltage (Volts)	−9	+5 −5
Audio Amplifier	Internal	External
Pitch Coding (Bits)	5	6
Frame Rate (Samples Frame)	200	200
Internal Clock Frequency (KHz)	640	640
ROM Interface (TMS100 128K-Bit)	1-16	1-16
Technology	PMOS	PMOS
DIP Package Type	28 pin	28 pin

* All VSP's are linear predictive coding with 10 poles

Voice Synthesis Memories (VSM)

TMS6100 VOICE SYNTHESIS MEMORY

- Low-cost, 128K-bit ROM

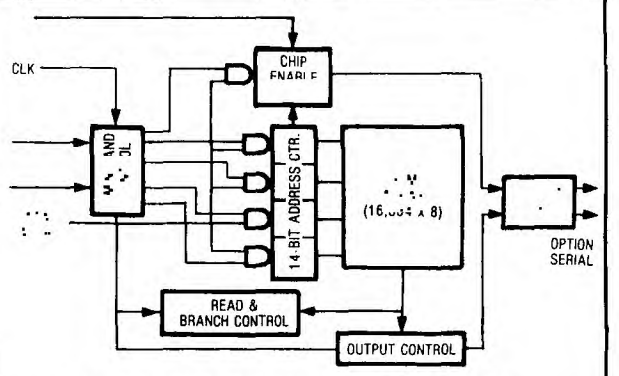
TMS6125 VOICE SYNTHESIS MEMORY

- Low-cost, 32K-bit ROM

FEATURES:

- Optimized interface for use with TMS5110 series and TMS5220 series voice synthesis processors
- On-chip address decode logic – no address decoding required for up to 16 VSM's with the TMS6100s or up to 4 VSM's with the TMS6125s
- On-chip memory address register – autoincrements through speech data until stopped by VSP
- Look-up and branch capability allows vocabulary-independent access to speech data on chip

TMS6100 128K VS MEMORY BLOCK DIAGRAM



•SIMPLE, DEDICATED INTERFACE TO ALL TI VSPs.

Voice Synthesis Memory Summary

FEATURES	DEVICE NUMBER	
	TMS6100	TMS6125
Memory Storage (Bits)	128K	32K
DIP Package Type	28 pin	16 pin
Oscillator Clock	External	Internal/External
Chip Select Bits	4	2
Address Bits	14	12
Serial Option	Yes	Yes
4-Bit Parallel Option	Yes	Yes
Operating Voltage (Volts)	−9	−9
Access Time (μs)	2	2
Clocking Frequency (kHz)	160	160
Technology	PMOS	PMOS

Speech Library Service

FEATURES:

- Pre-encoded words and phrases available
- Low-cost means of obtaining speech data
- Much faster turnaround than with custom processing
- Adequate quality for prototyping and many applications
- Available through TI Regional Technology Centers

Preprogrammed Speech Vocabulary ROMS

VOCABULARY ROMs (VROMs)

FEATURES:

- Preprogrammed vocabularies for industrial, consumer, and military markets
- Male or female voice intonations offered
- Used with TI's TMS5110A and TMS5220A Voice Synthesis Processors
- Very low-cost synthesized speech
- Ideal for industrial use, low-volume applications, evaluation, and prototyping

Preprogrammed Vocabulary ROMS

DEVICE NUMBER	TYPE OF VOCABULARY	VOICE TYPE OPTION	NO. OF WORDS	VSP INTERFACE	NO. OF BITS
VM61002	Industrial	Male	204	TMS5110A	128K
VM61003	Industrial	Male	206	TMS5220A	128K
VM61004	Time/Weather	Male	139	TMS5220A	128K
VM61005*	Military	Male	148	TMS5220A	128K
VM61006A	Avionics	Male	119	TMS5220A	128K
VM71003	Industrial	Male	50	TMS5110A	32K
VM71004A	Numeric/Time	Male	35	TMS5110A	32K
VM71005A	Numeric/Time	Female	34	TMS5220A	32K

NOTE: All devices have an operating voltage of −9V

* To have a complete avionics vocabulary, the TMS61003, 004, and 005 should be used together

Example:

The VM71004 is a TMS6125 voice synthesis memory precoded for a male voice with a vocabulary of 50 words. Each of the words, syllables, and selected letters of the alphabet is accessed individually and then concatenated to form phrases and sentences.

Vocabulary Data in VM71004A

Word List		
Zero	Hundred	Power
One	Thousand	Check
Two	A	Complete
Three	M	Connect
Four	P	Degrees
Five	T	Minus
Six	And	Repair
Seven	The	Seconds
Eight	Amps	Service
Nine	Hertz	Not
Ten	Farad	Temperature
Eleven	Watts	Start
Twelve	Meter	Stop
Thir-	Ohms	Off
Fif-	Area	On
– teen	Light	Is
Twenty	Pressure	

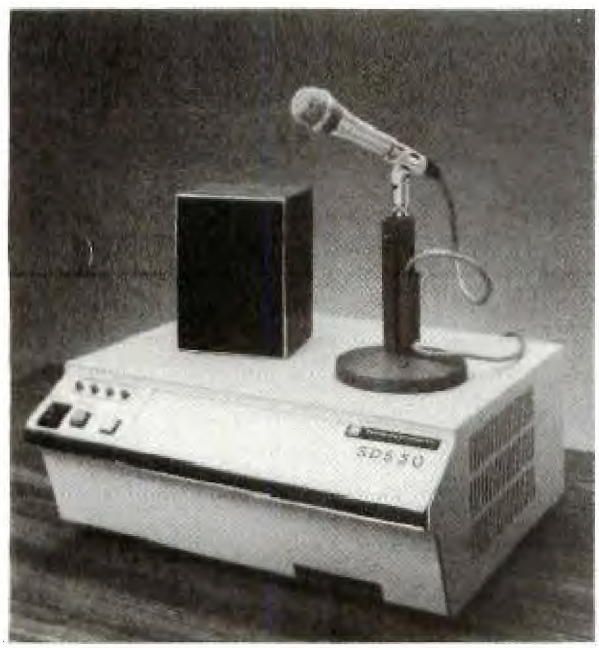
Speech Development System – SDS50

Machines communicating vocally with humans represent a rapidly expanding market. Applications span virtually every market segment from consumer, to automotive, to telecom, to computer, to industrial uses.

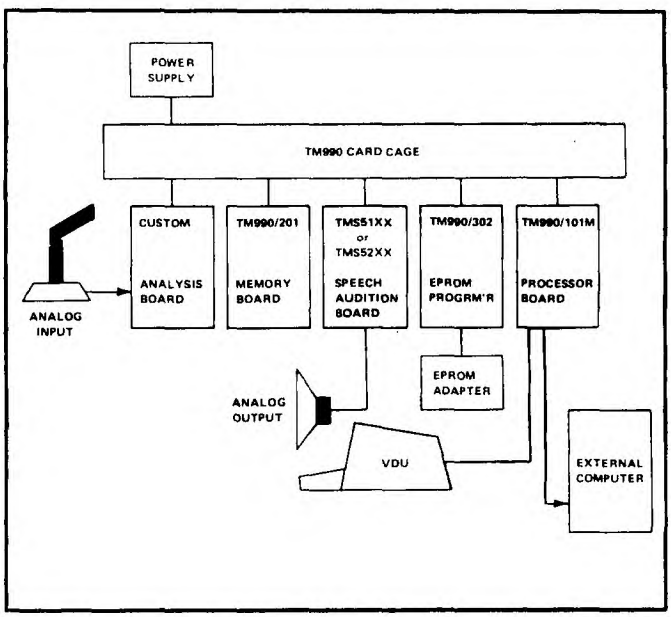
While the reproduction of speech from encoded data has been reduced to a readily available chip set, up until very recently encoding speech and storing it in memory has required a great deal more effort and hardware. Texas Instruments Speech Development System is a self-contained speech analysis system which allows one to listen to data encoded for Texas Instruments voice synthesis processors the instant the person has spoken a sentence.

The necessary hardware has been reduced in size from a mainframe computer to a standard Texas Instruments microcomputer and a number of dedicated signal processing boards.

The Speech Development System dramatically reduces the time, effort, and assets involved in putting speech into silicon, by directly converting the spoken text into "Linear Prediction" coefficients and synthesizing the results immediately to the user. Not only does this ensure that users can iteratively optimize the results obtained, but it also permits the particular words to be encoded at short notice.



System Configuration



The Speech Development System may be used in three modes:

(1) As a stand-alone demonstration system with only a microphone and a loudspeaker. This is useful for evaluating and training speakers.

(2) As an interactive system with a VDU. This permits speech data to be displayed in terms of the Linear Prediction Codes which are used to regenerate utterances and these can then be edited to improve quality. Further, new sounds can be created in this way. Once the appropriate speech has been captured. The EPROM programmer may be used so that the speech stored in the SDS50 may be downloaded directly into nonvolatile memory for use in an actual product.

(3) As a speech processing front end to a computer. In this, way, speech can be transferred to an archive so that when various words or phrases are needed for subsequent refinement by editing or reuse they can quickly be retrieved from an archived file.

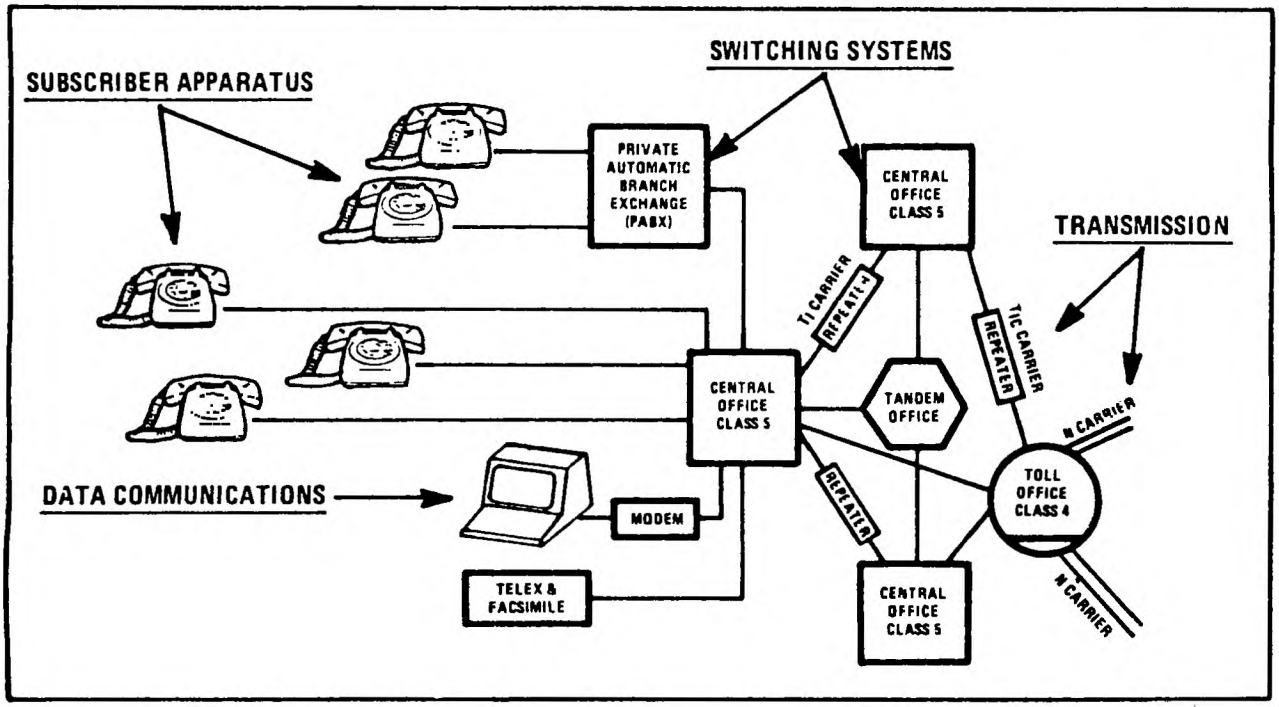
The SDS50 not only fills a gap in the speech synthesis development cycle but also forms the basis for speech development laboratories. The unit's ability to do this is due both to its unique hardware design and the implementation in software of a proprietary algorithm.

Products Summary

DEVICE NUMBER	DESCRIPTION		PROCESS	PACKAGE	SUPPLY VOLTAGE	SECOND SOURCE	EQUIPMENT	REGION OF APPLICATION
TCM1101	Pulse Dialer		CMOS	N 16 Pin	2.5-5V		Subscriber	World Wide
TCM1501A TCM1505A TCM1506A TCM1512A	Ringers	2KHz Standard Double Input 500 Hz Output 1 KHz Output	BIDFET	P 8 Pin	40-150 V AC 15-50 V AC 40-150 V AC 40-150 V AC		Subscriber	World Wide
TCM1520A	Ring Detector	TTL/MOS Output	BIDFET	P 8 Pin	40-150 V AC		Subscriber/ Switching	World Wide
TCM1705A	Hybrid Gain Network	Dynamic or Electret MIC	BIPOLAR	N 16 Pin	4.3-22 V		Subscriber	World Wide
TCM1703	Polarity Bridge	0.5 V DC Loss	BIPOLAR	P 8 Pin	2.2-14 V		Subscriber	World Wide
TCM2101 TCM2102	PCM Repeaters	Low Q High Q	BIPOLAR	N,J 24 Pin	5 V		Transmission	World Wide
TCM2201	HDB3 Transcoder		CMOS	N,J 16 Pin	9.5-12 V		Transmission	Europe
TCM2202 TCM2212	HD83/AMI Encoder/Decoder		NMOS	N,J 28 Pin 40 Pin	5 V		Transmission/ Switching	World Wide
TCM2203 TCM2204	HDB3/AMI Line Interface	Low Q High Q	BIPOLAR	N,J 28 Pin	5 V		Transmission/ Switching	World Wide
TCM2401	Elastic Store	8.448 Mb/s	CMOS	N 16 Pin	9.5-12 V		Transmission/ Switching	World Wide
TCM3101	FSK Modem	CCITT V23/Bell 202	CMOS	N,J 16 Pin	5 V		Data Comms	World Wide
TCM2910A TCM2911A TCM4910 TCM4110	Codec:	u-LAW A-LAW tight SPEC u-LAW Premium u-LAW	NMOS	J 24 Pin 22 Pin 24 Pin 24 Pin	+ 12 V, ± 5 V	2910A 2911A	Switching	Japan/N. Amer. Europe/S. Amer. Japan/N. Amer. Japan/N. Amer.
TCM2912B	PCM Line Filter		NMOS	J 16 Pin	± 5 V	2912A	Switching	World Wide
TCM2913 TCM2914 TCM2916	Combos:	Synchronous Asynchronous	NMOS	J 20 Pin 24 Pin 16 Pin	± 5 V	2913 2914 2916	Switching	World Wide
TCM4204 TCM4205	Subscriber Line Control Circuit:	Standard External Ground Start Reference	CMOS	J 24 Pin 28 Pin	± 5 V		Switching	World Wide
TCM5087 TCM5089 TCM5091 TCM5092	DTMF Encoder	Standard Electronic Input European High Output	CMOS	N 16 Pin 16 Pin 18 Pin 16 Pin	3.5-10 V 3.0-10 V 3.0-10 V 3.5-10 V	MK5087 MK5089 MK5091 MK5092	Subscriber	World Wide World Wide Europe World Wide

Telecommunication Products

Telecommunications Equipment Segments



Subscriber Station ICs

TCM1101 ELECTRONIC PULSE DIALER is designed to produce a pulse stream for use in telephone dialing systems.

- Low power supply: 3 V typical
- Last number re-dial
- 16 Pin dual-in-line package

TMC1501A, 05A, 06A, 12A RING DETECTOR/DRIVERs are monolithic ICs which detect a ring signal and produce an output to drive a transducer. These ICs are normally used to replace the mechanical bell in the telephone but also have applications in alarm systems and other consumer products.

- Requires fewer external parts than Bipolar or CMOS ringer ICs.
- Built in lightning and static protection
- Built in anti-'tapping' circuitry
- Built in input rectifiers (Bridge or Doubler)
- High input standby impedance

TCM1520A RING SIGNAL DETECTOR is a monolithic IC which detects a ring signal and produces a TTL or MOS compatible output to a microprocessor, microcomputer, or other logic. This IC has applications in modems, facsimile equipment, automatic telephone answering equipment, and PABX equipment.

- Requires few external components
- Built in lightning and static protection
- Built in anti-'tapping' circuitry
- Built in input rectifier bridge
- High input standby impedance
- Can be used in isolated and line-powered applications

TCM1705A TELEPHONE HYBRID/GAIN IC is a monolithic circuit designed to replace the hybrid coil for the 2-to-4 wire conversion in a telephone set. On-chip amplifiers allow replacement of the carbon microphone with more reliable high-quality transducers.

- Automatic gain compensation with loop length
- Externally adjustable transmit and receive gains
- Externally adjustable side tone
- Operates on long or short loops
- For Electrodynamic or Electret MIC Elements

TCM1703 POLARITY BRIDGE is an integrated circuit which protects against polarity reversal and has a very low series voltage drop, thus providing up to 25% more DC power than the conventional diode circuits.

- Low DC power loss
- Low AC insertion loss
- Electronic load switching

TCM5087/5089/5091/5092 TONE ENCODERS are specifically designed to produce dual-tone multifrequency outputs for use in telephone dialing systems.

- Uses inexpensive color-burst crystal
- Minimal standby power requirement
- Powered directly from phone line
- On-chip buffers to drive the line
- On-chip auxiliary switching functions
- Designed to be interchangable with Mostek MK5087/5089/5091/5092

Telecommunication Products

Transmission ICs

TCM2101, 02 PCM REPEATERs are designed to provide equalization, clock recovery, pulse detection, and pulse transmission on a digital transmission link. These monolithic ICs are optimized for AMI and HDB3 encoded PCM signals up to 3 MHz.

- PCM signal amplification (50 dB open loop gain)
- Two ALBO taps
- Low Q (TCM2101) or High Q (TCM2102) clock extraction
- Auto adaptive data slicing level

TCM2201 HDB3 TRANSCODER is a monolithic IC containing a transmission coder and a reception decoder.

- Standard 2.048 MHz Clock Speed
- HDB3-NRZ: Coder/Decoder
- Bipolar-NRZ: Coder/Decoder
- Transmission Errors Detection

TCM2202, 12 HDB3/AMI ENCODERs are monolithic ICs which provide HDB3/AMI encoding of binary NRZ inputs, decoding to NRZ binary of HDB3/AMI encoded data, and error detection and signalling.

- Loopback facility
- TTL compatible I/O

TCM2203, 04 HDB3/AMI EQUIPMENT LINE INTERFACE ICs are designed to perform the interface function between the HDB3/AMI encoder/decoder (e.g. TCM2202) and the line.

- Low Q (TCM2203) or High Q (TCM2204) operation
- On-chip 50 dB open loop gain amplifier
- Transmit data loss detection
- Receive line signal loss detection
- 3 MHz bandwidth

TCM2401 ELASTIC STORE is a synchronizing memory device, providing the buffer store and justification or pulse-stuffing functions in a second-order PCM multiplexer.

- 8 bits wide
- Phase comparator
- Justification (pulse stuffing) code detector
- For U.S. and European systems up to 8.448 Mb/s

TCM3101 FSK MODEM is a monolithic IC containing a versatile medium speed frequency shift keying modem with on-chip filters, pin selectable to CCITT V.23 or Bell 202 standard frequencies.

- Reliable Low Power Silicon Gate CMOS technology
- Meets CCITT V.23 or Bell 202 standards
- Full duplex operation up to 1200 Baud receive, 150 Baud transmit
- Half duplex operation up to 1200 Baud transmit and receive
- On-chip compromise line equalization and transmit/receive filtration
- Carrier detect level adjustment and carrier fail output

Switching ICs

TCM2910A/2911A/4110/4910 CODECs are single chip pulse code modulated (PCM) encoder/decoders which provide all the functions required to interface a full duplex voice telephone circuit with a time division multiplexed (TDM) system.

- TCM2910A/4110/4910 u-Law coding
- TCM2911A A-law coding
- Optional programmable time-slot selection
- CCITT G.711,G.712,G.732 Compatible
- Designed to be interchangable with Intel 2910A/2911A

TCM2912B PCM LINE FILTER is specifically designated to implement the transmit and receive filters of a PCM trunk or line termination. The transmit and receive passband filter sections are implemented using switched-capacitor techniques.

- Sixth order low-pass transmit filter for improved performance
- CCITT G.712 as well as AT&T^{R} D3-D4 compatible
- Low power: 60 mW operating (less than 1 mW standby)
- Direct interface with the TCM2910A/4910/4110/2911A PCM CODECs
- Designed to be interchangable with Intel 2912A

TCM2913, 2914, 2916 COMBINED SINGLE CHIP PCM CODEC AND FILTER are designed to provide the functions formerly provided by the TCM2910A or TCM2912B with superior performance.

- Two Timing Modes
- Pin Selectable u-LAW or A-LAW Operation
- Low Power Dissipation: 175 mW Operating, 10 mW Standby
- Excellent power supply rejection
- Designed to be interchangable with Intel 2913, 2914, 2916

TCM4204, 05 SUBSCRIBER LINE CONTROL CIRCUIT ICs are monolithic ICs which integrate all of the low voltage analog signal processing, and control functions not performed by a PCM codec and filter, for a complete voice band PCM channel.

- Independently programmable T_X and R_X gain attenuators
- TTL compatible digital I/O
- Programmable external balance networks
- On/Off hook detection and ring trip
- Control of ring and up to three additional relays
- External ground start reference (TCM4205)
- Reliable low power Silicon gate CMOS Technology

MEMORY PRODUCTS

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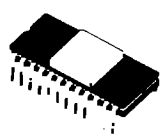
Note:

RAM = Random-access memory
ROM = Read-only memory
PROM = Programmable read-only memory
EPROM = Erasable-programmable read-only memory
FIFO = First-in, first-out

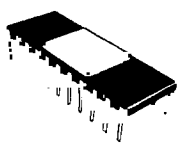
PACKAGE TYPES:

Ceramic



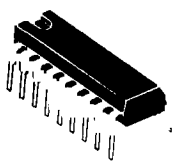
J-16,18,20,24,28pin

Ceramic-side braze



JD-16,18,20,24,28pin

Plastic



N-16,18,20,24,28pin

For more Information on the products in this section, see the MOS MEMORY DATA BOOK or the BIPOLAR MICROCOMPUTER COMPONENTS DATA BOOK. (See page 141 to order).

MOS Static RAMs

SIZE (BITS)	ORGANIZATION (WORDS X BITS)	DEVICE NUMBER	MAX ACCESS TIME (ns)	POWER SUPPLY (V)	MAX POWER DISSIPATION ACTIVE (mW)	MAX POWER DISSIPATION STANDBY (mW)	NUMBER OF PINS	COMMENTS
4K	1024 X 4	TMS2114-15NL	150	+5	550	120	18	
4K	1024 X 4	TMS2114-20NL	200	+5	550	120	18	
4K	1024 X 4	TMS2114-25NL	250	+5	550	120	18	
4K	1024 X 4	TMS2114-45NL	450	+5	550	120	18	
4K	1024 X 4	TMS2114L-15NL	150	+5	360	72	18	
4K	1024 X 4	TMS2114L-20NL	200	+5	330	72	18	
4K	1024 X 4	TMS2114L-25NL	250	+5	330	72	18	LOW POWER
4K	1024 X 4	TMS2114L-45NL	450	+5	330	72	18	
16K	2048 X 8	TMS4016-12NL	120	+5	385		24	
16K	2048 X 8	TMS4016-15NL	150	+5	385		24	
16K	2048 X 8	TMS4016-20NL	200	+5	385		24	
16K	2048 X 8	TMS4016-25NL	250	+5	385		24	
CACHE TAG	512 X 9	TMS2150-4JDL	45	+5	660		24	CACHE ADDRESS COMPARATOR
	512 X 9	TMS2150-5JDL	55	+5	660		24	
	512 X 9	TMS2150-7JDL	70	+5	660		24	
	512 X 9	TMS2150-9JDL	90	+5	660		24	

MOS Dynamic RAMs

SIZE (BITS)	ORGANIZATION (WORDS X BITS)	DEVICE NUMBER	MAX ACCESS TIME (ns)	POWER SUPPLY (V)	MAX POWER DISSIPATION ACTIVE (mW)	MAX POWER DISSIPATION STANDBY (mW)	NUMBER OF PINS	COMMENTS
16K	16384 X 1	TMS4116-15NL	150	±5,+12	462	20	16	
16K	16384 X 1	TMS4116-20NL	200	±5,+12	462	20	16	
64K	65536 X 1	TMS4164-12NL/FPL	120	+5	248	28	16	FPL=PLASTIC CHIP CARRIER
64K	65536 X 1	TMS4164-15NL/FPL	150	+5	215	28	16	
64K	65536 X 1	TMS4164-20NL/FPL	200	+5	187	28	16	
64K	16384 X 4	TMS4416-15NL	150	+5	264	28	18	
64K	16384 X 4	TMS4416-20NL	200	+5	231	28	18	
	CONTROLLER	TMS4500A-15NL	150	+5	770		40	DRAM CONTROLLER
	CONTROLLER	TMS4500A-20NL	200	+5	770		40	
	CONTROLLER	TMS4500A-25NL	250	+5	770		40	

MOS EPROMs

SIZE (BITS)	ORGANIZATION (WORDS X BITS)	DEVICE NUMBER	MAX ACCESS TIME (ns)	POWER SUPPLY (V)	MAX POWER DISSIPATION		NUMBER OF PINS	COMMENTS
					ACTIVE (mW)	STANDBY (mW)		
8K	1024 X 8	TMS2708-35JL	350	±5,+12	800		24	
8K	1024 X 8	TMS2708-45JL	450	±5,+12	800		24	
8K	1024 X 8	TMS27L08-45JL	450	±5,+12	580		24	LOW POWER
16K	2048 X 8	TMS2716-30JL	300	±5,+12	720		24	
16K	2048 X 8	TMS2716-45JL	450	±5,+12	720		24	
16K	2048 X 8	TMS2516-35JL	350	+5	525	131	24	
16K	2048 X 8	TMS2516-45JL	450	+5	525	131	24	
32K	4096 X 8	TMS2532-30JL	300	+5	840	131	24	ALL DEVICES ARE ROM COMPATIBLE
32K	4096 X 8	TMS2532-35JL	350	+5	840	131	24	
32K	4096 X 8	TMS2532-45JL	450	+5	840	131	24	
32K	4096 X 8	TMS25L32-45JL	450	+5	500	131	24	LOW POWER
32K	4096 X 8	TMS2732-25JL	250	+5	788	193	24	
32K	4096 X 8	TMS2732-35JL	350	+5	788	193	24	
32K	4096 X 8	TMS2732-45JL	450	+5	788	193	24	
64K	8192 X 8	TMS2564-35JL	350	+5	840	158	28	ROM COMPATIBLE
64K	8192 X 8	TMS2564-45JL	450	+5	840	158	28	
64K	8192 X 8	TMS2764-20JL	200	+5	525	183	28	
64K	8192 X 8	TMS2764-25JL	250	+5	525	183	28	
64K	8192 X 8	TMS2764-30JL	300	+5	550	193	28	
64K	8192 X 8	TMS2764-45JL	450	+5	788	220	28	

MOS PROMs

SIZE (BITS)	ORGANIZATION (WORDS X BITS)	DEVICE NUMBER	MAX ACCESS TIME (ns)	POWER SUPPLY (V)	MAX POWER DISSIPATION		NUMBER OF PINS	COMMENTS
					ACTIVE (mW)	STANDBY (mW)		
32K	4096 × 8	TMS3532-45NL	450	+5	525	131	24	PLASTIC PACKAGE
32K	4096 X 8	TMS3732A-45NL	450	+5	525	158	24	
64K	8192 X 8	TMS3564-45NL	450	+5	525	158	28	PLASTIC PACKAGE
64K	8192 × 8	TMS3764-45NL	450	+5	525	184	28	

MOS ROMs

SIZE (BITS)	ORGANIZATION (WORDS X BITS)	DEVICE NUMBER	MAX ACCESS TIME (ns)	POWER SUPPLY (V)	MAX POWER DISSIPATION		NUMBER OF PINS	COMMENTS
					ACTIVE (mW)	STANDBY (mW)		
32K	4096 X 8	TMS4732-30NL	300	+5	440	110	24	ALL DEVICES ARE AVAILABLE IN PLASTIC (NL) PACKAGES.
32K	4096 X 8	TMS4732-35NL	350	+5	440	110	24	
32K	4096 X 8	TMS4732-45NL	450	+5	440	110	24	
64K	8192 X 8	TMS4764-30NL	300	+5	440	110	24	
64K	8192 X 8	TMS4764-35NL	350	+5	440	110	24	
64K	8192 X 8	TMS4764-45NL	450	+5	440	110	24	

Bipolar PROMs

SIZE (BITS)	ORGANIZATION (WORDS X BITS)	DEVICE NUMBER		TYP. ACCESS TIME(ns)**	TYP POWER DISSIPATION (mW)	OUTPUT TYPE*	PACKAGE		COMMENTS
		NEW	OLD				SIZE (mils)	PINS	
256	32 X 8	TBP18SA030	SN74S188	25	400	OC	300	16	
256	32 X 8	TBP18S030	SN74S288	25	400	3S	300	16	
1K	256 X 4	TBP24S10		35	375	3S	300	16	
1K	256 X 4	TBP24SA10		35	375	OC	300	16	
1K	256 X 4	TBP14S10	SN74S287	42	500	3S	300	16	Replaced by TBP24S10
1K	256 X 4	TBP14SA10	SN74S387	42	500	OC	300	16	Replaced by TBP24SA10
2K	256 X 8	TBP28L22		45	375	3S	300	20	Low Power
2K	256 X 8	TBP28LA22		45	375	OC	300	20	Low Power
2K	256 X 8	TBP18SA22	SN74S470	50	550	OC	300	20	Replaced by TBP28LA22
2K	256 X 8	TBP18S22	SN74S471	50	550	3S	300	20	Replaced by TBP28L22
4K	512 X 8	TBP28S42		35	500	3S	300	20	
4K	512 X 8	TBP28SA42		35	500	OC	300	20	
4K	512 X 8	†TBP28S45		35	500	3S	300	24	
4K	512 X 8	†TBP28SA45		35	500	OC	300	24	
4K	512 X 8	TBP28S46		35	500	3S	600	24	
4K	512 X 8	TBP28SA46		35	500	OC	600	24	
4K	512 X 8	TBP28L42		55	275	3S	300	20	Low Power
4K	512 X 8	†TBP28L45		60	250	3S	300	24	Low Power
4K	512 X 8	TBP28L46		55	275	3S	600	24	Low Power
4K	1024 X 4	TBP24S41	SN74S476	40	475	3S	300	18	
4K	1024 X 4	TBP24SA41	SN74S477	40	475	OC	300	18	
4K	512 X 8	TBP18S46	SN74S474	55	600	3S	600	24	Replaced by TBP28S46
4K	512 X 8	TBP18SA46	SN74S475	55	600	OC	600	24	Replaced by TBP28SA46
4K	512 X 8	TBP18S42	SN74S472	55	600	3S	300	20	Replaced by TBP28S42
4K	512 X 8	TBP18SA42	SN74S473	55	600	OC	300	20	Replaced by TBP28SA42
8K	1024 X 8	†TBP28S85A		35	550	3S	300	24	
8K	1024 X 8	†TBP28L85A		65	300	3S	300	24	Low Power
8K	1024 X 8	TBP28S86	SN74S478	45	625	3S	600	24	Replaced by TBP28S86A
8K	1024 X 8	TBP28S86A		35	550	3S	600	24	
8K	1024 X 8	TBP28S86A-50		35	550	3S	600	24	
8K	1024 X 8	TBP28SA86	SN74S479	45	625	OC	600	24	Replaced by TBP28SA86A
8K	1024 X 8	TBP28SA86A		35	550	OC	600	24	
8K	1024 X 8	TBP28L86	SN74LS478	80	350	3S	600	24	Replaced by TBP28L86A
8K	1024 X 8	TBP28L86A		65	275	3S	600	24	Low Power
8K	1024 X 8	TBP28SA86A-50		35	550	OC	600	24	
8K	1024 X 8	TBP28S2708	SN74S2708	45	625	3S	600	24	Replaced by TBP28S2708A
8K	1024 X 8	TBP28S2708A		35	550	3S	600	24	
8K	2048 X 4	TBP24S81	SN74S454	45	625	3S	300	18	
8K	2048 X 4	TBP24S81-55		35	625	3S	300	18	
8K	2048 X 4	TBP24SA81	SN74S455	45	625	OC	300	18	
8K	2048 X 4	TBP24SA81-55		35	625	OC	300	18	
16K	2048 X 8	†TBP28S165A		35	650	3S	300	24	
16K	2048 X 8	†TBP28S165A-35		30	650	3S	300	24	
16K	2048 X 8	†TBP28R166A		20	700	3S	600	24	Registered Output
16K	2048 X 8	TBP28S166	SN74S452	45	675	3S	600	24	
16K	2048 X 8	TBP28S166-55		35	675	3S	600	24	
16K	2048 X 8	†TBP28S166A		35	650	3S	600	24	
16K	2048 X 8	†TBP28S166A-35		30	650	3S	600	24	
16K	2048 X 8	TBP28SA166	SN74S453	45	675	OC	600	24	
16K	2048 X 8	TBP28SA166-55		35	675	OC	600	24	
16K	2048 X 8	TBP28L166		65	350	3S	600	24	Low Power

* 3S = 3 State, OC = Open Collector

** Devices can be speed screened during production to variable maximum access times.

†Planned new products

Bipolar RAMs

ORGANIZATION (WORDS X BITS)	DEVICE NUMBER*	TYPICAL ACCESS TIME (ns)	POWER SUPPLY (V)	POWER DISSIPATION	WRITE PULSE (ns)	OUTPUT TYPE**	NUMBER OF PINS
16 X 1	**SN7481A**	**13**	**+5**	**300**	**20**	**OC**	**16**
16 X 1	**SN7484A**	**13**	**+5**	**300**	**20**	**OC**	**16**
16 X 4	SN7489	33	+5	375	40	OC	16
16 X 4	SN74S189B	25	+5	375	25	3S	16
16 X 4	SN74LS189A	50	+5	175	60	3S	16
16 X 4	SN74LS219A	50	+5	175	60	3S	16
16 X 4	SN74S289B	25	+5	375	25	OC	16
16 X 4	SN74LS289A	50	+5	175	60	OC	16
16 X 4	**SN74LS319A**	**50**	**+5**	**175**	**60**	**OC**	**16**
16 X 4, 16 X 4	†SN74AS870	8	+5			3S	24
16 X 4, 16 X 4	†SN74AS871	8	+5			3S	28
4 X 4	**SN74LS170**	**20**	**+5**		**25**	**OC**	**16**
4 X 4	**SN74LS670**	**20**	**+5**		**25**	**3S**	**16**
8 X 2	**SN74172**	**15**	**+5**			**3S**	**24**
32 X 8	†SN74ALS218	40	+5	250	30	3S	20
32 X 8	†SN74ALS318	40	+5	250	30	OC	20
64 X 4	**†SN74ALS217**	**40**	**+5**	**250**	**30**	**3S**	**20**
64 X 4	**†SN74ALS317**	**40**	**+5**	**250**	**30**	**OC**	**20**
256 X 1	SN74S201	42	+5	500	65	3S	16
256 X 1	SN74S301	42	+5	500	65	OC	16

* Also Available in Military (54) Series
** OC = Open Collector, 3S = 3 State
† Planned new products

Bipolar FIFO Memories

ORGANIZATION (WORDS X BITS)	DEVICE NUMBER FOR TEMPERATURE RANGE		DATA RATES		FALL THROUGH (ns) Typ	POWER DISSIPATION (mW) Typ	OUTPUT TYPE*	NUMBER OF PINS
	−55°C to 125°C	0°C to 70°C	INPUT	OUTPUT				
16 X 4	SN54LS222	SN74LS222	DC	DC	50	445	3S	20
16 X 4	SN54LS224	SN74LS224	TO	TO	50	445	3S	16
16 X 4	SN54LS227	SN74LS227	10 MHz	10 MHz	50	445	OC	20
16 X 4	SN54LS228	SN74LS228			50	445	OC	16
16 X 5		**SN74S225**			**190**	**400**	**3S**	**20**

*3S = State, OC = Open Collector

LINEAR PRODUCTS

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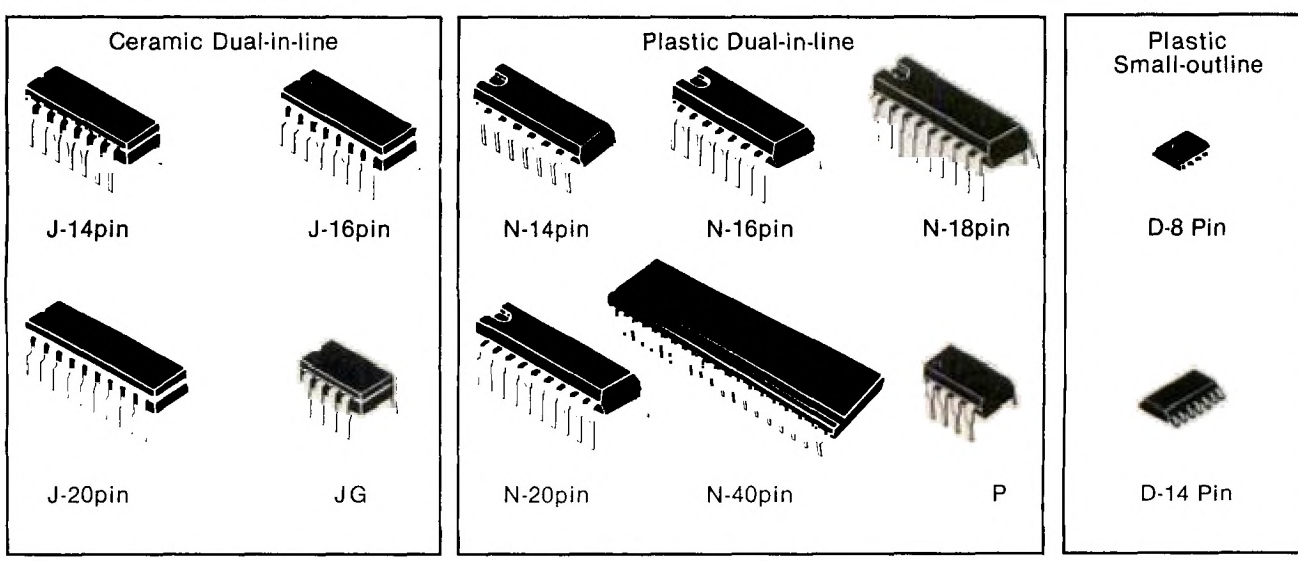
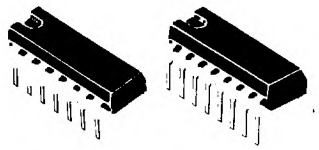
PACKAGE TYPES:



For more information on the products in this section, see the LINEAR CONTROL CIRCUITS DATA BOOK, the INTERFACE CIRCUITS DATA BOOK, or the VOLTAGE REGULATOR DATABOOK. (See page 141 to order).

PACKAGE TYPES (continued)

Plastic Dual-in-line with Copper Lead Frame



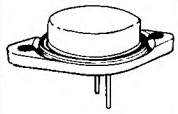
NE, NG-14pin NE, NG-16pin

Plastic

KC

LP

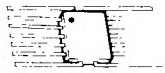
Metal



KA

Ceramic Flat-pack

U-10pin



U-14pin

W-14pin

W-16pin

FH = Ceramic chip carrier (see package outline drawing on page 120 in the appendix.)

Single operational amplifiers: Uncompensated

Military temperature range (−55°C to 125°C)

I_{IB} (nA) MAX	V_{IO} (mV) MAX	I_{IO} (nA) MAX	A_{VD} (V/mV) MIN	B_1 (MHz) TYP	SR (V/μs) TYP	SUPPLY CURRENT I_{CC} (mA) MAX	SUPPLY VOLTAGE (V) MIN	SUPPLY VOLTAGE (V) MAX	DESCRIPTION	DEVICE NUMBER	PACKAGES
75	2	10	50	1	0.5	3	±5	±22	High Performance	LM101A	J,JG,U,FH
500	5	200	25	1	0.3	5.5		±18	General Purpose	uA709M	J,JG,U,FH
500	5	200	50	1	0.5	2.8	±2	±22	General Purpose	uA748M	J,JG,U,W

Industrial temperature range (−25°C to 85°C)

75	2	10	50	1	0.6	3	±5	±22	High Performance	LM201A	JG,P
0.2	6	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL060I	P,JG
0.2	6	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL070I	P,JG
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL080I	P,JG

Commercial temperature range (0°C to 70°C)

1500	7.5	500	12	1	0.3	5.5		±18	General Purpose	uA709C	P,JG,J,N
500	6	200	20	1	0.5	2.8	±2	±18	General Purpose	uA748C	P,JG
250	7.5	50	25	1	0.5	3	±5	±18	High Performance	LM301A	P,JG,N
100	5	20	25	1	0.5	3.3	±5	±22	High Performance	uA777C	P,JG
0.4	15	0.2	25	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL080C	P,JG
0.4	15	0.2	3	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL060C	P,JG
0.4	15	0.1	25	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL070C	P,JG
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL080AC	P,JG
0.2	6	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL060AC	P,JG
0.2	3	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL [illegible]	P
0.2	6	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL [illegible]	P,JG
0.2	3	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL [illegible]	P

*V_n = 18nV/$\sqrt{Hz}$ TYP.

Single operational amplifiers: Internally compensated

Military temperature range (−55°C to 125°C)

I_{IB} (nA) MAX	V_{IO} (mV) MAX	I_{IO} (nA) MAX	A_{VD} (V/mV) MIN	B_1 (MHz) TYP	SR (V/µs) TYP	SUPPLY CURRENT I_{CC} (mA) MAX	SUPPLY VOLTAGE (V) MIN	SUPPLY VOLTAGE (V) MAX	DESCRIPTION	DEVICE NUMBER	PACKAGES
75	2	10	50	1	0.5	3	±2	±22	High Performance	LM107	JG,U,J,FH
0.2	6	0.1	4	1	3.5	2	±1.5	±18	BIFET, Lower Power	TL061M	JG,U,FH
0.2	6	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL071M	JG,U,FH
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL081M	JG,U,FH
0.2	3	0.1	50	3	13	2.8	±4	±18	BIFET, Low V_{IO}	TL088M	JG,FH
0.4	9	0.2	50	1	0.6	2.5	±1.5	±18	NFET Single Supply	TL091M	JG,FH
800	2	200	50	10	13	6.5	±3	±22	Low Noise	SE5534	JG,FH
500	5	200	50	1	0.5	2.8	±2	±22	General Purpose	uA741M	J,JG,W,FH
2000	5	2000	1.4		11	6.7	+6 −3	+14 −7	General Purpose	TL702M	J,JG,U
5000	2	500	2.5		11	6.7	+6 −3	+14 −7	General Purpose	uA702M	J,JG,U

Industrial temperature range (−25°C to 85°C)

250	4	50	50	15	70	8		±20	High Performance	LM218	P,JG
500	6	200	20	1	0.5	2.8	±2	±18	General Purpose	uA741I	P
0.4	1	0.1	50	3	13	2.8	±4	±18	BIFET, Low Offset	TL088I	P,JG
0.4	0.5	0.1	50	3	13	2.8	±4	±18	BIFET, Low Offset	TL087I	P,JG
0.2	6	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL061I	P,JG
0.2	6	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL066I	P,JG
0.2	6	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL071I	P,JG
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL081I	P,JG

Commercial temperature range (0°C to 70°C)

15000	10	5000	1		11	7	±6 −3	±14 −7	General Purpose	TL702C	N,J
1500	4	300	25	10	13	8	±3	±22	Low Noise	NE5534	P,JG,D
1500	4	300	25	10	13	8	±3	±22	Low Noise	NE5534A	P,JG
500	6	200	20	1	0.5	2.8	±2	±18	General Purpose	uA741C	P,JG,J,N,D
500	10	200	25	15	70	10		±20	High Performance	LM318	P,JG,D
250	7.5	0.50	25	1	0.5	3	±2	±18	High Performance	LM307	P,JG,N
250	7	50	25	1	0.5	0.5	±3	±32	General Purpose, Single Supply	TL321C	P,JG
30	0.25	20	3.0	0.6	0.2	2.0	±3	±18	Very Low Offset V.	uA714L/	P
12	0.15	6	120	0.6	0.2	5.0	±3	±18	Very Low Offset V.	0P-07D	P
7	0.15	6	120	0.6	0.2	5.0	±3	±18	Very Low Offset V.	0P-07C	P
7	0.15	6	120	0.6	0.2	1.3	±3	±18	Very Low Offset V.	uA-714C	P
4	0.075	3.8	200	0.6	0.2	4.0	±3	±18	Very Low Offset V.	0P-07E	P
4	0.075	3.8	200	0.6	0.2	1.0	±3	±18	Very Low Offset V.	uA-714E	P
0.4	15	0.2	3	1	3.5	0.25	±1.5	±18	BIFET, Lower Power	TL061C	P,JG,D
0.4	15	0.2	3	1	3.5	0.25	±1.5	±18	BIFET, Low Power with Power Control	TL066C	P,JG
0.4	15	0.2	25	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL081C	P,JG
0.4	0.5	0.2	25	3	13	2.8	±4	±18	BIFET, Low V_{IO}	TL087C	P,JG
0.4	1	0.2	50	3	13	2.8	±4	±18	BIFET, Low V_{IO}	TL088C	P,JG
0.4	15	0.2	20	1	0.6	2.5	±1.5	±18	NFET, Single Supply	TL091C	P
0.2	6	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL061AC	P,JG,D
0.2	3	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL061BC	P,JG,D
0.2	6	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power with Power Control	TL066AC	P,JG
0.2	3	1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power with Power Control	TL066BC	P,JG
0.2	6	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL071AC	P,JG,D
0.2	3	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL071BC	P,JG,D
0.2	10	0.1	25	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL071C	P,JG,D
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL081AC	P,JG
0.2	3	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL081BC	P,JG
0.2	15	0.05	0.001	1	7	0.25	±1.5	±18	BIFET, Buffer	TL068C	LP
0.15	10	0.1	10	2.3	4.5	2	4	18	Programmable LinCMOS™	TLC271C	D,P
0.15	10	0.1	10	2.3	4.5	2	1	18	Programmable LinCMOS™	TLC251C	D,P
0.15	5	0.1	10	2.3	4.5	2	4	18	Programmable LinCMOS™	TLC271AC	D,P
0.15	5	0.1	10	2.3	4.5	2	1	18	Programmable LinCMOS™	TLC251AC	D,P
0.15	2	0.1	10	2.3	4.5	2	4	18	Programmable LinCMOS™	TLC271BC	D,P
0.15	2	0.1	10	2.3	4.5	2	1	18	Programmable LinCMOS™	TLC251BC	D,P

*V_n = 18nV/$\sqrt{\text{Hz}}$ TYP.

Dual operational amplifiers:

Military temperature range (-55°C to 125°C)

I_{IB} (nA) MAX	V_{IO} (mV) MAX	I_{IO} (nA) MAX	A_{VD} (V/mV) MIN	B_1 (MHz) TYP	SR (V/µs) TYP	SUPPLY CURRENT I_{CC} (mA) MAX	SUPPLY VOLTAGE (V) MIN	SUPPLY VOLTAGE (V) MAX	DESCRIPTION	DEVICE NUMBER	PACKAGES
150	5	30	50	1	0.3	0.6	+3	+32	General Purpose	LM158	JG,U,FH
500	5	200	50	1	0.6	2.8	±2	±22	General Purpose	MC[illegible]	JG,FH
500	5	200	50	3	1.5	2.8		±22	[illegible] Performance	RM[illegible]	JG,FH
100	5	40	4	0.5	0.5	0.1	±2	±22	Low Power	TL022M	JG,FH
0.2	6	0.1	4	1	3.5	0.2	±1.5	±18	BIFET, Low Power	TL062M	
0.2	6	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL072M	JG,U,FH
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL082M	JG,U,FH
0.2	3	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL288M	JG,U,FH
0.4	9	0.2	50	1	0.6	5	±1.5	±18	NFET, Single Supply	TL092M	JG,FH
500	5	200	50	1	0.5	2.8	±2	±22	General Purpose	uA747M	J,W,FH

Automotive temperature range (-40°C to 85°C)

500	10	50	100	5	1	6	±3	±26	General Purpose	LM2904	P,JG

Industrial temperature range (-25°C to 85°C)

500	8	75	20	1	0.6	4	+3	+36	General Purpose	T[illegible]	P
150	5	30	50	1	0.3	3	+3	±32	General Purpose	LM[illegible]	P,JG
									[illegible] e Supply		
0.4	0.5	0.1	50	3	13	2.8	±3.5	±18	B[illegible] Low Offset	TL287I	P,JG
0.4	1	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL288I	P,JG
0.2	6	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Lower Power	TL062I	P,JG
0.2	6	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL072I	P,JG
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL082I	P,JG
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL083I	N,J

Commercial temperature range (0°C to 70°C)

800	4	150	25	10	9	16	±3	±22	TMLow Noise	NE5532	P,JG
800	4	150	25	10	9	16	±3	±22	Low Noise	NE5532A	P,JG
500	6	200	20	1	0.5	2.8	±2	±18	General Purpose	MC1458	P,JG,D
500	6	200	20	3	1	2.8		±18	High Performance	RC4558	P,JG,D
500	10	50	20	1	0.6	4	+3	+36	General Purpose	TL322C	P
500	6	200	25	1	0.5	2.8	±2	±18	General Purpose	uA747C	N,J
500	6	200	25	1	0.5	2.8	±2	±18	General Purpose	uA747-1C	N
250	7	50	25	1	0.3	0.6	+3	+32	General Purpose	LM358	P,JG,D
250	5	80	1	0.5	0.5	0.125	±2	±18	Low Power	TL[illegible]	P,JG
100	3	30	25	1	0.25	2.0	±1.5	±15	General Purpose	LM[illegible]	P,D
0.4	15	0.2	3	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL062C	P,JG,D
0.4	15	0.2	25	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL082C	P,JG
0.4	15	0.2	25	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL[illegible]	N,J
0.4	0.5	0.1	25	3	13	2.8	±3.5	±18	BIFET, Low Offset	TL[illegible]	P,JG
0.4	1	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL288C	P,JG
0.4	15	0.2	20	1	0.6	5	±1.5	±18	NFET, Single Supply	TL092C	P
0.2	6	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL062AC	P,JG,D
0.2	3	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL062BC	P,JG,D
0.2	6	0.1	25	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL072AC	P,JG,D
0.2	3	0.1	25	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL072BC	P,JG,D
0.2	10	0.1	25	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL072C	P,JG,D
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL082AC	P,JG
0.2	3	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL082BC	P,JG
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL083AC	N,J
0.15	2	0.1	10	2.3	4.5	2	1	18	High Bias LinCMOS™	TLC252BC	D,P
0.15	2	0.1	10	2.3	4.5	2	4	18	High Bias LinCMOS™	TL[illegible]272BC	D,P
0.15	2	0.1	20	0.7	0.6	0.3	1	18	Medium Bias LinCMOS™	TL[illegible]M2BC	D,P
0.15	2	0.1	20	0.7	0.6	0.3	4	18	Medium Bias LinCMOS™	TL[illegible]M2BC	D,P
0.15	2	0.1	30	0.1	0.04	0.02	1	18	Low Bias LinCMOS™	TLC25L2BC	D,P
0.15	2	0.1	30	0.1	0.04	0.02	4	18	Low Bias LinCMOS™	TLC27L2BC	D,P
0.15	5	0.1	10	2.3	4.5	2	1	18	High Bias LinCMOS™	TLC252AC	D,P
0.15	5	0.1	70	2.3	4.5	2	4	18	High Bias LinCMOS™	TLC272AC	D,P
0.15	5	0.1	20	0.7	0.6	0.3	1	18	Medium Bias LinCMOS™	TLC25M2AC	D,P
0.15	5	0.1	20	0.7	0.6	0.3	4	18	Medium Bias LinCMOS™	TLC27M2AC	D,P
0.15	5	0.1	30	0.1	0.04	0.02	1	18	Low Bias LinCMOS™	TLC25L2AC	D,P
0.15	5	0.1	30	0.1	0.04	0.02	4	18	Low Bias LinCMOS™	TLC27L2AC	D,P
0.15	10	0.1	10	2.3	4.5	2	1	18	High Bias LinCMOS™	TLC252C	D,P
0.15	10	0.1	10	2.3	4.5	2	4	18	High Bias LinCMOS™	TLC272C	D,P
0.15	10	0.1	20	0.7	0.6	0.3	1	18	Medium Bias LinCMOS™	TLC25M2C	D,P
0.15	10	0.1	20	0.7	0.6	0.3	4	18	Medium Bias LinCMOS™	TLC27M2C	D,P
0.15	10	0.1	30	0.1	0.04	0.02	1	18	Low Bias LinCMOS™	TLC25L2C	D,P
0.15	10	0.1	30	0.1	0.04.	0.02	4	18	Low Bias LinCMOS™	TLC27L2C	D,P

*V_n = 18nV/ $\sqrt{Hz}$ TYP.

Quad operational amplifiers:

Military temperature range (–55°C to 125°C)

I_{IB} (nA) MAX	V_{IO} (mV) MAX	I_{IO} (nA) MAX	A_{VD} (V/mV) MIN	B_1 (MHz) TYP	SR (V/µs) TYP	SUPPLY CURRENT I_{CC} (mA) MAX	SUPPLY VOLTAGE (V) MIN	SUPPLY VOLTAGE (V) MAX	DESCRIPTION	DEVICE NUMBER	PACKAGES
150	5	30	50	1	0.5	0.5	+3	+32	General Purpose	LM124	J,W,FH
500	5	200	50	3.5	1.5	2.8	±4	±22	High Performance	RM4136	J,W,FH
0.2	9	0.1	4	1	3.5	0.2	±1.5	±18	T, Low Power	TL064M	J,W,FH
0.2	6	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL074M	J,W,FH
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL084M	J,W,FH
100	5	25	50	1	0.5	3.6		±22	General Purpose	LM148	J,W,FH
500	5	50	50	1	0.6	4	+3	+36	General Purpose	MC3503	J,FH
100	5	40	4	0.5	0.5	0.1	±2	±22	Low Power	TL044M	J,FH
0.4	9	0.2	50	1	0.6	10	±1.5	±18	NFET Single Supply	TL094M	J

Automotive temperature range (–40°C to 85°C)

500	10	50	100	5	1	5	+3	+26	General Purpose	LM2902	N,J
500	8	75	20	1	0.6	7	+3	+36	General Purpose	MC3303	N,J
200			1.2	2.5	0.5	0.10	+4.5	+32	General Purpose	LM2900	N,J

Industrial temperature range (–25°C to 85°C)

250	7	50	25	1	0.5	3	+3	+32	General Purpose, Single Supply	LM224	N,J
0.2	6	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL064I	N,J
0.2	6	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL074I	N,J
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL084I	N,J

Commercial temperature range (0°C to 70°C)

500	10	50	20	1	0.6	7	±3	±36	General Purpose	MC3403	N,J,D
500	6	200	20	3	1	2.8	±4	±18	High Performance	RC4136	N,J,D
500	6	200	20	3	1.0	2.8	+4.0	±18	High Performance	TL136C	N,J
250	7	50	25	1	0.5	0.5	+3	+32	General Purpose	LM324	N,J,D
250	5	80	1	0.5	0.5	0.5	±2.0	±18	Low Power	TL044C	N
200	6	50	25	1	0.5	4.5		±18	General Purpose	LM348	N,J,D
200	1.2			2.5	5	0.10	+4.5	+32	General Purpose	LM3900	N,J
100	3	30	25	1	NA	4.8	±1.5	±15	High Performance	LM324A	J,N,D
0.4	15	0.2	3	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL064C	N,J,D
0.4	15	0.2	25	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL084C	N,J
0.4	15	0.2	25	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL085C	N
0.4	15	0.2	20	1	0.6	10	±1.5	±18	NFET, Single Supply	TL094C	N
0.2	6	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL064AC	N,J,D
0.2	3	0.1	4	1	3.5	0.25	±1.5	±18	BIFET, Low Power	TL064BC	N,J,D
0.2	6	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL074AC	N,J,D
0.2	3	0.1	50	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL074BC	N,J,D
0.2	10	0.1	25	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL074C	N,J,D
0.2	10	0.1	25	3	13	2.5	±3.5	±18	BIFET, Low Noise*	TL075C	N
0.2	6	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL084AC	N,J
0.2	3	0.1	50	3	13	2.8	±3.5	±18	BIFET, General Purpose	TL084BC	N,J
0.15	2	0.1	10	2.3	4.5	2	1	18	[illegible] Bias LinCMOS™	TLC254BC	D,N
0.15	2	0.1	10	2.3	4.5	2	4	18	[illegible] Bias LinCMOS™	TLC274BC	D,N
0.15	2	0.1	20	0.7	0.6	0.3	1	18	Medium Bias LinCMOS™	TLC25M4BC	D,N
0.15	2	0.1	20	0.7	0.6	0.3	4	18	Medium Bias LinCMOS™	TLC27M4BC	D,N
0.15	2	0.1	30	0.1	0.04	0.02	1	18	Low Bias LinCMOS™	TLC25L4BC	D,N
0.15	2	0.1	30	0.1	0.04	0.02	4	18	Low Bias LinCMOS™	TLC27L4BC	D,N
0.15	5	0.1	10	2.3	4.5	2	1	18	High Bias LinCMOS™	TLC254AC	D,N
0.15	5	0.1	10	2.3	4.5	2	4	18	High Bias LinCMOS™	TLC274AC	D,N
0.15	5	0.1	20	0.7	0.6	0.3	1	18	Medium Bias LinCMOS™	TLC25M4AC	D,N
0.15	5	0.1	20	0.7	0.6	0.3	4	18	Medium Bias LinCMOS™	TLC27M4AC	D,N
0.15	5	0.1	30	0.1	0.04	0.02	1	18	Low Bias LinCMOS™	TLC25L4AC	D,N
0.15	5	0.1	30	0.1	0.04	0.02	4	18	Low Bias LinCMOS™	TLC27L4AC	D,N
0.15	10	0.1	10	2.3	4.5	2	1	18	High Bias LinCMOS™	TLC254C	D,N
0.15	10	0.1	10	2.3	4.5	2	4	18	High Bias LinCMOS™	TLC274C	D,N
0.15	10	0.1	20	0.7	0.6	0.3	1	18	Medium Bias LinCMOS™	TLC25M4C	D,N
0.15	10	0.1	20	0.7	0.6	0.3	4	18	Medium Bias LinCMOS™	TLC27M4C	D,N
0.15	10	0.1	30	0.1	0.04	0.02	1	18	Low Bias LinCMOS™	TLC25L4C	D,N
0.15	10	0.1	30	0.1	0.04	0.02	4	18	Low Bias LinCMOS™	TLC27L4C	D,N

*V_n = 18nV/$\sqrt{\text{Hz}}$ TYP.

Voltage comparators

Military temperature range (-55°C to 125°C)

TYPE	DEVICE NUMBER	INPUT OFFSET VOLTAGE MAX (mV)	INPUT OFFSET CURRENT MAX (μA)	INPUT BIAS CURRENT MAX (μA)	VOLTAGE AMPLIFICATION MIN	LOW-LEVEL OUTPUT CURRENT MIN (mA)	RESPONSE TIME MAX (ns)	POWER SUPPLIES REQUIRED V_{CC+} NOM (V)	POWER SUPPLIES REQUIRED V_{CC-} NOM (V)	REMARKS	PACKAGES
Single	LM106M	2	3	45	40,000(Typ)	100	40	12	-6		JG,U,FH
Single	LM111*	4	0.02	0.15	200,000(Typ)	8	140(Typ)	15	-15	Strobe	JG,J,U,FH
Single	TL710M	5	10	75	7,000		40(Typ)	12	-6		JG,U,FH
Single	uA710M	2	3	20	12,000		40(Typ)	12	-6		J,JG,U,FH
Dual	LM193*	5	0.025	-0.1	200,000(Typ)	6	1300(Typ)	5	0	V_{CC} :2V to 36V	JG,U,FH
Dual	TL820M	3	7	25	10,000	0.5	80	12	-6	Dual TL8*	J,FC
Dual	TL514M	3	7	25	10,000	0.5	80	12	-6	Dual TL5*	J,W,FH
Dual	TL811M	3.5	3	20	12,500		33(Typ)	12	-6		J,U,FH
Dual	TL506M	2	3	20	40,000(Typ)	100	40	12	-6		J,W,FH
Dual Channel	uA711M	6	20	150	500	0.5	80	12	-6	Strobes	J,U,FH
Quad	LM139*	5	0.025	-0.1	200,000(Typ)	6	1300(Typ)	5	0	V_{CC} : 2V to 36V	J,W,FH

Automotive temperature range (-40°C to 85°C)

Dual	LM2903*	7	0.05	-0.25	200,000(Typ)	6	1300(Typ)	5	0	V_{CC}:2V to 36V	P,JG
Quad	LM2901*	7	0.05	-0.25	200,000(Typ)	6	1300(Typ)	5	0	V_{CC}:2V to 36V	N,J
Quad	LM3302*	20	0.1	0.5	30,000(Typ)	6	1300(Typ)	5	0	V_{CC}:2V to 28V	N,J

Industrial temperature range (-25°C to 85°C)

Single	LM211*	4	0.02	0.15	200,000(Typ)	8	140(Typ)	15	-15	Strobe	P,JG
Single	TL331I*	5	0.025	-0.1	200,000(Typ)	6	1300(Typ)	5	0	V_{CC}:2V to 36V	P
Dual	LM293*	5	0.05	-0.25	200,000(Typ)	6	1300(Typ)	5	0	V_{CC}:2V to 36V	P,JG
Quad	LM239*	5	0.05	-0.25	200,000(Typ)	6	1300(Typ)	5	0	V_{CC}:2V to 36V	N,J

Commercial temperature range (0°C to 70°C)

Single	LM306	5	5	40	40,000	100		12	-6		P
Single	LM311*	10	0.07	0.3	200,000(Typ)	8	165(Typ)	15	-15	Strobe	P,JG,D
Single	TL311C*	13	0.004	0.01	200,000(Typ)	8	210(Typ)	+15	-15	JFET—INPUT	P,JG
Single	TL331C*	5	0.05	-0.25	200,000(Typ)	6	1300(Typ)	5	0	V_{CC} :2V to 36V	P,JG
Single	TL810C	4.5	7.5	30	8,000	0.5	80	12	-6	Improved TL710C	P,JG,J,N
Single	uA710C	5	5	25	1,000	1.6		12	-6		P,JG,J
Single	TL710C	7.8	15	100	700			12	-6		P,JG
Dual	LM393*	5	0.05	-0.25	200,000(Typ)	6	1300(Typ)	5	0	V_{CC} :2V to 36V	P,JG,D
Dual	TL506C	5	5	25		100		12	-6		N
Dual	TL514C	4.5	7.5	30	8,000	0.5	80	12	-6	Dual TL510C	N,J
Dual	TL820C	4.5	7.5	30	8,000	0.5	80	12	-6	Dual TL810C	N,J
Dual Channel	TL811C	10	10	50	5,000	0.5	33(Typ)	12	-6	Improved uA711C	N,J P,JG
Dual Channel	uA711C	10	25	150	500	0.5	40(Typ)	12	-6	Strobe	N,J
Quad	LM339*	5	0.05	-0.25	200,000(Typ)	6	1300(Typ)	5	0	V_{CC} :2V to 36V	N,J,D
Quad	LM339A*	2	0.05	0.25	50,000	6		5	0		N,J,D
Hex	TL336C*	5	0.05	-0.25		6		5	0		N

*Capable of operating with a single 5-volt supply.

Fixed output voltage regulators

Positive output regulators

DEVICE SERIES	OUTPUT VOLTAGE TOLERANCE	MINIMUM DIFFERENTIAL VOLTAGE	OUTPUT CURRENT RATING	AVAILABLE VOLTAGE SELECTIONS	PACKAGES
LM323	± 10% †	2.5V	3A	1 @ 5V	KA
LM[illegible]0	± 10% †	0.6V	150mA	2 @ 5V to 8V	KC
LM[illegible])	± 4% ‡	0.6V	150mA	1 @ 5V	KC
LM340-00	± 4% ‡	2.0V	1.5A	3 @ 5V to 15V	KC
TL780-00C	± 1% ‡	2.0V	1.5A	3 @ 5V tp 15V	KC
uA7800C	± 4% ‡	2.0V-3.0V	1.5A	9 @ 5V to 24V	KC
uA78L00AC	± 5% ‡	2.0V	100mA	8 @ 2.6V to 15V	LP
uA78L00C	± 10% ‡	2.0V-5.0V	100mA	8 @ 2.6V to 15V	LP
uA78M00C*	± 5% ‡	2.0V-3.0V	500mA	8 @ 5V to 24V	KC

Negative output regulators

LM320-00	± 4%	2.0V	1.5A	3 @ 5V to 15V	KC
MC79L00AC	± 5%	1.7V	100mA	3 @ 5V to 15V	LP
MC79L00C	±10%	1.7V	100mA	3 @ 5V to 15V	LP
uA7900C	± 5%	2.0V-3.0V	1.5A	8 @ 5V to 24V	KC
uA79M00C*	± 5%	2.0V-3.0V	500mA	7 @ 5V to 24V	KC

Available output voltages for above regulator series

DEVICE SERIES	VOLTAGE SELECTIONS												
	2.6	5.0	5.2	6.0	6.2	8.0	8.5	9.0	10.0	12.0	15.0	18.0	20.0	24.0
LM2930-0		X				X								
LM320-00		X								X	X			
LM330-0		X												
LM340-00		X								X	X			
MC79L00AC		X								X	X			
MC79L00C		X								X	X			
TL780-00C		X								X	X			
uA7800C		X		X		X	X		X	X	X	X		X
uA78L00AC	X	X			X	X		X	X	X	X			
uA78L00C	X	X			X	X		X	X	X	X			
uA78M00C*		X		X		X			X	X	X		X	X
uA7900C		X	X	X		X				X	X	X		X
uA79M00C*		X		X		X				X	X		X	X

*Also available in military temperature range (M Suffix)

Protection Circuits

Undervoltage

DEVICE NUMBER	TEMP RANGE	PACKAGE	FEATURES
TL7702 TL7705 TL7712 TL7715	0°C to 70°C	P	Power-Up and voltage drop reset generator specifically for microcomputer control supervision. These devices operate over a wide supply voltage range (3 V to 18 V) and have externally adjustable pulse width to ensure system reset.

Overvoltage

DEVICE NUMBER	TEMP RANGE	PACKAGE	FEATURES
MC3423	0°C to 70°C	JG, P	Separate outputs for "crowbar" and logic circuitry, Programmable time display, TTL-level activation isolated from voltage-sensing inputs.

Variable output voltage regulators

Positive output series regulators

DEVICE NUMBER	OUTPUT VOLTAGE MIN	OUTPUT VOLTAGE MAX	DIFFERENTIAL VOLTAGE MAX	OUTPUT CURRENT RATING	PACKAGES
LM217	1.2V	37V	V_I - 1.2V	1.5A	KC
LM317	1.2V	37V	V_I - 1.2V	1.5A	KC
LM350	1.2V	33V	V_I - 1.2V	3A	KA, KC
TL317C	1.2V	32V	V_I - 1.2V	100mA	LP
TL783C	10V	125V	37V	700mA	KC
uA723C*	3V	38V	37V	25mA	J,N,U

Negative output series regulator

LM237	1.2V	37V	V_I +1.2V	1.5A	KC
LM337	1.2V	37V	V_I +1.2V	1.5A	KC

Positive shunt regulators

DEVICE NUMBER	SHUNT VOLTAGE MIN	SHUNT VOLTAGE MAX	CURRENT MIN	CURRENT MAX	TEMP. COEFF. MAX	PACKAGES
TL430C*	3V	30V	2mA	100mA	200 ppm/°C	JG,LP
TL431C*	3V	30V	0.5mA	100mA	100 ppm/°C	LP,P
TL431L**	2.55V	36V	1mA	100mA	100 ppm/°C	LP,P

*Also available in Military temperature range (M suffix).
**I — Suffix for Industrial Temperature Range.

Switching voltage regulators/controllers

FEATURES	BASE DEVICE NUMBERS: MC35060 MC34060	RC4193	SG3524 SG2524 SG1524	SG3525A SG2525A SG1525A	SG3527A SG2527A SG1527A	TL493	TL494	TL495
General Features								
•General Purpose	X	X	X	X	X	X	X	X
•Special Purpose	—	—	—	—	—	—	—	—
•Dual Independent PWM Control	—	—	—	—	—	—	—	—
•Fixed On Time	—	—	—	—	—	—	—	—
•Fixed Frequency PWM	X	X	X	X	X	X	X	X
•Adjustable Frequency PWM	—	—	—	—	—	—	—	—
•Low Bias Current Requirements	—	135μA	—	—	—	—	—	—
•Expandable	X	—	X	X	X	X	X	X
Control Features								
•On Chip Reference	X	X	X	X	X	X	X	X
•Precision On Chip Ref.	—	—	—	X	X	—	—	—
•Dead Time Adjust	X	—	—	X	X	X	X	X
•Current Sense Amplifier	—	—	—	—	—	1	—	—
•Error Amplifier	2	—	2	1	1	1	2	2
•Operates to 40V	X	24 V	35 V	35 V	35 V	X	X	X
•Operates above 40V	—	—	—	—	—	—	—	X
•Feed Forward Line Regulator	—	—	—	—	—	—	—	—
Protection Features								
•On Chip Regulator	X	—	—	—	—	—	—	X
•Internal Soft Start	—	—	X	X	X	—	—	—
•Under Voltage Lockout	—	—	X	X	X	—	—	—
•Inhibit Control	—	X	X	X	X	X	X	X
•Double Pulse Protection	—	—	X	X	X	X	X	X
Output Features								
•Single-Ended Output	X	X	—	—	—	—	—	—
•Double-Ended Outputs	—	—	X	X	X	X	X	X
•Totem-Pole Outputs	—	—	—	X	X	—	—	—
•Parallelable Outputs	—	—	—	—	—	X	X	X
•Adjustable Output (2.5 V to 24 V)	—	X	—	—	—	—	—	—
•Output Current Capa-bility (150 mA)	—	X	—	—	—	—	—	—
•Isolated Power and Ground to Output	—	—	—	—	—	—	—	—
•High Noise Immunity	—	—	—	—	—	—	—	—
•External Output Trigger	—	—	—	—	—	—	—	X
Part Number Ordering Information								
• Commercial Temp Rng. Plastic	MC34060N	RC4193CP	SG3524N	SG3525AN	SG3527AN	TL493CN	TL494CN	TL495CN
Ceramic	MC34060J	RC4193CJG	SG3524J	SG3525AJ	SG3527AJ	TL493CJ	TL494CJ	TL495CJ
• Industrial Temp. Rng. Plastic		RC4193IP	SG2524N	SG2525AN	SG2527AN		TL494IN	
Ceramic		RC4193IJG	SG2524J	SG2525AJ	SG2527AJ		TL494IJ	
• Military Temp. Rng. Ceramic	MC35060J	RC4193MJG	SG1524J	SG1525AJ	SG1527AJ	TL493MJ	TL494MJ	

Key: "X" = Device has the feature, "—" = Device doesn't have the feature

Switching voltage regulators/controllers (Continued)

FEATURES	BASE DEVICE NUMBERS						
	TL496	TL497A	TLC498	TL593	TL594	TL595	TL1451
General Features							
•*General Purpose*	—	X	X	X	X	X	X
•Special Purpose	9 V	—	—	—	—	—	—
•Dual Independent PWM Control	—	—	X	—	—	—	—
•Fixed On Time	X	X	—	—	—	—	—
•Fixed Frequency PWM	—	—	X	X	X	X	X
•Adjustable Frequency PWM	—	—	X	—	—	—	—
•Low Bias Current Requirements	—	—	X	—	—	—	—
•Expandable	—	—	X	X	X	X	X
Control Features							
•On Chip Reference	X	X	X	X	X	X	X
•Precision On Chip Ref.	—	—	X	X	X	X	—
•Dead Time Adjust	X	—	X	X	X	X	X
•Current Sense Amplifier	X	X	—	1	—	—	—
•Error Amplifier	—	1	X	1	2	2	2
•Operates to 40V	—	—	20 V	X	X	X	X
•Operates above 40V	—	—	—	—	—	X	—
•Feed Forward Line Regulator	—	—	X	—	—	—	—
Protection Features							
•On Chip Regulator	X	—	X	—	—	X	—
•Internal Soft Start	—	—	X	—	—	—	—
•Under Voltage Lockout	—	—	X	X	X	X	—
•Inhibit Control	—	X	X	X	X	X	—
•Double Pulse Protection	—	—	X	X	X	X	—
Output Features							
•Single-Ended Output	X	X	—	—	—	—	2
•Double-Ended Outputs	—	—	X	X	X	X	—
•Totem-Pole Outputs	—	—	X	—	—	—	—
•Parallelable Outputs	—	—	—	X	X	X	—
•Adjustable Output (2.5 V to 24 V)	—	—	—	—	—	—	—
•Output Current Capa-bility (150 mA)	—	—	—	—	—	—	—
•Isolated Power and Ground to Output	—	—	X	—	—	—	—
•High Noise Immunity	—	—	X	—	—	—	—
•External Output Trigger	—	—	—	—	—	X	—
Part Number Ordering Information							
• Commercial Temp Rng.							
Plastic	TL496CP	TL497ACN	TLC498CN	TL593CN	TL594CN	TL595CN	TL1451CN
Ceramic		TL497ACJ			TL594CJ		TL1451CJ
• Industrial Temp. Rng.							
Plastic		TL497AIN			TL594IN		
Ceramic		TL497AIJ			TL594IJ		
• Military Temp. Rng.							
Ceramic		TL497AMJ		TL593MJ	TL594MJ		

Key: "X" = Device has the feature, "—" = Device doesn't have the feature

Line drivers

General purpose drivers

OUTPUT CURRENT CAPABILITY(mA)	PROPAGATION DELAY TIME TYP(ns)	S = SINGLE ENDED D = DIFFERENTIAL	PARTY-LINE OPERATION	STROBE OR ENABLE	POWER SUPPLIES (V)	DEVICE NUMBER FOR TEMPERATURE RANGE		PACKAGE TYPE	DRIVERS PER PACKAGE	COMPANION RECEIVERS	ADDITIONAL FEATURES
						−55°C to 125°C	0°C to 70°C				
300	20	D,S	Yes	Yes	5	SN55450B	SN75450B	J,FH J,N	2	SN75122, 152, SN75115, 182, SN75140 series	
300	18	S	Yes	Yes	5	SN55451B	SN75451B	JG,U,FH JG,P	2		
100	36	S	No	Yes	5	SN55361A	SN75361A	JG JG,P	2		
100	22	S	Yes	Yes	5	SN55121	SN75121	J,W,FH J,N	2	SN75122	
100	22	S	Yes	Yes	5		N8T13	J,N	2	N8T14	
40	12	D	No	Yes	5	SN55183	SN75183	J,W,FH J,N	2	SN75115, SN75182	
40	15	D	No	Yes	5	SN55114	SN75114	J,W,FH J,N	2		
40	13	D	Yes	Yes	5	SN55113	SN75113	J,W,FH J,N	2		• 3-State Output
40	15	D,S*	Yes	Yes	5	DS7831	DS8831	J,FH J,N	2,4*	SN75140 [illegible] 15, 122, [illegible] 124, 125, SN75127, 128, SN75129, 152, SN75182	• Output clamp diodes to V_{CC} • 3-State Output
40	15	D,S*	Yes	Yes	5	DS7832	DS8832	J,W,FH J,N	2,4*		• 3-State Output
40	15	D	No	Yes	5		9614C	J,N	2	9615	
40	12	D	No	Yes	5		DS8830	J,N	2	DS8820A	

360/370 I/O interface

100	20	S	Yes	Yes	5		SN75123	J,N	2	SN75124, 125, SN75127, 128	
100	20	S	Yes	Yes	5		N8T23	J,N	2	N8T24	
60	37	S	Yes	Yes	5		SN75126 SN75130	J,N	4	SN75125, 127, SN75128, 129	
60	37	S	Yes	Yes	5		MC3481	J,N	4	SN75125, 127, SN75128, 129	
60	37	S	Yes	Yes	5		MC3485	J,N	4	SN75125, 127, SN75128, 129	

Drivers meeting EIA standards

60	44	D	Yes	Yes	5		SN75172	J,NG	4	SN75173	• RS-485
60	44	D	Yes	Yes	5		SN75174	J,NG	4	SN75175	
48	13	D	Yes	Yes	5		MC3487	J,N	4		• RS422 with 3-State Outputs
40	16	D	No	No	5	SN55158	SN75158	JG JG,P	2	AM26LS32A, MC3486,	• RS422
40 40 40 20	16 16 16 13	D	Yes	Yes	5		SN75159 SN75151 SN75153 AM26LS31C	J,N J,N J,N J,N	2 4 4 4	[illegible] 173, [illegible] 175, uA9637	• RS422 with 3-State Outputs
40	15	D	No	No	5	uA9638M	uA9638C	JG JG,P	2	uA9637A	• RS422
11	–	S	No	No	±12		uA9636AC	JG,P	2	uA9637A	• RS423
10	60	S	No	Yes	±12	SN55150	SN75150	JG, J JG,P,J	2	SN75152, 154 SN75189	• RS232C
6	220	S	No	Yes	±12	SN55188	SN75188, MC1488	J J,N	4	SN75189A, MC1489	

* Differential on 2 channel and single-ended on 4 channel operation.

Line drivers (continued)

Current mode drivers

OUTPUT CURRENT CAPABILITY (mA)	PROPAGATION DELAY TIME TYP (ns)	S = SINGLE D = DIFFERENTIAL	PARTY-LINE OPERATION	STROBE OR ENABLE	POWER SUPPLIES (V)	DEVICE NUMBER FOR TEMPERATURE RANGE		PACKAGE TYPE	DRIVERS PER PACKAGE	COMPANION RECEIVERS	ADDITIONAL FEATURES
						−55°C to 125°C	0°C to 70°C				
18	9	D	Yes	Yes	±5		SN75112	J,N	2	SN75107A, 107B, SN75108A, 108B, SN75207, 207B, SN75208, 208B	
6.5	9	D	Yes	Yes	±5	SN55110A		J,W,FH	2		
							SN75110A	J,N			
3.5	9	D	Yes	Yes	±5	SN55109A		J,W,FH	2		
							SN75109A	J,N			

Line receivers

General purpose receivers

S = SINGLE ENDED D = DIFFERENTIAL	TYPE OF OUTPUT	PROPAGATION DELAY TIME TYP(ns)	PARTY-LINE OPERATION	STROBE OR ENABLE	POWER SUPPLIES (V)	DEVICE NUMBER FOR TEMPERATURE RANGE		PACKAGE TYPE	RECEIVERS PER PACKAGE	COMPANION DRIVERS	ADDITIONAL FEATURES
						−55°C to 125°C	0°C to 70°C				
D	T-P	17	Yes	Yes	±5		SN75207 SN75207B	J,N	2	SN75109A, SN75110A, SN75112	• B versions have input-protection diodes for power-off condition
	O-C	19	Yes	Yes			SN75208 SN75208B	J,N			
	T-P	17	Yes	Yes		SN55107A		J,W,FH			
							SN75107A	J,N			
						SN55107B		J,W,FH			
	O-C	19	Yes	Yes			SN75107B	J,N			
						SN55108A		J,W,FH			
							SN75108A	J,N			
						SN55108B		J,FH			
							SN75108B	J,N			
S	T-P	20	Yes	Yes	5	SN55122		J,W,FH	3	SN75121, DS8831, DS8832	• Hysteresis for improved noise immunity
							SN75122	J,N			
							N8T14	J,N		N8T13	
		22	Yes	Yes	5	SN55140		JG,FH	2	75450B series SN75361A, SN75113, DS8830	• Common ref. voltage pin and strobe • Input-protection diodes (141)
							SN75140	JG,P			
						SN55141		JG,FH			
							SN75141	JG,P			
						SN55142A		J,FH			• Individual ref. voltage and strobe terminals Input protection diodes (143A)
							SN75142A	J,N			
						SN55143A		J,FH			
							SN75143A SN75143	J,N			

Receivers for 360/370 I/O interface

S	T-P	20	Yes	Yes	5		SN75124 N8T24	J,N	3	SN75123	• Hysteresis
S	T-P	18	Yes	No	5		SN75125 SN75127	J,N	7	SN75123	• Schottky Circuitry Standard V_{CC} Pinout (SN75127)
S	T-P	18	Yes	Yes	5		SN75128 SN75129	J,N	8	SN75123	• Schottky Circuitry

Line receivers (continued)

Receivers meeting EIA standard RS-232-C

S= Single-ended D= Differential	TYPE * OF OUTPUT	PROPAGATION DELAY TIME TYP(ns)	PARTY-LINE OPERATION	STROBE OR ENABLE	POWER SUPPLIES (V)	DEVICE NUMBER FOR TEMPERATURE RANGE		PACKAGE TYPE	RECEIVERS PER PACKAGE	COMPANION DRIVERS	ADDITIONAL FEATURES
						-55°C to 125°C	0°C to 70°C				
S	T-P	22	No	No	5 or 12	SN55154	SN75154	J,N,FH	4	SN75150	• Hysteresis
S	R	25	No	No	5	SN55189		J,FH	4	SN75188	• Response Threshold Control 189A has more hysteresis than 189
							SN75189 MC1489	J,N			
						SN55189A		J,FH			
							SN75189A MC1489A	J,N			
D	R	60	No	Yes	±12	SN55152		J,FH	2	SN75150	• Also meets MIL-STD-188C Hysteresis
							SN75152	J,N			

*T-P = Totem pole, O-C = Open collector, R = Resistor pull-up

Receivers meeting EIA standard RS-422/423

S,D	T-P	25	Yes	E	6	AM26LS32AM		J,W,FH	4	SN75158, SN75159, SN75151, SN75153, AM26LS31,	• Hysteresis Fail-safe Schottky Circuitry
							AM26LS32AC	N,J			
					5	AM26LS33AM		J,W,FH	4		• ±15V Common Range with ±500mV sensitivity
							AM26LS33AC	J,N			
							MC3486	N,J	4	MC3487	• Hysteresis
		20	No	No	5		uA9637AC	P,JG	2	uA9636A	
							SN75157	JG,P	2	AM26LS31	
		25	Yes	E/E	5		SN75173	N,J	4	SN75172	• Also meets EIA standard RS-485
			Yes	E	5		SN75175	N,J	4	SN75174	
		85(max)	No	No	5		uA9639C	P,JG	2	uA9636A	• Hysteresis

Receivers with response time control

D	O-C or T-P	20	Yes	Yes	5		9615C	J,N	2	9614C	• Input Sensitivity ±500 mV
	T-P	31					SN75182	J,N			
							DS8820A	J,N		DS8830	
	O-C or T-P	20				SN55115		J,W,FH	2	SN75113, SN75114, SN75183,	• Input Sensitivity ±500 mV
							SN75115	J,N			
	T-P	31				SN55182		J,W,FH		DS8831, DS8832	• Common-Mode Range ±15V

*T-P = Totem pole, O-C = Open collector, R = Resistor pull-up

Single-ended line transceivers

COMMON FEATURES	DRIVER CHARACTERISTICS			RECEIVER CHARACTERISTICS		DEVICE NUMBER FOR TEMPERATURE RANGE		PACKAGE TYPE	ADDITIONAL FEATURES
	OUTPUT CURRENT CAPABILITY	t_{PD} TYPICAL (ns)	STROBE OR ENABLE	t_{PD} TYPICAL (ns)	STROBE OR ENABLE	−55°C to 125°C	0°C to 70°C		
• Single 5-V supply • Party line operation • TTL-compatible driver inputs • Totem-pole receiver outputs • Four transceivers per package	100 mA	10	Strobe	10	Strobe	AM26S10M	AM26S10C	J J,N	• Schottky circuitry P-N-P inputs to minimize loading
		12	Strobe	10	Strobe	AM26S11M	AM26S11C	J J,N	• Inverting driver (AM26S10)
		15	Strobe	8	Strobe	SN55138	SN75138 MC3443	J,W,FH J,N	• 2.3V receiver threshold for maximum system noise margin
	40 mA	16	Enable	8	Enable		SN75136	J,N	• Similar to N8T26 3-State driver and receiver outputs with Schottky circuitry P-N-P inputs to minimize loading
		14 11	Enable Enable	8 8	Enable Enable		N8T26 N8T26A	J,N	• P-N-P inputs to minimize loading
• Meets IEE 488 Standard	48 mA	30	Strobe	30	Strobe		MC3446	J,N	• Quad receiver input hysteresis • Drivers also MOS compatible
		12	Enable	12	Enable	SN55160A	SN75160A	FH N	• Octal Data X-CVR
						SN55161A	SN75161A	FH N	• Octal Management X-CVR
							SN75162A	N	• Octal Management X-CVR
• General Purpose	48 mA	12	Enable	12	Enable		SN75163A	N	• Octal X-CVR

Differential line transceivers

COMMON FEATURES	RECEIVER CHARACTERISTICS			DEVICE NUMBER FOR TEMPERATURE RANGE		PACKAGE TYPE	ADDITIONAL FEATURES
	STROBE OR ENABLE	TYPE* OF OUTPUT	COMMON-MODE RANGE	−55°C to 125°C	0°C to 70°C		
• Single 5-V supply • Party-line operation • TTL-compatible driver inputs • Driver enable for 3-state driver output • Driver output current capability: 40 mA • Driver propagation delay time: 14 ns (typical) • Receiver propagation delay time: 20 ns (typical) • ±500 mV receiver input sensitivity • One transceiver per package	Strobe	O-C or T-P	±15V	SN55116	SN75116	J,FH J,N	• Receiver frequency response control
		T-P	0V to 6V	SN55117	SN75117	JG,FH JG,P	• Driver and receiver connected internally
	Enable	O-C or T-P	±15V	SN55118	SN75118	J,FH J,N	• Same as 116 with 3-state receiver output
		T-P	0V to 6V	SN55119	SN75119	JG,FH JG,P	• Same as 117 with 3-state receiver output
• Transceivers meeting EIA RS422 and EIA RS485 1 per package	Enable	T-P	±12 −7		SN75176A	JG,P	• Bi-Directional Bus Transceiver • Active-high Receiver Enable • Active-low Dr. Enable
					SN75177	JG,P	• Repeater Application • Active-High Enable
					SN75178	JG,P	• Repeater Application • Active-low Enable
	No				SN75179	JG,P	• Full Duplex Bus Transceiver

*T-P = Totem pole, O-C = Open Collector

Peripheral drivers

100 mA drivers

LOGIC FUNCTION	INPUT COMPATIBILITY	OFF-STATE VOLTAGE MAXIMUM (V)	LATCH-UP VOLATGE MINIMUM (V)	DELAY TIME TYPICAL (ns)	DRIVERS PER PACK-AGE	OUTPUT CLAMP DIODES	DEVICE NUMBER AND PACKAGE TYPE FOR TEMPERATURE RANGE			
							– 55°C to 125°C		0°C to 70°C	
							DEVICE NUMBER	PACKAGE	DEVICE NUMBER	PACKAGE
+/–	TTL/CMOS	70	60	1000	4	YES			DS3680	J,N

300 mA drivers

AND	TTL,DTL	15	15	15	2	NO			SN75430 SN75431	J,N JG,P
		30	20	21	2	NO	SN55450B SN55451B	J,FH JG,U,FH	SN75450B SN75451B	J,N JG,P
		35	30	33	2	NO	SN55461	JG,FH	SN75460 SN75461	J,N JG,P
		70	55	33	2	NO	SN55471	JG,FH	SN75470 SN75471	J,N JG,P
	TTL,DTL,MOS	70	55	100	2	YES			SN75476	JG,P
NAND	TTL,DTL	15 30 35 70	15 20 30 55	15 21 33 33	2 2 2 2	NO NO NO NO	SN55452B SN55462 SN55472	JG,U,FH JG,FH JG,FH	SN75432 SN75452B SN75462 SN75472	
	TTL,DTL,MOS	70	55	100	2	YES			SN75477	
OR	TTL,DTL	15 30 35 70	15 20 30 55	15 21 33 33	2 2 2 2	NO NO NO NO	SN55453B SN55463 SN55473	JG,U,FH JG,FH JG,FH	SN75433 SN75453B SN75463 SN75473	
	TTL,DTL,MOS	70	55	100	2	YES	SN55478	JG,FH	SN75478	
NOR	TTL,DTL	15 30 35 70	15 20 30 55	15 21 33 33	2 2 2 2	NO NO NO NO	SN55454B SN55464 SN55474	JG,U,FH JG,FH JG,FH	SN75434 SN75454B SN75464 SN75474	
	TTL,DTL MOS	70	55	100	2	YES			SN75479	

350 mA drivers

AND	TTL,MOS	70	50	300	2	YES			SN75446	JG,P
NAND	TTL,MOS	70	50	300	2	YES			SN75447	
OR	TTL,MOS	70	50	300	2	YES			SN75448	
NOR	TTL,MOS	70	50	300	2	YES			SN75449	
INVERT	TTL,CMOS,PMOS	50 100	50 60	130 130	7 7	YES YES			ULN2001A SN75466	J,N
	14V to 25V PMOS	50 100	50 60	130 130	7 7	YES YES			ULN2002A SN75467	
	TTL & 5V CMOS	50 100	50 60	130 130	7 7	YES YES			ULN2003A SN75468	
	6V to 15V MOS	50 100	50 60	130 130	7 7	YES YES			ULN2004A SN75469	

Peripheral drivers (Continued)

500 mA drivers

LOGIC FUNCTION	INPUT COMPATIBILITY	OFF-STATE VOLTAGE MAXIMUM (V)	LATCH-UP VOLTAGE MINIMUM (V)	DELAY TIME TYPICAL (ns)	DRIVERS PER PACKAGE	OUTPUT CLAMP DIODES	DEVICE NUMBER AND PACKAGE TYPE FOR TEMPERATURE RANGE			
							−55°C to 125°C		0°C to 70°C	
							DEVICE NUMBER	PACKAGE	DEVICE NUMBER	PACKAGE
AND	TTL,DTL,MOS	70	55	100	2	YES			SN75416	NE
NAND	TTL,DTL,MOS	70	55	100	2	YES			SN75417	NE
	TTL,MOS	70 70	50 35	750 750	4 4	YES YES			SN75436 SN75437A	NE
		70	50	500	2	YES			SN75407	P
OR	TTL,DTL,MOS	70	55	100	2	YES			SN75418	NE
	TTL,MOS	70	50	500	2	YES			SN75408	P
NOR	TTL,DTL	70	55	33	2	NO			SN75414	NE
	TTL,DTL,MOS	70	55	100	2	YES			SN75419	NE
BUFFER	MOS	22	18	300	2	NO			TL376C	NE

1.0A driver

NAND	TTL,MOS	70	35	750	4	Yes			SN75438	NE

1.5A drivers

INVERT	TTL	50 50 80 80	35 35 50 50	500 500 500 500	4 4 4 4	YES YES YES YES			ULN2064 SN75064 ULN2065 SN75065	NE
	MOS	50 50 80 80	35 35 50 50	500 500 500 500	4 4 4 4	YES YES YES YES			ULN2066 SN75066 ULN2067 SN75067	NE
	TTL,5V MOS	50 50 50 50 50 80 80 80	35 35 35 35 35 50 50 50	500 500 500 500 500 500 500 500	4 4 4 4 4 4 4 4	YES YES NO NO NO YES YES NO			ULN2068 SN75068 ULN2074 UDN2841 UDN2845 ULN2069 SN75069 ULN2075	NE

Motor drivers

2.0A drivers

NON-INVERTING	TTL, CMOS	45	40		1	YES			SN75603	KC
INVERTING		45	40		1	YES			SN75604	KC
NON-INVERTING		45	40		1	YES			SN75605	KC

Memory drivers

DESCRIPTION	MAXIMUM OUTPUT CURRENT (mA)	PROPAGATION DELAY TIME (ns)	POWER SUPPLIES	DEVICE NUMBER FOR TEMPERATURE RANGE		PACKAGE TYPE	ADDITIONAL FEATURES
				−55°C to 125°C	0°C to 70°C		
DUAL SINK/SOURCE MEMORY DRIVERS	600	35	V_{cc1} =5V, V_{cc2} variable to 24V	SN55325		J,W,FH	• Also used for high-voltage, high current driver applications • Output transient voltageprotection • Source output terminals swing between V_{cc2} and ground
					SN75325	J,N	
QUADRUPLE SINK MEMORY DRIVER	600	30	V_{cc} =5V,	SN55326		J,W,FH	• Also used for high-voltage, high-current driver applications • Output transient voltage protection • 24 V output capability
					SN75326	N	
QUADRUPLE MEMORY DRIVERS	600	35	V_{cc1} =5V, V_{cc2} variable to 24V	SN55327		J,W,FH	• Also used for high speed magnetic memory applications • Output transient voltage protection • Output capable of swinging between V_{cc2} and ground
					SN75327	J,N	

TTL-compatible inputs
Core memory applications

MOS drivers (0°C to 70°C)

INPUT COMPATIBILITY	POWER SUPPLIES (Nominal)	PROPAGATION DELAY TIME (ns)	V_{OH} (MIN)	V_{OL} (MAX)	DEVICE NUMBER	PACKAGE TYPE	DRIVERS PER PACKAGE	ADDITIONAL FEATURES
TTL	V_{cc} = 20V	35	V_{cc} −1V	0.3V	SN75369	P	2	• Compatible with many popular MOS RAMs and MOS shift registers • Single-ended inverting drivers
	V_{cc1} = 5V, V_{cc2} = 12V	31	V_{cc2}−0.4V	0.5V	SN75322	N	2	• Compatible with most popular MOS RAMs • Separate driver address inputs with common strobe • Requires two external P-N-P transistors for operation • Low standby power
	V_{cc1} = 5V, V_{cc2} = 12V	20	V_{cc2}−1.6V	0.5V	SN75367	N	4	• CMOS applications • 3-state output • Separate addresses and enable/disable inputs for each driver
	V_{cc1} = 5V, V_{cc2} = 15V	31	V_{cc2}−1V	0.3V	SN75350	P	2	• Compatible with many popular MOS RAMs • Lower-voltage, high-speed version of the SN75361A • V_{cc2} variable from 5V to 18V
	V_{cc1} = 5V, V_{cc2} = 20V	36	V_{cc2}−1V	0.3V	SN75361A*	JG,P	2	• Compatible with many popular MOS RAMs including the TMS 1103, TMS 4062, and TMS 4070 16K RAM • V_{cc2} variable from 5V to 24V
	V_{cc1} = 5V, V_{cc2} = 12V, V_{cc3} = 15V	33	V_{cc2}−0.3V	0.5V	SN75363*	N	2	• Compatible with many MOS RAMs including the TMS 4030 4K RAM and TMS 4070 16K RAM • Separate driver address inputs with common strobe • V_{cc2} variable from 5V to 15V
	V_{cc1} = 5V, V_{cc2} = 20V, V_{cc3} = 24V	31	V_{cc2}−0.3V	0.3V	SN75365*	J,N	4	• Compatible with many MOS RAMs including the TMS 1103, TMS 4062, and TMS 4070 16K RAM • V_{cc2} variable from 5V to 24V

* Also available in military temp range (SN55 prefix) with J,JG package.

Display drivers (0°C to 70°C)

DISPLAY TYPE	DESCRIPTION	INPUT COMPATIBILITY	POWER SUPPLIES	DRIVERS PER PACKAGE	DEVICE NUMBER	PACKAGE TYPE	ADDITIONAL FEATURES
AC PLASMA DISPLAYS	[illegible] DRIVERS	CMOS	V_{cc1} = 12V V_{cc2} variable from 40V to 90V	4	SN55426B SN75426B SN55427B SN75427B	J J,N J J,N	• Independent addressing of each gate for serial and parallel applications • High input impedance (typically 1 megohm) • 30-mA clamp diodes on output • Switches 70V in 1.2 uS • AND driver (SN75426); NAND driver (SN75427)
			V_{cc1} = 12V V_{cc2} variable from 0 V to 100V	32	S[illegible]A S[illegible]C SN75500A SN75501C	J J,N	• High-speed serially shifted data input (4 MHz max) • Fast output transitions • 20-mA output current capability • Output short-circuit protection • Static shift [illegible] can retain data on all outputs of S[illegible] pitely • X-axis driver—S[illegible] • Y-axis driver—SN[illegible], S[illegible]1 (performs Y-axis sustaining function)
LED DISPLAYS	SEGMENT DRIVERS	MOS	10V 20V	4 4	SN75491 SN75491A	N N	• 50-mA source/sink capability
	DIGIT DRIVERS	MOS	10V 20V	6 6	SN75492 SN75492A	J,N J,N	• 250-mA sink capability
			Variable from 3.2V to 8.8V	6	SN75494	N	• 250-mA sink capability • Display blanking provisions
		MOS, TTL	Variable from 2.7V to 6.6V	7	SN75497	N	• 100-mA sink capability • Input threshold. . .2.7V max • Low voltage saturating outputs (0.4V maximum)
		MOS, TTL	Variable from 2.7V to 6.6V	9	SN75498	N	• 100-mA sink capability • Input threshold. . .2.7V max
GAS DISCHARGE DISPLAYS	HIGH-VOLTAGE BCD-TO-SEVEN-[illegible] DECO[illegible] ANODE [illegible]	TTL	5V	7	SN75480	N	• Outputs regulated to insure constant brightness • Blanking and ripple blanking provisions • High off-state breakdown voltage (120V Typ) • Designed for seven segment displays such as Beckman and Panaplex II*
		TTL, MOS, CMOS	Variable from 5V to 15V	7 ½	SN75584A	N	same features as the SN75480 plus: • Decimal point provided • Latches to hold BCD information • Lower supply power requirements • Higher output voltage breakdown capability
	SERIAL-TO-PARALLEL ANODE DRIVER	TTL	V_{cc1} - 5V V_{cc2} -12V V_{OUT} -150V	7	SN75581	J,N	• Designed for Negative Power Supply Systems
THERMAL PRINT DISPLAYS	THERMAL PRINTHEAD DRIVERS	TTL	5V	12	SN75590	N	• Common strobe
		TTL/CMOS	±5V	6	SN75490	J,N	• 30-mA source, 50-mA sink capability
		MOS	5V	7	SN75270	J,N	• Single ended, noninverting operation
VACUUM FLUOR-ESCENT	ANODE, GRID DRIVERS FOR SEGMENTED OR DOT MA[illegible] DISPLAYS	TTL, CMOS	V_{cc1} = 5 - 15V V_{cc2} = 0-60V	10	UCN4810A TL4810A	N N	• Second source to Spraque UCN4810A • Latched Outputs • Serial data input and output
		TTL	V_{cc1} = 5 - 15V V_{cc2} = 0 to 60V		SN75512A SN75513A	J,N	• Serial data input and output • SN75512A features Latched Outputs • SN75513A features Data Reset Function
		MOS	V_{cc1} = 5 - 15V V_{cc2} = 0 - 60V	32	SN75518	N,FN	• Serial data input and output • Latched outputs • 25-mA output source capability
		TTL, CMOS	Vcc1 (Logic) = 5V to 15V Vcc2, Vcc3 (Display) = 0V to 130V	12	SN75514	N	• All features of SN75512A except 125V totem-pole outputs
ELECTRO-LUMINESCENT DISPLAYS	ROW DRIVERS	CMOS	Vcc1 (Logic) = 10.8V to 15V	32	SN75551	N,FN	• 225V open DRAIN DMOS output structures • Serial-In, Parallel-out architecture • 50 mA current sink output capability • Extremely low steady state power consumption • Left side (SN75551) and right side (SN75552) drivers enhance circuit layout
				32	SN75552	N,FN	
	COLUMN DRIVERS	CMOS	Vcc1 (Logic) = 10.8V to 15V Vcc2 (Display) = 0V to 60V	32	SN75553	N,FN	• 60V totem-pole BIDFET output structures • Serial-In, Parallel-out architecture • Latched outputs • 15 mA sink or source output [illegible]ity • Top (SN75553) and bottom ([illegible]554) drivers enhance circuit layout
				32	SN75554	N,FN	

*Trademark of the Burroughs Corporation

Data acquisition functions

A-TO-D converters

Dual-Slope converters

DEVICE NUMBER	FUNCTION	RESOLUTION	RECOMMENDED DIGITAL PROCESSOR	POWER SUPPLIES	PACKAGE
TL500C	Analog processor	13 BITS	TL502C,TL503C or microprocessor	±12V nom	N
TL501C		10-12 BITS		±12V nom	
TL505C		8-10 BITS		+9V	
TL502C	4 ½ digit seven segment output digital processor	NA	NA	+5V	N
TL503C	Multiplexed BCD output digital processor	NA	NA	+5V	N

Single-Slope converter

TL507C*	Pulse width modulator	7 BITS	microprocessor	+5V regulated +8 to 18V Unreg.	P

*Also available in industrial temp range, TL507IP

Successive-approximation A/D converters

DEVICE NUMBER	SIGNAL INPUTS			ADDRESS AND DATA I/O FORMAT	CONVERSION SPEED** (us)	UNADJUSTED ERROR ± LSB	POWER SUPPLY REQUIRED (V)	POWER DISSIPATION TYP (mW)	NUMBER OF PINS	PACKAGE
	DEDICATED ANALOG	DEDICATED DIGITAL	MULTIPURPOSE† AN. OR DIGITAL							
ADC0804C	1	0	0	Parallel	100	1.0	5 Nominal	29	20	N
ADC0808	8	0	0	Parallel	100	0.75	5 Nominal	12	28	N
ADC0809	8	0	0	Parallel	100	1.25	5 Nominal	12	28	N
ADC0831	1	0	0	Serial	84	0.5	5 Nominal	15	8	P
ADC0832	2	0	0	Serial	84	0.5	5 Nominal	15	8	P
ADC0833	4	0	0	Serial	84	0.5	5 Nominal	25	14	N
ADC0834	4	0	0	Serial	84	0.5	5 Nominal	15	14	N
ADC0838	8	0	0	Serial	84	0.5	5 Nominal	15	20	N
TL520	8	0	0	Parallel	70	0.75	3 TO 5.5	2	28	N
TL521	8	0	0	Parallel	100	1.0	3 TO 5.5	2	28	N
TL522	8	0	0	Parallel	208	0.5	2.75 TO 6	0.3	28	N
TL530	9	6	6	8 Pin Data Bus	300	0.5	5 Nominal	15	40	N
TL531	9	6	6	8 Pin Data Bus	300	1.0	5 Nominal	15	40	N
TL532	5	0	6	8 Pin Data Bus	300	0.5	5 Nominal	15	28	N
TLC532A	5	0	6	8 Pin Data Bus	15	0.5	5 Nominal	6	28	N
TL533	5	0	6	8 Pin Data Bus	300	1.0	5 Nominal	15	28	N
TLC533A	5	0	6	8 Pin Data Bus	15	1.0	5 Nominal	6	28	N
TLC540	11	0	0	Serial	12	0.5	5 Nominal	6	20	N
TLC541	11	0	0	Serial	34	1.0	5 Nominal	6	20	N

† Multi-purpose signal inputs can be used as either digital inputs for limit sensing or digital data or they can be used as analog inputs. For example: The TL530 can have 15 analog inputs and 6 digital inputs, 19 analog inputs and 12 digital inputs, or any combination between.

** Includes access time.

Data acquisition functions (Continued)

Analog switches: BI-MOS (30 mA capability)

FUNCTION	DEVICE NUMBER		Z_{SW} (TYP) OHMS ( )	ANALOG RANGE (V)	SUPPLIES (V)	PACKAGE
	0 to 70°C	-25°C to 85°C				
Twin SPST	TL182C	TL182I	100	±10	±15, +5	N
Twin DPST	TL185C	TL185I	150	±10	±15, +5	N
Dual Comp. SPST	TL188C	TL188I*	100	±10	±15, +5	N
Twin Dual Comp. SPST	TL191C	TL191I	150	±10	±15, +5	N

Analog switches: PMOS (10 mA capability)

SPDT	TL601C	TL601I*	200	±10	+10,-20	P
Dual Comp. SPST	TL604C	TL604I*	200	±10	+10,-20	P
SPDT with enable	TL607C	TL607I*	200	±10	+10,-20	P
SPST with 3 logic inputs	TL610C	TL610I*	100	±10	+10,-20	P

*Also available in military temp range, "M" suffix, JG package.

Current mirrors (fixed ratio)

DEVICE NUMBER	CURRENT RATIO INPUT TO OUTPUT		MAX OUTPUT CURRENT	INPUT CURRENT RANGE	PACKAGE
TL011C	1	1	1 mA	1μA to 1mA	LP
TL012C	1	2	2 mA	1μA to 1mA	LP
TL014C	1	4	4 mA	1μA to 1mA	LP
TL021C	2	1	1 mA	1μA to 2mA	LP

Current mirror (selectable ratio)

DEVICE NUMBER	33 AVAILABLE RATIOS		V_{IN} (MIN)	V_{OUT} (MIN)	MAX RATIO ERROR	PACKAGE
	INPUT	OUTPUT				
TL010C	1 to 3	1 to15	$2V_{BE}$	$V_{BE} + V_{SAT}$	10%	P

Linear Hall effect sensor

DEVICE NUMBER	DESCRIPTION	SENSITIVITY	LINEAR RANGE	POWER SUPPLY	PACKAGE
TL173C	Linear Hall effect sensor	1.5 mV/Gauss	±500 Gauss	10.8V to 13.2V	LP

Hall effect switches

DEVICE NUMBER	DESCRIPTION	ON (G)	OFF (G)	HYS (G)	PACKAGE
TL170C	General Purpose Switch	+350	-350	200	LP
TL172C	Normally Off Switch	+600	+100	230	LP

Timers

DEVICE NUMBER FOR TEMPERATURE RANGE			TIMING		OUTPUT CURRENT	PACKAGES
0-70°C	-40 TO 85°C	-55 TO 125°C	FROM	TO		
NE555	SA555	SE555	1μS	1S	±200 mA	P,JG,D
			1μS	1S	±200 mA	P,JG,U,FH
NE556*		SE556	1μS	1S	±200 mA	N,J,FH,D
uA2240C			10μS	DAYS	-4 mA	N,J

*Dual version of NE555

NOTE: The uA2240 is a programmable timer and an 8-BIT Counter. Actual output pulses can be selected from 1 to 255 times the base time constant. Preferred for delays greater than 1 second.

Amplifiers (0°C to 70°C)

DEVICE NUMBER	PACKAGES	DESCRIPTION
TL441C TL441M*	N,J J,FH	Logarithmic Amplifier, 80 dB Range, Bandwidth from dc to 40 MHz
uA733C uA733M*	N,J,D J,FH	Differential VIDEO Amplifier, 200 MHz Bandwidth, Selectable Nominal Amplification of 10,100, or 400
TL733C	P,D	8-Pin version of the uA733C
NE592 SE592*	N,D J,FH	Differential VIDEO Amplifier, 200 MHz Bandwidth, Selectable Nominal Amplification of 100 or 400, Adjustable GAIN from 0 to 400, Adjustable pass band
TL592	P,D	8-Pin version of the NE592
MC1445	N,J	2-Channel-Input VIDEO Amplifier, GATE Controlled, 50 MHz Bandwidth, 16 dB Minimum GAIN, Broadband Noise Typically 25μV
TL068C	LP	FET INPUT VOLTAGE follows Buffer Amplifier, 1MHz, Bandwidth, 7V/μS Slew RATE, 10^{12} Input Impedance, Very Low Input BIAS AND Offset Currents, in a 3-Leaded TO-226AA PACKAGE
MC3470	N	FLOPPY DISC Read Amplifier and signal conditioner
LM388-3	NE	1.5 Watt Audio Power Amplifier

*Military temperature range.

Miscellaneous functions (0°C to 70°C)

FUNCTION	DEVICE NUMBER	PACKAGES	DESCRIPTION
Three-Channel Stepper Motor Driver	TL376C	NE	500 mA Source or Sink Capability on each of the 3 Independent Channels, Inputs Compatible with BIPOLAR or MOS, Totem Pole Outputs
Zero-Voltage Switch	TL440C	N,J	Differential Amplifier Inputs, A-C Line operation, Proportional Control, Capable of Triggering Several Types of TRIACS.
Balanced MIXER	TL442C	N,J	Flat Response to 100 MHz, I.F. ISOLATION 30 dB Typ., R.F. Isolation 60 dB Typ., Conversion Gain 14dB Typ.
Sonar Ranging RCVR	TL852	N	Sonar receiver for use with TI's TL851 IC for range (distance) sensing.
Sonar Ranging Controller	TL851	N	Sonar ranging control IC for use with TI's TL852 IC for measuring distance from 6 inches to 35 feet, drives 50 kHz electrostatic transducers with simple interface.

DIGITAL PRODUCTS

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For more information on the products in this section, see the TTL DATA BOOK, the TTL DATA BOOK SUPPLEMENT, the ALS/AS LOGIC CIRCUITS DATA BOOK, the HIGH-SPEED CMOS LOGIC DATA BOOK, or the BIPOLAR MICROCOMPUTER COMPONENTS DATA BOOK. (See page 141 to order).

Package information

TECHNOLOGY			STANDARD TTL	ADVANCED LOW POWER SCHOTTKY TTL	ADVANCED SCHOTTKY TTL	HIGH SPEED TTL	LOW POWER SCHOTTKY TTL	SCHOTTKY TTL	HIGH-SPEED SILICON-GATE CMOS
Device Series	(0°C to 70°C)	SN74	SN74	SN74ALS	SN74AS	SN74H	SN74LS	SN74S	
	(−40°C to +85°C)	SN74							SN74HC
	(−55°C to 125°C)	SN54 JANB SNJ	SN54 JANB54 SNJ54	SN54ALS JANB54ALS SNJ54ALS	SN54AS SNJ54AS	SN54H JANB54H SNJ54H	SN54LS JANB54LS SNJ54LS	[illegible]	SN54HC SNJ54HC
Packages Available		SN74	J,N	N,FN	N,FN	J,N	J,N,FN	J,N	J,N,FH,FN
		SN54 JANB SNJ	J,W,FH J J,W,FH	J,FH J J,FH	J,FH J,FH	J,W J J,W	J,W,FH J J,W,FH	J,W,FH J J,W,FH	J,FH,FK J,FH,FK

Typical SSI performance**

Power Dissipation/Gate		(mW)	10	1	10	22	2	19	0.000003 †
Propagation Delay Time		(ns)	10	4	1.5	6	9.5	3	10
Speed-Power Product		(pj)	100	4	15	132	19	57	
Flip-flop Clock Frequency, f_{max}		(MHz)	35	50	175	50	45	125	40
Input Low Current, I_{IL}		(mA)	−1.0	−0.2	−0.4	−1.6	−0.2	−1.6	±0.001
Output Drive Current, I_{OL}	Standard	(mA)	16	8	20	20	8	20	4
	Buffer	(mA)	48	24	48	60	24	60	6

†Static Power Dissipation Only

Typical fan-out (drive capability)**

OUTPUT DEVICE		LOAD DEVICE					
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS	SN74S SN54S
SN74/SN54	Standard	10	80	80	8	40	8
	Buffer	30	240	240	24	120	24
SN74ALS/SN54ALS	Standard	5	40	40	4	20	4
	Buffer	15	120	120	12	60	12
SN74AS/SN54AS	Standard	12	100	100	10	50	10
	Buffer	30	240	240	24	120	24
SN74H/SN54H	Standard	12	100	100	10	50	10
	Buffer	37	300	300	30	150	30
SN74LS/SN54LS	Standard	5	40	40	4	20	4
	Buffer	15	120	120	12	60	12
SN74S/SN54S	Standard	12	100	100	10	50	10
	Buffer	37	300	300	30	150	30
SN74HC/SN54HC	Standard	3	20	20	2	10	2
	Buffer	4	30	30	3	15	3

**The tables on this page provide an overview of the performance of TI's digital logic families. The electrical characteristics of specific devices within each family may vary. Please consult the appropriate TI data sheet or data book for complete specifications.

How to read Digital Products selection tables:

The following symbols are common to all selection tables on pages 66 to 79.

- • = Product available in technology indicated
- # = New product planned in technology indicated
- A = "A" suffix version available in technology indicated
- B = "B" suffix version available in technology indicated

The complete device number is composed of a technology prefix plus a device number suffix.

For example, see the first selection table at the top of the next page:

Hex 2-input NAND Gates are available in the following device numbers:

SN74ALS804 SN54ALS804
SN74AS804A SN54AS804A

Further information on military processing of these products can be found on pages 92 to 101.
Further information on the part numbering system can be found in the Appendix on page 104.

Positive-NAND gates and inverters

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY						
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Hex 2-Input Gates	'804		•	A				
Hex Inverters	'04 '1004	•	• •	A •	•	•	•	•
Quadruple 2-Input Gates	'00 '1000	•	A •	# •	•	•	•	•
Triple 3-Input Gates	'10 '1010	•	• •	#	•	•	•	•
Dual 2-Input Gates	'8003		•					
Dual 4-Input Gates	'20 '1020	•	A •	#	•	•	•	•
8-Input Gates	'30	•	•	#	•	•	•	#
13-Input Gates	'133		•				•	#

Positive-NAND gates and inverters with open-collector (open - drain) outputs

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY						
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Hex Inverters	'05 '1005	•	• •		•	•	•	
Quadruple 2-Input Gates	'01 '03 '1003	• •	• A •		•	• •	•	#
Triple 3-Input Gates	'12	•	•			•		
Dual 4-Input Gates	'22	•	A		•	•	•	

Positive-AND gates

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY						
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Hex 2-Input Gates	'808		•	A				
Quadruple 2-Input Gates	'08 '1008	•	• •	# •		•	•	•
Triple 3-Input Gates	'11 '1011		• •	#	•	•	•	•
Dual 4-Input Gates	'21		•	#	•	•		•
Triple 4-Input AND/NAND	'800			#				

Positive-AND gates with open-collector (open - drain) outputs

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY						
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Quadruple 2-Input Gates	'09	•	•			•	•	#
Triple 3-Input Gates	'15		•		•	•	•	

Positive-OR gates

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY					
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Hex 2-Input Gates	'832		#	A			
Quadruple 2-Input Gates	'32 '1032	•	• •	# •	•	•	•
Triple 4-Input OR/NOR	'802			#			
Triple 3-Input OR Gates	'4075						•

See "How to read Digital Products selection tables" on page 65.

Positive-NOR gates

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY						
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Hex 2-Input Gates	'805		•	A				
Quadruple 2-Input Gates	'02 '1002 '36 '1036	•	• •	# •	•	•	•	• •
Triple 3-Input Gates	'27	•	•	#		•		•
Dual 4-Input Gate	'4002							•
Dual 4-Input Gates With Strobe	'25	•						
Dual 5-Input Gates	'260						•	
8-Input Gates	'4078							#

Schmitt-trigger positive-NAND gates and inverters

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY					
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Hex Inverters	'14 '19	•			• •		#
Dual 4-Input Positive-NAND	'13 '18	•			• •		
Quadruple 2-Input Positive-NAND	'24 '132	•			• •	•	#

AND-OR-INVERT gates

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY						
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
2-Wide 4-Input	'55				•	•		
4-Wide 4-2-3-2-Input	'64						•	
4-Wide 2-2-3-2-Input	'54				•			
4-Wide 2-Input	'54	•						
4-Wide 2-3-3-2-Input	'54					•		
Dual 2-Wide 2-Input	'51	•			•	•	•	•

AND-OR-INVERT gates with open-collector outputs

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY			
		SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S
4-Wide 4-2-3-2-Input	'65				•

Expandable gates

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY					
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS	SN74S SN54S
Dual 4-Input Positive-NOR With Strobe	'23	•					
4-Wide AND-OR	'52				•		
4-Wide AND-OR-Invert	'53	•			•		
2-Wide AND-OR-Invert	'55				•	•	
Dual 2-Wide AND-OR-Invert	'50	•			•		

See "How to read Digital Products selection tables" on page 65.

Expanders

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY				
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS
Dual 4-Input	'60	•			•	
Triple 3-Input	'61				•	
3-2-2-3-Input AND-OR	'62				•	

Current-sensing-gates

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY		
		SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS
Hex	'63			•

Buffers, clock/memory drivers

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY					
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS	SN74S SN54S
Quad 2-Input Positive-NOR	'28	•	•			•	
Quad 2-Input Positive-NAND	'37	•	•			•	•
Dual 4-Input Positive-NAND	'40	•	•		•	•	•
Line Driver Memory Driver	'436 '437						• •
Quad 2-Input Positive-NAND	'1000		•	•			
Hex Inverter	'1004 '1005		• •	•			
Hex Non-Inverter	'1034 '1035		• •	•			
Quad 2-Input Positive-NOR	'1002		•				
Quad 2-Input Positive-AND	'1008		•	•			
Triple 3-Input Positive-NAND	'1010		•				
Triple 3-Input Positive-AND	'1011		•				
Dual 4-Input Positive-NAND	'1020		•				
Quad 2-Input Positive-OR	'1032		•	•			
Triple 4-Input AND/NAND	'800			#			
Triple 4-Input OR/NOR	'802			#			
Hex 2-Input Positive-NAND	'804		•	A			
Hex 2-Input Positive-NOR	'805		•	A			
Hex 2-Input Positive-AND	'808		•	A			
Hex 2-Input Positive-OR	'832		•	A			

Delay elements

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY					
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Inverting and Non-Inverting Elements 2-Input NAND buffers	'31				•		

50-ohm/75-ohm line drivers

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY				
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S
Dual 4-Input Positive-NAND	'140					•
Quad 2-Input Positive-NOR	'128	•				
Hex 2-Input Positive-NAND	'804		•	A		
Hex 2-Input Positive-NOR	'805		•	A		
Hex 2-Input Positive-AND	'808		•	A		
Hex 2-Input Positive-OR	'832		•	A		

See "How to read Digital Products selection tables" on page 65.

Octal bi-/tri-directional bus transceivers

DESCRIPTION		TYPE OF OUTPUT	DEVICE NUMBER	TECHNOLOGY SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74HC † SN54HC
12mA/24mA Sink, True Outputs	Low Power	3-State	'245	•	#	•	•
		OC	'621	•		•	
		3-State	'623	•	#	•	•
		OC, 3-State	'639	•		•	
		3-State	'652	#	#	•	#
		OC, 3-State	'654	#		•	
	Very Low Power	OC	'1621	#			
		3-State	'1623	#			
		OC-3-State	'1639	#			
12mA/24mA Sink, Inverting Outputs	Low Power	3-State	'620	•	#	•	•
		OC	'622	•		•	
		OC, 3-State	'638	•		•	
		3-State	'651	#	#	•	#
		OC, 3-State	'653	#		•	
	Very Low Power	3-State	'1620	#			
		OC	'1622	#			
		OC, 3-State	'1638	#			
12mA/24mA/48mA Sink, True Outputs	Low Power	OC	'641	•		•	
		3-State	'645	•	#	•	•
	Very Low Power	OC	'1641	#			
		3-State	'1645	•			
12mA/24mA/48mA Sink, Inverting Outputs	Low Power	3-State	'640	•	#	•	•
		OC	'642	•		•	
	Very Low Power	3-State	'1640	•			
		OC	'1642	#			
12mA/24mA/48mA Sink, True and Inverting Outputs	Low Power	3-State	'643	•	#	•	•
		OC	'644	•		•	
	Very Low Power	3-State	'1643	#			
		OC	'1644	#			
Registered with Multiplexed 12mA/24mA True Outputs		3-State	'646	#	#	•	#
		OC	'647	#		•	
Registered with Multiplexed 12mA/24mA Inverting Outputs		3-State	'648	#	#	•	#
		OC	'649	#		•	
Universal Transceiver/ Port Controllers		3-State	'877		#		

† 6 mA sink

Buffer and interface gates with open-collector outputs

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S
Hex	'07	•				
	'17	•				
	'1035		•			
Hex Inverter	'06	•				
	'16	•				
	'1005		•			
Quad 2-Input Positive-NAND	'26	•			•	
	'38	•	•		•	•
	'1003		•			
Quad 2-Input Positive-NOR	'33	•	•		•	

Bi-tri-directional bus transceivers and drivers

DESCRIPTION	TYPE OF OUTPUT	DEVICE NUMBER	TECHNOLOGY SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S
Controller and Bus Driver For 8080A Systems		'428				•
		'438				•
4-Bit With Storage	3-State	'226				•
Quad With Bit-Direction Controls	3-State	'446			•	
	3-State	'449			•	
Quad Tridirection	OC	'440			•	
	OC	'441			•	
	3-State	'442			•	
	3-State	'443			•	
	3-State	'444			•	
	OC	'448			•	

See "How to read Digital Products selection tables" on page 65.

Gates, buffers, drivers, and bus transceivers with 3-State outputs

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY					
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
12-Input NAND Gate	**'134**					•	
Quadruple Bus Buffers/ Drivers With Independent Output Controls	'125	•			A		
	'126	•			A		
	'425	•					
	'426	•					
Hex Buffers/Drivers	**'365**	A	#		A		#
	'366	A	#		A		#
	'367	A	#		A		#
	'368	A	#		A		#
Octal Bus Buffers/Drivers	**'240**		•	•	•	•	•
	'241		•	•	•	•	•
	'244		•	#	•	•	•
	'340					•	
	'341					•	
	'344					•	
	'540		#		•		
	'541		#		•		
	'1240@		#				
	'1241@		#				
	'1244@		•				
Controller and Bus Driver for 8080A System	**'428**					•	
	'438					•	
Quadruple Transceivers Inverting 3-State Output	'242		•	#	•		•
	'1242@		#				
Quadruple Transceivers Non-Inverting 3-State Output	**'243**		•	#	•		•
	'1243@		•				
Quadruple Transceivers With Storage	**'226**					•	
Octal Transceivers	'245		•	#	•		
	'1245		•				
Octal Buffer 3-State	**'465**		•		•		
	'467		•		•		
Inv. Octal Buffer 3-State	**'466**		•		•		
	'468		•		•		
Octal Bus Driver with True and Inverting 3-State Outputs	'230			#			
Octal Bus Driver/ Receiver with 3-State Outputs	'231			#			

@ = Very low power

Dual and single flip-flops

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY						
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Dual J-K Edge-Triggered	**'73**					A		#
	'76					A		#
	'78					A		#
	'103				•			
	'106				•			
	'107					A		#
	'108				•			
	'109	•	•	•		A		#
	'112		A	•		A	•	#
	'113		A	•		A	•	#
	'114		A	•		A	•	#
Single J-K Edge-Triggered	'70	•						
	'101				•			
	'102				•			
Dual Pulse-Triggered	**'73**	•			•			
	'76	•			•			
	'78				•			
	'107	•						
Single Pulse-Triggered	'71				•			
	'72	•			•			
Dual J-K With Data Lockout	'111	•						
Single J-K With Data Lockout	**'110**	•						
Dual D-Type	**'74**	•	•	•	•	A	•	•

See "How to read Digital Products selection tables" on page 65.

Quad and hex flip-flops

DESCRIPTION	NO. FFs	OUTPUTS	DEVICE NUMBER	TECHNOLOGY					
				SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
D - Type With Enable	6 4	$\overline{Q}$ Q, $\overline{Q}$	'378 '379				• •		# #
D - Type With Clear	6 4	$\overline{Q}$ Q, $\overline{Q}$	'174 '175	• •	• •	# #	• •	• •	# #
J-K, Separate Clocks	4	Q	'276	•					
J-K, Common Clock	4	Q	'376	•					
D-Type	4	Q	'171				•		

Octal D-type flip-flops

DESCRIPTION	OUTPUT	DEVICE NUMBER	TECHNOLOGY					
			SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
True Data	3-State 3-State	'374 '574		• •	• •	•	•	# #
True Data With Clear	2-State 3-State 3-State 3-State	'273 '575 '874 '878	•	• • • •	 # # #	•		#
True With Enable	2-State	'377				•		#
Inverting	3-State 3-State 3-State	'534 '564 '576		• • •	• #			# #
Inverting With Clear	3-State 3-State	'577 '879		• •	# #			
Inverting With Preset	3-State	'876		•	•			

Octal latches

DESCRIPTION	OUTPUT	DEVICE NUMBER	TECHNOLOGY					
			SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Transparent	3-State 3-State	'373 '573		• •	• •	•	•	# #
Dual 4-Bit Transparent	2-State 2-State 3-State	'100 '116 '873	• •	 •	 #			
Inverting Transparent	3-State 3-State 3-State	'533 '563 '580		• • •	• #			# #
Dual 4-Bit Inverting Transparent	3-State	'880		•	•			
2-Input Multiplexed	3-State OC 3-State OC	'604 '605 '606 '607				• • • •		
Addressable	2-State	'259 '4724	•	#		•		# #
Multi-Mode Buffered	3-State	'412					•	

Quad latches

DESCRIPTION	OUTPUT	DEVICE NUMBER	TECHNOLOGY					
			SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Dual 2-Bit Transparent	2-State 2-State 2-State	'75 '77 '375	• •			• • •		# #
S-R	2-State	'279	•			•		

See "How to read Digital Products selection tables" on page 65.

Monostable multivibrators with Schmitt-trigger inputs

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY				
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74HC SN54HC
Single	'121	•				
Dual	'221	•			•	#

Retriggerable monostable multivibrators

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY					
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74L SN54L	SN74HC SN54HC
Single	'122 '422	•			• •	•	
Dual	'123 '423 '4538	•			• •	•	# # #

Clock generator circuits

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY				
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S
Quadruple Complementary-Output Logic Elements	'265	•				
Dual Pulse Synchronizers/Drivers	'120	•				
Crystal-Controlled Oscillators	'320 '321				• •	
Digital Phase-Lock Loop	'297				•	
Programmable Frequency Dividers/Digital Timers	'292 '294				• •	
Triple 4-Input AND/NAND Drivers	'800			#		
Triple 4-Input OR/NOR Drivers	'802			#		
8080A Clock Drivers	'424				•	

Frequency dividers, rate multipliers

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY					
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
50 - to - 1 Frequency Divider	'56				•		
60 - to - 1 Frequency Divider	'57				•		
6 - Bit Binary Rate Multiplier	'97	•					
Decade Rate Multiplier	'167	•					

Voltage-controlled oscillators

DESCRIPTION						DEVICE NUMBER	TECHNOLOGY				
NUMBER VCO'S	COMP'L Z_{OUT}	ENABLE	RANGE INPUT	$R_{EXT.}$	f_{max} (MHz)		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S
Single	Yes	Yes	Yes	No	20	'624				•	
Single	Yes	Yes	Yes	Yes	20	'628				•	
Dual	No	Yes	Yes	No	60	'124					•
Dual	Yes	No	No	No	20	'625				•	
Dual	Yes	Yes	No	No	20	'626				•	
Dual	No	No	No	No	20	'627				•	
Dual	No	Yes	Yes	No	20	'629				•	

See "How to read Digital Products selection tables" on page 65.

Register files

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY			
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS
Eight Words of Two Bits	'172	• †			
Four Words of Four Bits	'170	•			•
Four Words of Four Bits (3-State Outputs)	'670				•
Dual 16-Word X 4-Bit Register	'870			#	
Files With 3-State Output	'871			#	

† SN74 Only

Shift registers

DESCRIPTION	NO. OF BITS	MODES				DEVICE NUMBER	TECHNOLOGY						
		SHIFT RIGHT	SHIFT LEFT	LOAD	HOLD		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN54L	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
8-Bit Sign Protected Register	8	X		X	X	'322					A		
Parallel-In, Parallel-Out (Bidirectional)	8	X X X	X X X	X X X	X X X	'198 '299 '323	•	• •	# #		• •	•	# #
	4	X	X	X	X	'194	•				A	•	#
Parallel-In, Parallel-Out Registered Outputs	4	X X	X X	X X	X X	'671 '672					• •		
Parallel-In, Parallel-Out	8	X		X	X	'199	•						
	5	X		X		'96	•			•	•		
	4	X X X X X X		X X X X X X	X X	'99 '178 '179 '195 '295 '395	• • •		# #	•	A B A	•	#
Serial-In, Parallel-Out	16	X		X	X	'673					•		
	8	X				'164	•	#		•	•		#
Parallel-In, Serial-Out	16	X		X	X	'674					•		
	8	X X		X X	X X	'165 '166	• •	# #			A A		# #
Serial-In, Serial-Out	8	X				'91	A			•	•		
	4	X		X		'94	•						

Shift registers with latches

DESCRIPTION	NO. OF BITS	TYPE OF OUTPUT	DEVICE NUMBER	TECHNOLOGY			
				SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74HC SN54HC
Serial-In, Parallel-Out Shift Registers With Storage	8	T-P 3-State OC OC	'594 '595 '596 '599			• • • •	# #
	16	T-P	'673			•	
Parallel-In, Serial-Out Shift Register With Storage	8	T-P	'597			•	#
	16	3-State	'674			•	
I/Q Ports Provide Parallel Shift Register Outputs & Multiplexed Serial Data Inputs	8	3-State	'598			•	#

Other registers

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY					
		SN74 SN54	SN74ALS SN54ALS	SN54L	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S
Quadruple Multiplexers With Storage	'98 '298 '398 '399	•		•		• • •	
8-Bit Universal Shift Registers	'323 '299		• •		# #	• •	# #
Quadruple Bus-Buffer Registers	'173	•				A	
Octal Storage Register	'396					•	

See "How to read Digital Products selection tables" on page 65.

Accumulator registers/scalers

DESCRIPTION	NO. OF BITS	MODES				DEVICE NUMBER	TECHNOLOGY		
		SHIFT RIGHT	SHIFT LEFT	LOAD	HOLD		SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS
Sign-Protected Register	8	X		X	X	'322	•		A

Synchronous counters — positive-edge triggered

DESCRIPTION	PARALLEL LOAD	DEVICE NUMBER	TECHNOLOGY					
			SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Decade	Sync	'160	•	•	#	A		#
	Sync	'162	•	•	#	A	•	#
	Sync	'668				•		
	Sync	**'560**		•				
	Sync	**'690**				•		
	Sync	**'692**				•		
Decade Up/Down	**Sync**	**'168**		•	#			
	Async	'190	•	•		•		#
	Async	'192	•	•		•		#
	Sync	**'568**		•				
	Sync	**'696**				•		
	Sync	**'698**				•		
Decade Rate, 1 Multiplier, N10	Async Set-To-9	'167	•					
4-Bit Binary	Sync	'161	•	•	#	A		#
	Sync	'163	•	•	#	A	•	#
	Sync	'561		•				
	Sync	'669				•		
	Sync	'691				•		
	Sync	'693				•		
4-Bit Binary Up/ Down	**Sync**	**'169**		•	#	B	•	
	Async	'191	•	•		•		#
	Async	'193	•	•		•		#
	Sync	'569		•				
	Sync	'697				•		
	Sync	**'699**				•		
6-Bit Binary Rate, 1 Multiplier, N2		'97	•					
8-Bit Up/Down	**Async CLR**	**'867**			•			
	Sync CLR	'869			•			

Asynchronous counters (Ripple Clock)—negative-edge triggered

DESCRIPTION	PARALLEL LOAD	DEVICE NUMBER	TECHNOLOGY					
			SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Decade	Set-To-9	'90	A			•		
	Yes	'68				•		
	Yes	'176	•				•	
	Set-To-9	'196	•			•		
		'290	•			•		
4-Bit Binary	None	'93	A			•		
	Yes	'69				•		
	Yes	'177	•					
	None	'197	•			•	•	
		'293	•			•		
Divide-By-12	None	'92	A			•		
	None	'390	•			•		#
Dual Decade	Set-To-9	'490	•			•		#
Dual 4-Bit Binary	None	'393	•			•		#
12-Bit Binary	None	'4040						#
14-Bit Binary	None	'4020						#
14-Bit Binary with on-Chip Oscillator	None	'4060						#

See "How to read Digital Products selection tables" on page 65.

8-Bit Binary Counters With Registers

DESCRIPTION	TYPE OF OUTPUT	DEVICE NUMBER	TECHNOLOGY			
			SN74ALS SN54ALS	SN74S SN54S	SN74LS SN54LS	SN74HC SN54HC
Parallel Register Outputs	3-State OC	'590 '591			• •	#
Parallel Register Inputs	2-State	'592			•	#
Parallel I/O	3-State	'593			•	#

Decoders/demultiplexers

DESCRIPTION	TYPE OF OUTPUT	DEVICE NUMBER	TECHNOLOGY					
			SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
4-To-16	T-P OC	'154 '159	• •					
4-To-16 with Address Latches	T-P T-P	'4514 '4515						# #
4-To-10 BCD-To-Decimal	T-P	'42	A			•		#
4-To-10 Excess-3-To-Decimal	T-P	'43	A					
4-To-10 Excess-3-Gray-To-Decimal	T-P	'44	A					
3-To-8 With Address Latches	T-P	'131 '137		• •		• 		#
3-To-8	T-P 3-State	'138 '538		• #		•	•	#
Dual 2-To-4	T-P T-P OC	'139 '155 '156	• •	#		• • •	•	#
Dual 1-To-4 Decoders	3-State	'539		#				

OC = Open collector, T-P = Totem-pole

Open-collector display decoders/drivers

DESCRIPTION	OFF-STATE OUTPUT VOLTAGE	DEVICE NUMBER	TECHNOLOGY			
			SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS
BCD-To-Decimal	30V 60V 15V 7V	'45 '141 '145 '445	• • † •			 • •
BCD-To-Seven-Segment	30 V 15 V 5.5V 5.5V 30 V	'46 '47 '48 '49 '246	A A • • •			 • • •
	15 V 7 V 7 V 5.5 V 5.5 V	'247 '347 '447 '248 '249	• • •			• • • • •

Open-collector display decoders/drivers with counters/latches

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY			
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74HC SN54HC
BCD Counter/4-Bit Latch/BCD-To-Decimal Decoder/Driver	'142	• †			
BCD Counter/4-Bit Latch/BCD-To-Seven-Segment Decoder/Led Driver	'143	•			
BCD Counter/4-Bit Latch/BCD-To-Seven-Segment Decoder/Lamp Driver	'144	•			
4-Bit Latch/BCD-To-Seven Segment Decoder/Driver	'4511				#

† SN74 Only

See "How to read Digital Products selection tebles" on page 65.

Priority encoders/registers

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY				
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74HC SN54HC
Full BCD	'147	•			•	#
Cascadable Octal	'148	•			•	
Cascadable Octal With 3-State Outputs	'348				•	
4-Bit Cascadable With Registers	'278	•				

Data selectors/multiplexers

DESCRIPTION	TYPE OF OUTPUT	DEVICE NUMBER	TECHNOLOGY					
			SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
16-To-1	T-P	'150	•		#			
Dual 8-To-1	3-State	'351	• †					
8-To-1	T-P	'151	A	#	#	•	•	#
	T-P	'152	A			• ‡		#
	3-State	'251	•	#	#	•	•	#
	3-State	'354				•		#
	T-P	'355				•		
	3-State	'356				•		#
	T-P	'357				•		
Dual 4-To-1	T-P	'153	•	#	#	•	•	#
	3-State	'253		#	#	•	•	#
	T-P	'352		#	#	•		#
	3-State	'353		#	#	•		#
Octal 2-To-1 With Storage	3-State	'604				•		
	OC	'605				•		
	3-State	'606				•		
	OC	'607				•		
Quad 2-To-1 With Storage	2-T-P	'298	•			•		
	2-T-P	'398				•		
	2-T-P	'399				•		
Quadruple 2-To-1	2-T-P	'157	•	#	•	•	•	#
	2-T-P	'158		#	•	•	•	#
	3-State	'257		#	•	A	•	#
	3-State	'258		#	•	A	•	#
6-Line-To-1-Line Universal Multiplexer	3-State	'857		•	#			

Code converters

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY	
		SN74 SN54	SN74S SN54S
6-Line-BCD To 6-Line Binary, Or 4-Line To 4-Line BCD 9's/BCD 10's Converters	'184	•	
6-Bit-Binary To 6-Bit-BCD Converters	'185	A	
BCD-To-Binary Converters	'484		•
Binary-To-BCD Converters	'485		•

Parallel binary adders

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY					
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74LS SN54LS	SN74S SN54S
1-Bit Gated	'80	•					
2-Bit Gated	'82	•					
4-Bit	'83	A				A	
	'283	•				•	•
Dual 1-Bit Carry-Save	'183				•	•	

† SN74 only ‡ SN54 only

See "How to read Digital Products selection tables" on page 65.

Accumulators, arithmetic logic units, look-ahead carry generators

DESCRIPTION		DEVICE NUMBER	TECHNOLOGY				
			SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S
4-Bit Parallel Binary Accumulators		'281 '681				• •	•
4-Bit Arithmetic Logic Units/ Function Generators		'181 '381 '881	•		A A	•	• •
Arithmetic Logic Unit With Ripple Carry		'382				•	
Look-Ahead Carry Generators	16-Bit	'182	•				•
	32-Bit	'882			•		
Quad Serial Adder/Subtractor		'385				•	
4-Bit-Slice Element		'481				•	•
8-Bit-Slice Element		'888 '889			# #		

Multipliers

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY				
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S
2-Bit-By-4-Bit Parrallel Binary Multipliers	'261				•	
4-Bit-By-4-Bit Parrallel Binary Multipliers	'274 '284 '285	• •				•
7-Bit-Slice Wallace Trees	'275				•	•
25-MHz 6-Bit-Binary Rate Multipliers	'97	•				
25-MHz Decade Rate Multipliers	'167	•				
8-Bit X 1-Bit 2's Complement Multiplier	'384				•	
16-Bit Parallel Multiplier	'1616		#			

4-Bit Comparators

DESCRIPTION					DEVICE	TECHNOLOGY					
P = Q	P > Q	P < Q	OUTPUT	OUTPUT ENABLE	NUMBER	SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Yes	Yes	No	2-State	Yes	'85	•			•	•	#

See "How to read Digital Products selection tables" on page 65.

8-Bit Comparators

DESCRIPTION							DEVICE	TECHNOLOGY			
INPUTS	P = Q	$\overline{P=Q}$	P>Q	P<Q	OUTPUT	OUTPUT ENABLE	NUMBER	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74HC SN54HC
20-K Pull-Up	Yes	No	No	No	OC	Yes	'518	•			
	No	Yes	No	No	2-State	Yes	'520	•			
	No	Yes	No	No	OC	Yes	'522	•			
	Yes	No	Yes	No	2-State	No	'682			•	
	Yes	No	Yes	No	OC	No	'683			•	
Standard	Yes	No	No	No	OC	Yes	'519	•			
	No	Yes	No	No	2-State	Yes	'521	•			
	Yes	No	Yes	No	2-State	No	'684			•	
	Yes	No	Yes	No	OC	No	'685			•	
	Yes	No	Yes	No	2-State	Yes	'686			•	
	Yes	No	Yes	No	OC	Yes	'687			•	
	No	Yes	No	No	2-State	Yes	'688	•		•	#
	No	Yes	No		OC	Yes	'689	•		•	
Latched P	No	No	Yes	Yes	2-State	Yes	'885		•		
Latched P and Q	Yes	No	Yes	Yes	Latched	Yes	'866		•		

Address Comparators

DESCRIPTION	OUTPUT ENABLE	LATCHED OUTPUT	DEVICE NUMBER	TECHNOLOGY					
				SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
16-Bit to 4-Bit	Yes		'677		#				
		Yes	'678		#				
12-Bit to 4-Bit	Yes		'679		#				
		Yes	'680		#				

Other arithmetic operators

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY							
		SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74H SN54H	SN74L SN54L	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
Quad 2-Input Exclusive-OR Gates With Totem-Pole Outputs	'86	•	#			•	•	•	#
	'386						•		#
Quad 2-Input Exclusive-OR Gates With Open-Collector Outputs	'136	•					•		
Quad 2-Input Exclusive-NOR Gates	'266						•		#
Quad Exclusive OR/NOR Gates	'135							•	
Bit True/Complement, Element	'87				•				

Error detection and correction circuits, Parity generators/checkers

DESCRIPTION		DEVICE NUMBER	TECHNOLOGY					
			SN74 SN54	SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S	SN74HC SN54HC
9-Bit Odd/Even Parity Generators/Checkers		'280			#	•	•	#
8-Bit Odd/Even Parity Generators/Checkers		'180	•					
8-Bit EDAC	3-State	'636				•		
	OC	'637				•		
16-Bit Parallel Error Detection/Correction Circuit	3-State	'630				•		
	OC	'631				•		
32-Bit Parallel Error Detection/Correction Circuit Byte-Write Capability	3-State	'632		•				
	OC	'633		#				
32-Bit Parallel Error Detection/Correction Circuit	3-State	'634		#				
	OC	'635		#				

See "How to read Digital Products selection tables" on page 65.

Bipolar bit-slice processor elements

DESCRIPTION	CASCADABLE TO N-BITS	DEVICE NUMBER	TECHNOLOGY			
			SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S
4-Bit-Slice	Yes	'481			•	•
8-Bit-Slice	Yes	'888		#		
	Yes	'889		#		

Memory/microprocessor controllers

DESCRIPTION			DEVICE NUMBER	TECHNOLOGY			
				SN74ALS SN54ALS	SN74AS SN54AS	SN74LS SN54LS	SN74S SN54S
System Clock for 8080A			'424			•	
System Controllers For 8080A			'428 '438				• •
System Controller, Universal			'482				•
System Controller, Universal (or for '888, '889)			'890 '891		# #		
Memory Refresh Controllers	Transparent, Burst Modes	4K, 16K 64K	'600 '601			A A	
	Cycle Steal, Burst Modes	4K, 16K 64K	'602 '603			A A	
Memory Cycle Controller			'608			•	
Memory Mappers		3-State* OC**	'612 '613			• •	
Memory Mappers With Output Latches		3-State* OC**	'610 '611			• •	
Multi-Mode Latches (8080A Applications)			'412				•
Clock Elements (8080A Applications)			'424			•	

*Map Output Type **OC=Open collector

Programmable Logic Arrays

DESCRIPTION	DEVICE NUMBER	TECHNOLOGY		
		ALS SN74PL SN54PL	AS SN74PL SN54PL	LS SN74PL SN54PL
Octal 16-Input AND-OR-Invert Gate Array	'16L8	•		
Octal 16-Input Registered AND-OR Gate Array	'16R8	•		
Hex 16-Input Registered AND-OR Gate Array	'16R6	•		
Quad 16-Input Registered AND-OR Gate Array	'16R4	•		
Field-Programmable Logic Sequencers With 3-State Outputs	'333			#
Field-Programmable Logic Sequencers With Open-Collector Outputs	'335			#
14 x 32 x 6 Field-Programmable Logic Arrays With 3-State Output	'839		#	
14 x 32 x 6 Field-Programmable Logic Arrays With Open-Collector Outputs	'840		#	

See "How to read Digital Products selection tables" on page 65.

Custom Logic

Complex sound generators

DEVICE NUMBER	TYPE	MICROPROCESSOR INTERFACE	ATTACK/ DECAY CONTROL	PITCH CONTROL	ENVELOPE CONTROL	AUDIO DRIVE (ma)	NUMBER OF PINS
SN76477	Analog	4/8 BIT*	Yes/Yes	Yes	Yes	10	28
SN76487	Analog	4/8 BIT*	Fixed/Yes	No	No	125	16
SN76488	Analog	4/8 BIT*	Fixed/Yes	No	Yes	125	28
SN76489A **	Digital	8/16 BIT	Yes/Yes	Yes	Yes	10	16
SN76493	Digital	4/8 BIT	Yes/Yes	Yes	Yes	125	16
SN76494	Digital	8/16 BIT	Yes/Yes	Yes	Yes	10	16
SN76495	Analog	4/8 BIT*	Yes/Yes	No	Yes	125	16
SN76496 **	Digital	8/16 BIT	Yes/Yes	Yes	Yes	10	16

* Capable of stand-alone operation where sounds are changed by digital and analog type input control.
** The SN76489A will be replaced with the SN76496, a pin for pin replacement.

Remote servo controllers

DEVICE NUMBER	DESCRIPTION	Vee (V)	ADJUSTABLE DEADBAND	DIRECT MOTOR DRIVE	MAX OUTPUT CURRENT (mA)	BI-DIRECTIONAL DRIVE	NUMBER OF PINS
SN76602	Servo Control	3.8 to 5.5	Yes	No	350	Yes	14
SN76604	Servo Control	3.8 to 5.5	Yes	Yes	400	Yes	14

Remote control transmitters and receivers

DEVICE NUMBER	DESCRIPTION	No. OF CHANNELS	Vcc (V)	TRANS. MODE	FEATURES	NUMBER OF PINS
SN76730	Freq/Decoder	6	5	IR,RF, Ultrasonic	64 Step DAC	18
SN76881	Transmitter	30	6 to 9	IR	Direct led drive auto power-down	16
SN76891	Transmitter	30	6 to 9	IR	Same as 881 but with flag bit	16
SN76882	Transmitter	128	6 to 9	IR	Expansion bits for up to 128 channels from up to 64 keys	24
SN76832A	Receiver		12 to 15	IR	PLL demodulator serial output Microprocessor Interface	16

Radio and TV IF Amps

DEVICE NUMBER	DESCRIPTION	Vcc (V)	MAX FREQUENCY RANGE(MHz)	FEATURES	EQUIVALENT	NUMBER OF PINS
SN76600	Video IF Amp	12	75	6MHz BW	MC135OP	8
SN76642	FM IF Amp	16	50	Quad. Demond.	MC1357,ULN2111	14
SN76645	Video IF Amp	5	150	45db Gain		14
SN76650	Video IF Amp	18	45	Keyed AGC	MC1352,CA1352E	14
SN76666	FM IF Amp	24	5.5	DC Vol. Ctrl.	MC1358,CA3065	14

Specialty circuits

DEVICE NUMBER	DESCRIPTION	Vcc (V)	INPUT/OUTPUT	FEATURES	NUMBER OF PINS
SN76566	T.V. Vertical Countdown	12	Composite Sync. Vertical Sync. Asynchronous	525/684 Countdown Vertical Blanking Voltage Regulator	14
AC5947	18 Seg. L.E.D. Display Driver	5		6-Bit ASCII Input, Interfaces with HDSP 6504/6508	28

OPTOELECTRONIC PRODUCTS

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PACKAGE TYPES:

For package outline drawings on Optoelectronic products, see Appendix, pages 107 - 129.

For further information on the products in this section, see the OPTOELECTRONICS DATA BOOK
(See page 141 to order).

CCD Image Sensors

DEVICE NUMBER*	DYNAMIC * RANGE	CHARGE TRANSFER EFFICIENCY	PRNU** PEAK-TO-PEAK (TYP)	V_{SAT} (TYP)	SENSOR ELEMENT ORGANIZATION	PACKAGE
TC101	[illegible]	0.99999	50 mV	1000 mV	[illegible]	CL-75
TC102	[illegible]	0.99999	50 mV	1000 mV	[illegible]	CL-76
TC103	1000:1	0.99999	50 mV	1000 mV	[illegible]	CL-83
TC104	1000:1	0.99999	30 mV	600 mV	3456X1	CL-84

*Measured as V_{SAT} /Peak-To-Peak Noise
**Photo Response Non-Uniformity

CCD Image Sensor Evaluation Kits

KIT NUMBER	EVALUATION KIT CONSISTS OF
TCK101	TC101 plus PC401 Evaluation Board with complete operating instructions
TCK102	TC102 plus PC402 Evaluation Board with complete operating instructions
TCK103	TC103 plus PC401 Evaluation Board with complete operating instructions
TCK104	TC104 plus PC401 Evaluation Board with complete operating instructions

Infrared-emitting diodes (IRED's)

DEVICE NUMBER	POWER OUTPUT MIN (mW)	POWER OUTPUT @ I_F (mA)	Θ_{HI} TYP	V_F MAX@ (V)	V_F @ I_F (mA)	λ_{TP} TYP (NM)	FEATURES	PACKAGE
TIL23	0.4	50	35°	1.5	50	940	Pill package for mounting on double-sided circuit boards.	CL-1
TIL24 †	1	50	35°	1.5	50	940		
TIL25	0.75	50	35°	1.5	50	940		
TIL31B †	3.3	100	10°	1.75	100	940	Hermetic TO-18	CL-18
TIL32	0.5	20	35°	1.6	20	940	Plastic T-1 package	CL-9
TIL33B	2.5	100	80°	1.75	100	940	Hermetic TO-18	CL-18
TIL34B	2.0	100	10°	1.75	100	940	Hermetic TO-18	CL-18
TIL38	6	100	50°	1.75	100	940	Plastic T-1¾	CL-10
TIL39	6	100	20°	1.75	100	940	Plastic T-1¾	CL-10
TIL40	0.05	20	30°	1.6	20	940	Plastic side looker package	
TIL902-1	1.5	20	35°	1.6	20	880	Plastic T-1 package	CL-9
TIL902-2	2.5	20	35°	1.6	20	880	Similar to TIL32	
TIL903-1	6	100	10°	2.1	100	880	Hermetic TO-18	CL-18
TIL903-2	9	100	10°	2.1	100	880	Similar to TIL31B	
TIL904-1	5	100	80°	2.1	100	880	Hermetic TO-18	CL-18
TIL904-2	9	100	80°	2.1	100	880	Similar to TIL33B	
TIL905-1	1.5	20	50°	1.6	20	880	Plastic T-1¾	CL-10
TIL905-2	2.5	20	50°	1.6	20	880	Similar to TIL38	
TIL906-1	1.5	20	20°	1.6	20	880	Plastic T-1¾	CL-10
TIL906-2	2.5	20	20°	1.6	20	880	Similar to TIL39	

† High-reliability versions (TIL24HR2 and TIL31BHR2) are also available.

Special Function infrared-emitting diodes

DEVICE NUMBER	RADIANT POWER OUTPUT (TYP) (mW)	FORWARD CURRENT (mA)	DIAMETER OF EMITTING AREA (inches)	WAVELENGTH AT PEAK EMISSION (μm)	TYPICAL RISE TIME (ns)	FEATURES	PACKAGE
TIES06	1.2	500	.0075	910	15	Fast rise time	CL-17
TIES13	25	300	.036	930	600	High power,	CL-17
TIES13A	35	300	.036	930	600	High efficiency.	CL-17
TIES14	75	1000	.072	930	600		CL-17
TIES15	50	1000	.072	930	600		CL-17
TIES16A	150	2000	.072	930	300	Efficient heat sink.	CL-15
TIES27	20	300	18x18 sq.	930	600	Low cost	CL-16
TIES35	1.2	50	.018	910	15	High speed.	CL-61

Photodetectors (sensors)

DEVICE NUMBER	LIGHT CURRENT @5V MIN (mA)	LIGHT CURRENT @5V MAX (mA)	IRRADIANCE E_e	FEATURES	RECOMMENDED EMITTER	PACKAGE
1N5722	0.5	3.0	20 mW/cm²	Pill pkg, EIA-Registered	TIL23 series	CL-2
1N5723	2.0	5.0	20 mW/cm²	Versions of	TIL23 series	CL-2
1N5724	4.0	8.0	20 mW/cm²	TIL601-TIL604	TIL23 series	CL-2
1N5725	7.0	—	20 mW/cm²		TIL23 series	CL-2
LS600	0.8	—	20 mW/cm²	Pill pkg	TIL23 series	CL-2
TIL78	1.0		20 mW/cm²	Plastic pkg T1	TIL32, 902	CL-9
TIL81*	5.0	—	5 mW/cm²	Hermetic TO-18	TIL31B, 33B, 34B, TIL903, 904	CL-18
TIL99**	1.0	—	20 mW/cm²	Hermetic TO-18	TIL33B, 31B	CL-18
TIL100***	0.01	—	250 μW/cm²	Sidelooker pkg	TIL38, 39, 905, 906	CL-66
TIL411	0.1	—	500 μW/cm²	Sidelooker pkg Phototransistor	TIL40	CL-67
TIL412	0.5	—	100 μW/cm²	Sidelooker pkg Darlington	TIL40	CL-67
TIL413	0.01	—	250 μW/cm²	Sidelooker pkg Photodiode	TIL38/39/905/906	CL-68
TIL414	0.1	—	250 μW/cm²	Plastic pkg T-1¾ Phototransistor	TIL38/39/905/906	CL-10
TIL415	0.1		500 μW/cm²	Sidelooker pkg Phototransistor	TIL40	CL-67
TIL416	0.5		100 μW/cm²	Sidelooker pkg Darlington	TIL40	CL-67
TIL601	0.5	3.0	20 mW/cm²	Pill pkg	TIL23 series	CL-2
TIL602	2.0	5.0	20 mW/cm²	Pill pkg	TIL23 series	CL-2
TIL603	4.0	8.0	20 mW/cm²	Pill pkg	TIL23 series	CL-2
TIL604*	7.0	—	20 mW/cm²	Pill pkg	TIL23 series	CL-2

*High-reliability versions (TIL81HR2 an TIL604HR2) are also available.
**Flat Lens
***V_{CC} =10V

Avalanche photodiodes (APD's)

DEVICE NUMBER	BREAKDOWN VOLTAGE (V@ I R =100μA) MIN	BREAKDOWN VOLTAGE (V@ I R =100μA) MAX	AVALANCHE GAIN (TYP)	RADIANT RESPONSIVITY A/W (TYP)	CAPACITANCE (pF) (TYP)	DIAMETER OF ACTIVE AREA (inches)	FEATURES	PACKAGE
TIED56	155	185	600	20	1.2	.010	Low noise. High gain.	CL-18
TIED59	155	185	600	20	8.5	.030	Designed to operate in	CL-19
TIED69	155	185	600	20	30	.060	avalanche region.	CL-19
TIED87	155	185	600	20	2.5	.010	Photodiode and reference	CL-21
TIED88	155	185	600	20	9	.030	diode have matched breakdown	CL-21
TIED89	155	185	600	20	30	.060	characteristics. High gain. High speed.	CL-21

Optocouplers (isolators)

DEVICE NUMBER	ISOLATION VOLTAGE (kV) PEAK	RMS	MIN CTR %	FEATURES	PACKAGE TYPE	PACKAGE
3N261	1.0	—	50	Hermetic JEDEC	Metal Can	TO-72
3N262	1.0	—	100-500	Hermetic JEDEC	Metal Can	TO-72
3N263	1.0	—	200-1000	Hermetic JEDEC	Metal Can	TO-72
4N22*	1.0	—	25	Hermetic JEDEC	Metal Can	CM-14
4N23*	1.0	—	60	Hermetic JEDEC	Metal Can	CM-14
[illegible]*	1.0	—	100	Hermetic JEDEC	Metal Can	CM-14
[illegible]†	2.5	—	20	JEDEC	Plastic DIP	CP-7
[illegible]	1.5	—	20	[illegible]	Plastic DIP	CP-7
[illegible]	1.5	—	10	[illegible]	Plastic DIP	CP-7
4N28	0.5	—	10	JEDEC	Plastic DIP	CP-7
4N35†	3.55	2.5	100	JEDEC	Plastic DIP	CP-7
4N36	2.5	1.75	100	JEDEC	Plastic DIP	CP-7
4N37	1.5	1.05	100	JEDEC	Plastic DIP	CP-7
4N47**	1.0	—	50	Hermetic JEDEC	Metal Can	CM-14
4N48**	1.0	—	100	Hermetic JEDEC	Metal Can	CM-14
4N49**	1.0	—	200	Hermetic JEDEC	Metal Can	CM-14
MCT2	1.5	—	20		Plastic DIP	CP-7
MCT2E	2.5	—	20		Plastic DIP	CP-7
TIL102	1.0	—	25	Hermetic	Metal Can	CM-14
TIL103	1.0	—	100	Hermetic	Metal Can	CM-14
TIL111	1.5	—	13		Plastic DIP	CP-7
TIL112	1.5	—	2		Plastic Dip	CP-7
TIL113	1.5	—	300	Darlington	Plastic DIP	CP-7
TIL114	2.5	—	13		Plastic DIP	CP-7
TIL115	2.5	—	2		Plastic DIP	CP-7
TIL116	2.5	—	20		Plastic DIP	CP-7
TIL117†	2.5	—	50		Plastic DIP	CP-7
TIL118	1.5	—	10		Plastic DIP	CP-7
TIL119‡	1.5	—	300	Darlington	Plastic DIP	CP-7
TIL119A	1.5	—	300	(A) No base connection	Plastic DIP	CP-7
TIL120	1.0	—	25	Hermetic TO-72	Metal Can	TO-72
TIL121	1.0	—	50	Hermetic TO-72	Metal Can	TO-72
TIL124	5.0	—	10	High voltage	Plastic DIP	CP-7
TIL125	5.0	—	20	High voltage	Plastic DIP	CP-7
TIL126	5.0	—	50	High voltage	Plastic DIP	CP-7
TIL127	5.0	—	300	High voltage, Darlington	Plastic DIP	CP-7
TIL128	5.0	—	300	High voltage, Darlington	Plastic DIP	CP-7
TIL128A	5.0	—	300	(A) No base connection	Plastic DIP	CP-7
TIL153	3.54	2.5	10	High voltage, UL File E-65085	Plastic DIP	CP-7
TIL154	3.54	2.5	20	High voltage, UL File E-65085	Plastic DIP	CP-7
TIL155	3.54	2.5	50	High voltage, UL File E-65085	Plastic DIP	CP-7
TIL156	3.54	2.5	300	High voltage, Darlington UL File E-65085	Plastic DIP	CP-7
TIL157	3.54	2.5	300	High voltage, Darlington UL File E-65085	Plastic DIP	CP-7
TIL157A	3.54	2.5	300	(A) No base connection		

*JAN, JANTX, TANTXV levels to MIL-S-19500/486A USAF are also available
**JAN, JANTX, JANTXV levels to MIL-S-19500/548A available
†PEP3 processing optional
‡TIL119A also available with guaranteed unbonded base lead

Source and Detector Assemblies/SDA's (Switches)

DEVICE	TYPE	ON-STATE COLLECTOR CURRENT			OFF-STATE COLLECTOR CURRENT		FEATURES
		MIN $I_{C(on)}$	@ I_F	@ V_{CE}	MAX $I_{C(off)}$	@ V_{CE}	
TIL138	Transmissive Assembly with Mounting Tabs	1.6 mA 0.4 mA	35 mA 15 mA	0.5 V 0.5 V	100 nA	30 V	A TIL32 galluim arsenide IRED and a TIL78 phototransistor
TIL139	Reflective Assembly	10 µA † 100 µA ‡	40 mA 40 mA	5 V 5 V	100 nA	30 V	A TIL32 galluim arsenide IRED and a TIL78 phototransistor
TIL143	Transmissive Assembly with Mounting Tabs	600 µA	20 mA	5 V	100 nA	10 V	A TIL40 galluim arsenide IRED and a TIL11 silicon phototransistor
TIL144		200 µA	20 mA	5 V	100 nA	10 V	
TIL145	Transmissive Assembly with Mounting Tabs	2 mA	16 mA	1 V	100 nA	5 V	A TIL 40 gallium arsenide IRED and a high-gain TIL412 silicon Darlington phototransistor
TIL146		1.6 mA	50 mA	1 V	100 nA	5 V	
TIL147	Transmissive Assembly	4 mA	20 mA	5 V	100 nA	10 V	Hermetic pill devices mounted in dual-in-line package (TIL23/TIL601 Series)
TIL148		1 mA	20 mA	5 V	100 nA	10 V	
TIL149	Reflective Assembly	25 µA ‡	40 mA	5 V	100 nA	15 V	A TIL32 and a TIL78
TIL158	Transmissive Assembly	600 µA	20 mA	5 V	100 nA	10 V	A TIL40 gallium arsenide IRED and a TIL411 silicon phototransistor
TIL159		200 µA	20 mA	5 V	100 nA	10 V	
TIL160	Transmissive Assembly	2 mA	10 mA	2 V	100 nA	5 V	A TIL40 gallium arsenide IRED and a high-gain TIL412 silicon Darlington phototransistor
TIL161		0.5 mA	10 mA	2 V	100 nA	5 V	
TIL167-1	Transmissive Assembly with Mounting Tabs	200 µA	20 mA	5 V	100 nA	10 V	A TIL40 gallium arsenide IRED and a TIL415 silicon phototransistor
TIL197-2		600 µA	20 mA	5 V	100 nA	10 V	
TIL168-1	Transmissive Assembly with Mounting Tabs	0.5 mA	10 mA	2 V	100 nA	5 V	A TIL40 gallium arsenide IRED and a high-gain TIL416 silicon Darlington photoransistor
TIL168-2		2 mA	10 mA	2 V	100 nA	5 V	
TIL169-1	Transmissive Assembly	200 µA	20 mA	5 V	100 nA	10 V	A TIL40 gallium arsenide IRED and a TIL415 silicon phototransistor
TIL169-2		600 µA	20 mA	5 V	100 nA	10 V	
TIL170-1	Transmissive Assembly	0.5 mA	10 mA	2 V	100 nA	5 V	A TIL40 gallium arsenide IRED and a TIL416 silicon Darlington photoransistor
TIL170-2		2 mA	10 mA	2 V	100 nA	5 V	

Light-emitting diodes (LED's)

DEVICE NUMBER	SOURCE COLOR	LENS	BRIGHTNESS		FEATURES	PACKAGE
			MIN (mcd)	I_F (mA)		
5082-4550	Yellow	Diffused	1.0	10	Replaces HP device	CL-10
[illegible]	Yellow	Diffused	2.2	10	Replaces HP device	CL-10
5082-4[illegible]	Red	Diffused	1.0	10	Replaces HP device	CL-10
5082-4655	Red	Diffused	3.0	10	Replaces HP device	CL-10
5082-4950	**Green**	**Diffused**	**1.0**	**20**	**Replaces HP device**	**CL-10**
5082-4955	Green	Diffused	2.2	20	Replaces HP device	CL-10
TIL209A	Red	Diffused	0.5	20	T-1 pkg, low cost	CL-9
TIL212-1	Yellow	Diffused	0.8	20	T-1 pkg, high intensity	CL-9
TIL212-2	Yellow	Diffused	2.1	20	T-1 pkg, high intensity	CL-9
TIL216-1	Red	Diffused	2.1	20	T-1 pkg, high intensity	CL-9
TIL216-2	Red	Diffused	6.0	20	T-1 pkg, high intensity	CL-9
TIL[illegible]	Red	Diffused	0.8	20	T-1 ¾ pkg, low cost	CL-10
TIL[illegible]	Red	Clear	1.0	20	T-1 ¾ pkg.	CL-10
TIL224-1	Yellow	Diffused	2.1	20	T-1 ¾ pkg, high intensity	CL-10
TIL224-2	Yellow	Diffused	6.0	20	T-1 ¾ pkg, high intensity	CL-10
TIL228-1	Red	Diffused	2.1	20	T-1 ¾ pkg, high intensity	CL-10
TIL228-2	Red	Diffused	6.0	20	T-1 ¾ pkg, high intensity	CL-10
TIL232-1	Green	Diffused	0.5	20	T-1 pkg, high intensity	CL-9
TIL232-2	Green	Diffused	1.3	20	T-1 pkg, high intensity	CL-9
TIL234-1	Green	Diffused	0.8	20	T-1 ¾ pkg, high intensity	CL-10
TIL234-2	Green	Diffused	2.1	20	T-1 ¾ pkg, high intensity	CL-10

Mounting hardware available for all devices
TILM1 Mounting hardware T-1 pkg
TILM4 Mounting hardware T-1 ¾ pkg

Led Displays – Single-digit

DEVICE NUMBER	CHARACTER HEIGHT & COLOR	TYPE CHARACTERS	FEATURES	PACKAGE	RECOMMENDED DRIVERS
5082-7730	0.3" Red	7-segment, LHDP	CA, HP equivalent	CL-63	SN7447
5082-7731	0.3" Red	7-segment, RHDP	CA, HP equivalent	CL-63	SN7447
5082-7740	0.3" Red	7-segment, RHDP	CC, HP equivalent	CL-65	MC14411
TIL302*	0.27" Red	7-segment, LHDP	High performance	CL-34	SN7447
TIL303*	0.27" Red	7-segment, RHDP	High performance	CL-35	SN7447
TIL304*	0.27" Red	±1, RHDP	High performance	CL-36	
TIL305	0.3" Red	5x7, LHDP	Alphanumeric	CL-37	TMS2708
TIL306*	0.27" Red	7-segment, LHDP	Logic with counter	CL-38	
TIL307*	0.27" Red	7-segment, RHDP	Logic with counter	CL-39	
TIL308*	0.27" Red	7-segment, LHDP	Logic with BCD input	CL-38	
TIL309*	0.27" Red	7-segment, RHDP	Logic with BCD input	CL-39	
TIL311*	0.27" Red	4x7, R & LHDP	Hexadecimal with logic	CL-40	
TIL312	0.3" Red	7-segment, R & LHDP	CA, 125 ucd min @10mA	CL-41	SN7447
TIL313	0.3" Red	7-segment, RHDP	CC, 125 ucd min @10mA	CL-41	MC14411
TIL314	0.3" Green	7-segment, R & LHDP	CA, 125 ucd min @ 10mA	CL-41	
TIL315	0.3" Green	7-segment, RHDP	CC, 125 ucd min @ 10 mA	CL-41	
TIL321A	0.5" Red	7-segment, RHDP	CA, 125 ucd min @ 10mA	CL-43	SN7447
TIL322A	0.5" Red	7-segment, RHDP	CC, 125 ucd min @ 10mA	CL-43	MC14411
TIL323	0.5" Green	7-segment, RHDP	CA, 125 ucd min @ 10mA	CL-43	
TIL324	0.5" Green	7-segment, RHDP	CC, 125 ucd min @ 10mA	CL-43	
TIL327	0.3" Red	±1, LHDP	CA, 125 ucd min @ 10mA	CL-42	
TIL328	0.3" Green	±1, LHDP	CA, 125 ucd min @ 10mA	CL-43	
TIL330A	0.5" Red	±1, RHDP	CA, 125 ucd min @ 10mA	CL-44	
TIL331	0.5" Green	±1, RHDP	CA, 125 ucd min @ 10mA	CL-44	
TIL333	0.3" Red	7-segment, R & LHDP	CA, 320 ucd min @ 10mA	CL-41	
TIL334	0.3" Red	7-segment, RHDP	CC, 320 ucd min @ 10mA	CL-41	
TIL335	0.3" Red	±1, LHDP	CA, 320 ucd min @ 10mA	CL-42	
TIL339	0.3" Yellow	7-segment, R & LHDP	CA, 320 ucd min @ 10mA	CL-41	
TIL340	0.3" Yellow	7-segment, RHDP	CC, 320 ucd min @ 10mA	CL-41	
TIL341	0.3" Yellow	±1, LHDP	CA, 320 ucd min @ 10mA	CL-42	
TIL345	0.5" Yellow	7-segment Display RHDP	CA, 320 ucd min @ 10mA	CL-43	MC14511
TIL346	0.5" Yellow	7-segment Display RHDP	CC, 320 ucd min @ 10mA	CL-43	MC14511
TIL347	0.5" Yellow	± 1, RHDP	CA, 320 ucd min @ 10mA	CL-43	MC14511
TIL348	0.5" Red	7-segment, RHDP	CA, 320 ucd min @ 10mA	CL-43	
TIL349	0.5" Red	7-segment, RHDP	CC, 320 ucd min @ 10mA	CL-43	
TIL350	0.5" Red	±1, RHDP	CA, 320 ucd min @ 10mA	CL-44	
TIL729	0.5" Red	7-segment, RHDP	CA, 400 ucd min @ 10mA	CL-82	
TIL730	0.5" Red	7-segment, RHDP	CC, 400 ucd min @ 10mA	CL-82	

* Texas Instruments offers 2 versions of the above designated devices
1. Fully encapsulated device utilizing epoxy casting process
2. Version "A" is epoxy sealed molded lens process utilizing air cavity technology.

NOTE:
CA = Common Anode
CC = Common Cathode
LHDP = Left Hand Decimal Point
RHDP = Right Hand Decimal Point

Led Displays – Multi-digit

DEVICE NUMBER	NO. OF DIGITS	CHARACTER HEIGHT & COLOR	TYPE CHARACTERS	FEATURES	PACKAGE	RECOMMENDED DRIVERS
TIL393-6*	6	0.102" Red	7-segment & RHDPs	Double sided PCB, CC, calculator type	CL-47	TMS0980
TIL393-8*	8	0.102" Red	7-segment & RHDPs	Double sided PCB, CC, calculator type	CL-47	or
TIL393-9*	9	0.102" Red	7-segment & RHDPs	Double sided PCB, CC, calculator type	CL-47	TMS1000 + SN75492
TIL804-8	8	0.27" Red	7-segment & RHDPs	PCB, CC	CL-48	TMS1000 + SN75492
TIL804-10	10	0.27" Red	7-segment & RHDPs	PCB, CC	CL-48	
TIL804-12	12	0.27" Red	7-segment & RHDPs	PCB, CC	CL-48	
HDSP6504	4	0.15" Red	Alphanumeric	ASG II, 64 character set	CL-71	AC5947
HDSP6508	8	0.15" Red	Alphanumeric	plus SPECIALS	CL-70	

* Optional with red or clear magnifier (0.135" character height)

NOTE:
CA = Common Anode
CC = Common Cathode
LHDP = Left Hand Decimal Point
RHDP = Right Hand Decimal Point

High-reliability LED displays

DEVICE NUMBER	CHARACTER HEIGHT & COLOR	TYPE CHARACTERS	PACKAGE	RECOMMENDED DRIVERS
4N41(TIL501)	0.27" Red	7-segment, TIL302	CL -55	SN5447
TIL504	0.3" Red	5x7 Alphanumeric TIL305**	CL -56	TMS2708
4N56(TIL505)	0.3" Red	4x7 Hexadecimal with logic similar to TIL311	CL -57	
4N57(TIL506)	0.3" Red	7-segment, LHDP, with logic	CL -58	
4N58(TIL507	0.3" Red	5x7 Alphanumeric with logic	CL -59	
TIL509	0.3" Yellow	4x7 Hexadecimal with logic similar to TIL505	CL -57	
TIL510	0.3" Yellow	5x7 Alphanumeric, similar to TIL507	CL -59	

**Electrical equivalent only

Fiber-Optic Components and Amplifiers

Silicon photodetectors

DEVICE	DETECTOR TYPE	RADIANT RESPONSIVITY (A/W)	RISETIME (ns) @ 5 V	FEATURES
TIED458	Phototransistor	120	10,000	High Responsivity
TIED459	PIN Photodiode	0.42	10	High Speed

Silicon integrated analog receivers

DEVICE	RADIANT RESPONSIVITY (mV/μW)	EQUIVALENT INPUT NOISE RADIANT POWER (μW)	PULSED TRANSITION * TIME (ns)	FEATURES
TIED400	**60**	**0.007**	**80 for t_w = 500 ns**	**Single +5 V**
TIED461	**26**	**0.015**	**35 for t_w = 250 ns**	**Supply converts**
TIED462	12	0.04	18 for t_w = 100 ns	optical input
TIED463	4.8	0.13	10 for t_w = 50 ns	to voltage output

*Time required for output voltage to change from 20% to 80% of its peak value.

Transimpedance amplifiers

DEVICE	BANDWIDTH (MHz)	FORWARD TRANSFER IMPEDANCE (K Ω)	EQUIVALENT INPUT NOISE CURRENT (pA/$\sqrt{Hz}$)	FEATURES
TIEF150	100	1	8.5	rts
TIEF151	50	4	4.5	lectector current
TIEF152	20	12	3	voltage output

Gallium aluminum arsenide infrared-emitting diodes

DEVICE	RADIANT POWER OUTPUT (μW)* @ 50 mA	RADIANT PULSE RISETIME (ns)	HALF INTENSITY BEAM ANGLE	λ_p (nm)	FEATURES
TIES494	45	12	20°	820	Microlens
TIES495	75	12	20°	820	metal case
TIES496	110	12	20°	820	packaging

*Radiant power transmitted through a 0.2 mm (0.008-inch) diameter mechanical aperture into a numerical aperture of 0.25.

POWER PRODUCTS

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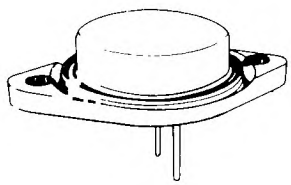
PACKAGE TYPES:



TO-3

TO-218AA

TO-220AB

Power transistors: Plastic case

POLARITY	RATED I_C (A)	RATED V_{CEO} (V)	DEVICE NUMBER	RATED V_{CBO} (V)	RATED P_T * (W)	h_{FE} MIN	h_{FE} MAX	h_{FE} @I_C (A)	f_T MIN (MHz)	RESISTIVE-LOAD SWITCHING t_{on} TYP(μs)	RESISTIVE-LOAD SWITCHING t_{off} TYP(μs)	RESISTIVE-LOAD SWITCHING @I_C (A)	PACKAGE
NPN	**1**	**40**	**TIP29**	40	12	15	75	1	3	0.5	2	1	TO-220AB
NPN	1	60	TIP29A	60	12	15	75	1	3	0.5	2	1	TO-220AB
NPN	1	80	TIP29B	80	12	15	75	1	3	0.5	2	1	TO-220AB
NPN	**1**	**100**	**TIP29C**	**100**	**12**	**15**	**75**	**1**	**3**	**0.5**	**2**	**1**	TO-220AB
NPN	1	250	TIP47	350	17	30	150	0.3	10	0.2	2	1	TO-220AB
NPN	1	300	TIP48	400	17	30	150	0.3	10	0.2	2	1	TO-220AB
NPN	1	350	TIP49	450	17	30	150	0.3	10	0.2	2	1	TO-220AB
NPN	**1**	**400**	**TIP50**	**500**	**17**	**30**	**150**	**0.3**	**10**	**0.2**	**2**	**1**	**TO-220AB**
NPN	2	60	TIP110	60	20	1000		1		2.6	4.5	2	TO-220AB
NPN	2	80	TIP111	80	20	1000		1		2.6	4.5	2	TO-220AB
NPN	2	100	TIP112	100	20	1000		1		2.6	4.5	2	TO-220AB
NPN	3	40	TIP31	40	16	10	50	3	3	0.5	2	1	TO-220AB
NPN	**3**	**60**	**TIP**	**60**	**16**	**10**	**50**	3	3	0.5	2	1	TO-220AB
NPN	**3**	**80**	**TIP**	**80**	**16**	**10**	**50**	3	3	0.5	2	1	TO-220AB
NPN	**3**	**100**	**TIP**	100	**16**	**10**	50	3	3	0.5	2	1	TO-220AB
NPN	**3**	**200**	**TIP75**	**350**	**26**	**30**	**250**	**0.5**	10	0.36	2.2	2	TO-220AB
NPN	**3**	**250**	**TIP51**	**350**	**40**	**30**	**150**	**0.3**	**2.5**	**0.25**	**5**	**1**	**TO-218AA**
NPN	3	250	TIP75A	400	26	30	250	0.5	10	0.36	2.2	2	TO-220AB
NPN	3	300	TIP52	400	40	30	150	0.3	2.5	0.25	5	1	TO-218AA
NPN	3	300	TIP75B	450	26	30	250	0.5	10	0.36	2.2	2	TO-220AB
NPN	**3**	**350**	**TIP53**	**450**	**40**	**30**	**150**	**0.3**	**2.5**	**0.25**	**5**	**1**	**TO-218AA**
NPN	3	400	TIP54	500	40	30	150	0.3	2.5	0.25	5	1	TO-218AA
NPN	3	400	TIP75C	500	26	30	250	0.5	10	0.36	2.2	2	TO-220AB
NPN	**4**	**600**	**MJE13004**	**600**	**30**	**10**	**60**	**1**	**4**	**0.32**	**2.1**	**2**	**TO-220AB**
NPN	4	700	MJE13005	700	30	10	60	1	4	0.32	2.1	2	TO-220AB
NPN	5	60	TIP120	60	26	1000		3		1.5	8.5	3	TO-220AB
NPN	5	80	TIP121	80	26	1000		3		1.5	8.5	3	TO-220AB
NPN	5	100	TIP122	100	26	1000		3		1.5	8.5	3	TO-220AB

*Total dissipation at case temperature of 100°C.

Power transistors: Plastic case

POLARITY	RATED I_C (A)	RATED V_{CEO} (V)	DEVICE NUMBER	RATED V_{CBO} (V)	RATED P_T * (W)	h_{FE} MIN	h_{FE} MAX	h_{FE} @I_C (A)	f_T MIN (MHz)	RESISTIVE-LOAD SWITCHING t_{on} TYP(μs)	t_{off} TYP(μs)	@I_C (A)	PACKAGE
NPN	6	40	TIP41	40	26	15	75	3	3	0.6	1	6	TO-220AB
NPN	6	60	TIP41A	60	26	15	75	3	3	0.6	1	6	TO-220AB
NPN	6	80	TIP41B	80	26	15	75	3	3	0.6	1	6	TO-220AB
NPN	6	100	TIP41C	100	26	15	75	3	3	0.6	1	6	TO-220AB
NPN	7	300	TIP150	300	32	150		2.5	10	1.1	5	5	TO-220AB
NPN	7	350	TIP151	350	32	150		2.5	10	1.1	5	5	TO-220AB
NPN	7	400	TIP152	400	32	150		2.5	10	1.1	5	5	TO-220AB
NPN	7	320	TIP160	320	50	200		4		1.54	4.8	6.5	TO-218AA
NPN	7	350	TIP161	350	50	200		4		1.54	4.8	6.5	TO-218AA
NPN	7	380	TIP162	380	50	200		4		1.54	4.8	6.5	TO-218AA
NPN	7.5	250	TIP55A	350	50	10	100	1		0.17	1.7	5	TO-218AA
NPN	7.5	300	TIP56A	400	50	10	100	1		0.17	1.7	5	TO-218AA
NPN	7.5	350	TIP57A	450	50	10	100	1		0.17	1.7	5	TO-218AA
NPN	7.5	400	TIP58A	500	50	10	100	1		0.17	1.7	5	TO-218AA
NPN	8	60	TIP100	60	32	1000	20K	3		0.39	4.3	8	TO-220AB
NPN	8	80	TIP101	80	32	1000	20K	3		0.39	4.3	8	TO-220AB
NPN	8	100	TIP102	100	32	1000	20K	3		0.39	4.3	8	TO-220AB
NPN	10	40	TIP33	40	32	20	100	3	3	0.6	1	6	TO-218AA
NPN	10	60	TIP33A	60	32	20	100	3	3	0.6	1	6	TO-218AA
NPN	10	60	TIP140	60	50	1000		5		0.9	11	10	TO-218AA
NPN	10	80	TIP33B	80	32	20	100	3	3	0.6	1	6	TO-218AA
NPN	10	80	TIP141	80	50	1000		5		0.9	11	10	TO-218AA
NPN	10	100	TIP33C	100	32	20	100	3	3	0.6	1	6	TO-218AA
NPN	10	100	TIP142	100	50	1000		5		0.9	11	10	TO-218AA
NPN	15	40	TIP73	50	32	20	150	5	5	0.37	0.9	5	TO-220AB
NPN	15	60	TIP73A	70	32	20	150	5	5	0.37	0.9	5	TO-220AB
NPN	15	80	TIP73B	90	32	20	150	5	5	0.37	0.9	5	TO-220AB
NPN	15	100	TIP73C	110	32	20	150	5	5	0.37	0.9	5	TO-220AB
NPN	25	40	TIP35	40	50	10	50	15	3	1.2	0.9	15	TO-218AA
NPN	25	60	TIP35A	60	50	10	50	15	3	1.2	0.9	15	TO-218AA
NPN	25	80	TIP35B	80	50	10	50	15	3	1.2	0.9	15	TO-218AA
NPN	25	100	TIP35C	100	50	10	50	15	3	1.2	0.9	15	TO-218AA
PNP	1	40	TIP30	40	12	15	75	1	3	0.3	1	1	TO-220AB
PNP	1	60	TIP30A	60	12	15	75	1	3	0.3	1	1	TO-220AB
PNP	1	80	TIP30B	80	12	15	75	1	3	0.3	1	1	TO-220AB
PNP	1	100	TIP30C	100	12	15	75	1	3	0.3	1	1	TO-220AB
PNP	2	60	TIP115	60	20	1000		1		2.6	4.5	2	TO-220AB
PNP	2	80	TIP116	80	20	1000		1		2.6	4.5	2	TO-220AB
PNP	2	100	TIP117	100	20	1000		1		2.6	4.5	2	TO-220AB
PNP	3	40	TIP32	40	16	10	50	3	3	0.3	1	1	TO-220AB
PNP	3	60	TIP32A	60	16	10	50	3	3	0.3	1	1	TO-220AB
PNP	3	80	TIP32B	80	16	10	50	3	3	0.3	1	1	TO-220AB
PNP	3	100	TIP32C	100	16	10	50	3	3	0.3	1	1	TO-220AB
PNP	5	60	TIP125	60	26	1000		3		1.5	8.5	3	TO-220AB
PNP	5	80	TIP126	80	26	1000		3		1.5	8.5	3	TO-220AB
PNP	5	100	TIP127	100	26	1000		3		1.5	8.5	3	TO-220AB
PNP	6	40	TIP42	40	26	15	75	3	3	0.4	0.7	6	TO-220AB
PNP	6	60	TIP42A	60	26	15	75	3	3	0.4	0.7	6	TO-220AB
PNP	6	80	TIP42B	80	26	15	75	3	3	0.4	0.7	6	TO-220AB
PNP	6	100	TIP42C	100	26	15	75	3	3	0.4	0.7	6	TO-220AB
PNP	8	60	TIP105	60	32	1000	20K	3		0.34	2.2	8	TO-220AB
PNP	8	80	TIP106	80	32	1000	20K	3		0.34	2.2	8	TO-220AB
PNP	8	100	TIP107	100	32	1000	20K	3		0.34	2.2	8	TO-220AB
PNP	10	40	TIP34	40	32	20	100	3	3	0.6	1	6	TO-218AA
PNP	10	60	TIP34A	60	32	20	100	3	3	0.6	1	6	TO-218AA
PNP	10	60	TIP145	60	50	1000		5		0.9	11	10	TO-218AA
PNP	10	80	TIP34B	80	32	20	100	3	3	0.6	1	6	TO-218AA
PNP	10	80	TIP146	80	50	1000		5		0.9	11	10	TO-218AA
PNP	10	100	TIP34C	100	32	20	100	3	3	0.6	1	6	TO-218AA
PNP	10	100	TIP147	100	50	1000		5		0.9	11	10	TO-218AA
PNP	15	40	TIP74	50	32	20	150	5	5	0.14	0.9	5	TO-220AB
PNP	15	60	TIP74A	70	32	20	150	5	5	0.14	0.9	5	TO-220AB
PNP	15	80	TIP74B	90	32	20	150	5	5	0.14	0.9	5	TO-220AB
PNP	15	100	TIP74C	110	32	20	150	5	5	0.14	0.9	5	TO-220AB
PNP	25	40	TIP36	40	50	10	50	15	3	1.1	0.8	15	TO-218AA
PNP	25	60	TIP36A	60	50	10	50	15	3	1.1	0.8	15	TO-218AA
PNP	25	80	TIP36B	80	50	10	50	15	3	1.1	0.8	15	TO-218AA
PNP	25	100	TIP36C	100	50	10	50	15	3	1.1	0.8	15	TO-218AA

*Total dissipation at case temperature of 100°C.

Power transistors: Metal case

POLARITY	RATED I_C (A)	RATED V_{CEO} (V)	DEVICE NUMBER	RATED V_{CBO} (V)	RATED P_T* (W)	h_{FE} MIN	h_{FE} MAX	h_{FE} @I_C (A)	f_T (MHz)	RESISTIVE-LOAD SWITCHING t_{on} TYP(µs)	RESISTIVE-LOAD SWITCHING t_{off} TYP(µs)	RESISTIVE-LOAD SWITCHING @I_C (A)	PACKAGE
NPN	5	250	MJ1800	250	40	40	120	0.4					TO-3
NPN	5	300	MJ3430	400	50	15	45	2.5	2.5				TO-3
NPN	5	300	2N6542	650	57	7	35	3	6	0.75	4.8	3	TO-3
NPN	5	400	2N6543	850	57	7	35	3	6	0.75	4.8	3	TO-3
NPN	7	300	MJ3040	400	40	100		2.5					TO-3
NPN	7	300	MJ3041	400	40	250		2.5					TO-3
NPN	7.5	250	TIP558	350	100	10	100	1		0.17	1.7	5	TO-3
NPN	7.5	300	TIP559	400	100	10	100	1		0.17	1.7	5	TO-3
NPN	7.5	350	TIP560	450	100	10	100	1		0.17	1.7	5	TO-3
NPN	7.5	400	TIP561	500	100	10	100	1		0.17	1.7	5	TO-3
NPN	8	250	2N6306	500	71	12	60	3	5	0.6	2	3	TO-3
NPN	8	300	2N6544	650	71	12	60	2.5	6	1.05	5	5	TO-3
NPN	8	300	2N6307	600	71	15	75	3	5	0.6	2	3	TO-3
NPN	8	350	2N6308	700	71	12	60	3	5	0.6	2	3	TO-3
NPN	8	400	2N6545	850	71	12	60	2.5	6	1.05	5	5	TO-3
NPN	10	100	TIP642	100	100	1000		5		0.9	11	10	TO-3
NPN	10	100	TIP602	100	57	1000	20K	3		0.38	4.25	8	TO-3
NPN	10	140	2N3442	160	86	20	70	3	0.8				TO-3
NPN	10	150	2N6262	170	86	20	70	3	0.8				TO-3
NPN	10	350	MJ13014	550	85.5	12	40	2.5		0.1	0.9	5	TO-3
NPN	10	400	MJ13015	600	85.5	12	40	2.5		0.1	0.9	5	TO-3
NPN	12	60	2N6057	60	86	750	18K	6	4		3.1	6	TO-3
NPN	12	80	2N6058	80	86	750	18K	6	4		3.1	6	TO-3
NPN	12	100	2N6360	120	86	15	60	6					TO-3
NPN	12	100	2N6059	100	86	750	18K	6	4		3.1	6	TO-3
NPN	15	40	MJ2801	40	65	15	60	8	1				TO-3
NPN	16	100	2N5629	100	114	25	100	8	1		2.4	8	TO-3
NPN	16	100	MJ4035	100	86	1000		10					TO-3
NPN	16	120	2N6302	140	86	15	60	8	1	1.5	3.8	8	TO-3
NPN	16	120	MJ6302	120	86	15	60	8	1	1.5	3.8	8	TO-3
NPN	16	120	2N5630	120	114	20	80	8	1		2.4	8	TO-3
NPN	16	140	2N5631	140	114	15	60	8	1		2.4	8	TO-3
NPN	20	120	2N5039	75	80	20	100	10	60	0.5	2	10	TO-3
NPN	20	150	2N5038	90	80	20	100	12	60	0.5	2	10	TO-3
NPN	30	100	2N6328	100	114	6	30	30	3	0.6	0.9	15	TO-3
PNP	10	60	TIP605	60	80	1000		3		0.3	2.2	8	TO-3
PNP	10	60	TIP645	60	100	1000		5		0.9	11	10	TO-3
PNP	10	80	TIP606	80	80	1000		3		0.3	2.2	8	TO-3
PNP	10	80	TIP646	80	100	1000		5		0.9	11	10	TO-3
PNP	10	100	TIP607	100	80	1000		3		0.3	2.2	1	TO-3
PNP	10	100	TIP647	100	100	1000		5		0.9	11	10	TO-3
PNP	10	110	2N6248	110	71	20	100	5	10				TO-3
PNP	12	100	2N6052	100	86	750	18K	6	4		3.1	6	TO-3
PNP	16	100	MJ4032	100	86	1000		10					TO-3
PNP	30	100	2N6331	100	114	6	30	30	3	0.6	0.9	15	TO-3

*Total dissipation at case temperature of 100°C.

Fast-switching transistors: 800-1000 V

POLARITY	RATED I_C (A)	RATED $V_{(BR)CEO}$ (V)	DEVICE NUMBER	RATED $V_{(BR)CBO}$ (V)	POWER (W)		V_{CE} @ I_C / I_B = 5 MAXIMUM		100°C INDUCTIVE SWITCHING		PACKAGE
					25°C	100°C	Volts	Amps	$t_{sv(\mu s)}$ MAX	$t_{xo(\mu s)}$ MAX	
NPN	4	375	TIPL760	800	80	32	2.5	4	3	0.75	TO-220AB
NPN	4	375	TIPL751	800	120	68.5	2.5	4	3	0.75	TO-3
NPN	4	420	TIPL760A	1000	80	32	2.5	4	3	0.75	TO-220AB
NPN	4	420	TIPL751A	1000	120	68.5	2.5	4	3	0.75	TO-3
NPN	6	375	TIPL752	800	150	85.5	2.5	6	3	0.5	TO-3
NPN	6	420	TIPL752A	1000	150	85.5	2.5	6	3	0.5	TO-3
NPN	8	375	TIPL753	800	150	85.5	2.5	8	3	0.5	TO-3
NPN	8	420	TIPL753A	1000	150	85.5	2.5	8	3	0.5	TO-3
NPN	10	375	TIPL755	800	[illegible]	[illegible]	2.5	10	3	0.5	TO-3
NPN	10	420	TIPL755A	1000	[illegible]	[illegible]	2.5	10	3	0.5	TO-3
NPN	15	375	TIPL757	800	200	111	2.5	15	3	0.5	TO-3
NPN	15	420	TIPL757A	1000	200	111	2.5	15	3	0.5	TO-3

Fast-switching darlingtons: 150-200 V

POLARITY	RATED I_C (A)	RATED $V_{(BR)CEO}$ (V)	DEVICE NUMBER	RATED $V_{(BR)CBO}$ (V)	POWER (W)		V_{CE} @ I_C / I_B = 5 MAXIMUM		25°C INDUCTIVE SWITCHING		PACKAGE
					25°C	100°C	Volts	Amps	$t_{sv(\mu s)}$ MAX	$t_{xo(\mu s)}$ MAX	
NPN	10	120	TIPL775	150	100	57.2	2	10	0.45	0.32	TO-3
NPN	10	150	TIPL775A	200	100	57.2	2	10	0.45	0.32	TO-3

High-energy darlingtons: 550 V

POLARITY	RATED I_C (A)	RATED $V_{(BR)CEO}$ (V)	DEVICE NUMBER	RATED $V_{(BR)CBO}$ (V)	POWER (W)		V_{CE} @ I_C / I_B = 5 MAXIMUM		FORWARD PULSE ENERGY (mj)	PACKAGE
					25°C	100°C	Volts	Amps		
NPN	20	450	TIPL774	550	175	100	3	15	300	TO-3

MILITARY PRODUCTS

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Overview

Texas Instruments Military program offers high reliability integrated circuits covering a complete product spectrum. The program is designed to meet and support Military processing requirements. Processing to JM-38510 (JANB) and MIL-Standard-883 Class B assures the user of quality products and reliable performance.

Devices are available in ceramic dual-in-line, flatpack and chip carrier packaging alternatives to allow for maximum flexibility in system use.

PRODUCT LINE	PROCESSING FLOWS	TYPES	NUMBER OF UNIQUE TYPES AVAILABLE
DIGITAL LOGIC	SN,SNJ,JANB	54TTL 54H 54S 54L 54LS 54ALS 54AS 54HC	154 23 63 37 180 41 FUTURE PRODUCT FUTURE PRODUCT
LINEAR	SN,SNJ,/883B JANB	INTERFACE, CONTROL	132
MOS MEMORY	TMS,SMJ	EPROM,DRAM,SRAM	10
BIPOLAR MEMORY	JBP, SNJ	PROM,RAM,SUPPORT	25
MICROPROCESSOR	N	9989	1
LOGIC ARRAY		STL,I2L	6

The following pages provide information on product nomenclature and screening requirements. Electrical and mechanical parametric specifications are available for review in the appropriate Texas Instruments data books.

Additional information is available by contacting your local TI authorized distributor or TI sales office.

Processing Flow Features

PROCESSING FLOW FEATURES	JANB	SNJ	JBP	SMJ
• QUALIFIED PER MIL-M-38510 CLASS B	X			
• PRODUCED IN DESC-CERTIFIED DOMESTIC PRODUCTION FACILITY	X			
• TESTED PER MIL-STD-883B METHOD 5004 CLASS B	X	X	X	X
• ELECTRICAL CHARACTERISTICS PER APPROPRIATE SLASH SHEETS	X			
• ELECTRICAL AND MECHANICAL CHARACTERISTICS PER TI DATA SHEETS		X	X	X
• 100% FUNCTIONAL TEST AT TEMPERATURE EXTREMES		X	X	X
• 100% AC TESTING OF SWITCHING CHARACTERISTICS AS SPECIFIED IN TI DATA SHEETS		X	X	X
• TESTED PER MIL-STD -- [illegible] METHOD 5005 CLASS B, GROUPS A,B,C,D EXCEPT AS NOTED IN APPROPRIATE SCH[illegible]G AND LOT CONFORMANCE TABLE (NOTE 1)	X	X	X	X
• TIGHTENED GROUP A LTPD		X	X	X
• GROUP A TESTED BY INSPECTION LOT	X	X	X	X
• EACH SHIPMENT INCLUDES A CERTIFICATE OF COMPLIANCE AND GROUP A SUMMARY REPORT		X	X	X
• GROUP B,C, AND D GENERIC DATA AVAILABLE PER TI BROCHURE CB159		X	X	X
• TESTED AND MARKED PER APPROPRIATE DESC MINISPEC WHEN TI IS LISTED AS APPROVED SOURCE		X		X

NOTE: FOR DETAILED SCREENING AND LOT CONFORMANCE INFORMATION REFER TO MILITARY PRODUCTS BROCHURE SCG714.

Packages Available

PACKAGE DESCRIPTION	PACKAGE TYPE	MILITARY PRODUCTS					
		DIGITAL	LINEAR	BIPOLAR MEMORY	MOS MEMORY	LOGIC ARRAY	MICRO PROCESSOR
CERAMIC DIP	J JG	X	X X	X	X		
SIDE BRAZE CERAMIC DIP	JD				X		X
CERAMIC FLAT PACK	W WC	X	X X				
CERAMIC FLAT PACK	U		X				
SQUARE TOTAL CERAMIC CHIP CARRIER	FH	X	X	X			
THREE LAYER SQUARE CERAMIC CHIP CARRIER	FK	X	X	X		X(FD)	X(FD)
MEMORY RECTANGULAR [illegible] CHIP CARRIER PACKAGE	FE			X	X		
MEMORY RECTANGULAR CERAMIC CHIP CARRIER PACKAGE	FG			X	X		
PIN GRID ARRAY						X	

Chip Carrier Process/Package Options

PRODUCT LINE	PROCESSING FLOWS						PACKAGE TYPES				
	SN	SNJ	/883B	SMJ	JBP	N	FH	FK	FE	FG	FD
LOGIC (54LS,54S,54ALS, 54AS)	X	X					X	X			
LINEAR	X	X	X				X	X			
MOS MEMORY				X					X	X	
BIPOLAR MEMORY					X		X	X	X	X	
MICROPROCESSOR						X					X
LOGIC ARRAY											X

Logic Array Products

PRODUCT SPECTRUM

DEVICE TYPE	GATE TECHNOLOGY	MINIMUM PROCESSING GEOMETRY (MICRONS)	USEABLE GATE COUNT	INTERNAL GATE PROPAGATION DELAY (ns)	INTERNAL GATE POWER DISSIPATION (mW)	I/O SIGNAL PADS	AUTO ROUTE	T_J RANGE	RAD. TOLERANT
TA[illegible]	[illegible]	4.5	400	2.5	600	76	Yes	-55 to 150C	Yes
TA[illegible]	[illegible]	4.5	800	2.5	600	104	Yes	-55 to 150C	Yes
STL700	STL	4.5	560	3.0	300	61	Yes	-55 to 150C	Yes
SBP96600	I^2L	4.5	2120	15.0	100	140	No	-55 to 150C	Yes
SBP96700	I^2L	4.5	1120	15.0	100	96	No	-55 to 150C	Yes

*Future product

PACKAGE OPTIONS **

DEVICE TYPE	40 PIN DIP	64 PIN FLATPACK	LCCC		PIN GRID ARRAY		
			68 PAD	84 PAD	84 PIN	108 PIN	132 PIN
TAT004	X	X	X				
TAT008	X	X	X				
STL700	X	X	X				
SBP96600	X		X	X		X	X
SBP96700	X		X	X		X	X

** Dependent on custom circuit design I/O

Bipolar Microprocessor Products

SBP 9989 Bipolar Microprocessor Family

The SBP9900 family features memory-to-memory architecture and Bipolar I²L technology enabling it to operate over the full military temperature range. The SBP9989 is a second generation 16-bit microprocessor offering three times the performance of its predecessor, the SBP9900A. The SBP9989 fully supports interrupt intensive applications, including high level languages and multitasking, with designed-in multi-processor support. Downward compatibility is maintained such that all SBP9900 software executes on the SBP9989 without change.

SBP 9989 Product Features

- 4.4-MHz clock rate, single phase, 50% duty cycle
- Designed-in support for advanced multiprocessor system architecture
- 16 bit data and address bus
- Serial I/O via Communications Register Unit (CRU)
- 16 prioritized hardware interrupts /16 software interrupts
- 9900 Family instruction set including signed multiply (MPY) and signed divide (DIV).
- Direct access to 128K bytes of memory (via new output pin MPEN)
- Operation over full MIL-TEMP range (-55°C to 125°C)
- Radiation tolerance characteristics of I²L Technology

Peripheral Support Functions

DEVICE TYPE	DESCRIPTION
SBP9901 SBP9965 SBP9966	Programmable Systems Interface Peripheral Interface Adaptor Interrupt Controller

Microprocessor/Peripheral Nomenclature

EXAMPLE: SBP 9989 N J

1. PREFIX
   Must contain three or four letters
   SBP —
   JAN B — JM38510/JANB Qualified
2. CIRCUIT DESIGNATOR
   Must contain four digits
   9989 — advanced 4.4 MHz 16 bit processor
3. TEMPERATURE RANGE —
   Must contain one letter only (omit for JANB part)
   N — -55°C to 125°C
4. PACKAGE TYPE
   Must contain one or two letters — J,FD

Digital Logic Products

See detailed product listings in Digital Logic Products section

DIGITAL LOGIC NOMENCLATURE

EXAMPLE: SNJ 54LS00 FH

1. Prefix

Must contain three or four letters
SNJ — MIL-STD-883B, JEDEC Standard 101
JANB — JM38510/JANB Qualified, Note 1

2. Circuit Designator

Must contain four to eight digits
54 — Standard TTL Circuits
54H — High-speed TTL
54L — Low-power TTL
54LS — Low-power Schottky TTL
54S — Schottky TTL
54ALS — Advanced Low-power Schottky TTL
54AS — Advanced Schottky
54HC — High Speed CMOS

3. Package Type

Must contain one or two letters

Linear Products

See detailed product listings in Linear Products section

LINEAR NOMENCLATURE

EXAMPLE: JANB 55108 J /883B

1. Prefix

Must contain three or four letters
TL — TI Linear Control Products
TLC — LinCMOS™ Control Products
SNJ — MIL-STD-883B, JEDEC Standard 101
JANB — JM38510/JANB Qualified, Note 1

2. Circuit Designator

including temperature range
Must contain three to seven characters
(from individual data sheets)
examples: 022M, 55450B, 78M05M

3. Package Type

Must contain one or two letters
(From pin connection diagram on individual data sheets)

4. Screening and Lot Conformance

/883B — MIL-STD-883B Method 5004 Class B
(Not used with part numbers having a JANB or an SN Prefix)

Note 1. Where devices are qualified under Military Specification MIL-M-38510

Bipolar Memory Products

PROMs

DEVICE	TEMP.	SPEED (ns) MAX $t_{a(A)}$*	ORGANIZATION	PACKAGE TYPE	
				C-DIP	CHIP CARRIER
18S030	E,M	50	32 × 8	16 Pin (J)	20 Pad (FC,FD)
18SA030		50	32 × 8	16 Pin (J)	20 Pad (FC,FD)
24S10		75	256 × 4	16 Pin (J)	20 Pad (FH,FK)
24SA10		75	256 × 4	16 Pin (J)	20 Pad (FH,FK)
28L22		75	256 × 8	20 Pin (J)	20 Pad (FH,FK)
24S41		75	1K × 4	18 Pin (J)	28 Pad (FG)
28S42		70	512 × 8	20 Pin (J)	28 Pad (FC,FD)
28L42		110	512 × 8	20 Pin (J)	28 Pad (FC,FD)
28S46		70	512 × 8	24 Pin (J)	28 Pad (FC,FD)
24S81		85	2K × 4	18 Pin (J)	28 Pad (FG)
28S86A		80	1K × 8	24 Pin (J)	32 Pad (FG)
28L86A	E,M	175	1K × 8	24 Pin (J)	32 Pad (FG)

*$t_{a(A)}$ Access time from address

BIPOLAR MEMORY NOMENCLATURE

Example: JBP 2 8 S 8 6 M J

These two digits comprise the series designation

Prefix

JBP — MIL-STD-883B
JEDEC standard 101

JANB — JM 38510/JANB
Qualified, Note 1

Generic Programming Family

1—Single level
2—Double level
3—Oxide Isolated
4—Other

Output Word Width

4 or 8

Output Type

S = standard three-state
L = low-power three-state
P = power-down three-state
R = registered three-state
D = power-down and registered three-state
T = latched three-state
SA = standard open-collector
LA = low-power open-collector
PA = power-down open-collector
RA = registered open-collector
DA = power-down and registered open-collector
TA = latched open-collector

Bit Complexity

03 = 256 bits
1 = 1,024 bits
2 = 2,048 bits
4 = 4,096 bits
8 = 8,192 bits
16 = 16,384 bits
32 = 32,768 bits

Package Size*

No. of Pins	Row spacing in inches (millimeters) 0.300 (7,62)	0.400 (10,16)	0.600 (15,24)
16	0	-	-
18	1	-	-
20	2	-	-
22	3	4	-
24	5	-	6
28	-	-	7
40	-	-	8

* Package size designation is not applicable with chip carrier, and should be replaced with the letter X for this package type.

Temperature Range

No designator 0°C to 70°C
E — 40°C to 85°C
M — 55°C to 125°C

Package Type

J = ceramic dual-in-line
FH/FK/FE/FG = ceramic chip carrier

Note 1. Where devices are qualified under Military specification MIL-M-38510

MOS Memory Products

RAMs

DEVICE	TEMP.	MAX. ACCESS TIME (ns)	ORGANIZATION	PACKAGE TYPE	
				C-DIP	CHIP CARRIER
SRAM					
2114	M,S,E,L	200,250,450	1K × 4	18 Pin (JD)	18 Pad (FG)
2114L	M,S,E,L	200,250,450	1K × 4	18 Pin (JD)	18 Pad (FG)
4016	M,S,E,L	200,250,450	2K × 8	24 Pin (JD)	32 Pad (FG)
DRAM					
4164	M,S,E,L	150,200,250	64K × 1	16 Pin (JD)	28/18 Pad (FE/FG)

EPROMs

DEVICE	TEMP.	MAX. ACCESS TIME (ns)	ORGANIZATION	PACKAGE TYPE	
				C-DIP	CHIP CARRIER
2516	M,S,E,L	350,450	2K × 8	24 Pin (J)	32 Pad (FG)
2532	M,S,E,L	350,450	4K × 8	24 Pin (J)	32 Pad (FE)
[illegible]2	M,S,E,L	450	4K × 8	24 Pin (J)	32 Pad (FE)
[illegible]	M,S,E,L	450	8K × 8	28 Pin (J)	32 Pad (FE)
[illegible]	M,S,E,L	350,450	1K × 8	24 Pin (J)	32 Pad (FE)
27L08	M,S,E,L	350,450	1K × 8	24 Pin (J)	32 Pad (FE)

MOS MEMORY NOMENCLATURE

EXAMPLE: SMJ 2564 -45 J M

1. Prefix

   Must contain three or four letters
   SMJ — MIL-STD-883B, JEDEC Standard 101

2. Circuit Designator

   Must contain four or five characters
   All standard types have four digits
   All low-power versions have five characters
   examples: Standard 32K EPROM — 2532
   Low-power 32K EPROM — 25L32

3. Access Time

   Device types are available with various speeds

4. Package Type

   Must contain one or two letters

5. Temperature Range

   Must contain one letter only
   M -55 to + 125°C
   S -55 to + 100°C
   E -40 to + 85°C
   L 0 to + 70°C

Systems Products

DRAM Module Nomenclature

Multiple 4164's in chip carrier packages mounted on ceramic dual-in-line substrate.

EXAMPLE: SMJ 4 4 4164-20 M

1. **Prefix**

   Must contain three letters
   SMJ — MIL-STD-883B

2. **Word Width**

   One digit only
   1,2 or 4

3. **Number Devices Per Unit**

   One Digit Only
   2 or 4

4. **Device Type**

   Contains four or five characters

5. **Access Time**

   Available with various speeds

6. **Temperature Range**

   Must contain one letter only

   M -55°C to + 125°C
   S -55°C to + 100°C
   E -40°C to + 85°C
   L 0°C to + 70°C

Power Transistors, Radiation Tolerant (metal case)

POLARITY	RATED I_C (A)	RATED V_{CEO} (V)	DEVICE NUMBER	RATED V_{CBO} (V)	RATED P_T (W)	h_{FE} MIN-MAX	@I_C (A)	f_T MIN (MHz)	PACKAGE	HARDNESS CLASS (See Note 1)
NPN	2	80	2N5000	100	20	70-200	1	60	TO59(I)	F
PNP	2	80	2N5001	100	20	70-200	1	60	TO59(I)	F
NPN	5	80	2N5004	100	33	70-200	2.5	70	TO59(I)	F
NPN	5	80	2N5005	100	33	70-200	2.5	70	TO59(I)	F
PNP	2	80	2N5149	100	4	70-200	1	60	TO5	F
NPN	2	80	2N5150	100	4	70-200	1	60	TO5	F
PNP	3	80	2N5153	100	6.7	70-200	2.5	70	TO5	F
NPN	3	80	2N5154	100	6.7	70-200	2.5	70	TO5	F
PNP	10	80	2N6127	100	67	30-120	5	50	TO61(I)	P
NPN	10	80	2N6128	100	67	30-120	5	50	TO61(I)	P
NPN	30	100	2N6273	120	150	40-200	5	75	TO63	P
NPN	18	90	SP10949	140	67	50-	7	180	TO61(I)	F-G
NPN	2.5	90	SP10950	140	5	50-	1.5	180	TO5	F-G
NPN	18	90	SP10951	140	33	50-	5	150	TO59(I)	F
NPN	25	80	SP10952	140	67	50-	7	150	TO61(I)	F-G
NPN	22	100	SP10953	150	67	50-	6	120	TO61(I)	F
NPN	20	80	SP10954	130	67	50-	8	120	TO61(I)	F
NPN	3	80	SP10955	130	4	50-	1.5	120	TO5	F
NPN	20	140	SP10956	170	100	50-	4	60	TO-61(I)	P-F
NPN	40	80	SP10957	100	200	30-	20	50	TO-63	F
NPN	3	70	SP10964	120	5	50-	1.5	250	TO5	G
NPN	15	80	SP10965	130	50	50-	8	250	TO61(I)	G
NPN	1	60	SP10958	100	3	50-	0.5	300	TO5	E
NPN	3	60	SP10959	100	5	50-	1.5	300	TO5	E
NPN	15	70	SP10960	110	50	50-	8	300	TO61(I)	E
PNP	1	60	SP10961	80	3	50-	0.5	300	TO5	E
PNP	3	60	SP10962	80	5	50-	1.5	300	TO5	E
PNP	15	70	SP10963	90	50	50-	8	300	TO-61(I)	E
NPN	5	70	SP10970	100	6.7	50-	8	120	TO-5	G
PNP	1	50	SP10971	80	0.75	50-	0 5	300	TO-18	E
NPN	1	50	SP10972	80	0.75	50-	0.5	300	TO-18	E

NOTE 1:

Test Parameter	Conditions
h_{FE} = 10 Min.	V_{CE} = 5V, $I_C = h_{FE}$ measurement current

Classes of Neutron Fluence (MCV equivalent)

P	F	G	E
n/cm²	n/cm²	n/cm²	n/cm²
1×10^{11}	1×10^{13}	7×10^{13}	3×10^{14}

MILITARY PRODUCTS CROSS REFERENCE
JM38510 SLASH SHEETS TO TI JANB PART NUMBER

JM38510/00101BCB	JANB5430J
JM38510/00102BCB	JANB5420J
JM38510/00103BCB	JANB5410J
JM38510/00104BCB	JANB5400J
JM38510/00105BCB	JANB5404J
JM38510/00106BCB	JANB5412J
JM38510/00107BCB	JANB5401J
JM38510/00108BCB	JANB5405J
JM38510/00109BCB	JANB5430J
JM38510/00201BCB	JANB5472J
JM38510/00202BCB	JANB5473J
JM38510/00203BCB	JANB54107J
JM38510/00204BEB	JANB5476J
JM38510/00205BCB	JANB5474J
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JM38510/00403BCB	JANB5425J
JM38510/00404BCB	JANB5427J
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JM38510/00502BCB	JANB5451J
JM38510/00503BCB	JANB5453J
JM38510/00504BCB	JANB5454J
JM38510/00602BEB	JANB5483J
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JM38510/30903BEB	JANB54LS157J
JM38510/30904BEB	JANB54LS158J
JM38510/30905BEB	JANB54LS251J
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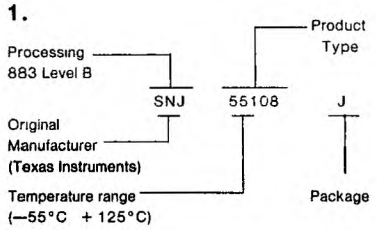
MILITARY PRODUCTS

Military I/C Cross Reference Guide

Linear/Interface Examples:

1.



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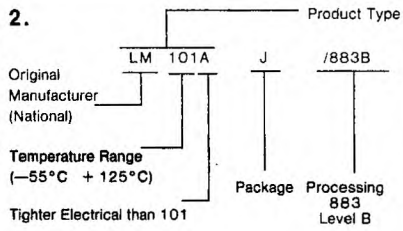

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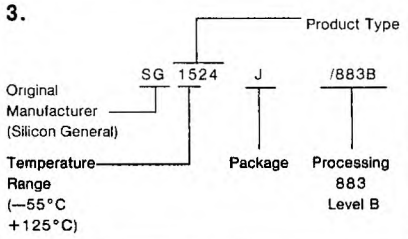

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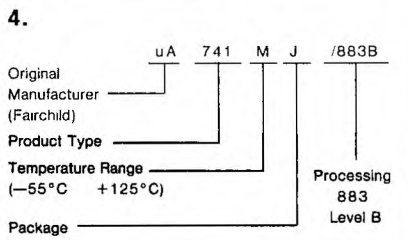

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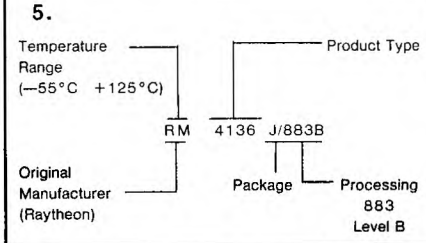

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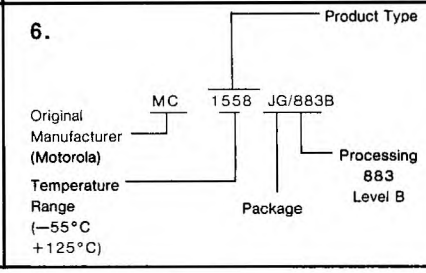


Logic

MANUFACTURER	PREFIX	DUAL-IN-LINE	FLAT PACK
T.I.	SNJ XXX	J	W
Motorola	54XX/BXBJC	L	F
National	DM XXXX	J/883B	W/883B
Signetics	S XXXX	F/883B	W/883B
Fairchild	XXXX	DMQB	FMQB
AMD	SN XXXX	DMB	FMB

MOS Memory

MANUFACTURER	PREFIX
T.I.	SMJ XXXX-XXJX
Mostek	MKB XXXX
Intel	M XXXX/B
Motorola	MCM XXXX BXBA
National	MM XXXX XX/883
AMD	XXXX DMB
Fairchild	XXXX DMQB

Bipolar PROM

ORG	TI	NATIONAL	SIGNETICS	INTEL	MMI	HARRIS	INTERSIL	AMD	FAIRCHILD	RAYTHEON	MOTOROLA
32 x 8	JBP18S030MJ JBP18SA030MJ	DM54S288J DM54S188J	S82S123F S82S23F		5331-1J 5330-1J	HM7603-8 HM7602-8	IM5610MJ IM5600MJ	27S19DMB 27S18DMB			
256 x 4	JBP24S10MJ JBP24SA10MJ	DM54S287J DM54S387J	S82S129F S82S126F	M3621 M3601	5301-1J 5300-1J	HM7611-8 HM7610-8	IM5623MJ IM5603MJ	27S21DMB 27S20DMB	93427DMQB 93417DMQB	29661DMB 29660DMB	
256 x 8	JBP28L22MJ	DM54S471J DM54S470J			5309-1J 5308-1J					29601DMB 29600DMB	
512 x 8	JBP28S42MJ	DM54S472J DM54S473J	S82S147F S82S146F		5349-1J 5348-1J	HM7649-8 HM7648-8		27S29DMB 27S28DMB		29621DMB 29620DMB	
512 x 8	JBP28S46MJ	DM54S474J DM54S475J	S82S141F S82S140F	M3624 M3604	5341-1J 5340-1J	HM7641-8 HM7640-8	IM5625MJ IM5605MJ	27S31DMB 27S30DMB	93448DMQB 93438DMQB	29625DMB 29624DMB	MCM7641 MCM7640
1024 x 4	JBP24S41MJ	DM54S573J DM54S572J	S82S137F S82S136F	M3625 M3605	5353-1J 5352-1J	HM7643-8 HM7642-8		27S33DMB 27S32DMB	93453DMQB 93452DMQB	29641DMB 29640DMB	MCM7643 MCM7642
1024 x 8	JBP28S86MJ	DM77S181J DM77S180J	S82S181F S82S180F	M3628 M3608	5381-1J 5380-1J	HM7681-8 HM7680-8		27S181DMB 27S180DMB	93451DMQB 93450DMQB	29631DMB 29630DMB	MCM7681 MCM7680
2048 x 4	JBP24S81AMJ	DM77S185J DM77S184J	S82S185F S82S184F			HM7685-8 HM7684-8		27S185DMB 27S184DMB		29651DMB 29650DMB	MCM7685 MCM7684
2048 x 8	JBP28S166AMJ	DM77S191J DM77S190J	S82S191F S82S190F	M3636		HM76161-8 HM76160-8		27S191DMB 27S190DMB	93511DMQB 93510DMQB	29681DMB 29680DMB	

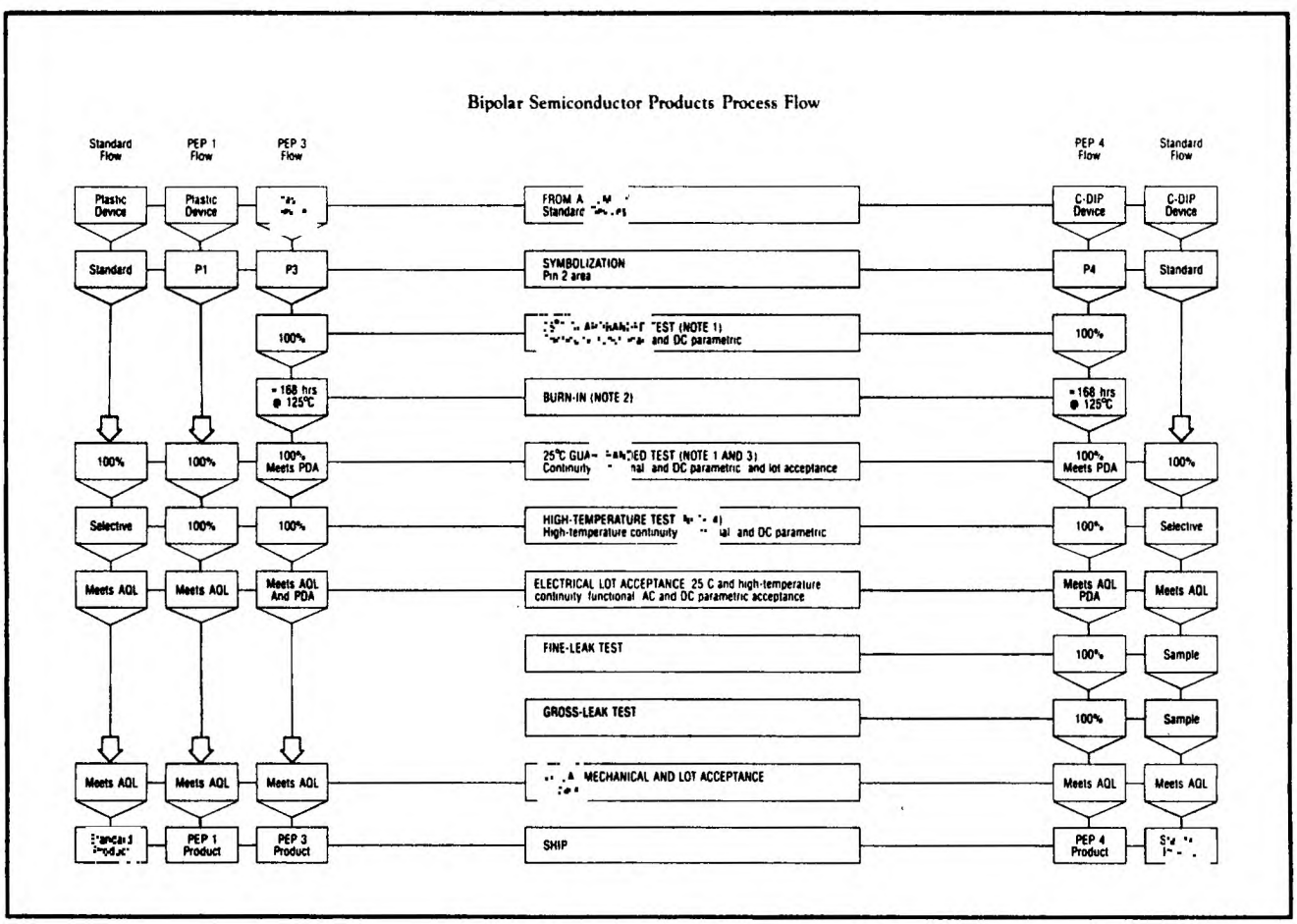
Note: This is a functional cross-reference.
National, Signetics and MMI use "883B" suffix to indicate military processing to MIL-STD-883B.

Texas Instruments
Product Enhancement Program
PEP

QUALITY IS . . .
a product's degree of conformance to its specified parameters. It pertains to the probability of defective units existing in a given lot when received by the user. Although zero percent defective is a goal, the probability of some percentage of defective units exists in any lot of mass produced items. The number of defective units received by the user is a function of the acceptable outgoing quality (AOQ) used by the supplier.

RELIABILITY IS . . .
a measurement of how well an initially good device will perform over time to its specified characteristics. Semiconductor failures primarily occur during the early life phase of operation. A continually diminishing failure rate can be expected until the wear-out phase is eventually reached. System reliability is improved if these potential early-life failures are found and not installed in the system.

The Product Enhancement Program (PEP) is an effective approach to lower total system cost. Three levels of 100% processing - PEP 1, 3, 4 provide you with high quality material for your application. A brief description of this program is shown below. The following process flow is effective on PEP products bearing date code 8309 and subsequent.



Notes:
(1). All products are tested at 25°C to guardbanded data sheet limits.
(2). Burn-in is the equivalent of 125°C for 168 hours at 0.96 ev activation energy. Some high-power dissipation 74AS, STTL, TTL, interface, linear, and bipolar memory devices are derated to 125°C junction temperature.
(3). Post Burn-in a percent defective allowable (PDA) is 2% for all digital logic and 5% for all interface, linear and biopolar memory devices. PDA on rescreened products is at half this percent, 1% and 2.5% respectively.
(4). 74ALS and LS are tested at 80°C to data sheet limits, 74AS, bipolar memory, STTL, and TTL, are tested at 100°C to guardbanded (0°C to 70°C) data sheet limits. Interface and linear are tested at maximum data sheet temperature to data sheet limits.

INTEGRATED CIRCUITS PART NUMBER CODING

Digital Circuits

XXX XXXXX XXXX XXX

- XXX: Prefix
- XXXXX: Family
- XXXX: 2-to4-character unique device designator
- XXX: PEP Level or Lead modification — See Table B
- XXX: Package — See Table A

Prefix

AC	Custom Circuits
SN	Standard Circuits
SNJ	MIL STD-883 Method 5004 Level B
SNC	MACH IV, Level 3, Bipolar Circuits
JANB	JAN-Qualified Circuits, Level B

Family

Series		Description
– 55°C to 125°C	0°C to 70°C	
54	74	Standard TTL Circuits
54H	74H	High-speed TTL
54L		Low-power TTL
54LS	74LS	Low-power Schottky TTL
54S	74S	Schottky TTL
54AL	74AS	Advanced Schottky TTL
54ALS	74ALS	Advanced Low-power Schottky TTL
	76	Custom Circuits

Linear and Interface Circuits

XXX XXXXX XX

Package Type (See Table A)

ORIGINAL MANUFACTURER	PREFIX	DEVICE NUMBER	TEMP * RANGE	Op Amps	Comparators	A/D Converters	Voltage Regulators	Timers	Special Functions	Line Circuits	Display Drivers	Interface Drivers
TI	TL	XXXC XXXI XXXM	COM IND MIL	X	X	X	X		X			
	SN	75XXX 55XXX	COM MIL							X	X	X
NATIONAL	LM	1XXX 2XXX 3XXX	MIL IND COM	X	X		X					
	ADC	XXXX	COM			X						
	DS	78XX 88XX	MIL COM							X	X	
RAYTHEON	RC RM	4XXX 4XXX	COM MIL	X								
SIGNETICS	NE SA SE	5/55XX 5/55XX 5/55XX	COM AUTO MIL	X				X	X			
	N8T	XX	COM							X		
FAIRCHILD	uA	7XXXC 7XXXI 7XXXM	COM IND MIL	X	X		X	X	X			
	uA	9XXX	COM							X		
MOTOROLA	MC	13/33XX 14/34XX 15/35XX	IND COM MIL	X			X		X	X		
SPRAGUE	UCN UDN ULN	XXXX XXXX XXXX	COM COM COM							X	X	
AMD	AM	····XM ····XC	MIL COM							X		
SILICON GENERAL	SG	15XX 25XX 35XX	MIL IND COM				X					
PMI	OP-	XX	COM	X								

*** Temperature ranges:**

COM = 0°C to 70°C
IND = – 25°C to 85°C
AUTO = – 40°C to 85°C
MIL = – 55°C to 125°C

Table A — Packages

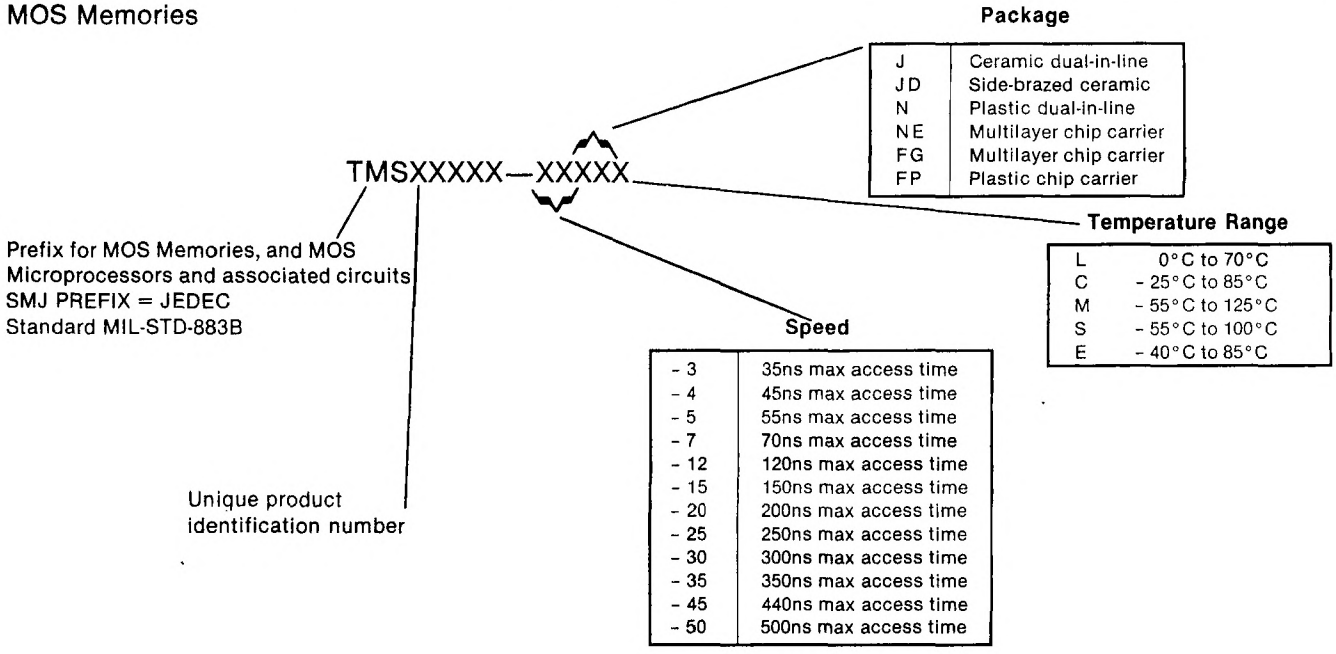
TYPE	PACKAGE DESCRIPTION
N	Plastic DIP
NE, NG	Plastic DIP, copper lead frame
NF	Plastic DIP, 28 pin, 400 mil
NT	Plastic DIP, 24 pin, 300 mil
P	Plastic DIP, 8 pin
D	Plastic SO, small outline
J	Ceramic DIP
JD	Ceramic DIP, side braze
JG	Ceramic DIP, 8 pin
FE, FG	Ceramic chip carrier, rectangular
FH, FK	Ceramic chip carrier, square
FN	Plastic chip carrier, square
KA	TO-3 metal can
KC	TO-220 plastic, power tab
LP	TO-226 plastic
U	Ceramic flat pack, square
W, WC	Ceramic flat pack, rectangular

Table B — Special Processing

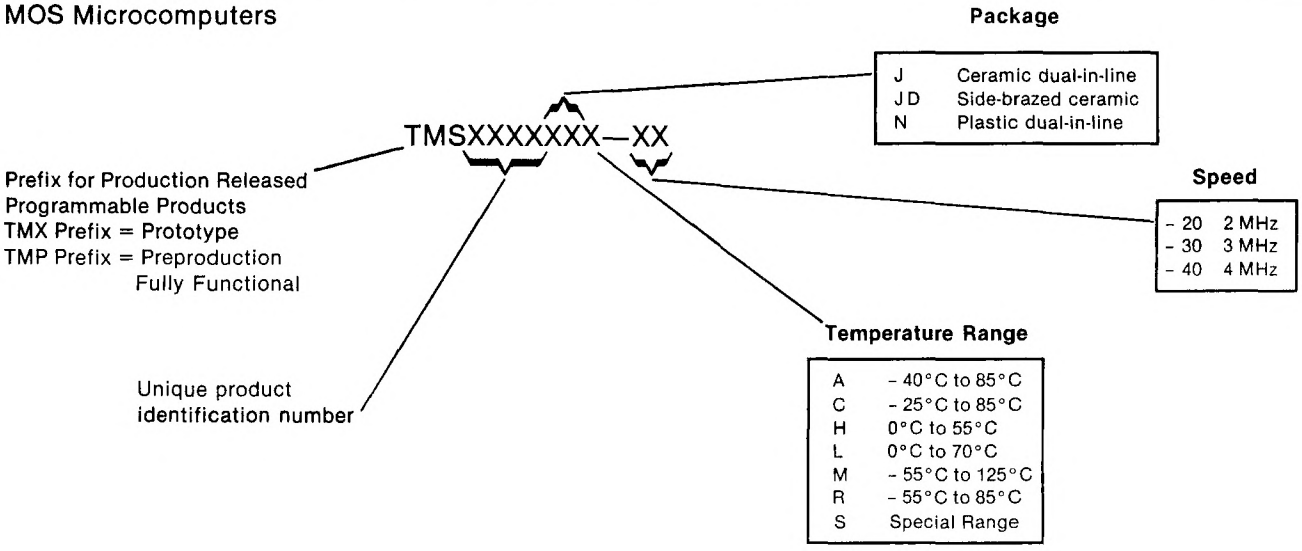
SUFFIX	DESCRIPTION
3	PEP processing, level 3
4	PEP processing, level 4
10	Solder dipped leads

INTEGRATED CIRCUITS PART NUMBER CODING

MOS Memories

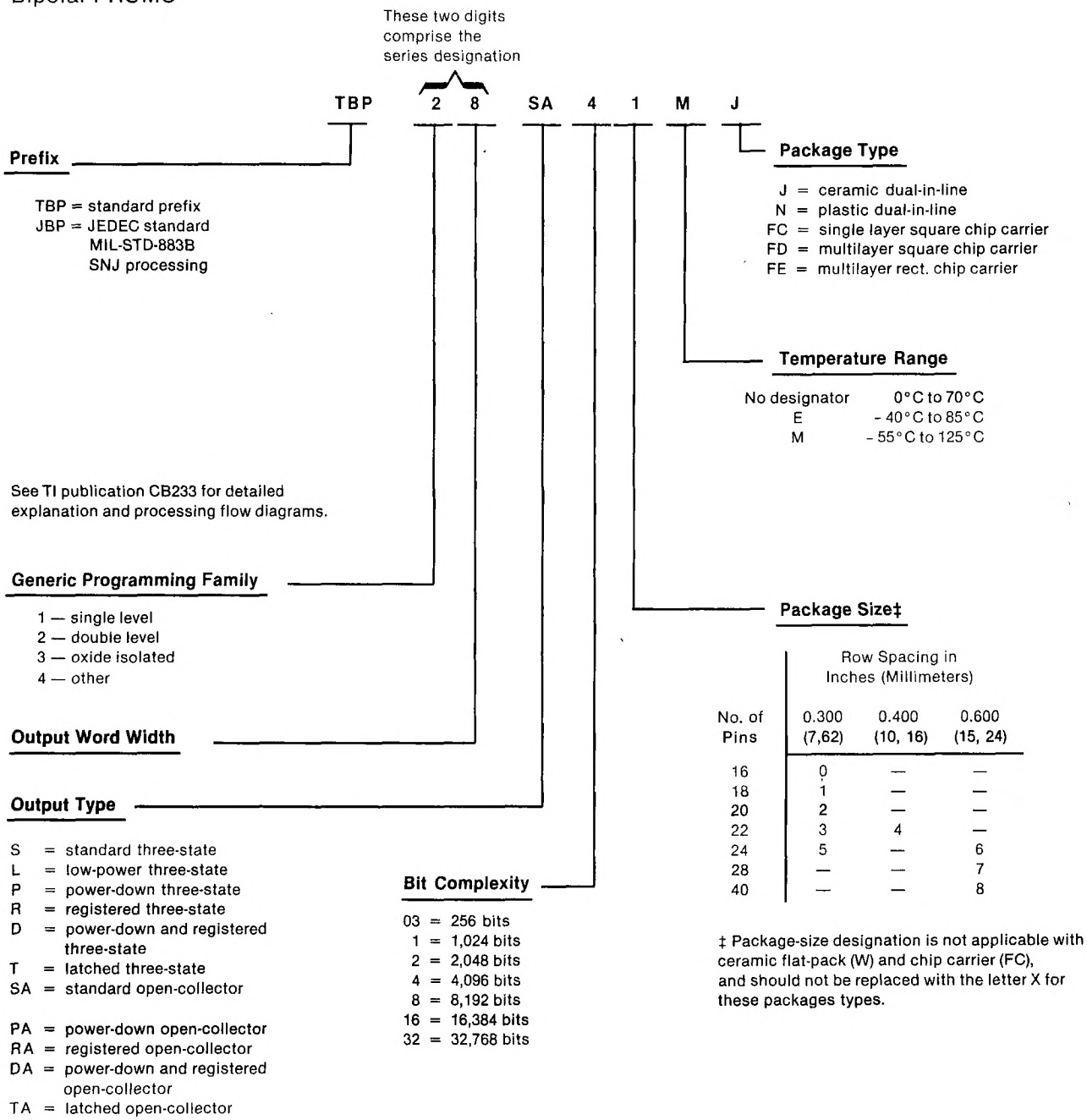


MOS Microcomputers



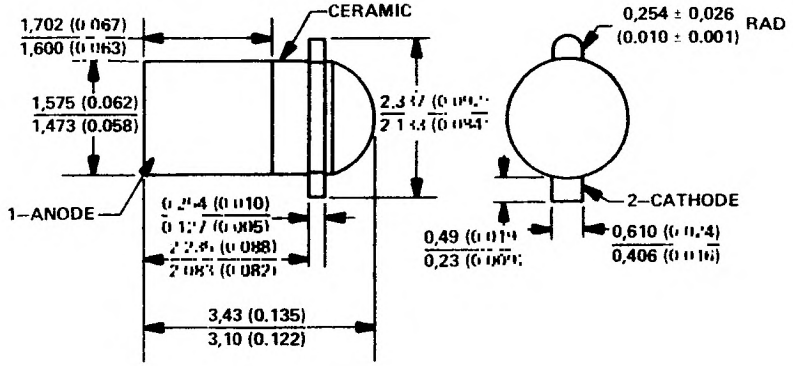
INTEGRATED CIRCUITS PART NUMBER CODING

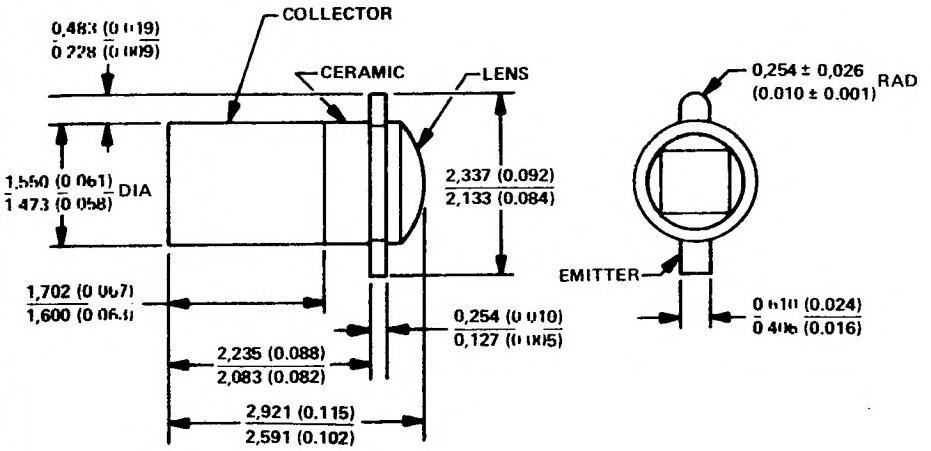
Bipolar PROMS



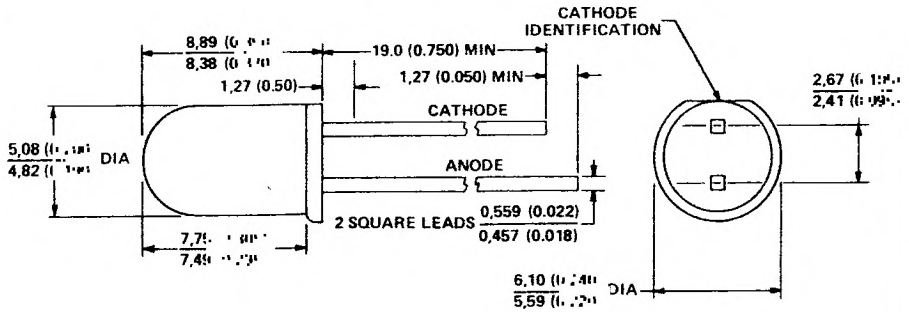
No. of Pins	Row Spacing in Inches (Millimeters) 0.300 (7,62)	0.400 (10, 16)	0.600 (15, 24)
16	0	—	—
18	1	—	—
20	2	—	—
22	3	4	—
24	5	—	6
28	—	—	7
40	—	—	8

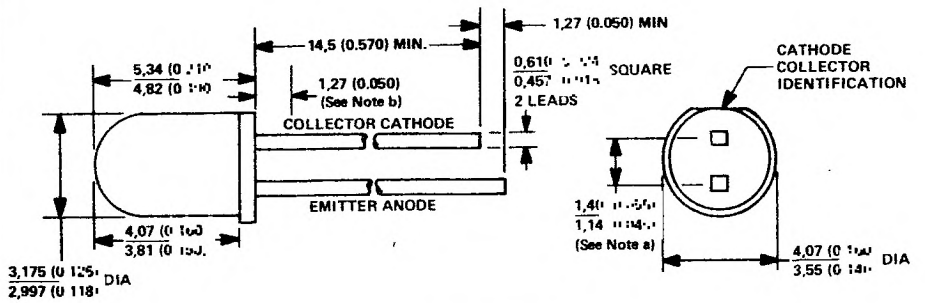
‡ Package-size designation is not applicable with ceramic flat-pack (W) and chip carrier (FC), and should not be replaced with the letter X for these packages types.





CL-1 CL-2 CL-10 CL-9





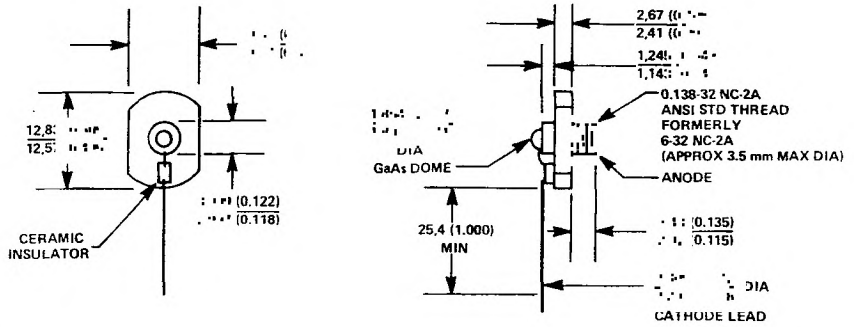
NOTES: a. This diameter is measured 0,127 mm (0.005 inches) from the shoulder.
b. Lead spacing is measured where the leads emerge from the package.

APPENDIX-PACKAGE OUTLINE DRAWINGS

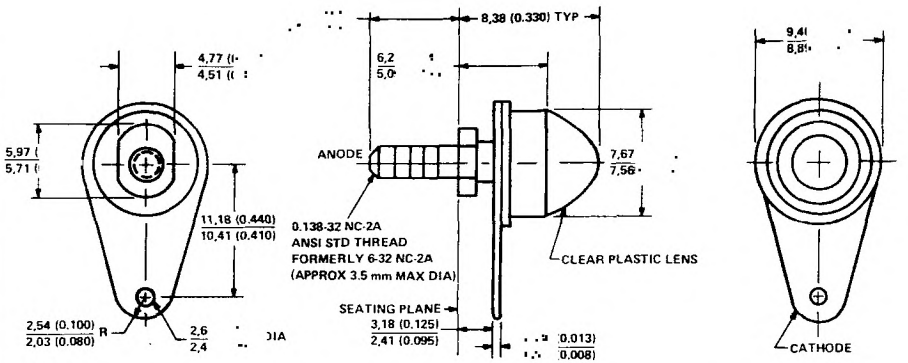
APPENDIX-PACKAGE OUTLINE DRAWINGS

ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

CL-15

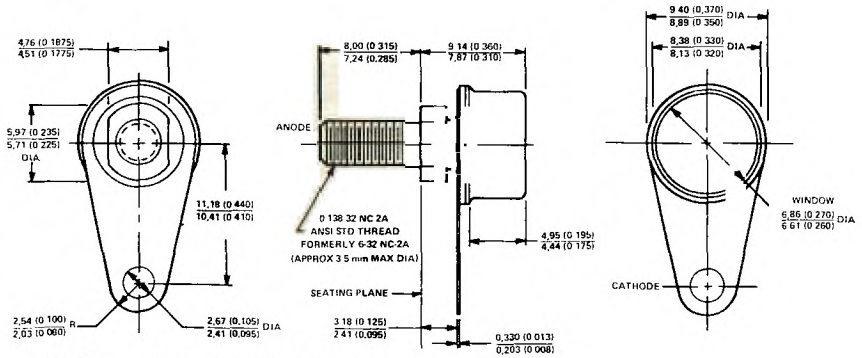


CL-16



NOTES: a. The orientation of the lug in relation to the stud flats is not controlled.
b. Torque between stud and lug must be avoided. Flats are provided on the stud for tightening to heat sink.

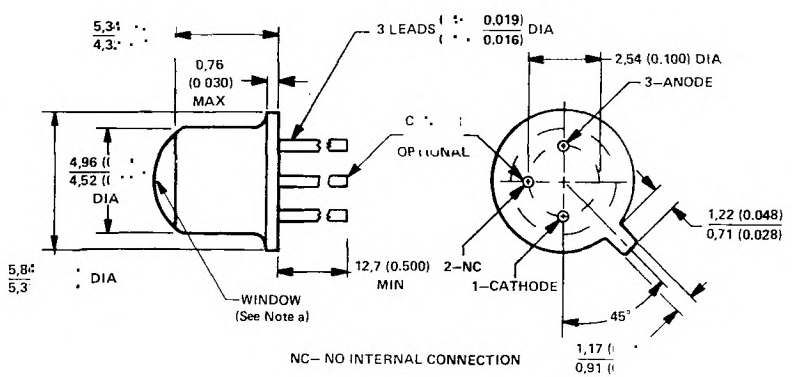
CL-17



NOTES a. Torque between stud and can or lug must be avoided. Flats are provided on the stud for tightening to heat sink.
b. The orientation of the lug in relation to the stud flats is not controlled.

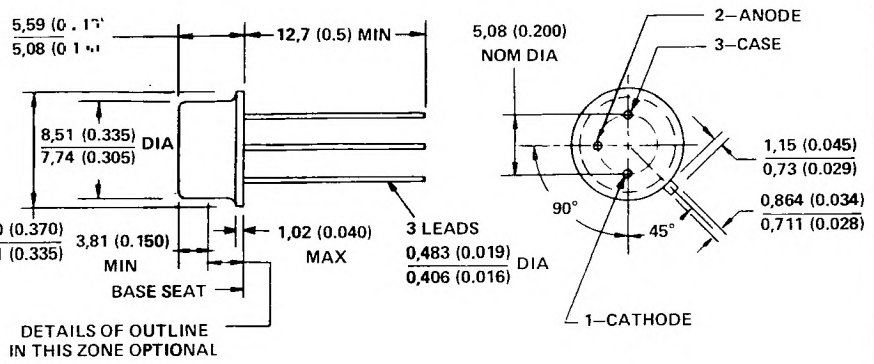
CL-18

THE COLLECTOR IS IN ELECTRICAL CONTACT WITH THE CASE

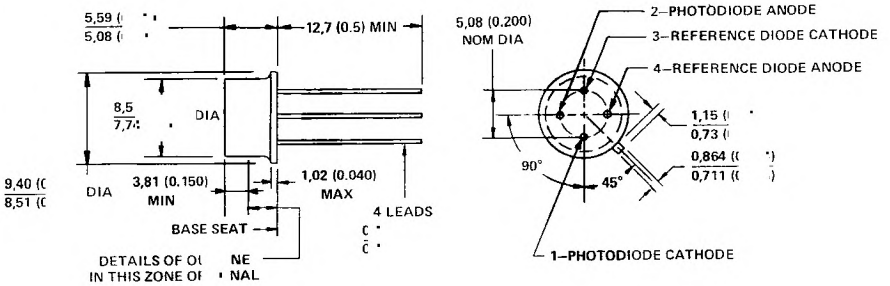


NC– NO INTERNAL CONNECTION

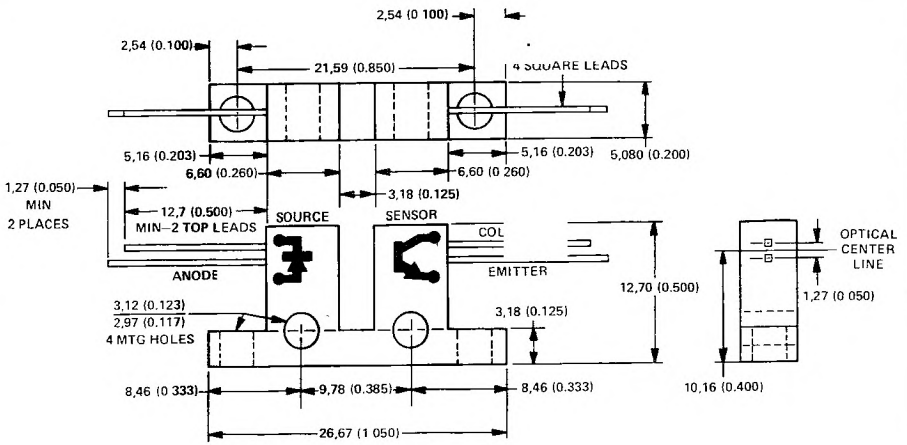
CL-19



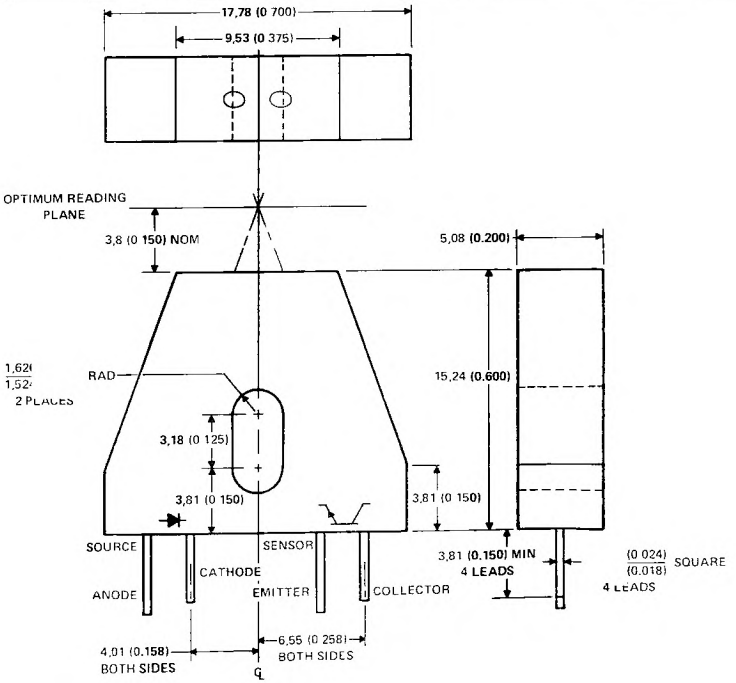
CL-21



CL-28



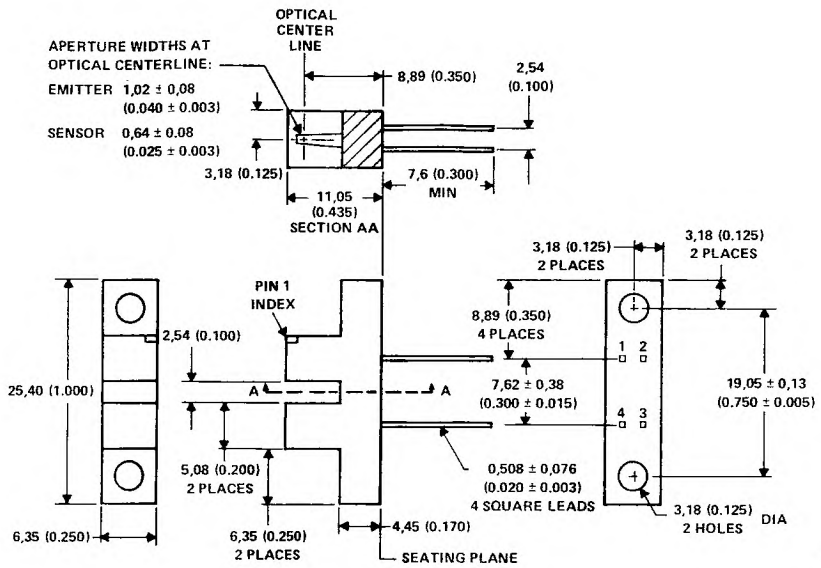
CL-29



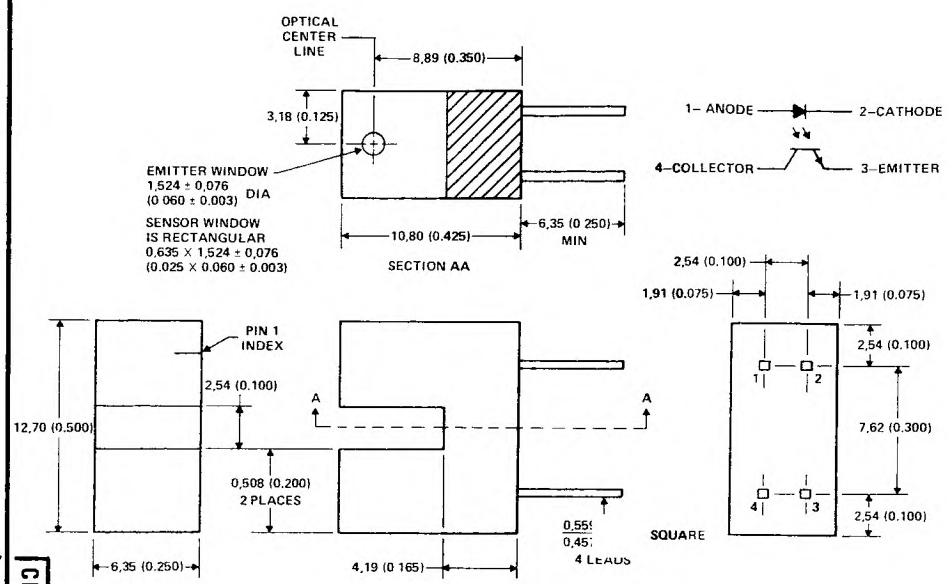
APPENDIX-PACKAGE OUTLINE DRAWINGS

APPENDIX-PACKAGE OUTLINE DRAWINGS

ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

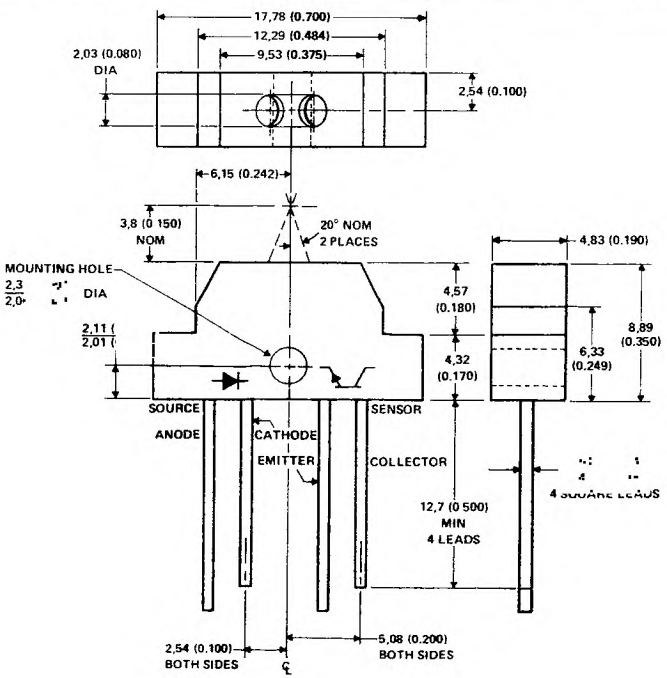


CL-31

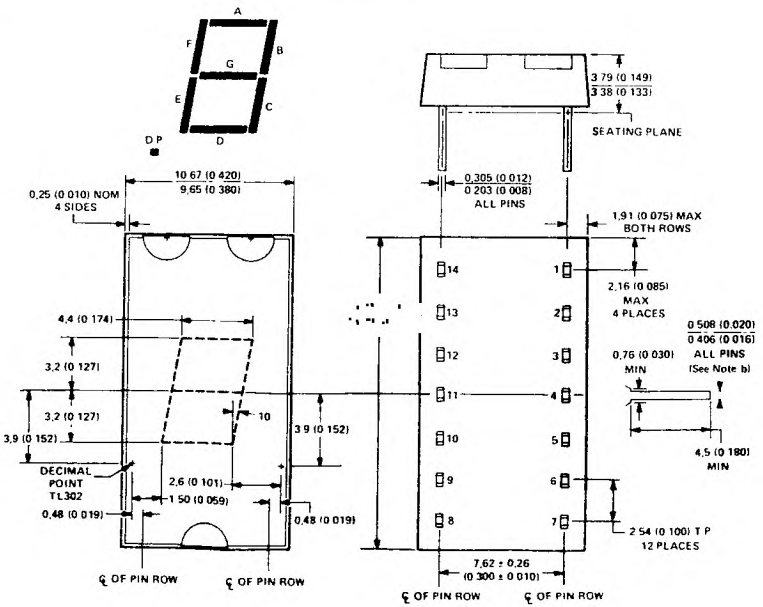


CL-32

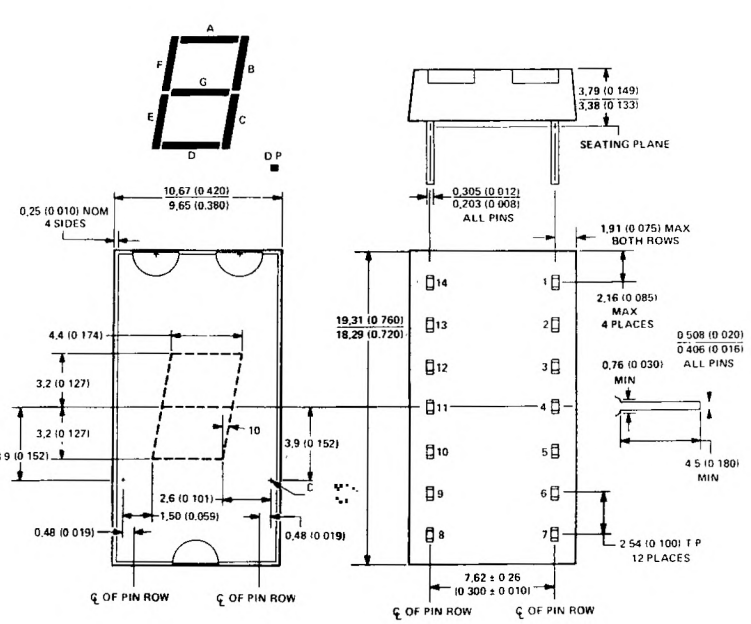
CL-33



CL-34

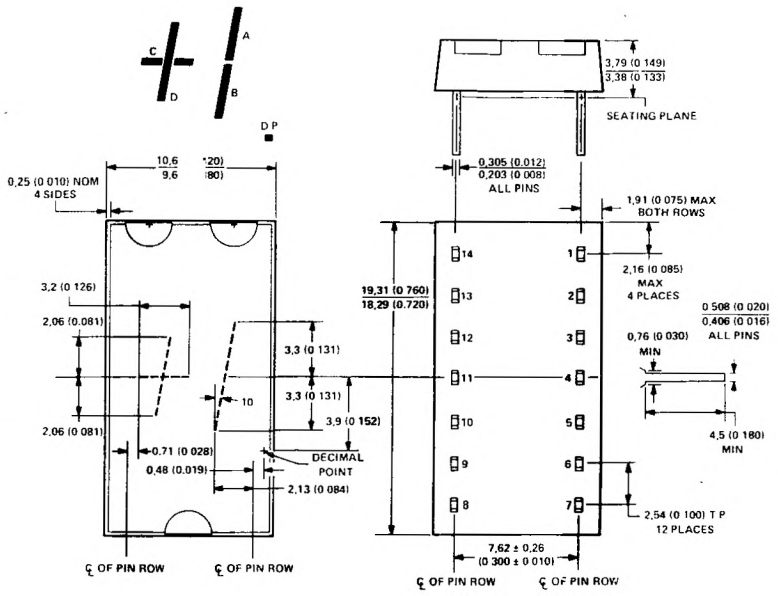


ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES



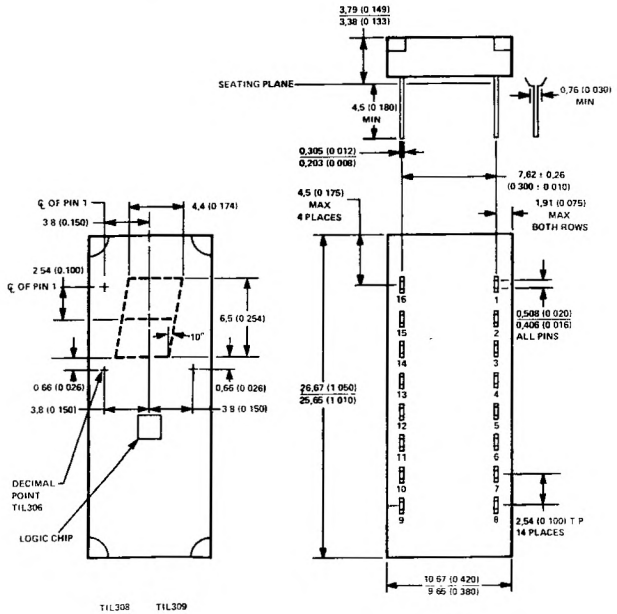
CL-35

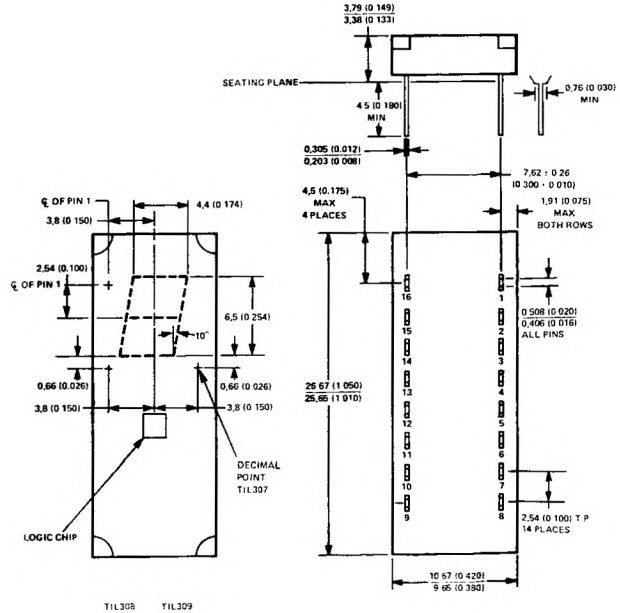
CL-36



CL-38

CL-39



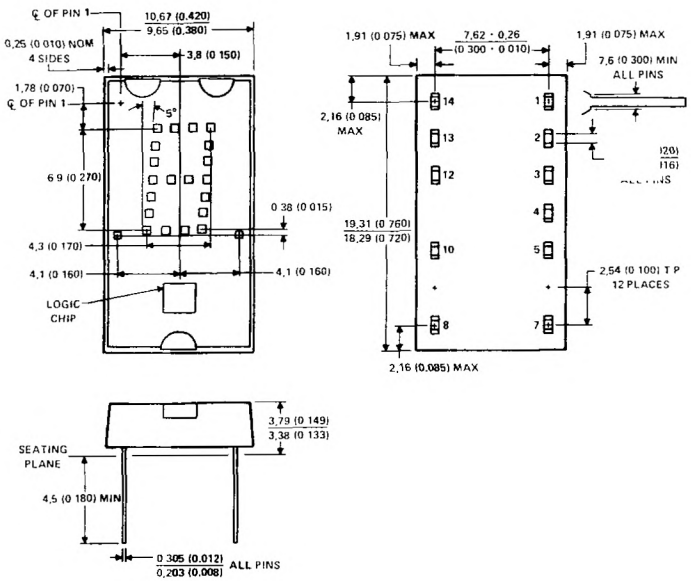


APPENDIX-PACKAGE OUTLINE DRAWINGS

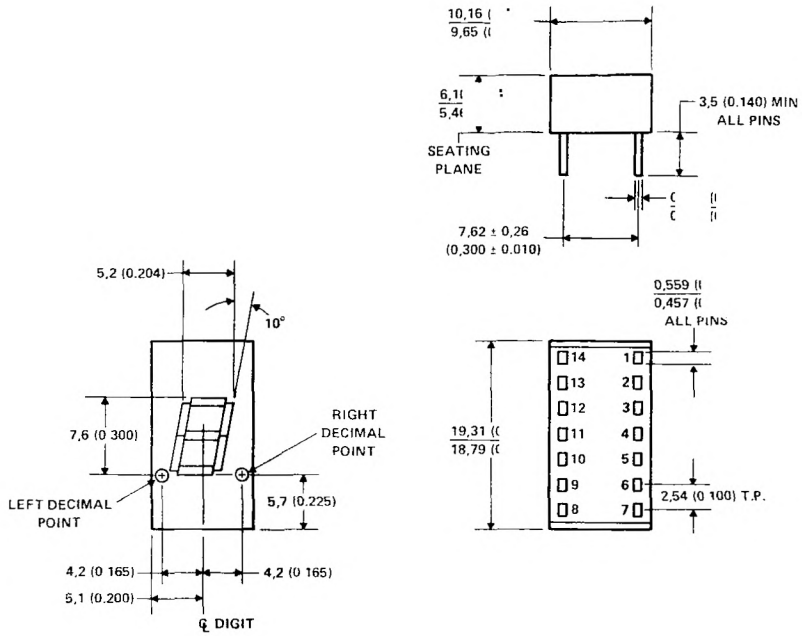
APPENDIX-PACKAGE OUTLINE DRAWINGS

ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

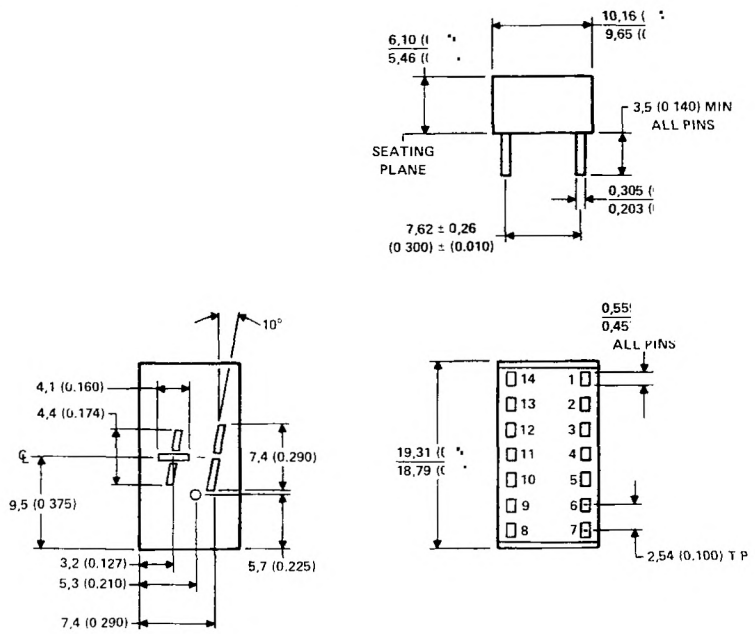
CL-40



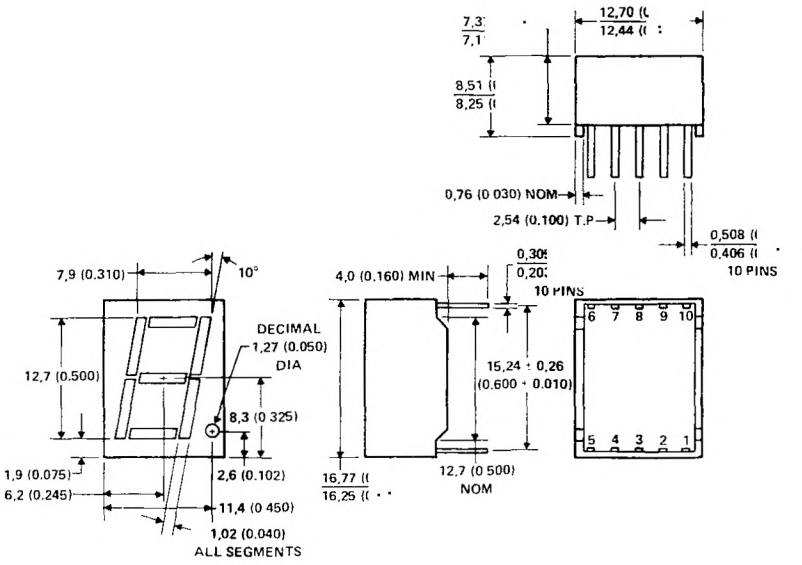
CL-41

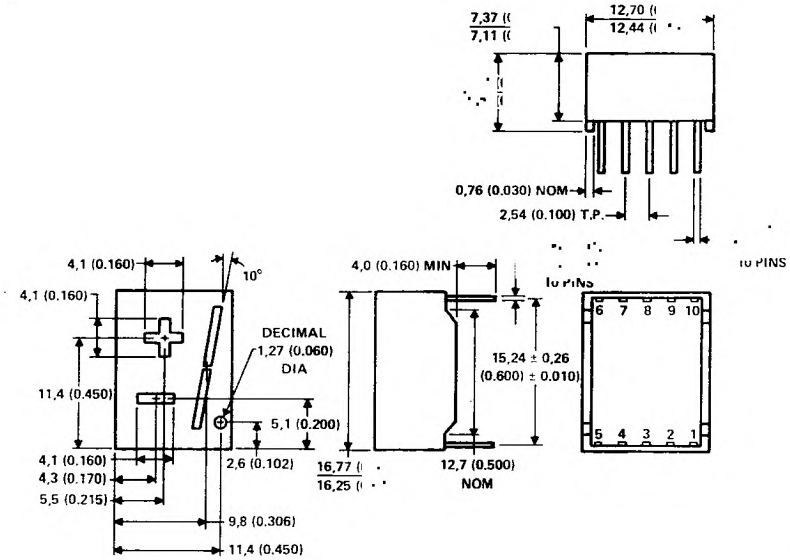


CL-42

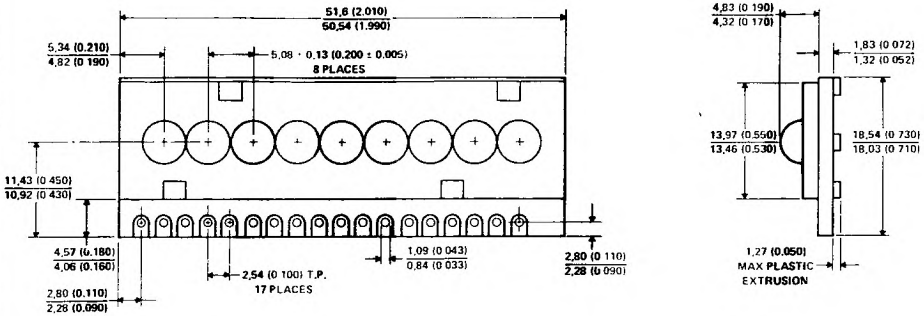


CL-43



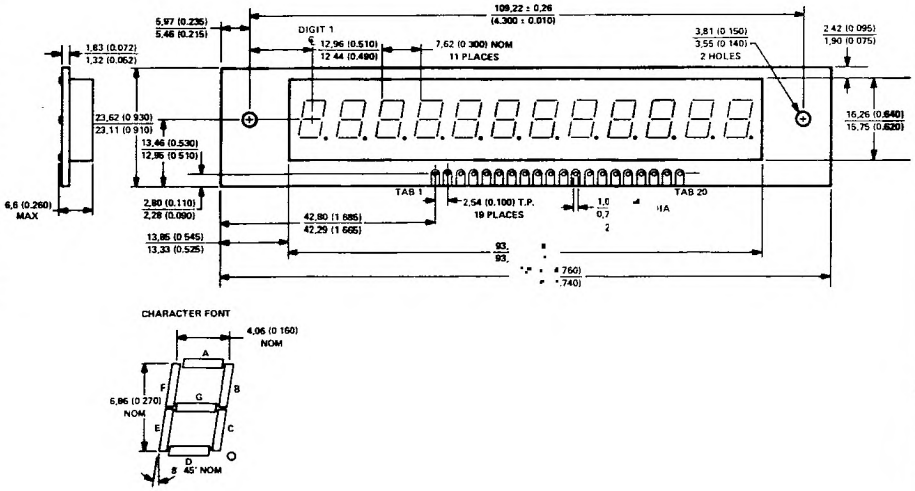


CL44

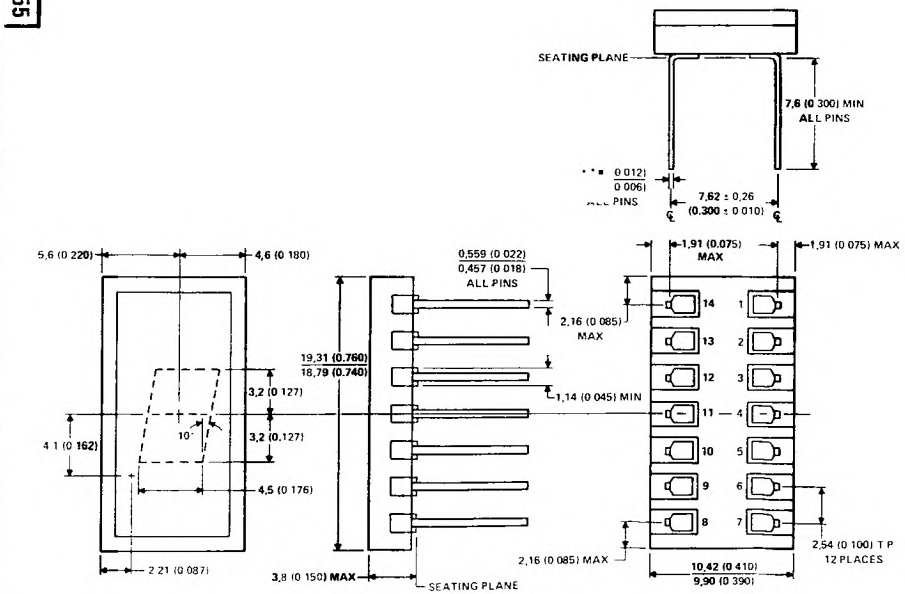


CL47

CL48



CL55

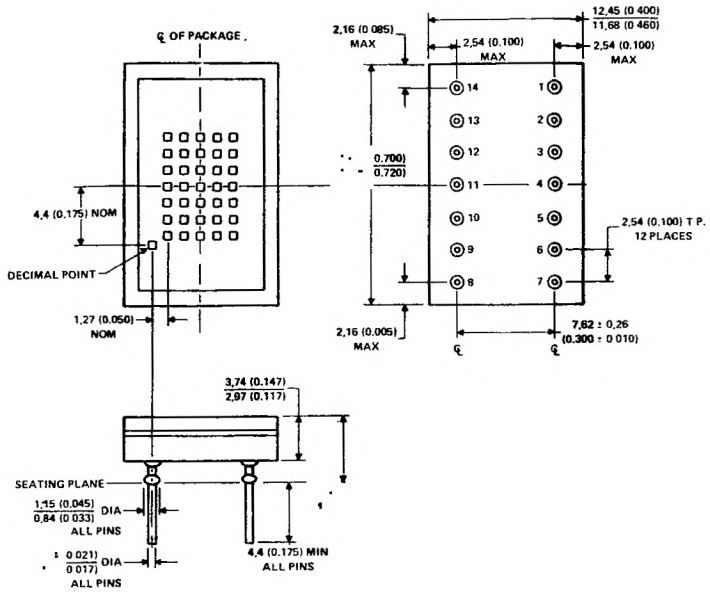


APPENDIX-PACKAGE OUTLINE DRAWINGS

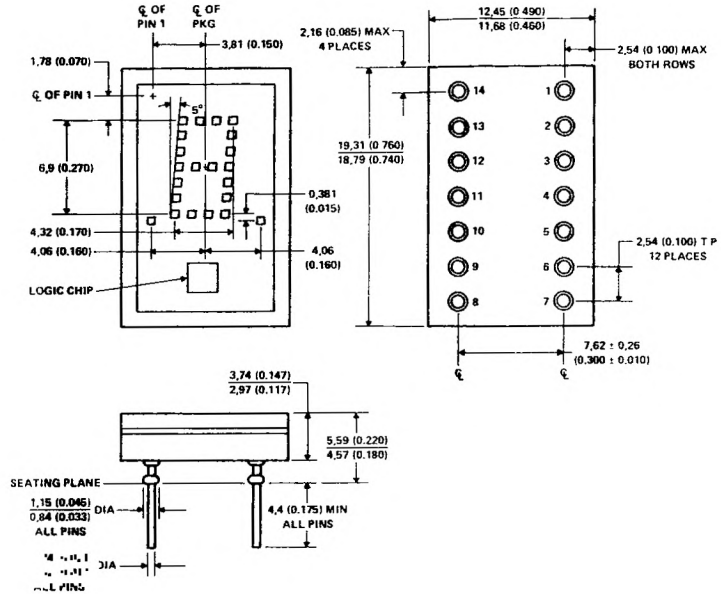
APPENDIX-PACKAGE OUTLINE DRAWINGS

ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

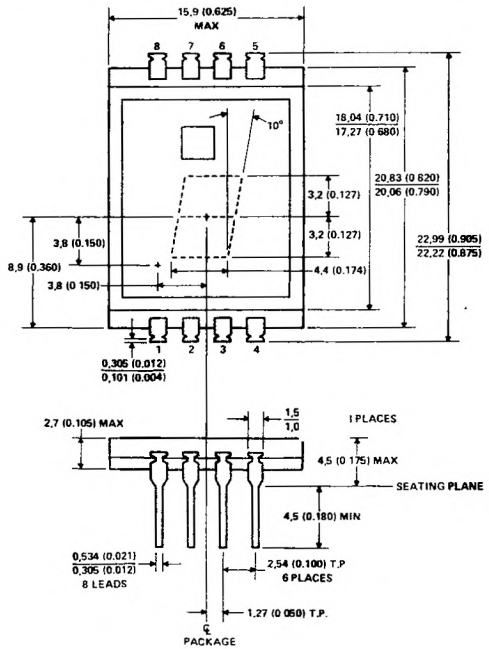
CL-56



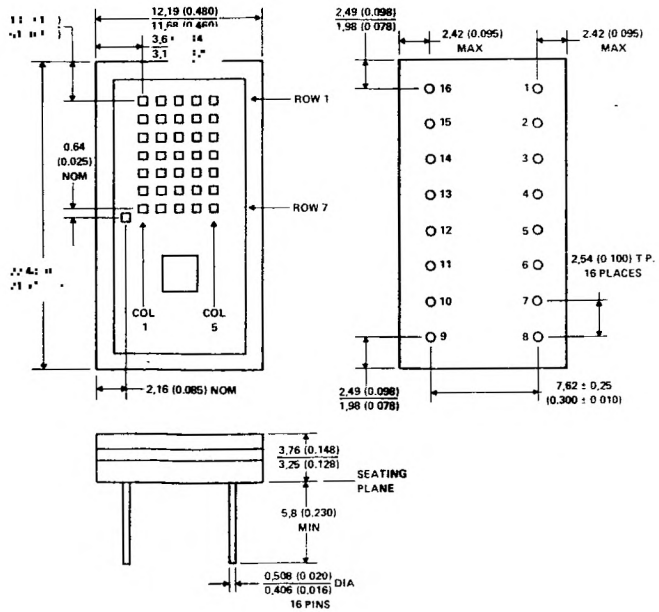
CL-57



CL-58

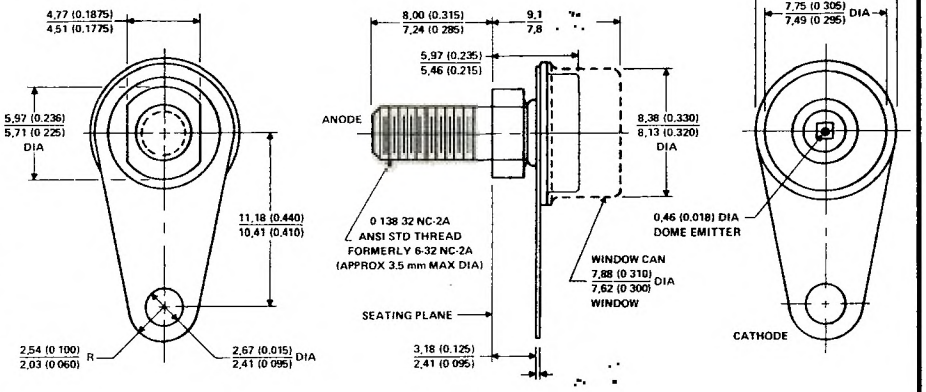


CL-59

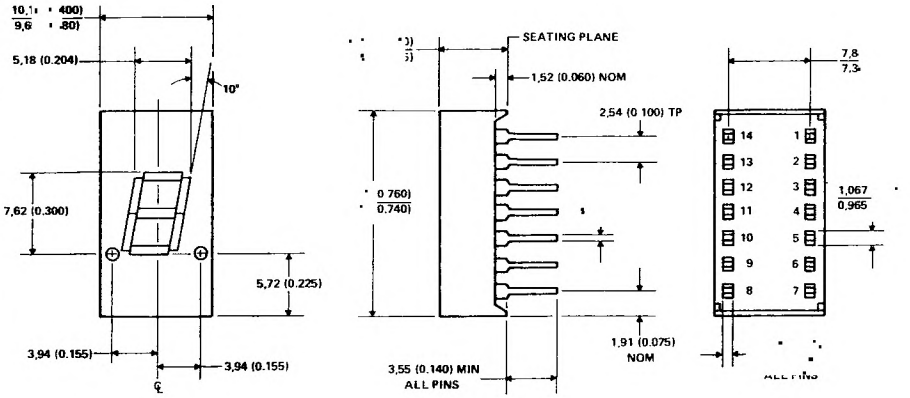


ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

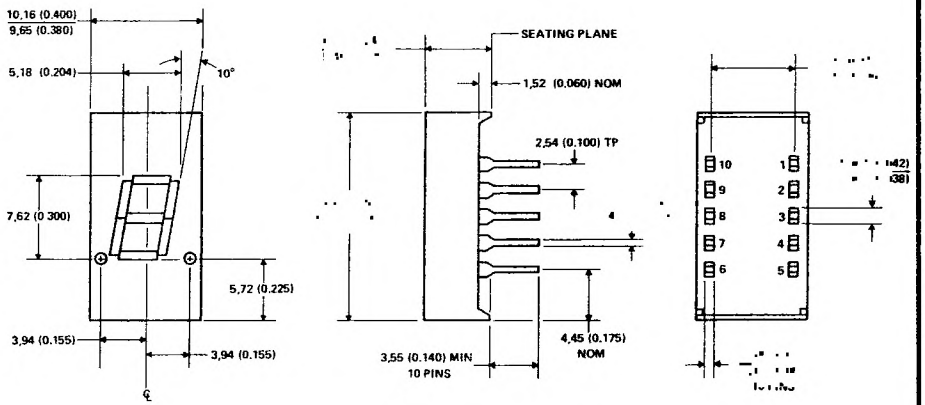
CL-61



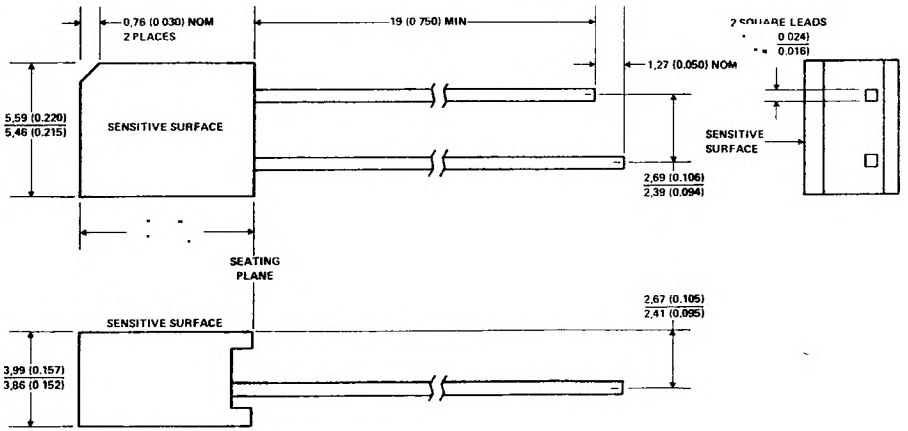
CL-63



CL-65

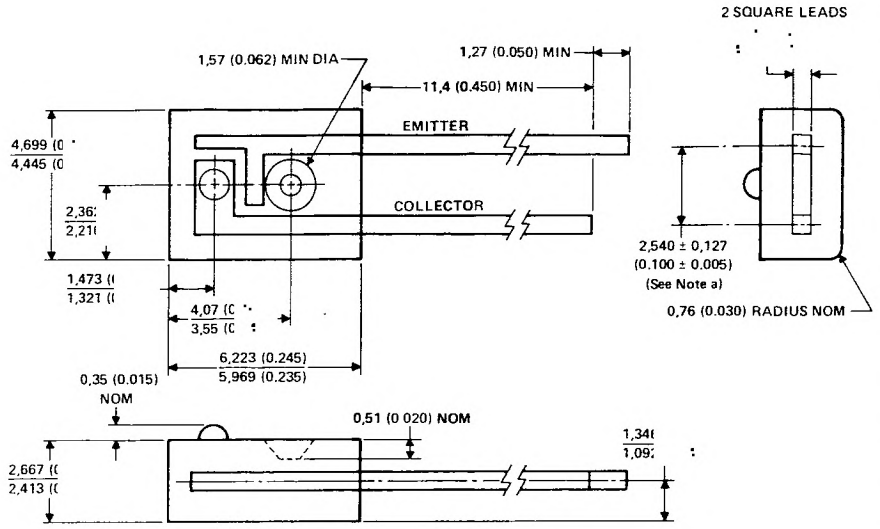


CL-66



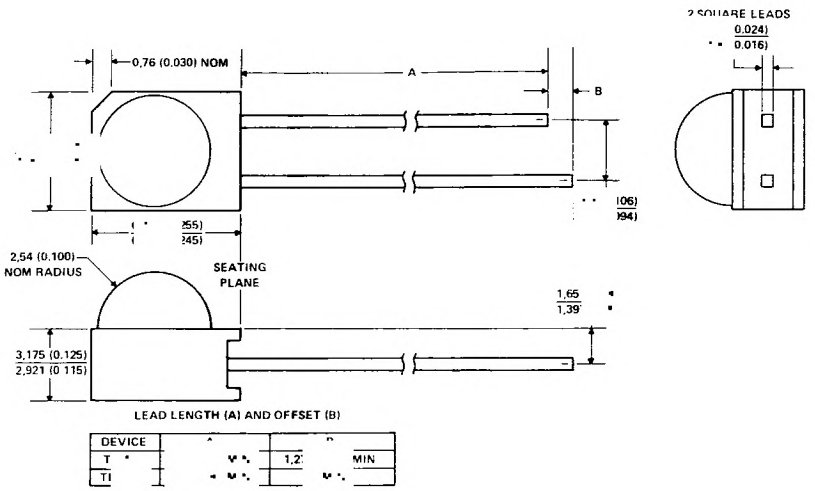
APPENDIX-PACKAGE OUTLINE DRAWINGS

CL-67



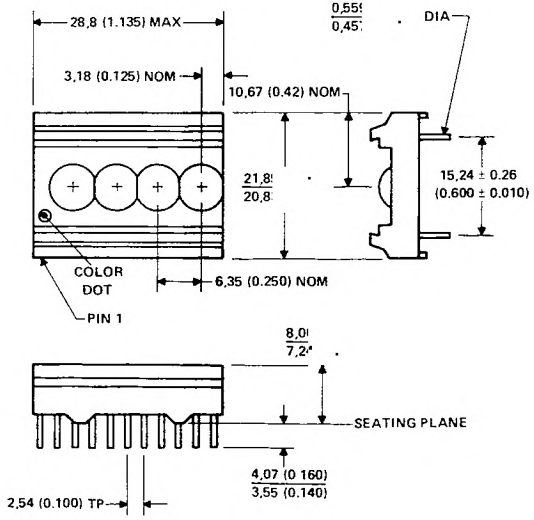
NOTE Lead spacing is measured where the leads emerge from the package.

CL-68



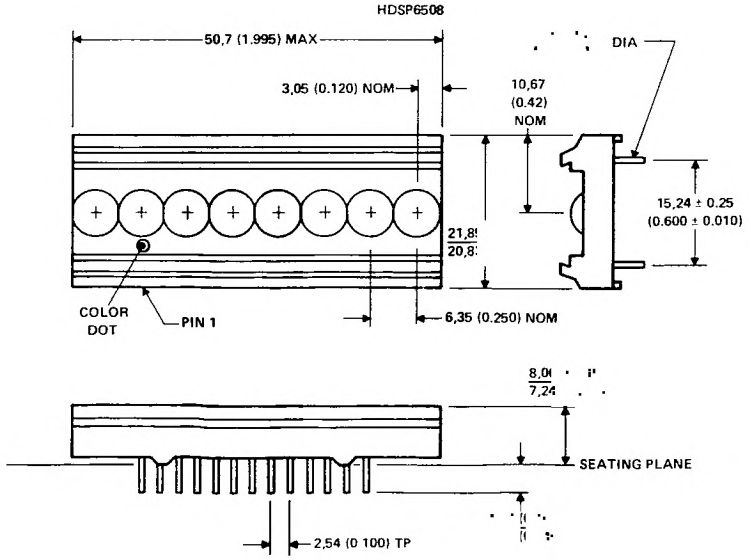
CL-70

HDSP6504



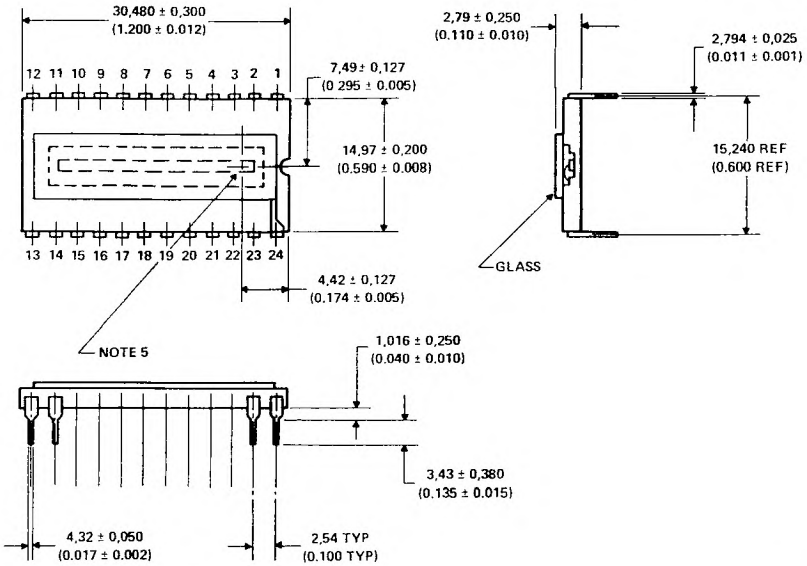
CL-71

HDSP6508

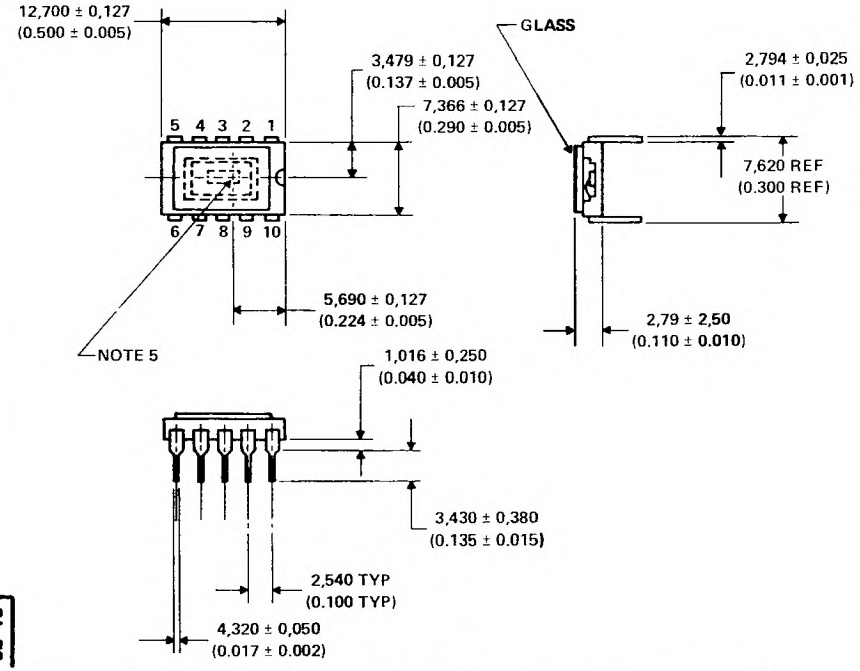


ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

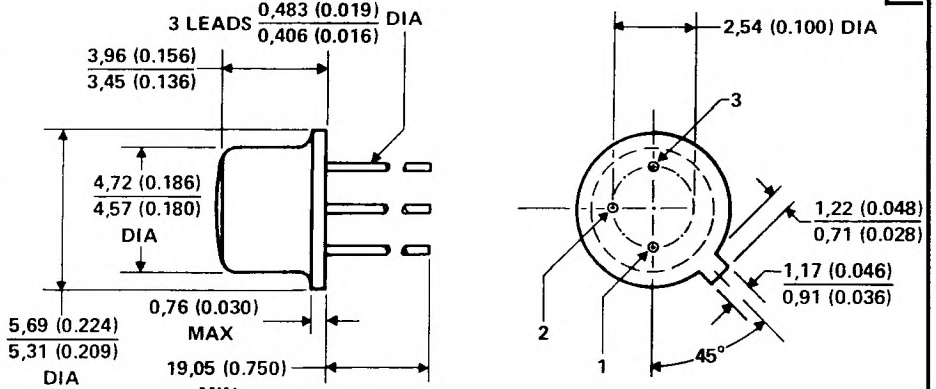
CL-75



CL-76

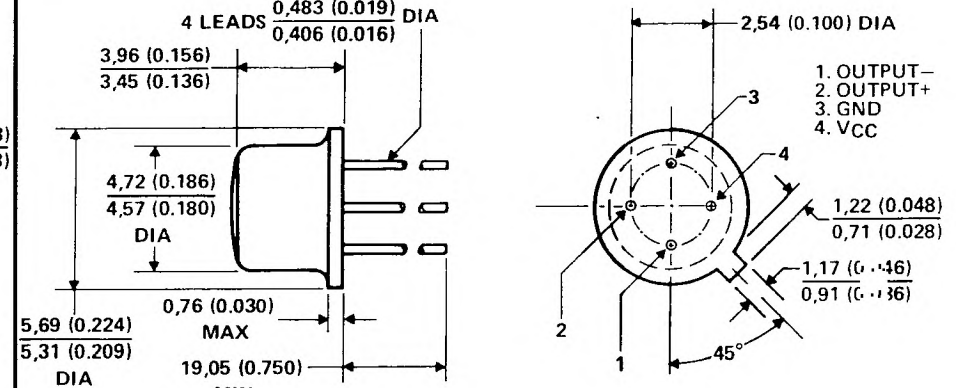


CL-77



1. ANODE
2. CATHODE
3. CASE

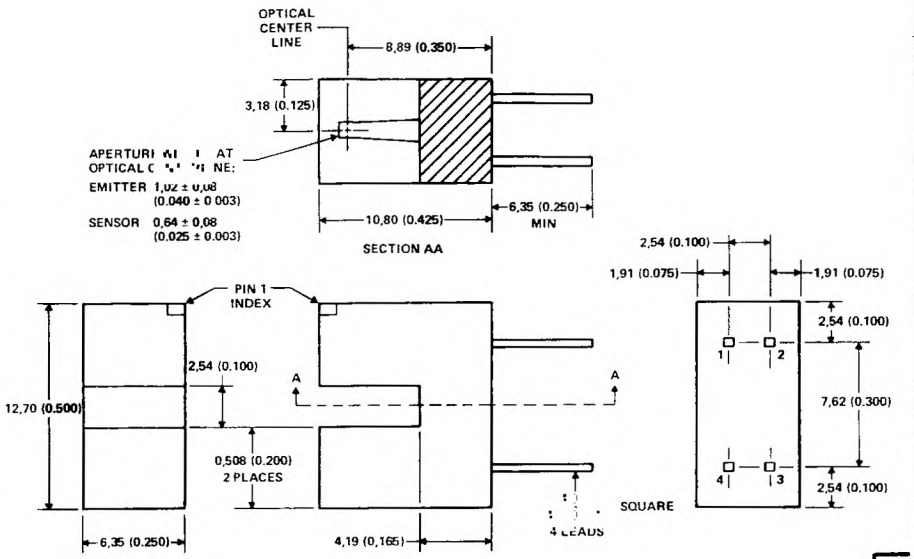
CL-79



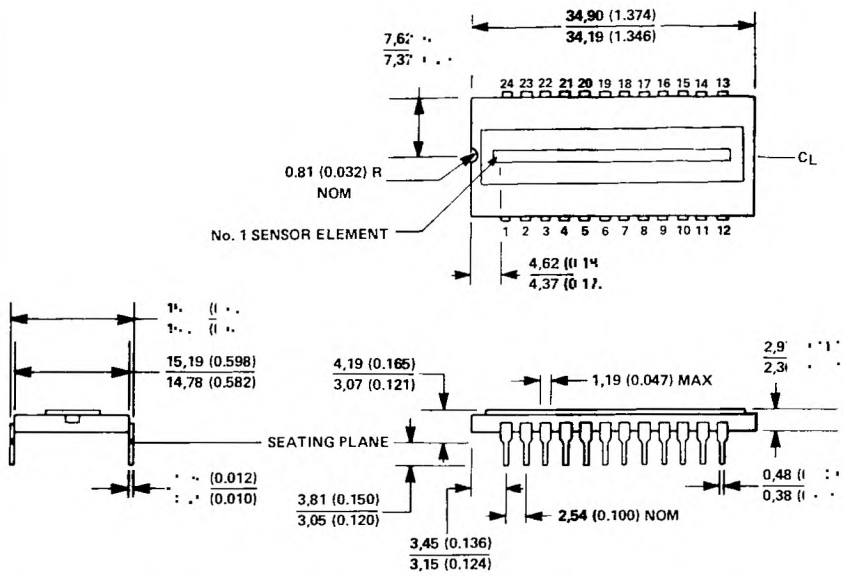
1. EMITTER
2. COLLECTOR
3. CASE

APPENDIX-PACKAGE OUTLINE DRAWINGS

CL-81

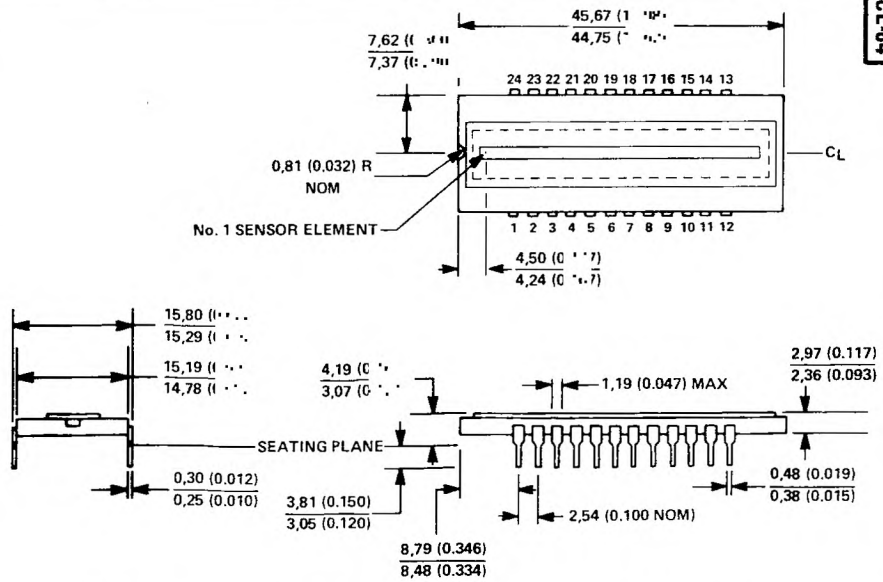


CL-83



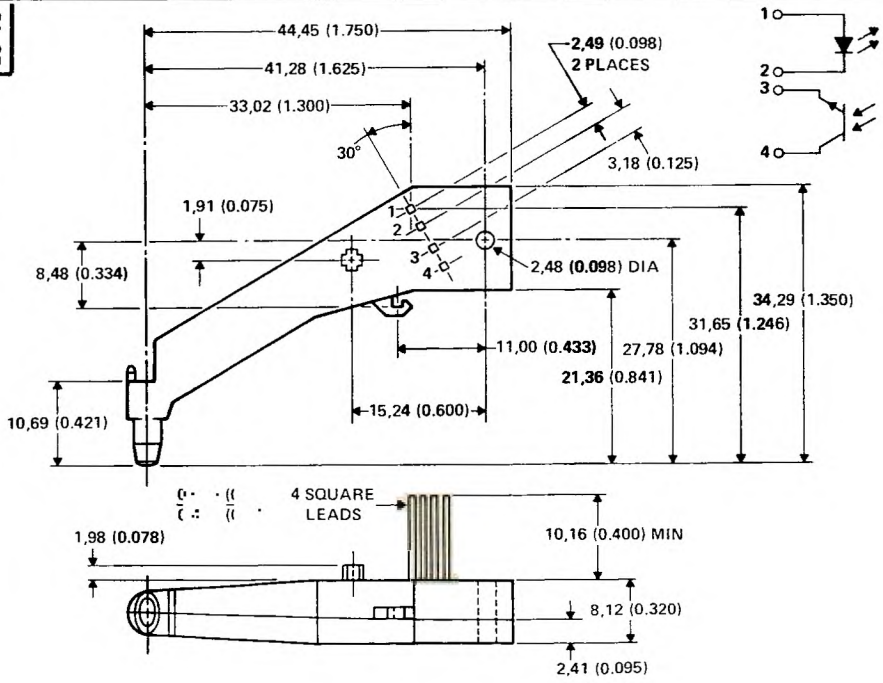
NOTE 1: The distance between the top surface of the window and the surface of the sensor is nominally 0,89 (0.035). This is determined by observing the vertical motion of a microscope focused first at one plane, then at the other.

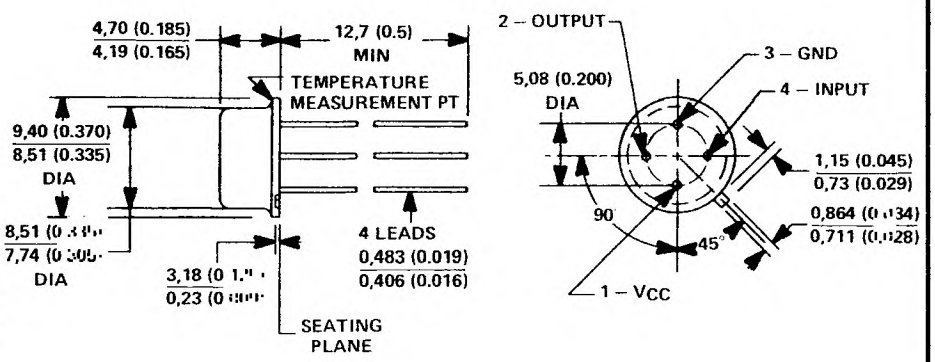
CL-84



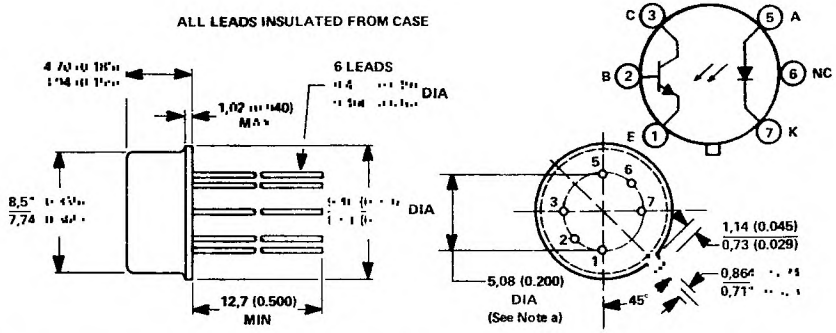
NOTE 1: The distance between the top surface of the window and the surface of the sensor is nominally 0,89 (0.035). This is determined by observing the vertical motion of a microscope focused first at one plane, then at the other.

CL-85





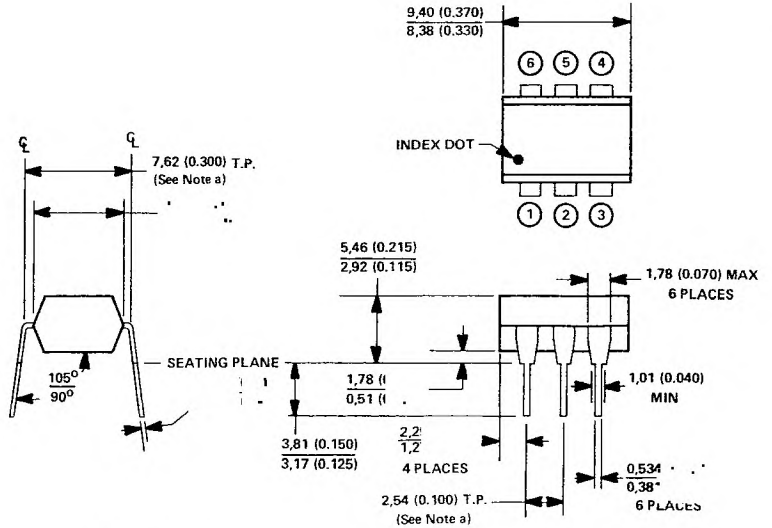
CM-12



NOTE a: Leads having maximum diameter shall be within 0,18 mm (0.007 inches) of true position relative to a maximum-width tab when measured in the gaging plane between 1,371 mm (0.054 inches) and 1,397 mm (0.055 inches) below the seating plane.

CM-14

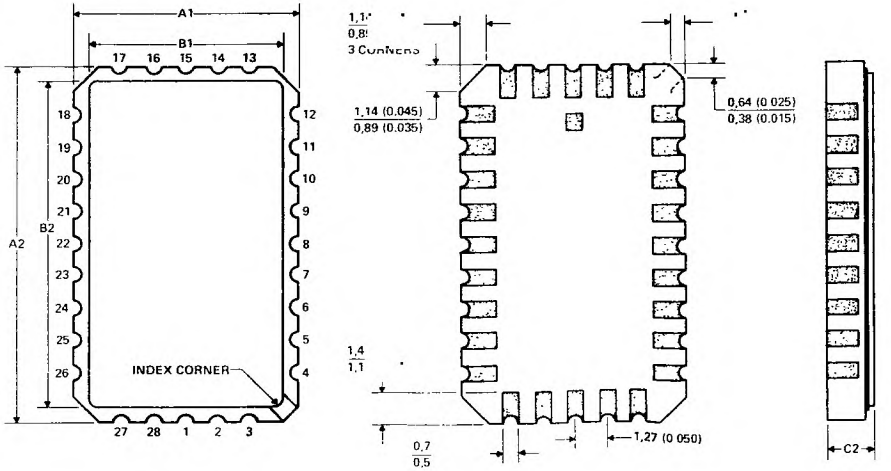
CP-7



NOTE a: Leads are within 0,127 (0.005) radius of true position (T.P.) with maximum material condition and unit installed.
ALL JEDEC MO-001AM DIMENSIONS AND NOTES ARE APPLICABLE

FE

NUMBER OF TERMINALS	A1 MIN	A1 MAX	A2 MIN	A2 MAX	B1 MIN	B1 MAX	B2 MIN	B2 MAX	C2 MIN	C2 MAX
28	8,76 (0.345)	[illegible]	[illegible] (0.545)	14,10 (0.555)	7,80 (0.307)	7,95 (0.313)	12,88 (0.507)	13.03	1,65 (0.065)	2,01 (0.079)
32	11,30 (0.445)	11,56 (0.455)	13,84 (0.545)	14,10 (0.555)	10,34 (0.407)	13,03 (0.513)	12,88 (0.507)	[illegible]	1,65 (0.065)	2,01 (0.079)

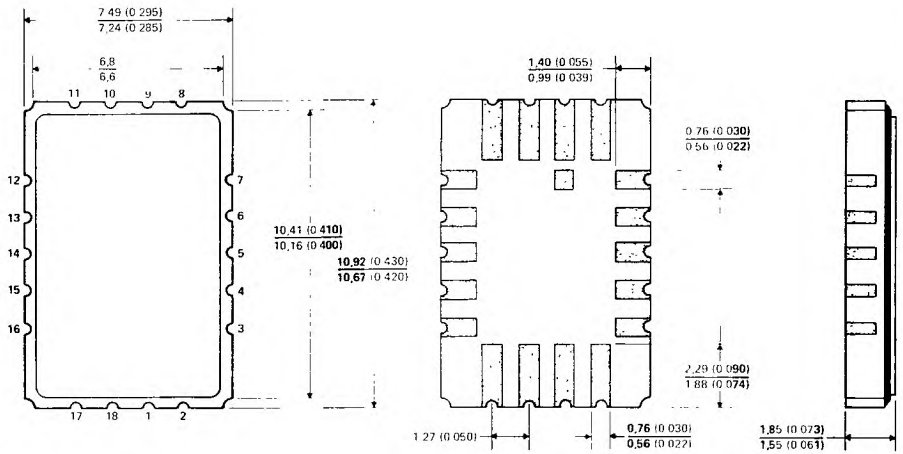


APPENDIX-PACKAGE OUTLINE DRAWINGS

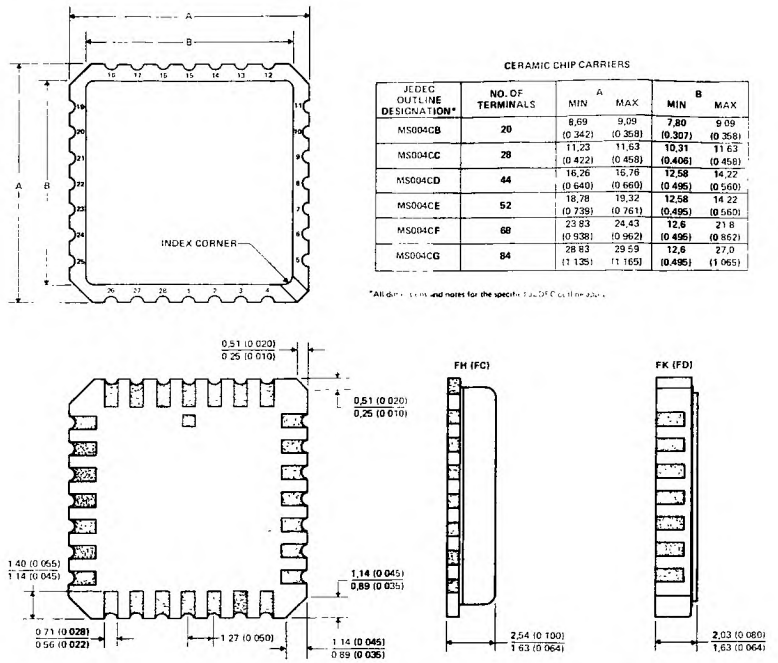
APPENDIX-PACKAGE OUTLINE DRAWINGS

ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

FG



FH/FK



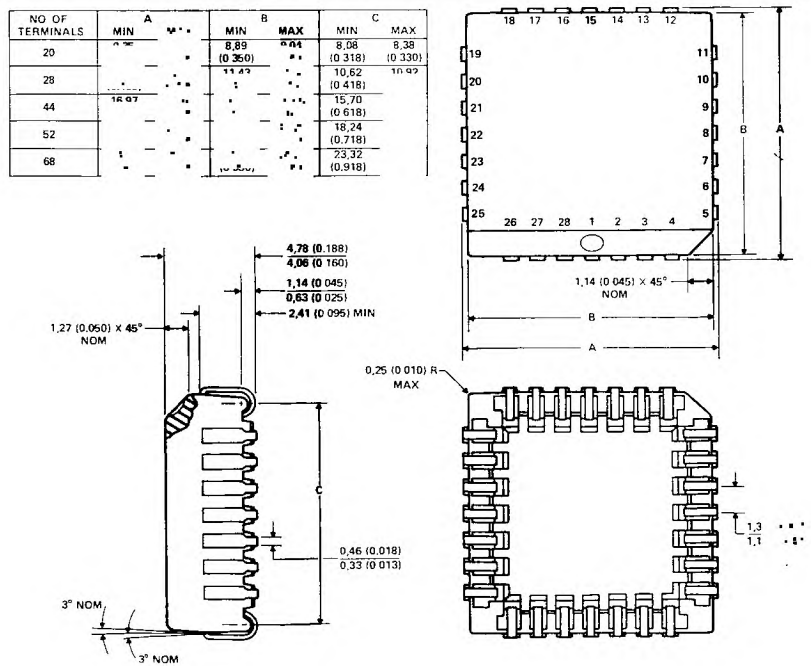
CERAMIC CHIP CARRIERS

JEDEC OUTLINE DESIGNATION*	NO. OF TERMINALS	A MIN	A MAX	B MIN	B MAX
MS004CB	20	8,69 (0,342)	9,09 (0,358)	7,80 (0,307)	9,09 (0,358)
MS004CC	28	11,23 (0,422)	11,63 (0,458)	10,31 (0,406)	11,63 (0,458)
MS004CD	44	16,26 (0,640)	16,76 (0,660)	12,58 (0,495)	14,22 (0,560)
MS004CE	52	18,78 (0,739)	19,32 (0,761)	12,58 (0,495)	14,22 (0,560)
MS004CF	68	23,83 (0,938)	24,43 (0,962)	12,6 (0,496)	21,8 (0,862)
MS004CG	84	28,83 (1,135)	29,59 (1,165)	12,6 (0,495)	27,0 (1,065)

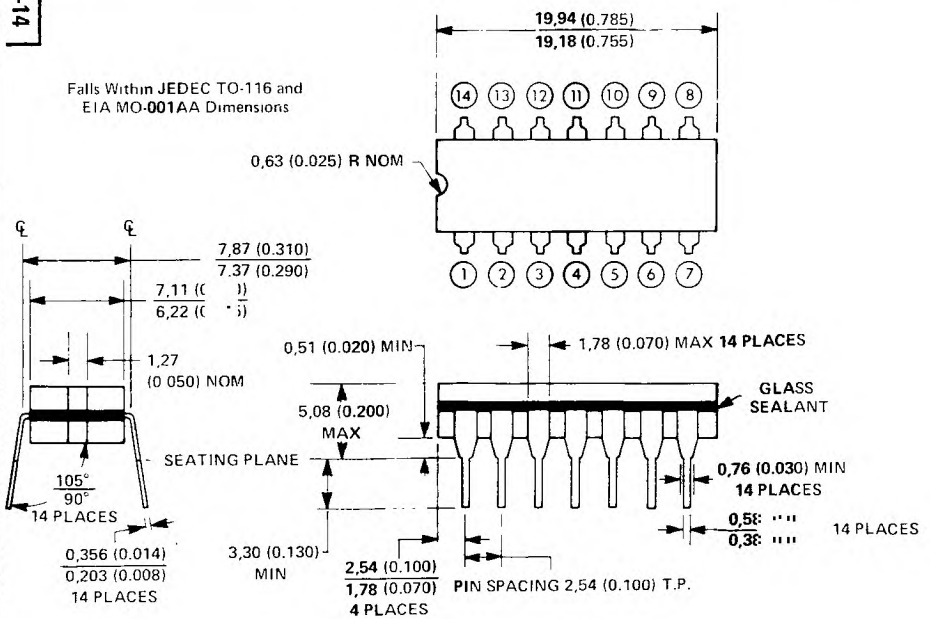
*All dimensions and notes for the specific JEDEC outline apply

FN

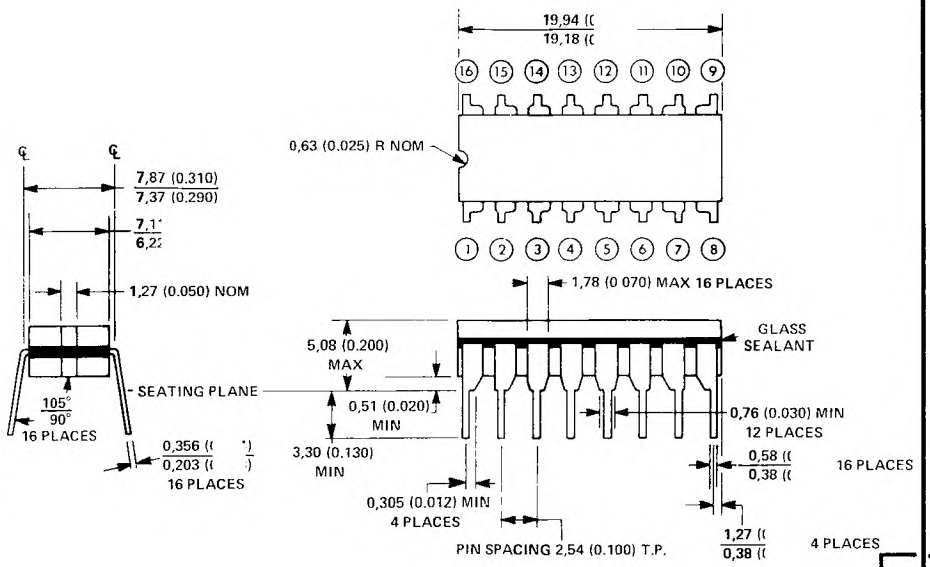
NO OF TERMINALS	A MIN	A MAX	B MIN	B MAX	C MIN	C MAX
20			8,89 (0,350)		8,08 (0,318)	8,38 (0,330)
28					10,62 (0,418)	
44					15,70 (0,618)	
52					18,24 (0,718)	
68					23,32 (0,918)	



J-14



ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES



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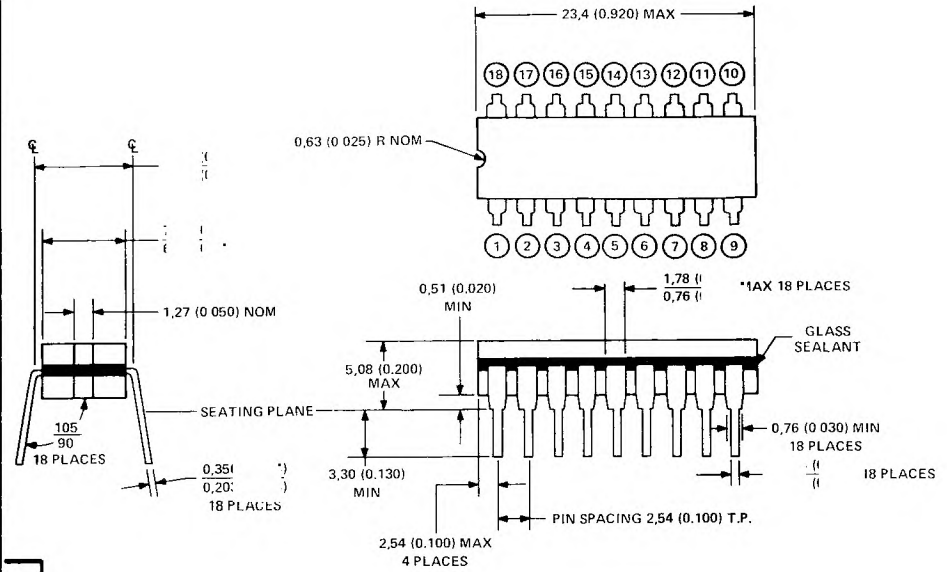
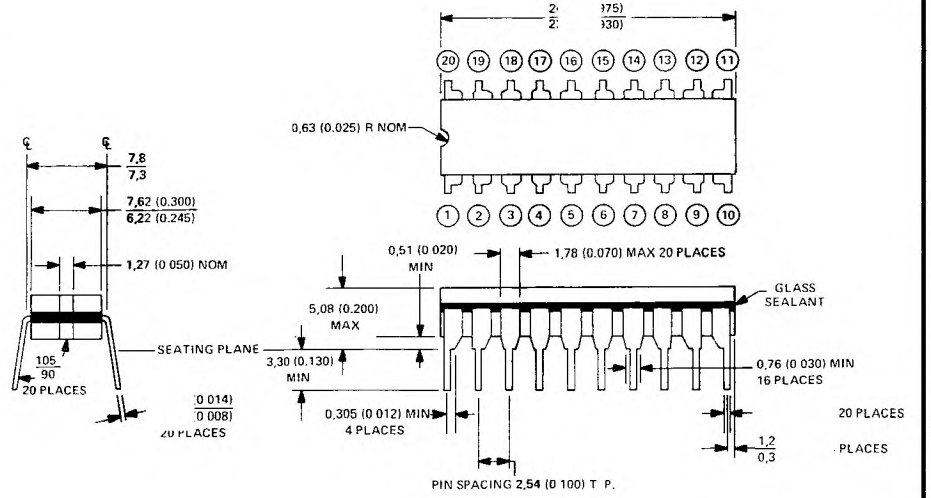


J-18

J-20



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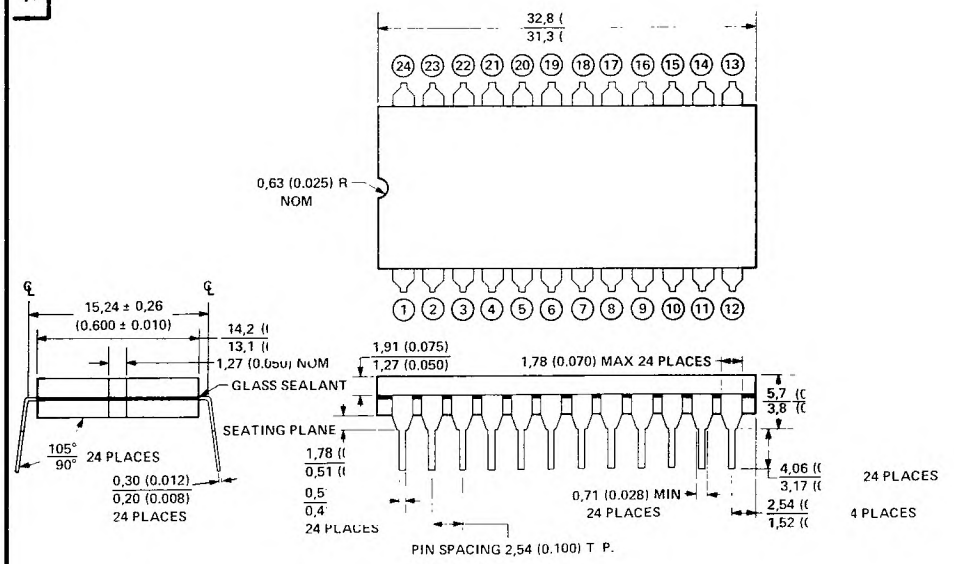
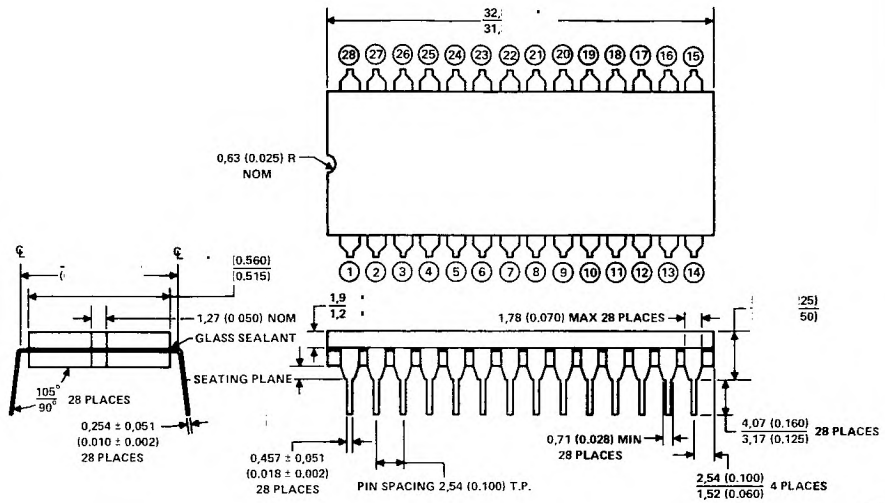


APPENDIX-PACKAGE OUTLINE DRAWINGS

ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

J-28



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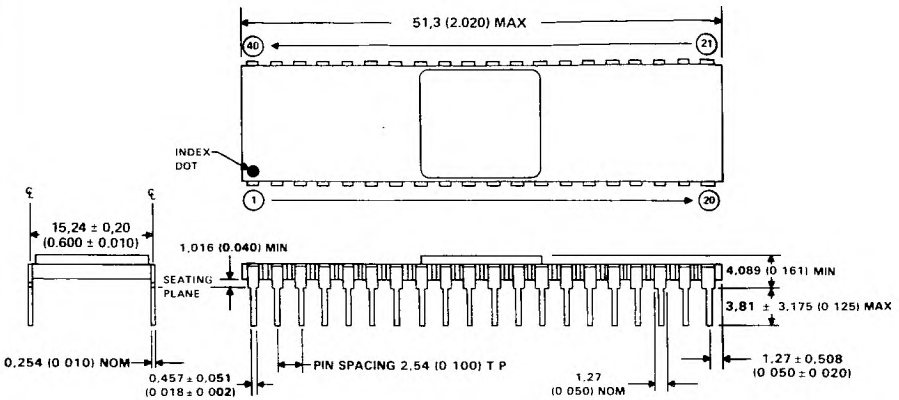

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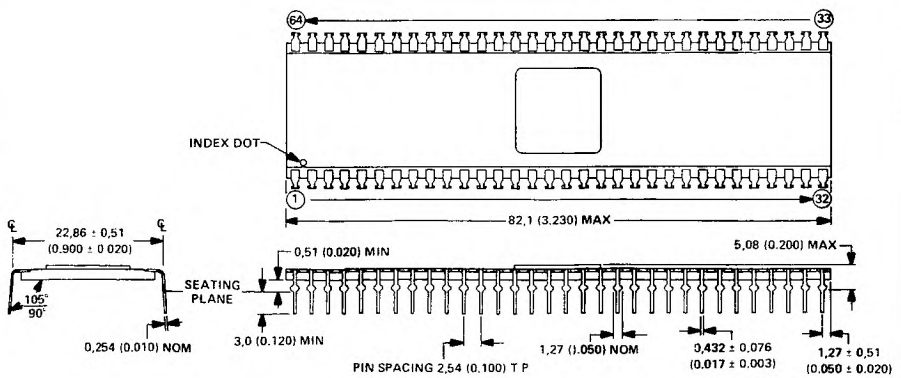

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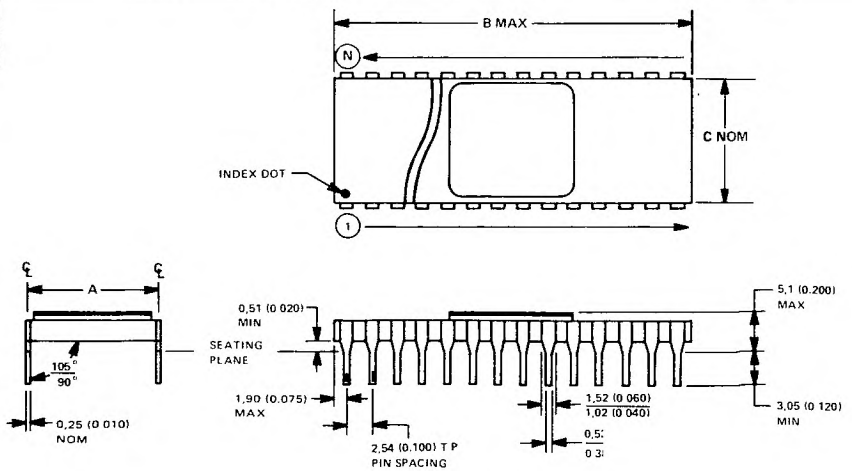
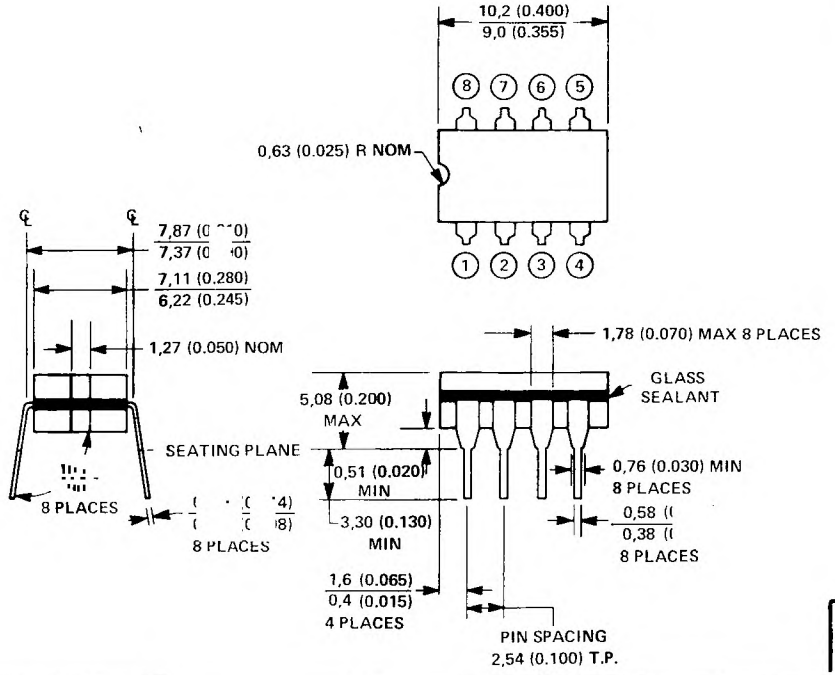
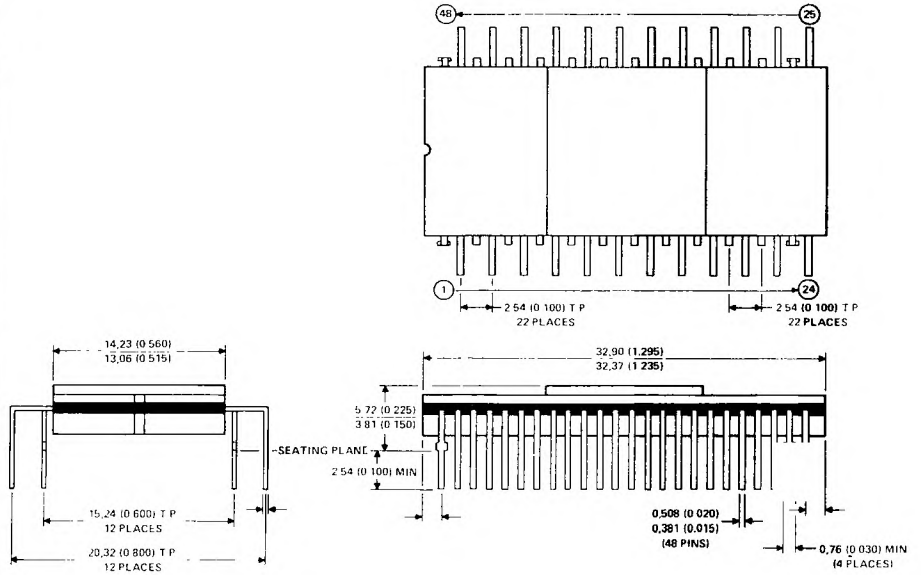


DIM \ PINS	24	28	40	48	52	64
A ... 0,25 (0 010)	15,24 (0 600)	15,24 (0.600)	15,24 (0 600)	15,24 (0 600)	15,24 (0 600)	22,86 (0 900)
B ... X	31,8 (1 25)	36,8 (1.45)	52,1 (2.05)	62,2 (2 45)	67,3 (2 65)	82,6 (3 25)
C ... M	15,0 (0 590)	15,0 (0.590)	15,0 (0 590)	15,0 (0 590)	15,0 (0.590)	22,6 (0 890)

ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

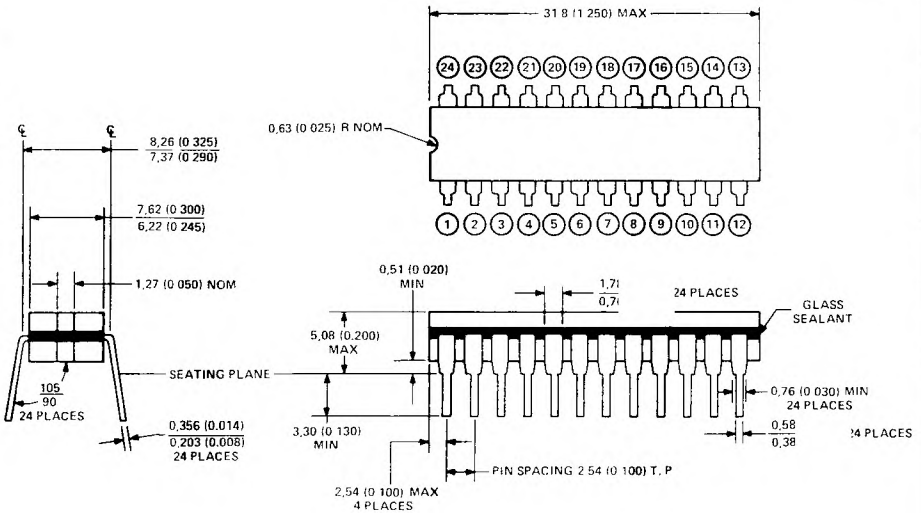


J-68



JD-48

JT-24



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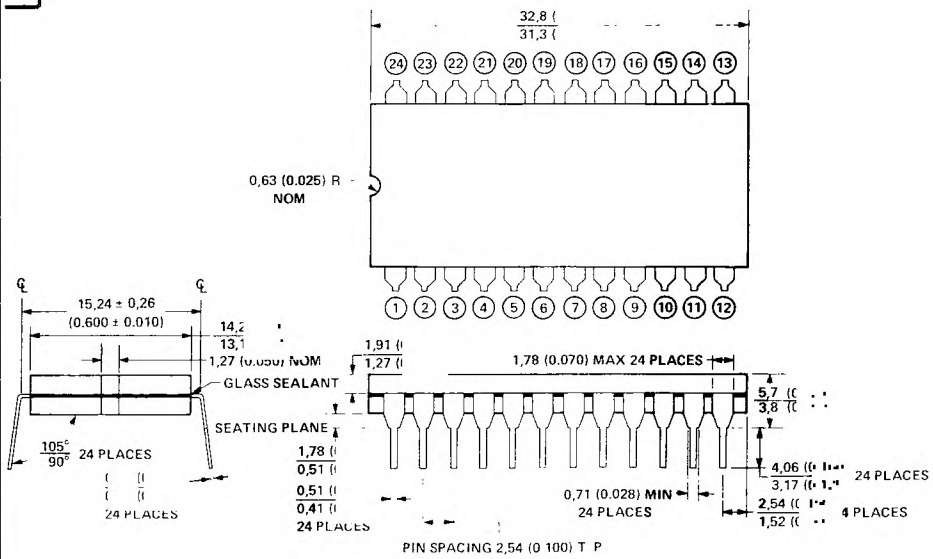
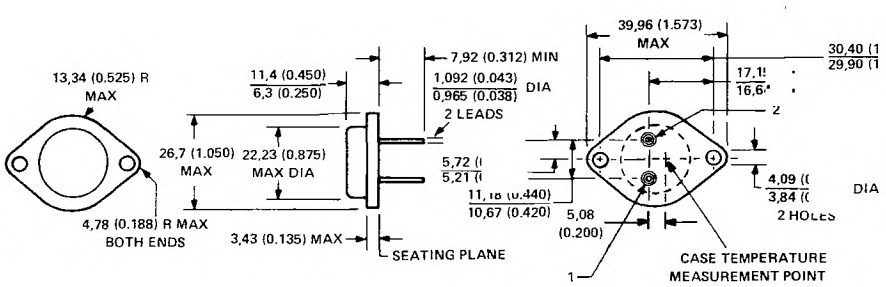


APPENDIX-PACKAGE OUTLINE DRAWINGS

APPENDIX-PACKAGE OUTLINE DRAWINGS

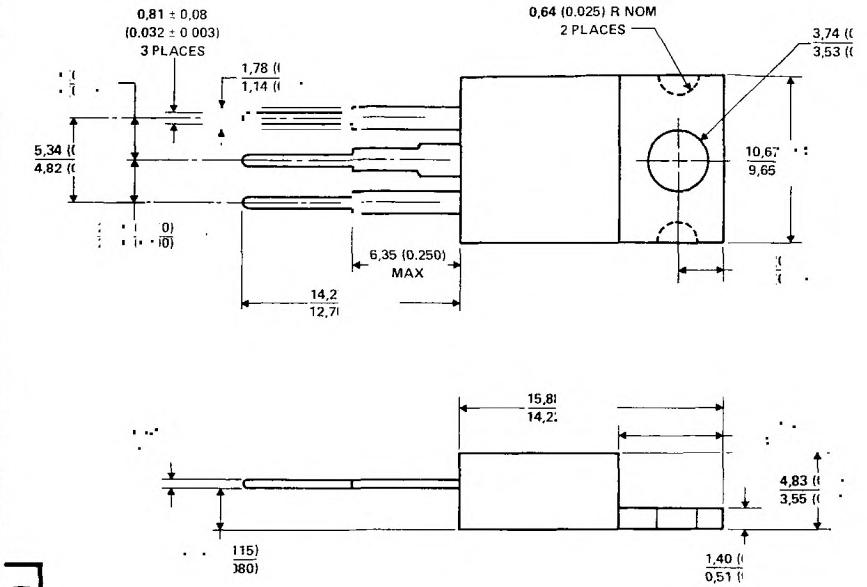
ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

KA

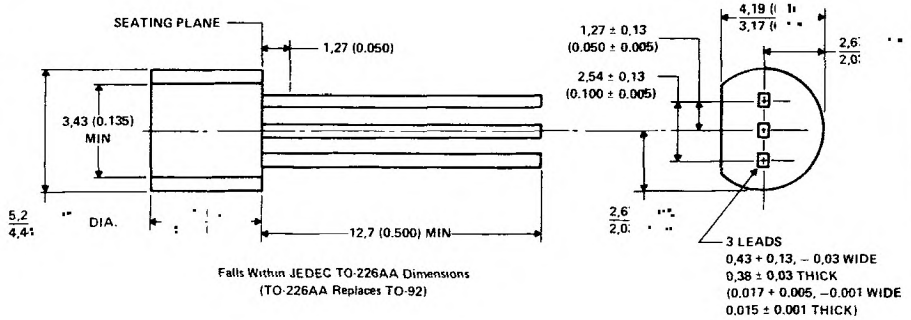


ALL JEDEC TO-3 DIMENSIONS AND NOTES ARE APPLICABLE

KC

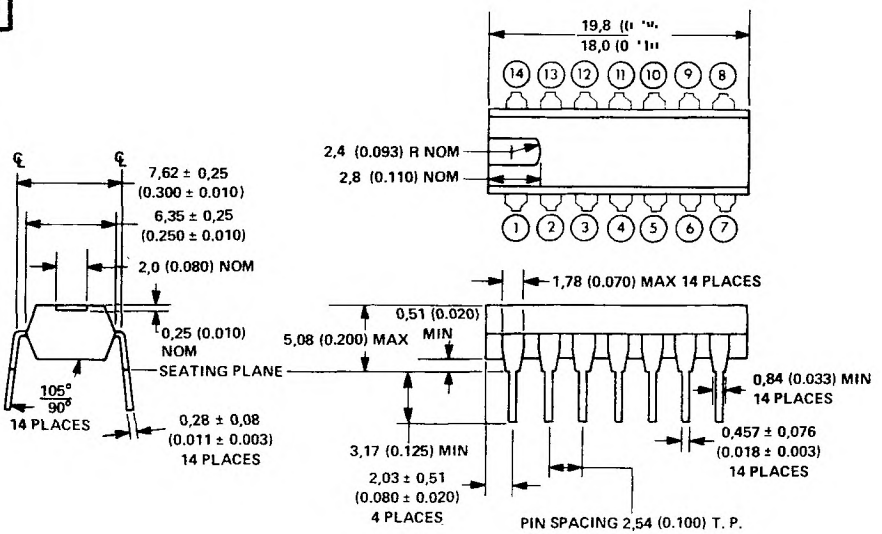


LP



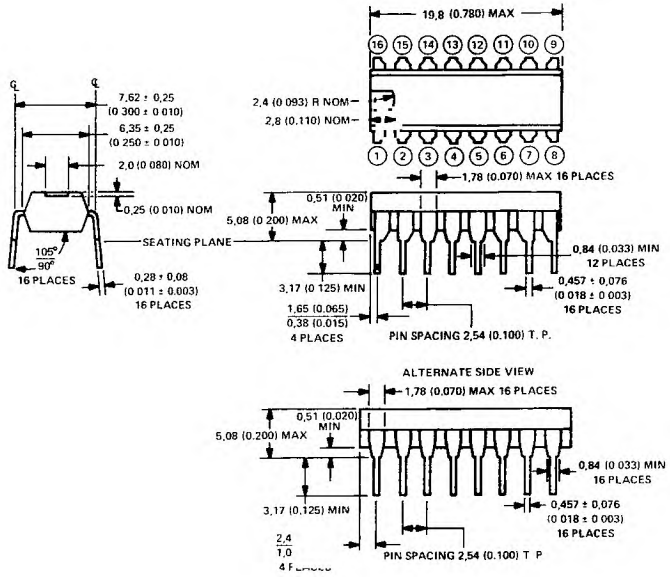
Falls Within JEDEC TO-226AA Dimensions
(TO-226AA Replaces TO-92)

N-14



Falls Within JEDEC TO-116 and EIA MO-001AA Dimensions

N-16



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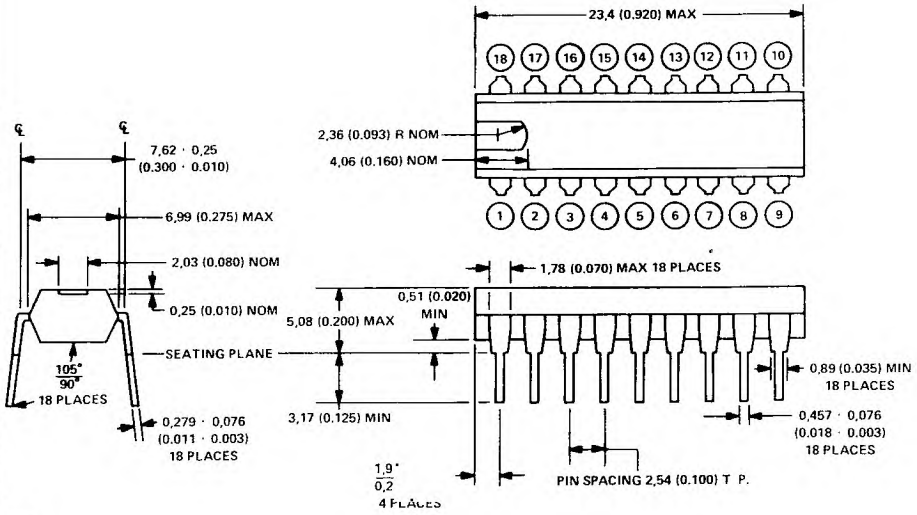
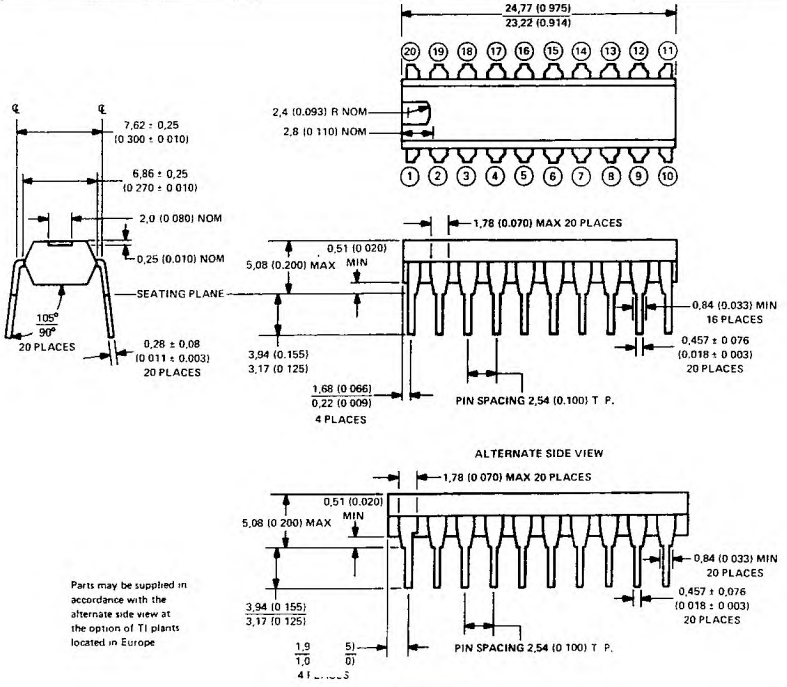


N-20



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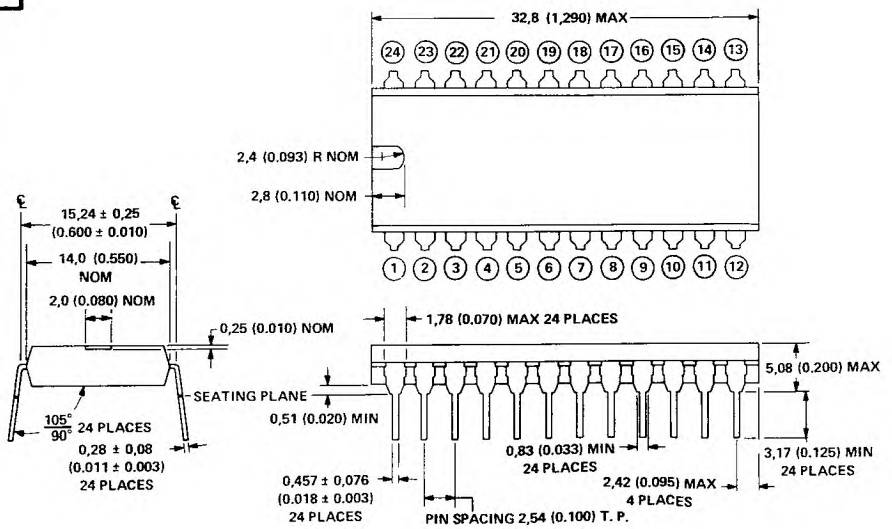
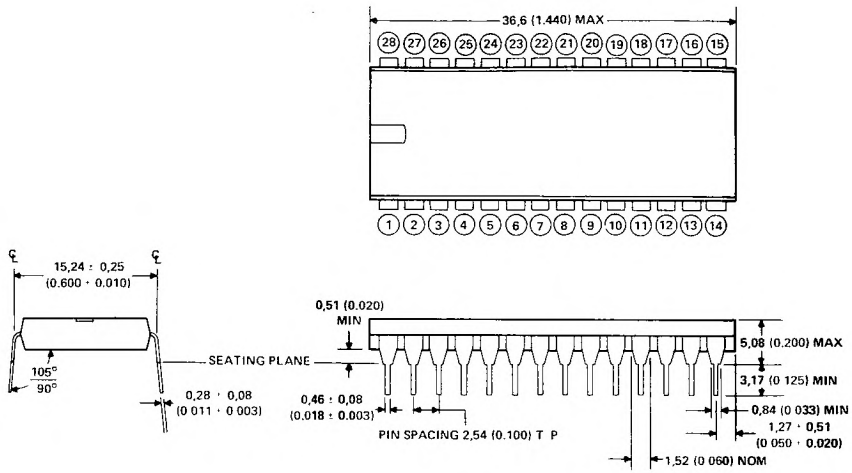


APPENDIX-PACKAGE OUTLINE DRAWINGS

APPENDIX-PACKAGE OUTLINE DRAWINGS

ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

N-28



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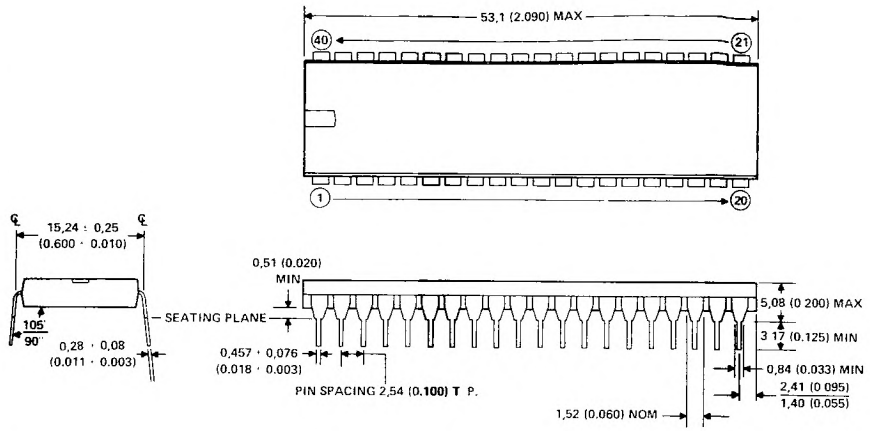
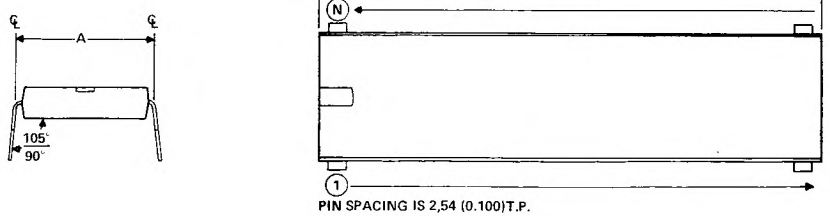
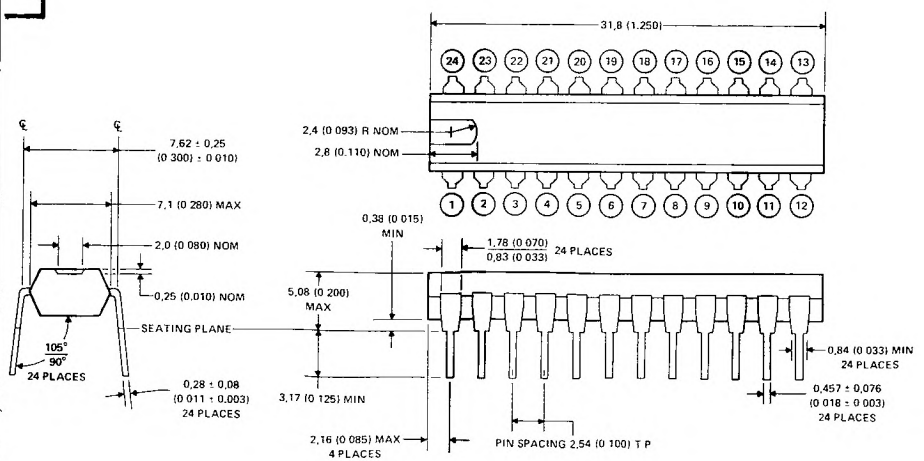


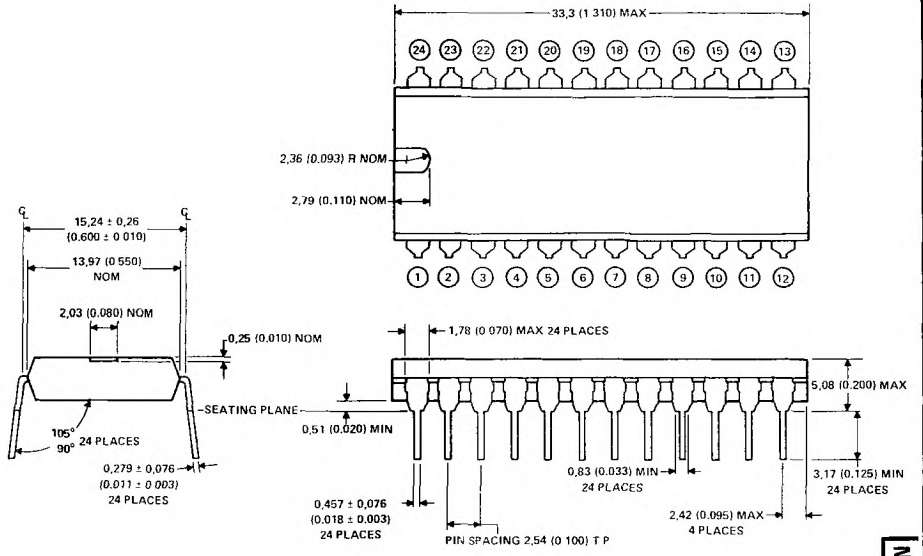
N-48, 52, 64



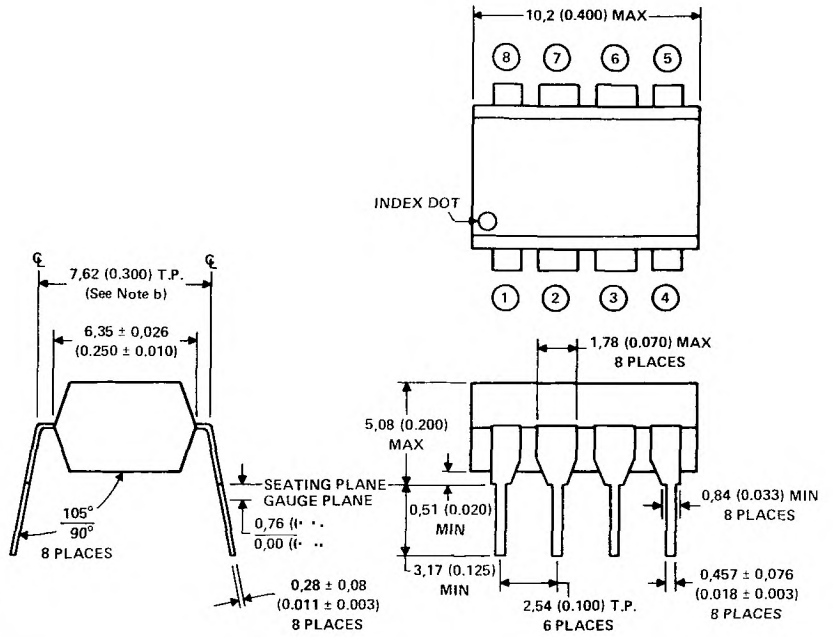
DIM \ PINS	48	52	64
A ± 0,25 (0 010)	15,24 (0.600)	15,24 (0.600)	22,86 (0.900)
B MAX	62,2 (2.45)	67,3 (2.65)	81,3 (3.20)

NT-24



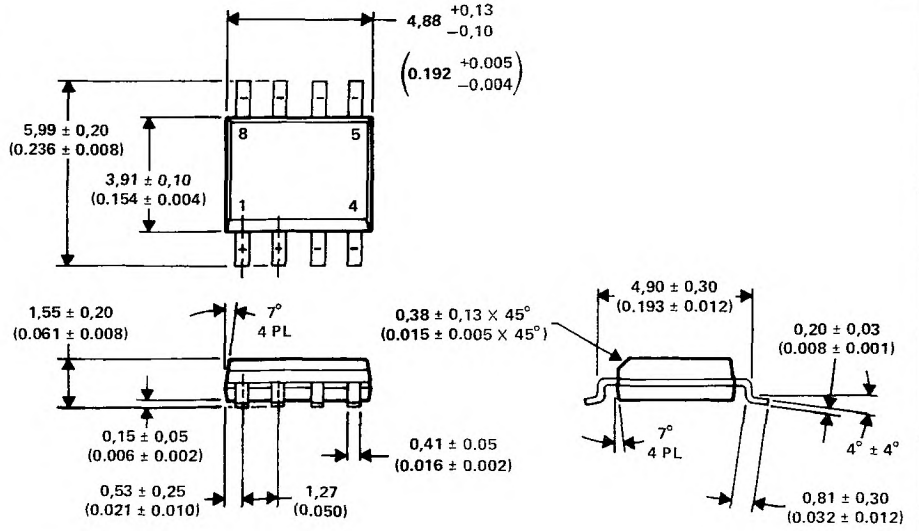


NW-24

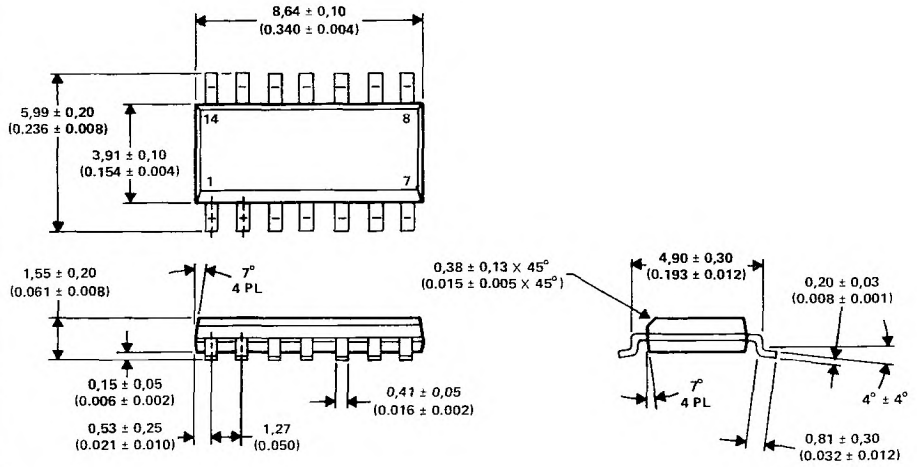


P-8

D-8



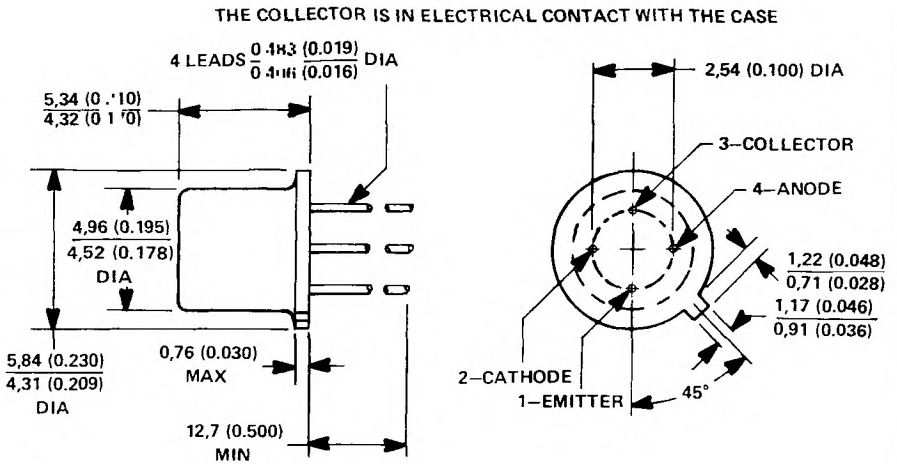
D-14



APPENDIX-PACKAGE OUTLINE DRAWINGS

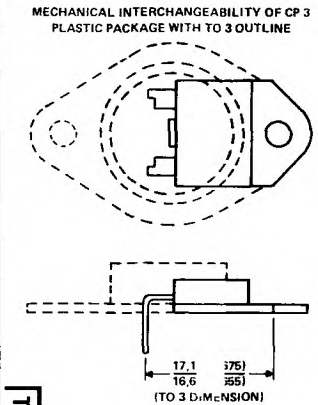
APPENDIX-PACKAGE OUTLINE DRAWINGS

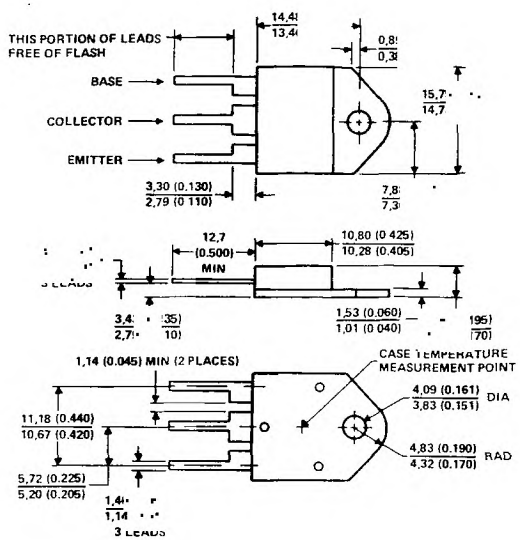
TO-72



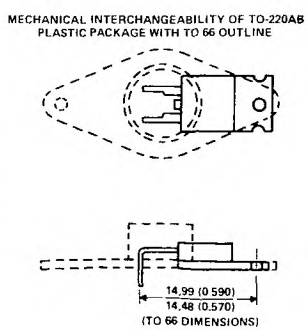
ALL JEDEC TO-72 DIMENSIONS AND NOTES ARE APPLICABLE

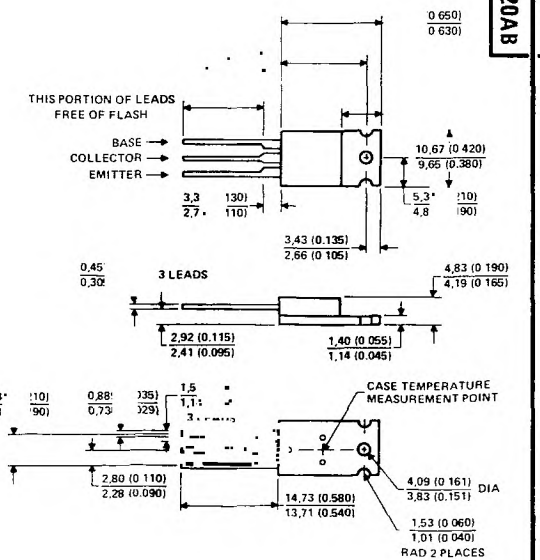
TO-218AA



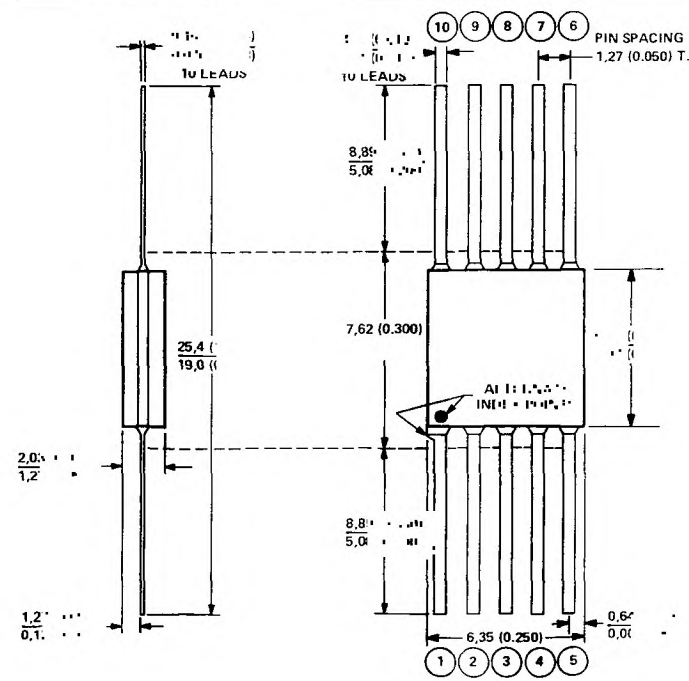


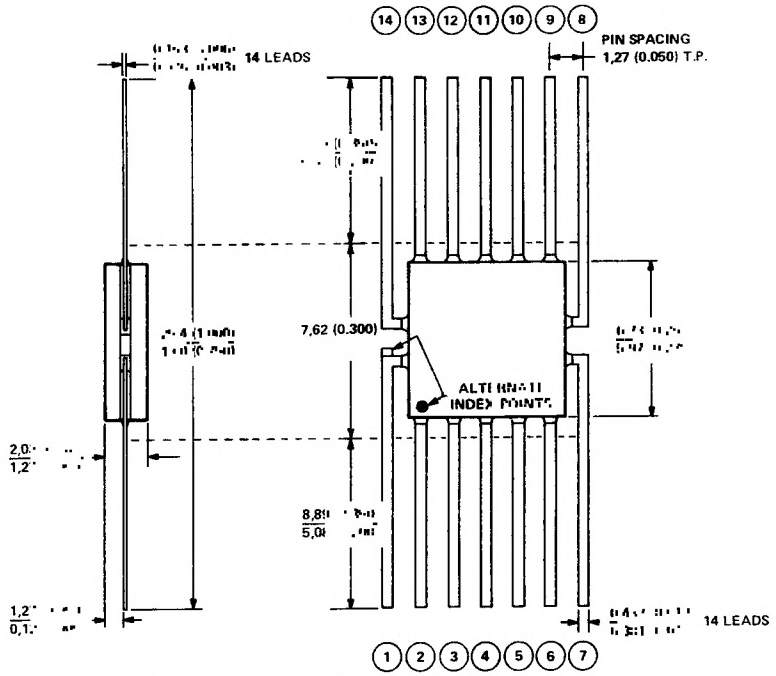
TO-220AB



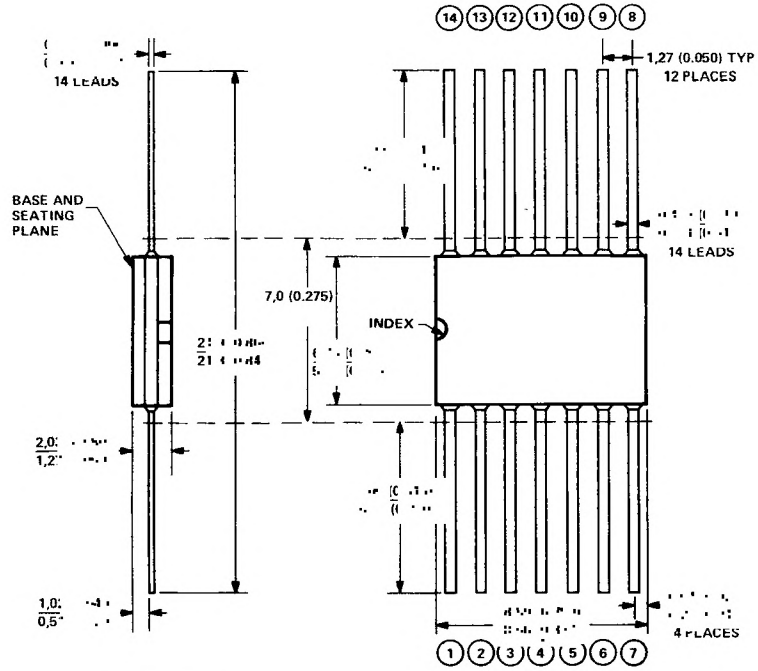


U&Z-10

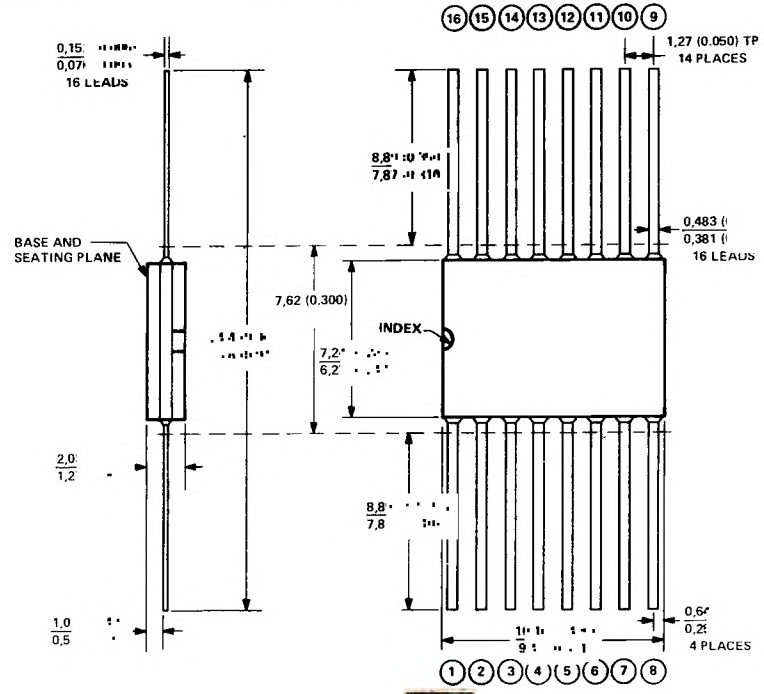




U82-14



M14



M16

ALL DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

APPENDIX-PACKAGE OUTLINE DRAWINGS

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DEVICE NUMBER	PAGE	DEVICE NUMBER	PAGE	DEVICE NUMBER	PAGE	DEVICE NUMBER	PAGE	DEVICE NUMBER	PAGE
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1N5723	83	ADC0804C	61	LM318	46	NE5532A	47	SMJ4164	98
1N5724	83	ADC0808	61	LM320-05	50	NE5534	46	SN5400	66
1N5725	83	ADC0809	61	LM320-12	50	NE5534A	46	SN5401	66
2N3442	90	ADC0831	61	LM320-15	50	NE555	63	SN5402	67
2N5000	99	ADC0832	61	LM323	50	NE556	63	SN5403	66
2N5001	99	ADC0833	61	LM324	48	NE592	63	SN5404	66
2N5004	99	ADC0834	61	LM324A	48	OP-07C	46	SN5405	66
2N5005	99	ADC0838	61	LM330-5	50	OP-07D	46	SN5406	69
2N5038	90	AM26LS31C	53	LM3302	49	OP-07E	46	SN5407	69
2N5039	90	AM26LS32AC	55	LM337	51	PDOS-01	27	SN5408	66
2N5149	99	AM26LS32AM	55	LM339	49	PDOS-02	27	SN5409	66
2N5150	99	AM26LS33AC	55	LM339A	49	RC4136	48	SN5410	66
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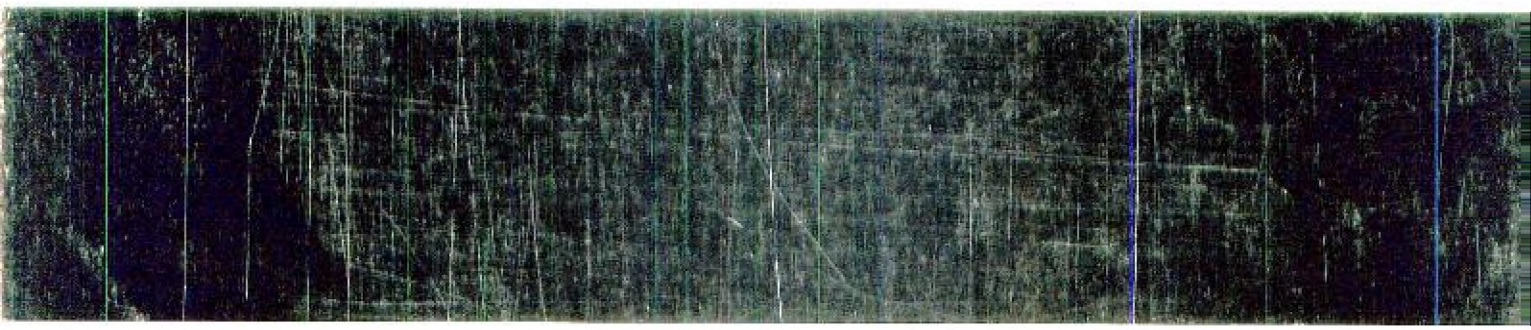

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