RAYTHEON

Field-Programmable Read-Only Memories

29000 Series

Description

Raytheon's 29000 Series of Field-Programmable Read-Only Memories includes most of the popular PROM configurations in both standard and power-switched versions. The power-switched devices (SPROMs) were originated by Raytheon to reduce overall power dissipation in large PROM arrays (Page 30). This technique takes advantage of the non-volatile nature of PROMs by removing power when a particular device is not being used in the system. Unlike previous power-switching schemes, which employed external transistors and resistors, the SPROM includes all power-switching circuitry on the same chip as the memory. Moreover, the power-switch is activated by the same Chip Select (CS) input that is used to address a standard PROM; thus, in most cases, SPROMs can be directly substituted for standard devices without system redesign.

All Raytheon 29000 Series PROMs and SPROMs are manufactured with nichrome fuses and Low-Power Schottky technology. The devices are shipped with all bits in the HIGH (logical ONE) state. To achieve a LOW state in a given bit position, the nichrome link is fused open by passing a short, high-current pulse through the link. All 29000 Series devices are programmed using the same programming techniques. (See Page 4.)

Features

- Low-Power Schottky technology
- Highly reliable nichrome fuses
- Three-state and open-collector versions
- PROM and SPROM versions of most configurations.
- Typical SPROM "OFF" power is 25% of standard power.
- SPROMs feature guaranteed access times and full Vcc tolerance under power-switched conditions.
- All devices use same programming techniques (generic)
- All devices available in both commercial (0 to 75°C) and military (-55 to +125°C) versions.
- All devices are industry standard pin-out
- All devices available in space saving Flat Packs.

Applications

- Prototyping/Volume Production
- Non-Volatile Fixed Instructions
- Microprogram Control Storage
- Complex LSI Logic Simulation
- Custom Look-up Tables
- Security Encoding/Decoding
- Error Correction
- Code Conversion
- Character Generation

Ordering Information

No. of Bits	Configuration (Words x Bits)	Package (No. of Pins)	Output	Part Numbers					
				PROMs			SPROMs		
				0 to +75° C DIP	-55 to +125° C DIP Note 1,2	Page Ref.	0 to +75° C DIP	-55 to +125° C DIP Note 1,2	Page Ref.
1K	256 x 4	16	OC	29660DC	29660DM	26	29662DC	29662DM	27
			TS	29661DC	29661DM	26	29663DC	29663DM	27
2K	256 x 8	20	OC	29600DC	29600DM	12	29602DC	29602DM	13
			TS	29601DC	29601DM	12	29603DC	29603DM	13
2K	512 x 4	16	OC	29610DC	29610DM	14	29612DC	29612DM	15
			TS	29611DC	29611DM	14	29613DC	29613DM	15
4K	512 x 8	20	OC	29620DC	29620DM	16	29622DC	29622DM	17
			TS	29621DC	29621DM	16	29623DC	29623DM	17
		24	OC	29624DC	29624DM	18	29626DC	29626DM	19
			TS	29625DC	29625DM	18	29627DC	29627DM	19
8K	1024 x 8	24 Note 3,4	OC	29630DC	29630DM	20	29632DC	29632DM	21
			TS	29631DC	29631DM	20	29633DC	29633DM	21
		24	OC	29634DC	29634DM	22	29636DC	29636DM	23
			TS	29635DC	29635DM	22	29637DC	29637DM	23
8K	2048 x 4	18 Note 3	OC	29650DC	29650DM	24	29652DC	29652DM	25
			TS	29651DC	29651DM	24	29653DC	29653DM	25
16K	2048 x 8	24 Note 3,4	OC	29680DC	29680DM	28	29682DC	29682DM	29
			TS	29681DC	29681DM	28	29683DC	29683DM	29

Note:
1. For 883B processing, add the letter "B" to the basic part number, e.g., 29653DMB.
2. All devices available in space saving military speced Flat Pack, change the letter "D" to "F" in the basic part number, e.g., 29633FM.
3. High speed version of some products available, add the letter "A" after the device number before the package description. e.g., 29631ADM
4. Skinny DIP 0.3 inch, 24 Pin Package Available.

Data in shaded area is included for reference only; I

Maximum Ratings (Above which the usef

Storage temperature..... -65 to +150° C
Temperature (case)
under bias ..... -55 to +125° C
Supply voltage to ground
potential (continuous) ..... -0.5 to +7V
DC voltage applied to
outputs(except
during programming)..... -0.5 to +Vcc max

Operating Range

29000XC	T_C = 0 to +75°C	V_{CC} = 5.0V ±5%	Commercial
29000XM	T_C = -55 to +125°C	V_{CC} = 5.0V ±10%	Military

Common Electrical Characteristics
Over Operating Range (unless otherwise noted)

Parameter	Description	Test Conditions		Min.	Typ. Note 1	Max.	Units
V_{OH} (tri-state only)	Output HIGH Voltage	V_{CC} = MIN, I_{OH} = -2.0mA V_{IN} = V_{IH} or V_{IL}		2.4	3.6		Volts
V_{OL}	Output LOW Voltage	V_{CC} = MIN V_{IN} = V_{IH} or V_{IL}	I_{OL} = 8mA		0.30	0.4	Volts
			I_{OL} = 16mA		0.35	0.5	
V_{IH}	Input HIGH Level	Guaranteed input logical HIGH voltage for all inputs		2.0		5.5	Volts
V_{IL}	Input LOW Level	Guaranteed input logical LOW voltage for all inputs		0.0		0.8	Volts
I_{IL}	Input LOW Current	V_{CC} = MAX, V_{IN} = 0.4V			-20	-250	μA
I_I	Input HIGH Current	V_{CC} = MAX, V_{IN} = 2.7V				10	μA
I_I	Input HIGH Current	V_{CC} = MAX, V_{IN} = 5.5V				1.0	mA
I_{SC} (tri-state only)	Output Short Circuit Current	V_{CC} = MAX, V_{OUT} = 0.0V Note 2		-12	-35	-85	mA
V_I	Input Clamp Voltage	V_{CC} = MIN, I_{IN} = -18mA				-1.5	V
I_{CEX}	Output Leakage Current	V_{CC} = MAX Chip disabled	V_O = 4.5V			+100	μA
			V_O = 0.4V			-100	

Note: 1. Typical limits are at V_{CC} = 5.0V and T_C = 25°C
2. Not more than one output should be shorted at a time. Duration of the short circuit should not be more than one second.

Programming Instructions

General

The device is manufactured with all outputs high in all storage locations. To make an output low at a particular word, a nichrome fusible link must be opened. This procedure is called programming.

Programming Description

To select a particular link for programming, the word address is presented with TTL levels on A_0 through A_N, a V_{CC} of 5.50V is applied or left applied, and the program pin and the output to be programmed is taken to an elevated voltage to supply the required current to the fuse. The outputs must be programmed one at a time, since internal decoding circuitry is capable of sinking only one unit of programming current.

Other Chip Select Inputs

On some devices, additional Chip Select Inputs are present. These may be high, low or open during programming. When checking that an output is programmed (which is called verification) these inputs must be enabled to activate the device. Since they must be enabled during verification and the state is irrelevant during programming, the simplest procedure is to activate them during the entire procedure.

Timing

The programming procedure involves the use of the program pin (a chip select) and the output pin. In order to guarantee that the output transistor is off before increasing the voltage on the output pin, the program pin's voltage pulse must come before the output pin's programming pulse and leave after the output pin's programming pulse. The programming pulse applied to the output pin and program pin must have a 0.4/microsecond rise time. See Figure 3.

It is recommended that only one programming pulse be applied for each bit to be programmed. To maximize programming yield, this pulse should be applied with V_{PP} = 33V and V_{OUT} = 26V. Any other conditions are not recommended.

AC Test Conditions

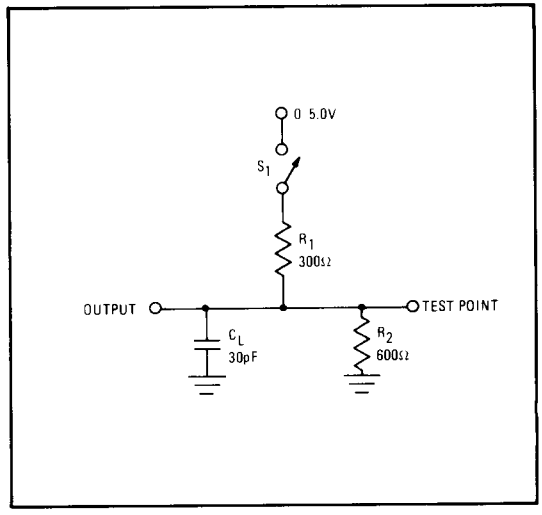


Figure 1. AC Test Circuit

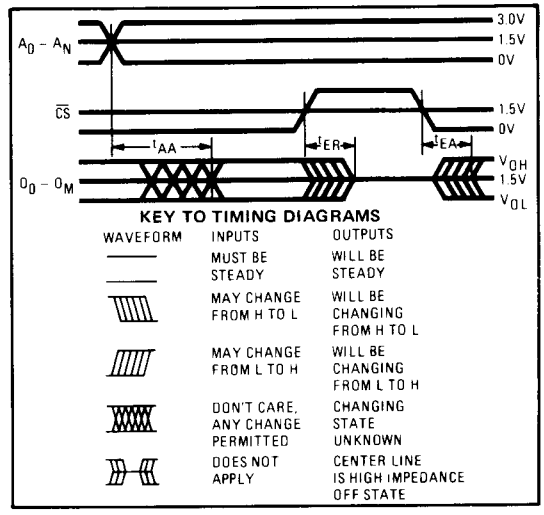


Figure 2. Switching Waveforms

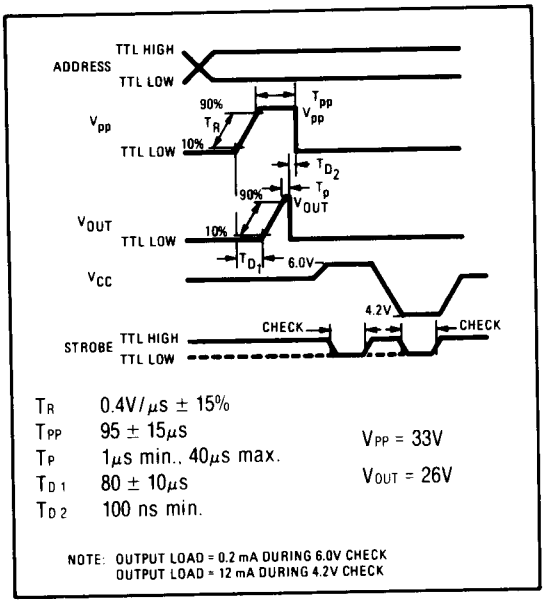


Figure 3. Programming Timing

Verification

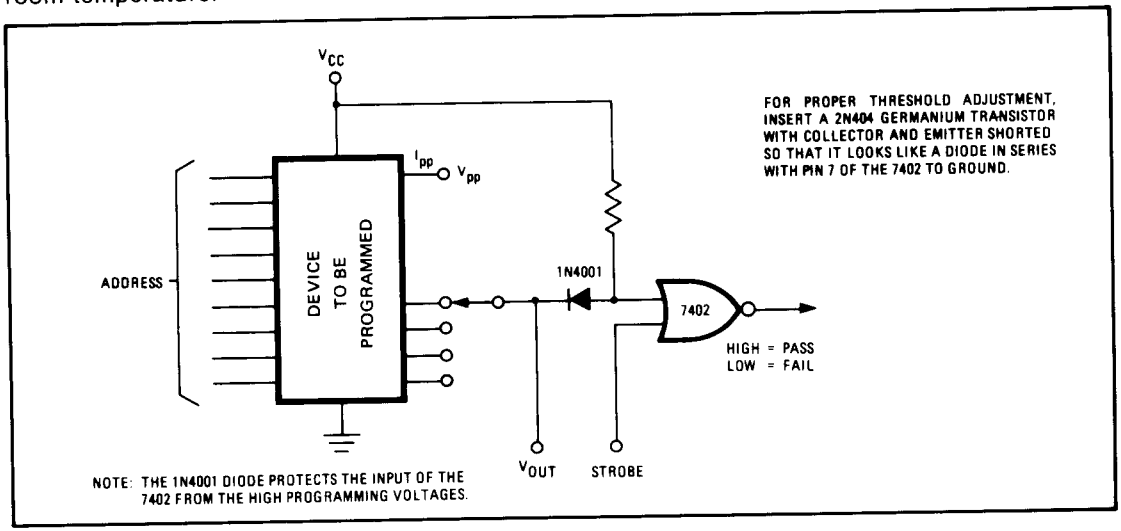
After programming a device, it can be checked for a low output by turning all chip selects on. To guarantee operation at minimum and maximum Vcc, current and temperature, the device must sink 12mA at a Vcc of 4.20V when low and 0.2mA at a Vcc of 6.0V when high at room temperature.

Board Programming

Units may be programmed at the board level by bringing the program pin of each package to the card connector. To program a particular package "A", the program pin of package A and one output pin of package A, which may or may not be "OR" tied to other packages, are taken to the required programming voltage. An alternate procedure is to tie the enable and outputs together as required by the system function and only apply Vcc to the device to be programmed. The number of units soldered on a board should be consistent with expected programming yields to avoid rework.

Unprogrammable Units

Visual inspection at 200X prior to encapsulation, test fuses and decoding circuitry tests are used to guarantee a high programming yield of the device in the field. However, because of random defects, it is impossible to guarantee that any given bit will program correctly. UNITS RETURNED TO RAYTHEON AS UNPROGRAMMABLE MUST BE ACCOMPANIED BY A COMPLETE DESCRIPTION OF THE PROGRAMMING METHOD USED AND A CONTACT PHONE NUMBER FOR CLARIFICATION OF ANY ENGINEERING OR PURCHASING QUESTIONS.



Programming Parameters (Do not test these limits or you may program the device)

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Units
I_{PP}	Current program pin during programming, before and after fuse has blown	V_{CC} = 5.50V V_{OUT} = 5.0V to 25V V_{PP} = 4.50V		0		mA
		V_{PP} = 27V		30		mA
I_{OUT}	Current into output during programming before the fuse has programmed	V_{PP} = 27V, V_{CC} =5.50V V_{OUT} = 9.0V		0.1		mA
		V_{OUT} = 20V		50		mA
I_{OUT}	Current into output during programming after the fuse has programmed	V_{PP} = 27V V_{OUT} = 20V V_{CC} = 5.50V		0.1		mA
T_R	Rise time of program pulse applied to the data out or program pin		0.34	0.4	0.46	V/μs
V_{CCP}	V_{CC} required during programming		5.40	5.50	5.60	V
I_{OLV1}	Output current required during verification	Both chip enables low T_A = 25°C, V_{CC} = 4.2V	11	12	13	mA
I_{OLV2}	Output current required during verification	Both chip enables low	0.1	0.2	0.3	mA
MDC	Maximum duty cycle during automatic programming of program pin	$\frac{T_{PP}}{T_C}$			25	%
V_{PP}	Required programming voltage on program pin		27		33	V
V_{OUT}	Required programming voltage on output pin		20		26	V
I_L	Required current limit of the power supply feeding the program pin and the output during programming	V_{PP} = 33V V_{OUT} = 26V V_{CC} = 5.50V	250			mA
T_P	Required coincidence among the program pin, output, address and V_{CC} for programming		1		40	μs
T_{D1}	Required time delay between disabling the memory output and application of the output programming pulse	Measure at 10% levels	70	80	90	μs
T_{D2}	Required time delay between removal of programming pulse and enabling the memory output	Measure at 10% levels	100			ns

Truth Tables

Raytheon can program devices at our facility from Raytheon truth table forms (see page 9). For customers desiring to make their own forms, an example is shown below:

Example For X8 Devices:

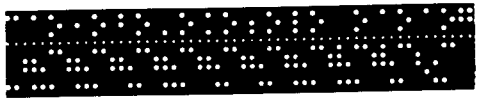
Word Number (Decimal)	Pin	14 O_8	13 O_7	12 O_6	11 O_5	9 O_4	8 O_3	7 O_2	6 O_1
		Outputs							
0		H	H	H	L	H	L	L	L
1		L	H	L	H	H	H	H	L
.		.	.	.	.	.	.	.	.
.		.	.	.	.	.	.	.	.
Last		L	H	H	H	H	H	H	H

Example For X4 Devices:

Word Number (Decimal)	Pin	9 O_4	10 O_3	11 O_2	12 O_1
		Outputs			
0		H	H	H	L
1		L	H	L	H
.		.	..	.	.
.		.	.	.	.
Last		L	H	H	H

Note: A high voltage on the data out lines is signified by an "H". A low voltage on the data out lines is signified by an "L". The word number assumes positive logic on the address pins, so for example, word 511 = HHHHHHHHH (Decimal Word No.).

Paper Tape Format



The PROM program tape in hexadecimal code is sequentially formatted as follows:

1) Approximately 12 inches of unpunched leader section.
2) The applicable program tape number with any note or comment.
3. A data start mark consisting of 25 'control A' characters.
4) The data in hexadecimal characters (0-9 and A-F) which represent the output data of word Ø; a space and the output data of word 1; a space...etc.
5) The character 'control C' is used to end the data string.

NOTE: 'Carriage Return' and 'Line Feed' characters may be included to make data more legible when printed out.

Truth tables can also be sent to Raytheon in an ASCII tape format. Information can be sent to us by air mail or TWX 910-379-6481. The tape reading equipment at Raytheon recognizes ASCII characters S, B, P, N, F, and E and interprets them as:

S Start
B Begin a word
P High data
N Low data
F Finish a word
E End of tape

All other characters such as carriage returns, line feeds, etc. are ignored so that comments and spaces may be sent in the data field to improve readability. Comments, however, should not use the characters S, B, P, N, F, and E. Word addresses must begin with zero and count sequentially to the highest address.

Paper Tape Format (Cont.)

In order to assist the machine operator in determining where the heading information stops and the data field begins, 25 bell characters or rubout characters should precede the start of the truth table. Any type of 8 level tape (paper, mylar, fanfold, etc.) is acceptable. Channel 1 is the most significant bit and channel 8 (parity) is ignored. Sprocket holes are located between channels 3 and 4.

Note that the order of the outputs between characters B and F is:

$O_8, O_7, O_6, O_5, O_4, O_3, O_2, O_1$

not

$O_1, O_2, O_3, O_4, O_5, O_6, O_7, O_8$

A typical list of characters and their machine interpretations are shown at the bottom of this page.

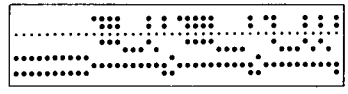
The required heading information at the beginning of the tape is as follows:

Customer name and phone _____ Truth table number _____
Customer TWX number _____ Number of truth tables _____
Purchase order number _____ Total number of parts _____
Raytheon part number _____ Number of parts of each truth table _____
Customer symbolized part number _____ 25 bell or rubout characters _____

Example For X4 Devices

Blarney Electronics 408-735-8140
TWX 911-338-9225
P0142
29653
0431
12
1 8 level
3 TWX
3

BNNNPF BNNNNF BNPNPF BNPPPF
BNNNNF BNPNPF BNNPPF BPPPNF



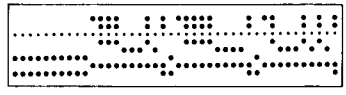
Begin Data Field
Data Field (P = High Voltage, N = Low Voltage)
Finished Data Field

B P P N P F BPPPPF BPNNPF etc. BPNNNF
$O_4\ O_3\ O_2\ O_1$
Word 0 Word 1 Word 2 Word N

Example For X8 Devices

Blarney Electronics 408-735-8140
TWX 911-338-9225
P0142
29633 8 Level
etc. TWX

BNNNPPPNPF BNNNNPPPPF BNPPPNPNF BNNNNNNNF
BNNNNNNNF BNNNPPPNPF BPPPPPPPPF BNPPNPNNNF



Begin Data Field
Data Field (P = High Voltage, N = Low Voltage)
Finished Data Field

B P P P N P P N P F BPPPPPPPPF BPNPPPNNPF etc. BPPNPPNNNF
$O_8\ O_7\ O_6\ O_5\ O_4\ O_3\ O_2\ O_1$
Word 0 Word 1 Word 2 Word N

RAYTHEON

Universal Truth Table

Company Name _____

Address _____

City _____ State _____

Telephone _____ Zip _____

Contact Name _____

Authorized Signature _____ Date _____

Raytheon Part No. _____

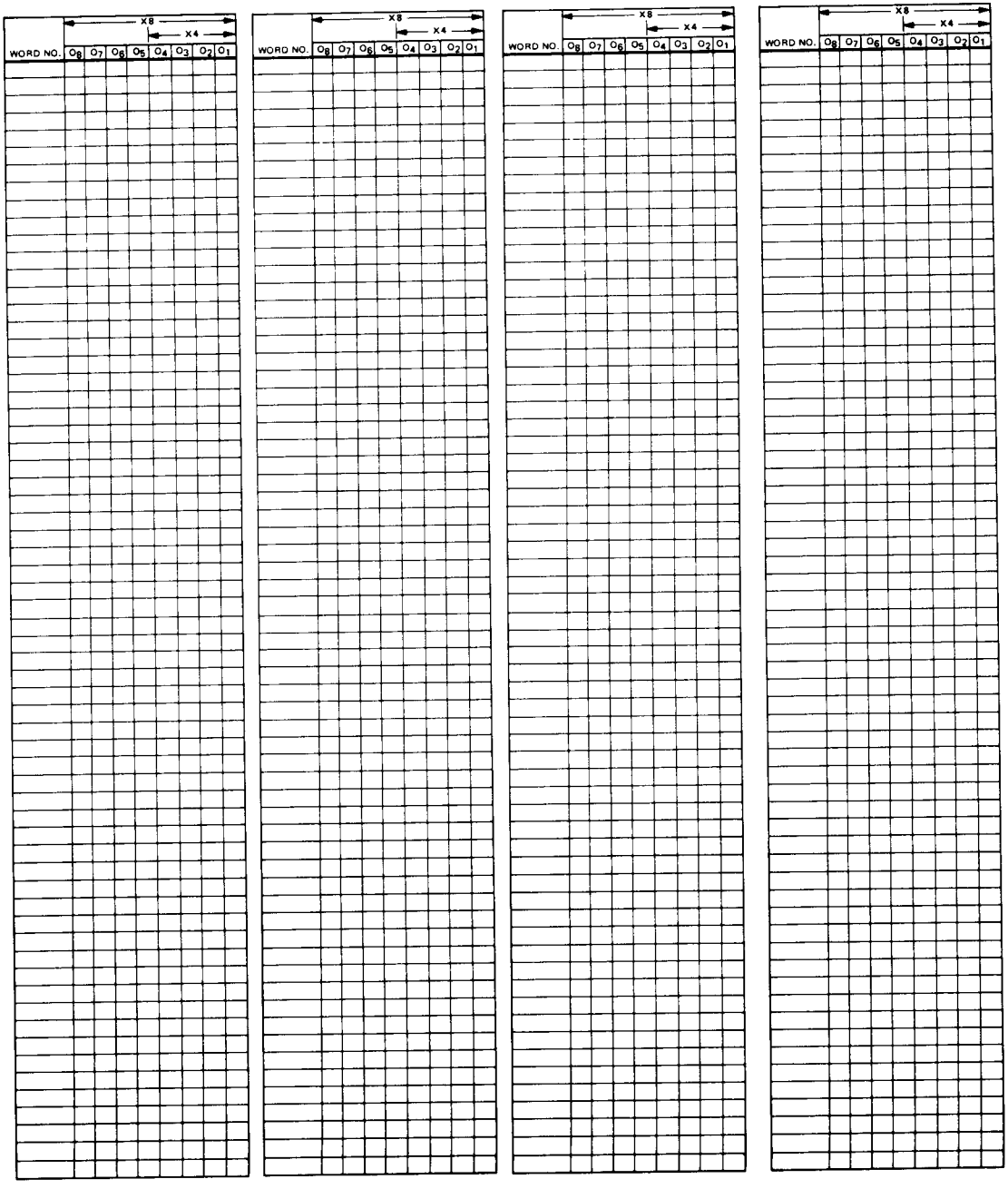
Raytheon Code _____ (Internal use only)

Customer Part No. _____

PROM Organization _____

Page _____ of _____

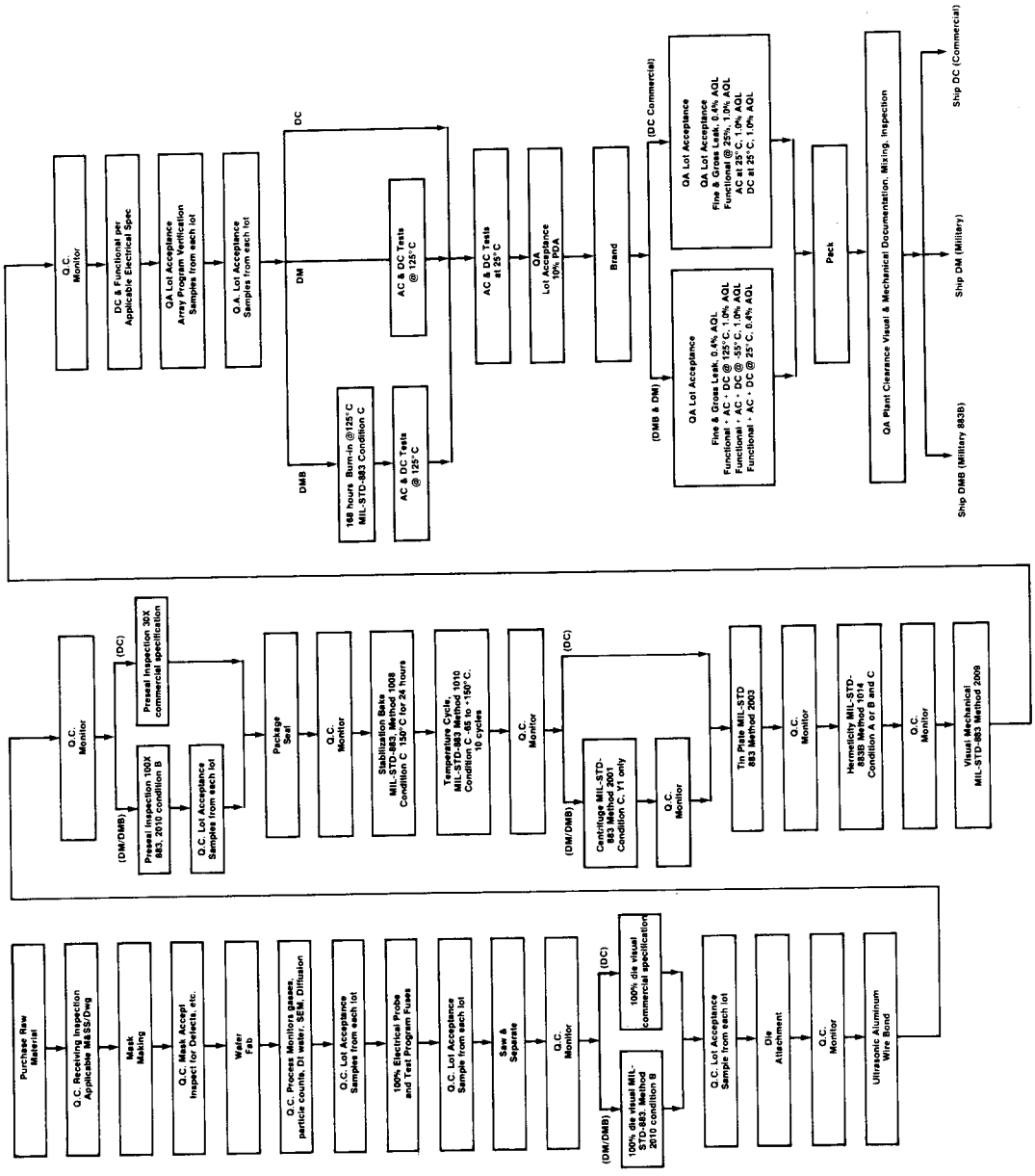
Words _____ through _____



Commercial Programmers

All Raytheon PROMs are designed and tested to give an average programming yield in excess of 90%. This average yield should be achieved using the programming procedure described previously or with any of the commercial PROM programmers listed below when they are properly calibrated and in good operating condition. Raytheon maintains a close relationship with programmer manufacturers to assure that their systems provide the proper programming environment for all Raytheon PROMs and SPROMs.

Programmer Manufacturing Model/Series			Data I/O V, IX	Pro Log 90,92
Raytheon Part No.	Org.	Pins	Program Card Set 909-1226-1 Socket Adaptor	Personality Module PM9037 Pin Out Adaptor
29600/601 29602/603	256 x 8	20	715-1028-1	PA-20-2
29610/611 29612/613	512 x 4	16	715-1035-2	PA-16-1
29620/621 29622/623	512 x 8	20	715-1064	PA-20-2
29624/625 29626/627	512 x 8	24	715-1033-2	PA-24-1
29630/631 29632/633	1024 x 8	24	715-1033-3	PA-24-1
29634/635 29636/637	1024 x 8	24	715-1033-3	PA-24-1
29650/651 29652/653	2048 x 4	18	715-1039	PA-18-2
29660/661 29662/663	256 x 4	16	715-1035-1	PA-16-1
29680/681 29682/683	2048 x 8	24	715-1033	PA-24-1



Product Flow for Quality & Reliability

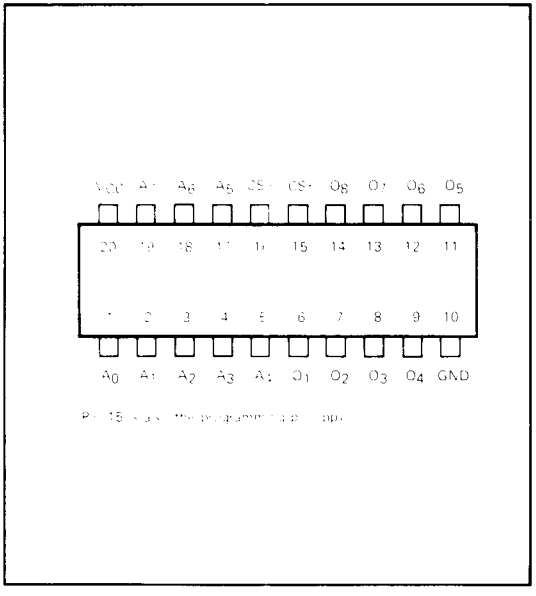
Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions	Typical 5V 25° C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current		90	130	130	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω V_{CC} and 600Ω to GND (16 mA load) Note 1	50	60	75	ns
t_{EA}	Enable access time		20	40	50	ns
t_{ER}	Enable recovery time		20	40	50	ns

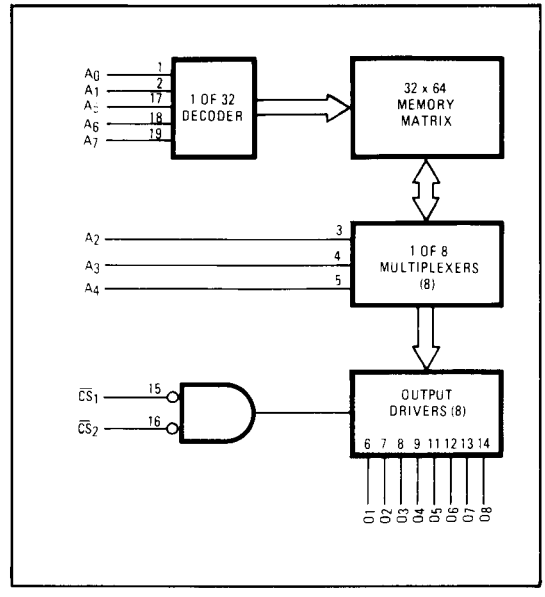
Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.

2. These parts are not recommended for new design.

Pin Out Information



Block Diagram



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Power and AC Characteristics over Operating Range (Unless otherwise noted)

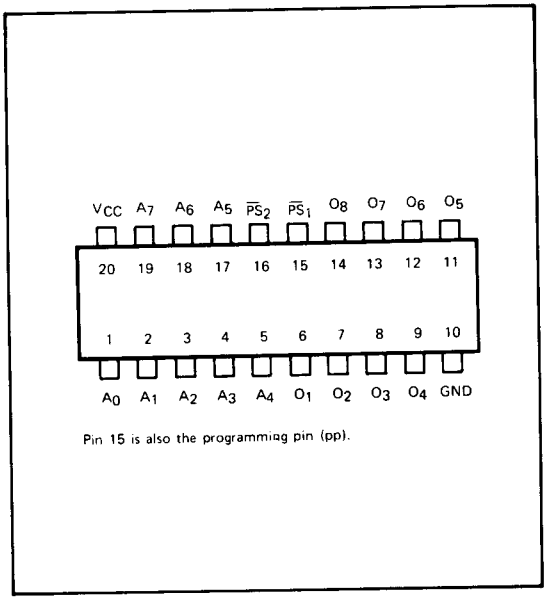
Parameter	Description	Test Conditions		Typical 5V 25° C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current	CS = 2.4V	29602	20	30	30	mA
			29603	30	45	45	mA
		CS = 0.4V (Enabled)		110	170	170	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1		40	65	80	ns
t_{EA}	Enable access time			40	65	80	ns
t_{ER}	Enable recovery time			15	30	40	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.

2. These parts are not recommended for new design.

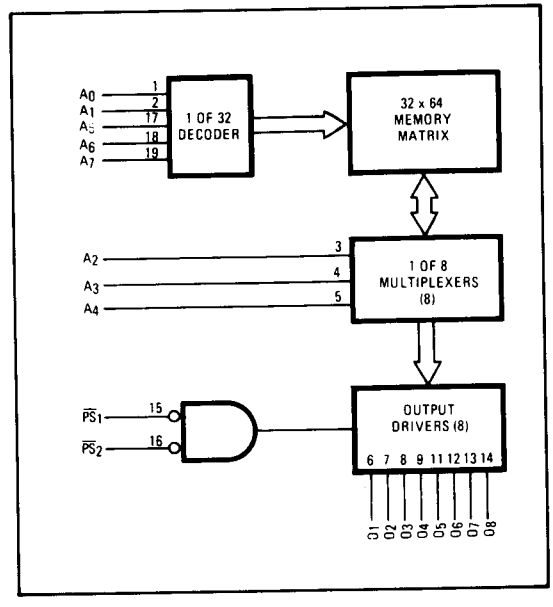
OBSOLETE PRODUCT
Data for Reference Only

Pin Out Information



Pin 15 is also the programming pin (pp).

Block Diagram



Power and AC Characteristics over Operating Range (Unless otherwise noted)

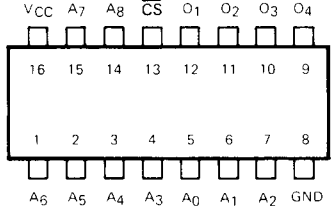
Parameter	Description	Test Conditions	Typical 5V 25°C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current		90	130	130	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1	30	55	70	ns
t_{EA}	Enable access time		15	30	40	ns
t_{ER}	Enable recovery time		15	30	40	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.

2. These parts are not recommended for new design.

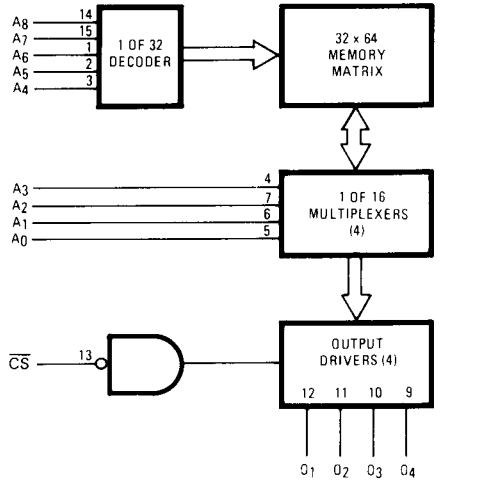
OBSOLETE PRODUCT
Data for Reference Only

Pin Out Information



Pin 13 is also the programming pin (pp).

Block Diagram



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Power and AC Characteristics over Operating Range (Unless otherwise noted)

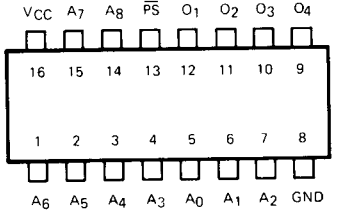
Parameter	Description	Test Conditions		Typical 5V 25° C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current	CS = 2.4V	29612	20	30	30	mA
			29613	30	45	45	mA
		CS = 0.4V (Enabled)		90	130	130	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1		35	60	75	ns
t_{EA}	Enable access time			40	60	75	ns
t_{ER}	Enable recovery time			15	30	40	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.

2. These parts are not recommended for new design.

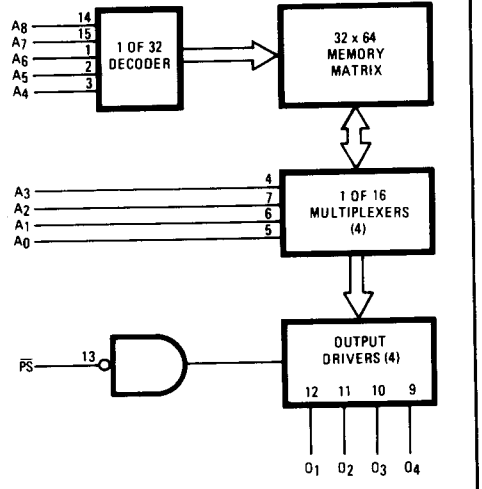
29612 is an **OBSOLETE PRODUCT** Data for Reference Only

Pin Out Information



Pin 13 is also the programming pin (pp).

Block Diagram



Power and AC Characteristics over Operating Range (Unless otherwise noted)

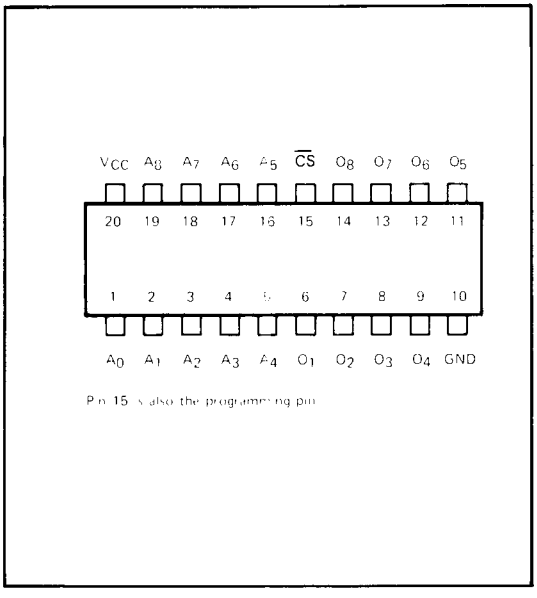
Parameter	Description	Test Conditions	Typical 5V 25° C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current		90	155	155	mA
t_{AA}	Address access time	CL = 30 pF	50	65	80	ns
t_{EA}	Enable access time	RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1	20	30	40	ns
t_{ER}	Enable recovery time		20	30	40	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.

2. These parts are not recommended for new design.

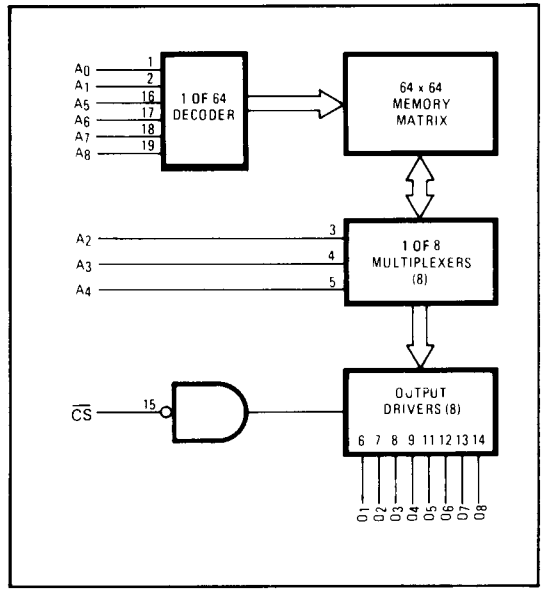
OBSOLETE PRODUCT
Data for Reference Only

Pin Out Information



Pin 15 is also the programming pin

Block



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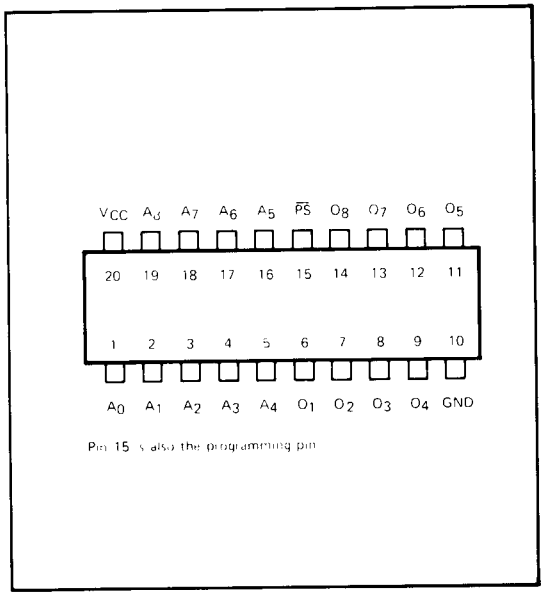
Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions		Typical 5V 25° C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current	CS = 2.4V	29622	20	30	30	mA
			29623	30	45	45	mA
		CS = 0.4V (Enabled)		90	155	155	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1		55	70	85	ns
t_{EA}	Enable access time			55	70	85	ns
t_{ER}	Enable recovery time			20	30	40	ns

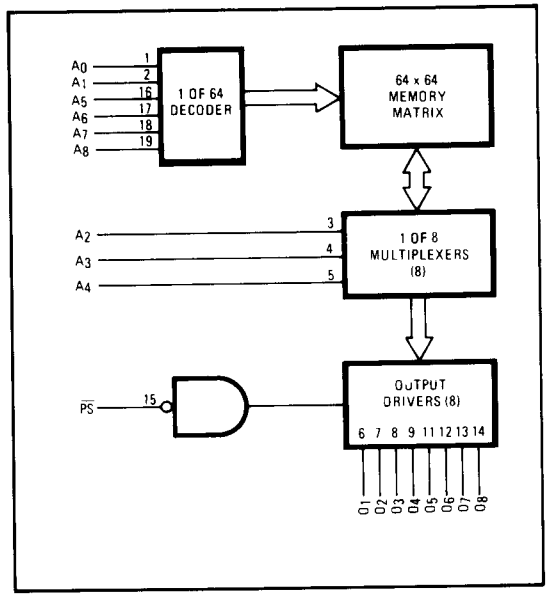
Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.

2. These parts are not recommended for new design.

Pin Out Information



Block Diagram



Power and AC Characteristics over Operating Range (Unless otherwise noted)

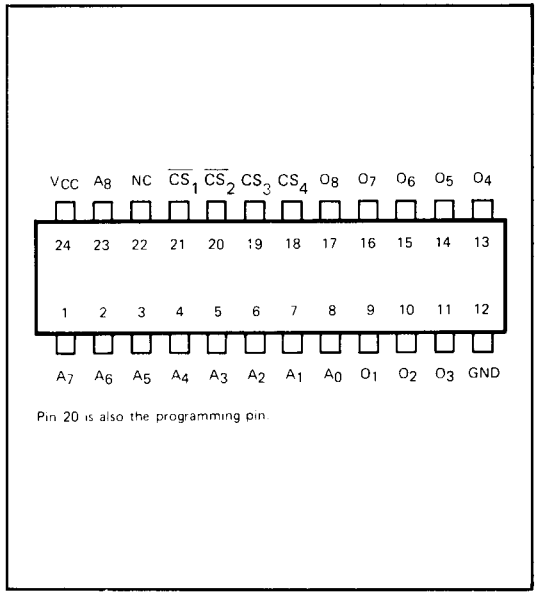
Parameter	Description	Test Conditions	Typical 5V 25°C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current		110	170	170	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1	35	60	75	ns
t_{EA}	Enable access time		20	30	40	ns
t_{ER}	Enable recovery time		15	25	35	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.

2. These parts are not recommended for new design.

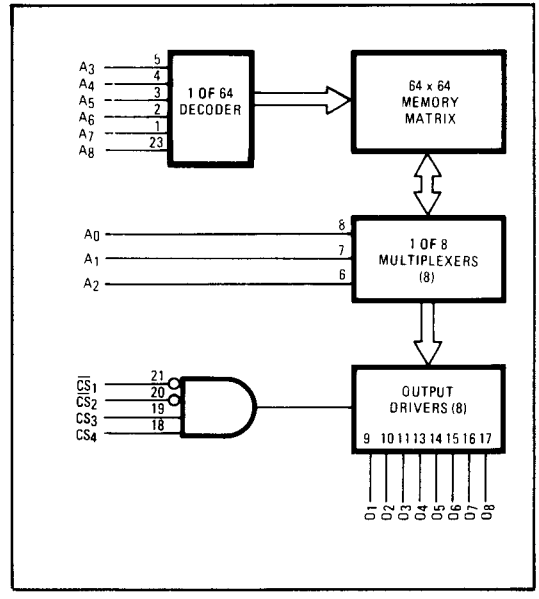
OBSOLETE PRODUCT
Data for Reference Only

Pin Out Information



Pin 20 is also the programming pin.

Block Diagram



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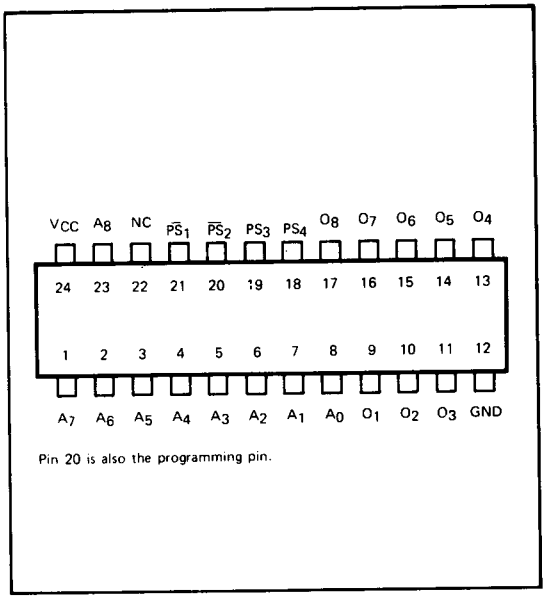
Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions		Typical 5V 25°C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current	Disabled	29626	20	30	30	mA
			29627	30	45	45	mA
		Enabled		110	170	170	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1		40	65	80	ns
t_{EA}	Enable Access time			40	65	80	ns
t_{ER}	Enable recovery time			15	25	35	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.
2. These parts are not recommended for new design.

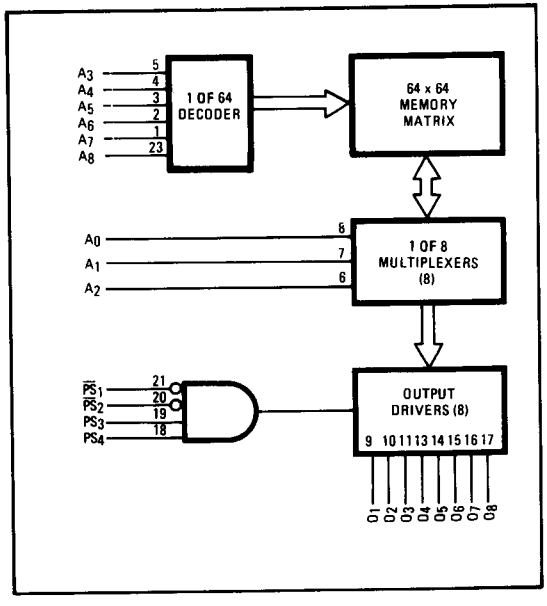
OBSOLETE PRODUCT
Data for Reference Only

Pin Out Information



Pin 20 is also the programming pin.

Block Diagram



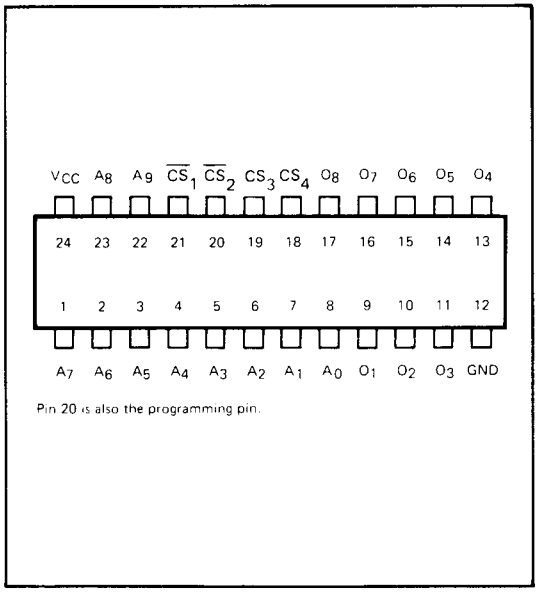
Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions	Typical 5V 25° C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current		120	170	170	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1	45 (40)	70 (50)	90 (60)	ns
t_{EA}	Enable access time		20 (20)	35 (35)	45 (40)	ns
t_{ER}	Enable recovery time		15	30	40	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.

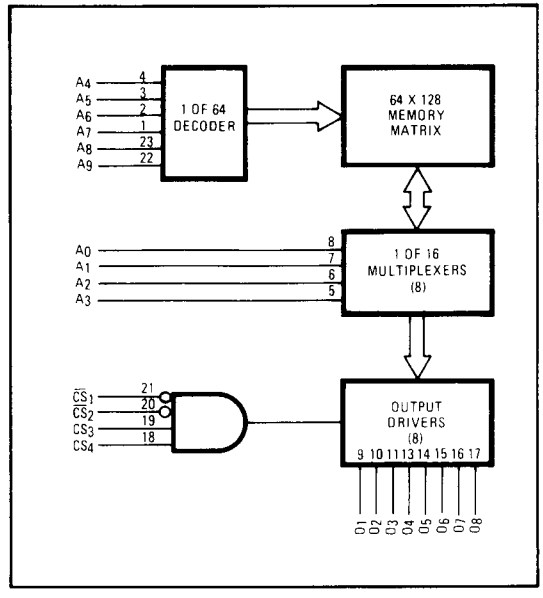
2. Numbers in parenthesis are for the 29631A device only.

Pin Out Information



Pin 20 is also the programming pin.

Block Diagram



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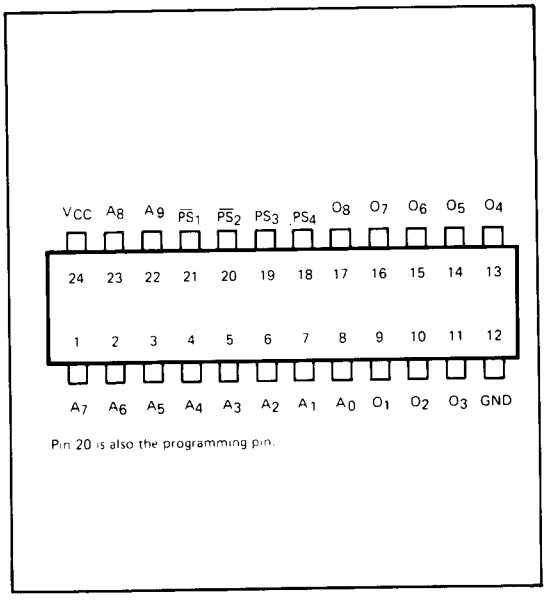
Power and AC Characteristics over Operating Range (Unless otherwise noted)

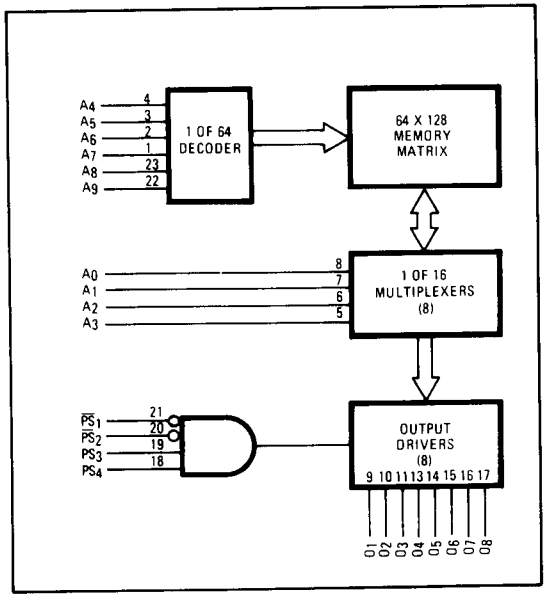
Parameter	Description	Test Conditions		Typical 5V 25°C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current	Disabled	29632 Note 3	20	30	30	mA
			29633	30	45	45	mA
		Enabled		110	170	170	mA
t_{AA}	Address access time	C_L = 30pF R_L = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1		50	75 (55)	90 (75)	ns
t_{EA}	Enable access time			50	75 (50)	95 (70)	ns ns
t_{ER}	Enable recovery time			15	30	40	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.
2. Numbers in parenthesis are for 29633A device only.
3. These parts are not recommended for new design.

Pin Out Information



Block Diagram

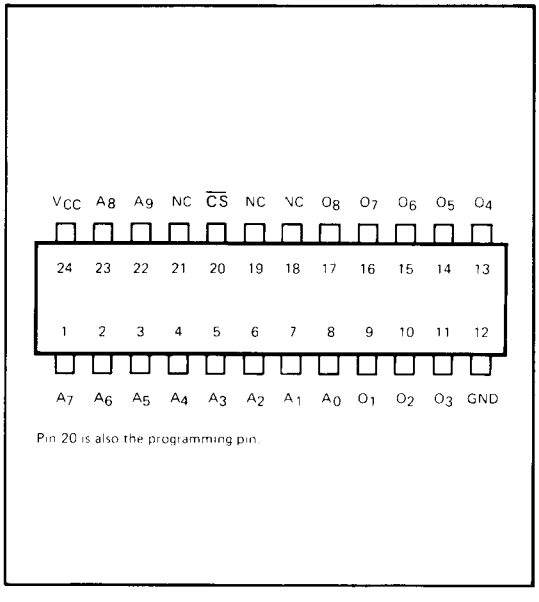


Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions	Typical 5V 25°C	Maximum		Units
				Com'l	Mil	
I_{CC}	Power supply current		120	170	170	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1	45	70	90	ns
t_{EA}	Enable access time		20	35	45	ns
t_{ER}	Enable recovery time		15	30	40	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.

Pin Out Information



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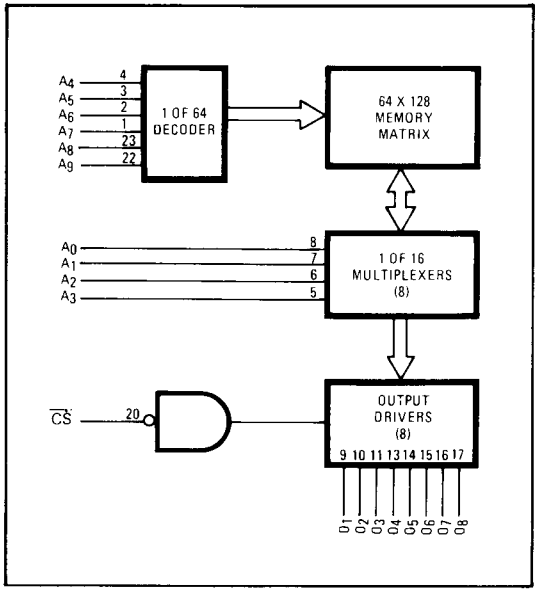

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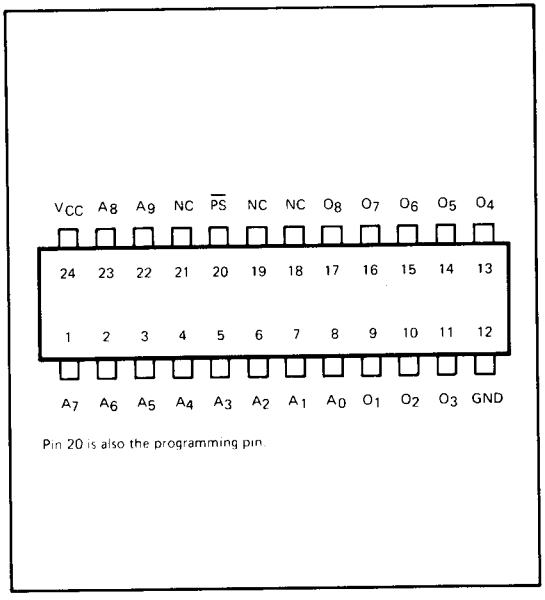
Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions		Typical 5V 25°C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current	CS = 2.4V	29636 Note 2	20	30	30	mA
			29637	30	45	45	mA
		CS = 0.4V (Enabled)		110	170	170	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1		50	75	115	ns
t_{EA}	Enable access time			50	75	115	ns
t_{ER}	Enable recovery time			15	30	40	ns

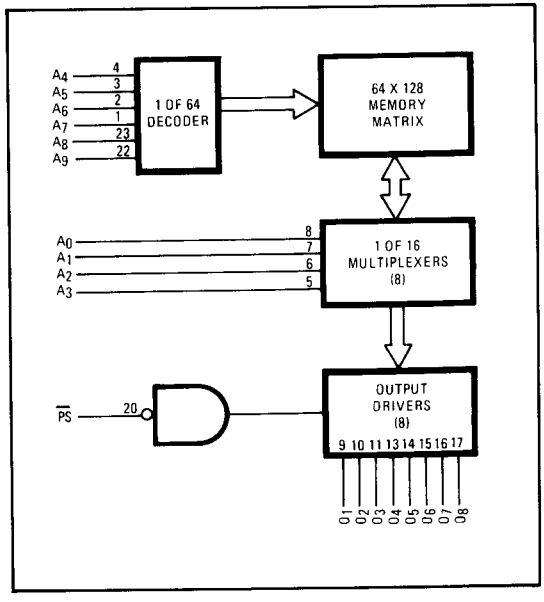
Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.

2. These parts are not recommended for new design.

Pin Out Information



Block Diagram



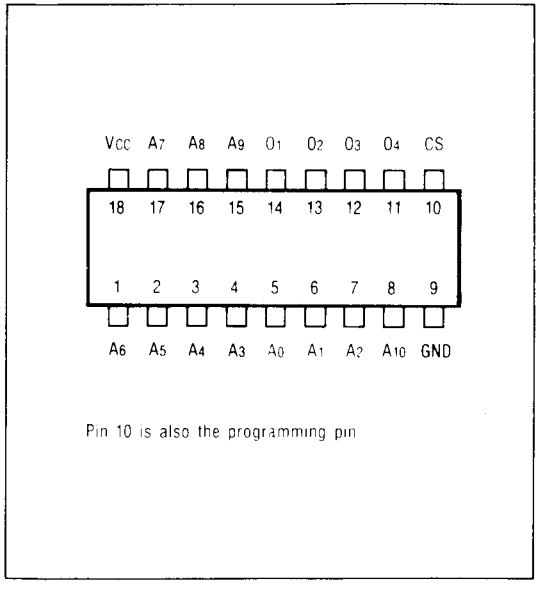
Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions	Typical 5V 25° C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current		120	170	170	mA
t_{AA}	Address access time	CL = 30pF	45	70	90	ns
		RL = 300Ω to V_{CC}	(35)	(50)	(60)	
t_{EA}	Enable access time	and	20	40	50	ns
		600Ω to GND	(15)	(35)	(45)	ns
t_{ER}	Enable recovery time	(16mA load) Note 1	15	35	45	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.
2. Numbers in parentheses are for the 29651A device only.

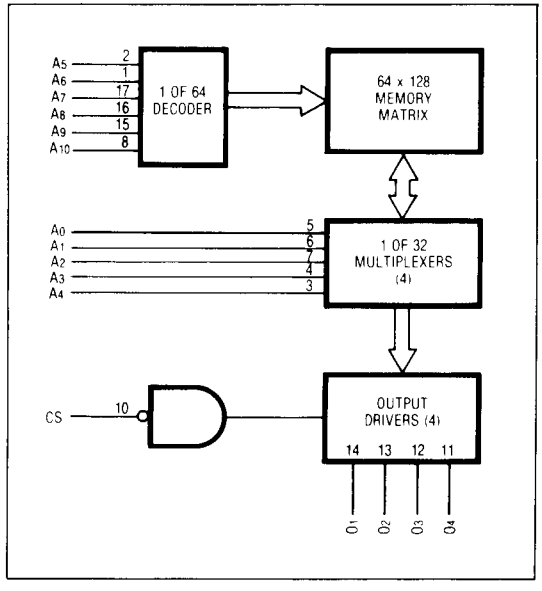
PRELIMINARY DATA
This is not a final specification. Some limits of the characteristics are subject to change.

Pin Out Information



Pin 10 is also the programming pin

Block Diagram



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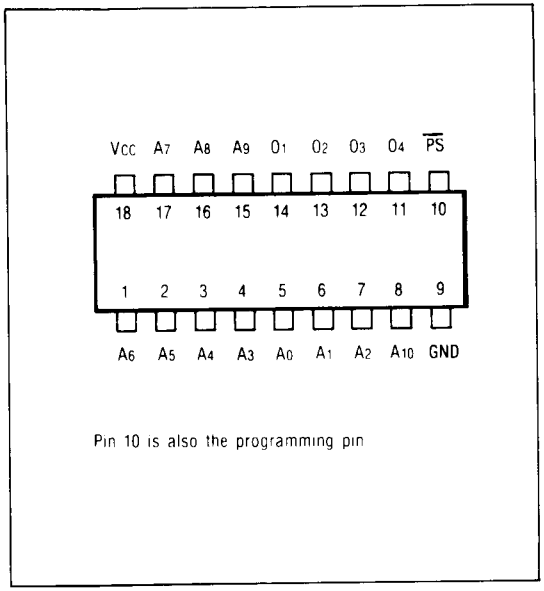
Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions		Typical 5V 25°C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current	Disabled	29652 Note 3	20	30	30	mA
			29653	30	45	45	mA
		Enabled		110	170	170	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1		50 (38)	75 (55)	90 (65)	ns
t_{EA}	Enable access time			50 (40)	70 (50)	80 (60)	ns
t_{ER}	Enable recovery time			15	35	45	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.
2. Numbers in parentheses are for the 29653A device only.
3. These parts not recommended for new design.

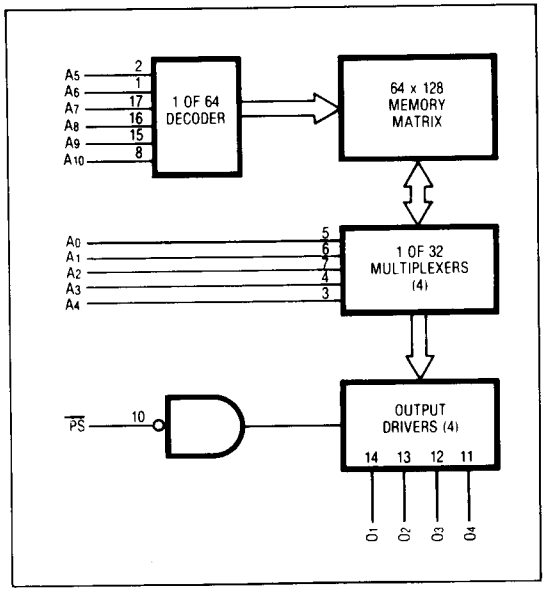
PRELIMINARY DATA
This is not a final specification. Some limits of the characteristics are subject to change.

Pin Out Diagram



Pin 10 is also the programming pin

Block Diagram

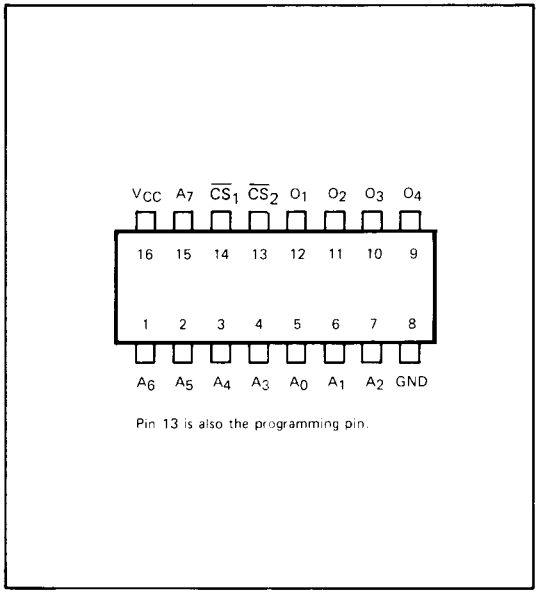


Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions	Typical 5V 25°C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current		90	130	130	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1	45	55	70	ns
t_{EA}	Enable access time		20	30	40	ns
t_{ER}	Enable recovery time		20	30	40	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.
2. These parts are not recommended for new design.

Pin Out Information



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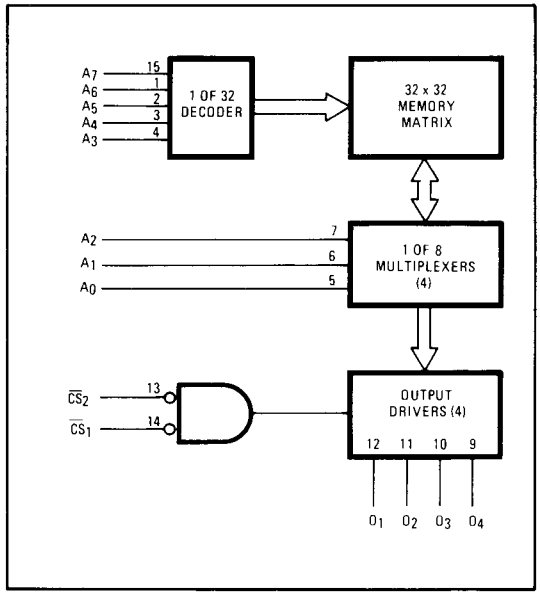

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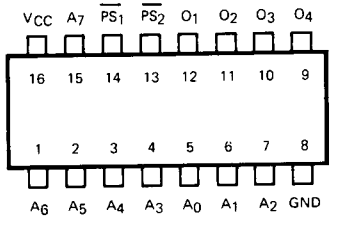
Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions		Typical 5V 25°C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current	CS = 2.4V	29662	20	30	30	mA
			29663	30	45	45	mA
		CS = 0.4V		90	130	130	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1		35	60	75	ns
t_{EA}	Enable Access Time			40	60	75	ns
t_{ER}	Enable recovery time			15	30	40	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.
2. These parts are not recommended for new design.

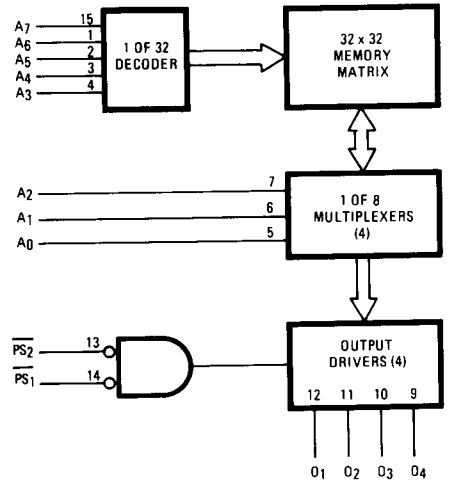
OBSOLETE PRODUCT
Data for Reference Only

Pin Out Information



Pin 13 is also the programming pin.

Block Diagram



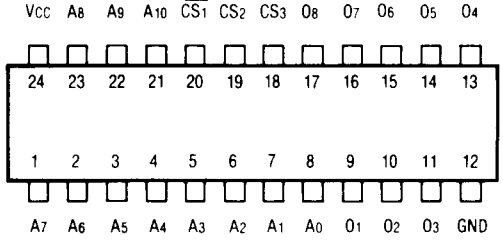
Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions	Typical 5V 25°C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current		125	180	180	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC}	50 (35)	80 (50)	100 (70)	ns
t_{EA}	Enable access time	and 600Ω to GND	30 (25)	40 (35)	50 (45)	ns
t_{ER}	Enable recovery time	(16mA load) Note 1	25 (15)	40 (30)	45 (35)	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.
2. Numbers in parenthesis are for the 29681A device only.

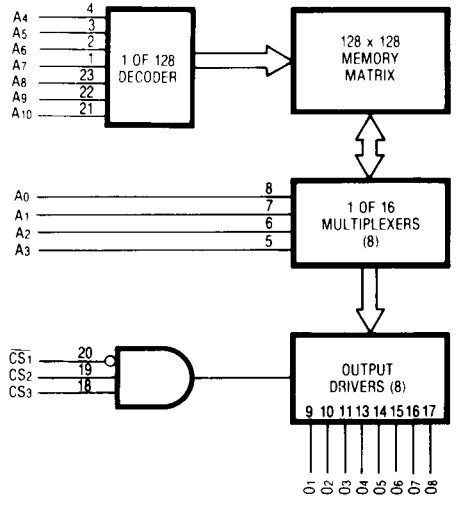
PRELIMINARY DATA
This is not a final specification. Some limits of the characteristics are subject to change.

Pin Out Diagram



Pin 20 is also the programming pin.

Block Diagram



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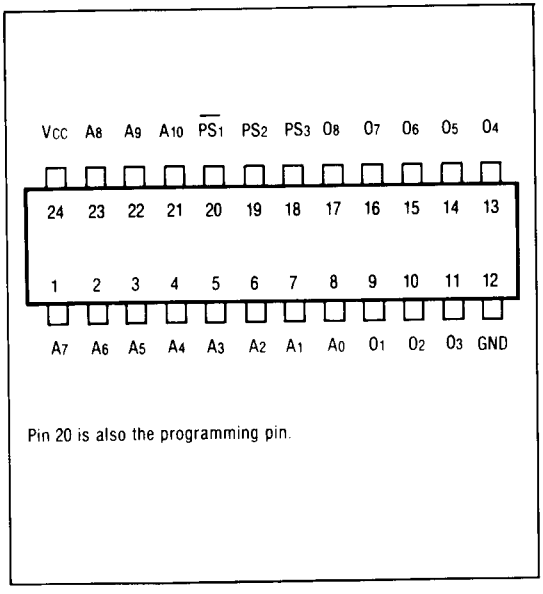
Power and AC Characteristics over Operating Range (Unless otherwise noted)

Parameter	Description	Test Conditions		Typical 5V 25°C	Maximum Com'l	Maximum Mil	Units
I_{CC}	Power supply current	Disabled	29682 Note 3	20	30	30	mA
			29683	30	45	45	mA
		Enabled		125	180	180	mA
t_{AA}	Address access time	CL = 30pF RL = 300Ω to V_{CC} and 600Ω to GND (16mA load) Note 1		55 (38)	85 (50)	105 (75)	ns
t_{EA}	Enable access time			55 (40)	85 (65)	105 (75)	ns
t_{ER}	Enable recovery time			35 (20)	45 (35)	50 (45)	ns

Note 1. 300Ω resistor opened for t_{EA} and t_{ER} measurements between HIGH and OFF states.
2. Numbers in parentheses are for the 29683A device only.
3. These parts not recommended for new design.

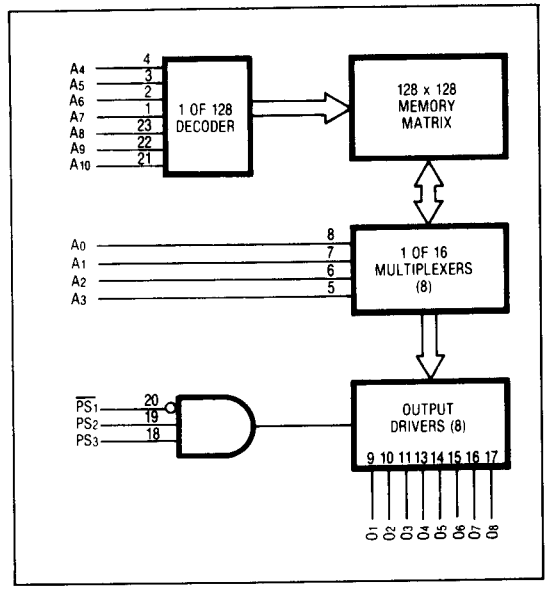
PRELIMINARY DATA
This is not a final specification. Some limits of the characteristics are subject to change.

Pin Out Diagram



Pin 20 is also the programming pin.

Block Diagram



These applications describe high speed PROM arrays that achieve significant power reduction through the use of a Raytheon chip select power switched PROM(SPROM).

1 Watt 50ns 4K x 8 ROM Array

Figure 1 shows a high speed low power 4K x 8 PROM array using four 1K x 8 SPROMs (29633).

The unique feature of this application is the use of the internal chip select logic to eliminate any extra decoders or gates in expanding the 1K word 29633 (10-bit address) into the 4K word array (12-bit address). As the power enabling chip select speed is comparable to the address delay there is no speed loss using this technique. In fact it is considerably faster than using an extra decoder and power supply switching transistor.

An additional benefit of this method of word expansion with SPROMs is the automatic "power off" of the de-selected PROMs without using any extra Power transistors or their decoder drivers and the elimination of any power required to drive them.

All 12 address lines are balanced with 4 loads each. To achieve the proper decoding using the chip select inputs the proper unused chip select inputs must be connected either to ground or to V_{CC} as required by their logical inputs.

The power savings of this structure over standard PROMs is significant. A SPROM when de-selected typically consumes < 25% of the power of a standard PROM or selected SPROM. The power consumed by this SPROM array is the power of one enabled or selected SPROM (typically 550mw) plus the power of three disabled or de-selected SPROMs (150mw each) for a total of 1000mw. This compares with 4 full power PROMs (typically 550mw each) for 2.2 watts or guaranteed power savings of 55%. (maximum ratings reflect a greater power savings)

2.8 Watt 65ns 8K x 16 ROM Array

Figure 2 shows an 8K x 16 PROM array that achieves a significant power savings by two methods.

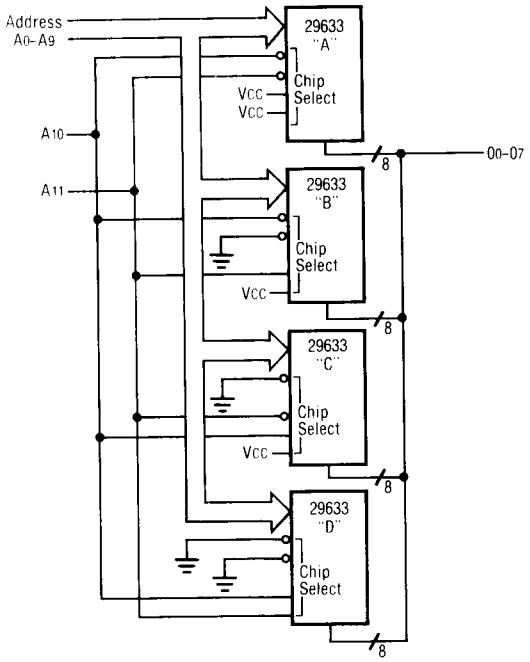
First, the expansion of the 2K word 29653 SPROM (2K x 4) to 8K words is accomplished by use of a 2-line to 4-line decoder. This device enables or selects only one fourth of the SPROMs at a time resulting in a power savings of about 50 to 60 percent. Expansion of the array to 16K words can be accomplished using only a 3-line to 8-line decoder in place of the 2 of 4 with a total power savings greater than 65%.

Second, the system clock or Processor read enable is connected to the decoder chip "enable" or "data" input. This permits the entire ROM array to be disabled when not required.

The speed of the expansion address inputs is slightly slower than the direct addres inputs as the additional delay of the decoder chip/IC is added to the delay of the SPROM power switched chip select. Use of the very high speed version of the 2K x 4 SPROMs can achieve a better than 90ns address or array enable to output delay over full military power supply and temperature variations. The system power is 4 enabled devices (typically 550mw) for 2.2 watts plus 12 disabled devices (typically 150mw) for a total selected power of 2.2w + 1.8 = 4 watts. Totally disabled the array power is typically 2.4w.

By use of the systems clock or memory select enable the typical operating system power can be reduced to 3.2 watts for a 50% duty cycle and 2.8 watts for a 25% duty cycle.

These two SPROM arrays point out the power saving capability of the internally power switched PROM. They achieve lower array power than obtainable with low power devices while maintaining the speed performance of the standard power units. Both of these arrays can be expanded to further improve power savings over conventional PROMs.



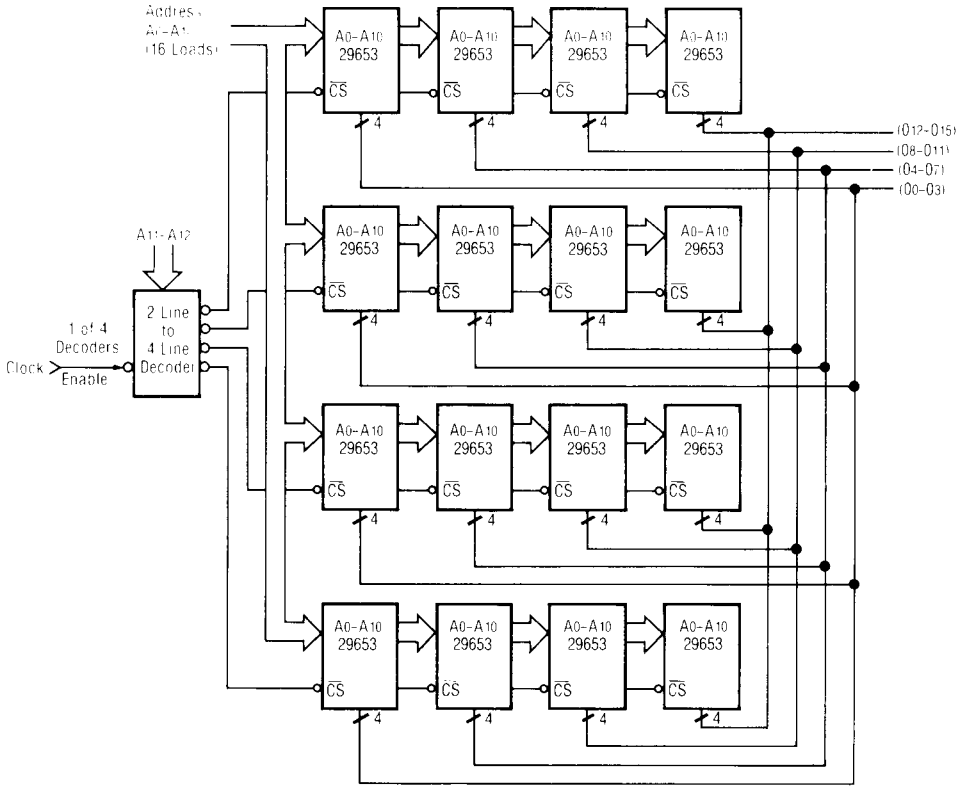
A10	A11	29633 Activated
Lo	Lo	"A"
Lo	Hi	"B"
Hi	Lo	"C"
Hi	Hi	"D"

Typical Power Dissipation, Access Time = 50nsec

Without Power Switching
4 devices × 550 mW/device = 2.2 Watts

With Power Switching
1 device × 550mW/device + 3 devices × 150mW/device = 1.000 Watts
power savings ~ 55%

Figure 1. High Speed Low Power 4K x 8 PROM Array Example Using 1K x 8 SPROMs (Raytheon 29633)



Typical Power Dissipation

Without Power Switching
16 devices × 550mW/device = 8.8 watts

With Power Switching — 100% Duty Cycle
4 devices × 550mW/device
+ 12 devices × 150mW/device
= 4 watts

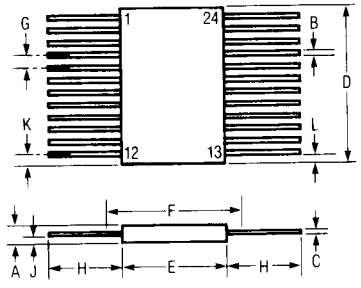
50% Clock with Power Switching — 50% Clock Duty Cycle
4 devices × 550mW/device × 50%
+ 4 devices × 150mW/device × 50%
+ 12 devices × 150mW/device
= 3.2 watts

25% with Power Switching — 25% Clock Duty Cycle
4 devices × 550mW/device × 25%
+ 4 devices × 150mW/device × 75%
+ 12 devices × 150mW/device
2.8 watts

Figure 2. 8K x 16 Low Power, High Speed, Clocked PROM Array using 2K x 4 SPROMs (Raytheon 29653)

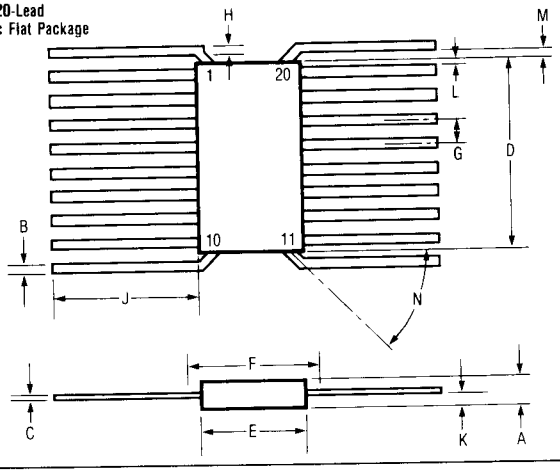
24-Lead
Ceramic Flat Package

Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A	.045	.090	1.14	2.29
B	.015	.019	.38	.48
C	.003	.006	.08	.15
D		.640		16.26
E	.360	.420	9.14	10.67
F		.440		11.18
G	.050 BSC		1.27 BSC	
H	.250	.370	6.35	9.40
J	.010	.040	.25	1.02
K		.045		1.14
L	.005		.13	



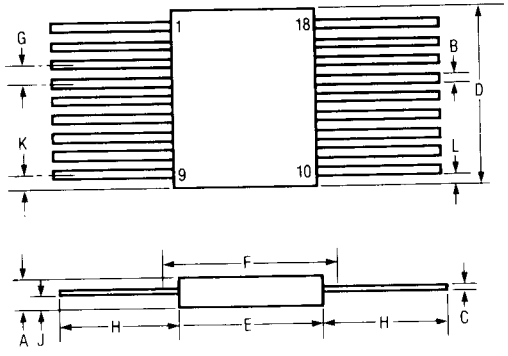
20-Lead
Ceramic Flat Package

Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A	.045	.085	1.14	2.16
B	.015	.019	.38	.48
C	.003	.006	.08	.15
D		.440		11.18
E	.245	.285	6.22	7.24
F		.305		7.75
G	.050 BSC		1.27 BSC	
H	.008	.015	.20	.38
J	.250	.370	6.35	9.40
K	.010	.040	.25	1.02
L	.005		.13	
M	.004		.10	
N	30°	90°	30°	90°



18-Lead
Ceramic Flat Package

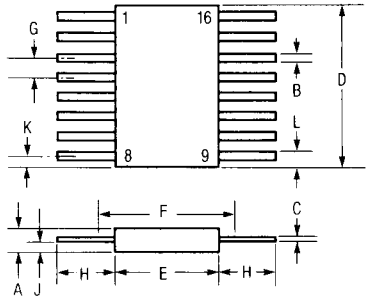
Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A	.050	.085	1.27	2.16
B	.015	.019	.38	.48
C	.003	.006	.08	.15
D	.590	.625	14.41	15.88
E	.220	.310	5.95	7.87
F		.320		8.13
G	.050 BSC		1.27 BSC	
H	.330	.370	8.38	9.40
J	.020	.040	0.52	1.02
K	.060	.080	1.52	2.03
L		.060		1.52



Packaging Information

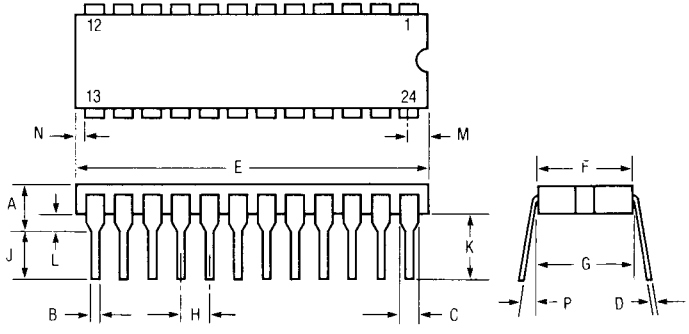
16-Lead
Ceramic Flat Package

Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A	.045	.085	1.14	2.16
B	.015	.019	.38	.48
C	.003	.006	.08	.15
D		.440		11.18
E	.245	.285	6.22	7.24
F		.305		7.75
G	.050 BSC		1.27 BSC	
H	.250	.370	6.35	9.40
J	.010	.040	.25	1.02
K		.045		1.14
L	.005		.13	



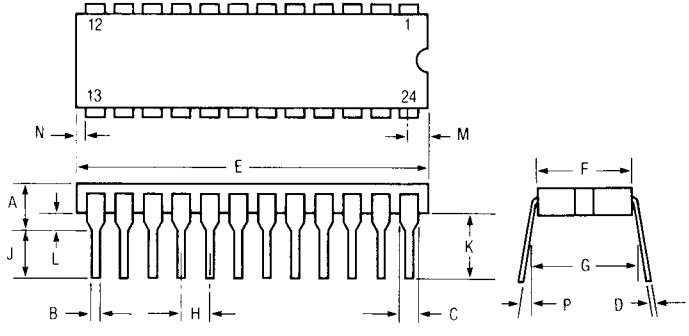
24-Lead
Ceramic Dual-in-Line

Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		.225		5.72
B	.014	.023	.36	.58
C	.030	.070	.76	1.78
D	.008	.015	.20	.38
E		1.290		32.77
F	.500	.610	12.70	15.49
G	.590	.620	14.99	15.75
H	.100BSC		2.54BSC	
J	.120	.200	3.05	5.08
K	.150		3.81	
L	.015	.075	.38	1.91
M		.098		2.49
N	.005		.13	
P	0°	15°	0°	15°



24-Lead
Ceramic Dual-in-Line
Narrow Package

Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		.225		5.72
B	.014	.023	.36	.58
C	.030	.070	.76	1.78
D	.008	.015	.20	.38
E		1.290		32.77
F		.302		7.67
G	.290	.320	7.37	8.13
H	.100BSC		2.54BSC	
J	.120	.200	3.05	5.08
K	.150		3.81	
L	.015	.075	.38	1.91
M		.098		2.49
N	.005		.13	
P	0°	15°	0°	15°

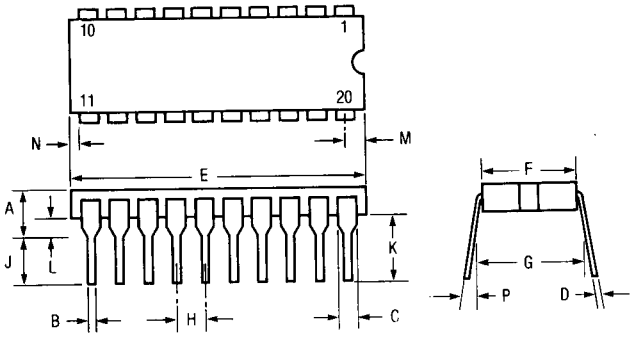


RAYTHEON

Packaging Information

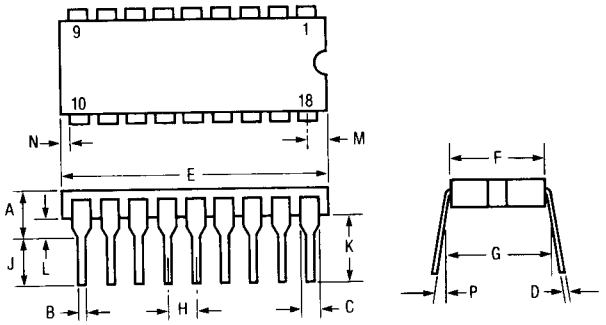
20-Lead Ceramic Dual-in-Line Package

Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		.200		5.08
B	.014	.023	.36	.58
C	.030	.070	.76	1.78
D	.008	.015	.20	.38
E	.930	.975	23.60	24.80
F	.220	.310	5.59	7.87
G	.290	.320	7.37	8.13
H	.100BSC		2.54BSC	
J	.120	.200	3.05	5.08
K	.150		3.81	
L	.015	.060	.38	1.52
M		.098		2.49
N	.005		.13	2.49
P	0°	15°	0°	15°



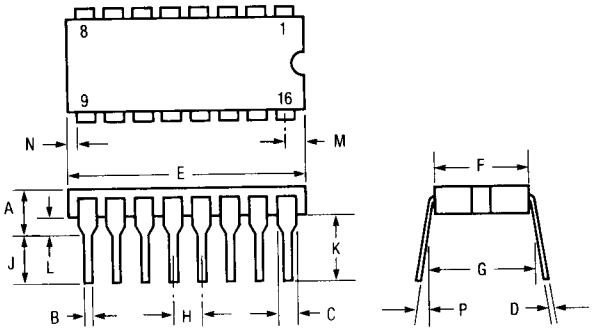
18-Lead Ceramic Dual-in-Line

Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		.200		5.08
B	.014	.023	.36	.58
C	.030	.070	.76	1.78
D	.008	.015	.20	.38
E		.940	23.90	23.90
F		.310		7.87
G	.290	.320	7.37	8.13
H	.100BSC		2.54BSC	
J	.120	.200	3.05	5.08
K	.150		3.81	
L	.015	.060	.38	1.52
M		.080	.38	2.03
N	.005		.13	
P	0°	15°	0°	15°



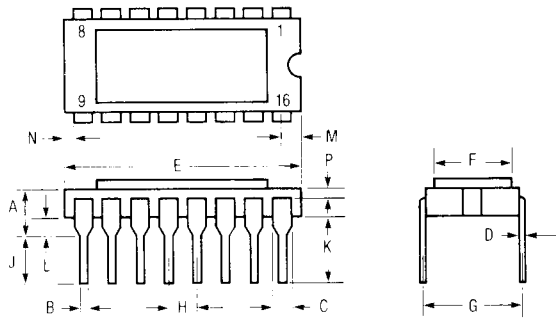
16-Lead Ceramic Dual-in-Line

Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		.200		5.08
B	.014	.023	.36	.58
C	.030	.070	.76	1.78
D	.008	.015	.20	.38
E		.840		21.34
F	.220	.310	5.59	7.87
G	.290	.320	7.37	8.13
H	.100BSC		2.54BSC	
J	.125	.200	3.18	5.08
K	.150		3.81	
L	.015	.060	.38	1.52
M		.080		2.03
N	.005		.13	
P	0°	15°	0°	15°



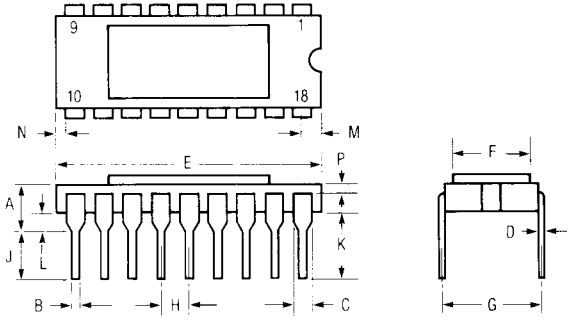
Packaging Information

16-Lead
Ceramic Side-Brazed
Dual-in-Line
ML Package



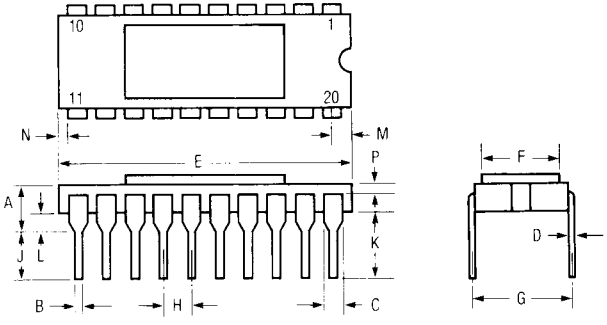
Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		.200		5.08
B	.015	.021	0.38	0.53
C	.045	.060	1.14	1.52
D	.008	.012	0.20	0.31
E	.740	.830	18.80	21.08
F	.290	.310	7.37	7.87
G	.280	.320	7.11	8.13
H	.100BSC		2.54BSC	
J	.125	.175	3.18	4.45
K	.150		3.81	
L	.025	.055	0.63	1.40
M	.060	.098	1.52	2.49
N	.005		0.13	
P	.005		0.13	

18-Lead
Ceramic Side-Brazed
Dual-in-Line
Package



Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		.200		5.08
B	.015	.021	0.38	0.53
C	.045	.060	1.14	1.52
D	.008	.012	0.20	0.31
E	.690	.785	17.53	19.94
F	.280	.310	7.11	7.87
G	.280	.320	7.11	8.13
H	.100BSC		2.54BSC	
J	.125		3.18	
K	.150	.230	3.81	5.85
L	.025	.055	0.63	1.40
M	.045	.095	1.14	2.41
N	.005		0.13	
P	.005		0.13	

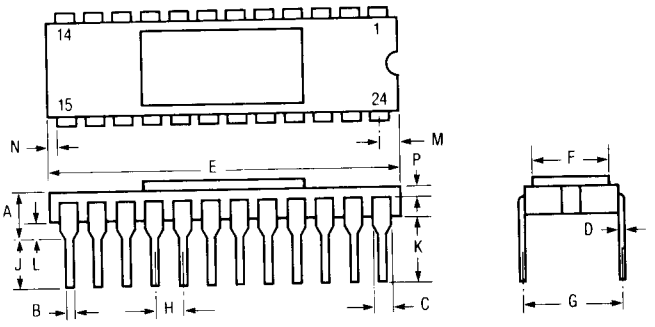
20-Lead
Ceramic Side-Brazed
Dual-in-Line
MS Package



Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		.200		5.08
B	.015	.023	0.38	0.58
C	.045	.060	1.14	1.52
D	.008	.012	0.20	0.31
E	.942	.990	23.93	25.15
F	.290	.310	7.37	7.87
G	.280	.320	7.11	8.13
H	.100BSC		2.54BSC	
J	.125	.175	3.18	4.45
K	.150		3.81	
L	.015	.060	0.38	1.52
M	.050	.065	0.76	1.65
N	.005		0.13	
P	.005		0.13	

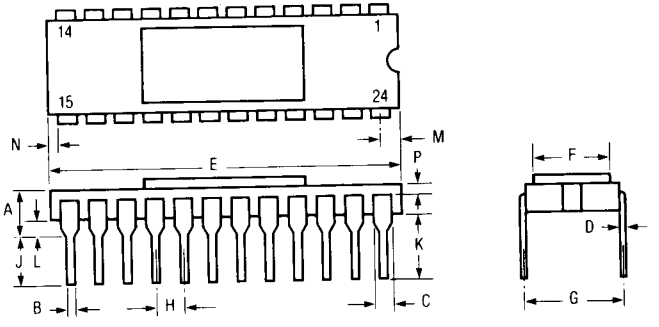
RAYTHEON

24-Lead
Ceramic Side-Brazed
Dual-in-Line
Package



Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		.200		5.08
B	.015	.021	0.38	0.53
C	.045	.060	1.14	1.52
D	.008	.012	0.20	0.31
E	1.180	1.220	29.97	31.01
F	.580	.610	14.73	15.49
G	.580	.620	14.73	15.75
H	.100BSC		2.54BSC	
J	.125		3.18	
K	.120	.200	3.05	5.08
L	.030	.070	0.76	1.78
M	.030	.065	0.76	1.65
N	.005		0.13	
P	.005		0.13	

24-Lead
Ceramic Side-Brazed
Dual-In-Line
Narrow Package



Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		.200		5.08
B	.015	.023	0.38	0.58
C	.045	.060	1.14	1.52
D	.008	.012	0.20	0.31
E	1.150	1.220	29.20	31.01
F	.280	.310	7.11	7.87
G	.290	.320	7.37	8.13
H	.100BSC		2.54BSC	
J	.125		3.18	
K	.120	.200	3.05	5.08
L	.015	.060	0.38	1.52
M	.030	.065	0.76	1.65
N	.005		0.13	
P	.005		0.13	