

# Military 24-Pin PAL Devices

## Features

- Registers with feedback
- Programmable three-state outputs
- Security fuse prevents duplication of logic
- Variety of speed/power options available in same architecture
- Register preload to aid in device testing
- Power-up reset to logical high
- Programmable output polarity
- Product term sharing
- Programmable register or combinatorial outputs
- Dual feedback allows buried state registers or input registers (PAL32VX10)
- Programmable flip-flops allow J-K, S-R, T or D types (PAL32VX10)
- Asynchronous preset/synchronous reset, synchronous preset/asynchronous reset (PAL32VX10)
- Through-hole or surface mount device packaging
- Neutron fluence (permanent damage):  $1 \times 10^{13}$  N/cm<sup>2</sup>
- Dose rate (transient upset) junction Isolated Bipolar processes:  $2 \times 10^{10}$  RADs (Si) per sec recovered in 50 to 70  $\mu$ s from a 1  $\mu$ s pulse

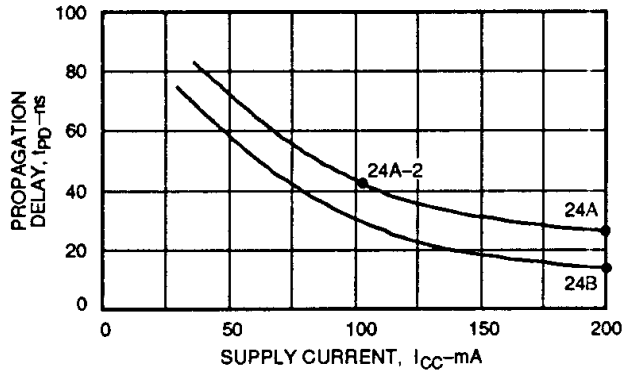
## Benefits

- Instant prototyping/zero NRE charge
- Low-cost programmable replacement for TTL logic
- Reduces inventory by reducing chip count
- Programmed on standard PROM/PAL device programmers
- Several software programs available to assist in creating bit pattern designs

## Applications

- High speed graphic controllers
- High speed computers
- High frequency state machines
- High frequency counters
- Microprocessor clock generation and interface logic
- DMA controllers
- Asynchronous bus interface
- CRT controllers
- Peripheral/handshaking interface
- Interrupt controllers
- Memory mapped I/O (PAL8L14A)
- Microprocessor decoder (PAL8L14A)

24-Pin PAL Device Speed vs. Power



503 144

## Register Preload

Register preload is an aid to functional testing, which is usually performed after the device is programmed but before it is installed on the circuit board. Using register preload, the register of a device can be "preloaded" to any desired state value. This is particularly useful in applications where the output is fed back into the array as an input, since it may take many state transitions to reach a desired state in the output register. Register preload also allows the user to set the device to an "illegal" state which cannot be reached through normal state transitions, in order to test for proper recovery.

## Power-Up Reset

Another added testability feature found on these Series is power-up reset. Power-up reset makes system initialization simple; registers are reset to logic 0 at power-up, thus all outputs are set to logic 1.

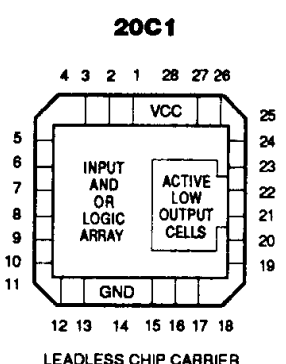
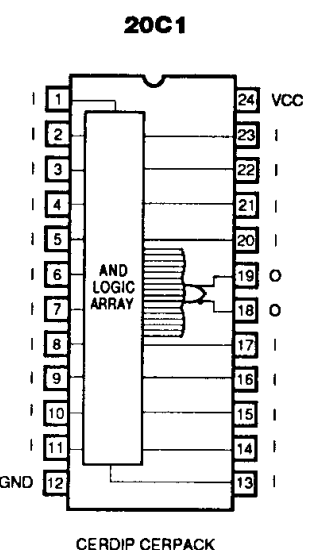
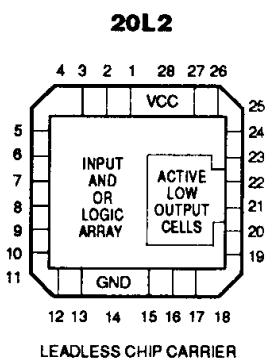
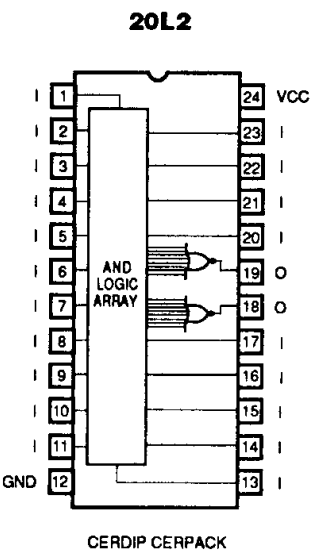
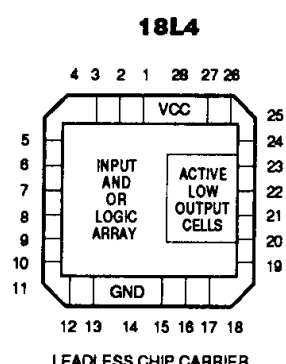
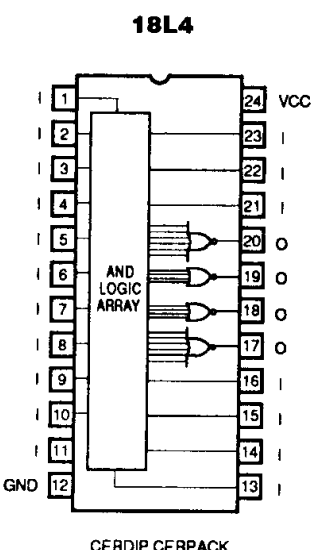
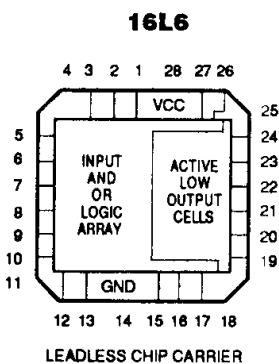
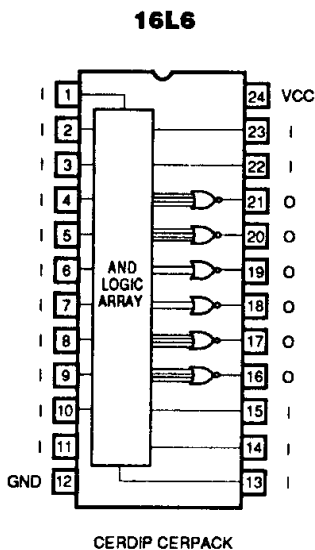
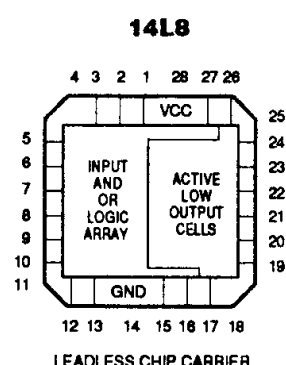
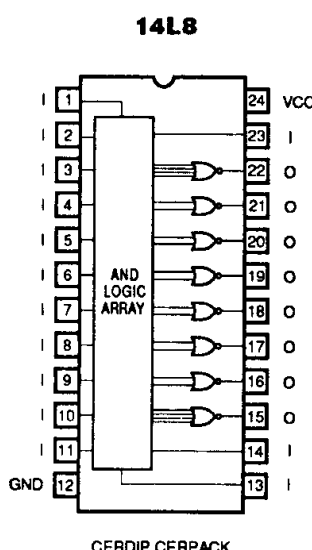
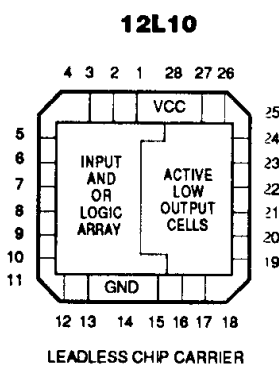
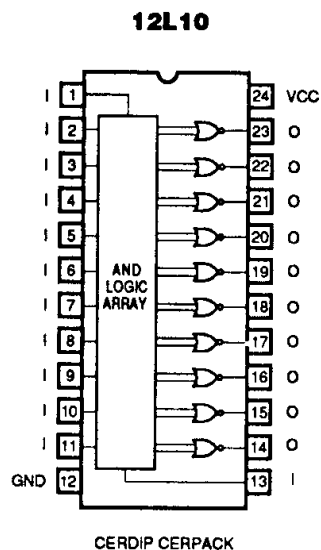
The table below is a brief summary of our current devices that do have register preload and/or power-up reset.

## Devices with Register Preload and Power-Up Reset

DEVICE FAMILY	REGISTER PRELOAD	POWER-UP RESET
Exclusive OR 24XA	YES	YES
Shared Product terms 24RS	YES	YES
Asynchronous 24RA	YES	YES
Varied Product terms 24VX*	YES	YES

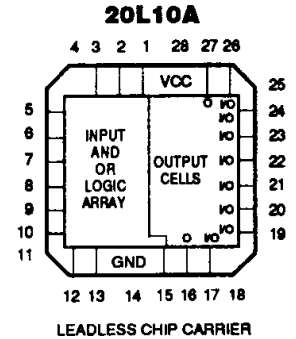
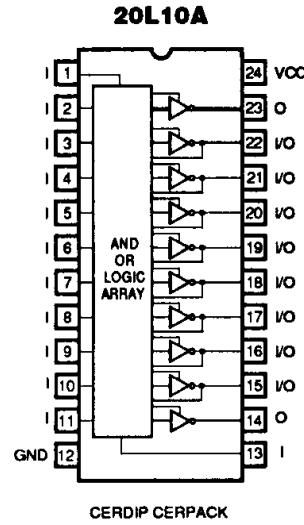
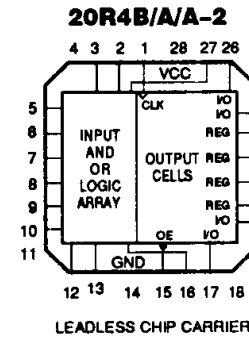
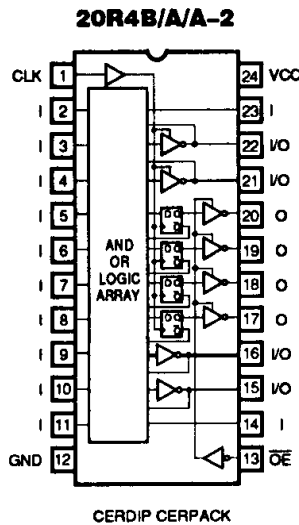
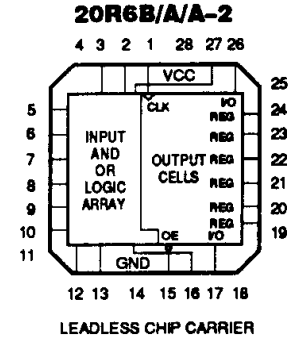
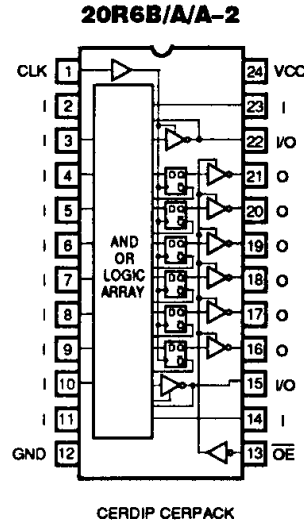
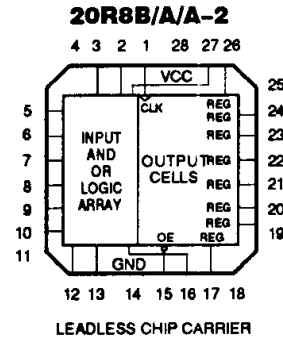
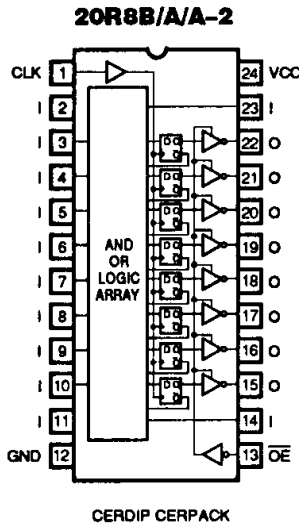
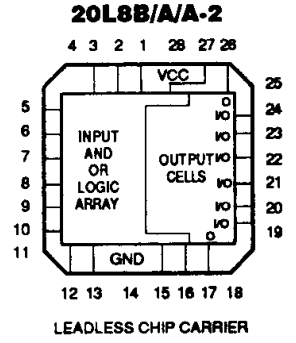
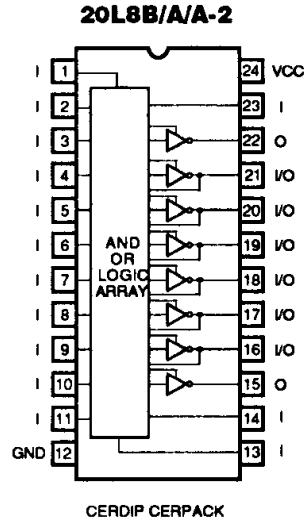
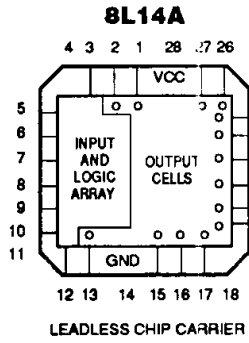
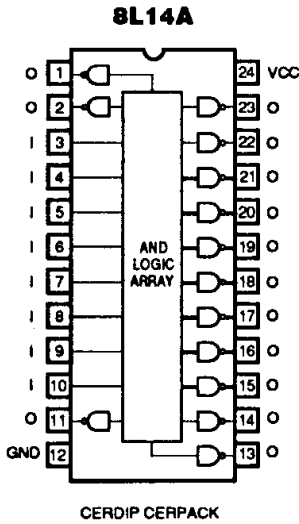
\* The PAL32VX10/10A has power-up preset; registers are set to logical 1 on power up.

# Military 24-Pin PAL Device Pinouts



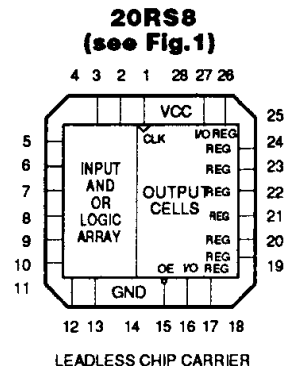
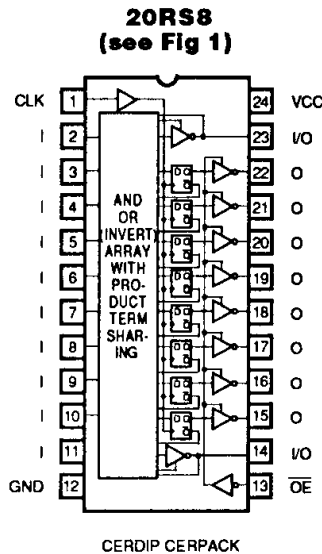
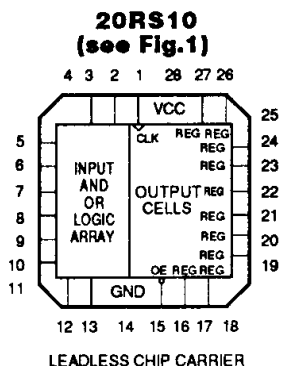
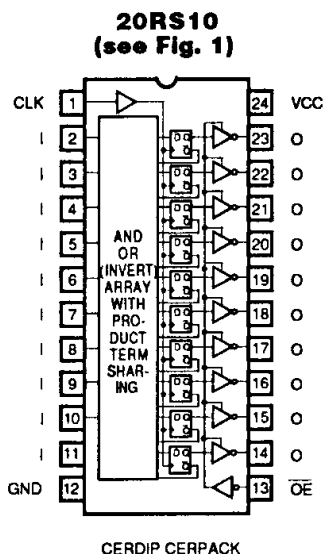
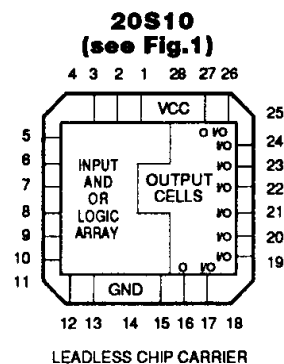
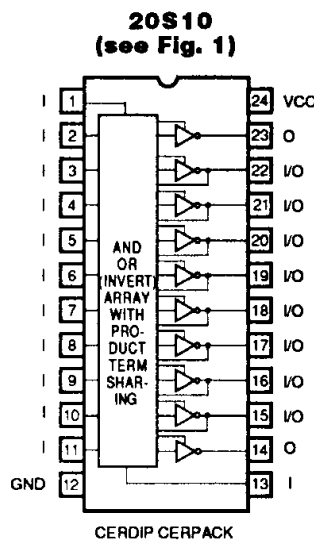
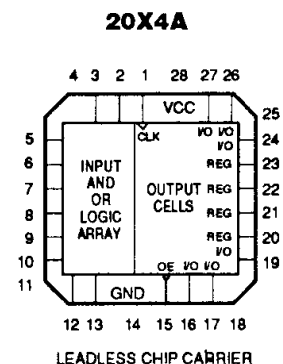
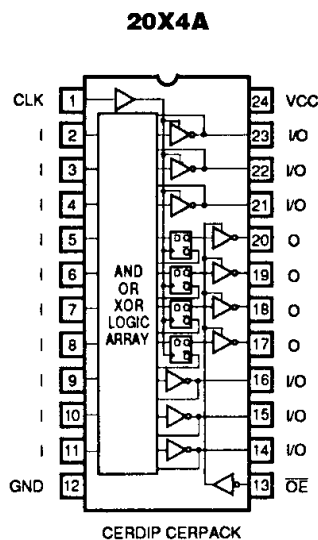
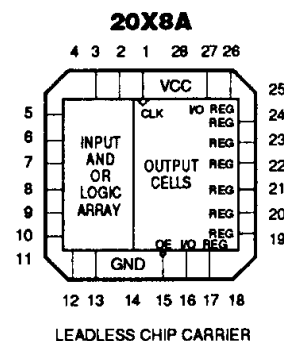
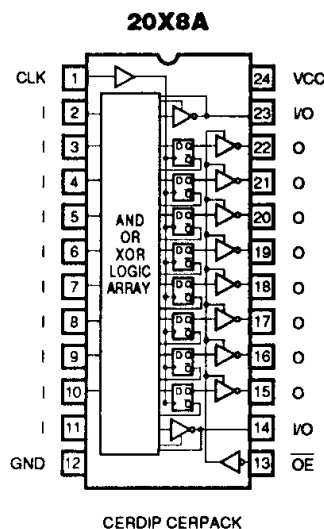
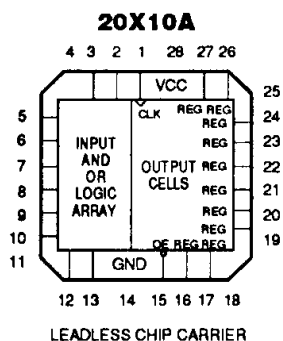
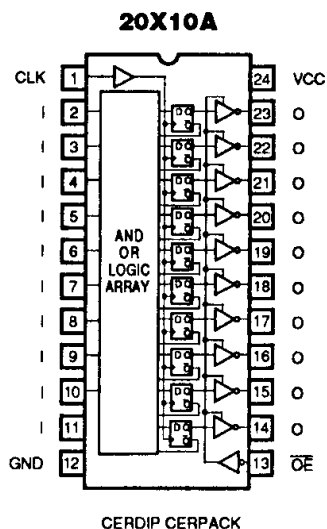
5

# Military 24-Pin PAL Device Pinouts



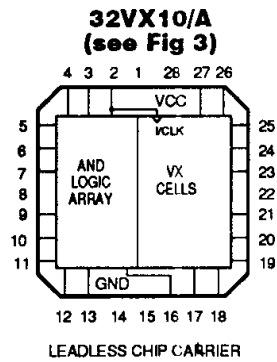
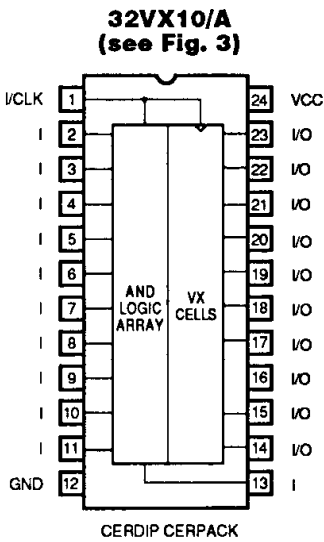
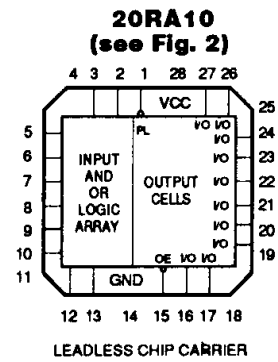
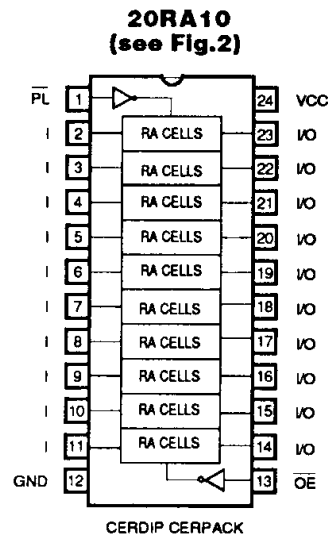
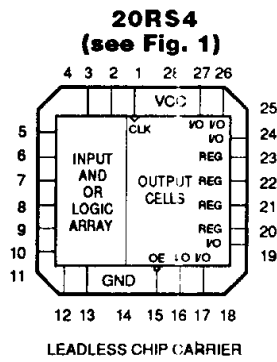
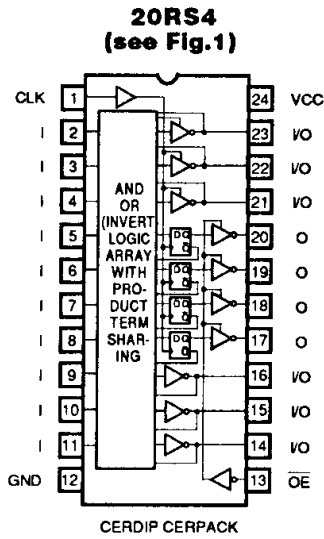
503 157

# Military 24-Pin PAL Device Pinouts



5

# Military 24-Pin PAL Device Pinouts



503 181

# Military PAL20S10, 20RS10, 20RS8, 20RS4 Series

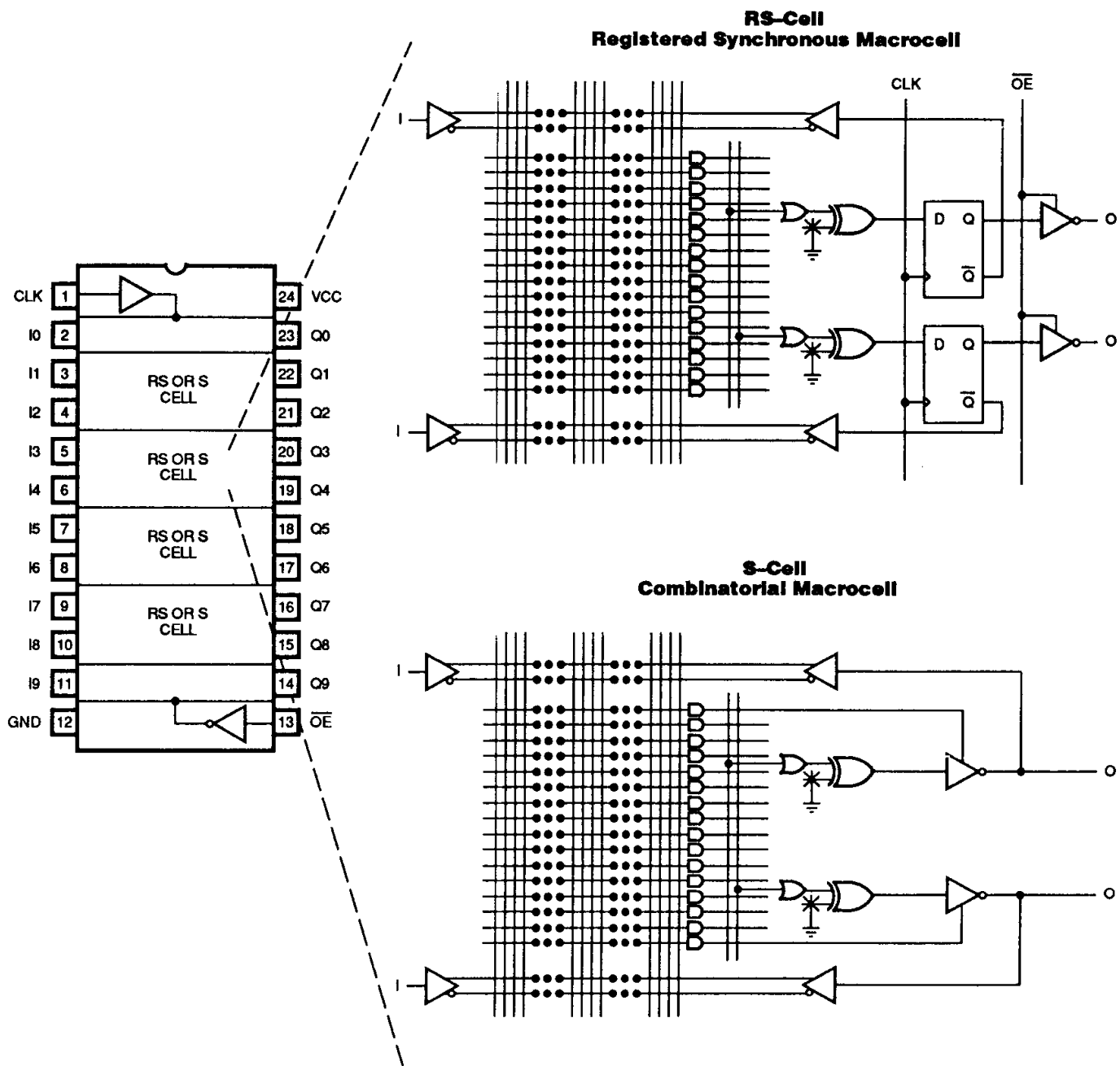


Figure 1.

503 187

5

# Military PAL20RA10 Device

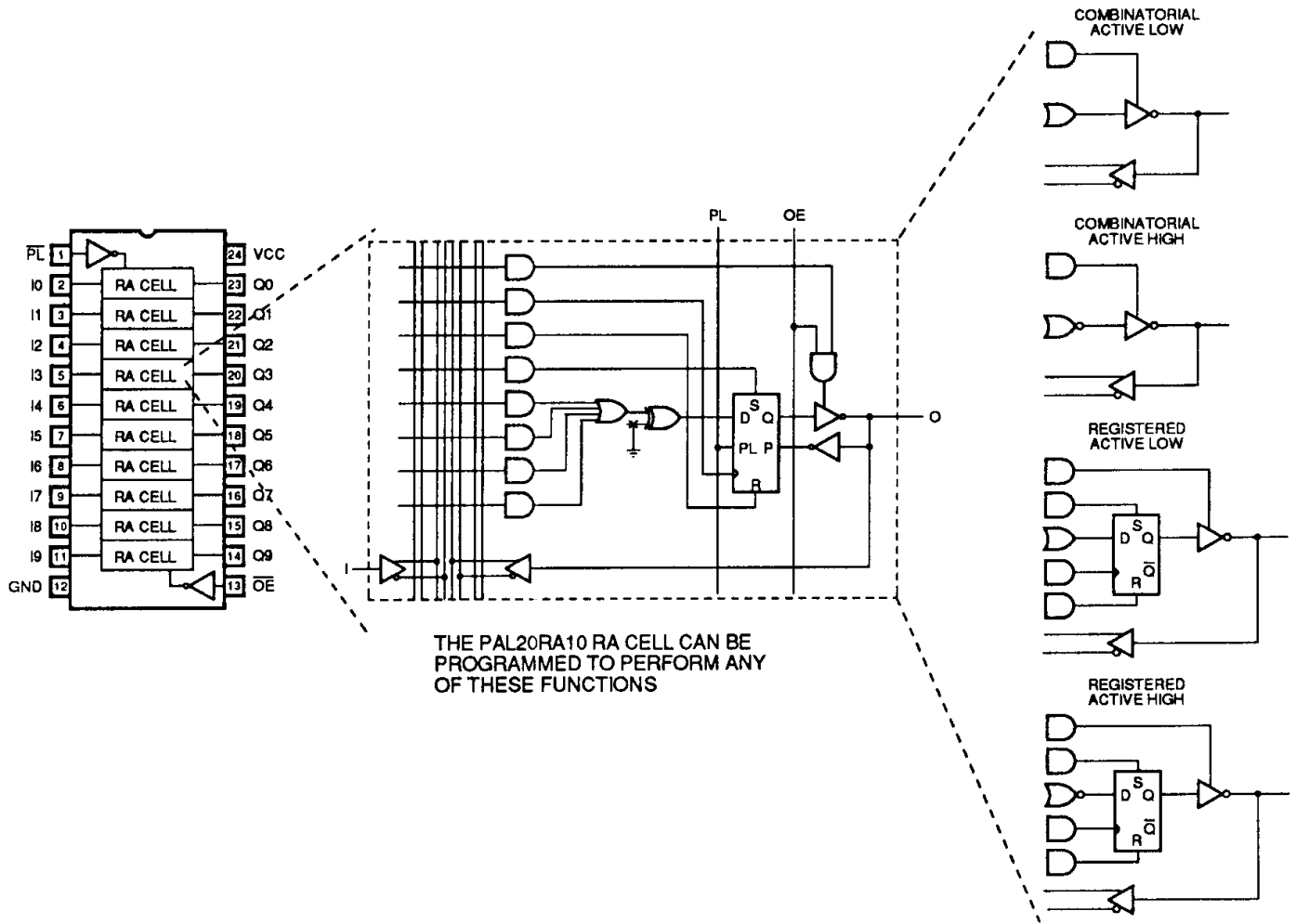


Figure 2.



# Military PAL32VX10 Device

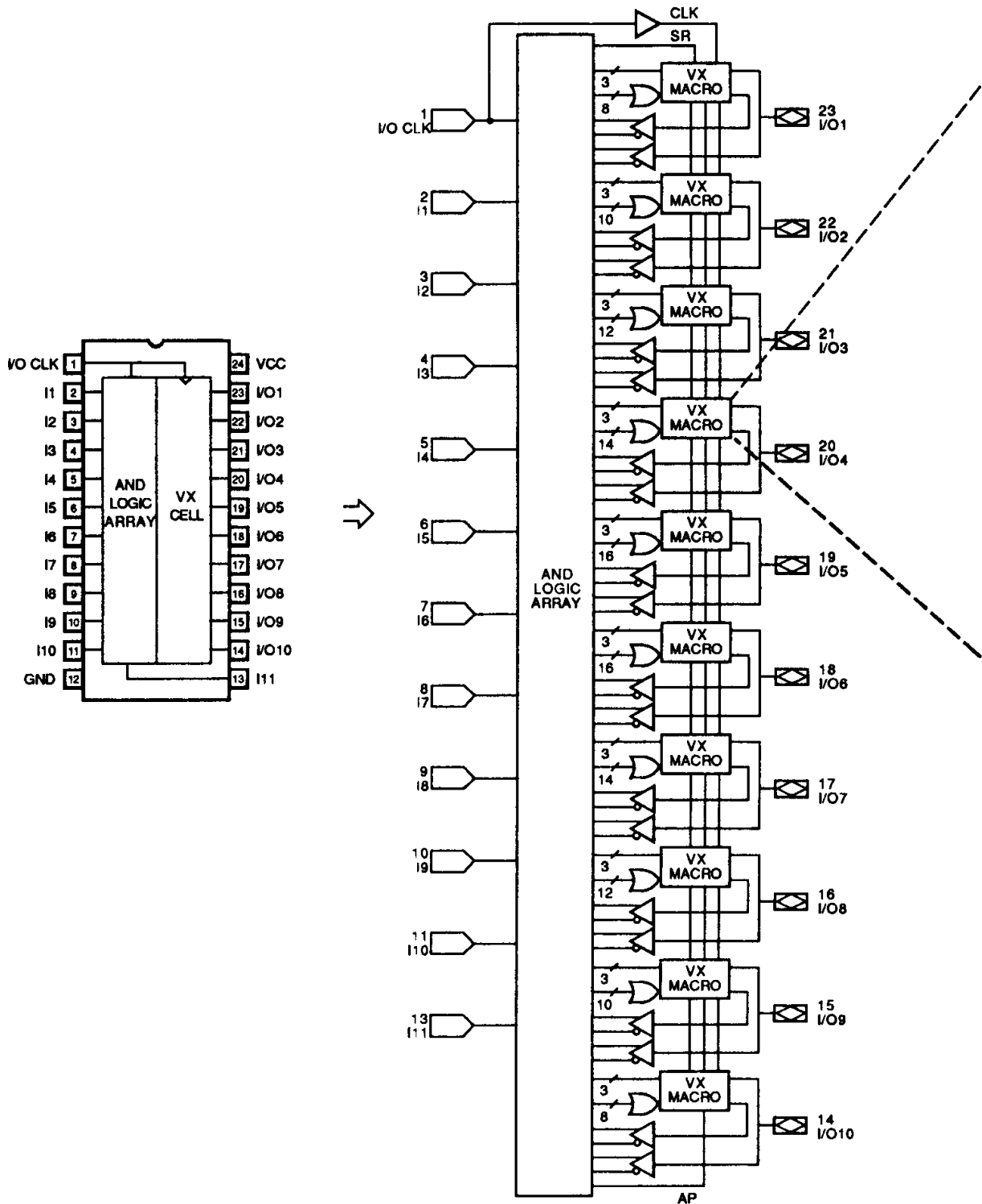
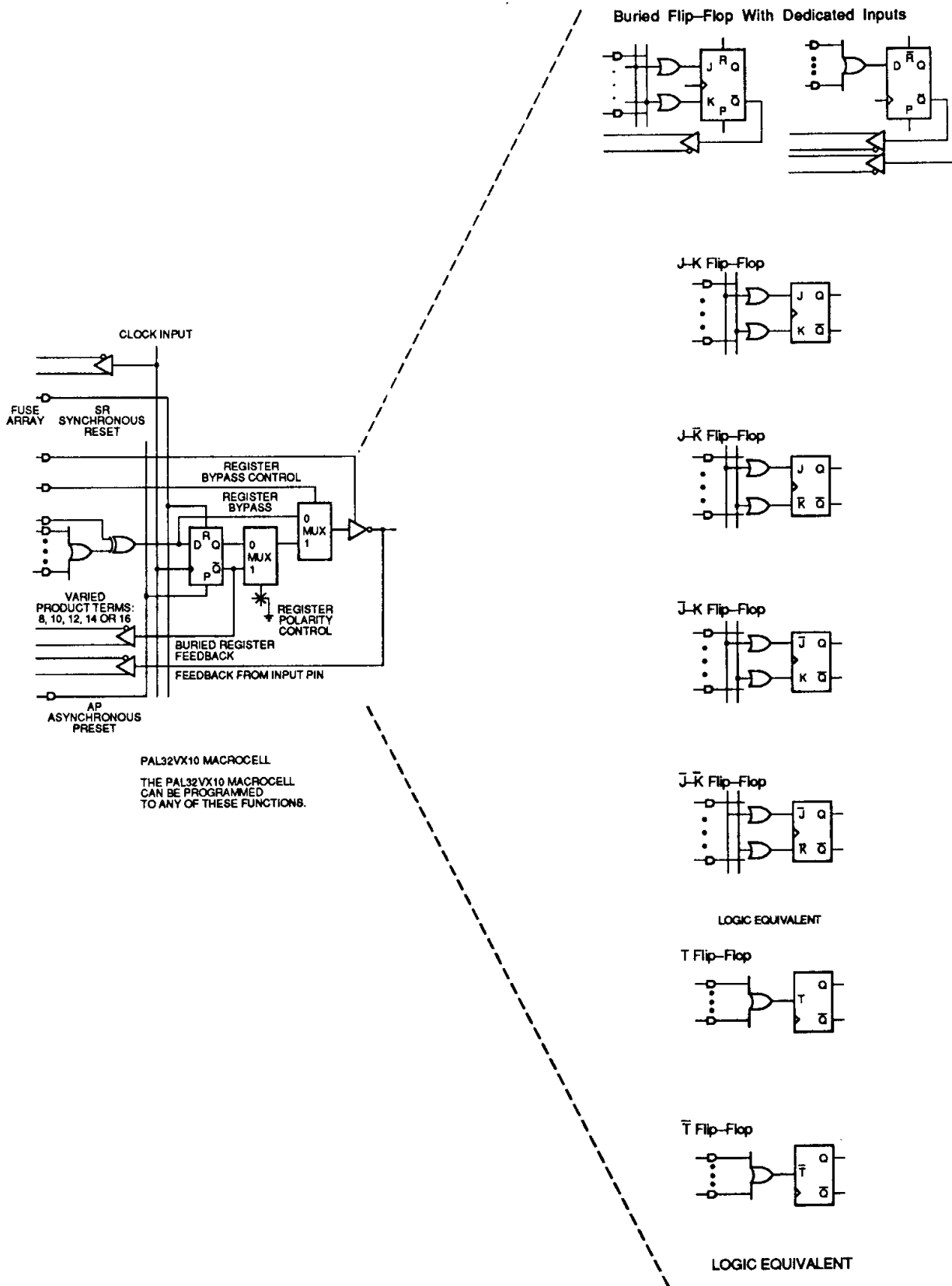


Figure 3.

503 191

5

# Military 24-Pin PAL Devices



503 192

Figure 3. (Cont'd.)

# Military 24-Pin PAL Devices

## Absolute Maximum Ratings

	Operating
Supply voltage $V_{CC}$ .....	-0.5 V to 7 V
Input voltage .....	-1.5 V to 5.5 V
Off-state output voltage .....	5.5 V
Storage temperature .....	-65°C to +150°C
Maximum junction temperature ( $T_J$ ) .....	175°C
Lead temperature (soldering, 10 sec max) .....	300°C
Maximum current density $5 \times 10^{-5}$ A/cm <sup>2</sup> per Mil-M-38510 .....	< $5 \times 10^{-5}$ A/cm <sup>2</sup>
Maximum $\theta_{JC} = 28^\circ\text{C/W}$ for cerdips per Mil-M-38510 .....	< $28^\circ\text{C/W}$
Maximum $\theta_{JC} = 22^\circ\text{C/W}$ for flatpacks per Mil-M-38510 .....	< $22^\circ\text{C/W}$
Maximum $\theta_{JC} = 20^\circ\text{C/W}$ for leadless chip carriers per Mil-M-38510 .....	< $20^\circ\text{C/W}$

# Military Standard 24-Pin PAL Series

## PAL12L10, 14L8, 16L6, 18L4, 20L2, 20C1

Can be purchased to military drawing 5962-86804, latest revision in effect.

### Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
$V_{CC}$	Supply voltage	4.5	5.5	V
$T_A$	Operating free-air temperature	-55		°C
$T_C$	Operating case temperature		125	°C
$V_{IL}^*$	Low-level input voltage		≤0.8	V
$V_{IH}^*$	High-level input voltage	≥2.0		V

Note: Virgin array verify of unprogrammed PAL device is performed at 25°C only.

\* These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise.

### Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	MAX	UNIT
$V_{IC}$	Input clamp voltage	$V_{CC} = \text{MIN}$	$I_I = -18 \text{ mA}$		-1.5	V
$I_{IL}$	Low-level input current	$V_{CC} = \text{MAX}$	$V_I = 0.4 \text{ V}$		-0.25	mA
$I_{IH}$	High-level input current	$V_{CC} = \text{MAX}$	$V_I = 2.4 \text{ V}$		25	μA
$I_I$	Maximum input current	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$		1	mA
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}$	$I_{OL} = 8 \text{ mA}$		0.5	V
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}$	$I_{OH} = -2 \text{ mA}$	2.4		V
$I_{OS}^*$	Output short-circuit current	$V_{CC} = 5 \text{ V}$	$V_O = 0.5 \text{ V}$	-30	-130	mA
$I_{CC}$	Supply current	$V_{CC} = \text{MAX}$			100	mA

\*Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.

### Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT
$t_{PD}$	Input or feedback to output	$R_1 = 560 \Omega$ $R_2 = 1.1 \text{ K}\Omega$		45	ns

Programmed devices conform to Mil-Std-883, Method 5005, Group A, Subgroups 1, 2, 3, 7, 8, 9, 10 and 11.

# Military Decoder 24-Pin PAL Device

## PAL8L14A

### Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
$V_{cc}$	Supply voltage	4.5	5.5	V
$T_A$	Operating free-air temperature	-55		°C
$T_C$	Operating case temperature		125	°C
$V_{IL}^*$	Low-level input voltage		≤0.8	V
$V_{IH}^*$	High-level input voltage	≥2.0		V

Note: Virgin array verify of unprogrammed PAL device is performed at 25°C only.

\* These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise.

### Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	MAX	UNIT
$V_{ic}$	Input clamp voltage	$V_{cc} = \text{MIN}$	$I_i = -18 \text{ mA}$		-1.5	V
$I_{iL}$	Low-level input current	$V_{cc} = \text{MAX}$	$V_i = 0.4 \text{ V}$		-0.25	mA
$I_{iH}$	High-level input current	$V_{cc} = \text{MAX}$	$V_i = 2.4 \text{ V}$		25	μA
$I_i$	Maximum input current	$V_{cc} = \text{MAX}$	$V_i = 5.5 \text{ V}$		1	mA
$V_{oL}$	Low-level output voltage	$V_{cc} = \text{MIN}$	$I_{oL} = 8 \text{ mA}$		0.5	V
$V_{oH}$	High-level output voltage	$V_{cc} = \text{MIN}$	$I_{oH} = -2 \text{ mA}$	2.4		V
$I_{os}^*$	Output short-circuit current	$V_{cc} = 5 \text{ V}$	$V_o = 0.5 \text{ V}$	-30	-130	mA
$I_{cc}$	Supply current	$V_{cc} = \text{MAX}$			100	mA

\*Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.

**5**

### Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT
$t_{pd}$	Input to output propagation delay	$R_1 = 560 \Omega$ $R_2 = 1.1 \text{ K}\Omega$		30	ns

Programmed devices conform to Mil-Std-883, Method 5005, Group A, Subgroups 1, 2, 3, 7, 8, 9, 10 and 11.

## Military Very High Speed 24-Pin PAL Series

### PAL20L8B, 20R8B, 20R6B, 20R4B

Can be purchased to standard military drawing 5962-87671, latest revision in effect.

## Military High Speed 24-Pin PAL Series

### PAL20L8A, 20R8A, 20R6A, 20R4A

Can be purchased to standard military drawing 84129, latest revision in effect.

### Operating Conditions

SYMBOL	PARAMETER	24 B		24 A		UNIT
		MIN	MAX	MIN	MAX	
$V_{CC}$	Supply voltage	4.5	5.5	4.5	5.5	V
$T_A$	Operating free-air temperature	-55		-55		°C
$T_C$	Operating case temperature		125		125	°C
$t_w^\dagger$	Width of clock (except 20L8)	Low, $t_{wL}$	12	20		ns
		High, $t_{wH}$	12	20		ns
$t_{su}^\dagger$	Set up time from input or feedback to clock (except 20L8)	20		30		ns
$t_h^\dagger$	Hold time	0		0		ns
$V_{IL}^*$	Low-level input voltage		≤0.8		≤0.8	V
$V_{IH}^*$	High-level input voltage	≥2.0		≥2.0		V

Note: Virgin array verify of unprogrammed PAL device is performed at 25°C only.

\* These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise.

† These are device set-up conditions, which are measured during initial qualification, and are not directly tested.

### Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	MAX	UNIT
$V_{IC}$	Input clamp voltage	$V_{CC} = 4.5\text{ V}$	$I_I = -18\text{ mA}$		-1.5	V
$I_{IL}^*$	Low-level input current	$V_{CC} = 5.5\text{ V}$	$V_I = 0.4\text{ V}$		-0.25	mA
$I_{IH}^*$	High-level input current	$V_{CC} = 5.5\text{ V}$	$V_I = 2.4\text{ V}$		25	μA
$I_I$	Maximum input current	$V_{CC} = 5.5\text{ V}$	$V_I = 5.5\text{ V}$		1.0	mA
$V_{OL}$	Low-level output voltage	$V_{CC} = 4.5\text{ V}$	$I_{OL} = 12\text{ mA}$		0.5	V
$V_{OH}$	High-level output voltage	$V_{CC} = 4.5\text{ V}$	$I_{OH} = -2\text{ mA}$	2.4		V
$I_{OZL}^*$	Offstate output current	$V_{CC} = 5.5\text{ V}$	$V_O = 0.4\text{ V}$		-100	μA
$I_{OHZ}^*$			$V_O = 2.4\text{ V}$		100	
$I_{OS}^{**}$	Output short-circuit current	$V_{CC} = 5.5\text{ V}$	$V_O = 0.5\text{ V}$	-30	-130	mA
$I_{CC}$	Supply current	$V_{CC} = 5.5\text{ V}$			210	mA

\* I/O pin leakage is worst case of IIX or IOZX; i.e., IIL and IOZH.

\*\* Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.

## Military Very High Speed 24-Pin PAL Series

PAL20L8B, 20R8B, 20R6B, 20R4B

## Military High Speed 24-Pin PAL Series

PAL20L8A, 20R8A, 20R6A, 20R4A

### Switching Characteristics Over operating conditions

SYMBOL	PARAMETER	TEST CONDITIONS	24 B		24 A		UNIT
			MIN	MAX	MIN	MAX	
$t_{PD}$	Input or feedback to output (except 20R8)	$R_1 = 390 \Omega$ $R_2 = 750 \Omega$		20		30	ns
$t_{CLK}$	Clock to output or feedback (except 20L8)			15		20	ns
$t_{PZX}$	Pin 13 to output enable (except 20L8)			20		25	ns
$t_{PXZ}$	Pin 13 to output disable (except 20L8)			20		25	ns
$t_{PZX}$	Input to output enable (except 20R8)			25		30	ns
$t_{PXZ}$	Input to output disable (except 20R8)			20		30	ns
$f_{MAX}^*$	State machine maximum operating frequency (except 20L8)			28.5		20	MHz
	Data path register maximum operating frequency (except 20L8)		41.6		25		

\*  $f_{MAX}$  is calculated and measured on initial qualifications only.

$f_{MAX}$  (state machine) =  $1/[t_{su} + t_{clk}]$

$f_{MAX}$  (data path register) =  $1/[t_{wl} + t_{wh}]$  or  $1/[t_{su} + t_h]$ , whichever is smaller.

Programmed devices conform to Mil-Std-883, Method 5005, Group A, Subgroups 1, 2, 3, 7, 8, 9, 10 and 11.

# Military Half-Power 24A-Pin Series

## PAL20L8A-2, 20R8A-2, 20R6A-2, 20R4A-2

Can be purchased to standard military drawing 84129 latest revision in effect.

### Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
$V_{CC}$	Supply voltage	4.5	5.5	V
$T_A$	Operating free-air temperature	-55	125	°C
$t_w^\dagger$	Width of clock (except 20L8)	Low	25	ns
		High	25	ns
$t_{su}^\dagger$	Setup time from input or feedback to clock (except 20L8)	50		ns
$t_h^\dagger$	Hold time	0		ns
$V_{IL}^*$	Low-level input voltage		≤0.8	V
$V_{IH}^*$	High-level input voltage	≥2.0		V

Note: Virgin array verify of unprogrammed PAL device is performed at 25°C only.

\* These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise.

† These are device set-up conditions, which are measured during initial qualification, and are not directly tested.

### Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	MAX	UNIT
$V_{IC}$	Input clamp voltage	$V_{CC} = \text{MIN}$	$I_I = -18 \text{ mA}$		-1.5	V
$I_{IL}^*$	Low-level input current	$V_{CC} = \text{MAX}$	$V_I = 0.4 \text{ V}$		-0.25	mA
$I_{IH}^*$	High-level input current	$V_{CC} = \text{MAX}$	$V_I = 2.4 \text{ V}$		25	μA
$I_I$	Maximum input current	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$		1	mA
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}$	$I_{OL} = 12 \text{ mA}$		0.5	V
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}$	$I_{OH} = -2 \text{ mA}$	2.4		V
$I_{ozL}^*$	Offstate output current	$V_{CC} = \text{MAX}$	$V_o = 0.4 \text{ V}$		-100	μA
$I_{ozH}^*$			$V_o = 2.4 \text{ V}$		100	μA
$I_{os}^{**}$	Output short-circuit current	$V_{CC} = 5 \text{ V}$	$V_o = 0.5 \text{ V}$	-30	-130	mA
$I_{CC}$	Supply Current	$V_{CC} = \text{MAX}$			105	mA

\* I/O pin leakage is worst case of IIX or IOZX; i.e., IIL and IOZH.

\*\* Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.



# Military Half-Power 24A-Pin Series

PAL20L8A-2, 20R8A-2, 20R6A-2, 20R4A-2

## Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT
$t_{PD}$	Input or feedback to output (except 20R8)	$R_1 = 390 \Omega$ $R_2 = 750 \Omega$		50	ns
$t_{CLK}$	Clock to output or feedback (except 20L8)			25	ns
$t_{PZX}$	Pin 13 to output enable (except 20L8)			25	ns
$t_{PXZ}$	Pin 13 to output disable (except 20L8)			25	ns
$t_{PZX}$	Input to output enable (except 20R8)			45	ns
$t_{PXZ}$	Input to output disable (except 20R8)			45	ns
$f_{MAX}^*$	State machine maximum operating frequency (except 20L8)			13.3	
	Data path register maximum operating frequency (except 20L8)		20		

\* $f_{MAX}$  is calculated and measured on initial qualifications only.

$$f_{MAX} \text{ (state machine)} = 1/[t_{su} + t_{clk}]$$

$$f_{MAX} \text{ (data path register)} = 1/[t_{wl} + t_{wh}] \text{ or } 1/t_{su} + t_h, \text{ whichever is smaller.}$$

Programmed devices conform to Mil-Std-883, Method 5005, Group A, Subgroups 1, 2, 3, 7, 8, 9, 10 and 11.

# Military High Speed 24XA-Pin Series

## PAL20L10A, 20X10A, 20X8A, 20X4A

Can be purchased to standard military print 84129, latest revision in effect.

### Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
$V_{CC}$	Supply voltage	4.5	5.5	V
$T_A$	Operating free-air temperature	-55		°C
$T_C$	Operating case temperature		125	°C
$t_w^\dagger$	Width of clock (except 20L10)	Low	35	ns
		High	20	
$t_{su}^\dagger$	Setup time from input or feedback to clock (except 20L10)	40		ns
$t_h^\dagger$	Hold time	0		ns
$V_{IL}^*$	Low-level input voltage		≤0.8	V
$V_{IH}^*$	High-level input voltage	≥2.0		V

Note: Virgin array verify of unprogrammed PAL device is performed at 25°C only.

\* These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise.

† These are device set-up conditions, which are measured during initial qualification, and are not directly tested.

### Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	MAX	UNIT
$V_{IC}$	Input clamp voltage	$V_{CC} = \text{MIN}$	$I_I = -18 \text{ mA}$		-1.5	V
$I_{IL}^*$	Low-level input current	$V_{CC} = \text{MAX}$	$V_I = 0.4 \text{ V}$		-0.25	mA
$I_{IH}^*$	High-level input current	$V_{CC} = \text{MAX}$	$V_I = 2.4 \text{ V}$		25	μA
$I_I$	Maximum input current	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$		1	mA
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}$	$I_{OL} = 12 \text{ mA}$		0.5	V
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}$	$I_{OH} = -2 \text{ mA}$	2.4		V
$I_{OZL}^*$	Off-state output current	$V_{CC} = \text{MAX}$	$V_O = 0.4 \text{ V}$		-100	μA
$I_{OZH}^*$			$V_O = 2.4 \text{ V}$		100	
$I_{OS}^{**}$	Output short-circuit current	$V_{CC} = 5 \text{ V}$	$V_O = 0.5 \text{ V}$	-30	-130	mA
$I_{CC}$	Supply current	$V_{CC} = \text{MAX}$	20X10A, 20X8A, 20X4A		180	mA
			20L10A		165	

\* I/O pin leakage is worst case of IIX or IOZX; i.e., IIL and IOZH.

\*\* Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.

# Military High Speed 24XA-Pin Series

PAL20L10A, 20X10A, 20X8A, 20X4A

## Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT
$t_{PD}$	20L10A, 20X8A, 20X4A Input or feedback to output (except 20X10)	$R_1 = 390 \Omega$ $R_2 = 750 \Omega$		35	ns
$t_{CLK}$	Clock to output or feedback (except 20L10)			25	ns
$t_{PZX}$	Pin 13 to output enable (except 20L10)			25	ns
$t_{PXZ}$	Pin 13 to output disable (except 20L10)			25	ns
$t_{PZX}$	Input to output enable (except 20X10)			35	ns
$t_{PXZ}$	Input to output disable (except 20X10)			35	ns
$f_{MAX}^*$	State machine maximum operating frequency (except 20L10)			15.4	
	Data path register maximum operating frequency (except 20L10)		18.2		

\* $f_{MAX}$  is calculated and measured on initial qualifications only.

$$f_{MAX} \text{ (state machine)} = 1/[t_{su} + t_{clk}]$$

$$f_{MAX} \text{ (data path register)} = 1/[t_{wl} + t_{wh}] \text{ or } 1/[t_{su} + t_h], \text{ whichever is smaller.}$$

Programmed devices conform to Mil-Std-883, Method 5005, Group A, Subgroups 1, 2, 3, 7, 8, 9, 10 and 11.

# Military 24RS-Pin Series

## PAL20S10, 20RS10, 20RS8, 20RS4

Standard military 5962-87530 is in the process of being generated—Contact the factory.

### Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
$V_{cc}$	Supply voltage	4.5	5.5	V
$T_A$	Operating free-air temperature	-55		°C
$T_c$	Operating case temperature		125	°C
$t_w^\dagger$	Width of clock (except 20S10)	Low	20	ns
		High	20	
$t_{w\uparrow}^\dagger$	Setup time from input or feedback to clock (except 20S10)	40		ns
$t_h^\dagger$	Hold time	0		ns
$V_{L}^*$	Low-level input voltage		≤0.8	V
$V_{IH}^*$	High-level input voltage	≥2.0		V

Note: Virgin array verify of unprogrammed PAL device is performed at 25°C only.

\* These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise.

† These are device set-up conditions, which are measured during initial qualification, and are not directly tested.

### Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	MAX	UNIT
$V_{Kc}$	Input clamp voltage	$V_{cc} = \text{MIN}$	$I_i = -18 \text{ mA}$		-1.5	V
$I_{L}^*$	Low-level input current	$V_{cc} = \text{MAX}$	$V_i = 0.4 \text{ V}$		-0.25	mA
$I_{IH}^*$	High-level input current	$V_{cc} = \text{MAX}$	$V_i = 2.4 \text{ V}$		25	μA
$I_i$	Maximum input current	$V_{cc} = \text{MAX}$	$V_i = 5.5 \text{ V}$		1	mA
$V_{OL}$	Low-level output voltage	$V_{cc} = \text{MIN}$	$I_{OL} = 12 \text{ mA}$		0.5	V
$V_{OH}$	High-level output voltage	$V_{cc} = \text{MIN}$	$I_{OH} = -2 \text{ mA}$	2.4		V
$I_{ozL}^*$	Off-state output current	$V_{cc} = \text{MAX}$	$V_o = 0.4 \text{ V}$		-100	μA
$I_{ozH}^*$			$V_o = 2.4 \text{ V}$		100	
$I_{os}^{**}$	Output short-circuit current	$V_{cc} = 5 \text{ V}$	$V_o = 0.5 \text{ V}$	-30	-130	mA
$I_{cc}$	Supply current	$V_{cc} = \text{MAX}$			240	mA

\* I/O pin leakage is worst case of IIX or IOZX; i.e., IIL and IOZH.

\*\* Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.

# Military 24RS-Pin Series

PAL20S10, 20RS10, 20RS8, 20RS4

## Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT
$t_{PD}$	Input or feedback to output (except 20RS10)	Polarity fuse intact		40	ns
		Polarity fuse Blown		45	
$t_{CLK}$	Clock to output or feedback (except 20S10)			20	ns
$t_{PZX}$	Pin 13 to output enable (except 20S10)	$R_1 = 390 \Omega$		25	ns
$t_{PXZ}$	Pin 13 to output disable (except 20S10)	$R_2 = 750 \Omega$		25	ns
$t_{PZX}$	Input to output enable (except 20RS10)			35	ns
$t_{PXZ}$	Input to output disable (except 20RS10)			30	ns
$f_{MAX}^*$	State machine maximum operating frequency (except 20S10)		16.7		MHz
	Data path register maximum frequency (except 20S10)		25		

\* $f_{MAX}$  is calculated and measured on initial qualifications only.

$$f_{MAX} \text{ (state machine)} = 1/[t_{su} + t_{CLK}]$$

$$f_{MAX} \text{ (data path register)} = 1/[t_{WL} + t_{WH}] \text{ or } 1/[t_{su} + t_p], \text{ whichever is smaller.}$$

Programmed devices conform to Mil-Std-883, Method 5005, Group A, Subgroups 1, 2, 3, 7, 8, 9, 10 and 11.

# Military 24RA-Pin Device

## PAL20RA10

Standard military 5962-86803 is in the process of being generated—Contact the factory.

### Operating Conditions

SYMBOL	PARAMETER		MIN	MAX	UNIT
$V_{CC}$	Supply voltage		4.5	5.5	V
$T_A$	Operating free-air temperature		-55		°C
$T_C$	Operating case temperature			125	°C
$t_w^\dagger$	Width of clock	Low	25		ns
		High	25		
$t_{wp}^\dagger$	Preload pulse width		45		ns
$t_{su}^\dagger$	Setup time from input or feedback to clock		25		ns
$t_{sup}^\dagger$	Preload setup time		30		ns
$t_h^\dagger$	Hold time	Polarity fuse intact	10		ns
		Polarity fuse blown	0		
$t_{hp}^\dagger$	Preload hold time		30		ns
$V_{IL}^*$	Low-level input voltage			≤0.8	V
$V_{IH}^*$	High-level input voltage		≥2.0		V

Note: Virgin array verify of unprogrammed PAL device is performed at 25°C only.

\* These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise.

† These are device set-up conditions, which are measured during initial qualification, and are not directly tested.

### Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
$V_{IC}$	Input clamp voltage	$V_{CC} = \text{MIN}$	$I_I = -18 \text{ mA}$			-1.5	V
$I_{IL}^*$	Low-level input current	$V_{CC} = \text{MAX}$	$V_I = 0.4 \text{ V}$			-0.25	mA
$I_{IH}^*$	High-level input current	$V_{CC} = \text{MAX}$	$V_I = 2.4 \text{ V}$			25	μA
$I_I$	Maximum input current	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$			1	mA
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}$	$I_{OL} = 8 \text{ mA}$			0.5	V
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}$	$I_{OH} = -2 \text{ mA}$	2.4			V
$I_{OZL}^*$	Off-state output current	$V_{CC} = \text{MAX}$	$V_O = 0.4 \text{ V}$			-100	μA
$I_{OZH}^*$			$V_O = 2.4 \text{ V}$			100	
$I_{OS}^{**}$	Output short-circuit current	$V_{CC} = 5 \text{ V}$	$V_O = 0.5 \text{ V}$	-30		-130	mA
$I_{CC}$	Supply current	$V_{CC} = \text{MAX}$				200	mA

\* I/O pin leakage is worst case of IIX or IOZX; i.e., IIL and IOZH.

\*\* Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.

# Military 24RA-Pin Device

## PAL20RA10

### Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT
$t_{PD}$	Input or feedback to output	Polarity fuse intact		35	ns
		Polarity fuse Blown		40	
$t_{CLK}$	Clock to output or feedback	$R_1 = 560 \Omega$ $R_2 = 1.1 K\Omega$		35	ns
$t_S$	Input to asynchronous set			40	ns
$t_R$	Input to asynchronous reset			45	ns
$t_{PZX}$	Pin 13 to output enable			25	ns
$t_{PXZ}$	Pin 13 to output disable			25	ns
$t_{PZX}$	Input to output enable			35	ns
$t_{PXZ}$	Input to output disable			35	ns
$f_{MAX}^*$	State machine maximum operating frequency			16.7	MHz
	Data path register maximum frequency			20	

\* $f_{MAX}$  is calculated and measured on initial qualifications only.

$$f_{MAX} (\text{state machine}) = 1/[t_{SU} + t_{CLK}]$$

$$f_{MAX} (\text{data path register}) = 1/[t_{WL} + t_{WH}] \text{ or } 1/[t_{SU} + t_H], \text{ whichever is smaller.}$$

Programmed devices conform to Mil-Std-883, Method 5005, Group A, Subgroups 1, 2, 3, 7, 8, 9, 10 and 11.

## ADVANCE INFORMATION

### Operating Conditions

SYMBOL	PARAMETER	STD		A		UNIT
		MIN	MAX	MIN	MAX	
$V_{CC}$	Supply voltage	4.5	5.5	4.5	5.5	V
$T_A$	Operating free-air temperature	-55	125	-55	125	°C
$t_w^\dagger$	Width of clock	Low	25	23		ns
		High	25	23		
$t_{su}^\dagger$	Setup time from input or feedback to clock	Product terms $P_1$ - $P_n$ , SR	35	30		ns
		Product term XOR	40	35		
$t_h^\dagger$	Hold time	0		0		ns
$t_{pw}^\dagger$	Asynchronous preset width	35		30		ns
$t_{sr}^\dagger$	Asynchronous preset recovery time	35		30		ns
$t_{sr}^\dagger$	Synchronous reset recovery time	35		30		ns
$V_{IL}^*$	Low-level input voltage		≤0.8		≤0.8	V
$V_{IH}^*$	High-level input voltage	≥2.0		≥2.0		V

Note: Virgin array verify of unprogrammed PAL device is performed at 25°C only.

\* These voltages apply with respect to the ground pin on the device and include all overshoots due to system and/or tester noise.

† These are device set-up conditions, which are measured during initial qualification, and are not directly tested.

### Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	MAX	UNIT
$V_{IC}$	Input clamp voltage	$V_{CC} = \text{MIN}$	$I_I = -18 \text{ mA}$		-1.5	V
$I_{IL}^*$	Low-level input current	$V_{CC} = \text{MAX}$	$V_I = 0.4 \text{ V}$		-0.25	mA
$I_{IH}^*$	High-level input current	$V_{CC} = \text{MAX}$	$V_I = 2.4 \text{ V}$		25	μA
$I_I$	Maximum input current	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$		200	μA
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}$	$I_{OL} = 12 \text{ mA}$		0.5	V
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}$	$I_{OH} = -2 \text{ mA}$	2.4		V
$I_{OZL}^*$	Off-state output current	$V_{CC} = \text{MAX}$	$V_O = 0.4 \text{ V}$		-100	μA
			$V_O = 2.4 \text{ V}$		100	μA
$I_{OS}^{**}$	Output short-circuit current	$V_{CC} = 5 \text{ V}$	$V_O = 0.5 \text{ V}$	-30	-130	mA
$I_{CC}$	Supply current	$V_{CC} = \text{MAX}$			180	mA

\* I/O pin leakage is worst case of I<sub>IX</sub> or IOZ<sub>X</sub>; i.e., I<sub>IL</sub> and IOZ<sub>H</sub>.

\*\* Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.



## ADVANCE INFORMATION

### Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	STD		A		UNIT	
				MIN	MAX	MIN	MAX		
$t_{PD}$	Input or feedback to output	Product terms $P_1-P_n$	$R_1 = 390 \Omega$ $R_2 = 750 \Omega$	35		30		ns	
		Product term XOR		40		35			
$t_{CLK}$	Clock to output or feedback	20		20		ns			
$t_{PZX}$	Input to output enable	35		30		ns			
$t_{PXZ}$	Input to output disable	35		30		ns			
$t_{AP}$	Asynchronous preset to output	35		30		ns			
$t_{CR}$	Input or feedback to registered output from combinatorial configuration	95		95		ns			
$t_{RC}$	Input or feedback to combinatorial output from registered configuration	95		95		ns			
$f_{MAX}^*$	Maximum frequency	Feedback ( $1/t_{p1}$ )			18		20		MHz
		Product terms $P_1-P_n$			16.7		18		
		Product term XOR	20		21.7				
		No feedback**							

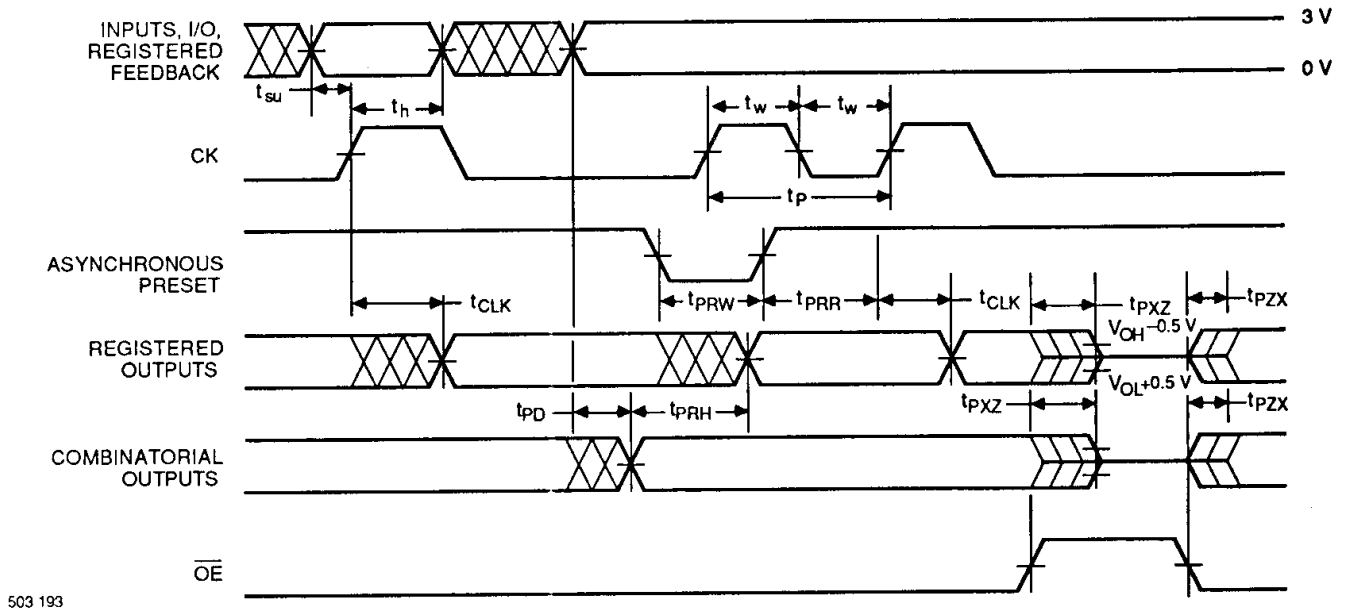
\* $f_{MAX}$  is calculated and measured on initial qualifications only.

$$f_{MAX} \text{ (NO feedback)} = 1/[t_{WL} + t_{WH}]$$

Programmed devices conform to Mil-Std-883, Method 5005, Group A, Subgroups 1, 2, 3, 7, 8, 9, 10 and 11.

# Military 24-Pin PAL Devices

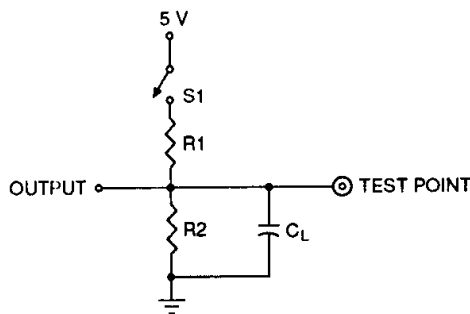
## Switching Waveforms



503 193

- Notes:
1.  $t_{PD}$  is tested with switch  $S_1$  closed.  $C_L = 50$  pF and measured at 1.5 V output level.
  2.  $t_{PZX}$  is measured at the 1.5 V output level with  $C_L = 50$  pF.  $S_1$  is open for high impedance "1" test and closed for high impedance "0" test.
  3.  $t_{PXZ}$  is tested with  $C_L = 5$  pF.  $S_1$  is open for "1" to high impedance test measured at  $V_{OH} - 0.5$  V output level.  $S_1$  is closed for "0" to high impedance test measured at  $V_{OL} + 0.5$  V output level.
  4. Equivalent test loads may be used on automatic test equipment.

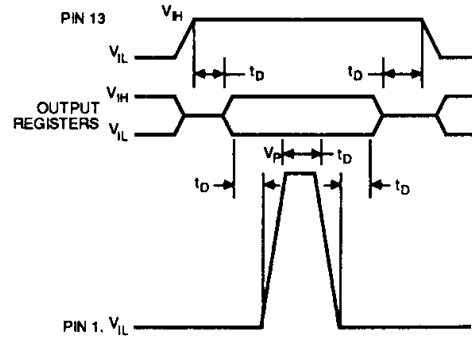
## Switching Test Load



503 194

**Output Register Preload PAL24XA Series, PAL24RS Series and PAL20RA10 Device**

1. Raise  $V_{CC}$  to 4.5 V.
2. Disable output registers by setting pin 13 to  $V_{IH}$ .
3. Apply  $V_{IL}/V_{IH}$  to all registered output pins.
4. Pulse pin 10 to  $V_p$  then back to 0 V.
5. Remove  $V_{IL}/V_{IH}$  from all output registers.
6. Lower pin 13 to  $V_L$  to enable the output registers.
7. Verify for  $V_{OL}/V_{OH}$  at all registered output pins.

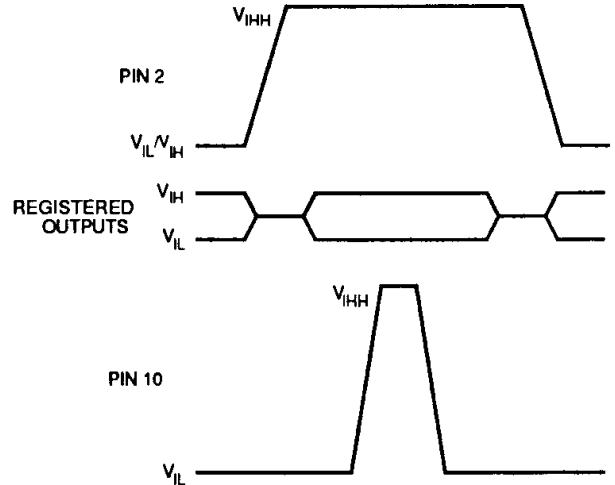


503 195

**Output Register Preload PAL32VX10 Device**

The preload function allows the register to be loaded from the output pins. This feature aids the functional testing of sequential designs by allowing direct setting of output states. The procedure is:

1. Raise  $V_{CC}$  to 4.5 V.
2. Disable output registers by setting pin 2 to  $V_{IHH}$  (12 V).
3. Apply  $V_{IL}/V_{IH}$  to all registered output pins. Leave combinatorial outputs floating.
4. Pulse pin 10 to  $V_{IHH}$ , then back to 0 V.
5. Remove  $V_{IL}/V_{IH}$  from all output registers.
6. Remove high voltage from pin 2.
7. Enable registered outputs per programmed pattern.
8. Verify for  $V_{OL}/V_{OH}$  at all registered output pins.



503 196

5

**Key to Timing Diagrams**

WAVEFORM	INPUTS	OUTPUTS
	DON'T CARE: CHANGE PERMITTED	CHANGING: STATE UNKNOWN
	NOT APPLICABLE	CENTER LINE IS HIGH IMPEDANCE STATE
	MUST BE STEADY	WILL BE STEADY

503 197

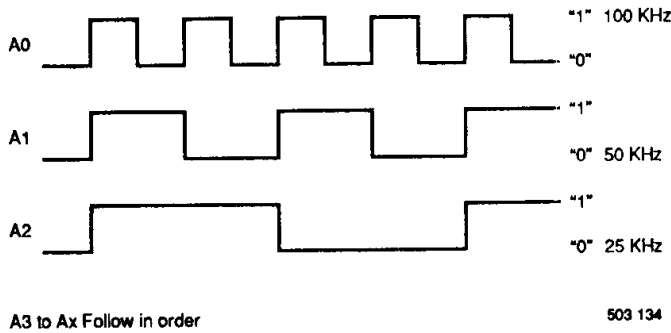
# Military 24-Pin PAL Devices

## Life Test/Burn-In Circuits

Complies with Mil-Std-883, Method 1005/1015, Condition D.

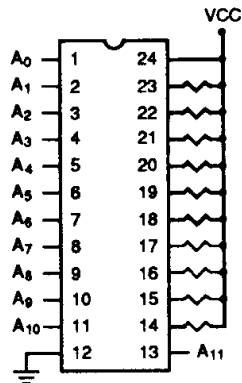
## Circuit Configurations

### Waveforms

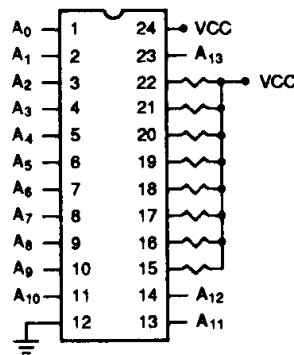


1. All Burn-In will be accomplished at 125°C +5/-0°C
2.  $V_{cc} = 5.25 \text{ volts} \pm 0.25 \text{ V}$
3. All Clocks (A0 to Ax) are square wave signals 50±15% Duty Cycle, with:
  - a. "0" = -0.5 V to +0.7 V
  - b. "1" = +2.4 V to  $V_{cc}$
  - c. Rise Time (+0.7 V to +2.4 V) < 1 μsec
  - d. Fall Time (+2.4 V to +0.7 V) < 1 μsec
4. Resistor Value  
330 Ω or 470 Ω ±5%
5. All Board Components to be compatible with 150°C Ambient (Min).

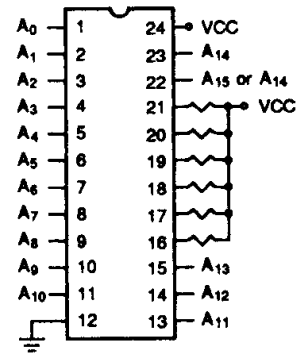
**PAL12L10**



**PAL14L8**



**PAL16L6**



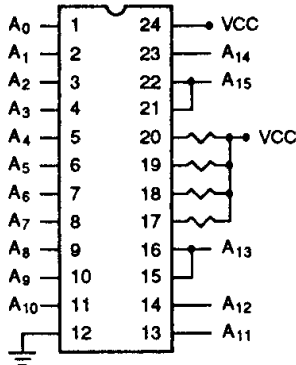
# Military 24-Pin PAL Devices

## Life Test/Burn-In Circuits

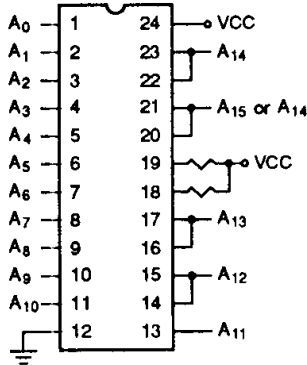
Complies with Mil-Std-883, Method 1005/1015, Condition D.

## Circuit Configurations

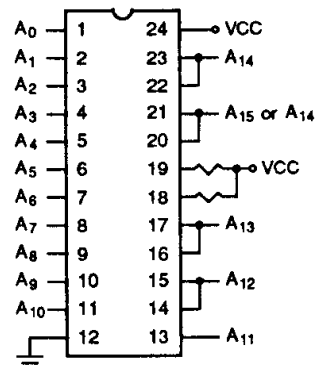
**PAL18L4**



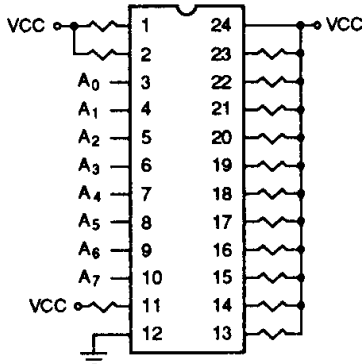
**PAL20L2**



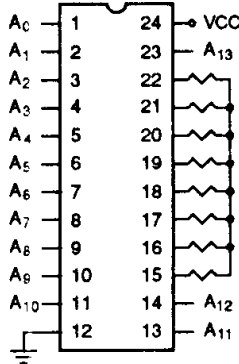
**PAL20C1**



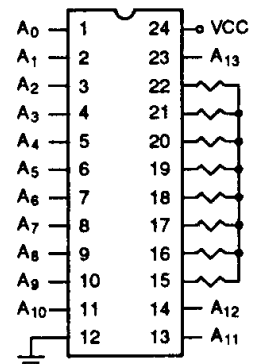
**PAL8L14A**



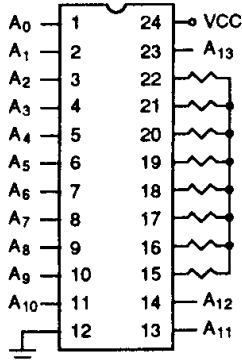
**PAL20L8A/B  
PAL20L8A-2**



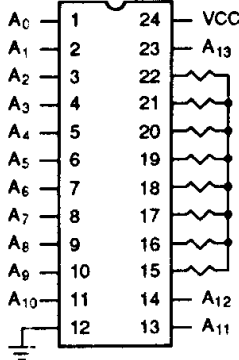
**PAL20R8A/B  
PAL20R8A-2**



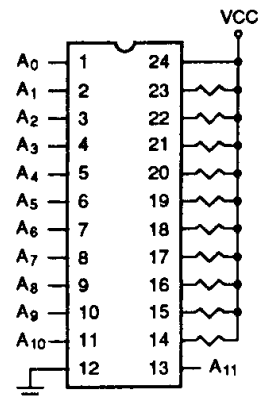
**PAL20R6A/B  
PAL20R6A-2**



**PAL20R4A/B  
PAL20R4A-2**



**PAL20L10A**



503 202

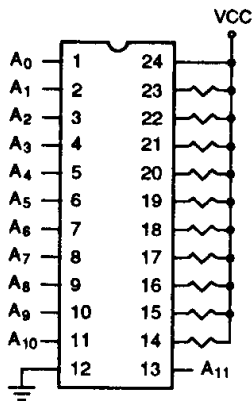
# Military 24-Pin PAL Devices

## Life Test/Burn-In Circuits

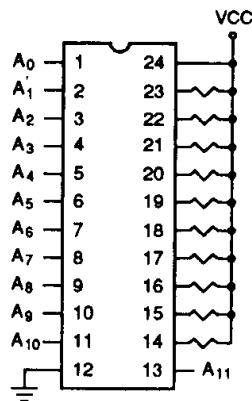
Complies with Mil-Std-883, Method 1005/1015, Condition D.

## Circuit Configurations

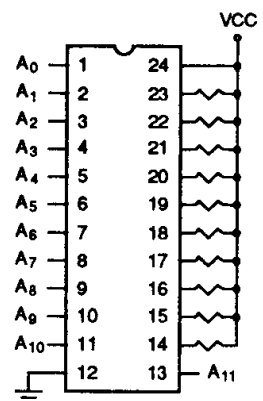
**PAL20X10A**



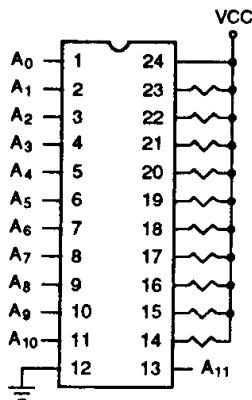
**PAL20X8A**



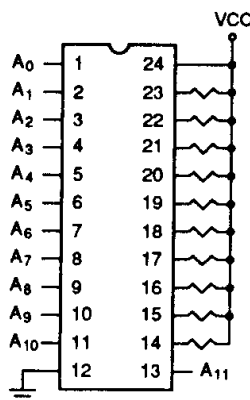
**PAL20X4A**



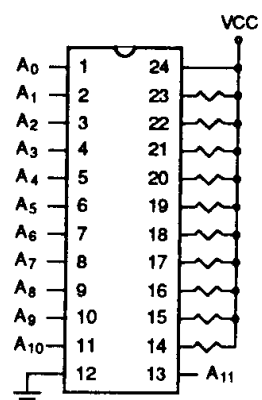
**PAL20S10**



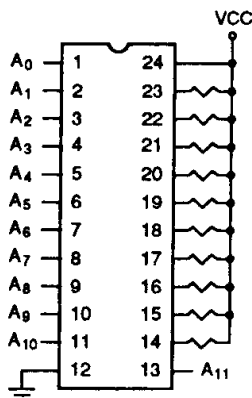
**PAL20RS10**



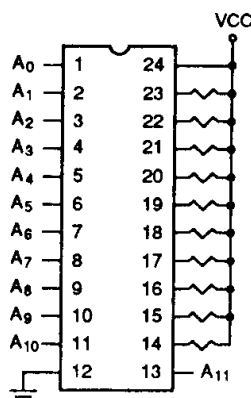
**PAL20RS8**



**PAL20RS4**



**PAL32VX10/10A**



503 211