



## Dual Video/Memory Clock Generator

### Features

- World standard **ICS2494A** has been reconfigured to allow 8 memory frequencies.
- Mask-programmable frequencies
- Pre-programmed versions for Industry Standard VGA chips
- Glitch-free frequency transitions
- Provision for external frequency input
- Internal clock remains locked when the external frequency input is selected
- Low power CMOS device technology
- Small footprint - 20-pin DIP or SOIC

### Applications

- VGA-Super VGA-XGA video adapters
- Workstations
- 8514A-TMS34010-TMS34020
- Motherboard

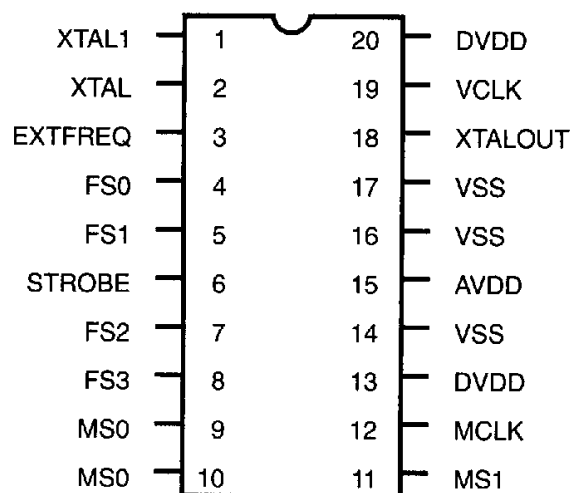
### Description

The Dot Clock Generator is an integrated circuit dual phase-locked loop frequency synthesizer capable of generating sixteen video dot clock frequencies and eight memory clock frequencies for use with high performance video display systems. Utilizing CMOS technology to implement all linear, digital and memory functions, the **ICS2494/94A** provides a low-power, small-footprint, low-cost solution to the generation of video dot clocks. Outputs are compatible with XGA, VGA, EGA, MCGA, CGA, MDA, as well as the higher frequencies needed for advanced applications in desktop publishing and workstation graphics. Provision is made via a single-level custom mask to implement customer-specific frequency sets. Phase-locked loop circuitry permits rapid glitch-free transitions between clock frequencies.

### New Features

- Buffered XTAL Out
- Integral loop filter components
- Fast acquisition of selected frequencies, strobed or non-strobed
- Guaranteed performance up to 135 MHz
- Excellent power supply rejection
- Advanced PLL for low phase-jitter
- Frequency change detection circuitry which enhances new frequency acquisition and eliminates problems caused by programs that rewrite frequency information.
- Improved pinout - easier board layout.

### Pin Configuration



**20-Pin DIP or SOIC  
K-4, K-7**

#### Notes:

1. In applications where the external frequency input is not specified, EXTREQ must be tied to  $V_{SS}$ .
2. ICS2494/94AM(SOIC) pinout is identical to ICS2494/94AN(DIP).



# ICS2494 ICS2494A

## Circuit and Application Options

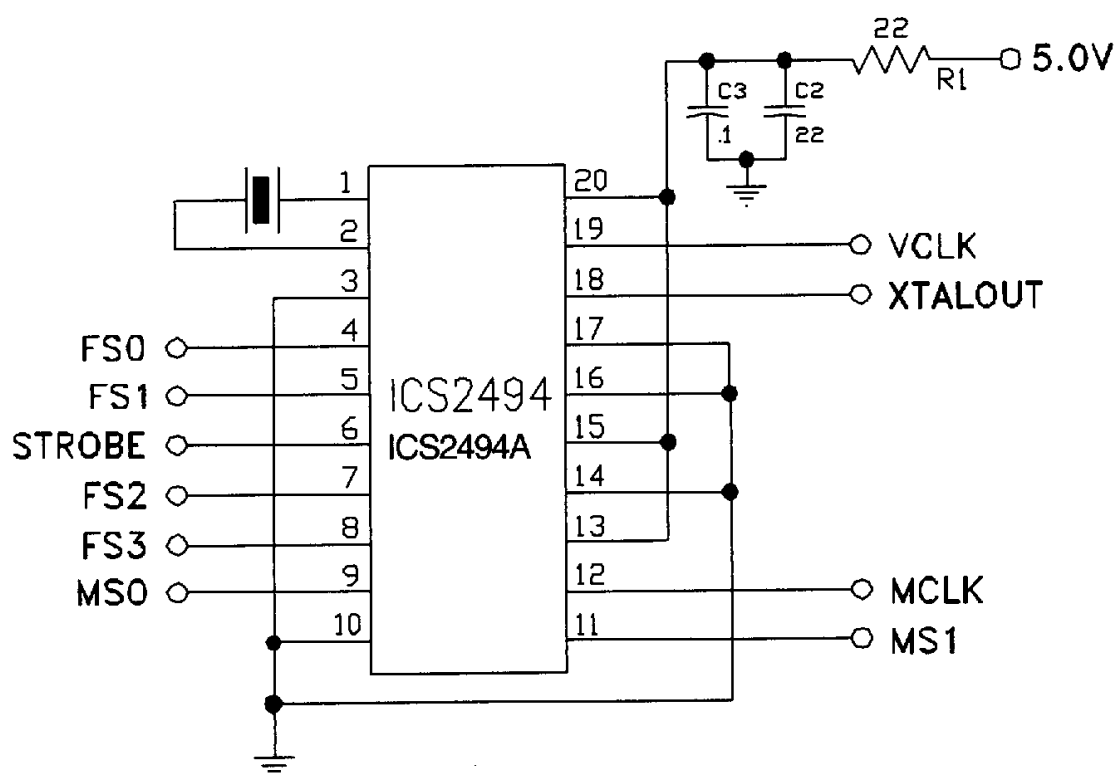
The ICS2494/94A will typically derive its frequency reference from a series-resonant crystal connected between pins 1 and 2. Where a high quality reference signal is available, such as in an application where the graphics subsystem is resident on the motherboard, this reference may directly replace the crystal. This signal should be coupled to pin 1. If the reference signal amplitude is less than 3.5 volts, a .047 microfarad capacitor should be used to couple the reference signal into XTAL1. Pin 2 must be left open.

### Power Supply Conditioning

The ICS2494/94A is a member of the second generation of dot clock products. By incorporating the loop filter on chip and upgrading the VCO, the ease of application has been substantially improved over earlier products. If a stable and noise-free power supply is available, no external components are required. However, in most applications it is judicious to decouple the power supply as shown in Figures 1 or 2. Figure 1 is the normal configuration for 5 volt only applications. Which of the two provides superior performance depends on the noise content of the power supplies. In general, the configuration of Figure 1 is satisfactory. Figure 2 is the more conventional if a 12 volt analog supply is available, although the improved performance comes at a cost of an extra component. The cost of the discretes used in Figure 2, however, are less than the cost of Figure 1's discrete components.

The number and differentiation of the analog and digital supply pins are intended for maximum performance products. In most applications, all VDDs may be tied together. The function of the multiple pins is to allow the user to realize the maximum performance from the silicon with a minimum degradation due to the package and PCB. At the frequencies of interest, the effects of the inductance of the bond wires and package lead frame are non-trivial. By using the multiple pins, ICS minimized the effect of packaging and minimized the interaction of the digital and analog supply currents.

Figure 1





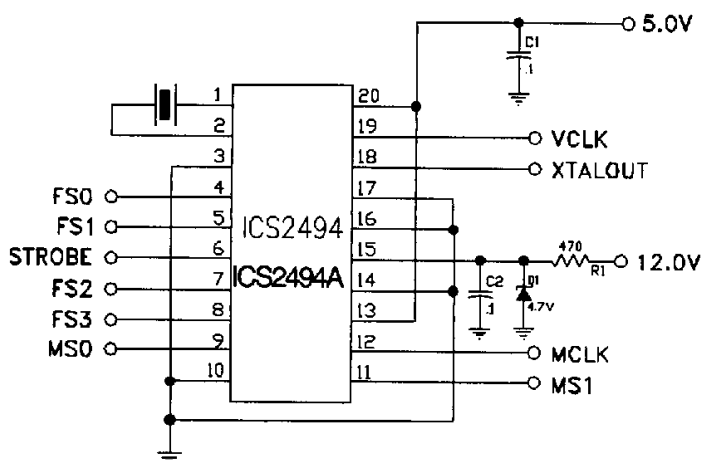
# ICS2494 ICS2494A

## Applications

### Layout Considerations

Utilizing the **ICS2494/94A** in video graphics adapter cards or on PS2 motherboards is simple but does require precautions in board layout if satisfactory jitter-free performance is to be realized. Care should be exercised in ensuring that components not related to the **ICS2494/94A** do not share its ground. In applications utilizing a multi-layer board, VSS should be directly connected to the ground plane. Multiple pins are utilized for all analog and digital VSS and VDD connections to permit extended frequency VCLK operation to 135 MHz. However, in all cases, all VSS and VDD pins should be connected.

**Figure 2**



### Frequency Reference

The internal reference oscillator contains all of the passive components required. An appropriate series-resonant crystal should be connected between **XTAL1 (1)** and **XTAL2 (2)**. In IBM-compatible applications this will typically be a 14.31818 MHz crystal, but fundamental mode crystals between 10 MHz and 25 MHz have been tested. Maintain short lead lengths between the crystal and the **ICS2494/94A**. In some applications, it may be desirable to utilize the bus clock. If the signal amplitude is equal to or greater than 3.5 volts, it may be connected directly to **XTAL1 (1)**. If the signal amplitude is less than 3.5 volts, connect the clock through a .047 microfarad capacitor to **XTAL1 (1)**, and keep the lead length of the capacitor to **XTAL1 (1)** to a minimum to reduce noise susceptibility. This input is internally biased at  $VDD/2$ . Since TTL compatible clocks typically exhibit a  $VOH$  of 3.5V, capacitively coupling the input restores noise immunity.

The **ICS2494/94A** is not sensitive to the duty cycle of the bus clock; however, the quality of this signal varies considerably with different motherboard designs. As the quality of this signal is typically outside of the control of the graphics adapter card manufacturer, it is suggested that this signal be buffered on the graphics adapter board. **XTAL2 (2)** must be left open in this configuration.

### Buffered XTALOUT

In motherboard applications it may be desirable to have the **ICS2494/94A** provide the bus clock for the rest of the system. This eliminates the need for an additional 14.31818 MHz crystal oscillator in the system, saving money as well as board space. To do this, the **XTALOUT (18)** output should be buffered with a CMOS driver.

### Output Circuit Considerations

As the dot clock is usually the highest frequency present in a video graphics system, consideration should be given to EMI. To minimize problems with meeting FCC EMI requirements, the trace which connects **VCLK (19)** or **MCLK (12)** and other components in the system should be kept as short as possible. The **ICS2494/94A** outputs have been designed to minimize overshoot. In addition it may be helpful to place a ferrite bead in these signal paths to limit the propagation of high order harmonics of this signal. A suitable device would be a Ferroxcube 56-590-65/4B or equivalent. This device should be placed physically close to the **ICS2494/94A**. A 33 to 47 Ohm series resistor, sometimes called source termination, in this path may be necessary to reduce ringing and reflection of the signal and may reduce phase-jitter as well as EMI.

### Digital Inputs

**FS0 (4)**, **FS1 (5)**, **FS2 (7)**, and **FS3 (8)** are the TTL compatible frequency select inputs for the binary code corresponding to the frequency desired. **STROBE (6)**, when high, allows new data into the frequency select latches; and when low, prevents address changes per Figure 3. The internal power-on-clear signal will force an initial frequency code corresponding to an all zeros input state. **MS0 (9)**, **MS1 (11)** and **MS2 (3)** are the corresponding memory select inputs and are not strobed.



# ICS2494

## ICS2494A

### Absolute Maximum Ratings

Supply Voltage	$V_{DD}$	-0.5V to +7V
Input Voltage	$V_{IN}$	-0.5V to $V_{DD}+0.5V$
Output Voltage	$V_{OUT}$	-0.5V to $V_{DD}+0.5V$
Clamp Diode Current	$V_{IK}$ & $I_{OK}$	$\pm 30mA$
Output Current per Pin	$I_{OUT}$	$\pm 50mA$
Operating Temperature	$T_o$	0 °C to 70 °C
Storage Temperature	$T_s$	-85 °C to +150 °C
Power Dissipation	$P_D$	500mW

Values beyond these ratings may damage the device. This device contains circuitry to protect the inputs and outputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid applications of any voltage higher than the maximum rated voltages. For proper operation it is recommended that  $V_{IN}$  and  $V_{OUT}$  be constrained to  $\geq V_{SS}$  and  $\leq V_{DD}$ .

### DC Characteristics (0 °C to 70 °C)

SYMBOL	PARAMETER	MIN	MAX	UNITS	CONDITIONS
$V_{DD}$	Operating Voltage Range	4.0	5.5	V	
$V_{IL}$	Input Low Voltage	$V_{SS}$	0.8	V	$V_{dd} = 5V$
$V_{IH}$	Input High Voltage	2.0	$V_{dd}$	V	$V_{dd} = 5V$
$I_{IH}$	Input Leakage Current	-	10	$\mu A$	$V_{in} = V_{cc}$
$V_{OL}$	Output Low Voltage	-	0.4	V	$I_{ol} = 4.0 mA$
$V_{OH}$	Output High Voltage	2.4	-	V	$I_{oh} = 4.0 mA$
$I_{DD}$	Supply Current	-	35	mA	$V_{dd} = 5V, V_{CLK} = 80 MHz$
$R_{UP} *$	Internal Pull-up Resistors	50	200	K Ohm	$V_{dd} = 5V, V_{in} = 0V$
$C_{in}$	Input Pin Capacitance	-	8	pF	$F_c = 1 MHz$
$C_{out}$	Output Pin Capacitance	-	12	pF	$F_c = 1 MHz$

\* The following inputs have pull-ups: FS0-3, MS0-1, STROBE.

### Frequency Pattern Availability

ICS offers the largest variety of standard frequency patterns in the industry, supporting all popular VGA controller devices. The attached listing provides the selection as of this publication date. Contact your local ICS sales office for latest frequency pattern availability.

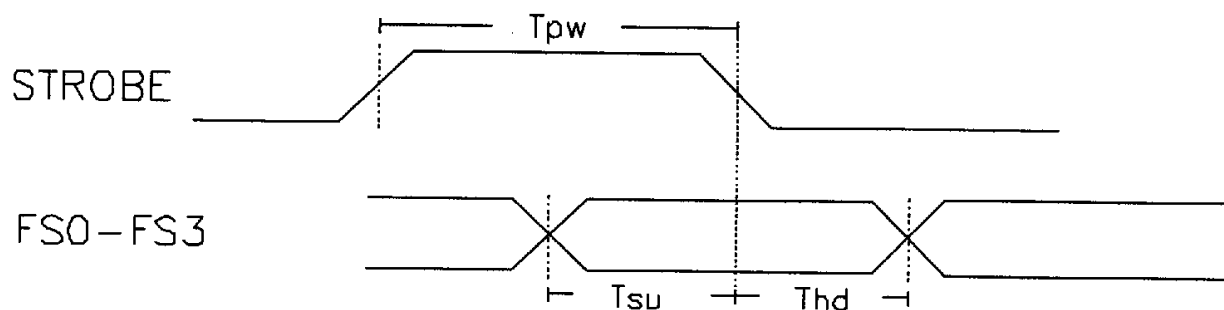


### AC Timing Characteristics

The following notes apply to all parameters presented in this section:

1. Xtal Frequency = 14.31818 MHz
2.  $T_C = 1/F_C$
3. All units are in nanoseconds (ns).
4. Rise and fall time is between 0.8 and 2.0 VDC.
5. Output pin loading = 25pF
6. Duty cycle is measured at 1.4V.
7. Supply Voltage Range = 4.0 to 5.5 Volts
8. Temperature Range = 0 °C to 70 °C

SYMBOL	PARAMETER	MIN	MAX	NOTES
<b>STROBE TIMING</b>				
Tpw	Strobe Pulse Width	20	-	
Tsu	Setup Time Data to Strobe	10	-	
Thd	Hold Time Data to Strobe	10	-	
<b>MCLK AND VCLK TIMINGS</b>				
Tr	Rise Time	-	3	Duty Cycle 40% min. to 60% max.
Tf	Fall Time	-	3	
-	Frequency Error	-	0.5	%
-	Maximum Frequency	-	135	MHz
-	Propagation Delay for Pass Through Frequency	-	15	ns



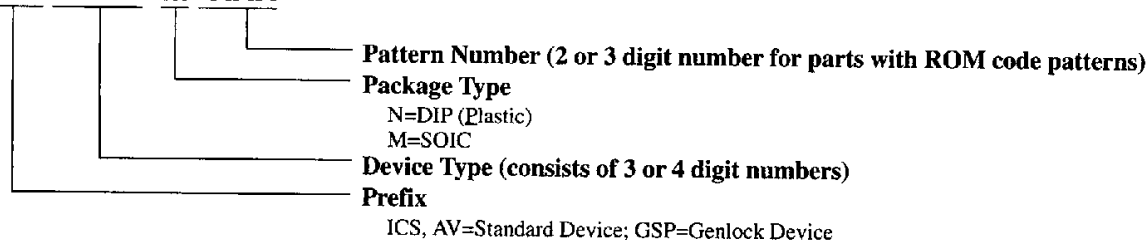
**Figure 3**

### Ordering Information

**ICS2494AN-XXX or ICS2494AM-XXX**

Example:

**ICS XXXX M -XXX**





# ICS2494/2494A

## ICS2494 Standard Patterns

ICS produces a selection of standard pattern ICS2494's pre-programmed for compatibility with many popular VGA chipsets. Custom patterns are also available, although a significant volume commitment and/or one-time mash charge will apply. Contact ICS sales for details.

ICS Part Number	ICS2494-236 ICS2494A-310* <sup>1</sup>	ICS 9294-237 ICS2494A-304* <sup>2</sup>	ICS2494-240	ICS2494-244 ICS2494A-317* <sup>3</sup>	ICS2494-245/307	ICS2494-247	ICS2494-253	ICS2494-256
Compatible VGA Chipsets	Cirrus Logic GD6410	Tseng Labs ET4000 ET400-W32 Acer M3125	Texas Instr. TMS34010 TMS34020	Motherboard Applications (CPU Clocks)		Cirrus Logic GD5320	NCR 77C22E	S3 86C911 86C924
Video Clock Address (HEX)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0	XTAL	50.350	25.175	20.000	50.350	XTAL	25.175	25.175
1	65.028	56.644	28.332	24.000	56.644	16.257	28.322	28.322
2	EXTFREQ	65.000	28.636	32.000	65.000	EXTFREQ	40.000	40.000
3	36.000	72.000	36.000	40.000	72.000	32.514	65.000	EXTFREQ
4	25.175	80.000	40.000	50.000	80.000	25.175	44.900	50.000
5	28.322	89.800	42.954	66.667	89.800	28.322	50.000	77.000
6	24.000	63.000	44.900	80.000	63.000	24.000	130.000	36.000
7	40.000	75.000	57.272	100.000	75.000	40.000	75.000	44.889
8	44.900	25.175	60.000	54.000	25.175	XTAL	25.175	130.000
9	50.350	28.322	63.960	70.000	28.322	16.257	28.322	120.000
A	16.257	31.500	75.000	90.000	31.500	EXTFREQ	EXTFREQ	80.000
B	32.514	36.000	80.000	110.000	36.000	36.000	EXTFREQ	31.500
C	56.644	40.000	85.000	25.000	40.000	25.175	60.000	110.000
D	20.000	44.900	99.000	33.333	44.900	28.322	80.000	65.000
E	41.539	50.000	102.000	40.000	50.000	24.000	EXTFREQ	75.000
F	80.000	65.000	108.000	50.000	77.500	40.000	EXTFREQ	72.000
Memory Clock Address (HEX)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0	32.900	40.000	64.000	16.000	40.000	31.000	50.000	55.000
1	35.600	41.612	40.000	24.000	41.612	36.400	60.000	75.000
2	43.900	44.744	48.000	50.000	44.744	43.900	65.000	70.000
3	49.100	50.000	60.000	66.667	50.000	49.100	75.000	80.000

\*1 ICS2494A-310 directly replaces ICS2494-236.

\*2 ICS2494A-304 directly replaces ICS2494-237.

\*3 ICS2494A-317 directly replaces ICS2494-244.

\*4 ICS2494A-318 directly replaces ICS2494-266.

Standard frequencies shown have been specified by and are supported by the respective VGA manufacturer.

All standard patterns shown above use 14.31818 MHz as the input reference frequency.

Order info: ICS2494M-XXX or ICS2494N-XXX (M= SOIC pkg., N= DIP pkg., XXX= Pattern number)  
ICS2494AM-XXX or ICS2494AN-XXX (M= SOIC pkg., N= DIP pkg., XXX= Pattern number)



# ICS2494/2494A

ICS Part Number	ICS2494-260	ICS2494-263	ICS2494-266 ICS2494-318*4	ICS2494-271/321	ICS2494-273	ICS2494-275	ICS2494-277	ICS2494-280	ICS2494-281
Compatible VGA Chipsets	Weitek W5086 W5186	NCR 77C22E	Cirrus Logic GD5410		Headland HT216 HT216-32	S3 86C801 86C805 86C928	NCR 77C22E+	S3 86C801 86C805	Tseng
Video Clock Address (HEX)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0	50.350	25.175	30.250	25.175	25.175	25.175	25.175	25.175	50.350
1	56.644	28.322	65.000	28.322	28.322	28.322	28.322	28.322	56.644
2	33.250	36.000	85.000	EXT	40.000	40.000	36.000	40.000	65.000
3	52.000	65.000	36.000	44.900	32.500	EXTFREQ	65.000	EXT	72.000
4	80.000	44.900	25.175	41.539	50.350	50.000	44.900	50.000	80.000
5	63.000	50.000	283.322	78.000	65.000	77.000	50.000	77.000	89.800
6	EXTFREQ	80.000	34.000	79.200	38.000	36.000	80.000	36.000	63.000
7	75.000	75.000	40.000	80.000	44.900	44.889	75.000	44.889	75.000
8	25.175	25.175	44.900	31.469	31.500	130.000	56.644	130.000	83.078
9	28.322	28.322	50.350	35.402	36.000	120.000	63.000	120.000	93.463
A	31.500	EXTFREQ	31.500	EXTFREQ	80.000	80.000	72.000	80.000	100.000
B	36.000	EXTFREQ	32.500	56.125	63.000	31.500	130.000	31.500	104.000
C	40.000	60.000	63.000	51.924	50.000	110.000	90.000	110.000	108.000
D	44.900	80.000	72.000	91.000	100.00	65.000	100.000	65.000	120.000
E	50.000	EXTFREQ	75.000	87.406	76.000	75.000	110.000	75.000	130.000
F	65.000	EXTFREQ	80.000	36.000	110.000	94.500	120.000	94.500	134.700
Memory Clock Address (HEX)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0	40.000	50.000	36.000	51.924	70.000	45.000	50.000	55.000	50.000
1	33.333	40.000	44.000	41.539	63.830	38.000	60.000	60.000	55.000
2	45.000	65.000	49.000	44.900	60.000	52.000	65.000	70.000	60.000
3	50.000	75.000	40.000	56.125	81.000	50.000	75.000	65.000	65.000

\*1 ICS2494A-310 directly replaces ICS2494-236.

\*2 ICS2494A-304 directly replaces ICS2494-237.

\*3 ICS2494A-317 directly replaces ICS2494-244.

\*4 ICS2494A-318 directly replaces ICS2494-266.

Standard frequencies shown have been specified by and are supported by the respective VGA manufacturer.

All standard patterns shown above use 14.31818 MHz as the input reference frequency.

Order info: ICS2494M-XXX or ICS2494N-XXX (M= SOIC pkg., N= DIP pkg., XXX= Pattern number)

ICS2494AM-XXX or ICS2494AN-XXX (M= SOIC pkg., N= DIP pkg., XXX= Pattern number)



# ICS2494/2494A

ICS Part Number	ICS2494A-305	ICS2494-306	ICS2494-314	ICS2494A-319	ICS2494A-320	ICS2494A-322	ICS2494A-324
Compatible VGA Chipsets	S3 86C924	Cirrus Logic GD6410 GD6412	Texas Instruments		AdvanceLogic ALG2101 ALG2201		Tseng Labs ET4000 ET4000 W32
Video Clock Address (HEX)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0	25.175	XTAL	12.273	25.175	50.350	20.000	50.000
1	28.322	65.000	13.500	28.322	56.644	20.480	56.644
2	40.000	EXTFREQ	14.750	40.000	89.800	24.576	65.000
3	EXTFREQ	36.000	25.175	72.000	72.000	24.704	72.000
4	50.000	25.175	28.322	50.000	75.000	25.216	80.000
5	77.000	28.322	36.000	77.500	65.000	25.248	89.800
6	36.000	24.000	40.000	36.000	63.000	25.600	63.000
7	44.889	40.000	44.900	44.900	80.000	26.000	75.000
8	130.000	44.900	50.000	63.000	57.272	28.800	83.078
9	120.000	50.350	64.000	100.000	85.000	29.491	93.463
A	80.000	16.257	75.000	80.000	94.000	30.720	100.000
B	31.500	32.514	80.000	31.500	96.000	32.768	104.000
C	110.000	56.644	100.000	110.000	100.000	33.6000	108.000
D	65.000	20.000	108.000	65.000	108.000	44.736	120.000
E	75.000	41.539	120.000	75.000	110.000	9.600	130.000
F	94.500	80.000	135.000	94.500	77.000	20.500	134.700
Memory Clock Address (HEX)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0	55.000	32.900	32.000	48.000	76.000	15.360	50.000
1	75.000	35.600	40.000	52.500	80.000	13.947	56.000
2	70.000	43.900	48.000	55.000	85.000	13.947	60.000
3	80.000	39.900	60.000	50.000	90.000	24.000	65.000

\*1 ICS2494A-310 directly replaces ICS2494-236.

\*2 ICS2494A-304 directly replaces ICS2494-237.

\*3 ICS2494A-317 directly replaces ICS2494-244.

\*4 ICS2494A-318 directly replaces ICS2494-266.

Standard frequencies shown have been specified by and are supported by the respective VGA manufacturer.

All standard patterns shown above use 14.31818 MHz as the input reference frequency.

Order info: ICS2494M-XXX or ICS2494N-XXX (M= SOIC pkg., N= DIP pkg., XXX= Pattern number)

ICS2494AM-XXX or ICS2494AN-XXX (M= SOIC pkg., N= DIP pkg., XXX= Pattern number)





# ICS2494/2494A

ICS Part Number	ICS2494-325	ICS2494-326	ICS2494-330	ICS2494-334	ICS2494-	ICS2494	ICS2494-
Compatible VGA Chipsets	Maxtek						
Video Clock Address (HEX)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0	25.175	66.000	18.432	25.175			
1	28.322	62.000	31.470	28.322			
2	31.500	61.236	50.000	31.500			
3	36.000	61.000	EXTFREQ	36.000			
4	40.000	60.500	48.000	40.000			
5	44.900	60.000	54.000	44.900			
6	50.350	59.300	59.200	50.000			
7	65.000	59.000	75.500	65.000			
8	56.644	58.968	96.000	75.000			
9	72.00	57.200	108.778	77.500			
A	75.000	56.200	73.410	80.000			
B	77.000	55.500	50.490	90.000			
C	80.000	40.000	110.439	100.000			
D	94.500	38.200	100.000	110.000			
E	120.000	32.500	125.000	126.000			
F	108.000	30.500	135.000	135.000			
Memory Clock Address (HEX)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0	45.000	48.000	47.720	60.000			
1	50.000	50.000	45.000	50.000			
2	65.000	40.000	40.000	55.000			
3	70.000	60.000	50.000	50.000			

\*1 ICS2494A-310 directly replaces ICS2494-236.

\*2 ICS2494A-304 directly replaces ICS2494-237.

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\*4 ICS2494A-318 directly replaces ICS2494-266.

Standard frequencies shown have been specified by and are supported by the respective VGA manufacturer.

All standard patterns shown above use 14.31818 MHz as the input reference frequency.

Order info: ICS2494M-XXX or ICS2494N-XXX (M= SOIC pkg., N= DIP pkg., XXX= Pattern number)

ICS2494AM-XXX or ICS2494AN-XXX (M= SOIC pkg., N= DIP pkg., XXX= Pattern number)