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# AMD GEODE™ CLOCK SOURCE

MK1491-06

## Description

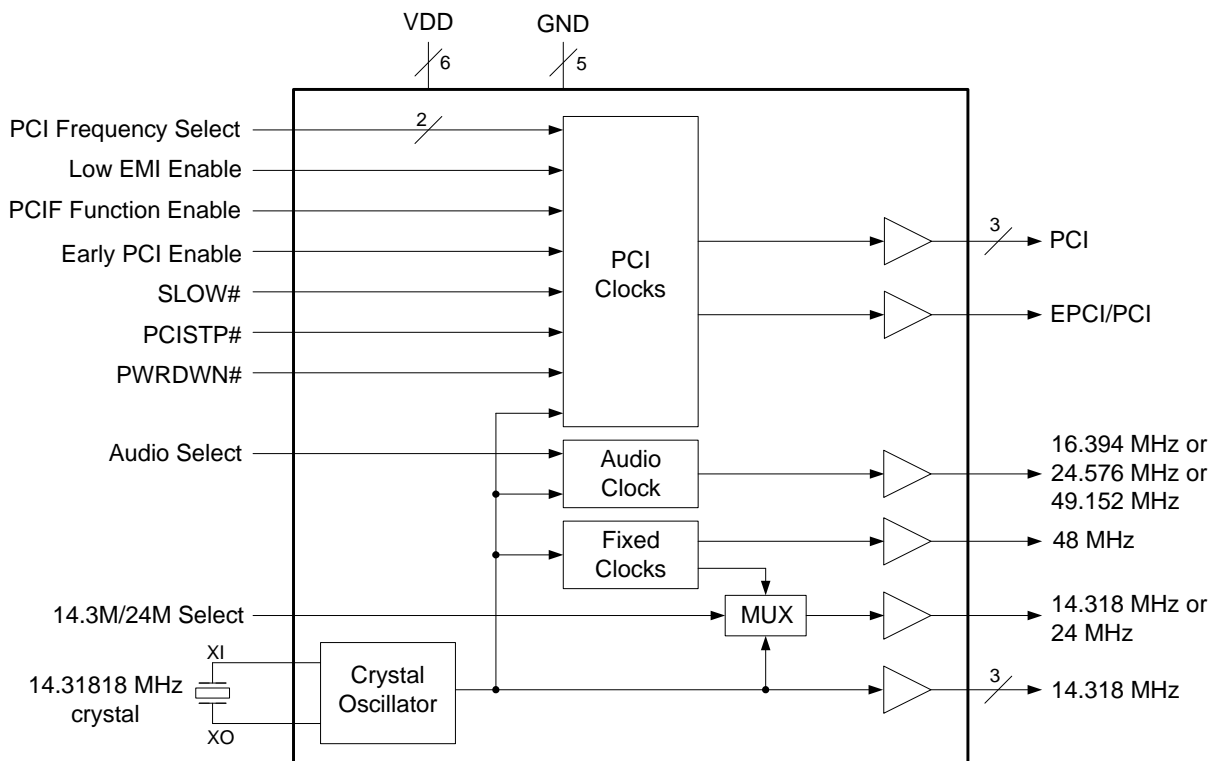
The MK1491-06 is a low-cost, low-jitter, high-performance clock synthesizer for AMD's Geode-based computer and portable appliance applications. Using patented analog Phased-Locked Loop (PLL) techniques, the device accepts a 14.318 MHz crystal input to produce multiple output clocks. It provides selectable PCI local bus and AC97 audio clocks, 24 MHz and 48 MHz clocks for Super I/O and USB, as well as multiple Reference outputs.

The device has multiple power-down modes to reduce power consumption.

## Features

- Packaged in 28-pin SOIC or in 28-pin SSOP
- Pb (lead) free, RoHS compliant
- Provides all critical timing for the AMD Geode companion chip
- Four PCI clocks
- Selectable PCIF on up to 2 outputs
- Early PCI clock selectability
- Up to 4 Reference clocks
- 48 MHz USB and 24MHz SIO support
- AC97 audio clock
- Multiple power down modes
- Low EMI Enable pin reduces EMI radiation on PCI clocks (patented)
- Operating voltage of 3.3 V  $\pm$ 5%
- Available in commercial (0 to +70°C) and industrial (-40°C to +85°C) temperature ranges

## Block Diagram



## Pin Assignment

|                   |                          |    |    |                          |                  |
|-------------------|--------------------------|----|----|--------------------------|------------------|
| VDD               | <input type="checkbox"/> | 1  | 28 | <input type="checkbox"/> | AC97 AUDIO (PEN) |
| XI                | <input type="checkbox"/> | 2  | 27 | <input type="checkbox"/> | PCI              |
| XO                | <input type="checkbox"/> | 3  | 26 | <input type="checkbox"/> | VDD              |
| GND               | <input type="checkbox"/> | 4  | 25 | <input type="checkbox"/> | PCI              |
| 14.3M (TS)        | <input type="checkbox"/> | 5  | 24 | <input type="checkbox"/> | PCI              |
| 14.3M             | <input type="checkbox"/> | 6  | 23 | <input type="checkbox"/> | GND              |
| GND               | <input type="checkbox"/> | 7  | 22 | <input type="checkbox"/> | PCI (EPCI#)      |
| 14.3M (SEL AUDIO) | <input type="checkbox"/> | 8  | 21 | <input type="checkbox"/> | 48M (LE#)        |
| VDD               | <input type="checkbox"/> | 9  | 20 | <input type="checkbox"/> | VDD              |
| SLOW#             | <input type="checkbox"/> | 10 | 19 | <input type="checkbox"/> | 24M/14.3M        |
| GND               | <input type="checkbox"/> | 11 | 18 | <input type="checkbox"/> | VDD              |
| FS                | <input type="checkbox"/> | 12 | 17 | <input type="checkbox"/> | GND              |
| SEL24             | <input type="checkbox"/> | 13 | 16 | <input type="checkbox"/> | PCISTP#          |
| VDD               | <input type="checkbox"/> | 14 | 15 | <input type="checkbox"/> | PWRDWN#          |

## Early PCI Control Table

| EPCI# | PCI (Pin 22) |
|-------|--------------|
| 0     | 1 ns early   |
| 1     | Normal       |

## EMI Control

| LE# | PCI Low EMI |
|-----|-------------|
| 0   | ON          |
| 1   | OFF         |

Spread direction is DOWN.

## Pin Descriptions

| Pin Number       | Pin Name   | Pin Type | Pin Description  |
|------------------|------------|----------|--|
| 1, 9, 14         | VDD        | P        | Connect to +3.3 V. Must be same voltage on all pins.                                   |
| 2                | XI         | I        | Crystal connection. Connect to a 14.31818 MHz crystal or input clock.                  |
| 3                | XO         | O        | Crystal connection. Connect to a 14.31818 MHz crystal, or leave unconnected for clock. |
| 4, 7, 11, 17, 23 | GND        | P        | Connect to Ground.   |
| 5                | 14.3M (TS) | TI/O     | 14.318 MHz output. Input control for all clocks per table above.                       |
| 6                | 14.3M      | O        | 14.318 MHz buffered reference clock output.  |

## PCI Frequency Select Table

| TS | FS | PCI                 |
|----|----|---------------------|
| 0  | 0  | Tristate all clocks |
| 0  | 1  | Reserved            |
| M  | 0  | 30 MHz              |
| M  | 1  | 33.3 MHz            |
| 1  | 0  | 25 MHz              |
| 1  | 1  | 37.5 MHz            |

## 24M/14.3M Frequency Select Table

| SEL24 | 24M/14.3M    |
|-------|--------------|
| 0     | 14.31818 MHz |
| 1     | 24.0 MHz     |

## PCIF Enable Control

| PEN | Pin 25 | Pin 24 |
|-----|--------|--------|
| 0   | PCI    | PCI    |
| M   | PCI    | PCIF   |
| 1   | PCIF   | PCIF   |

PCIF continues to run in PCI STOP mode. See table on page 4.

## AC97 Audio Frequency Select

| SEL AUDIO | AC97 AUDIO  |
|-----------|-------------|
| 0         | 16.9344 MHz |
| M         | 24.576 MHz  |
| 1         | 49.152 MHz  |

| Pin Number | Pin Name          | Pin Type | Pin Description  |
|------------|-------------------|----------|--|
| 8          | 14.3M (SEL AUDIO) | TI/O     | 14.318 MHz output and audio frequency select input per table above.                      |
| 10         | SLOW#             | I        | PCI normal or slow mode select input per table on page 4.                                |
| 12         | FS                | I        | Frequency Select for PCI clocks per table above.   |
| 13         | SEL24             | I        | Fixed frequency select input per table above. Selects frequency on pin 19.               |
| 15         | PWRDWN#           | I        | Power down control; defined in table on page 4.  |
| 16         | PCISTP#           | I        | PCI Stop power down control; defined in table on page 4.                                 |
| 18, 20, 26 | VDD               | P        | Connect to +3.3 V. Must be same voltage on all pins.                                     |
| 19         | 24M/14.3M         | O        | Fixed frequency clock output per table above.  |
| 21         | 48 (LE#)          | I/O      | Fixed frequency clock output and low EMI (spread spectrum) enable input per table above. |
| 22         | PCI (EPCI#)       | I/O      | PCI Output clock that can be early. Input control for Early PCI per table above.         |
| 24         | PCI               | O        | PCI Output clock. PCI/PCIF control set by PEN per table above.                           |
| 25         | PCI               | O        | PCI Output clock. PCI/PCIF control set by PEN per table above.                           |
| 27         | PCI               | O        | PCI Output clock.  |
| 28         | AC97 AUDIO (PEN)  | TI/O     | Audio clock output and PCIF Function Enable per table above.                             |

**KEY:**

I = Input

TI = Tri-level

O = Output

P = Power supply connection

(T)I/O = Input on power up, becomes an Output after 10 ms

Weak internal pull-up resistors are present on SEL24, EPCI#, FS, LE#, PCISTP#, and SLOW#. These pins should be tied to VDD or GND, and not be left floating. Internal resistors on PEN, SEL AUDIO, and TS pull to mid-level (M).

## Power Down Control Table

| PCISTP# | PWRDWN# | SLOW# | MODE       | PCI | PCIF | 24/14.3 | 14.3 | Description   |
|---------|---------|-------|------------|-----|------|---------|------|---|
| X       | 0       | X     | Power down | LOW | LOW  | LOW     | LOW  | All outputs low. PLL's and oscillators off.         |
| 0       | 1       | X     | PCI STOP   | LOW | ON   | ON      | ON   | PCI clocks synchronously enter and leave low state. |
| 1       | 1       | X     | ON         | ON  | ON   | ON      | ON   | All clocks on.                                      |

Key: 1 = connected to VDD, 0 = connected to ground, X = any valid logic level, combination inputs/outputs should be connected to VDD or ground through a 10 k $\Omega$  resistor as shown below.

## Power-on Default Conditions

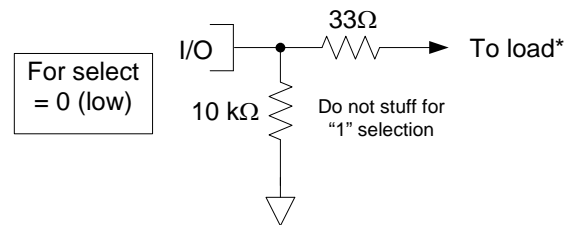
| Pin # | Function  | Default | Condition  |
|-------|-----------|---------|--|
| 5     | TS        | M       | All outputs enabled.   |
| 8     | SEL AUDIO | M       | Audio clock (pin 28) set to 24.576 MHz   |
| 10    | SLOW#     | 1       | PCI clocks set to 33.3 MHz. Refer to Power Down Control Table above.                   |
| 12    | FS        | 1       | PCI frequency = 33.3 MHz.  |
| 13    | SEL 24    | 1       | 24M/14.3M (pin 19) set to 24 MHz.  |
| 15    | PWRDWN#   | 1       | All clocks running.  |
| 16    | PCISTP#   | 1       | PCI clocks running.  |
| 21    | LE#       | 1       | Low EMI function OFF   |
| 22    | EPCI#     | 1       | Pin 22 set to normal PCI signal (not early).   |
| 28    | PEN       | M       | PCI (pin 25) set to PCI clock (33.33 MHz). PCI (pin 24) set to PCIF clock (33.33 MHz). |

## External Components

The MK1491-06 requires some inexpensive external components for proper operation. Decoupling capacitors of 0.1 $\mu$ F should be connected on each VDD pin to ground, as close to the MK1491-06 as possible. A series termination resistor of 33 $\Omega$  may be used for each clock output. See the discussion below for other external resistors required for proper I/O operation. The 14.3 MHz oscillator has internal caps that provide the proper load for a parallel resonant crystal with  $C_L=18$  pF. For tuning with other values of  $C_L$ , the formula  $2*(C_L-18)$  gives the value of each capacitor that should be connected between X1 and ground and X2 and ground.

## I/O Structure

The MK1491-06 provides more functionality in a 28-pin package by using a unique I/O technique. The device checks the status of all I/O pins during power-up and at exit from the Power Down state. This status (pulled high, low, or mid-level) then determines the frequency selections and power down modes (see the tables on pages 2 and 4). Within 10ms after power up, the inputs change to outputs and the clocks start up. In the diagrams to the right, the 33 $\Omega$  resistors are the normal output termination resistors. The 10k $\Omega$  resistor pulls low to generate a logic zero. Weak internal pull-up resistors are present on SEL24, EPCI#, FS, LE#, PCISTP#, and SLOW#. These pins should be connected directly to VDD or GND if not under active control. Internal resistors on PEN, SEL AUDIO, and TS pull to a mid-level (M).



\*Note: Do not use a TTL load. This will overcome the 10 k $\Omega$  pull-down and force the input to a logic 1.

## Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the MK1491-06. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

| Item                   | Rating              |
|------------------------|---------------------|
| Supply Voltage, VDD    | 7 V                 |
| All Inputs and Outputs | -0.5 V to VDD+0.5 V |
| Storage Temperature    | -65 to +150°C       |
| Junction Temperature   | 125°C               |
| Soldering Temperature  | 260°C               |

## Recommended Operation Conditions

| Parameter   | Min.  | Typ. | Max.  | Units |
|---|-------|------|-------|-------|
| Ambient Operating Temperature (commercial)        | 0     |      | +70   | °C    |
| Ambient Operating Temperature (industrial)        | -40   |      | +85   | °C    |
| Power Supply Voltage (measured in respect to GND) | +3.15 | +3.3 | +3.45 | V     |

## DC Electrical Characteristics

Unless stated otherwise, VDD = 3.3 V ±5%, Ambient Temperature 0 to +70°C or -40 to +85°C

| Parameter                                   | Symbol          | Conditions              | Min.    | Typ. | Max. | Units |
|---|-----------------|-------------------------|---------|------|------|-------|
| Operating Voltage                           | VDD             |                         | 3.15    | 3.3  | 3.45 | V     |
| Input High Voltage                          | V <sub>IH</sub> |                         | 2       |      |      | V     |
| Input Mid-level Voltage                     | V <sub>IM</sub> |                         | 1.2     | 1.4  | 1.6  | V     |
| Input Low Voltage                           | V <sub>IL</sub> |                         |         |      | 0.8  | V     |
| Output High Voltage                         | V <sub>OH</sub> | I <sub>OH</sub> = -8 mA | 2.4     |      |      | V     |
| Output Low Voltage                          | V <sub>OL</sub> | I <sub>OL</sub> = 8 mA  |         |      | 0.4  | V     |
| Output High Voltage                         | V <sub>OH</sub> | I <sub>OH</sub> = -8 mA | VDD-0.4 |      |      | V     |
| Operating Supply Current                    | IDD             | 33 MHz, no load         |         | 30   |      | mA    |
| Power Down Mode Supply Current              |                 |                         |         | 15   |      | μA    |
| Short Circuit Current, Single Output Driver |                 | VDD = 3.3 V             |         | ±60  |      | mA    |
| Input Capacitance                           | C <sub>IN</sub> |                         |         | 7    |      | pF    |

## AC Electrical Characteristics

Unless stated otherwise, VDD = 3.3 V ±5%, Ambient Temperature 0 to +70°C or -40 to +85° C

| Parameter  | Symbol   | Conditions            | Min. | Typ.     | Max. | Units |
|--|----------|-----------------------|------|----------|------|-------|
| Input Frequency                                  | $F_{IN}$ |                       |      | 14.31818 |      | MHz   |
| Output Clock Rise Time                           | $t_{OR}$ | 20% to 80%            |      |          | 1.5  | ns    |
| Output Clock Fall Time                           | $t_{OF}$ | 80% to 20%            |      |          | 1.5  | ns    |
| Output Clock Duty Cycle, all MHz Clocks          | $t_{OD}$ | At 1.5 V              | 45   | 49 to 51 | 55   | %     |
| PCI Output to Output Skew                        |          | Rising edges at 1.5 V |      |          | 500  | ps    |
| Skew of EPCI with respect to PCI                 |          |                       |      | 1        |      | ns    |
| Cycle-to-Cycle Jitter, PCI clocks                |          |                       |      | 250      |      | ps    |
| EMI Reduction, peaks of 5th - 19th odd harmonics |          | 33.3 MHz PCI Clock    |      | 6        | 11   | dB    |
| Power-up Time, PWRDWN# High to all Clocks Stable |          |                       |      | 8        | 20   | ms    |
| Power-on Time, applied VDD to all Clocks Stable  |          |                       |      | 12       | 25   | ms    |

## Thermal Characteristics

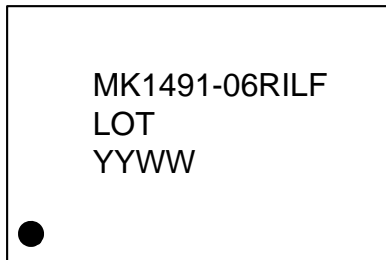
| Parameter                              | Symbol        | Conditions     | Min. | Typ. | Max. | Units |
|--|---------------|----------------|------|------|------|-------|
| Thermal Resistance Junction to Ambient | $\theta_{JA}$ | Still air      |      | 100  |      | °C/W  |
|  | $\theta_{JA}$ | 1 m/s air flow |      | 80   |      | °C/W  |
|  | $\theta_{JA}$ | 3 m/s air flow |      | 67   |      | °C/W  |
| Thermal Resistance Junction to Case    | $\theta_{JC}$ |                |      | 60   |      | °C/W  |



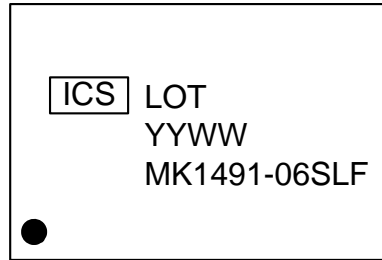
## Marking Diagrams



MK1491-06RLF



MK1491-06RILF



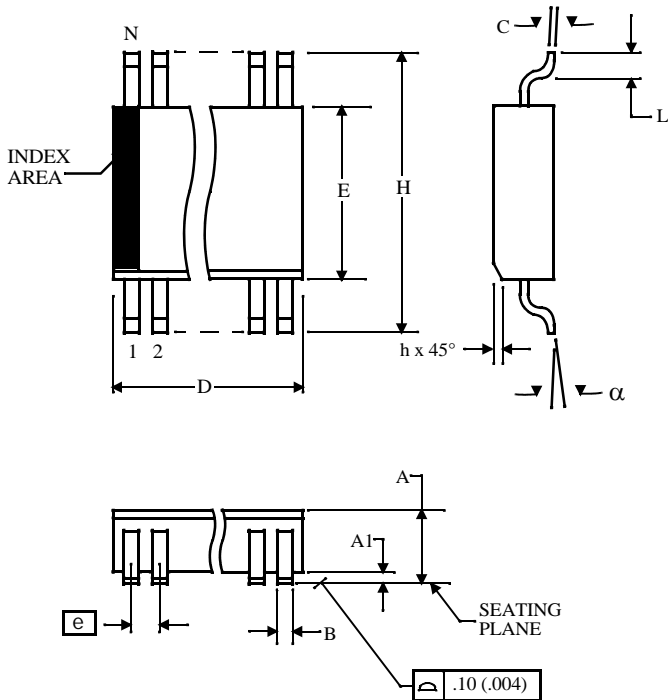
MK1491-06SLF

### Notes:

1. LOT is the lot code.
2. YYWW is the last two digits of the year, and the week number that the part was assembled.
3. Bottom marking: country of origin.

### Package Outline and Package Dimensions (28-pin SOIC, 150 mil Body)

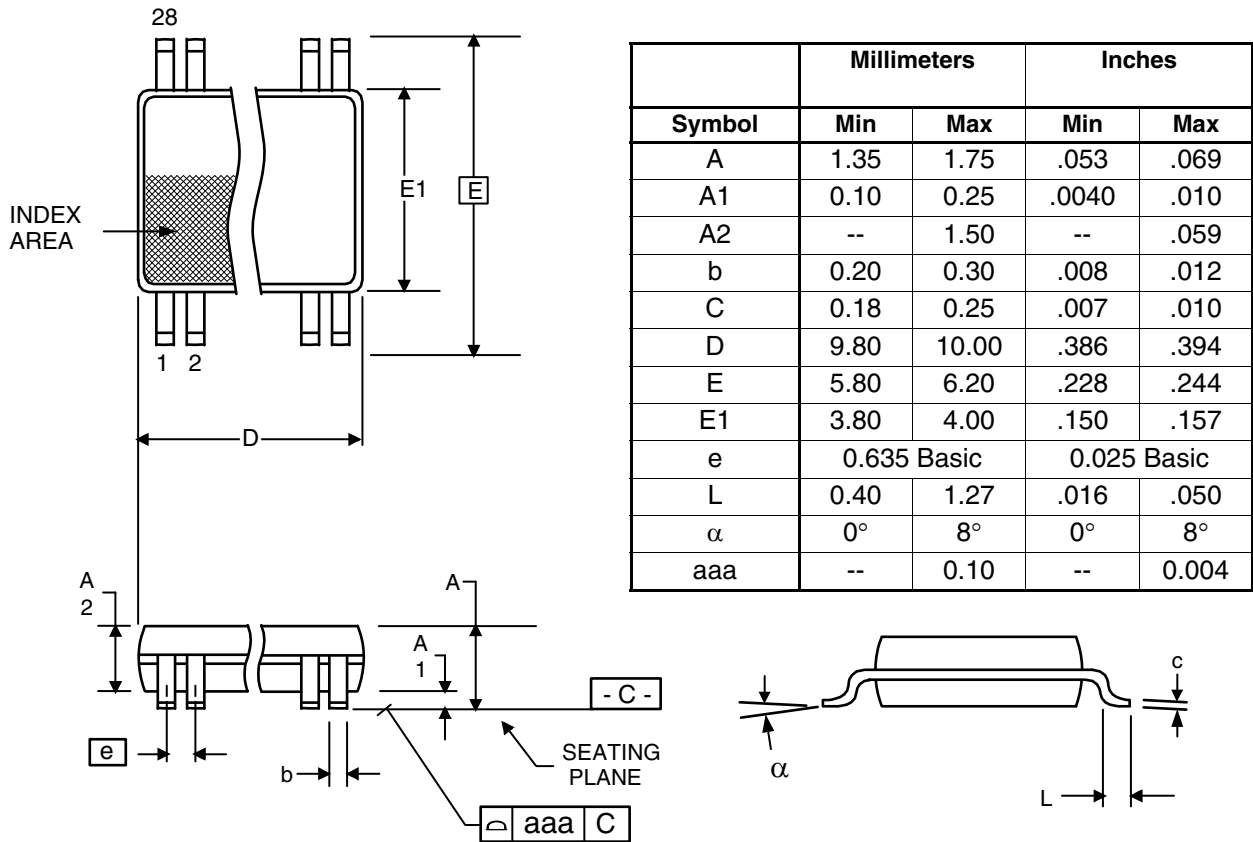
Package dimensions are kept current with JEDEC Publication No. 95, MO-153



| Symbol   | Millimeters |       | Inches      |       |
|----------|-------------|-------|-------------|-------|
|          | Min         | Max   | Min         | Max   |
| A        |             | 2.65  |             | 0.104 |
| A1       | 0.10        |       | .0040       |       |
| B        | 0.33        | 0.51  | .013        | .020  |
| C        | 0.18        | 0.32  | .007        | .013  |
| D        | 17.70       | 18.40 | .697        | .724  |
| E        | 7.40        | 7.60  | .291        | .299  |
| e        | 1.27 Basic  |       | 0.050 Basic |       |
| H        | 10.00       | 10.65 | .394        | .419  |
| h        | 0.25        | 0.75  | .010        | .029  |
| L        | 0.40        | 1.27  | .016        | .050  |
| $\alpha$ | 0°          | 8°    | 0°          | 8°    |

## Package Outline and Package Dimensions (28-pin SSOP, 150 mil Body, 0.025 mm Pitch)

Package dimensions are kept current with JEDEC Publication No. 95, MO-153



## Ordering Information

| Part / Order Number | Marking    | Shipping Packaging | Package     | Temperature  |
|---------------------|------------|--------------------|-------------|--------------|
| MK1491-06RLF        | see page 8 | Tubes              | 28-pin SSOP | 0 to +70°C   |
| MK1491-06RLFTR      |            | Tape and Reel      | 28-pin SSOP | 0 to +70°C   |
| MK1491-06RILF       |            | Tubes              | 28-pin SSOP | -40 to +85°C |
| MK1491-06RILFTR     |            | Tape and Reel      | 28-pin SSOP | -40 to +85°C |
| MK1491-06SLF        |            | Tubes              | 28-pin SOIC | 0 to +70°C   |
| MK1491-06SLFTR      |            | Tape and Reel      | 28-pin SOIC | 0 to +70°C   |

“LF” denotes Pb (lead) free package, RoHS compliant.

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## Revision History

| Rev. | Date     | Originator | Description of Change              |
|------|----------|------------|------------------------------------|
| M    | 06/09/14 | RDW        | Added I-temp throughout datasheet. |
|      |          |            |                                    |
|      |          |            |                                    |
|      |          |            |                                    |
|      |          |            |                                    |

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