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## Understanding [Embedded - CPLDs \(Complex Programmable Logic Devices\)](#)

Embedded - CPLDs, or Complex Programmable Logic Devices, are highly versatile digital logic devices used in electronic systems. These programmable components are designed to perform complex logical operations and can be customized for specific applications. Unlike fixed-function ICs, CPLDs offer the flexibility to reprogram their configuration, making them an ideal choice for various embedded systems. They consist of a set of logic gates and programmable interconnects, allowing designers to implement complex logic circuits without needing custom hardware.

## Applications of Embedded - CPLDs

### Details

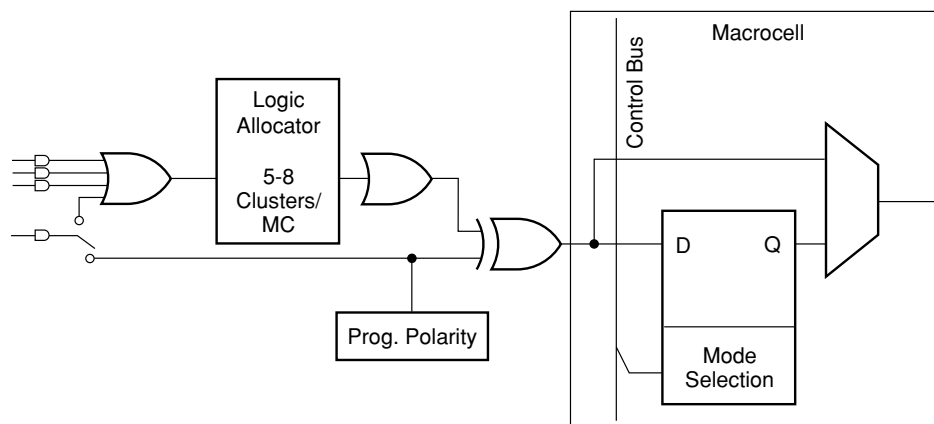
|                                 |                                                                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Status                  | Obsolete                                                                                                                                                                |
| Programmable Type               | In System Programmable                                                                                                                                                  |
| Delay Time tpd(1) Max           | 20 ns                                                                                                                                                                   |
| Voltage Supply - Internal       | 3V ~ 3.6V                                                                                                                                                               |
| Number of Logic Elements/Blocks | -                                                                                                                                                                       |
| Number of Macrocells            | 512                                                                                                                                                                     |
| Number of Gates                 | -                                                                                                                                                                       |
| Number of I/O                   | 120                                                                                                                                                                     |
| Operating Temperature           | -40°C ~ 85°C (TA)                                                                                                                                                       |
| Mounting Type                   | Surface Mount                                                                                                                                                           |
| Package / Case                  | 160-BQFP                                                                                                                                                                |
| Supplier Device Package         | 160-PQFP (28x28)                                                                                                                                                        |
| Purchase URL                    | <a href="https://www.e-xfl.com/product-detail/lattice-semiconductor/m5lv-512-120-20yi">https://www.e-xfl.com/product-detail/lattice-semiconductor/m5lv-512-120-20yi</a> |

## Macrocells

The macrocells for MACH 5 devices consist of a storage element which can be configured for combinatorial, registered or latched operation (Figure 3). The D-type flip-flops can be configured as T-type, J-K, or S-R operation through the use of the XOR gate associated with each macrocell.

Each PAL block has the capability to provide two input registers by using macrocells 0 and 15. In order to use this option, these macrocells must be accessed via the I/O pins associated with macrocells 3 and 12, respectively. Once the macrocell is used as an input register, it cannot be used for logic, so its clusters can be re-directed through the logic allocator to another macrocell. The

I/O pins associated with macrocells 0 and 15 can still be used as input pins. Although the I/O pins for macrocells 3 and 12 are used to connect to the input registers, these macrocells can still be used as “buried” macrocells to drive device logic via the matrix.



20446G-003

Figure 3. Macrocell Diagram

## Control Generator

The control generator provides four configurable clock lines and three configurable set/reset lines to each macrocell in a PAL block. Any of the four clock lines and any of the three set/reset lines can be independently selected by any flip-flop within a block. The clock lines can be configured to provide synchronous global (pin) clocks and asynchronous product term clocks, sum term clocks, and latch enables (Figure 4). Three of the four global clocks, as well as two product-term clocks and one sum-term clock, are available per PAL block. Positive or negative edge clocking is available as well as advanced clocking features such as **complementary** and **biphase** clocking. Complementary clocking provides two clock lines exactly 180 degrees out of phase, and is useful in applications such as fast data paths. A biphase clock line clocks flip-flops on both the positive and negative edges of the clock. The configuration options for the four clock lines per PAL block are as follows:

### Clock Line 0 Options

- ◆ Global clock (0, 1, 2, or 3) with positive or negative edge clock enable
- ◆ Product-term clock ( $A*B*C$ )
- ◆ Sum-term clock ( $A+B+C$ )

### Clock Line 1 Options

- ◆ Global clock (0, 1, 2, or 3) with positive edge clock enable
- ◆ Global clock (0, 1, 2, or 3) with negative edge clock enable

Select devices have been discontinued.  
See Ordering Information section for product status.

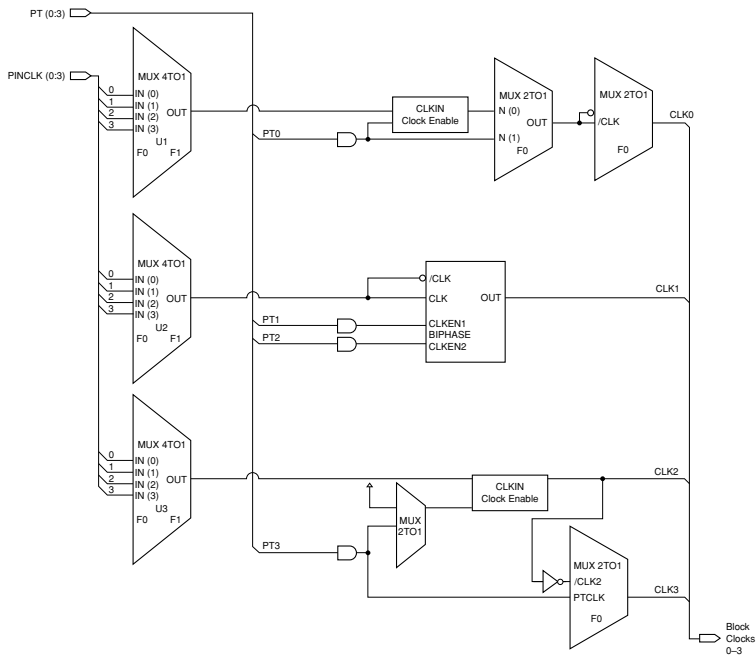
- ◆ Global clock (0, 1, 2, or 3) with positive and negative edge clock enable (biphase)

#### Clock Line 2 Options

- ◆ Global clock (0, 1, 2, or 3) with clock enable

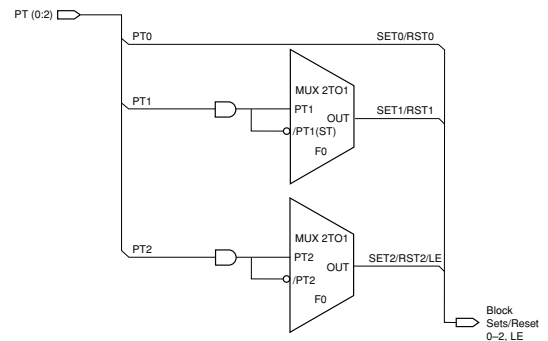
#### Clock Line 3 Options

- ◆ Complement of clock line 2 (same clock enable)
- ◆ Product-term clock (if clock line 2 does not use clock enable)



20446G-004

**Figure 4. Clock Generator**



20446G-005

**Figure 5. Set/Reset Generator**

The set/reset generation portion of the control generator (Figure 5) creates three set/reset lines for the PAL block. Each macrocell can choose one of these three lines or choose no set/reset at all. All three lines can be configured for product term set/reset and two of the three lines can be configured as sum term set/reset and one of the lines can be configured as product-term or sum-term latch enable. While the set/reset signals are generated in the control generator, whether that signal sets or resets a flip-flop is determined within the individual macrocell. The same signal can set one flip-flop and reset another. PT2 or /PT2 can also be used as a latch enable for macrocells configured as latches.

**Select devices have been discontinued.  
See Ordering Information section for product status.**

## OE Generator

There is one output enable (OE) generator per PAL block that generates two product-term driven output enables. Each I/O cell is simply an output buffer. Each I/O cell within the PAL block can choose to be permanently enabled, permanently disabled, or choose one of the two product term output enables per PAL block (Figure 6).

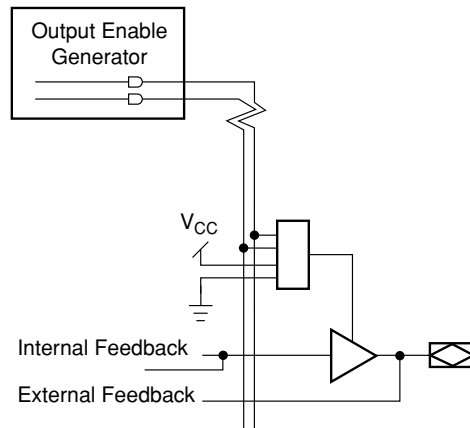


Figure 6. Output Enable Generator and I/O Cell

20446G-006

Select devices have been discontinued.  
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## MACH 5 TIMING MODEL

The primary focus of the MACH 5 timing model is to accurately represent the timing in a MACH 5 device, and at the same time, be easy to understand. This model accurately describes all combinatorial and registered paths through the device, making a distinction between **internal feedback** and **external feedback**. A signal uses internal feedback when it is fed back into the switch matrix or block without having to go through the output buffer. The input register specifications are also reported as internal feedback. When a signal is fed back into the switch matrix after having gone through the output buffer, it is using external feedback.

The parameter,  $t_{BUF}$  is defined as the time it takes to go through the output buffer to the I/O pad. If a signal goes to the internal feedback rather than to the I/O pad, the parameter designator is followed by an "i". By adding  $t_{BUF}$  to this internal parameter, the external parameter is derived. For example,  $t_{PD} = t_{PDi} + t_{BUF}$ . A diagram representing the modularized MACH 5 timing model is shown in Figure 7. Refer to the Technical Note entitled *MACH 5 Timing and High Speed Design* for a more detailed discussion about the timing parameters.

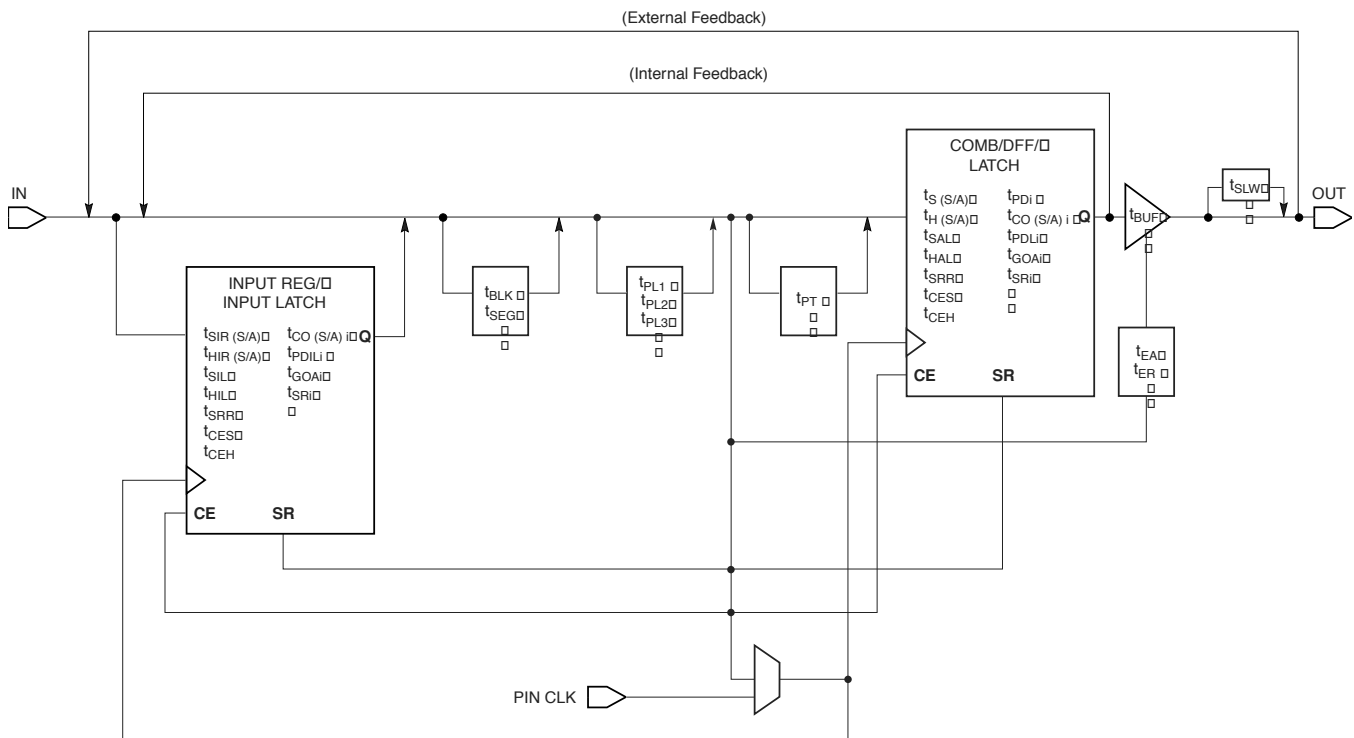
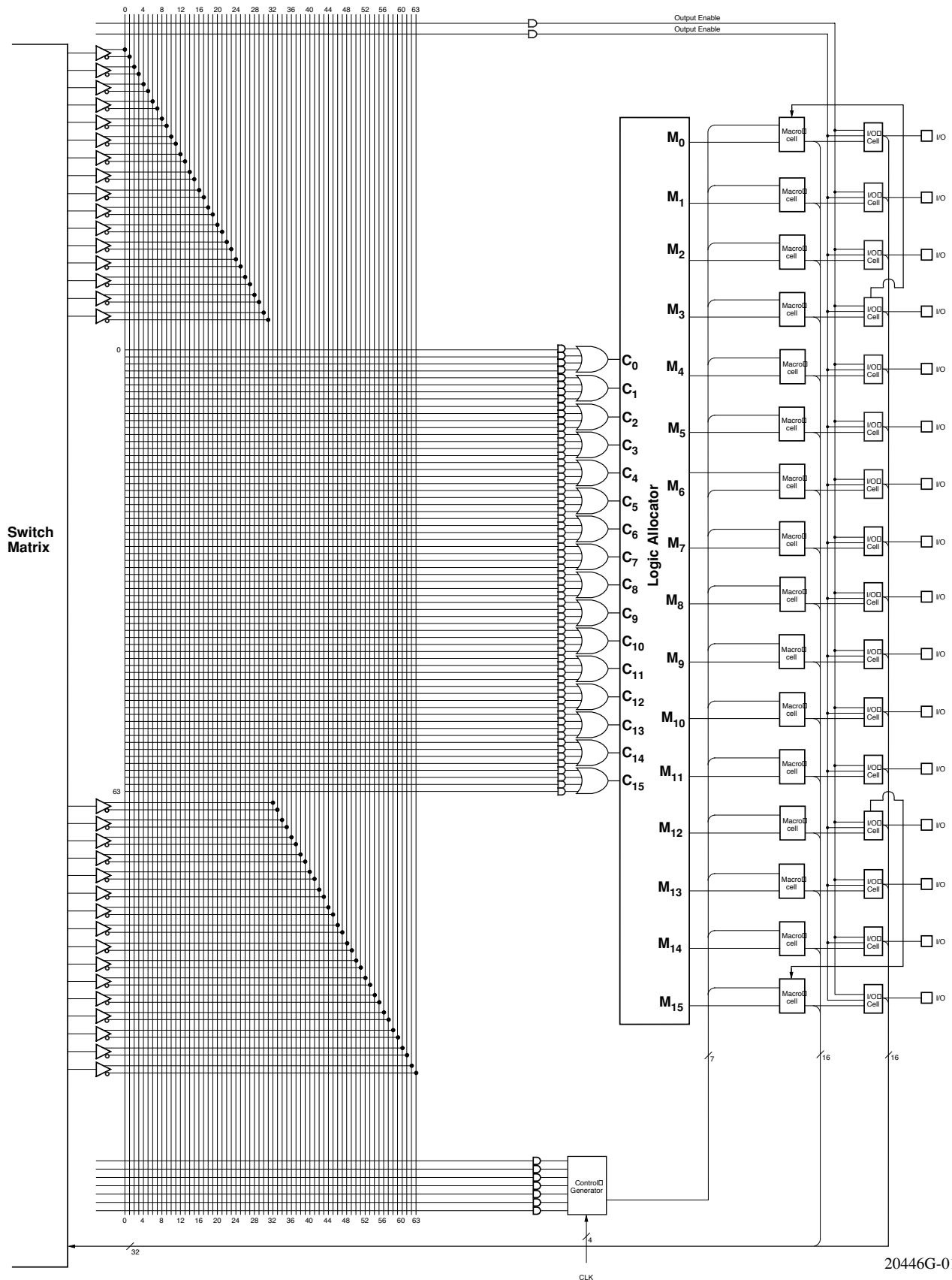


Figure 7. MACH 5 Timing Model

20446G-014

Select devices have been discontinued.  
See Ordering Information section for product status.

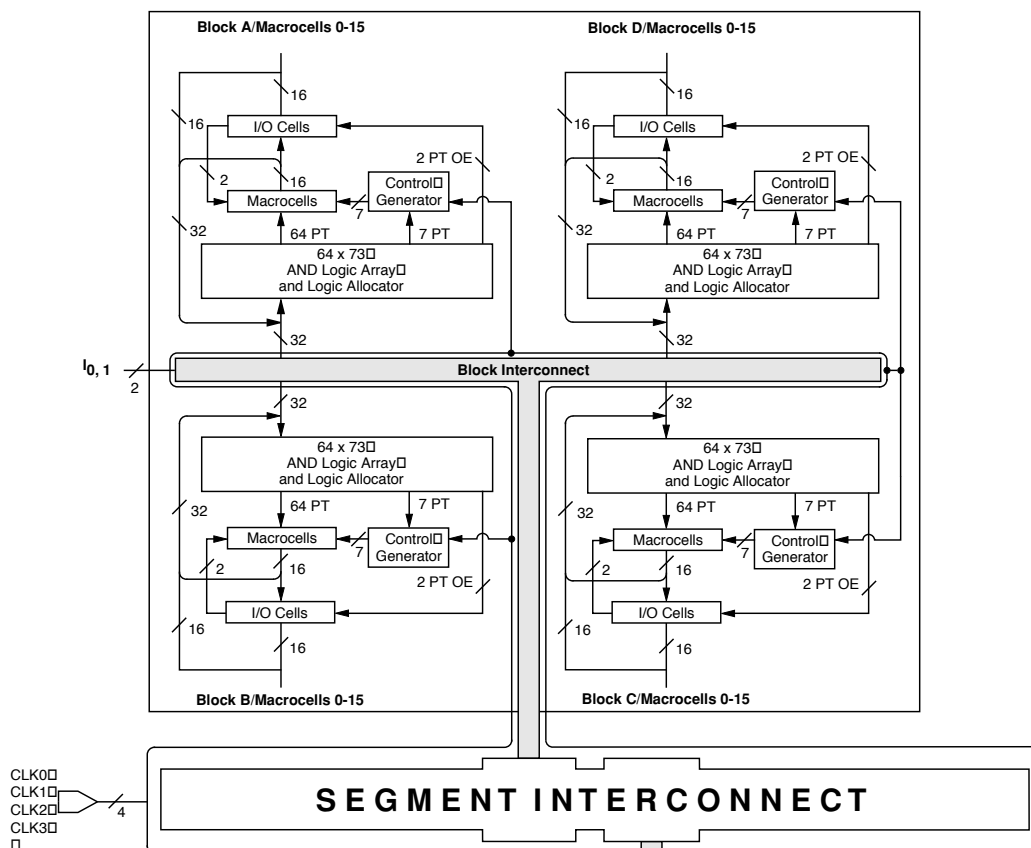
## MACH 5 PAL BLOCK



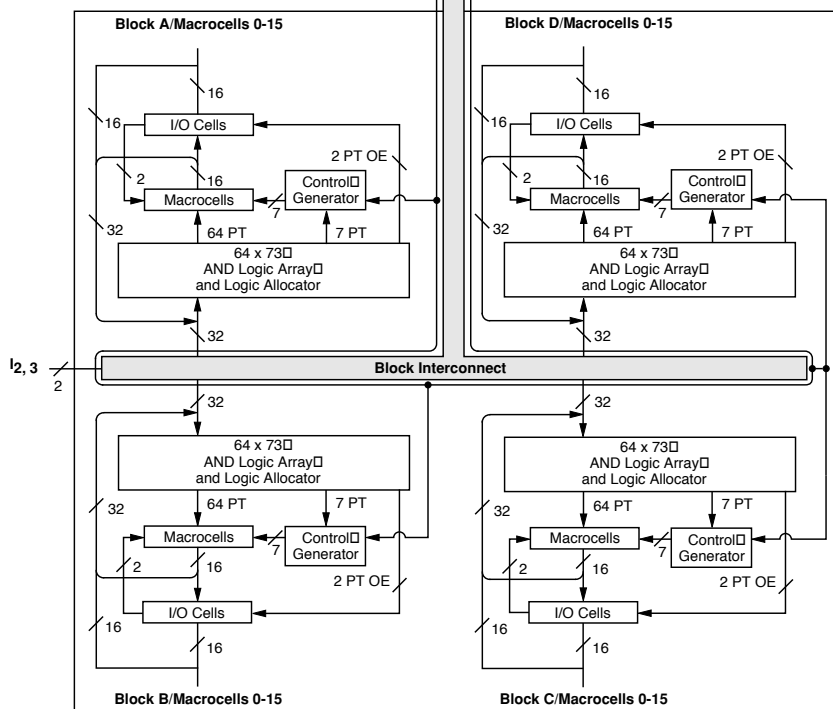
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# BLOCK DIAGRAM — M5(LV)-128/XXX

## SEGMENT 0



## SEGMENT 1



Select devices have been discontinued.  
See Ordering Information section for product status.

20446G-007

## ABSOLUTE MAXIMUM RATINGS

### M5

Storage Temperature. . . . . -65°C to +150°C  
 Device Junction  
 Temperature (Note 1) . . . . . +130°C or +150°C  
 Supply Voltage  
 with Respect to Ground . . . . . -0.5 V to +7.0 V  
 DC Input Voltage . . . . . -0.5 V to 5.5 V  
 Static Discharge Voltage . . . . . 2000 V  
 Latchup Current (-40°C to +85°C) . . . . . 200 mA

*Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability.*

## OPERATING RANGES

### Commercial (C) Devices

Ambient Temperature ( $T_A$ )  
 Operating in Free Air. . . . . 0°C to +70°C  
 Supply Voltage ( $V_{CC}$ )  
 with Respect to Ground. . . . . +4.75 V to +5.25 V

### Industrial (I) Devices

Ambient Temperature ( $T_A$ )  
 Operating in Free Air. . . . . -40°C to +85°C  
 Supply Voltage ( $V_{CC}$ )  
 with Respect to Ground. . . . . +4.5 V to +5.5 V

*Operating ranges define those limits between which the functionality of the device is guaranteed.*

Select devices have been discontinued.  
See Ordering Information section for product status.

## 5-V DC CHARACTERISTICS OVER OPERATING RANGES

| Parameter Symbol | Parameter Description                                                                     | Test Description                                                                              | Min | Typ | Max  | Unit          |
|------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-----|-----|------|---------------|
| $V_{OH}$         | Output HIGH Voltage<br>(For M5-128/1, M5-192/1, M5-256/1, M5-320, M5-384, M5-512 Devices) | $I_{OH} = -3.2 \text{ mA}$ , $V_{CC} = \text{Min}$ , $V_{IN} = V_{IH} \text{ or } V_{IL}$     | 2.4 |     |      | V             |
|                  |                                                                                           | $I_{OH} = -100 \mu\text{A}$ , $V_{CC} = \text{Max}$ , $V_{IN} = V_{IH} \text{ or } V_{IL}$    |     | 3.3 | 3.6  | V             |
|                  | Output HIGH Voltage<br>(For M5-128, M5-192, M5-256 Devices)                               | $I_{OH} = -3.2 \text{ mA}$ , $V_{CC} = \text{Min}$ , $V_{IN} = V_{IH} \text{ or } V_{IL}$     | 2.4 |     |      | V             |
|                  |                                                                                           | $I_{OH} = -2.5 \text{ mA}$ , $V_{CC} = 5.25 \text{ V}$ , $V_{IN} = V_{IH} \text{ or } V_{IL}$ |     |     | 3.6  | V             |
| $V_{OL}$         | Output LOW Voltage (Note 2)                                                               | $I_{OL} = +16 \text{ mA}$ , $V_{CC} = \text{Min}$ , $V_{IN} = V_{IH} \text{ or } V_{IL}$      |     |     | 0.5  | V             |
| $V_{IH}$         | Input HIGH Voltage                                                                        | Guaranteed Input Logical HIGH Voltage for all Inputs (Note 3)                                 | 2.0 |     |      | V             |
| $V_{IL}$         | Input LOW Voltage                                                                         | Guaranteed Input Logical LOW Voltage for all Inputs (Note 3)                                  |     |     | 0.8  | V             |
| $I_{IH}$         | Input HIGH Leakage Current                                                                | $V_{IN} = 5.25$ , $V_{CC} = \text{Max}$ (Note 4)                                              |     |     | 10   | $\mu\text{A}$ |
| $I_{IL}$         | Input LOW Leakage Current                                                                 | $V_{IN} = 0$ , $V_{CC} = \text{Max}$ (Note 4)                                                 |     |     | -10  | $\mu\text{A}$ |
| $I_{OZH}$        | Off-State Output Leakage Current HIGH                                                     | $V_{OUT} = 5.25$ , $V_{CC} = \text{Max}$ , $V_{IN} = V_{IH} \text{ or } V_{IL}$ (Note 4)      |     |     | 10   | $\mu\text{A}$ |
| $I_{OZL}$        | Off-State Output Leakage Current LOW                                                      | $V_{OUT} = 0$ , $V_{CC} = \text{Max}$ , $V_{IN} = V_{IH} \text{ or } V_{IL}$ (Note 4)         |     |     | -10  | $\mu\text{A}$ |
| $I_{SC}$         | Output Short-Circuit Current                                                              | $V_{OUT} = 0.5 V_{CC} = \text{Max}$ , $V_{IN} = V_{IH} \text{ or } V_{IL}$ (Note 5)           | -30 |     | -180 | mA            |

### Note:

- 150° for M5-128, M5-192 and M5-256 devices. 130° for M5-128/1, M5-192/1, M5-256/1, M5-320, M5-384 and M5-512 devices.
- Total  $I_{OL}$  between ground pins should not exceed 64 mA.
- These are absolute values with respect to device ground, and all overshoots due to system and/or tester noise are included.
- I/O pin leakage is the worst case of  $I_{IL}$  and  $I_{OZL}$  or  $I_{IH}$  and  $I_{OZH}$ .
- Not more than one output should be shorted at a time. Duration of the short-circuit should not exceed one second.

## M5(LV) TIMING PARAMETERS OVER OPERATING RANGES<sup>1</sup>

|                        |                                                       | -5  |     | -6  |      | -7  |      | -10 |      | -12 |      | -15 |      | -20  |      | Unit |
|------------------------|-------------------------------------------------------|-----|-----|-----|------|-----|------|-----|------|-----|------|-----|------|------|------|------|
|                        |                                                       | Min | Max | Min | Max  | Min | Max  | Min | Max  | Min | Max  | Min | Max  | Min  | Max  |      |
| Combinatorial Delay:   |                                                       |     |     |     |      |     |      |     |      |     |      |     |      |      |      |      |
| t <sub>PDi</sub>       | Internal combinatorial propagation delay              |     | 3.5 |     | 4.5  |     | 5.5  |     | 8.0  |     | 10.0 |     | 13.0 |      | 18.0 | ns   |
| t <sub>PD</sub>        | Combinatorial propagation delay                       |     | 5.5 |     | 6.5  |     | 7.5  |     | 10.0 |     | 12.0 |     | 15.0 |      | 20.0 | ns   |
| Registered Delays:     |                                                       |     |     |     |      |     |      |     |      |     |      |     |      |      |      |      |
| t <sub>SS</sub>        | Synchronous clock setup time                          | 3.0 |     | 3.0 |      | 4.0 |      | 5.0 |      | 6.0 |      | 8.0 |      | 10.0 |      | ns   |
| t <sub>SA</sub>        | Asynchronous clock setup time                         | 3.0 |     | 3.0 |      | 4.0 |      | 5.0 |      | 6.0 |      | 7.0 |      | 8.0  |      | ns   |
| t <sub>HS</sub>        | Synchronous clock hold time                           | 0.0 |     | 0.0 |      | 0.0 |      | 0.0 |      | 0.0 |      | 0.0 |      | 0.0  |      | ns   |
| t <sub>HA</sub>        | Asynchronous clock hold time                          | 3.0 |     | 3.0 |      | 4.0 |      | 5.0 |      | 6.0 |      | 7.0 |      | 8.0  |      | ns   |
| t <sub>COSi</sub>      | Synchronous clock to internal output                  |     | 2.5 |     | 3.0  |     | 4.0  |     | 5.0  |     | 6.0  |     | 8.0  |      | 10.0 | ns   |
| t <sub>COS</sub>       | Synchronous clock to output                           |     | 4.5 |     | 5.0  |     | 6.0  |     | 7.0  |     | 8.0  |     | 10.0 |      | 12.0 | ns   |
| t <sub>COAi</sub>      | Asynchronous clock to internal output                 |     | 6.0 |     | 6.0  |     | 8.0  |     | 10.0 |     | 13.0 |     | 15.0 |      | 18.0 | ns   |
| t <sub>COA</sub>       | Asynchronous clock to output                          |     | 8.0 |     | 8.0  |     | 10.0 |     | 12.0 |     | 15.0 |     | 17.0 |      | 20.0 | ns   |
| Latched Delays:        |                                                       |     |     |     |      |     |      |     |      |     |      |     |      |      |      |      |
| t <sub>SAL</sub>       | Latch setup time                                      | 3.0 |     | 4.0 |      | 4.0 |      | 5.0 |      | 6.0 |      | 7.0 |      | 8.0  |      | ns   |
| t <sub>HAL</sub>       | Latch hold time                                       | 3.0 |     | 3.0 |      | 4.0 |      | 5.0 |      | 6.0 |      | 7.0 |      | 8.0  |      | ns   |
| t <sub>PDLi</sub>      | Transparent latch internal                            |     | 6.0 |     | 7.0  |     | 7.0  |     | 8.0  |     | 9.0  |     | 10.0 |      | 10.0 | ns   |
| t <sub>PDL</sub>       | Propagation delay through transparent latch           |     | 8.0 |     | 9.0  |     | 9.0  |     | 10.0 |     | 11.0 |     | 12.0 |      | 12.0 | ns   |
| t <sub>GOAi</sub>      | Gate to internal output                               |     | 7.0 |     | 8.0  |     | 8.0  |     | 9.0  |     | 10.0 |     | 11.0 |      | 12.0 | ns   |
| t <sub>GOA</sub>       | Gate to output                                        |     | 9.0 |     | 10.0 |     | 10.0 |     | 11.0 |     | 12.0 |     | 13.0 |      | 14.0 | ns   |
| Input Register Delays: |                                                       |     |     |     |      |     |      |     |      |     |      |     |      |      |      |      |
| t <sub>SIRS</sub>      | Input register setup time using a synchronous clock   | 2.0 |     | 2.0 |      | 2.0 |      | 3.0 |      | 3.0 |      | 3.0 |      | 3.0  |      | ns   |
| t <sub>SIRA</sub>      | Input register setup time using an asynchronous clock | 0.0 |     | 0.0 |      | 0.0 |      | 0.0 |      | 0.0 |      | 0.0 |      | 0.0  |      | ns   |
| t <sub>HIRS</sub>      | Input register hold time using a synchronous clock    | 3.0 |     | 3.0 |      | 3.0 |      | 4.0 |      | 4.0 |      | 4.0 |      | 4.0  |      | ns   |
| t <sub>HIRA</sub>      | Input register hold time using an asynchronous clock  | 6.0 |     | 6.0 |      | 6.0 |      | 7.0 |      | 7.0 |      | 7.0 |      | 7.0  |      | ns   |
| Input Latch Delays:    |                                                       |     |     |     |      |     |      |     |      |     |      |     |      |      |      |      |
| t <sub>SIL</sub>       | Input latch setup time                                | 2.0 |     | 2.0 |      | 2.0 |      | 3.0 |      | 3.0 |      | 3.0 |      | 3.0  |      | ns   |
| t <sub>HIL</sub>       | Input latch hold time                                 | 6.0 |     | 6.0 |      | 6.0 |      | 7.0 |      | 7.0 |      | 7.0 |      | 7.0  |      | ns   |
| t <sub>PDILi</sub>     | Transparent input latch                               |     | 5.0 |     | 5.0  |     | 5.5  |     | 6.0  |     | 6.0  |     | 6.0  |      | 6.0  | ns   |
| Output Delays:         |                                                       |     |     |     |      |     |      |     |      |     |      |     |      |      |      |      |
| t <sub>BUF</sub>       | Output buffer delay                                   |     | 2.0 |     | 2.0  |     | 2.0  |     | 2.0  |     | 2.0  |     | 2.0  |      | 2.0  | ns   |
| t <sub>SLW</sub>       | Slow slew rate delay                                  |     | 2.5 |     | 2.5  |     | 2.5  |     | 2.5  |     | 2.5  |     | 2.5  |      | 2.5  | ns   |
| t <sub>EA</sub>        | Output enable time                                    |     | 7.5 |     | 7.5  |     | 9.5  |     | 10.0 |     | 12.0 |     | 15.0 |      | 20.0 | ns   |
| t <sub>ER</sub>        | Output disable time                                   |     | 7.5 |     | 7.5  |     | 9.5  |     | 10.0 |     | 12.0 |     | 15.0 |      | 20.0 | ns   |

Select devices have been discontinued.  
See Ordering Information section for product status.

## M5(LV) TIMING PARAMETERS OVER OPERATING RANGES<sup>1</sup> (CONTINUED)

|                           |                                                                     | -5  |               | -6  |      | -7  |               | -10 |               | -12 |               | -15  |               | -20  |               | Unit |
|---------------------------|---------------------------------------------------------------------|-----|---------------|-----|------|-----|---------------|-----|---------------|-----|---------------|------|---------------|------|---------------|------|
|                           |                                                                     | Min | Max           | Min | Max  | Min | Max           | Min | Max           | Min | Max           | Min  | Max           | Min  | Max           |      |
| Power Delays:             |                                                                     |     |               |     |      |     |               |     |               |     |               |      |               |      |               |      |
| t <sub>PL1</sub>          | Power level 1 delay (Note 2)                                        |     | 4.0<br>(5.0)  |     | 4.0  |     | 4.0<br>(5.0)  |     | 4.0<br>(5.0)  |     | 4.0<br>(5.0)  |      | 4.0<br>(5.0)  |      | 4.0<br>(5.0)  | ns   |
| t <sub>PL2</sub>          | Power level 2 delay (Note 2)                                        |     | 6.0<br>(9.0)  |     | 6.0  |     | 6.0<br>(9.0)  |     | 6.0<br>(9.0)  |     | 6.0<br>(9.0)  |      | 6.0<br>(9.0)  |      | 6.0<br>(9.0)  | ns   |
| t <sub>PL3</sub>          | Power level 3 delay (Note 2)                                        |     | 9.0<br>(17.5) |     | 9.0  |     | 9.0<br>(17.5) |     | 9.0<br>(17.5) |     | 9.0<br>(17.5) |      | 9.0<br>(17.5) |      | 9.0<br>(17.5) | ns   |
| Additional Cluster Delay: |                                                                     |     |               |     |      |     |               |     |               |     |               |      |               |      |               |      |
| t <sub>PT</sub>           | Product term cluster delay                                          |     | 0.3           |     | 0.3  |     | 0.3           |     | 0.3           |     | 0.3           |      | 0.3           |      | 0.3           | ns   |
| Interconnect Delays:      |                                                                     |     |               |     |      |     |               |     |               |     |               |      |               |      |               |      |
| t <sub>BLK</sub>          | Block interconnect delay                                            |     | 1.5           |     | 1.5  |     | 1.5           |     | 2.0           |     | 2.0           |      | 2.0           |      | 2.0           | ns   |
| t <sub>SEG</sub>          | Segment interconnect delay                                          |     | 4.5           |     | 4.5  |     | 5.0           |     | 6.0           |     | 6.0           |      | 6.0           |      | 6.0           | ns   |
| Reset and Preset Delays:  |                                                                     |     |               |     |      |     |               |     |               |     |               |      |               |      |               |      |
| t <sub>SRI</sub>          | Asynchronous reset or preset to internal register output            |     | 6.0           |     | 8.0  |     | 8.0           |     | 10.0          |     | 12.0          |      | 14.0          |      | 16.0          | ns   |
| t <sub>SR</sub>           | Asynchronous reset or preset to register output                     |     | 8.0           |     | 10.0 |     | 10.0          |     | 12.0          |     | 14.0          |      | 16.0          |      | 18.0          | ns   |
| t <sub>SRR</sub>          | Reset and set register recovery time                                | 5.5 |               | 7.5 |      | 7.5 |               | 8.0 |               | 9.0 |               | 10.0 |               | 11.0 |               | ns   |
| t <sub>SRW</sub>          | Asynchronous reset or preset width                                  | 3.0 |               | 4.0 |      | 4.0 |               | 5.0 |               | 6.0 |               | 7.0  |               | 8.0  |               | ns   |
| Clock Enable Delays:      |                                                                     |     |               |     |      |     |               |     |               |     |               |      |               |      |               |      |
| t <sub>CES</sub>          | Clock enable setup time                                             | 4.0 |               | 5.0 |      | 5.0 |               | 6.0 |               | 7.0 |               | 7.0  |               | 8.0  |               | ns   |
| t <sub>CEH</sub>          | Clock enable hold time                                              | 3.0 |               | 4.0 |      | 4.0 |               | 5.0 |               | 6.0 |               | 6.0  |               | 7.0  |               | ns   |
| Width:                    |                                                                     |     |               |     |      |     |               |     |               |     |               |      |               |      |               |      |
| t <sub>WLS</sub>          | Global clock width low (Note 3)                                     | 2.5 |               | 3.0 |      | 3.0 |               | 4.0 |               | 5.0 |               | 6.0  |               | 6.0  |               | ns   |
| t <sub>WHS</sub>          | Global clock width high (Note 3)                                    | 2.5 |               | 3.0 |      | 3.0 |               | 4.0 |               | 5.0 |               | 6.0  |               | 6.0  |               | ns   |
| t <sub>WLA</sub>          | Product term clock width low                                        | 3.0 |               | 4.0 |      | 4.0 |               | 5.0 |               | 6.0 |               | 7.0  |               | 8.0  |               | ns   |
| t <sub>WHA</sub>          | Product term clock width high                                       | 3.0 |               | 4.0 |      | 4.0 |               | 5.0 |               | 6.0 |               | 7.0  |               | 8.0  |               | ns   |
| t <sub>GWA</sub>          | Gate width low (for low transparent) or high (for high transparent) | 3.0 |               | 4.0 |      | 4.0 |               | 5.0 |               | 6.0 |               | 7.0  |               | 8.0  |               | ns   |
| t <sub>WIR</sub>          | Input register clock width low or high                              | 3.0 |               | 4.0 |      | 4.0 |               | 5.0 |               | 6.0 |               | 7.0  |               | 8.0  |               | ns   |

Select devices have been discontinued.  
See Ordering Information section for product status.

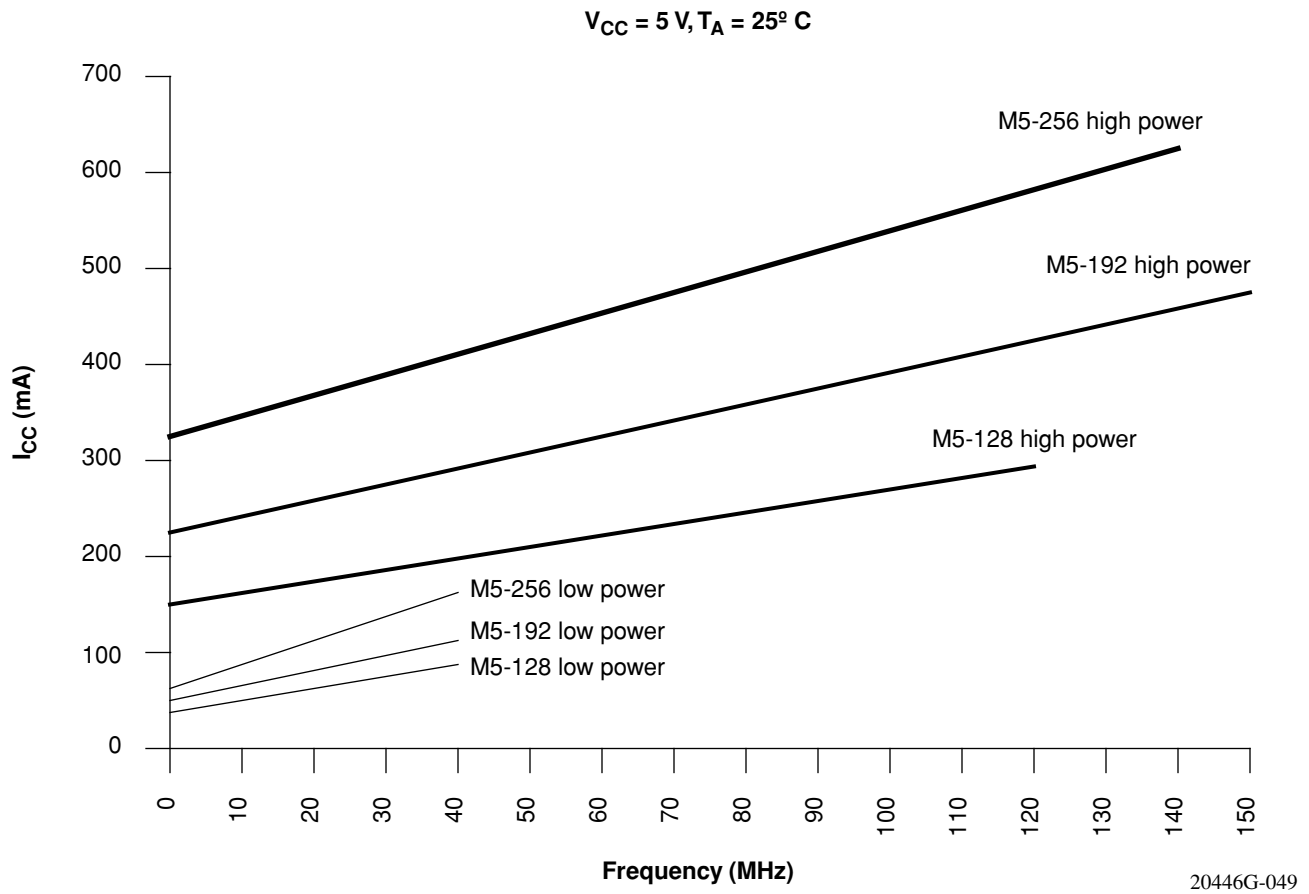


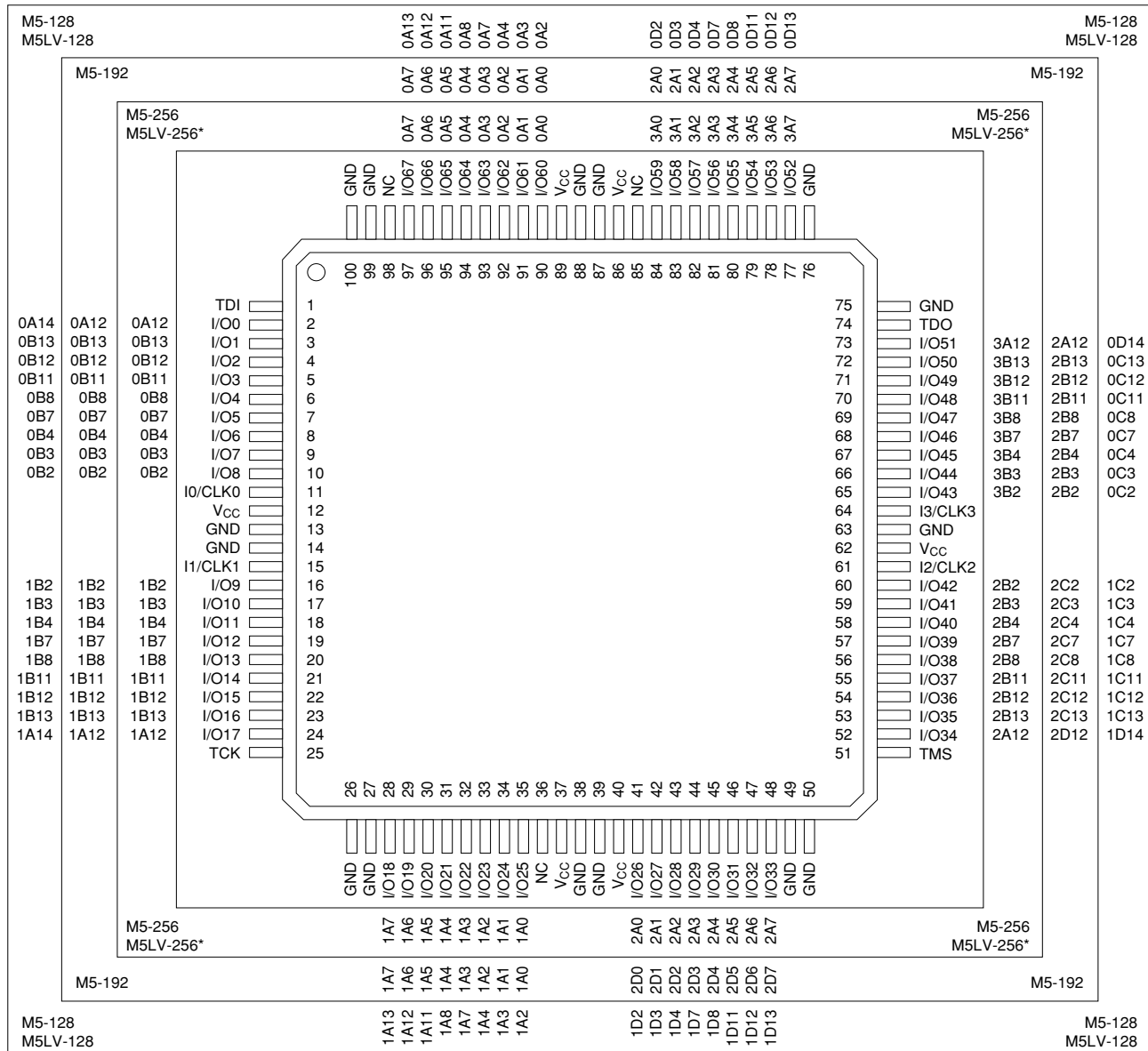
Figure 9.  $I_{CC}$  Curves at High/Low Power Modes

Select devices have been discontinued.  
See Ordering Information section for product status.

# 100-PIN TQFP CONNECTION DIAGRAM – 68 I/O

## Top View

100-Pin TQFP (68 I/O)



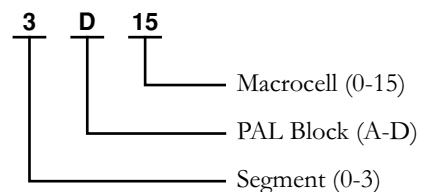
\*Package obsolete, contact factory.

20446G-017

## Pin Designations

CLK = Clock  
GND = Ground  
I = Input  
I/O = Input/Output  
NC = No Connect

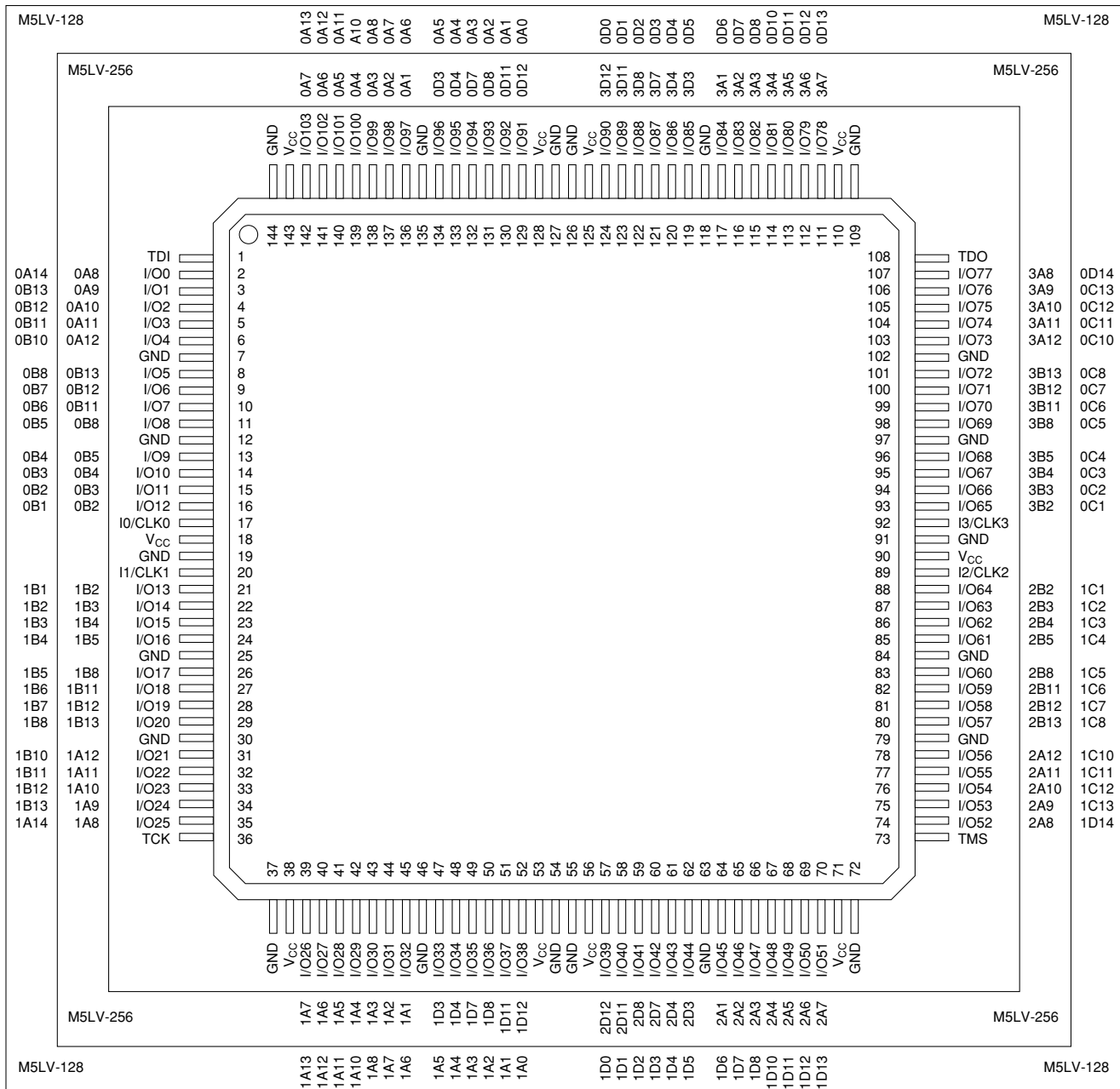
V<sub>CC</sub> = Supply Voltage  
TDI = Test Data In  
TCK = Test Clock  
TMS = Test Mode Select  
TDO = Test Data Out



Select devices have been discontinued.  
See Ordering Information section for product status.

## Top View

## 144-Pin TQFP



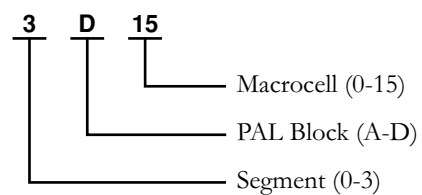
**Select devices have been discontinued.  
See Ordering Information section for product status.**

20446G-020

## Pin Designations

CLK = Clock  
 GND = Ground  
 I = Input  
 I/O = Input/Output  
 NC = No Connect

|                 |   |                  |
|-----------------|---|------------------|
| V <sub>CC</sub> | = | Supply Voltage   |
| TDI             | = | Test Data In     |
| TCK             | = | Test Clock       |
| TMS             | = | Test Mode Select |
| TDO             | = | Test Data Out    |

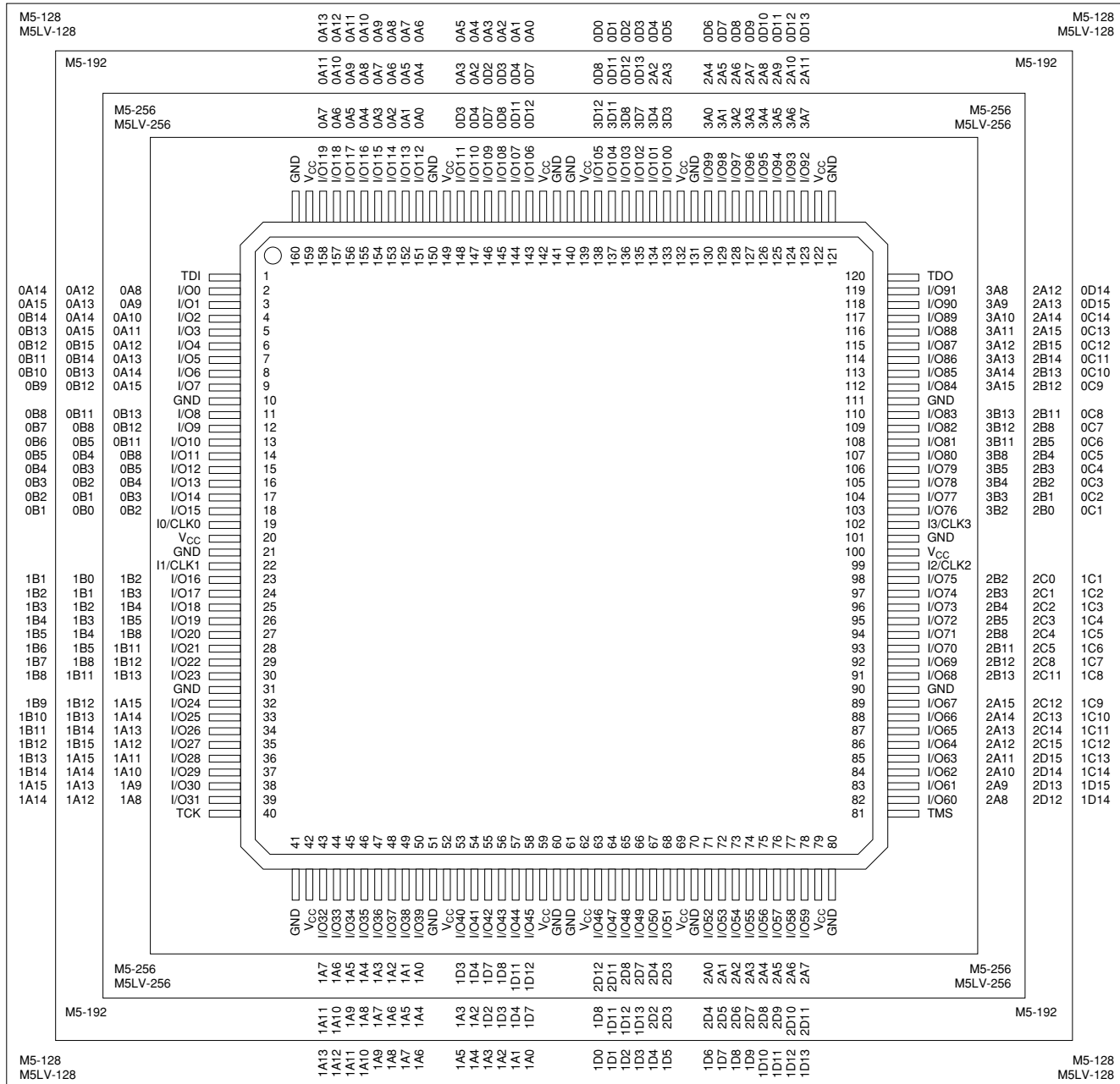


# 160-PIN PQFP CONNECTION DIAGRAM

## Top View

### 160-Pin PQFP (128, 192, 256 Macrocells)

Select devices have been discontinued.  
See Ordering Information section for product status.

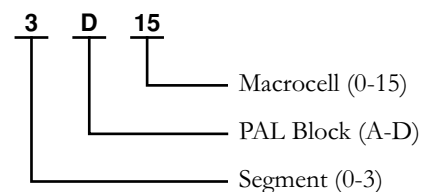


20446G-021

### Pin Designations

CLK = Clock  
GND = Ground  
I = Input  
I/O = Input/Output  
NC = No Connect

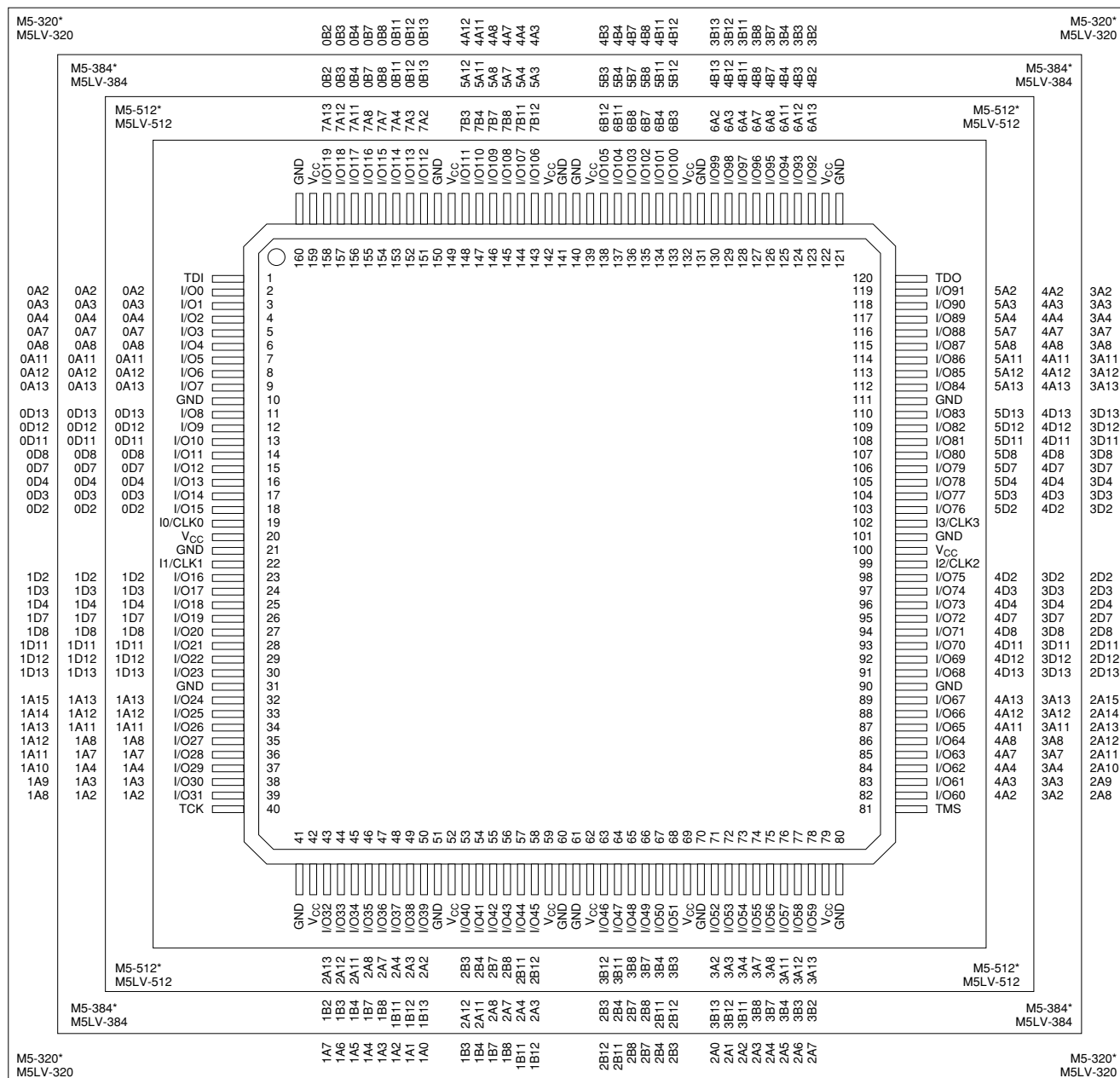
V<sub>CC</sub> = Supply Voltage  
TDI = Test Data In  
TCK = Test Clock  
TMS = Test Mode Select  
TDO = Test Data Out



# 160-PIN PQFP (WITH INTERNAL HEAT SPREADER) CONNECTION DIAGRAM

## Top View

160-Pin PQFP (320, 384, 512 Macrocells)



\*Package obsolete, contact factory.

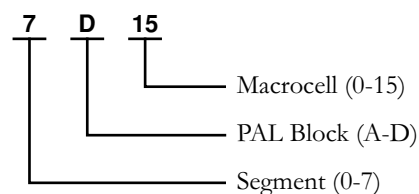
Select devices have been discontinued.  
See Ordering Information section for product status.

20446G-022

### Pin Designations

CLK = Clock  
GND = Ground  
I = Input  
I/O = Input/Output  
NC = No Connect

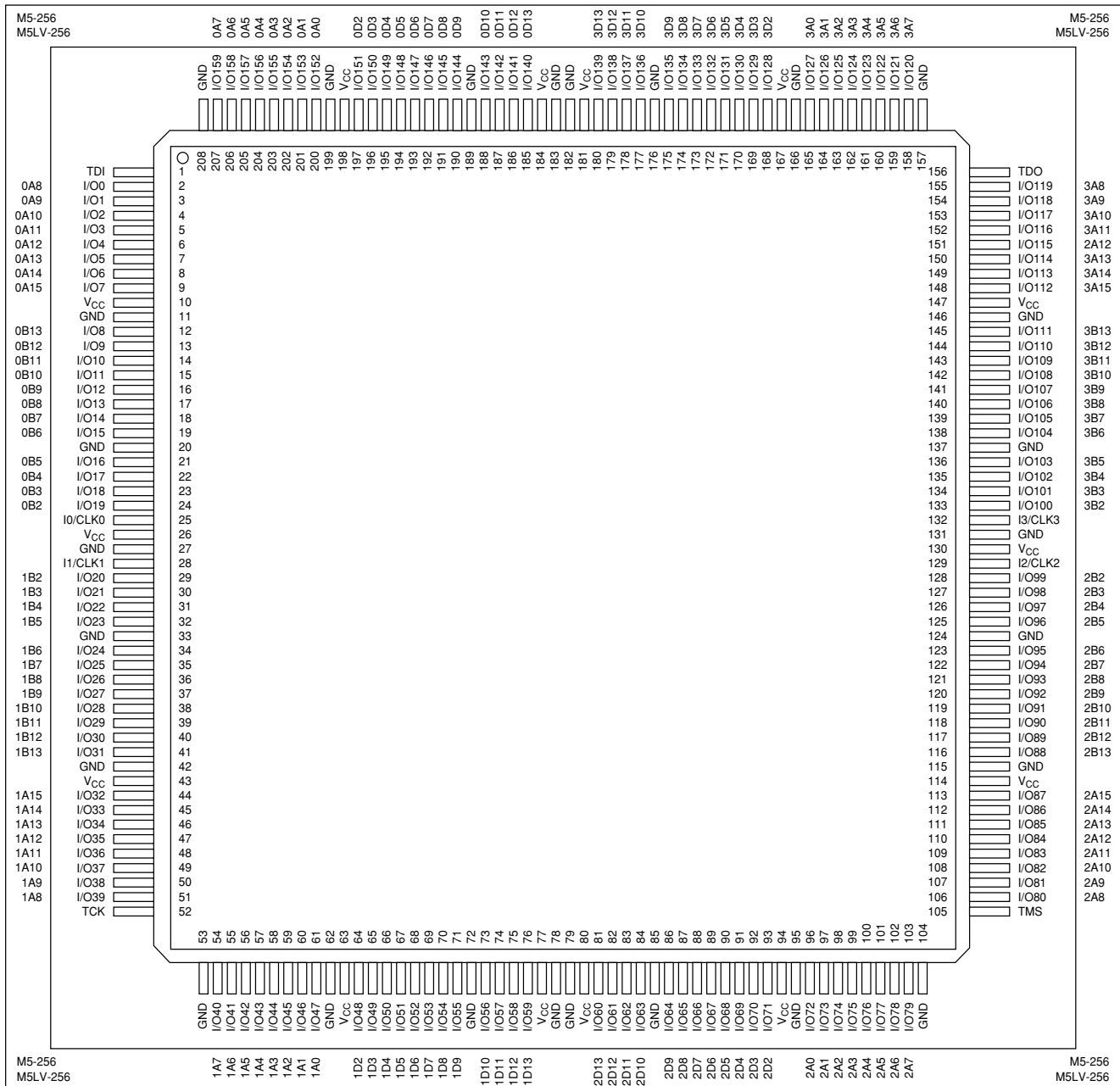
V<sub>CC</sub> = Supply Voltage  
TDI = Test Data In  
TCK = Test Clock  
TMS = Test Mode Select  
TDO = Test Data Out



## 208-PIN PQFP CONNECTION DIAGRAM

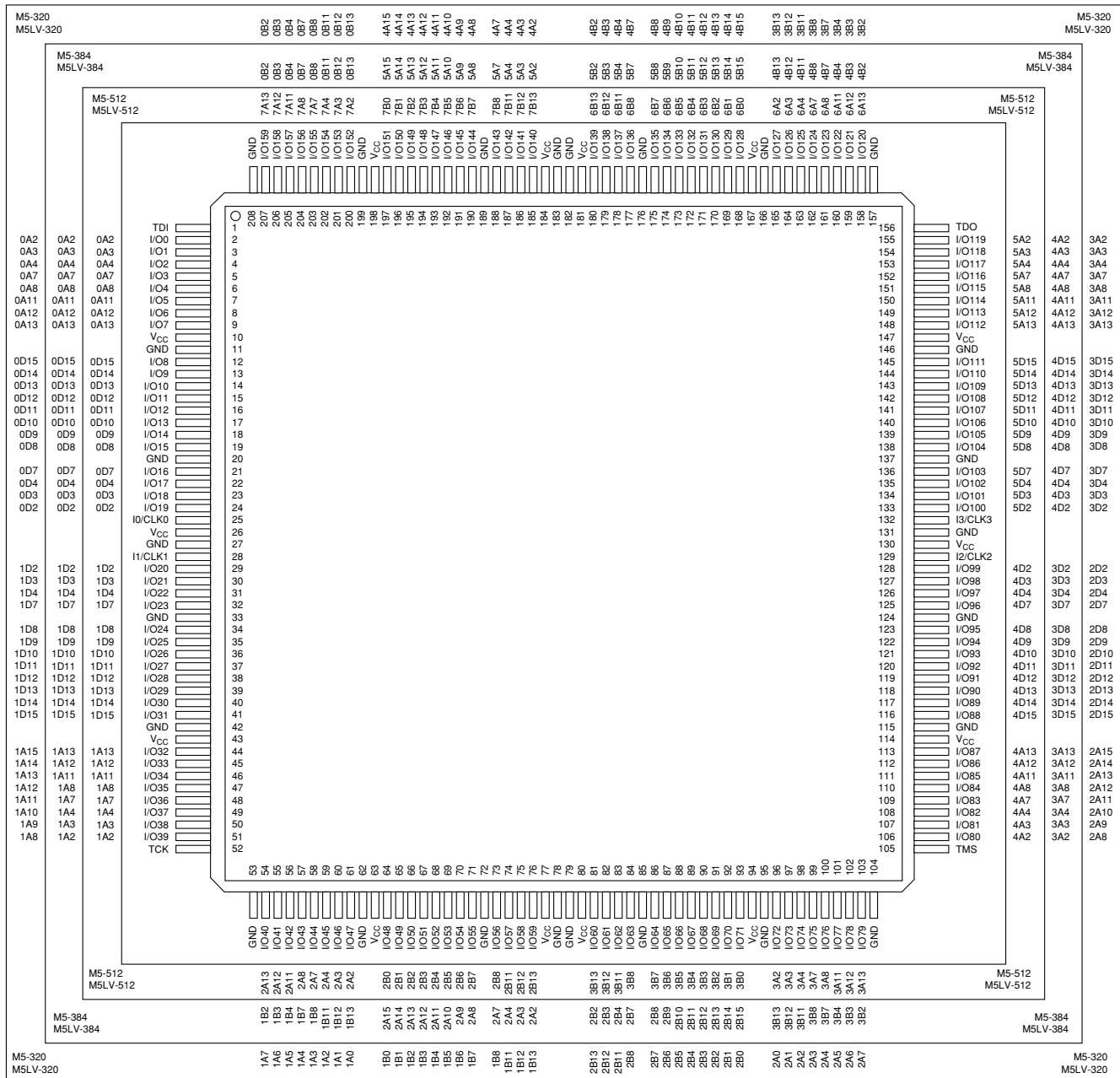
### Top View

208-Pin PQFP (256 Macrocells)



# 208-PIN PQFP (WITH INTERNAL HEAT SPREADER) CONNECTION DIAGRAM Top View

208-Pin PQFP (320, 384, 512 Macrocells)



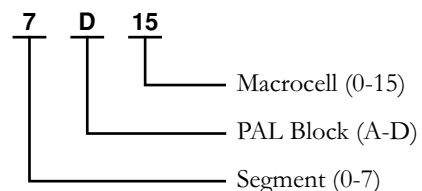
Select devices have been discontinued.  
See Ordering Information section for product status.

20446G-024

## Pin Designations

CLK = Clock  
GND = Ground  
I = Input  
I/O = Input/Output  
NC = No Connect

V<sub>CC</sub> = Supply Voltage  
TDI = Test Data In  
TCK = Test Clock  
TMS = Test Mode Select  
TDO = Test Data Out



## 256-BALL BGA CONNECTION DIAGRAM — M5-320

### Bottom View (I/O Pin-outs)

256-Ball BGA

|    | A      | B      | C               | D               | E                                                                                                                                                                                                                                               | F      | G               | H      | J      | K      | L      | M      | N      | P               | R               | T               | U               | V               | W               | Y               |                 |
|----|--------|--------|-----------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------|--------|--------|--------|--------|--------|--------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 1  | GND    | GND    | I/O181          | I/O182          | I/O183                                                                                                                                                                                                                                          | GND    | I/O184          | GND    | I/O185 | I/O186 | GND    | I/O187 | GND    | I/O188          | GND             | I/O189          | I/O190          | I/O191          | GND             | GND             |                 |
| 2  | GND    | I/O164 | I/O165          | I/O166          | I/O167                                                                                                                                                                                                                                          | I/O168 | I/O169          | I/O170 | I/O171 | I/O172 | I/O173 | I/O174 | I/O175 | I/O176          | I/O177          | I/O178          | I/O179          | I/O180          | GND             | GND             |                 |
| 3  | GND    | I/O148 | V <sub>CC</sub> | I/O149          | I/O150                                                                                                                                                                                                                                          | I/O151 | I/O152          | I/O153 | I/O154 | I/O155 | I/O156 | I/O157 | I/O158 | I/O159          | I/O160          | I/O161          | I/O162          | V <sub>CC</sub> | I/O163          | GND             |                 |
| 4  | I/O134 | I/O135 | I/O136          | V <sub>CC</sub> | TDO                                                                                                                                                                                                                                             | I/O137 | V <sub>CC</sub> | I/O138 | I/O139 | I/O140 | I/O141 | I/O142 | I/O143 | V <sub>CC</sub> | I/O144          | TMS             | V <sub>CC</sub> | I/O145          | I/O146          | I/O147          |                 |
| 5  | I/O128 | I/O129 | I/O130          | V <sub>CC</sub> | <b>Pin Designations</b><br><br>CLK = Clock<br>GND = Ground<br>I = Input<br>I/O = Input/Output<br>NC = No Connect<br>V <sub>CC</sub> = Supply Voltage<br>TDI = Test Data In<br>TCK = Test Clock<br>TMS = Test Mode Select<br>TDO = Test Data Out | I/O122 | I/O123          | I/O124 | I/O108 | I/O109 | I/O103 | I/O104 | I/O096 | I/O097          | I/O098          | I/O099          | I/O100          | I/O101          | I/O102          | I/O103          |                 |
| 6  | GND    | I/O117 | I/O118          | V <sub>CC</sub> |                                                                                                                                                                                                                                                 | I/O116 | I/O110          | I/O111 | I/O084 | I/O085 | I/O086 | I/O087 | I/O088 | I/O089          | I/O076          | I/O077          | I/O078          | I/O079          | I/O070          | I/O064          | I/O065          |
| 7  | I/O108 | I/O109 | I/O110          | V <sub>CC</sub> |                                                                                                                                                                                                                                                 | I/O076 | I/O077          | I/O078 | I/O079 | I/O070 | I/O064 | I/O065 | I/O066 | I/O058          | I/O044          | I/O045          | I/O046          | I/O029          | I/O030          | I/O031          | I/O032          |
| 8  | GND    | I/O102 | I/O103          | I/O104          |                                                                                                                                                                                                                                                 | I/O096 | I/O097          | I/O098 | I/O099 | I/O090 | I/O084 | I/O085 | I/O086 | I/O087          | I/O080          | I/O073          | I/O067          | I/O061          | I/O055          | V <sub>CC</sub> | I/O043          |
| 9  | GND    | I/O096 | I/O097          | I/O098          |                                                                                                                                                                                                                                                 | I/O092 | I/O086          | I/O087 | I/O088 | I/O089 | I/O082 | I/O075 | I/O066 | I/O060          | I/O046          | I/O029          | I/O030          | I/O031          | I/O032          | I/O033          | I/O034          |
| 10 | GND    | I/O096 | I/O097          | I/O098          |                                                                                                                                                                                                                                                 | I/O092 | I/O086          | I/O087 | I/O088 | I/O089 | I/O082 | I/O075 | I/O066 | I/O060          | I/O046          | I/O029          | I/O030          | I/O031          | I/O032          | I/O033          | I/O034          |
| 11 | GND    | I/O096 | I/O097          | I/O098          |                                                                                                                                                                                                                                                 | I/O092 | I/O086          | I/O087 | I/O088 | I/O089 | I/O082 | I/O075 | I/O066 | I/O060          | I/O046          | I/O029          | I/O030          | I/O031          | I/O032          | I/O033          | I/O034          |
| 12 | GND    | I/O096 | I/O097          | I/O098          |                                                                                                                                                                                                                                                 | I/O092 | I/O086          | I/O087 | I/O088 | I/O089 | I/O082 | I/O075 | I/O066 | I/O060          | I/O046          | I/O029          | I/O030          | I/O031          | I/O032          | I/O033          | I/O034          |
| 13 | I/O076 | I/O077 | I/O078          | I/O079          |                                                                                                                                                                                                                                                 | I/O070 | I/O064          | I/O065 | I/O066 | I/O058 | I/O044 | I/O045 | I/O046 | I/O029          | I/O030          | I/O031          | I/O032          | I/O033          | I/O034          | I/O035          | I/O036          |
| 14 | I/O070 | I/O071 | I/O072          | V <sub>CC</sub> |                                                                                                                                                                                                                                                 | I/O066 | V <sub>CC</sub> | I/O067 | I/O068 | I/O069 | I/O062 | I/O057 | I/O050 | I/O051          | I/O052          | I/O053          | V <sub>CC</sub> | I/O054          | TCK             | V <sub>CC</sub> | I/O042          |
| 15 | GND    | I/O064 | I/O065          | I/O066          |                                                                                                                                                                                                                                                 | I/O067 | I/O068          | I/O069 | I/O062 | I/O057 | I/O050 | I/O051 | I/O052 | I/O053          | V <sub>CC</sub> | I/O054          | TCK             | V <sub>CC</sub> | I/O042          | V <sub>CC</sub> | I/O043          |
| 16 | I/O058 | I/O059 | I/O060          | V <sub>CC</sub> |                                                                                                                                                                                                                                                 | I/O058 | I/O059          | I/O060 | I/O061 | I/O062 | I/O063 | I/O064 | I/O065 | I/O066          | I/O067          | I/O068          | I/O069          | I/O070          | I/O071          | I/O072          | I/O073          |
| 17 | I/O044 | I/O045 | I/O046          | V <sub>CC</sub> |                                                                                                                                                                                                                                                 | I/O044 | I/O045          | I/O046 | I/O047 | I/O048 | I/O049 | I/O050 | I/O051 | I/O052          | I/O053          | V <sub>CC</sub> | I/O054          | TCK             | V <sub>CC</sub> | I/O042          | V <sub>CC</sub> |
| 18 | GND    | I/O028 | V <sub>CC</sub> | I/O029          | I/O030                                                                                                                                                                                                                                          | I/O031 | I/O032          | I/O033 | I/O034 | I/O035 | I/O036 | I/O037 | I/O038 | I/O039          | I/O040          | I/O041          | I/O042          | V <sub>CC</sub> | I/O043          | I/O044          |                 |
| 19 | I/O011 | I/O012 | I/O013          | I/O014          | I/O015                                                                                                                                                                                                                                          | I/O016 | I/O017          | I/O018 | I/O019 | I/O020 | I/O021 | I/O022 | I/O023 | I/O024          | I/O025          | I/O026          | I/O027          | I/O028          | I/O029          | I/O030          |                 |
| 20 | GND    | GND    | I/O0            | I/O1            | I/O2                                                                                                                                                                                                                                            | GND    | I/O3            | GND    | I/O4   | GND    | I/O5   | I/O6   | GND    | I/O7            | GND             | I/O8            | I/O9            | I/O10           | GND             | GND             |                 |

20446G-026

Select devices have been discontinued.  
See Ordering Information section for product status.



# 352-BALL BGA CONNECTION DIAGRAM — M5-512, M5LV-512

## Bottom View (Macrocell Association)

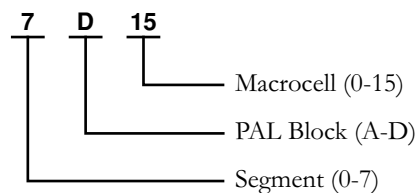
352-Ball BGA

|    | A    | B    | C    | D               | E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | F    | G    | H               | J               | K               | L    | M    | N                                | P                                | R    | T   | U               | V               | W    | Y               | AA   | AB  | AC              | AD   | AE   | AF   |     |    |    |
|----|------|------|------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-----------------|-----------------|-----------------|------|------|----------------------------------|----------------------------------|------|-----|-----------------|-----------------|------|-----------------|------|-----|-----------------|------|------|------|-----|----|----|
| 1  | NC   | NC   | NC   | GND             | NC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 5A12 | GND  | 5D15            | 5D11            | GND             | 5D6  | 5D3  | 13/CLK3                          | GND                              | 4D1  | 4D5 | 4D9             | GND             | 4D15 | 4A13            | GND  | NC  | 4A6             | GND  | NC   | NC   |     |    |    |
| 2  | NC   | NC   | NC   | 5A2             | 5A5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 5A9  | 5A14 | 5A15            | 5D13            | 5D10            | 5D8  | 5D4  | 5D0                              | 4D0                              | 4D2  | 4D6 | 4D10            | 4D13            | 4A15 | 4A12            | 4A9  | 4A8 | 4A3             | 4A1  | GND  | GND  |     |    |    |
| 3  | GND  | GND  | NC   | 5A1             | 5A4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 5A7  | 5A8  | 5A10            | 5A13            | 5D14            | 5D9  | 5D5  | 5D1                              | 12/CLK2                          | 4D4  | 4D7 | 4D11            | 4D14            | 4A14 | 4A10            | 4A7  | 4A5 | 4A2             | TMS  | NC   | NC   |     |    |    |
| 4  | NC   | 6A14 | NC   | TDO             | 5A0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 5A3  | 5A6  | V <sub>CC</sub> | 5A11            | V <sub>CC</sub> | 5D12 | 5D7  | 5D2                              | V <sub>CC</sub>                  | 4D3  | 4D8 | 4D12            | V <sub>CC</sub> | 4A11 | V <sub>CC</sub> | 4A4  | 4A0 | V <sub>CC</sub> | 3A15 | 3A13 | 3A12 |     |    |    |
| 5  | GND  | 6A12 | 6A13 | V <sub>CC</sub> | <div>Pin Designations</div> <div>CLK = Clock</div> <div>GND = Ground</div> <div>I = Input</div> <div>I/O = Input/Output</div> <div>NC = No Connect</div> <div>V<sub>CC</sub> = Supply Voltage</div> <div>TDI = Test Data In</div> <div>TCK = Test Clock</div> <div>TMS = Test Mode Select</div> <div>TDO = Test Data Out</div> <div><div><div>7</div><div>D</div><div>15</div></div><div><div>Segment (0-7)</div><div>Macrocell (0-15)</div><div>PAL Block (A-D)</div></div></div> | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | 1A5  | 1A2 | NC | NC |
| 6  | NC   | 6A9  | 6A10 | 6A15            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 7  | GND  | 6A6  | 6A8  | 6A11            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 8  | 6A1  | 6A4  | 6A5  | 6A7             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 9  | 6B1  | 6A0  | 6A2  | 6A3             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 10 | GND  | 6B2  | 6B0  | V <sub>CC</sub> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 11 | 6B6  | 6B5  | 6B4  | 6B3             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 12 | 6B10 | 6B9  | 6B8  | 6B7             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 13 | 6B14 | 6B13 | 6B12 | 6B11            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 14 | GND  | 7B15 | 6B15 | V <sub>CC</sub> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 15 | 7B14 | 7B13 | 7B12 | 7B11            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 16 | NC   | 7B10 | 7B9  | 7B8             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 17 | 7B7  | 7B6  | 7B5  | 7B4             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 18 | GND  | 7B3  | 7B2  | V <sub>CC</sub> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 19 | 7B1  | 7B0  | 7A1  | 7A4             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 20 | 7A0  | 7A2  | 7A3  | 7A8             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3A14 | 3A10 | 3A6             | 3A2             | V <sub>CC</sub> | 3B3  | 3B7  | 3B11                             | 3B14                             | 2B11 | 2B7 | 2B3             | V <sub>CC</sub> | 2A3  | 2A7             | 2A11 | 2A5 | 2A1             | GND  | NC   | NC   | NC  |    |    |
| 21 | 7A5  | 7A6  | 7A7  | 7A12            | 3A14                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3A10 | 3A6  | 3A2             | V <sub>CC</sub> | 3B3             | 3B7  | 3B11 | 3B14                             | 2B11                             | 2B7  | 2B3 | V <sub>CC</sub> | 2A3             | 2A7  | 2A11            | 2A5  | 2A1 | GND             | NC   | NC   | NC   |     |    |    |
| 22 | GND  | 7A9  | 7A11 | 7A15            | 3A14                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3A10 | 3A6  | 3A2             | V <sub>CC</sub> | 3B3             | 3B7  | 3B11 | 3B14                             | 2B11                             | 2B7  | 2B3 | V <sub>CC</sub> | 2A3             | 2A7  | 2A11            | 2A5  | 2A1 | GND             | NC   | NC   | NC   |     |    |    |
| 23 | 7A10 | 7A13 | 7A14 | V <sub>CC</sub> | 3A14                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3A10 | 3A6  | 3A2             | V <sub>CC</sub> | 3B3             | 3B7  | 3B11 | 3B14                             | 2B11                             | 2B7  | 2B3 | V <sub>CC</sub> | 2A3             | 2A7  | 2A11            | 2A5  | 2A1 | GND             | NC   | NC   | NC   |     |    |    |
| 24 | NC   | NC   | TDI  | 0A2             | 0A5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0A7  | 0A10 | 0A11            | 0D14            | 0D11            | 0D7  | 0D4  | I <sub>0</sub> /CLK <sub>0</sub> | 1D1                              | 1D5  | 1D9 | 1D14            | 1A13            | 1A10 | 1A8             | 1A7  | 1A4 | 1A1             | NC   | GND  | GND  |     |    |    |
| 25 | GND  | GND  | 0A1  | 0A3             | 0A8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0A9  | 0A12 | 0A15            | 0D13            | 0D10            | 0D6  | 0D2  | 0D0                              | 1D0                              | 1D4  | 1D8 | 1D10            | 1D13            | 1A15 | 1A14            | 1A9  | 1A5 | 1A2             | NC   | NC   | NC   |     |    |    |
| 26 | NC   | NC   | GND  | 0A6             | NC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | GND  | 0A13 | 0D15            | GND             | 0D9             | 0D5  | 0D1  | GND                              | I <sub>1</sub> /CLK <sub>1</sub> | 1D3  | 1D6 | GND             | 1D11            | 1D15 | GND             | 1A12 | NC  | GND             | NC   | NC   | NC   |     |    |    |

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### Pin Designations

- CLK = Clock
- GND = Ground
- I = Input
- I/O = Input/Output
- NC = No Connect
- V<sub>CC</sub> = Supply Voltage
- TDI = Test Data In
- TCK = Test Clock
- TMS = Test Mode Select
- TDO = Test Data Out

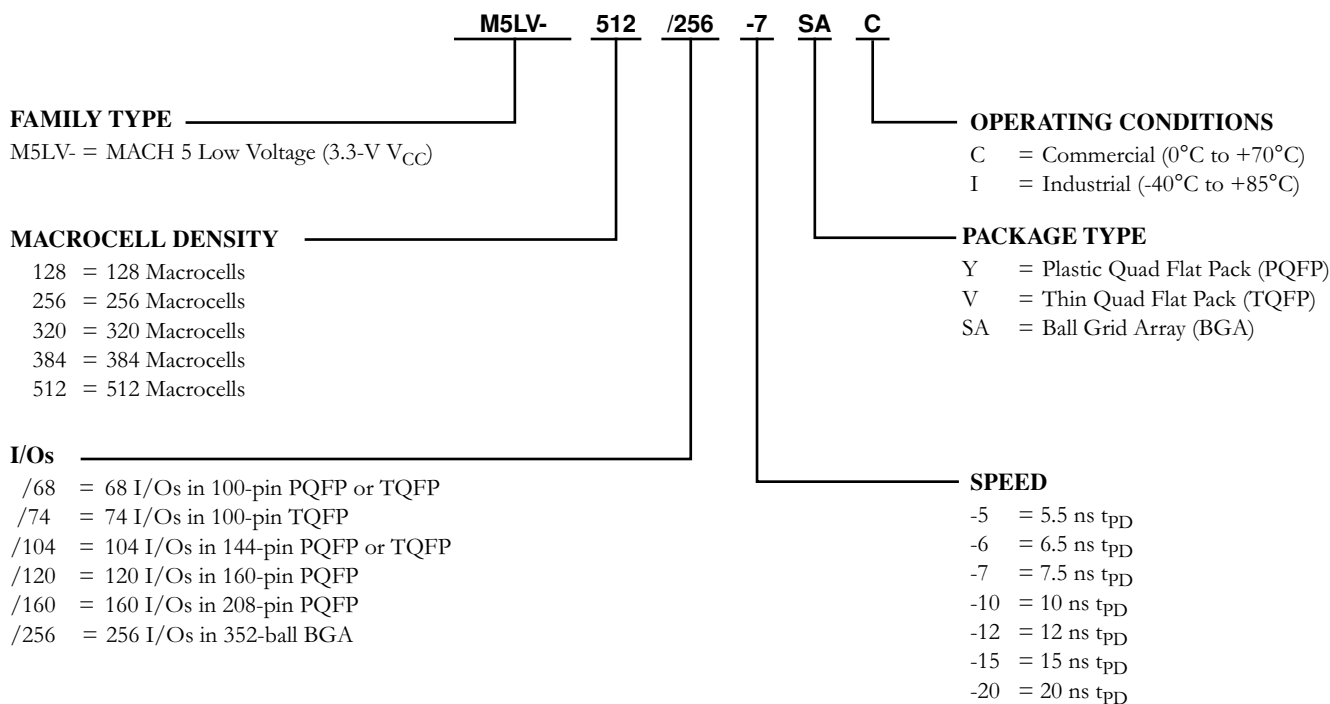


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Select devices have been discontinued.  
See Ordering Information section for product status.

## 3.3V M5LV ORDERING INFORMATION<sup>1</sup>

Lattice standard products are available in several packages and operating ranges. The order number (Valid Combination) is formed by a combination of the elements below.



### Note:

1. See below for valid device/package combinations.

| Valid Combinations |                                  |        |
|--------------------|----------------------------------|--------|
| M5LV-128/68        | Commercial:<br>-5, -7, -10, -12  | VC, VI |
| M5LV-128/74        |                                  | VC, VI |
| M5LV-128/104       |                                  | VC, VI |
| M5LV-128/120       |                                  | YC, YI |
| M5LV-256/68        | Industrial:<br>-7, -10, -12, -15 | YC, YI |
| M5LV-256/74        |                                  | VC, VI |
| M5LV-256/104       |                                  | VC, VI |
| M5LV-256/120       |                                  | YC, YI |
| M5LV-256/160       |                                  | YC, YI |
|                    |                                  |        |

### Device Marking

Actual device marking differs from the ordering part number (OPN). All MACH devices are dual-marked with both Commercial and Industrial grades. The Industrial grade is slower, i.e., M5LV-512/256-7AC-10AI.

| Valid Combinations |                                      |          |
|--------------------|--------------------------------------|----------|
| M5LV-320/120       | Commercial:<br>-6, -7, -10, -12, -15 | YC, YI   |
| M5LV-320/160       |                                      | YC, YI   |
| M5LV-384/120       |                                      | YC, YI   |
| M5LV-384/160       |                                      | YC, YI   |
| M5LV-512/120       | Industrial:<br>-10, -12, -15, -20    | YC, YI   |
| M5LV-512/160       |                                      | YC, YI   |
| M5LV-512/256       |                                      | SAC, SAI |

### Valid Combinations

Valid Combinations list configurations planned to be supported in volume for this device. Consult the local Lattice sales office to confirm availability of specific valid combinations and to check on newly released combinations.

Select devices have been discontinued.  
See Ordering Information section for product status.