**Features**

- **HIGH DRIVE E\(^2\)CMOS\(^\text{\textregistered}\) GAL\(^\text{\textregistered}\) DEVICE**
  - TTL Compatible 64 mA Output Drive
  - 15 ns Maximum Propagation Delay
  - \(F_{\text{max}} = 80\) MHz
  - 10 ns Maximum from Clock Input to Data Output
  - UltraMOS\(^\text{\textregistered}\) Advanced CMOS Technology

- **ENHANCED INPUT AND OUTPUT FEATURES**
  - Schmitt Trigger Inputs
  - Programmable Open-Drain or Totem-Pole Outputs
  - Active Pull-Ups on All Inputs and I/O pins

- **E\(^2\) CELL TECHNOLOGY**
  - Reconfigurable Logic
  - Reprogrammable Cells
  - 100% Tested/100% Yields
  - High Speed Electrical Erasure (\(<100\)ms)
  - 20 Year Data Retention

- **EIGHT OUTPUT LOGIC MACROCELLS**
  - Maximum Flexibility for Complex Logic Designs
  - Programmable Output Polarity
  - Architecturally Compatible with Standard GAL20V8

- **PRELOAD AND POWER-ON RESET OF ALL REGISTERS**
  - 100% Functional Testability

- **APPLICATIONS INCLUDE:**
  - Ideal for Bus Control & Bus Arbitration Logic
  - Bus Address Decode Logic
  - Memory Address, Data and Control Circuits
  - DMA Control

- **ELECTRONIC SIGNATURE FOR IDENTIFICATION**

---

**Description**

The GAL20VP8, with 64 mA drive capability and 15 ns maximum propagation delay time is ideal for Bus and Memory control applications. The GAL20VP8 is manufactured using Lattice Semiconductor's advanced E\(^2\)CMOS process which combines CMOS with Electrically Erasable (E\(^2\)) floating gate technology. High speed erase times (\(<100\)ms) allow the devices to be reprogrammed quickly and efficiently.

System bus and memory interfaces require control logic before driving the bus or memory interface signals. The GAL20VP8 combines the familiar GAL20V8 architecture with bus drivers as its outputs. The generic architecture provides maximum design flexibility by allowing the Output Logic Macrocell (OLMC) to be configured by the user. The 64mA output drive eliminates the need for additional devices to provide bus-driving capability.

Unique test circuitry and reprogrammable cells allow complete AC, DC, and functional testing during manufacture. As a result, Lattice Semiconductor delivers 100% field programmability and functionality of all GAL products. In addition, 100 erase/write cycles and data retention in excess of 20 years are specified.
## GAL20VP8 Ordering Information

### Commercial Grade Specifications

<table>
<thead>
<tr>
<th>Tpd (ns)</th>
<th>Tsu (ns)</th>
<th>Tco (ns)</th>
<th>Icc (mA)</th>
<th>Ordering #</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>8</td>
<td>10</td>
<td>115</td>
<td>GAL20VP8B-15LP</td>
<td>24-Pin Plastic DIP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>115</td>
<td>GAL20VP8B-15LJ</td>
<td>28-Lead PLCC</td>
</tr>
<tr>
<td>25</td>
<td>10</td>
<td>15</td>
<td>115</td>
<td>GAL20VP8B-25LP</td>
<td>24-Pin Plastic DIP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>115</td>
<td>GAL20VP8B-25LJ</td>
<td>28-Lead PLCC</td>
</tr>
</tbody>
</table>

### Part Number Description

- **GAL20VP8B** Device Name
- **Speed (ns)**
- **L = Low Power** Power
- **Grade** Blank = Commercial
- **Package** P = Plastic DIP, J = PLCC

Discontinued Product (PCN #02-06). Contact Rochester Electronics for Availability.

www.latticesemi.com/sales/discontinueddevicessales.cfm
Output Logic Macrocell (OLMC)

The following discussion pertains to configuring the output logic macrocell. It should be noted that actual implementation is accomplished by development software/hardware and is completely transparent to the user.

There are three global OLMC configuration modes possible: simple, complex, and registered. Details of each of these modes is illustrated in the following pages. Two global bits, SYN and AC0, control the mode configuration for all macrocells. The XOR bit of each macrocell controls the polarity of the output in any of the three modes, while the AC1 and AC2 bit of each of the macrocells controls the input/output and totem-pole/open-drain configuration. These two global and 24 individual architecture bits define all possible configurations in a GAL20VP8. The information given on these architecture bits is only to give a better understanding of the device. Compiler software will transparently set these architecture bits from the pin definitions, so the user should not need to directly manipulate these architecture bits.

Compiler Support for OLMC

Software compilers support the three different global OLMC modes as different device types. Most compilers also have the ability to automatically select the device type, generally based on the register usage and output enable (OE) usage. Register usage on the device forces the software to choose the registered mode. All combinatorial outputs with OE controlled by the product term will force the software to choose the complex mode. The software will choose the simple mode only when all outputs are dedicated combinatorial without OE control. For further details, refer to the compiler software manuals.

When using compiler software to configure the device, the user must pay special attention to the following restrictions in each mode. In registered mode pin 1(2) and pin 12(14) are permanently configured as clock and output enable, respectively. These pins cannot be configured as dedicated inputs in the registered mode.

In complex mode pin 1(2) and pin 12(14) become dedicated inputs and use the feedback paths of pin 22(26) and pin 14(17) respectively. Because of this feedback path usage, pin 22(26) and pin 14(17) do not have the feedback option in this mode.

In simple mode all feedback paths of the output pins are routed via the adjacent pins. In doing so, the two inner most pins (pins 17(20) and 19(23)) will not have the feedback option as these pins are always configured as dedicated combinatorial output.

In addition to the architecture configurations, the logic compiler software also supports configuration of either totem-pole or open-drain outputs. The actual architecture bit configuration, again, is transparent to the user with the default configuration being the standard totem-pole output.
Registered Mode

In the Registered mode, macrocells are configured as dedicated registered outputs or as I/O functions.

All registered macrocells share common clock and output enable control pins. Any macrocell can be configured as registered or I/O. Up to eight registers or up to eight I/Os are possible in this mode. Dedicated input or output functions can be implemented as sub-sets of the I/O function.

Registered outputs have eight product terms per output. I/Os have seven product terms per output.

The JEDEC fuse numbers, including the User Electronic Signature (UES) fuses and the Product Term Disable (PTD) fuses, are shown on the logic diagram on the following page.

Registered Configuration for Registered Mode

- SYN=0.
- AC0=1.
- XOR=0 defines Active Low Output.
- XOR=1 defines Active High Output.
- AC1=0 defines this output configuration.
- AC2=1 defines totem pole output.
- AC2=0 defines open-drain output.
- Pin 1(2) controls common CLK for the registered outputs.
- Pin 12(14) controls common OE for the registered outputs.
- Pin 1(2) & Pin 12(14) are permanently configured as CLK & OE for registered output configuration.

Combinatorial Configuration for Registered Mode

- SYN=0.
- AC0=1.
- XOR=0 defines Active Low Output.
- XOR=1 defines Active High Output.
- AC1=1 defines this output configuration.
- AC2=1 defines totem pole output.
- AC2=0 defines open-drain output.
- Pin 1(2) & Pin 12(14) are permanently configured as CLK & OE for registered output configuration.

Note: The development software configures all of the architecture control bits and checks for proper pin usage automatically.
Complex Mode

In the Complex mode, macrocells are configured as output only or I/O functions.

Up to six I/Os are possible in this mode. Dedicated inputs or outputs can be implemented as subsets of the I/O function. The two outer most macrocells (pins 14(17) & 22(26)) do not have input capability. Designs requiring eight I/Os can be implemented in the Registered mode.

All macrocells have seven product terms per output. One product term is used for programmable output enable control. Pins 1(2) and 12(14) are always available as data inputs into the AND array.

The JEDEC fuse numbers including the UES fuses and PTD fuses are shown on the logic diagram on the following page.

Note: The development software configures all of the architecture control bits and checks for proper pin usage automatically.

Combinatorial I/O Configuration for Complex Mode

- SYN=1.
- AC0=1.
- XOR=0 defines Active Low Output.
- XOR=1 defines Active High Output.
- AC1 has no effect on this mode.
- AC2=1 defines totem pole output.
- AC2=0 defines open-drain output.
- Pin 15(18) through Pin 21(25) are configured to this function.

Combinatorial Output Configuration for Complex Mode

- SYN=1.
- AC0=1.
- XOR=0 defines Active Low Output.
- XOR=1 defines Active High Output.
- AC1 has no effect on this mode.
- AC2=1 defines totem pole output.
- AC2=0 defines open-drain output.
- Pin 14(17) and Pin 22(26) are configured to this function.

Note: The development software configures all of the architecture control bits and checks for proper pin usage automatically.
Specifications GAL20VP8

Complex Mode Logic Diagram

DIP (PLCC) Package Pinouts

OLMC
XOR-2560
AC1-2632
AC2-2708

OLMC
XOR-2561
AC1-2633
AC2-2707

OLMC
XOR-2562
AC1-2634
AC2-2708

OLMC
XOR-2563
AC1-2635
AC2-2709

OLMC
XOR-2564
AC1-2636
AC2-2710

OLMC
XOR-2565
AC1-2637
AC2-2711

OLMC
XOR-2566
AC1-2638
AC2-2712

OLMC
XOR-2567
AC1-2639
AC2-2713

64-USER ELECTRONIC SIGNATURE FUSES
2568, 2569, .... 2630, 2631
Byte7 Byte6 .... Byte1 Byte0

SYN-2704
AC0-2705

Discontinued Product (PCN #02-06). Contact Rochester Electronics for Availability.

www.latticesemi.com/sales/discontinueddevicesales.cfm
Specifications **GAL20VP8**

**Simple Mode**

In the Simple mode, macrocells are configured as dedicated inputs or as dedicated, always active, combinatorial outputs.

All outputs in the simple mode have a maximum of eight product terms that can control the logic. In addition, each output has programmable polarity.

Pins 1(2) and 12(14) are always available as data inputs into the AND array. The center two macrocells (pins 17(20) & 19(23)) cannot be used in the input configuration.

The JEDEC fuse numbers including the UES fuses and PTD fuses are shown on the logic diagram.

**Combinatorial Output with Feedback Configuration for Simple Mode**

- **SYN=1.**
- **AC0=0.**
- **XOR=0** defines Active Low Output.
- **XOR=1** defines Active High Output.
- **AC1=0** defines this configuration.
- **AC2=1** defines totem pole output.
- **AC2=0** defines open-drain output.
- All OLMC except pins 17(20) & 19(23) can be configured to this function.

**Combinatorial Output Configuration for Simple Mode**

- **SYN=1.**
- **AC0=0.**
- **XOR=0** defines Active Low Output.
- **XOR=1** defines Active High Output.
- **AC1=0** defines this configuration.
- **AC2=1** defines totem pole output.
- **AC2=0** defines open-drain output.
- Pins 17(20) & 19(23) are permanently configured to this function.

**Dedicated Input Configuration for Simple Mode**

- **SYN=1.**
- **AC0=0.**
- **XOR=0** defines Active Low Output.
- **XOR=1** defines Active High Output.
- **AC1=1** defines this configuration.
- **AC2=1** defines totem pole output.
- **AC2=0** defines open-drain output.
- All OLMC except pins 17(20) & 19(23) can be configured to this function.

Note: The development software configures all of the architecture control bits and checks for proper pin usage automatically.

---

Discontinued Product (PCN #02-06). Contact Rochester Electronics for Availability.

www.latticesemi.com/sales/discontinueddevicessales.cfm
**Specifications GAL20VP8**

### Absolute Maximum Ratings\(^{(1)}\)

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>CONDITION</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{IL} )</td>
<td>Input Low Voltage</td>
<td></td>
<td>( V_{SS} - 0.5 )</td>
<td>—</td>
<td>0.8</td>
<td>V</td>
</tr>
<tr>
<td>( V_{IH} )</td>
<td>Input High Voltage</td>
<td></td>
<td>2.0</td>
<td>—</td>
<td>( V_{CC} + 1 )</td>
<td>V</td>
</tr>
<tr>
<td>( V_{I1} )</td>
<td>Input Clamp Voltage</td>
<td>( V_{CC} = \text{Min.} )</td>
<td>—</td>
<td>—</td>
<td>1.2</td>
<td>V</td>
</tr>
<tr>
<td>( I_{IL2} )</td>
<td>Input or I/O Low Leakage Current</td>
<td>( 0 V \leq V_{IN} \leq V_{IL} ) (MAX.)</td>
<td>—</td>
<td>—</td>
<td>100</td>
<td>( \mu A )</td>
</tr>
<tr>
<td>( I_{IH} )</td>
<td>Input or I/O High Leakage Current</td>
<td>( 3.5 V \leq V_{IN} \leq V_{CC} )</td>
<td>—</td>
<td>—</td>
<td>10</td>
<td>( \mu A )</td>
</tr>
<tr>
<td>( V_{OL} )</td>
<td>Output Low Voltage</td>
<td>( I_{OL} = \text{MAX.} )</td>
<td>—</td>
<td>—</td>
<td>0.5</td>
<td>V</td>
</tr>
<tr>
<td>( V_{OH} )</td>
<td>Output High Voltage</td>
<td>( I_{OH} = \text{MAX.} )</td>
<td>—</td>
<td>—</td>
<td>2.4</td>
<td>V</td>
</tr>
<tr>
<td>( I_{OL} )</td>
<td>Low Level Output Current</td>
<td></td>
<td>—</td>
<td>—</td>
<td>64</td>
<td>mA</td>
</tr>
<tr>
<td>( I_{OH} )</td>
<td>High Level Output Current</td>
<td></td>
<td>—</td>
<td>—</td>
<td>—32</td>
<td>mA</td>
</tr>
<tr>
<td>( I_{OS3} )</td>
<td>Output Short Circuit Current</td>
<td>( V_{CC} = 5 V )</td>
<td>—</td>
<td>—</td>
<td>400</td>
<td>mA</td>
</tr>
</tbody>
</table>

1. Stresses above those listed under the “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress only ratings and functional operation of the device at these or at any other conditions above those indicated in the operational sections of this specification is not implied (while programming, follow the programming specifications).

### Recommended Operating Conditions

**Commercial Devices:**

- Ambient Temperature \((T_A)\) ................. 0 to 75°C
- Supply voltage \((V_{CC})\) with Respect to Ground ........... +4.75 to +5.25 V

### DC Electrical Characteristics

#### Over Recommended Operating Conditions (Unless Otherwise Specified)

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>CONDITION</th>
<th>MIN.</th>
<th>TYP. (^{4})</th>
<th>MAX.</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_{CC} )</td>
<td>Operating Power Supply Current</td>
<td>( V_{IL} = 0.5 V )</td>
<td>—</td>
<td>90</td>
<td>115</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{IH} = 3.0 V )</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( f_{\text{toggle}} = 15MHz ) Outputs Open</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>mA</td>
</tr>
</tbody>
</table>

1) Characterized but not 100% tested.
2) The leakage current is due to the internal pull-up resistor on all pins. See Input Buffer section for more information.
3) One output at a time for a maximum duration of one second. \( V_{OUT} = 0.5 V \) was selected to avoid test problems by tester ground degradation. Characterized but not 100% tested.
4) Typical values are at \( V_{CC} = 5 V \) and \( T_A = 25 \) °C

---

Discontinued Product (PCN #02-06). Contact Rochester Electronics for Availability.

www.latticesemi.com/sales/discontinueddevicessales.cfm
### AC Switching Characteristics

#### Over Recommended Operating Conditions

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>MAXIMUM</th>
<th>UNITS</th>
<th>TEST CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_i</td>
<td>Input Capacitance</td>
<td>10</td>
<td>pF</td>
<td>(V_{CC} = 5.0\text{V}, V_i = 2.0\text{V})</td>
</tr>
<tr>
<td>C_{IO}</td>
<td>I/O Capacitance</td>
<td>15</td>
<td>pF</td>
<td>(V_{CC} = 5.0\text{V}, V_{iO} = 2.0\text{V})</td>
</tr>
</tbody>
</table>

*Characterized but not 100% tested.*
Specifications **GAL20VP8**

### Switching Waveforms

#### Combinatorial Output

- **INPUT or I/O FEEDBACK**
- **VALID INPUT**
- **COMBINATIONAL OUTPUT**

#### Registered Output

- **INPUT or I/O FEEDBACK**
- **VALID INPUT**
- **CLK**
- **REGISTERED OUTPUT**

#### OE to Output Enable/Disable

- **INPUT or I/O FEEDBACK**
- **OE**
- **REGISTERED OUTPUT**

#### Clock Width

- **CLK**
- **twh**
- **twl**
- **1/fmax (w/o fb)**

#### fmax with Feedback

- **CLK**
- **1/fmax (internal fbk)**
- **tcf**
- **tsu**

---

**Discontinued Product (PCN #02-06). Contact Rochester Electronics for Availability.**

[www.latticesemi.com/sales/discontinueddevicessales.cfm](http://www.latticesemi.com/sales/discontinueddevicessales.cfm)
Specifications **GAL20VP8**

### fmax Descriptions

**fmax with External Feedback** \(1/(t_{su} + t_{co})\)

**Note:** \(f_{\text{max}}\) with external feedback is calculated from measured \(t_{su}\) and \(t_{co}\).

**fmax with Internal Feedback** \(1/(t_{su} + t_{cf})\)

**Note:** \(t_{cf}\) is a calculated value, derived by subtracting \(t_{su}\) from the period of \(f_{\text{max}}\) with internal feedback (\(t_{cf} = 1/f_{\text{max}} - t_{su}\)). The value of \(t_{cf}\) is used primarily when calculating the delay from clocking a register to a combinatorial output (through registered feedback), as shown above. For example, the timing from clock to a combinatorial output is equal to \(t_{cf} + t_{pd}\).

**fmax with No Feedback**

**Note:** \(f_{\text{max}}\) with no feedback may be less than \(1/(t_{wh} + t_{wl})\). This is to allow for a clock duty cycle of other than 50%.

### Switching Test Conditions

- **Input Pulse Levels:** GND to 3.0V
- **Input Rise and Fall Times:** 3ns 10% – 90%
- **Input Timing Reference Levels:** 1.5V
- **Output Timing Reference Levels:** 1.5V
- **Output Load:** See Figure

3-state levels are measured 0.5V from steady-state active level.

**Output Load Conditions (see figure)**

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>(R_1)</th>
<th>(R_2)</th>
<th>(C_L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>500Ω</td>
<td>500Ω</td>
<td>50pF</td>
</tr>
<tr>
<td>B</td>
<td>(\infty)</td>
<td>500Ω</td>
<td>50pF</td>
</tr>
<tr>
<td>Active Low</td>
<td>500Ω</td>
<td>500Ω</td>
<td>50pF</td>
</tr>
<tr>
<td>C</td>
<td>(\infty)</td>
<td>500Ω</td>
<td>5pF</td>
</tr>
<tr>
<td>Active Low</td>
<td>500Ω</td>
<td>500Ω</td>
<td>5pF</td>
</tr>
</tbody>
</table>

\(+5V\) FROM OUTPUT (O/Q) UNDER TEST

\(R_1, R_2\) INCLUDES TEST FIXTURE AND PROBE CAPACITANCE

Discontinued Product (PCN #02-06). Contact Rochester Electronics for Availability.

www.latticesemi.com/sales/discontinueddevicessales.cfm
Specifications **GAL20VP8**

**Electronic Signature**
An electronic signature word is provided in every GAL20VP8 device. It contains 64 bits of reprogrammable memory that can contain user-defined data. Some uses include user ID codes, revision numbers, or inventory control. The signature data is always available to the user independent of the state of the security cell.

NOTE: The electronic signature is included in checksum calculations. Changing the electronic signature will alter the checksum.

**Signature Cell**
The security cell is provided on all GAL20VP8 devices to prevent unauthorized copying of the array patterns. Once programmed, the circuitry enabling array is disabled, preventing further programming or verification of the array. The cell can only be erased by reprogramming the device, so the original configuration can never be examined once this cell is programmed. Signature data is always available to the user.

**Latch-Up Protection**
GAL20VP8 devices are designed with an on-board charge pump to negatively bias the substrate. The negative bias is of sufficient magnitude to prevent input undershoots from causing the circuitry to latch. Additionally, outputs are designed with n-channel pull-ups instead of the traditional p-channel pull-ups to eliminate any possibility of SCR induced latching.

**Bulk Erase Mode**
During a programming cycle, a clear function performs a bulk erase of the array and the architecture word. In addition, the electronic signature word and the security cell are erased. This mode resets a previously configured device back to its original state, which is all JEDEC ones.

**Schmitt Trigger Inputs**
One of the enhancements of the GAL20VP8 for bus interface logic implementation is input hysteresis. The threshold of the positive going edge is 1.5V, while the threshold of the negative going edge is 1.3V. This provides a typical hysteresis of 200mV between positive and negative transitions of the inputs.

**Bulk Erase Mode**
All eight outputs of the GAL20VP8 are capable of driving 64 mA loads when driving low and 32 mA loads when driving high. Near symmetrical high and low output drive capability provides small skews between high-to-low and low-to-high output transitions.

**Output Register Preload**
When testing state machine designs, all possible states and state transitions must be verified in the design, not just those required in the normal machine operations. This is because, in system operation, certain events occur that may throw the logic into an illegal state (power-up, line voltage glitches, brown-outs, etc.). To test a design for proper treatment of these conditions, a way must be provided to break the feedback paths, and force any desired (i.e., illegal) state into the registers. Then the machine can be sequenced and the outputs tested for correct next state conditions.

The GAL20VP8 device includes circuitry that allows each registered output to be synchronously set either high or low. Thus, any present state condition can be forced for test sequencing. If necessary, approved GAL programmers capable of executing test vectors can perform output register preload automatically.

**Programmable Open-Drain Outputs**
In addition to the standard GAL20V8 type configuration, the outputs of the GAL20VP8 are individually programmable either as a standard totem-pole output or an open-drain output. The totem-pole output drives the specified \( V_{OH} \) and \( V_{OL} \) levels whereas the open-drain output drives only the specified \( V_{OL} \). The \( V_{OH} \) level on the open-drain output depends on the external loading and pull-up. This output configuration is controlled by the AC2 fuse. When AC2 cell is erased (JEDEC ‘1’) the output is configured as a totem-pole output and when AC2 cell is programmed (JEDEC ‘0’) the output is configured as an open-drain. The default configuration when the device is in bulk erased state is totem-pole configuration. The AC2 fuses associated with each of the outputs is included in all of the logic diagrams.

**Input Buffers**
The GAL20VP8 devices are designed with TTL level compatible input buffers. These buffers have a characteristically high impedance, and present a much lighter load to the driving logic than bipolar TTL devices.

GAL20VP8 input buffers have active pull-ups within their input structure. As a result, unused inputs and I/O’s will float to a TTL “high” (logical “1”). Lattice Semiconductor recommends that all unused inputs and tri-stated I/O pins for both devices be connected to another active input, \( V_{CC} \) or \( GND \). Doing this will tend to improve noise immunity and reduce \( I_{CC} \) for the device.
Circuitry within the GAL20VP8 provides a reset signal to all registers during power-up. All internal registers will have their Q outputs set low after a specified time ($t_{pr}, 1\mu s$ MAX). As a result, the state on the registered output pins (if they are enabled) will always be high on power-up, regardless of the programmed polarity of the output pins. This feature can greatly simplify state machine design by providing a known state on power-up. The timing diagram for power-up is shown above. Because of the asynchronous nature of system power-up, some conditions must be met to provide a valid power-up reset of the GAL20VP8. First, the $V_{CC}$ rise must be monotonic. Second, the clock input must be at static TTL level as shown in the diagram during power up. The registers will reset within a maximum of $t_{pr}$ time. As in normal system operation, avoid clocking the device until all input and feedback path setup times have been met. The clock must also meet the minimum pulse width requirements.

**Input/Output Equivalent Schematics**

Vref = 3.1V  
Typical Input  
Vref = 3.1V  
Typical Output

Discontinued Product (PCN #02-06). Contact Rochester Electronics for Availability.  
www.latticesemi.com/sales/discontinueddevicessales.cfm
Specifications GAL20VP8

Typical AC and DC Characteristic Diagrams

Normalized Tpd vs Vcc

Normalized Tco vs Vcc

Normalized Tsu vs Vcc

Normalized Tpd vs Temp

Normalized Tco vs Temp

Normalized Tsu vs Temp

Delta Tpd vs # of Outputs Switching

Delta Tco vs # of Outputs Switching

Delta Tpd vs Output Loading

Delta Tco vs Output Loading

Discontinued Product (PCN #02-06). Contact Rochester Electronics for Availability.

www.latticesemi.com/sales/discontinueddevicesales.cfm
Specifications **GAL20VP8**

**Typical AC and DC Characteristic Diagrams**

- **Vol vs Iol**
  - Vol (V) vs Iol (mA)
  - Graph showing typical characteristics.

- **Voh vs Ioh**
  - Voh (V) vs Ioh (mA)
  - Graph showing typical characteristics.

- **Voh vs Ioh**
  - Voh (V) vs Ioh (mA)
  - Graph showing typical characteristics.

- **Normalized Icc vs Vcc**
  - Normalized Icc vs Supply Voltage (V)
  - Graph showing typical characteristics.

- **Normalized Icc vs Temp**
  - Normalized Icc vs Temperature (deg. C)
  - Graph showing typical characteristics.

- **Normalized Icc vs Freq.**
  - Normalized Icc vs Frequency (MHz)
  - Graph showing typical characteristics.

- **Delta Icc vs Vin (1 input)**
  - Delta Icc (mA) vs Vin (V)
  - Graph showing typical characteristics.

- **Input Clamp (Vik)**
  - Iik (mA) vs Vik (V)
  - Graph showing typical characteristics.

Discontinued Product (PCN #02-06). Contact Rochester Electronics for Availability. www.latticesemi.com/sales/discontinueddevicessales.cfm
Discontinued Product (PCN #02-06). Contact Rochester Electronics for Availability.

www.latticesemi.com/sales/discontinueddevicessales.cfm