PRELIMINARY

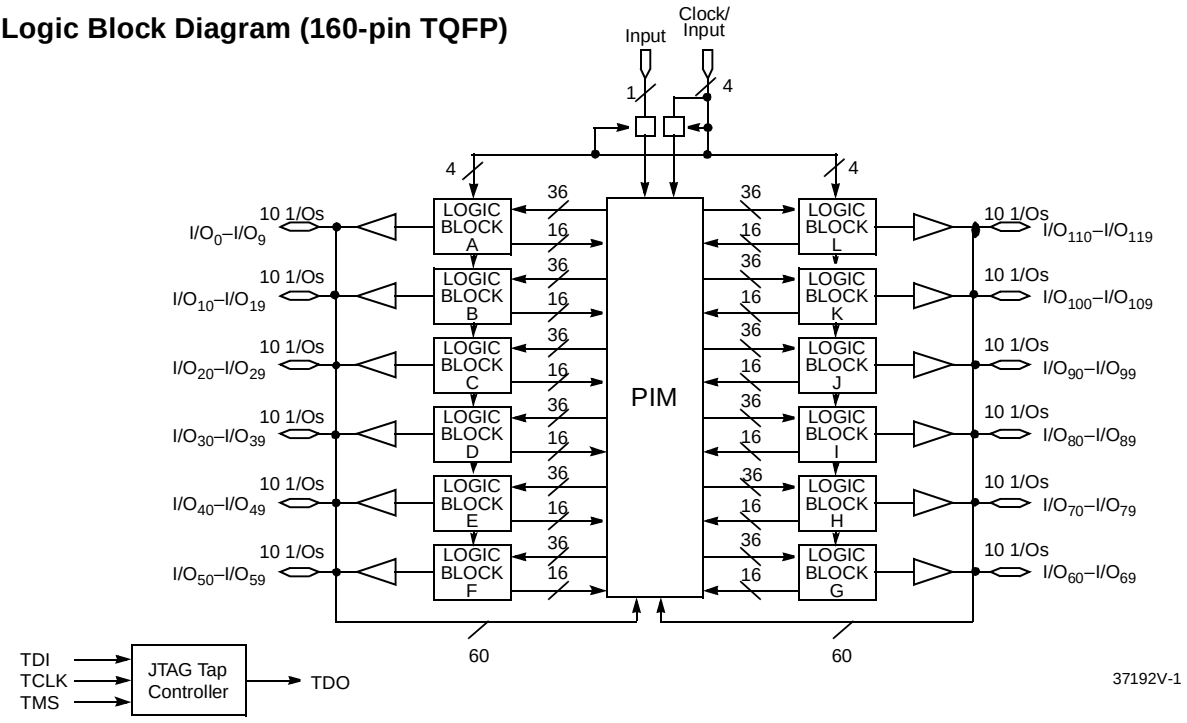
CY37192V

UltraLogic™ 3.3V 192-Macrocell ISR™ CPLD

Features

- 192 macrocells in twelve logic blocks
- IEEE standard 3.3V operation
  - 3.3V ISR
  - 5V tolerant
- 3.3V In-System Reprogrammable™ (ISR™)
  - JTAG-compliant on-board programming
  - Design changes don't cause pinout changes
  - Design changes don't cause timing changes
- 120 I/Os
  - plus 5 dedicated inputs including 4 clock inputs
- High speed
  - f_{MAX} = 100 MHz
  - t_{PD} = 12 ns
  - t_S = 7 ns
  - t_{CO} = 6.5 ns
- Product-term clocking
- IEEE 1149.1 JTAG boundary scan
- Programmable slew rate control on individual I/Os
- Low power option on individual logic block basis
- User-Programmable Bus Hold capabilities on all I/Os
- Simple Timing Model
- PCI compliant[1]
- Available in 160-pin TQFP
- Pinout compatible with the CY37192, CY37128/37128V, CY37256/37256V

Logic Block Diagram (160-pin TQFP)



Selection Guide

	CY37192V-100	CY37192V-66
Maximum Propagation Delay, t_{PD} (ns)	12	20
Minimum Set-Up, t_S (ns)	7	10
Maximum Clock to Output, t_{CO} (ns)	6.5	10
Typical Supply Current, I_{CC} (mA) in Low Power Mode	90	90

Note:

1. Due to the 5V tolerant nature of the I/Os, the I/Os are not clamped to V_{CC}.

Functional Description

The CY37192V is an In-System Reprogrammable (ISR) Complex Programmable Logic Device (CPLD) and is part of the Ultra37000™ family of high-density, high-speed CPLDs. Like all members of the Ultra37000 family, the CY37192V is designed to bring the ease of use and high performance of the 22V10 to high-density PLDs. The CY37192VP160 features 72 Buried and 120 I/O Macrocells.

For a more detailed description of the architecture and features of the CY37192V see the Ultra37000 family data sheet.

Fully Routable with 100% Logic Utilization

The CY37192V is designed with a robust routing architecture which allows utilization of the entire device with a fixed pinout. This makes Ultra37000 optimal for implementing on-board design changes using ISR without changing pinouts.

Simple Timing Model

The CY37192V features a very simple timing model with predictable delays. Unlike other high-density CPLD architectures, there are no hidden speed delays such as fanout effects, interconnect delays, or expander delays. The timing model allows for design changes with ISR without causing changes to system performance.

Low Power Operation

Each Logic Block of the CY37192V can be configured as either High-Speed (default) or Low-Power. In the Low-Power mode, the logic block consumes approximately 50% less power and slows down by t_{LP}.

Output Slew Rate Control

Each output can be configured with either a fast edge rate (default) for high performance, or a slow edge rate for added noise reduction. In the fast edge rate mode, outputs switch at 3V/ns max. and in the slow edge rate mode, outputs switch at 1V/ns max. There is a nominal delay for I/Os using the slow edge rate mode.

In-System Reprogramming

The CY37192V can be programmed in system using IEEE 1149.1 compliant JTAG programming protocol. The CY37192V can also be programmed on a number of traditional parallel programmers including Cypress's *Impulse3*™ programmer and industry standard third-party programmers. For an overview of ISR programming, refer to the Ultra37000 Family data sheet and for UltraISR cable and software specifications, refer to InSRkit: ISR Programming data sheet (CY3600i).

User-Programmable Bus Hold

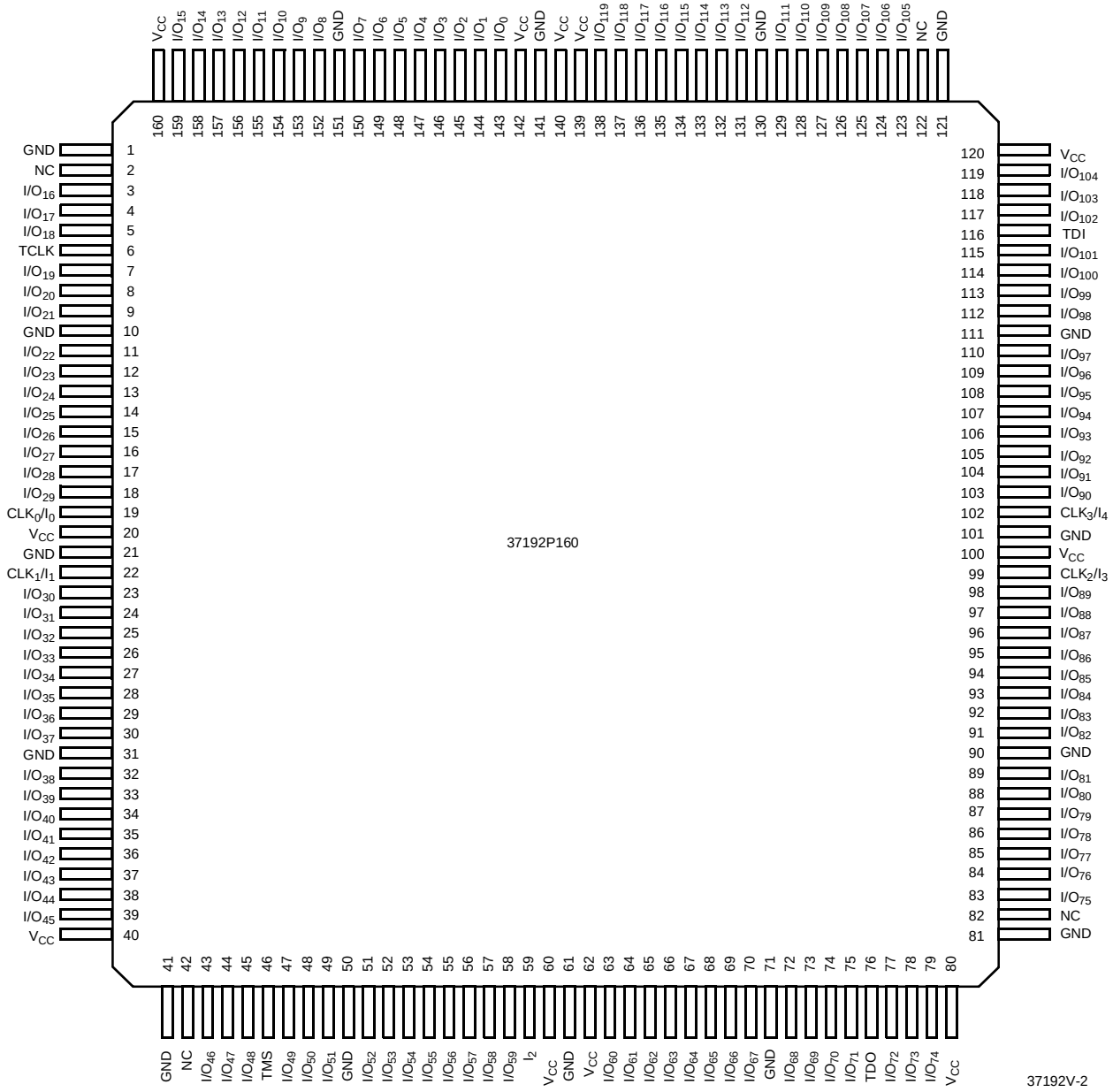
All outputs of the CY37192V can either be configured into bus hold mode or left floating. When in bus hold mode, the undriven outputs retain their last value with a weak latch. This feature allows the designer the flexibility of either eliminating or including external pull-up/pull-down resistors. Enabling this feature affects all I/Os simultaneously.

Design Tools

Development software for the CY37192V is available from Cypress's *Warp*™ or third-party bolt-in software packages as well as a number of third-party development packages. Please refer to the *Warp* or third-party tool support data sheets for further information.

Pin Configuration

160-pin TQFP
Top View



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Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature ..... –65°C to +150°C

Ambient Temperature with Power Applied ..... –55°C to +125°C

Supply Voltage to Ground Potential ..... –0.5V to +4.6V

DC Voltage Applied to Outputs in High Z State ..... –0.5V to +7.0V

DC Input Voltage ..... –0.5V to +7.0V

DC Program Voltage ..... 3.0V to 3.6V

Current into Outputs ..... 8 mA

Static Discharge Voltage ..... >2001V (per MIL-STD-883, Method 3015)

Latch-Up Current ..... >200 mA

Operating Range

Range	Ambient Temperature[2]	Junction Temperature	V_{CC}
Commercial	0°C to +70°C	0°C to +90°C	3.3V ± 0.3V
Industrial	–40°C to +85°C	–40°C to +125°C	3.3V ± 0.3V

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions		Min.	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = Min.	I_{OH} = –4 mA (Com'l)[3]	2.4		V
V_{OL}	Output LOW Voltage	V_{CC} = Min.	I_{OL} = 8 mA (Com'l)[3]		0.5	V
V_{IH}	Input HIGH Voltage	Guaranteed Input Logical HIGH voltage for all inputs[4]		2.0	V_{CCmax}	V
V_{IL}	Input LOW Voltage	Guaranteed Input Logical LOW voltage for all inputs[4]		–0.5	0.8	V
I_{IX}	Input Load Current	V_I = GND or V_{CC}		–10	10	µA
I_{OZ}	Output Leakage Current	V_O = GND or V_{CC}, Output Disabled		–50	50	µA
I_{OS}	Output Short Circuit Current[5, 6]	V_{CC} = Max., V_{OUT} = 0.5V		–30	–160	mA
I_{BHL}	Input Bus Hold LOW Sustaining Current	V_{CC} = Min., V_{IL} = 0.8V		+75		µA
I_{BHH}	Input Bus Hold HIGH Sustaining Current	V_{CC} = Min., V_{IH} = 2.0V		–75		µA
I_{BHLO}	Input Bus Hold LOW Overdrive Current	V_{CC} = Max.			+500	µA
I_{BHHO}	Input Bus Hold HIGH Overdrive Current	V_{CC} = Max.			–500	µA

Inductance[6]

Parameter	Description	Test Conditions	160-lead TQFP	Unit
L	Maximum Pin Inductance	V_{IN} = 3.3V at f = 1 MHz	9	nH

Capacitance[6]

Parameter	Description	Test Conditions	Max.	Unit
$C_{I/O}$	Input/Output Capacitance	V_{IN} = 3.3V at f = 1 MHz at T_A = 25°C	8	pF
C_{CLK}	Clock Signal Capacitance	V_{IN} = 3.3V at f = 1 MHz at T_A = 25°C	12	pF

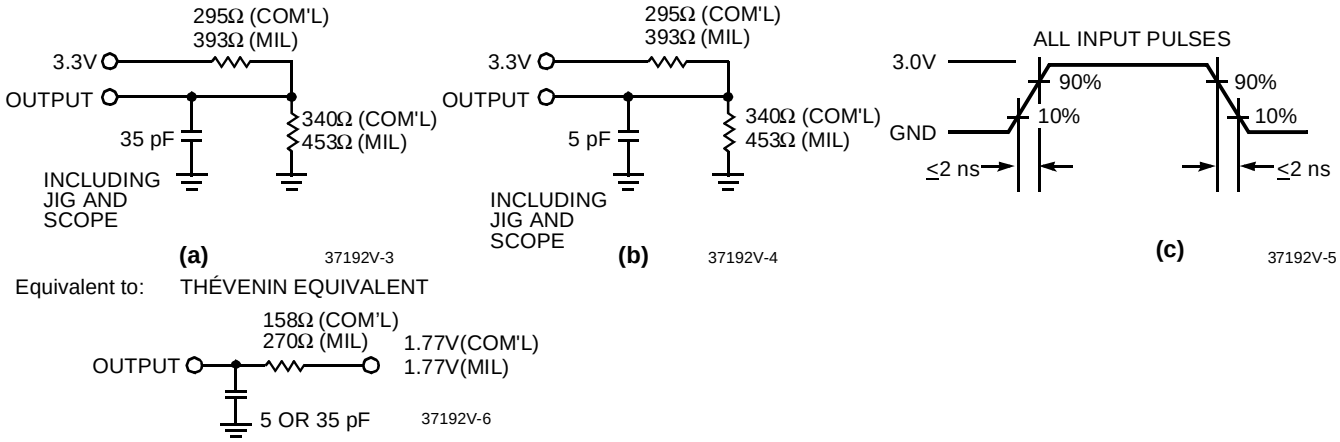
Notes:

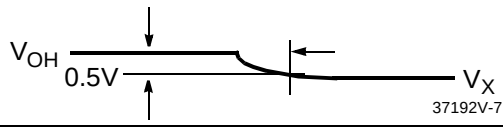
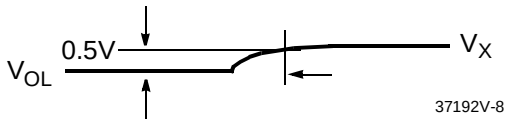
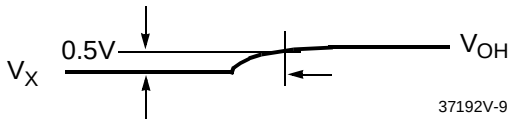
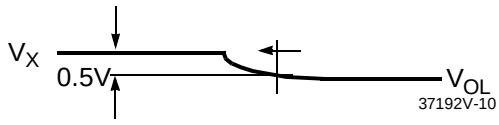
2. Normal Programming Conditions apply across Ambient Temperature Range for specified programming methods. For more information on programming the Ultra37000 family devices see the Ultra37000 family data sheet
3. I_{OH} = –2 mA, I_{OL} = 2 mA for TDO.
4. These are absolute values with respect to device ground. All overshoots due to system or tester noise are included.
5. Not more than one output should be tested at a time. Duration of the short circuit should not exceed 1 second. V_{OUT} = 0.5V has been chosen to avoid test problems caused by tester ground degradation.
6. Tested initially and after any design or process changes that may affect these parameters.

Endurance Characteristics[6]

Parameter	Description	Test Conditions	Min.	Typ.	Unit
N	Minimum Reprogramming Cycles	Normal Programming Conditions[2]	1,000	10,000	Cycles

AC Test Loads and Waveforms



Parameter[7]	V_X	Output Waveform--Measurement Level
$t_{ER(-)}$	1.5V	
$t_{ER(+)}$	2.6V	
$t_{EA(+)}$	1.5V	
$t_{EA(-)}$	V_{the}	

(d) Test Waveforms

Note:

7. t_{ER} measured with 5-pF AC Test Load and t_{EA} measured with 35-pF AC Test Load.

Switching Characteristics Over the Operating Range[8]

Parameter	Description	37192V-100		37192V-66		Unit
		Min.	Max.	Min.	Max.	
Combinatorial Mode Parameters						
t_{PD}[9, 10]	Input to Combinatorial Output		12		20	ns
t_{PDL}[9, 10]	Input to Output Through Transparent Input or Output Latch		16.5		22	ns
t_{PDLL}[9, 10]	Input to Output Through Transparent Input and Output Latches		17		24	ns
t_{EA}[9, 10]	Input to Output Enable		16		24	ns
t_{ER}[9]	Input to Output Disable		16		24	ns
Input Register Parameters						
t_{WL}	Clock or Latch Enable Input LOW Time[6]	3		5		ns
t_{WH}	Clock or Latch Enable Input HIGH Time[6]	3		5		ns
t_{IS}	Input Register or Latch Set-Up Time	2.5		4		ns
t_{IH}	Input Register or Latch Hold Time	2.5		4		ns
t_{ICO}[9, 10]	Input Register Clock or Latch Enable to Combinatorial Output		16		24	ns
t_{ICOL}[9, 10]	Input Register Clock or Latch Enable to Output Through Transparent Output Latch		18		26	ns
Synchronous Clocking Parameters						
t_{CO}[10]	Synchronous Clock (CLK_0, CLK_1, CLK_2, or CLK_3) or Latch Enable to Output		6		10	ns
t_S[9]	Set-Up Time from Input to Synchronous Clock (CLK_0, CLK_1, CLK_2, or CLK_3) or Latch Enable	7		10		ns
t_H	Register or Latch Data Hold Time	0		0		ns
t_{CO2}[9, 10]	Output Synchronous Clock (CLK_0, CLK_1, CLK_2, or CLK_3) or Latch Enable to Combinatorial Output Delay (Through Logic Array)		16		24	ns
t_{SCS}[9]	Output Synchronous Clock (CLK_0, CLK_1, CLK_2, or CLK_3) or Latch Enable to Output Synchronous Clock (CLK_0, CLK_1, CLK_2, or CLK_3) or Latch Enable (Through Logic Array)	10		15		ns
t_{SL}[9]	Set-Up Time from Input Through Transparent Latch to Output Register Synchronous Clock (CLK_0, CLK_1, CLK_2, or CLK_3) or Latch Enable	12		15		ns
t_{HL}	Hold Time for Input Through Transparent Latch from Output Register Synchronous Clock (CLK_0, CLK_1, CLK_2, or CLK_3) or Latch Enable	0		0		ns
Product Term Clocking Parameters						
t_{COPT}[9, 10]	Product Term Clock or Latch Enable (PTCLK) to Output		13		20	ns
t_{SPT}	Set-Up Time from Input to Product Term Clock or Latch Enable (PTCLK)	3		6		ns
t_{HPT}	Register or Latch Data Hold Time	3		6		ns
t_{ISPT}[9]	Set-Up Time for buried register used as an input register from Input to Product Term Clock or Latch Enable (PTCLK)		–2		–2	ns

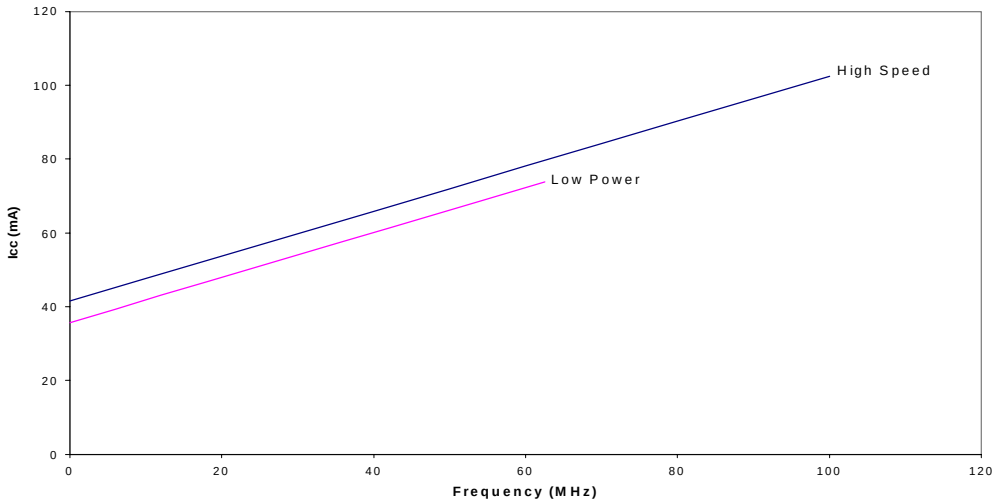
Notes:

8. All AC parameters are measured with 16 outputs switching and 35-pF AC Test Load.
9. Logic Blocks operating in low power mode, add t_{LP} to this spec.
10. Outputs using Slow Output Slew Rate, add t_{SLEW} to this spec.

Switching Characteristics Over the Operating Range[8] (continued)

Parameter	Description	37192V-100		37192V-66		Unit
		Min.	Max.	Min.	Max.	
t_{IHPT}	Buried Register Used as an Input Register or Latch Data Hold Time		11		19	ns
t_{CO2PT}[9, 10]	Product Term Clock or Latch Enable (PTCLK) to Output Delay (Through Logic Array)		21		30	ns
Pipelined Mode Parameters						
t_{ICS}[9]	Input Register Synchronous Clock (CLK_0, CLK_1, CLK_2, or CLK_3) to Output Register Synchronous Clock (CLK_0, CLK_1, CLK_2, or CLK_3)	10		15		ns
Operating Frequency Parameters						
f_{MAX1}	Maximum Frequency with Internal Feedback (Lesser of $1/t_{SCS}$, $1/(t_S + t_H)$, or $1/t_{CO}$)[6]	100		66.7		MHz
f_{MAX2}	Maximum Frequency Data Path in Output Registered/Latched Mode (Lesser of $1/(t_{WL} + t_{WH})$, $1/(t_S + t_H)$, or $1/t_{CO}$)	143		100		MHz
f_{MAX3}	Maximum Frequency with External Feedback (Lesser of $1/(t_{CO} + t_S)$ or $1/(t_{WL} + t_{WH})$)	76.9		50		MHz
f_{MAX4}	Maximum Frequency in Pipelined Mode (Lesser of $1/(t_{CO} + t_{IS})$, $1/t_{ICS}$, $1/(t_{WL} + t_{WH})$, $1/(t_{IS} + t_{IH})$, or $1/t_{SCS}$)	100		66.7		MHz
Reset/Preset Parameters						
t_{RW}	Asynchronous Reset Width[6]	12		20		ns
t_{RR}[9]	Asynchronous Reset Recovery Time[6]	14		22		ns
t_{RO}[9, 10]	Asynchronous Reset to Output		18		26	ns
t_{PW}	Asynchronous Preset Width[6]	12		20		ns
t_{PR}[9]	Asynchronous Preset Recovery Time[6]	14		22		ns
t_{PO}[9, 10]	Asynchronous Preset to Output		18		26	ns
User Option Parameters						
t_{LP}	Low Power Adder		4		4	ns
t_{SLEW}	Slow Output Slew Rate Adder		2		2	ns
JTAG Timing Parameters						
$t_{S\ JTAG}$	Set-Up Time from TDI and TMS to TCK	0		0		ns
$t_{H\ JTAG}$	Hold Time on TDI and TMS	20		20		ns
$t_{CO\ JTAG}$	Falling Edge of TCK to TDO		20		20	ns
f_{JTAG}	Maximum JTAG Tap Controller Frequency		20		20	MHz

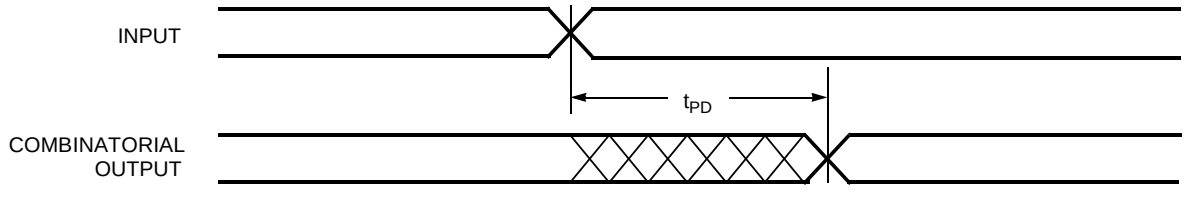
Typical I_{cc} Characteristics



The typical pattern is a 16-bit up counter, per logic block, with outputs disabled.
V_{cc} = 3.3V, T_A = Room Temperature

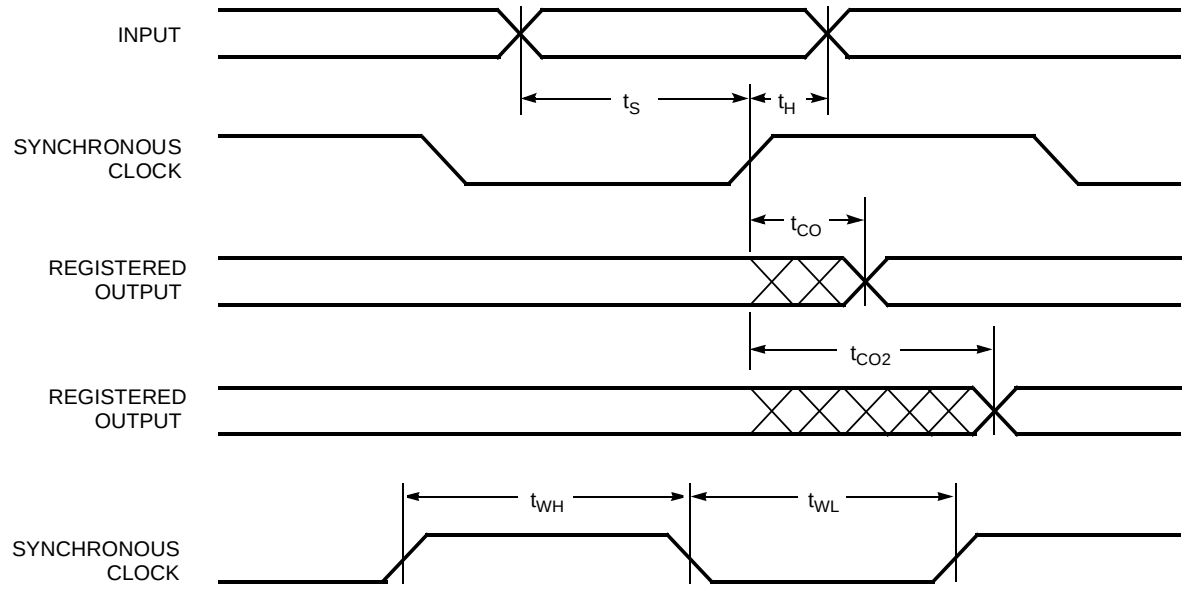
Switching Waveforms

Combinatorial Output



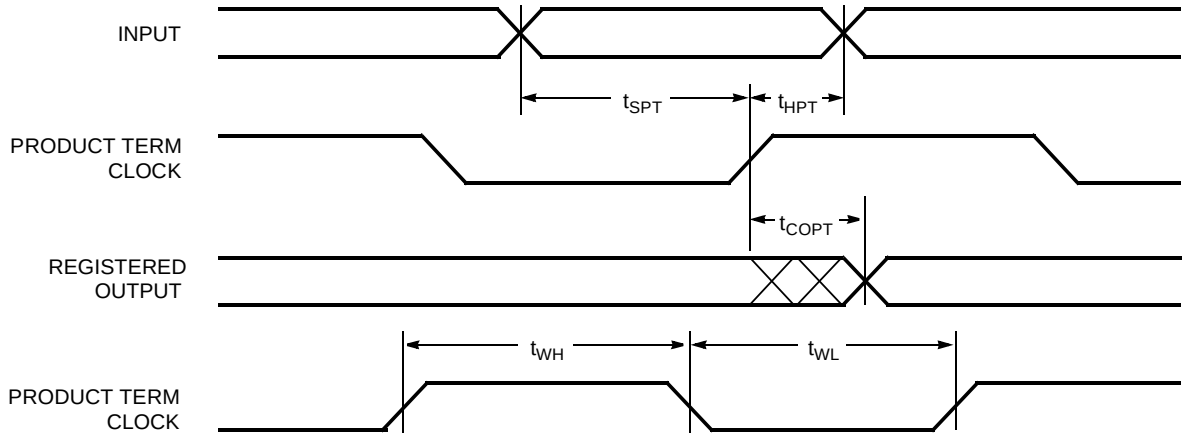
37192V-11

Registered Output with Synchronous Clocking



37192V-12

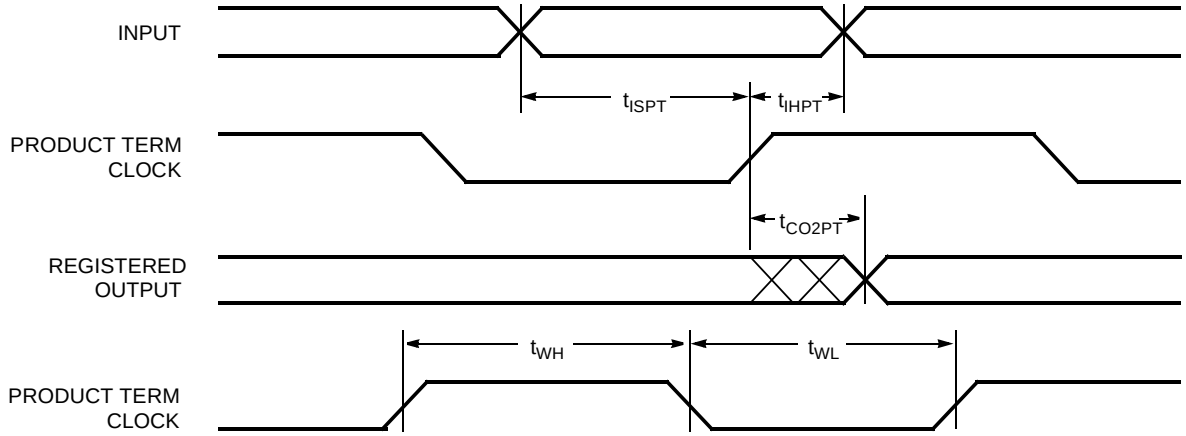
Registered Output with Product Term Clocking Input going through the Array



37192V-13

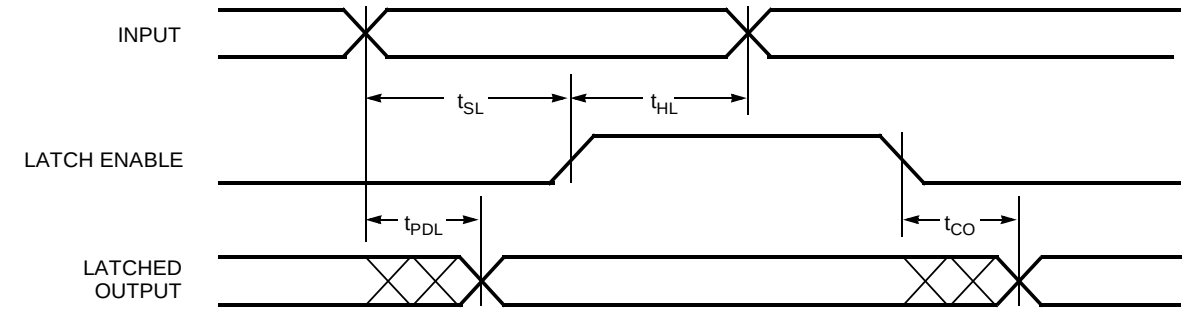
Switching Waveforms (continued)

Registered Output with Product Term Clocking Input coming from Adjacent Buried Register



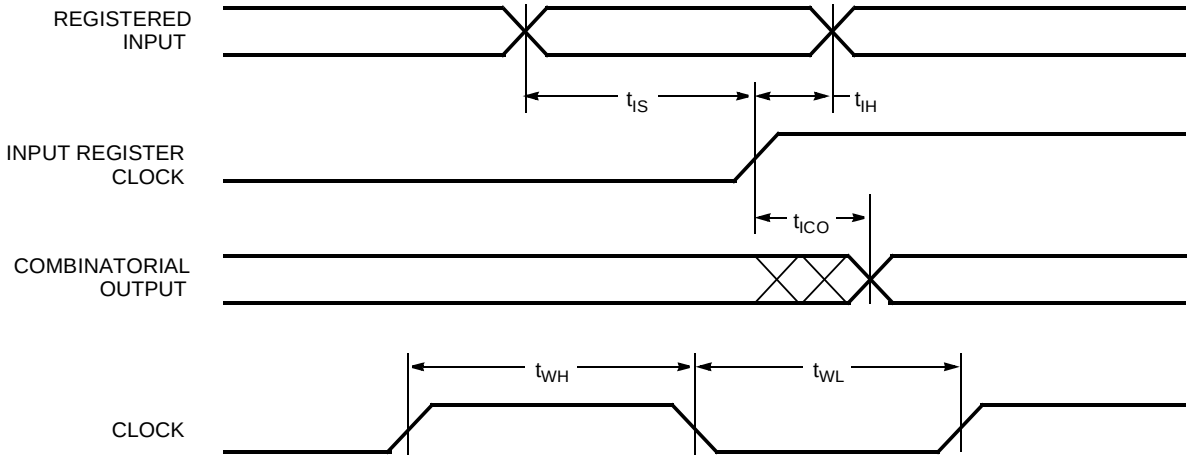
37192V-14

Latched Output



37192V-15

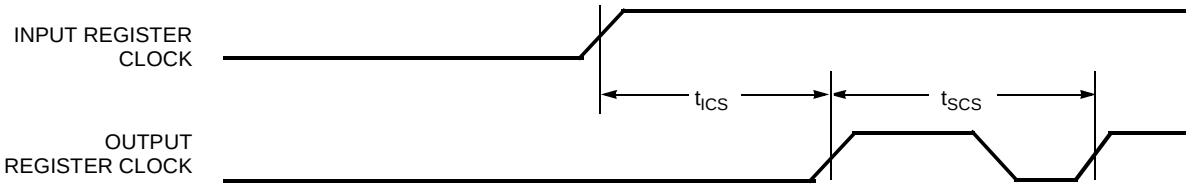
Registered Input



37192V-16

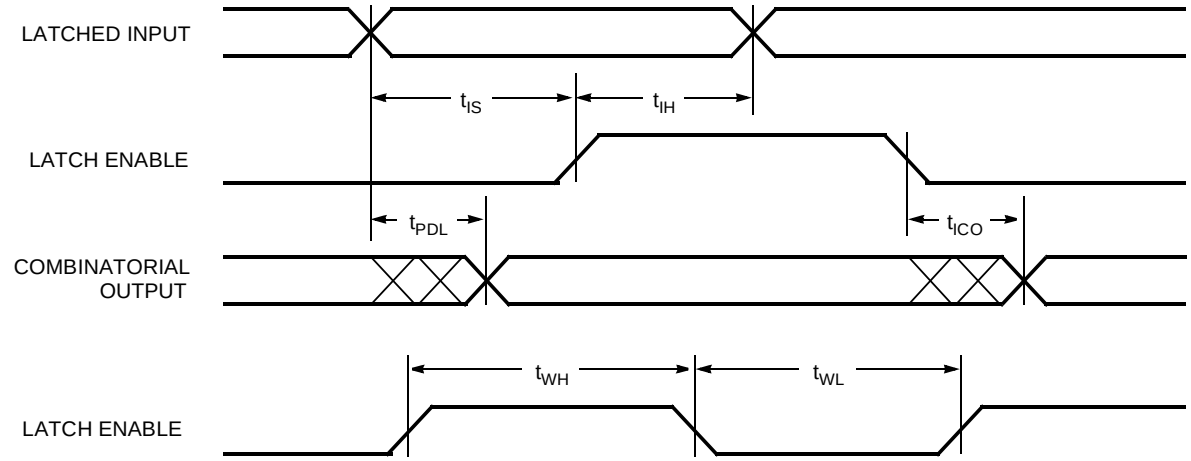
Switching Waveforms (continued)

Clock to Clock



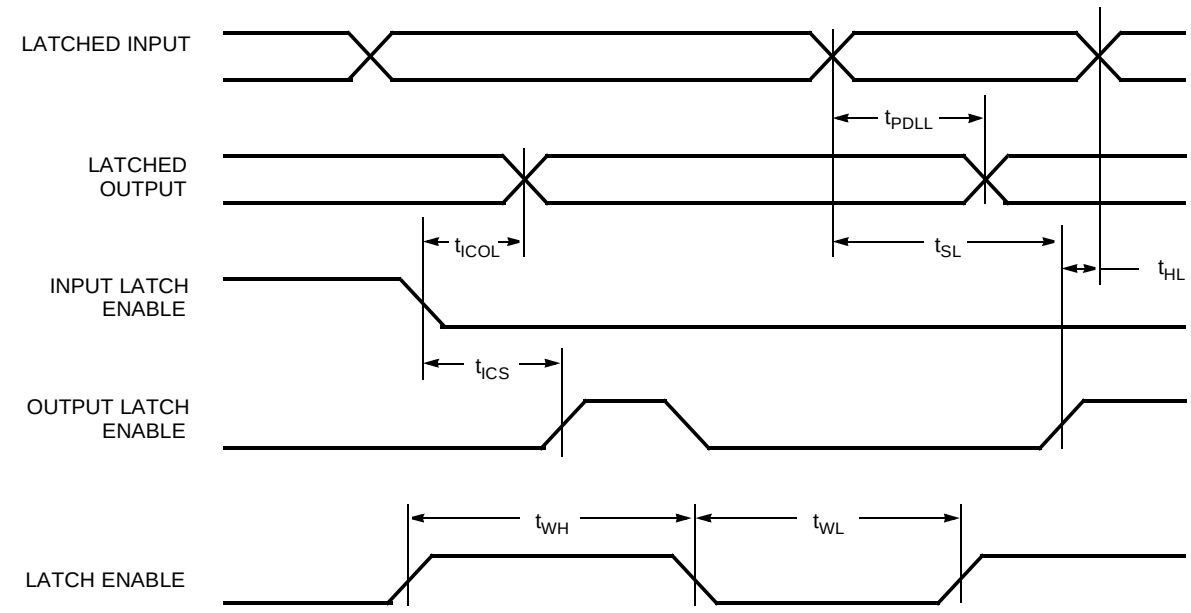
37192V-17

Latched Input



37192V-18

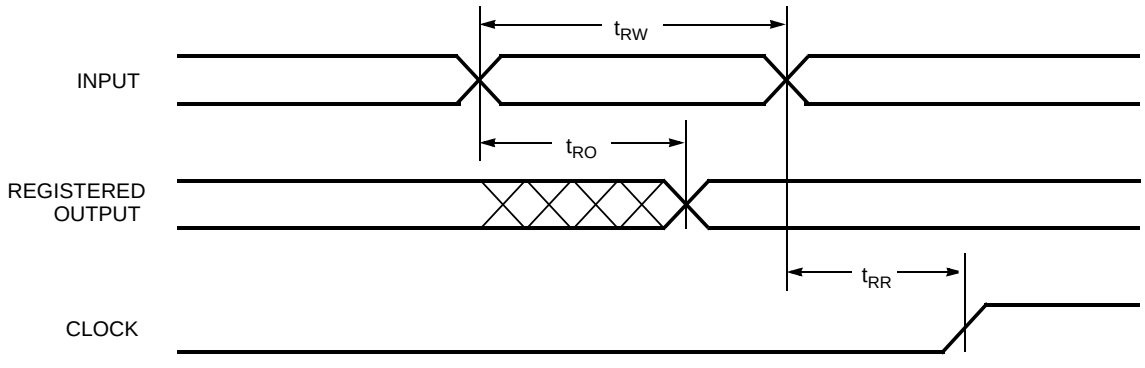
Latched Input and Output



37192V-19

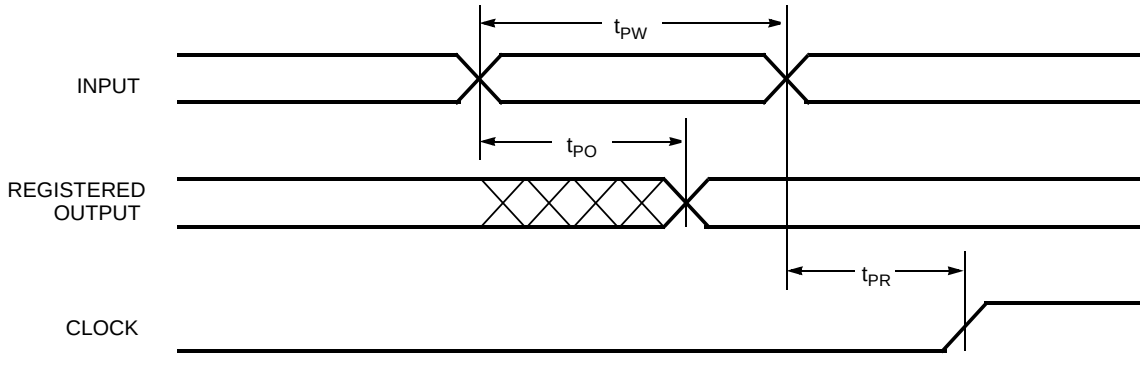
Switching Waveforms (continued)

Asynchronous Reset



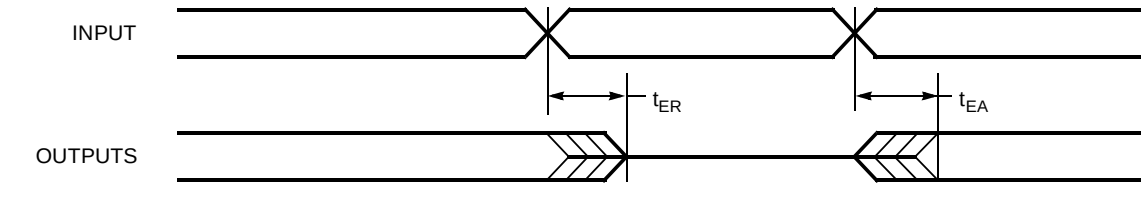
37192V-20

Asynchronous Preset



37192V-21

Output Enable/Disable



37192V–22

Ordering Information

Speed (MHz)	Ordering Code	Package Name	Package Type	Operating Range
100	CY37192VP160–100AC	A160	160-Pin Thin Quad Flatpack	Commercial
66	CY37192VP160–66AC	A160	160-Pin Thin Quad Flatpack	Commercial
	CY37192VP160–66AI	A160	160-Pin Thin Quad Flatpack	Industrial

Document #: 38-00650-B

Package Diagram

160-Pin Thin Plastic Quad Flat Pack (TQFP) A160