



C9716

100 MHz Clock Generator with SSCG and Power Management for Mobile Application

Approved Product

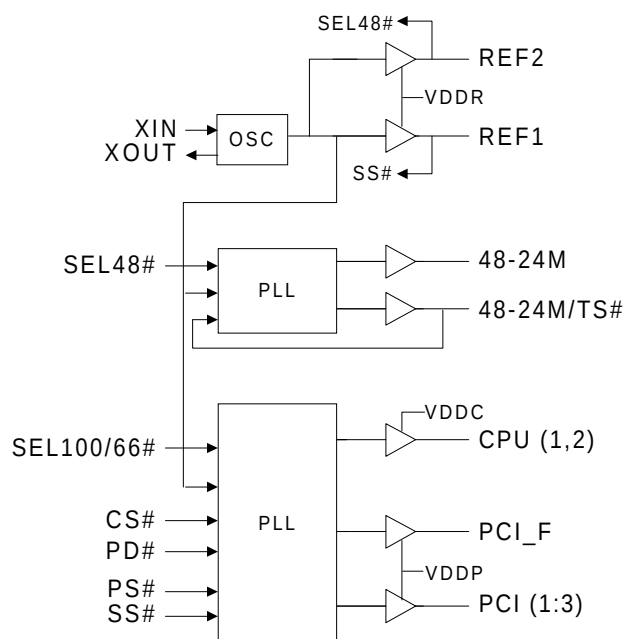
Product Features

- Supplies:
- 2 Ref clocks
2 Host (CPU) clocks
- 1 free running and 5 PCI Clocks
- 1 48MHz fixed clock
- 1 48 or 24 MHz fixed clock
- Separate supply pins for mixed (3.3/2.5V) voltage application.
- 100 or 66 MHz CPU clock operation
- -1.5% Spread Spectrum modulation for reducing EMI
- Rich Power Management Functions.
- 28-pin SSOP & TSSOP packages for minimum board space.

Frequency Table

SEL 100/66#	CPU Clock	PCI Clock
0	66 MHz	33 MHz
1	100 MHz	33 MHz

Block Diagram



Pin Configuration

VSS	1	28	VDDR
XIN	2	27	REF/SEL48#
XOUT	3	26	REF1/SS#
PCI_F	4	25	VDDC
PCI1	5	24	CPU1
PCI2	6	23	CPU2
VSS	7	22	VSS
VDDP	8	21	VSS
PCI3	9	20	PS#
PCI4	10	19	VDD
PCI5	11	18	CS#
VDDF	12	17	PD#
48M	13	16	SEL100/66#
48-24/TS#	14	15	VSS

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Pin Description

PIN No.	Pin Name	PWR	I/O	TYPE	Description
2	XIN	VDD	I	XTAL4	On-chip reference oscillator input pin. Requires either an external parallel resonant crystal (nominally 14.318 MHz) or externally generated reference signal
3	XOUT	VDD	O	XTAL4	O-chip reference oscillator output pin. Drives an external parallel resonant crystal (14.318 MHz) when an externally generated reference signal is used.
19	VDD	-	P	PWR	3.3 volt power supply for core logic.
23, 24	CPU (1,2)	VDDC	O	C100S	Clock outputs. CPU frequency table specified on page 1.
17	PD#	-	I	INP3U	Powers down device when LOW
18	CS#	-	I	INP3U	When signal is LOW, stops CPU clocks in low state.
16	SEL100/66#	-	I	INP3	Frequency select input pins. See frequency select table on page 1. NO INTERNAL PULLUP RESISTOR IS PROVIDED BY DEVICE
25	VDDC	-	P	PWR	2.5V power for CPU and Host clock outputs.
4	PCI_F	VDDP	O	P100S	Free running PCI clock 3.3V. Does not stop when PS# is at a logic LOW level
5,6,9,10,11	PCI(1:5)	VDDP	O	P100S	PCI output clocks. See frequency table of page 1.
20	PS#	-	I	INP3U	When signal is LOW, stops all PCI clocks in low state.
8	VDDP	-	P	PWR	3.3 Volt power supply pins for free running PCI clock output buffer.
13	48M	VDDF	O	U48	Fixed 48 MHz clock.
14	48-24M/TS#	VDDF	I/O	U48BU	Power up selectable 48 or 24 MHz clock. If strapped LOW at powerup causes the devices outputs to be tri-stated until the next power up sequence occurs.
26	REF1/SS#	VDDR	I/O	U48BU	At power up this pin determines if the device's spread spectrum modulation feature is enabled or disabled. After power up this pin becomes a reference clock output. A 0 (logic low) enables SSCG and a 1 (logic high) disables SSCG.
27	REF2/SEL48 #	VDDR	I/O	U48BU	At power up this pin determine the frequency of the clock at pin 14. If it is LOW, the clock will be 48 MHz, if HIGH the clock will be 24 MHz. After power up this pin will become a reference clock output.
12	VDDF	-	P	PWR	Power for fixed clock output buffer.
1, 7, 15, 21, 22	VSS	-	P	PWR	Ground pins for device.
28	VDDR	-	P	PWR	Power for Reference Oscillator output buffer.

Notes

1. INP3U pins have internal pullup resistors that will guarantee to a logic1 (high) level if no connection is made to the device's pin. INP3 pins do not contain this function and must be electrically connected to VDD or VSS by external circuitry to ensure a valid logic 1 or 0 is sensed.



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Frequency Selection Table

<i>Descriptions</i>	<i>Outputs</i>					
	<i>48-24M/TS# at Power UP</i>	<i>SEL 66/100</i>	<i>CPU</i>	<i>PCI</i>	<i>48M</i>	<i>48/24M</i>
All Outputs Tri-State	0	0	Hi-Z	Hi-Z	Hi-Z	Hi-Z
66 MHz	1	0	66 MHz	33 MHz	48 MHz	24/48 MHz
100 MHz	1	1	100 MHz	33 MHz	48 MHz	24/48 MHz
Test Mode	0	1	7.16 MHz	2.38 MHz	7.16 MHz	7.16/3.58 MHz

Power Management Functions

PS#	CS#	PD#	CPU	48M	PCI	PCI_F	VCOs
X	X	0	LOW	LOW	LOW	LOW	OFF
1	0	1	LOW	ON	ON	ON	ON
0	1	X	ON	ON	LOW	ON	ON

CS# is an input clock synthesizer. It is used to turn off the CPU clocks for low power operation. CS# is asserted asynchronously by the external clock control logic with the rising edge of free running PCI clock (and hence CPU Clock) and must be internally synchronized to the external PCI_F output. All other clocks will continue to run while the CPU clocks are disabled. The CPU clocks must always be stopped in a low state and started in such a manner as to guarantee that the high pulse width is a full pulse. CPU clock on latency need to be **2 or 3 CPU clocks** periods in time and CPU clock off latency needs to be **2 or 3 CPU clocks** periods in time.

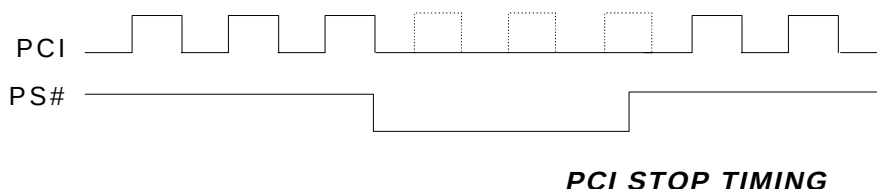
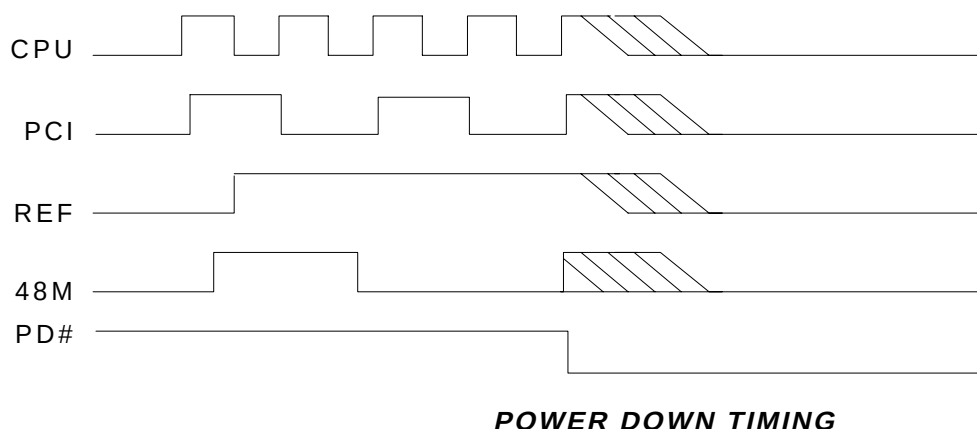
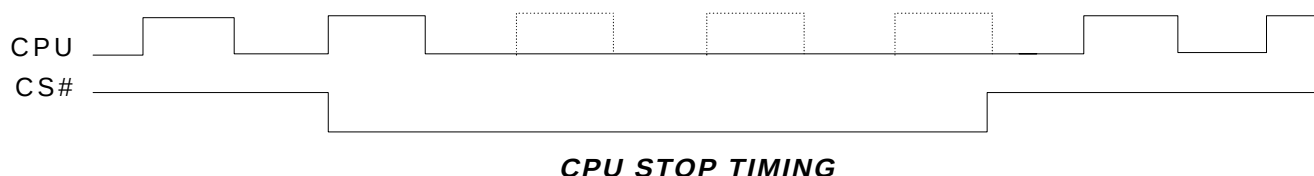


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Power Management Timing



The power down selection is used to put the part into a very low power state without turning off the power to the part. PD# is an asynchronous active low input. This signal needs to be synchronized internal to the device prior to powering down the clock synthesizer. PD# is an asynchronous function for powering up the system. Internal clocks are not running after the device is put in power down. When PD# is active low, all clocks need to be driven to a low value and held prior to turning off the VCO's and the Crystal. The power-up latency needs to be less than 3 mS. The power down latency should be as short as possible but conforming to the sequence requirements shown below. AS# and CS# are considered to be don't cares during the power down operations.

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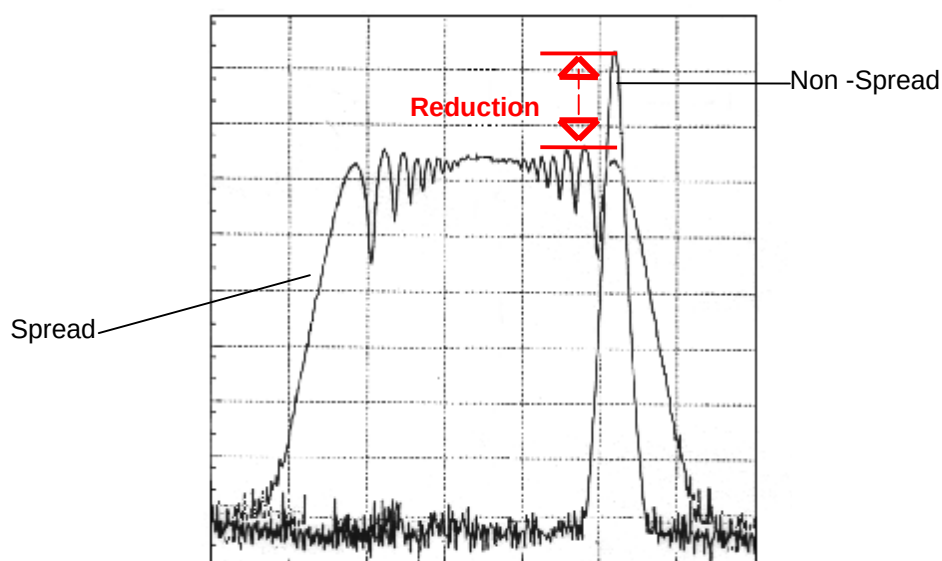
Power Management Timing

Signal	Signal State	Latency
		No. of rising edges of free running PCI CLOCK (PCIF)
CS#	0 (disabled)	1
	1 (enabled)	1
PD#	1 (cold start/normal operation)	3 mS
	0 (power down)	1

NOTES:

1. Clock on/off latency is defined in the number of rising edges of free running PCI CLOCK between the clock disable goes low/high to the first valid clock comes out of the device.

Spectrum Spread Clocking



Spectrum Analysis

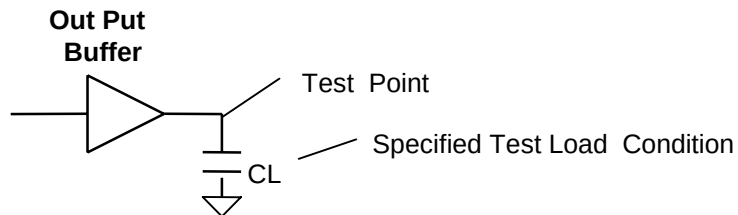
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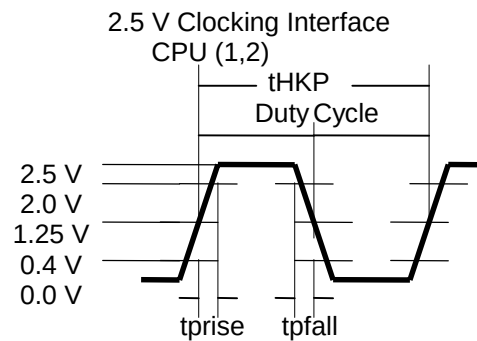
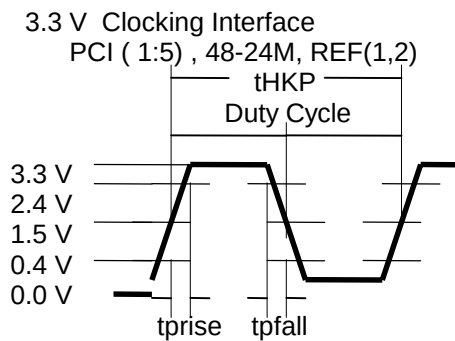
Spectrum Spreading Selection Table

Min (MHz)	Center (MHz)	Max (MHz)	CPU Frequency	% OF FREQUENCY SPREADING	MODE
98.51285	99.2634	100.01397	100	1.5% (-1.5% + 0%)	Down Spread
65.6649	66.166	66.667	66	1.5% (1.5% + 0%)	Down Spread

Test and Measurement Condition



Clock Output Wave form





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Absolute Maximum Ratings

Voltage Relative to VSS:	-0.3V
Voltage Relative to VDD:	0.3V
Storage Temperature:	0°C to +125°C
Operating Temperature:	0°C to +70°C
Maximum Power Supply:	7V

This device contains circuitry to protect the inputs against damage due to high static voltages or electric field; however, precautions should be taken to avoid application of any voltage higher than the maximum rated voltages to this circuit. For proper operation, Vin should be constrained to the range:

$$VSS < (V_{in}) < VDD$$

Unused inputs must always be tied to an appropriate logic voltage level (either VSS or VDD).

DC Parameters

Characteristic	Symbol	Min	Typ	Max	Units	Conditions
Input Low Voltage	VIL	-	-	0.8	Vdc	
Input High Voltage	VIH	2.0	-	-	Vdc	
Input Low Current	IIL			-66	μA	
Input High Current	IIH			5	μA	
Output Low Voltage IOL = 4mA	VOL	-	-	0.4	Vdc	All Outputs (see buffer spec)
Output High Voltage IOH = 4mA	VOH	2.4	-	-	Vdc	All Outputs Using 3.3V Power (see buffer spec)
Tri-State leakage Current	Ioz	-	-	10	μA	
Dynamic Supply Current (2.5 Volt Supply)	Idd2 ₆₆	-	-	35	mA	TS# = 1, 100/66 = 0, CS# = 1
	Idd2 ₁₀₀	-	-	45	mA	TS# = 1, 100/66 = 0, CS# = 1
Dynamic Supply Current (3.3 Volt Supply)	Idd3 ₆₆	-	-	100	mA	TS# = 1, 100/66 = 1, CS# = 1
	Idd3 ₁₀₀	-	-	120	mA	TS# = 1, 100/66 = 1, CS# = 1
Power Down Mode	I2.5 _{PD}	-	-	200 uA	mA	PD# at logic low level
Power Down Mode	I3.3 _{PD}	-	-	100 uA	mA	PD# at logic low level
VDD = VDDF = VDDP=VDDR = 3.3V ±5%, VDDC = 2.5V ±5%, TA = 0°C to +70°C						



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AC Parameters

Characteristic	Symbol	Min	Typ	Max	Units	Conditions
Output Duty Cycle	-	45	50	55	%	CPU and CPU/2 = Measured at 1.25V all others measured at 1.50V
CPU to PCI Offset	tOFF	1	-	4	ns	CPU = 20 pF load Measured at 1.25V PCI = 30 pF load Measure at 1.50V
Buffer out Skew All CPU and PCI Buffer Outputs	tSKEW	-	-	250	ps	CPU = 20 pF load Measured at 1.25V PCI = 30 pF Load Measured at 1.5V
ΔPeriod Adjacent Cycles	ΔP	-	-	±250	ps	CPU and CPU/2
ΔPeriod Adjacent Cycles	ΔP	-	-	± 500	pS	PCI Only
VDD = VDDF = VDDP = VDDR = 3.3V ±5%, VDDC = 2.5V ±5%, TA = 0°C to +70°C						

AC Skew Requirements

Characteristic	Bank Skew	Cycle to Cycle Jitters	VDD	Skew, Jitters Measure Point
CPU	175pS	+/- 250pS	2.5V	1.25V
48 MHz	n/a	+/- 500pS	3.3V	1.5V
PCI, PCI_F	500pS	+/- 500pS	3.3V	1.5V
Ref	n/a	+/- 500pS	3.3V	1.5V

Offset Requirements

Characteristic	Bank Offset	Measurement Loads (lumped)	Measure Points
CPU to PCI, PCI-5	1.5-4.0nS CPU leads	CPU @ 20pF, PCI @ 30 pF	CPU @ 1.25V, PCI @ 1.5V

DC Buffer Characteristics for CPU Outputs

Characteristic	Symbol	Min	Typ	Max	Units	Conditions
Pull-Up Current Min	IOH _{min}	-82	-		mA	Vout = 1.0 V
Pull-Up Current Max	IOH _{max}			-67	mA	Vout = 2.375 V
Pull-Down Current Min	IOL _{min}	81	-	-	mA	Vout = 1.2 V
Pull-Down Current Max	IOL _{max}	-	-	60	mA	Vout = 0.3 V
Rise Time Between 0.4 V and 2.4 V	TR	0.4	-	1.6	nS	20 pF Load
Fall Time Between 0.4 V and 2.4 V	TF	0.5	-	1.6	nS	20 pF Load
VDD = VDDF = VDDP = VDDR = 3.3V ±5%, VDDC = 2.5V ±5%, TA = 0°C to +70°C						



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DC Buffer Characteristics for 48M, 48-24M and REF Outputs

Characteristic	Symbol	Min	Typ	Max	Units	Conditions
Pull-Up Current Min	IOH _{min}	-29	-	-	mA	Vout = 1.0 V
Pull-Up Current Max	IOH _{max}	-	-	-23	mA	Vout = 3.135 V
Pull-Down Current Min	IOL _{min}	29	-	-	mA	Vout = 1.95 V
Pull-Down Current Max	IOL _{max}	-	-	27	mA	Vout = 0.4 V
Rise Time Between 0.4 V and 2.4 V	TR	0.5	-	2.0	nS	20 pF Load
Fall Time Between 0.4 V and 2.4 V	TF	0.5	-	2.0	nS	20 pF Load
VDD = VDDP= VDDR =3.3V ±5%, VDDC = 2.5V ±5%, TA = 0°C to +70°C						

DC Buffer Characteristics for PCI_F, PCI (1:5)

Characteristic	Symbol	Min	Typ	Max	Units	Conditions
Pull-Up Current Min	IOH _{min}	-33	-	-	mA	Vout = 1.0 V
Pull-Up Current Max	IOH _{max}	-	-	-33	mA	Vout = 3.135 V
Pull-Down Current Min	IOL _{min}	30	-	-	mA	Vout = 1.95 V
Pull-Down Current Max	IOL _{max}	-	-	38	mA	Vout = 0.4 V
Rise Time Between 0.4 V and 2.4 V	TR	0.5	-	2.0	nS	30 pF Load
Fall Time Between 0.4 V and 2.4 V	TF	0.5	-	2.0	nS	30 pF Load
VDDP= VDDR =3.3V ±5%, VDDC = 2.5V ±5%, TA = 0°C to +70°C						



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Crystal and Reference Oscillator Parameters

Characteristic	Symbol	Min	Typ	Max	Units	Conditions
Frequency	F ₀	12.00	14.31818	16.00	MHz	
Tolerance	TC	-	-	+/-100	PPM	Calibration note 1
	TS	-	-	+/- 100	PPM	Stability (Ta -10 to +60C) note 1
Mode	OM	-	-	-		Parallel Resonant
Pin Capacitance	CP		5		pF	Capacitance of XIN and Xout pins
DC Bias Voltage	V _{BIAS}	0.3Vdd	Vdd/2	0.7Vdd	V	
Startup time	Ts	-	-	30	μS	
Load Capacitance	CL	-	20	-	pF	Note 1
Effective Series resistance	R1	-	-	40	Ohms	
Power Dissipation	DL	-	-	0.10	mW	Note 1
Shunt Capacitance	CO	-	--	7	pF	
X1 and X2 Load	CL		32		pF	Internal crystal loading capacitors on each pin (to ground)

For maximum accuracy, the total circuit loading capacitance should be equal to CL. This loading capacitance is the effective capacitance across the crystal pins and includes the device pin capacitance (CP) in parallel with any circuit traces, the clock generator and any onboard discrete load capacitors.

Budgeting Calculations

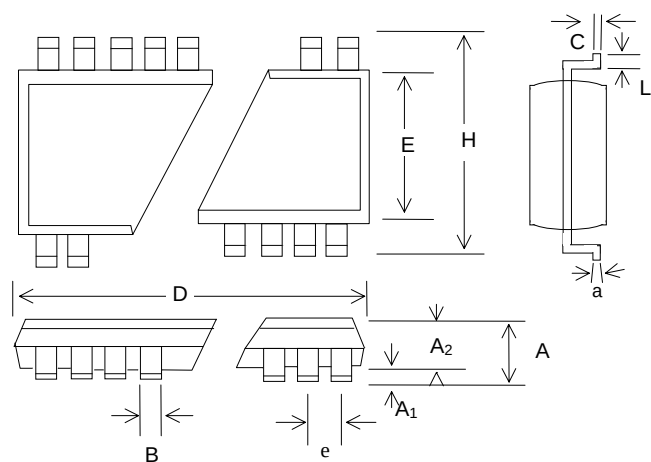
Typical trace capacitance, (< half inch) is 4 pF, Load to the crystal is therefore 2.0 pF
 Clock generator internal pin capacitance of 36 pF, Load to the crystal is therefore 18.0 pF
 the total parasitic capacitance would therefore be = 20.0 pF(matching CL)

Note 1: It is recommended but not mandatory that a crystal meets these specifications.

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Package Drawing and Dimensions



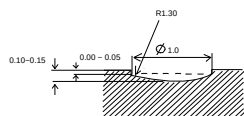
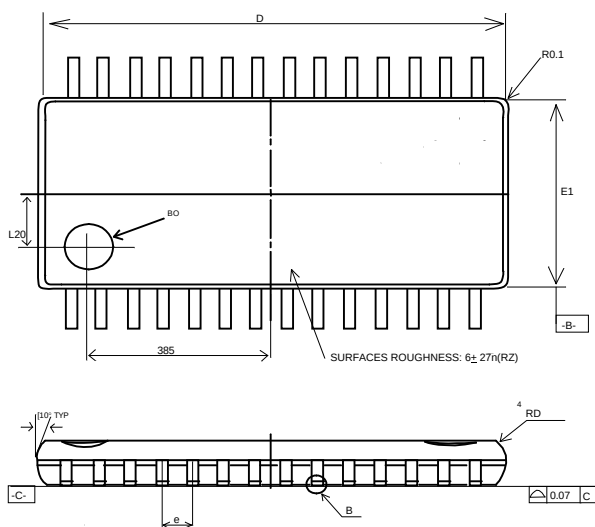
28 Pin SSOP Outline Dimensions

SYMBOL	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.068	0.073	0.078	1.73	1.86	1.99
A ₁	0.002	0.005	0.008	0.05	0.13	0.21
A ₂	0.066	0.068	0.070	1.68	1.73	1.78
B	0.010	0.012	0.015	0.25	0.30	0.38
C	0.005	0.006	0.009	0.13	0.15	0.22
D	0.397	0.402	0.407	10.07	10.20	10.33
E	0.205	0.209	0.212	5.20	5.30	5.38
e	0.0256 BSC			0.65 BSC		
H	0.301	0.307	0.311	7.65	7.80	7.90
a	0°	4°	8°	0°	4°	8°
L	0.022	0.030	0.037	0.55	0.75	0.95

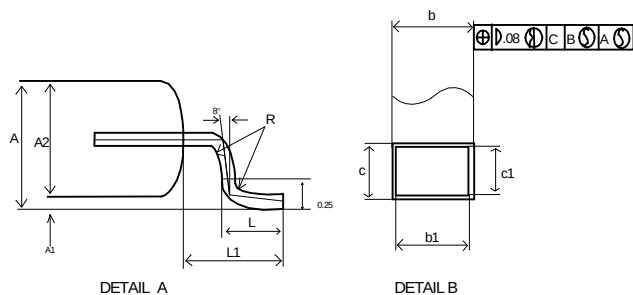
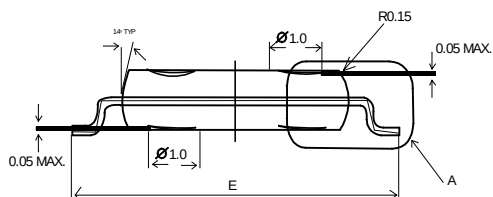
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Package Drawing and Dimensions (Cont.)



SECTION V-V



28 Pin TSSOP Dimensions

SYMBOL	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	-	-	0.047	-	-	1.20
A1	0.002	0.004	0.006	0.05	0.10	0.15
A2	0.037	0.039	0.041	0.95	1.00	1.05
L	0.019	0.023	0.029	0.50	0.60	0.75
L1	0.035	0.039	0.043	0.90	1.00	1.10
b	0.007	-	0.011	0.19	-	0.30
b1	0.007	0.008	0.010	0.19	0.22	0.25
c	0.004	-	0.007	0.105	-	0.175
c1	0.004	0.005	0.006	0.105	0.125	0.145
θ	0°	-	8°	0°	-	8°
e	0.026 BSC			0.65 BSC		
D	0.378	0.382	0.386	9.6	9.7	9.8
E	0.244	0.252	0.260	6.2	6.4	6.6
E1	0.169	0.173	0.177	4.3	4.4	4.5
R	0.035	-	-	0.9	-	-



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Ordering Information

Part Number	Package Type	Production Flow
IMIC9716CYB	28 PIN SSOP	Commercial, 0°C to +70°C
IMIC9716CTB	28 PIN TSSOP	Commercial, 0°C to +70°C

Note: The ordering part number is formed by a combination of device number, device revision, package style, and screening as shown below.

Marking: Example: IMI
C9716C
Date Code, Lot #

IMIC9716CYB

Flow	B = Commercial, 0°C to + 70°C
Package	Y = SSOP T = TSSOP
Revision	
IMI Device Number	