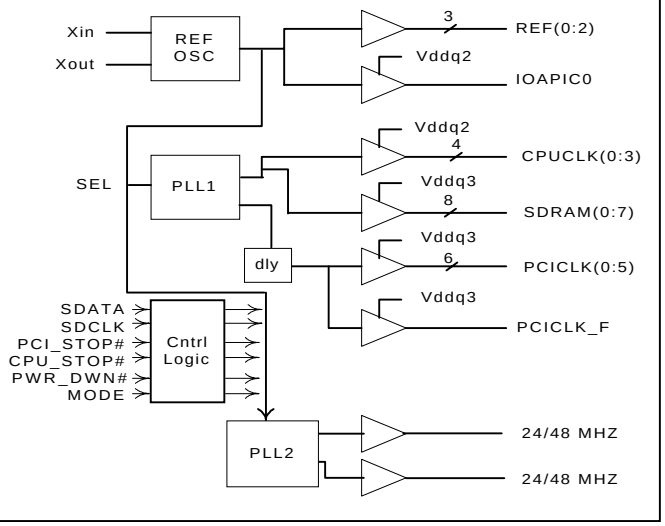
I²C Frequency Clock Generator w/ EMI Reduction Spread Spectrum Technology for Pentium® Processor Based Designs.

Preliminary

PRODUCT FEATURES

- Supports Pentium® and Mobil Pentium® Processor Designs.
- 4 CPU clocks up to 8 loads.
- Up to 8 SDRAM clocks for 2 DIMMs.
- Supports Power Management.
- 7 PCI synchronous clocks.
- Optional common or mixed supply mode:
- (Vdd = Vddq3 = Vddq2 = 3.3V) or
- (Vdd = Vddq3 = 3.3V, Vddq2 = 2.5V)
- < 250ps skew CPU and SDRAM clocks.
- < 500ps skew among PCI clocks.
- I²C 2-Wire serial interface
- Programmable registers featuring:
- - enable/disable each output pin
- - mode as tri-state, test, or normal
- - 24/48 MHz selections
- 1 IOAPIC clock for multiprocessor support.
- 48-pin SSOP package
- **Spread Spectrum** Technology for up to 13dB of EMI reduction

BLOCK DIAGRAM

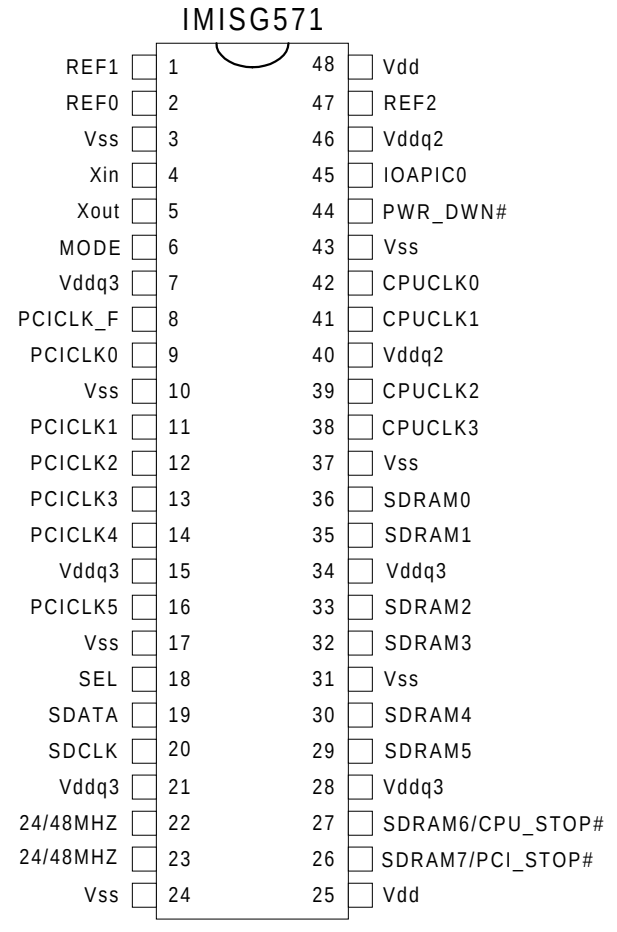


FREQUENCY TABLE

SEL	CPU	PCI
0	60.0	30.0
1	66.6*	33.3*

*Spread Spectrum mode capable

CONNECTION DIAGRAM



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PIN DESCRIPTION

Xin, Xout - These pins form an on-chip reference oscillator when connected to terminals of an external parallel resonant crystal (nominally 14.318 MHz). Xin may also serve as input for an externally generated reference signal.

SEL - Standard frequency select input. It has internal pull-up.

CPUCLK(0:3) - Low skew (<250 pS) clock outputs for host frequencies such as CPU, Chipset, Cache. Vddq2 is the supply voltage for these outputs.

SDRAM(0:5) - Synchronous DRAM DIMs clocks. They are powered by Vddq3.

SDRAM6/CPU_STOP# - If MODE=1, this pin is a Synchronous DRAM DIMs clock output powered by Vddq3. If MODE=0, this pin is a CPU_STOP# input signal, where a low level stops the CPU however, the SDRAM clocks will stay active. It has an internal pull-up.

SDRAM7/PCI_STOP# - If MODE=1, this pin is a Synchronous DRAM DIMs clock output powered by Vddq3. If MODE=0, this pin is a PCI_STOP# input signal, where a low level stops the PCI clocks. It has an internal pull-up.

MODE - A low level on this pin causes pins 26, and 27 to be power management inputs PCI_STOP#, and CPU_STOP# respectly. A high level on this pin causes pins 26, and 27 to be clock output signals SDRAM7, and SDRAM6 respectively. It has an internal pull-up resistor.

PCICLK(0:5) - Low skew (<250pS) clock outputs for PCI frequencies. These buffers voltage level is controlled by Vddq3

PCICLK_F - A PCI clock output that does not stop until in power down mode. It is synchronous with other PCI clocks.

REF(0:2) - Buffered outputs of on-chip reference.

IOAPIC0 - Buffered output of 14.3MHZ for multiprocessor support. It is powered by Vddq2.

PWR_DWN# - Power down pin. When this pin is asserted low, the IC is in shutdown mode where all circuitry is turned off including VCO, crystal buffer and PCICLK_F. It has an internal pull-up. The I^2C interface is disabled with the PWR_DWN# pin is low.

48/24MHz(0:1) - Programmable 48 MHZ or 24 MHZ clock outputs.

SDATA - serial data of I^2C 2-wire control interface. Has internal pull-up resistor.

SDCLK - serial clock of I^2C 2-wire control interface. Has internal pull-up resistor.

Vss - Ground pins for the chip.

Vdd - 3.3 Volt power supply pins for analog circuit and core logic.

Vddq3 - Power supply pins for 3.3V IO pins.

Vddq2 - Power supply pins for 2.5V/3.3V IO pins.

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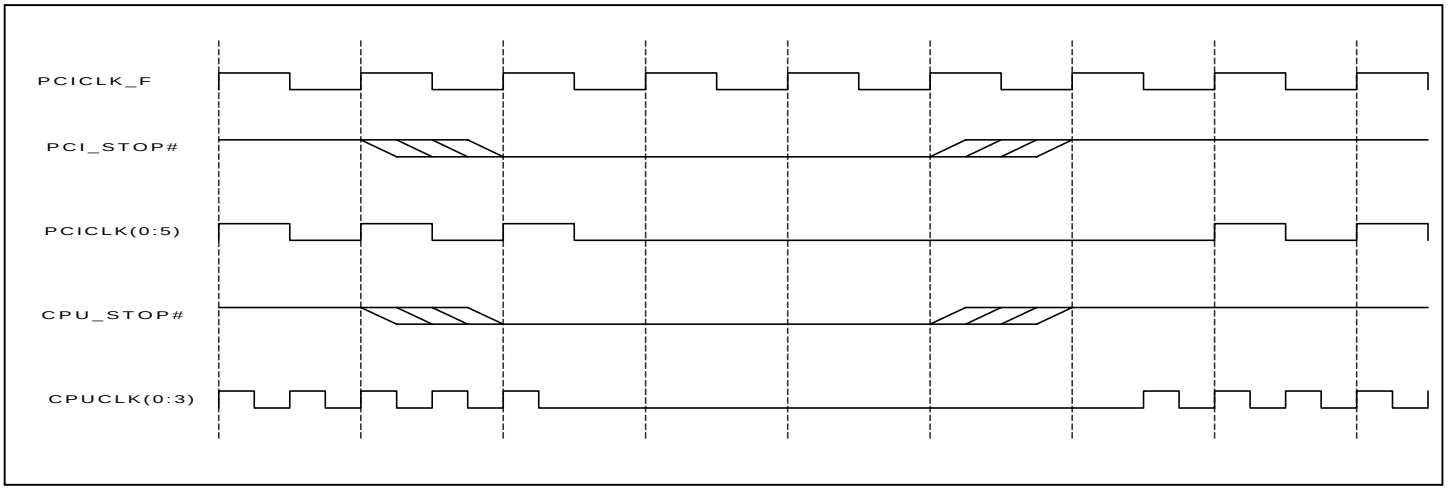
POWER MANAGEMENT FUNCTIONS

All clocks can be individually enabled or stopped via the 2-wire control interface. All clocks are stopped in the low state. All clocks maintain a valid high period on transitions from running to stopped and on transitions from stopped to running when the chip was not powered down. On power up, the VCOs will stabilize to the correct pulse widths within about 0.2 mS. The CPU, SDRAM, and PCI clocks transition between running and stopped by waiting for one positive edge on PCICLK_F followed by a negative edge on the clock of interest, after which high levels of the output are either enabled or disabled.

When MODE=0, pins 26 and 27 are inputs PCI_STOP# and CPU_STOP# respectively (when MODE=1, these functions are not available). A particular output is enabled only when both the serial interface and these pins indicate that it should be enabled. The IMISG571 clocks may be disabled according to the following table in order to reduce power consumption. All clocks are stopped in the low state. All clocks maintain a valid high period on transitions from running to stopped. On low to high transitions of PWR_DWN#, external circuitry should allow 0.2 mS for the VCOs to stabilize prior to assuming the clock periods are correct. The CPU and PCI clocks transition between running and stopped by waiting for one positive edge on PCICLK_F followed by a negative edge on the clock of interest, after which high levels of the output are either enabled or disabled.

CPU_STOP#	PCI_STOP#	PWR_DWN#	CPUCLK	PCICLK	OTHER CLKs	XTAL & VCOs
X	X	0	LOW	LOW	LOW	OFF
0	0	1	LOW	LOW	RUNNING	RUNNING
0	1	1	LOW	33/30 MHZ	RUNNING	RUNNING
1	0	1	66/60 MHZ	LOW	RUNNING	RUNNING
1	1	1	66/60 MHZ	33/30 MHZ	RUNNING	RUNNING

POWER MANAGEMENT TIMING



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2-WIRE I²C CONTROL INTERFACE

The 2-wire control interface implements a write only slave interface. The IMISG571 cannot be read back. Sub-addressing is not supported, thus all preceding bytes must be sent in order to change one of the control bytes. The 2-wire control interface allows each clock output to be individually enabled or disabled. It also allows 24/48 MHZ frequency selection and test mode enable.

During normal data transfer, the SDATA signal only changes when the SDCLK signal is low, and is stable when SDCLK is high. There are two exceptions to this. A high to low transition on SDATA while SDCLK is high is used to indicate the start of a data transfer cycle. A low to high transition on SDATA while SDCLK is high indicates the end of a data transfer cycle. Data is always sent as complete 8-bit bytes, after which an acknowledge is generated. The first byte of a transfer cycle is a 7-bit address with a Read/Write bit as the LSB. Data is transferred MSB first.

The device will respond to writes to 10 bytes (max) of data to address **D2** by generating the acknowledge (low) signal on the SDATA wire following reception of each byte. The device will not respond to any other control interface conditions. The I^2C interface is disabled when the PWR_DWN# pin is low. Previously set control registers are retained.

SERIAL CONTROL REGISTERS

NOTE: The Pin# column lists the affected pin number where applicable. The @Pup column gives the state at true power up. Bytes are set to the values shown only on true power up, and not when the PWR_DWN# pin is activated.

Following the acknowledge of the Address Byte (D2), two additional bytes must be sent:
1) "**Command Code** " byte, and
2) "**Byte Count**" byte.
Although the data (bits) in these two bytes are considered "don't care", they must be sent and will be acknowledged.

Byte 0: Function Select Register

Bit	@Pup	Pin#	Description
7	0	*	Reserved
6	0	*	Reserved
5	0	*	Reserved
4	0	*	Reserved
3	1	22	24/48 Mhz (a"1" sets the output to 48MHz, a "0" sets the output to 24MHz)
2	1	23	24/48 Mhz (a"1" sets the output to 48MHz, a "0" sets the output to 24MHz)
1 0	0 0		Bit1 Bit0 1 1 Tri-State 1 0 ***Spread Spectrum operating mode*** 0 1 Test Mode 0 0 Normal operating mode

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SERIAL CONTROL REGISTERS (Cont.)

Function Table

Function Description	Outputs						
	CPU	PCI	SDRAM	Ref	IOAPIC	24MHZ	48MHZ
Tri-State	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z
Test Mode	Tclk/2	Tclk/4	Tclk/2	Tclk	Tclk	Tclk/4	Tclk/2
Normal SEL=1	66	CPU/2	CPU	14.318	14.318	24	48
Normal SEL=0	60	CPU/2	CPU	14.318	14.318	24	48

Notes:
1. Tclk is a test clock over driven on the Xin input during test mode.
2. The frequency ratio Fout/Fin for the USB output is 3.35294.

Byte 1: CPU, 48/24 MHz Clock Register (1 = enable, 0 = Stopped)

Bit	@Pup	Pin#	Description
7	1	22	48/24 MHz enable/Stopped
6	1	23	48/24 MHz enable/Stopped
5	don't care	-	Reserved
4	don't care	-	Reserved
3	1	38	CPUCLK3 enable/Stopped
2	1	39	CPUCLK2 enable/Stopped
1	1	41	CPUCLK1 enable/Stopped
0	1	42	CPUCLK0 enable/Stopped

Byte 2: PCI Clock Register (1 = enable, 0 = Stopped)

Bit	@Pup	Pin#	Description
7	don't care	-	Reserved
6	1	8	PCICLK_F enable/Stopped
5	1	16	PCICLK5 enable/Stopped
4	1	14	PCICLK4 enable/Stopped
3	1	13	PCICLK3 enable/Stopped
2	1	12	PCICLK2 enable/Stopped
1	1	11	PCICLK1 enable/Stopped
0	1	9	PCICLK0 enable/Stopped

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SERIAL CONTROL REGISTERS(Continued)

Byte 3: SDRAM Clock Register (1 = enable, 0 = Stopped)

Bit	@Pup	Pin#	Description
7	1	26	SDRAM7 enable/Stopped
6	1	27	SDRAM6 enable/Stopped
5	1	29	SDRAM5 enable/Stopped
4	1	30	SDRAM4 enable/Stopped
3	1	32	SDRAM3 enable/Stopped
2	1	33	SDRAM2 enable/Stopped
1	1	35	SDRAM1 enable/Stopped
0	1	36	SDRAM0 enable/Stopped

Byte 4: Additional SDRAM Clock Register (1 = enable, 0 = Stopped)

Bit	@Pup	Pin#	Description
7	don't care	-	Reserved
6	don't care	-	Reserved
5	don't care	-	Reserved
4	don't care	-	Reserved
3	don't care	-	Reserved
2	don't care	-	Reserved
1	don't care	-	Reserved
0	don't care	-	Reserved

Byte 5: Peripheral Control (1 = enable, 0 = Stopped)

Bit	@Pup	Pin#	Description
7	don't care	-	Reserved
6	don't care	-	Reserved
5	1	-	Reserved
4	1	45	IOAPIC0 enable/Stopped
3	don't care	-	Reserved
2	1	47	REF2 enable/Stopped
1	1	1	REF1 enable/Stopped
0	1	2	REF0 enable/Stopped

I²C Frequency Clock Generator w/ EMI Reduction Spread Spectrum Technology for Pentium® Processor Based Designs.

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SERIAL CONTROL REGISTERS(Continued)

Byte 6: Reserved Register

Bit	@Pup	Pin#	Description
7	don't care	-	Reserved
6	don't care	-	Reserved
5	don't care	-	Reserved
4	don't care	-	Reserved
3	don't care	-	Reserved
2	don't care	-	Reserved
1	don't care	-	Reserved
0	don't care	-	Reserved

Byte 7: Frequency Control

Bit	@Pup	Description
7	don't care	Reserved
6	don't care	Reserved
5	don't care	Reserved
4	don't care	Reserved
3	don't care	Reserved
2	1	Reserved
1	don't care	Reserved
0	don't care	Reserved

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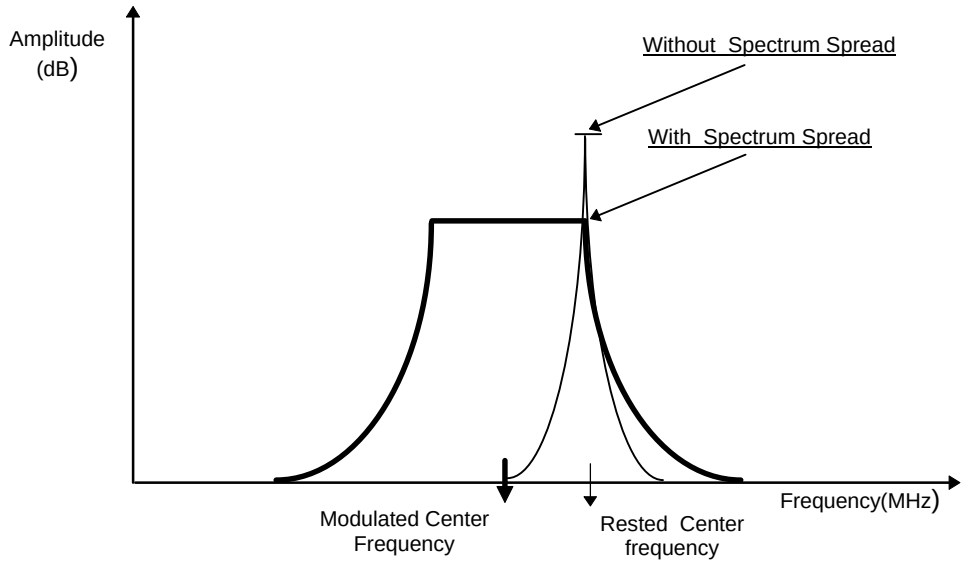
SPREAD SPECTRUM CLOCK GENERATION (SSCG)

Spread Spectrum is a modulation technique applied here for maximum efficiency in minimizing Electro-Magnetic Interference radiation generated from repetitive digital signals mainly clocks. A clock accumulates EM energy at the center frequency it is generating. Spread Spectrum distributes this energy over a small frequency bandwidth therefore spreading the same amount of energy over a spectrum. This technique is achieved by modulating the clock down from its resting frequency by a certain percentage (which also determines the energy distribution bandwidth). In this product, the modulation is 1.0% down from the resting frequency.



Spectrum Analysis

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MAXIMUM RATINGS

Voltage Relative to VSS:	-0.3V
Voltage Relative to VDD:	0.3V
Storage Temperature:	-65ºC to + 150ºC
Operating Temperature:	0ºC to +70ºC
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 and Vout should be constrained to the range:

VSS<(Vin or Vout)<VDD

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

ELECTRICAL CHARACTERISTICS

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	@3.465 volts
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	Idd	-	-	100	mA	CPU = 66.6 MHz, PCI = 33.3 MHz
Static Supply Current	Isdd	-	-	1	mA	Powered Down = Active
Short Circuit Current	ISC	25	-	-	mA	1 output at a time - 30 seconds

VDD = VDDQ3 =3.3V ±5***%, VDDQ2 = 2.5V***±5***% , TA = 0ºC to +70ºC***

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SWITCHING CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Units	Conditions
Output Duty Cycle	-	45	50	55	%	Measured at 1.5V
CPU to PCI Offset	tOFF	1	-	4	ns	15 pf Load Measured at 1.5V
Buffer out Skew All CPU Buffer Outputs	tSKEW	-	-	250	ps	15 pf Load Measured at 1.5V
ΔPeriod Adjacent Cycles	ΔP	-	-	±250	ps	-
Jitter Spectrum 20 dB Bandwidth from Center	BW_J			500	KHz	
Overshoot/Undershoot Beyond Power Rails	V_{over}	-	-	1.5	V	22 ohms @ source of 8 inch PCB run to 15 pf load
Ring Back Exclusion	V_{RBE}	0.7		2.1	V	note1

VDD = VDDQ3 =3.3V ±5%, VDDQ2 = 2.5V±5% , TA = 0ºC to +70ºC

note 1: Ring Back must not enter this range.

TB40 TYPE BUFFER CHARACTERISTICS FOR CPUCLK(0:3), IOAPIC

Characteristic	Symbol	Min	Typ	Max	Units	Conditions
Pull-Up Current	IOH	22	-	31	mA	Vout = VDDQ2 -.5V
Pull-Up Current	IOH	37	-	56	mA	Vout = 1.25V
Pull-Down Current	IOL	30	-	41	mA	Vout = 0.4V
Pull-Down Current	IOL	75	-	102	mA	Vout = 1.2V
Rise/Fall Time Max Between 0.4 V and 2.0 V	TRF_{max}	0.4	-	2.0	nS	20 pF Load

VDD = VDDQ3 =3.3V ±5%, VDDQ2 = 2.5V±5% , TA = 0ºC to +70ºC

TB5L TYPE BUFFER CHARACTERISTICS FOR REF(1:2) and 48/24 MHz

Characteristic	Symbol	Min	Typ	Max	Units	Conditions
Pull-Up Current	IOH	13	-	17	mA	Vout = VDDQ3 - .5V
Pull-Up Current	IOH	30	-	44	mA	Vout = 1.5V
Pull-Down Current	IOL	13	-	19	mA	Vout = 0.4V
Pull-Down Current	IOL	32	-	44	mA	Vout = 1.5V
Rise/Fall Time Max Between 0.4 V and 2.4 V	TRF_{max}	1.0	-	2.0	nS	20 pF Load

VDD = VDDQ3 =3.3V ±5%, VDDQ2 = 2.5V±5% , TA = 0ºC to +70ºC

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TB40 TYPE BUFFER CHARACTERISTICS FOR SDRAM(0:7)						
Characteristic	**Symbol**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Pull-Up Current	IOH	30	-	39	mA	Vout = VDDQ3 - .5V
Pull-Up Current	IOH	75	-	109	mA	Vout = 1.5V
Pull-Down Current	IOL	30	-	40	mA	Vout = 0.4V
Pull-Down Current	IOL	75	-	103	mA	Vout = 1.2V
Rise/Fall Time Max Between 0.4 V and 2.4 V	TRF_{max}	0.5	-	2.0	nS	20 pF Load
VDD = VDDQ3 =3.3V ±5%, VDDQ2 = 2.5V±5% , TA = 0ºC to +70ºC						

TYPE 4 BUFFER CHARACTERISTICS FOR PCICLK [0:5], F)						
Characteristic	**Symbol**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Pull-Up Current	IOH	18	-	23	mA	Vout = VDDQ3 - .5V
Pull-Up Current	IOH	44	-	64	mA	Vout = 1.5V
Pull-Down Current	IOL	18	-	25	mA	Vout = 0.4V
Pull-Down Current	IOL	50	-	70	mA	Vout = 1.5V
Rise/Fall Time Max Between 0.4 V and 2.4 V	TRF_{max}	0.5	-	2.0	nS	30 pF Load
VDD = VDDQ3 =3.3V ±5%, VDDQ2 = 2.5V±5% , TA = 0ºC to +70ºC						

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CRYSTAL AND REFERENCE OSCILLATOR PARAMETERS						
Characteristic	**Symbol**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Frequency	F_o	12.00	14.31818	16.00	MHz	
Tolerence	TC	-	-	+/-100	PPM	Calibration note 1
	TS	-	-	+/- 100	PPM	Stability (Ta -10 to +60C) note 1
	TA	-	-	5	PPM	Aging (first year @ 25C) note 1
Mode	OM	-	-	-		Parallell Resonant
Pin Capacitance	CP		6		pF	Capacitance of XIN and Xout pins to ground (each)
DC Bias Voltage	V_{BIAS}	0.3Vdd	Vdd/2	0.7Vdd	V	
Startup time	Ts	-	-	30	µS	
Load Capacitance	CL	-	20	-	pF	the crystals rated load. note 1
Effective Series resonant resistance	R1	-	-	40	Ohms	
Power Dissipation	DL	-	-	0.10	mW	note 1
Shunt Capacitance	CO	-	--	8	pF	crystals internal package capacitance (total)

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 3.0 pF

External crystal loading capacitors (connect to ground) 15.0 pF

the total parasitic capacitance would therefore be = 20.0.0 pF.

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

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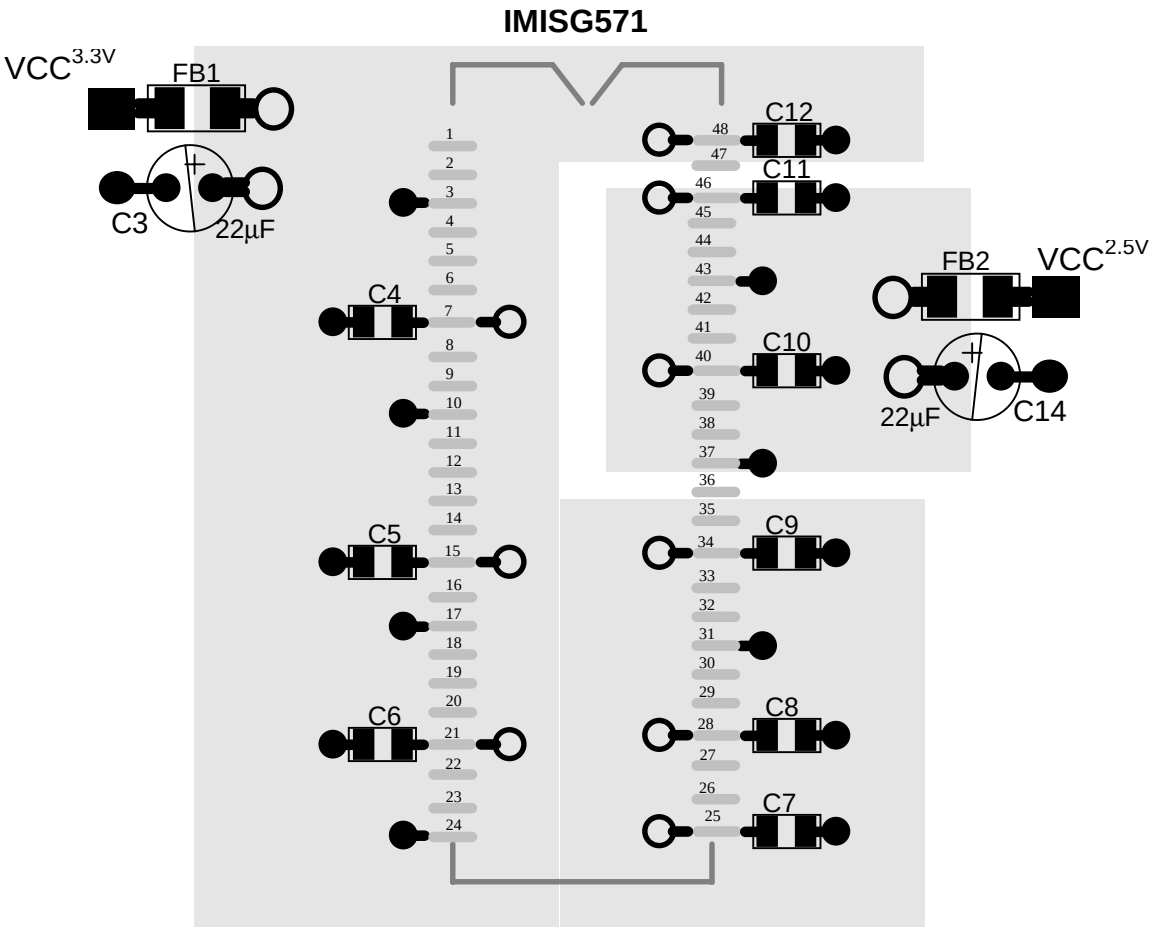
PCB LAYOUT SUGGESTION

Via to VDD Island

Via to GND plane



This is only a layout recommendation for best performance and lower EMI. The designer may choose a different approach but C4, C5, C6, C7, C8, C9, C10, C11and C12 (all are 0.1µf) should always be used and placed close to their VDD pins.

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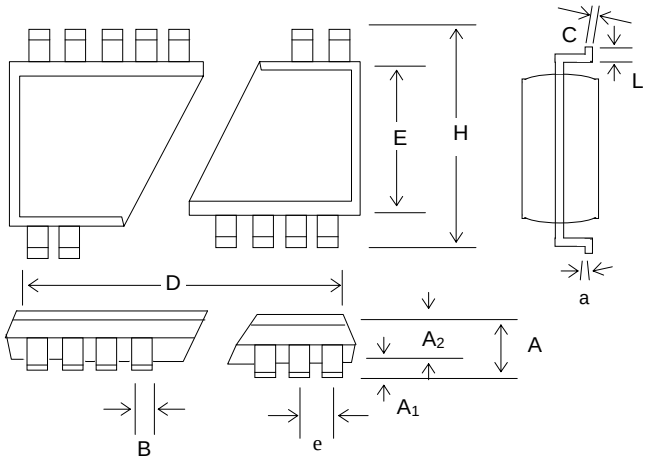
PACKAGE DRAWING AND DIMENSIONS



48 PIN SSOP OUTLINE DIMENSIONS

SYMBOL	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.095	0.102	0.110	2.41	2.59	2.79
A_1	0.008	0.012	0.016	0.20	0.31	0.41
A2	0.085	0.090	0.095	2.16	2.29	2.41
b	0.008	0.010	0.0135	0.203	0.254	0.343
c	0.005	.008	0.010	0.127	0.20	0.254
D	0.620	0.625	0.637	15.75	15.88	16.18
E	0.291	0.295	0.299	7.39	7.49	7.59
e	0.0256 BSC			0.640 BSC		
H	0.395	0.408	0.420	10.03	10.36	10.67
L	0.024	0.030	0.040	0.61	0.76	1.02
a	0º	4º	8º	0º	4º	8º

ORDERING INFORMATION

Part Number	Package Type	Production Flow
IMISG571BYB	48 PIN SSOP	Commercial, 0ºC to +70ºC

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
SG571BYB
Date Code, Lot #

IMISG571BYB

- Flow
  B = Commercial, 0ºC to + 70ºC
- Package
  Y = SSOP
- Revision
- IMI Device Number