

## Description

The 5PB12xx is a high-performance TCXO/LVCMOS clock fanout buffer family with individual OE pin for each output. The CLKIN pin can accept either a square wave (LVCMOS) or clipped sine wave (such as TCXO clipped sine wave output) as input.

There are 3 different fan-out versions available: 1:3, 1:4 and 1:6.

The 5PB12xx has industry-leading low jitter and extremely low current consumption, making it ideal for smart mobile devices.

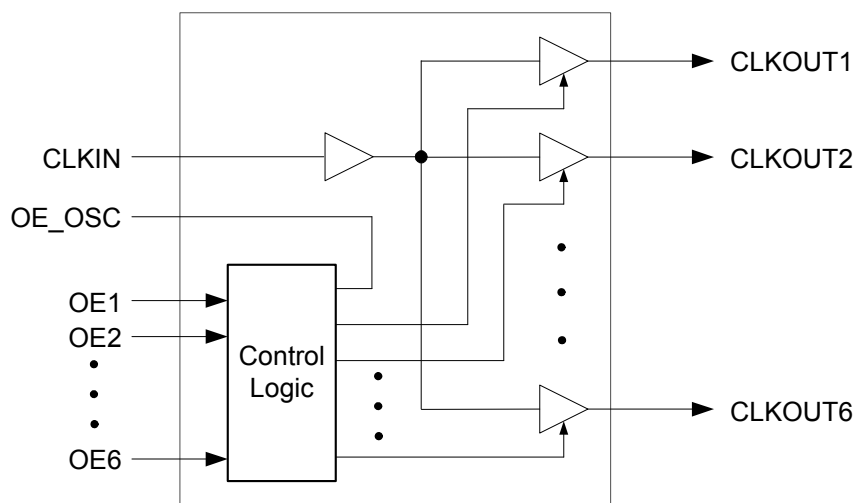
## Applications

- Smart Mobile Handsets
- RF and baseband peripheral clock distribution
- Automotive

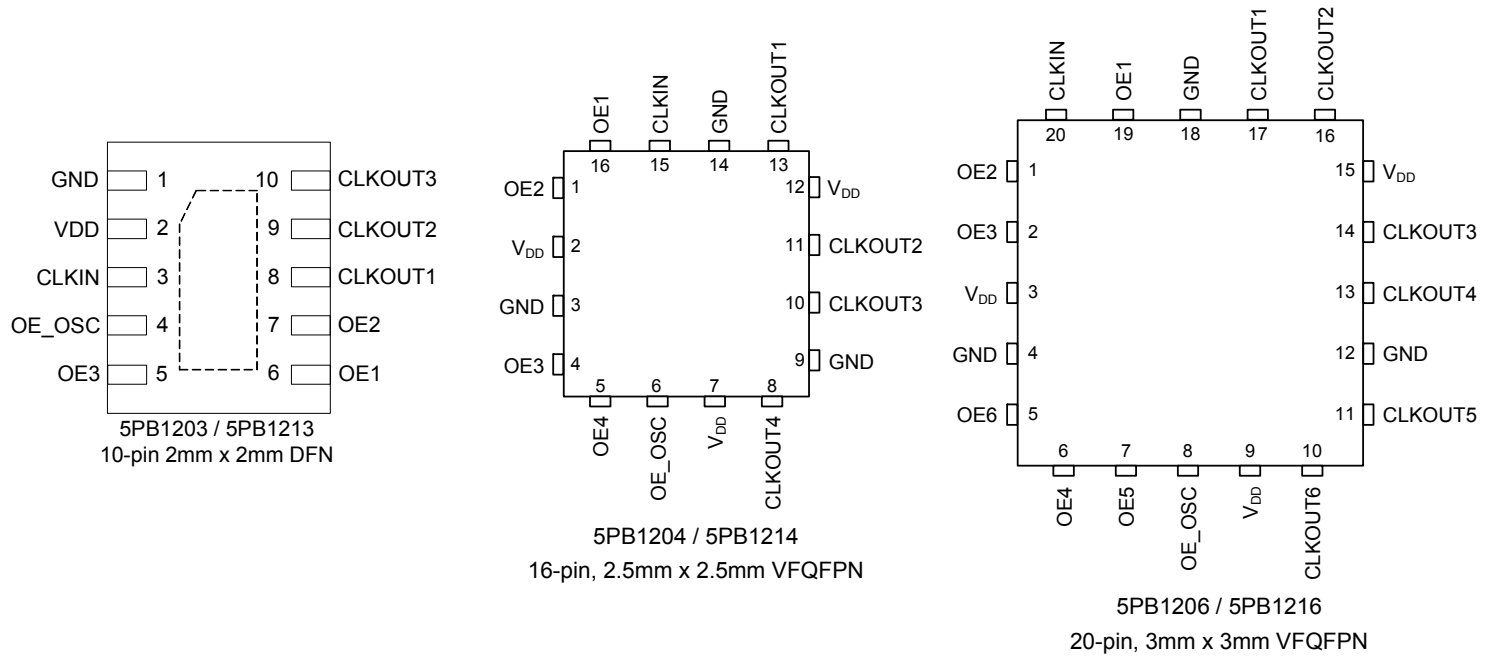
## Features

- Extremely low operating and standby current consumption
- Low RMS Additive Phase jitter
- Family supports 1.8V to 3.3V power supply voltage:
  - For 1.8V supply: 5PB1203, 5PB1204, 5PB1206
  - For 2.5V / 3.3V supply: 5PB1213, 5PB1214, 5PB1216
- Three, four, and six outputs with individual Output Enable pin
- One input
- OE\_osc control pin to enable/disable reference TCXO/XO
- Small 10-pin, 16-pin and 20-pin packages available
- Industrial -40° to +105°C temperature range

## Block Diagram



## Pin Assignments



## Pin Descriptions

Pin Name	Pin Number			Pin Type	Pin Description
	5PB1203 5PB1213	5PB1204 5PB1214	5PB1206 5PB1216		
VDD	2	2, 7, 12	3, 9, 15	Power	Connect 1.8V to 5PB1203/5PB1204/5PB1206. Connect 2.5V or 3.3V to 5PB1213/5PB1214/5PB1216.
GND	1	3, 9, 14	4, 12, 18	Power	Power supply ground.
CLKIN	3	15	20	Input	Reference input pin. Connect to LVCMOS input or TCXO.
OE_osc	4	6	8	Output	Input Crystal Oscillator enable pin. Follow Enable Function Truth Table. If all OE pins are low then OE_osc is low. Otherwise OE_osc is high, enabling reference crystal oscillator.
OE1	6	16	19	Input	Output Enable pin for CLKOUT1. Active High. Internal 120kΩ pull-down.
OE2	7	1	1	Input	Output Enable pin for CLKOUT2. Active High. Internal 120kΩ pull-down.
OE3	5	4	2	Input	Output Enable pin for CLKOUT3. Active High. Internal 120kΩ pull-down.
OE4	—	5	6	Input	Output Enable pin for CLKOUT4. Active High. Internal 120kΩ pull-down.
OE5	—	—	7	Input	Output Enable pin for CLKOUT5. Active High. Internal 120kΩ pull-down.
OE6	—	—	5	Input	Output Enable pin for CLKOUT6. Active High. Internal 120kΩ pull-down.
CLKOUT1	8	13	17	Output	Clock Output 1. Same frequency as CLKIN.
CLKOUT2	9	11	16	Output	Clock Output 2. Same frequency as CLKIN.
CLKOUT3	10	10	14	Output	Clock Output 3. Same frequency as CLKIN.
CLKOUT4	—	8	13	Output	Clock Output 4. Same frequency as CLKIN.
CLKOUT5	—	—	11	Output	Clock Output 5. Same frequency as CLKIN.
CLKOUT6	—	—	10	Output	Clock Output 6. Same frequency as CLKIN.

## Enable Function Truth Table

Input						Output						
OE1	OE2	OE3	OE4	OE5	OE6	OE_OSC	CLKOUT1	CLKOUT2	CLKOUT3	CLKOUT4	CLKOUT5	CLKOUT6
0	0	0	0	0	0	0	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z
1	0	0	0	0	0	1	CLOCK	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z
1	1	0	0	0	0	1	CLOCK	CLOCK	Hi-Z	Hi-Z	Hi-Z	Hi-Z
...	...	...	...	...	...	...	...	...	...	...	...	...
1	1	1	1	1	1	1	CLOCK	CLOCK	CLOCK	CLOCK	CLOCK	CLOCK

## External Components

A minimum number of external components are required for proper operation. A decoupling capacitor of 0.01  $\mu$ F should be connected between VDD on pin 1 and GND on pin 4, as close to the device as possible. A 33  $\Omega$  series terminating resistor may be used on each clock output if the trace is longer than 1 inch.

To achieve the low output skew that the 5PB12xx is capable of, careful attention must be paid to board layout. Essentially, all four outputs must have identical terminations, identical loads and identical trace geometries. If they do not, the output skew will be degraded. For example, using a 30 $\Omega$  series termination on one output (with 33 $\Omega$  on the others) will cause at least 15 ps of skew.

## Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the 5PB12xx. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

Item	Rating
Supply Voltage, VDD	3.465V
Output Enable and All Inputs/Outputs	-0.5 V to VDD+0.5 V
Ambient Operating Temperature (extended)	-40 to +105°C
Storage Temperature	-65 to +150°C
Junction Temperature	125°C
Soldering Temperature	260°C

## DC Electrical Characteristics

(VDD = 1.8V, 2.5V, 3.3V)

**VDD=1.8V ±5%**, Ambient temperature -40° to +105°C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		1.7		1.9	V
Input High Voltage, CLKIN	V <sub>IH</sub>	LVC MOS input. Note 1	0.7xVDD		VDD	V
Input Low Voltage, CLKIN	V <sub>IL</sub>	LVC MOS input. Note 1			0.3xVDD	V
Input High Voltage, OE	V <sub>IH</sub>		0.7xVDD		VDD	V
Input Low Voltage, OE	V <sub>IL</sub>				0.3xVDD	V
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -4mA	0.8xVDD			V
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 4mA			0.2xVDD	V
Nominal Output Impedance	Z <sub>O</sub>			17		Ω
Input Capacitance	C <sub>IN</sub>			5		pF
Operating Supply Current						
5PB1203	IDD	CLKIN=26MHz, all outputs enabled		5.10		mA
		CLKIN=Low or High, all outputs disabled		0.02	0.03	
5PB1204		CLKIN=26MHz, all outputs enabled		8.30		
		CLKIN=Low or High, all outputs disabled		2.51	2.52	
5PB1206		CLKIN=26MHz, all outputs enabled		11.90		
		CLKIN=Low or High, all outputs disabled		2.5	2.6	

**VDD=2.5 V ±5%**, Ambient temperature -40° to +105°C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		2.375		2.625	V
Input High Voltage, CLKIN	V <sub>IH</sub>	LVC MOS input. Note 1	0.7xVDD		VDD	V
Input Low Voltage, CLKIN	V <sub>IL</sub>	LVC MOS input. Note 1			0.3xVDD	V
Input High Voltage, OE	V <sub>IH</sub>		0.7xVDD		VDD	V
Input Low Voltage, OE	V <sub>IL</sub>				0.3xVDD	V
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -4mA	0.8xVDD			V
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 4mA			0.2xVDD	V
Nominal Output Impedance	Z <sub>O</sub>			17		Ω
Input Capacitance	C <sub>IN</sub>	ICLK, OE pin		5		pF
Operating Supply Current						
5PB1213	IDD	CLKIN=26MHz, all outputs enabled		6.68		mA
		CLKIN=Low or High, all outputs disabled		0.05	0.31	
5PB1214		CLKIN=26MHz, all outputs enabled		10.2		
		CLKIN=Low or High, all outputs disabled		3.47	3.47	
5PB1216		CLKIN=26MHz, all outputs enabled		16.5		
		CLKIN=Low or High, all outputs disabled		3.50	3.60	

**VDD=3.3 V  $\pm$ 5%** , Ambient temperature -40° to +105°C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		3.15		3.45	V
Input High Voltage, CLKIN	V <sub>IH</sub>	LVC MOS input. Note 1	0.7xVDD		VDD	V
Input Low Voltage, CLKIN	V <sub>IL</sub>	LVC MOS input. Note 1			0.3xVDD	V
Input High Voltage, OE	V <sub>IH</sub>		0.7xVDD		VDD	V
Input Low Voltage, OE	V <sub>IL</sub>				0.3xVDD	V
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -4mA	0.8xVDD			V
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 4mA			0.2xVDD	V
Nominal Output Impedance	Z <sub>O</sub>			17		Ω
Input Capacitance	C <sub>IN</sub>	ICLK, OE pin		5		pF
Operating Supply Current						
5PB1213	IDD	CLKIN=26MHz, all outputs enabled		9.10		mA
		CLKIN=Low or High, all outputs disabled		0.22	0.25	
5PB1214		CLKIN=26MHz, all outputs enabled		13.4		
		CLKIN=Low or High, all outputs disabled		4.28	4.45	
5PB1216		CLKIN=26MHz, all outputs enabled		21.4		
		CLKIN=Low or High, all outputs disabled		4.60	5.60	

Notes: 1. Nominal switching threshold is VDD/2

## AC Electrical Characteristics

(VDD = 1.8V, 2.5V, 3.3V)

**VDD = 1.8V ±5%**, For **5PB1203 / 1204 / 1206**, ambient Temperature -40° to +105°C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Frequency			0		200	MHz
Output Rise Time	$t_{OR}$	0.36 to 1.44 V, $C_L=5$ pF		0.6	1.0	ns
Output Fall Time	$t_{OF}$	1.44 to 0.36 V, $C_L=5$ pF		0.6	1.0	ns
Propagation Delay	Note 1	Note 1	2.5	3	3.5	ns
Buffer Additive Phase Jitter, RMS		26MHz TCXO clipped sine wave input, Integration Range: 12KHz to 20MHz		420		fs
		125MHz LVCMOS input, Integration Range: 12KHz to 20MHz		42		fs
Output to Output Skew	$t_{SKEWO-O}$	Note 2, Rising edges at VDD/2		50	65	ps
Device to Device Skew	$t_{SKEWD-D}$	Rising edges at VDD/2			200	ps
Delay for Output Enable / Disable Time ENABLEx to BCLKn	$t_{EN}/t_{DIS}$	CL < 5 pF			3	cycles
Start-up Time	$t_{START-UP}$				2	ms
TCXO Clock Clipped Sine Wave Input Voltage Swing Level	VIN <sub>pp</sub>	VDD = 1.8V, should connect to CLKIN through AC coupling and bias circuit		0.8		V

**VDD = 2.5 V ±5%**, For **5PB1213 / 1214 / 1216**, ambient Temperature -40° to +105°C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Frequency			0		200	MHz
Output Rise Time	$t_{OR}$	0.5 to 2.0 V, $C_L=5$ pF		0.6	1.0	ns
Output Fall Time	$t_{OF}$	2.0 to 0.5 V, $C_L=5$ pF		0.6	1.0	ns
Propagation Delay	Note 1	Note 1	3	3.5	4	ns
Buffer Additive Phase Jitter, RMS		26MHz TCXO clipped sine wave input, Integration Range: 12KHz to 20MHz		280		fs
		125MHz LVCMOS input, Integration Range: 12KHz to 20MHz		30		fs
Output to Output Skew	$t_{SKEWO-O}$	Note 2, Rising edges at VDD/2		40	65	ps
Device to Device Skew	$t_{SKEWD-D}$	Rising edges at VDD/2			200	ps
Delay for Output Enable / Disable Time ENABLEx to BCLKn	$t_{EN}/t_{DIS}$	CL < 5 pF			3	cycles
Start-up Time	$t_{START-UP}$	Part start-up time for valid outputs after VDD ramp-up			2	ms
TCXO Clock Clipped Sine Wave Input Voltage Swing Level	VIN <sub>pp</sub>	VDD = 2.5V, should connect to CLKIN through AC coupling and bias circuit		0.8		V

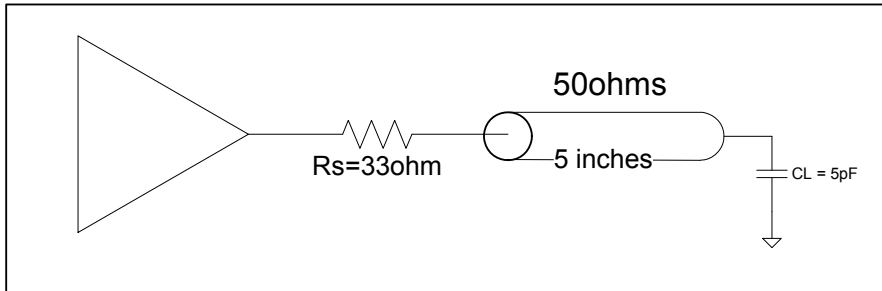
**VDD = 3.3 V  $\pm$ 5%**, For 5PB1213 / 1214 / 1216, ambient Temperature -40° to +105°C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Frequency			0		200	MHz
Output Rise Time	$t_{OR}$	0.5 to 2.0 V, $C_L=5$ pF		0.6	1.0	ns
Output Fall Time	$t_{OF}$	2.64 to 0.66 V, $C_L=5$ pF		0.6	1.0	ns
Propagation Delay	Note 1	Note 1	2.5	3	3.5	ns
Buffer Additive Phase Jitter, RMS		26MHz TCXO clipped sine wave input, Integration Range: 12KHz to 20MHz		377		fs
		125MHz LVCMOS input, Integration Range: 12KHz to 20MHz		18		fs
Output to Output Skew	$t_{SKEWO-O}$	Note 2, Rising edges at VDD/2		25	65	ps
Device to Device Skew	$t_{SKEWD-D}$	Rising edges at VDD/2			200	ps
Delay for Output Enable / Disable Time ENABLEx to BCLKn	$t_{EN}/t_{DIS}$	$CL < 5$ pF			3	cycles
Start-up Time	$t_{START-UP}$	Part start-up time for valid outputs after VDD ramp-up			2	ms
TCXO Clock Clipped Sine Wave Input Voltage Swing Level	$V_{IN_{pp}}$	VDD = 3.3V, should connect to CLKIN through AC coupling and bias circuit		0.5		V

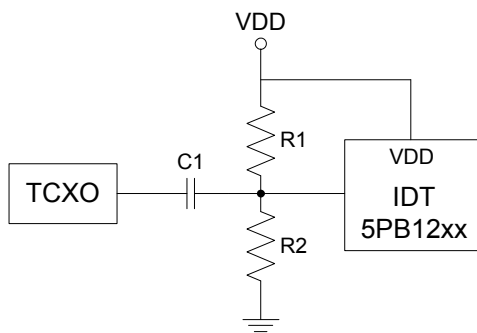
Notes:

1. With rail to rail input clock
2. Between any 2 outputs with equal loading.
3. Duty cycle on outputs will match incoming clock duty cycle. Consult IDT for tight duty cycle clock generators.

## Test Load and Circuit

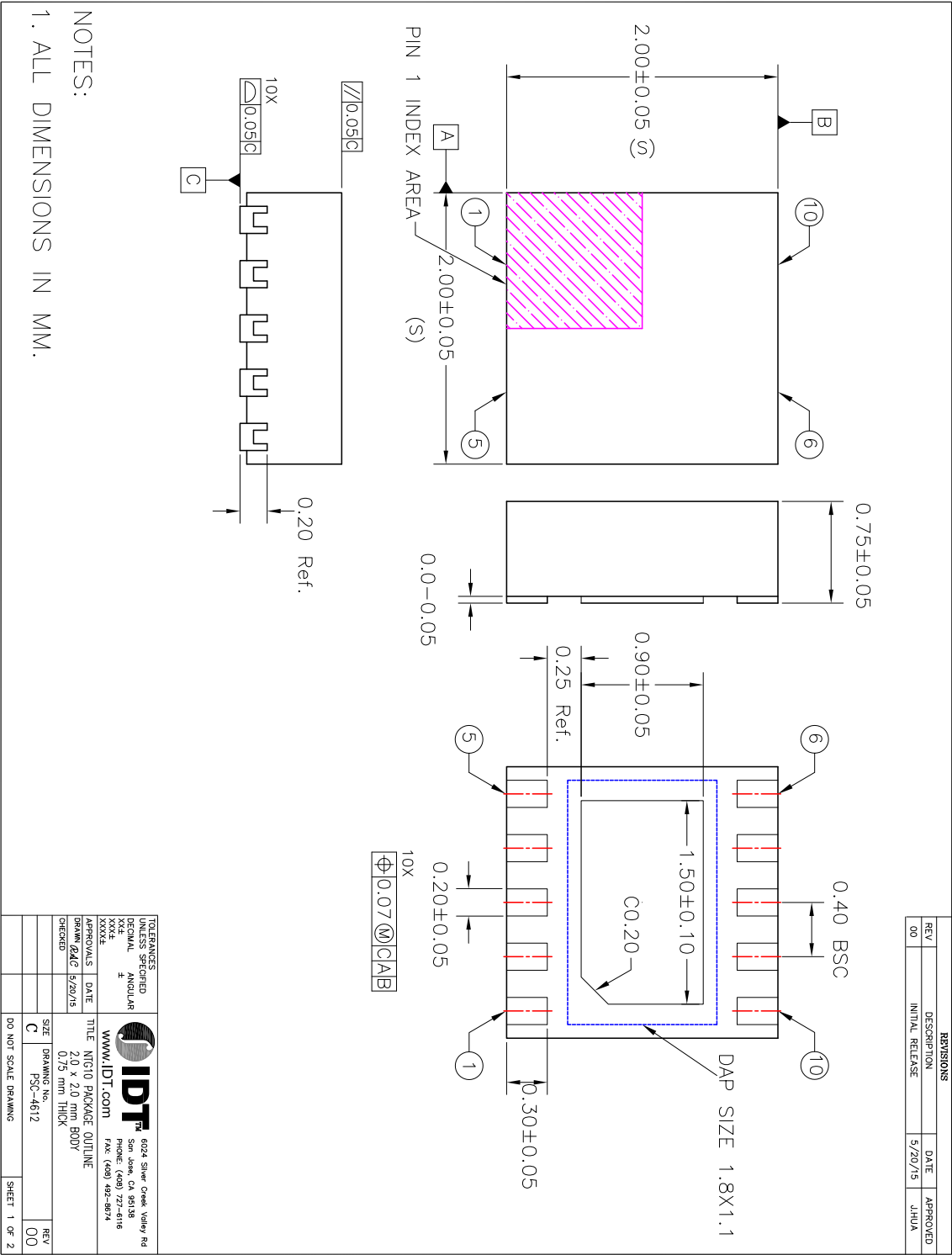


## AC Coupling and Bias Circuit

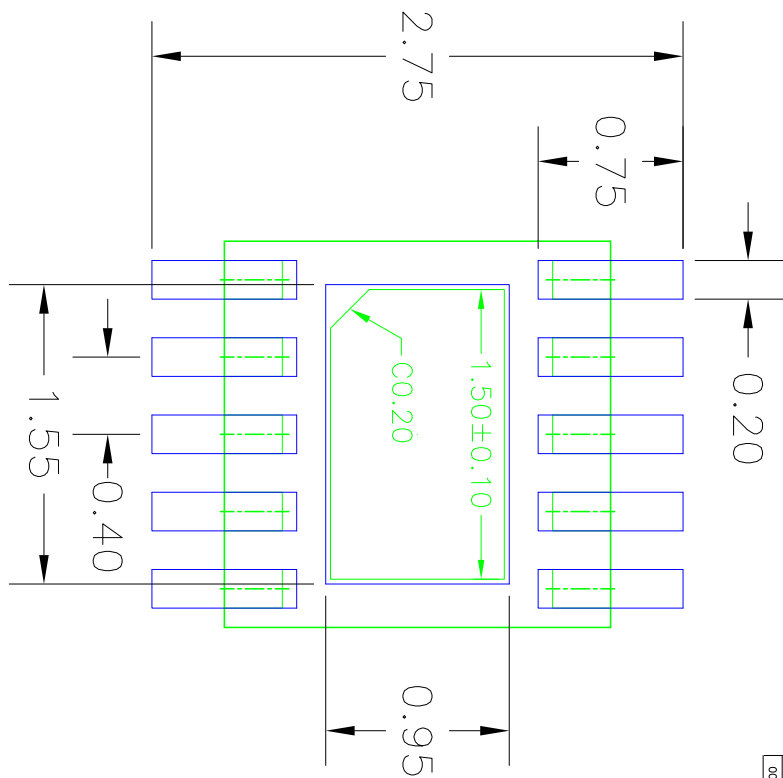


Component	Value
C1	1 $\mu$ F
R1	10k
R2	10k

Package Outline and Dimensions (5PB1203 / 5PB1213 10-pin DFN)





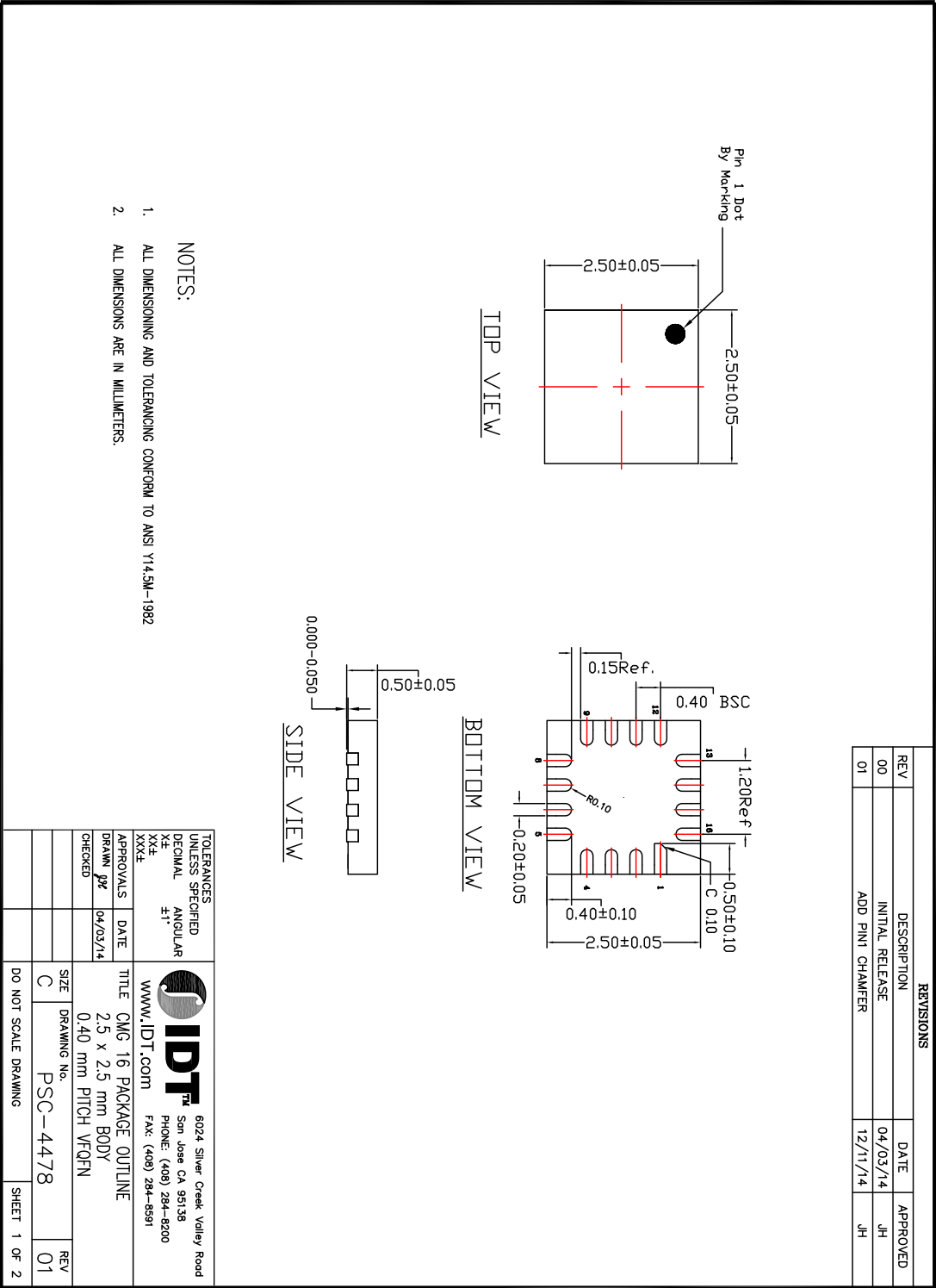


1. ALL DIMENSIONS ARE IN MM. ANGLES IN DEGREES.
2. TOP DOWN VIEW. AS VIEWED ON PCB.
3. COMPONENT OUTLINE IS SHOWN FOR REFERENCE IN GREEN.
4. LAND PATTERN IN BLUE. NSMD PATTERN ASSUMED.
5. LAND PATTERN RECOMMENDATION PER IPC-7351B. GENERIC REQUIREMENT FOR SURFACE MOUNT DESIGN AND LAND PATTERN.

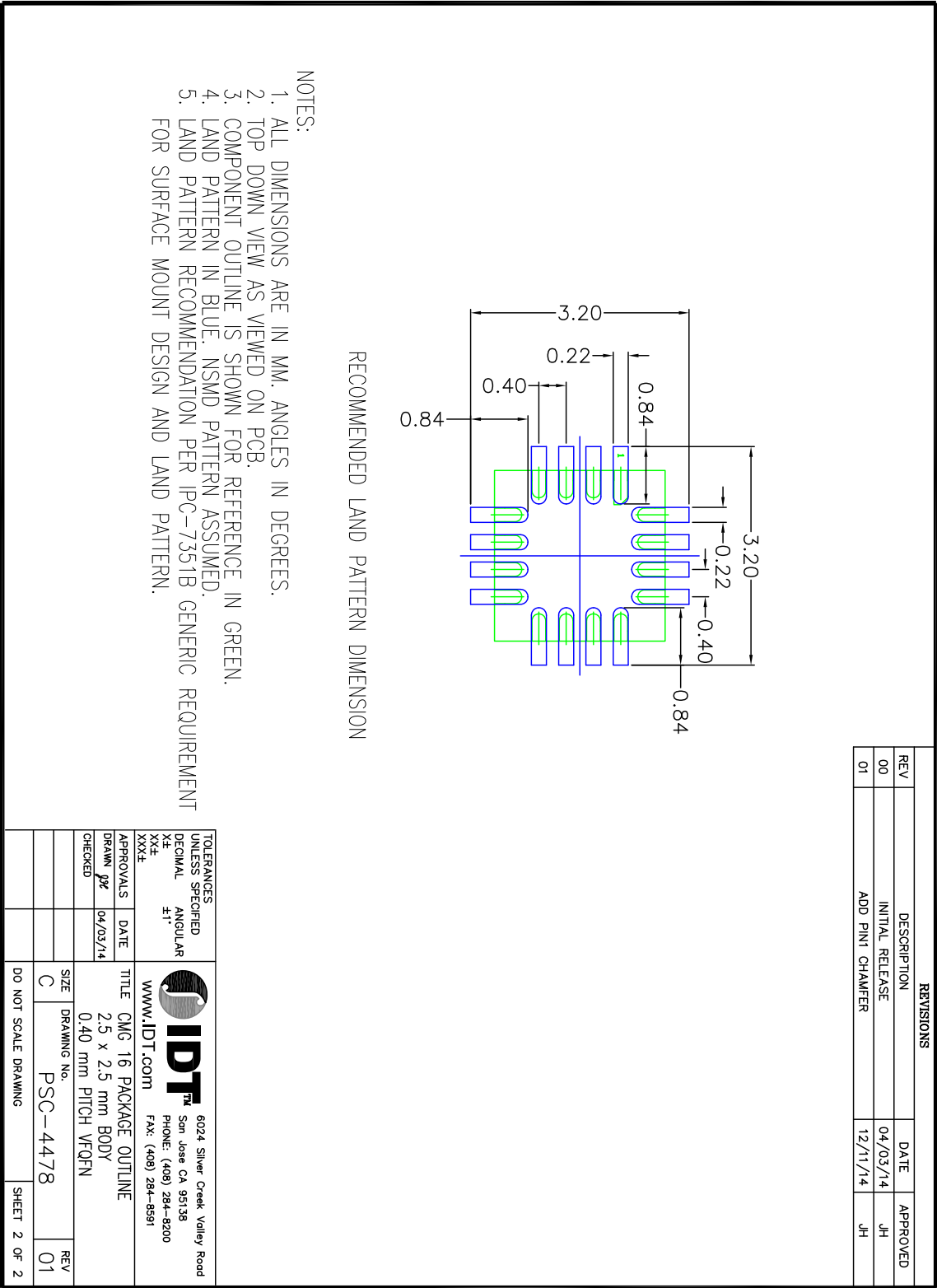
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
00	INITIAL RELEASE	5/20/15	J.HUA

TOLERANCES UNLESS SPECIFIED		<b>IDT<sup>®</sup></b>		8024 Shaw Road, Valley Forge PA 19078-6116 Phone: (480) 773-6116 Fax: (480) 482-8974
ANGLER				
XXXX	DATE	TITLE NIGISO PACKAGE OUTLINE		
APPROVALS		2.0 x 2.0 mm BODY		
DRAWN QAC	9/20/75	0.5 mm THICK		
CHECKED				
		SIZE DRAWING NO.	REV	
		C	PSC-4612	00
DO NOT SCALE DRAWING		SHEET 2 OF 2		

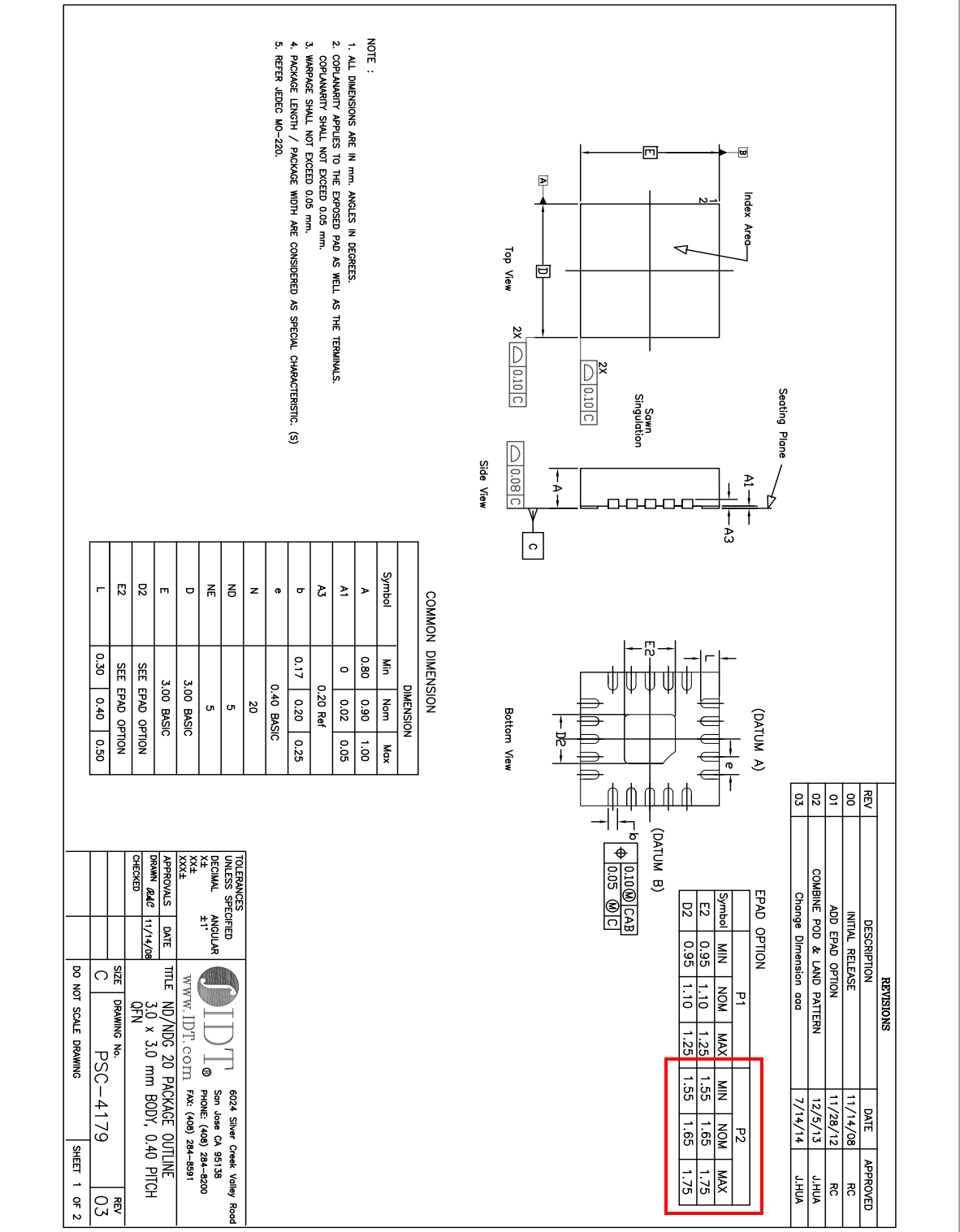
Package Outline and Dimensions (5PB1204 / 5PB1214 16-pin VFQFPN)



Package Outline and Dimensions (5PB1204 / 5PB1214 16-pin VFQFPN), cont.



Package Outline and Dimensions (5PB1206 / 5PB1216 20-pin VFQFPN), use EPAD Option P2



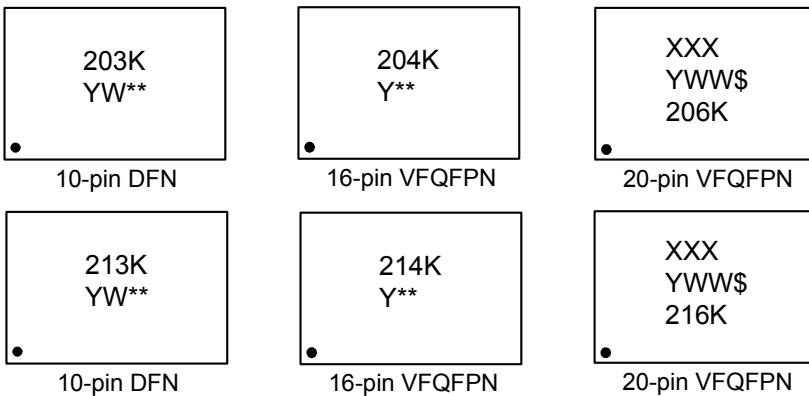


## Ordering Information

Part / Order Number	Shipping Packaging	Package	Temperature
5PB1203NTGK	Cut Tape	10-pin DFN	-40 to +105°C
5PB1203NTGK8	Tape and Reel	10-pin DFN	-40 to +105°C
5PB1213NTGK	Cut Tape	10-pin DFN	-40 to +105°C
5PB1213NTGK8	Tape and Reel	10-pin DFN	-40 to +105°C
5PB1204CMGK	Cut Tape	16-pin VFQFPN	-40 to +105°C
5PB1204CMGK8	Tape and Reel	16-pin VFQFPN	-40 to +105°C
5PB1214CMGK	Cut Tape	16-pin VFQFPN	-40 to +105°C
5PB1214CMGK8	Tape and Reel	16-pin VFQFPN	-40 to +105°C
5PB1206NDGK	Tube	20-pin VFQFPN	-40 to +105°C
5PB1206NDGK8	Tape and Reel	20-pin VFQFPN	-40 to +105°C
5PB1216NDGK	Tube	20-pin VFQFPN	-40 to +105°C
5PB1216NDGK8	Tape and Reel	20-pin VFQFPN	-40 to +105°C

“G” after the two-letter package code denotes Pb-Free configuration, RoHS compliant.

## Marking Diagrams



### Notes:

1. “\*\*” is the lot number.
2. “YWW”, “YW”, or “Y” are the last digit(s) of the year and week that the part was assembled.
3. “\$” denotes mark code.
4. “K” denotes extended temperature range device.
5. “XXX” denotes last three characters of Asm lot.

## Revision History

Rev.	Date	Originator	Description of Change
A	07/11/16	H.G.	Release to final.



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