

DSC Motors Driver IC

Features

- H Bridges Independent Control
- Channels Saturation Voltage Drive, One Channel Constant Voltage Drive and One Channel Constant Current Drive
- Support DSC Exposure/Shutter/Focus/Zoom Motor Driving
- Power Save Mode
- Lower Power Excitation Mode for Constant Current H Bridge
- Thermal Shutdown Protection
- Low Voltage Detection
- Lower Voltage Operation From 2.5V ~ 5.5V
- CMOS Process, Lower Power Consumption
- Compact Design for Small Size Package
- Lead Free Available (RoHS Compliant)

General Description

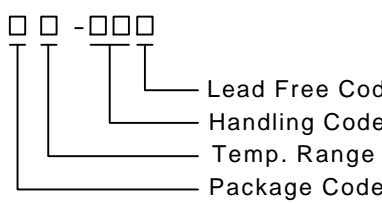

The APX6223 CMOS integrated circuit builds driving capability for Digital Still Camera Exposure/Shutter/Focus/Zoom motor operation. Independent control inputs drive Saturation, Constant voltage and Constant current H bridge.

Advanced CMOS processing is used to take advantage of low-voltage and low-power requirements. A power saving mood can optimize the energy saving in portable application. The APX6223 comes in a miniature 48-pin LQFP and TQFN packages.

Applications

- Digital Still Camera for Exposure/Shutter/Focus/Zoom Motor Driving

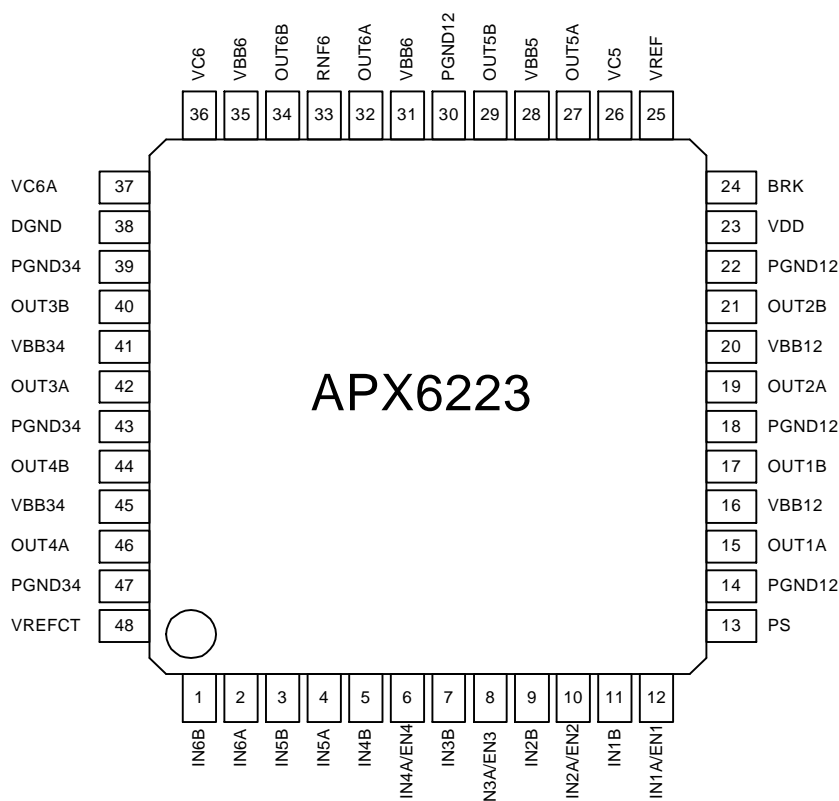
Ordering and Marking Information

<p>APX6223 □ □ - □ □ □</p>  <p> □ □ □ □ — Lead Free Code □ □ □ — Handling Code □ □ — Temp. Range □ □ — Package Code </p>	<p>Package Code QD : LQFP - 48 QB : TQFN - 48 Operating Ambient Temp. Range I : -40 to 85 °C Handling Code TY : Tray Lead Free Code L : Lead Free Device Blank : Original Device</p>
<p>APX6223 QD/QB :</p> 	<p>XXXXX - Date Code</p>

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS and compatible with both SnPb and lead-free soldering operations. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J STD-020C for MSL classification at lead-free peak reflow temperature.

ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

Pin Configuration



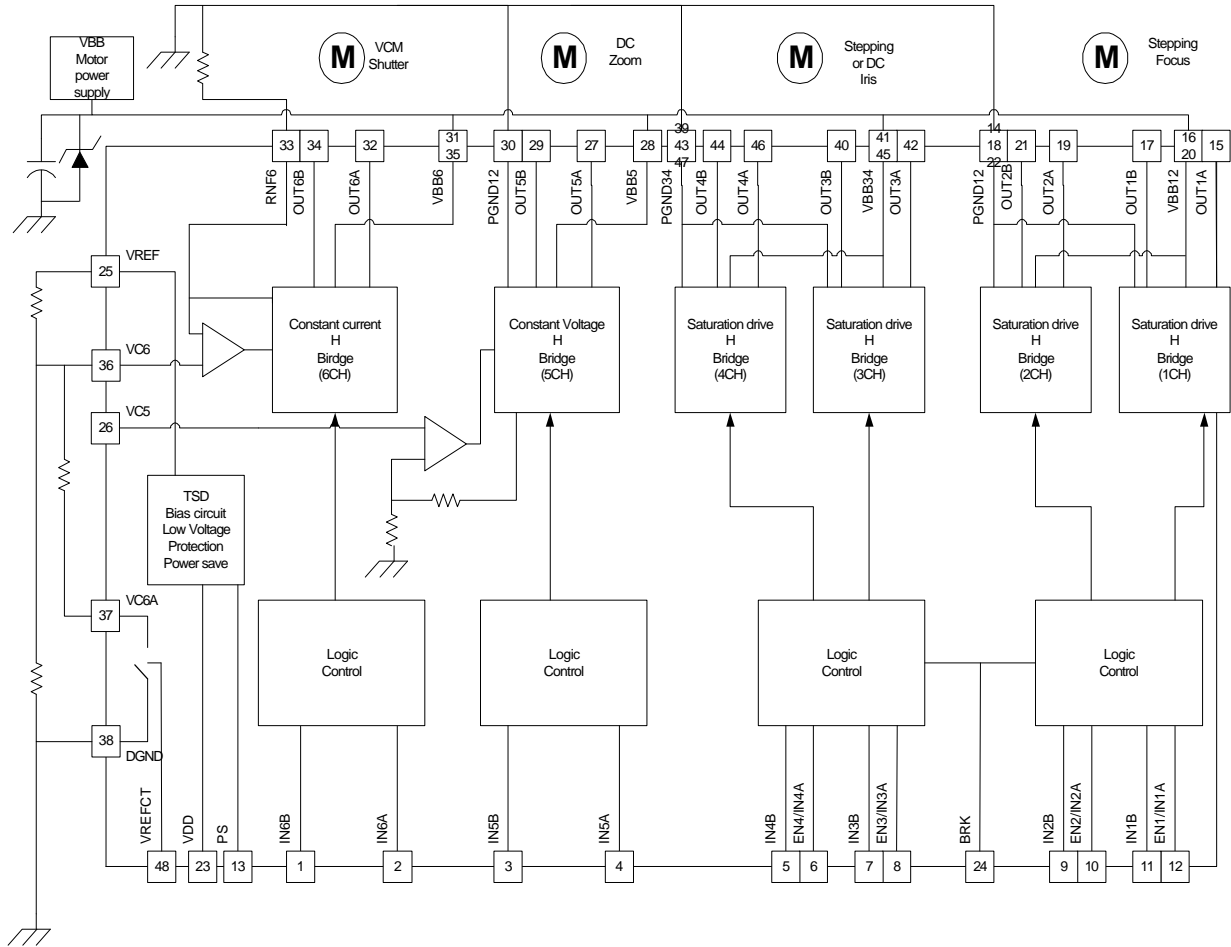
Pin Description

PIN		I/O	Description
No.	Name		
1	IN6B	I	Input B of channel 6 H bridge
2	IN6A	I	Input A of channel 6 H bridge
3	IN5B	I	Input B of channel 5 H bridge
4	IN5A	I	Input A of channel 5 H bridge
5	IN4B	I	Input B of channel 4 H bridge
6	IN4A/EN4	I	Input A of channel 4 H bridge, or enable control
7	IN3B	I	Input B of channel 3 H bridge
8	IN3A/EN3	I	Input A of channel 3 H bridge, or enable control
9	IN2B	I	Input B of channel 2 H bridge
10	IN2A/EN2	I	Input A of channel 2 H bridge, or enable control
11	IN1B	I	Input B of channel 1 H bridge
12	IN1A/EN1	I	Input A of channel 1 H bridge, or enable control
13	PS	I	Power save mode, H: circuit operation, L: stand by
14,18,22	PGND12		H bridge channel 1,2 power GND
15	OUT1A	O	H bridge channel 1 output A
16,20	VBB12		H bridge channel 1,2 power source
17	OUT1A	O	H bridge channel 1 output B

Pin Description (Cont.)

PIN		I/O	Description
No.	Name		
19	OUT2A	O	H bridge channel 2 output A
21	OUT2B	O	H bridge channel 2 output B
23	V _{DD}		Power source for control logic
24	BRK	I	Set mode brake function for channel 1~4
25	V _{REF}	O	1.2 V, this is a input voltage for resistors divider to generate the VC6 voltage
26	VC5	O	The voltage of VOUT5A, VOUT5B is four times large as VC5, output will be saturated once the VC5=V _{DD}
27	OUT5A	O	H bridge channel 5 output A
28	VBB5		H bridge channel 5 power source
29	OUT5B	O	H bridge channel 5 output B
30	PGND5		H bridge channel 5 power GND
31,35	VBB6		H bridge channel 6 power source
32	OUT6A	O	H bridge channel 6 output A
33	RNF6	I	Channel 6 motor drive current sense, connect a resistor between this terminal and GND
34	OUT6B	O	H bridge channel 6 output B
36	VC6	I	Channel 6 comparator input
37	VC6A	I	Channel 6 comparator adjustable input
38	GND		Control logic GND
39,43,47	PGND34		H bridge channel 3,4 power GND
40	OUT3B	O	H bridge channel 3 output B
41,45	VBB34		H bridge channel 3,4 power source
42	OUT3A	O	H bridge channel 3 output A
44	OUT4B	O	H bridge channel 4 output B
46	OUT4A	O	H bridge channel 4 output A
48	V _{REFCT}	I	Motor excitation saving control, set H save control, set L normal control, only valid for channel 6 current driving

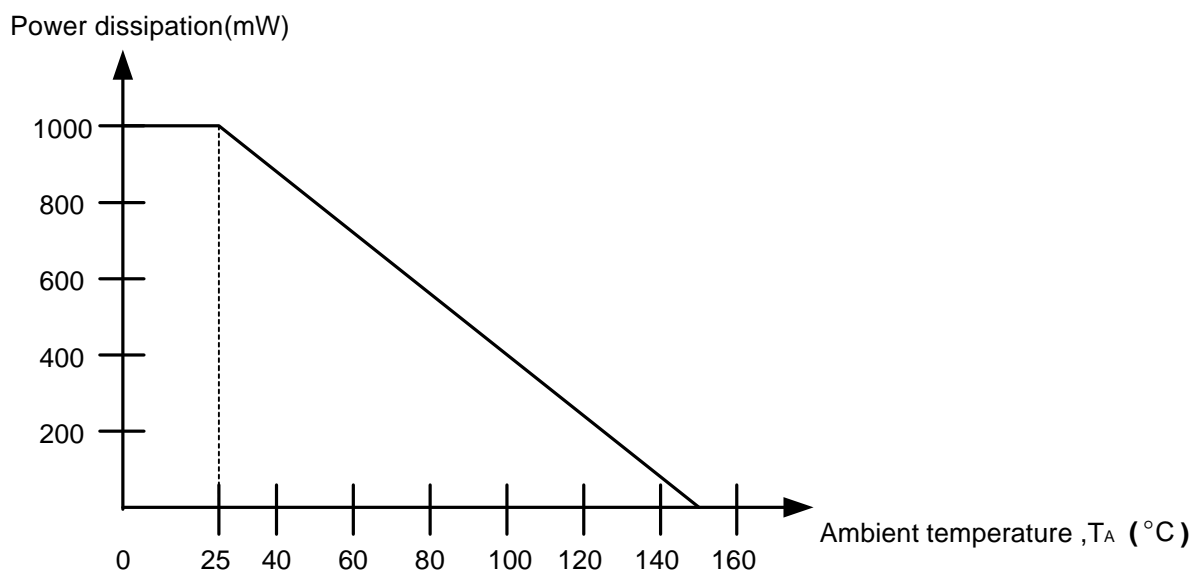
Block Diagram



Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
V _{DD}	Logic Supply Voltage	6.5	V
V _{BB}	Motor Supply Voltage	6.5	V
I _O	Peak Output Current (1ch ~ 6ch)	+800	mA
I _O	Continuous Output Current (1ch ~ 6ch)	+500	mA
R _{TJA}	Thermal Resistance – Junction to Ambient LQFP 48	125	°C/W
T _J	Junction Temperature	0 to 150	°C
T _{OP}	Operating Temperature Range	0 to 70	°C
T _{STG}	Storage Temperature Range	-65 to +150	°C
T _L	Lead Temperature (Soldering, 10 second)	260	°C

Thermal Characteristics



Electrical Characteristics

Unless otherwise noted these specifications apply over full temperature, $V_{BB} = 5V$, $V_{DD} = 3V$, $T_A = -40$ to $85^\circ C$. Typical values refer to $T_A = 25^\circ C$.

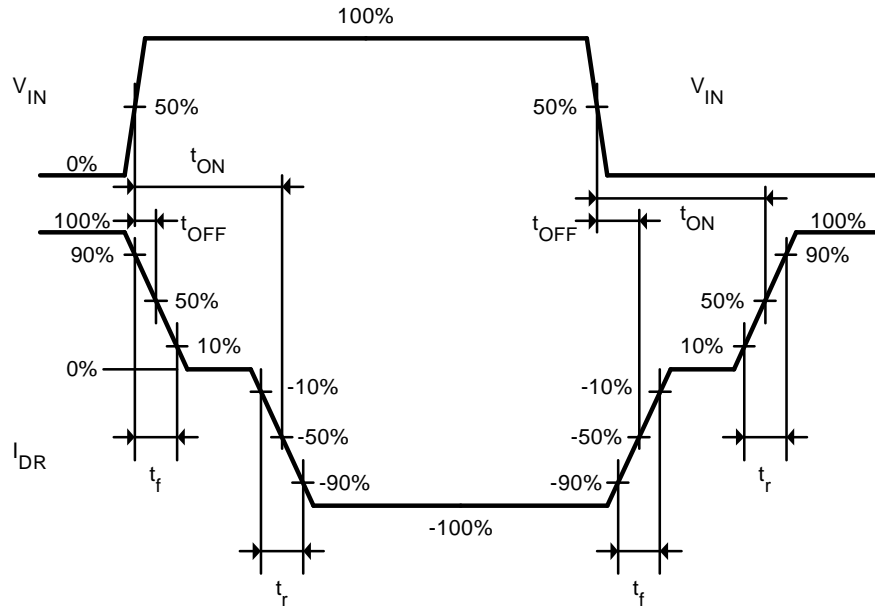
Symbol	Parameter	Condition	APX6223			Unit
			Min.	Typ.	Max.	
Control logic						
V_{IH}	High Input Voltage	All inputs	$V_{DD} \times 0.7$			V
V_{IL}	Low Input Voltage	All inputs			$V_{DD} \times 0.3$	V
I_{IH}	High Input Current	$V_{IN} = V_{DD} = 3V$	15	30	60	μA
I_{IL}	Low Input Current		-1			μA
V_{REF}	Reference Voltage		1.13	1.21	1.29	V
$I_{DD} (on)$	Supply Current	$V_{DD} = 3V$, $V_{BB} = 5V$, PS = H		1.0	2.0	mA
$I_{DD} (stb)$	Standby Supply Current	$V_{DD} = 3V$, $V_{BB} = 5V$, PS = L		0.1	5	μA
I_{BB1}	Motor Supply Current	$V_{DD} = 3V$, $V_{BB} = 5V$, PS = L, sum of V_{BB}		0.1	5	μA
I_{BB2}	Motor Supply Current	$V_{DD} = 0V$, $V_{BB} = 5V$, PS = L, sum of V_{BB}		0.1	5	μA

Electrical Characteristics (Cont.)

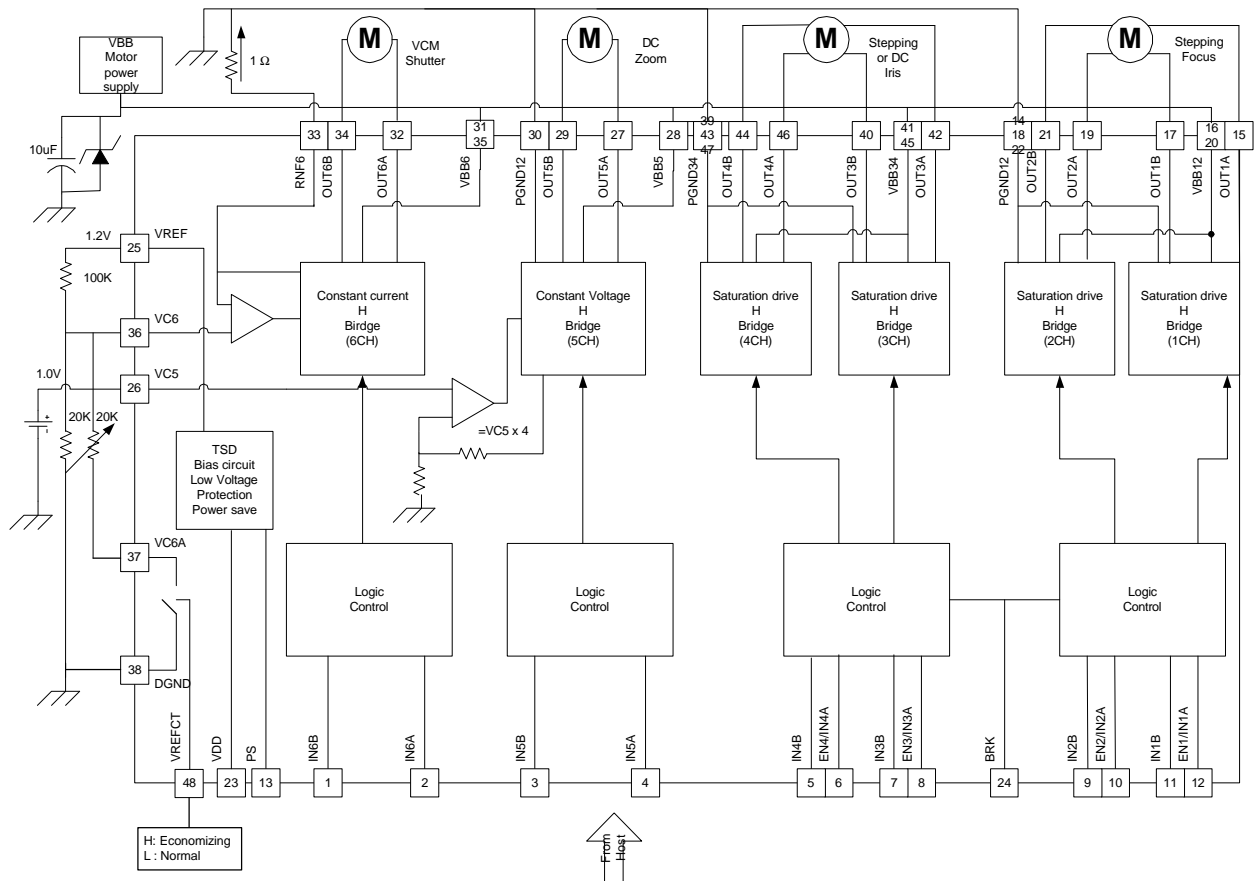
Unless otherwise noted these specifications apply over full temperature, $V_{BB} = 5V$, $V_{DD} = 3V$, $T_A = -40$ to $85^\circ C$. Typical values refer to $T_A = 25^\circ C$.

Symbol	Parameter	Condition	APX6223			Unit
			Min.	Typ.	Max.	
V_{DDH}	Low Voltage Detection	$V_{BB} = 5V$	1.0	1.8	2.4	V
V_{DDL}	Low Voltage Detection	$V_{BB} = 3V$	0.8	1.2	1.8	V
Output Drivers (OUT1A, OUT1B, OUT2A, OUT2B, OUT3A, OUT3B, OUT4A, OUT4B)						
RON1	Saturation Drive On Resistance (upper+lower)	$I_o = 100mA, V_{BB} = 5V$		1.5	2.0	Ω
RON2	Saturation Drive On Resistance (upper+lower)	$I_o = 100mA, V_{BB} = 3V$		1.75	2.3	Ω
T_{ON}	Turn On Time	$R_M = 50\Omega, I_o = 100mA$		0.5	2	μs
T_{OFF}	Turn Off Time			0.1	0.5	μs
T_R	Output Rise Time			0.3	1	μs
T_F	Output Fall Time			0.05	0.2	μs
Output Drivers (OUT5A, OUT5B)/Constant Voltage						
V_{OUT5}	Constant Voltage Output Limit	$I_o = 100mA, V_{BB} = 5V$	VCx3.7	VCX4	VCx4.3	V
RVON1	Constant Voltage Drive On Resistance (upper+lower)	$I_o = 100mA, V_{BB} = 5V$		1.5	2.0	Ω
RVON2	Constant Voltage Drive On Resistance (upper+lower)	$I_o = 100mA, V_{BB} = 3V$		1.75	2.3	Ω
I_{IN5}	VC5 Input Current	$VC = 2V$	-1	0	1	μA
V_{IN5}	VC5 Input Voltage Range		0.15		1.0	V
T_{VON}	Turn On Time	$R_M = 50\Omega, I_o = 100mA$		5	20	μs
T_{VOFF}	Turn Off Time			0.1	2	μs
T_{VR}	Output Rise Time			4	10	μs
T_{VF}	Output Fall Time			0.05	1	μs
Output drivers (OUT6A, OUT6B)/Constant Current						
VC6A ON	VC6A (ON Voltage)	At $I_o = 5mA, V_{DD} = 5V$		40	200	mV
I_{IN6}	VC6 Input Current		-1	0	1	μA
I_{OUT6}	Constant Current Precision	$VC6 = 0.1V, R_{NF} = 1\Omega, R_M = 5\Omega$	95	100	105	mA
RCON1	Constant Current Drive On Resistance (upper+lower)	$I_o = 100mA, R_{NF} = 0V, V_{BB} = 5V$		1.25	2.0	Ω
RCON2	Constant Current Drive On Resistance (upper+lower)	$I_o = 100mA, R_{NF} = 0V, V_{BB} = 3V$		1.45	2.3	Ω
T_{CON}	Turn On Time	$R_M = 5\Omega, V_{LIM} = 0.2V, R_{NF} = 2\Omega, I_o = 100mA$		5	10	μs
T_{COFF}	Turn Off Time			0.05	2	μs
T_{CR}	Output Rise Time			4	8	μs
T_{CF}	Output Fall Time			0.03	1	μs
TSD	Thermal Shutdown Temperature			150		$^\circ C$

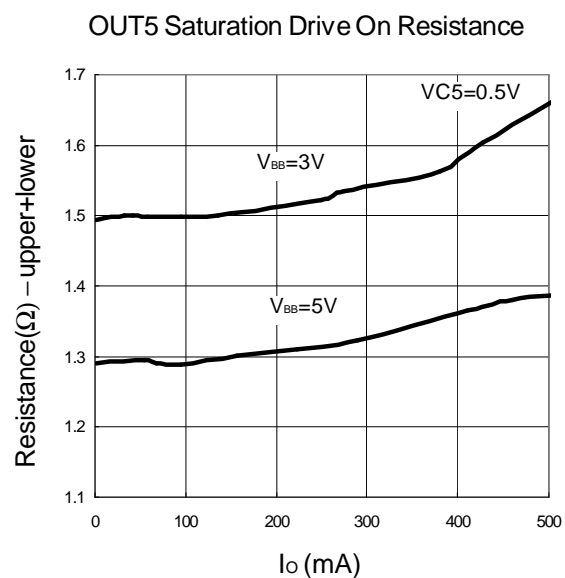
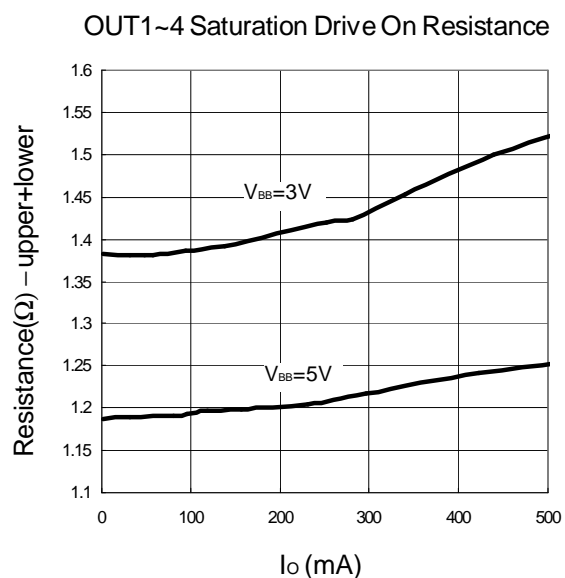
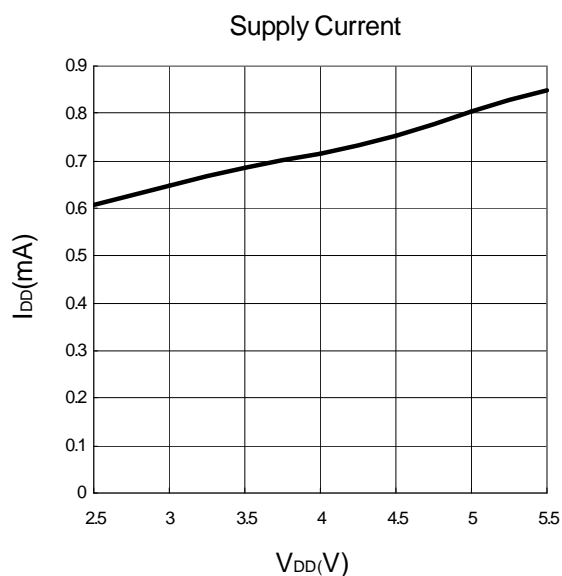
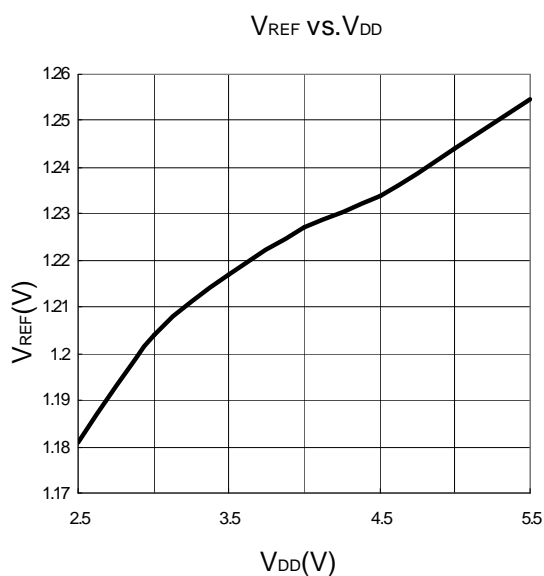
Switching Characteristic Wave Shape



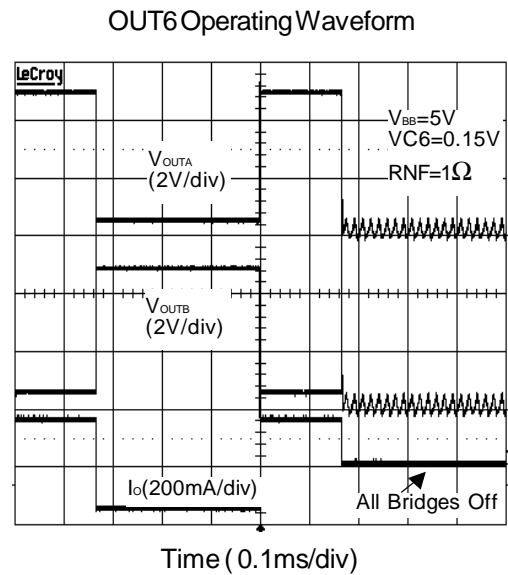
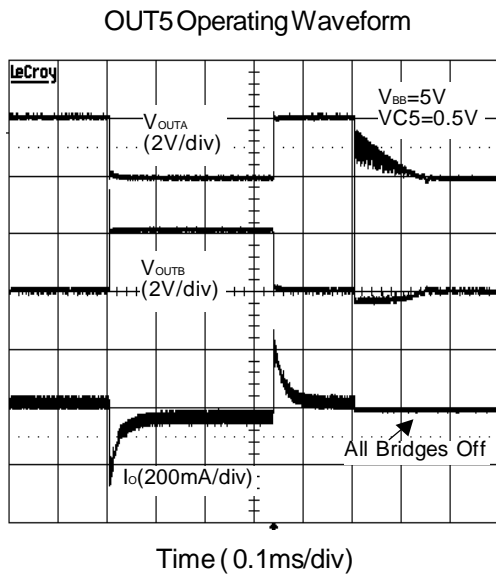
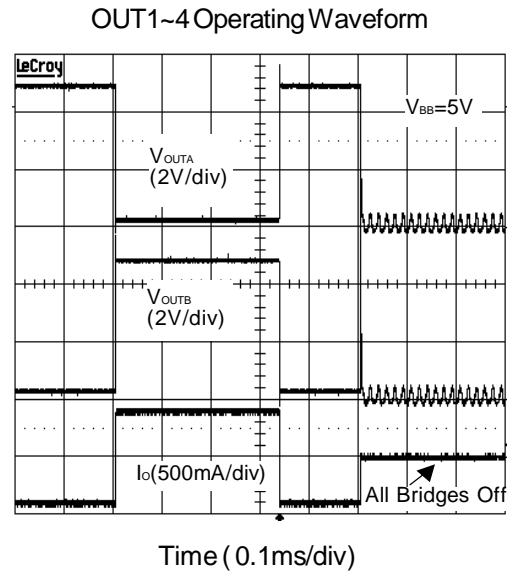
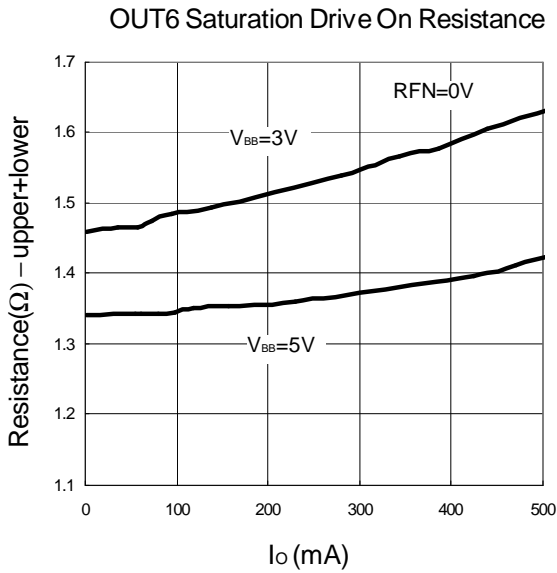
Typical Applications



Typical Characteristics



Typical Characteristics



Function Descriptions

The APX6223 CMOS single chip builds driving capability for Digital Still Camera Exposure/Shutter/Focus/Zoom motor operation. The APX6223 can meet maximum various combinations of motor types inside of the DSC. The four groups of the independent inputs from host to control drive motor operations. The BRK selection pin can set 2 types of operations for channels 1~4 H bridge, which can set brake function for voltage control H bridge if BRK set "L".

BRK	CH1	CH2	CH3	CH4
H	IN1A/IN1B	IN2A/IN2B	IN3A/IN3B	IN4A/IN4B
L	EN1/IN1B	EN2/IN2B	EN3/IN3B	EN4/IN4B

Note: BRK pin setting only available channel 1~4

IN/IN input control truth table (n=1~6)

INnA	INnB	OUTnA	OUTnB	Mode
L	L	Z	Z	OFF
H	L	H	L	Forward
L	H	L	H	Reversed
H	H	L	L	Brake

Note : 'Z' high impedance

EN/IN input control truth table (n=1~4)

ENn	INnB	OUTnA	OUTnB	Mode
L	-	Z	Z	OFF
H	L	H	L	Forward
H	H	L	H	Reversed

Note : 'Z' high impedance

Stepping Motor Control

Refer the list below table for stepping motor control, which is defined as half-step and full-step motor control. The half-step is controlled by the following sequence (1)->(2)->(8)->(1) ->..., but for reverse side, sequence (1)->(8)->(7)->.... Moreover, the full-step is controlled by the following sequence (1)->(2)->(3)->(4)->(1)...., but for reverse side, sequence (1)->(4)->(3)->.... These channels are for DC motor Focus & Iris operation.

Stepping motor control truth table (for channel 1,2 or 3,4)

IN1A	IN1B	IN2A	IN2B	OUT1A	OUT1B	OUT2A	OUT2B	Half-step	Full-step
H	L	L	L	H	L	Z	Z	(1)	
H	L	H	L	H	L	H	L	(2)	(1)
L	L	H	L	Z	Z	H	L	(3)	
L	H	H	L	L	H	H	L	(4)	(2)
L	H	L	L	L	H	Z	Z	(5)	
L	H	L	H	L	H	L	H	(6)	(3)
L	L	L	H	Z	Z	L	H	(7)	
H	L	L	H	H	L	L	H	(8)	(4)

Note : 'Z' high impedance

Constant Voltage H-Bridge (Channel 5)

The VOUT5A & VOUT5B are constant voltage output, which is four times as large as VC5 input. Output becomes saturated when VC5=V_{DD}. This channel is for DC motor Zoom operation.

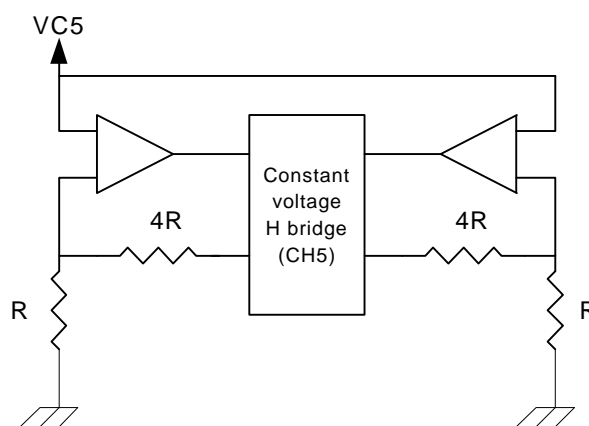


Figure1. Constant Voltage Control Setting

Constant Current H-Bridge (Channel 6)

Channel 6 is a fixed current drive for VCM motor Shutter operation. When set V_{REFCT} to "L", and voltage from V_{REF} is 1.2V through voltage resistors divider 100KΩ & 20KΩ (refer Figure2), and that VC6 can be calculated $1.2V \times 20 / (100 + 20) = 0.2V$. If the package leads impedance is ignored (compare with RNF6 1Ω), that

Function Descriptions (Cont.)

Constant Current H-Bridge (Channel 6) (Cont.)

current about $200\text{mA} = 0.2\text{V}/1\Omega$ is limited by VC6 voltage. When the setup value of the weak excitation mode is changed, add a variable resistor between VC6 and VC6A pin to adjust the current limit (V_{REFCT} set to "H"), for example, if VC6 & VC6A pin add a variable resistor and the value is $20\text{K}\Omega$, since this $20\text{K}\Omega$ is parallel with another $20\text{K}\Omega$, the equal resistor value is $10\text{K}\Omega$. So VC6 will be equal $1.2\text{V} \times 10/(100+10) = 0.11\text{V}$, the current limit is equal $0.11\text{V}/1\Omega = 110\text{mA}$. AD/A value direct connects to VC6 (V_{REFCT} to "L") is another method to control the current limit as well.

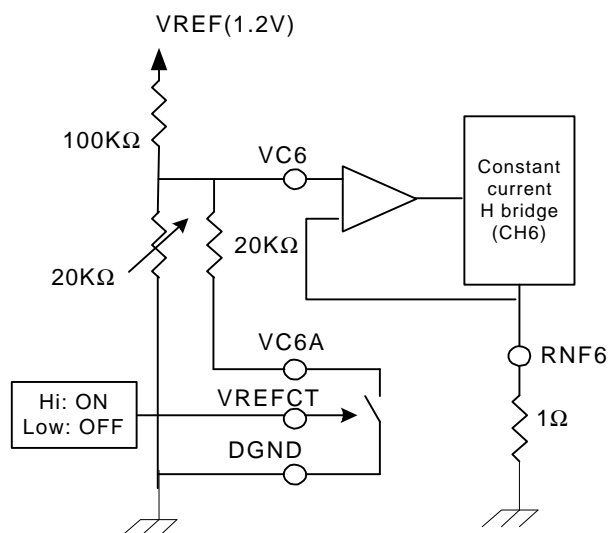
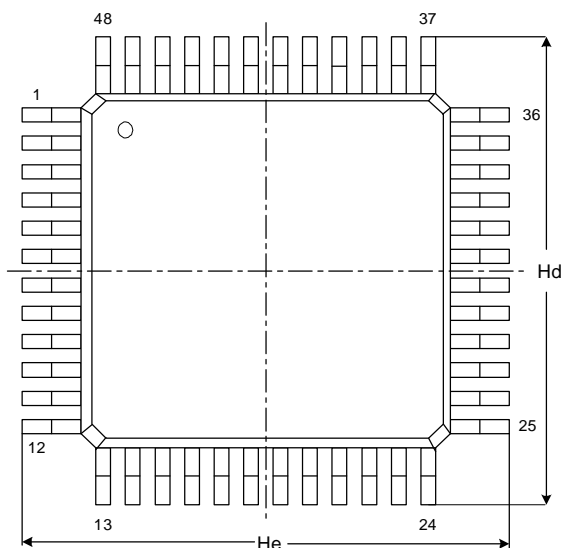
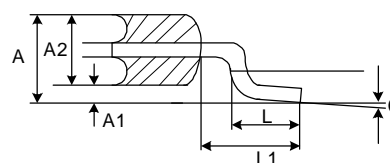
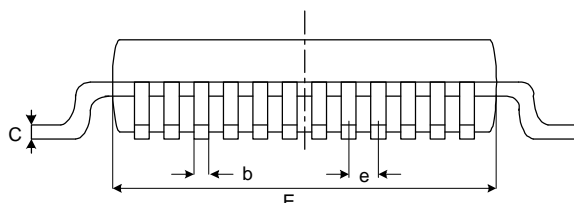


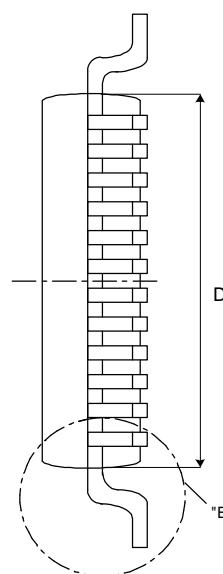
Figure2. Constant Current Control Setting

Package Information

LQFP-48



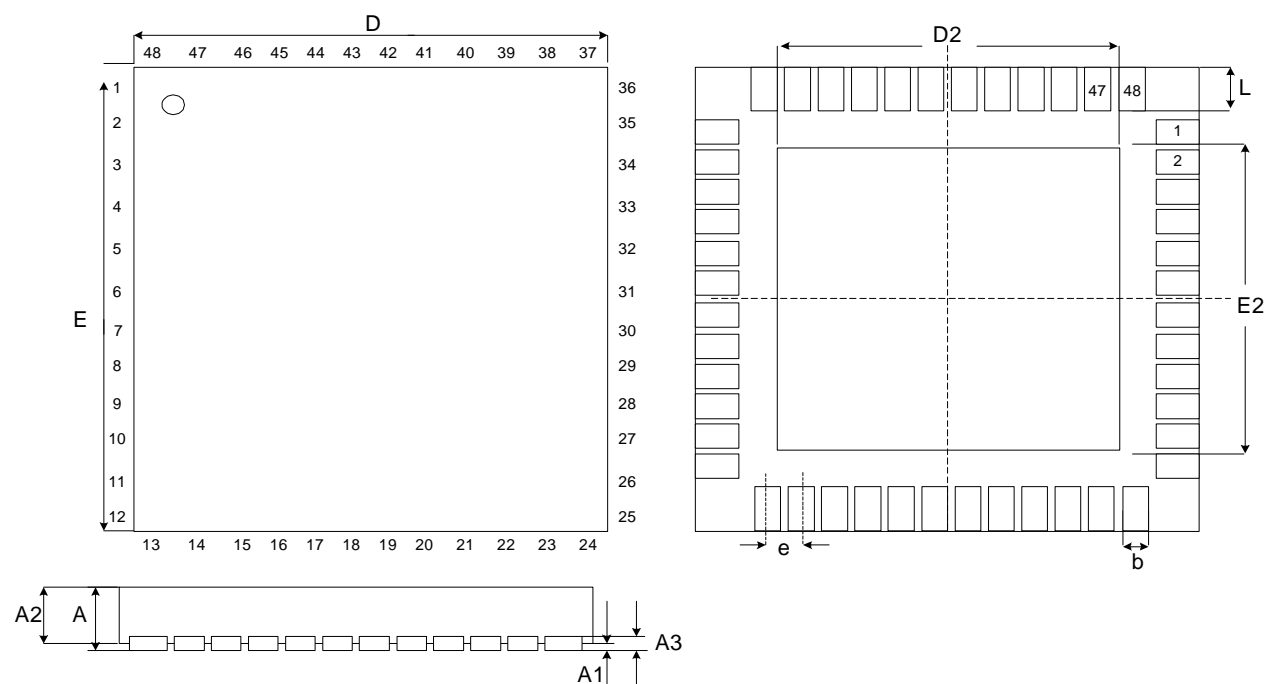
DETAIL "E"



Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	-	1.600	-	0.0630
A1	0.050	0.150	0.0020	0.0059
A2	1.400±0.05		0.0551±0.0020	
b	0.200TYP		0.0078TYP	
c	0.127TYP		0.0050TYP	
D	7.000±0.100		0.2756±0.0039	
E	7.000±0.100		0.2756±0.0039	
e	0.500TYP		0.0196TYP	
Hd	9.000±0.250		0.3543±0.0098	
He	9.000±0.250		0.3543±0.0098	
L	0.600±0.150		0.0236	0.006
L1	1.000REF		0.0393REF	
y	-	0.100	-	0.0039
θ	0°	7°	0°	7°

Package Information

TQFN-48

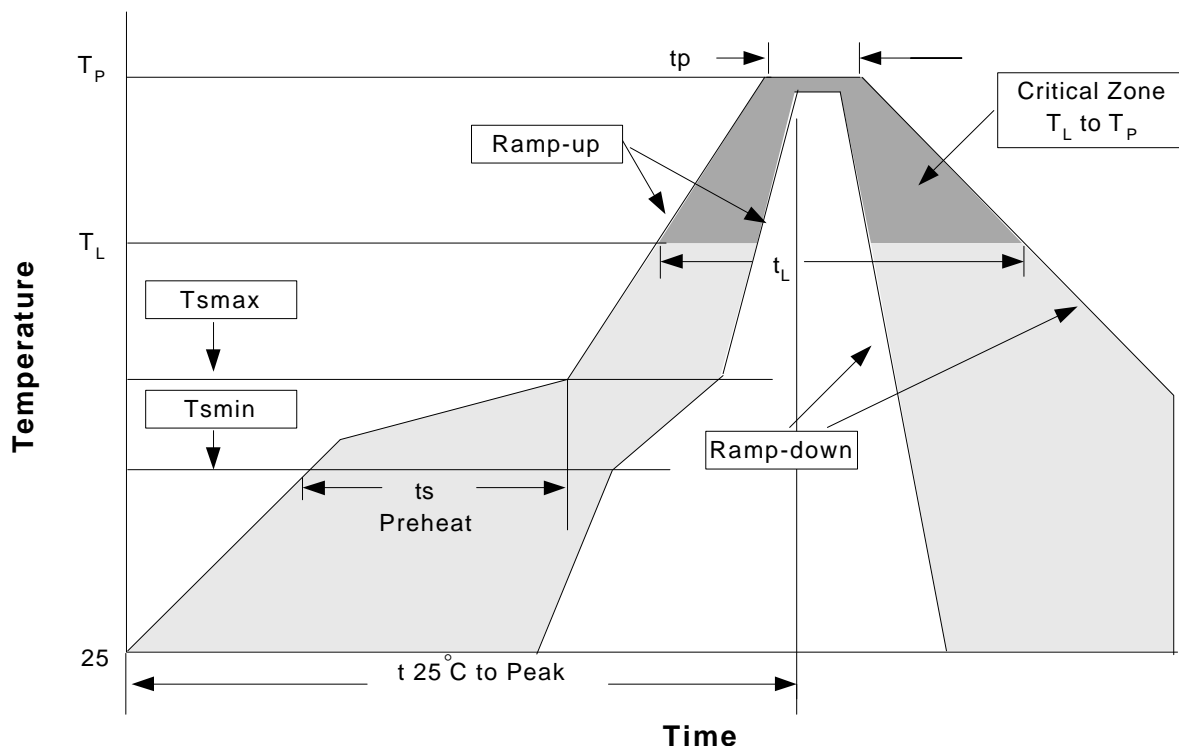


Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.80	1.00	0.03	0.04
A1	0	0.05	0	0.002
A2	0	1.00	0	0.04
A3	0.20REF		0.008REF	
b	0.18	0.30	0.007	0.01
D	7BSC		0.28BSC	
D2	4.15	5.25	0.09	0.21
E	7BSC		0.28BSC	
E2	4.15	5.25	0.09	0.21
e	0.50BSC		0.02BSC	
L	0.30	0.50	0.01	0.01

Physical Specifications

Terminal Material	Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb), 100%Sn
Lead Solderability	Meets EIA Specification RSI86-91, ANSI/J-STD-002 Category 3.

Reflow Condition (IR/Convection or VPR Reflow)



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	3°C/second max.	3°C/second max.
Preheat		
- Temperature Min (T_{smin})	100°C	150°C
- Temperature Max (T_{smax})	150°C	200°C
- Time (min to max) (t_s)	60-120 seconds	60-180 seconds
Time maintained above:		
- Temperature (T_L)	183°C	217°C
- Time (t_L)	60-150 seconds	60-150 seconds
Peak/Classification Temperature (T_p)	See table 1	See table 2
Time within 5°C of actual Peak Temperature (t_p)	10-30 seconds	20-40 seconds
Ramp-down Rate	6°C/second max.	6°C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.

Notes: All temperatures refer to topside of the package .Measured on the body surface.

Classification Reflow Profiles(Cont.)

Table 1. SnPb Eutectic Process – Package Peak Reflow Temperatures

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<2.5 mm	240 +0/-5°C	225 +0/-5°C
≥2.5 mm	225 +0/-5°C	225 +0/-5°C

Table 2. Pb-free Process – Package Classification Reflow Temperatures

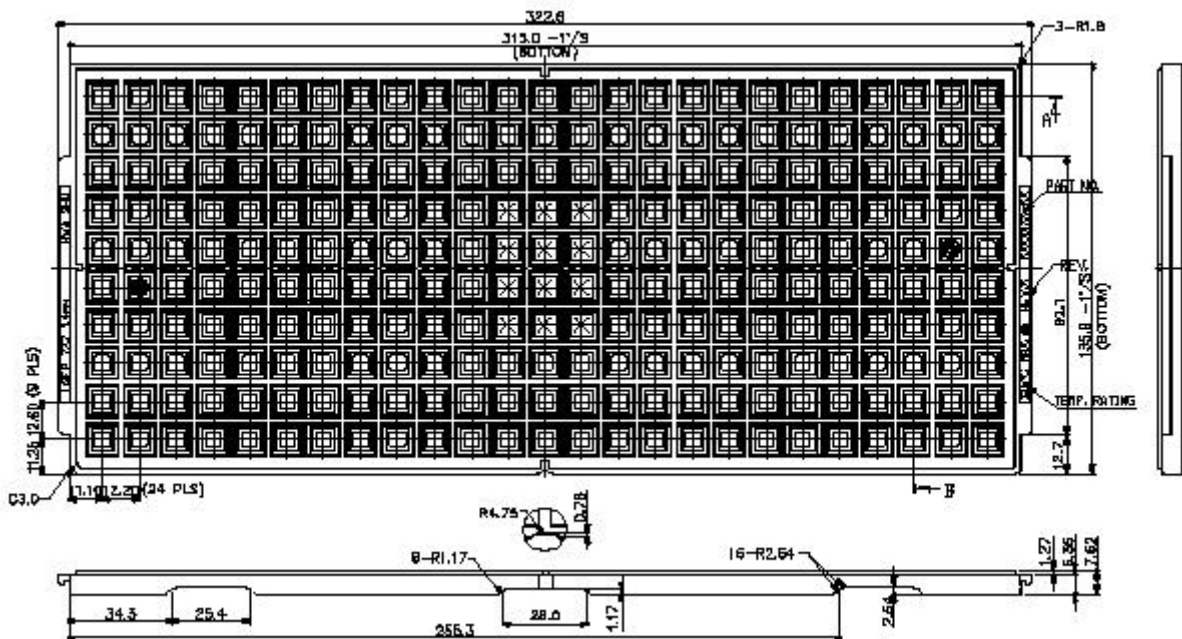
Package Thickness	Volume mm ³ <350	Volume mm ³ 350-2000	Volume mm ³ >2000
<1.6 mm	260 +0°C*	260 +0°C*	260 +0°C*
1.6 mm – 2.5 mm	260 +0°C*	250 +0°C*	245 +0°C*
≥2.5 mm	250 +0°C*	245 +0°C*	245 +0°C*

*Tolerance: The device manufacturer/supplier **shall** assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0°C. For example 260°C+0°C) at the rated MSL level.

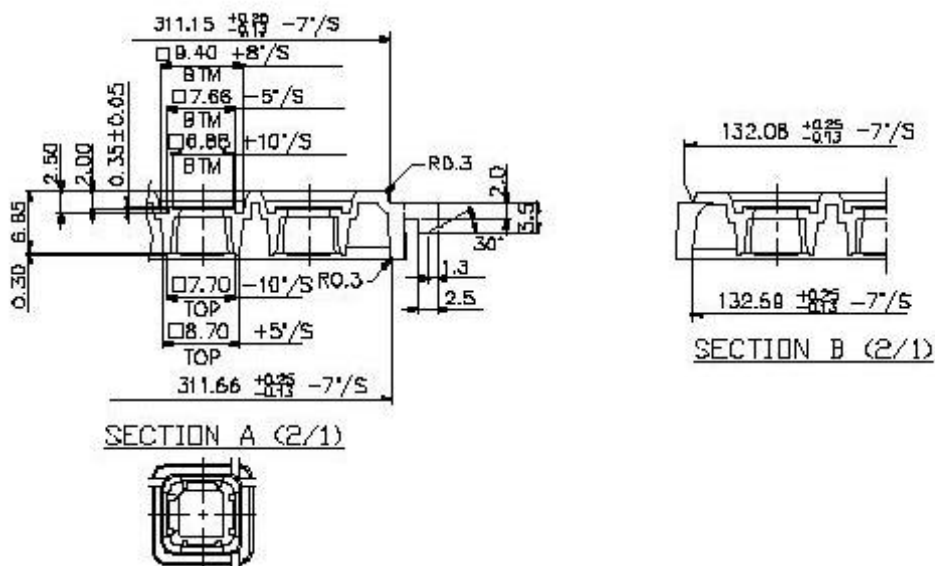
Reliability test program

Test item	Method	Description
SOLDERABILITY	MIL-STD-883D-2003	245°C, 5 SEC
HOLT	MIL-STD-883D-1005.7	1000 Hrs Bias @125°C
PCT	JESD-22-B,A102	168 Hrs, 100%RH, 121°C
TST	MIL-STD-883D-1011.9	-65°C~150°C, 200 Cycles
ESD	MIL-STD-883D-3015.7	VHBM > 2KV, VMM > 200V
Latch-Up	JESD 78	10ms, I _{tr} > 100mA

7X7mm Shipping Tray



7X7mm Shipping Tray (Cont.)



Customer Service

Anpec Electronics Corp.

Head Office :

5F, No. 2 Li-Hsin Road, SBIP,
Hsin-Chu, Taiwan, R.O.C.

Tel : 886-3-5642000

Fax : 886-3-5642050

Taipei Branch :

7F, No. 137, Lane 235, Pac Chiao Rd.,
Hsin Tien City, Taipei Hsien, Taiwan, R. O. C.

Tel : 886-2-89191368

Fax : 886-2-89191369