Data Sheet

Type Description : PWM Forward Controller

Product Name : EST.1580P

Reversion : V1.0

Reversion Date : 08, 2020

Page : 13 Pages

General Description

The EST.1580P controller offers everything needed to build cost− effective and reliable ac−dc switching supplies dedicated to ATX power supplies. Thanks to the use of an internally fixed timer, EST.1580P detects an output overload without relying on the auxiliary Vcc. A Brown−Out input offers protection against low input voltages and improves the converter safety. Finally a SOP−8 package saves PCB space and represents a solution of choice in cost sensitive project.

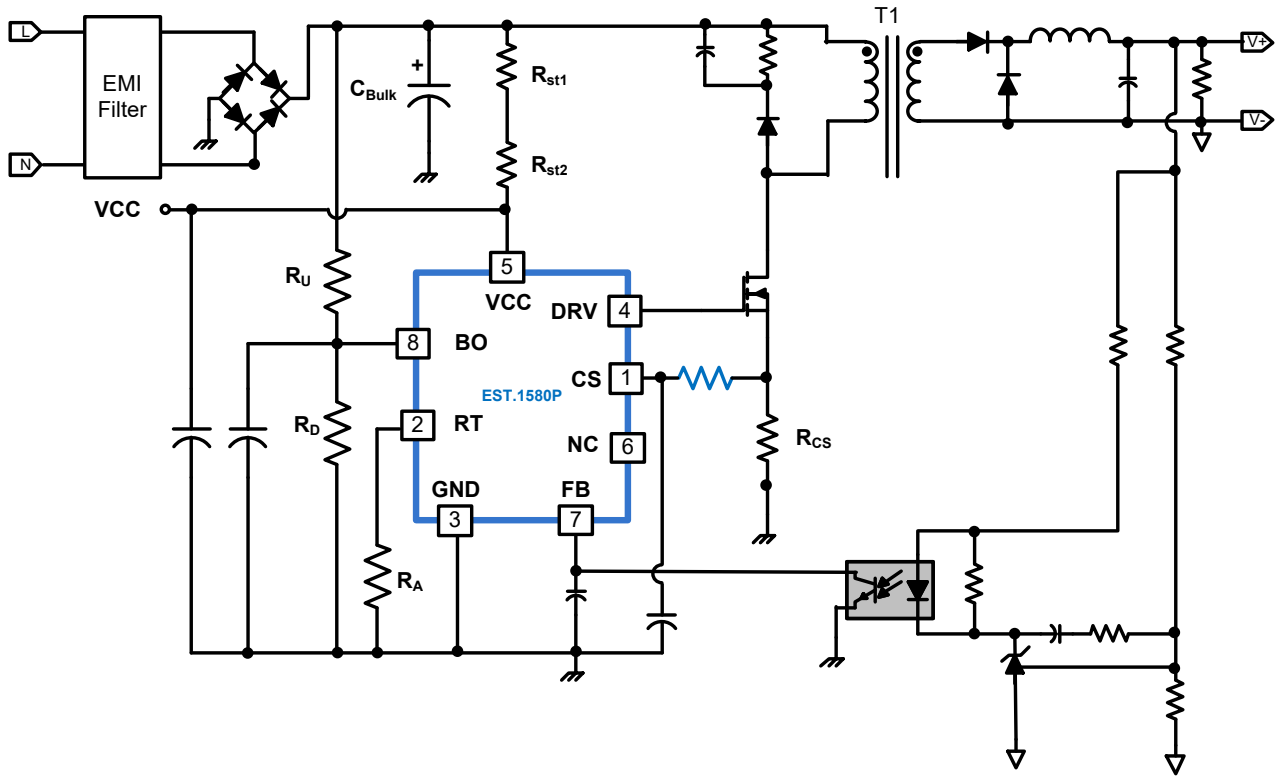
Application

- Switching AC/DC adapter for PC silver Boxes, Games Adapter
- Flyback and Forward Converter

Feature

- High voltage CMOS process with excellent ESD protection
- Very low startup current (<15 uA)
- Adaptive Frequency Shuffling and Slope Compensation @ Fix Frequency CCM Mode
- Current mode control with Cycle-by-Cycle current limit
- Built-in slope and load regulation compensation
- LEB (Leading-edge blanking) on CS Pin
- UVLO (Under voltage lockout)
- V_{DD} OVP (Over Voltage Protection)
  OLP (Over load protection

Application Circuit

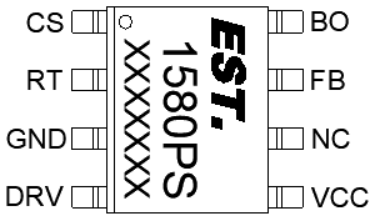


Ordering Information

Part Number	Package	Packaging	Top Marking	Note
EST.1580P	DIP-8	Tape	EST.1580P	Green
EST.1580PS	SOP-8	Tape	EST.1580PS	Green
EST.1580PSR	SOP-8	Reel	EST.1580PS	Green

Note:EST lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS.EST 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.EST defines “Green” to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

Pin connection (Top View)



SOP-8L

EST: LOGO

1580PS: P=Frequency Type; S=smd

XXXXXX: Production lot code

Pin Assignments and Package Type

SOP-8	NAME Description	Description
1	CS	Monitors the primary current and allows the selection of the ramp compensation amplitude.
2	RTL	A resistor connected to ground fixes the switching frequency.
3	GND	Ground
4	DRV	This pin connects to the MOSFET gate
5	VCC	This pin accepts voltage range from 10.5 V up to 26.5 V
6	NC	
7	FB	This pin directly connects to an optocoupler collector.
8	BO	This pin monitors the input voltage image to offer a Brown in/out protection.

Absolute Maximum Ratings

Parameter Symbol		Symbol	Limit Values		Unit	Remark
			Min.	Max		
Supply Voltage V_{CC}		V_{CC}	-0.3	40	V	
FB,BO,CS,RT Voltage		V_{FB},V_{BO},V_{CS},V_{RT}	-0.3	7	V	
Gate Driver Voltage		V_{DRV}	-0.3	V_{CC}+0.3	V	
Operation Junction Temperature		Tj	-40	125	℃	
Operation Ambient Temperature		TA	-25	85	℃	
Storage Temperature		T_{stg}	-55	150	℃	
Power Dissipation	Ta = 25℃	PD	-	556	mW	SOP-8
Junction-to-Ambient Thermal Resistance*		θ_{JA}		180	℃/W	
Junction-to-Case Thermal Resistance**		θ_{JC}		39	℃/W	
Lead temperature (Soldering, 10 sec)			-	260	℃	
ESD Voltage Protection	HBM	$V_{ESD-HBM}$	-	3.0	KV	
	MM	V_{ESD-MM}	-	300	V	

Stress beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliablity.

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Recommended Operating Conditions

Parameter Symbol	Symbol	Limit Values		Unit	Remarks
		Min.	Max		
Supply Voltage V_{DD}	V_{DD}	10.5	26.5	V	
Startup Resistor Value	R_{star}	1	14	MΩ	
Ambient temperature range	T_{opr}	-40	85	℃	

DC Electrical Characteristics (V_{DD} =15V, Ta=25°C)

***Supply Voltage (V_{DD} Pin)*:**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Startup Current	I_{CC-ST}	2		15	μA	UVLO ON - 0.1V
Operating Current (with 1nF load on DRV pin)	I_{CC-OP}	1.2		2.2	mA	V_{CC}=22V, VFB=0V
	I_{CC-OP}	2.3		3.3	mA	V_{CC}=22V,VFB=2.5V DRV=1nF
	I_{CC-OLP}	0.6	0.8	1	mA	OLP
UVLO (off)	$V_{UVLO-OFF}$	8	9	10	V	
UVLO (on)	$V_{UVLO-ON}$	9	10	11	V	
Hysterics UVLO	V_{HYS_UVLO}	0.8	1		V	
V_{DD} OVP Level	V_{OVP}	27.5	28	29.5	V	
OVP Debounce Time	T_{OVP}		100		uS	Guarantee by Design

***Voltage Feedback(FB Pin)*:**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Short Circuit Current	I_{Zero}	0.7		1.5	mA	V_{FB}=0V
Open Loop Voltage	V_{FB-OP}	4.5	5	5.5	V	FB pin open
Burst Mode	V_{BTM}	0.25	0.3	0.35	V	
Burst Mode Hysterics	V_{BST_H}		100		mV	

Current Sensing (CS Pin):

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Leading Edge Blanking Time & Propagation Delay to Output	T_{LEB}	400	500	600	ns	
Current Sense Voltage Threshold	V_{IOLP}	0.9	0.95	1	V	
Current Sense Voltage Limit	V_{LIM}	0.95	1	1.05	V	
Hysterics OCP	V_{LIM} - V_{IOLP}	0.03		0.07	V	
Over Load Protection Time	T_{OLP}		13		mS	Freq = 100KHz
Slop Compensation Current	I_{SLOP}	119	132	145	uA	Guarantee by Design
Short Circuit Protection Voltage	V_{SCP}		1.3			

Timer Section:

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Internal Soft Startup Time	Tss		5		ms	Freq = 100KHz
Frequency at PWM	F_{PWM}	92	100	108	KHz	RT=400KΩ
Frequency Shuffling Range	F_jitter	+/-4	+/-6	+/-8	%	
Max Duty cycle	D_max	45.6	47.6	49.6	%	
Frequency v.s Voltage Stability	f_{DV}		1		%	

Driver(DRV Pin) :

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Output Low Level	V_{OL}			1	V	V_{CC} = 16V, I_O=20mA
Output High Level	V_{OH}	8			V	V_{CC} = 16V, I_O=20mA
Output Clamp Voltage Level	V_{G_Clamp}	14	16	18	V	V_{CC} = 25V
Rising Time	T_R	110	150	190	nS	V_{CC} = 15V, C_L= 1nF
Falling Time	T_F	50	80	100	nS	V_{CC} = 15V, C_L= 1nF

Brown In/Out(BO Pin) :

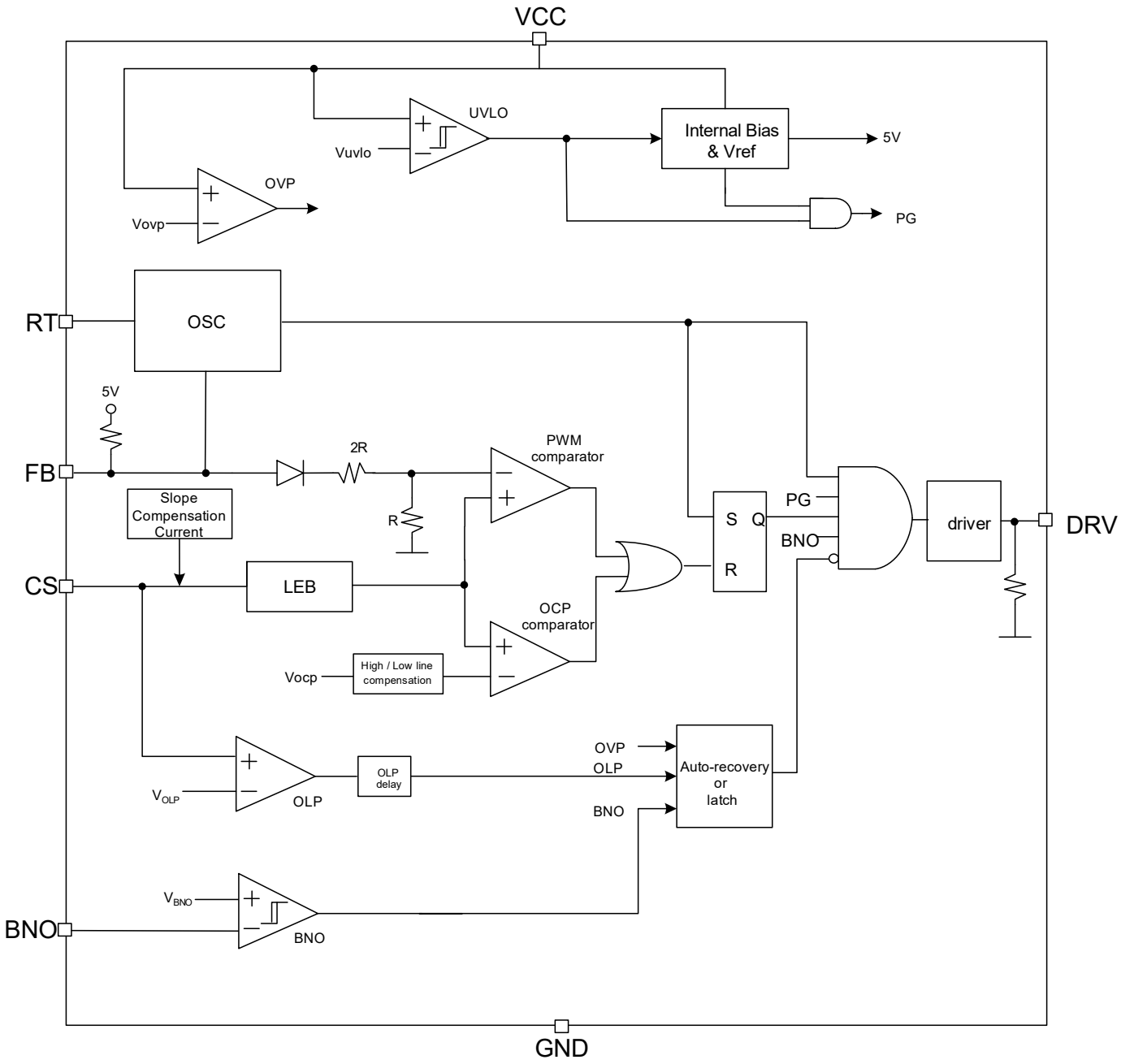
arameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Brownout Turn-On Trip Level	V_{BNO_ON}	0.9	1	1.1	V	
Brownout Turn-Off Trip Level	V_{BNO_Off}	0.7	0.8	0.9	V	
BO pin de-bounce time	T_{DBNO}		100		uS	Guarantee by Design

RT:

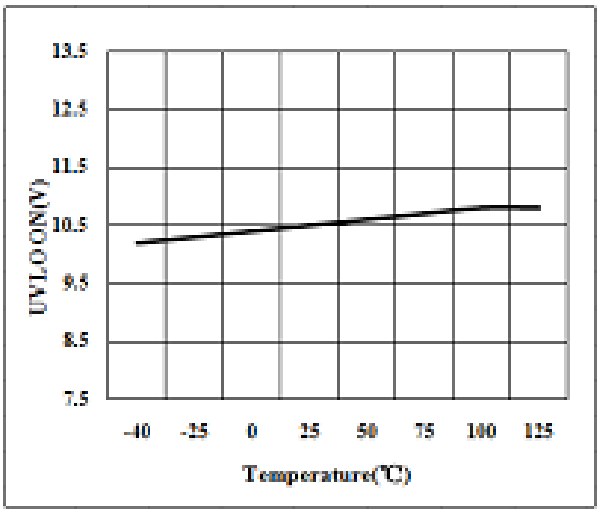
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
VRT	VRT	1.1	1.15	1.2	V	Fsw = 40000KK/RA

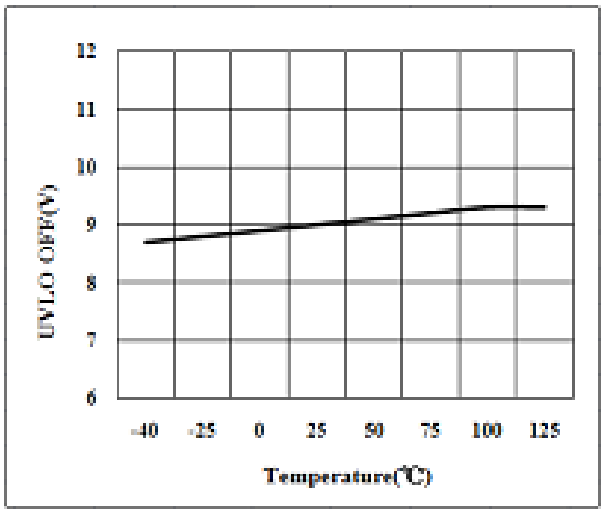
Block Diagram

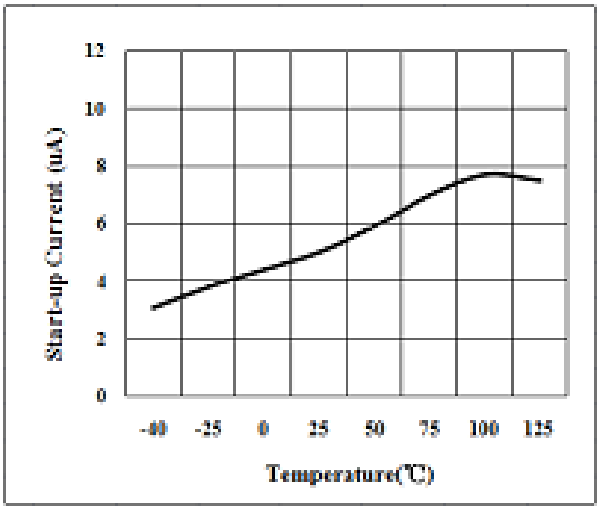
EST.1580P

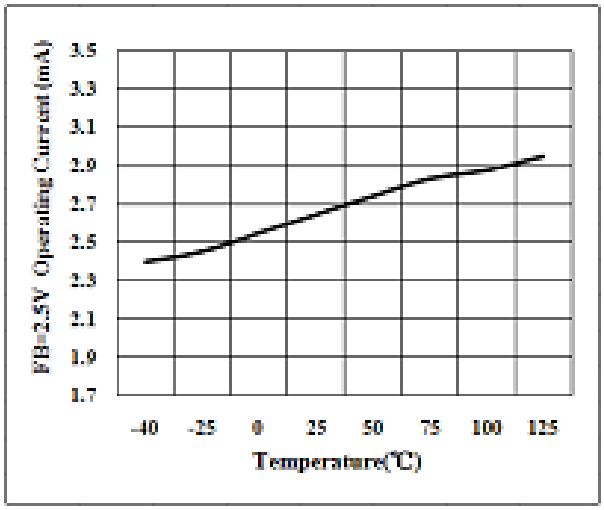


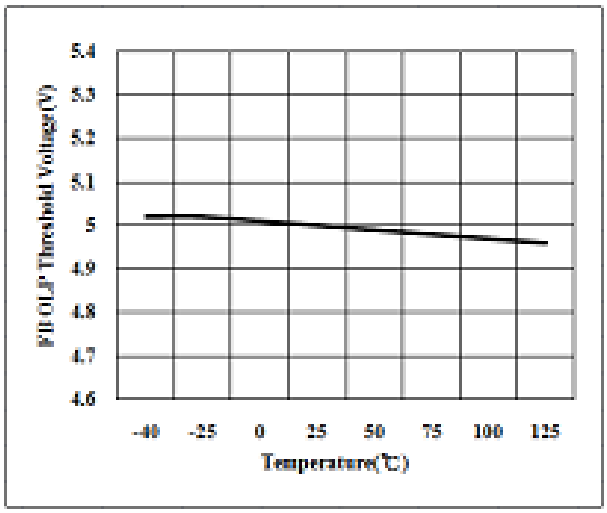
Typical Performance Characteristics

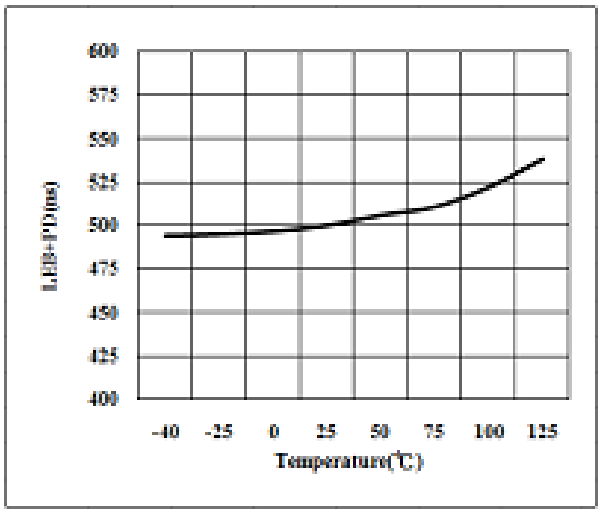


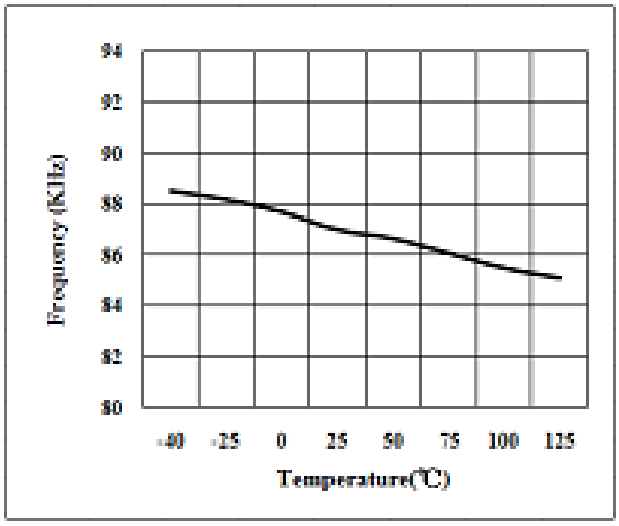


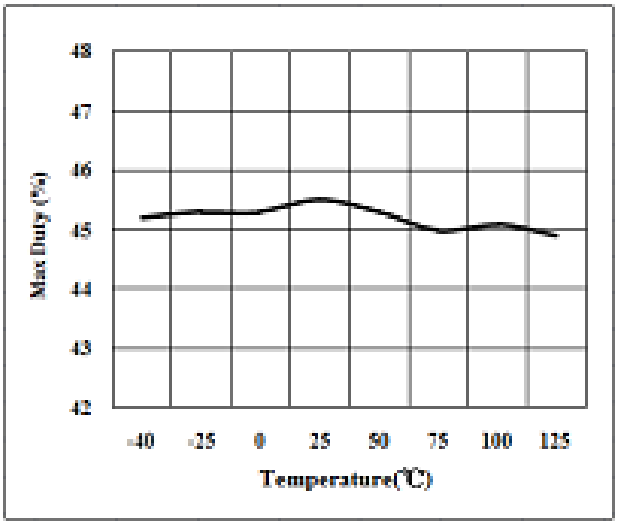


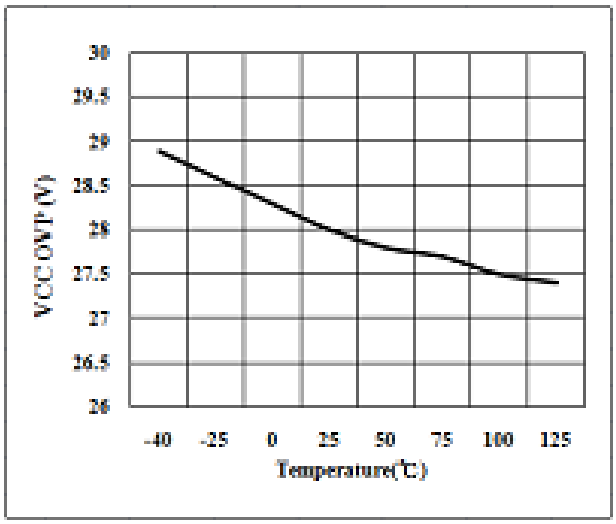


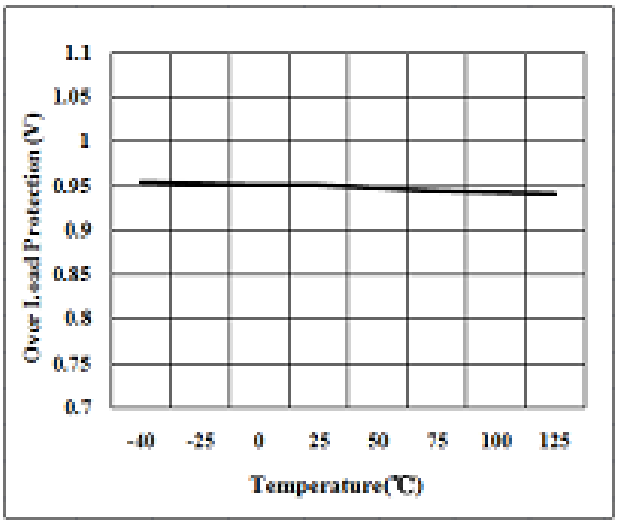


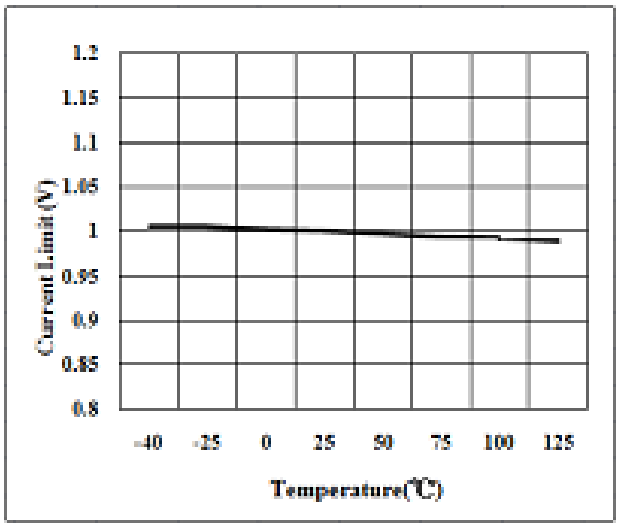


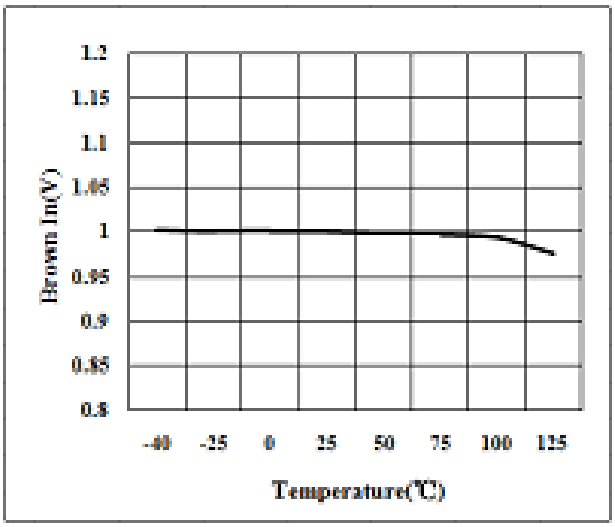

Frequency (KHz)
94
92
90
88
86
84
82
80
-40 -25 0 25 50 75 100 125
Temperature(℃)


Max Duty (%)
48
47
46
45
44
43
42
-40 -25 0 25 50 75 100 125
Temperature(℃)


VCC OVP (V)
30
29.5
29
28.5
28
27.5
27
26.5
26
-40 -25 0 25 50 75 100 125
Temperature(℃)


Over Load Protection (V)
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
-40 -25 0 25 50 75 100 125
Temperature(℃)


Current Limit (V)
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
-40 -25 0 25 50 75 100 125
Temperature(℃)


Brown In(V)
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
-40 -25 0 25 50 75 100 125
Temperature(℃)

Application Note

Operation Overview

The EST.1580P is a high−performance forward controller specifically developed to drive power supplies designed for the ATX 、the adapter and outdoor LED lighting market: Its current Mode operation implementing peak current−mode control topology, which offers UC384X−like features to build rugged power supplies.

EST.1580P provide (50～450KHz) switching frequency for various application. Meanwhile, it also built internal frequency jittering to spreading out peak energy for the merit of lower EMI.

Start-up

The start-up circuit of EST.1252 by used the internal comparator, which will detect the voltage on the Vcc pin, and assure the supply voltage enough to turn on it (UVLO_on) . At beginning, the startup current is provided by (Rstart) to charge the capacitor C_{Vcc} till V_{CC} get enough voltage (UVLO_ON) to turn on it. Once the start-up sequence has been activated the internal soft-start delay triggers, and waiting BO pin level is above brown-in level to let soft-start allowed.

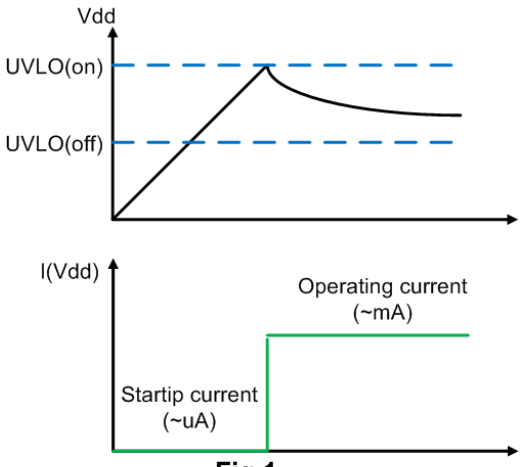


Fig.1

EST.1580P series is process with low power mix-mode process (5V and 40V), which max start-up current is around I_{CC-ST}。R-start calculate as below

$$\frac{V_{bulk} - V_{UVLO\_ON}}{R_{start}} > I_{CC-ST}$$

It is trade off between startup time and a higher startup resistance. Therefore, carefully select the value of Rstart , C_{Vcc} to optimize the power consumption and startup time.

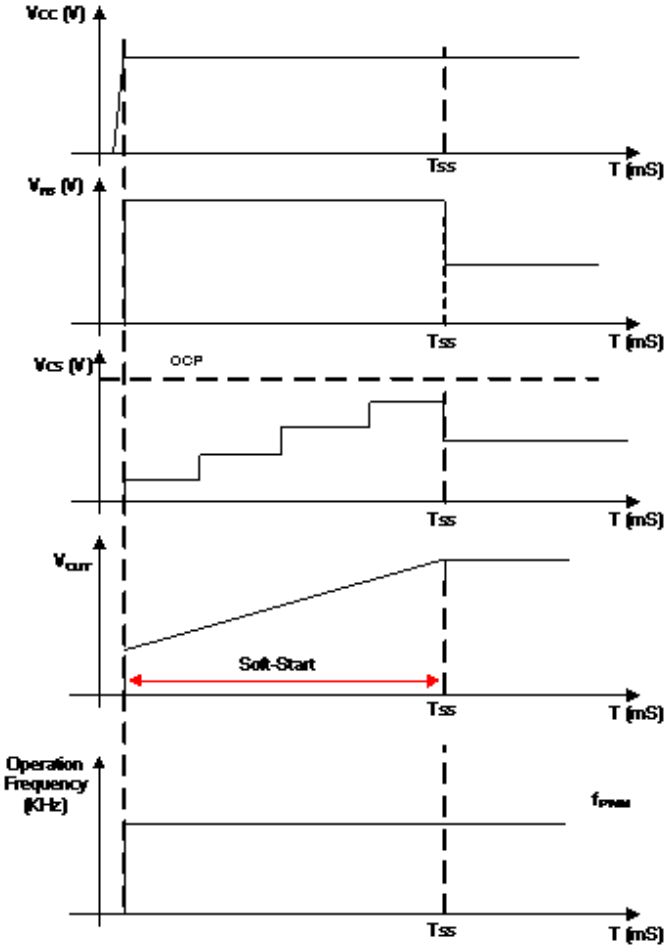


Fig.2

PRT , Prevent protection PG pin

This pin is monitor flag of protection. It keeps low at normal operation, and pull high after V_{CC} OVP trigger or OLP. This pin is similar to PG function, that is say, normal operation is 0V, and protection trigger is 5V. If system doesn't need PG function, can let it floating.

If the start-up current of original solution is more than 600uA(I_{CC-OLP}), suggest to connect 1KΩ~10KΩ to ground for V_{CC}_cap discharge.

BO, Brown-out Protection

By monitoring the level on BO pin, the controller protects the forward power against low input voltage conditions. When the BO pin level falls below the V_{BNO} level, it will stop pulsing until the input level goes back to normal and kick off the operation via a new soft-start sequence.

$$V_{AC\_min} \times 1.414 \times \frac{R_d}{R_u + R_d} = V_{BNO\_OFF}$$

$$\frac{R_d}{R_u + R_d} = \frac{V_{BNO\_OFF}}{V_{AC} \times 1.414}$$

Choose the resistance of R_u and R_d

$$\text{Brown in } V_{AC\_min} = \frac{V_{BNO\_ON}}{1.414} \times \frac{R_u + R_d}{R_d}$$

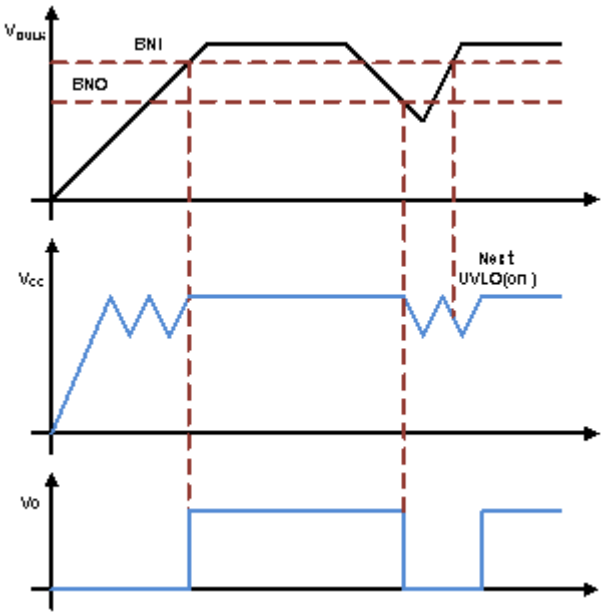


Fig.3

FB, Voltage feedback

EST.1580P series adopt current mode control, that is say, the voltage feedback signal is provided from TL431 at secondary side through the photo-coupler to FB pin and compare to the current signal sensing from Cs pin at primary side of MOS current to control the on/off of MOSFET.

No load burst mode :

Burst cycle operation is for the power saving of full no-load operation. Based on the voltage of comp. it will decrease following by the reduce of output load, and reach Vskip level to stop the driver pulses. No switching at some periods that can saves switching loss and reduces the standby power consumption. For forward application, it prevents over voltage on the output in case of light or no-load operation.

CS, Current sense Loop

Current mode PWM control mode detects the current command (CS) from the Rsense (the primary MOSFET current sense resistor) and voltage command from photocoupler (FB) to determine whether the system reaches a stable or not.

Complete Protection

SCP , Short circuit protection

EST.1580P provide various short circuit protection, secondary side schottky short protection (SDSP) , output over load protection (OLP).

OLP : A output short circuit or an overload situation is detected when the CS pin level reaching its maximum level at V_{IOLP}. In that case the fault status is stored in the latch and allows the digital timer count. If the digital timer ends then the fault is latched and the controller permanently stops the pulses on the driver pin.

If the fault is gone before ending the digital timer, the timer is reset only after 3 switching controller periods without fault detection (or when the CS pin < 1 V during at least 3 switching periods).

If the fault is latched the controller can be reset if a BO reset is sensed or if VCC is cycled down to VCC(off).

SDSP, Secondary side schottky short protection

EST.1580P provide various short circuit protection, secondary side schottky short protection (SDSP) , output over load protection (OLP).

VCC OVP (Over Voltage Protection)

The maximum ratings of the EST.1580P are around 40V. To prevent the V_{CC} enter breakdown condition, EST.1580P series are integrated with OVP function on VCC pin. Whenever the VCC voltage is higher than the VOVP threshold, the output gate drive circuit will be turn-off simultaneously and the power MOSFET is turn-off until the next UVLO(on) cycle.

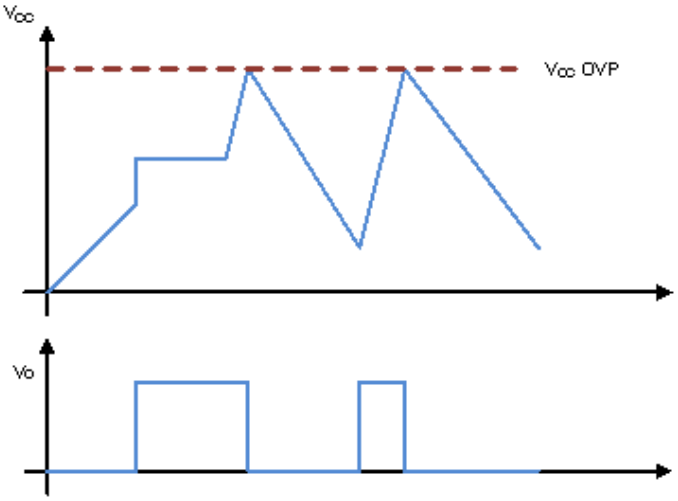
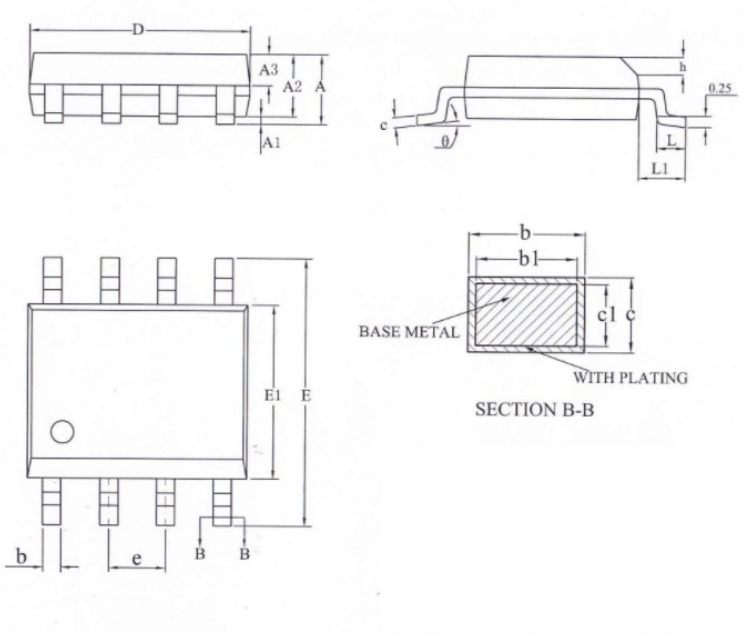


Fig.4

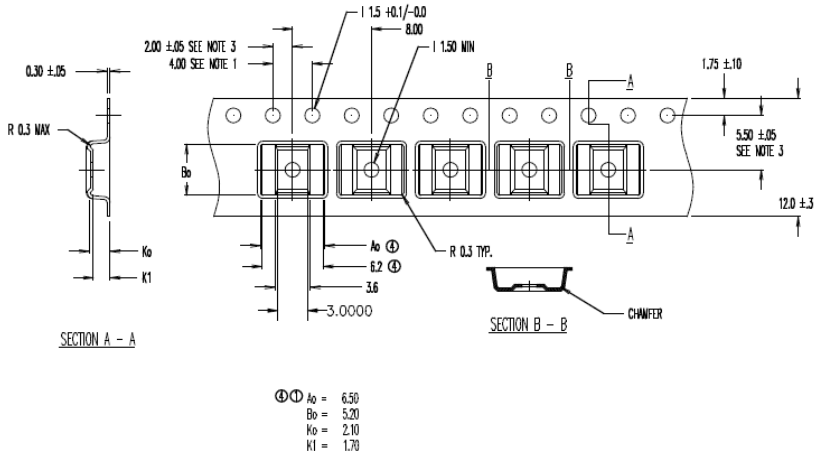
Package Information

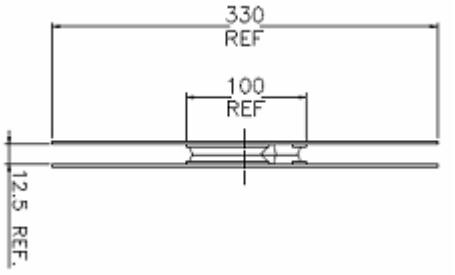
SOP-8



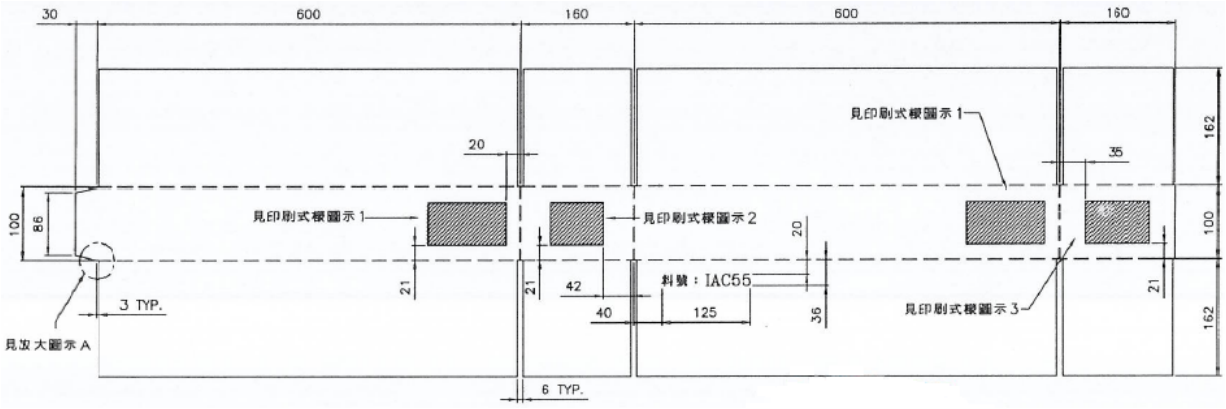
Symbol	Dimension in mm		
	MIN	NOM	MAX
A	--	--	1.75
A1	0.1		0.225
A2	1.3	1.4	1.5
A3	0.6	0.65	0.7
b	0.39	--	0.47
b1	0.38	0.41	0.44
c	0.2	--	0.24
c1	0.19	0.2	0.21
D	4.8	4.9	5
E	5.8	6	6.2
E1	3.8	3.9	4
e	1.27BSC		
h	0.25	--	0.5
L	0.5	--	0.8
L1	1.05REF		
θ°	0°	--	8°

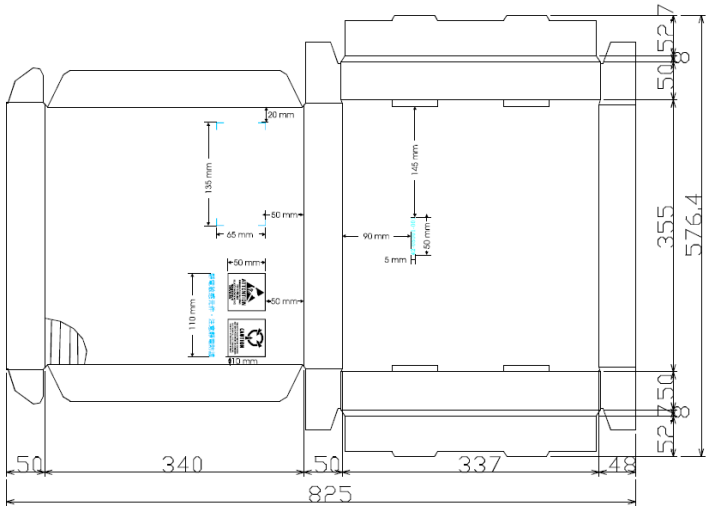
SOP-8 / Tape Reel Data

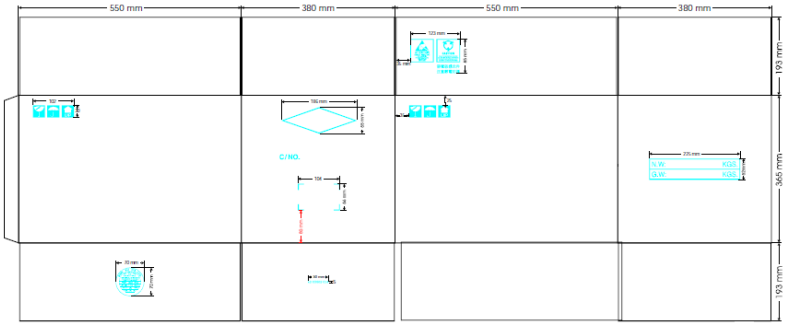




Tube Inner box Data

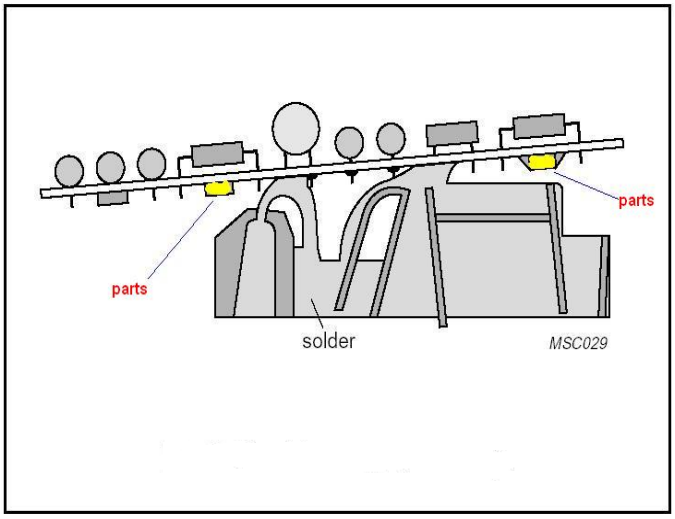


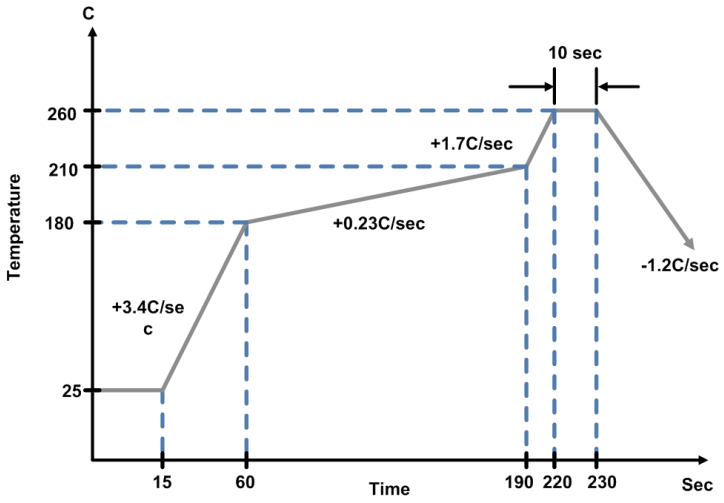




Reliability Test Program

Reflow Condition (IR/Convection or VPR Reflow)





Test Item	Method	Description
SOLDERABILITY	MIL-STD-883D-2003	245℃, 5sec
HOLT	MIL-STD-883D-1005.7	1000Hrs Bias@125℃
PCT	JESD-22-B,A102	168Hrs, 100% RH, 121℃
TST	MIL-STD-883D-1011.9	-65℃~150℃, 200 Cycles
ESD	MIL-STD-883D-3015.7	VHMB>2KV, VMM>200V
Latch-Up	JESD 78	10ms, 1_{tr}> 100mA

Revision History

REVISION	DESCRIPTION	PAGE	DATE
0.1	Primarily		2019/10/24

www.esthome.com