Data Sheet

Type Description : Green-Mode PWM Controller

Product Name : EST.3500xS

Reversion : V1.0

Reversion Date : May, 2021

Page : 11 Pages

General Description Features

The EST.3500xS is a higher integrated multi-mode flyback controller suitable for designing high-performance off-line power converters. It provides several functions to enhance the efficiency to meet the criteria of global standards such as DoE Level VI and EU CoC V5 Tier-2. It implements the multi-mode function, smart quasi-resonant mode, Continuous (CCM) and Discontinuous (DCM) modes, which depends on high and low line of input and loading.

Meantime, it also provides excellent EMI-improved solution, and also builts in all complete protection.

To increase various load performance, the EST.3500xS family features a green mode function, which implements low start-up current, green-mode power-saving. It is also built-in the leading-edge blanking (LEB) of the current sensing and feedback loop to screen the spike noise from any input signal. The internal slope compensation can limit the constant output over universal AC input range. The sawtooth over frequency function for EMI improved solution.

Meanwhile, to ensure system ruggedness , the EST.3500xS is also implements various protection, such as, OLP (Over Load Protection) ,VDD OVP (Over Voltage Protection) , Output OLP and output OVP to prevent the circuit damage from the abnormal conditions.

- Integrated 700V Start-Up Device
- Brown-In and Brown-Out
- EST.3500DS=65KHz/3500MS=100KHz/3500HS= 135KHz fix frequency mode at PWM Mode
- Very low startup current (<6 uA)
- 0.5mA ultra-low operating current at light load
- Programmable adaptive Frequency Shuffling and Slope Compensation @ QR and PWM 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)
- Fault Protections : VDD Over Voltage, CS OVP(Over Voltage), Output Short-Circuit, Over-Current, OLP (Over load protection) , External Over Temperature (OTP) and Pin Fault
- Photo coupler short & Feedback open protection
- High voltage CMOS process with excellent ESD protection
- 250mA/-500mA driving capability
- Hazardous Substance Free
- RoHs/REACH Compliant

SOP-8L

Application

- Switching AC/DC adapter and battery charger
- ATX standby power
- Open frame switching power and CD(R) Set-top-boxes(STB) 384Xreplacement

***EST.3500XS works with current sensing synchronous rectifier controllers, such as EST.6001C/02A, to achieve higher conversion efficiency and very compact power density.

Function and Protection Options

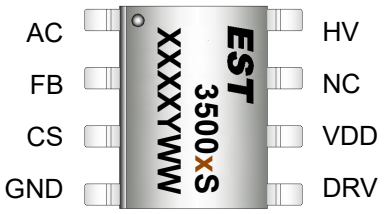
Part No.	Package	Freq. KHZ	Protection						
			OLP	VDD OVP	CS OVP	OTP	CS Open	SDSP	BNO
EST.3500DS	SOP-8	65KHz	Hiccup / 100ms	Hiccup	Hiccup	Hiccup	Hiccup	Hiccup	Hiccup
EST.3500MS	SOP-8	100KHz	Hiccup / 65ms	Hiccup	Hiccup	Hiccup	Hiccup	Hiccup	Hiccup
EST.3500HS	SOP-8	135KHz	Hiccup / 48ms	Hiccup	Hiccup	Hiccup	Hiccup	Hiccup	Hiccup

Ordering Information

Part Number	Package	Packaging	Note
EST.3500DS & ASR	SOP-8L	Tape & Reel	Green
EST.3500MS & RSR	SOP-8L	Tape & Reel	Green
EST.3500HS & LSR	SOP-8L	Tape & Reel	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)

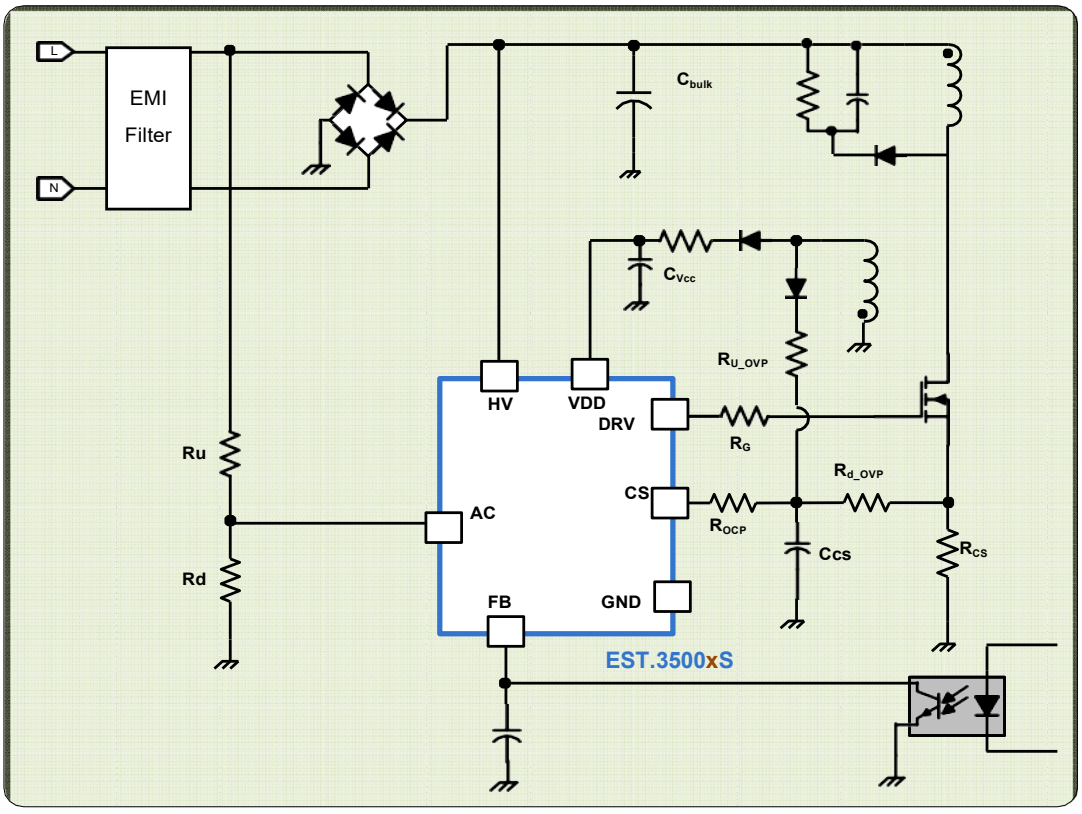
Pin Assignments and Package Type



EST: LOGO
3500xS:
3500= Part Number
xS = Frequency Type
DS=65KHz, MS=100Hz; HS=135KHz
XXXX: Production lot code
Y: Year code; **WW** : Week code

SOP-8L	NAME Description	Description
1	AC	AC/DC Brown in/out (option, can floating)
2	FB	Voltage input pin by connecting a photo-coupler
3	CS	Current Sense input. The current sense resistor between this pin and GND is used for current limit setting.
4	GND	Ground
5	DRV	Driver output to driver the external MOSFET
6	VDD	Power supply pin
7	NC	No Connect
8	HV	High Voltage Input for Start-Up. This pin can withstand high voltage up to 700V.

Application Circuit



Absolute Maximum Ratings

Parameter Symbol		Symbol	Limit Values		Unit	Remark
			Min.	Max		
Supply Voltage VDD		V_{DD}	-0.3	32	V	
FB,CS,AC		V_{FB} V_{CS} V_{RTL}	-0.3	7	V	
HV to GND		V_{HV}	-0.3	700		
Gate Driver Voltage		V_{DRV}	-0.3	V_{DD}+0.3	V	
Gate Output Current		I_{DRV}		500	mA	
Operation Junction Temperature		Tj	-40	150	℃	
Operation Ambient Temperature		T_A	-25	85	℃	
Storage Temperature		T_{stg}	-55	150	℃	
Power Dissipation @TA=85℃		P_D	-	556	mW	
Junction-to-Ambient Thermal Resistance*	Ta = 25℃	θ_{JA}		180	℃/W	SOP-8
Junction-to-Case Thermal Resistance**	Ta = 25℃	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.

Recommended Operating Conditions

Parameter Symbol	Symbol	Limit Values		Unit	Remarks
		Min.	Max		
Supply Voltage VDD	V_{DD}	11	25	V	
Supply Voltage HV	V_{HV}		700	V	
CS Diode (D_{CS})	trr		150	ns	1N4148
CS OVP	R_{d_OVP}	100	400	Ω	
Ambient temperature range	Topr	-40	85	℃	
Capacitance of FB pin	C_{FB}		2.2	nF	

DC Electrical Characteristics (VCC =15V, Ta=25°C)

HV Section (VHV Pin):

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
IHV Supply Current for HV pin	I_{HV-ST1}		20		mA	VDD < UVLO ON, V_{HV}=200V
Off State Leakage Current	I_{HV-LK}		1		μA	VDD > UVLO ON, V_{HV}=560V

Supply Voltage (VCC Pin):

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Operating Current (with 1nF load on DRV pin)	I_{CC-OP}	0.4	0.6	0.8	mA	V_{FB}=0V
	I_{CC-OP}	1	2	2.5	mA	V_{FB}=2.5V CL=1nF
	I_{CC-OLP}	0.2	0.35	0.5	mA	Protection Current
UVLO (off)	$V_{UVLO-OFF}$	7.5	8	8.5	V	
UVLO (on)	$V_{UVLO-ON}$	16	18	19	V	
VDD OVP Level	V_{OVP}	26	27	28.5	V	
OVP Debounce Time	T_{OVP}		4		cycle	Guarantee by Design
VDD Simulation mode(ON)	VDD_{-HD_ON}	9.7	10.2	10.7	V	
VDD Simulation mode(OFF)	VDD_{-HD_OFF}	10.2	10.7	11.2	V	

Voltage Feedback(FB Pin):

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Short Circuit Current	J_{Zero}	0.1	0.14	0.18	mA	V_{FB}=0V
Open Loop Voltage	V_{FB-OP}	4.8	5	5.2	V	FB pin open
Over Load Protection	V_{OLP}	3.5	4	4.5	V	
Debounce Time of OLP	T_{OLP}	90	100	110	ms	EST.3500DS
		55	65	75	ms	EST.3500MS
		38	48	58	ms	EST.3500HS
Burst mode start voltage(on)	V_{BUR_ON}	--	0.45	--	V	
Burst Mode Hysterics	V_{BUR_HY}	0.05	0.1	0.15	V	
Green Mode Threshold	F_{th_GR}	35	45	55	KHz	V_{FB}=1.3V EST.3500DS
		50	60	70	KHz	V_{FB}=1.3V EST.3500MS
		70	80	90	KHz	V_{FB}=1.3V EST.3500HS

Current Sensing (CS Pin):

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Leading Edge Blanking Time & Propagation Delay to Output	T_{LEB} +T_{PD}	400	500	600	ns	
Maximum CS Off Voltage	V_{CSTH}	0.66	0.7	0.74	V	
OCP source current	I_{OCP}	240	250	260	uA	Min. Duty
CS Over Voltage Protection	V_{CS_OVP}	0.47	0.5	0.53	V	T = T_{off}
CS OVP De-bounce Time	T_{CS_OVP1}		4		cycle	V_{CS}> V_{CS_OVP} & V_{FB}> V_{OLP}
	T_{CS_OVP2}	90	100	110	ms	EST.3500DS
		55	65	75		EST.3500MS
		38	48	58		EST.3500HS
OVP Leading Blanking time	T_{OVP_LEB}		2		us	Guarantee by Design
Internal Slope Compensation*	$V_{SLP\_LP\_LEB}$		160		mV	
Short Circuit Protection Voltage	V_{SCP}		0.85		V	
Debounce Time of VSCP	T_{SCP}		2		cycle	
Short Circuit Detection Time	T_{SCP}		100		us	

Alternating Current Detect (AC Pin):

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Brown In trigger point	V_{BNI}	0.65	0.7	0.75	V	
Brown Out trigger point	V_{BNO}	0.55	0.6	0.65	V	
BNO De-bounce time	T_{BNO}	20		25	ms	EST.3500D
		13		19,5		EST.3500M
		9.5		10.6		EST.3500H

Driver(DRV Pin) :

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Output Low Level	V_{OL}			1	V	VDD = 16V, IO=20mA
Output High Level	V_{OH}	8			V	VDD = 16V, IO=20mA
Output Clamp Voltage Level	V_{G_Clamp}	11	12.5	14	V	VDD = 25V
Rising Time	T_R	200	300	400	nS	VDD = 16V, CL= 1nF
Falling Time	T_F	10	30	50	nS	VDD = 16V, CL= 1nF

Timer Section:

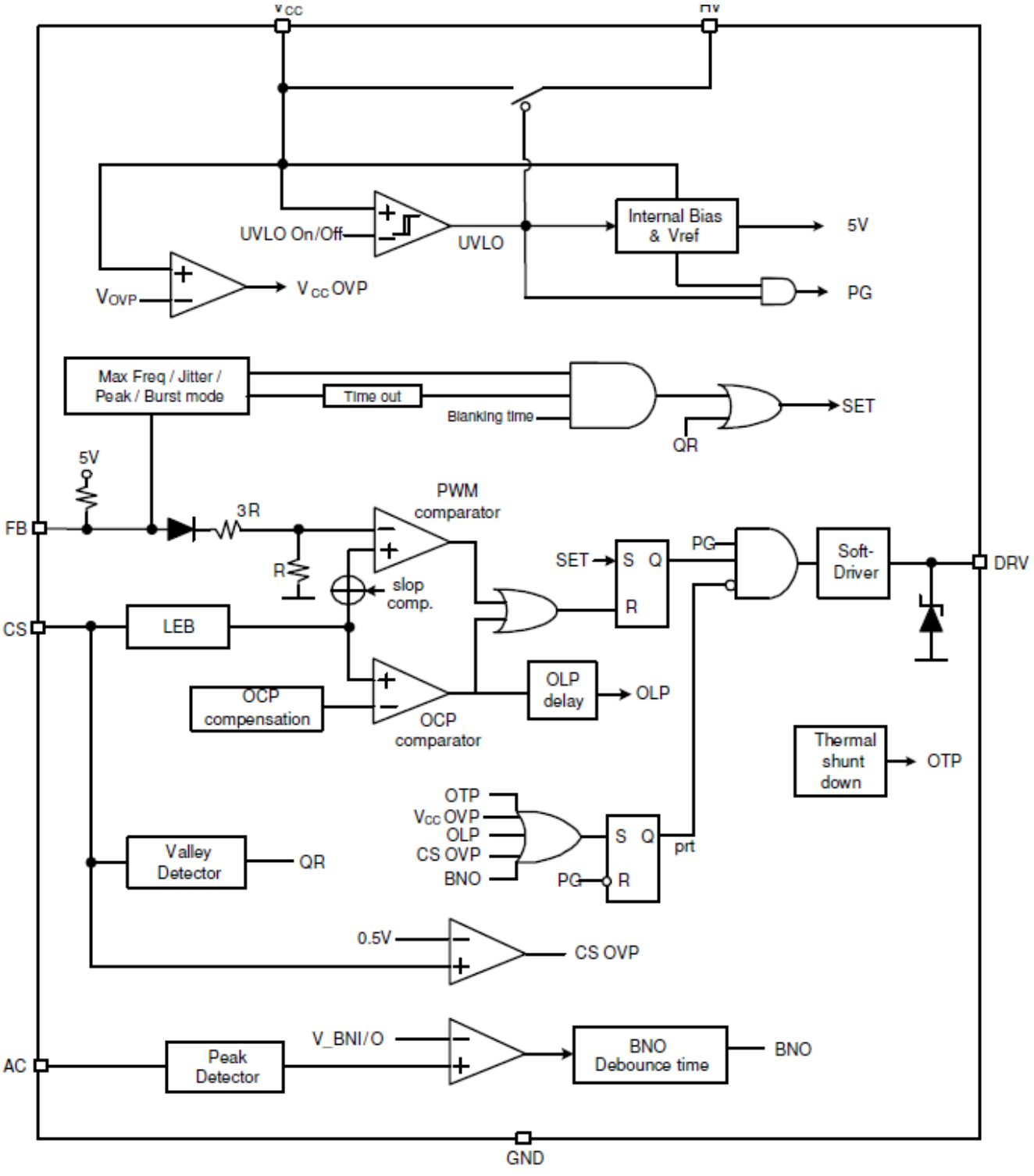
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Burst Mode Frequency	F_{Burst}	20	22.5	25	KHz	
PWM Mode Frequency	F_{PWM}	61	65	69	KHz	EST.3500DS
		95	100	105		EST.3500MS
		130	135	140		EST.3500HS
Voltage stability of Frequency	F_{PSRR}	-1		+1	%	VDD = 11V~25V
Frequency Shuffling Range	F_{jitter}	+/-4	+/-6	+/-8	%	
Maximum duty cycle	D_{MAX}	75	80	85	%	
Internal Soft Startup Time	T_{SS}	10.3	13.2	16.2	mS	EST.3500DS
		6.7	8.6	10.5		EST.3500MS
		4.9	6.4	7.8		EST.3500HS

On chip OTP:

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
OTP Level			150		℃	
OTP exit			120		℃	

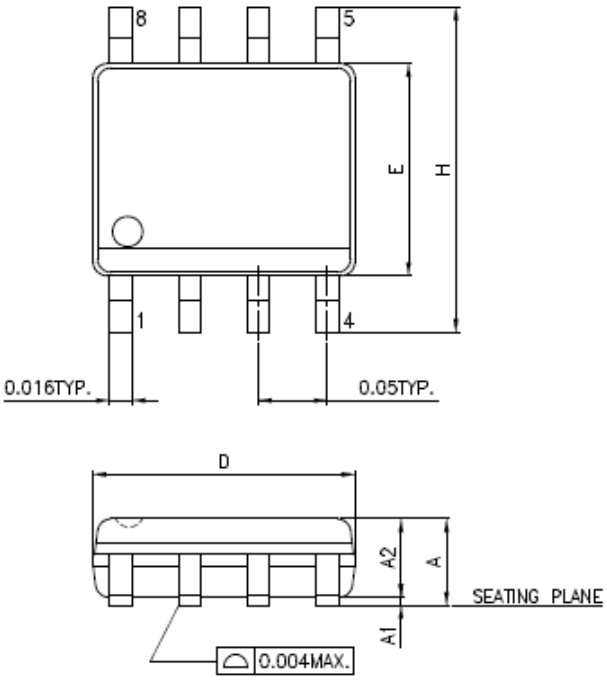
Block Diagram

EST.3500xS



Package Information

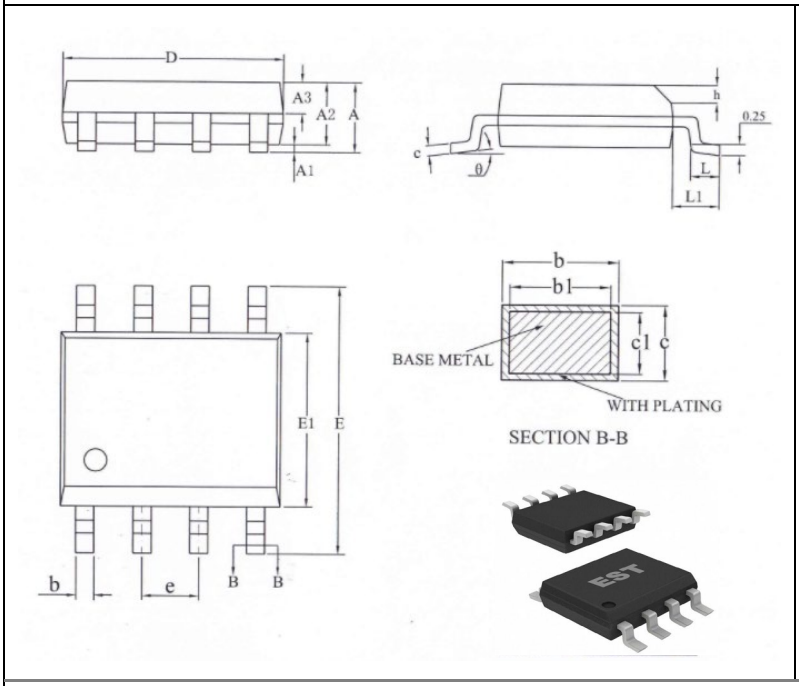
SOP-8 Package (mm)



Symbols	Dimensions In Inches			Dimensions In millimeters		
	MIN.	NOR.	MAX.	MIN.	NOR.	MAX.
A	0.050	0.061	0.072	1.270	1.549	1.829
A1	0.000	------	0.010	0.000	------	0.254
A2	------	------	0.062	------	------	1.575
D	0.185	0.193	0.200	4.699	4.902	5.080
E	0.147	0.154	0.160	3.734	3.912	4.064
H	0.225	0.237	0.249	5.715	6.020	6.325
L	0.013	0.033	0.053	0.330	0.838	1.346
θ	0°	4°	8°	0°	4°	8°

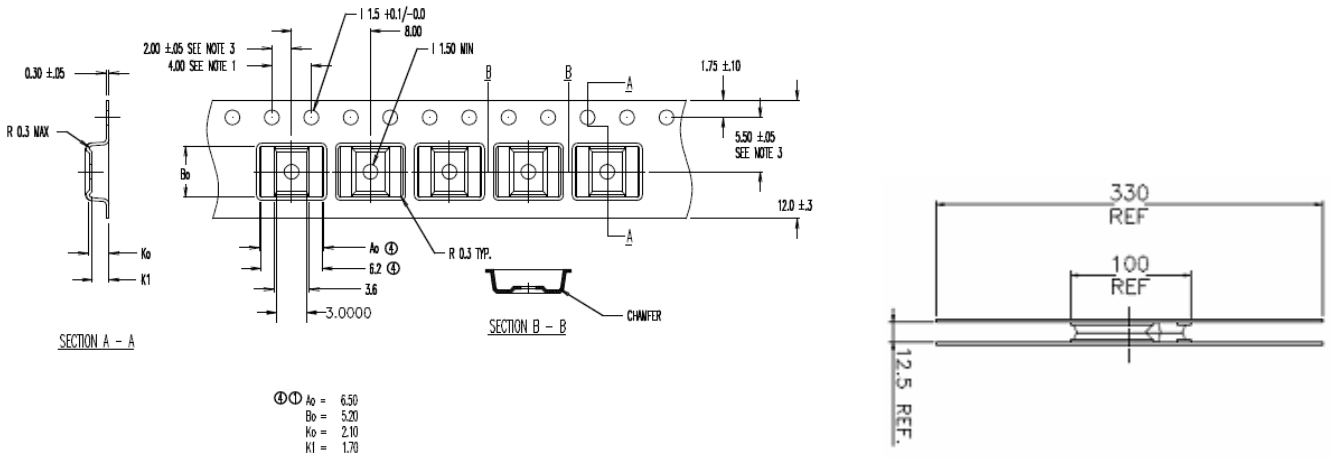
Package Information

SOP-8

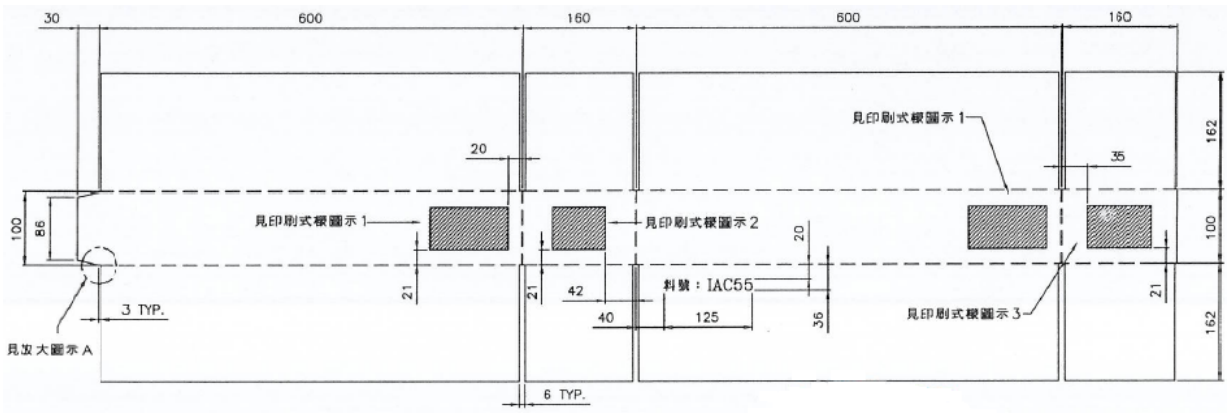


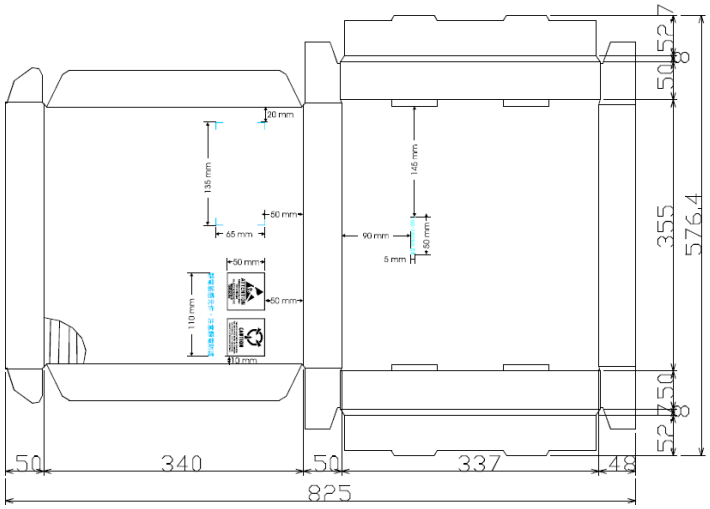
Symbol	Dimension in mm		
	MIN	NOM	MAX
A	--	--	1.75
A1	0.1		0.225
A2	1.3	1.4	1.5
A3	0.6	0.65	0.7
b	0.39	--	0.47
b1	0.38	0.41	0.44
c	0.2	--	0.24
c1	0.19	0.2	0.21
D	4.8	4.9	5
E	5.8	6	6.2
E1	3.8	3.9	4
e	1.27BSC		
h	0.25	--	0.5
L	0.5	--	0.8
L1	1.05REF		
θ°	0°	--	8°

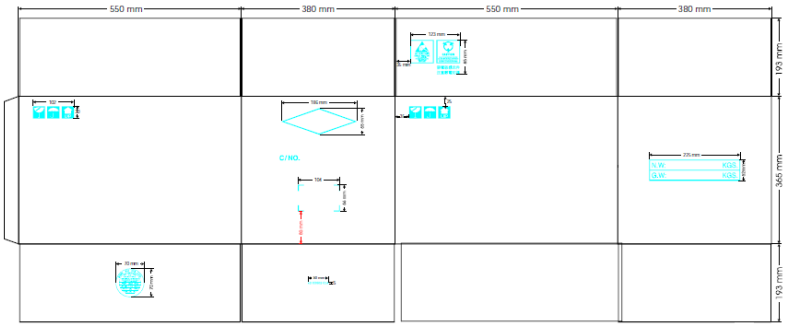
SOP-8 / Tape Reel Data



Tube Inner box Data







NOTE
1.紙箱尺寸：L550 X W380 X H365 mm
2.尺寸公差：± 5 mm
3.紙箱材質：面紙白紙 240
蕊紙 B 浪 100
中紙 175
蕊紙 A 浪 180
底紙 A 級 200
4.破裂強度：250LBS ± 10LBS
5.印刷顏色：天空藍
6.備　　註：紙箱打釘

Revision History

REVISION	DESCRIPTION	PAGE	DATE
V1.0	First Release		2021/10/22