

DESCRIPTION

The LR5920 is a current mode PWM switching power supply controller that specifically designed for AC/DC converter with high performance versus cost ratio. It provides continuous output power up to 12W in the broad voltage range of 85V – 265V. Its optimized and highly reasonable circuit design has made it possible to minimize the total cost of the product. This power supply controller could be used in typical flyback circuit topology to constitute simple AC/DC converter. The internal initiating circuit of 5920 has been designed with a unique means of current sink to complete the startup using the amplifying function of the power switching tube. This will significantly reduce the power consumption of the start-up resistor; and when the output power becomes smaller, 5920 will automatically lower its operating frequency to enable very low standby power consumption.

When the power tube stops, the internal circuit will turn the power tube reverse bias to greatly raise the voltage resistant capacity of OC pin. This will ensure the safety of the power tube. The internal design of the 5920 is also provided with over-load and saturation preventive function capable of preventing disorders such as overload, transformer saturation and output short-circuit, so as to increase the reliability of the power supply. A voltage reference of 2.5V is also integrated in the 5920 to provide accurate power supply to the clock circuit, and the clock frequency may be set by external timing capacitance. Presently, standard DIP8 package and environmental friendly lead-free package in compliance with European standard can be supplied.

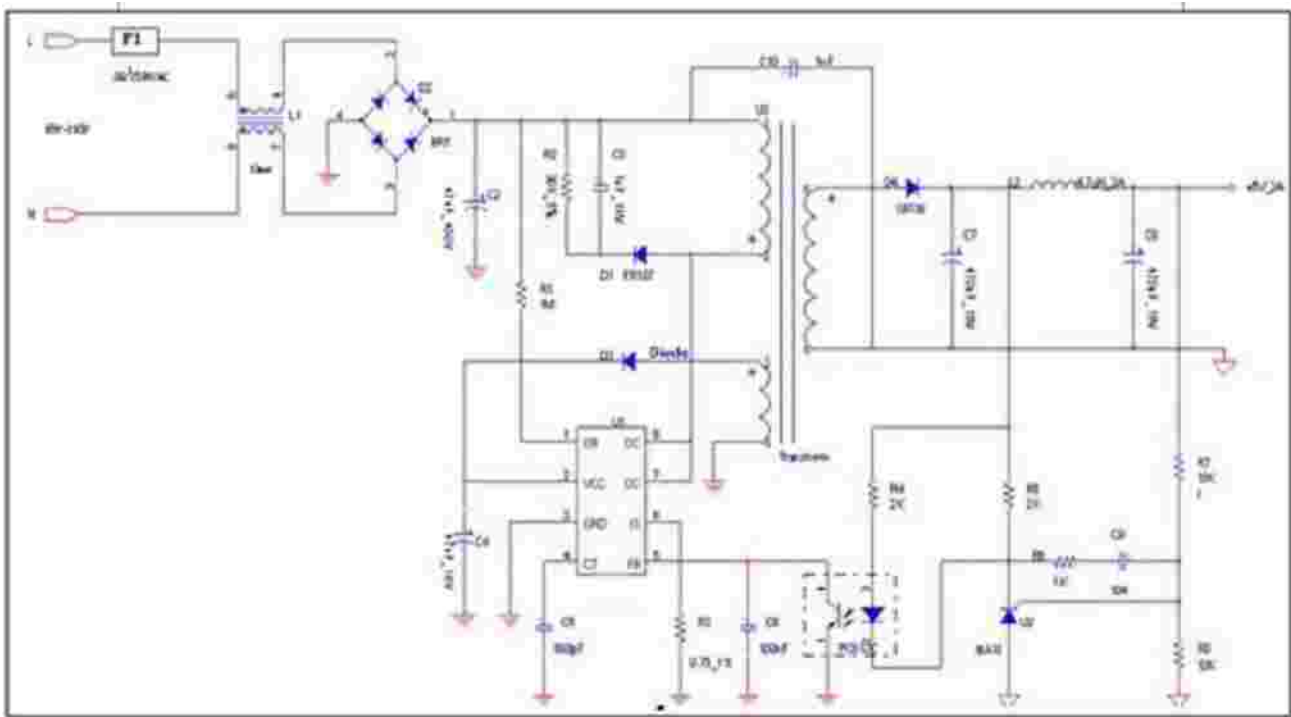
FEATURES

- | Built-in 750V high voltage power switching tube with minimal external parts count
- | Latched PWM and pulse-by-pulse current limiting inspection
- | Reduced frequency at low output with standby power consumption below 0.25W
- | Built-in slope and feedback compensation function
- | Separate upper limit current inspection controller to handle timely the over-current and overload of the controller
- | Turn off periodic bias output of the emitter to improve the voltage resistance of the power tube
- | Built-in thermal protective circuit
- | Complete start-up using amplification of the switching power tube to reduce the power consumption of the start-up resistor more than ten times
- | Automatic VCC over-voltage limit
- | Broad voltage output power up to 12W and narrow voltage output power up to 18W

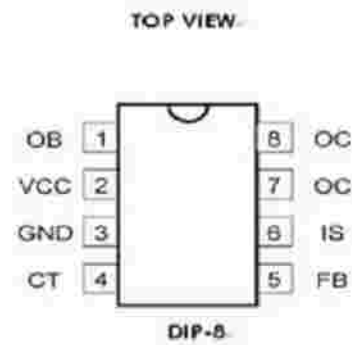
Applications

- | Power Adaptors(traveling chargers ,stand-alone power set)
- | Internal power supply for Energy-Saving Appliances (such as electromagnetic oven, microwave oven and etc.)

TYPICAL APPLICATION



PACKAGE INFORMATION



PIN FUNCTIONS

Pin	Symbol	
1	OB	Base Pin of the Power Tube. (Enabling current input and connect to initiating resistance)
2	VCC	Power Supply Pin
3	GND	Ground Pin
4	CT	Oscillation Capacitance Pin. (Connect to timing capacitance)
5	FB	Feedback Pin
6	IS	Current Inspection Pin
7 ~ 8	OC	Output Pin (Connect to switching transformer)

ABSOLUTE MAXIMUM RATINGS^(Note 1)

Supply Voltage VCC.....	18V	Pin Input Voltage.....	VCC+0.3V
OC Voltage.....	-0.3-750V	Switching Current.....	800mA
Total Dissipation Power.....	1000mW	Operating Temperature Range.....	0-75°C
Storage Temperature Range.....	-40 - 150°C	Welding Temperature.....	+260°C, 10S

ELECTRICAL CHARACTERISTICS

The specifications are applied at T=25°C, VCC=5.5-7.5V, Ct=680PF, RS=1Ω, unless otherwise noted.(Note 2)

Parameter	Symbol	Conditions	Typ	Max	Units	
Output Section						
Max. Withstanding Voltage of the Switching Tube		IOc=10mA			V	
Saturation Voltage	V _{SAT}	Ioc=250mA		1	V	
Output Rise Time	TR	CL=1nF		75	ns	
Output Fall Time	TF	CL=1nF		75	ns	
Output Limiting Current		Tj=0-100°C	270	290	mA	
Reference Section						
Reference Output Voltage	VREF	Io=1.0mA	2.5	2.6	V	
Line Regulation		Vcc=5.5-9V	2	20	mV	
Load Regulation		Io=0.1-1.2mA		3	%	
Temperature Stability			0.2		mV/°C	
Output Noise Voltage		F=10Hz-10KHz		50	uV	
Long Term Stability		1000 hours@85°C	5		mV	
Oscillator Section						
Oscillating Frequency	Fosc	Ct=680PF	61	67	KHz	
Voltage Stability		Vcc=5.5-9V		1	%	
Temperature Stability		Ta=0-85°C		1	%	
Oscillator Amplitude (Vp-p)			2.2		V	
Feedback Section						
Input Impedance	Pull-up Current	FB=2.5V, IS=0V	0.6	0.65	mA	
	Pull-Down Resistor		30		KΩ	
Power Supply Suppression Ratio		Vcc=5.5-9V	60	70	dB	
Current Sampling Section						
Current Sampling Threshold	Vcs		0.60	0.65	V	
Anti-Upper Limit Current	IL		0.27	0.29	A	
Power Supply Suppression Ratio			60	70	dB	
PWM Section						
Maximum Duty Ratio	D _{MAX}		57	61	%	
Minimum Duty Ratio	D _{MIN}			3.5	%	
Power Supply Current Section						
Initiating Reception Current			2.4	3.2	mA	
Initiating Static Current			55	80	uA	
Static Current	I _Q	Vcc=8V	3.0	3.3	mA	
Start-up voltage			8.8	9.0	V	
Oscillator Turn-off Voltage			4.6	4.8	V	

ELECTRICAL CHARACTERISTICS

The specifications are applied at $T=25^{\circ}\text{C}$, $V_{CC}=5.5\text{--}7.5\text{V}$, $C_t=680\text{PF}$, $R_S=1\Omega$, unless otherwise noted.(Note 2)(continued)

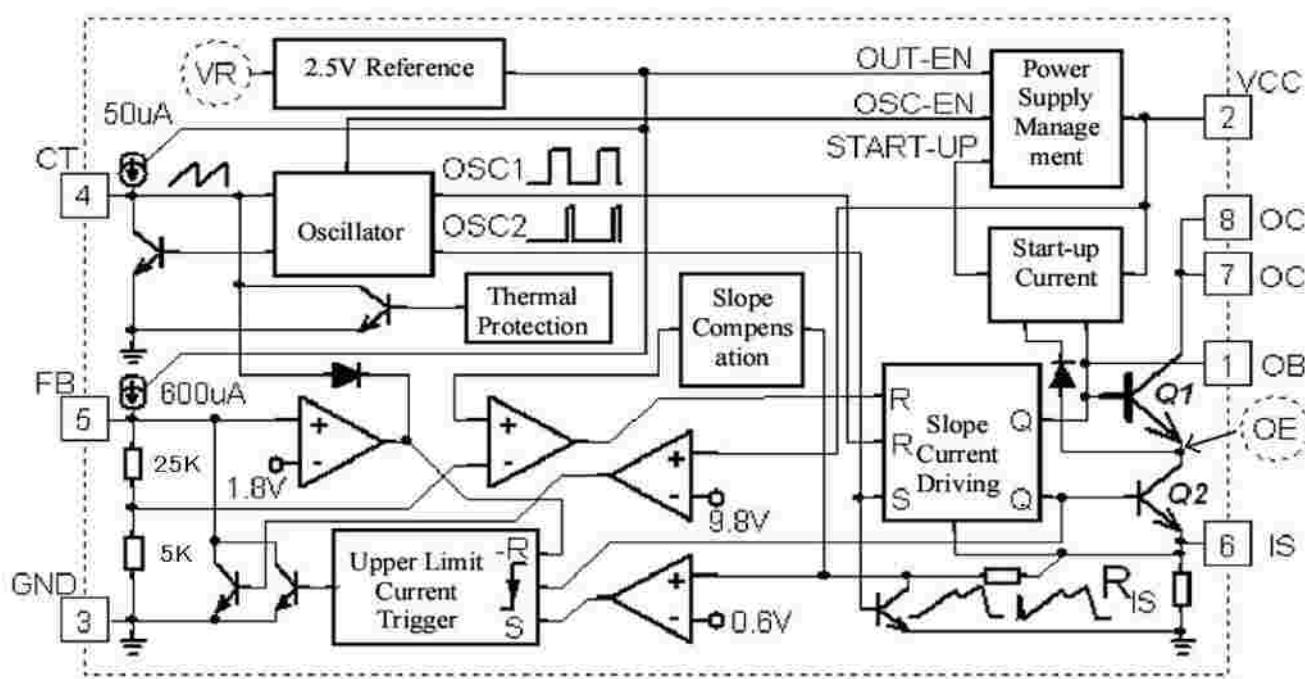
Re-enabling voltage			3.6	3.8	4.0	V
Over-Voltage Limiting Threshold			9.5	10	10.5	V

Note1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note2: The 5920 is guaranteed to meet performance specifications from 0°C to 70°C .

Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

BLOCK DIAGRAM



OPERATION (Refer to Block Diagram)

In the start-up stage, when power is on, VR is closed; the pull-up current source FB is closed; OE inputs enabling current from power tube to VCC; OB controls the base current of the power tube, limits the collector current of the power tube (i.e. 5920 initiates the reception current), so as to ensure the safety of the power tube; when VCC voltage raises up to 8.8 V, the enabling stage ends and it goes into the normal stage.

In the normal stage, VCC voltage should be maintained at 4.8V to 9.0V, VR outputs 2.5V reference; FB pull-up current source is opened; the oscillator output OSC1 decides the maximum duty ratio, output OSC2 tries to trigger the power into open period, and the screened power tube turns on the current peak; if FB is below 1.8V (approximately between 1.2V and 1.8V), the oscillator period will then be increased, the smaller

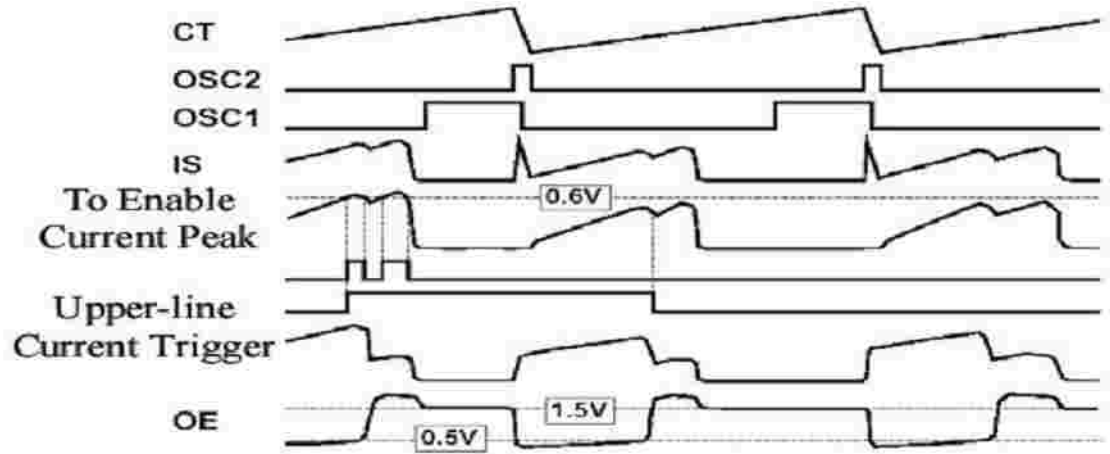
the FB is, the wider the oscillator period will be, until the stop of the oscillator (this feature will lower the stand-by power consumption of the switch power source); if the external feedback intends to make VCC higher than 10V, the internal circuit feedback to FB will stabilize VCC at 9.8V (with this feature, the internal circuit rather than the external feedback circuit will be used to stabilize the output voltage, but the stabilizing accuracy may be low); in the open period, OB supplies base current to power tube, OE pulls down the emitter of the power tube to IS, and the OB uses the slope current driving (i.e. the OB open current is the function of IS, when $IS = 0\text{V}$, OB open current is approximately 40mA, then the OB open current will increase along with IS linearly, when IS raises to 0.6V, the OB open current is approximately 100mA, this feature will effectively utilize the output current of OB and lower the power

consumption of 5920), if IS detects the specified current of FB, it goes into close period; in the close period, OB pulls down, the power tube may not be turned off immediately, but OE clamps on 2.0V (after the power tube turns off, the base will be reverse bias and the voltage withstanding capacity is increased); in the open or close period, if it detects the current exceeding upper limit of the power tube, then the upper limit flip-flop will be put at the preferential position, forcing FB to decrease and the duty ratio will turn smaller, so that the power tube and transformer will be protected; at the beginning of next close period edge or if FB is below 1.8V, the upper limit flip-flop will reset. Besides, the built-in heat

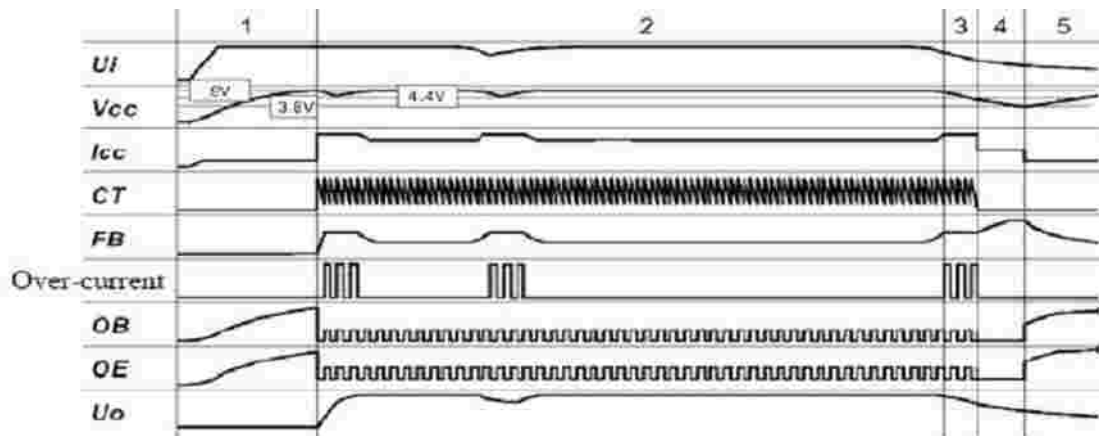
protection of 5920 will widen the oscillator period when the internal temperature is above 125°C to ensure the temperature of 5920 will not exceed 135 °C; the built-in slope compensation will stabilize the open/close period when 5920 is at high duty ratio or in continuous current mode.

When VCC lowers to about 4.6V, the oscillator will be closed, OSC1 and OSC2 will be at low level, and the power source will be maintained at close period; when VCC goes on lowering to about 4.2V, 5920 will enter the enabling stage again.

Normal Stage Switching Cycle Oscillogram



Global Oscillogram



TEST DATA

LR5920 (12V)

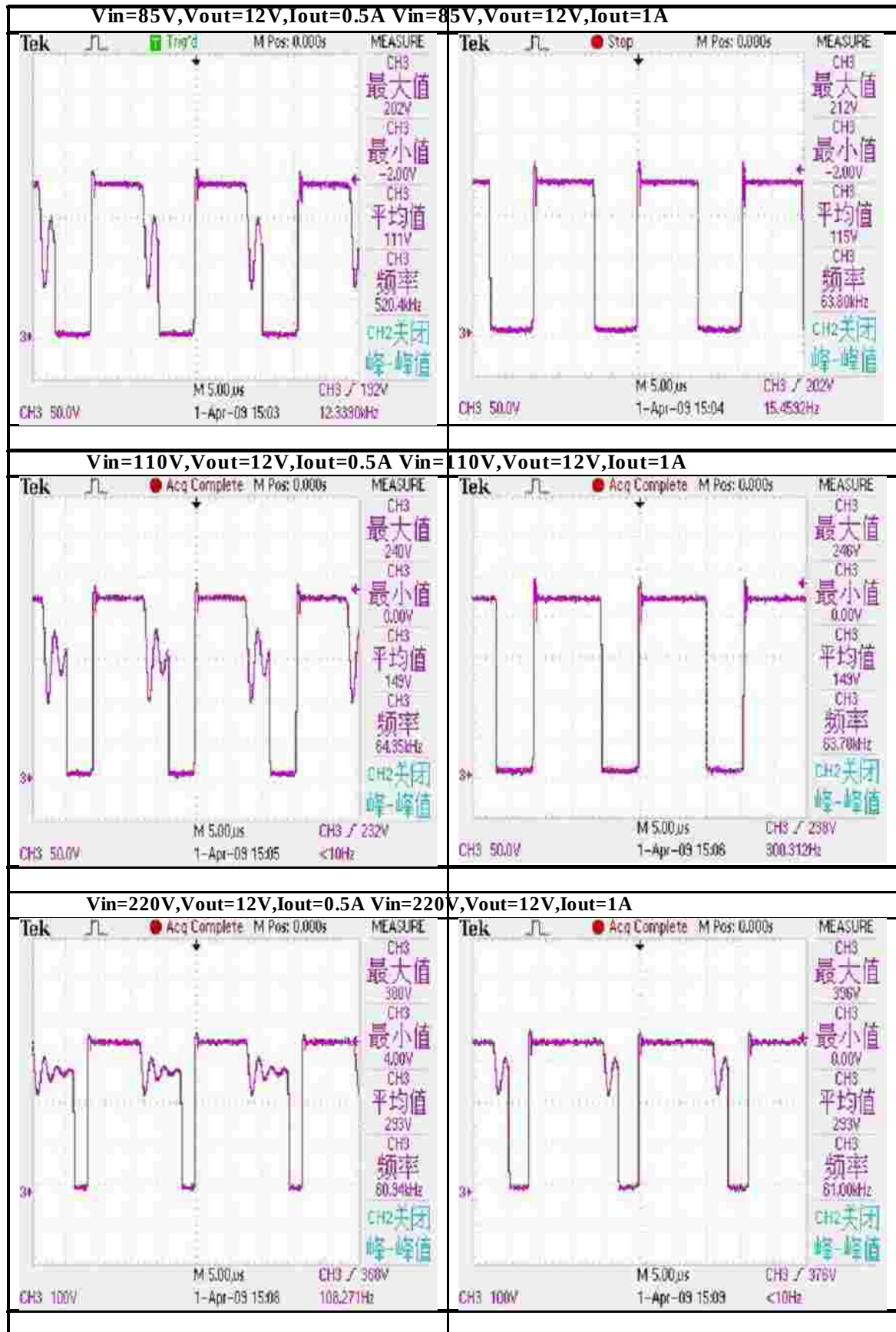
V _{IN} (V _{AC})	P _{IN} (W)	V _{OUT} (V)	I _{OUT} (A)	V _{CC} (V)	V _{OR} (mVp-p)	P _{OUT} (W)	? (%)	OCP (A)	OPP (A)	Average ?(%)	CEC Standard ?(%)
90Vac	0.1	12.1	0	5.36		0		1.07	1.36	79.05	
	3.2	12.1	0.2	6.64		2.4	75.0				
	7.6	12.1	0.5	6.64		6.1	80.3				
	12.0	12.1	0.8	6.64		9.7	80.8				
	15.1	12.1	1.0	6.64		12.1	80.1				
100Vac	0.1	12.1	0	5.28		0		1.13	1.45	80.35	
	3.1	12.1	0.2	6.70		2.4	77.4				
	7.5	12.1	0.5	6.70		6.1	81.3				
	11.9	12.1	0.8	6.70		9.7	81.5				
	14.9	12.1	1.0	6.70		12.1	81.2				
240Vac	0.1	12.1	0	4.96		0		1.69	2.13	82.95	
	3.0	12.1	0.2	6.96		2.4	80.0				
	7.3	12.1	0.5	6.96		6.1	83.5				
	11.5	12.1	0.8	6.96		9.7	84.3				
	14.4	12.1	1.0	6.96		12.1	84.0				
265Vac	0.1	12.1	0	4.88		0		1.72	2.17	82.35	
	3.0	12.1	0.2	7.04		2.4	80.0				
	7.4	12.1	0.5	7.04		6.1	82.4				
	11.6	12.1	0.8	7.04		9.7	83.6				
	14.5	12.1	1.0	7.04		12.1	83.4				

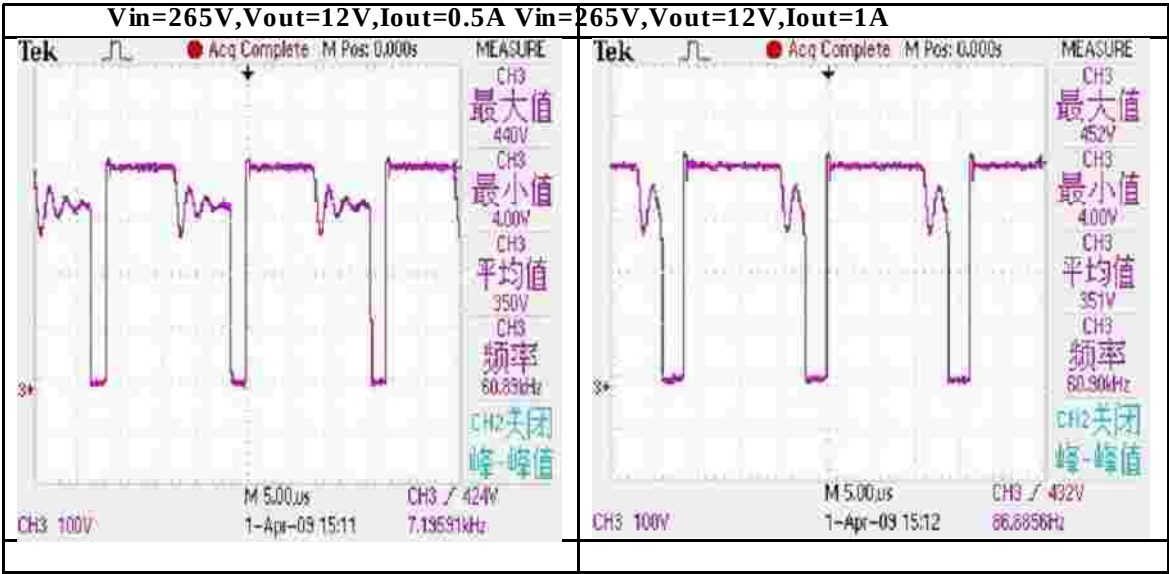
Output Voltage and Output Ripple Voltage

V _{in} (V) I _{out} (A)	85V		110V		135V	
	V _{out} (V)	V _{ripple} (mV)	V _{out} (V)	V _{ripple} (mV)	V _{out} (V)	V _{ripple} (mV)
0.25	12.18	5.00	12.18	3.52	12.18	3.76
0.50	12.18	9.00	12.18	5.36	12.18	5.84
0.75	12.18	14.00	12.18	8.00	12.18	7.68
1.00	12.18	31.20	12.18	11.60	12.18	8.40
V _{in} (V) I _{out} (A)	180V		220V		265V	
	V _{out} (V)	V _{ripple} (mV)	V _{out} (V)	V _{ripple} (mV)	V _{out} (V)	V _{ripple} (mV)
0.25	12.18	4.32	12.18	5.12	12.18	5.36
0.50	12.18	6.40	12.18	6.16	12.18	5.92
0.75	12.18	7.00	12.18	7.28	12.18	6.40
1.00	12.18	9.00	12.18	8.48	12.18	7.76

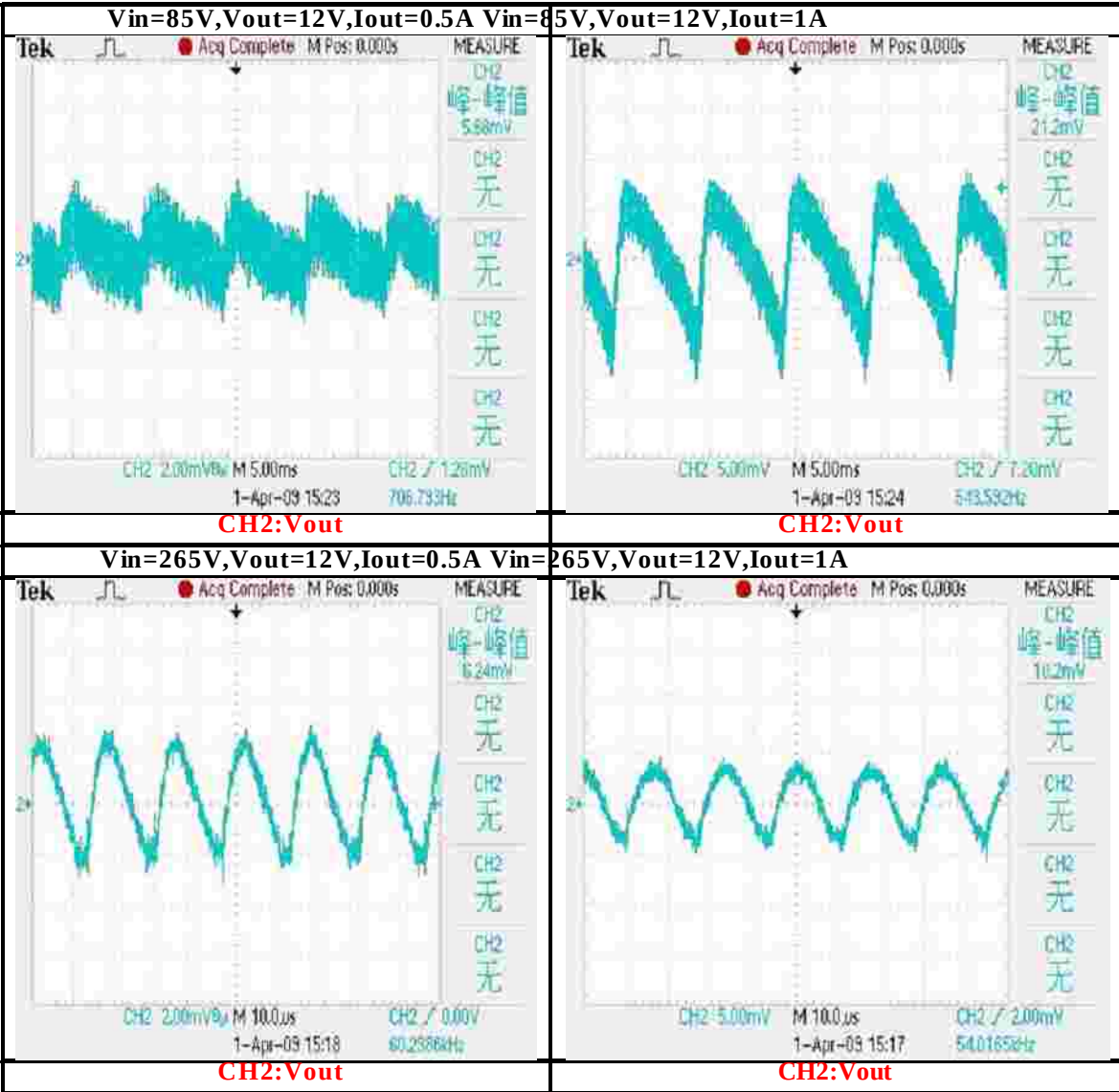
Test Waveform:

Vce waveform:

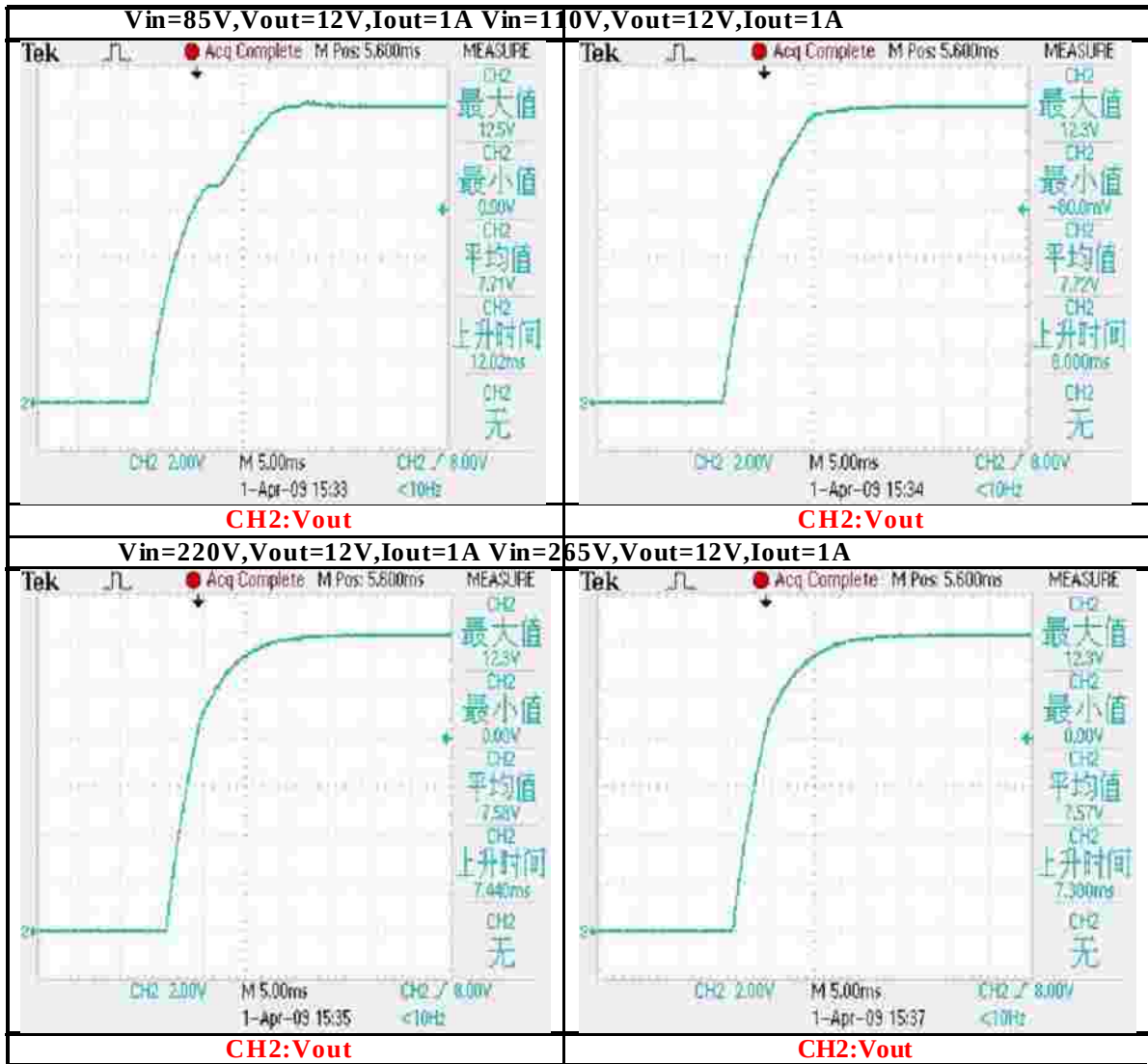




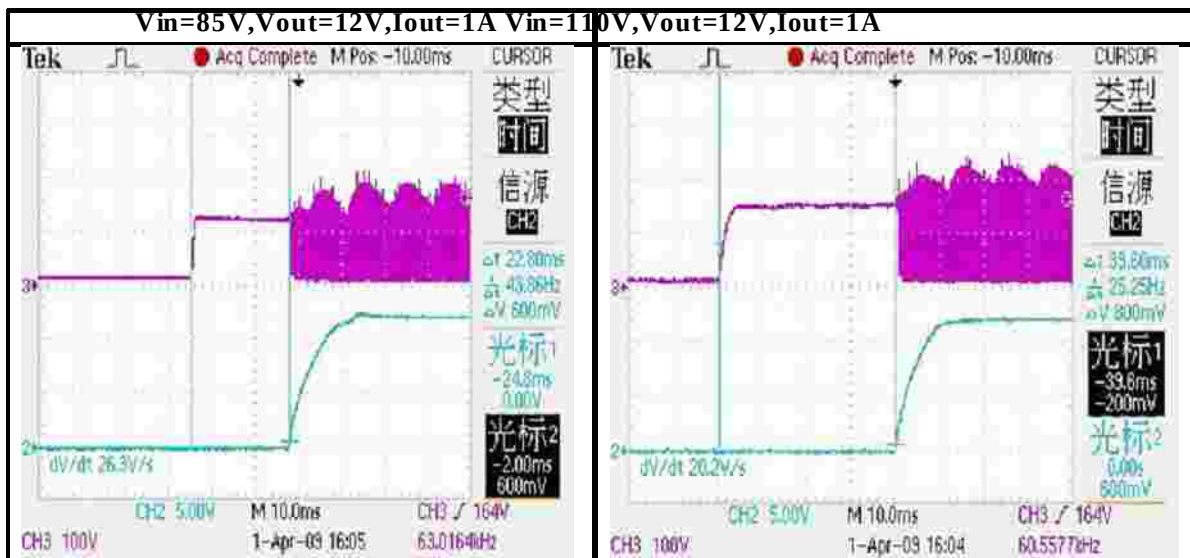
Output Ripple Voltage

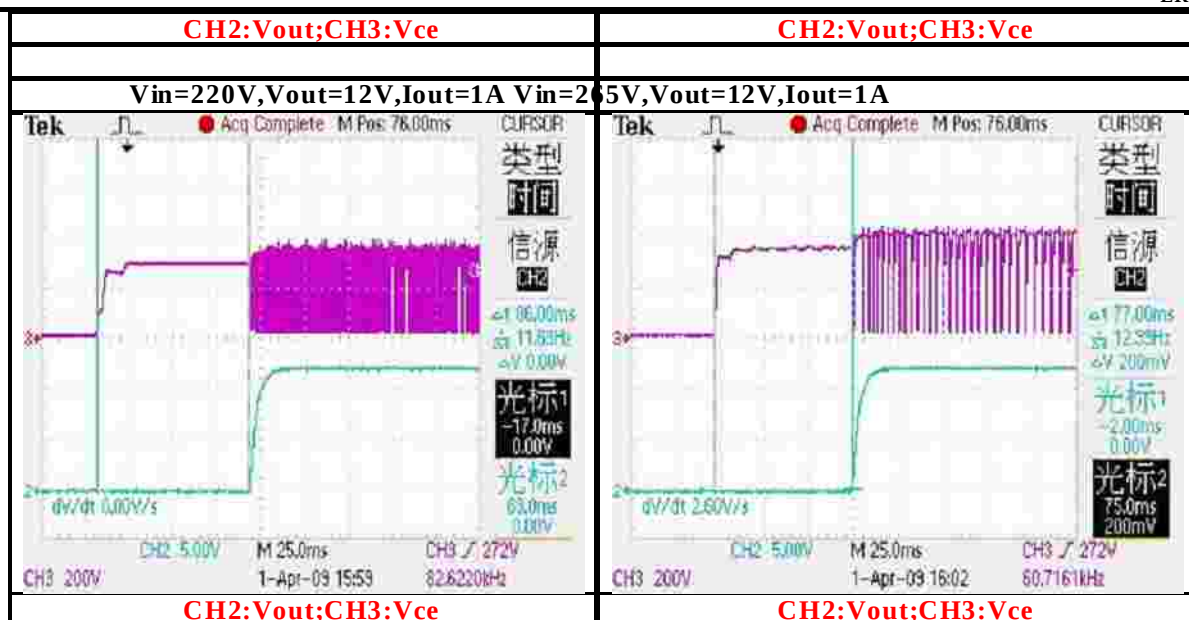


Turn On Waveform:

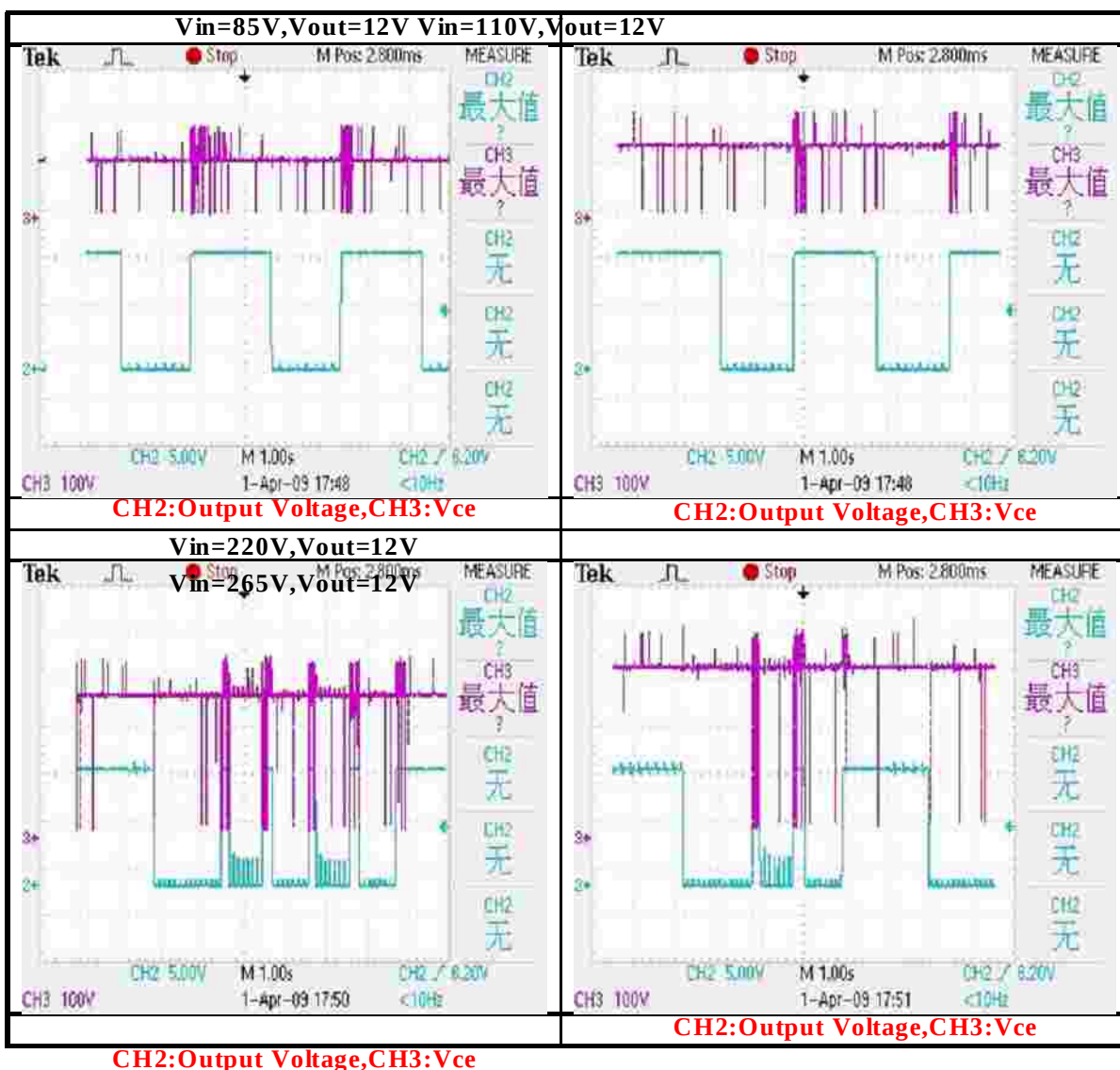


Vce and Vout

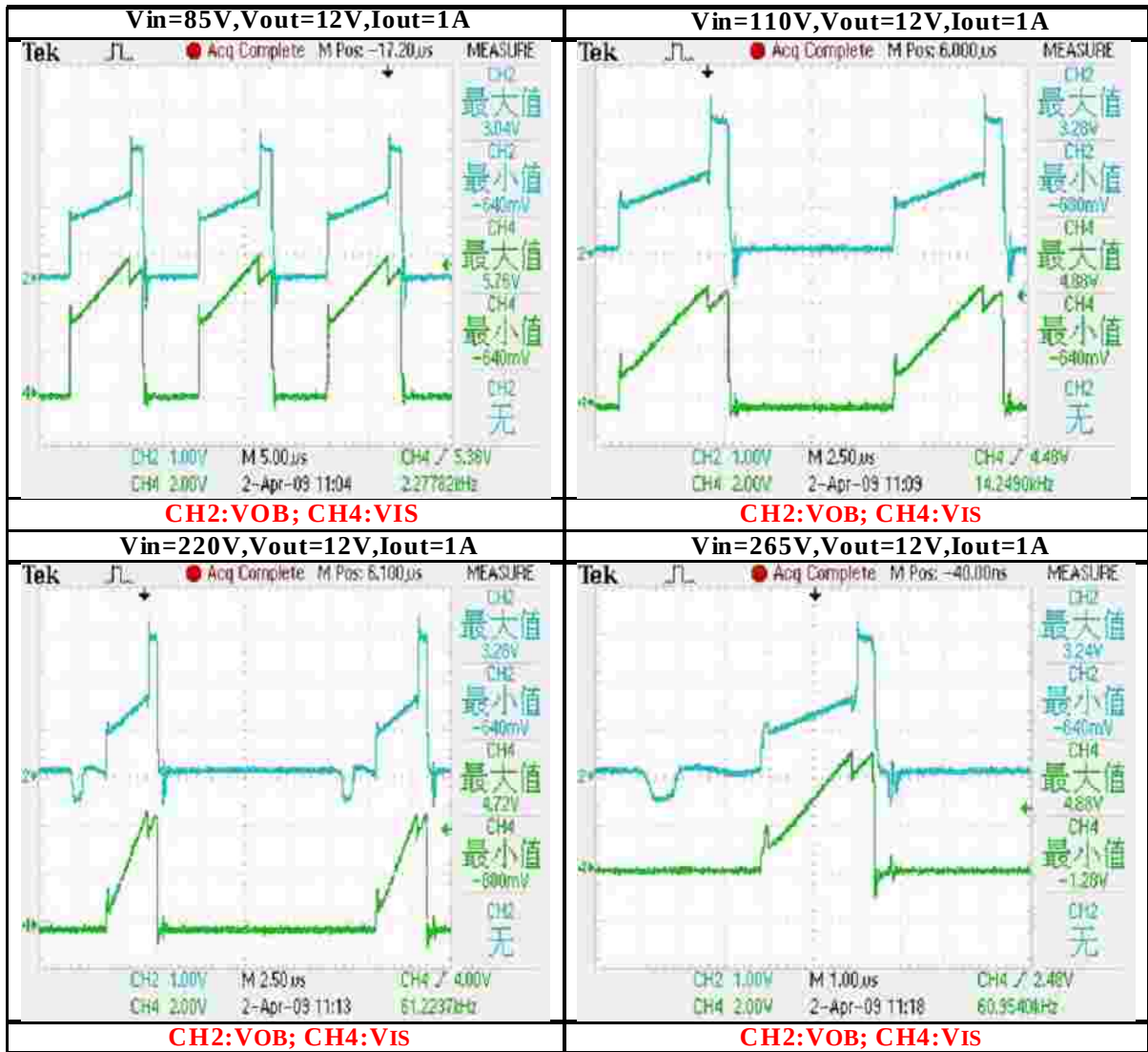




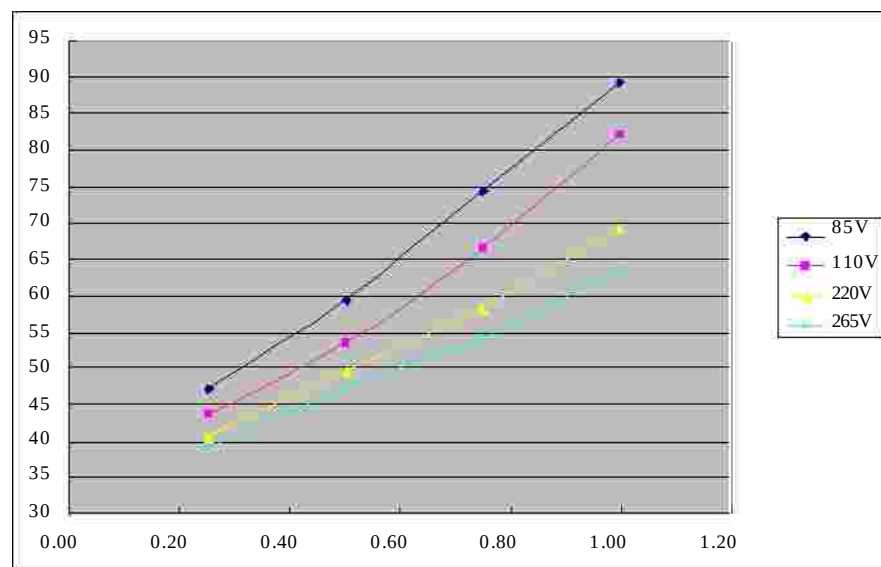
Short Output:



VOB and Vis

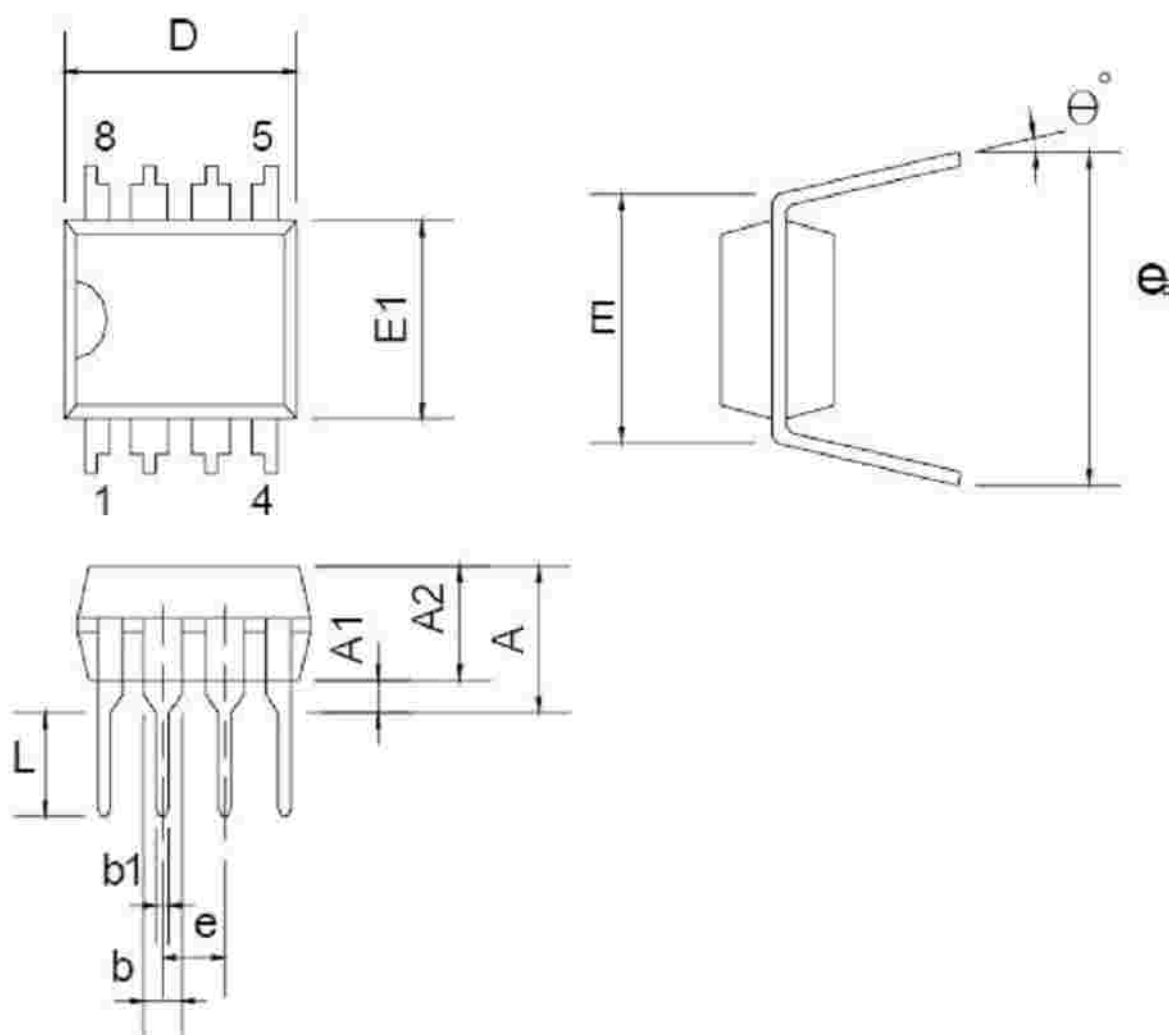


Temperature:



PACKAGE INFORMATION

DIP-8



Dimensions

Symbol	Millimeter			Inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			5.334			0.210
A1	0.381			0.015		
A2	3.175	3.302	3.429	0.125	0.130	0.135
b		1.524			0.060	
b1		0.457			0.018	
D	9.017	9.271	10.160	0.355	0.365	0.400
E		7.620			0.300	
E1	6.223	6.350	6.477	0.245	0.250	0.255
E		2.540			0.100	
L	2.921	3.302	3.810	0.115	0.130	0.150
e _B	8.509	9.017	9.525	0.335	0.355	0.375
θ°	0°	7°	15°	0°	7°	15°