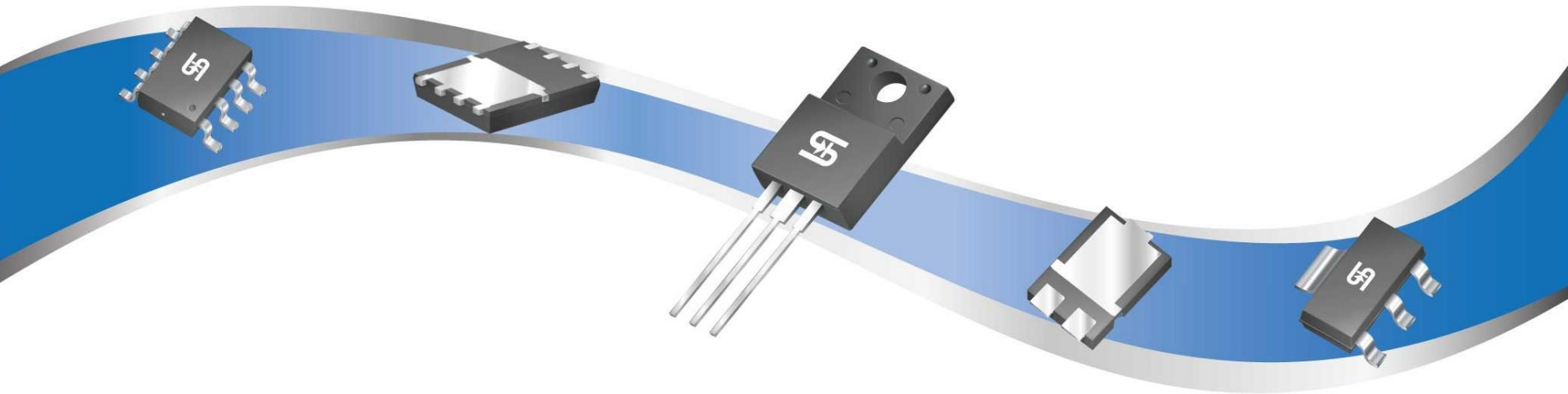


TS19706CS USER MANUAL



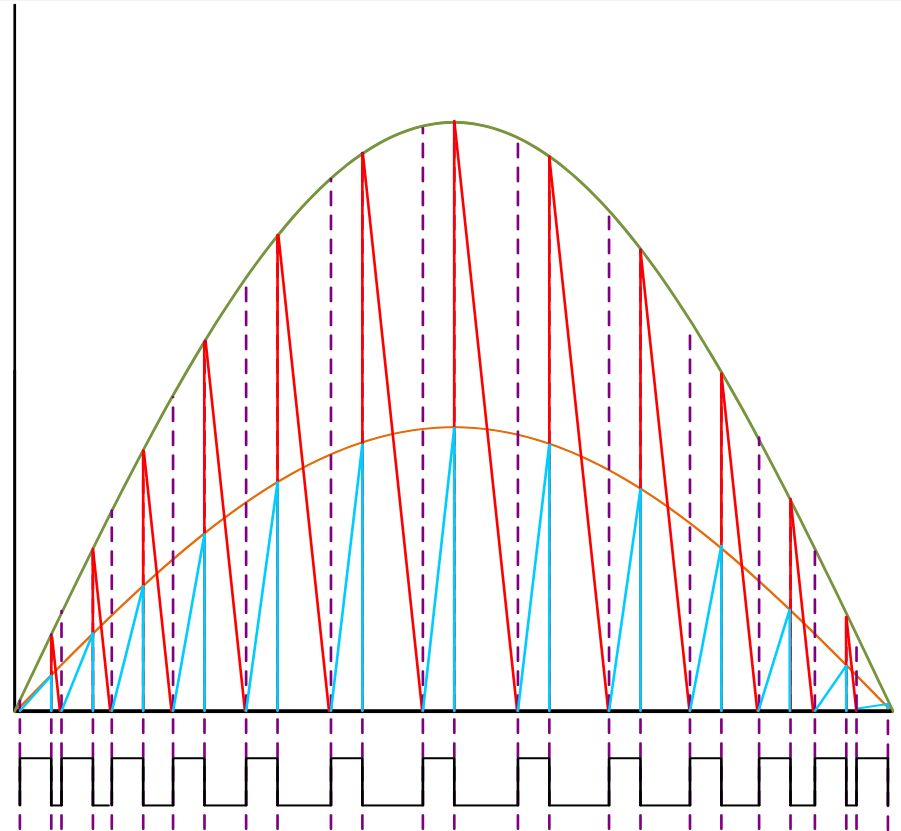
FEATURES :

- Integrated 630V MOSFET
- Constant Current Accuracy within $<\pm 3\%$
- Primary-Side Feedback Control
- Application Voltage Range $80 V_{AC} \sim 308 V_{AC}$
- Transition-Mode PFC Operating
- Built-in Active Power Factor Correction
- Constant Output Current Control
- Good Line and Load Regulation
- Open-LED Protection on DMG pin
- Over-Voltage Protection on V_{CC} pin
- Short-LED Protection
- Cycle by Cycle Over Current Protection on CS pin
- Over-Temperature Protection
- Gate Driving Voltage Clamping

DESCRIPTION

Operation principle

- PSR Topology (Flyback Buck Boost)
- Constant Current Accuracy $< \pm 5\%$
- Boundary Conduction Mode (BCM)
- Constant On Time (COT)
- Gate Output Voltage Clamp
- LED Open Protection (OVP)
- LED Short Protection (SCP)
- Over Current Protection (OCP)
- Over Thermal Protection (OTP)



Constant On time Topology

→ Transformer Peak Current \propto Input Voltage

---→ Input Voltage Waveform

---→ 2nd Side Diode Peak Current Shape

---→ 2nd Side Diode Current Waveform

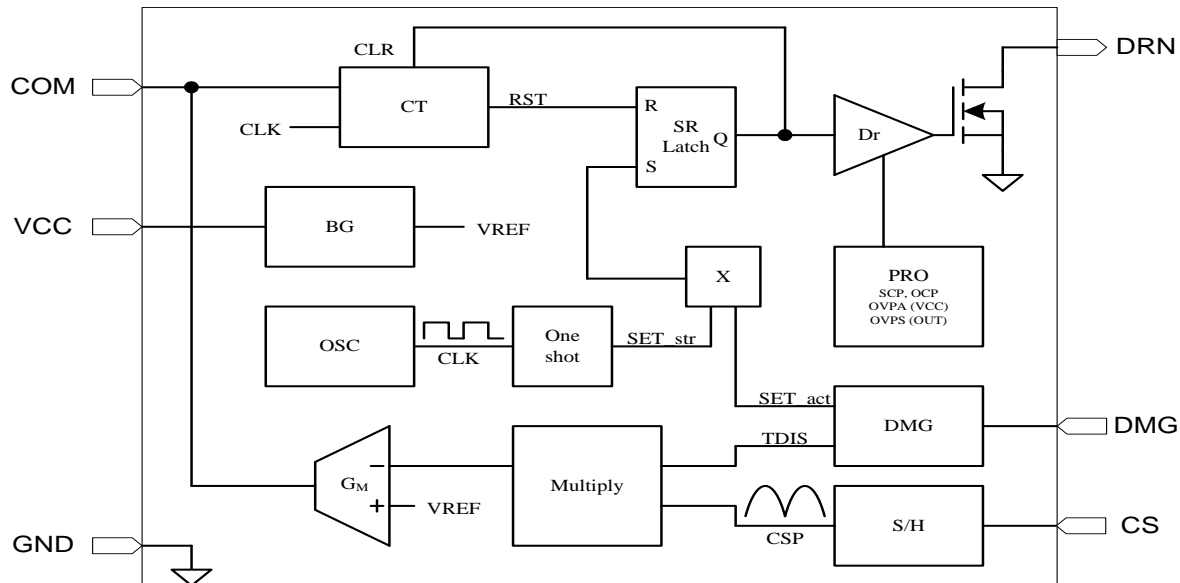
---→ 1st side Transformer Peak Current Shape

---→ 1st Side Transformer Waveform

---→ MOS Gate Waveform

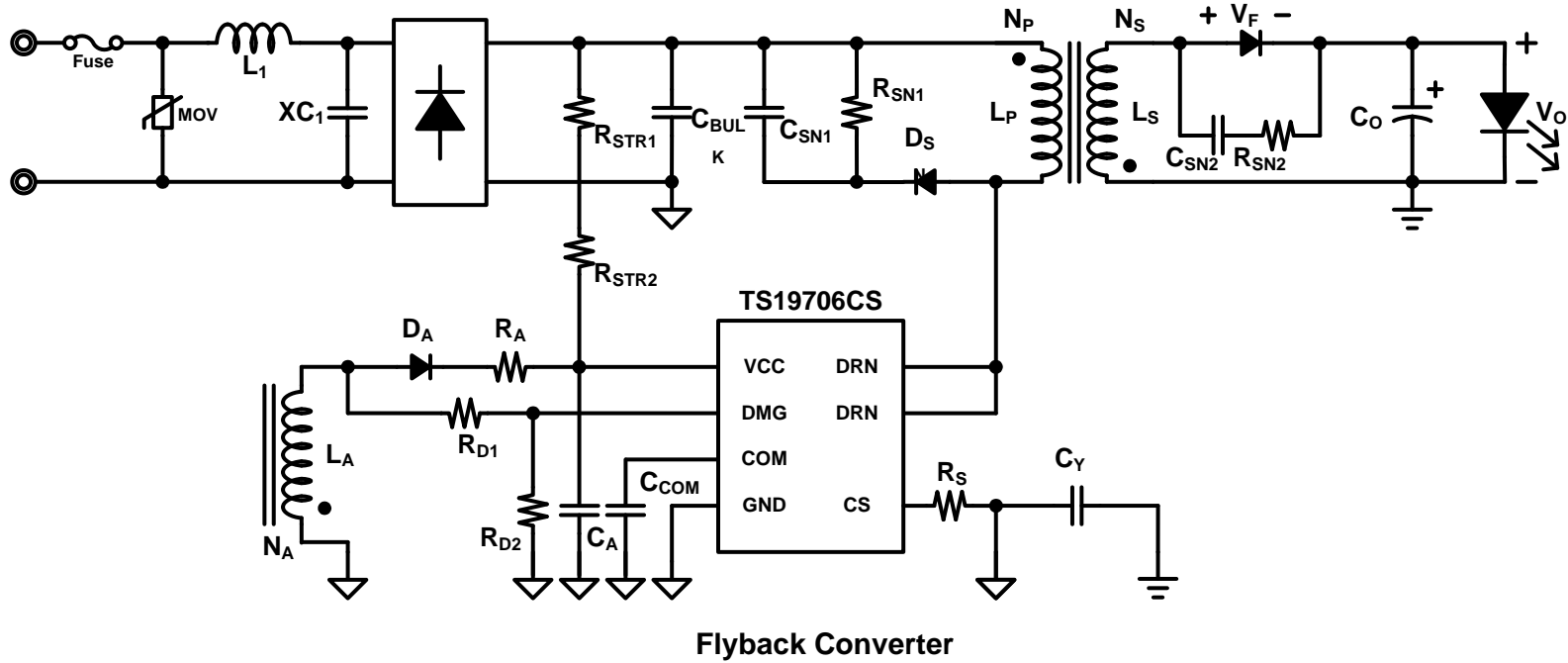
PIN DESCRIPTION AND FUNCTION BLOCK

PIN NO.	NAME	FUNCTION
1	GND	Ground return for all internal circuitry.
2	COM	Output pin of error amplifier.
3	DMG	Zero current demagnetization sensing.
4	Vcc	Power supply pin for all internal circuitry.
5	DRN	Drain of the internal power MOSFET
6	DRN	Drain of the internal power MOSFET
7	NC	Not connected.
8	CS	Input current sense pin



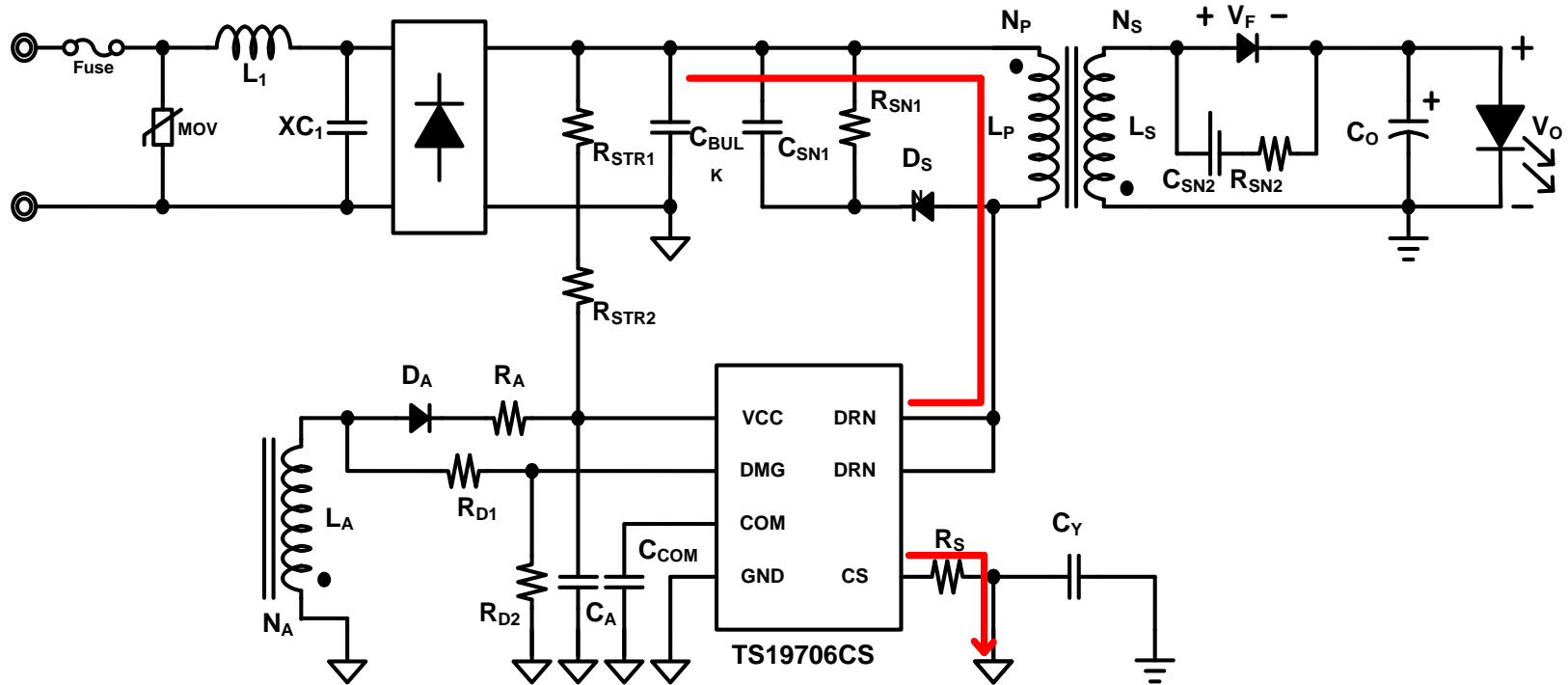
Block Diagram

APPLICATION CIRCUIT (FLYBACK)



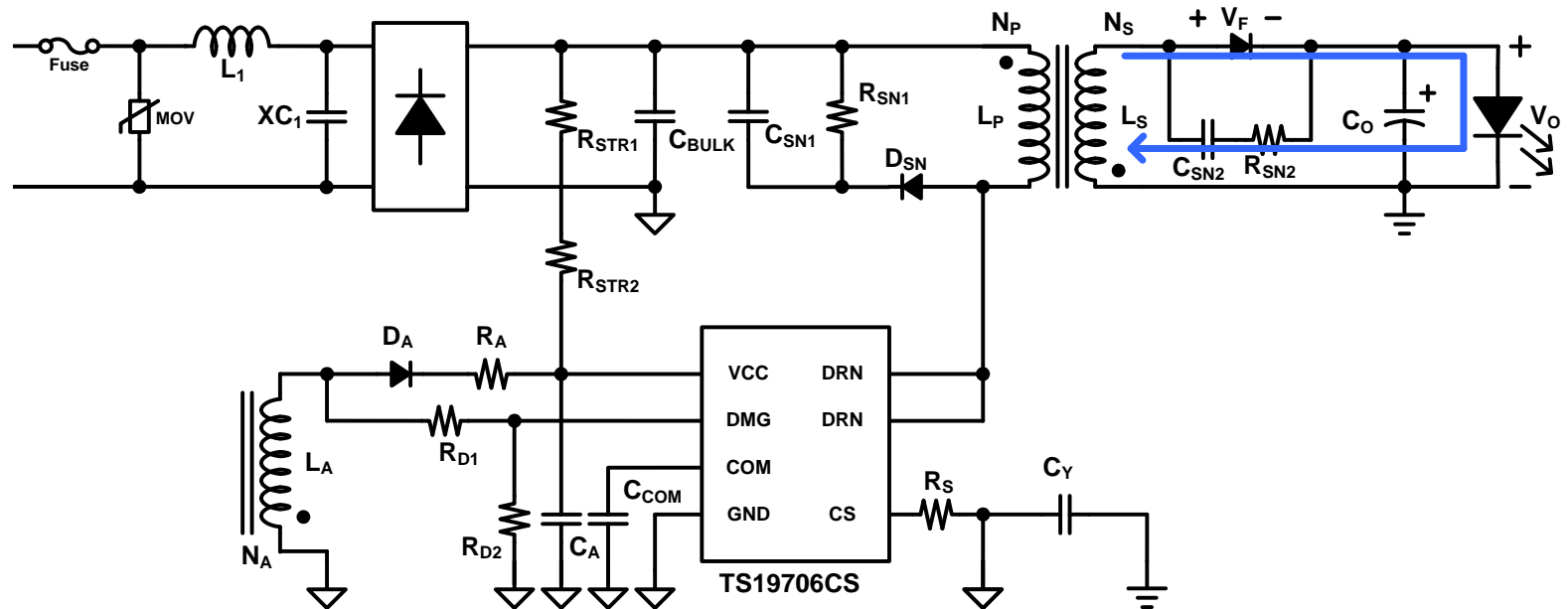
FLYBACK PRINCIPLE – MOSFET TURN ON

MOSFET Turn ON



FLYBACK PRINCIPLE – MOSFET TURN OFF

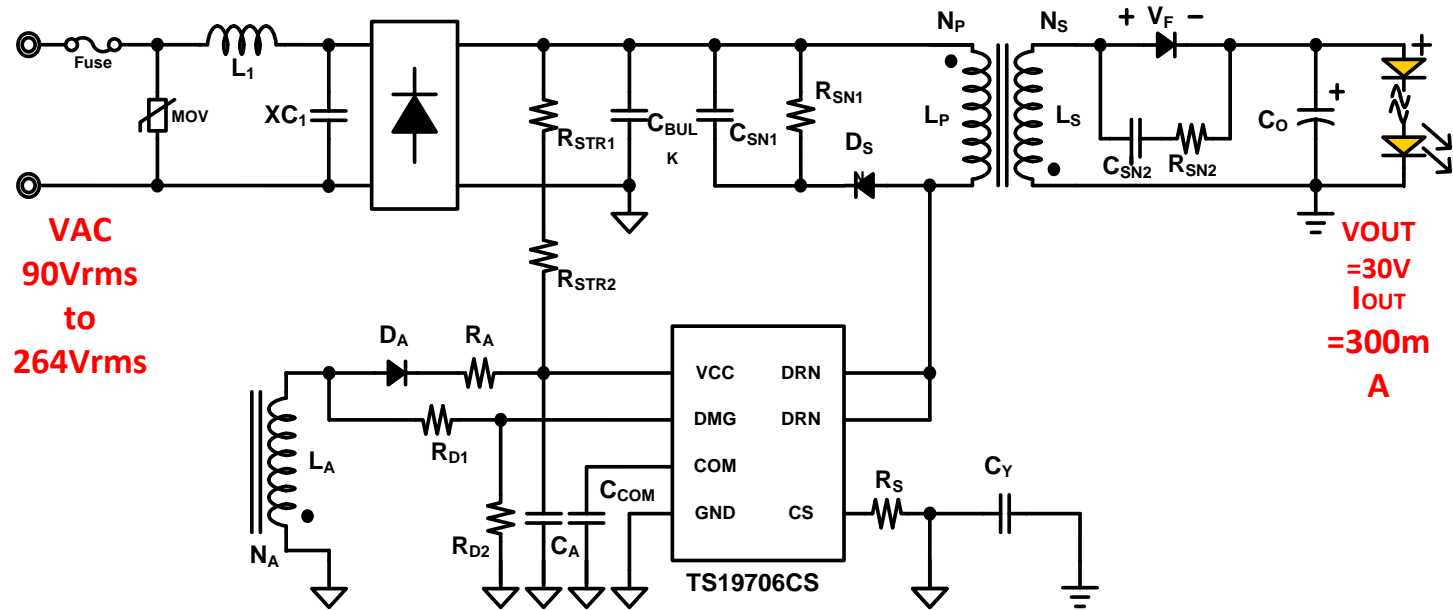
MOSFET Turn Off



DESIGN SAMPLE

Input : 90Vac~264Vac / 50Hz~60Hz

Output : 30VDC / 300mA



CALCULATION FORM – POWER OUTPUT

Power Output		
Output Voltage(Vout)	30	V
Output Current (Iout)	0.3	A
2nd Diode Forward Voltage (VF)	1.5	V
Output Power (Pout)	9.45	W
Efficiency (η)	0.87	
Input Power (Pin)	10.86	W
IC Vcc Voltage	27	V

Input Condition

Vout = 30V

Iout = 0.3A

VF = 1.5V

Efficiency = 87% → 0.87 (Suggested 80%~90%)

IC Vcc = 27V (Suggested 20V~28V)

PS.

TS19705 IC VCC Parameter

VOVP = 32V (Typ)

VUVLO(off) = 9.5V (Typ)

Suggested VCC Point 20V~28V

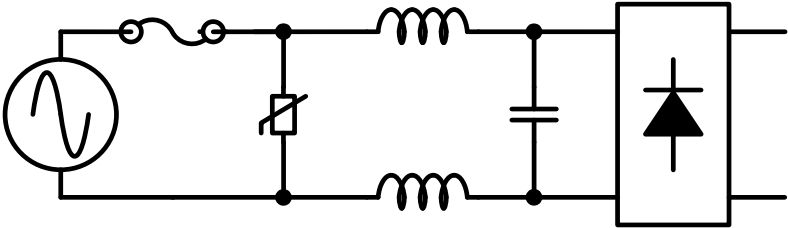
	=>Key in
	=>Output
	=>Select

CALCULATION FORM – POWER INPUT

Power Input		
Min. Input Voltage (Vac_min) Select	90	Vrms
Max. Input Voltage (Vac_max) Select	265	Vrms

Input Condition
 Vac_min = 90Vrms
 Vac_max = 264Vrms

VAC
 90Vrms
 to
 264Vrms



	=>Key in
	=>Output
	=>Select

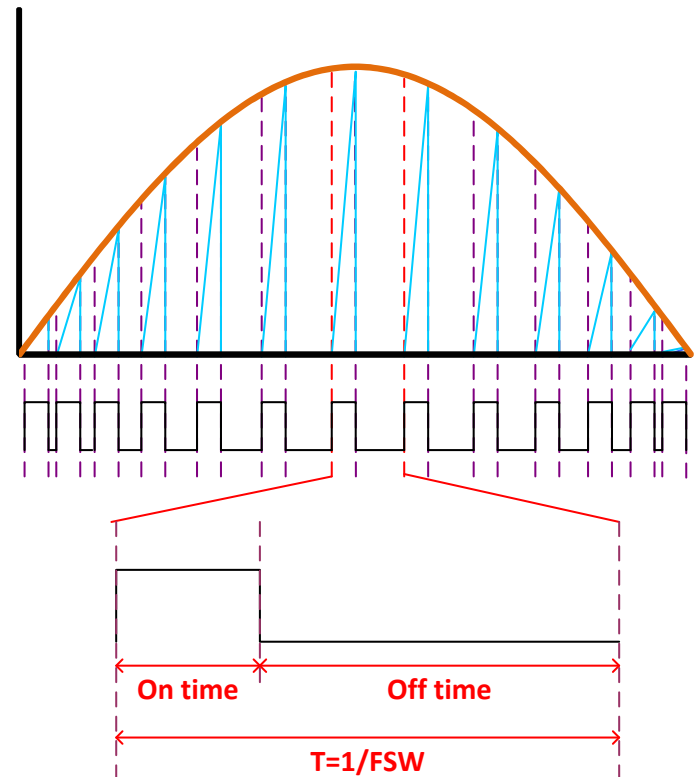
CALCULATION FORM – FLYBACK OPERATION PARAMETER

Flyback Operation Parameter		
Switching frequency $F_{sw}(\text{min})@V_{ac_min}$	55	khz
Reflected Voltage $N*(V_F+V_{out})$ Select	110	VDC
Maximum On time @ V_{ac_min}	8.428888104	μs

Switching Frequency F_{sw} @ V_{ac_min} = 90Vrms at Peak Voltage

Max On time should be designed $\leq 12\mu\text{s}$

Suggest Reflected Voltage $V*(V_F+V_{out}) = 80\text{VDC} \sim 120\text{VDC}$



	=>Key in
	=>Output
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CALCULATION FORM – TRANSFORMER DESIGN

Transformer Design		
Ae value of the core	36.6	mm ²
Maximum Flux Density (Bmax)	3250	Gauss

Input Condition

Ae Value → Ae =36.6 mm² (RM6)



Type	Material	Ap	Ae	Aw	AL	Le	Ve	Wt
		(cm ⁴)	(mm ²)	(mm ²)	(nH/N ²)	(mm)	(mm ³)	(g)
RM4	PC40	0.0218	14.00	15.60	680.00	22.70	318.00	1.70
RM5	PC40	0.0431	23.70	18.20	1250.00	22.40	530.00	3.00
RM6	PC40	0.0952	36.60	26.00	1600.00	28.60	1050.00	5.50
RM8	PC40	0.3130	64.00	48.90	1950.00	38.00	2430.00	13.00
RM10	PC40	0.6811	98.00	69.50	3630.00	44.00	4310.00	23.00
RM12	PC40	1.5400	140.00	110.00	4150.00	56.90	7960.00	42.00
RM14	PC40	2.9140	188.00	155.00	4600.00	69.00	13000.00	70.00

	=>Key in
	=>Output
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CALCULATION FORM – TRANSFORMER DESIGN

Transformer Design		
Ae value of the core	36.6	mm ²
Maximum Flux Density (Bmax)	3250	Gauss

MATERIAL CHARACTERISTICS

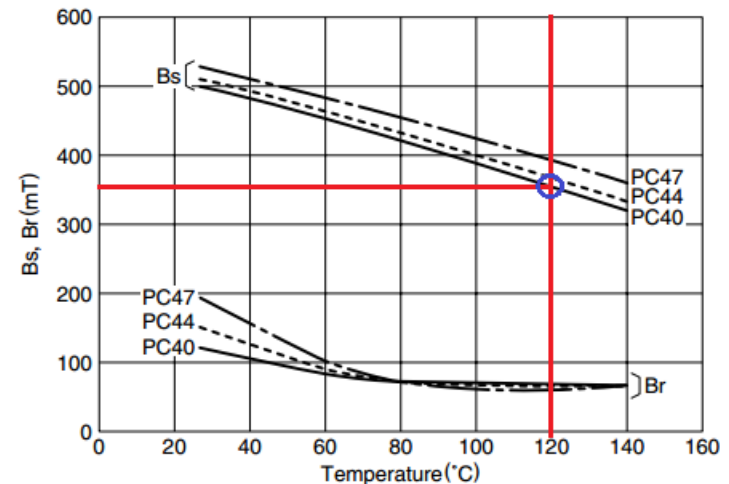
Material			PC47	PC44	PC40	
Initial permeability	μ	25°C	2500±25%	2400±25%	2300±25%	
Core loss volume density [100kHz, 200mT]	Pcv	kW/m ³	25°C	600	600	600
			60°C	400	400	450
			100°C	250	300	410
Saturation magnetic flux density [1000A/m]	Bs	mT	25°C	530	510	510
			100°C	420	390	390
Remanent flux density	Br	mT	25°C	180	110	95
			100°C	60	60	55
Curie temperature	Tc	°C	min.	230	215	215
Density	db	kg/m ³		4.9×10 ³	4.8×10 ³	4.8×10 ³

Flux density

- Choose PC40 Material
- 120°C Bs Value is About 350mT
- Setting Maximum Flux Density 325mT = 3250Gauss

	=>Key in
	=>Output
	=>Select

Bs and Br TEMPERATURE DEPENDENCE CHARACTERISTICS (Typical)

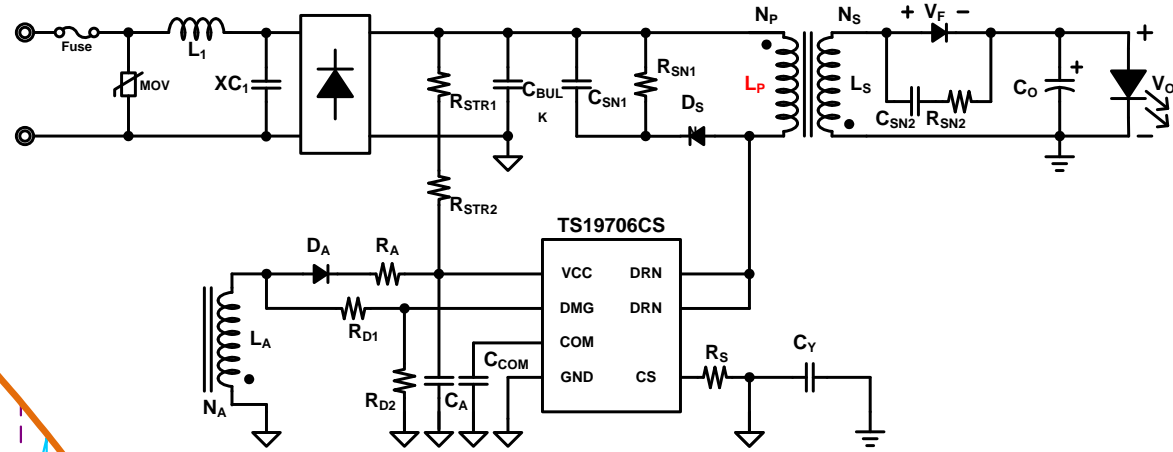
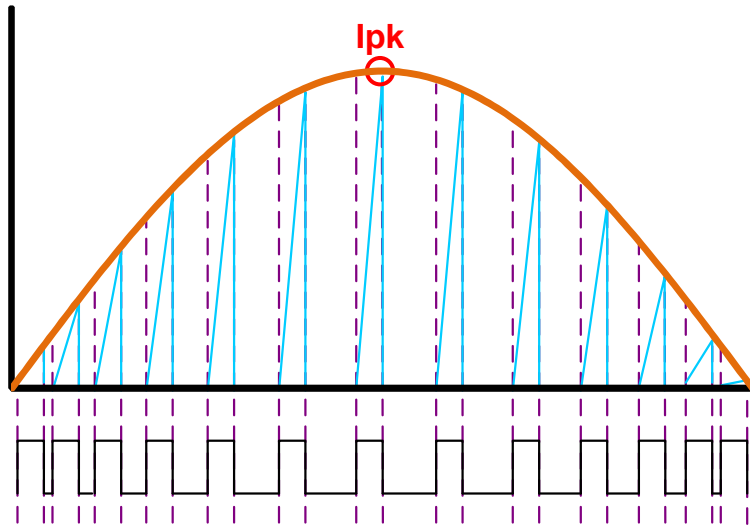


CALCULATION FORM – TRANSFORMER INDUCTANCE

Transformer inductance		
Primary Side Peak Current @ Vac_min (Ipk)	0.6684	A
Primary Side Inductor Values Lp	1605.00	μH

Condition :

Vac_min = 90Vac



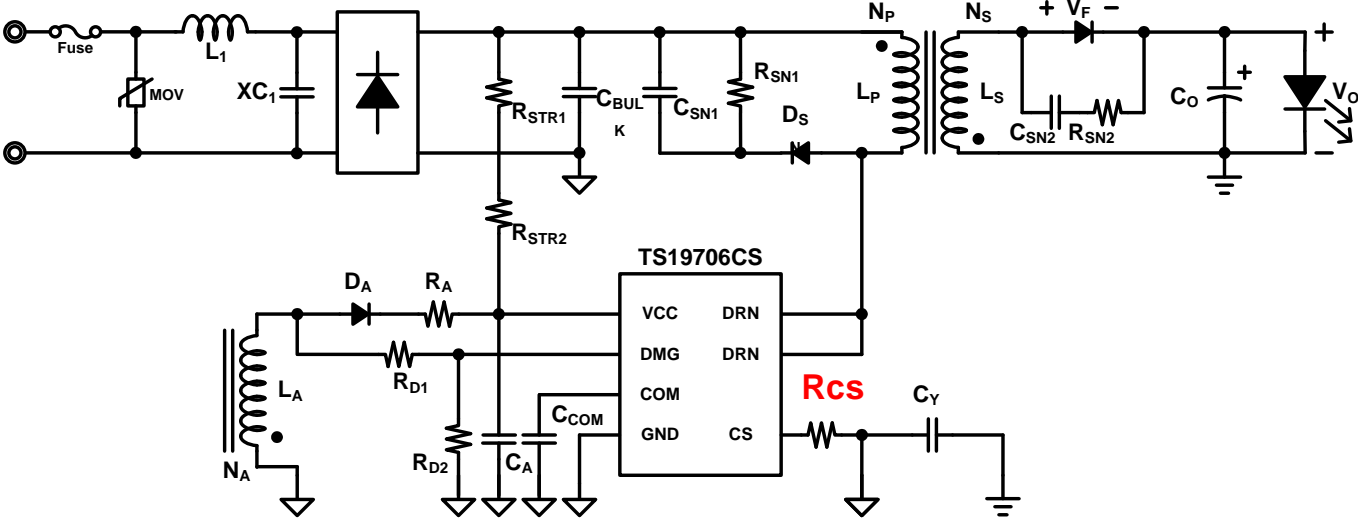
	=>Key in
	=>Output
	=>Select

CALCULATION FORM – TRANSFORMER TURNS

Calculation Winding Turn Ratio		
Np_1	90.19	Turns
Turns of Primary Side Np =	90.00	Turns
Turn ratio N=	3.49	
Ns_1	25.77	Turns
Turns of Secondary Side Ns =	26.00	Turns
Na_1	23.40	Turns
Turns Of Auxiliary Winding Na =	23.00	Turns
Check Vcc =	26.54	V

CALCULATION FORM – RCS SETTING

CS Resistance Setting		
RCS =	1.6714	Ω



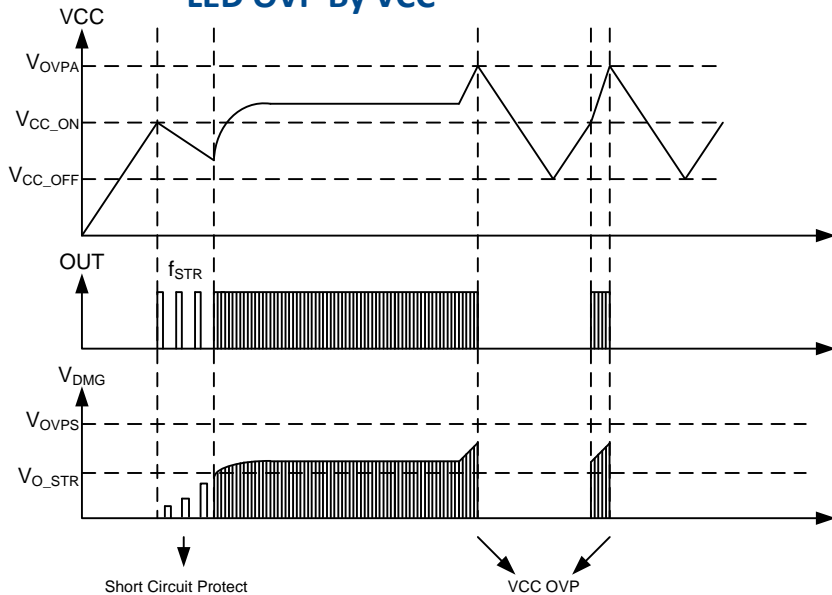
Suggest RCS (Need to fine tune)
 $RCS = 0.333x \times Np / (2 \times I_{out} \times Ns)$

=>Key in
 =>Output

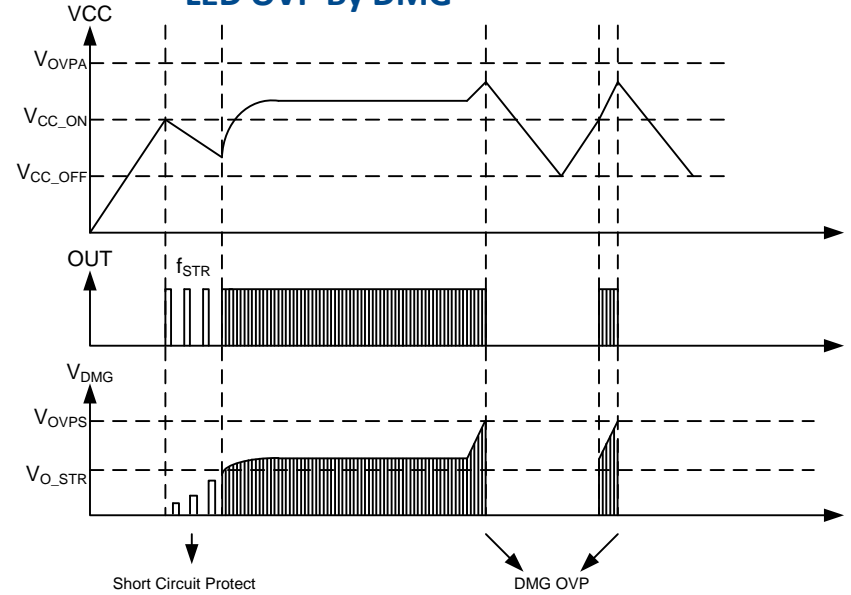
CALCULATION FORM – LED OPEN OVP SETTING

OVP Setting						
RDMG_1	82	Kohm	OK			
RDMG_2	39	Kohm				
DGM_OVP_Min_10 (VDMG)	35.07	V		LED Open VOUT OVP		
DGM_OVP_Typ_10.5 (VDMG)	36.83	V		Min	Typ	Max
DGM_OVP_Max_11 (VDMG)	38.58	V	=>	35.0	36.2	38.4
VCC_OVP_Min_31 (VCC)	35.04	V		V	V	V
VCC_OVP_Min_32 (VCC)	36.17	V				
VCC_OVP_Min_34 (VCC)	38.43	V				

LED OVP By VCC

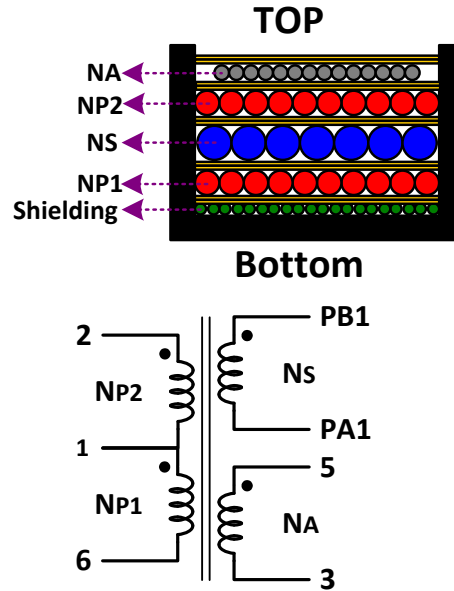
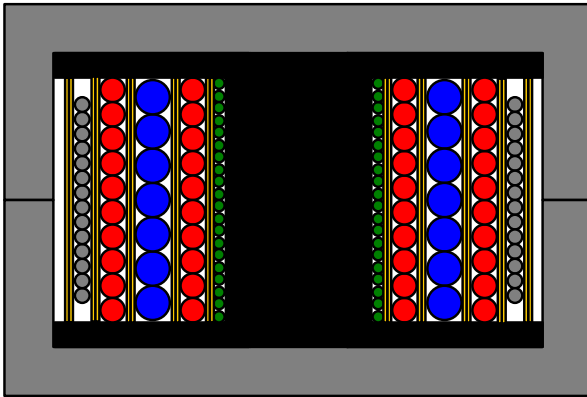


LED OVP By DMG

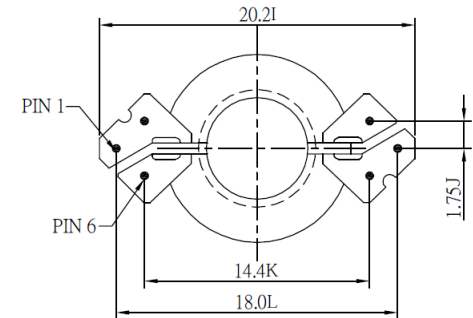
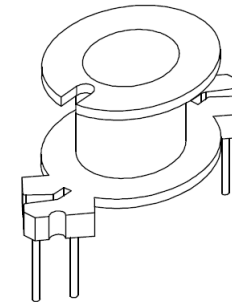


	=>Key in
	=>Output
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TRANSFORMER DESIGN



Core → RM6
Bobbin → RM6



- → NP
- → Ns
- → Na
- → Shielding

→ Core ROUNDING TAPE

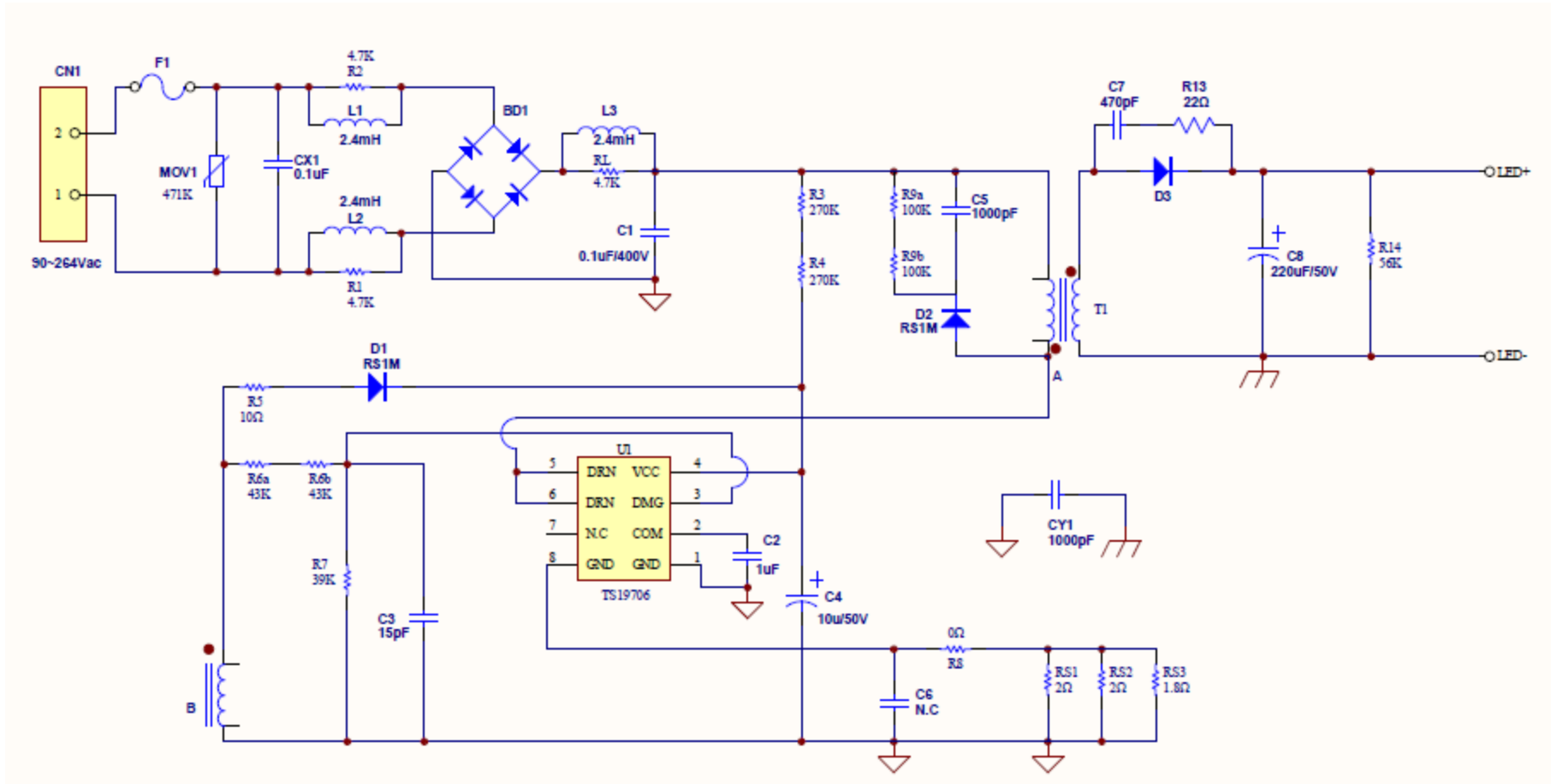
→ Bobbin

→ Core

No.	Winding	Terminal		Wire	Turns	Winding Method
		S	F			
1		2		0.13mm x 1P	1 layer	Solenoid winding
2	Insulaion : Polyester Tape t=0.025mm, 2Layer					
3	NP1	2	6	0.21mm x 1P	50	Solenoid winding
4	Insulaion : Polyester Tape t=0.025mm, 2Layer					
5	Ns	2	3	0.25mm x 1P (TIW)	26	Solenoid winding
6	Insulaion : Polyester Tape t=0.025mm, 2Layer					
7	NP2	2	6	0.21mm x 1P	40	Solenoid winding
8	Insulaion : Polyester Tape t=0.025mm, 2Layer					
9	NA	2	3	0.13mm x 1P	23	Solenoid winding
10	Insulaion : Polyester Tape t=0.025mm, 2Layer					

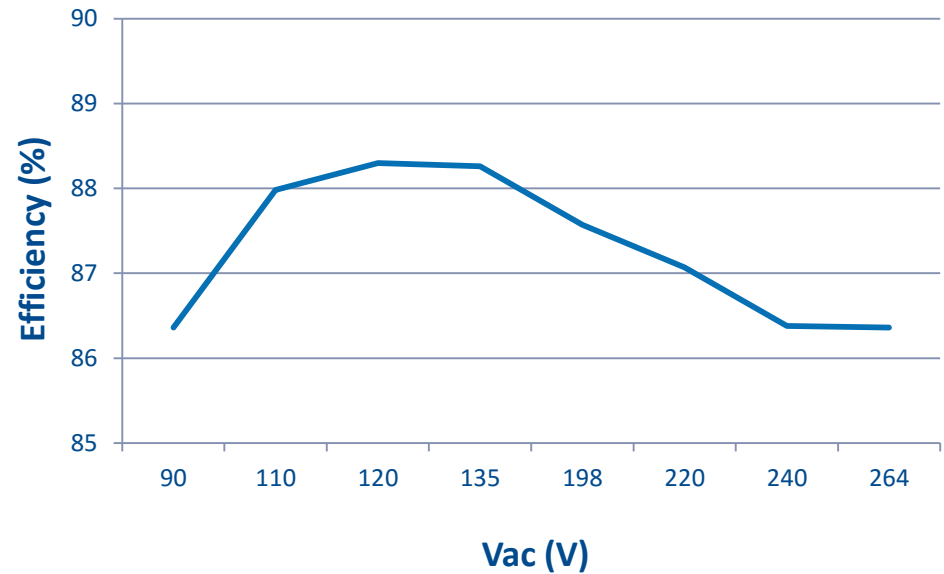
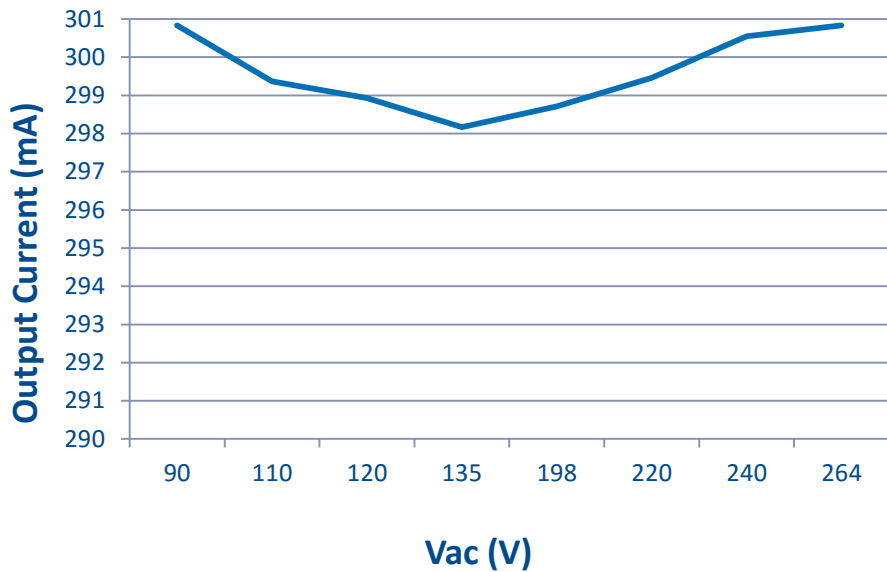
	Pin	Sepecification	Remark
Primary Side Inductance	2<=>6	1600uH+/- 10%	100KHz, 1V
Leakage Inductance	2<=>6	< 15uH	100KHz, 1V, Short All Output Pins

TS19706CS DEMO BOARD ELECTRICAL CIRCUIT



TS19706 DEMO BOARD TEST RESULT

Vac	Pin (W)	Vout (V)	Iout (mA)	Pout(W)	Eff (%)	PF	THD
90	10.679	30.657	300.83	9.22	86.36	0.9968	6.1221
110	10.425	30.639	299.37	9.17	87.98	0.992	7.8382
120	10.371	30.636	298.93	9.157	88.30	0.9882	8.5039
135	10.35	30.635	298.17	9.134	88.26	0.9692	10.376
198	10.454	30.646	298.71	9.154	87.57	0.9399	11.974
220	10.544	30.659	299.46	9.180	87.07	0.9207	12.731
264	10.675	30.682	300.55	9.22	86.38	0.8941	13.633



THANK YOU

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