iW1696 for 6V500mA Adapter Design

General Design Specification :

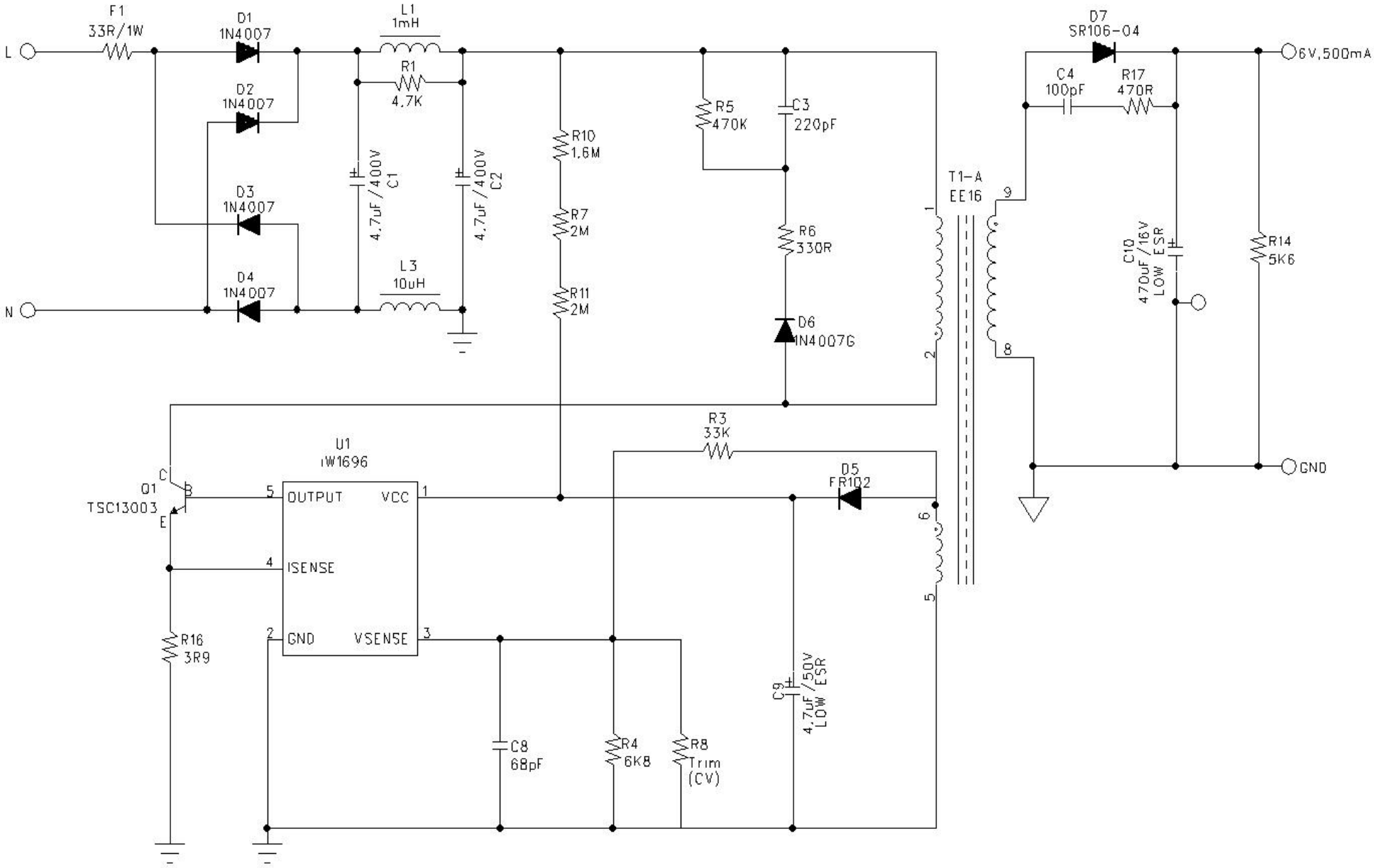
1. **AC Input Range 85-264Vac**
2. **DC Output 6V, 500mA**
3. **Max Ripple 200mV$_{P_P}$**
4. **No Y-CAP design**
5. **Meet EPA2.0**
6. **Surge (IEC61000-4-5) 2.5KV**
7. **6V/50mA@0.3W load with more than 60% efficiency**

06 Jan '09

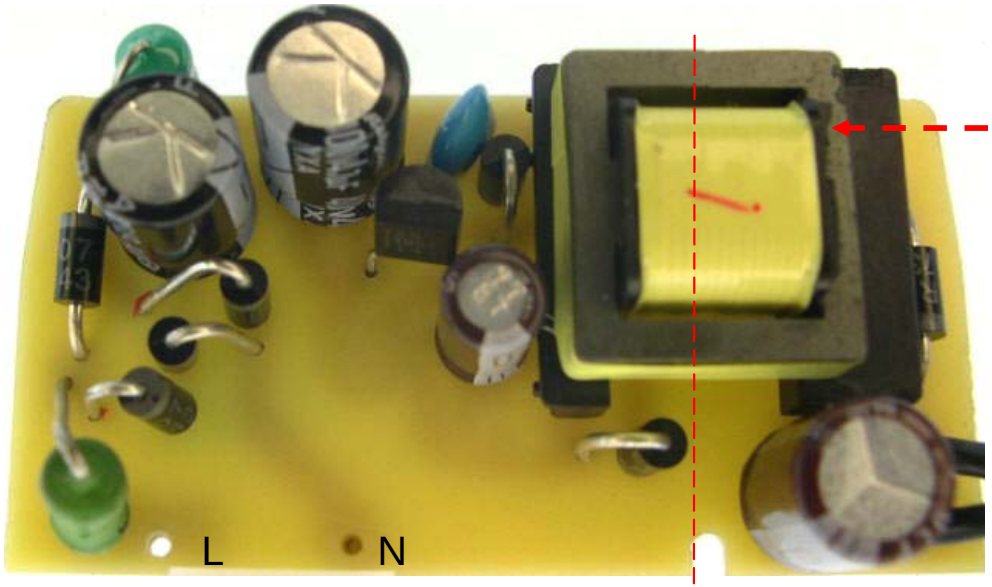
1. Specification

Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	V_{IN}	85		264	V_{AC}	2 Wire
Frequency	f_{LINE}	47	50/60	63	Hz	
No-load Input Power (264V_{AC})				0.15	W	
Output						
Output Voltage	V_{OUT}		6.0		V	
Output Current	I_{OUT}		0.5		A	
Output Ripple Voltage	V_{RIPPLE}			200	mV_{P_P}	Measured at the End of DC Output cable
Total Output Power						
Output Power	P_{OUT}			3	W	
Over Current Protection	I_{OUT_MAX}			0.7	A	
Efficiency	η	70			%	Measured at the end of PCB (T_A = 25 ℃)
Environmental						
Conducted EMI		**Meets CISPR22B / EN55022B**				
Surge Immunity		**IEC61000-4-5**				Up to 2.5KV
Safety		**Designed to meet IEC950, UL1950 Class II**				
Ambient Temperature	T_{AMB}	0		40	° C	Free convection, sea level

2. Schematic


F1
33R/1W
D1
1N4007
D2
1N4007
D3
1N4007
D4
1N4007
L1
1mH
R1
4.7K
L3
10uH
C1
4.7uF/400V
C2
4.7uF/400V
R10
1.6M
R7
2M
R11
2M
R5
470K
C3
220pF
R6
330R
D6
1N4007G
T1-A
EE16
D7
SR106-04
C4
100pF
R17
470R
C10
470uF/16V
LOW ESR
R14
5K6
6V,500mA
GND
L
N
U1
iW1696
OUTPUT
VCC
ISENSE
GND
VSENSE
Q1
TSC13003
R3
33K
D5
FR102
R16
3R9
C8
68pF
R4
6K8
R8
Trim
(CV)
C9
4.7uF/50V
LOW ESR

3. PCB Board



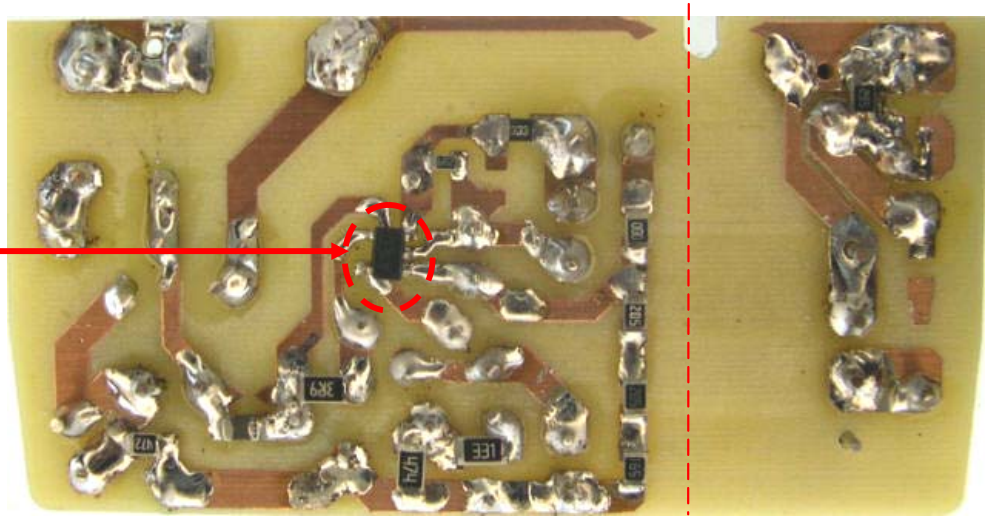
Low Cost EE16
Transformer

Top Side

Primary Side

Secondary Side

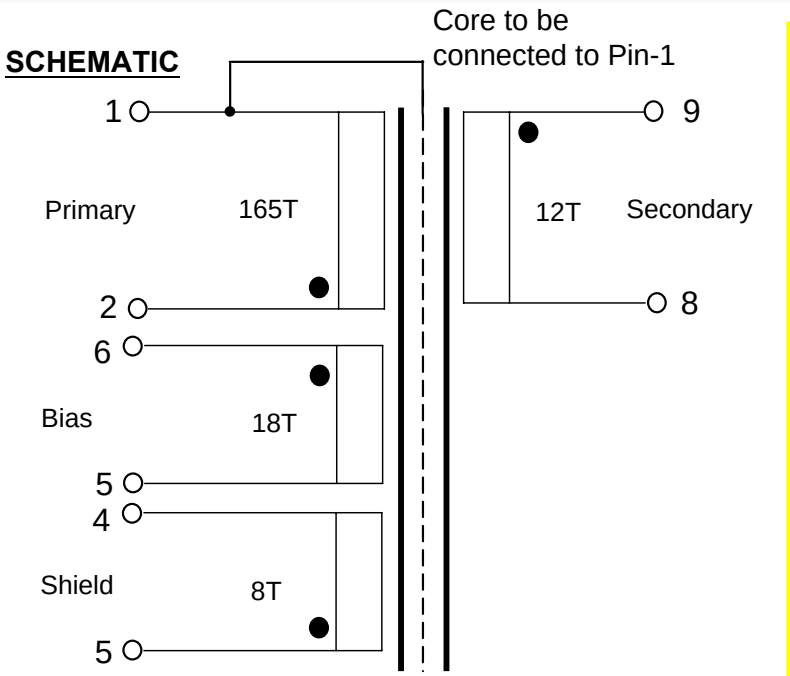
iW1696



Bottom Side

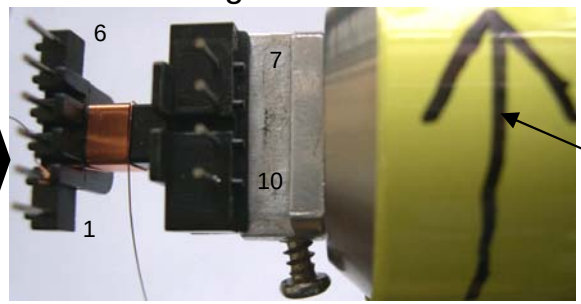
4. Transformer Construction

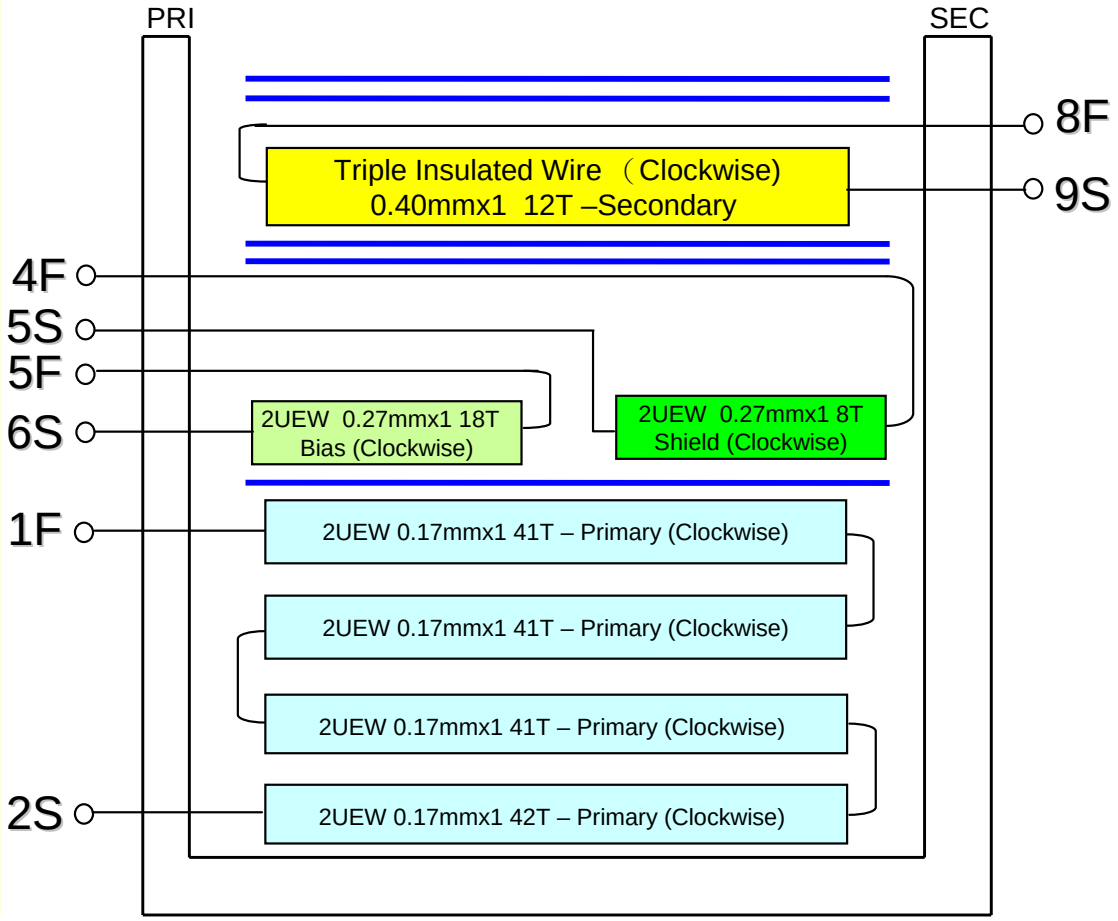
SCHEMATIC



Instruction for start of first winding…

Winding Start pin-2 & End pin-1 in "Clockwise" direction – looking from Pin 1/6 side of the Bobbin.





ELECTRICAL SPECIFICATIONS:

1. Primary Inductance (Lp) = 3.7mH @10KHz
2. Primary Leakage Inductance<90uH (Short pin8-9 & pin5-6)
3. Electrical Strength = 3KV, 50/60Hz,1Min

MATERIALS:

1. Core : EE1614 (Ferrite Material TDK PC40 or equivalent)
2. Bobbin : EE1614 Horizontal.
3. Magnet Wires (Pri) : Type 2-UEW
4. Magnet Wire (Sec) : Triple Insulated Wires
5. Layer Insulation Tape :3M1298 or equivalent.

FINISHED :

1. Connect core to pin1 used tin wire
2. Cut Pin3, Pin4 and Pin10
3. Varnish the complete assembly

5. BOM

Item	Qty.	Ref.	Description	Cost (US Cent) / unit	Sub-Total (Cent)
1	1	F1	33R, 1W, Fusible Resistor (Wire round type)		
2	1	L1	1mH, 0510, Difference Choke		
3	1	L3	10uH, SMD-0805		
4	1	R1	4K7, 5%, SMD-1206		
5	4	D1, D2, D3, D4	1N4007		
6	2	C1,C2	4.7uF,400V,105deg(Low ESR Type)		
7	1	R10	1.6M,5%,SMD-0805		
8	2	R7,R11	2M,5%,SMD-0805		
9	1	U1	iW1696, Off-line digital PWM Controller		
10	1	Q1	TSC13003, TO-92		
11	1	D6	1N4007G		
12	1	R6	330R, 5%, SMD-1206		
13	1	R5	470K, 5%, SMD-1206		
14	1	C3	220pF/500V, Ceramic Cap		
15	1	R16	3R9,1%,SMD-1206		
16	1	R3	33K,1%,SMD-1206		
17	1	R4	6K8,1%,SMD-0603		
18	1	R8	Trim,1%,SMD-0603		
19	1	C8	68pF,16V,SMD-0603		
20	1	C9	4.7uF,50V,105deg(Low ESR Type)		
21	1	D5	FR102		
22	1	T1	EE16, Transformer		
23	1	PCB	1.0mm, 94V0		
24	1	D7	SR106-04(ESD Type)		
25	1	C4	100pF, 50V, SMD-0603		
26	1	R17	470R, 5%, SMD-0805		
27	1	C10	470uF, 16V, 105deg(Low ESR Type)		
28	1	R14	5K6, 5%, SMD-0805		

6. Regulation, Ripple & Efficiency Measurement

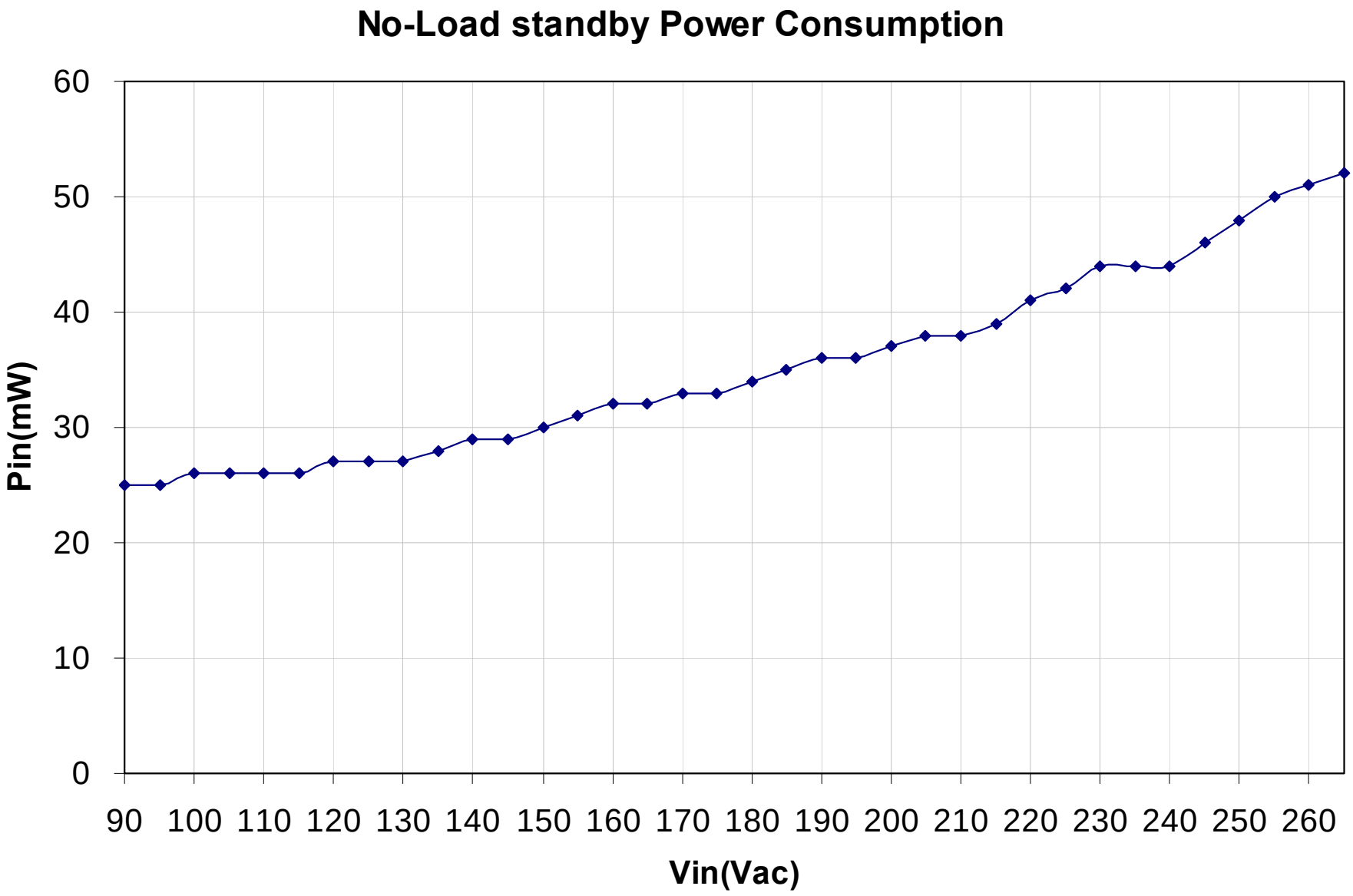
*** Note: Output voltage measured at the end of PCB.**

V_{IN} (V_{AC})	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (mA)	V_{RIPPLE} (mV_{P-P})	P_{OUT} (W)	η (%)	OCP (mA)	Average η(%)	EPA 2.0 η (%)
90	0.025	6.00	0	9			652	73.48	69.08
	1.023	6.10	125	42	0.76	74.54			
	2.051	6.14	250	46	1.54	74.84			
	3.185	6.22	375	54	2.33	73.23			
	4.439	6.33	500	75	3.17	71.30			
115	0.026	6.00	0	13			661	75.92	
	1.005	6.10	125	40	0.76	75.87			
	1.992	6.14	250	44	1.54	77.06			
	3.070	6.22	375	52	2.33	75.98			
	4.225	6.32	500	68	3.16	74.79			
230	0.044	5.98	0	30			676	77.26	
	1.006	6.02	125	48	0.75	74.80			
	1.979	6.13	250	45	1.53	77.44			
	2.984	6.23	375	64	2.34	78.29			
	4.038	6.34	500	70	3.17	78.50			
264	0.052	5.96	0	24			671	76.61	
	1.021	6.00	125	38	0.75	73.46			
	1.995	6.13	250	54	1.53	76.82			
	2.998	6.23	375	66	2.34	77.93			
	4.052	6.34	500	84	3.17	78.23			

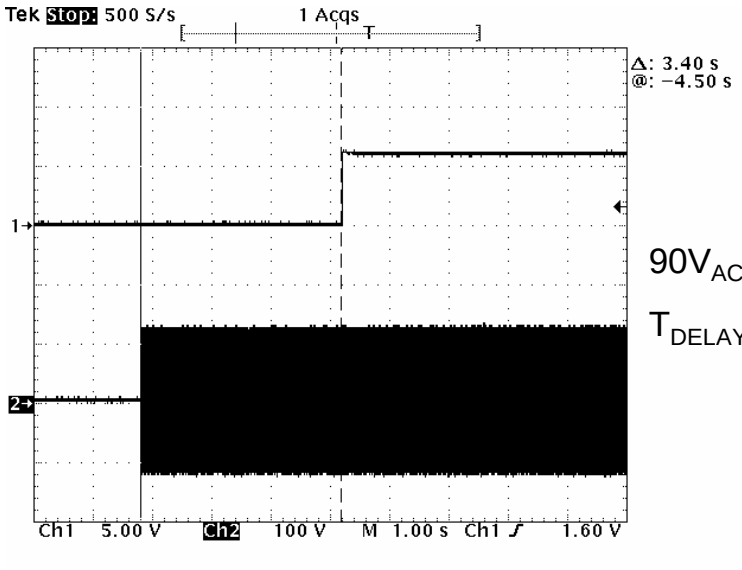
Vin(Vac)	Pin(W)	Iout(mA)	Vout(Vdc)	Pout(W)	Eff(%)	Ripple(mV)
90	0.427	50	6.00	0.30	70.26	24
115	0.426	50	6.00	0.30	70.42	28
230	0.462	50	6.00	0.30	64.94	45
264	0.478	50	6.00	0.30	62.76	42

*** Note: Power consumption load with 50mA is lower than 0.5W.**

7. No-Load Stand-by Power

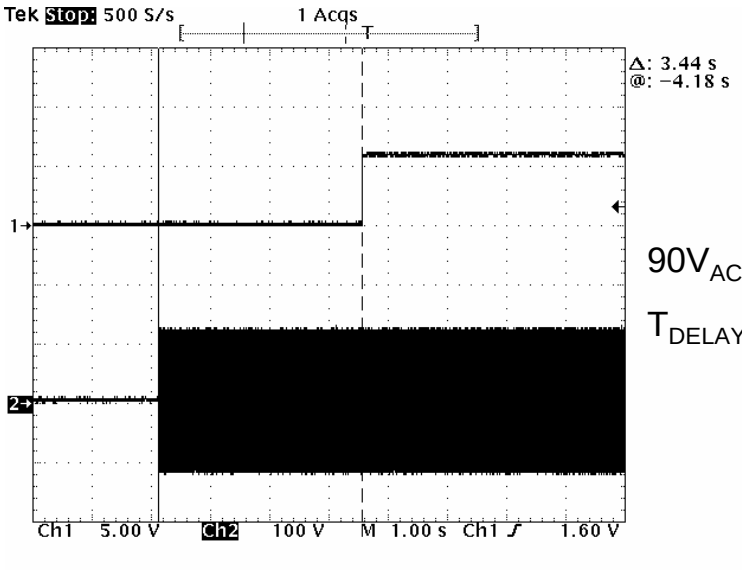


8. Start-Up & Delay Time



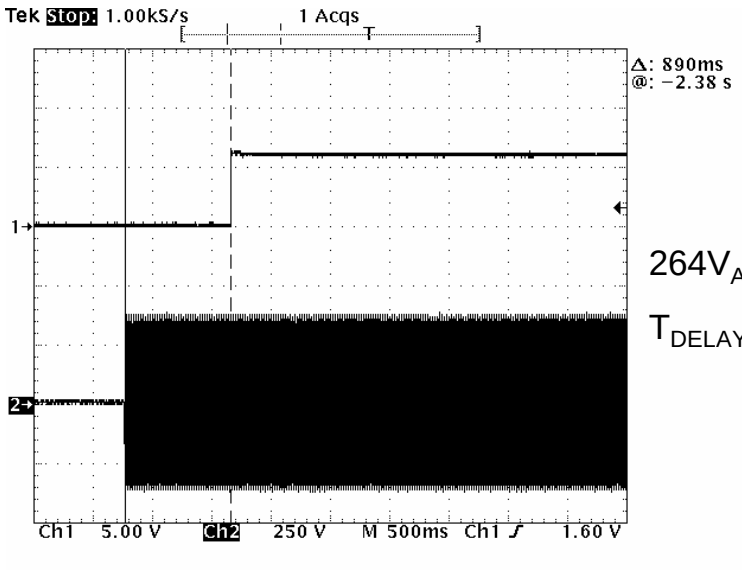
90V_{AC},No Load

T_{DELAY}=3.40S



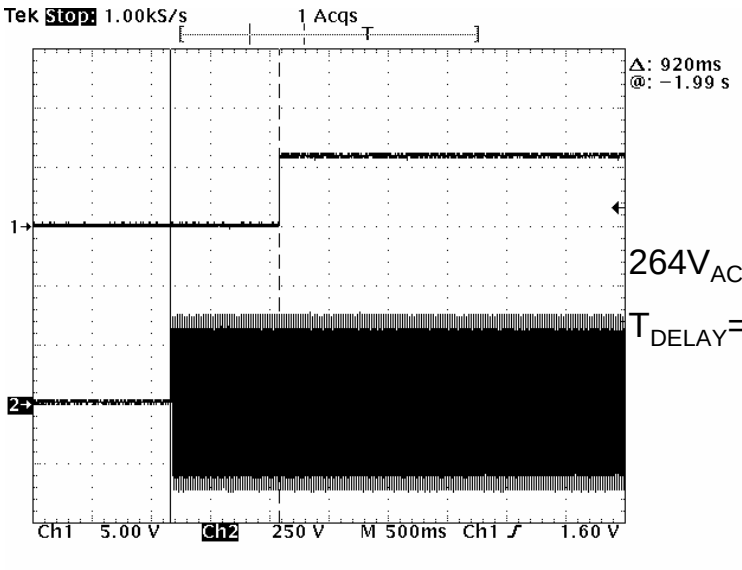
90V_{AC},Full Load

T_{DELAY}=3.44S



264V_{AC},No Load

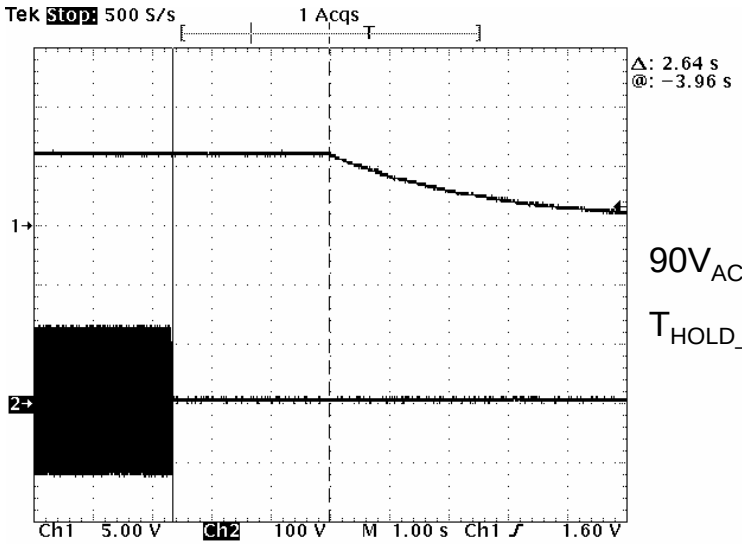
T_{DELAY}=890mS



264V_{AC},Full Load

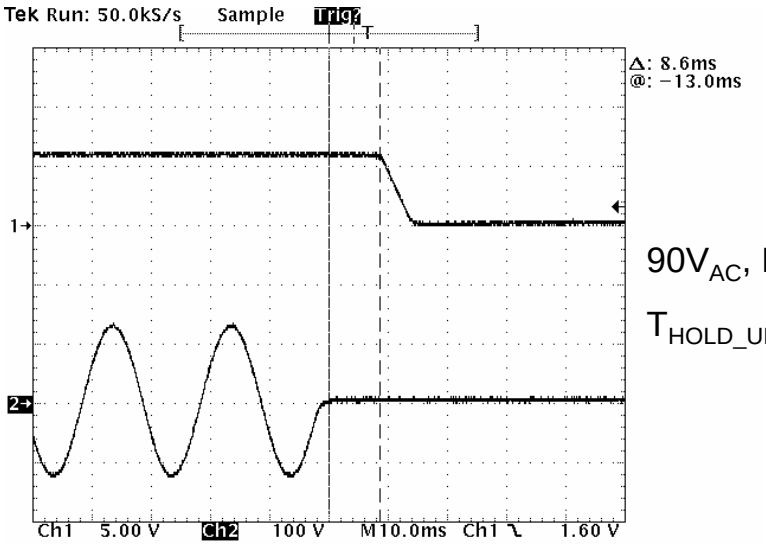
T_{DELAY}=920mS

9. Shut Down & Hold up Time



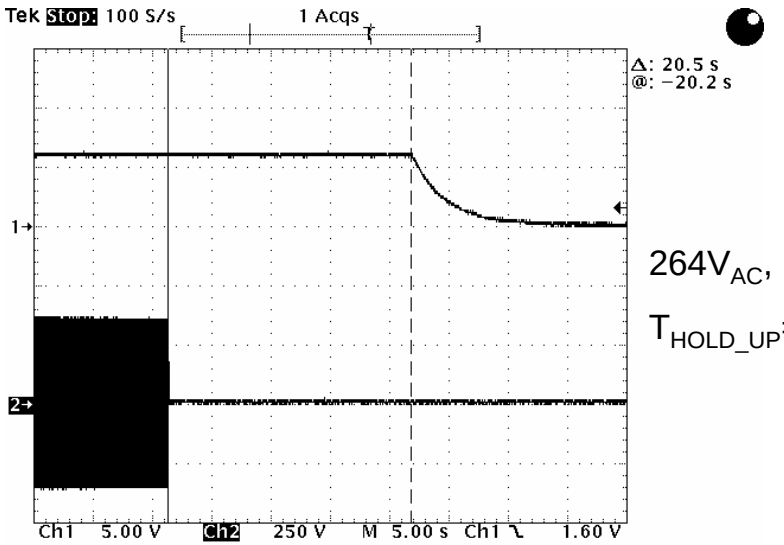
90V_{AC}, No Load

T_{HOLD_UP}=2.64S



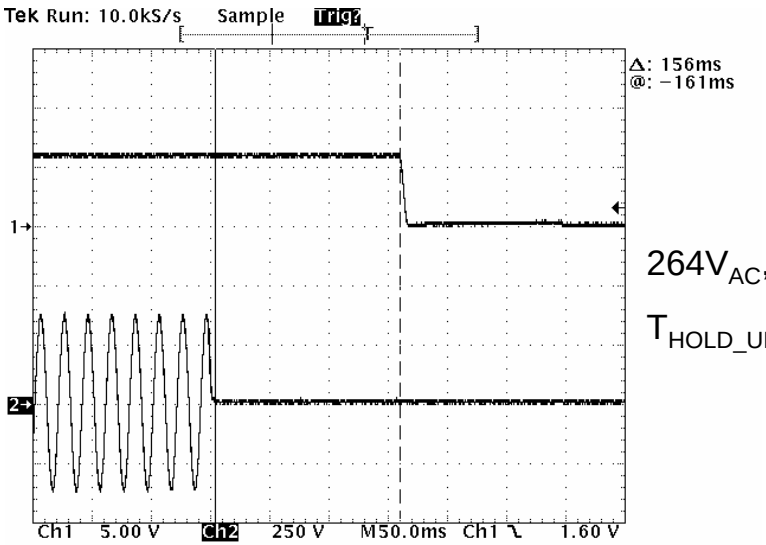
90V_{AC}, Full Load

T_{HOLD_UP}=8.6mS



264V_{AC}, No Load

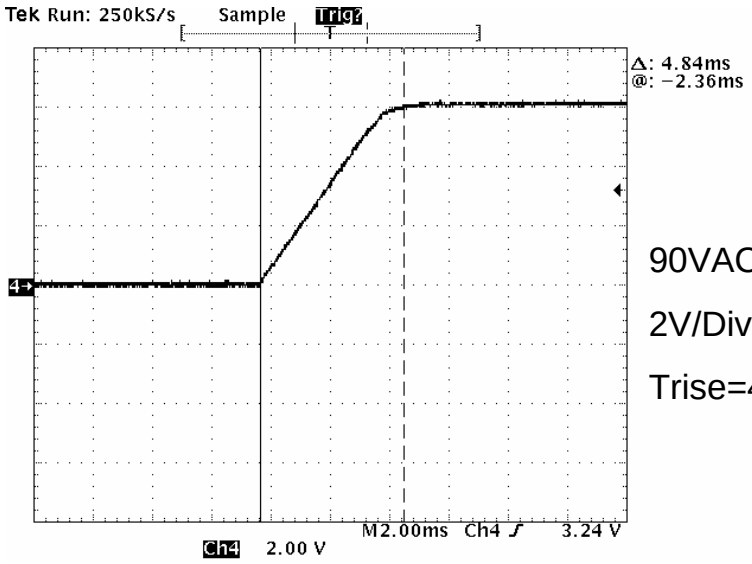
T_{HOLD_UP}=20.5S



264V_{AC}, Full Load

T_{HOLD_UP}=156mS

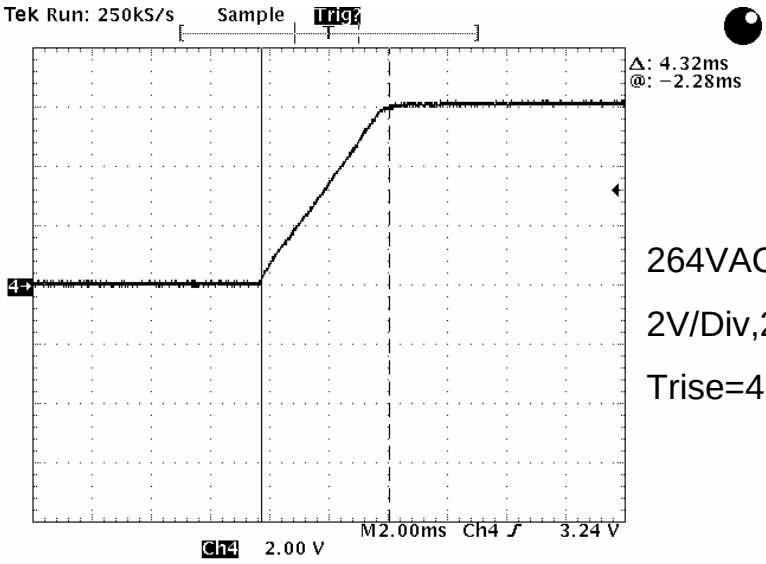
10. Output Voltage Rise Time



90VAC,No Load

2V/Div,2ms/Div

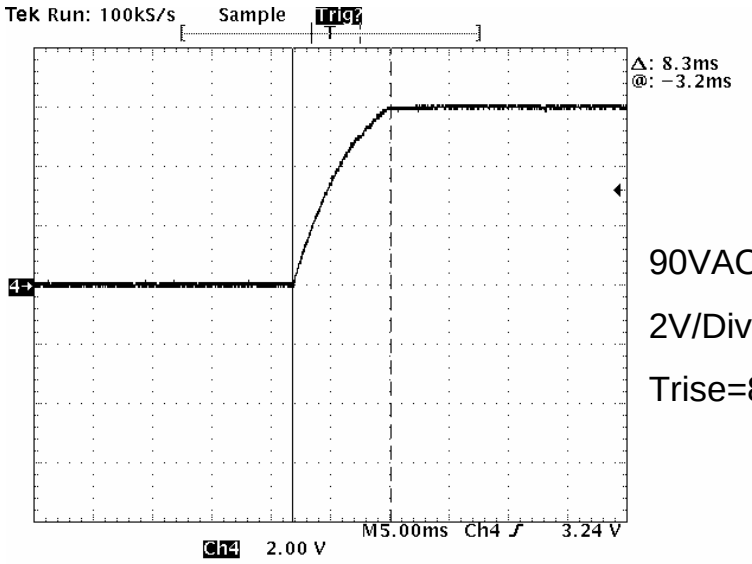
Trise=4.84mS



264VAC,No Load

2V/Div,2ms/Div

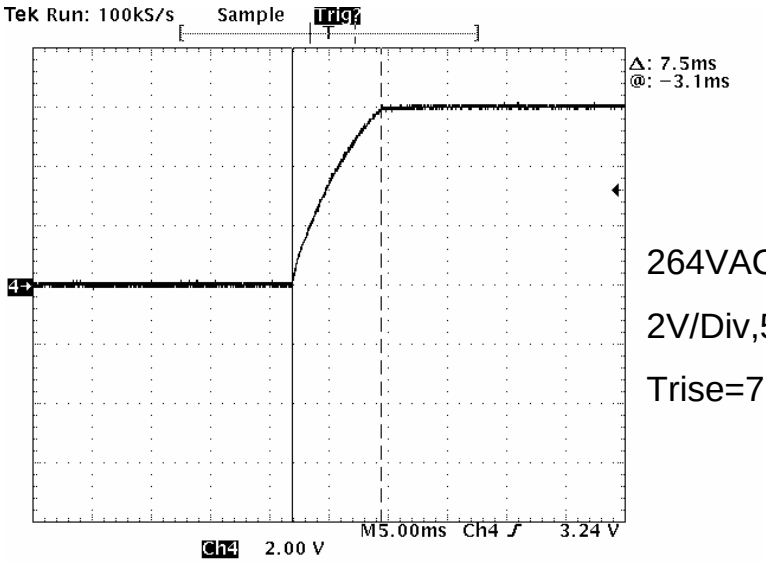
Trise=4.32mS



90VAC,Full Load

2V/Div,5ms/Div

Trise=8.30mS



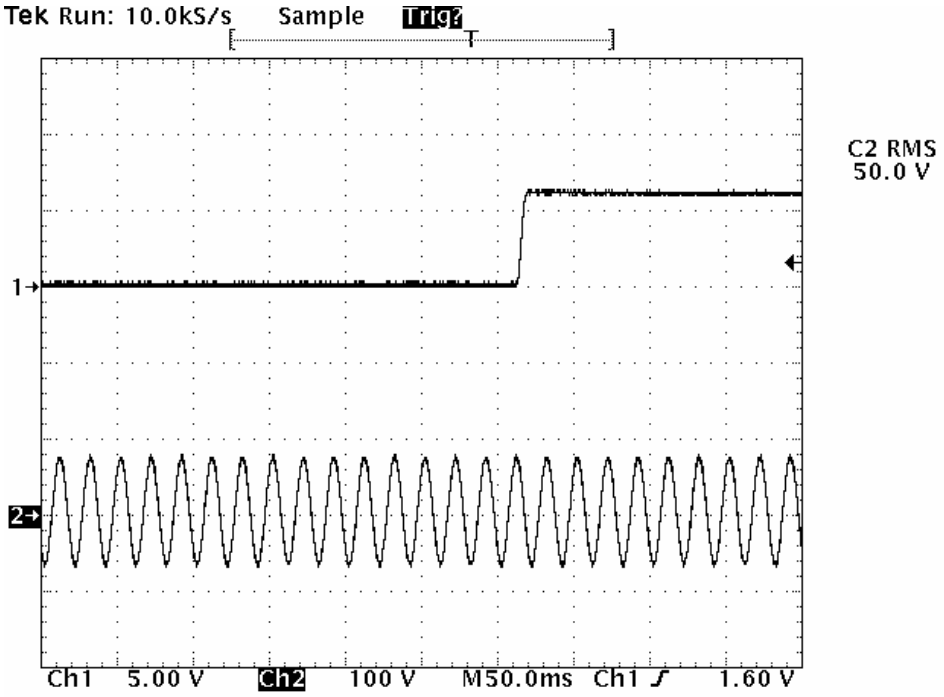
264VAC,Full Load

2V/Div,5ms/Div

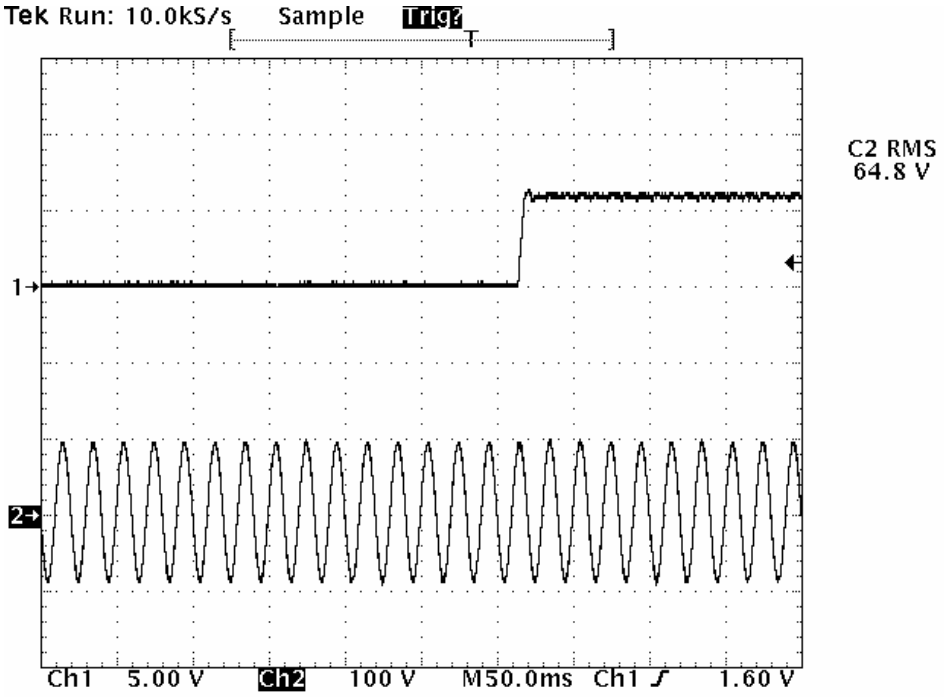
Trise=7.5mS

11. AC Start-up Voltage

No Load, $V_{IN\_START\_UP}$ =50.0V_{AC}

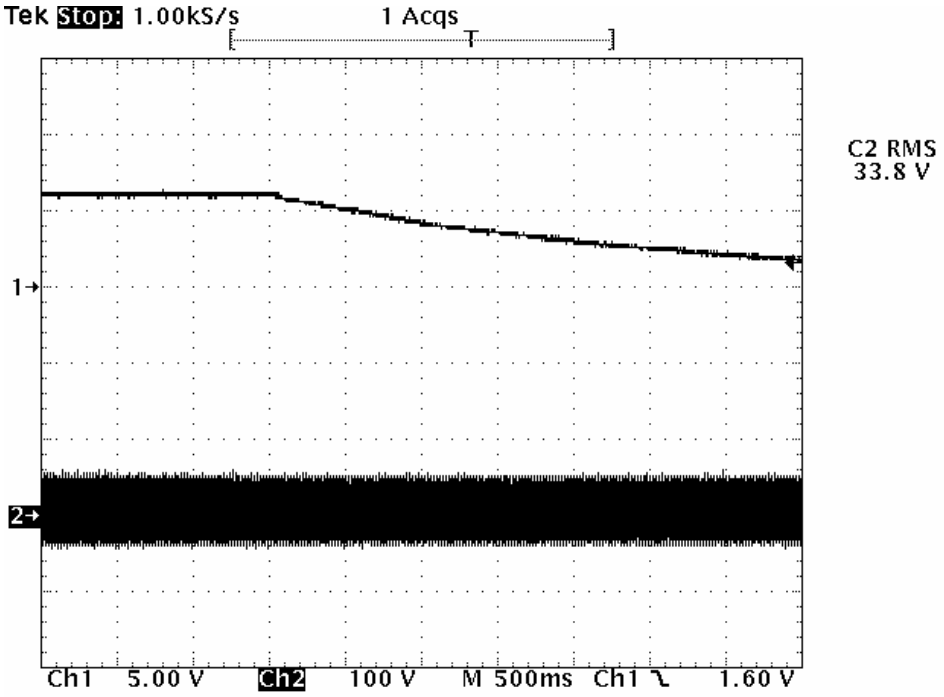


Full Load, $V_{IN\_START\_UP}$=64.8V_{AC}

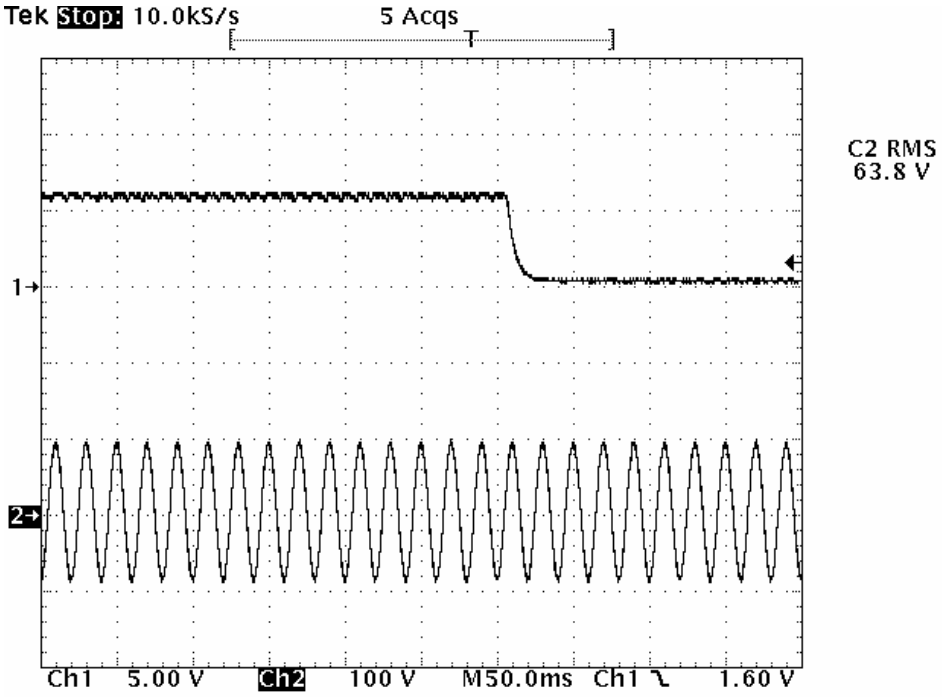


12. AC Brown Out Voltage

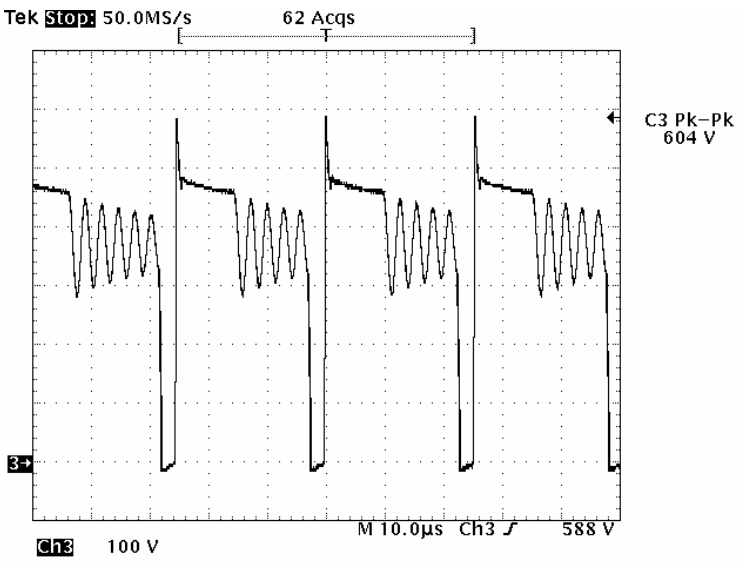
No Load, $V_{IN\_BROWN\_OUT}$ =33.8V_{AC}



Full Load, $V_{IN\_BROWN\_OUT}$ =63.8V_{AC}



13. Q1 Waveform (Normal Operate)



Test Condition:

V_{IN}=264V_{AC}, I_{OUT}=500mA

Result:

V_{DS_MAX}=**604V**

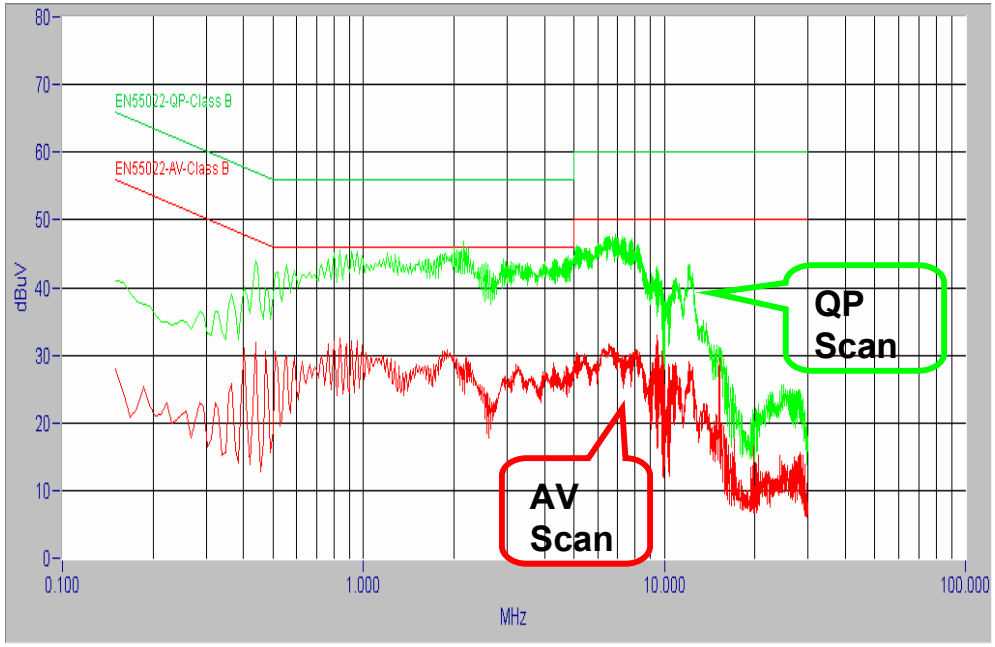
TSC13003 Spec

Absolute Maximum Rating (Ta = 25 °C unless otherwise noted)

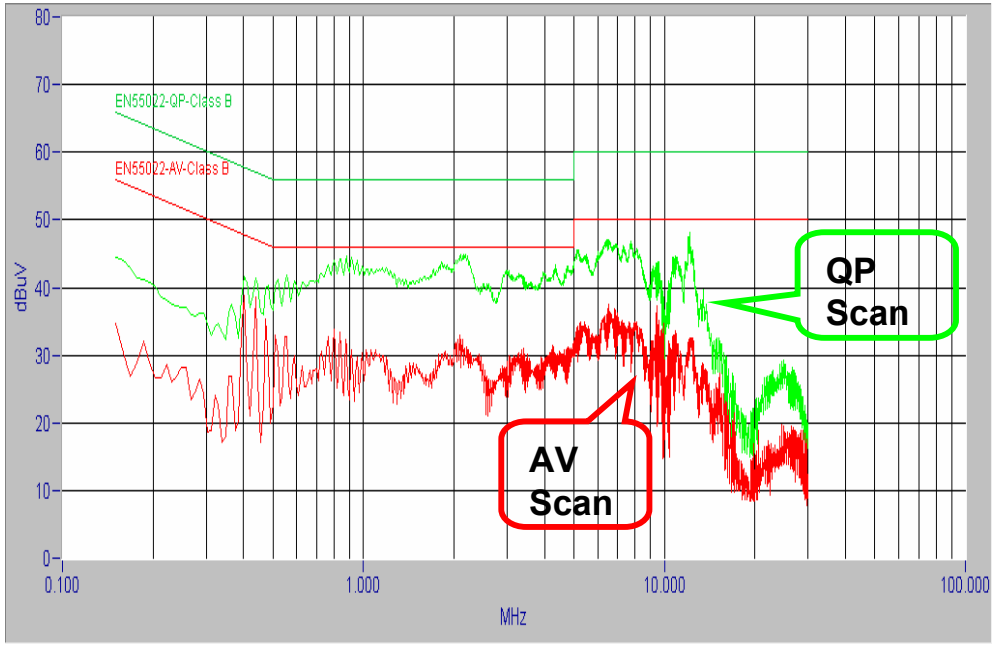
Parameter	Symbol	Limit	Unit
Collector-Base Voltage	V_{CBO}	700V	V

14. Conducted EMI (No Y-CAP)

230V_{AC}/50Hz,Live



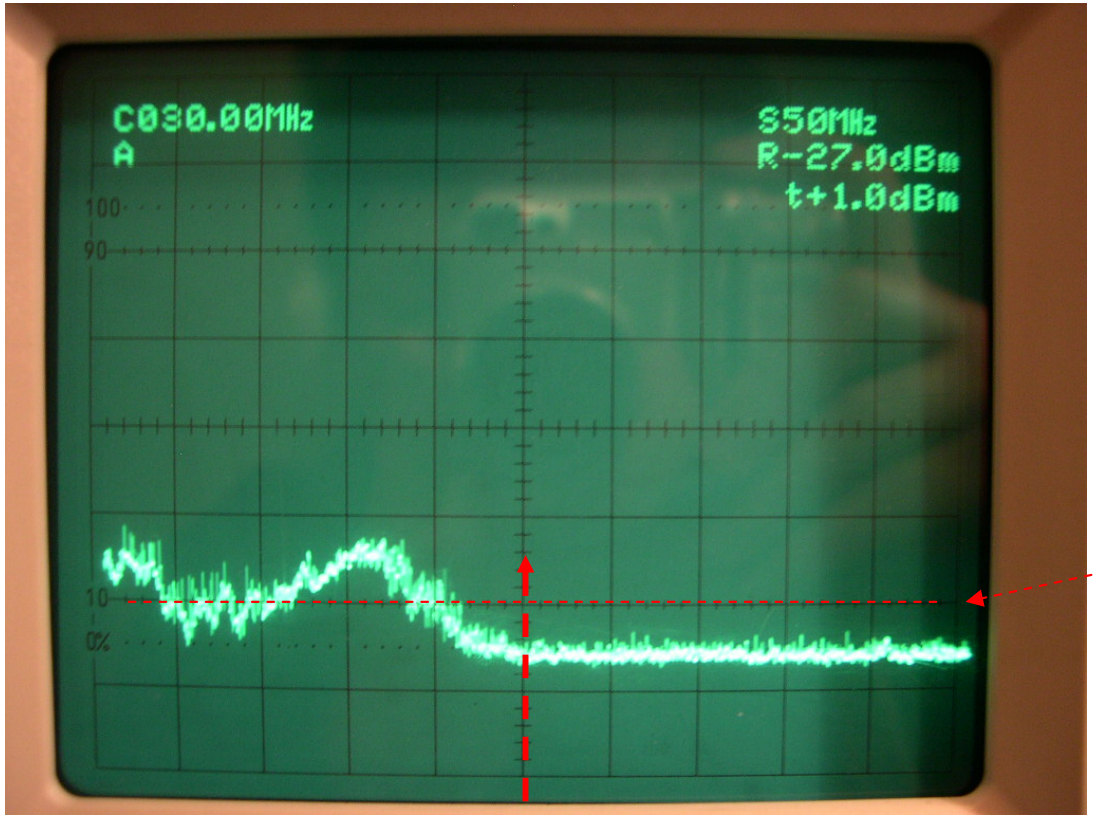
230V_{AC}/50Hz,Neutral



Test Conditions : Resistive Full load. Output Grounded.

15. Radiated EMI

230V_{AC}/50Hz



Limited Line

30M

Test Conditions : Resistive Full load.