iWatt
Intelligent AC-DC and LED Power™

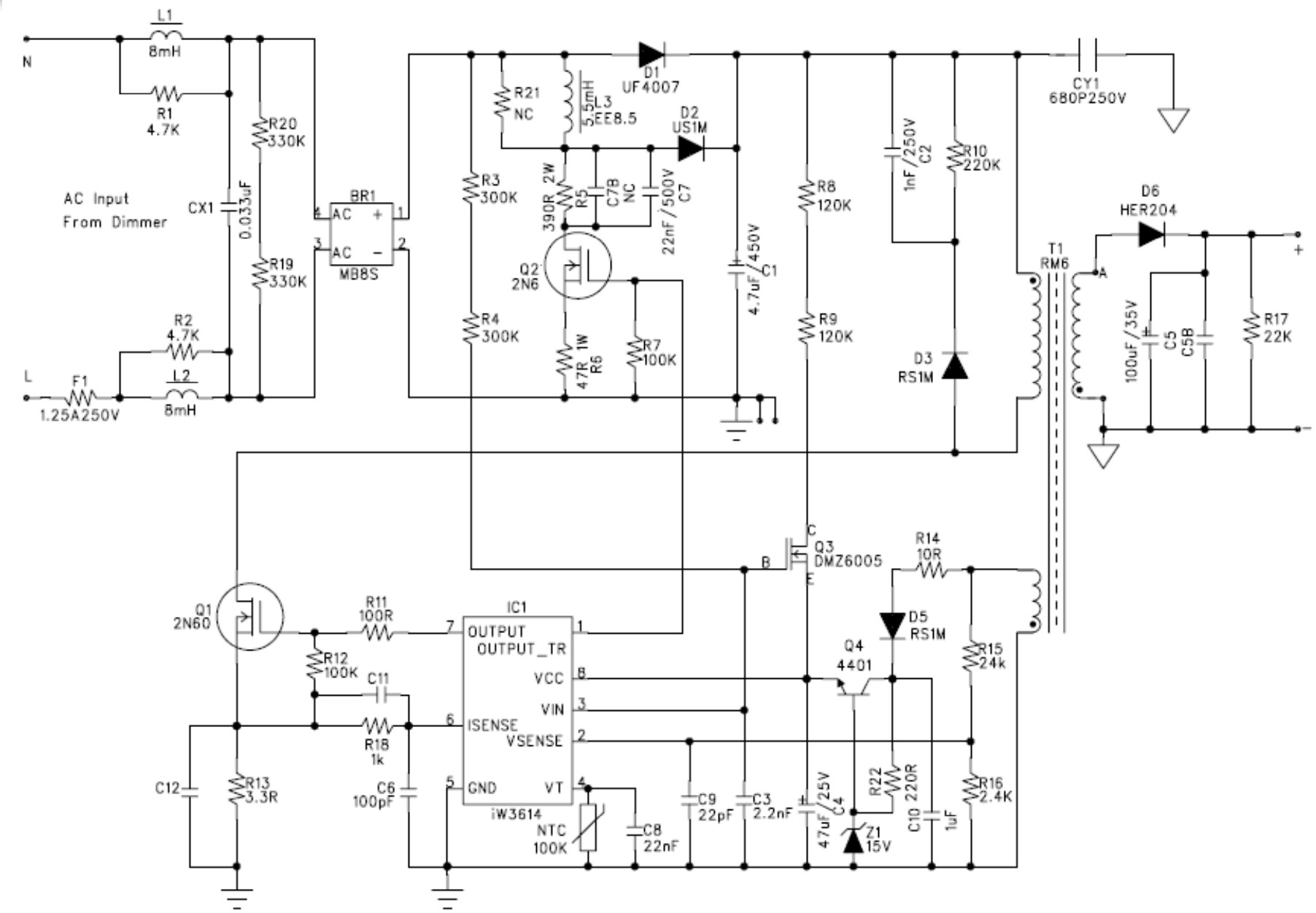
Dimmable LED Driver with iW3614

(Input 230Vac Output 24V350mA)

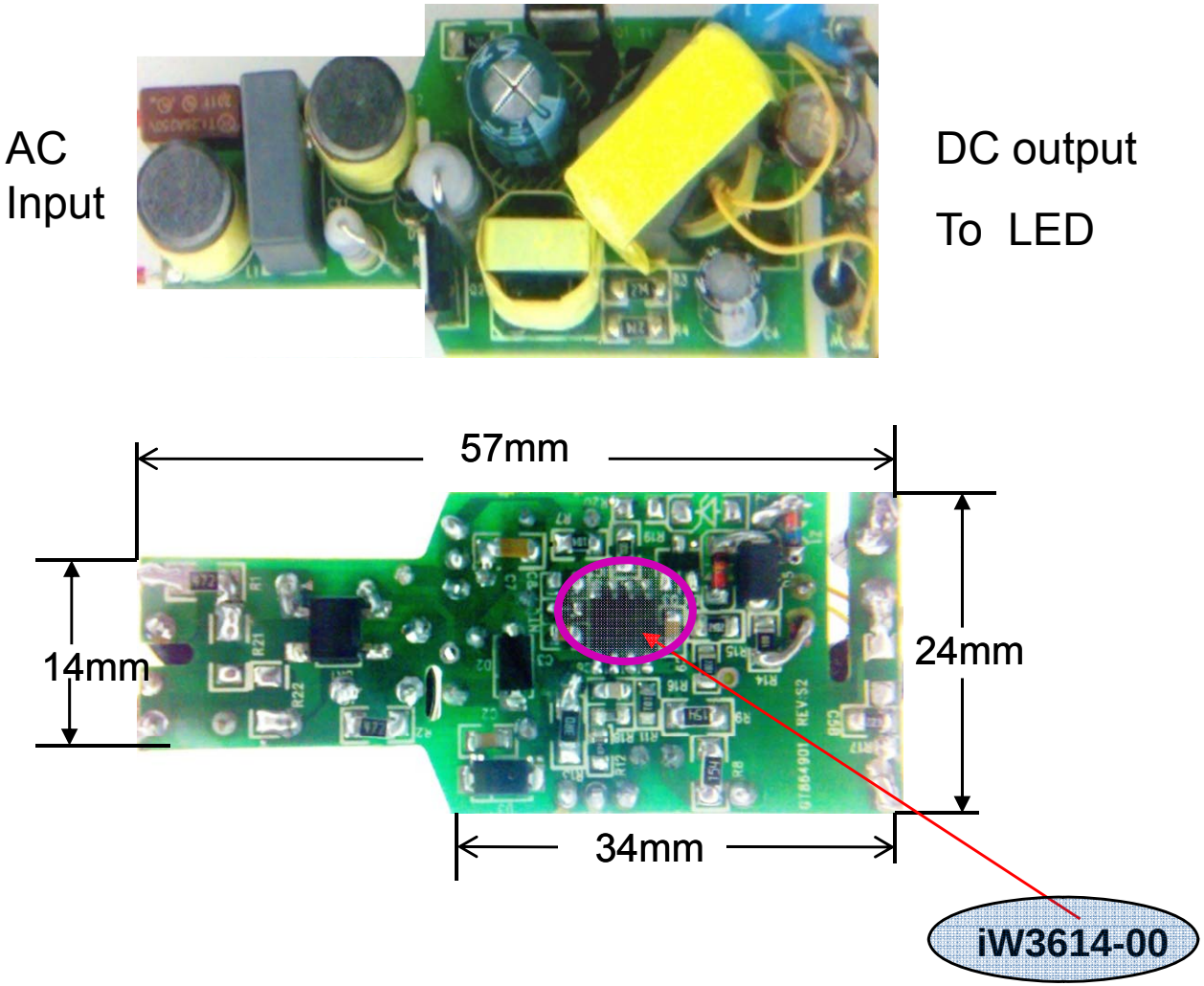
1. Design Purpose and Feature

- Isolated ac-dc offline , Input 230Vac, Output 7 LEDs 350mA
- Intelligent wall dimmer detections
  - Leading-edge dimmer , Trailing-edge dimmer , No-dimmer
- Multiple dimming control scheme
  - Hybrid dimming scheme
  - PWM dimming scheme,900Hz
  - Amplitude dimming scheme
- Wide dimming range from 2% up to 100%
- No visible flicker
- Resonant control to achieve high efficiency
- High Power Factor, 0.9 without dimmer
- Temperature degrade control to adjust the LED
- Primary-only Sensing eliminates opto-isolator feedback and simplifies design

2. Schematic circuit__24V350mA_230Vac



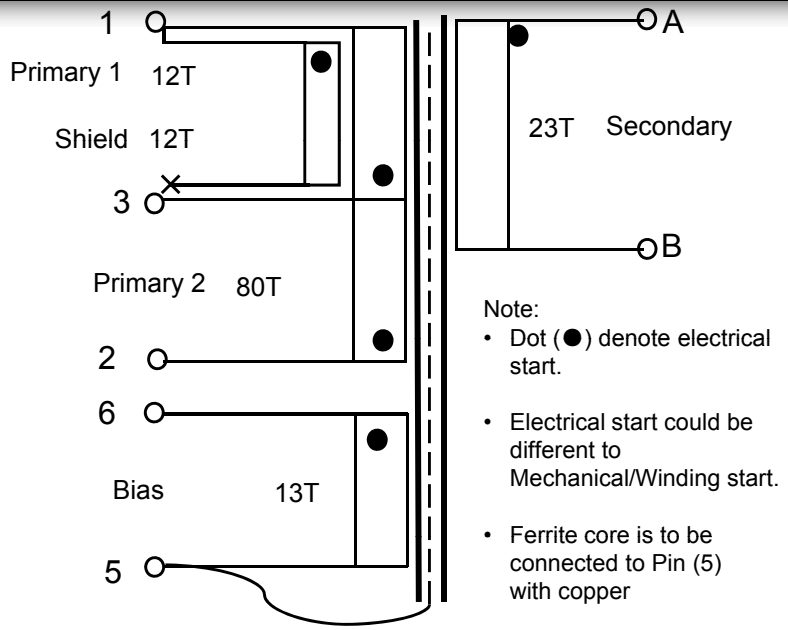
3.PCB Layout



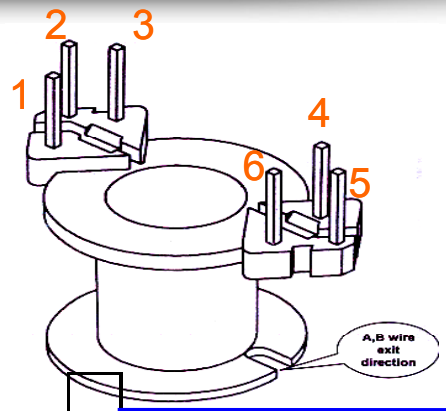
4.BOM__24V350mA__ 230Vac

Ref.	Description	Qty	Ref.	Description	Qty
IC1	Iw 3614-00, Digital PWM Controller,Dimmable, SO-8	1	R11	100Ω ±5％, SMD-0805	1
CX1	0.033uF,275V, X2	1	R14	10Ω ±5％, SMD-0805	1
C1	4.7uF, 450V, E-CAP, 105'C	1	R15	24KΩ ±1％, SMD-0805	1
C2	1nF, 250V, X7R, SMD1206	1	R16	2.4KΩ ±1％, SMD-0603	1
C3	2.2nF,50V, X7R, SMD 0603	1	NTC	100KΩ ±5％, SMD-0603	1
C4	47uF, 25V, E-CAP	1	R17	22KΩ ±5％, SMD-1206	1
C5	100uF,25V,E-CAP	1	R19,R20	330K, 1206	2
C6	100pF,25V, X7R, SMD 0603	1	FR1	T1A250V	1
C7	22nF/250V ,	1	BR1	BM8SS, SMD	1
C8	22nF,25V, X7R, SMD 0603	1	D1,D2	UF4007	2
C9	22pF,50V, X7R, SMD 0603	1	D3	FR107,1A1000V	1
C10	1uF, 25V, X7R, SMD 1206	1	D4	1N4148 0.1A/100V, SMD	1
R1, R2	4.7KΩ ±5％, SMD-1206	1	D5	RS1M 1A 200V SMD	1
R3	270KΩ,±1％, SMD-1206	3	D6	HER204	1
R4	270KΩ,±1％, SMD-1206	1	Z1	Zener, 15V, SMD	1
R5	390Ω,±5％, 2W	1	CY1	Y1,680pF,250V	1
R6	47Ω ,±5％, 1W	1	Q1	4N60,TO-251	1
R10	220KΩ,±5％, SMD-1206	1	Q2	2N60, TO-251	1
R7,R12	100KΩ±5％, SMD-0805	1	Q3	DMZ6005, N-Depletion, 600V, SOT-23	1
R8,R9	120KΩ,±5％, SMD-1206	2	Q4	SOT23 NPN 2SC4401	1
R18	1KΩ ±1％, SMD-0603	2	L1	8mH, Drum choke, 8X10mm, 0.14mm,500Ts	1
R13	3.6Ω ±1％, SMD-1206	1	L2	8mH, Drum choke, 8X10mm, 0.14mm,500Ts	1
L3	5mH, EE10, 0.11mmX300Ts	1			
T1	RM6, Transformer	1			

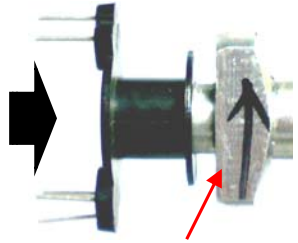
5. Transformer Design 24V350mA 230Vac



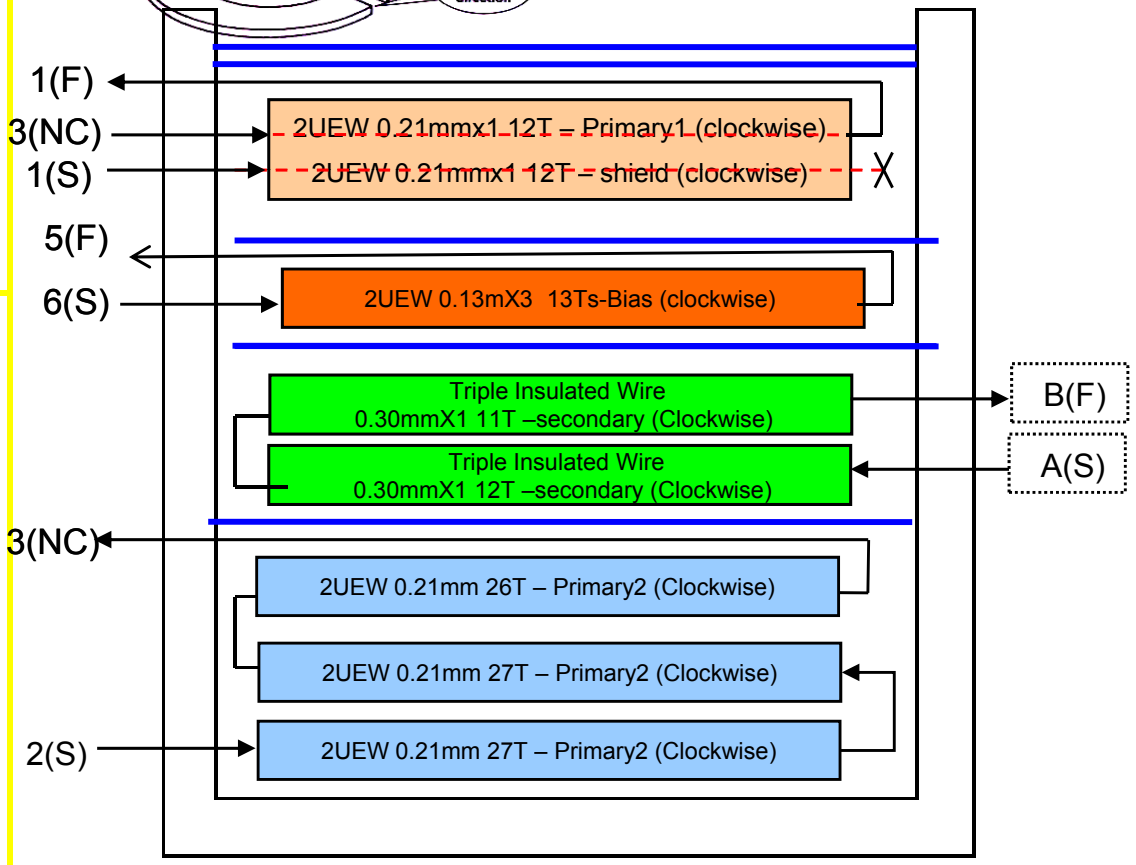
Note:
- Dot (●) denote electrical start.
- Electrical start could be different to Mechanical/Winding start.
- Ferrite core is to be connected to Pin (5) with copper



Instruction for start of first winding



Rotating direction of winding machine



ELECTRICAL SPECIFICATIONS:

1. Primary Inductance (Lp) = 3.3mH @10KHz
2. Primary Leakage Inductance (Lk)< = 150uH @10KHz
3. Electrical Strength = 3KV, 50/60Hz,1Min

MATERIALS:

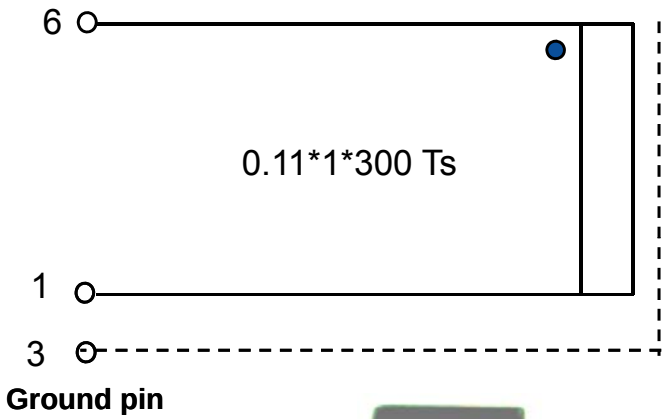
1. Core : RM6 (Ferrite Material TDK PC40 or equivalent)
2. Bobbin : RM6 Horizontal. Primary=3, Secondary=3
3. Magnet Wires (Pri) : Type 2-UEW
4. Magnet Wire (Sec) : Triple Insulated Wires
5. Layer Insulation Tape :3M1298 or equivalent.

FINISHED :

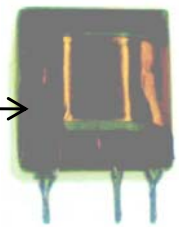
1. Cut remained of Pin after wires termination
2. Core is connected to PRI-GND pin5.
3. Varnish the complete assembly

6.PFC choke and EMI Inductor__ For input 230Vac

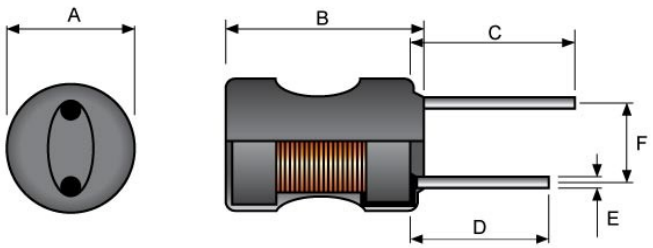
L3 SCHEMATIC



Copper shielding is connected to pin 3

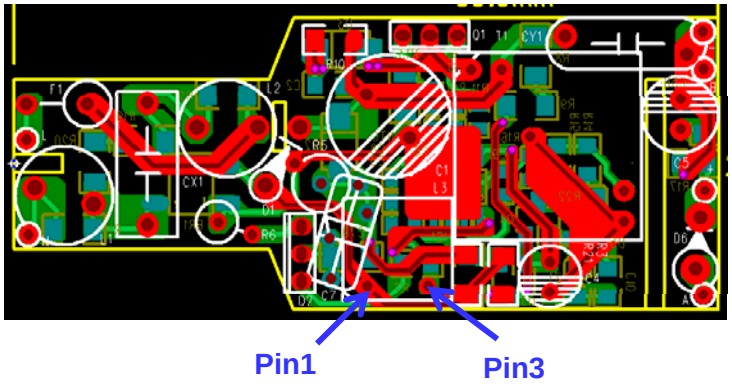


EMI Inductor L1,L2



ELECTRICAL SPECIFICATIONS:

1. **Inductance (Lp) = 5.0 mH @10KHz**
2. Core : EE8.3 (Ferrite Material TDK PC40 or equivalent)
3. Bobbin : EE8.3 Horizontal
4. Ferrite core is connected to Pin 3 after assembling
5. Cut Pin2 4 5 after wires termination
6. Varnish the complete assembly



Ferrite core size : Ax B 8x10mm 0.14*500T

Inductance @10kHz, 1V: 8mH +/-20%

DCR: 16 OHM +/-20%

7.Constant Current and Efficiency __No Dimmer

iWatt
Intelligent AC-DC and LED Power™

(AC input 180~264Vac,Output 7 LEDs)

#of LEDs	Vin (V)	Pin (W)	Vout (V)	Iout (A)	Ripple (mA)	efficiency	PF
7LEDs	180	10.55	23.87	0.362	52	81.90%	0.980
	190	10.40	23.78	0.361	50	82.54%	0.987
	200	10.36	23.7	0.361	50	82.58%	0.987
	210	10.31	23.66	0.361	50	82.84%	0.986
	220	10.29	23.61	0.361	50	82.83%	0.983
	230	10.31	23.58	0.360	50	82.34%	0.979
	240	10.30	23.57	0.361	49	82.61%	0.974
	250	10.25	23.51	0.361	49	82.80%	0.966
	260	10.24	23.48	0.360	49	82.55%	0.955
	264	10.23	23.45	0.360	49	82.52%	0.949

8. Vcc supply voltage

The purpose of this test is to verify operating range of Vcc voltage under different loading conditions.

Item	Vcc range [Max: 16V, Min: 8V]		
Input Vac	Vin=180Vac	Vin=230Vac	Vin=264Vac
Without dimming	12.625V	12.614V	12.620V
Use dimming at min load	8.627V	8.640V	8.742V
Use dimming at max load	12.696V	12.732V	12.877V

V_{CC} SECTION (Pin 8)						
Maximum operating voltage	$V_{CC(MAX)}$				16	V
Start-up threshold	$V_{CC(ST)}$	V_{CC} rising	11	12	13	V
Undervoltage lockout threshold	$V_{CC(UVL)}$	V_{CC} falling	7	7.5	8	V
Operating current	I_{CCQ}	C_L = 330 pF, V_{SENSE} = 1.5 V		4.1	4.7	mA
Zener diode clamp voltage	$V_{Z(CLAMP)}$			19		V

9.Constant Current and Efficiency_ with dimmer

Leading edge dimmer

_ Schneider ALT400902

_7 LEDs

Vin	DIM Level	Pin	LED Voltage	LED current	Pout	Eff	ripple current
(V)		(W)	(V)	(mA)	(W)	(%)	(mA)
180	Max.	10.80	23.10	340	7.85	72.7%	
		5.58	21.28	178	3.79	67.9%	
	Min.	0.40	17.62	3.28	0.06	14.4%	
230	Max.	10.32	23.28	344.7	8.02	77.7%	
		6.04	21.32	176.08	3.75	62.2%	
	Min.	0.39	17.39	1.78	0.03	7.9%	
264	Max.	10.45	23.31	349	8.14	77.9%	
		6.15	21.28	171.4	3.65	59.3%	
	Min.	0.49	17.66	3.76	0.07	13.5%	

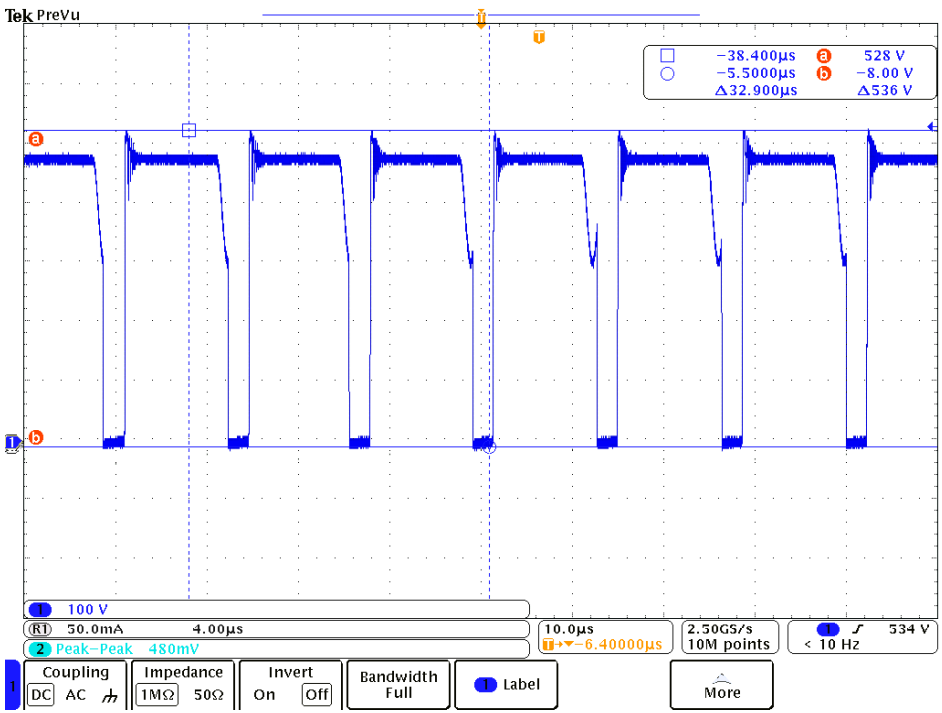
Trailing edge dimmer

_AURORA AU-PSP400

_7 LEDs

Vin	DIM Level	Pin	LED Voltage	LED current	Pout	Eff	ripple current
(V)		(W)	(V)	(mA)	(W)	(%)	(mA)
180	Max.	10.63	23.21	339.6	7.88	74.1%	
		5.16	21.16	163.8	3.47	67.2%	
	Min.	0.33	17.36	1.64	0.03	8.6%	
230	Max.	10.55	23.28	345.4	8.04	76.2%	
		5.67	21.24	169.7	3.60	63.6%	
	Min.	0.49	17.82	5.5	0.10	20.0%	
264	Max.	10.93	23.32	349.3	8.15	74.5%	
		5.62	21.16	164.1	3.47	61.8%	
	Min.	0.39	17.36	1.67	0.03	7.4%	

10. V_{DS} Waveform



Test Condition:

Vin=264Vac, I_{OUT}=CV24V

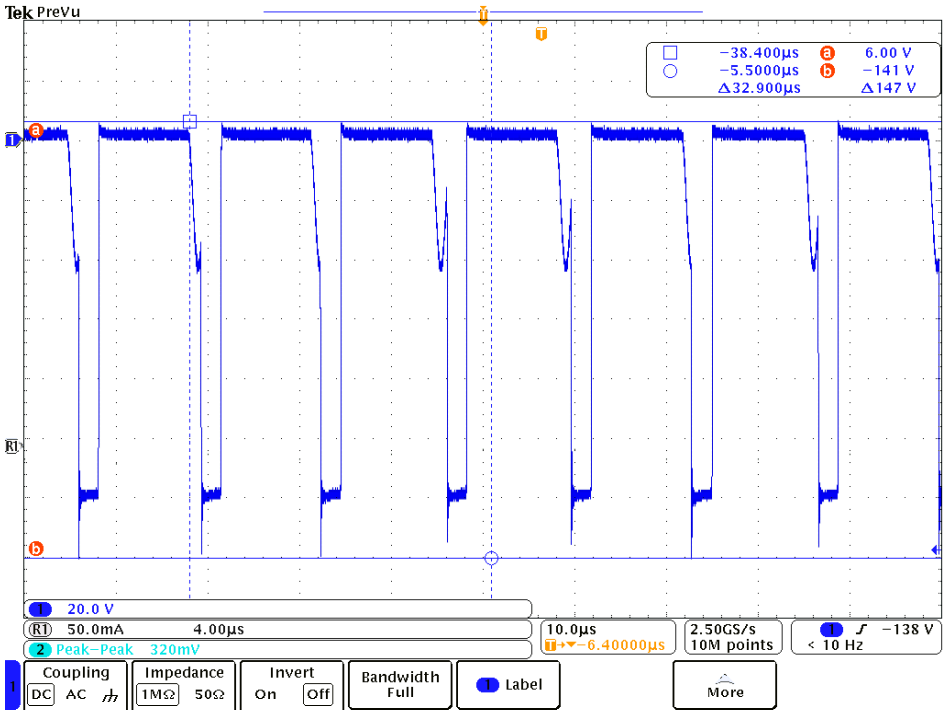
Result:

V_{DS_MAX}=536**V**

Q1, use 2N60; Q2 use 4N60

Parameter	Symbol	Limit	Units
Drain-Source Voltage	V_{DS}	600	V
Gate-Source Voltage	V_{GS}	±30	V
Drain Current-Continuous	I_D	1.3	A
Drain Current-Pulsed [a]	I_{DM}	5.2	A
Maximum Power Dissipation @ T_C = 25°C	P_D	35.7	W
- Derate above 25°C		0.29	W/°C
Operating and Store Temperature Range	T_J,T_{stg}	-55 to 150	°C

11. Output rectifier V_R waveform



Test Condition:

V_{IN}=264VAC, CV24V load

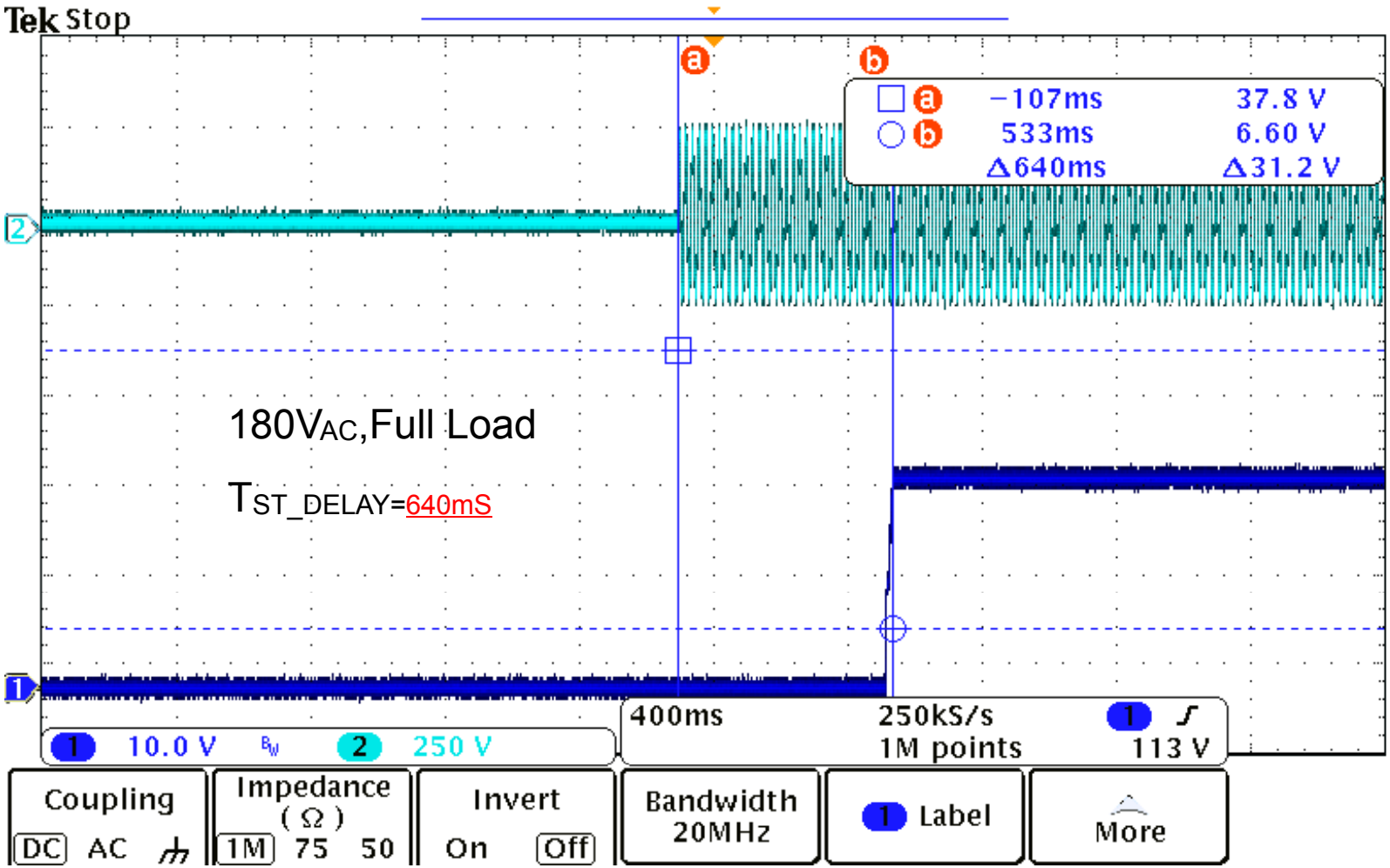
Result:

$V_{R\ (pk—pk)}$=147V

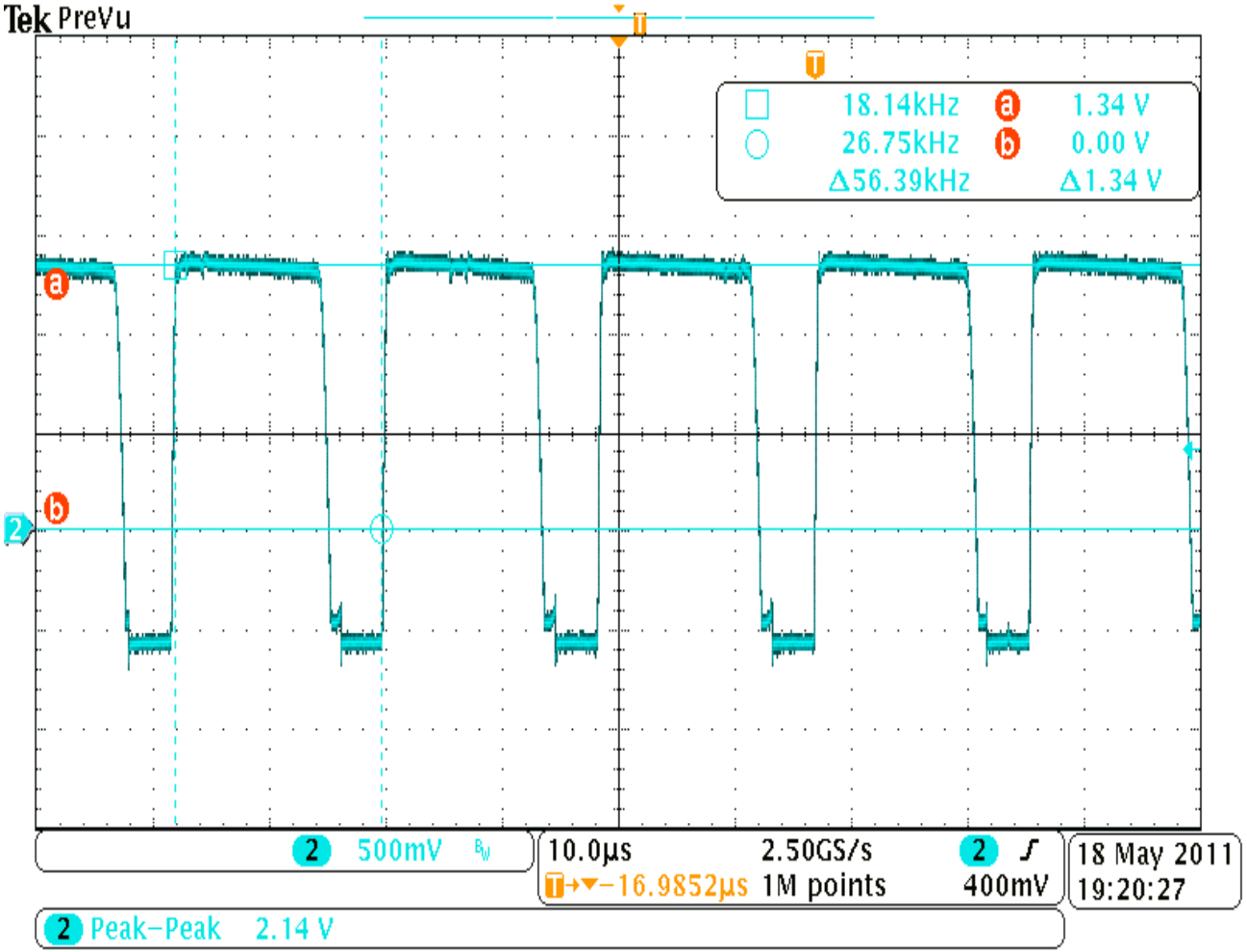
Output rectifier diode: HER203(2A 200V)

Characteristic	Symbol	HER 201	HER 202	HER 203	HER 204	HER 205	HER 206	HER 207	HER 208	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	300	400	600	800	1000	V
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	210	280	420	560	700	V
Average Rectified Output Current (Note 1) @T_A = 55°C	Io	2.0								A

12. Turn On Delay Time



13. Vsense PIN waveform



Test Condition:

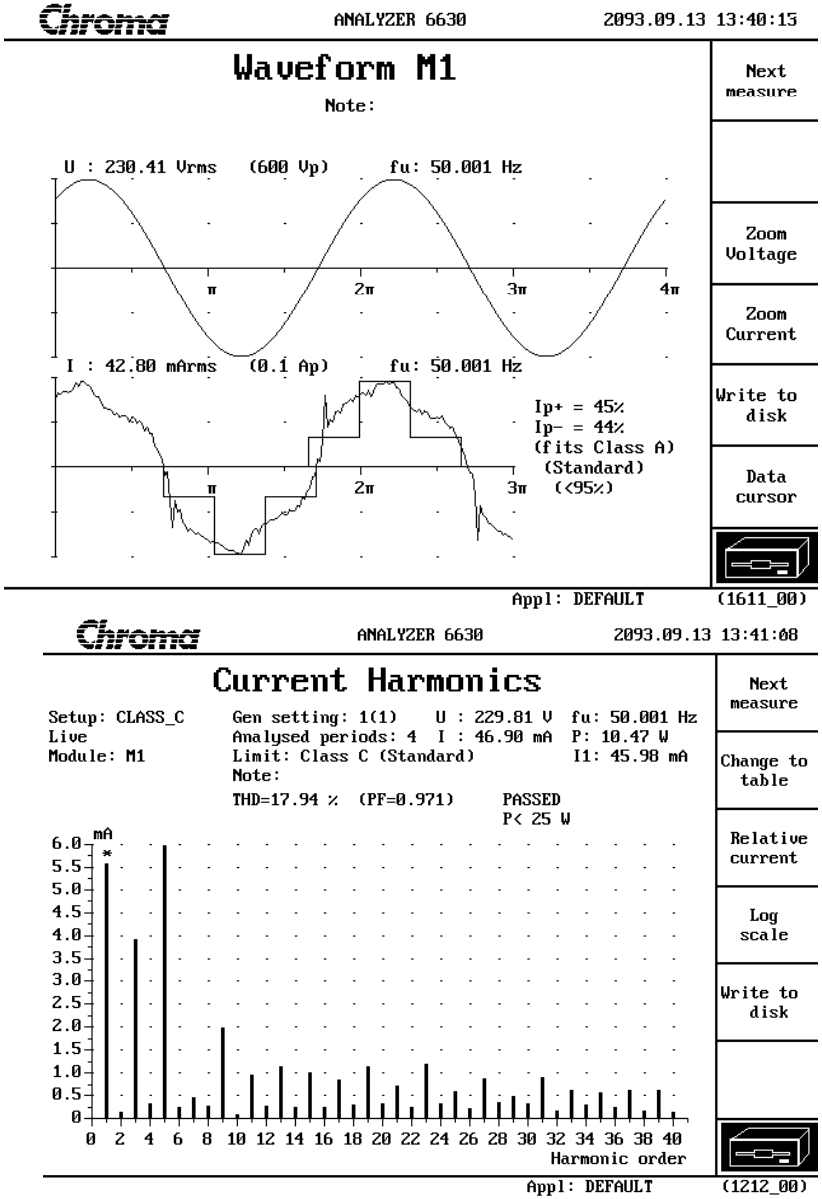
V_{IN}=230VAC, V_{OUT_CV}=23.5V

Result:

V_{sense} =**1.34V**

Vsens <1.538V

14 . Harmonic and current waveform_ NO dimmer _3614-00



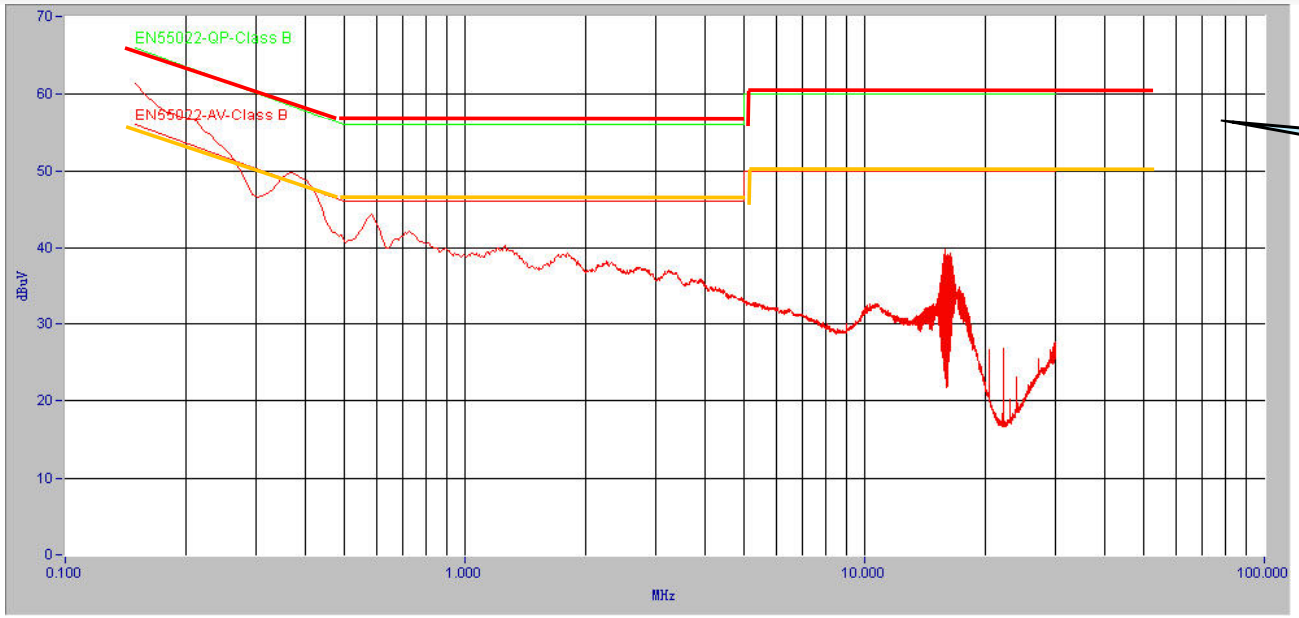
Harmonics current @230Vac

Meet IEC61000-3-2 requirement

Ac current waveform @230Vac

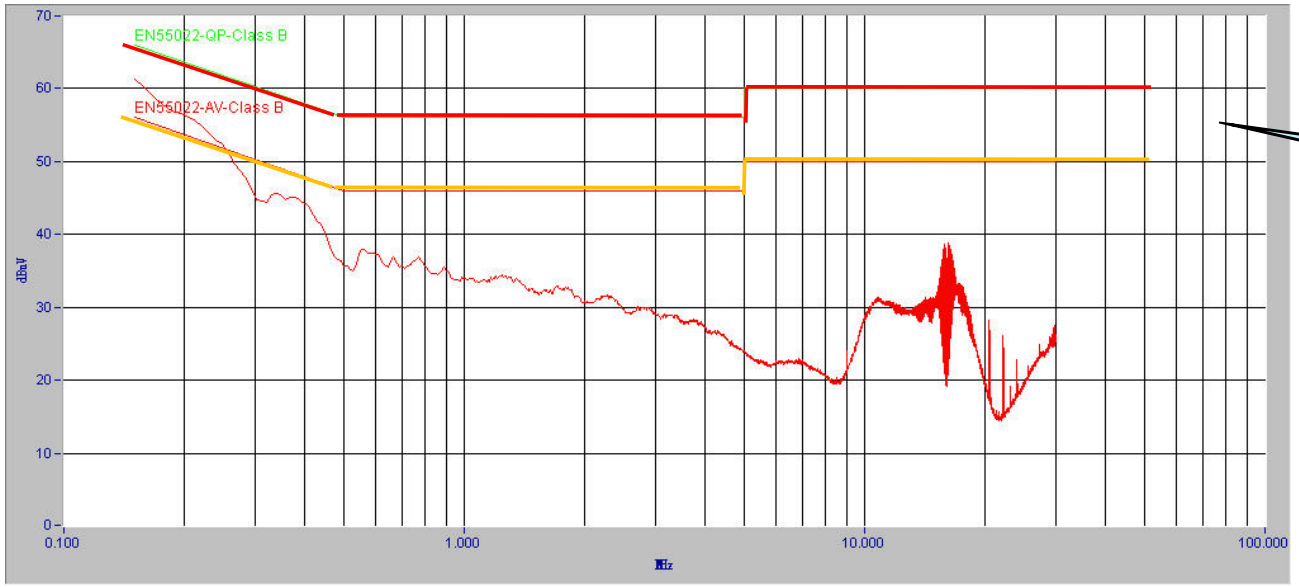
PF=0.971 ,THD=17.94%

15.Conducted EMI (Input 230Vac)



QP Scan
QP Limit line

QP scan N



QP Scan
QP Limit line

QP scan L