iWatt

LED Driver Design with iW3620

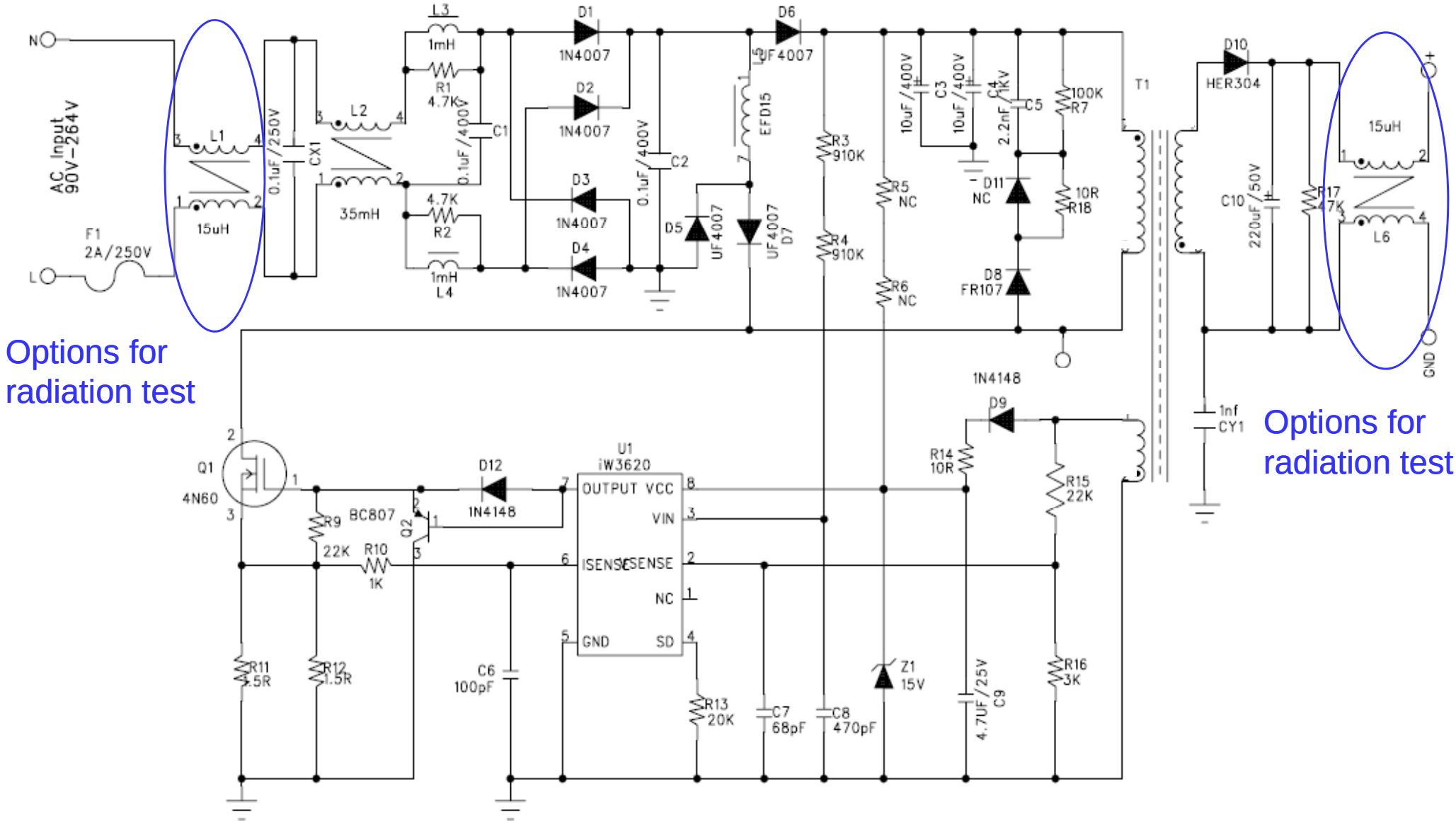
Summary and Features :

1. **LED driver, 40V, 450mA ; AC input range: 90Vac-135Vac,180Vac-264Vac**
2. **For Isolated Applications**
3. **High Efficiency, High Power Factor and Least Parts Solution**
4. **Meet EMI Requirement (EN55015BQP&AV scan)**
5. **Fully Protection Against AC input UV/OV,O/P Short &Open, Component single fault**

1. Specification

Description		Symbol	Min	Typ	Max	Units	Comment
Input							
Voltage		V_{IN}	90		264	V_{AC}	2 Wire
Frequency		f_{LINE}	47	50	63	Hz	
Open-load Input Power ($264V_{AC}$)						W	
Output							
Const Voltage	Output Voltage	V_{OUT_CV}		40		V	Measured at the PCB connector
	Output Current	I_{OUT_CV}				A	
Const Current	Output Voltage	V_{OUT_CV}				V	Min Vout is depend on Vcc
	Output Current	I_{OUT_CV}		0.45		A	
Total Output Power							
Continuous Output Power		P_{OUT}		18		W	
Over Current Protection		I_{OUT_MAX}				A	Auto-restart
Efficiency		η		83		%	Measured at end of PCB
Power Fact		*PF*		0.9			Harmonic meet IEC61000-3-2
Turn on Delay Time						Sec	
Conducted EMI				Meets EN55015B			
Hi-pot test				3		KV	
Operation temperature		T_{opr}		40		° C	Free convection, sea level

2. Schematic


AC Input
90V-264V
N
L
F1
2A/250V
L1
15uH
0.1uF/250V
CX1
L2
35mH
L3
1mH
R1
4.7K
C1
0.1uF/400V
4.7K
R2
L4
1mH
D1
1N4007
D2
1N4007
D3
1N4007
D4
1N4007
0.1uF/400V
C2
D5
UF4007
D6
UF4007
D7
UF4007
EFD15
R3
910K
R4
910K
10uF/400V
C3
10uF/400V
2.2nF/1KV
C4
C5
100K
R7
R5
NC
R6
NC
D11
NC
10R
R18
D8
FR107
T1
D10
HER304
15uH
L6
C10
220uF/50V
R17
4.7K
GND
1nf
CY1
Options for radiation test
Options for radiation test
1N4148
D9
R14
10R
R15
22K
Q1
4N60
D12
1N4148
U1
iW3620
OUTPUT
VCC
VIN
ISENSE
FSENSE
NC
GND
SD
R9
22K
BC807
Q2
R10
1K
R11
1.5R
R12
1.5R
C6
100pF
R13
20K
C7
68pF
C8
470pF
Z1
15V
4.7UF/25V
C9
R16
3K

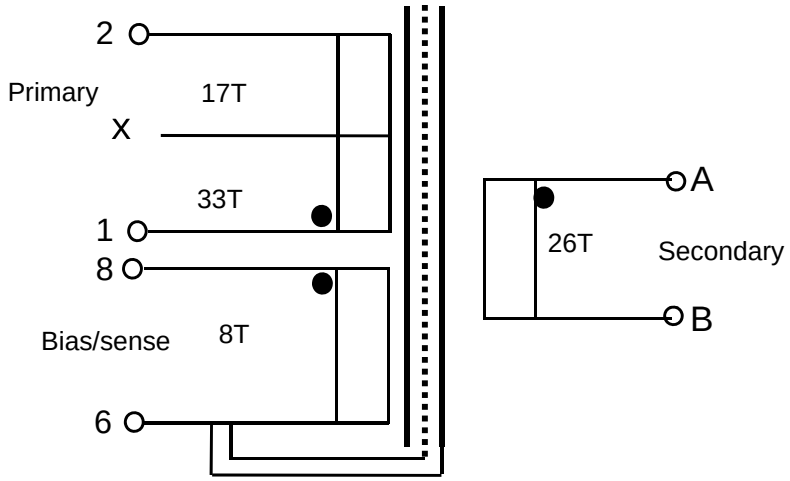
3.Circuit Board Photograph

Top side

L x W x H= 250x18x10mm

4. Transformer Design

SCHEMATIC



ELECTRICAL SPECIFICATIONS:

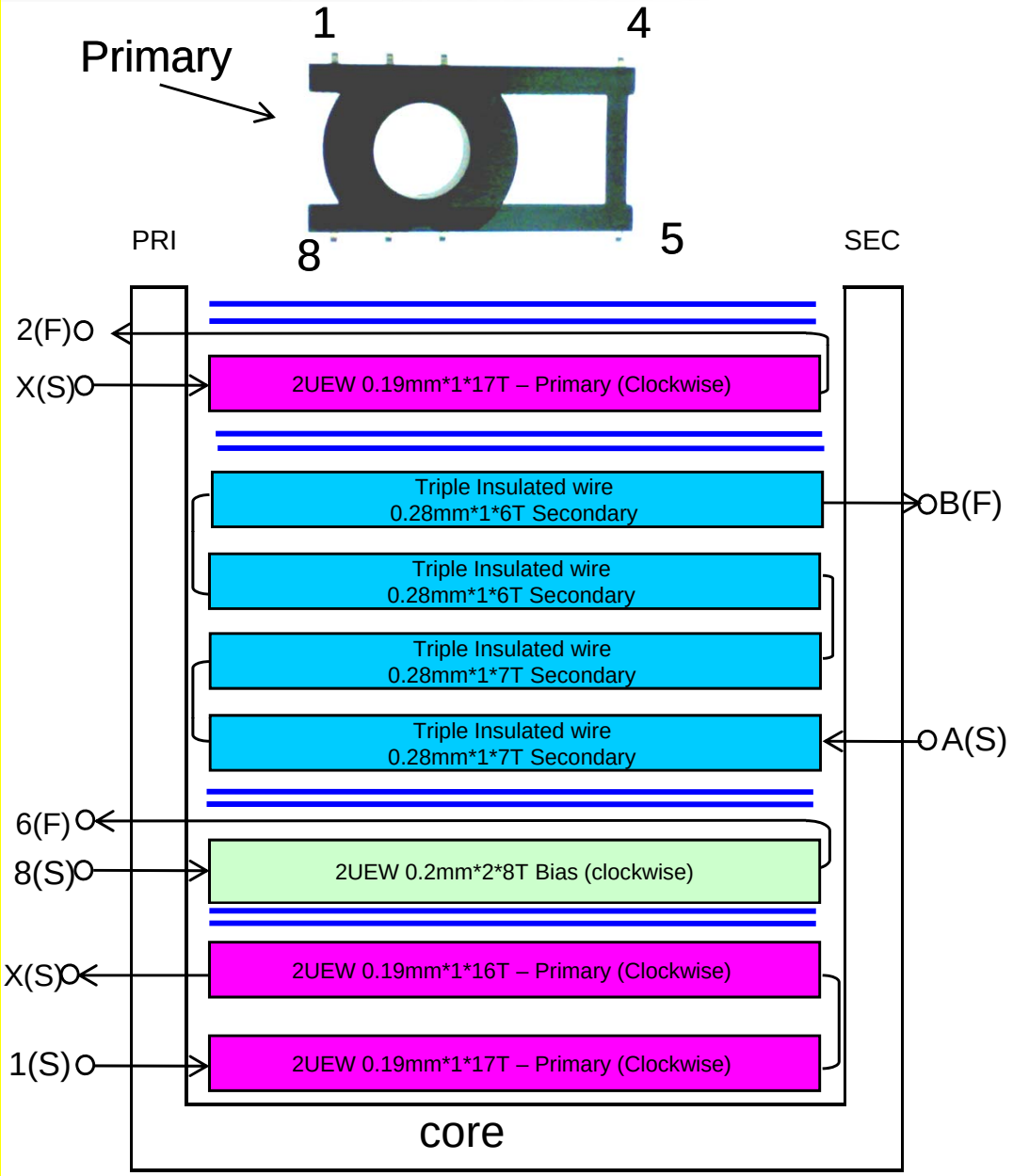
1. Primary Inductance
   Lp = **1.2mH @10KHz (230Vac)**
   Lp = **1.1mH @10KHz (115Vac)**
2. Primary Leakage Inductance (Lk)< = 30uH @10KHz
3. Electrical Strength = 3KV, 50/60Hz,1Min

MATERIALS:

1. Core : ER2510S(Ferrite Material TDK PC40 or equivalent)
2. Bobbin :ER2510S.
3. Magnet Wires (Pri) : Type 2-UEW
4. Magnet Wire (Sec) : Triple Insulated Wires
5. Layer Insulation Tape :3M1298 or equivalent.

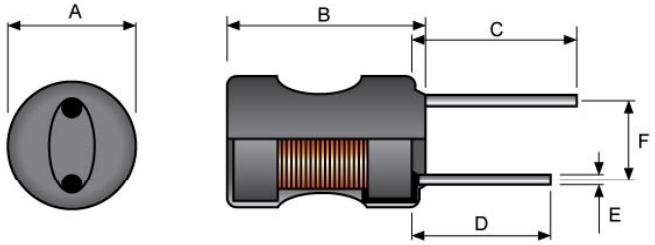
FINISHED :

1. Cut remained of Pin after wires termination
2. Core is connected to PRI-GND pin6.
3. Varnish the complete assembly



5. EMI Inductor

Differential Mode Inductor L1



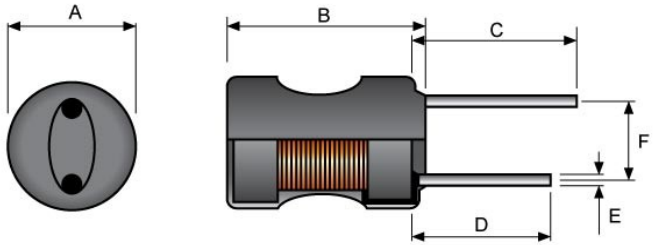
Ferrite core size : AxB 8x10mm

Wire gauge: 0.26mm, 150 Turns

Inductance @10kHz, 1V: 750uH +/-20%

ICR: 0.8 OHM +/-20%

Differential Mode Inductor L2



Ferrite core size : AxB 8x10mm

Wire gauge: 0.3mm, 100 Turns

Inductance @10kHz, 1V: 330uH +/-20%

ICR: 0.5 OHM +/-20%

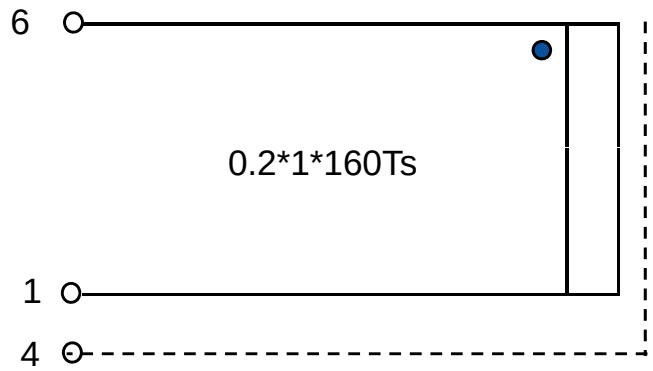
Common Choke L2 for EMI

Core : Mn-Zn T14 x8x6 mm
Turns: 0.2*70T

Inductance 35mH +/-20%

PFC Inductor L4 Design

SCHEMATIC



ELECTRICAL SPECIFICATIONS:

1. Inductance (Lp) = **1.35mH(230Vac),0.95mH(115Vac)** @10KHz
2. Core : EFD15 (Ferrite Material TDK PC40 or equivalent)
3. Bobbin : EFD15 Vertical
4. Ferrite core is connected to Pin 10 after assembling
5. Cut remained of Pin2,3, 7,8after wires termination
6. Varnish the complete assembly

7.1.Bill of Material__ Input 120Vac

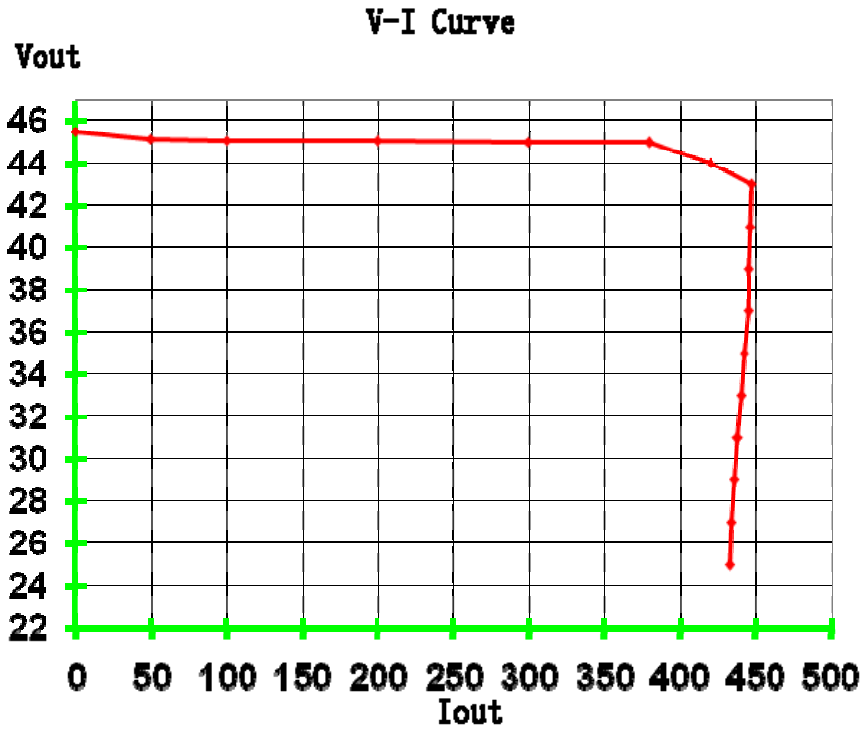
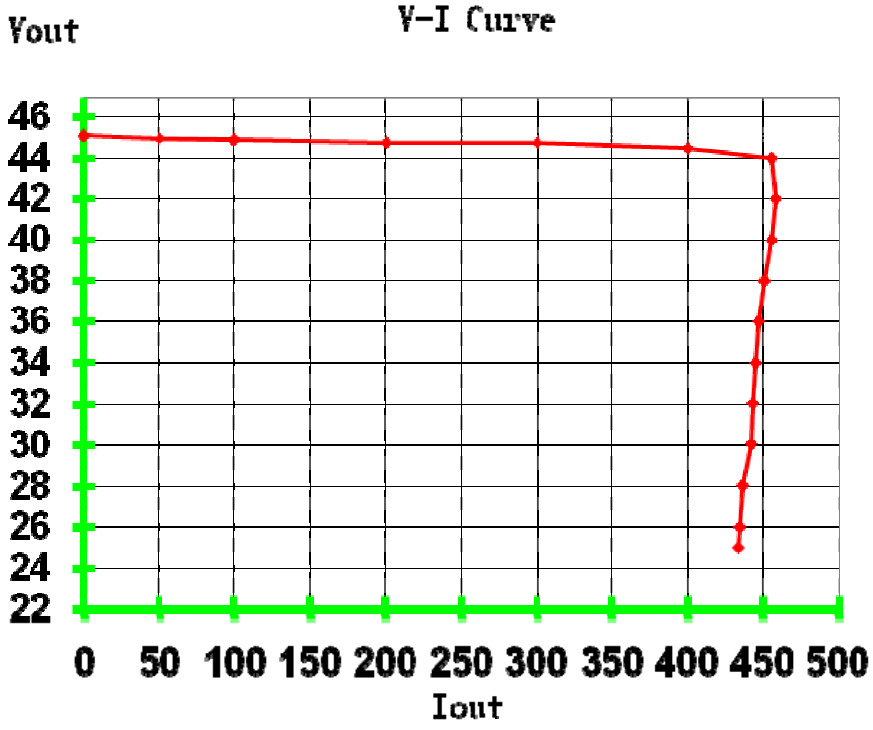
Item	Qty.	Ref.	Description		Item	Qty.	Ref.	Description
1	1	F1	2A/250Vac Fuse		23	1	Q1	4N60
2	1	CX1	0.1uF/250V X Capacitor		24	1	T1	ER2510S 1.1mH
3	2	C2,C3	MPE 0.1uF,400V		25	2	R1,R2	4.7KΩ +/-5%,SMD-0805
4	2	C3,C4	10uF/400V,E-CAP,1050C		26	2	R3	680KΩ +/-5%,SMD-1206
5	1	C5	2.2nF,1KV		27	1	R4	620KΩ +/-5%,SMD-1206
6	1	C6	100pF,50V,NPO,SMD-0602		28	1	R7	100KΩ +/-5%,SMD-1206
7	1	C8	470pF,50V,NPO,SMD-0603		29	1	R8	10Ω +/-5%,SMD-0805
8	1	C9	4.7uF,50V,E-CAP,1050C		30	1	R9	22kΩ +/-5%,SMD-0805
9	1	C7	68pF,50V,NPO,SMD-0603		31	1	R10	2.2KΩ +/-5%,SMD-0805
10	1	C10	220uF,50V,E-CAP,1050C		32	1	R11	1.5Ω +/-5%,SMD-0805
11	1	C11	220pF,250V,NPO,SMD-0805		33	3	R12	1.5Ω +/-1%,SMD-0805
12	1	L1,L6	15uH(5*8)		34	1	R13	20KΩ +/-5%,SMD-06805
13	1	L2	35mH(T14 X 8 X 6)		35	1	R14	10Ω +/-5%,SMD-0805
14	1	L5	EFD15 Transformer 0.9mH		36	1	R15	22KΩ +/-5%,SMD-0805
15	2	L2,L4	1mH (8 X 10)		37	1	R16	3KΩ +/-1%,SMD-0805
16	4	D1,D2,D3,D4	1N4007		38	1	R18	22Ω +/-1%,SMD-0806
17	3	D5,D6,D7	UF4007		39	1	R17	47KΩ +/-1%,SMD-0805
18	2	D8	FR107		40	1	CY1	Y-CAP 1nF 250V
19	1	Z1	15V					
20	1	D9	FR102,SMD					
21	1	D10	SR3200 3A 200V Schottky					
22	1	U1	IW3620,Off-line digital PWM controller,SOT-8					

7.2. Bill of Material ___ Input 230Vac

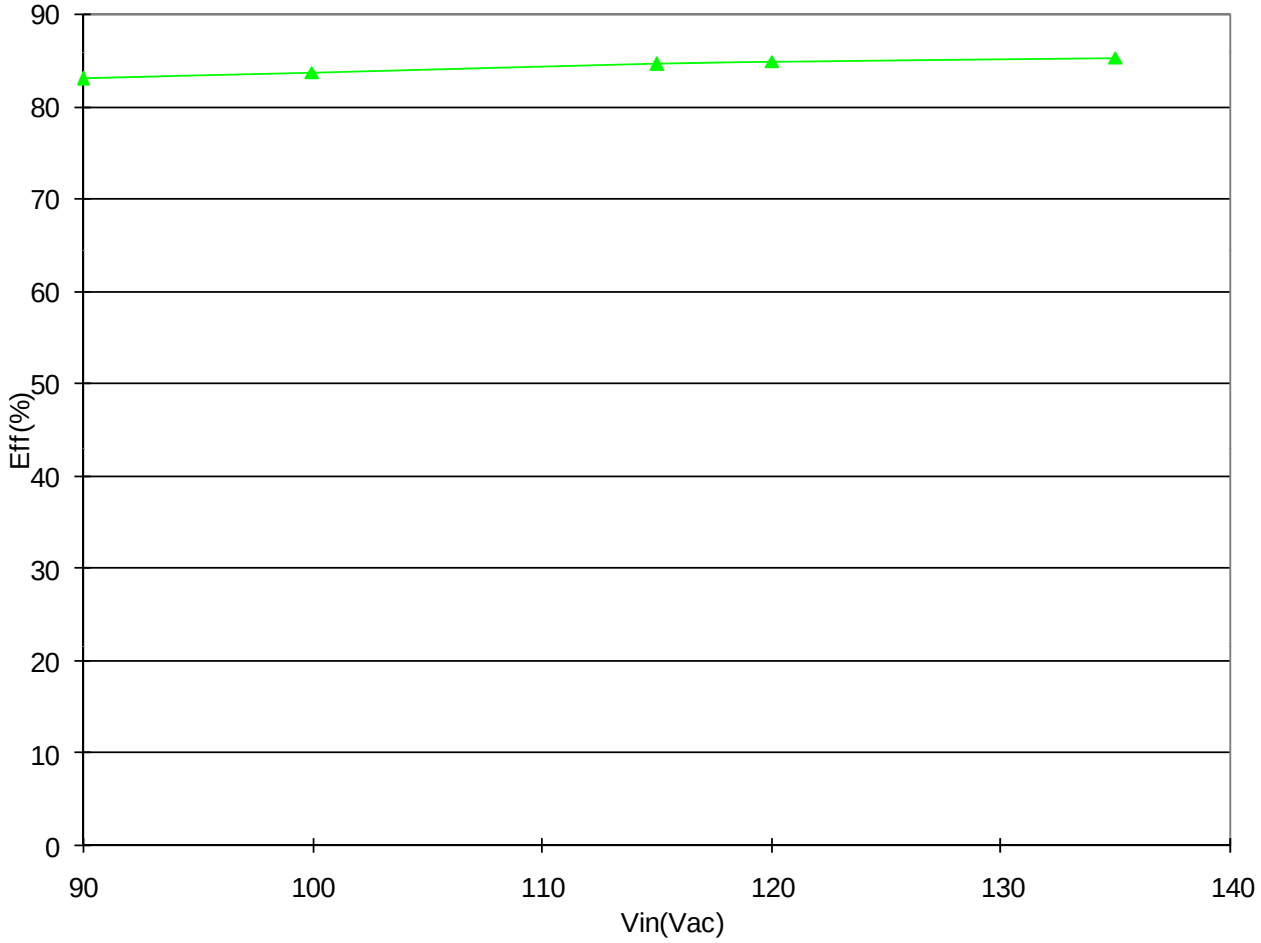
Item	Qty.	Ref.	Description		Item	Qty.	Ref.	Description
1	1	F1	2A/250Vac Fuse		23	1	Q1	4N60
2	1	CX1	0.1uF/250V X Capacitor		24	1	T1	ER2510S
3	2	C2,C3	MPE 0.1uF,400V		25	2	R1,R2	4.7KΩ +/-5%,SMD-0805
4	2	C3,C4	10uF/400V,E-CAP,1050C		26	1	R3	910KΩ +/-5%,SMD-1206
5	1	C5	2.2nF,1KV		27	1	R4	910KΩ +/-5%,SMD-1206
6	1	C6	100pF,50V,NPO,SMD-0602		28	1	R7	100KΩ +/-5%,SMD-1206
7	1	C8	470pF,50V,NPO,SMD-0603		29	1	R8	10Ω +/-5%,SMD-0805
8	1	C9	4.7uF,50V,E-CAP,1050C		30	1	R9	22kΩ +/-5%,SMD-0805
9	1	C7	68pF,50V,NPO,SMD-0603		31	1	R10	2.2KΩ +/-5%,SMD-0805
10	1	C10	220uF,50V,E-CAP,1050C		32	1	R11	1.5Ω +/-5%,SMD-0805
11	1	C11	220pF,250V,NPO,SMD-0805		33	3	R12	1.8Ω +/-1%,SMD-0805
12	1	L1,L6	15uH(5*8)		34	1	R13	20KΩ +/-5%,SMD-06805
13	1	L2	35mH(T14 X 8 X 6)		35	1	R14	10Ω +/-5%,SMD-0805
14	1	L5	EFD15 Transformer		36	1	R15	22KΩ +/-5%,SMD-0805
15	2	L2,L4	1mH (8 X 10)		37	1	R16	3KΩ +/-1%,SMD-0805
16	4	D1,D2,D3,D4	1N4007		38	1	R18	22Ω +/-1%,SMD-0806
17	3	D5,D6,D7	UF4007		39	1	R17	47KΩ +/-1%,SMD-0805
18	2	D8	FR107		40	1	CY1	Y-CAP 1nF 250V
19	1	Z1	15V					
20	1	D9	FR102,SMD					
21	1	D10	HER304					
22	1	U1	IW3620,Off-line digital PWM controller,SOT-8					

8. V-I Curve

*** Note: Output voltage measured at PCB end, T_{AMB}=25 ℃**

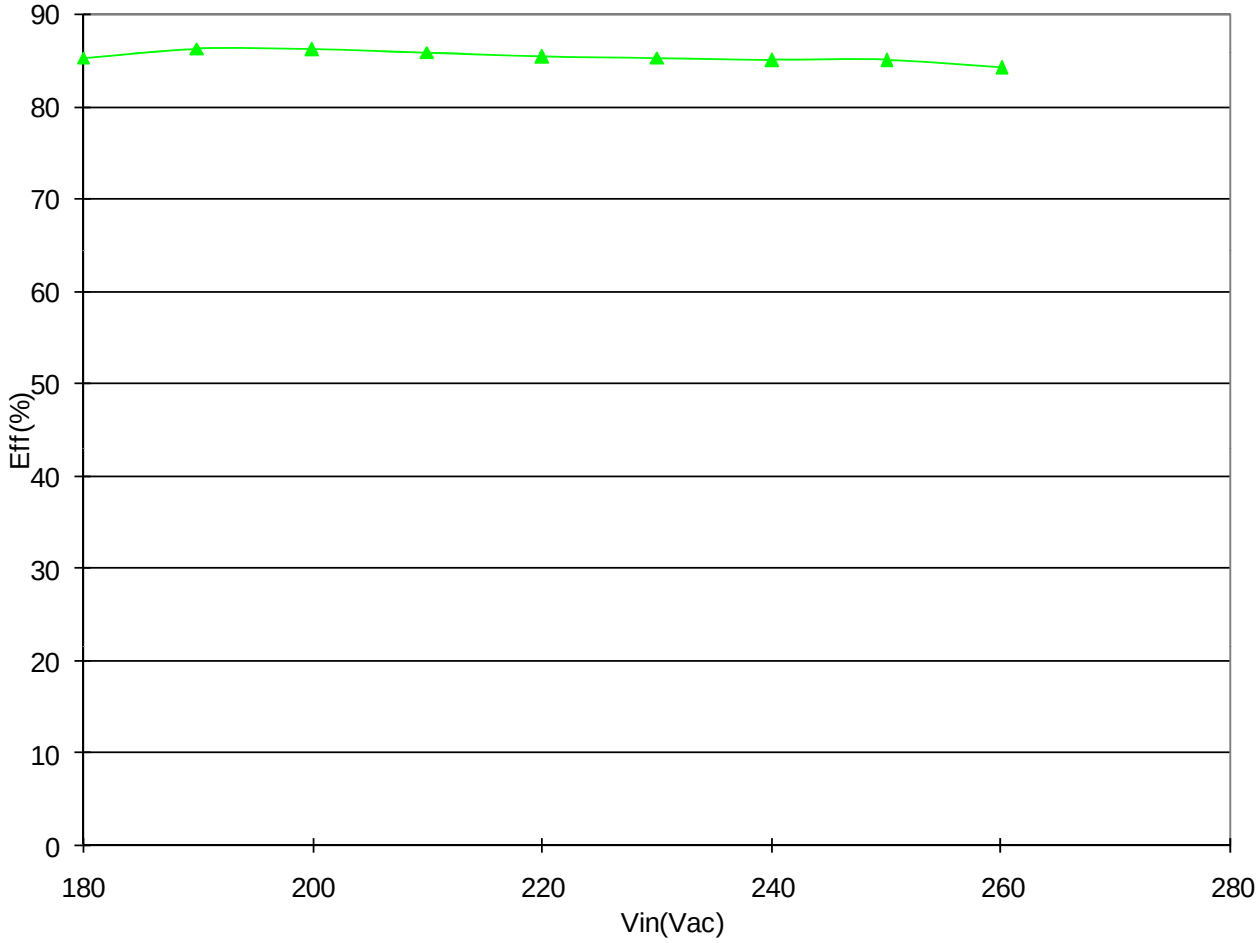
V_{IN}=115V_{AC}, T_{AMB}=25℃	V_{IN}=230V_{AC}, T_{AMB}=25℃
	

9.1. Efficiency Measurement(90Vac-135Vac)



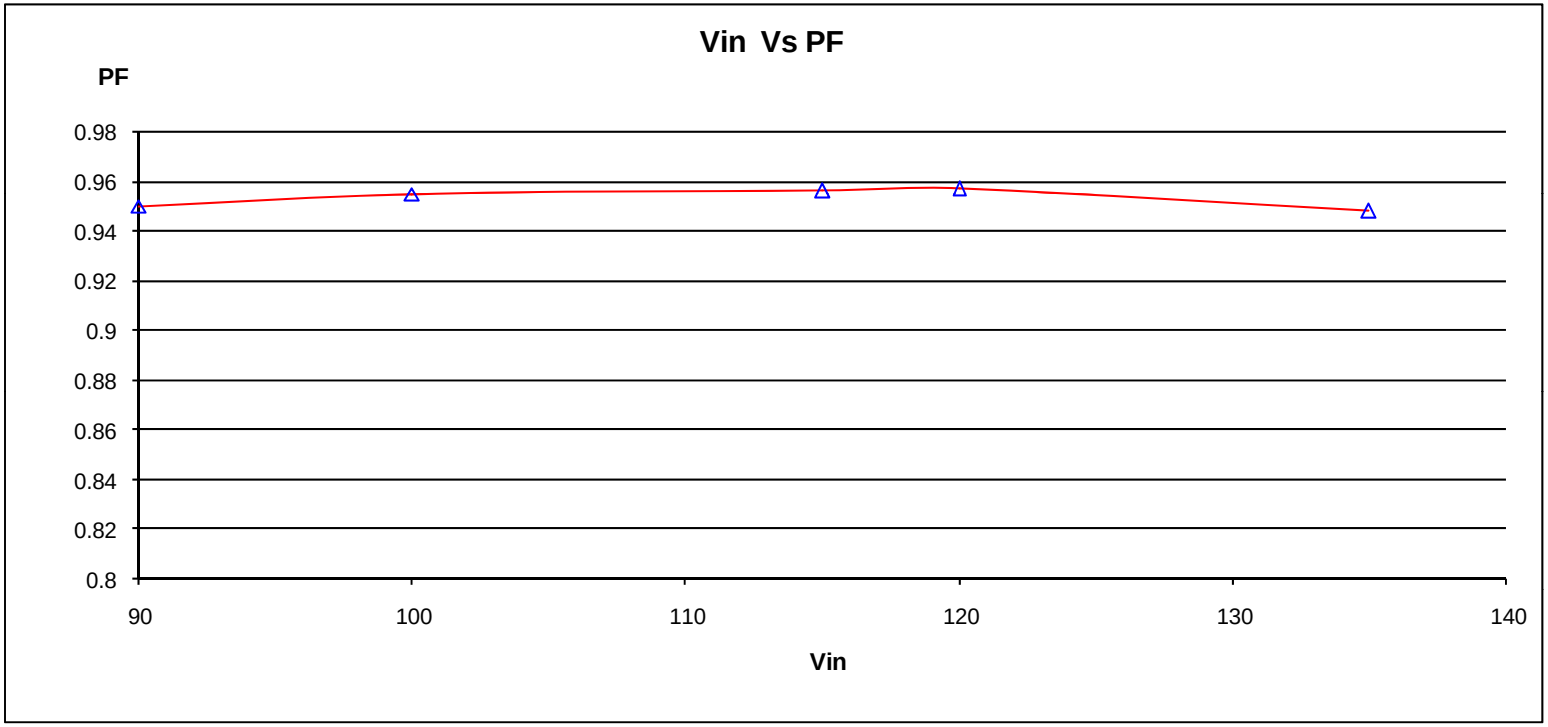
*** Note: Output voltage measured at end of PCB.**

9.2. Efficiency Measurement(180Vac-264Vac)

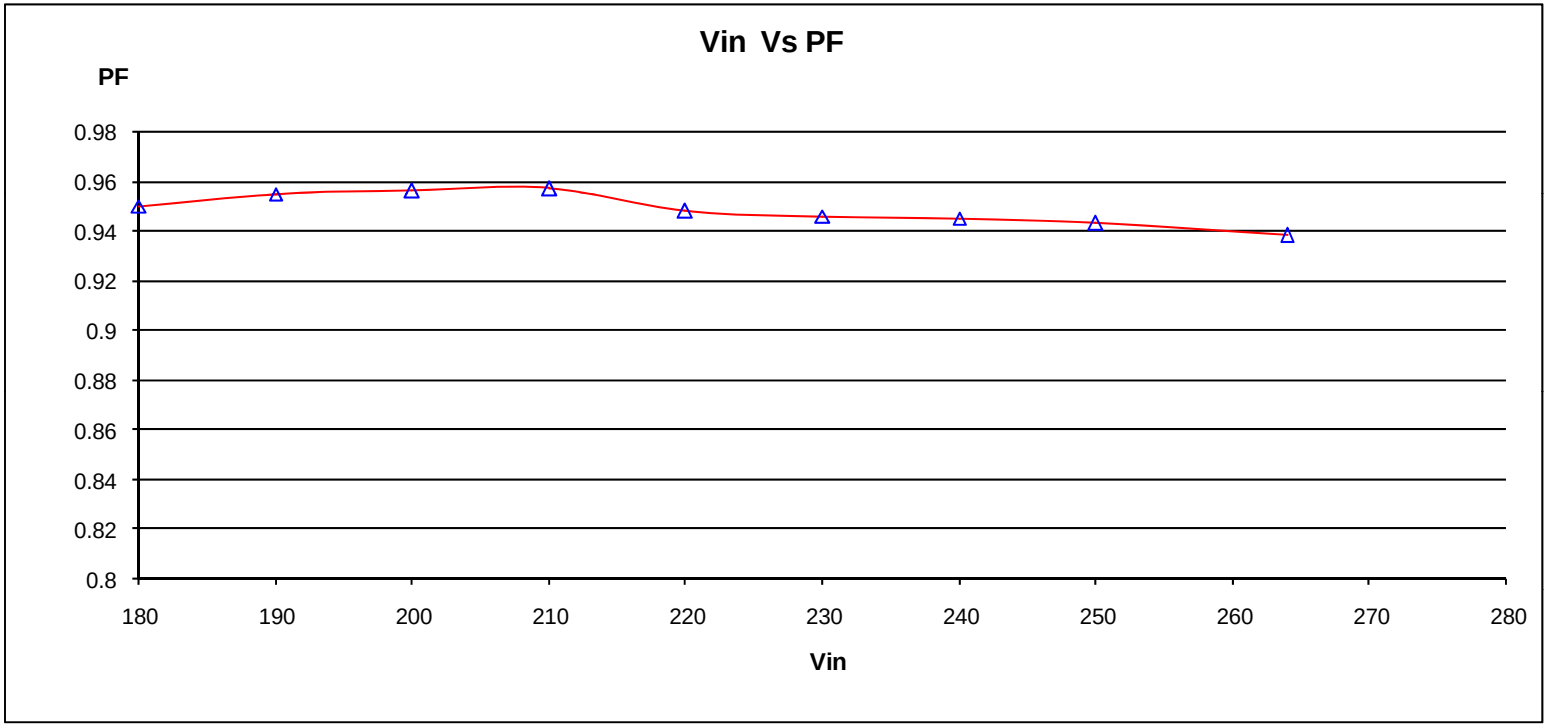


*** Note: Output voltage measured at end of PCB.**

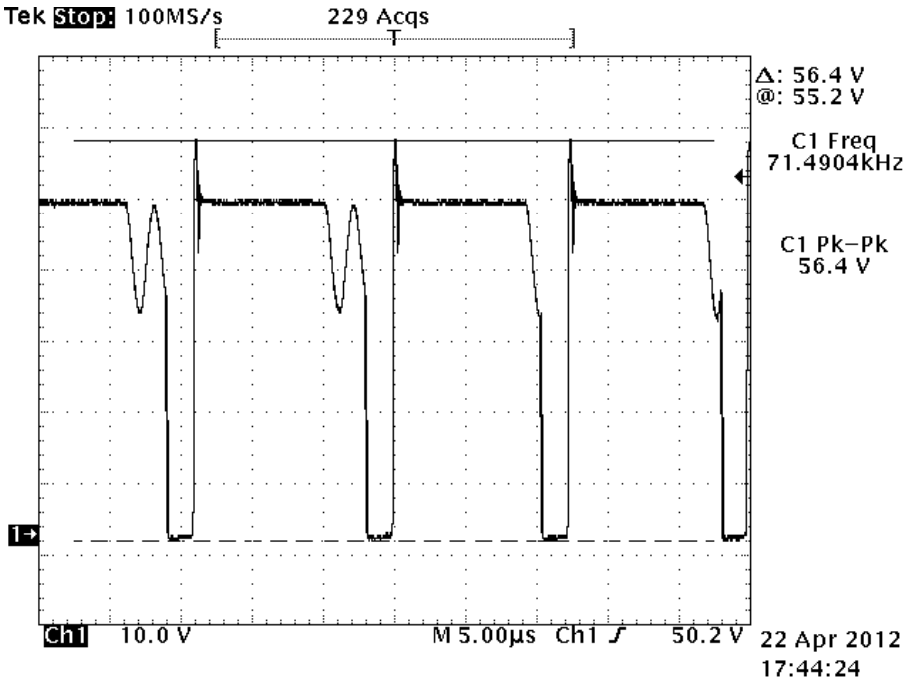
10.1. Input voltage VS PF curve(90Vac-135Vac)



10.2. Input voltage VS PF curve(180Vac-264Vac)



11. V_{DS} waveform



Test Condition:

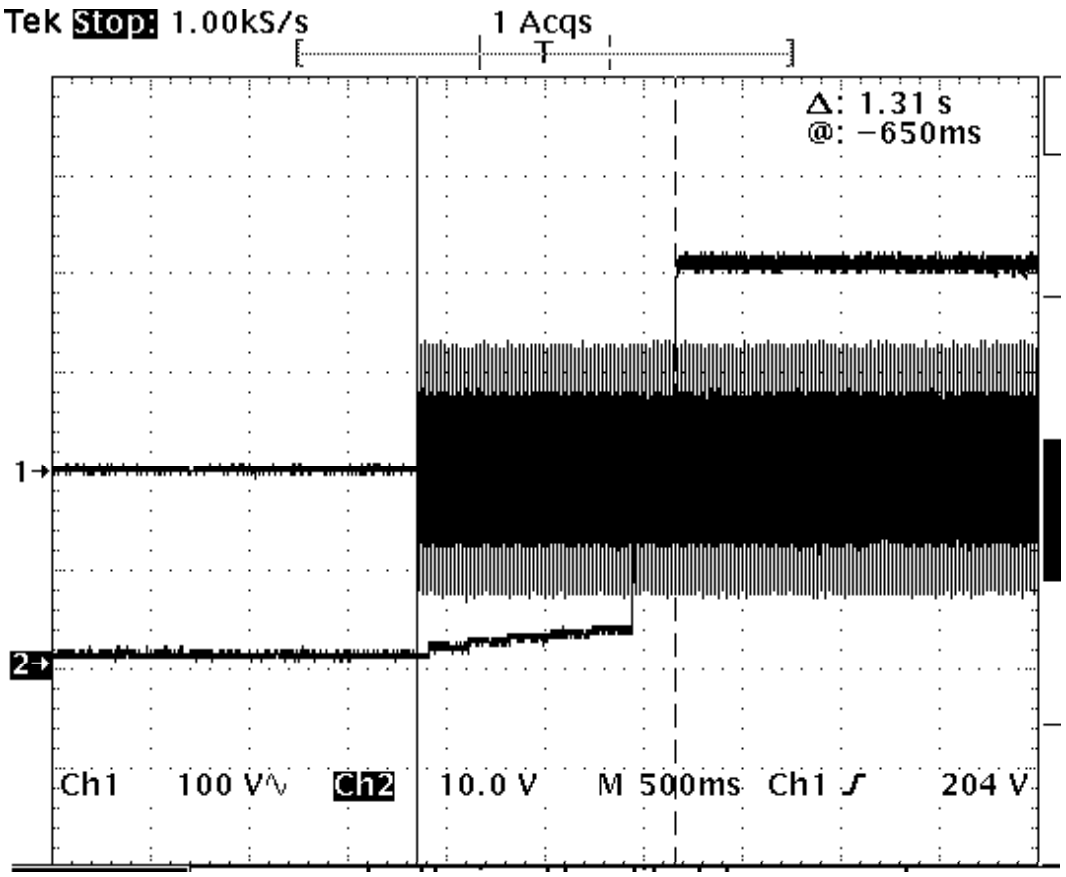
V_{IN}=264VAC, V_{OUT_CV}=40V

Result:

V_{DS_MAX}=**564V**

Remark: Mosfet Spec__4A 650V

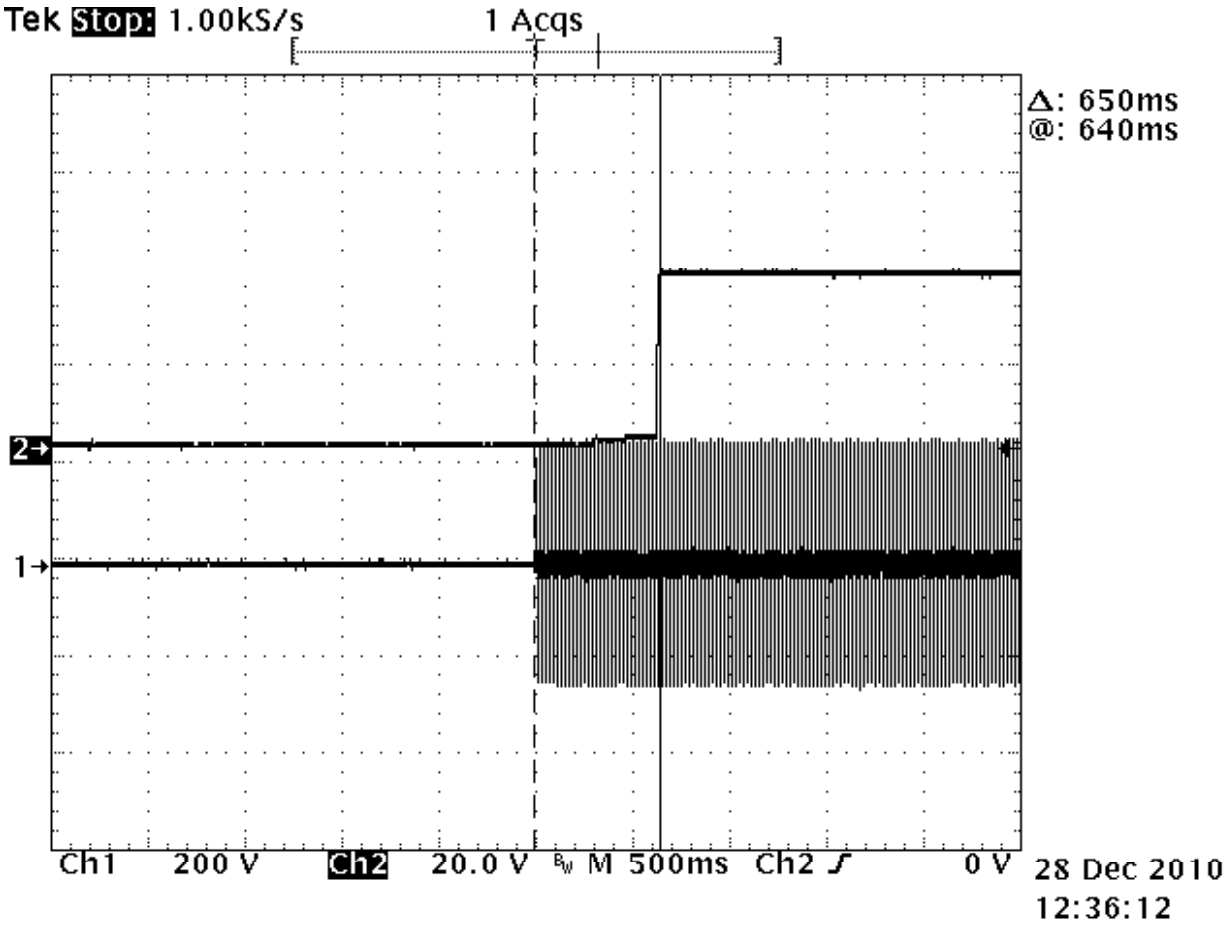
12. 1. Start up and turn on delay time(90Vac-135Vac)



90V_{AC},Full Load

T_{ST_DELAY}=1.3 s

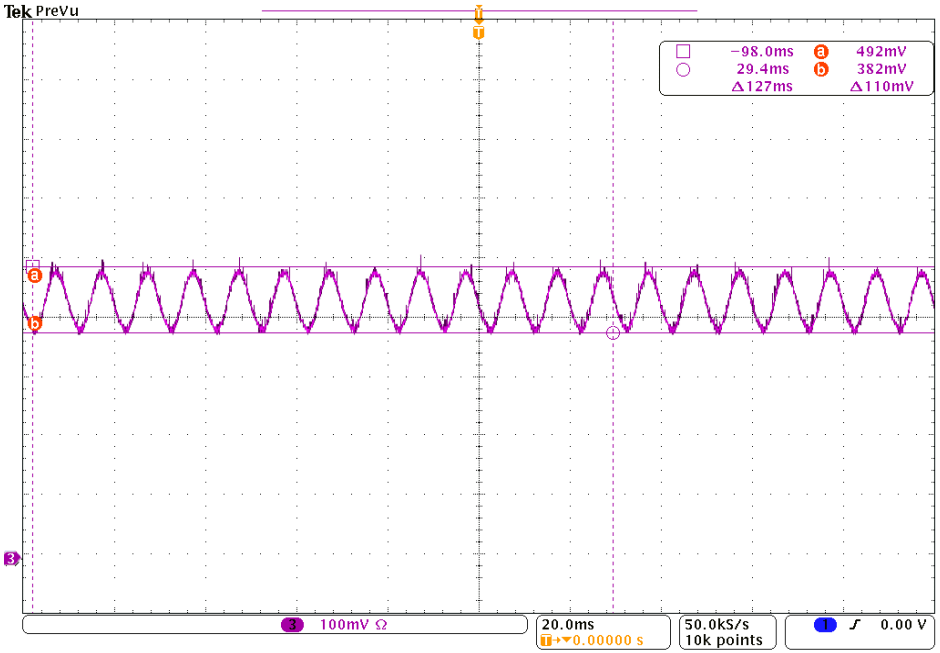
12.2. Start up and turn on delay time(180Vac-264Vac)



180V_{AC},Full Load

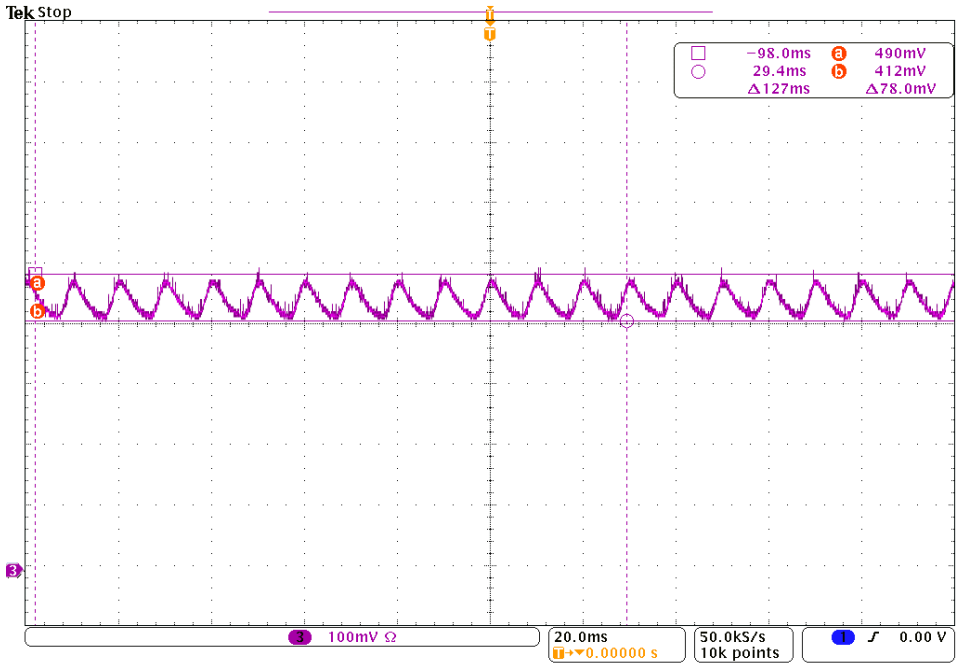
T_{ST_DELAY}=650ms

13. Output ripple current _90Vac and 180Vac__Full load



Vin=90Vac Iout=450mA Ripple current =110mA

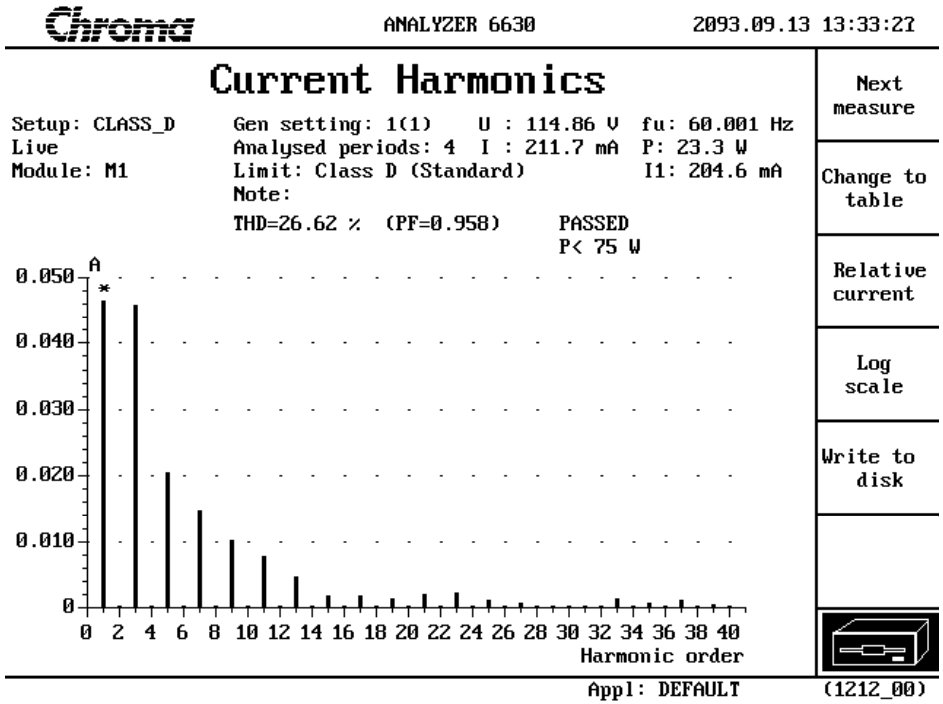
Ripple =24 %

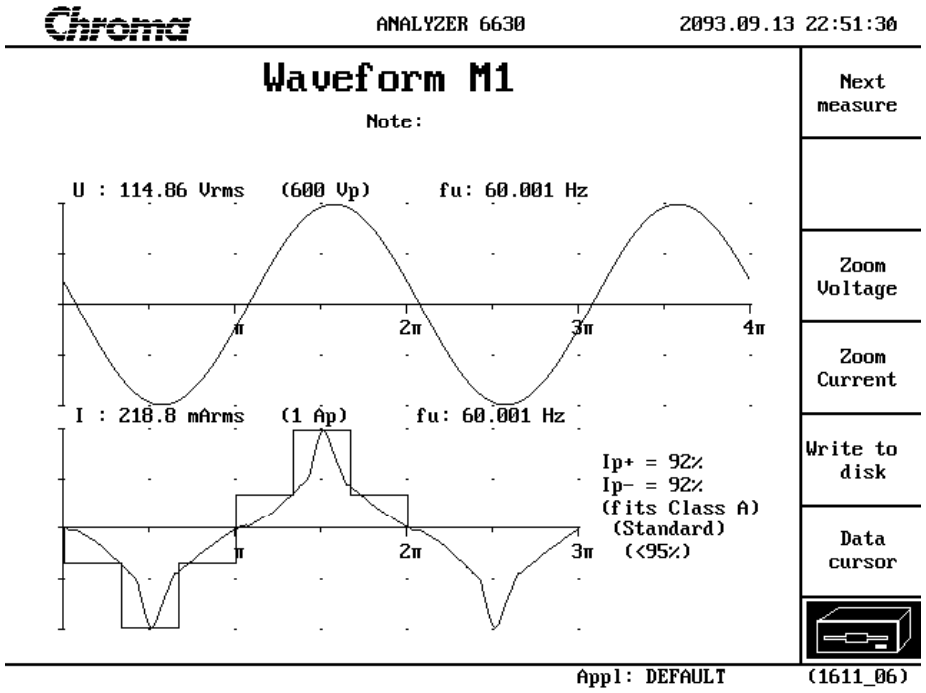


Vin=230Vac Iout=450mA Ripple current =78mA

Ripple =17 %

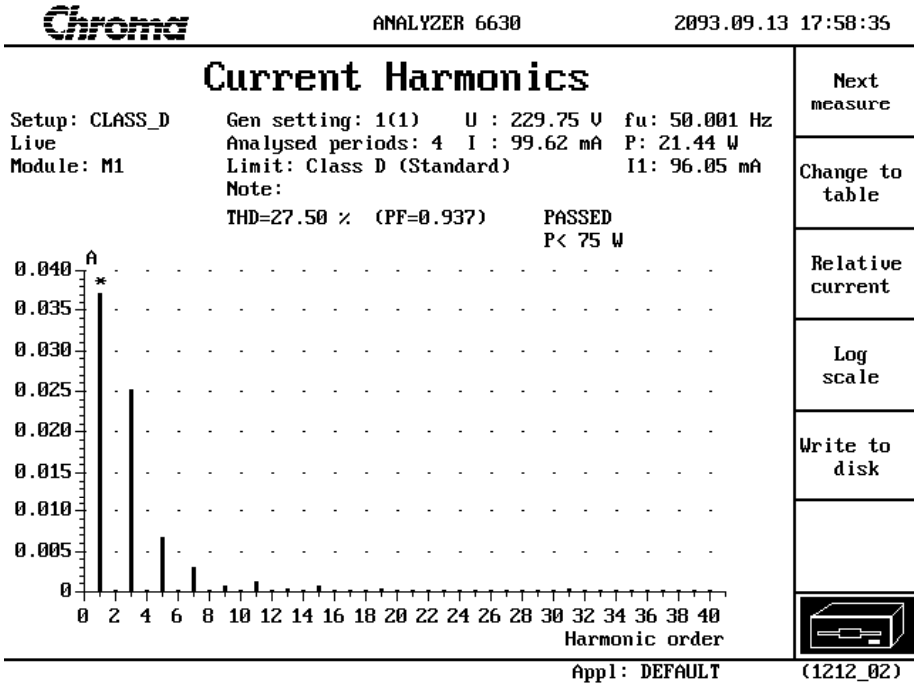
14.1. PF and harmonic current(90Vac-135Vac)

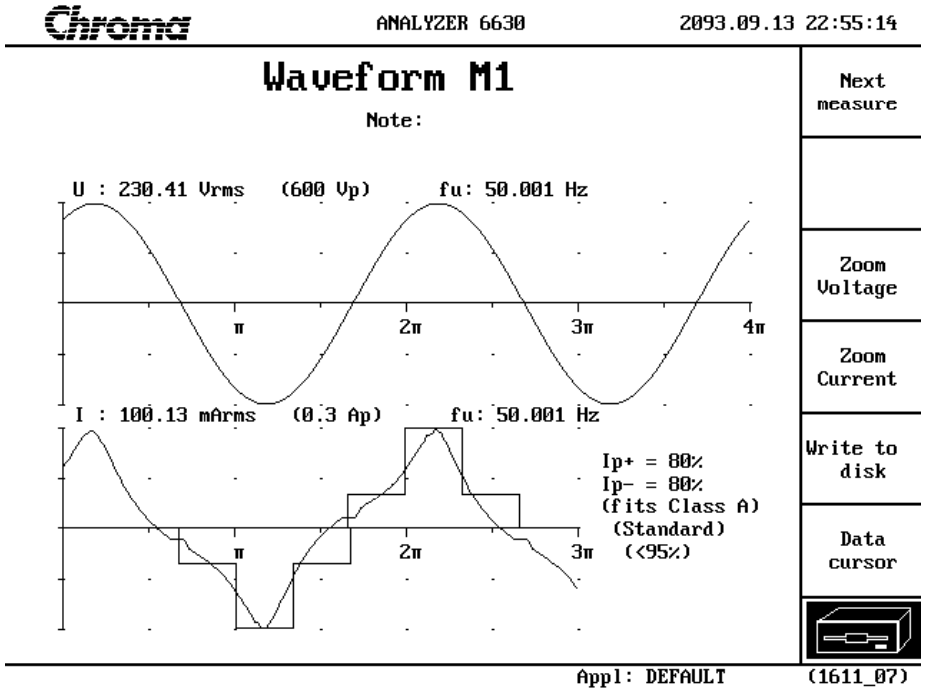




Vin__115V PF=0.945 THD <30%

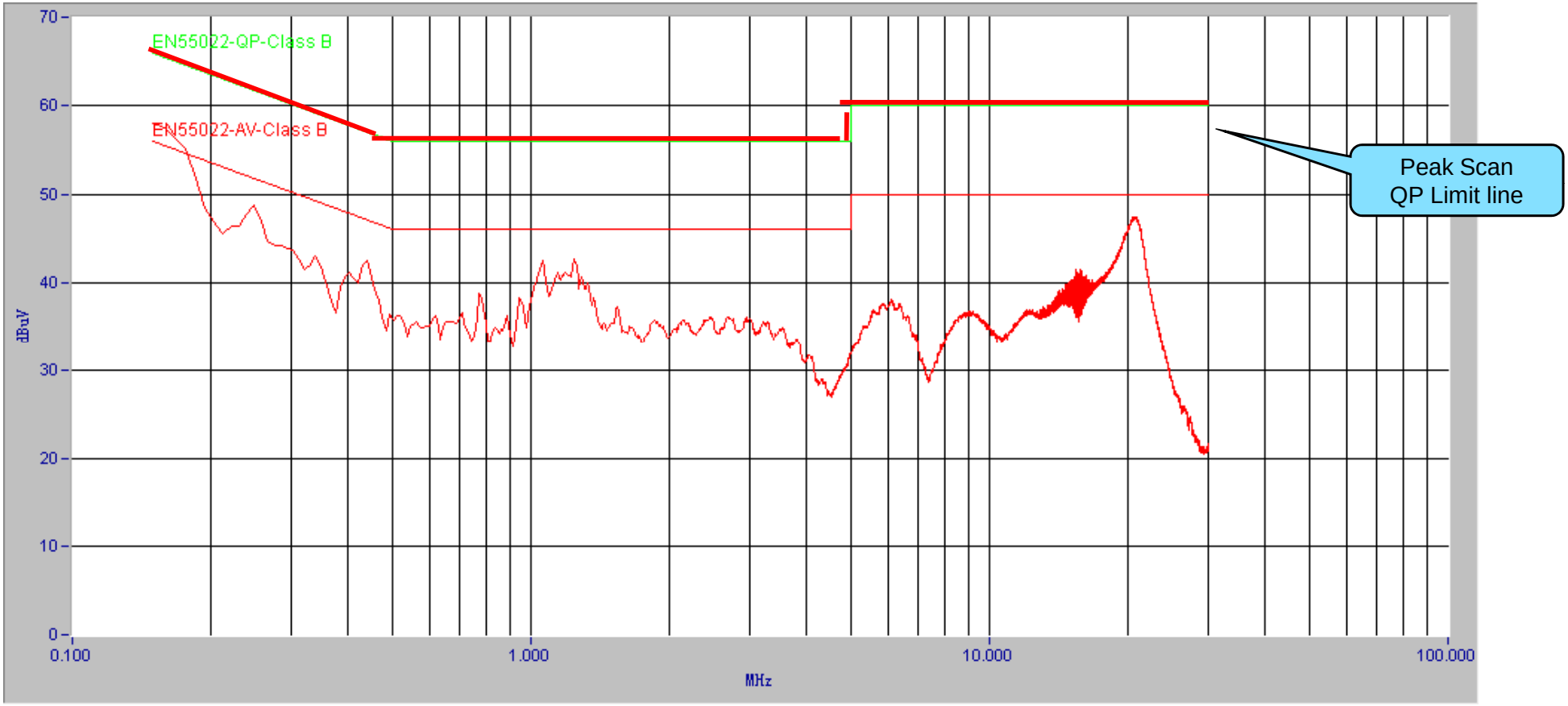
14.2. PF and harmonic current(180Vac-264Vac)





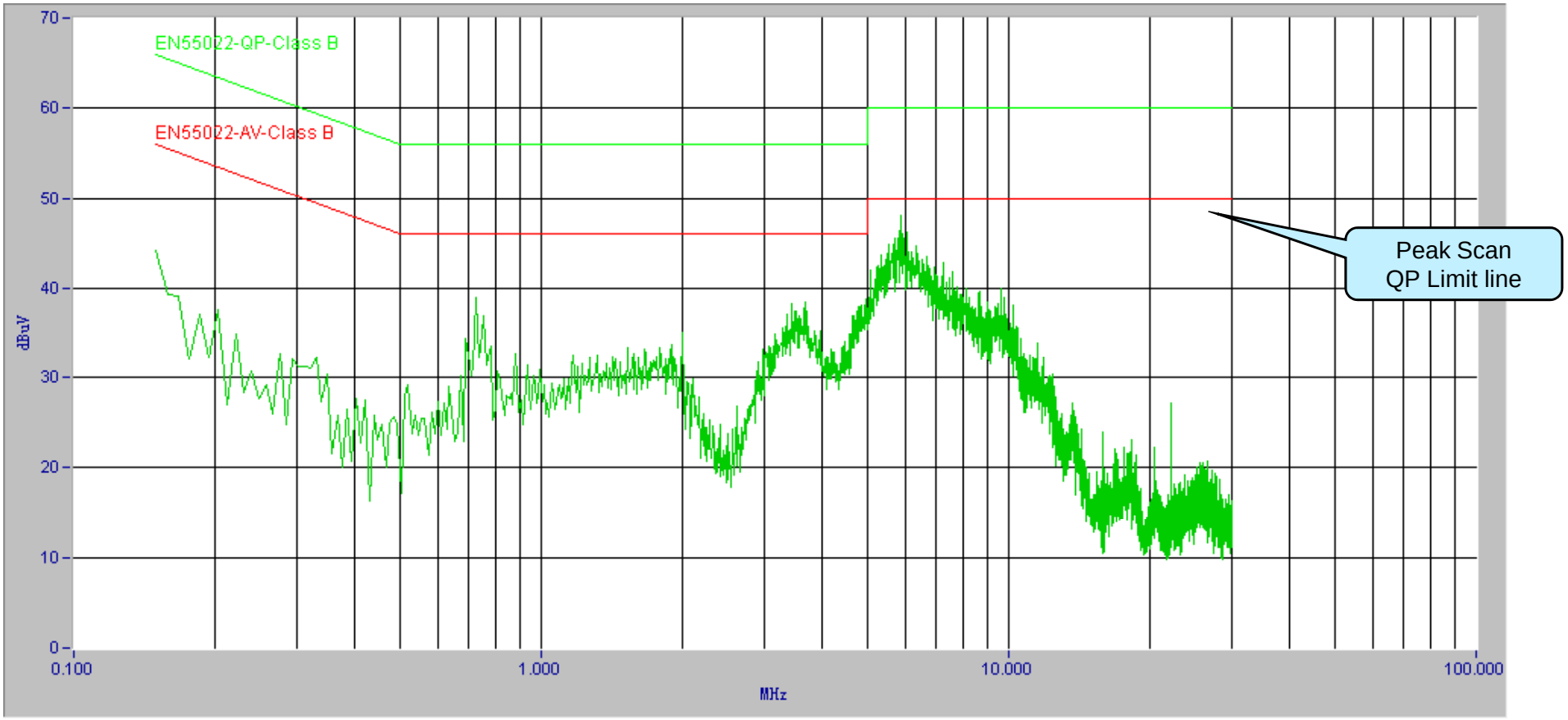
Vin__230V PF=0.945 THD<30%

15.1. Conducted EMI (Input 115Vac Full Load, output floating)



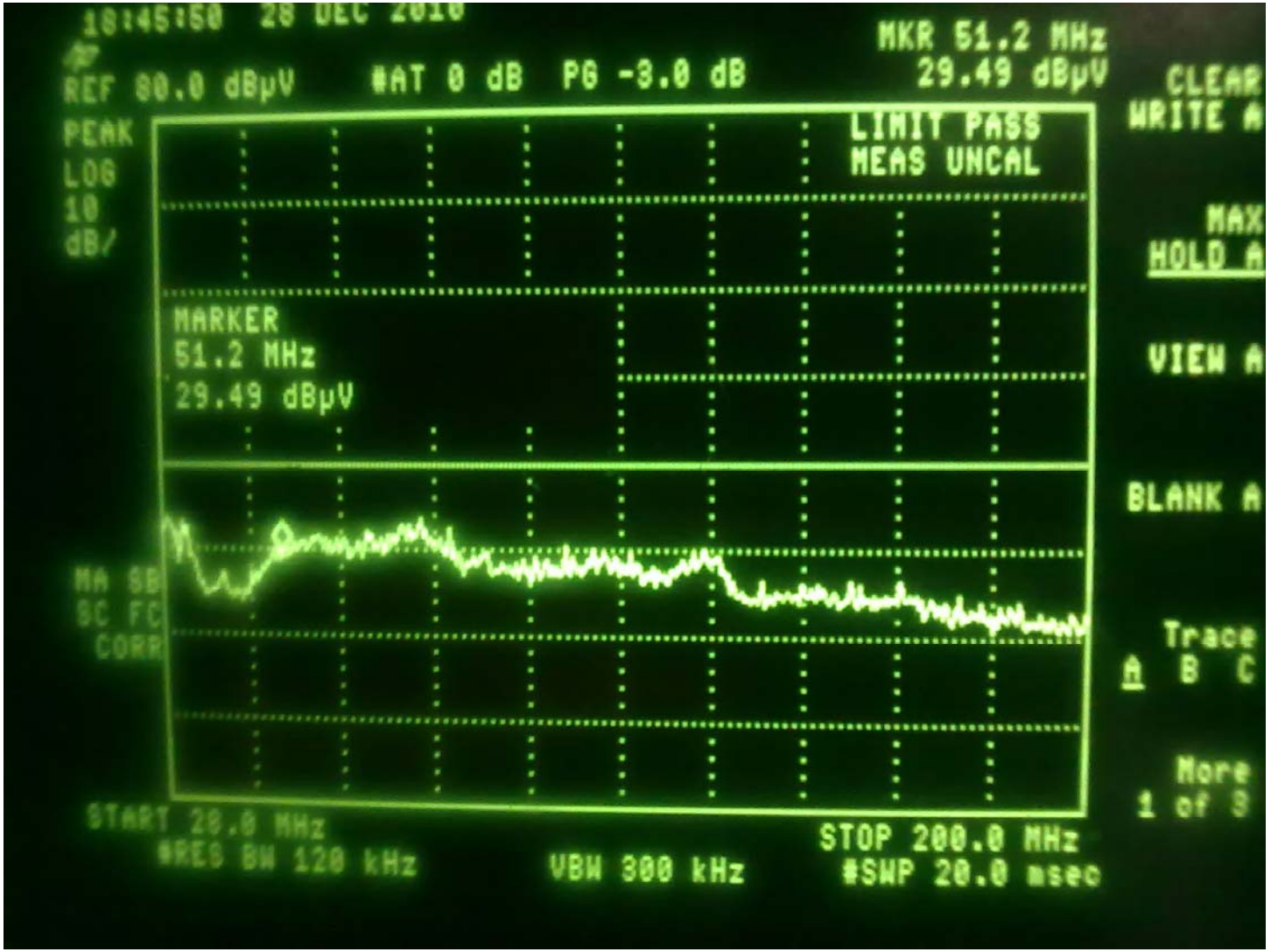
Peak scan L

15.2. Conducted EMI (Input 230Vac Full Load, output floating)



Peak scan L

16. Radiated IEM (for reference)



Note: 1, Vin=230Vac, output is 11X 2W LED(38.34V 564mA)

2, Output is floating