

## DIO8650 buck boost-90V90mA- THD<5% for LED T-tube lighting

### General Design Specification:

1. AC Input Voltage : 100~277Vac
2. DC Output Voltage: 90V
3. DC Output Current: 90mA
4. Min Power Factor > 0.95
5. Total Harmonic Distortion < 5%

# 1. Introduction

This Demo evaluation report describes a 90V DC output, universal input (100~277V<sub>AC</sub>) single stage Flyback & PFC power supply for isolated LED applications. DIO8650 is used for this design. This document contains the complete specification of the LED driver, a detailed circuit diagram, an entire BOM to build the LED driver, a drawing of the power transformer, and test data of the most important performance.



Figure 1.1 PCB Top view



## 2. Specification

Table 2.1 Performance Specification Summary

Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	$V_{IN}$	100		277	V <sub>AC</sub>	2 Wire
Frequency	$F_{IN}$	47	50/60	63	Hz	
Output						
Output Voltage	$V_{OUT}$		90		V	Measured at the end of PCB
Output Current	$I_{OUT}$		90		mA	
Continuous Output Power	$P_{OUT}$		8.1		W	
Efficiency	$\eta$	88			%	Measured at $V_{IN} = 115V_{AC}$ and $230V_{AC}$
Power Factor	$PF$	0.95				
THD	$THD$			5	%	Measured at $V_{IN} = 115V_{AC}$ and $230V_{AC}$
Reliability	Full Protection					
Ambient Temperature	$T_{AMB}$	0		40	°C	Free convection, sea level

# 3. Schematic

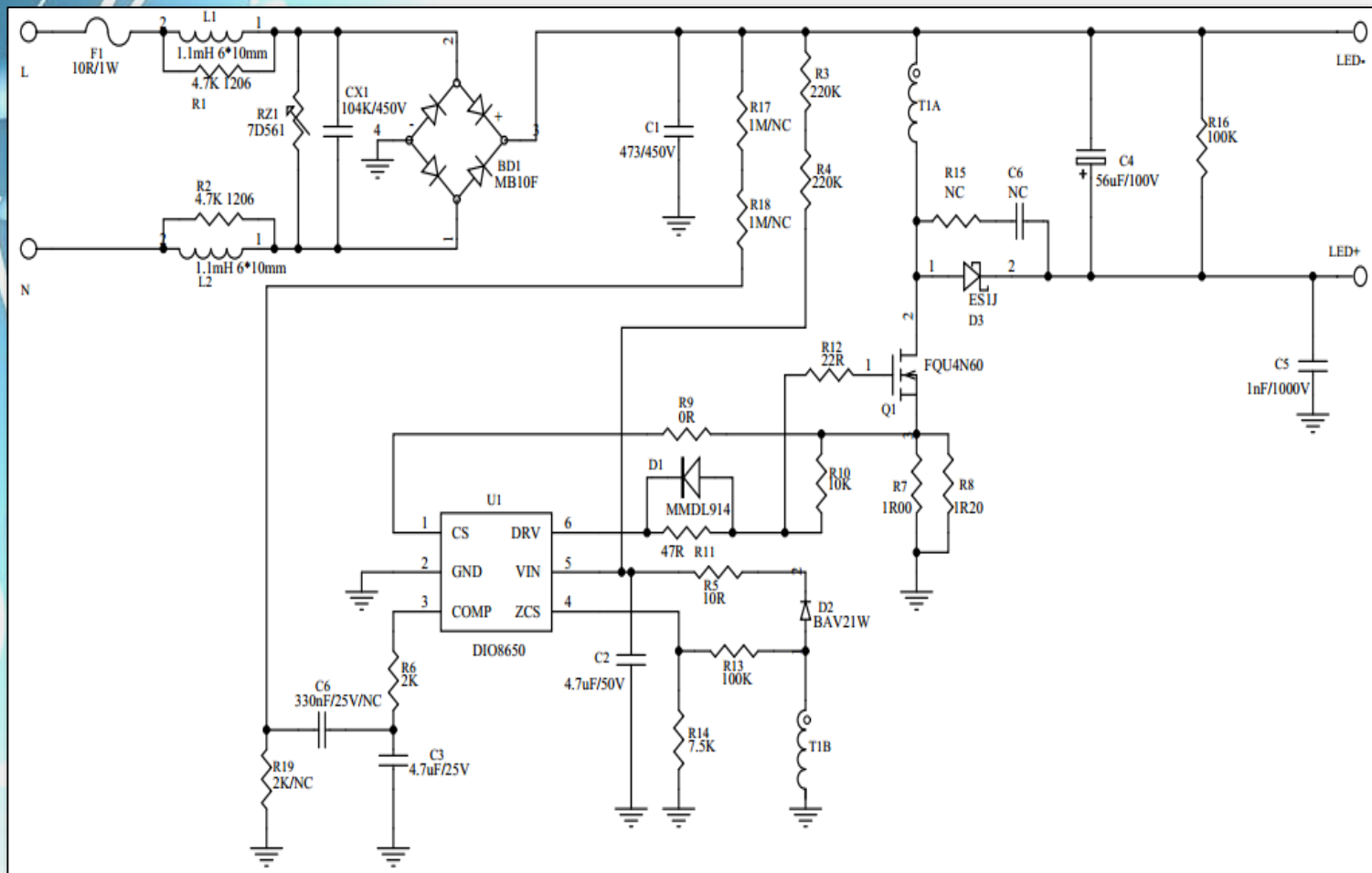


Figure3.1 System Schematic

## 4. Bill of Material

Table 4.1 BOM List

Type	Description	Qty.	Unit	Ref.	Remark
SMD Resistor	RES-SMD-1206-220.00K-1%-0.250W	2	Pcs	R3,R4	
	RES-SMD-1206-100.00K-1%-0.250W	1	Pcs	R16	
	RES-SMD-1206-001.00M-5%-0.250W	2	Pcs	R17,R18	NC
	RES-SMD-0805-0.00R-1%-0.125W	1	Pcs	R9	
	RES-SMD-0805-1.00R-1%-0.125W	1	Pcs	R7	
	RES-SMD-0805-1.20R-1%-0.125W	1	Pcs	R8	
	RES-SMD-0805-022.00R-1%-0.125W	1	Pcs	R12	
	RES-SMD-0805-047.00R-1%-0.125W	1	Pcs	R11	
	RES-SMD-0805-100.00K-5%-0.125W	1	Pcs	R13	
	RES-SMD-0805-7.50K-5%-0.125W	1	Pcs	R14	
	RES-SMD-0805-010.00K-5%-0.125W	1	Pcs	R10	
	RES-SMD-0805-004.70K-5%-0.125W	2	Pcs	R1.R2	
	RES-SMD-0805-002.00K-5%-0.125W	1	Pcs	R6	
	RES-SMD-0805-010.00R-5%-0.125W	1	Pcs	R5	
SMD Capacitor	CAP-SMD-0805-X7R-004.70uF-10%-25V	2	Pcs	C2,C3	
	CAP-SMD-0805-X7R-330.00nF-10%-25V	1	Pcs	C6	NC
	CAP-SMD-1206-X7R-001.00nF-10%-1000V	1	Pcs	C4	
Varistor	VAR-Φ7-560V-Φ7D561K	1	Pcs	VZ1	
Safety Capacitor	CAP-X2-100.00nF-400Vac P7.5	1	Pcs	CX1	
Electrolytic Capacitor	CAP-AEC-056.00uF-100V 10*12.5 P5	1	Pcs	C5	
Film Capacitor	CAP-MPP-47.00nF-450V-7*9 P7.5	1	Pcs	C1	
SMD Diode	DIO-USF-SMA-001.00A-600V-ES1J	1	Pcs	D1	
DM inductor	Ld-G6*10-1.1mH	2	Pcs	L1,L2	
Transformer	TI-EE13-1.1mH	1	Pcs	T1	
Fuse	FUS-AXIAL0.5-10R-1W	1	Pcs	F1	
MOSFET	MOS-4.0A-600V-FQU4N60_TO251	1	Pcs	Q1	
Rectifier bridge	BR-0.6A-1000V-MB10F	1	Pcs	BD1	
IC	IC-DIO8650-SOT23-6	1	Pcs	U1	
PCB		1	EA		

# 5. PCB Layout

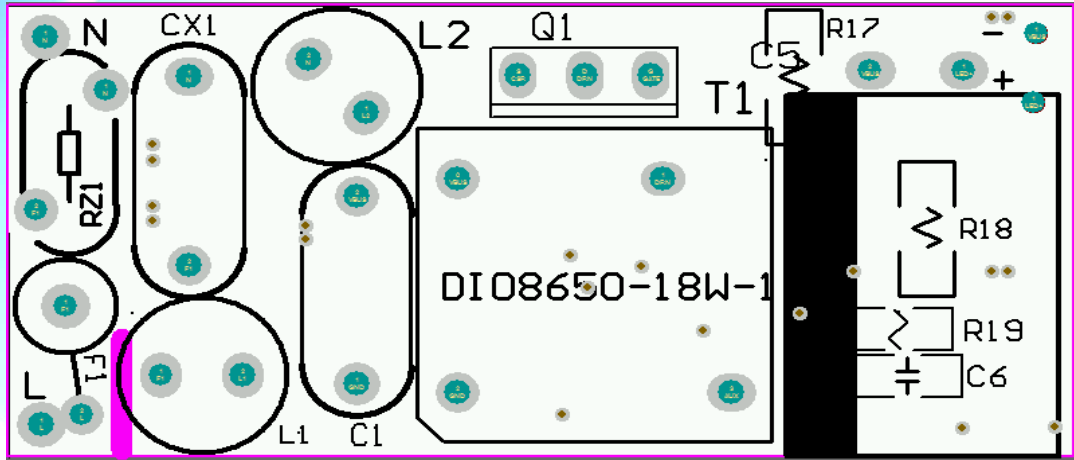


Figure 5.1 PCB Silkscreen Layout Top View

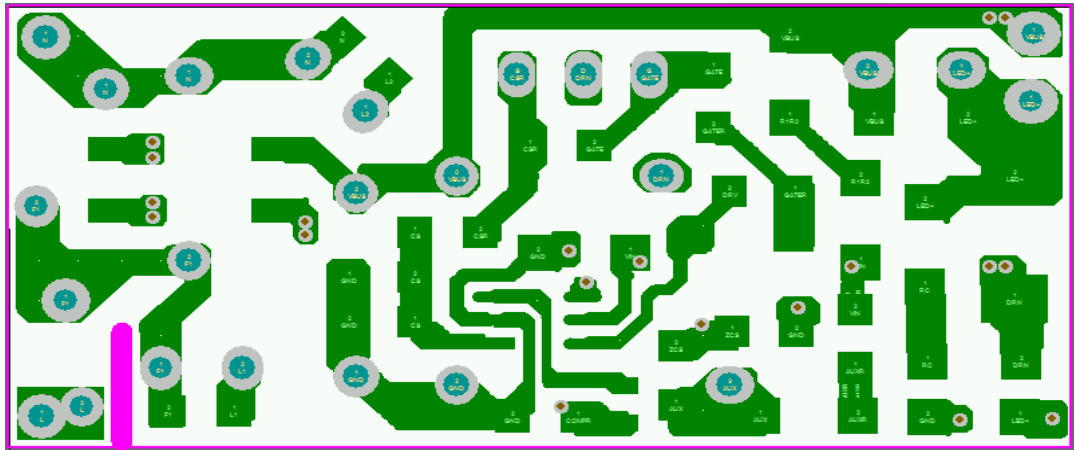
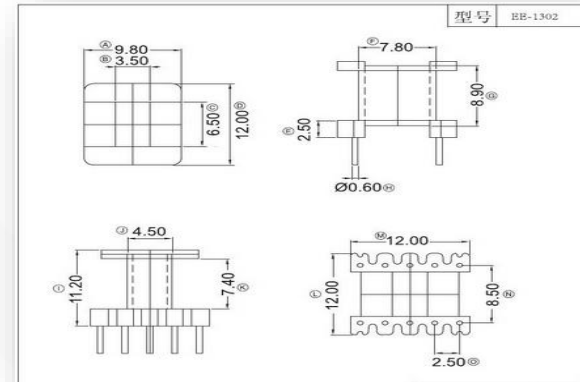


Figure 5.2 PCB Copper Foil Layout Bottom View

# 6. Transformer Drawing



a) Transformer schematic



b) Transformer view

Figure 6.1 Transformer Drawing

Table 6.1 Transformer Drawing Specification

<b>Electrical Specifications:</b>	
1	Primary inductance ( $L_p$ ) = $1.1\text{mH} \pm 5\% @ 10\text{kHz}, 1V_{\text{RMS}}$
2	Primary leakage inductance ( $L_k$ ) = $60\mu\text{H} @ 10\text{kHz}, 1V_{\text{RMS}}$
<b>Materials:</b>	
1	Core : EE13W (ferrite material TDK PC40)
2	Bobbin : EE13
3	Magnet wires (Pri): 2UEW0.25 $\phi$ , 2UEW0.15 $\phi$ ( $T > 130^\circ\text{C}$ )
4	Magnet wire (Sec) : triple insulated wires
5	Layer insulation tape : 3M1298 or equivalent

# 7. Line Regulation

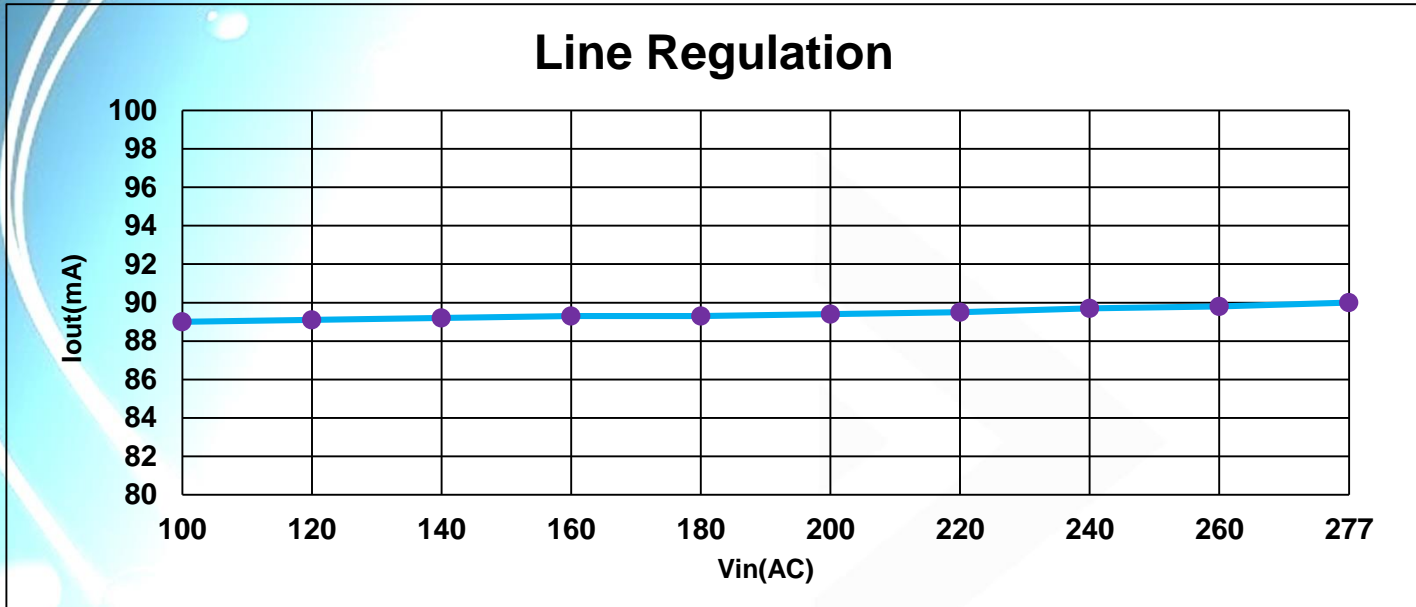


Figure 7.1 Line Regulation curve

Table 7.1 Line Regulation test data

Line Regulation											
Load (V <sub>DC</sub> )	V <sub>IN</sub> (V <sub>AC</sub> )										Line Regulation
	100	120	140	160	180	200	220	240	260	277	
90	89	89.1	89.2	89.3	89.3	89.4	89.5	89.7	89.8	90	1.12%





# 8. Efficiency

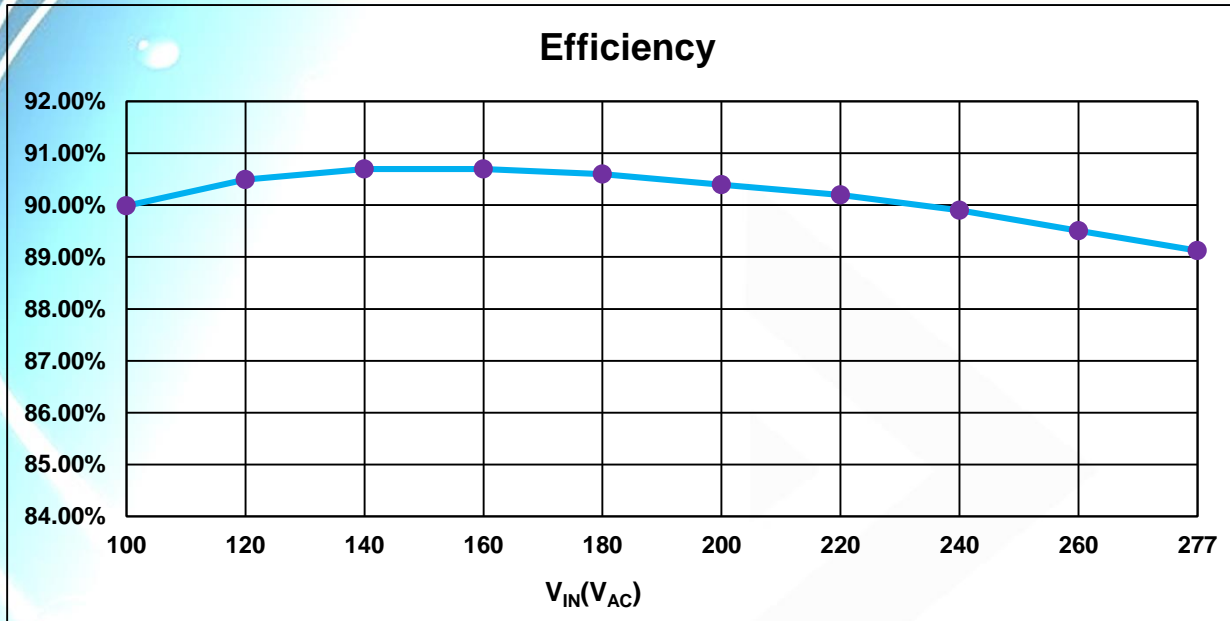
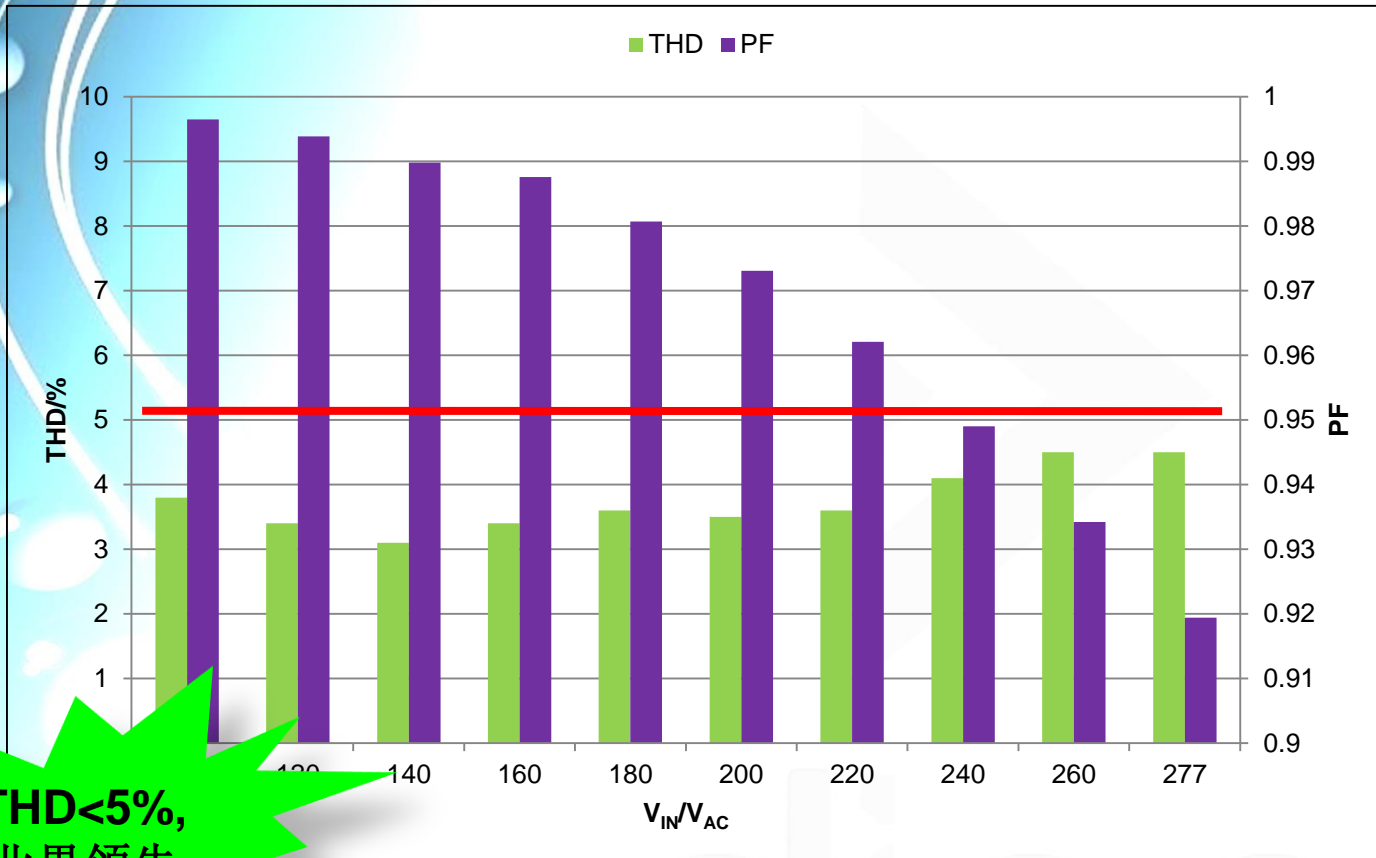


Figure 8.1 Efficiency curve

Table 8.1 Efficiency test data

V <sub>in</sub> (AC)	P <sub>in</sub> (W)	V <sub>out</sub> (V)	I <sub>out</sub> (mA)	η (%)
100	9.01	91.1	89	89.99%
120	8.97	91.1	89.1	90.49%
140	8.96	91.1	89.2	90.69%
160	8.97	91.1	89.3	90.69%
180	8.98	91.1	89.3	90.59%
200	9.01	91.1	89.4	90.39%
220	9.04	91.1	89.5	90.19%
240	9.09	91.1	89.7	89.90%
260	9.14	91.1	89.8	89.51%
277	9.2	91.1	90	89.12%

# 9. PF & THD



**THD < 5%,  
业界领先**

Figure 9.1 Total Harmonics Distribution & Power Factor VS  $V_{IN}/V_{AC}$



# 10.1 Current Harmonics

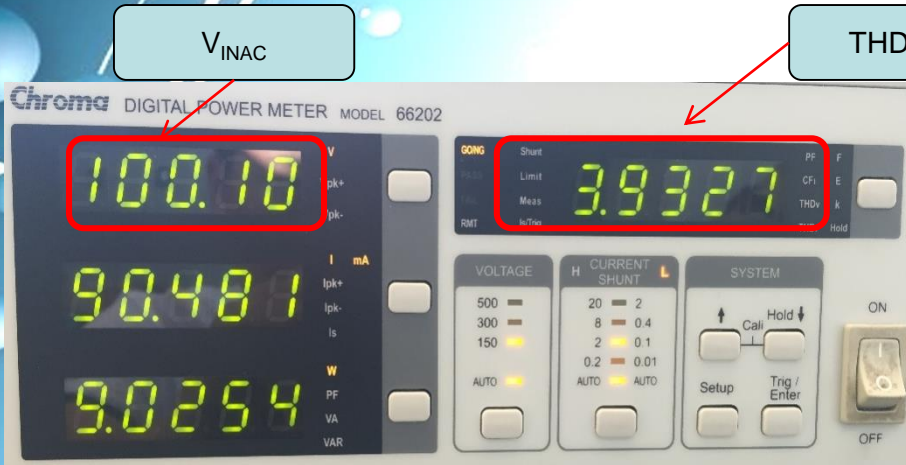


Figure 10.1 Current Harmonics @100V<sub>AC</sub>



Figure 10.2 Current Harmonics @277V<sub>AC</sub>

## Measurement Specification:

- ◆ Condition: IEC61000-3-2
- ◆ Power Supply:
  - 100V<sub>AC</sub>/60Hz
  - 277V<sub>AC</sub>/50Hz
- ◆ Ambient: 22°C, 48%RH
- ◆ Test mode: Lighting

**THD<5%,  
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