

HFE3500

EVALUATION DATA

Template	260711 iss 4
DWG. No.	360254 iss 01

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Terminology Used:

	Definition	
V _{in}		Input voltage
V _{out}		Output voltage
I _{in}		Input current
I _{out}		Output current
T _a		Ambient temperature
F		Frequency

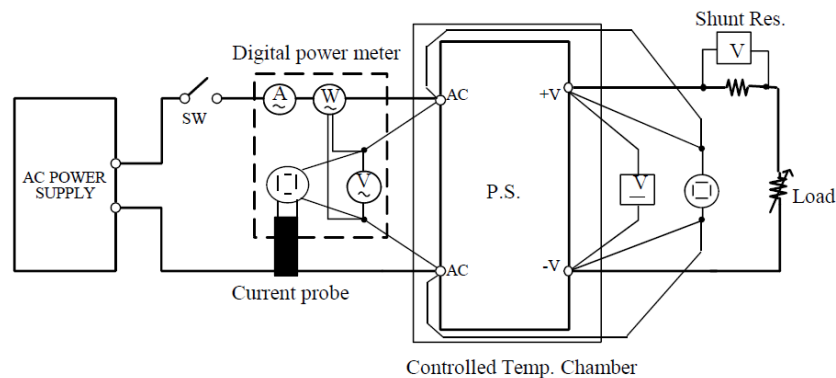
TDK Lambda UK Ltd.
Kingsley Avenue
Ilfracombe
Devon, EX34 8ES
United Kingdom

1. Evaluation Method

1.1 Circuit used for determination

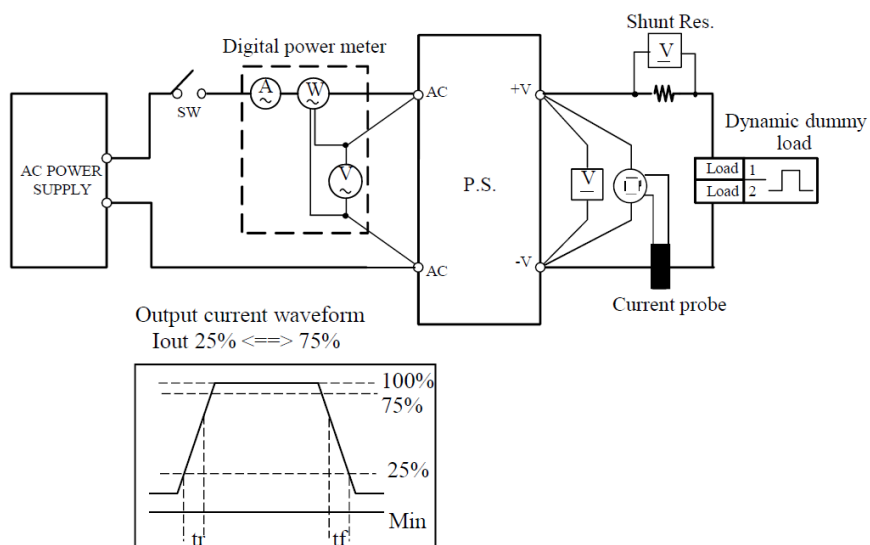
Circuit 1 used for determination

Steady state data
 Over current protection (OCP) characteristics
 Over voltage protection (OVP) characteristics
 Output rise characteristics
 Output fall characteristics
 Hold up time characteristics
 Response to brownout characteristics
 Input current harmonics
 Input current



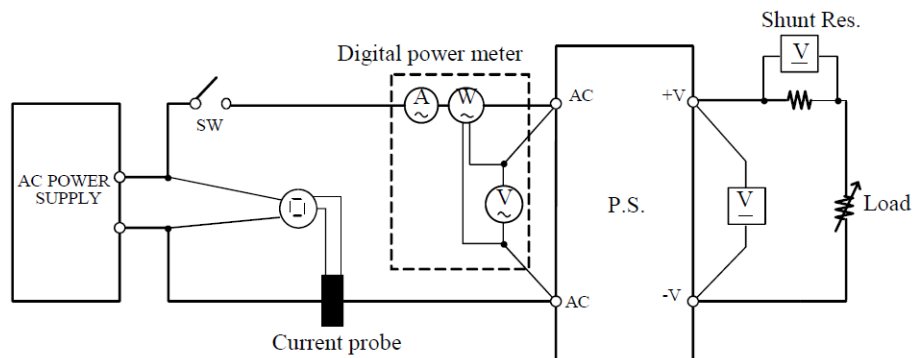
Circuit 2 used for determination

Dynamic load response characteristics



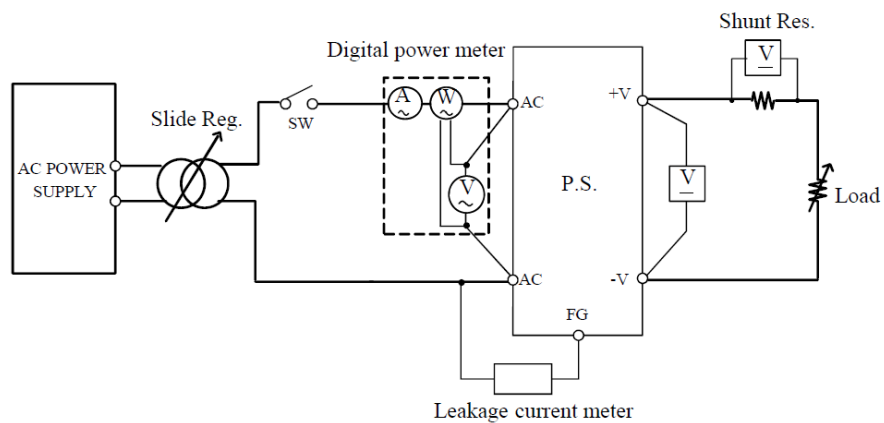
Circuit 3 used for determination

Inrush current waveform



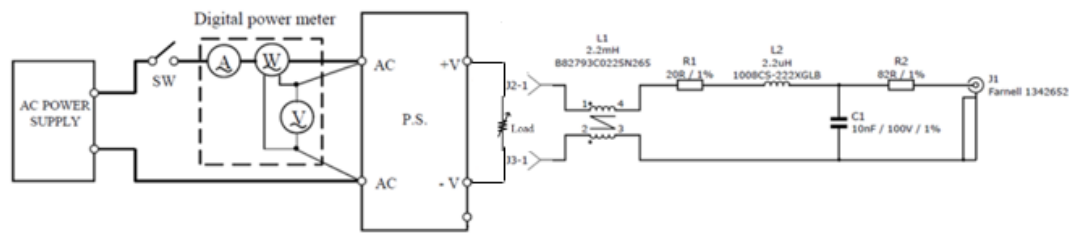
Circuit 4 used for determination

Leakage current characteristics



Circuit 5 used for determination

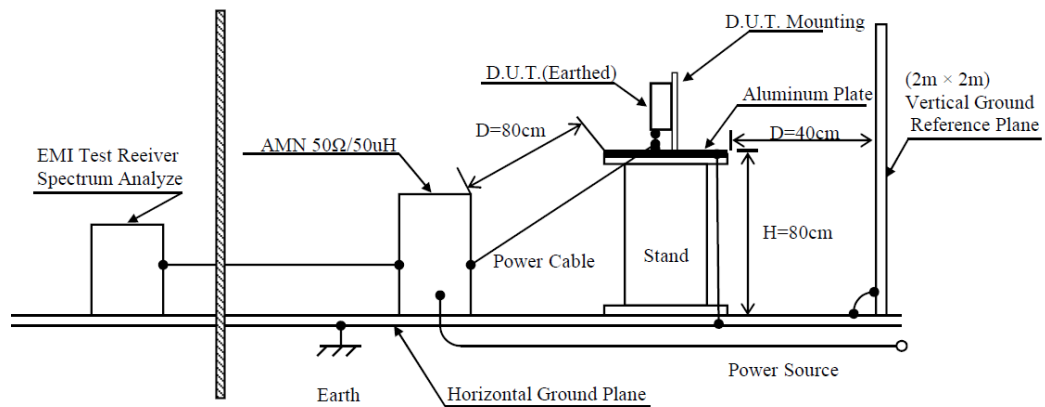
Output ripple and noise waveform



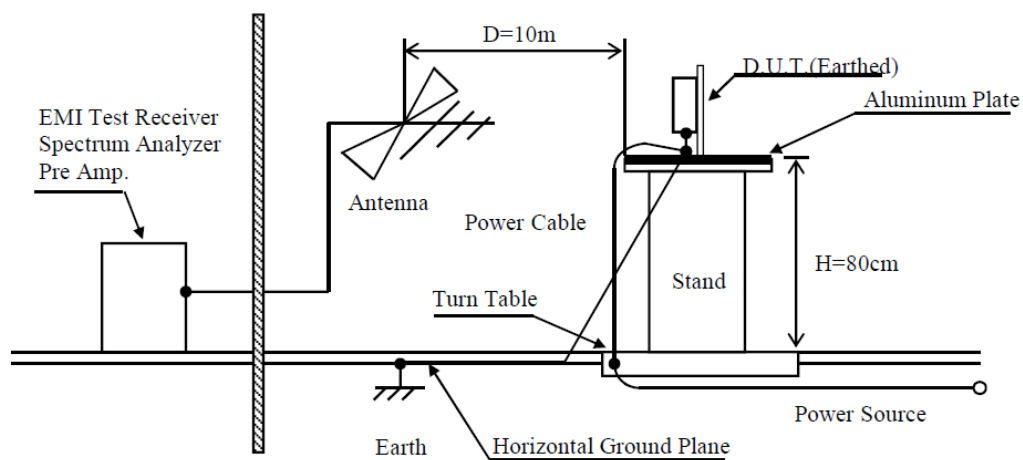
Configuration used for determination

Electro-Magnetic interference characteristics

(a) Conducted Emissions



(b) Radiated Emissions



1.2 List of equipment used

	Equipment Used	Manufacturer	Model No.
1	Chamber	Montford	-
2	AC Source	Chroma	61511
3	Electronic Load	Chroma	63305
4	Electronic Load	Chroma	63208A
5	Power Analyser	Vitretek	PA900
6	Scope	Rohde & Schwarz	RTM3004
7	Current Probe 1	Agilent	1146B
8	Current Probe 2	Agilent	1146B
9	Receiver	Rohde & Schwarz	ESPI
10	Receiver	Rohde & Schwarz	ESR3
11	LISN	Rohde & Schwarz	ENV432
13	CMAD	Chase	CEC-8110
14	Antenna	Schwarzbeck-Mess	VULB 9168
15	Antenna Mast	Maturo	AM 4.0
16	Turntable Control Unit	Maturo	MCU
17	Turntable	Maturo	TT 2.0 SI

2. Characteristics**2.1 Steady state data****(1) Regulation – line and load, temperature drift / Start up and Drop out voltage**

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1 Regulation – line and load

Condition

Ta: 25°C

Iout \ Vin	85Vac	120Vac	230Vac	264Vac	Line Regulation	
0%	24.046	24.055	24.056	24.054	10mV	0.04%
50%	24.049	24.047	24.032	24.032	17mV	0.07%
100%	24.034	24.031	24.029	24.028	6mV	0.02%
Load Regulation	15mV	24mV	27mV	26mV		
	0.06%	0.1%	0.11%	0.11%		

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1 Regulation – line and load

Condition

Ta: 25°C

Iout \ Vin	85Vac	120Vac	230Vac	264Vac	Line Regulation	
0%	48.029	48.103	48.027	48.011	92mV	0.19%
50%	48.113	48.114	48.114	48.116	3mV	0.006%
100%	48.113	48.116	48.119	48.137	24mV	0.05%
Load Regulation	84mV	13mV	92mV	126mV		
	0.17%	0.02%	0.19%	0.26%		

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2 Temperature drift

Condition

Vin: 120Vac

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Iout: 100%

Ta	-10°C	25°C	50°C	Temperature Stability	
Vout	24.089V	24.062V	24.046V	43mV	0.18%

3 Start-up voltage and Dropout voltage

Condition

Ta: 25°C

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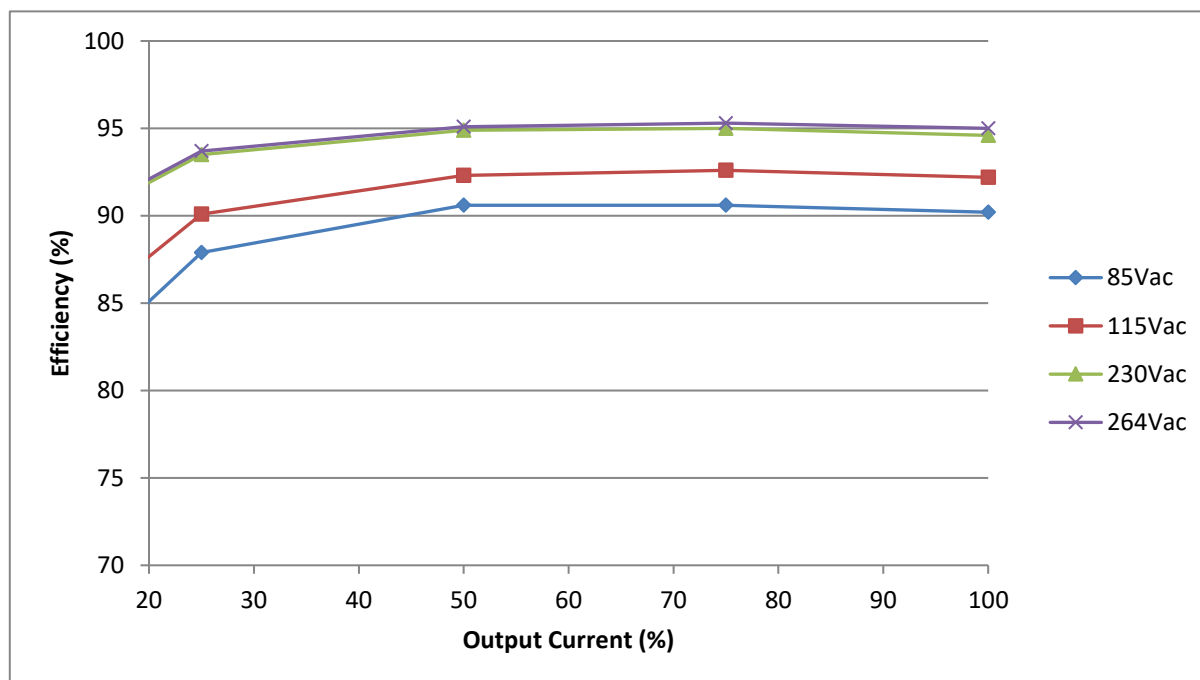
Iout: 100%

Start-up voltage (Vin)	83Vac
Dropout Voltage (Vin)	54Vac

(2) Efficiency vs. Output current

Conditions: Vin : 85Vac
 : 115Vac
 : 230Vac
 : 264Vac
 Ta : 25°C

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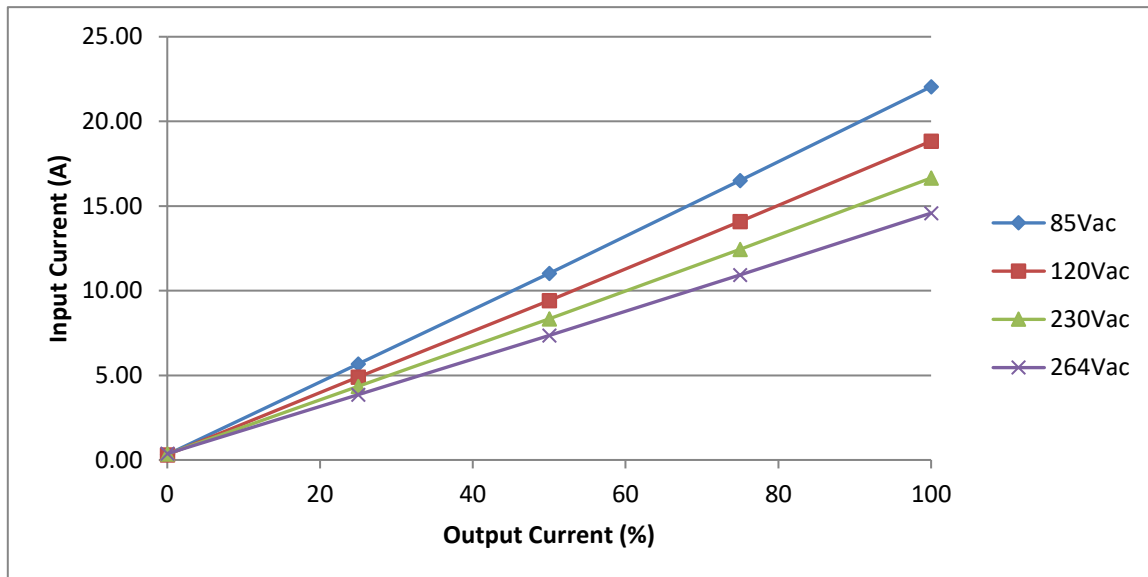


(3) Input current vs. Output current

Conditions: V_{in} : 85Vac
: 120Vac
: 230Vac
: 264Vac
 T_a : 25°C

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V_{in}	Input Current				
	Iout: 0%	Iout: 25%	Iout: 50%	Iout: 75%	Iout: 100%
85Vac	0.31A	5.62A	10.92A	16.40A	21.92A
120Vac	0.30A	4.85A	9.34A	13.98A	18.76A
230Vac	0.35A	4.29A	8.27A	12.37A	16.61A
264Vac	0.37A	3.82A	7.29A	10.86A	14.52A

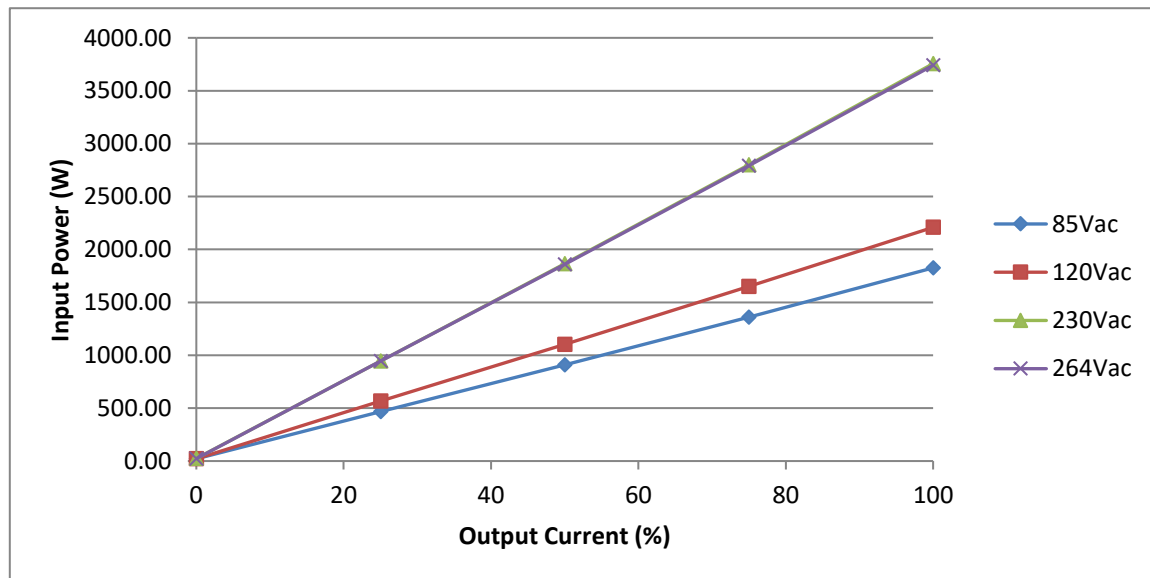


(4) Input power vs. Output current

Conditions: Vin : 85Vac
 : 120Vac
 : 230Vac
 : 264Vac
 Ta : 25°C

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Vin	Input Power				
	Iout: 0%	Iout: 25%	Iout: 50%	Iout: 75%	Iout: 100%
85Vac	20.9W	468.0W	908.0W	1361.1W	1825.6W
120Vac	21.2W	566.5W	1103.9W	1650.3W	2208.6W
230Vac	24.2W	945.7W	1864.3W	2799.8W	3755.8W
264Vac	22.5W	944.2W	1860.3W	2790.8W	3740.8W

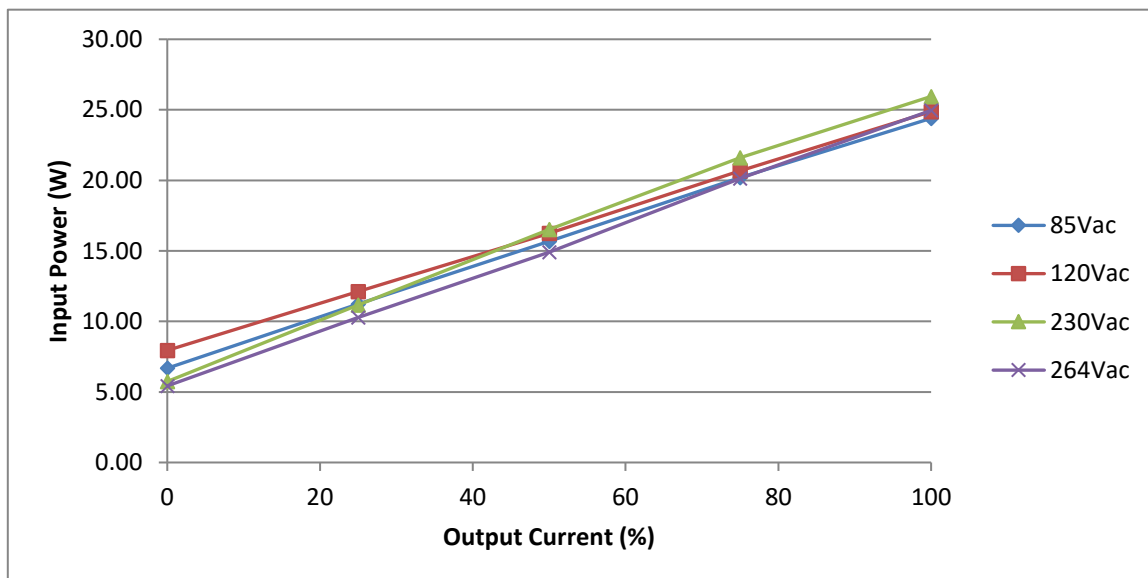


(5) Input power vs. Output current (Unit inhibited)

Conditions: V_{in} : 85Vac
: 120Vac
: 230Vac
: 264Vac
 T_a : 25°C

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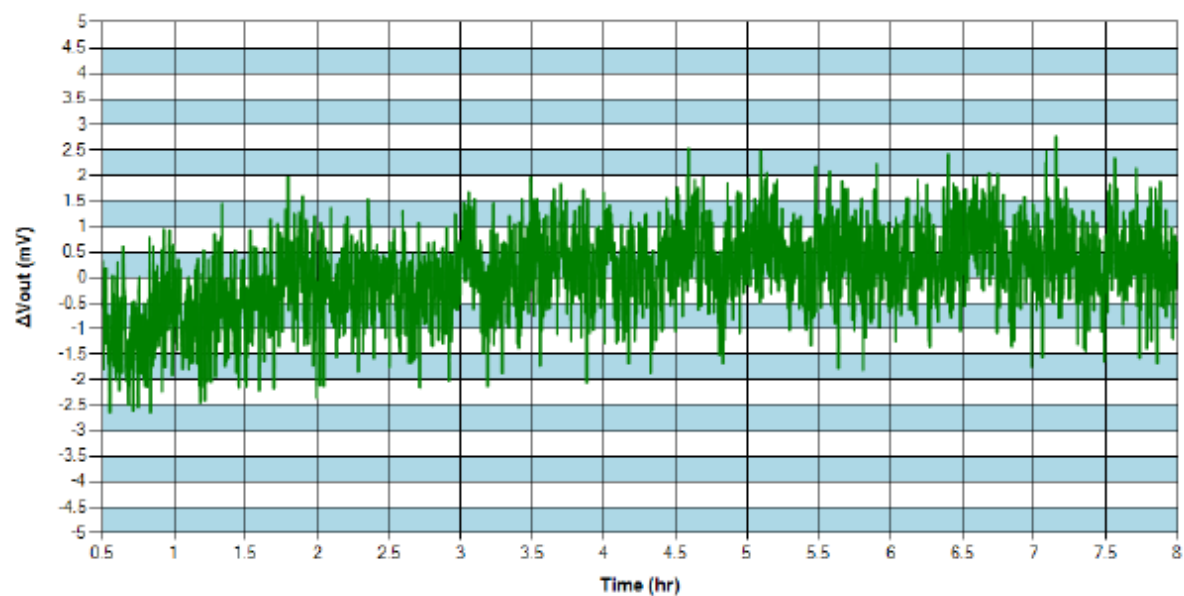
V_{in}	Input Power				
	Iout: 0%	Iout: 25%	Iout: 50%	Iout: 75%	Iout: 100%
85Vac	11.0W	15.4W	20.0W	24.2W	11.0W
120Vac	12.1W	16.1W	20.5W	24.6W	12.1W
230Vac	11.1W	16.4W	21.8W	26.2W	11.1W
264Vac	10.2W	14.7W	19.9W	24.7W	10.2W



2.2 Warm up voltage drift characteristics

Conditions: V_{in} : 120Vac
 I_{out} : 100%
 T_a : 25°C

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2.3 Over current protection (OCP) characteristics

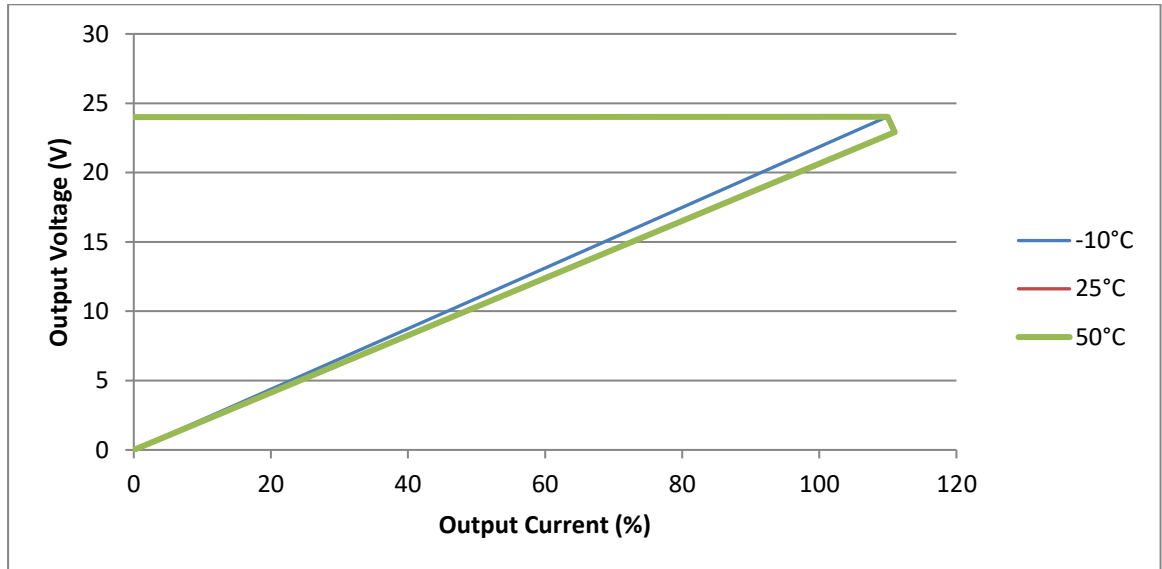
Conditions: V_{in} : 230Vac

T_a : -10°C

25°C

50°C

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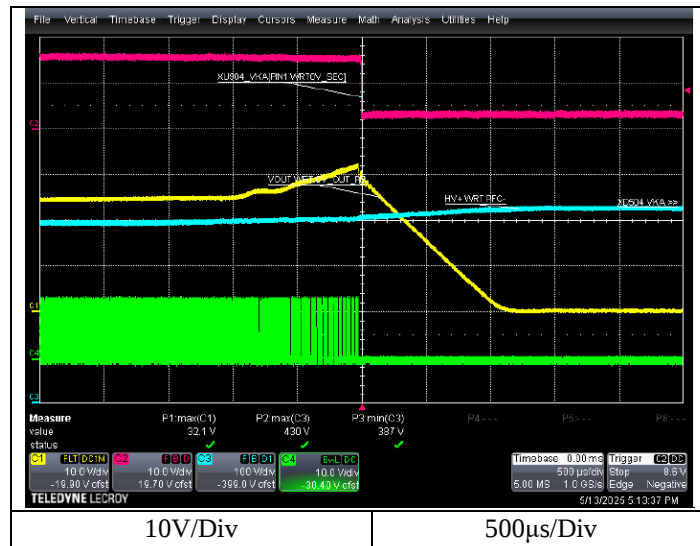
2.4 Over voltage protection (OVP) characteristics

Conditions: Vin: 230Vac

Iout: 100%

Ta: 25°C

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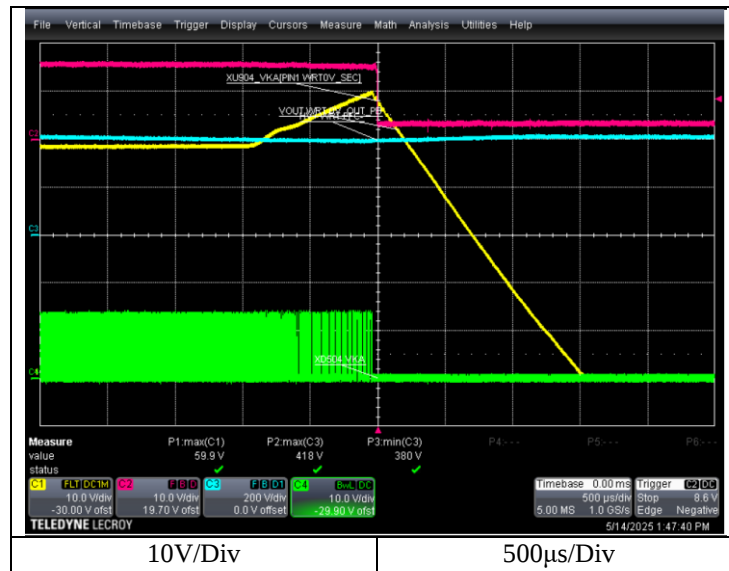
2.4 Over voltage protection (OVP) characteristics

Conditions: Vin: 230Vac

Iout: 100%

Ta: 25°C

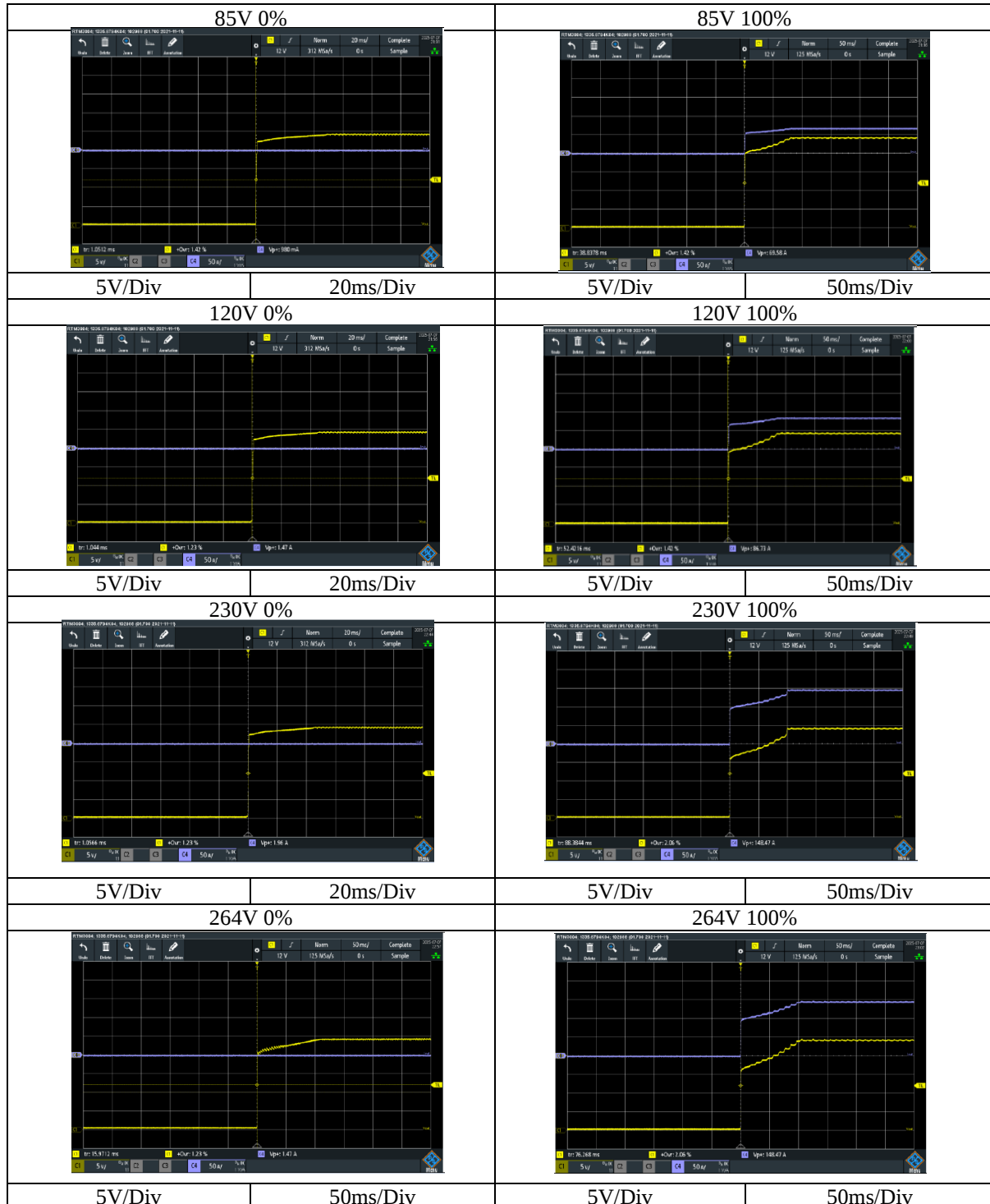
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2.5 Output rise characteristics

Conditions: Vin: 85Vac
: 115Vac
: 230Vac
: 264Vac
Ta: 25°C
Iout: 0%: 100%

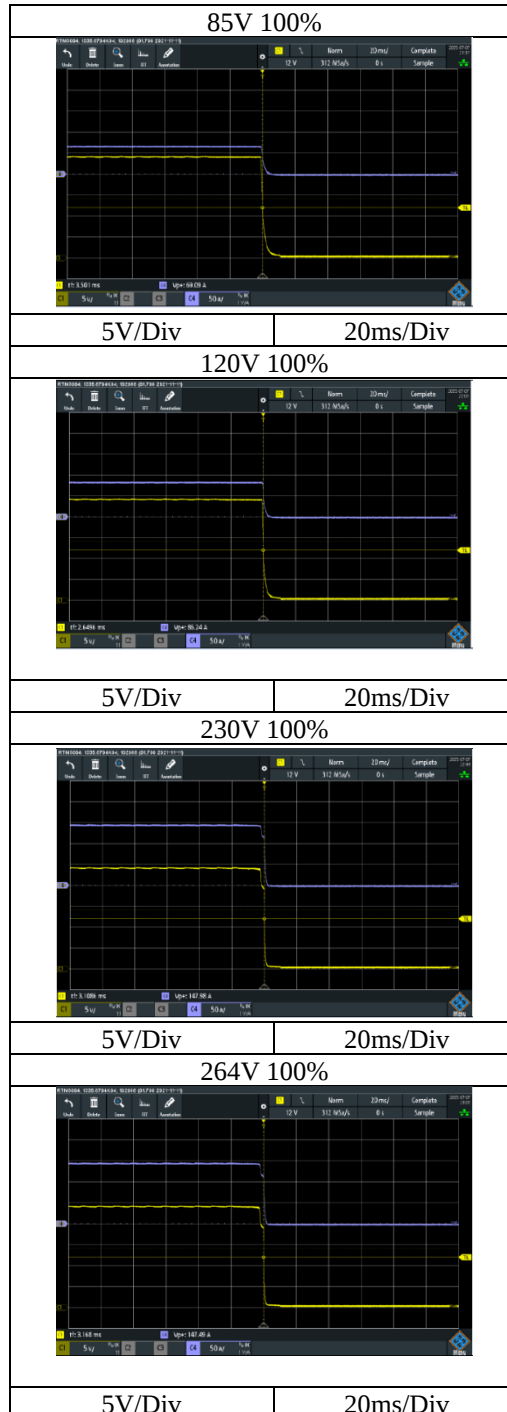
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2.6 Output Fall Characteristics

Conditions: Vin: 85Vac
: 115Vac
: 230Vac
: 264Vac
Ta: 25°C
Iout: 0%: 100%

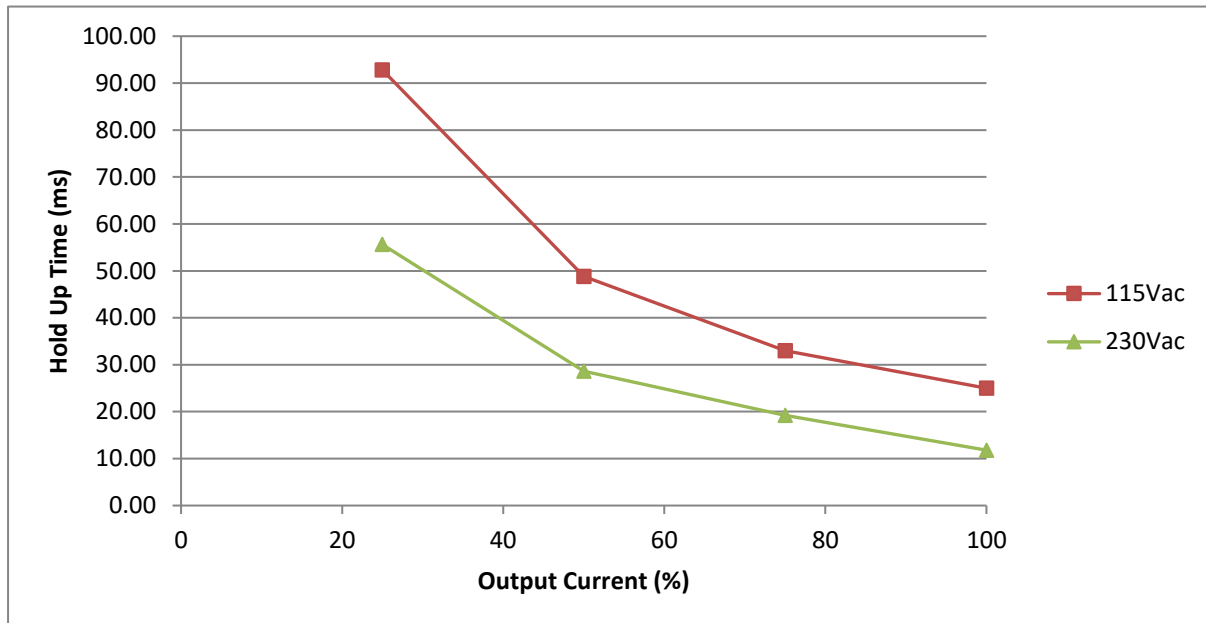
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2.7 Hold up time characteristics

Conditions: Vin: 115Vac
: 230Vac
Ta: 25°C

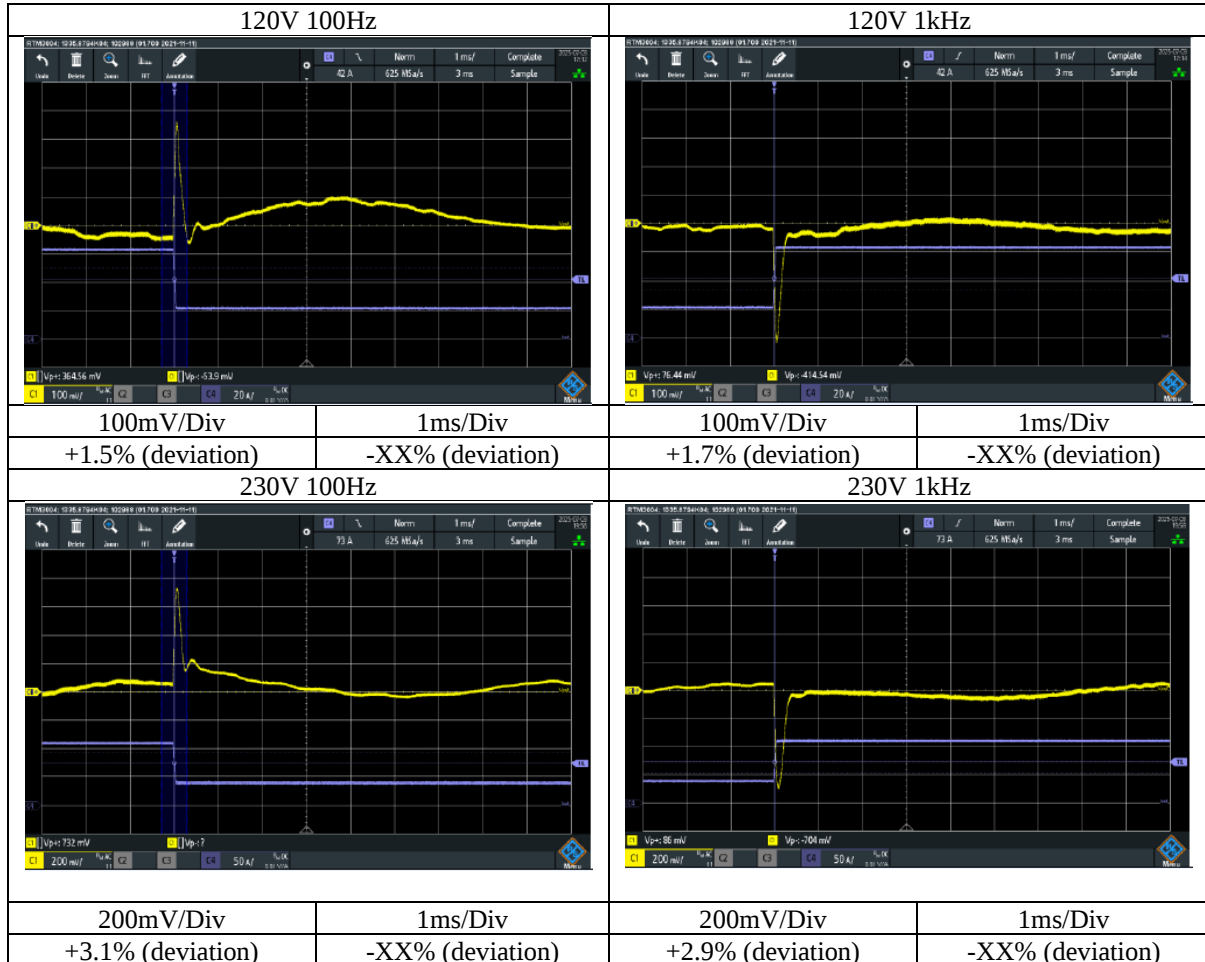
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2.8 Dynamic load response characteristics

Conditions: Vin: 120Vac
Ta: 25°C
Iout: 25%↔75%
(tr = tf = 50μS)
f :100Hz
:1kHz

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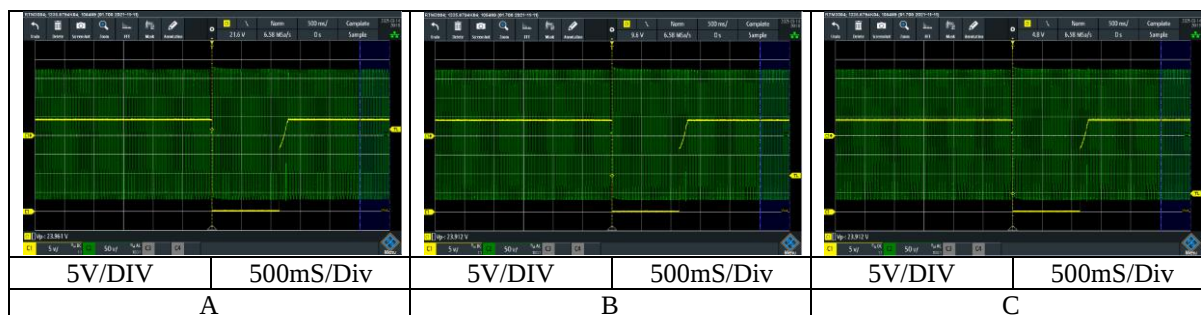


2.9 Response to brownout characteristics

Conditions: Vin: 120Vac
Iout: 100%
Ta: 25°C

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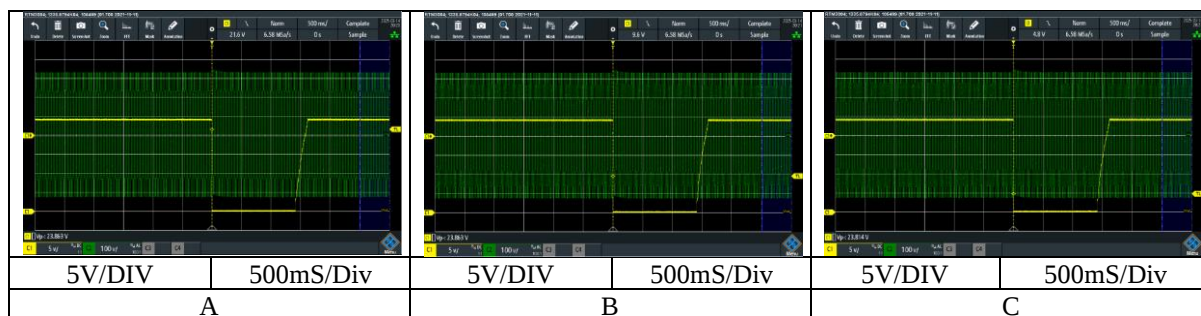
Performance parameters: A - The shortest interruption time for the output to drop below the regulation band
B – The interruption time for the output to drop down to 20 – 40 % of nominal
C – The interruption time for the output to drop down to <20% of nominal



Conditions: Vin: 230Vac
Iout: 100%
Ta: 25°C

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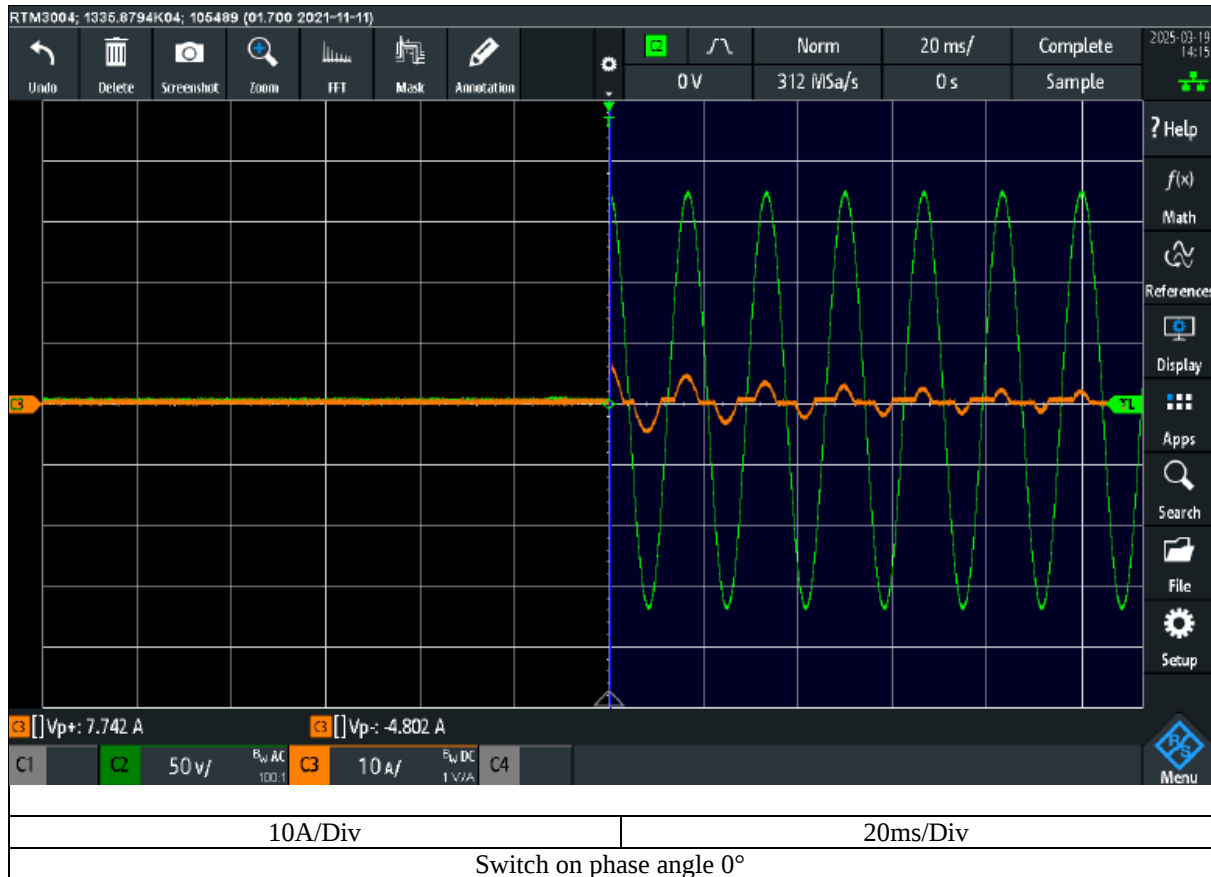
Performance parameters: A - The shortest interruption time for the output to drop below the regulation band
B – The interruption time for the output to drop down to 20 – 40 % of nominal
C – The interruption time for the output to drop down to <20% of nominal



2.10 Inrush Current Waveform

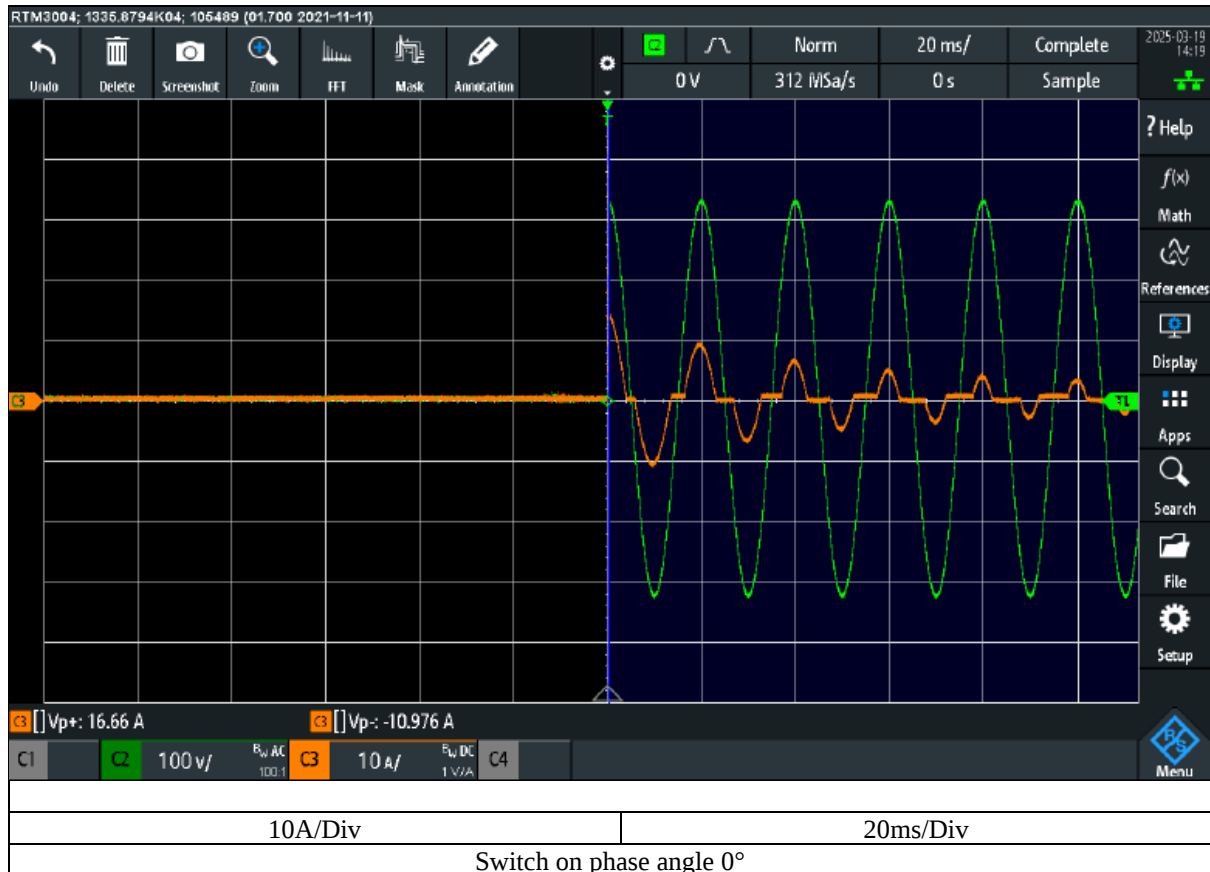
Conditions: Vin: 120Vac
Iout: 100%
Ta: 25°C

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Conditions: Vin: 230Vac
Iout: 100%
Ta: 25°C

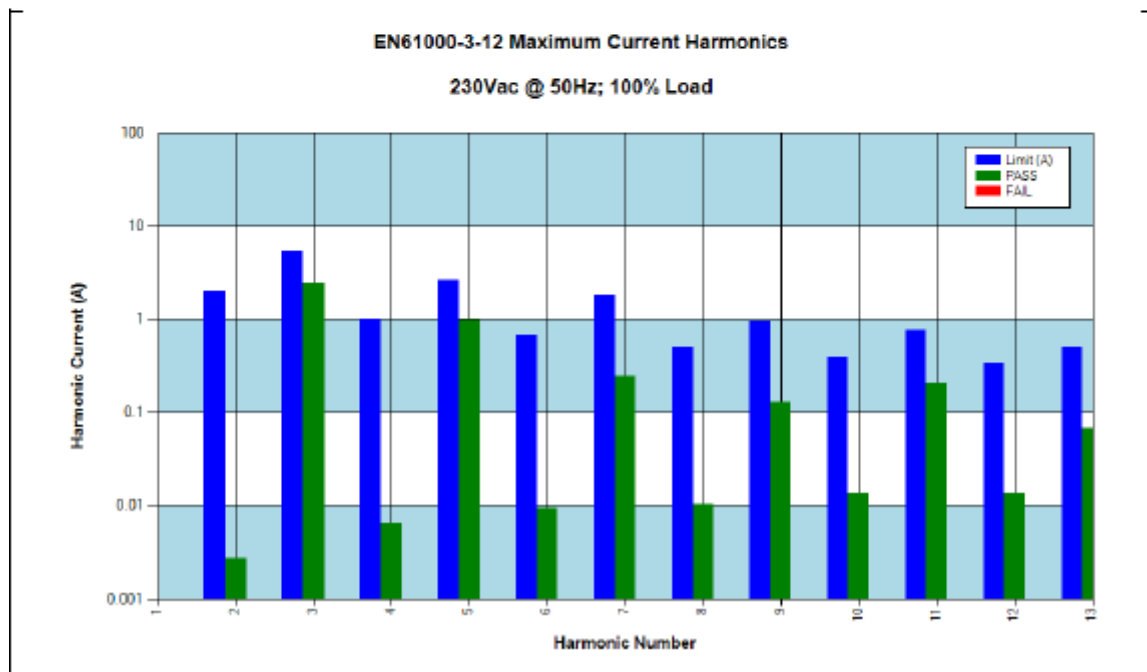
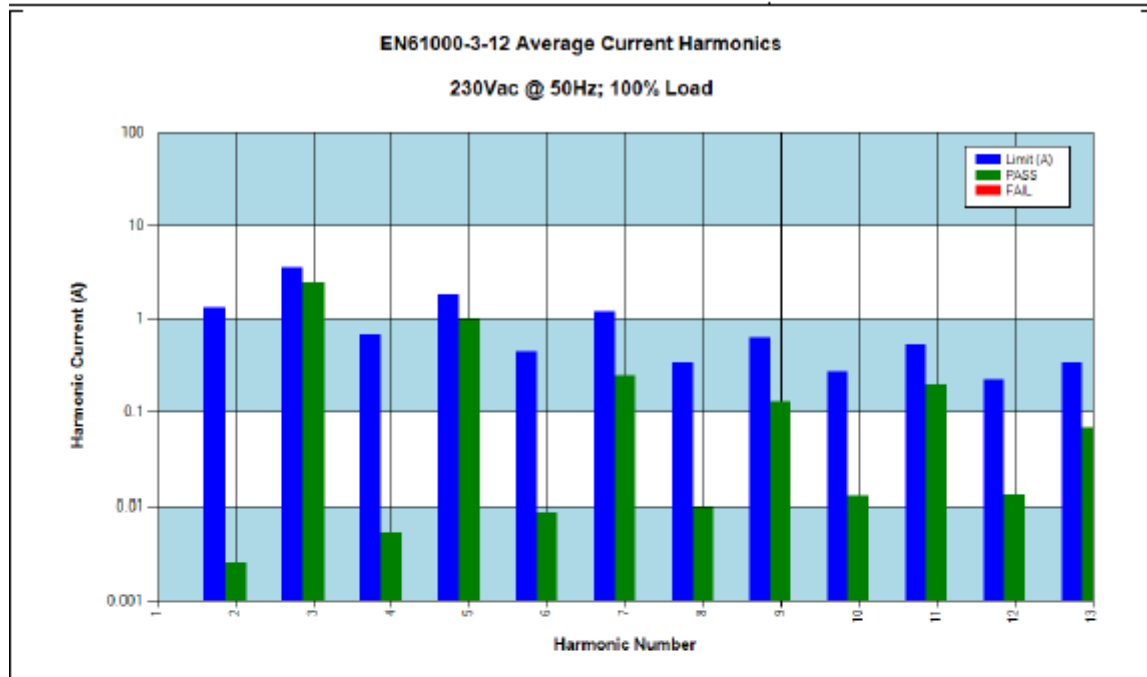
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2.11 Input current harmonics

Conditions: Vin: 230Vac
Iout: 100%
Ta: 25°C

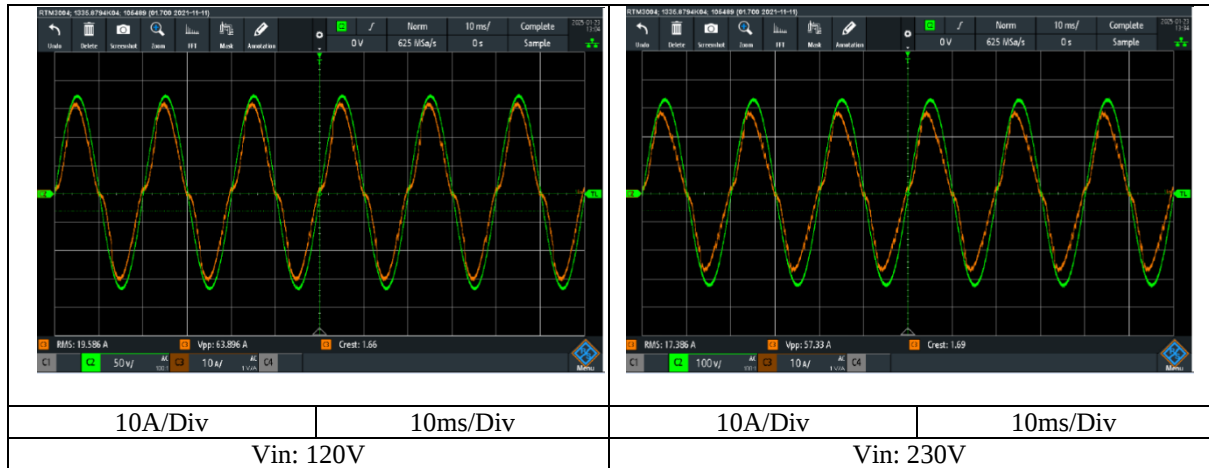
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2.12 Input current waveform

Conditions: Iout: 100%
Ta: 25°C

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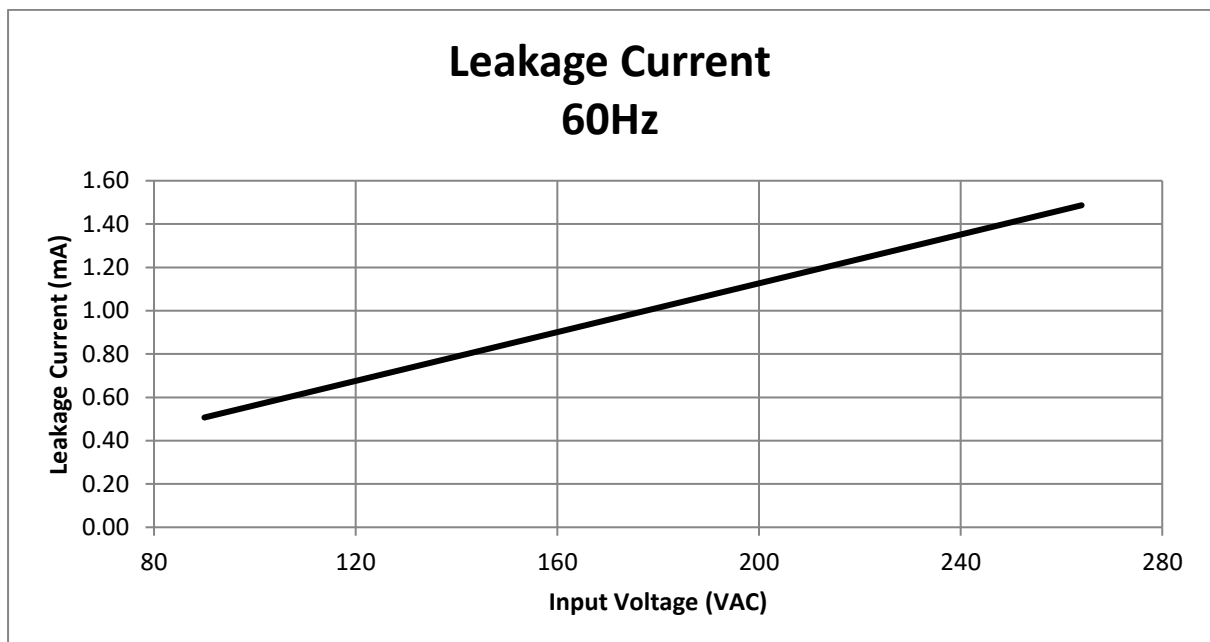
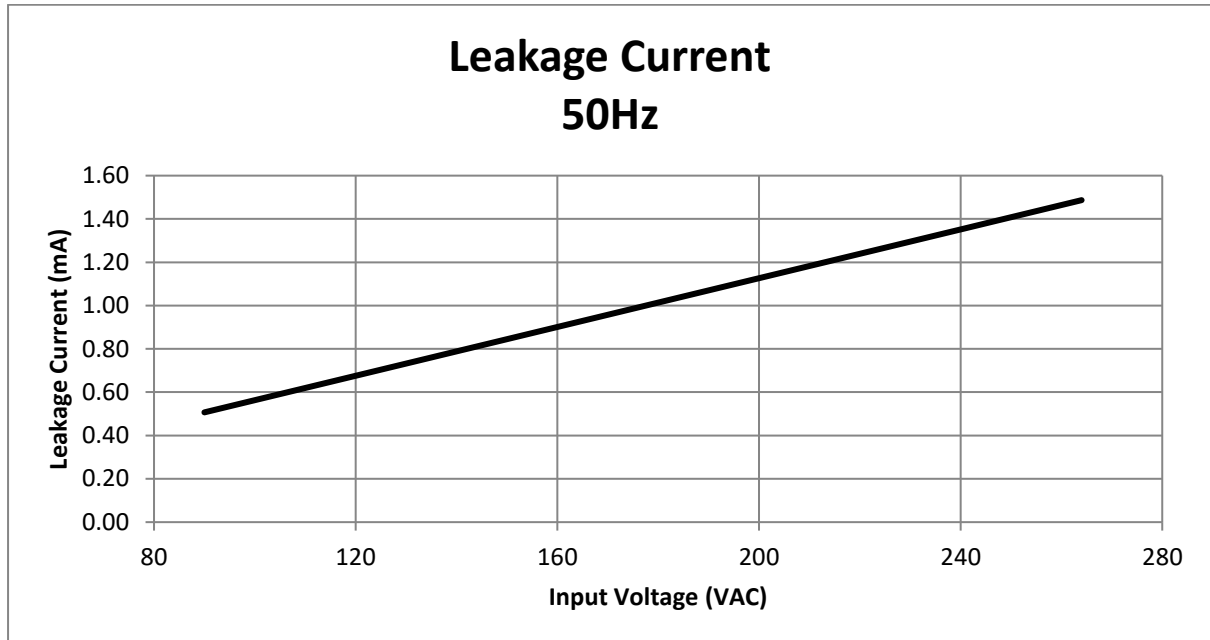


2.13 Leakage current characteristics

Conditions: I_{out}: 0%

T_a: 25°C

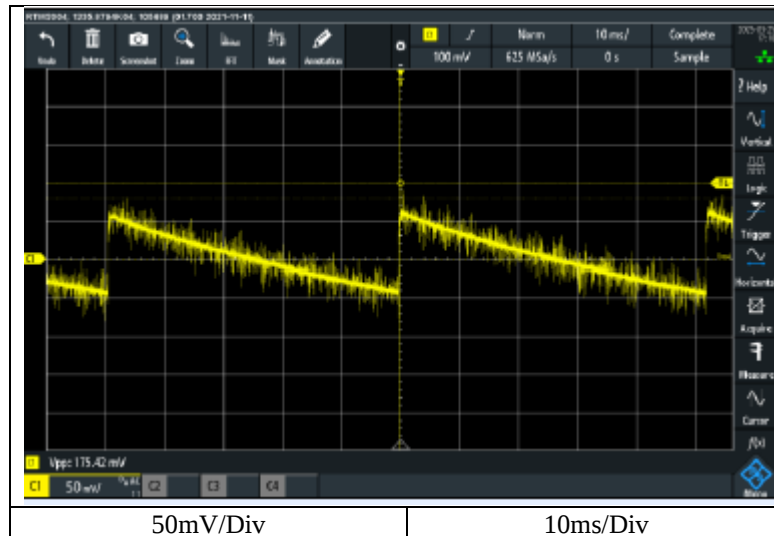
HFE3500-xx/xxx



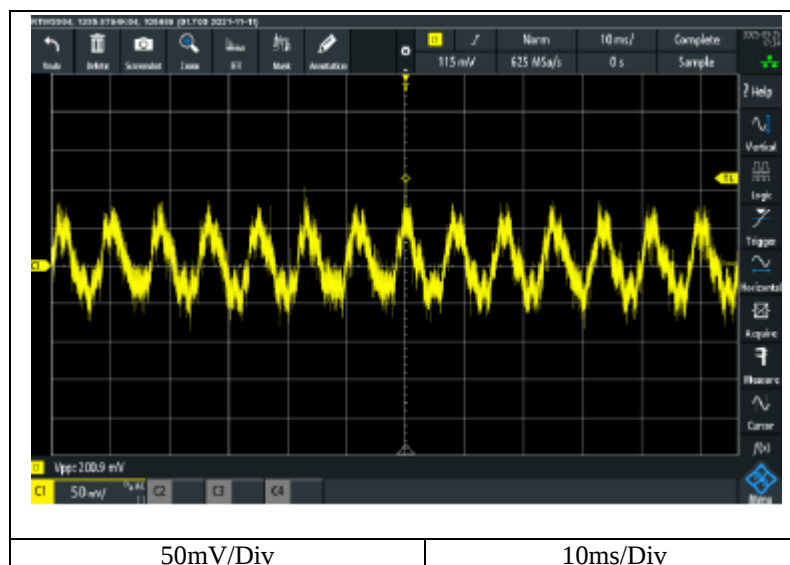
2.14 Output ripple and noise waveform

Conditions: V_{in} : 120Vac
 I_{out} : 0%
 T_a : 25°C

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Conditions: V_{in} : 120Vac
 I_{out} : 100%
 T_a : 25°C



2.15 Electro-Magnetic Interference characteristics

Conducted Emissions

Conditions: Vin: 240Vac

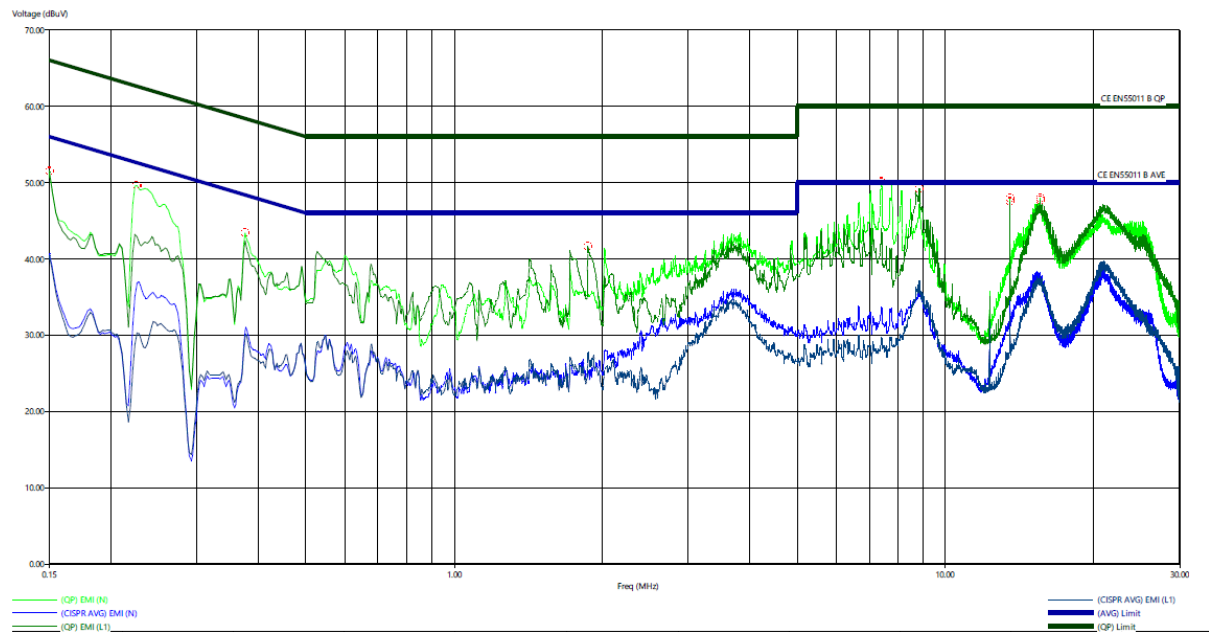
Iout: 100%

Ta: 25°C

QP Limit: —

AVE Limit: —

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Live

Point A (8.846 MHz)		
Ref Data	Limit (dBμV)	Measure (dBμV)
QP	60.00	49.17
AVE	50.00	37.10

Neutral

Point B (7.415 MHz)		
Ref Data	Limit (dBμV)	Measure (dBμV)
QP	60.00	50.07
AVE	50.00	29.74

2.15 Electro-Magnetic Interference characteristics

Conducted Emissions

Conditions: Vin: 240Vac

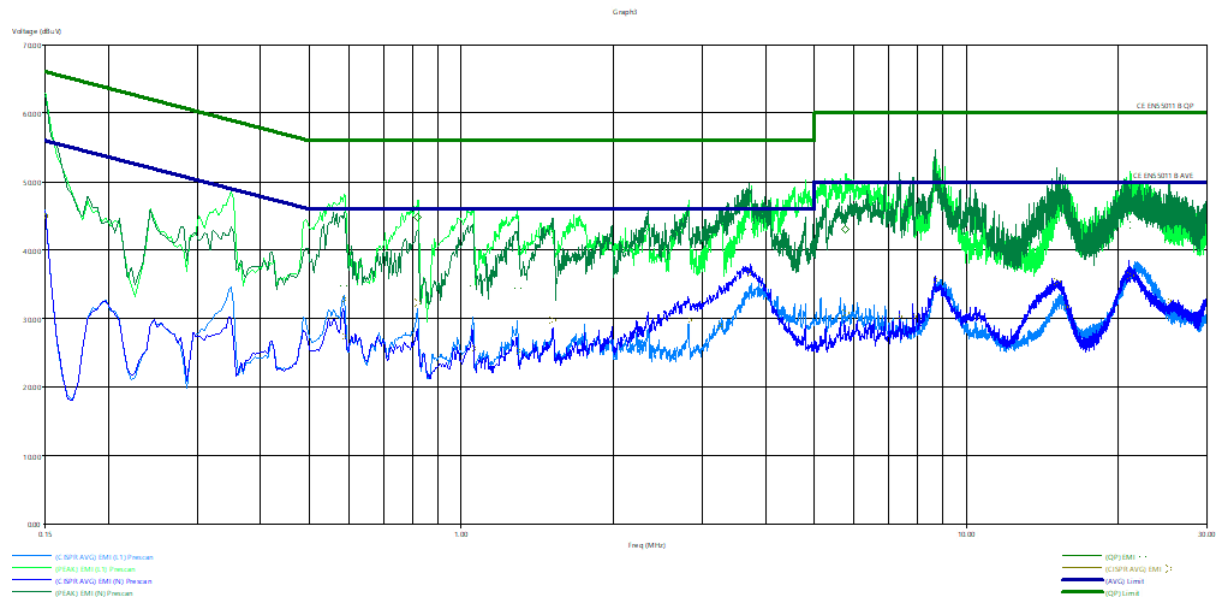
Iout: 100%

Ta: 25°C

QP Limit: —

AVE Limit: —

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Live

Point A (0.15 MHz)		
Ref Data	Limit (dBμV)	Measure (dBμV)
QP	65.98	58.21
AVE	55.98	45.01

Neutral

Point B (0.15 MHz)		
Ref Data	Limit (dBμV)	Measure (dBμV)
QP	65.98	58.38
AVE	55.98	45.16

2.16 Electro-Magnetic Interference characteristics

Radiated Emissions

Conditions: Vin: 240Vac

Iout: 100%

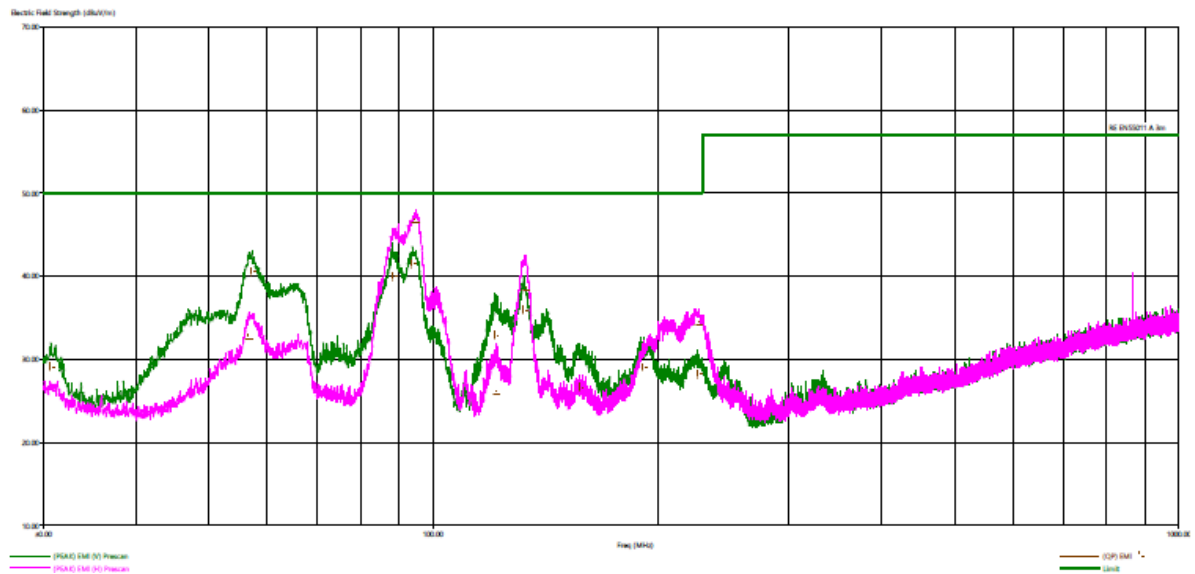
Ta: 25°C

Horizontal: —

Vertical: —

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Point A (94.71 MHz)		
Ref Data	Limit (dBμV)	Measure (dBμV)
QP	50.00	46.44



2.16 Electro-Magnetic Interference characteristics

Radiated Emissions

Conditions: Vin: 240Vac

Iout: 100%

Ta: 25°C

Horizontal: —

Vertical: —

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Point A (57.21 MHz)		
Ref Data	Limit (dBμV)	Measure (dBμV)
QP	50.00	41.68

