LS50

EVALUATION DATA

DWG.No PA582-53-01		
APPD	CHK	DWG
2 Apr 08	1-Apr-08	01/04/08

DENSEI-LAMBDA

INDEX

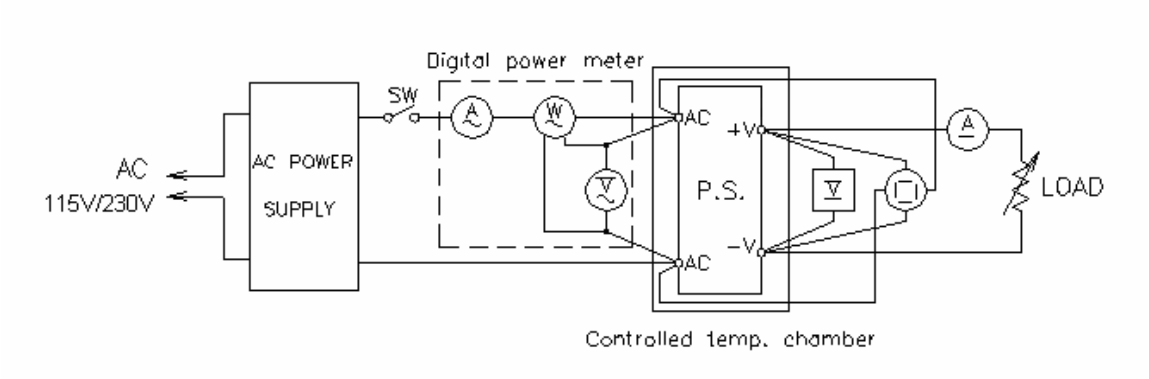
Terminology Used

	Definition	
Vin	. . . . .	Input voltage
Vout	. . . . .	Output Voltage
Iin	. . . . .	Input Current
Iout	. . . . .	Output Current
Ta	. . . . .	Ambient temperature

1. Evaluation Method

1-1 Circuit used for determination

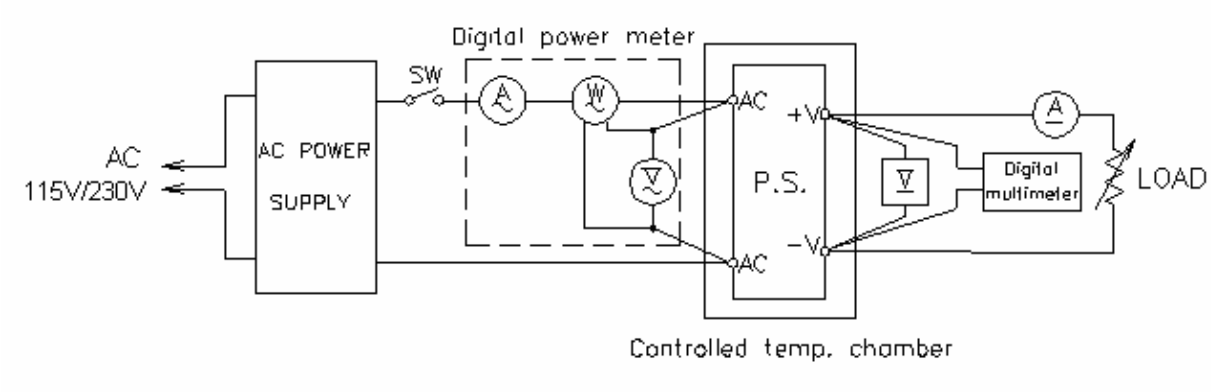
(1) Steady state data



(2) Warm up voltage drift characteristics

Same as Steady state data

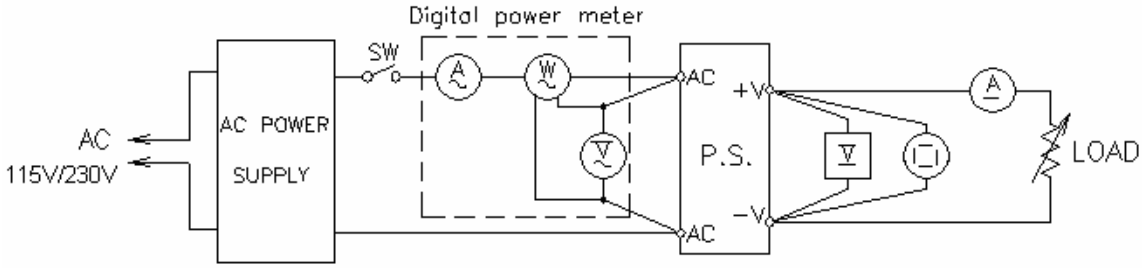
(3) Over current protection (OCP) characteristics



(4) Over voltage protection (OVP) characteristics

Same as Steady state data

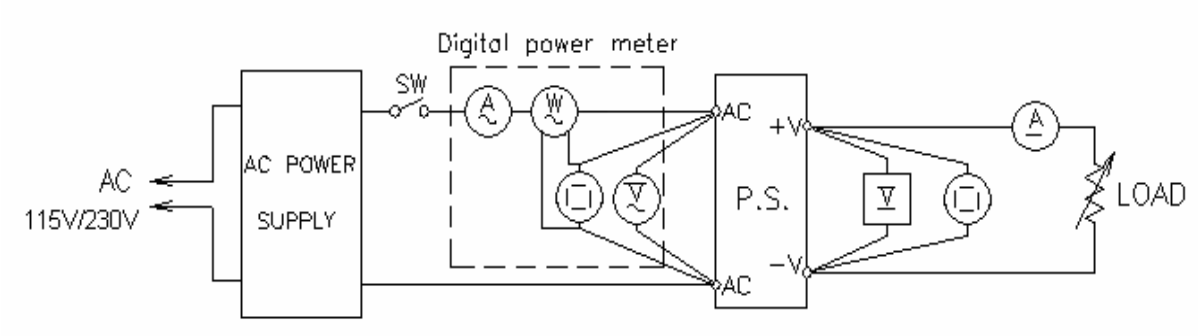
(5) Output rise characteristics



(6) Output fall characteristics

Same as Output rise characteristics

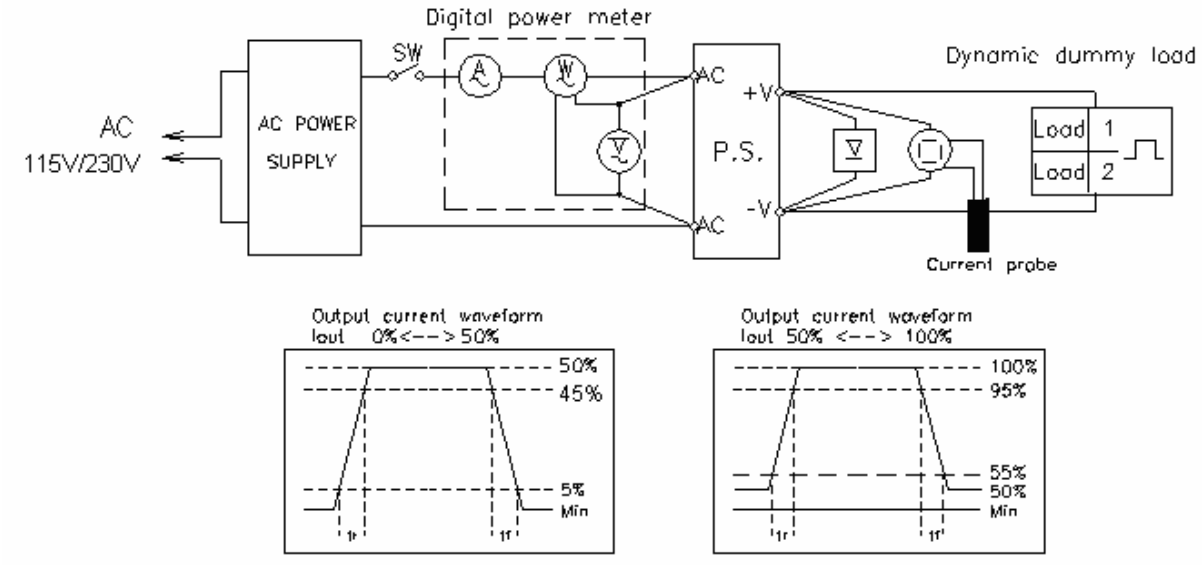
(7) Response to brown out characteristics



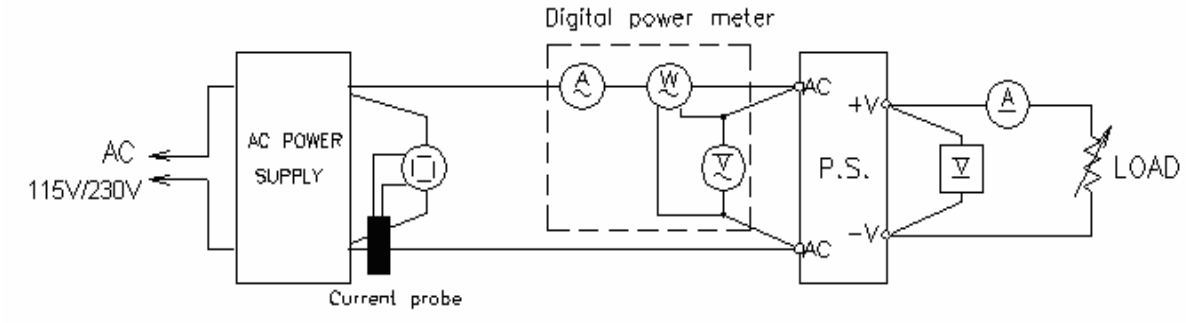
(8) Dynamic line characteristics

Same as Response to brown out characteristics.

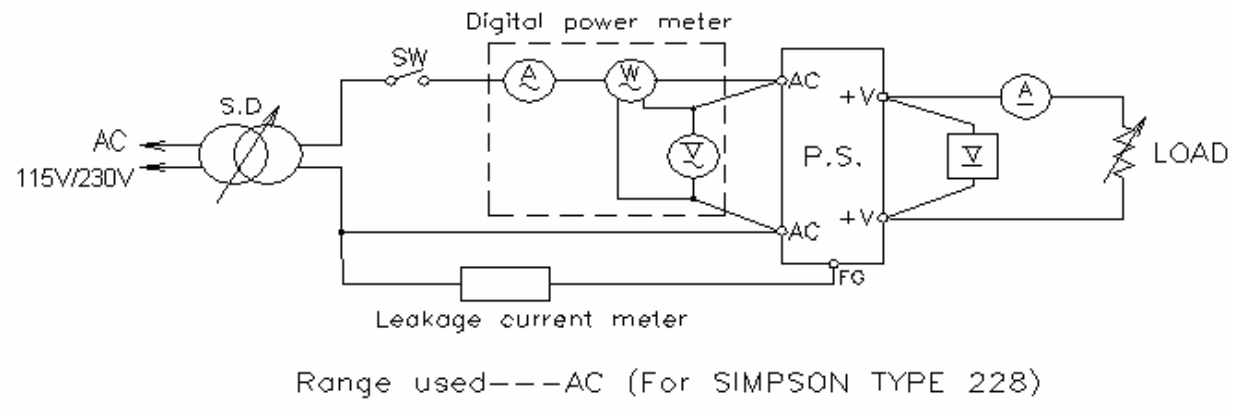
(9) Dynamic load response characteristics



(10) Inrush current characteristics

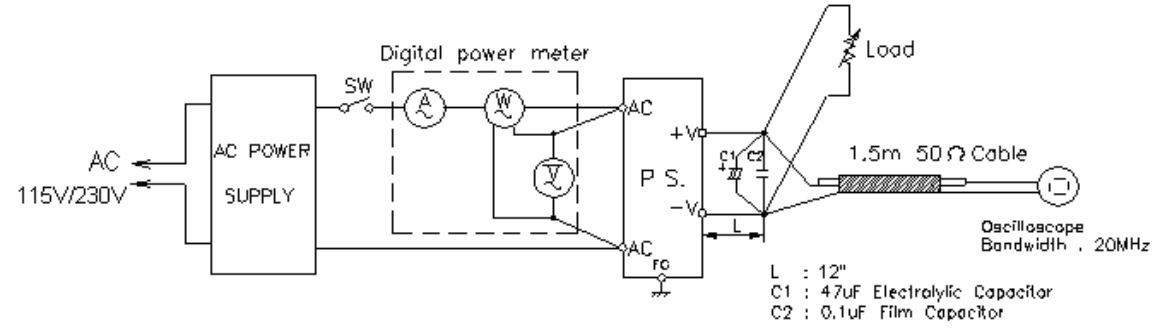


(11) Leakage current characteristics

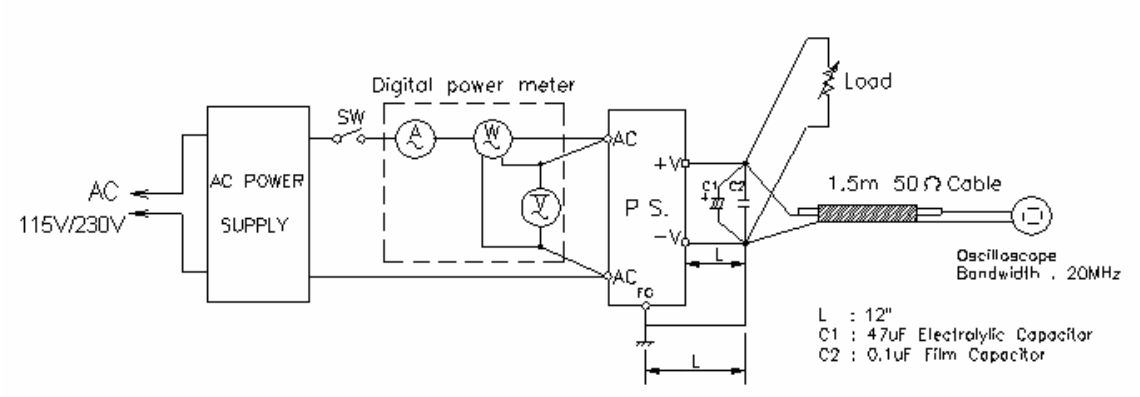


(12) Output ripple and noise waveform

(a) Normal Mode (using a 12" twisted pair terminated with 0.1uF and 47uF capacitor at 20MHz)

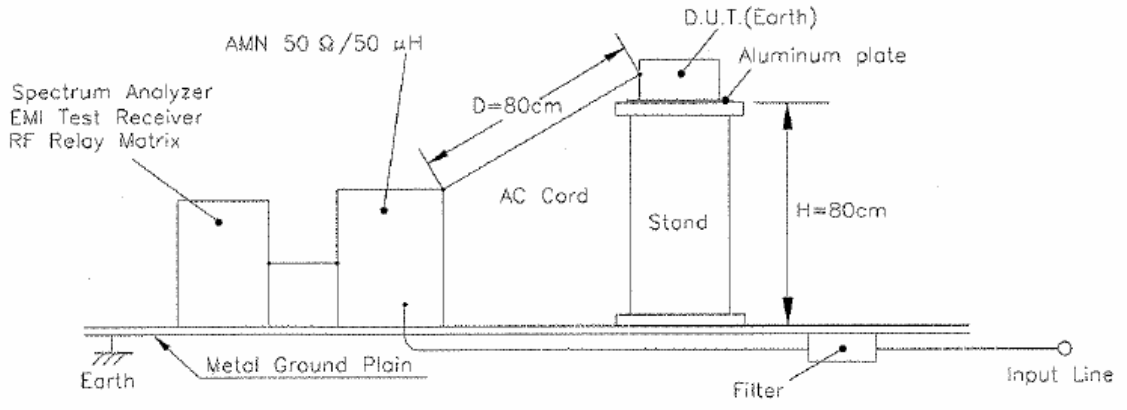


(b) Normal +Common Mode

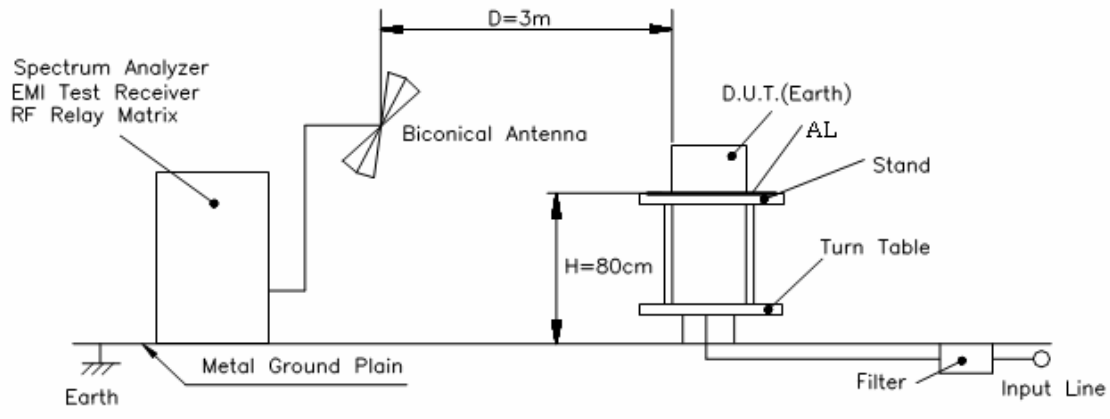


(13) Electro-Magnetic Interference characteristics

(a) Conducted Emission Noise



(b) Radiated Emission Noise



1-2 List of equipment used

	EQUIPMENT USED	MANUFACTURER	MODEL NO.
1	DIGITAL STORAGE OSCILLOSCOPE	YOKOGAWA	DL1740/DL1740E
2	DIGITAL MULTIMETER	FLUKE	89 VI
3	DIGITAL POWER METER	YOKOGAWA	WT210
4	CURRENT PROBE/AMPLIFIER	TEKTRONIX	TCP404XL/TCPA400
5	DYNAMIC DUMMY LOAD	CHROMA	63030/63201
6	DYNAMIC DUMMY LOAD	KIKUSUI	PLZ1004W
7	CONTROLLED TEMP. CHAMBER	ESPEC	SU-241
8	LEAKAGE CURRENT METER	SIMPSON	228
9	AC SOURCE	KIKUSUI	PCR-2000L
10	AC SOURCE	CHROMA	6530
11	POWER ANALYZER	CHROMA	6630
12	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI
13	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESI26
14	LISN	ROHDE&SCHWARZ	ENV216
15	ANTENNA	ROHDE&SCHWARZ	HL562

2. Characteristics

2-1 Steady state data

(1) Regulation - line and load, Temperature drift

5V

1. Regulation-line and load — Condition Ta : 25°C

Iout \ Vin	88VAC	115VAC	230VAC	264VAC	line regulation	
0%	5.014	5.014	5.017	5.017	0.003V	0.060%
50%	5.007	5.007	5.008	5.008	0.001V	0.020%
100%	5.000	5.000	4.999	4.999	0.001V	0.020%
load	0.014V	0.014V	0.018V	0.018V		
regulation	0.280%	0.280%	0.360%	0.360%		

2. Temperature drift — Conditions Vin = 115VAC, Iout =100%

Ta	-25°C	25°C	50°C	temperature stability	
Vout	4.991V	5.000V	4.996V	0.009V	0.18%

12V

1. Regulation-line and load — Condition Ta : 25°C

Iout \ Vin	88VAC	115VAC	230VAC	264VAC	line regulation	
0%	12.003	12.003	12.003	12.003	0.000V	0.000%
50%	11.998	11.998	11.998	11.998	0.000V	0.000%
100%	11.993	11.993	11.994	11.994	0.001V	0.008%
load	0.010V	0.010V	0.009V	0.009V		
regulation	0.083%	0.083%	0.075%	0.075%		

2. Temperature drift — Conditions Vin = 115VAC, Iout = 100%

Ta	-25°C	25°C	50°C	temperature stability	
Vout	12.006V	11.993V	11.978V	0.028V	0.23%

24V

1. Regulation-line and load — Condition Ta : 25°C

Iout \ Vin	88VAC	115VAC	230VAC	264VAC	line regulation	
0%	23.992	23.99	23.99	23.989	0.003V	0.013%
50%	23.986	23.985	23.986	23.985	0.001V	0.004%
100%	23.982	23.982	23.982	23.982	0.000V	0.000%
load	0.010V	0.008V	0.008V	0.007V		
regulation	0.042%	0.033%	0.033%	0.029%		

2. Temperature drift — Conditions Vin = 115VAC, Iout =100%

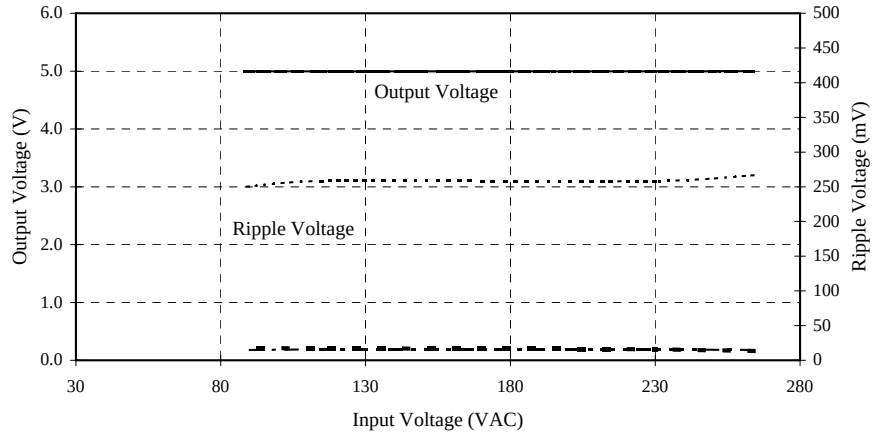
Ta	-25°C	25°C	50°C	temperature stability	
Vout	23.963V	23.982V	23.921V	0.061V	0.254%

2-1 Steady State Data

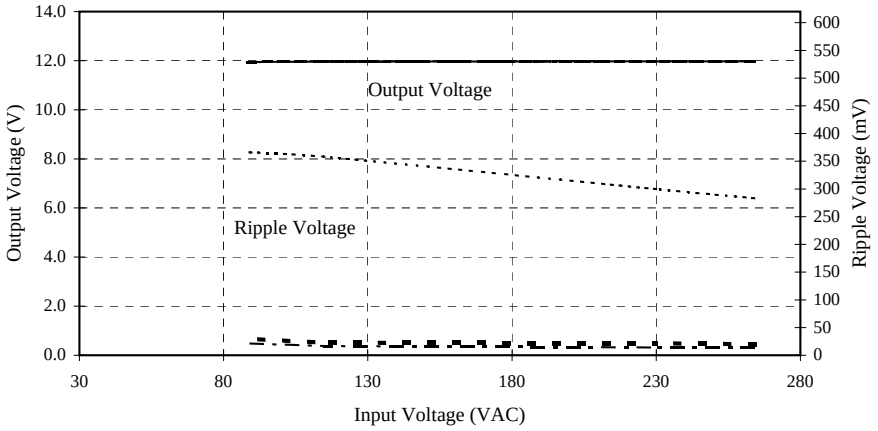
(2) Output Voltage And Ripple Voltage Vs Input Voltage

Condition : Iout = 100%
Ta = -25°C
= 25°C
= 50°C

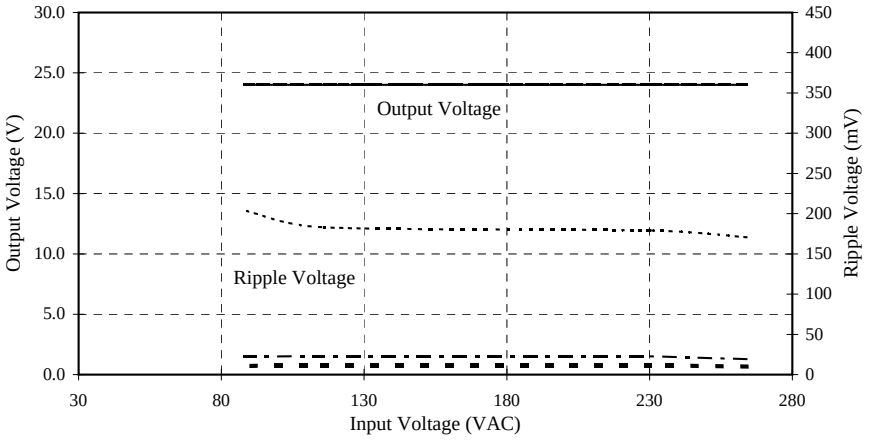
5V



12V



24V

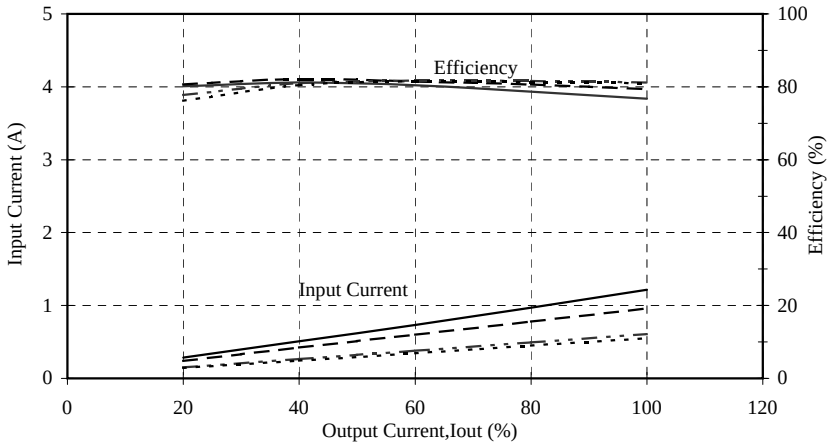


2-1 Steady State Data

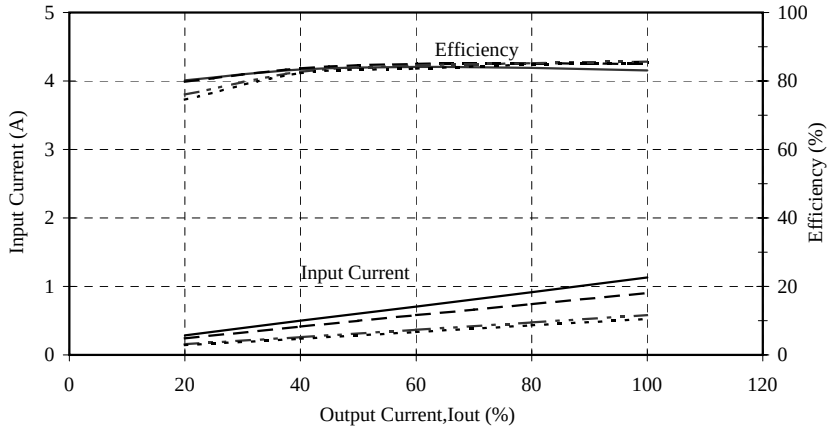
(3) Efficiency And Input Current Vs Output Current

Conditions: Ta= 25°C
Vin= 88VAC
115VAC
230VAC
264VAC

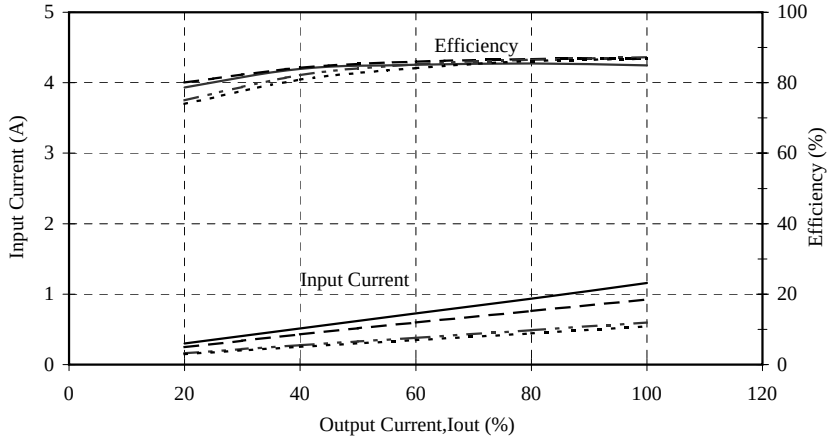
5V



12V



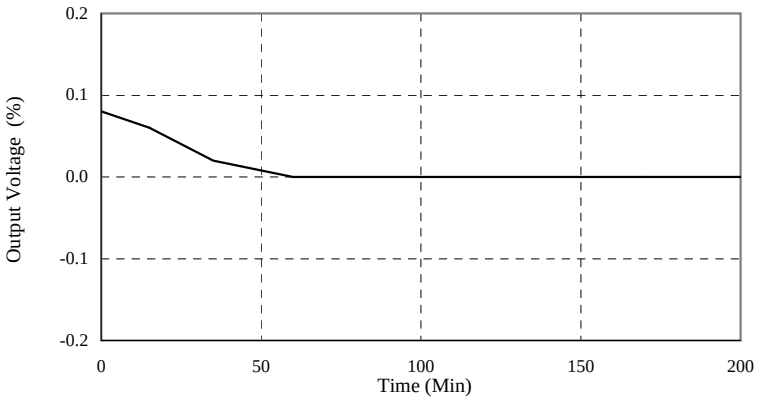
24V



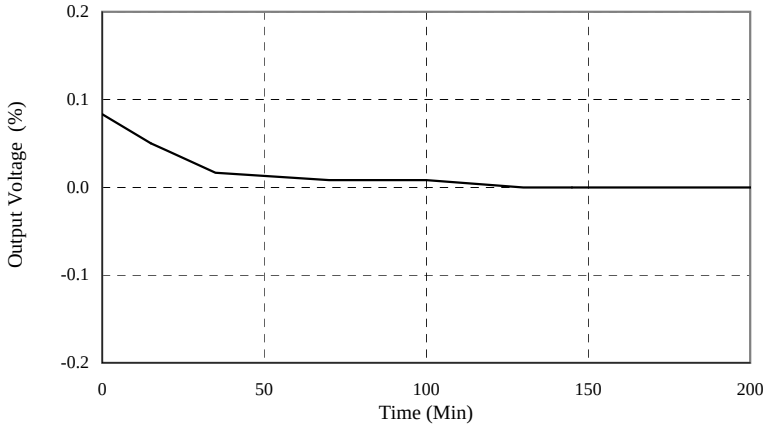
2-2 Warm up voltage drift characteristics

Conditions: Vin : 230VAC
Iout : 100%
Ta : 25℃

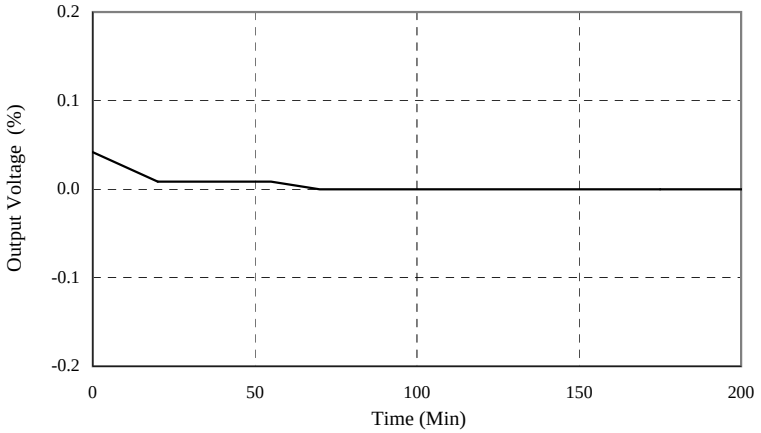
5V



12V



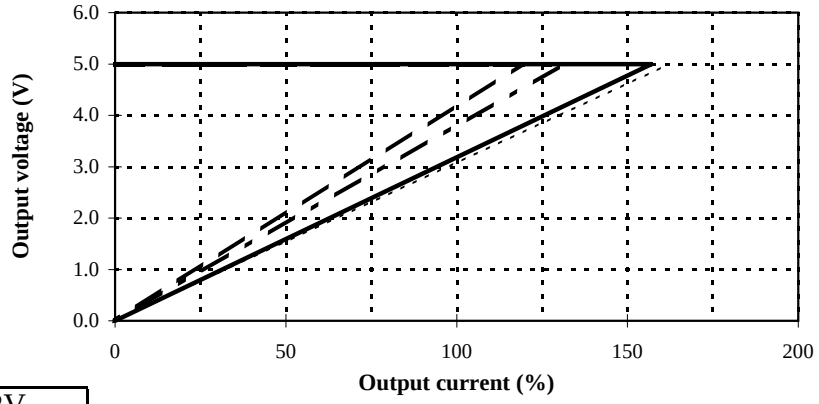
24V



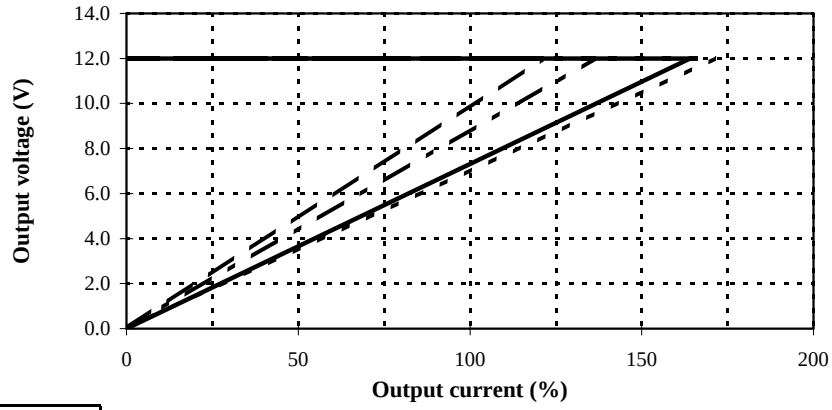
2-3 Over current protection (OCP) characteristics

Conditions: Vin : 88 VAC
115 VAC
230 VAC
264 VAC
Ta : 25℃

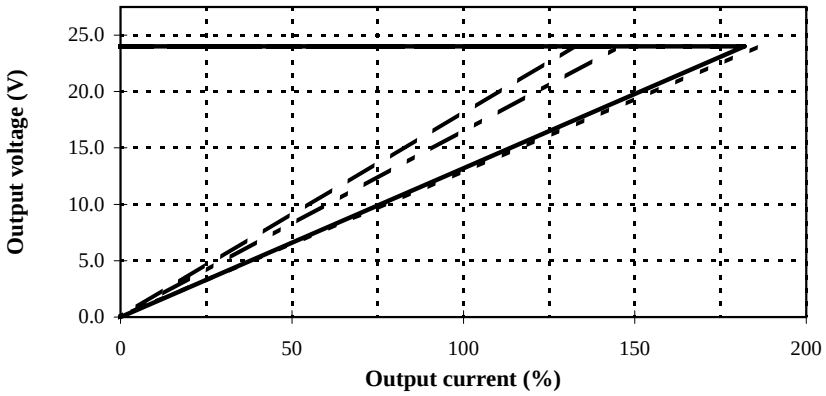
5V



12V



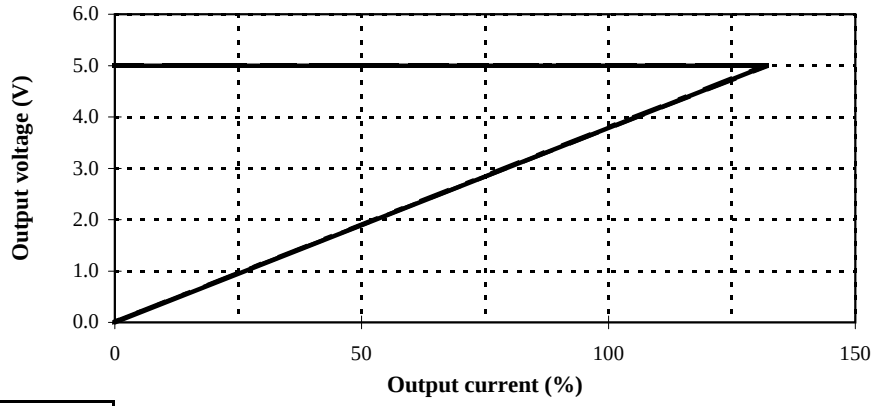
24V



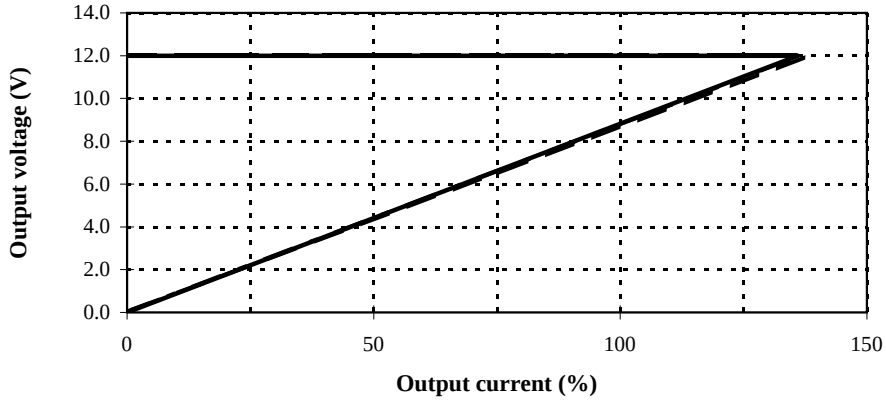
2-3 Over current protection (OCP) characteristics

Conditions: Vin : 115VAC
Ta : -25℃ – – – – –
25℃ - · - · - · -
50℃ ———

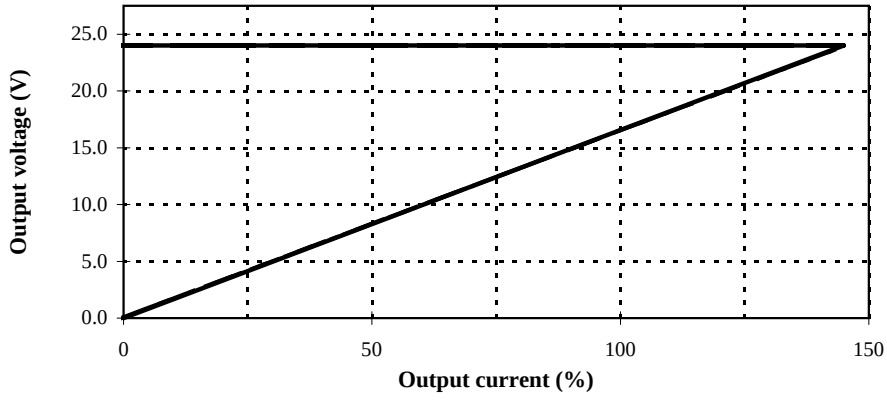
5V



12V



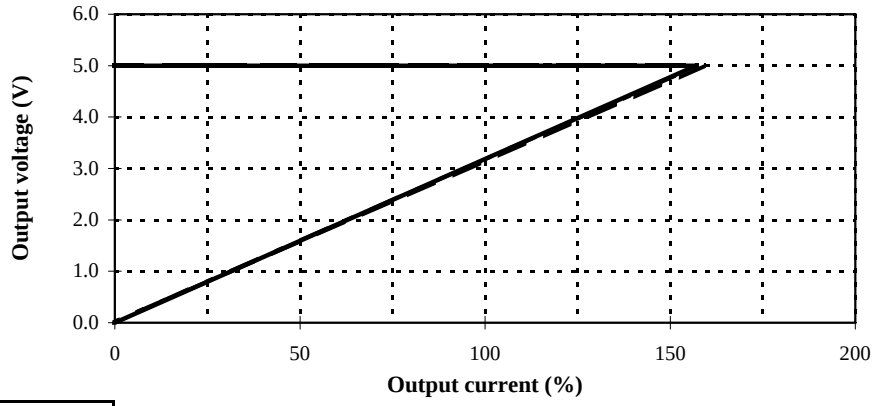
24V



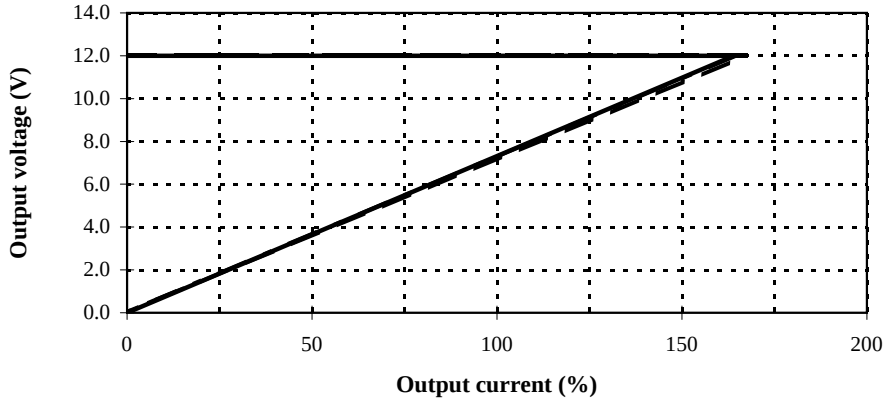
2-3 Over current protection (OCP) characteristics

Conditions: Vin : 230VAC
Ta : -25℃ – – – – –
25℃ - · - · - · -
50℃ ———

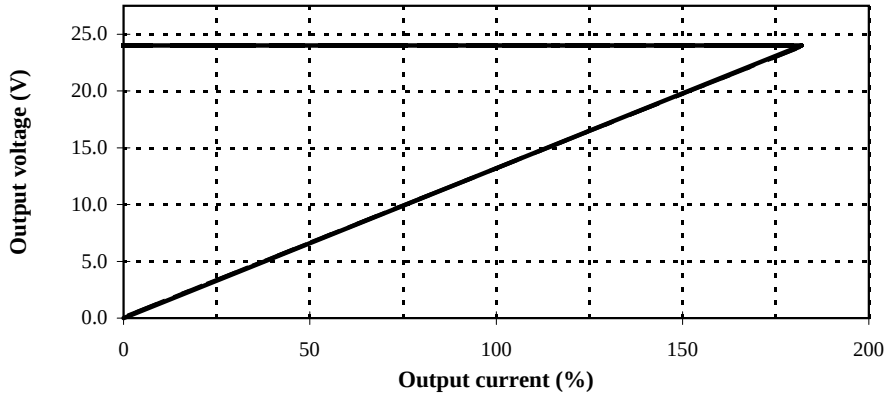
5V



12V



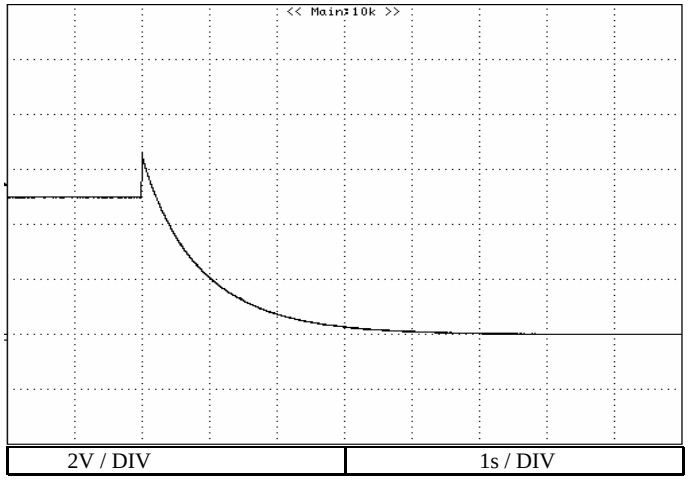
24V



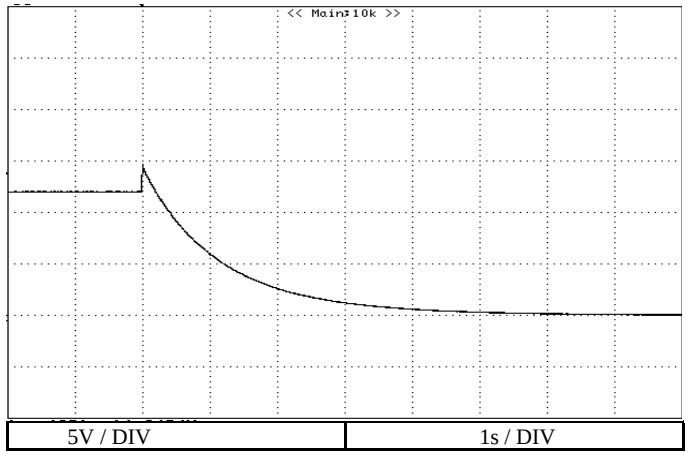
2-4 Over voltage protection (OVP) characteristics

Conditions : Ta = 25°C
Vin = 230VAC
Iout = 0%

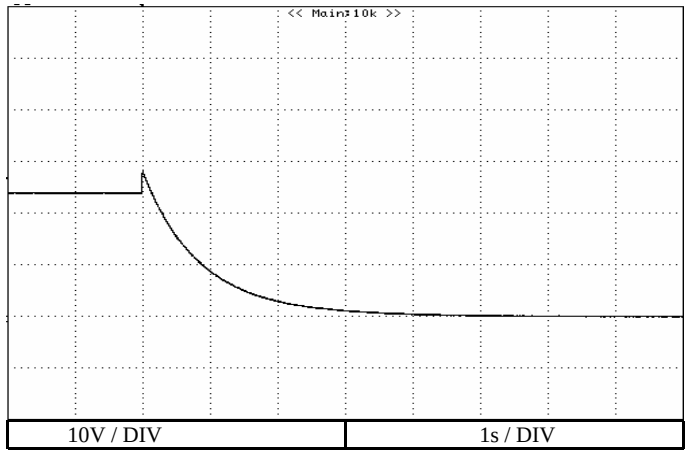
5V



12V



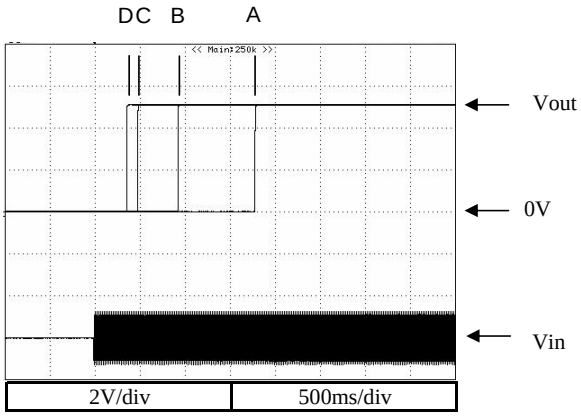
24V



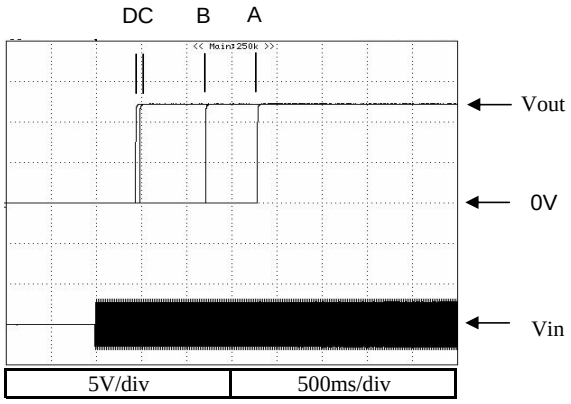
2-5 Output Rise Characteristics

Conditions: Vin : 88VAC (A)
: 115VAC (B)
: 230VAC (C)
: 264VAC (D)
Iout : 0%
Ta : 25°C

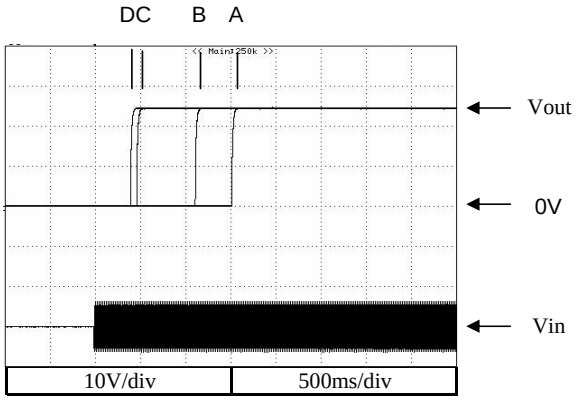
5V



12V



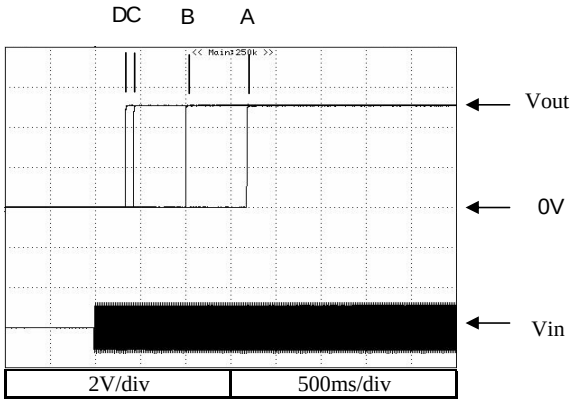
24V



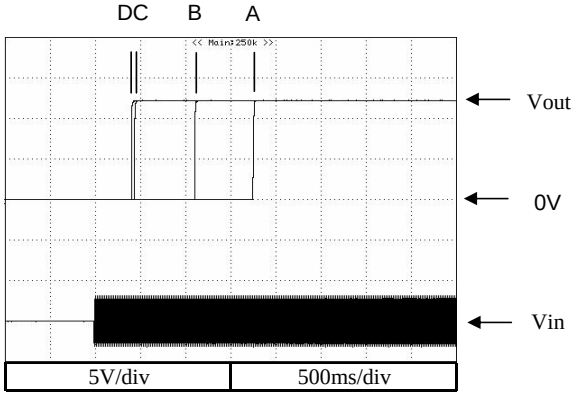
2-5 Output Rise Characteristics

Conditions:
Vin : 88VAC (A)
: 115VAC (B)
: 230VAC (C)
: 264VAC (D)
Iout : 100%
Ta : 25°C

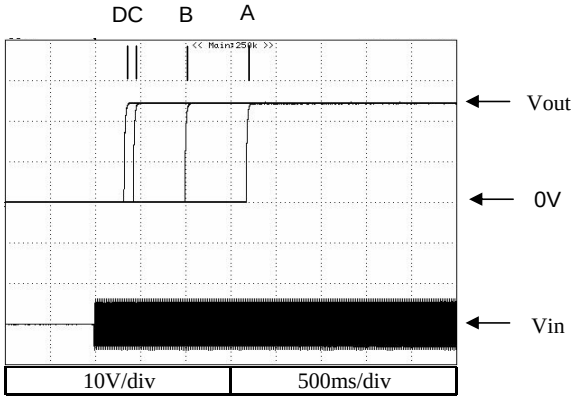
5V



12V



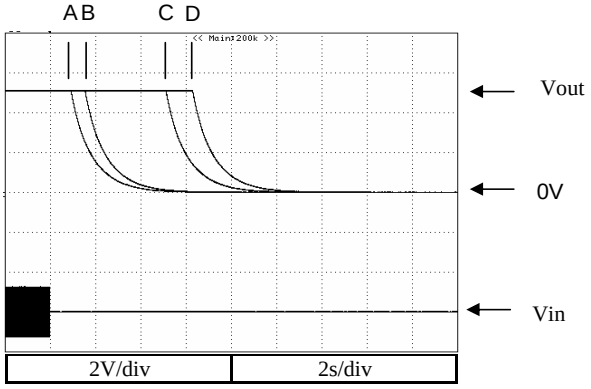
24V



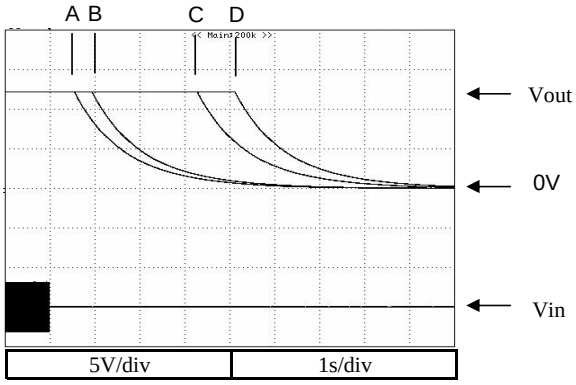
2-6 Output Fall Characteristics

Conditions: Vin : 88VAC (A)
: 115VAC (B)
: 230VAC (C)
: 264VAC (D)
Iout : 0%
Ta : 25°C

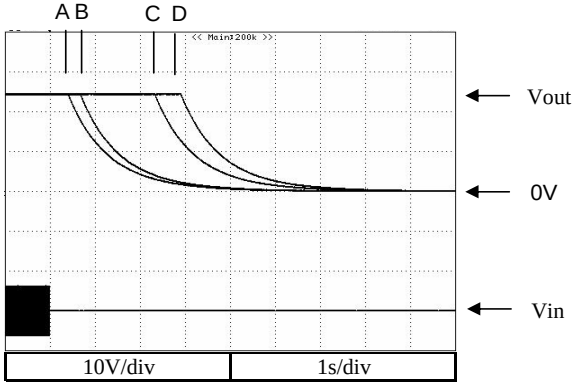
5V



12V



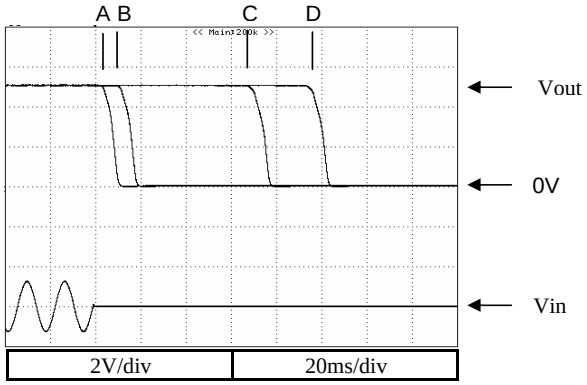
24V



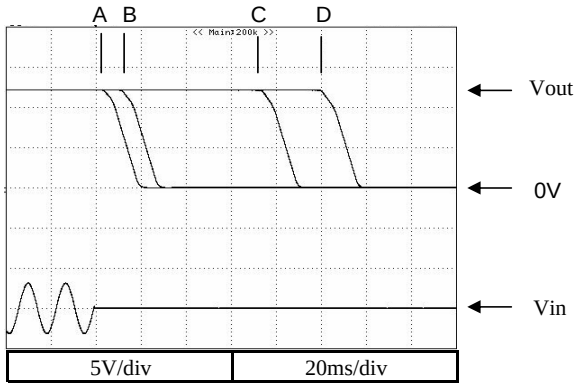
2-6 Output Fall Characteristics

Conditions: Vin : 88VAC (A)
: 115VAC (B)
: 230VAC (C)
: 264VAC (D)
Iout : 100%
Ta : 25°C

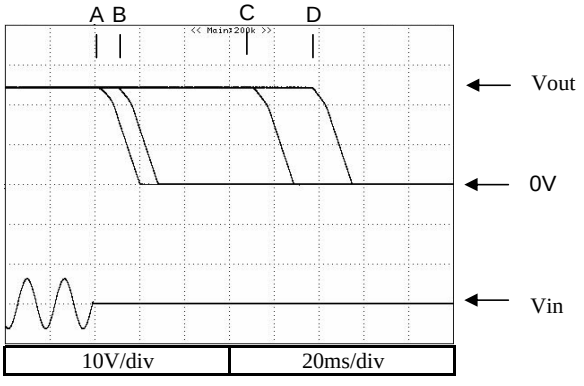
5V



12V



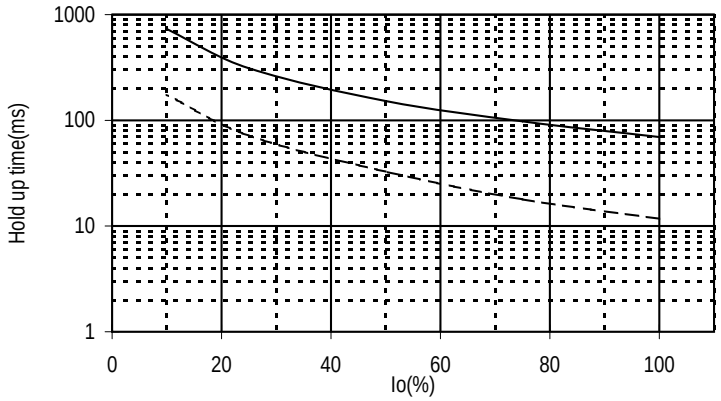
24V



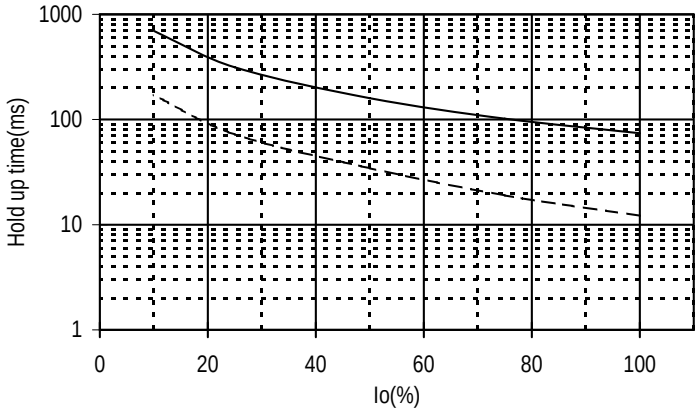
2-7 Hold Up Time Characteristics

Conditions Vin: 115VAC - - - - - - - -
230VAC ————
Ta: 25°C

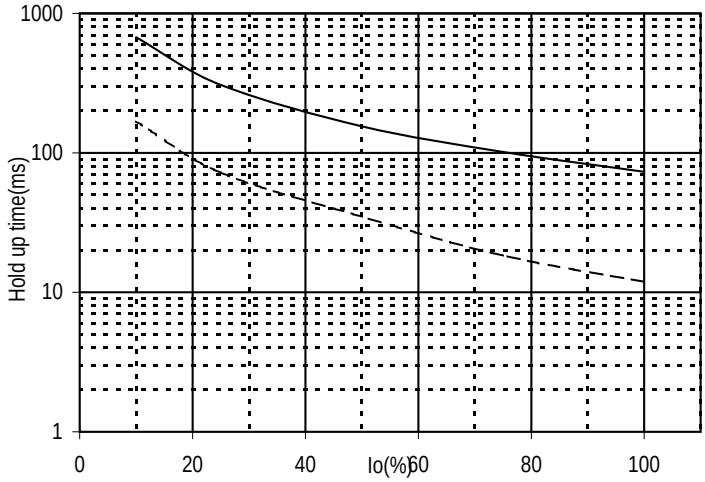
5V



12V



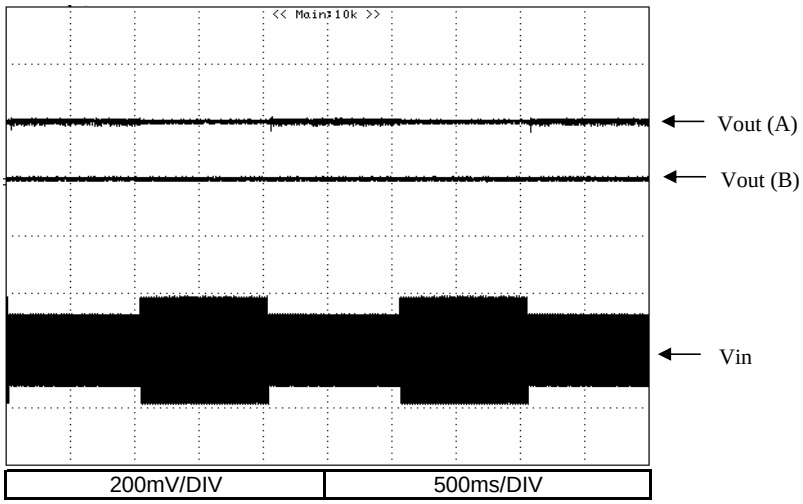
24V



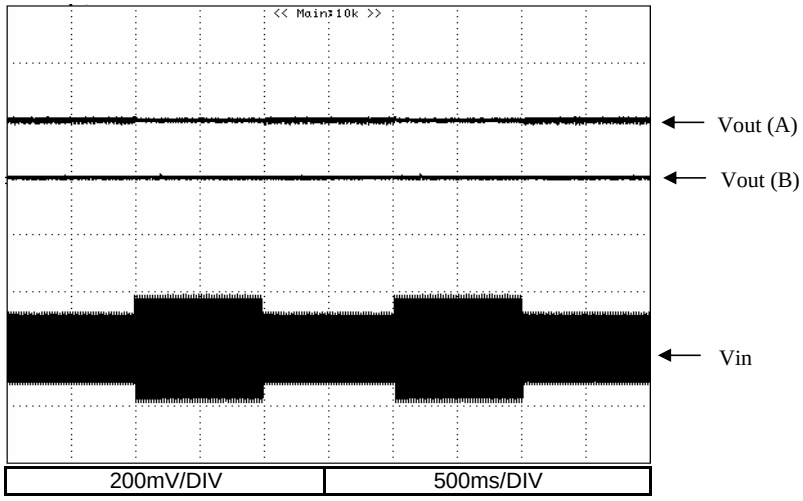
2-8 Dynamic Line Response Characteristics

Conditions : Vin = 88<=>132 VAC (A)
= 170<=>264 VAC (B)
Iout = 100%
Ta = 25°C

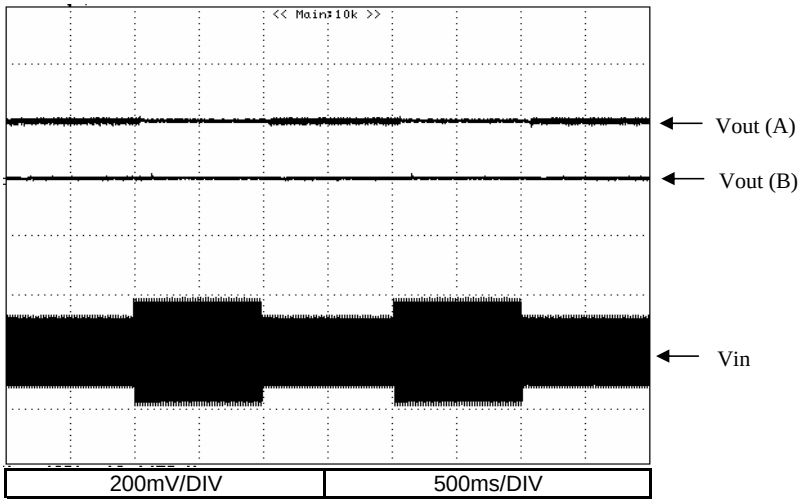
5V



12V



24V

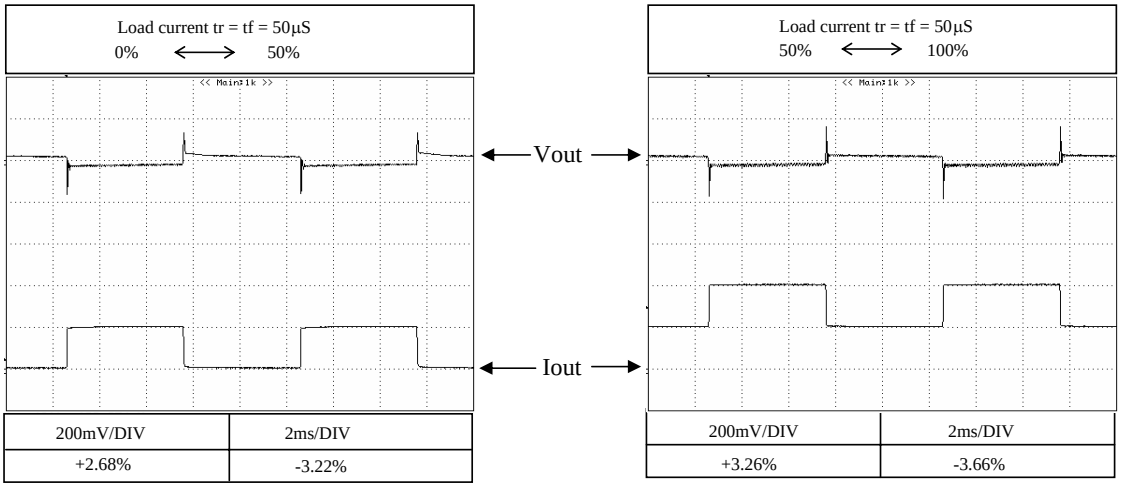


2-9 Dynamic Load Response Characteristics

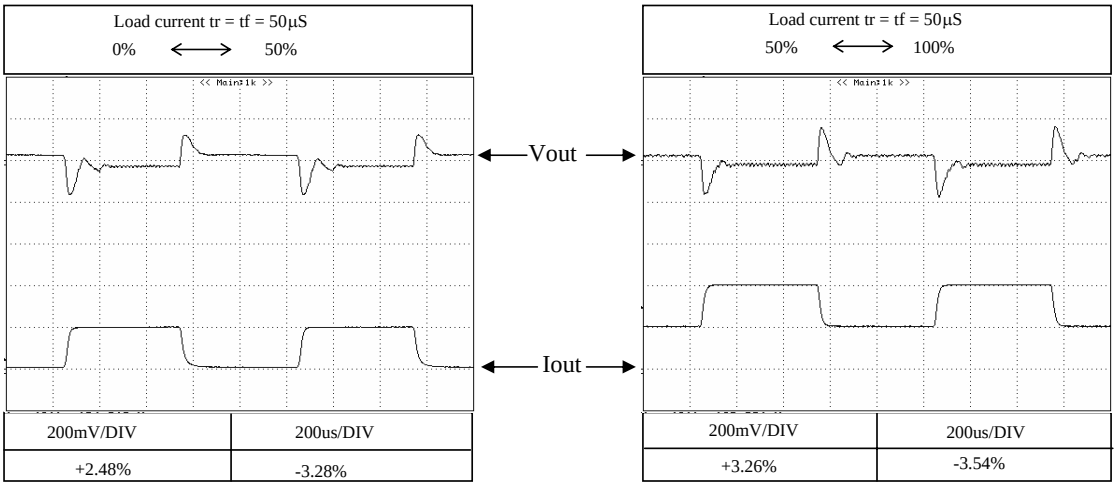
Conditions : Vin = 115VAC
Ta = 25°C

5V

f=100Hz



f=1KHz

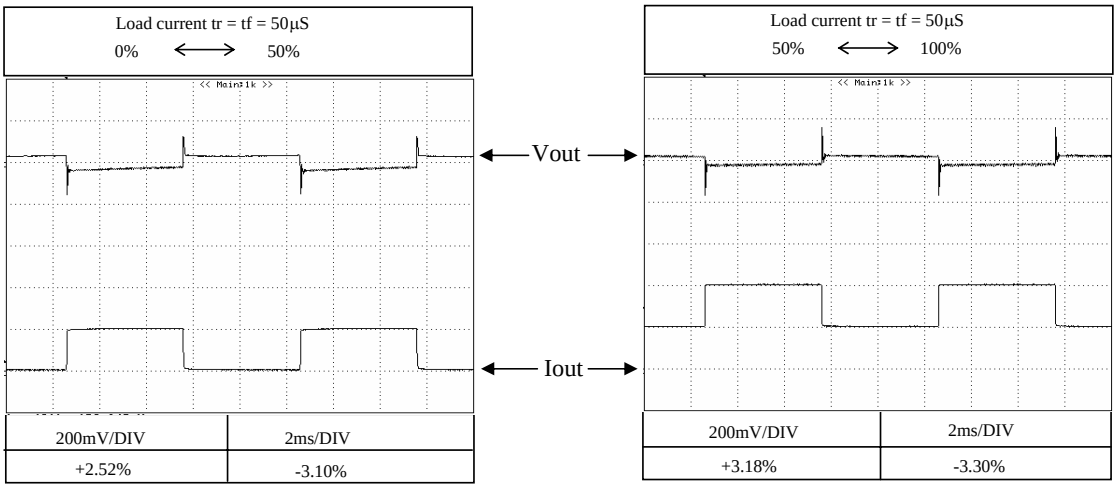


2-9 Dynamic Load Response Characteristics

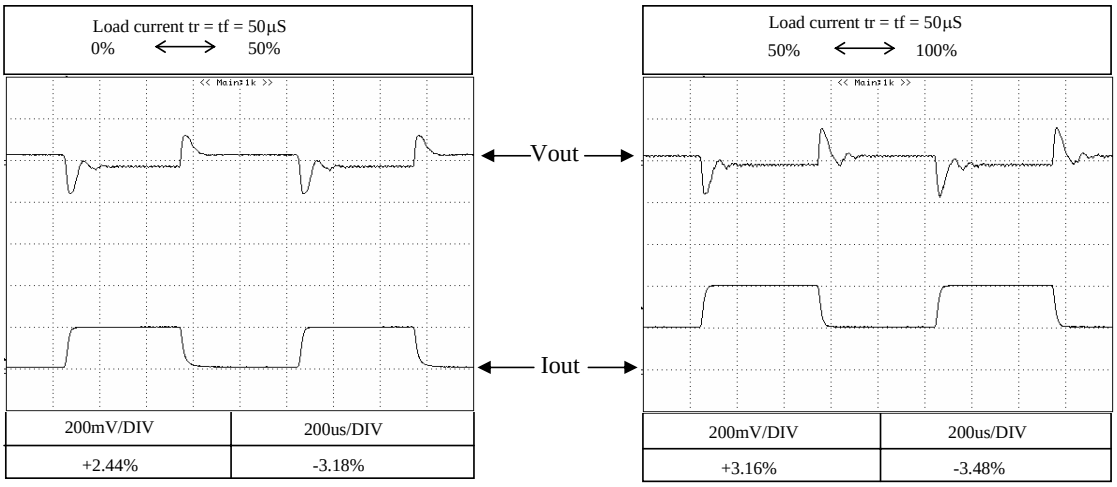
Conditions : Vin = 230VAC
Ta = 25°C

5V

f=100Hz



f=1KHz

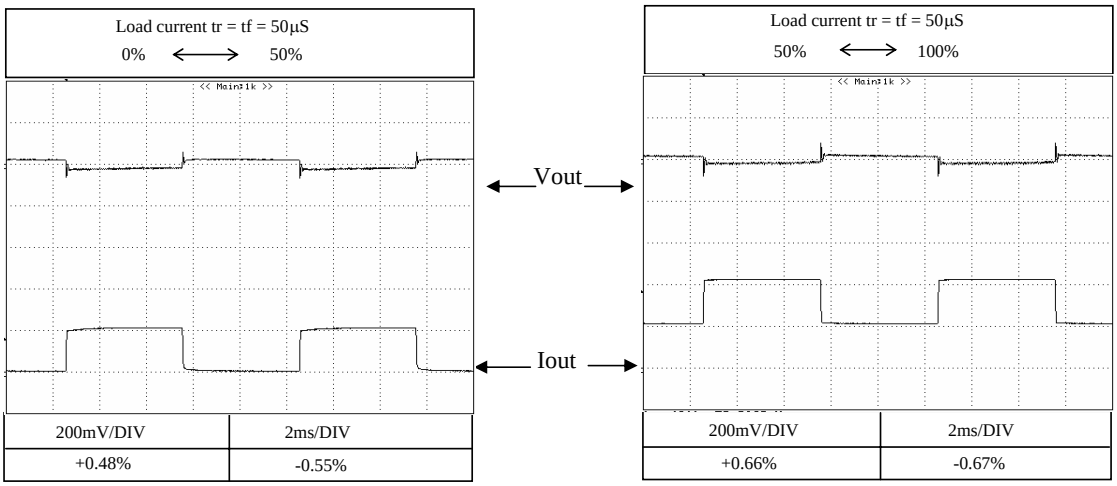


2-9 Dynamic Load Response Characteristics

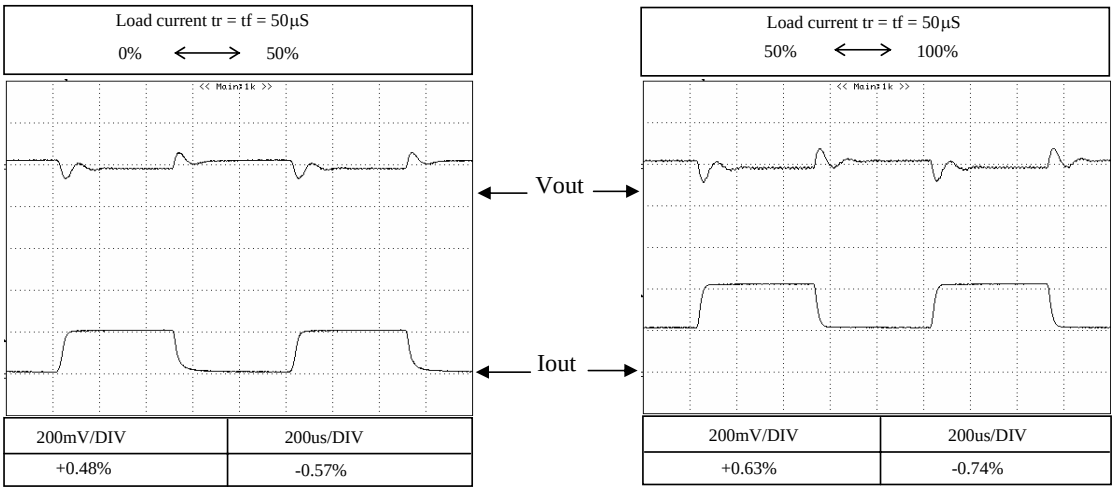
Conditions : Vin = 115VAC
Ta = 25°C

12V

f=100Hz



f=1KHz

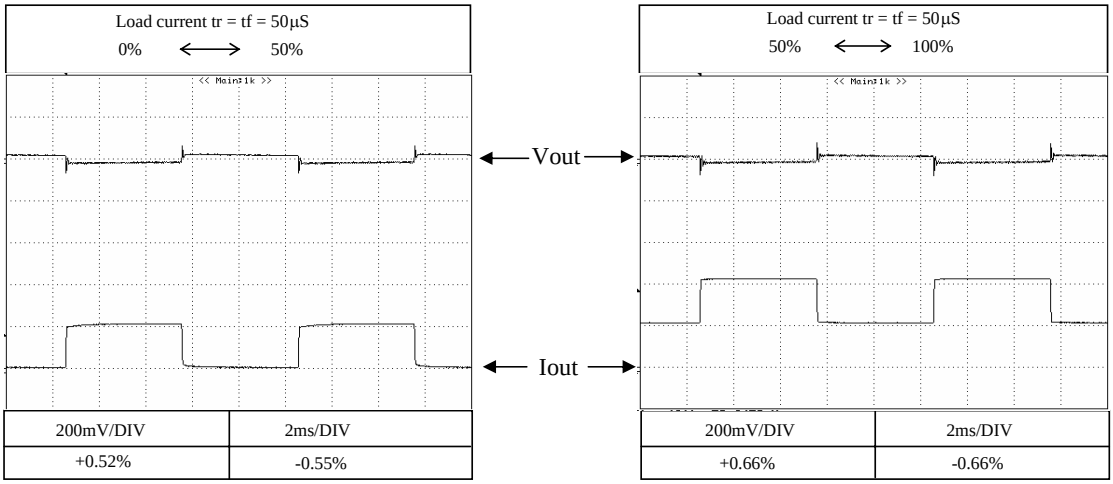


2-9 Dynamic Load Response Characteristics

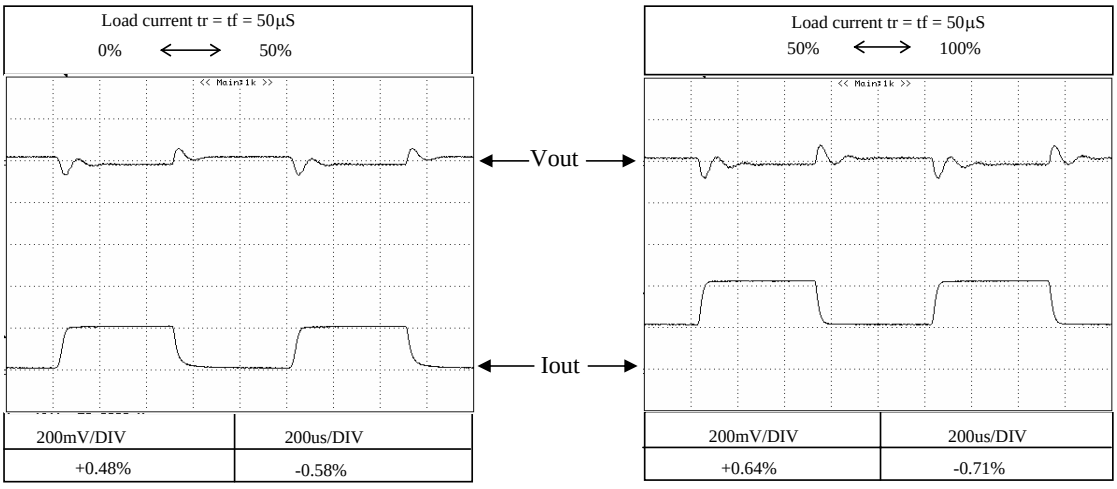
Conditions Vin = 230VAC
Ta = 25°C

12V

f=100Hz



f=1KHz

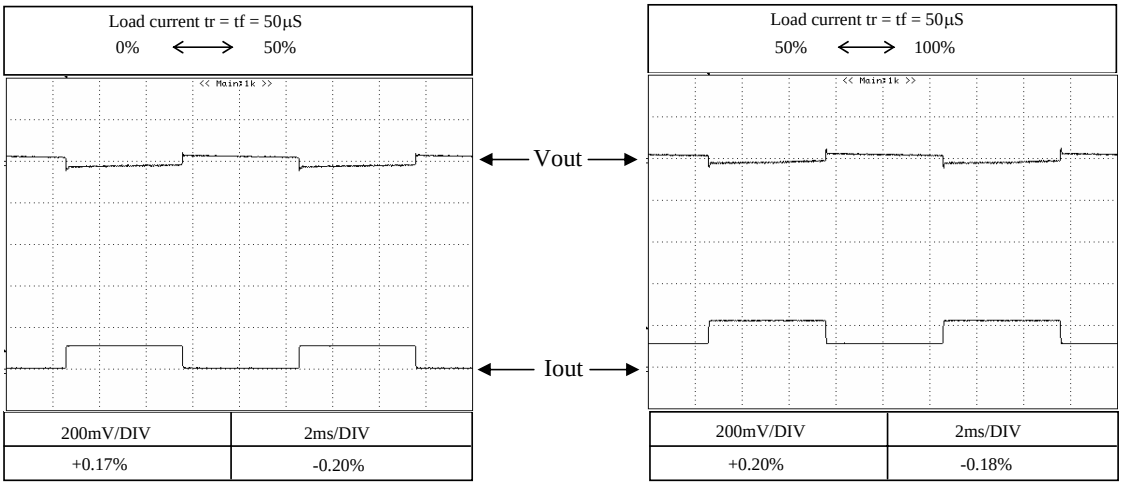


2-9 Dynamic Load Response Characteristics

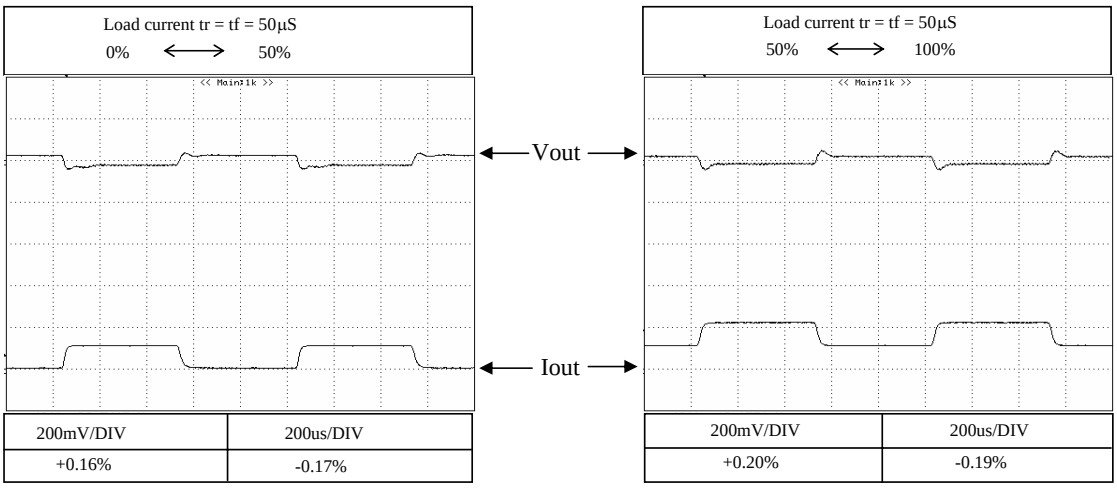
Conditions : Vin = 115VAC
Ta = 25°C

24V

f=100Hz



f=1KHz

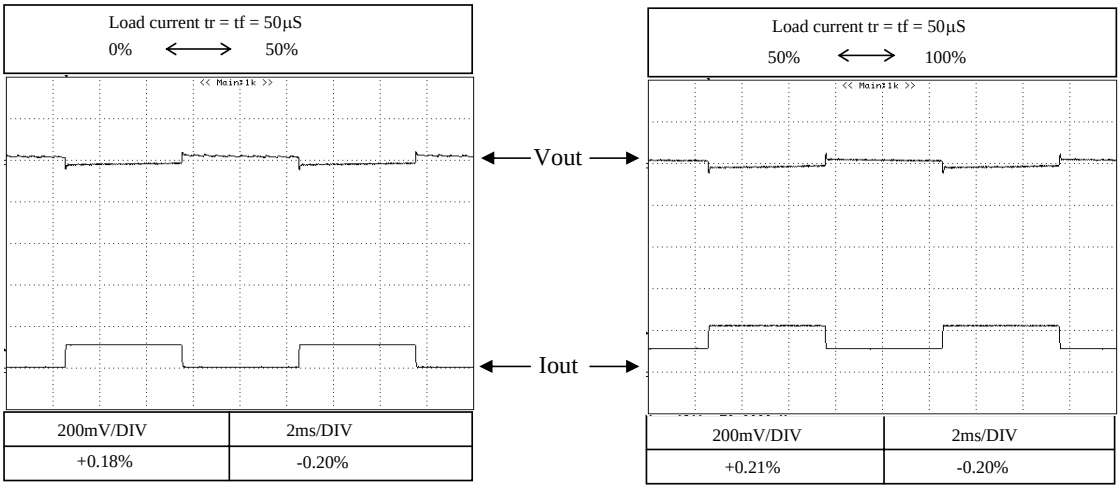


2-9 Dynamic Load Response Characteristics

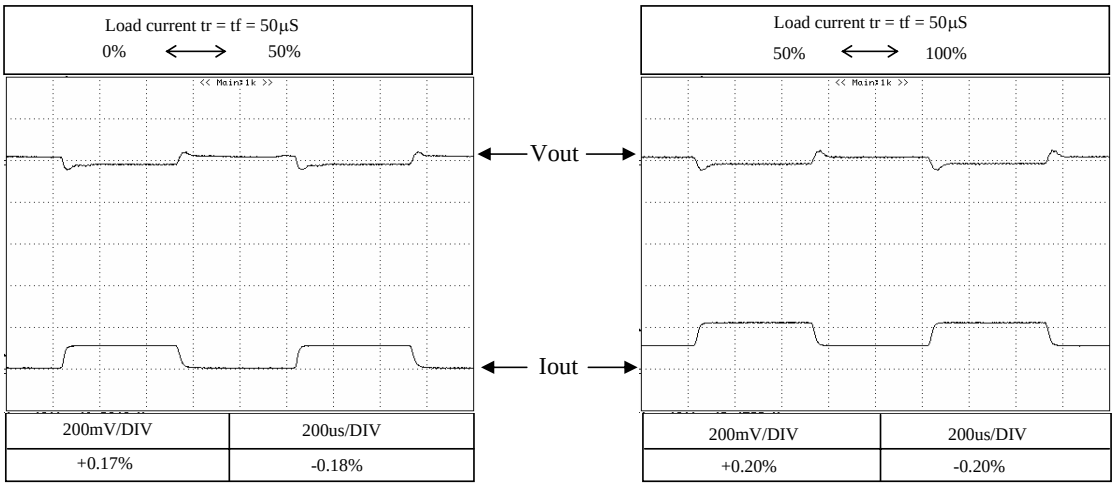
Conditions Vin = 230VAC
Ta = 25°C

24V

f=100Hz



f=1KHz

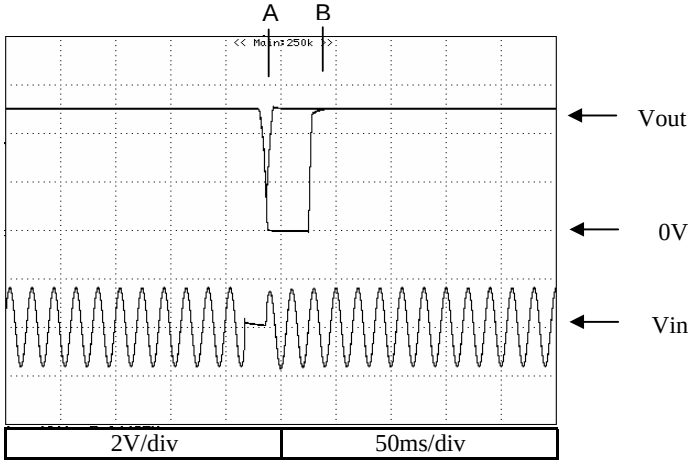


2-10 Response to Brown Out Characteristics

Conditions: Vin : 115VAC
Iout : 100%
Ta : 25°C

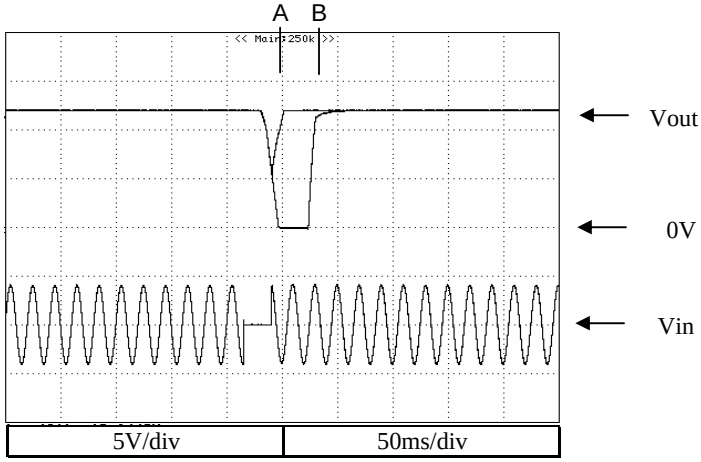
5V

A = 20ms
B = 60ms



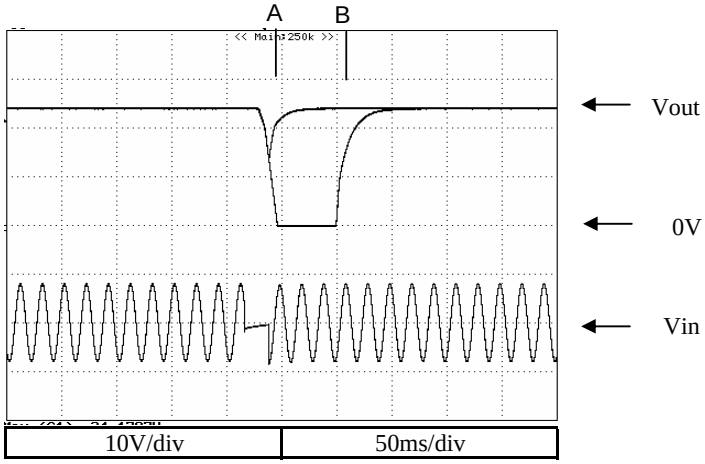
12V

A = 25.8ms
B = 58.0ms



24V

A = 22ms
B = 80ms

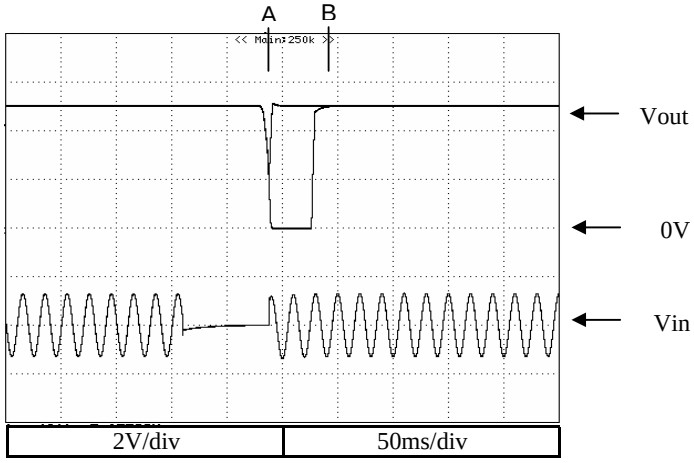


2-10 Response to Brown Out Characteristics

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

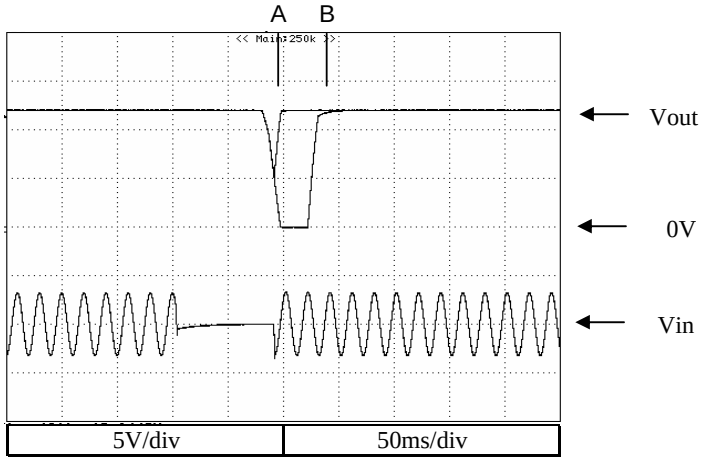
5V

A = 78ms
B = 120ms



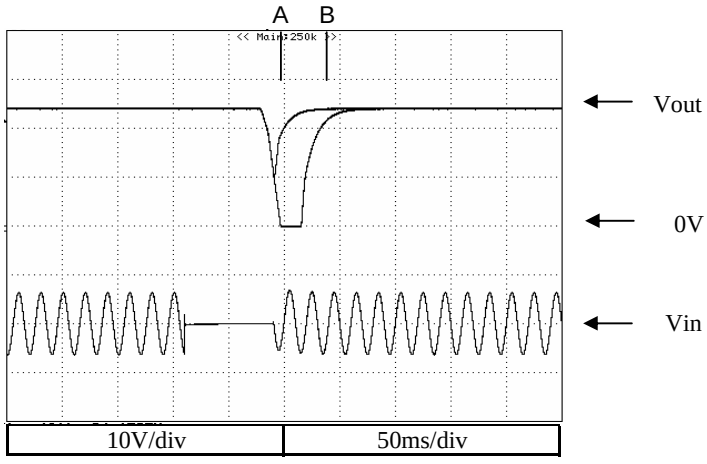
12V

A = 88ms
B = 120ms



24V

A = 80ms
B = 110ms

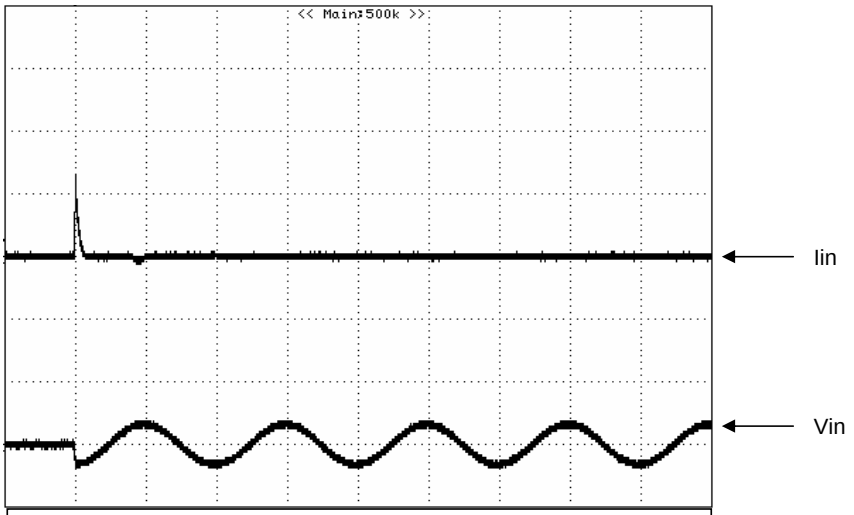


2-11 Inrush Current

Conditions : Vin = 115VAC
Iout = 100%
Ta = 25°C

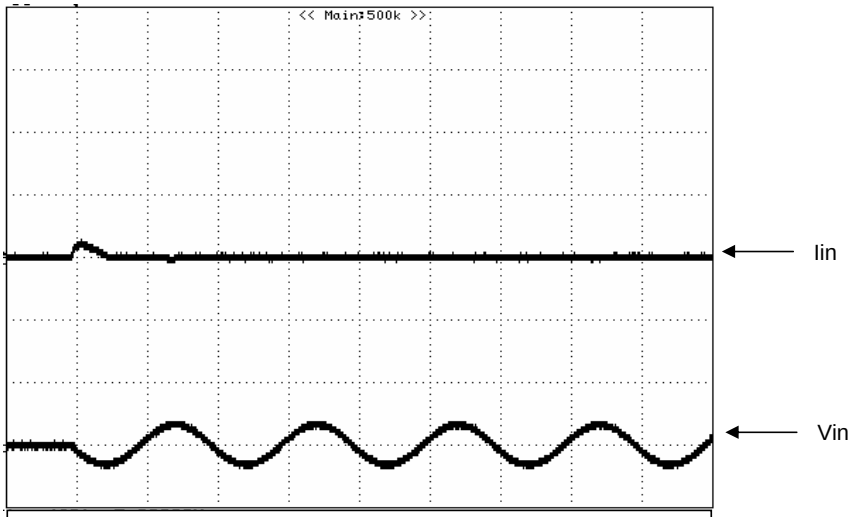
5V

Φ = 90°



25.83 A	
20A/DIV	10mS/DIV

Φ = 0°



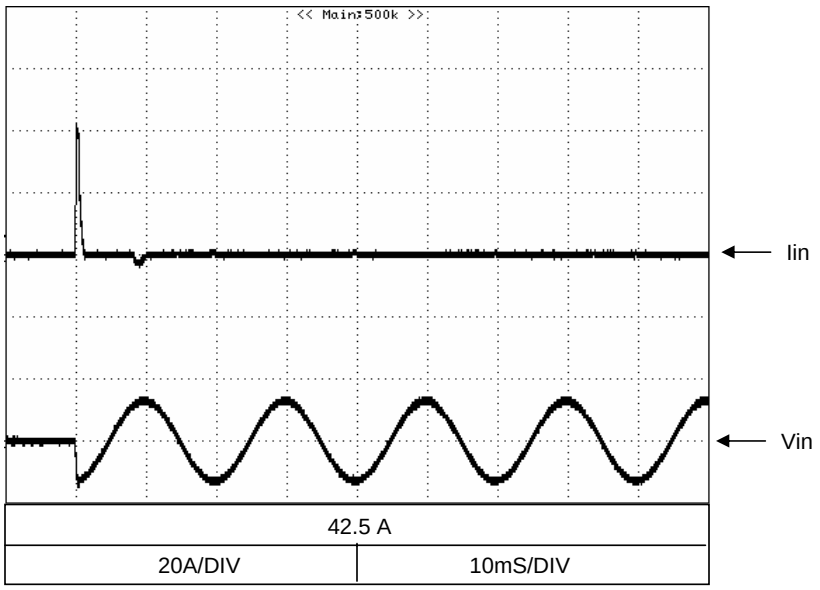
5.83 A	
20A/DIV	10mS/DIV

2-11 Inrush Current

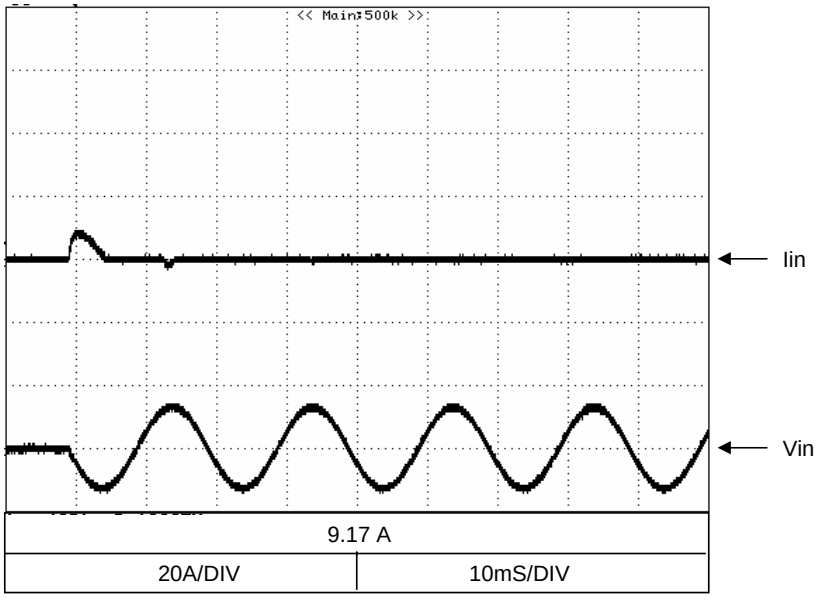
Conditions : Vin = 230VAC
Iout = 100%
Ta = 25°C

5V

Φ = 90°



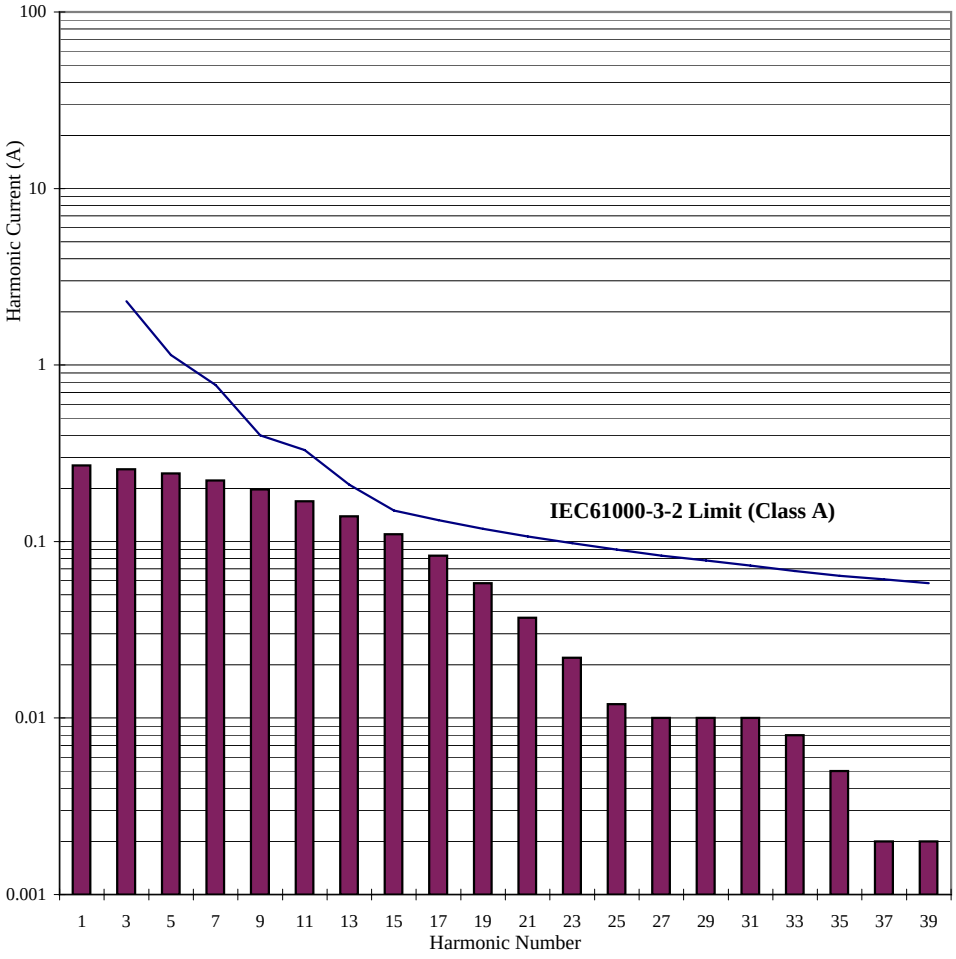
Φ = 0°



2-12 Input Current Harmonics

Conditions : Vin = 230VAC
Iout = 100%
Ta = 25°C
f = 60Hz

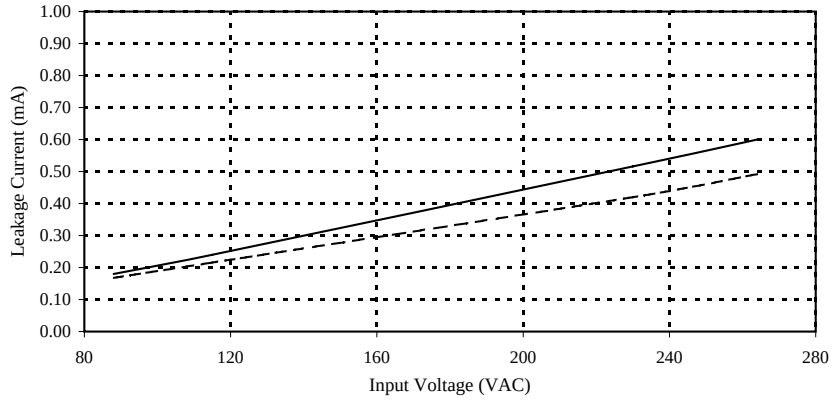
5V



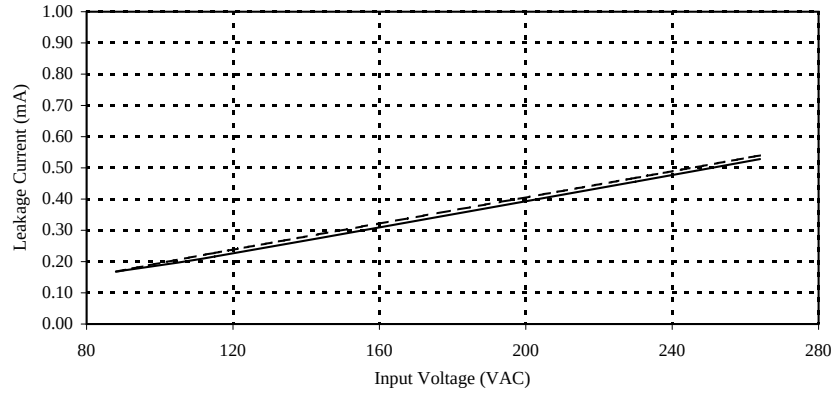
2-13 Leakage Current Characteristics

Conditions : Iout = 0% ——
= 100% - - - - - -
Ta = 25°C
f = 50Hz

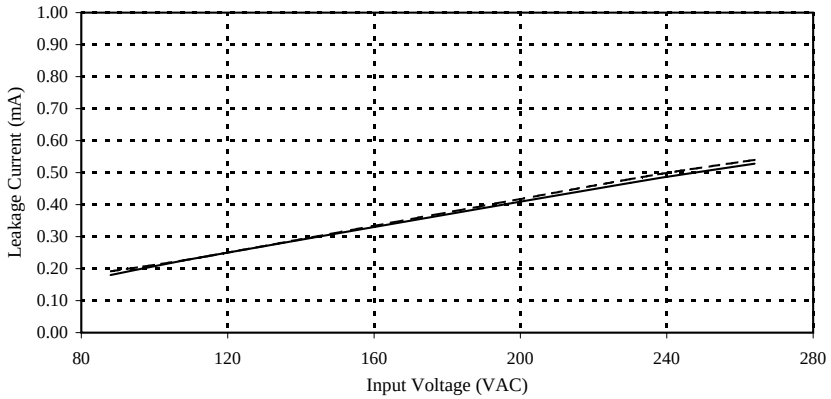
5V



12V



24V

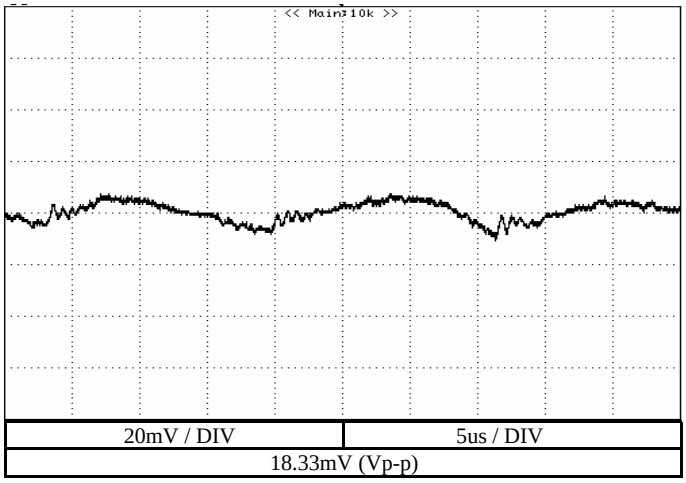


2-14 Output Ripple And Noise Waveform

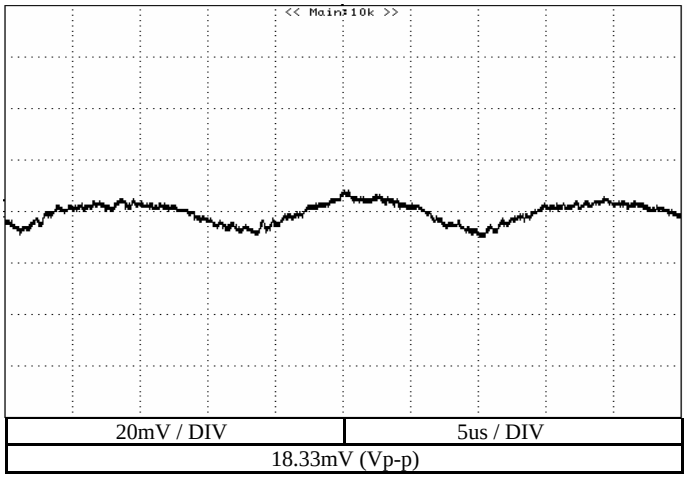
Conditions Vin = 230VAC
Iout = 100%
Ta = 25°C

NORMAL MODE

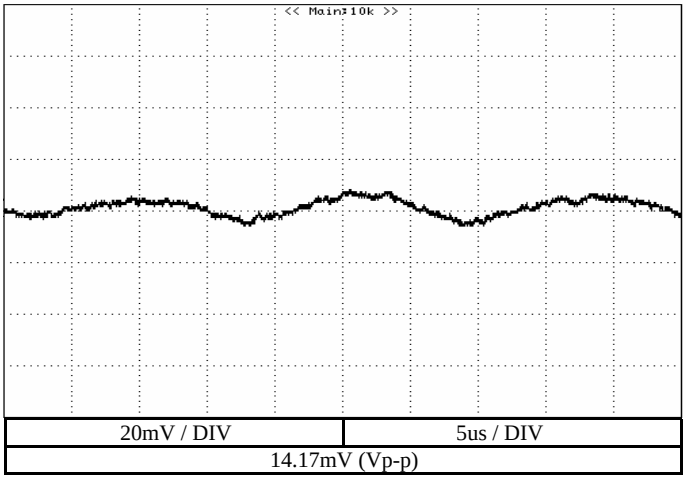
5V



12V



24V

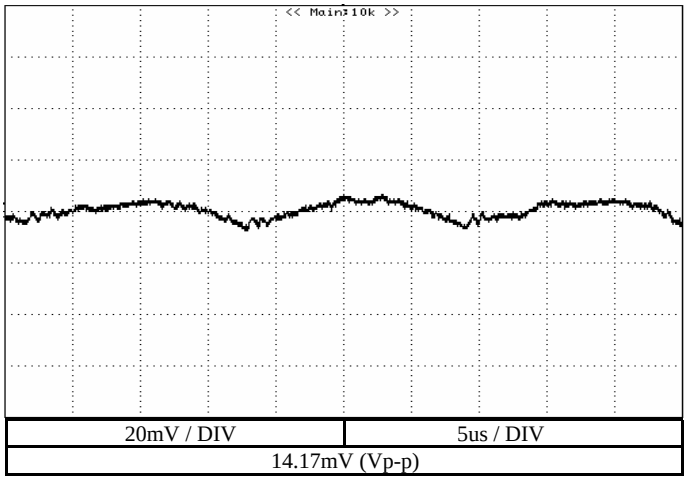


2-14 Output Ripple And Noise Waveform

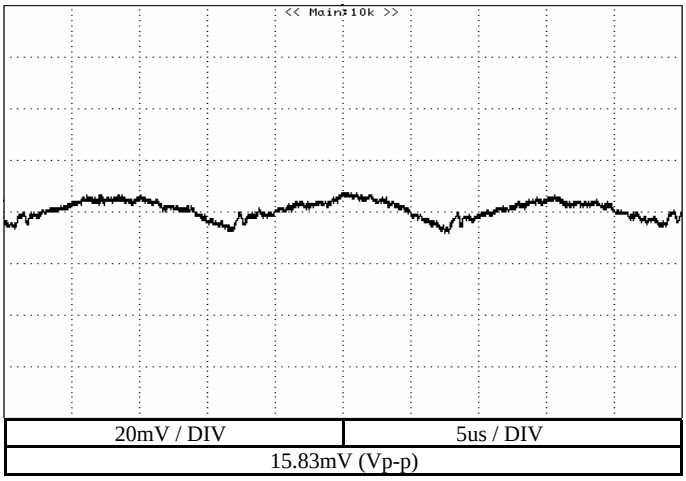
Conditions Vin = 230VAC
Iout = 100%
Ta = 25°C

NORMAL + COMMON MODE

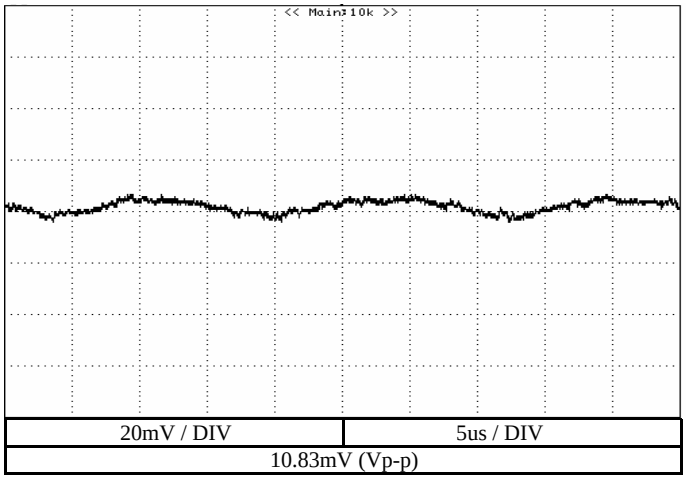
5V



12V



24V



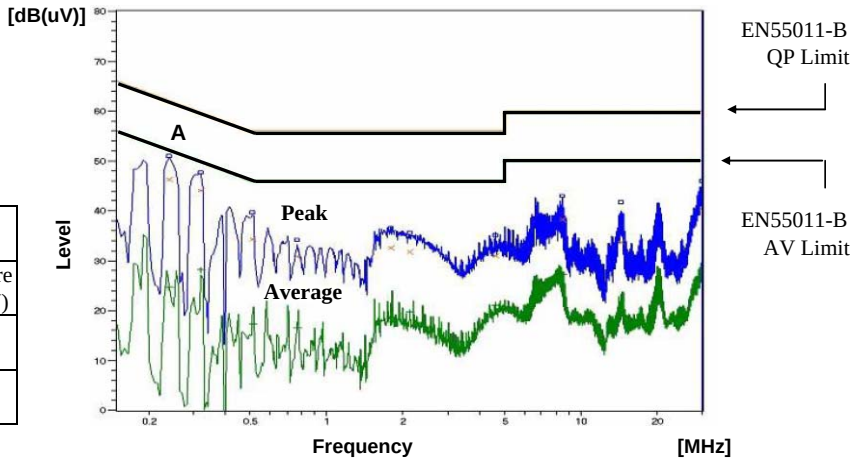
2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 115VAC
Iout : 100%

Conducted Emission

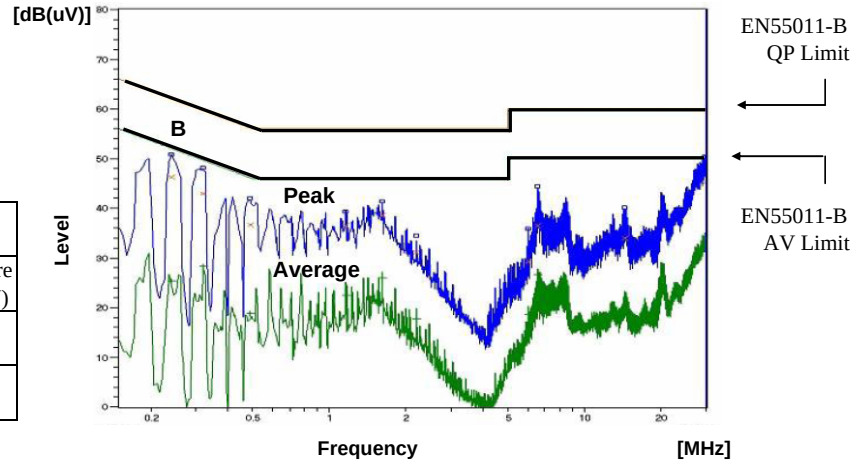
5V

Ref. / Data	Point A (0.240MHz) Limit (dBµV)	Measure (dBµV)
QP	62.1	46.3
AV	52.1	24.7



Phase : N

Ref. / Data	Point B (0.240MHz) Limit (dBµV)	Measure (dBµV)
QP	62.1	46.3
AV	52.1	25.4



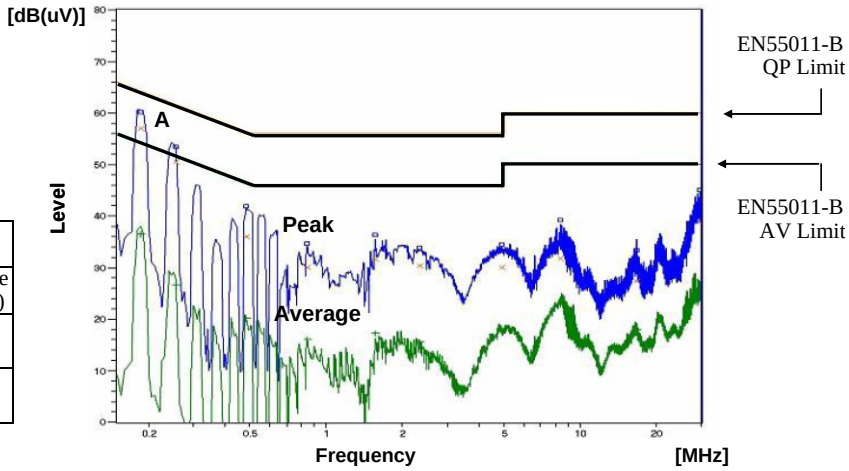
Phase : L

2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 230VAC
Iout : 100%

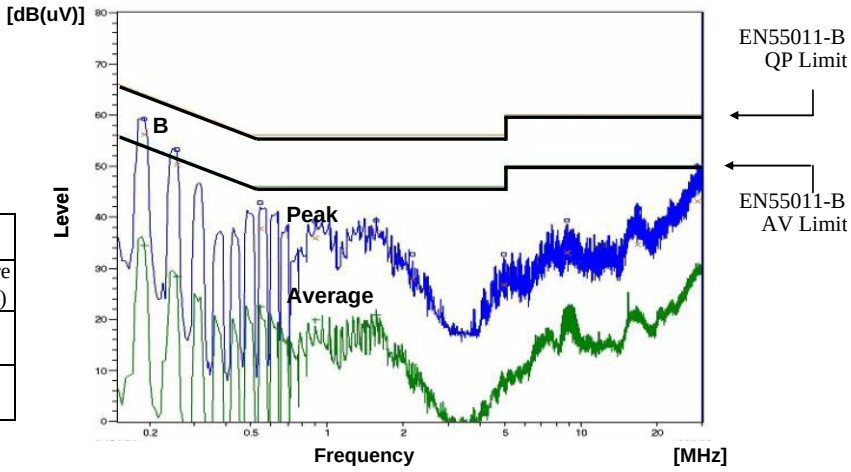
Conducted Emission

5V



Ref. Data	Point A (0.185MHz) Limit (dBµV)	Measure (dBµV)
QP	64.3	57.0
AV	54.3	36.6

Phase : N



Ref. Data	Point B (0.190MHz) Limit (dBµV)	Measure (dBµV)
QP	64.0	56.2
AV	54.0	34.5

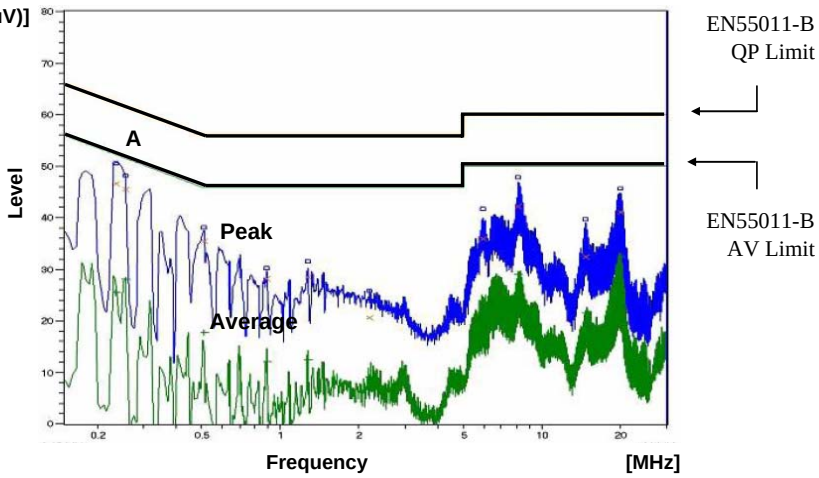
Phase : L

2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 115VAC
Iout : 100%

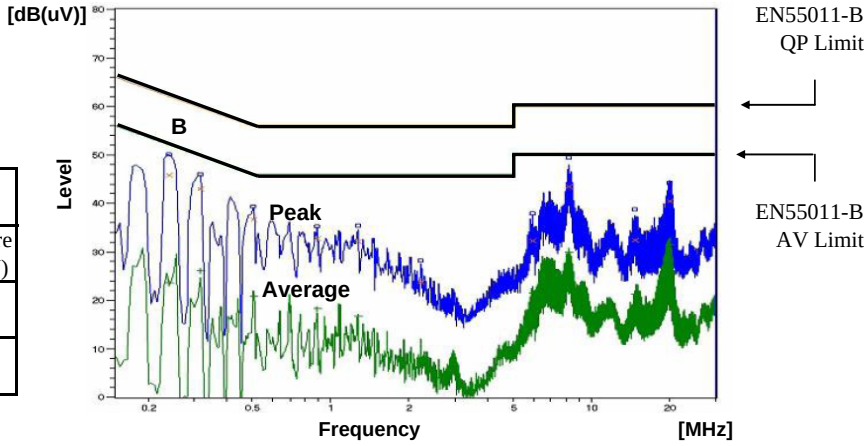
Conducted Emission

12V



Ref. / Data	Point A (0.235 MHz) Limit (dBµV)	Measure (dBµV)
QP	62.3	46.7
AV	52.3	25.5

Phase : N



Ref. / Data	Point B (0.24 MHz) Limit (dBµV)	Measure (dBµV)
QP	62.1	45.9
AV	52.1	23.6

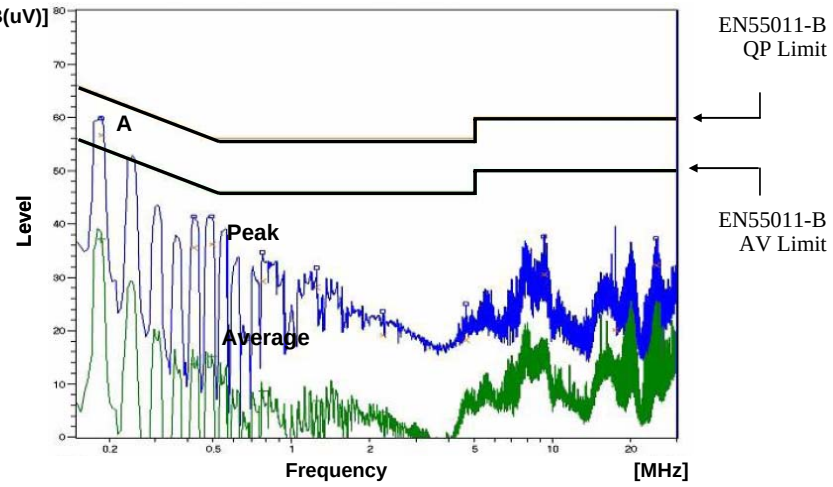
Phase : L

2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 230VAC
Iout : 100%

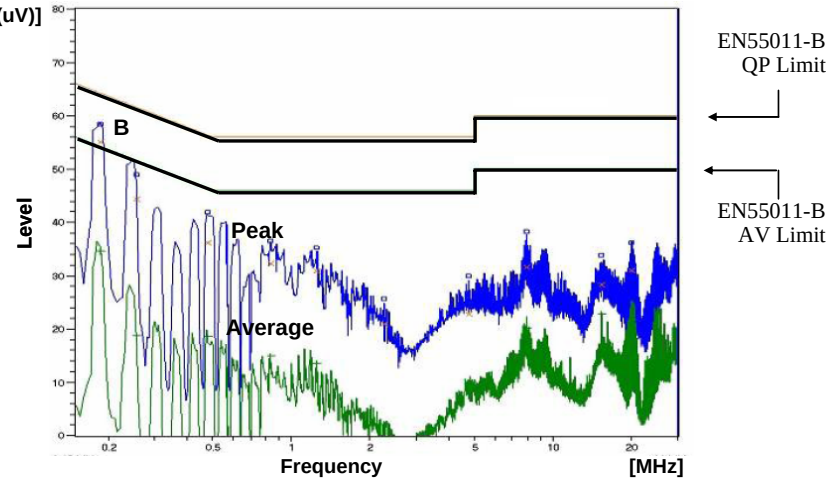
Conducted Emission

12V



Ref. / Data	Point A (0.185 MHz) Limit (dBµV)	Measure (dBµV)
QP	64.3	56.6
AV	54.3	37.1

Phase : N



Ref. / Data	Point B (0.185MHz) Limit (dBµV)	Measure (dBµV)
QP	64.3	55.1
AV	54.3	34.6

Phase : L

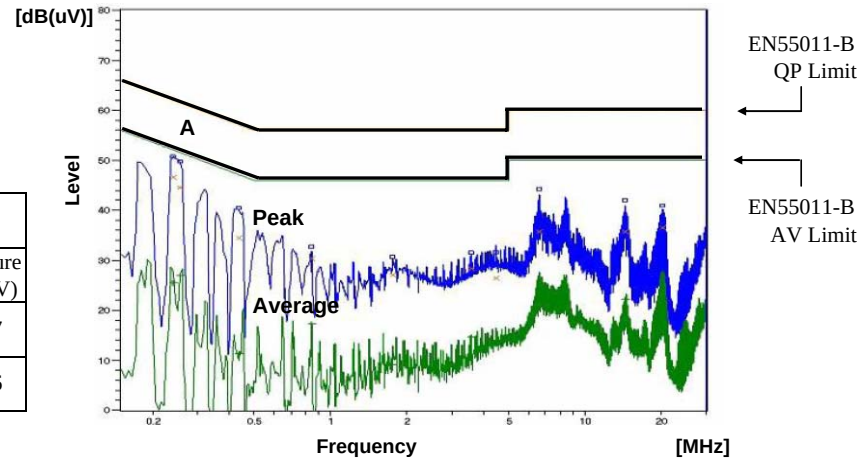
2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 115VAC
Iout : 100%

Conducted Emission

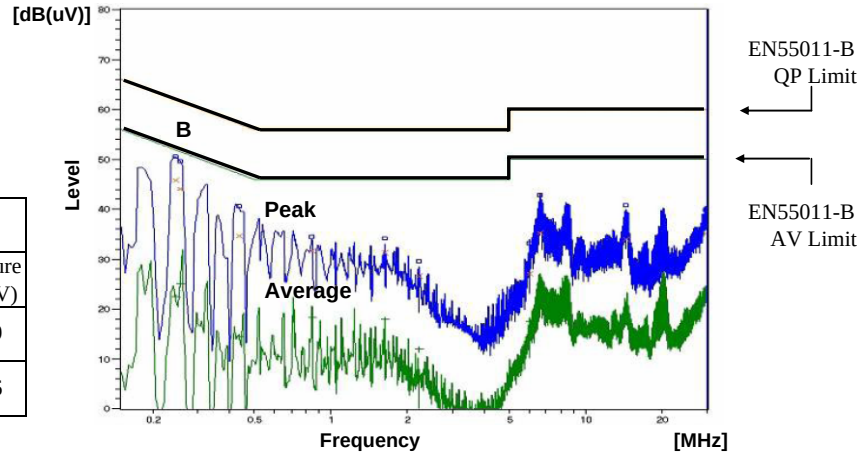
24V

Ref. Data	Point A (0.240 MHz) Limit (dBµV)	Measure (dBµV)
QP	52.1	46.7
AV	62.1	25.6



Phase : N

Ref. Data	Point B (0.245 MHz) Limit (dBµV)	Measure (dBµV)
QP	61.9	45.9
AV	51.9	22.6



Phase : L

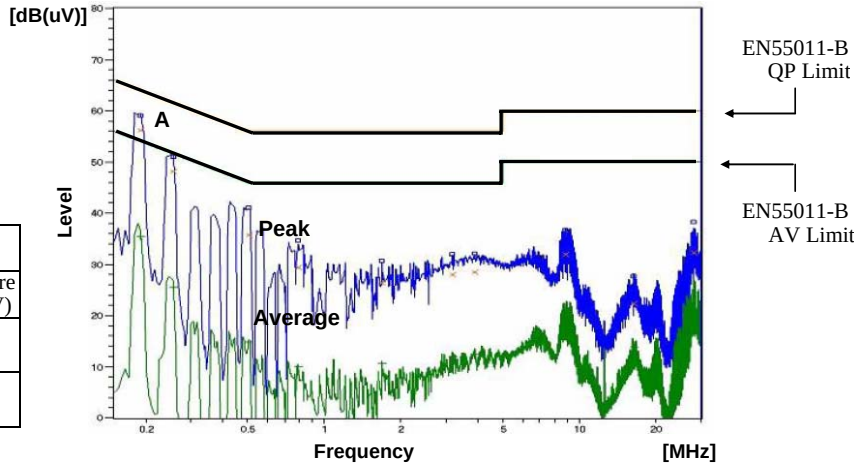
2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 230VAC
Iout : 100%

Conducted Emission

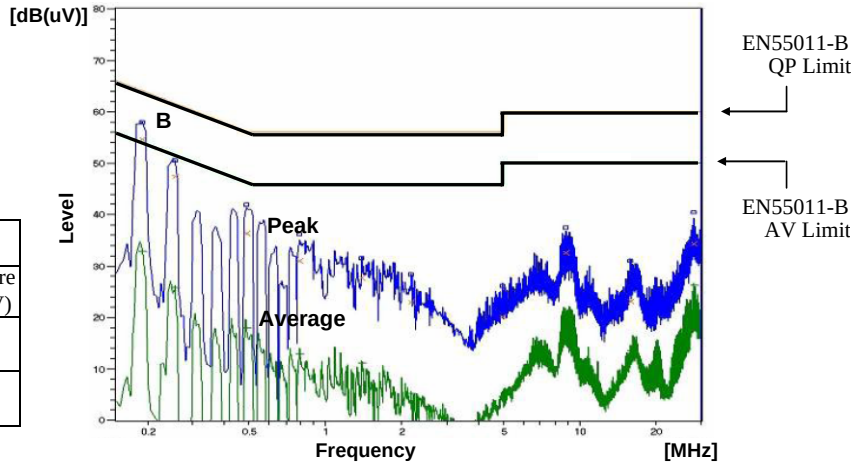
24V

Ref. Data	Point A (0.190MHz) Limit (dBµV)	Measure (dBµV)
QP	64.0	56.2
AV	54.0	35.4



Phase : N

Ref. Data	Point B (0.190MHz) Limit (dBµV)	Measure (dBµV)
QP	64.0	54.7
AV	54.0	33.0



Phase : L

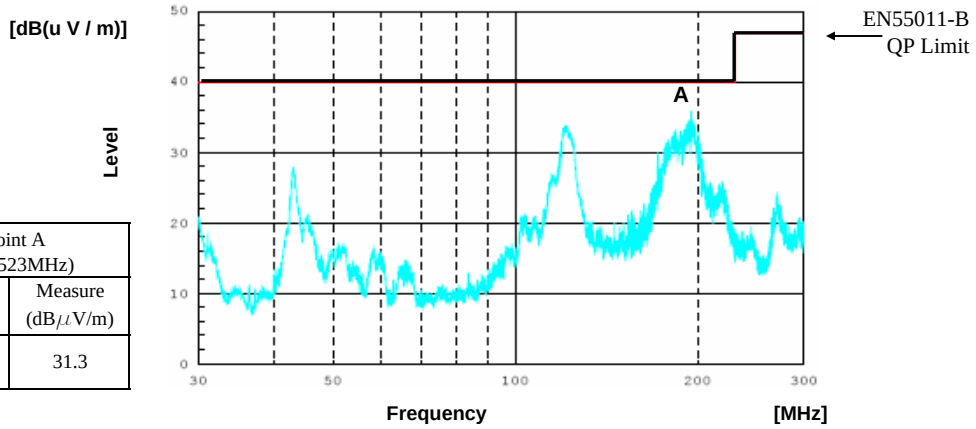
2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 115VAC
Iout : 100%

Radiated Emission

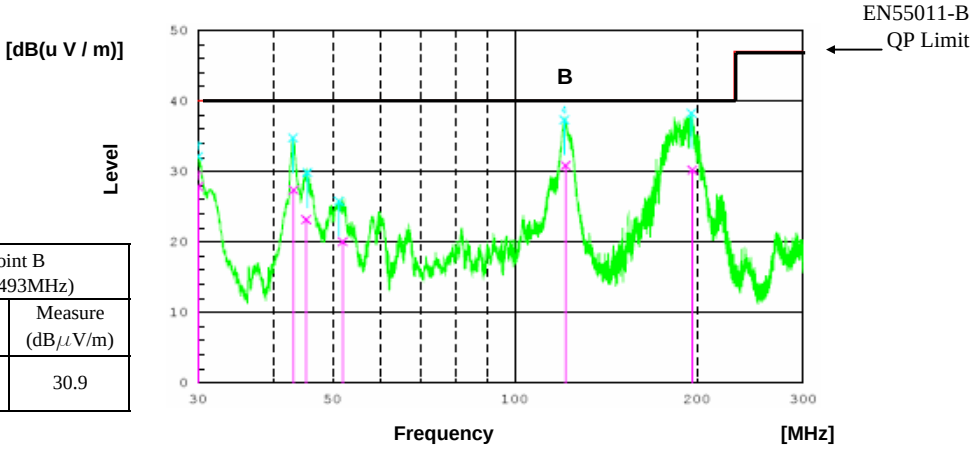
5V

HORIZONTAL



Point A (197.523MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	31.3

VERTICAL



Point B (121.493MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	30.9

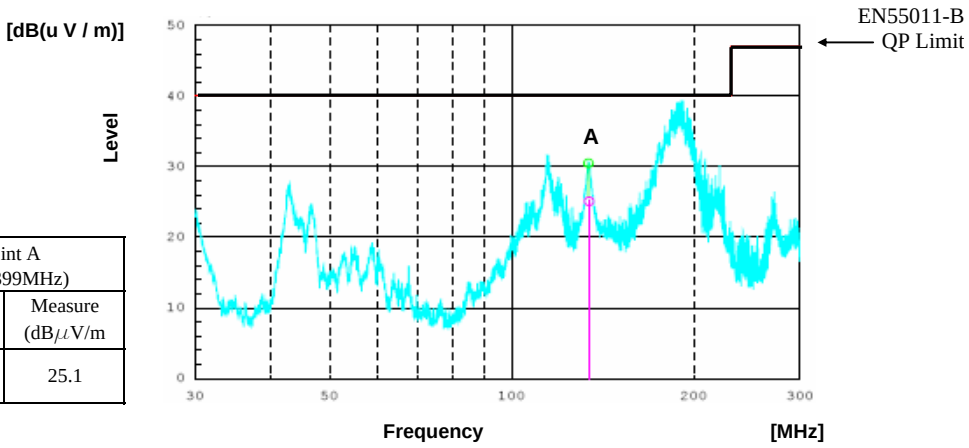
2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 230VAC
Iout : 100%

Radiated Emission

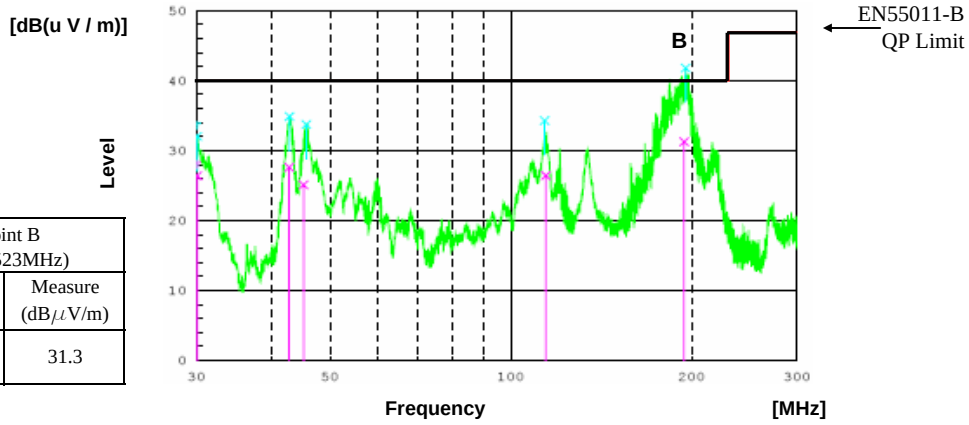
5V

HORIZONTAL



Point A (134.399MHz)	
Limit (dBμV/m	Measure (dBμV/m
40.0	25.1

VERTICAL



Point B (194.523MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	31.3

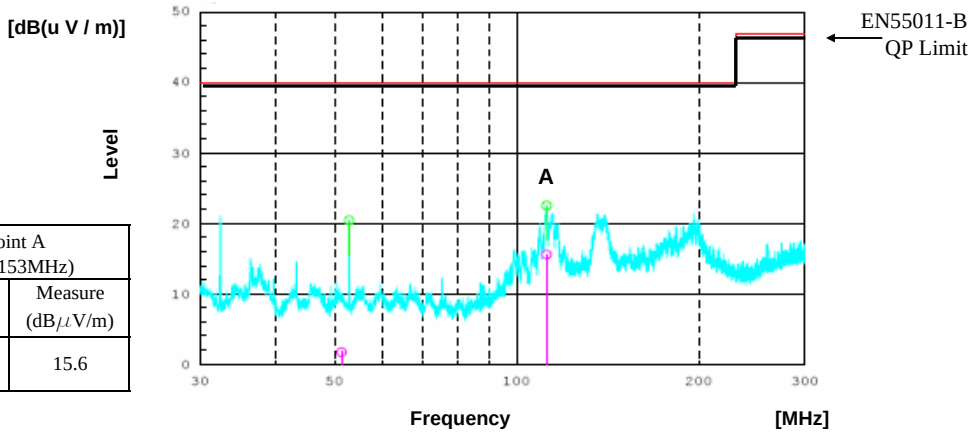
2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 115VAC
Iout : 100%

Radiated Emission

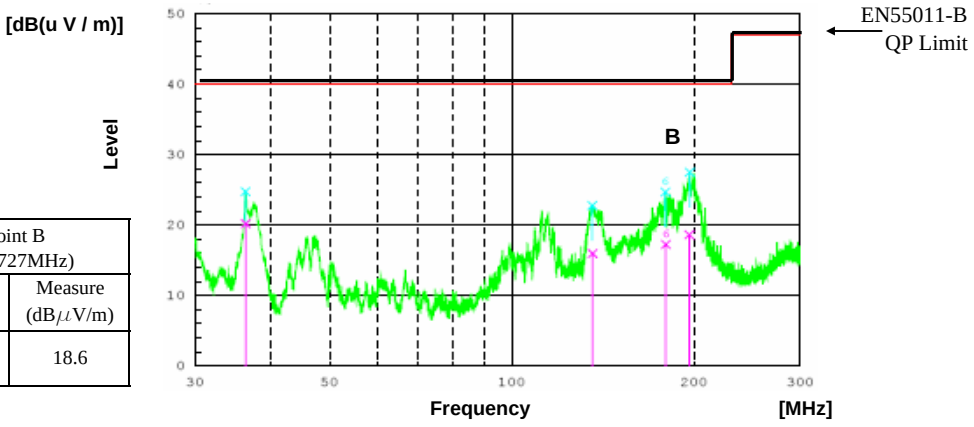
12V

HORIZONTAL



Point A (112.153MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	15.6

VERTICAL



Point B (196.727MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	18.6

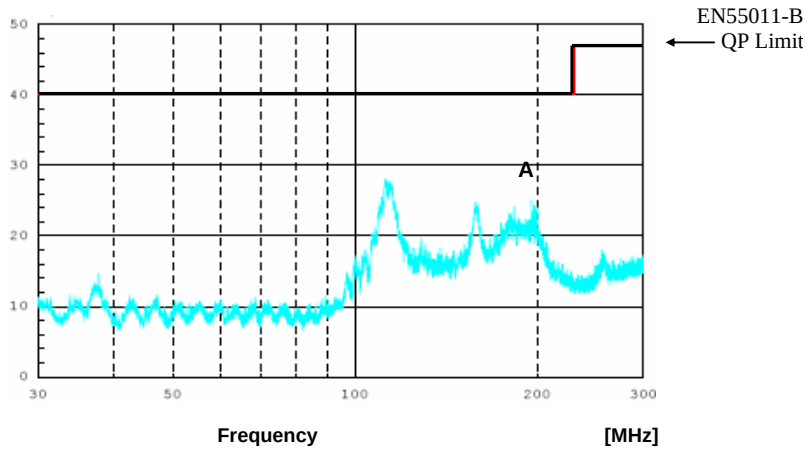
2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 230VAC
Iout : 100%

Radiated Emission

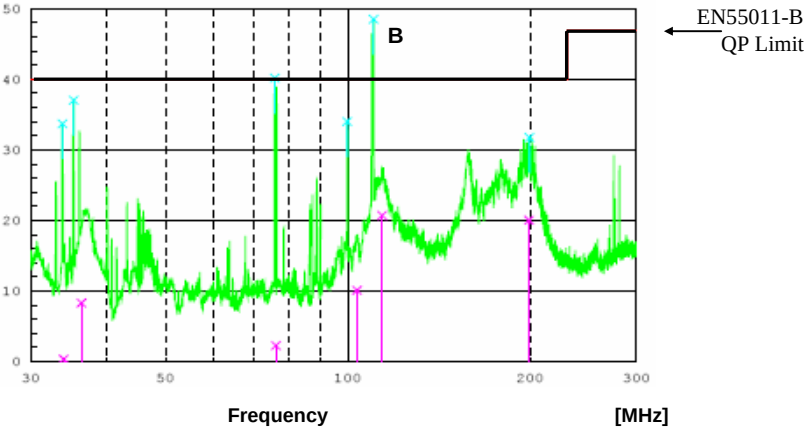
12V

HORIZONTAL



Point A (199.272MHz)	
Limit (dBμV/m	Measure (dBμV/m
40.0	20.0

VERTICAL



Point B (114.009MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	20.7

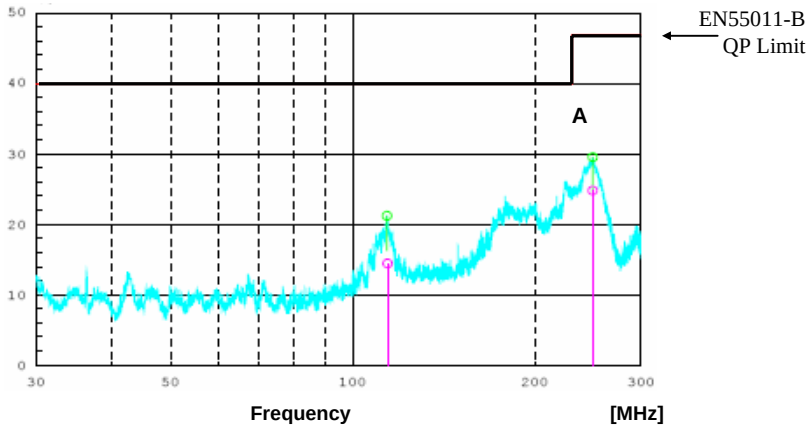
2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 115VAC
Iout : 100%

Radiated Emission

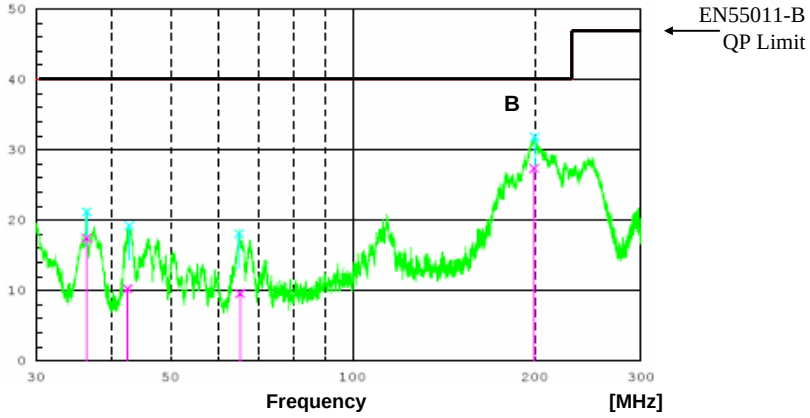
24V

HORIZONTAL



Point A (249.528MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
47.0	24.8

VERTICAL



Point B (199.618MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	27.4

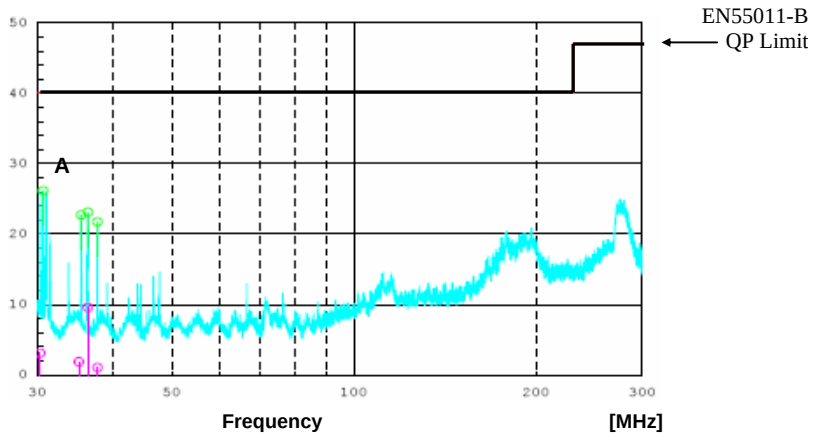
2-15 Electro-Magnetic Interference characteristics

Conditions: Vin : 230VAC
Iout : 100%

Radiated Emission

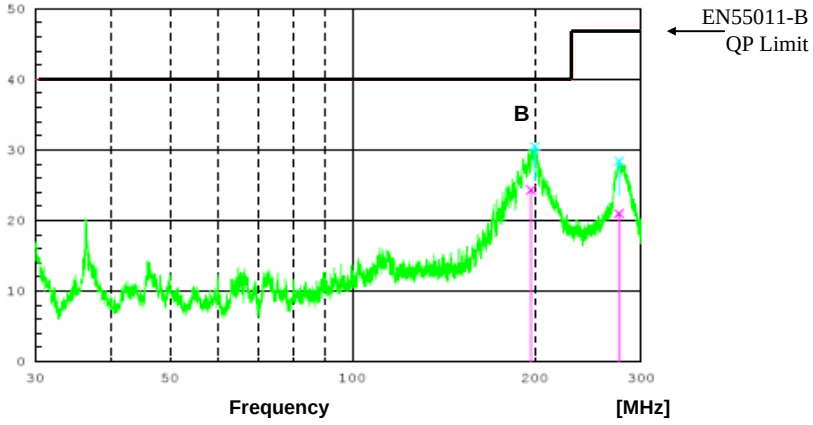
24V

HORIZONTAL



Point A (30.319MHz)	
Limit (dBμV/m	Measure (dBμV/m
40.0	3.1

VERTICAL



Point B (197.284MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	24.3