


SWS150

EVALUATION DATA

CA732-53-01			
QA APPD	APPD	CHK	DWG
	<i>Wth</i> 23-May-03	Jackson 21-May-03	Joe 21-May-03

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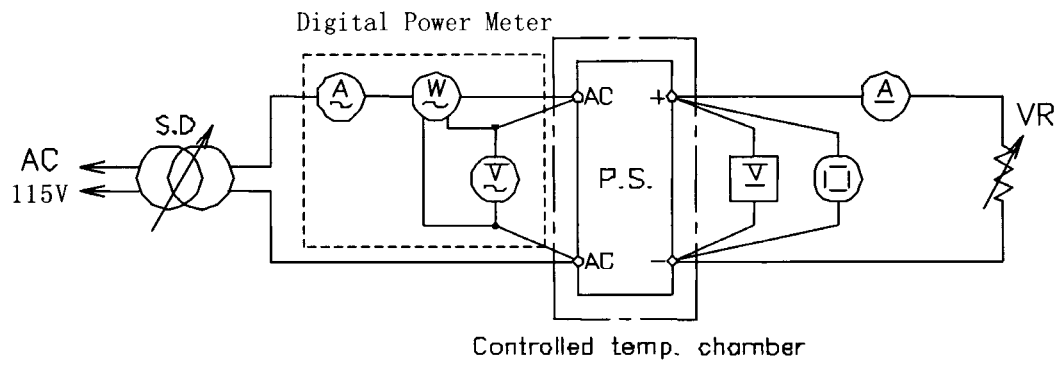
Terminology used

	Definition
V_{in}	Input voltage
V_{out}	Output voltage
I_{in}	Input current
I_{out}	Output current
T_a	Ambient temperature

※ The SWS150-5 evaluation data is measured under forced air cooling with air velocity 1.2m/s , flow through the component side of power supply.

1.1 Circuit used for determination

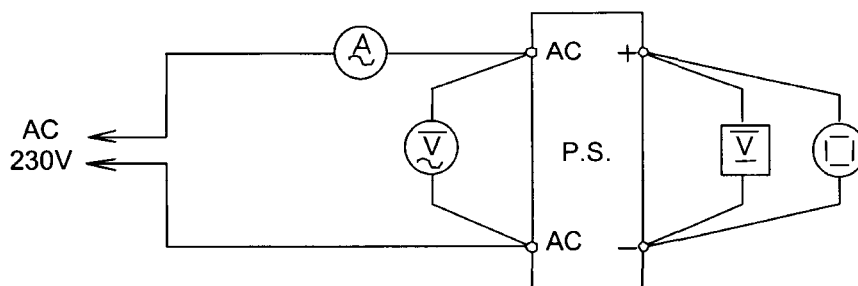
(1) Steady state data



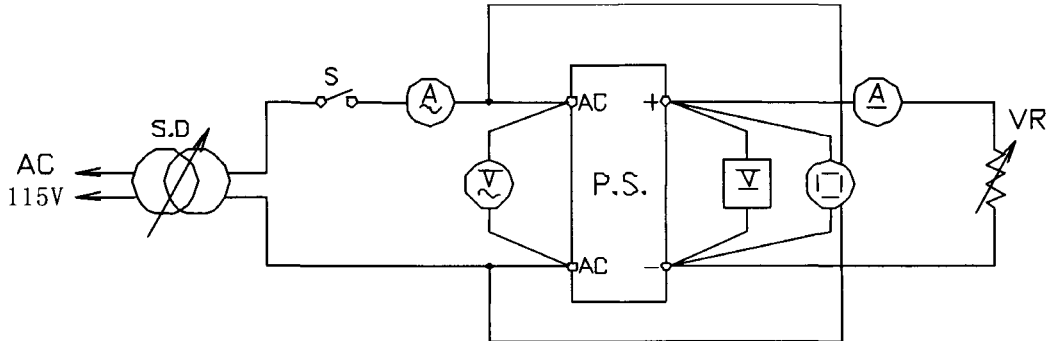
(2) Over current protection (O.C.P) characteristics

Same as steady state data.

(3) Over voltage protection (O.V.P) characteristics



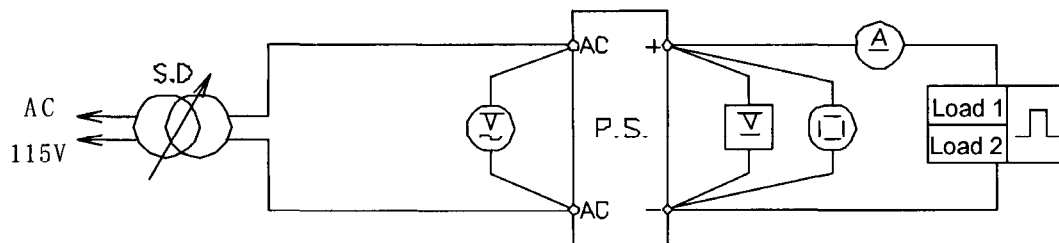
(4) Output rise characteristics



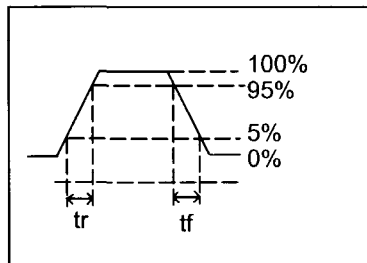
(5) Output fall characteristics

Same as output rise characteristics.

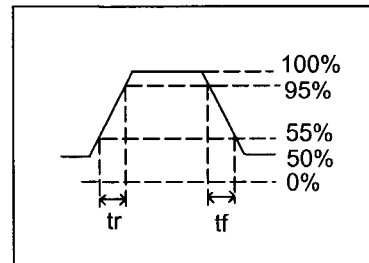
(6) Dynamic load response characteristics



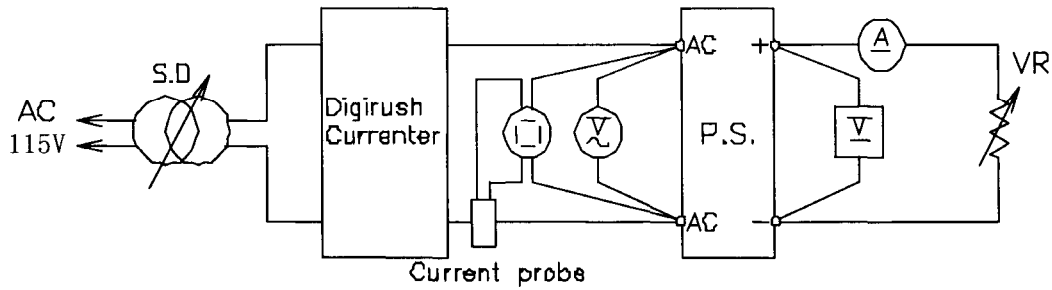
Output current waveform :
I_{out} 0% ↔ 50%



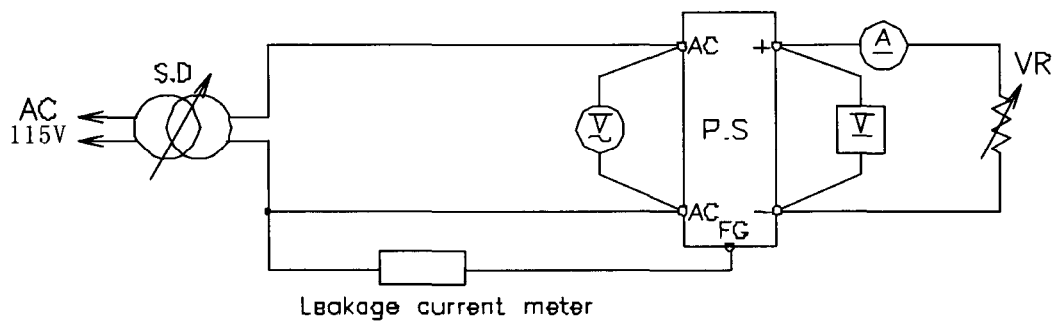
Output current waveform :
I_{out} 50% ↔ 100%



(7) Inrush current characteristics



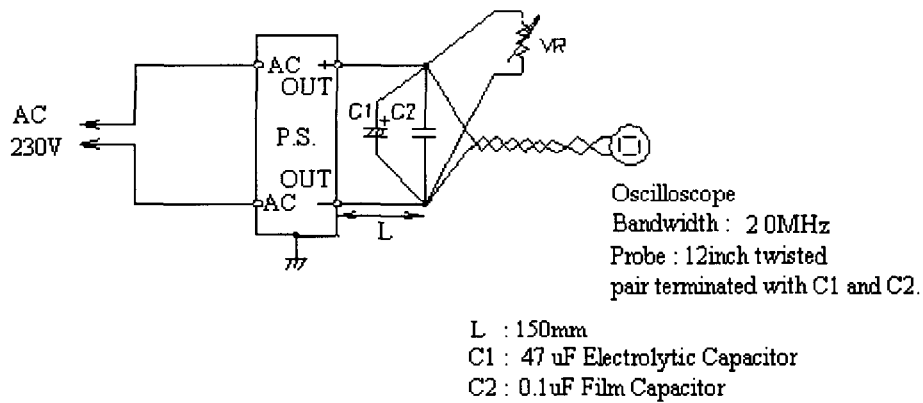
(8) Leakage current characteristics



Note : Leakage current measured through a 1k ohm resistor.
 Range used : AC + DC (For SIMPSON MODEL 228)

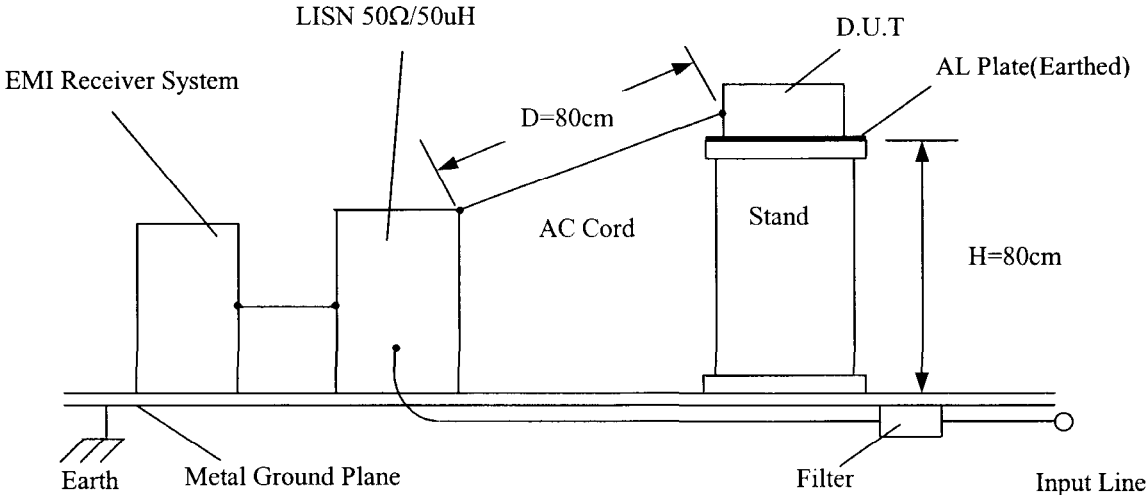
(9) Output - ripple, noise waveform

Normal Mode

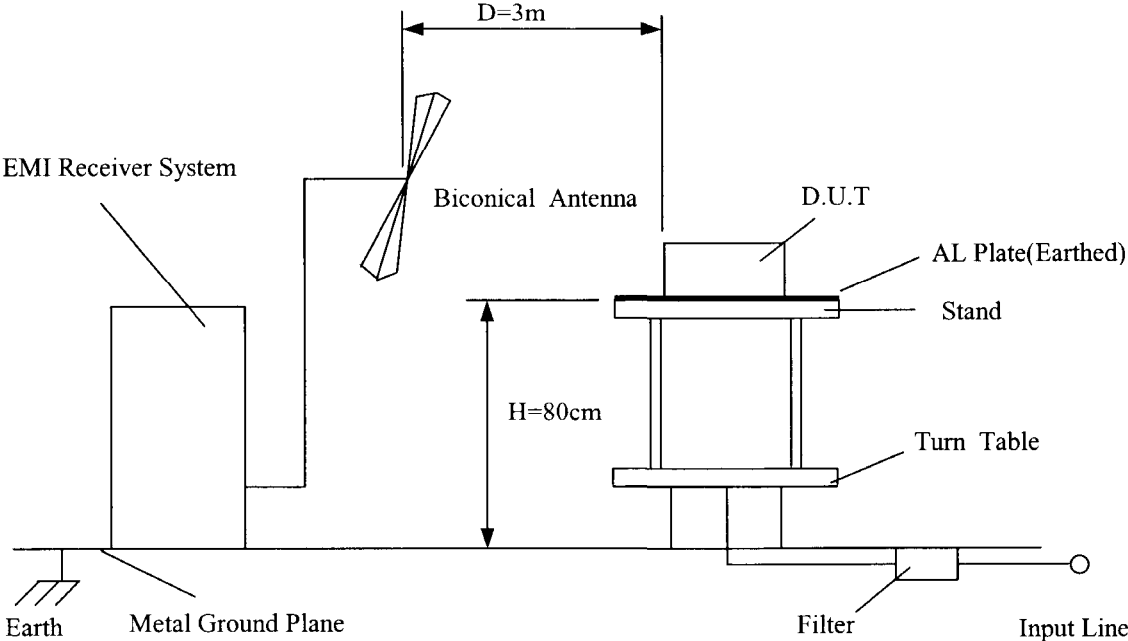


(10) Electro-Magnetic Interference characteristics

(a) Conducted Emission Noise



(b) Radiated Emission Noise



1.2 LIST OF EQUIPMENT USED

	EQUIPMENT USED	MANUFACTURER	MODEL NO.
1	Oscilloscope	HITACHI	V-1050F
2	Digital storage oscilloscope	TEKTRONIX	TDS 540A
3	Digital volt meter	FLUKE	45
4	Digital power meter	YOKOGAWA	WT110
5	DC ampere meter	YOKOGAWA	2051
6	Dynamic dummy load	CHROMA	63030
7	Current probe/amplifier	TEKTRONIX	A6303/AM503B
8	Controlled temperature chamber	TABAI-ESPEC	SU-240
9	Leakage current meter	SIMPSON	228
10	Digirush currenter	TAKAMIZAWA CYBERNETICS	PSA-200
11	EMI receiver	HEWLETT PACKARD	HP8546A
12	LISN	EMCO	3825/2
13	Biconical antenna	EMCO	3110B

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	85VAC	115VAC	230VAC	265VAC	line regulation	
0%	5.041V	5.041V	5.041V	5.040V	0.001V	0.020%
50%	5.026V	5.026V	5.025V	5.025V	0.001V	0.020%
100%	5.009V	5.009V	5.009V	5.009V	0.000V	0.000%
load	0.032V	0.032V	0.032V	0.031V		
regulation	0.640%	0.640%	0.640%	0.620%		

2. Temperature drift

Conditions Vin =115VAC

Iout =100%

Ta	-10°C	+25°C	+50°C	temperature stability	
Vout	5.014V	5.009V	5.004V	0.010V	0.200%

12V

1. Regulation-line and load

condition Ta : 25°C

Iout \ Vin	85VAC	115VAC	230VAC	265VAC	line regulation	
0%	12.024V	12.024V	12.024V	12.024V	0.000V	0.000%
50%	12.014V	12.014V	12.015V	12.015V	0.001V	0.008%
100%	12.007V	12.007V	12.006V	12.006V	0.001V	0.008%
load	0.017V	0.017V	0.018V	0.018V		
regulation	0.142%	0.142%	0.150%	0.150%		

2. Temperature drift

Conditions Vin =115VAC

Iout =100%

Ta	-10°C	+25°C	+50°C	temperature stability	
Vout	12.038V	12.007V	11.985V	0.053V	0.442%

24V

1. Regulation-line and load

condition Ta : 25°C

Iout \ Vin	85VAC	115VAC	230VAC	265VAC	line regulation	
0%	24.068V	24.067V	24.066V	24.066V	0.002V	0.008%
50%	24.059V	24.058V	24.057V	24.057V	0.002V	0.008%
100%	24.053V	24.054V	24.055V	24.055V	0.002V	0.008%
load	0.015V	0.013V	0.011V	0.011V		
regulation	0.063%	0.054%	0.046%	0.046%		

2. Temperature drift

Conditions Vin =115VAC

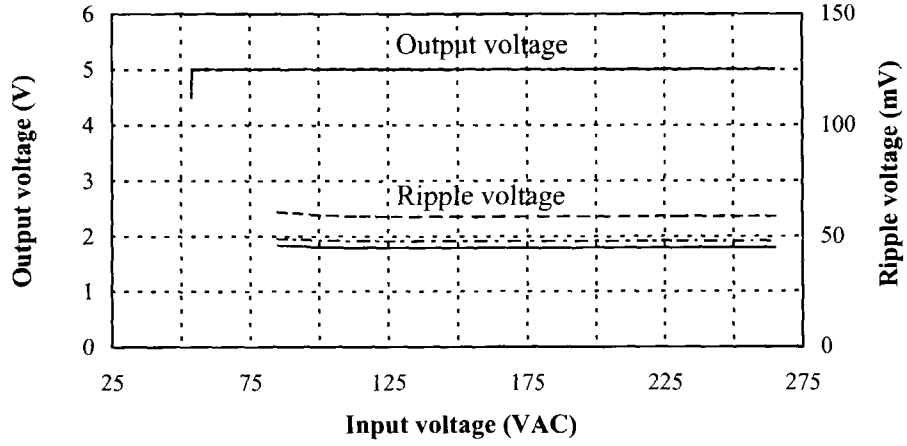
Iout =100%

Ta	-10°C	+25°C	+50°C	temperature stability	
Vout	24.094V	24.054V	24.023V	0.071V	0.296%

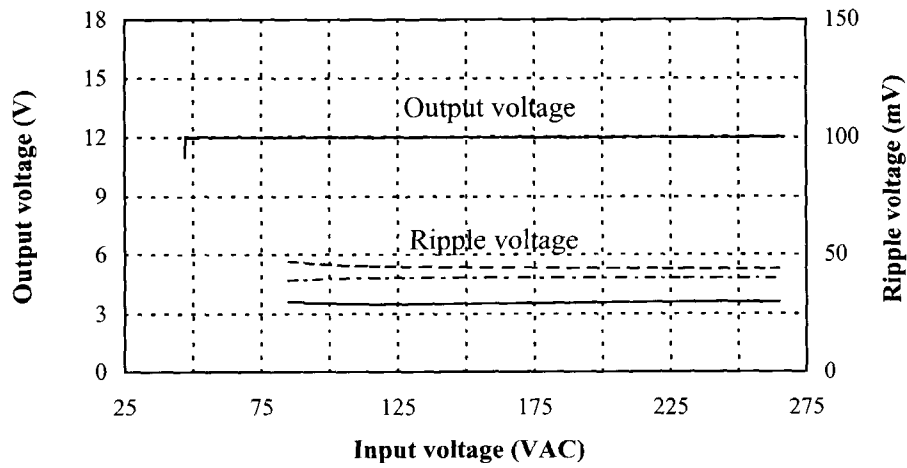
2.1 (2) Output voltage and Ripple voltage v.s. Input voltage

Conditions Iout : 100%
 Ta : -10°C -----
 : 25°C -.-.-.-.-
 : 50°C _____

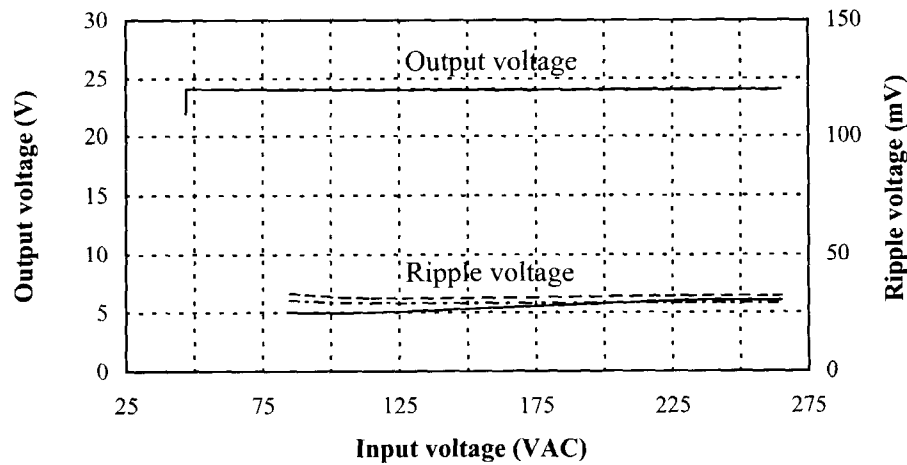
5V



12V



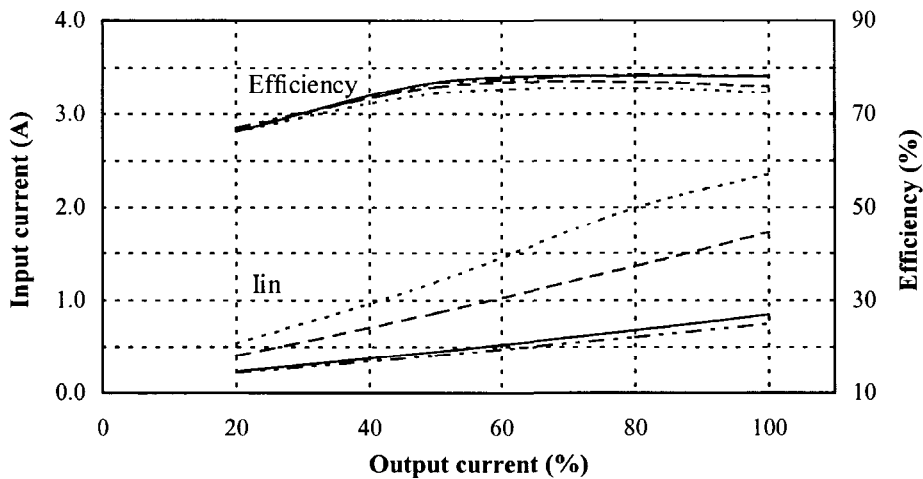
24V



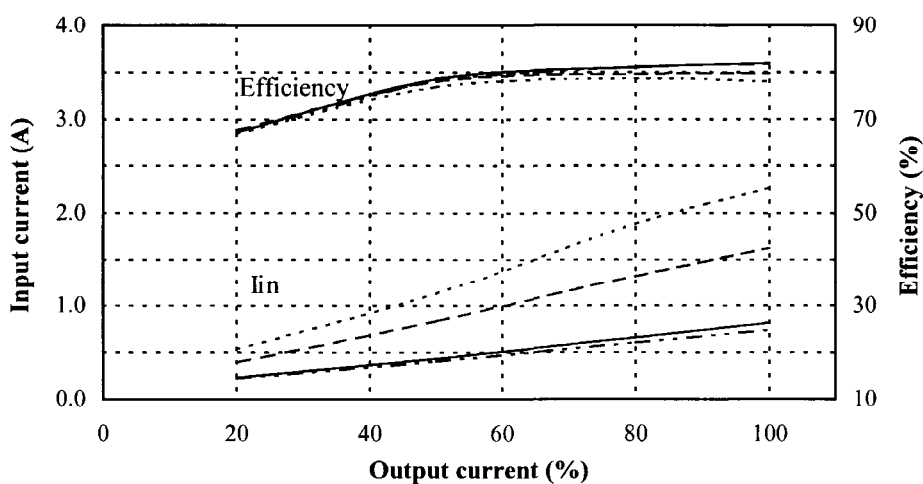
2.1 (3) Efficiency and input current v.s. Output current

Conditions Vin : 85VAC -----
 : 115VAC -----
 : 230VAC -----
 : 265VAC -----
 Ta : 25°C

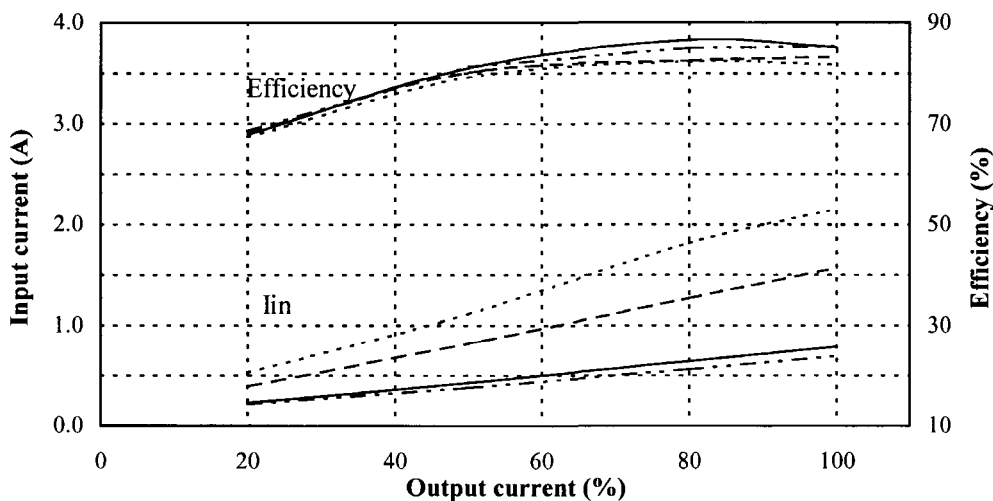
5V



12V



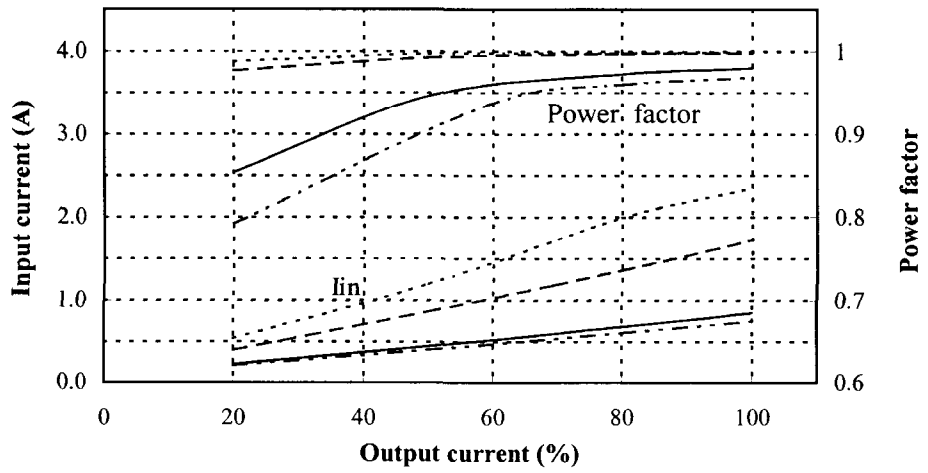
24V



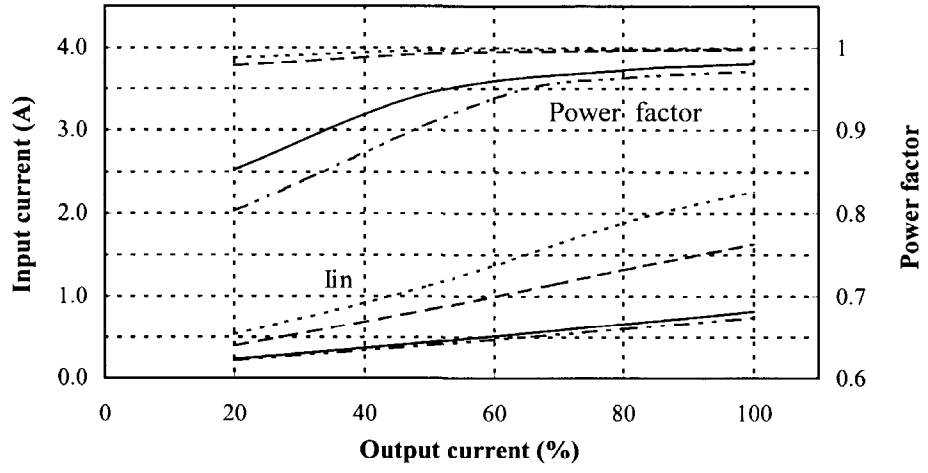
2.1 (4) Power factor and Input current v.s Output current

Conditions Vin : 85VAC -----
 : 115VAC - - - - -
 : 230VAC _____
 : 265VAC - . - . -
 Ta : 25°C

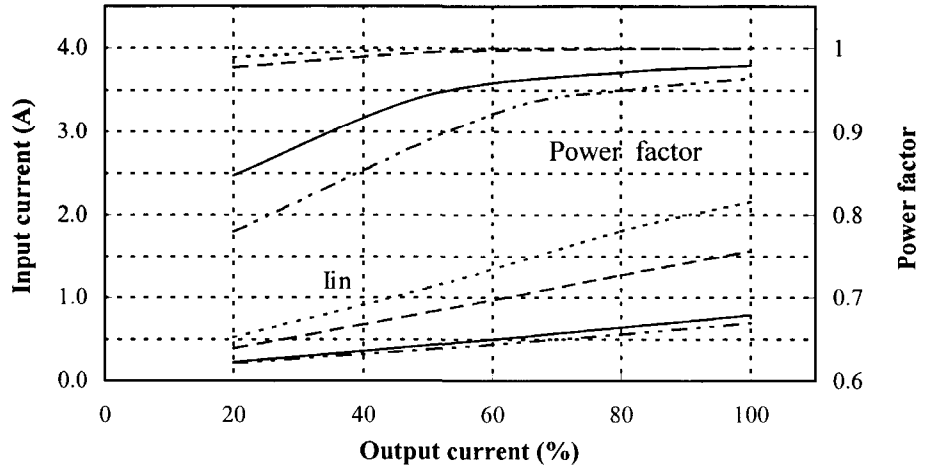
5V



12V



24V

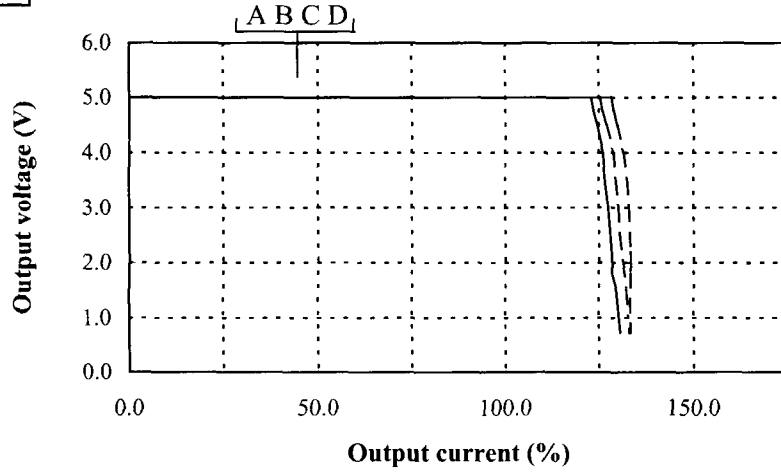


2.2 Over current protection (OCP) characteristics

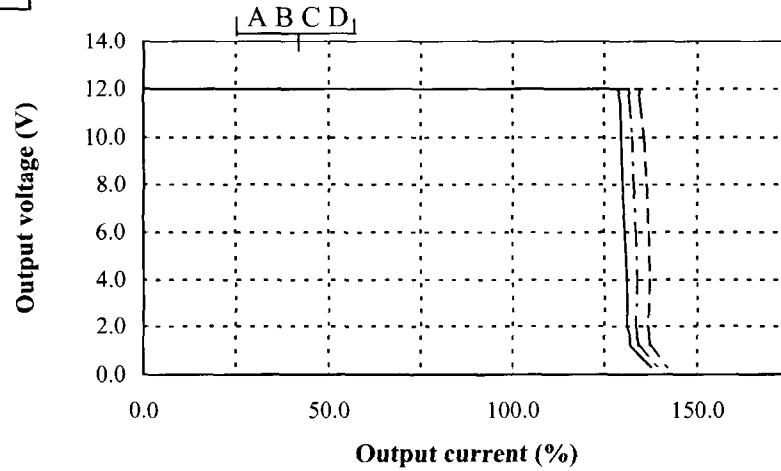
Conditions Vin : 85VAC (A)
 : 115VAC (B)
 : 230VAC (C)
 : 265VAC (D)

Ta : -10°C -----
 : 25°C - - - - -
 : 50°C _____

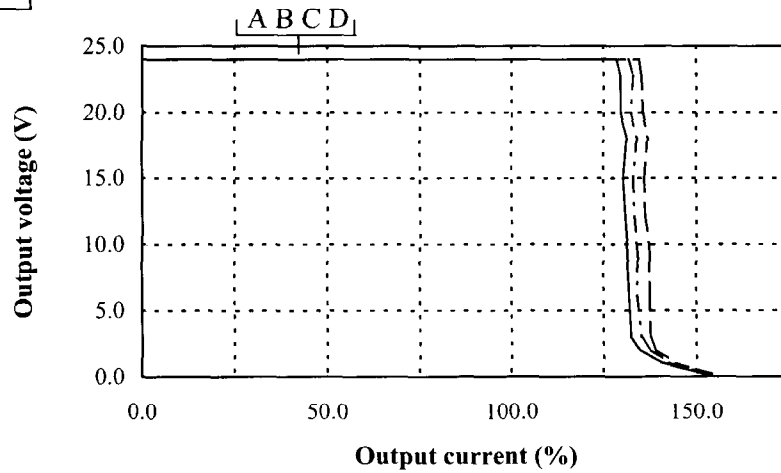
5V



12V



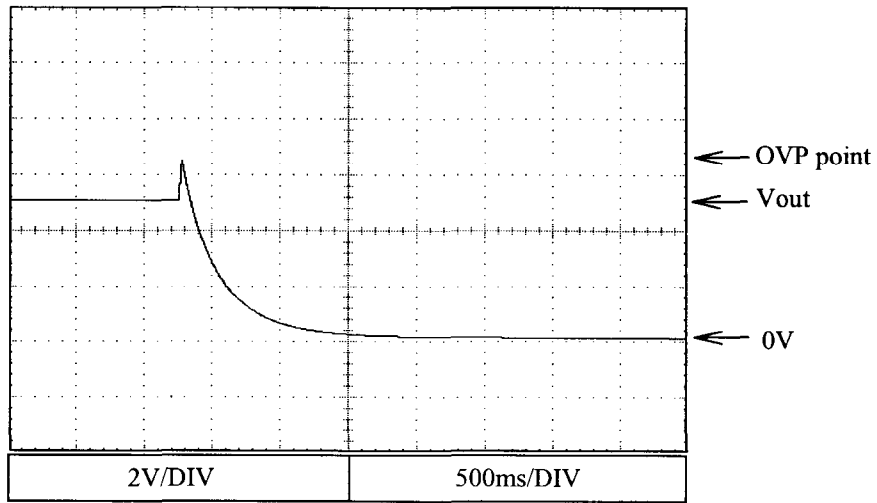
24V



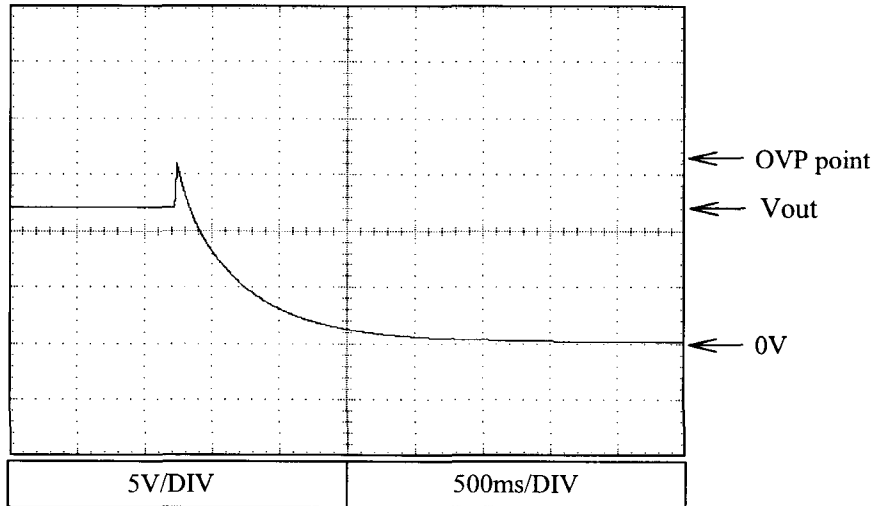
2.3 Over voltage protection (OVP) characteristics

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

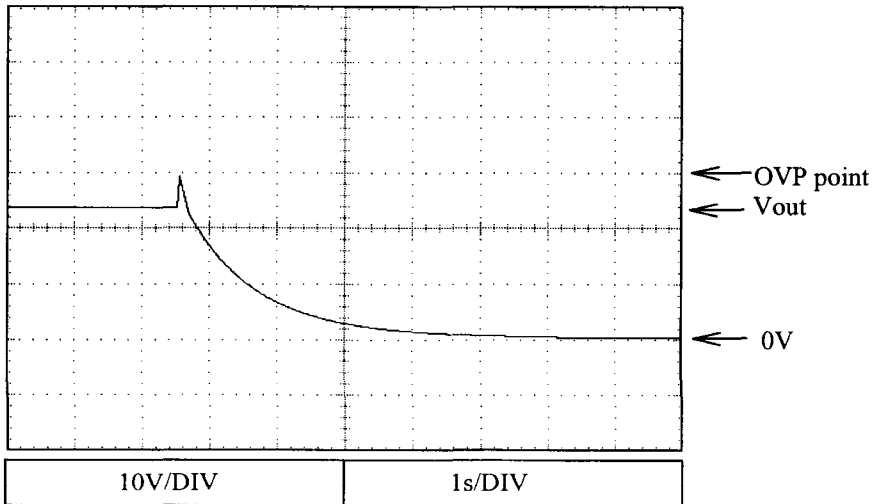
5V



12V



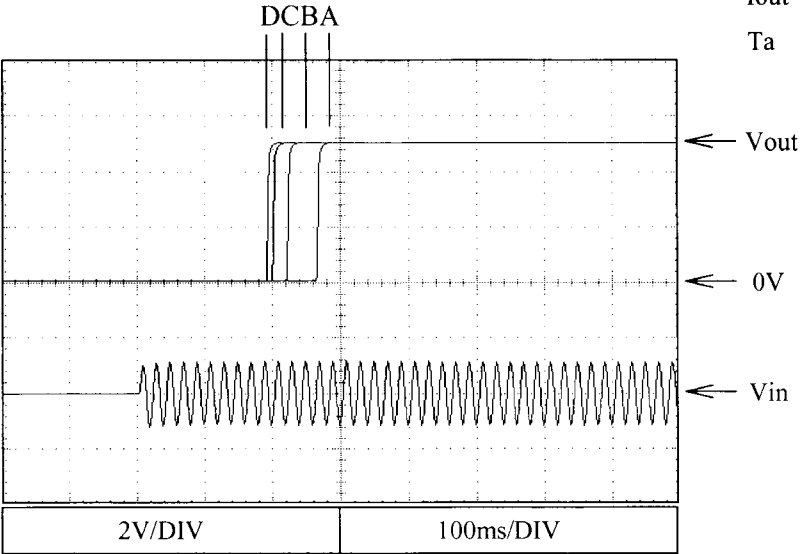
24V



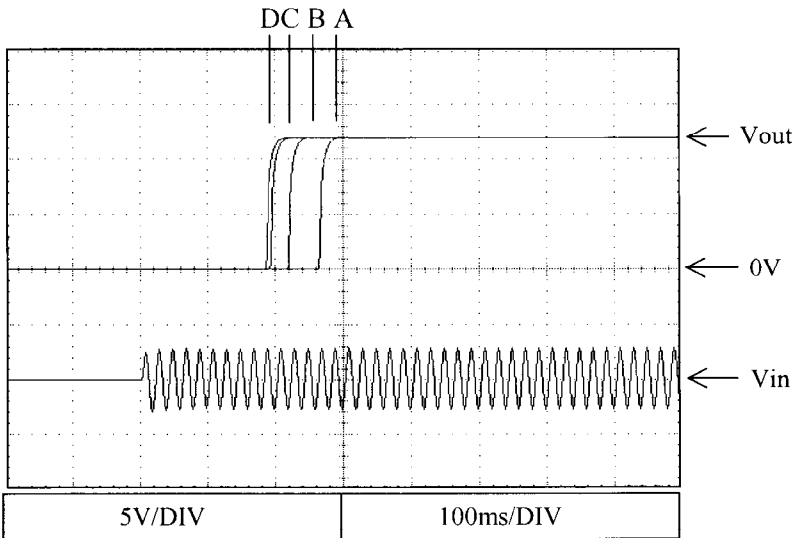
2.4 Output rise characteristics

Conditions Vin : 85VAC (A)
: 115VAC (B)
: 230VAC (C)
: 265VAC (D)
Iout : 0%
Ta : 25°C

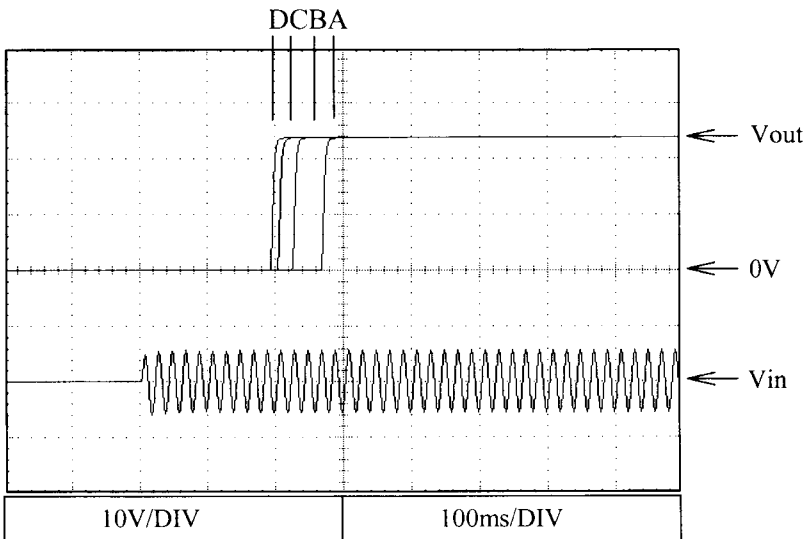
5V



12V

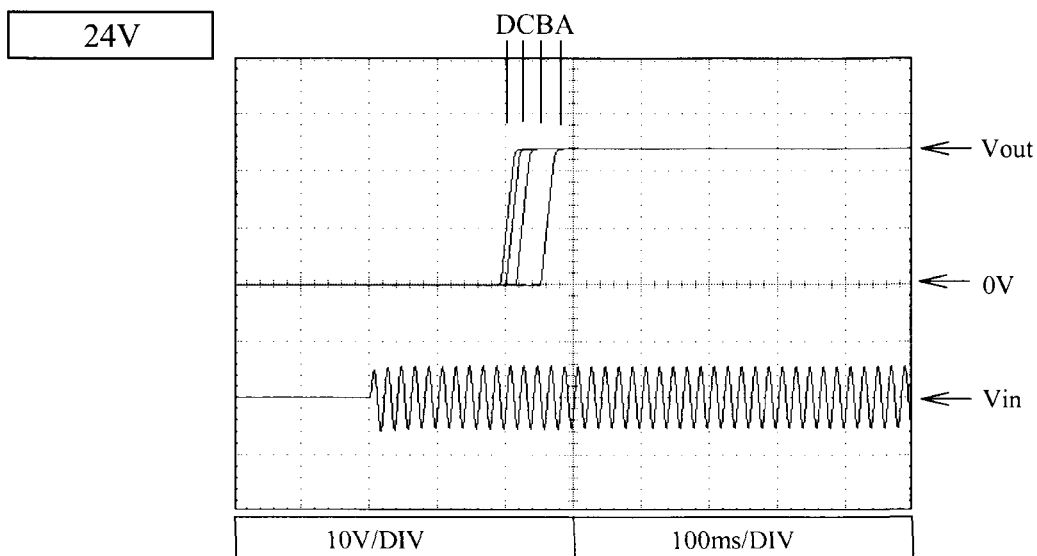
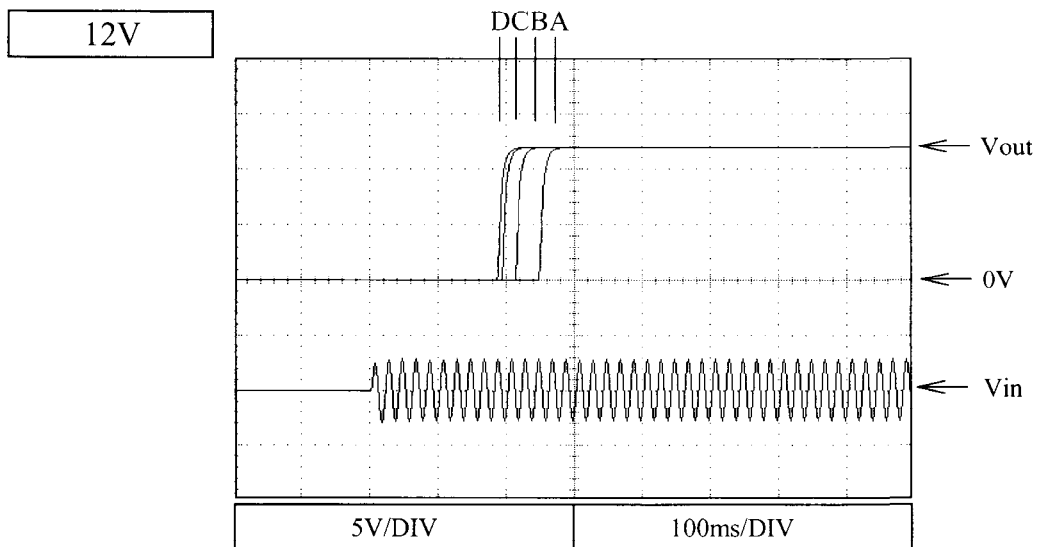
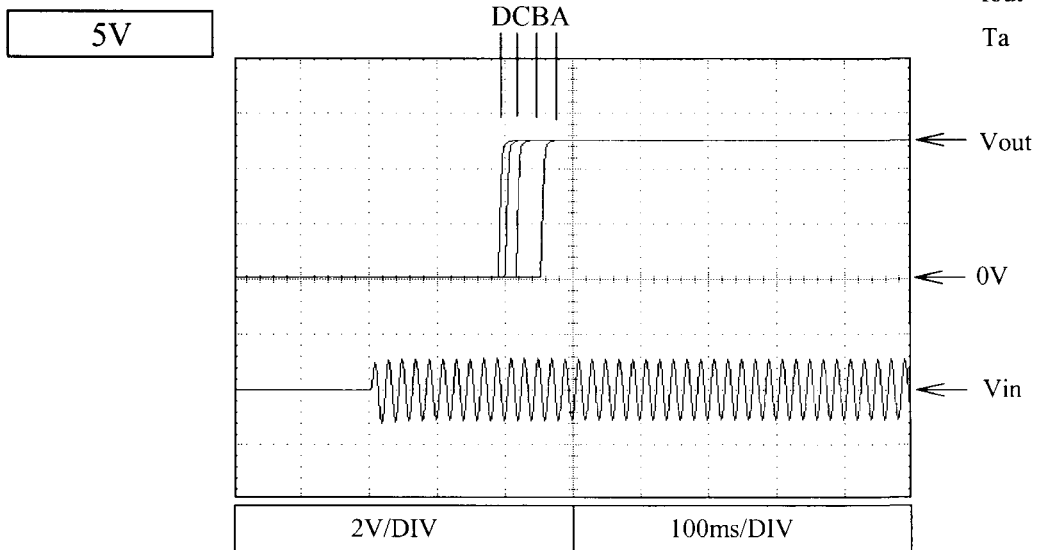


24V



2.4 Output rise characteristics

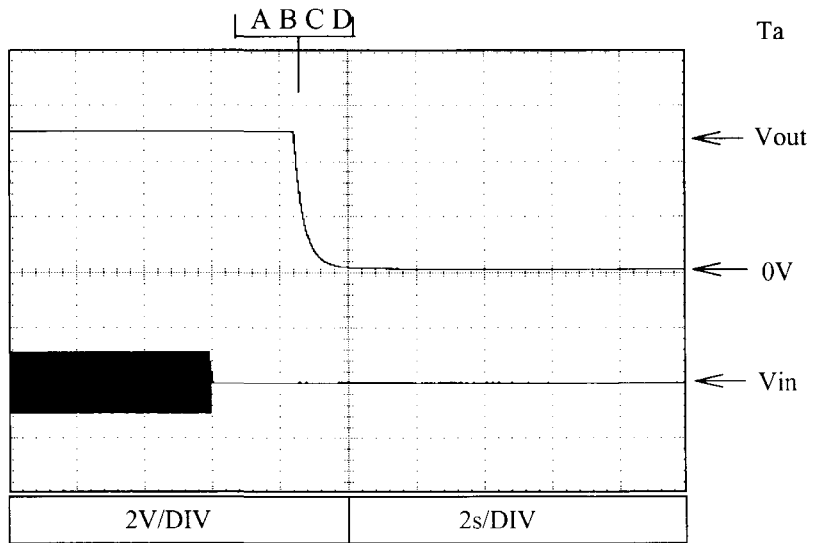
Conditions Vin : 85VAC (A)
 : 115VAC (B)
 : 230VAC (C)
 : 265VAC (D)
 Iout : 100%
 Ta : 25°C



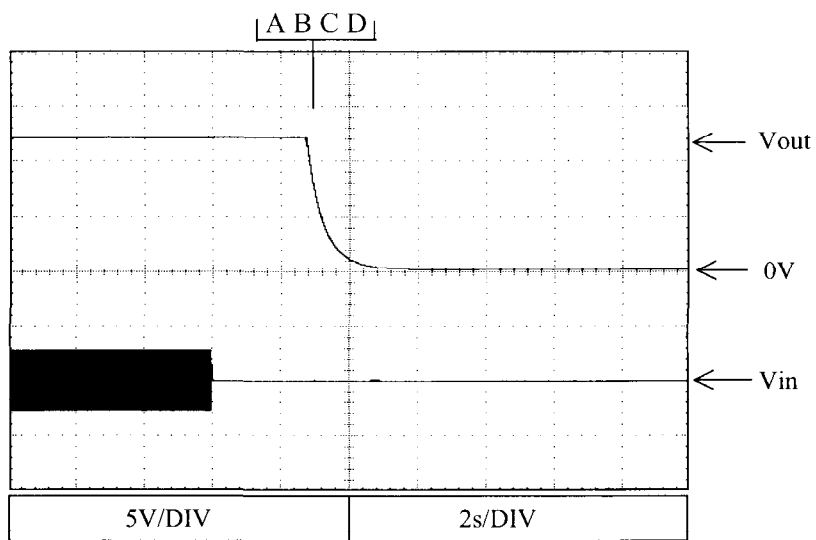
2.5 Output fall characteristics

Conditions Vin : 85VAC (A)
 : 115VAC (B)
 : 230VAC (C)
 : 265VAC (D)
 Iout : 0%
 Ta : 25°C

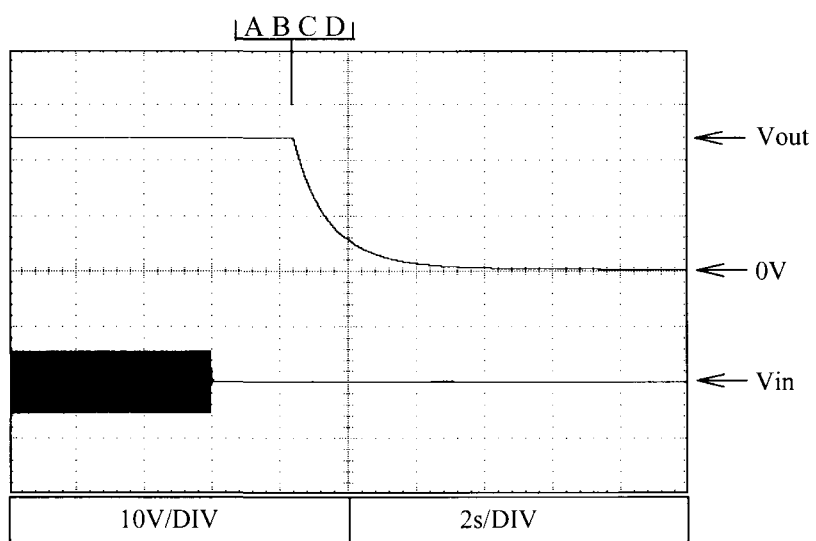
5V



12V



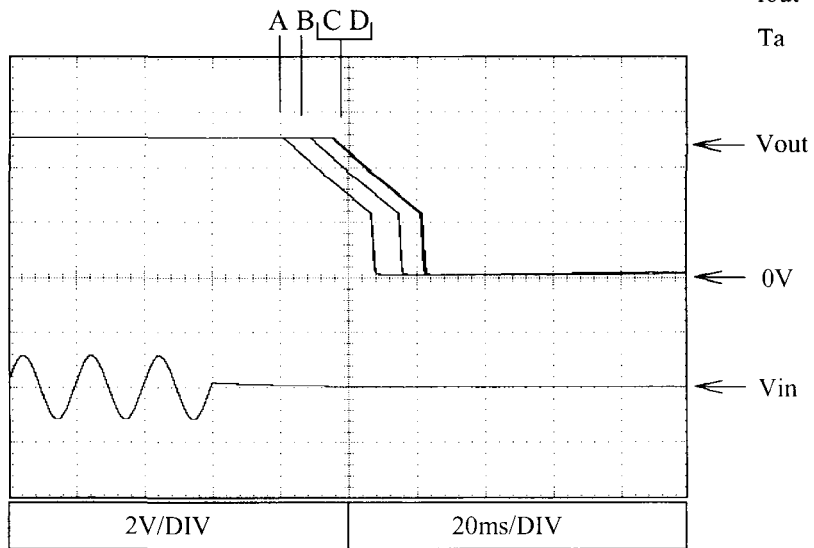
24V



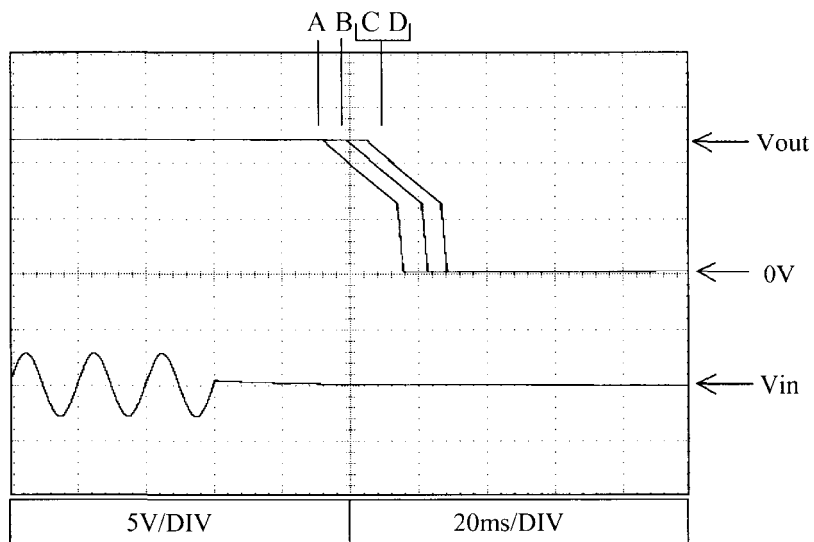
2.5 Output fall characteristics

Conditions Vin : 85VAC (A)
 : 115VAC (B)
 : 230VAC (C)
 : 265VAC (D)
 Iout : 100%
 Ta : 25°C

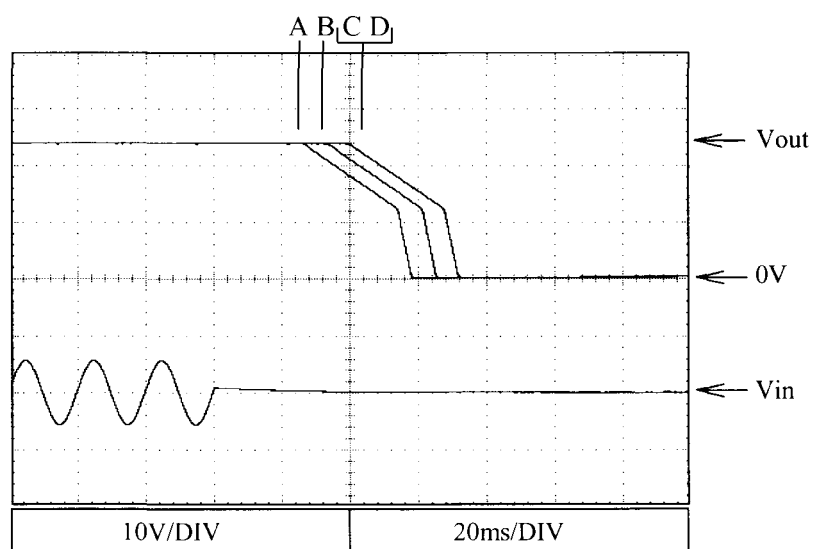
5V



12V

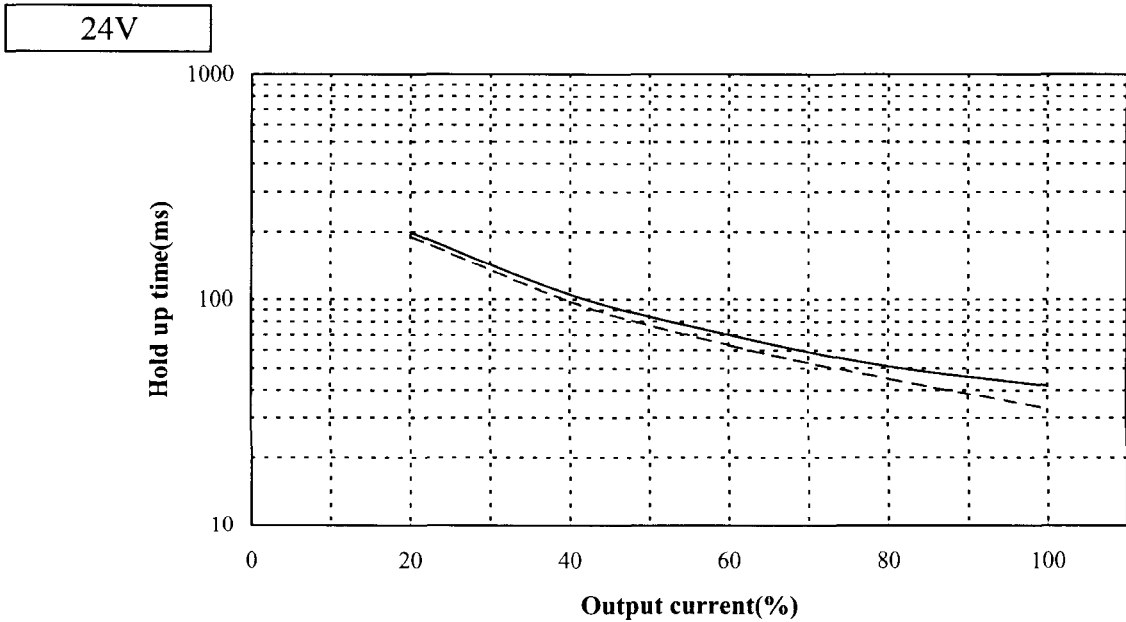
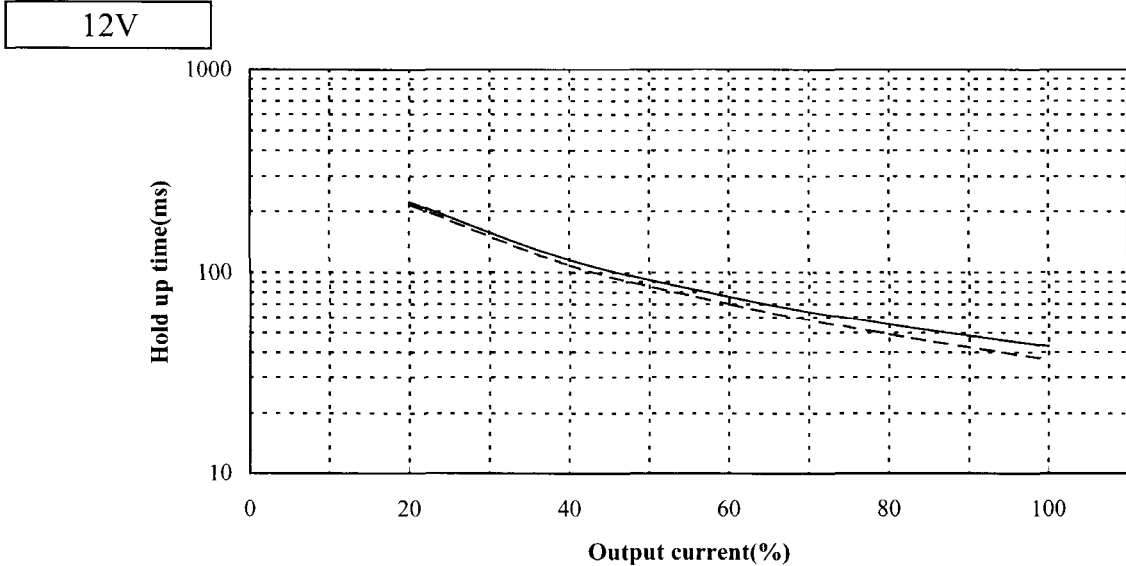
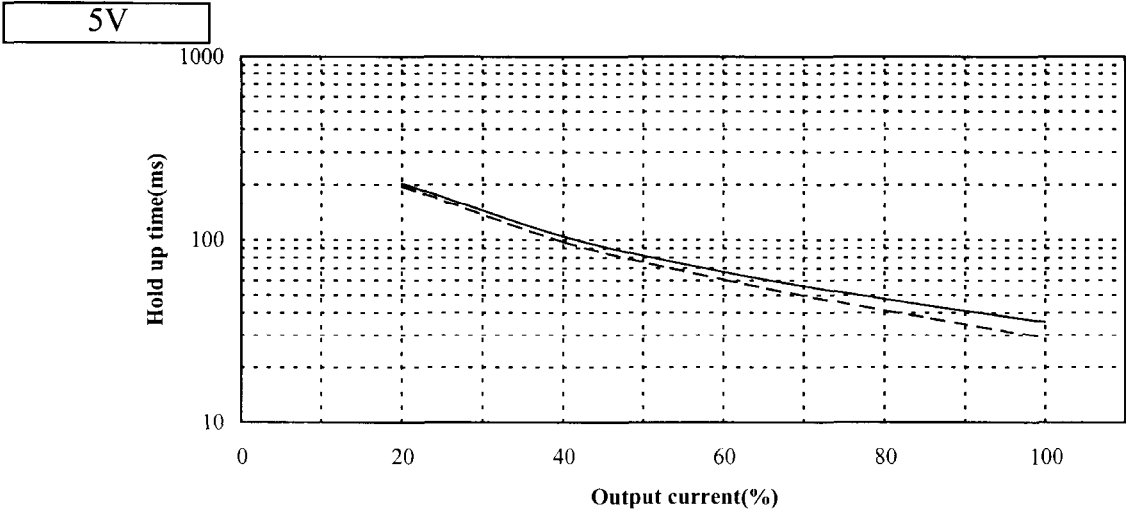


24V



2.6 Hold up time characteristics

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

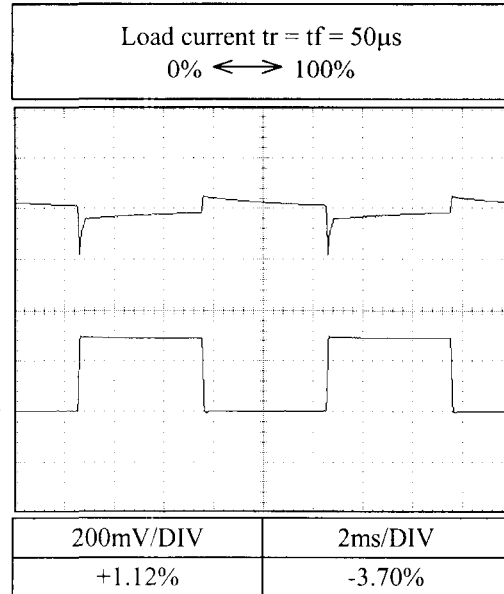
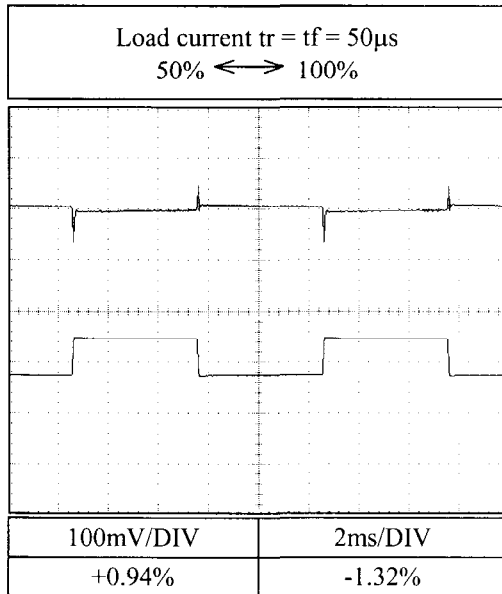


2.7 Dynamic load response characteristics

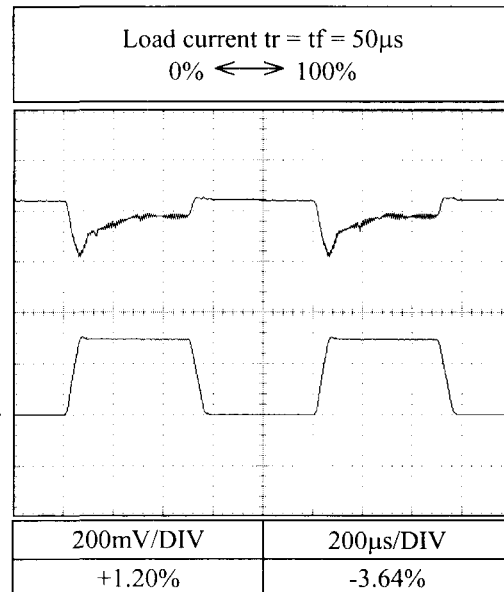
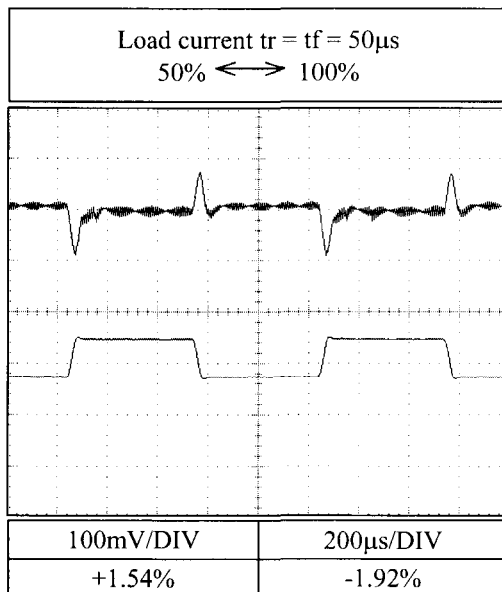
Conditions Vin : 115VAC
Ta : 25°C

5V

f=100Hz



f=1kHz

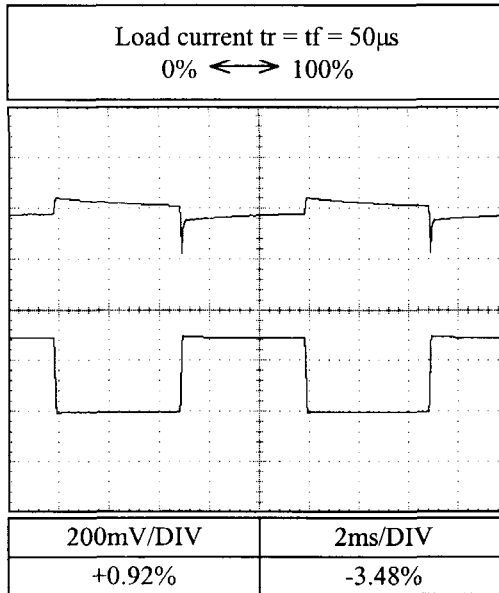
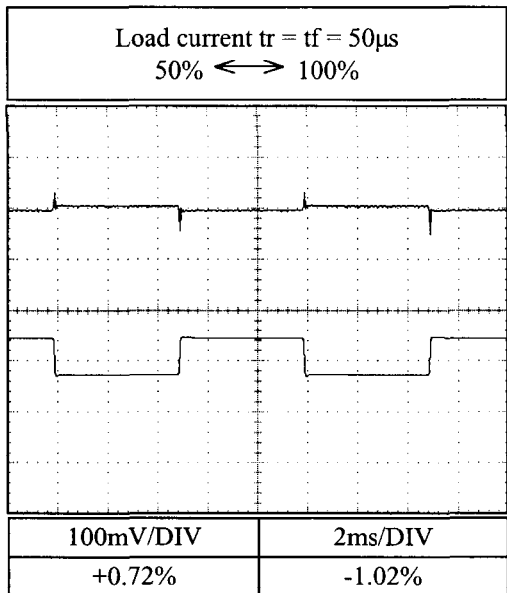


2.7 Dynamic load response characteristics

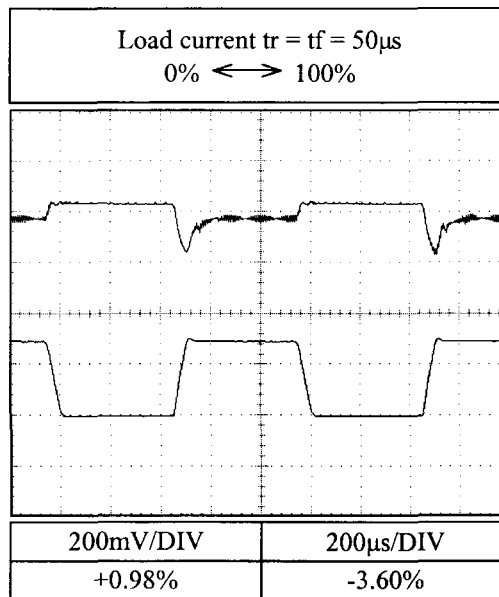
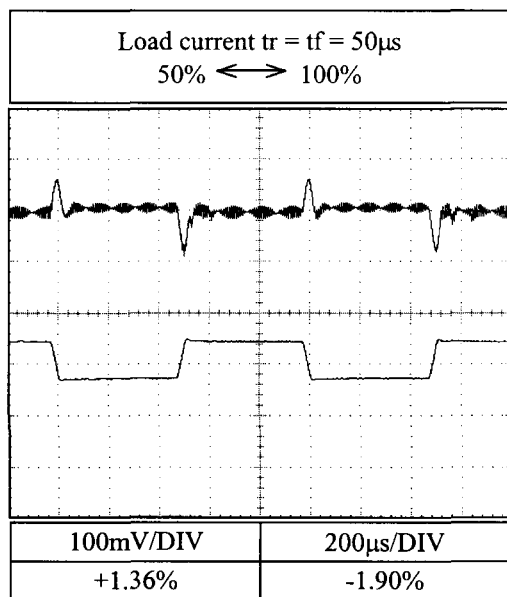
Conditions V_{in} : 230VAC
 T_a : 25°C

5V

$f=100\text{Hz}$



$f=1\text{kHz}$

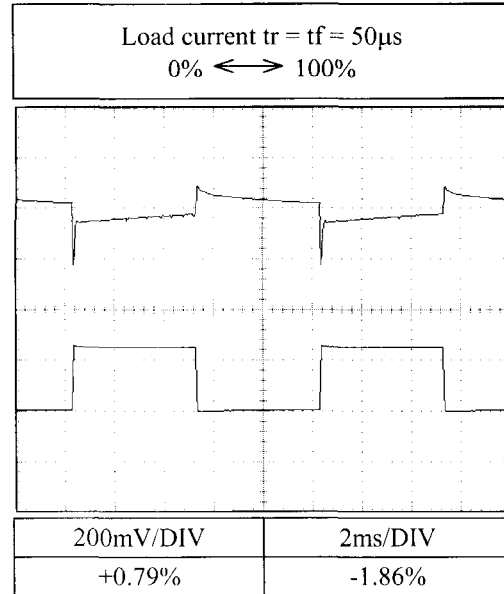
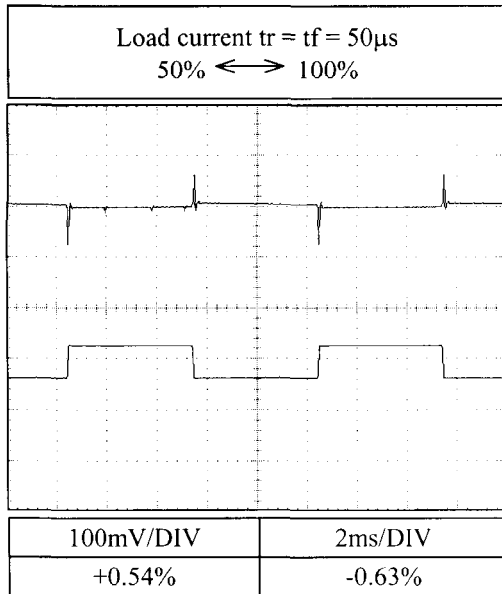


2.7 Dynamic load response characteristics

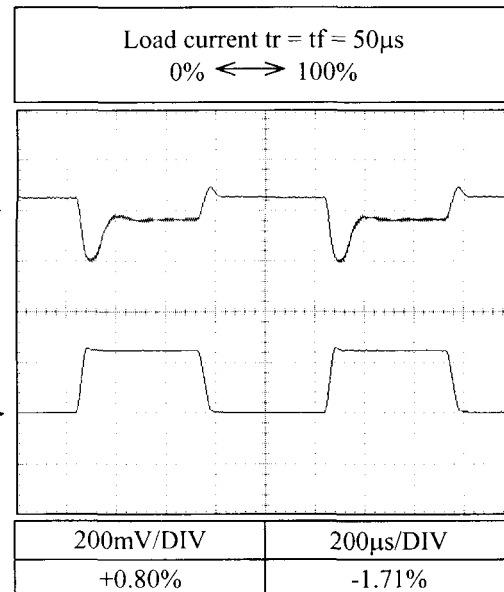
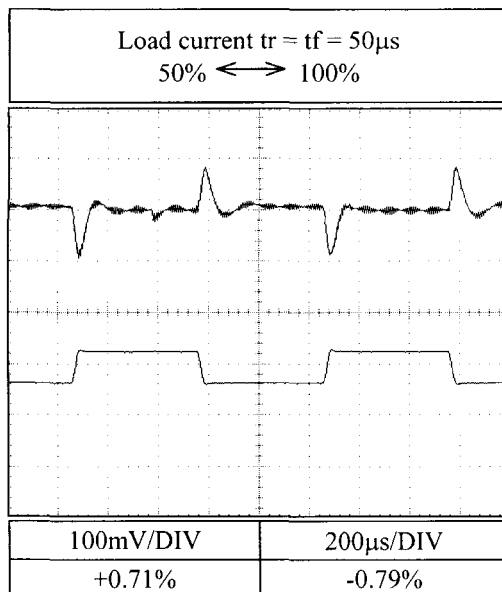
Conditions Vin : 115VAC
Ta : 25°C

12V

f=100Hz



f=1kHz

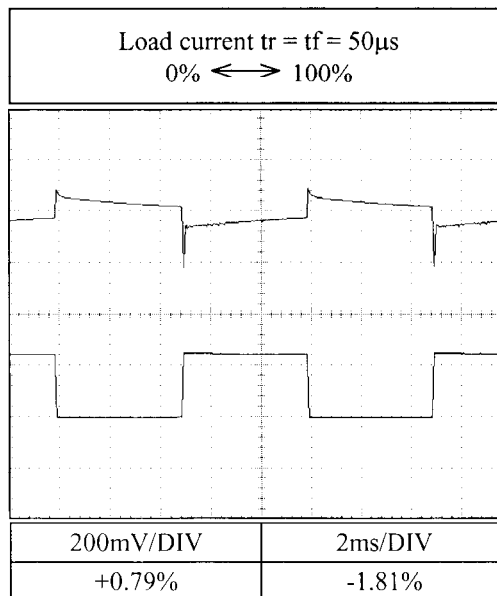
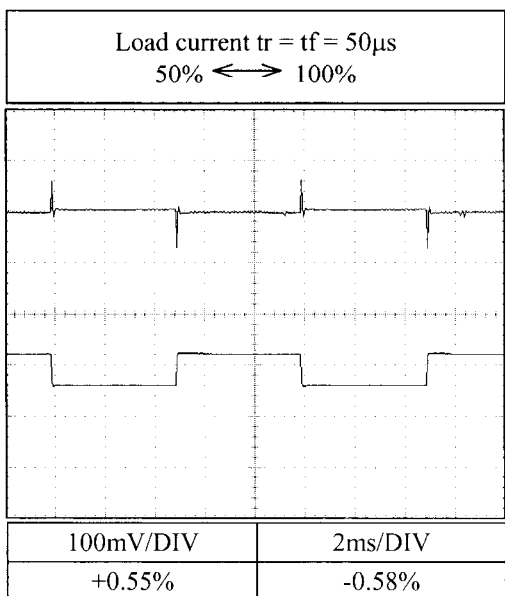


2.7 Dynamic load response characteristics

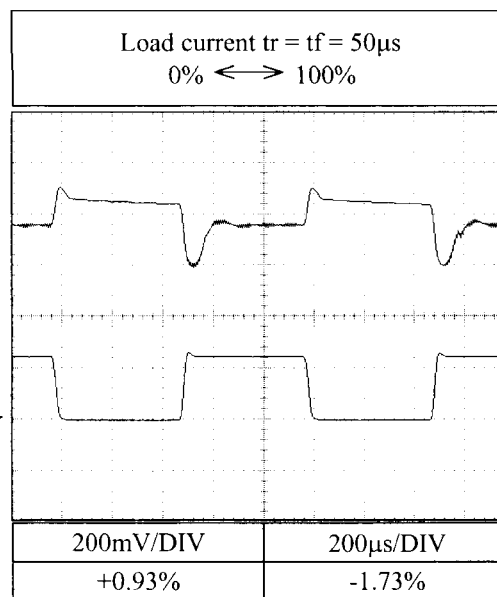
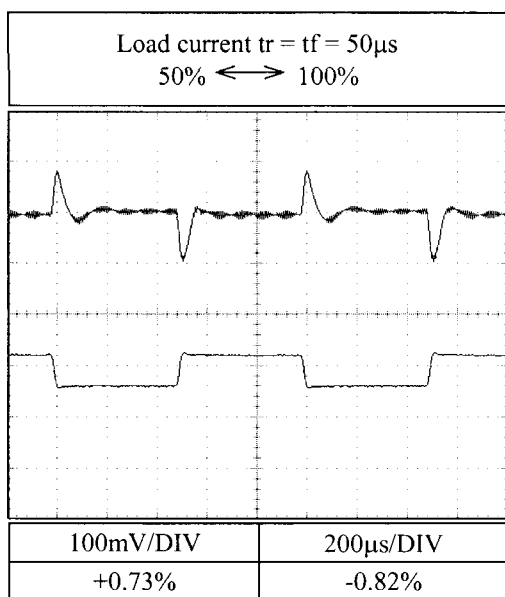
Conditions Vin : 230VAC
Ta : 25°C

12V

f=100Hz



f=1kHz

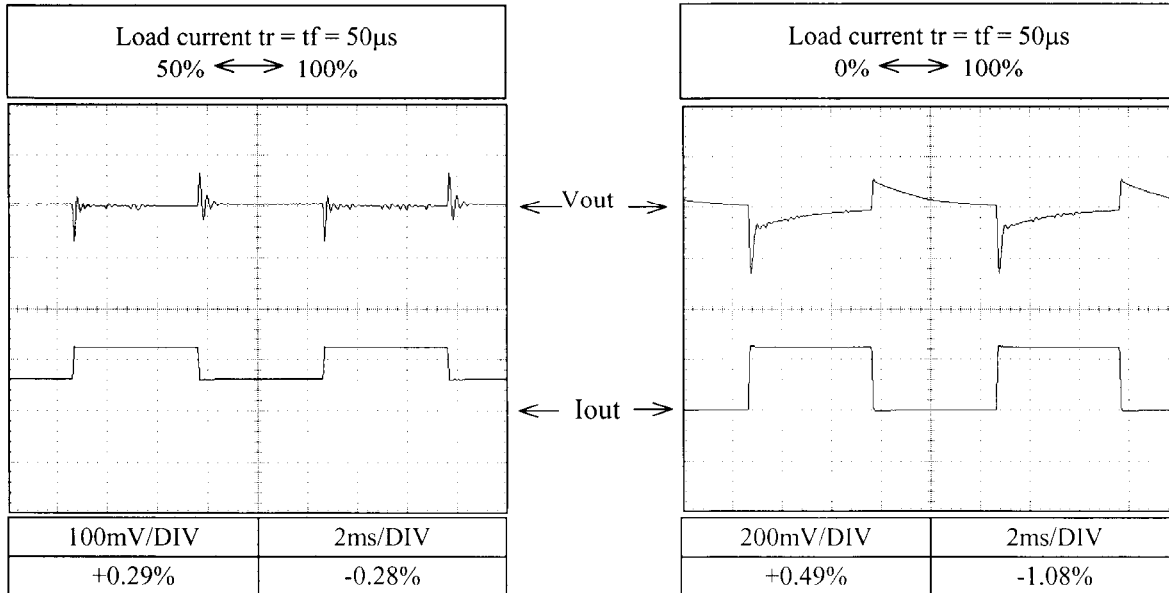


2.7 Dynamic load response characteristics

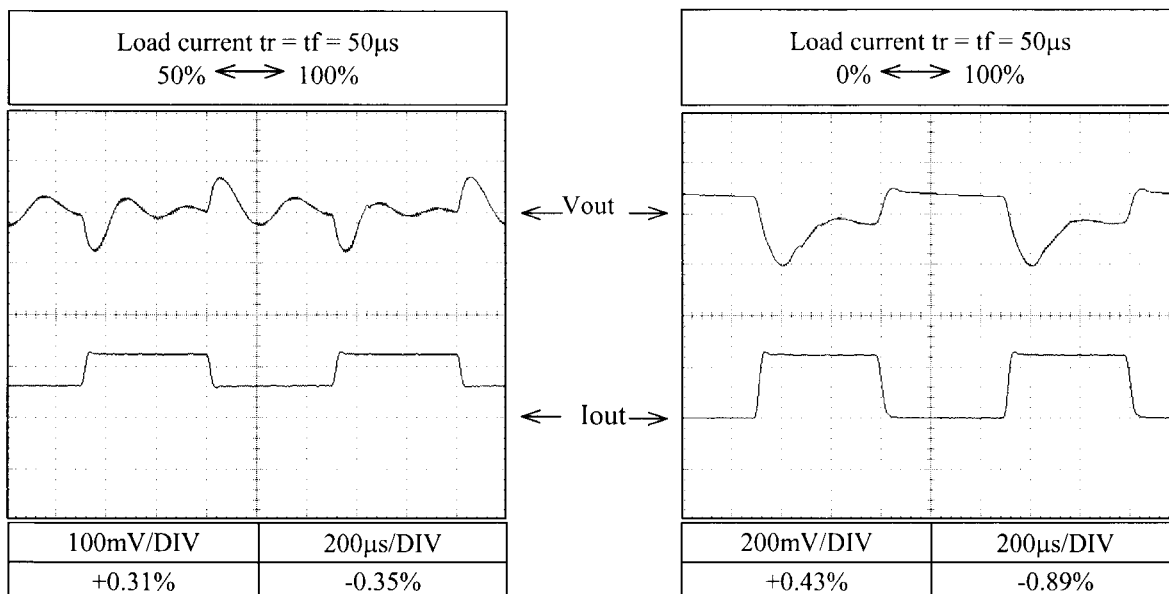
Conditions Vin : 115VAC
Ta : 25°C

24V

f=100Hz



f=1kHz

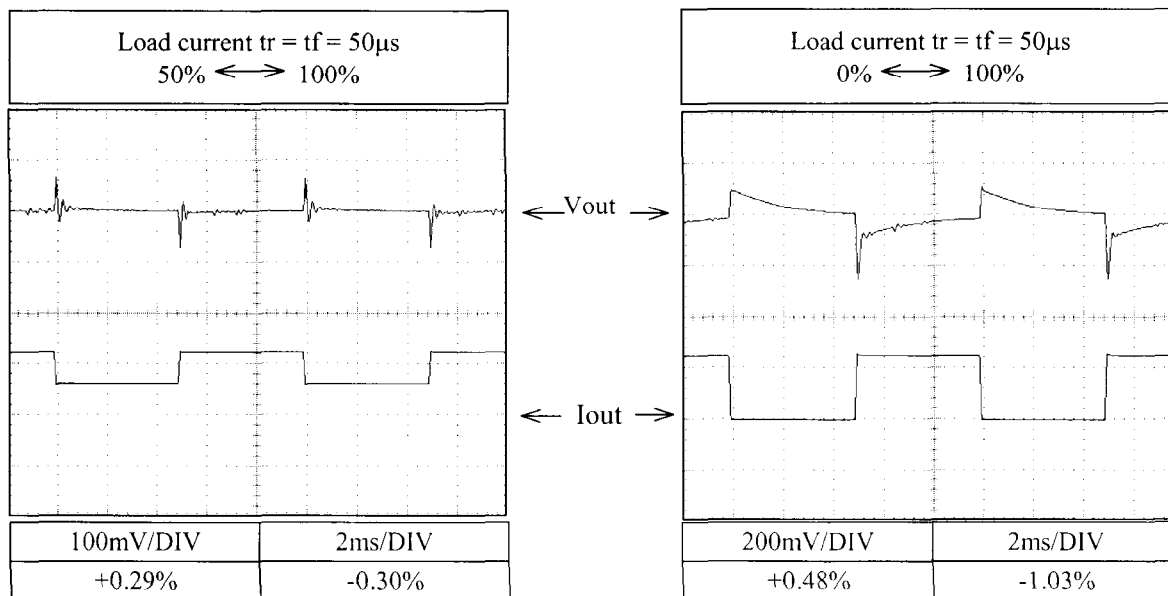


2.7 Dynamic load response characteristics

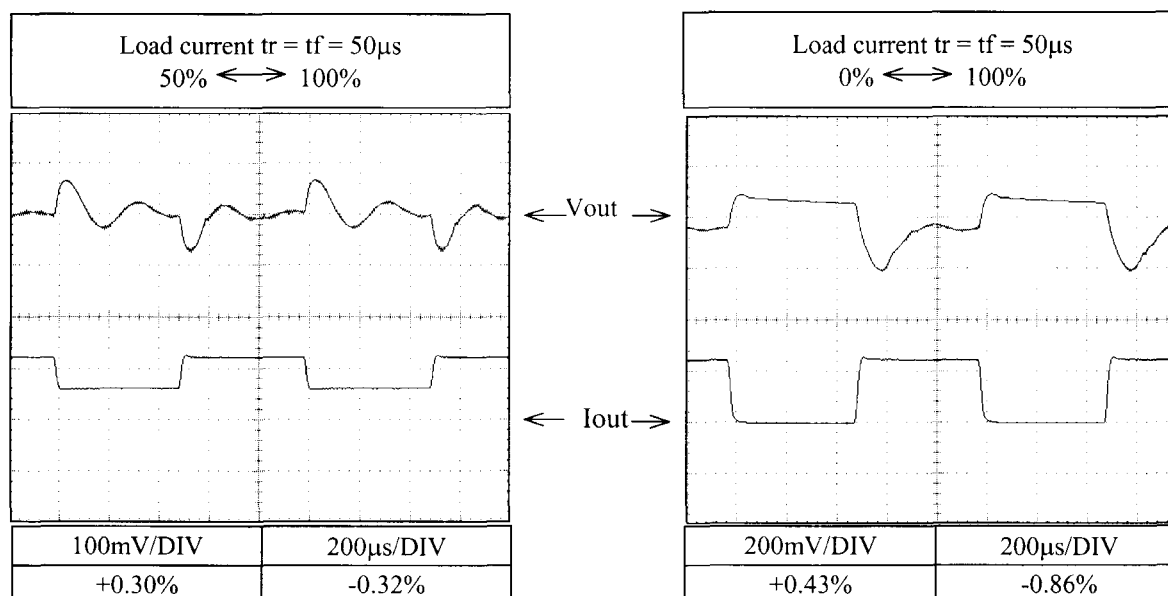
Conditions Vin : 230VAC
Ta : 25°C

24V

f=100Hz

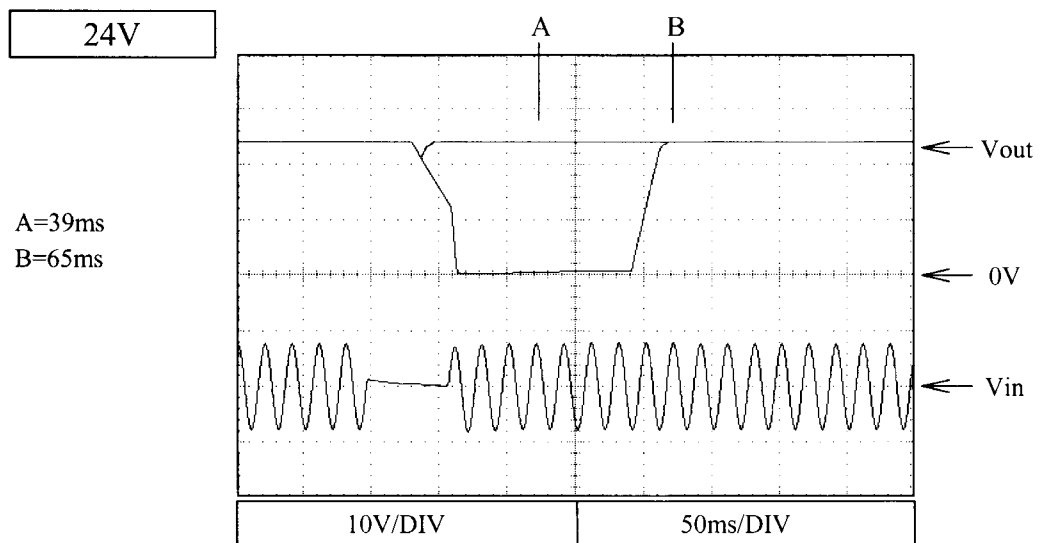
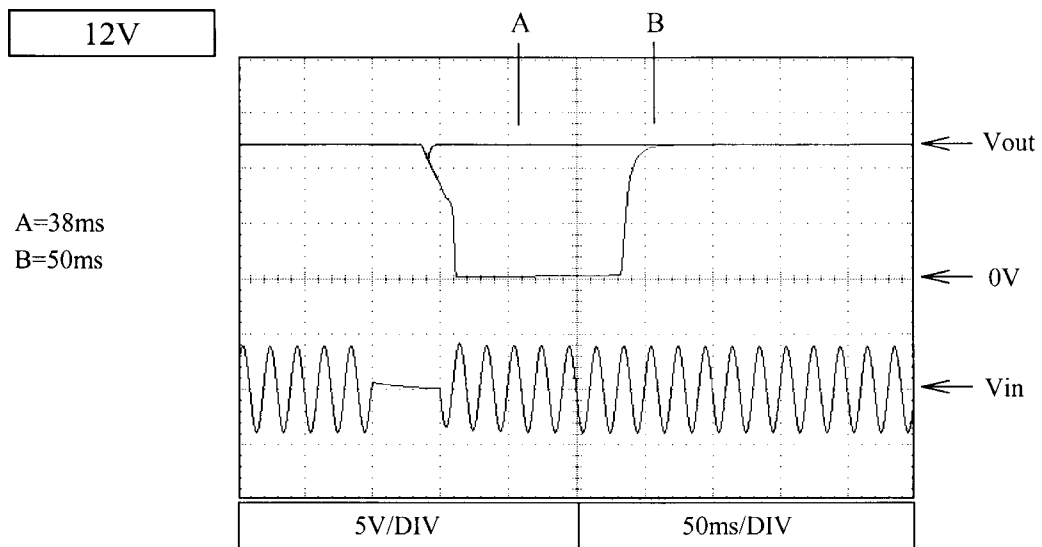
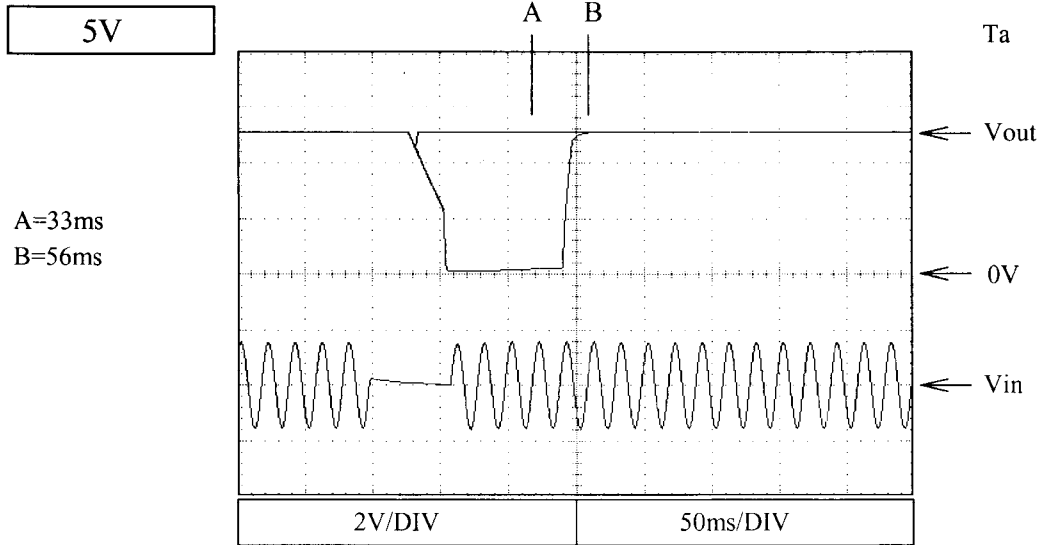


f=1kHz



2.8 Response to brown out characteristics

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

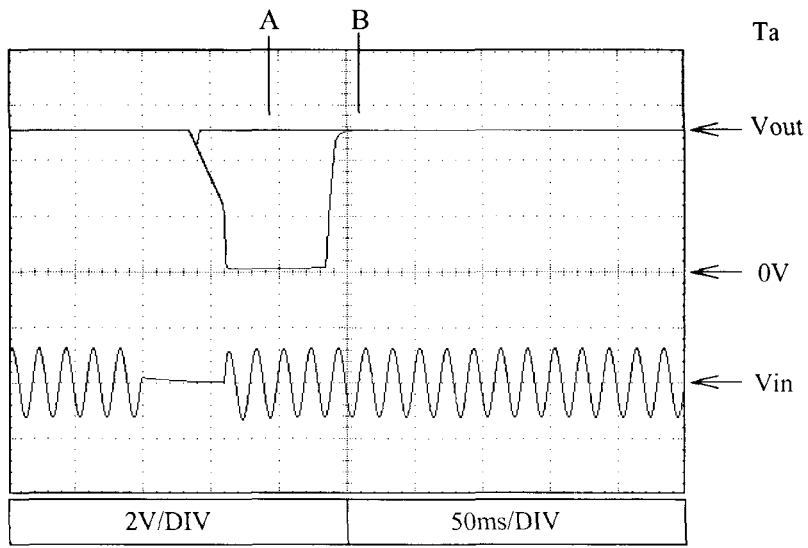


2.8 Response to brown out characteristics

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

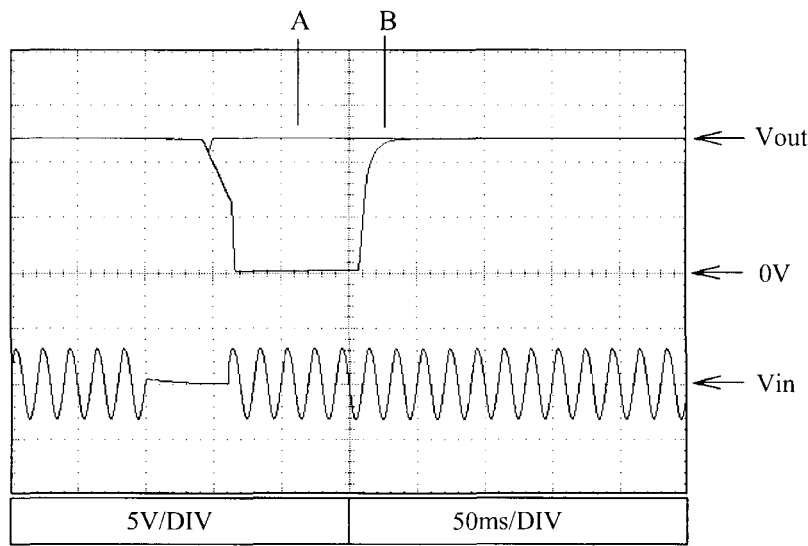
5V

A=38ms
B=64ms



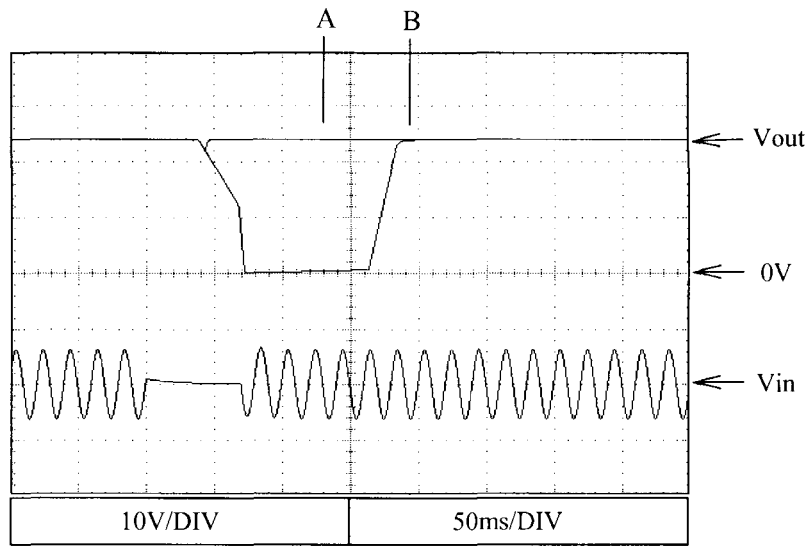
12V

A=45ms
B=65ms



24V

A=47ms
B=74ms

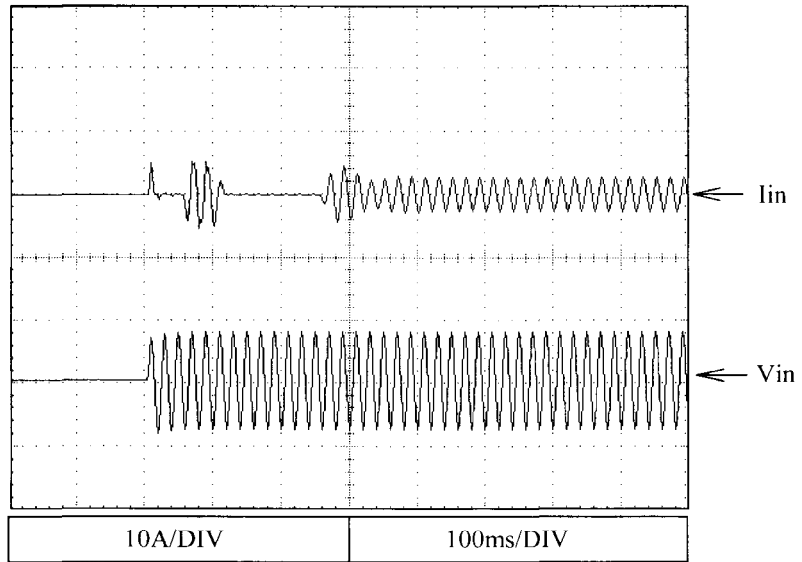


2.9 Inrush current waveform

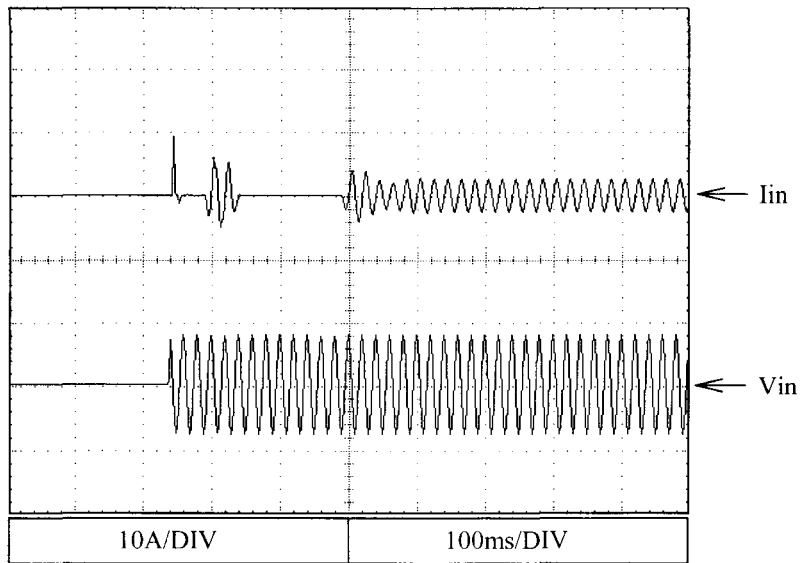
Conditions Vin : 115VAC
Iout : 100%
Ta : 25°C

5V

Switch on phase angle
of input AC voltage
 $\phi = 0^\circ$



Switch on phase angle
of input AC voltage
 $\phi = 90^\circ$

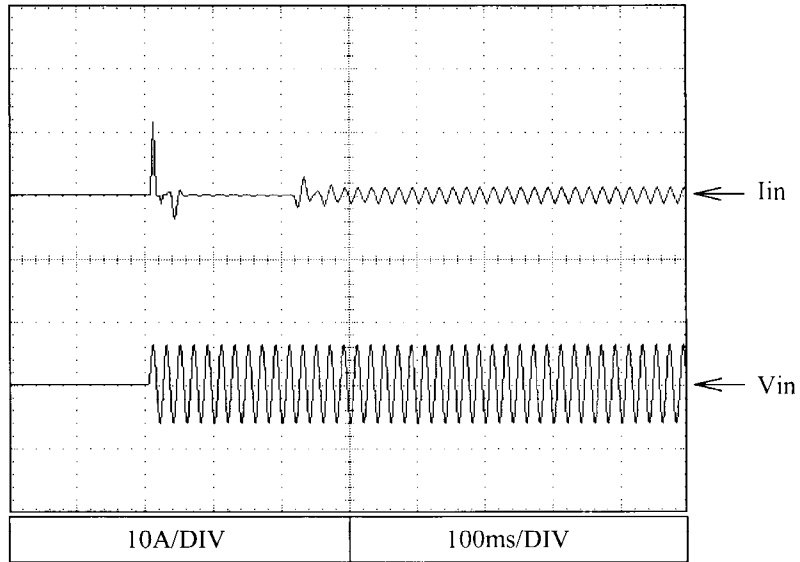


2.9 Inrush current waveform

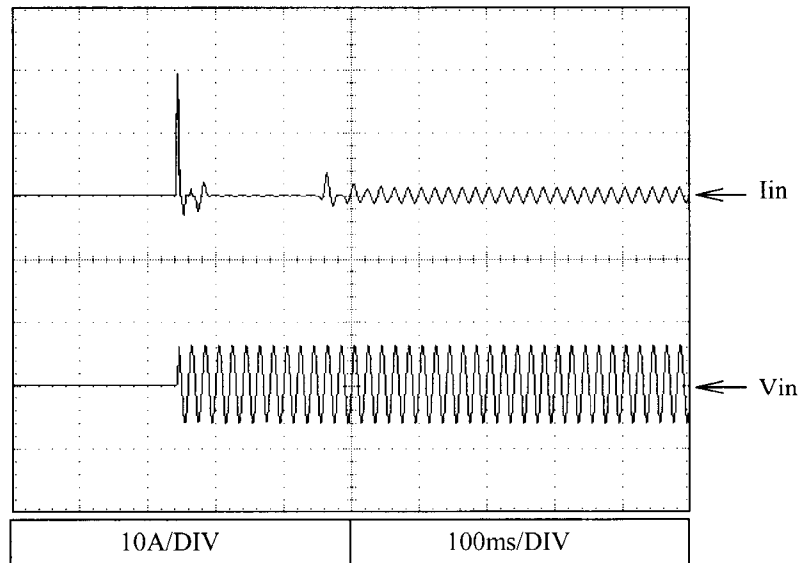
Conditions Vin : 230VAC
Iout : 100%
Ta : 25°C

5V

Switch on phase angle
of input AC voltage
 $\phi = 0^\circ$



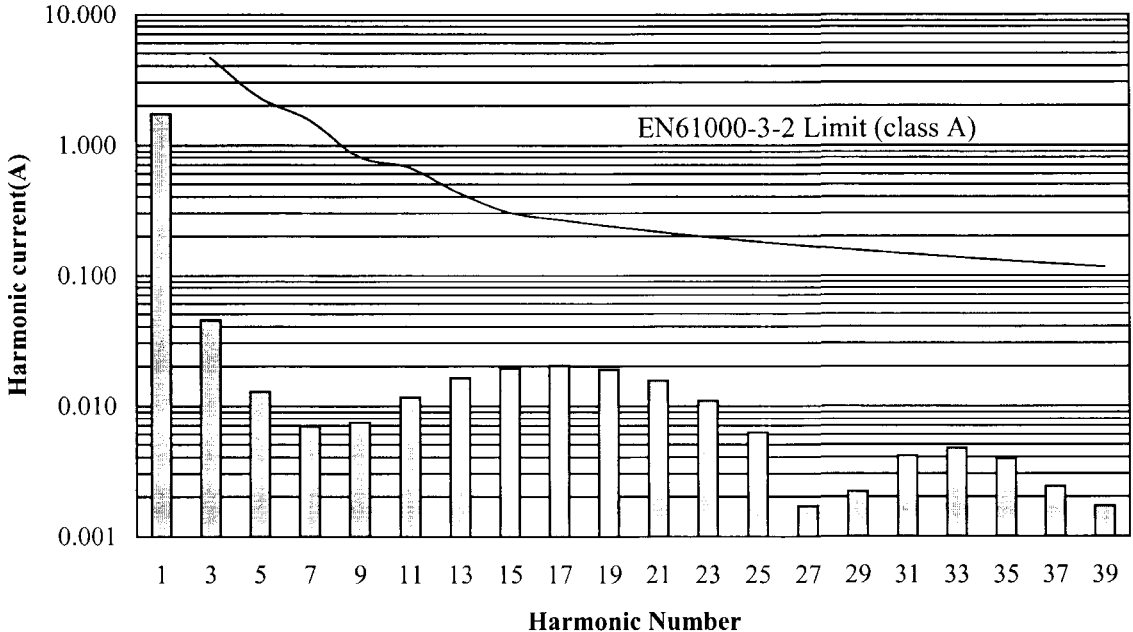
Switch on phase angle
of input AC voltage
 $\phi = 90^\circ$



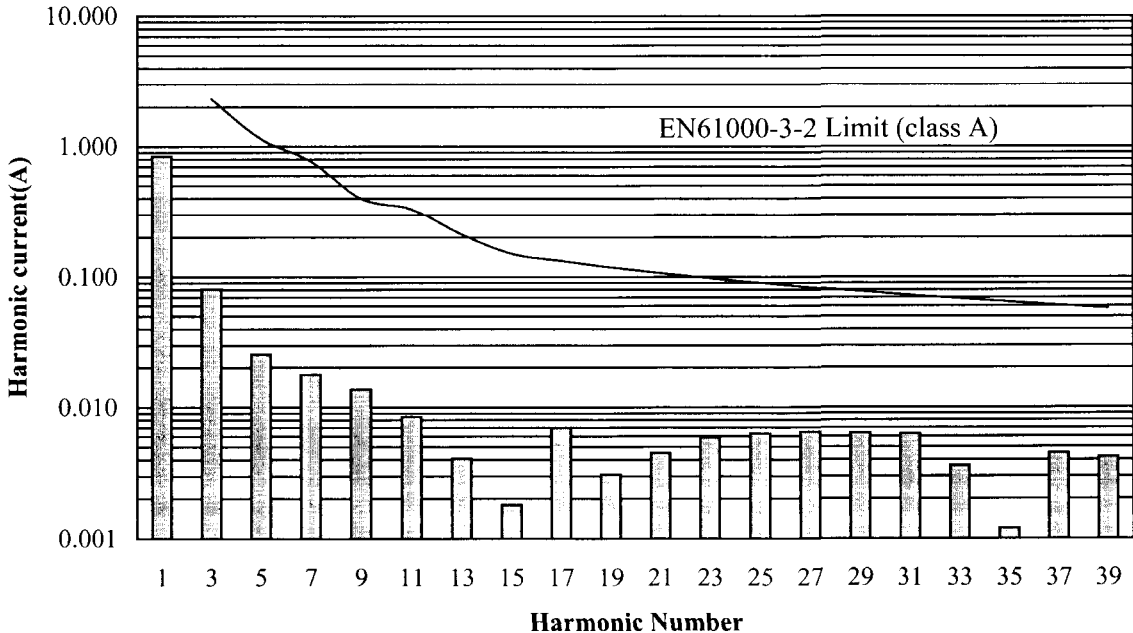
2.10 Input current harmonics

5V

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



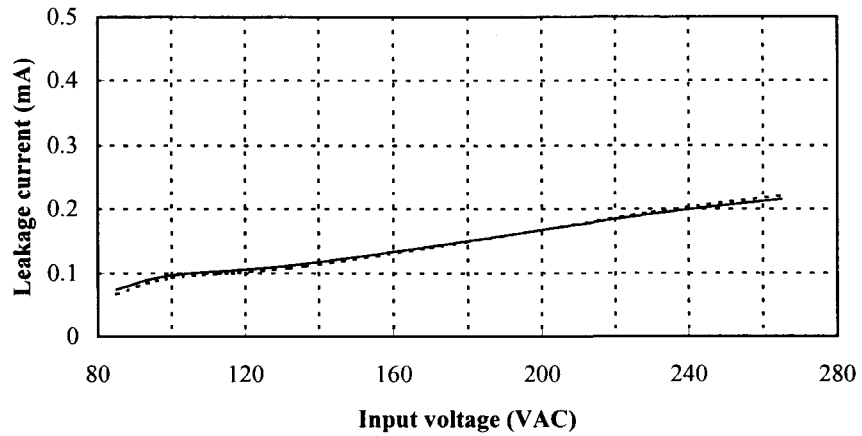
Conditions Vin : 230VAC
Iout : 100%
Ta : 25°C



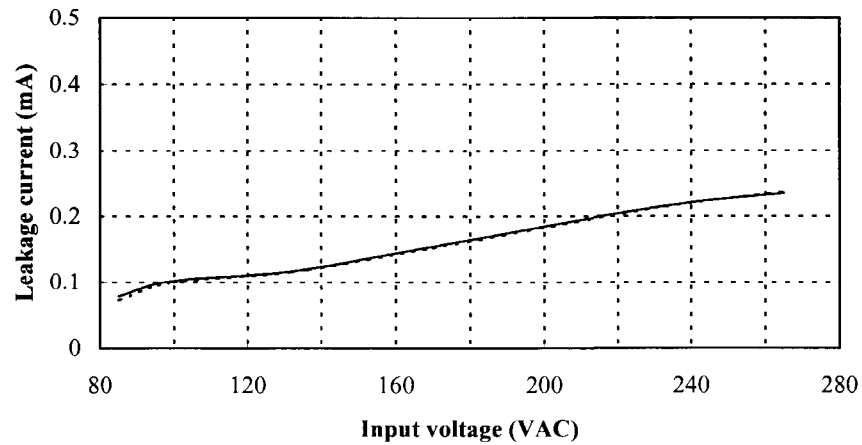
2.11 Leakage current characteristics

Conditions Iout : 0% -----
 : 100% —————
 Ta : 25°C
 f : 50Hz
 Equipment used : MODEL 228 (Simpson)

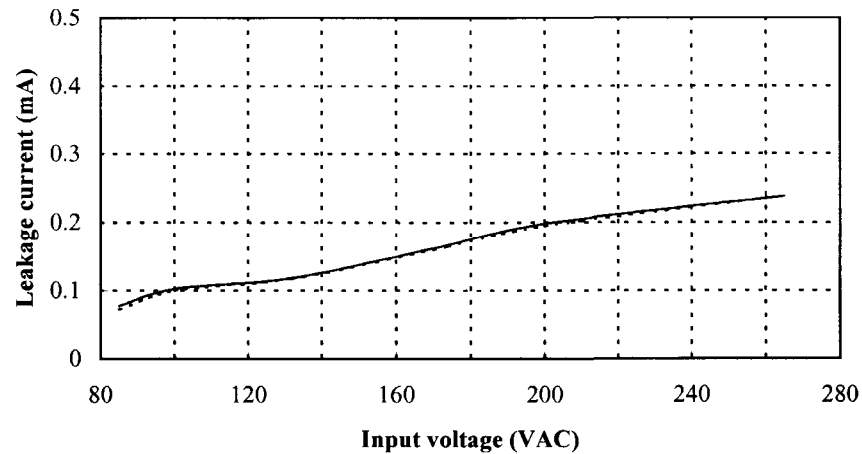
5V



12V



24V

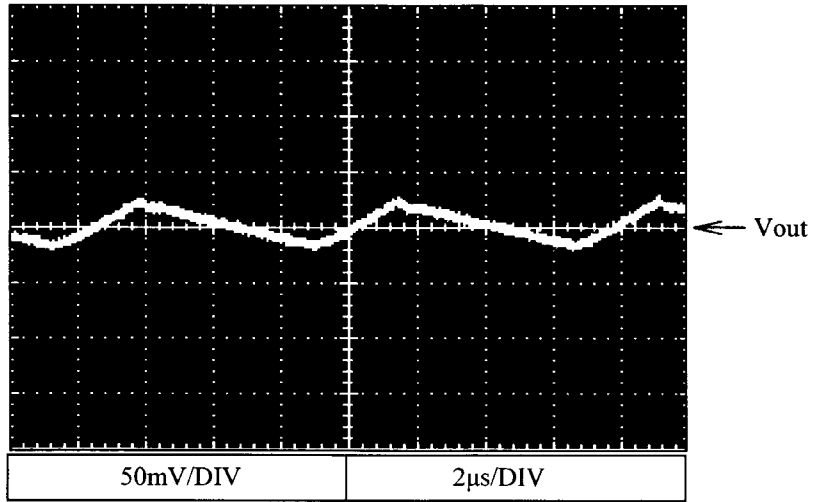


2.12 Output ripple and noise waveform

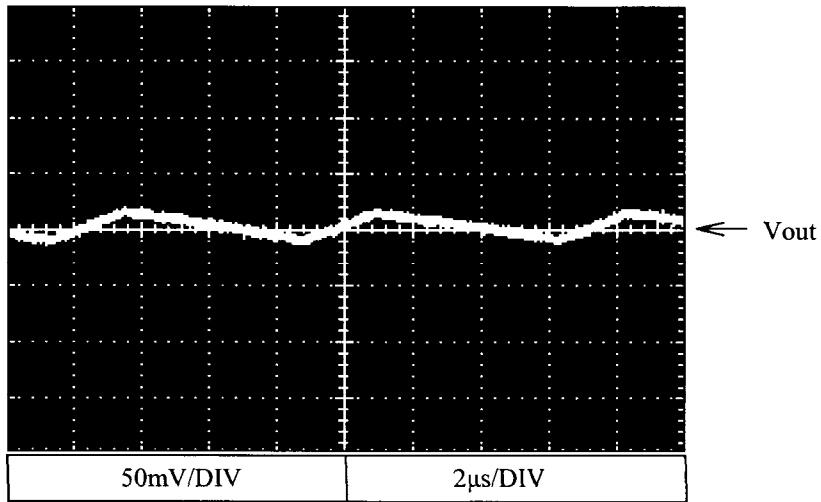
Conditions Vin : 230VAC
Iout : 100%
Ta : 25°C

NORMAL MODE

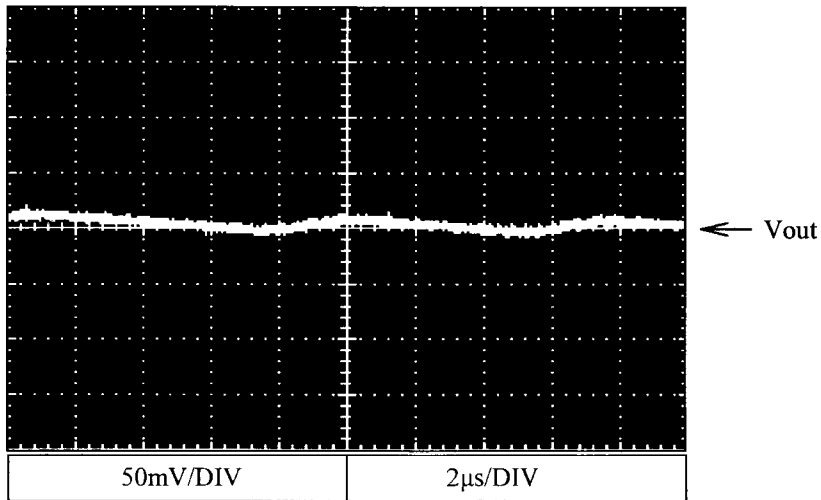
5V



12V



24V



2.13 Electro-Magnetic Interference characteristics

Conducted Emission

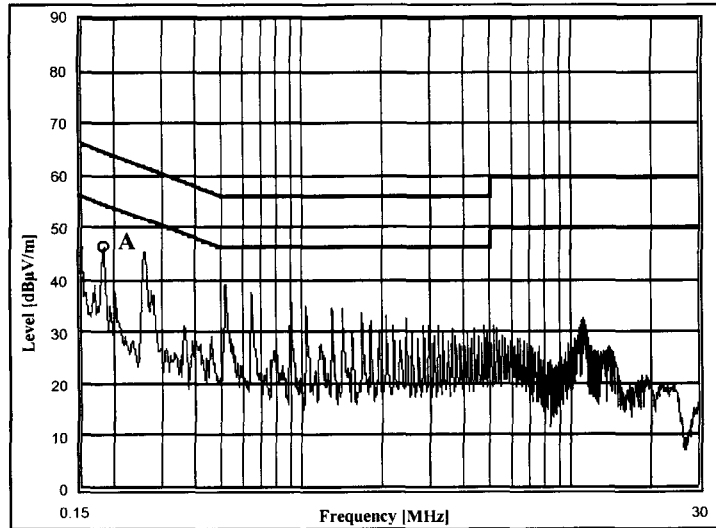
5V

Conditions

Vin : 115VAC

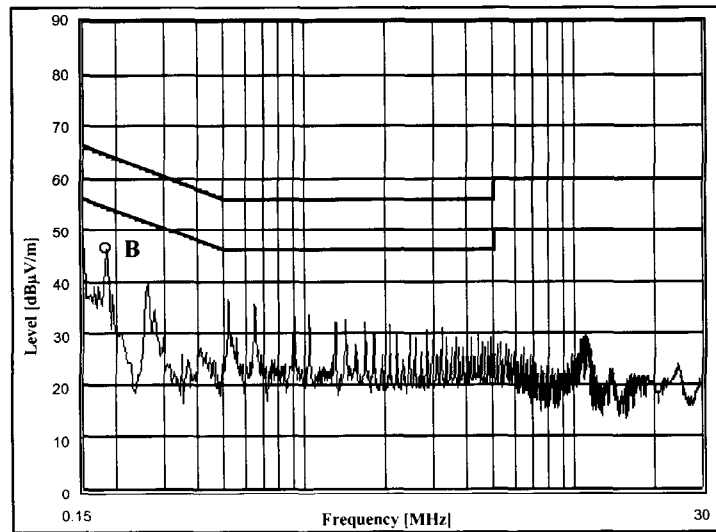
Iout : 100%

Ref.	Point A (0.18MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	64.5	42.5
AV	54.5	38.9



Phase : L

Ref.	Point B (0.18MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	64.5	45.8
AV	54.5	41.1



Phase : N

2.13 Electro-Magnetic Interference characteristics

Conducted Emission

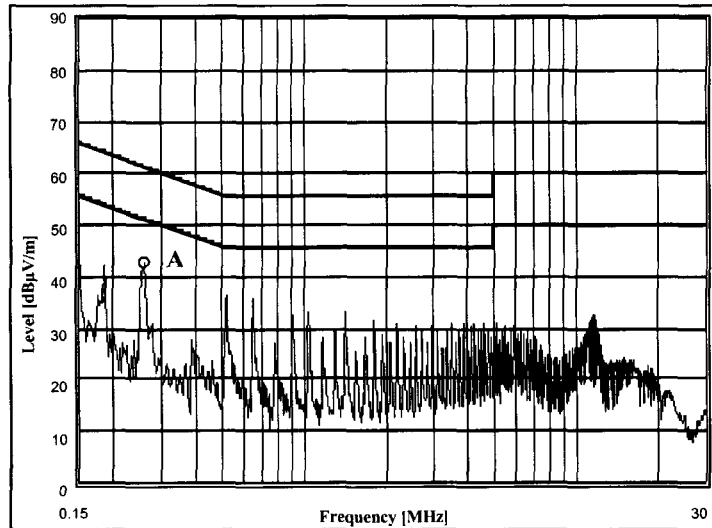
5V

Conditions

Vin : 230VAC

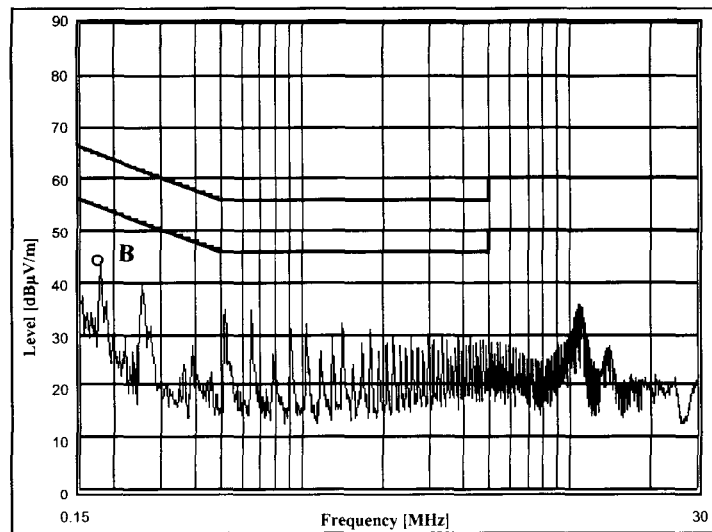
Iout : 100%

Ref.	Point A (0.26MHz)	
	Data	Measure (dBμV)
QP	61.5	40.9
AV	51.5	41.8



Phase : L

Ref.	Point B (0.18MHz)	
	Data	Measure (dBμV)
QP	64.5	42.7
AV	54.5	36.8



Phase : N

2.13 Electro-Magnetic Interference characteristics

Conducted Emission

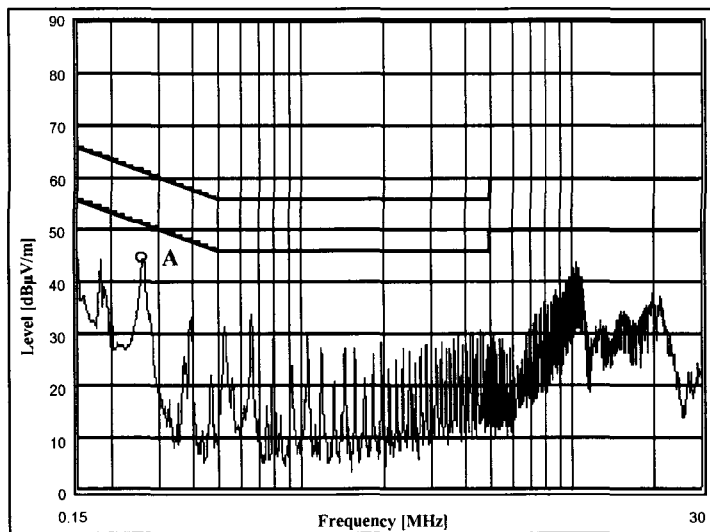
12V

Conditions

Vin : 115VAC

Iout : 100%

Ref.	Point A (0.26MHz)	
	Data	Measure (dBμV)
QP	61.5	45.0
AV	51.5	44.2

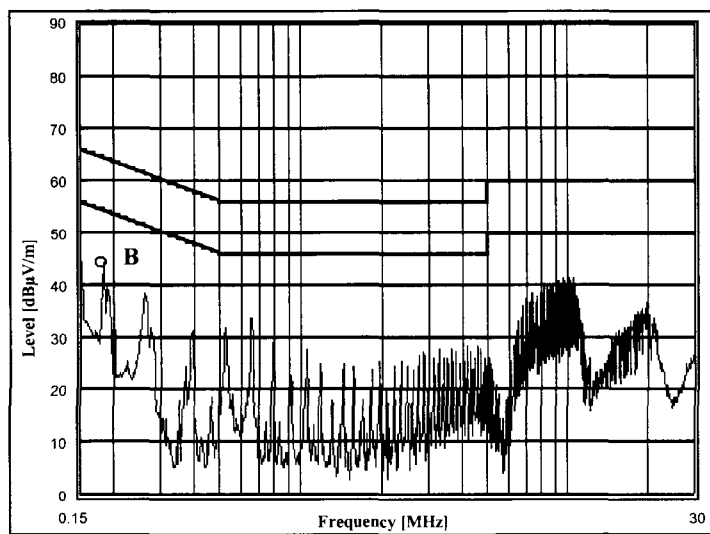


EN55011-B
EN55022-B
FCC Class B
QP Limit

EN55011-B
EN55022-B
FCC Class B
AV Limit

Phase : L

Ref.	Point B (0.18MHz)	
	Data	Measure (dBμV)
QP	64.5	42.5
AV	54.5	37.3



EN55011-B
EN55022-B
FCC Class B
QP Limit

EN55011-B
EN55022-B
FCC Class B
AV Limit

Phase : N

2.13 Electro-Magnetic Interference characteristics

Conducted Emission

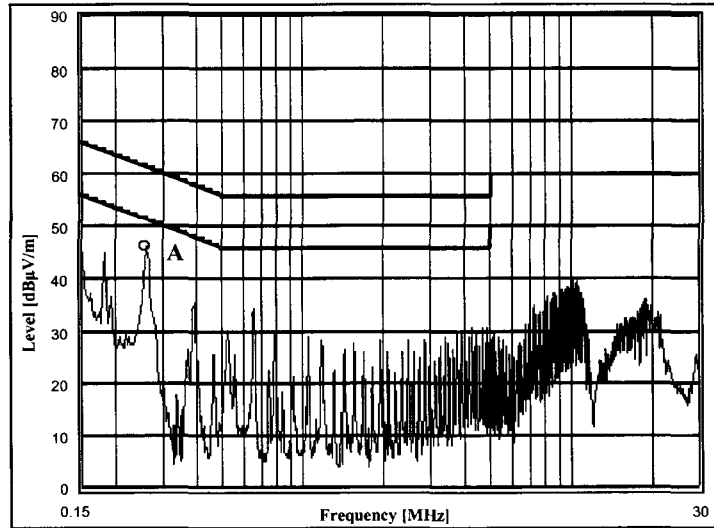
12V

Conditions

Vin : 230VAC

Iout : 100%

Ref.	Point A (0.26MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	61.5	45.0
AV	51.5	44.5

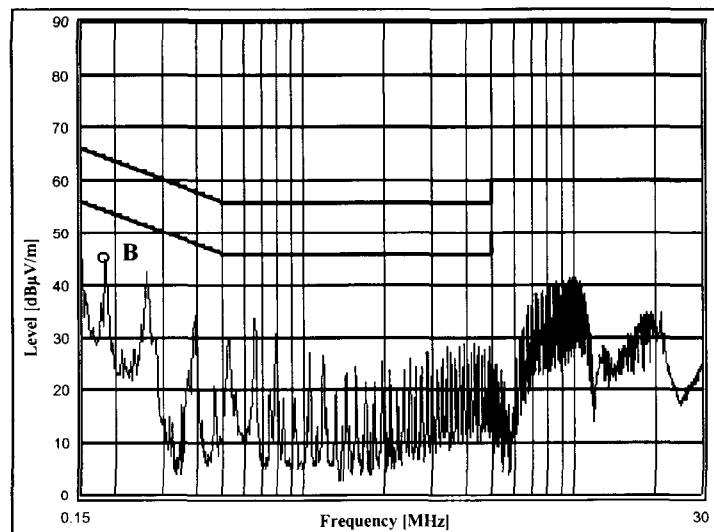


Phase : L

EN55011-B
EN55022-B
FCC Class B
QP Limit

EN55011-B
EN55022-B
FCC Class B
AV Limit

Ref.	Point B (0.18MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	64.5	42.5
AV	54.5	36.5



Phase : N

EN55011-B
EN55022-B
FCC Class B
QP Limit

EN55011-B
EN55022-B
FCC Class B
AV Limit

2.13 Electro-Magnetic Interference characteristics

Conducted Emission

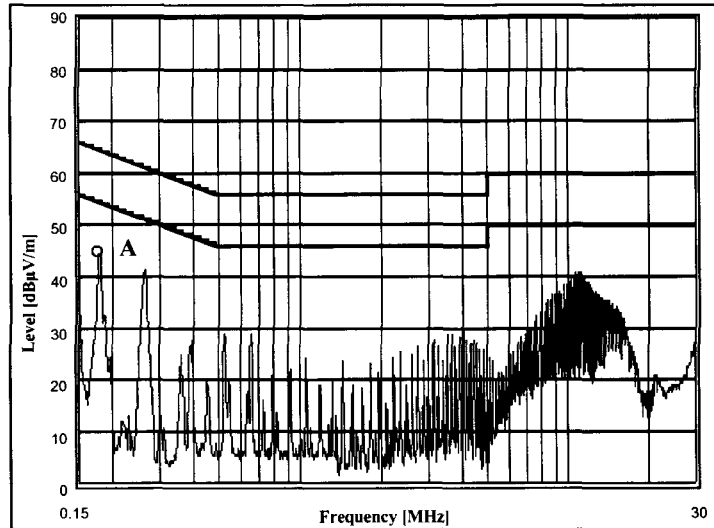
24V

Conditions

Vin : 115VAC

Iout : 100%

Ref.	Point A (0.18MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	64.5	43.2
AV	54.5	38.0

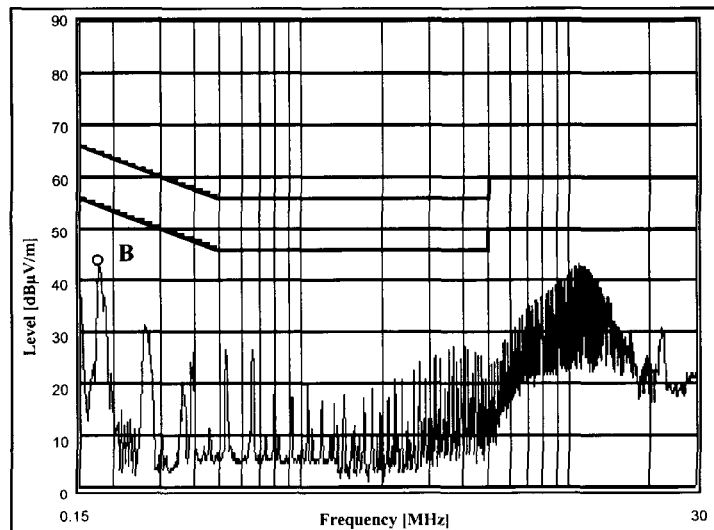


Phase : L

EN55011-B
EN55022-B
FCC Class B
QP Limit

EN55011-B
EN55022-B
FCC Class B
AV Limit

Ref.	Point B (0.18MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	64.5	42.8
AV	54.5	37.5



Phase : N

EN55011-B
EN55022-B
FCC Class B
QP Limit

EN55011-B
EN55022-B
FCC Class B
AV Limit

2.13 Electro-Magnetic Interference characteristics

Conducted Emission

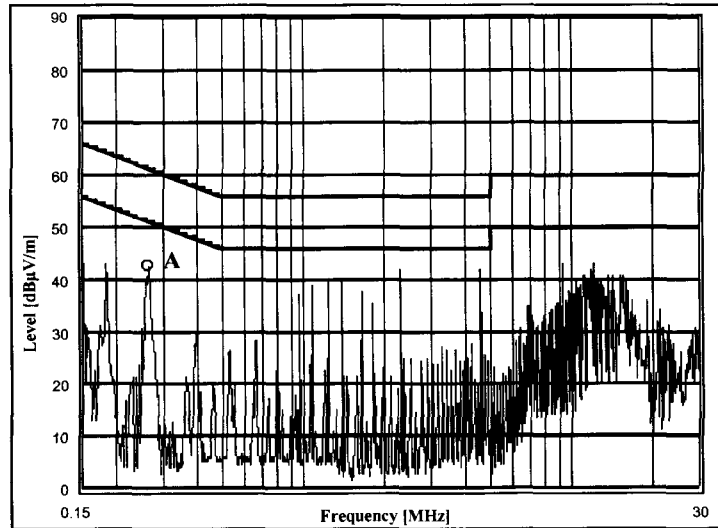
24V

Conditions

Vin : 230VAC

Iout : 100%

Ref.	Point A (0.26MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	61.5	39.3
AV	51.5	39.4

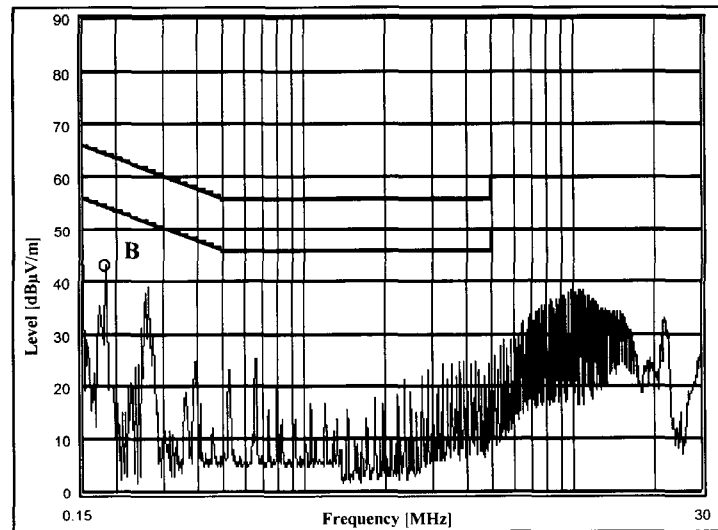


EN55011-B
EN55022-B
FCC Class B
QP Limit

EN55011-B
EN55022-B
FCC Class B
AV Limit

Phase : L

Ref.	Point B (0.18MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	64.5	39.1
AV	54.5	32.4



EN55011-B
EN55022-B
FCC Class B
QP Limit

EN55011-B
EN55022-B
FCC Class B
AV Limit

Phase : N

2.13 Electro-Magnetic Interference characteristics

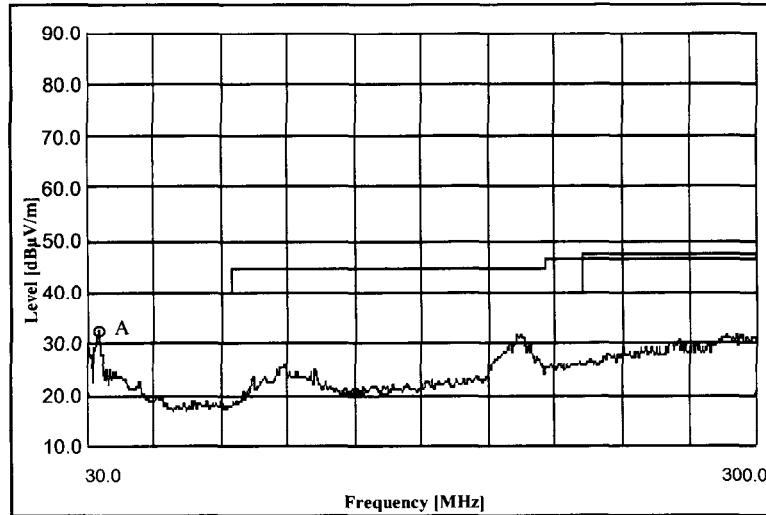
Radiated Emission

Conditions
 Vin : 115VAC
 Iout : 100%

5V

HORIZONTAL:

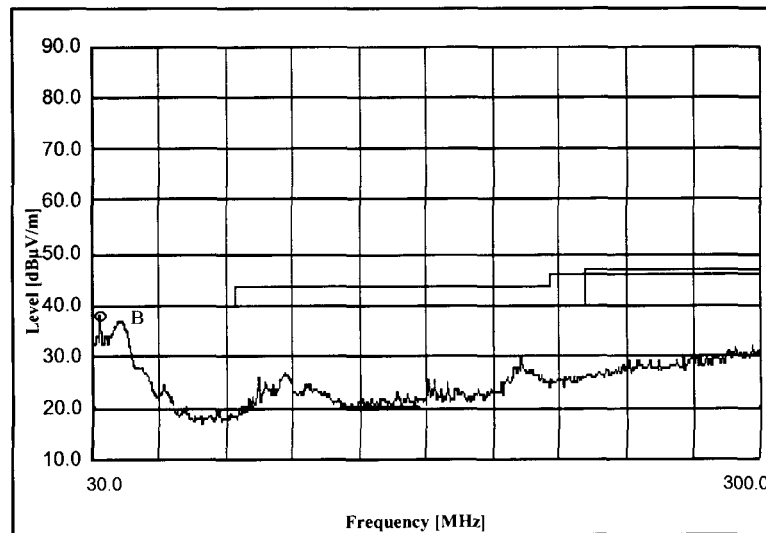
Point A (33.4MHz)	
Limit (dB μ V/m)	Measure (dB μ V/m)
40.0	32.2



EN55011-B
 EN55022-B
 QP Limit
 FCC Class B
 QP Limit

VERTICAL:

Point B (31.9MHz)	
Limit (dB μ V/m)	Measure (dB μ V/m)
40.0	36.4



EN55011-B
 EN55022-B
 QP Limit
 FCC Class B
 QP Limit

2.13 Electro-Magnetic Interference characteristics

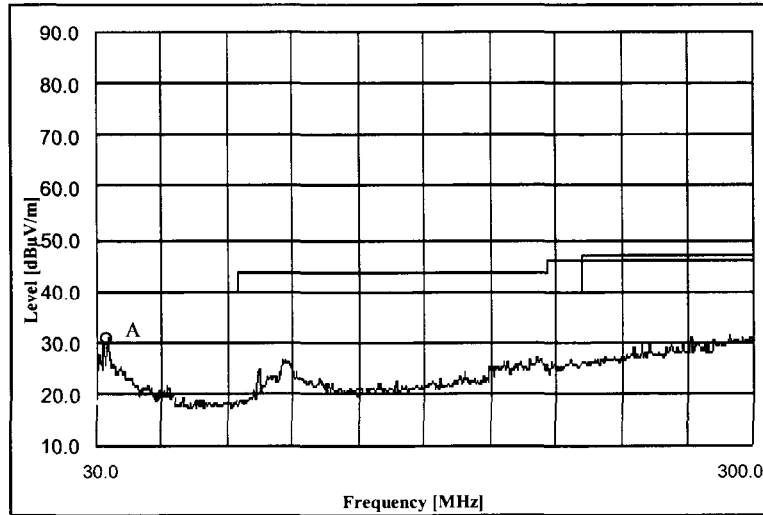
Radiated Emission

Conditions
 Vin : 230VAC
 Iout : 100%

5V

HORIZONTAL:

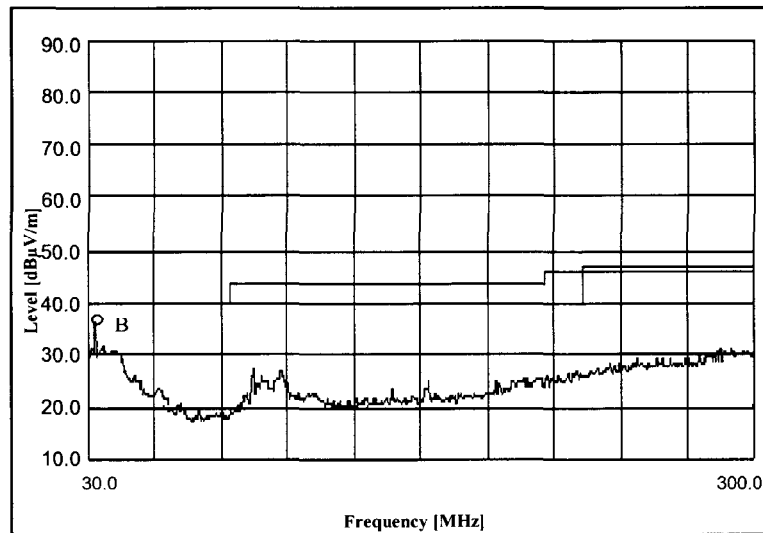
Point A (32.7MHz)	
Limit (dB μ V/m)	Measure (dB μ V/m)
40.0	29.7



EN55011-B
 EN55022-B
 QP Limit
 FCC Class B
 QP Limit

VERTICAL:

Point B (32.1MHz)	
Limit (dB μ V/m)	Measure (dB μ V/m)
40.0	36.2



EN55011-B
 EN55022-B
 QP Limit
 FCC Class B
 QP Limit

2.13 Electro-Magnetic Interference characteristics

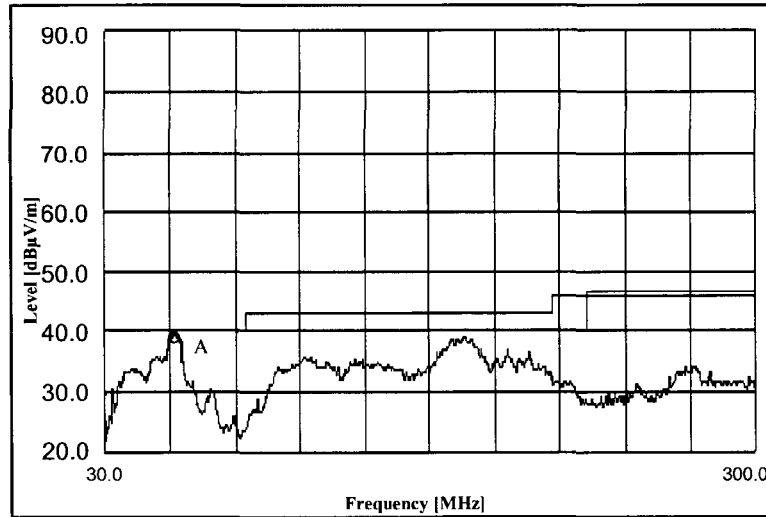
Radiated Emission

Conditions
 Vin : 115VAC
 Iout : 100%

12V

HORIZONTAL:

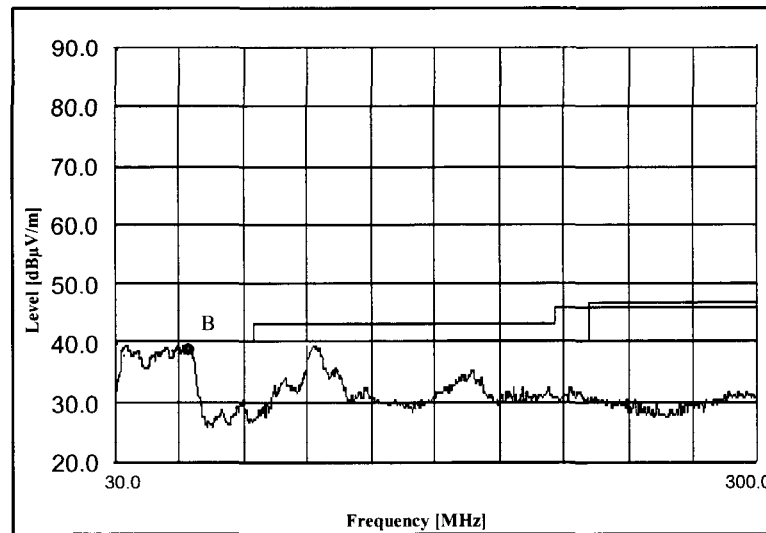
Point A (60.4MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	38.2



EN55011-B
 EN55022-B
 QP Limit
 FCC Class B
 QP Limit

VERTICAL:

Point B (60.1MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	37.3



EN55011-B
 EN55022-B
 QP Limit
 FCC Class B
 QP Limit

2.13 Electro-Magnetic Interference characteristics

Radiated Emission

Conditions

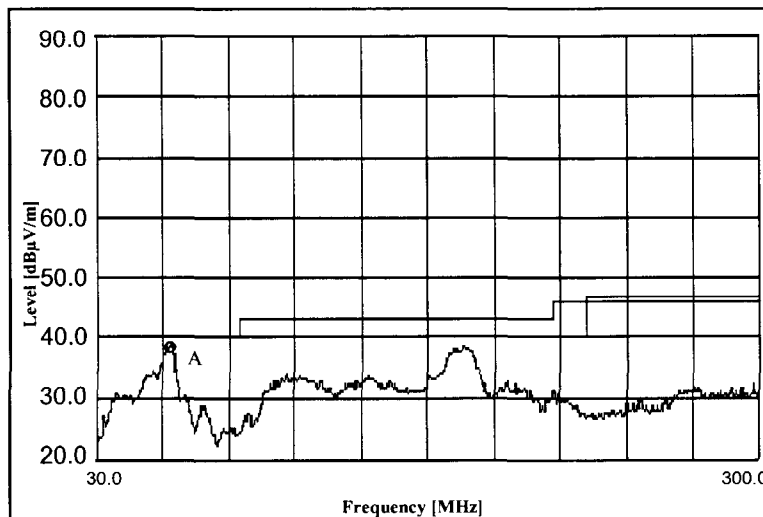
Vin : 230VAC

Iout : 100%

12V

HORIZONTAL:

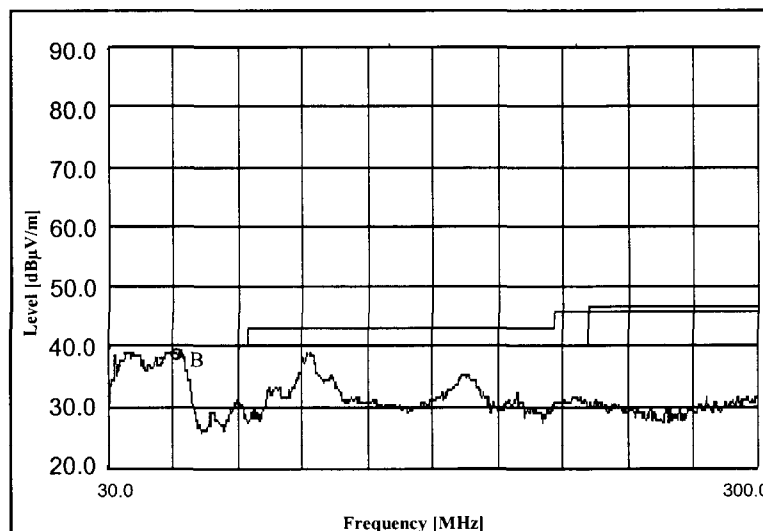
Point A (60.5MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	39.1



EN55011-B
EN55022-B
QP Limit
FCC Class B
QP Limit

VERTICAL:

Point B (61.9MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	37.7



EN55011-B
EN55022-B
QP Limit
FCC Class B
QP Limit

2.13 Electro-Magnetic Interference characteristics

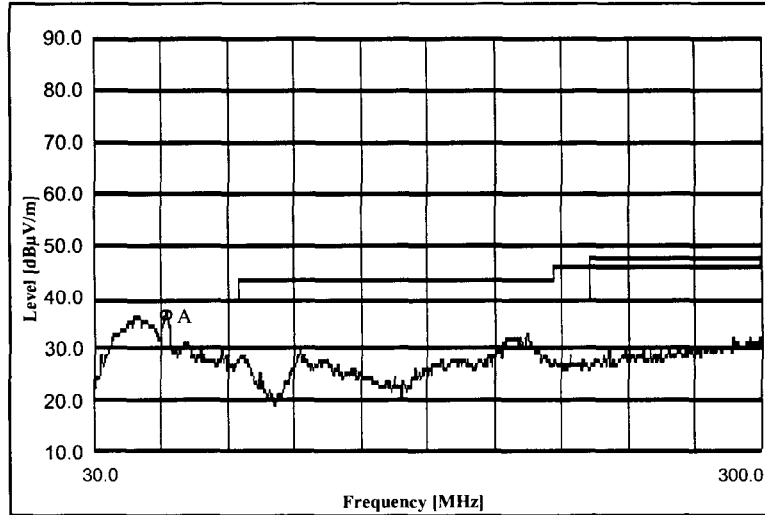
Radiated Emission

Conditions
 Vin : 115VAC
 Iout : 100%

24V

HORIZONTAL:

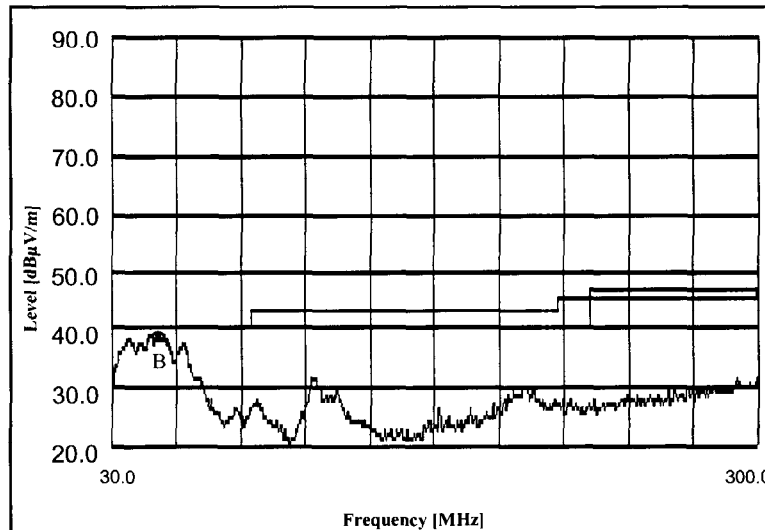
Point A (60.9MHz)	
Limit (dB μ V/m)	Measure (dB μ V/m)
40.0	36.5



EN55011-B
 EN55022-B
 QP Limit
 FCC Class B
 QP Limit

VERTICAL:

Point B (50.7MHz)	
Limit (dB μ V/m)	Measure (dB μ V/m)
40.0	38.4



EN55011-B
 EN55022-B
 QP Limit
 FCC Class B
 QP Limit

2.13 Electro-Magnetic Interference characteristics

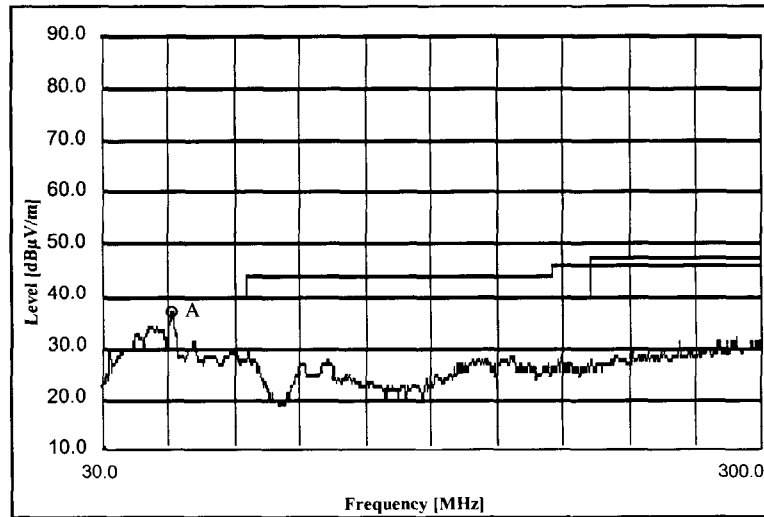
Radiated Emission

Conditions
 Vin : 230VAC
 Iout : 100%

24V

HORIZONTAL:

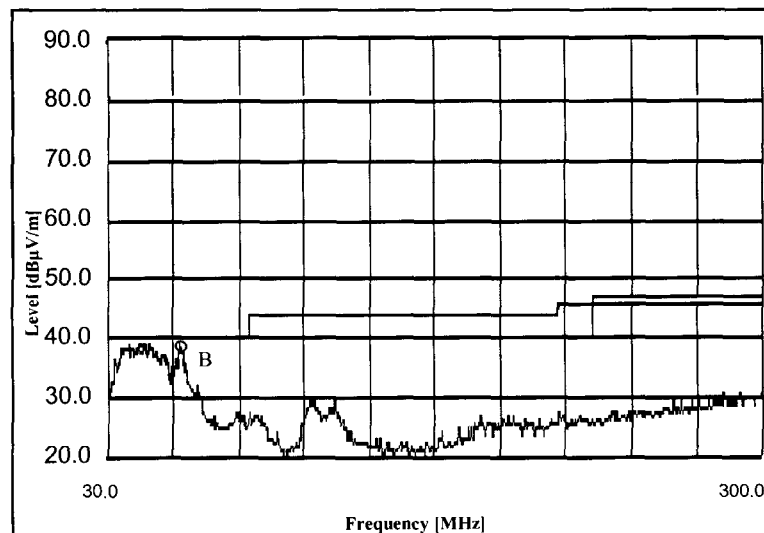
Point A (58.9MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	37.9



EN55011-B
 EN55022-B
 QP Limit
 FCC Class B
 QP Limit

VERTICAL:

Point B (62.7MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	38.6



EN55011-B
 EN55022-B
 QP Limit
 FCC Class B
 QP Limit