

CUS350M

EVALUATION DATA

DWG No. CA820-53-01		
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14-Aug-15	14-Aug-15	14-Aug-15

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Terminology used

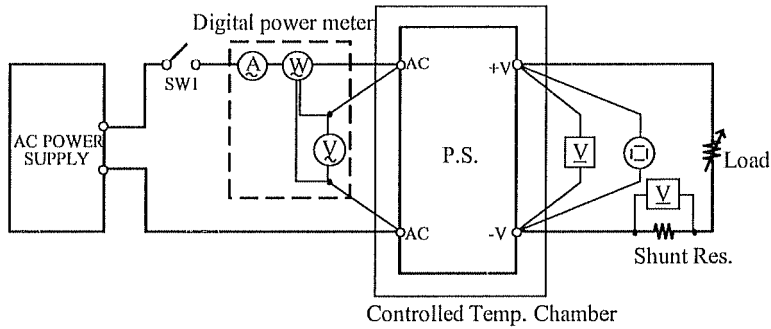
	Definition
V_{in} Input voltage
V_{out} Output voltage
I_{in} Input current
I_{out} Output current
T_a Ambient temperature
f Frequency

1. Evaluation Method

1.1 Circuit used for determination

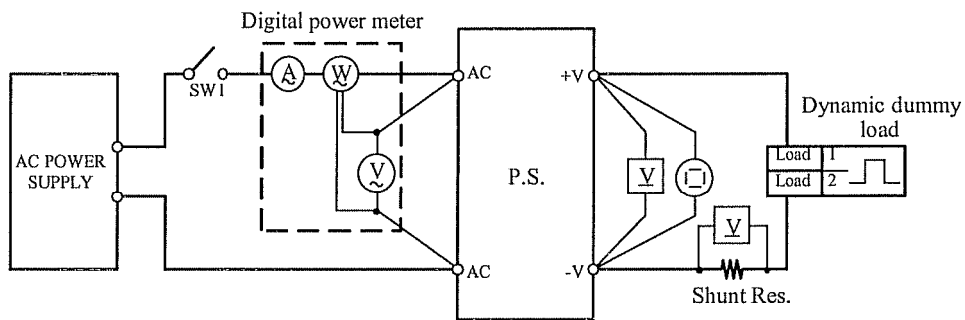
Circuit 1 used for determination

- Steady state data
- Over current protection (OCP) characteristics
- Over voltage protection (OVP) characteristics
- Output rise characteristics
- Output fall characteristics
- Hold up time characteristics

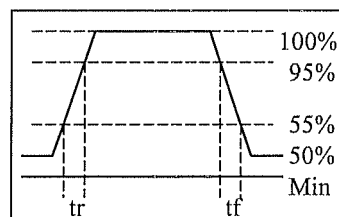


Circuit 2 used for determination

- Dynamic load response characteristics

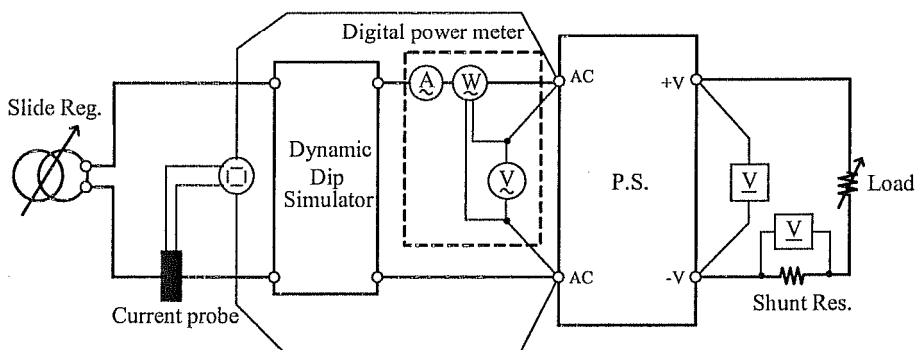


Output current waveform



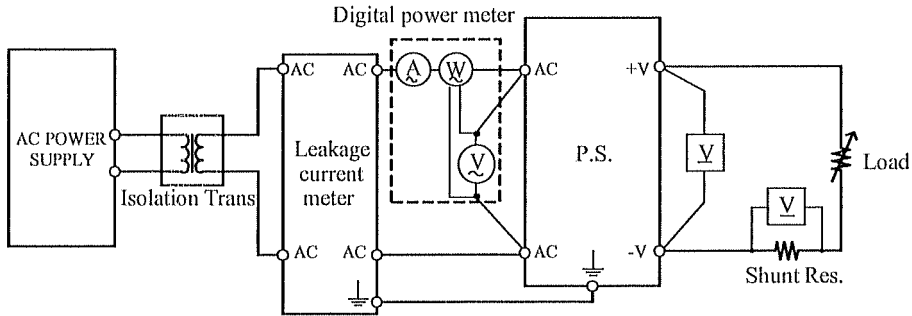
Circuit 3 used for determination

- Inrush current waveform



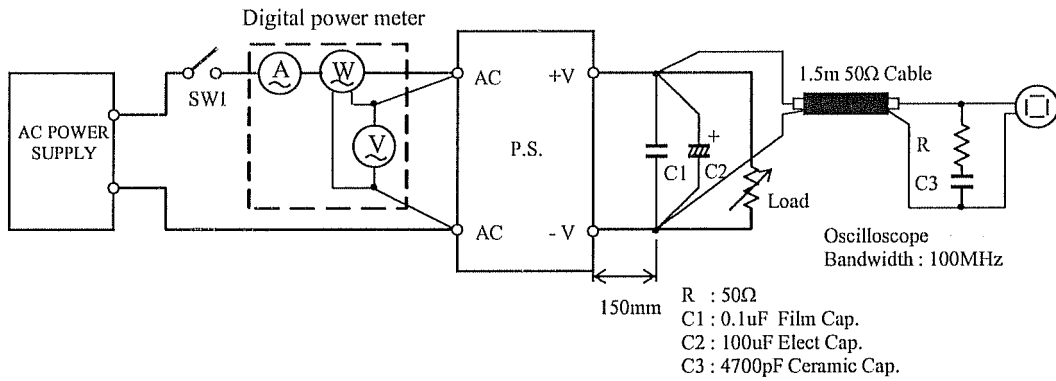
Circuit 4 used for determination

- Leakage current characteristics



Circuit 5 used for determination

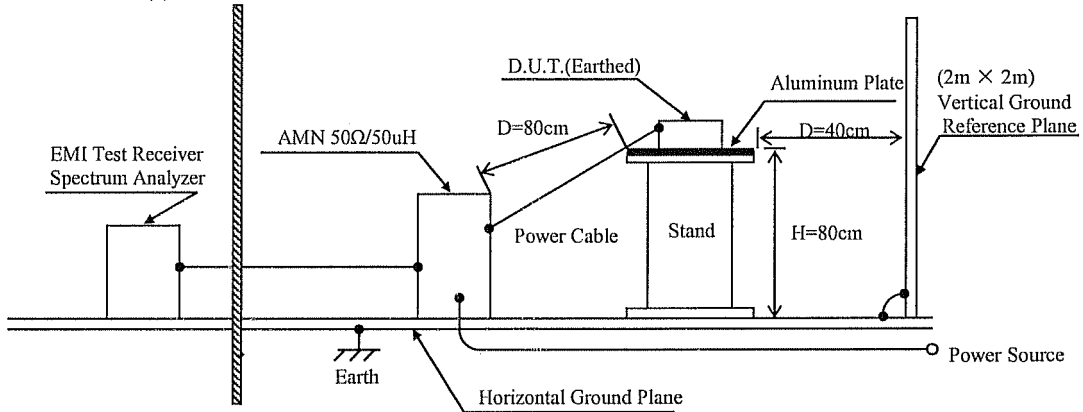
- Output ripple and noise waveform



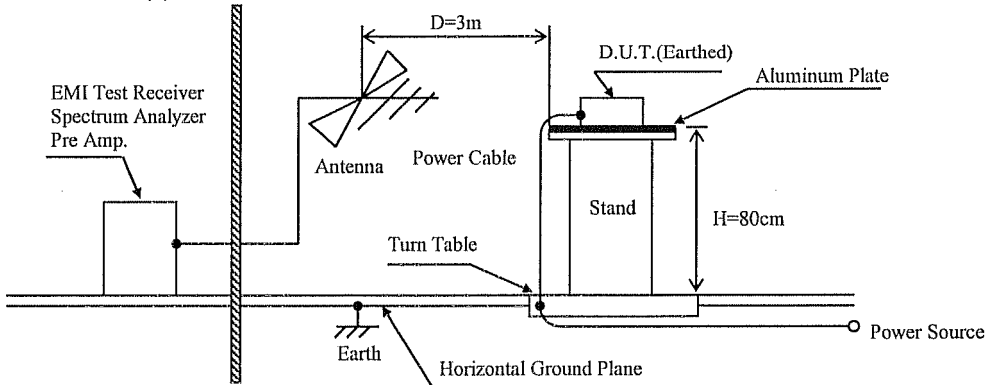
Configuration used for determination

- Electro-Magnetic Interference characteristics

(a) Conducted Emission



(b) Radiated Emission



1.2 List of equipment used

	EQUIPMENT USED	MANUFACTURER	MODEL NO.
1	DIGITAL STORAGE OSCILLOSCOPE	YOKOGAWA ELECT.	DLM2054
2	DIGITAL MULTIMETER	FLUKE	111
3	DIGITAL POWER METER	YOKOGAWA ELECT.	WT210
4	CURRENT PROBE	YOKOGAWA ELECT.	701932
5	DYNAMIC DUMMY LOAD	CHROMA	63201
6	CVCF	KIKUSUI	PCR2000LE
7	LEAKAGE CURRENT METER	SIMPSON	228
8	CONTROLLED TEMP. CHAMBER	TABAI-ESPEC	SH-661
9	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESCI-03
10	LISN	ROHDE & SCHWARZ	ENV216
11	BICONICAL ANTENNA	EMCO	63208

2.1 Steady state data

(1) Regulation - line and load, Temperature drift / Start up voltage and Drop out voltage

12V

1. Regulation - line and load

Condition Ta : 25 °C

Iout \ Vin	85VAC	115VAC	230VAC	265VAC	line regulation	
0%	12.033V	12.033V	12.033V	12.033V	0mV	0.000%
50%	11.999V	11.998V	11.999V	11.999V	1mV	0.008%
100%	-	11.993V	11.993V	11.993V	0mV	0.000%
load regulation	34mV	40mV	40mV	40mV		
	0.283%	0.333%	0.333%	0.333%		

2. Temperature drift

Conditions Iout : 100 %

	Vin \ Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	115VAC	11.957V	11.993V	11.995V	38mV	0.317%
	230VAC	11.957V	11.993V	11.995V	38mV	0.317%

3. Start up voltage and Drop out voltage

Conditions Ta : 25 °C

Iout : 100 %

Start up voltage (Vin)	82VAC
Drop out voltage (Vin)	70VAC

18V

1. Regulation - line and load

Condition Ta : 25 °C

Iout \ Vin	85VAC	115VAC	230VAC	265VAC	line regulation	
0%	18.058V	18.059V	18.058V	18.059V	1mV	0.006%
50%	18.025V	18.025V	18.025V	18.025V	0mV	0.000%
100%	-	18.025V	18.026V	18.026V	1mV	0.006%
load regulation	33mV	34mV	33mV	34mV		
	0.183%	0.189%	0.183%	0.189%		

2. Temperature drift

Conditions Iout : 100 %

	Vin \ Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	115VAC	17.923V	18.025V	18.027V	104mV	0.578%
	230VAC	17.922V	18.026V	18.027V	105mV	0.583%

3. Start up voltage and Drop out voltage

Conditions Ta : 25 °C

Iout : 100 %

Start up voltage (Vin)	82VAC
Drop out voltage (Vin)	70VAC

(1) Regulation - line and load, Temperature drift / Start up voltage and Drop out voltage

24V

1. Regulation - line and load

Condition Ta : 25 °C

Iout \ Vin	85VAC	115VAC	230VAC	265VAC	line regulation	
0%	24.012V	24.012V	24.012V	24.012V	0mV	0.000%
50%	24.009V	24.009V	24.009V	24.009V	0mV	0.000%
100%	-	24.007V	24.007V	24.007V	0mV	0.000%
load regulation	3mV	5mV	5mV	5mV		
	0.013%	0.021%	0.021%	0.021%		

2. Temperature drift

Conditions Iout : 100 %

	Vin \ Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	115VAC	23.935V	24.007V	24.004V	72mV	0.300%
	230VAC	23.935V	24.007V	24.004V	72mV	0.300%

3. Start up voltage and Drop out voltage

Conditions Ta : 25 °C

Iout : 100 %

Start up voltage (Vin)	82VAC
Drop out voltage (Vin)	70VAC

48V

1. Regulation - line and load

Condition Ta : 25 °C

Iout \ Vin	85VAC	115VAC	230VAC	265VAC	line regulation	
0%	48.041V	48.042V	48.042V	48.041V	1mV	0.002%
50%	47.996V	47.997V	47.997V	47.998V	2mV	0.004%
100%	-	48.002V	48.002V	48.002V	0mV	0.000%
load regulation	45mV	45mV	45mV	43mV		
	0.094%	0.094%	0.094%	0.090%		

2. Temperature drift

Conditions Iout : 100 %

	Vin \ Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	115VAC	47.847V	48.002V	48.003V	156mV	0.325%
	230VAC	47.847V	48.002V	48.000V	155mV	0.323%

3. Start up voltage and Drop out voltage

Conditions Ta : 25 °C

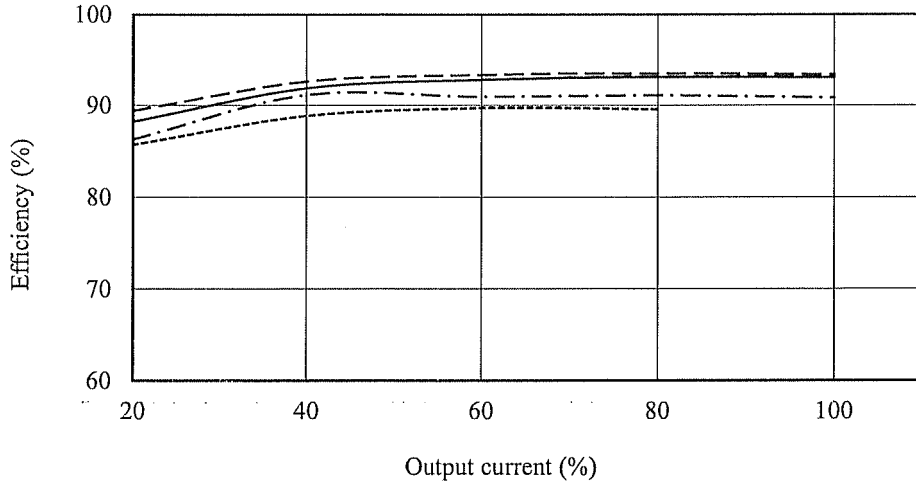
Iout : 100 %

Start up voltage (Vin)	82VAC
Drop out voltage (Vin)	70VAC

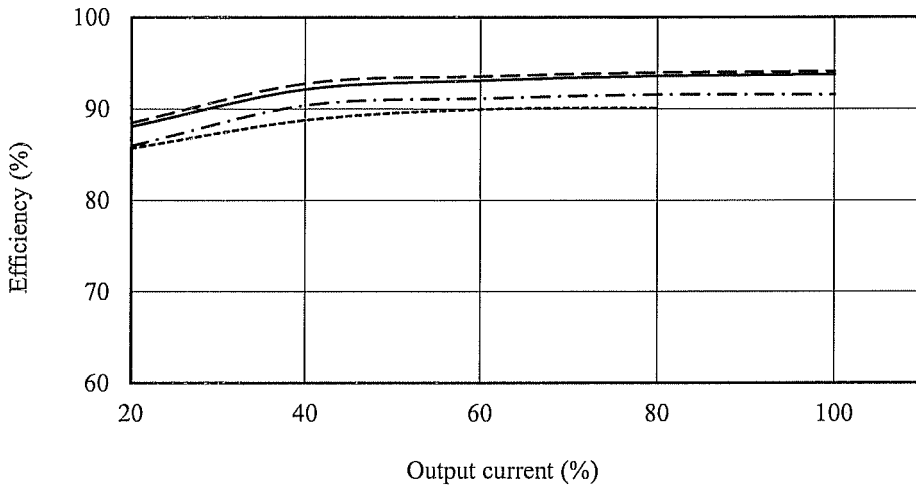
(2) Efficiency vs. Output current

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

12V



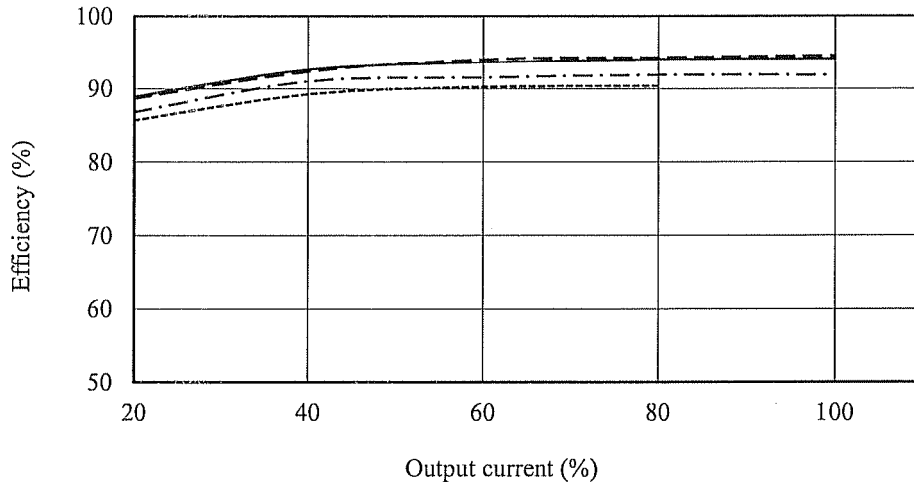
18V



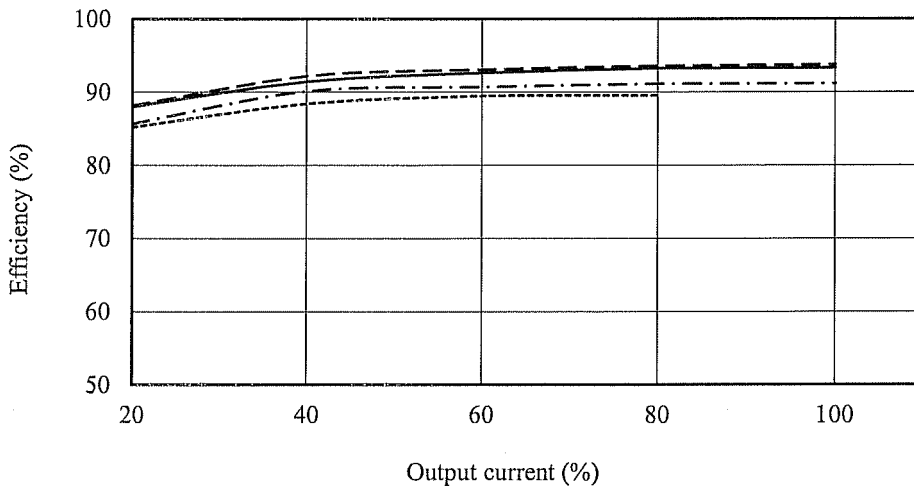
(2) Efficiency vs. Output current

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

24V



48V



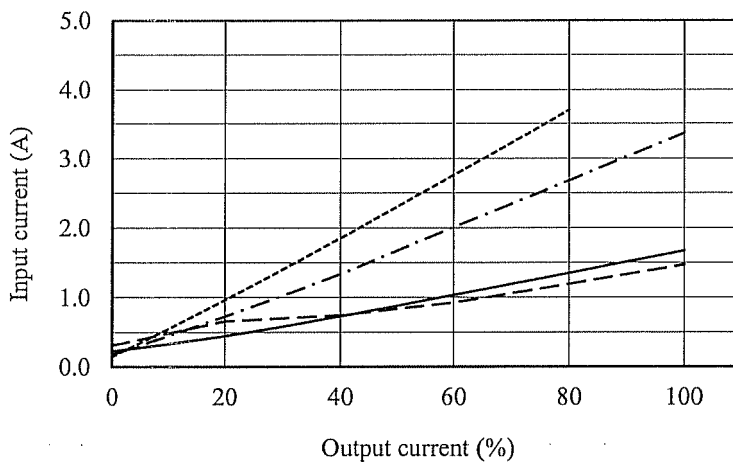
(3) Input current vs. Output current

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

12V

Io: 0%

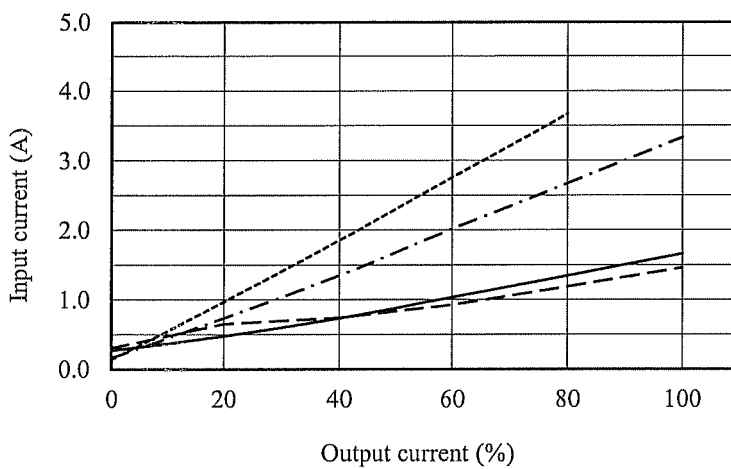
Vin	Input current
85VAC	0.152A
115VAC	0.181A
230VAC	0.228A
265VAC	0.311A



18V

Io: 0%

Vin	Input current
85VAC	0.140A
115VAC	0.166A
230VAC	0.271A
265VAC	0.307A



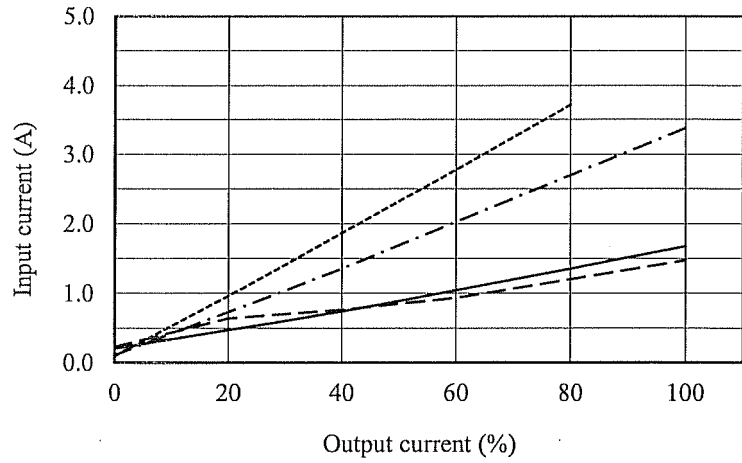
(3) Input current vs. Output current

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

24V

Io: 0%

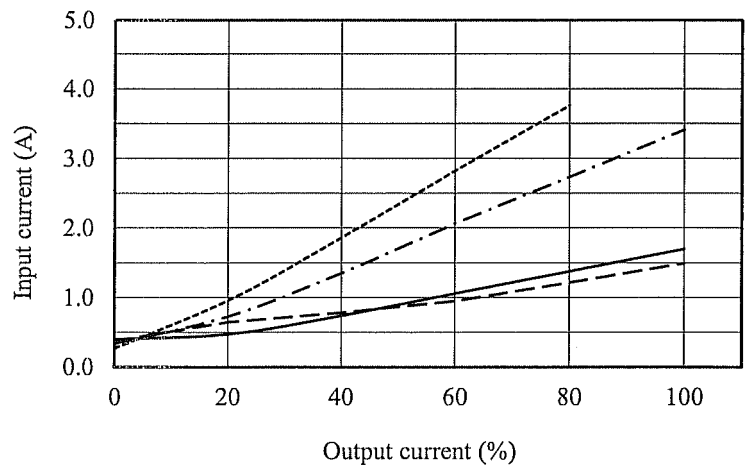
Vin	Input current
85VAC	0.097A
115VAC	0.112A
230VAC	0.205A
265VAC	0.234A



48V

Io: 0%

Vin	Input current
85VAC	0.269A
115VAC	0.339A
230VAC	0.400A
265VAC	0.372A



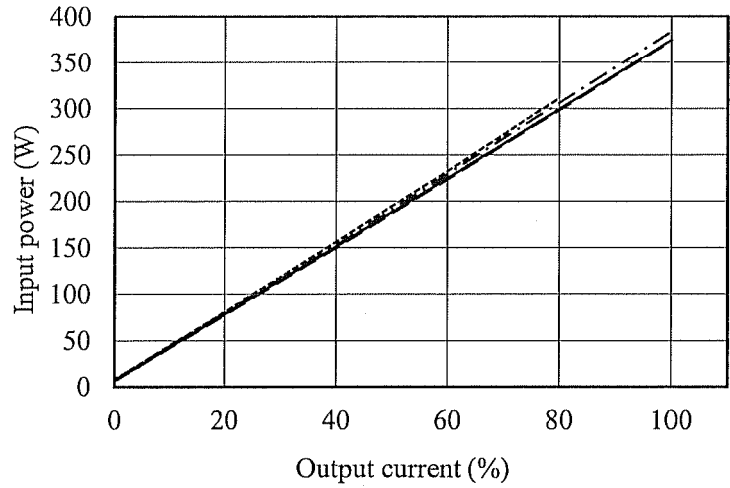
(4) Input power vs. Output current

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

12V

Io: 0%

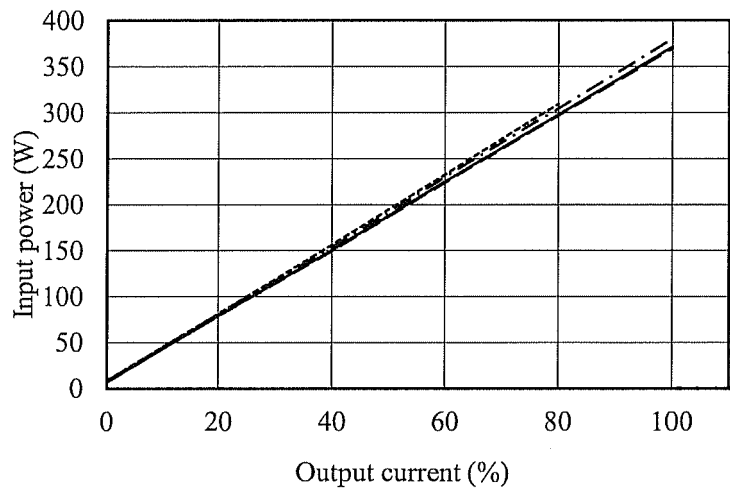
Vin	Input power
85VAC	8.00W
115VAC	7.59W
230VAC	6.57W
265VAC	6.13W



18V

Io: 0%

Vin	Input power
85VAC	8.55W
115VAC	8.24W
230VAC	6.74W
265VAC	6.60W



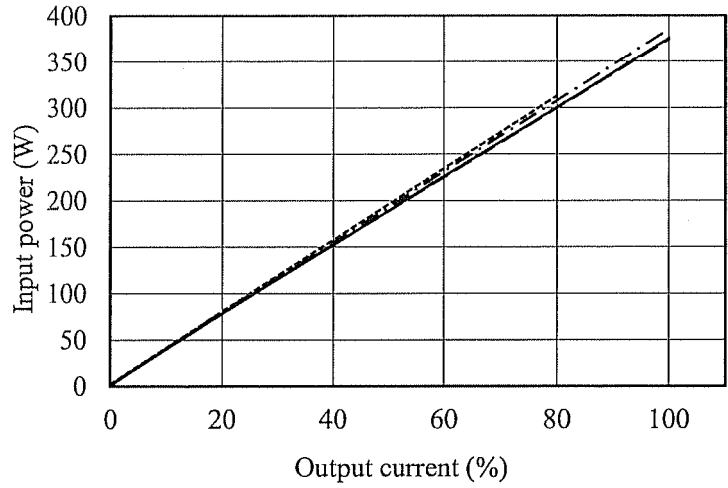
(4) Input power vs. Output current

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

24V

Io: 0%

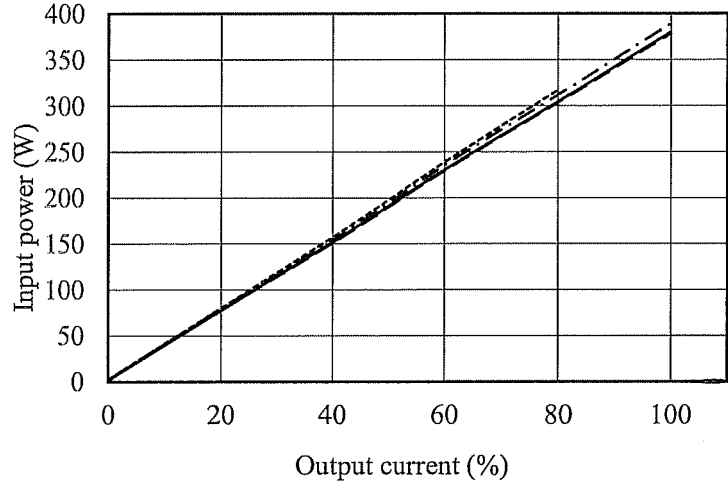
Vin	Input power
85VAC	2.21W
115VAC	1.63W
230VAC	1.18W
265VAC	1.00W



48V

Io: 0%

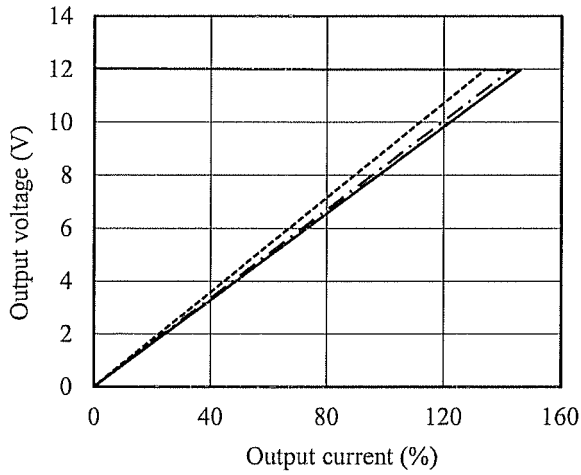
Vin	Input power
85VAC	2.23W
115VAC	2.17W
230VAC	1.38W
265VAC	1.30W



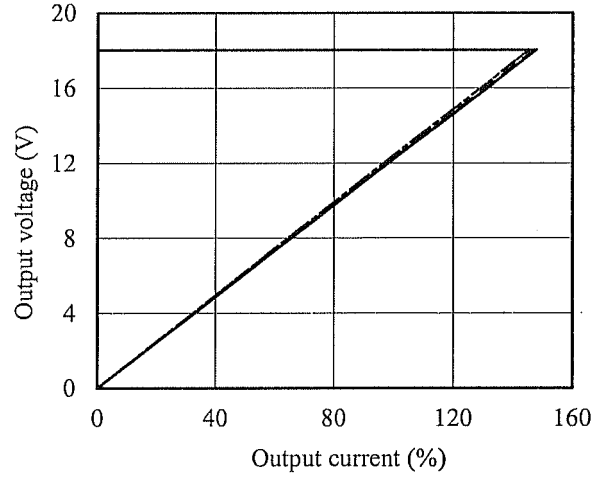
2.2 Over current protection (OCP) characteristics

Conditions V_{in} : 85 VAC-----
 115 VAC-----
 230 VAC-----
 265 VAC-----
 T_a : 25 °C

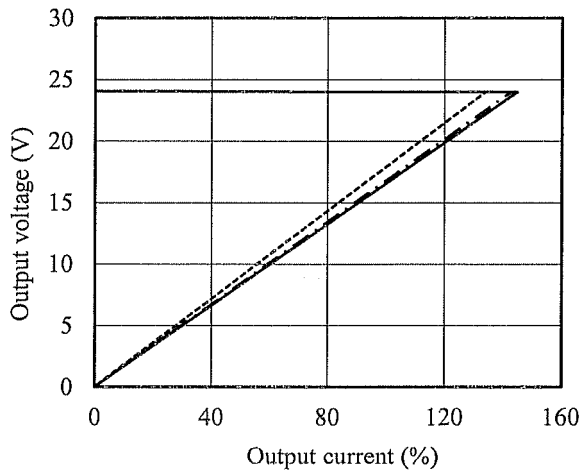
12V



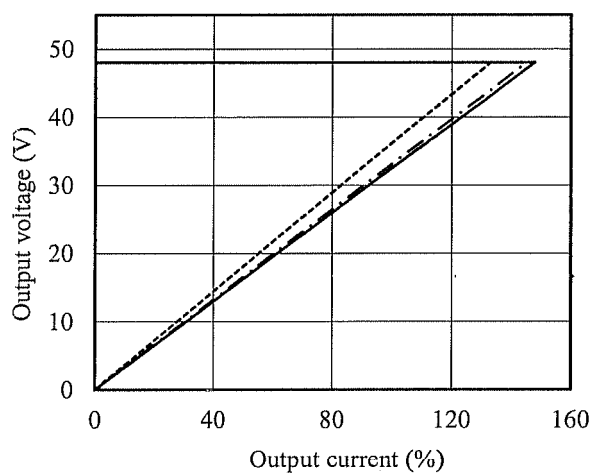
18V



24V

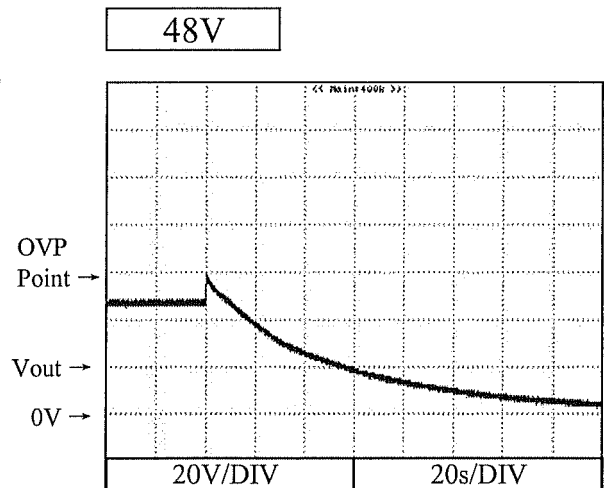
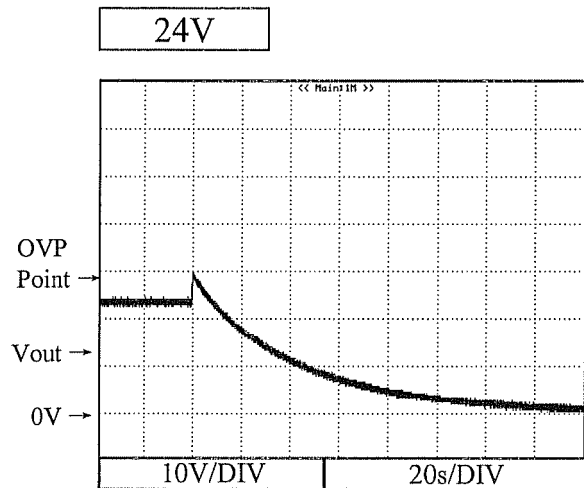
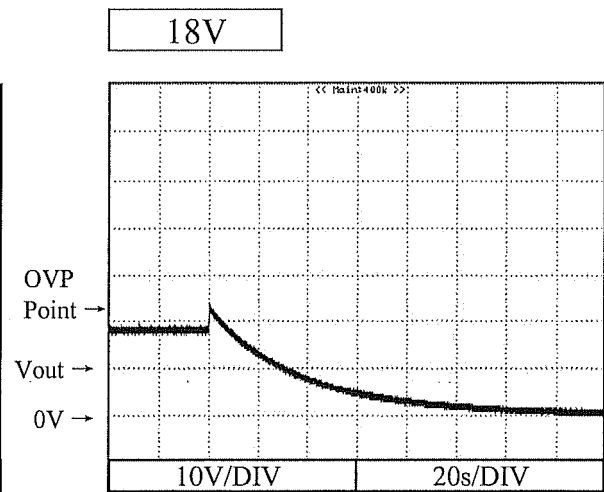
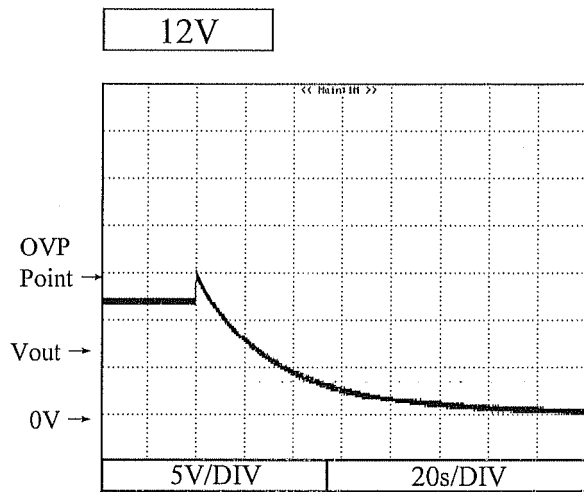


48V



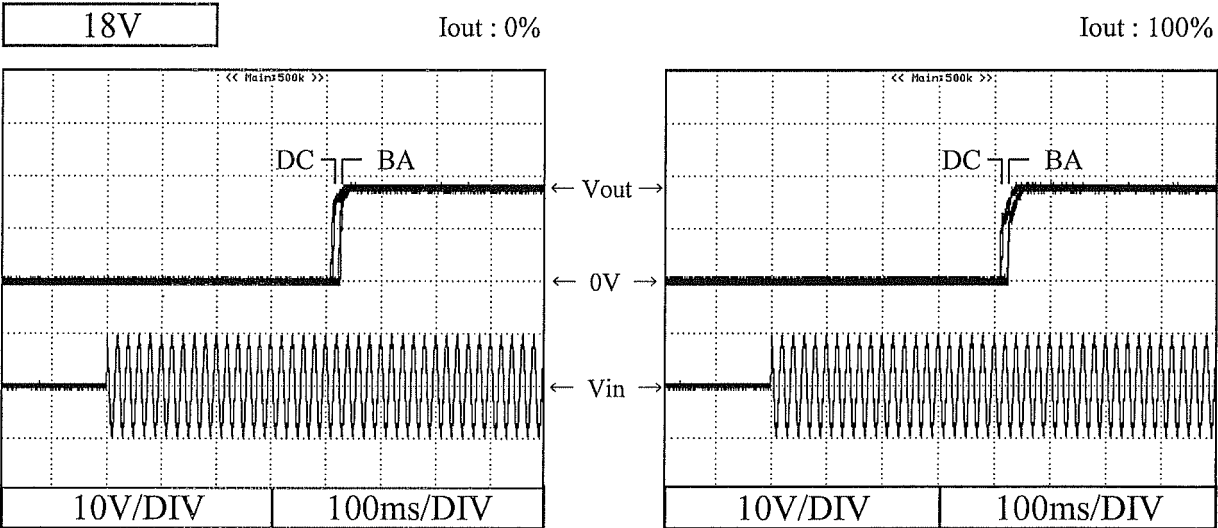
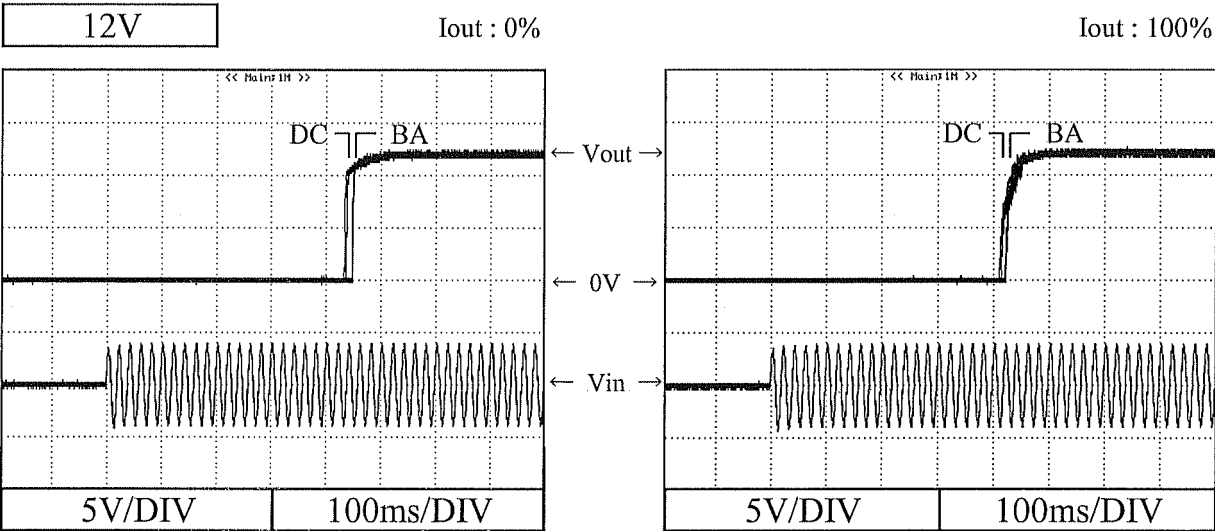
2.3 Over voltage protection (OVP) characteristics

Conditions V_{in} : 115 VAC
 I_{out} : 0 %
 T_a : 25 °C



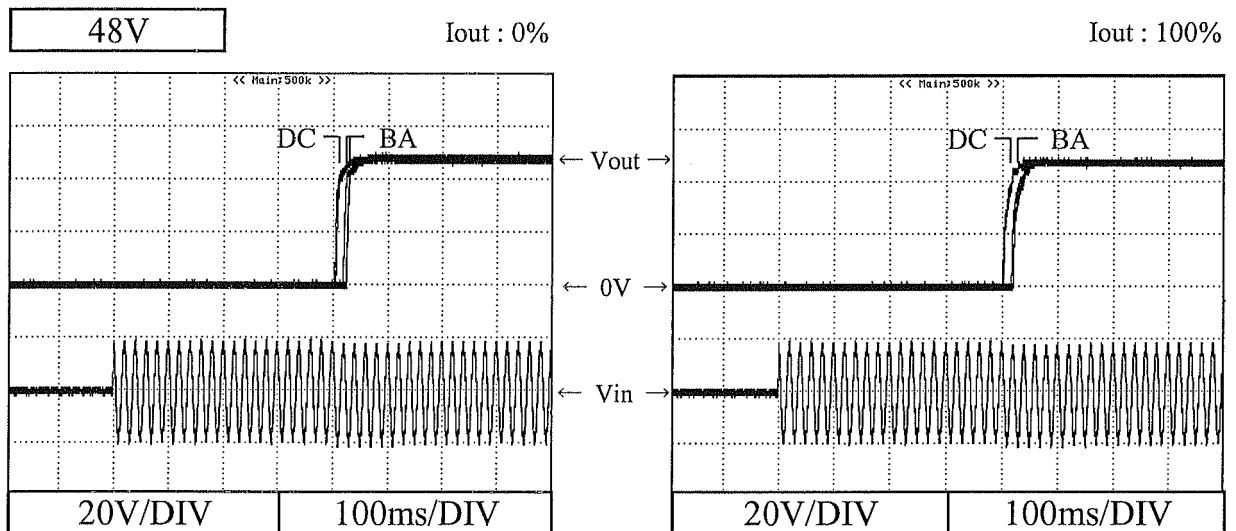
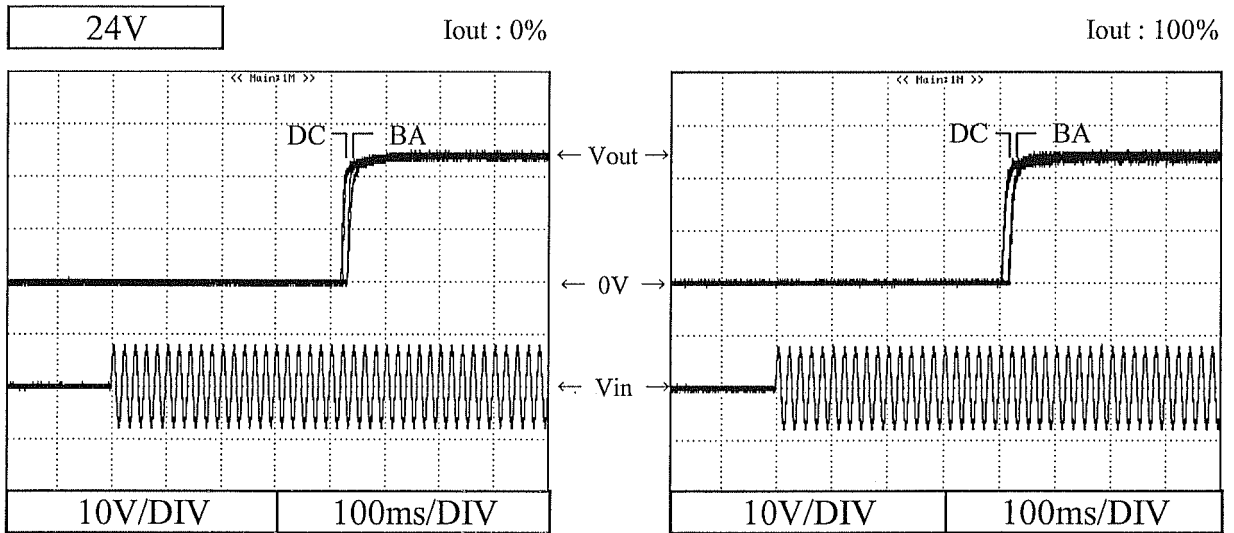
2.4 Output rise characteristics

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



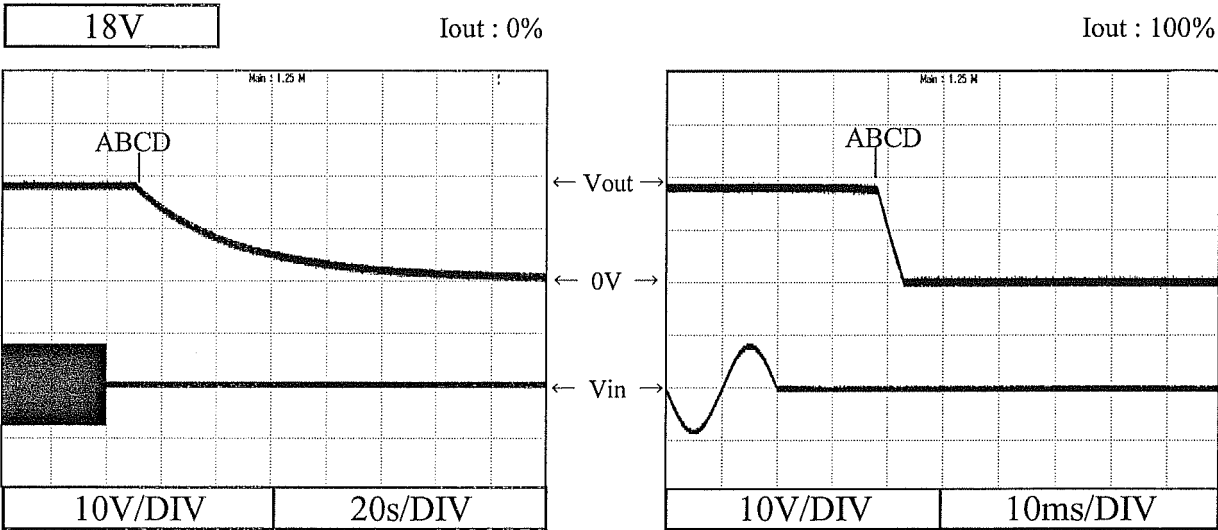
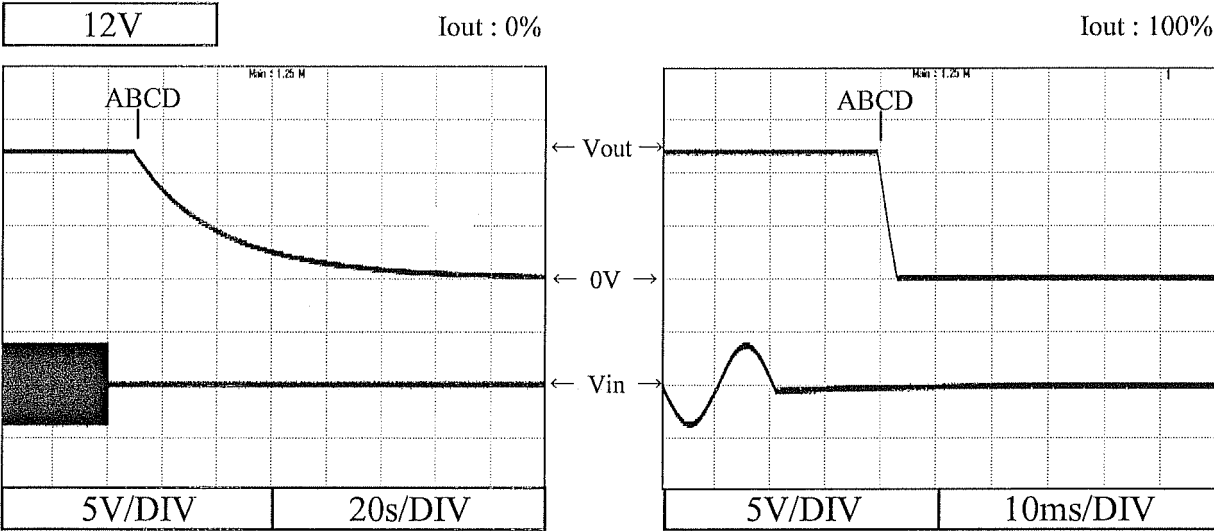
2.4 Output rise characteristics

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



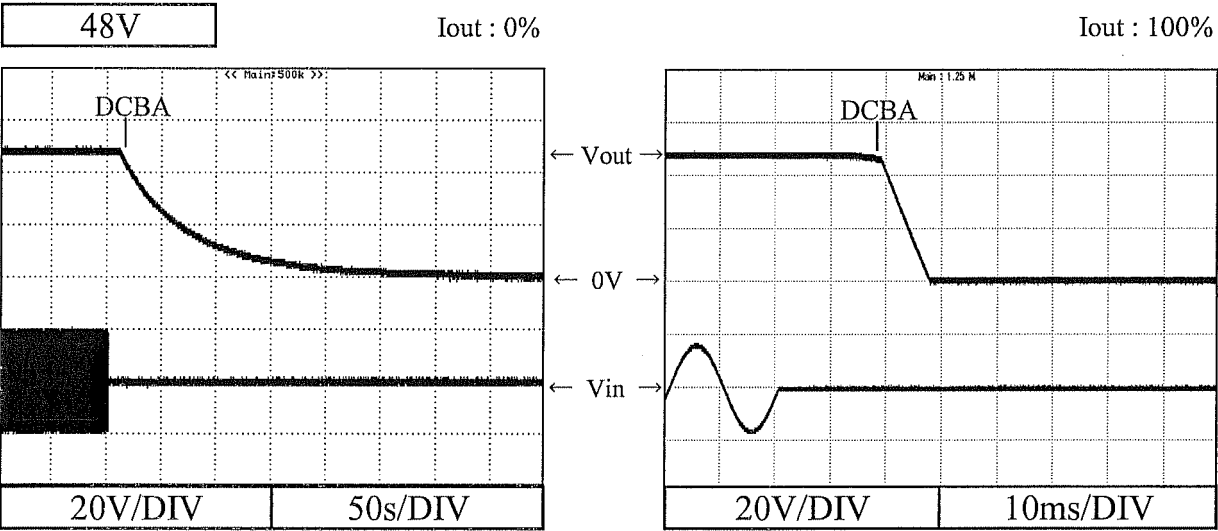
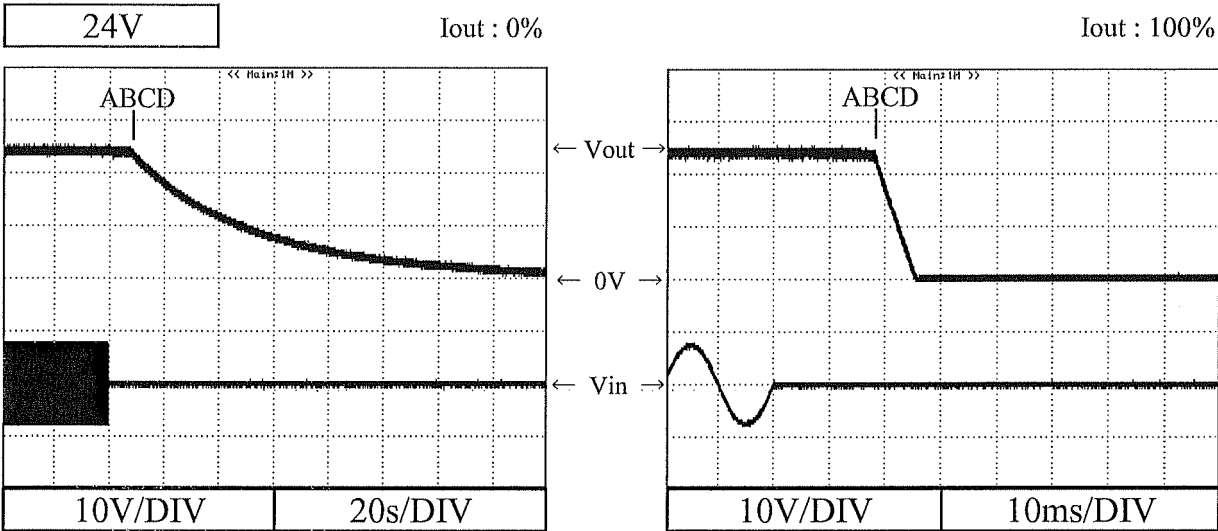
2.5 Output fall characteristics

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



2.5 Output fall characteristics

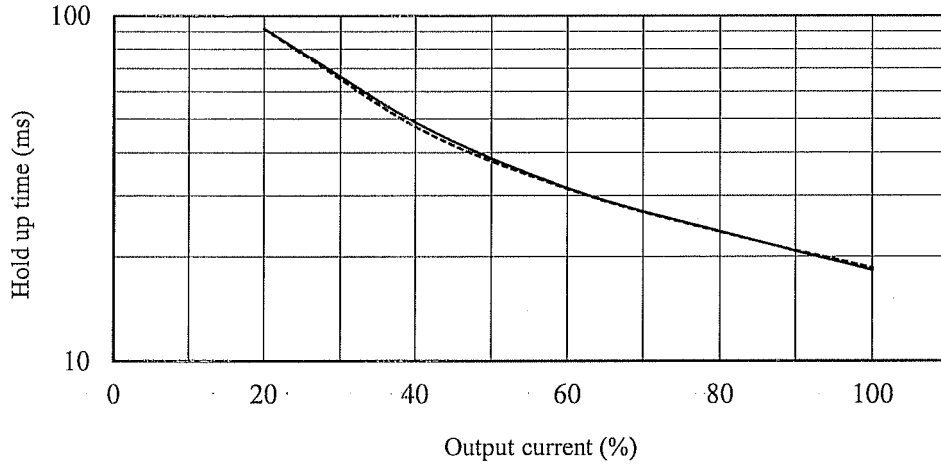
Conditions Vin : 85 VAC (A)
115 VAC (B)
230 VAC (C)
265 VAC (D)
Ta : 25 °C



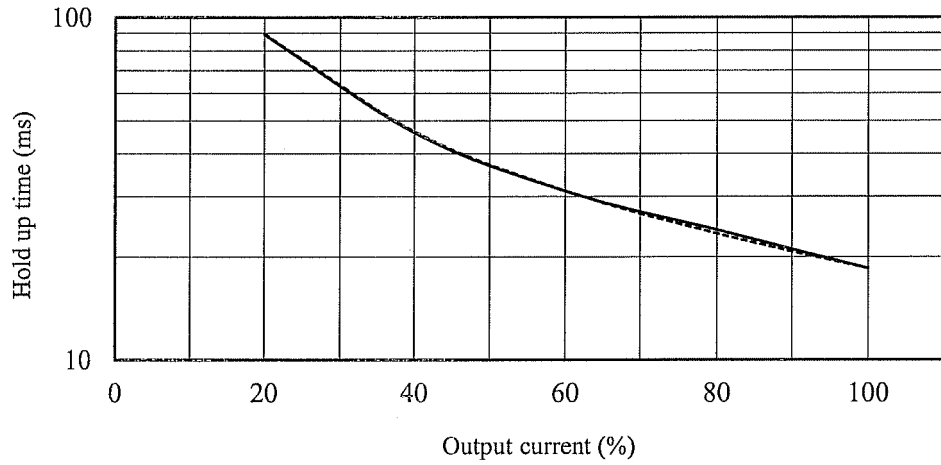
2.6 Hold up time characteristics

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

12V



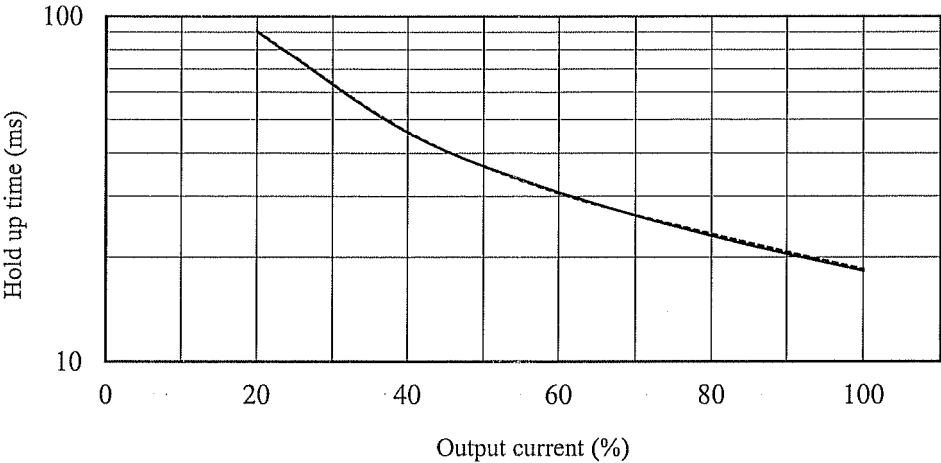
18V



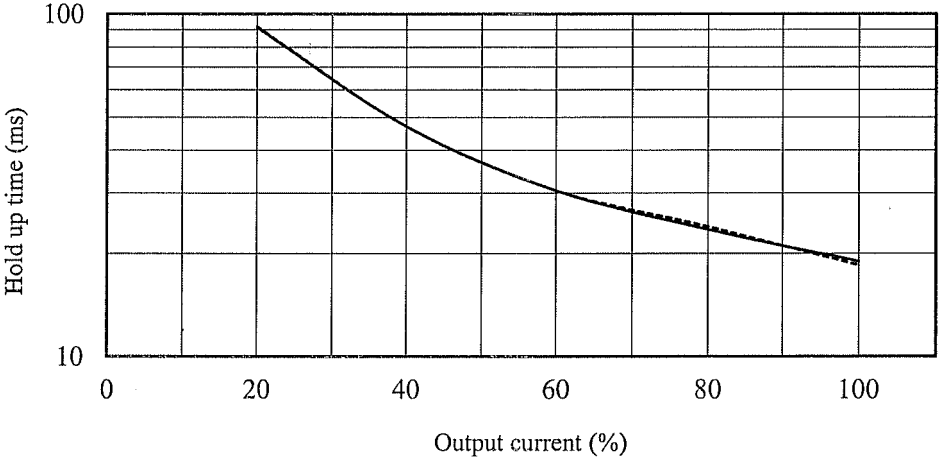
2.6 Hold up time characteristics

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

24V

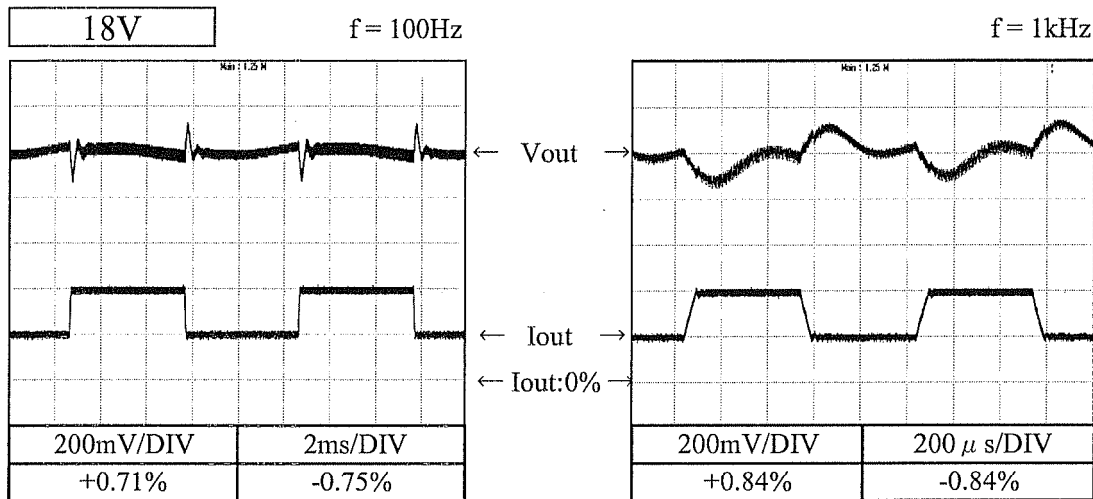
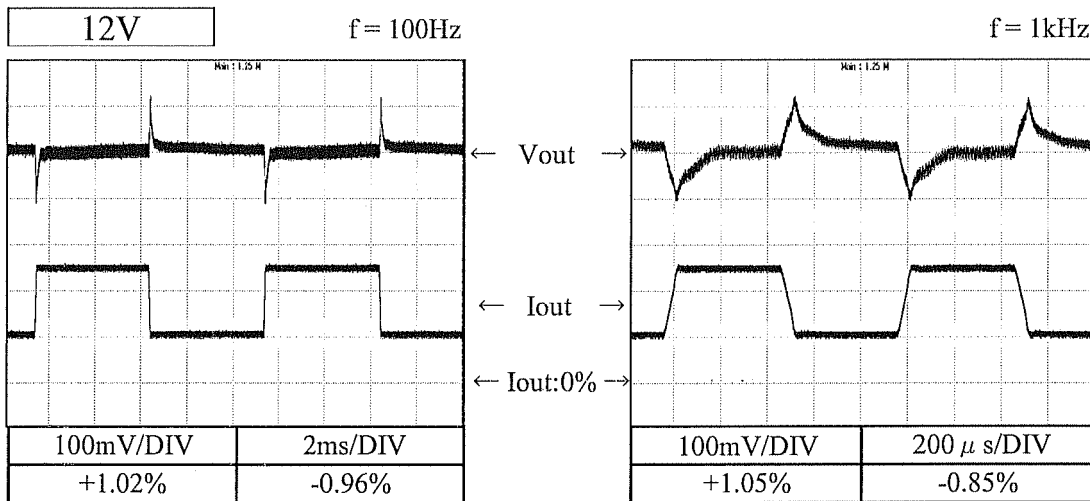


48V



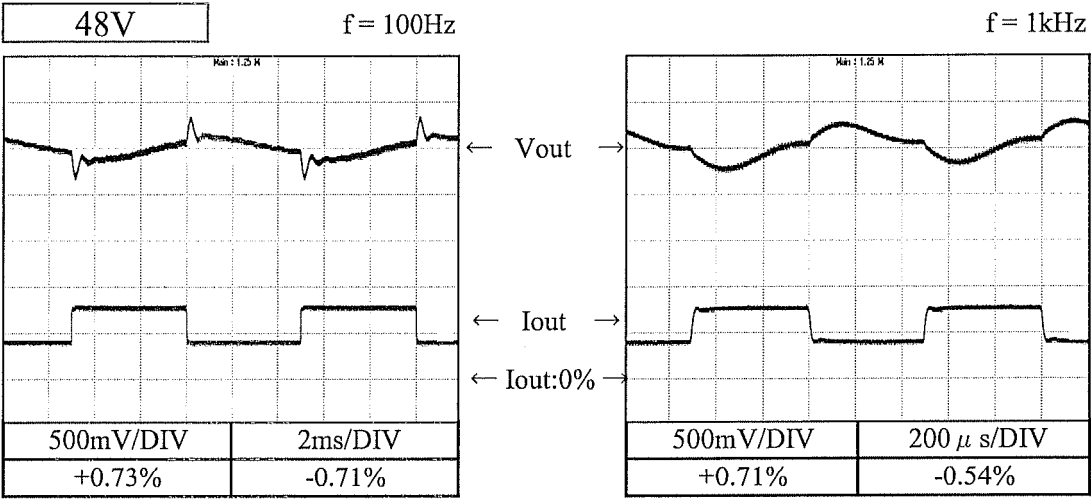
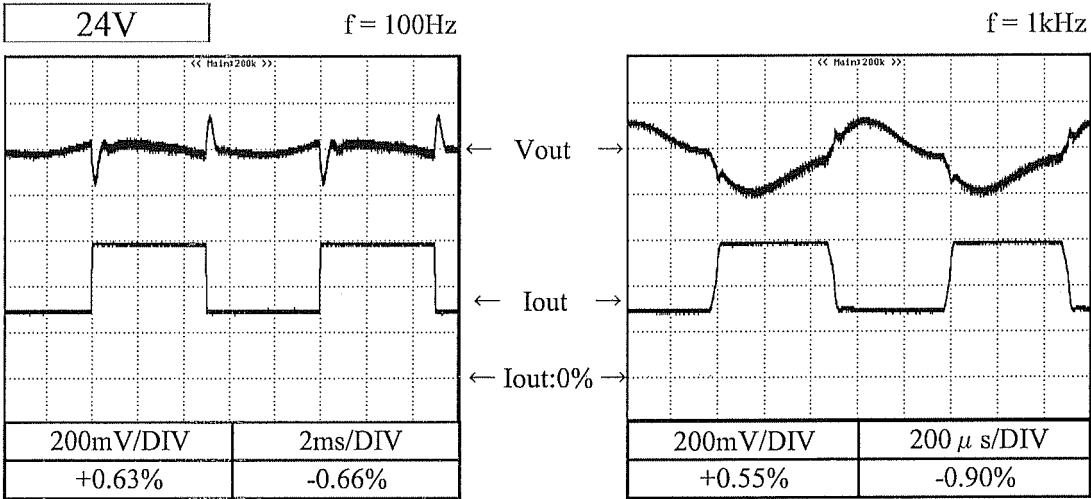
2.7 Dynamic load response characteristics

Conditions Vin : 115 VAC
 Iout : 50 % ↔ 100 %
 (tr = tf = 75us)
 Ta : 25 °C



2.7 Dynamic load response characteristics

Conditions Vin : 115 VAC
Iout : 50 % ↔ 100 %
(tr = tf = 75us)
Ta : 25 °C

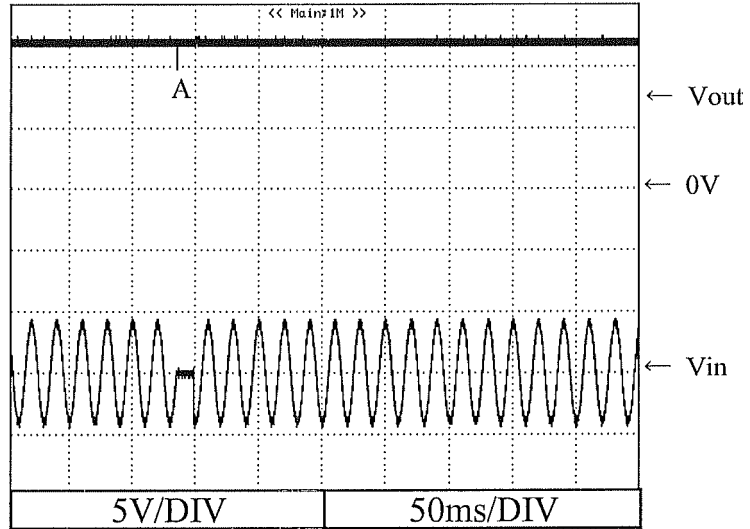


2.8 Response to brown out characteristics

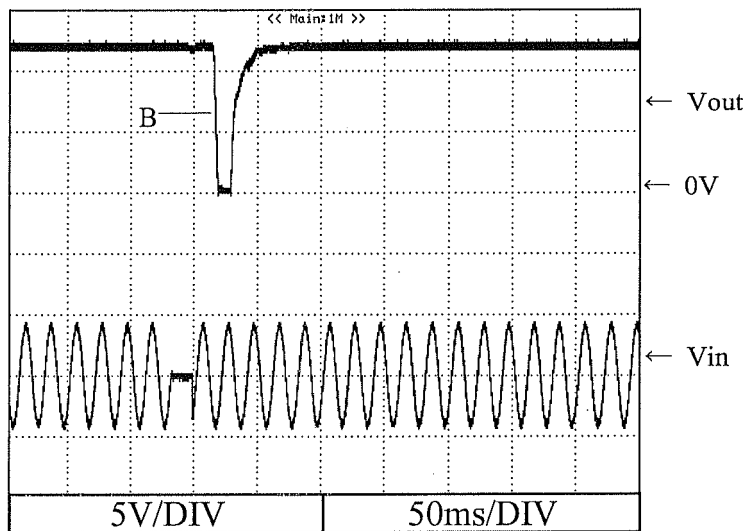
Conditions Vin : 115 VAC
Iout : 100 %
Ta : 25 °C

12V

A = 14ms



B = 17.2ms

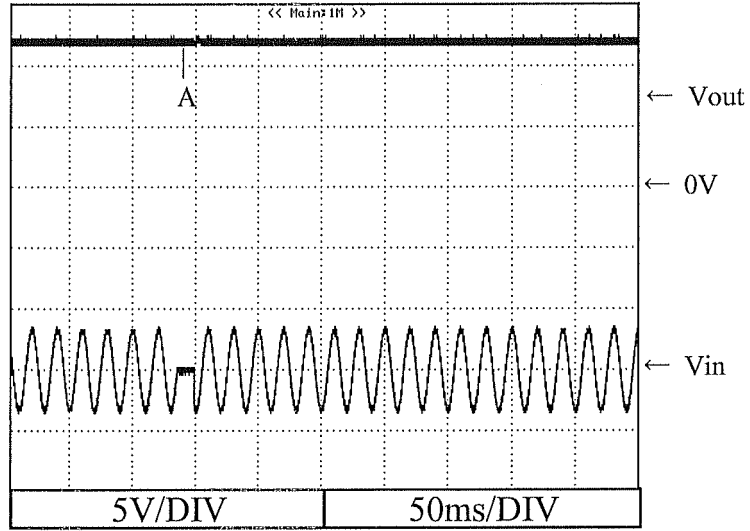


2.8 Response to brown out characteristics

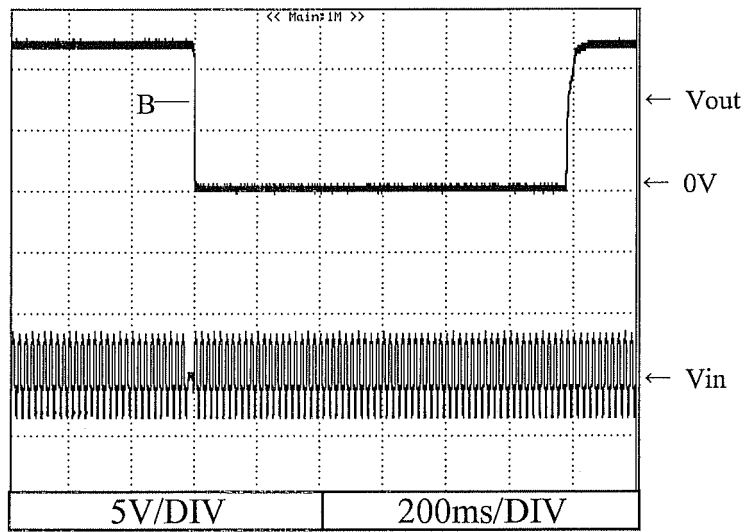
Conditions Vin : 230 VAC
Iout : 100 %
Ta : 25 °C

12V

A = 14ms



B = 18.9ms

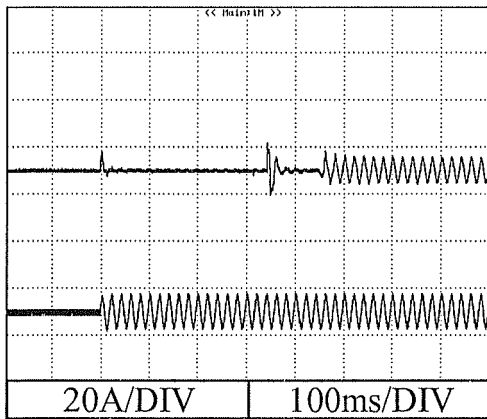


2.9 Inrush current waveform

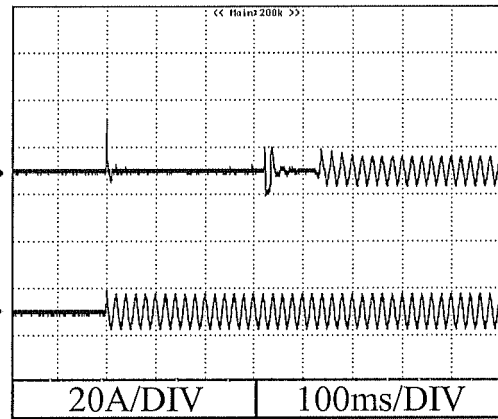
12V

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

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

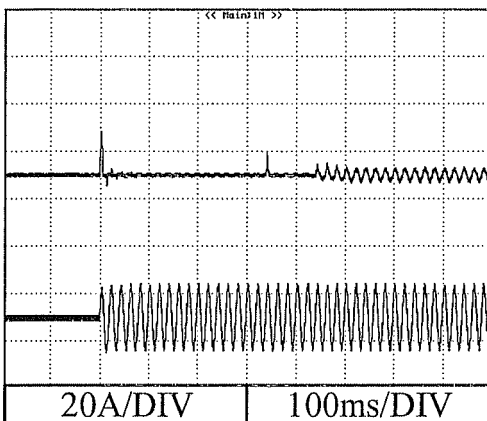


Switch on phase angle of input AC voltage
 $\phi = 90^\circ$

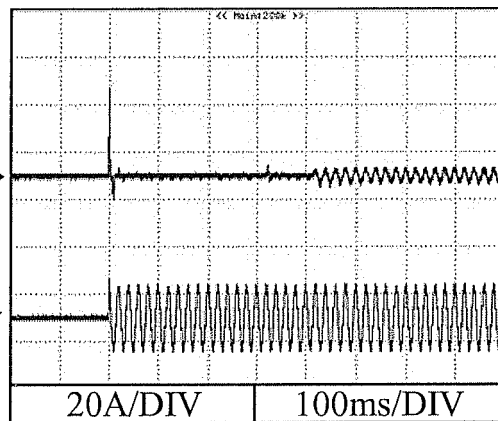


Conditions Vin : 230 VAC
Iout : 100 %
Ta : 25 °C

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



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

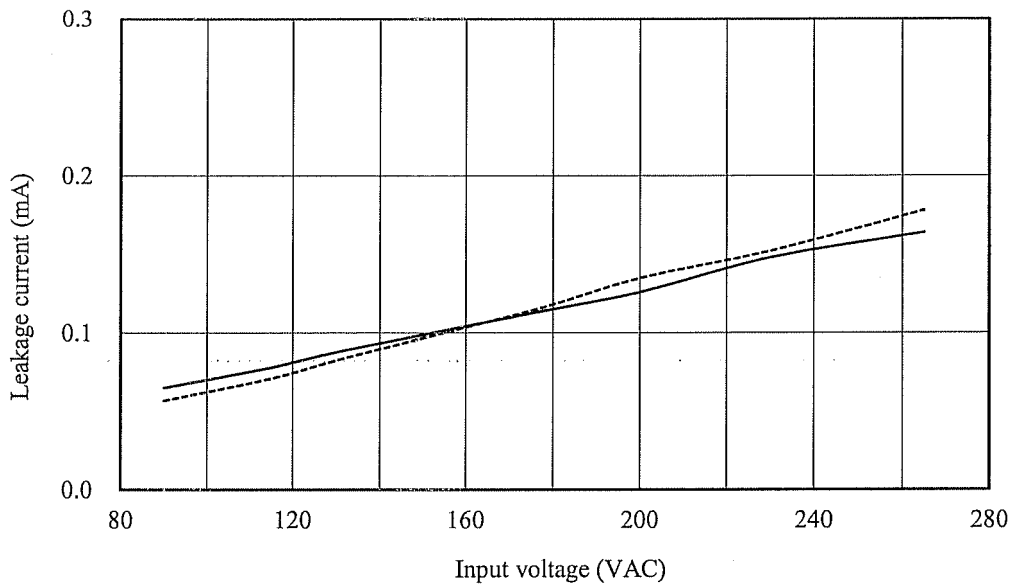


2.10 Leakage current characteristics

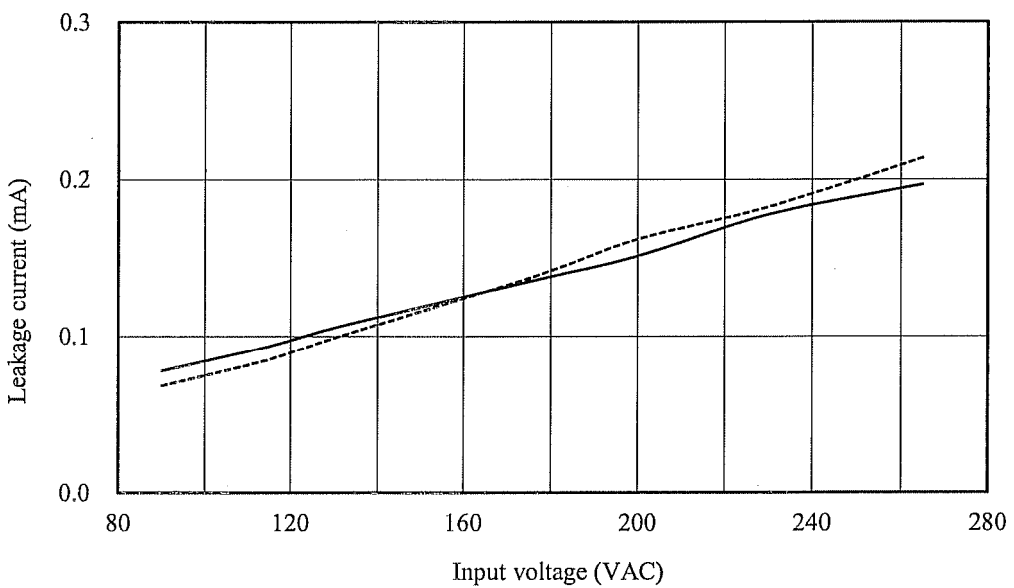
Conditions Iout : 0 % -----
 100 % ———
 Ta : 25 °C
 Equipment used : 228 (Simpson)

12V

f: 50 Hz

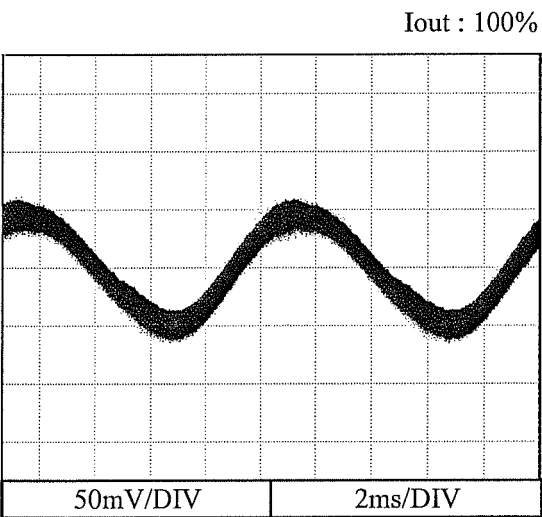
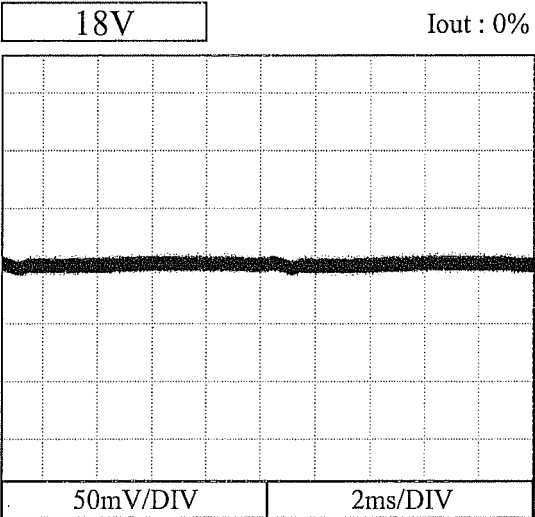
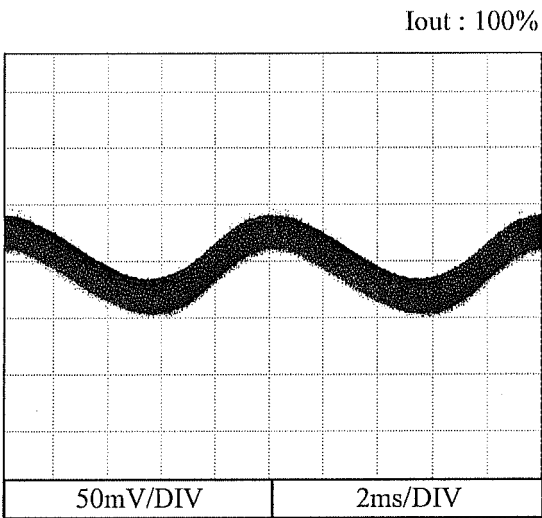
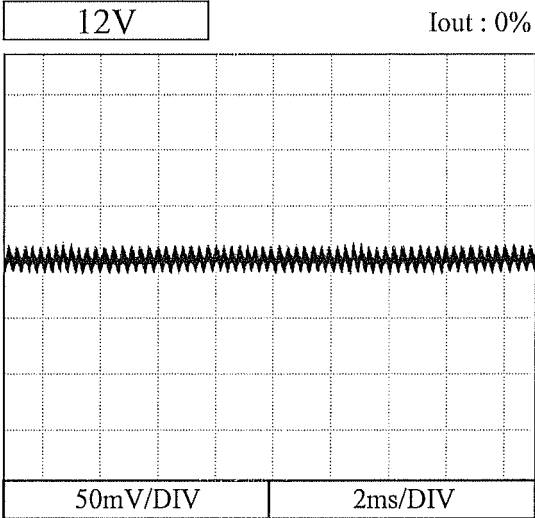


f: 60 Hz



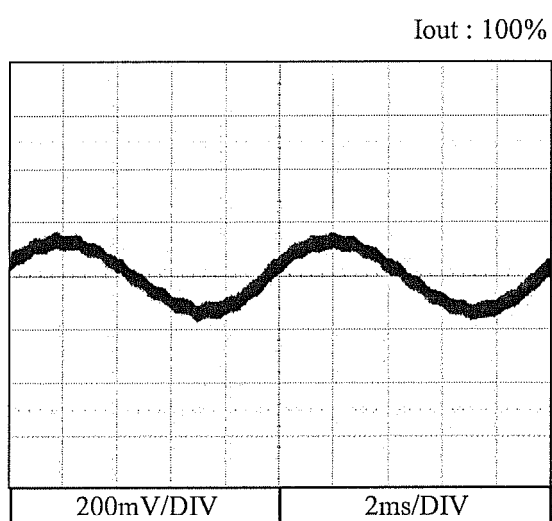
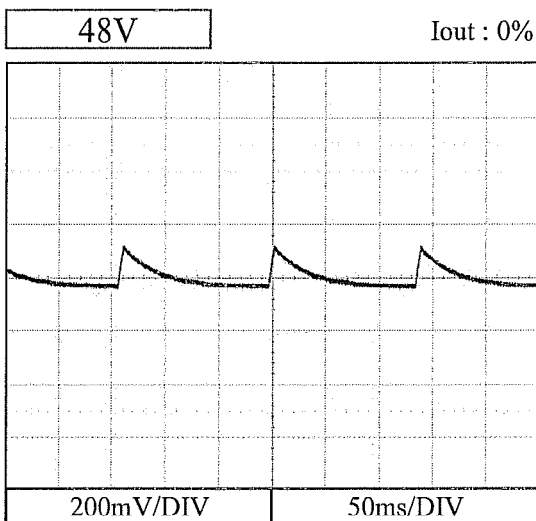
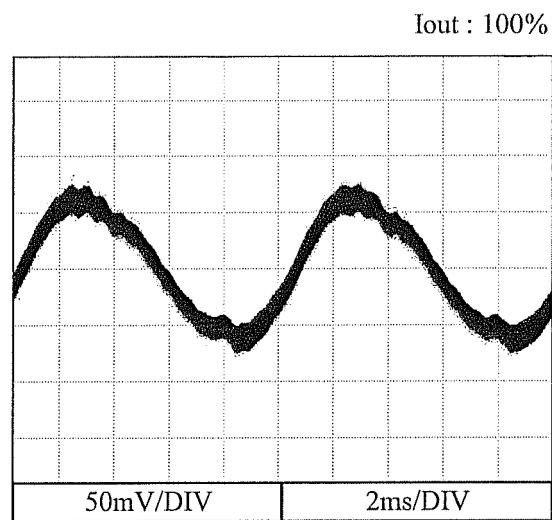
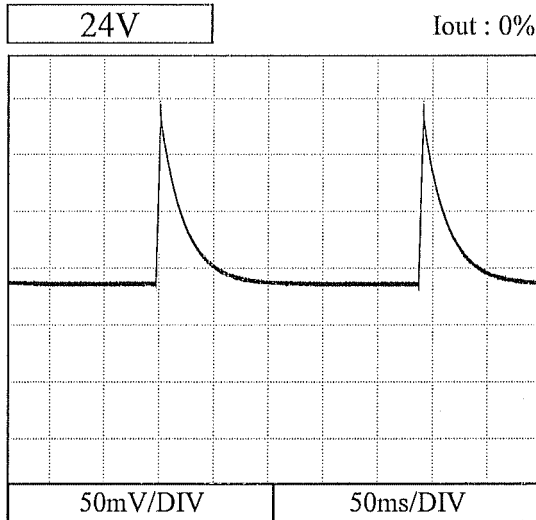
2.11 Output ripple and noise waveform

Conditions Vin : 115 VAC
Ta : 25 °C



2.11 Output ripple and noise waveform

Conditions Vin : 115 VAC
Ta : 25 °C



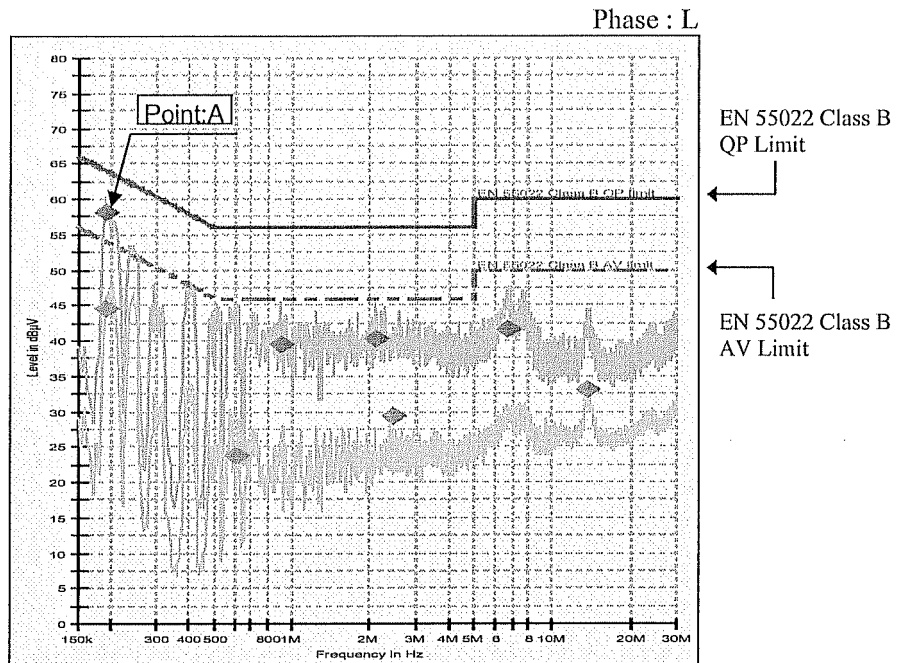
2.12 Electro-Magnetic Interference characteristics

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

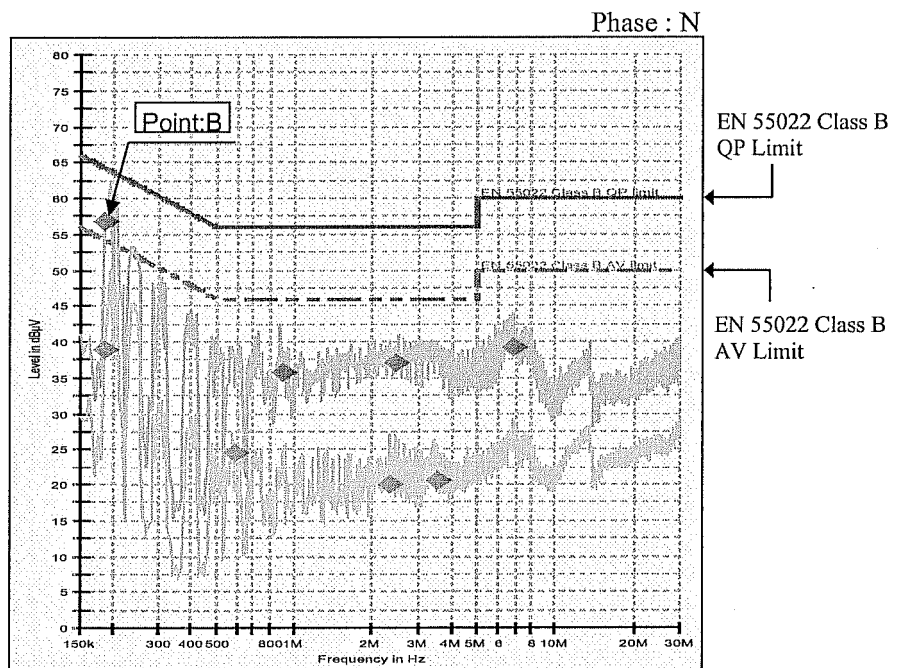
Conducted Emission

12V

Point A (190.5kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	64.0	58.0
AV	54.1	44.6



Point B (186kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	64.2	56.9
AV	54.2	39.0



Limit of EN55011-B,VCCI-B,FCC-B are same as its EN55022 class B.

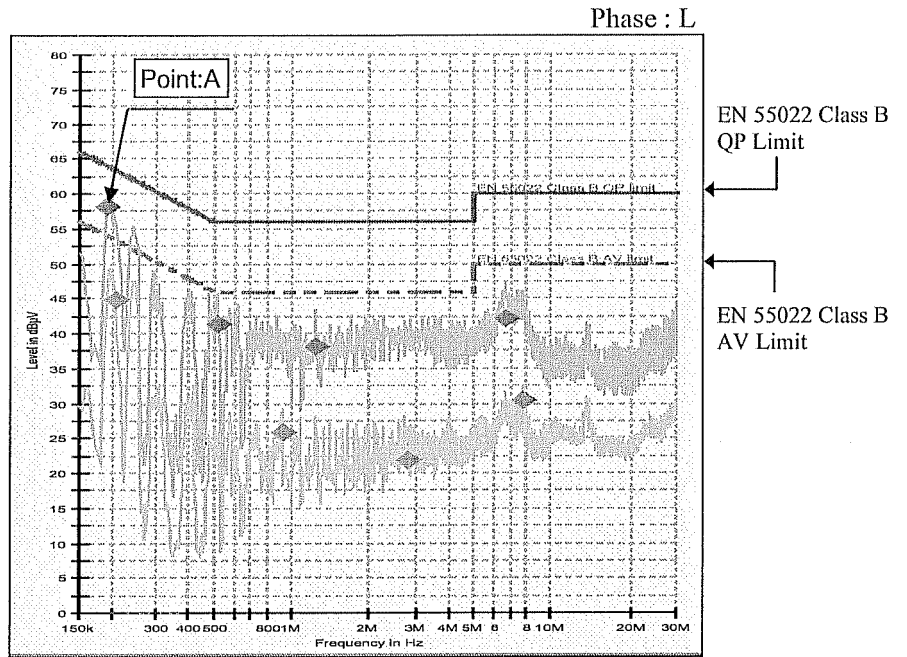
2.12 Electro-Magnetic Interference characteristics

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

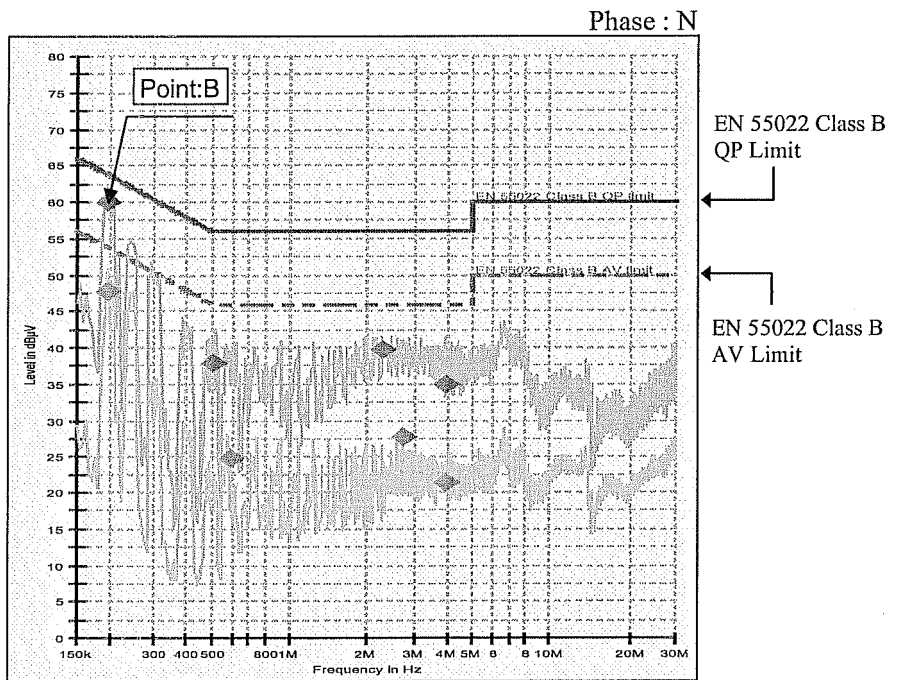
Conducted Emission

12V

		Point A (190.5kHz)	
Ref. Data	Limit (dBuV)	Measure (dBuV)	
QP	64.0	58.0	
AV	53.3	44.9	



		Point B (195kHz)	
Ref. Data	Limit (dBuV)	Measure (dBuV)	
QP	63.8	59.9	
AV	53.8	47.8	



Limit of EN55011-B,VCCI-B,FCC-B are same as its EN55022 class B.

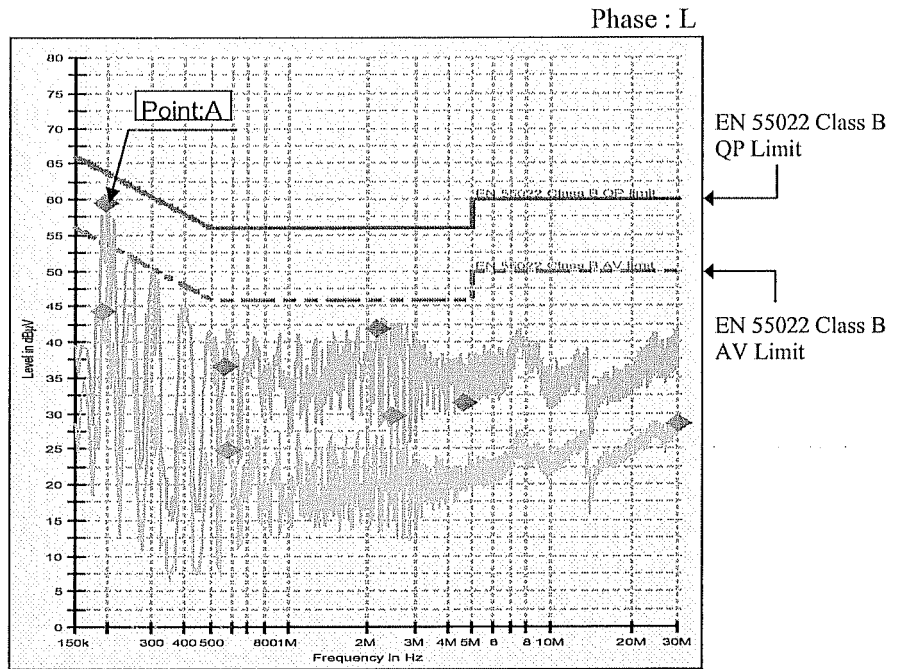
2.12 Electro-Magnetic Interference characteristics

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

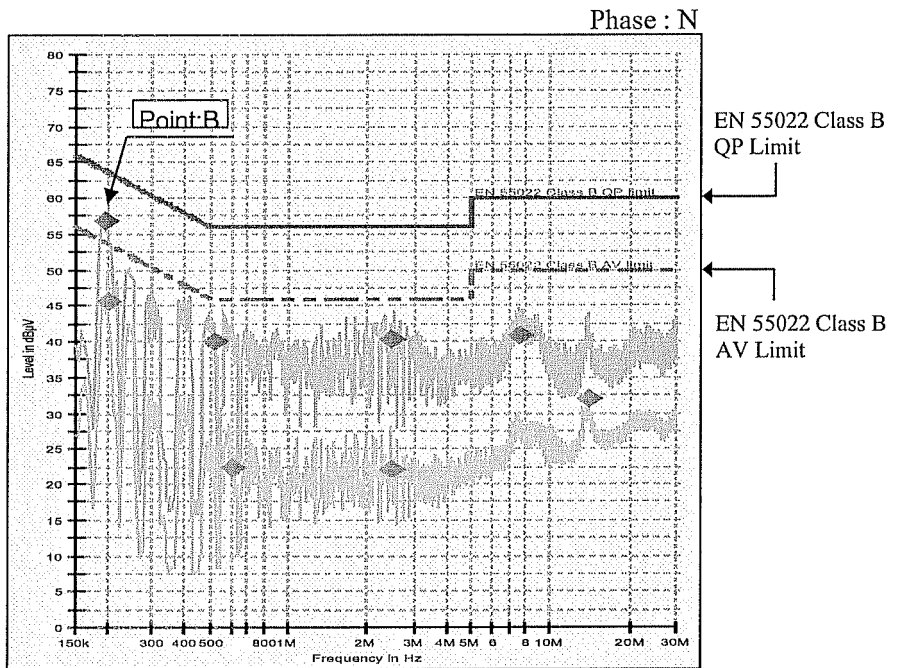
Conducted Emission

18V

Ref. Data	Point A (194kHz)	
	Limit (dBuV)	Measure (dBuV)
QP	63.9	59.6
AV	54.1	44.2



Ref. Data	Point B (194kHz)	
	Limit (dBuV)	Measure (dBuV)
QP	63.9	56.9
AV	53.5	45.7



Limit of EN55011-B, VCCI-B, FCC-B are same as its EN55022 class B.

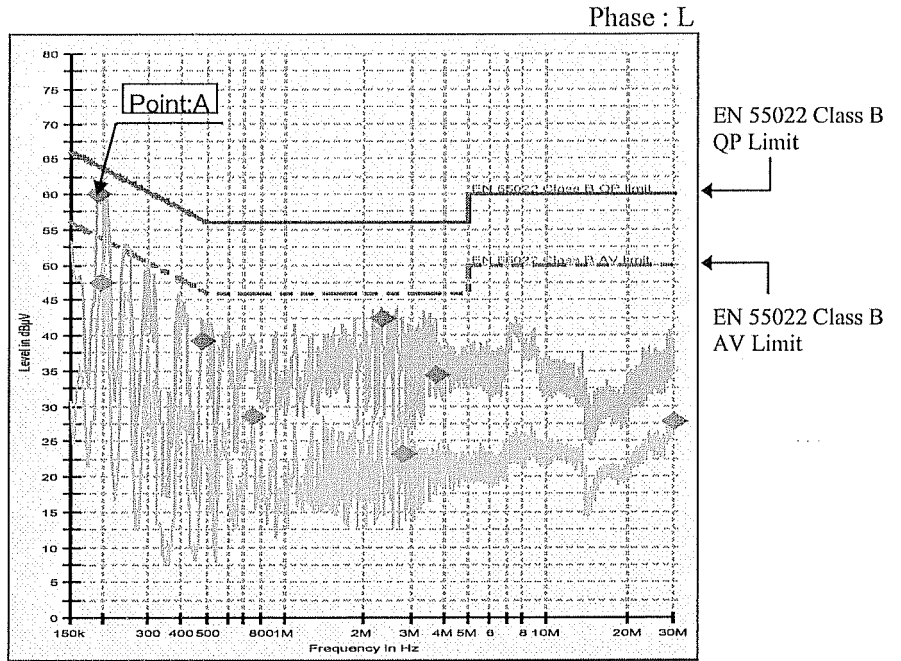
2.12 Electro-Magnetic Interference characteristics

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

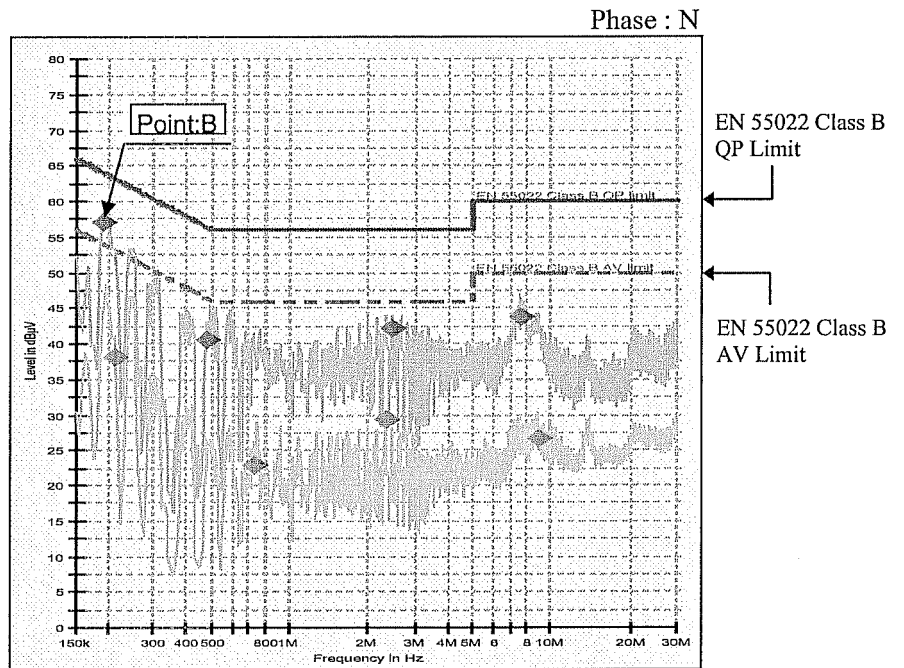
Conducted Emission

18V

Point A (189.5kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	64.1	59.9
AV	53.9	47.3



Point B (190.5kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	64.0	57.1
AV	53.1	38.2



Limit of EN55011-B,VCCI-B,FCC-B are same as its EN55022 class B.

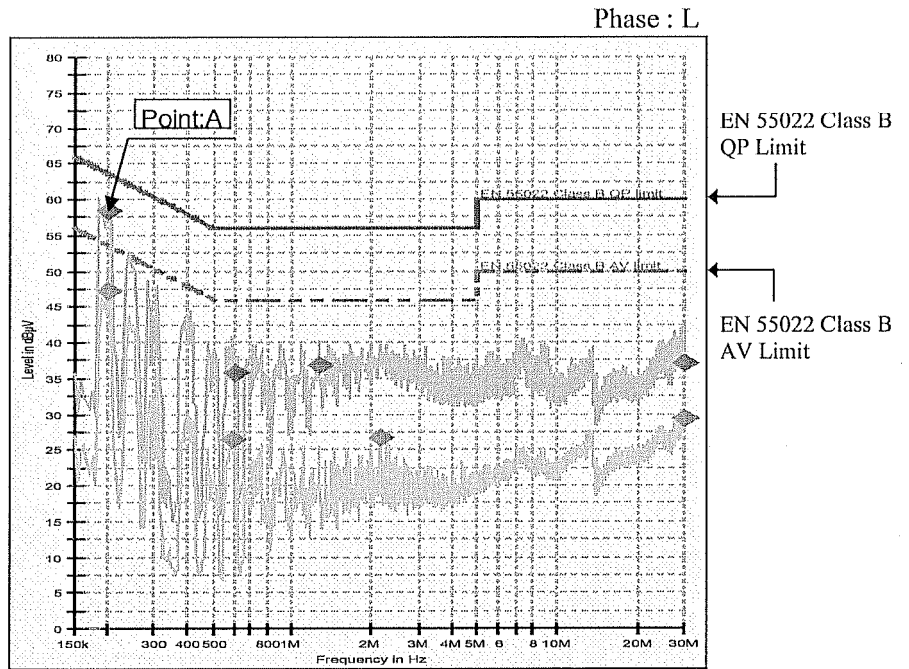
2.12 Electro-Magnetic Interference characteristics

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

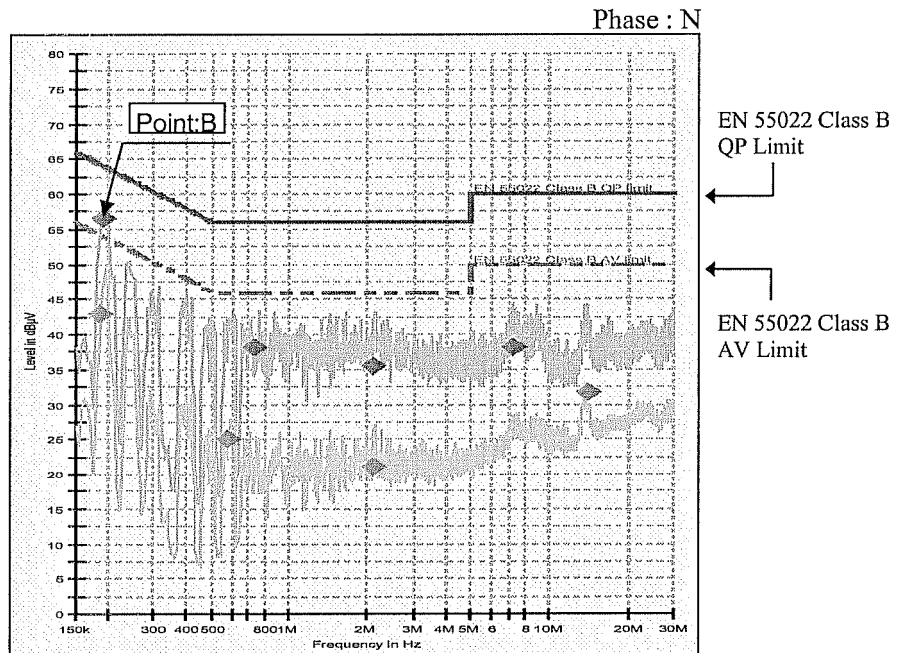
Conducted Emission

24V

Point A (198.5kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	63.7	58.4
AV	53.7	47.1



Point B (190.5kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	64.0	56.7
AV	54.2	43.0



Limit of EN55011-B,VCCI-B,FCC-B are same as its EN55022 class B.

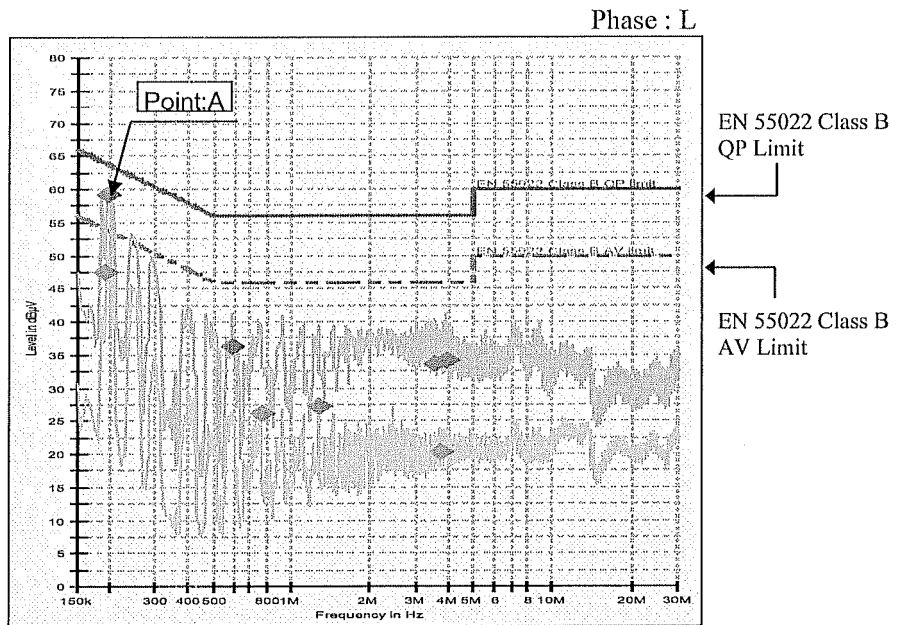
2.12 Electro-Magnetic Interference characteristics

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

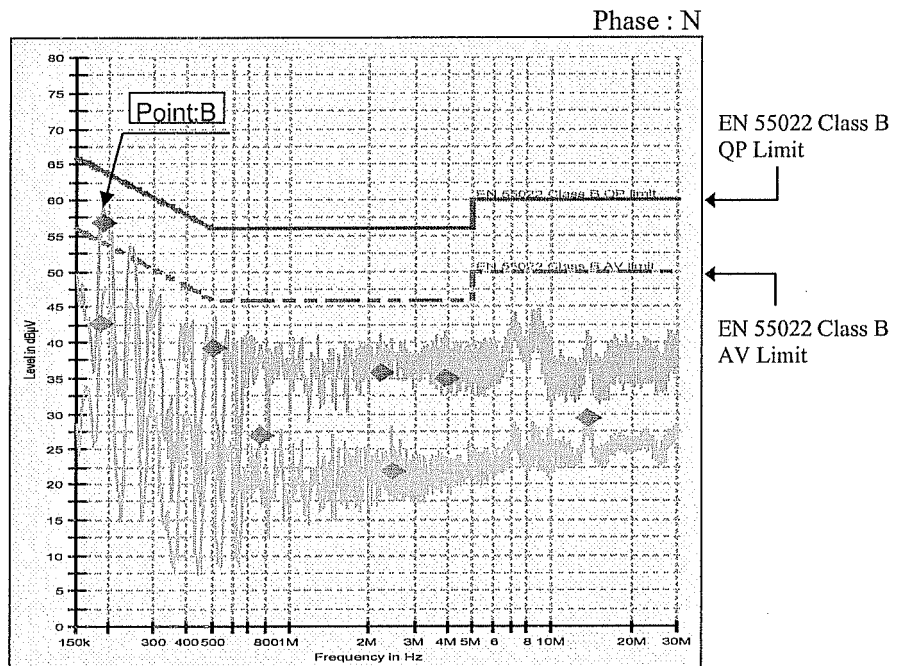
Conducted Emission

24V

Point A (194kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	63.9	59.2
AV	54.0	47.5



Point B (190.5kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	64.0	56.7
AV	54.2	42.6



Limit of EN55011-B,VCCI-B,FCC-B are same as its EN55022 class B.

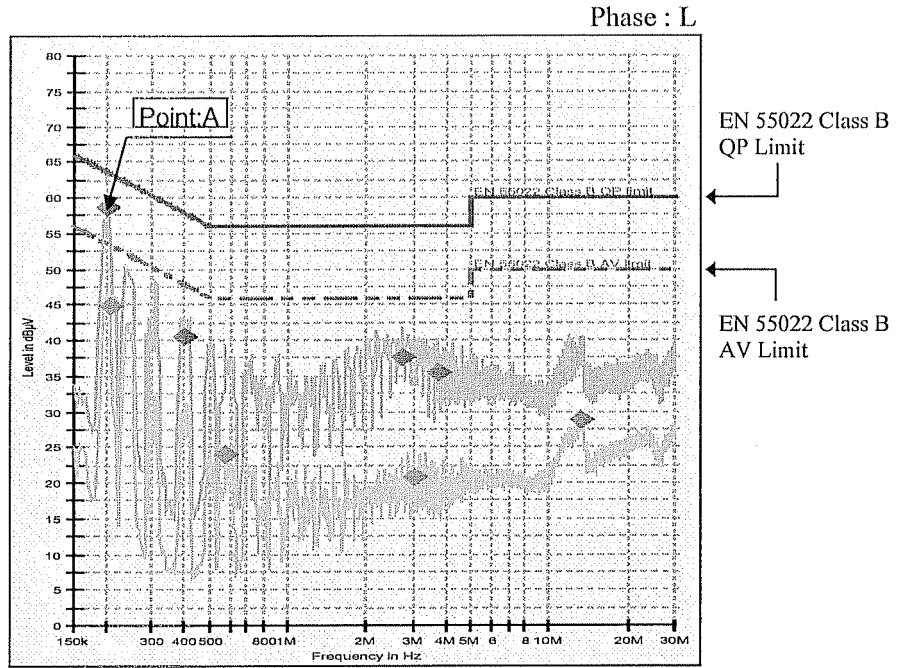
2.12 Electro-Magnetic Interference characteristics

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

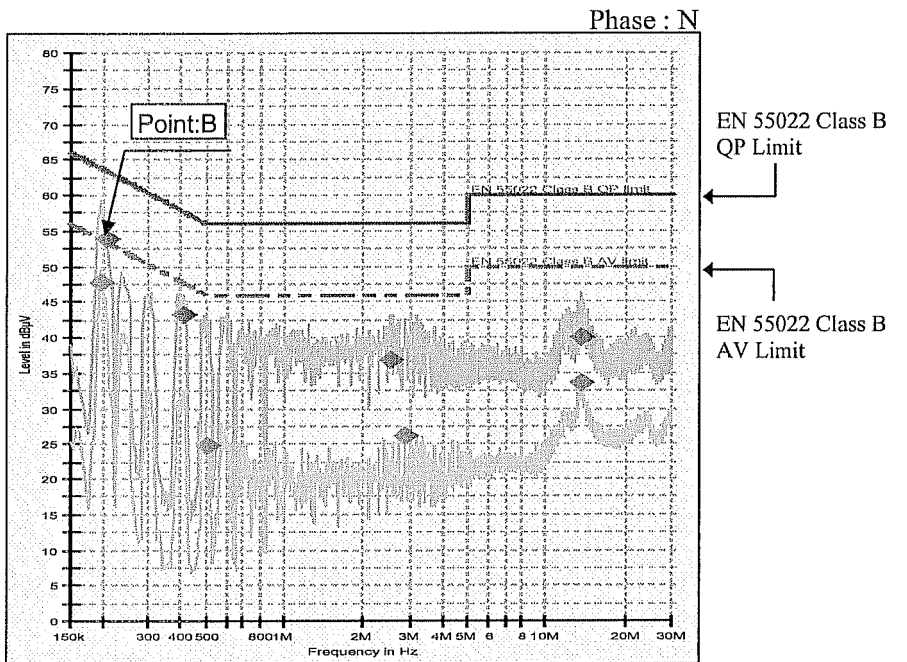
Conducted Emission

48V

Point A (198.5kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	63.7	58.6
AV	53.3	44.9



Point B (208.5kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	63.3	54.0
AV	53.8	47.7



Limit of EN55011-B,VCCI-B,FCC-B are same as its EN55022 class B.

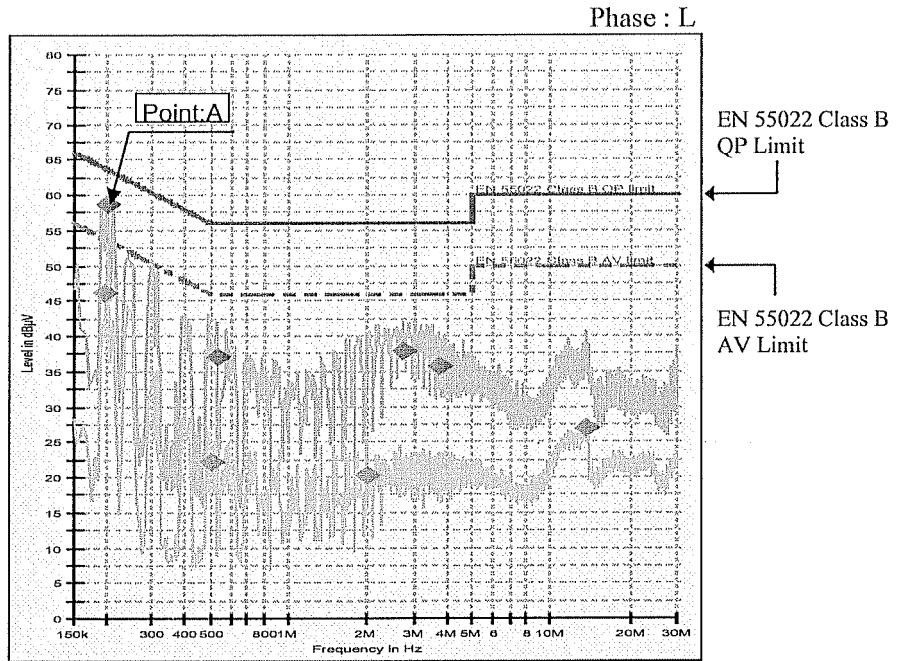
2.12 Electro-Magnetic Interference characteristics

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

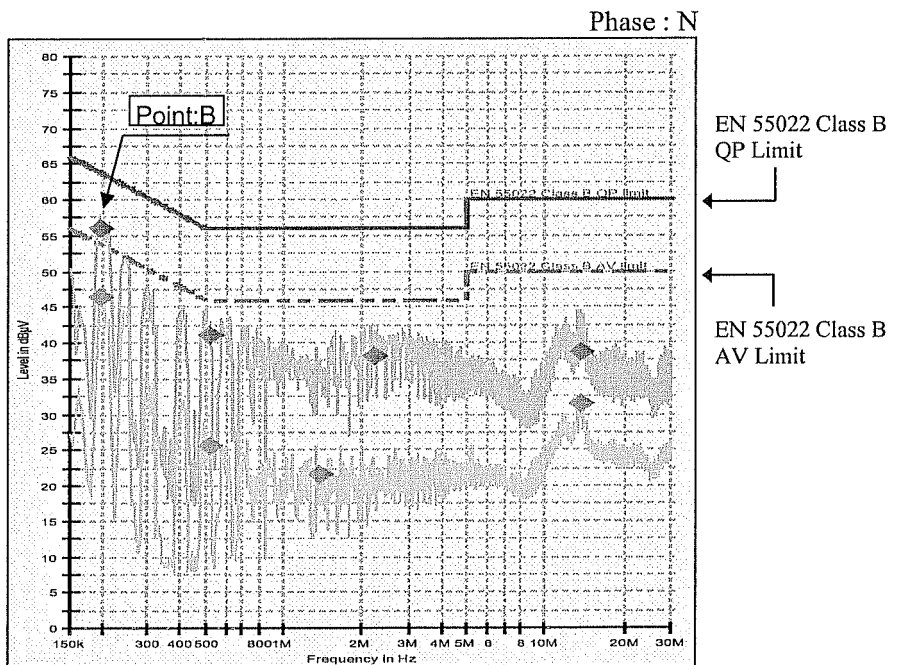
Conducted Emission

48V

Point A (198.5kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	63.7	58.7
AV	53.9	46.2



Point B (195kHz)		
Ref. Data	Limit (dBuV)	Measure (dBuV)
QP	63.8	56.0
AV	53.9	46.4



Limit of EN55011-B, VCCI-B, FCC-B are same as its EN55022 class B.

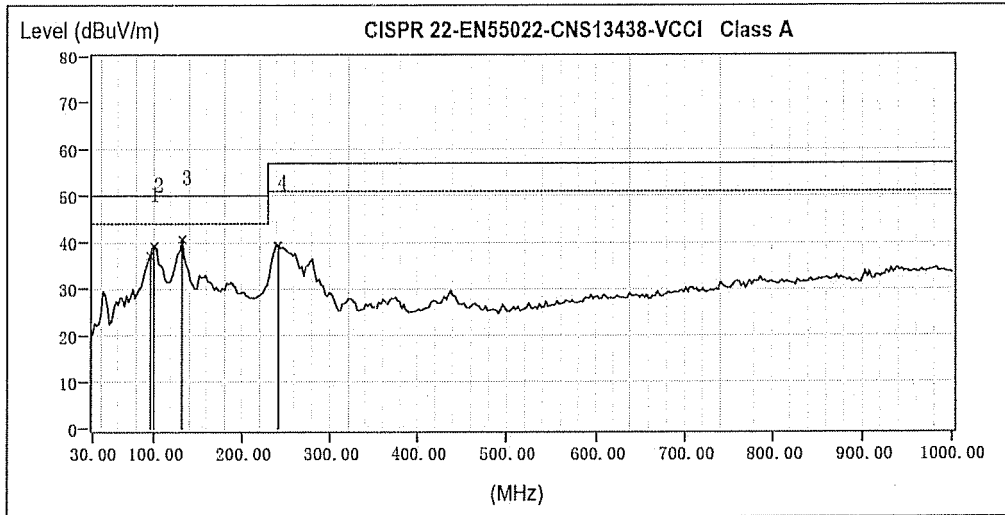
2.12 Electro-Magnetic Interference characteristics

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

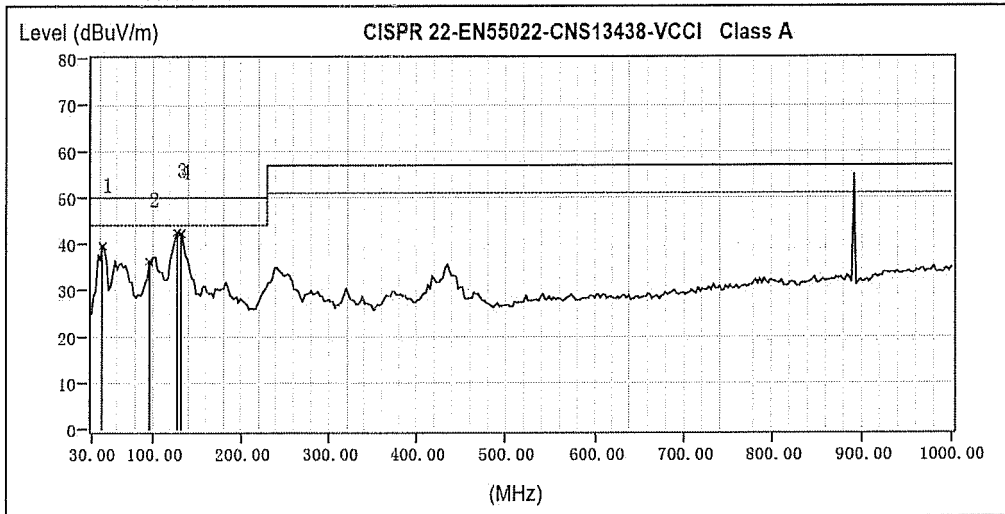
Radiated Emission

12V

HORIZONTAL



VERTICAL



Limit of EN55011-A,EN55022-A are same as its VCCI class A.

Indication is peak values.

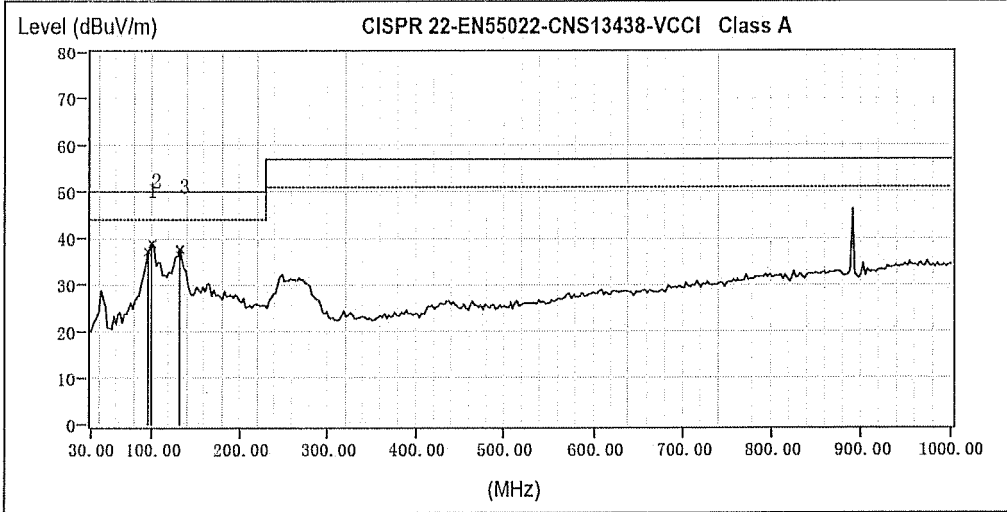
2.12 Electro-Magnetic Interference characteristics

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

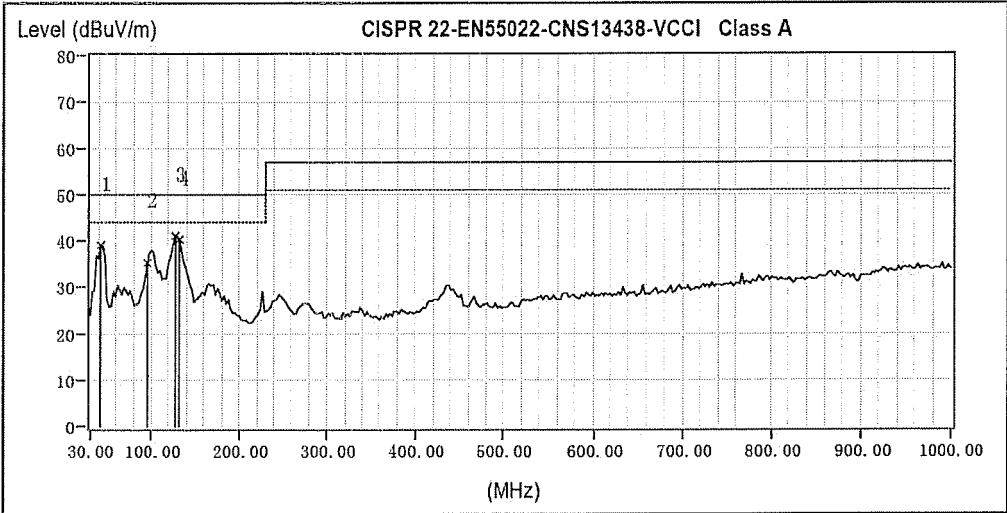
Radiated Emission

12V

HORIZONTAL



VERTICAL



Limit of EN55011-A,EN55022-A are same as its VCCI class A.

Indication is peak values.

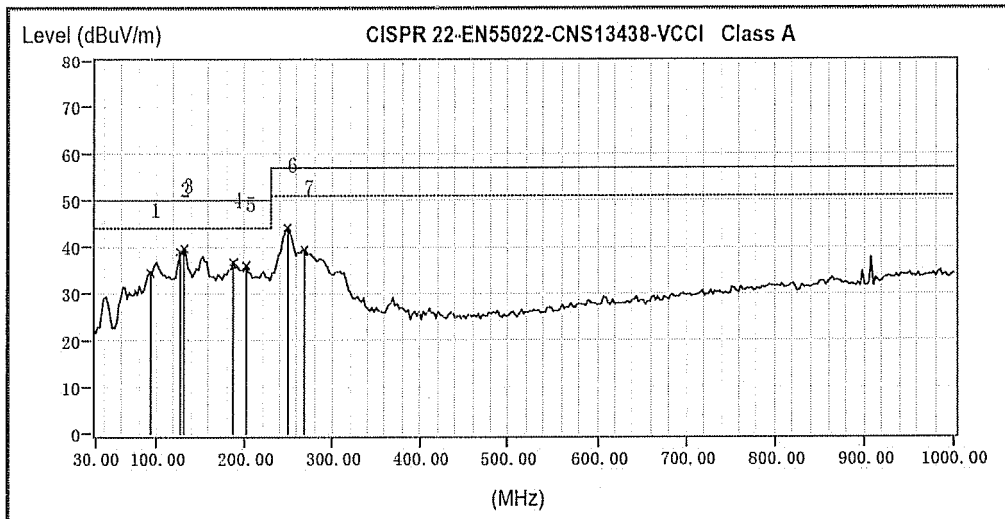
2.12 Electro-Magnetic Interference characteristics

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

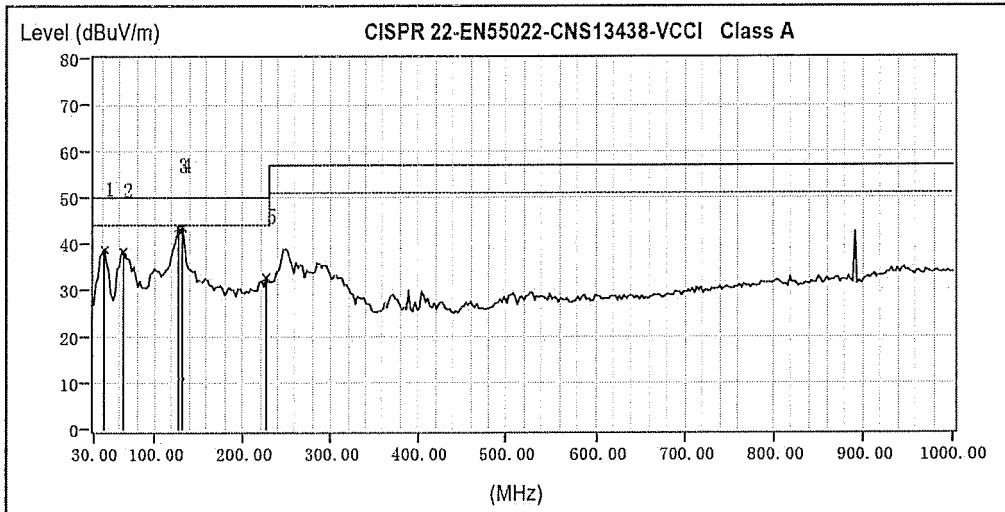
Radiated Emission

18V

HORIZONTAL



VERTICAL



Limit of EN55011-A,EN55022-A are same as its VCCI class A.

Indication is peak values.

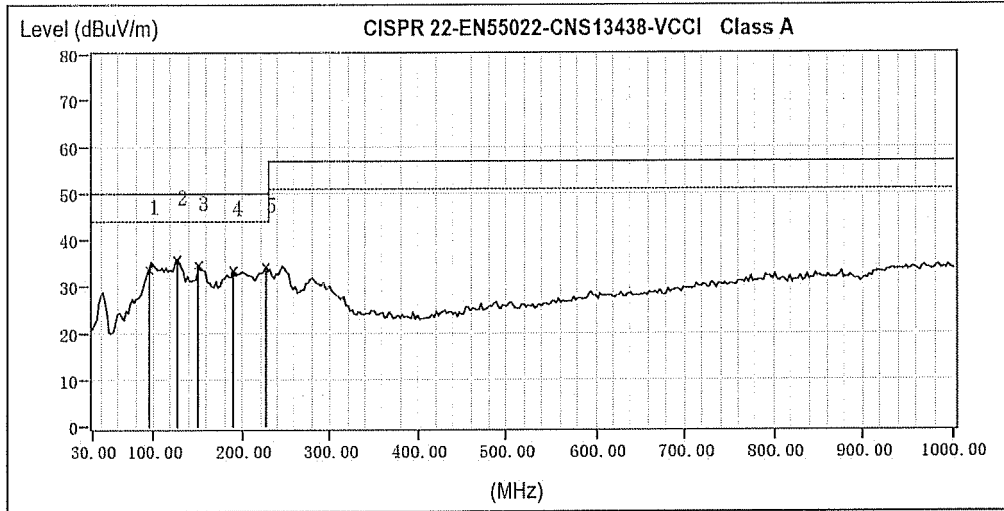
2.12 Electro-Magnetic Interference characteristics

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

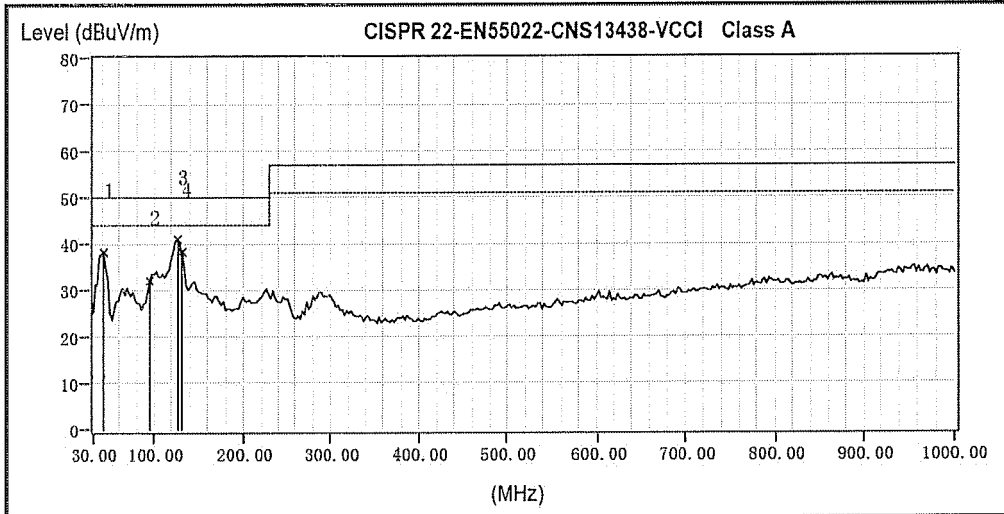
Radiated Emission

18V

HORIZONTAL



VERTICAL



Limit of EN55011-A,EN55022-A are same as its VCCI class A.

Indication is peak values.

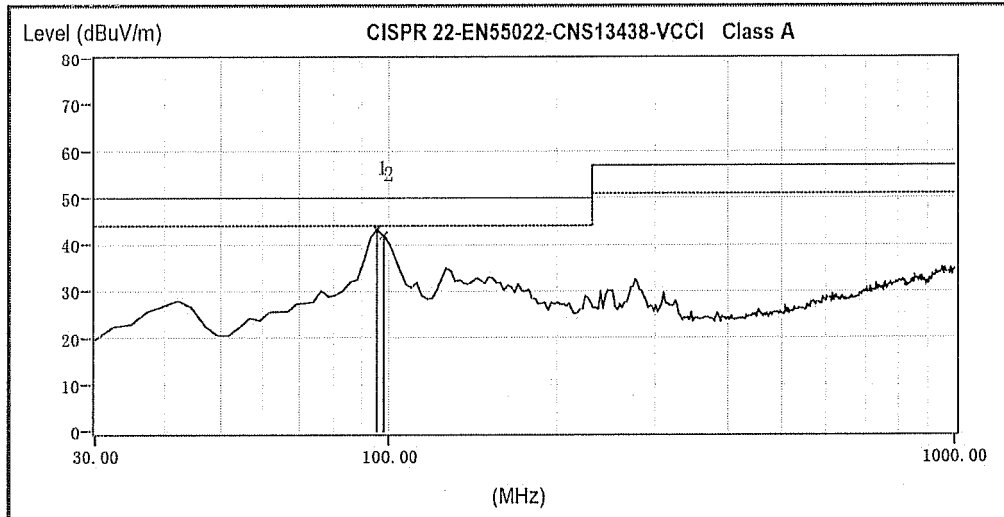
2.12 Electro-Magnetic Interference characteristics

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

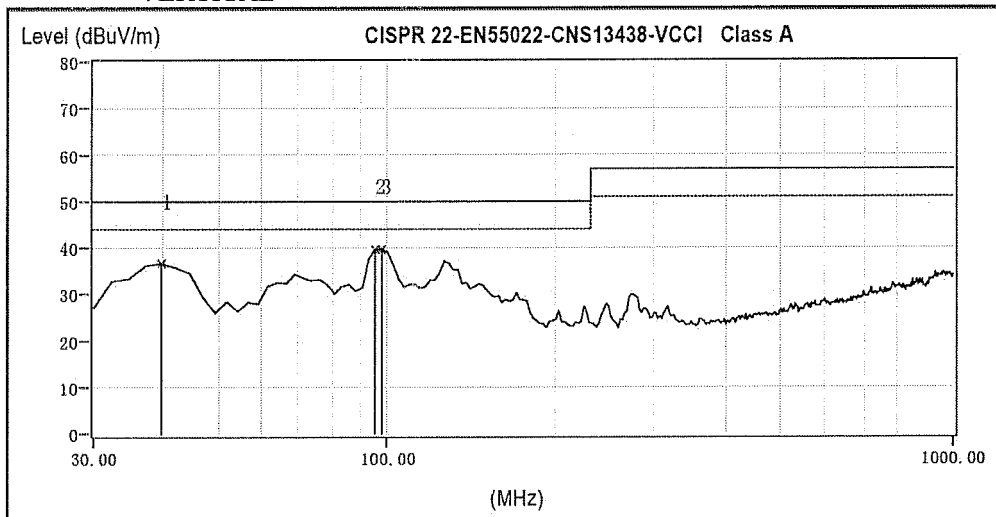
Radiated Emission

24V

HORIZONTAL



VERTICAL



Limit of EN55011-A,EN55022-A are same as its VCCI class A.

Indication is peak values.

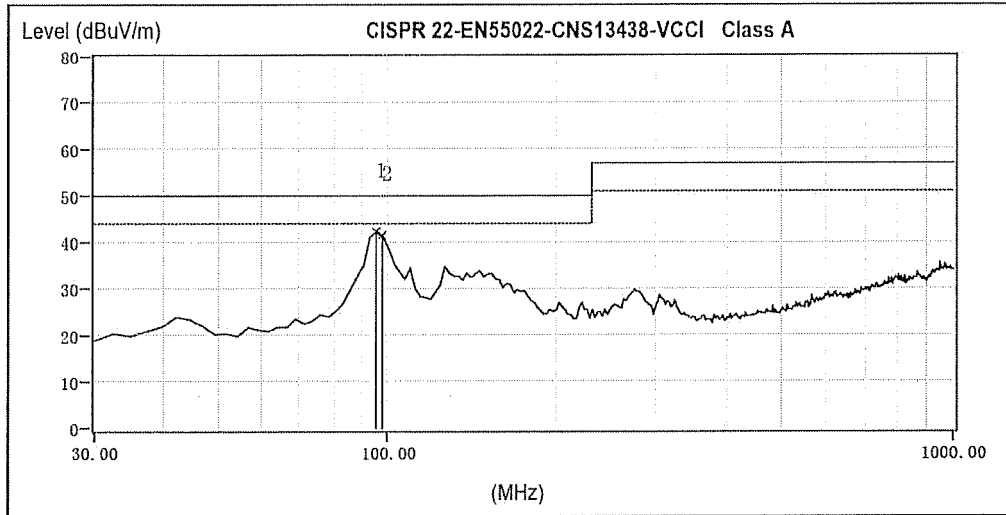
2.12 Electro-Magnetic Interference characteristics

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

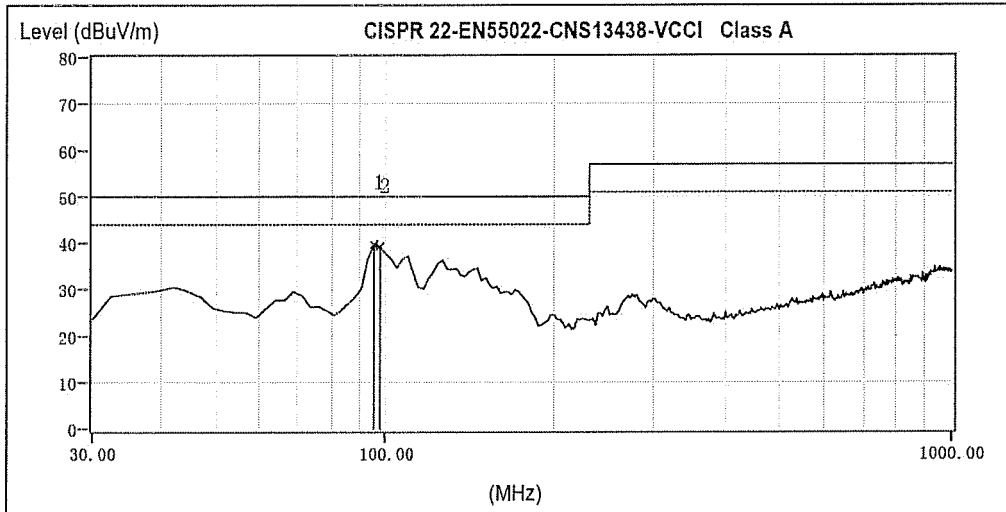
Radiated Emission

24V

HORIZONTAL



VERTICAL



Limit of EN55011-A,EN55022-A are same as its VCCI class A.

Indication is peak values.

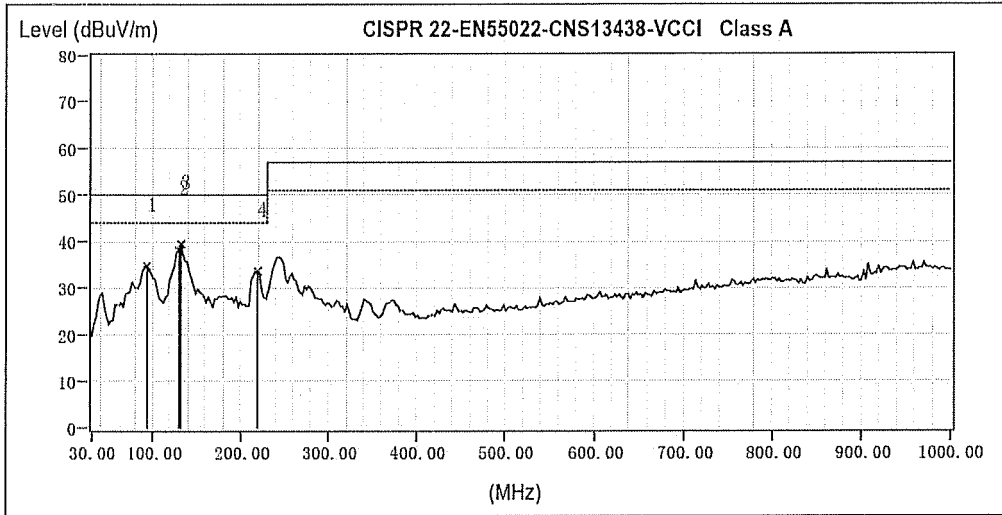
2.12 Electro-Magnetic Interference characteristics

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

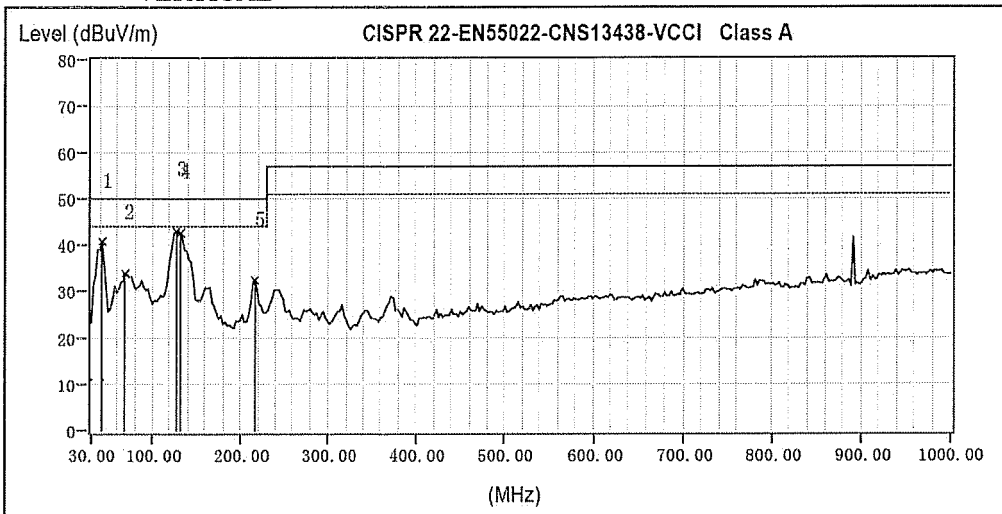
Radiated Emission

48V

HORIZONTAL



VERTICAL



Limit of EN55011-A,EN55022-A are same as its VCCI class A.

Indication is peak values.

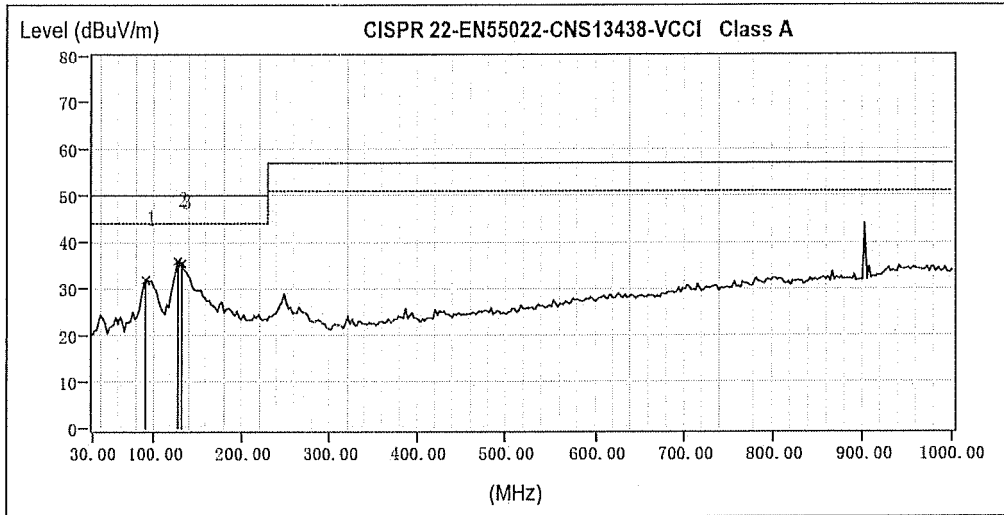
2.12 Electro-Magnetic Interference characteristics

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

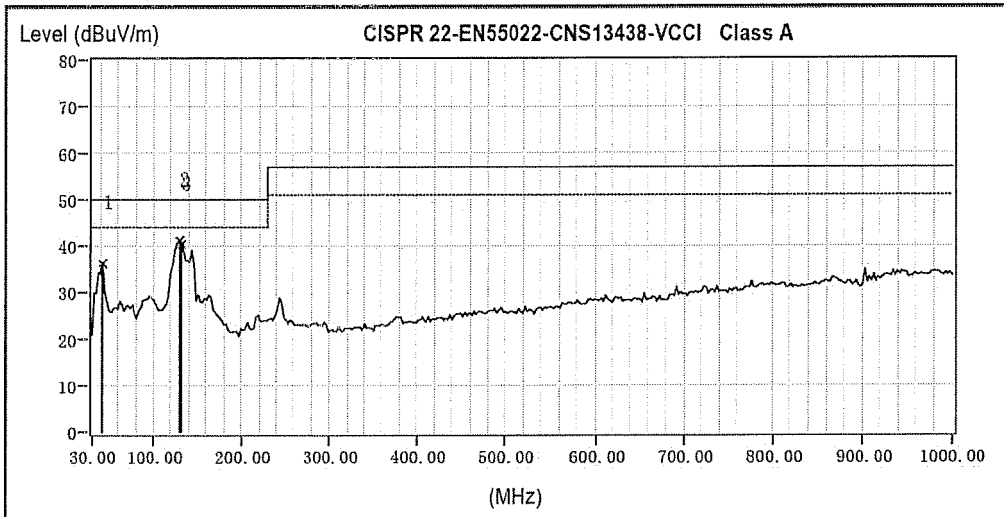
Radiated Emission

48V

HORIZONTAL



VERTICAL



Limit of EN55011-A,EN55022-A are same as its VCCI class A.

Indication is peak values.