

RFE1600

EVALUATION DATA

DWG: IA745-53-01		
APPD	CHK	DWG
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<i>23-Jan-13</i>	<i>13-Jan-2013</i>	<i>9/1/2013</i>

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TERMINOLOGY USED

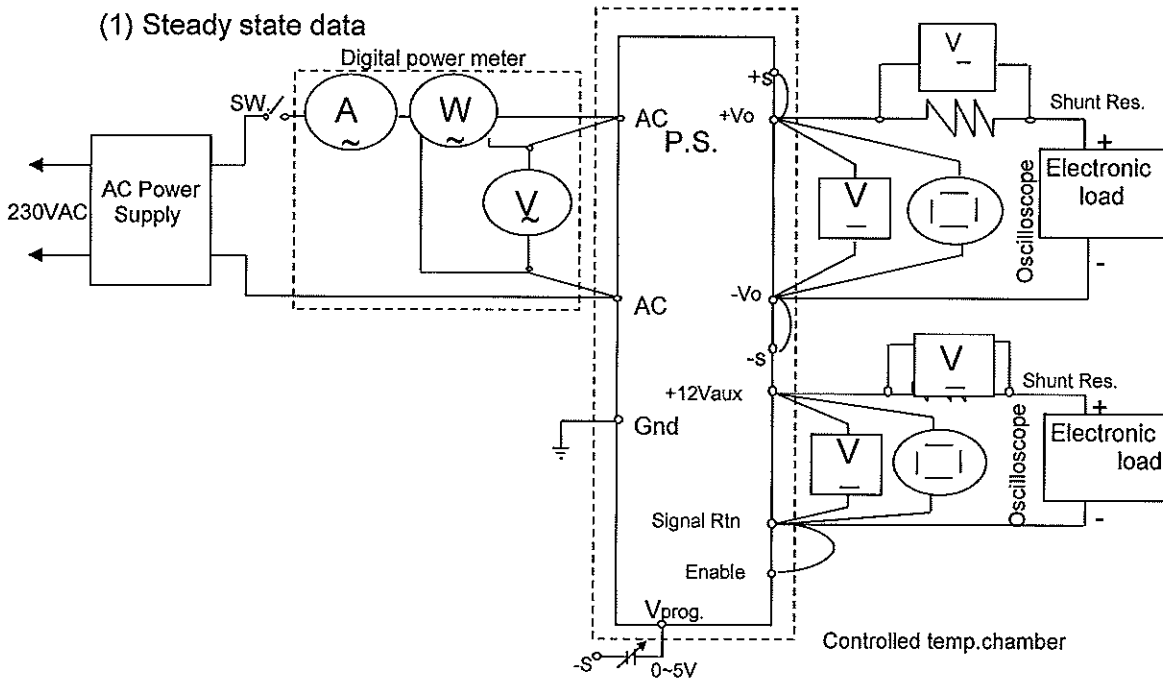
Definition

V _{in}	Input voltage
V _{out}	Output voltage
I _{in}	Input current
I _{out}	Output current
T _a	Ambient Temperature

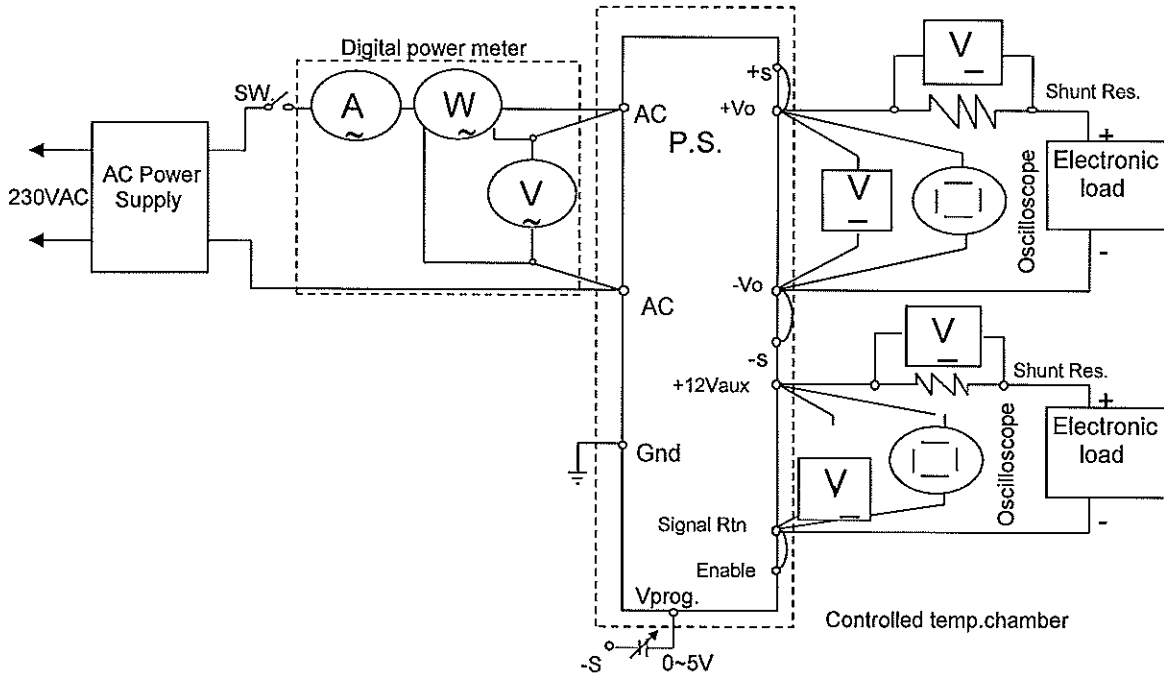
1.EVALUATION METHOD

1-1.Circuits used for determination

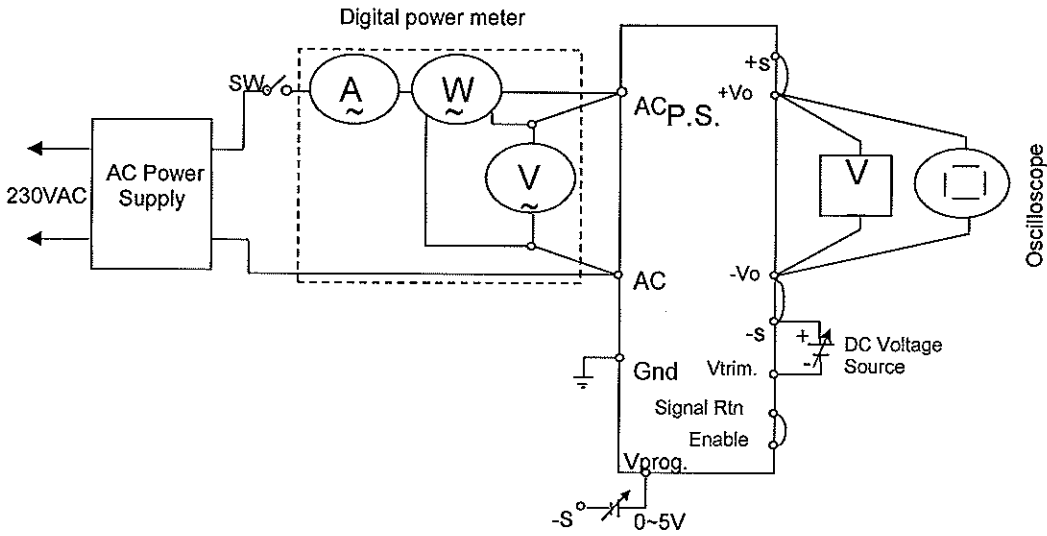
(1) Steady state data



(2) Warm up voltage drift & temperature stability



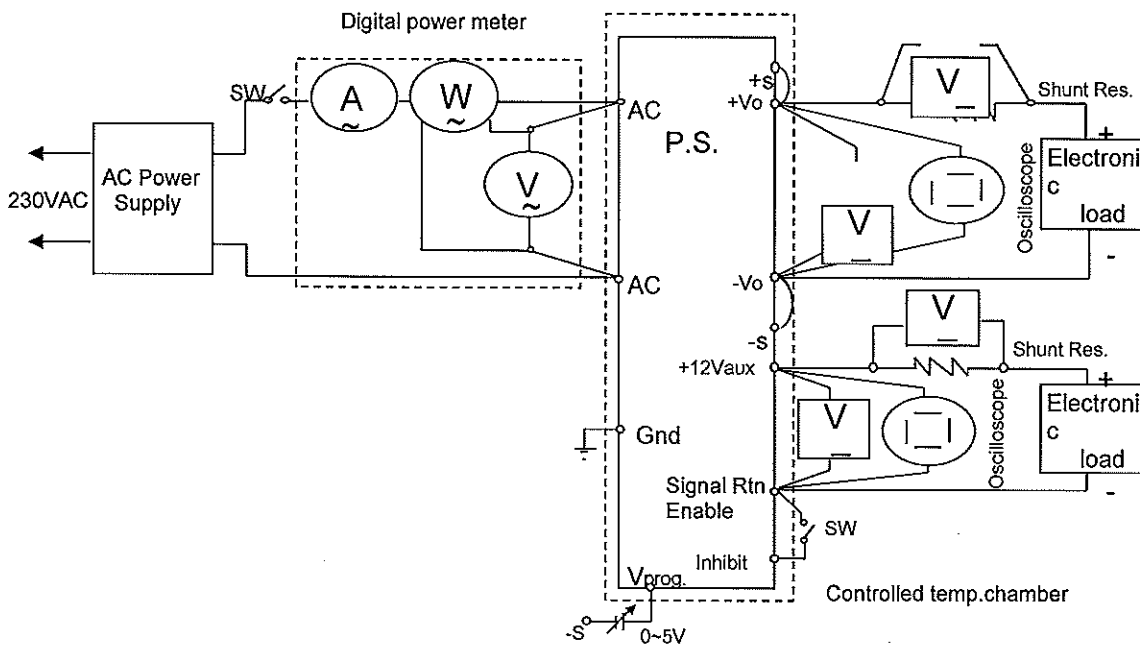
(3) Over Voltage Protection (OVP) characteristics



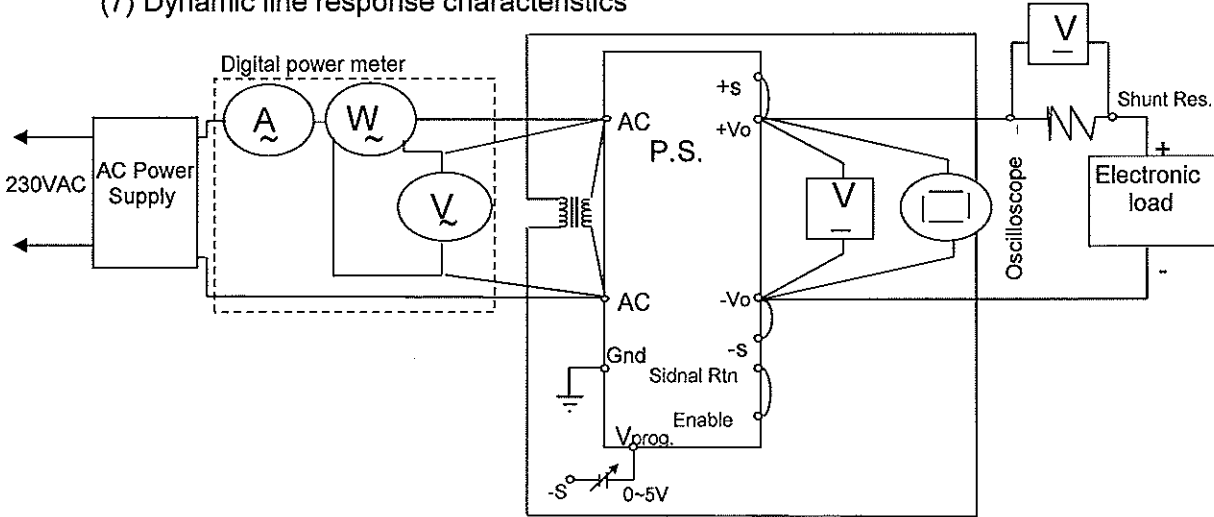
(4) Over Current Protection (OCP) characteristics

Same as item (1)

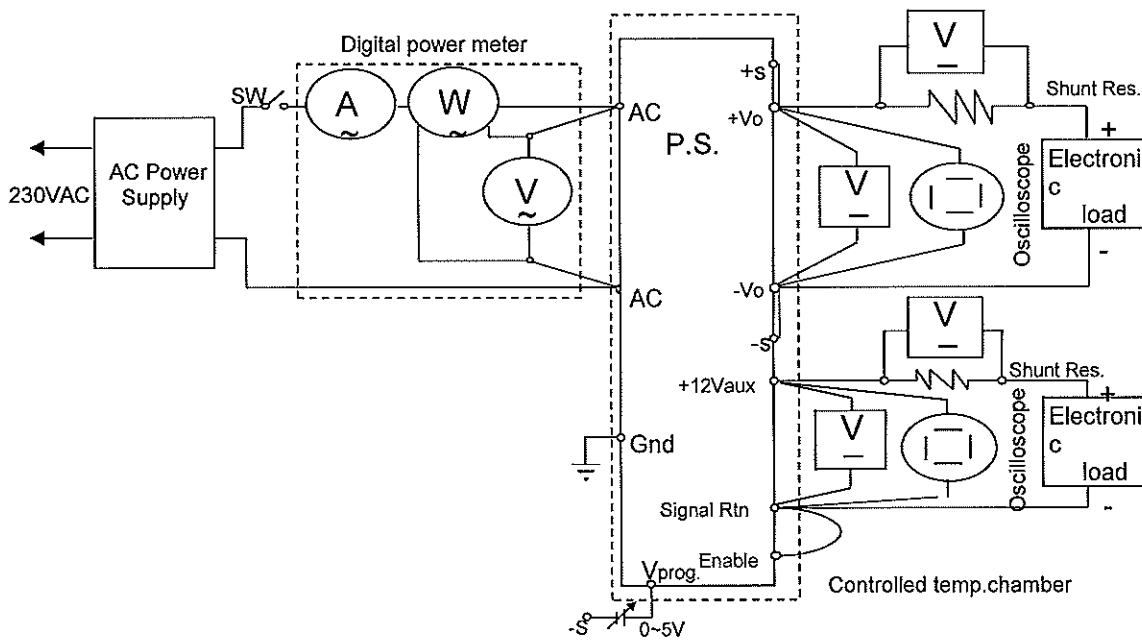
(5) (6) Output Rise & Fall Characteristics



(7) Dynamic line response characteristics



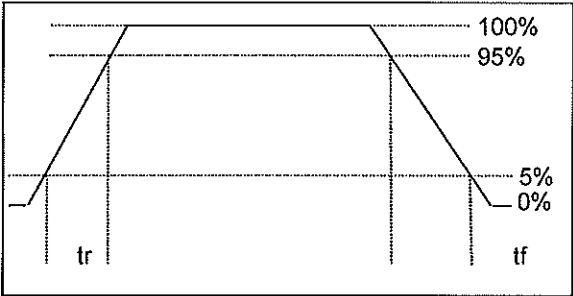
(8) Dynamic load response characteristics



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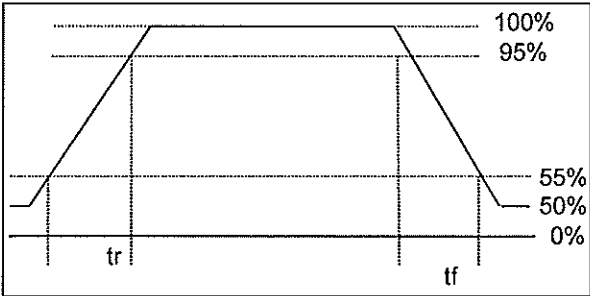
Dynamic load response characteristics

Output current waveform
Iout 0% <---> 100%



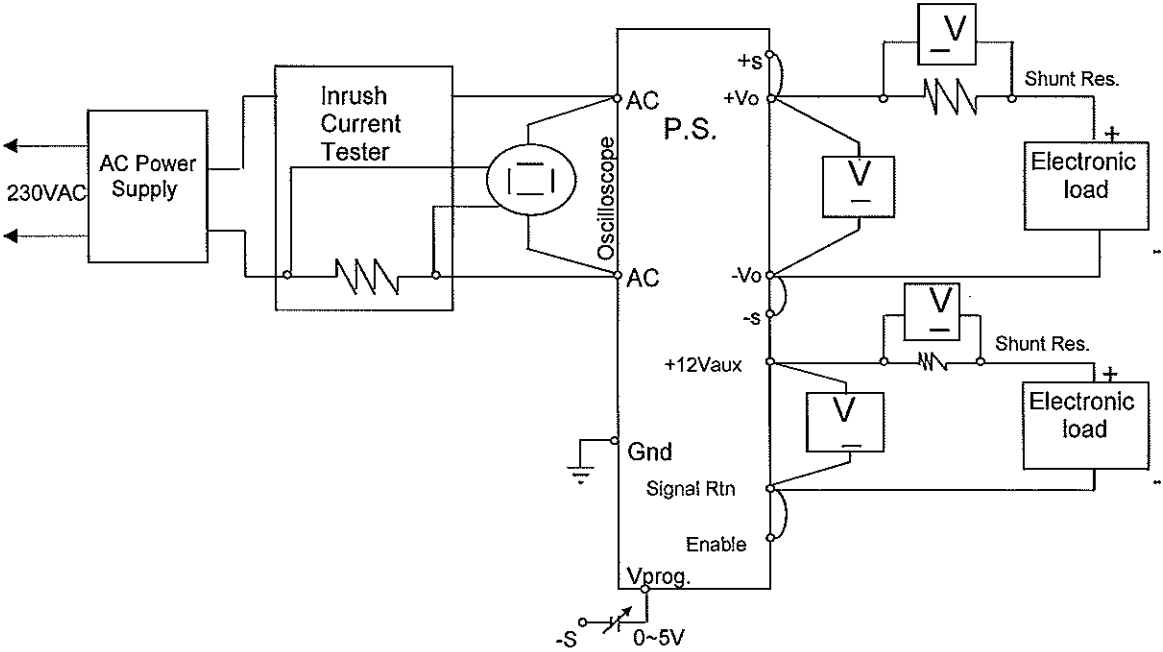
$t_r = 100\mu s$
 $t_f = 100\mu s$

Output current waveform
Iout 50% <---> 100%



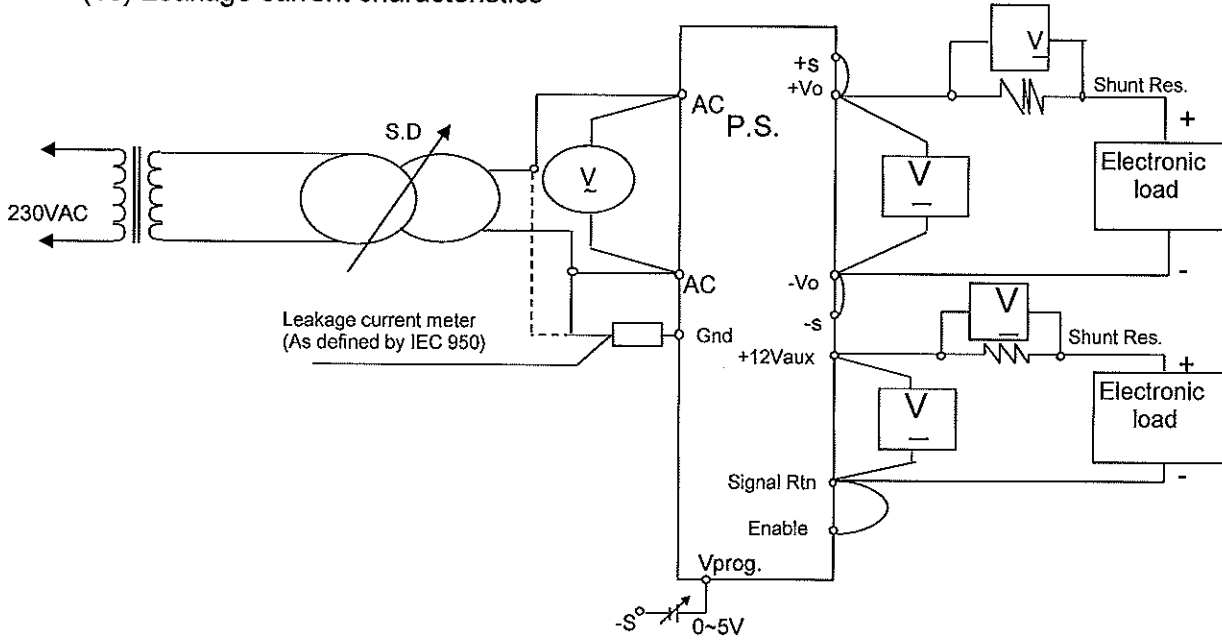
$t_r = 100\mu s$
 $t_f = 100\mu s$

(9) Inrush current characteristics



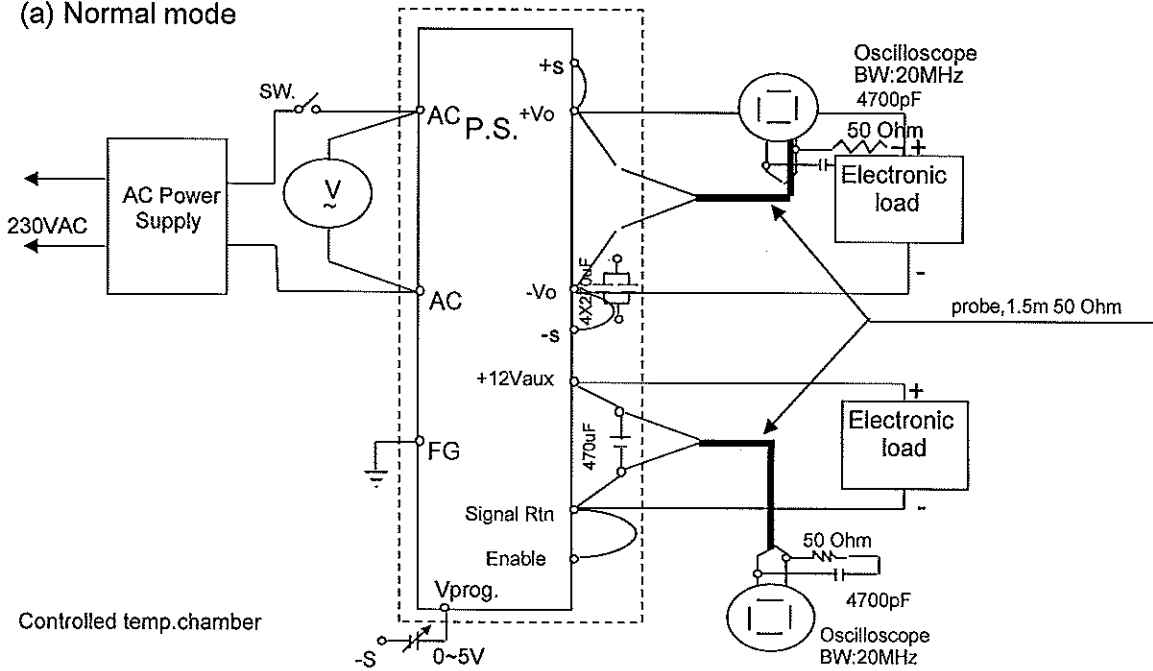
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(10) Leakage current characteristics

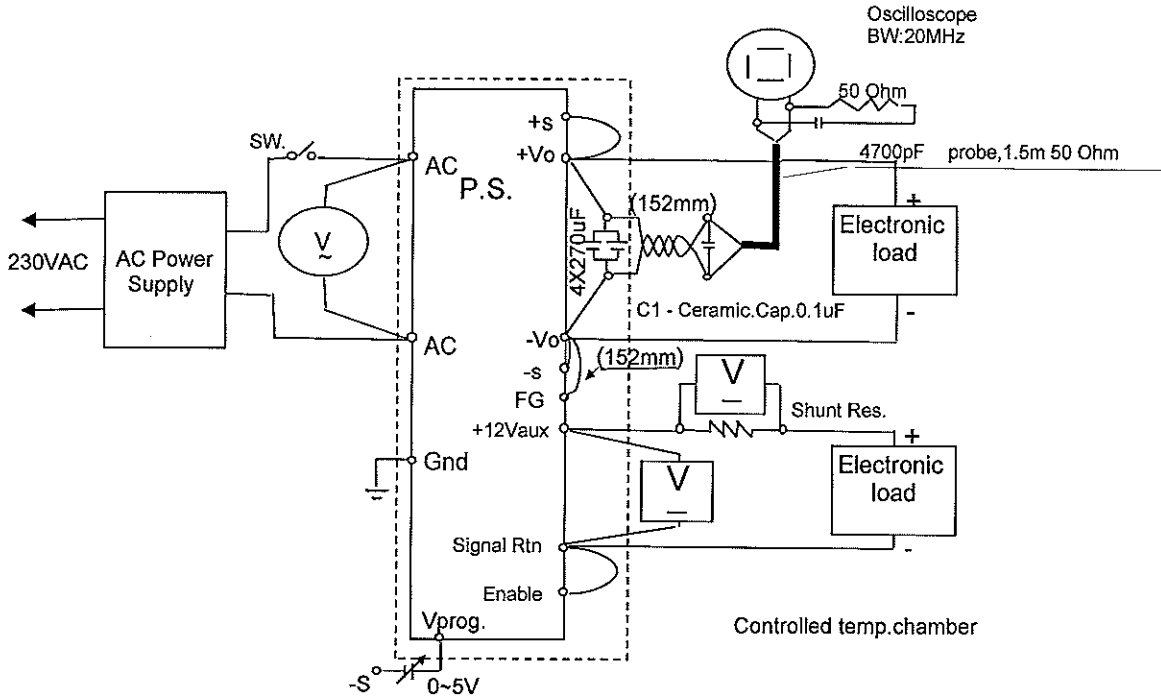


(11) Output ripple & noise waveform

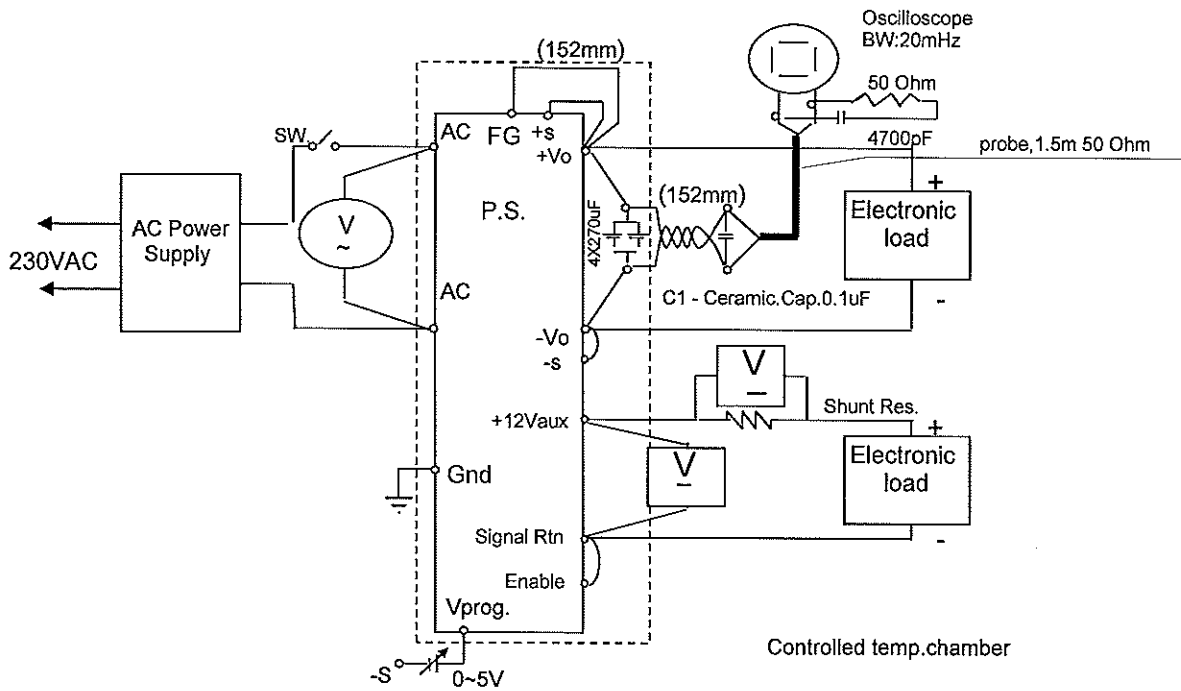
(a) Normal mode



(b) Normal and common mode -Vo Terminal grounded



(c) Normal and common mode +Vo Terminal grounded



(12) Standby current
Same as Steady state data

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1-2 List of equipment used

No	EQUIPMENT USED	MANUFACTURER	MODEL No.
1	Storage oscilloscope	YOKOGAWA	DL7100
2	Storage oscilloscope	YOKOGAWA	DL1740
3	Digital multimeter	AGILENT	34401A
4	Digital power meter	YOKOGAWA	WT110
5	Autotransformer	VOLTAC	B15
6	Autotransformer	METREL	HSN 260/30
7	Electronic load	H&H	ZS6060 SC150
8	Electronic load	H&H	ZS7006
9	Electronic load	H&H	ZS7060
10	Electronic load	CHROMA	63203
11	Electronic load	CHROMA	63206
12	Controlled temp. chamber	THERMOTRON	SM-16-3800
13	Controlled temp. chamber	THERMOTRON	SE-600-6-6
14	AC Source	CHROMA	6590
15	Analyzing AC power supply	TAKASAGO	AA2000XG
16	Inrush current tester	TAKAMISAWA	PSA-210
17	Leakage current tester	HIOKI	3155
18	Current probe	YOKOGAWA	701933

2. CHARACTERISTICS

2-1. Steady state data

(1). Regulation-Line and Load, Temperature drift

12V

1.1 Regulation - Line & Load

CONDITIONS: $T_a = 25^\circ\text{C}$
 $I_{aux}=0.5\text{A}$

Io	Vin (AC)			Line Regulation	
	85	100	132	$\Delta V(V)$	(%)
0%	12.002	12.003	12.003	0.000	0.001
50%	11.998	11.998	11.997	0.000	0.003
100%	11.993	11.994	11.994	0.001	0.011
Load Regulation	0.010	0.008	0.009	$\Delta V(V)$	(%)
	0.081	0.071	0.072	(%)	

*Note: Load at 85Vac is derated according to specification

Io	Vin (AC)				Line Regulation	
	170	200	230	265	$\Delta V(V)$	(%)
0%	12.005	12.005	12.005	12.005	0.000	0.001
50%	11.995	11.995	11.995	11.995	0.000	0.001
100%	11.987	11.986	11.986	11.986	0.001	0.008
Load Regulation	0.018	0.018	0.019	0.019	$\Delta V(V)$	(%)
	0.149	0.153	0.157	0.159	(%)	

1.2 Temperature drift

Vo (V)	Ta			Drift (V)	PPM/°C
	-10°C	25°C	50°C		
11.989	11.989	11.994	11.998	0.009	11

CONDITIONS: $V_{in}=230\text{VAC}$
 $V_o=12\text{V}$
 $I_o=133\text{A}$
 $I_{aux}=0.5\text{A}$

2-1. Steady state data

(1). Regulation-Line and Load, Temperature drift

24V

1.1 Regulation - Line & Load

CONDITIONS: $T_a = 25^{\circ}\text{C}$
 $I_{aux}=0.5\text{A}$

Io	Vin (AC)			Line Regulation	
	85	100	132		
0%	24.008	24.008	24.008	0.000	0.000
50%	24.009	24.009	24.009	0.001	0.003
100%	24.013	24.011	24.009	0.003	0.013
Load Regulation	0.005	0.003	0.002	$\Delta V(V)$	(%)
	0.020	0.013	0.007	(%)	

*Note: Load at 85Vac is derated according to specification

Io	Vin (AC)				Line Regulation	
	170	200	230	265		
0%	24.011	24.011	24.011	24.011	0.000	0.001
50%	24.015	24.014	24.014	24.014	0.001	0.003
100%	24.009	24.009	24.009	24.009	0.000	0.000
Load Regulation	0.005	0.005	0.005	0.005	$\Delta V(V)$	(%)
	0.023	0.021	0.021	0.020	(%)	

1.2 Temperature drift

Vo (V)	Ta			Drift (V)	PPM/ $^{\circ}\text{C}$
	-10 $^{\circ}\text{C}$	25 $^{\circ}\text{C}$	50 $^{\circ}\text{C}$		
24.059	24.0481	24.0515	0.011	6	

CONDITIONS: $V_{in}=230\text{VAC}$
 $V_o=24\text{V}$
 $I_o=67\text{A}$
 $I_{aux}=0.5\text{A}$

2-1. Steady state data

(1). Regulation-Line and Load, Temperature drift

48V

1.1 Regulation - Line & Load

CONDITIONS: $T_a = 25^{\circ}\text{C}$
 $I_{aux}=0.5\text{A}$

Io	Vin (AC)			Line Regulation	
	85	100	132	$\Delta V(V)$	(%)
0%	48.003	48.004	48.004	0.001	0.002
50%	48.004	48.001	48.000	0.004	0.008
100%	48.004	48.001	48.000	0.004	0.008
Load Regulation	0.001	0.003	0.004	$\Delta V(V)$	(%)
	0.002	0.006	0.008	(%)	

*Note:Load at 85Vac is derated according to specification

Io	Vin (AC)				Line Regulation	
	170	200	230	265	$\Delta V(V)$	(%)
0%	48.009	48.009	48.008	48.007	0.002	0.004
50%	48.004	48.003	48.003	48.003	0.001	0.002
100%	48.012	48.010	48.010	48.010	0.002	0.004
Load Regulation	0.008	0.007	0.007	0.007	$\Delta V(V)$	(%)
	0.017	0.015	0.015	0.015	(%)	

1.2 Temperature drift

Vo (V)	Ta			Drift (V)	PPM/ $^{\circ}\text{C}$
	-10 $^{\circ}\text{C}$	25 $^{\circ}\text{C}$	50 $^{\circ}\text{C}$		
48.000	47.991	48.024	48.032	0.041	12

CONDITIONS: $V_{in}=230\text{VAC}$
 $V_o=48\text{V}$
 $I_o=33\text{A}$
 $I_{aux}=0.5\text{A}$

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(2). Output ripple Vs Input and Output Voltages

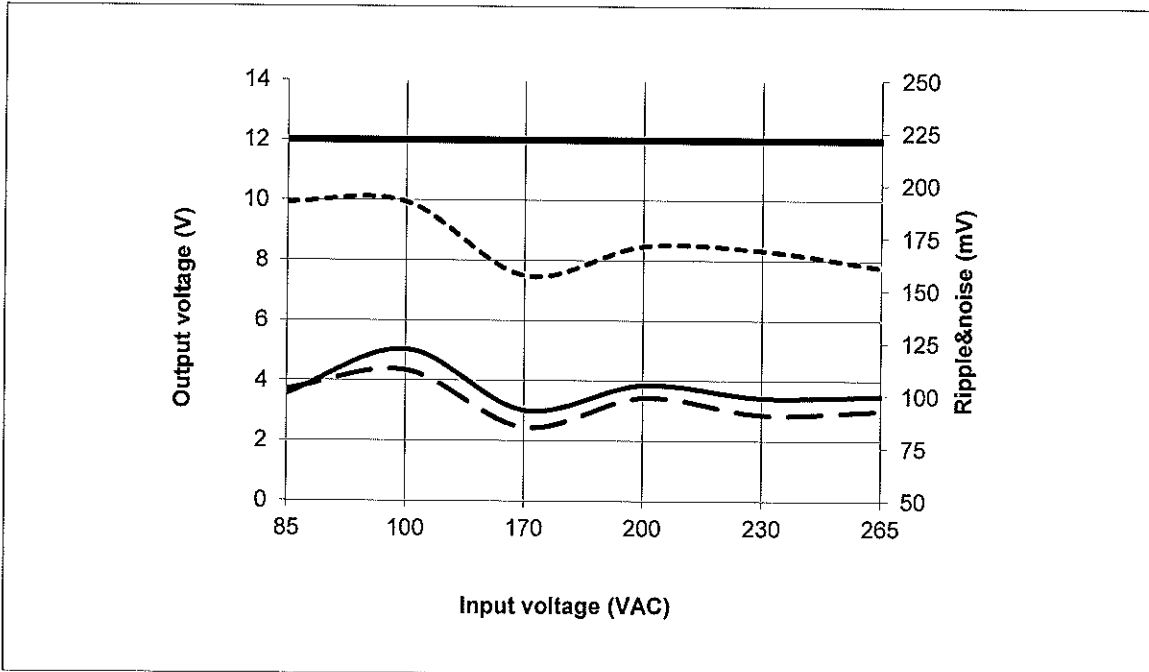
CONDITIONS: Iout:100%

Ta: -10°C -----

25°C - - - - -

50°C _____

12V



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(2). Output ripple Vs Input and Output Voltages

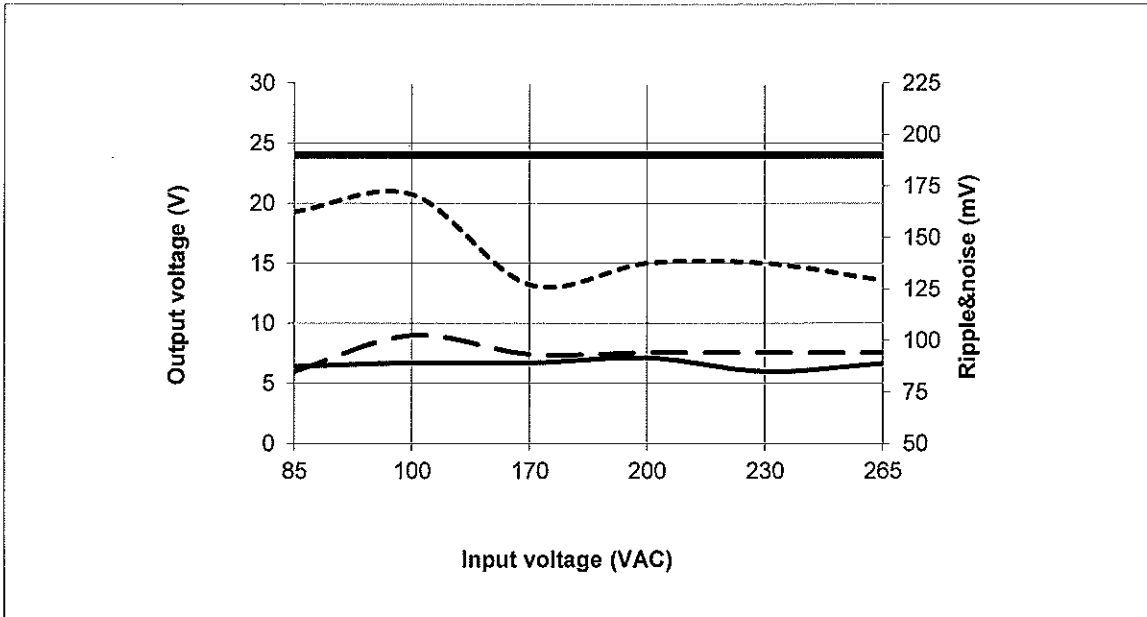
CONDITIONS: Iout:100%

Ta: -10°C -----

25°C -----

50°C -----

24V



RFE1600

(2). Output ripple Vs Input and Output Voltages

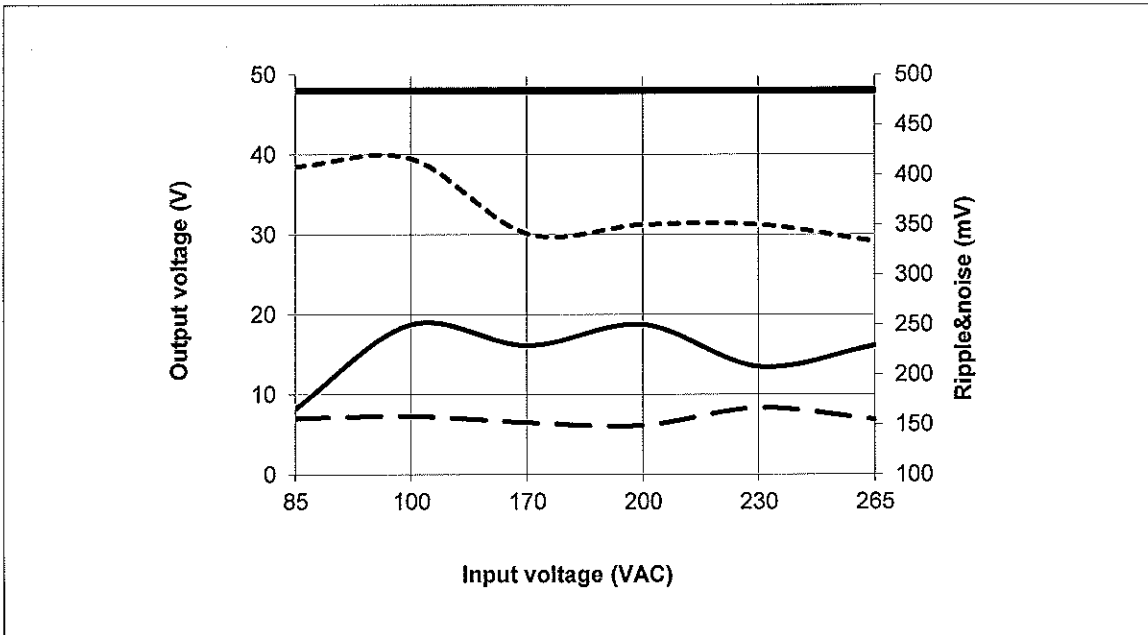
CONDITIONS: Iout:100%

Ta: -10°C -----

25°C -----

50°C -----

48V



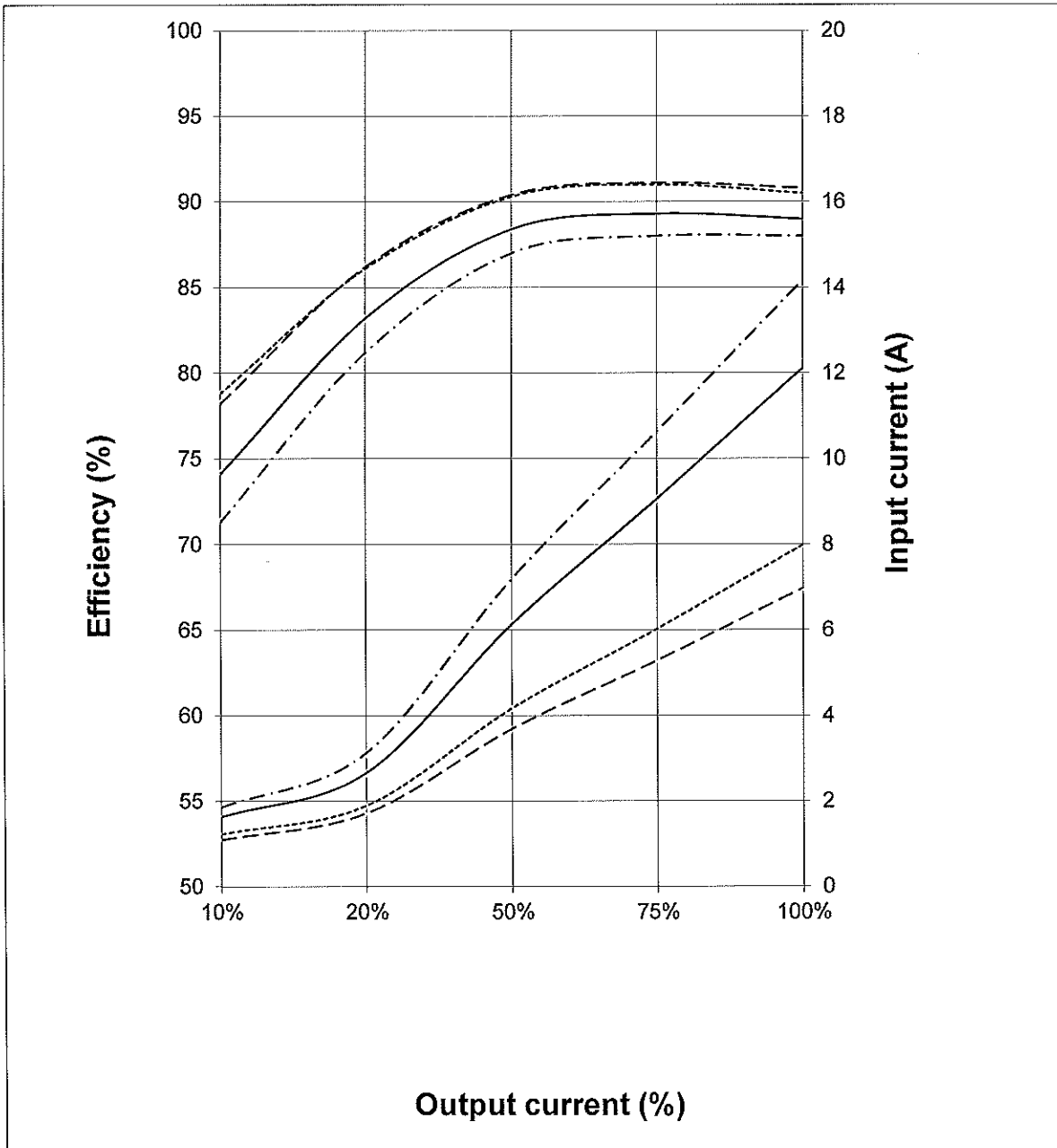
RFE1600

(3). Efficiency and Input current vs. Output current

CONDITIONS:

Vin: 85 VAC
115 VAC
230 VAC
265 VAC
Vout: 100%
Ta: 25°C

12V



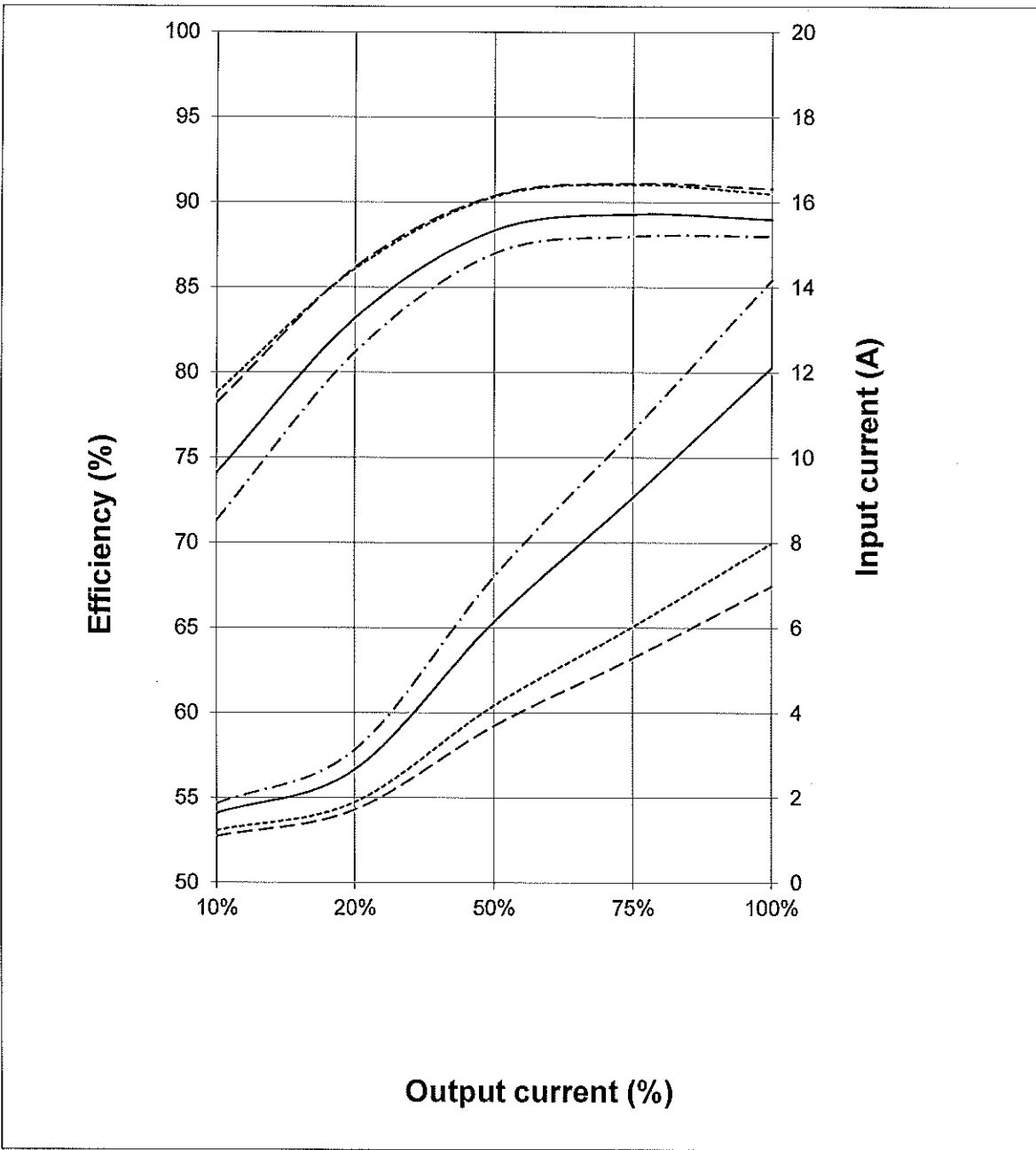
RFE1600

(3). Efficiency and Input current vs. Output current

CONDITIONS:

Vin: 85 VAC
115 VAC
230 VAC
265 VAC
Vout: 100%
Ta: 25°C

24V



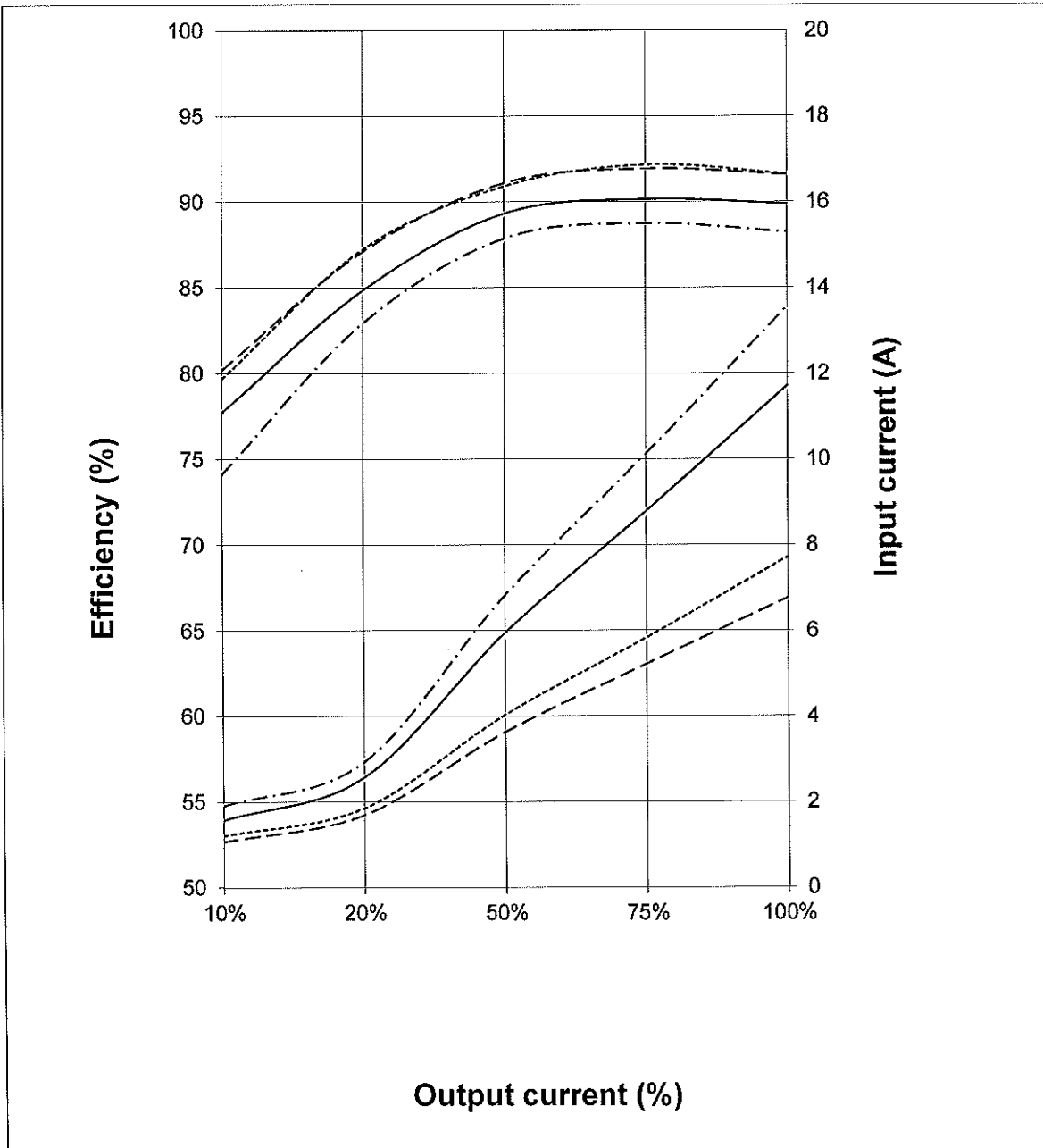
RFE1600

(3). Efficiency and Input current vs. Output current

CONDITIONS:

Vin: 85 VAC
115 VAC
230 VAC
265 VAC
Vout:100%
Ta: 25°C

48V



RFE1600

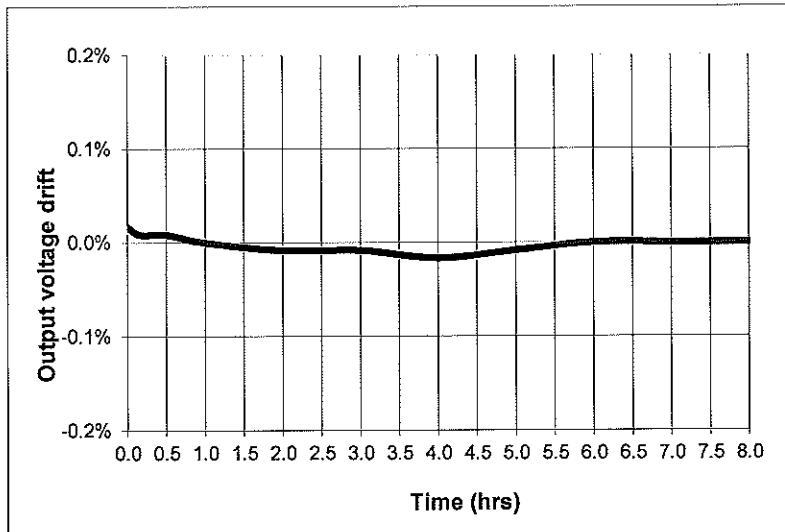
2.2. Warm up voltage drift characteristics

CONDITIONS: V_{in} : 230Vac

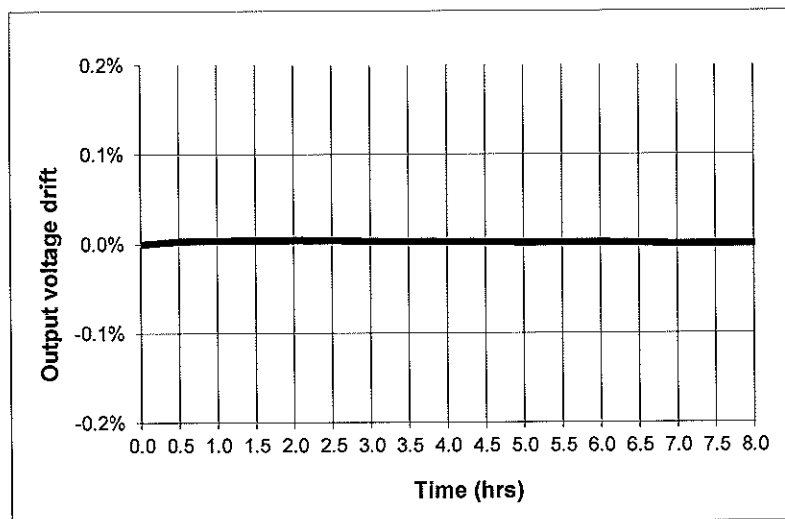
I_{out} : 100%

$T_a = 25^\circ\text{C}$

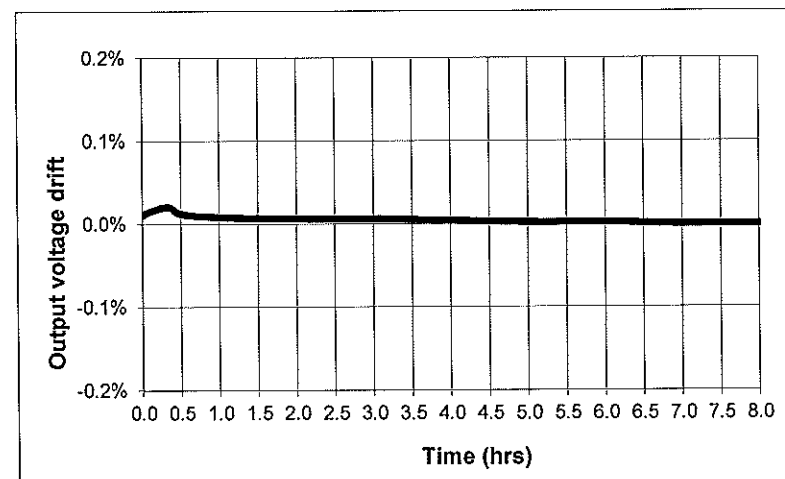
12V



24V



48V

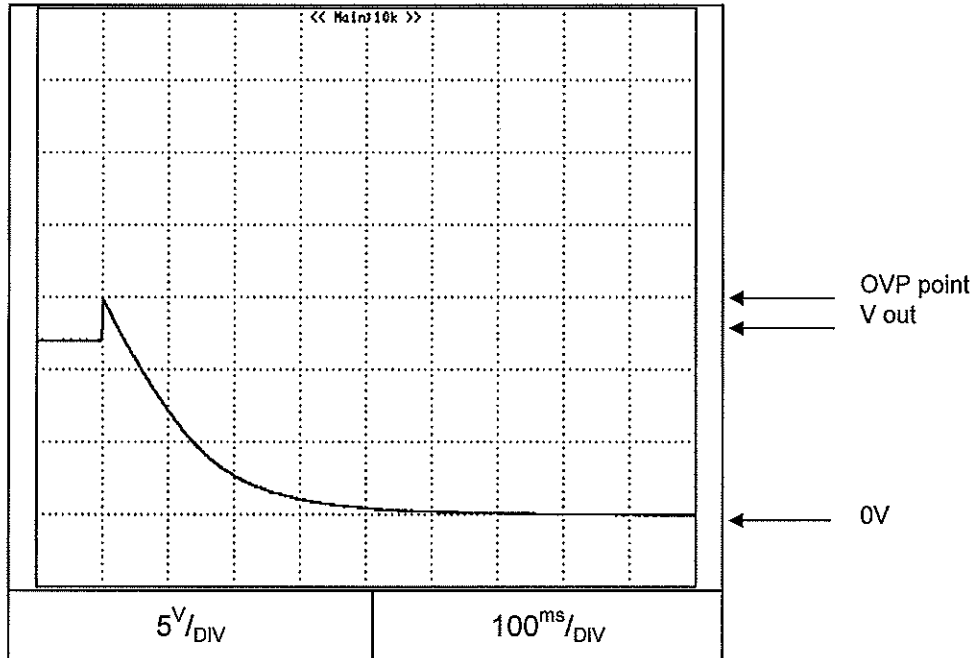


RFE1600

2.3. Over Voltage protection (OVP) characteristics

CONDITIONS: Vin: 230Vac
Vout: 12Vdc
Iout: 0%
Ta = 25°C

12V

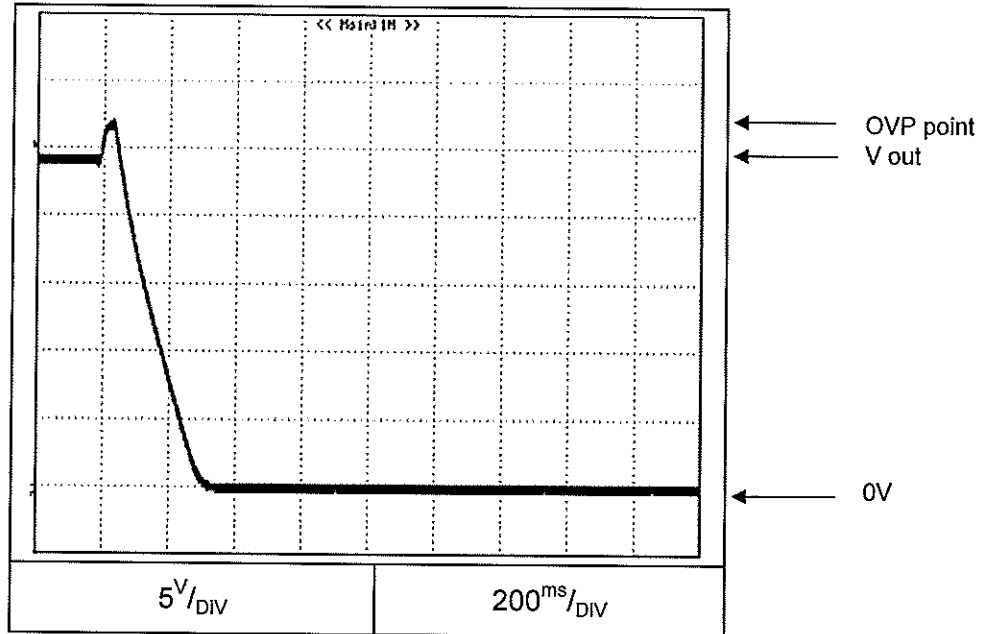


RFE1600

2.3. Over Voltage protection (OVP) characteristics

CONDITIONS: V_{in} : 230Vac
 V_{out} : 24Vdc
 I_{out} : 0%
 T_a = 25°C

24V

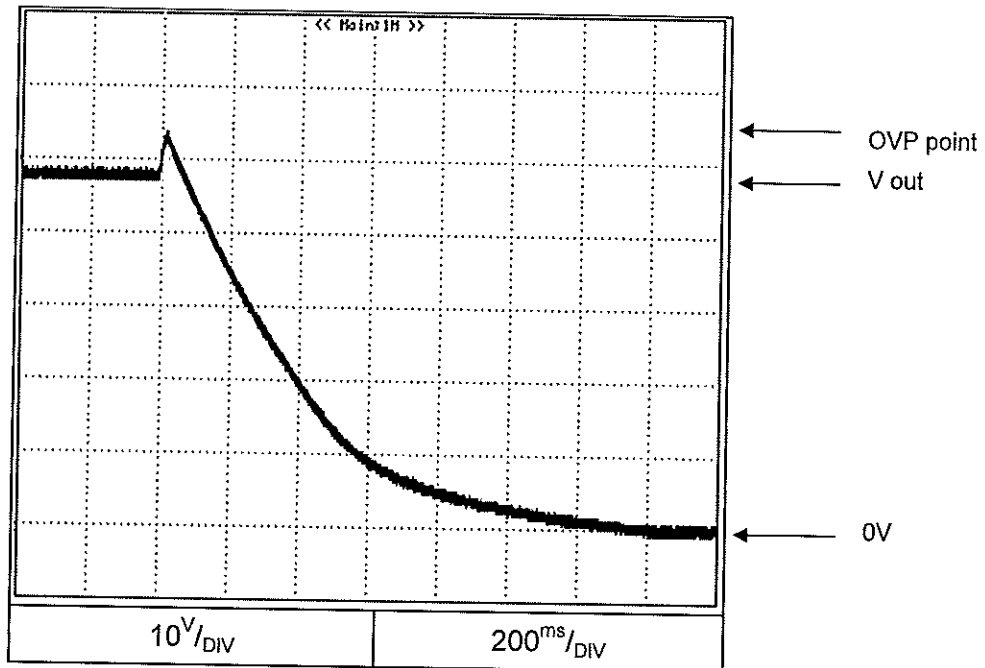


RFE1600

2.3. Over Voltage protection (OVP) characteristics

CONDITIONS: V_{in} : 230Vac
 V_{out} : 48Vdc
 I_{out} : 0%
 T_a = 25°C

48V

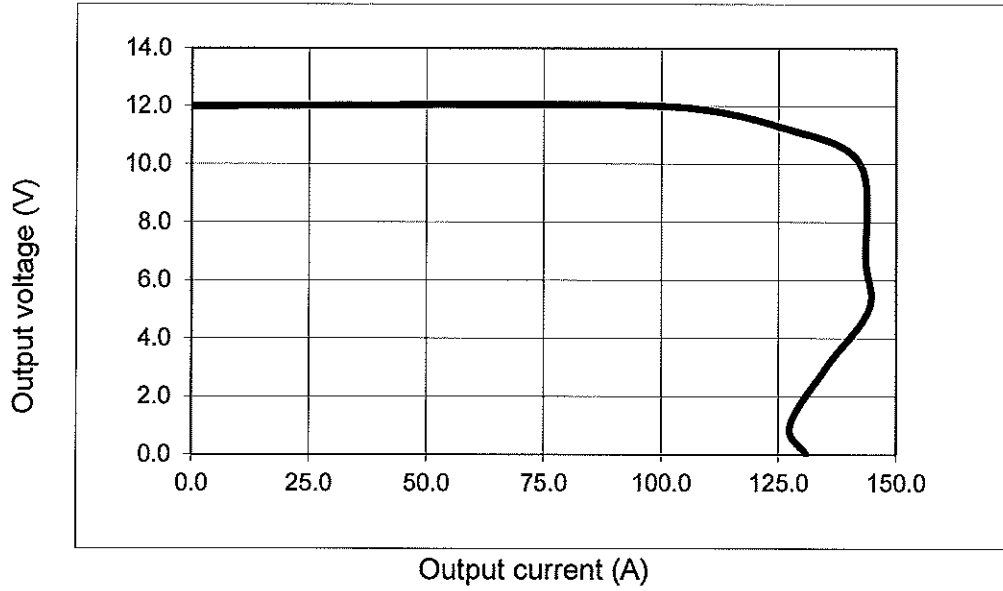


2.4. Over Current protection (OCP) characteristics

12V

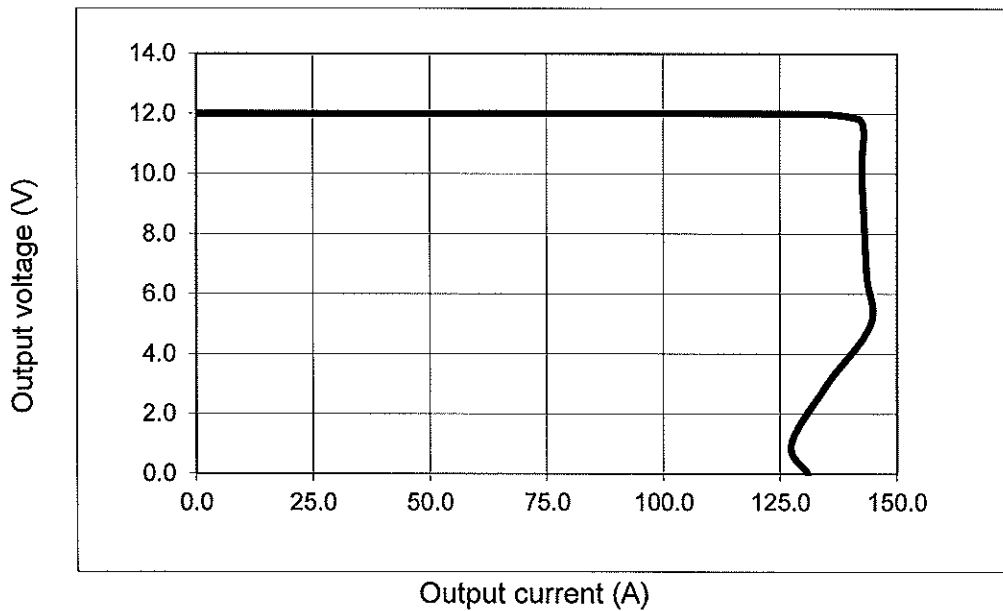
CONDITIONS: Vin: 115Vac

Ta = 25°C



CONDITIONS: Vin: 230Vac

Ta = 25°C

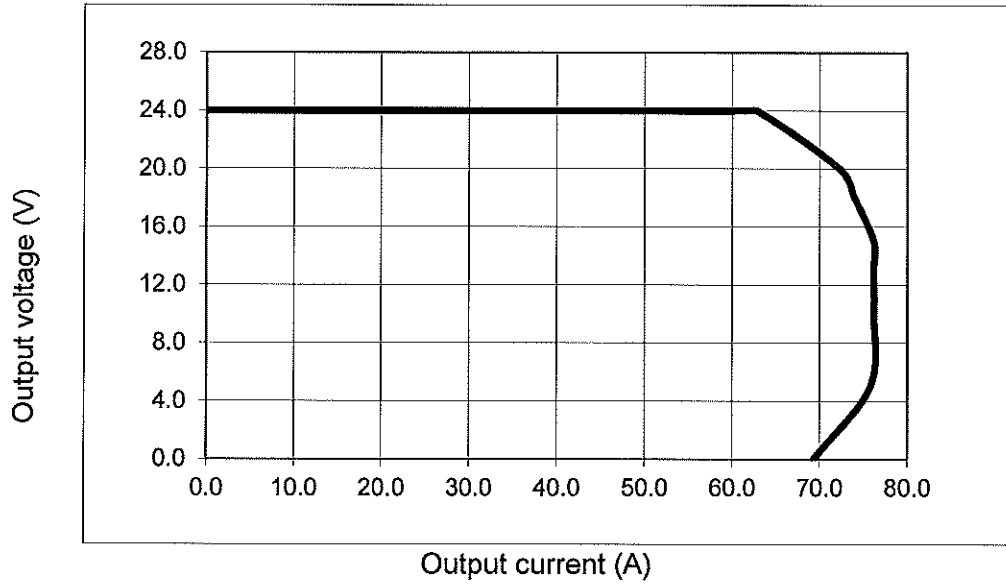


2.4. Over Current protection (OCP) characteristics

24V

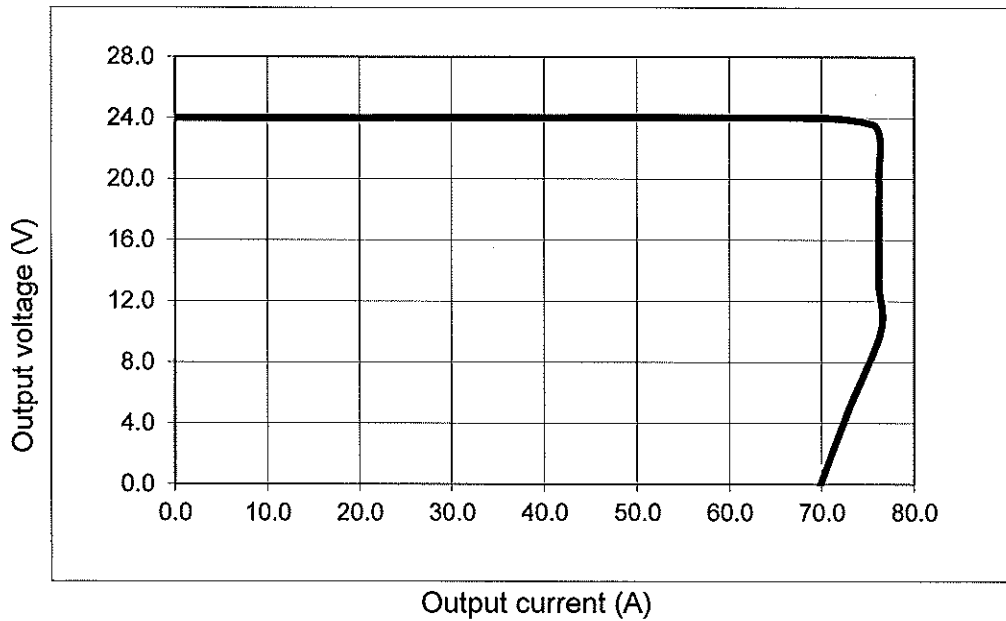
CONDITIONS: Vin: 115Vac

Ta = 25°C



CONDITIONS: Vin: 230Vac

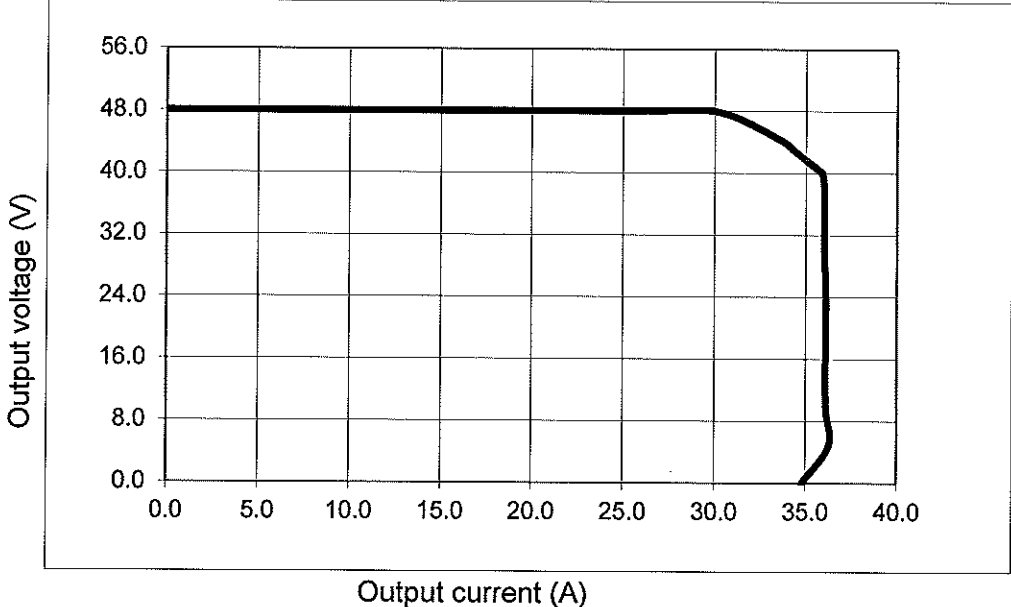
Ta = 25°C



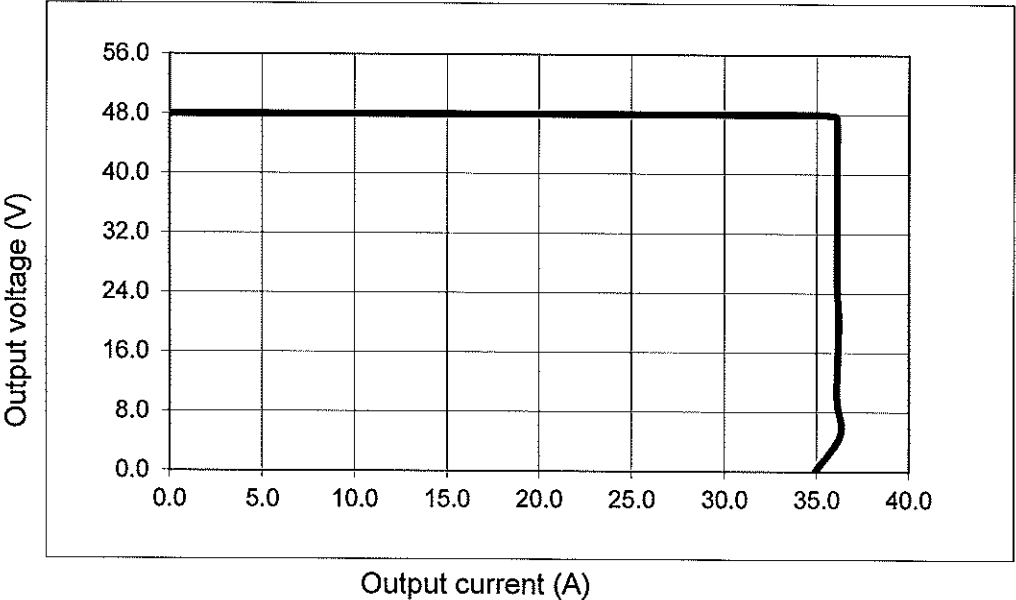
2.4. Over Current protection (OCP) characteristics

48V

CONDITIONS: Vin: 115Vac
Ta = 25°C



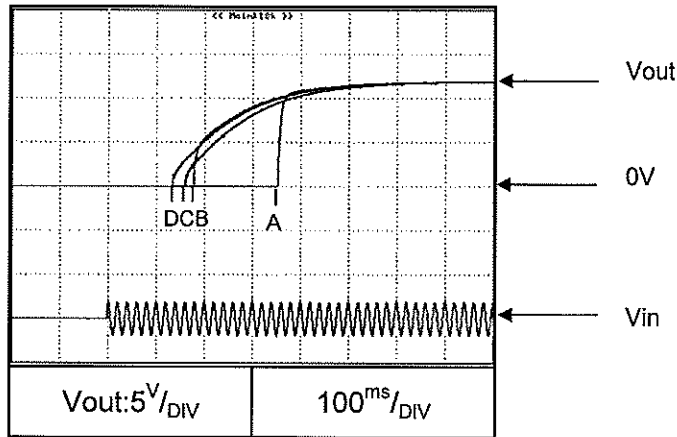
CONDITIONS: Vin: 230Vac
Ta = 25°C



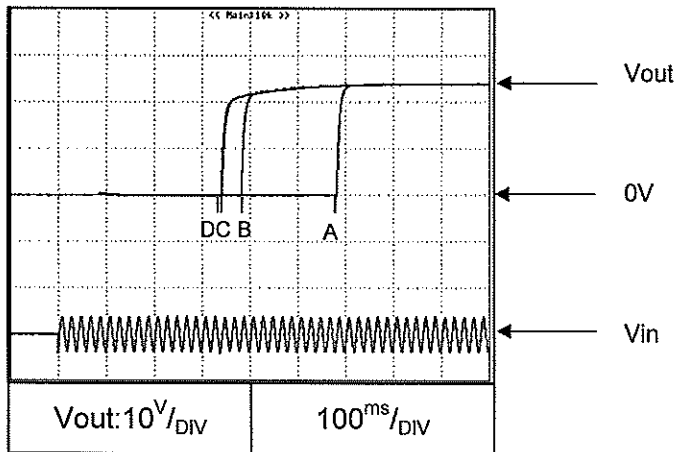
2.5. Output rise characteristics

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

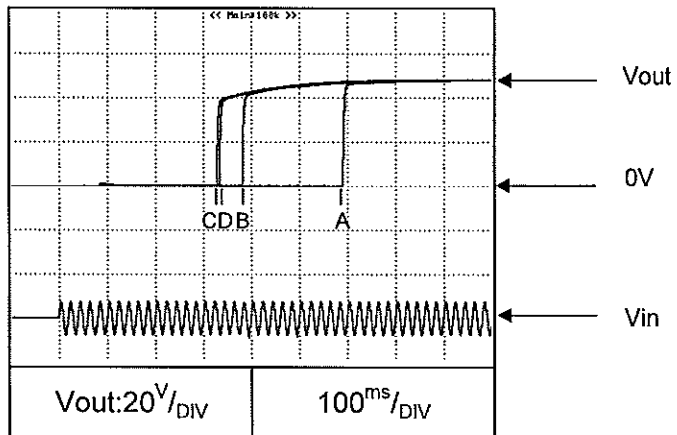
12V



24V



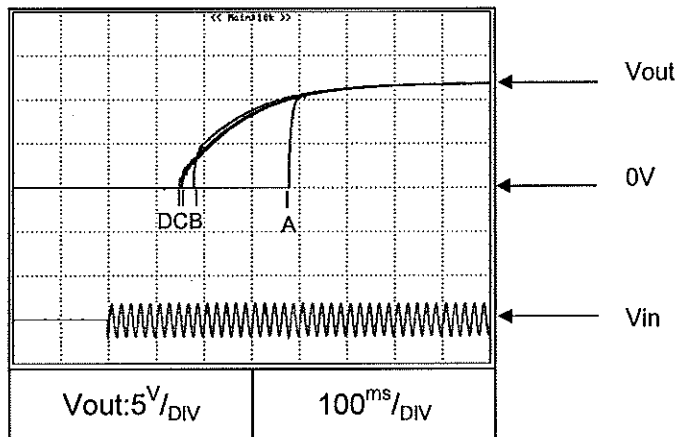
48V



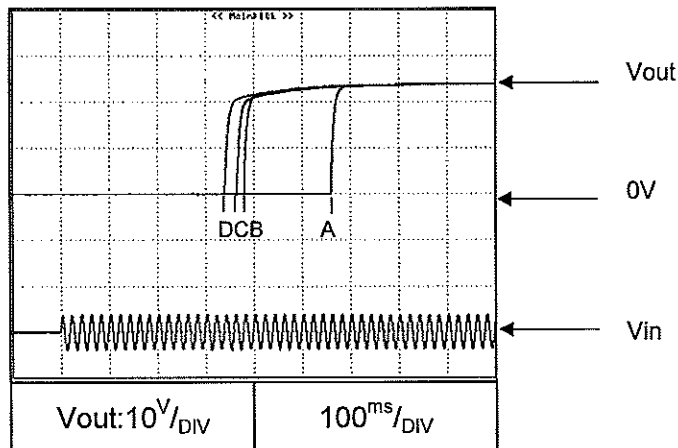
2.5. Output rise characteristics

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

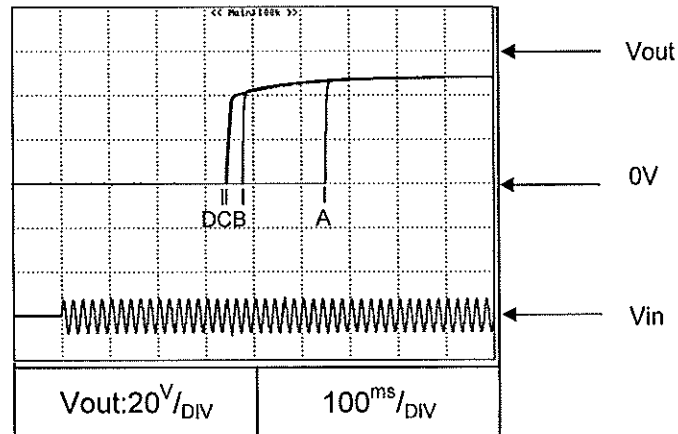
12V



24V



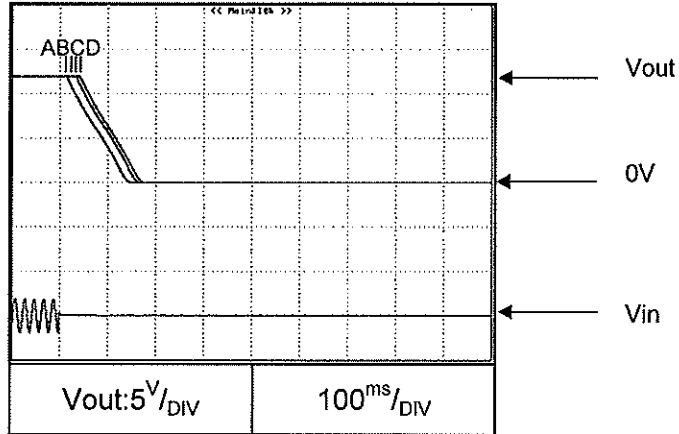
48V



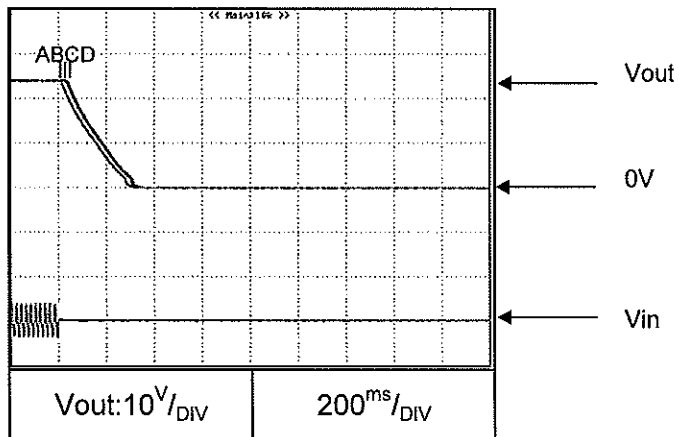
2.6. Output fall characteristics

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

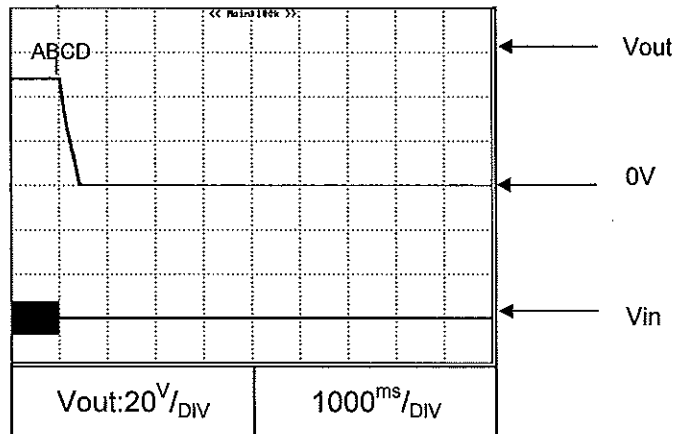
12V



24V



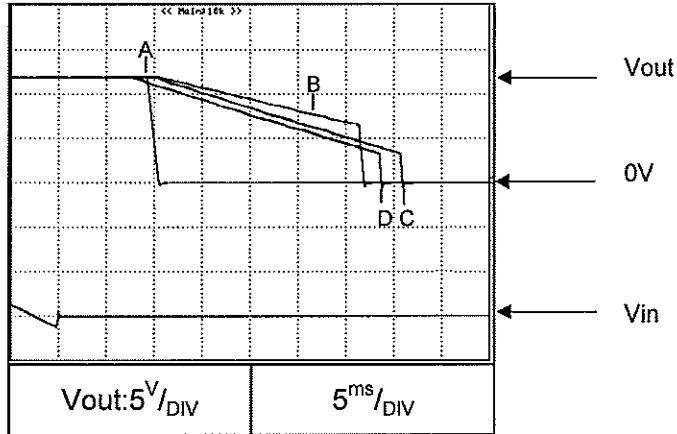
48V



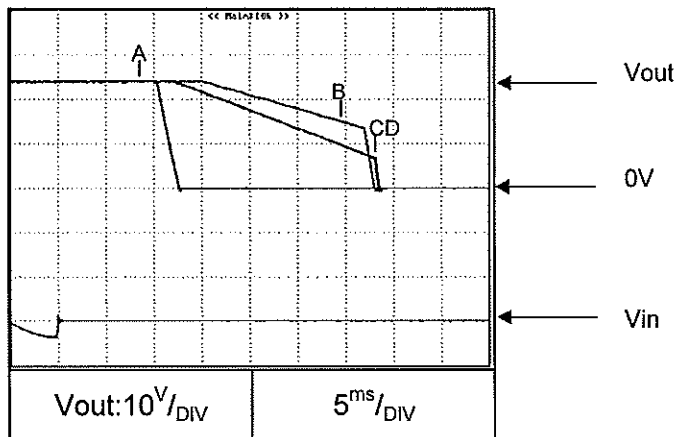
2.6. Output fall characteristics

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

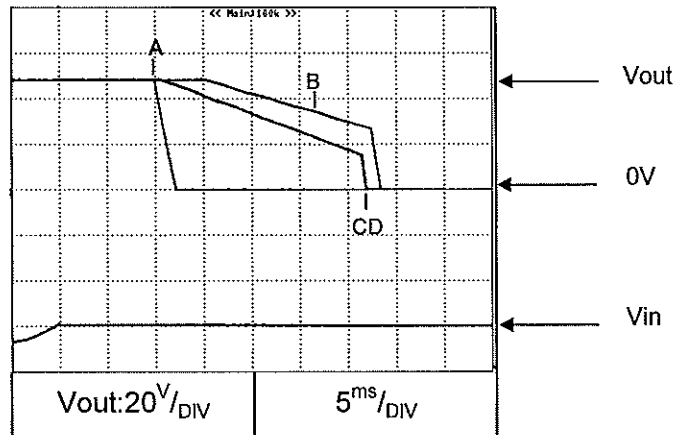
12V



24V



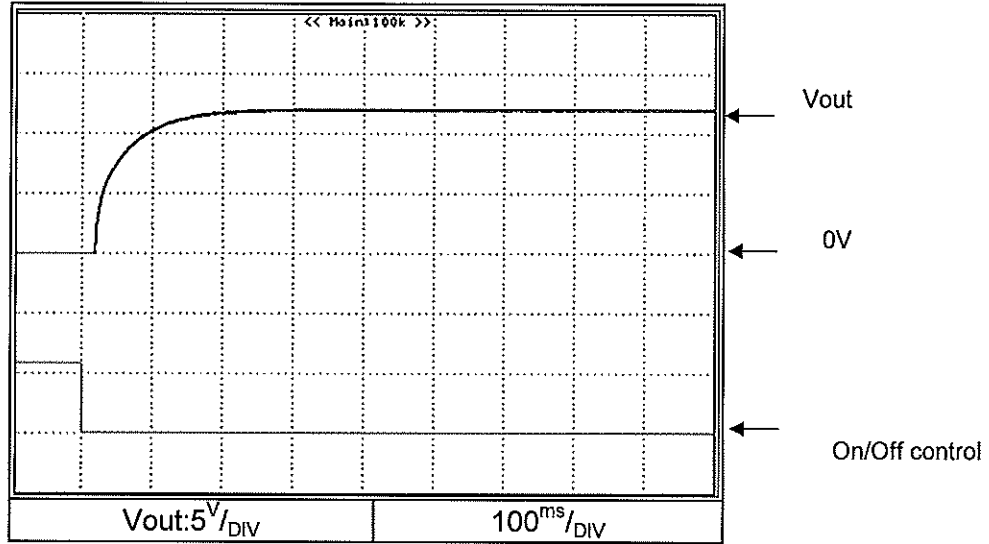
48V



2.7. Output rise characteristics with On/Off control

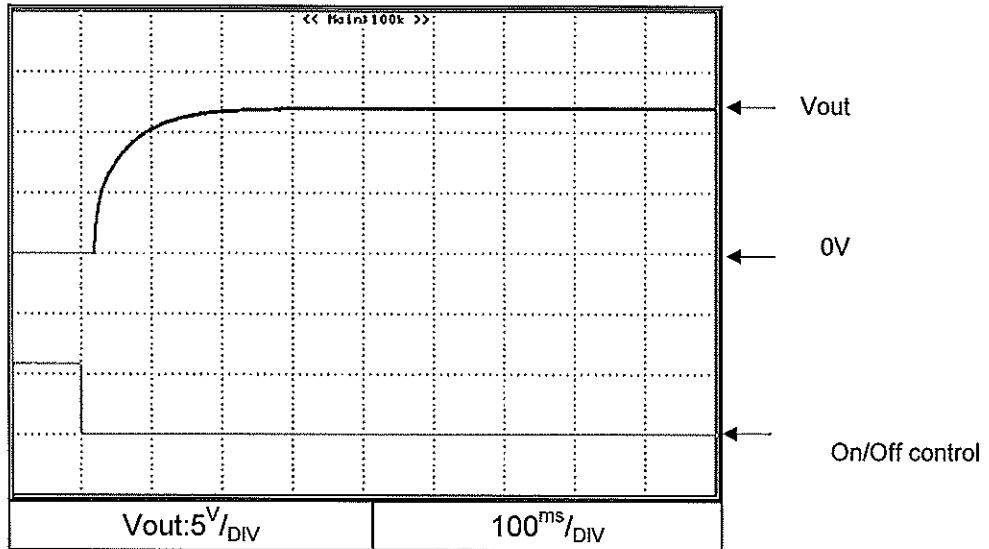
CONDITIONS: Vin: 115 VAC
Iout: 100%
Ta: 25°C

12V



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

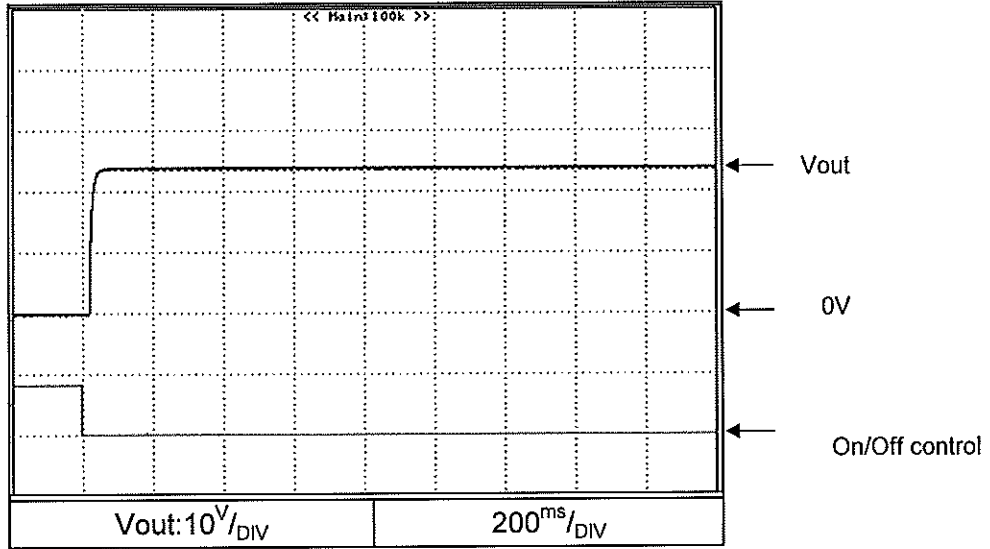
12V



2.7. Output rise characteristics with On/Off control

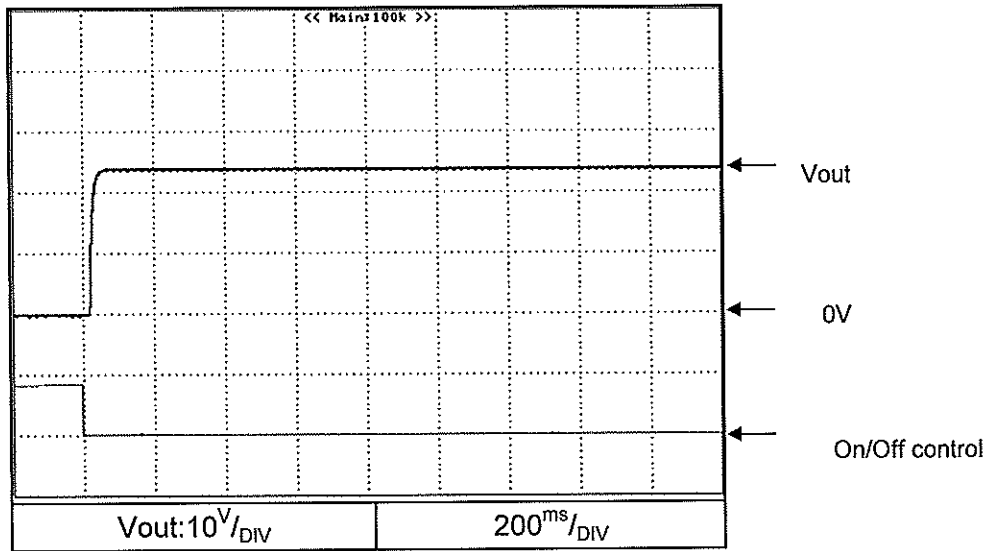
CONDITIONS: Vin: 115 VAC
Iout: 100%
Ta: 25°C

24V



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

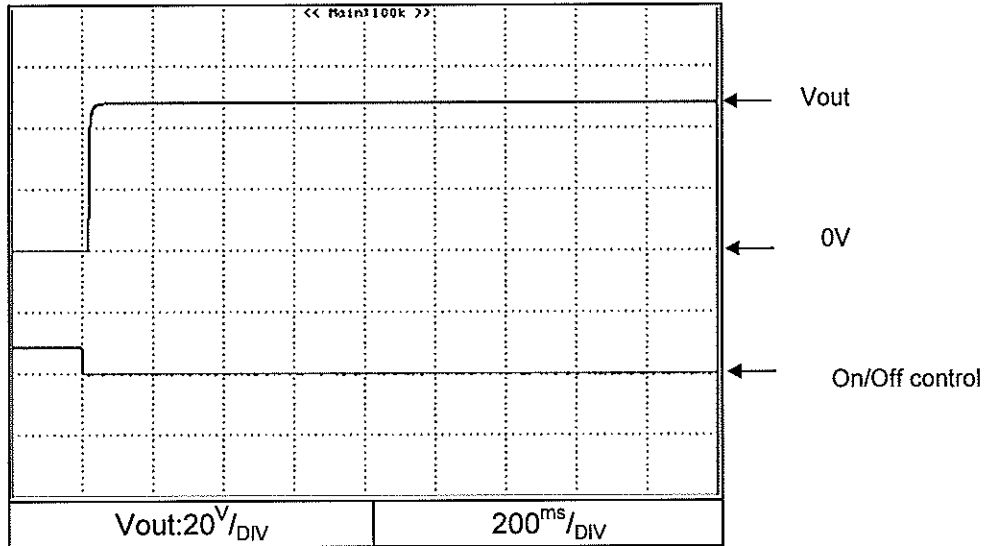
24V



2.7. Output rise characteristics with On/Off control

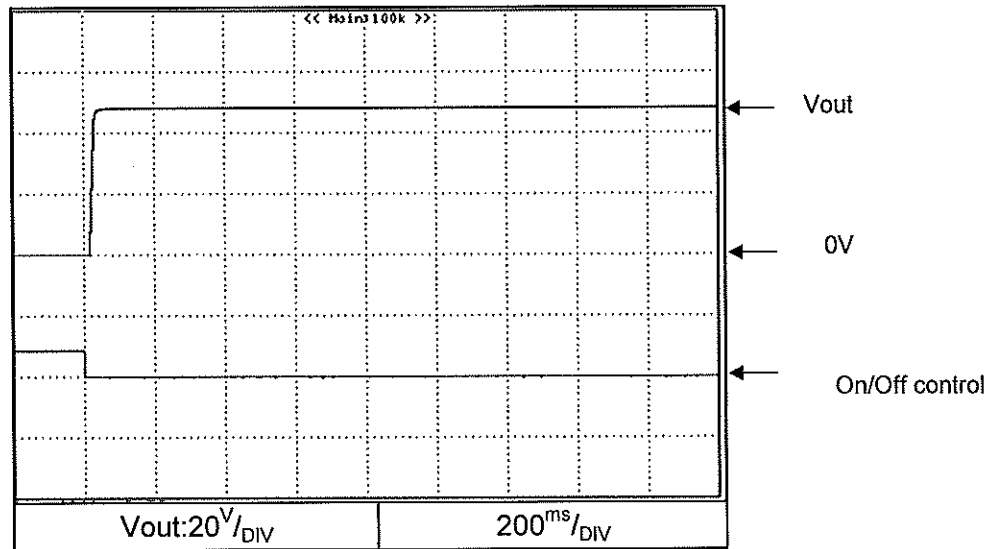
CONDITIONS: Vin: 115 VAC
Iout: 100%
Ta: 25°C

48V



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

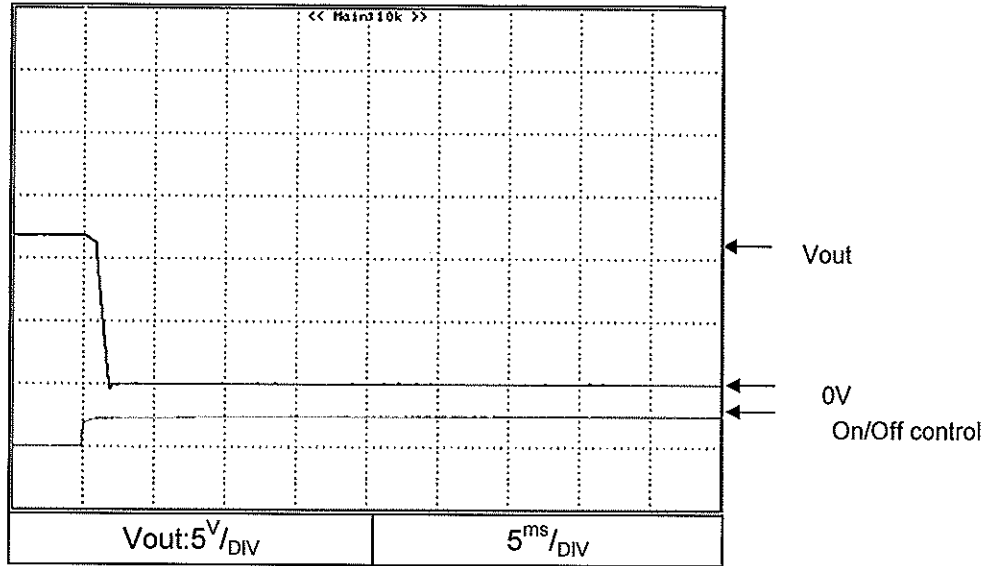
48V



2.8. Output fall characteristics with On/Off control

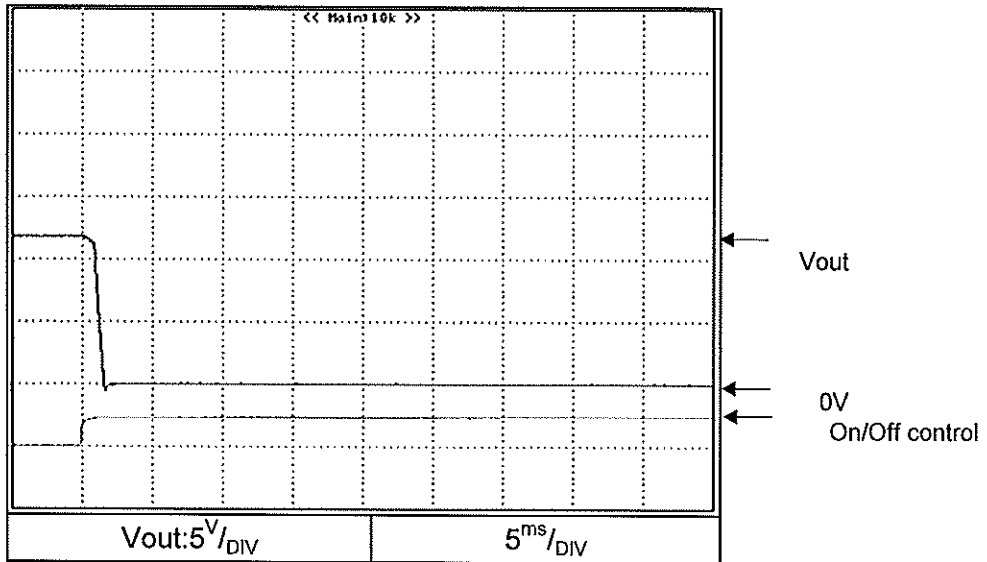
CONDITIONS: Vin: 115 VAC
Iout: 100%
Ta: 25°C

12V



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

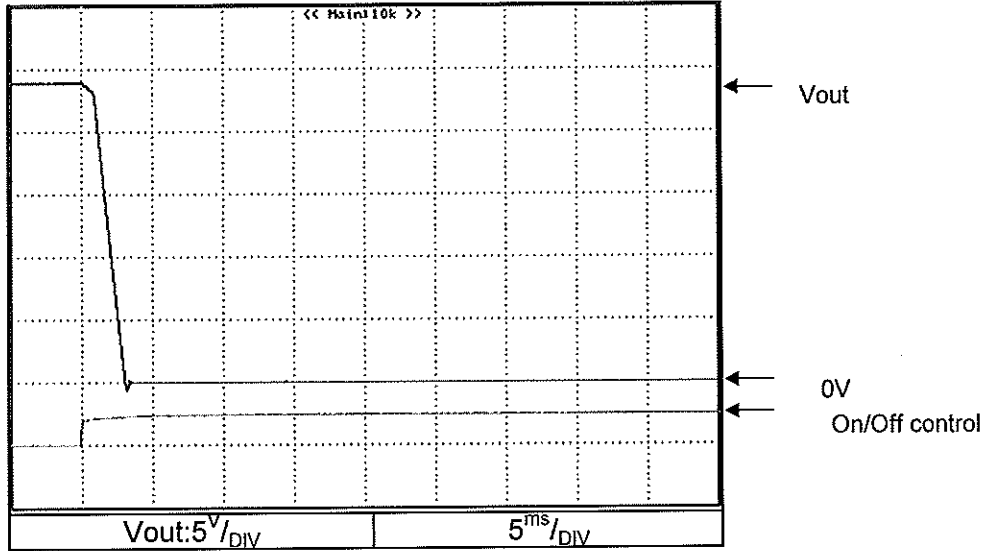
12V



2.8. Output fall characteristics with On/Off control

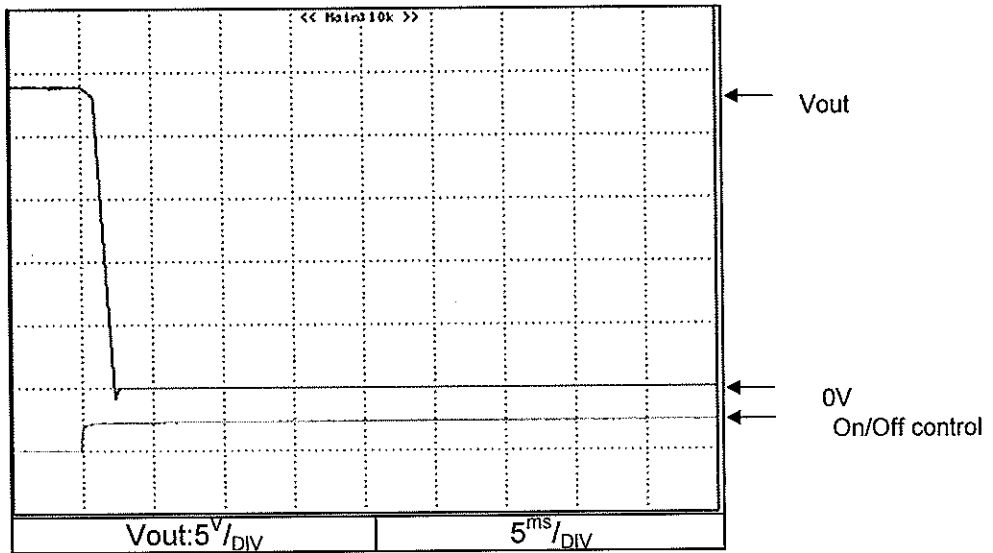
CONDITIONS: Vin: 115 VAC
Iout: 100%
Ta: 25°C

24V



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

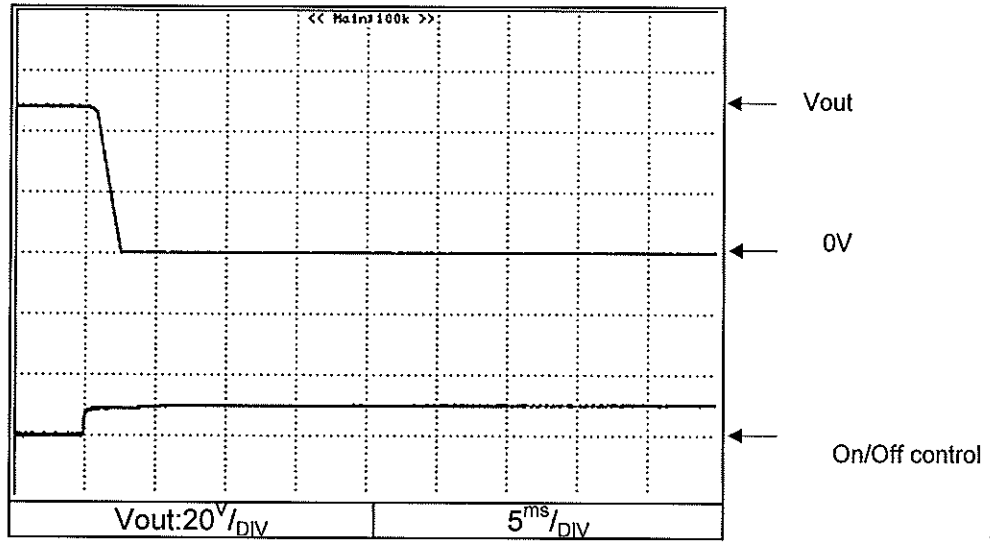
24V



2.8. Output fall characteristics with On/Off control

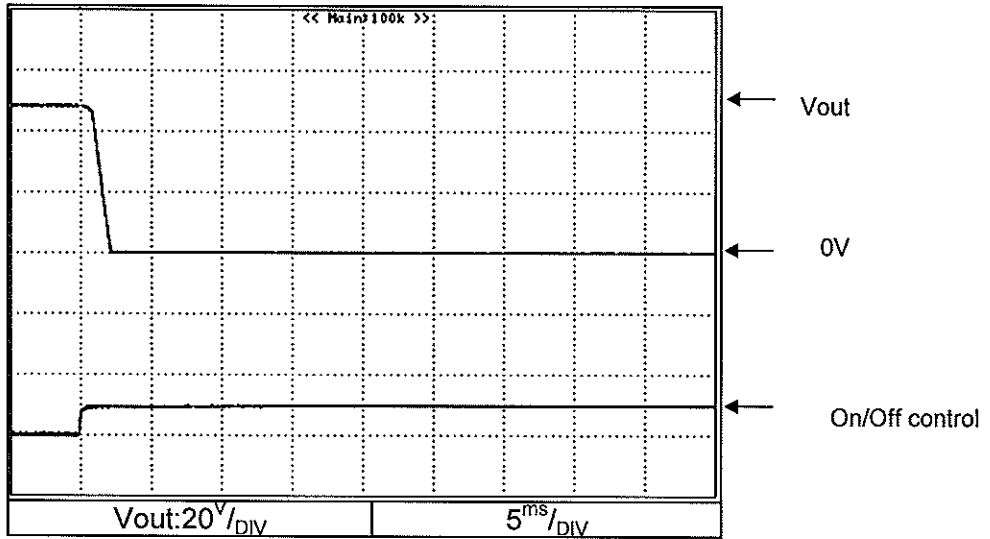
CONDITIONS: Vin: 115 VAC
Iout: 100%
Ta: 25°C

48V



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

48V

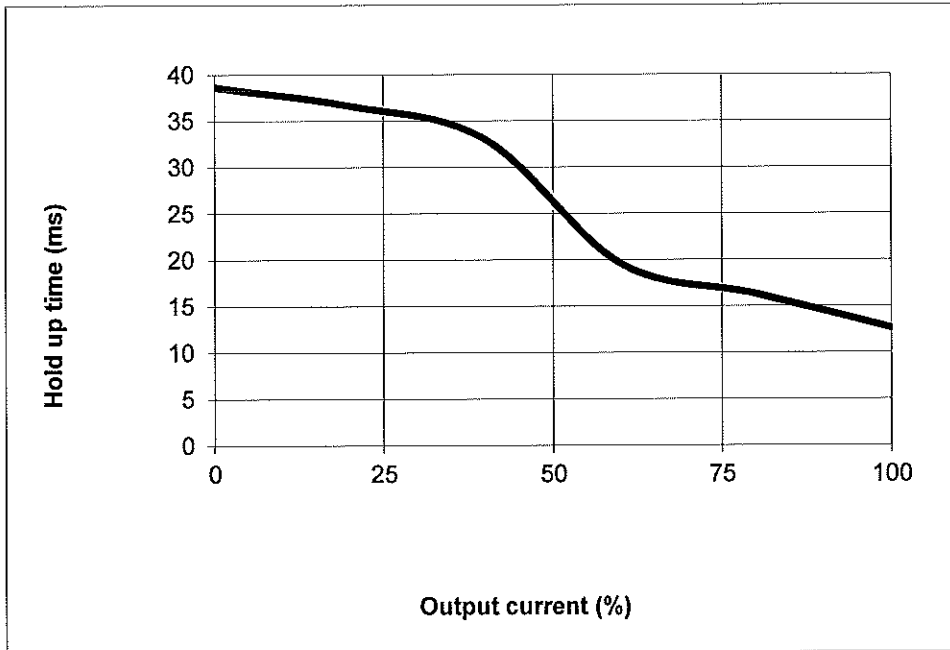


2.9. Hold up time characteristics

CONDITIONS: Vout: 100%
Ta: 25°C

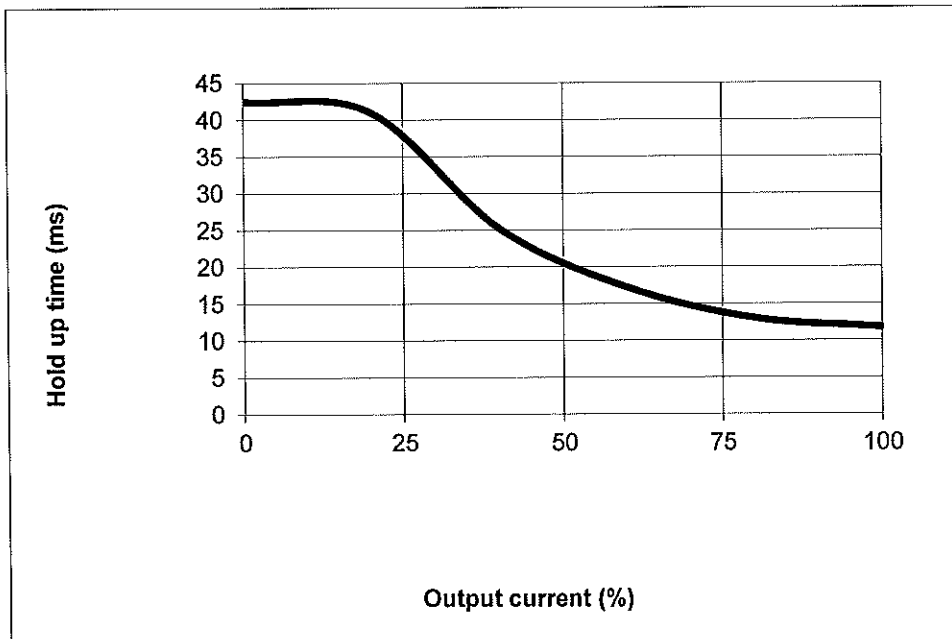
Vin: 115 VAC

12V



Vin: 230 VAC

12V

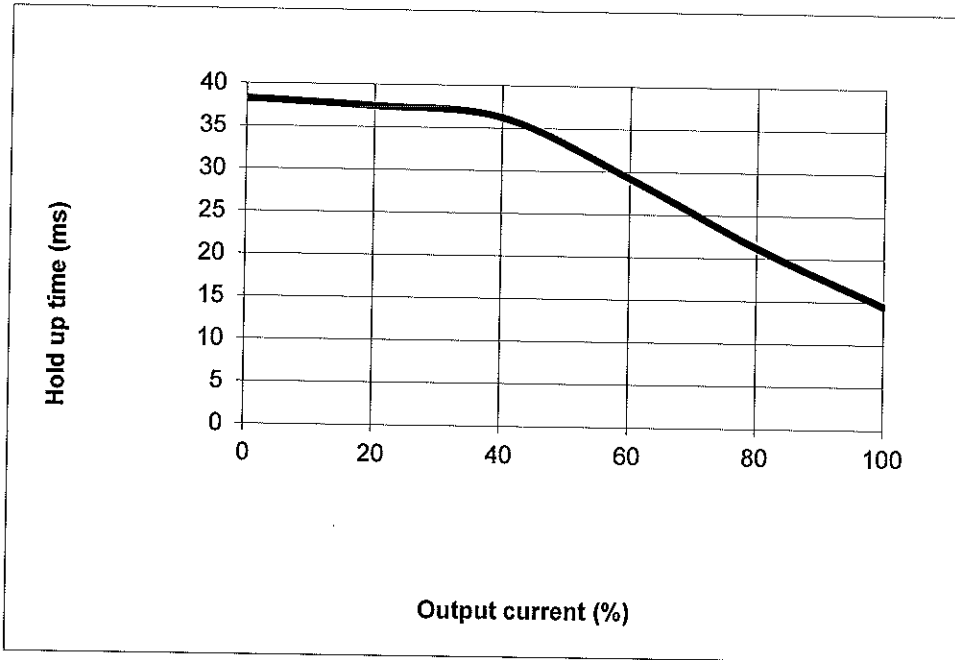


2.9. Hold up time characteristics

CONDITIONS: Vout: 100%
Ta: 25°C

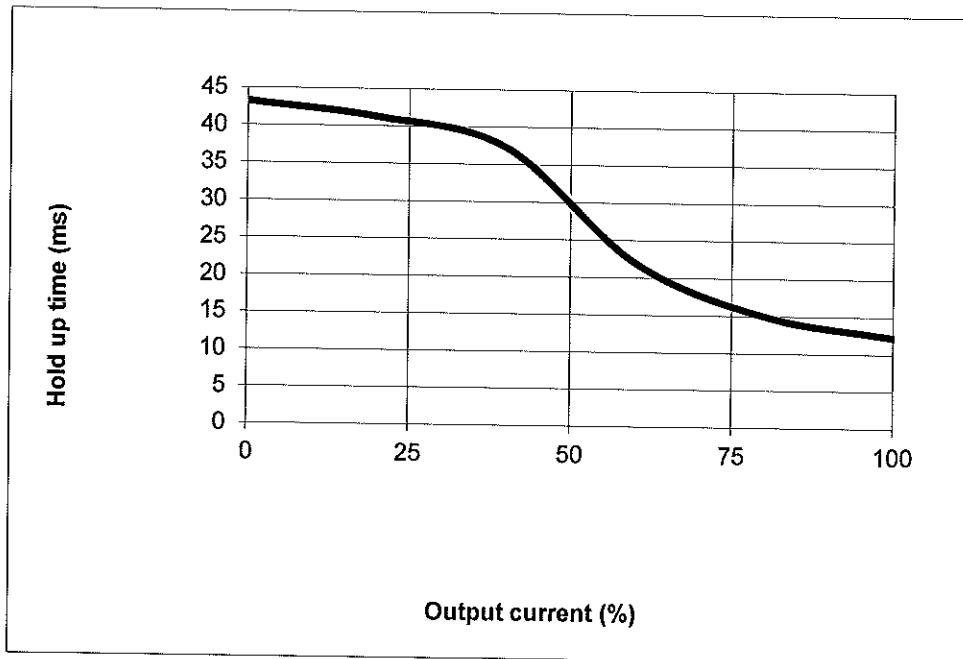
Vin: 115 VAC

24V



Vin: 230 VAC

24V

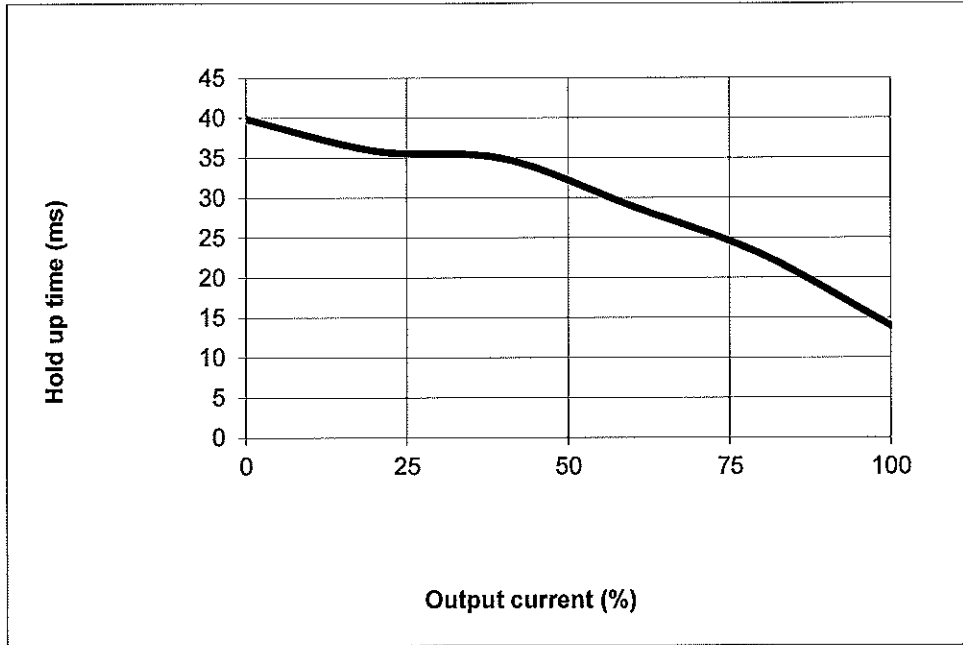


2.9. Hold up time characteristics

CONDITIONS: Vout: 100%
Ta: 25°C

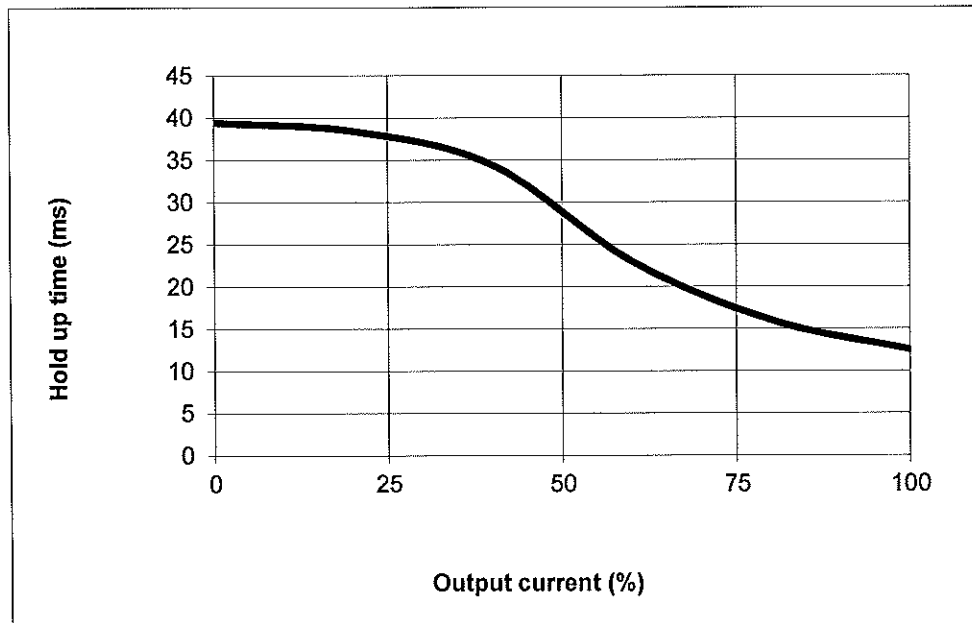
Vin: 115 VAC

48V



Vin: 230 VAC

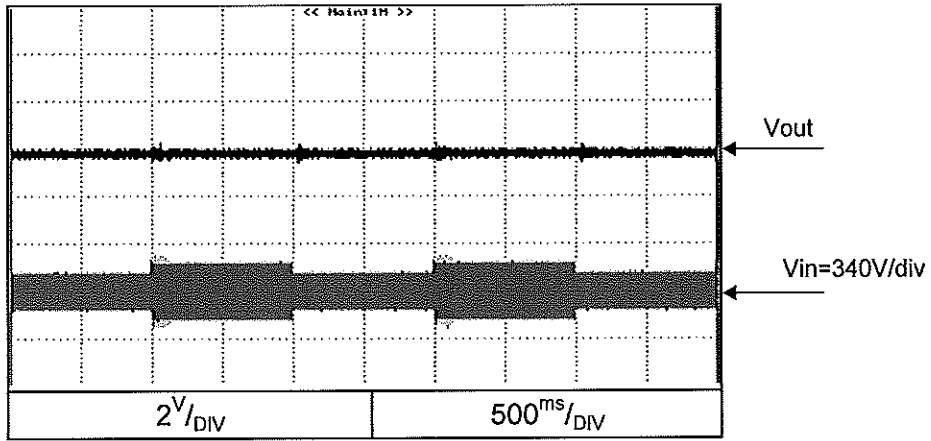
48V



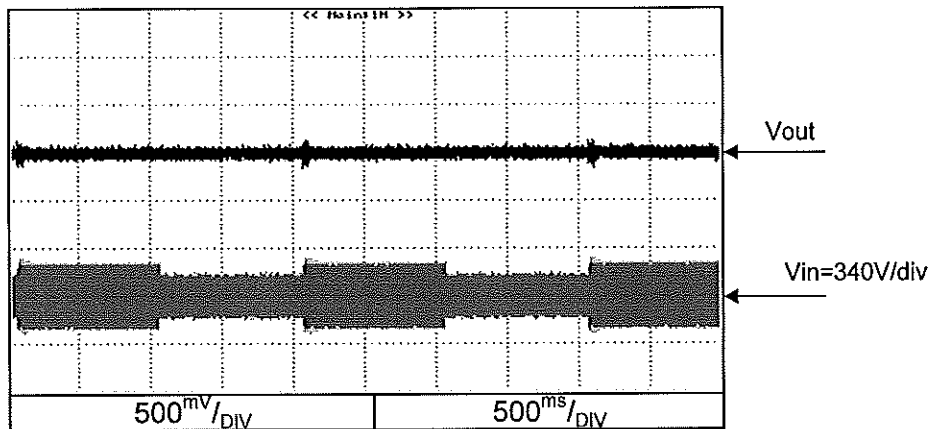
2.10. Dynamic line response characteristics

CONDITIONS: Vin: 85V↔132V
Iout: 100%
Ta: 25°C

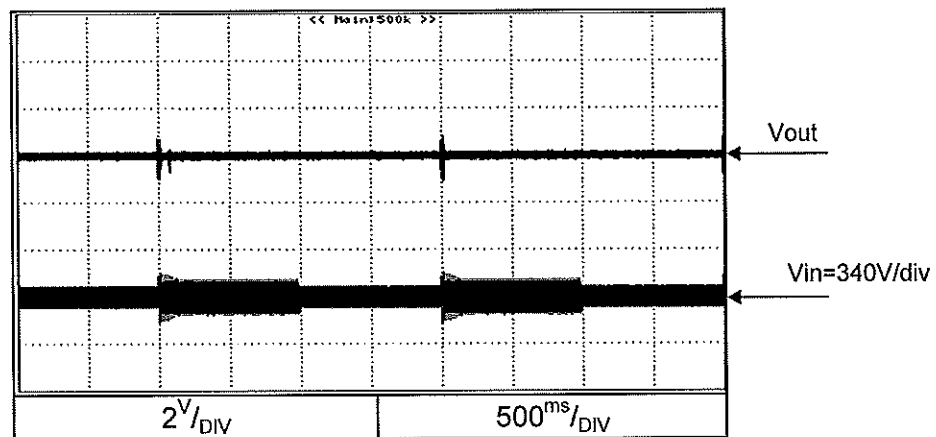
12V



24V



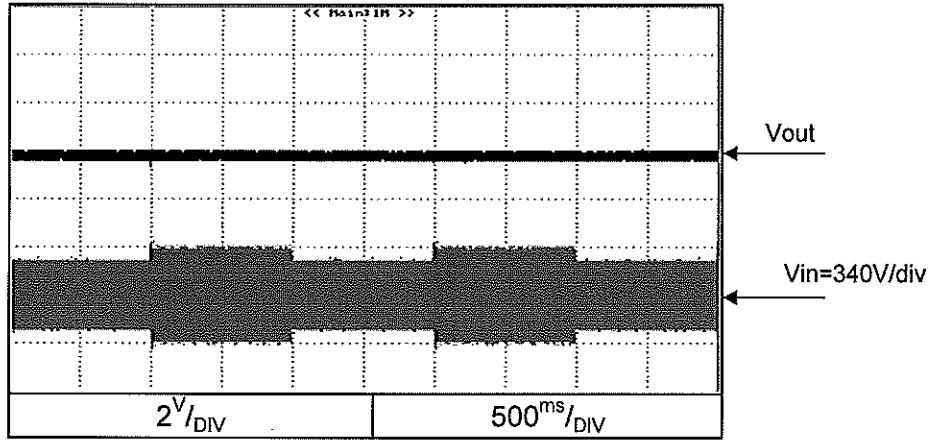
48V



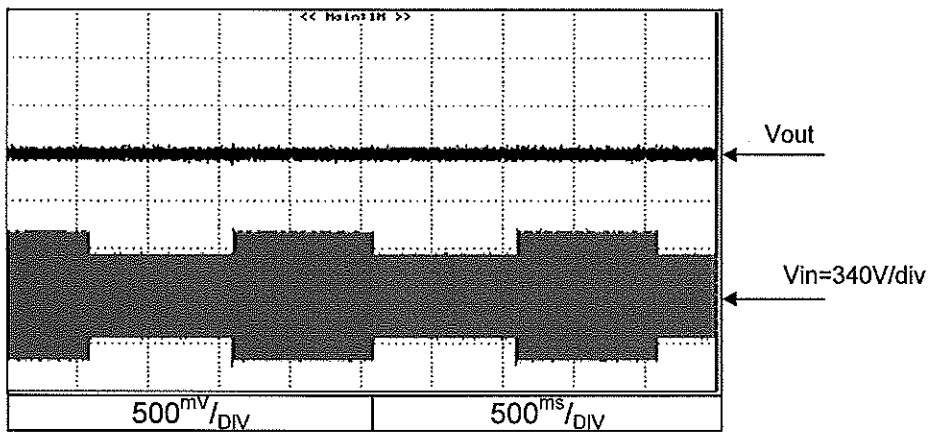
2.10. Dynamic line response characteristics

CONDITIONS: Vin: 170V↔265V
Iout: 100%
Ta: 25°C

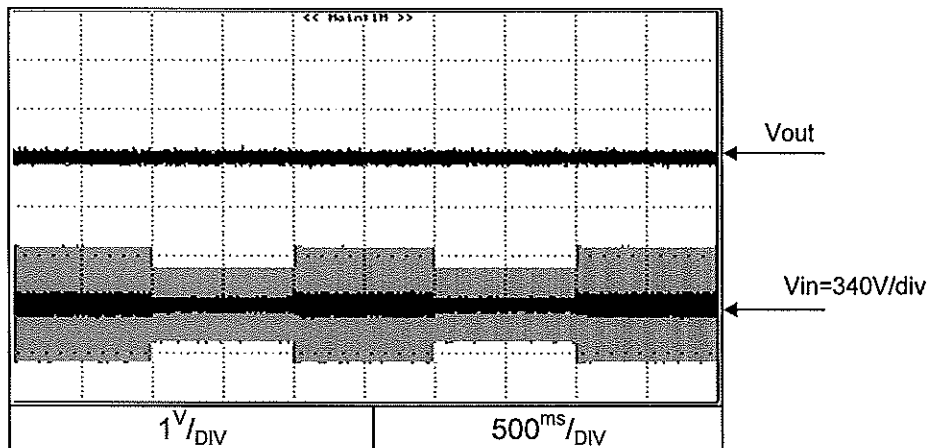
12V



24V



48V

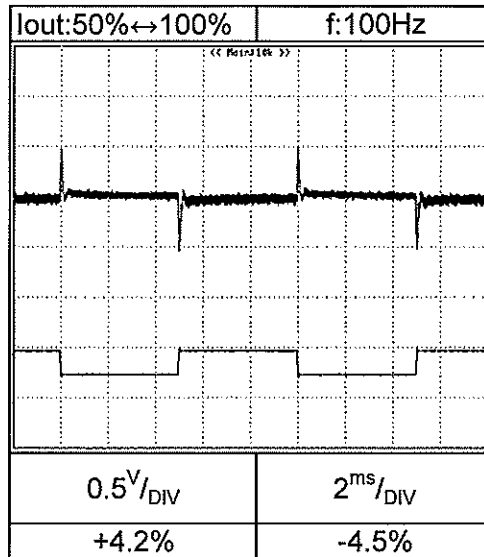
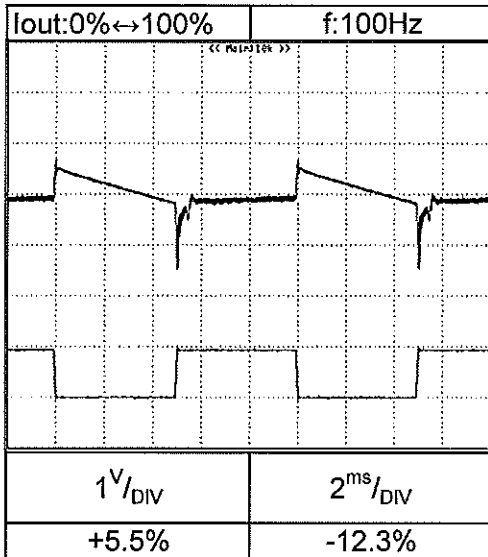


2.11. Dynamic load response characteristics

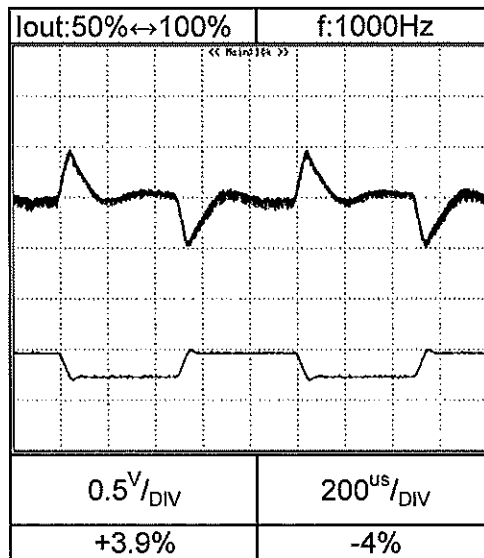
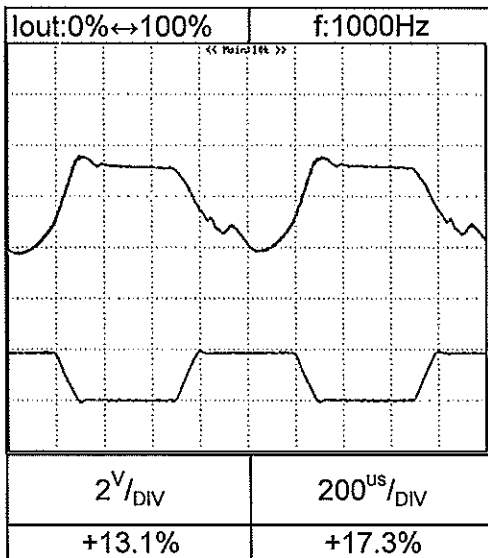
CONDITIONS: Vin: 230VAC
 Vout: 100%
 Ta: 25°C
 Load current: tr=tf=100uS

12V

f=100Hz



f=1kHz

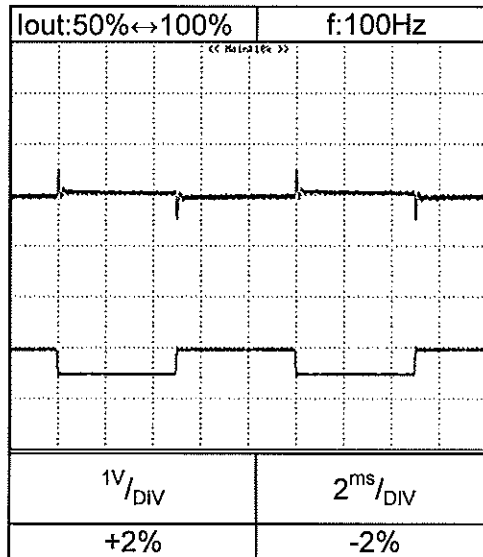
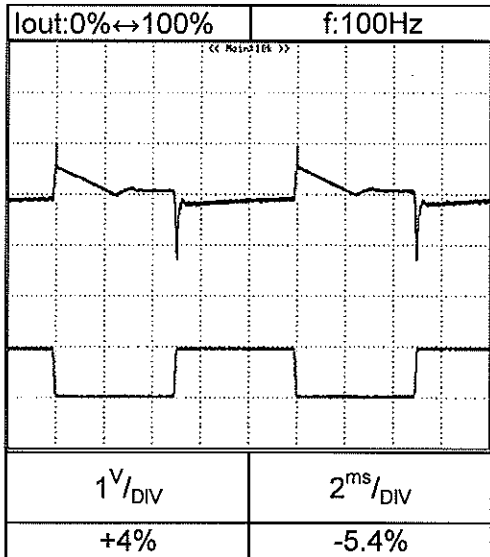


2.11. Dynamic load response characteristics

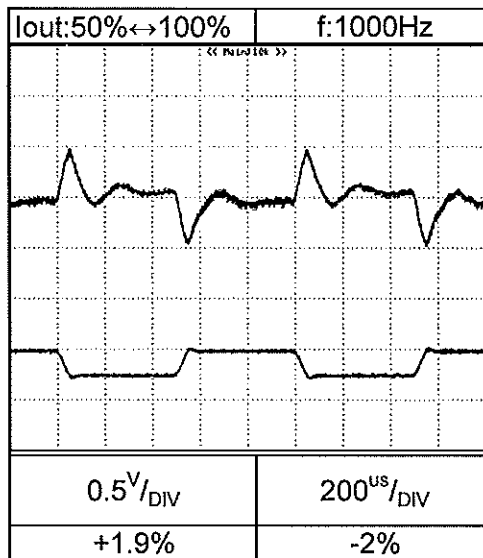
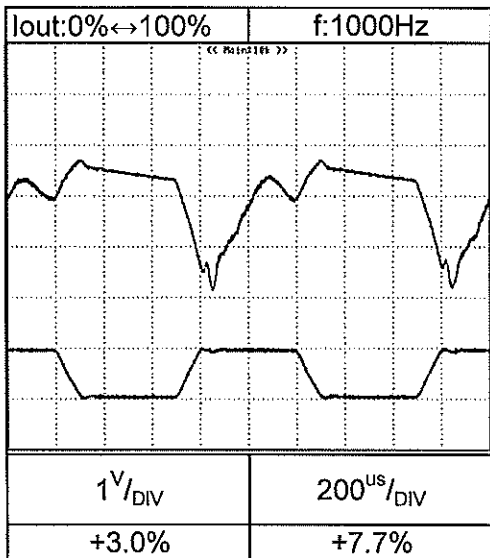
CONDITIONS: Vin: 230VAC
 Vout: 100%
 Ta: 25°C
 Load current: tr=tf=100uS

24V

f=100Hz



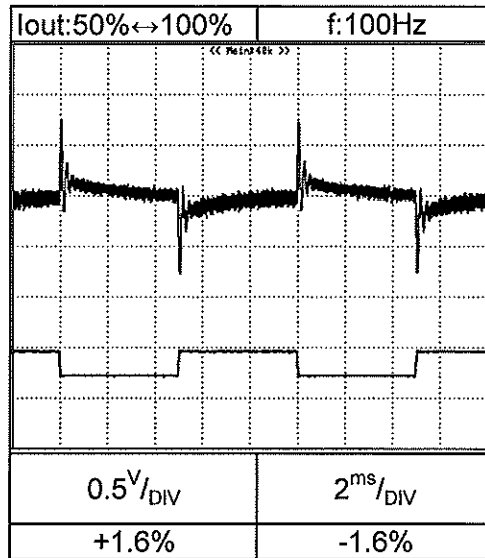
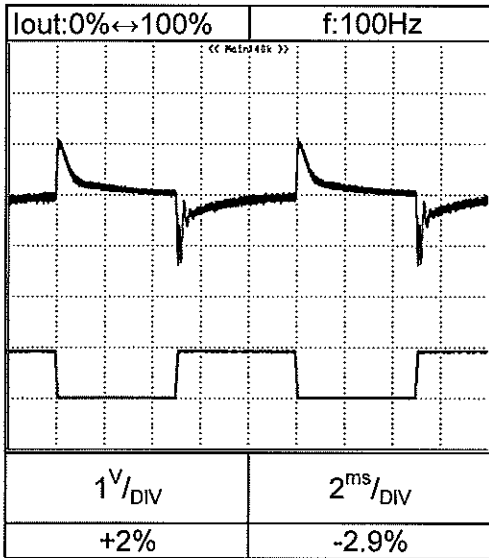
f=1kHz



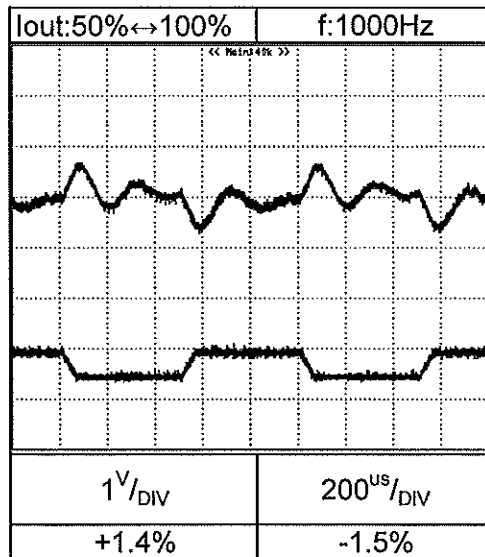
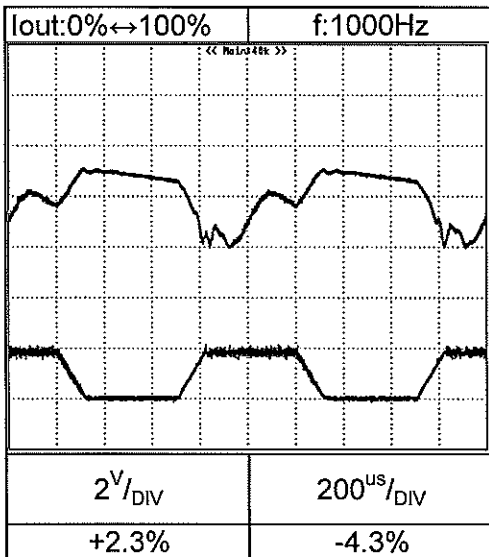
2.11. Dynamic load response characteristics

CONDITIONS: Vin: 230VAC
 Vout: 100%
 Ta: 25°C
 Load current: tr=tf=100uS

48V
 f=100Hz



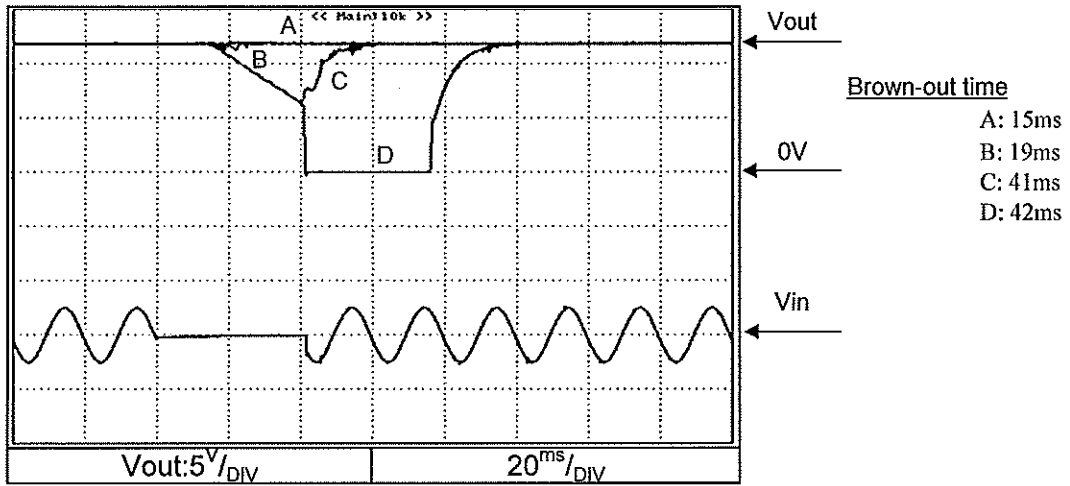
f=1kHz



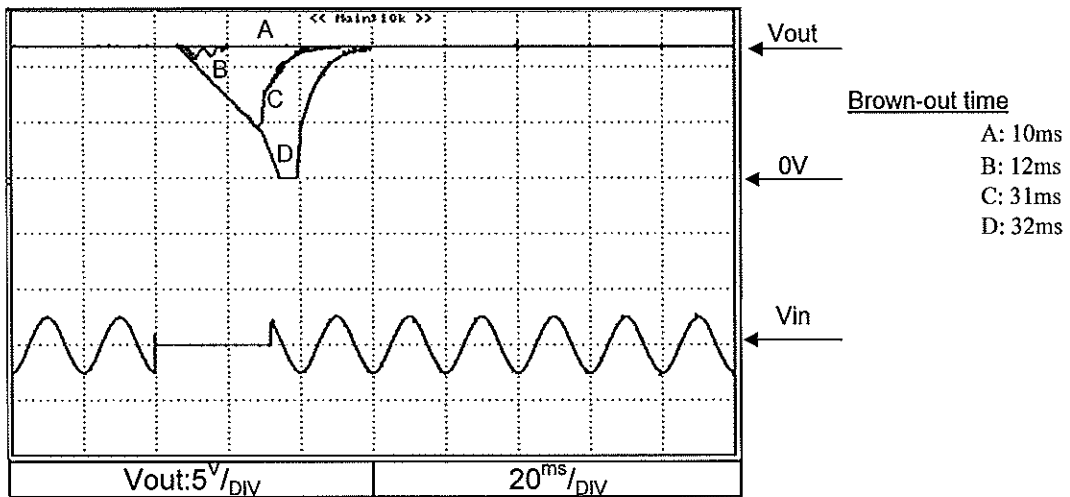
2.12. Response to brown out characteristics

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

12V



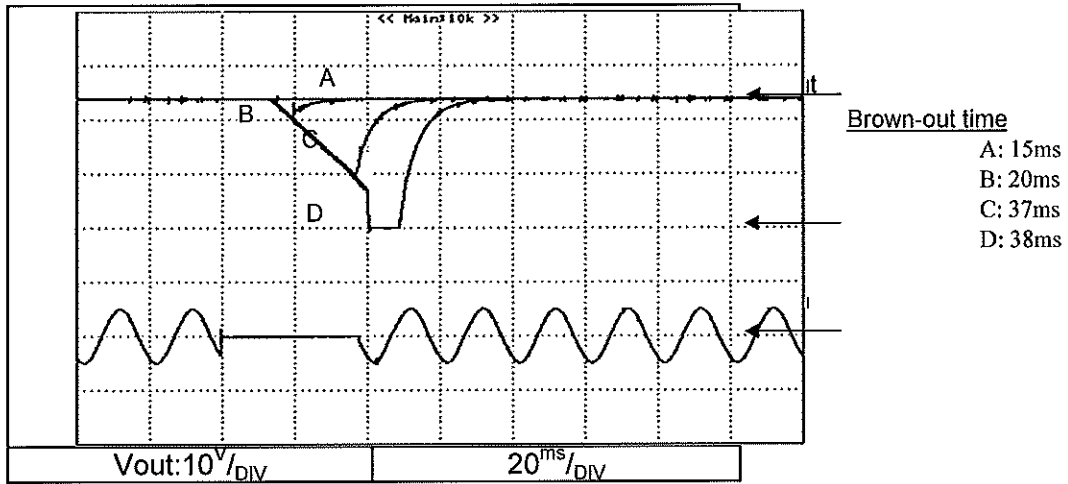
CONDITIONS: Vin: 230 VAC
Ta: 25°C



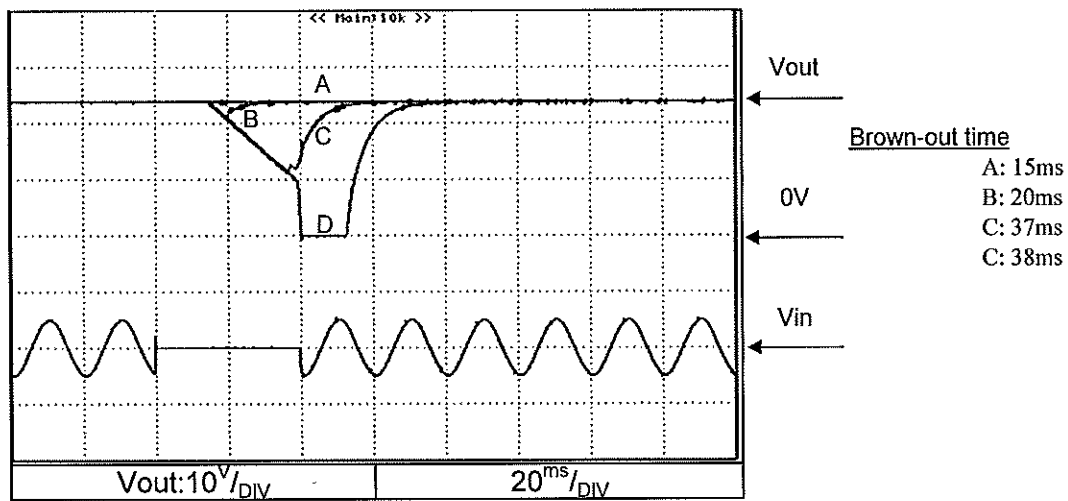
2.12. Response to brown out characteristics

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

24V



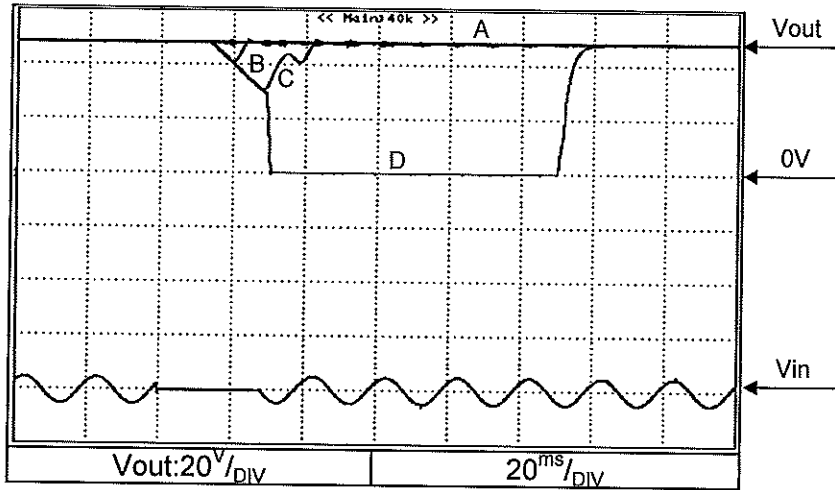
CONDITIONS: Vin: 230 VAC
Ta: 25°C



2.12. Response to brown out characteristics

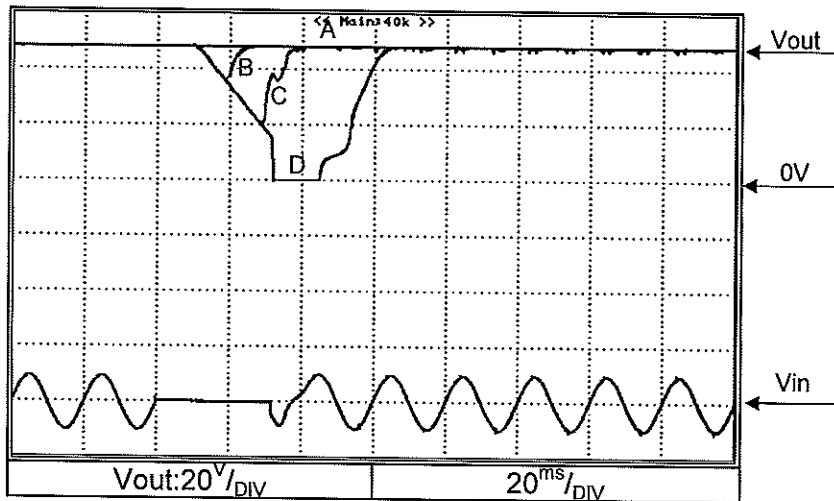
CONDITIONS: Vin: 115 VAC
Iout: 100%
Ta: 25°C

48V



Brown-out time
A: 13ms
B: 20ms
C: 28ms
D: 29ms

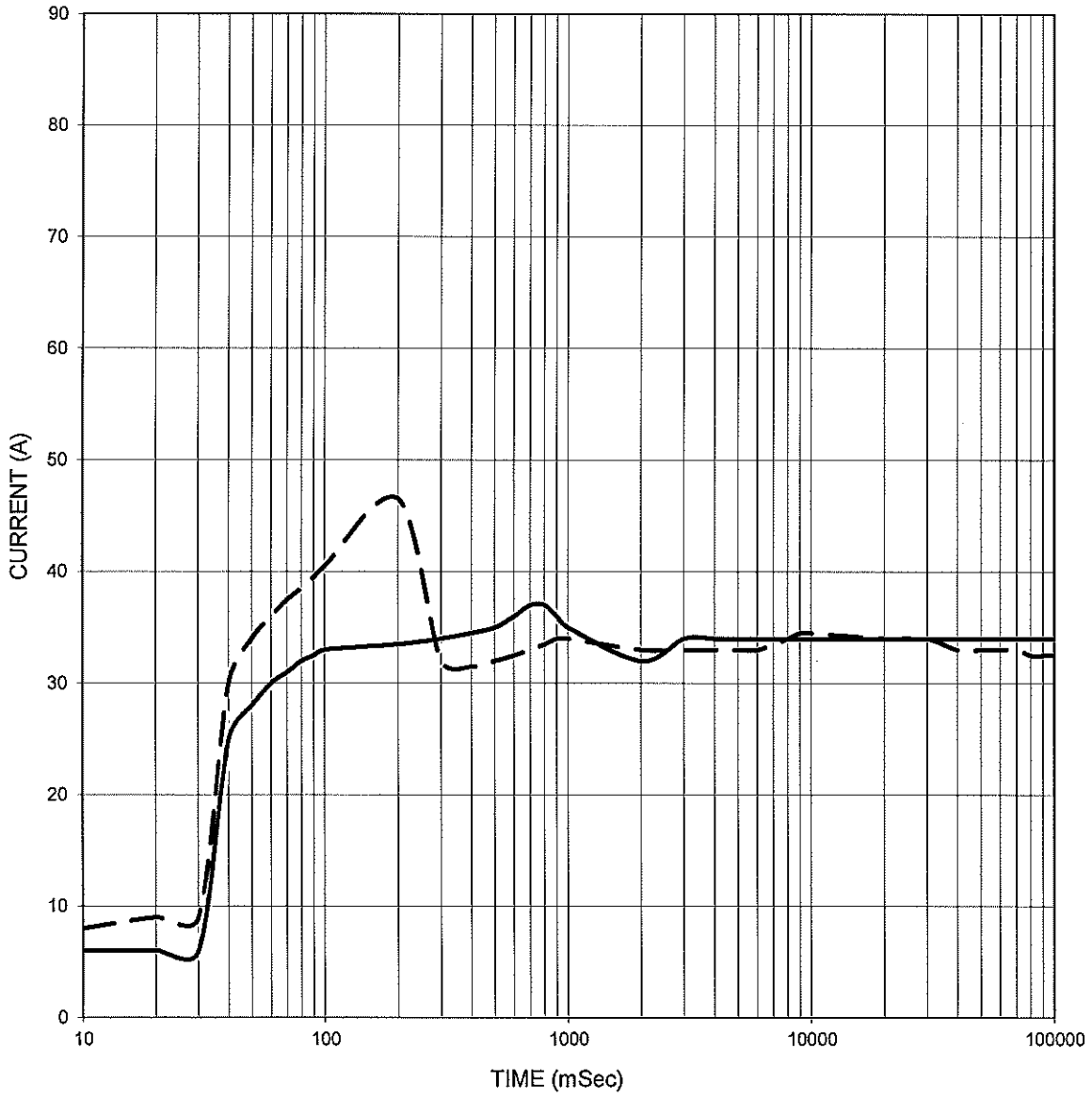
CONDITIONS: Vin: 230 VAC
Ta: 25°C



Brown-out time
A: 10ms
B: 20ms
C: 30ms
D: 32ms

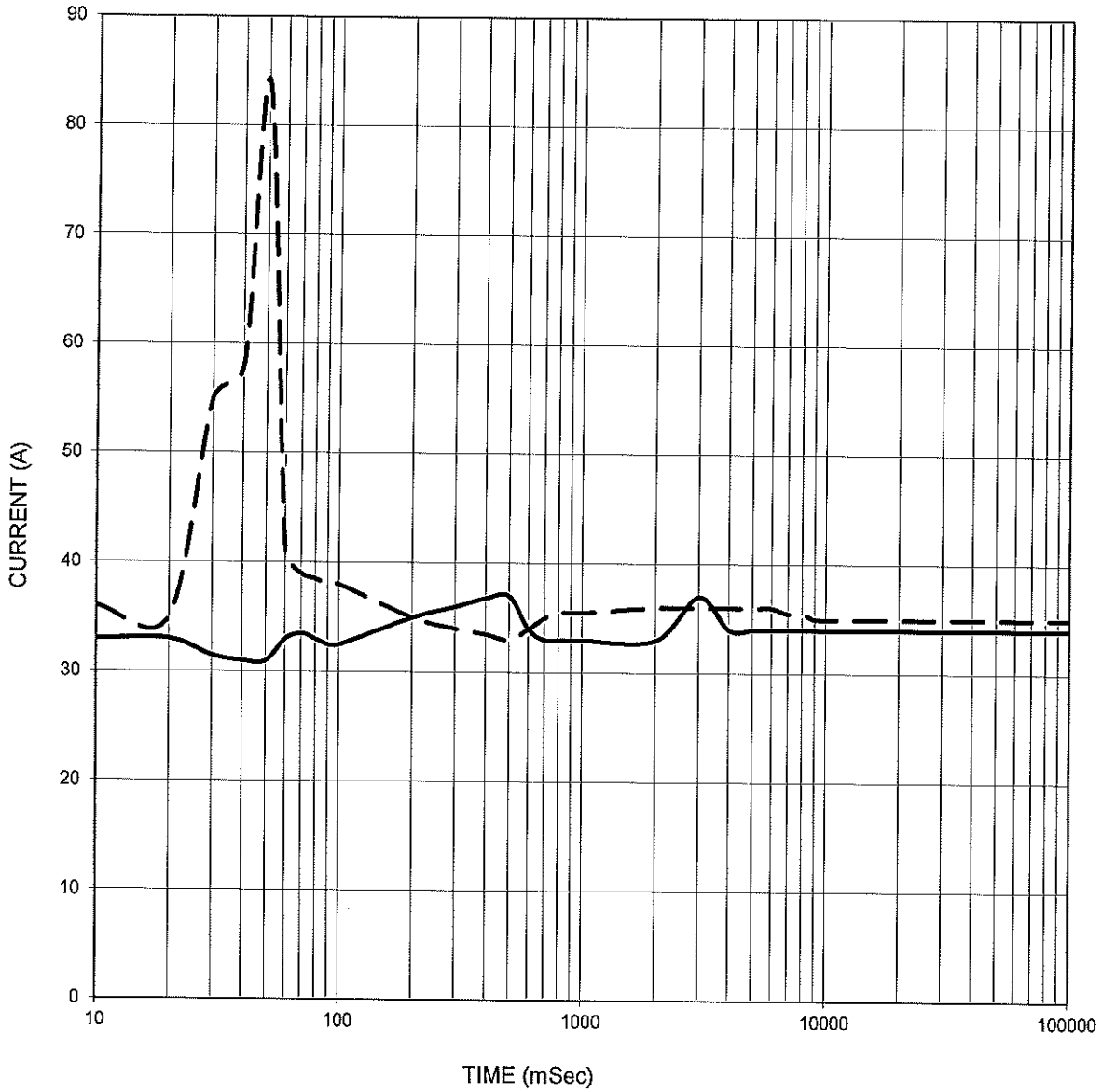
2.13. Inrush current characteristics

CONDITIONS: Vin: 115 VAC ———
 230 VAC - - - - -
Vout: 100%
Iout: 0%
Ta: 25°C



2.13. Inrush current characteristics

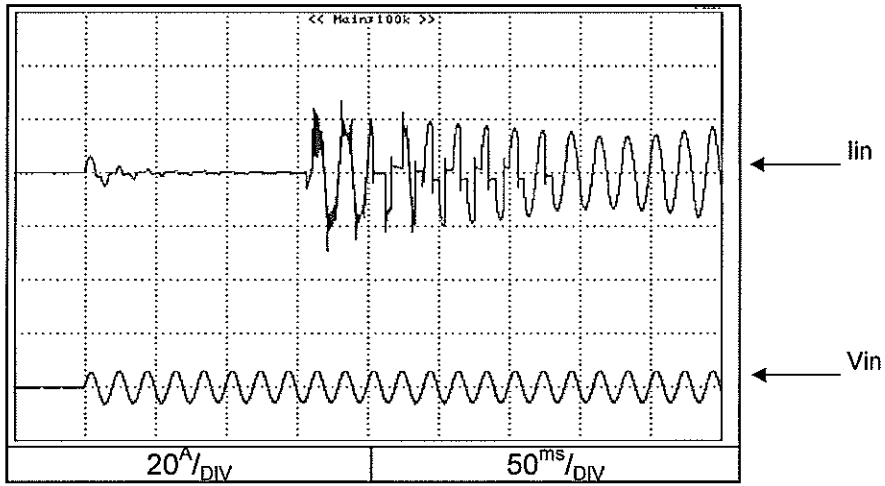
CONDITIONS: Vin: 115 VAC ———
 230 VAC - - - - -
Vout: 100%
Iout: 100%
Ta: 25°C



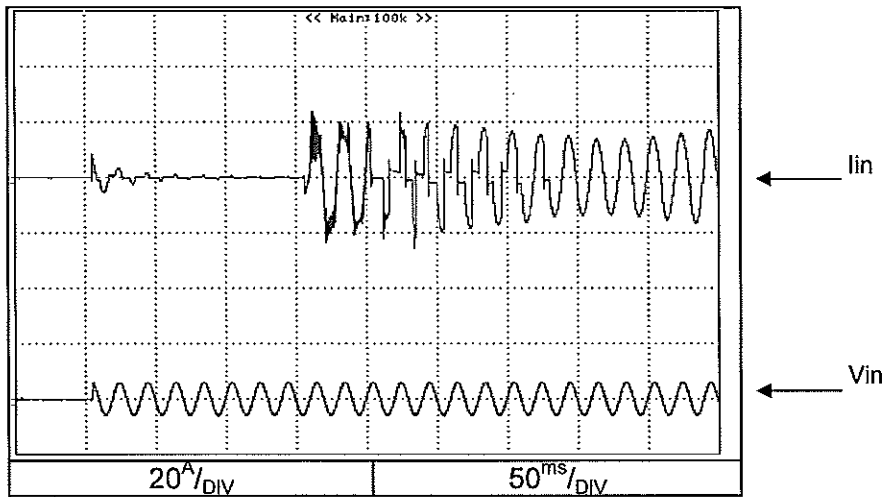
2.14. Inrush current waveform

CONDITIONS: Vin: 115 VAC
Vout: 100%
Iout: 100%
Ta: 25°C

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



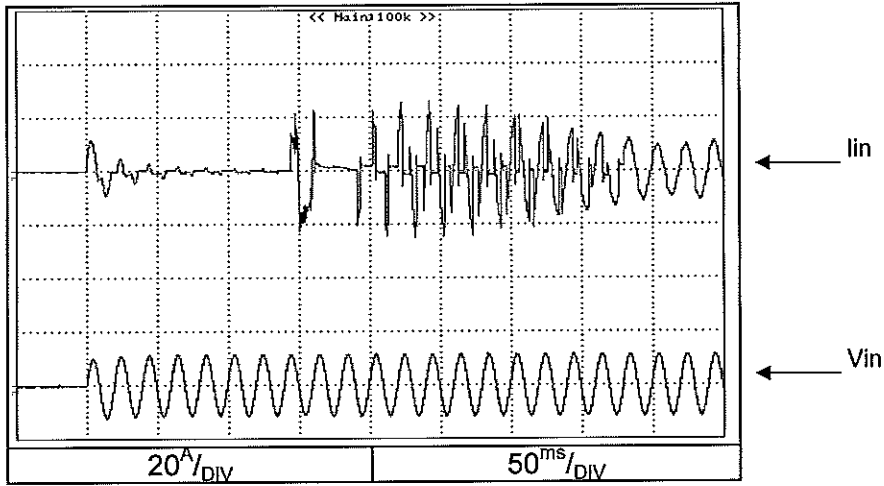
Switch on phase angle of input AC
 $\phi=90^\circ$



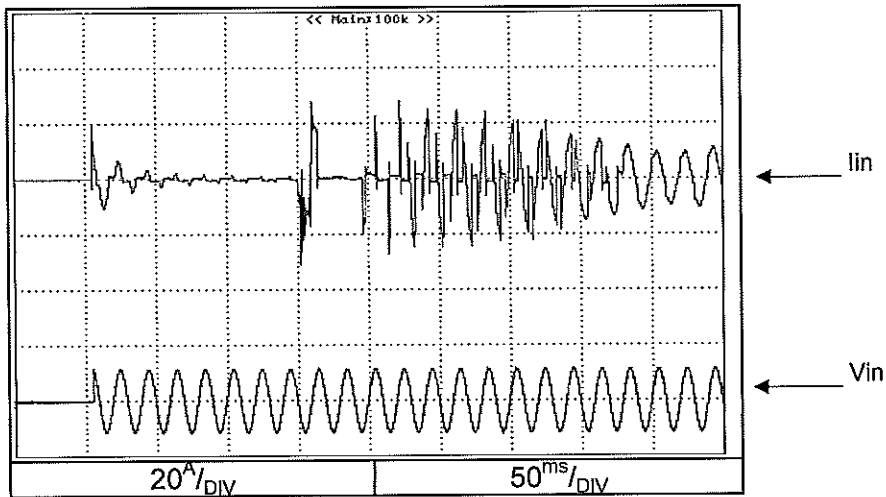
2.14. Inrush current waveform

CONDITIONS: Vin: 230 VAC
Vout: 100%
Iout: 100%
Ta: 25°C

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

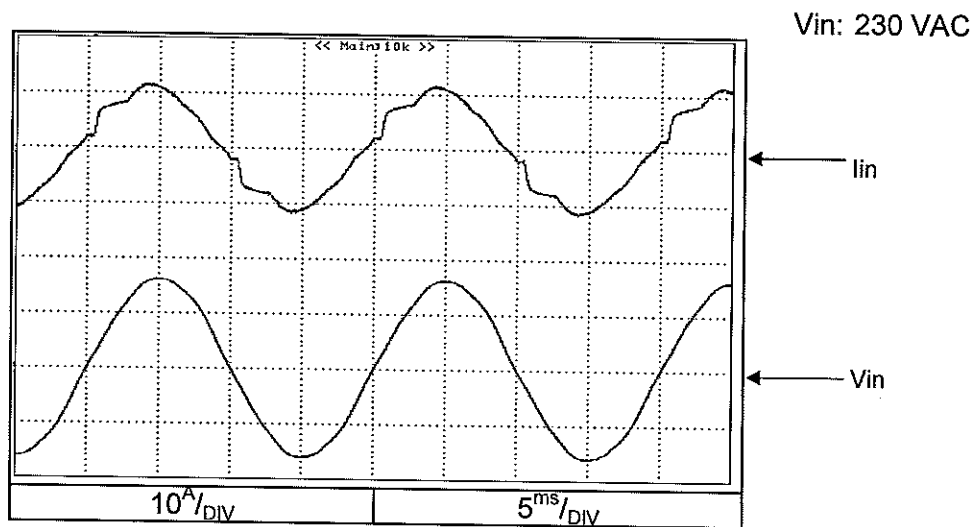
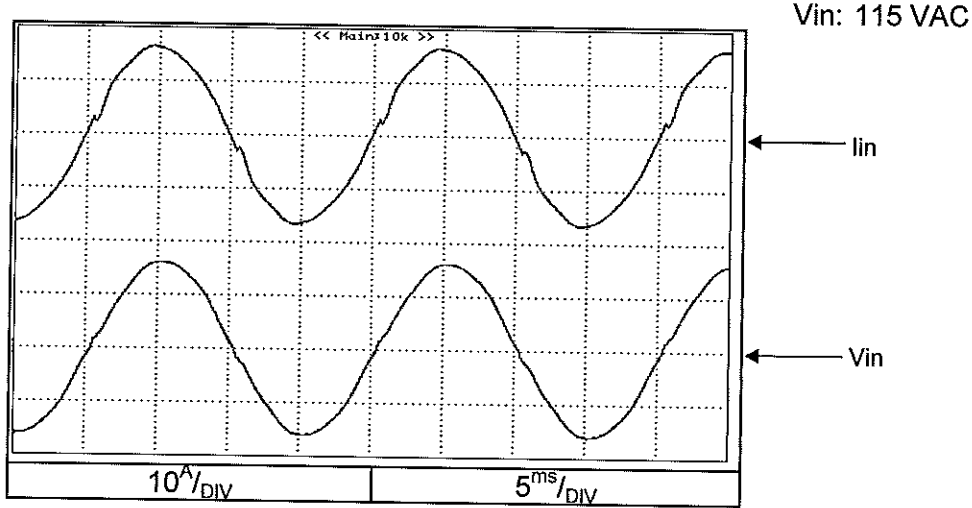


Switch on phase angle of input AC $\phi=90^\circ$



2.15. Input current waveform

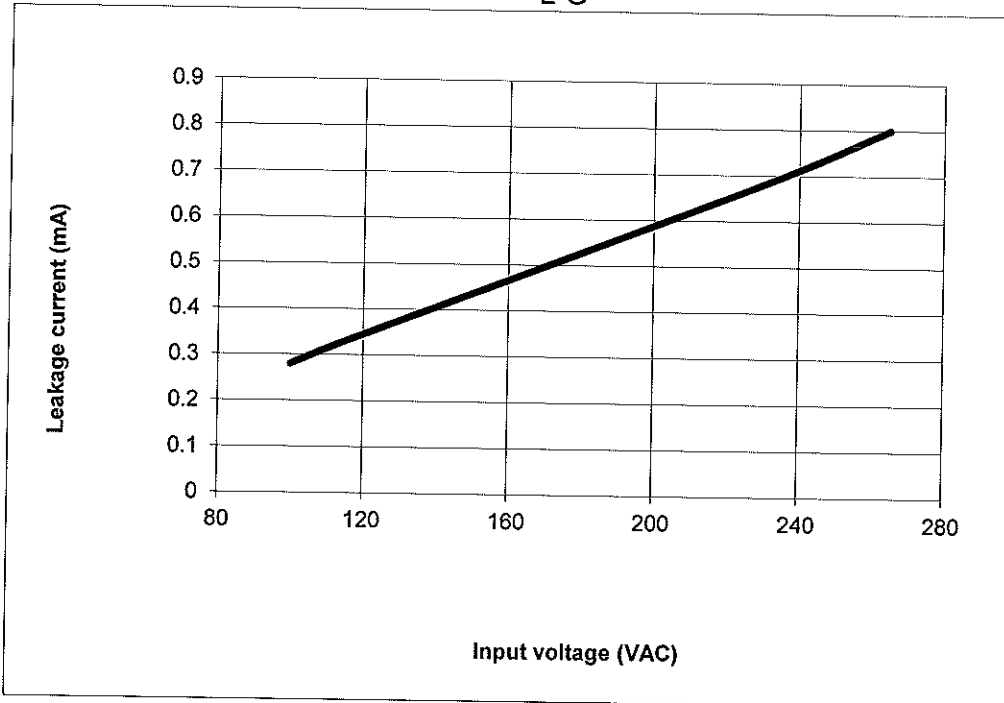
CONDITIONS: Vout: 100%
Iout: 100%
Ta: 25°C



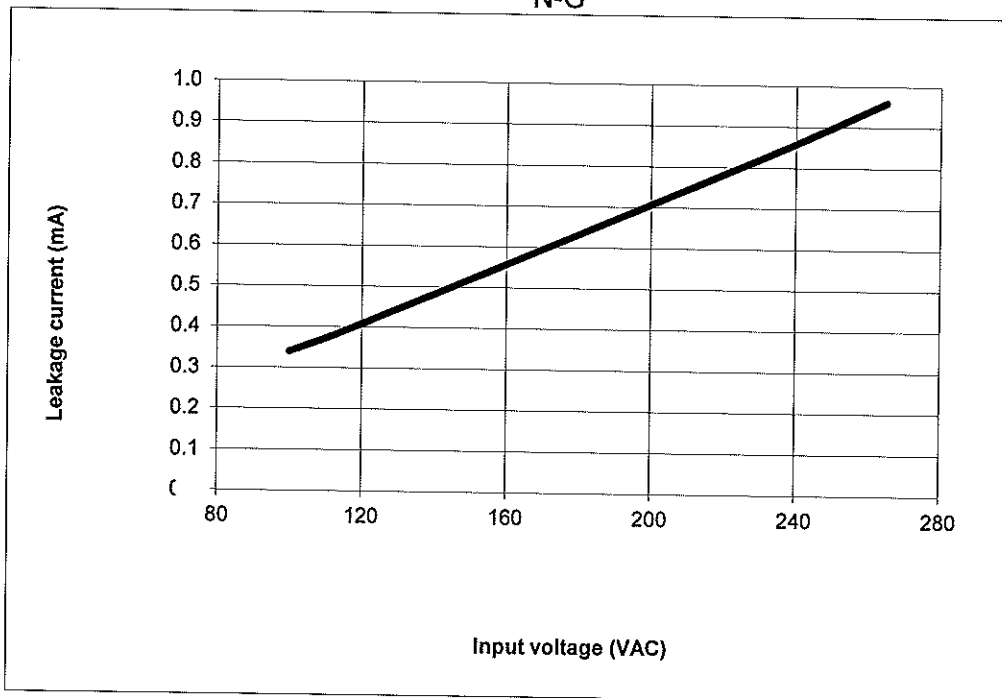
2.16. Leakage current characteristics

CONDITIONS: Vout: 100%
Iout: 100%
Ta: 25°C
f: 50Hz

L-G



N-G

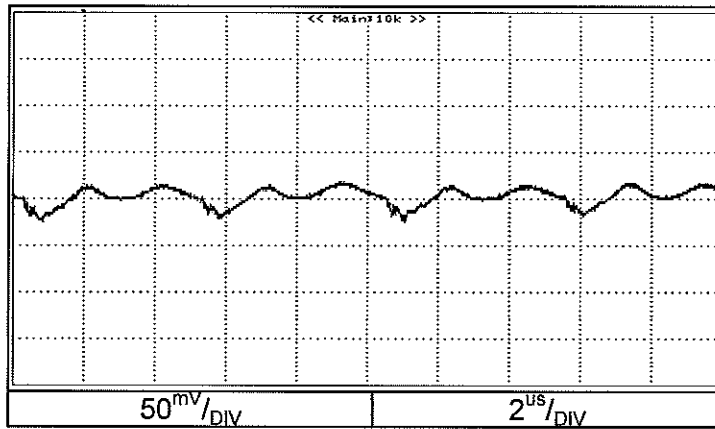


2.17. Output ripple and noise waveform

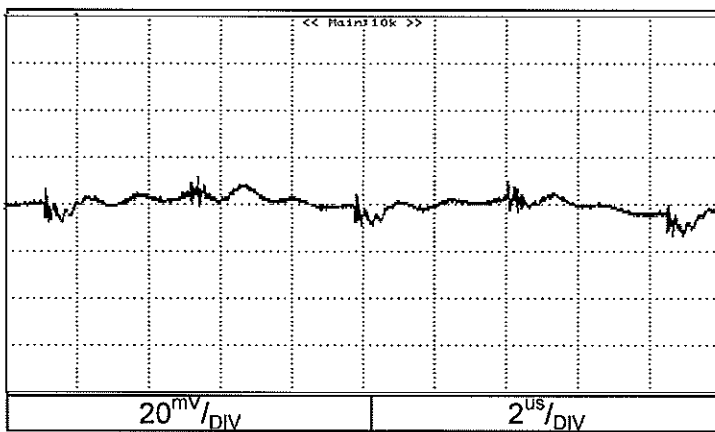
CONDITIONS: Vin: 115VAC
Vout: 100%
Iout: 100%
Ta: 25°C

Normal Mode

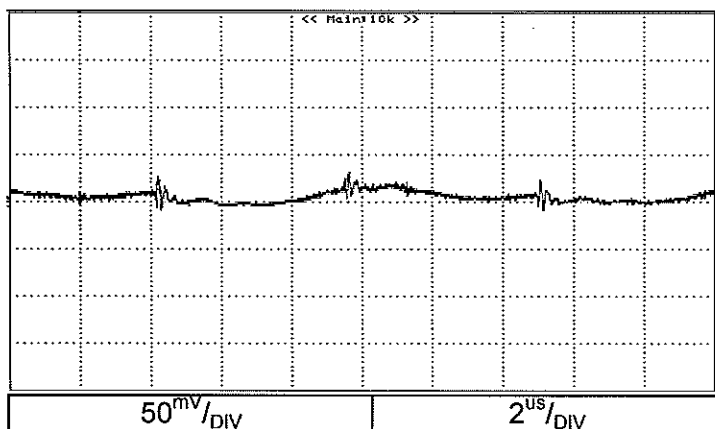
12V



24V



48V

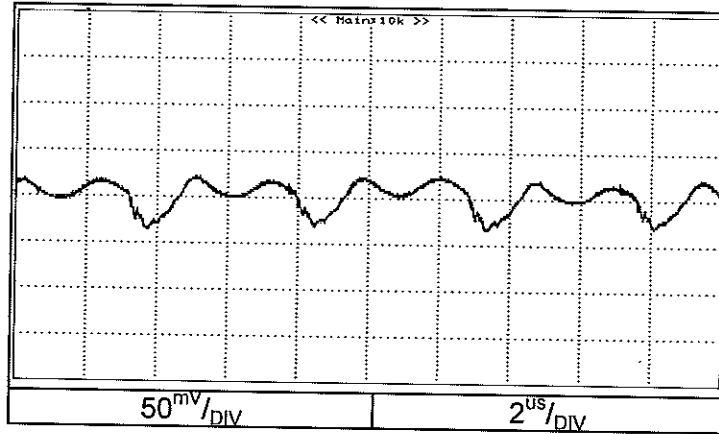


2.17. Output ripple and noise waveform

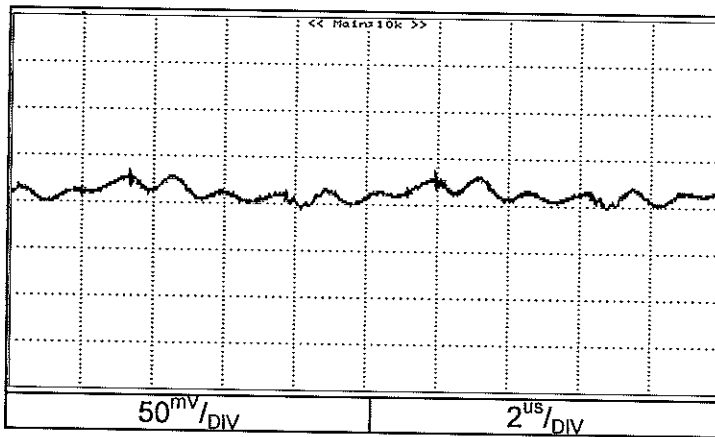
CONDITIONS: Vin: 230VAC
Vout: 100%
Iout: 100%
Ta: 25°C

Normal Mode

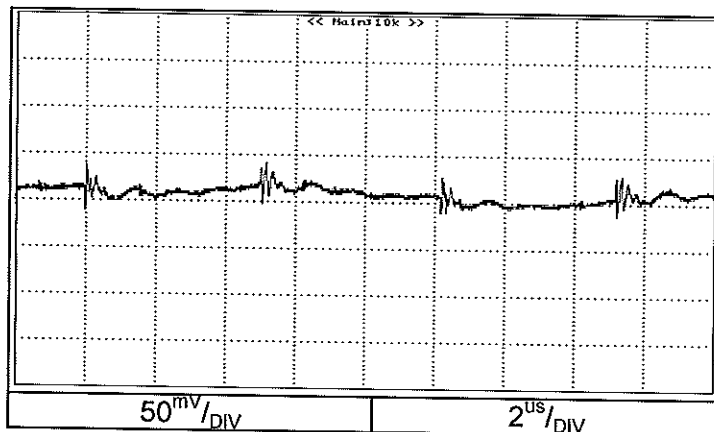
12V



24V



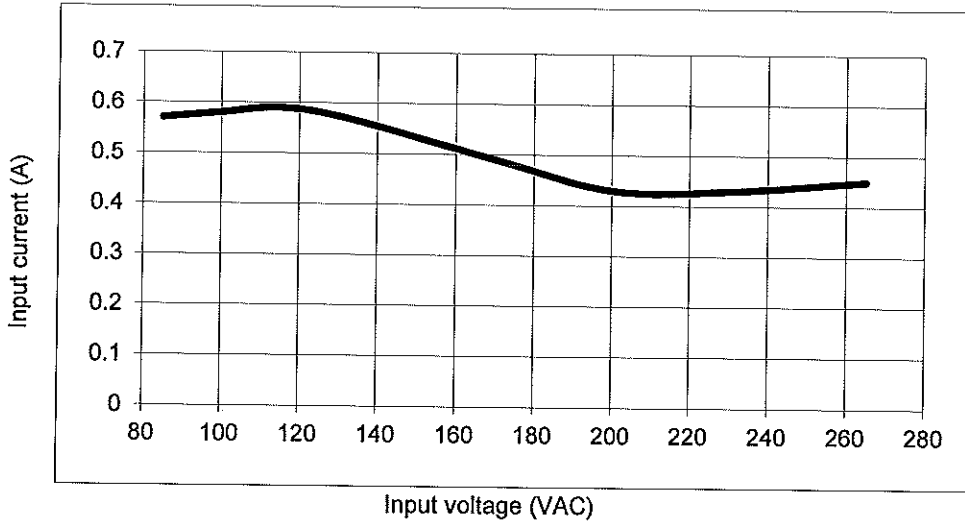
48V



2.18. Standby current

CONDITIONS: Ta: 25°C

Io=0%



Remote control OFF

