SWS600L

EVALUATION DATA

DWG.No CA757-53-01		
APPD	CHK	DWG
11-May.07	11/May/07	

INDEX

DENSEI-LAMBDA

Terminology used

	Definition	
Vin	. . . .	Input voltage
Vout	. . . .	Output voltage
Iin	. . . .	Input current
Iout	. . . .	Output current
Ta	. . . .	Ambient temperature
f	. . . .	Frequency
FG	. . . .	Frame Ground

DENSEI-LAMBDA

1. Evaluation Method

1.1 Circuit used for determination

(1) Steady state data
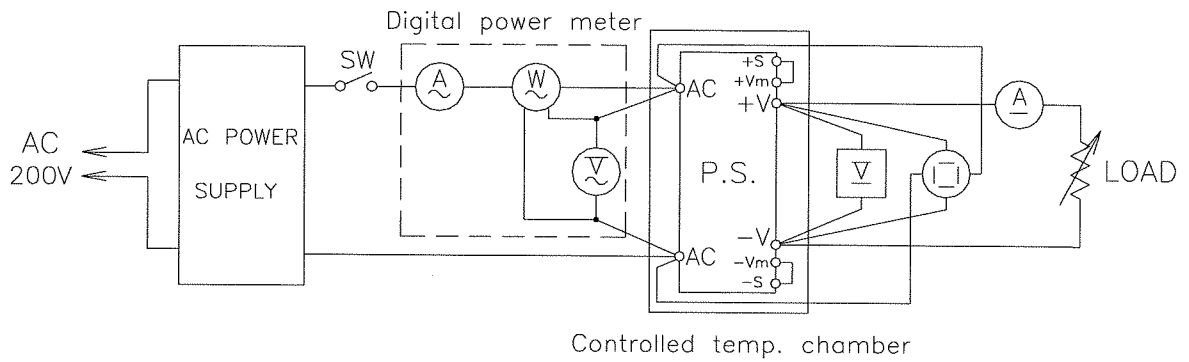
(2) Warm up voltage drift characteristics
Same as Steady state data

(3) Over current protection (OCP) characteristics
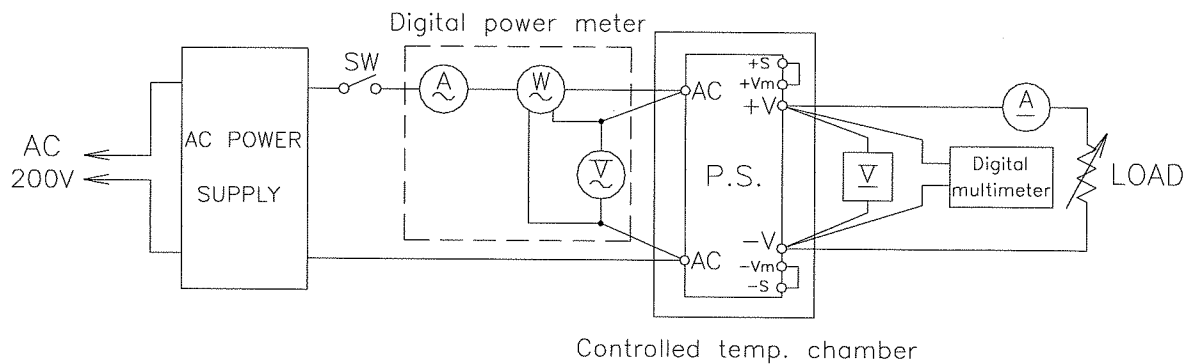
(4) Over voltage protection (OVP) characteristics
Same as Steady state data

(5) Output rise characteristics
Same as Steady state data

(6) Output fall characteristics
Same as Steady state data

DENSEI-LAMBDA

(7)   Output rise characteristics with ON/OFF CONTROL
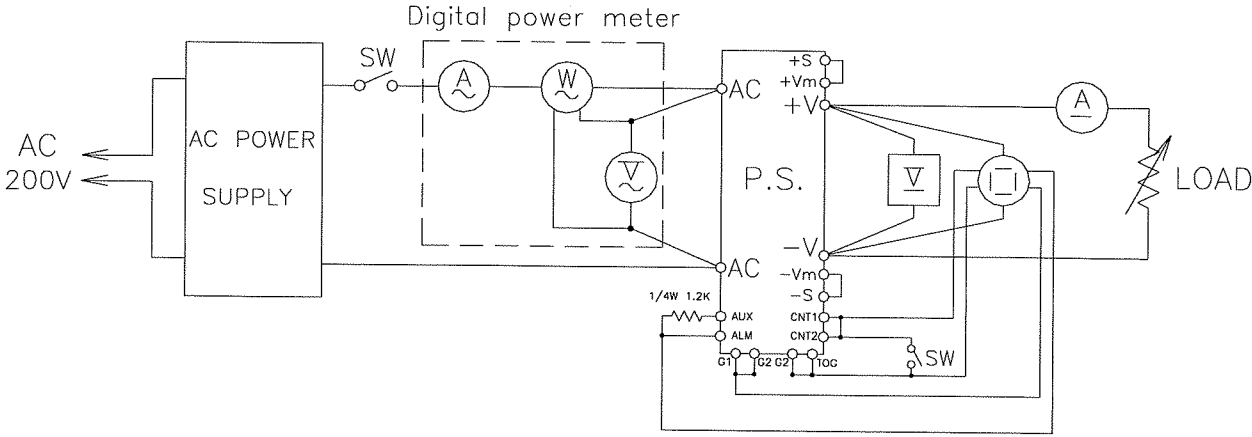
(8)   Output fall characteristics with ON/OFF CONTROL
        Same as Output rise characteristics with ON/OFF CONTROL

(9)   Dynamic line response characteristics
        Same as Steady state data

(10)   Dynamic load response characteristics
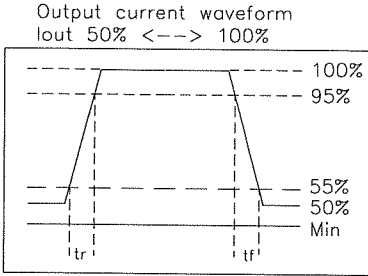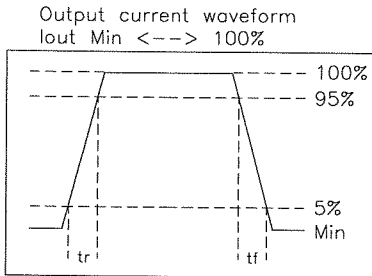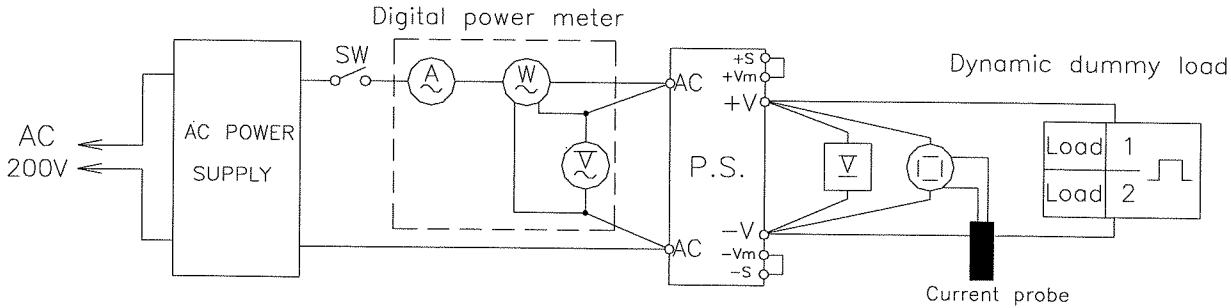
DENSEI-LAMBDA

(11)　Inrush current characteristics

Digital power meter

Current probe

(12)　Leakage current characteristics

Digital power meter
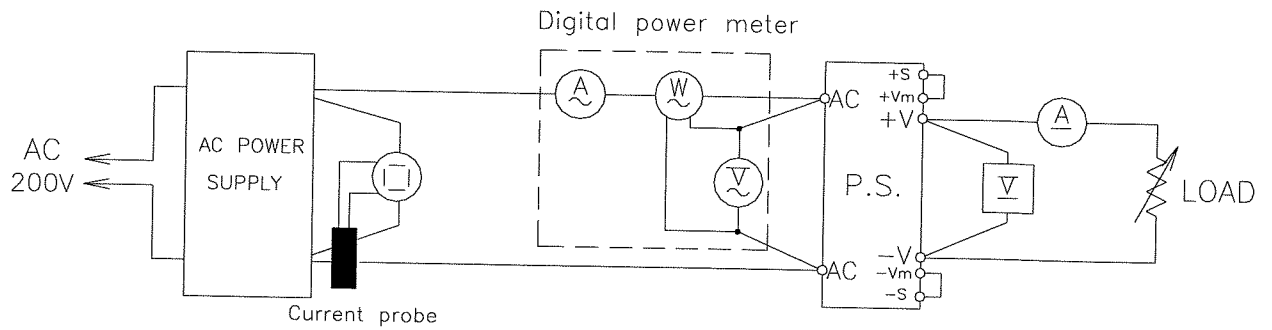
Leakage current meter
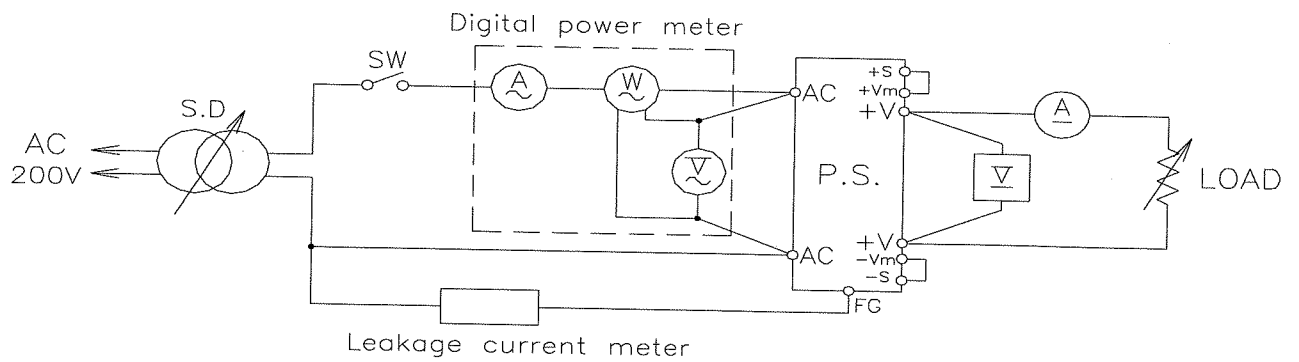
Range used————AC (For SIMPSON TYPE 228)

DENSEI-LAMBDA

(13)   Output ripple and noise waveform

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

Digital power meter

SW

AC POWER SUPPLY

AC 200V

A W V

AC +S +Vm
+V
P.S.
C1 C2
−V
AC −Vm
FG −S

L

Load

1.5m Coaxial Cable

Oscilloscope
Bandwidth : 20MHz

L : 150mm
C1 : 47uF Electrolylic Capacitor
C2 : 0.1uF Film Capacitor

(b) Normal + Common Mode

Digital power meter

SW

AC POWER SUPPLY

AC 200V

A W V

AC +S +Vm
+V
P.S.
C1 C2
−V
AC −Vm
FG −S

L1

L2

Load

1.5m Coaxial Cable

Oscilloscope
Bandwidth : 20MHz

L1 : 150mm
L2 : 150mm
C1 : 47uF Electrolylic Capacitor
C2 : 0.1uF Film Capacitor

(14)   Standby current

Same as Steady state data

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(15) Electro-Magnetic Interference characteristics

(a) Conducted Emission Noise

AMN 50 Ω/50 μH

D.U.T.(Earth)

Spectrum Analyzer
EMI Test Receiver
RF Relay Matrix

AL Plate

D=80cm

AC Cord

H=80cm

Stand

Earth

Metal Ground Plain

Filter

Input Line

(b) Radiated Emission Noise

D=3m

Spectrum Analyzer
EMI Test Receiver
RF Relay Matrix

D.U.T.(Earth)

AL Plate

Biconical Antenna

Stand

H=80cm

Turn Table

Earth

Metal Ground Plain

Filter

Input Line

DENSEI-LAMBDA
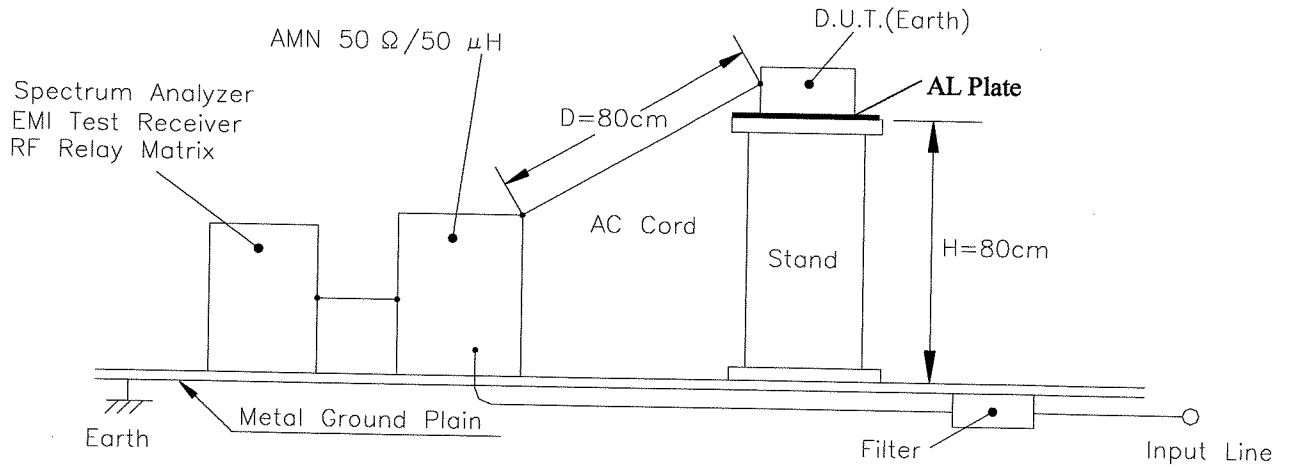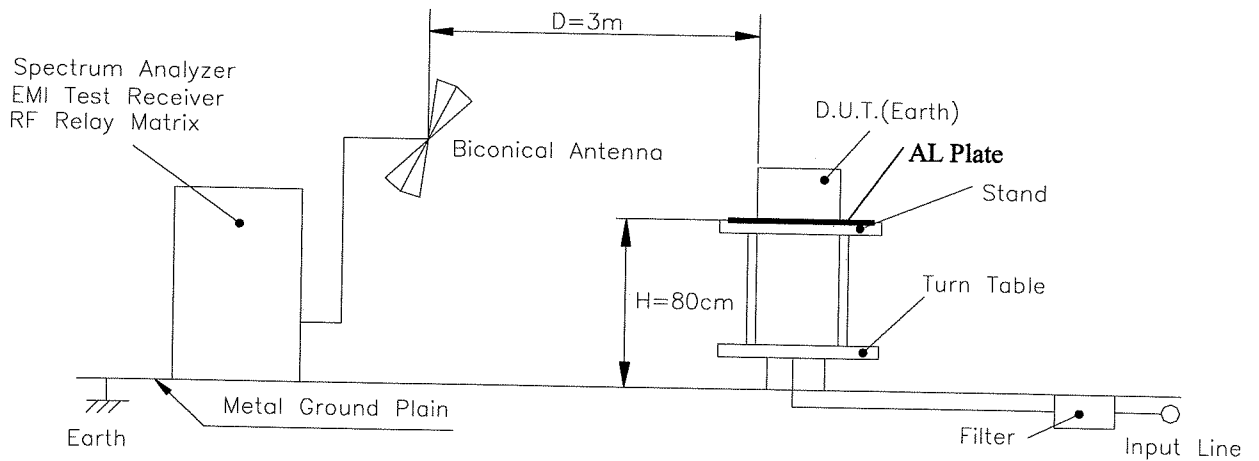
1.2   List of equipment used

	EQUIPMENT USED	MANUFACTURER	MODEL NO.
1	OSCILLOSCOPE	TEKTRONIX	TAS 475
2	DIGITAL STORAGE OSCILLOSCOPE	TEKTRONIX	TDS 724D/540A
3	DIGITAL MULTIMETER	FLUKE	45
4	DIGITAL POWER METER	YOKOGAWA	WT110/WT210
5	CURRENT PROBE/AMPLIFIER	TEKTRONIX	TCP404XL/TCPA400
6	DYNAMIC DUMMY LOAD	CHROMA	63030/63201
7	DYNAMIC DUMMY LOAD	KIKUSUI	PLZ1004W
8	CONTROLLED TEMP. CHAMBER	ESPEC	SU-241
9	LEAKAGE CURRENT METER	SIMPSON	228
10	AC SOURCE	KIKUSUI	PCR-2000L
11	AC SOURCE	CHROMA	6530
12	POWER ANALYZER	CHROMA	6630
13	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI
14	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESI26
15	LISN	ROHDE&SCHWARZ	ENV216
16	ANTENNA	ROHDE&SCHWARZ	HL562

DENSEI-LAMBDA

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%	5.008V	5.006V	5.006V	5.006V	0.002V	0.040%
50%	5.005V	5.004V	5.004V	5.003V	0.002V	0.040%
100%	5.000V	5.000V	5.000V	5.001V	0.001V	0.020%
load	0.008V	0.006V	0.006V	0.005V		
regulation	0.160%	0.120%	0.120%	0.100%		

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

Ta	-20°C	+25°C	+50°C	temperature stability	
Vout	5.004V	5.000V	4.995V	0.009V	0.18%

12V

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

Iout \ Vin	85VAC	115VAC	230VAC	265VAC	line regulation	
0%	12.029V	12.024V	12.023V	12.021V	0.008V	0.067%
50%	12.025V	12.022V	12.022V	12.020V	0.005V	0.042%
100%	12.014V	12.014V	12.018V	12.018V	0.004V	0.033%
load	0.015V	0.010V	0.005V	0.003V		
regulation	0.125%	0.083%	0.042%	0.025%		

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

Ta	-20°C	+25°C	+50°C	temperature stability	
Vout	11.988V	12.014V	12.012V	0.026V	0.217%

24V

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

Iout \ Vin	85VAC	115VAC	230VAC	265VAC	line regulation	
0%	24.027V	24.028V	24.030V	24.031V	0.004V	0.017%
50%	24.033V	24.032V	24.032V	24.031V	0.002V	0.008%
100%	24.036V	24.036V	24.034V	24.034V	0.002V	0.008%
load	0.009V	0.008V	0.004V	0.003V		
regulation	0.038%	0.033%	0.017%	0.013%		

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

Ta	-20°C	+25°C	+50°C	temperature stability	
Vout	23.857V	24.036V	24.060V	0.203V	0.85%

DENSEI-LAMBDA

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

Conditions; Iout : 100%

Ta : -20°C - - - - - -

: 25°C - - - -

: 50°C ———

| 5V |

| 12V |

| 24V |

DENSEI-LAMBDA
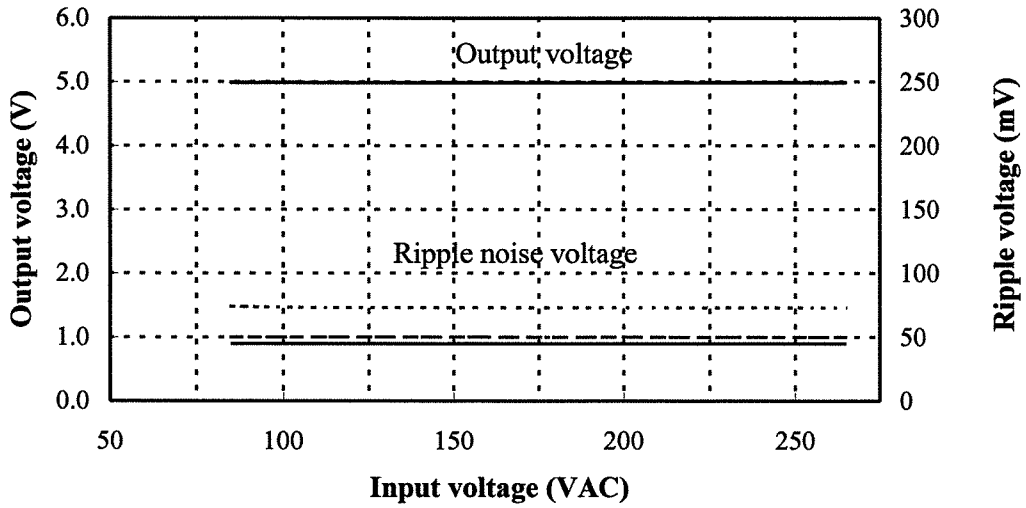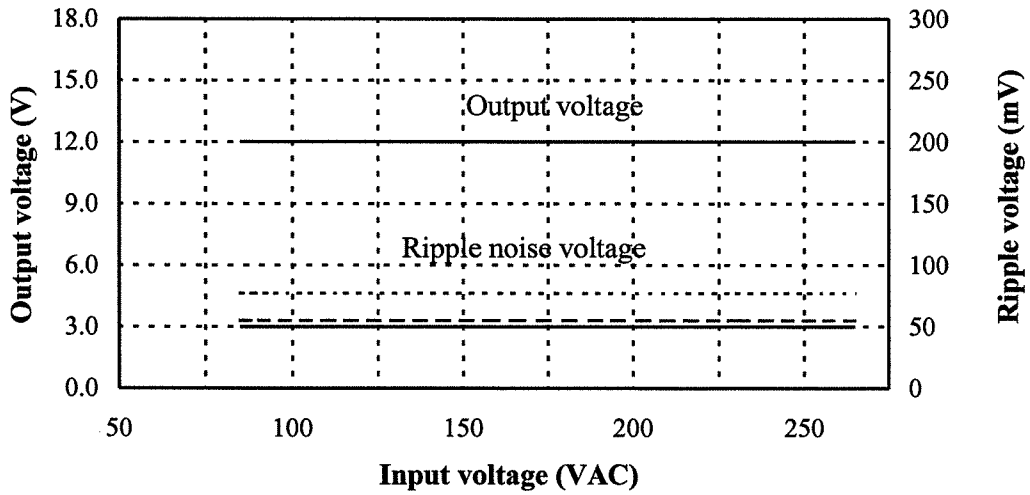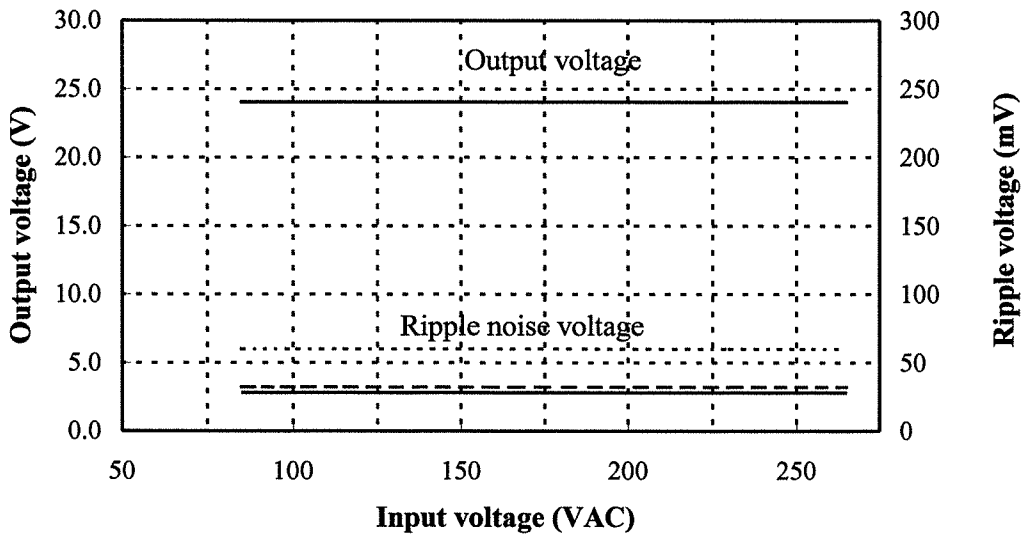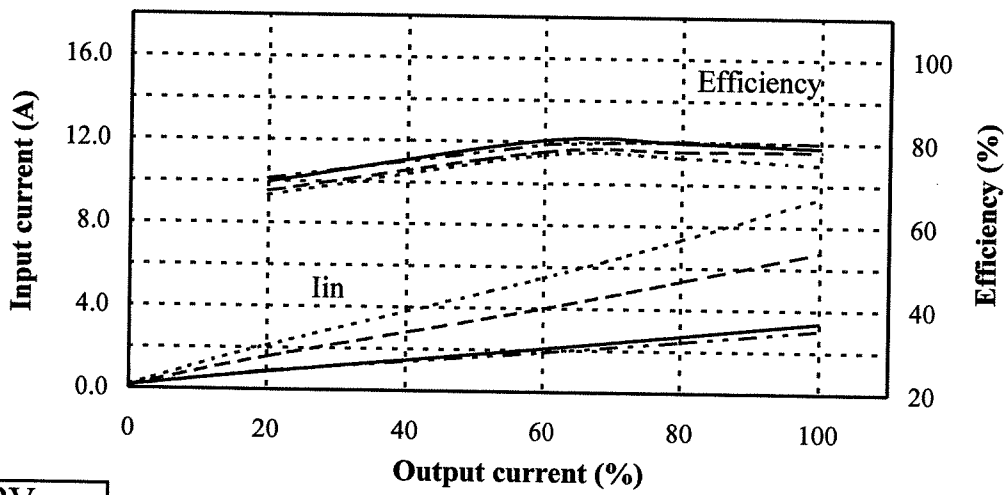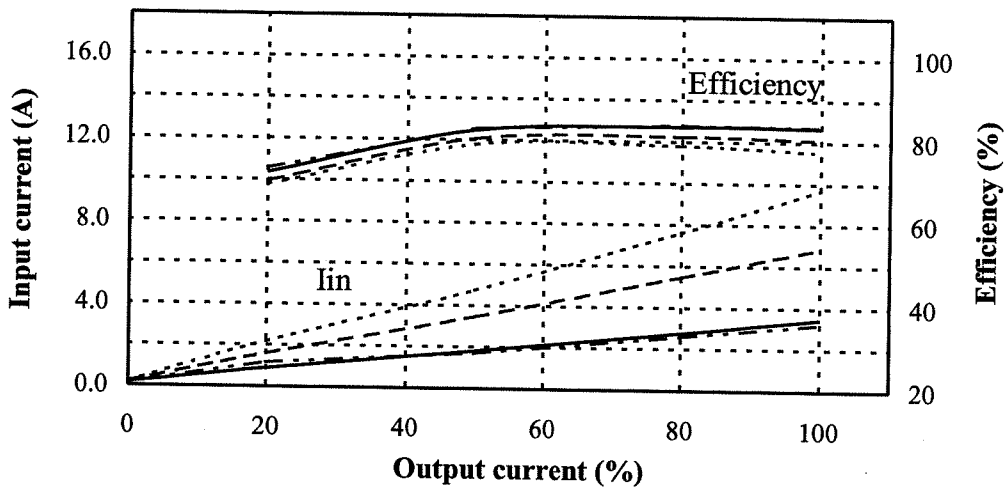
(3) Efficiency and input current v.s. output current

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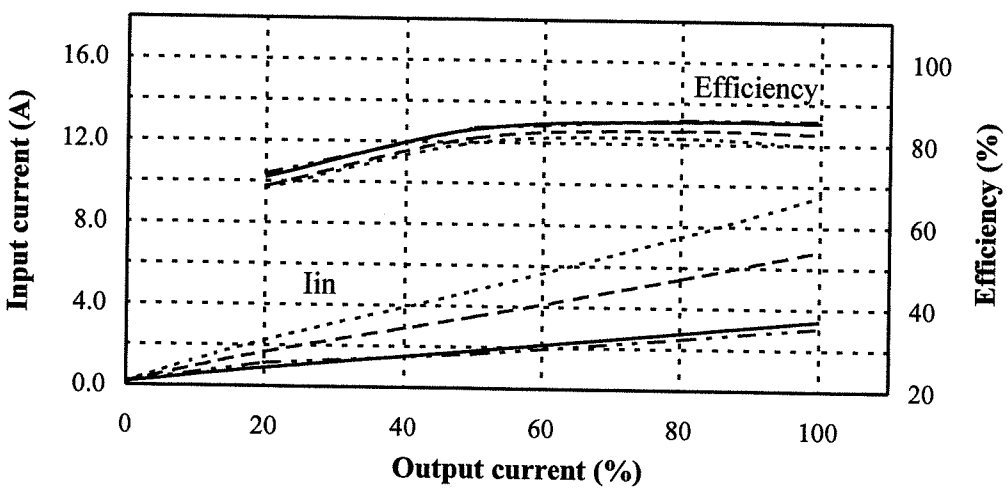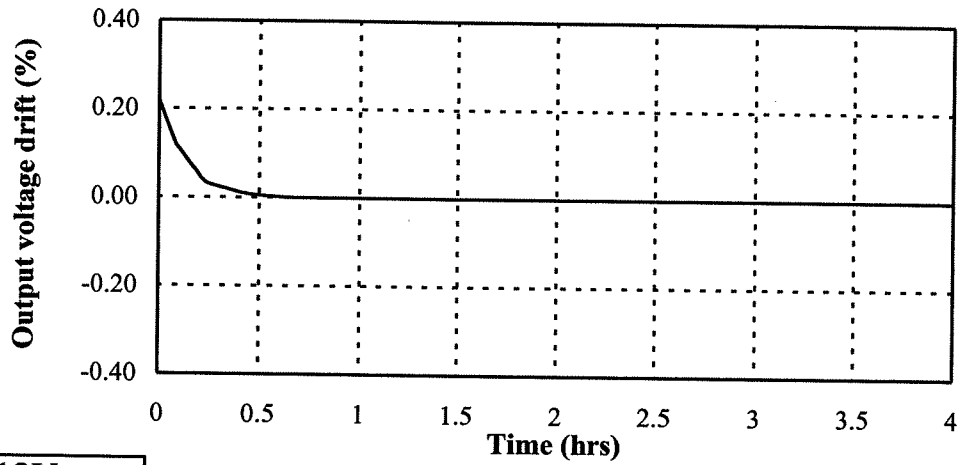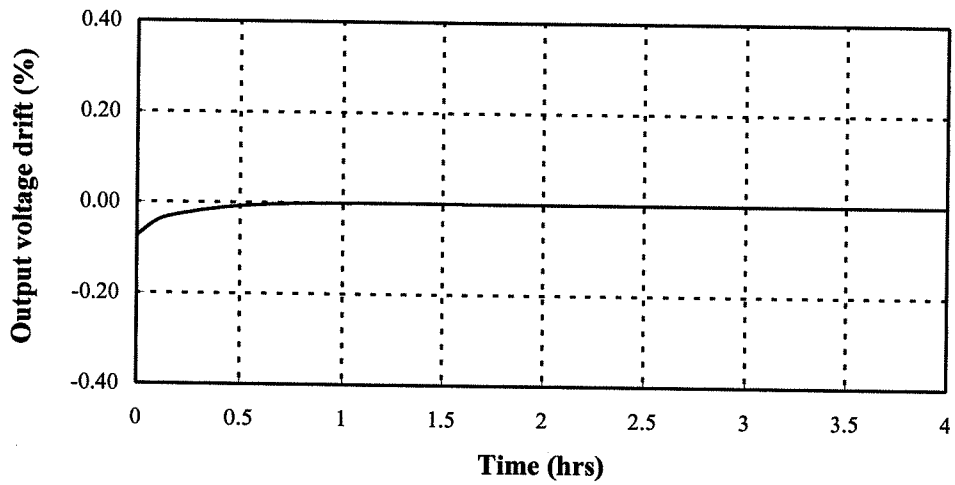   : 265VAC   -·-·-·
         Ta   : 25°C

5V

12V

24V

DENSEI-LAMBDA

(4) Power factor and input current v.s output current   Conditions Vin : 85VAC ------
: 115VAC -----
: 230VAC ———
: 265VAC —·—·—
Ta : 25°C

5V

12V

24V

DENSEI-LAMBDA

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2.2 Warm up voltage drift characteristics

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

5V

Output voltage drift (%) vs Time (hrs)

12V

Output voltage drift (%) vs Time (hrs)

24V

Output voltage drift (%) vs Time (hrs)

DENSEI-LAMBDA

2.3 Over current protection (OCP) characteristics

Conditions   Vin : 85 VAC ――――

115 VAC ―・―・―

230 VAC ――――

265 VAC ------

Ta : 25℃

5V

12V

24V

DENSEI-LAMBDA
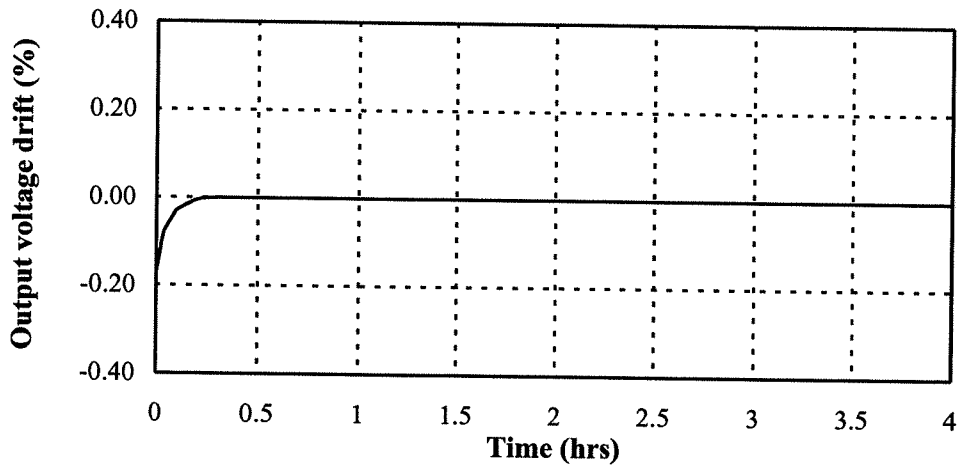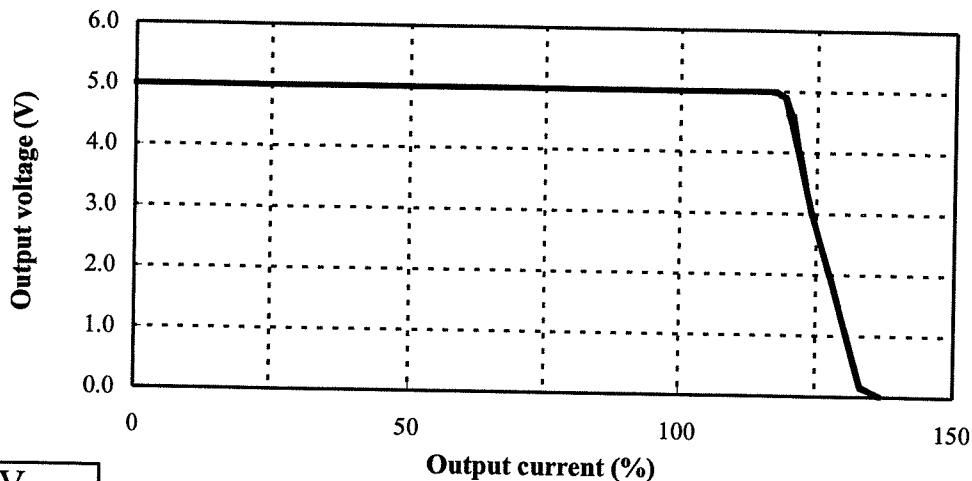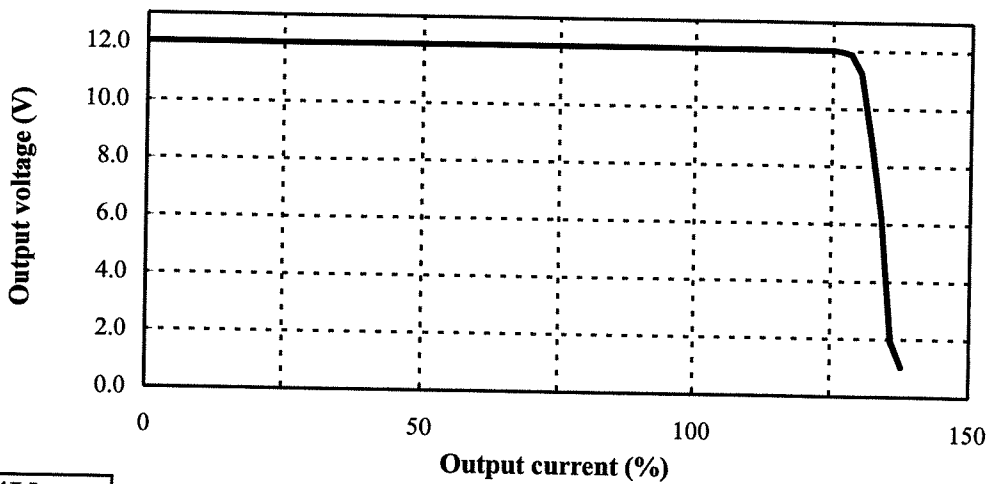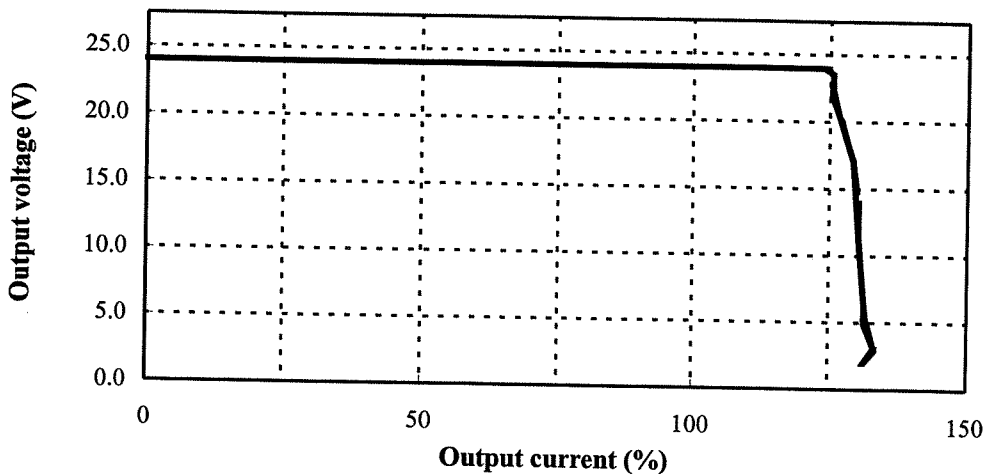
2.3   Over current protection (OCP) characteristics

Conditions;   Vin : 115VAC

Ta : -20℃ ─ ─ ─ ─
25℃ ─·─··─··─
50℃ ──────

5V

12V

24V

DENSEI-LAMBDA
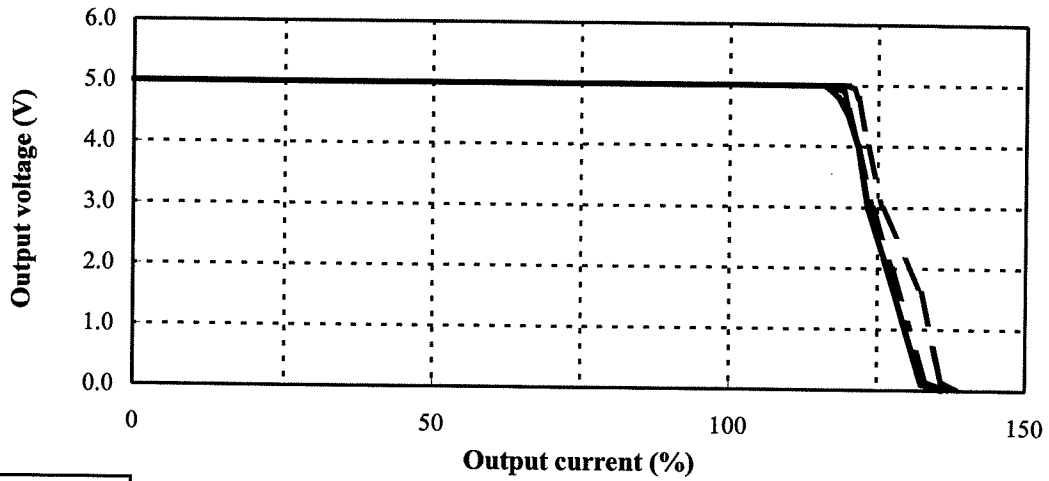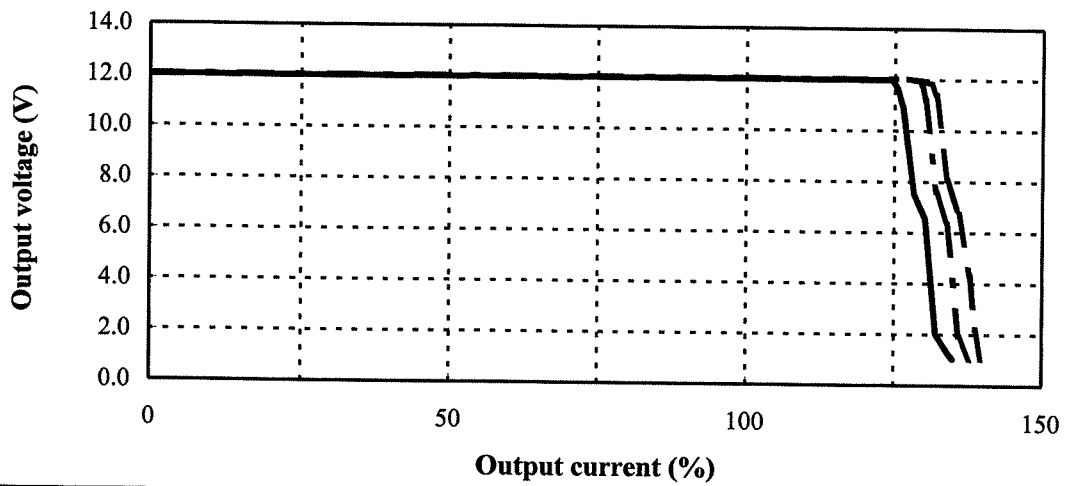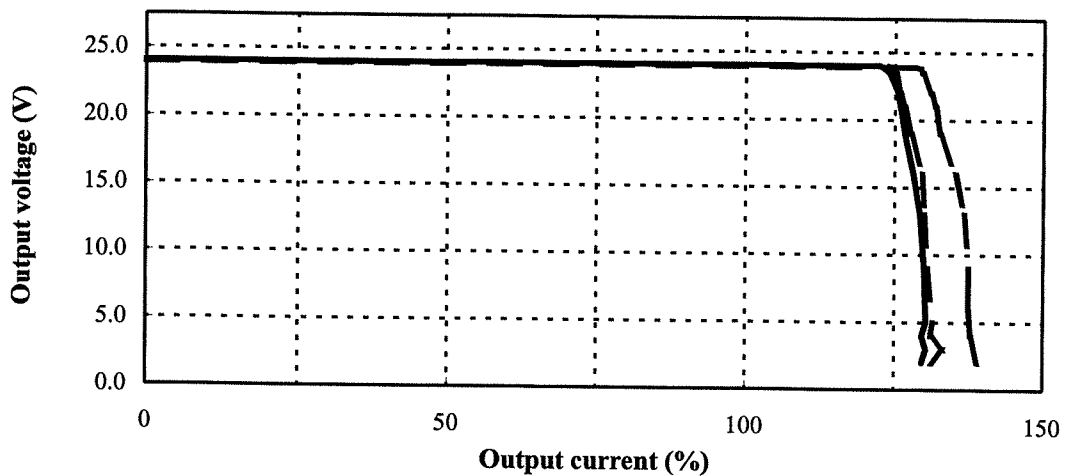
2.4   Over voltage protection (OVP) characteristics

Conditions; Vin : 115VAC
Iout :   0%
Ta   : 25°C

5V
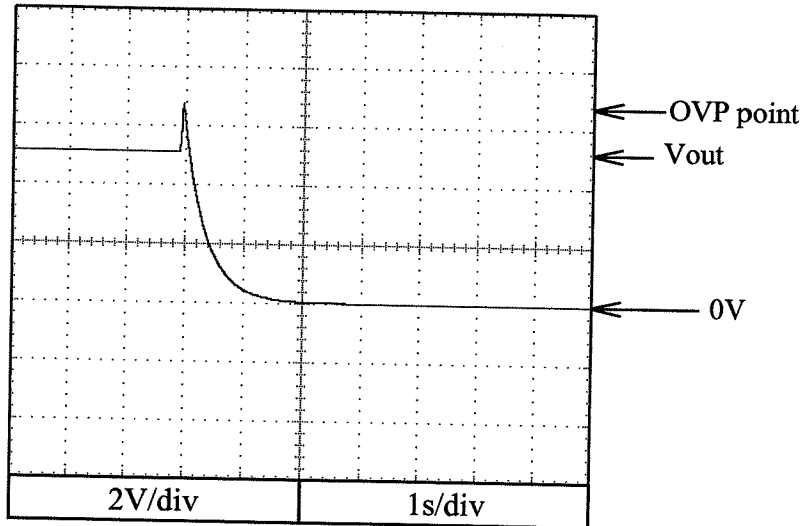
| 2V/div | 1s/div |

OVP point
Vout
0V

12V

| 5V/div | 1s/div |

OVP point
Vout
0V

24V

| 10V/div | 2s/div |

OVP point
Vout
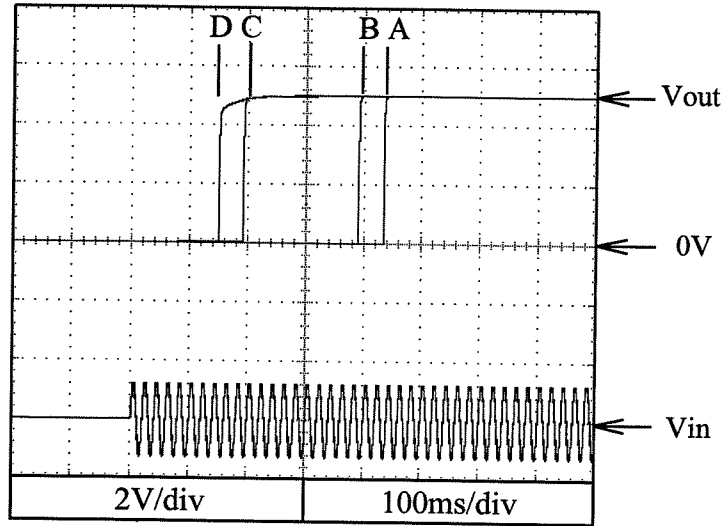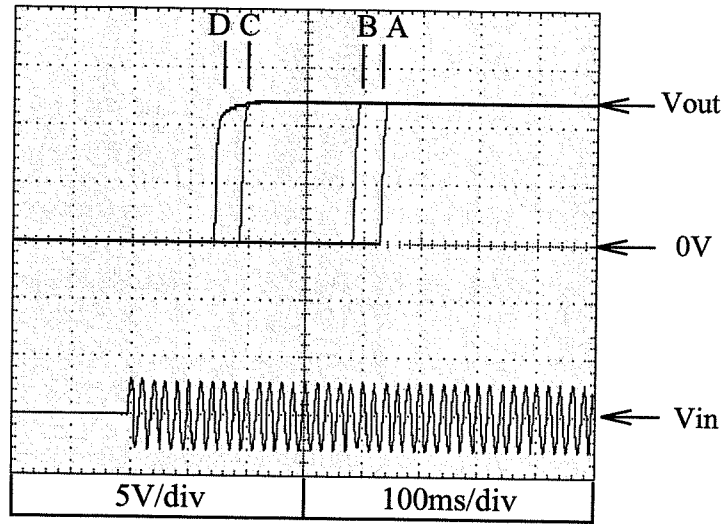0V

DENSEI-LAMBDA
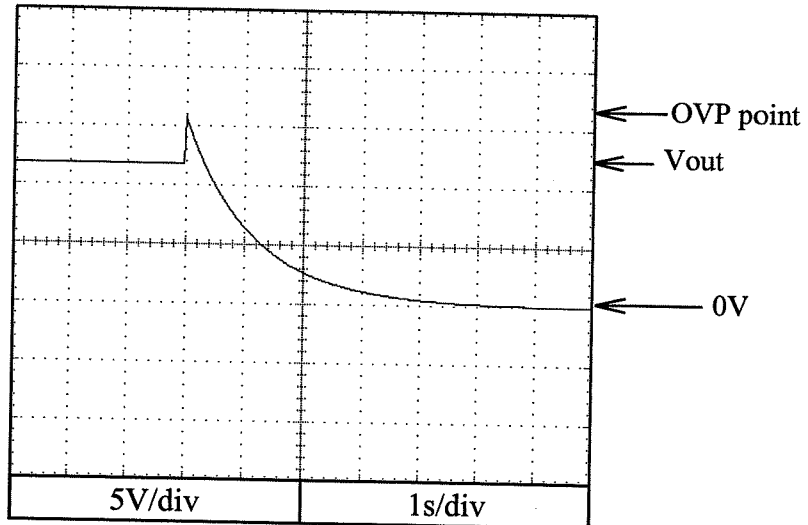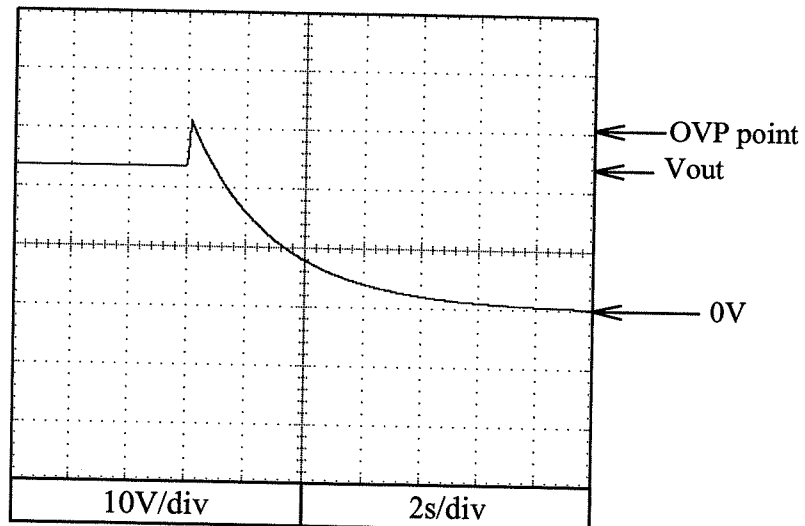
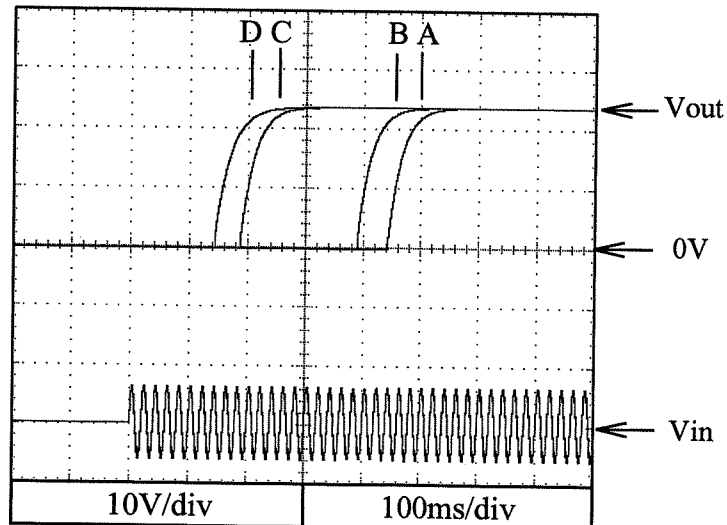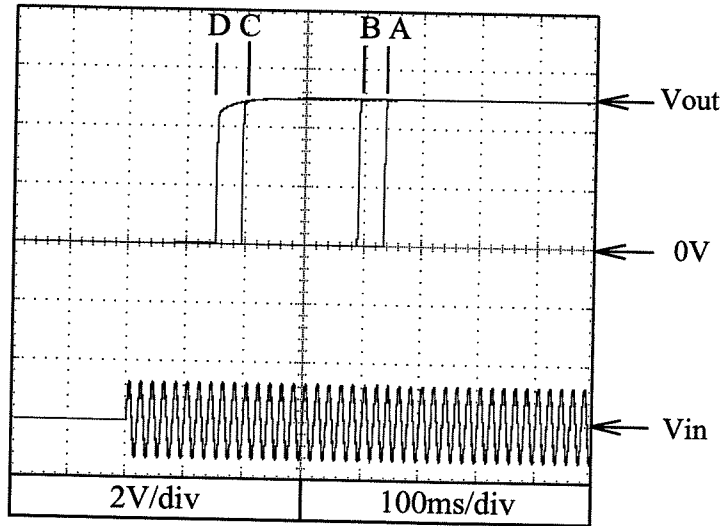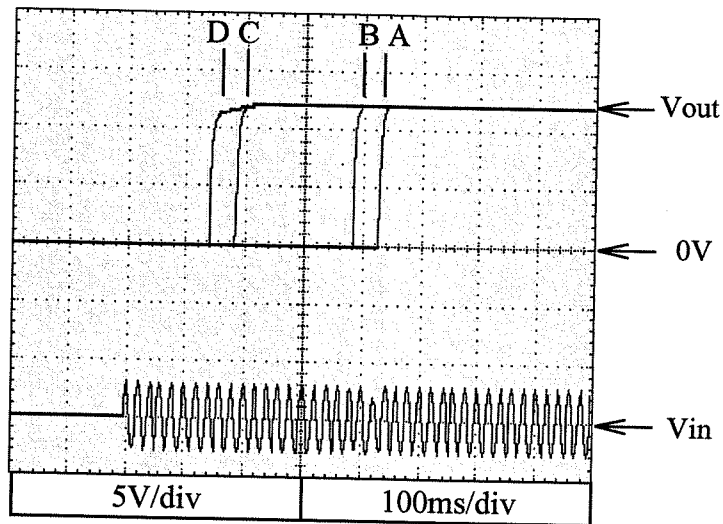**2.5   Output rise characteristics**

Conditions;

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

5V

| 2V/div | 100ms/div |

12V

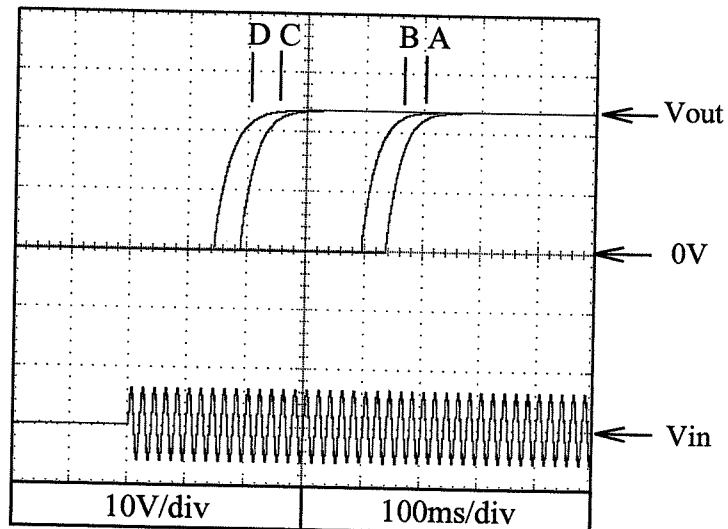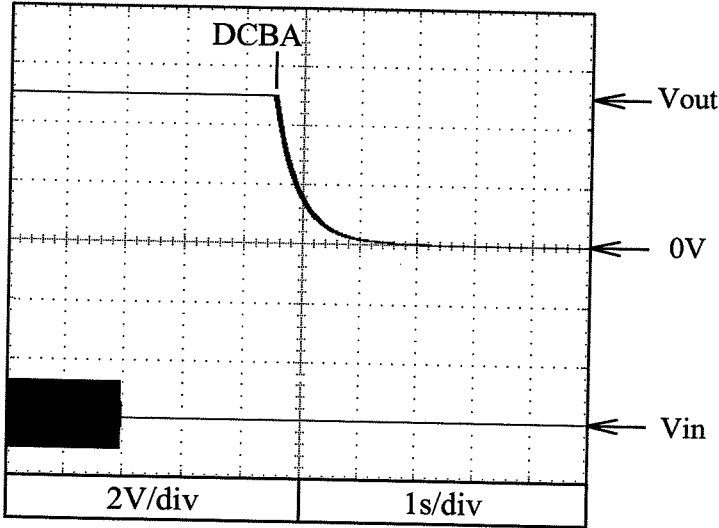| 5V/div | 100ms/div |

24V

| 10V/div | 100ms/div |

DENSEI-LAMBDA

2.5 Output rise characteristics

Conditions;

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

5V

Vout
0V
Vin

| 2V/div | 100ms/div |

12V

Vout
0V
Vin

| 5V/div | 100ms/div |

24V

Vout
0V
Vin

| 10V/div | 100ms/div |

DENSEI-LAMBDA

2.6 Output fall characteristics

5V

2V/div	1s/div

12V

5V/div	1s/div

24V

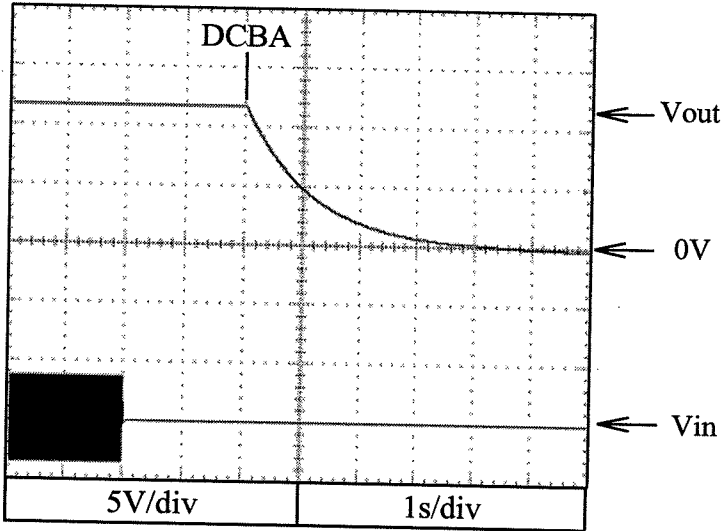| 10V/div	2s/div

DENSEI-LAMBDA

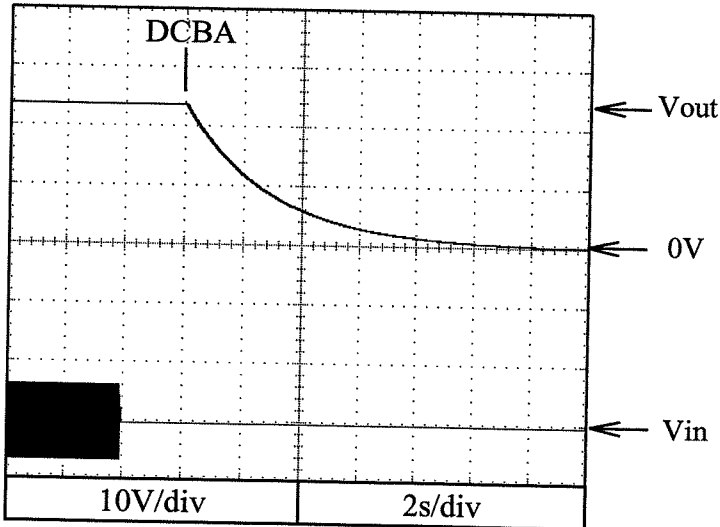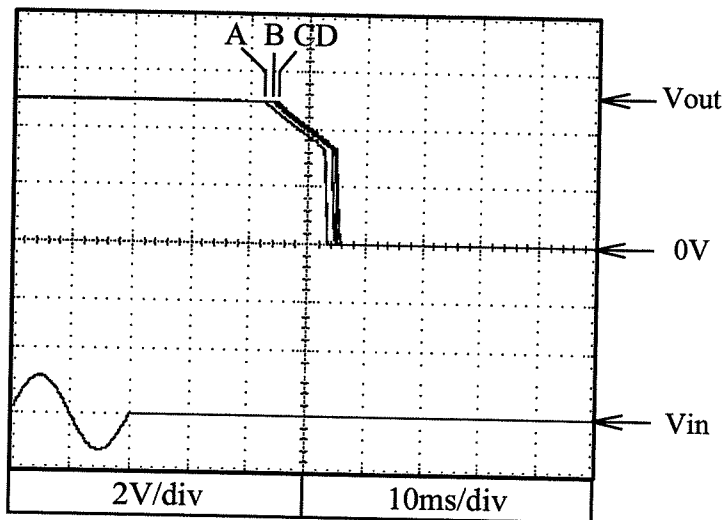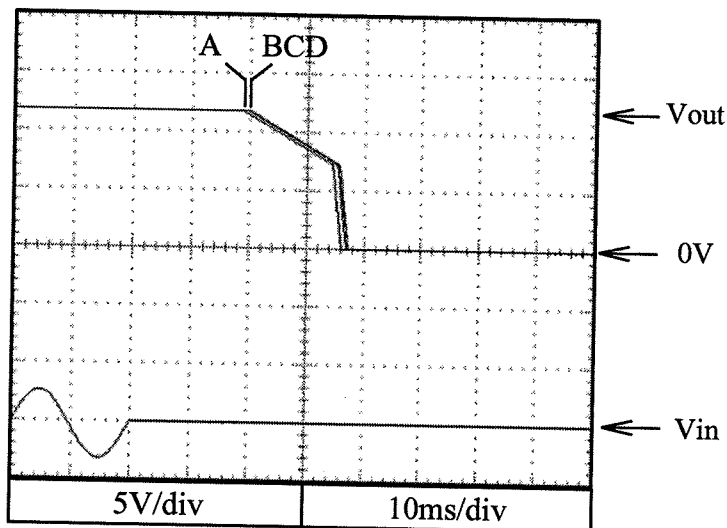## 2.6 Output fall characteristics

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

| 5V |

A B CD
←— Vout
←— 0V
←— Vin

| 2V/div | 10ms/div |

| 12V |

A BCD
←— Vout
←— 0V
←— Vin

| 5V/div | 10ms/div |

| 24V |

A BCD
←— Vout
←— 0V
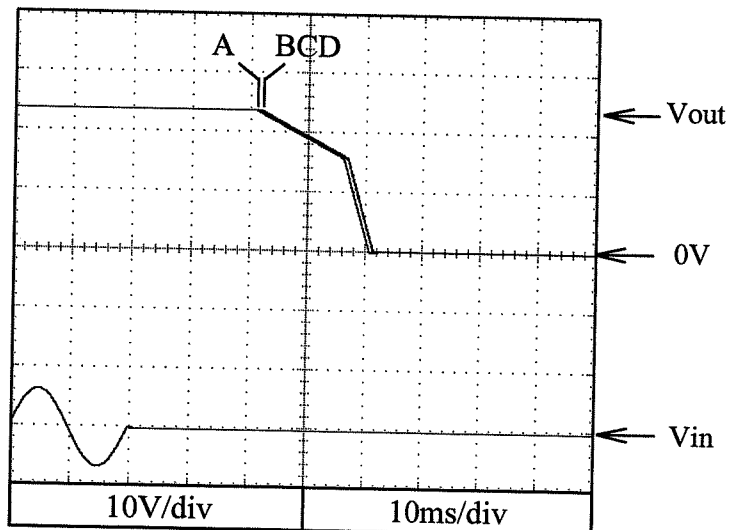←— Vin

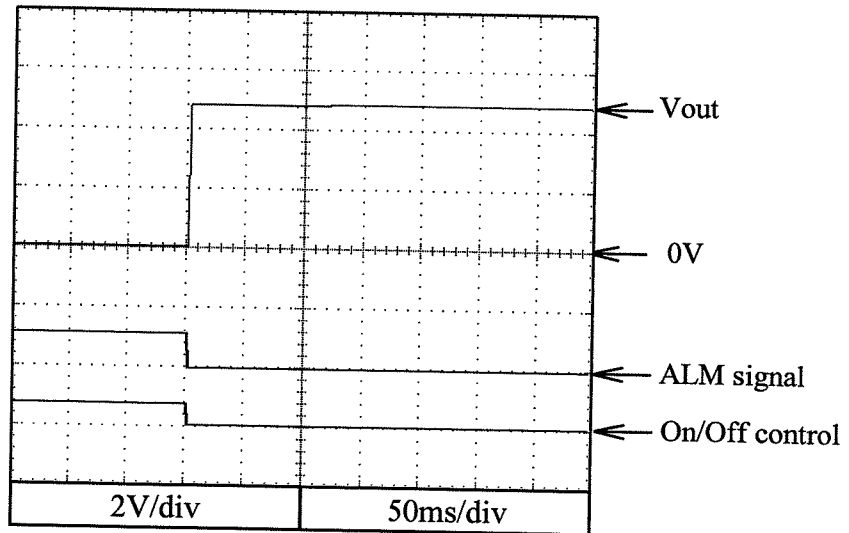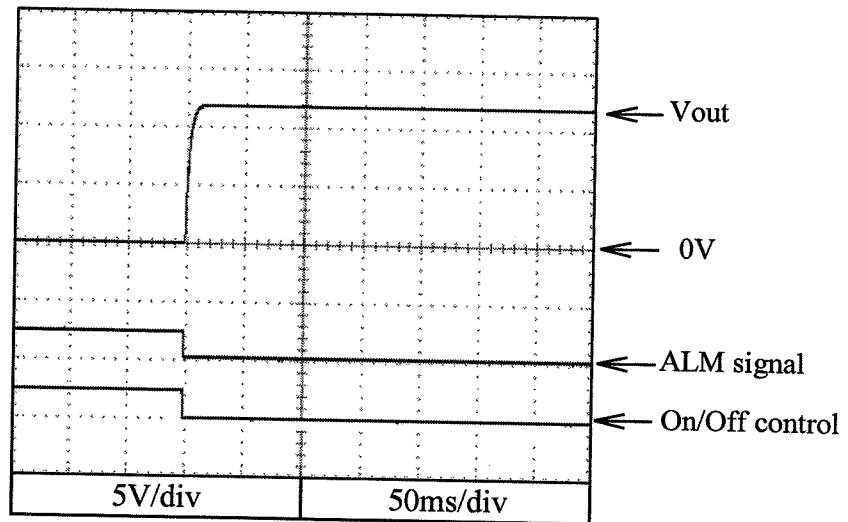| 10V/div | 10ms/div |

DENSEI-LAMBDA

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2.7   Output rise characteristics with On/Off control   Conditions;   Vin : 115VAC
Iout : 100%
Ta   : 25°C

5V

| 2V/div | 50ms/div |

←— Vout

←— 0V

←— ALM signal

←— On/Off control

12V

| 5V/div | 50ms/div |

←— Vout

←— 0V

←— ALM signal

←— On/Off control

24V

| 10V/div | 50ms/div |

←— Vout

←— 0V
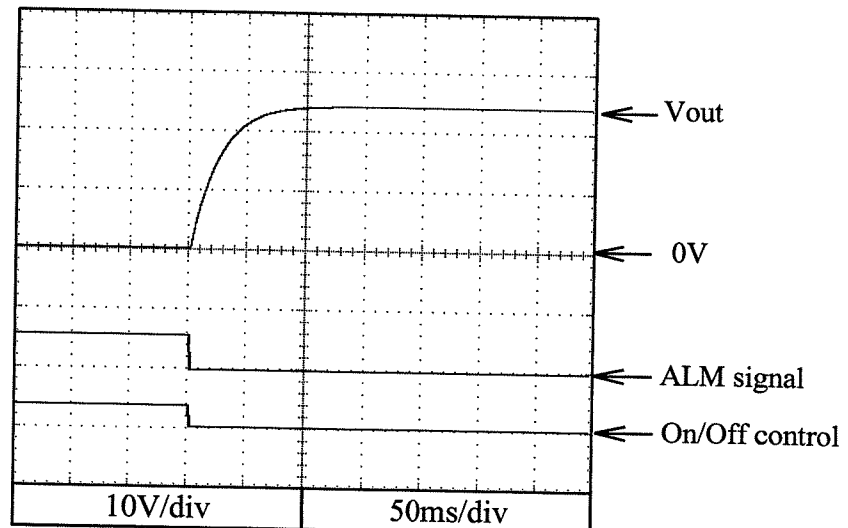
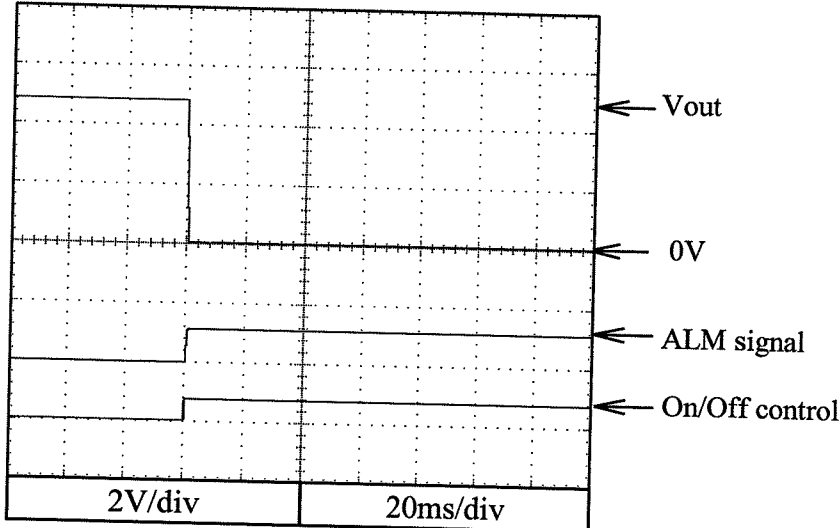←— ALM signal
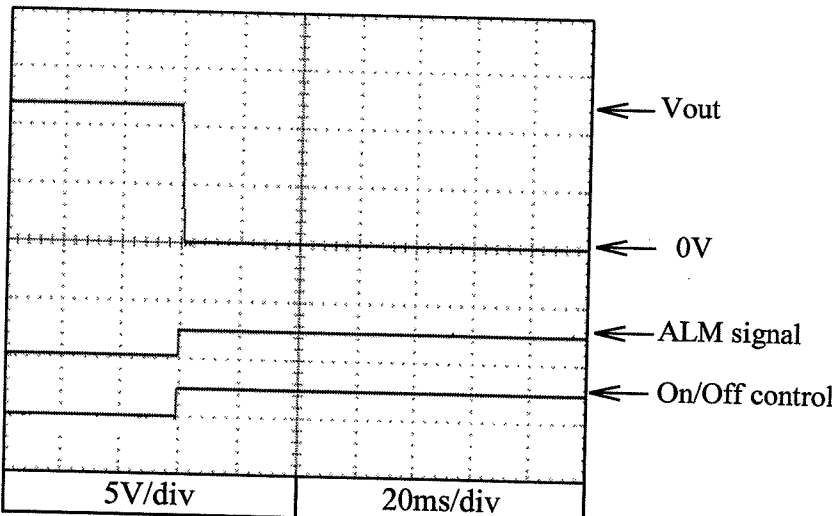
←— On/Off control

DENSEI-LAMBDA

2.8   Output fall characteristics with On/Off control

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

5V

Vout

0V

ALM signal

On/Off control

2V/div	20ms/div

12V

Vout

0V

ALM signal

On/Off control

5V/div	20ms/div

24V

Vout

0V

ALM signal

On/Off control

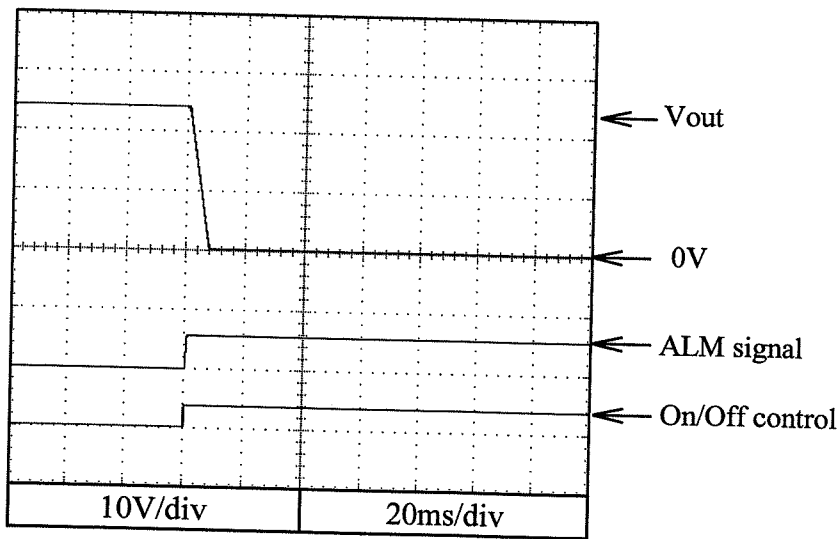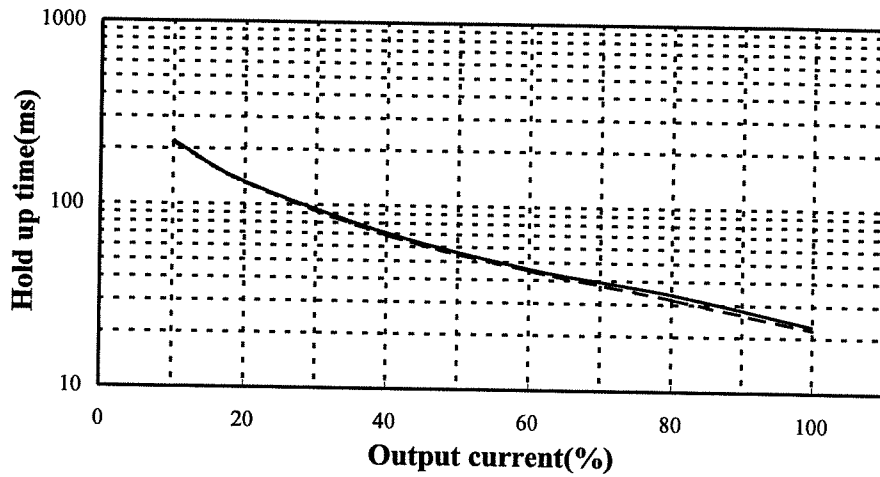| 10V/div	20ms/div

DENSEI-LAMBDA

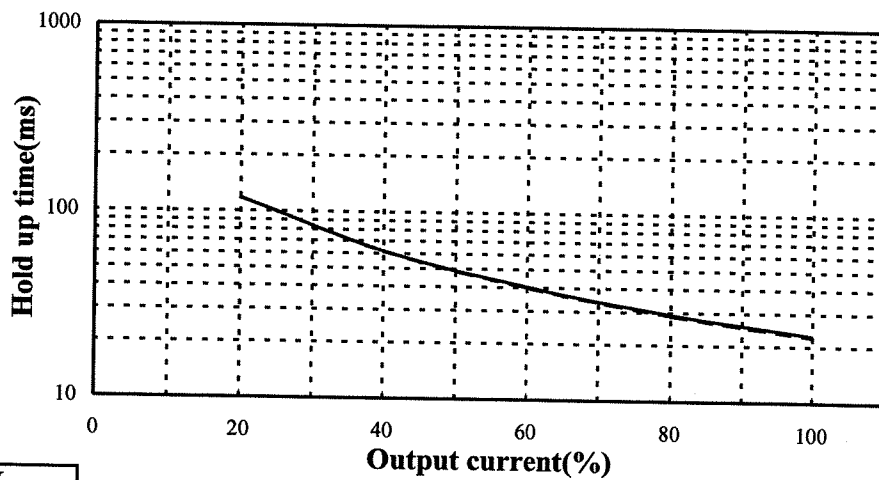## 2.9 Hold up time characteristics

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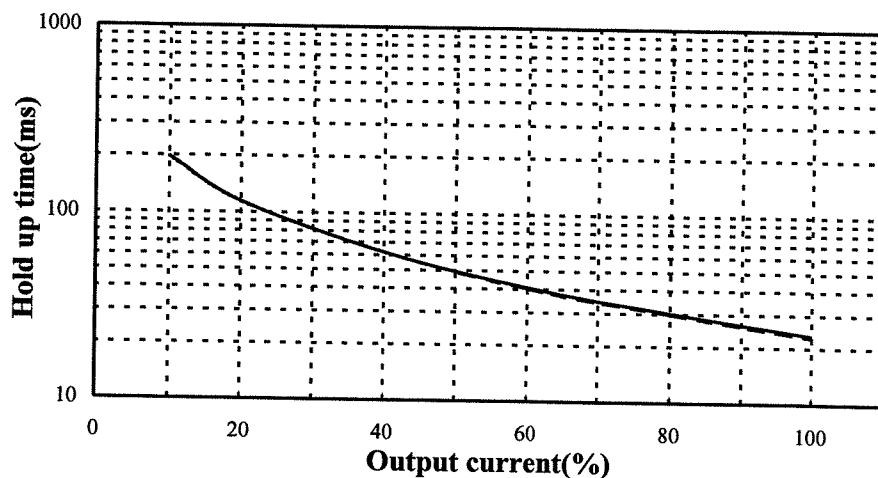   : 230VAC _____
       Ta   : 25°C

5V

12V

24V

DENSEI-LAMBDA

2.10 Dynamic line response characteristics

Conditions; Vin : 85VAC ⟷ 132VAC(A)
                          170VAC ⟷ 265VAC(B)
          Iout : 100%
          Ta : 25°C
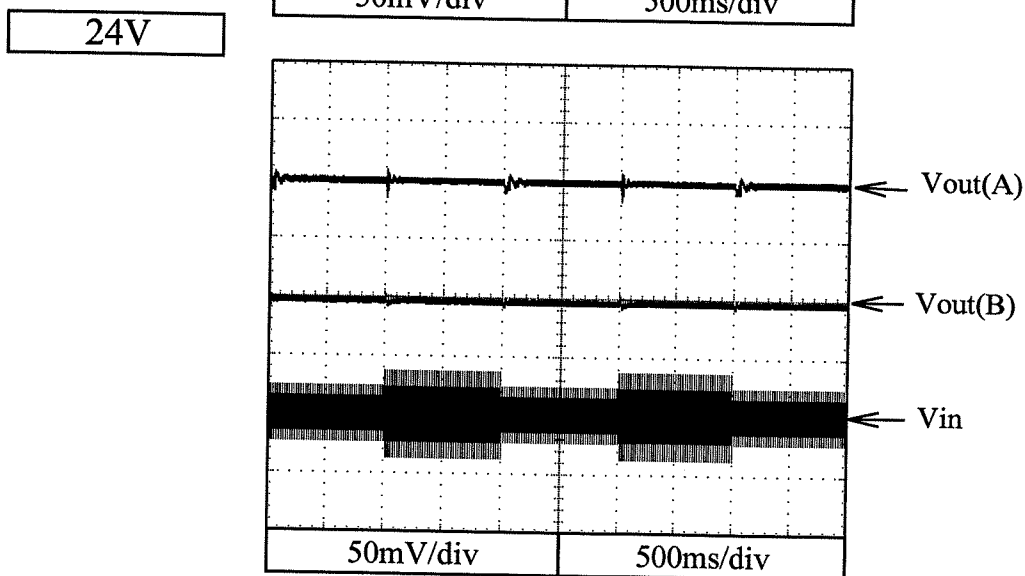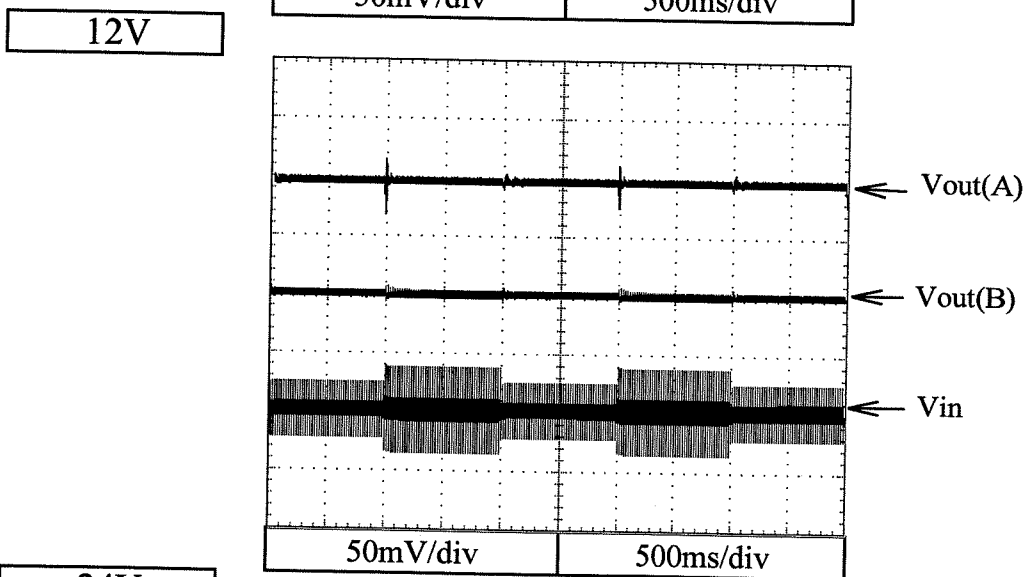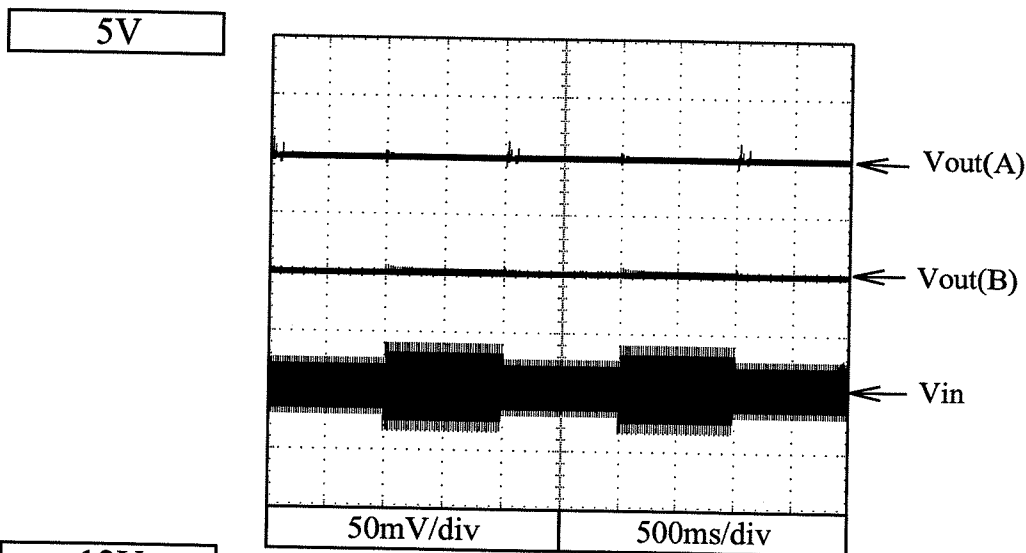
5V

← Vout(A)

← Vout(B)

← Vin

50mV/div	500ms/div

12V

← Vout(A)

← Vout(B)

← Vin

50mV/div	500ms/div

24V

← Vout(A)

← Vout(B)

← Vin

50mV/div	500ms/div

DENSEI-LAMBDA

2.11 Dynamic load response characteristics

5V

f=100Hz

Load current tr = tf = 50μs
50% ←→ 100%

← Vout →

← Iout →

500mV/DIV	2ms/DIV
+1.9%	-2.2%

Load current tr = tf = 50μs
0% ←→ 100%

500mV/DIV	2ms/DIV
+3.4%	-10.0%

f=1kHz

Load current tr = tf = 50μs
50% ←→ 100%

← Vout →

← Iout →

500mV/DIV	200μs/DIV
+2.48%	-2.76%

Load current tr = tf = 50μs
0% ←→ 100%

500mV/DIV	200us/DIV
+5.2%	-8.6%

DENSEI-LAMBDA

2.11 Dynamic load response characteristics

12V

f=100Hz

Load current tr = tf = 50μs 50% ⟷ 100%	
← Vout →	
← Iout →	
100mV/DIV	2ms/DIV
+0.45%	-0.60%

Load current tr = tf = 50μs 0% ⟷ 100%	
← Vout →	
← Iout →	
200mV/DIV	2ms/DIV
+0.86%	-2.09%

f=1kHz

Load current tr = tf = 50μs 50% ⟷ 100%	
← Vout →	
← Iout →	
100mV/DIV	200μs/DIV
+0.47%	-0.67%

Load current tr = tf = 50μs 0% ⟷ 100%	
← Vout →	
← Iout →	
200mV/DIV	200us/DIV
+0.76%	-1.44%

DENSEI-LAMBDA
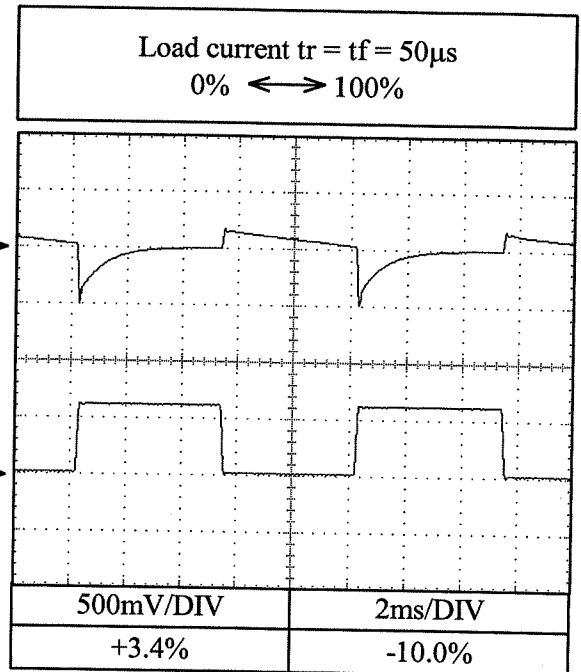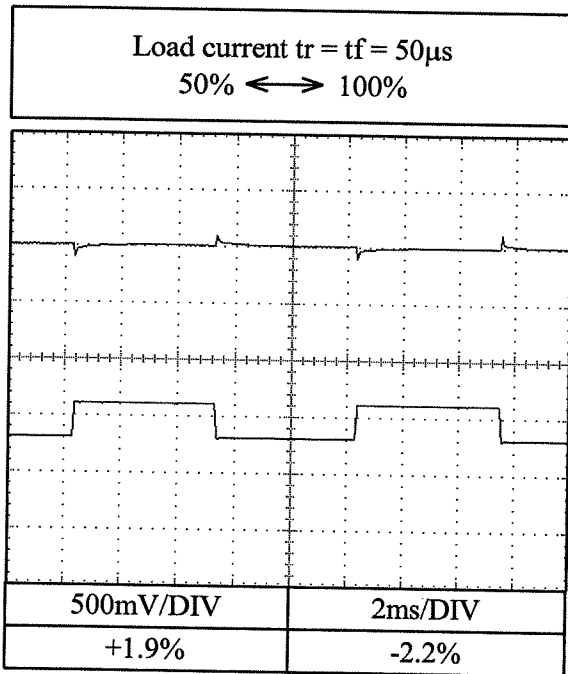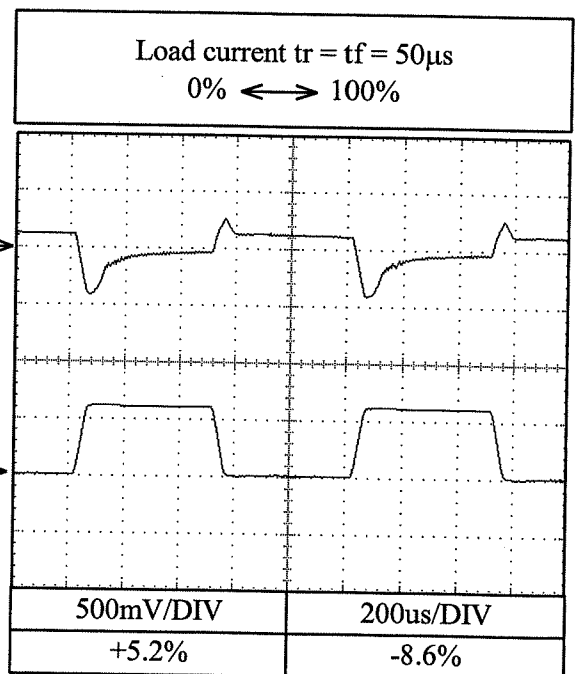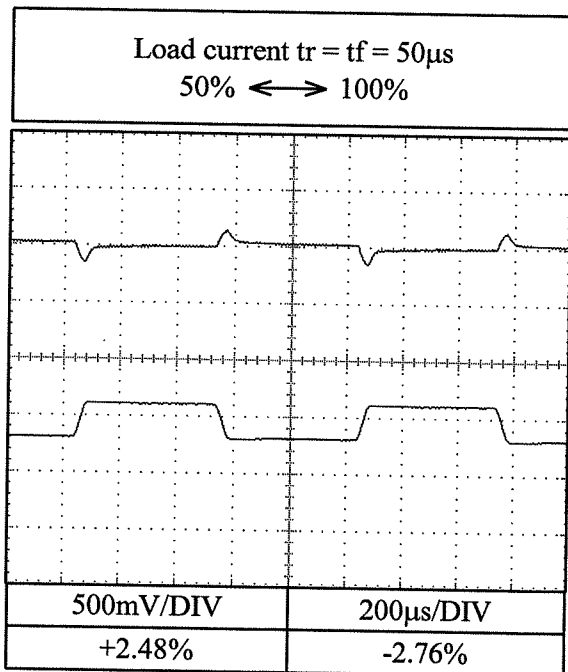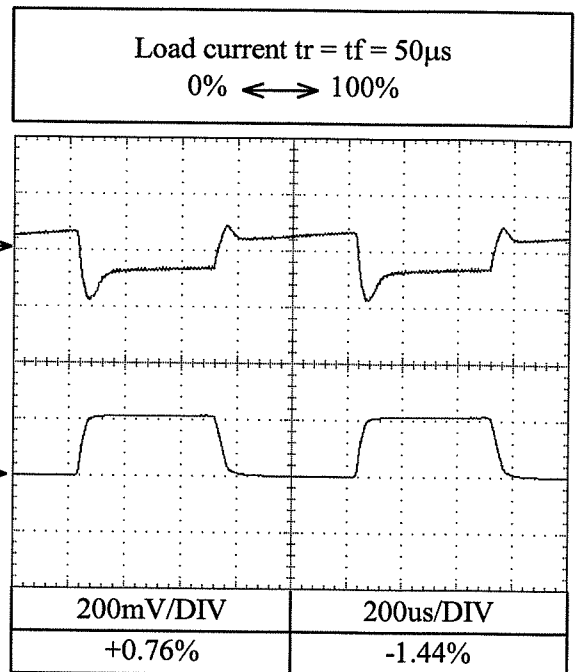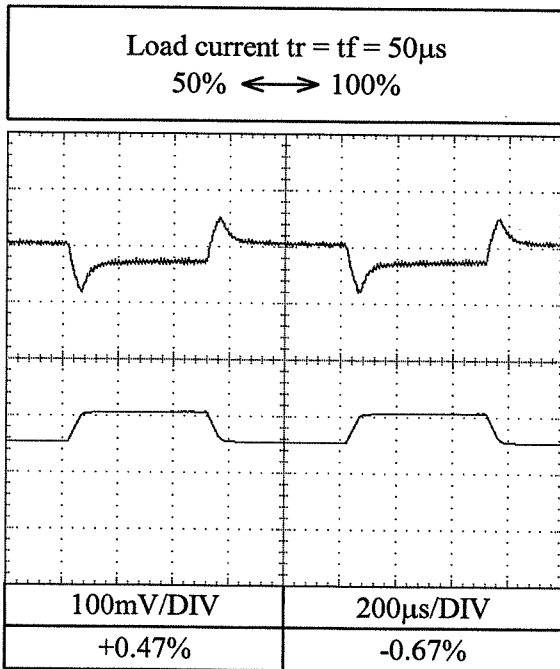
2.11 Dynamic load response characteristics
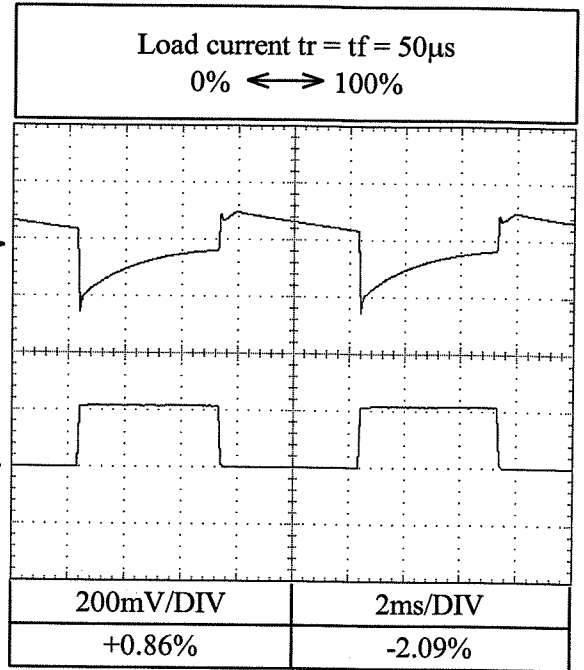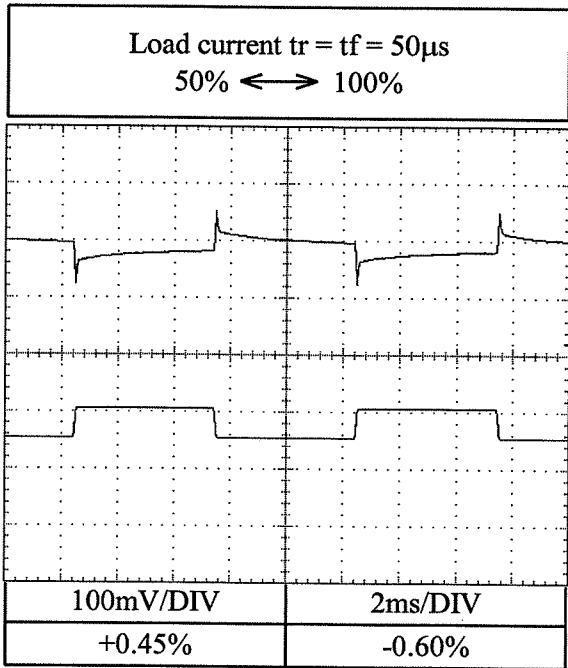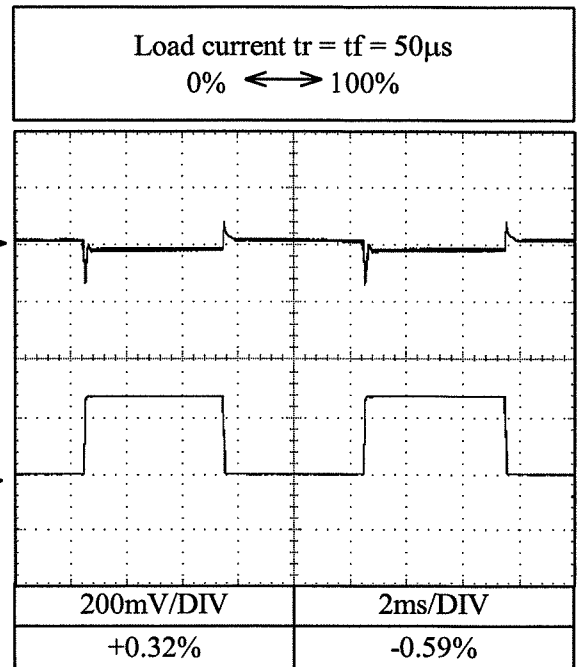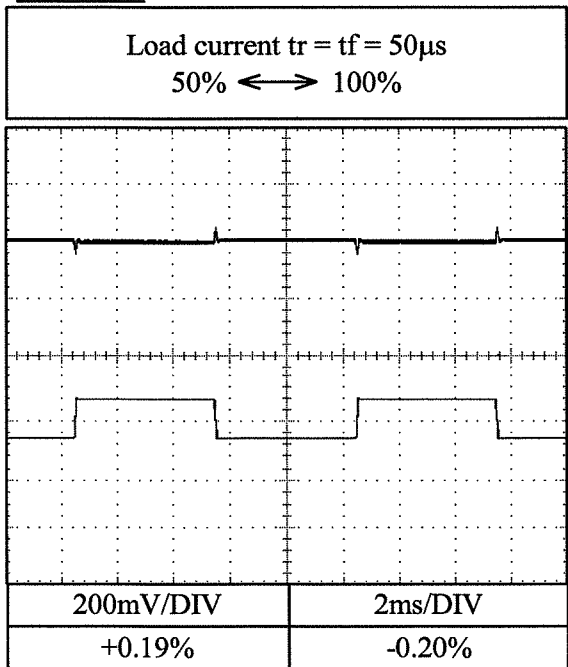
Conditions; Vin : 115VAC
Ta : 25°C

24V

f=100Hz

Load current tr = tf = 50μs 50% ⟵⟶ 100%		Load current tr = tf = 50μs 0% ⟵⟶ 100%	

⟵Vout⟶

⟵Iout⟶

200mV/DIV	2ms/DIV	200mV/DIV	2ms/DIV
+0.19%	-0.20%	+0.32%	-0.59%

f=1kHz

Load current tr = tf = 50μs 50% ⟵⟶ 100%		Load current tr = tf = 50μs 0% ⟵⟶ 100%	

⟵Vout⟶

⟵Iout⟶

200mV/DIV	200μs/DIV	200mV/DIV	200us/DIV
+0.26%	-0.23%	+0.38%	-0.66%

DENSEI-LAMBDA
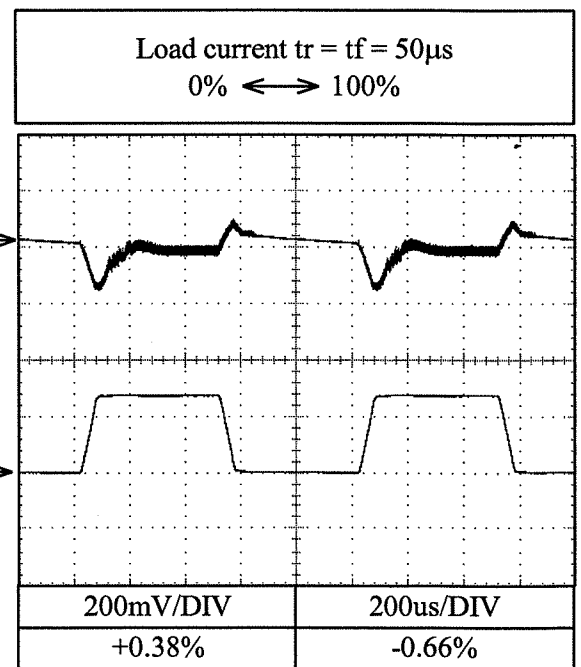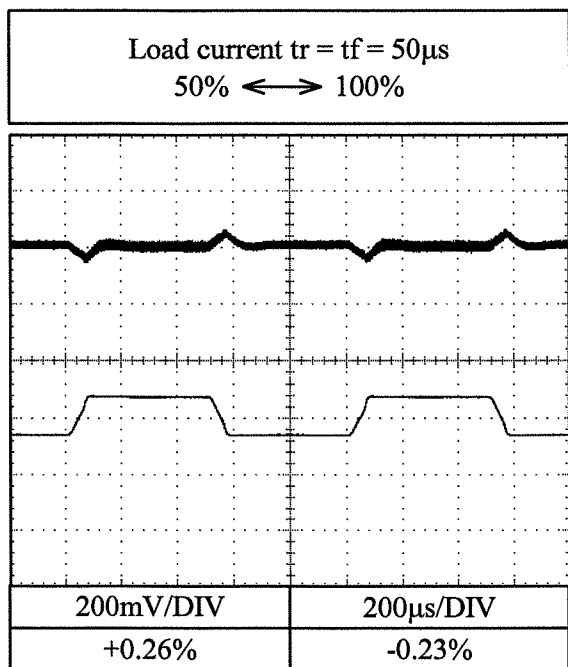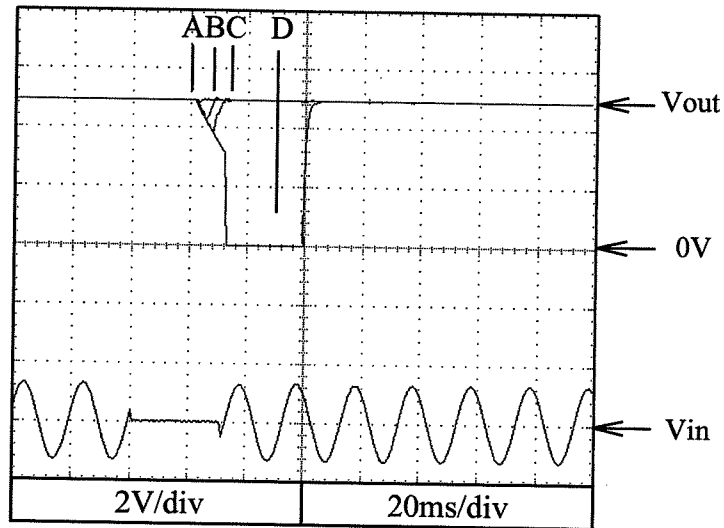
2.12 Response to brownout characteristics

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

5V

A=21ms
B=22ms
C=30ms
D=31ms

2V/div   20ms/div

12V

A=21ms
B=22ms
C=33ms
D=34ms

5V/div   20ms/div
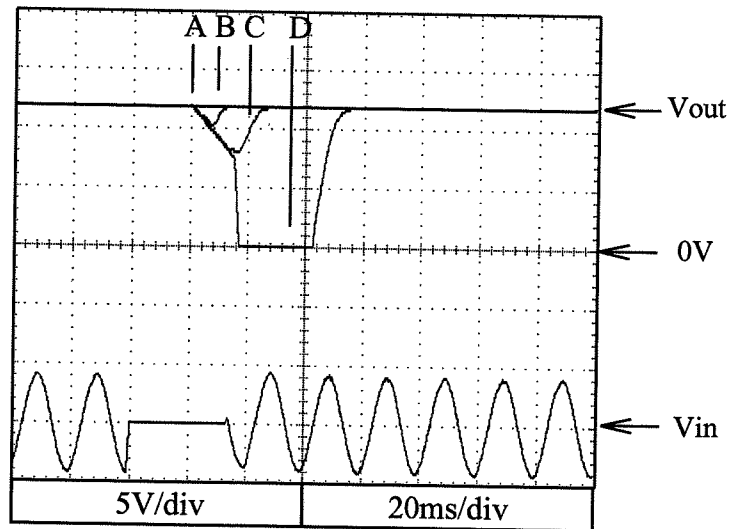
24V

A= 23ms
B= 24ms
C= 34ms
D= 35ms

10V/div   20ms/div

DENSEI-LAMBDA

T-26

2.12   Response to brownout characteristics
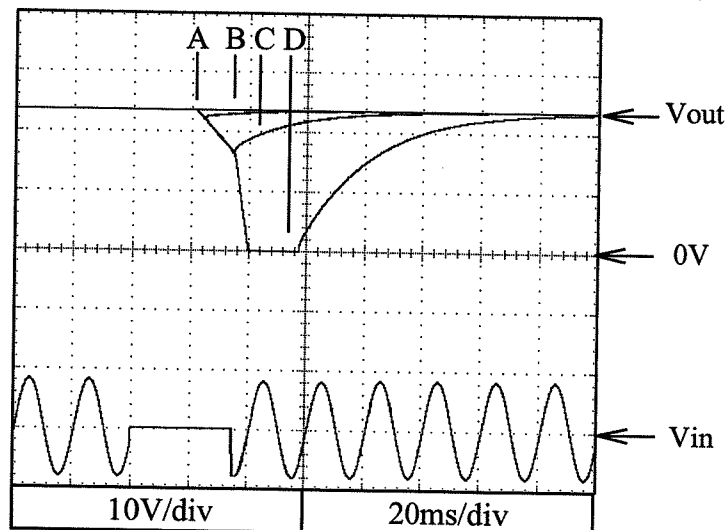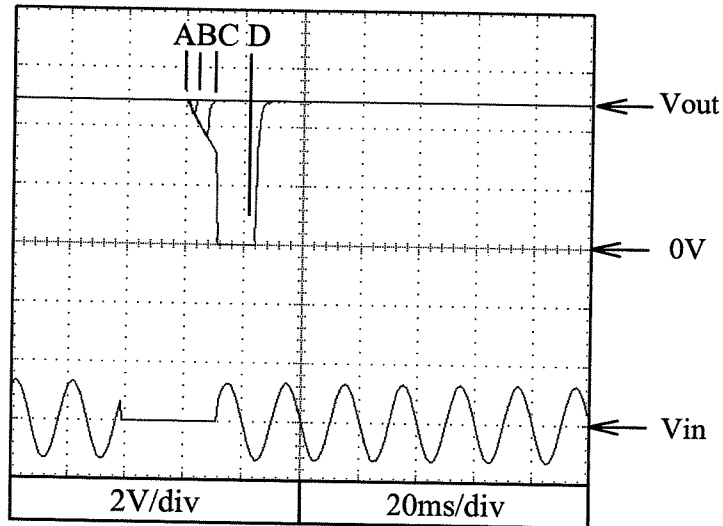
Conditions;   Vin : 230VAC
Iout : 100%
Ta   : 25°C

5V

A=22ms
B=23ms
C=32ms
D=33ms

ABC D

← Vout

← 0V

← Vin

2V/div   20ms/div

12V

A= 22ms
B= 23ms
C= 35ms
D= 36ms

AB C D

← Vout

← 0V

← Vin

5V/div   20ms/div
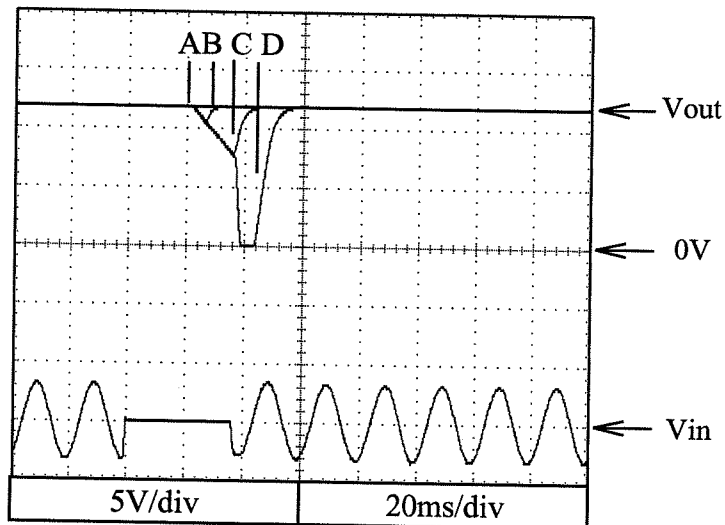
24V

A= 23ms
B= 24ms
C= 33ms
D= 34ms
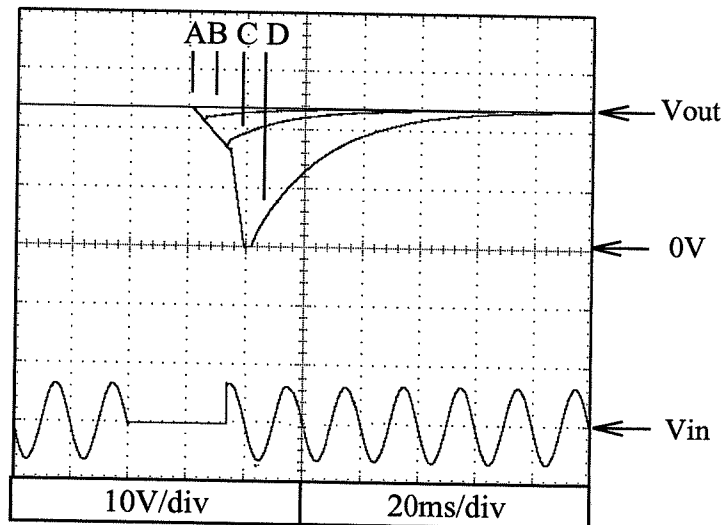
AB C D

← Vout

← 0V

← Vin

10V/div   20ms/div

DENSEI-LAMBDA

2.13   Inrush current waveform

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

5V

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

← Iin

← Vin

20A/div	100ms/div

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

← Iin

← Vin

20A/div	100ms/div

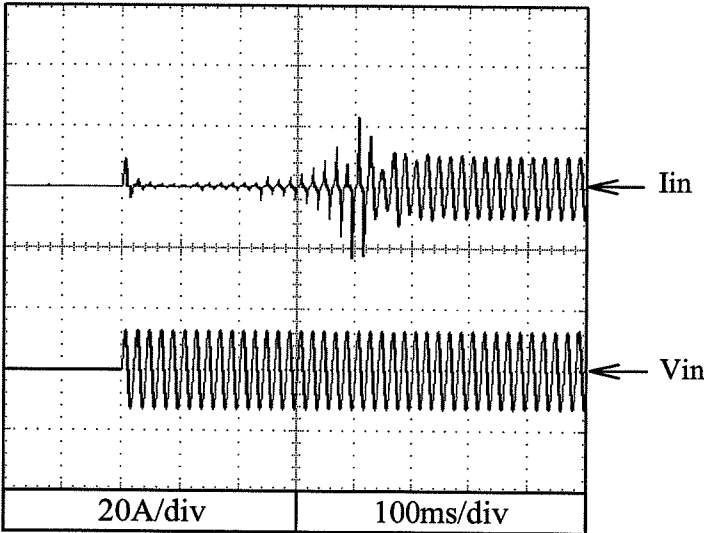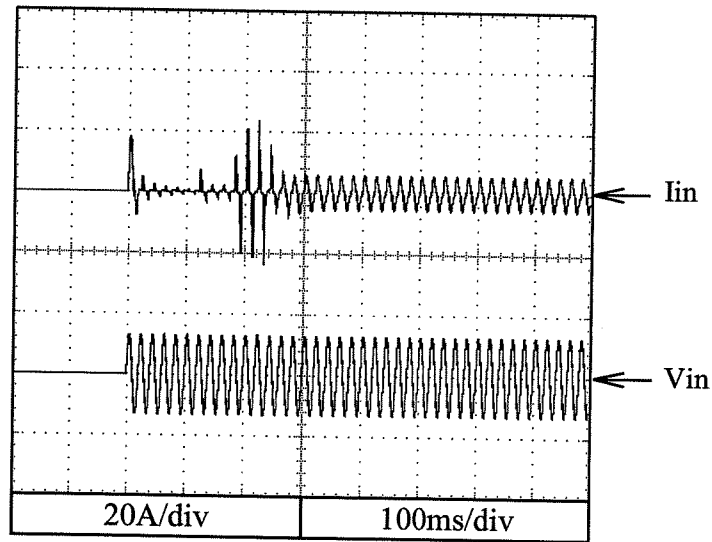## 2.13 Inrush current waveform

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

5V

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

← Iin

← Vin

20A/div	100ms/div

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

← Iin

← Vin

20A/div	100ms/div

DENSEI-LAMBDA
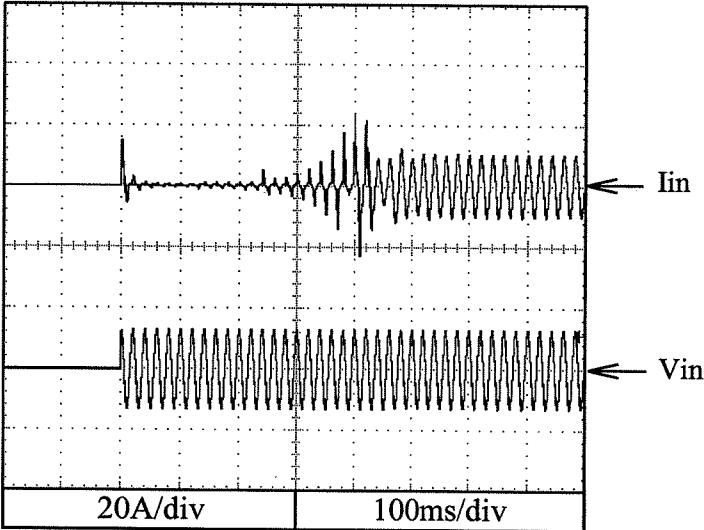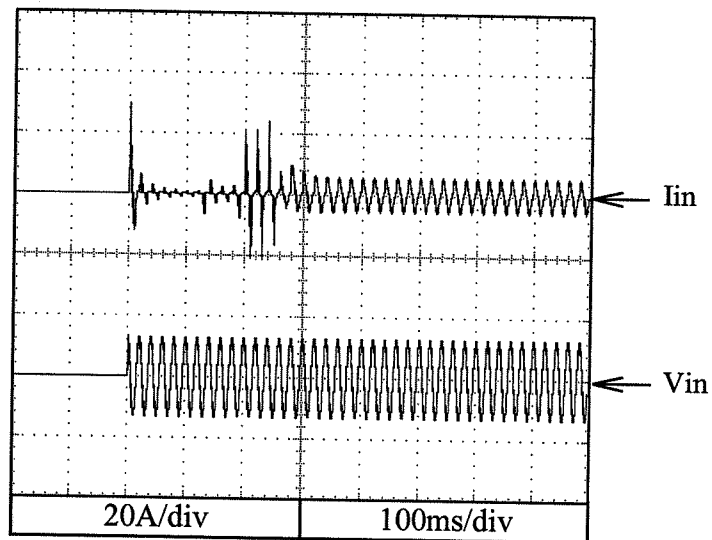
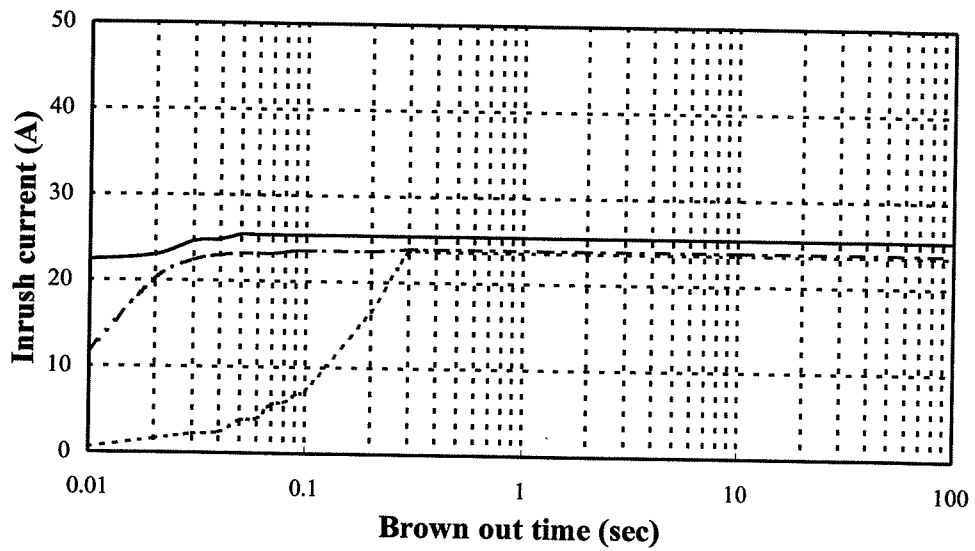**2.14 Inrush current characteristics**
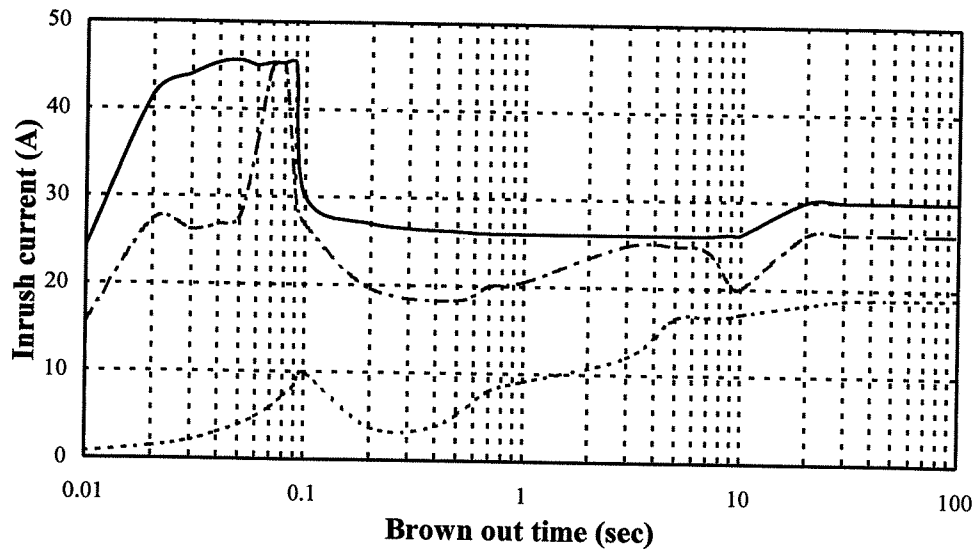
Conditions; Iout   :   0%   ─────
              :   50%   ─·──·──·
              :   100%   ─────
Ta   : 25°C

5V

Vin: 115VAC

Vin: 230VAC

Above data included secondary inrush current.

DENSEI-LAMBDA

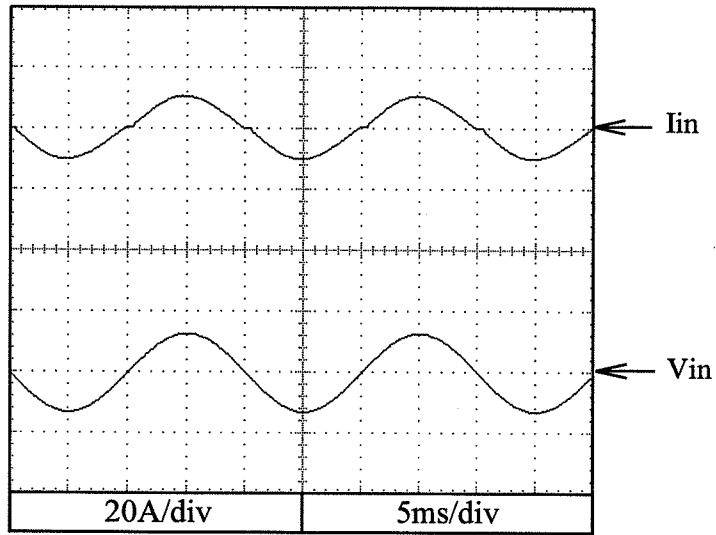**2.15   Input current waveform**   Conditions;   Iout : 100%
                                                          Ta   : 25°C

5V

Vin : 115VAC

←— Iin

←— Vin

20A/div	5ms/div

Vin : 230VAC

←— Iin

←— Vin

20A/div	5ms/div

DENSEI-LAMBDA   T-31
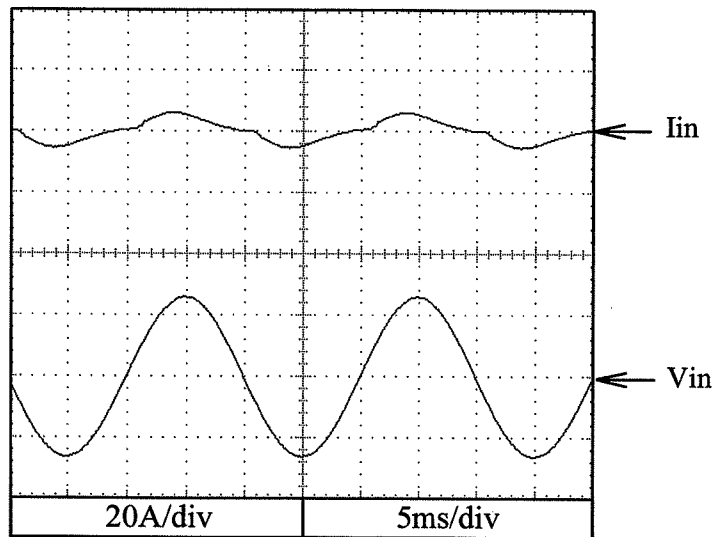
2.16   Input current harmonics

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

5V

Harmonic current(A)

IEC61000-3-2 Limit (class A)

Harmonic Order

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

Harmonic current(A)

IEC61000-3-2 Limit (class A)

Harmonic Order

DENSEI-LAMBDA
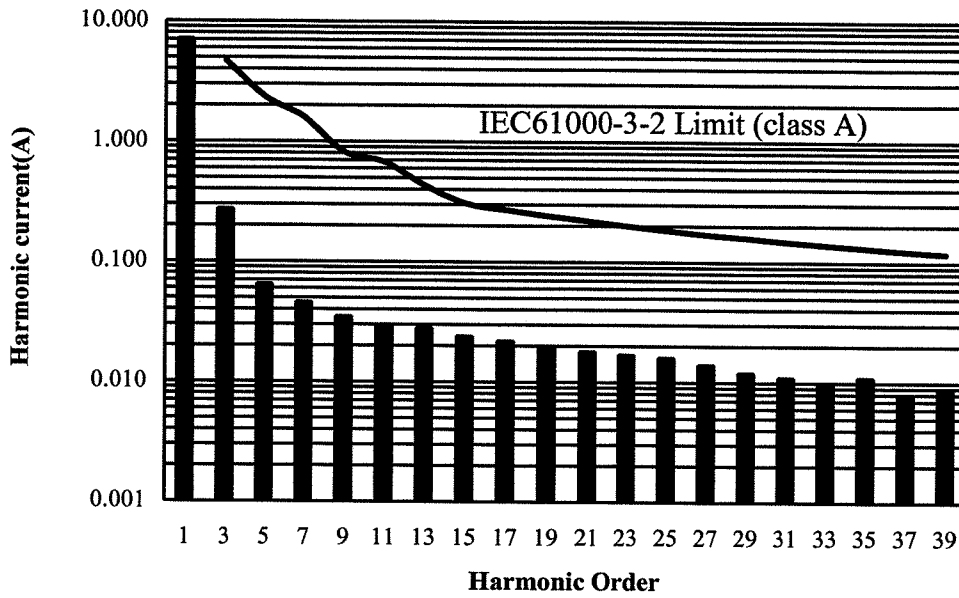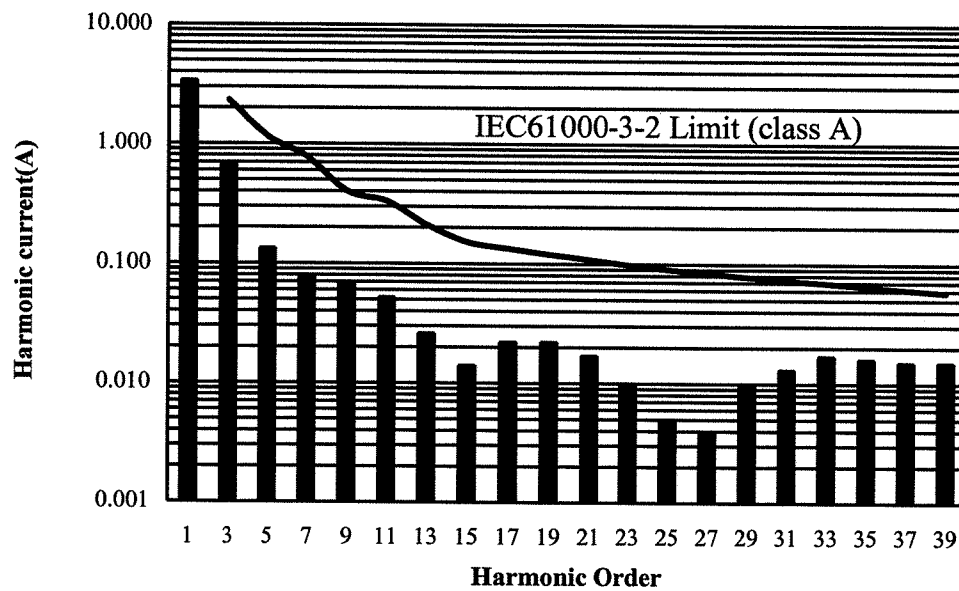
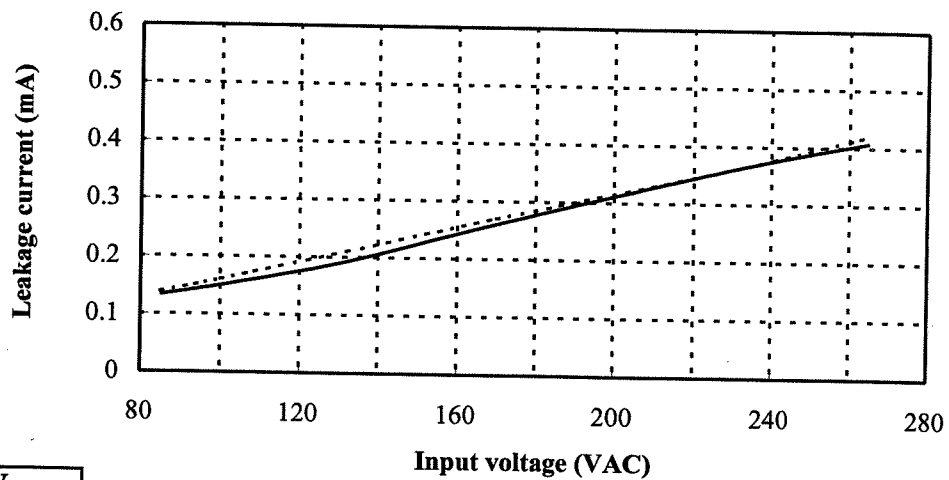### 2.17 Leakage current characteristics

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

5V

12V

24V

DENSEI-LAMBDA

2.18 Output ripple and noise waveform

NORMAL MODE

5V

20mV/DIV	1us/DIV

12V

20mV/DIV	1us/DIV

24V

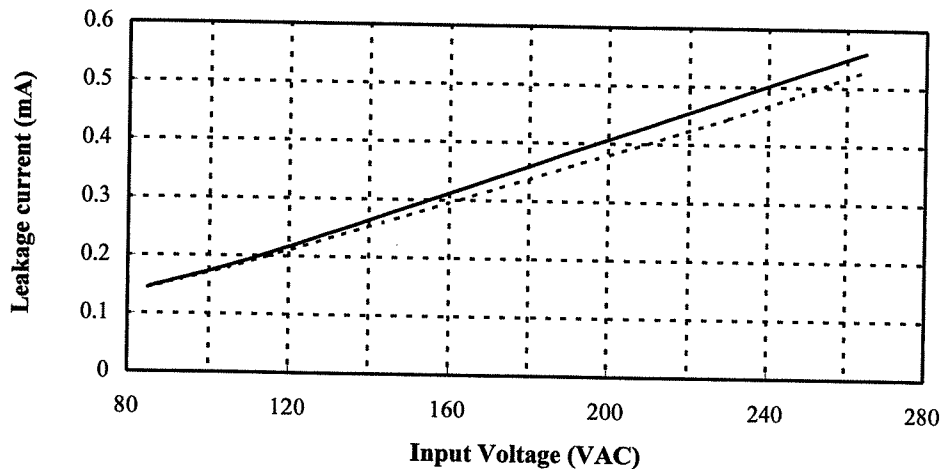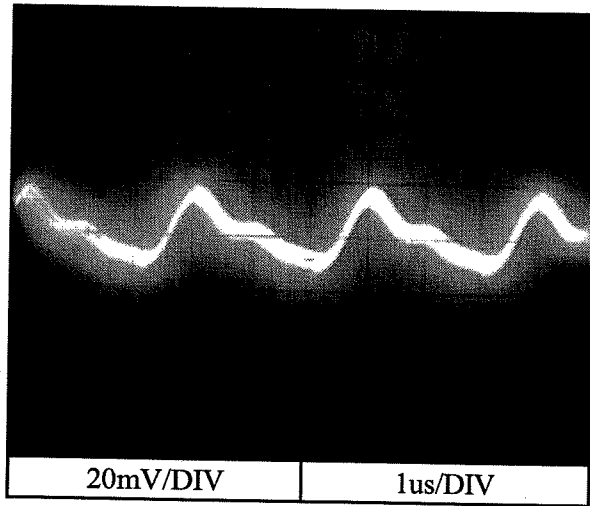| 20mV/DIV	1us/DIV

DENSEI-LAMBDA
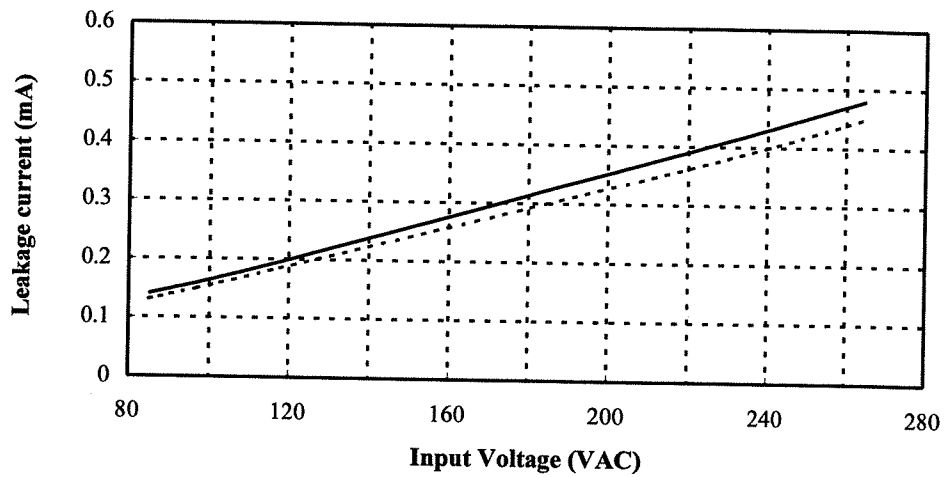
2.18 Output ripple and noise waveform
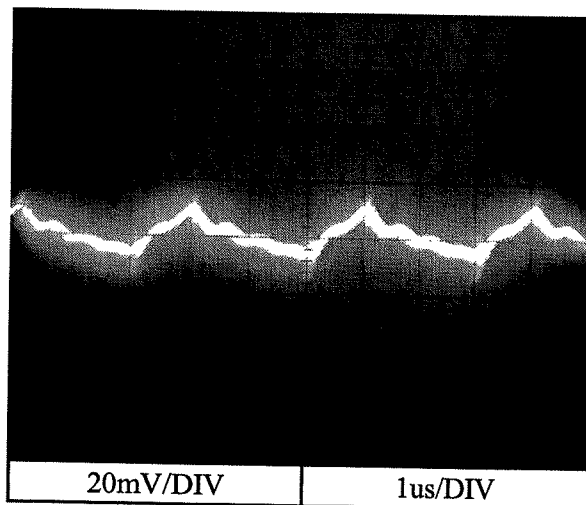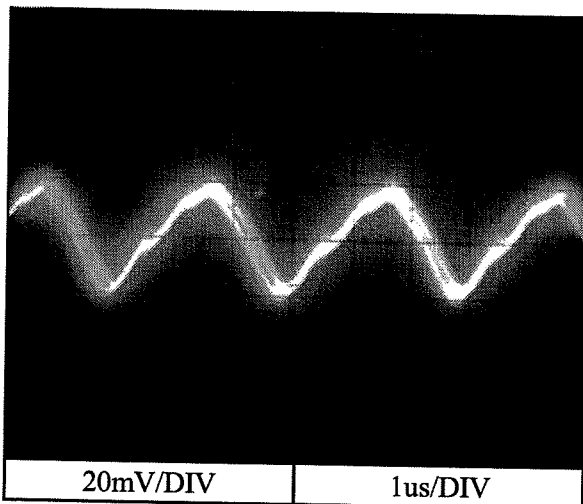
Conditions; Vin : 115VAC
Iout : 100%
Ta : 25°C

NORMAL+COMMON MODE

5V

20mV/DIV	1us/DIV

12V

20mV/DIV	1us/DIV

24V

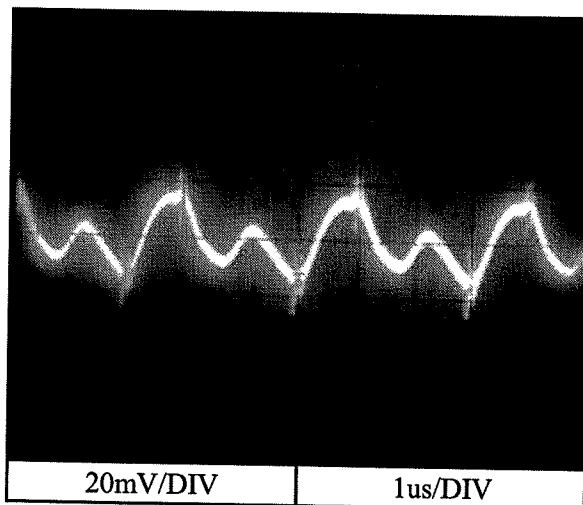| 20mV/DIV	1us/DIV

DENSEI-LAMBDA
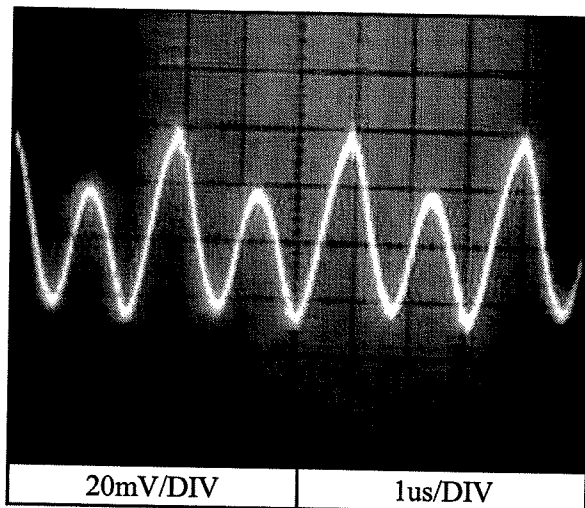
2.19 Standby current

Conditions; Ta : 25°C

5V

Io=0%
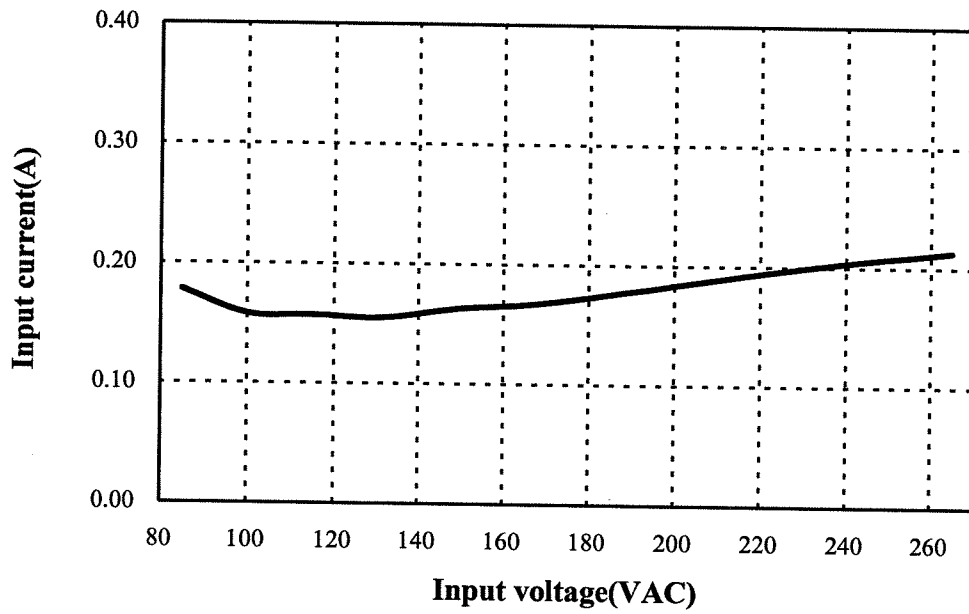
Remote control OFF
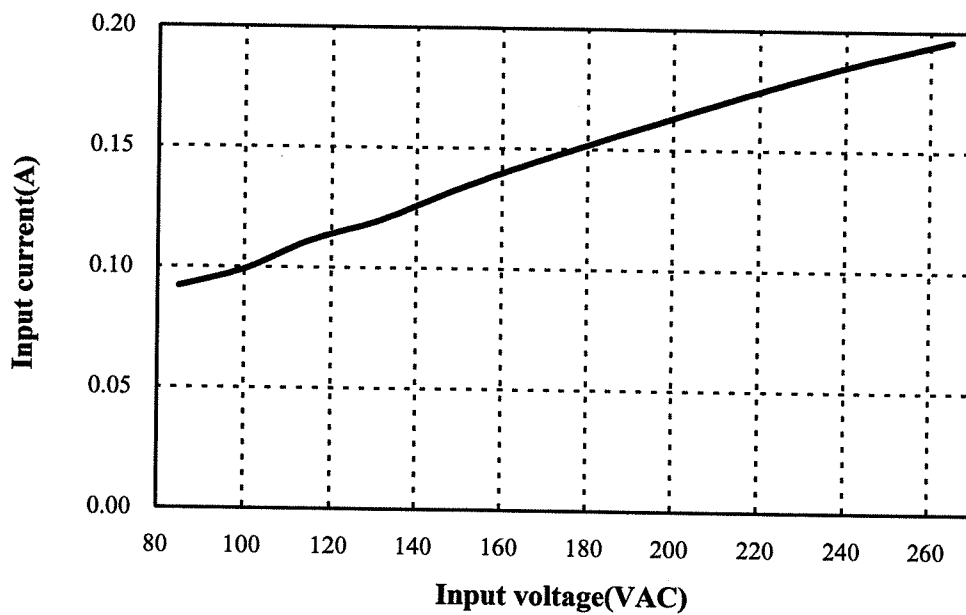
2.20   Electro-Magnetic Interference characteristics

Conditions Vin : 230VAC
Iout : 100%

Conducted Emission

5V

[dB(uV)]

Ref. Data	Point A (15.3MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	60.0	46.9
AV	50.0	42.3

VCCI Class B
QP Limit

VCCI Class B
AV Limit

Phase : L

[dB(uV)]

Ref. Data	Point B (0.33MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	59.5	42.4
AV	49.5	42.8
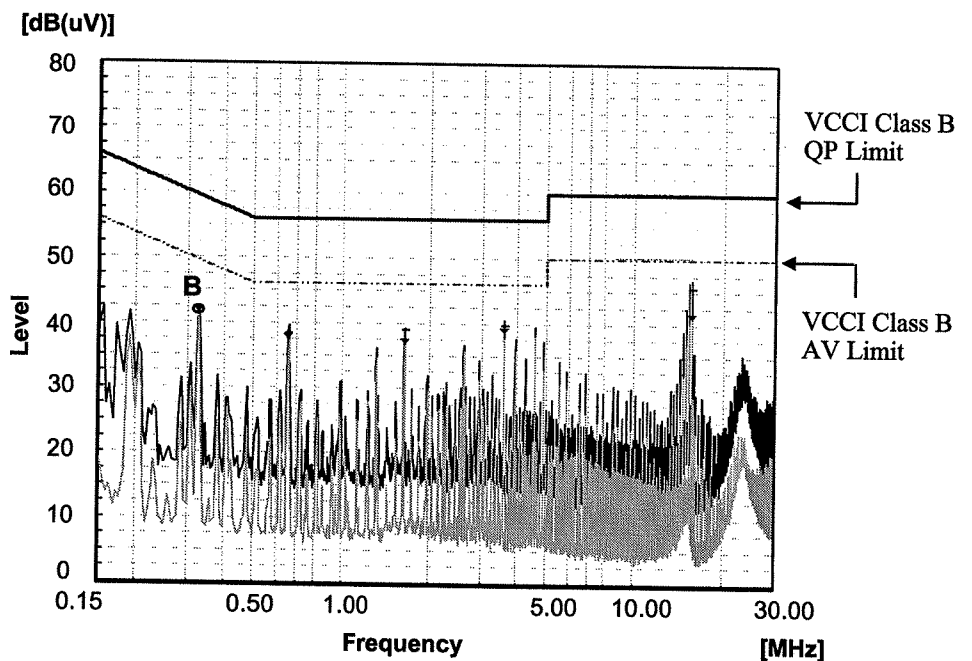
VCCI Class B
QP Limit

VCCI Class B
AV Limit

Phase : N

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

DENSEI-LAMBDA

2.20   Electro-Magnetic Interference characteristics

Conditions   Vin : 230VAC
            Iout : 100%

Conducted Emission

12V

[dB(uV)]

Ref. Data	Point A (0.183MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	64.7	46.1
AV	54.5	41.1

VCCI Class B
QP Limit

VCCI Class B
AV Limit

Phase : L

[dB(uV)]

Ref. Data	Point B (0.184MHz)	
	Limit (dBμV)	Measure (dBμV)
QP	64.5	45.8
AV	54.2	41.2

VCCI Class B
QP Limit

VCCI Class B
AV Limit

Phase : N

Limit of EN55011-B,EN55022-B are same as its VCCI Class B.
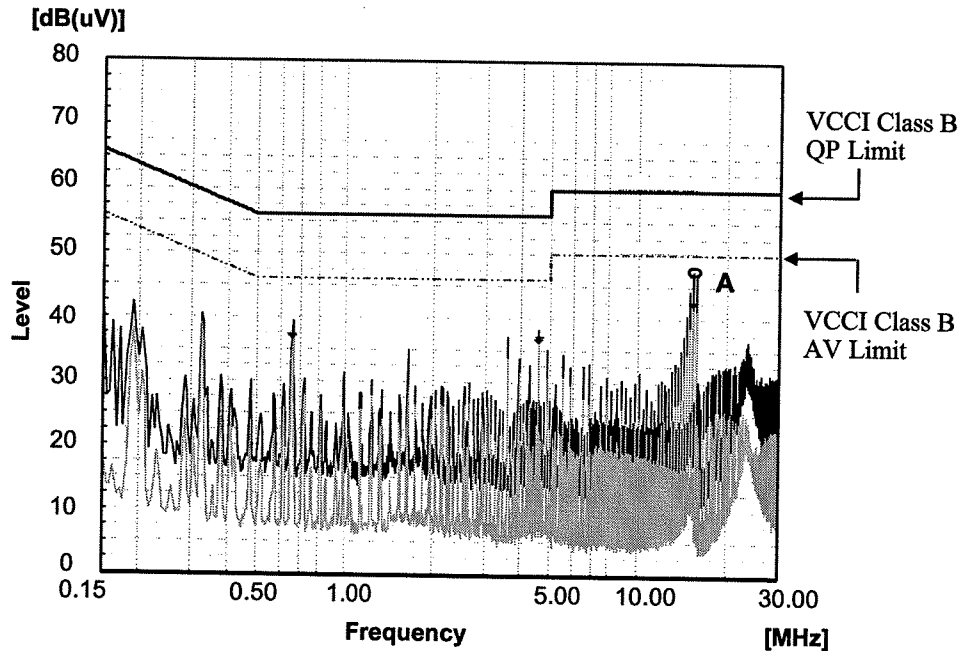
DENSEI-LAMBDA

2.20   Electro-Magnetic Interference characteristics

Conditions   Vin : 230VAC
Iout : 100%

Conducted Emission

| 24V |

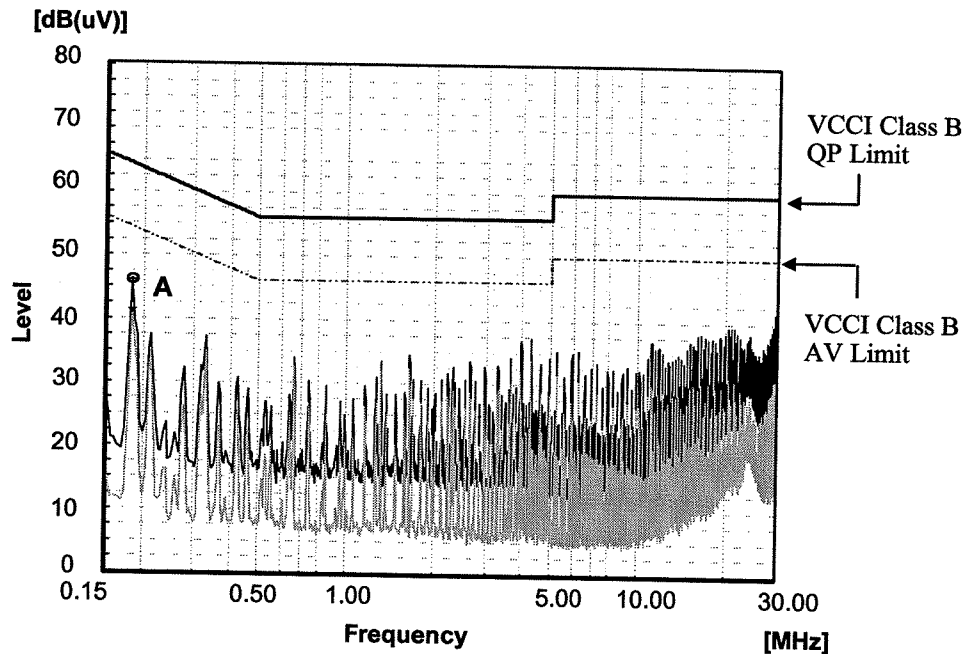| Ref.	Point A (15.1MHz)	
Data	Limit (dBμV)	Measure (dBμV)
QP	60.0	48.9
AV	50.0	38.3
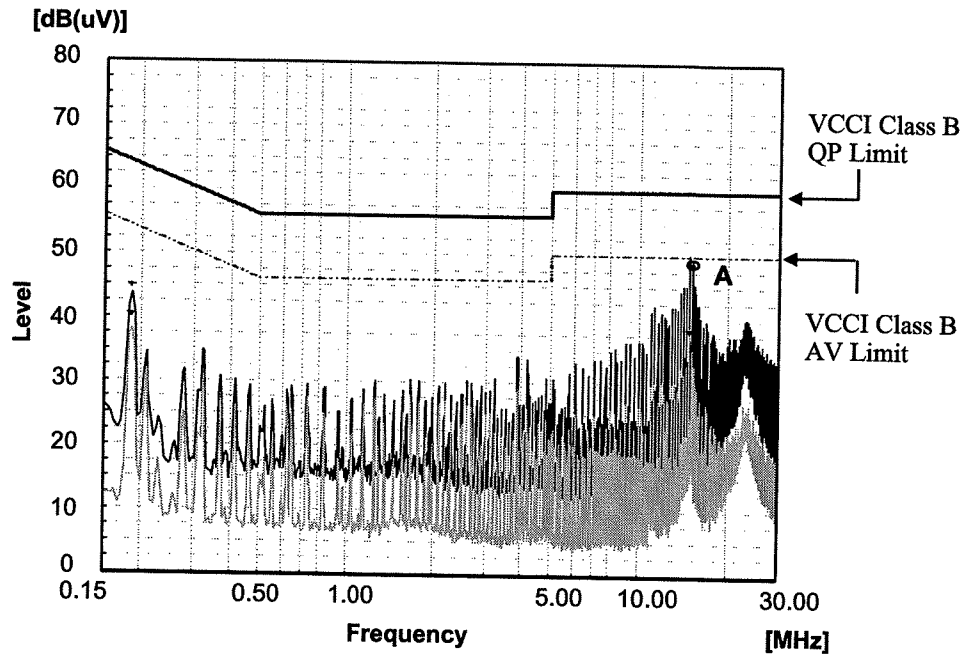
Phase : L

Ref.	Point B (0.33MHz)	
Data	Limit (dBμV)	Measure (dBμV)
QP	59.5	38.9
AV	49.5	38.2
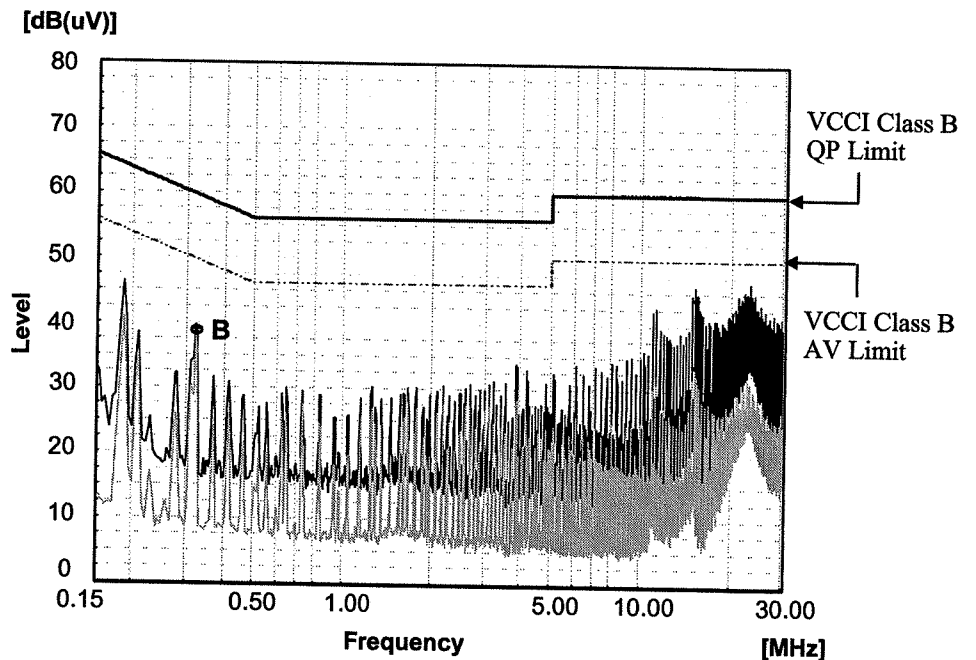
Phase : N

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

DENSEI-LAMBDA

2.20   Electro-Magnetic Interference characteristics
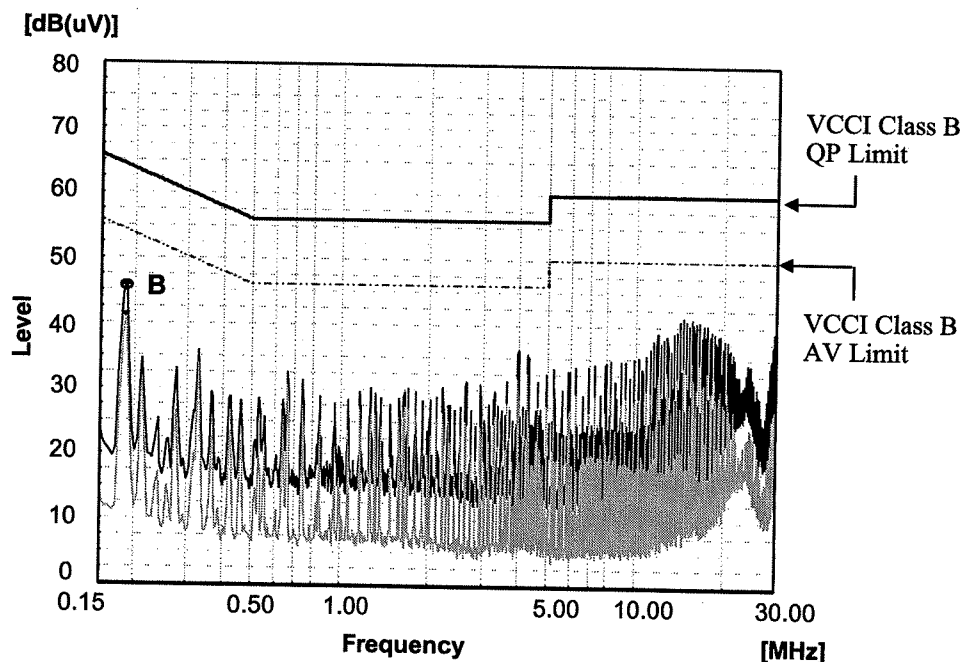
Conditions Vin : 230VAC
Iout : 100%

Radiated Emission

5V

HORIZONTAL

[dB(u V / m)]

Point A (125.7MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	27.8

VCCI Class B QP Limit

VERTICAL

[dB(u V / m)]

Point B (30.3MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	30.2

VCCI Class B QP Limit

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

DENSEI-LAMBDA

T-40

2.20   Electro-Magnetic Interference characteristics

Conditions Vin : 230VAC
Iout : 100%

Radiated Emission

```
12V
```

HORIZONTAL

[dB(u V / m)]

Point A (166.6MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	25.6

VERTICAL

[dB(u V / m)]

Point B (39.8MHz)	
Limit (dBμV/m)	Measure (dBμV/m)
40.0	32.6

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

DENSEI-LAMBDA

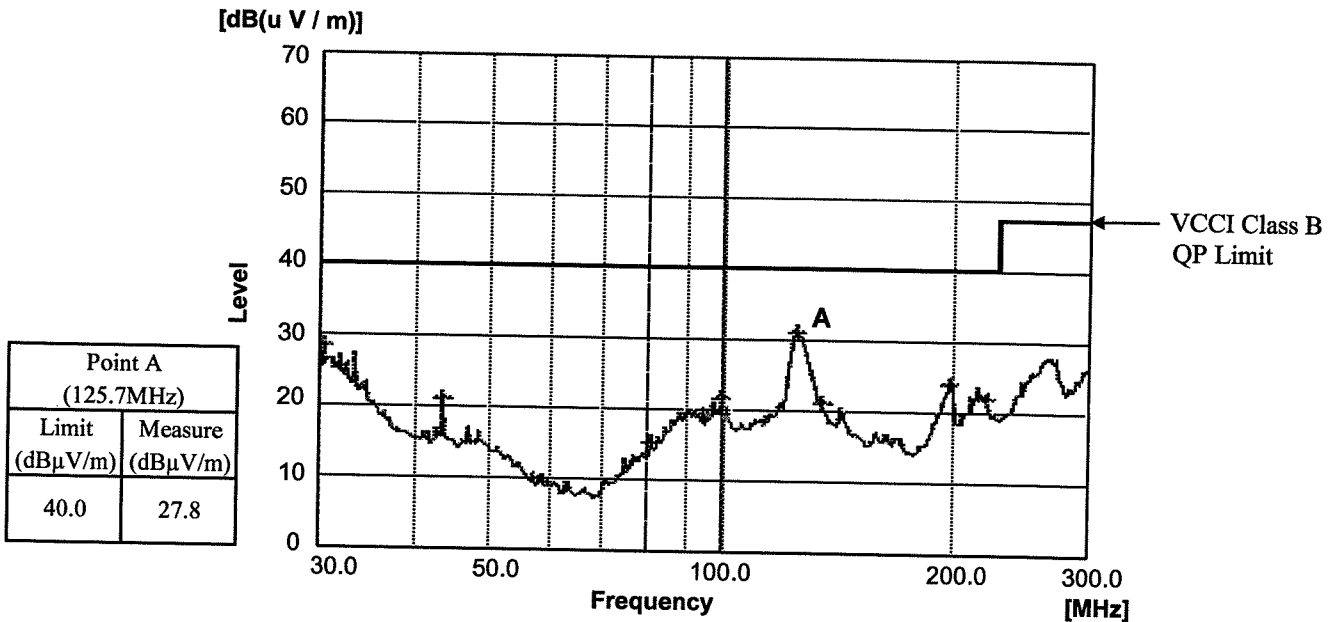**2.20   Electro-Magnetic Interference characteristics**   Conditions   Vin : 230VAC
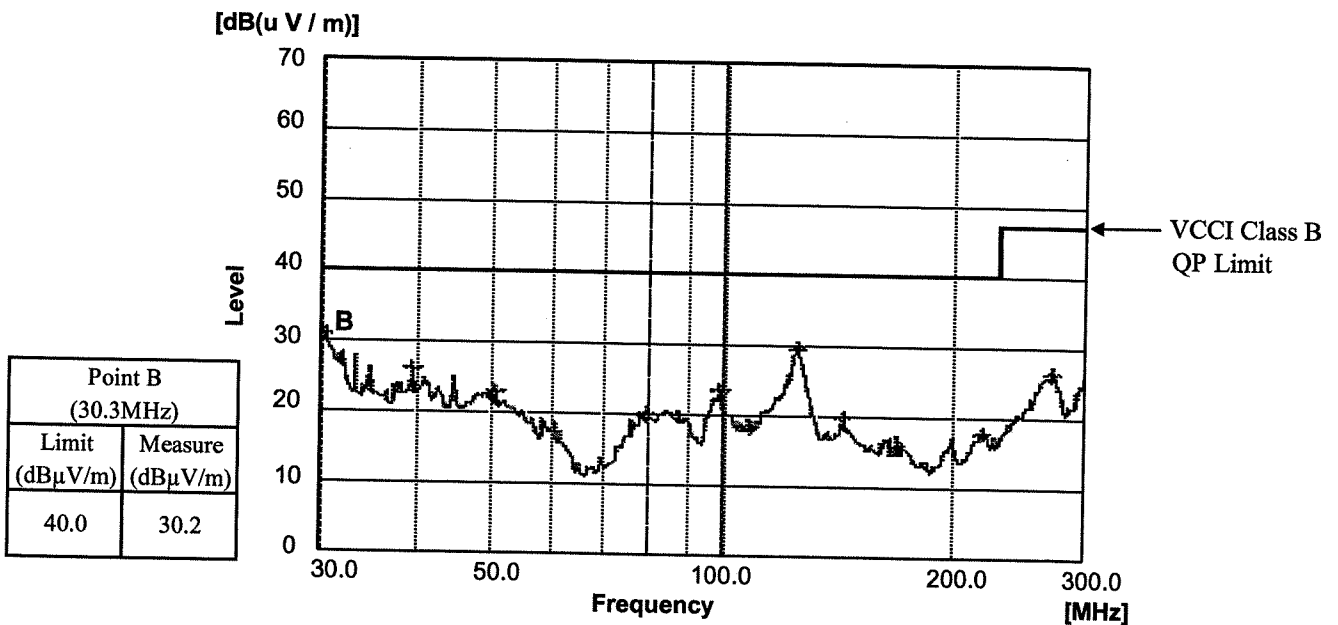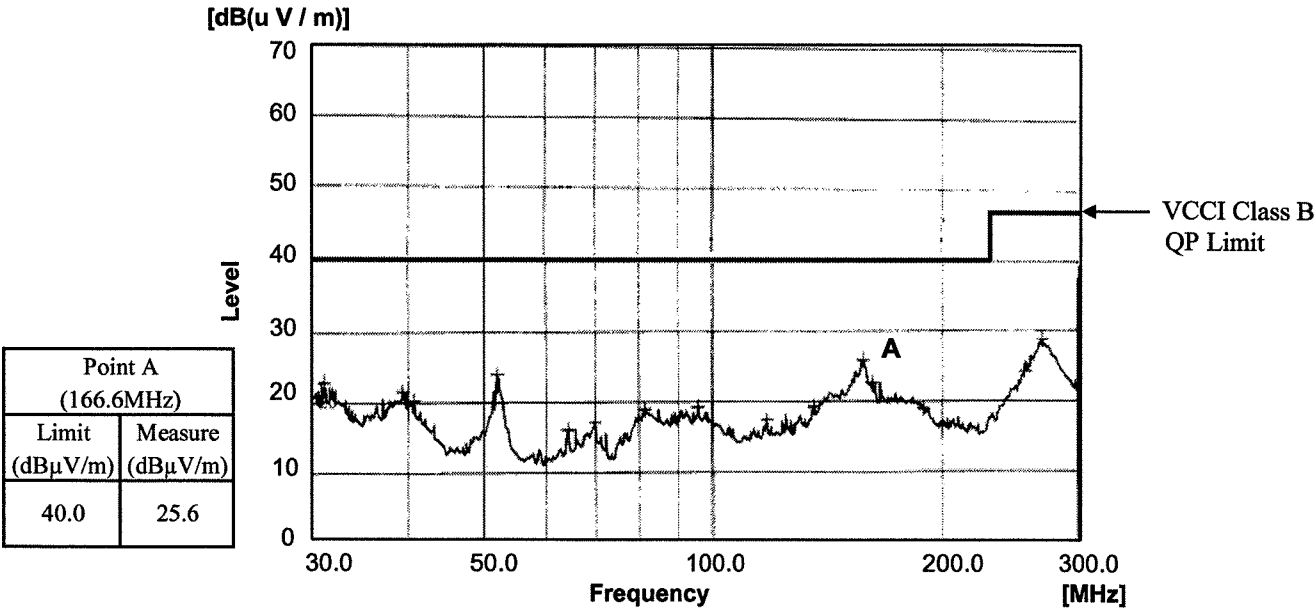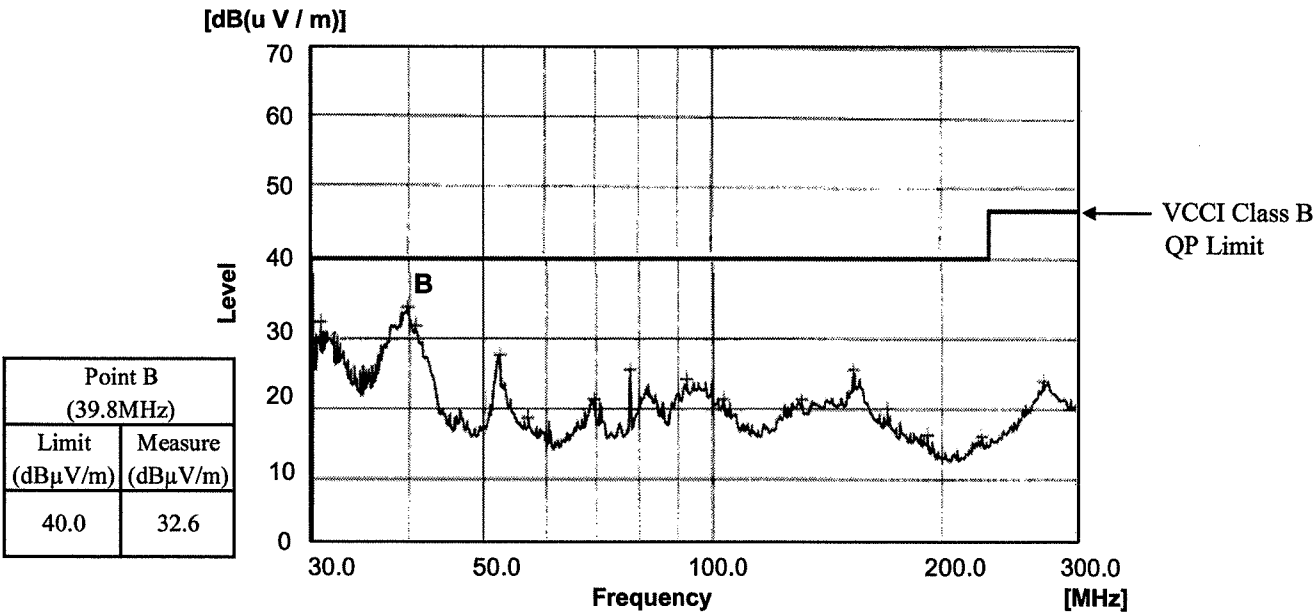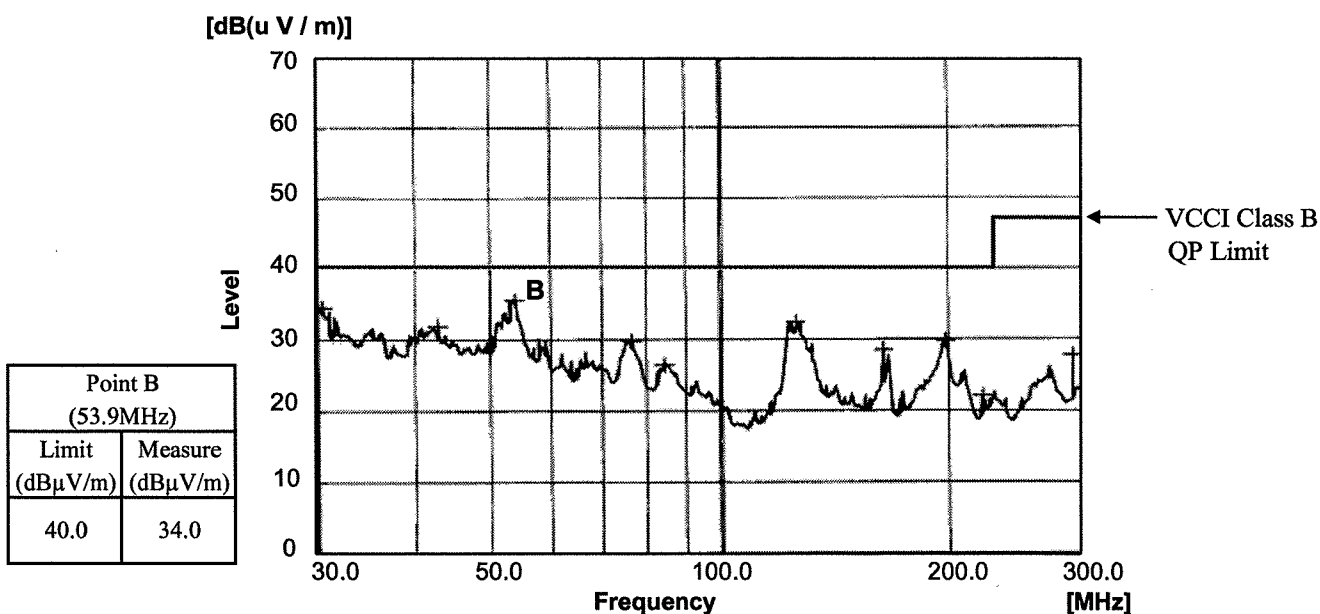   Iout : 100%

Radiated Emission

$\boxed{\text{24V}}$

HORIZONTAL

[dB(u V / m)]

Point A (128.0MHz)	
Limit (dBµV/m)	Measure (dBµV/m)
40.0	32.3

VERTICAL

[dB(u V / m)]

Point B (53.9MHz)	
Limit (dBµV/m)	Measure (dBµV/m)
40.0	34.0

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

DENSEI-LAMBDA   T-42