DLP120-24-1

EVALUATION DATA

INDEX

Terminology used

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

1.1 Circuit used for determination

(1) Measurement Circuit. 1

・Steady state data

・Warm up voltage drift characteristics

・Over voltage protection (OVP) characteristics

・Output rise characteristics

・Output fall characteristics

・Dynamic line response characteristics

・Stand-by current characteristics
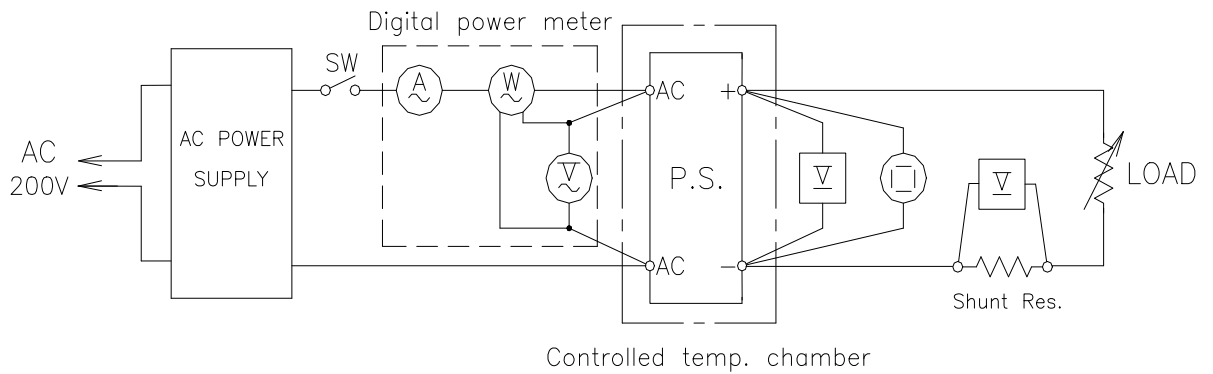
(2) Measurement Circuit. 2

・Over current protection (OCP) characteristics

TDK-Lambda

Measurement circuit. 3

·Dynamic load response characteristics

Digital power meter

AC POWER SUPPLY
AC 200V
SW
(A) (W) (V)
AC + P.S. AC −
(V) (□) (V)
Shunt Res.
Dynamic dummy load
Load 1
Load 2

Output current waveform
Iout 0% <--> 100%
100%
95%
5%
0%
tr   tf

Output current waveform
Iout 50% <--> 100%
100%
95%
55%
50%
0%
tr   tf
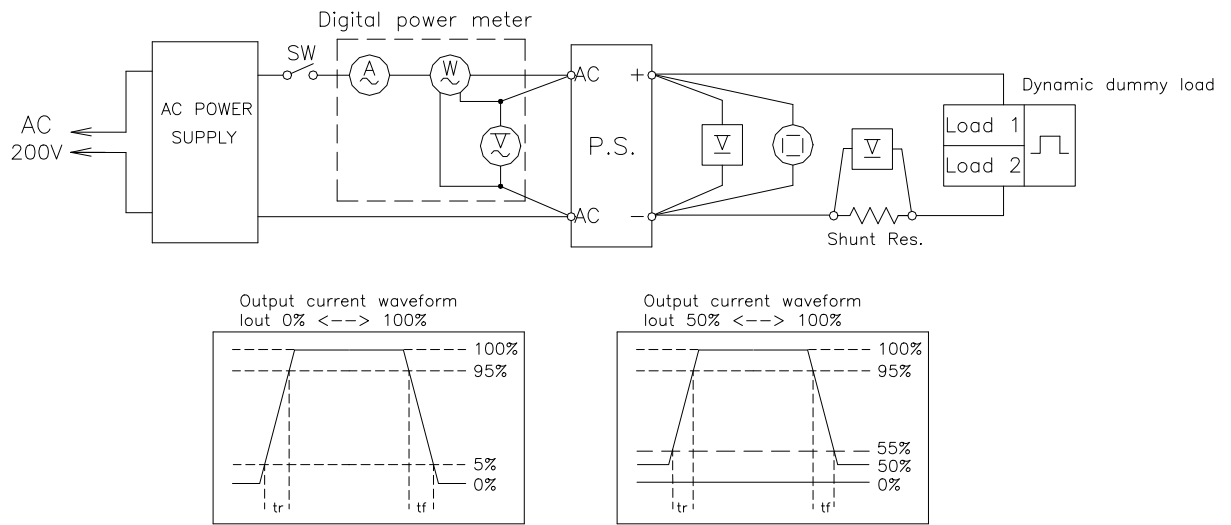
Measurement circuit. 4

·Inrush current characteristics

Digital Power meter

AC 100V 200V
Digirush Currenter
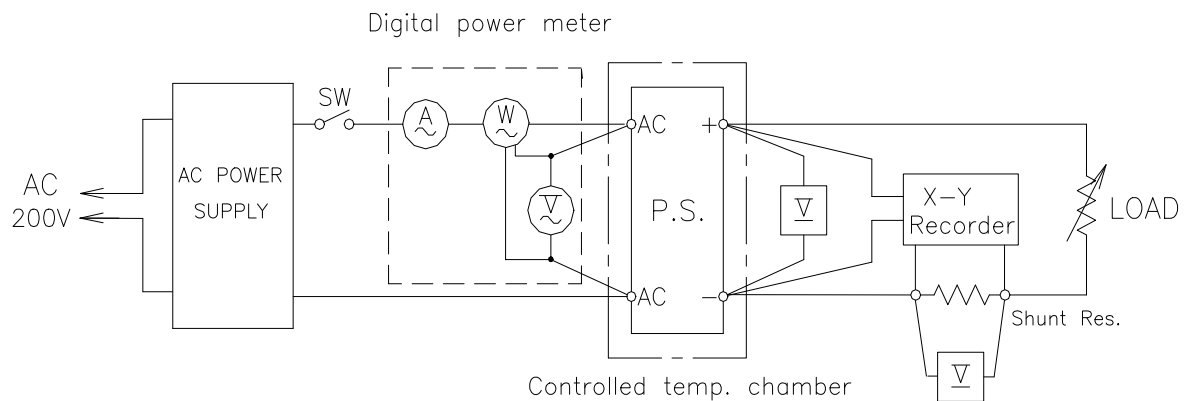SW
(□)
Current probe
(A) (W) (V)
AC + P.S. AC −
(V) (V)
LOAD
Shunt Res.
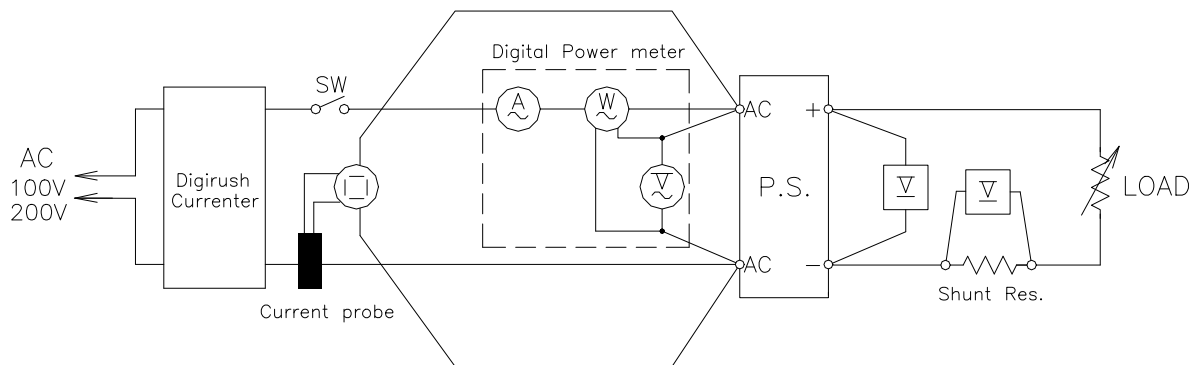
Measurement circuit. 5

·Leakage current characteristics

Digital power meter

AC 200V
S.D
SW
(A) (W) (V)
AC + P.S. AC − FG
(V) (V)
LOAD
Shunt Res.
Leakage current meter
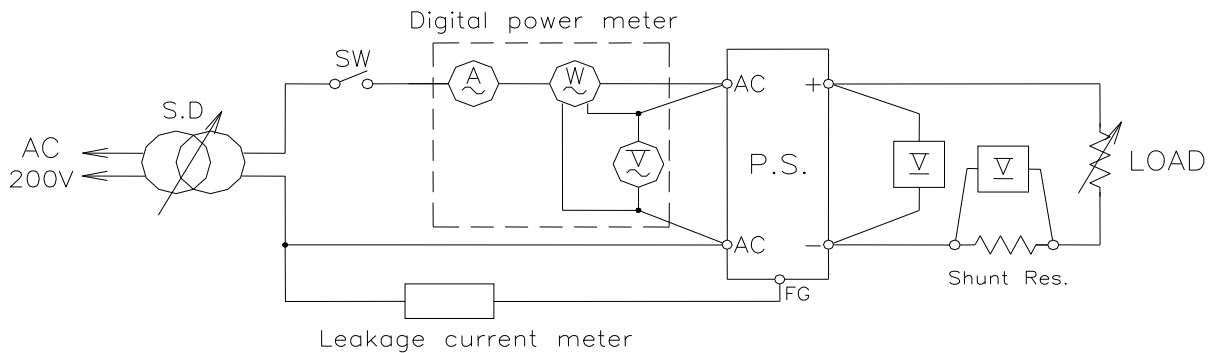
NOTE : Leakage current measured through a 1k ohm resistor.

Range used ··· AC + DC   (For YOKOGAMA : TYPE3226)

AC   (For SIMPSON : MODEL 228)

Measurement circuit. 6

・Output ripple and noise

(a)　Normal Mode (JEITA Standard RC-9131)

Digital power meter

SW

Slide Reg.

AC
200V

P.S.

AC

AC

FG

150mm

C2　C3

Load

1.5m　50Ω Cable

R

C1

Oscilloscope
Bandwidth : 100MHz

R : 50 Ω
C1: 4700pF Film Capacitor
C2: 100uF Electrolytic Capacitor
C3: 0.1uF Film Capacitor
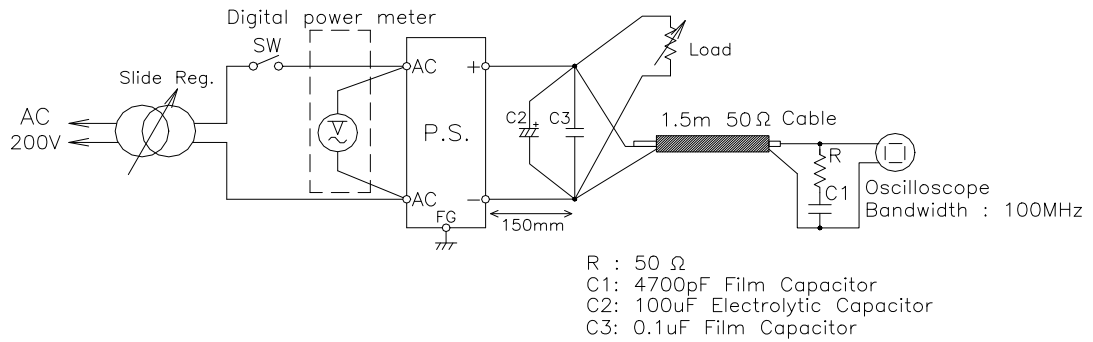
Measurement circuit. 7

・Output ripple and noise

(b)　Normal + Common Mode

Digital power meter

SW

Slide Reg.

AC
200V

P.S.

AC

AC

FG

C2　C3

Load

1.5m　50Ω Cable

L1

L2

Oscilloscope
Bandwidth : 100MHz

L1: 150mm
L2: 246mm
C2: 100uF Electrolytic Capacitor
C3: 0.1uF Film Capacitor
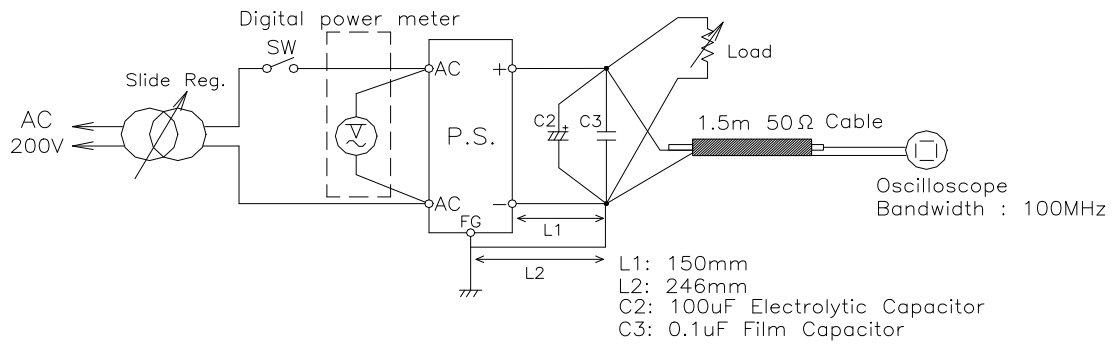
Measurement circuit. 8

・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

D=80cm

AC Cord

Stand

H=80cm

Metal Ground Plain

Earth

Filter

Input Line
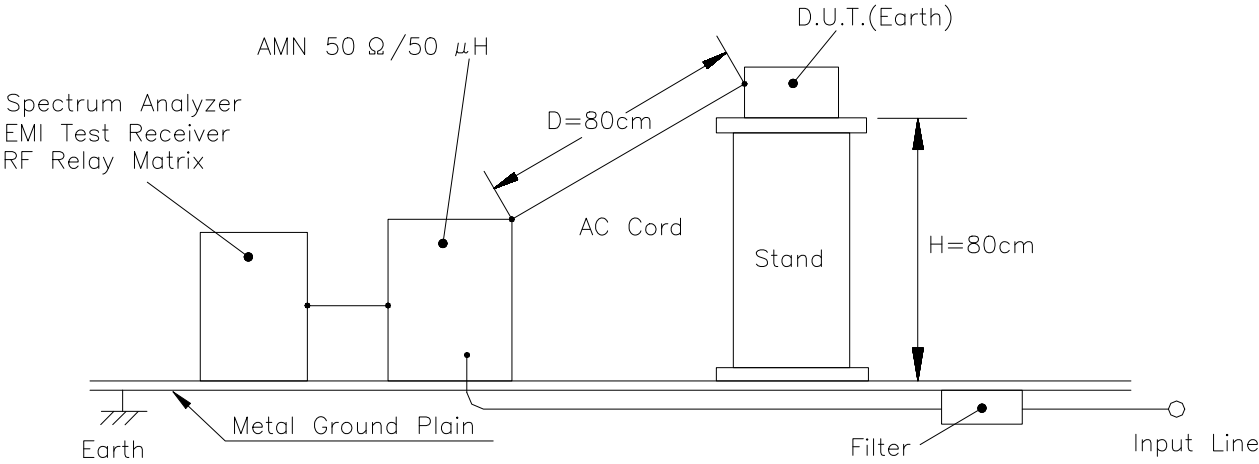
Measurement circuit. 9

・Electro-Magnetic Interference characteristics

(b) Radiated Emission Noise

D=3m

Spectrum Analyzer
EMI Test Receiver
RF Relay Matrix

Biconical Antenna

D.U.T.(Earth)

Stand

Turn Table

H=80cm

Metal Ground Plain

Earth

Filter

Input Line
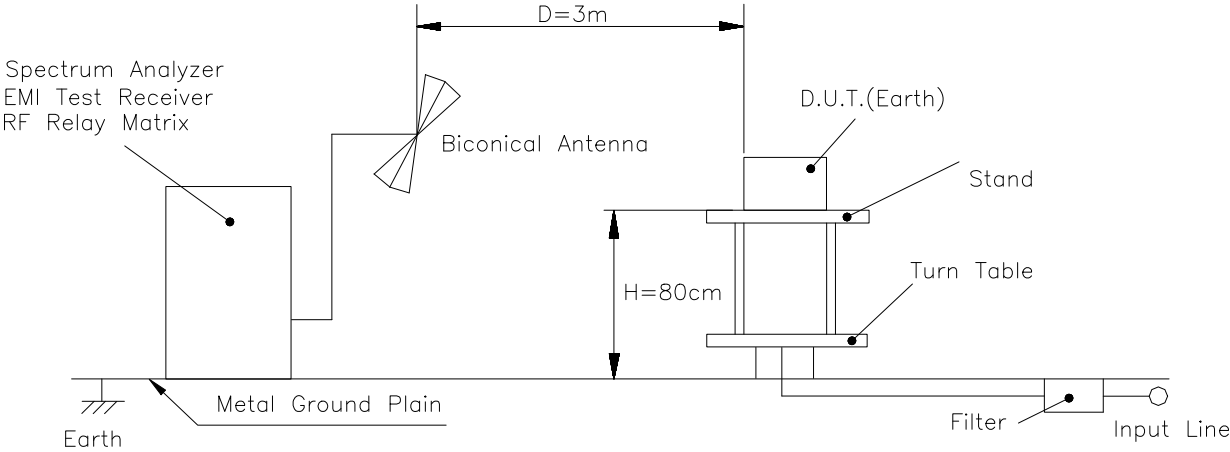
1.2   LIST OF EQUIPMENT USED

	EQUIPMENT USED	MANUFACTURER	MODEL NO.
1	OSCILLOSCOPE	HITACHI	V-1100A
2	DIGITAL STORAGE OSCILLOSCOPE	TEKTRONIX	TDS754C
3	DIGITAL MULTIMETER	ADVANTEST	R6551
4	DIGITAL POWER METER	YOKOGAWA ELECT.	WT110E
5	SHUNT RSISTOR	YOKOGAWA ELECT.	2215
6	DYNAMIC DUMMY LOAD	TAKASAGO	FK-200L
7	CURRENT PROBE/AMPLIFIER	TEKTRONIX	A6303/AM503
8	CONTROLLED TEMP. CHAMBER	TABAI-ESPEC	SH-240SI
9	AC POWER SUPPLY	TAKASAGO	AA2000XG
10	LEAKAGE CURRENT METER	SIMPSON	MODEL229-2
11	LEAKAGE CURRENT METER	YOKOGAWA ELECT.	TYPE3226
12	X-Y RECORDER	GRAPHTEC	WX3000
13	SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSA
14	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESHS10
15	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESVS10
16	RF RELAY MATRIX	ROHDE & SCHWARZ	PSU
17	AMN	KYORITU DENSHI	KNW-242
18	ANTENNA(BICONICAL ANTENA)	SCHWARZBECK	BBA9106

2. Characteristics

2.1 Steady state data
 (1) Regulation - line and load, temperature drift

24V

1. Regulation-line and load

Iout \ Vin	85VAC	100VAC	230VAC	265VAC	line regulation	
0%	24.029V	24.030V	24.030V	24.030V	0.001V	0.004%
50%	24.013V	24.013V	24.013V	24.013V	0.000V	0.000%
100%	23.996V	23.997V	23.997V	23.997V	0.001V	0.004%
load	0.033V	0.033V	0.033V	0.033V		
regulation	0.138%	0.138%	0.138%	0.138%		

2. Temperature drift

Conditions; Vin = 100VAC

Iout = 100%

Ta	-10°C	+25°C	+50°C	Temperature stability	
Vout	24.011V	23.997V	23.962V	0.049V	0.20%

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

Conditions; Iout : 100%
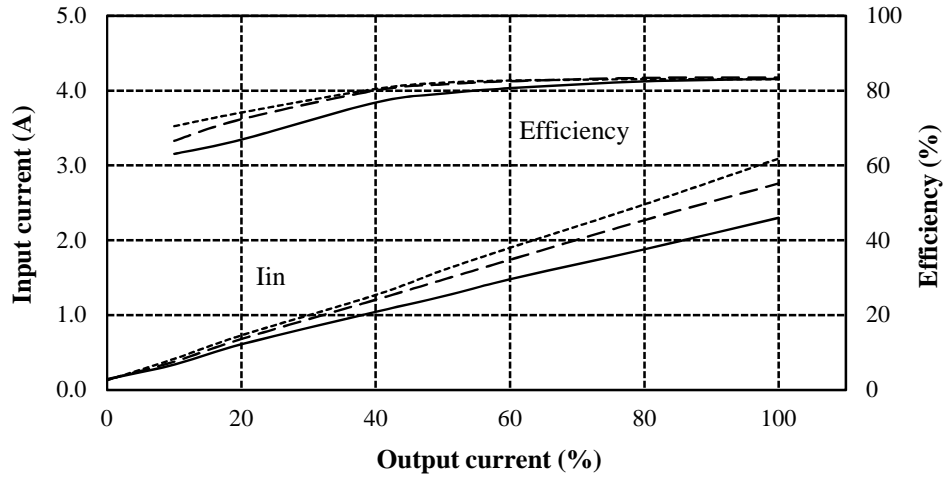
Ta : -10°C -------
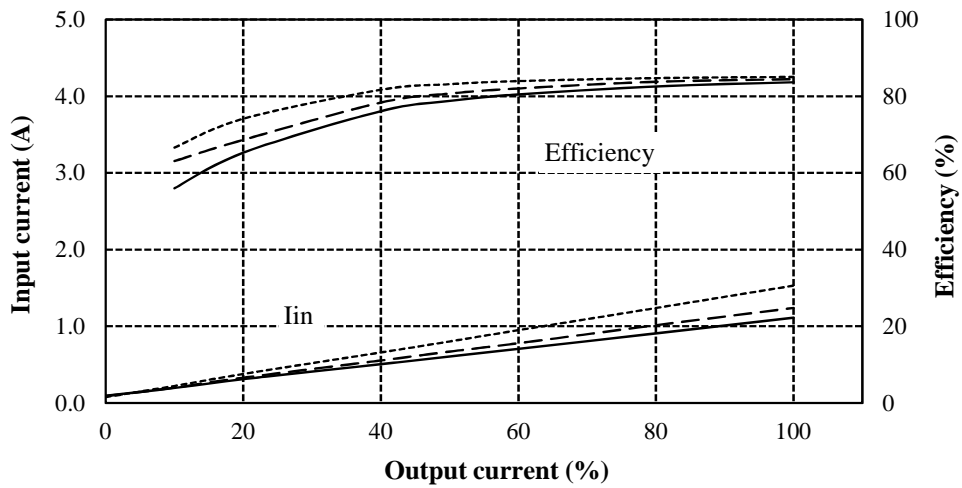
: 25°C - - - - -

: 50°C ———

24V

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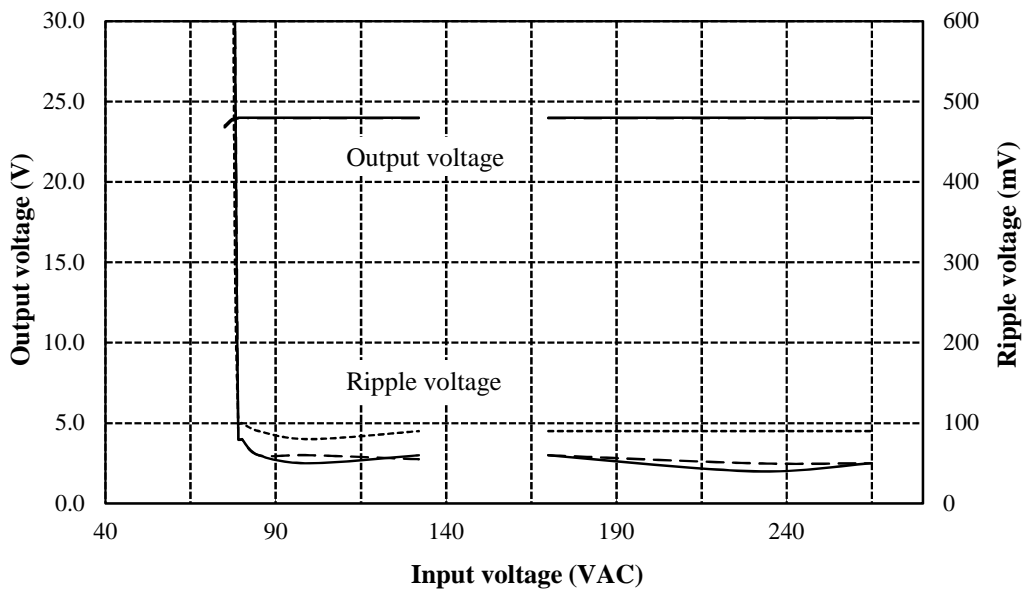
2.1 (3)   Efficiency and input current v.s. Output current

Conditions; Vin : 85VAC   ----------
             : 100VAC   ----------
             : 132VAC   _____
        Ta   : 25°C

24V

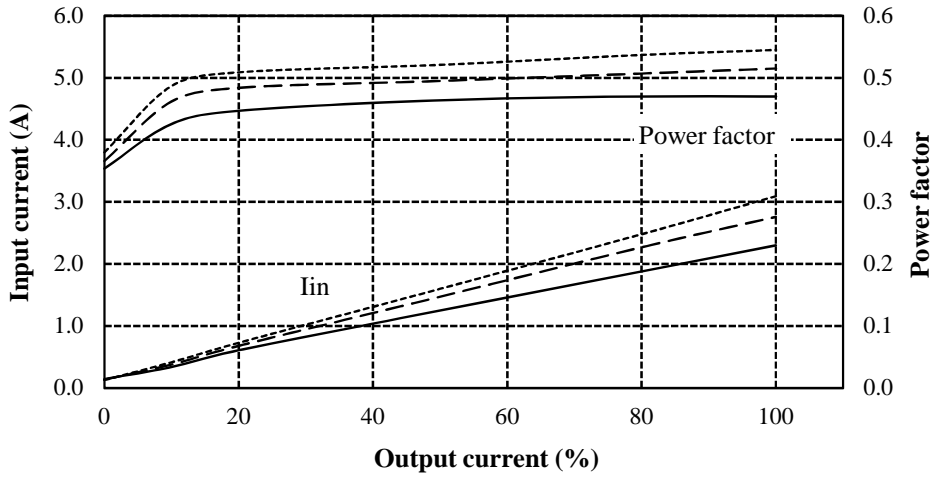
Conditions; Vin : 170VAC   ----------
             : 230VAC   ----------
             : 265VAC   _____
        Ta   : 25°C

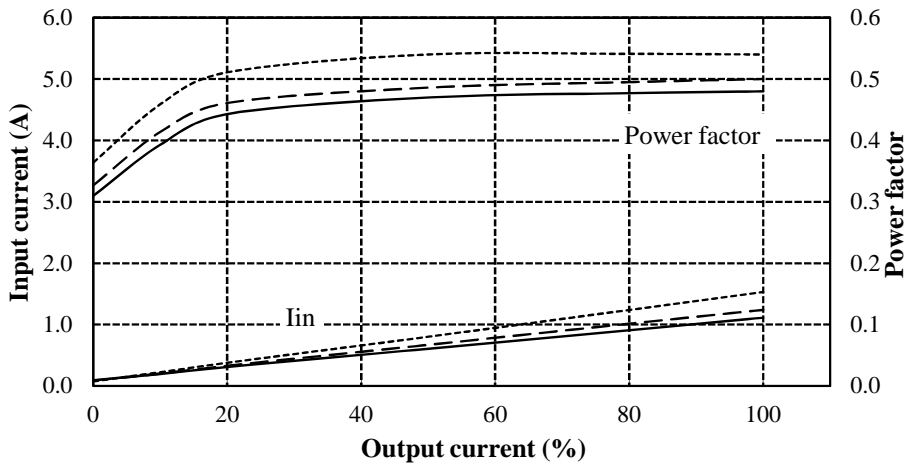**2.1 (4)   Power factor and Input current v.s Output current**

Conditions; Vin   : 85VAC   ----------
                  : 100VAC   ----------
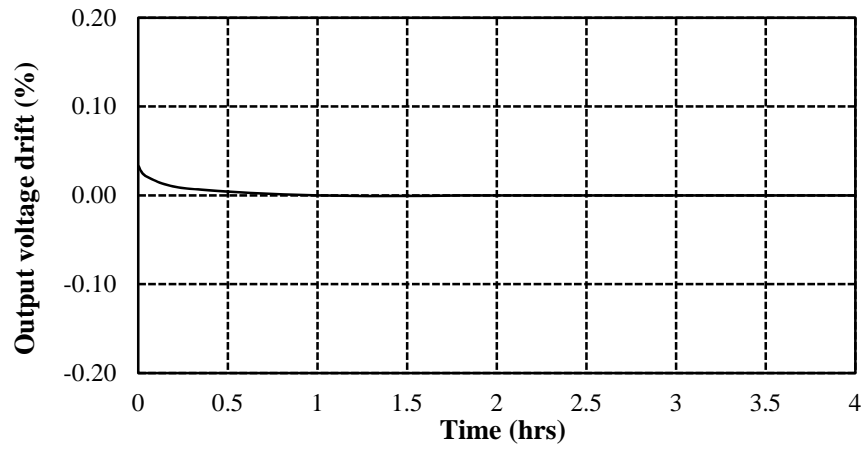   : 132VAC   ————
        Ta   : 25°C

24V

Conditions; Vin   : 170VAC   ----------
                  : 230VAC   ----------
                  : 265VAC   ————
        Ta   : 25°C

TDK-Lambda   T-8

2.2 Warm up voltage drift characteristics

24V

Output voltage drift (%) vs Time (hrs)

0.20	
0.10	
0.00	
-0.10	
-0.20	

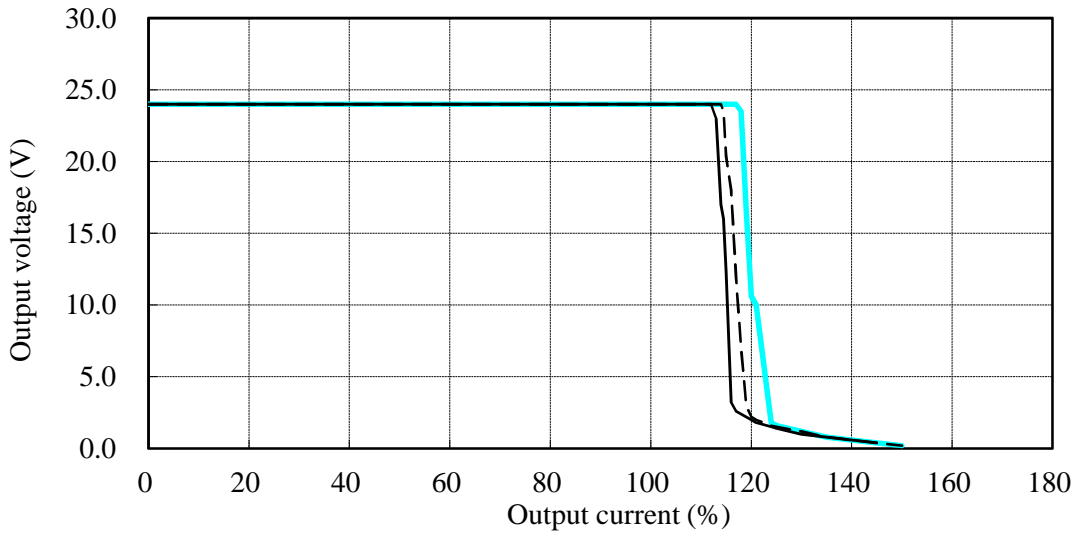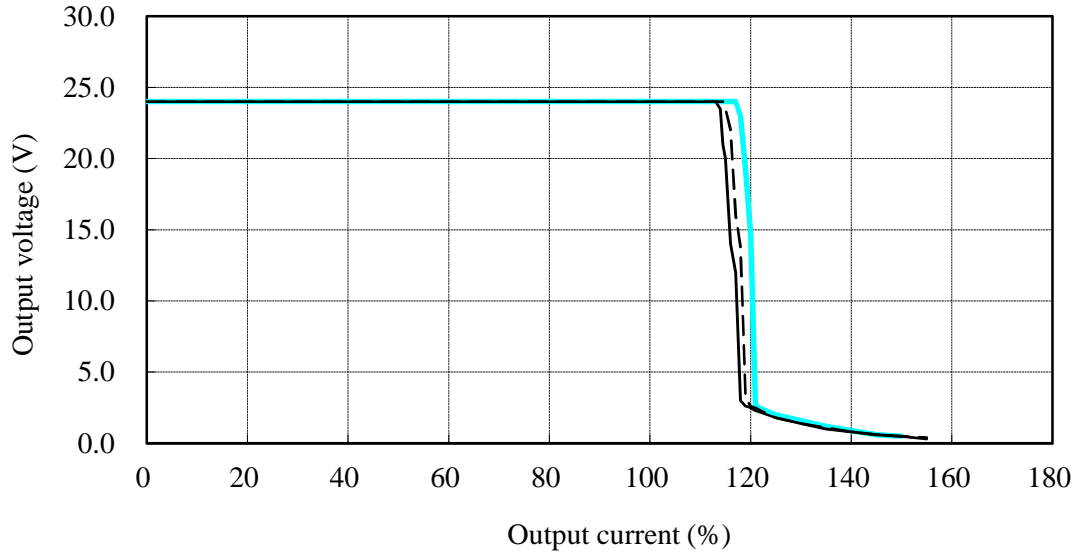Time (hrs): 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4

TDK-Lambda

2.3 Over current protection (OCP) characteristics

Conditions ; Ta : -10 °C ━━━
: 25 °C ─ ─ ─ ─
: 50 °C ────
Vin : 100VAC

24V

Conditions ; Ta : -10 °C ━━━
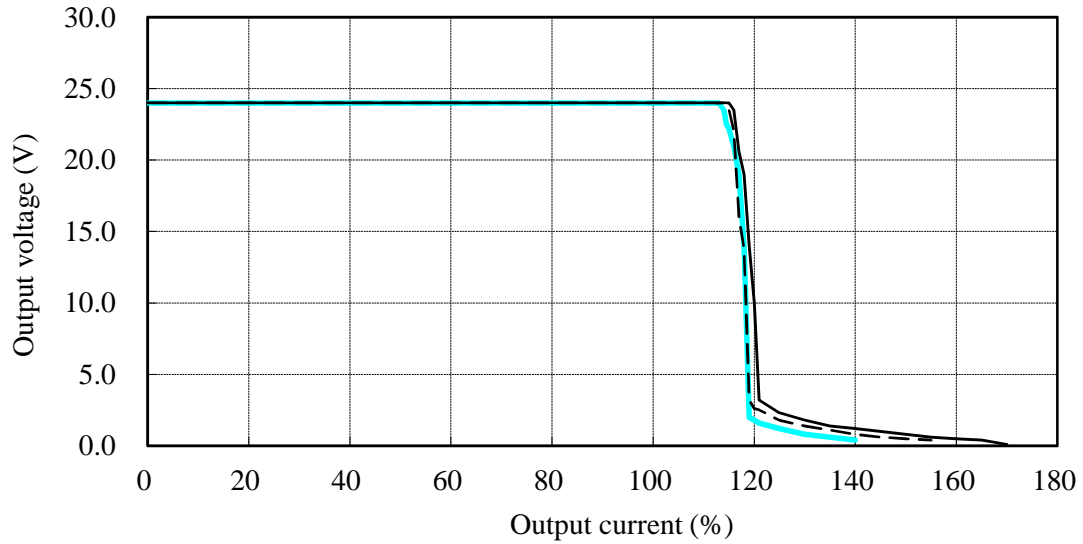: 25 °C ─ ─ ─ ─
: 50 °C ────
Vin : 230VAC

TDK-Lambda

2.3 Over current protection (OCP) characteristics

Conditions; Vin : 85VAC ▬▬▬
: 100VAC ▬ ▬ ▬
: 132VAC ▬▬▬
Ta : 25℃

24V

Conditions; Vin : 170VAC ▬▬▬
: 230VAC ▬ ▬ ▬
: 265VAC ▬▬▬
Ta : 25℃

TDK-Lambda
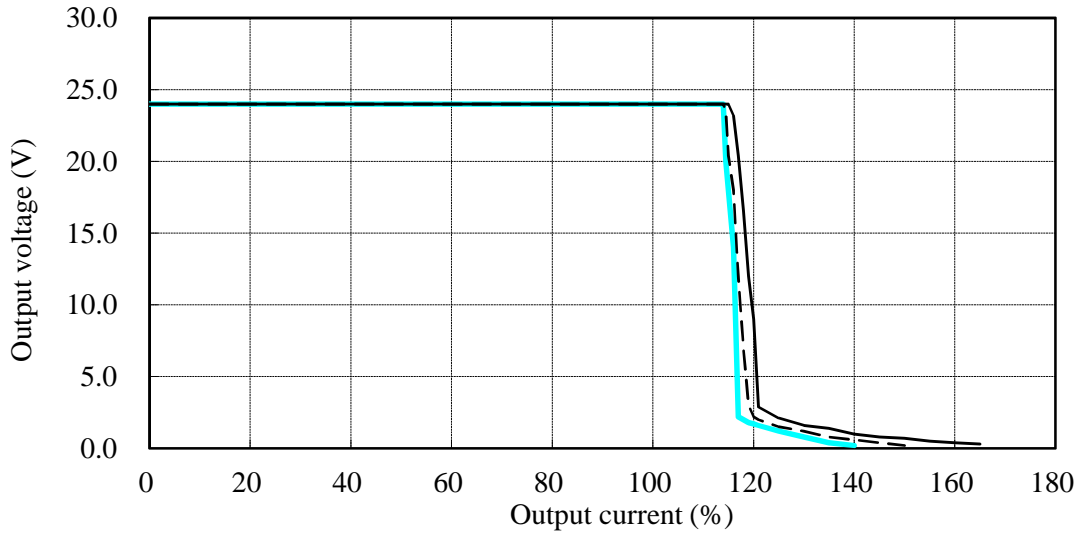
2.4   Over voltage protection (OVP) characteristics

Conditions; Vin : 100VAC
Iout : 0%
Ta   : 25°C

24V

Ch3 Zoom: 1.0X Vert   0.05X Horz

← OVP point

← Vout

← 0V

10V/DIV	1s/DIV

2.5   Output rise characteristics

24V

| 10V/DIV | 100ms/DIV |

Conditions ;
Vin   : 85VAC   (A)
        : 100VAC (B)
        : 130VAC (C)
Iout : 0%
Ta   : 25°C

| 10V/DIV | 100ms/DIV |

Conditions ;
Vin   : 170VAC (D)
        : 230VAC (E)
        : 265VAC (F)
Iout : 0%
Ta   : 25°C

TDK-Lambda

2.5 Output rise characteristics

24V

Ref3 Zoom: 1.0X Vert   0.2X Horz

C   B   A

← Vout

← 0V

← Vin

10V/DIV	100ms/DIV

Conditions ;
Vin : 85VAC (A)
     : 100VAC (B)
     : 130VAC (C)
Iout : 100%
Ta : 25°C

Ref2 Zoom: 1.0X Vert   0.2X Horz

F E   D

← Vout

← 0V

← Vin

10V/DIV	100ms/DIV

Conditions ;
Vin : 170VAC (D)
     : 230VAC (E)
     : 265VAC (F)
Iout : 100%
Ta : 25°C

TDK-Lambda

2.6   Output fall characteristics

24V

Ch2 Zoom: 1.0X Vert   0.1X Horz

← Vout

← 0V

← Vin

10V/DIV	1s/DIV

A B   C

Conditions ;
Vin : 85VAC   (A)
     : 100VAC (B)
     : 130VAC (C)
Iout : 0%
Ta   : 25°C

D   E F

Ref2 Zoom: 1.0X Vert   0.1X Horz

← Vout

← 0V

← Vin

10V/DIV	1s/DIV

Conditions ;
Vin : 170VAC (D)
     : 230VAC (E)
     : 265VAC (F)
Iout : 0%
Ta   : 25°C

TDK-Lambda

2.6　Output fall characteristics

24V

A　B　　　　C

Ref2 Zoom:　1.0X Vert　　0.1X Horz

← Vout

← 0V

← Vin

10V/DIV	20ms/DIV

Conditions ;
Vin　: 85VAC　(A)
　　　: 100VAC　(B)
　　　: 130VAC　(C)
Iout　: 100%
Ta　　: 25°C

D　　　E　　F

Ref2 Zoom:　1.0X Vert　　0.1X Horz

← Vout

← 0V

← Vin

10V/DIV	20ms/DIV
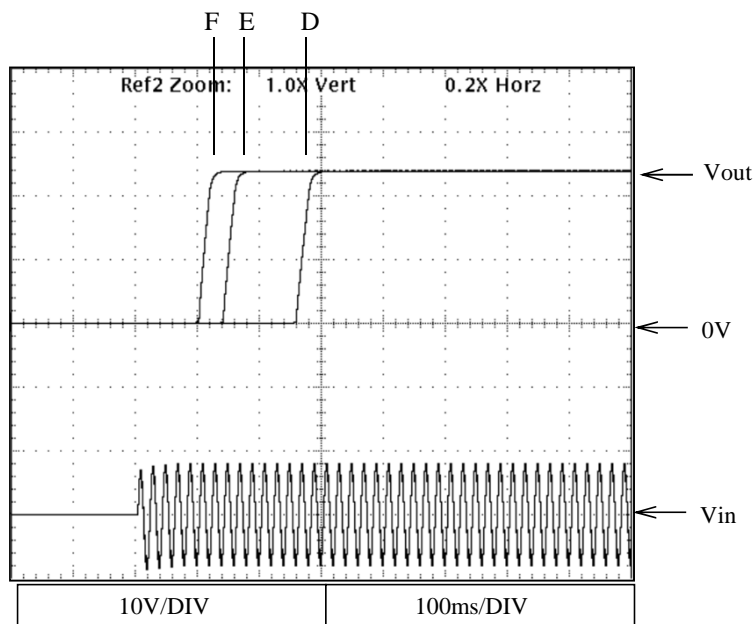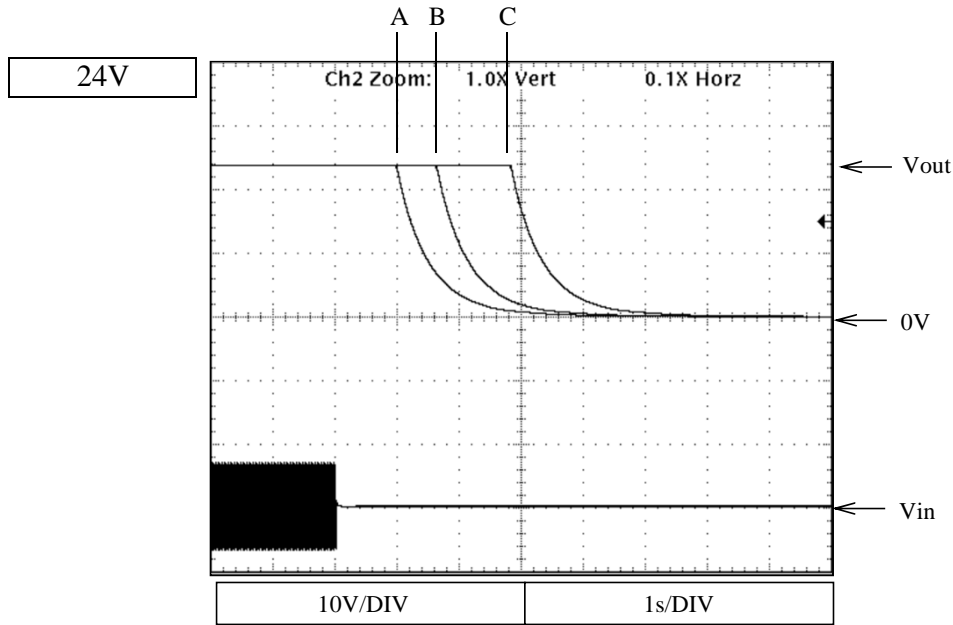
Conditions ;
Vin　: 170VAC　(D)
　　　: 230VAC　(E)
　　　: 265VAC　(F)
Iout　: 100%
Ta　　: 25°C

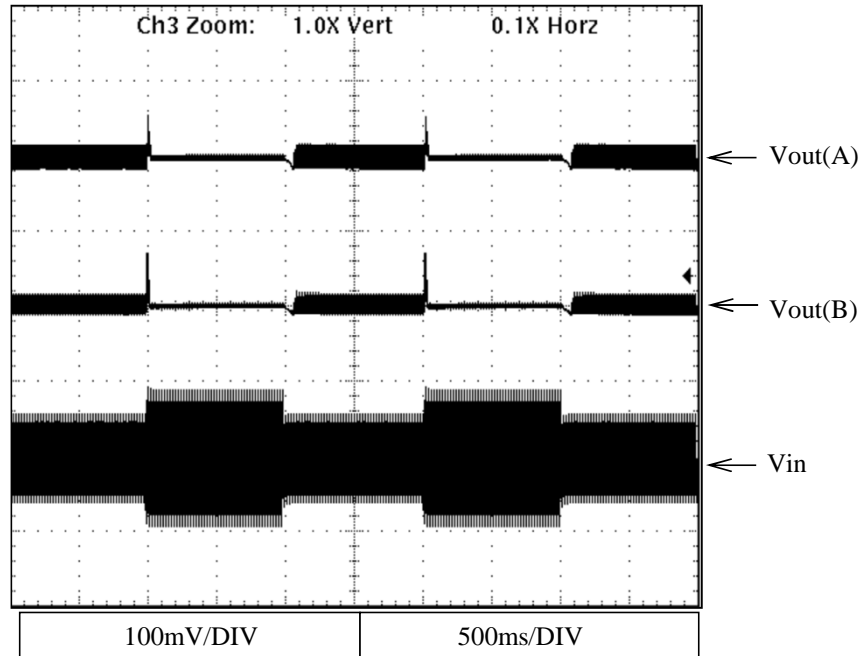**2.7   Dynamic line response characteristics**

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

24V

Ch3 Zoom: 1.0X Vert   0.1X Horz

⟵ Vout(A)

⟵ Vout(B)

⟵ Vin

100mV/DIV	500ms/DIV

2.8 Input voltage DIP test

Conditions ;
 Ta : 25°C
 Iout : 20%

| 24V |

Input voltage
200VAC ⟷ 100VAC
Tdip=200ms

Ch4 Zoom: 1.0X Vert   0.1X Horz

← Vout(DC)

← Vout(AC)

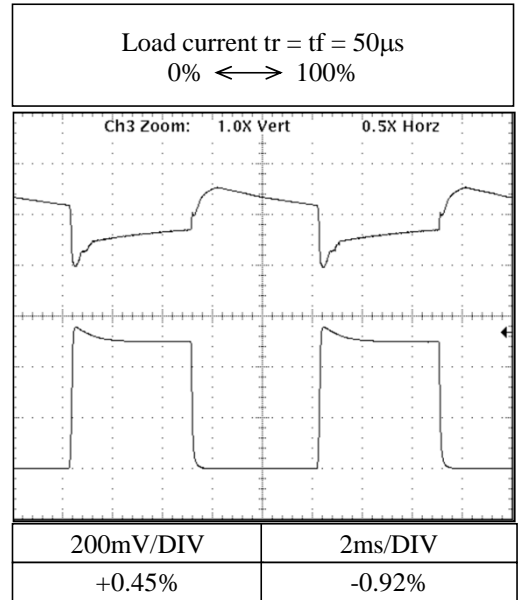← 0V(Vout_DC)
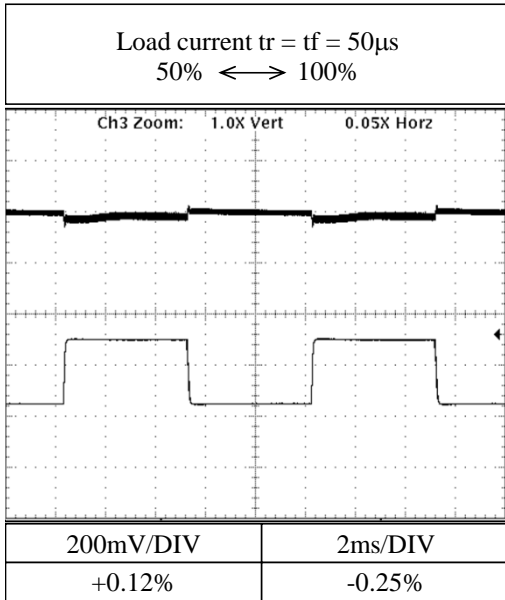
← Vin

| Vout(DC) ; 10V/DIV Vout(AC) ; 1V/DIV | 50ms/DIV |
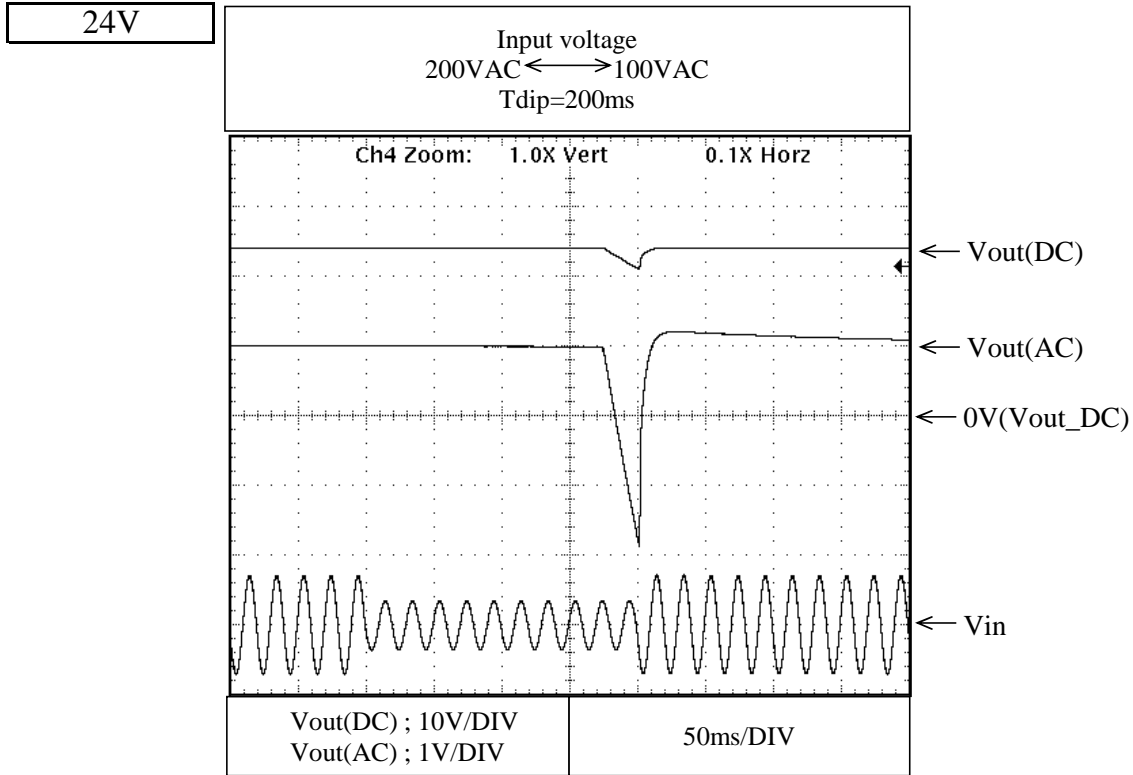
2.9 Dynamic load response characteristics

Conditions ; Vin : 100VAC
Ta : 25°C

24V

f=100Hz

Load current tr = tf = 50μs 50% ⟷ 100%	
Ch3 Zoom: 1.0X Vert	0.05X Horz
← Vout →	
← Iout →	
200mV/DIV	2ms/DIV
+0.12%	-0.25%

Load current tr = tf = 50μs 0% ⟷ 100%	
Ch3 Zoom: 1.0X Vert	0.5X Horz
← Vout →	
← Iout →	
200mV/DIV	2ms/DIV
+0.45%	-0.92%

f=1kHz

Load current tr = tf = 50μs 50% ⟷ 100%	
Ch3 Zoom: 1.0X Vert	0.5X Horz
← Vout →	
← Iout →	
200mV/DIV	200μs/DIV
+0.13%	-0.24%

Load current tr = tf = 50μs 0% ⟷ 100%	
Ch3 Zoom: 1.0X Vert	0.5X Horz
← Vout →	
← Iout →	
200mV/DIV	200μs/DIV
+0.37%	-0.58%
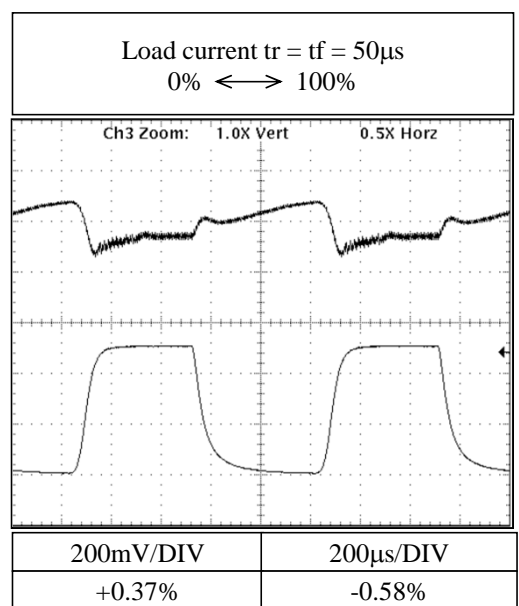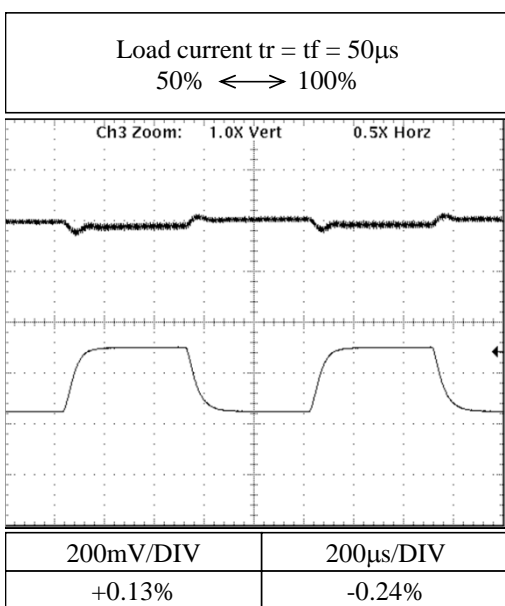
2.10 Response to brown out characteristics
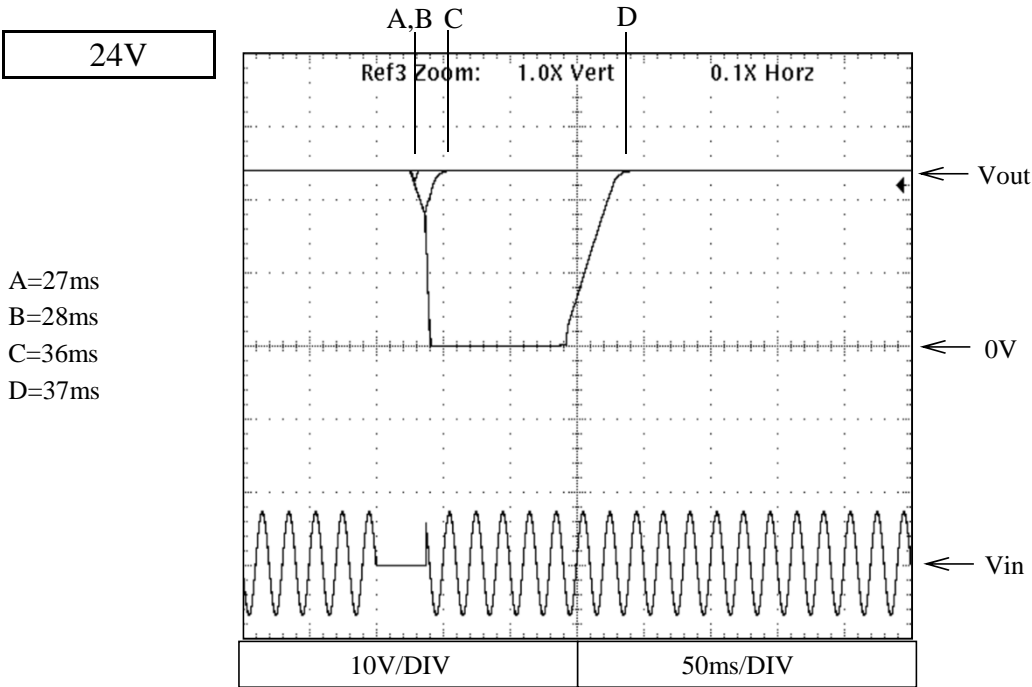
24V

A,B C   D

Ref3 Zoom: 1.0X Vert   0.1X Horz

← Vout

A=27ms
B=28ms
C=36ms
D=37ms

← 0V

← Vin

10V/DIV	50ms/DIV

A,B C   D

Ref3 Zoom: 1.0X Vert   0.1X Horz

← Vout

A=53ms
B=54ms
C=63ms
D=64ms

← 0V

← Vin

10V/DIV	50ms/DIV
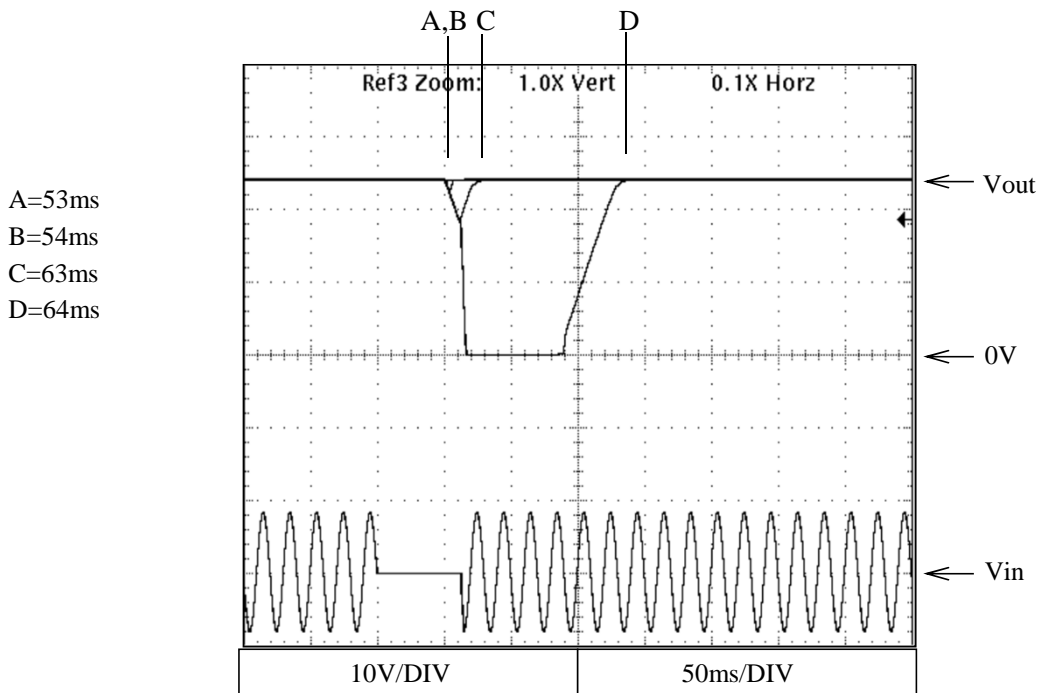
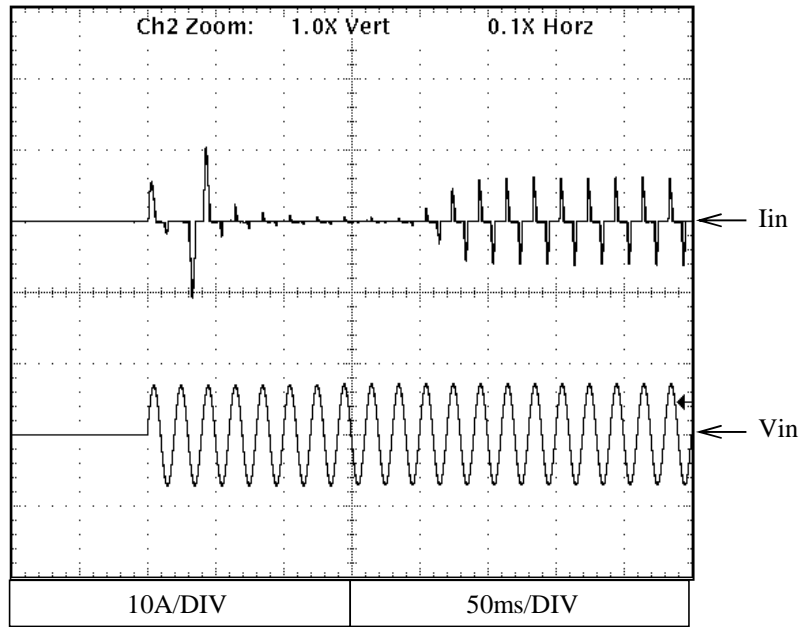**2.11   Inrush current waveform**

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

24V

Switch on phase angle
of input AC voltage
$\phi = 0^{o}$

Ch2 Zoom:	1.0X Vert	0.1X Horz

← Iin

← Vin

10A/DIV	50ms/DIV

Switch on phase angle
of input AC voltage
$\phi = 90^{o}$

Ch2 Zoom:	1.0X Vert	0.1X Horz

← Iin

← Vin

10A/DIV	50ms/DIV

2.11   Inrush current waveform

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

24V

Ch2 Zoom: 0.5X Vert   0.1X Horz

← Iin

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

← Vin

20A/DIV	50ms/DIV

Ch2 Zoom: 0.5X Vert   0.1X Horz

← Iin

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

← Vin

20A/DIV	50ms/DIV

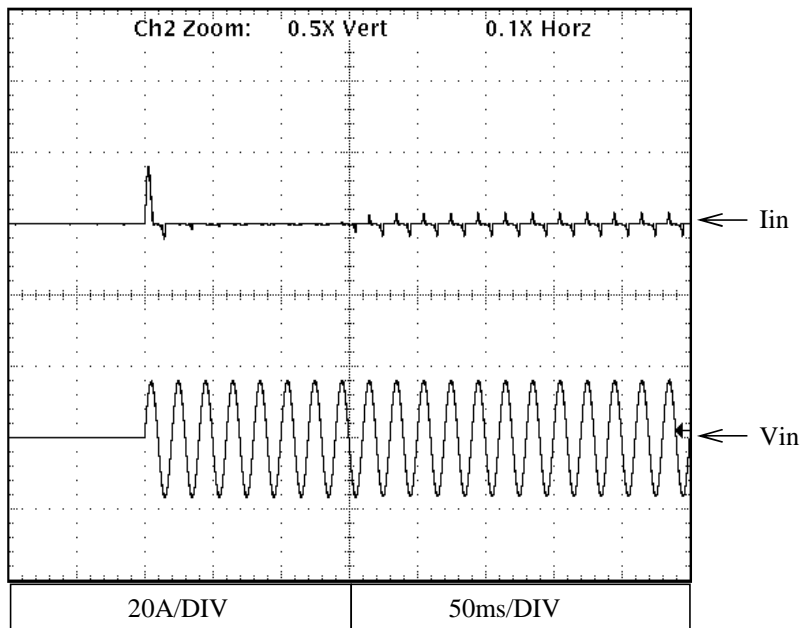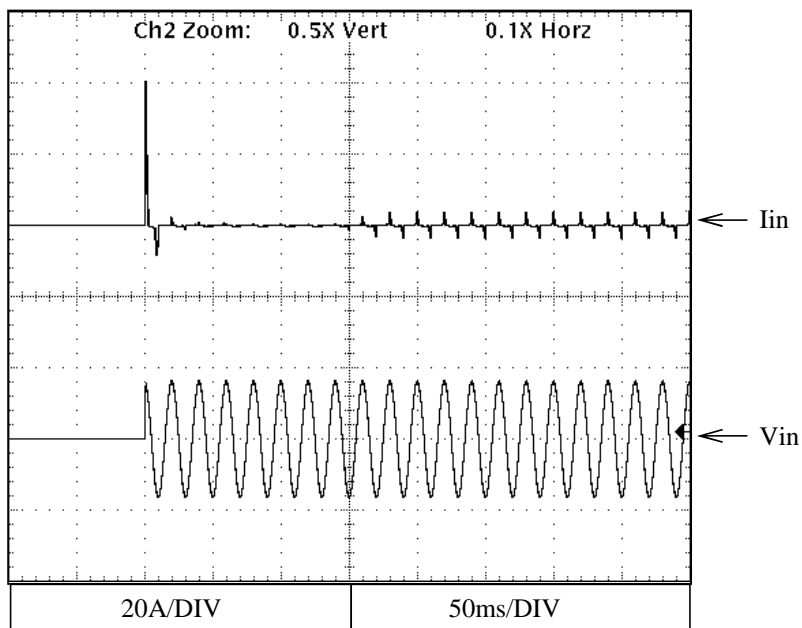**2.12   Input current waveform**

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

24V

```
                                    ← Iin



                                    ← Vin


    5A/DIV              5ms/DIV
```
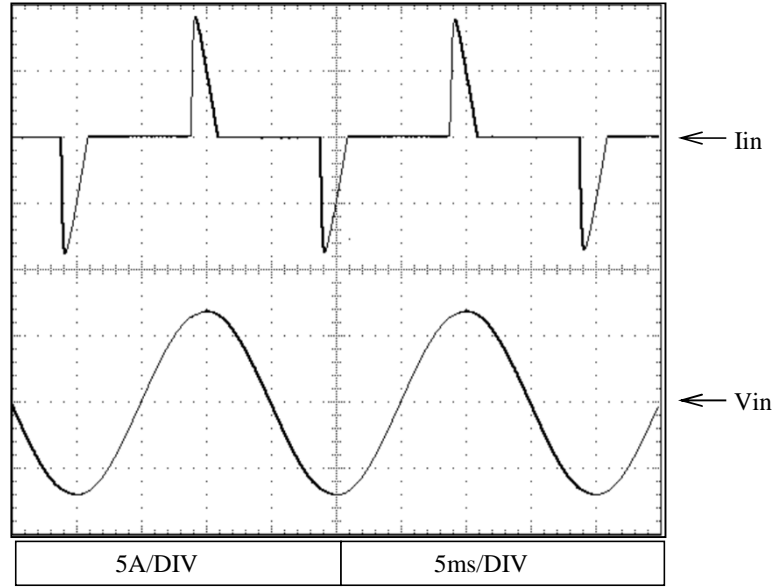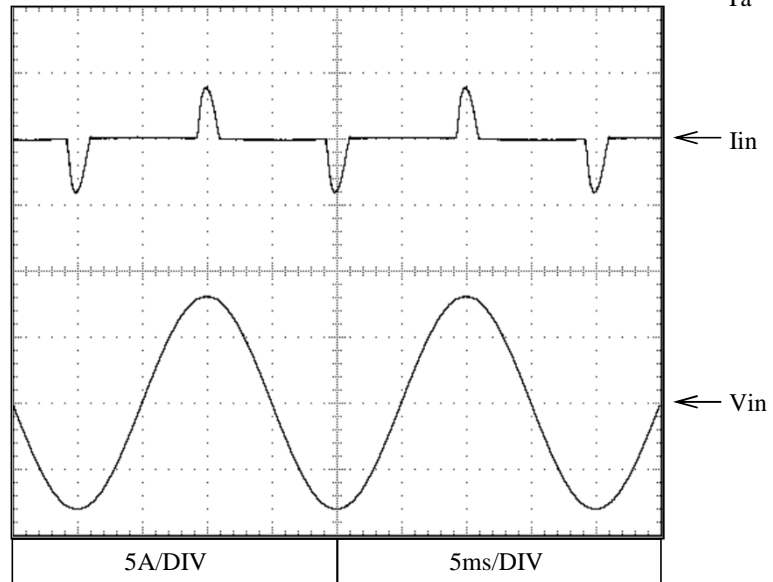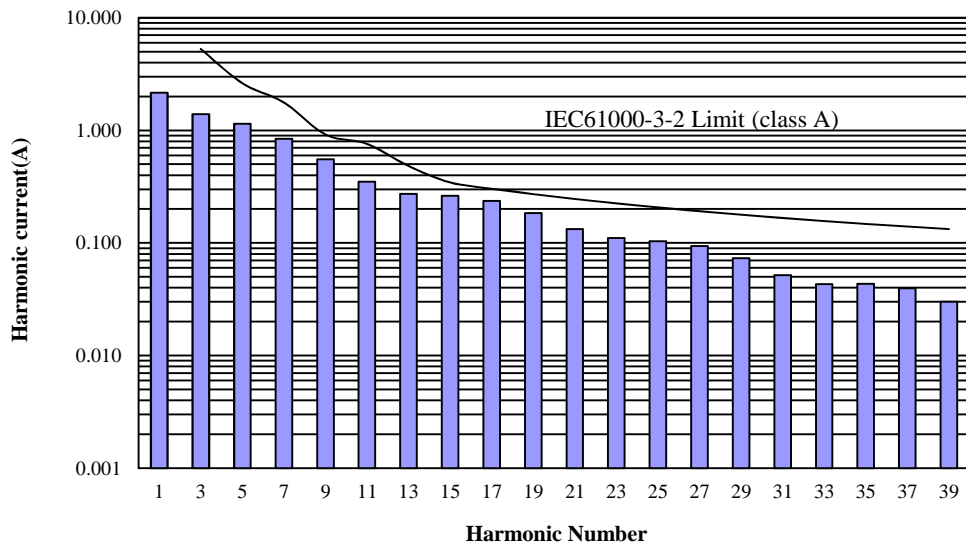
Conditions   Vin   : 230VAC
              Iout   : 100%
              Ta   : 25°C

```
                                    ← Iin



                                    ← Vin


    5A/DIV              5ms/DIV
```

2.13   Input current harmonics

24V

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

IEC61000-3-2 Limit (class A)

Harmonic current(A)

Harmonic Number

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

IEC61000-3-2 Limit (class A)

Harmonic current(A)

Harmonic Number

TDK-Lambda
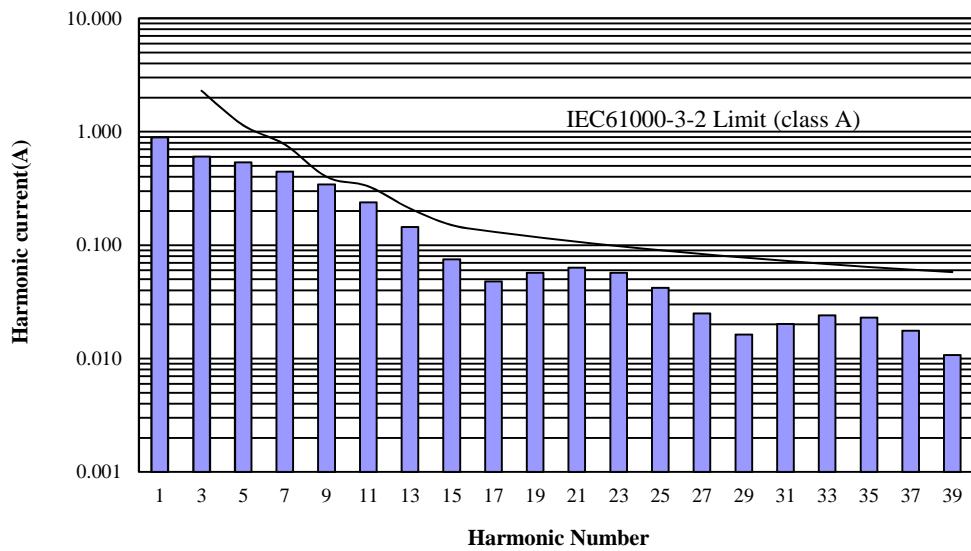
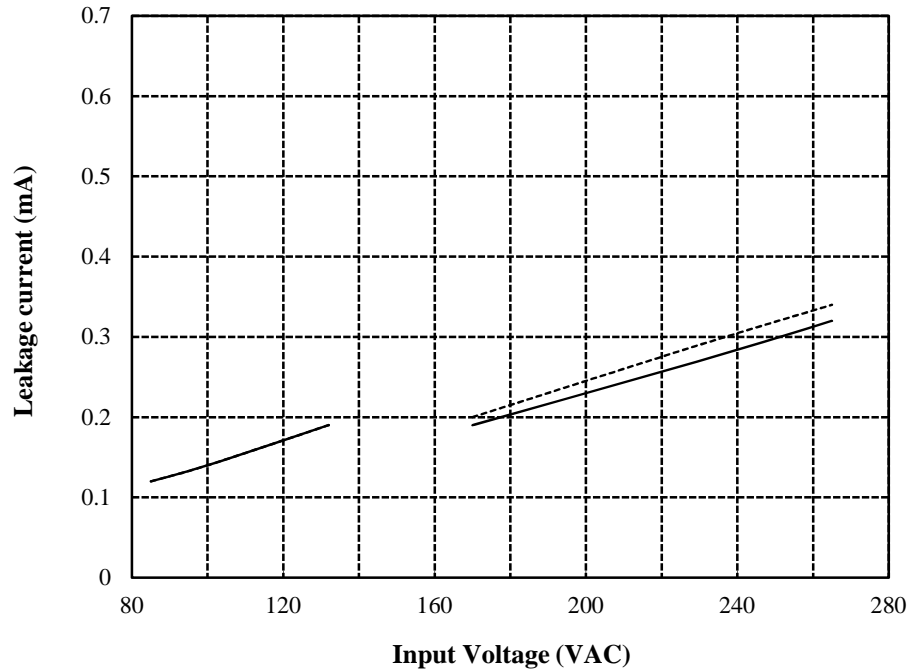**2.14   Leakage current characteristics**

Conditions; Iout   :   0%   ------
                   : 100%   ———
          Ta   : 25°C
          f   : 50Hz
Equipment used   : MODEL 229-2 (Simpson)

24V

Input Voltage (VAC)

Conditions; Iout   :   0%   ------
                   : 100%   ———
          Ta   : 25°C
          f   : 50Hz
Equipment used   : TYPE 3226 (YOKOGAWA)

Input Voltage (VAC)

TDK-Lambda   T-25
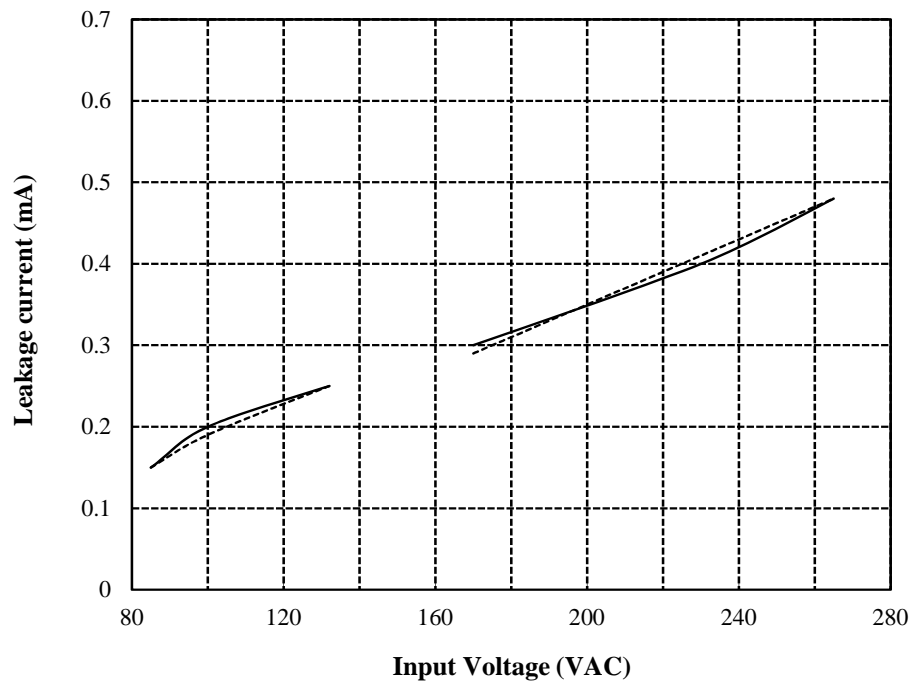
2.15 Output ripple and noise waveform

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

NORMAL MODE

24V

20mV/DIV	2μs/DIV

← Vout
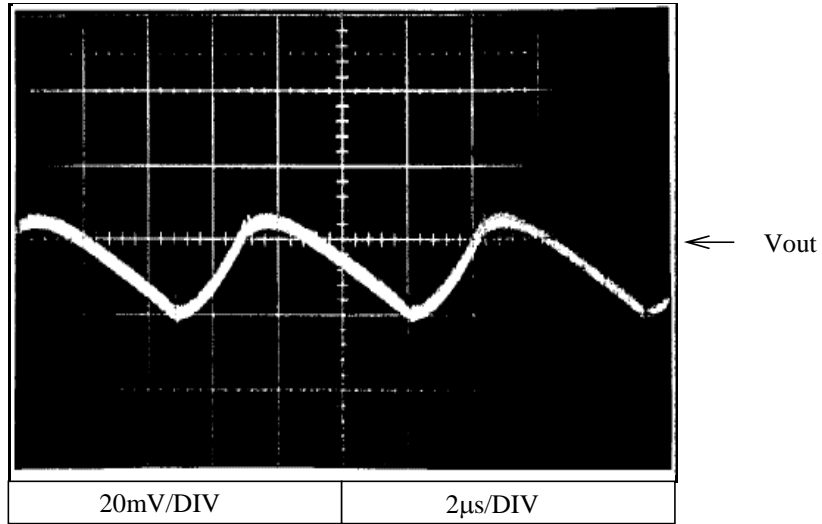
Conditions Vin : 100VAC
Iout : 100%
Ta : 25°C

NORMAL + COMMON MODE

20mV/DIV	2μs/DIV

← Vout

TDK-Lambda
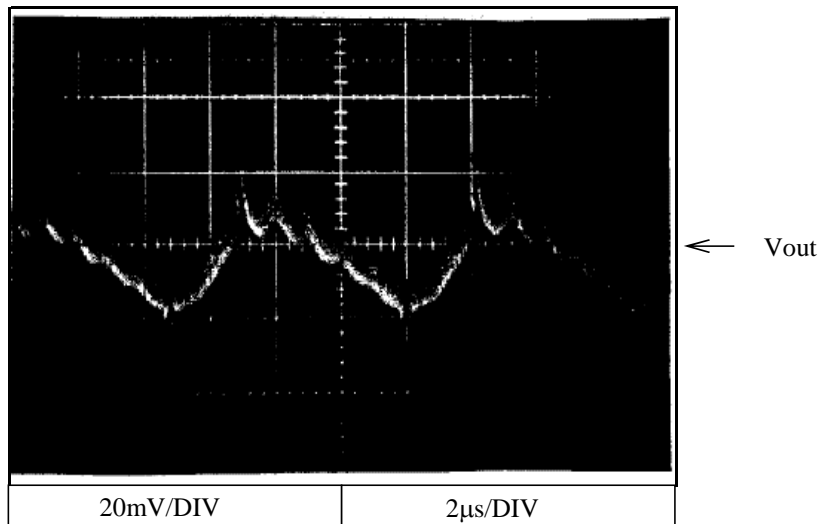
2.16   Stand-by current

24V
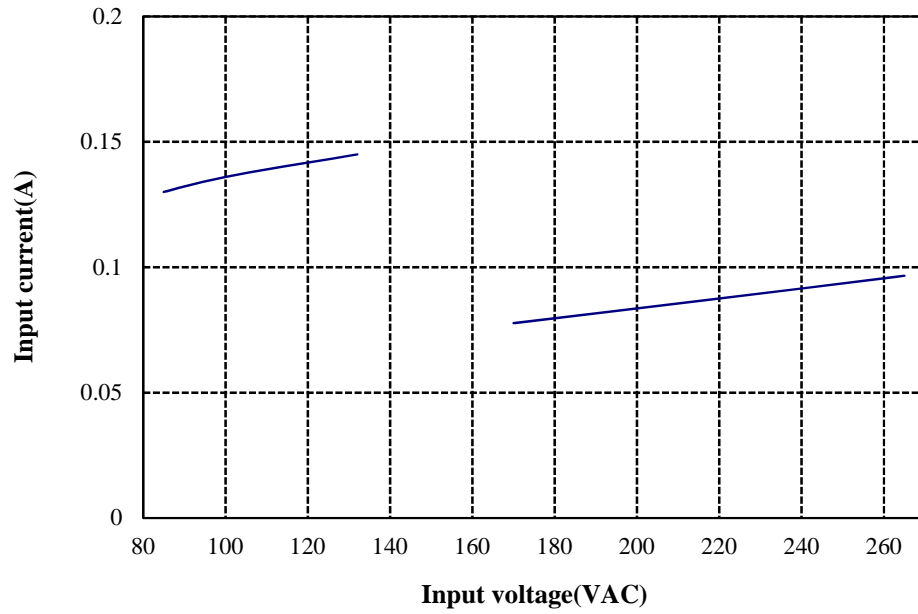
2.17   Hold up time characteristics
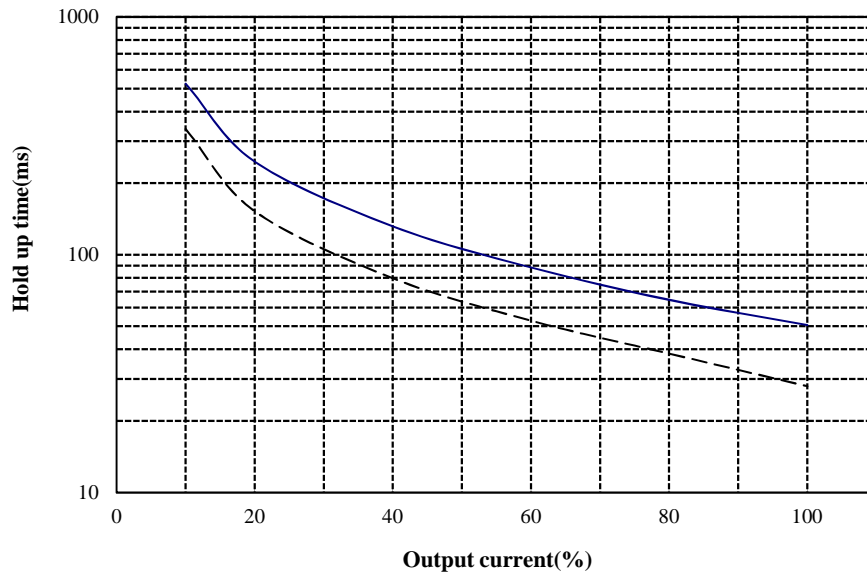
24V

Output current(%)

2.18 Electro-Magnetic Interference characteristics

Conducted Emission

Conditions ;
Vin : 100VAC
Iout : 100%

24V

Ref. Data	Point A (0.150MHz)	
	Limit (dBuV)	Measure (dBuV)
QP	66.0	58.5
AV	56.0	34.1

Ref. Data	Point B (0.161MHz)	
	Limit (dBuV)	Measure (dBuV)
QP	65.4	53.1
AV	55.4	22.9

Ref. Data	Point C (20.285MHz)	
	Limit (dBuV)	Measure (dBuV)
QP	60.0	48.6
AV	50.0	44.7
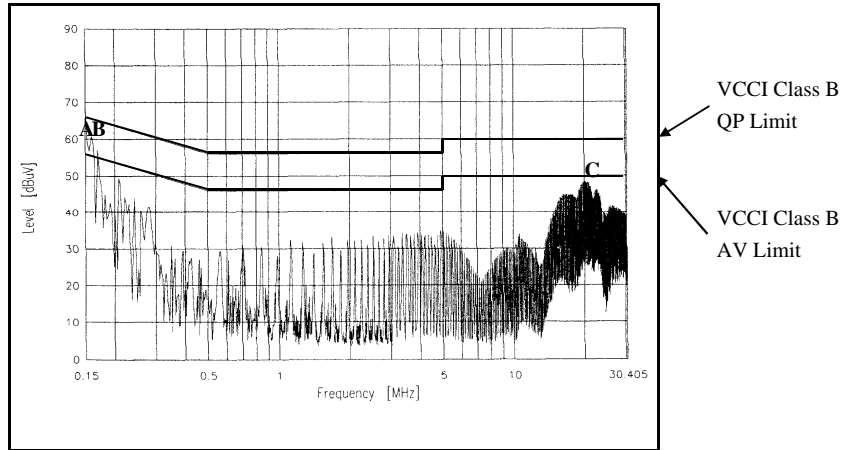
Phase : L

Ref. Data	Point D (0.150MHz)	
	Limit (dBuV)	Measure (dBuV)
QP	66.0	58.5
AV	56.0	32.7

Ref. Data	Point E (0.160MHz)	
	Limit (dBuV)	Measure (dBuV)
QP	65.5	53.3
AV	55.5	23.1

Ref. Data	Point F (20.265MHz)	
	Limit (dBuV)	Measure (dBuV)
QP	60.0	48.6
AV	50.0	44.5

Phase : N

Limits of EN55032-B,FCC Class B are same as VCCI class B.

TDK-Lambda   T-29

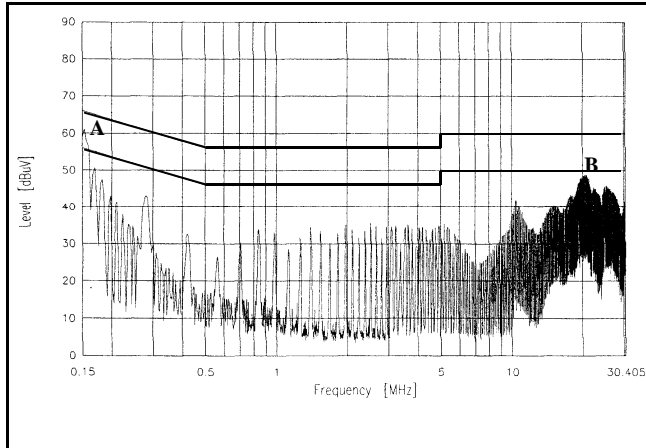## 2.18   Electro-Magnetic Interference characteristics

Conducted Emission

Conditions ;
Vin : 230VAC
Iout : 100%

24V

Ref. \ Data	Point A (0.150MHz)	
	Limit (dBuV)	Measure (dBuV)
QP	66.0	48.9
AV	56.0	32.2

Ref. \ Data	Point B (20.586MHz)	
	Limit (dBuV)	Measure (dBuV)
QP	60.0	49.3
AV	50.0	45.7

VCCI Class B QP Limit

VCCI Class B AV Limit

Phase : L

Ref. \ Data	Point C (0.150MHz)	
	Limit (dBuV)	Measure (dBuV)
QP	66.0	49.8
AV	56.0	31.1

Ref. \ Data	Point D (20.574MHz)	
	Limit (dBuV)	Measure (dBuV)
QP	60.0	49.4
AV	50.0	45.2

VCCI Class B QP Limit

VCCI Class B AV Limit

Phase : N

Limits of EN55032-B,FCC Class B are same as VCCI class B.

TDK-Lambda   T-30

2.18   Electro-Magnetic Interference characteristics

Radiated Emission

Conditions ;
Vin : 100VAC
Iout : 100%

24V

HORIZONTAL:

Point A	
(103.679MHz)	
Limit (dBuV/m)	Measure (dBuV/m)
40.0	30.7
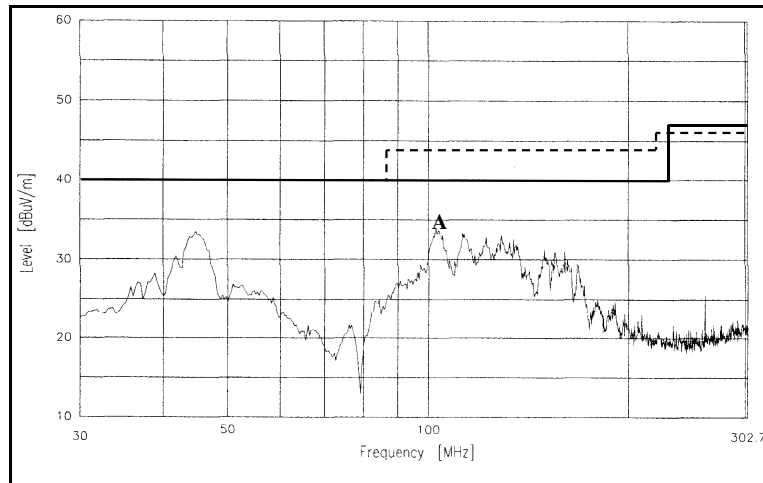
VCCI Class B
QP Limit

FCC Class B
QP Limit

VERTICAL:

Point B	
(45.856MHz)	
Limit (dBuV/m)	Measure (dBuV/m)
40.0	35.9

VCCI Class B
QP Limit

FCC Class B
QP Limit

Limits of EN55032-B are same as its VCCI class B.

TDK-Lambda
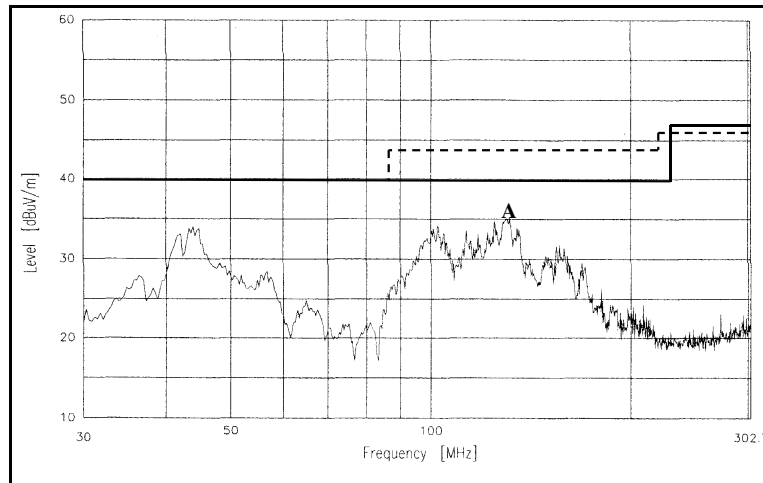
2.18   Electro-Magnetic Interference characteristics

Radiated Emission

Conditions ;
                Vin : 230VAC
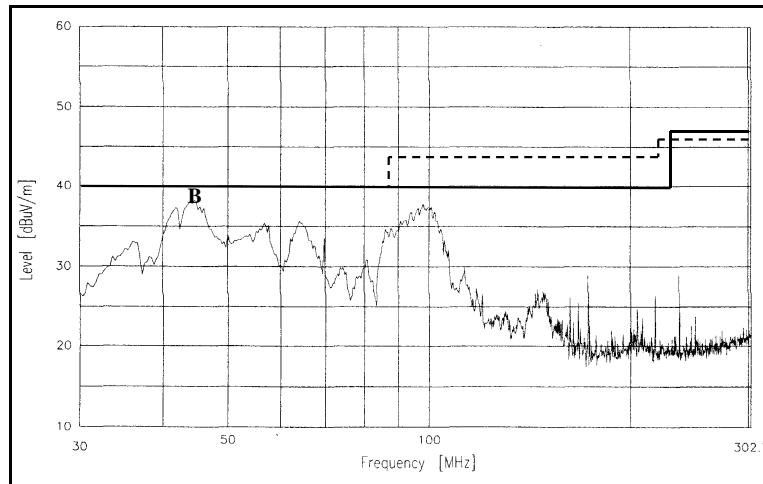   Iout : 100%

24V

HORIZONTAL:

VCCI Class B
QP Limit

FCC Class B
QP Limit

Point A	
(129.567MHz)	
Limit	Measure
(dBuV/m)	(dBuV/m)
40.0	33.6

VERTICAL:

VCCI Class B
QP Limit

FCC Class B
QP Limit

Point B	
(43.582MHz)	
Limit	Measure
(dBuV/m)	(dBuV/m)
40.0	36.0

Limits of EN55032-B are same as its VCCI class B.

TDK-Lambda