

# PAF500F24-\*

## EVALUATION DATA

### 型式データ

DWG.No. C169-53-01			
承認	承認	査閲	担当
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12.Oct.'01	12.Oct.'01	11/Oct./01	11/sep/d

DENSEI-LAMBDA

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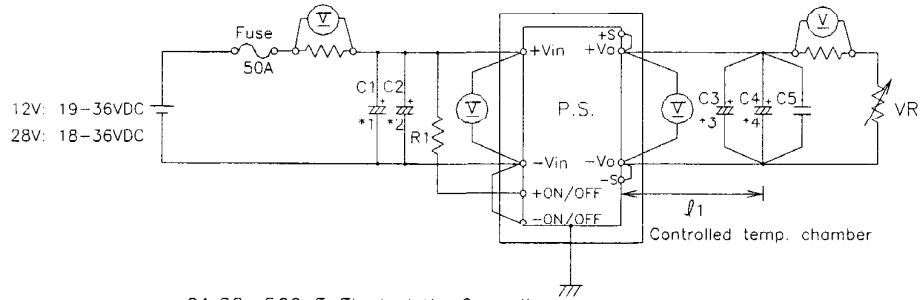
使用記号 Terminology used

	Definition	
Vin	..... 入力電圧	Input Voltage
Vout	..... 出力電圧	Output Voltage
Von/off	..... ON/OFF電圧	ON/OFF Voltage
Iin	..... 入力電流	Input Current
Iout	..... 出力電流	Output Current
Tp	..... ベースプレート温度	Base-Plate Temperature

1. 測定方法 Evaluation Method

1.1 測定回路 Circuits used for determination

(1) 静特性 Steady state data

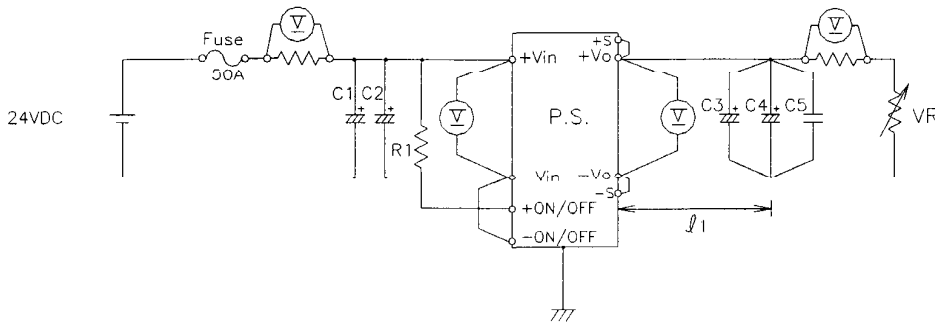


C1,C2: 560uF Electrolytic Capacitor  
 C3,C4: 12V-470uF Electrolytic Capacitor  
 28V-220uF Electrolytic Capacitor  
 C5: 10uF Ceramic Capacitor  
 R1: 15kΩ (1/4W)  
 φ1: 50mm

==NOTE==

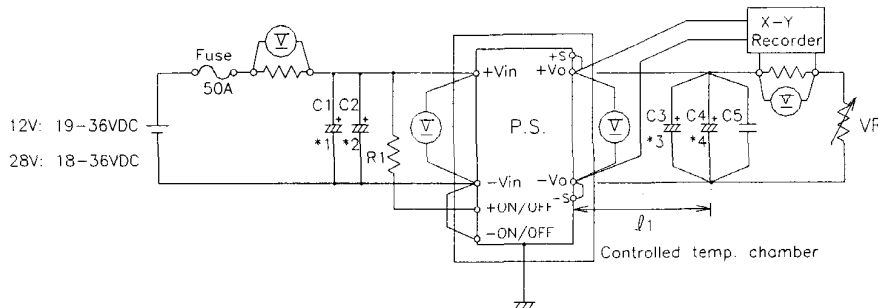
\*1,\*2,\*3,\*4. If the ambient temperature is less than -20°C, use twice of the recommended capacitor above.

(2) 通電ドリフト Warm up voltage drift characteristics



C1,C2: 560uF Electrolytic Capacitor  
 C3,C4: 12V-470uF Electrolytic Capacitor  
 28V-220uF Electrolytic Capacitor  
 C5: 10uF Ceramic Capacitor  
 R1: 15kΩ (1/4W)  
 φ1: 50mm

(3) 過電流保護特性 Over current protection (OCP) characteristics

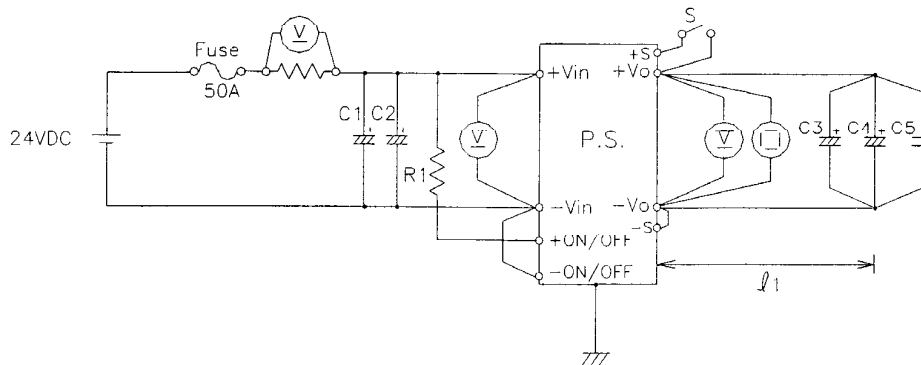


C1,C2: 560uF Electrolytic Capacitor  
 C3,C4: 12V-470uF Electrolytic Capacitor  
 28V-220uF Electrolytic Capacitor  
 C5: 10uF Ceramic Capacitor  
 R1: 15kΩ (1/4W)  
 φ1: 50mm

==NOTE==

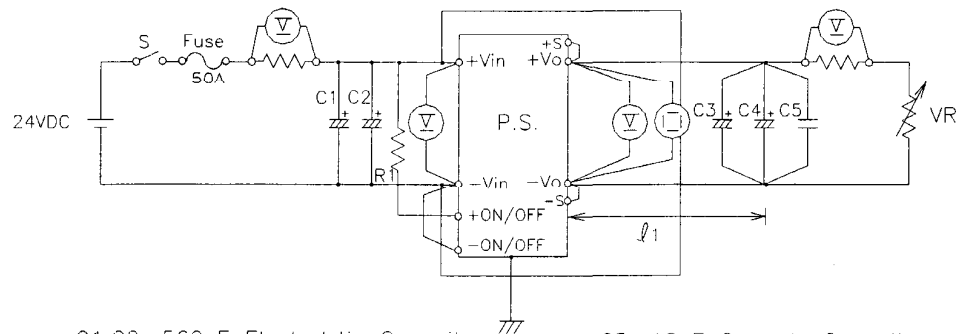
\*1,\*2,\*3,\*4. If the ambient temperature is less than -20°C, use twice of the recommended capacitor above.

(4) 過電圧保護特性 Over voltage protection (OVP) characteristics



C1,C2: 560uF Electrolytic Capacitor  
 C3,C4: 12V-470uF Electrolytic Capacitor  
 28V-220uF Electrolytic Capacitor  
 C5: 10uF Ceramic Capacitor  
 R1: 15kΩ (1/4W)  
 $I_1$ : 50mm

(5) 出力立ち上がり特性 Output rise characteristics



C1,C2: 560uF Electrolytic Capacitor  
 C3,C4: 12V-470uF Electrolytic Capacitor  
 28V-220uF Electrolytic Capacitor  
 C5: 10uF Ceramic Capacitor  
 R1: 15kΩ (1/4W)  
 $I_1$ : 50mm

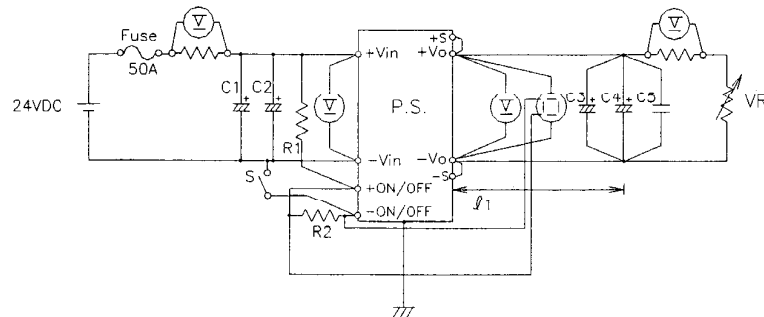
(6) 出力立ち下がり Output fall characteristics

出力立ち上がり特性と同じ

Same as output rise characteristics

(7) 出力立ち上がり特性 (ON/OFFコントロール時)

Output rise characteristics with ON/OFF CONTROL



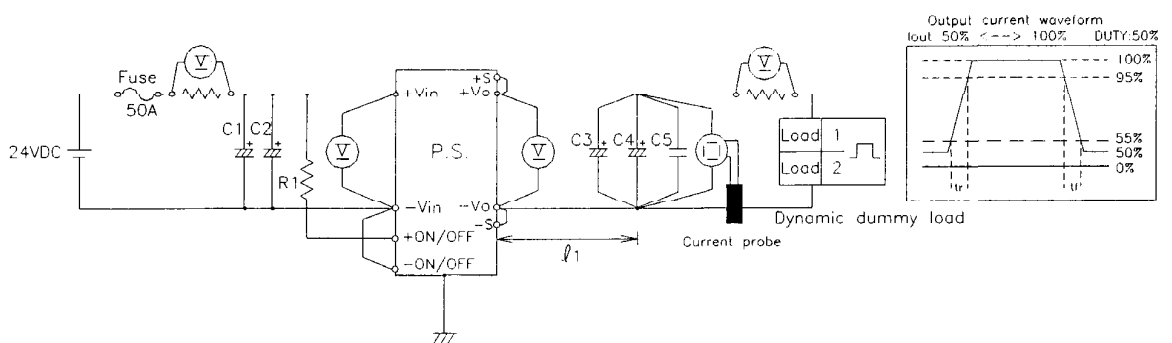
C1,C2: 560uF Electrolytic Capacitor  
 C3,C4: 12V-470uF Electrolytic Capacitor  
 28V-220uF Electrolytic Capacitor  
 C5: 10uF Ceramic Capacitor  
 R1: 15kΩ (1/4W)  
 R2: 1MΩ  
 I1: 50mm

(8) 出力立ち下がり特性 (ON/OFFコントロール時)

Output fall characteristics with ON/OFF CONTROL

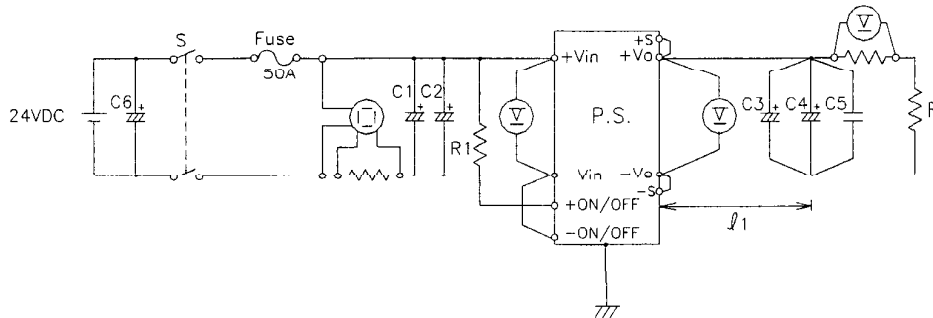
出力立ち上がり特性 (ON/OFFコントロール時) と同じ  
 Same as output rise characteristics with ON/OFF CONTROL

(9) 過渡応答(負荷急変)特性 Dynamic load response characteristics



C1,C2: 560uF Electrolytic Capacitor  
 C3,C4: 12V-470uF Electrolytic Capacitor  
 28V-220uF Electrolytic Capacitor  
 C5: 10uF Ceramic Capacitor  
 R1: 15kΩ (1/4W)  
 I1: 50mm

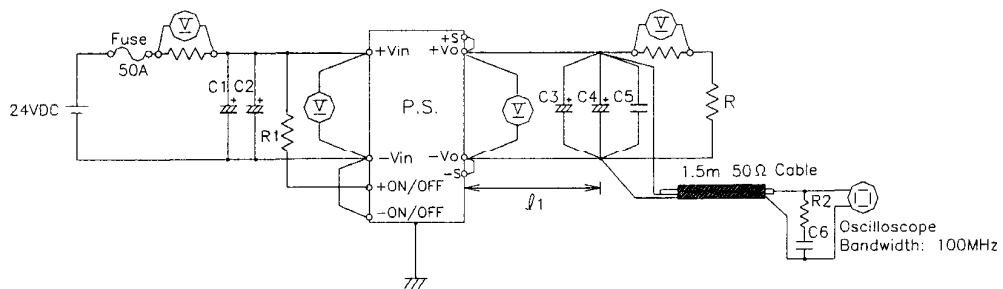
(10) 入力サージ電流 (突入電流) 特性 Inrush current characteristics



- |   |                                    |
|---|------------------------------------|
| C1,C2: 560uF Electrolytic Capacitor     | C6: 15000uF Electrolytic Capacitor |
| C3,C4: 12V-470uF Electrolytic Capacitor | R1: 15kΩ (1/4W)                    |
| 28V-220uF Electrolytic Capacitor        | l1: 50mm                           |
| C5: 10uF Ceramic Capacitor              |                                    |

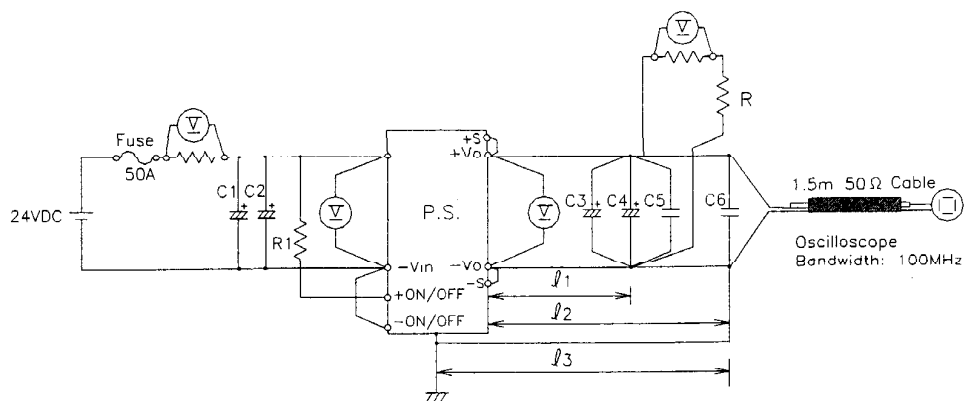
(11) 出力リップル、ノイズ波形 Output ripple and noise waveform

(a) Normal Mode



- |   |                              |
|---|------------------------------|
| C1,C2: 560uF Electrolytic Capacitor     | C6: 4700pF Ceramic Capacitor |
| C3,C4: 12V-470uF Electrolytic Capacitor | R1: 15kΩ (1/4W)              |
| 28V-220uF Electrolytic Capacitor        | R2: 50Ω                      |
| C5: 10uF Ceramic Capacitor              | l1: 50mm                     |

(b) Normal + Common Mode



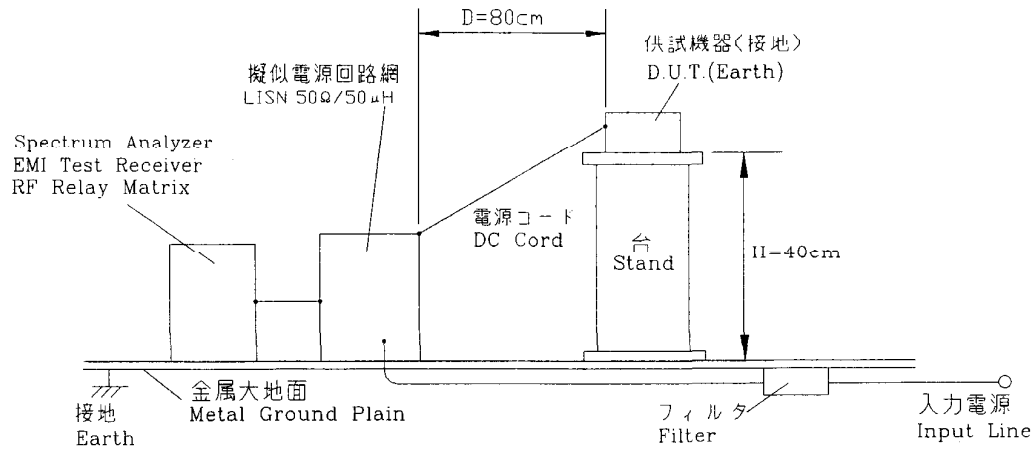
- |   |                             |
|---|-----------------------------|
| C1,C2: 560uF Electrolytic Capacitor     | C6: 0.1uF Ceramic Capacitor |
| C3,C4: 12V-470uF Electrolytic Capacitor | R1: 15kΩ (1/4W)             |
| 28V-220uF Electrolytic Capacitor        | l1: 50mm                    |
| C5: 10uF Ceramic Capacitor              | l2, l3: 152mm               |

(12) EMI 特性

Electro-Magnetic Interference characteristics

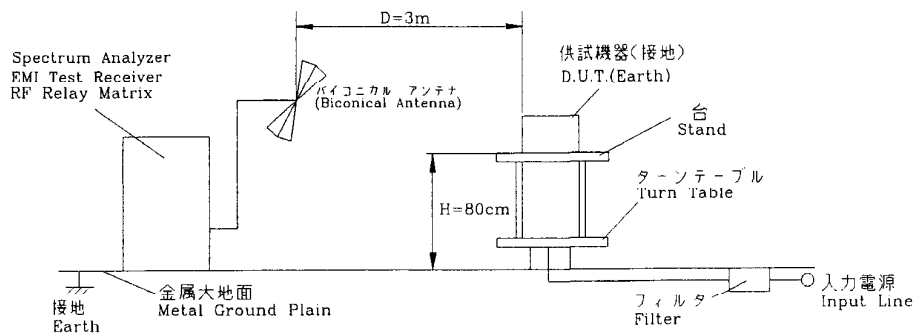
(a) 雑音端子電圧 (帰還ノイズ)

Conducted Emission Noise



(b) 雑音電界強度 (輻射ノイズ)

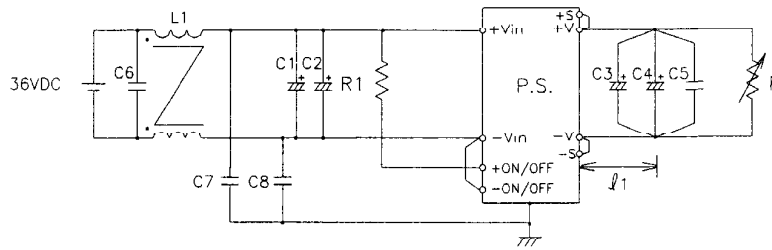
Radiated Emission Noise





(1) VCCI class A 対応アプリケーションシステム

VCCI class A application system



- |  |                                 |
|--|---------------------------------|
| L1 : 1mH                                 | C6 : 2.2uF Ceramic Capacitor    |
| C1,C2 : 470uF Electrolytic Capacitor     | C7,C8 : 0.1uF Ceramic Capacitor |
| C3,C4 : 12V-470uF Electrolytic Capacitor | R1 : 15kΩ (1/4W)                |
| C5 : 28V-220uF Electrolytic Capacitor    | I1 : 50mm                       |
| C6 : 10uF Ceramic Capacitor              |                                 |

## 1.2 使用測定機器 List of equipment used

	EQUIPMENT USED	MANUFACTURER	MODEL NO.
1	OSCILLO SCOPE	HITACHI DENSHI	V-1100A
2	DIGITAL STORAGE OSCILLOSCOPE	TEKTRONIX	TDS540B
3	DIGITAL MULTIMETER	YOKOGAWA ELECT.	7544
4	DIGITAL POWER METER	YOKOGAWA ELECT.	WT110
5	CURRENT PROBE/AMPLIFIER	TEKTRONIX	A6303/AM503
6	DYNAMIC DUMMY LOAD	TAKASAGO	FK-1000L
7	DC POWER SUPPLY	TAKASAGO	EX-1500L
8	X-Y RECORDER	GRAPHTEC	WX4309
9	CONTROLLED TEMP. CHAMBER	TABAI ESPEC	SH-240
10	SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSA
11	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESHS10
12	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESVS10
13	RF RELAY MATRIX	ROHDE & SCHWARZ	PSU
14	AMN	KYORITSU DENSHI	KNW-408
15	ANTENNA(BICONICAL ANTENNA)	SCHWARZBECK	BBA9106

## 2. 特性データ

## 2.1 静特性 Steady state data

(1) 入力、負荷、温度変動 Regulation - line and load, temperature drift

12V

## 1. Regulation - line and load

condition  $T_p : 25^{\circ}\text{C}$ 

$I_{out} \setminus V_{in}$	19VDC	24VDC	36VDC	line regulation	
0%	11.991V	11.988V	11.990V	3mV	0.025%
50%	11.990V	11.987V	11.988V	3mV	0.025%
100%	11.989V	11.986V	11.987V	3mV	0.025%
load	2mV	2mV	3mV		
regulation	0.017%	0.017%	0.025%		

## 2. Temperature drift

conditions  $V_{in} : 24\text{VDC}$  $I_{out} : 100\%$ 

$T_p$	$-40^{\circ}\text{C}$	$25^{\circ}\text{C}$	$100^{\circ}\text{C}$	temperature stability	
$V_{out}$	12.004V	11.986V	11.937V	67mV	0.558%

28V

## 1. Regulation - line and load

condition  $T_p : 25^{\circ}\text{C}$ 

$I_{out} \setminus V_{in}$	18VDC	24VDC	36VDC	line regulation	
0%	28.000V	28.000V	28.000V	0mV	0.000%
50%	27.989V	27.987V	27.990V	3mV	0.011%
100%	27.997V	27.991V	27.988V	9mV	0.032%
load	11mV	13mV	12mV		
regulation	0.039%	0.046%	0.043%		

## 2. Temperature drift

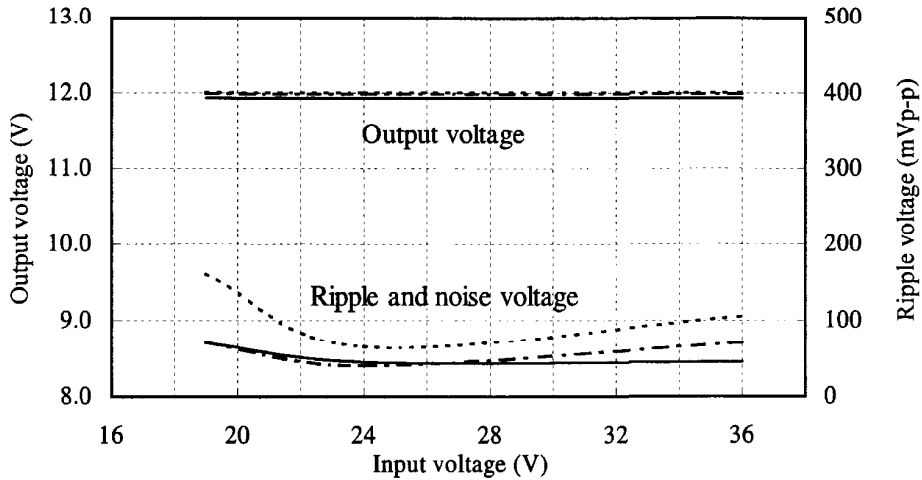
conditions  $V_{in} : 24\text{VDC}$  $I_{out} : 100\%$ 

$T_p$	$-40^{\circ}\text{C}$	$25^{\circ}\text{C}$	$100^{\circ}\text{C}$	temperature stability	
$V_{out}$	28.039V	27.991V	27.877V	162mV	0.579%

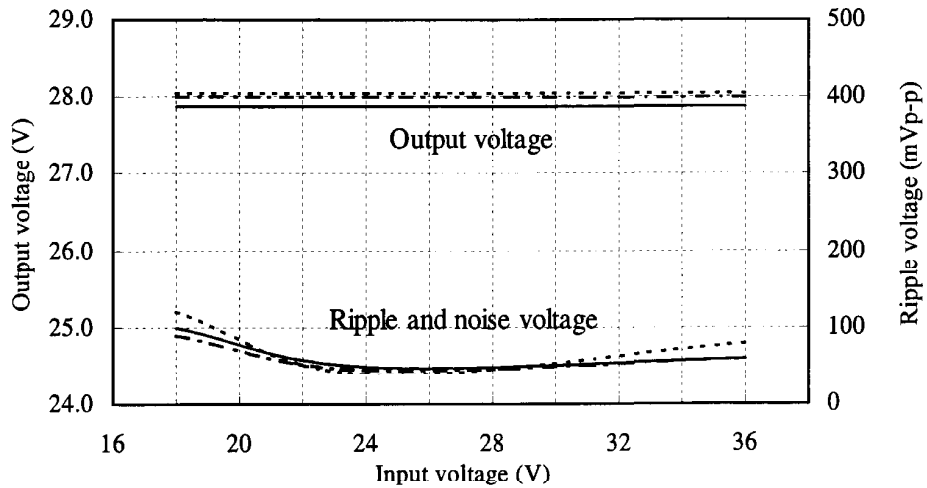
2.1 (2) 出力電圧、リップル電圧対入力電圧  
Output voltage and ripple voltage vs input voltage

Conditions Iout : 100 %  
Tp : -40 °C -----  
          : 25 °C       - - - - -  
          : 100 °C      \_\_\_\_\_

12V



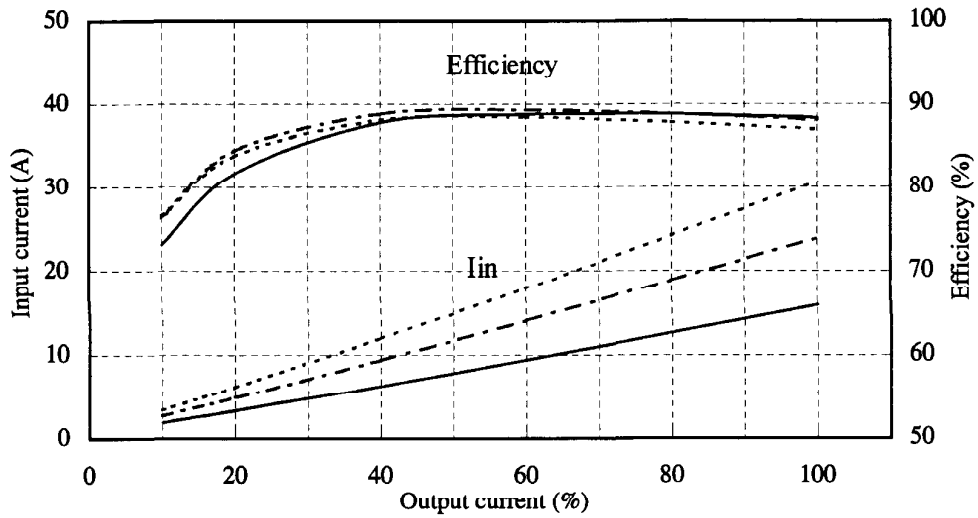
28V



2.1 (3) 効率、入力電流対出力電流  
Efficiency and input current vs output current

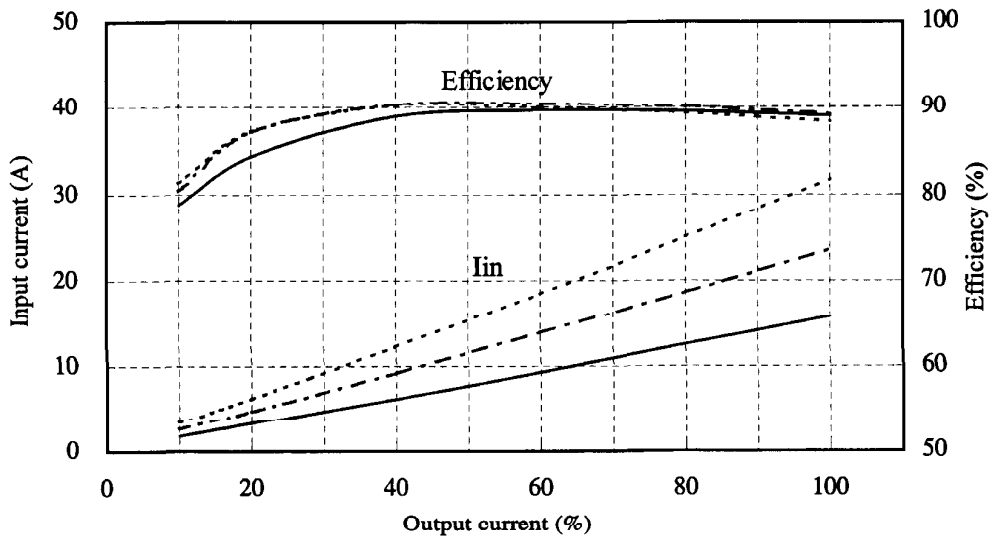
12V

Conditions  $V_{in}$  : 19 VDC -----  
 : 24 VDC -.-.-.-  
 : 36 VDC ————  
 $T_p$  : 25 °C



28V

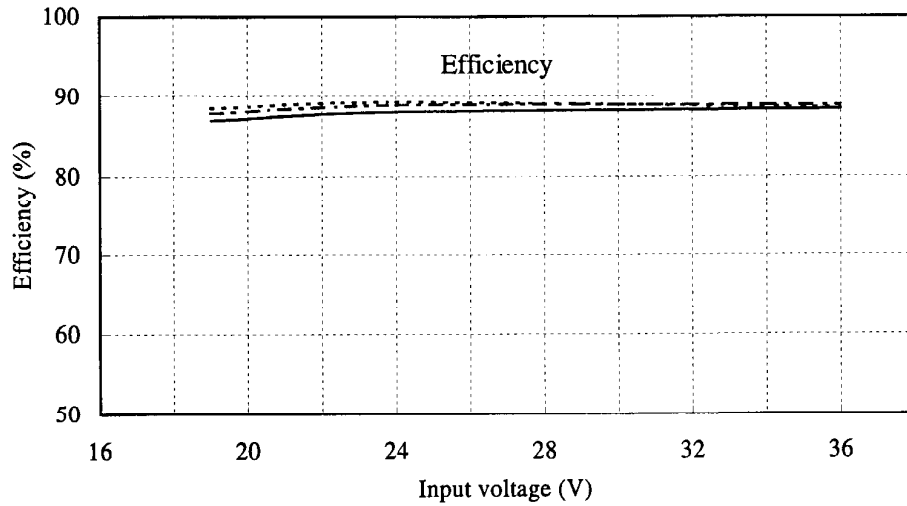
Conditions  $V_{in}$  : 18 VDC -----  
 : 24 VDC -.-.-.-  
 : 36 VDC ————  
 $T_p$  : 25 °C



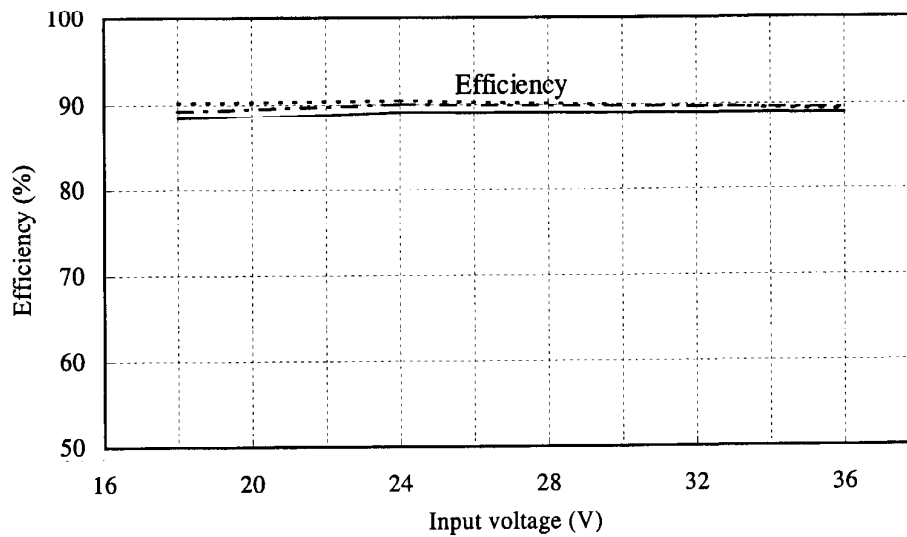
2.1 (4) 効率対入力電圧  
Efficiency vs input voltage

Conditions  $T_p$  : 25 °C  
 $I_{out}$  : 50 % -----  
 80 % - - - - -  
 100 % ————

12V



28V

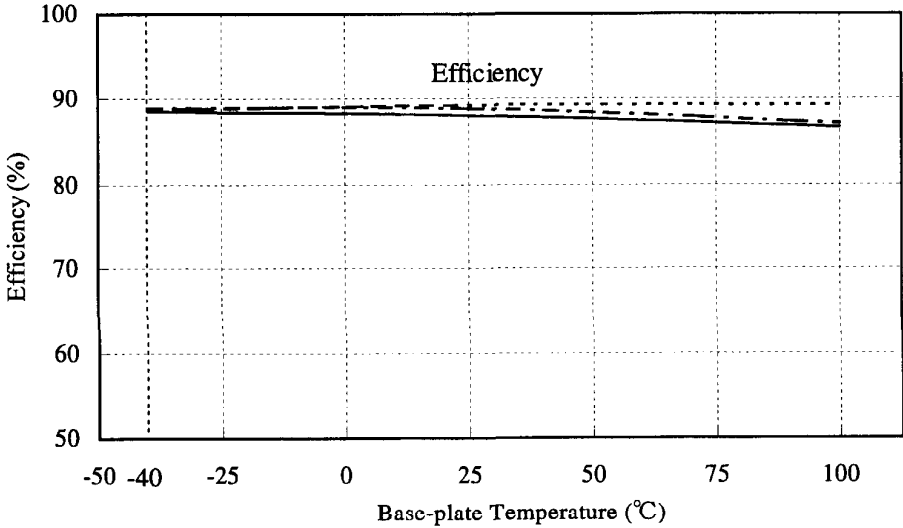


2.1 (5) 効率対ベースプレート温度  
Efficiency vs base-plate temperature

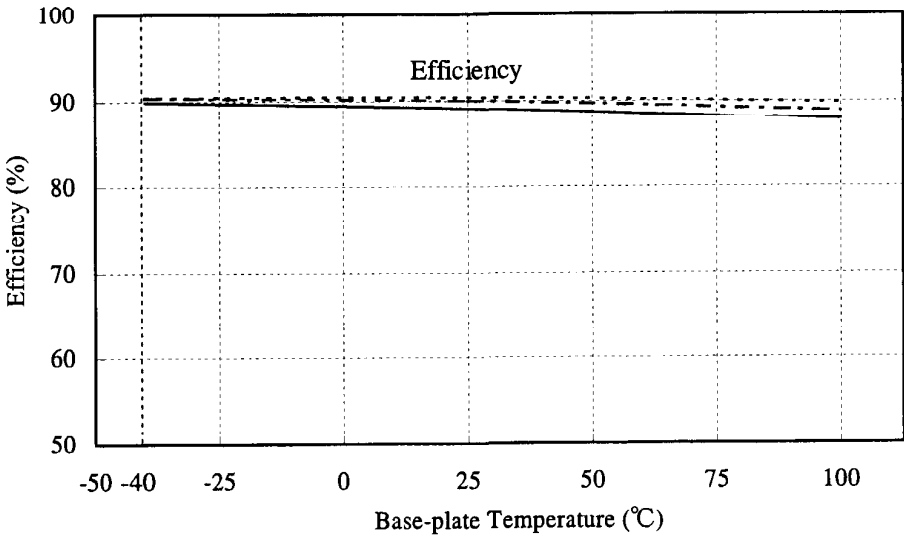
Conditions Vin : 24 VDC

Iout : 50 % -----  
80 % - - - - -  
100 % \_\_\_\_\_

12V



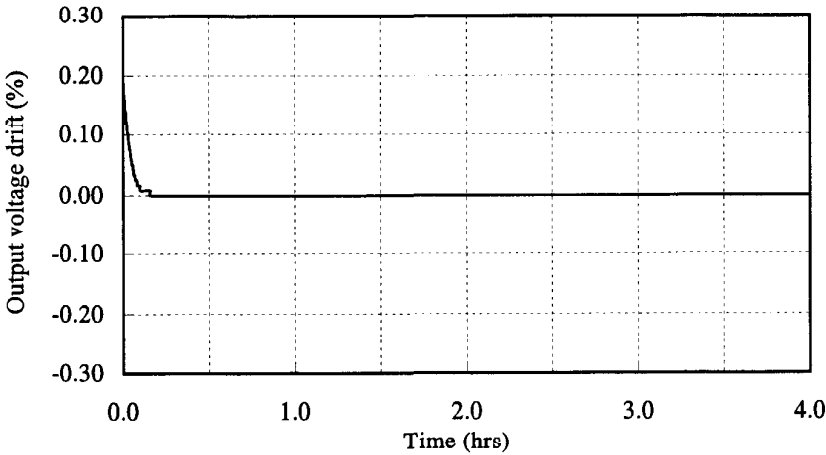
28V



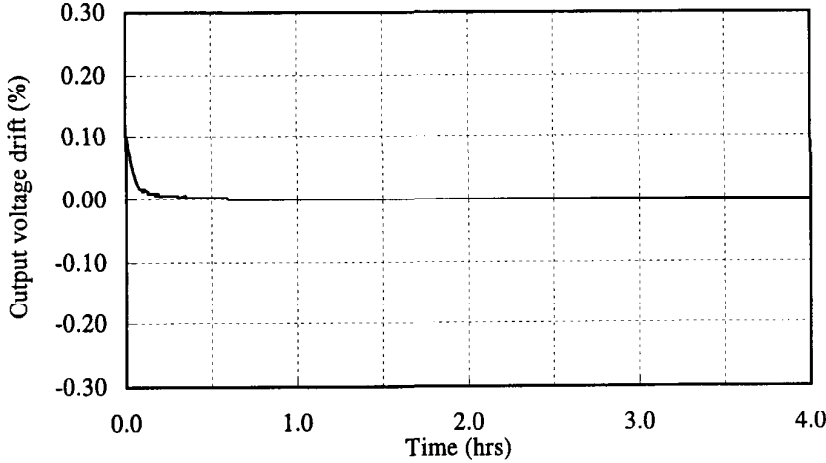
2.2 通電ドリフト特性  
Warm up voltage drift characteristics

Conditions Vin : 24 VDC  
Iout : 100 %  
Tp : 25 °C

12V



28V

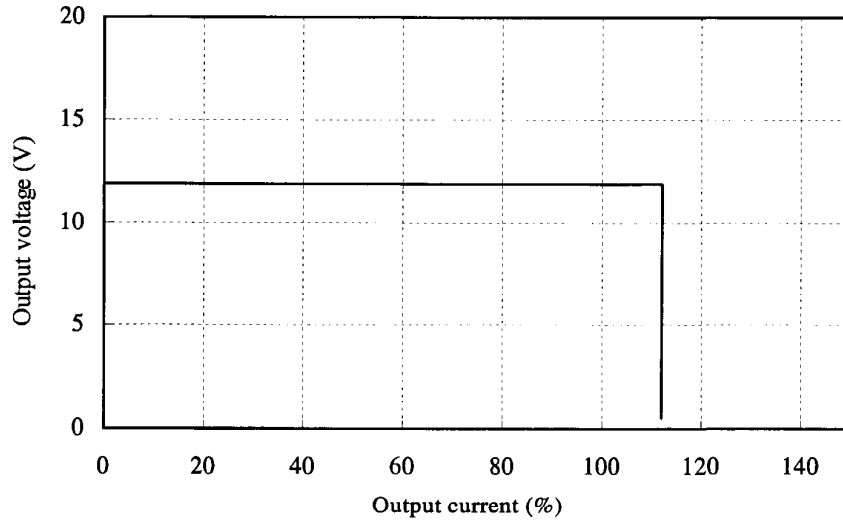




2.3 過電流保護特性  
Over current protection (OCP) characteristics

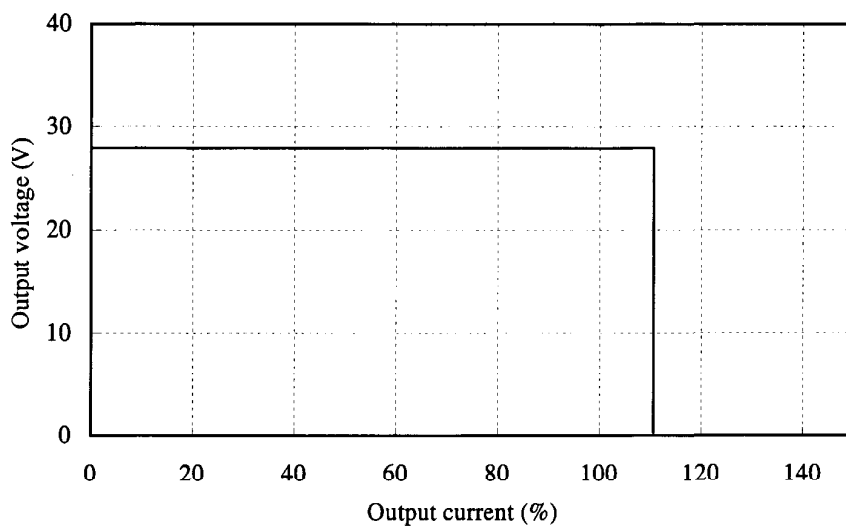
12V

Conditions Vin : 19 VDC -----  
 : 24 VDC - - - - -  
 : 36 VDC ————  
 Tp : 25 °C



28V

Conditions Vin : 18 VDC -----  
 : 24 VDC - - - - -  
 : 36 VDC ————  
 Tp : 25 °C



2.3 過電流保護特性

Over current protection (OCP) characteristics

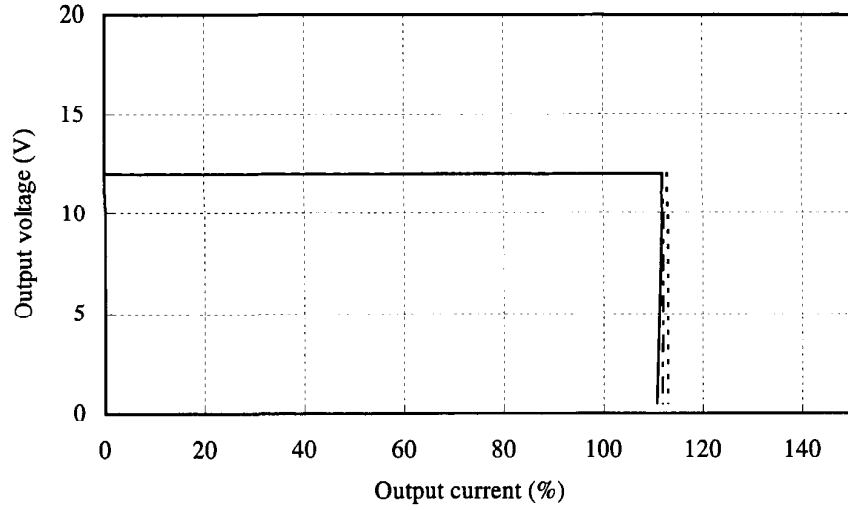
Conditions Vin : 24 VDC

Tp : -40 °C -----

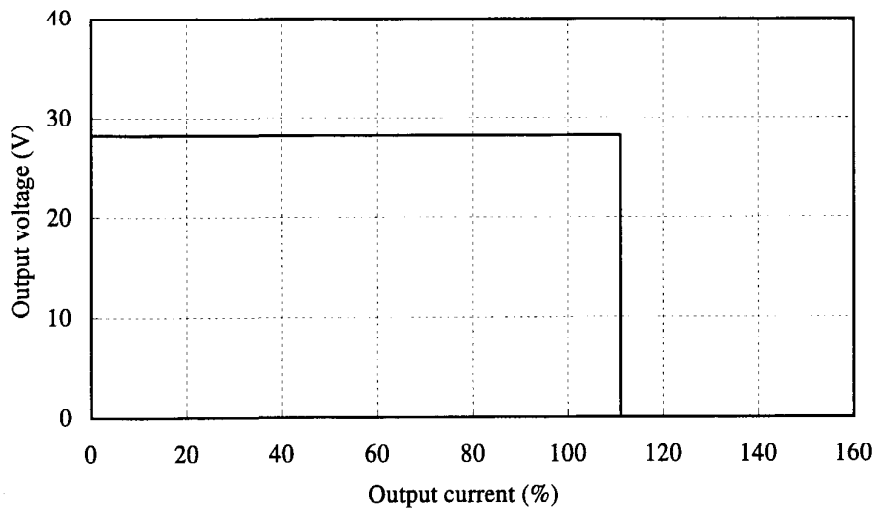
: 25 °C - - - - -

: 100 °C \_\_\_\_\_

12V



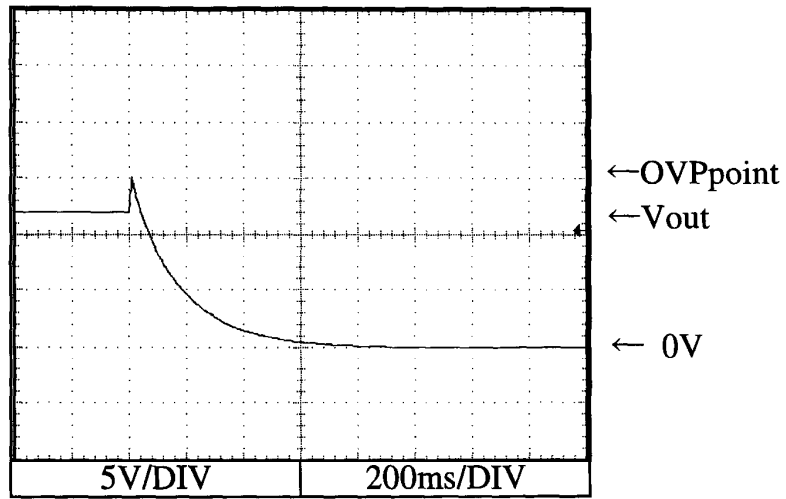
28V



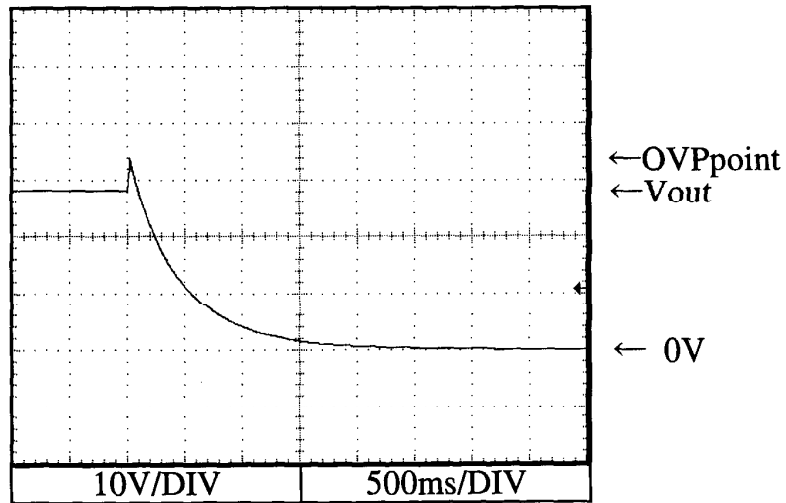
2.4 過電圧保護特性  
Over voltage protection (OVP) characteristics

Conditions Vin : 24 VDC  
Iout : 0 %  
Tp : 25 °C

12V



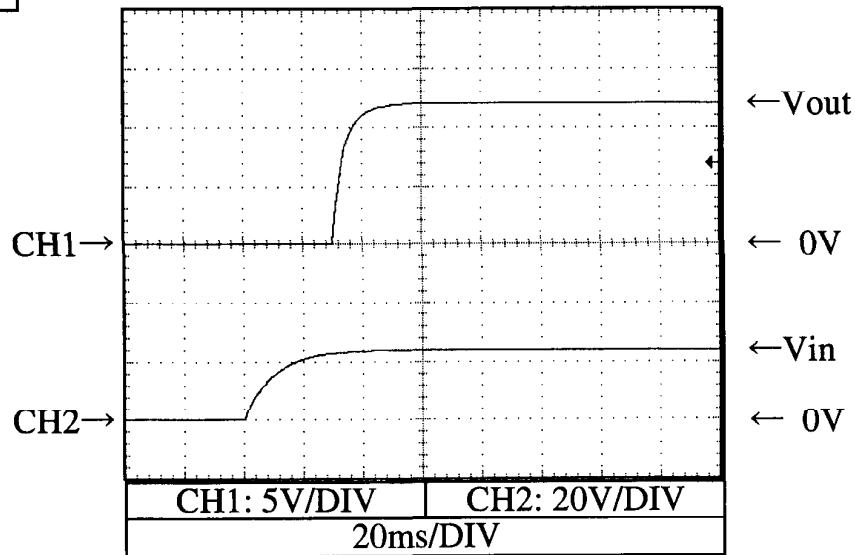
28V



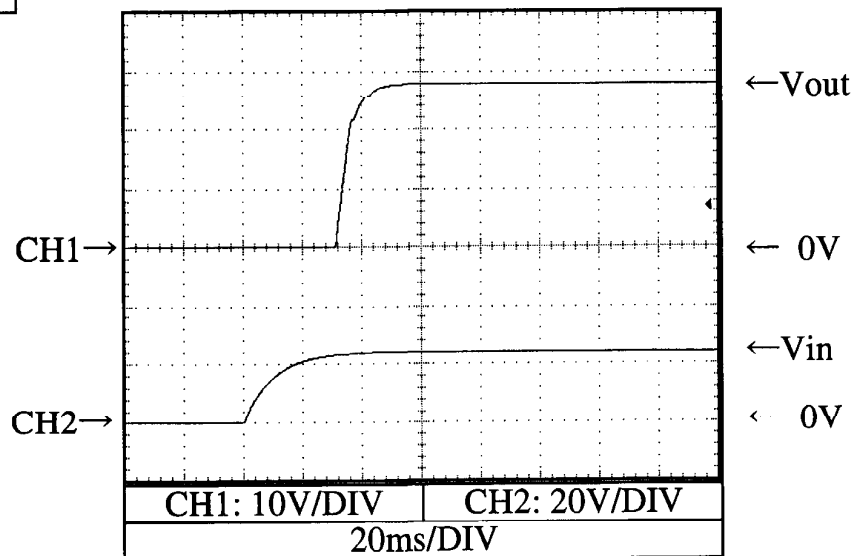
2.5 出力立ち上がり特性  
Output rise characteristics

Conditions Vin : 24 VDC  
Iout : 0 %  
Tp : 25 °C

12V



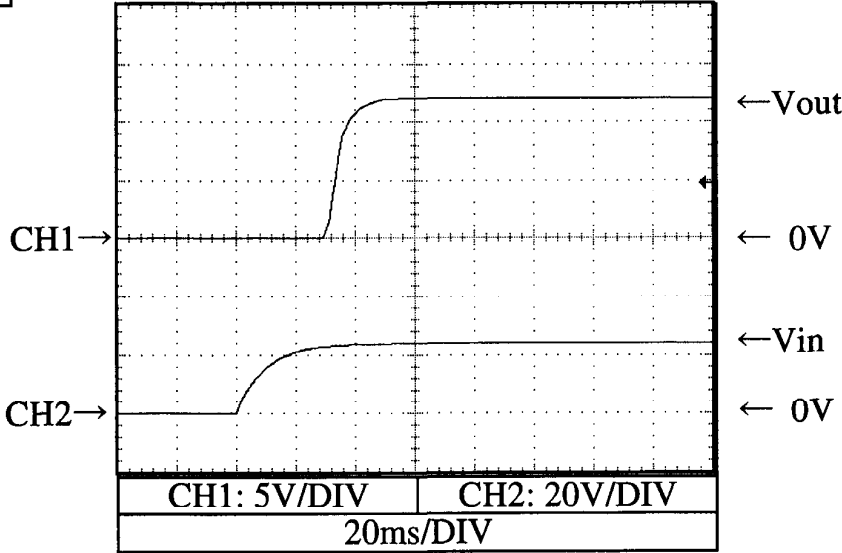
28V



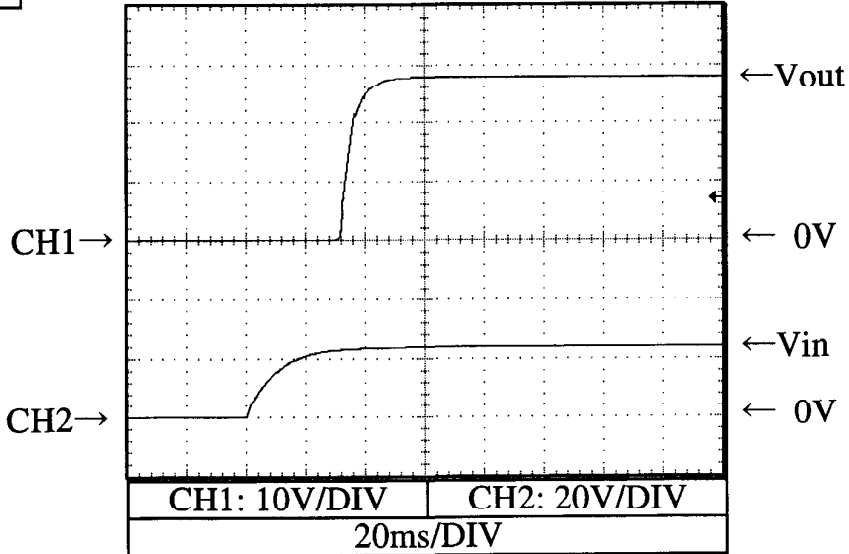
2.5 出力立ち上がり特性  
Output rise characteristics

Conditions Vin : 24 VDC  
Iout : 100 %  
Tp : 25 °C

12V



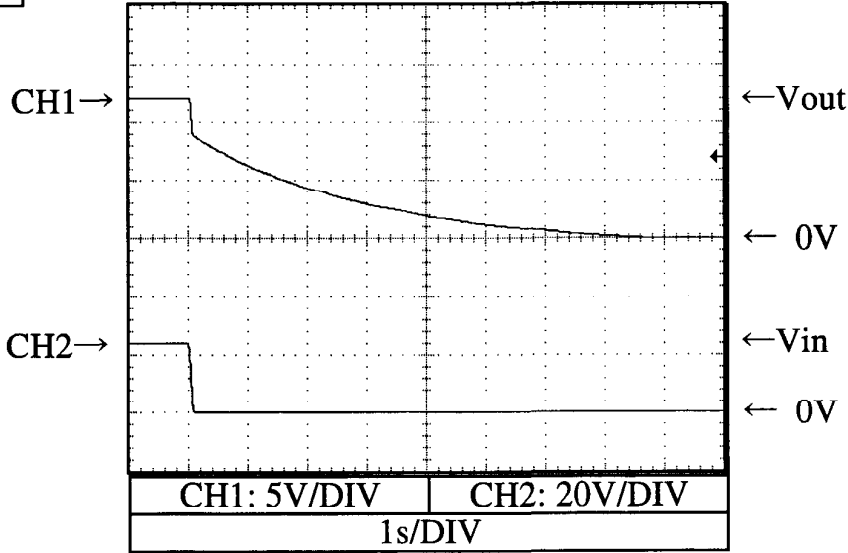
28V



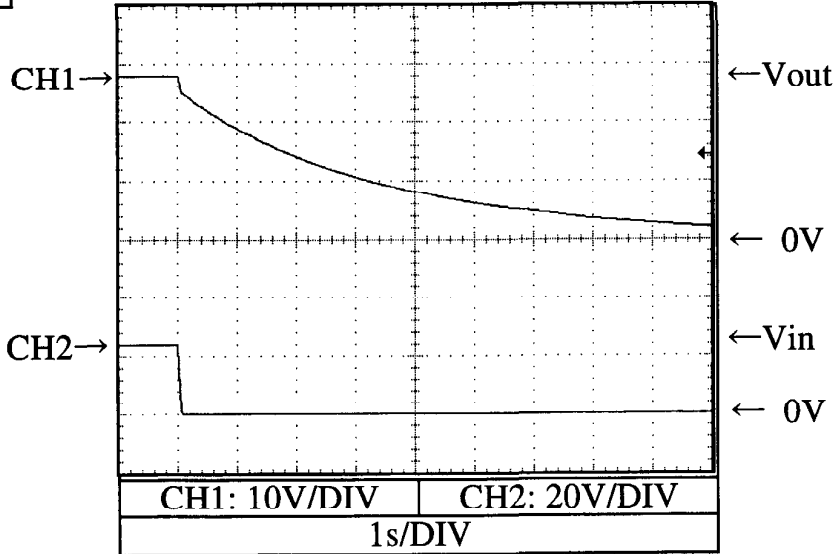
2.6 出力立ち下がり特性  
Output fall characteristics

Conditions Vin : 24 VDC  
Iout : 0 %  
Tp : 25 °C

12V



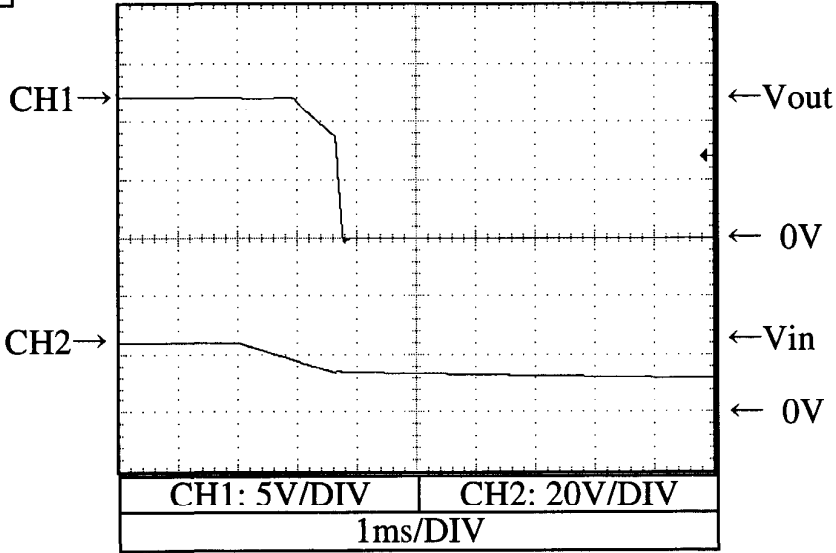
28V



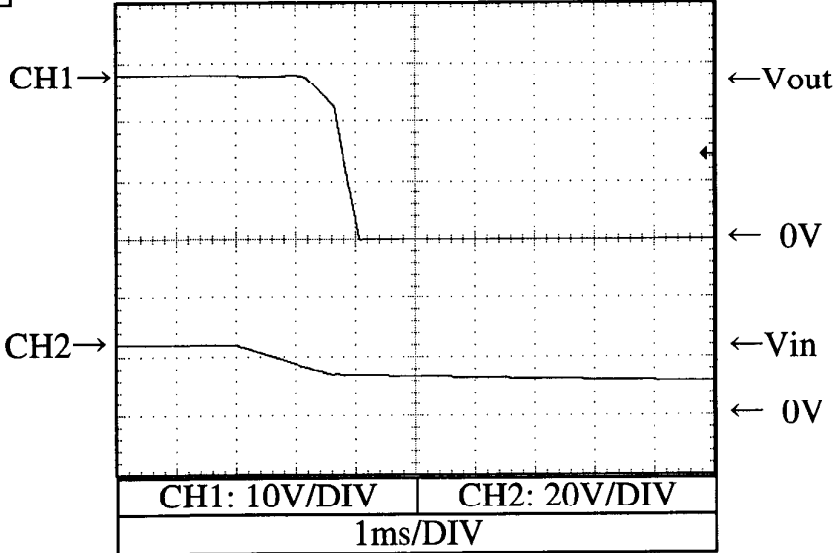
2.6 出力立ち下がり特性  
Output fall characteristics

Conditions Vin : 24 VDC  
Iout : 100 %  
Tp : 25 °C

12V



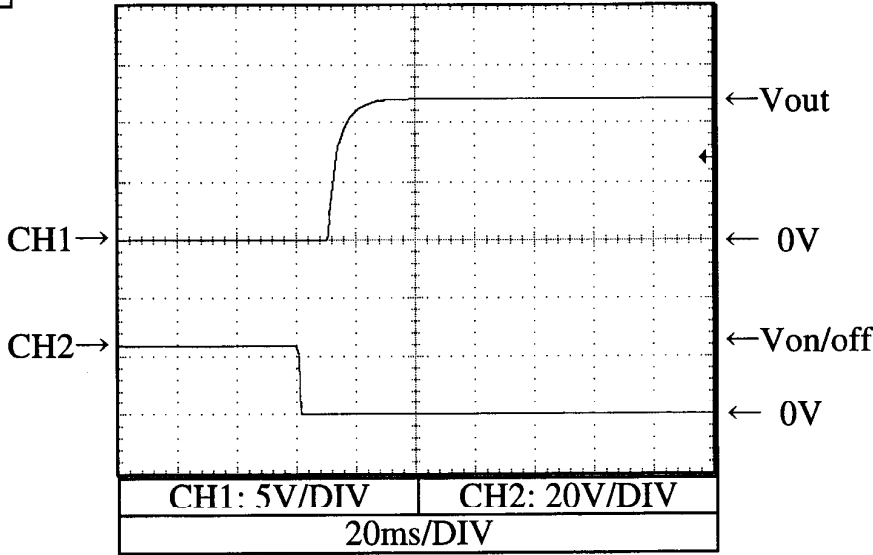
28V



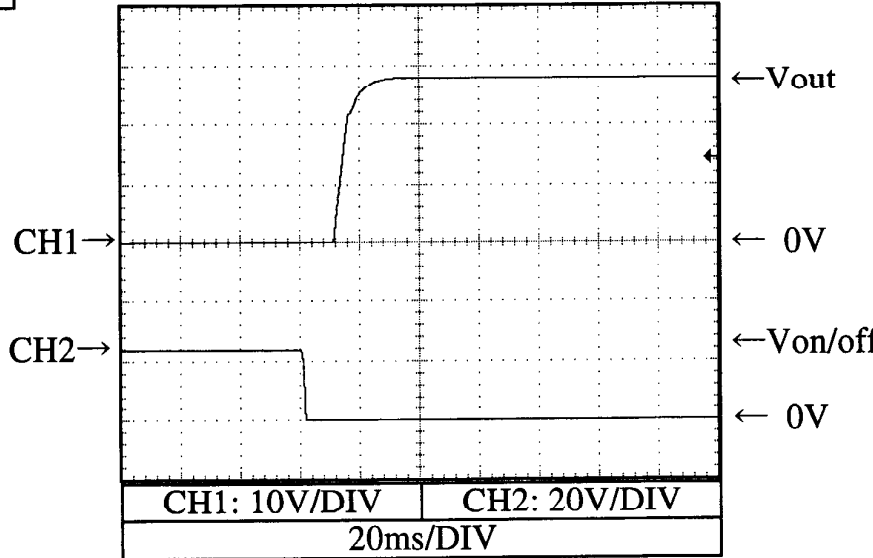
2.7 出力立ち上がり特性 (ON/OFFコントロール時)  
Output rise characteristics with ON/OFF CONTROL

Conditions Vin : 24 VDC  
Iout : 0 %  
Tp : 25 °C

12V



28V

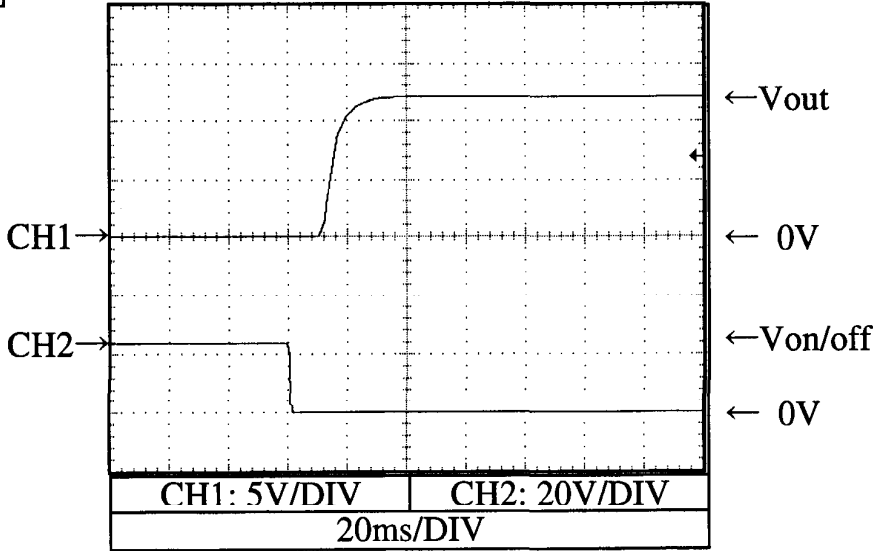




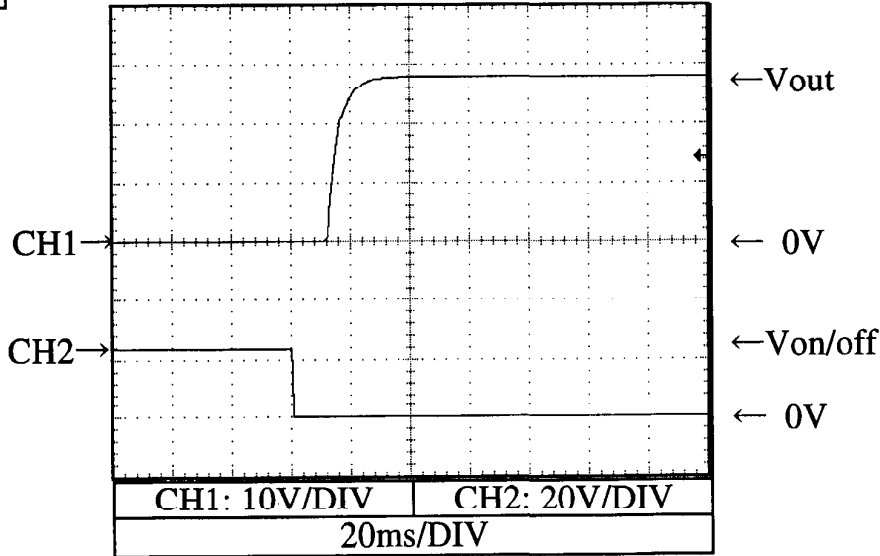
2.7 出力立ち上がり特性 (ON/OFFコントロール時)  
Output rise characteristics with ON/OFF CONTROL

Conditions Vin : 24 VDC  
Iout : 100 %  
Tp : 25 °C

12V



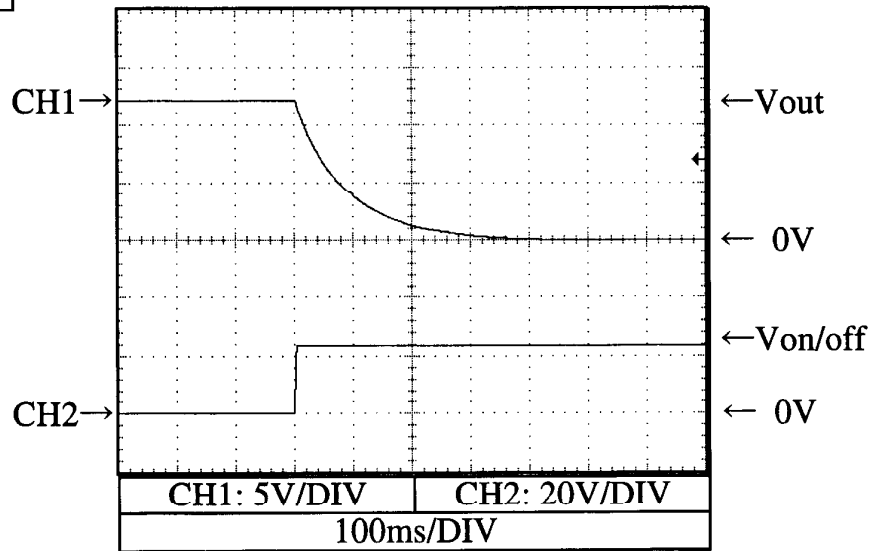
28V



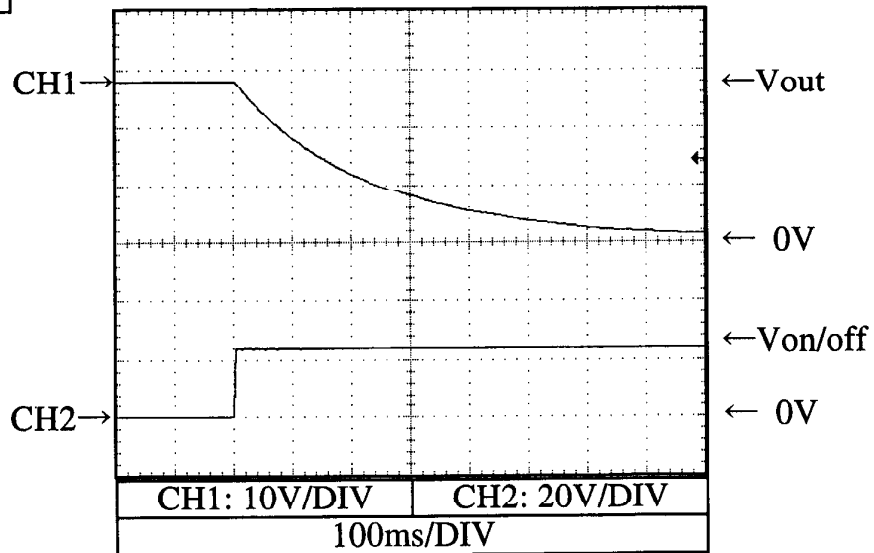
2.8 出力立ち下がり特性 (ON/OFFコントロール時)  
Output fall characteristics with ON/OFF CONTROL

Conditions Vin : 24 VDC  
Iout : 0 %  
Tp : 25 °C

12V



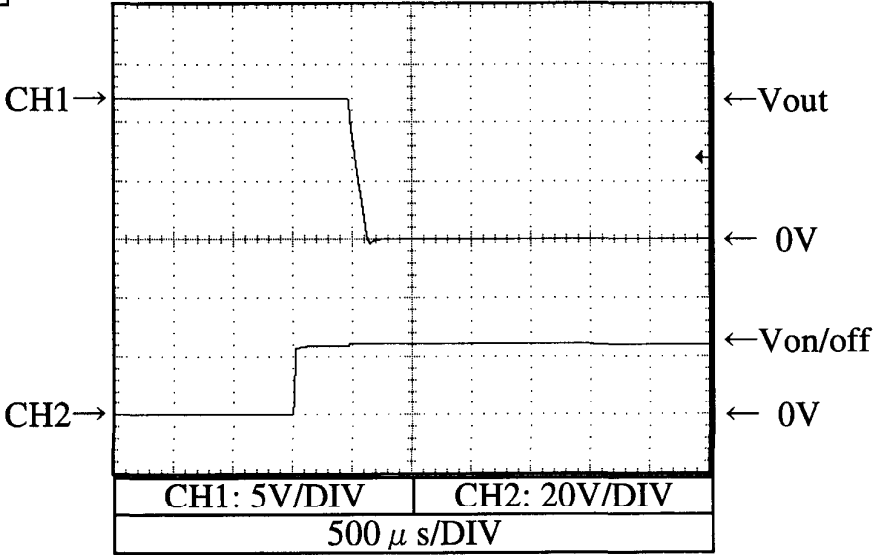
28V



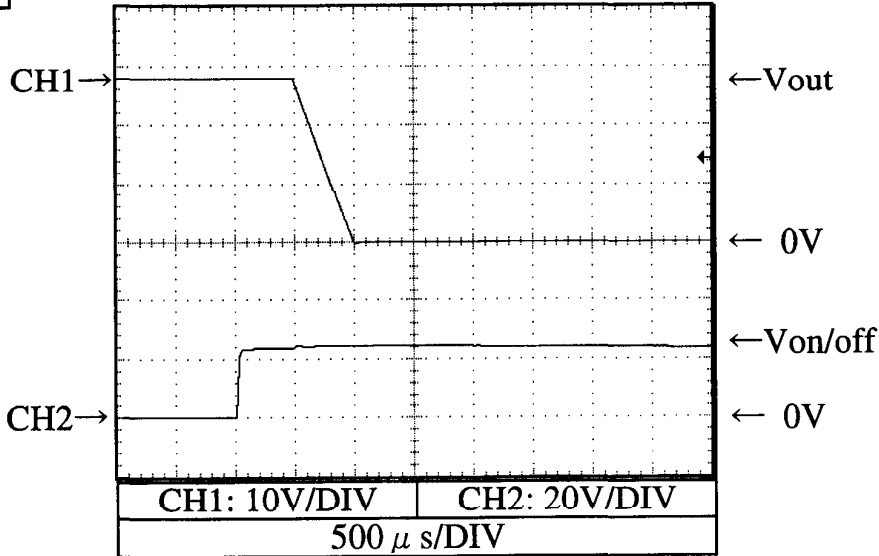
2.8 出力立ち下がり特性 (ON/OFFコントロール時)  
Output fall characteristics with ON/OFF CONTROL

Conditions Vin : 24 VDC  
Iout : 100 %  
Tp : 25 °C

12V



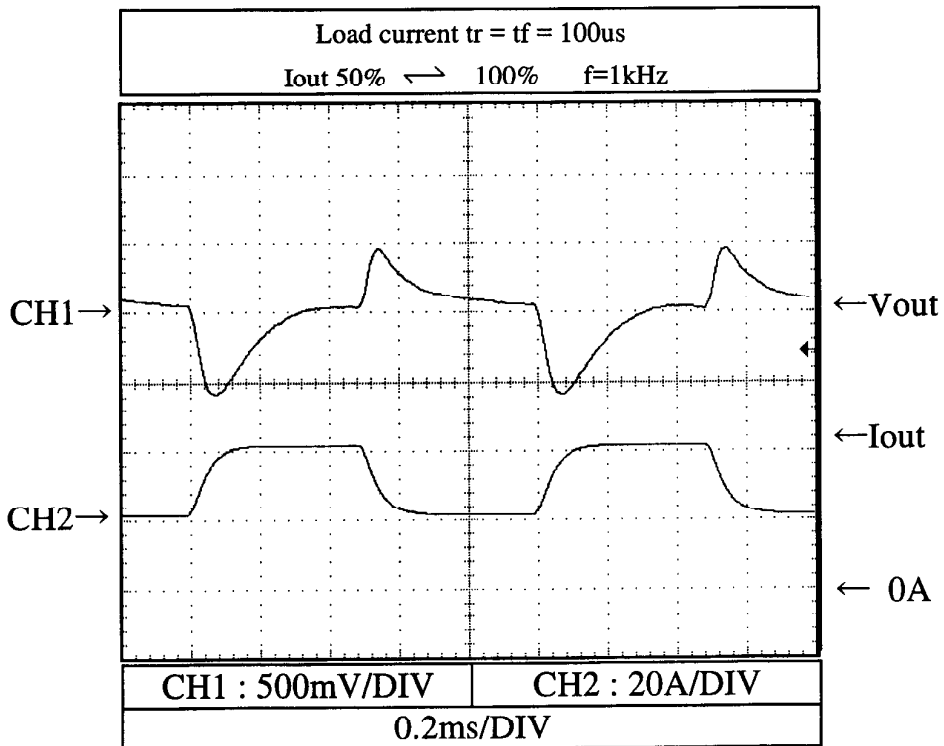
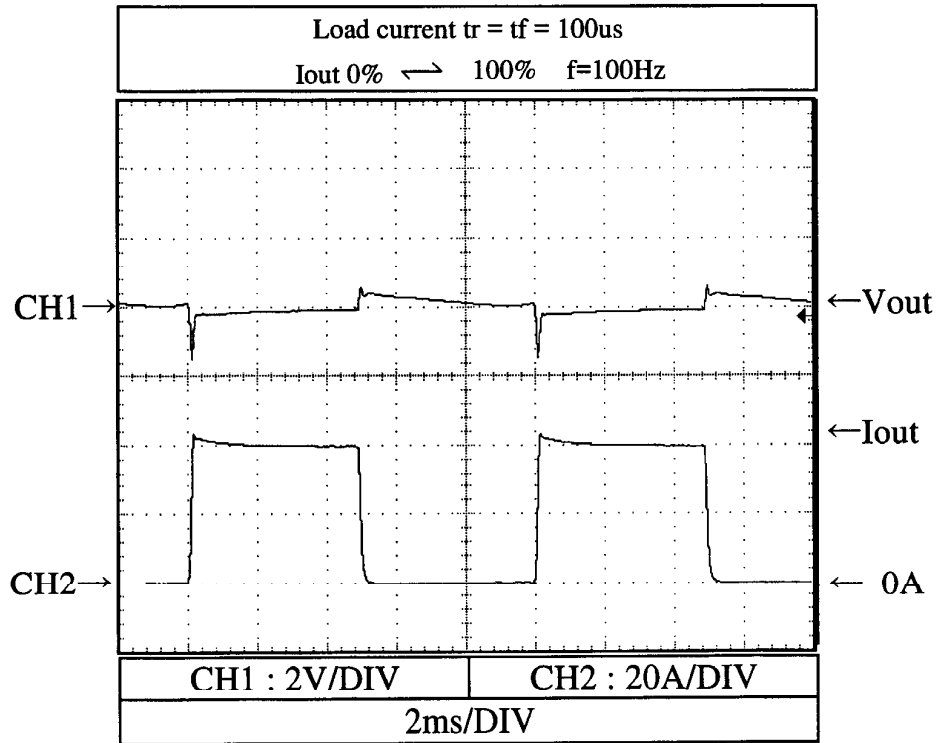
28V



2.9 過渡応答（負荷急変）特性  
Dynamic load response characteristics

Conditions Vin : 24 VDC  
Tp : 25 °C

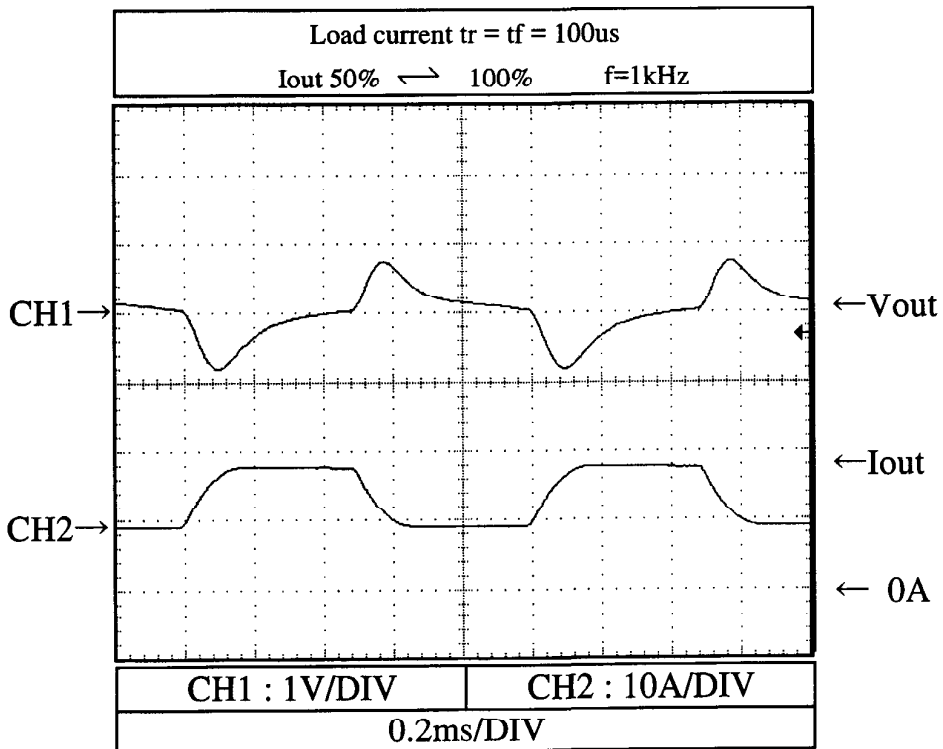
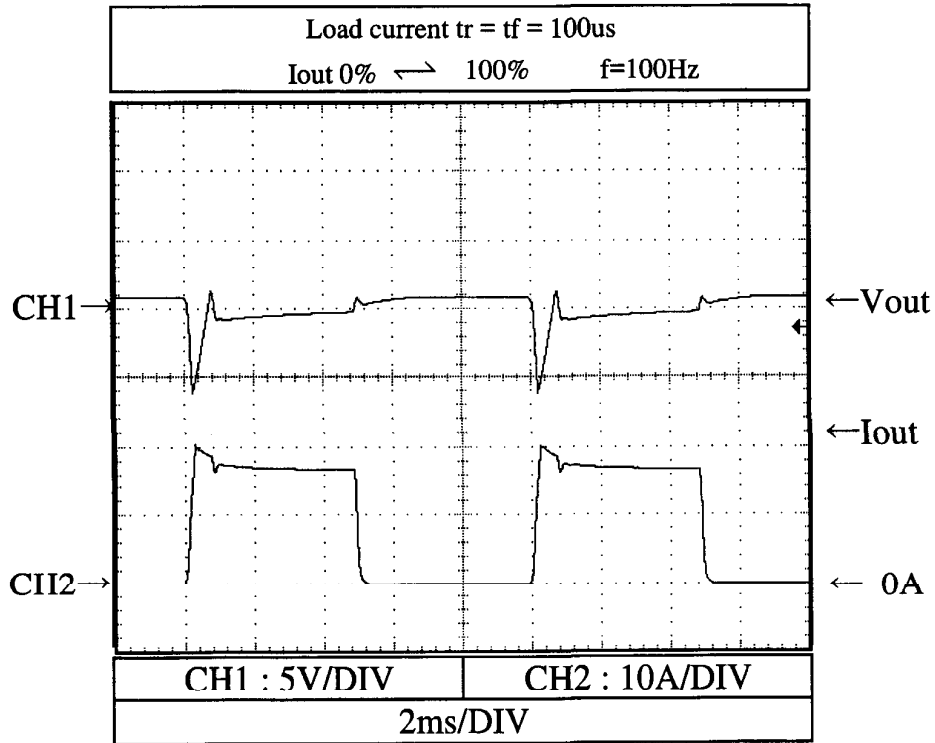
12V



2.9 過渡応答（負荷急変）特性  
Dynamic load response characteristics

Conditions Vin : 24 VDC  
Tp : 25 °C

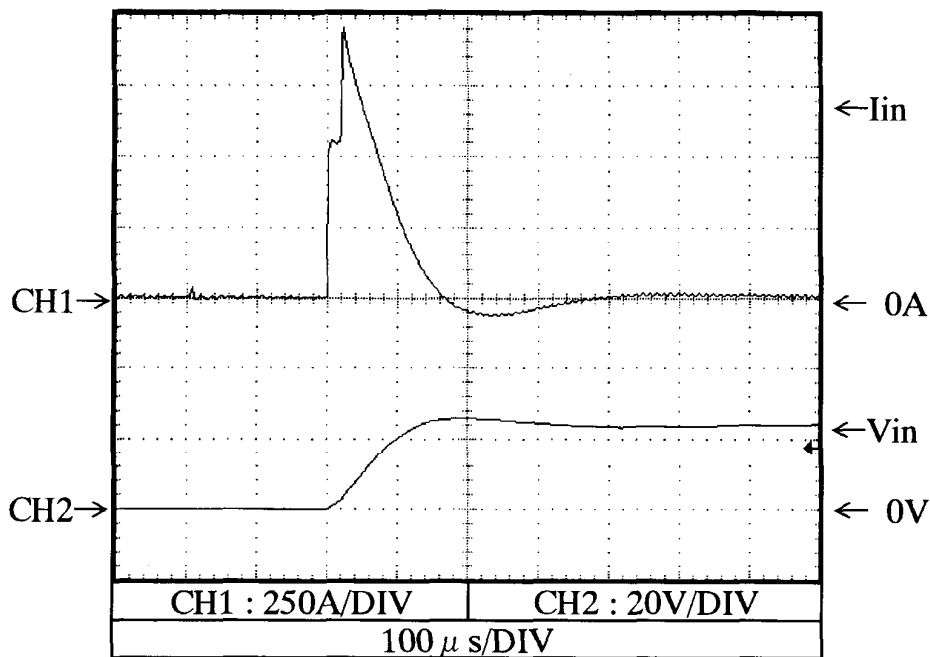
28V



2.10 入力サージ電流 (突入電流) 特性  
Inrush current waveform

Conditions Vin : 24 VDC  
Iout : 100 %  
Tp : 25 °C

12V

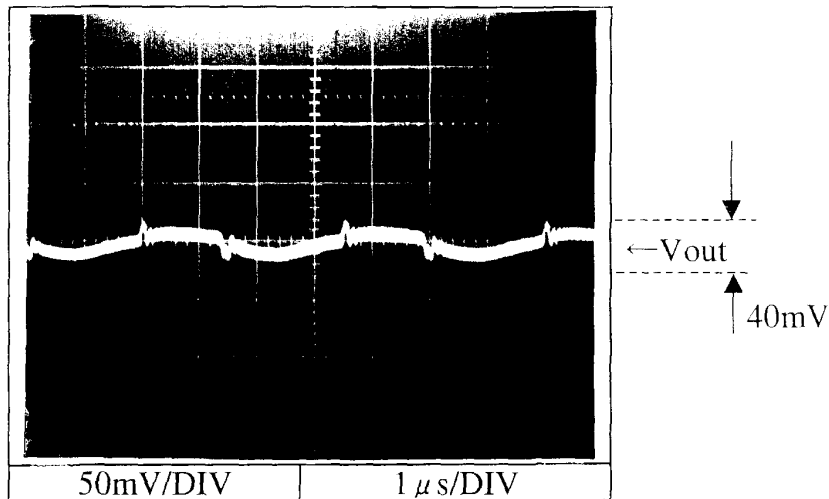


2.11 出カリップル、ノイズ波形  
Output ripple and noise waveform

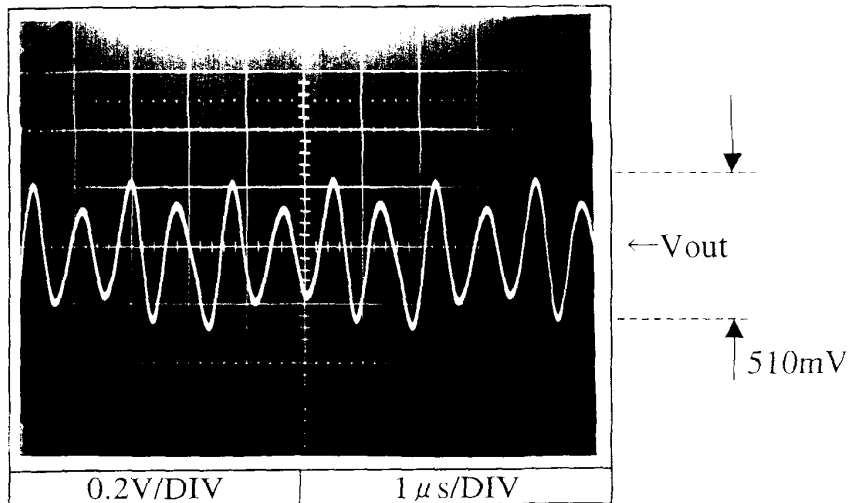
Conditions  $V_{in}$  : 24 VDC  
 $I_{out}$  : 100 %  
 $T_a$  : 25 °C

12V

Normal mode



Normal + common mode

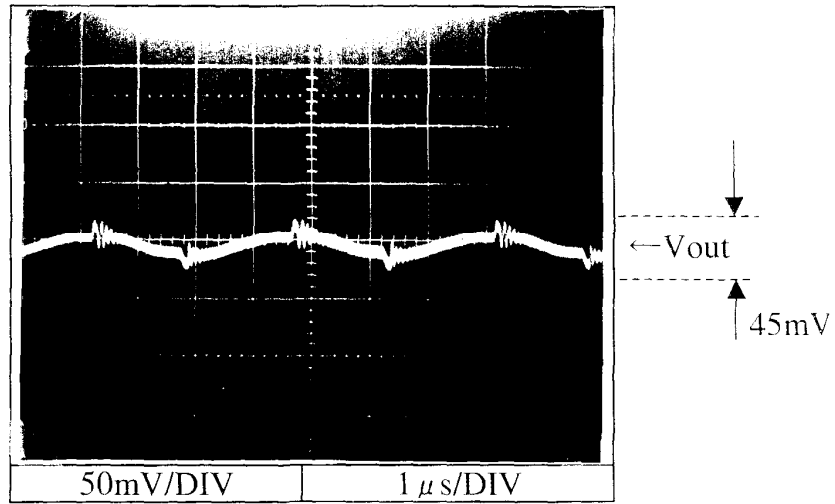


2.11 出力リップル、ノイズ波形  
Output ripple and noise waveform

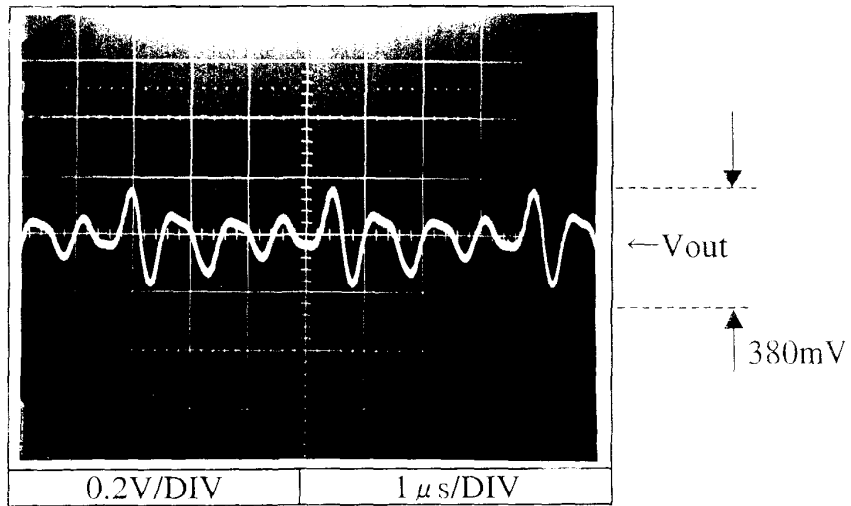
Conditions  $V_{in}$  : 24 VDC  
 $I_{out}$  : 100 %  
 $T_a$  : 25 °C

28V

Normal mode



Normal + common mode





2.12 EMI特性

Electro-Magnetic Interference characteristics

(a) 雑音端子電圧 (帰還ノイズ)

Conditions Vin : 36 VDC

Conducted Emission

Iout : 100 %

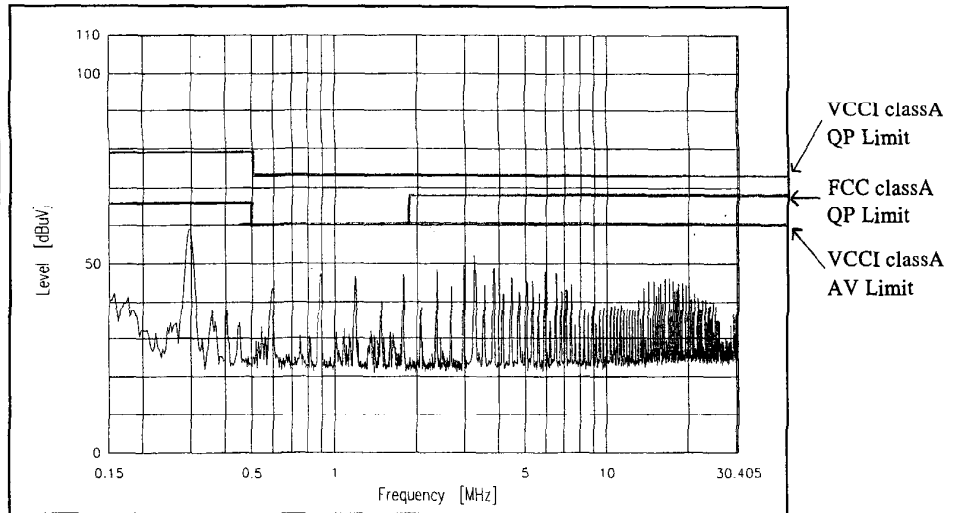
(1) VCCI class A 対応アプリケーションシステム

Tp : 25 °C

VCCI class A application system

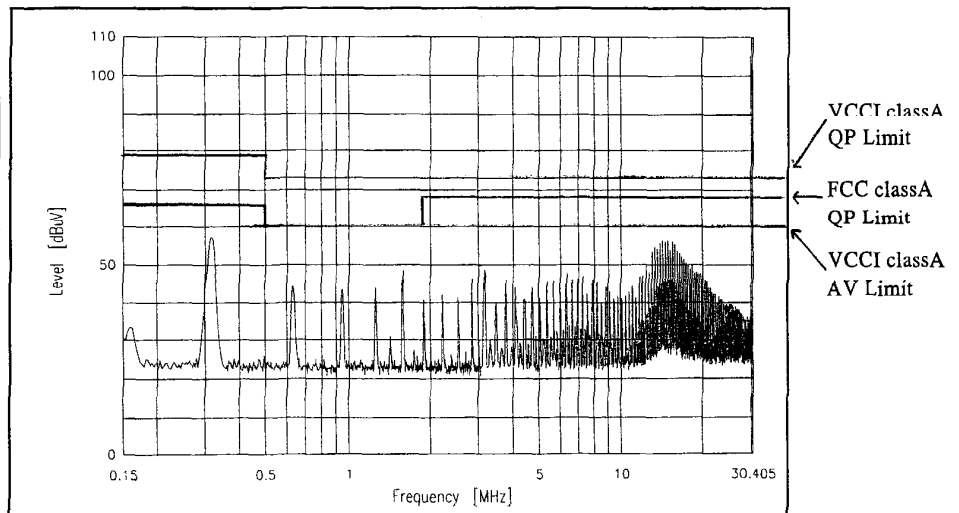
12V

Point (326kHz)		
Ref Date	Limit (dbuV)	Measure (dbuV)
QP	79.0	57.9
AV	66.0	57.9



28V

Point (315kHz)		
Ref Date	Limit (dbuV)	Measure (dbuV)
QP	79.0	56.6
AV	66.0	56.6



2.12 EMI特性

Electro-Magnetic Interference characteristics

(b) 雑音電界強度 (輻射ノイズ)

'Conditions Vin : 36 VDC

Radiated Emission

Iout : 100 %

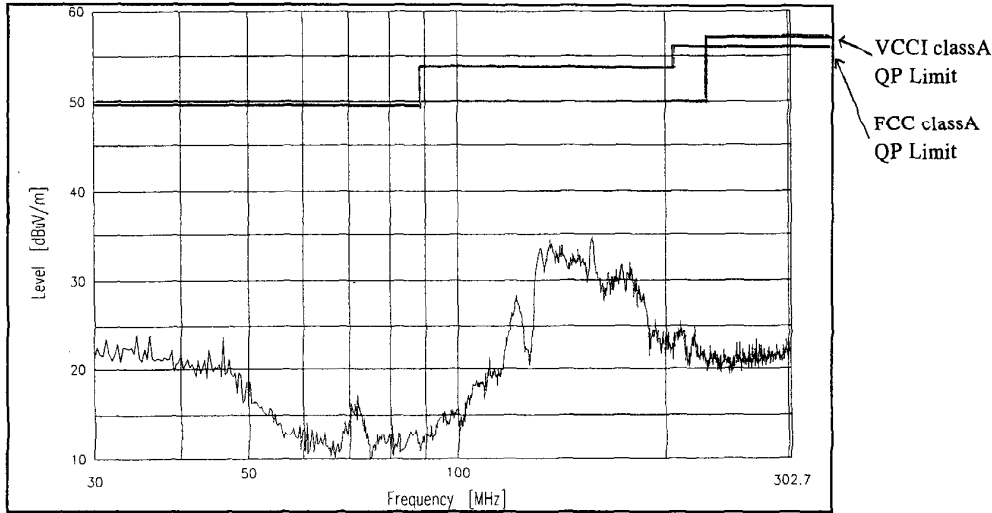
(1) VCCI class A 対応アプリケーションシステム

Tp : 25 °C

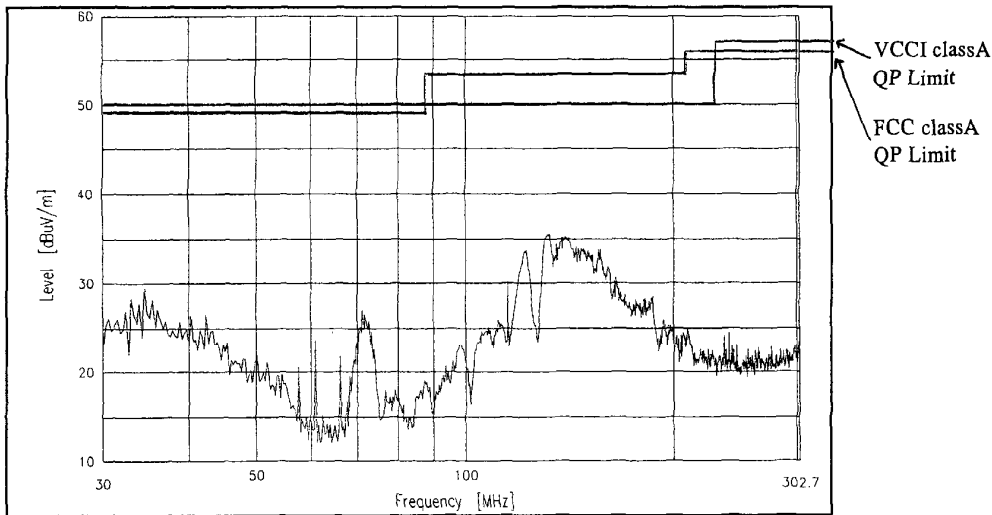
VCCI class A application system

12V

HORIZONTAL:



VERTICAL:



2.12 EMI特性

Electro-Magnetic Interference characteristics

(b) 雑音電界強度 (輻射ノイズ)

Conditions Vin : 36 VDC

Radiated Emission

Iout : 100 %

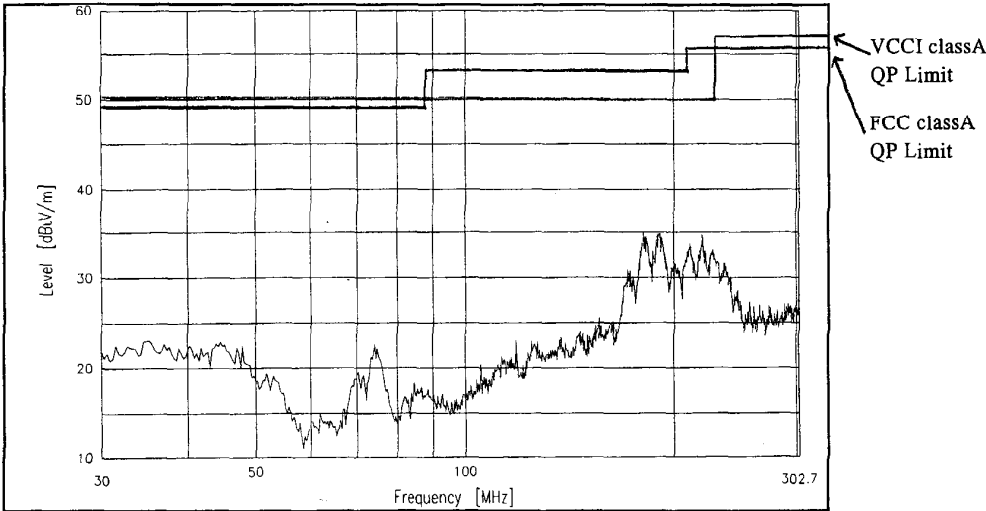
(1) VCCI class A 対応アプリケーションシステム

Tp : 25 °C

VCCI class A application system

28V

HORIZONTAL:



VERTICAL:

