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## Characteristic Evaluation of Medical X-Ray Using High-Voltage Generator with Inverter System

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**Abstract:** Medical X-ray has been brought many changes according to the rapid development of high technology. Especially, for high-voltage generator which is the most important in X-ray generation the traditional way is to use high-voltage electric transformers primarily. However, since it is large and heavy and the ripple rate of DC high-voltage applied to X-ray tube is too big, it has a disadvantage of low X-ray production efficiency. To solve these problems, the studies about high-voltage power supply are now proceeding. At present, the high-voltage generator that generates high-voltage by making high frequency using inverter control circuit consisting of semiconductor device is mainly used. High-voltage generator using inverter has advantages in the diagnosis using X-ray including high performance with short-term use, miniaturization of power supply and ripple reduction. In this study, the X-ray high-voltage device with inverter type using pulse width modulation scheme to the control of tube voltage and tube current was designed and produced. For performance evaluation of produced device, the control signal analysis, irradiation dose change and beam quality depending on the load variation of tube voltage and tube current were evaluated.

**Keywords:** X-ray, Inverter, Generator, Medical

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[1],

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[2-4].

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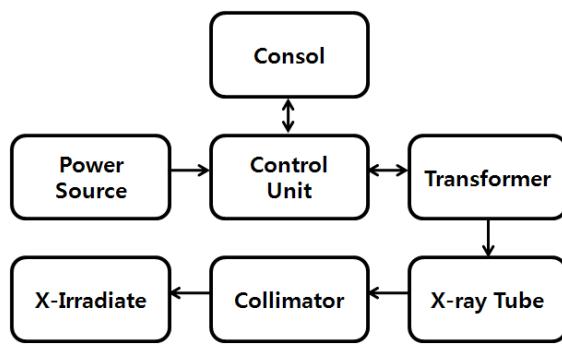


Fig. 1. Configuration of X-ray system.

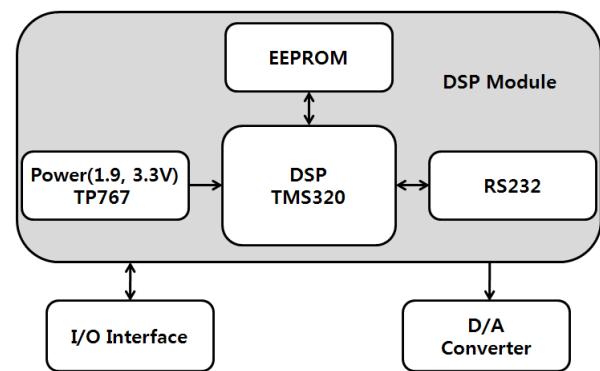


Fig. 2. Configuration of CPU board.

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, X  
X( )  
1 X  
2.1

[5-6].

X on/off,

control unit CPU board (RS232  
: recommended standard 232)[7-9].  
width modulation)(PWM: pulse  
X

## 2.2 Control Unit

PWM

Control unit

2. X

X

## 1) CPU

CPU(central processing unit)

CPU

DSP(digital signal processor)

PWM

CPU

DSP , bucky

rotor

AUX

control unit, X

interface,

PWM

DSP

X

X

D/A converter

2 CPU

X

DSP TMS320  
150 Mbps,  
sampling,

TMS320 20 A  
I/O precharge

2.3

DSP			TP767,
DSP		RS 323,	
EEPROM		.	DSP
PWM	0000	4,095	4,096
	X		

X

X

2

IGBT

1

2

PWM

1

```

graph LR
    PWM[PWM] --> DAD[Digital-to-Analog converter]
    DAD --> DAC[D/A converter]
    DAC --> CPU[CPU]
    CPU --> PWM
    
```

This block diagram illustrates a feedback control loop. The CPU provides digital control signals to the PWM module. The PWM module generates a digital signal that is converted to analog by the D/A converter. This analog signal is then converted to a digital signal by the D/A converter, which is fed back to the CPU.

PWM 1 DC 320 V

PWM

1

10

gate bipolar transistor) 2.4 X

X Toshiba E7239  
(cathode)

x

X

X

3)

3,200 rpm  
filament

18,800 uF

X

20 kV

X

## A/D converter

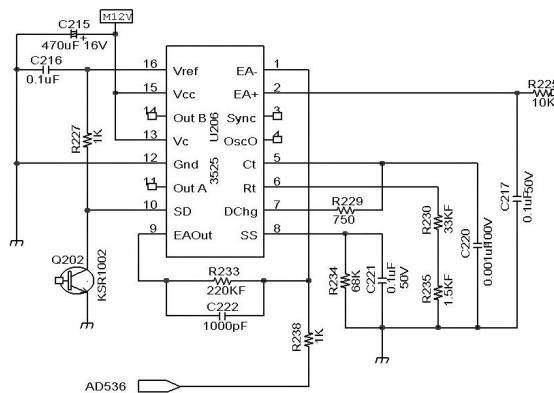


Fig. 3. Circuit diagram of KA3525.

## 2.5 (照射野)

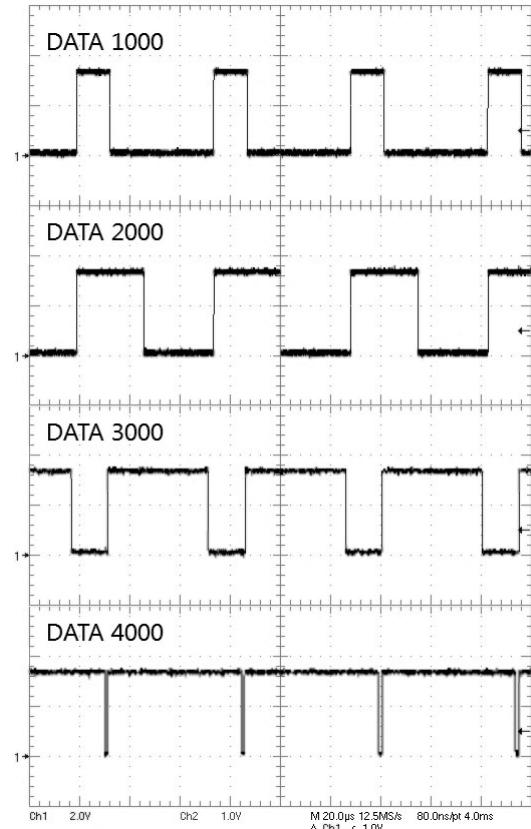


Fig. 4. PWM control signal.

3.

### 3.1 DSP

X

(ICRP: international commission on radiological protection)

[10].

X

PWM

PWM  
KA3525  
EA-  
PWM  
KA3525

IC(integrated circuit)  
EA+ analog  
feedback  
. 3 PWM

Fig. 5. Change of reference voltage according to PWM control signal.



