Regular Paper
J. KIEEME
Vol. 24, No. 1, pp. 36-41, January 2011
DOI: 10.4313/JKEM.2011.24.1.36

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

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(Received October 15, 2010; Revised November 25, 2010; Accepted December 5, 2010)

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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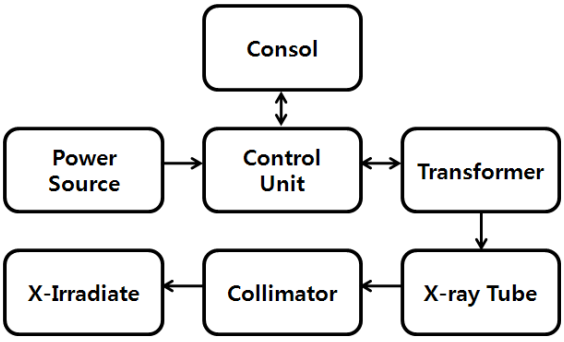

Fig. 1. Configuration of X-ray system.

X

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X

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[7-9]. (PWM: pulse width modulation) X

, X

PWM ,

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2. X

X

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CPU(central processing unit) ,
PWM

,

control unit, X

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X X ,

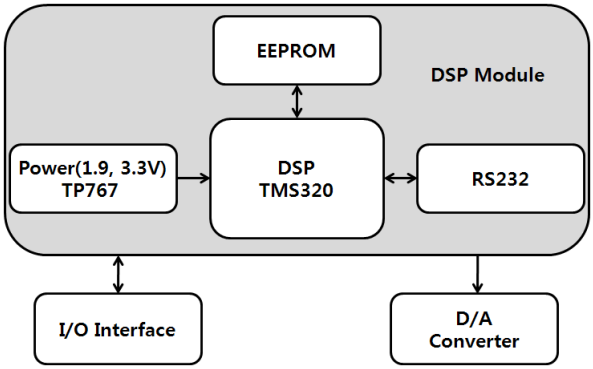

Fig. 2. Configuration of CPU board.

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X on/off, ,

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control unit CPU board (RS232 : recommended standard 232)

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2.2 Control Unit

Control unit

system

CPU , PWM , ·

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1) CPU

CPU DSP(digital signal processor)

. CPU

DSP , bucky rotor

AUX

interface, DSP

PWM

D/A converter .

2 CPU .
X . ,
,
, .
DSP TMS320 . TMS320 20 A
150 Mbps, I/O precharge .
port, sampling,
. 2.3
DSP TP767,
DSP RS323, X
EEPROM . DSP X
PWM 0000 4,095 4,096
, X .
. ,
20 kHz LC
2) IGBT 1
2 .
, , PWM
PWM 1 ,
. DC 320 V .
DSP 4,096 150 kV
PWM , CPU
D/A converter analog X . X
. analog
. PWM
KA3525 1 10
feedback 30 V . X
2 X
PWM . .
PWM IGBT (insulated
gate bipolar transistor) 2.4 X
,
1 X X Toshiba E7239
. (cathode)
PWM IGBT X (anode)
X . X
. X
, ,
3) .
3,200 rpm
. filament
18,800 uF . , X
X 20 kV
X X
A/D converter .

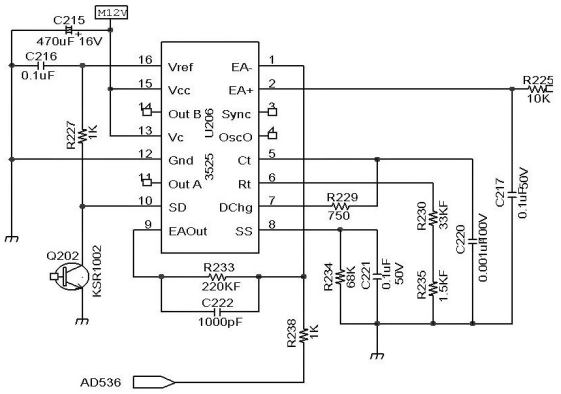

Fig. 3. Circuit diagram of KA3525.

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X

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3.

3.1 DSP

X

(ICRP: international commission on radiological protection)

[10].

X

X

PWM

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PWM IC(integrated circuir) KA3525 EA-
KA3525 EA+ analog
EA- feedback feedback , analog
PWM . 3 PWM KA3525
KA3525 . on , on

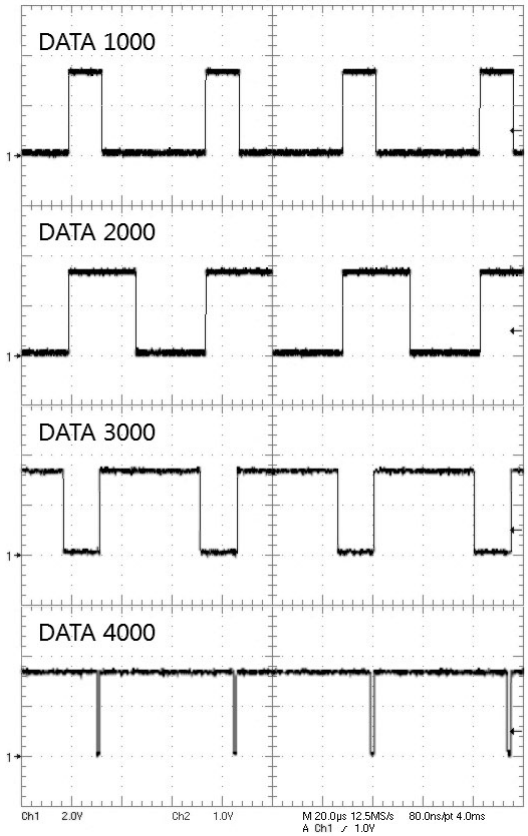

Fig. 4. PWM control signal.

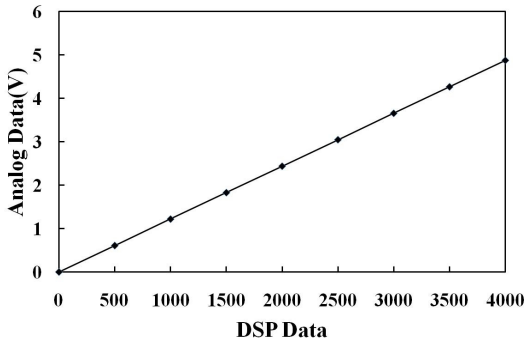

Fig. 5. Change of reference voltage according to PWM control signal.