

PWM

PWM

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Amplitude Reduction of Harmonics of Output Voltage of A Three-Phase PWM Inverter Using Parallel Transistors

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Abstract

This paper presents a three-phase PWM inverter in which power transistors are used as switches. In this type of inverter current-sharing reactors are used, and in each phase four transistors are used compared to two transistors used in conventional inverters. By using this inverter more amount of current can be attained as well as output voltage harmonics are greatly reduced and output voltage waveform will be a curve of five levels of voltage which resembles more closely to a sine wave. The correction role of increase in number of transistors in each phase, which causes increase in power level and a reduction in output voltage harmonics has been shown using time-scale waveforms, frequency spectrum and the effect of variations of modulation index on amplitude of harmonic component. Finally, experimental results of such an inverter design in a laboratory has been presented which completely agrees with theory.

Key words: Inverter, PWM, Harmonic, Parallel transistor, Current-sharing reactors.

(ac)

PWM

$$a = \frac{m_s}{m_r}$$

()

m_s a

m_r

(- b) a = l

T_{U1}, T_{U2}

((- c))

RS ()

((- d))

PWM

(- a)

$T_{W1} - T_{W4}, T_{V1} - T_{V4}, T_{U1} - T_{U4}$

l_3, l_2, l_1

()

[]

emf

i_2

i_1

l_1

[]

i_1

()

$i_2 i_1$

emf

(- b)

a = l

T_{U2}, T_{U1}

[]

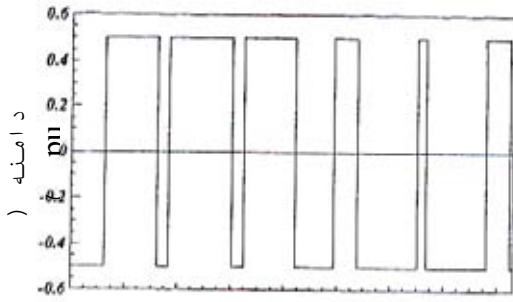
PWM

T_{U4}, T_{U3}

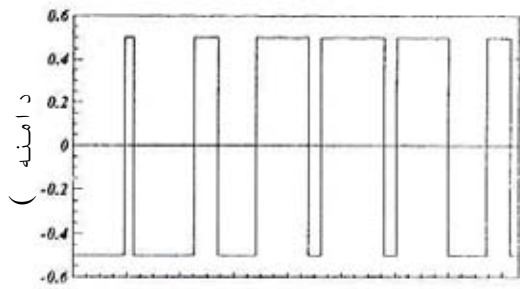
((- c))

(- a)

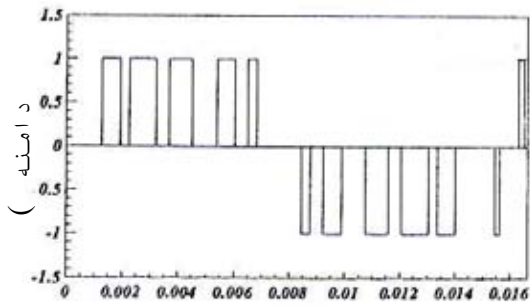
(



شکل موج R

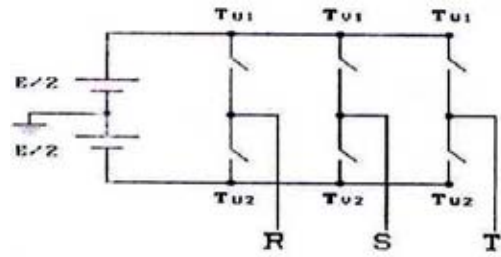


شکل موج S

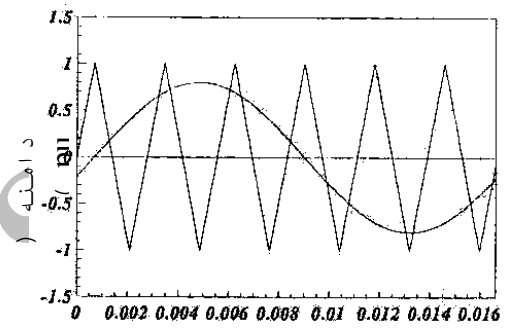


شکل موج RS

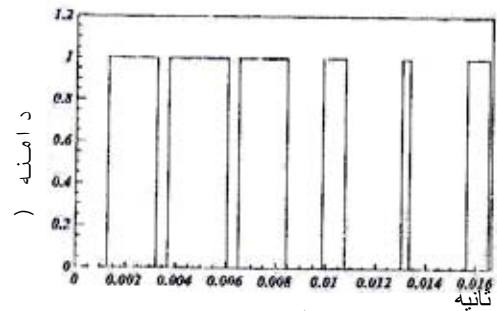
(1-d) شکل موج ولتاژ فاز و خط (RS, S, R)



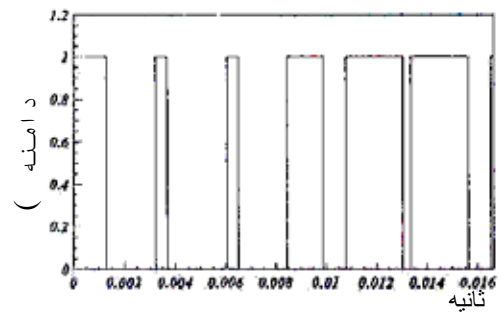
(1-a) شمای مداری



(1-b) سیگنال مدولاسیون



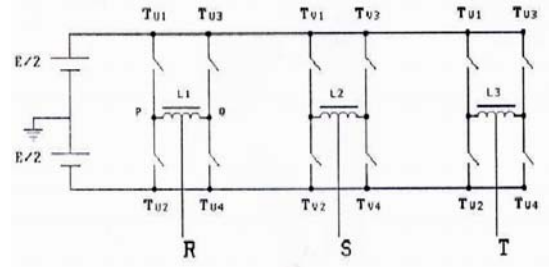
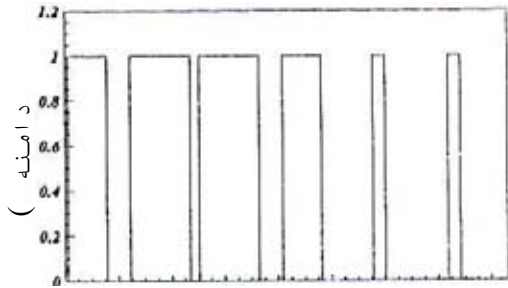
سیگنال سه نجه 1



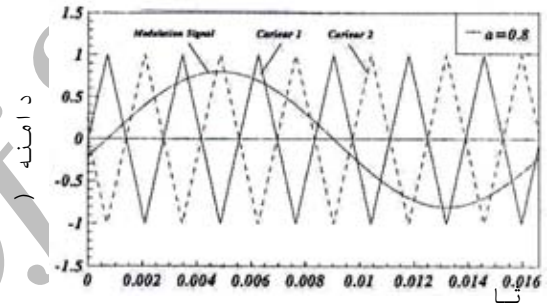
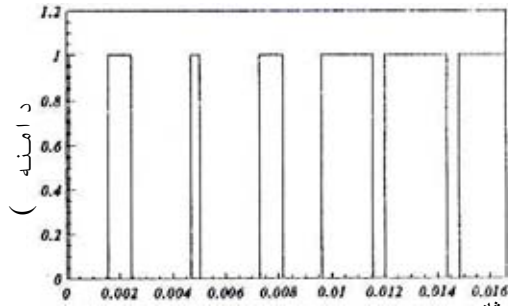
(1-c) سیگنالهای سوئیچ

توانسته های فاز u

U
(-d) Q P

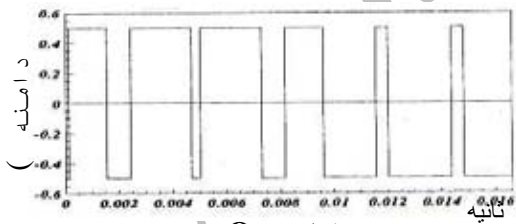


شماي (۲-ا)

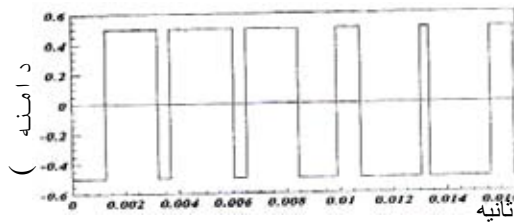
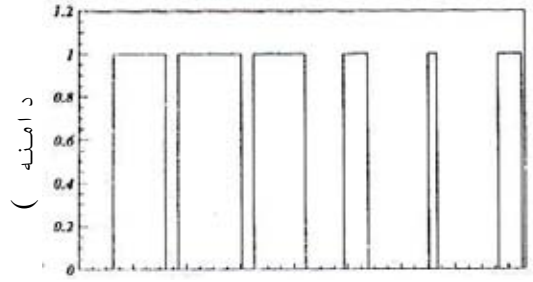


قطع موج (۲-ب)

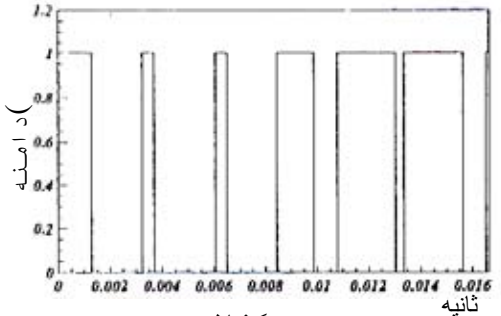
سیگنال
ثانیه
(۲-ج) سیگنالهای سوئیچ



شکل موج Q



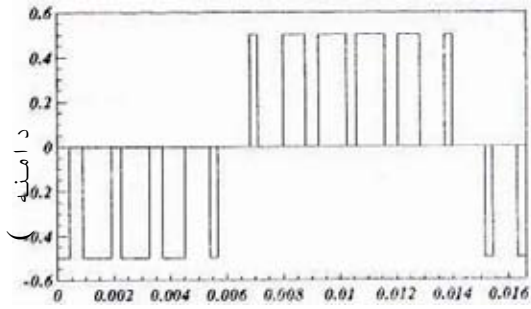
شکل موج P



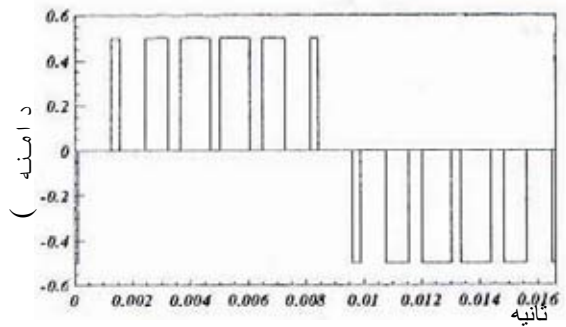
(۲-د) شکل موج

سیگنال

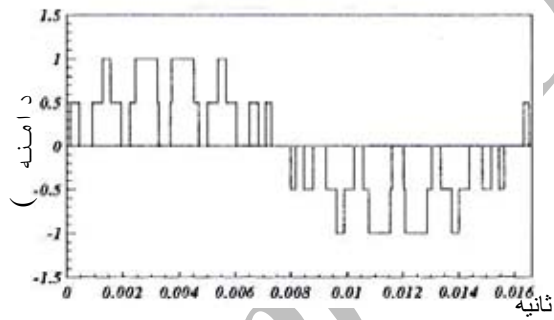
PWM



شکل (۲-f)



-e)



(۲-g)

PWM

i_4, i_3, i_2, i_1 () e_q, e_p
 (T_{U8}, T_{U1}) ()
 $(T_{U4}-T_{U3}), (T_{U1}-T_{U2})$

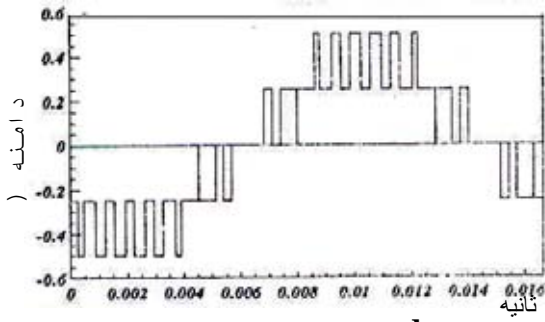
$(T_{U8}-T_{U7}), (T_{U6}-T_{U5})$: e_q, e_p R
 $e_R = (e_p + e_q) / 2$ ()

$(-b)$ (e_s)
 (T_{U8}, T_{U1}) e_{RS} e_s, e_R
 $(-c)$ e_{p3}, e_{q3} e_s, e_R (-e, f, g)

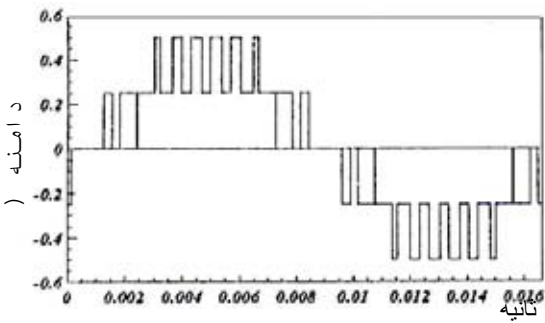
: R
 $e_R = (e_{q3} + e_{p3}) / 2$ () PWM -

$V(e_s)$ (l_3, l_2, l_1) $(T_{U1}-T_{U8})$ (-a)
 e_s, e_R (e_{RS}) U

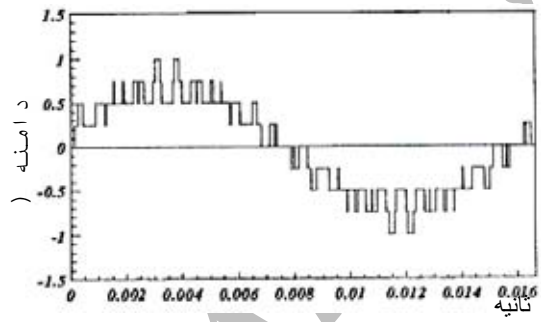
(- d,e,f)



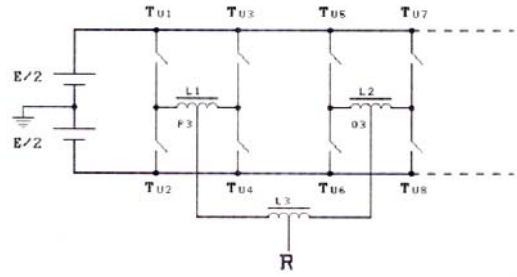
شکل موج (۳-d)



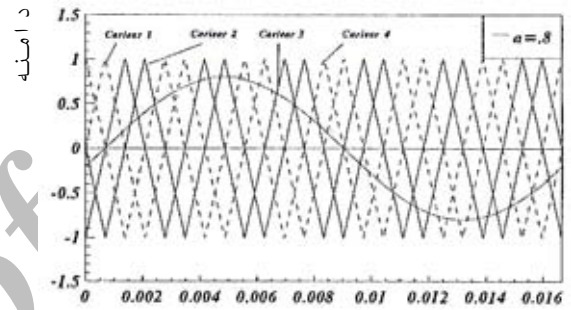
شکل موج (۳-e)



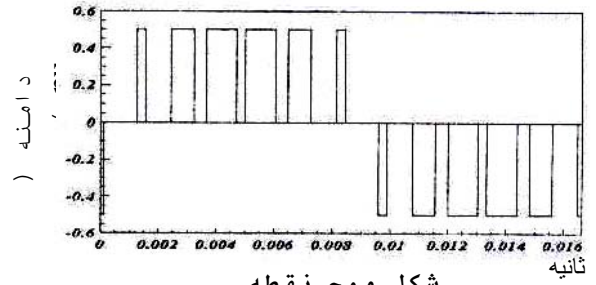
شکل موج (۳-f)



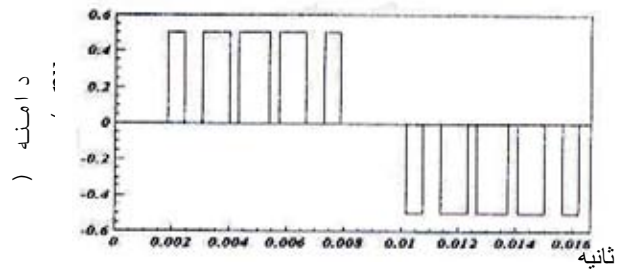
شماي (۳-a)
مداره



قطع موج سینوسی (۳-b)



شکل موج نقطه
F



شکل موج نقطه
(۳- c) شکل موج نقاط
D2 D3

PWM

() -

$(\omega_r + 2\omega_s)$

(-c) (-b) (-a)

(-a) $(2\omega_r + \omega_s)$ (n +)

$\omega_s \omega_r$) (-c) (-b) ((n)

(

a= ()

()

--

(- a b)

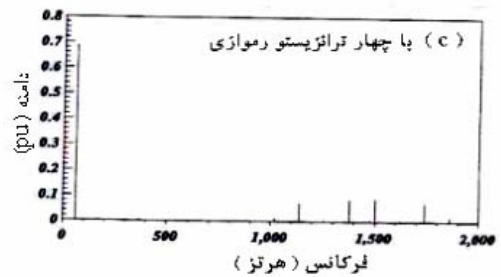
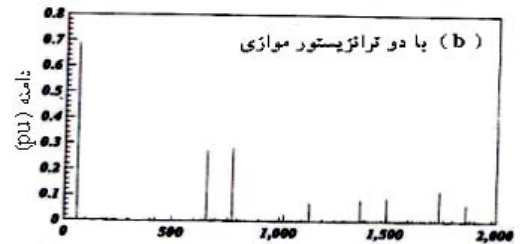
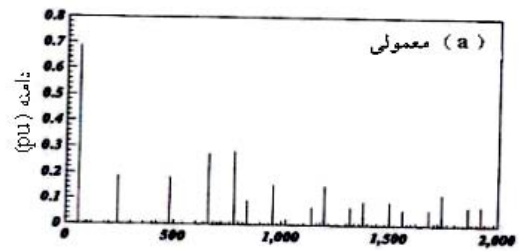
VCO P LL
 Input Voltage DC

)

(
PWM

EPROM

$360 \times 50 = 18KHZ,$ $360 \times 1 = 360HZ$

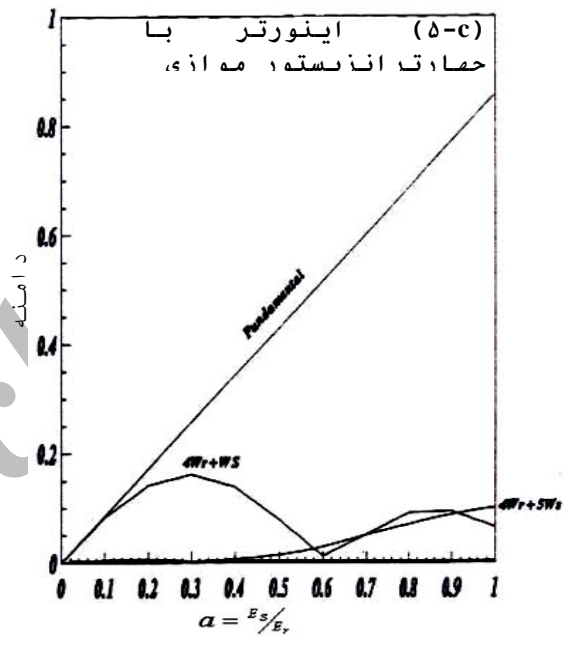
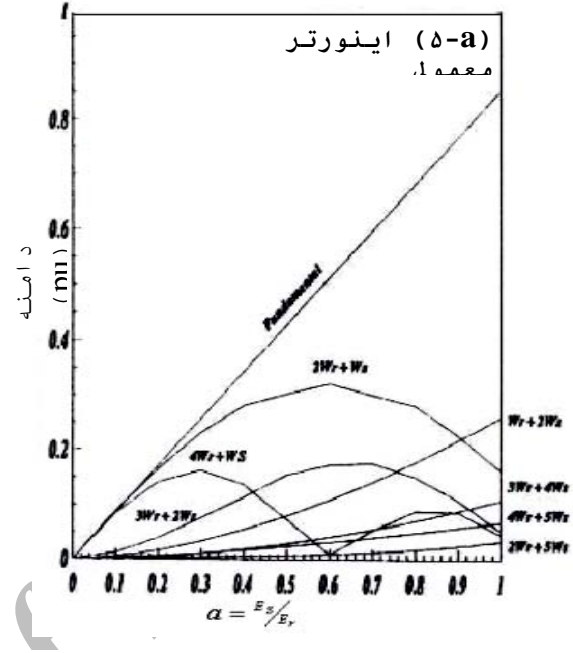
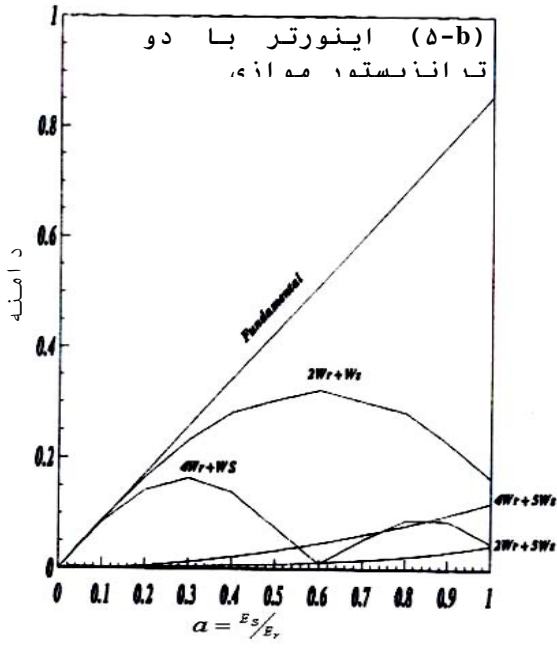


CMOS

TTL

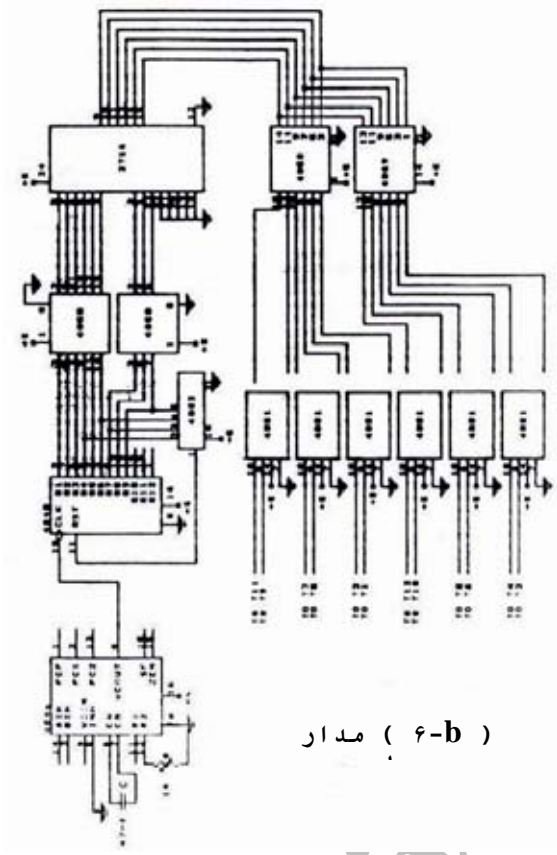
EPROM

PWM

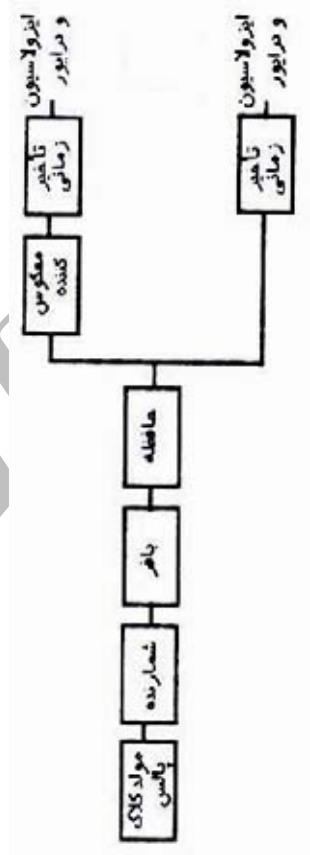


PWM

T_{U3} EPROM PWM
 $(T_{U3}) U T_{U4}$ U T_{U1}
 $(())$ T_{U1}
 U T_{U2}
 T_{U1}

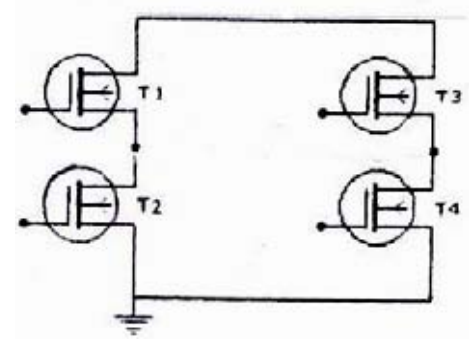


(b-6) مدار



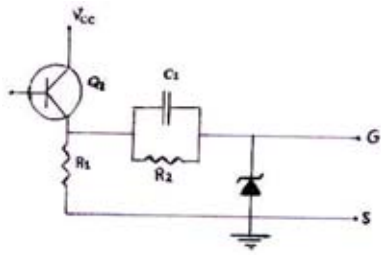
(a-6) بلوک

High
Low
((-a, b))
MOSFET

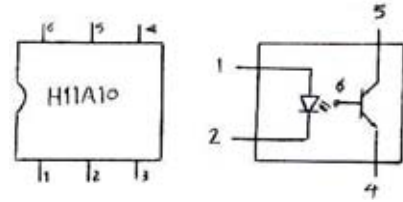


U

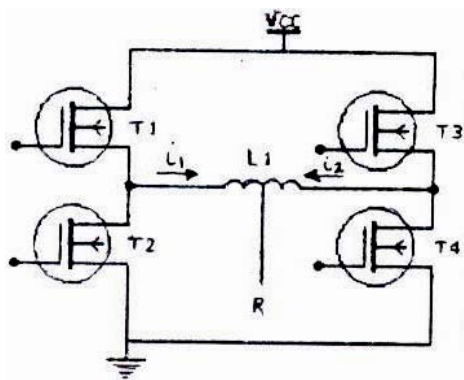
BJT MOSFET
MOSFET



(8-b) مدار راه

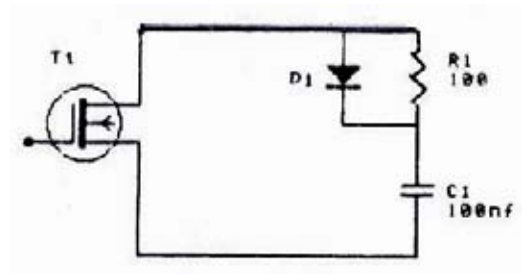


(8-a) آی سی اپتوکوپلر



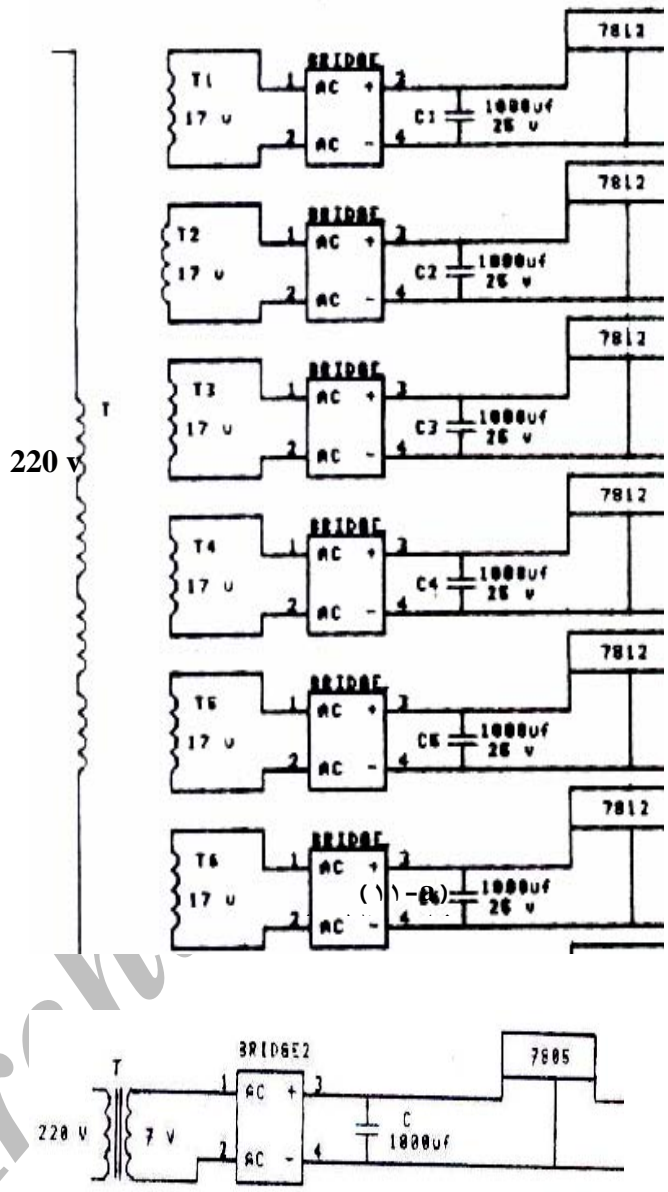
MOSFET

(-a, b)



-MOSFET

$$i_1 = i_2 \quad ()$$



(b-1) منبع 5 ولتي

Arku

()
 P u
 RS S R Q

-
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PWM

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