2SBB1260 – PNP Marking BE

Q2
2SAR554PT100

100nF (C104p) / 100V
C4
GND

REM

ON:9V:OFF1
Conn_01x03_Male

R4A
2K2
D11
16v
D12
1N4148WS

R8A
680
1K

R8
10K

R10
4.99K

5V

1N4148WS
D5

R12
100K

1N4148WS
D6

1N4148WS
D7

10K
R13

RB160M-60TR
D3A1

4.7K
R15

4.7K
R16

4.7K
R17

5V

C23
100nF (C104p) / 100V

R23
1M

C24
47uF/25v

100nF (C104p) / 100V
C5

100uF/25v
C6

GND

U2C
LM2903

V+

V-

REM

C24
Soft Start Cap
capacitor and resistor are connected to pin 4 TL594
to let the voltage on it go from 5v initially to 0.0v after
about 3-5 seconds

+12V

2SC2412K Marking BR (hFE 180-390)

Remote

R1
10K

R2
2.72K

Q1
MMBT3904

GND

2SC2412K Marking BR (hFE 180-390)

Q4
MMBT3904

R3
330R

R90
10K

R4
10K

RY

Q5
2SCR554P5

2SD1898 NPN Marking DF

(8)PRT

R29B
R29B1
4.7K

D29B1
5.6V

C18
22uF/25v

(Vin) +5
(R13) 10K
(R14) 10K
(Vout)=2.5v

U2A
LM2903

C19
100nF (C104p) / 100V

10K
R14

Pin7

D8
1N4148WS

D10
1N4148WS

5V

4.32K
R18

C21
10uF (C103p) / 100V

R19
100K

R20
100K

Q6
MMBT3904

2SC2412K Marking BR (hFE 180-390)

PT-O

1.5K
R24

To thermistor. NTC.
Temp increase causes resistance to drop
triggering protection pin 6
due to change in voltage divider.

TempProt

U2B
LM2903

4.32K
R9

C17
100nF (C104p) / 100V

D9
1N4148WS

100R
R11

C20
100nF (C104p) / 100V

R5
270K

D3
1N4148WS

R6
10K

R6A
10K

2SD1898 NPN Marking DF

Q3
2SCR554P5

100R
R7

C32
10nF (C103p) / 100V

C3
100uF/25v

R5A
1K/1206
R22

The protect signals pass through diodes D9/D10.
This drives TLx94 internal comparator (TLx94, pin 1).
When the comparator gets the protect signal, the
voltage on pin 3 goes high and drives the protect LED on.

C22
10nF (C103p) / 100V

R21
100R

REM

Drive(8)
Drive(9)

U1
TL594CD

TL594 Pin 4 Dead Time Control:

If there is little to no load (resistance or capacitance) on pin 4,
the load from the probe could make the IC unstable and could
possibly cause the power supply to fail. If the IC is unstable when
pin 4 is probed, you can connect a 1000pf capacitor between pins 4 and 7.
That should make the IC stable to probe.

Pin 9 and 10 are out of phase.
When 9 is high the other is low.
5v5/2

For the TL594,
a 20k ohm timing resistor and a 1000pf capacitor
will give you approximately 30khz.
The GoldenMax capacitors from Digi-Key
have an NPO/C0G temperature coefficient which means
essentially no drift in value as the temperature changes.
If you use a capacitor that has a high temperature coefficient an
d the supply design is marginal
(where the transformer is close to saturation),
a significant change in temperature could cause the supply to fail.

Oscilator Frequency
TLx94 Pin 5 and Pin 6
fOSC= 1/2RtCt
1/22000ohms x .000000001 farads

Oscilator frequency?
45.454545kHz

Output frequency?
22.72727kHz

R25
4.7K

R26
5.83K

C25
1.5nF

C26
10nF

R27

C27

100nF (C104p) / 100V

C28
22uF/25v

GND

Pin 6:
This pin is for the timing resistor (Rt).
The timing resistor is connected from this pin to ground.
The combination of this resistor and the capacitor on pin 5 determine the oscillator frequency.
The oscillator operates at twice the output frequency on pin 9 or 10.

J1
Conn_01x11_Male

1	2	3	4	5	6	7	8	9	10	11
RY	PT-O	REM	Remote	GND	+12V	Pin7	Drive(8)	Drive(9)	TempProt	(8)PRT

TL594 Pin 4:

If the voltage on this pin is 0, the output will be able to go from the minimum
possible pulse width to the maximum possible pulse width (as controlled by
the other input pins).

If this pin is set to about 1.5 volts, the output pulse width will be limited to
about 50% of its maximum pulse width (or 25% duty cycle for a push-pull design

If the voltage on this pin is high (> 3.5 volts),
there's no way for the power supply to produce output pulses
(the voltage on this pin controls the output on pins 9 and 10 much like
the voltage does on pin 3).

To produce a bit more dead time between the output pulses on pins 9 and 10,
a small voltage is driven to this pin
(generally with a voltage divider connected between the 5v reference pin and ground). It's generally no more than 0.1v DC.

On amplifiers that want a 'soft-start',
a capacitor and resistor are connected to pin 4
to let the voltage on it go from 5v initially to near 0.0v after
about 3-5 seconds.
This prevents having such an intense current surge when
the power supply initially starts and charges the rail capacitors.

TL594 Pin 1:
This is the positive (non-inverting) input of error amplifier 1.

If the voltage on this pin is lower than the voltage on pin 2, the output of the error amplifier (pin 3) will be low.

If the voltage on this pin is higher than the voltage on pin 2, the output of error amp 1 will be high.

The output essentially follows the positive input with pin 2 as a reference.

TL594 Pin 3:
Pin 3 is connected to the output of both error amplifiers via diodes. If the output of either EA goes high, the voltage on pin 3 goes high.
The high output has priority here.

When voltage on pin 3 goes above 3.3 volts, the pulsed drive output shuts off (0% duty cycle on pins 9 and 10.

When the voltage on pin 3 is at or near 0 volts, the pulse width is at its maximum value.

When the voltage on pin 3 is between 0 and 3.3 volts, the pulse width will be between 50% and 0% (pins 9 and 10).

Pin 3 can be used as an input or can be used to provide damping to the rate of change of the pulse width.

Power supply will be shutdown above 3.5v on pin 3.

D.K.H.

Sheet: /
File: PWM.sch

Title: PWM and Protection

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