ANALOG ELECTRONICS PROJECT REPORT

12V DC TO 220V AC CONVERTER(INVERTER)

Submitted To: Dr Neeta Pandey

Submitted By:
Siddhant Verma(2K18/EC/167)
Siddharth Rajput(2K18/EC/168)
Siddharth Mehra(2K18/EC/169)
Souradip Biswas(2K18/EC/170)

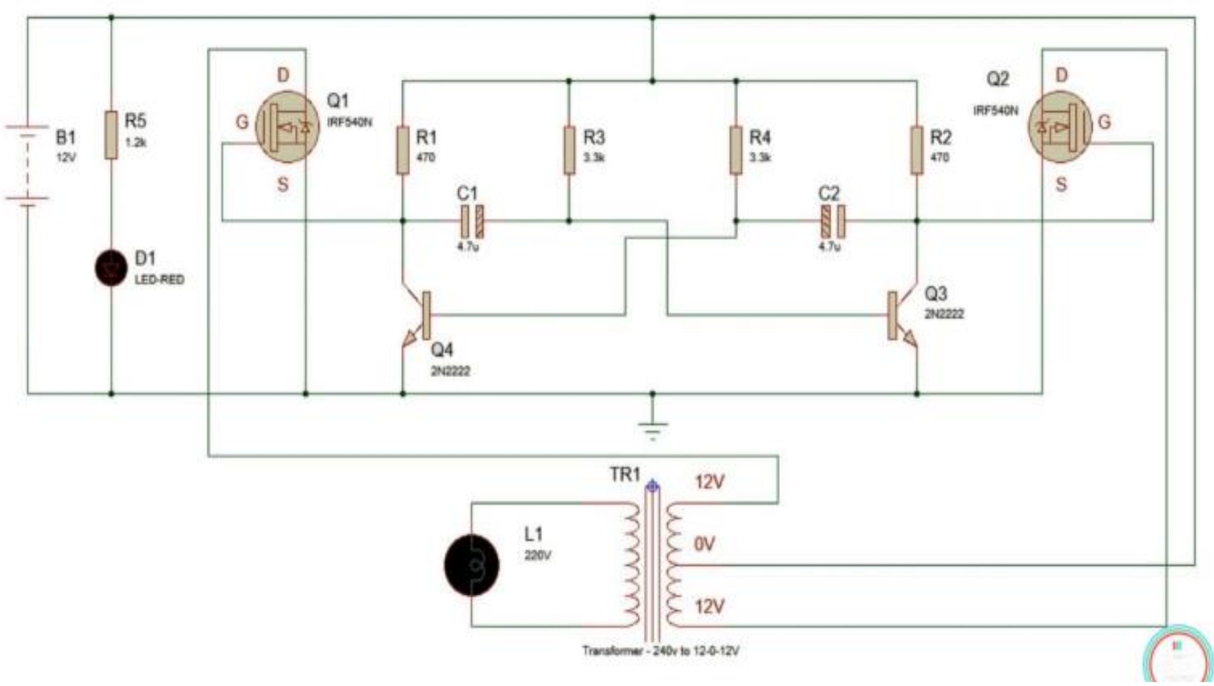
ACKNOWLEDGEMENT

We would like to thank our faculty in charge Dr. Neeta Pandey Ma’am who continuously guided us and without whose support it would not have been possible to complete the project successfully.

AIM

To create an inverter circuit using MOSFETs, BJTs, transformer, capacitors and resistors.

THEORY & CIRCUIT DIAGRAM



Inverters are often needed at places where it is not possible to get AC supply from the Mains. An inverter circuit is used to convert the DC power to AC power. Inverters can be of two types True/pure sine wave inverters and quasi or modified inverters. These true /pure sine wave inverters are costly, while modified or quasi inverters are inexpensive.

These modified inverters produce a square wave and these are not used to power delicate electronic equipment. A simple voltage driven inverter circuit using power transistors as switching devices is build, which converts 12V DC signal to single phase 220V AC.

Principle

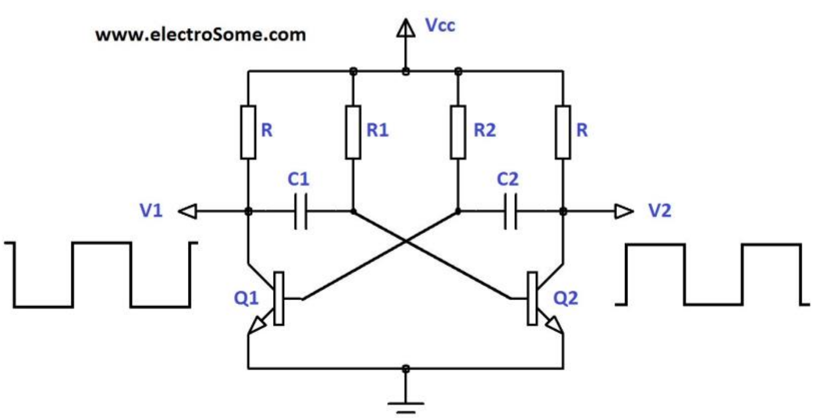
The basic idea behind every inverter circuit is to produce oscillations using the given DC and apply these oscillations across the primary of the transformer by amplifying the current. This primary voltage is then stepped up to a higher voltage depending upon the number of turns in primary and secondary coils.

A 12V DC to 220 V AC converter can also be designed using simple transistors. It can be used to power lamps up to **35W** but can be made to drive more powerful loads by adding more MOSFETS.

The inverter implemented in this circuit is a square wave inverter and works with devices that do not require pure sine wave AC.

Working

The circuit can be divided into three parts: oscillator, amplifier and transformer. A 50Hz oscillator is required as the frequency of AC supply is 50Hz.



A stable multi vibrator

This can be achieved by constructing an unstable multivibrator which produces a square wave at 50Hz. In the circuit, R1, R2, R3, R4, C1, C2, Q4 and Q3 form the oscillator.

Each transistor produces inverting square waves. The values of R4, R3 and C1 (R4, R3 and R1, R2 andC2, C1 are identical) will decide the frequency. The formula for the frequency of square wave generated by the unstable multivibrator is

F = 1/(1.38*R4*C1)

The inverting signals from the oscillator are amplified by the Power MOSFETS Q1 and Q4. These amplified signals are given to the step-up transformer with its centre tap connected to 12V DC.

APPARATUS REQUIRED

➢ NPN transistors - 2 (2n2222a)

P2N2222A

Amplifier Transistors

NPN Silicon

Features

- These are Pb−Free Devices*

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Value	Unit
Collector − Emitter Voltage	V_{CEO}	40	Vdc
Collector − Base Voltage	V_{CBO}	75	Vdc
Emitter − Base Voltage	V_{EBO}	6.0	Vdc
Collector Current − Continuous	I_C	600	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	625 5.0	mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	1.5 12	W mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

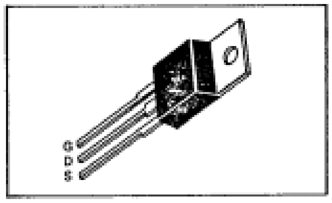
➢ MOSFET IRF840 x2

T-39-13

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

IRF840
IRF841
IRF842
IRF843

Part Number	V_{DSS}	$r_{DS(on)}$	I_D
IRF840	500 V	0.85 Ω	8.0 A
IRF841	450 V	0.85 Ω	8.0 A
IRF842	500 V	1.10 Ω	7.0 A
IRF843	450 V	1.10 Ω	7.0 A

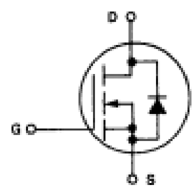


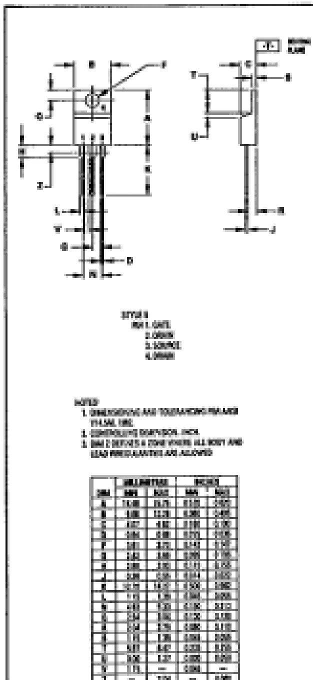
N-CHANNEL ENHANCEMENT-MODE SILICON GATE TMOS POWER FIELD EFFECT TRANSISTOR

These TMOS Power FETs are designed for high voltage, high speed power switching applications such as switching regulators, converters, solenoid and relay drivers.

- Silicon Gate for Fast Switching Speeds
- Low $r_{DS(on)}$ to Minimize On-Losses. Specified at Elevated Temperature
- Rugged — SOA is Power Dissipation Limited
- Source-to-Drain Diode Characterized for Use With Inductive Loads

TMOS™





CASE 221A-04
TO-220AB

MAXIMUM RATINGS

Rating	Symbol	IRF 840	IRF 841	IRF 842	IRF 843	Unit
Drain-Source Voltage	V_{DSS}	500	450	500	450	Vdc
Drain-Gate Voltage (R_{GS} = 1.0 mΩ)	V_{DGR}	500	450	500	450	Vdc
Gate-Source Voltage	V_{GS}	±20				Vdc
Drain Current Continuous Pulsed	I_D I_{DM}	8.0 32		7.0 28		Adc
Total Power Dissipation @ T_C = 25°C Derate above 25°C	P_D	125 1.0				Watts W/°C
Operating and Storage Temperature Range	T_J, T_{stg}	−55 to 150				°C

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal Resistance Junction to Case Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.0 62.5	°C/W
Maximum Lead Temp. for Soldering Purposes, 1/8" from Case for 5 Seconds	T_L	275	°C

See the MTP8N45 Designer's Data Sheet for a complete set of design curves for the product on this data sheet.

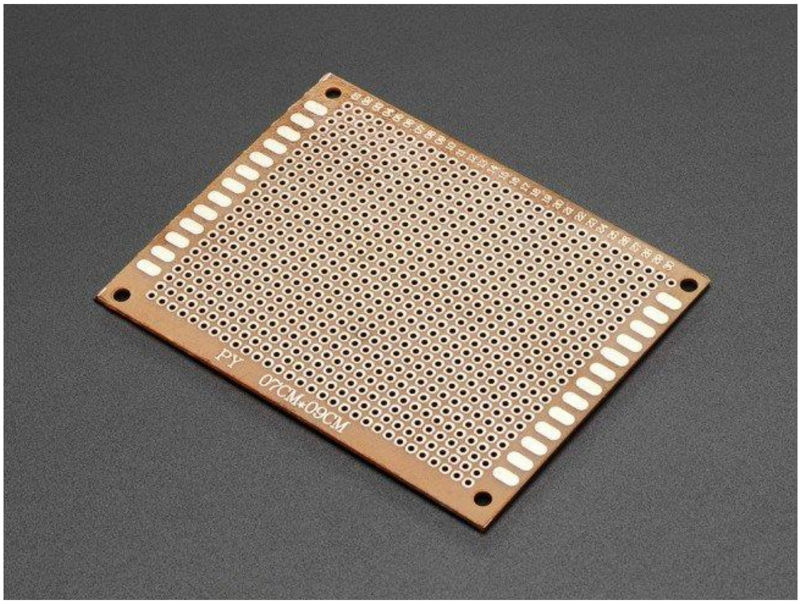
The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Drain-Source Breakdown Voltage (V_{GS} = 0, I_D = 0.25 mA)	IRF841, IRF843 IRF840, IRF842	$V_{(BR)DSS}$	450 500	— —	Vdc
Zero Gate Voltage Drain Current (V_{DS} = Rated V_{DSS}, V_{GS} = 0) (V_{DS} = 0.8 Rated V_{DSS}, V_{GS} = 0, T_J = 125°C)		I_{DSS}	— —	0.25 1.00	mAdc
Gate-Body Leakage Current, Forward (V_{GSF} = 20 Vdc, V_{DS} = 0)		I_{GSSF}	—	500	nAdc
Gate-Body Leakage Current, Reverse (V_{GSR} = 20 Vdc, V_{DS} = 0)		I_{GSSR}	—	500	nAdc
ON CHARACTERISTICS*					
Gate Threshold Voltage (V_{DS} = V_{GS}, I_D = 0.25 mA)		$V_{GS(th)}$	2.0	4.0	Vdc
Static Drain-Source On-Resistance (V_{GS} = 10 Vdc, I_D = 4.0 Adc)	IRF840, IRF841 IRF842, IRF843	$r_{DS(on)}$	— —	0.85 1.0	Ohm
On-State Drain Current (V_{GS} = 10 V) (V_{DS} ≥ 6.8 Vdc) (V_{DS} ≥ 7.0 Vdc)	IRF840, IRF841 IRF842, IRF843	$I_{D(on)}$	8.0 7.0	— —	Adc
Forward Transconductance (V_{DS} ≥ 6.8 V, I_D = 4.0 A) (V_{DS} ≥ 7.0 V, I_D = 4.0 A)	IRF840, IRF841 IRF842, IRF843	g_{FS}	4.0 4.0	— —	mhos
DYNAMIC CHARACTERISTICS					
Input Capacitance	(V_{DS} = 25 V, V_{GS} = 0, f = 1.0 MHz)	C_{iss}	—	1600	pF
Output Capacitance		C_{oss}	—	360	
Reverse Transfer Capacitance		C_{rss}	—	150	
SWITCHING CHARACTERISTICS*					
Turn-On Delay Time	(V_{DD} ≈ 200 V, I_D = 4.0 Apk, R_{gen} = 4.7 Ohms)	$t_{d(on)}$	—	35	ns
Rise Time		t_r	—	15	
Turn-Off Delay Time		$t_{d(off)}$	—	90	
Fall Time		t_f	—	30	
Total Gate Charge	(V_{GS} = 10 V, V_{DS} = 0.8 × Rated V_{DSS}, I_D = Rated I_D)	Q_g	40 (Typ)	60	nC
Gate-Source Charge		Q_{gs}	20 (Typ)	—	
Gate-Drain Charge		Q_{gd}	20 (Typ)	—	
SOURCE DRAIN DIODE CHARACTERISTICS*					
Forward On-Voltage	(I_S = Rated I_D, V_{GS} = 0)	V_{SD}	—	1.9 (1)	Vdc
Forward Turn-On Time		t_{on}	Limited by stray inductance		
Reverse Recovery Time		t_{rr}	800 (Typ)	—	ns
INTERNAL PACKAGE INDUCTANCE (TO-220)					
Internal Drain Inductance (Measured from the contact screw on tab to center of die) (Measured from the drain lead 0.25" from package to center of die)		L_d	3.5 (Typ) 4.5 (Typ)	— —	nH
Internal Source Inductance (Measured from the source lead 0.25" from package to source bond pad)		L_s	7.5 (Typ)	—	

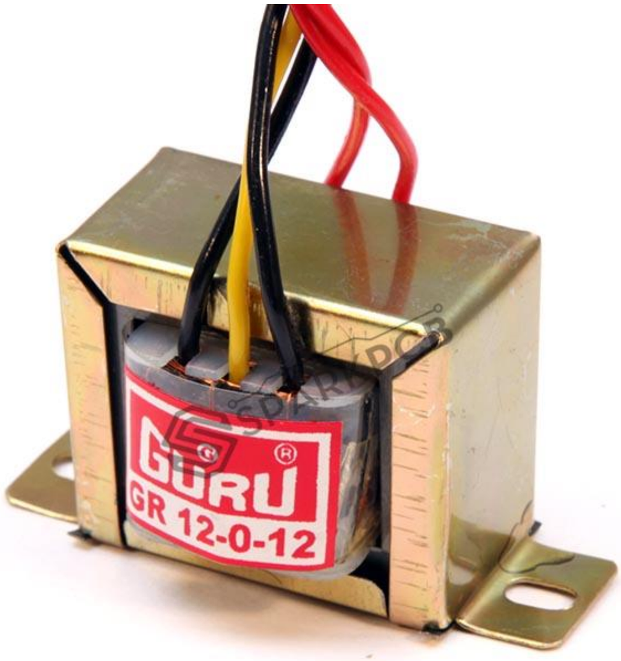
*Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
(1) Add 0.1 V for IRF840 and IRF841.

➢ Perforated board – 1



➢ Resistors of values: 3.3k Ohm x2, 470-ohm x2, 1.2k ohm.

- ➢ 12-0-12 transformer 3 amp



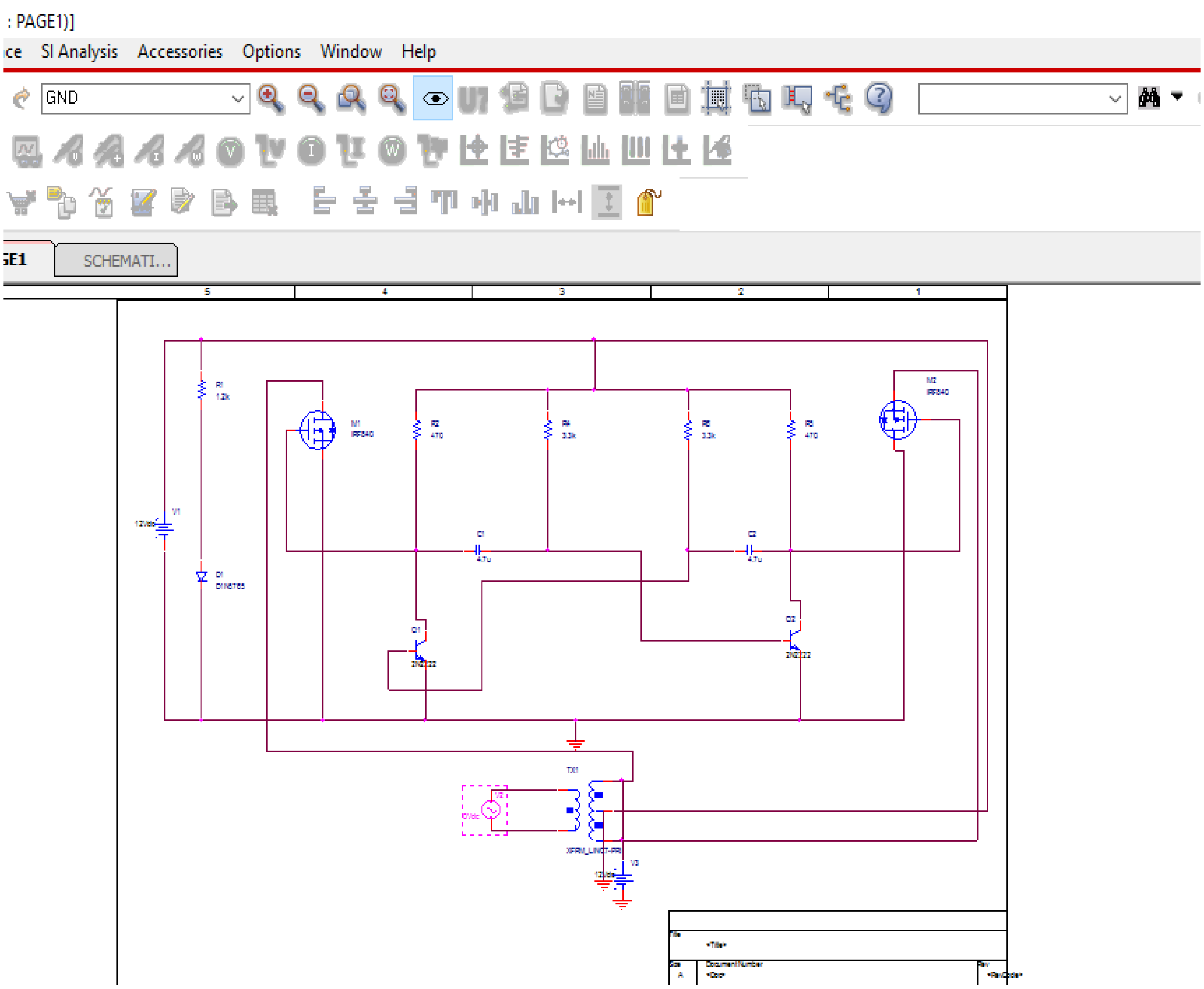
- ➢ Capacitor: 4.7 uF /25 Vx2

- ➢ LED
- ➢ Connecting wires
- ➢ 12v battery
- ➢ Solder alloy
- ➢ Soldering iron

PROCEDURE

The circuit is assembled as shown in the circuit diagram.

PSpice Simulation Circuit



CALCULATIONS

For a frequency of 50Hz F=50

So, by using the above-mentioned formula

$$F = 1/(1.38*R4*C1)$$

R4*C1=0.0144

Taking the value of capacitor as 4.7uF we find out that the resistor required is of 3083-ohm i.e. near about 3k ohm so we can use 3.3k ohm resistor to form the required unstable multivibrator.

RESULT

220v ac output at 50Hz is obtained.
In this way an inverter (is made for devices like Bulb, CFL, LED etc.) was designed.

LIMITATIONS

The devices which are very sensitive to ac voltage or require pure sinusoidal ac voltage cannot be driven using this circuit because square wave is used as an approximate of sinusoidal ac voltage.