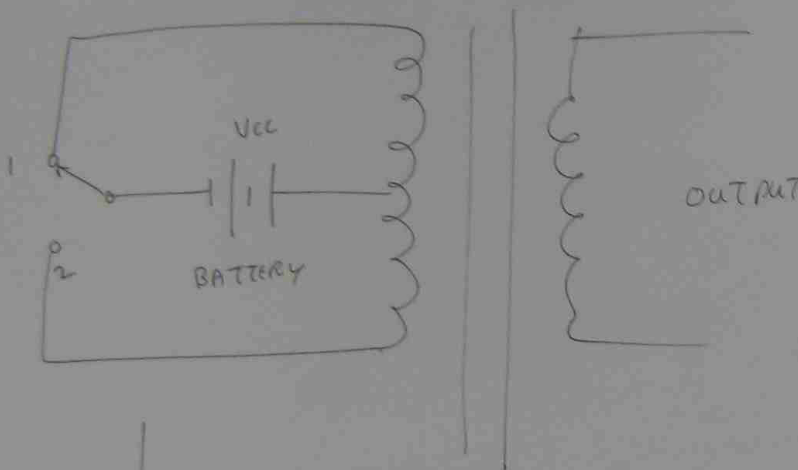
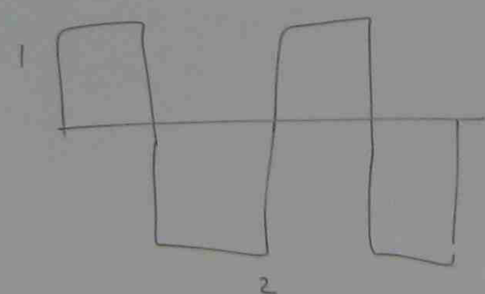
BASIC INVERTER PRINCIPLE CIRCUIT

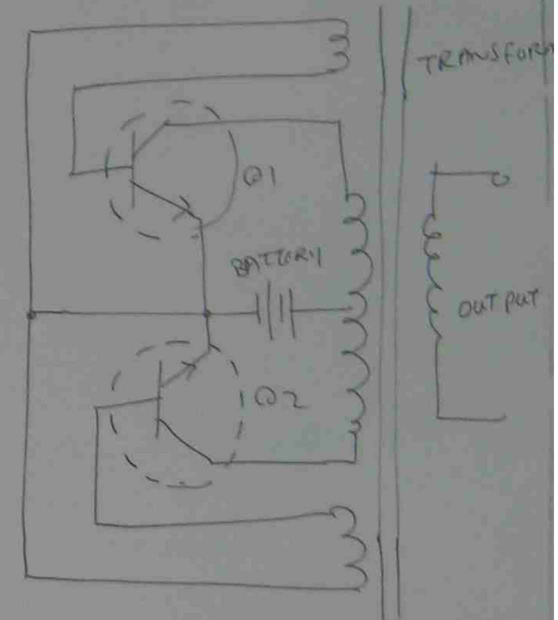


INPUT

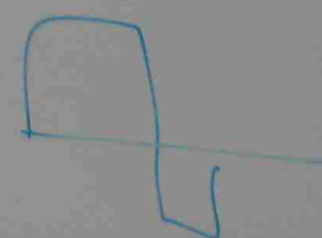


OUTPUT

TRANSISTOR SWITCHING CIRCUIT FOR INVERTER

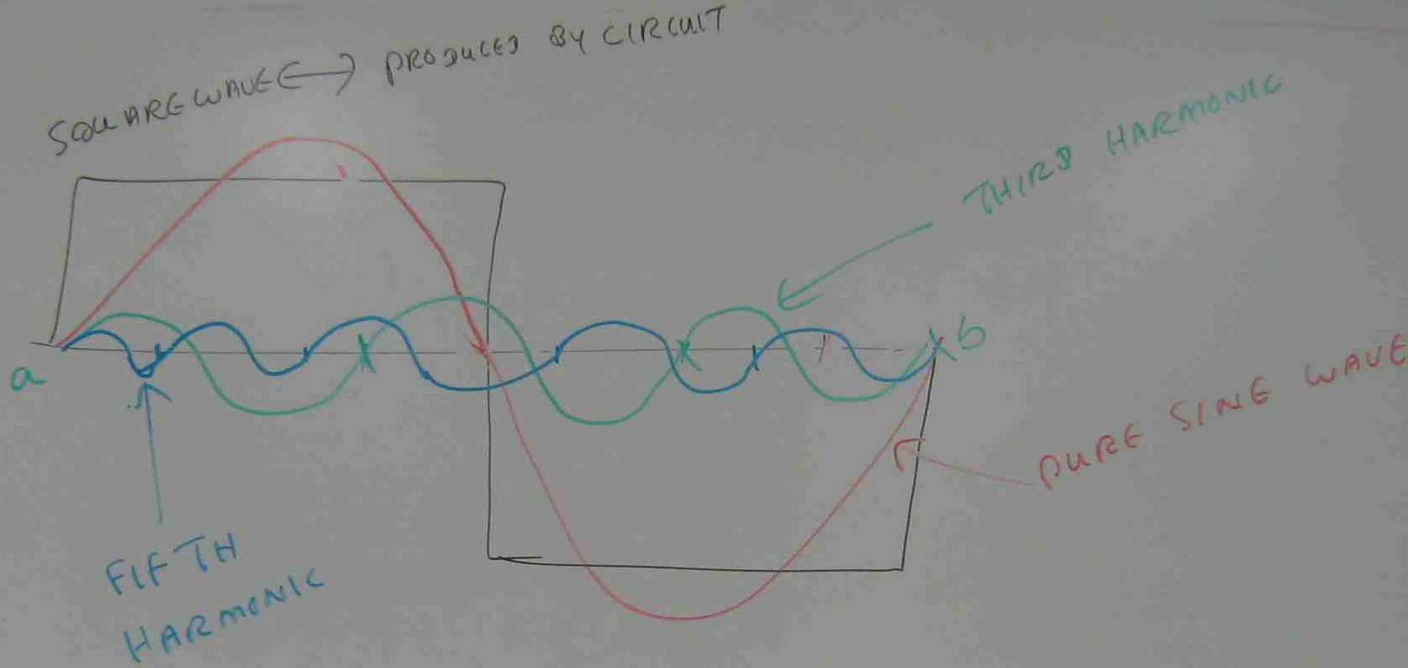


Q_1, Q_2 = TRANSISTOR



SFORMER

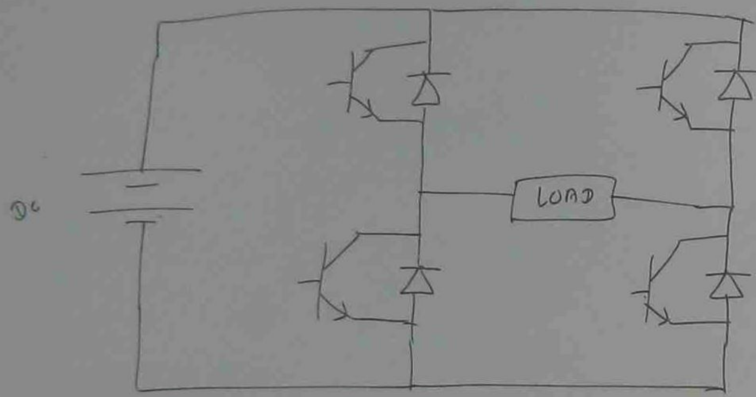
PUT



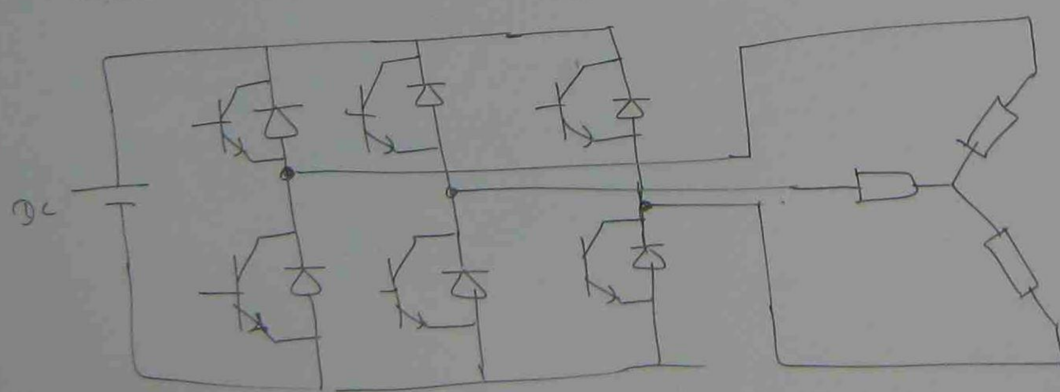
FUNDAMENTAL SINE WAVE + THIRD HARMONIC + FIFTH HARMONIC $\simeq$ SQUARE WAVE

BY FILTERING OUT THE 3rd HARMONIC AND 5th HARMONIC, APPROXIMATE SINE WAVE CAN BE LEFT.

H BRIDGE INVERTER



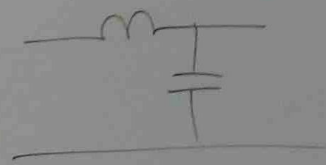
THREE PHASE INVERTER



CAPACITORS AND INDUCTORS CAN BE USED TO FILTER THE WAVE FORM.

IF THE DESIGN INCLUDE A TRANSFORMER, FILTERING CAN BE APPLIED TO THE PRIMARY (OR) TO BOTH SIDES.

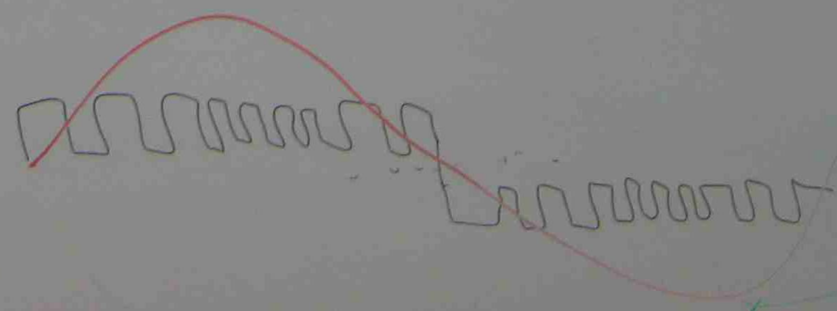
LOW PASS FILTERS ARE APPLIED TO ALLOW THE FUNDAMENTAL COMPONENT OF THE WAVE FORM TO PASS TO THE OUT PUT WHILE LIMITING THE PASSAGE OF THE HARMONIC COMPONENTS.

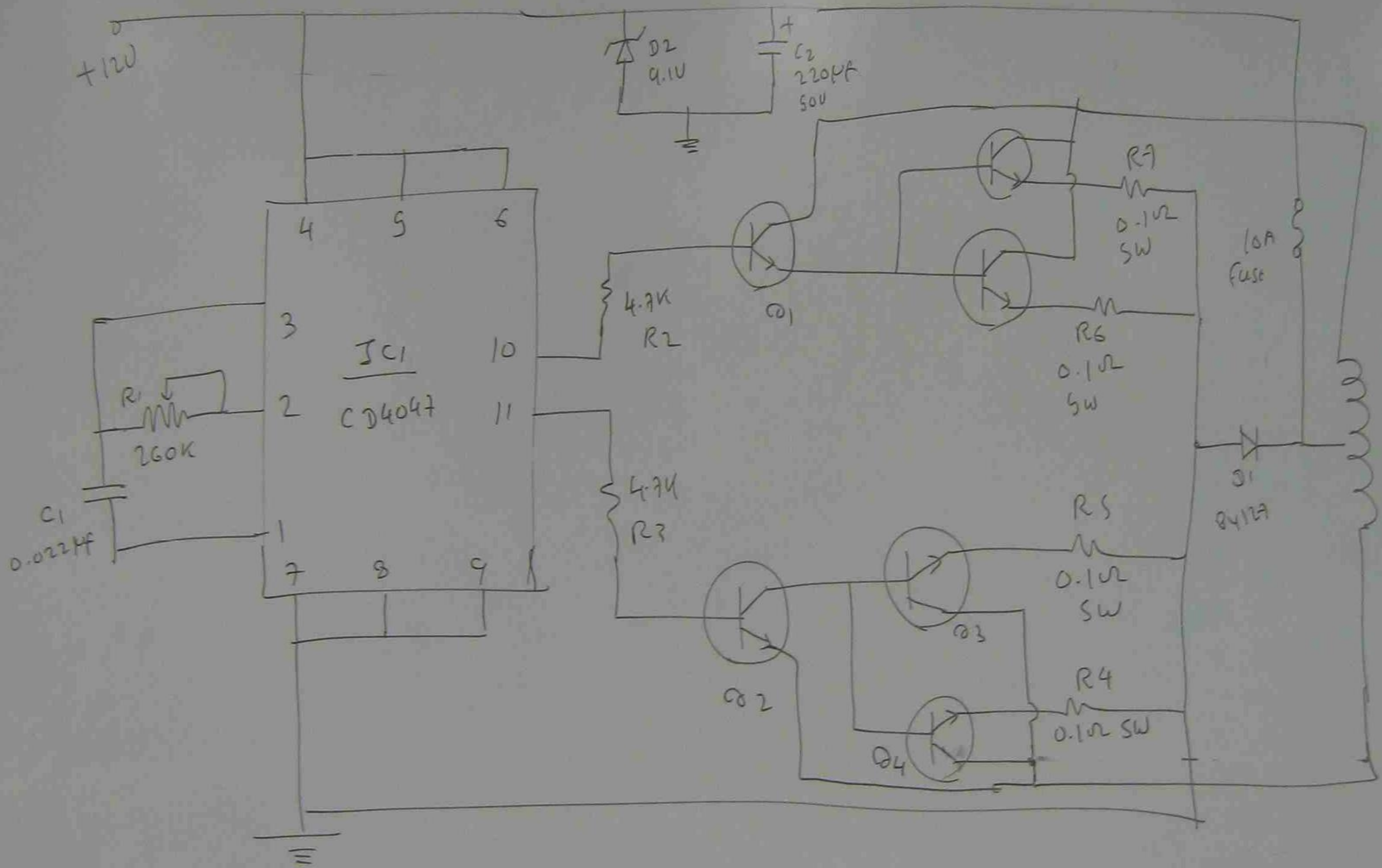


P.W.M TECHNOLOGY (PULSE WIDTH MODULATION TECHNOLOGY)

MODULATING (OR) REGULATING THE WIDTH OF A SQUARE WAVE PULSE IS OFTEN USED AS A METHOD OF REGULATING (OR) ADJUSTING AN INVERTER'S OUTPUT VOLTAGE.

WHEN VOLTAGE CONTROL IS NOT REQUIRED, A FIXED PULSE WIDTH CAN BE SELECTED TO REDUCE (OR) ELIMINATE HARMONICS.





FUNDAMENTAL SIX

BY FILTERING

APPROXIMATE

100W

INVERTER

Q_1 Q_2 = TIP 122

Q_3 TO Q_4 = 2N3055

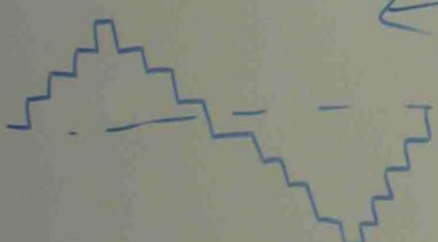
VOLTAGE

ITS

IT'S LEVEL

TAGE DISTANCE TRANSMISSION

ED SINE WAVE

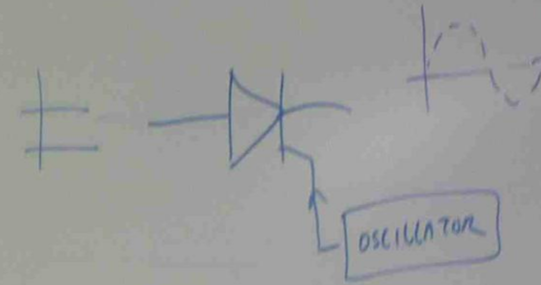


INVERTER

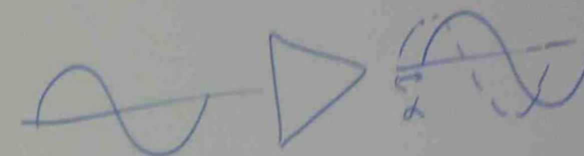
MODIFIED SINE WAVE

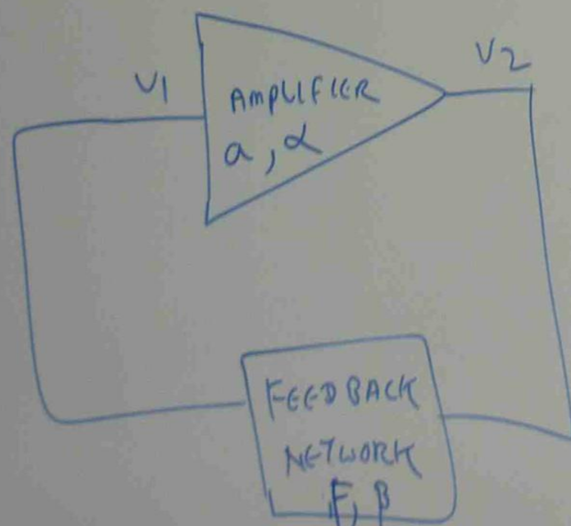
THE MODIFIED SINE WAVE IS THE CHEAP AND EASY SOLUTION FOR POWERING AC DEVICES BUT NOT ALL EQUIPMENTS ESPECIALLY COMPUTER AND MEDICAL WILL NOT PROPERLY WORK WITH IT. FILTER IS REQUIRED TO PROVIDE PURE SINE WAVE.

OSCILLATOR FOR INVERTER CIRCUIT



RESISTORS, INDUCTORS, CAPACITORS AND AN AMPLIFIER WITH HIGH GAIN ARE BASIC COMPONENTS OF AN OSCILLATOR. IN DESIGNING OSCILLATORS, INSTEAD OF USING DISCRETE PASSIVE COMPONENTS (RESISTORS, INDUCTORS AND CAPACITORS), CRYSTAL OSCILLATORS ARE A BETTER CHOICE BECAUSE OF THEIR EXCELLENT FREQUENCY STABILITY AND WIDE FREQUENCY RANGE.





a = GAIN = $\frac{V_2}{V_1}$

α = PHASE SHIFT

F = TRANSFER FUNCTION

β = PHASE SHIFT OF FEED BACK SIGNAL

$|F| \times |a| \geq 1 \longrightarrow$ OSCILLATION

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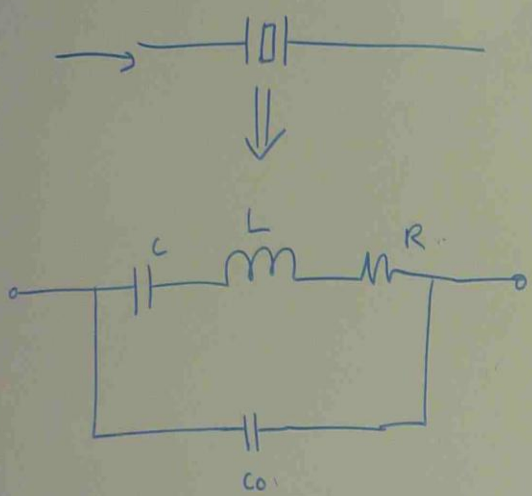
CHARACTERISTICS OF CRYSTAL OSCILLATOR



$Z \rightarrow 0$ → CRYSTAL OSCILLATOR FREQUENCY = SERIES RESONANCE FREQUENCY

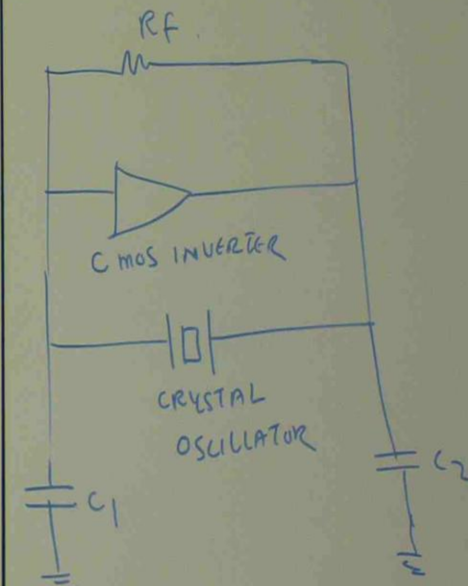
$$f_{ser} = \frac{1}{2\pi\sqrt{LC}}$$

$Z \rightarrow \infty$ CRYSTAL OSCILLATOR FREQUENCY = PARALLEL RESONANCE FREQUENCY

$$f_{par} = f_{ser}\sqrt{1+\frac{C}{C_0}}$$

$$f_{par} = \frac{1}{2\pi\sqrt{LC}} \times \sqrt{1+\frac{C}{C_p + C_0}}$$

$$C_p = \frac{C_1 C_2}{C_1 + C_2}$$



TO IMPROVE THE FREQUENCY RESPONSE OF CRYSTAL OSCILLATOR, C_1 AND C_2 ARE TO BE CONNECTED.

BASED ON C_1, C_2 VALUES, IT DETERMINES THE OSCILLATOR FREQUENCY

$$f = \frac{C_1}{C_2}$$

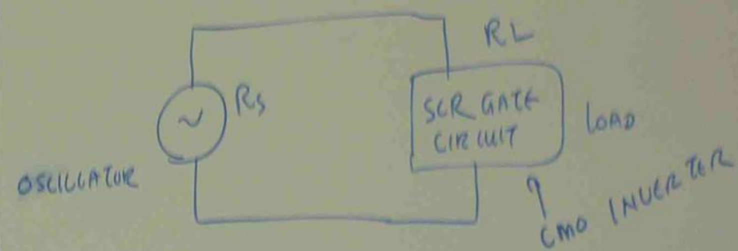
IN AN OSCILLATOR CIRCUIT, THE CMOS INVERTER OPERATES IN THE LINEAR MODE AND WORKS AS AN AMPLIFIER.

THE PHASE SHIFT PROVIDED BY THE INVERTER IS 180 DEGREES.

FOR $C_1 = C_2$, PHASE SHIFT IS 180°

INPUT IMPEDANCE OF OSCILLATOR $Z_i = \frac{R_f}{a}$

MAXIMUM POWER TRANSFER



R_S = SOURCE IMPEDANCE

R_L = LOAD IMPEDANCE

IF $R_S = R_L \rightarrow$ MAXIMUM POWER TRANSFER

OSCILLATOR IS RUNNING AT PARALLEL RESONANCE CONDITION.

OSCILLATOR PARALLEL RESONANCE RESISTANCE R_p = SOURCE IMPEDANCE

$$R_p = \frac{1}{R\omega^2 (C_o + C_p)^2}$$

$$\omega = 2\pi f$$

FREQUENCY AT WHICH THE OSCILLATOR IS OPERATING

R_p SHOULD MATCH THE INPUT IMPEDANCE OF THE CMOS INVERTER TO ALLOW MAXIMUM POWER TRANSFER AS WELL AS TO EFFECTIVELY DRIVE THE SCR GATE CIRCUIT OF INVERTER.

EX

A CRYSTAL OSCILLATOR HAS THE FOLLOWING PARAMETERS.

$C_p = 30\,pF$

$C_0 = 7\,PF$

$R = 20\,\Omega$ AT 5 MHZ

FOR A CMOS INVERTER WITH AN OPEN LOOP GAIN

$a = 100$, CALCULATE THE VALUE OF FEED BACK

RESISTOR.

USE THE FOLLOWING CONCEPT

THE VALUE OF FEED BACK RESISTOR = Z_i (OR) R_P × GAIN

$$R_f = R_p \times a$$

$$R_p = \frac{1}{R\omega^2 (C_o + C_p)^2}$$

$$\omega = 2\pi f$$

$$= 2\pi \times 5 \times 10^6$$

$$C_o = 7 \times 10^{-12} \text{ F}$$

$$C_p = 30 \times 10^{-12} \text{ F}$$

$$R_p = \frac{1}{80 \times (2\pi \times 5 \times 10^6)^2 (7 \times 10^{-12} + 30 \times 10^{-12})^2}$$

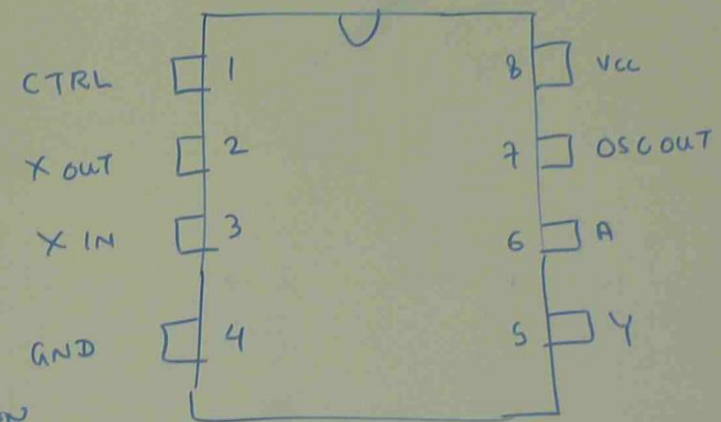
$$= 10{,}000\ \Omega \simeq 10\text{k}\Omega$$

$$R_F = R_p \times a = 10{,}000 \times 100 = 10{,}000{,}00$$

$$= 1\text{m}\Omega$$

TI LUC 1404 (TEXAS INSTRUMENT)

THE TI LUC 1404 IC IS A DUAL INVERTER GATE THAT IS VERY SUITABLE FOR OSCILLATOR APPLICATIONS.



PIN OUT DIAGRAM FOR TI (LUC 1404)

CONNECTION

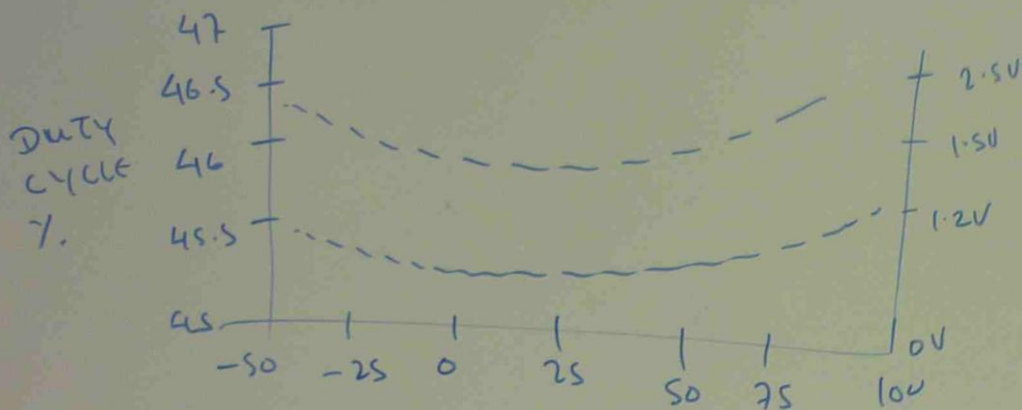
X_{IN} - CONNECTED TO UNBUFFERED INVERTER

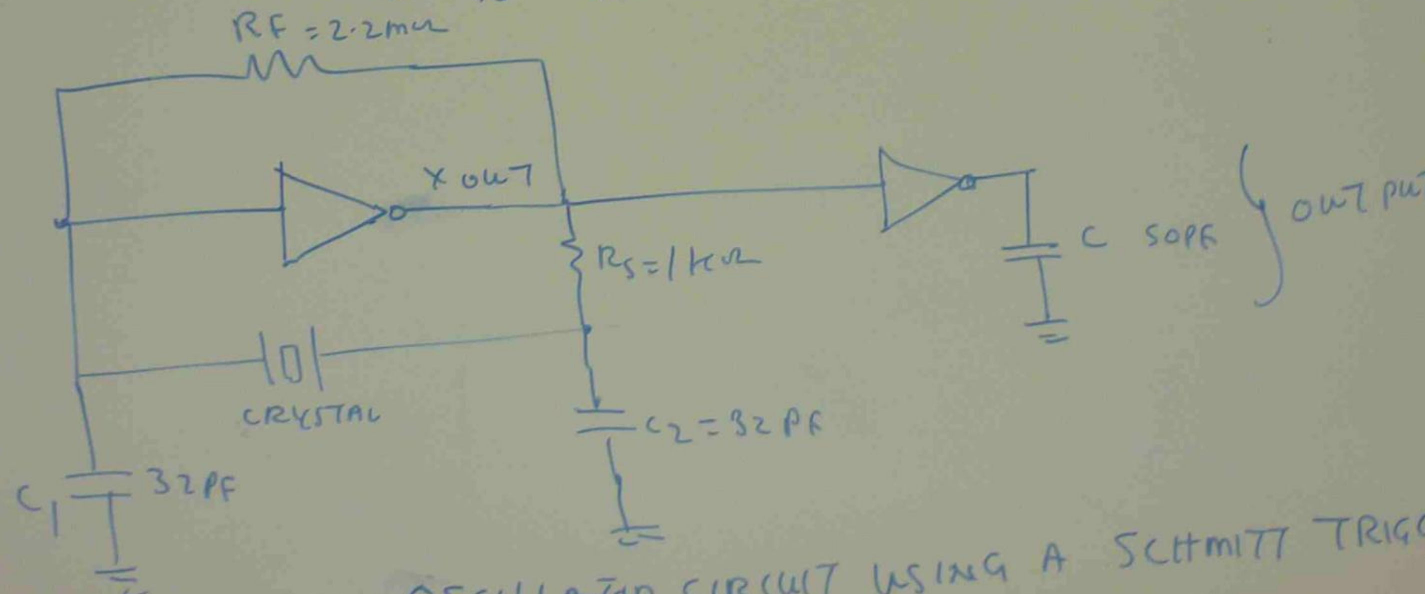
X_{OUT} - OUTPUT OF THIS INVERTER

IT IS CONNECTED TO THE INPUT OF ANOTHER INVERTER TO GET A CLEAN SIGNAL

THE CRYSTAL IS CONNECTED BETWEEN X_{IN} & X_{OUT}

V_{CC} 1.2 → 2.5V up to 5V





OSCILLATOR CIRCUIT USING A SCHMITT TRIGGER INPUT INVERTER

OPERATIONAL REQUIREMENTS

- GOOD POWER SUPPLY DECOUPLING IS NECESSARY TO SUPPRESS NOISE ON THE SUPPLY LINE
- LOW RESONANCE CERAMIC CAPACITORS SHOULD BE USED AS CLOSE TO THE CIRCUIT AS POSSIBLE. THE REFERENCE VALUE IS 100 nF
- CONNECTIONS IN THE LAYOUT SHOULD BE AS SHORT AS POSSIBLE TO KEEP THE RESISTANCE AND INDUCTANCE LOW.
- TO REDUCE CROSS TALK, STANDARD PCB DESIGN TECHNIQUES SHOULD BE USED.
- WITHOUT CRYSTAL, THE OSCILLATOR SHOULD NOT OSCILLATE. TO CHECK THIS, THE CRYSTAL IN A CMOS OSCILLATOR CAN BE REPLACED BY IT'S EQUIVALENT PARALLEL RESONANT RESISTANCE.

R

SINE WAVE INVERTER DESIGN

DC CURRENT – STEADY AND CONSTANT VOLTAGE

USED FOR DIGITAL CIRCUITS

AC CURRENT – CAN EASILY BE CHANGED IT'S LEVEL

REDUCE POWER LOSS

SUITABLE FOR HIGH VOLTAGE DISTANCE TRANSMISSION

AC WAVE –
- SQUARE WAVE
- MODIFIED SINEWAVE | STEP SINE WAVE
- PURE SINE WAVE

INVERTER

MODIFIED

THE

SOLUTION

ESPEC

WORK

PURE

TO COMBAT THE SURGE PROBLEM, SNUBBER CIRCUIT CAN REDUCE OR ELIMINATE ANY SEVERE VOLTAGE AND CURRENTS.

COMPOSED OF SIMPLY RESISTOR AND CAPACITOR PLACED ACROSS EACH SWITCH ALLOWS ANY CURRENT OR VOLTAGE SPIKES TO BE SUPPRESSED BY CRITICALLY DAMPING THE SURGG AND PROTECTING THE SWITCH FROM DAMAGE.