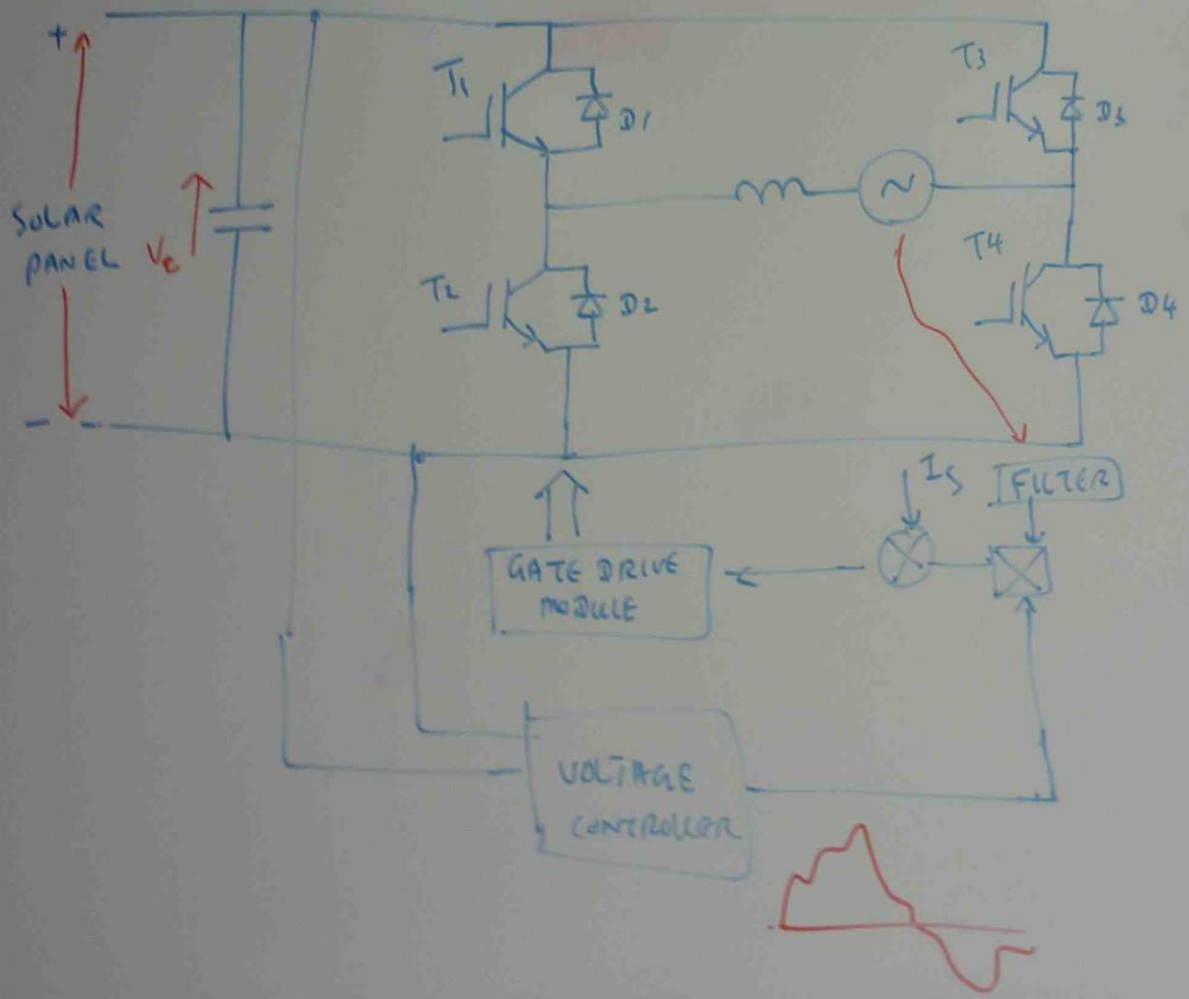
PV INVERTER SYSTEM



GRID CONNECTED SINGLE PHASE PHOTOVOLTAIC SYSTEM MAY BE UNIPOLAR SWITCHED (OR) BIPOLAR SWITCHED.

THEY CAN BE CURRENT CONTROLLED (OR) VOLTAGE CONTROLLED.

THE GRID CONNECTED INVERTERS HAVE TO OPERATE WITH IN DISTORTION LIMIT SPECIFIED AUSTRALIAN STANDARD AS 4777.2

UNI POLAR MODE

T_3 – OFF
T_4 – ON

(POSITIVE HALF CYCLE

TRANSISTOR T_1 IS SWITCHED ON WHEN THE INVERTER CURRENT GOES BELOW BOTTOM LIMIT

I_s RISES WHILE IT FLOWS THROUGH T_1 AND T_4

(NEGATIVE HALF CYCLE)

T_4 IS OFF

T_3 IS ON

TRANSISTOR T_2 IS SWITCHED ON

BIPOLAR MODE

TWO SWITCHES CAN BE SWITCHED ON AND SWITCHED OFF.

POSITIVE HALF CYCLE

T_1 AND T_4 ARE SWITCHED

IF THE CURRENT RISES THROUGH T_1 AND T_4,

T_1 AND T_4 ARE SWITCHED OFF

NEGATIVE HALF CYCLE

T_2 AND T_3 ARE SWITCHED ON

AS THE SWITCHING RATE DETERMINES THE OUT PUT AC VOLTAGE AND CURRENT, IT CAN CAUSE HIGHER FREQUENCIES (HARMONIC FREQUENCIES AND HARMONIC DISTORTION).

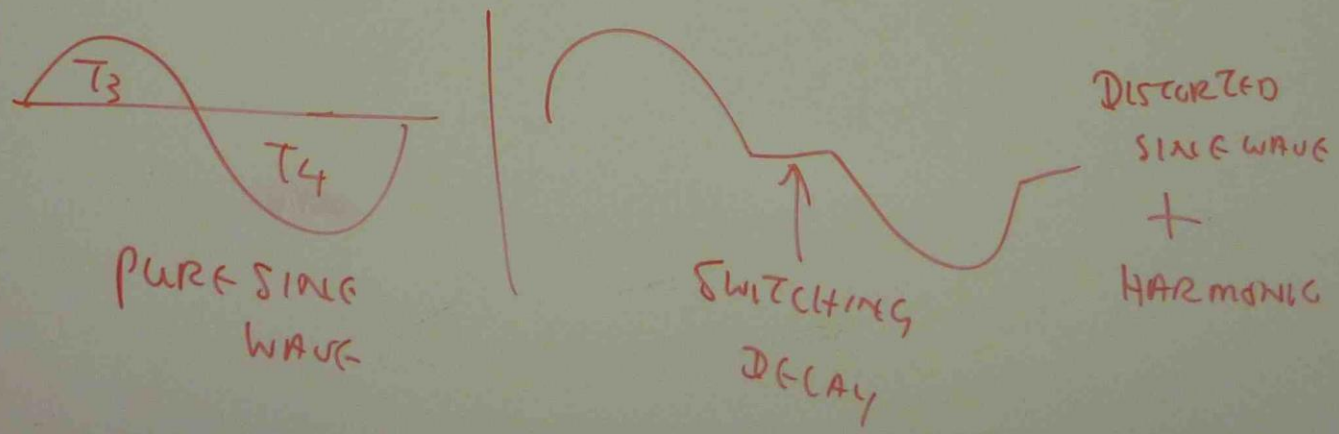
THE FOLLOWINGS CAUSE LOW FREQUENCY DISTORTION

(a) HARMONIC CONTENTS IN SIGNAL VOLTAGE V_{ref}

(b) HARMONIC CONTENT IN THE VOLTAGE CONTROLLER OUT PUT

(c) SWITCHING DELAY

(d) INDUCTOR NON LINEARITY



MULTIPLIER INPUT SIGNAL VOLTAGE

WITHOUT ANY SIGNAL CONDITIONING, MULTIPLIER SIGNAL V_{REF} IS MERELY AN ATTENUATED VERSION OF AC MAIN VOLTAGE.

THE HARMONIC DISTORTION IN V_{REF} EQUAL TO TOTAL HARMONIC DISTORTION OF SUPPLY VOLTAGE

3.4 %.

TO MINIMIZE DISTORTION, TOTAL HARMONIC DISTORTION OF OUT PUT FILTER NEEDS TO BE 1.5%.

HARMONIC CONTENT IN VOLTAGE CONTROLLER OUTPUT SIGNAL

THE FEED BACK SIGNAL TO THE VOLTAGE CONTROLLER CONTAINS THE HARMONIC BECAUSE OF DISTORTION IN DC BUS VOLTAGE.

THE MAIN CAUSE of THAT DISTORTION IS THAT DISTORTION IS COMPONENTS AT 100 Hz AND HIGHGR MULTIPLES of 100 Hz WHICH ARE PART of STORAGE CAPACITOR.

WITH ANALOG PI CONTROLLER, THE HARMONIC PROPAGATE TO CONTROLLER OUTPUT DOMINATED BY THIRD HARMONIC.

BY USING DIGITAL CONTROLLER, 100 Hz HARMONIC FROM PI CONTROLLER OUTPUT CAN BE ELIMINATED.

PI - PROPORTIONAL INTEGRAL CONTROL

SWITCHING DELAY

$$i_s - i_{ref} = \frac{SGN(V_S)\, t_d\, V_C}{2L} - \frac{t_d V_S}{L}$$

i_s = SUPPLY CURRENT

i_{ref} = REFERENCE CURRENT

$SGN(V_S)$ = SIGNIFICANT PORTION OF SUPPLY VOLTAGE

t_d = SWITCHING TIME DELAY

V_C = CAPACITOR VOLTAGE

L = INDUCTANCE

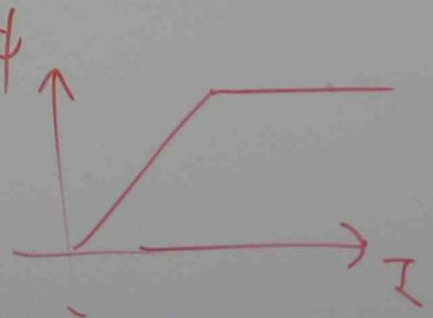
$$i_s - i_{ref} = \frac{-t_d V_s}{L}$$

INDUCTOR SATURATION

$$t_d = \frac{(i_s - i_{ref}) \times (-L)}{V_s}$$

FOR LOW FREQUENCY, THE VALUE OF INDUCTANCE IS MAIN FUNCTION OF SWITCHING DELAY.

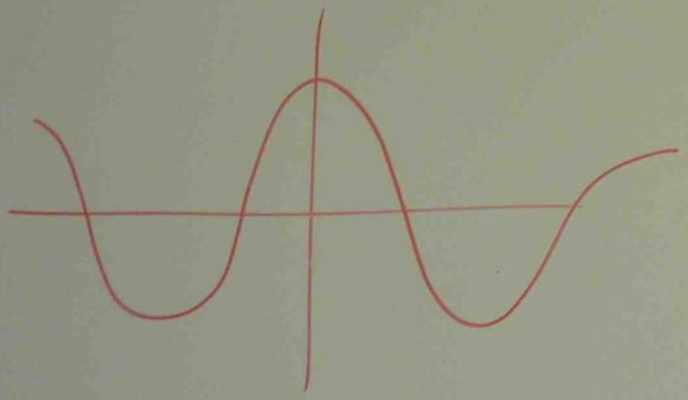
INDUCTOR IS TO BE USED WITHIN LINEAR RANGE.



INVERTER OUTPUT CURRENT

DIGITAL OSCILLOSCOPE

TETRONIK TDS 720
THS 720



BIPOLAR SWITCHING

$i_{ref} = 2\ A$

$i_{ref} = 0.5A$

BIPOLAR SWITCHING

UNIPOLAR SWITCHING

$i_{ref} = 2A$

UNIPOLAR SWITCHING

$i_{ref} = 0.5\ A$

TOTAL HARMONIC DISTORTION

REFERENCE CURRENT AMP (RMS)	% THD UNIPOLAR SWITCHING	% THD BIPOLAR SWITCHING
0.5	11.25%	8.37%
0.75	8.18%	5.02%
1.0	6.34%	3.8%
2.0	3.42%	2.06%