INSTRUCTION MANUL
FOR
AMPLITUDE MODULATION & DEMODULATION

Amplitude modulation & demodulation apparatus has been designed to study the following:

A. Amplitude Modulation & Calculation of Modulation Index Percentage Modulation of Side Band Frequency.
B. Amplitude Demodulator.

The instruments comprises of the following built parts:

1. Fixed output DC regulated power supply of ± 12Volts.
2. Built in Carrier Sine Wave generator of 450 KHz frequency 2.5V peak to peak amplitude.
3. Built in Audio Frequency Function Generator of 1 KHz 1.5V peak to Peak Amplitude.
4. Circuit diagram for modulator & demodulator are printed on the front panel and components are soldered behind the front panel.

THEORY

Modulation is the process in which some property of high frequency wave, also called as carrier wave ωc, is altered in such way by low frequency information signal, called as modulating wave ωm, to transmit from one place to other place through air. In double sideband amplitude modulation the amplitude of carrier wave is altered by modulating wave such to from an envelope upon the carrier on both sides. A non linear element is used to perform the high level modulation and a linear element for low level modulation. Properly biased transistors provide linear/non linear operation with some amplification. The AM wave is represents as shown in fig. (3) and its sidebands as shown in Fig. (4). The top envelope is represents as

Vc+Vm sin ωmt,

Where the bottom envelope is represented as

(Vc+Vm sin ωmt,)

When Vc is the carrier voltage, Vm is the modulating voltage. It is shown that formatting of envelops depends upon the term Vc+Vm, where Vc is kept constant hence the envelope height depends upon Vm only. The ratio between envelope amplitude is called as modulation index or factor mf, which is represented as

$$\frac{V\max - V\min/2}{V\max + V\min/2}$$

Calculating mf with 100 gives percentage modulation m%, which should never> 100. The power radiated in a given load is related in two terms, one the carrier power Pc and the other is modulated carrier power Pm. The difference of two sideband power Ps which is equal to Pusb+Plsb. The Pm is related with Pc as

$$\frac{Pm}{Pc} = 1 + \frac{mf2}{2}$$

THEORY OF OPERATION

For Amplitude Modulation

Figure (1) that shows the shows the internal circuit of the chip. We see that the carrier signal is applied to pins 8 and 10 in a common mode to a set of cross coupled differential amplifiers (Q1 with Q4 and Q2 with Q3). Transistor Q7 and Q8 serve as the constant current generator for the differential amplifiers, wheras the bias voltage applied to pin 5 determines the amount of current through the

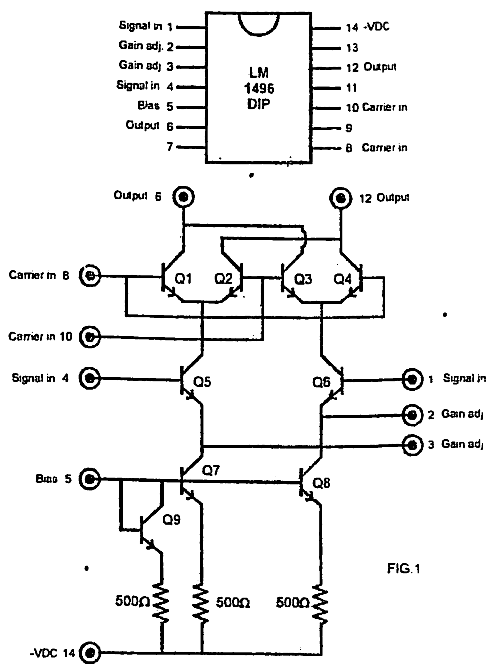


FIG.1

amplifiers. The resistor connected to pins 2 and 3 sets the modulator gain with a smaller resistor resulting in higher gain. The DC voltage difference between pins 1 and 4 will balance the differential amplifiers for complete carrier regection by equalizing the current in each differential amplifier. When the message signal is applied to pins 1 and 4 transistor Q5 and Q6 will alternately increase (or decrease) the current through their associated amplifier to output the sum and difference frequencies in the side band pair. The output is taken pin 6 for the modulator.

DEMODULATION OF AM WAVE

There are may procedure to demodulate the amplitude modulated waves. In present board (envelope detection) linear diode demodulation circuitry is provided. In linear diode detector circuits, diode presents a low ohmic path to input signal in

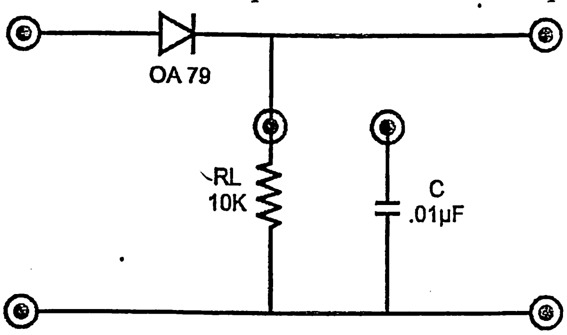


FIG.2

one direction only. For this reason changes in the peak current through the diode will remain confined to straight portion of Volt-ampere characteristics of the diode in other words it can be said that it acts as half wave rectifier carrier wave components. When carrier is presented only the average current Iavg will pass through the diode and has a constant amplitude output. When modulated wave is at the input the current 1 peak varies through forms a low pass filter to remove these HF components (in actual practice pye filters are employed). The maximum time constant is kept max equal RLC= 1/ωcωm.

The detection efficieny of diode detector is calculated from the input modulated signal power, or by mean of modulation depth and detected output as

β = average potential across RL/peak input signal voltage

The maximum detection efficiency lies between 80-90%, and upto 60-70% of modulation index.

PROCEDURE

For Modulation

1. Connect the carrier OSC output to carrier input.
2. Connect AF signal output to AF signal input.
3. Connect CRO channel A with the Amplitude Modulation output sockets.
4. Connect the CRO channel B with the AF signal output sockets.
5. Keep the Amplitude control at minimum position.
6. Switch ON the instrument using ON/OFF toggle switch.

7. Adjust CRO time base for 0.2ms.DV and vert gain at 1V/Div a band will appear upon the screen. Position it at the center of the screen & calculate

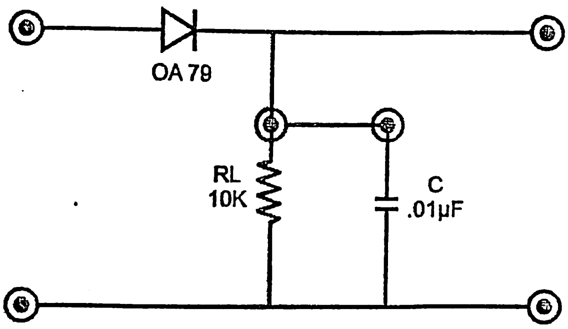


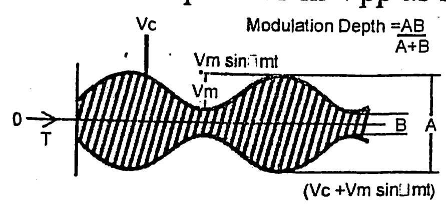
FIG.3

the value of modulation index percentage modulation upper side band frequency and lower side band frequency.

Formula used calculation of modulation index or modulation coefficient and side band frequencies.
ma = 2V max -2V min/2V max +-2V min

Percent modulation = ma x 100%
Upper side band frequency =carrier signal frequency + modulating signal frequency.

8. Connect the resistance box across the modulated output sockets in parallel with CRO leads measure the signal in Vpp.
9. Feed one volt p-p AF signal to the AF input. Trace out the pattern of the modulated wave and measure amplitudes in Vpp as shown in Fig. (4).



Envelop formation of Amplitude Modulated Wavèform

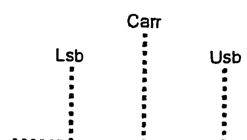


Fig.4

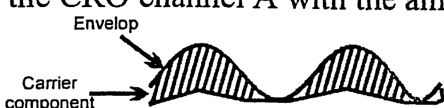
10. Increase AF input to successive levels and note amplitude A and B, for each increment. Calculate modulation factor for each input. Draw a plot between input signal (AF) modulation factor. The curve of the graph shown the modulation process. Increase maximum AF signal to observe the distorted wave form since cut-off and saturation of the transistor Q5.

11. Calculate peak power and Pc = VPP& RL and modulated power 2Pm = VA%RL, where AV is the pp amplitude traces from modulated envelope. Find out the power in side bands as p side bands = Pm. PC.
12. Plot side bands spectrum measuring AF and carrier signal frequencies.
13. Trigger CRO with input signal (For external triggering)

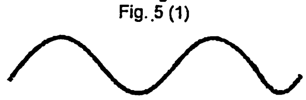
Note: - If resistance box and resistor is not available then modulated output may be terminated in provided RL = 10K in demodulator circuit as shown Fig. (3) & Fig. (4).

For Demodulation

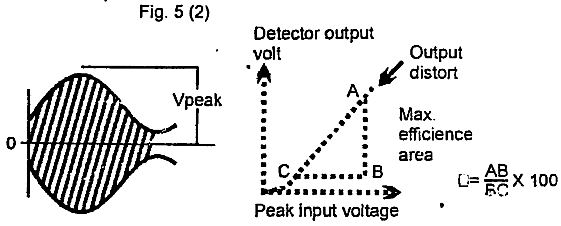
1. Connect the Amplitude modulation circuit to the input of Amplitude demodulation circuit.
2. Connect the CRO channel A with the amplitude demodulation output.



Demodulated signal without 'c'
Fig. 5 (1)



Output wave form with 'c'
Fig. 5 (2)



Different wave form at demodulator and its response curve
Fig. 5 (3)

3. Remain C out Circuit and no RL should be connected across modulated output sockets then the output is as shown in fig. 5 (i).
4. Connect CRO channel B with the AF modulated signal output.
5. Connect C in the Circuit and note its effect upon the RF components as shown in Fig. 5 (ii).
6. Feed AF signal for different modulation factor and note the amplitude of demodulated output voltage in p-p, and input voltage as Vp=Vpp/2 or A/S.
7. Plot a response curve between output voltage and Vp input. Select the linear part of the curve and calculate the efficiency of the detector as

   β=Slope of the curve as shown in Fig. 5 (iii).

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INSTRUCTION MANUAL
FOR
PUSH-PULL AMPLIFIER

ush-Pull Amplifier Apparatus has been designed to study the Output Gain, Output wer and Frequency Response of a Push Pull Amplifier.

Instrument comprises of the following built in parts :-

DC Regulated power supply of 12V.

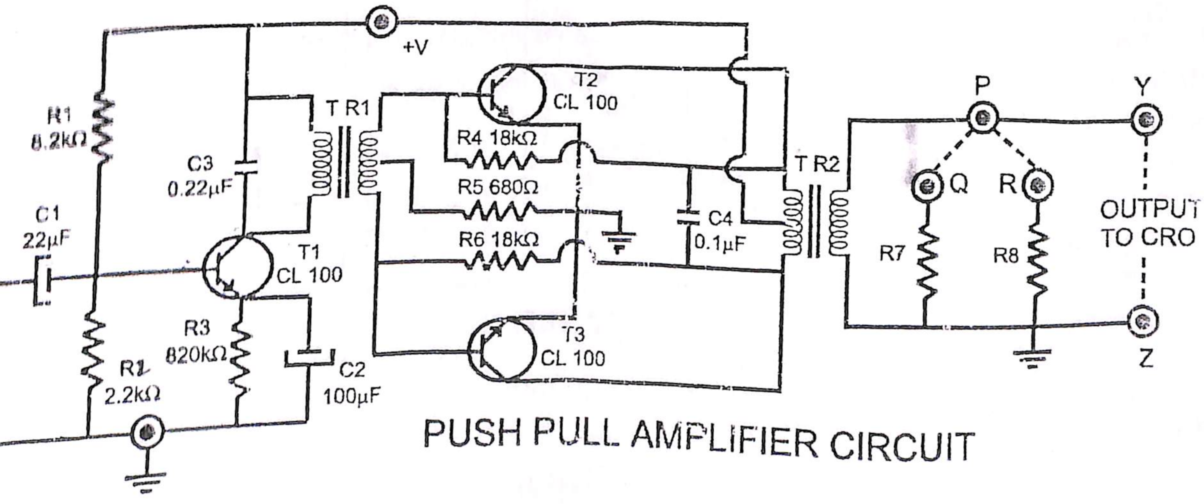
Two L plate (Driver Tranformers) matching transformers.

Three NPN transistors (CL100) are mounted on the front panel & important connections brought out on sockets.

Different types of resistances and capacitors are mounted on the front panel.

THEORY

Push Pull Amplifier is a power amplifier and is frequently employed in the output stages ectronic circuits. It is used whenever high output power at high efficiency is required. ed diagram shows the circuit of a push pull amplifier. Two trasistors TR_1 and TR_2 placed to back are employed. Both transistors are operated in class B operation i.e collector nt is nearly zero in the absence of the signal. The centre tapped secondary of driver ormer T_1 supplies equal and opposite voltage to the base circuit of two transistors. The t transformer T_2 has the centre-tapped primary winding. The supply voltage Vcc is ected between the bases and this centre tap. The output load is connected across the dary of this transformer. Input signal appears across the secondary AB of driver



PUSH PULL AMPLIFIER CIRCUIT

mer. Suppose during the first half cycle of the signal, end A becomes positive and end ive. This will make the base emitter junction of TR_1 reverse biased and that of Tr_2 biased. The circuit will conduct current due to TR_2 only. Therefore, this half cycle of the