CARRIER ACQUISITION

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ACHIEVEMENTS: carrier recovery from a modulated signal, using a phase locked loop.

PREREQUISITES: none

ADVANCED MODULES: BIT CLOCK REGEN

PREPARATION

In a commercial application carrier acquisition (recovery, regeneration) from a (digitally) modulated signal is always required.

In a laboratory situation it has been seen that the use of a stolen carrier is preferred, to sharpen focus on other aspects of the experiment.

In this experiment the main focus is on carrier acquisition.

There are two cases to be examined - those modulated signals which already contain a component at carrier frequency, and those which don’t!

The latter is far more likely to be the case in commercial practice. Both types of signals are present at TRUNKS.

The modulated signals could have been derived from any of the baseband signals already studied, and then have been translated (modulated) to a higher (carrier) frequency.

The scheme outlined in Figure 1 will be modelled.

Figure 1: carrier regeneration from a modulated signal

Should there be a carrier component present in the received signal then the SQUARER, and DIVIDE-BY-2, can be omitted. The VCO would be then tuned to ω.
A model of the scheme of Figure 1 is shown in Figure 2.

Observe that the block labelled as DIVIDE-BY-2 in Figure 2 will be a digital (TTL) sub-system, whereas the MULTIPLIER of the VCO requires an analog (sinusoidal) signal. This is easily accommodated by the TIMS VCO since it has both a TTL and an analog output.

The filter in Figure 1 following the SQUARER is perhaps not essential in many cases. It is included for completeness in the block diagram. In this experiment it can safely be omitted. See Tutorial Question Q3.

![TIMS model of Figure 1](image)

Figure 2: TIMS model of Figure 1

**T1** patch up the model of Figure 2 without the SQUARER. Select the modulated signals appearing at TRUNKS on the 100 kHz carrier.

**T2** use the oscilloscope to view both the incoming signal and the sinusoidal output of the VCO. Trigger to the latter.

**T3** with the gain of the VCO set fully anti-clockwise (zero loop gain - no negative feedback) tune the VCO to near 100 kHz. Watch the two oscilloscope traces. See if you can judge when the VCO is near the carrier frequency.

**T4** when you think you have tuned the VCO close to the incoming carrier then introduce some negative feedback. Watch for indications of phase lock. If and when it occurs report the frequency of the recovered carrier.

**T5** in your notes describe the technique you have adopted for obtaining and confirming phase lock with the PLL.

**T6** is your recovered carrier free of linear or non-linear modulation? What technique did you use to check this?
T7 introduce the SQUARER to the model, and repeat the previous Tasks, this time working with the TRUNKS signal based on a 50 kHz carrier.
Q1 how would the scheme illustrated in Figure 1 be modified if the received signal already had a spectral component at carrier frequency?

Q2 it is essential that the MULTIPLIER following the filter of the SQUARER be AC coupled. Why is this?

Q3 what is the purpose of the filter following the SQUARER in Figure 1?