Applications Information

Subcarrier Oscillator

The oscillator is a crystal-controlled design to ensure the accuracy and stability required of the subcarrier frequency for use with television receivers. Lag-lead networks (R2C2 and C1R1) define a quadrature phase relationship between pins 1 and 18 at the subcarrier frequency of 3.579545 MHz. Other frequencies can be used and where high stability is not a requirement, the crystal can be replaced with a parallel resonant L-C tank circuit—to provide a 2 MHz clock, for example. Note that since one of the chrominance modulators is internally connected to the feedback path of the oscillator, operation of the oscillator at other than the correct subcarrier frequency precludes chrominance modulation.

When an external subcarrier source is available or preferred, this can be used instead. For proper modulator operation, a subcarrier amplitude of 500 mVp-p is required at pins 1 and 18. If the quadrature phase shift networks shown in the application circuit are retained, about 1 Vp-p subcarrier injected at the junction of C1 and R2 is sufficient. The crystal, C4 and R3 are eliminated and pin 17 provides a 5 Vp-p signal shifted +125° from the external reference.

Chrominance Modulation

The simplest method of chroma encoding is to define the quadrature phases provided at pins 1 and 18 as the color difference axes R-Y and B-Y. A signal at pin 2 (R-Y) will give a chrominance subcarrier output from the modulator with a relative phase of 90° compared to the subcarrier output produced by a signal at pin 4 (B-Y). The zero signal dc level of the R-Y and B-Y inputs will determine the bias level required at pin 3. For example, a pin 2 signal that is 1V positive with respect to pin 3 will give 0.6 Vp-p subcarrier at a relative phase of 90°. If pin 2 is 1V negative with respect to pin 3, the output is again 0.6 Vp-p, but with a relative phase of 270°. When a simultaneous signal exists at pin 4, the subcarrier output level and phase will be the vector sum of the quadrature components produced by pin 2 and 4 inputs. Clearly, with the modulation axes defined as above, a negative pulse on pin 4 during the burst gate period will produce the chrominance synchronizing "burst" with a phase of 180°. Both color difference signals must be dc coupled to the modulators and the zero signal dc level of both must be the same and within the common-mode range of the modulators.

The 0.6 Vp-p/V_{dc} conversion gain of the chrominance modulators is obtained with a 2 kΩ resistor connected at pin 13. Larger resistor values can be used to increase the gain, but capacitance at pin 13 will reduce the bandwidth. Notice that equi-bandwidth encoding of the color difference signals is implied as both modulator outputs are internally connected and summed into the same load resistor.

Sound Oscillator

Frequency modulation is achieved by using a 4.5 MHz tank circuit and deviating the center frequency via a capacitor or a varactor diode. Switching a 5 pF capacitor to ground at an audio frequency rate will cause a 50 kHz deviation from 4.5 MHz. A 1N5447 diode biassed −4V from pin 16 will give ±20 kHz deviation with a 1 Vp-p audio signal. The coupling network to the video modulator input and the varactor diode bias must be included when the tank circuit is tuned to center frequency.

A good level for the RF sound carrier is between 2% and 20% of the picture carrier level. For example, if the peak video signal offset of pin 12 with respect to pin 13 is 3V, this corresponds to a 30 mVrms picture RF carrier. The source impedance at pin 12 is defined by the external 2 kΩ resistor and so a series network of 15 kΩ and 24 pF will give a sound carrier level at −32 dB to the picture carrier.

RF Modulation

Two RF channels are available, with carrier frequencies up to 100 MHz being determined by L-C tank circuits at pins 6, 7, 8 and 9. The signal inputs (pins 12, 13) to both modulators are common, but removing the power supply from an RF oscillator tank circuit will also disable that modulator.

As with the chrominance modulators, it is the offset between the two signal input pins that determines the level of RF carrier output. Since one signal input (pin 13) is also internally connected to the chrominance modulators, the 2 kΩ load resistor at this point should be connected to a bias source within the common-mode input range of the video modulators. However, this bias source is independent of the chrominance modulator bias and where chrominance modulation is not used, the 2 kΩ resistor is eliminated and the bias source connected directly to pin 13.

To preserve the dc content of the video signal, amplitude modulation of the RF carrier is done in one direction only, with increasing video (toward peak white) decreasing the carrier level. This means the active composite video signal at pin 12 must be offset with respect to pin 13 and the sync pulse should produce the largest offset (i.e., the offset voltage of pin 12 with respect to pin 13 should have the same polarity as the sync pulses).

The largest video signal (peak white) should not be able to suppress the carrier completely, particularly if sound transmission is needed. For example, a signal with 1V sync amplitude and 2.5V peak white (3.5 Vp-p — negative polarity sync) and a black level at 5 V_{dc} will require a dc bias of 8V on pin 13 for correct modulation. A simple way of obtaining the required offset is to bias pin 13 at 4 x (sync amplitude) from the sync tip level at pin 12.

Composite Video Output

When both chrominance and luminance modulation is being done, a simple technique can be used to check the chrominance to luminance ratio before modulation on the RF carrier. This is shown in *Figure 1* where the tank circuit of one RF-oscillator has been replaced. Pin 8 is

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held one diode voltage droo below pin 9, thereby offsetting the upper rank of the modulator which now behaves as a cascode stage for the composite video signal. A 1.8 kΩ resistor as a load at pin 11 gives a gain of about 0.5. If pin 11 is buffered by an external amplifier, composite video at 75Ω can be made available for injection into the video stage of a TV receiver. Putting the diode D1 in-series with pin 9 will reverse the video polarity.

Split Power Supplies

The LM1889 is designed to operate over a wide range of supply voltages so that much of the time it can utilize the signal source power suoolies. An example of this is shown in *Figure 2* where the composite video signal from a character generator is modulated onto an RF carrier for display on a conventional home TV receiver. The LM1889 is biased between the −12V and +5V supplies and pin 13 is put at ground. A 9.1 kΩ resistor from pin 12 to −12V dc offsets the video input signal (which has sync tips at ground) to establish the proper modulation depth − R1/R2 = $V_{IN}/12 \times 0.375$. This design is for monochrome transmission and features an extremely low external parts count.

Frequently, the use of split power supplies will make matching the LM1889 to available signal generator outputs a simple process. *Figure 3a* shows the LM1889 configured to accept the composite video patterns available from a Tektronix Type 144 generator that has black level at ground and negative polarity syncs. In this application the oscillator amplifier is used to provide a gain of two and a 10 kΩ pot adjusts the over-all dc level of the amplified signal. Since the generator does not conveniently provide the required supply voltages, a circuit is shown in *Figure 3b* that will split 15V into +5V and −10V. An advantage is that the supplies will track with the 15V source. However, once the modulation depth has been set, the supply voltage should be stabilized. The power supply "split" is set by the resistor connected to pin 1 of the LM380.

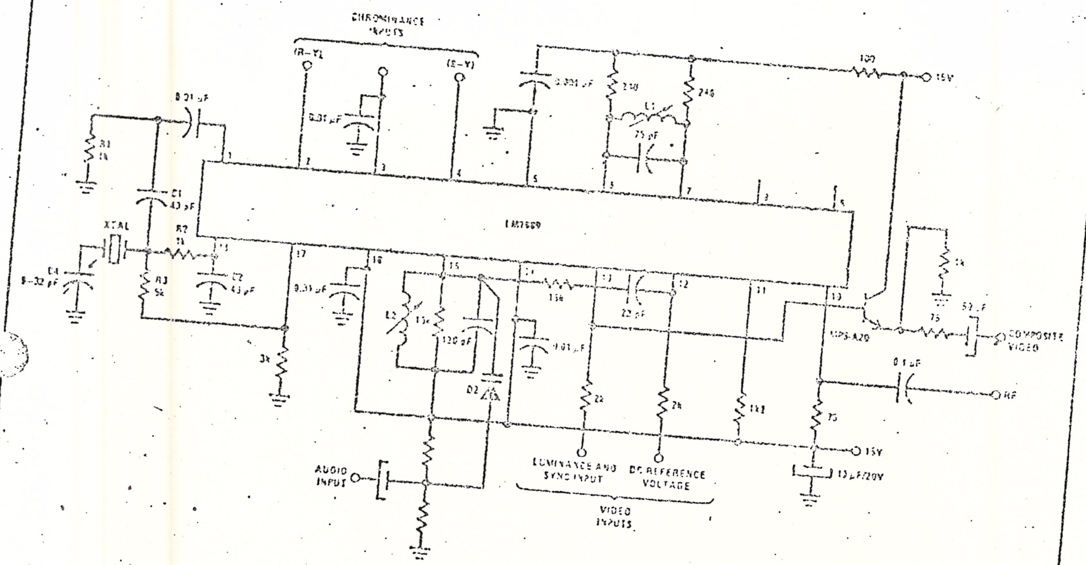

FIGURE 1. Luminance and Chrominance Encoding Composite Video or RF Output

Applications Information (Continued)

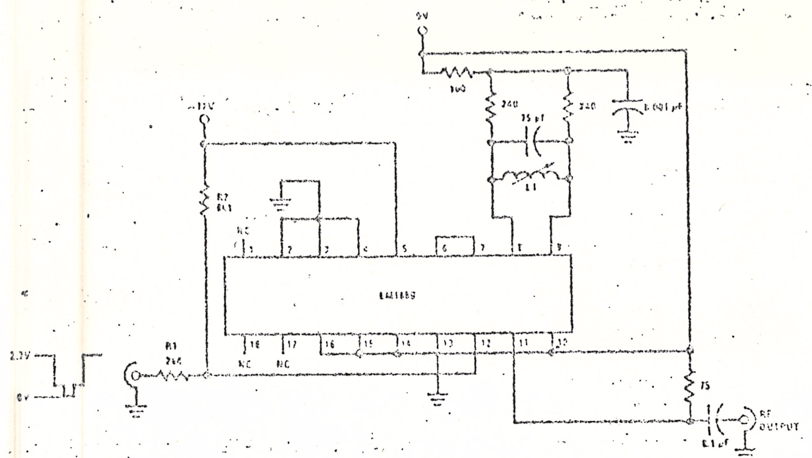

FIGURE 2. Low Cost Monochrome Modulator for Character Generator Display

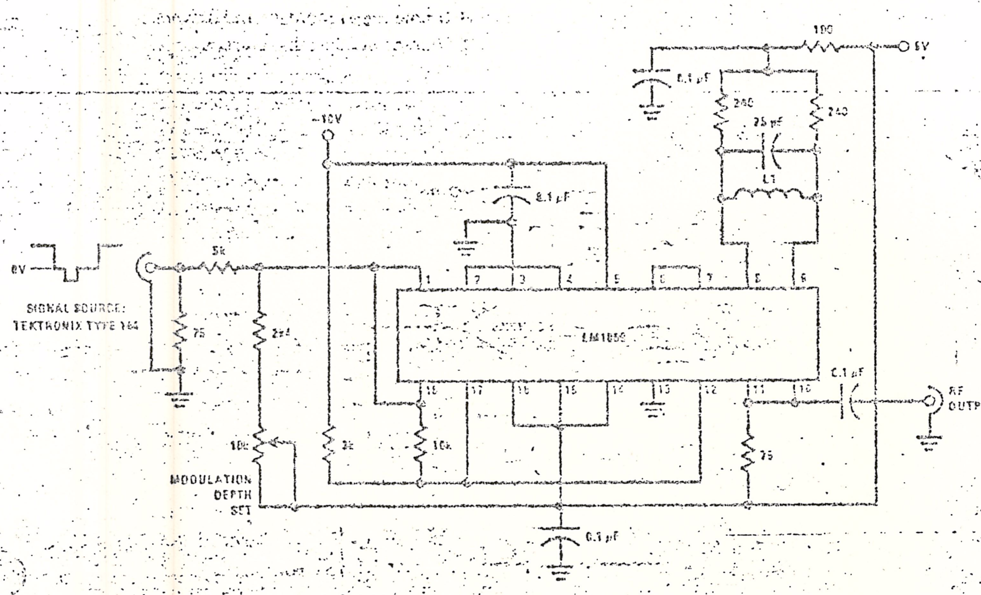

FIGURE 3a. dc Coupled Modulator for NTSC Pattern Generators

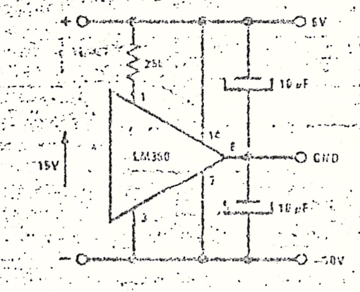

FIGURE 3b. Tracking Split Power Supply