An Up-Converter for Extending the Frequency Range of Signal Generators

by J. M. Noding, LA 8 AK

It is not a new idea to extend the frequency range of a signal generator with the aid of a mixer. A large number of obsolete signal generators are to be found in amateur shacks that do not possess a VHF-range, and even less a UHF-range. If the signal generator signal is converted from HF to VHF or UHF, using a modern Schottky diode ring mixer, it is possible to obtain a very large level range with a good level accuracy over a wide frequency range.

The principle of this method is given in the block diagram **(Figure 1)**. This assumes a signal generator that has a frequency range of up to at least 15 MHz and is extended up to 144 MHz with the aid of a crystal-controlled wideband mixer. The loss of the mixer can be taken from the data sheet as first approximation and be brought to a rounded value with the aid of simple attenuators (e.g. 10 dB).

The switchable attenuator shown in Fig. 1 need only operate at the lower frequency; it is used to extend the level range of the signal generator.

Figure 2 shows the resulting circuit which comprises a crystal oscillator, tripler, and an amplifier which drives the ring mixer via a matching link with approximately 10 mW. A DC-voltmeter can be connected to test-point TP 1 for alignment of the oscillator chain.

The ring mixer type SBL-1 (MCL) used by the author has a conversion loss of 6.2 dB when driven at this level, which is a very typical value. The Pi-attenuator link at the input of 0.8 dB, and one at the output with 3 dB, ensure that the overall loss amounts to 10 dB. Since these ring mixers only achieve their given data with exactly 50 Ω termination at all ports, it is not a bad idea to design the two Pi-attenuator links for higher values – for instance 3.8 dB at the input and 10 dB at the output.

This results in an overall conversion loss of 20 dB, which corresponds to 1/10 of the output voltage read off on the signal generator.

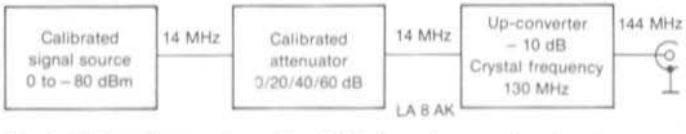

Fig. 1: Using a linear mixer with a high dynamic range to extend the frequency range of a signal generator

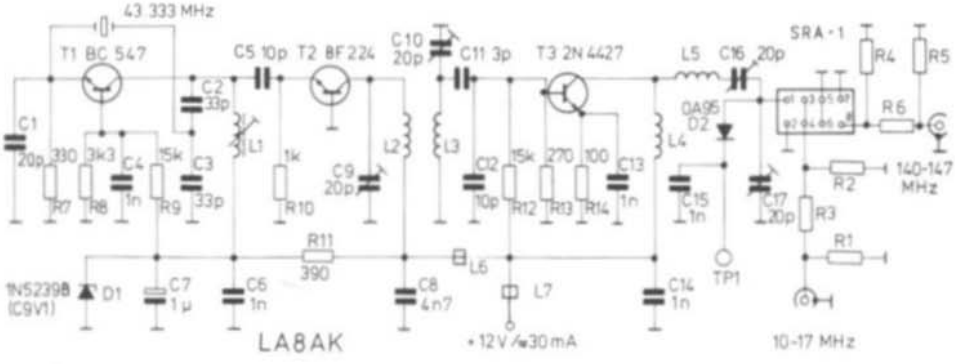

Fig. 2: Recommended circuit for a linear up-converter with suitable oscillator chain

CONSTRUCTION AND COMPONENT DETAILS

The circuit given in **Figure 2** can be accommodated on PC-board DK 1 OF 042 (1). Several circuit details were also taken from this module. Further details about the components and especially the inductances can also be taken from this article.

Since the circuit given in Figure 2 is actually only an example on how such an up-converter can be constructed, complete constructional details are not to be given.

Mainly the inexpensive mixer types such as IE-500, MD-108, SRA-1 or SBL-1 will be used for this application, which means that all frequencies between 5 and 500 MHz can be achieved as long as a suitable oscillator circuit is provided. Such mixers require an oscillator power of 5 to 10 mW for most favorable operation; one should be able to measure approximately 0.6 V at the test-point when using a high-impedance voltmeter. The conversion loss of such mixers is in the order of 5.5 to 7 dB. The exact value is dependent on the frequency, the oscillator level, and on the individual mixer.

The following table gives the required resistance values for the Pi-attenuator links (rounded values):

Attenuation dB	R 1 = R 2 Ω	R 3 Ω
0.8	910	5.6
3.0	300	18
3.8	220	22
6.0	150	39
10.0	100	68

USING THE MIXER AS »WAVE ANALYZER«

The author has also used the described mixer module the other way round, in other words using an oscillator frequency of 143 MHz to convert signals on the 2 m band to an intermediate frequency of 1 to 3 MHz. When using a 20 dB amplifier (e.g. BF 900) at the IF-output (pin 3 and 4), it is possible to drive a cheap oscilloscope, and, for instance, to examine one's own SSB-signal for distortion, or for adjusting the shape of the keying envelope in CW by altering the time constant in the keying line. The latter example shows how a difficult problem can be solved simply.

REFERENCES

(1) J. Kestler: A 29 MHz Transverter for Use with 145 MHz Transceivers VHF COMMUNICATIONS 12, Edition 2/1980, pages 88-95