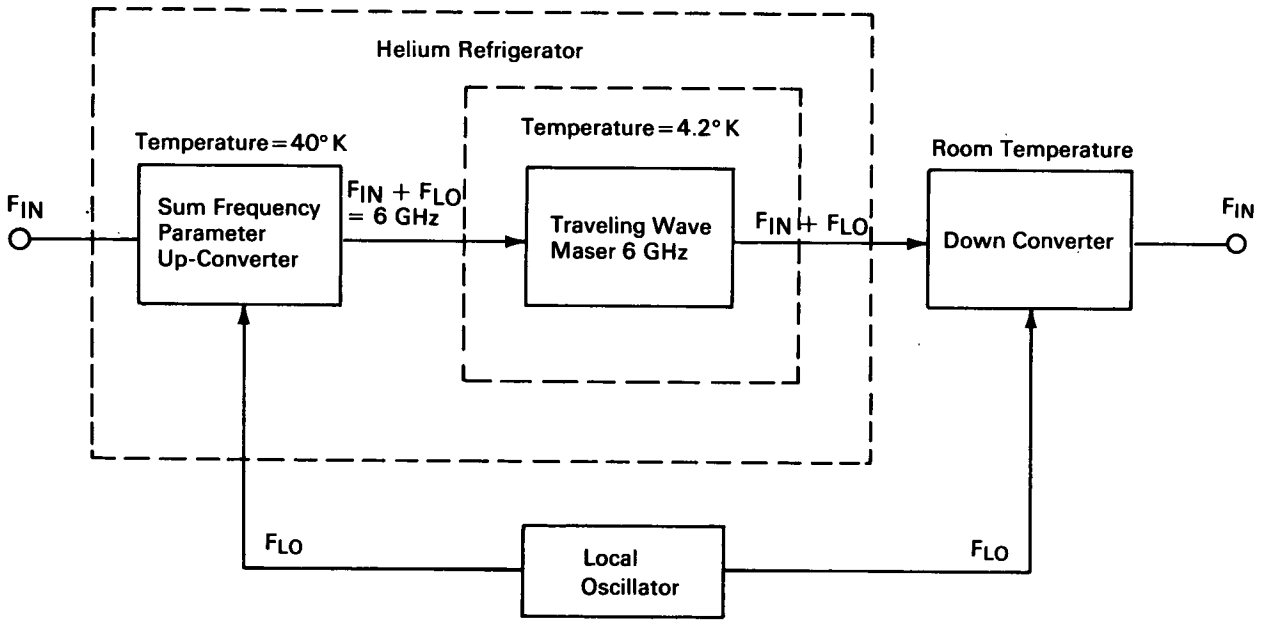
April 1967

Brief 67-10104

NASA TECH BRIEF

Parametric Up-Converter Increases Flexibility of Maser



The problem:

The maser (microwave amplification by stimulated emission of radiation) provides the lowest noise amplification of microwave signals available to the communications engineer. However the maser is inherently a narrow band device with a very limited tuning range. Complexity and the cryogenic requirements of the maser amplifier result in a very expensive system, especially when it is necessary to duplicate maser equipment for accommodations of a wider range of frequencies than can be obtained from a single unmodified maser.

The solution:

A parametric up-converter to translate a broad band of signals to the fixed tuned input frequency of the maser. Operation in the range of 1700–2300 Mc has been achieved with this modified maser.

How it's done:

The parametric up-converter is a positive reactance, low gain, very low noise device and results in only a slight noise temperature increase in maser operation. It up-converts signals into the fixed bandpass of the maser by means of an appropriate local oscillator. After low noise maser amplification, the signal is

(continued overleaf)

down-converted to the original signal frequency through use of the same local oscillator.

Notes:

1. The basic technique was tested on a single fixed tuned maser amplifier operating in the 6 GHz region. Spot center frequency tuning ranges of ±10 percent have been achieved. Larger changes in center frequency can be accomplished by substituting up-converters. Overall gains in excess of 30 db, bandwidth of 60 Mc, and noise temperatures of less than 20°K have been achieved. Continued refinement of this device theoretically should result in performance limited only by the maser itself.
2. The parametric up-converter maser has the distinct advantage of providing maser-like performance with parametric-like tunability. The excellent dynamics and stability of the maser are retained.
3. This technique should find appropriate use in microwave and satellite communications, and radio astronomy. Spectrum analysis may also be considered to offer potential application.
4. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Kennedy Space Center
   Kennedy Space Center, Florida 32899
   Reference: B67-10104

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Raymond H. Summy
(KSC-67-98)