HEWLETT PACKARD

Clock Recovery Using Si MMICs

Application Note 1055

One of the functions that must be performed by a fiber optic receiver is the re-timing of the output data stream. This function is commonly referred to as clock recovery. This note discusses a method of clock recovery that makes use of a number of Hewlett-Packard's silicon MMICs.

Figure 1 shows schematically one way of performing clock recovery. A sample of the recovered clock+data analog signal is fed into a mixer connected as a frequency doubler. This device will function as a transition detector, creating a signal each time the data stream changes states. The output of the mixer is fed into a high Q bandpass filter such as a SAW filter. This removes the spectral contributions of the characteristic transmission frequency (bit rate /2). The resultant signal is then amplified using gain blocks and fed into the clock port of a decision circuit. Since this signal should consist of sharp-edged pulses, some limiting may be desired in this portion of the circuitry.

Hewlett-Packard's IAM series of active mixers can be used to construct the frequency doubler. For this application, the data+clock signal must be fed in phase to both the RF and LO ports of the mixer. These two signals will then sum in the mixer, with the resultant 2f signal appearing at the IF port. Phase matching of the signal at RF and LO ports is critical for proper operation, and is accomplished by inserting a transmission line having the proper delay (length) between the in-coming signal and the LO port. The frequency range over which this scheme will work is a

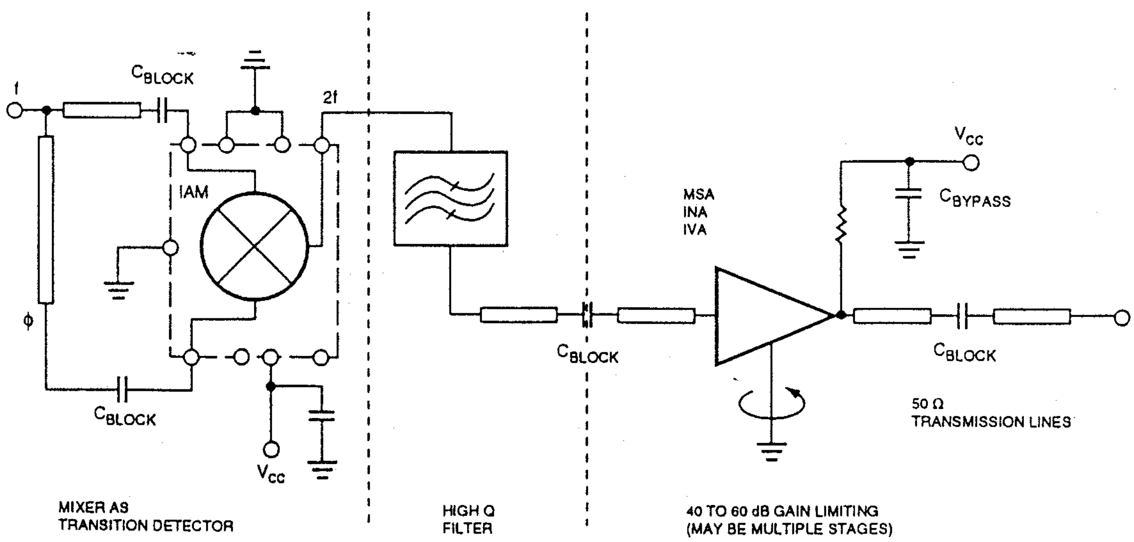

Figure 1. Clock Recovery Using Si MMICs.

function of the frequency response of the mixer used. In the case of the IAM series active mixers, it is the frequency response of the IF port that limits operation. Both the IAM-81 and the IAM-82 families can accept input signals at both the RF and LO ports up to 5 GHz. However, the gain-bandwidth of the IF port limits the IAM-81 geometry to outputs in the 1 GHz (1.5 Gb/s) range. The IAM-82 geometry can be used with outputs in the 2 GHz (2.5 Gb/s) range, with higher operating voltage and current being the primary trade-offs. The output power available from the doubler will be a function of frequency, input drive, and geometry selected, and can be determined from the mixer data sheets.

The filter used in the system should have a very high Q factor. SAW filters have been found to function well for this application. The filter should be centered at twice the maximum data rate of the received signal. Hewlett-Packard does not manufacture SAW filters.

The amplification after the filter can be accomplished using any Hewlett-Packard gain block, with the MSA MODAMP™ MMICs, INA low noise amplifiers and IVA variable gain amplifiers being popular candidates. 40 to 60 dB of amplification is typically required to compensate for the loss in the SAW filter and create a signal strong enough to drive the decision circuit; exact values will depend on components chosen. Since the amplification chain should have reasonable limiting properties, IVA devices are the best choice for the output stage. Note that the IVA series of variable gain amplifiers have excellent limiting properties when run in saturation with no control voltage applied. The next best choice is the INA-03 geometry. INA devices have superior limiting qualities to the MSA devices, as they lack the front-to-back feedback resistor present in the latter designs. The INA-03 geometry is a preferred choice due to its 2 GHz bandwidth, low bias requirements, and relatively low compressed output power.

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Printed in U.S.A. 5091-4917E (6/93)