Overview

Daylight Solutions is proud to offer a photodetector that will be used to detect IR photons from 4 – 12 um over the tunable range of our QCL lasers. The detector is offered in a Photo Conductive configuration for the photon starved environment such as in spectroscopy. It is based on a Vigo Photoconductive Mercury Cadmium Telluride (MCT) room temperature 2-stage TE-cooled detector,

Theory of operation

Detectors

Vigo offers MCT photoconductive and photovoltaic detectors in a TO-8 can. The one we have chosen also offers an internal 2 stage TE-cooler. It uses an immersion lens to improve detector performance, but limits the field of view. Photoconductive devices are based on the photoconductive effect, which basically changes their conductivity (resistance) by incident radiation power which generates additional charge carriers. Photovoltaic detectors are semiconductor structures with p-n junctions. Absorbed photons produce electron-hole pairs resulting in photocurrent in an external circuit.

Immersion Lens and FOV

The Vigo detectors are offered with an optical immersion GaAs lens that improves performance of the detector, but limits the Field Of View (FOV). However, due to the 6 mm physical aperture of the TO-8 can, the FOV is limited to 82º. Therefore, we have chosen to use the hemispherical lens which has an acceptance angle of 180º.Once placed in the detector housing and with the detector cover, the FOV is ~78 º.

RF section

The signal output of the photodetector is coupled into a 2 stage RF amplifier with 40db of gain. A two stage RF amp was designed with a bandwidth of 20 kHz - 2 GHz, 40dB Gain, and an output of 17.8dBm. The output of the RF amp is coupled to an SMA connector that requires 50Ω termination. The response of the detector is limited to a rise time of 3 ns so the full Bandwidth of the RF section is not realized.

TEC controller

The Vigo detectors have built in 2 stage TE-coolers. The Thermal Electric Coolers (TEC) are controlled by a custom PID control circuit. The detector set temp is controlled internally and set to 265K. The bandwidth of the TEC is limited to 10kHz.

Power supplies

The detector requires two different power supplies to operate. A +15VDC supply is for the RF section. The TEC controller requires +5VDC and is separate from the +15VDC supply. Glass to metal feed-thru's are used with internal RLC circuits to minimize EMI from the external power supply. Since the power is internally filtered and isolated, block power supplies can be used with little degradation of performance. Very low noise power supplies can also be used to reach the detector NEP.

Packaging

In order to minimize electromagnetic interference (EMI), the detector is housed in a gold anodized microwave enclosure and attached to its base using a ceramic plate for electrical isolation. All power terminals are isolated using glass-to-metal feed-thru's which have internal RLC circuits to block RF interference and pass DC voltage.

Normal Operation

A normal power up sequence will have the +5VDC TEC current surge to 1.2A as the TEC comes on and tries to drive the detector to cooler temperatures. Once the thermister in the detector reaches the set temperature the TEC current should stabilize on ~0.4A. The +15VDC can be applied at any time. Allow 15 mins for the unit to come to thermal equilibrium before performing any calibrated experiments.

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