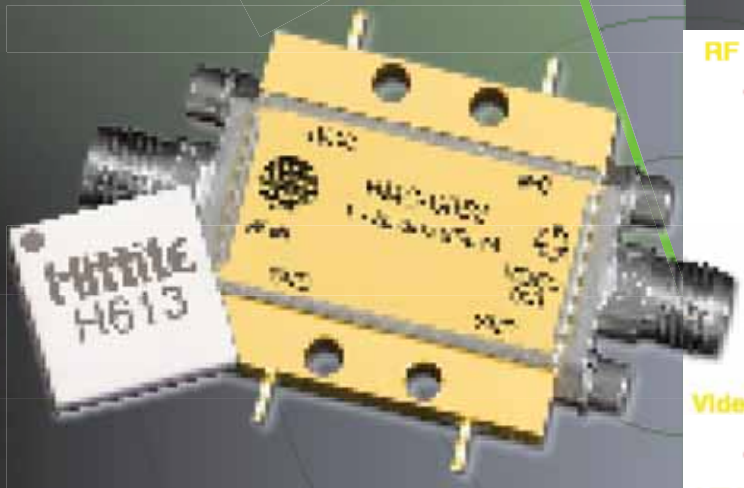
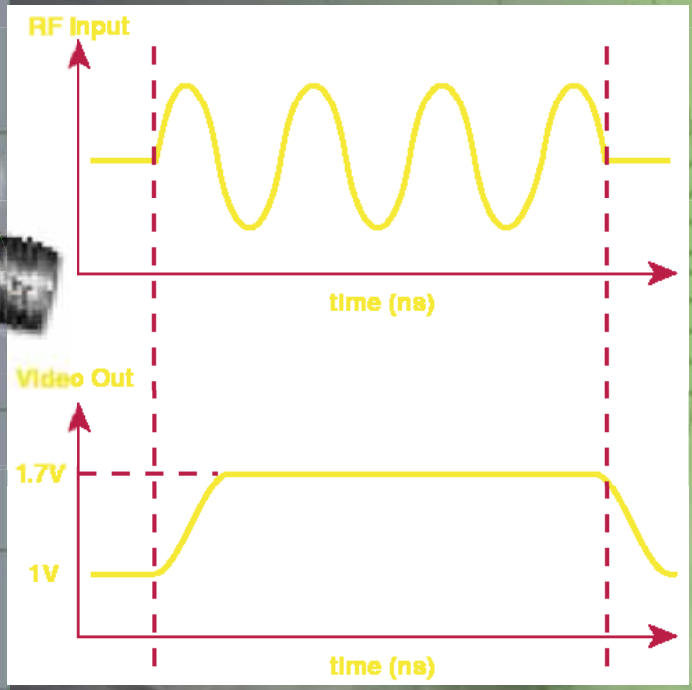
WIDEBAND SDLVAs

Analog & Mixed-Signal ICs, Modules, Subsystems & Instrumentation

Tiny SDLVAs Tackle 20-GHz Bandwidth





Tiny SDLVAs Tackle 20-GHz Bandwidth

These high-performance successive-detection log-video amplifiers (SDLVAs) offer outstanding wide frequency ranges and dynamic ranges with low power consumption in compact housings.

Military system designers are often faced with processing input signals over a wide dynamic range. With many systems, such as direct-finding (DF) receivers, electronic-intelligence (ELINT) receivers, electronic-countermeasures (ECM) systems, radar warning receivers (RWRs), and commercial instrumentation, it is often necessary to capture and analyze narrow pulses with large variations in amplitude. Traditionally, the successive detection log video amplifier (SDLVA) is the component of choice for this task.

Figure 1. Model HMC613LC4B is a surface-mount SDLVA (shown mounted to a PCB) that operates from 100 MHz to 20 GHz.

Figure 2. Model HMC-C052 is a miniature connectorized SDLVA module that operates from 1 to 20 GHz.

Today, when system designers need a high-performance SDLVA, they have two more choices with outstanding performance over the wide frequency range of 0.1 to 20.0 GHz. The SDLVA models HMC613LC4B and HMC-C052 from Hittite Microwave Corp. (Chelmsford, MA) are supplied in a compact 4 x 4 mm ceramic package and miniature hermetic module. Respectively, both offer the signal-processing capability needed to capture and analyze narrow, high-speed RF pulses over wide dynamic ranges. The small size and low power requirements of these SDLVA solutions allows designers to incorporate this function into systems once limited to alternative signal-processing approaches, such as portable systems.

The HMC613LC4B SDLVA operates over the 0.1 to 20 GHz frequency range and provides a logging range of 62 dB. It consumes only 83 mA current from a single +3.3V DC supply when processing RF signals at -30 dBm input power. Ideal for EW and ELINT applications, the HMC613LC4B is capable of processing RF pulses in the 0.1 to 20.0 GHz frequency band with amplitudes from -57 to +5 dBm with only 4 ns rise times and 26 ns of recovery time.

The HMC613LC4B employs a successive compression topology which delivers extremely high dynamic range and conversion accuracy over its wide input frequency range (Fig. 3). As the input power is increased, successive RF amplifier stages move into saturation one by one creating an accurate approximation of the logarithmic function. The output of a series of detectors is summed into a single video amplifier for the purpose of providing a single detected output. When the HMC613LC4B is used in detection mode, the VIDEO OUT pin is connected to the Video FB pin via a 0Ω resistor, providing a nominal logarithmic slope of 14 mV/dB and a typical intercept of -119 dBm at 10 GHz. The output gain stage of the HMC613LC4B may be modified by connecting appropriate

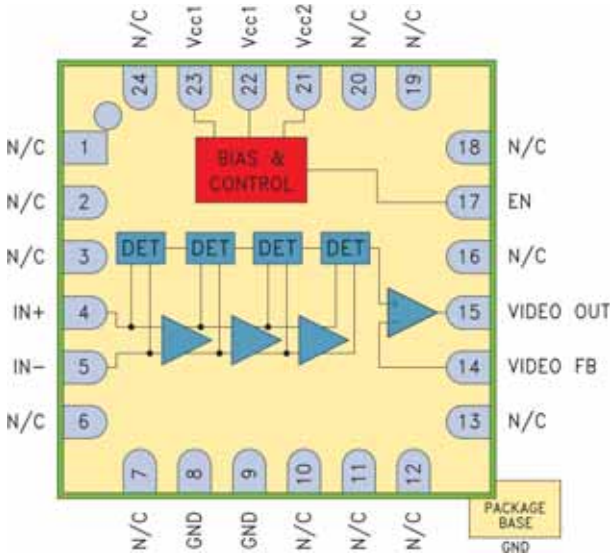


Figure 3. This block diagram shows the various functions of the HMC613LC4B SMT SDLVA.

external resistors between the VIDEO OUT and the VIDEO FB pin, and also between the VIDEO FB pin and ground. The HMC613LC4B also provides an EN (enable) pin, which is connected to Vcc (+3.3 VDC) during normal operation. If the enable pin is connected to ground, the SDLVA is disabled, and the total supply current is reduced to less than 3 mA. This is a useful feature for controlling total system power, particularly in high-speed channelized receiver designs, where multiple channels/SDLVAs are deployed.

Figures 4 and 5 show the typical logarithmic error and video output voltage performance of the HMC613LC4B over the -40 to +85°C operating temperature range at 2 and 20 GHz. The typical flatness over the 2-to-20-GHz band from -55 to +5 dBm is shown in Fig. 6. Measurements on the HMC613LC4B typically reveal better than ± 2 dB flatness to 20 GHz at a -30-dBm input-power level. The maximum temperature-related deviation is ±1 dB at any given frequency and power level over the full operating temperature range.

The HMC-C052 integrates the HMC613 bare die, a linear regulator IC, and off-chip components within a hermetically sealed package that can be used as a connectorized module (2.92 mm or SMP connectors) or as a MIC drop-in design. The HMC-C052 operates from 1 to 20 GHz and draws only 86 mA of current from a single +7 to +16 VDC supply. (The table compares the key specifications of the HMC613LC4B and the HMC-C052 SDLVAs.) The HMC-C052 operates from -55 to +85°C and is housed in a miniature 22.6 x 21.6 x 5.84 mm package.

The miniature HMC-C052 module represents a space savings of more than 85 percent compared with existing typical broadband connectorized SDLVA modules with similar performance (Fig. 7). The connectorized HMC-C052 module can immediately replace existing broadband SDLVA modules, resulting in a lower-cost,

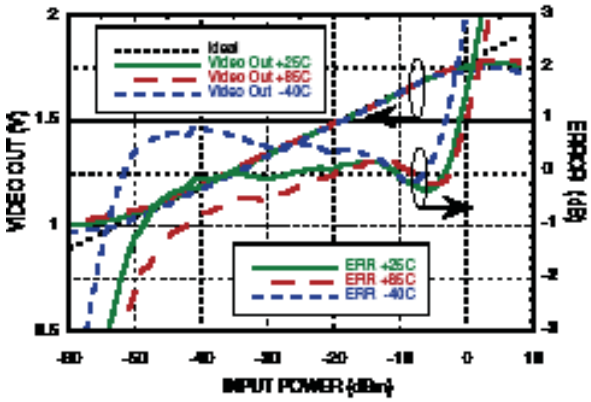


Figure 4. This plot shows the video output and log error vs. input power at 2 GHz for the HMC613LC4B SDLVA.

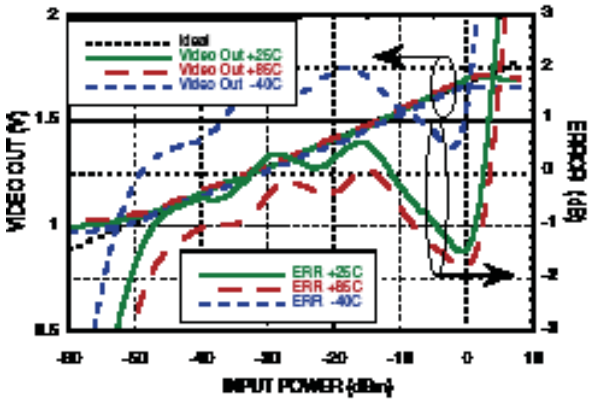


Figure 5. This plot shows the video output and log error vs. input power at 20 GHz for the HMC613LC4B SDLVA.

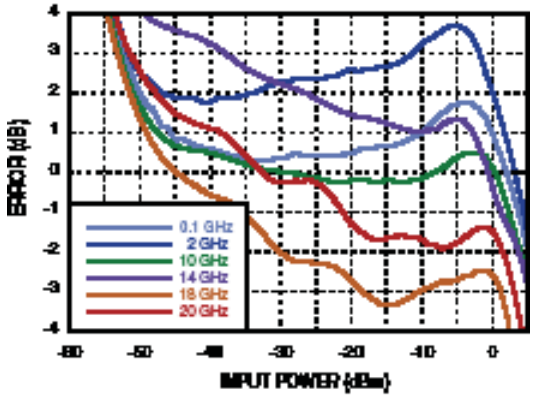


Figure 6. This plot shows gain error flatness vs. input power from 0.1 to 20 GHz for the HMC613LC4B SDLVA.

Figure 7. A traditional, MIC hybrid-based SDLVA (top) requiring both positive and negative DC power supplies is shown with the HMC-C052 SDLVA module and the HMC613LC4B SMT SDLVA.

reduced-power-dissipation (heat) solution occupying a significantly smaller form factor.

Hittite Microwave's design philosophy involves the careful selection of the best semiconductor processes and design techniques available for each component solution ensuring the delivery of market-leading product performance. This performance improvement allows the systems designer to maximize the true potential of the design to ultimately deliver a superior product. The block diagram for a RWR (Fig. 8) shows how a system design can be optimized by careful section of Hittite Microwave catalog components. In this application example, the RWR combines signal filtering, amplification, detection, and frequency measurement into one multifunction unit. In such a design, a system engineer is often seeking to reduce power consumption along with the overall size and weight of the RWR module. Any reduction in power consumption and weight renders a double benefit, particularly in airborne or unmanned-aerial-vehicle (UAV) applications, as a smaller, lighter power supply is required. The HMC613LC4B or the HMC-C052 SDLVAs are key components required to implement the RWR function, and compared with traditional SDLVA solutions, provide significant savings in both power consumption and size for equivalent performance.

Table: Comparing the HMC613LC4B and HMC-C052.

Parameter	HMC613LC4B	HMC-C052
Input frequency range	0.1 to 20.0 GHz	1.0 to 20.0 GHz
Logging range	62 dB	59 dB
Logarithmic range (±3 dB)[1]	-57 to +5 dBm	-54 to +5 dBm
Logarithmic slope	14 mV/dB	14 mV/dB
Frequency flatness at -30 dBm RF input power	±2 dB	±2 dB
Logarithmic error over temperature	±1 dB	±1 dB
Rise/fall time	4/18 ns[2]	2/7 ns[3]
Recovery time	26 ns	21 ns
Output voltage	1.0 to 1.8 V	0.9 to 1.5 V
Bias supply	+3.3 VDC at 83 mA	+7 to +12 VDC at 86 mA

Note 1: Based on linear regression of error curve from input power of -40 dBm to input power of -10 dBm.
Note 2: Rise/fall times measured from no power to 0 dBm.
Note 3: Rise/fall times measured from no power to -20 dBm.

Wideband SDLVAs, 0.01 - 20 GHz

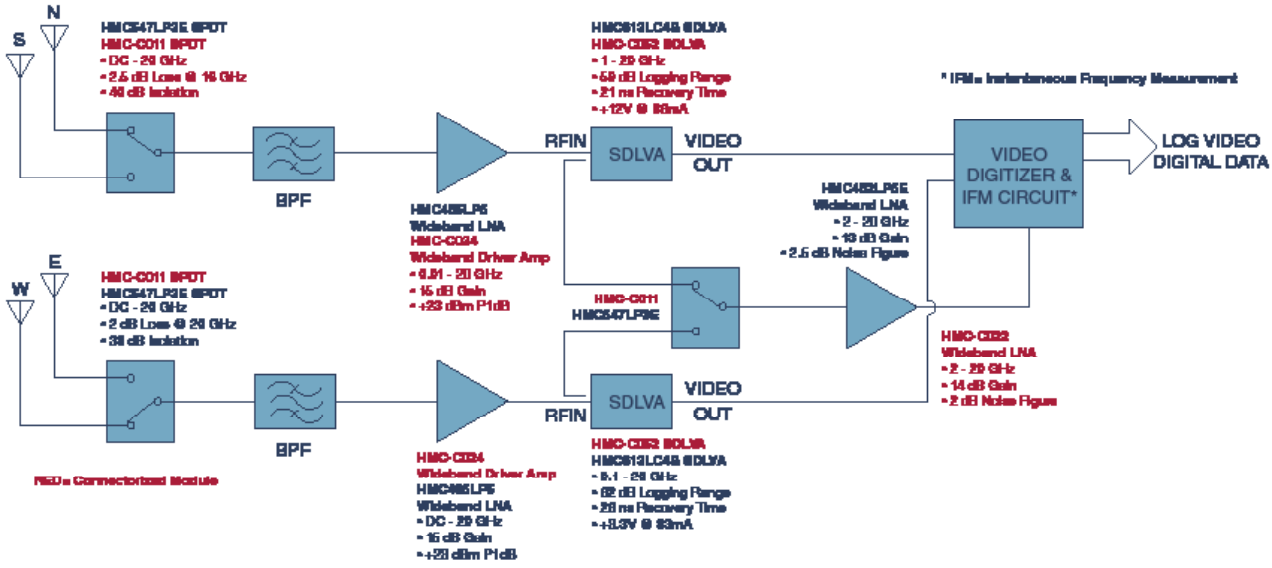


Figure 8. This block diagram for a typical RWR front end highlights the high-reliability SMT and connectorized modules (in red) from Hittite Microwave Corp

The HMC613LC4B or the HMC-C052 SDLVA can be combined with a number of additional high-performance catalog components from Hittite Microwave to implement an RWR capable of measuring signals from 2 to 20 GHz. The simplified block diagram of Fig. 8 shows two amplitude measurement channels which allow direction finding by comparing the signal amplitude of the adjacent antennas. One of the amplitude channels is selected via the HMC547LP3E single-pole, double-throw (SPDT) switch and feeds the RWR's instantaneous-frequency-measurement (IFM) circuit, thus performing a frequency measurement on an antenna pair. The HMC613LC4B SDLVAs provide the logarithmic video voltage signals which are usually digitized with a series of comparator circuits, prior to further processing. To meet military/high-reliability or ruggedized system requirements, the RWR function may be implemented with hermetically sealed, connectorized modules (labeled in red) which are available as stock items.

The SDLVA models HMC613LC4B and HMC-C052 combine wide input bandwidths, wide dynamic range, and fast rise/fall times with extremely compact packaging for system-level designers seeking alternatives to traditional microwave-integrated-circuits (MIC) hybrid and discrete-based SDLVAs. The HMC613LC4B and HMC-C052 facilitate accurate logarithmic power measurement of RF signals in the 0.1-to-20-GHz and 1-to-20-GHz frequency ranges, respectively, in commercial, military, and space applications, especially where DC power is a constraining factor. These SDLVAs are also ideal for a myriad of applications including RWRs, DF receivers, IFM receivers, EW and ECM systems, phased-array antennas, radar altimeters, digital frequency discriminator circuits, and RF test and measurement equipment.

In addition to these new SDLVA products, Hittite Microwave continues to expand its product portfolio and designers can now choose from more than 700 standard products spanning the frequency range from DC to 110 GHz. The portfolio includes 18 product lines: amplifiers, attenuators, data converters, frequency dividers and detectors, frequency multipliers, high-speed logic, interface ICs, modulators and demodulators, mixers and converters, oscillators, passive devices, phase shifters, phase-locked loops (PLLs), power detectors, sensors, switches, frequency synthesizers, and variable-gain amplifiers (VGAs). Data sheets and detailed product information for all Hittite products are available on-line at the Hittite Microwave Corp. website at www.hittite.com.

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