

# Analog Devices Welcomes Hittite Microwave Corporation

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## SUCCESSIVE DETECTION LOG VIDEO AMPLIFIER (SDLVA) WITH LIMITED RF OUTPUT, 1 - 26 GHz

### Typical Applications

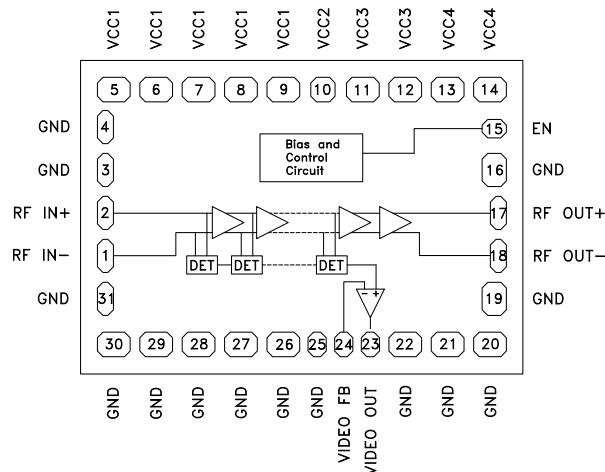
The HMC813 is ideal for:

- EW, ELINT & IFM Receivers
- DF Radar Systems
- ECM Systems
- Broadband Test & Measurement
- Power Measurement & Control Circuits
- Military & Space Applications

### Features

- 1 to 26 GHz Operation
- High Logging Range: 55 dB
- Frequency Flatness:  $\pm 1.5$  dB
- Saturated Output Power: -7 dBm
- Fast Rise/Fall Times: 4/10 ns
- Single Positive Supply: +3.3V
- ESD Sensitivity (HBM): Class 1A
- 55 to +85° C Operating Temperature

### Functional Diagram



### General Description

The HMC813 is a Successive Detection Log Video Amplifier (SDLVA) With Limited RF which operates from 1 to 26 GHz. The HMC813 provides a logging range of 55 dB. This device offers typical fast rise/fall times of 4/10 ns. The HMC813 log video output slope is typically 14.5 mV/dB. Maximum recovery times are less than 20 ns. Ideal for high speed channelized receiver applications, the HMC813 operates from a single +3.3 V supply, and consumes only 150 mA. All data shown herein is measured with the chip in a 50 Ohm environment and contacted with RF probes.

### Electrical Specifications, $T_A = +25^\circ\text{C}$ , $V_{cc1} = V_{cc2} = V_{cc3} = V_{cc4} = 3.3\text{V}$ [1]

| Parameter                            | Conditions                   | Typ.      | Units |
|--------------------------------------|------------------------------|-----------|-------|
| Input Frequency Range <sup>[2]</sup> |                              | 1 - 26    | GHz   |
| Frequency Flatness (Video out)       | Pin= -25 dBm                 | $\pm 1.5$ | dB    |
| Log Linearity                        | Pin= -40 dBm to +0 dBm       | $\pm 1$   | dB    |
| Log Linearity over Temperature       | -55 to +85° C, Pin= -20 dBm  | $\pm 0.5$ | dB    |
| Minimum Logging Range                | to $\pm 3$ dB error @ 18 GHz | -53       | dBm   |
| Maximum Logging Range                | to $\pm 3$ dB error @ 18 GHz | 6         | dBm   |
| Saturated Output Power, Psat         |                              | -7        | dBm   |
| Saturated Output Power Flatness      |                              | $\pm 2.5$ | dB    |
| RF Input Return Loss                 |                              | 7         | dB    |
| RF Output Return Loss                |                              | 13        | dB    |
| Log Video Minimum Output Voltage     |                              | 0.875     | V     |
| Log Video Maximum Output Voltage     |                              | 1.65      | V     |
| Log Video Output Rise Time           | Pin = 0 dBm, 10% to 90%      | 4         | ns    |
| Log Video Output Fall Time           | Pin = 0 dBm, 90% to 10%      | 10        | ns    |

[1] Electrical specs and performance plots are given for single-ended operation.

[2] Video output load should be 1K Ohm or higher.



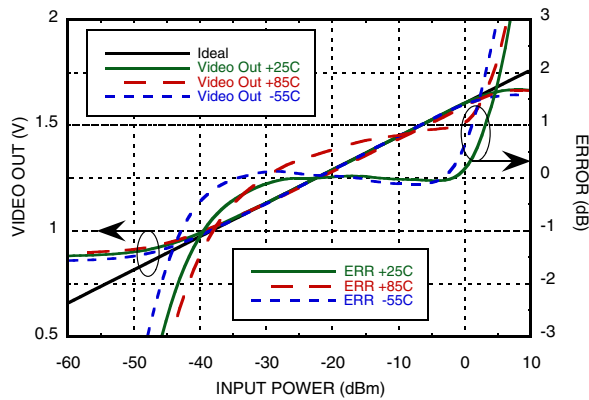
**SUCCESSIVE DETECTION LOG VIDEO AMPLIFIER (SDLVA)  
WITH LIMITED RF OUTPUT, 1 - 26 GHz**

**Electrical Specifications, (continued) [1]**

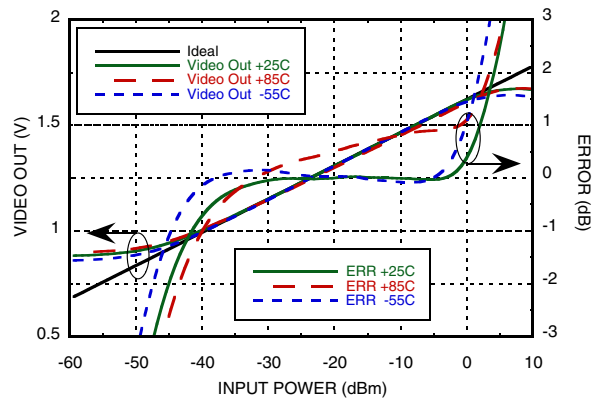
| Parameter                                         | Conditions       | Typ. | Units                                 |
|---------------------------------------------------|------------------|------|---------------------------------------|
| Log Video Recovery Time                           | -50 dBm to 0 dBm | 20   | ns                                    |
| Log Video Output Slope                            |                  | 14.5 | mV/dB                                 |
| Log Video Output Slope Variation over Temperature | @ 10 GHz         | 3    | $\mu\text{V}/\text{dB}^\circ\text{C}$ |
| Log Video Propagation Delay                       |                  | 15   | ns                                    |
| Supply Current (I <sub>dc</sub> )                 |                  | 150  | mA                                    |

[1] Electrical specs and performance plots are given for single-ended operation

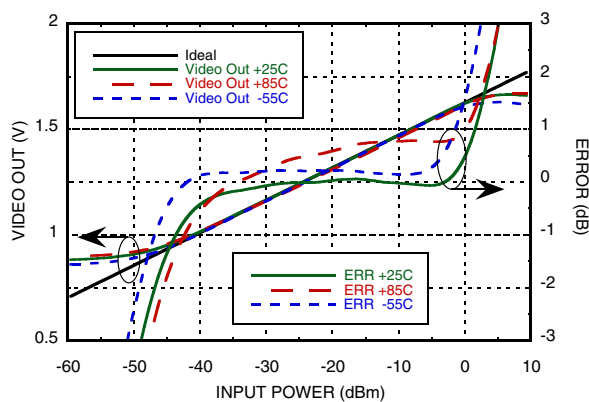
**VIDEO OUT & Error vs. Input Power, Fin = 1 GHz [1]**



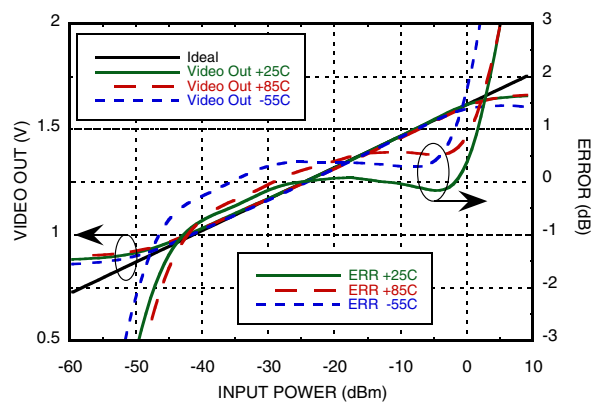
**VIDEO OUT & Error vs. Input Power, Fin = 2 GHz [1]**



**VIDEO OUT & Error vs. Input Power, Fin = 6 GHz [1]**



**VIDEO OUT & Error vs. Input Power, Fin = 10 GHz [1]**



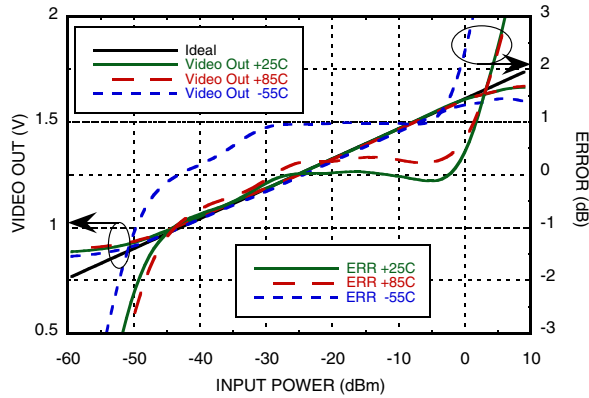
[1] Electrical specs and performance plots are given for single-ended operation



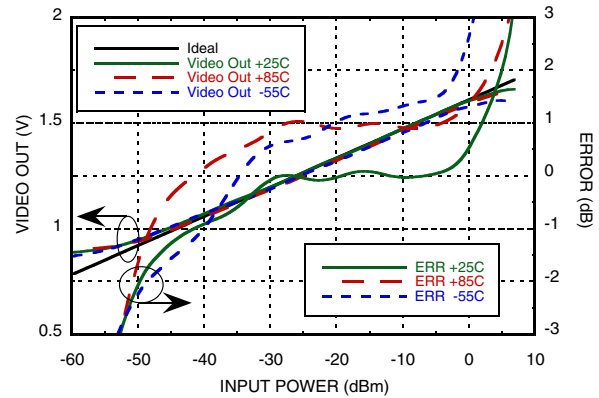
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POWER DETECTORS - CHIP

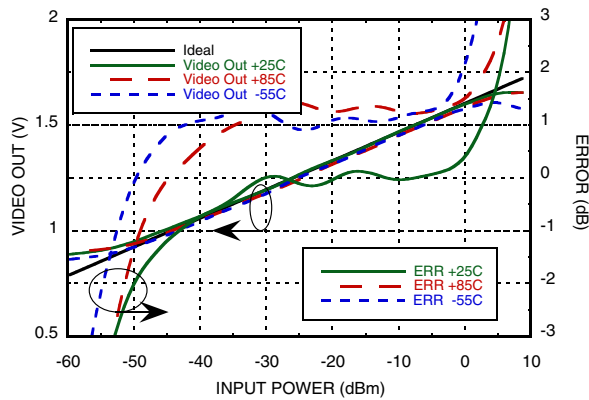
**VIDEO OUT & Error vs. Input Power,  $F_{in} = 14$  GHz <sup>[1]</sup>**



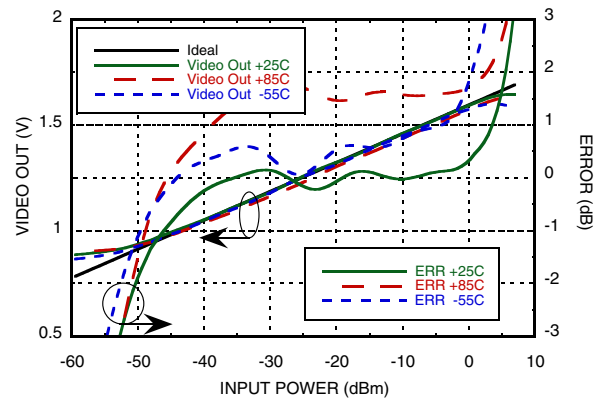
**VIDEO OUT & Error vs. Input Power,  $F_{in} = 18$  GHz <sup>[1]</sup>**



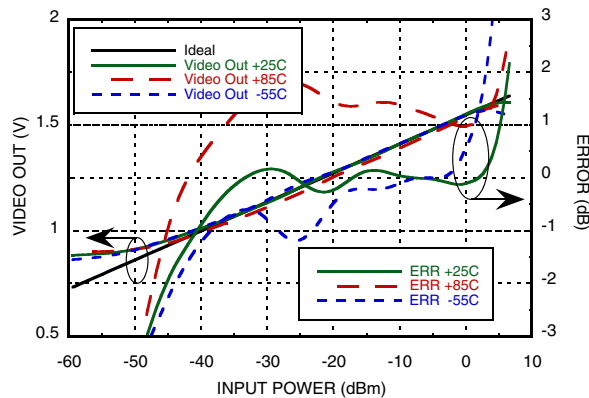
**VIDEO OUT vs. Error vs. Input Power,  $F_{in} = 20$  GHz <sup>[1]</sup>**



**VIDEO OUT & Error vs. Input Power,  $F_{in} = 22$  GHz <sup>[1]</sup>**



**VIDEO OUT & Error vs. Input Power,  $F_{in} = 26$  GHz <sup>[1]</sup>**

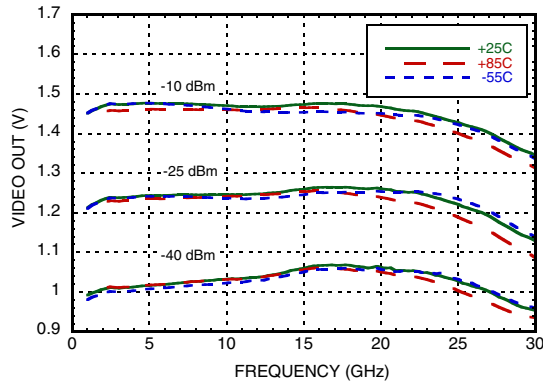


[1] Electrical specs and performance plots are given for single-ended operation

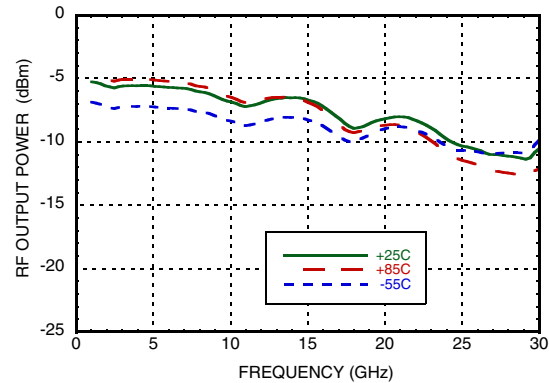


## SUCCESSIVE DETECTION LOG VIDEO AMPLIFIER (SDLVA) WITH LIMITED RF OUTPUT, 1 - 26 GHz

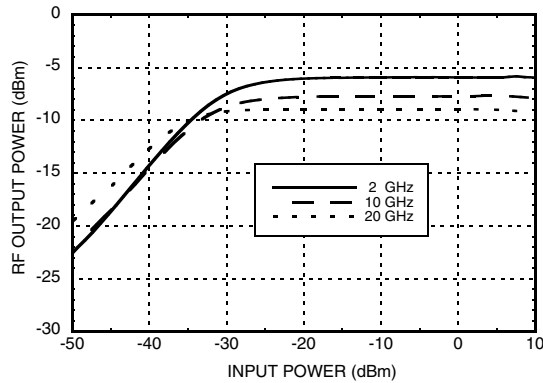
**VIDEO OUT vs. Frequency  
Over Input Power & Temperature [1]**



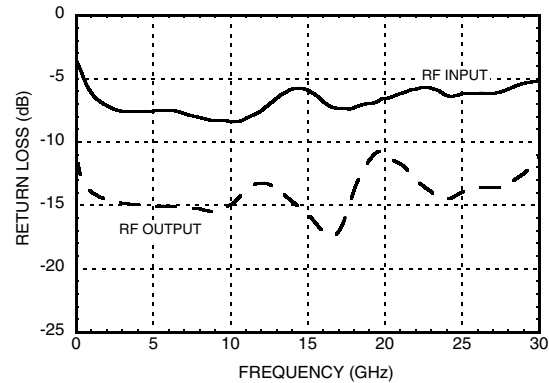
**Saturated RF Output Power vs. Frequency  
Over Temperature @ Pin = -10 dBm [1]**



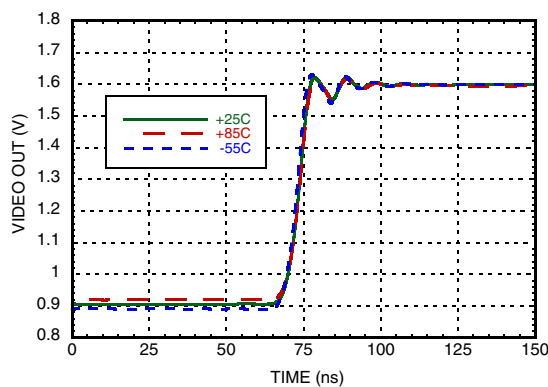
**RF Output Power vs. Input Power  
Over Frequency [1]**



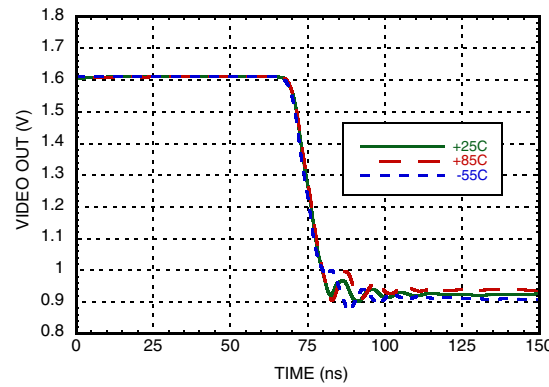
**Return Loss vs. Frequency  
Over Temperature [1]**



**Rise Time @ Fin = 10 GHz @ Pin = 0 dBm  
Over Temperature [1]**



**Fall Time @ Fin = 10 GHz @ Pin = 0 dBm  
Over Temperature [1]**



[1] Electrical specs and performance plots are given for single-ended operation



## SUCCESSIVE DETECTION LOG VIDEO AMPLIFIER (SDLVA) WITH LIMITED RF OUTPUT, 1 - 26 GHz

### Absolute Maximum Ratings

|                                                                        |                |
|------------------------------------------------------------------------|----------------|
| Vcc1, Vcc2, Vcc3, Vcc4                                                 | +3.6V          |
| ENBL                                                                   | +3.6V          |
| RF Input Power                                                         | +15 dBm        |
| Channel Temperature                                                    | 125 °C         |
| Continuous P <sub>diss</sub> (T=85°C)<br>Derate 12.63 mW/°C above 85°C | 0.51 W         |
| Thermal Resistance<br>(Channel to die bottom)                          | 79.20 °C/W     |
| Storage Temperature                                                    | -65 to +150 °C |
| Operating Temperature                                                  | -55 to +85 °C  |
| ESD Sensitivity (HBM)                                                  | Class 1A       |

### Die Packaging Information <sup>[1]</sup>

| Standard           | Alternate |
|--------------------|-----------|
| WP-3 (Waffle Pack) | [2]       |

[1] Refer to the "Packaging Information" section for die packaging dimensions.

[2] For alternate packaging information contact Hittite Microwave Corporation.

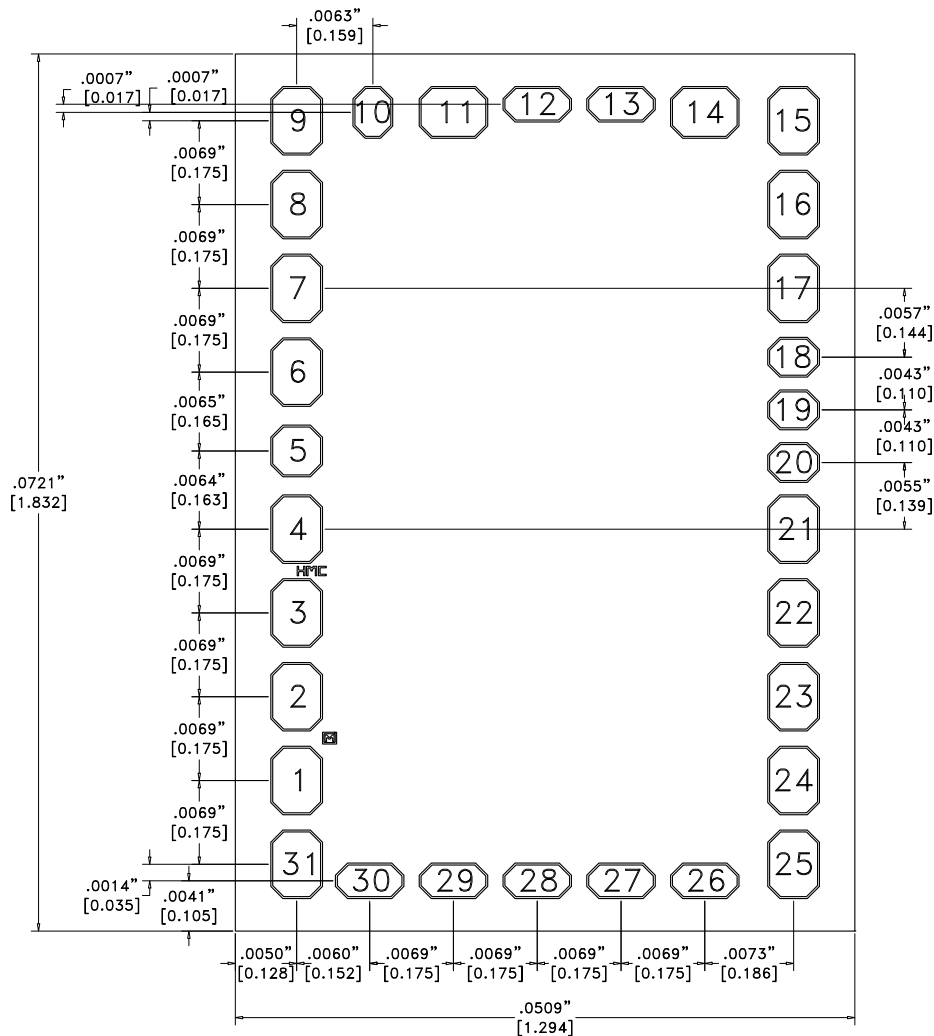
#### NOTES:

1. ALL DIMENSIONS IN INCHES [MILLIMETERS]
2. DIE THICKNESS IS 0.011 [0.28]
3. TYPICAL BOND PAD IS 0.0024 SQUARE
4. BOND PAD METALLIZATION: ALUMINUM
5. NO BACKSIDE METAL
6. NO CONNECTION REQUIRED FOR UNLABELED BOND PADS
7. OVERALL DIE SIZE IS ±.002



**ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS**

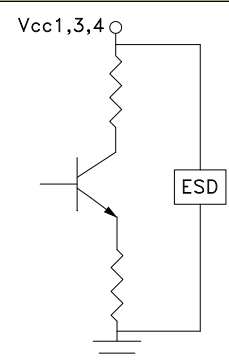
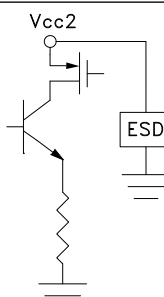
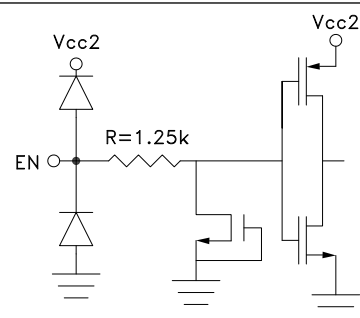

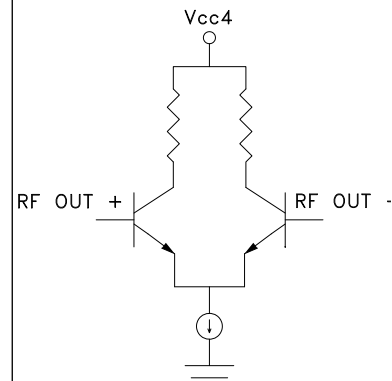
### Outline Drawing





## SUCCESSIVE DETECTION LOG VIDEO AMPLIFIER (SDLVA) WITH LIMITED RF OUTPUT, 1 - 26 GHz

### Pad Descriptions

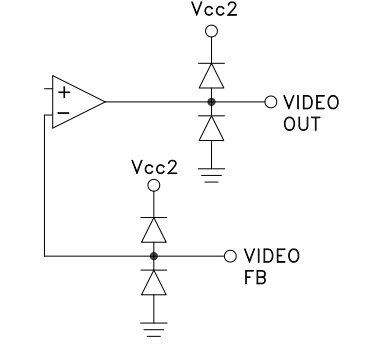
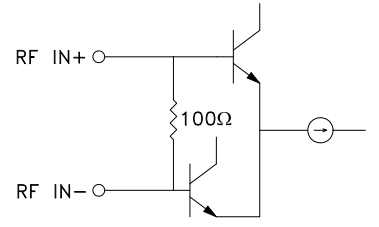
| Pad Number                                 | Function          | Description                                                                                                                                                                        | Interface Schematic                                                                   |
|--------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1 -4, 31                                   | VCC1              | Bias supply. Connect supply voltage to these pads with appropriate filtering. See application circuit.<br>To ensure proper start-up supply rise time should be faster than 100usec |    |
| 6, 7                                       | VCC3              |                                                                                                                                                                                    |                                                                                       |
| 8, 9                                       | VCC4              |                                                                                                                                                                                    |                                                                                       |
| 5                                          | VCC2              | Bias supply. Connect supply voltage to this pad with appropriate filtering. See application circuit.<br>To ensure proper start-up supply rise time should be faster than 100usec   |   |
| 10                                         | EN                | Enable pad, connected to supply voltage for normal operation. Total supply current reduced to less than 3mA when EN is set to 0V.                                                  |  |
| 11, 14 - 17, 20 - 26, 29, 30<br>Die Bottom | GND               | Die bottom must be connected to RF and DC ground.                                                                                                                                  |  |
| 12, 13                                     | RFOUT+,<br>RFOUT- | RF Output pads. AC couple RF to RF OUT+, and AC couple RF OUT- to ground via 50 Ohm for single ended operation.                                                                    |  |





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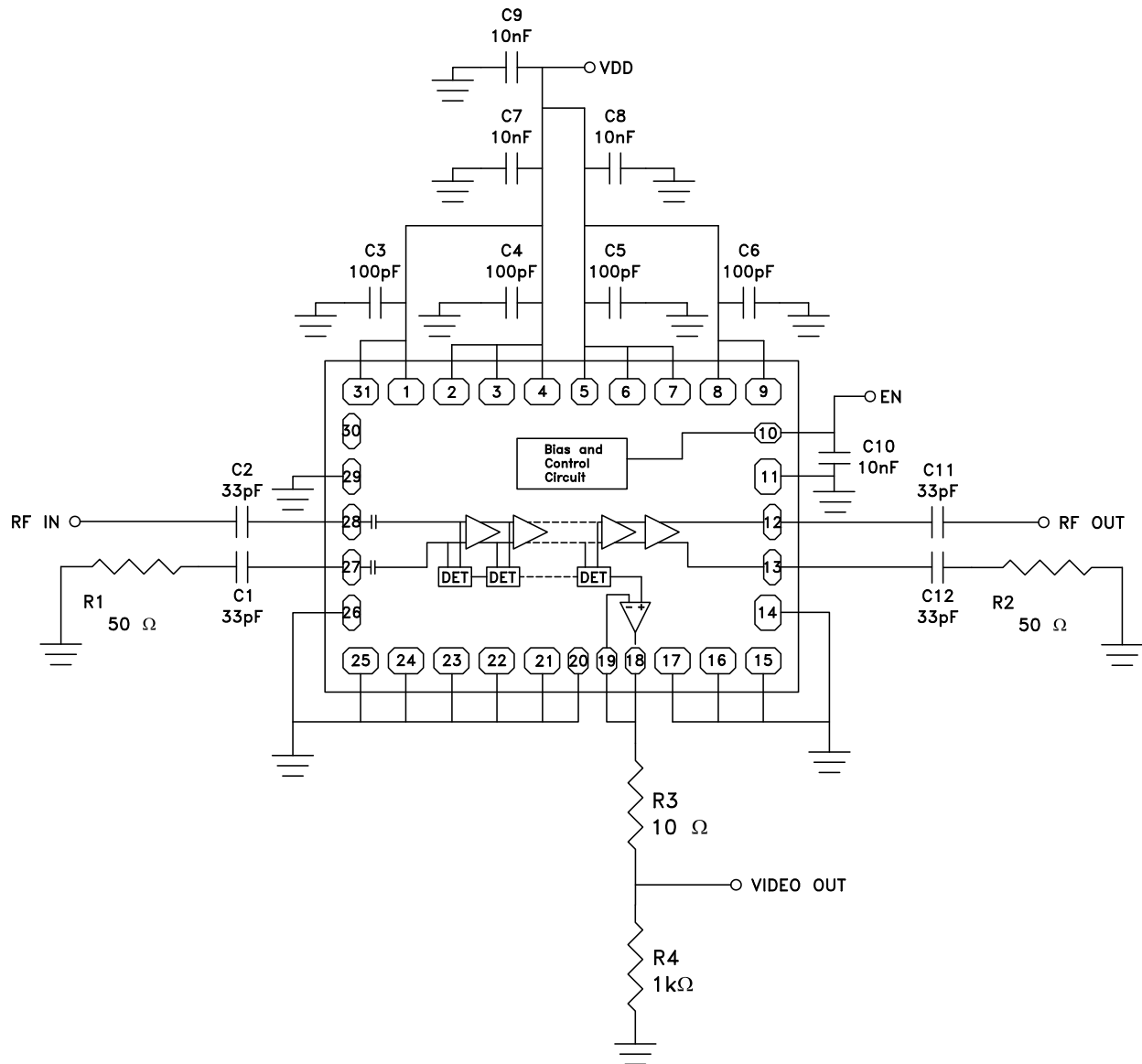
### Pad Descriptions (Continued)

| Pad Number | Function               | Description                                                                                                                                       | Interface Schematic                                                                  |
|------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 18, 19     | VIDEO FB,<br>VIDEO OUT | Video out and feedback. These pins should be shorted to each other (see application circuit). Video out load should be at least 1K Ohm or higher. |   |
| 27, 28     | RFIN-, RFIN+           | RF Input pads. Connect RF to RF IN+, and AC couple RF IN- to ground via 50 Ohm for single ended operation.                                        |  |



## SUCCESSIVE DETECTION LOG VIDEO AMPLIFIER (SDLVA) WITH LIMITED RF OUTPUT, 1 - 26 GHz

### Application Circuit

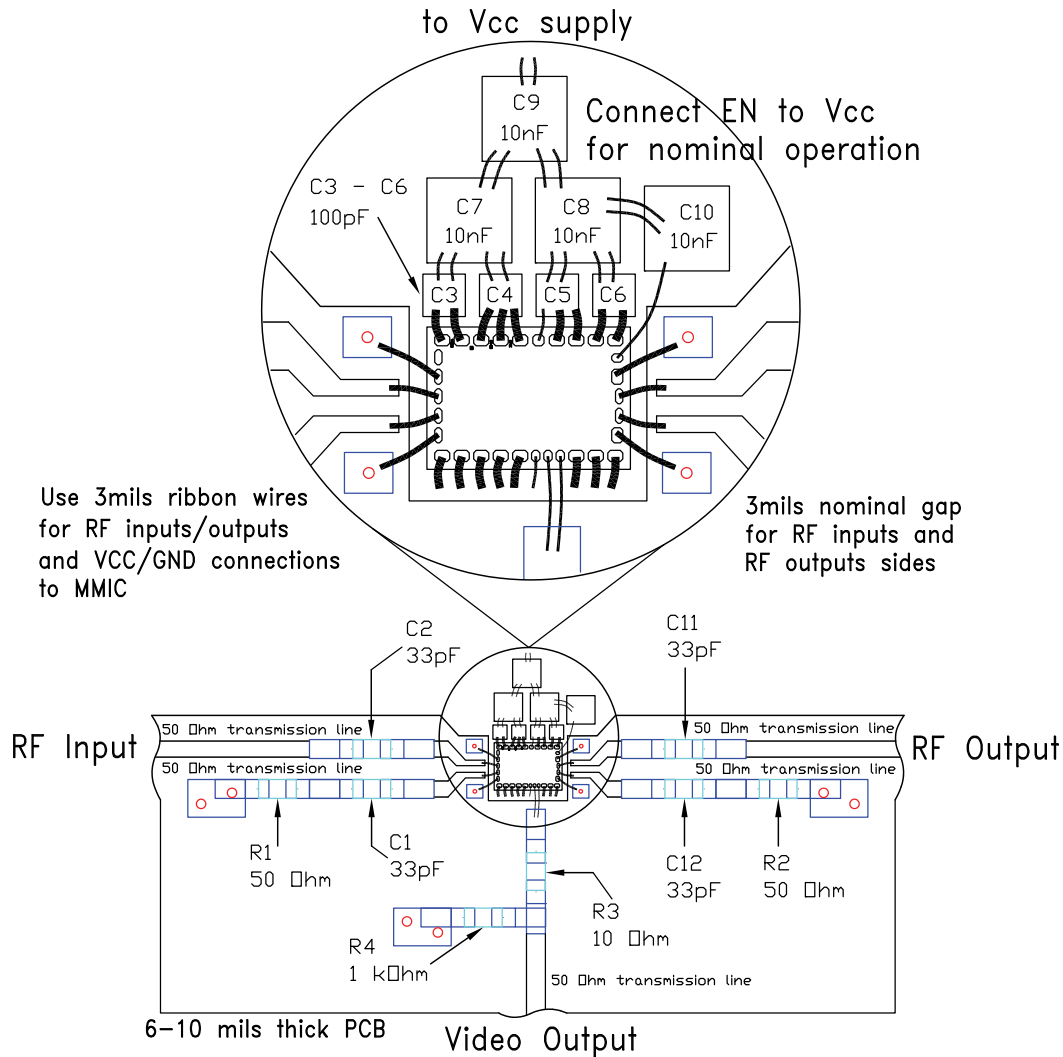


Note: Video output load should be 1K Ohm or higher.



**SUCCESSIVE DETECTION LOG VIDEO AMPLIFIER (SDLVA)  
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**Assembly Diagram**



**List of Materials for Assembly Diagram**

| Item             | Description                                       |
|------------------|---------------------------------------------------|
| C3 - C6          | 100 pF SLC Capacitor, Presidio SA1212BX101M16VHXF |
| C7 - C10         | 10 nF SLC Capacitor, Presidio MVB3030X103ZGH5N    |
| C1, C2, C11, C12 | 33 pF Capacitor, 0402 Pkg.                        |
| R1, R2           | 50 Ohm Resistor, 0402 Pkg.                        |
| R3               | 10 Ohm Resistor, 0402 Pkg.                        |
| R4               | 1k Ohm Resistor, 0402 Pkg.                        |
| U1               | HMC813 Die                                        |



**ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS**



## **SUCCESSIVE DETECTION LOG VIDEO AMPLIFIER (SDLVA) WITH LIMITED RF OUTPUT, 1 - 26 GHz**

### **Mounting & Bonding Techniques for MMICs**

The die should be attached directly to the ground plane with epoxy (see HMC general Handling, Mounting, Bonding Note).

50 Ohm Microstrip transmission lines on 0.254mm (10 mil) thick alumina thin film substrates are recommended for bringing RF to and from the chip (Figure 1).

Microstrip substrates should be placed as close to the die as possible in order to minimize bond wire length. Typical die-to-substrate spacing is 0.076mm to 0.152 mm (3 to 6 mils).

### **Handling Precautions**

*Follow these precautions to avoid permanent damage.*

**Storage:** All bare die are placed in either Waffle or Gel based ESD protective containers, and then sealed in an ESD protective bag for shipment. Once the sealed ESD protective bag has been opened, all die should be stored in a dry nitrogen environment.

**Cleanliness:** Handle the chips in a clean environment. DO NOT attempt to clean the chip using liquid cleaning systems.

**Static Sensitivity:** Follow ESD precautions to protect against ESD strikes. HMC813 is a Class-1A ESD sensitive part. Observe handling precautions.

**Transients:** Suppress instrument and bias supply transients while bias is applied. Use shielded signal and bias cables to minimize inductive pick-up.

**General Handling:** The chip may be handled by a vacuum collet or with a sharp pair of tweezers.

### **Mounting**

**Epoxy Die Attach:** Apply a minimum amount of epoxy to the mounting surface so that a thin epoxy fillet is observed around the perimeter of the chip once it is placed into position. Cure epoxy per the manufacturer's schedule.

