HEMT Bias Controller HBC-1

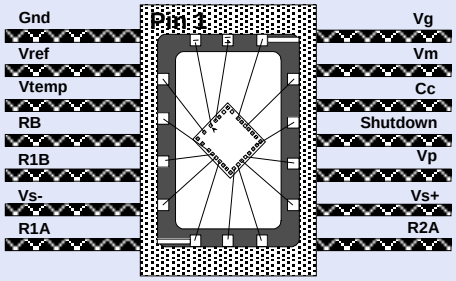
Features

- Only one external component other than sense resistor in HEMT drain
- Preset references for common HEMT operating currents
- Other operating points can be set with two external resistors
- Logic level on/off control allows HEMT shutdown
- Full military temperature range
- Temperature indicator
- Minimizes power dissipation
- Low operating current
- Tight clamping of HEMT gate voltage
- Available packaged (SOIC-14) or as dice (74 x 79 mils)

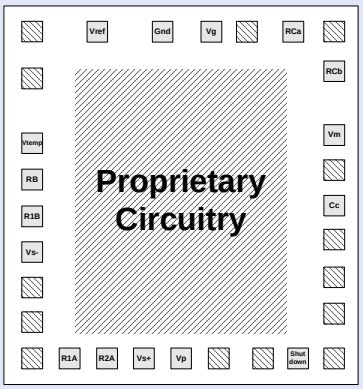
Description

The HBC-1 provides an integrated solution to the biasing of HEMT devices used in millimeter wave amplifiers. These devices require tight control of the gate voltage to prevent damage to the gate and to stabilize the RF parameters such as gain and power output. In MMICs, minimization of biasing components is critical to packaging density. The HBC-1 requires only one external component other than the current sense resistor in the HEMT drain lead.

Package Diagrams



Ceramic SOIC-14



Dice
Size: 74 x 79 x 10 mils
Bond Pads: 4 mils square

SOIC-14 PINOUT

Pin#/Name	Function
1/Gnd	Ground.
2/Vref	Voltage Reference. Under correct operation Vref = +1.22V relative to Vm.
3/Vtemp	Temperature Sense Voltage.[6,7]
4/RB	Input Bias Current Programming Pin.
5/R1B	Connect to RB for Default Input Bias Current.
6/Vs-	Sense Minus.
7/R1A	Positive Input for 108mV Sense Voltage.
8/R2A	Positive Input for 82mV Sense Voltage.
9/Vs+	Sense Voltage – User Defined.
10/Vp	V Positive – Positive Voltage Input.
11/Shutdown	Shutdown[5] – Logic Level On/Off Control. Active Low.
12/Cc	(Phase) Compensation Capacitor. 10nF from Cc to Vm required for unconditional stability.
13/Vm	V Minus – Negative Voltage Input.
14/Vg	Gate Voltage – Output to HEMT Gate.

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Specifications

Unless otherwise specified: Vp=+4.5V; Vm=-5.0V; -55C to +125C; Typical at +25C

PARAMETER		Units	MIN	TYPICAL	MAX
Supply Voltage[1]	Vp	Volts	2.5	4.5	15
	Vm		-15	-5.0	-3.0
Gate Voltage Upper Clamp	Vg max	volts	-0.02	-0.01	0.00
Gate Voltage Lower Clamp	Vg min	volts	-1.05	-1.00	-0.91
Positive Supply Current	I_{Vp}	ma	0.4	0.55	0.7
Negative Supply Current[2]	I_{Vm}	ma	1.5	2.0	2.6
Sense Voltage (V_{s+} - V_{s-})	Vp = R1A RB = R1B	mv	99	108	122
(See Table 1)	Vp = R2A RB = R1B	mv	75	82	96
Short Circuit Output Current (output grounded)	Isc	ma		9.5	13
Common Mode Input Voltage		volts	0		Vp
Input Bias Current	Vs+,R1A, R2A	µa		109	
	Vs-			.010	
Open-Loop Gain (Vs- to Vg, 100 Hz)		dB		54	
Gain-Bandwidth Product[3]		MHz		1	
Phase Margin[4]		deg		50	
CMRR (10 kHz)		dB		32	
PSRR (10 kHz)	Vp	dB		59	
	Vm			59	
Shutdown Voltage[5]	Threshold	volts		1.5	
	Hysteresis	MV		500	
Shutdown Response Time (on or off)		µs		20	
Temperature Sensor[6,7]	Slope	mV/°C		-2.84	
	Offset	mV @ 25°C	-850	-700 (See Notes 6&7)	-575

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Notes:

[1]Positive supply voltage to the HEMT must not be present unless the HBC-1 negative supply voltage is at or more negative than three volts. Failure to observe this precaution will prevent the HBC-1 from being able to maintain a negative gate voltage to the HEMT, and damage to or destruction of the HEMT may result. The HBC-1 itself is fully functional at zero positive supply voltage.

[2]Values given are for normal operation. For output shorted to ground, max is 5 ma.

[3]Capacitance of 0 to 200 pF at gate voltage output Vg.

[4]The HBC-1 is noninverting from Vs- to Vg. Phase margin is 180 degrees minus input to output phase lag at unity gain crossover.

[5]The shutdown pin may be left floating if unused. It is internally pulled up. Allowable voltage input is -0.3 V to Vp + 0.3 V. Max input current is 1 mA.

[6]The temperature sense is not intended as a precision device but to allow assessment of temperature rise of the part as installed. The slope is quite linear and predictable, but the offset should be characterized for each device at a known temperature. The sensor voltage is measured with respect to ground. The offset may range from -0.575 to -.850 Volts device to device. The slope of -2.84 mV/°C is typically linear within +3.3 degrees C from +25 to -55 degrees C and -3.2 degrees C from +25 to +125 degrees C. The slope of the Temperature Versus Voltage does become slightly steeper at -55 degrees C and slightly less steep at +125 degrees C. Typically when one thinks they are at -55 degrees C from assuming perfect linearity, they are usually actually at -51.7 degrees C, and when one thinks they are at 125 degrees C, they are actually at 128.2 degrees C. By applying an intentional 1.65 degrees offset error at +25 degrees C (that is, add a +1.65 degree C offset to +25 C in the formula), the linearity can be improved to +/-1.65 degrees C.

[7]Temperature Sense Voltage is produced by sinking a temperature-varying current through a 7.5kOhm +/-20% resistor to ground. Loading the temperature sense pin can vary the temperature sense voltage. The typical room-temperature current used to establish the temperature voltage is, therefore, 700mV/7.5kOhm ~ 10uA. The load should sink considerably less than 10uA.

Specifications subject to change without notice.

Absolute Maximum Limits

Supply Voltages……	$-0.3V \leq Vp \leq +20V$ $-20V \leq Vm \leq +0.3V$ $-0.3V \leq (Vp - Vm) \leq +20V$
Input Voltage(Vs+ or Vs-)……	$Vm - 0.3V \leq Vs \leq Vp + 0.3V$
Differential Input Voltage……..	$\lvert Vs+ - Vs- \rvert \leq 7V$
Voltage Applied to R1A or R2A……	$Vm - 0.3V \leq VA \leq Vp + 0.3V$, $VA \leq Vs- + 7V$
Voltage Applied to RB……	$Vm - 0.3V \leq VB \leq Vs- + 6V$
Output Short Circuit Duration……	Unlimited to ground

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Typical Application

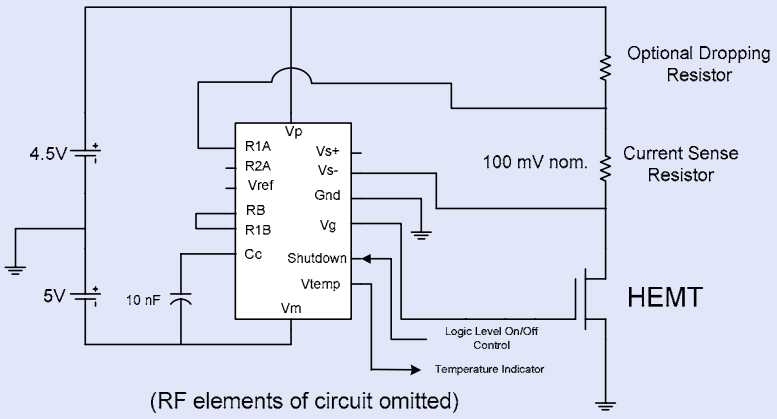

Table 1 - Typical Operating Configuration

HEMT Operating Current	Sense Resistor	HBC-1 Resistor Pair
114 ma	0.953 ohm	R1A, R1B
275 ma	0.300 ohm	R2A, R1B
413 ma	0.200 ohm	R2A, R1B
826 ma	2 - 0.200 ohm in parallel	R2A, R1B

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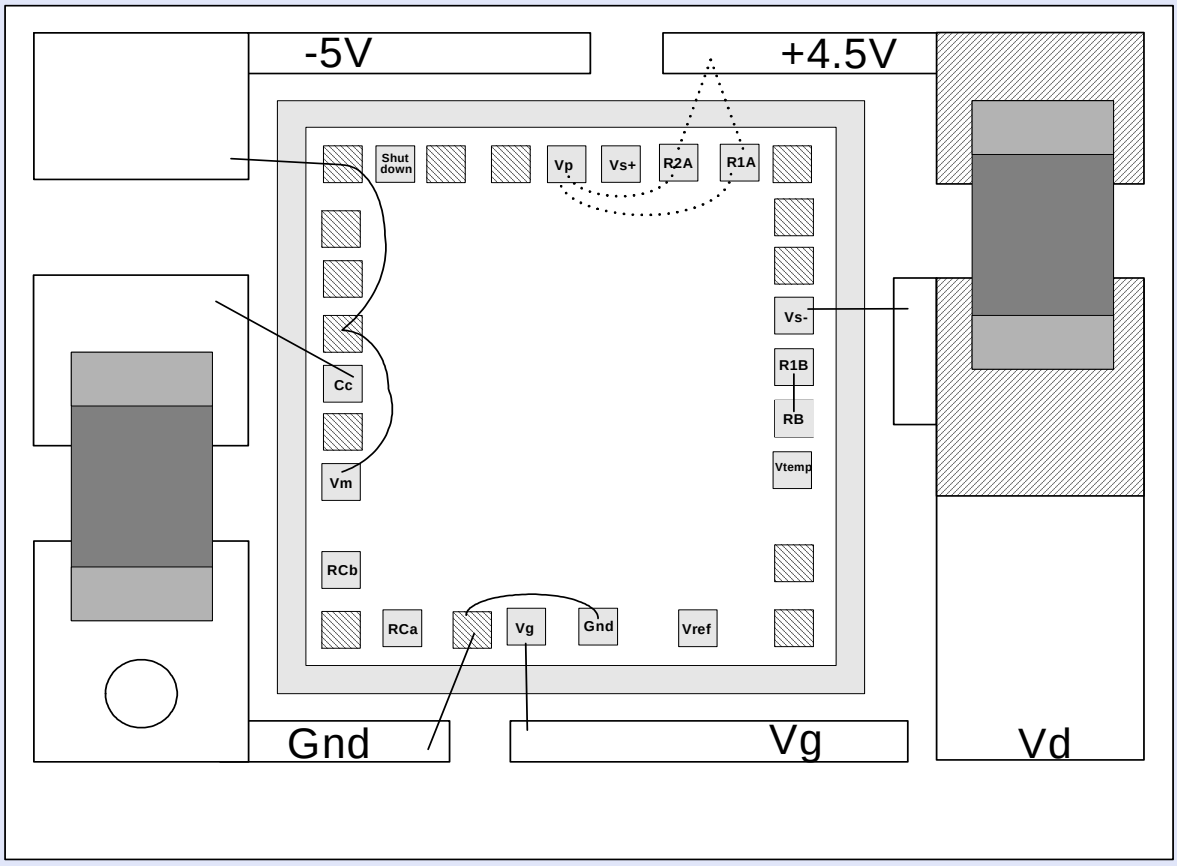
Typical Layout Using Dice



Notes:

[1]The hash area represents pre-tinned copper surface. All other surfaces are to be gold plated.

[2]Dashed wire bonds indicate options.

[3]Substrate is connected to Vm.

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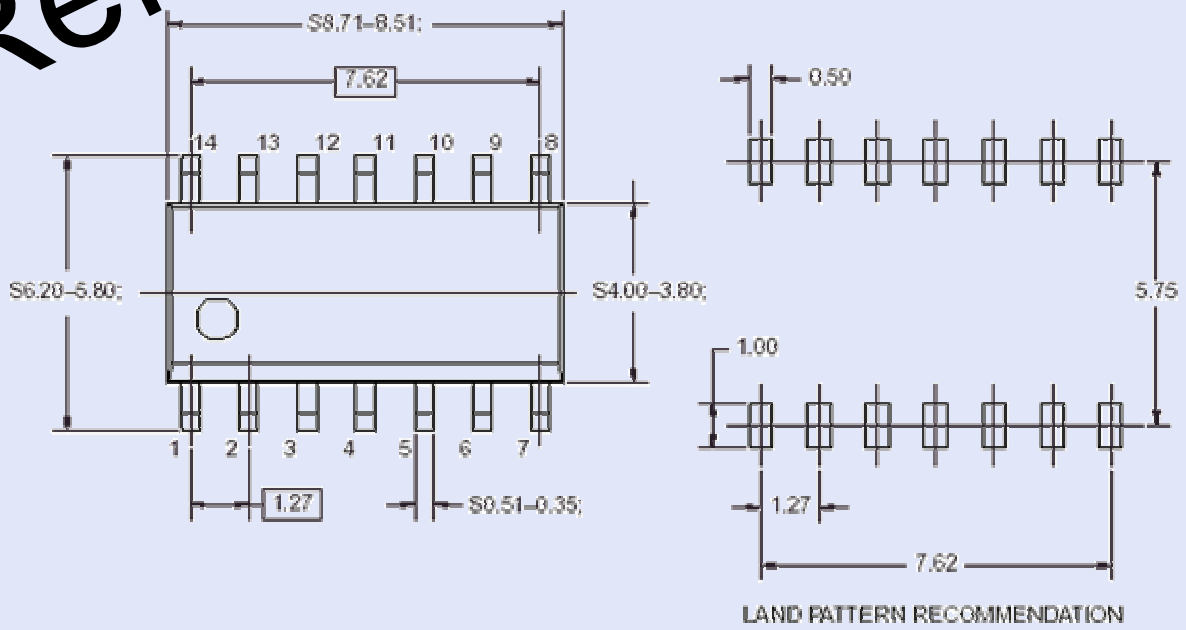
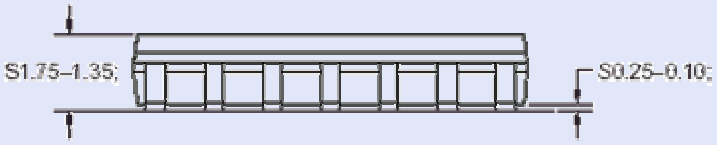
Outline Dimensions





Notes:

[1]All dimensions are in millimeters.

[2]Contact PIVC, L.L.C. for actual dimensions.

[3]Subject to change without notice.

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