

**NOT RECOMMENDED FOR NEW DESIGNS**  
See HI3086

October 1998

## 6-Bit, 140 MSPS, Flash A/D Converter

### Features

- Ultra-High Speed Operation with Maximum Conversion Rate..... 140 MSPS
- Low Input Capacitance .....7pF
- Wide Analog Input Bandwidth (Min) ..... 200MHz
- Low Power Consumption .....225mW
- Low Error Rate

### Applications

- RGB Graphics Processing
- Digital Data Storage Read Channels
- Digital Communications

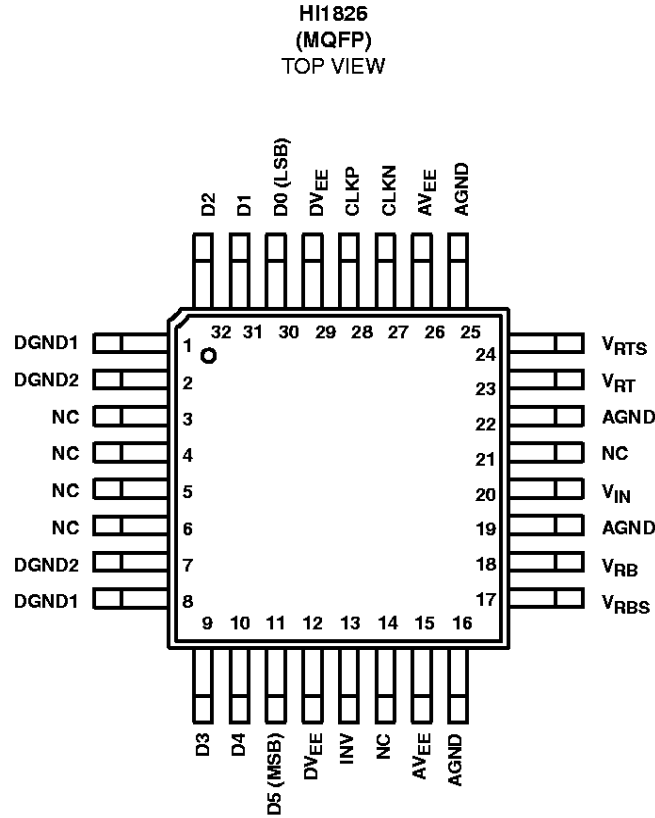
### Description

HI1826 is a 6-bit, 140 MSPS, flash A/D converter IC capable of digitizing analog signals at the maximum rate of 140 MSPS. The digital input/output level is compatible with the ECL 100K/10KH/10K.

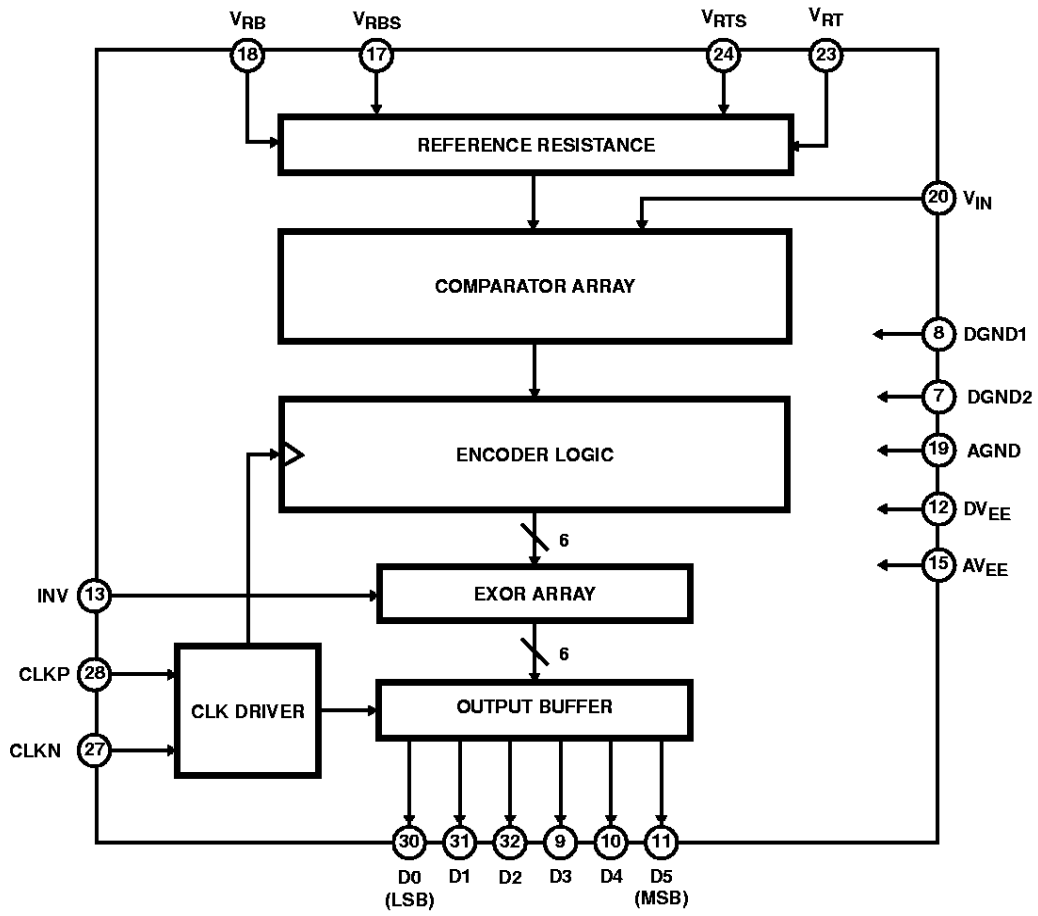
### Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
HI1826JCQ	-20 to 75	32 Ld MQFP	Q32.7x7-S

### Pinout



**Block Diagram**



**Pin Descriptions**

PIN NO.	SYMBOL	I/O	TYPICAL VOLTAGE LEVEL	EQUIVALENT CIRCUIT	DESCRIPTION
16, 19, 22, 25	AGND	-	0V		Analog GND. Used as GND for input buffers and latches of comparators. Separated from DGND1 and DGND2.
15, 26	AV <sub>EE</sub>	-	-5.2V		Analog V <sub>EE</sub> . Typical voltage is -5.2V. Connected internally with DV <sub>EE</sub> . (Resistance is 4 to 6Ω.) Connect to AGND through a ceramic chip capacitor of 0.1μF or more just near the pin.
28	CLKP	I	ECL		CLK Input.
27	CLKN				CLK Complementary Input. When left open, voltage goes to ECL threshold potential (-1.3V). Although only CLKP input can be used for operation with CLKN input open, complementary input is recommended in order to attain high speed and stable operation.
1, 8	DGND1	-	0V		Digital GND for Internal Circuits.
2, 7	DGND2	-	0V		Digital GND for Output Transistors.
12, 29	DV <sub>EE</sub>	-	-5.2V		Digital V <sub>EE</sub> . Connected internally with AV <sub>EE</sub> . (Resistance is 4 to 6Ω.) Connect to DGND through a ceramic chip capacitor of 0.1μF or more just near the pin.
30	D0	O	ECL		LSB of Data Output. External pull-down resistor is required.
31	D1				Data Output. External pull-down resistors are required.
32	D2				
9	D3				
10	D4				
11	D5				MSB of Data Output. External pull-down resistor is required.

Pin Descriptions (Continued)

PIN NO.	SYMBOL	I/O	TYPICAL VOLTAGE LEVEL	EQUIVALENT CIRCUIT	DESCRIPTION
13	INV	I	ECL		Output polarity inversion input for D0 (LSB) to D5 (MSB). (Refer to the output code table.) When left open, Low levels maintained.
20	V <sub>IN</sub>	I	V <sub>RT</sub> to V <sub>RB</sub>		Analog Input.
18	V <sub>RB</sub>	I	-2V		Reference Voltage (Bottom) Force; typical voltage is -2V. Connect to AGND through a ceramic chip capacitor of 0.1μF or more and a tantalum capacitor of 10μF or more just near the pin.
17	V <sub>RBS</sub>		Reference Voltage (Bottom) Sense.		
23	V <sub>RT</sub>	I	0V		Reference Voltage (Top) Force; typical voltage is 0V. When applying a voltage other than AGND to this pin, connect to AGND through a ceramic chip capacitor of 0.1μF for more and a tantalum capacitor of 10μF or more just near the pin.
24	V <sub>RTS</sub>		Reference Voltage (Top) Sense.		
3, 4 5, 6 14, 21	NC	-	-		Not Connected. Although not connected in the IC, it is recommended that these pins should be connected to AGND or DGND on printed circuit board.

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## Absolute Maximum Ratings $T_A = 25^\circ\text{C}$

Supply Voltage ( $V_{EE}$ )	-7V to 0.5V
Reference Voltage ( $V_{RT}, V_{RB}$ )	-1.5V to 0.5V
$V_{RT} - V_{RB}$	2.5V
Analog Input Voltage ( $V_{IN}$ )	-2.7V to 0.5V
Digital Input Voltage (CLKP, CLKN, INV)	-4V to 0.5V
CLKP - CLKN	2.7V
Digital Output Current ( $I_{D0}$ to $I_{D5}$ )	-30mA to 0mA

## Thermal Information

Thermal Resistance (Typical, Note 1)	$\theta_{JA}$ ( $^\circ\text{C}/\text{W}$ )
MQFP Package	122
Maximum Junction Temperature (Plastic Package)	150 $^\circ\text{C}$
Maximum Storage Temperature Range	-65 $^\circ\text{C}$ to 150 $^\circ\text{C}$
Maximum Lead Temperature (Soldering 10s)	300 $^\circ\text{C}$ (Lead Tips Only)

## Operating Conditions

Temperature Range ( $T_A$ )	-20 $^\circ\text{C}$ to 75 $^\circ\text{C}$
Supply Voltage	
$V_{EE}, D_{VEE}$	-5.5V to -4.95V
$V_{EE}, D_{VEE}$	-0.05V to 0.05V
AGND, DGND	-0.05V to 0.05V
Reference Voltage	
$V_{RT}$	-0.1V to 0.1V
$V_{RB}$	-2.2V to -1.8V
Analog Input Voltage ( $V_{IN}$ )	$V_{RB}$ to $V_{RT}$
Clock Pulse Width	
$t_{PW1}$	3.0ns
$t_{PW0}$	3.0ns

**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### NOTE:

- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.

## Electrical Specifications $V_{DD} = +5\text{V}, V_{RB} = 1.0\text{V}, V_{RT} = 2.0\text{V}, T_A = 25^\circ\text{C}$

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Resolution	n		6	6	6	bits
<b>DC CHARACTERISTICS</b>						
Integral Linearity Error	$E_{IL}$	$f_C = 140\text{MHz}$	-0.25	-	+0.25	LSB
Differential Linearity Error	$E_{DL}$	$f_C = 140\text{MHz}$	-0.25	-	+0.25	LSB
<b>ANALOG INPUT</b>						
Analog Input Capacitance	$C_{IN}$	$V_{IN} = -1\text{V} + 0.07V_{RMS}$	-	7	18	pF
Analog Input Resistance	$R_{IN}$		300	-	-	k $\Omega$
Input Bias Current	$I_{IN}$	$V_{IN} = -1\text{V}$	-	-	400	$\mu\text{A}$
<b>REFERENCE INPUT</b>						
Reference Resistance	$R_{REF}$		-	200	-	$\Omega$
Offset Voltage $V_{RT}$	$E_{OT}$		-	-	20	mV
$V_{RB}$	$E_{OB}$		-	-	20	mV
<b>DIGITAL INPUT</b>						
Logic High Level	$V_{IH}$		-1.13	-	-0.65	V
Logic Low Level	$V_{IL}$		-2.1	-	-1.5	V
Logic High Current	$I_{IH}$	Apply -0.8V to Input	0	-	50	$\mu\text{A}$
Logic Low Current	$I_{IL}$	Apply -1.6V to Input	-50	-	50	$\mu\text{A}$
Input Capacitance			-	7		pF
<b>SWITCHING CHARACTERISTICS</b>						
Maximum Conversion Frequency	$f_C$	Error rate 1E-9 TPS (Note 1)	140	-	-	MSPS
Aperture Jitter	$t_{AJ}$		-	10	-	ps

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## Electrical Specifications $V_{DD} = +5V, V_{RB} = 1.0V, V_{RT} = 2.0V, T_A = 25^\circ C$ (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Sampling Delay	$t_{DS}$		-	1.5	-	ns
High Pulse Width of Clock	$t_{PW1}$		3.0	-	-	ns
Low Pulse Width of Clock	$t_{PW0}$		3.0	-	-	ns
<b>DIGITAL OUTPUT</b>						
Logic High Level	$V_{OH}$	$R_L = 100\Omega$ to $-2V$	-1.10	-	-0.65	V
Logic Low Level	$V_{OL}$	$R_L = 100\Omega$ to $-2V$	-2.1	-	-1.6	V
Output Delay	$t_{DO}$	$R_L = 100\Omega$ to $-2V$	3.0	3.6	4.2	ns
Output Rise Time	$t_r$	$R_L = 100\Omega$ to $-2V, 20\%$ to $80\%$	-	0.8	-	ns
Output Fall Time	$t_f$	$R_L = 100\Omega$ to $-2V, 20\%$ to $80\%$	-	1.0	-	ns
<b>DYNAMIC CHARACTERISTICS</b>						
Analog Input Bandwidth		$f_{CLK} = 140MHz, f_{IN} = 69.999MHz$	200	-	-	MHz
Error Rate		Error Amplitude $\geq 4$ LSB $-3dB f_S$	-	-	1E-09	TPS (Note 1)
S/N Ratio	SNR	$f_{CLK} = 140MHz, f_{IN} = 1MHz$	-	36	-	dB
		$f_{CLK} = 140MHz, f_{IN} = 35MHz$	-	34	-	dB
<b>POWER SUPPLY</b>						
Supply Current	$I_{EE}$	$AV_{EE} = DV_{EE} = -5.2V$	-60	-40	-25	mA
Power Consumption	$P_D$		-	225	-	mW

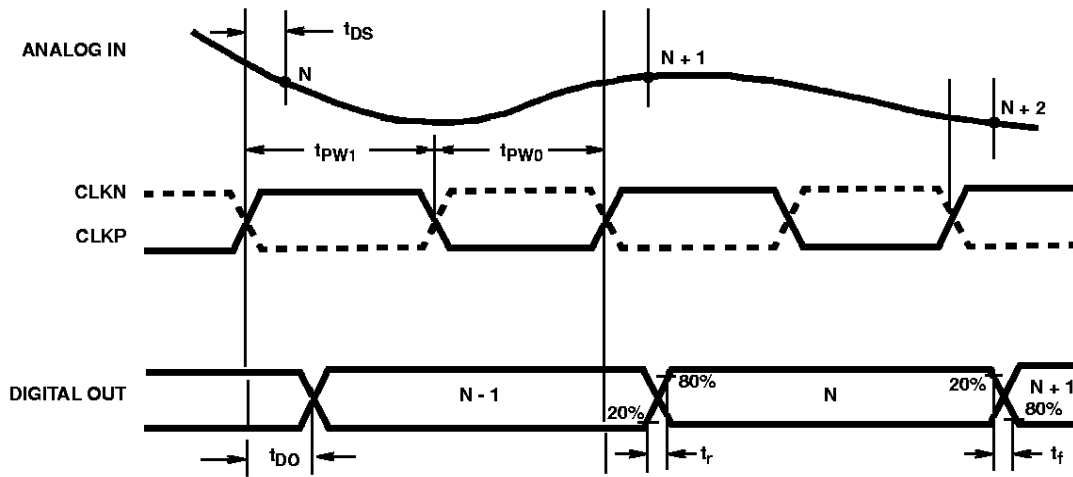
Note 1. TPS: Times Per Sample

## Output Code Table

$V_{IN}$ (NOTE)	STEP	INV: 1		INV: 0	
		D5	D0	D5	D0
0V	0	000000		111111	
	1	000001		111110	
		•		•	
		•		•	
		•		•	
-1.0V	31	011111		100000	
	32	100000		011111	
		•		•	
		•		•	
		•		•	
-2.0V	62	111110		000001	
	63	111111		000000	

NOTE:  $V_{RT} = 0V, V_{RB} = -2V$

Timing Diagram



Test Circuits

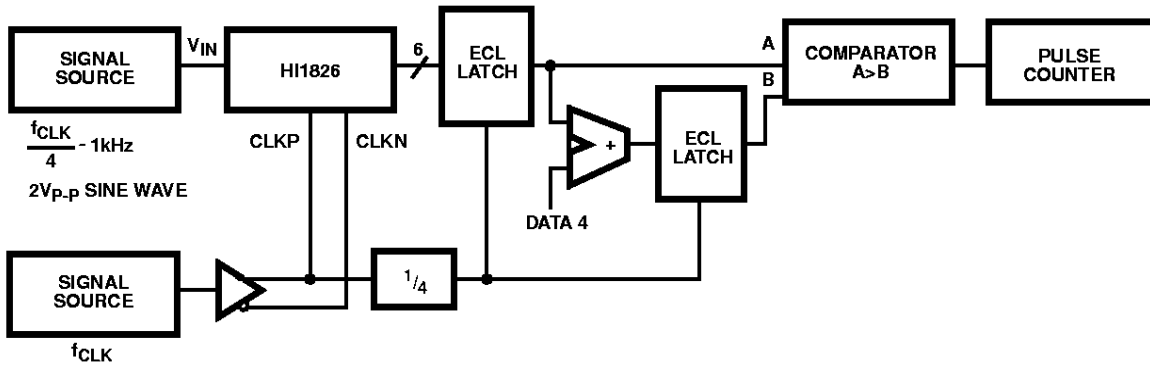


FIGURE 1. MAXIMUM CONVERSION RATE MEASUREMENT CIRCUIT

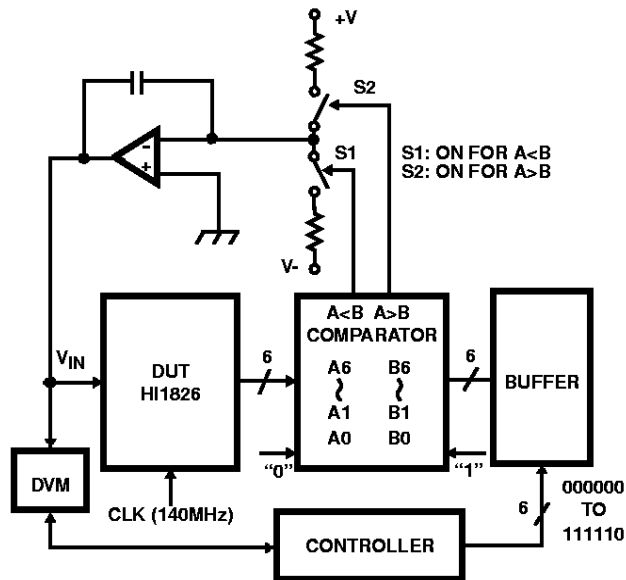


FIGURE 2. INTEGRAL LINEARITY ERROR MEASUREMENT CIRCUIT, DIFFERENTIAL LINEARITY ERROR MEASUREMENT CIRCUIT

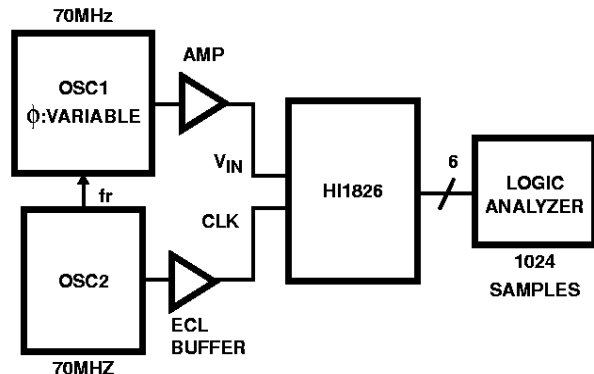


FIGURE 3. SAMPLING DELAY MEASUREMENT CIRCUIT APERTURE JITTER MEASUREMENT CIRCUIT

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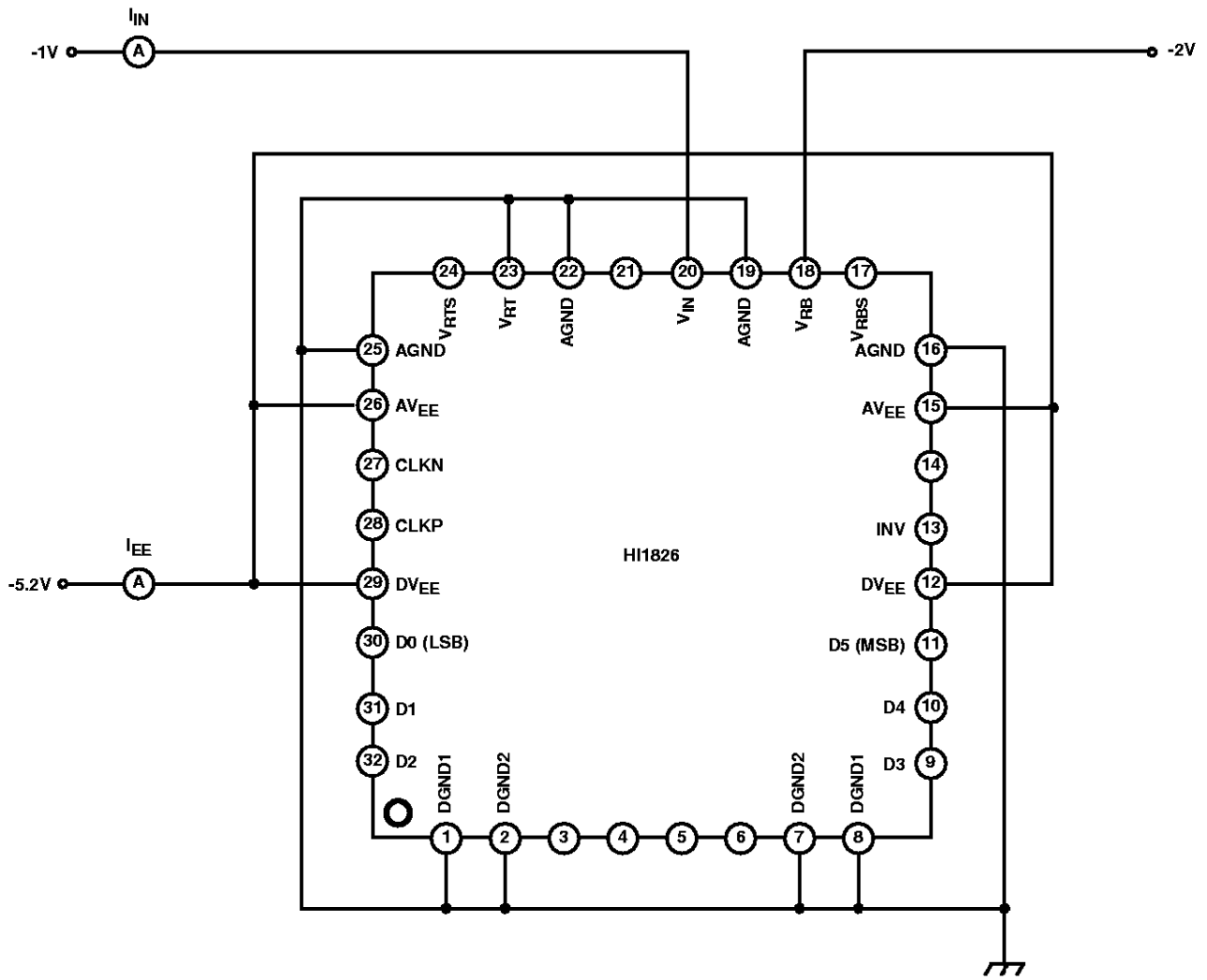


FIGURE 4. SUPPLY CURRENT MEASUREMENT CIRCUIT ANALOG INPUT BIAS CURRENT MEASUREMENT CIRCUIT