

April 1995

## 8-Bit 250 MSPS Flash A/D Converter

### Features

- Differential Linearity Error . . . . .  $\pm 0.5$  LSB or Less
- Integral Linearity Error . . . . .  $\pm 0.5$  LSB or Less
- Built-In Integral Linearity Compensation Circuit
- Ultra High Speed Operation with Maximum Conversion Rate of 250 MSPS (Min)
- Low Input Capacitance . . . . . 18pF (Typ)
- Wide Analog Input Bandwidth . . . . . 200MHz (Min. for Full-Scale Input)
- Single Power Supply . . . . . -5.2V
- Low Power Consumption . . . . . 1400mW (Typ)
- Low Error Rate
- Capable of Driving 50 $\Omega$  Loads

### Applications

- Spectrum Analyzers
- Radar Systems
- Direct RF Down-Conversion
- Video Digitizing
- Communication Systems
- Digital Oscilloscopes

### Description

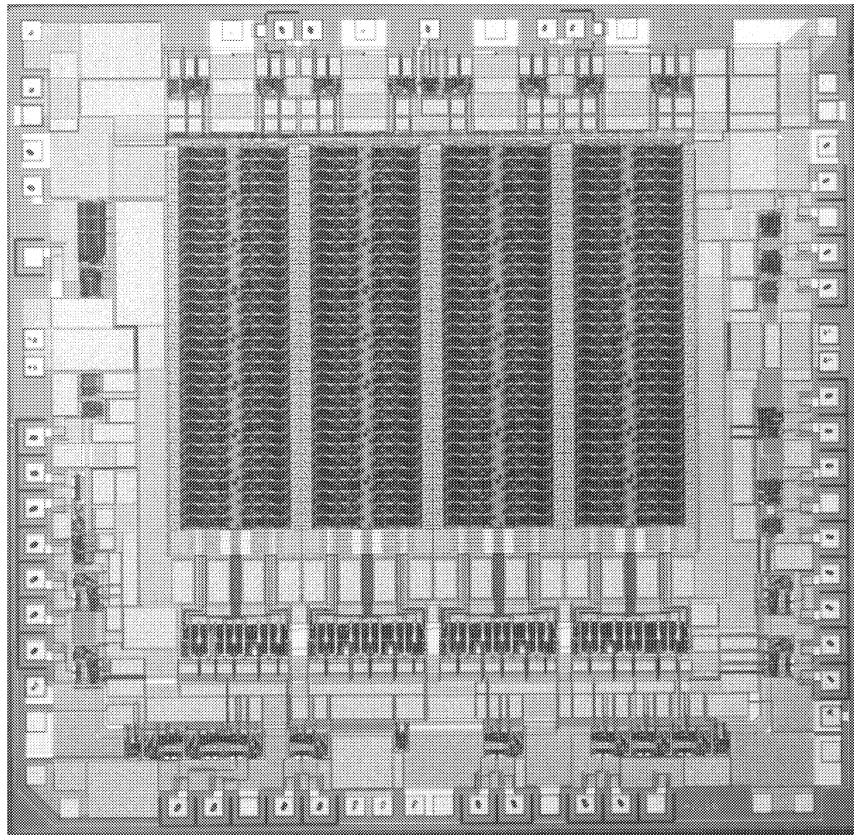
This is a specification that outlines the mechanical and electrical characteristics for the HI1166Y, 8-bit Flash A/D converter IC, in chip (die) form.

### Ordering Information

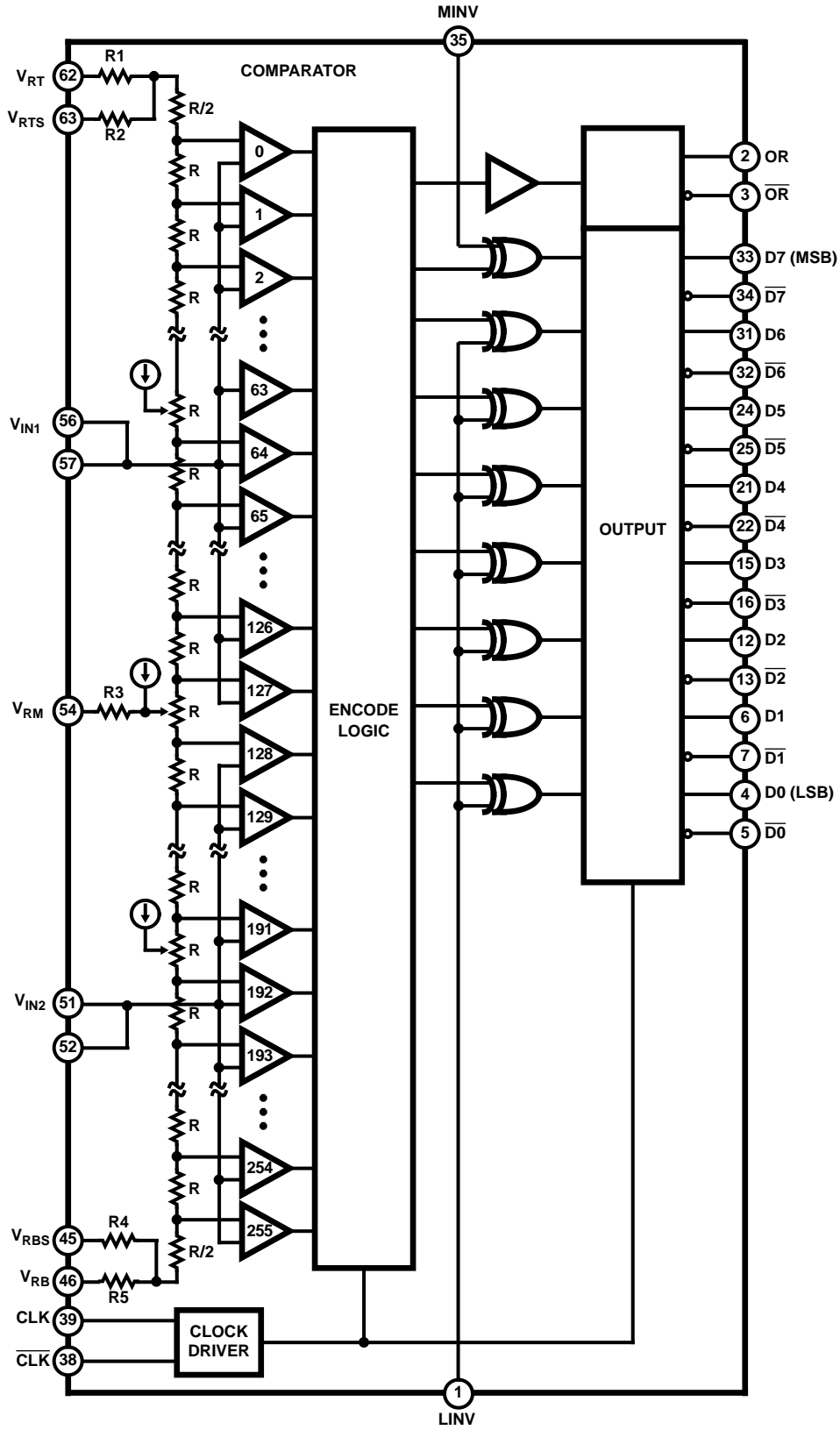
PART NUMBER	TEMPERATURE	PACKAGE
HI1166Y	+25°C	Die

• All performance parameters are for packaged devices when supplied by Harris.

### Die Metallization Layer



Functional Block Diagram



## Specifications HI1166Y

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

Supply Voltage ( $AV_{EE}$ , $DV_{EE}$ )	-7V to +0.5V	$V_{RM}$ Pin Input Current ( $I_{VRM}$ )	-3mA to +3mA
Analog Input Voltage ( $V_{IN}$ )	-2.7V to +0.5V	Digital Output Current	( $ID0$ to $ID7$ , $IOR$ , $\overline{ID0}$ to $\overline{ID7}$ , $\overline{IOR}$ )
Reference Input Voltage		Storage Temperature Range ( $T_{STG}$ )	-65°C to +150°C
$V_{RT}$ , $V_{RB}$ , $V_{RM}$	-2.7V to +0.5V		
$ V_{RT} - V_{RB} $	2.5V		
Digital Input Voltage			
$\overline{MINV}$ , $\overline{LINV}$ , $\overline{CLK}$ , $\overline{CLK}$	-4V to +0.5V		
$ \overline{CLK} - \overline{CLK} $	2.7V		

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.

### Operating Conditions

Supply Voltage		Reference Input Voltage	
$AV_{EE}$ , $DV_{EE}$	-5.5V to -4.95V	$V_{RT}$	-0.1V to 0.1V
$AV_{EE} - DV_{EE}$	-0.05V to 0.05V	$V_{RB}$	-2.2V to -1.8V
AGND - DGND	-0.05V to 0.05V	Analog Input Voltage, $V_{IN}$	$V_{RB}$ to $V_{RT}$

Electrical Specifications  $T_A = +25^\circ\text{C}$ ,  $DV_{EE}$ ,  $AV_{EE} = -5.2\text{V}$ ,  $V_{RT} = 0\text{V}$ ,  $V_{RB} = -2\text{V}$

PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT
Differential Linearity Error (DNL) (00000000 to 11111111)		-0.7	0.7	LSB
Integral Linearity Error (INL) (00000000 to 11111111)		-0.7	0.7	LSB
Resolution		8	-	Bits
Input Bias Current, $I_{IN}$	$V_{IN} = -1.0\text{V}$	35	400	$\mu\text{A}$
Analog Input Resistance, $R_{IN}$	$V_{IN} = -1.0\text{V}$	55	350	$\text{k}\Omega$
Resister-String Current, $I_{REF}$		-24	-13	$\text{mA}$
Reference Voltage, $V_{RM}$		-1.1	-0.9	V
Residual Resistance, R1		0.1	1.2	$\Omega$
Residual Resistance, R2		380	620	$\Omega$
Residual Resistance, R5		0.1	1.2	$\Omega$
Residual Resistance, R4		380	620	$\Omega$
Digital Input Current HI, $I_{IH}$	$H_i = -0.8\text{V}$	0	40	$\mu\text{A}$
Digital Input Current LO, $I_{IL}$	$L_o = -1.6\text{V}$	-30	30	$\mu\text{A}$
$\overline{CLK}$ Open Voltage, $V_{OPN}$	$\overline{CLK} = \text{Open}$	-1.4	-1.2	V
Leakage (1) D0 to D7, $V_{LEAK}$	$I = -10\mu\text{A}$	-1.0	-0.3	V
Leakage (2) D0 to D7, $V_{IN}$ , $\overline{LINV}$ , $\overline{MINV}$ , $\overline{CLK}$ , $\overline{CLK}$ , $I_{LEAK}$	$V = 0.3\text{V}$	-1.0	1.0	$\mu\text{A}$
Digital Output Voltage HI, $V_{OH}$	$620\Omega$ to $-5.2\text{V}$	-1	-0.6	V
Digital Output Voltage LO, $V_{OL}$	$620\Omega$ to $-5.2\text{V}$	-2	-1.55	V
Supply Current, $I_{EE}$		-330	-190	$\text{mA}$

Timing Diagram

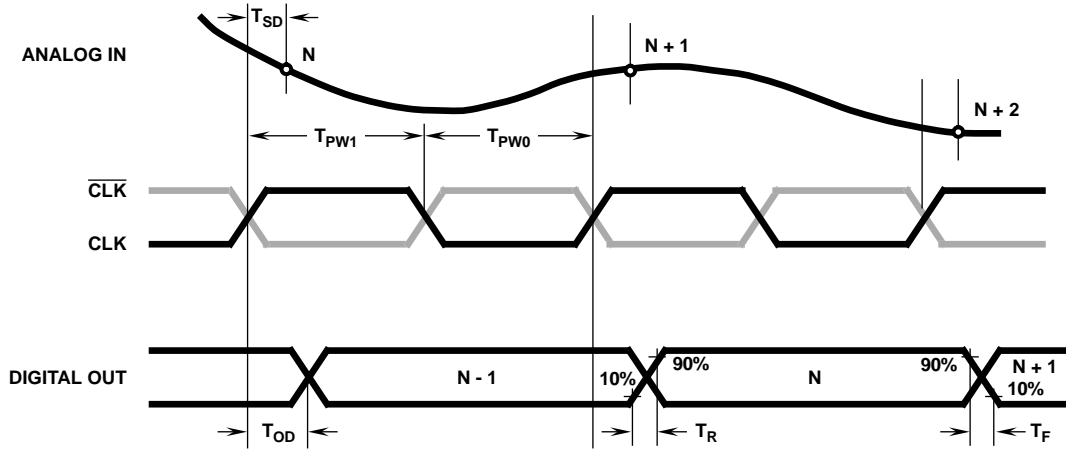


FIGURE 1.

Pad Descriptions

PAD NUMBER	SYMBOL	I/O	STANDARD VOLTAGE LEVEL	EQUIVALENT CIRCUIT	DESCRIPTION
4, 5	D0, $\overline{D0}$	O	ECL		LSB and complementary LSB output.
6, 7	D1, $\overline{D1}$				D1 to D6: Data output D1 to $\overline{D6}$ : Complementary Data output
12, 13	D2, $\overline{D2}$				
14, 15	D3, $\overline{D3}$				
21, 22	D4, $\overline{D4}$				
24, 25	D5, $\overline{D5}$				
31, 32	D6, $\overline{D6}$				
33, 34	D7, $\overline{D7}$				MSB complementary MSB data output.
2, 3	OR, $\overline{OR}$	Overrange and complementary overrange output.			
1	LINV	I	ECL		Polarity selection for LSBs (refer to the A/D Output Code Table.) Pulled low when left open.
35	MINV	I	ECL		Polarity selection for MSB (refer to the A/D Output Code Table). Pulled low when left open.

**Pad Descriptions** (Continued)

PAD NUMBER	SYMBOL	I/O	STANDARD VOLTAGE LEVEL	EQUIVALENT CIRCUIT	DESCRIPTION
39	CLK	I	ECL		CLK Input
38	$\overline{\text{CLK}}$				Complementary CLK input. Pulled down to -1.3V when left open.
62	$V_{RT}$	I	0V		Analog reference voltage (top) (0V Typ.).
63	$V_{RTS}$	O	0V		Reference voltage sense (top).
54	$V_{RM}$	I	$V_{RB}/2$		Reference voltage mid point. Can be used for linearity compensation.
45	$V_{RBS}$	O	-2V		Reference voltage sense (bottom).
46	$V_{RB}$	I	-2V		Analog reference voltage (bottom).
51, 52	$V_{IN2}$	I	$V_{RTS}$ to $V_{RBS}$		Analog input. All of the pins must be wired externally.
56, 57	$V_{IN1}$				

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## Pad Descriptions (Continued)

PAD NUMBER	SYMBOL	I/O	STANDARD VOLTAGE LEVEL	EQUIVALENT CIRCUIT	DESCRIPTION
49, 50, 53, 55, 58, 59	AGND	-	0V		Analog ground.
40, 41, 47, 48, 60, 61, 65, 66	AVEE		-5.2V		Analog supply. Internally connected to DV <sub>EE</sub> (resistance: 4Ω to 6Ω).
9, 19, 20, 29	DGND1		0V		Digital ground.
10, 17, 18, 27, 28	DGND2		0V		Digital ground for output drive.
8, 14, 23, 30	DV <sub>EE</sub>		-5.2V		Digital supply. Internally connected to AV <sub>EE</sub> (resistance: 4Ω to 6Ω).

**A/D OUTPUT CODE TABLE**

V <sub>IN</sub> (Note 1)	STEP	MINV 1 LINV 1		0 1		1 0		0 0									
		OR	D7	D0	OR	D7	D0	OR	D7	D0	OR	D0	D7				
0V	0	0	000	•••••	00	0	100	•••••	00	0	011	•••••	11	0	111	•••••	11
		1	000	•••••	00	1	100	•••••	00	1	011	•••••	11	1	111	•••••	11
	1	1	000	•••••	01	1	100	•••••	01	1	011	•••••	10	1	111	•••••	10
		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
-1V	127	1	011	•••••	11	1	111	•••••	11	1	000	•••••	00	1	100	•••••	00
	128	1	100	•••••	00	1	000	•••••	00	1	111	•••••	11	1	011	•••••	11
	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	254	1	111	•••••	10	1	011	•••••	10	1	100	•••••	01	1	000	•••••	01
255	1	111	•••••	11	1	011	•••••	11	1	100	•••••	00	1	000	•••••	00	
-2V	1	1	111	•••••	11	1	011	•••••	11	1	100	•••••	00	1	000	•••••	00

NOTE:

1. V<sub>RT</sub> = V<sub>RTS</sub> = 0V, V<sub>RM</sub> = -1V or open, V<sub>RB</sub> = V<sub>RBS</sub> = -2V

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## Pad Coordinates

### PAD COORDINATE 1

PAD NO.	PAD NAME	X [ $\mu\text{m}$ ]	Y [ $\mu\text{m}$ ]
1	LINV	2198.40	4490.40
2	OR	2008.00	4490.40
3	$\overline{\text{OR}}$	1817.60	4490.40
4	D0	1627.20	4490.40
5	$\overline{\text{D0}}$	1436.80	4490.40
6	D1	1246.40	4490.40
7	$\overline{\text{D1}}$	1056.00	4490.40
8	DV <sub>EE</sub>	865.60	4490.40
9	DGND1	675.20	4490.40
10	DGND2	388.80	4490.40
11	DGND2	209.60	4311.20
12	D2	209.60	3730.40
13	$\overline{\text{D2}}$	209.60	3540.00
14	DV <sub>EE</sub>	209.60	3349.60
15	D3	209.60	3159.20
16	$\overline{\text{D3}}$	209.60	2968.80
17	DGND2	209.60	2778.40
18	DGND2	209.60	2629.60
19	DGND1	209.60	2458.40
20	DGND1	209.60	2301.60
21	D4	209.60	2111.20
22	$\overline{\text{D4}}$	209.60	1920.80

PAD NO.	PAD NAME	X [ $\mu\text{m}$ ]	Y [ $\mu\text{m}$ ]
23	DV <sub>EE</sub>	209.60	1730.40
24	D5	209.60	1540.00
25	$\overline{\text{D5}}$	209.60	1349.60
26		209.60	1159.20
27	DGND2	209.60	588.00
28	DGND2	209.60	362.40
29	DGND1	484.80	215.20
30	DV <sub>EE</sub>	675.20	215.20
31	D6	865.60	215.20
32	$\overline{\text{D6}}$	1056.00	215.20
33	D7	1246.40	215.20
34	$\overline{\text{D7}}$	1436.80	215.20
35	MINV	1627.20	215.20
36		1817.60	215.20
37		2008.00	215.20
38	$\overline{\text{CLK}}$	2198.40	215.20
39	CLK	2388.80	215.20
40	AV <sub>EE</sub>	2579.20	215.20
41	AV <sub>EE</sub>	2728.00	215.20
42		2974.40	215.20
43		3164.80	215.20
44		3355.20	215.20

PAD NO.	PAD NAME	X [ $\mu\text{m}$ ]	Y [ $\mu\text{m}$ ]
45	V <sub>RBS</sub>	3545.60	215.20
46	V <sub>RB</sub>	3736.00	215.20
47	AV <sub>EE</sub>	3926.40	215.20
48	AV <sub>EE</sub>	4075.20	215.20
49	AGND	4377.60	215.20
50	AGND	4377.60	1292.00
51	V <sub>IN2</sub>	4377.60	1570.40
52	V <sub>IN2</sub>	4377.60	1720.80
53	AGND	4377.60	1999.20
54	V <sub>RM</sub>	4377.60	2352.80
55	AGND	4377.60	2698.40
56	V <sub>IN1</sub>	4377.60	2984.80
57	V <sub>IN1</sub>	4377.60	3135.20
58	AGND	4377.60	3413.60
59	AGND	4377.60	4490.40
60	AV <sub>EE</sub>	4075.20	4490.40
61	AV <sub>EE</sub>	3926.40	4490.40
62	V <sub>RT</sub>	3736.00	4490.40
63	V <sub>RTS</sub>	3545.60	4490.40
64		3164.80	4490.40
65	AV <sub>EE</sub>	2728.00	4490.40
66	AV <sub>EE</sub>	2579.20	4490.40

**Pad Coordinates (Continued)**

**PAD COORDINATE 2**

PAD NO.	PAD NAME	X [ $\mu\text{m}$ ]	Y [ $\mu\text{m}$ ]
1	LINV	2158.40	4450.40
2	OR	1968.00	4450.40
3	$\overline{\text{OR}}$	1777.60	4450.40
4	D0	1587.20	4450.40
5	$\overline{\text{D0}}$	1396.80	4450.40
6	D1	1206.40	4450.40
7	$\overline{\text{D1}}$	1016.00	4450.40
8	DV <sub>EE</sub>	825.60	4450.40
9	DGND1	635.20	4450.40
10	DGND2	348.80	4450.40
11	DGND2	169.60	5271.20
12	D2	169.60	3690.40
13	$\overline{\text{D2}}$	169.60	3500.00
14	DV <sub>EE</sub>	169.60	3309.60
15	D3	169.60	3119.20
16	$\overline{\text{D3}}$	169.60	2928.80
17	DGND2	169.60	2738.40
18	DGND2	169.60	2589.60
19	DGND1	169.60	2418.40
20	DGND1	169.60	2261.60
21	D4	169.60	2071.20
22	$\overline{\text{D4}}$	169.60	1880.80

PAD NO.	PAD NAME	X [ $\mu\text{m}$ ]	Y [ $\mu\text{m}$ ]
23	DV <sub>EE</sub>	169.60	1690.40
24	D5	169.60	1500.00
25	$\overline{\text{D5}}$	169.60	1309.60
26		169.60	1119.20
27	DGND2	169.60	548.00
28	DGND2	169.60	322.40
29	DGND1	444.80	175.20
30	DV <sub>EE</sub>	635.20	175.20
31	D6	825.60	175.20
32	$\overline{\text{D6}}$	1016.00	175.20
33	D7	1206.40	175.20
34	$\overline{\text{D7}}$	1396.80	175.20
35	MINV	1587.20	175.20
36		1777.60	175.20
37		1968.00	175.20
38	$\overline{\text{CLK}}$	2158.40	175.20
39	CLK	2348.80	175.20
40	AV <sub>EE</sub>	2539.20	175.20
41	AV <sub>EE</sub>	2688.00	175.20
42		2934.40	175.20
43		3124.80	175.20
44		3315.20	175.20

PAD NO.	PAD NAME	X [ $\mu\text{m}$ ]	Y [ $\mu\text{m}$ ]
45	V <sub>RBS</sub>	3505.60	175.20
46	V <sub>RB</sub>	3696.00	175.20
47	AV <sub>EE</sub>	3886.40	175.20
48	AV <sub>EE</sub>	4035.20	175.20
49	AGND	4337.60	175.20
50	AGND	4337.60	1252.00
51	V <sub>IN2</sub>	4337.60	1530.40
52	V <sub>IN2</sub>	4337.60	1680.80
53	AGND	4337.60	1959.20
54	V <sub>RM</sub>	4337.60	2312.80
55	AGND	4337.60	2658.40
56	V <sub>IN1</sub>	4337.60	2944.80
57	V <sub>IN1</sub>	4337.60	3095.20
58	AGND	4337.60	3373.60
59	AGND	4337.60	4450.40
60	AV <sub>EE</sub>	4035.20	4450.40
61	AV <sub>EE</sub>	3886.40	4450.40
62	V <sub>RT</sub>	3696.00	4450.40
63	V <sub>RTS</sub>	3505.60	4450.40
64		3124.80	4450.40
65	AV <sub>EE</sub>	2688.00	4450.40
66	AV <sub>EE</sub>	2539.20	4450.40

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