Low IF Receiver Reference Design Board

National Semiconductor
RD-147
Data Conversions Applications
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1.0 Design Description

The ADC14DS105KARB is a low IF receiver subsystem reference design board that utilizes a pair of LMH6552 differential drivers and a dual ADC to enable immediate evaluation of a quadrature direct conversion or near-zero IF receiver for signal frequencies from DC to 40 MHz. This receiver architecture is commonly used in WiMAX and WCDMA receiver systems. The 1 GHz input bandwidth of the ADC and the 1.5 GHz differential amplifier gain stage enable large signal-to-noise ratio (SNR) of 73.3 decibels full scale (dBFS) and spurious free dynamic range (SFDR) greater than 85 dBFS for input signals up to 40 MHz. In addition to the LMH6552, the board includes National's ADC14DS105 dual 14-bit, 105 mega-sample per second (MSPS) low-distortion, low-noise ADC with serialized low-voltage differential signaling (LVDS) outputs; LMK02000 low-jitter clock conditioner; as well as several energy-efficient power management integrated circuits (ICs).

2.0 Features

Key Features of the ADC14DS105KARB Low IF Receiver Reference Design Board

- Enables immediate evaluation of a quadrature direct conversion or near-zero IF receiver subsystem architecture
- Demonstrates a receiver architecture commonly used in WiMAX and WCDMA receiver systems
- Configured for signal frequencies from DC to 40 MHz
- **Featured Products include** :
  - LMH6552 1.5 GHz differential current feedback amplifiers from National Semiconductor's Powerwise® family
  - ADC14DS105: 14-bit, 105 MSPS, 1 GHz input bandwidth dual channel ADC with serial LVDS outputs from National Semiconductor's Powerwise® family
  - LMK02000: low-jitter clock conditioner from National Semiconductor's Powerwise® family provides 128 fs jitter (100 Hz to 20 MHz integration bandwidth)
  - Several energy-efficient power management integrated circuits (ICs) from National Semiconductor
- Reference design performance for input signals up to 40 MHz:
  - Small-signal SNR of 74 dBFS and SFDR greater than 90 dBFS
  - Large-signal SNR of 73.3 dBFS and SFDR greater than 85 dBFS

3.0 Schematic

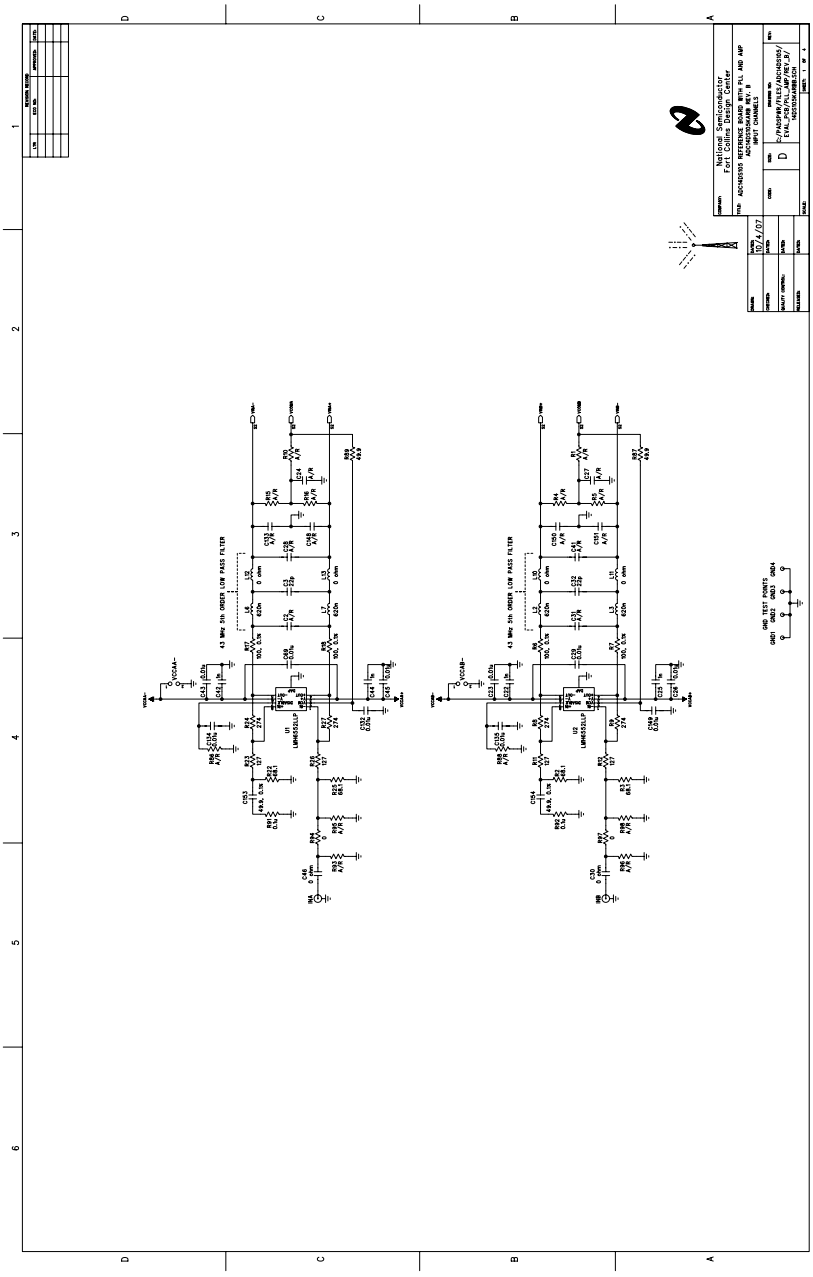
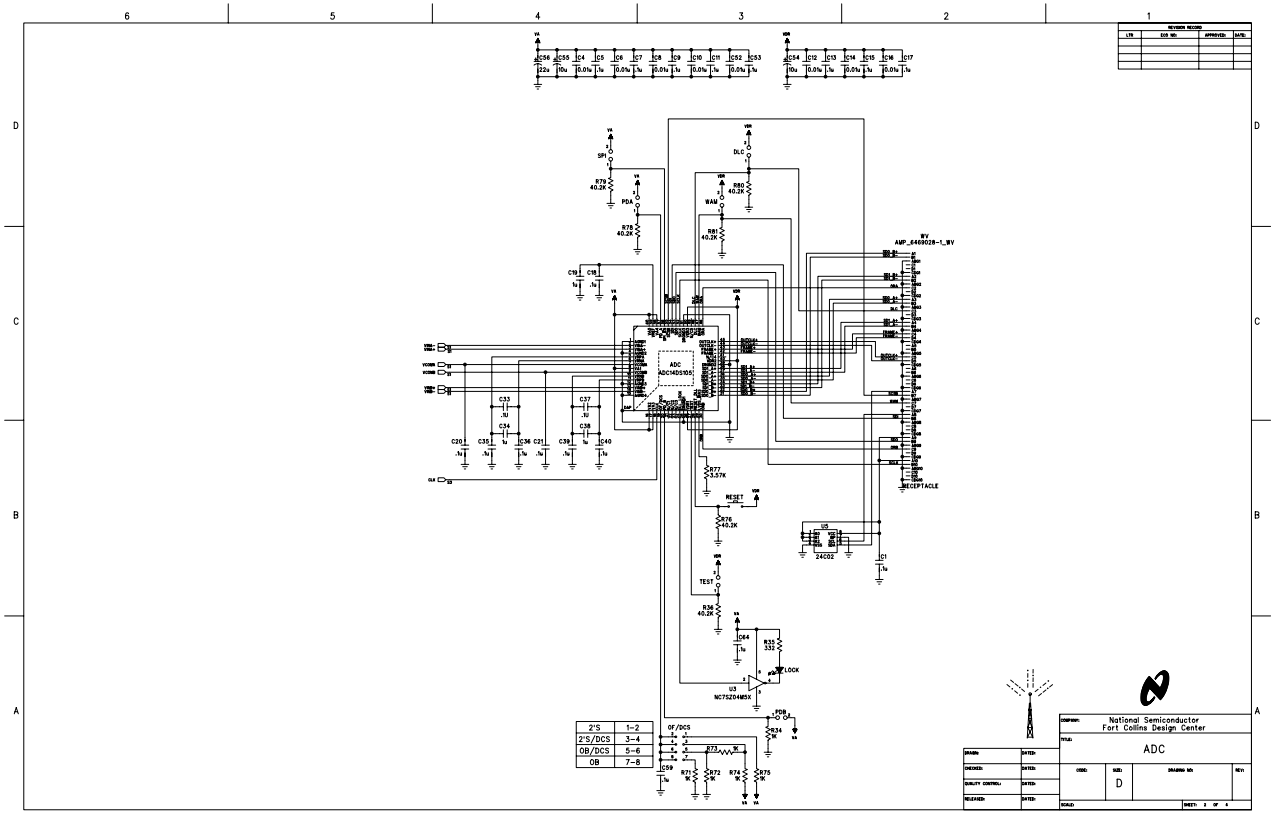
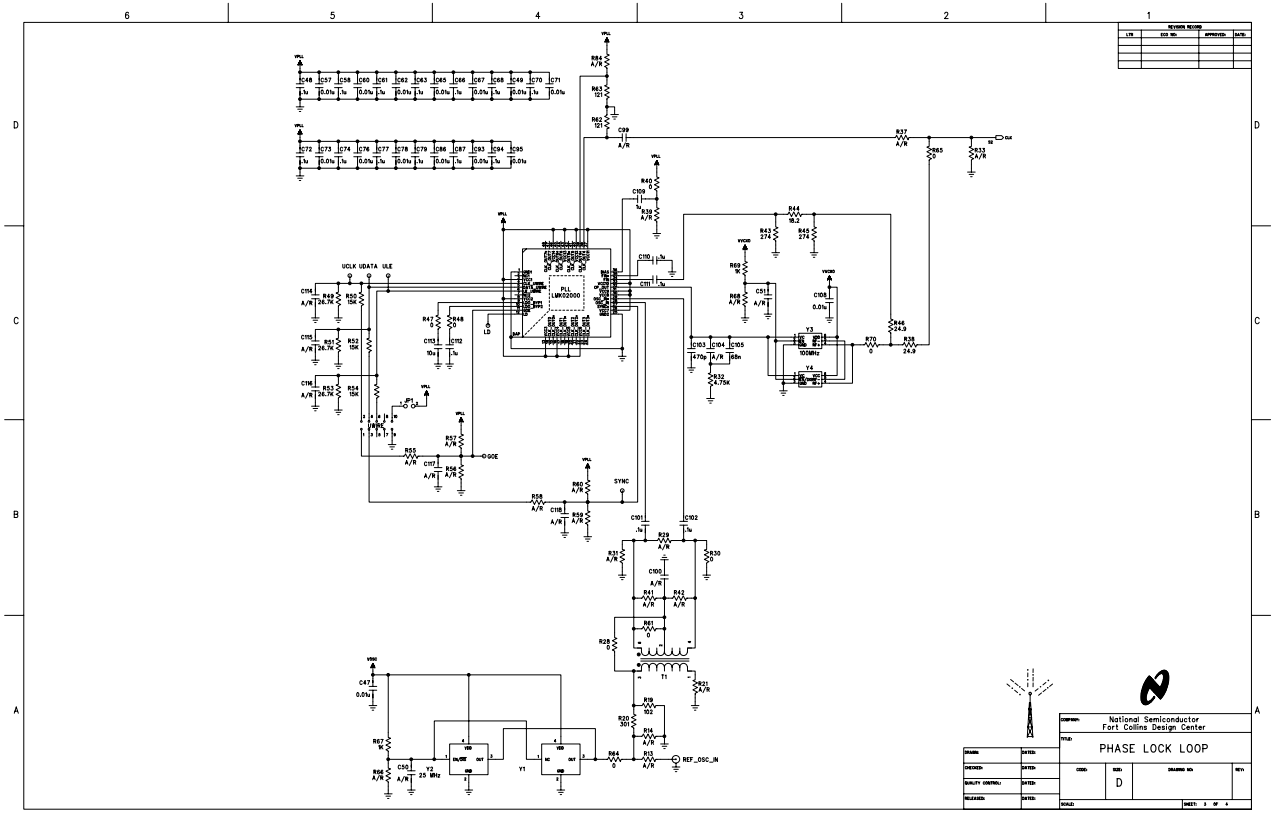


FIGURE 1. ADC14D105 SCHEMATIC



schematic1

FIGURE 2. ADC14D105 SCHEMATIC



schematic2

FIGURE 3. ADC14D105 SCHEMATIC

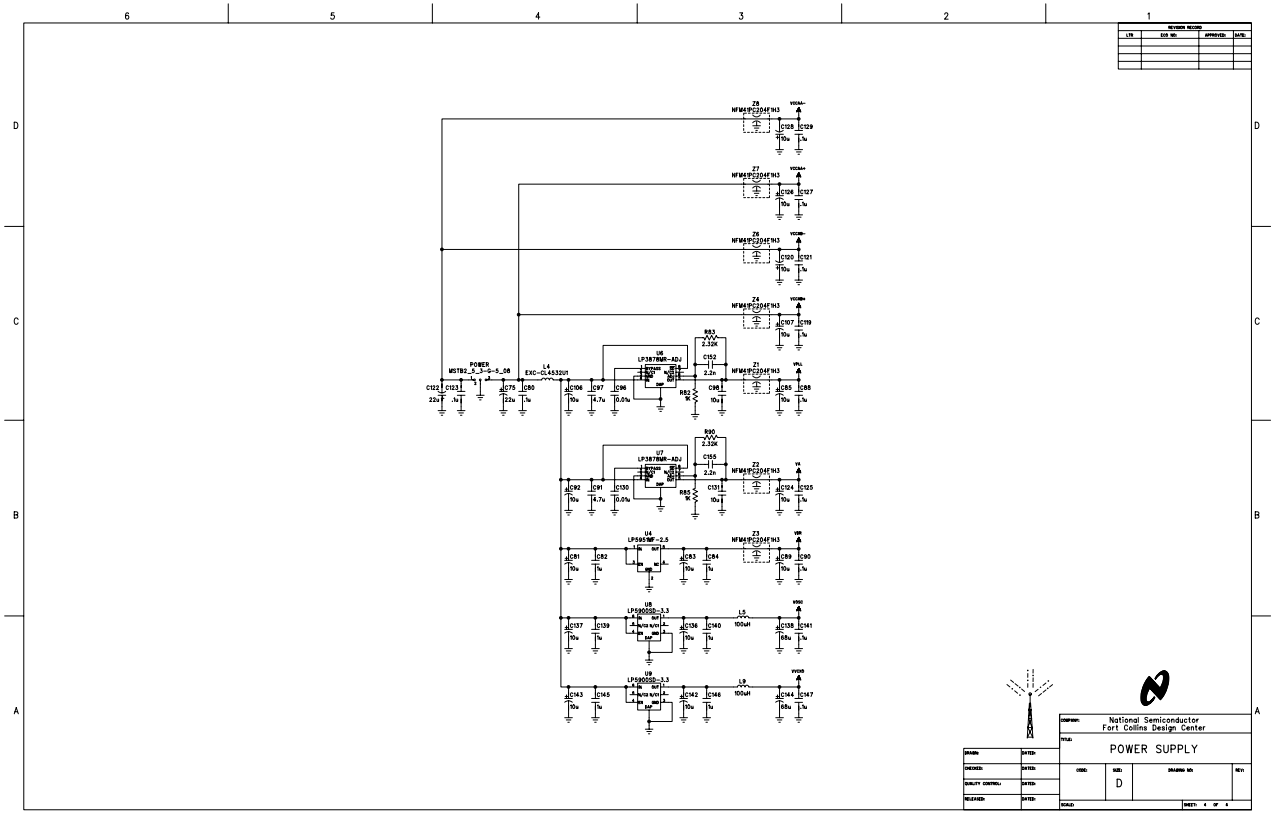


FIGURE 4. ADC14D105 SCHEMATIC

4.0 Bill of Materials

NATIONAL SEMICONDUCTOR

Item	Quantity	Schematic Reference	Part Name	Description	PCB Footprint	Manufacturer	Supplier	Supplier Part Number	Notes
1	1	U5	EEPROM	2K SERIAL EEPROM	8 PIN SOIC	ATMEL	Digi Key	AT24C02BN-SH-B-ND	
2	1	ADC	CONVERTER	DUAL 14-BIT 105 MSPS A/D CONVERTER WITH SERIAL LVDS OUTPUTS	LLP-60	NATIONAL SEMICONDUCTOR	NATIONAL SEMI	ADC14DS105CISQ	
3	1	VW	WAVEVISION CONNECTOR HMDz RECEPTACLE		-	TYCO	Newark	42K7651	AFTER PRESS FITTING THIS CONNECTOR INTO THE BOARD IT SHOULD ALSO BE SOLDER TO THE BOARD
4	2	C33, C37	0.1uF	0.1uF SMD CAP CERAMIC 6.3V X5R 10%	sm⁄c_0201	Panasonic - ECG	Digi Key	PCC2366CT-ND	
5	2	C153-154	49.9 ohms	49.9 OHM SMD RESISTOR 1/16W 0.1%	sm⁄c_0603	Susumu	Digi Key	RG10P49.9BCT-ND	THIS IS A 0402 SIZE RESISTOR PLACED ON 0603 CAPACITOR PADS
6	2	C98, C131	10uF	CAPCER 10UF 10V X7R	sm⁄c_1210	Taiyo Yuden	Digi Key	587-1469-1-ND	
7	5	C1, C119, C121, C127, C129	0.1uF	0.1uF SMD CAP CERAMIC 25V X5R 10%	sm⁄c_0603	AVX Corporation	Digi Key	478-1244-1-ND	
8	37	C5, C7, C9, C11, C13, C15, C17-18, C20-21, C 35-36, C39-40, C48, C53, C58-59, C61, C63-64, C66, C68, C70, C72, C74, C77, C79, C87, C94, C101-102, C110-112, C141, C147	0.1uF	0.1uF SMD CAP CERAMIC 10V X5R 10%	sm⁄c_0402	Panasonic - ECG	Digi Key	PCC2146CT-ND	
9	23	C4, C6, C8, C10, C12, C14, C16, C47, C49, C52, C57, C60, C62, C65, C67, C71, C73, C76, C78, C86, C93, C95, C108	0.01uF	0.01uF SMD CAP CERAMIC 16V X7R 10%	sm⁄c_0402	AVX Corporation	Digi Key	478-1114-1-ND	
10	10	C23, C26, C29,C43, C45, C69, C132, C134-135, C149	0.01uF	0.01uF SMD CAP CERAMIC 50V X7R 10%	sm⁄c_0603	Panasonic - ECG	Digi Key	PCC1784CT-ND	
11	2	C96, C130	0.01uF	0.01uF SMD CAP CERAMIC 50V X7R 5%	sm⁄c_1206	Kemet	Digi Key	399-1237-1-ND	
12	2	C30, C46	0 ohms	0 OHM SMD RESISTOR 1/4W 5%	sm⁄c_1206	Vishay Dale	Digi Key	541-0.0ECT-ND	THIS IS A 1206 SIZE RESISTOR PLACED ON 1206 CAPACITOR PADS
13	1	C113	10uF	10uF SMD CAP CERAMIC 10V X5R 20%	sm⁄c_1206	Panasonic - ECG	Digi Key	PCC2178CT-ND	
14	4	C22, C25, C42, C44	1nF	1000PF SMD CAP CERAMIC 50V NPO 5%	sm⁄c_0603	Panasonic - ECG	Digi Key	PCC2151CT-ND	
15	4	C19, C34, C38, C109	1uF	1uF SMD CAP CERAMIC 6.3V X5R 10%	sm⁄c_0402	Panasonic - ECG	Digi Key	PCC1349JCT-ND	
16	6	C84, C82, C139-140, C145-146	1uF	1uF SMD CAP CERAMIC 25V X7R 10%	sm⁄c_1206	Panasonic - ECG	Digi Key	PCC1893CT-ND	
17	2	C152, C155	2.2nF	2200pF SMD CAP CERAMIC 100V X7R 5%	sm⁄c_0603	AVX Corporation	Digi Key	478-3705-1-ND	
18	2	C3, C32	22pF	22pF SMD CAP CERAMIC 50V NPO 5%	sm⁄c_0603	Panasonic - ECG	Digi Key	PCC220ACVCT-ND	
19	2	C91, C97	4.7uF	4.7uF SMD CAP CERAMIC 25V X5R 10%	sm⁄c_1206	Panasonic - ECG	Digi Key	PCC2297CT-ND	
20	1	C103	470pF	470pF SMD CAP CERAMIC 50V C0G 5%	sm⁄c_0402	TDK Corporation	Digi Key	490-1297-1-ND	
21	0	-	-	-	-	-	-	-	
22	1	C105	68nF	68000pF SMD CAP CERAMIC 25V X7R 10%	sm⁄c_0603	Murata Electronics	Digi Key	490-1523-1-ND	
23	17	C54-55, C81, C83, C85, C89, C92, C106-107, C120, C124, C126, C128, C136-137, C142-143	10uF	10uF SMD CAP TANTALUM 6.3V 20%	sm⁄c_3216	Kemet	Digi Key	495-2381-1-ND	
24	3	C56, C75, C122	22uF	22uF SMD CAP TANTALUM 10V 10%	sm⁄c_3216	AVX Corporation	Digi Key	478-1603-1-ND	
25	2	C138, C144	68uF	68uF SMD CAP TANTALUM 10V 20%	sm⁄c_6032	Kemet	Digi Key	495-1526-1-ND	
26	1	RISET	RESET SWITCH	LIGHT TOUCH SWITCH 240GF SMD	-	Panasonic - ECG	Digi Key	P8087SCT-ND	
27	1	L4	Ferrite Bead Core	SMD FERRITE BEAD CORE 4.5X3.2X1.8	-	Panasonic - ECG	Digi Key	P9812CT-ND	
28	1	LOCK	LOCK LED	RED LIGHT EMITTING DIODE	-	AVAGO	Digi Key	516-1440-1-ND	
29	2	L5, L9	Inductor	100UH SMD INDUCTOR UNSHIELDED	sm⁄l_1812	API Delevan	Digi Key	DN412133JCT-ND	
30	4	L2-3, L6-7	620nH	620nH Series 1008CS (2520) Ceramic Chip Inductor	sm⁄l_1008	Coilcraft	Coilcraft	1008CS-621XJLB	
31	4	L10-13	0 ohms	0 OHM SMD RESISTOR 1/8W 5%	sm⁄l_1008	ROHM	Digi Key	RHM0.0ARCT-ND	THIS IS A 0805 SIZE RESISTOR PLACED ON 1005 INDUCTOR PADS
32	2	JP1, SPI	Jumper 1X2	1X2 JUMPER BLOCK HEADER	-	Samtec	Samtec	MTSW-101-07-T-D-240	
33	3	JP1, SPI, OF/DCS	Shunt	PLACE SHUNT SO IT IS ON ONE OF JP1 CONNECTOR PINS BUT DOES NOT CONNECTOR TO THE OTHER PIN, PLACE SHUNT FROM PINS 1-2 ON SPI, PLACE SHUNT FROM PINS 7-8 ON OF/DCS	-	FCI Electronic	Arrow Electronics	68786-302LF	PLACE SHUNT SO IT IS ON ONE OF JP1 CONNECTOR PINS BUT DOES NOT CONNECTOR TO THE OTHER PIN, PLACE SHUNT FROM PINS 1-2 ON SPI, PLACE SHUNT FROM PINS 7-8 ON OF/DCS
34	1	OF/DCS	Jumper 2X4	2X4 JUMPER BLOCK HEADER	-	Samtec	Samtec	MTSW-104-07-T-D-240	
35	1	UWIRE	Jumper 2X5	2X5 JUMPER BLOCK HEADER	-	Samtec	Samtec	MTSW-105-07-T-D-240	
36	2	U1-2	DIFF AMP	1 GHz Fully Differential Amplifier	LLP-8	NATIONAL SEMICONDUCTOR	NATIONAL SEMI	LMH6552SD	
37	1	PLL	Phase Lock Loop	PRECISION CLOCK DISTRIBUTOR WITH INTERGRATED PLL	LLP-48	NATIONAL SEMICONDUCTOR	NATIONAL SEMI	LMK02000SQ	
38	2	U6-7	Voltage Regulator	ADJUSTABLE VOLTAGE REGULATOR	PSOP-8	NATIONAL SEMICONDUCTOR	Digi Key	LP3878MR-ADJ-ND	
39	2	U8-9	Voltage Regulator	LINEAR REGULATOR FOR RF/ANALOG CIRCUITS	LLP-6	NATIONAL SEMICONDUCTOR	Digi Key	LP5900SD-3.3CT-ND	
40	1	U4	Voltage Regulator	LOW-DROPOUT CMOS VOLTAGE REGULATOR	SOT 23-5	NATIONAL SEMICONDUCTOR	Digi Key	LP5951MF-2.5CT-ND	
41	1	POWER	Power Connector Terminal BI	TERMINAL BLOCK 3POS 5.08mm	-	Phoenix Contact	Digi Key	277-1096-ND	
42	1	-	Power Connector Plug	TERMINAL BLOCK PLUG 2POS 5.08mm	-	Phoenix Contact	Digi Key	277-1012-ND	
43	1	U3	Inverter	INVERTER SGL TINYLOGIC	SOT 23-5	FAIRCHILD	Digi Key	NC7SZ04M5XCT-ND	
44	7	Z1-4, Z6-8	Noise Suppression Filter	FILTER LC HIGH FREQ 2LIF	1806	Murata Electronics	Digi Key	490-2550-1-ND	
45	5	R28, R61, R64, R94, R97	0 ohms	0 OHM SMD RESISTOR 1/10W 5%	sm⁄l_0603	Vishay Dale	Digi Key	541-0.0GCT-ND	
46	6	R30, R40, R65, R70, R47-48	0 ohms	0 OHM SMD RESISTOR 1/16W 1%	sm⁄r_0402	Vishay Dale	Newark	52K6543	
47	1	R19	102 ohms	102 OHM SMD RESISTOR 1/10W 1%	sm⁄r_0603	Vishay Dale	Digi Key	541-103HCT-ND	
48	2	R62-63	121 ohms	121 OHM SMD RESISTOR 1/16W 1%	sm⁄r_0402	Panasonic - ECG	Digi Key	P121LCT-ND	
49	3	R50, R52, R54	15K ohms	15K OHM SMD RESISTOR 1/8W 1%	sm⁄r_0402	Vishay Dale	Digi Key	541-15.0KLCT-ND	
50	1	R44	18.2 ohms	18.2 OHM SMD RESISTOR 1/16W 1%	sm⁄r_0402	Vishay Dale	Digi Key	541-18.2LCT-ND	
51	10	R34, R67, R69, R71-75, R82, R85	1K ohms	1K OHM SMD RESISTOR 1/8W 1%	sm⁄r_0402	Vishay Dale	Digi Key	541-1.00KLCT-ND	
52	2	R83, R90	2.32K ohms	2.32K OHM SMD RESISTOR 1/16W 1%	sm⁄r_0402	Vishay Dale	Digi Key	541-2.32KLCT-ND	
53	2	R38, R46	24.9 ohms	24.9 OHM SMD RESISTOR 1/16W 1%	sm⁄r_0402	Vishay Dale	Digi Key	541-24.9LCT-ND	
54	3	R49, R51, R53	26.7K ohms	26.7K OHM SMD RESISTOR 1/16W 1%	sm⁄r_0402	Vishay Dale	Digi Key	541-26.7KLCT-ND	
55	2	R43 R45	274 ohms	274 OHM SMD RESISTOR 1/16W 1%	sm⁄r_0402	Vishay Dale	Digi Key	541-274LCT-ND	
56	1	R77	3.57K ohms	3.57K OHM SMD RESISTOR 1/10W 1%	sm⁄r_0603	Vishay Dale	Digi Key	541-357KHCT-ND	
57	1	R20	301 ohms	301 OHM SMD RESISTOR 1/10W 1%	sm⁄r_0603	Vishay Dale	Digi Key	541-301HCT-ND	
58	1	R35	332 ohms	332 OHM SMD RESISTOR 1/10W 1%	sm⁄r_0603	Vishay Dale	Digi Key	541-332HCT-ND	
59	1	R32	4.75K ohms	4.75K OHM SMD RESISTOR 1/16W 1%	sm⁄r_0402	Vishay Dale	Digi Key	541-4.75KLCT-ND	
60	6	R36, R76, R78-81	40.2K ohms	40.2K OHM SMD RESISTOR 1/10W 1%	sm⁄r_0603	Vishay Dale	Digi Key	541-40.2KHCT-ND	
61	4	R8-9, R24, R27	274 ohms	274 OHM SMD RESISTOR 1/10W 1%	sm⁄r_0603	ROHM	Digi Key	311-274HRCT-ND	
62	4	R6-7, R17-18,	100 ohms	100 OHM SMD RESISTOR 1/16W 0.1%	sm⁄r_0603	Panasonic - ECG	Digi Key	P100DBCT-ND	
63	2	R87, R89	49.9 ohms	49.9 OHM SMD RESISTOR 1/16W 1%	sm⁄r_0402	Yageo Corporation	Digi Key	311-49.9LRCT-ND	
64	2	INA, INB	SMA Input	PCB MOUNTABLE SMA CONNECTOR	-	Molex/Waldom Electronics Corp	Digi Key	WM5534-ND	
65	1	Y2	OSC	25 MHz Oscillator	-	Connor-Winfield	Digi Key	CW450CT-ND	
66	1	Y3	VCXO	100 MHz Voltage Controlled Oscillator	-	Crystek Crystal Corpotation	Mouser Electronics	549-CVHD-950X-100	16 IN PARTS KIT 5 MORE ON ORDER
67	4	MT1-4	Bump-on Rubber Feet	PLACE BUMP ONS AT THE 4 CORNERS, ON BOTTOM OF BOARD	-	3M	Digi Key	SJ5003-0-ND	PLACE BUMP ONS AT THE 4 CORNERS, ON BOTTOM OF BOARD
68	2	R91-92	0.1uF	0.1uF SMD CAP CERAMIC 25V X5R 10%	sm⁄r_0603	AVX Corporation	Digi Key	478-1244-1-ND	THIS IS A 0603 SIZE CAPACITOR PLACED ON 0603 SIZE RESISTOR PADS
69	0	-	-	-	-	-	-	-	
70	4	R11-R12, R23, R26	127 ohms	127 OHM SMD RESISTOR 1/10W 1%	sm⁄r_0603	ROHM	Digi Key	311-127HRCT-ND	
71	4	R2-3, R22, R25	68.1 ohms	68.1 OHM SMD RESISTOR 1/10W 1%	sm⁄r_0603	Vishay Dale	Digi Key	541-68.1HCT-ND	

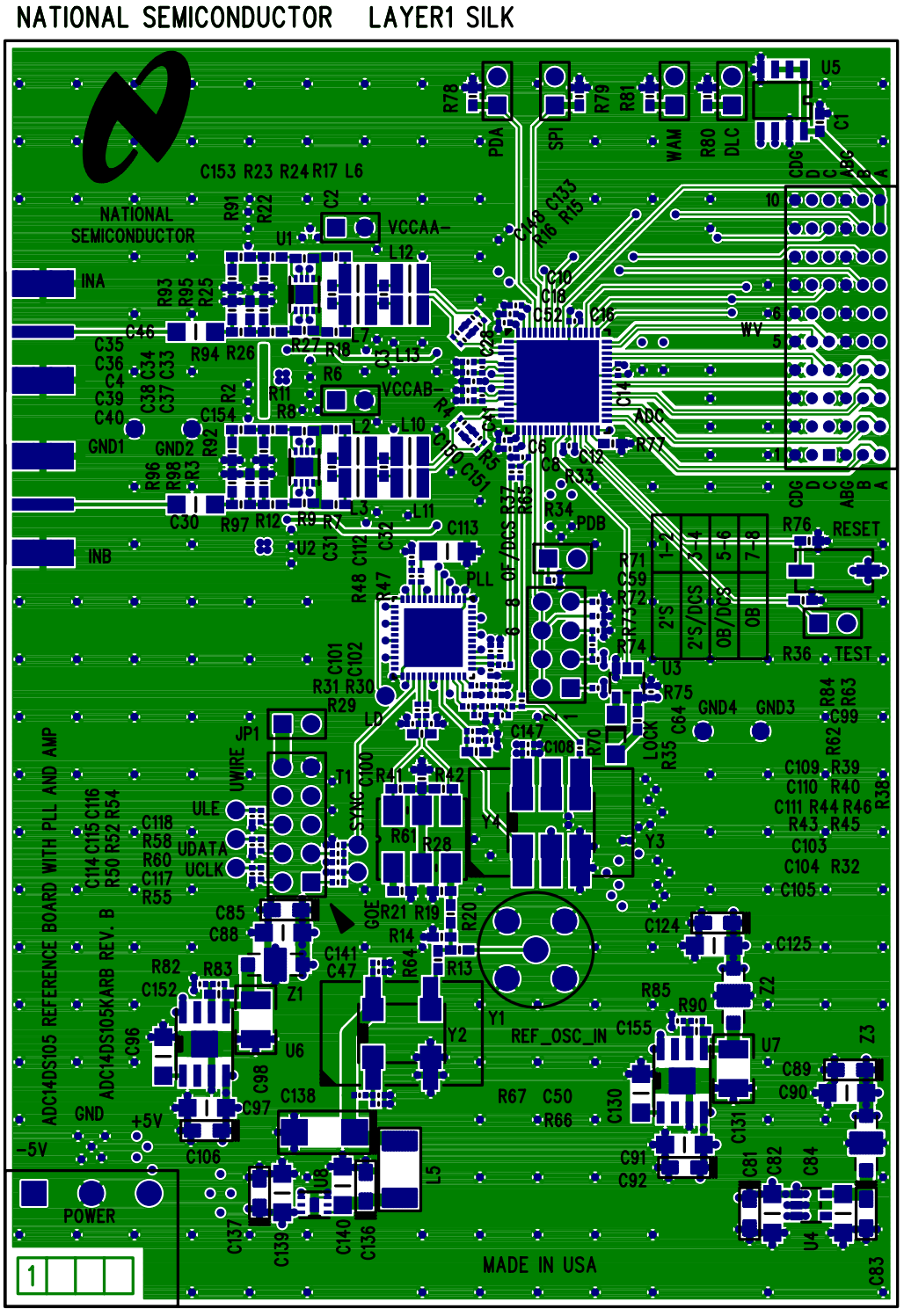
bom3

FIGURE 5. ADC14D105 BOM

5.0 Board Photos

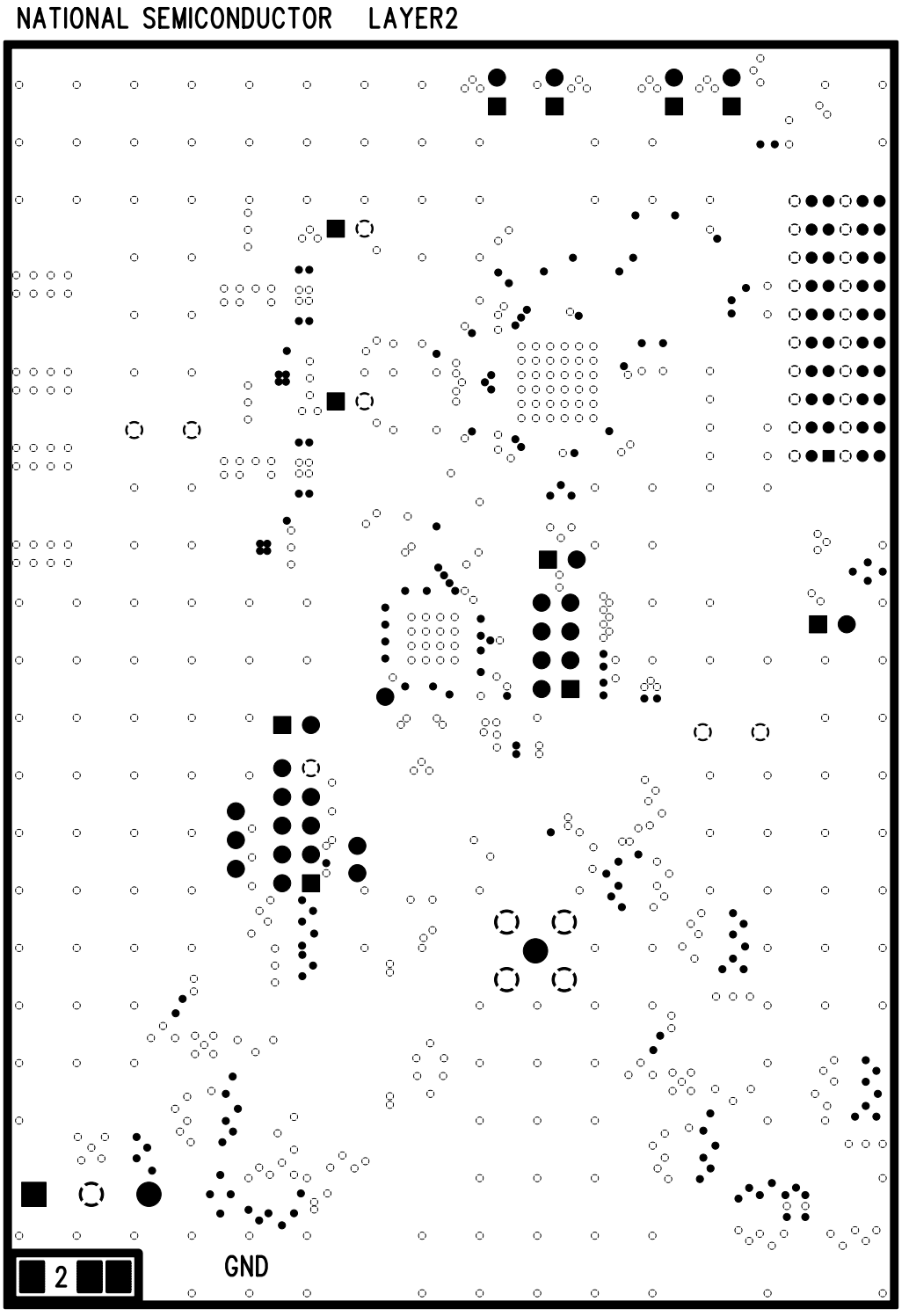
FIGURE 6. ADC14D105 Board Photo

6.0 Layouts



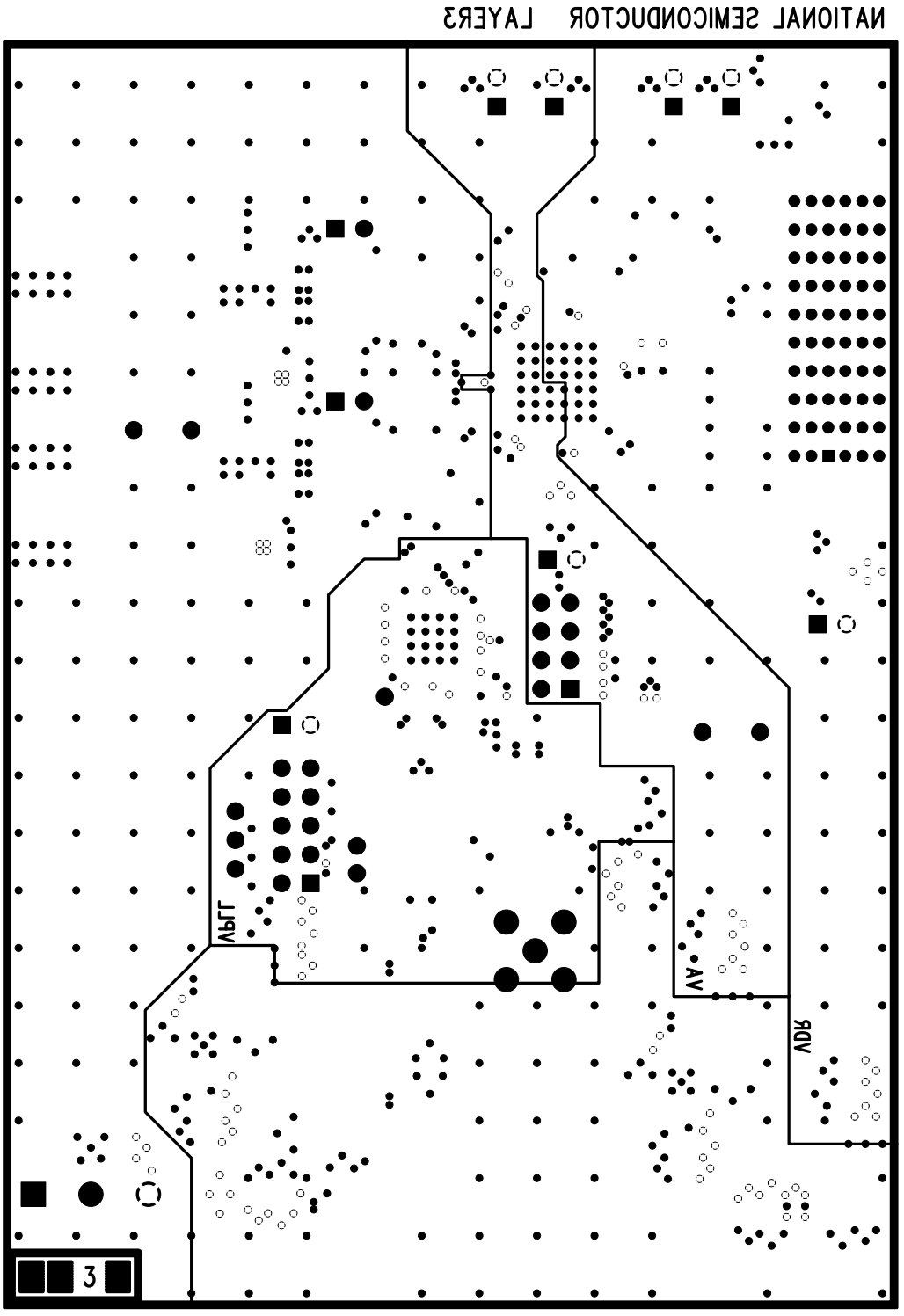
layout12

FIGURE 7. 14DS105KARBB



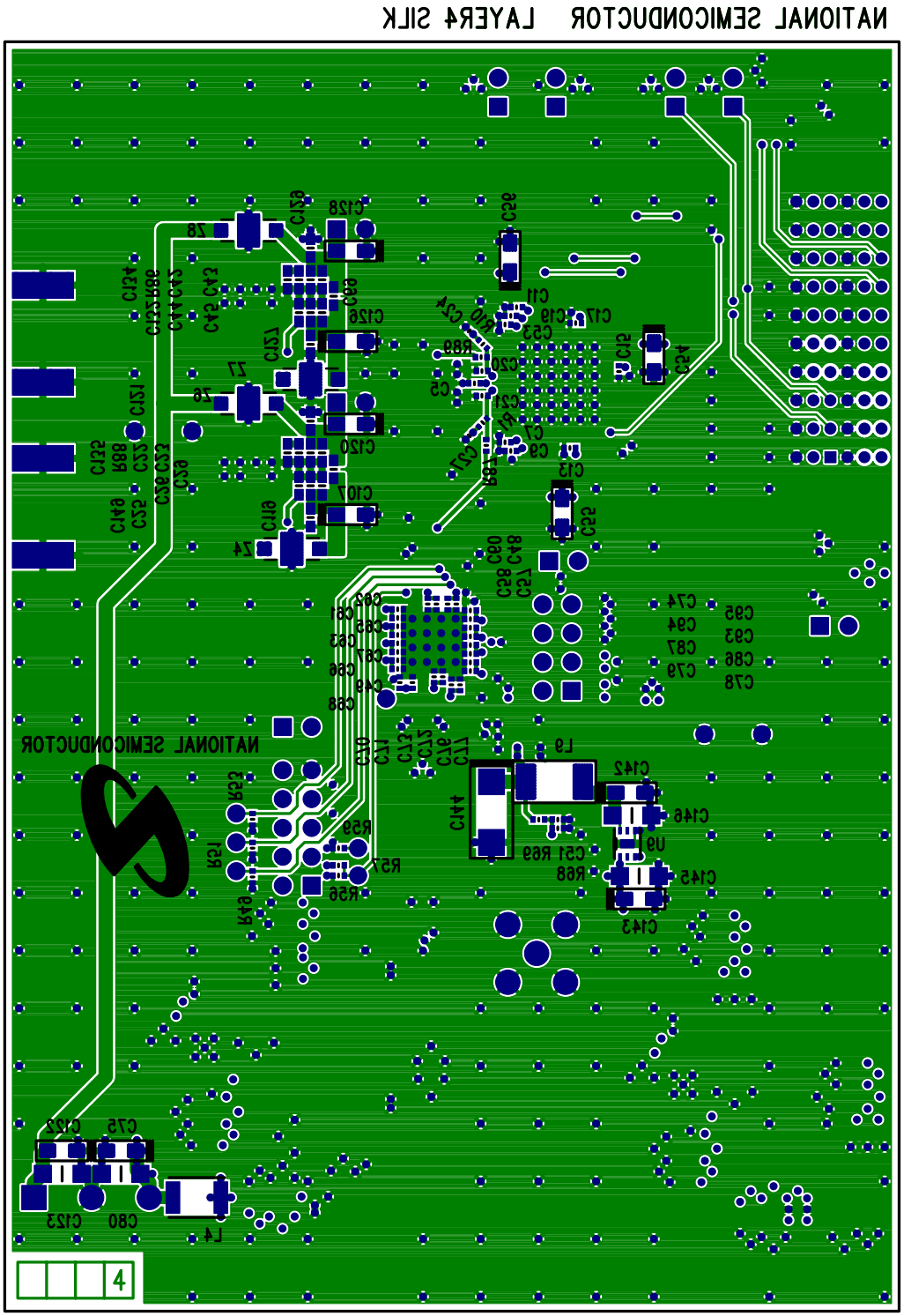
layout13

FIGURE 8. 14DS105KARBB



layout14

FIGURE 9. 14DS105KARBB



layout15

FIGURE 10. 14DS105KARBB

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