

ADS5500/5541/5542/5520/ 5521/5522 14- and 12-Bit Single Channel ADC EVM

User's Guide

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It is important to operate this EVM within the specified input and output voltage ranges described in the EVM user's guide.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 60°C. The EVM is designed to operate properly with certain components above 60°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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Overview

This user's guide document gives a general overview of the ADS55xx evaluation module (EVM), and provides a general description of the features and functions to be considered while using this module.

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1.2 EVM Basic Functions	1-2
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1.1 Purpose

The ADS55xx EVM provides a platform for evaluating the ADS55xx high-speed analog-to-digital converters (ADC) family under various signal, input, and supply conditions. This document should be used in combination with the EVM schematic diagram supplied.

1.2 EVM Basic Functions

Analog input to the ADC is provided via external SMA connectors. The single-ended input the user provides is converted into a differential signal at the input of the device. One input path uses a differential amplifier, while the other input is transformer coupled.

The EVM provides external SMA connectors for input of the ADC clock. The single-ended input the user provides is converted into a differential signal at the input of the device. One input path uses an PECL differential driver, while the other input is transformer coupled. The EVM also allows the user to send a single-ended or true differential clock if desired.

Digital output from the EVM is via a 40-pin connector.

Power connections to the EVM are via banana jack sockets. Separate sockets are provided for the ADC analog and buffer supplies, the external buffer supply, and the differential amplifier supply.

1.3 Power Requirements

The EVM can be powered directly with only a single 3.3-V supply if using the module with transformer coupled input and internal reference mode. ± 5 V is required if using the differential amplifier input. Provision has also been made to allow the EVM to be powered with independent supplies to provide higher performance.

Voltage Limits

Exceeding the maximum input voltages can damage EVM components. Under voltage may cause improper operation of some or all of the EVM components.

The ADS55xx EVM provides a platform for evaluating the analog-to-digital (ADC) devices shown in Table 1–1.

Table 1–1. Device List

DEVICE	RESOLUTION	SAMPLE RATE
ADS5500	14-bit resolution	125 MSPS
ADS5541	14-bit resolution	105 MSPS
ADS5542	14-bit resolution	80 MSPS
ADS5520	12-bit resolution	125 MSPS
ADS5521	12-bit resolution	105 MSPS
ADS5522	12-bit resolution	80 MSPS

The EVM allows the user to evaluate an ADS55xx ADC under various input signal and supply conditions. This document should be used in combination with device data sheet when evaluating a device.

1.4 ADS55xx EVM Operational Procedure

The ADS55xx EVM provides a flexible means of evaluating the ADS55xx in a number of modes of operation. A basic set-up procedure that can be used as a board confidence check is as follows:

- 1) Verify all jumper settings against the schematic jumper list in the following tables:

Table 1–2. Two-Pin Jumper List

JUMPER	FUNCTION	INSTALLED	REMOVED	DEFAULT
W3	Access point for providing SCLK for programming ADC internal registers	Connects Pin 2 to GND	Removes Pin 2 from GND	Installed
W6	Access point for providing SDATA for programming ADC internal registers	Connects Pin 3 to GND	Removes Pin 3 from GND	Installed
W7	Access point for providing SEN for programming ADC internal registers	Connects Pin 4 to GND	Removes Pin 4 from GND	Installed

Table 1–3. Three-Pin Jumper List

JUMPER	FUNCTION	LOCATION: PINS 1– 2	LOCATION: PINS 2–3	DEFAULT
SJP1	Common mode voltage from ADC	Provides common mode voltage to Differential Amplifier	Provides common mode voltage to Transformer T2	2–3
SJP2	ECL Driver input power select	Provides +5 VDC	Provides +3.3 VDC	1–2
W2	ADC output enable control	ADC output enabled	ADC output disabled	1–2
SJP6	Reset polarity select	Used with active low ADC reset	Used with active high ADC reset	2–3

Table 1–4. Five-Pin Jumper List

JUMPER	FUNCTION	LOCATION	DATA FORMAT	OUTPUT CLOCK POLARITY	DEFAULT
W5	ADC data format and output clock polarity select	Pins 4–5 Pins 3–5 Pins 2–5 Pins 1–5	Straight Binary 2s Complement Straight Binary 2s Complement	Data valid on rising edge Data valid on rising edge Data valid on falling edge Data valid on falling edge	Pins 4–5

-
- 2) Connect supplies to the EVM as follows:
3.3-V ADC output buffer supply to J17 and return to J18.
3.3-V ADC analog supply to J11 and return to J10.
 - 3) Switch power supplies on.
 - 4) Use a function generator with 50- Ω output to input a 80 – 125 MHz, 0-V offset, 1 V_{rms} sine wave signal into J3. The frequency of the clock must be within the specification for the device speed grade.
 - 5) Use a frequency generator with a 50- Ω output to provide a 10 MHz, 0-V offset, –1 dBFS amplitude sine wave signal into J7. This provides a transformer-coupled differential input signal to the ADC.
 - 6) The digital pattern on the output connector J8 should now represent a sine wave and can be monitored using a logic analyzer.

Circuit Description

This chapter describes the circuit functions of the ADS55xx EVM.

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2.2 Circuit Function	2-2

2.1 Schematic Diagram

The schematic diagram for the EVM is attached to the end of this document.

2.2 Circuit Function

The following paragraphs describe the function of individual circuits. See the appropriate data sheet for device operating characteristics.

2.2.1 Analog Inputs

The EVM can be configured to provide the ADC with either transformer-coupled or differential amplifier inputs from a single-ended source. The inputs are provided via SMA connectors J7 for transformer coupled input, and J1 and J2 for differential amplifier input. To setup for one of these options, the EVM must be configured as follows:

- 1) For a 1:1 transformer-coupled input to the ADC, a single-ended source is connected to J7. R22, and R35 must be removed and R41 and R45 must be installed. SJP1 must have pins 2 and 3 shorted. This is the default configuration for the EVM.
- 2) For a single-ended input into the differential amplifier, a single-ended source is connected to J1. R22 and R35 must be installed, and R41 and R45 must be removed. SJP1 must have pins 1 and 2 shorted. C12, C32, C35, and R40 provide the user with the option to add filters if desired.
- 3) For a differential input into the amplifier, the positive source is connected to J1 and the negative source to J2. R22 and R35 must be installed, and R41 and R45 removed. SJP1 must have pins 1 and 2 shorted. R8 must be replaced with a 54.9- Ω resistor and R19 with a 383- Ω resistor for proper amplifier termination.

2.2.2 Clock Inputs

The EVM provides three methods for inputs for the ADC clock pins. The initial configuration of the EVM provides a transformer coupled clock to the converter.

2.2.2.1 *Transformer-Coupled Differential ADC Clock*

To provide a transformer-coupled differential clock using a single-ended input source, C25 and C40 must be installed and R11, R25, R32, C36, C39, and C49 must be removed. R31 is 0 Ω for proper transformer configuration. This is the default configuration for the EVM.

2.2.2.2 *True Differential ADC Clock*

To provide a true differential ADC clock input, install J4, R11, R25, C25, and C40, replace R31 with a 49.9- Ω resistor, and remove R32, C36, C39, C49, and T3. The positive source should be connected to J3 and the negative source to J4.

2.2.2.3 ECL Differential ADC Clock

To provide an ECL differential clock input, install C36, C39, and C49 and remove C25 and C40. Configure SJP2 to provide either AVDD or +VCC supply to the ECL differential driver supply pin.

2.2.3 Control Inputs

The EVM has three discrete inputs and a 3-pin serial bus to control the operation of the device:

2.2.3.1 Output Enable

With jumper W2 installed between pins 1 and 2, the ADC outputs are enabled. The device outputs are disabled with jumper W2 installed between pins 2 and 3.

2.2.3.2 DFS Control

By adjusting the voltage on the data format and clock polarity select (DFS) pin, the user can set the mode of operation of the device. Test point 10 should be used to monitor this level. Once the appropriate voltage is reached, the ADC automatically sets the corresponding data format and clock polarity setting. Jumper W5 selects the voltage used for this pin. See Table 1–3 for the data format and clock polarity settings determined by the position of the jumper on W5.

2.2.3.3 IREF Control

By adjusting the resistance on pin 31 (IREF), the user can adjust the bias current used by the ADS55xx device. The default value for the EVM is 56.2 k Ω . Care must be taken when changing this value. See the appropriate data sheet for more information.

2.2.4 Power

Power is supplied to the EVM via banana jack sockets. A separate connection is provided for a 3.3-V analog supply (J11 and J10), 3.3-V buffer supply (J17 and J18) supply, $\pm$ 5-V amplifier supply (J14, J13, and J12), and 3.3-V external buffer supply (J19 and J20).

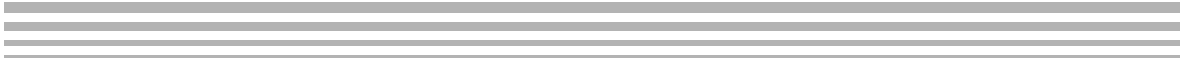
2.2.5 Outputs

The data outputs from the ADC are routed to connector J8. This connector is a standard 40-pin header on a 100-mil grid, and allows easy connection to a logic analyzer. The connector pinout is listed in Table 2–1.

Table 2–1. Output Connector J8

J8 PIN	DESCRIPTION	J8 PIN	DESCRIPTION
1	DGND	21	DGND
2	Output Clock	22	Data Bit 6
3	DGND	23	DGND
4	NC	24	Data Bit 7
5	DGND	25	DGND
6	NC	26	Data Bit 8
7	DGND	27	DGND
8	NC	28	Data Bit 9
9	DGND	29	DGND
10	Data Bit 0 (LSB)	30	Data Bit 10
11	DGND	31	DGND
12	Data Bit 1	32	Data Bit 11
13	DGND	33	DGND
14	Data Bit 2	34	Data Bit 12
15	DGND	35	DGND
16	Data Bit 3	36	Data Bit 13 (MSB)
17	DGND	37	DGND
18	Data Bit 4	38	Overflow
19	DGND	39	DGND
20	Data Bit 5	40	NC

Physical Description



This chapter describes the physical characteristics and PCB layout of the EVM and lists the components used on the module.

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3.1 PCB Layout	3-1
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3.1 PCB Layout

The EVM is constructed on a 6-layer, 4.5-inch x 4.15-inch, 0.062-inch thick PCB using FR-4 material. The individual layers are shown in the following figures.

Figure 3–1. Top Layer

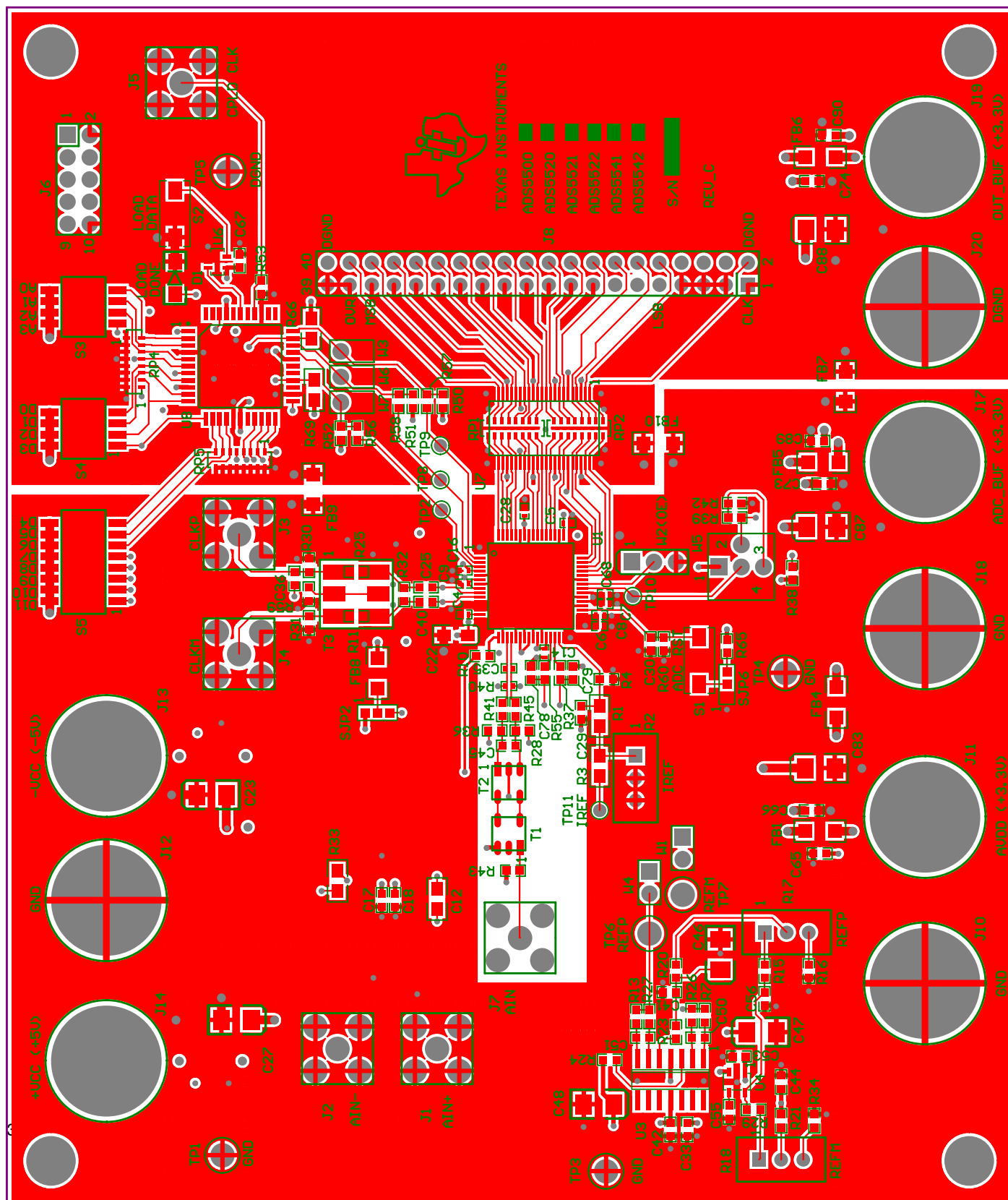
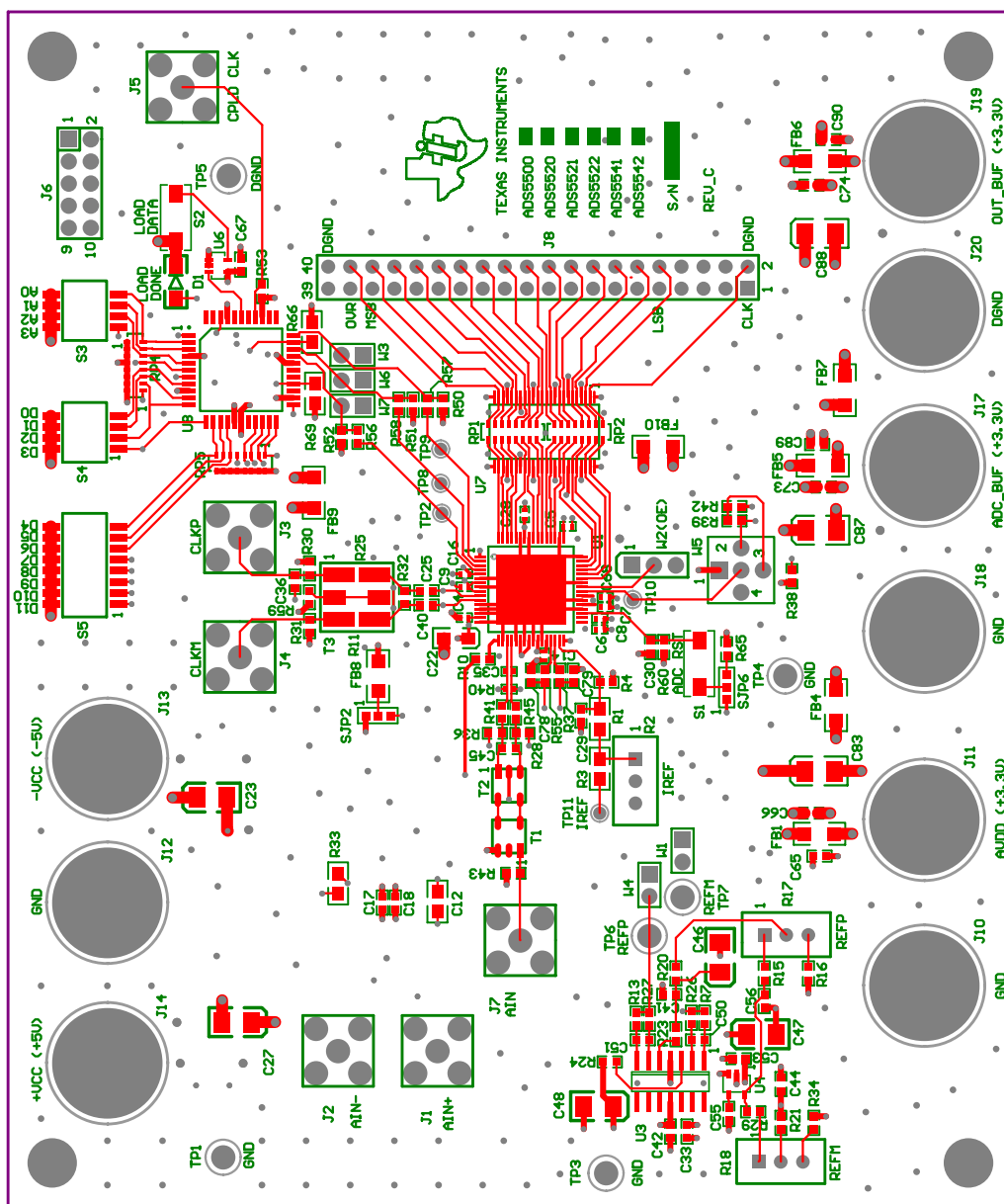


Figure 3-2. Top Layer (NH)



1 SILKSCREEN TOP

Figure 3–3. Layer 2, Ground Plane

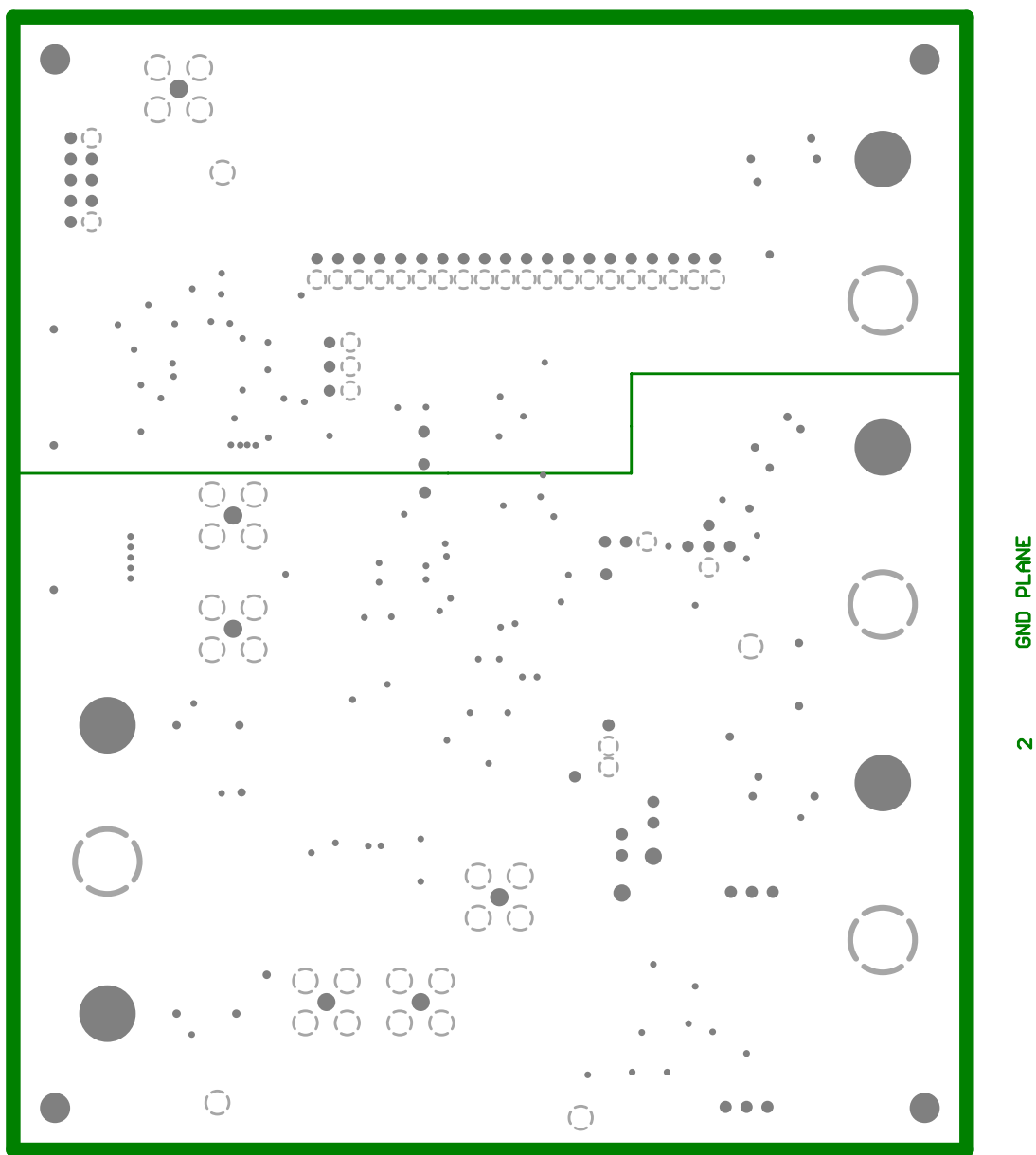


Figure 3-4. Layer 3, Split Power Plane #1

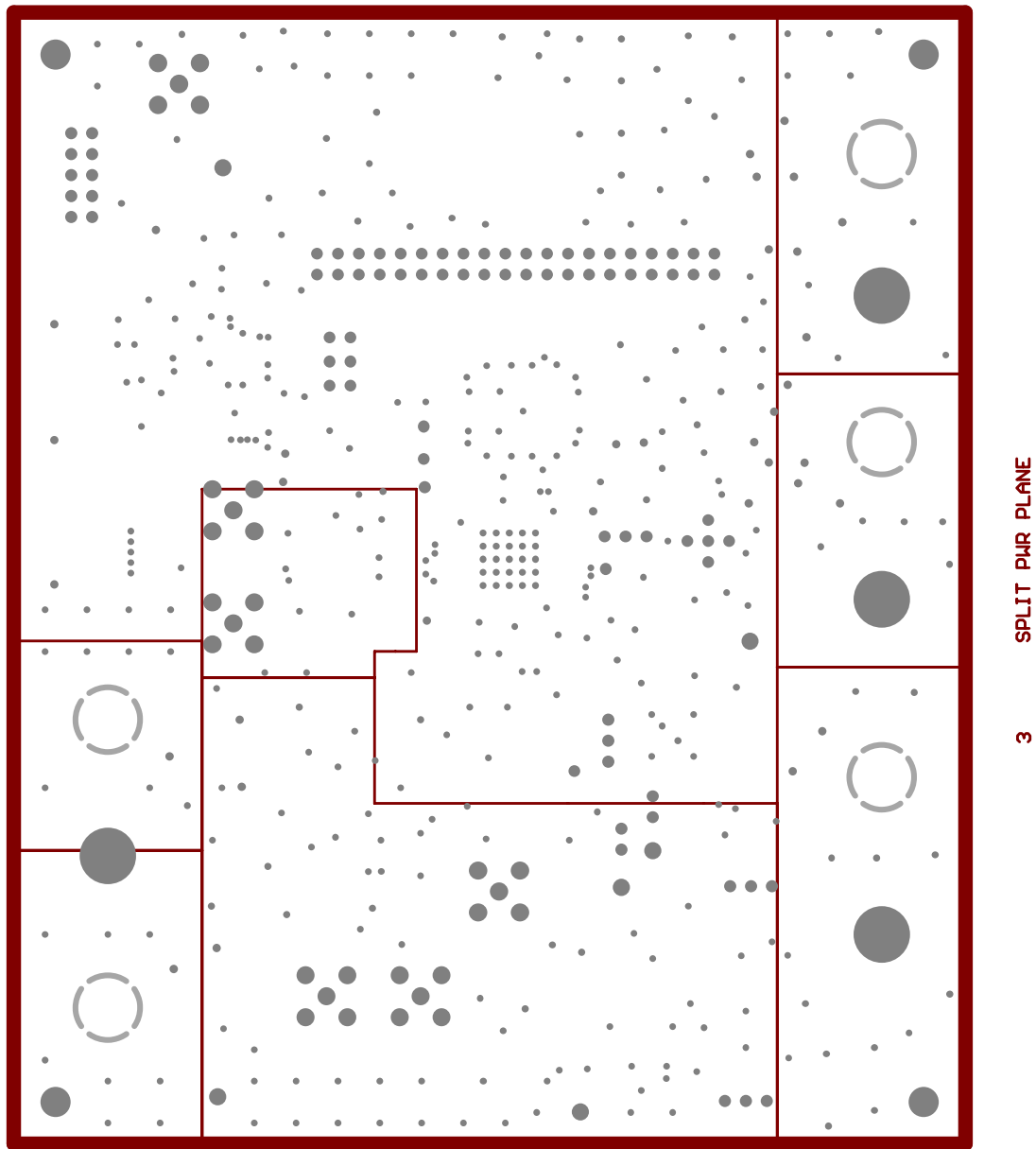


Figure 3–5. Layer 4, Split Power Plane #2

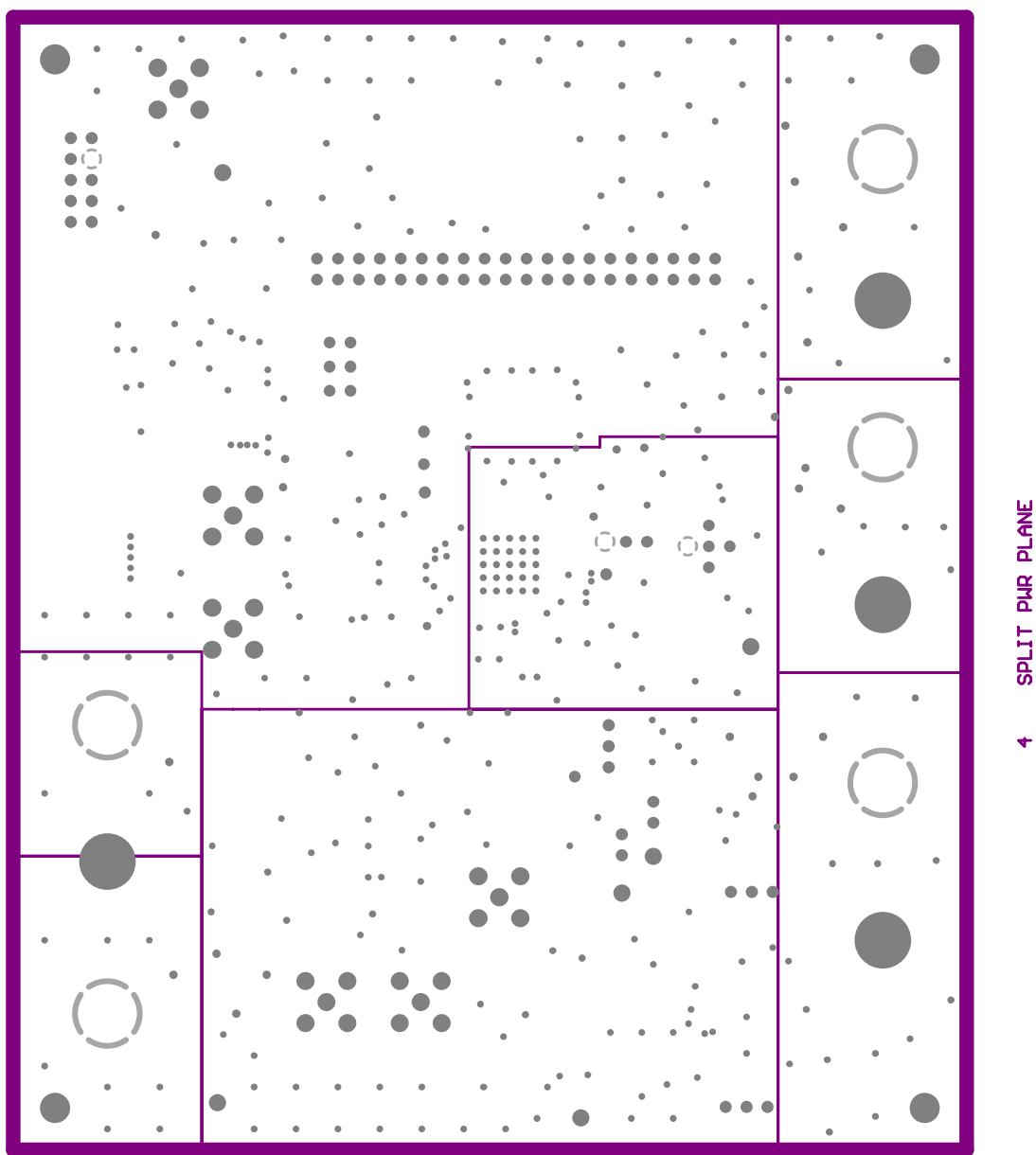


Figure 3-6. Layer 5, Ground Plane

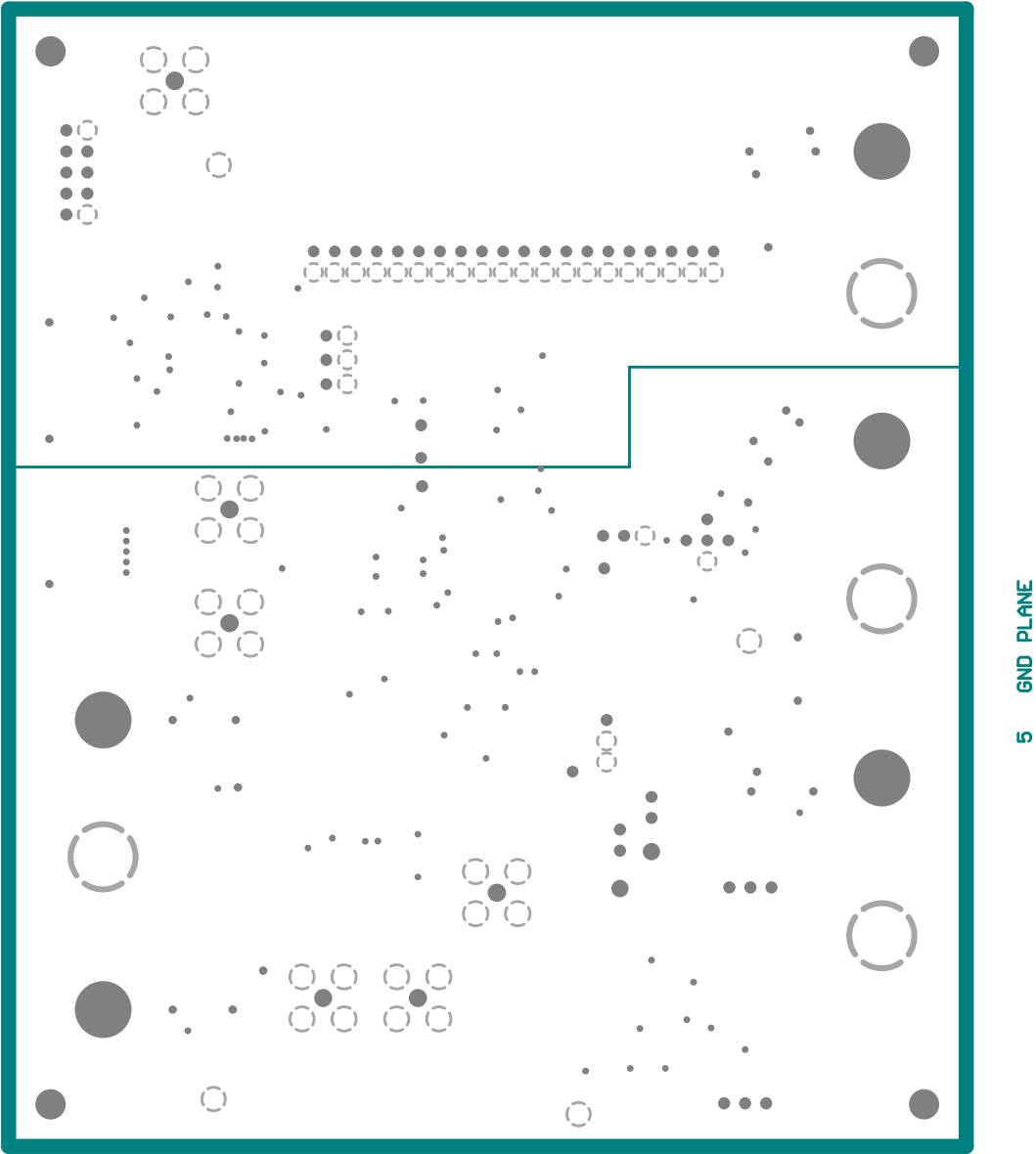


Figure 3–7. Layer 6, Bottom Layer

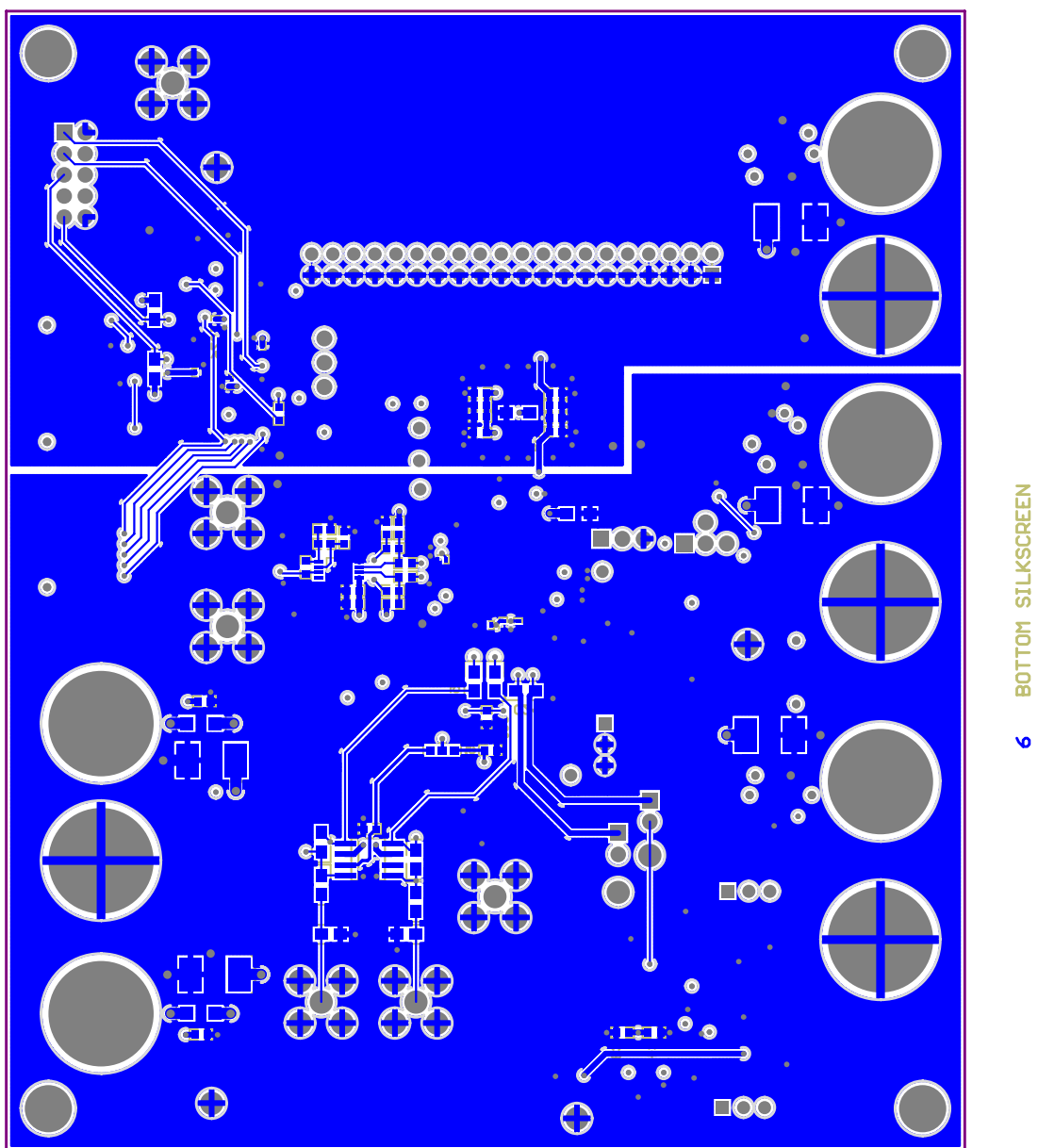
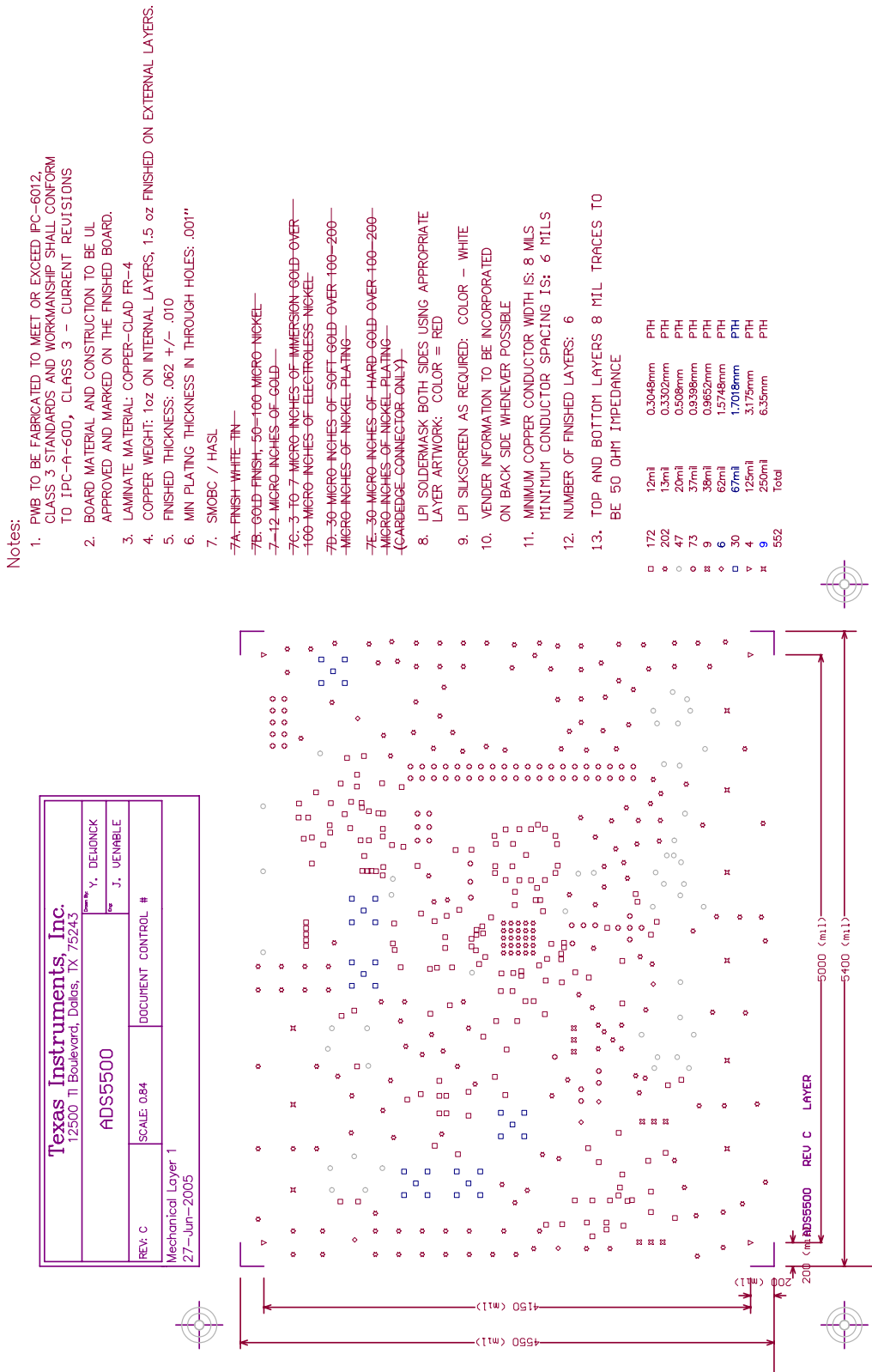




Figure 3–9. Drill Drawing



3.2 Parts List

The following pages contain the bill of materials..

3.3 Scehmatics

The following pages contain the schematics.

Bill Of Material For ADS5500 REV C 06-27-2005

Value	Footprint	QTY	Part Number	Vendor	Digi-Key Number	REF DES	TI SUPPLIED	Not Installed
CAPACITORS								
47 uF, tantalum, 20%, 10V	7343	5	ECS-T1AD476R	Panasonic	PCS2476CT-ND	C19 C21 C75 C81 C82		
10 uF, 10V, 20% Capacitor	3528	5	ECS-T1AX106R	Panasonic	PCS2106CT-ND	C23 C27 C83 C87 C88		C46 C47 C48
10 uF, 10V, 10% Capacitor	3216	3	T491A106K010AS	KEMET	399-1563-1-ND	C20 C22 C26		
.1uF,16V, 10% Capacitor	805	0	ECJ-2VB1C104K	Panasonic	PCC1812CT-ND			C24
6.8pF,50V, +/- .25pF Capacitor	805	2	08055A6R8CAT2A	AVX	478-1302-1-ND	C12 C32		
470 pF,100V, 10% Capacitor	603	4	ECJ-1VB2A471K	Panasonic	PCC1950CT-ND	C57 C59 C61 C63		C33 C34
.047uF,16V, 10% Capacitor	603	0	ECJ-1VB1H473K	Panasonic	PCC2286CT-ND			C50 C51
10 pF, 50V, +/- .5pF Capacitor	603	0	ECJ-1VC1H100D	Panasonic	PCC100CVCT-ND			C45
.01uF, 50V,10% Capacitor	603	4	ECJ-1VB1C103K	Panasonic	PCC1750CT-ND	C31 C52 C54 C69		C55
.1uF,16V, 10% Capacitor	603	19	ECJ-1VB1C104K	Panasonic	PCC1762CT-ND	C1 C13 C15 C17 C18 C25 C37 C38 C40 C58 C60 C62 C64 C65 C66 C73 C74 C89 C90		C29 C30 C36 C39 C41 C42 C43 C44 C49 C67
1uF, 6.3V,10% Capacitor	603	2	ECJ-1VB0J105K	Panasonic	PCC1915CT-ND	C78 C79		C53
2.2uF, 6.3V,+/- 80%/-20% Capacitor	603	0	ECJ-1VF0J225Z	Panasonic	PCC2181CT-ND			C56
.1uF,16V, +/- 80%/-20% Capacitor	402	14	ECJ-0EF1C104Z	Panasonic	PCC1731CT-ND	C2-C11 C14 C16 C28 C68		C71 C72 C76 C77
27 pF, 50V, 5% Capacitor	402	0	ECU-E1H270JCQ	Panasonic	PCC270CQCT-ND			C35
RESISTORS								
0 ohm resistor, 1/16 W, 1 %	805	1	ERJ-6ENF0R00V	Panasonic	P0.0CCT-ND	R8		
54.9 ohm resistor, 1/16 W, 1 %	805	1	ERJ-6ENF54R9V	Panasonic	P54.9CCT-ND	R9		
383 Ohm resistor, 1/16 W, 1 %	805	1	ERJ-6ENF3830V	Panasonic	P383CCT-ND	R12		
392 Ohm resistor, 1/16 W, 1 %	805	2	ERJ-6ENF3920V	Panasonic	P392CCT-ND	R14 R33		
412 Ohm resistor, 1/16 W, 1 %	805	1	ERJ-6ENF4120V	Panasonic	P412CCT-ND	R19		
1K Ohm resistor, 1/16 W, 1%	805	0	ERJ-6ENF1001V	Panasonic	P1.0KCCT-ND			R66 R67 R68 R69
10K Ohm resistor, 1/16 W, 1%	805	0	ERJ-6ENF1002V	Panasonic	P10.0KCCT-ND			R3
20K Ohm resistor, 1/16 W, 1%	805	0	ERJ-6ENF2002V	Panasonic	P20.0KCCT-ND			R1

Bill Of Material For ADS5500 REV C 06-27-2005

Value	Footprint	QTY	Part Number	Vendor	Digi-Key Number	REF DES	TI SUPPLIED	Not Installed
0 ohm resistor, 1/16 W, 1 %	603	5		Panasonic	P0.0CCT-ND	R31 R56 R57 R58 R59		R11 R25
1 Ohm resistor, 1/16 W, 5 %	603	2	9C0603A1 JLFHT	Panasonic	311-1 GTR-ND	R37 R55		
100 ohm resistor, 1/16 W, 1%	603	0	ERJ-3EKF1000V	Panasonic	P100HCT-ND			R23 R24
113 ohm resistor, 1/16 W, 1%	603	1	ERJ-3EKF1130V	Panasonic	P113HCT-ND	R64		
24.9 ohm resistor, 1/16 W, 1%	603	2	ERJ-3EKF24R9V	Panasonic	P24.9HCT-ND	R41 R45		R22 R35
36.5 ohm resistor, 1/16 W, 1%	603	2	ERJ-3EKF36R5V	Panasonic	P36.5HCT-ND	R28 R36		R22 R35
49.9 ohm resistor, 1/16 W, 1%	603	4	ERJ-3EKF49R9V	Panasonic	P49.9HCT-ND	R10 R30 R47 R48		R7 R13 R43 R53 R62 R63
82.5 ohm resistor, 1/16 W, 1%	603	0	ERJ-3EKF82R5V	Panasonic	P82.5HCT-ND			R54
200 ohm resistor, 1/16 W, 1%	603	0	ERJ-3EKF200V	Panasonic	P200HCT-ND			R32
499 ohm resistor, 1/16 W, 1%	603	2	ERJ-3EKF499V	Panasonic	P499HCT-ND	R44 R46		R15
1K ohm resistor, 1/16 W, 1%	603	3	ERJ-3EKF1001V	Panasonic	P1.00KHCT-ND	R38 R39 R42		
2K ohm resistor, 1/16 W, 1%	603	0	ERJ-3EKF2001V	Panasonic	P2.00KHCT-ND			R26 R27
2.55K ohm resistor, 1/16 W, 1%	603	0	ERJ-3EKF2551V	Panasonic	P2.55KHCT-ND			R34
2.87K ohm resistor, 1/16 W, 1%	603	0	ERJ-3EKF2871V	Panasonic	P2.87KHCT-ND			R29
4.7K ohm resistor, 1/16 W, 1%	603	1	ERJ-3EKF4701V	Panasonic	P4.7KHCT-ND	R65		
5.62K ohm resistor, 1/16 W, 1%	603	0	ERJ-3EKF5621V	Panasonic	P5.62KHCT-ND			R16
49.9K ohm resistor, 1/16 W, 1%	603	3	ERJ-3EKF4992V	Panasonic	P49.9KHCT-ND	R50 R51 R52		
56.2K ohm resistor, 1/16 W, 1%	603	1	ERJ-3EKF5622V	Panasonic	P56.2KHCT-ND	R4		
10K ohm resistor, 1/16 W, 1%	603	1	ERJ-3EKF1002V	Panasonic	P10.0KHCT-ND	R60		R20 R21
174 ohm resistor, 1/16 W, 1 %	402	0	ERJ-2RFK1740X	Panasonic	P174LCT-ND			R40
1K VARIABLE RESISTOR	POT_RES_TH	0	CT94W102	CERMET	CT94W102-ND			R17 R18
100K VARIABLE RESISTOR	POT_RES_TH	0	CT94W104	CERMET	CT94W104-ND			R2
0 ohm R-Pack	CTS-742-8RES	0	742C163000X	CTS	742C163000X-ND			RP1 RP2

Bill Of Material For ADS5500 REV C 06-27-2005

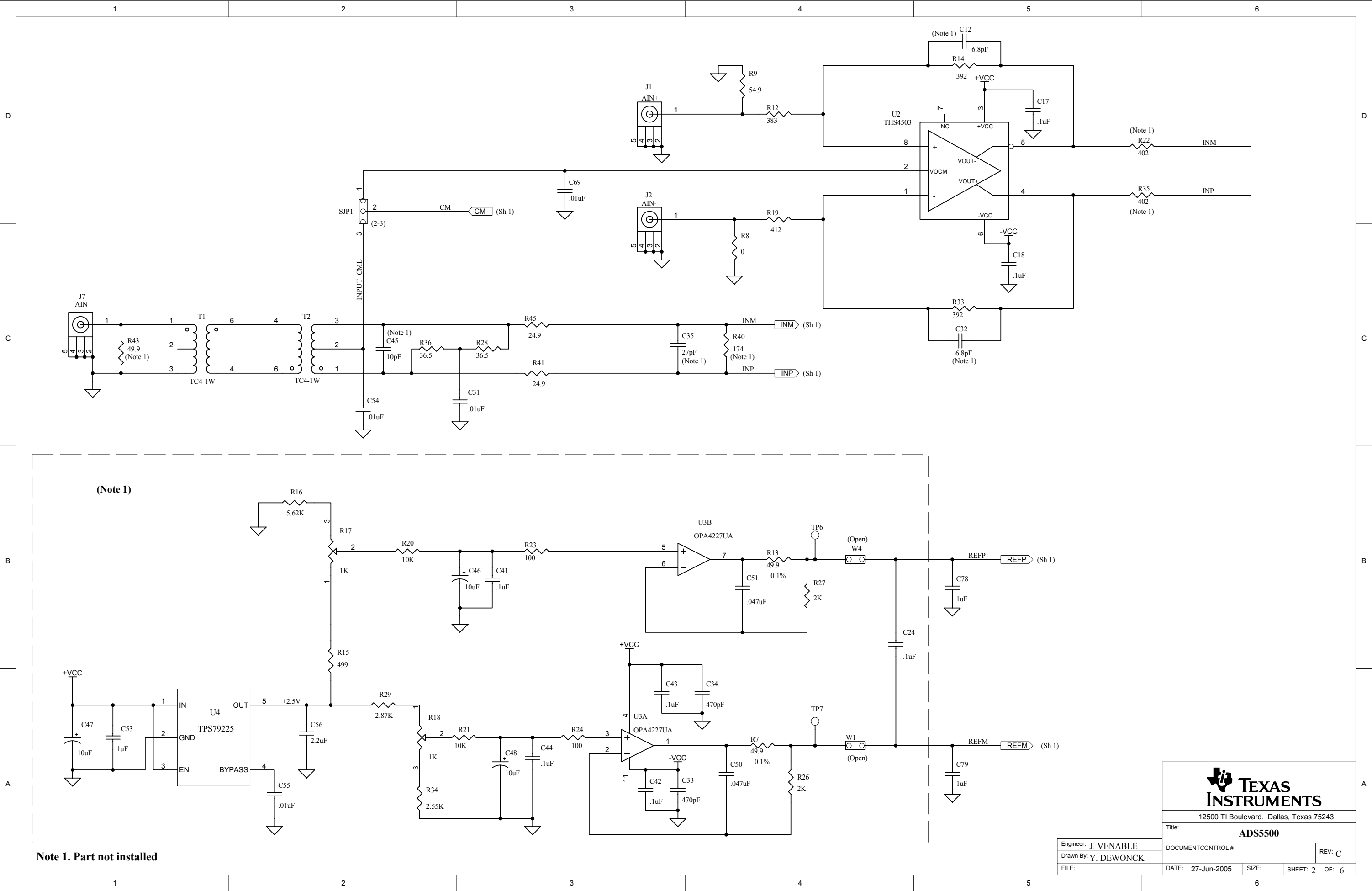
Value	Footprint	QTY	Part Number	Vendor	Digi-Key Number	REF DES	TI SUPPLIED	Not Installed
100K ohm R-Pack	CTS-742-4RES	0	742C163100KJCT	CTS	742C163100KJCT-ND			RP4 RP5
CONNECTORS, JUMPERS, HEADERS, FERRITE BEADS, TRANSFORMERS, ICS								
Ferrite Bead	1206	4	EXC-ML32A680U		P10437CT-ND	FB1 FB2 FB3 FB5 FB6 FB8 FB10		FB4 FB7 FB9
Transformer	TC4-1W_TRANSFORMER	2	TC4-1W	Mini-Circuits		T1 T2		
Transformer	MC-CD542	1	ADT4-1WT	Mini-Circuits		T3		
SMA connectors	SMA_Jack	4	901-144-8RFX	AMP	ARFX1231-ND	J1 J2 J3 J7		J4 J5
Black test point	Test_point	4	5011K-ND	Keystone	5011K-ND	TP1 TP3 TP4 TP5		
RED test point	Test_point	0	5010K-ND	Keystone	5010K-ND			TP6 TP7
RED test point	Test_point2	4	5000K-ND	Keystone	5000K-ND	TP2 TP8 TP9 TP10		TP11
2POS_header	2pos_jumper	3	HTSW-150-07-L-S	Samtec		W3 W6 W7		W1 W4
3POS_header	3pos_jumper	1	HTSW-150-07-L-S	Samtec		W2		
3 Circuit Jumpers	SJP3	3				SJP1 SJP2 SJP6		
5 Circuit Jumpers	5POS_JUMPER_TH	1				W5		
SWITCH	EVQ-PJ	1	EVQ-PJX04M	Panasonic	P8050SCT-ND	S1		S2
SWITCH 4 POSITION	SWITCH_4POS_SMT	0	DHS4S	APEM				S3 S4
SWITCH 8 POSITION	SWITCH_8POS_SMT	0	DHS8S	APEM				S5
40 pin IDC Connector	20X2X.1	1	HTSW-120-07-L-D	Samtec	N/A	J8		
10 pin IDC Connector	5X2X.1	0	HTSW-120-07-L-D	Samtec				J6
Red Banana Jacks	BANANA_JACK	5	ST-351A	ALLIED		J11 J13 J14 J17 J19		
Black Banana Jacks	BANANA_JACK	4	ST351B	ALLIED		J10 J12 J18 J20		
GREEN LED	LED-1206	0	CMD15-21VGC/TR8	Panasonic	L62205CT-ND			D1
ADS5500IPAP	64-HTQFP(PAP)	1	ADS5500IPAP	TI		U1	YES	
THS4503ID	8-SOP(D)	1	THS4503ID	TI	296-12938-5-ND	U2	YES	
OPA4227UA	14-SOP(D)	0	OPA4227UA	TI	OPA4227UA-ND			U3
TPS79225DBVR	5-SOT(DBV)	0	TPS79225DBVR	TI	296-11869-2-ND			U4
MC10EP16DT	8-TSSOP(DGK)	1	MC10EP16DT	ON Semiconductor	MC10EP16DTOS-ND	U5		

Bill Of Material For ADS5500 REV C 06-27-2005

Value	Footprint	QTY	Part Number	Vendor	Digi-Key Number	REF DES	TI SUPPLIED	Not Installed
TPS3801J25DCKR	5-SOT(DCK)	0	TPS3801J25DCKR	TI	296-3326-2-ND			U6
SN74AVC16244DGGR	48-TSSOP(DGG)	1	SN74AVC16244DGGR	TI	296-9783-1-ND		YES	
EPM7032BTC44	44-TQFP(PGT)	0	EPM7032BTC44-3	ALTERA				U8
SCREWS	4-40 screw	4						
Plastic Stand Off Hex (1/4 x .5")	4-40 screw	4	1902CK-ND	allied	1902CK-ND			

SURFACE MOUNT JUMPER LOCATION: SJP6 2-3; SJP1 2-3; SJP2 1-2;

JUMPER SHUNT LOCATION: W2 PINS 1-2, W5 PINS 4-5, W1, W3, W4, W6, W7 DO NOT INSTALL;



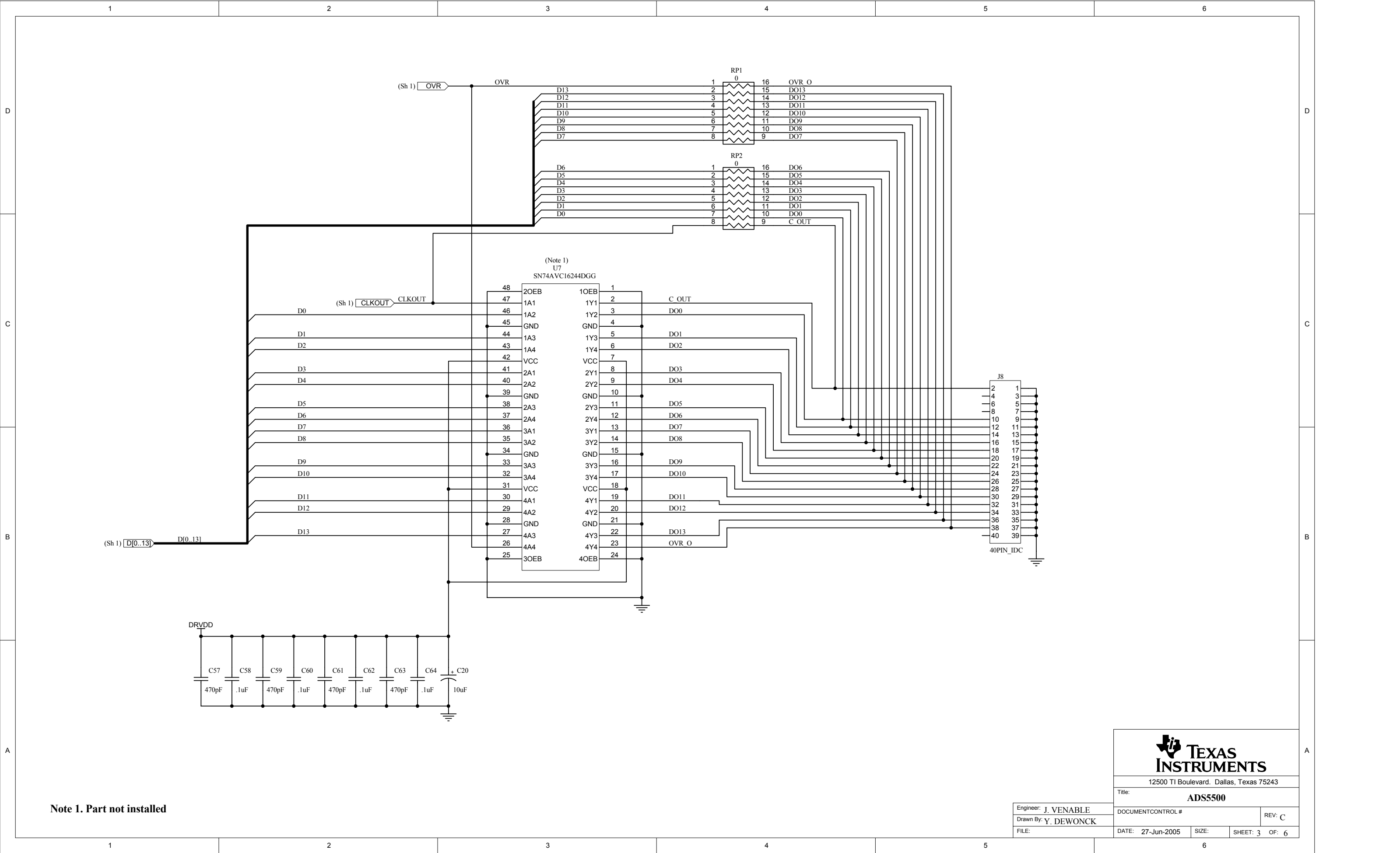
Note 1. Part not installed

Engineer: J. VENABLE	DOCUMENT CONTROL #	REV: C
Drawn By: Y. DEWONCK	DATE: 27-Jun-2005	SIZE: SHEET: 2 OF: 6
FILE:		



12500 TI Boulevard. Dallas, Texas 75243

Title: ADS5500



Note 1. Part not installed

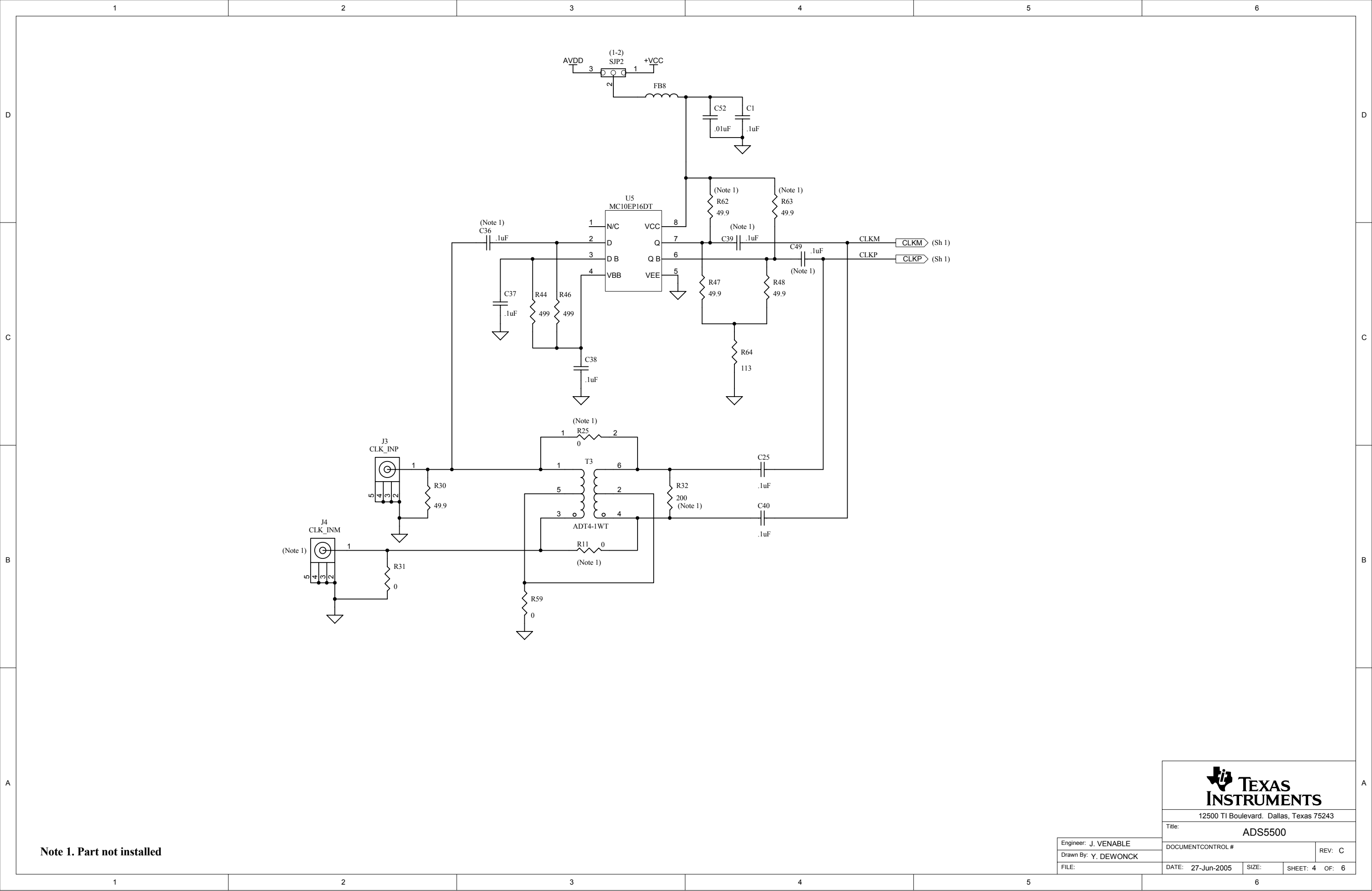


**TEXAS
INSTRUMENTS**

12500 TI Boulevard. Dallas, Texas 75243

Title: **ADS5500**

Engineer: J. VENABLE	DOCUMENT CONTROL #	REV: C
Drawn By: Y. DEWONCK	DATE: 27-Jun-2005	SIZE: SHEET: 3 OF: 6



12500 TI Boulevard. Dallas, Texas 75243

Title: ADS5500

DOCUMENT CONTROL #

REV: C

Engineer: J. VENABLE

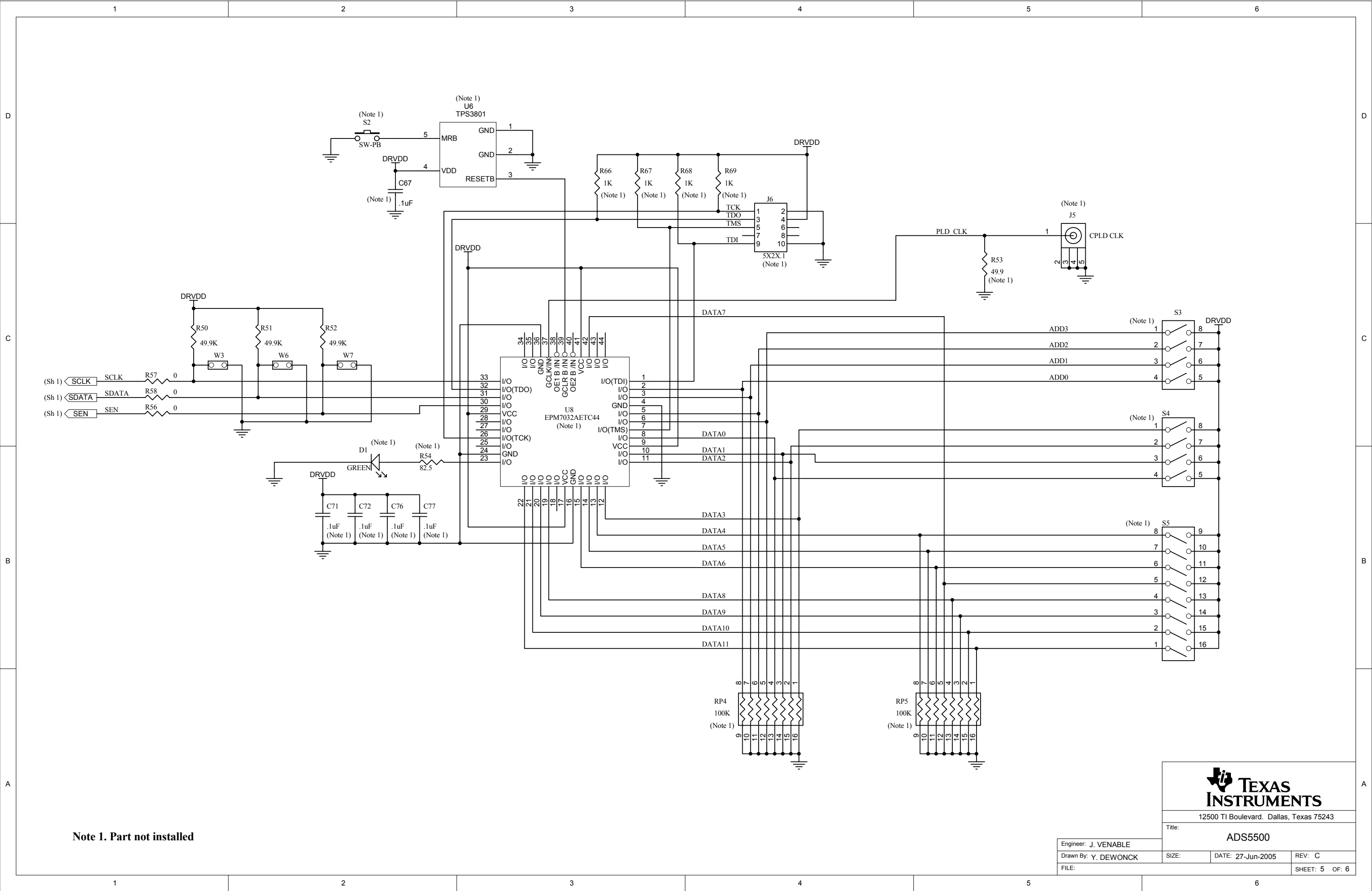
Drawn By: Y. DEWONCK

FILE:

DATE: 27-Jun-2005

SIZE:

SHEET: 4 OF: 6



Note 1. Part not installed

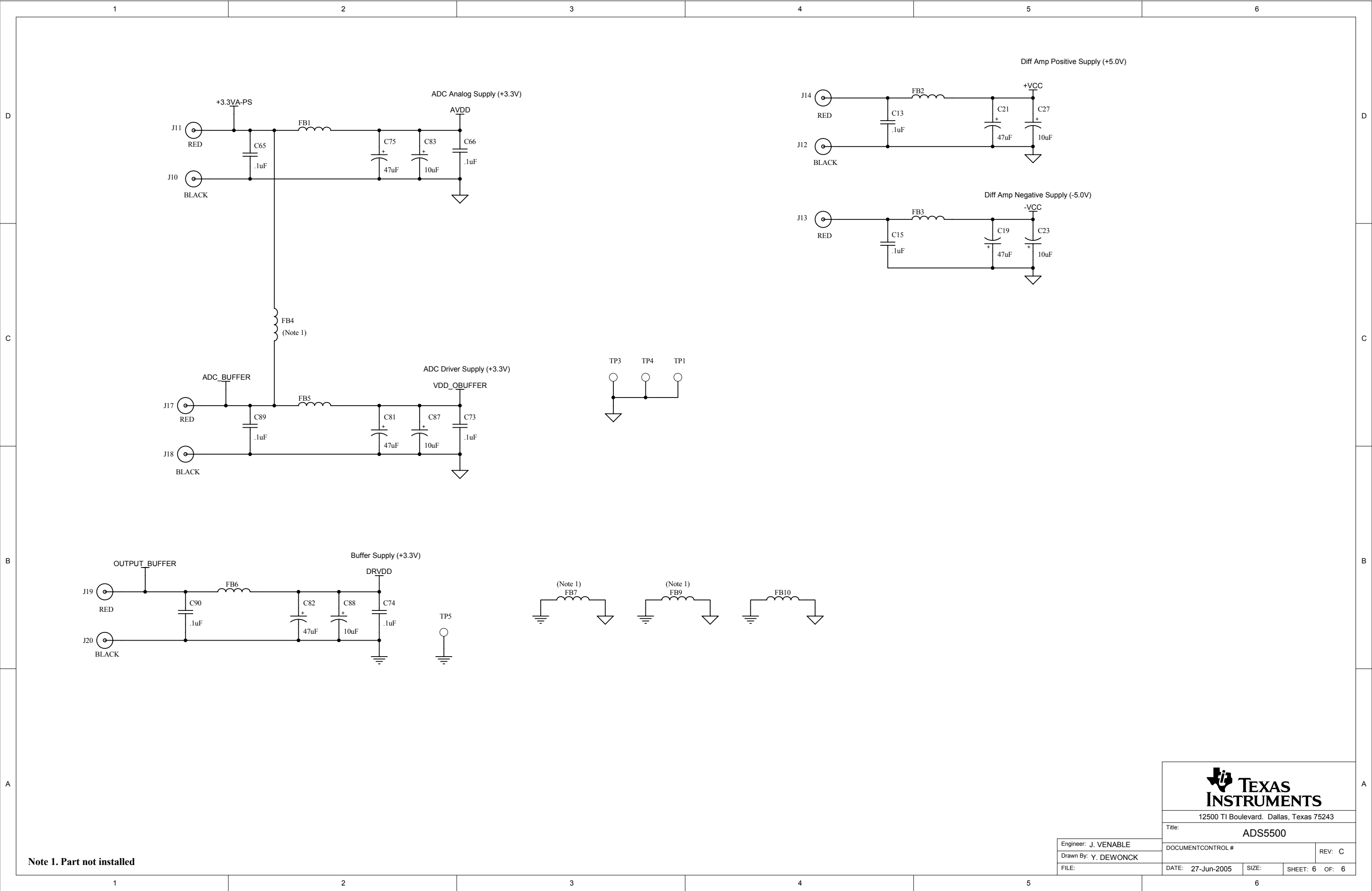


**TEXAS
INSTRUMENTS**

12500 TI Boulevard. Dallas, Texas 75243

Title: ADS5500

Engineer: J. VENABLE	SIZE:	DATE: 27-Jun-2005	REV: C
Drawn By: Y. DEWONCK	FILE:		SHEET: 5 OF: 6



Note 1. Part not installed

**TEXAS
INSTRUMENTS**

12500 TI Boulevard. Dallas, Texas 75243

Title: **ADS5500**

Engineer: J. VENABLE	DOCUMENT CONTROL #		REV: C
Drawn By: Y. DEWONCK	DATE: 27-Jun-2005	SIZE:	SHEET: 6 OF: 6



**Стандарт
Электрон
Связь**

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С нами вы становитесь еще успешнее!

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