

# ***TLC3578EVM Family***

## *User's Guide*

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DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
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## **EVM WARNINGS AND RESTRICTIONS**

It is important to operate this EVM within the input voltage range of  $\pm 15$  V.

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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# Read This First

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### ***About This Manual***

This user's guide describes the characteristics, operation, and use of the following evaluation boards:

- TLC3578 EVM Bipolar-Input, 8-channel 14-bit serial analog-to-digital converter
- TLC3574 EVM Bipolar-Input, 4-channel 14-bit serial analog-to-digital converter
- TLC3548 EVM Unipolar-Input, 8-channel 14-bit serial analog-to-digital converter
- TLC3544 EVM Unipolar-Input, 4-channel 14-bit serial analog-to-digital converter
- TLC2578 EVM Bipolar-Input, 8-channel 12-bit serial analog-to-digital converter
- TLC2574 EVM Bipolar-Input, 4-channel 12-bit serial analog-to-digital converter

A complete circuit description as well as schematic diagram and bill of materials is included. Contact the Product Information Center or e-mail [dataconvapps@list.ti.com](mailto:dataconvapps@list.ti.com) for questions regarding this EVM.

### ***How to Use This Manual***

This document contains the following chapters:

- Chapter 1—EVM Overview
- Chapter 2—Analog Interface
- Chapter 3—Digital Interface
- Chapter 4—Power Supply
- Chapter 5—Getting the Most From Your EVM
- Chapter 6—Bill of Materials, Board Layouts, and Schematic

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This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

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<b>Data Sheets</b>	<b>Literature Number</b>
TLC3578 TLC3574 TLC2578 TLC2574	SLAS262
TLC3548 TLC3544	SLAS266
OPA132	PDS1309
REF3040 REF3033	SBVS032

# Contents

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---

<b>1</b>	<b>EVM Overview</b> .....	<b>1-1</b>
1.1	Features .....	1-2
<b>2</b>	<b>Analog Interface</b> .....	<b>2-1</b>
2.1	Analog Interface Block Diagram .....	2-2
2.2	Signal Conditioning .....	2-2
2.3	Single Supply Operation .....	2-2
2.4	Physical Pinout Description .....	2-3
2.5	Reference Voltage .....	2-3
2.6	Configuration Options .....	2-4
<b>3</b>	<b>Digital Interface</b> .....	<b>3-1</b>
3.1	Physical Pinout Description .....	3-2
<b>4</b>	<b>Power Supply</b> .....	<b>4-1</b>
<b>5</b>	<b>Getting the Most From Your EVM</b> .....	<b>5-1</b>
5.1	Additional Hardware Options .....	5-2
5.1.1	Stand-Alone EVM .....	5-2
5.1.2	DSP Interface .....	5-2
5.1.3	MSP430 Microcontroller interface .....	5-3
<b>6</b>	<b>Bill of Materials, Board Layouts, and Schematic</b> .....	<b>6-1</b>
6.1	Bill of Materials for EVM .....	6-2
6.2	Board Layouts .....	6-4
6.3	EVM Schematic .....	6-7

# Figures

---

---

---

2-1	Block Diagram .....	2-2
5-1	EVM Selection .....	5-3
5-2	DSK-To-EVM Stackup Diagram .....	5-3
6-1	Top Layer .....	6-4
6-2	Internal Plane 1 .....	6-5
6-3	Internal Plane 2 .....	6-5
6-4	Bottom Layer (Mirrored) .....	6-6

# Tables

---

---

---

2-1	Analog Input Pinout Description .....	2-3
2-2	ADC Reference Voltage .....	2-3
2-3	Jumper Settings .....	2-4
3-1	Digital Signal Pinout Description .....	3-2
4-1	Power Connector Pinout Description .....	4-1



# **EVM Overview**

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Each evaluation board is based on the equivalent ADC. All ADCs use a synchronous serial interface which can be simply interfaced to many micro-controllers using the SPI protocol.

Each EVM also incorporates a stable voltage reference, and operational amplifier to ensure a low-noise voltage reference for the ADC.

<b>Topic</b>	<b>Page</b>
<b>1.1 Features</b> .....	<b>1-2</b>

## 1.1 Features

- Evaluation board featuring one of the following:
  - TLC3578 ADC (order TLC3578 EVM)
  - TLC3574 ADC (order TLC3574 EVM)
  - TLC3548 ADC (order TLC3548 EVM)
  - TLC3544 ADC (order TLC3544 EVM)
  - TLC2578 ADC (order TLC2578 EVM)
  - TLC2574 ADC (order TLC2574 EVM)
- Onboard reference, with recommended buffer circuitry
- Suggested signal conditioning circuitry for 1 channel only

# Analog Interface

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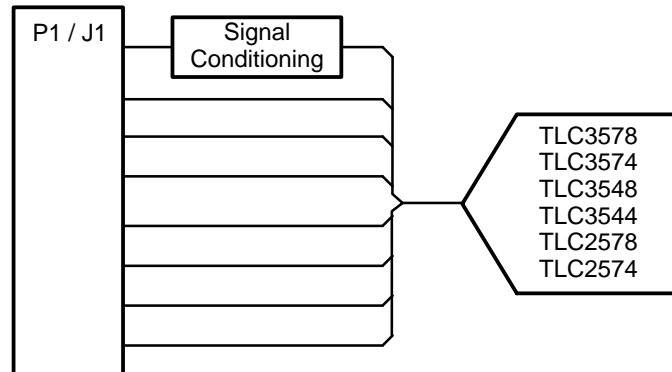
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<b>Topic</b>	<b>Page</b>
2.1 Analog Interface Block Diagram .....	2-2
2.2 Signal Conditioning .....	2-2
2.3 Single Supply Operation .....	2-2
2.4 Physical Pinout Description .....	2-3
2.5 ADC Reference Voltage .....	2-3
2.6 Configuration Options .....	2-4

## 2.1 Analog Interface Block Diagram

A block diagram for the analog interface of the EVM is shown in Figure 2–1.

Figure 2–1. Block Diagram



The channels are arranged to comply with the EVM standard developed for data converters. This standard defines eight channels of analog I/O on each EVM module.

## 2.2 Signal Conditioning

The facility exists for the signal connected to channel 0 to be conditioned via an operational amplifier. The amplifier present on the EVM operates from a dual power supply and is configured with a gain of +1.

If signal conditioning is not required, it can easily be bypassed via a shorting bar.

## 2.3 Single Supply Operation

Should the user wish to operate the amplifier from a single supply rail, this is also possible by simply removing the dual supply amplifier and replacing it with a suitable single supply alternative, for example the OPA353.

The suggested procedure is detailed below:

- Carefully desolder amplifier, U1
- Replace with a suitable single-supply alternative, for example TI part number OPA353UA
- Install appropriate resistor at R9
- Install appropriate capacitor at C11
- Install shorting bar at W1

## 2.4 Physical Pinout Description

Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-T-DV-P provide a convenient 10-pin dual row header/socket combination at P1. This header/socket provides access to the analog input pins of the TLV2553/6.

Consult Samtec at [www.samtec.com](http://www.samtec.com) or 1-800-SAMTEC-9 for a variety of mating connector options.

Table 2–1. Analog Input Pinout Description

Pin Number		Signal	Description
Header	Socket		
P1.2	J1.2	CH0	Channel 0 input, can be direct from P1/J1 connector or through Op-Amp
P1.4	J1.4	CH1	Channel 1 input, direct from P1/J1 connector
P1.6	J1.6	CH2	Channel 2 input, direct from P1/J1 connector
P1.8	J1.8	CH3	Channel 3 input, direct from P1/J1 connector
P1.10	J1.10	CH4	Channel 4 input, direct from P1/J1 connector
P1.12	J1.12	CH5	Channel 5 input, direct from P1/J1 connector
P1.14	J1.14	CH6	Channel 6 input, direct from P1/J1 connector
P1.16	J1.16	CH7	Channel 7 input, direct from P1/J1 connector
P1.18	J1.18	REF–	External Reference negative input
P1.20	J1.20	REF+	External Reference positive input

## 2.5 Reference Voltage

The accuracy of conversion from a SAR ADC depends directly upon the accuracy of the reference voltage. It is very important, therefore, that the reference be stable, accurate and low drift.

The ADC reference pin presents a dynamic capacitive load to the amplifier. The voltage supplied to the ADC must be capable of driving this dynamic load properly, ensuring that the reference remain stable regardless of load.

The bipolar and unipolar devices are specified to use a different voltage for the reference pin.

Table 2–2. ADC Reference Voltage

ADC	Reference Voltage
<b>Bipolar input</b>	
TLC3578	3.3 V
TLC3574	3.3 V
TLC2578	3.3 V
TLC2574	3.3 V
<b>Unipolar input</b>	
TLC3548	4.096 V
TLC3544	4.096 V

## 2.6 Configuration Options

There are a number of options available via shorting jumpers. These are detailed below:

Table 2–3. Jumper Settings

Reference Designator	Description	Factory Set Condition Position	Optional Position
		1–2	2–3
W1	Single supply operation	Not installed	
W2	Select negative supply for op amp	–Vs	AGND (0 V)
W3	Select positive supply for op amp	+Vs	+Vcc (5 V)
W4	Select signal source for channel 0	Signal is via op amp	Signal is directly from P1.2
W5	Select positive voltage reference	Onboard reference	Reference via P1.18
W6	Select digital power	5 V	3.3 V
W7	Select negative voltage reference	Onboard reference	Reference via P1.20
W8	$\overline{\text{CSTART}}$ , initiate manual conversion	Disabled	Enabled
W9	FS mode	Disabled	Enabled
W10	Device always selected	Disabled	Enabled

# Digital Interface

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The digital interface for the EVM is simply the appropriate digital signals from the ADC routed and presented to the 20-pin digital interface connector.

<b>Topic</b>	<b>Page</b>
<b>3.1 Physical Pinout Description .....</b>	<b>3-2</b>

### 3.1 Physical Pinout Description

The EVM is designed for easy interfacing to multiple platforms. Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-T-DV-P provide a convenient 10-pin dual row header/socket combination.

This header/socket combination provides access to the digital control and serial data pins of the EVM. Consult Samtec at [www.samtec.com](http://www.samtec.com) or 1-800-SAMTEC-9 for a variety of mating connector options.

Table 3-1. Digital Signal Pinout Description

Pin Number		Signal	Description
Header	Socket		
P3.1	J3.1	$\overline{CS}$	Chip select selects the device for data transfer.
P3.3	J3.3	SCLK/CLKX	Data transfer clock
P3.5	J3.5	Reserved	
P3.7	J3.7	FSX	
P3.9	J3.9	FSR	
P3.11	J3.11	SDI	Serial data into the device
P3.13	J3.13	SDO	Serial data out of the device
P3.15	J3.15	EOC or $\overline{INT}/EOC^\dagger$	Selects either EOC or $\overline{INT}$ – see data sheet for details.
P3.17	J3.17	Reserved	
P3.19	J3.19	$\overline{CSTART}$	Control the beginning of a conversion

<sup>†</sup> Programmable as either EOC or  $\overline{INT}$



# Power Supply

The EVM accepts four power supplies.

- A dual  $\pm V_s$  dc supply for the dual-supply op-amps.
- A single 5.0 V dc supply for the analog section of the ADC.
- A single 3.3 V to 5 V dc supply for the digital section of the ADC.

There are two ways to provide these voltages.

- Hook-up the test points on the EVM. The test points are clearly labeled +Vdd (3.3 V to 5 V), +5VA, +Vs (up to 18 V depending upon the amplifiers) and -Vs (up to -18 V depending upon the amplifiers).
- Use the power connector P5/J5 and derive the voltages elsewhere.

The pinout for this connector is shown in Table 4-1.

*Table 4-1. Power Connector Pinout Description*

Signal	P5/J5 Pin Number		Signal
+VA	1	2	-VA
+5VA	3	4	-5VA
AGND	5	6	DGND
+1.8VD	7	8	VD1
+3.3VD	9	10	+5VD



# Getting the Most From Your EVM

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A wide range of prototyping options and software solutions are available from TI, and offer additional flexibility, reducing your time-to-market. Hardware and software offerings from TI help you easily get from concept to hardware and software prototype.

<b>Topic</b>	<b>Page</b>
<b>5.1 Additional Hardware Options .....</b>	<b>5-2</b>

## 5.1 Additional Hardware Options

In general there are three hardware directions that the user can take with the EVM.

### 5.1.1 Stand-Alone EVM

The EVM can be used on its own. Using the EVM in this manner obliges the user to provide a custom digital interface between the EVM and a host system. Users are entirely responsible for ensuring proper timing requirements are met in addition to providing any glue logic necessary. Users must also provide the necessary analog interface and supply power to the EVM.

### 5.1.2 DSP Interface

Depending upon the DSP that the user chooses, there are a number of TI DSKs available. DSKs are **DSP Starter Kits**, and provide users with a DSP starter system. They contain all the necessary hardware and software to quickly begin prototype construction.

For example, the TMS320C6711 DSP starter kit includes the DSK hardware, a parallel port cable to connect to a PC, a 5-V universal power supply, and a Code Composer Studio™ CD-ROM containing all the necessary software.

Each family of DSKs provides different physical interface options. These interface options enable address, data, and control signals to be decoded and used by mezzanine-level cards (such as EVMs).

To connect this EVM to any DSK requires selection of the correct interface card. Generally the procedure is outlined below.

- Select the DSP you wish to use.
- Select the appropriate DSK.
- Select the suitable interface card.

As an example, assume that the user wishes to use the TLC3578 EVM with the TMS320C6711 DSP, the steps that should be taken are shown below following a side-elevation of the boards required.

Figure 5–1. EVM Selection

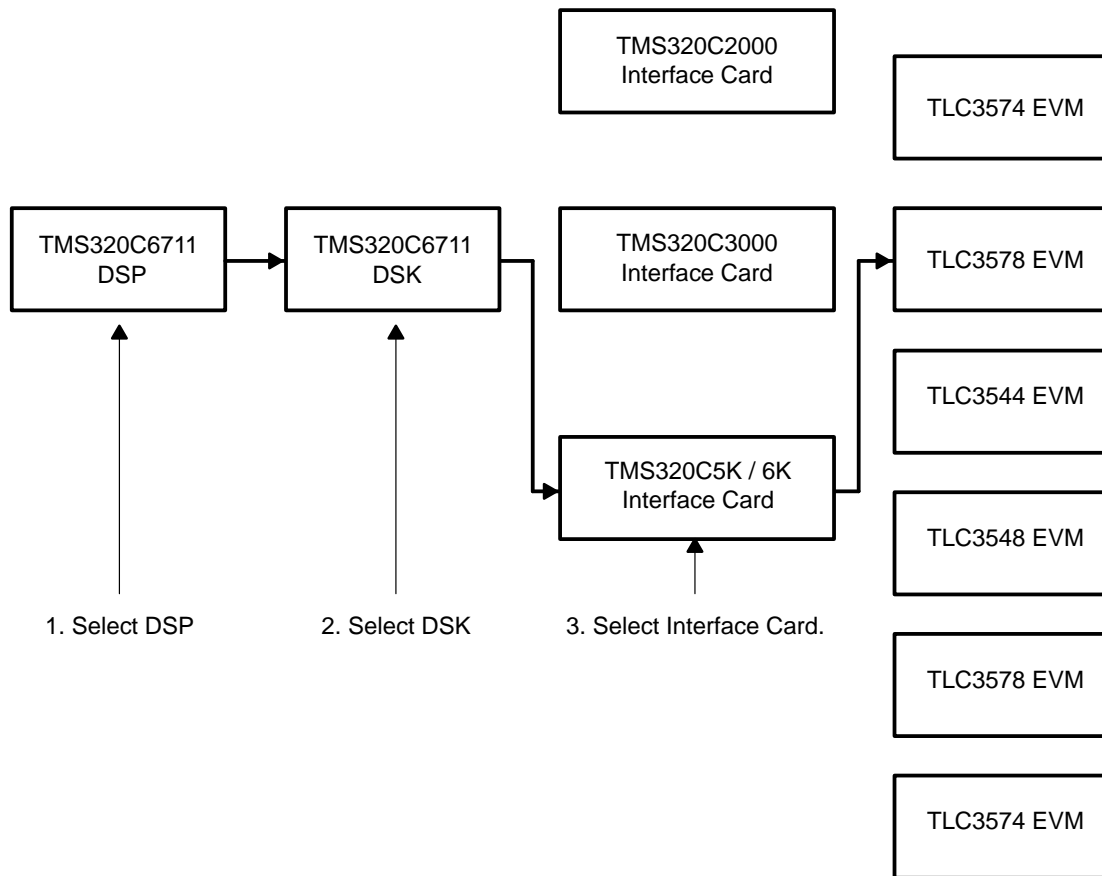
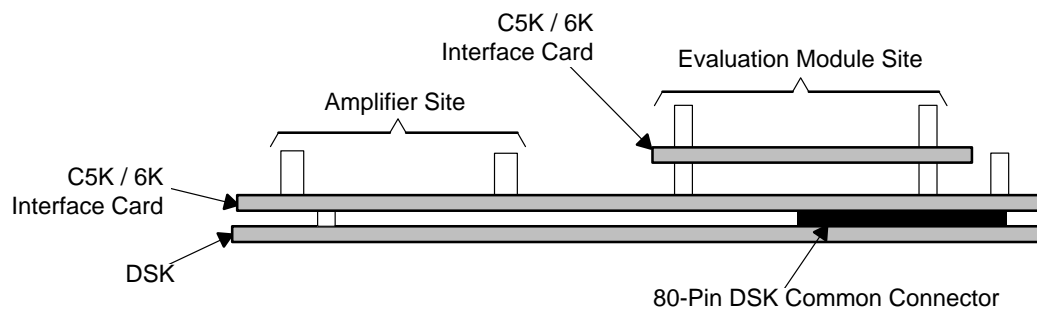


Figure 5–2. DSK-To-EVM Stackup Diagram



### 5.1.3 MSP430 Microcontroller interface

TI also offer a range of low-power microcontrollers that have an SPI interface. You can check-out these devices and order evaluation modules at [www.ti.com](http://www.ti.com)

A microcomputer evaluation board exists, featuring the MSP430F449 that also enables the ADC EVMs to be connected directly.

The HPA449 evaluation board, available from Softbaugh [www.softbaugh.com](http://www.softbaugh.com) includes the following features:



# **Bill of Materials, Board Layouts, and Schematic**

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This chapter contains the EVM bill of materials, board layouts and schematics.

<b>Topic</b>	<b>Page</b>
<b>6.1 Bill of Materials for EVM .....</b>	<b>6-2</b>
<b>6.2 Board Layouts .....</b>	<b>6-3</b>
<b>6.3 EVM Schematic .....</b>	<b>6-6</b>

## 6.1 Bill of Materials for EVM

Item no.	Qty	Value	Ref Des	Description	Vendor	Part number
1	1	0R	R19	Resistor, 0-Ω 1/16 W 5% 0402 SMD	Panasonic	ERJ-2GE0R00X
2	2	0R	R8, R17	Resistor, 0-Ω 1/8 W 5% 1206 SMD	Panasonic	ERJ-8GEY0R00V
3	1	10R	R15	Resistor 10-Ω 1/8 W 5% 1206 SMD	Panasonic	ERJ-8GEYJ100V
4	9	33R	R1, R2, R3, R4, R5, R6, R7, R12, R13	Resistor, 33-Ω 1/8 W 5% 1206 SMD	Panasonic	ERJ-8GEYJ330V
5	4	100R	R10, R11, R20, R21	Resistor, 100-Ω 1/8 W 5% 1206 SMD	Panasonic	ERJ-8GEYJ101V
6	2	10 KΩ	R16, R18	Resistor, 10-kΩ, 1/8 W 5% 1206 SMD	Panasonic	ERJ-8GEYJ103V
7	1	10 pF	C3	Capacitor, 10-pF 50 V Ceramic chip, 0805 SMD	Panasonic	ECJ-2VC1H100D
8	8	0.1 μF	C1, C13, C15, C16, C20, C22, C23, C24	Capacitor, .1-μF 25 V Ceramic, X7R 0805	Panasonic	ECJ-2VB1E104K
9	8	27 nF	C4, C5, C6, C7, C8, C9, C10, C14	Capacitor, 27000-pF 50 V, Ceramic, X7R 0805	Panasonic	ECJ-2VB1H273K
10	1	1 μF	C18	Capacitor, 1-μF 10 V J Ceramic X5R 0805	Panasonic	ECJ-2YB1A105K
11	1	10 μF	C17	Capacitor, 10-μF 16 V tantalum, TE series	Panasonic	ECS-T1CX106R
12	4	10 μF	C2 C12 C19 C21	Capacitor, 10-μF 16 V, VS electrolytic, SMD	Panasonic	ECE-V1CA100SR
13	2		W1, W10	2-pin header	Samtec	TSW-102-07-L-S
14	8		W2, W3, W4, W5, W6, W7, W8, W9	3-Pin header	Samtec	TSW-103-07-L-S
15	1		P5	10-Pin header	Samtec	TSM-105-01-T-DV-P
16	1		J5	10-Socket strip	Samtec	SSW-105-22-F-D-VS-K
17	4		P1 P2 P3 P4	20-Pin header	Samtec	TSM-110-01-T-DV-P
18	4		J1 J2 J3 J4	20-Socket strip	Samtec	SSW-110-22-F-D-VS-K
19	3		FB1, FB2, FB3	Fair-Rite SM beads #24--44447	Fair-Rite	2744044447
20	2	OPA132UA	U1, U3	IC, FET-input op amp, 8-SOIC	Texas Instruments	OPA132UA
21	1	REF3033	U2	IC voltage reference, 3.33-V LP SOT-23	Texas Instruments	REF3033AIDBZT
Contingent on Item 22		REF3040	U2	IC, voltage reference, 4.096-V, LP SOT-23	Texas Instruments	REF3040AIDBZT



22	1	TLC3578	U4	IC, A/D 8-CH, 14-BIT, LP 24-TSSOP	Texas Instruments	TLC3578IPW
	Alternate	TLC3574	U4	IC, A/D, 4-Ch, 14-bit LP 20-TSSOP	Texas Instruments	TLC3574IPW
	Alternate	TLC3548	U4	IC, Unipolar A/D 8-CH 24-SOIC	Texas Instruments	TLC3548IPW
	Alternate	TLC3544	U4	IC, Unipolar A/D 4-CH 20-SOIC	Texas Instruments	TLC3544IPW
	Alternate	TLC2578	U4	IC, Serial out A/D 8-CH 24-SOIC	Texas Instruments	TLC2578IPW
	Alternate	TLC2574	U4	IC, Serial out A/D 4-CH 20-TSSOP	Texas Instruments	TLC2574IPW
23	2	SN74LVC1G07	U5, U6	Single IC buffer driver with open drain o/p	Texas Instruments	SN74LVC1G07DBVR
24	1			TLC3578 Rev A PWB	Texas Instruments	6448024
25	4	TP_.025	+5VA, +VA, -VA, Vdd	Test Point – Single .025" Pin	Keystone Electronics	5000
26	2	TP_turret	AGND, DGND	Turret terminal test point	Cambion	180-7337-02-05
	1	Not Installed	R14	*	*	*
	1	Not Installed	C11	*	*	*
	1	Not Installed	R9	*	*	*

## 6.2 Board Layouts

Figure 6-1. Top Layer

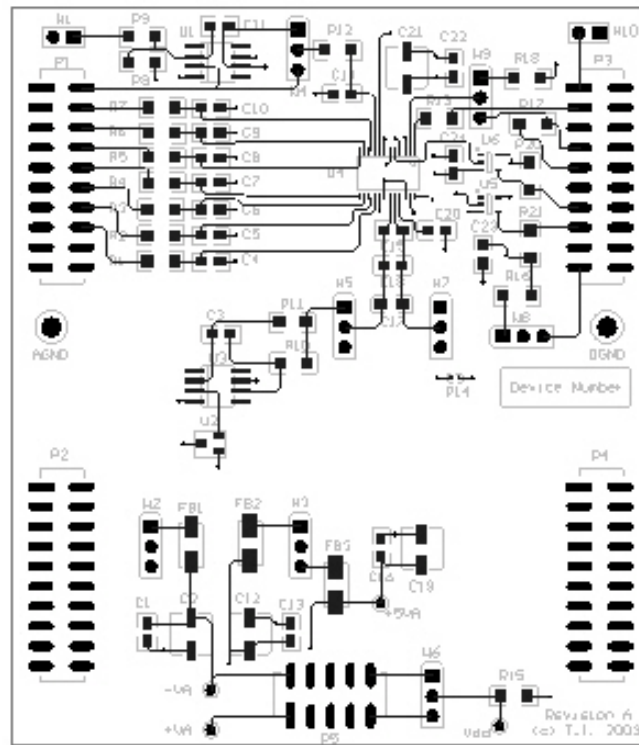


Figure 6-2. Internal Plane 1

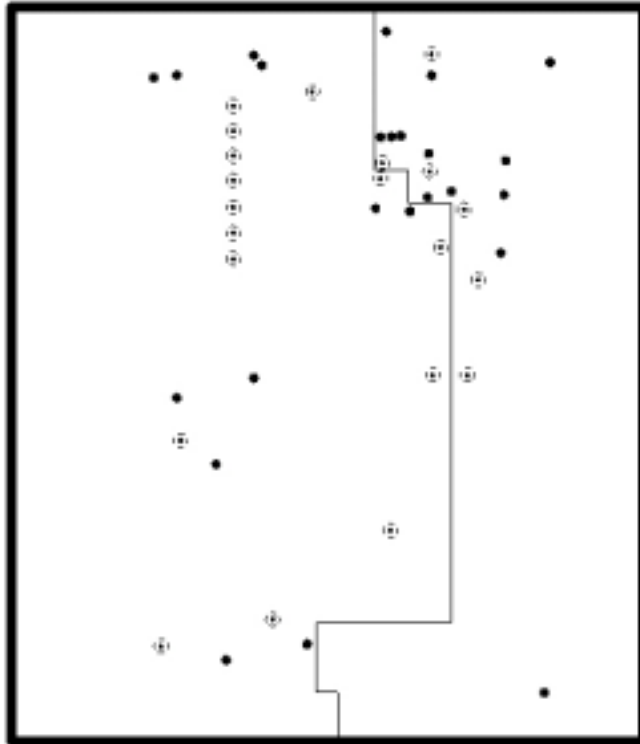


Figure 6-3. Internal Plane 2

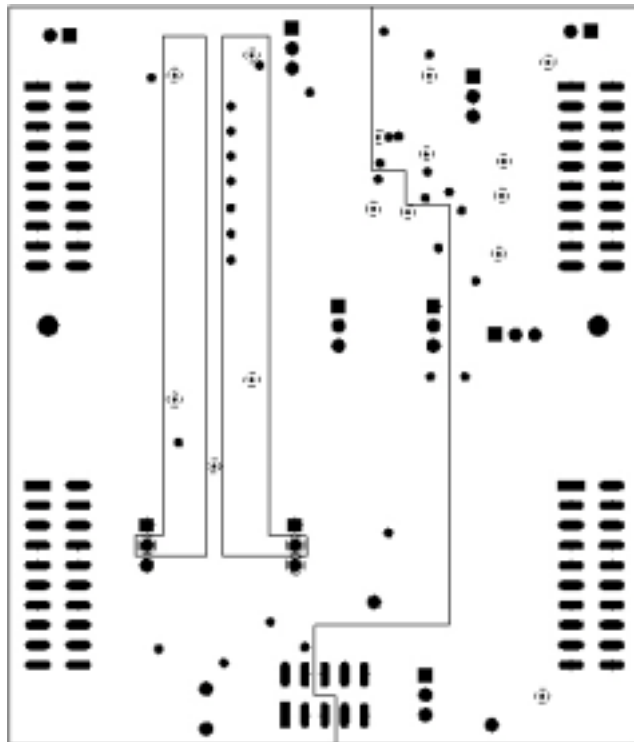
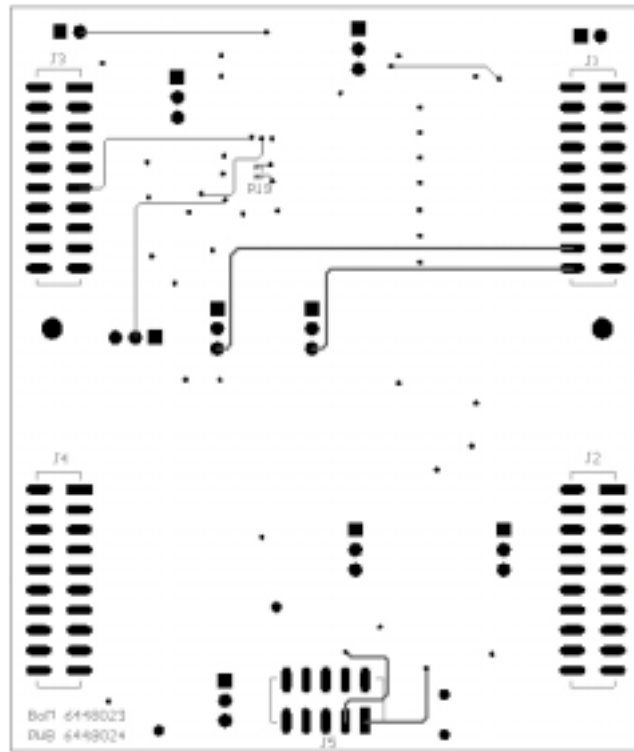


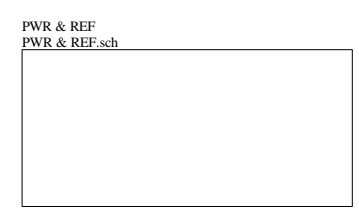
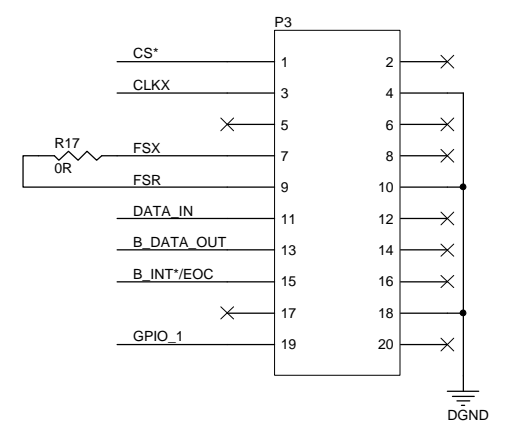
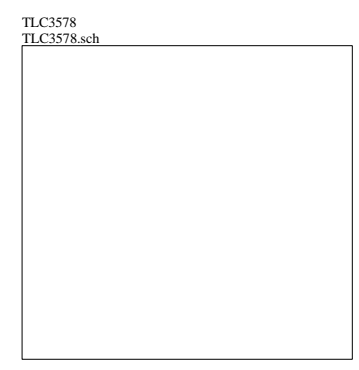
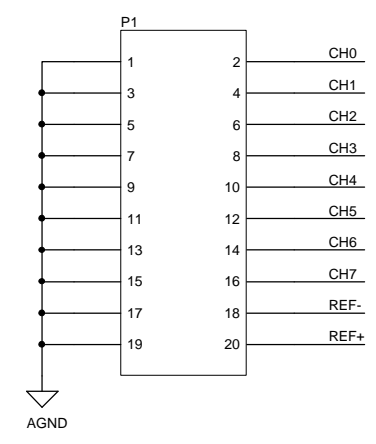
Figure 6–4. Bottom Layer (Mirrored)



### **6.3 EVM Schematic**

The EVM schematic is a PDF attachment following this page.

Revision History		
REV	ECN Number	Approved

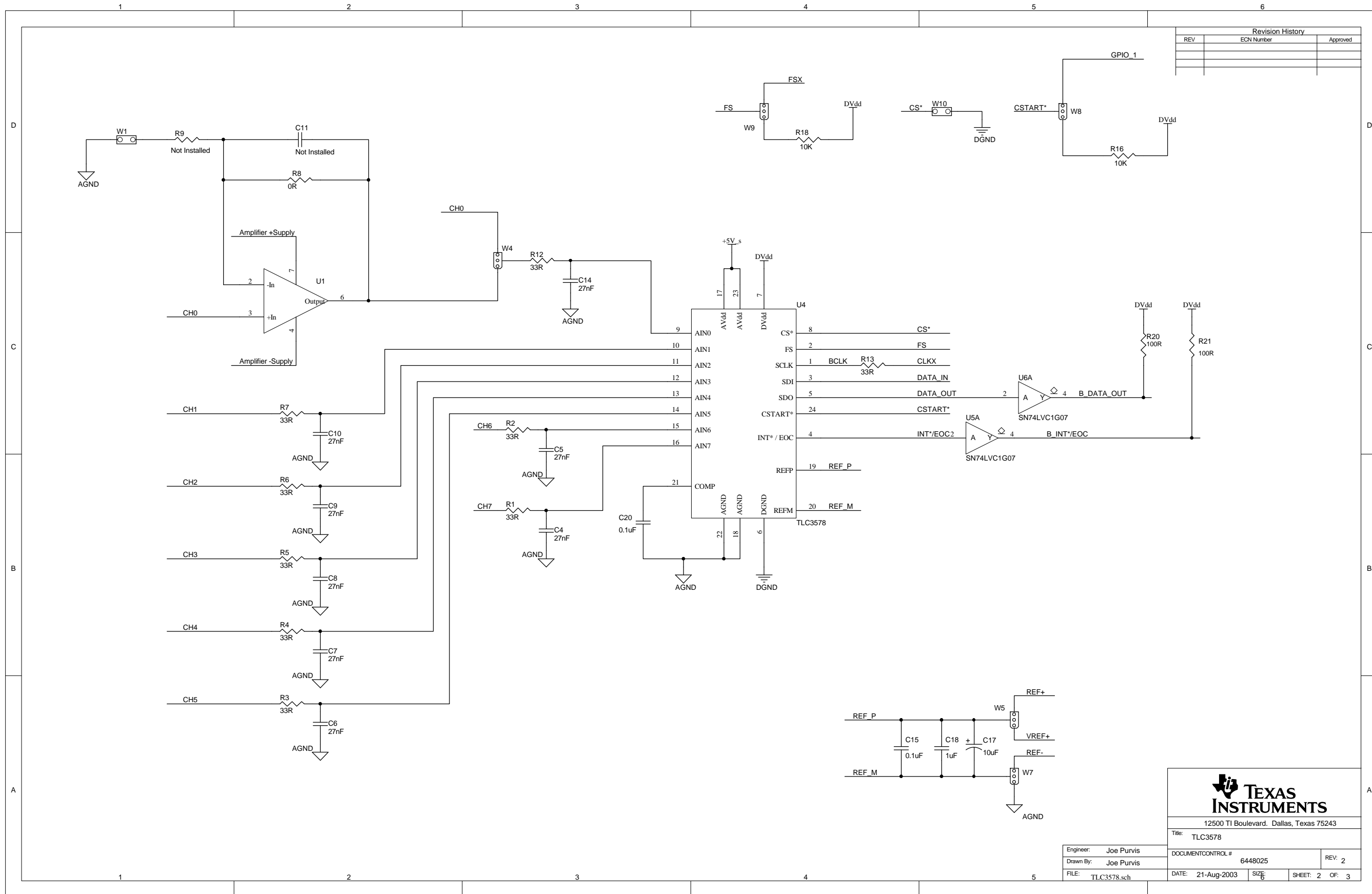


12500 TI Boulevard, Dallas, Texas 75243

Title: TLC3578 EVM Block Diagram

Engineer: Joe Purvis	DOCUMENT CONTROL # 6448025	REV: 2
Drawn By: Joe Purvis	DATE: 21-Aug-2003	SIZE: SHEET: 1 OF: 3

FILE: TLC3578 EVM Block Diagram



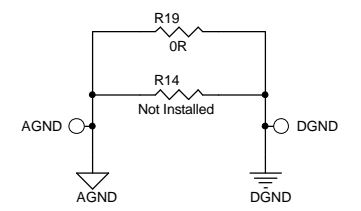
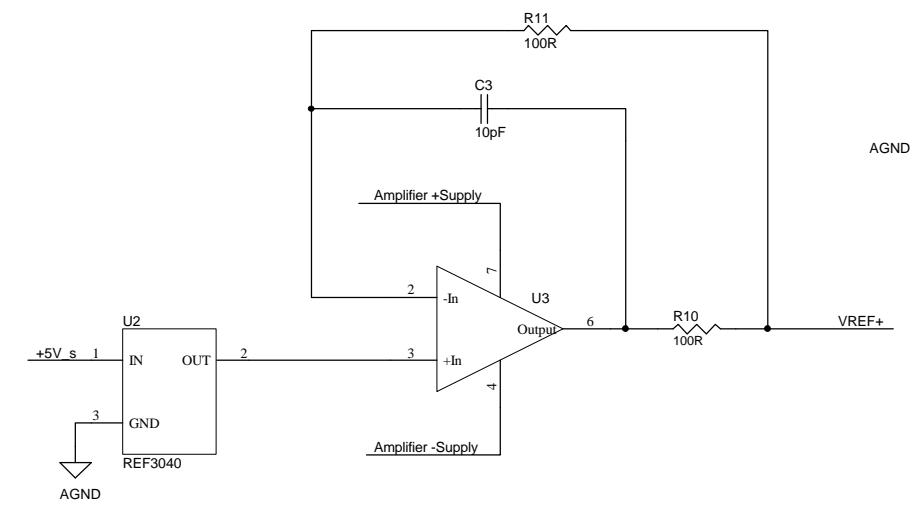
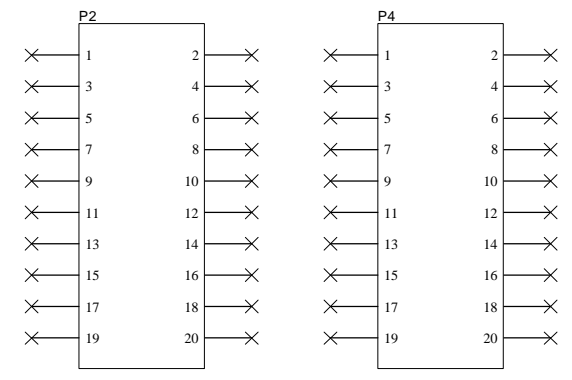
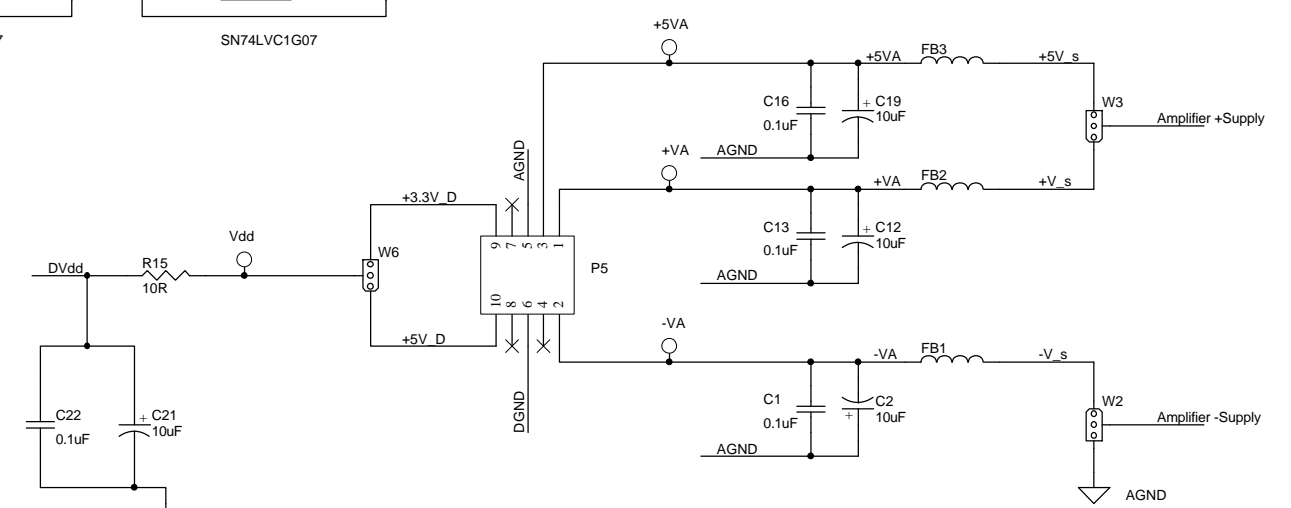
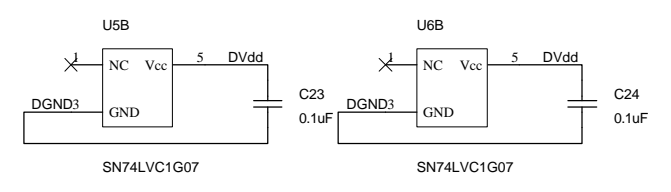
Revision History		
REV	ECN Number	Approved

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Title: TLC3578

Engineer: Joe Purvis	DOCUMENT CONTROL # 6448025	REV: 2
Drawn By: Joe Purvis	DATE: 21-Aug-2003	SIZE: 6
FILE: TLC3578.sch	DATE: 21-Aug-2003	SHEET: 2 OF 3

Revision History		
REV	ECN Number	Approved



12500 TI Boulevard, Dallas, Texas 75243

Title: TLC3578 EVM Power & Reference

Engineer: Joe Purvis

DOCUMENT CONTROL #

REV: 2

Drawn By: Joe Purvis

6448025

FILE: PWR & REF.sch

DATE: 21-Aug-2003

SIZE: 6

SHEET: 3 OF: 3