

***THS1030/31EVM Evaluation  
Module for the  
THS1030/THS1031 10-Bit  
ADC***

*User's Guide*

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

This manual describes the physical characteristics, functions, modes of operation, and configuration of the THS1030/31EVM evaluation module (EVM).

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

- Chapter 1 – Overview
- Chapter 2 – Physical Description
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# Overview

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This chapter gives a general overview of the THS1030/31EVM evaluation module (EVM), and describes some of the factors that must be considered in using this module.

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## 1.1 Purpose

The THS1030/31EVM evaluation module (EVM) provides a platform for evaluation of the THS1030 and THS1031 10-bit analog-to-digital converters (ADC) under various signal, reference, and supply conditions. Unless stated explicitly, the functionality described in this user's guide applies to both THS1030 and THS1031 devices.

## 1.2 EVM Basic Functions

Analog input to the THS1030/31 is provided via an external SMA connector. The input can be configured onboard to be ac, dc, or transformer coupled to the input of the device.

An external SMA connector is provided on the THS1031 for the clamp input. This allows external digital control of the ADC's clamping function. The ADC can be clamped to either the device reference or to ground via an onboard jumper.

The EVM provides an external SMA connection for ADC clock input. This can be configured to be either ac or dc coupled. Space is reserved on the board for a crystal oscillator to perform this function, and can be populated when required.

In addition to the internal reference from the THS1030/31 device, options are provided on the EVM to allow adjustment of the ADC reference via an onboard reference circuit.

Output from the EVM is via a 40-pin header connector. The digital lines from the THS1030/31 are buffered using the SN74LVCC4245A before going to the header. This allows the THS1030/31 supplies to be varied without affecting the output signal levels.

Power connections to the EVM are via 4-mm banana sockets. Separate input connectors are provided for the analog and digital supply to the device, and for the reference and output buffer circuits.

The THS1031 has a number of programmable registers that can be programmed using DIL switches on the EVM.

## 1.3 Power Requirements

The EVM has 4 dc-power supply connections: 5 V for the output buffers, 2.7 V to 5 V for the analog and digital supplies to the ADC, and 2.7 V to 5 V for the reference circuit. Each of these supplies is independent, but it should be noted that the input thresholds of the ADC will vary dependent on the digital and analog supply voltages, as per the datasheet specification.

**Voltage Limits**

**Exceeding the 5-V maximum can damage EVM components. Undervoltage may cause improper operation of some or all of the EVM components.**

## 1.4 THS1030/31EVM Operational Procedure

The THS1030/31EVM provides a flexible means of evaluating the THS1030 and THS1031 in a number of modes of operation. These are described more fully in chapter 4. The following basic setup procedure can be used as a board-confidence check:

- Verify all jumper settings against the following schematic jumper table:

| Device  | Jumper Table (connection)   |
|---------|---|
| THS1030 | H1 pin 2–3, H2 pin 2–3, H3 pin 1–2, H4 pin 2–3, H6 pin 1–2, H8 pin 1–2, H9 pin 1–2, H10 pin 1–2, H11 pin 1–2, LINK4, LINK6, LINK10, LINK11, LINK12, LINK13, LINK14, LINK16. |
| THS1031 | H1 pin 2–3, H2 pin 2–3, H3 pin 1–2, H4 pin 2–3, H6 pin 1–2, H8 pin 2–3, H9 pin 1–2, H10 pin 1–2, H11 pin 2–3, LINK4, LINK6, LINK10, LINK11, LINK12, LINK13, LINK14, LINK16. |

- Check that T1 is unpopulated.
- Connect supplies to the EVM: 5 V on J9, J6, J7, and J8; GND on J10 and J11.
- Switch power supplies on.
- Use a DVM to monitor the voltage from TP24 to TP21. Use a potentiometer adjusting tool to adjust P2 such that the DVM reads 2.5 V.
- Use a DVM to monitor the voltage from TP26 to TP21. Use a potentiometer adjusting tool to adjust P3 such that the DVM reads 0.5 V.
- Use a function generator with 50- $\Omega$  output to input a 10-MHz, 2.5-V offset, 5-V<sub>p-p</sub> amplitude signal into J2.
- Use a function generator with 50- $\Omega$  output to input a 50-kHz, 1.5-V offset, 1.5-V<sub>p-p</sub> amplitude signal into J3.
- The digital pattern on the output header J4 should now represent a sine wave, and can be monitored using a logic analyzer.



# Physical Description

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

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Figure 2-2. Silk Bottom

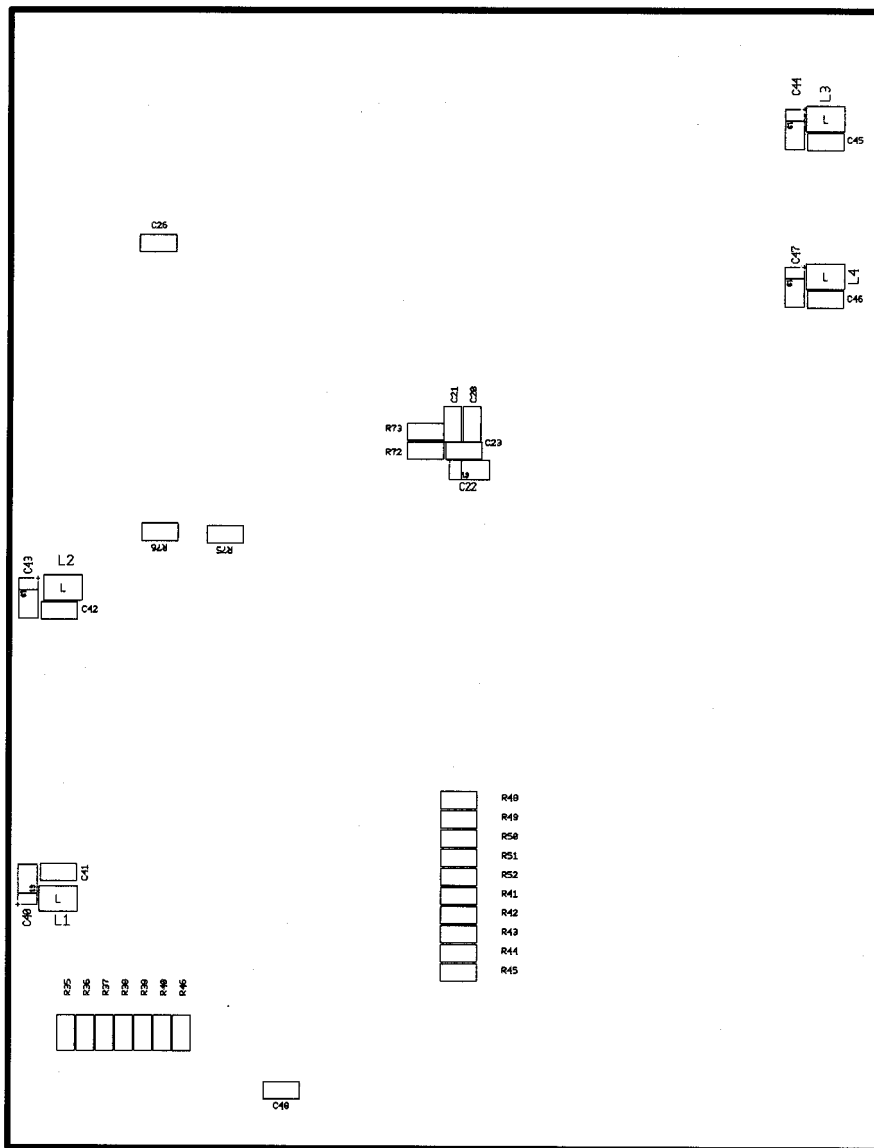


Figure 2-3. Top

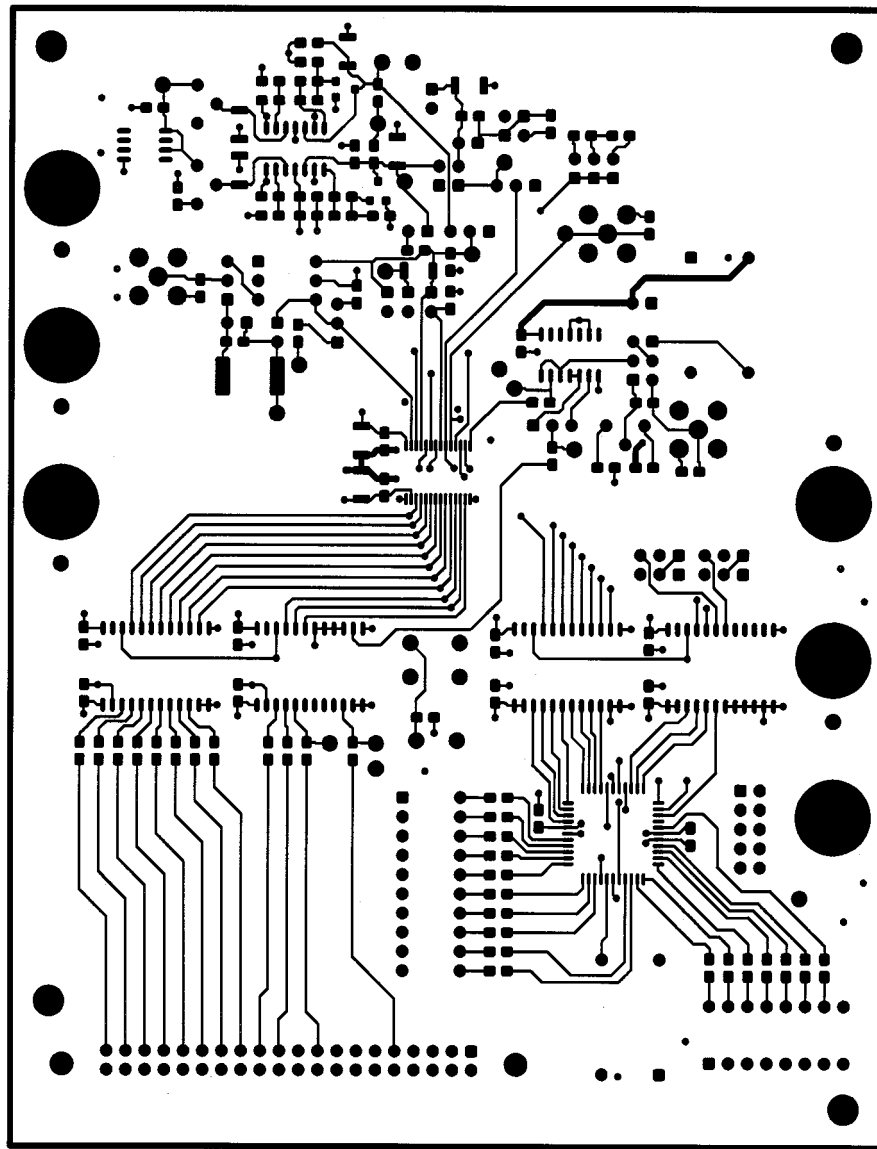




Figure 2-4. Inner 1

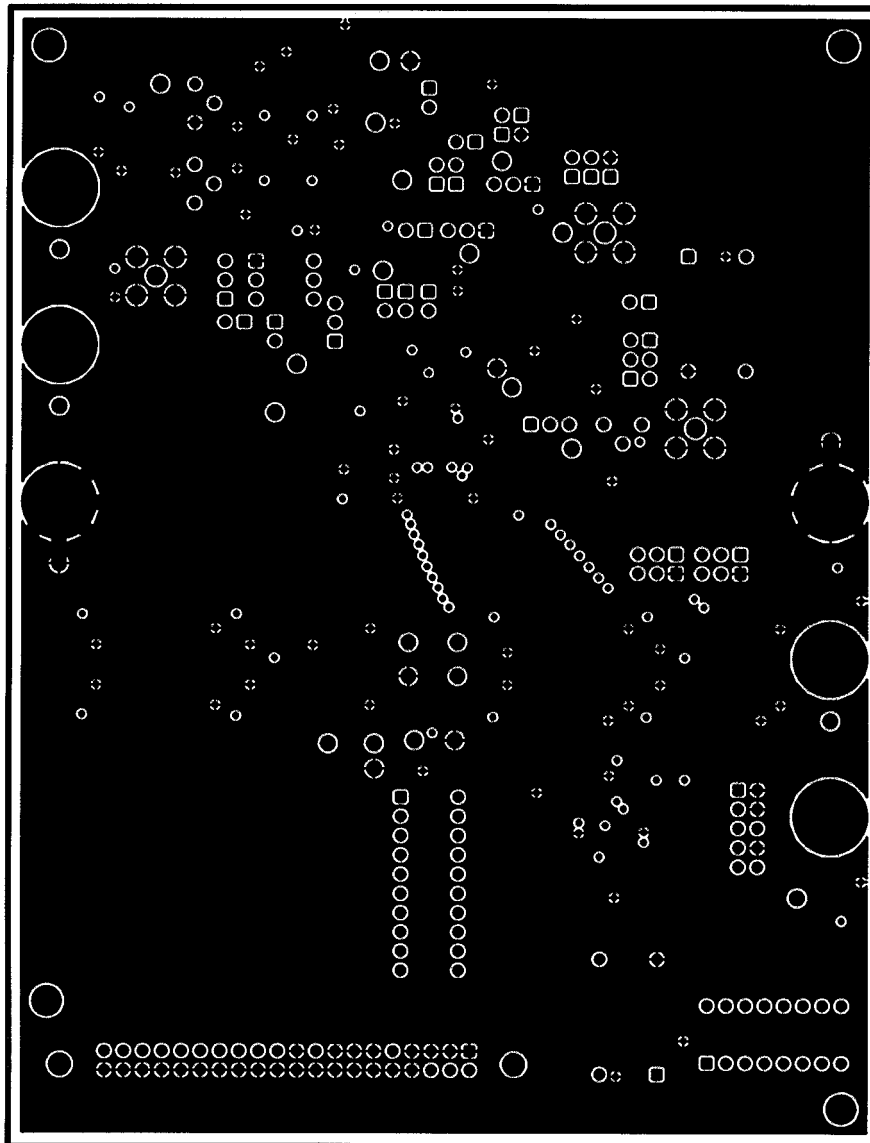


Figure 2-5. Inner 2

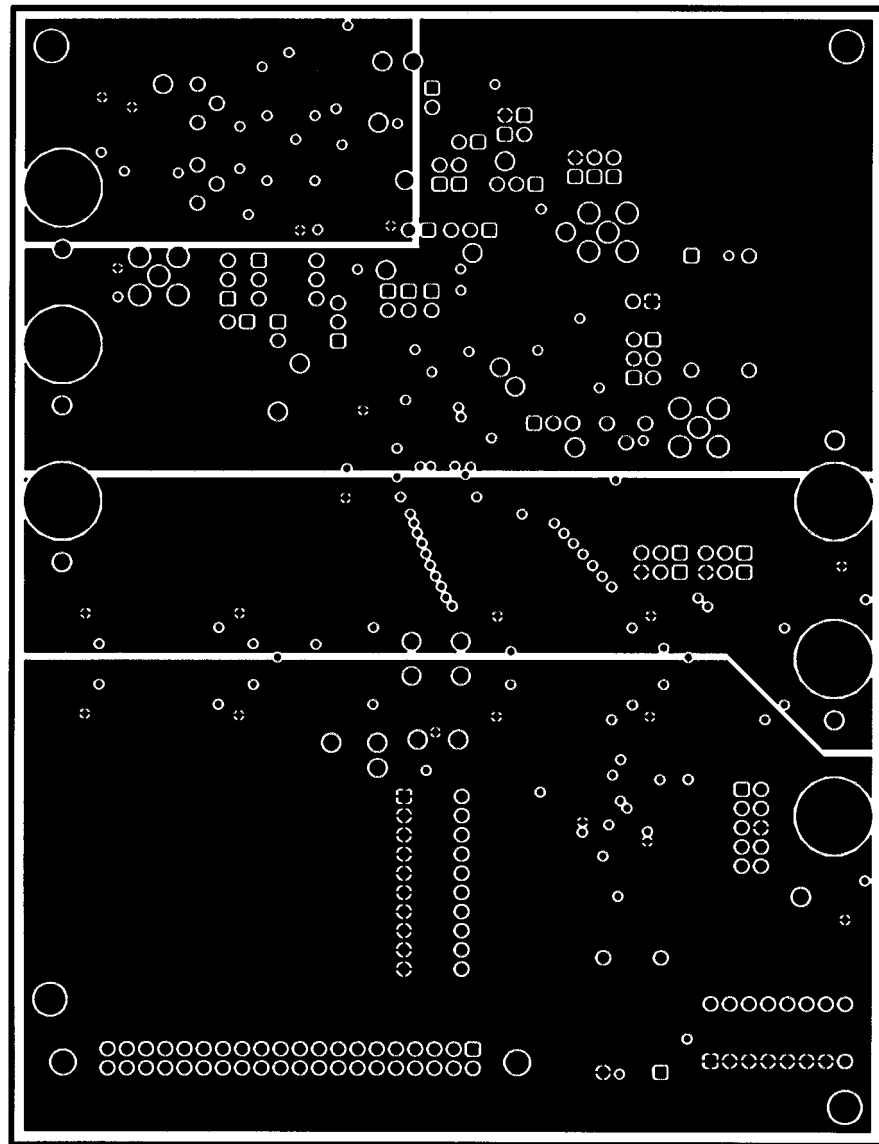
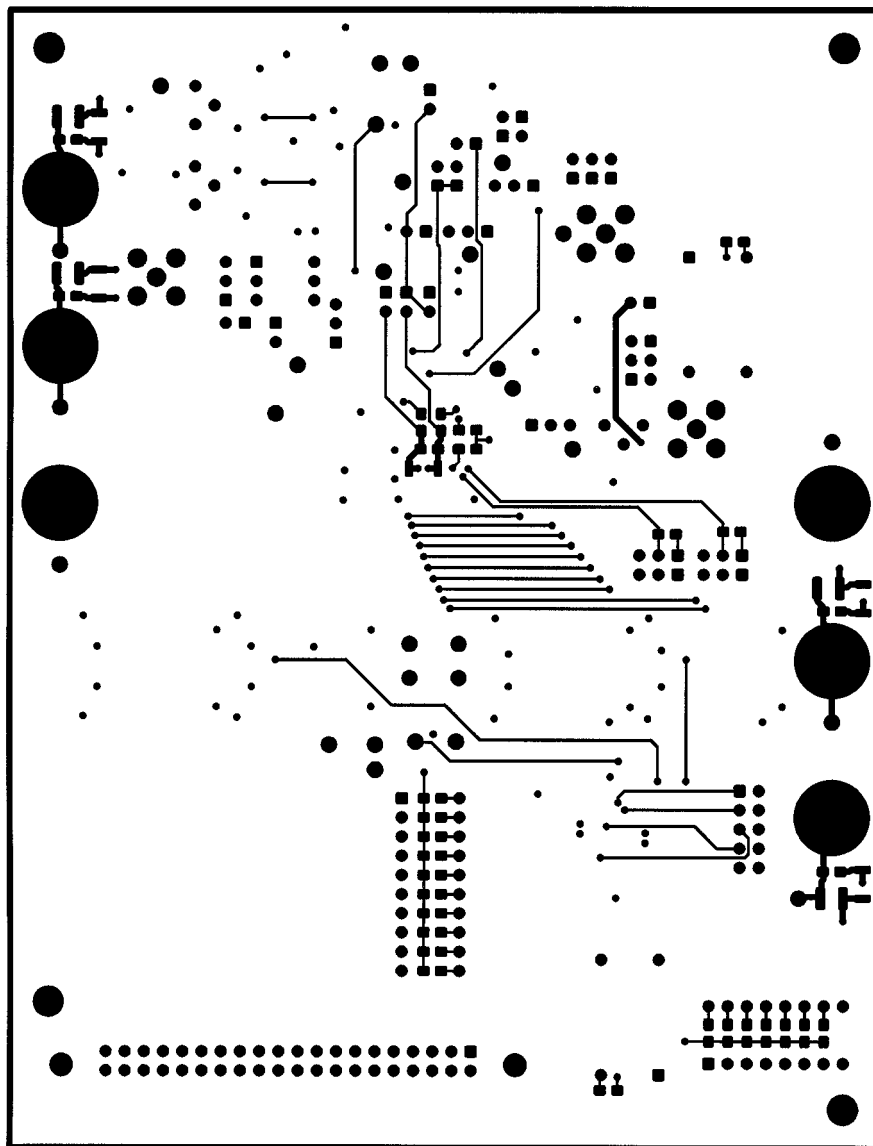


Figure 2-6. Bottom



## 2.2 Parts List

Table 2–1 lists the parts used in constructing the EVM.

Table 2–1. Parts List

| Qty | Reference Description   | Description                           | Manufacturer | Part Number     |
|-----|---|---------------------------------------|--------------|-----------------|
| 1   | D1  | LT1004-1.2 voltage reference          | TI           | LT1004CD-1-2    |
| 1   | U4  | SN74AHC14D hex inverter               | TI           | SN74AHC14D      |
| 4   | U6 U8 U9 U10  | SN74LVCC4245ADW bus transceiver       | TI           | SN74LVCC4245ADW |
| 1   | U7  | TLV2464CD quad opamp                  | TI           | TLV2464CD       |
| 1   | U11   | CMOS Dil 14 oscillator, 4-MHz         | IQD          | IQXO-100C 4MHz  |
| 1   | SW1   | 6x6 mm flat push-button switch        | Omron        | B3F1000         |
| 6   | TP5, TP6, TP19, TP20, TP21, TP22  | 1.32-mm test pin, black               | W Hughes     | 100-103         |
| 18  | TP2, TP3, TP4, TP7, TP8, TP9, TP10, TP11, TP12, TP14, TP15, TP16, TP17, TP18, TP23, TP24, TP25, TP26  | 1.32-mm test pin, red                 | W Hughes     | 100-107         |
| 1   | TP1   | 1.32-mm test pin, green               | W Hughes     | 100-108         |
| 1   | SW3   | 0.1" spacing TH 8 way Dil switch      | Multicomp    | MCDS08          |
| 3   | J2, J3, J5  | SMB connector vertical PCB            | MACOM        | B65N07G999X     |
| 1   | P1  | 2-k $\Omega$ 3296Y potentiometer      | Bourns       | 3296Y-001-202   |
| 2   | P2, P3  | 10-k $\Omega$ potentiometer           | Bourns       | 3296Y-001-106   |
| 6   | J6, J7, J8, J9, J10, J11  | 4-mm panel socket                     | Hirschmann   | BO10            |
| 1   | C38   | 470-pF 0805 SMD ceramic capacitor NPO | AVX          | 08051A471JAT00J |
| 16  | LNK1, LNK2, LNK3, LNK4, LNK5, LNK6, LNK7, LNK8, LNK9, LNK10, LNK11, LNK12, LNK13, LNK14, LNK15, LNK16 | 0.1" spacing 1X2 header               | Harwin       | M20-9990206     |
| 11  | H1, H2, H3, H4, H5, H6, H7, H8, H9, H10, H11  | 0.1" spacing 1X3 header straight      | Harwin       | M20-9990306     |
| 1   | SW4   | 0.1" spacing TH 10 way Dil switch     | Multicomp    | DS10            |
| 3   | R7, R10, R59  | 51R 0805 thick-film resistor 5%       | Multicomp    | CR10510JT       |
| 1   | R74   | 2K 0805 thick-film resistor 1%        | Multicomp    | CR10202JT       |
| 3   | R8, R9, R16   | 5K1 0805 thick-film resistor 5%       | Multicomp    | CR10512JT       |
| 1   | R55   | 11K 0805 thick-film resistor 5%       | Multicomp    | CR10113JT       |
| 4   | L1, L2, L3, L4  | 0R 1206 thick-film resistor           | Multicomp    | CR8XXXJTZ32     |

Table 2–1. Parts List (Continued)

| Qty | Reference Description  | Description  | Manufacturer          | Part Number     |
|-----|--|--|-----------------------|-----------------|
| 14  | R5, R6, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71   | 39R 0805 thick-film resistor 1%                            | Multicomp             | CR10390FT       |
| 2   | R11, R12   | 100R 0805 thick-film resistor 1%                           | Multicomp             | CR10101FT       |
| 2   | R53, R58   | 180R 0805 thick-film resistor 1%                           | Multicomp             | CR10181FT       |
| 2   | R47, R57   | 330R 0805 thick-film resistor 1%                           | Multicomp             | CR10331FT       |
| 2   | R17, R56   | 820R 0805 thick-film resistor 1%                           | Multicomp             | CR10821FT       |
| 1   | R13  | 1-k $\Omega$ 0805 thick-film resistor 1%                   | Multicomp             | CR10102FT       |
| 1   | R14  | 1K5 0805 thick-film resistor 1%                            | Multicomp             | CR10152FT       |
| 17  | R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34  | 4K7 0805 thick-film resistor 1%                            | Multicomp             | CR10472FT       |
| 5   | R3, R4, R54, R75, R76,   | 10-k $\Omega$ 0805 thick-film resistor 1%                  | Multicomp             | CR10103FT       |
| 1   | R15  | 15-k $\Omega$ 0805 thick-film resistor 1%                  | Multicomp             | CR10153FT       |
| 17  | R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R48, R49, R50, R51, R52  | 100-k $\Omega$ 0805 thick-film resistor 1%                 | Multicomp             | CR10104FT       |
| 1   | J4   | 40-way male PCB mounting header, 0.05" cable pitch, 90-deg | Multicomp             | 9.18541E+11     |
| 1   | J1   | 0.1" spacing 2X5 header straight                           | Elco                  | 008380010000010 |
| 12  | C15, C18, C19, C22, C30, C32, C34, C37, C40, C43, C44, C47   | 10- $\mu$ F case B SMD tantalum capacitor, 16-V            | Multicomp             | TAJB10M16RFX    |
| 1   | C29  | 47- $\mu$ F case D SMD tantalum capacitor, 16-V            | Multicomp             | TAJD47M16RFX    |
| 29  | C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C16, C17, C20, C21, C23, C24, C25, C26, C28, C31, C33, C35, C36, C39, C41, C42, C45, C46, C48 | 0.1- $\mu$ F 0805 SMD ceramic capacitor, X7R, 16-V         | AVX                   | 08053C104KA800J |
| 1   | Q2   | 2N3904 SOT23 transistor                                    | General Semiconductor | IMBT3904        |
| 1   | Q1   | 2N3906 SOT23 transistor                                    | General Semiconductor | IMBT3906        |
| 1   | T1   | TT1-6-X65 RF transformer                                   | Mini Circuits         | TT1-6-X65       |
| 1   | U2   | THS1031CDB ADC   | TI                    | THS1031CDB      |
| 1   | U1   | Vantis Mach4_32_32_44TQFP                                  | Vantis                | M4-32/32-15VC   |



# Circuit Description

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This chapter contains the EVM schematic diagram and discusses the various functions on the EVM.

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### 3.1 Schematic Diagram

Figures 3–1 through 3–5 show the schematic diagram for the EVM. The following paragraphs describe the EVM circuits.

Figure 3–1. EVM Schematic Diagram

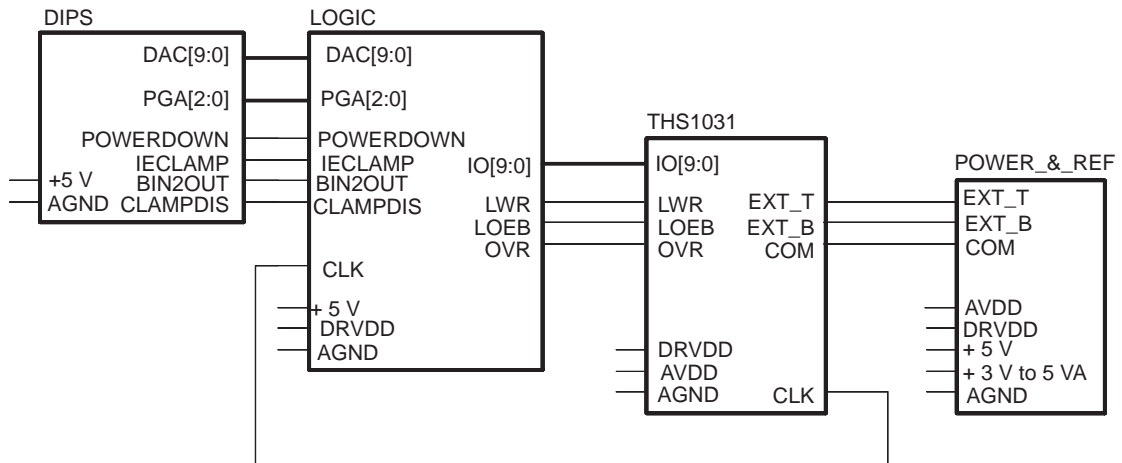




Figure 3–2. EVM Schematic Diagram – DIPS

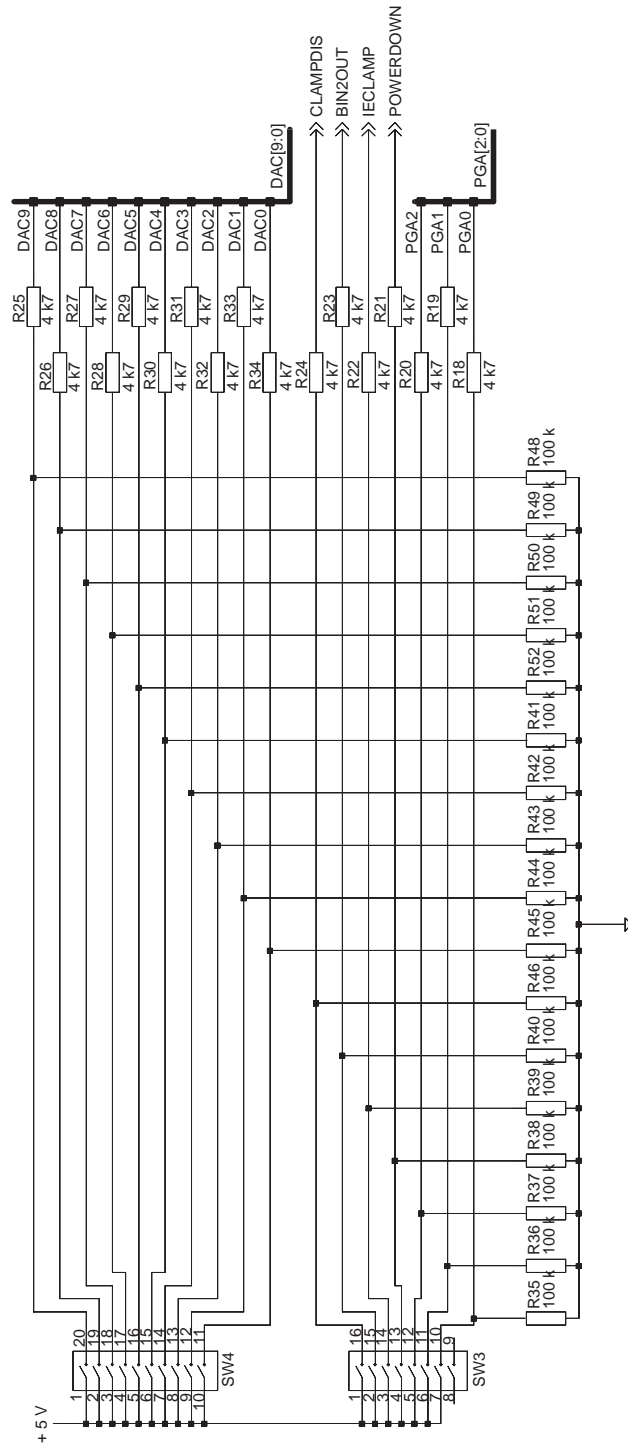


Figure 3–3. EVM Schematic Diagram – LOGIC

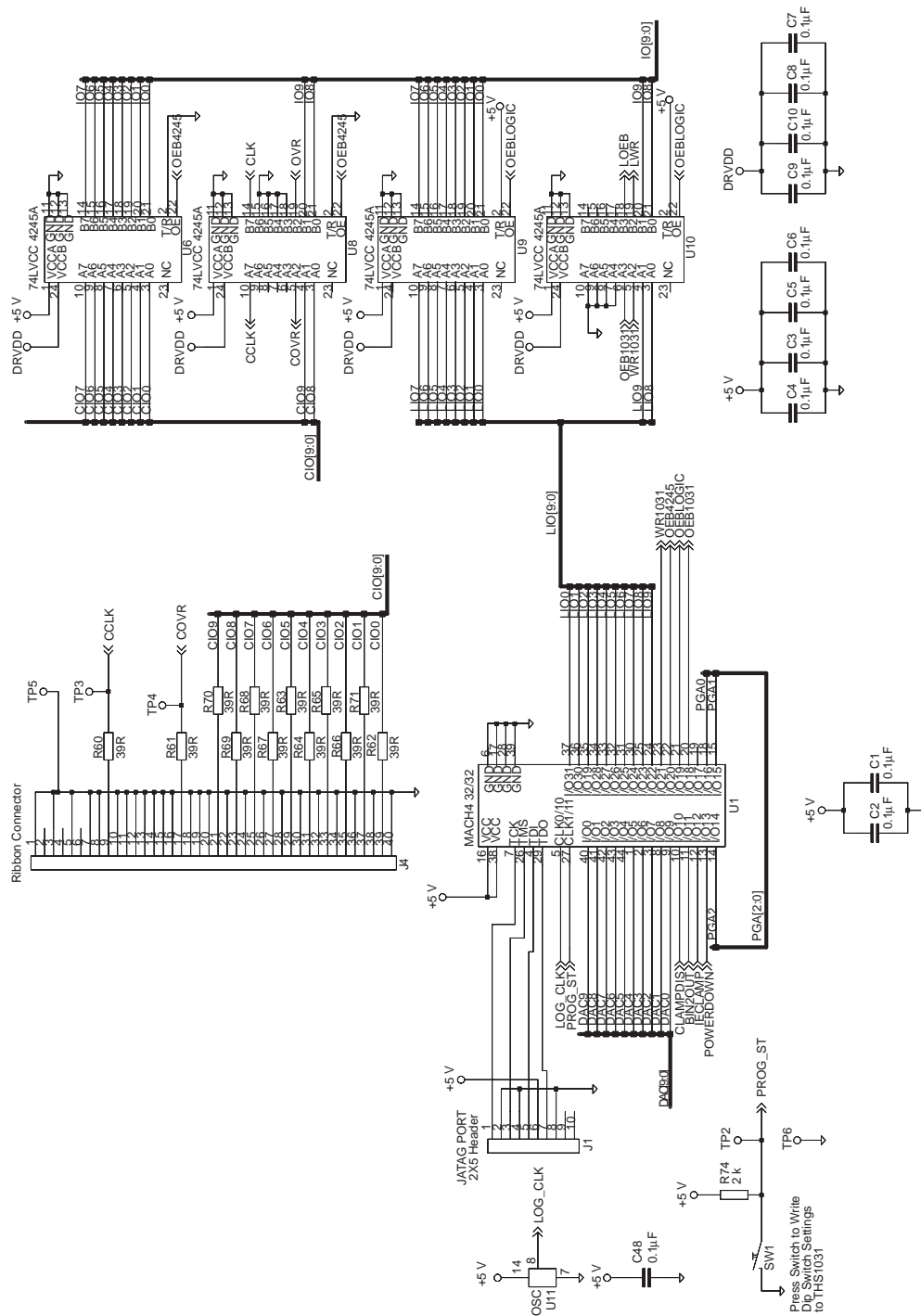


Figure 3–4. EVM Schematic Diagram – THS1031

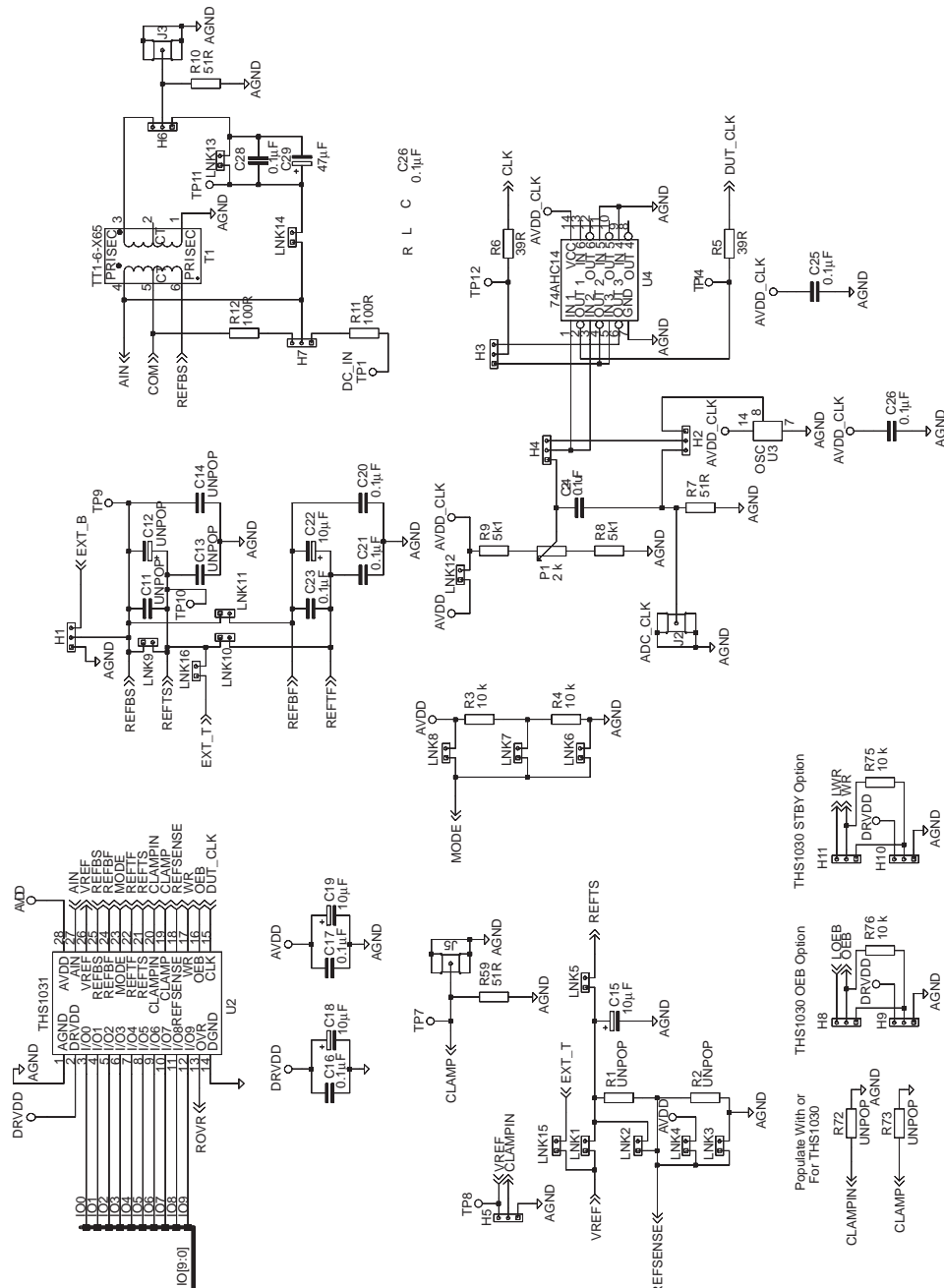
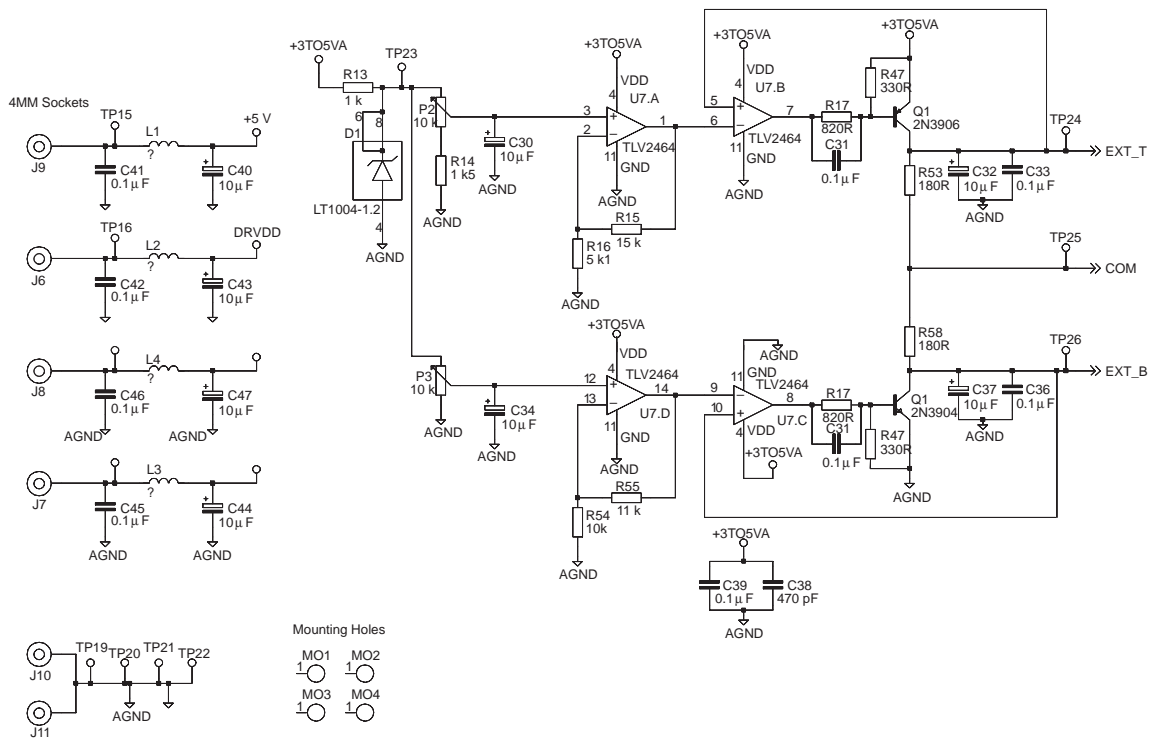


Figure 3–5. EVM Schematic Diagram – POWER\_ &\_REF



### 3.2 Circuit Function

The following paragraphs describe the function of individual circuits. Refer to Chapter 4 for jumper configurations for various modes of operation, and to the relevant data sheet for device operating characteristics.

#### 3.2.1 Inputs

The EVM has one analog input via SMA connector J3. The path from this connector to the THS1030/31 AIN pin can be configured to cater to different operating modes and input signal levels. The main operating modes are ac, dc, and transformer coupled.

**Note:**

The transformer should be removed from the board in modes that do not use the signal path through it.

The THS1031 has a clamp input that can be fed in directly via SMA connector J5. This affords external digital control of the ADC’s clamping function. The ADC can be clamped (via the clamping pin) to either the device reference or to ground using a jumper on H5.

SMA Connector J2 can be used to input a clock signal to the board from an external source. If the source does not have the correct dc level for input to the

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74AHC14 hex inverter IC (U4), then it should be ac-coupled through C24, with its dc level trimmed using potentiometer P1 if necessary.

### 3.2.2 Clock Options

The EVM provides flexibility as to the source of the ADC conversion clock: this can come from an external source as described above, or from a crystal-oscillator module when U3 is populated with a standard DIL14 HCMOS.

**Note:**

Care should be taken when selecting a crystal oscillator module to make sure that it operates at the AVDD supply voltage being used.

To synchronize the output data from the ADC to external circuitry, a buffered version of the conversion clock is provided to output header J4 via U4 and U8. The phase relationship between the conversion clock and the output clock can be selected using header H3.

### 3.2.3 References

In addition to the capability to configure the on-chip reference via jumpers, a reference circuit has been included on the EVM. This uses a 1.2-V shunt reference diode (D1) as its primary source, and allows adjustment of the REFTS and REFBS signals to the ADC using potentiometers P2 and P3, respectively. The ranges of the external reference signals are: REFTS, 0.60 V to 2.68 V on a 2.7-V supply, and 0.60 V to 4.85 V on a 5-V supply; REFBS, 0 V to 1.79 V on a 2.70-V supply, and 0V to 2.00V on a 5 V supply. See Chapter 4 for further details on the jumper settings required to use this mode.

### 3.2.4 Power

Power is supplied to the EVM via 4-mm banana sockets. Separate input connectors are provided for the analog (J8) and digital (J6) supplies to the device, and for the reference (J7) and output buffer (J9) circuits. The supply for J9 should be 5 V, with the supply for J6, J7, and J8 being between 2.7 V and 5.5 V. Power-supply return paths (GND) are via connectors J10 and J11. Each of these supplies is independent, but it should be noted that the input thresholds of the ADC will vary depending on the digital and analog supply voltages, in accordance with the data sheet specifications.

### 3.2.5 Outputs

The data outputs from the ADC are buffered using SN74LVCC4245A before going to header J4. This allows the supplies on the THS1030/31 to be varied without affecting the output signal levels. Header J4 is a standard 40-pin device on a 100-mil grid, and allows easy connection to a logic analyzer. The connector test points are listed in Table 3–1.

Table 3–1. Output Connector J4

| J4 Pin | Output | Function | J4 Pin | Output | Function |
|--------|--------|----------|--------|--------|----------|
| 1      |        | GND      | 21     | I/O9   | DATA     |
| 2      |        | NC       | 22     |        | GND      |
| 3      |        | GND      | 23     | I/O8   | DATA     |
| 4      |        | NC       | 24     |        | GND      |
| 5      |        | GND      | 25     | I/O7   | DATA     |
| 6      |        | NC       | 26     |        | GND      |
| 7      |        | GND      | 27     | I/O6   | DATA     |
| 8      |        | GND      | 28     |        | GND      |
| 9      | CLK    | CLK      | 29     | I/O5   | DATA     |
| 10     |        | GND      | 30     |        | GND      |
| 11     |        | GND      | 31     | I/O4   | DATA     |
| 12     |        | GND      | 32     |        | GND      |
| 13     |        | GND      | 33     | I/O3   | DATA     |
| 14     |        | GND      | 34     |        | GND      |
| 15     |        | GND      | 35     | I/O2   | DATA     |
| 16     |        | GND      | 36     |        | GND      |
| 17     | OVR    | OVR      | 37     | I/O1   | DATA     |
| 18     |        | GND      | 38     |        | GND      |
| 19     |        | GND      | 39     | I/O0   | DATA     |
| 20     |        | GND      | 40     |        | GND      |

### 3.2.6 THS1031 Register Write

The THS1031 has a number of registers that can be written to put the device into various modes of operation (see data sheet). This can be accomplished easily on the EVM using the two banks of DIL switches SW3 and SW4. A write operation to the THS1031 is performed as follows :

- 1) Set the DIL switches to the value to be programmed into the THS1031 registers. Each DIL switch refers to a register bit in either clamp register1, clamp register2, or in the control register. DAC0 DIL switch refers to bit 0 of clamp register1, BIN2O DIL switch refers to bit 5 of the control register. A DIL switch in the *on* position represents a logic 1.
- 2) Press and release the push button switch SW1.
- 3) The THS1031 registers are now programmed with the DIL switch values.

**Note:**

After first application of power, the values on the DIL switches only represent what is programmed into the THS1031 after switch SW1 has been pressed. Prior to this, the device is in its default power-up state.

# Modes of Operation

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The EVM can be easily configured, via jumper connections, to operate the THS1030/31 in various modes of operation. Figures 4–1 to 4–7 depict various modes of operation, with Tables 4–1 and 4–2 listing the corresponding jumper settings. For further information on these modes of operation, please refer to the relevant device data sheet.

Figure 4–1. Common Mode Input  $V_{REF}/2 - 1V_{p-p}$  Input Span (top/bottom mode)

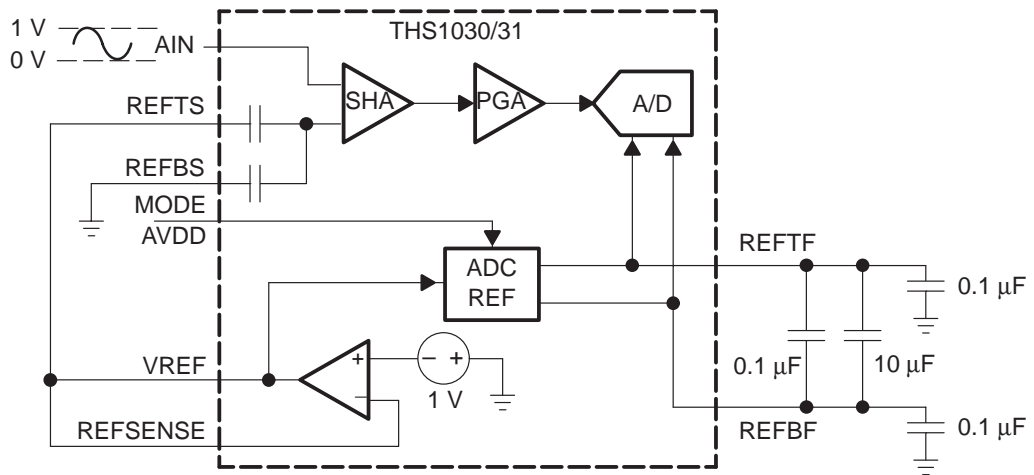


Figure 4–2. Common Mode Input  $V_{REF}/2 - 2V_{p-p}$  Input Span (top/bottom mode)

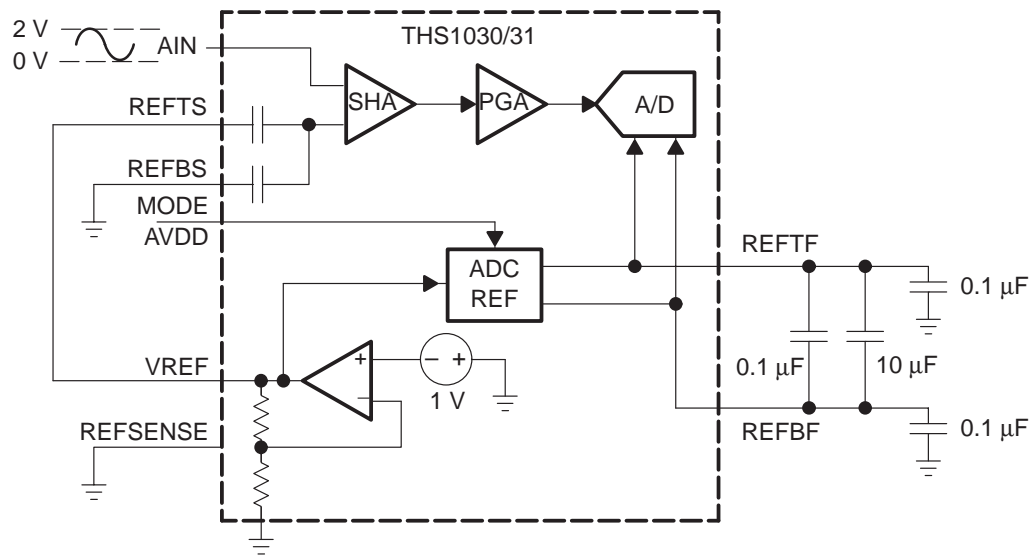




Figure 4–3. External Common Mode Input – 1Vp-p Input Span (center span mode)

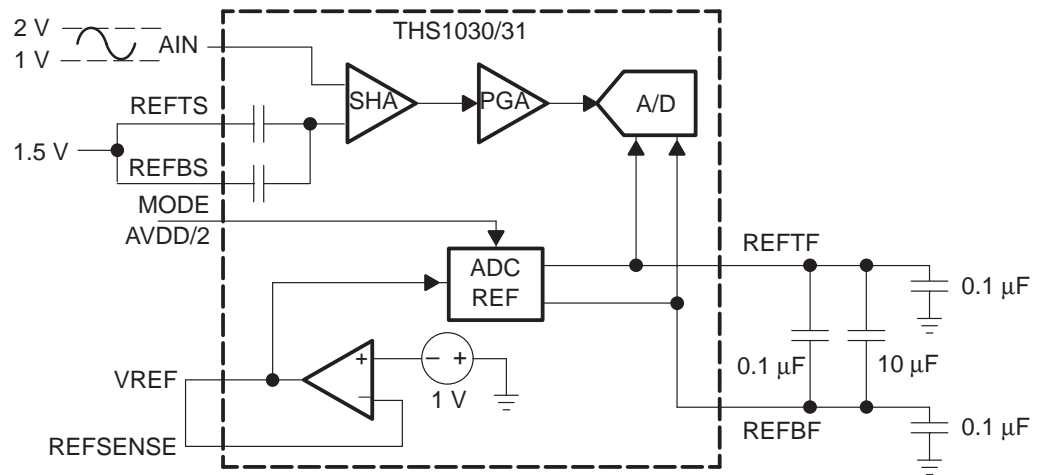


Figure 4–4. External Common Mode Input – 2Vp-p Input Span (center span mode)

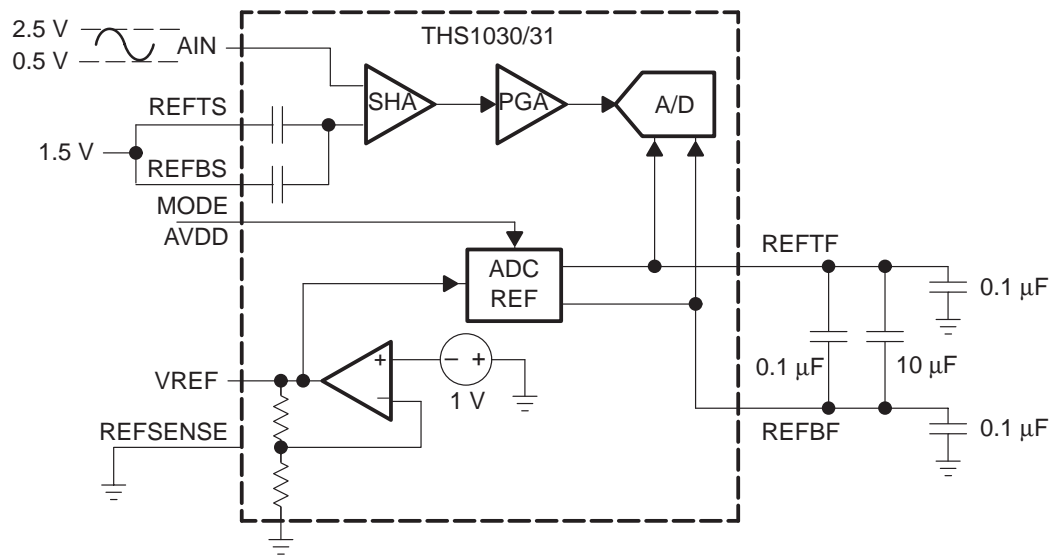


Figure 4–5. Differential Input – 1Vp-p Input Span (differential input mode)

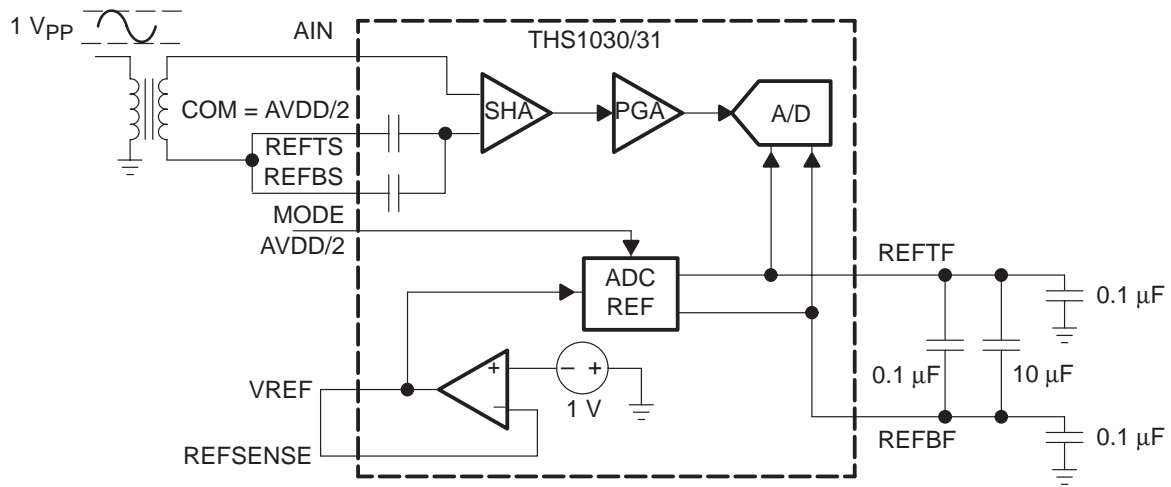


Figure 4–6. Differential Input – 2Vp-p Input Span (differential input mode)

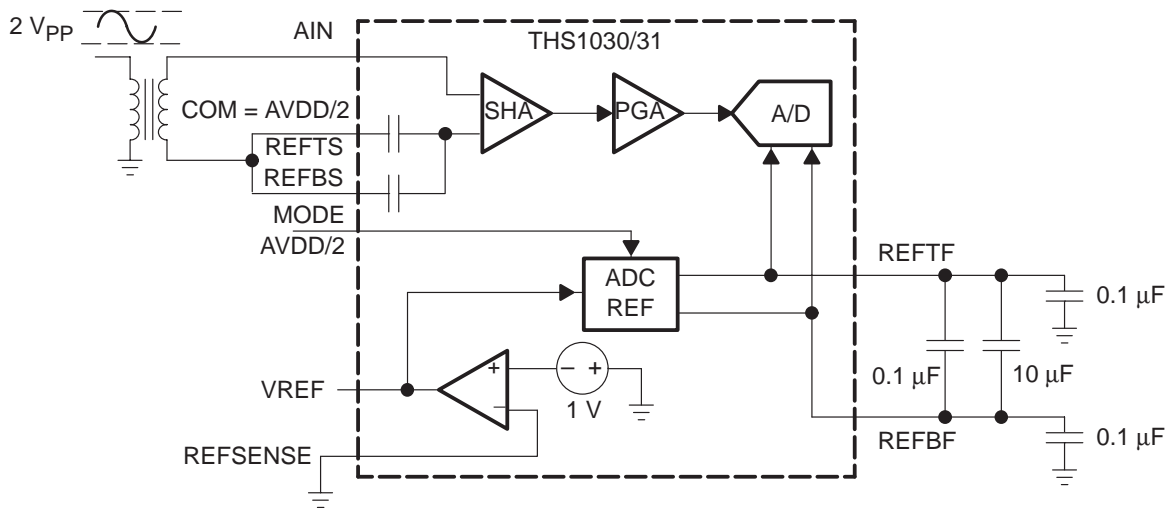


Figure 4–7. External Reference – Input Span and Bias Set by on Board Reference Circuit (potentiometer P2 sets EXT\_T, potentiometer P3 sets EXT\_B)

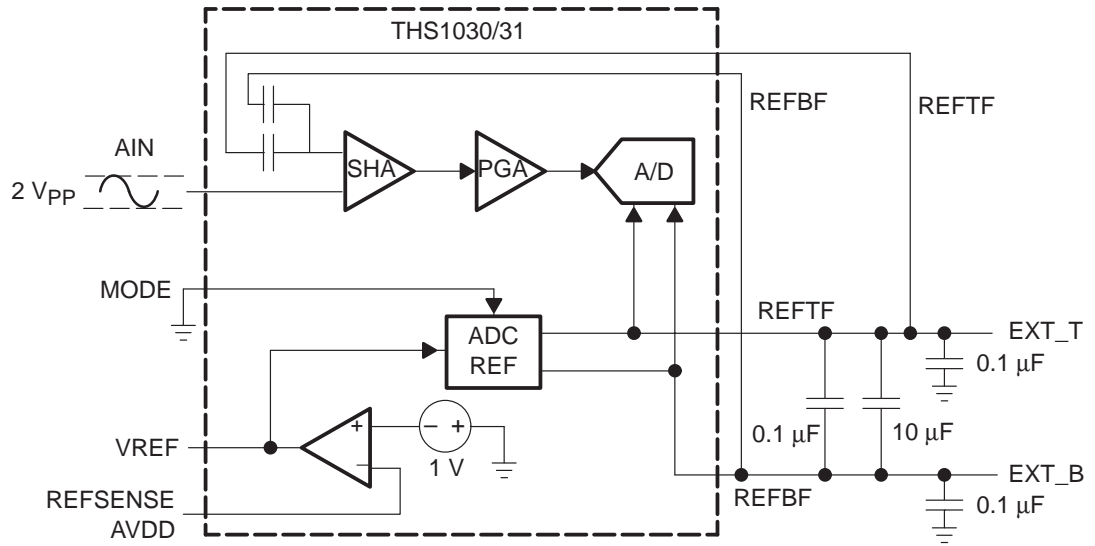


Table 4–1. Board Jumper Settings for Various Modes of Operation

| Mode :             | Top/Bottom (1V) | Top/Bottom (2V) | Cent. Span (1V) | Cent. Span (2V) | Differential (1V) | Differential (2V) | Ext. Ref. |              |
|--------------------|-----------------|-----------------|-----------------|-----------------|-------------------|-------------------|-----------|--------------|
| Reference:         | Int             | Int             | Int             | Int             | Int               | Int               | Ext. Only |              |
| Refbs/bf           | –               | –               | POT P3          | POT P3          | –                 | –                 | POT P3    |              |
| Refts/tf           | –               | –               | –               | –               | –                 | –                 | POT P2    |              |
| Clampin            | H 5             | H 5             | H 5             | H 5             | H 5               | H 5               | H 5       | THS1031 only |
| Clamp              | J 5             | J 5             | J 5             | J 5             | J 5               | J 5               | J 5       | THS1031 only |
| <b>Header/link</b> |                 |                 |                 |                 |                   |                   |           |              |
| H 1                | 1–2             | 1–2             | 2–3             | 2–3             | NO                | NO                | 2–3       |              |
| H 6                | 1–2             | 1–2             | 1–2             | 1–2             | 2–3               | 2–3               | 1–2       |              |
| H 7                | NO              | NO              | NO              | NO              | NO                | NO                | NO        |              |
| H 8                | 2–3             | 2–3             | 2–3             | 2–3             | 2–3               | 2–3               | 2–3       |              |
| H 9                | 1–2             | 1–2             | 1–2             | 1–2             | 1–2               | 1–2               | 1–2       |              |
| H 10               | 1–2             | 1–2             | 1–2             | 1–2             | 1–2               | 1–2               | 1–2       |              |
| H 11               | 2–3             | 2–3             | 2–3             | 2–3             | 2–3               | 2–3               | 2–3       |              |
| LINK 1             | YES             | YES             | YES             | NO              | YES               | NO                | NO        |              |
| LINK 2             | YES             | NO              | YES             | NO              | YES               | NO                | NO        |              |
| LINK 3             | NO              | YES             | NO              | YES             | NO                | YES               | NO        |              |
| LINK 4             | NO              | NO              | NO              | NO              | NO                | NO                | YES       |              |
| LINK 5             | YES             | YES             | NO              | NO              | NO                | NO                | NO        |              |
| LINK 6             | NO              | NO              | NO              | NO              | NO                | NO                | YES       |              |
| LINK 7             | NO              | NO              | YES             | YES             | YES               | YES               | NO        |              |
| LINK 8             | YES             | YES             | NO              | NO              | NO                | NO                | NO        |              |

|         |            |            |            |            |            |            |            |  |
|---------|------------|------------|------------|------------|------------|------------|------------|--|
| LINK 9  | NO         | NO         | YES        | YES        | YES        | YES        | NO         |  |
| LINK 10 | NO         | NO         | NO         | NO         | NO         | NO         | YES        |  |
| LINK 11 | NO         | NO         | NO         | NO         | NO         | NO         | YES        |  |
| LINK 13 | YES        | YES        | YES        | YES        | NO         | NO         | YES        |  |
| LINK 14 | YES        | YES        | YES        | YES        | NO         | NO         | YES        |  |
| LINK 15 | NO         | NO         | NO         | NO         | NO         | NO         | NO         |  |
| LINK 16 | NO         | NO         | NO         | NO         | NO         | NO         | YES        |  |
|         | Figure 4-1 | Figure 4-2 | Figure 4-3 | Figure 4-4 | Figure 4-5 | Figure 4-6 | Figure 4-7 |  |

*Table 4-2. Jumper Settings for Clock Options*

| <b>Clock Options</b> | <b>Onboard Oscillator</b> | <b>External AC coupled Via J2</b> | <b>External DC coupled Via J2</b> |
|----------------------|---------------------------|-----------------------------------|-----------------------------------|
| H 2                  | 1-2                       | 1-2                               | 2-3                               |
| H 3                  | 1-2, 2-3                  | 1-2, 2-3                          | 1-2, 2-3                          |
| H 4                  | 2-3                       | 1-2                               | 2-3                               |
| LINK 12              | YES                       | YES                               | YES                               |

