

THAT1580/THAT5171  
Digitally-Controlled Microphone Preamplifier  
Demo Board

User's Guide  
Document 600189 Rev 00



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## **Packing List**

- (1) THAT1580/5171 DEMO Board PCB Assembly
- (1) USB Cable

If you are missing any of the above items please contact us at [support@thatcorp.com](mailto:support@thatcorp.com).

## **FCC Warning**

This device is only intended for laboratory test environments. It may radiate radio frequency energy and has not been tested for compliance with subpart J of part 15 of the FCC regulations. Operation of this device in other environments may cause interference with radio communications.

## Features

- “Combo” XLR/TRS balanced input with switchable 48V phantom power
- Balanced audio output on XLR and TRS connectors
- Supports pro audio signal levels: +21dBu input / output
- Gain (measured input to output) adjustable in 1dB steps: 0dB, and 8-63dB
- USB 1.1 and USB 2.0 compatible control port
- Graphical user interface software for controlling 5171 parameters
- Prototyping area

## Description

The THAT Digitally-Controlled Mic Preamp Demo Board allows developers to evaluate the performance of the THAT1580 / THAT5171 chipset. The demo board provides a balanced audio input on a Neutrik “combo” connector with 48V phantom power, and a balanced audio output on XLR and ¼” TRS connectors. The supplied graphical user interface (GUI) controls all functions in the 5171 chip via USB. A prototyping area is available for adding or modifying circuitry.

## Specifications

| Parameter  | Symbol   | Typical   | Units |
|--|--|---|-------|
| Power Supply Voltage   | V+ - V-  | ±15   | V     |
| Maximum Input Level<br>(V+ /V- = ±15V)   | V <sub>in-BAL</sub>                                  | +22   | dBu   |
| Maximum Differential Output Level<br>(V+ /V- = ±15V)   | V <sub>OUT</sub>                                     | +22   | dBu   |
| Gain (input to output)   | A <sub>dB</sub>                                      | 0<br>8 to 63 in 1dB steps   | dB    |
| Gain error (all settings)  | A <sub>err</sub>                                     | ±0.15   | dB    |
| Total Harmonic Distortion<br>(V <sub>OUT</sub> = +16dBu (5V <sub>RMS</sub> ); R <sub>L</sub> = 10kΩ;<br>C <sub>L</sub> = 10 pF; f = 1kHz; BW = 22 kHz) | THD  | 0.0004 (0dB gain)<br>0.0003 (20dB gain)<br>0.0008 (40dB gain)<br>0.006 (60dB gain)  | %     |
| Equivalent Input Noise<br>(main output)<br>(150Ω source, BW = 22 kHz)  | EIN  | -127.9 (60dB gain)<br>-127.1 (40dB gain)<br>-120.0 (20dB gain)<br>-107.0 (0dB gain) | dBu   |
| Supply Current   | I <sub>CC</sub> ; -I <sub>EE</sub> , I <sub>DD</sub> | 23 (V+ supply)<br>23 (V- supply)<br>0.5 (+5V supply)                                | mA    |

## THAT1580 / THAT5171 Overview

The THAT1580 and THAT5171 ICs enable digitally-controlled microphone preamplifier applications with exceptionally high performance. Operating on maximum +/-17V supplies, the chipset accepts pro audio input levels (+22dBu max) without an input pad. Gain is adjustable to 5.6dB, and 13.6dB to 68.6dB in 1dB increments (a 5.6dB attenuator at the output offsets the overall gain range to 0dB, and 8-63dB). The 5171's built-in zero-crossing detector and other patent-pending techniques for reducing zipper noise enable very smooth and silent gain changes. A differential servo reduces output offsets to less than 1.5mV. Four general purpose outputs on the 5171 can be connected to a variety of peripheral functions, e.g. an input pad, phantom power switch, signal routing switches, LEDs, etc. The 5171's addressable SPI interface supports read-back. By separating the analog mic pre amp front end (THAT1580) from the digital functions and switched resistor ladder (THAT5171), each IC is optimized for high performance.

The THAT1580 is fabricated using THAT's high-voltage BiCMOS process, yielding extremely high performance. The THAT5171 is fabricated using a high-voltage CMOS process, with proprietary techniques for reducing FET switching glitches. Packaged in 4x4mm QFN16 and 7x7mm QFN32 packages respectively, the THAT1580 and THAT5171 require very little PCB area.

### Block Diagram

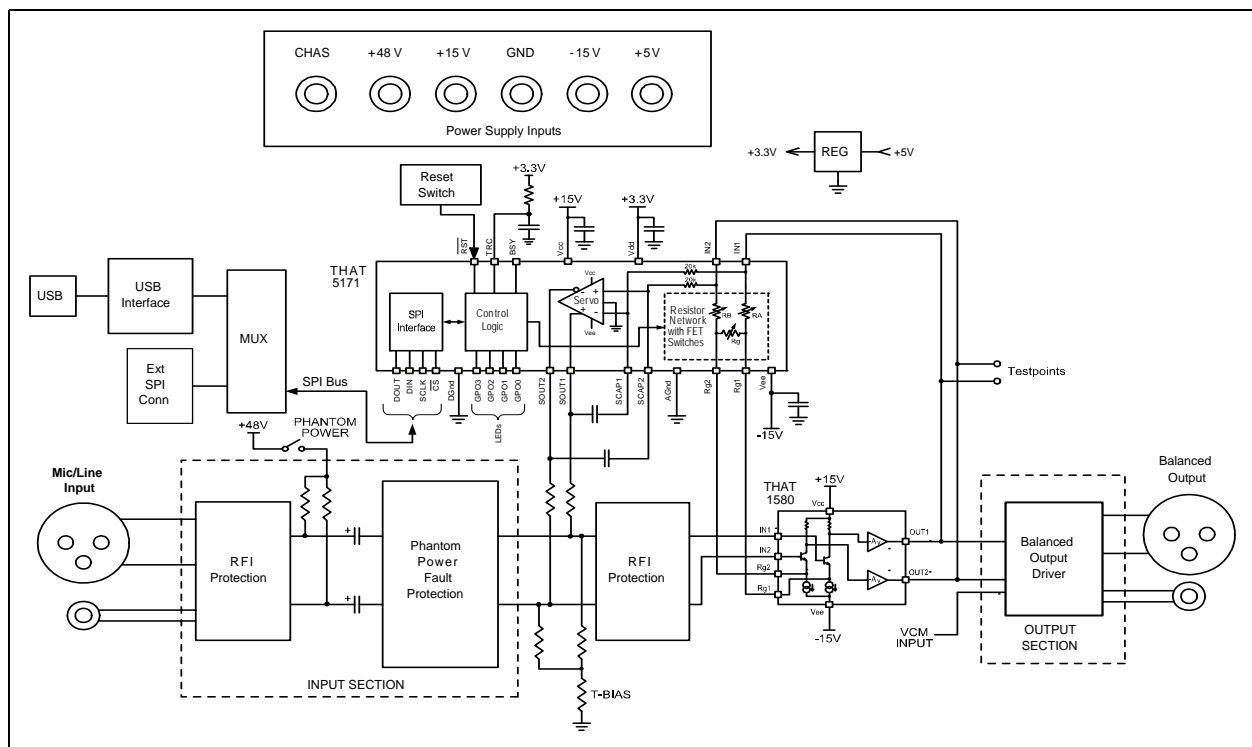


Figure 1 -- Block Diagram of the THAT 1580/5171 Demo Board

## **Connections**

### ***Power***

The USB interface runs on USB bus power, but the rest of the demo board requires an external power supply. +/-15 V (maximum +/-17V) supplies the analog circuitry. +48V phantom power is input (not generated on the board) and switched on and off via the on-board Phantom Power switch. Note that the ground return for +48V phantom power is via the CHAS (chassis ground) connector. The +5V input is regulated on board to 3.3V and supplies the digital logic.

### ***Audio Input***

The Neutrik combo connector accepts an XLR or 1/4" TRS cable. Maximum input signal level is +21dBu with +/-15V supplies, or +22dBu with +/-17V supplies. The 1/4" TRS signal path includes a 20dB pad in order to support very high line levels.

### ***Audio Output***

Separate XLR and 1/4" TRS connectors are wired in parallel. Maximum output signal level is +21dBu with +/-15V supplies, or +22dBu with +/-17V supplies. The differential attenuator/output buffer (U3) adds a small amount of noise and distortion to the signal and it is therefore recommended that test points TP1-TP3 be used to measure performance of the 1580/5171 ICs.

### ***USB***

A PC must be plugged into the demo board via USB in order to control parameters in the 5171 (e.g. gain). Take care not to hot plug the demo board while the GUI software is running as this will often crash the Windows drivers.

### ***General Purpose Outputs (GPO)***

The GPO3:0 pins are connected to header J12. J12 is conveniently located near the prototyping area, so the user can easily connect optional circuitry to them. Note that the GPO pins are also connected to LEDs, D1-D4, and pull up and pull down resistors which set the 5171 device address during reset. Consideration must be given to how any application circuitry that is added interacts with these other functions.

## **Hardware Set-up**

1. Connect a power supply to the V+, V-, +5V, +48V, CHAS and GND connectors. Do not turn on power yet.
2. Plug in the audio input and output
3. Attach a USB cable to the demo board, but do not plug it into the PC yet
4. Turn on the power supply
5. Turn on phantom power to microphone (if appropriate)
6. Plug USB cable into PC. Windows should go through its procedure for discovering the new USB peripheral and loading its driver.

7. Once the Windows driver has been loaded, launch the THAT Corporation MicPreController GUI application. See software section (below) for further instructions on operating the GUI.
8. When finished, close the MicPreController GUI first, then power down the demo board. Unplugging the USB cable before the demo board is powered down will likely crash the Windows drivers.

## Software Set-up

### **Installation**

1. Download the software. The software is available from the THAT Corporation website on the page: [www.thatcorp.com/Demonstration\\_Boards.shtml](http://www.thatcorp.com/Demonstration_Boards.shtml).

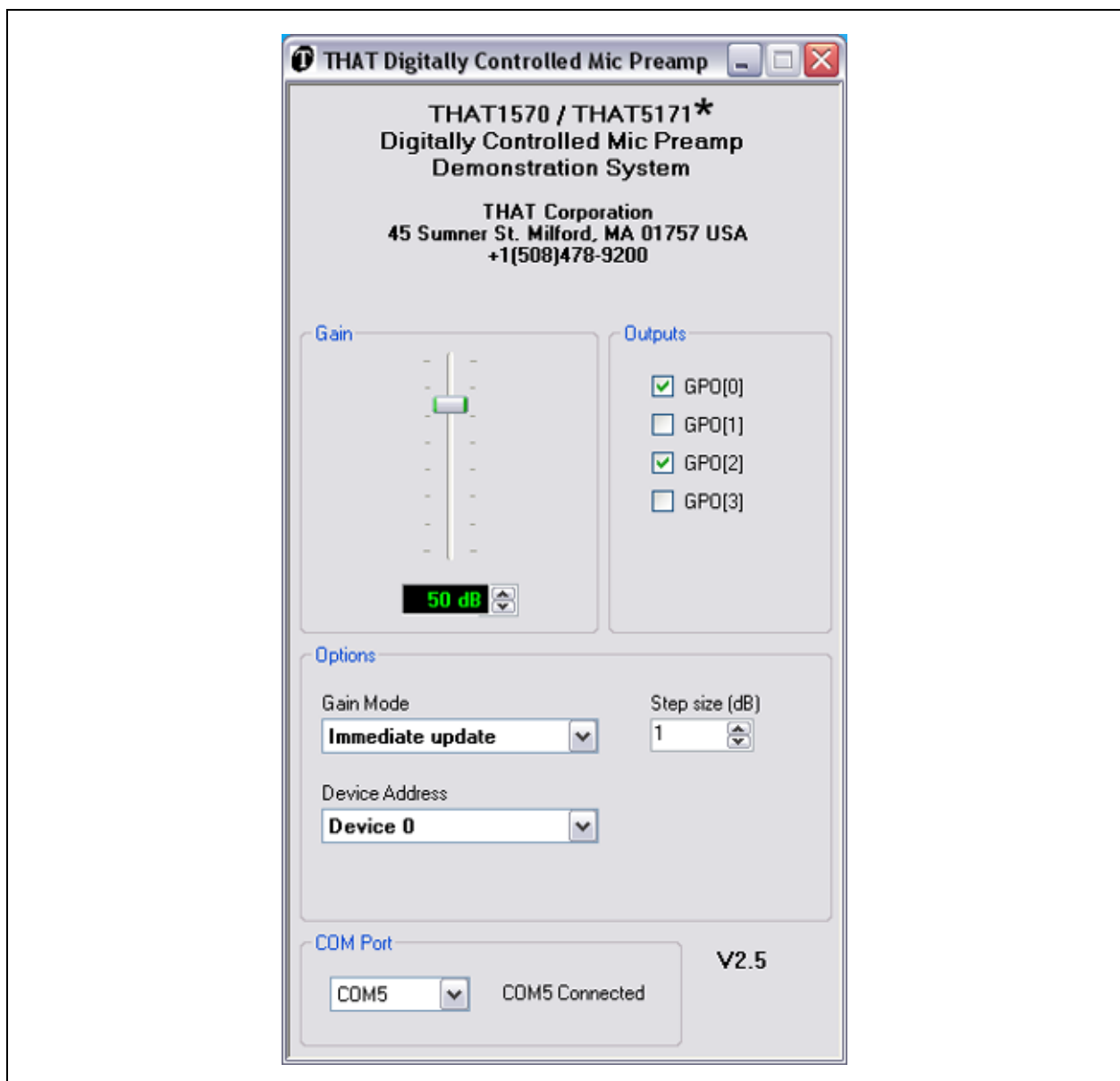


Figure 2. Control GUI

2. Run the software installer program (double-click "1570\_5171\_Demo\_Setup.msi")\*. The installer automatically detects your operating system and configures the appropriate drivers without any further input from you. You will see a "DOS box" and Windows dialogue box temporarily appear and then disappear during the process. Once the software installation process is complete, you will find an icon labeled "THAT 1570 5171 Demo"\* on your desktop and a new THAT Corporation group in your start menu.

### **Operation**

1. Apply power to the demo board, then plug the demo board into the PC via USB.
2. Launch the MicPreController GUI application.
3. The USB interface on the demo board will appear in Windows as a new COM port. Click the COM drop down menu in the MicPreController application and select the COM port associated with the USB module.
4. The GUI should now be connected to the demo board and ready to control its parameters. The GUI initially turns on LED1 as an indication that it is successfully communicating with the demo board. If LED1 is not lit, confirm proper cable connections and that you selected the correct COM port in the previous step.
5. Select "Immediate Update" or "Update on Zero Crossings" via the Gain Mode drop down box, depending on your preference.
6. Move the gain slider to adjust gain of the 5171. Gains are continuously adjusted as you move the slider. Note that gain settings of 1-7dB are invalid. You may also adjust the gain slider by first giving it scope (clicking it with the mouse) and then pressing the UP and DOWN arrow keys on your computer keyboard, or by clicking the up or down arrow buttons next to the numeric gain text box below the gain slider. The Step Size box in the Options area allows you to set how many decibels the slider changes when you press the UP/DOWN and arrow keys.

### **Jumper Options**

#### ***T-Bias Jumper, J4***

The input circuit provides a jumper (J4) which enables/disables the "T-Bias" function. With a shunt installed on J4, T-Bias is disabled and the circuit provides a 2 k $\Omega$  differential input impedance to the XLR input. With the shunt removed from J4, T-Bias is enabled and provides a high common mode impedance (ideal for both mic and line inputs) but maintains a modest differential impedance.

#### ***VCM Jumper/Input, J6***

The output attenuator (U3) is normally biased at 0 VDC via R30 connected to ground through a shunt on jumper J6. If the J6 shunt is removed, a bias voltage may be input via J6, e.g. the common mode voltage output pin (VCOM) of an A/D Converter.

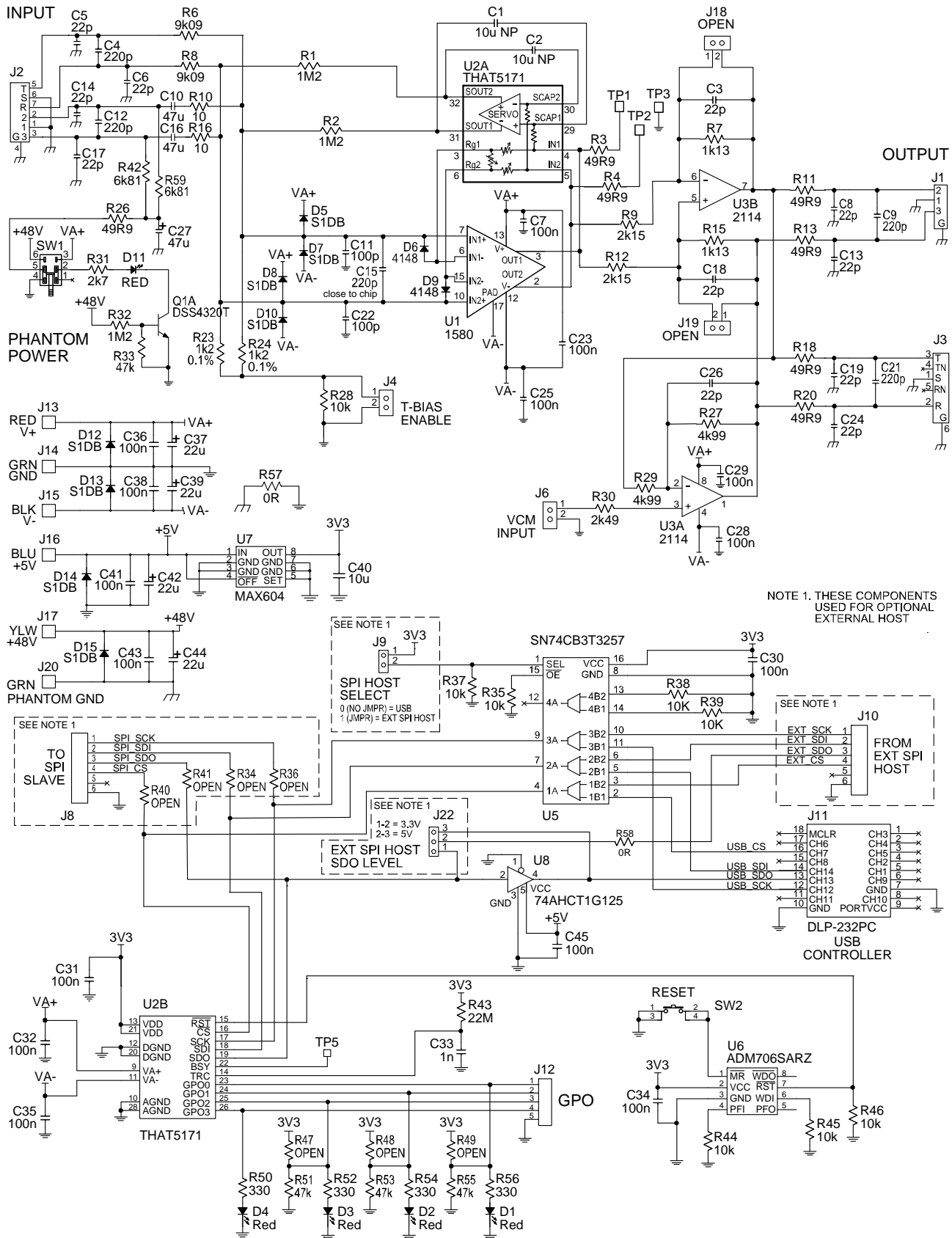
\* Note: The THAT1580/5171 DEMO uses the same software as the THAT1570/5171 DEMO.

***External SPI Host Jumpers & Connectors***

The demo board has two connectors, J8 and J10, for connecting up to 8 boards to an external SPI master device, such as a microcontroller. J8 is not installed at the factory and it is up to the user to add it if required. Note also that current limiting resistors R34, R36, R40, and R41 must be installed with the appropriate value for the application. Please contact THAT Corporation technical support for assistance.



# Appendix A. Schematic Diagram



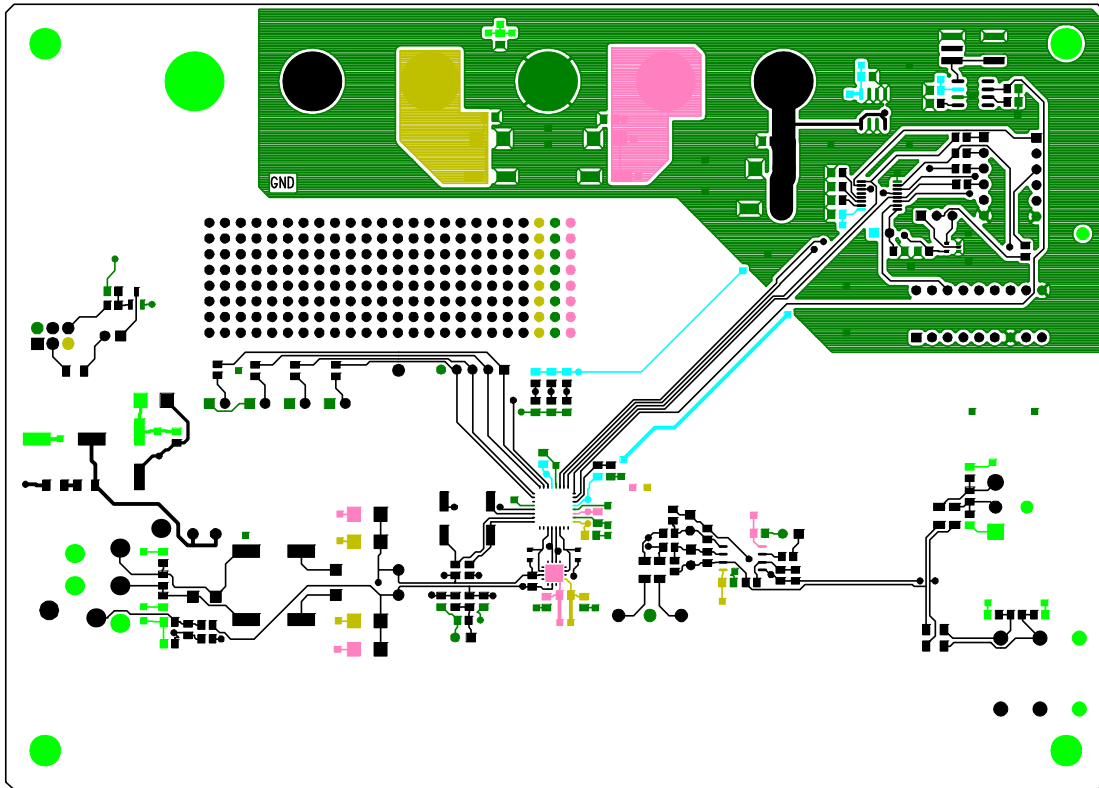
NOTE 1. THESE COMPONENTS USED FOR OPTIONAL EXTERNAL HOST

## Appendix B. Bill of Materials

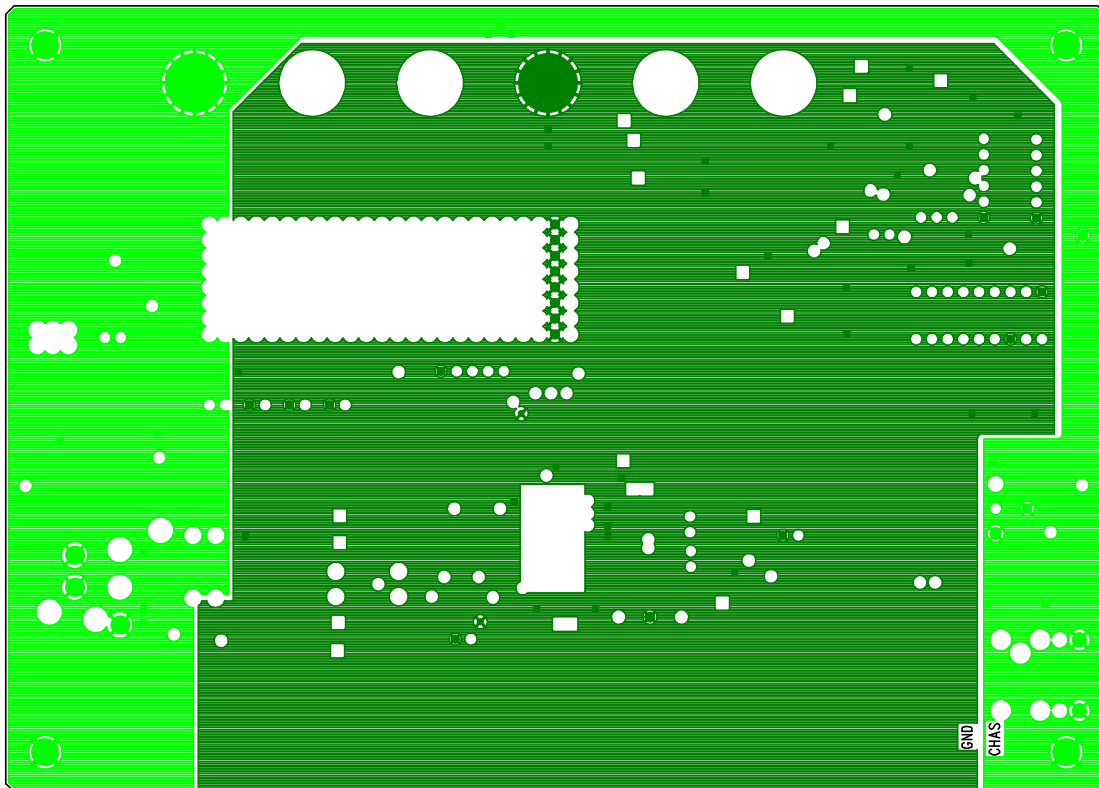
| Item | Qty | Ref  | Value      | Description                        | MFR         | MFR PN        |
|------|-----|--|------------|------------------------------------|-------------|---------------|
| 1    | 2   | C1, C2   | 10uF/NP    | Cap. EL, nonpol, 20%, 16V          | Nichicon    |               |
| 2    | 11  | C3, C5, C6, C8, C13, C14, C17, C18, C19, C24, C26                        | 22pF       | Cap., 50V, 5%, NPO                 | Panasonic   | ECJ-2VC1H220J |
| 3    | 5   | C4, C9, C12, C15, C21  | 220pF      | Cap., 50V, 5%, NPO                 | Panasonic   | ECJ-2VC1H221J |
| 4    | 15  | C7, C23, C25, C28, C29, C30, C31, C32, C34, C35, C36, C38, C41, C43, C45 | 100nF      | Cap., 50V,10%, X7R                 | Panasonic   | ECJ-2YB1H104K |
| 5    | 3   | C10, C16, C27  | 47UF       | Cap, EL, 20%, 63V, 1ohm            | Panasonic   | EEV-TG1J470P  |
| 6    | 2   | C11, C22   | 100PF      | Cap., 50V, 5%, NPO                 | Panasonic   | ECJ-2YB1H104K |
| 7    | 1   | C33  | 1nF        | Cap., 50V,10%, X7R                 | Panasonic   | ECJ-2VB1H102K |
| 8    | 3   | C37, C39, C42  | 22uF       | Cap. EL, 20%, 25V                  | Panasonic   | EEV-FC1E220P  |
| 9    | 1   | C40  | 10uF       | Cap., 10V,10%, X5R                 | Panasonic   | ECJ-2FB1A106K |
| 10   | 1   | C44  | 22uF       | Cap, EL, 20%, 63V, 1ohm            | Panasonic   | EEV-TG1J220P  |
| 11   | 5   | D1, D2, D3, D4, D11  | RED        | LED, red, T1                       | Rohm        | SLA-560LT3F   |
| 12   | 8   | D5, D7, D8, D10, D12, D13, D14, D15                                      | S1DB       | Diode, RECTIFIER GPP SMD 200V 1A   | Diodes, Inc | S1DB-13       |
| 13   | 2   | D6, D9   | 4148       | Diode, DIODE SWITCHING 75V 150MA   | Comchip     | CDSU4148      |
| 14   | 1   | J1   | NC3MAH     | Conn., XLR, Male, PCB              | Neutrik     | NC3MAH        |
| 15   | 1   | J2   | NCJ6FI-H   | Conn., Combo, PCB                  | Neutrik     | NCJ6FI-H      |
| 16   | 1   | J3   | NRJ6HF-1   | Conn., Phone Jack, TRS             | Neutrik     | NRJ6HF-1      |
| 17   | 3   | J4, J6, J9   | CON2       | Conn., HEADER 36POS .100 VERT GOLD | Molex       | 22-28-4363    |
| 18   | 3   | J5, J7, J21  | SHUNT-2POS | Conn, shunt, 2-pos, 100mil         | TYCO        | 382811-6      |
| 19   | 1   | J8   | CON6       | Conn., HEADER 36POS .100 VERT GOLD | Molex       | OPEN          |
| 20   | 1   | J10  | CON6       | Conn., HEADER 36POS .100 VERT GOLD | Molex       | 22-28-4363    |
| 21   | 1   | J11  | DLP-232PC  | PCB, USB Module                    | DLP         | DLP-232PC     |
| 22   | 1   | J12  | CON5       | Conn., HEADER 36POS .100 VERT GOLD | Molex       | 22-28-4363    |
| 23   | 1   | J13  | 5WBP, RED  | Conn., 5-way binding post, Red     | Pomona      | 3760-2        |
| 24   | 2   | J14, J20   | 5WBP, GRN  | Conn., 5-way binding post, Green   | Pomona      | 3760-5        |
| 25   | 1   | J15  | 5WBP, BLK  | Conn., 5-way binding post, Black   | Pomona      | 3760-0        |
| 26   | 1   | J16  | 5WBP, BLU  | Conn., 5-way binding post, Blue    | Pomona      | 3760-6        |
| 28   | 1   | J17  | 5WBP, YLW  | Conn., 5-way binding post, Yellow  | Pomona      | 3760-4        |
| 29   | 1   | J22  | CON3       | Conn., HEADER 36POS .100 VERT GOLD | Molex       | 22-28-4363    |
| 30   | 1   | Q1   | DSS4320T   | NPN, 20V, 2A                       | Diodes, Inc | DSS4320T-7    |

|    |   |  |                 |   |                   |                    |
|----|---|--|-----------------|---|-------------------|--------------------|
| 31 | 3 | R1, R2, R32                                | 1M2             | Res., thick film, 1/8W, 1%              | YAGEO             | RC0805FR-071M2L    |
| 32 | 8 | R3, R4, R11,<br>R13, R18, R20,<br>R25, R26 | 49R9            | Res., thin film, 1/4W, 0.1%             | Vishay            | TNPW120649R9BEEN   |
| 33 | 2 | R6, R8                                     | 9K09            | Res., thin film, 1/8W, 0.1%,<br>25ppm/c | Susumu            | RG2012P-9091-B-T5  |
| 34 | 2 | R7, R15                                    | 1K13            | Res., thin film, 1/10W, 0.5%            | Susumu            | RR1220P-1131-D-M   |
| 35 | 2 | R9, R12                                    | 2K15            | Res., thin film, 1/10W, 0.5%            | Susumu            | RR1220P-2151-D-M   |
| 36 | 2 | R10, R16                                   | 10              | Res., metal film, 1/4W, 1%              | Vishay            | CMF5010R000FHEB    |
| 37 | 1 | R23  | 1K2             | Res., thin film, 1/4W, 0.1%,<br>25ppm/c | Susumu            | RGH2012-2E-P-122-B |
| 38 | 1 | R24  | 1K2             | Res., thin film, 1/4W, 0.1%,<br>5ppm/c  | Susumu            | RGH2012-2E-P-122-B |
| 39 | 2 | R27, R29                                   | 4K99            | Res., thin film, 1/10W, 0.5%            | Susumu            | RR1220P-4991-D-M   |
| 40 | 1 | R28  | 10K             | Res., thin film, 1/10W, 25ppm,<br>0.5%  | Susumu            | RR1220P-103-D      |
| 41 | 1 | R30  | 2K49            | Res., thin film, 1/10W, 0.5%            | Susumu            | RR1220P-2491-D-M   |
| 42 | 1 | R31  | 2K7             | Res., thick film, 1/4W, 5%              | YAGEO             | RC1206JR-072K7L    |
| 43 | 4 | R33, R51, R53,<br>R55                      | 47K             | Res., thick film, 1/8W, 1%              | YAGEO             | RC0805FR-0747KL    |
| 44 | 7 | R35, R37, R38,<br>R39, R44, R45,<br>R46    | 10K             | Res., thin film, 1/10W, 25ppm,<br>0.5%  | YAGEO             | RR1220P-103-D      |
| 45 | 2 | R42, R59                                   | 6K81            | Res., metal film, 1/4W, 0.1%            | IRC               | RC55LF-D-6K81-B-B  |
| 46 | 1 | R43  | 22M             | Res., thick film, 1/8W, 10%             | Panasonic         | ERJ-6GEYK226V      |
| 47 | 4 | R50, R52, R54,<br>R56                      | 330             | Res., thick film, 1/8W, 1%              | YAGEO             | RC0805FR-07330RL   |
| 48 | 2 | R57, R58                                   | 0R              | Res., thick film, 1/8W, 5%              | YAGEO             | RC0805JR-070RL     |
| 49 | 1 | SW1  | PBH2UEENAGX     | SW., push, DPDT                         | E Switch          | PBH2UEENAGX        |
| 50 | 1 | SW2  | SW MOM.<br>PUSH | SW., push, mom, DPST                    | Panasonic         | EVQ-PHV03T         |
| 51 | 3 | TP1, TP2, TP3                              | TP              | Conn., Test point                       | Keystone          | 1250               |
| 52 | 1 | U1   | THAT1580        | IC, Mic Pre                             | THAT Corp         | THAT1580           |
| 53 | 1 | U2   | THAT5171        | IC, Mic Pre Controller                  | THAT Corp         | THAT5171           |
| 54 | 1 | U3   | NJM2114         | IC, op amp, dual                        | NJR               | NJM2114M           |
| 55 | 1 | U5   | SN74CB3T3257    | IC, Quad MUX                            | TI                | SN74CB3T3257PWR    |
| 56 | 1 | U6   | ADM706SARZ      | IC, Reset monitor                       | Analog<br>Devices | ADM706SARZ         |
| 57 | 1 | U7   | MAX604          | IC, Adj LDO Reg.                        | Maxim             | MAX604CSA          |
| 58 | 1 | U8   | 74AHCT1G125     | IC, buffer, single                      | TI                | SN74AHCT1G125DCK   |

### Appendix C. PCB Layout

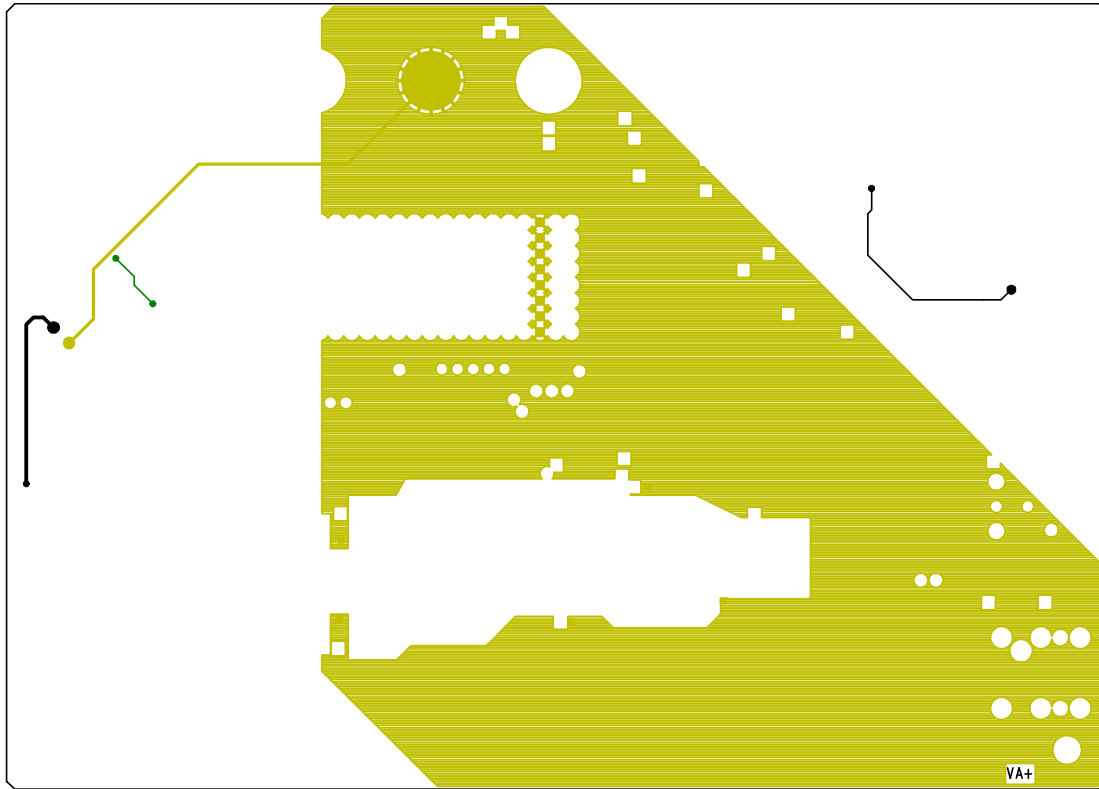


PCB Layout - Layer 1 (Top)

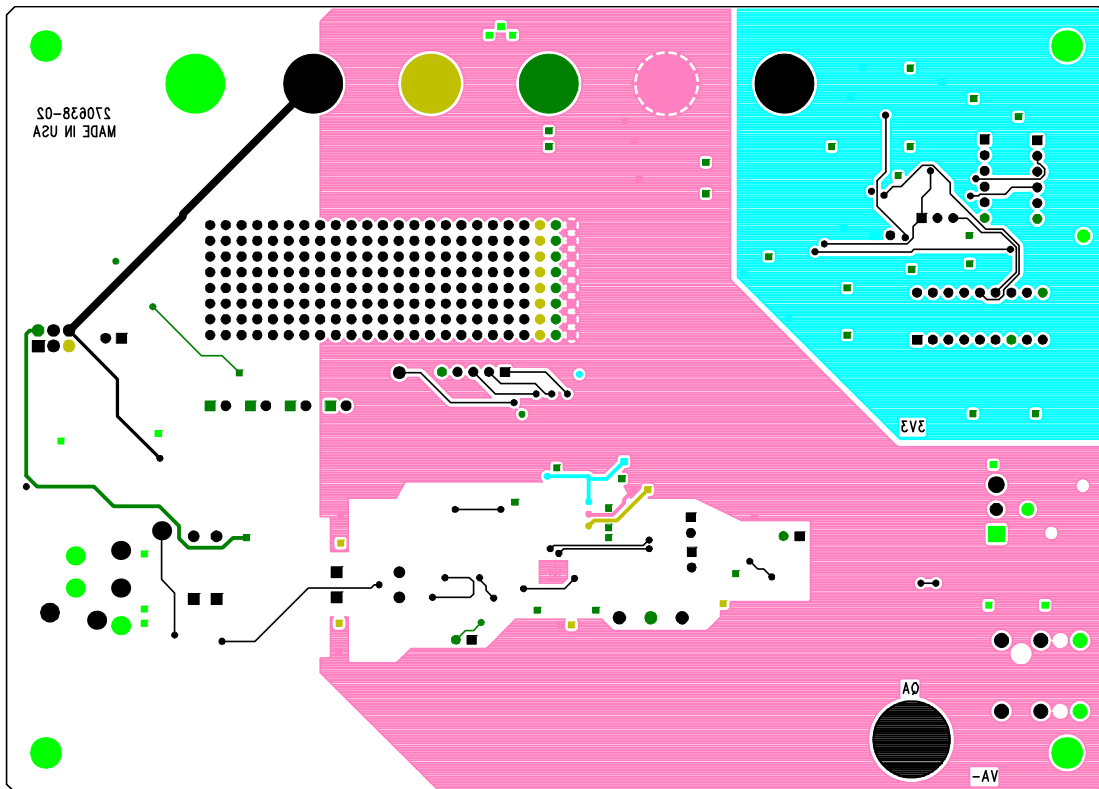


PCB Layout - Layer 2

### Appendix C. PCB Layout (Continued)

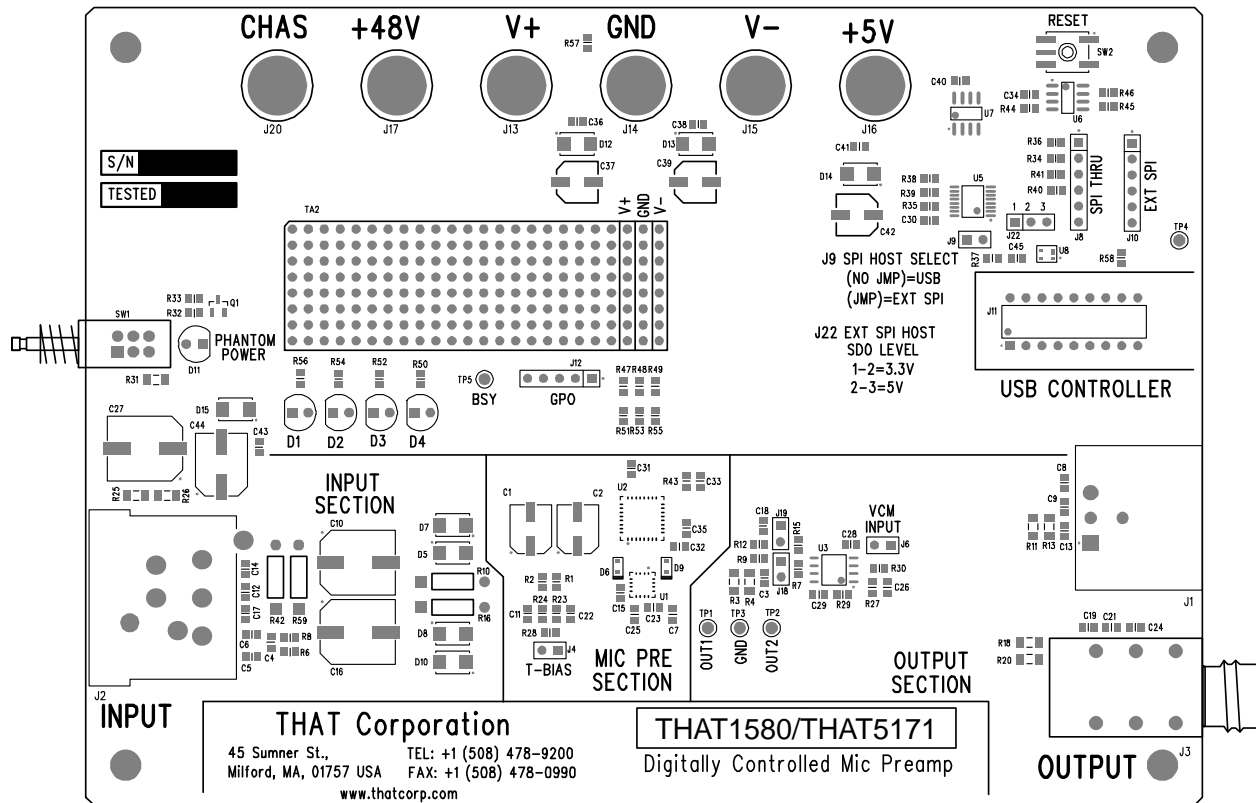


PCB Layout - Layer 3



PCB Layout - Layer 4 (Bottom)

### Appendix C. PCB Layout (Continued)



PCB Layout - Silk Screen

## Notes

**Revision History**

| <b>Revision</b> | <b>ECO</b> | <b>Date</b> | <b>Changes</b> | <b>Page</b> |
|-----------------|------------|-------------|----------------|-------------|
| 00              | —          | 10/08/15    | Released       | —           |
|                 |            |             |                |             |
|                 |            |             |                |             |
|                 |            |             |                |             |