FEATURES

- Demonstrates a complete digitally-controlled microphone preamplifier system utilizing the THAT5171 controller IC paired with a THAT1580 preamplifier IC
- Balanced microphone-level audio inputs on XLR connector with switchable phantom power via external 48V supply
- Balanced line input with -20dB pad on TRS connector
- Balanced audio output on XLR and TRS connectors
- Supports pro audio signal levels: +22 dBu input and +22 dBu output
- Easy to use PC Graphical User Interface software provides control of gain, GPO states, and Zero Crossing Detector modes
- Gain (measured input to output) is adjustable in 1 dB steps: 0 dB, and 8 - 63dB
- Direct SPI control and multiple board daisy-chaining is available via on-board headers
- External VCM input available for output stage biasing
- On-board prototyping area
**THAT5171/1580 Overview**

The THAT5171 and THAT1580 ICs enable digitally-controlled microphone preamplifier applications with exceptionally high performance. The chipset accepts professional audio input levels (+22 dBu max) without an input pad. Gain is adjustable to 5.6 dB, 13.6 dB to 68.6 dB in 1 dB increments (a 5.6 dB attenuator at the output offsets the overall gain range to 0 dB, and 8-63 dB). The 5171’s built-in zero-crossing detector and other techniques for reducing zipper noise enable very smooth and silent gain changes. A differential servo reduces output offsets to less than 1.5 mV. 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 readback. By separating the analog mic preamp 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 4x4 mm QFN16 and 7x7 mm QFN32 packages respectively, the THAT1580 and THAT5171 require very little PCB area.

**Block Diagram**

![Block Diagram of the THAT 5171 Demo Board](image-url)

Figure 2. Block Diagram of the THAT 5171 Demo Board
## 5171 Demo Specifications\(^{1,2,3}\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Typical</th>
<th>Units</th>
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<tbody>
<tr>
<td>Power Supply Voltage</td>
<td>V+ - V-</td>
<td>±15</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Input Level (V+ / V- = ±15V)</td>
<td>V\text{IN-BAL}</td>
<td>+22</td>
<td>dBU</td>
</tr>
<tr>
<td>Maximum Differential Output Level (V+ / V- = ±15V)</td>
<td>V\text{OUT}</td>
<td>+22</td>
<td>dBU</td>
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<tr>
<td>Gain (input to output)</td>
<td>A\text{dB}</td>
<td>0 to 63 in 1dB steps</td>
<td>dB</td>
</tr>
<tr>
<td>Gain error (all settings)</td>
<td>A\text{err}</td>
<td>±0.15</td>
<td>dB</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>THD</td>
<td>0.0004 (0dB gain)</td>
<td>%</td>
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<tr>
<td>(V\text{OUT}=+16dBu (5V\text{RMS}); R\text{L}=10kΩ</td>
<td></td>
<td>0.0003 (20dB gain)</td>
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<tr>
<td>C\text{L}=10pF; f = 1kHz; BW = 22 kHz</td>
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<td>0.0008 (40dB gain)</td>
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<tr>
<td>(V\text{OUT}=+16dBu (5V\text{RMS}); R\text{L}=10kΩ</td>
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<td>0.006 (60dB gain)</td>
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<tr>
<td>Equivalent Input Noise</td>
<td>E\text{IN}</td>
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<td>dBU</td>
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<tr>
<td>(main output)</td>
<td></td>
<td>-127.1 (40dB gain)</td>
<td></td>
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<tr>
<td>(150 Ω source, BW=22kHz)</td>
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<td></td>
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<td>-107.0 (0dB gain)</td>
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<td>Supply Current</td>
<td>l\text{CC}, -l\text{EE}, l\text{DD}</td>
<td>23 (V+ supply)</td>
<td>mA</td>
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<tr>
<td></td>
<td></td>
<td>23 (V- supply)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>0.5 (+5V supply)</td>
<td></td>
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</table>

1. All specifications are subject to change without notice.
2. Unless otherwise specified, T\text{a}=25°C, V\text{CC}=+15V, V\text{EE}=-15V, V\text{DD}=+3.3V
3. All audio specifications include the effects of the differential output buffer stage.
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 ¼" TRS cable. Maximum input signal level is +22dBu with +/-15 V supplies. The 1/4" TRS signal path includes a 20 dB pad in order to support very high line levels.

Audio Output

Separate XLR and ¼" TRS connectors are wired in parallel. Maximum output signal level is +22 dBu with +/-15 V 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 the various parameters in the 5171.

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.

A note about the phantom power fault protection circuitry included on the demo board:

Phantom power faults are a serious concern in any preamplifier design and external protection circuitry is always required for safe and reliable operation. A momentary short at the input connector while using phantom power can cause 48 V negative spikes to appear at the preamplifier inputs, often destroying the IC if left unprotected. THAT Corporation has recently revised its protection recommendations which now include:

1) Schottky diodes
2) Larger power supply bypass capacitors. The full details of our latest recommendations can be found in our Design Brief 201, “Revisiting Phantom Power Fault Protection”, available on our website here: www.thatcorp.com/Design_Briefs.shtml

The part number for our recommended Schottky diode can be found in the bill of materials included in this document.

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 1 kΩ common-mode input impedance per input leg to the XLR input. With the shunt removed from J4, T-Bias is enabled and provides a higher common mode impedance (nominally 5.1 kΩ per input leg), which will improve CMRR performance, particularly at low frequencies where mismatches in the input coupling capacitors tend to degrade it. The differential input impedance is 2 kΩ in both cases.

VCM Input Jumper, 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.

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.
Software Set-up and Operation

Download the latest Demo Board GUI software from the THAT Corporation web site. There is no “installation” process and the .exe file can be placed anywhere convenient on your computer, typically, directly on the desktop. Connect the demo board to your PC using the supplied USB cable and power up the board (don’t forget to include the +5V digital power supply in addition to the V+ and V- supplies).

Double click the MicPre.exe icon and the Digitally Controlled Mic Preamp Demo Board Selector will appear. Select the THAT5171 from the drop-down menu.

That’s it. Test for connectivity by toggling one of the GPO check boxes and see if the appropriate LED lights up on the board.

If the GUI fails to recognize the demo board (most likely caused by a missing USB connection) you will see the following error message:

If this message appears, you can click OK and the GUI will open, but there will be no connection to the demo board. Once the source of the problem has been resolved (i.e. Turn on the power or connect the missing USB cable), use the Port=>Reconnect pull down to establish communications.

The Port=>Reconnect pull down can be used anytime to reestablish the USB link between the GUI and demo board.
Appendix A. Schematic Diagram (1 of 2)
Appendix A. Schematic Diagram (2 of 2)
THAT5171-Demo Datasheet

PCB Component Placement

INPUT

THAT Corporation
45 Summer St.
Milford, MA 01757 USA
Tel: +1 508 478 9200; Fax: +1 508 478 0990; Web: www.thatcorp.com
Email: info@thatcorp.com

THAT5171
Digitally Controlled Mic Preamp Demo Board
Made in the USA

OUTPUT
## Appendix B. Bill of Materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Qty</th>
<th>Designator</th>
<th>Description</th>
<th>Manufacturer</th>
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<td>Standoff 4-40 X 1/4&quot; X 1&quot; HEX AL</td>
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THAT Corporation; 45 Sumner Street; Milford, MA 01757-1656; USA
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Appendix C. PCB Layout (1 of 3)

PCB Layout – Top Layer Silkscreen

PCB Layout – Top Layer
Appendix C. PCB Layout (2 of 3)

PCB Layout – Internal Layer 1

PCB Layout – Internal Layer 2
Appendix C. PCB Layout (3 of 3)

PCB Layout – Bottom Layer
## Revision History

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