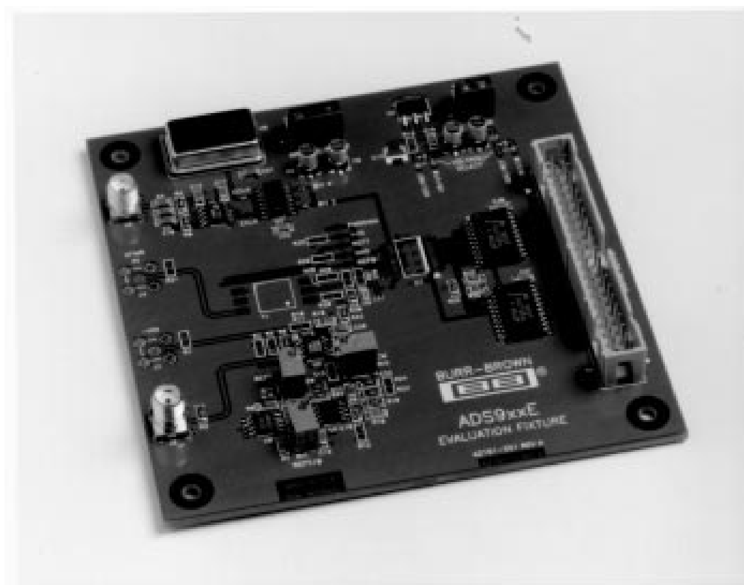
# DEM-ADS9xxE

**EVALUATION FIXTURE**



## FEATURES

- PROVIDES FAST AND EASY PERFORMANCE TESTING FOR ADS900/ADS901 AND ADS930/ADS931
- AC- AND DC-COUPLED INPUTS
- ON-BOARD REFERENCE
- ON-BOARD CLOCK
- ON-BOARD REGULATOR FOR +3V AND +5V OPERATION

## DESCRIPTION

The DEM-ADS9xxE evaluation fixture is designed for ease of use when evaluating the high speed analog-to-digital converter of the ADS9xx family. It was designed to be the common evalution platform for four of the models within the ADS9xxE family. The board will acommodate the ADS900 and ADS930, converters with internal references, as well as the ADS901 and ADS931, which require the external references. Because of its flexible design, the user can evaluate the converter in many different configurations; either with DC-coupled or AC-coupled input, or single-ended or differential inputs.

Furthermore, the board can be operated with the on-board crystal clock or with an external clock. The on-board reference circuit is adjustable, and the data outputs from the ADS9xx converter are decoupled from the connector via the TTL-buffer.

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Internet: http://www.burr-brown.com/ • FAXLine: (800) 548-6133 (US/Canada Only) • Cable: BBRCORP • Telex: 066-6491 • FAX: (520) 889-1510 • Immediate Product Info: (800) 548-6132

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## INITIAL CONFIGURATION AND QUICK START

Through the use of the solder switches the demonstration board, DEM-ADS9xxE, can be adjusted in a variety of configurations to accommodate a specific model or function. Before starting evalution, the user should decide on the configuration and make the appropriate connections. The following list is a guideline for an inital setup:

- The supply voltage should be +3V for the A/D converter; close switch ‘ADC/REF’ at the +3V side. If the board is equipped with HC541 buffers, select switch ‘U9/U10’ on the +5V side. If LCX541s are used, select the +3V side. Note that the LCX series will provide logic levels compatible for 3V logic.
- The clock source is the on-board crystal. Close switch ‘CCLK’ and ‘DIV2’ to activate the clock and operate with a divider ratio of ÷2.
- The DC-coupled input is activated through connecter J2, ‘$-V_{IN}$ BUF’.
- The external references are not applied to the converter; solder switches ‘REFT’ and ‘REFB’ are open.
- The power-down function is disabled.

The evaluation board typically requies a ±5V supply unit. The negative supply is necessary to appropriately power the op amp used in the interface circuit. Reconfiguring the demonstration board for AC-coupled input, in combination with the crystal clock, makes it possible to operate the board on a single +5V supply.

## INPUTS

### DC-Coupled

The standard configuration of the evaluation board uses the dual high-speed op amp OPA2650, a voltage feedback type op amp. In order to implement level shifting into the DC-coupled circuit, op amp U3:B operates in an inverting mode, with the level shifting voltage applied its noninverting input. To offer a high impedance input to this interface circuit, the second op amp, U3:A, buffers the inverting gain stage. This provides a terminated 50Ω input to the demonstration board through connector J2, ‘$-V_{IN}$ BUF’. Besides using op amp U3:A as a buffer, it can be reconfigured for gain by changing the resistor values for $R_9$ and $R_3$. If it is desired to evaluate the circuit with only one op amp in the signal path, the second input, J1, can be used which requires some additional components to be soldered to the board. Note that in this case, the input impedance to the board is also determined by the input resistor value, $R_{10}$, and an appropriate termination resistor, $R_1$, value must be selected. A desired common-mode voltage can be set by adjusting potentiometer $RV_2$.

### AC-Coupled

The DC-coupled circuit previously discussed can also be reconfigured for AC-coupling. To do so, resistor $R_{17}$ (0Ω) must be taken out and capacitors $C_{20}$ and $C_{22}$ assembled. The purpose of using two capacitors, one ceramic and one tantalum type, in parallel, is to assure a constant impedance throughout a wide frequency range. The level shift should be set to 0V at pin 5 of the OPA2650 by adjusting $RV_2$, which will produce a ground-centered signal swing at the output of the op amp. In order to implement the correct common-mode voltage for the A/D converter, resistor $R_{30}$ must be added. The value is not critical but should be between 1kΩ and 5kΩ.

Alternatively, a single-ended-to-differential input interface can be implemented using a RF transformer. Note that only the ADS900 and ADS930 feature the differential inputs. For setting it up, remove resistor $R_{22}$ and add resistors $R_{28}$ and $R_{29}$, which should have a value of 24.9Ω. Remove resistors $R_{27}$ and $R_{30}$, if used, and close solder switch ‘MID’. To establish symmetrical inputs, capacitor $C_{26}$ should equal capacitor $C_{31}$, typically 22pF. The footprint of the transformer was selected to accommodate RF-transformer case style KK81, similar to T1-6T by Mini-Circuits.

## CLOCK

### On-Board Clock

The ADS9xxE demonstration board is equipped with a crystal oscillator and D-type Flip-Flops (U7), which allow two different divider ratios (÷2 and ÷4) for the clock. The selection of the divider ratio can be done using the solder switched labeled ‘DIV2’ and ‘DIV4’. When using the on-board clock make sure that solder switch ‘CCLK’ is closed and ‘ECLK’ is open. The DEM-ADS9xxE comes with a 40MHz crystal which supports the full sampling speed of the ADS900 and ADS901. To evaluate the ADS930 and ADS931 at its maximum sampling speed of 30MHz, the crystal must be replaced with a 60MHz type. The replacement is easily done since the crystal is socketed.

### External Clock

In addition to the on-board clock, the A/D converter can be driven by an external clock. For this, a low-jitter sine wave generator may be used. Apply the generator to SMA connector J3 (‘EXT CLK’). The ECL to TTL translator IC (U4) will transform the sine wave into a logic signal with a 50% duty cycle. When operating in this external clock mode, open solder switch ‘CCLK’ and close ‘ECLK’. Note that the external clock passes the divider as well.

## EXTERNAL REFERENCE

While the ADS900 and ADS930 have references on-chip, the ADS901 and ADS931 require two external reference voltages; a top reference (REFT) and a bottom reference (REFB). Both references are available by the on-board reference circuit consisting of the micropower reference IC, REF-1004, and a general purpose single-supply op amp. This reference circuit is designed to operate on +5V and +3V. This supply voltage can be selected via the solder switches ‘ADC/REF’. The REF-1004 produces a stable +1.2V. With potentiometer $RV_1$ (REFT/B), this voltage can be adjusted between approximately +1.24V and +0.4V, and will affect both reference levels at the same time. The default configuration for the bottom reference driver (U5:B) is a unity gain stage, but can easily be modified by changing resistors $R_{12}$ and $R_{18}$. The top reference driver (U5:A) employs gain, which can be adjusted through potentiometer $RV_3$. The gain range is from approximately 1.3V/V to 3V/V. If the ADS901 or ADS931 are to be used on the demonstration board, solder switches 'REFB' and 'REFT' must be closed. The voltage set for the references on these models determines the full-scale input signal range of the converter. For example, with REFT = +2V and REFB = +1V, the input range for an ADS901 will be 1Vp-p.

Alternatively, a very simple way of setting up the reference voltages is by deriving them from the power supply. Using resistors $R_{25}$ and $R_{26}$ will allow a current flow from the supply through the A/D's internal resistor ladder. In this case, solder switches '$+V_S$' and 'GND' must be closed and 'REFT' and 'REFB' open.

Depending on the model and its specified supply voltage, it may be necessary to reconfigure the reference circuit to obtain the recommended reference voltages (see the individual data sheets for details). Resistors $R_{23}$ and $R_{24}$ are used to establish the level shift voltage (common-mode voltage, $V_{CM}$) needed for the DC-coupled input circuit. This voltage will track if adjustments are made to the reference voltages.

## DATA OUTPUT

The data output is provided at CMOS logic levels. All ADS9xx converters use straight offset binary coding. The data output pins of the converter are buffered from the connector, P3, by two CMOS octal buffers (HC541). As an alternative, the HC type can be replaced with the new LCX541 (available from Motorola or National Semiconductor). These devices are designed for +3V operation and offer 5V tolerant inputs.

## PC BOARD LAYOUT

The DEM-ADS9xxE demonstration board is made as a four-layer PC board. To achieve the highest level of performance, surface-mount components are used wherever possible. This reduces the trace length and minimizes the effects of parasitic capacitance and inductance. The A/D converter is treated like an analog component therefore, the demonstration board has a consistent ground plane. Keep in mind that this approach may not yield optimum performance results when designing the ADS9xx into different individual applications. In any case, thoroughly bypassing the supply and reference pins of the converter, as shown on the demonstration board, is strongly recommended.

## SUPPLY VOLTAGE SETTING

The ADS9xx converter family consists of models that operate on +3V or +5V supplies. To allow the evaluation of each converter in its typical environment, a voltage regulator was added to the demonstration board. The factory configuration uses the REG1117-3, a fixed +3V voltage regulator. Through a set of four solder switches, the two circuit blocks—the A/D plus the reference, and the output buffer, can be tied independently to either the +3V or +5V supply. The respective labels of the solder switches are 'ADC/REF' and 'U9/U10'. If desired, the REG1117-3 can be replaced with models producing other output voltages, such as +2.85V or +3.3V, or the adjustable output model. Refer to the REG1117 data sheet for details.

## ADS900/ADS930 SETTINGS

The ADS900 and ADS930 are 10- and 8-bit converters, respectively, and operate with sampling frequencies up to 20MHz. Both models have internal references, therefore, the solder switches 'REFT' and 'REFB' must be open. Resistor $R_{27}$ ($0\Omega$) and $R_{30}$ ($3k\Omega$) should be installed. For the ADS900, the supply voltage must be set to +3V, whereas the ADS930 can operate with either +3V or +5V.

## ADS901/ADS931 SETTINGS

The ADS901 and ADS931 are 10-and 8-bit converters, respectively, and operate with sampling frequencies up to 30MHz. These models do not have an internal reference and the connection to the on-board reference circuit is required. Also, resistor $R_{27}$ must be removed.

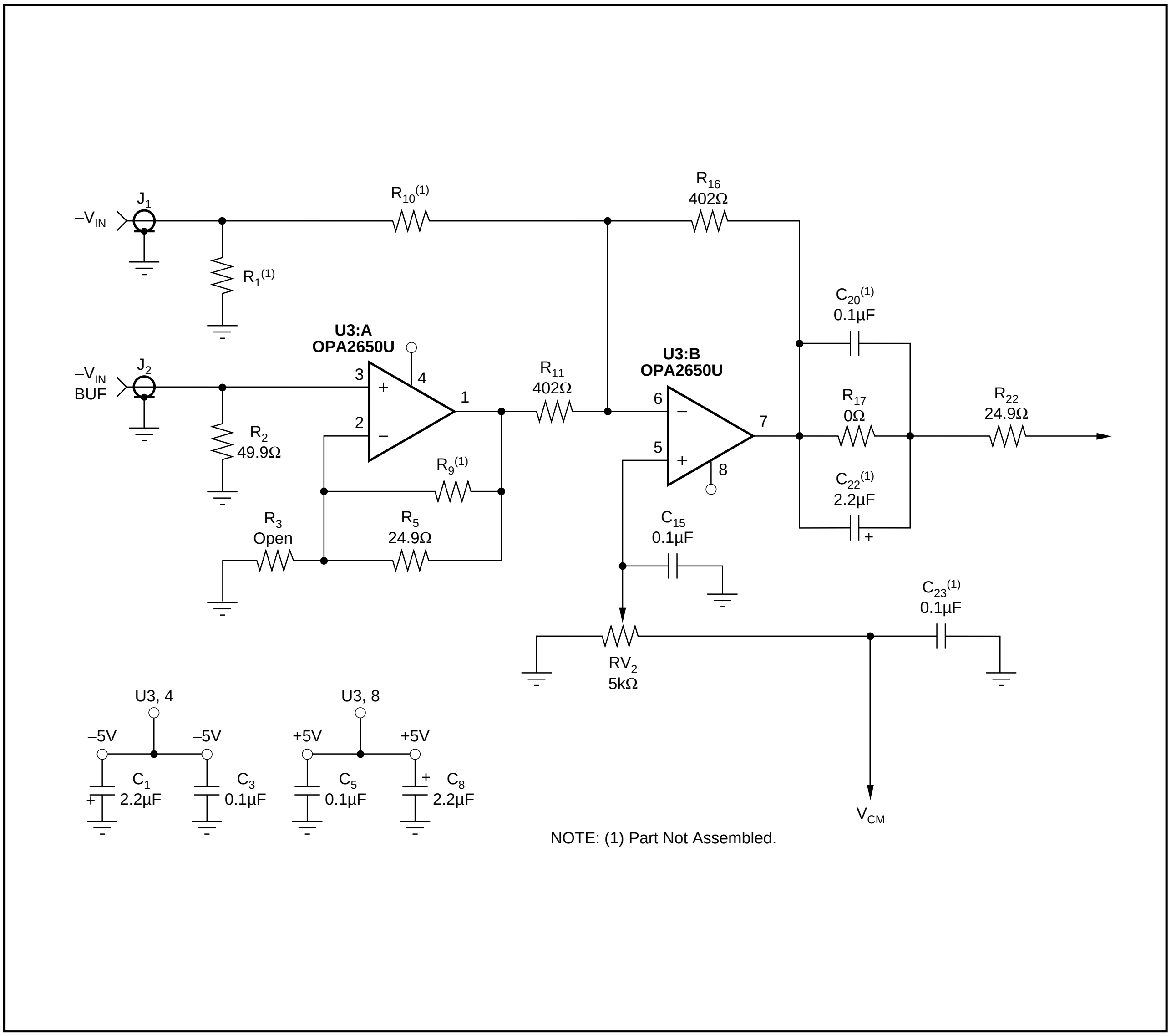


FIGURE 1. DEM-ADS9xxE Analog Input Circuit.

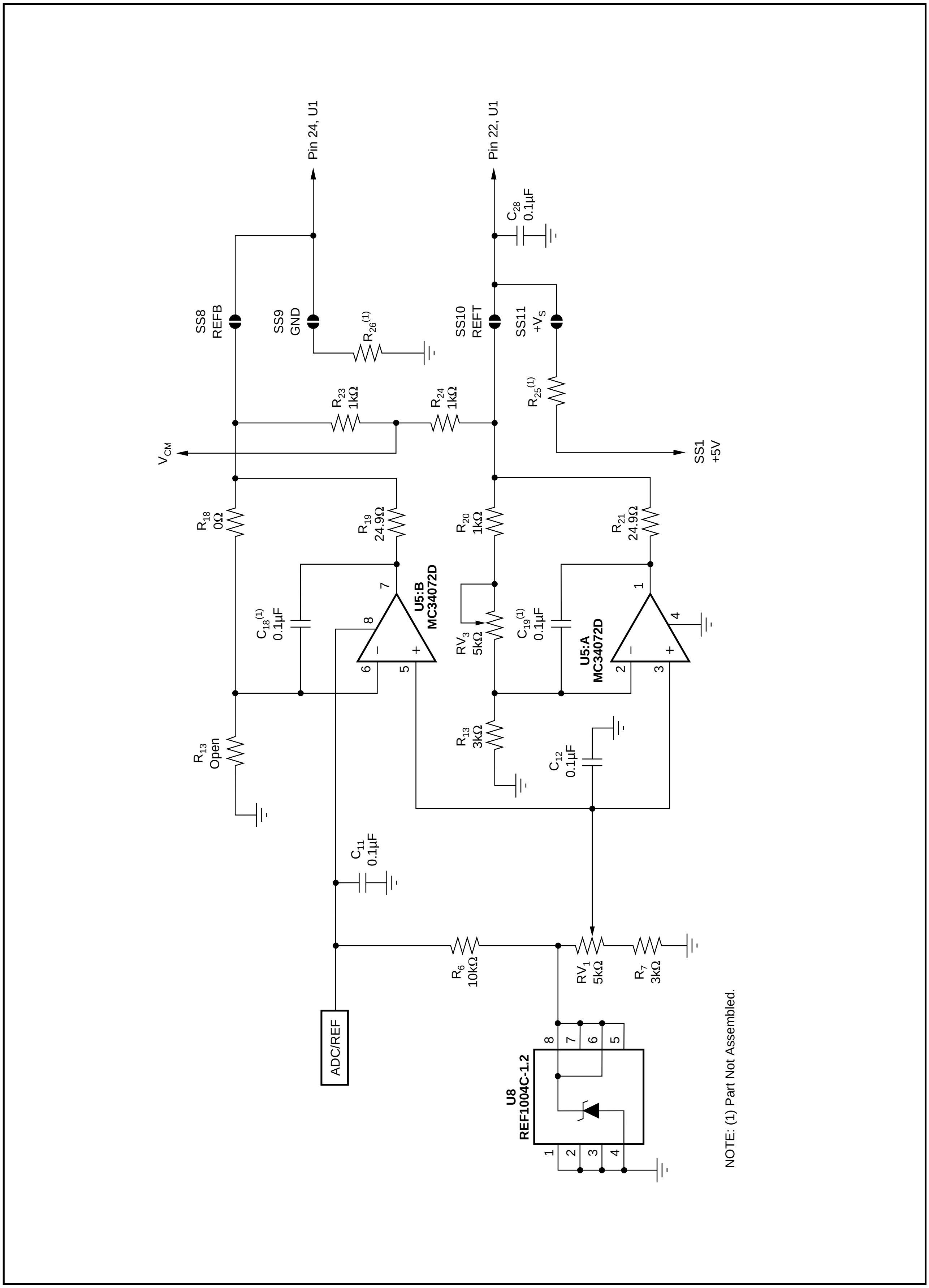


FIGURE 2. DEM-ADS9xxE Reference Circuit.

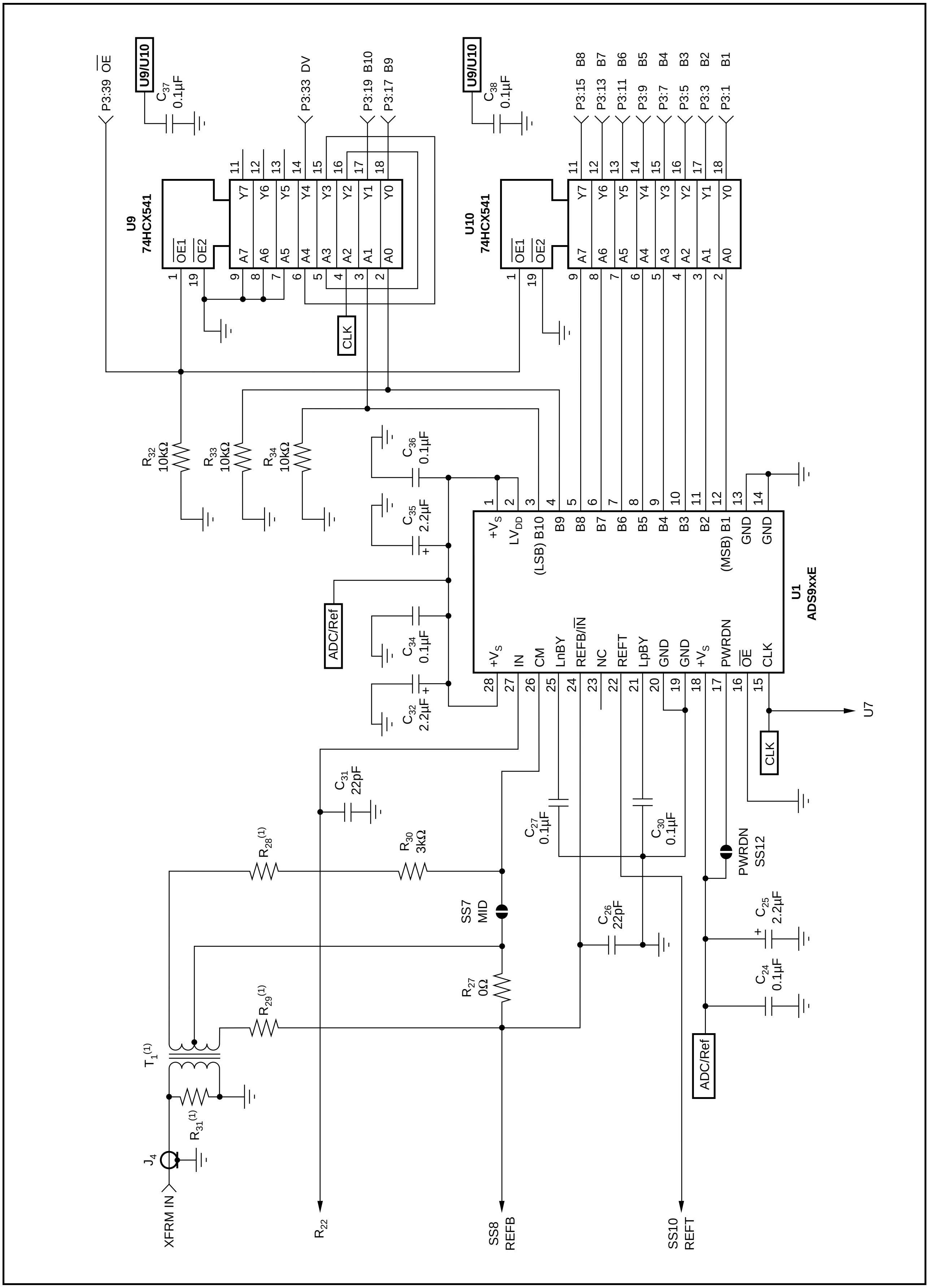


FIGURE 3. DEM-ADS9xxE DUT and Digital Outputs.

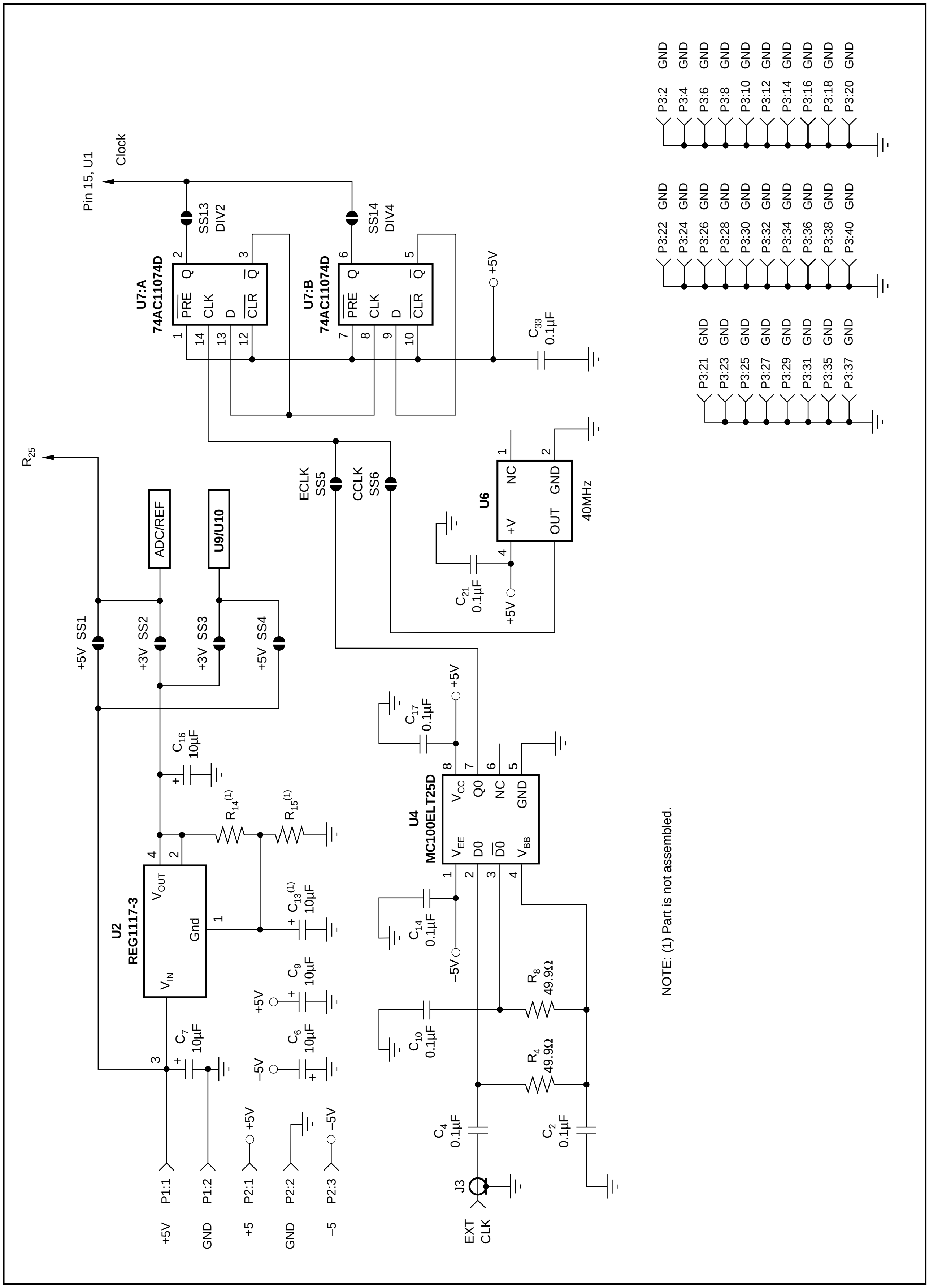


FIGURE 4. DEM-ADS9xxE Clock and Power Supply Circuit.

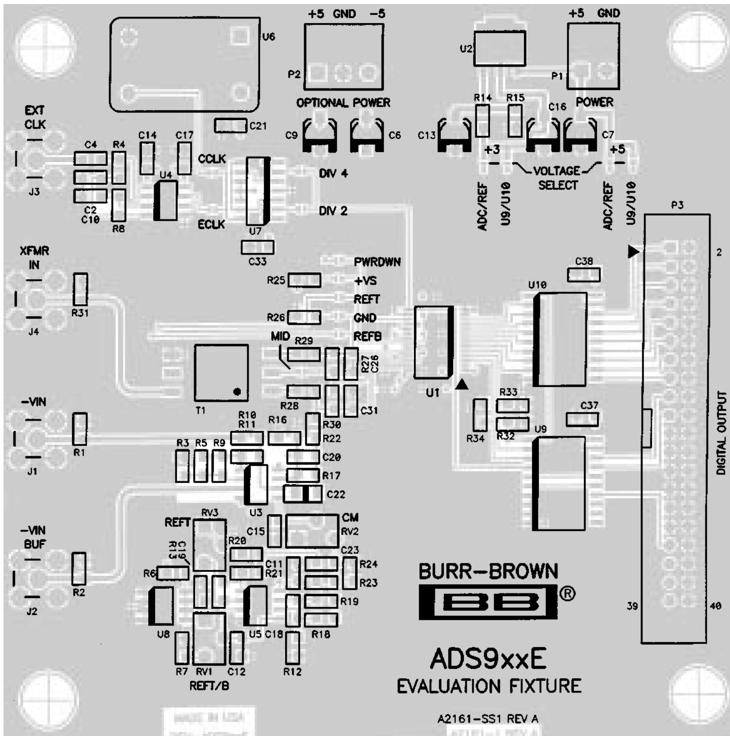

FIGURE 5. Top-Layer (component side) with Silkscreen; DEM-ADS9xxE.

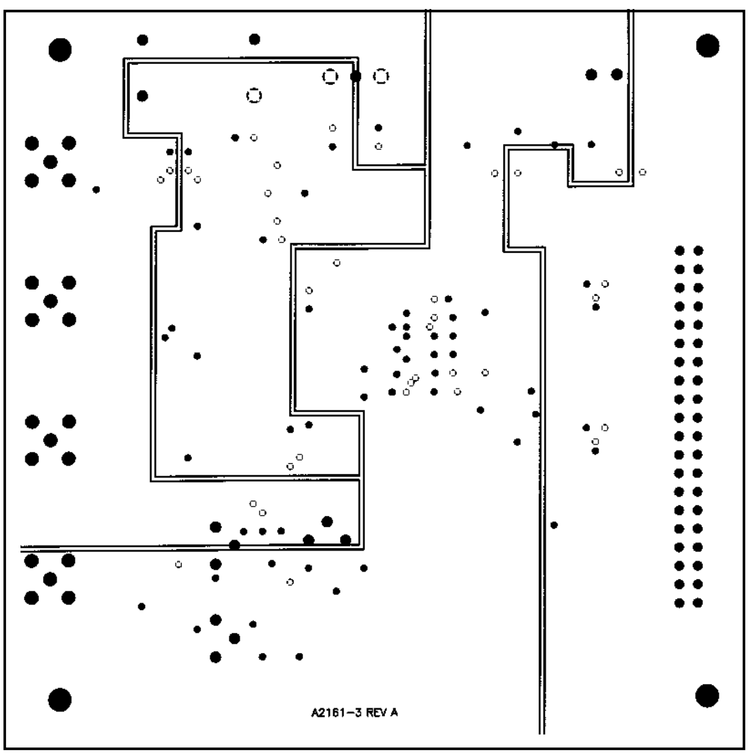

FIGURE 6. Power Plane; DEM-ADS9xxE.

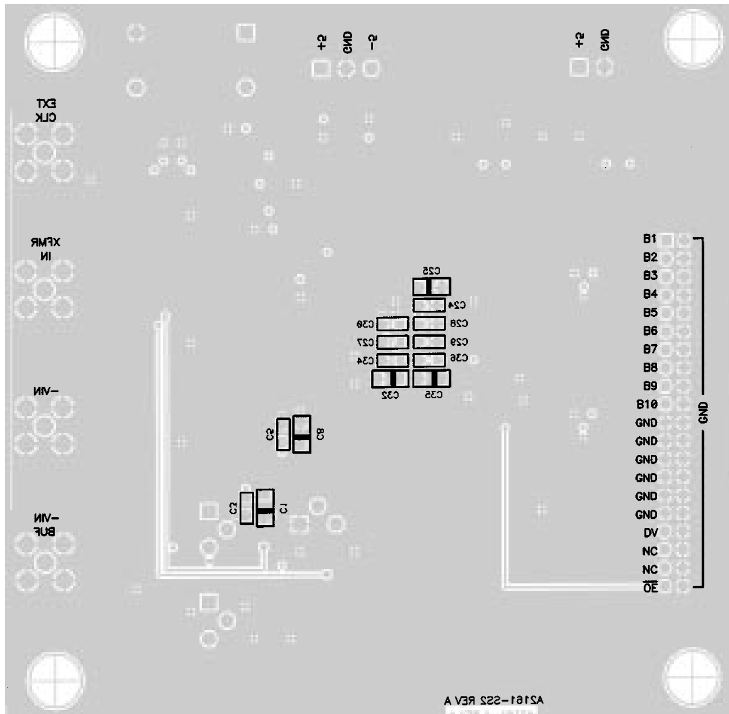

FIGURE 7. Bottom Layer with Silkscreen; DEM-ADS9xxE.

## COMPONENT LIST

| REFERENCE | QTY | COMPONENT | DESCRIPTION | MANUFACTURER |
|---|---|---|---|---|
| U1 | 1 | ADS9xxE | High-Speed ADC, 28-Pin SSOP | Burr-Brown |
| U2 | 1 | REG1117-3 | 3V Fixed Regulator | Burr-Brown |
| U3 | 1 | OPA2650U | Dual VFA Op Amp, SO-8 | Burr-Brown |
| U4 | 1 | MC100ELT25D | ECL to TTL Translator, SO-8 | Motorola |
| U5 | 1 | MC34072D | Dual, Single-Supply Op Amp, SO-8 | Motorola |
| U6 | 1 | F3000 | Crystal, 40MHz/60MHz | Fox |
| U7 | 1 | 74AC11074D | Dual D-Type Flip-Flop, SO-14 | Texas Instruments |
| U8 | 1 | REF1004C-1.2 | 1.2V Reference, SO-8 | Burr-Brown |
| U9, U10 | 2 | MC74LCX541DW | 3V Octal Buffer, 20-Pin SOIC | Motorola |
| U9, U10 | 2 | 74HC541 | 5V Octal Buffer, 20-Pin SOIC | div. |
| R15, R17, R18 | 3 | CRCW1206ZEROF | 0Ω, MF 1206 Chip Resistor, 1% | Dale |
| R5, R19, R21, R22 | 4 | CRCW120624R9F | 24.9Ω, MF 1206 Chip Resistor, 1% | Dale |
| R2, R4, R8 | 3 | CRCW120649R9F | 49.9Ω, MF 1206 Chip Resistor, 1% | Dale |
| R11, R16 | 2 | CRCW12064020F | 402Ω, MF 1206 Chip Resistor, 1% | Dale |
| R20, R23, R24 | 3 | CRCW12061001F | 1kΩ, MF 1206 Chip Resistor, 1% | Dale |
| R7, R13, R30 | 3 | CRCW12063001F | 3kΩ, MF 1206 Chip Resistor, 1% | Dale |
| R6, R32, R33, R34 | 4 | CRCW12061002 | 10kΩ, MF 1206 Chip Resistor, 1% | Dale |
| RV1, RV2, RV3 | 3 | RJ26FW-502 | 5kΩ, 1/4" 10-Turn Pot | Bourns |
| C6, C7, C9, C16 | 4 | ECE-V1CV100SR | 10µF/16V, Surface-Mount Polar, Alu Capacitor | Panasonic |
| C1, C8, C25, C32, C35<br>C2, C3, C4, C5, C10, C11, C12, C14,<br>C15, C17, C21, C24, C27, C28, C29 | 5 | TAJR225006 | 2.2µF/10V, 3216 Tantalum Capacitor | AVX |
| C30, C33, C34, C36, C37, C38 | 22 | 12065C104KAT | 0.1µF/50V, X7R 1206 Ceramic Capacitor | AVX |
| C26, C31 | 2 | 12065C220KAT | 22pF/50V, NP0 1206 Ceramic Capacitor | AVX |
| P1 | 1 | ED555/2DS | 2-Pin Term Block | On-Shore Technology |
| P2 | 1 | ED555/3DS | 3-Pin Term Block | On-Shore Technology |
| P3 | 1 | IDH-40LP-S3-TG | 20x2 Dual-Row Shrouded Header | Robinson-Nugent |
| J2, J3 | 2 | 142-0701-201 | Straight SMA PCB Connector | EF Johnson |
| Sockets for U6 | 4 | #701C | Flush Mount Pins | McKenzie Technology |
| | 4 | 1-SJ5003-0-N | Rubber Feet, Black, 0.44x0.2 | Digi-Key |
| | 1 | PCBA 2161 | PC Board A2161, Rev. A | Burr-Brown |