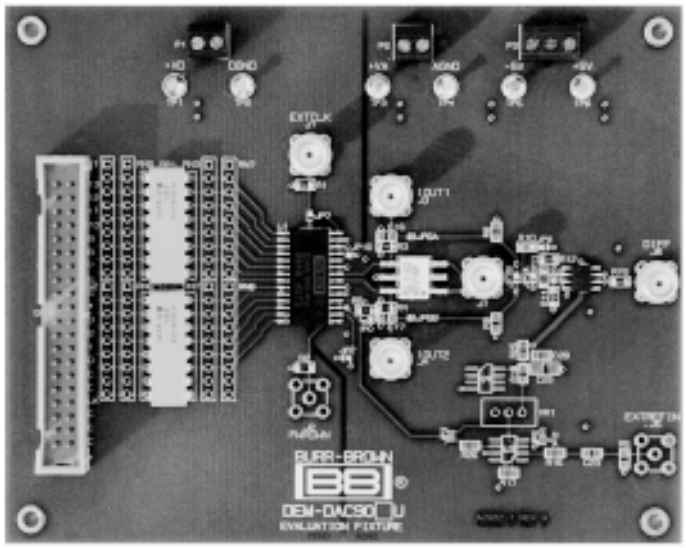
BURR-BROWN®

DEM-DAC90xU/E

EVALUATION FIXTURE



FEATURES

- **POPULATED EVALUATION BOARDS FOR THE SO-28 (DEM-DAC90xU) AND TSSOP-28 (DEM-DAC90xE) PACKAGE**
- **PROVIDES FAST AND EASY PERFORMANCE TESTING FOR THE DAC90x**
- **TRANSFORMER COUPLED DIFFERENTIAL OR SINGLE-ENDED SMA OUTPUT CONFIGURATIONS**
- **SELECTABLE EXTERNAL OR INTERNAL REFERENCE OPERATION**

DESCRIPTION

The DEM-DAC90xU, E evaluation fixture is designed to provide a flexible and easy to use pc-board platform for the evaluation of the high speed digital-to-analog converter family DAC90x. The evaluation boards support the complete family consisting of the 8-bit DAC908, the 10-bit DAC900, the 12-bit DAC902 and the 14-bit DAC904.

The DEM-DAC90xU is designed for the SO-28 package, while the DEM-DAC90xE supports the smaller TSSOP-28 package version.

The analog output signal can be observed either using the differential or single-ended output configuration. The full-scale output current, typically 20mA, is determined by an external resistor, and the use of either the internal or an external reference. The evaluation board can be operated on supply voltages ranging from +3V to +5V. The digital and the analog supplies can be set independently.

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FUNCTIONAL DESCRIPTION

Two versions of the DEM-DAC90xU evaluation board are available to support in the evaluation process of the high-speed digital-to-analog converter, DAC90x. The DEM-DAC90xU is a generic board designed for the SO-28 package models of the DAC90xU family. All DAC90x models feature the same pin out (MSB justified, Pin 1), and may be soldered into the same 28-pin socket. The unused digital inputs may be left unconnected.

The DEM-DAC90xE evaluation boards are designed for the TSSOP-28 package version and include the D/A converter, as shown in Table I.

The board allows the user to operate the DAC90x in a variety of configurations. The output signal, for example, can be examined either single-ended or differentially using the on-board operational amplifier or transformer. The user can also evaluate the use of an external reference, which may be desired to increase the gain accuracy of the converter. In addition, the power down (PD) feature of the DAC90x may be exercised. For a more detailed description of the functions of the DAC90x, refer to the individual data sheets.

BOARD SETUP AND CONFIGURATION

A typical evaluation board setup is shown in Figure 1. For this setup, some equipment is needed (i.e., a digital word generator and clock source to provide the digital stimulus to the converter, a spectrum analyzer, and an oscilloscope to observe the output signal in its frequency and time domain. Linear, low-noise power supplies are recommended, and should be capable of supplying at least 100mA each.

Although the DEM-DAC90x evaluation board allows for a variety of configurations, it is shipped with the following configuration:

- The digital inputs are set to be directly driven by the word generator using standard positive logic (TTL, CMOS). A set of resistor networks, RP1, RP2 (22Ω), are placed in series with the digital input lines.
- The differential analog outputs (I_{OUT}, I_{OUT}) of the DAC90x are terminated to ground with 49.9Ω resistors (R3, R4). The differential signal is converted into a single-ended signal using a transformer (T1).
- The DAC90x is set up for internal reference, with solder jumper JP2 connected in its "B" position. The "EXT INT" pin is grounded.
- The full-scale current output of the DAC90x is set to 20mA (typ) FSR. This is defined by $I_{OUT}FS = 32 \cdot V_{REF}/R_{SET}$, with V_{REF} = 1.24V and R_{SET} = R6 = 2kΩ. Solder jumper JP4 is closed.
- The operational amplifier OPA680 (U2) and its external components are assembled, but not connected to the output of the DAC90x; solder jumper JP6A and JP6B are open. Refer to the "Signal Output" section for more details.
- To evaluate other functions of the DAC90x the user must assemble the necessary components to the applicable board sections.

POWER SUPPLY CONNECTIONS

The DAC90x converter is powered by two power supplies, an analog supply ($+V_A$) and a digital supply ($+V_D$). The typical test setup of the evaluation board DEM-DAC90x is shown in Figure 1. Each of the supplies may be varied independently from +3V to +5V depending on the application's requirements. When operating the DAC90x

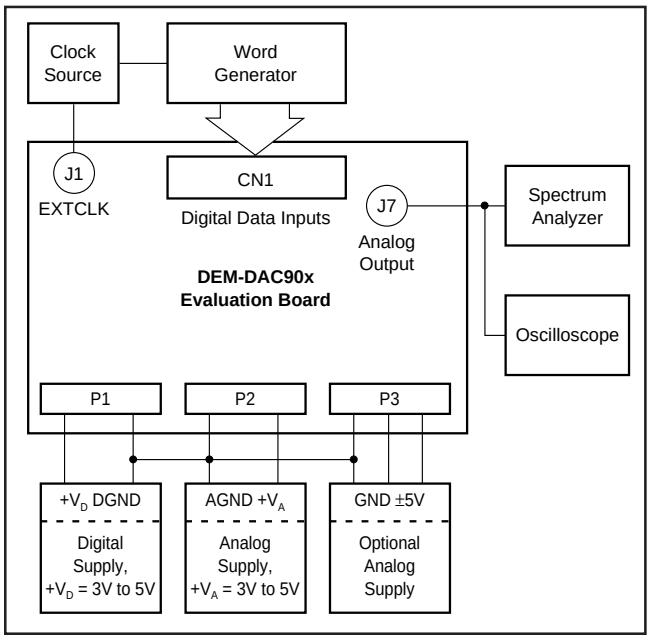


FIGURE 1. DAC90x Evaluation Board Test Setup.

DEMOBOARD PRODUCT	USED FOR DAC90x PRODUCT	DESCRIPTION
DEM-DAC90xU	DAC908U, DAC900U, DAC902U, DAC904U	8-bit to 14-bit D/A converter, SO-28 package version. Samples of desired DAC90xU model must be ordered separately.
DEM-DAC908E	DAC908E	8-bit D/A converter, TSSOP-28 package version, part already assembled onto the board.
DEM-DAC900E	DAC900E	10-bit D/A converter, TSSOP-28 package version, part already assembled onto the board.
DEM-DAC902E	DAC902E	12-bit D/A converter, TSSOP-28 package version, part already assembled onto the board.
DEM-DAC904E	DAC904E	14-bit D/A converter, TSSOP-28 package version, part already assembled onto the board.

TABLE I. Available Evaluation Boards for the DAC90x Family.

with a +3V digital supply, care must be taken that the digital input data is set to the appropriate logic level. The logic HIGH level must not exceed the power supplies by more than 0.3V. Refer to the product data sheet for more details. In addition to the DAC90x's supply connections (P1, P2), a third connector labeled P3 is used to power the output amplifier circuit (U2) and the optional external reference circuit. This section typically requires a dual ±5V supply voltage.

The analog and digital supplies as well as their respective grounds are distributed by power planes. The best performance is achieved when the analog and digital power is supplied by separate power supplies.

GROUNDING

The DEM-DAC90x uses separate ground planes for the analog and digital supplies. The ground planes are joined together at a star point located under the DAC90x (U1) (see Figures 7 and 11, Ground Plane Layouts).

DATA INPUT CONFIGURATION

The digital inputs of the DAC90x accept standard positive binary coding. For example, an input of all 1s will result in a full-scale output current at I_{OUT}, with the complementary output I_{OUT} at zero output current. The inputs are CMOS compatible, and the logic threshold will vary according to the applied digital supply voltage, $V_{TH} = +V_D / 2$ (±20%).

Inserted between the connector CN1 and the DAC90x are series resistor networks RP1 and RP2. If ac-coupling is desired, RP1 and RP2 should be removed and coupling capacitors (C30 through C44) should be assembled to the backside of the evaluation board. Resistor networks RN3, RN4, RN7 and RN8 should be used to set up the correct bias voltage for the ac-coupled digital data.

The digital inputs on the evaluation board include a set of pull-up and pull-down resistor networks (RN1, RN2, RN5 and RN6). Use the pull-down resistor to interface the evaluation board to 5V logic levels from the generator while the DAC90x digital supply voltage is at 3V. Or, use the pull-up resistors to drive 3V logic levels when the DAC90x is operating with a 5V logic supply.

In any case, the applied digital input signal must be properly terminated to insure clean edges and avoid ringing.

CLOCK INPUT

The maximum update rate for all DAC90x models is 200MSPS when the converter is supplied with +5V, and 165MSPS when operated on a +3V supply. A proper clock signal must be provided to the DAC90x through SMA connector J1. This input is terminated with 50Ω and the clock signal is fed to the DAC90x with position 'A' of solder jumper JP7 closed. Alternatively, a clock signal may be applied through connector CN1. In this case, close jumper JP7 in its "B" position. The recommended clock signal should be a square wave with a 50% duty cycle. Care should be taken to ensure that the clock signal has minimal undershoot and overshoot, which otherwise can degrade the DAC90x performance. In addition, the clock should have low phase noise (jitter), especially when operating the DAC90x at high update rates and output frequencies.

SIGNAL OUTPUT CONFIGURATION

The analog signal output of the DAC90x can be configured to drive a resistive load, a transformer, an operational amplifier, or other output configuration, as long as the limitations set by the output voltage compliance and full-scale range are not exceeded.

The optimum dynamic performance of the DAC90x is achieved with the outputs used differentially. The evaluation board is configured to operate with transformer output coupling.

This configuration was chosen because it utilizes both converter outputs, reduces the effect of even order harmonics, and offers a convenient method of converting the differential outputs to a single-ended signal. The selected transformer model (Mini-Circuits, ADT1-1WT) has a turns ratio of 1:1 and its lower and upper –3dB frequencies are at approximately 400kHz and 800MHz, respectively (1 to 400MHz for a –1dB insertion loss). Shown in Figure 2 is the typical DAC90x output configuration available on the evaluation board. Both outputs of the DAC90x are terminated with 50Ω resistors. The voltage swing developed between the outputs is applied to the primary side of the transformer, with its center tap grounded. This causes the output signal to be centered at ground, allowing for a maximum headroom to the compliance voltage boundaries. The termination resistors R3 and R4 may be removed and resistor R7 be used instead. This necessitates that the center tap of the transformer is grounded to ensure a dc-path for the signal current to the analog ground.

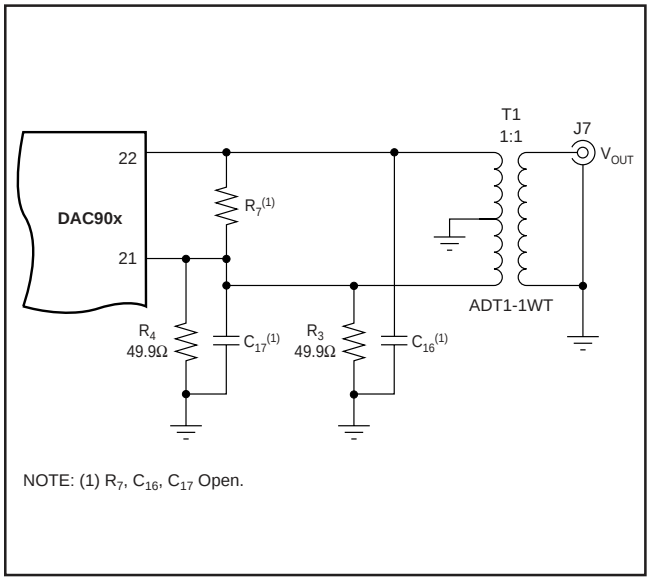


FIGURE 2. Typical Transformer Coupled Output Configuration.

In addition to the transformer coupled output configuration, the evaluation board offers three more configurations which use an operational amplifier:

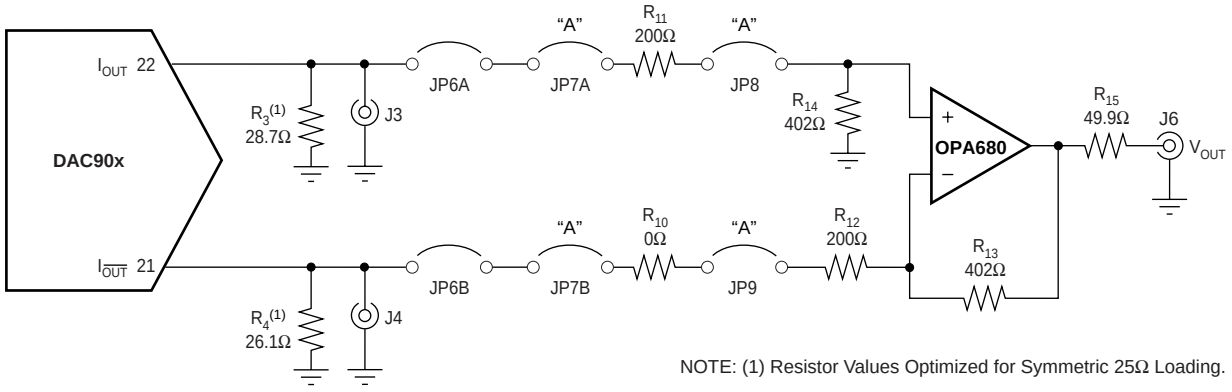
1. Difference amplifier configuration.
2. Non-inverting single-ended configuration
3. Inverting single-ended configuration

Shown in Figures 3a. through 3c. are the corresponding circuit schematics. They illustrate the necessary component values and jumper configurations.

POWER-DOWN MODE

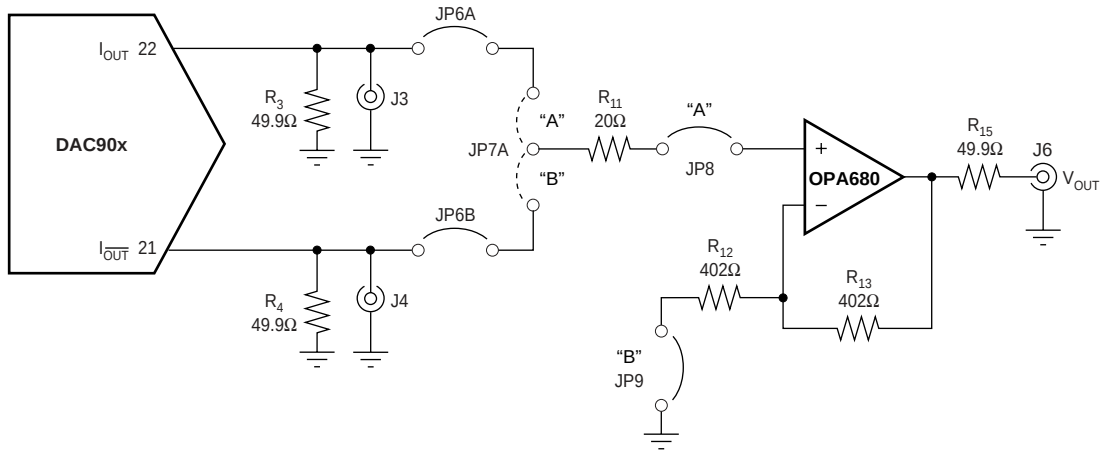
The DAC90x can be placed into a power-down mode by raising the voltage on pin 15 to a logic HIGH. The power-down pin of the DAC90x has an internal active pull-down circuit to ensure the converter to be fully operational when this pin is left unconnected. The evaluation board provides a SMA connector (J2) to the power-down pin, which is terminated with a 50Ω resistor (R2).

(a) Difference Amplifier Configuration.



NOTE: (1) Resistor Values Optimized for Symmetric 25Ω Loading.

(b) Non-Inverting Amplifier Configuration.



(c) Inverting Amplifier Configuration.

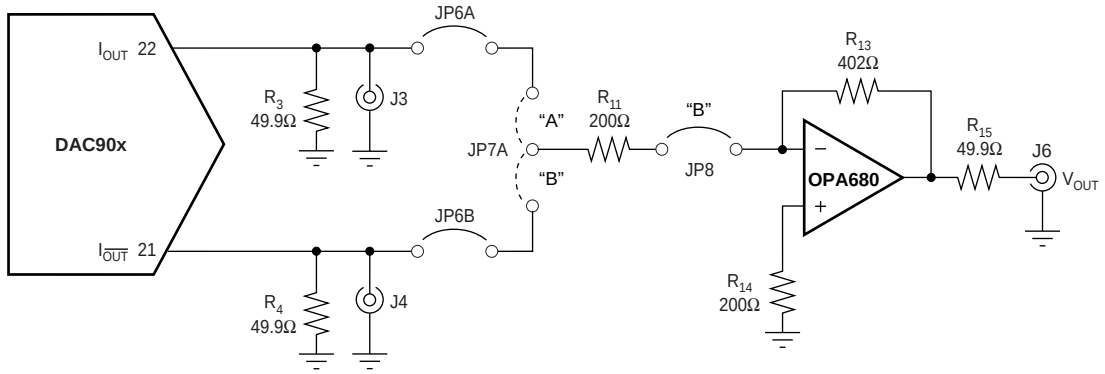


FIGURE 3. Output Configurations.

COMPONENT LIST

REFERENCE	QTY	COMPONENT	DESCRIPTION	MANUFACTURER
U1	1	DAC90xU	High-Speed DAC, SO-28	Burr-Brown
U2	1	OPA680U	Wideband op amp, SO-8	Burr-Brown
U3 (optional)	1	OPA680U	Wideband op amp, SO-8	Burr-Brown
U4 (optional)	1	REF1004-2.5	Voltage Reference IC, 2.5V	Burr-Brown
RP1, RP2	2	761-3-R22-ND	Resistor Network, DIP-16, 22Ω	CTS (Digi-Key)
RN1, RN2, RN3, RN4 (optional)	4	CSC09A01xxxG	Resistor Network, SIP-9	Dale
RN5, RN6, RN7, RN8 (optional)	4	CSC09A01xxxG	Resistor Network, SIP-9	Dale
R10	1	CRCW0805ZEROF	0.0Ω, MF 0805 Chip Resistor, 1%	Dale
R1, 2, 3, 4, 15	5	CRCW080549R9F		
R11, 12	3	CRCW0805ZEROF	0Ω, MF 0805 Chip Resistor, 1%	Dale
R13, 14	3	CRCW080549R9F	49.9Ω, MF 0805 Chip Resistor, 1%	Dale
R6	1	CRCW08052001F	2.0kΩ, MF 0805 Chip Resistor, 1%	Dale
R5, 7, 8, 9, 10 (optional)	5	—	MF 0805 Chip Resistor, 1%	Dale
R16, 17, 18, 25, 26 (optional)	5	—	MF 0805 Chip Resistor, 1%	Dale
VR1 (optional)		RJ26FW-xxx	10-Turn Potentiometer	Bourns
C2, 4, 6, 8	4	T491B106M035AS	10µF/35V, Size D, Tantalum Capacitor	Kemet
C20, 22	2	T491A225M010AS	2.2µF/10V, Size 3216 Tantalum Capacitor	Kemet
C25, 27, 29 (optional)	3		2.2µF/10V, Size 3216 Tantalum Capacitor	Kemet
C1, 3, 5, 7, 13, 14, 15, 19, 21, 45	10	08055C104KAT	0.1µF/50V X7R 0805 Ceramic Capacitor	AVX
C23, 24, 26, 28, 30-44 (optional)			0.1µF/50V X7R 0805 Ceramic Capacitor	
C10, 12	2	C1206C104M5UAC	0.1µF/50V X7R 1206 Ceramic Capacitor	Kemet
C16, 17, 18 (optional)	3	08055C220KAT	22pF/50V NP0 0805 Ceramic Capacitor	AVX
P1, P2	2	ED555/2DS	2-Pin Term Block	On-Shore Technology
P3	1	ED555/3DS	3-Pin Term Block	On-Shore Technology
CN1	1	IDH-40LP-S3-TG	20x2 Dual-Row Shrouded Header	Robinson-Nugent
TP1 - TP6 (optional)	6	10-216-2-01	Turret Terminal, Brass, Silver Plated	Concord
Socket for RP1, RP2	32	#701C	Flush Mount Pins	McKenzie Technology
J1, J3, J4, J6, J7	5	142-0701-201	Straight SMA PCB Connector	EF Johnson
J2, J5 (optional)	2	142-0701-201	SMA	EF Johnson
T1	1	ADT1-1WT	RF - Transformer Surface Mount	Mini-Circuits
	4	1-SJ5003-0-N	Rubber Feet, Black, 0.44x0.2	Digi-Key
	1	PCB A2892	PC Board A2892, Rev. B	Burr-Brown

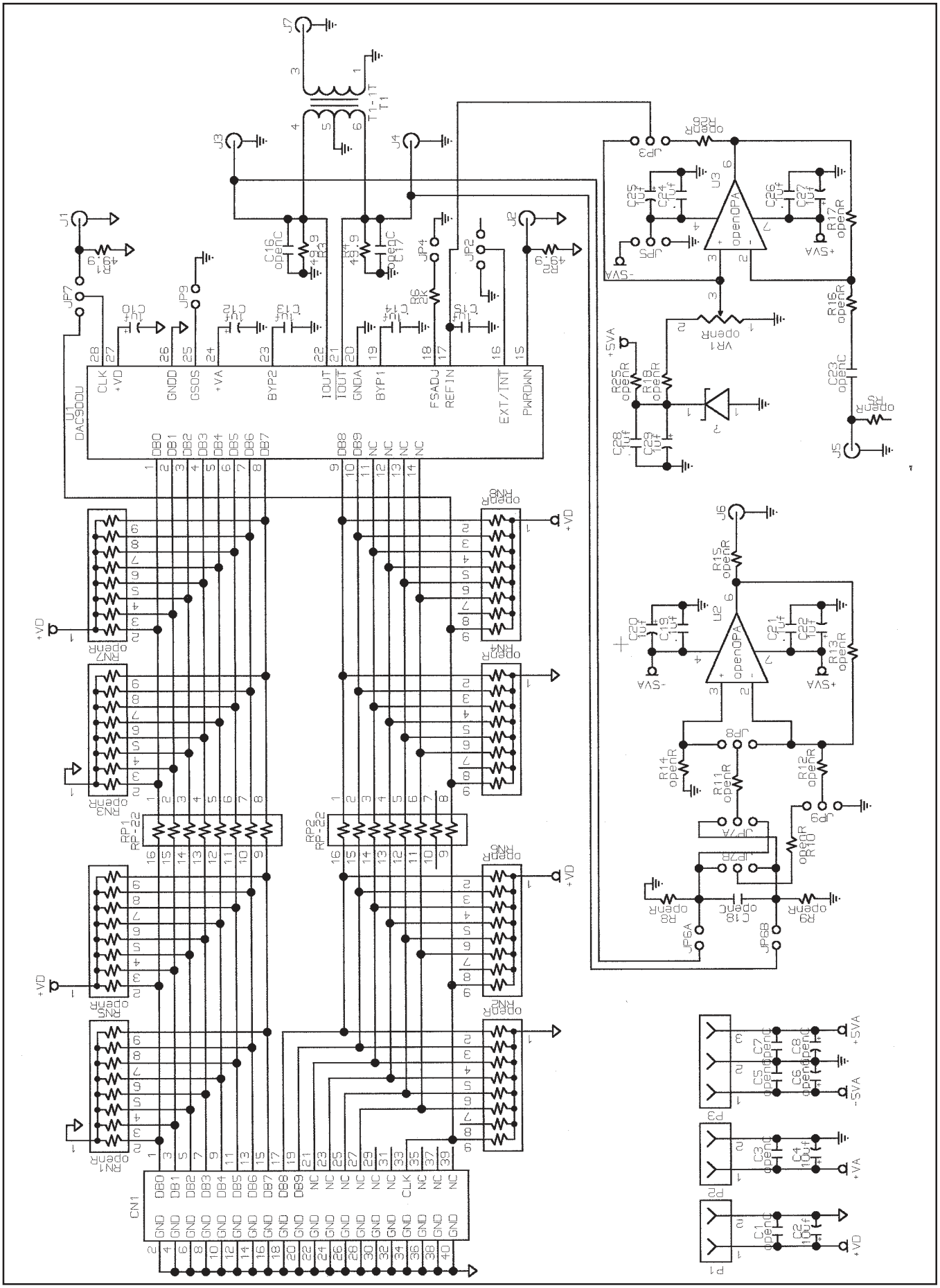


FIGURE 4. Circuit Schematic DEM-DAC90xU, E.

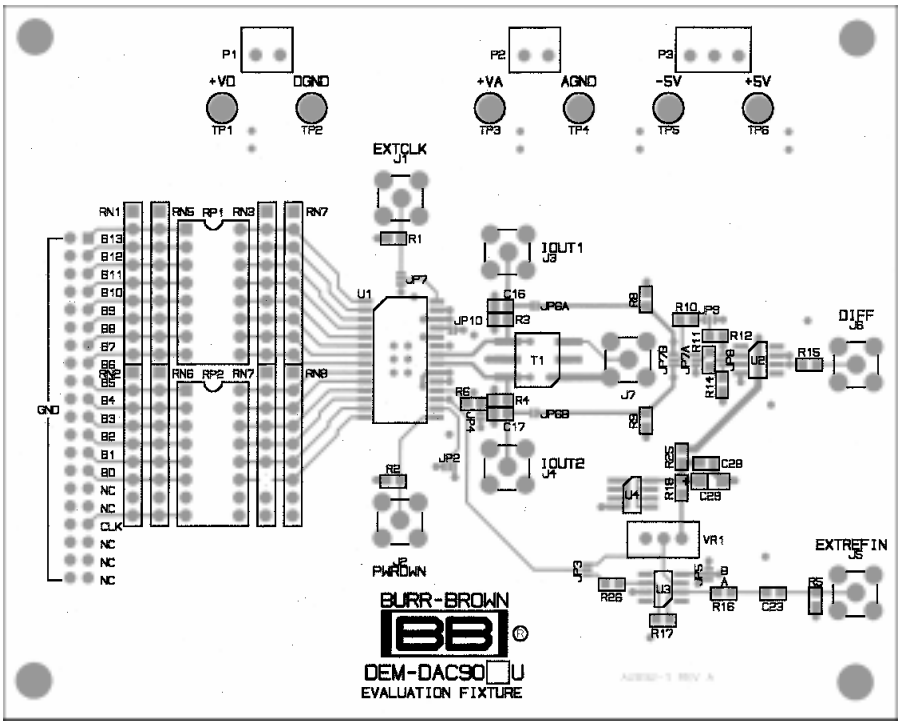


FIGURE 5. Top Layer (component side) with Silk-Screen (U-board).

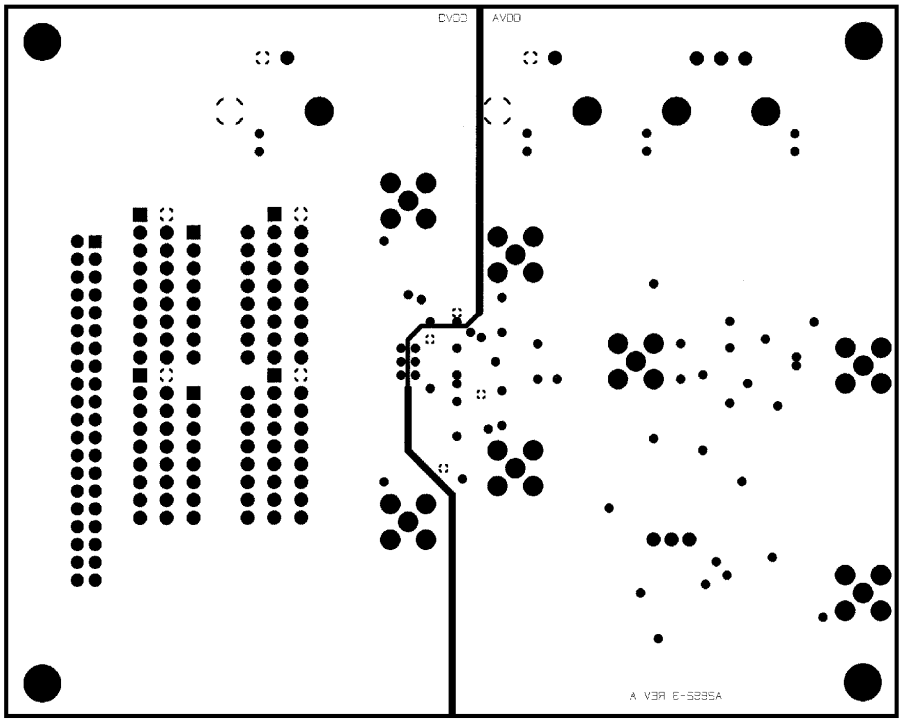


FIGURE 6. Power Plane (U-board).

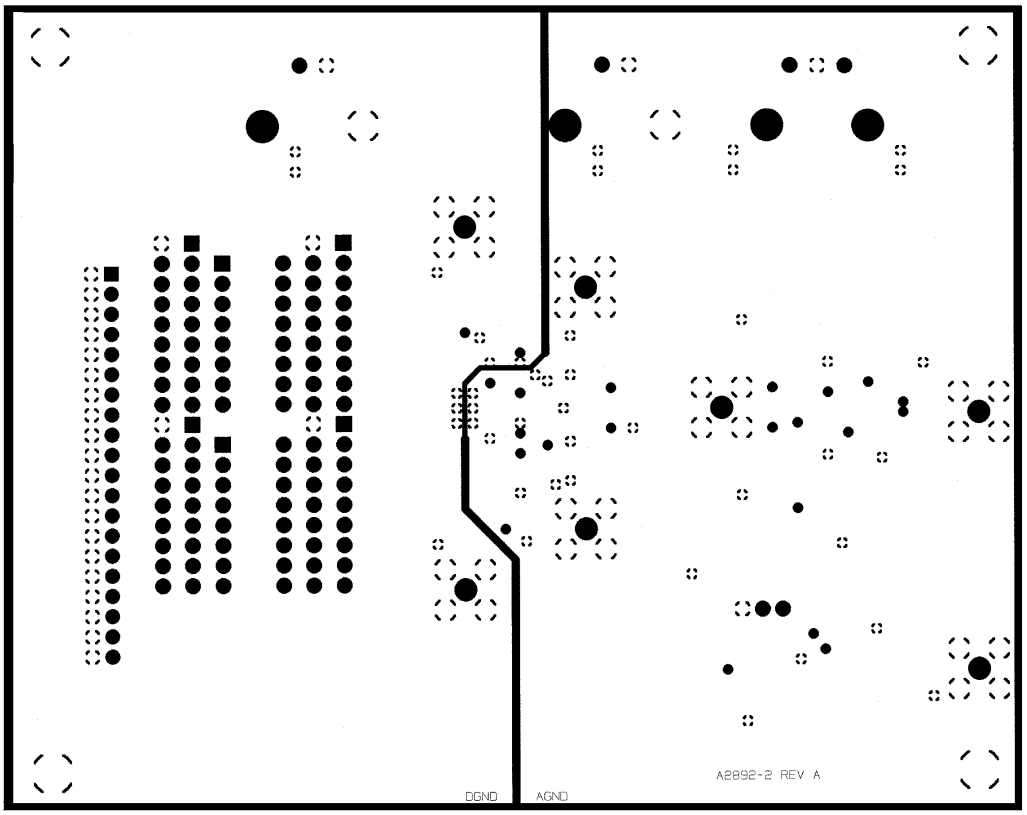


FIGURE 7. Ground Plane (U-board).

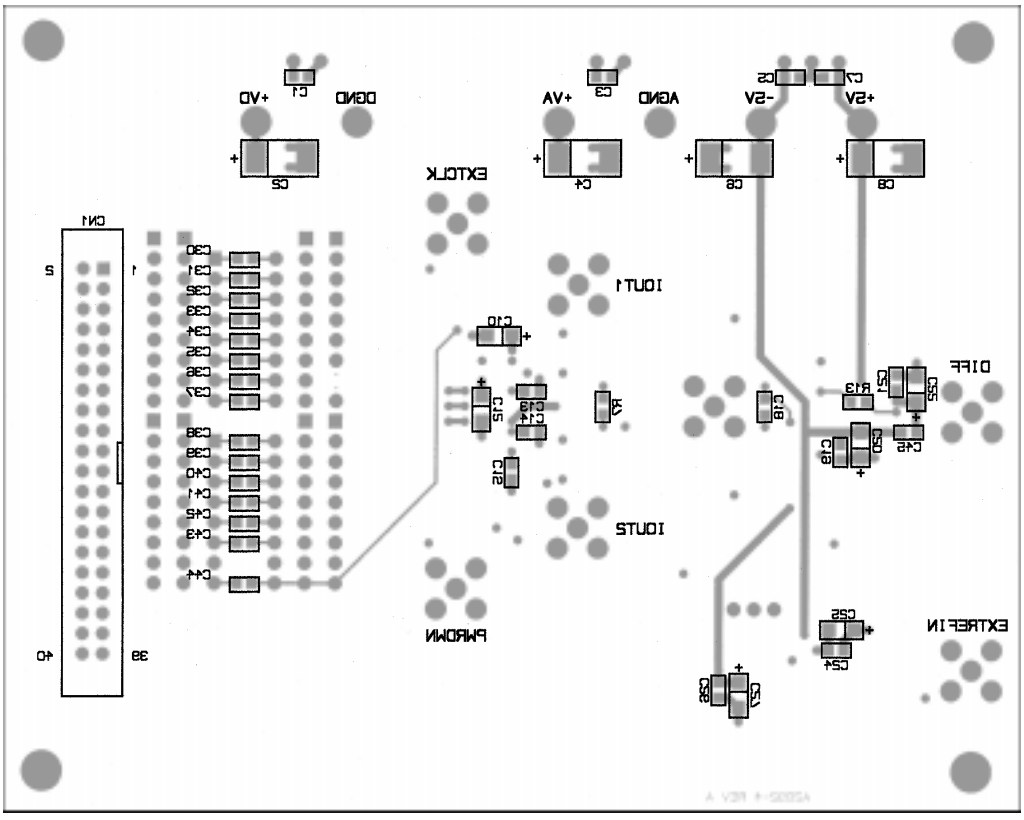


FIGURE 8. Bottom Layer with Silk-Screen (U-board).

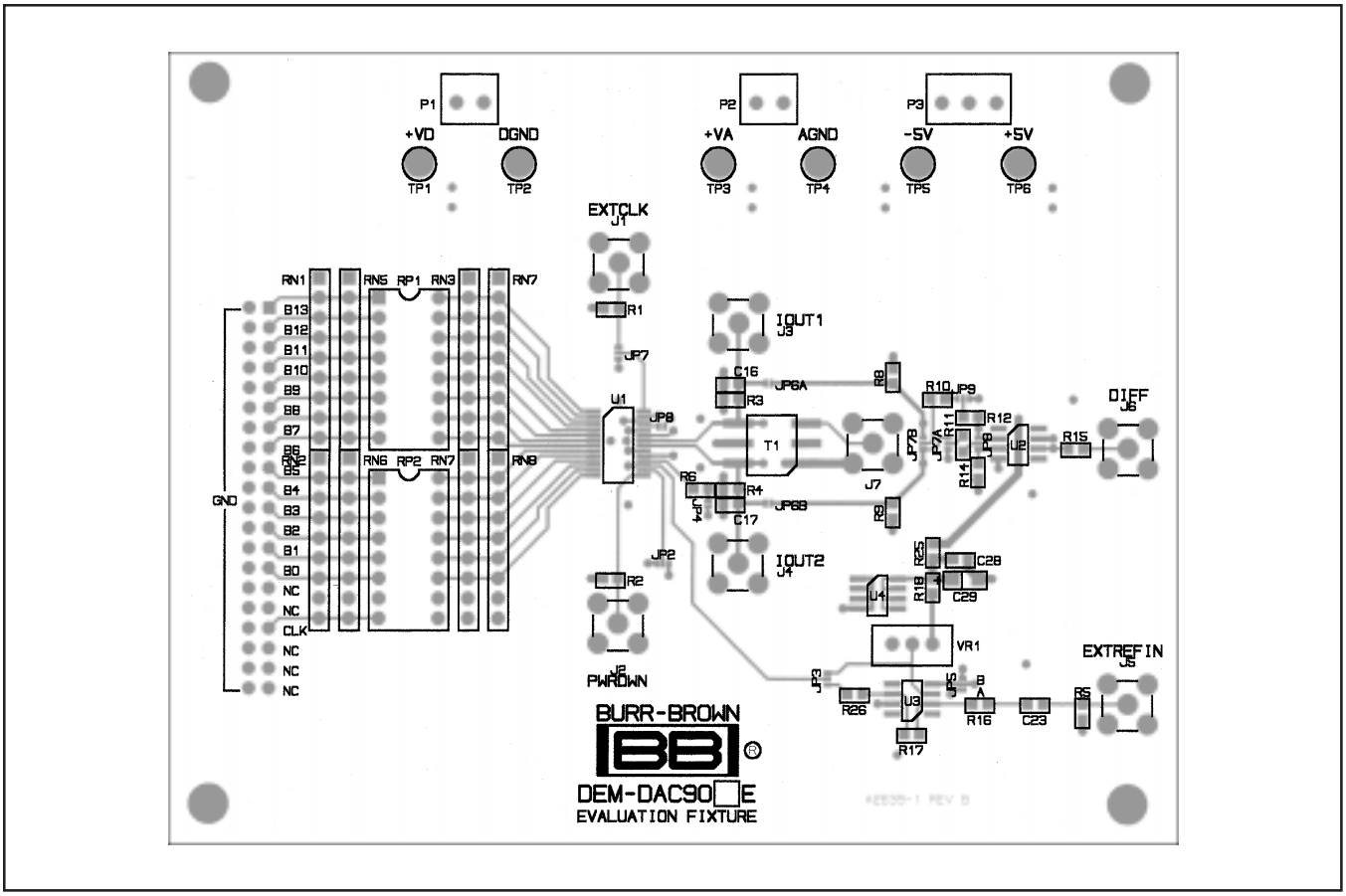


FIGURE 9. Top Layer (component side) with Silk-Screen (E-board).

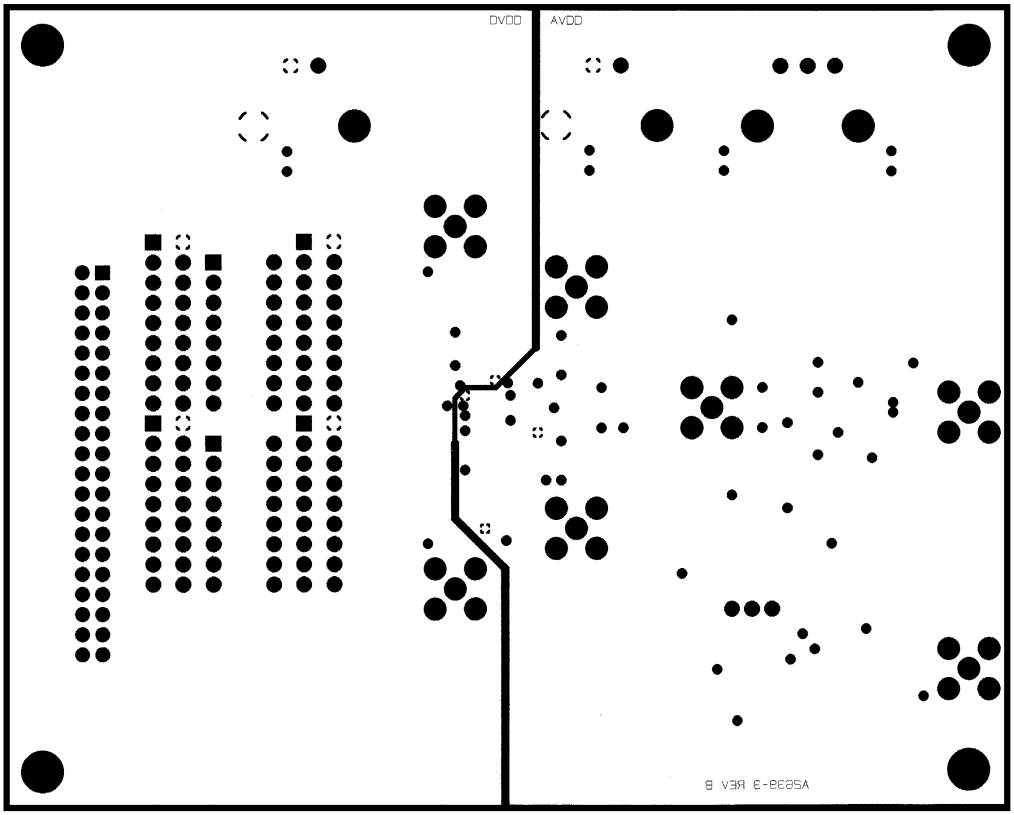


FIGURE 10. Power Plane (E-board).

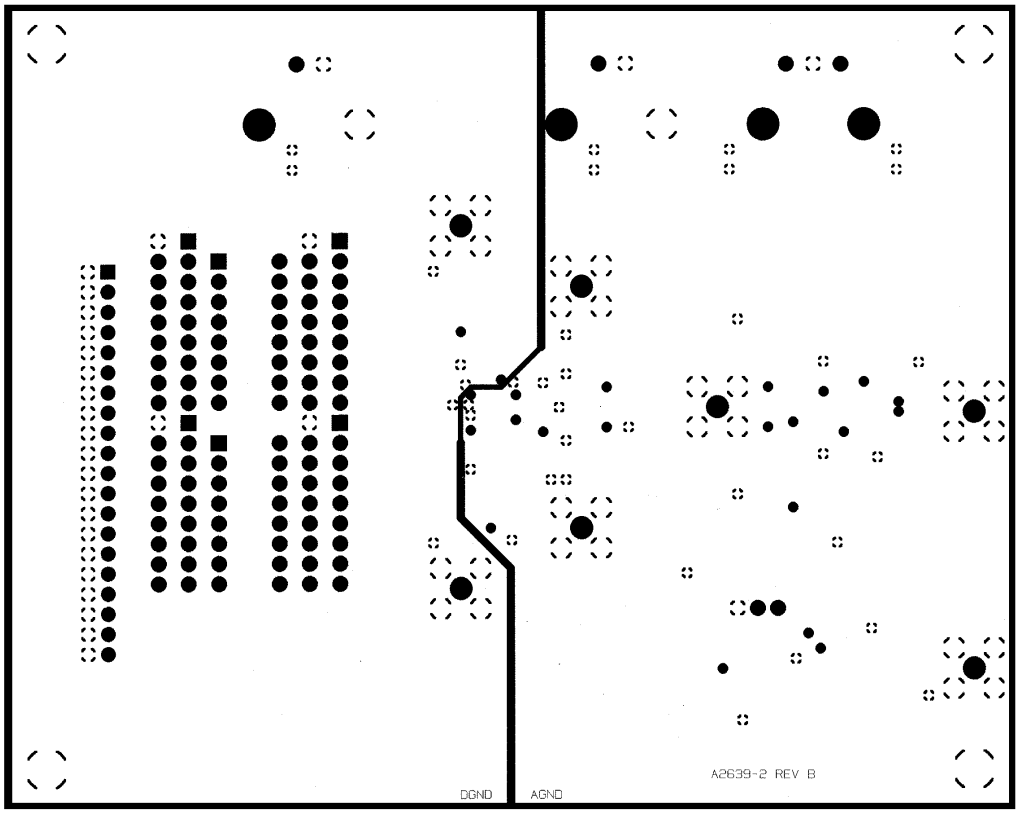


FIGURE 11. Ground Plane (E-board).

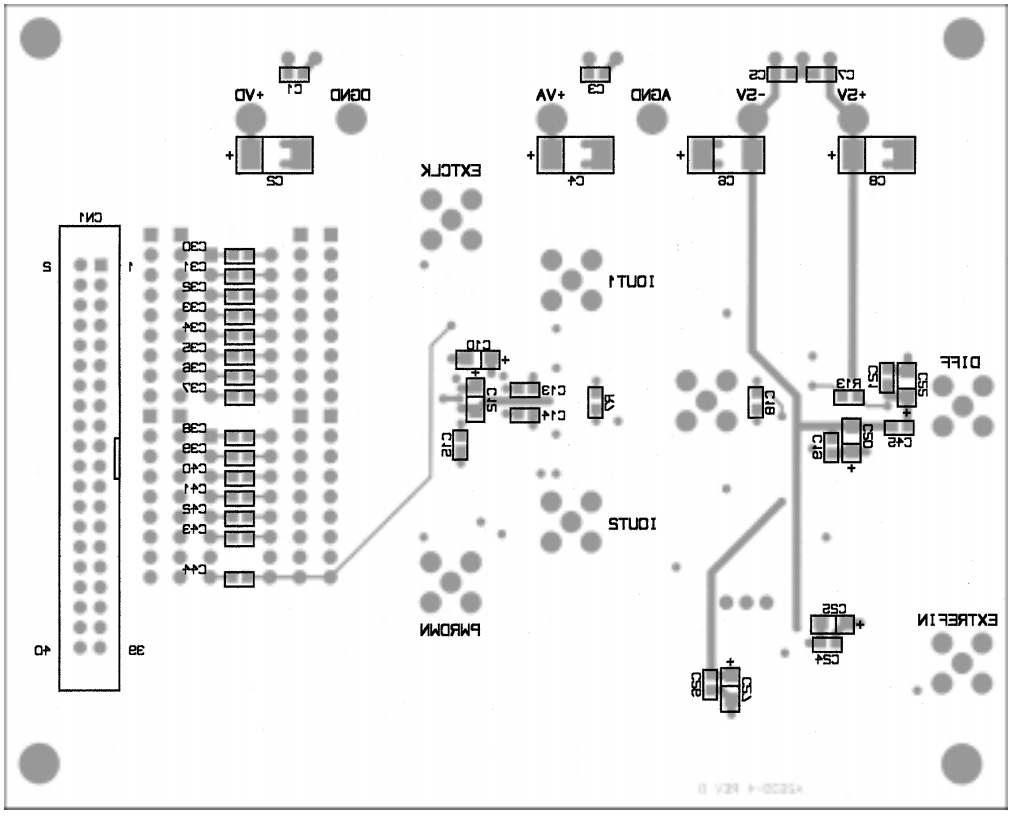


FIGURE 12. Bottom Layer with Silk-Screen (E-board).

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