

# LTC2387/LTC2386/LTC2385 18-/16-Bit, 15Msps/10Msps/5Msps, High Speed SAR ADCs

## DESCRIPTION

Demonstration circuit 2290A features the **LTC®2387** family. With up to 15Msps, these differential input, single channel, 18-/16-Bit, serial, high speed successive approximation register (SAR) ADCs are available in a 32-Pin QFN package. The LTC2387 family has an internal 20ppm/°C reference and a serial LVDS interface. The following text refers to the LTC2387 but applies to all members of the family, the only difference being the sample rate and the number of bits. The DC2290A demonstrates the AC performance of the LTC2387 in conjunction with the DC718 data collection

board. Differential amplifier demo boards are available separately that provide amplification of low level differential signals if required (see Table 2). Alternatively, by connecting the DC2290A into a customer application the performance of the LTC2387 can be evaluated directly in that circuit.

**Design files for this circuit board are available at <http://www.linear.com/demo/DC2290A>**

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## BOARD PHOTO

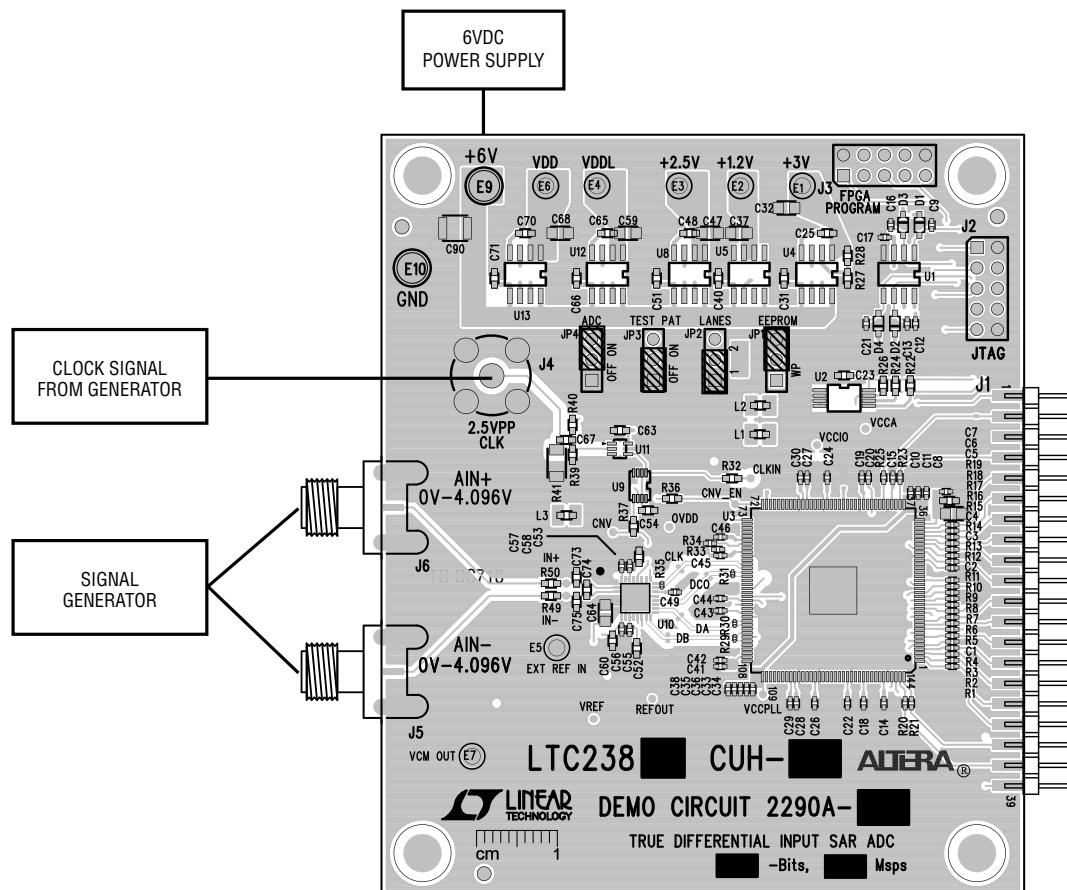


Figure 1. DC2290A Connection Diagram

## DC718 QUICK START PROCEDURE

Connect the DC2290A to a DC718 USB High Speed Data Collection Board using edge connector J1. Connect the DC718 to a host PC with a standard USB A/B cable. Apply a low noise differential signal to J6 ( $A_{IN}^+$ ) and J5 ( $A_{IN}^-$ ). Note that the DC2290A requires a differential input signal of approximately 8.192V peak-to-peak to reach 0dBFS. If a differential signal source of this amplitude is not available use one of the recommended differential amplifier demo boards available to increase the signal level. For a clock source, apply a low jitter 10dBm sine wave or square wave to connector J4. See Table 1 for maximum clock frequencies.

Note that J4 has a 50 $\Omega$  termination resistor to ground. Run the PScope™ software (Pscope.exe version K73 or later) supplied with DC718 or download it from [www.linear.com/software](http://www.linear.com/software). Complete software documentation is available from the Help menu. Updates can be downloaded from the Tools menu. Check for updates periodically as new features may be added. The PScope software should recognize the DC2290A and configure itself automatically. Click the Collect button (Figure 2) to begin acquiring data. The Collect button then changes to Pause, which can be used to stop data acquisition.

Table 1. DC2290A Assembly Options

| VERSION   | U1 PART NUMBER    | MAX CONVERSION RATE | # OF BITS | MAX CLOCK FREQUENCY |
|-----------|-------------------|---------------------|-----------|---------------------|
| DC2290A-A | LTC2387CUH-18#PBF | 15Msps              | 18        | 15MHz               |
| DC2290A-B | LTC2387CUH-16#PBF | 15Msps              | 16        | 15MHz               |
| DC2290A-C | LTC2386CUH-18#PBF | 10Msps              | 18        | 10MHz               |
| DC2290A-D | LTC2386CUH-16#PBF | 10Msps              | 16        | 10MHz               |
| DC2290A-E | LTC2385CUH-18#PBF | 5Msps               | 18        | 5MHz                |
| DC2290A-F | LTC2385CUH-16#PBF | 5Msps               | 16        | 5MHz                |

## HARDWARE SETUP

### SIGNAL CONNECTIONS

**J2:** JTAG. Factory use only.

**J3:** FPGA Program. Factory use only.

**J4:** CLK IN. This input has a 50 $\Omega$  termination resistor, and is intended to be driven by a low jitter, 10dBm sine or square wave. To achieve full AC performance of this part, the clock jitter should be kept under 2ps<sub>RMS</sub>. This input is capacitively coupled so that the input clock can be either 0V to 3.3V or  $\pm 1.65V$ . This eliminates the need for level shifting. To run at the maximum conversion rate, apply the frequency specified in Table 1.

**J5:**  $A_{IN}^-$  Input. This is the negative signal input.

**J6:**  $A_{IN}^+$  Input. This is the positive signal input.

### JUMPERS

**JP1:** EEPROM. Factory use only.

**JP2:** Lanes. Use this jumper to select either single lane or two lane data output mode from the LTC2387. The default setting is 1. The 1 setting clocks out all data on pin DA of the LTC2387. The 2 setting clocks out data alternately on pins DA and DB of the LTC2387.

**JP3:** Test Pattern. Use this jumper to deliver a fixed repeating test pattern from the LTC2387. The default setting is OFF. The output data will be -97796 if the jumper is in the ON position in 1 lane mode, and will be -52996 in 2 lane mode.

**JP4:** ADC ON. Use this jumper to enable or disable the ADC. The default setting is ON.

## HARDWARE SETUP

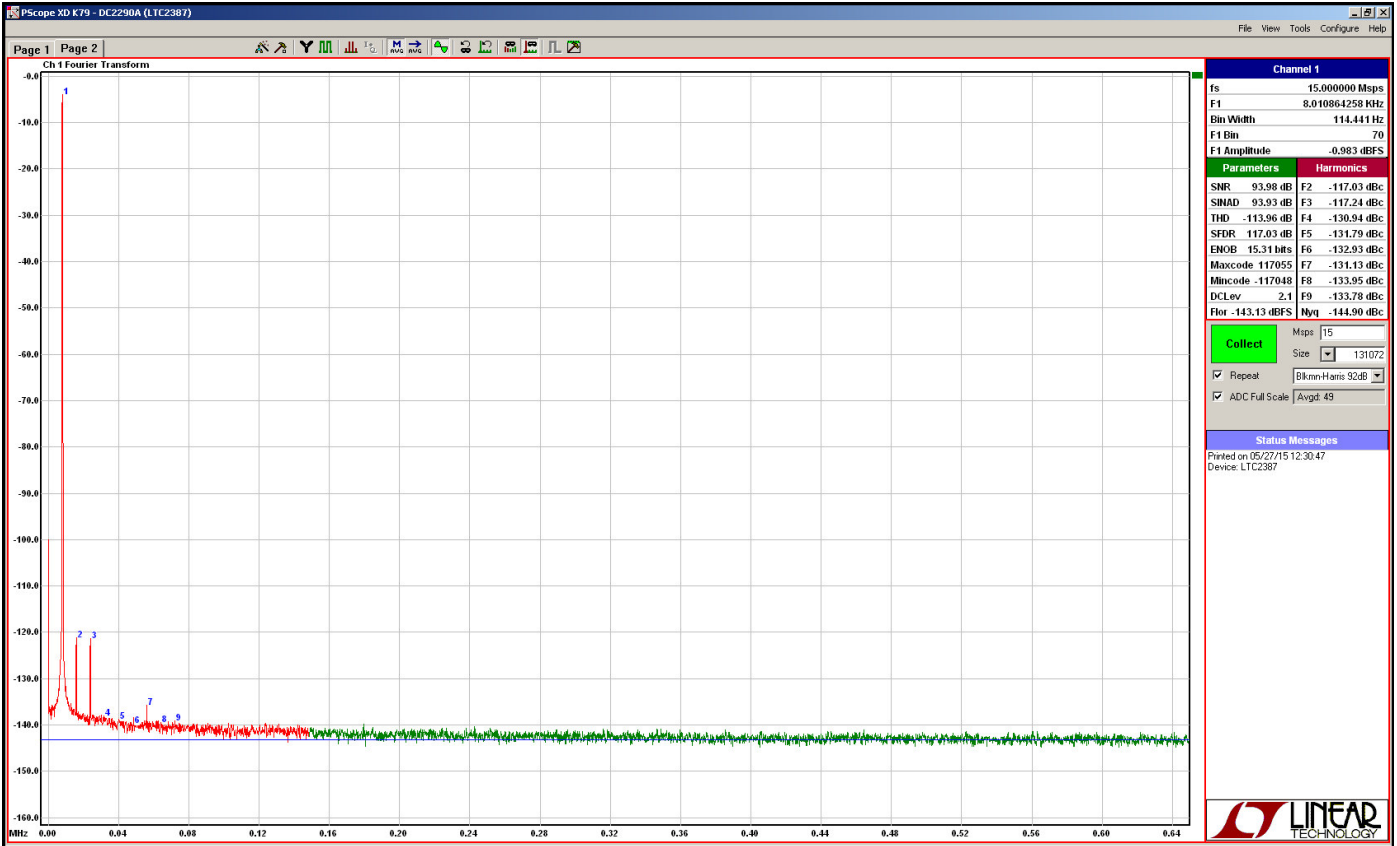


Figure 2. DC2290A PScope Screenshot

Table 2. DC2290A (LTC2387 Family) Driver Board

| INPUT FREQUENCY | DRIVE BOARD     | AMPLIFIER       |
|-----------------|-----------------|-----------------|
| Up to 10kHz     | DC2402          | LT6237          |
| Up to 1MHz      | DC2403          | LT6200          |
| > 1MHz          | Contact Factory | Contact Factory |

# DEMO MANUAL DC2290A

## PARTS LIST

| ITEM                               | QTY | REFERENCE                                                                                                                                                       | PART DESCRIPTION                     | MANUFACTURER/PART NUMBER          |
|------------------------------------|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------------------------------|
| <b>DC2290A</b>                     |     |                                                                                                                                                                 |                                      |                                   |
| <b>Required Circuit Components</b> |     |                                                                                                                                                                 |                                      |                                   |
| 1                                  | 3   | C7, C41, C42                                                                                                                                                    | CAP., X5R, 0.022µF, 25V, 10%, 0402   |                                   |
| 2                                  | 4   | C9, C13, C16, C21                                                                                                                                               | CAP., NPO, 10pF, 50V, 5%, 0402       | AVX, 04023A100KAT2A               |
| 3                                  | 7   | C32, C37, C47, C59, C64, C68, C77                                                                                                                               | CAP., X7R, 10µF, 6.3V, 10%, 0805     | AVX, 08056C106KAT2A               |
| 4                                  | 5   | C31, C51, C66, C69, C71                                                                                                                                         | CAP., X7R, 1µF, 10V, 10%, 0603       | AVX, 0603ZC105KAT2A               |
| 5                                  | 1   | C40                                                                                                                                                             | CAP., X5R, 3.3µF, 10V, 10%, 06035    | C1608X5R1A335K                    |
| 6                                  | 2   | C5, C97                                                                                                                                                         | CAP., X5R, 47µF, 6.3V, 20%, 0805     | TAIYO YUDEN, JMK212BJ476MG-T      |
| 7                                  | 1   | C90                                                                                                                                                             | CAP., X5R, 22µF, 16V, 20%, 1210      | AVX, 1210YD226MAT2A               |
| 8                                  | 1   | C8                                                                                                                                                              | CAP., X5R, 0.0047µF, 25V, 10%, 0402  | AVX, 04023D472KAT2A               |
| 9                                  | 33  | C1, C2, C3, C4, C12, C14, C15, C17, C18, C19, C20, C22, C24, C26, C27, C28, C29, C30, C33, C34, C35, C36, C38, C43, C44, C45, C46, C49, C55, C56, C57, C58, C98 | CAP., X5R, 0.1µF, 10V, 10%, 0402     | AVX, 0402ZD104KAT2A               |
| 10                                 | 5   | C23, C54, C63, C67, C87                                                                                                                                         | CAP., X7R, 0.1µF, 16V, 10%, 0603     | NIC, NMC0603X7R104K16TRPF         |
| 11                                 | 4   | C25, C48, C65, C70                                                                                                                                              | CAP., X7R, 0.01µF, 6.3V, 10%, 0603   | MURATA, GRM188R70J103KA01D        |
| 12                                 | 2   | C10, C11                                                                                                                                                        | CAP., X5R, 0.01µF, 25V, 10%, 0402    | AVX, 04023D103MAT2A               |
| 13                                 | 0   | C74                                                                                                                                                             | CAP, DNI, 0603                       |                                   |
| 14                                 | 1   | C76                                                                                                                                                             | CAP., X7R, 2.2µF, 10V, 10%, 0603     | AVX, 0603ZC225KAT2A               |
| 15                                 | 1   | C95                                                                                                                                                             | CAP., X7R, 0.0022µF, 50V, 10%, 0402  |                                   |
| 16                                 | 7   | C6, C52, C53, C60, C80, C96, C99                                                                                                                                | CAP., X5R, 4.7µF, 10V, 10%, 0603     | AVX 0603ZD475KAT2A                |
| 17                                 | 2   | C73, C75                                                                                                                                                        | CAP., NPO, 82pF, 25V, 10%, 0603      | AVX, 06033A820KAT2A               |
| 18                                 | 8   | E1, E2, E3, E4, E5, E6, E7, E8                                                                                                                                  | TEST POINT, TURRET, .064"            | MILL MAX, 2308-2-00-80-00-00-07-0 |
| 19                                 | 2   | E9, E10                                                                                                                                                         | TEST POINT, TURRET, .094"            | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| 20                                 | 1   | J1                                                                                                                                                              | HEADER, 20 × 2, 0.1IN, STRAIGHT_PINS | SAMTEC, TSW-120-07-L-D            |
| 21                                 | 2   | J2, J3                                                                                                                                                          | HEADER, 2 × 5, 0.100"                | SAMTEC, TSW-105-07-L-D            |
| 22                                 | 2   | J5, J6                                                                                                                                                          | CONN, SMA, 50Ω, EDGE-LAUNCH, FEMALE  | E.F. JOHNSON, 142-0701-851        |
| 23                                 | 1   | J4                                                                                                                                                              | CONN BNC FEM JACK PC MNT STRGHT      | AMPHENOL CONNEX, 112404           |
| 24                                 | 4   | JP1, JP2, JP3, JP4                                                                                                                                              | HEADER, 1 × 3, 0.100"                | SAMTEC, TSW-103-07-L-S            |
| 25                                 | 4   | L1, L2, L3, L5                                                                                                                                                  | FERRITE BEAD, 33Ω, 0603              | MURATA, BLM18PG330SN1L            |
| 26                                 | 1   | R44                                                                                                                                                             | RES., 0Ω, 1/10W, 0603                | PANASONIC, ERJ-3GEY0R00V          |
| 27                                 | 1   | R71                                                                                                                                                             | RES., 0Ω, 1/10W, 0402                | PANASONIC, ERJ-2GEY0R00V          |
| 28                                 | 0   | R38, R45, R46, R55, R57, R72                                                                                                                                    | RES, DNI, 0603                       |                                   |
| 29                                 | 19  | R1, R2, R3, R4, R5, R7, R8, R14, R15, R16, R17, R18, R19, R20, R21, R23, R25, R68, R69                                                                          | RES., 33Ω, 1/10W, 5%, 0402           | YAGEO, RC0402JR-0733RL            |
| 30                                 | 3   | R32, R36, R37                                                                                                                                                   | RES., 33Ω, 1/10W, 5%, 0603           | YAGEO, RC0603JR-0733RL            |
| 31                                 | 4   | R29, R30, R31, R35                                                                                                                                              | RES., 100Ω, 1/10W, 1%, 0201          | YAGEO, RC201FR-07101L             |
| 32                                 | 2   | R49, R50                                                                                                                                                        | RES., 10.0Ω, 1/10W, 1%, 0603         | PANASONIC, ERJ-3EKF10R0V          |
| 33                                 | 1   | R41                                                                                                                                                             | RES., 49.9Ω, 1/10W, 1%, 1206         | PANASONIC, ERJ-8ENF49R9V          |
| 34                                 | 7   | R6, R9, R10, R12, R13, R53, R54, R70                                                                                                                            | RES., 10k, 1/10W, 5%, 0402           | PANASONIC, ERJ-2GEYJ103V          |
| 35                                 | 3   | R22, R24, R26                                                                                                                                                   | RES., 4.99k, 1/10W, 5%, 0603         | PANASONIC, ERJ-3GEYJ4991V         |
| 36                                 | 3   | R27, R39, R40                                                                                                                                                   | RES., 1.00k, 1/10W, 5%, 0603         | PANASONIC, ERJ-3GEYJ102V          |

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## PARTS LIST

| ITEM | QTY | REFERENCE         | PART DESCRIPTION                   | MANUFACTURER/PART NUMBER             |
|------|-----|-------------------|------------------------------------|--------------------------------------|
| 37   | 1   | R11               | RES., 1.00k, 1/10W, 5%, 0402       | PANASONIC, ERJ-2GEYJ102V             |
| 38   | 1   | R28               | RES., 1.43k, 1/10W, 1%, 0603       | PANASONIC, ERJ-3EKF1431V             |
| 39   | 1   | D1, D2, D3, D4    | DIODE, SCHOTTKY 30V, 200MW, SOD323 | DIODE INC., BAT54WS-7-F              |
| 40   | 1   | U1                | IC, CONFIG DEVICE 4MBIT, SO8       | ALTERA, EPCS4SI8N                    |
| 41   | 1   | U2                | IC, EEPROM 2KBIT 400kHz, TSSOP8    | MICROCHIP, 24LC024-I/ST              |
| 42   | 1   | U3                | IC, CYCLONE III FPGA 5k, EQFP144   | ALTERA, EP3C5E144C7N                 |
| 43   | 1   | U4                | IC, MICROPOWER REGULATOR, SO8      | LINEAR TECH., LT1763CS8#PBF          |
| 44   | 1   | U5                | IC, LINEAR REGULATOR, SO8          | LINEAR TECH., LT3021ES8-1.2#PBF      |
| 45   | 1   | U11               | IC, INVERTER UHS SINGLE SC70-5     | FAIRCHILD, NC7SZ04P5X                |
| 46   | 2   | U8, U12           | IC, MICROPOWER REGULATOR, SO8      | LINEAR TECH., LT1763CS8-2.5#PBF      |
| 47   | 1   | U9                | IC, FLIP FLOP D-TYPE LOG, US8      | ON SEMI., NL17SZ74USG                |
| 48   | 1   | U13               | IC, MICROPOWER REGULATOR, SO8      | LINEAR TECH., LT1763CS8-5#PBF        |
| 49   | 1   | U14               | IC, VOLTAGE REFERENCE, MSOP8       | LINEAR TECH., LTC6655BHMS8-4.096#PBF |
| 50   | 1   | U17               | IC, OP-AMP, TSOT23-5               | LINEAR TECH., LT6202CS5#PBF          |
| 51   | 6   | SHOWN ON ASSY DWG | SHUNT, 0.100                       | SAMTEC, SNT-100-BK-G                 |
| 52   | 4   | MH1-MH4           | STANDOFF, NYLON 0.25"              | KEystone, 8831 (SNAP ON)             |

### DC2290A-A

|   |   |     |                              |                                 |
|---|---|-----|------------------------------|---------------------------------|
| 1 | 0 | R34 | RES, DNI, 0402               |                                 |
| 2 | 1 | R33 | RES., 1.00k, 1/10W, 5%, 0402 | PANASONIC, ERJ-2GEYJ102V        |
| 3 | 1 | U10 | I.C., SAR ADC, QFN32UH-5x5   | LINEAR TECH., LTC2387CUH-18#PBF |

### DC2290A-B

|   |   |     |                              |                                 |
|---|---|-----|------------------------------|---------------------------------|
| 1 | 1 | R34 | RES., 1.00k, 1/10W, 5%, 0402 | PANASONIC, ERJ-2GEYJ102V        |
| 2 | 0 | R33 | RES., DNI, 0402              |                                 |
| 3 | 1 | U10 | I.C., SAR ADC, QFN32UH-5x5   | LINEAR TECH., LTC2387CUH-16#PBF |

### DC2290A-C

|   |   |     |                              |                                 |
|---|---|-----|------------------------------|---------------------------------|
| 1 | 0 | R34 | RES, DNI, 0402               |                                 |
| 2 | 1 | R33 | RES., 1.00k, 1/10W, 5%, 0402 | PANASONIC, ERJ-2GEYJ102V        |
| 3 | 1 | U10 | I.C., SAR ADC, QFN32UH-5x5   | LINEAR TECH., LTC2386CUH-18#PBF |

### DC2290A-D

|   |   |     |                              |                                 |
|---|---|-----|------------------------------|---------------------------------|
| 1 | 1 | R34 | RES., 1.00k, 1/10W, 5%, 0402 | PANASONIC, ERJ-2GEYJ102V        |
| 2 | 0 | R33 | RES., DNI, 0402              |                                 |
| 3 | 1 | U10 | I.C., SAR ADC, QFN32UH-5x5   | LINEAR TECH., LTC2386CUH-16#PBF |

### DC2290A-E

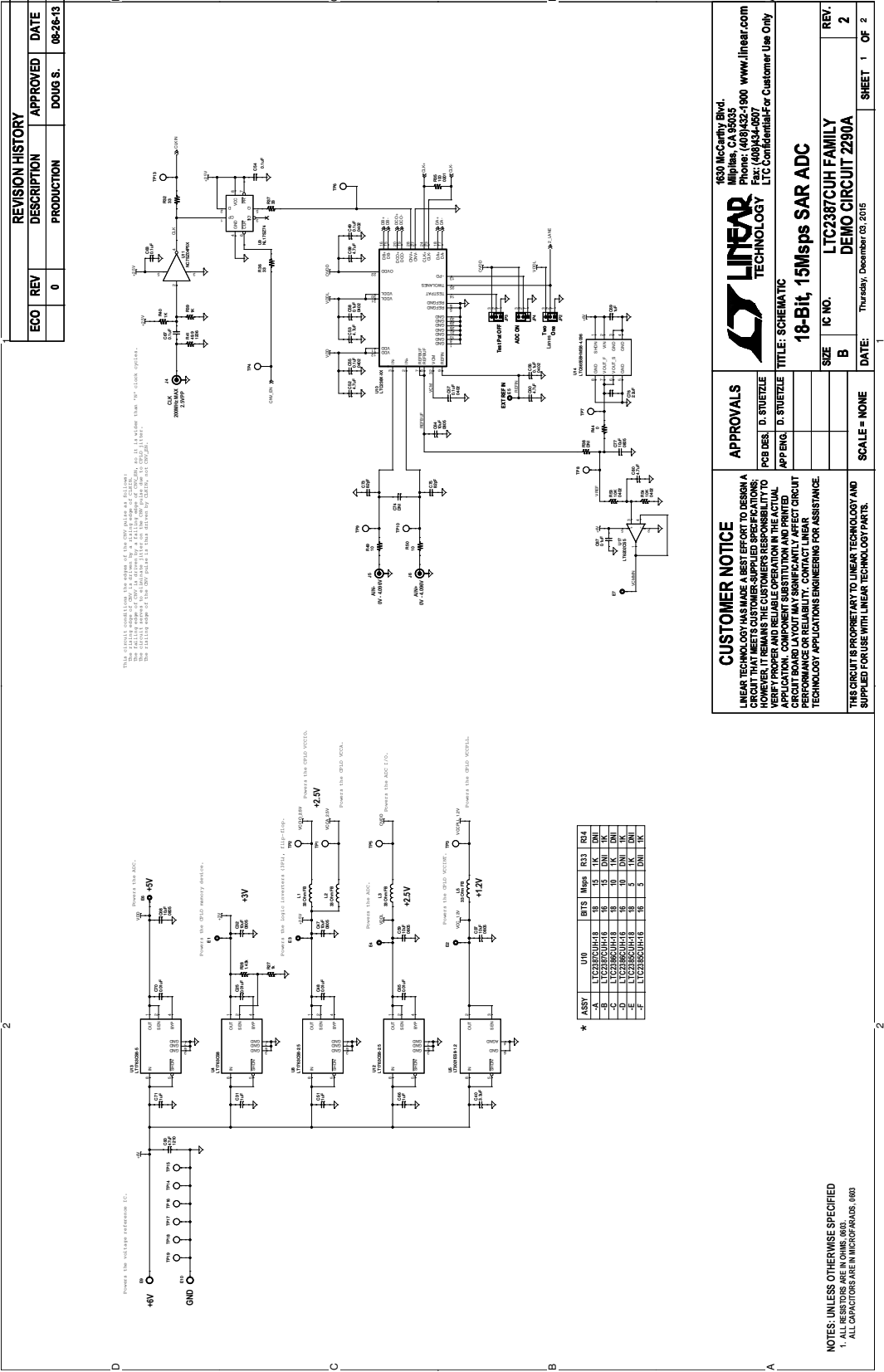
|   |   |     |                              |                                 |
|---|---|-----|------------------------------|---------------------------------|
| 1 | 0 | R34 | RES, DNI, 0402               |                                 |
| 2 | 1 | R33 | RES., 1.00k, 1/10W, 5%, 0402 | PANASONIC, ERJ-2GEYJ102V        |
| 3 | 1 | U10 | I.C., SAR ADC, QFN32UH-5x5   | LINEAR TECH., LTC2385CUH-18#PBF |

### DC2290A-F

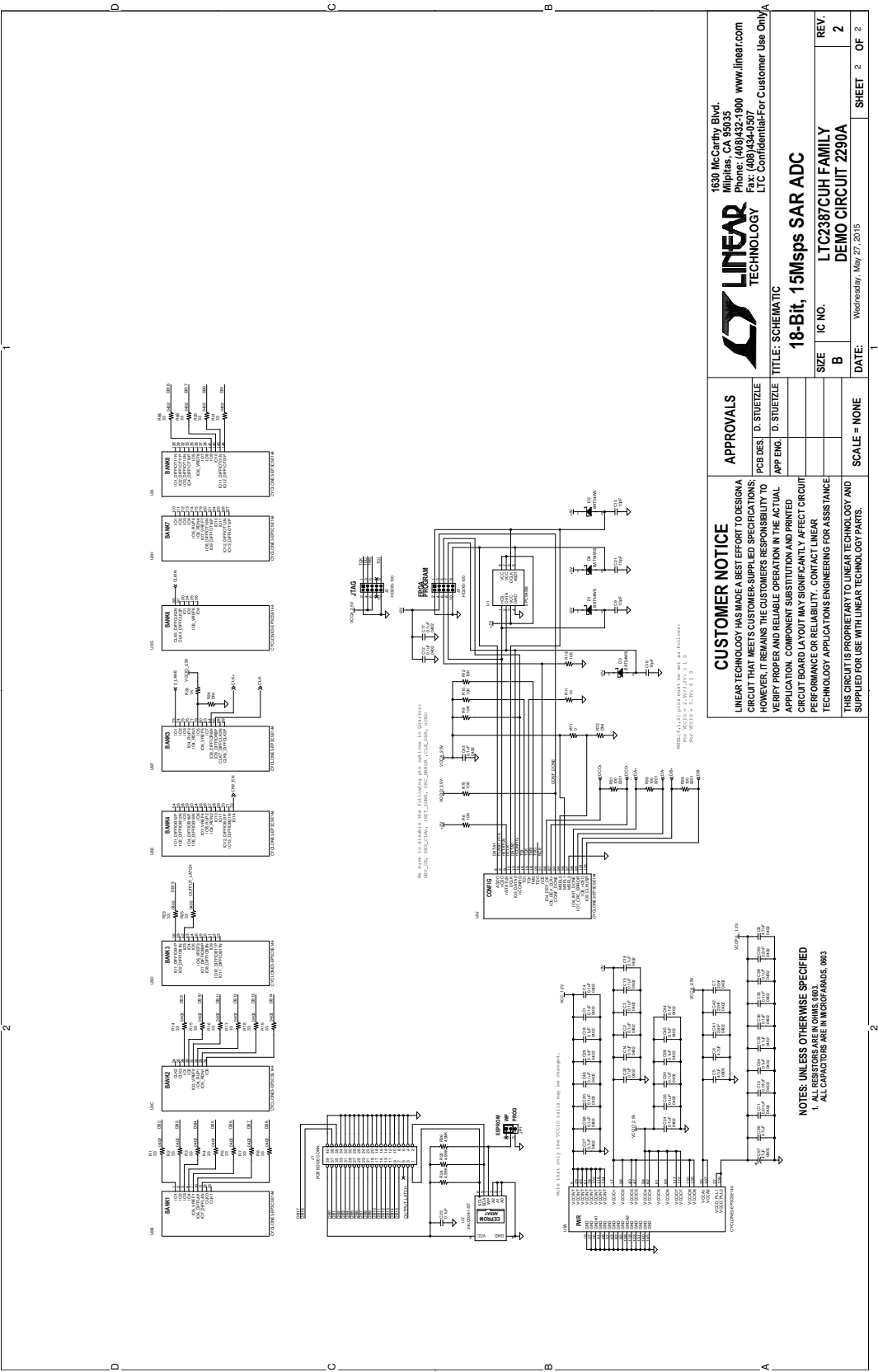
|   |   |     |                              |                                 |
|---|---|-----|------------------------------|---------------------------------|
| 1 | 1 | R34 | RES., 1.00k, 1/10W, 5%, 0402 | PANASONIC, ERJ-2GEYJ102V        |
| 2 | 0 | R33 | RES., DNI, 0402              |                                 |
| 3 | 1 | U10 | I.C., SAR ADC, QFN32UH-5x5   | LINEAR TECH., LTC2385CUH-16#PBF |

# DEMO MANUAL DC2290A

## SCHEMATIC DIAGRAM



## SCHEMATIC DIAGRAM



# DEMO MANUAL DC2290A

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