

## MAX13053A Shield

Evaluates: MAX13053A

### General Description

The MAX13053A Shield is a fully assembled and tested PCB that demonstrates the functionality of the MAX13053A fault-protected with extended common mode input range and  $\pm 25\text{kV}$  ESD Human Body Model (HBM) controller area network (CAN) transceiver. The shield features a digital isolator, used as a level translator (between the controller and the transceiver) and operates from a range of 1.71V to 5.5V supply.

### Features

- Integrated Protection Increases Robustness
  - $\pm 65\text{V}$  Fault Tolerant CANH and CANL
  - $\pm 25\text{kV}$  ESD HBM (Human Body Model)
  - $\pm 25\text{V}$  Extended Common Mode Input Range (CMR)
  - Transmitter Dominant Timeout Prevents CAN Bus Lockup
  - Short-Circuit Protection
  - Thermal Shutdown
- Family Provides Flexible Design Options
  - Silent Mode Enables/Disables Transmitter
  - 1.62V to 5.5V Logic-Supply (VL) Range
- High-Speed Operation of Up to 2Mbps
- Operating Temperature Range of  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  in 8-pin SOIC Package

[Ordering Information](#) appears at end of data sheet.

### Quick Start

#### Required Equipment

- MAX13053A Shield
- 5V, 500mA DC power supply
- Signal/function generator
- Oscilloscope

#### Procedure

- 1) Place the MAX13053A Shield on a nonconductive surface to ensure that nothing on the PCB gets shorted to the workspace.
- 2) Set the jumpers of **JU1**, **JU2**, **JU\_CANH**, and **JU\_CANL** to 2-3 position.
- 3) Place two shunts on **JU8**
  - a. Shunt pins 4-5 to connect TXD signal to D0 of J6.
  - b. Shunt pins 2-3 to connect RXD signal to D1 of J6.
- 4) Shunt S\_U1 and GND on **JU12**, 1-2 position.
- 5) Place shunts on **JU3**, **JU10**, **JU15**, and **JU20**, 1-2 position.
- 6) Verify that all jumpers are in their default position as shown in [Table 1](#).
- 7) With +5V power supply disabled, connect the positive terminal to VCC\_EXT, VL\_EXT, and IOREF test points. Connect the negative terminal to the GND test point.
- 8) Connect the positive terminal of the function generator to D1 of **J6** and negative terminal to any GND test points on the shield.
- 9) Turn on the +5V DC Power Supply.
- 10) Set Function generator to output a 250KHz square wave between 0V and 5V, and then enable function generator output.
- 11) Connect oscilloscope probes on CANH and CANL to GND test points of the Shield. Verify the difference voltage between CANH and CANL matches TXD input signal. The difference voltage should be between 1.5V-3V in dominant mode and -120mV to 12mV in recessive mode.
- 12) Connect an oscilloscope probe on D0 of J6 and verify the RXD output signal matches the TXD input signal.

## Detailed Description of Hardware

The MAX13053A Shield is a fully assembled and tested circuit board for evaluating the MAX13053A fault-protected high speed CAN transceiver (U1) with  $\pm 65V$  of fault protection. The Shield is designed to evaluate MAX13053A alone or in a CAN system. The MAX13053A Shield enables Mbed or Arduino platform to communicate on a CAN bus.

### Powering the Board

The MAX13053A Shield requires one power supply for 5V operation. The power supply can come from an external supply or the Arduino/Mbed microcontroller's 5V supply. To select the external supply, shunt the JU1 VDD pin to VDD\_EXT pin option, 2-3 default position. To connect the Arduino/Mbed 5V supply to VDD, shunt JU1 VDD pin to 5V, 1-2 position. Similarly, the VL supply is selected using JU2. Shunt JU2 to 2-3 position to select the external supply from a range of 1.62V to 5.5V. Shunt JU2 to 1-2 position to select the Arduino/Mbed 5V supply. Refer to [Table 1](#) for jumper settings.

### On-Board Termination

A properly terminated CAN bus is terminated at each end with the characteristic impedance of the cable. For CAT5 or CAT6 cables, this is typically 120 $\Omega$  on each end for a 60 $\Omega$  load on the CAN driver. The MAX13053A Shield features a selectable 60 $\Omega$  load and a 60 $\Omega$ -60 $\Omega$  split termination circuit between the CANH and CANL driver outputs. The 60 $\Omega$ -60 $\Omega$  split termination has a footprint for a capacitor to reduce high frequency noise and common mode drift. If the

board is evaluated in a system and is connected at the end of the cable, then select the 120 $\Omega$  (60 $\Omega$ -60 $\Omega$ ) termination. The termination resistors on the MAX13053A Shield should be changed to a 60 $\Omega$  with optional footprint for a 100pF load, to simulate a complete system load during evaluation. CANH and CANL can also be left unloaded.

### TXD and RXD Configuration

Digital channel assignments for TXD and RXD are selected through JU8. It consists of three columns, and 14 rows. The columns labeled TXD and RXD are connected to INA1 and OUTA1 pins on of the MAX14932FASE+ (U2), respectively. The middle column is the digital I/O pins, D0 to D15. This provides flexibility for the user to select different resources on the microcontroller for transmitting and receiving signals to and from the CAN transceiver. [Table 2](#) shows the list of JU8 jumper options.

### Silent Mode

Drive S pin high to place the MAX13053A in silent mode. This disables the transmitter regardless of the voltage level at TXD. However, RXD is still active and monitors activity on the bus line.

### DB9 Connector

The MAX13053A Shield has a DB9 connector to CANH and CANL (pins 7 and 2, respectively).

### SD Card

The MAX13053A Shield has a SD Card socket. The Micro SD card is connected to D10-D13 to interface with Arduino/Mbed board via SPI. The user can store CAN messages.

**Table 1. Table Jumper Settings**

| JUMPER              | SHUNT POSITION | DESCRIPTION                                 |
|---------------------|----------------|---------------------------------------------|
| JU_CANH and JU_CANL | 1-2            | Connects 120 $\Omega$ between CANH and CANL |
|                     | 2-3*           | Connects 60 $\Omega$ between CANH and CANL  |
|                     | Open           | No load is connected between CANH and CANL  |
| JU1                 | 1-2            | VDD is shorted to 5V supply                 |
|                     | 2-3*           | VDD is shorted to VDD_EXT supply            |
|                     | Open           | VDD is open                                 |
| JU2                 | 1-2            | VL is shorted to 5V supply                  |
|                     | 2-3*           | VL is shorted to VDD_EXT supply             |
|                     | Open           | VL is open                                  |
| JU3                 | 1-2*           | Connects VL to U1 Pin 5                     |
| JU8                 | -              | Refer to TXD and RXD Configuration          |
| JU9                 | 1-2            | Connects S pin to D7                        |
|                     | Open*          | Disconnects S pin from D7                   |

**Table 1. Table Jumper Settings (continued)**

| JUMPER | SHUNT POSITION | DESCRIPTION                                                          |
|--------|----------------|----------------------------------------------------------------------|
| JU10   | 1-2*           | Connects TVS diode to CANL                                           |
|        | Open           | Disconnects TVS diode to CANL                                        |
| JU12   | 1-2*           | Connects S_U1 to ground                                              |
|        | 1-3            | Internal pull up for silent mode.                                    |
|        | 1-4            | Connects S_U1 to the U2's OUTB2 pin used for Arduino/mbed interface. |
|        | Open           | Internal pull up for silent mode.                                    |
| JU15   | 1-2*           | Connects 15pF to receiver output to ground.                          |
|        | Open           | Disconnects 15pF on receiver output.                                 |
| JU20   | 1-2*           | Connects TVS diode to CANH                                           |
|        | Open           | Disconnects TVS diode to CANH                                        |

**Note:** '\*' indicates default jumper state.

**Table 2. Table TXD and RXD Jumper Setting**

| JUMPER | SHUNT POSITION | DESCRIPTION         |
|--------|----------------|---------------------|
| JU8    | 1-2            | Connects TXD to D0  |
|        | 4-5*           | Connects TXD to D1  |
|        | 7-8            | Connects TXD to D2  |
|        | 10-11          | Connects TXD to D3  |
|        | 13-14          | Connects TXD to D4  |
|        | 16-17          | Connects TXD to D5  |
|        | 19-20          | Connects TXD to D6  |
|        | 22-23          | Connects TXD to D7  |
|        | 25-26          | Connects TXD to D8  |
|        | 28-29          | Connects TXD to D9  |
|        | 31-32          | Connects TXD to D10 |
|        | 34-35          | Connects TXD to D11 |
|        | 37-38          | Connects TXD to D12 |
|        | 40-41          | Connects TXD to D13 |
| JU8    | 2-3*           | Connects RXD to D0  |
|        | 5-6            | Connects RXD to D1  |
|        | 8-9            | Connects RXD to D2  |
|        | 11-12          | Connects RXD to D3  |
|        | 14-15          | Connects RXD to D4  |
|        | 17-18          | Connects RXD to D5  |
|        | 20-21          | Connects RXD to D6  |
|        | 23-24          | Connects RXD to D7  |
|        | 26-27          | Connects RXD to D8  |
|        | 29-30          | Connects RXD to D9  |
|        | 32-33          | Connects RXD to D10 |
|        | 35-36          | Connects RXD to D11 |
|        | 38-39          | Connects RXD to D12 |
|        | 41-42          | Connects RXD to D13 |

**Note:** '\*' indicates default jumper state.

## Ordering Information

| PART            | TYPE   |
|-----------------|--------|
| MAX13053AESHLD# | SHIELD |

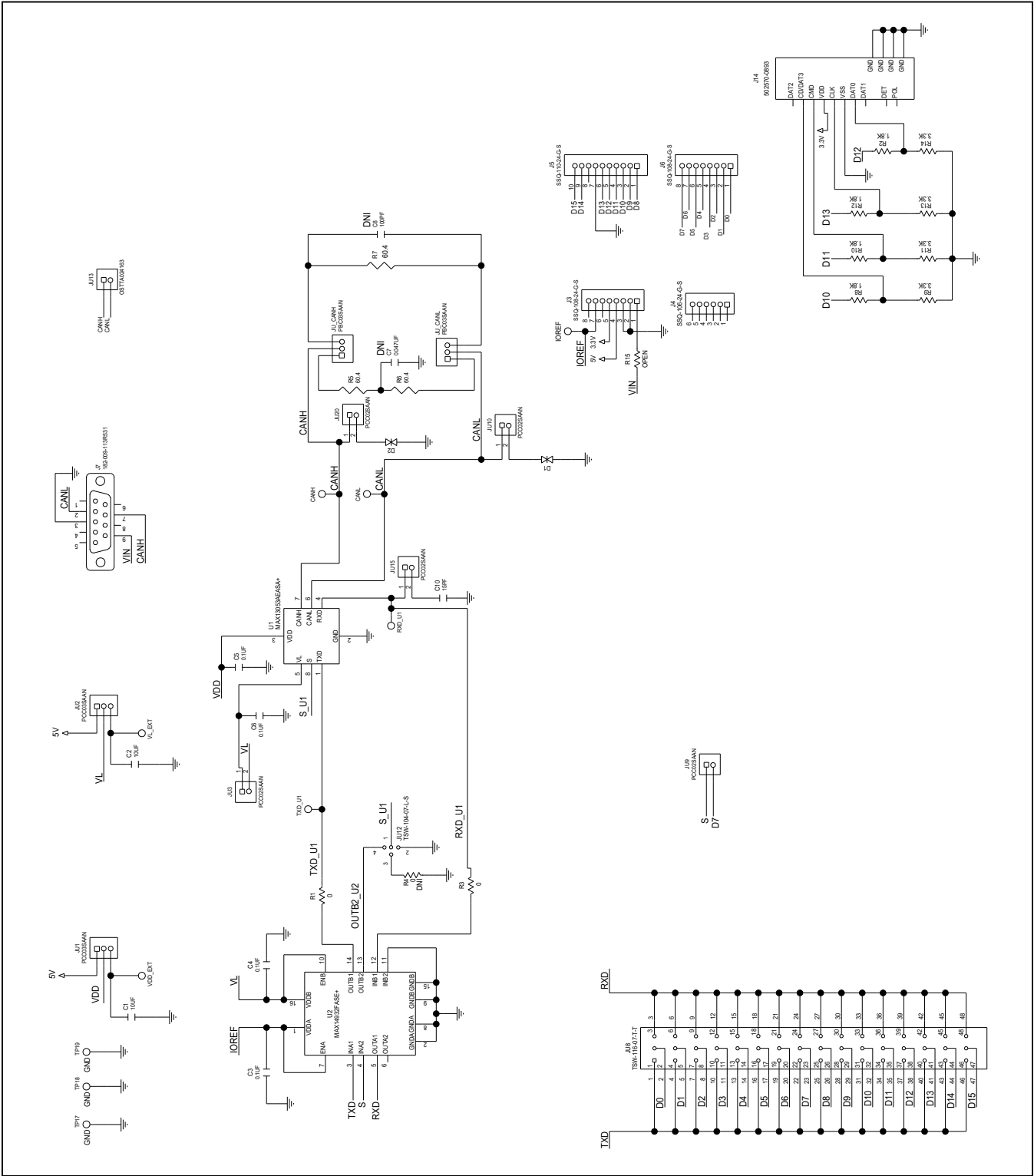
## MAX13053A Shield Bill of Materials

| ITEM | REF_DES                          | DNI/DNP | QTY | MFG PART #                               | MANUFACTURER        | VALUE           | DESCRIPTION                                                                                                      | COMMENTS |
|------|----------------------------------|---------|-----|------------------------------------------|---------------------|-----------------|------------------------------------------------------------------------------------------------------------------|----------|
| 1    | C1, C2                           | -       | 2   | GRM21BR71A106KE51                        | MURATA              | 10UF            | CAPACITOR; SMT (0805); CERAMIC CHIP; 10UF; 10V; TOL=10%; MODEL=GRM SERIES; TG=-55 DEGC TO +125 DEGC; TC=X7R      |          |
| 2    | C3-C6                            | -       | 4   | C0402C104J4RAC                           | KEMET               | 0.1UF           | CAPACITOR; SMT; 0402; CERAMIC; 0.1uF; 16V; 5%; X7R; -55degC to +125degC; 0 +/-15% degC MAX.                      |          |
| 3    | C10                              | -       | 1   | C0402C0G500-150JNP;<br>GRM1555C1H150JA01 | VENKEL LTD.;MURATA  | 15PF            | CAPACITOR; SMT (0402); CERAMIC CHIP; 15PF; 50V; TOL=5%; TG=-55 DEGC TO +125 DEGC; TC=C0G                         |          |
| 4    | CANH, CANL,<br>RXD_U1,<br>TXD_U1 | -       | 4   | 5002                                     | KEYSTONE            | N/A             | TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; WHITE; PHOSPHOR BRONZE WIRE SILVER;            |          |
| 5    | D1, D2                           | -       | 2   | SM15T30CA                                | ST MICROELECTRONICS | 25.6V           | DIODE; TVS; SMC (DO-214AB); VRM=25.6V; IPP=36A                                                                   |          |
| 6    | IOREF                            | -       | 1   | 5000                                     | KEYSTONE            | N/A             | TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; RED; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH; |          |
| 7    | J3, J6                           | -       | 2   | SSQ-108-24-G-S                           | SAMTEC              | SSQ-108-24-G-S  | CONNECTOR; FEMALE; THROUGH HOLE; .025INCH SQ POST SOCKET; STRAIGHT; 8PINS ;                                      |          |
| 8    | J4                               | -       | 1   | SSQ-106-24-G-S                           | SAMTEC              | SSQ-106-24-G-S  | CONNECTOR; FEMALE; THROUGH HOLE; .025INCH SQ POST SOCKET; STRAIGHT; 6PINS ;                                      |          |
| 9    | J5                               | -       | 1   | SSQ-110-24-G-S                           | SAMTEC              | SSQ-110-24-G-S  | CONNECTOR; FEMALE; THROUGH HOLE; .025INCH SQ POST SOCKET; STRAIGHT; 10PINS ;                                     |          |
| 10   | J7                               | -       | 1   | 182-009-113R531                          | NORCOMP             | 182-009-113R531 | CONNECTOR; MALE; THROUGH HOLE; D-SUBMINIATURE CONNECTOR; RIGHT ANGLE; 9PINS                                      |          |
| 11   | J14                              | -       | 1   | 502570-0893                              | MOLEX               | 502570-0893     | CONNECTOR; FEMALE; SMT; MICROSD CARD CONNECTOR; RIGHT ANGLE; 10PINS                                              |          |
| 12   | JU1, JU2                         | -       | 2   | PCC03SAAN                                | SULLINS             | PCC03SAAN       | CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 3PINS; -65 DEGC TO +125 DEGC                         |          |
| 13   | JU3, JU9,<br>JU10, JU15,<br>JU20 | -       | 5   | PCC02SAAN                                | SULLINS             | PCC02SAAN       | CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 2PINS; -65 DEGC TO +125 DEGC                         |          |
| 14   | JU8                              | -       | 1   | TSW-116-07-T-T                           | SAMTEC              | TSW-116-07-T-T  | CONNECTOR; MALE; THROUGH HOLE; 0.025IN SQ POST HEADER; STRAIGHT; 48PINS                                          |          |
| 15   | JU12                             | -       | 1   | TSW-104-07-L-S                           | SAMTEC              | TSW-104-07-L-S  | EVKIT PART-CONNECTOR; MALE; THROUGH HOLE; TSW SERIES; SINGLE ROW; STRAIGHT; 4PINS                                |          |

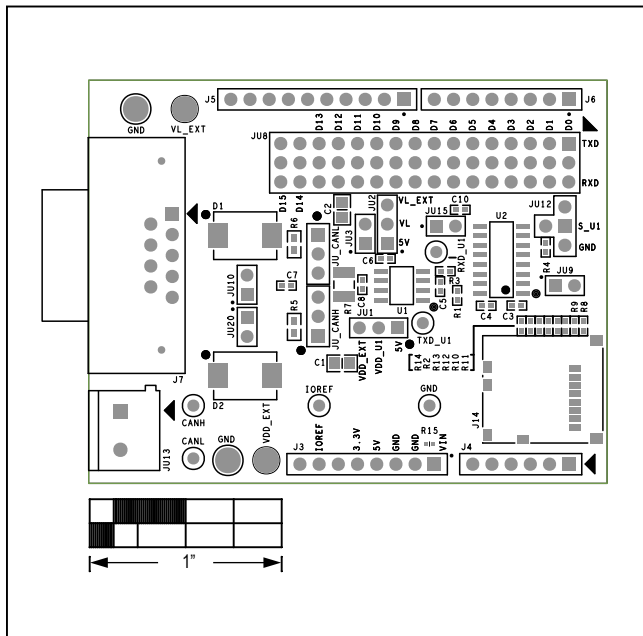
## MAX13053A Shield Bill of Materials (continued)

| ITEM  | REF_DES              | DN/DNP | QTY | MFG PART #                                                                                          | MANUFACTURER                                              | VALUE          | DESCRIPTION                                                                                                             | COMMENTS |
|-------|----------------------|--------|-----|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------|----------|
| 16    | JU13                 | -      | 1   | OSTTA024163                                                                                         | ON-SHORE TECHNOLOGY INC.                                  | OSTTA024163    | CONNECTOR; FEMALE; THROUGH HOLE; 5.08MM TERM BLOCK CONNECTOR; STRAIGHT; 2PINS; -30 DEGC TO +105 DEGC                    |          |
| 17    | JU_CANH,<br>JU_CANL  | -      | 2   | PBC03SAAN                                                                                           | SULLINS                                                   | PBC03SAAN      | CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 3PINS; -65 DEGC TO +125 DEGC                                        |          |
| 18    | R1, R3               | -      | 2   | ERJ-2GE0R00X                                                                                        | PANASONIC                                                 | 0              | RESISTOR; 0402; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM                                                                    |          |
| 19    | R2, R8,<br>R10, R12  | -      | 4   | CRCW04021K80FK;<br>RC0402FR-071K8L                                                                  | VISHAY DALE;YAGEO<br>PHICOMP                              | 1.8K           | RESISTOR, 0402, 1.8K OHM, 1%, 100PPM, 0.0625W, THICK FILM                                                               |          |
| 20    | R4                   | -      | 1   | RC0402JR-070RL;<br>CR0402-16W-000RJT                                                                | YAGEO PHYCOMP.;<br>VENKEL LTD.                            | 0              | RESISTOR; 0402; 0 OHM; 5%; JUMPER; 0.063W; THICK FILM                                                                   |          |
| 21    | R5, R6               | -      | 2   | CRCW060360R4FK                                                                                      | VISHAY DALE                                               | 60.4           | RESISTOR; 0603; 60.4 OHM; 1%; 100PPM; 0.10W; THICK FILM                                                                 |          |
| 22    | R7                   | -      | 1   | CRCW121060R4FKEAHP                                                                                  | VISHAY DRALORIC                                           | 60.4           | RES; SMT (1210); 60.4R; 1%; +/-100PPM/DEGK; 0.75W                                                                       |          |
| 23    | R9, R11,<br>R13, R14 | -      | 4   | CRCW04023K30FK                                                                                      | VISHAY DALE                                               | 3.3K           | RESISTOR, 0402, 3.3K OHM, 1%, 100PPM, 0.0625W, THICK FILM                                                               |          |
| 24    | TP17, TP19           | -      | 2   | 5011                                                                                                | KEYSTONE                                                  | N/A            | TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH; |          |
| 25    | TP18                 | -      | 1   | 5001                                                                                                | KEYSTONE                                                  | N/A            | TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;      |          |
| 26    | U1                   | -      | 1   | MAX13053AEASA+                                                                                      | MAXIM                                                     | MAX13053AEASA+ | IC; TXRX; +3.3V CAN TRANSCEIVER WITH +/-65V FP; +/-25V CMR AND +/-25KV ESD; NSOIC8                                      |          |
| 27    | U2                   | -      | 1   | MAX14932FASE+                                                                                       | MAXIM                                                     | MAX14932FASE+  | IC; DISO; 2/2 CHANNEL; 150MBPS; DEFAULT LOW; 2.75KVRMS DIGITAL ISOLATOR; NSOIC16 150MIL                                 |          |
| 28    | VDD_EXT,<br>VL_EXT   | -      | 2   | 5010                                                                                                | KEYSTONE                                                  | N/A            | TESTPOINT WITH 1.80MM HOLE DIA, RED, MULTIPURPOSE;                                                                      |          |
| 29    | PCB                  | -      | 1   | -                                                                                                   | MAXIM                                                     | PCB            | PCB:MAX13053ASHLD                                                                                                       | -        |
| 30    | C7                   | DNP    | 0   | C1005X7R1E473K;<br>GRM155R71E473K                                                                   | TDK;MURATA                                                | 0.047UF        | CAPACITOR; SMT (0402); CERAMIC CHIP; 0.047UF; 25V; TOL=10%; TG=-55 DEGC TO +125 DEGC                                    |          |
| 31    | C8                   | DNP    | 0   | C0402C101J5GAC;<br>NMC0402NPO101J;<br>CC0402JRNPO9BN101;<br>GRM1555C1H101JA01;<br>C1005C0G1H101J050 | KEMET;NIC COMPONENTS<br>CORP.;YAGEO<br>PHICOMP;MURATA;TDK | 100PF          | CAPACITOR; SMT (0402); CERAMIC CHIP; 100PF; 50V; TOL=5%; TG=-55 DEGC TO +125 DEGC; TC=C0G                               |          |
| 32    | R15                  | DNP    | 0   | N/A                                                                                                 | N/A                                                       | OPEN           | RESISTOR; 0402; OPEN; FORMFACTOR                                                                                        |          |
| TOTAL |                      |        | 54  |                                                                                                     |                                                           |                |                                                                                                                         |          |

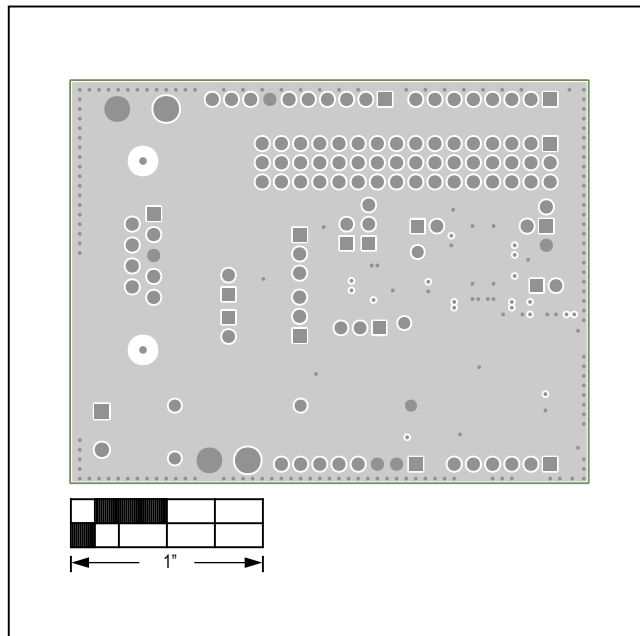
MAX13053A Shield Schematic



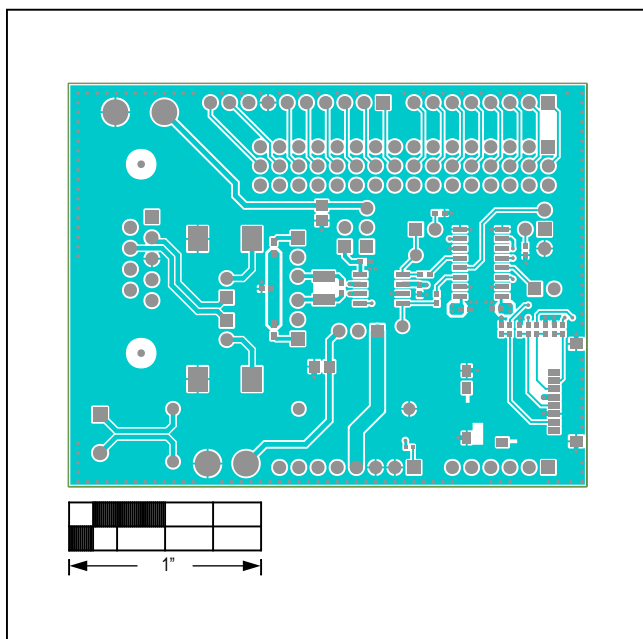
## MAX13053A Shield PCB Layout Diagrams



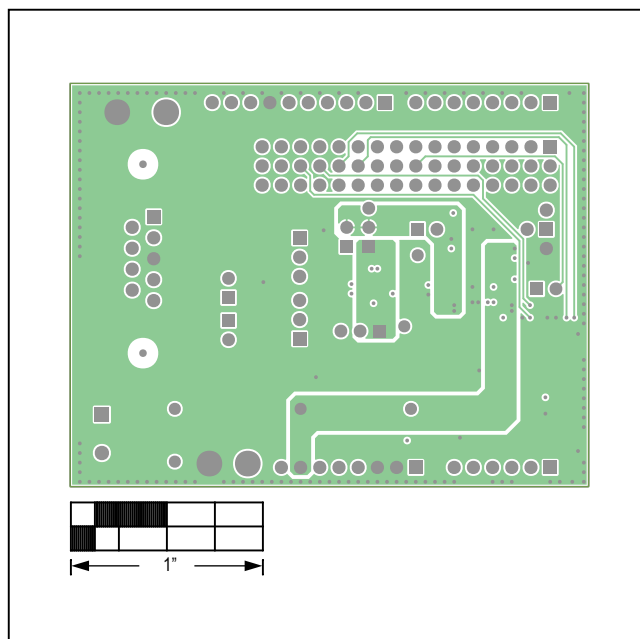
MAX13053A Shield—Top Silkscreen



MAX13053A Shield—Internal 2

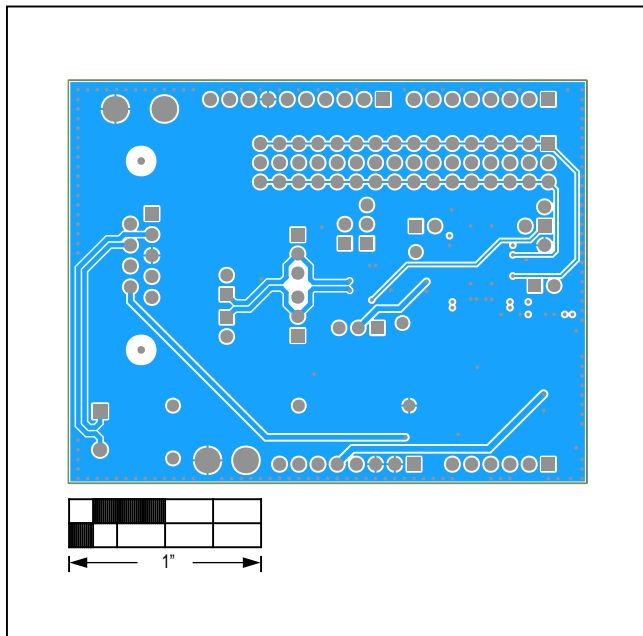


MAX13053A Shield—Top

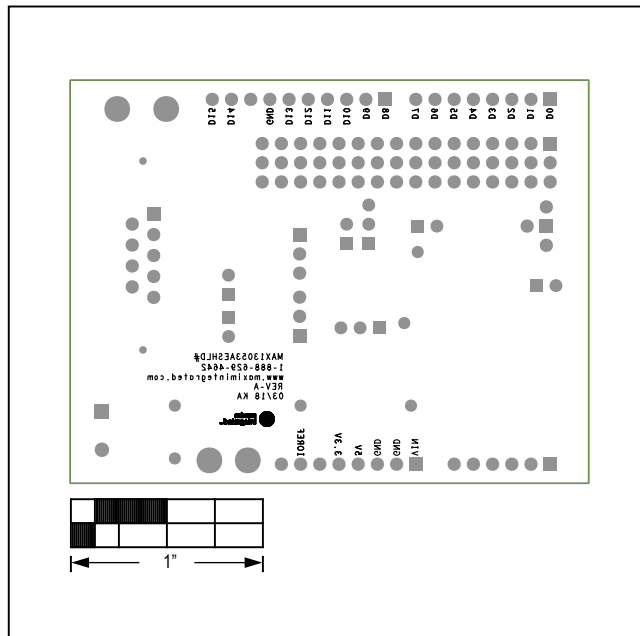


MAX13053A Shield—Internal 3

## MAX13053A Shield PCB Layout Diagrams (continued)



MAX13053A Shield—Bottom



MAX13053A Shield—Bottom Silkscreen



## Revision History

| REVISION<br>NUMBER | REVISION<br>DATE | DESCRIPTION     | PAGES<br>CHANGED |
|--------------------|------------------|-----------------|------------------|
| 0                  | 7/18             | Initial release | —                |

For pricing, delivery, and ordering information, please visit Maxim Integrated's online storefront at <https://www.maximintegrated.com/en/storefront/storefront.html>.

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