

# UG177: TS4100-01-02 EVB User's Guide

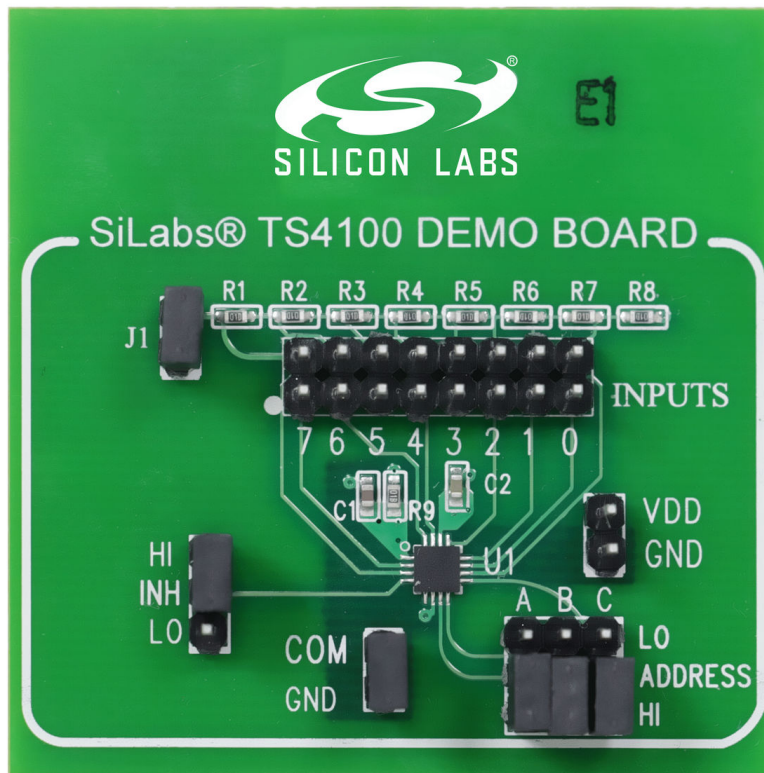
The TS410x series of multiplexers offer no compromise performance for the best signal integrity, simple design, and low power operation as they can operate at a supply voltage as low as 0.8 V while accepting an input signal swing above the supply voltage up to 5.25 V ("Rail-to-Rail Plus™"). Additionally, the on-resistance variation over the entire signal swing range is less than 1%, exhibiting excellent linearity and consistency in dynamic and measurement applications. The evaluation boards are simple to use and allow quick evaluation of the performance of the multiplexers.

The board is configured for testing all eight channels, NO0-NO7, or all three single-pole/double-throw switches with a dc input voltage derived from  $V_{DD}$ . Jumper INH is available to turn all switches OFF. Jumper A, B, and C is available to select an input, NC or NO.

These switches are fully specified over the  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  temperature range and are available in a low-profile, thermally-enhanced 16-pin 3x3 mm TQFN package with an exposed back-side paddle.

## KEY FEATURES

- TS4100: 1x 8 Channel Multiplexer
- TS4101: 2x 4 Channel Multiplexer
- TS4102: 3x Single-pole/Double-throw Switch (SPDT)



## 1. Procedure Description

### 1.1 TS4100DB Quick Start Procedure

**Table 1.1. TS4100DB Address Bits**

INH	ADDRESS BITS			COM
	A	B	C	Output
1	<b>X</b>	<b>X</b>	<b>X</b>	<b>GND</b>
0	0	0	0	NO0
0	0	0	1	NO1
0	0	1	0	NO2
0	0	1	1	NO3
0	1	0	0	NO4
0	1	0	1	NO5
0	1	1	0	NO6
0	1	1	1	NO7

The TS4100 demo board is configured with a COM output resistor and capacitor load of 1 kΩ and 10 pF. The TS4100 operates at a supply voltage range of 0.8 V to 5.25 V and an analog input/output "Rail-to-Rail Plus™" range of 0 V to 5.25 V.

The TS4100 can be tested with an on-board dc input signal or an external ac input signal. The on-board voltage is generated via a voltage divider circuit. The complete demo board circuit is shown in [Figure 2.1 TS4100DB Schematic on page 6](#). To select a channel or turn OFF all channels, jumper A, B, C, and INH can be set according to the table above.

**To evaluate the TS4100 analog 8-channel switch/multiplexer, perform the following steps:**

1. Before connecting the dc power supply to the demo board, turn on the power supply, set the dc voltage to 1.5 V, and then turn it off.
2. Connect the dc power supply positive terminal to the test point labeled  $V_{DD}$ . Connect the negative terminal of the dc power supply to the test point labeled GND.
3. Set jumpers A, B, and C to a HIGH state by moving the jumper position from LO to HI.
4. Find the 16-pin header on the board labeled INPUTS. Place a jumper on the two-pin header labeled 7. This sets a dc voltage to channel NO7.
5. To monitor the COM output signal, connect the positive terminal of the digital voltmeter to the test point labeled as COM and the negative terminal to the adjacent test point labeled as GND.
6. Turn on the power supply and check that the digital voltmeter is reading an output voltage of approximately 1.39 V. With an output voltage of 1.39 V across an output resistor value of 1 k $\Omega$ , the resulting load current is 1.39 mA. This yields an on-resistance of approximately 79  $\Omega$ , which is well within the data sheet on-resistance specification.
7. To test a different channel, refer to the table above and make the appropriate changes to jumpers A, B, and C.

**Measuring the Supply Current**

1. Turn off the power supply and connect a digital ammeter in series with the power supply.
2. Remove the positive terminal of the digital voltmeter from the COM output test point.
3. Remove jumper J1 and the jumper on the selected channel.
4. Turn on the power supply and check that the digital ammeter is reading a supply current less than 765 nA.

**Applying an External Input Signal**

1. Turn off the power supply.
2. Connect the positive terminal of a dc power supply or an ac signal generator to the test point labeled "0" on the 16-pin header labeled INPUTS. Connect the negative terminal to a test point labeled GND. For an ac input signal, make sure the maximum input voltage level is less than 5.25 V and the minimum input voltage level is greater than 0 V. For a dc input signal, make sure the input voltage is less than 5.25 V and greater than 0 V.
3. Check that the ac input signal levels are within the levels specified in the previous step with an oscilloscope. Check a dc input voltage level with a voltmeter.
4. With an applied dc input signal, connect the positive terminal of the digital voltmeter to the test point labeled as COM and the negative terminal to the adjacent test point labeled as GND. With an applied ac input signal, connect the signal terminal of an oscilloscope probe to the test point labeled as COM and the ground terminal to the adjacent test point labeled as GND.
5. Turn on the power supply.
6. Turn on the dc power supply input signal or ac signal generator. For a dc input signal, monitor the digital voltmeter. For an ac input signal, monitor the oscilloscope.

**Turn Off All Switches**

1. Turn off the power supply.
2. Remove the jumper between INH and LO and connect it between INH and HI. Refer to [Table 1.1 TS4100DB Address Bits on page 1](#).

## 1.2 TS4101DB Quick Start Procedure

**Table 1.2. TS4101DB Address Bits**

INH	ADDRESS BITS		COM-A	COM-B
	B	A	Output	Output
1	X	X	<b>GND</b>	
0	0	0	NO0A	NO0B
0	0	1	NO1A	NO1B
0	1	0	NO2A	NO2B
0	1	1	NO3A	NO3B

### To evaluate the TS4101 analog 2x4-channel switch/multiplexer, perform the following steps:

1. Before connecting the dc power supply to the demo board, turn on the power supply, set the dc voltage to 1.5 V, and then turn it off.
2. Connect the dc power supply positive terminal to the test point labeled  $V_{DD}$ . Connect the negative terminal of the dc power supply to the test point labeled GND.
3. Place a jumper on the two-pin header J1. Set jumpers A and B to a HIGH state by moving the jumper from LO to HI.
4. Find the 8-pin header on the board labeled OUTA and OUTB. Refer to [Figure 2.2 TS4101DB Schematic on page 6](#). Place a jumper on the two-pin header labeled 3. This sets a dc voltage channel NO3A and NO3B.
5. To monitor the COM-A or COM-B output signal, connect the positive terminal of the digital voltmeter to the test point labeled COM-A or COM-B and the negative terminal to the adjacent test point labeled GND.
6. Turn on the power supply and check that the digital voltmeter is reading an output voltage of approximately 1.39 V. With an output voltage of 1.39 V across an output resistor value of 1 k $\Omega$ , the resulting load current is 1.39 mA. This yields an on-resistance of approximately 79  $\Omega$ , which is well within the data sheet on-resistance specification.
7. To test a different channel, refer to the table above and apply the appropriate changes to jumpers A and B.

### Measuring the Supply Current

1. Turn off the power supply and connect a digital ammeter in series with the power supply.
2. Remove the positive terminal of the digital voltmeter from the COM-A or COM-B output test point.
3. Remove jumper j1 and the jumper on the selected channel.
4. Turn on the power supply and check that the digital ammeter is reading a supply current of approximately 756 nA.

### Applying an External Input Signal

1. Turn off the power supply.
2. Connect the positive terminal of a dc power supply or an ac signal generator to the test point labeled 0 on the 8-pin header labeled OUTA or OUTB. Connect the negative terminal to a test point labeled GND. For an ac input signal, make sure the maximum input voltage level is less than 5.25 V and the minimum input voltage level is greater than 0 V. For a dc input signal, make sure the input voltage is less than 5.25 V and greater than 0 V.
3. Check that the ac input signal levels are within the levels specified in the previous step with an oscilloscope. Check a dc input voltage level with a voltmeter.
4. With an applied dc input signal, connect the positive terminal of the digital voltmeter to the test point labeled COM-A or COM-B and the negative terminal to the adjacent test point labeled GND. With an applied ac input signal, connect the signal terminal of an oscilloscope probe to the test point labeled COM-A or COM-B and the ground terminal to the adjacent test point labeled GND.
5. Turn on the power supply.
6. Turn on the dc power supply input signal generator. For a dc input signal, monitor the digital voltmeter. For an ac input signal, monitor the oscilloscope.

### Turn Off All Switches

1. Turn off the power supply.
2. Remove the jumper between INH and LO and connect it between INH and HI. Refer to [Table 1.2 TS4101DB Address Bits on page 3](#).

### 1.3 TS4102DB Quick Start Procedure

**Table 1.3. TS4102DB Address Bits**

INH	ADDRESS BITS			COM-A	COM-B	COM-C
	A	B	C	Output	Output	Output
1	<b>X</b>	<b>X</b>	<b>X</b>	<b>GND</b>		
0	0	0	0	NCA	NCB	NCC
0	0	0	1	NOA	NCB	NCC
0	0	1	0	NCA	NOB	NCC
0	0	1	1	NOA	NOB	NCC
0	1	0	0	NCA	NCB	NOC
0	1	0	1	NOA	NCB	NOC
0	1	1	0	NCA	NOB	NOC
0	1	1	1	NOA	NOB	NOC

**To evaluate the TS4102 analog 3x single-pole/double-throw switch, perform the following steps:**

1. Before connecting the dc power supply to the demo board, turn on the power supply, set the dc voltage to 1.5 V, and then turn it off.
2. Connect the dc power supply positive terminal to the test point labeled  $V_{DD}$ . Connect the negative terminal of the dc power supply to the test point labeled GND.
3. Place a jumper on the two-pin header J3.
4. Find outputs COM-A, COM-B, and COM-C on the demo board. Refer to [Figure 2.3 TS4102DB Schematic on page 7](#). Note that each SPDT has its own individual NC and NO 2-pin header. Place a jumper on all 2-pin headers labeled NC and NO. This sets a dc voltage to all NC and NO outputs.
5. To monitor the COM-A, COM-B, or COM-C output signal, connect the positive terminal of the digital voltmeter to the test point labeled COM-A, COM-B, or COM-C and the negative terminal to the test point labeled GND.
6. Turn on the power supply and check that the digital voltmeter is reading an output voltage of approximately 1.39 V. With an output voltage of 1.39 V across an output resistor value of 1 k $\Omega$ , the resulting load current is 1.39 mA. This yields an on-resistance of approximately 79  $\Omega$ , which is well within the data sheet on-resistance specification.
7. To test a different channel, refer to the table above and apply the appropriate changes to jumpers A, B, and C.

**Measuring the Supply Current**

1. Turn off the power supply and connect a digital ammeter in series with the power supply.
2. Remove the positive terminal of the digital voltmeter from the COM-A, COM-B, or COM-C output test point.
3. Remove jumper J3 and all NC and NO jumpers.
4. Turn on the power supply and check that the digital ammeter is reading a supply current of approximately 765 nA.

**Applying an External Input Signal**

1. Turn off the power supply.
2. Connect the positive terminal of a dc power supply or an ac signal generator to the test point labeled NC that corresponds to output COM-A, COM-B, or COM-C. Connect the negative terminal to a test point labeled GND. For an ac input signal, make sure the maximum input voltage level is less than 5.25 V and the minimum input voltage level is greater than 0 V. For a dc input signal, make sure the input voltage is less than 5.25 V and greater than 0 V.
3. Check that the ac input signal levels are within the levels specified in the previous step with an oscilloscope. Check a dc input voltage level with a voltmeter.
4. With an applied dc input signal, connect the positive terminal of the digital voltmeter to the test point labeled COM-A, COM-B, or COM-C and the negative terminal to the test point labeled GND. With an applied ac input signal, connect the signal terminal of an oscilloscope probe to the test point labeled COM-A, COM-B, or COM-C and the negative terminal to the test point labeled GND.
5. Turn on the power supply.
6. Turn on the dc power supply input signal or ac signal generator. For a dc input signal, monitor the digital voltmeter. For an ac input signal, monitor the oscilloscope.

### Turn Off All Switches

1. Turn off the power supply.
2. Remove the jumper between INH and LO and connect it between INH and H1. Refer to [Table 1.3 TS4102DB Address Bits](#) on page 4.

## 2. Schematics

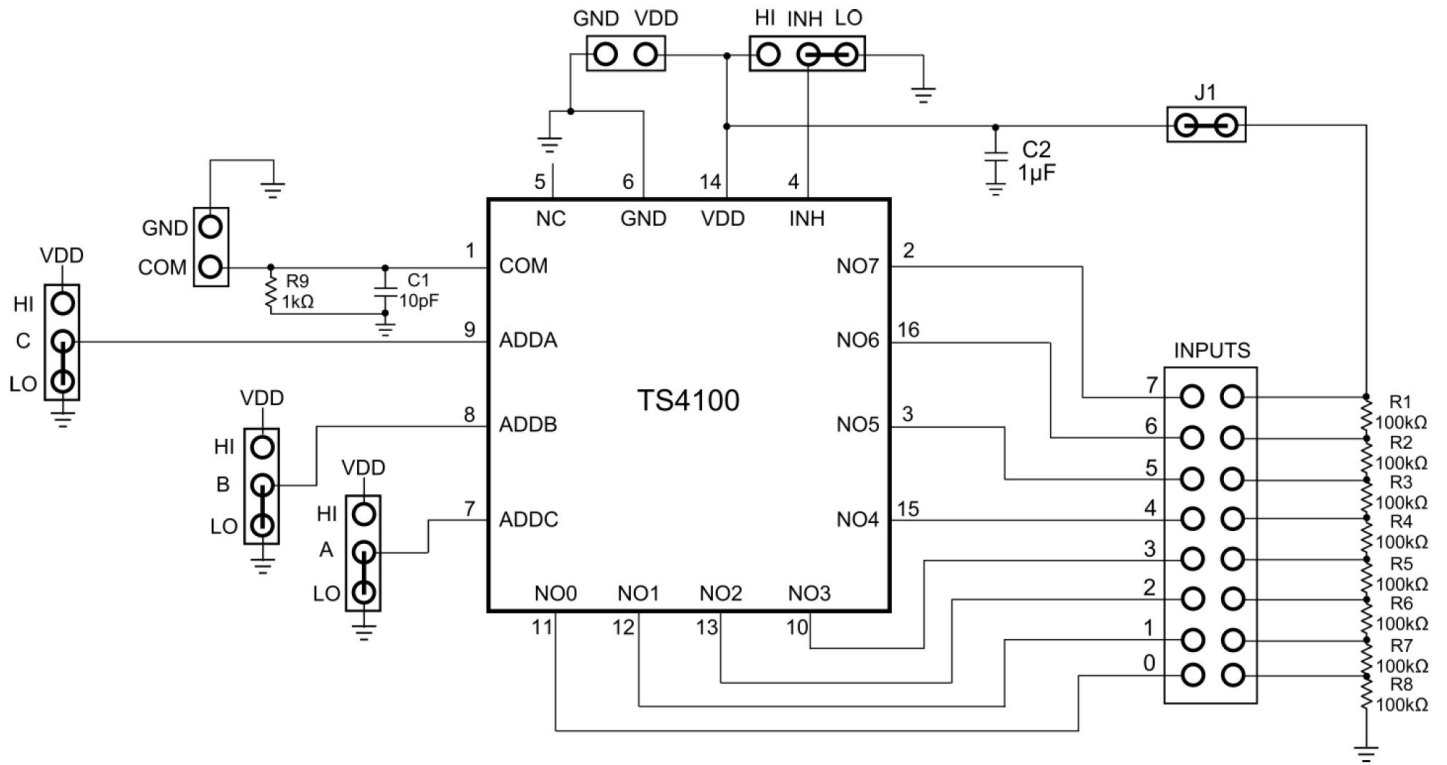


Figure 2.1. TS4100DB Schematic

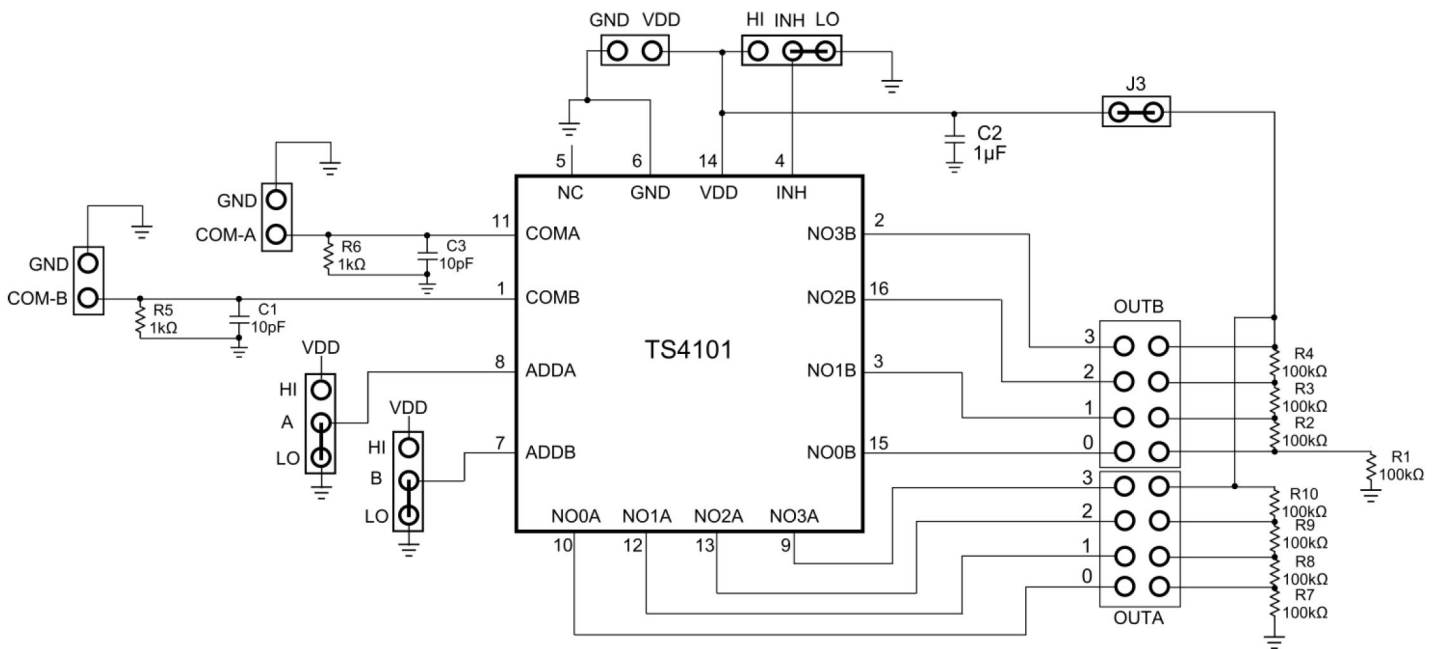
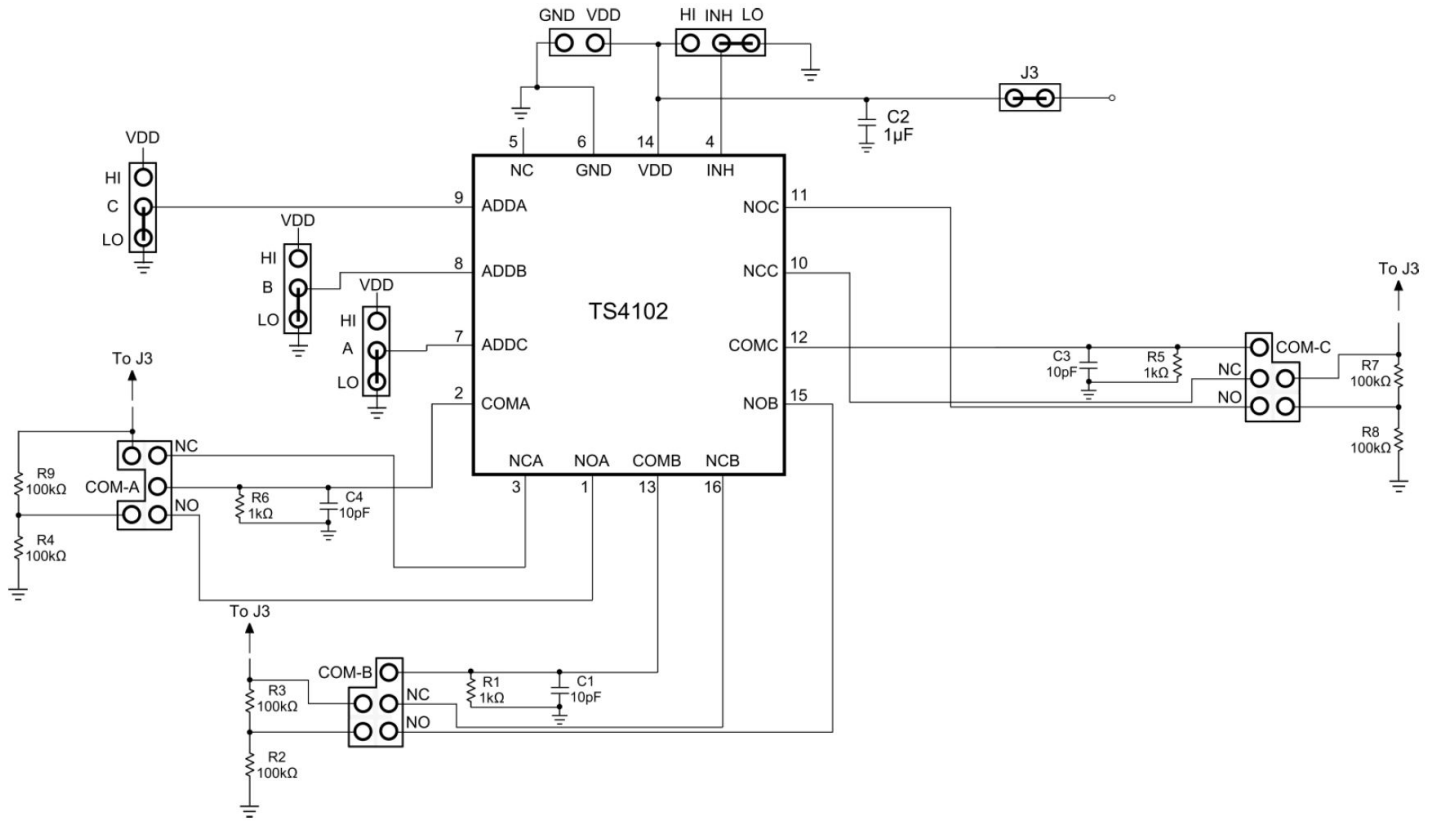


Figure 2.2. TS4101DB Schematic



**Figure 2.3. TS4102DB Schematic**



### 3. Component List

**Table 3.1. TS4100DB Component List**

DESIGNATION	QTY	DESCRIPTION
C1	1	10pF ±10% capacitor (0603)
C2	1	1µF ±10% capacitor (0603)
R1-R8	8	100kΩ ± 1% (0603)
R9	1	1kΩ ± 1% (0603)
U1	1	TS4100
VDD, COM, GND, 0-7	12	Test points
J1, INH, A, B, C	5	Jumper

**Table 3.2. TS4101DB Component List**

DESIGNATION	QTY	DESCRIPTION
C1, C3	2	10pF ±10% capacitor (0603)
C2	1	1µF ±10% capacitor (0603)
R1-R4, R7-R10	8	100kΩ ± 1% (0603)
R5, R6	2	1kΩ ± 1% (0603)
U1	1	TS4101
VDD, COM-A, COM-B, GND, OUTA(0-3), OUTB(0-3)	14	Test points
J3, INH, A, B	4	Jumper

**Table 3.3. TS4102DB Component List**

DESIGNATION	QTY	DESCRIPTION
C1, C3, C4	3	10pF ±10% capacitor (0603)
C2	1	1µF ±10% capacitor (0603)
R2-R4, R7-R9	8	100kΩ ± 1% (0603)
R1, R5, R6	3	1kΩ ± 1% (0603)
U1	1	TS4102
VDD, COM-A, COM-B, COM-C, GND, NO, NC	11	Test points
J3, INH, A, B, C	5	Jumper