

## MAX16602CL8 Evaluation Kit

Evaluates: MAX16602 and MAX20790

### General Description

The MAX16602CL8 evaluation kit (EV kit) is a fully assembled and tested surface-mount circuit board that contains all of the components necessary to evaluate the MAX16602 and MAX20790. The MAX16602 is a PMBus™-compatible, multiphase voltage regulator controller for AI cores or Intel® VR13.HC server CPUs. The IC is packaged in a 56-pin, 7mm x 7mm QFN. The controller generates eight pulse-width modulated (PWM) control signals or phases. The EV kit is an 8-phase multiphase synchronous buck converter that uses 2-phase coupled inductors, which reduce the effective inductor value and size without excessive ripple current, thus reducing the required output capacitance and improving transient response.

The EV kit also demonstrates the full functionality of the MAX20790 smart power-stage IC. The IC has monolithic integration and advanced packaging technology that allow high-switching frequencies with significantly lower losses than conventional implementations. There are eight MAX20790 devices for the main output rail.

**Warning:** The EV kit is designed to operate with 12V input and high current. Follow safe procedures when working with high-current electrical equipment.

Under severe fault or failure conditions, this EV kit can dissipate large amounts of power, which could result in the mechanical ejection of a component or of component debris at high velocity. Operate this kit with care to avoid possible personal injury.

### Features

- High Power Density and Efficiency
  - Monolithic, Smart Power-Stage Support: MAX20790
  - Small Power-Stage Footprint: ~24mm<sup>2</sup>
  - Top-Tier Efficiency (95.6% Peak Efficiency at 1.8V<sub>OUT</sub>)
  - Integrated Input Power Monitor
- Telemetry Through PMBus
  - Digitally Programmable Configuration
  - Input Voltage, Current, and Power Monitoring
  - Power-Stage Temperature Monitoring and Reporting
- Advanced Power Management
  - Autonomous Phase-Shedding
  - Orthogonal Current Rebalance for Phase-Current Balance During Transients
  - Low Quiescent Current—Improves Light-Load and Standby Efficiency
  - Protection Features
  - Controller Input and Bias Supply Undervoltage Protection
  - Power-Stage Supply and Boost UVLO Protection
  - Power-Stage Boost Refresh
  - Power-Stage VX Short and Overtemperature Shutdown
  - Fast Overcurrent Protection
- Proven PCB Layout
- Fully Assembled and Tested

Ordering Information appears at end of data sheet.

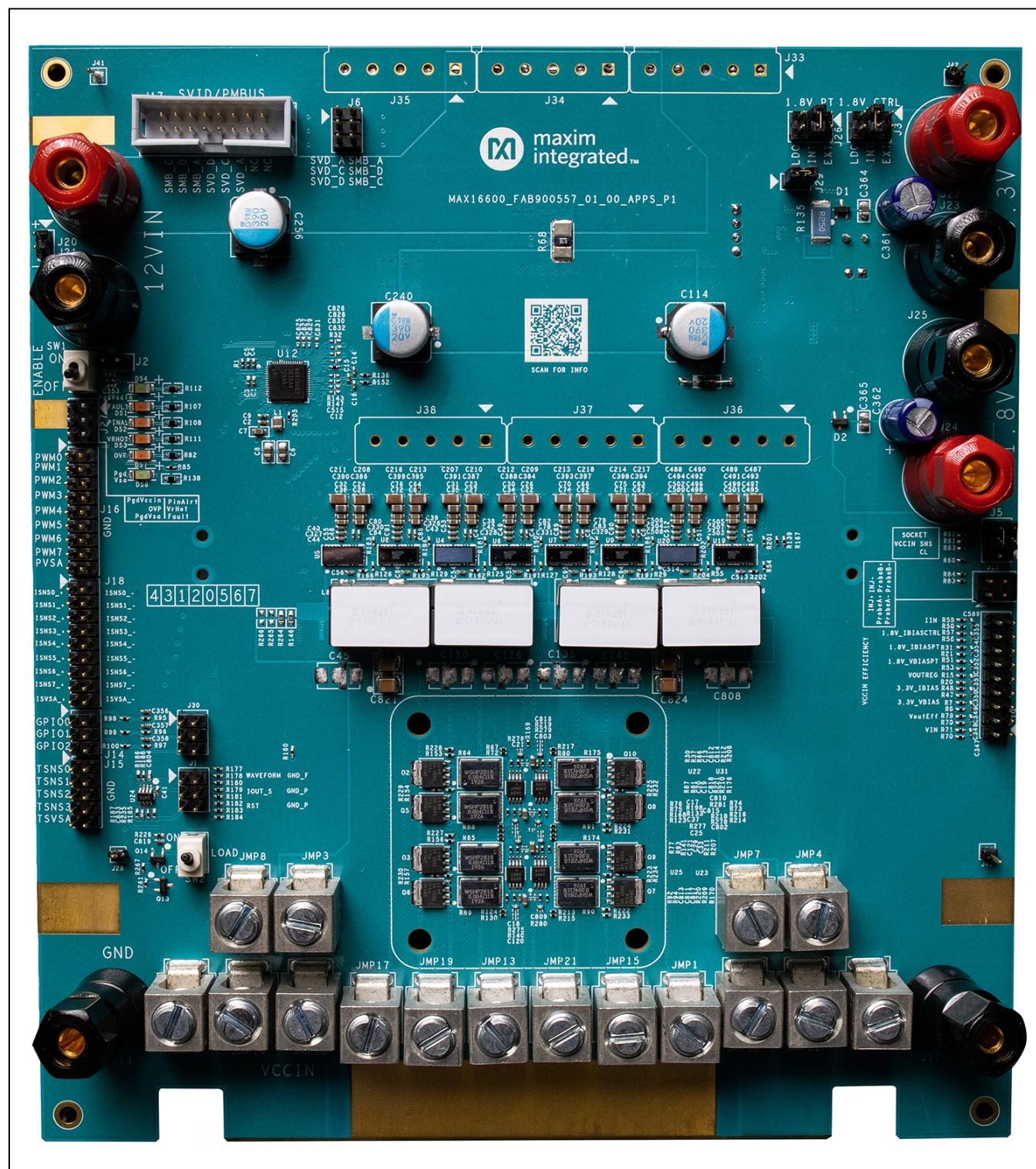
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## MAX16602CL8 EV Kit Photo





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## Quick Start

### Required Equipment

- MAX16602CL8 EV kit
- 12V DC power supply with 350W or higher power delivering capability
- Electronic load capable of sinking 200A
- MAXPOWERUSB dongle to SMBus interface (order separately)
- Maxim MAXPOWERUSB graphical user interface (GUI software)
- Digital voltmeters
- 600MHz 4-channel oscilloscope

### Procedure

The EV kit is fully assembled and tested. Use the following steps to verify board operation:

**Caution: Do not turn on the power supply until all connections are completed.**

- 1) Connect the USB cable from the PC to the MAXPOWERUSB dongle. Connect the adapter ribbon cable to the matching header J17 on the EV kit.
- 2) Shunt pins 3-5 and shunt pins 4-6 of J5 to connect the core output feedback sensing.
- 3) Generate a 3.3V bias power supply for the controller, on-board load, and other logic circuits. Two options are provided:
  - a. **Using the on-board 3.3V LDO:** Shunt J19 and the on-board LDO (U10) to generate a 3.3V bias output from the 12V VDDH input.
  - b. **Using the external 3.3V bias power supply:** Connect an external 3.3V power supply to J22 and J23.
- 4) Generate a 1.8V bias power supply for the controller and power stages. Three options are provided:
  - a. **Using the MAX16602 integrated baby buck converter:** Place a shunt across pins 3-4 of J3 and J26. Do not install R22 to enable the integrated baby buck converter.
  - b. **Using the on-board 1.8V LDO:** Place a shunt across pins 5-6 of J3 and J26. Install R22 to disable the integrated baby buck converter.
  - c. **Using the external 1.8V bias power supply:** Connect an external 1.8V power supply to J24 and J25. Place a shunt across pins 1-2 of J3 and J26. Install R22 to disable the integrated baby buck converter.
- 5) Connect VCCIN\_VOUT to the load. Two options are provided:
  - a. **Using the external electronic load:** Connect JMP1, JMP3, JMP7, JMP12, JMP15, JMP17, JMP19, and JMP21 to the input terminal of the load. Connect JMP4, JMP6, JMP8, JMP14, JMP16, JMP18, JMP20, and JMP22 to the ground of the load, being careful to observe the VOUT and GND polarity indicated by the silkscreen labels.
  - b. **Using the on-board load:** Switch on SW2 to enable the on-board load. Connect the function generator to pin 1 of J1 to set the on-board load current.
- 6) Enable the external 12V power supply. Start the GUI software.

## Detailed Description of Software

The MAX16602 supports standard PMBus protocol. The MAXPOWERUSB software is designed to work with the MAX16602. The software GUI presents system-level information on the **Dashboard** tab. This view collects basic information for all Maxim PMBus devices detected on the bus. This tab configures enable control, an overview of the system status, fault flag, and sequencing. The tab also presents rolling plotting results of the READ\_VOUT and READ\_IOUT registers.

For detailed information about a particular device, click the sub-tab for that device's slave address. This opens a view with a set of further sub-tabs specific to that device. The available sub-tabs vary depending on the GUI version and the connected device's capability, but typically include **Command Monitor**, **Command Configure**, **Command Faults**, and **Settings**.

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## Detailed Description of Hardware

The MAX16602CL8 EV kit is a fully assembled and tested board to evaluate the performance of the MAX16602 plus an 8-phase MAX20790 multiphase power solution to AI core or Intel VR13.HC server CPUs, which makes use of coupled inductors. This solution provides high output current with high efficiency, fast load-transient response, low ripple, and low noise. The EV kit provides completed peripheral circuits of the bias power supply, the on-board load, and PMBus for telemetry, which allow the EV kit to demonstrate the full functionality of the MAX16602 and MAX20790.

The MAX16602 controller automatically interleaves all PWM outputs assigned to a given output at even intervals. Each PWM signal is connected to one MAX20790 smart power-stage device, and each power stage is capable of supplying up to 45A with good air-cooling conditions. Every two power stages are connected to a 2-phase coupled inductor. Unused phases can be disabled by shorting the corresponding PWM pin to GND, allowing a single electrical design to be used for multiple applications with different output currents. A common PCB layout can be used with phases left unpopulated for lower output currents. The TSENSE and ISENSE pins for unused phases must be left unconnected.

The MAX16602 controller implements an orthogonal current rebalancing feature to provide active and dynamic current sharing between different phase currents. This

feature maintains current balance during load transients, even at load frequencies close to the VR switching frequency and its harmonics. The controller also allows autonomous phase-shedding control of the number of active phases to maximize the efficiency of the regulator and improve the transient response performance. The MAX16602 integrates all of the control-loop components that were previously externally mounted. The following V<sub>CORE</sub> regulator parameters are digitally selected:

- Switching frequency (300kHz to 857kHz)
- Load-line (0.105mΩ to 0.979mΩ). Refer to Table 6 in the MAX16602 data sheet for details on range and steps.
- System OCP (30A to 695A). Refer to Table 7 in the MAX16602 data sheet for details.
- APS fast and slow thresholds
- Modulator ramp rate (0.4V/μs to 1.9V/μs, 0.1V/μs LSB)
- AMS ramp rate (0.125V/μs to 1.0625V/μs, 0.0625V/μs LSB)
- Current-loop zero (8.4kHz to 45.5kHz)
- Voltage-loop zero (9.6kHz to 159.2kHz, no-droop configuration only)
- R<sub>P</sub> (195Ω to 3770Ω, 65Ω LSB lower range to 162.5Ω LSB upper range)
- R<sub>OCR</sub> (1.5kΩ to 17kΩ, 500Ω LSB)

**Table 1. Bias Power Supply Shunt/Connector**

| SHUNT/CONNECTOR | SHUNT POSITION                            | DESCRIPTION                                 |
|-----------------|-------------------------------------------|---------------------------------------------|
| J19             | Installed                                 | Enable on-board 3.3V LDO                    |
| J29             | Installed                                 | Enable on-board 1V LDO                      |
| J22, J23        | J22 connects to 3.3V, J23 connects to GND | Connect external 3.3V power supply          |
| J24, J25        | J24 connects to 1.8V, J25 connects to GND | Connect external 1.8V power supply          |
| J3, J26         | 1-2 pins                                  | Connect external 1.8V power supply          |
|                 | 3-4 pins                                  | Connect the MAX16602 integrated 1.8V output |
|                 | 5-6 pins                                  | Connect 1.8V LDO output                     |

## Ordering Information

| PART              | TYPE   |
|-------------------|--------|
| MAX16602CL8EVKIT# | EV Kit |

#Denotes RoHS compliance.



# MAX16602CL8 Evaluation Kit

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## MAX16602CL8 EV Kit Bill of Materials

| ITEM | REF_DES                                                                                                                                                                                                                | DN/<br>DNP | QTY | MFG PART #                                                                                                | MANUFACTURER                                             | VALUE   | DESCRIPTION                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---------|-----------------------------------------------------------------------------------------------|
| 1    | C1, C2, C14-C16, C20, C33, C41, C255, C332, C368, C372, C813, C814, C819, C820                                                                                                                                         | -          | 16  | GRM155R71E104KE14;<br>C1005X7R1E104K050BB;<br>TMK105B7104KVH;<br>CGJ2B3X7R1E104K050BB                     | MURATA; TDK; TAIYO YUDEN; TDK                            | 0.1UF   | CAP; SMT (0402); 0.1UF; 10%; 25V; X7R; CERAMIC                                                |
| 2    | C3-C5, C9, C49, C53, C55, C89-C91, C347-C352, C354-C358, C411-C413, C453-C455, C483, C484, C511, C512, C589, C835                                                                                                      | -          | 33  | C0402C105K8PAC;<br>CC0402KRX5R6BB105                                                                      | KEMET; YAGEO                                             | 1UF     | CAP; SMT (0402); 1UF; 10%; 10V; X5R; CERAMIC                                                  |
| 3    | C6, C8, C364, C365, C370, C373                                                                                                                                                                                         | -          | 6   | C0805C226M9PAC;<br>GRM21BR60J226ME39;<br>JMK212BJ226MG;<br>CL21A226MQCLQN;<br>885012107005                | KEMET; MURATA; TAIYO YUDEN; SAMSUNG EL; WURTH ELECTRONIK | 22UF    | CAP; SMT (0805); 22UF; 20%; 6.3V; X5R; CERAMIC                                                |
| 4    | C7, C22-C24, C26-C28, C62-C64, C66-C68, C374-C378, C380, C429-C434, C467-C470, C495-C498                                                                                                                               | -          | 33  | C1608X5R1E106M080AC;<br>CL10A106MA8NRNC;<br>GRM188R61E106MA73;<br>ZRB18AR61E106ME01;<br>GRT188R61E106ME13 | TDK; SAMSUNG ELECTRONICS; MURATA; MURATA                 | 10UF    | CAP; SMT (0603); 10UF; 20%; 25V; X5R; CERAMIC                                                 |
| 5    | C17, C18, C21, C25, C802, C803, C809, C810, C833, C834                                                                                                                                                                 | -          | 10  | C0402C0G500-100KNP                                                                                        | VENKEL LTD.                                              | 10PF    | CAP; SMT (0402); 10PF; 10%; 50V; C0G; CERAMIC                                                 |
| 6    | C19, C29-C32, C34-C36, C70-C72, C74-C76, C259, C381-C383, C385, C389, C392, C435-C440, C471-C474, C499-C502, C811, C812                                                                                                | -          | 37  | GMK107BJ105KA;<br>C1608X5R1V105K080AB                                                                     | TAIYO YUDEN; TDK                                         | 1.0UF   | CAP; SMT (0603); 1.0UF; 10%; 35V; X5R; CERAMIC                                                |
| 7    | C38-C40, C42-C44, C78-C80, C82-C84, C326-C331, C396, C400-C406, C408, C441-C448, C450, C475-C480, C503-C508                                                                                                            | -          | 48  | GRM155R71E472KA01                                                                                         | MURATA                                                   | 4700PF  | CAP; SMT (0402); 4700PF; 10%; 25V; X7R; CERAMIC                                               |
| 8    | C46-C48, C86-C88, C407, C409, C410, C449, C451, C452, C481, C482, C509, C510                                                                                                                                           | -          | 16  | C1005X5R1E474K050;<br>GRT155R61E474KE01                                                                   | TDK; MURATA                                              | 0.47UF  | CAP; SMT (0402); 0.47UF; 10%; 25V; X5R; CERAMIC                                               |
| 9    | C51, C57-C61, C65, C69, C73, C77, C81, C85, C92, C93, C99-C109, C112, C115, C116, C118, C119, C122-C125, C128-C134, C137-C140, C143-C206, C219-C239, C241-C253, C262-C325, C333-C338, C340, C379, C516-C588, C590-C801 | -          | 500 | GRM158C80G226ME01                                                                                         | MURATA                                                   | 22UF    | CAP; SMT (0402); 22UF; 20%; 4V; X6S; CERAMIC ;                                                |
| 10   | C52, C54, C56, C94-C96, C414-C416, C456-C458, C485, C486, C513, C514                                                                                                                                                   | -          | 16  | C1005X5R1C684K050                                                                                         | TDK                                                      | 0.68UF  | CAP; SMT (0402); 0.68UF; 10%; 16V; X5R; CERAMIC                                               |
| 11   | C97, C127, C136, C806, C821-C824                                                                                                                                                                                       | -          | 8   | GRM32ER60J227ME05                                                                                         | MURATA                                                   | 220UF   | CAP; SMT (1210); 220UF; 20%; 6.3V; X5R; CERAMIC                                               |
| 12   | C113, C114, C117, C240, C256                                                                                                                                                                                           | -          | 5   | APXG200ARA391MJ80G                                                                                        | UNITED CHEMI-CON                                         | 390UF   | CAP; SMT (CASE_J80); 390UF; 20%; 20V; CONDUCTIVE POLYMER                                      |
| 13   | C207-C218, C339, C341-C345, C417-C422, C459-C462, C487-C490                                                                                                                                                            | -          | 32  | C3216X5R1E226M160AB                                                                                       | TDK                                                      | 22UF    | CAP; SMT (1206); 22UF; 20%; 25V; X5R; CERAMIC                                                 |
| 14   | C254                                                                                                                                                                                                                   | -          | 1   | C1005X7R1E473K050BC;<br>GRM155R71E473K;<br>GCM155R71E473KA55                                              | TDK; MURATA; MURATA                                      | 0.047UF | CAP; SMT (0402); 0.047UF; 10%; 25V; X7R; CERAMIC                                              |
| 15   | C257, C361, C362                                                                                                                                                                                                       | -          | 3   | ECA-1EM331                                                                                                | PANASONIC                                                | 330UF   | CAP; THROUGH HOLE-RADIAL LEAD; 330UF; 20%; 25V; ALUMINUM-ELECTROLYTIC                         |
| 16   | C258, C260, C261                                                                                                                                                                                                       | -          | 3   | C3216X5R1E106M085                                                                                         | TDK                                                      | 10UF    | CAP; SMT (1206); 10UF; 20%; 25V; X5R; CERAMIC                                                 |
| 17   | C346, C359, C360, C363, C366, C367, C369, C371, C384, C386-C388, C390, C391, C393-C395, C397-C399, C423-C428, C463-C466, C491-C494                                                                                     | -          | 34  | TMK212BBJ106KG;<br>CL21A106KAFN3N                                                                         | TAIYO YUDEN; SAMSUNG ELECTRO-MECHAN                      | 10UF    | CAPACITOR; SMT (0805); CERAMIC; 10UF; 25V; TOL=10%; MODEL=; TG=-55 DEGC TO +85 DEGC; TC=X5R ; |
| 18   | C353                                                                                                                                                                                                                   | -          | 1   | C0402C102K5GAC                                                                                            | KEMET                                                    | 1000PF  | CAP; SMT (0402); 1000PF; 10%; 50V; C0G; CERAMIC                                               |

# MAX16602CL8 Evaluation Kit

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## MAX16602CL8 EV Kit Bill of Materials (continued)

| ITEM | REF_DES                                     | DN/<br>DNP | QTY | MFG PART #                                              | MANUFACTURER                    | VALUE          | DESCRIPTION                                                                                                                           |
|------|---------------------------------------------|------------|-----|---------------------------------------------------------|---------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------|
| 19   | C804                                        | -          | 1   | C0402C121J5GAC;<br>GCM1555C1H121JA16;<br>UMK105CG121JVH | KEMET; MURATA; TAIYO<br>YUDEN   | 120PF          | CAP; SMT (0402); 120PF; 5%; 50V; COG; CERAMIC                                                                                         |
| 20   | D1                                          | -          | 1   | BZX84C3V9-7                                             | DIODES INCORPORATED             | 3.9V           | DIODE; ZNR; SMT (SOT-23); Vz=3.9V; Iz=0.005A                                                                                          |
| 21   | D2                                          | -          | 1   | BZX84C2V7LT1G                                           | ON SEMICONDUCTOR                | 2.7V           | DIODE; ZNR; SMT (SOT-23); Vz=2.7V; Iz=0.01A;<br>PD=0.225W                                                                             |
| 22   | D3                                          | -          | 1   | 1N5250B                                                 | FAIRCHILD<br>SEMICONDUCTOR      | 20V            | DIODE, ZENER, DO-35, Pd=0.5W, Vz=20V@Iz=6.2mA                                                                                         |
| 23   | DS1-DS3, DS7                                | -          | 4   | HSMH-C650                                               | AVAGO TECHNOLOGIES              | HSMH-C650      | DIODE; LED; STANDARD; TINTED DIFFUSED; RED; SMT<br>(1206); PIV=1.8V; IF=0.025A                                                        |
| 24   | DS4, DS8                                    | -          | 2   | HSMG-C650                                               | AVAGO TECHNOLOGIES              | HSMG-C650      | DIODE; LED; STANDARD; TINTED DIFFUSED; GREEN;<br>SMT (1206); PIV=2.2V; IF=0.025A                                                      |
| 25   | J1, J3, J5, J6, J12, J14, J26, J30          | -          | 8   | TSW-103-07-L-D                                          | SAMTEC                          | TSW-103-07-L-D | CONNECTOR; MALE; THROUGH HOLE; THROUGH HOLE<br>0.025 POST HEADER; STRAIGHT; 6PINS                                                     |
| 26   | J2, J19, J29                                | -          | 3   | TSW-101-07-L-D                                          | SAMTEC                          | TSW-101-07-L-D | CONNECTOR; MALE; THROUGH HOLE; TSW SERIES;<br>DOUBLE ROW; STRAIGHT; 2PINS                                                             |
| 27   | J4                                          | -          | 1   | TSW-101-22-L-D                                          | SAMTEC                          | TSW-101-22-L-D | CONNECTOR; MALE; THROUGH HOLE; .025IN SQ POST<br>HEADER; STRAIGHT; 2PINS                                                              |
| 28   | J7                                          | -          | 1   | 22-28-4043                                              | MOLEX                           | 22-28-4043     | CONNECTOR; MALE; THROUGH HOLE; FLAT VERTICAL<br>BREAKAWAY; STRAIGHT; 4PINS                                                            |
| 29   | J9, J16, J18                                | -          | 3   | PBC09DAAN                                               | SULLINS ELECTRONICS<br>CORP.    | PBC09DAAN      | CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY;<br>STRAIGHT; 18PINS                                                                         |
| 30   | J11, J13, J21, J23, J25                     | -          | 5   | BP30B                                                   | SUPERIOR ELECTRIC               | BP30B          | CONNECTOR; FEMALE; PANELMOUNT; BLACK<br>STANDARD SINGLE 5-WAY BINDING POST; STRAIGHT;<br>1PIN                                         |
| 31   | J15                                         | -          | 1   | TSW-105-07-L-D                                          | SAMTEC                          | TSW-105-07-L-D | CONNECTOR; THROUGH HOLE; DOUBLE ROW;<br>STRAIGHT; 10PINS                                                                              |
| 32   | J17                                         | -          | 1   | AWHW16G-0202-T                                          | ASSMANN                         | AWHW16G-0202-T | CONNECTOR; MALE; THROUGH HOLE; BOXHEADER-<br>LOW PROFILE; STRAIGHT; 16PINS                                                            |
| 33   | J20, J22, J24                               | -          | 3   | BP30R                                                   | SUPERIOR ELECTRIC               | BP30R          | CONNECTOR; FEMALE; PANELMOUNT; RED<br>STANDARD SINGLE 5-WAY BINDING POST; STRAIGHT;<br>1PIN                                           |
| 34   | J27                                         | -          | 1   | PEC06SAAN                                               | SULLINS ELECTRONICS<br>CORP.    | PEC06SAAN      | CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY;<br>STRAIGHT; 6PINS                                                                          |
| 35   | J28, J41-J43                                | -          | 4   | TSW-101-07-L-S                                          | SAMTEC                          | TSW-101-07-L-S | CONNECTOR; MALE; THROUGH HOLE; TSW SERIES;<br>STRAIGHT; 1PIN                                                                          |
| 36   | JMP1, JMP3, JMP4, JMP6-JMP8,<br>JMP13-JMP22 | -          | 16  | B2A PCB                                                 | INTERNATIONAL<br>HYDRAULICS INC | B2A PCB        | TEST POINT; CONNECTOR BUSS STAPLE; STR; TOTAL<br>LENGTH=0.565; TIN; BODY = BRASS COPPER; TIN<br>PLATED                                |
| 37   | L1                                          | -          | 1   | DFE201610E-1R5M=P2                                      | MURATA                          | 1.5UH          | INDUCTOR; SMT (0806); MAGNETICALLY SHIELDED;<br>1.5UH; TOL=+/-20%; 2.1A                                                               |
| 38   | L6, L8                                      | -          | 4   | CTX17-18913-R                                           | EATON                           | CTX17-18913-R  | INDUCTOR; SMT; FERRITE CORE; 100NH; TOL=+/-20%;<br>90A                                                                                |
| 39   | MISC1                                       | -          | 1   | AFB0512VHD                                              | DELTA ELECTRONICS, INC          | AFB0512VHD     | FAN; PANELMOUNT 50MM X 50MM X 20MM; 12V                                                                                               |
| 40   | Q1, Q4, Q11, Q14                            | -          | 4   | BSS138                                                  | ON SEMICONDUCTOR                | BSS138         | TRAN; LOGIC LEVEL ENHANCEMENT MODE FIELD<br>EFFECT TRANSISTOR; NCH; SOT-23; PD-(0.36W); I-<br>(0.22A); V-(50V); -55 DEGC TO +150 DEGC |
| 41   | Q2, Q3, Q5-Q10                              | -          | 8   | PSMN2R0-30YLE                                           | NEXPERIA                        | PSMN2R0-30YLE  | TRAN; NCH; 2 MILLI-OHM LOGIC LEVEL MOSFET;<br>LFPK; PD-(272W); I-(100A); V-(30V)                                                      |
| 42   | Q13                                         | -          | 1   | FDV304P                                                 | FAIRCHILD<br>SEMICONDUCTOR      | FDV304P        | TRAN; P-CHANNEL; DIGITAL FET; PCH; SOT-23 ; PD-(-); I-<br>(-0.46A); V-(-25V)                                                          |
| 43   | R1                                          | -          | 1   | CRCW04024R70FK                                          | VISHAY DALE                     | 4.7            | RES; SMT (0402); 4.7; 1%; +/-100PPM/DEGC; 0.0630W                                                                                     |
| 44   | R2                                          | -          | 1   | ERJ-2RKF2371                                            | PANASONIC                       | 2.37K          | RES; SMT (0402); 2.37K; 1%; +/-100PPM/DEGC; 0.1000W                                                                                   |

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Evaluates: MAX16602 and MAX20790

## MAX16602CL8 EV Kit Bill of Materials (continued)

| ITEM | REF_DES                                                                                                                                                                                                                                      | DNI/<br>DNP | QTY | MFG PART #                                      | MANUFACTURER                            | VALUE | DESCRIPTION                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----|-------------------------------------------------|-----------------------------------------|-------|-------------------------------------------------------|
| 45   | R3                                                                                                                                                                                                                                           | -           | 1   | ERJ-2RKF1781                                    | PANASONIC                               | 1.78K | RES; SMT (0402); 1.78K; 1%; +/-100PPM/DEGC; 0.1000W   |
| 46   | R4, R5, R16-R19, R23-R29, R32, R34-R36, R38, R39, R43, R54, R55, R61-R63, R83, R84, R95-R100, R125-R129, R131, R132, R144, R145, R148, R153, R154, R156, R157, R160-R163, R166, R167, R169, R190-R197, R201-R204, R206, R222-R225, R237-R260 | -           | 95  | ERJ-2GE0R00                                     | PANASONIC                               | 0     | RES; SMT (0402); 0; JUMPER; JUMPER; 0.1000W           |
| 47   | R8-R13, R46, R49                                                                                                                                                                                                                             | -           | 8   | 9C04021A1000FL; RC0402FR-07100RL                | PANASONIC; YAGEO<br>PHYCOMP             | 100   | RES; SMT (0402); 100; 1%; +/-100PPM/DEGC; 0.0630W     |
| 48   | R30, R37, R67, R72-R77, R80, R81, R87, R92-R94, R123, R124, R130, R168, R170, R176-R184, R207-R217                                                                                                                                           | -           | 40  | ERJ-2RKF2001; ERJ-S02F2001                      | PANASONIC; PANASONIC                    | 2K    | RES; SMT (0402); 2K; 1%; +/-100PPM/DEGC; 0.1000W      |
| 49   | R33, R139                                                                                                                                                                                                                                    | -           | 2   | CRCW04022R0FK;<br>CRCW04022R00FK                | VISHAY DALE; VISHAY<br>DALE             | 2     | RES; SMT (0402); 2; 1%; +/-100PPM/DEGC; 0.0630W       |
| 50   | R60, R136, R152                                                                                                                                                                                                                              | -           | 3   | ERJ-2RKF10R0                                    | PANASONIC                               | 10    | RES; SMT (0402); 10; 1%; +/-100PPM/DEGC; 0.1000W      |
| 51   | R64, R65, R88-R91, R174, R175                                                                                                                                                                                                                | -           | 8   | WSHP28184L000F                                  | VISHAY                                  | 0.004 | RES; SMT (2818); 0.004; 1%; +/-200PPM/DEGC; 10W       |
| 52   | R68                                                                                                                                                                                                                                          | -           | 1   | WSL25123L000F                                   | VISHAY DALE                             | 0.003 | RES; SMT (2512); 0.003; 1%; +/-150PPM/DEGC; 1W        |
| 53   | R69                                                                                                                                                                                                                                          | -           | 1   | ERA-2ARB4751                                    | PANASONIC                               | 4.75K | RES; SMT (0402); 4.75K; 0.10%; +/-10PPM/DEGC; 0.0630W |
| 54   | R6, R7, R15, R20, R21, R31, R47, R48, R51, R53, R56-R59, R78, R79, R199, R200, R70, R71                                                                                                                                                      | -           | 20  | ERJ-2RKF1001                                    | PANASONIC                               | 1K    | RES; SMT (0402); 1K; 1%; +/-100PPM/DEGC; 0.1000W      |
| 55   | R82, R107, R108, R111, R112, R138                                                                                                                                                                                                            | -           | 6   | CRCW0603280R0FK; ERJ-3EKF2800                   | VISHAY DALE; PANASONIC                  | 280   | RES; SMT (0603); 280; 1%; +/-100PPM/DEGC; 0.1000W     |
| 56   | R85, R109                                                                                                                                                                                                                                    | -           | 2   | CRCW040220K0FK                                  | VISHAY DALE                             | 20K   | RES; SMT (0402); 20K; 1%; +/-100PPM/DEGC; 0.0630W     |
| 57   | R86, R114, R119, R158, R185, R187, R188, R226, R261, R268, R269                                                                                                                                                                              | -           | 11  | ERJ-2RKF1002                                    | PANASONIC                               | 10K   | RES; SMT (0402); 10K; 1%; +/-100PPM/DEGC; 0.1000W     |
| 58   | R101, R103, R105                                                                                                                                                                                                                             | -           | 3   | CRCW04022K10FK                                  | VISHAY DALE                             | 2.1K  | RES; SMT (0402); 2.1K; 1%; +/-100PPM/DEGC; 0.0630W    |
| 59   | R102, R104, R106                                                                                                                                                                                                                             | -           | 3   | ERJ-2RKF49R9                                    | PANASONIC                               | 49.9  | RES; SMT (0402); 49.9; 1%; +/-100PPM/DEGC; 0.1000W    |
| 60   | R110, R122                                                                                                                                                                                                                                   | -           | 2   | CRCW0603100R0FK; ERJ-3EKF1000; RC0603FR-07100RL | VISHAY DALE; PANASONIC                  | 100   | RES; SMT (0603); 100; 1%; +/-100PPM/DEGC; 0.1000W     |
| 61   | R113, R118                                                                                                                                                                                                                                   | -           | 2   | ERJ-2RKF1003                                    | PANASONIC                               | 100K  | RES; SMT (0402); 100K; 1%; +/-100PPM/DEGC; 0.1000W    |
| 62   | R115, R135, R171-R173                                                                                                                                                                                                                        | -           | 5   | LRC-LR2512LF-01-R250F                           | TT ELECTRONICS                          | 0.25  | RES; SMT (2512); 0.25; 1%; +/-100PPM/DEGC; 2W         |
| 63   | R116                                                                                                                                                                                                                                         | -           | 1   | CRCW0402453R0FK                                 | VISHAY DALE                             | 453   | RES; SMT (0402); 453; 1%; +/-100PPM/DEGC; 0.0630W     |
| 64   | R117, R121                                                                                                                                                                                                                                   | -           | 2   | CR0402-16W-6040FT;<br>CRCW0402604R0FK           | VENKEL LTD.; VISHAY DALE                | 604   | RES; SMT (0402); 604; 1%; +/-100PPM/DEGC; 0.0630W     |
| 65   | R120                                                                                                                                                                                                                                         | -           | 1   | CRCW04021K50FK                                  | VISHAY DALE                             | 1.5K  | RES; SMT (0402); 1.5K; 1%; +/-100PPM/DEGC; 0.0630W    |
| 66   | R134                                                                                                                                                                                                                                         | -           | 1   | ERA-2AEB1962                                    | PANASONIC                               | 19.6K | RES; SMT (0402); 19.6K; 0.10%; +/-25PPM/DEGC; 0.0630W |
| 67   | R137                                                                                                                                                                                                                                         | -           | 1   | ERA-2AEB3740                                    | PANASONIC                               | 374   | RES; SMT (0402); 374; 0.10%; +/-25PPM/DEGC; 0.0630W   |
| 68   | R142                                                                                                                                                                                                                                         | -           | 1   | CR0402-16W-12R7FT                               | VENKEL LTD.                             | 12.7  | RES; SMT (0402); 12.7; 1%; +/-100PPM/DEGC; 0.0630W    |
| 69   | R146, R264                                                                                                                                                                                                                                   | -           | 2   | RG1608P-101-B; ERA-3YEB101;<br>ERA-3AEB101      | SUSUMU CO LTD.;<br>PANASONIC; PANASONIC | 100   | RES; SMT (0603); 100; 0.10%; +/-25PPM/DEGC; 0.1000W   |
| 70   | R151                                                                                                                                                                                                                                         | -           | 1   | ERA-2ARB6650                                    | PANASONIC                               | 665   | RES; SMT (0402); 665; 0.10%; +/-10PPM/DEGC; 0.0630W   |



# MAX16602CL8 Evaluation Kit

Evaluates: MAX16602 and MAX20790

## MAX16602CL8 EV Kit Bill of Materials (continued)

| ITEM | REF_DES                                                             | DNI/<br>DNP | QTY | MFG PART #                                                                   | MANUFACTURER                            | VALUE         | DESCRIPTION                                                                                                                                                                                             |
|------|---------------------------------------------------------------------|-------------|-----|------------------------------------------------------------------------------|-----------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 71   | R155                                                                | -           | 1   | ERJ-2RK7153                                                                  | PANASONIC                               | 715K          | RES; SMT (0402); 715K; 1%; +/-100PPM/DEGC; 0.1000W                                                                                                                                                      |
| 72   | R159                                                                | -           | 1   | CRCW040214K3FK                                                               | VISHAY DALE                             | 14.3K         | RES; SMT (0402); 14.3K; 1%; +/-100PPM/DEGC; 0.0630W                                                                                                                                                     |
| 73   | R164                                                                | -           | 1   | CRCW040284K5FK                                                               | VISHAY DALE                             | 84.5K         | RES; SMT (0402); 84.5K; 1%; +/-100PPM/DEGC; 0.0630W                                                                                                                                                     |
| 74   | R165                                                                | -           | 1   | CRCW040231K6FK                                                               | VISHAY DALE                             | 31.6K         | RES; SMT (0402); 31.6K; 1%; +/-100PPM/DEGC; 0.0630W                                                                                                                                                     |
| 75   | R186                                                                | -           | 1   | CRCW04021K30FK                                                               | VISHAY DALE                             | 1.3K          | RES; SMT (0402); 1.3K; 1%; +/-100PPM/DEGC; 0.0630W                                                                                                                                                      |
| 76   | R189                                                                | -           | 1   | CRCW040253R6FK; CR0402-16W-53R                                               | VISHAY DALE; VENKEL LTD.                | 53.6          | RES; SMT (0402); 53.6; 1%; +/-100PPM/DEGC; 0.0630W                                                                                                                                                      |
| 77   | R205                                                                | -           | 1   | CRCW04021K00FK; RC0402FR-071KL; MCR01MZPF1001                                | VISHAY DALE; YAGEO PHICOMP; ROHM SEMI   | 1K            | RES; SMT (0402); 1K; 1%; +/-100PPM/DEGC; 0.0630W                                                                                                                                                        |
| 78   | R227-R234                                                           | -           | 8   | ERJ-2GEJ104                                                                  | PANASONIC                               | 100K          | RES; SMT (0402); 100K; 5%; +/-200PPM/DEGC; 0.1000W                                                                                                                                                      |
| 79   | R235, R236                                                          | -           | 2   | RCC-0402PW5R00J                                                              | INTERNATIONAL MANUFACTURING SERVICE     | 5             | RES; SMT (0402); 5; 5%; +/-100PPM/DEGC; 0.0630W                                                                                                                                                         |
| 80   | R267                                                                | -           | 1   | CRCW040212K0FK; MCR01MZPF1202                                                | VISHAY DALE; ROHM SEMICONDUCTOR         | 12K           | RES; SMT (0402); 12K; 1%; +/-100PPM/DEGC; 0.0630W                                                                                                                                                       |
| 81   | SU1-SU5                                                             | -           | 5   | S1100-B; SX1100-B; STC02SYAN                                                 | KYCON; KYCON; SULLINS ELECTRONICS CORP. | SX1100-B      | TEST POINT; JUMPER; STR; TOTAL LENGTH=0.24IN; BLACK; INSULATION=PBT; PHOSPHOR BRONZE CONTACT=GOLD PLATED                                                                                                |
| 82   | SW1, SW2                                                            | -           | 2   | GT21MCBE                                                                     | C&K COMPONENTS                          | GT21MCBE      | SWITCH; DPDT; THROUGH HOLE; 20V; 0.4VA; GT SERIES; SEALED ULTRAMINIATURE TOGGLE SWITCH; RCOIL= 0.05 OHM; RINSULATION=10G OHM; C&K COMPONENTS                                                            |
| 83   | U1, U2                                                              | -           | 2   | MAX15103EWL+                                                                 | MAXIM                                   | MAX15103EWL   | IC; VREG; SMALL 3A, LOW-DROPOUT LINEAR REGULATOR; WLP15                                                                                                                                                 |
| 84   | U4-U9, U19, U20                                                     | -           | 8   | MAX20790                                                                     | MAXIM                                   | MAX20790      | EVKIT PART - IC; MAX20790; SMART POWER-STAGE IC WITH INTEGRATED CURRENT AND TEMPERATURE SENSORS; PACKAGE OUTLINE DRAWING: 21-100261; LAND PATTERN DRAWING: 90-100099; PACKAGE CODE: F123A7F+1; FC2QFN12 |
| 85   | U12                                                                 | -           | 1   | MAX16602                                                                     | MAXIM                                   | MAX16602      | EVKIT PART-IC; VREG; MAX16602; TQFN56-EP                                                                                                                                                                |
| 86   | U13                                                                 | -           | 1   | MAX40010LAUT+                                                                | MAXIM                                   | MAX40010LAUT+ | IC; AMP; 76V PRECISION; HIGH-VOLTAGE; CURRENT-SENSE AMPLIFIER; GAIN=12.5V/V; SOT23-6                                                                                                                    |
| 87   | U21                                                                 | -           | 1   | MAXM17575ALI#                                                                | MAXIM                                   | MAXM17575ALI# | IC; PWRMOD; 4.5V TO 60V; 1.5A HIGH-EFFICIENCY; DC-DC STEP-DOWN POWER MODULE WITH INTEGRATED INDUCTOR; LGA28-3EP                                                                                         |
| 88   | U22, U23, U25, U31                                                  | -           | 4   | MAX9651AUA+                                                                  | MAXIM                                   | MAX9651AUA+   | IC; OPAMP; HIGH-CURRENT VCOM DRIVE OP AMP FOR TFT LCD; UMAX8-EP                                                                                                                                         |
| 89   | U24                                                                 | -           | 1   | MAX9141EKA+                                                                  | MAXIM                                   | MAX9141EKA+   | IC; COMP; 40NS, LOW-POWER, 3V/5V, RAIL-TO-RAIL SINGLE-SUPPLY COMPARATOR; SOT23-8                                                                                                                        |
| 90   | U26                                                                 | -           | 1   | LT1806CS6#PBF                                                                | ANALOG DEVICES                          | LT1806CS6#PBF | IC; OPAMP; 325MHZ; SINGLE; RAIL-TO-RAIL INPUT AND OUTPUT; LOW DISTORTION; LOW NOISE PRECISION OPERATIONAL AMPLIFIER; TSOT23-6                                                                           |
| 91   | PCB                                                                 | -           | 1   | MAX16600_FAB900557_01_00_APPS_P1                                             | MAXIM                                   | PCB           | PCB; MAX16600_FAB900557_01_00_APPS_P1                                                                                                                                                                   |
| 92   | C10-C13, C37, C120, C121, C515, C815-C818                           | DNP         | 0   | GRM155R71E104KE14; C1005X7R1E104K050BB; TMK105B7104KVH; CGJ2B3X7R1E104K050BB | MURATA; TDK; TAIYO YUDEN; TDK           | 0.1UF         | CAP; SMT (0402); 0.1UF; 10%; 25V; X7R; CERAMIC                                                                                                                                                          |
| 93   | C45, C50, C98, C110, C111, C126, C135, C141, C142, C805, C807, C808 | DNP         | 0   | EEF-GX0D561L                                                                 | PANASONIC                               | 560UF         | CAP; SMT (7343-20); 560UF; 20%; 2V; ALUMINUM-ELECTROLYTIC                                                                                                                                               |

# MAX16602CL8 Evaluation Kit

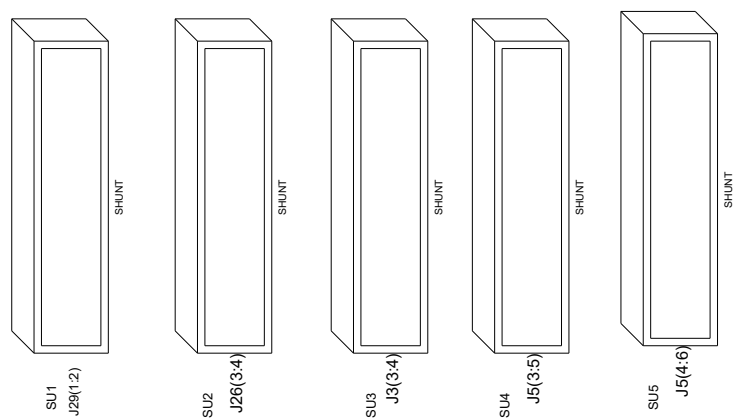
Evaluates: MAX16602 and MAX20790

## MAX16602CL8 EV Kit Bill of Materials (continued)

| ITEM  | REF_DES                                                       | DNI/<br>DNP | QTY  | MFG PART #                                 | MANUFACTURER                         | VALUE            | DESCRIPTION                                                                                                                                                                                             |
|-------|---------------------------------------------------------------|-------------|------|--------------------------------------------|--------------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 94    | C825-C832                                                     | DNP         | 0    | GRM1555C1E101GA01                          | MURATA                               | 100PF            | CAP; SMT (0402); 100PF; 2%; 25V; C0G; CERAMIC                                                                                                                                                           |
| 95    | J33-J38                                                       | DNP         | 0    | 5146800-1                                  | TE CONNECTIVITY                      | 5146800-1        | CONNECTOR; FEMALE; THROUGH HOLE; KEYLESS INSERT ASSEMBLY; RIGHT ANGLE; 5PINS                                                                                                                            |
| 96    | L2, L4                                                        | DNP         | 0    | CLB1108-4-50TR-R                           | COOPER BUSSMANN                      | CLB1108-4-50TR-R | INDUCTOR; SMT; FERRITE CORE; 50NH; TOL=+/-20%; 25A                                                                                                                                                      |
| 97    | Q12                                                           | DNP         | 0    | BSS138                                     | ON SEMICONDUCTOR                     | BSS138           | TRAN; LOGIC LEVEL ENHANCEMENT MODE FIELD EFFECT TRANSISTOR; NCH; SOT-23; PD-(0.36W); I-(0.22A); V-(50V); -55 DEGC TO +150 DEGC                                                                          |
| 98    | R14, R22, R40-R42, R44, R45, R50, R52, R143, R147, R149, R150 | DNP         | 0    | ERJ-2GE0R00                                | PANASONIC                            | 0                | RES; SMT (0402); 0; JUMPER; JUMPER; 0.1000W                                                                                                                                                             |
| 99    | R66, R133, R140, R141, R218-R221                              | DNP         | 0    | CRCW04022R0FK;<br>CRCW04022R00FK           | VISHAY DALE; VISHAY DALE             | 2                | RES; SMT (0402); 2; 1%; +/-100PPM/DEGC; 0.0630W                                                                                                                                                         |
| 100   | R198, R275-R281                                               | DNP         | 0    | CRCW0402200KFK;<br>RF73H1ELTP2003          | VISHAY DALE; KOA SPEER ELECTRONICS   | 200K             | RES; SMT (0402); 200K; 1%; +/-100PPM/DEGC; 0.0630W                                                                                                                                                      |
| 101   | R262, R263                                                    | DNP         | 0    | ERJ-2RKf1001                               | PANASONIC                            | 1K               | RES; SMT (0402); 1K; 1%; +/-100PPM/DEGC; 0.1000W                                                                                                                                                        |
| 102   | R265, R266                                                    | DNP         | 0    | RG1608P-101-B; ERA-3YEB101;<br>ERA-3AEB101 | SUSUMU CO LTD.; PANASONIC; PANASONIC | 100              | RES; SMT (0603); 100; 0.10%; +/-25PPM/DEGC; 0.1000W                                                                                                                                                     |
| 103   | U3, U10, U11, U14-U18                                         | DNP         | 0    | MAX20790                                   | MAXIM                                | MAX20790         | EVKIT PART - IC; MAX20790; SMART POWER-STAGE IC WITH INTEGRATED CURRENT AND TEMPERATURE SENSORS; PACKAGE OUTLINE DRAWING: 21-100261; LAND PATTERN DRAWING: 90-100099; PACKAGE CODE: F123A7F+1; FC2QFN12 |
| TOTAL |                                                               |             | 1148 |                                            |                                      |                  |                                                                                                                                                                                                         |

## MAX16602CL8 EV Kit Schematic Diagrams

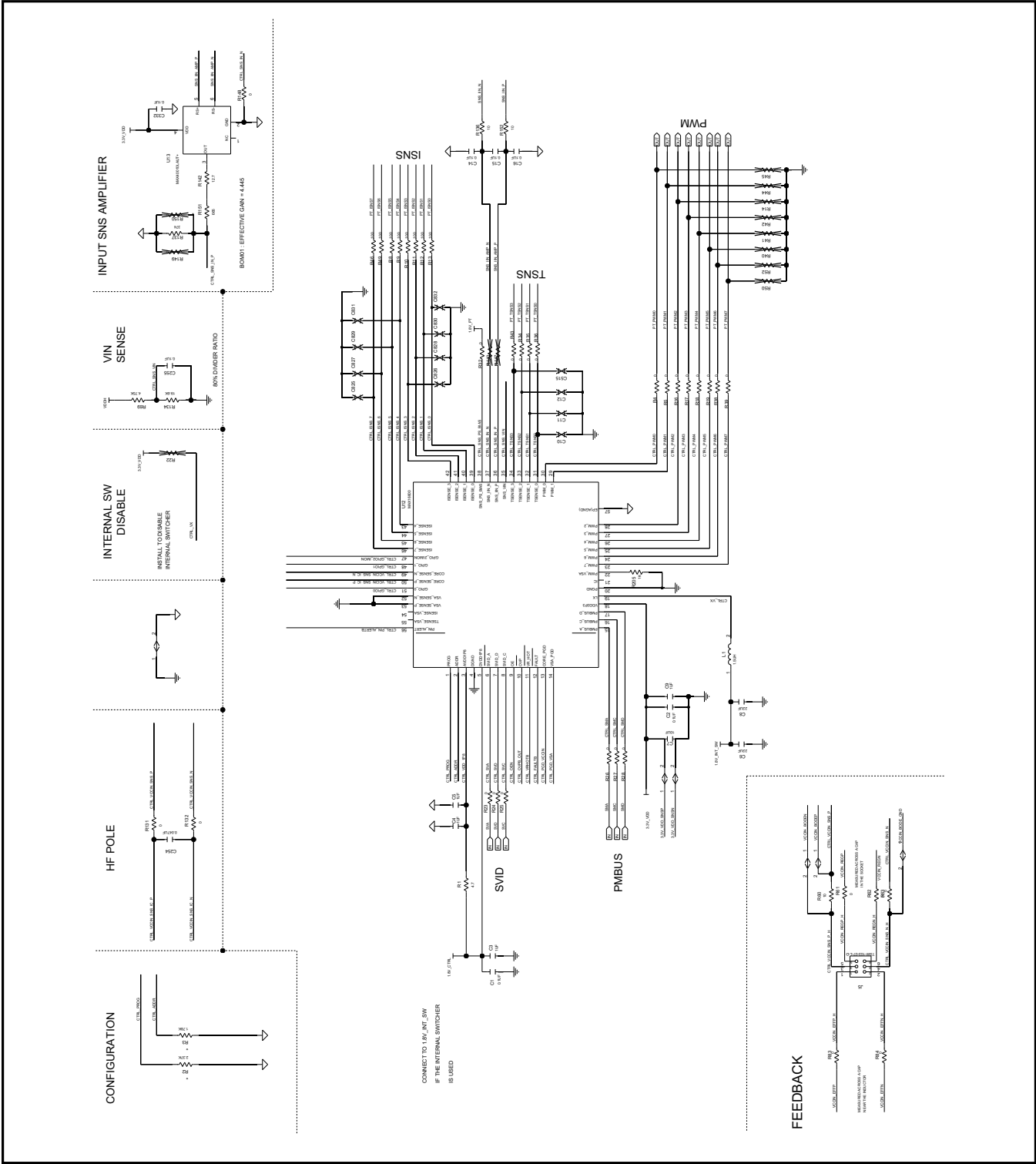
# MECHANICAL



MAX16602CL8  
Evaluation Kit

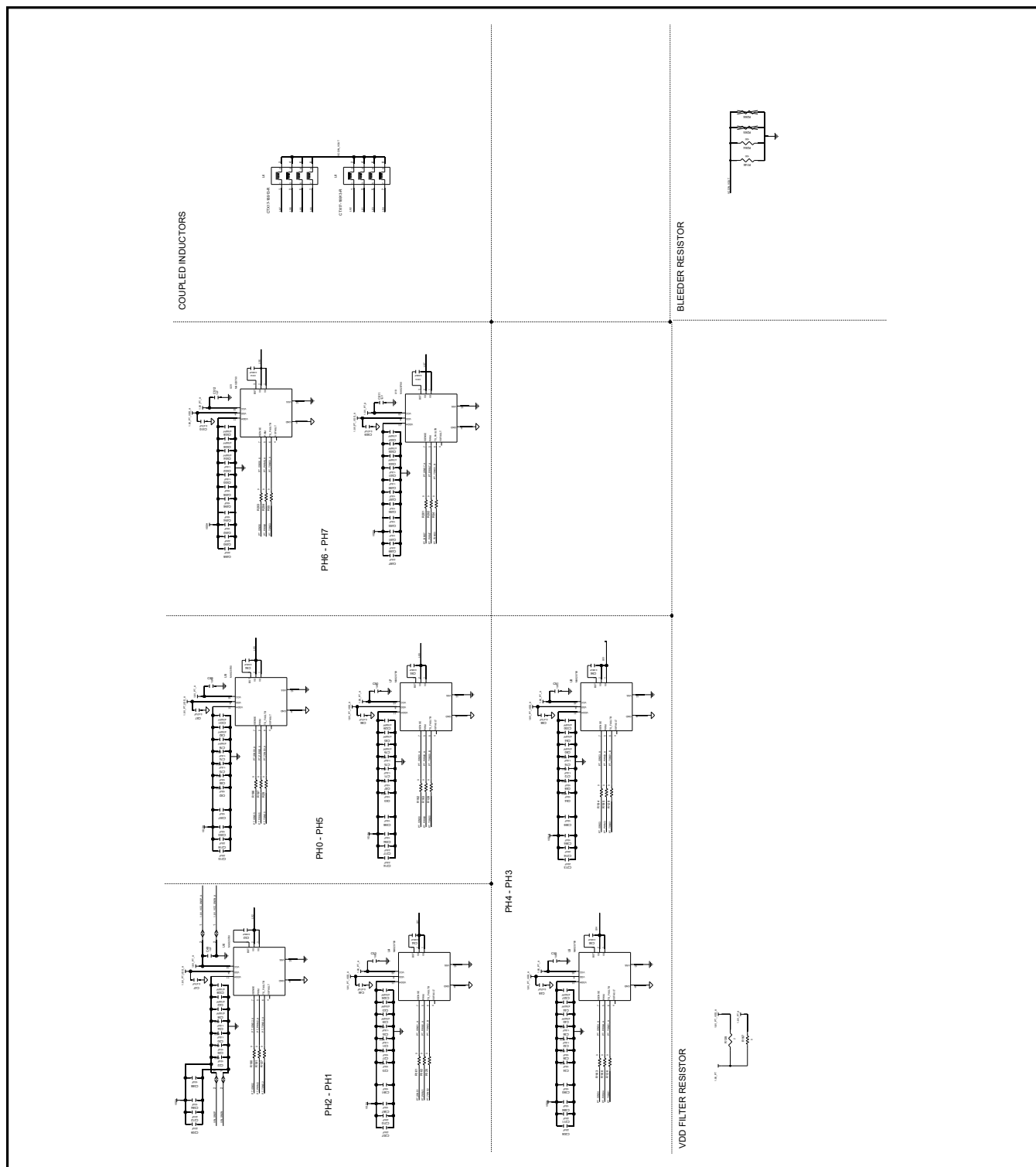
Evaluates: MAX16602 and MAX20790

MAX16602CL8 EV Kit Schematic Diagrams (continued)

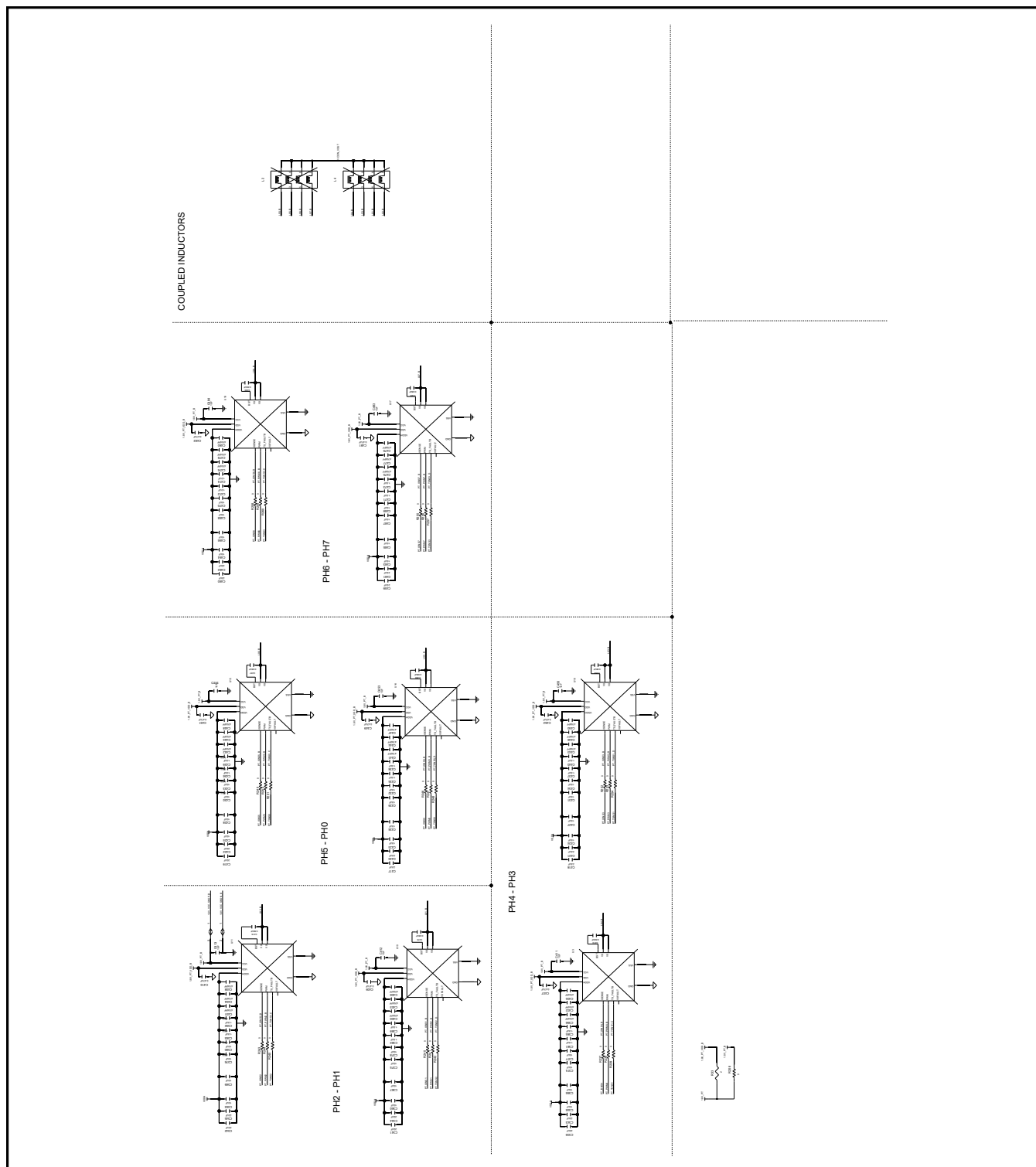




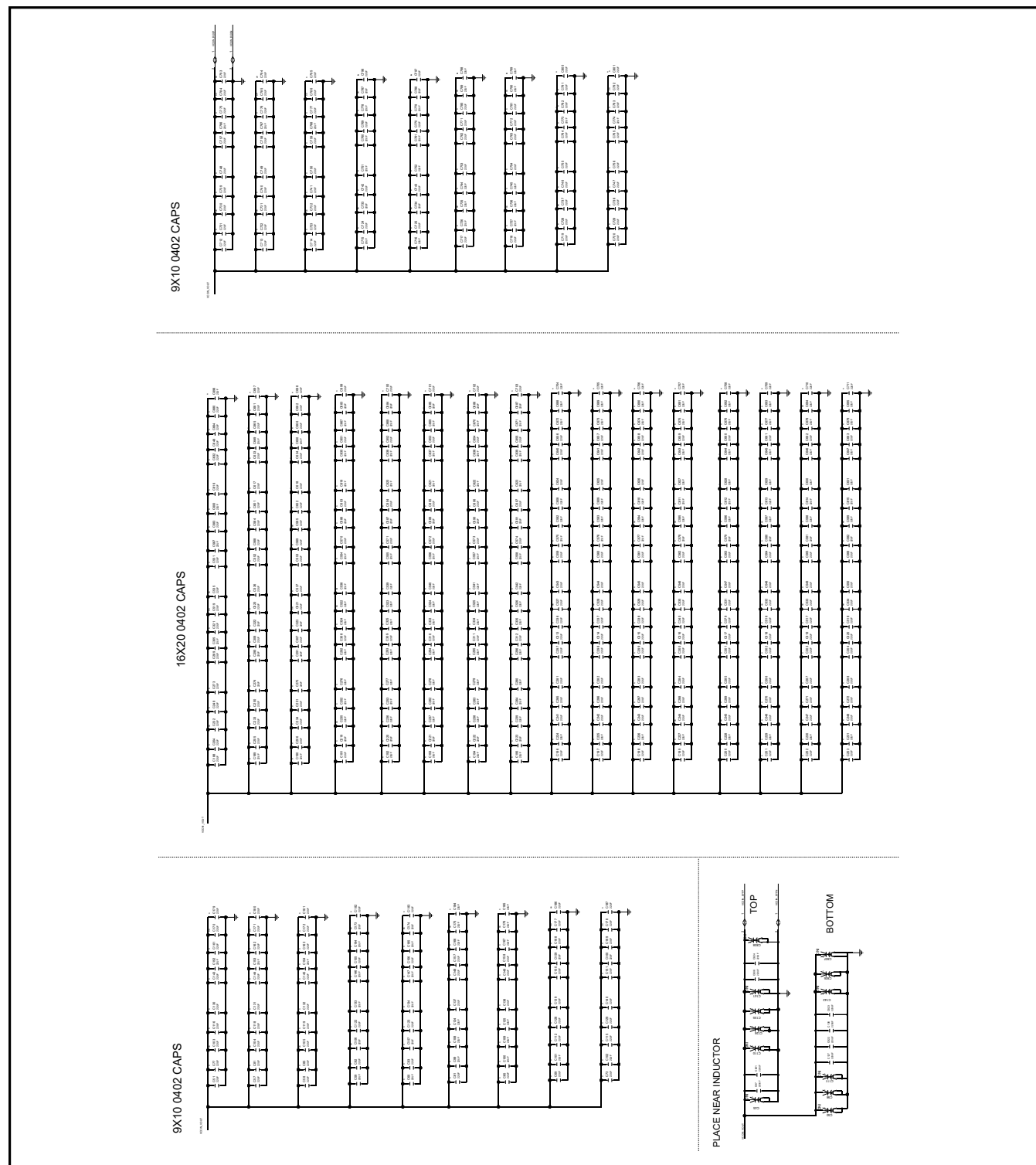
## MAX16602CL8 EV Kit Schematic Diagrams (continued)



## MAX16602CL8 EV Kit Schematic Diagrams (continued)



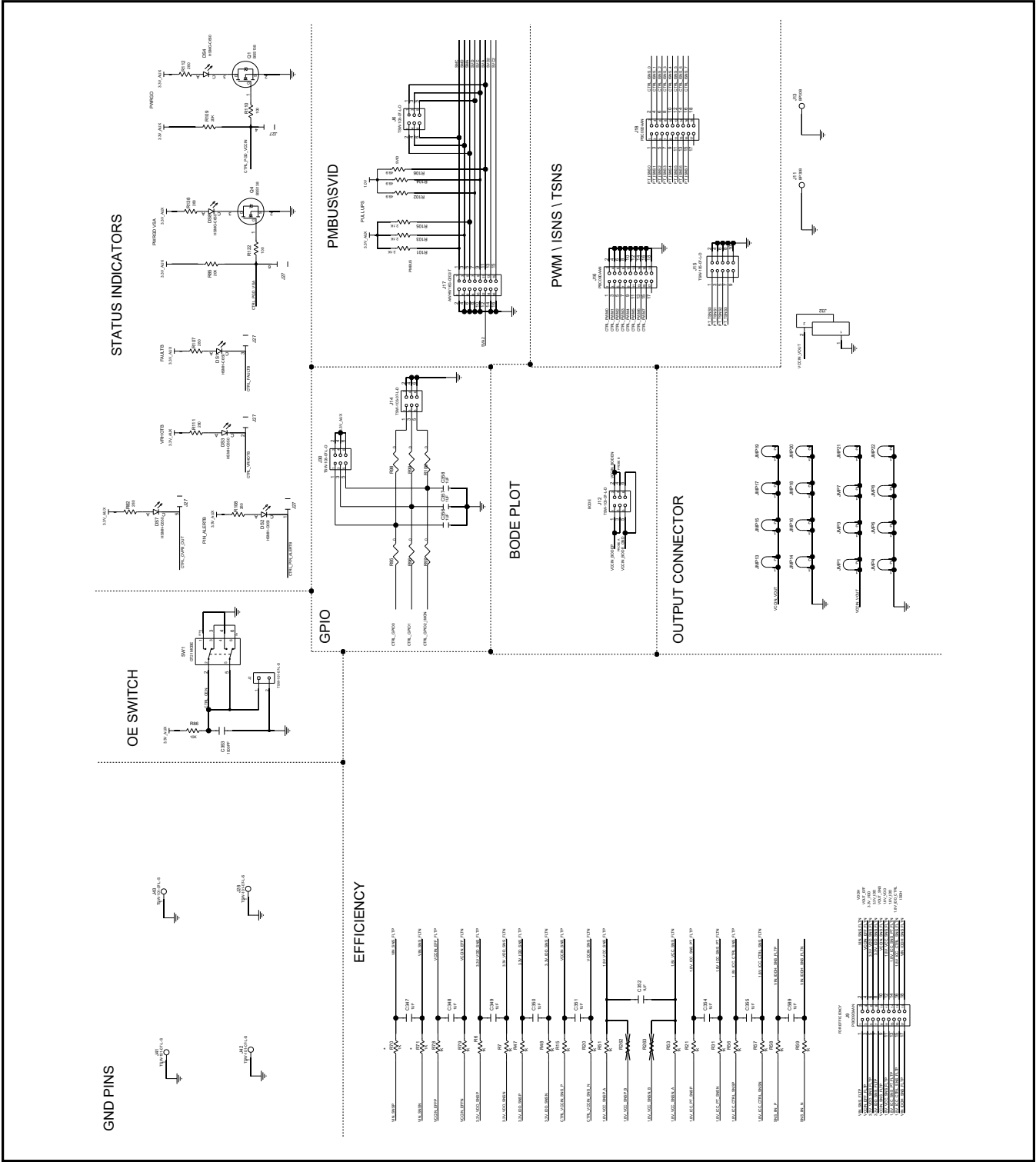
## MAX16602CL8 EV Kit Schematic Diagrams (continued)



MAX16602CL8  
Evaluation Kit

Evaluates: MAX16602 and MAX20790

MAX16602CL8 EV Kit Schematic Diagrams (continued)



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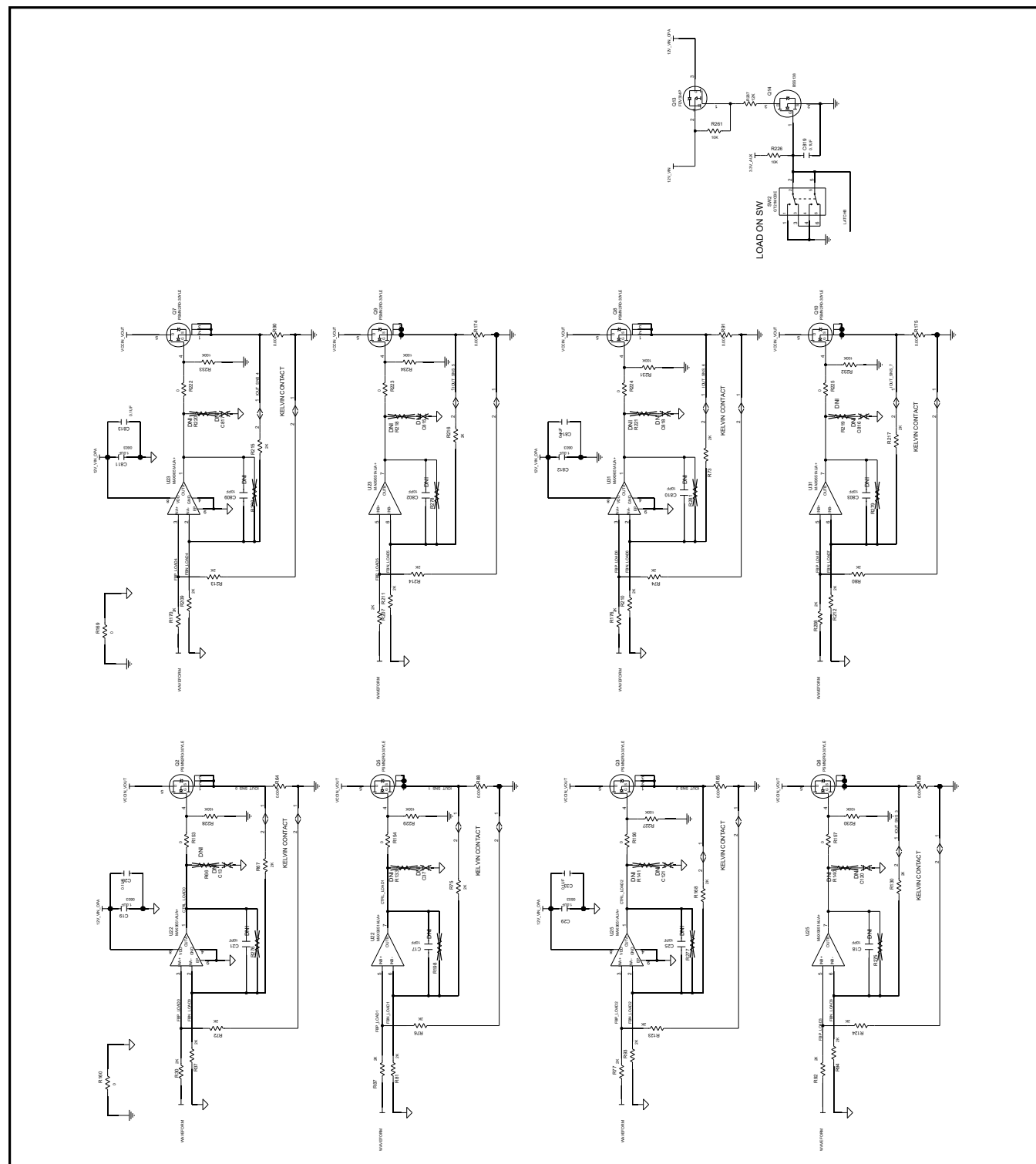




# MAX16602CL8 Evaluation Kit

Evaluates: MAX16602 and MAX20790

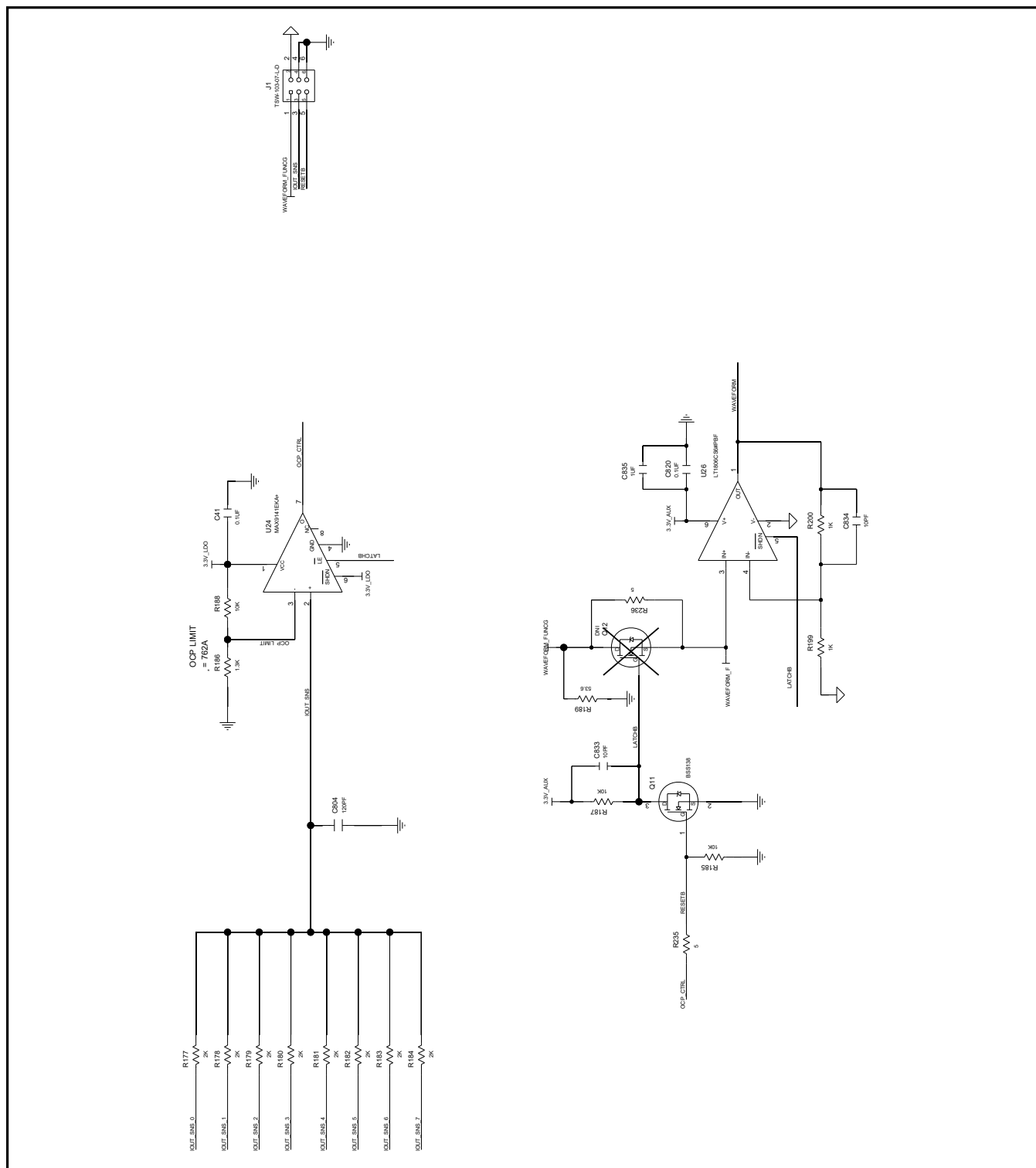
## MAX16602CL8 EV Kit Schematic Diagrams (continued)



# MAX16602CL8 Evaluation Kit

Evaluates: MAX16602 and MAX20790

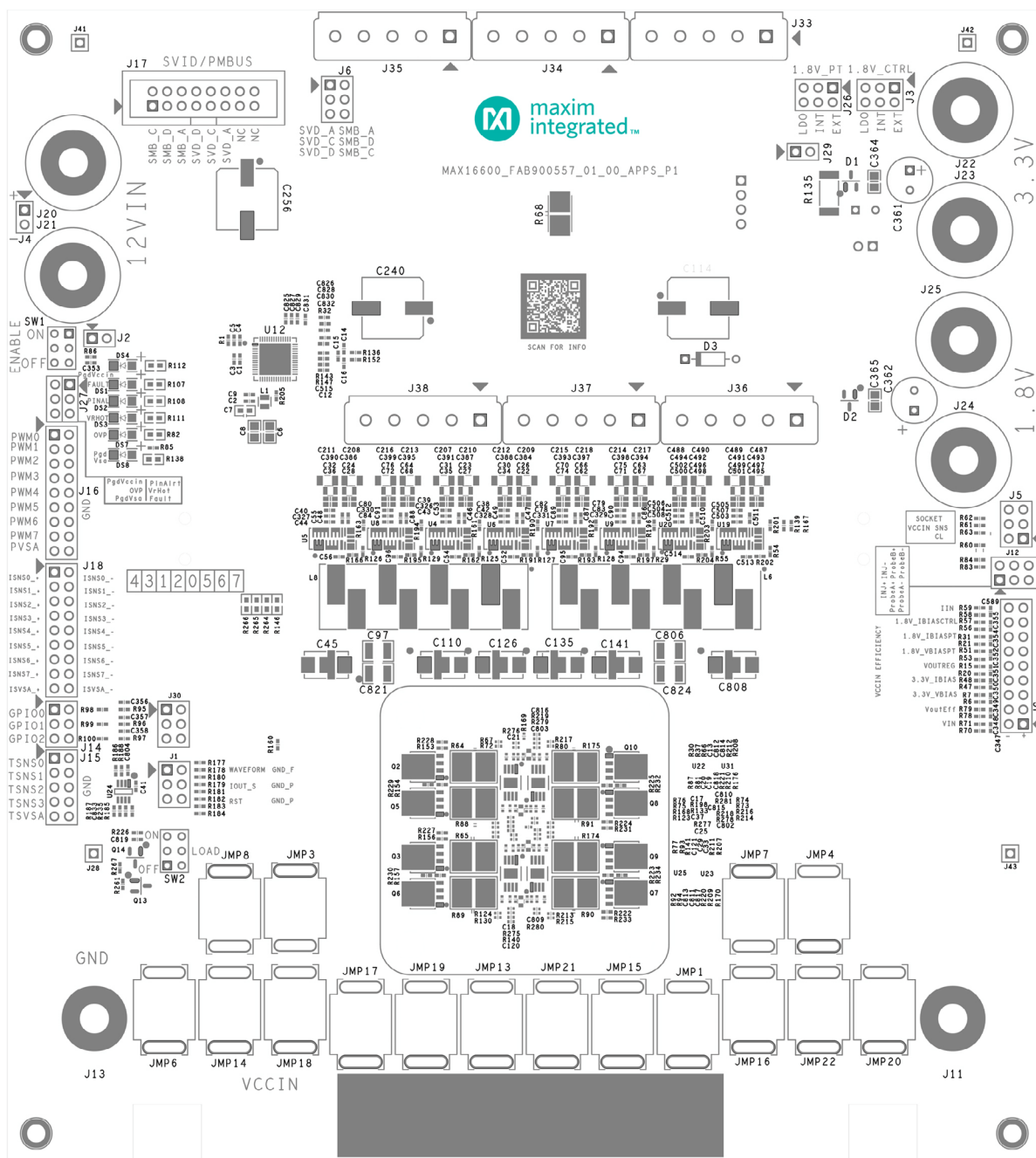
## MAX16602CL8 EV Kit Schematic Diagrams (continued)



# MAX16602CL8 Evaluation Kit

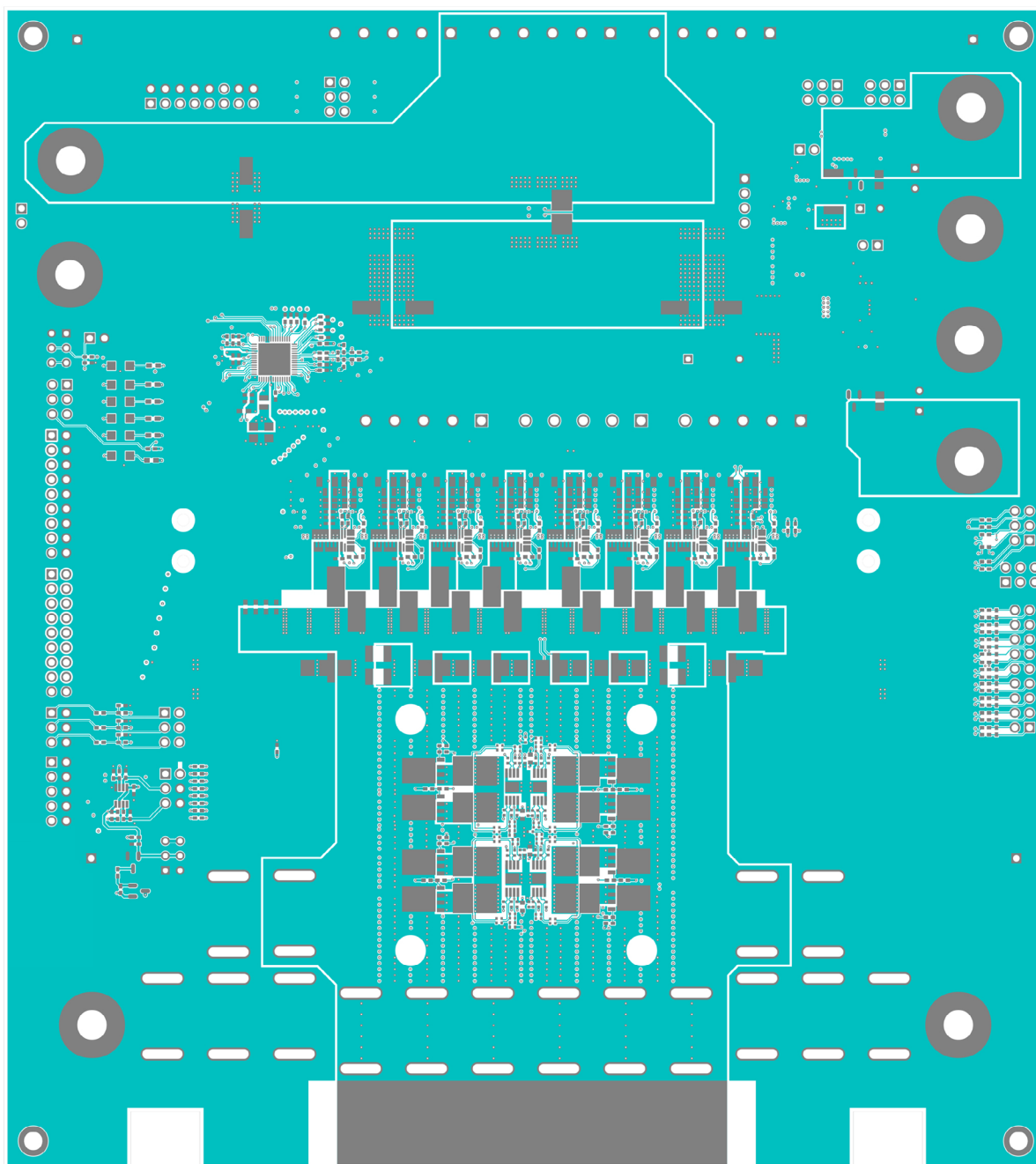
Evaluates: MAX16602 and MAX20790

## MAX16602CL8 EV Kit PCB Layout Diagrams



MAX16602CL8 EV Kit PCB—Silkscreen Top Side

## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)

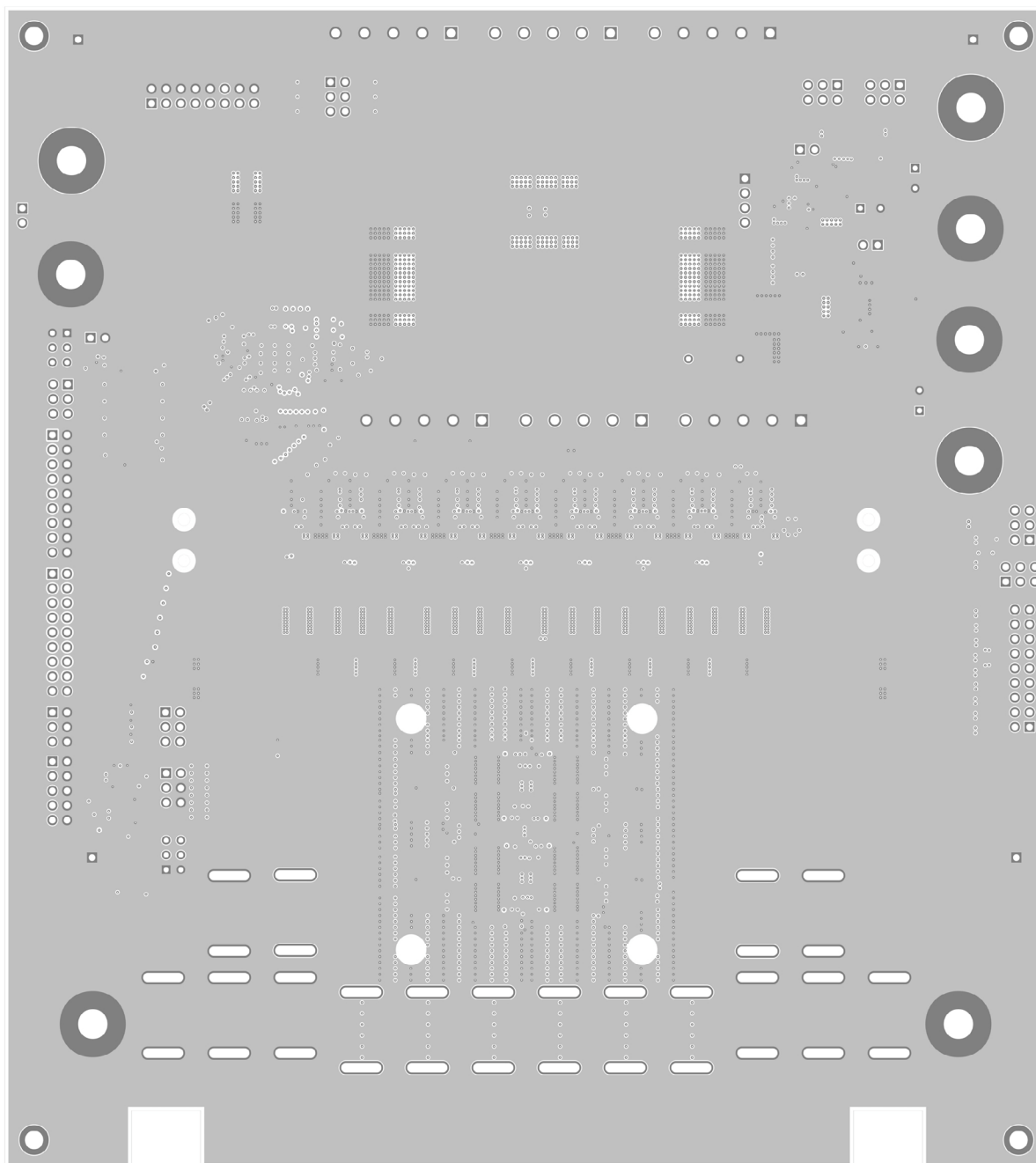


MAX16602CL8 EV Kit PCB—Top Side

# MAX16602CL8 Evaluation Kit

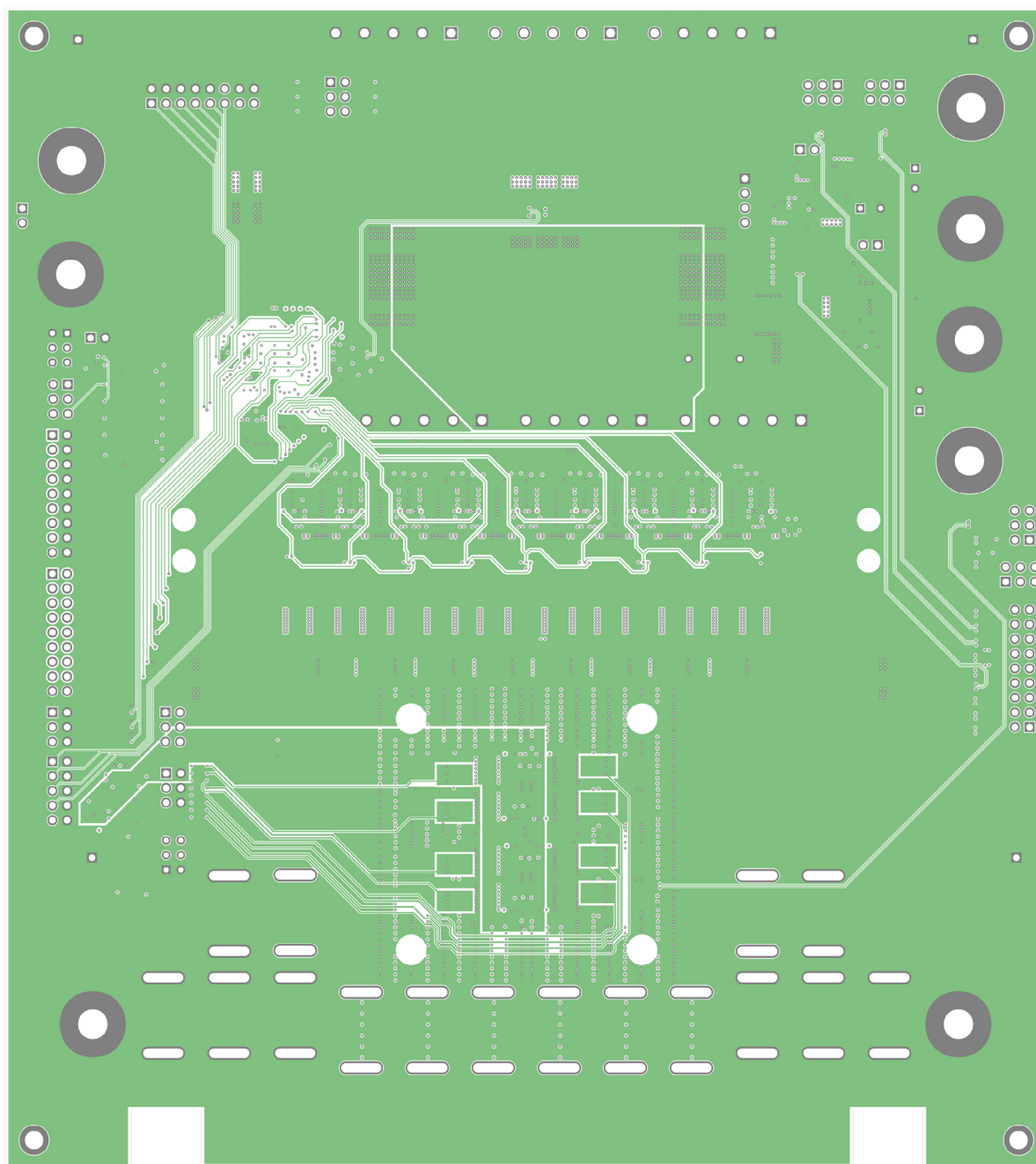
Evaluates: MAX16602 and MAX20790

## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



MAX16602CL8 EV Kit PCB—Internal Layer 2

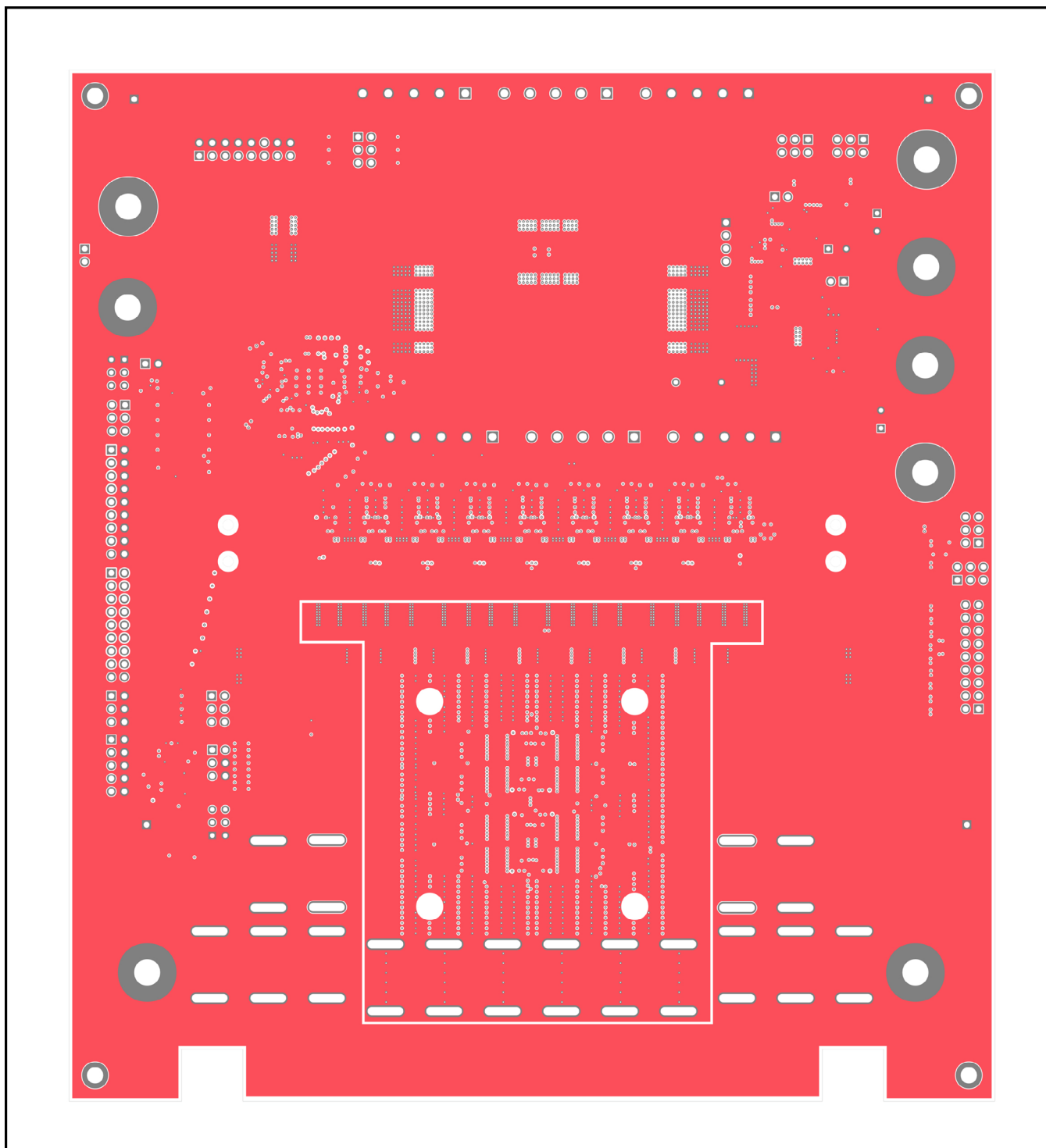
## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



MAX16602CL8 EV Kit PCB—Internal Layer 3

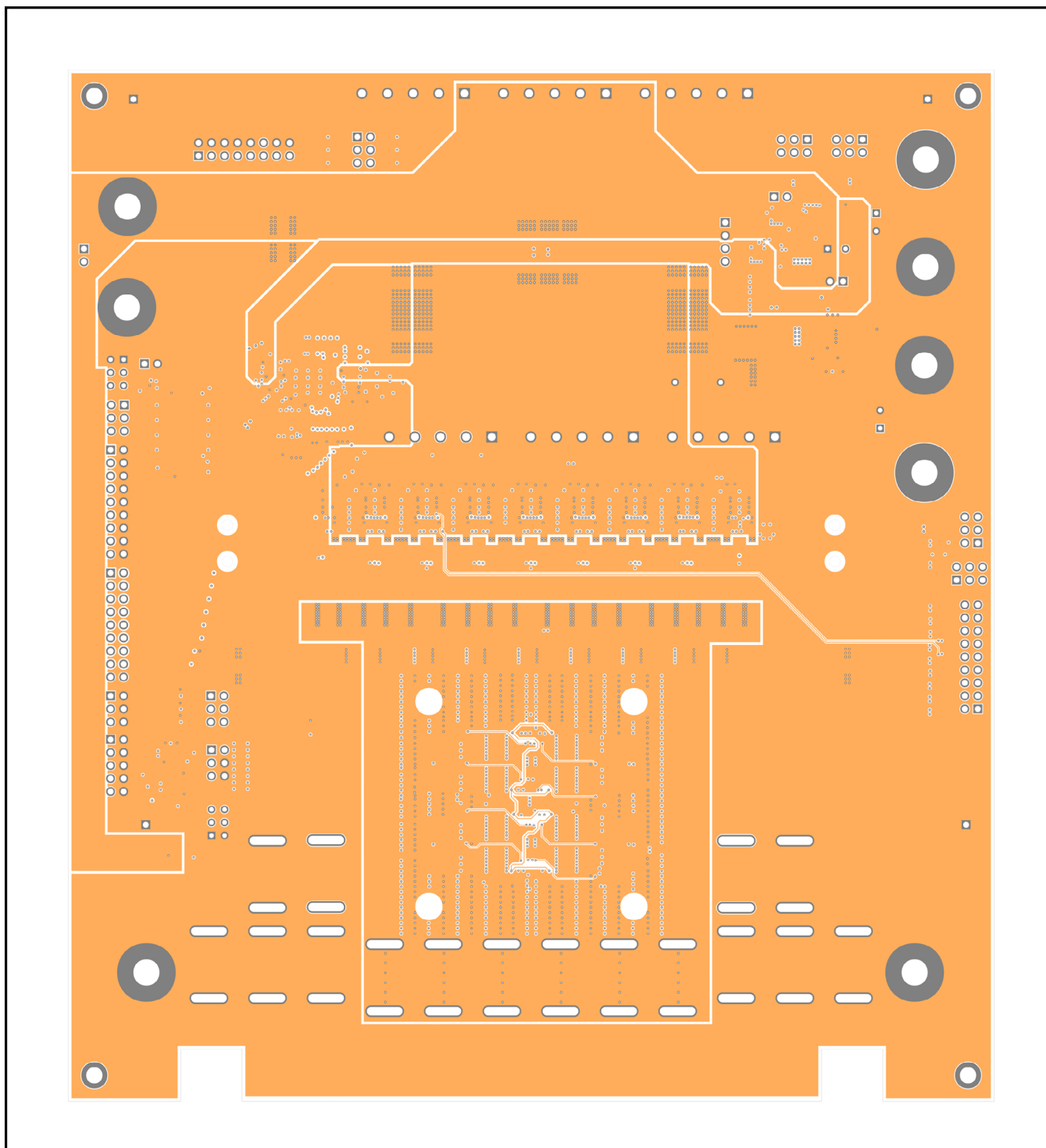


## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



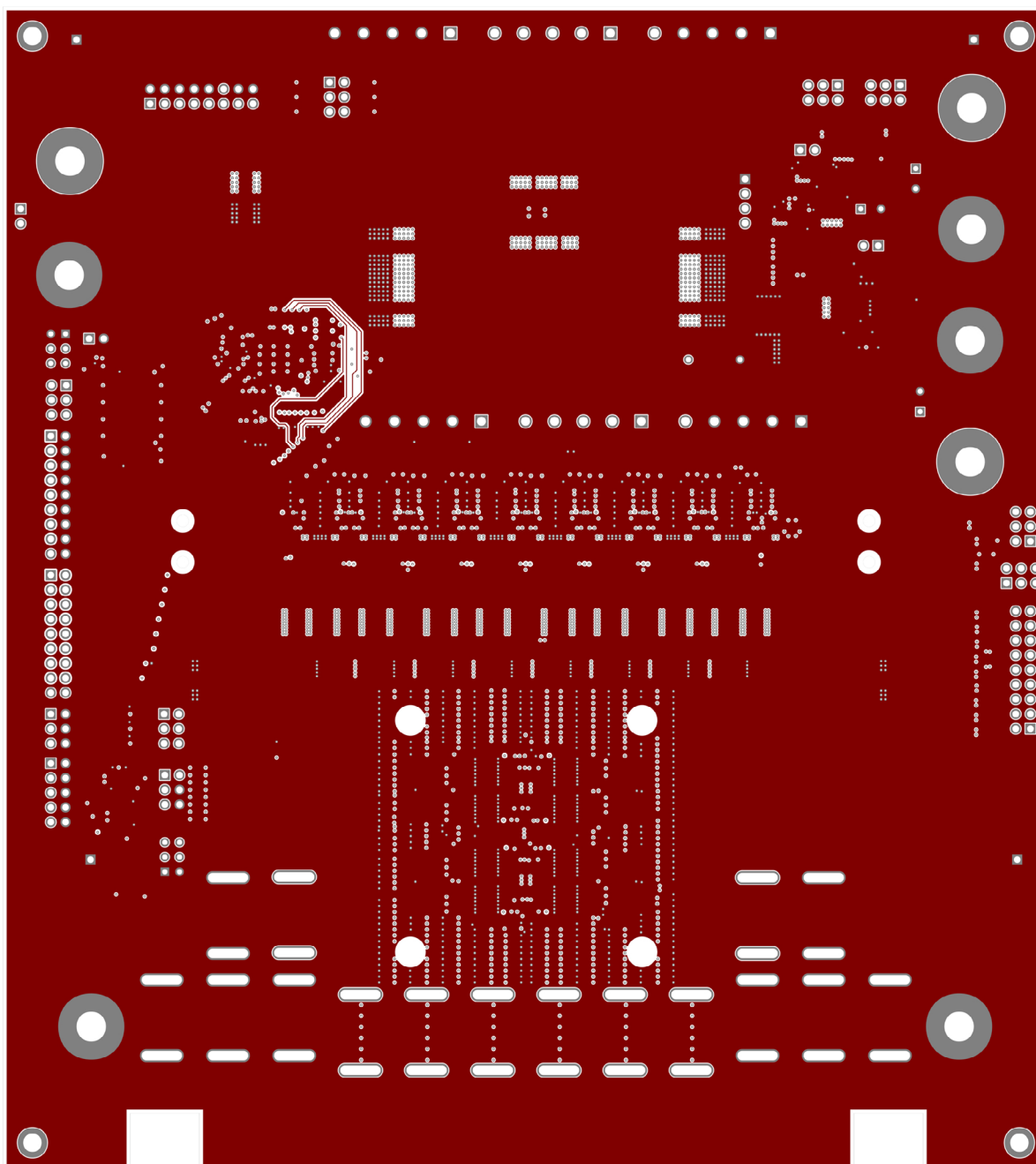
MAX16602CL8 EV Kit PCB—Internal Layer 4

## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



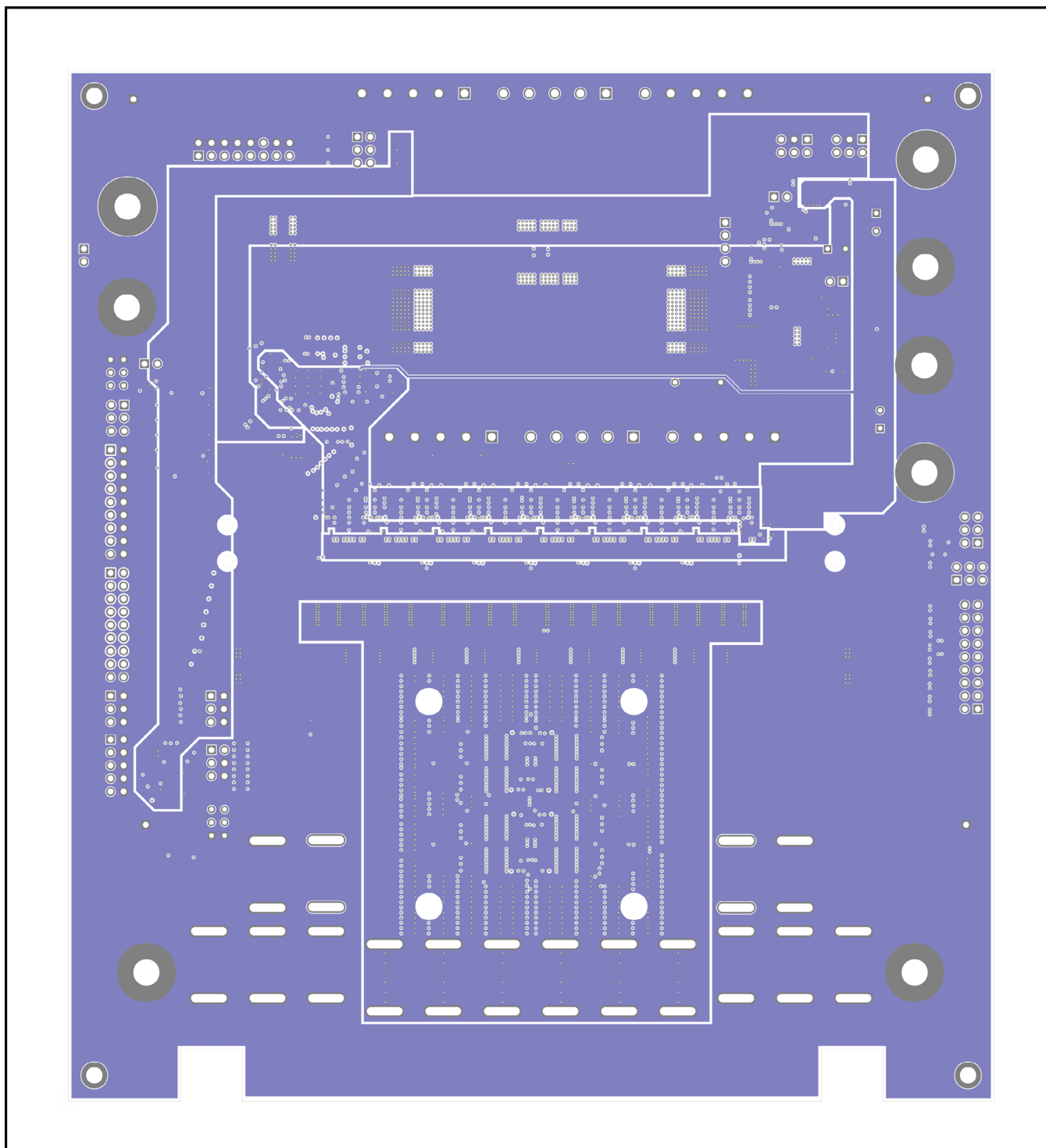
MAX16602CL8 EV Kit PCB—Internal Layer 5

## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



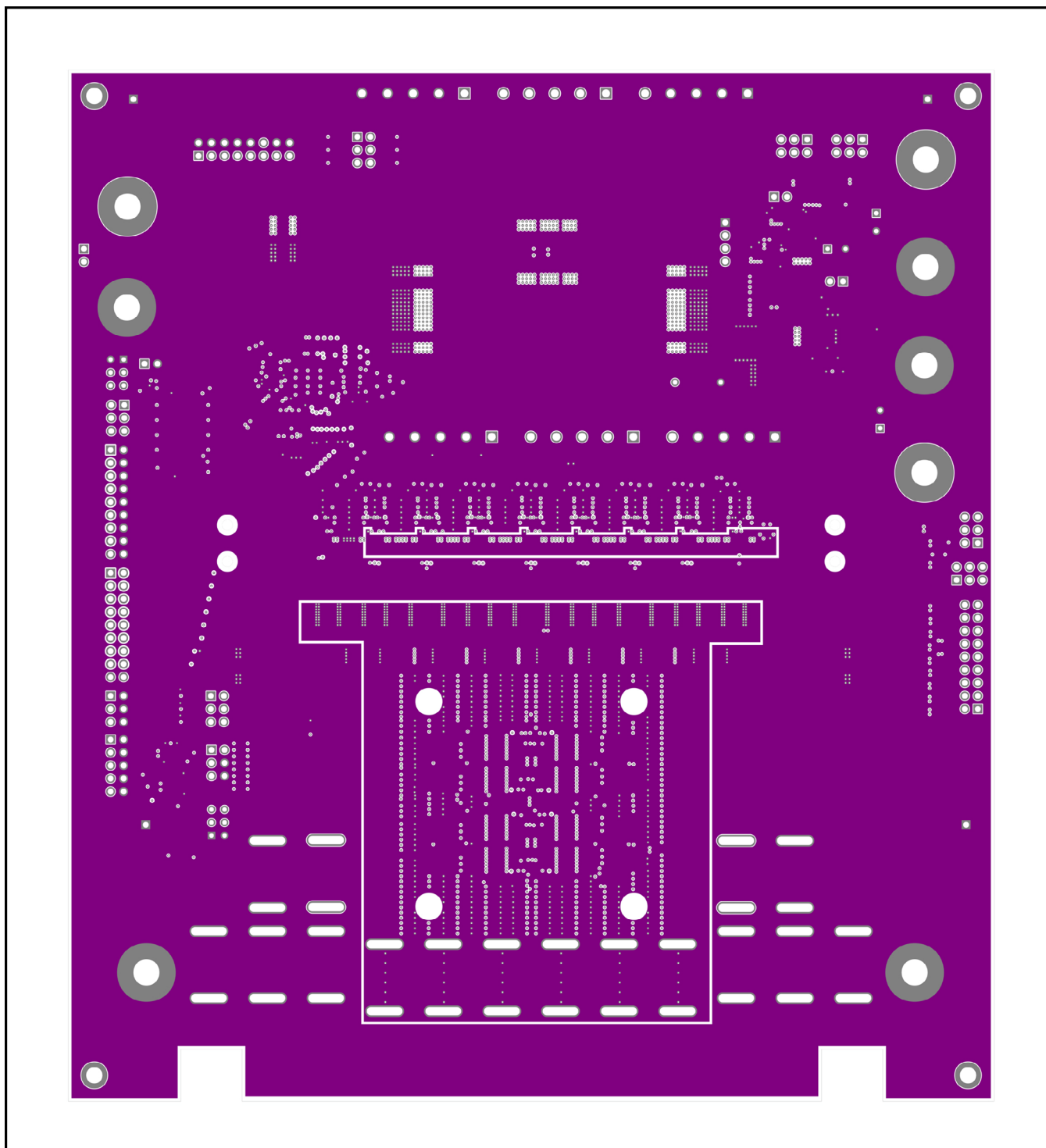
MAX16602CL8 EV Kit PCB—Internal Layer 6

## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



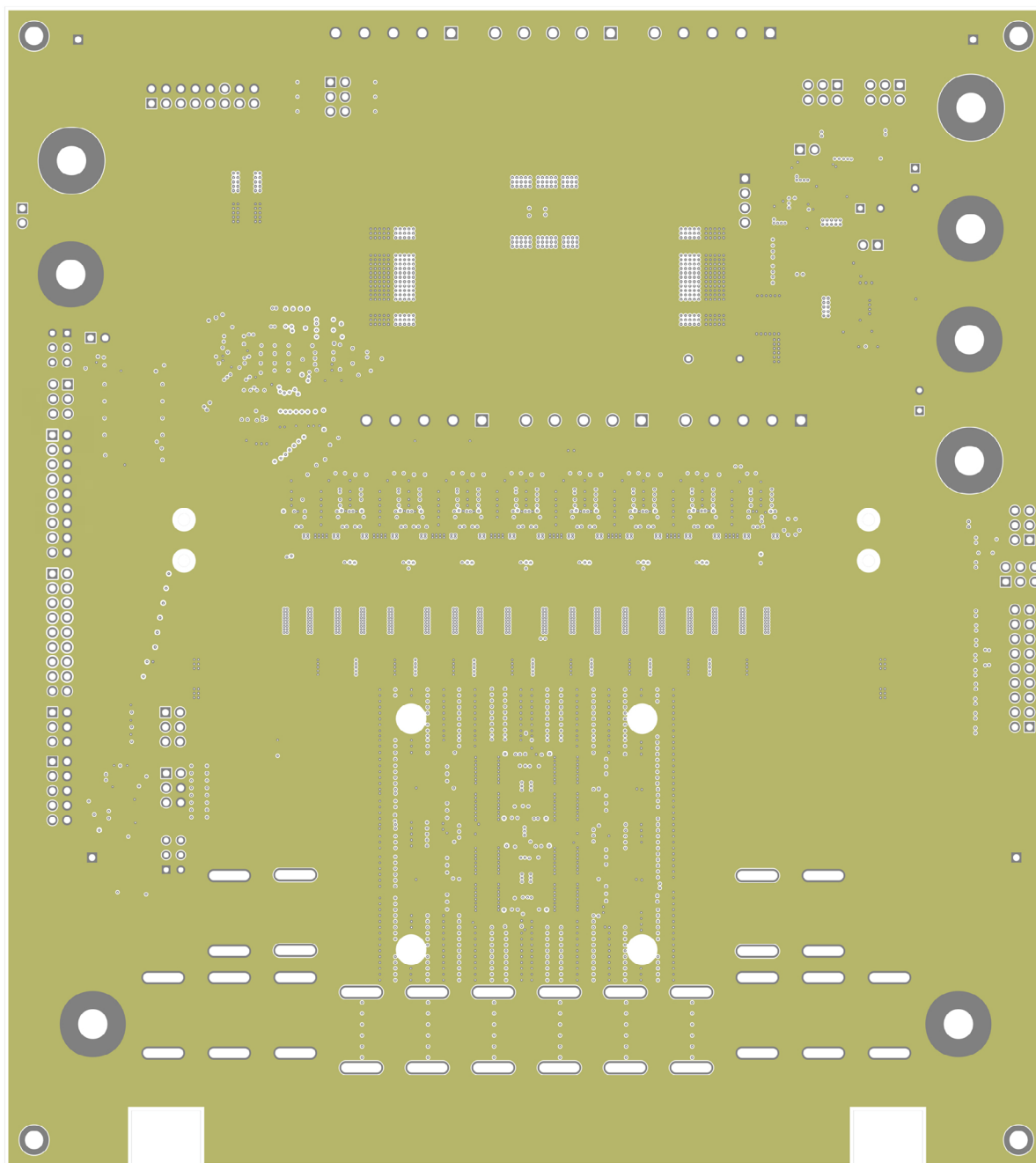
MAX16602CL8 EV Kit PCB—Internal Layer 7

## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



MAX16602CL8 EV Kit PCB—Internal Layer 8

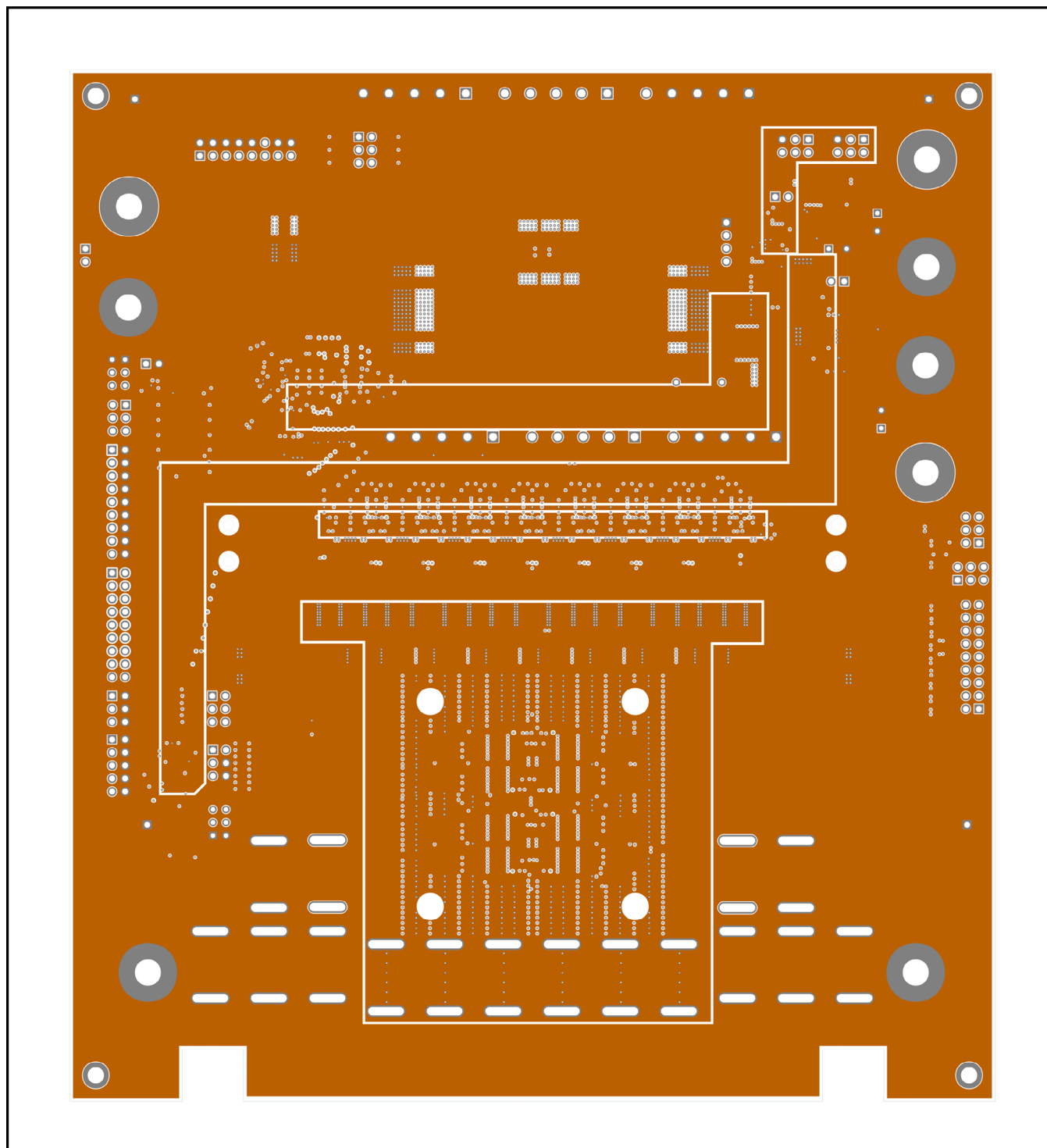
## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



MAX16602CL8 EV Kit PCB—Internal Layer 9



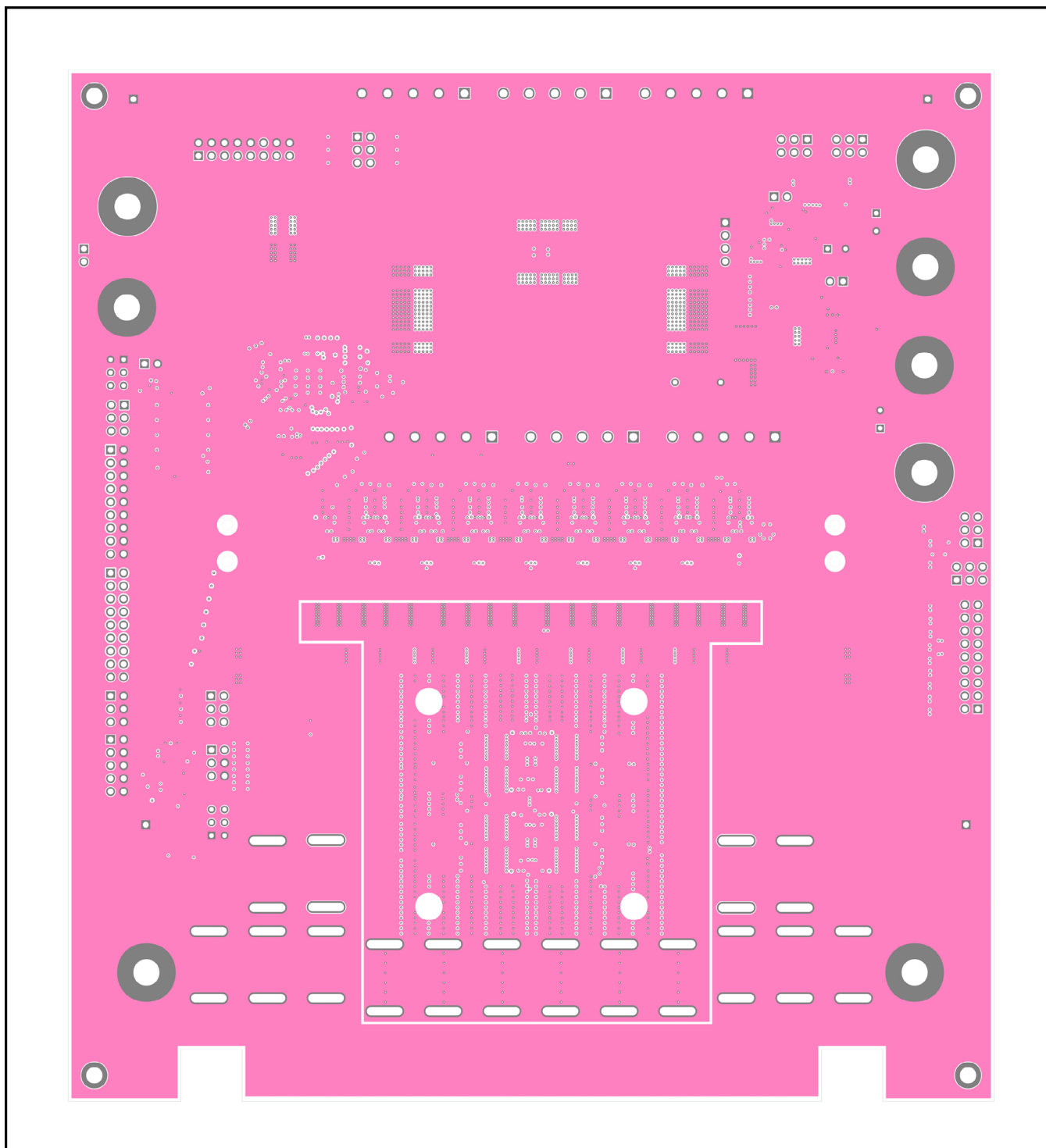
## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



MAX16602CL8 EV Kit PCB—Internal Layer 10

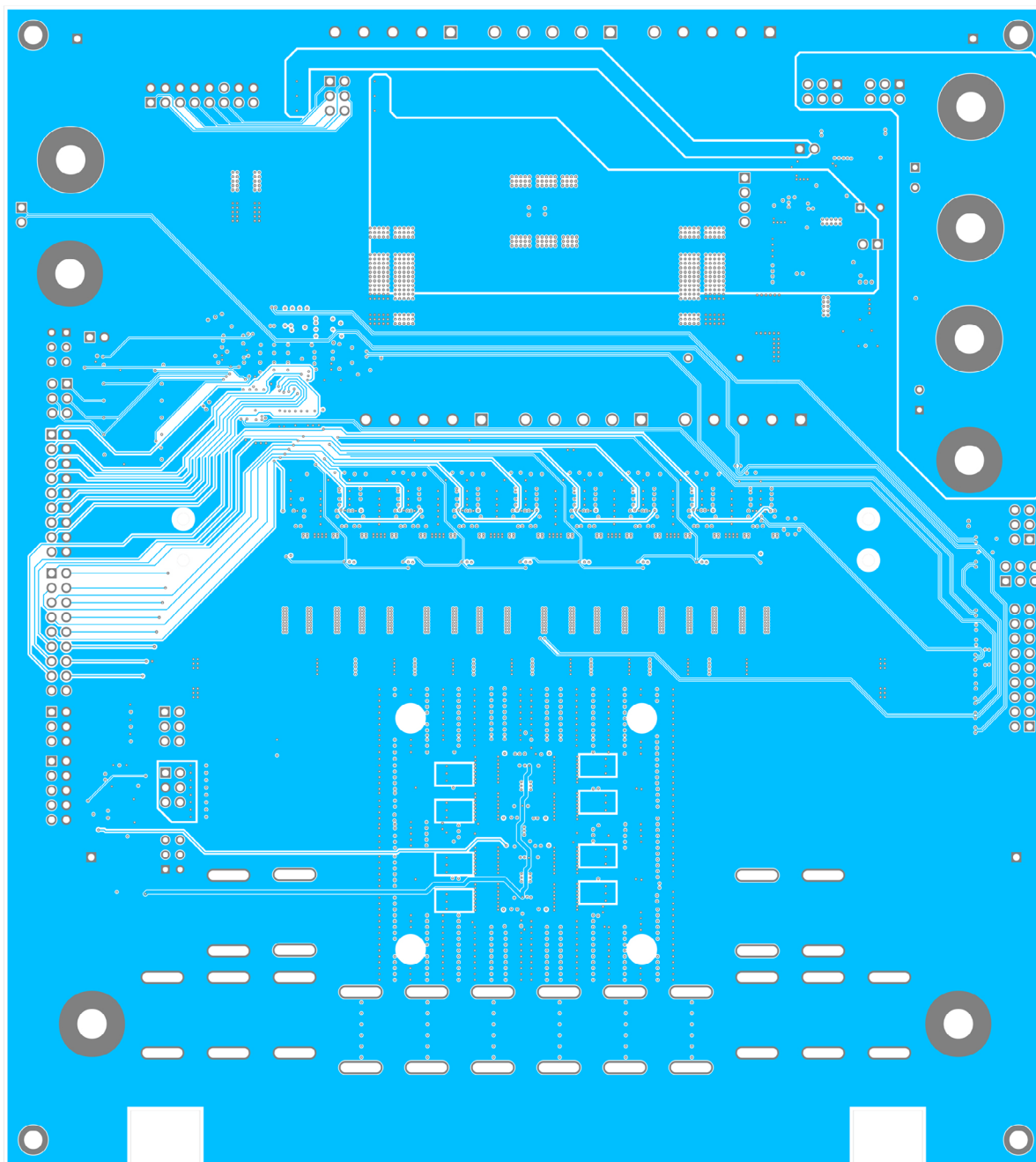


## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



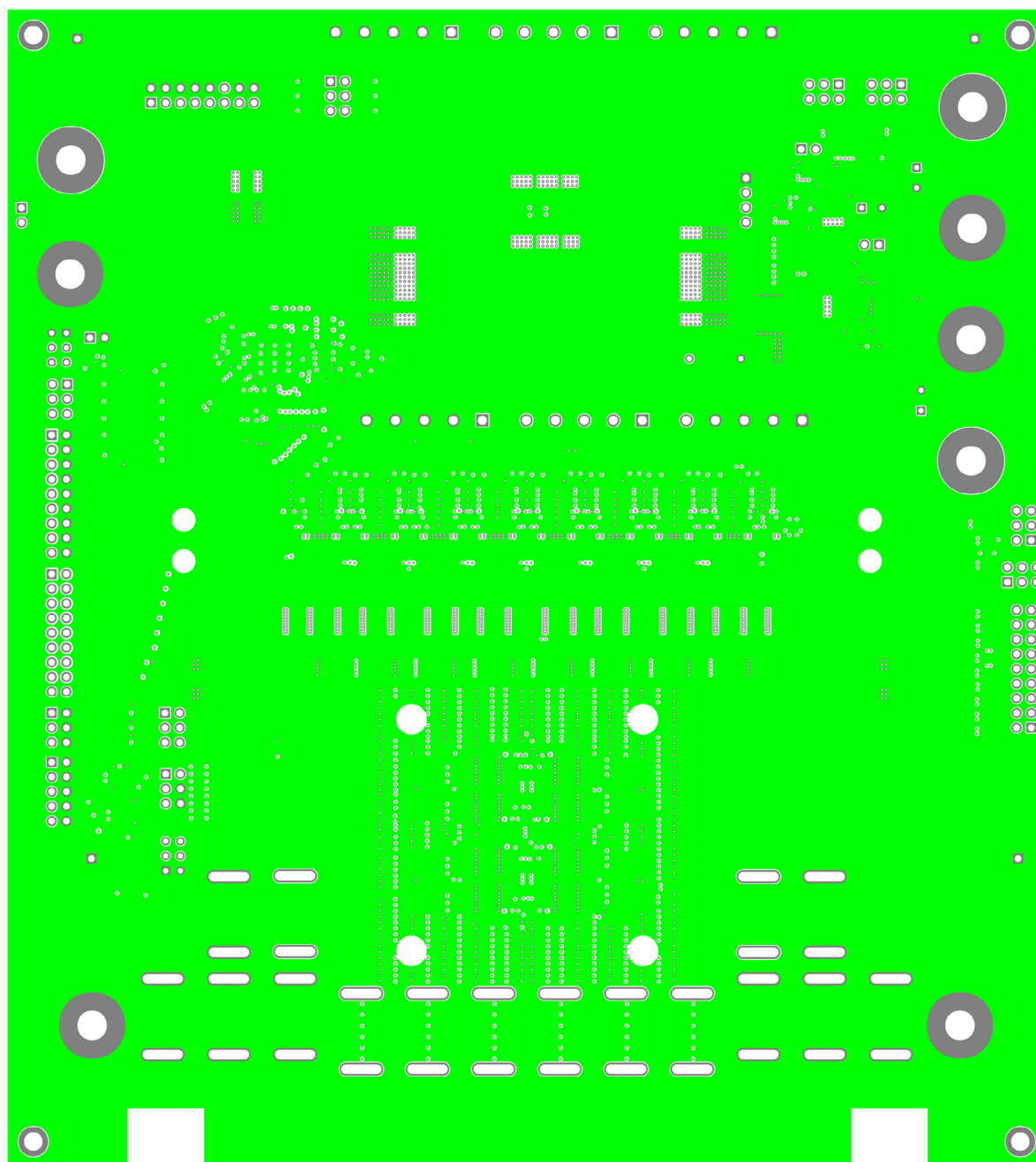
MAX16602CL8 EV Kit PCB—Internal Layer 11

## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



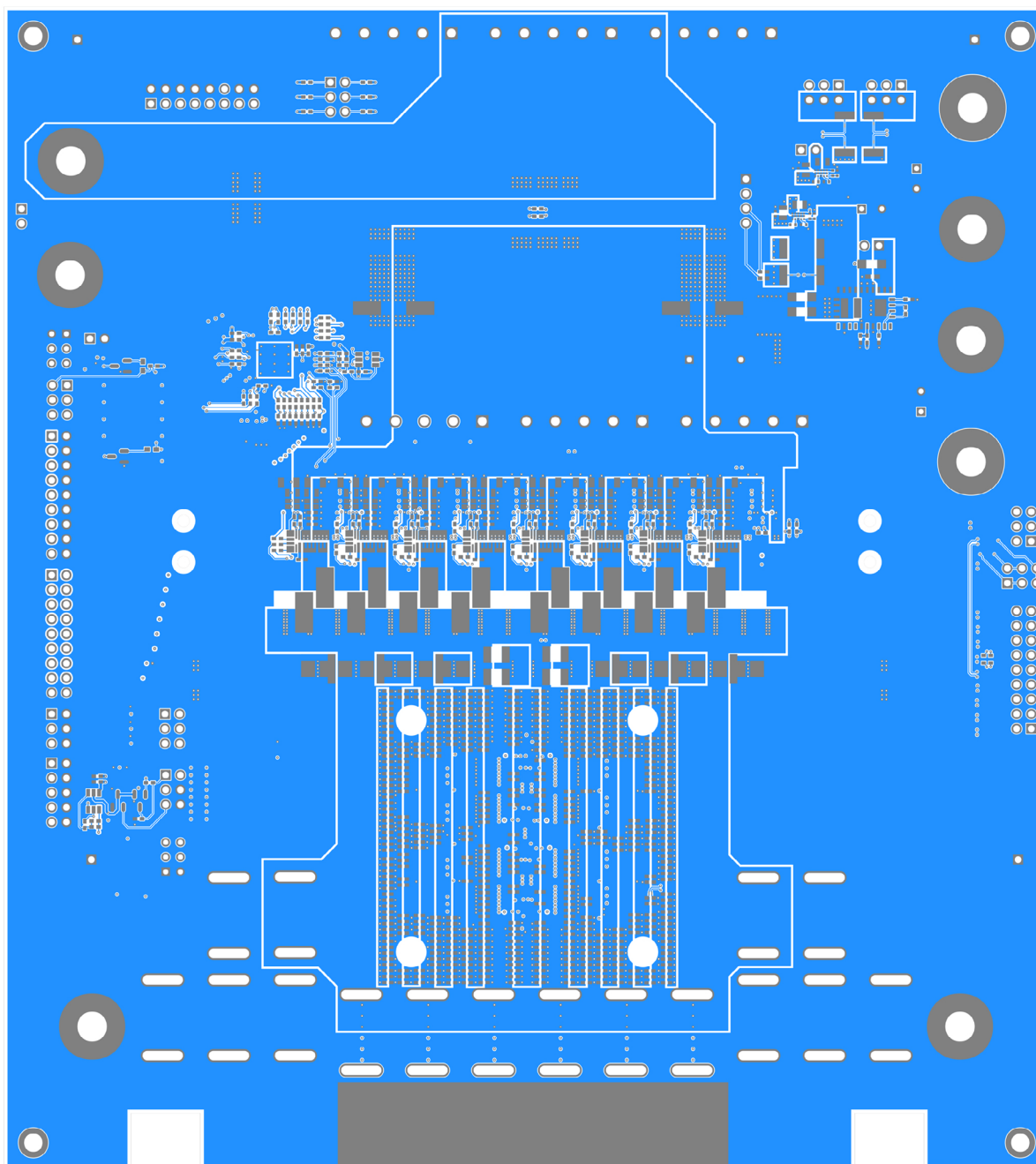
MAX16602CL8 EV Kit PCB—Internal Layer 12

## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



MAX16602CL8 EV Kit PCB—Internal Layer 13

## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)

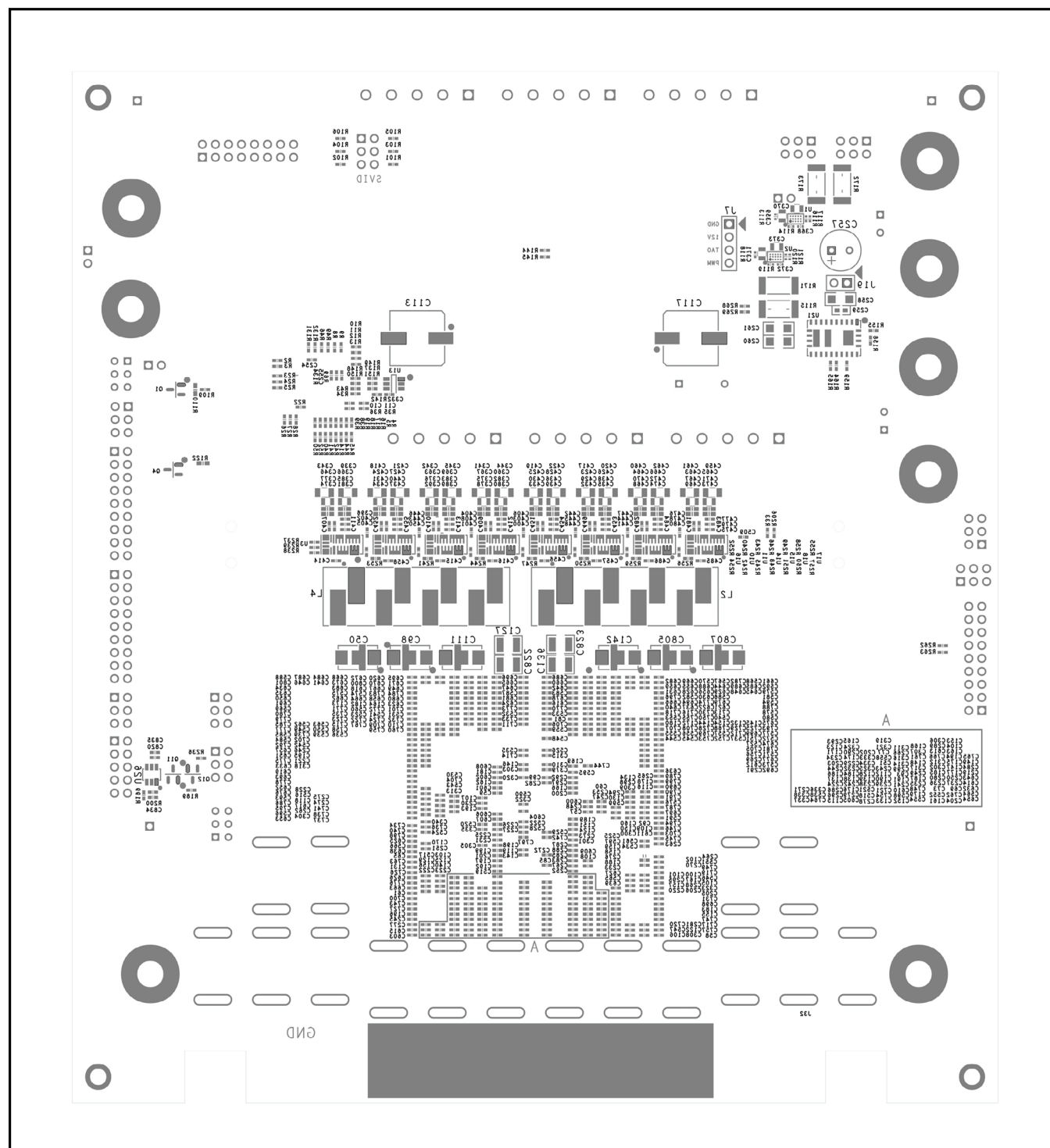


MAX16602CL8 EV Kit PCB—Bottom Side

# MAX16602CL8 Evaluation Kit

Evaluates: MAX16602 and MAX20790

## MAX16602CL8 EV Kit PCB Layout Diagrams (continued)



MAX16602CL8 EV Kit PCB—Silkscreen Bottom Side

MAX16602CL8  
Evaluation Kit

Evaluates: MAX16602 and MAX20790

## Revision History

| REVISION<br>NUMBER | REVISION<br>DATE | DESCRIPTION     | PAGES<br>CHANGED |
|--------------------|------------------|-----------------|------------------|
| 0                  | 11/20            | Initial release | —                |

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