# MAX20087 Evaluation Kit

# Evaluates: MAX20086–MAX20089

## General Description

The MAX20087 evaluation kit (EV kit) demonstrates the full capabilities of the series of power-protector ICs. The EV kit can operate as a stand-alone protector, or can be connected to a controller through an $I^2C$ interface for advanced control and diagnostics. The IC populated by default on the EV kit is the MAX20087, which has four output channels and a full suite of diagnostics active for compatibility with ASIL-grade applications. The EV kit is compatible with all other variants in the series, which can be evaluated by replacing the existing IC (U1) with the desired one.

The EV kit allows for simultaneous and independent operation and evaluation of the four protected output power channels. The EV kit has built-in interfaces to operate the part without needing an external $I^2C$ controller, although one can be connected to evaluate digital control and expanded diagnostics.

## Benefits and Features

- 400mΩ (typ) Input-to-Output Channel Resistance
- Automatic Shutdown and Retry on Output UV and OC Conditions Reduces IC Power Dissipation
- Channels Continuously Shut Off During Overvoltage Conditions to Protect the Rest of the System
- Capable of Basic Stand-Alone Operation or Advanced Control and Diagnostics Through $I^2C$ Interface
- Proven PCB Layout
- Fully Assembled and Tested

## Quick Start

### Required Equipment

- 3.3V power supply
- 12V power supply
- 0.5A, 25Ω electronic resistive load
- Digital multimeter (DMM)

### Procedure

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

1) Connect the 3.3V supply across the VEXT and GND test loops.
2) Place jumper on the header next to VEXT test loop, connecting the center pin to the EXT pin.
3) Activate the 3.3V supply.
4) Connect the 12V supply across the VIN and GND test loops. Activate supply.
5) Use the DMM to verify that OUT1–OUT4 are off (0V).
6) Install a jumper on EN to pull pin to 3.3V supply.
7) Use the DMM to verify that OUT1–OUT4 are at 12V.
8) Connect the 0.5A load across GND and an output channel.
9) Use the DMM to verify that voltage on channel is approximately 11.8V.

*Ordering Information* ***appears at end of data sheet.***

*319-100175; Rev 0; 4/18*

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## Detailed Description of Hardware

The MAX20086–MAX20089 ICs are multichannel power protectors designed for power-over-coax applications. The MAX20086/MAX20087 have four output channels, and the MAX20088/MAX20089 have two output channels. The MAX20086 and MAX20088 are standard ICs, while the MAX20087 and MAX20089 have advanced functionality for ASIL-rated applications. By default, the EV kit comes with the MAX20087 IC populated so that the full feature set of the IC family can be evaluated with one kit.

The IC takes in a single input power channel and feeds it through to multiple output channels. Each output channel has independent diagnosis/protection from undervoltage, overvoltage, overcurrent, and overtemperature conditions. The input channel and logic supplies are also monitored for undervoltage and overvoltage conditions. All output channels have soft-start and soft-shutdown ramp behavior to limit inrush current and avoid inductive ringing when used in power-over-coax applications.

The IC can operate in stand-alone mode, with a single enable input controlling all channels simultaneously and a single interrupt output communicating the presence of any fault conditions. The ICs also feature an $I^2C$ interface for advanced control and diagnosis. Through the digital interface, users can exert individual channel enable/disable control and determine specific fault types, and on which channel the fault was asserted. Additionally, each IC contains an on-board ADC to make system measurements. Standard ICs can measure output channel currents, while ASIL-compliant ICs can also measure output channel voltages, input and logic supply voltages, and current-set resistor voltage.

### EV Kit Interface

#### Supply

The EV kit requires a main power supply as a source for the four output channels and a small secondary supply for the IC's internal logic and control interface. The main supply can range from 3V to 15V, while the logic supply should fall between 3V and 5V. Apply the main supply at the test points labelled VIN and GND, and the logic supply at the test points labelled VEXT and GND.

#### Control

Stand-alone control can be exerted by simply placing or removing the EN jumper (or applying a logic-high signal to the EN test point). Adding the jumper activates all the output channels, and removing it shuts them down. The current limit is set by a single resistor on the ISET pin. The 600mA (max) current limit is set with a 100kΩ resistor; the limit scales linearly down to 12kΩ (72mA). The recommended minimum current limit is 16.5kΩ at 100mA.

The $\overline{INT}$ pin is open-drain active-low, and asserts whenever a fault occurs or when a triggered ADC conversion has completed (a pullup resistor for the $\overline{INT}$ pin is populated on the EV kit). By default, the pin shows real-time faults and deactivates when fault conditions are removed. The pin can be reconfigured to assert a fault until the diagnostic flags are read through $I^2C$. Likewise, different fault types can be masked off the $\overline{INT}$ pin and register. By default, all fault conditions assert the $\overline{INT}$ pin.

The $I^2C$ address of the IC can be configured at the factory to be one of several addresses. Additionally, the ADDR pin of the IC sets one bit in the address. There is an internal pulldown on the pin to default the address to 0x28 (default-factory address); populating the ADDR jumper to pull the pin high sets the address to 0x29. The EV kit has pullup resistors on the $I^2C$ lines. Note that the addresses "0x28" and "0x29" do not include the read/write bit that the $I^2C$ protocol requires. Refer to the MAX20087 IC data sheet for a full description of the $I^2C$ interface and available control/diagnostic registers.

### Power Channels

The main power supply has a 4.7µF capacitor connected to handle transient currents and noise. In a proper application, the supply comes from an upstream converter that has noticeable output capacitance of its own. That capacitance does not eliminate the need to have local capacitance for the protector, especially if there is noticeable impedance between the converter and the protector. There are four output channels for the IC populated by default and each have a 1µF capacitor for transient suppression. The EV kit does not innately support adding GMSL filters to emulate a power-over-coax application, but can be modified to allow for one. Such filtering can also be added externally.

Stand-alone control causes all outputs to enable/disable simultaneously, while individual channel control can be exerted over $I^2C$. Each channel has its own detectors for overvoltage, undervoltage, overcurrent, and overtemperature conditions. Inducing a fault on one channel causes that channel to turn off, leaving the other channels operating. Faults can be manually applied to the EV kit, such as shorting an output to ground, connecting an output to a higher voltage than the input, and more. In addition to the main output-channel test loops, there are also smaller test points for sensing the output-channel voltage directly at the output capacitor, which are labelled “OUT#S” (where “#” is the output channel number).

### EV Kit Layout

The EV kit’s layout is a good example to use as a basis for application design. All power traces are routed on the top layer, with a full, solid ground plane on the layer directly beneath. Open spaces are filled with ground, and both the ground pour and all the components are connected directly to the ground plane with multiple stitching vias to reduce impedance. Capacitors are located very close to the IC. The exposed pad (EP) of the IC is connected to ground, and multiple vias in the EP pad connect to additional ground planes of the board for maximum heat dissipation.

## Ordering Information

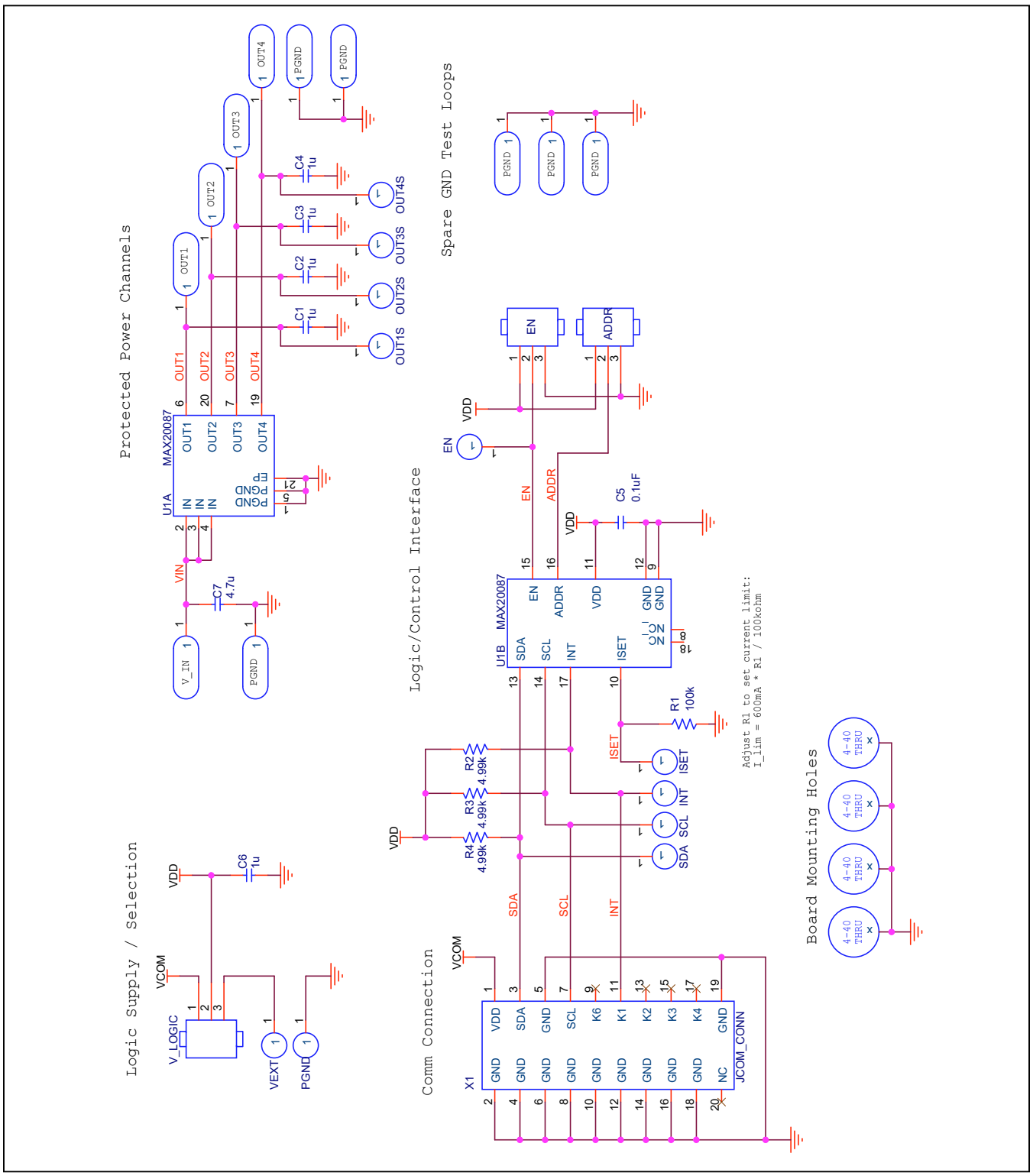
| PART | TYPE |
|---|---|
| MAX20087EVKIT# | EV Kit |

*#Denotes RoHS compliant.*

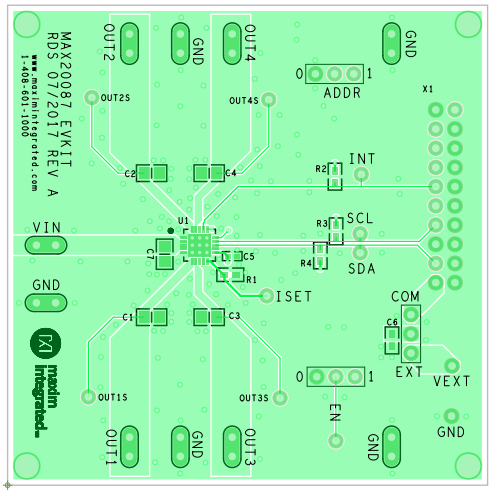
## MAX20087 EV Kit Bill of Materials

| QTY | REFERENCE DESIGNATOR | DESCRIPTION | MFG. PART NUMBER |
|---|---|---|---|
| 3 | ADDR, EN, V_LOGIC | pin header (cut to fit) | TE 4-103327-0 |
| 4 | C1-C4 | 1uF ceramic cap, 100V, X7S, 0805 | TDK CGA4J3X7S2A105K125AB |
| 1 | C5 | 0.1uF ceramic cap, 50V, X7R, 0402 | TDK CGA2B3X7R1H104K |
| 1 | C6 | 1uF ceramic cap, 16V, X7R, 0603 | TDK CGA3E1X7R1C105K080AC |
| 1 | C7 | 4.7uF ceramic cap, 35V, X7R, 0805 | TDK CGA4J1X7R1V475M125AE |
| 11 | EN, INT, ISET, OUT1S-OUT4S, PGND, SCL, SDA, VEXT | test point, yellow, 0.040" drill | Keystone 5014 or similar |
| 6 | OUT1-OUT4, PGND, VIN | wire loop, 18AWG solid | N/A |
| 1 | R1 | 100kohm resistor, 1%, 0402 | any |
| 3 | R2,R3,R4 | 4.99kohm resistor, 1%, 0603 | any |
| 1 | U1 (A/B) | MAX20087 quad power protector | Maxim MAX20087ATPA/VY+ |
| 1 | X1 | 2x10-pin connector, female, right-angle | Samtec SSW-110-02-S-D-RA |
| — | — | PCB: MAX20087 EVKIT | MAX20087EVKIT# |

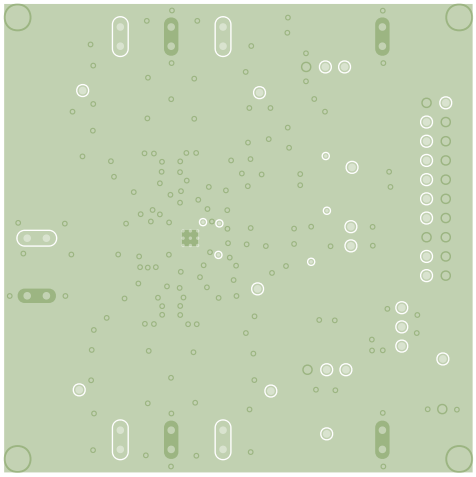
## MAX20087 EV Kit Schematic



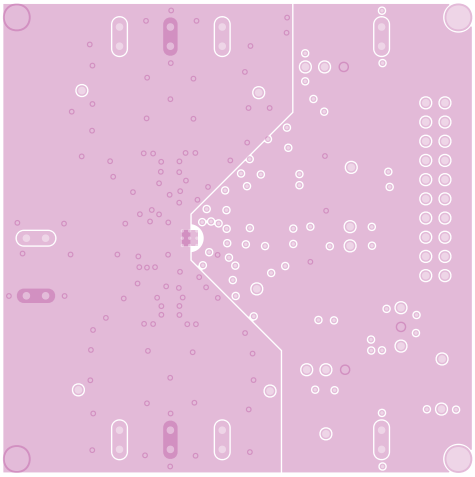
## MAX20087 EV Kit PCB Layouts



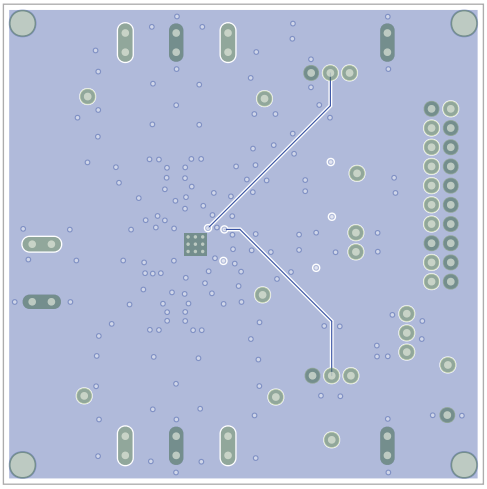

*MAX20087 EV Kit Component Placement Guide—Top Copper and Silkscreen*



*MAX20087 EV Kit PCB Layout—Inner Layer 2 (Copper)*



*MAX20087 EV Kit PCB Layout—Inner Layer 3 (Copper)*



*MAX20087 EV Kit PCB Layout—Bottom Copper*

## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|---|---|---|---|
| 0 | 4/18 | Initial release | — |

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