General Description

The MAX5988A evaluation kit (EV kit) is a fully assembled and tested surface-mount circuit board featuring an Ethernet port, network powered-device (PD) interface controller circuit for -57V supply rail systems. The EV kit uses the MAX5988A IEEE® 802.3af/at-compliant network PD interface controller in a 20-pin TQFN package with an exposed pad. The IC is used in Power-over-LAN (PoL) applications requiring DC power from an Ethernet network port for PDs such as IP phones, wireless access nodes, and security cameras.

The EV kit receives power from IEEE 802.3af/at-compliant power-sourcing equipment (PSE). Refer to the MAX5988A IC data sheet for PSE controllers. The PSE provides the required -36V to -57V DC power over an unshielded twisted-pair Ethernet network cable to the EV kit's RJ45 magnetic jack. The EV kit features a 1 x 1 gigabit RJ45 magnetic jack and two active full-wave rectifiers (DM1, DM2) for separating the DC power provided by an endspan or midspan Ethernet system.

The EV kit can also be powered by a wall adapter power source. The EV kit provides PCB pads to accept the output of a wall adapter power source. When a wall adapter power source is detected, it always takes precedence over the PSE source and allows the wall adapter to power the EV kit.

The EV kit demonstrates the full functionality of the IC, such as PD detection signature, PD classification signature, inrush current control, input undervoltage lockout (UVLO), and an integrated DC-DC step-down converter. The integrated step-down converter operates at a fixed 215kHz switching frequency and is configured for a non-isolated +5V DC output that can deliver 1.5A of current.

Warning: The EV kit is designed to operate with high voltages. Dangerous voltages are present on this EV kit and on equipment connected to it. Users who power up this EV kit or power the sources connected to it must be careful to follow safety procedures appropriately to work with high-voltage electrical equipment.

Under severe fault or failure conditions, this EV kit may 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

- IEEE 802.3af/at-Compliant PD Interface Circuit
- PoE Class 1/Class 2
- -36V to -57V Input Range
- Demonstrates an Integrated 6.49W Step-Down DC-DC Converter
- +5V Output at 1.15A
- Inrush Current Limit of 49mA (typ)
- Evaluates Endspan and Midspan Ethernet Systems
- Simplified Wall Adapter Interface
- Proven PCB Layout
- Fully Assembled and Tested

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

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2	2	0.1µF ±10%, 100V X7R ceramic capacitors (0603) Murata GRM188R72A104K
C3, C4	2	0.1µF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H104K
C5, C8, C9	3	1µF ±10%, 25V X7R ceramic capacitors (0603) Murata GRM188R71E105K
C6, C7	2	1µF ±10%, 100V X7R ceramic capacitors (1206) Murata GRM31CR72A105K
C10	1	10µF ±20%, 80V aluminum electrolytic capacitor (6.3mm X 7.7mm) Panasonic EEE-FK1K100XP
C11	0	Not installed, ceramic capacitor (0402)
C12	1	100µF ±10%, 6.3V X5R ceramic capacitor (1206) Murata GRM31CR60J107ME39L

maxim integrated™

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C13, C14	0	Not installed, ceramic capacitors (1206)
D1, D2	2	LEDs (SMB) Kingbright AA3528ACGCK
D3–D8	6	100V, 2A Schottky diodes (SMB) Diodes Inc. B2100
D9	0	Not installed, zener diode (SOD323)
D10–D13	4	12V, 200mW zener diodes (SOD323) Diodes Inc. BZT52C12S-7-F
DM1, DM2	2	100V, 3.5A dual n-channel MOSFETs (8 SO) Fairchild FDS86141
J1	1	RJ45 MagJack 1G Ethernet, 802.3af/at standard Bel Fuse Inc. 0826-1X1T-AC-F
JU1	1	2-pin header
L1	1	47µH, 2.5A inductor (12.4mm x 12.4mm) Sumida CDRH127NP-470MC
LDO_OUT, SLEEP, ULP	3	Orange miniature test points
Q1, Q2	2	Signal n-channel MOSFETs (SOT 23) Fairchild 2N7002
R1	1	100kΩ ±1% resistor (0402)
R2–R6	5	49.9kΩ ±1% resistors (0402)
R7–R9, R12–R14	6	0Ω ±1% resistors (0603)
R10, R11	0	Not installed, resistors (0603)
R15–R18	4	499kΩ ±1% resistors (0402)
R19–R21	3	24.9kΩ ±1% resistors (0402)
R22	1	1kΩ ±1% resistor (0603)
R23, R25, R28	0	Not installed, resistors (0402)
R24	1	0Ω ±1% resistor (0402)
R26	1	2.49kΩ ±1% resistor (0402)
R27	1	7.5kΩ ±1% resistor (0402)
R29, R30	2	10kΩ ±1% resistors (0402)
R31	1	60.4kΩ ±1% resistor (0603)
SW1	0	Not installed, 6mm tact 160GF switch (H = 4.3MM) Omron Electronics Inc. ECB Div: B3S-1000P
U1	1	PD with integrated DC-DC converter (20 TQFN-EP*) Maxim MAX5988A
VDD1, VOUT1	2	Red test points
VSS	1	Green miniature test point
VSS, VSS1	2	Black test points
—	1	PCB: MAX5988A EVALUATION KIT

**EP = Exposed pad.*

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Bel Fuse Inc.	201-432-0463	www.belfuse.com
Diodes Incorporated	805-446-4800	www.diodes.com
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Kingbright Corporation	909-468-0500	www.kingbrightusa.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Panasonic Corp.	800-344-2112	www.panasonic.com
Sumida Corp.	847-545-6700	www.sumida.com

Note: *Indicate that you are using the MAX5988A when contacting these component suppliers.*

Quick Start

Required Equipment

- MAX5988A EV kit
- IEEE 802.3af/at-compliant PSE and a Category 5e Ethernet network cable
- -48V, 1A capable DC power supply
- Voltmeter

Hardware Connections

The EV kit is fully assembled and tested. Follow the steps below to verify board operation. **Caution: Do not turn on the power supply until all connections are completed.**

1) Use one of the following methods to power the EV kit:
   a. **If network connectivity is required:** Connect a Category 5e Ethernet network cable from the EV kit input port RJ45 connector to the corresponding PSE Ethernet LAN connection that provides power to the EV kit.
   b. **If network connectivity is not required:** Connect a -48V DC power supply between the VSS and VDD1 PCB pads on the EV kit. Connect the power-supply positive terminal to the VDD1 PCB pad and the negative terminal to the VSS PCB pad.
2) Activate the PSE power supply or turn on the external DC power supply.
3) Using a voltmeter, verify that the EV kit provides +5V across the VOUT1 and VSS PCB pads.

Detailed Description of Hardware

The MAX5988A EV kit features an Ethernet port and network PD interface controller circuit for -57V supply rail systems. The EV kit contains a MAX5988A IEEE 802.3af/at-compliant network PD interface controller in a 20-pin TQFN-EP package. The IC is used in PoL applications for powering PDs from an unshielded twisted-pair (UTP) Ethernet Category 5e network cable and PSE port using endspan or midspan Ethernet systems.

The EV kit receives power from an IEEE 802.3af/at-compliant PSE and a UTP cable connected to the EV kit's RJ45 magnetic jack. The EV kit uses a 1 x 1 gigabit RJ45 magnetic jack and two active full-wave bridge power rectifiers to separate the -57V DC power sent by the PSE. The EV kit can accept power from an endspan or midspan PSE network configuration.

The EV kit can also accept power from a wall adapter power source. When a wall adapter power source is detected between the WAD_IN and WAD_GND PCB pads, the IC's internal isolation switch disconnects VCC from VDD, which allows the wall adapter to supply power to the EV kit.

The EV kit demonstrates the full functionality of the IC such as PD detection signature, PD classification signature, inrush current control, and UVLO. Setting the EV kit as Class 2 PD is done by installing resistors R9 and opening R11. Do not install R9 and R11 at the same time.

The EV kit's integrated DC-DC step-down converter is configured for a nonisolated output voltage of +5V and provides up to 1.2A at the output while achieving up to 87.3% and 92.2% efficiencies at the +36V and +12V input, respectively. The integrated step-down converter operates at a fixed 215kHz switching frequency.

Maintain Power Signature (MPS)

The MPS frunction is enabled by connecting the MPS pin to VDRV. This is done by installing resistors R8 and opening R10. Do not install R8 and R10 at the same time.

Wall Adapter Power Source (WAD_IN, WAD_GND)

The EV kit can also accept power from a wall adapter power source. Use the WAD_IN (0V) and WAD_GND (-10V to -57V) PCB pads to connect the wall adapter power source. The wall adapter power source operating-voltage range must be within +10V to +57V for the EV kit.

When the wall adapter power source is above +10V it always takes precedence over the PSE source. Once the wall adapter power source is detected, the IC's internal isolation switch disconnects VCC from VDD. The wall adapter power is supplied to VCC (through diode D7) and VSS. Once it takes over, the classification process is disabled.

When the wall adapter power source is below +8.5V, the PSE provides power through the IC's VSS. Diode D2 prevents the PSE from back-driving the wall adapter power source when it is below +8.5V.

Undervoltage Lockout (UVLO)

The EV kit operates up to a -57V supply with a turn-on UVLO threshold (V_{ON}) at -40V and a turn-off UVLO threshold (V_{OFF}) at -30V. When the input voltage is above V_{ON}, the EV kit is enabled. When the input voltage goes below V_{OFF}, the EV kit is disabled.

Schematic and PCB Layout Diagrams

Click on the links below for schematic and PCB layout diagrams:

- **MAX5988A EV Kit Schematic Diagram**
- **MAX5988A EV Kit PCB Layout Diagrams**

Ordering Information

PART	TYPE
MAX5988AEVKIT#	EV Kit

#Denotes RoHS compliant.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	8/16	Initial release	—

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at www.maximintegrated.com.

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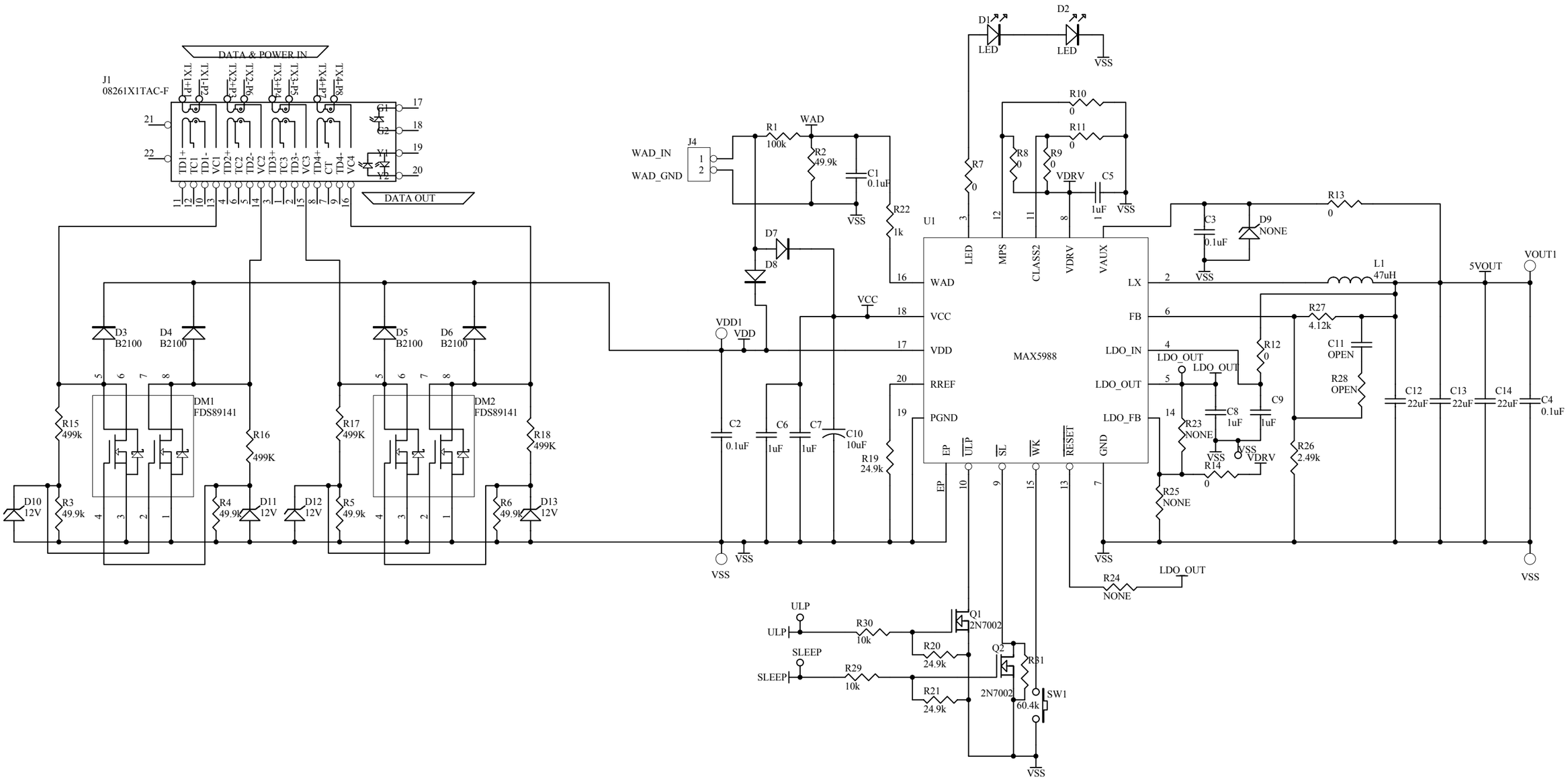
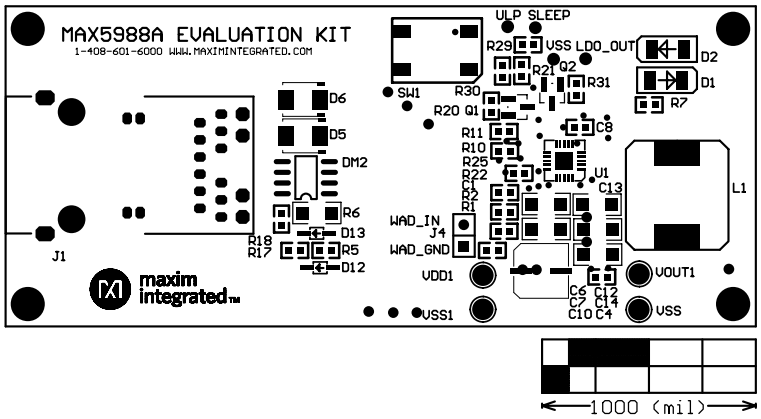
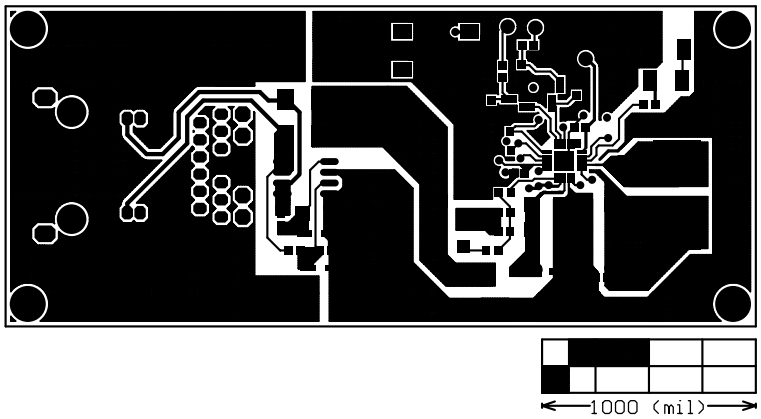
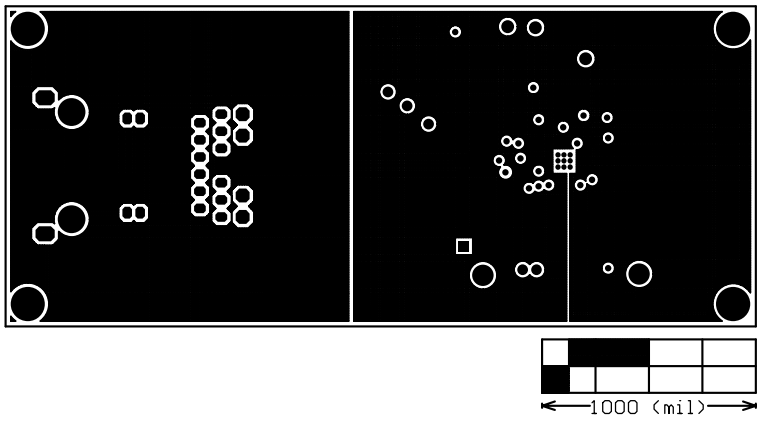
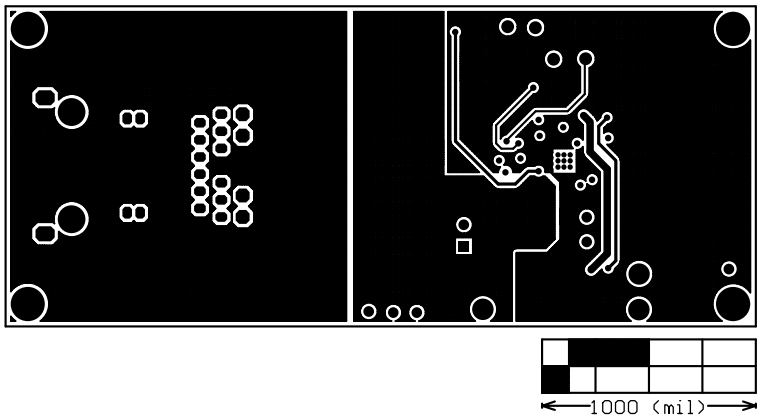
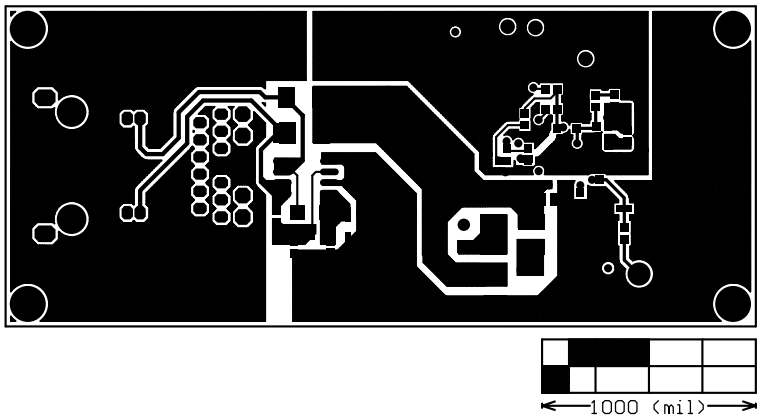

DATA & POWER IN
J1
08261X1TAC-F
TX1+P1
TX1-P2
TX2+P3
TX2-P6
TX3+P4
TX3-P5
TX4+P7
TX4-P8
TD1+
TC1
TD1-
VC1
TD2+
TC2
TD2-
VC2
TD3+
TC3
TD3-
VC3
TD4+
CT
TD4-
VC4
G1
G2
Y1
Y2
DATA OUT
D3 B2100
D4 B2100
D5 B2100
D6 B2100
DM1 FDS89141
DM2 FDS89141
R15 499k
R16 499K
R17 499K
R18 499K
D10 12V
R3 49.9k
R4 49.9k
D11 12V
D12 12V
R5 49.9k
R6 49.9k
D13 12V
WAD_IN
WAD_GND
J4
R1 100k
R2 49.9k
WAD
C1 0.1uF
R22 1k
D7
D8
VDD1
VDD
C2 0.1uF
C6 1uF
C7 1uF
C10 10uF
R19 24.9k
VSS
D1 LED
D2 LED
R10 0
R11 0
R7 0
R8 0
R9 0
VDRV
C5 1uF
U1
LED
MPS
CLASS2
VDRV
VAUX
WAD
VCC
VDD
RREF
PGND
EP
ULP
SL
WK
RESET
GND
LX
FB
LDO_IN
LDO_OUT
LDO_FB
MAX5988
C3 0.1uF
D9 NONE
R13 0
L1 47uH
5VOUT
VOUT1
R27 4.12k
R12 0
C11 OPEN
R28 OPEN
C8 1uF
C9 1uF
R23 NONE
R14 0
R25 NONE
R26 2.49k
C12 22uF
C13 22uF
C14 22uF
C4 0.1uF
R24 NONE
ULP
R30 10k
Q1 2N7002
R20 24.9k
SLEEP
R29 10k
Q2 2N7002
R31 60.4k
SW1
R21 24.9k


MAX5988A EVALUATION KIT
1-408-601-6000 WWW.MAXIMINTEGRATED.COM
maxim integrated™
ULP SLEEP
VSS LDO_OUT
SW1
R29
R21
Q2
R31
D2
D1
R7
R30
R20 Q1
C8
R11
R10
R25
R22
C1
R2
R1
U1
C13
L1
D6
D5
DM2
R6
D13
R5
D12
R18
R17
J1
WAD_IN
J4
WAD_GND
VDD1
VOUT1
VSS1
VSS
C6 C12
C7 C14
C10 C4
1000 (mil)


1000 (mil)


1000 (mil)


1000 (mil)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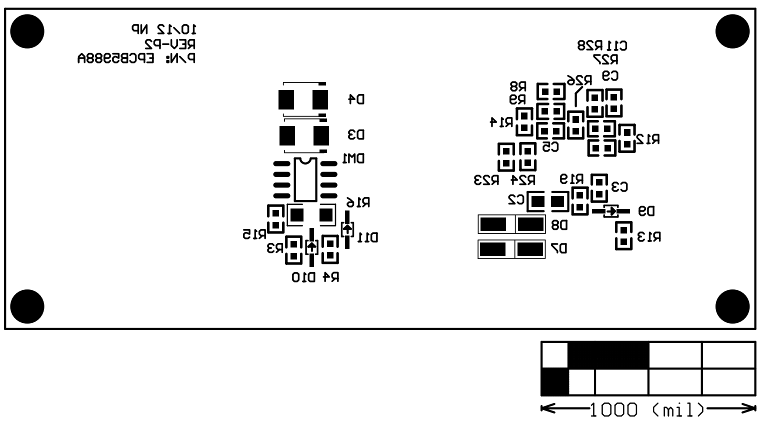
10/12 NP
REV-P2
P/N: EPCB5988A
D4
D3
DM1
R16
R15
R3
D11
R4 D10
C11 R28
R27
C9
R26
R8
R9
R14
R12
C5
R24 R23
R19
C3
C2
D9
D8
D7
R13
1000 (mil)