MxC™ 200 TL EVB Manual

MxC™ 200 Evaluation Boards

Helix Semiconductors offers three MxC 200 DC-DC TL (Transformerless Isolation) Evaluation Board configurations: 10W 48V to isolated unregulated 12V output, 3W 6V to isolated unregulated 6V output and 5W 48V to isolated unregulated ±12V and regulated 5V output. Each evaluation board is self-contained and ready for use.

Wiring connection diagram, schematic and BOM for each board are included in this manual. Gerber files are available upon request.

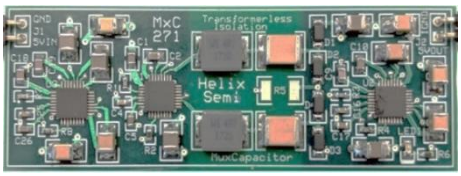
Target Applications

- PoE: Wireless Access Points, Security Cameras, VoIP Phones
- Electric & Hybrid Automobiles
- Industrial Controllers, HVAC
- Industry 4.0 Peripherals
- IoT & IIoT Gateways

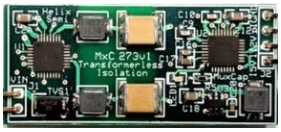
Features

- Three Isolated Configurations
  - 10W 48V to 12V Output
  - 3W 6V to 6V Output
  - 5W 48V to ±12V/5Vreg Outputs
- 88% Efficiency @ 5W
- 86% Efficiency @ 10W
- Highest Power Density
- Low profile board module
- All SMD manufacture
- Adjustable On-Board Oscillator
- Fault Detectors
  - Output Over-Current
  - Thermal Shutdown
- External Control Signals
  - Enable
  - External Clock Enable
  - External Clock Input

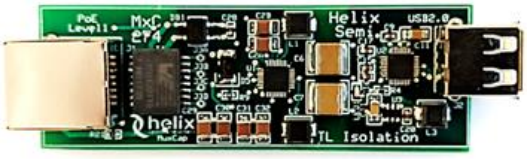
48V to 12V TL Isolation
P/N: MxC 270-EB-C



6V to 6V TL Isolation
P/N: MxC 271-EB-C



48V to ±12V & 5Vreg TL Isolation
P/N: MxC 273-EB-C



PoE Level 1 to USB-A 5Vreg TL Isolation
P/N: MxC 274-EB-C

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4. MxC 270 48V to 12V Output TL EVB

The MxC 270-EB-1 48V to 12V Output TL (Transformer less Isolation) EVB is a standalone isolated Divide-By-4 voltage reducer (Figure 2). The EVB is configured for 10W operation. A 4W configuration is provided (see Figure 4) using cheaper, smaller components.

Isolation is provided via the isolation barrier capacitors. Different types of capacitors are to be used depending on the required equipment safety classification. The 1.5KV capacitors used for 10W operation are not Y1/Y2 safety rated. Safety rated film capacitors can be substituted as required. The 4W TL EVB configuration references Y2 safety rated MLCC capacitors.

The MxC 270 48V to 12V Output TL EVB provides the highest power density for an isolated 12V output configuration. Additionally, a low-profile module can be manufactured using all SMD components.

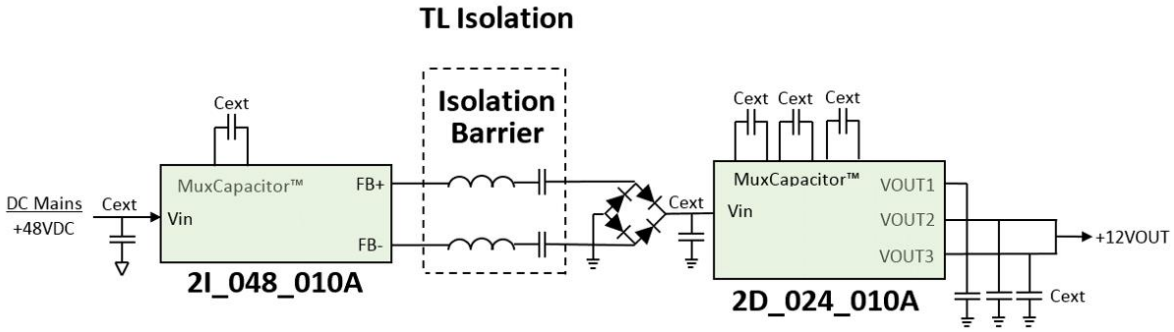

Figure 1: MxC 270 48V to 12V Output TL EVB Block Diagram

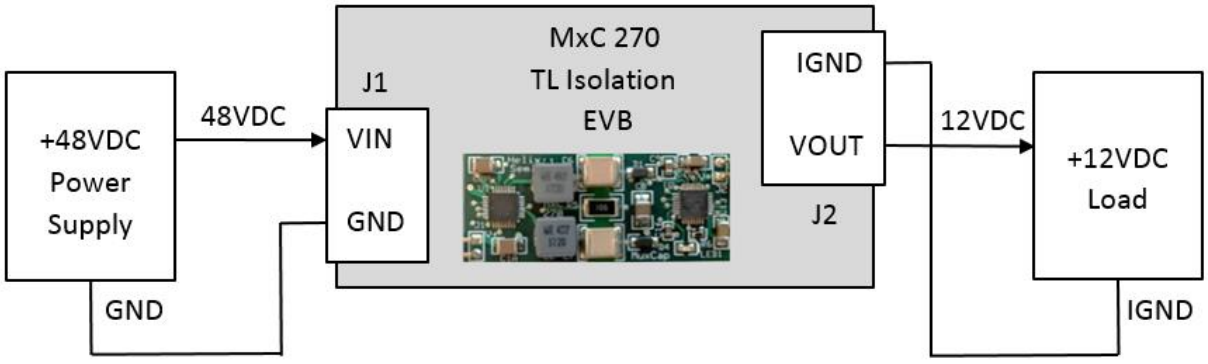

Figure 2: MxC 270 48V to 12V Output TL EVB Standalone Wiring Diagram

Warning: Do not "Hot-Plug" the power supply or electronic load.

Recommended start-up procedure:

1) With power supply turned off, attach power supply wires.
2) With electronic load disabled (monitor mode), attach electronic load wires.
3) Turn on power supply.
4) Enable electronic load with no load current, and then ramp up load current.

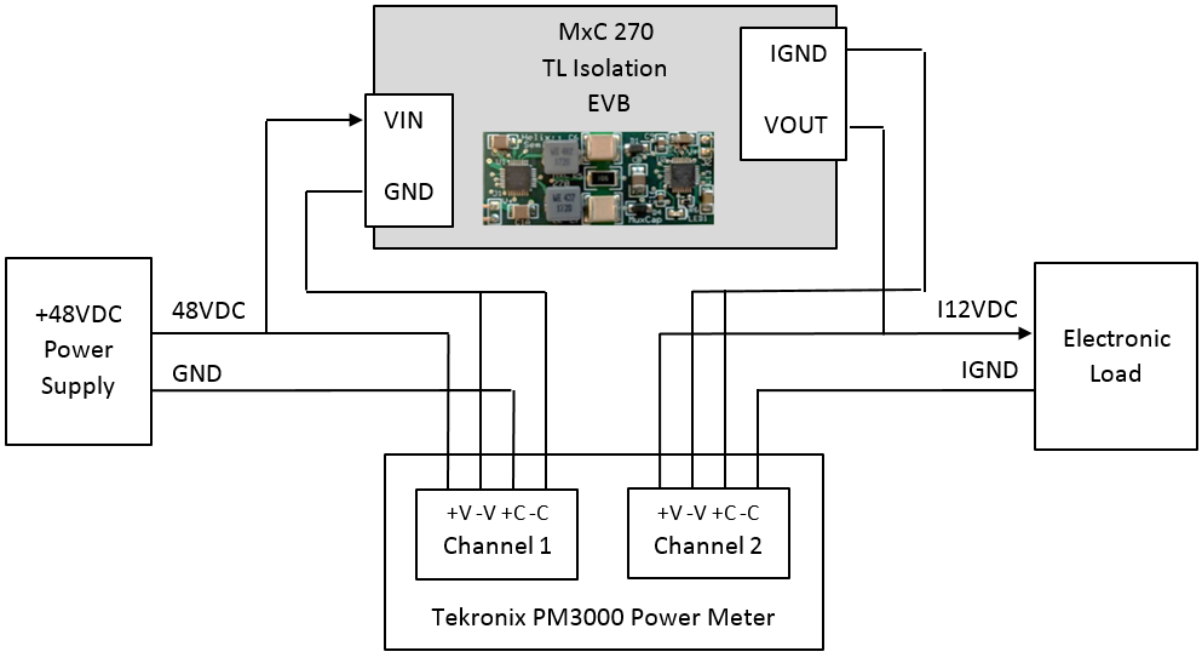

Figure 3: MxC 270 48V to 12V Output TL EVB Test Wiring Diagram

Table 1: MxC 270 48V to 12V Output TL EVB Connectors – J1 and J2

Pin No.	Name	Description
J1-1	VIN	+48VDC Input Power Pin
J1-2	GND	Power GND Pin
J2-1	IVOUT	Isolated unregulated +12VDC Output Power Pin
J2-2	IGND	Isolated Power GND Pin

Note:

1) Due to board's small size, thermal dissipation is limited and may exceed the over-temperature shutdown threshold.
2) The MxC 270 can be powered from 24V delivering 6Vout.

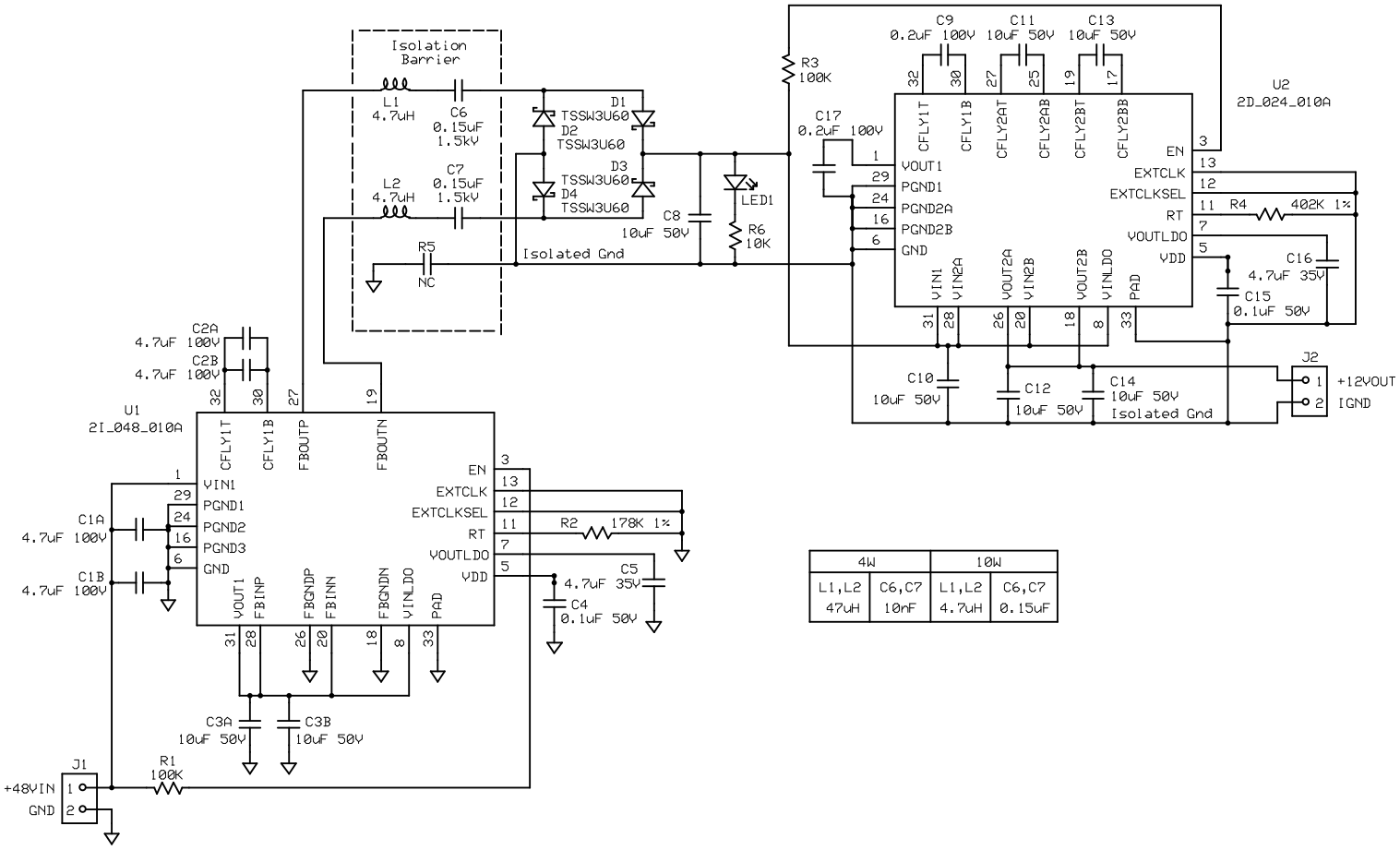

Figure 4: MxC 270 48V to 12V Output TL EVB Schematic

Table 2: MxC 270 48V to 12V Output TL EVB Bill of Materials (BOM)

Qty	Ref. No.	Description	Package	Manufacturer
2	C4, C15	CAP, 0.1µF±10%, 50V	0603 1608 Metric	Wurth Elektronik WCAP-CSGP 885012206095
2	C5, C16	CAP, 4.7µF±10%, 35V	0603 1608 Metric	TDK C1608X5R1V475M080AC
4	C3A, C3B, C8, C10	CAP, 10µF±10%, 50V	1210 3225 Metric	TDK C3225X7S1H106M250AB
4	C11, C12, C13, C14	CAP, 22µF±10%, 35V	1206 3216 Metric	TDK C3216X5R1V226M160AC
2	C9, C17	CAP, 0.22µF±10%, 100V	0805 2012 Metric	TDK C2012X7S2A224K085AE
4	C1A, C1B, C2A, C2B	CAP, 4.7µF±10%, 100V	1210 3225 Metric	TDK C3225X7S2A475M200AB
1	R6	RES, 10KΩ±10%	0603 1608 Metric	Rohm ESR03EZPJ103
2	R1, R3	RES, 100KΩ±10%	0603 1608 Metric	Rohm ESR03EZPJ104
1	R2	RES, 178KΩ±1%	0603 1608 Metric	Rohm MCR03ERTF1783
1	R4	RES, 402KΩ±1%	0603 1608 Metric	Rohm MCR03ERTF4023
1	R5	NC		
4	D1, D2, D3, D4	DIODE, SCHOTTKY	SOD-123W	Taiwan Semiconductor TSSW3U60
1	LED1	LED, Blue	0603 1608 Metric	Visual Communications VAOL-S6SB4
1	U1	IC, 2I_048_010A, QFN5x5, 32P 0.5	QFN32	Helix Semiconductors 2I-048-010A-QFN32-C
1	U2	IC, 2D_024_010A, QFN5x5, 32P 0.5	QFN32	Helix Semiconductors 2D-024-010A-QFN32-C
2	J1, J2	CONN, 2P, M, R/A, 0.100	SIP100P2	Wurth Elektronik WR-PHD 61300211021
2	L1, L2	IND, 4.7uH	7.3mm x 6.60mm	Wurth Electronik WE-LHMI 74437346047
2	C6, C7	CAP, 0.15uF, 1.5KV	2220 5750 Metric	Knowles Syfer 2220Y150154KXTWS2

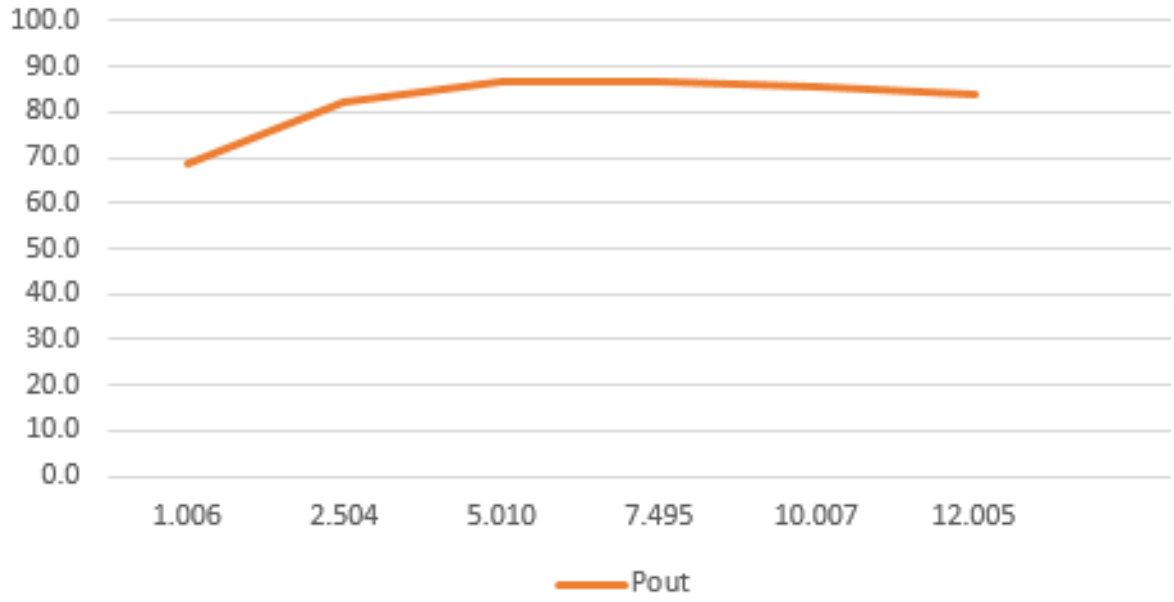

Figure 5: MxC 270 48V to 12V Output TL EVB Efficiency Curve

5. MxC 271 6V to 6V Output TL EVB

The MxC 271-EB-1 6V to unregulated 6V Output TL (Transformer less Isolation) EVB is a standalone isolated unity gain power interface (Figure 7). The EVB is configured for 3W operation. The MxC 271 will operate at 5V at a reduced 2W power level.

Isolation is provided via the isolation barrier capacitors. Different types of capacitors are to be used depending on the required equipment safety classification. The 1.5KV capacitors used for 3W operation are not Y1/Y2 safety rated. Safety rated film capacitors can be substituted as required.

The MxC 271 6V to unregulated 6V Output TL EVB provides the highest power density for a non-transformer based isolated 6V output configuration. Additionally, a low-profile module can be manufactured using all SMD components.

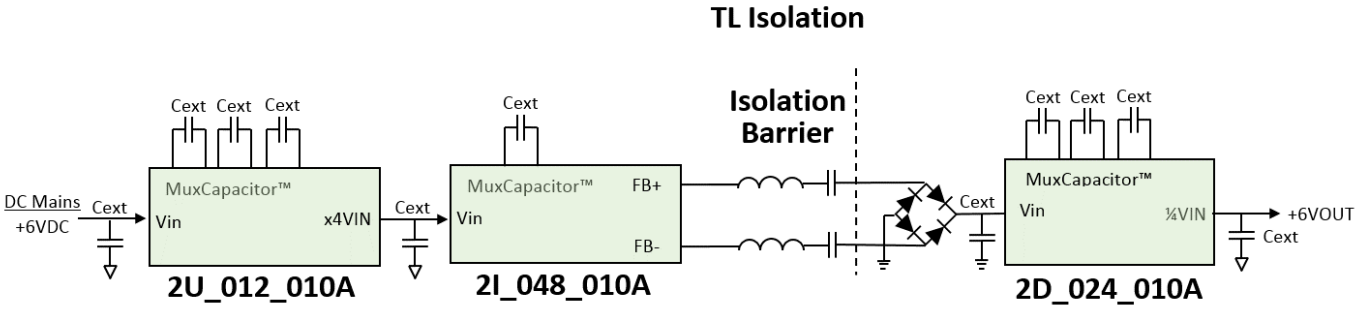

Figure 6: MxC 271 6V to 6V Output TL EVB Block Diagram

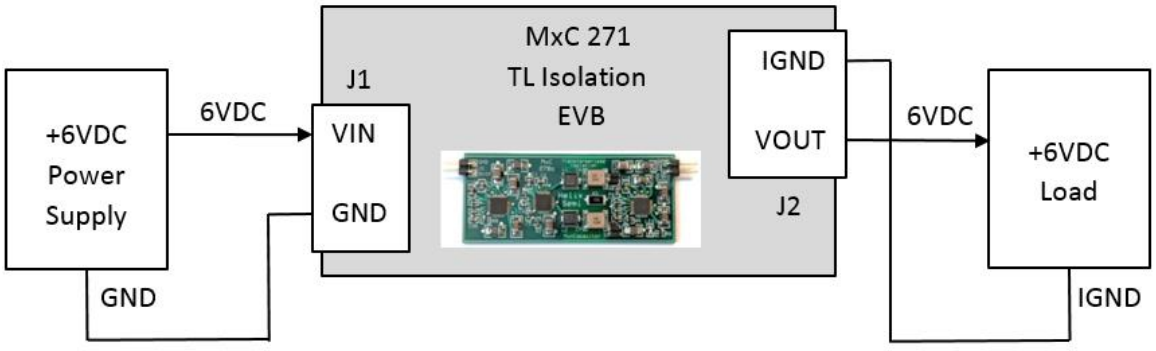

Figure 7: MxC 271 6V to 6V Output TL EVB Standalone Wiring Diagram

Warning: Do not "Hot-Plug" the power supply or electronic load.

Recommended start-up procedure:

1) With power supply off, attach power supply wires.
2) With electronic load disabled (monitor mode), attach electronic load wires.
3) Turn on power supply.
4) Enable electronic load with no load current, and then ramp up load current.

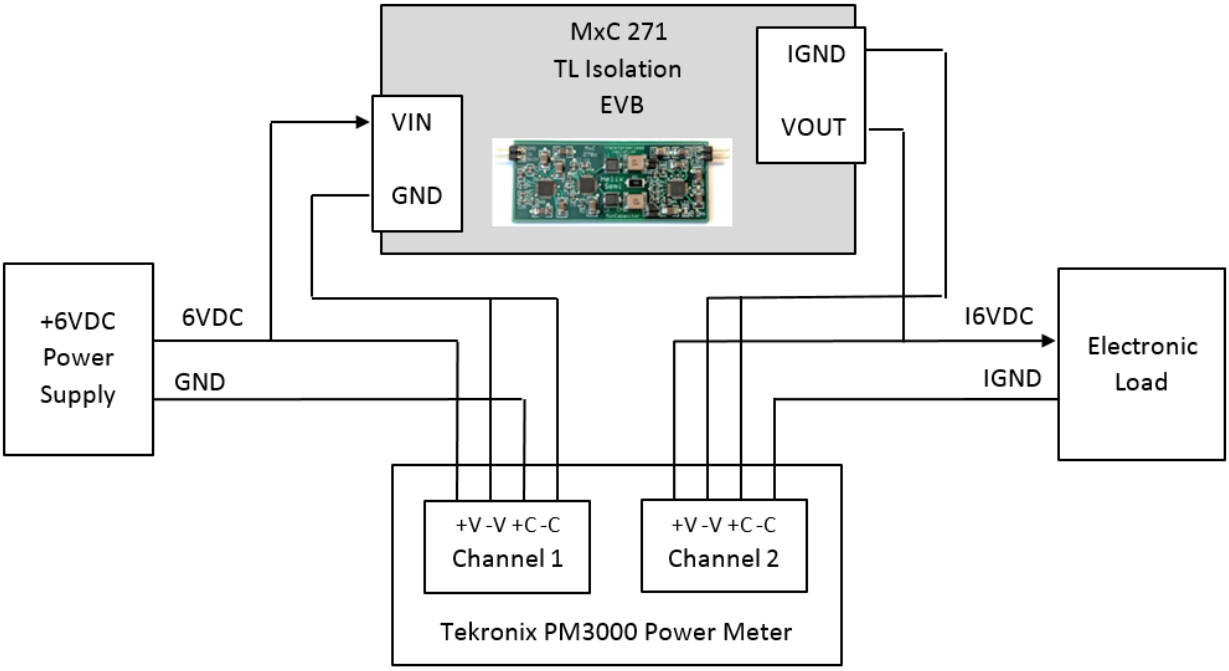

Figure 8: MxC 271 6V to 6V Output TL EVB Test Wiring Diagram

Table 3: MxC 271 6V to 6V Output TL EVB Connectors – J1 and J2

Pin No.	Name	Description
J1-1	VIN	+6VDC Input Power Pin
J1-2	GND	Power GND Pin
J2-1	IVOUT	Isolated unregulated +6VDC Output Power Pin
J2-2	IGND	Isolated Power GND Pin

Note:

1) Due to board's small size, thermal dissipation is limited and may exceed the over-temperature shutdown threshold.

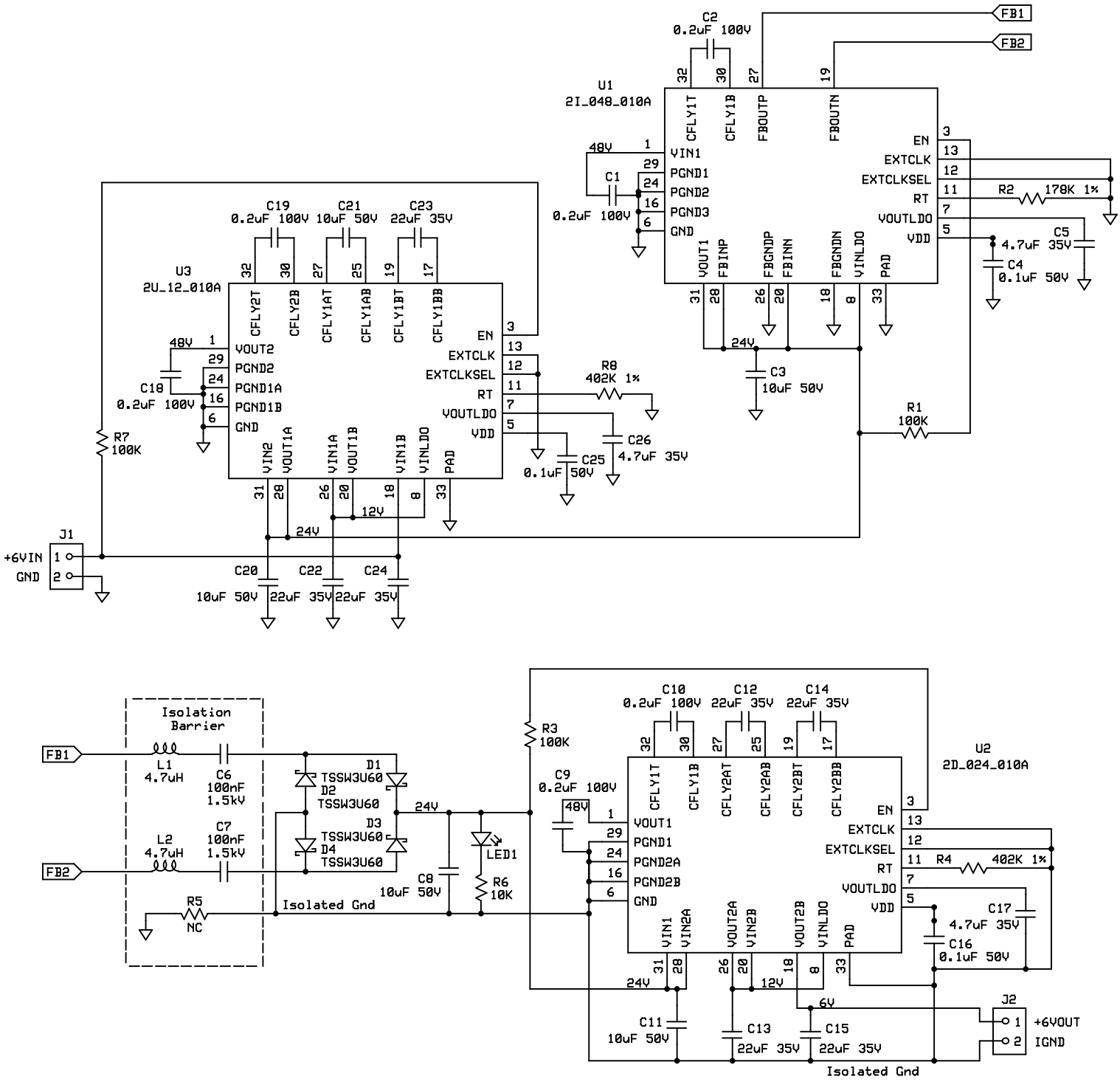

Figure 9: MxC 271 6V to 6V Output TL EVB Schematic

Table 4: MxC 271 6V to 6V Output TL EVB Bill of Materials (BOM)

Qty	Ref. No.	Description	Package	Manufacturer
3	C4, C16, C25	CAP, 0.1µF±10%, 50V	0603 1608 Metric	Wurth Elektronik WCAP-CSGP 885012206095
3	C5, C17, C26	CAP, 4.7µF±10%, 35V	0603 1608 Metric	TDK C1608X5R1V475M080AC
5	C3A, C3B, C8, C11, C20, C21	CAP, 10µF±10%, 50V	1210 3225 Metric	TDK C3225X7S1H106M250AB
7	C12, C13, C14, C15, C22, C23, C24	CAP, 22µF±10%, 35V	1206 3216 Metric	TDK C3216X5R1V226M160AC
6	C1, C2, C9, C10, C18, C19	CAP, 0.22µF±10%, 100V	0805 2012 Metric	TDK C2012X7S2A224K085AE
1	R6	RES, 10KΩ±10%	0603 1608 Metric	Rohm ESR03EZPJ103
3	R1, R3, R7	RES, 100KΩ±10%	0603 1608 Metric	Rohm ESR03EZPJ104
1	R2	RES, 178KΩ±1%	0603 1608 Metric	Rohm MCR03ERTF1783
2	R4, R8	RES, 200KΩ±1%	0603 1608 Metric	Rohm MCR03ERTF2003
1	R5	RES, 10MΩ±10%	2512 6432 Metric	Stackpole RMCF2512JT10M0
4	D1, D2, D3, D4	DIODE, SCHOTTKY	SOD-123W	Taiwan Semiconductor TSSW3U60
1	LED1	LED, Blue	0603 1608 Metric	Visual Communications VAOL-S6SB4
1	U1	IC, 2I_048_010A, QFN5x5, 32P 0.5	QFN32	Helix Semiconductors 2I-048-010A-QFN32-C
1	U2	IC, 2D_024_010A, QFN5x5, 32P 0.5	QFN32	Helix Semiconductors 2D-024-010A-QFN32-C
1	U3	IC, 2U_012_010A, QFN5x5, 32P 0.5	QFN32	Helix Semiconductors 2D-012-010A-QFN32-C
2	J1,J2	CONN, 2P, M, R/A, 0.100	SIP100P2	Wurth Elektronik WR-PHD 61300211021
2	L1, L2	IND, 4.7uH	7.3mm x 6.60mm	Wurth Electronik WE-LHMI 74437346047
2	C6, C7	CAP, 0.1uF, 1.5KV	2220 5750 Metric	AVX 2220AC104KAT1A

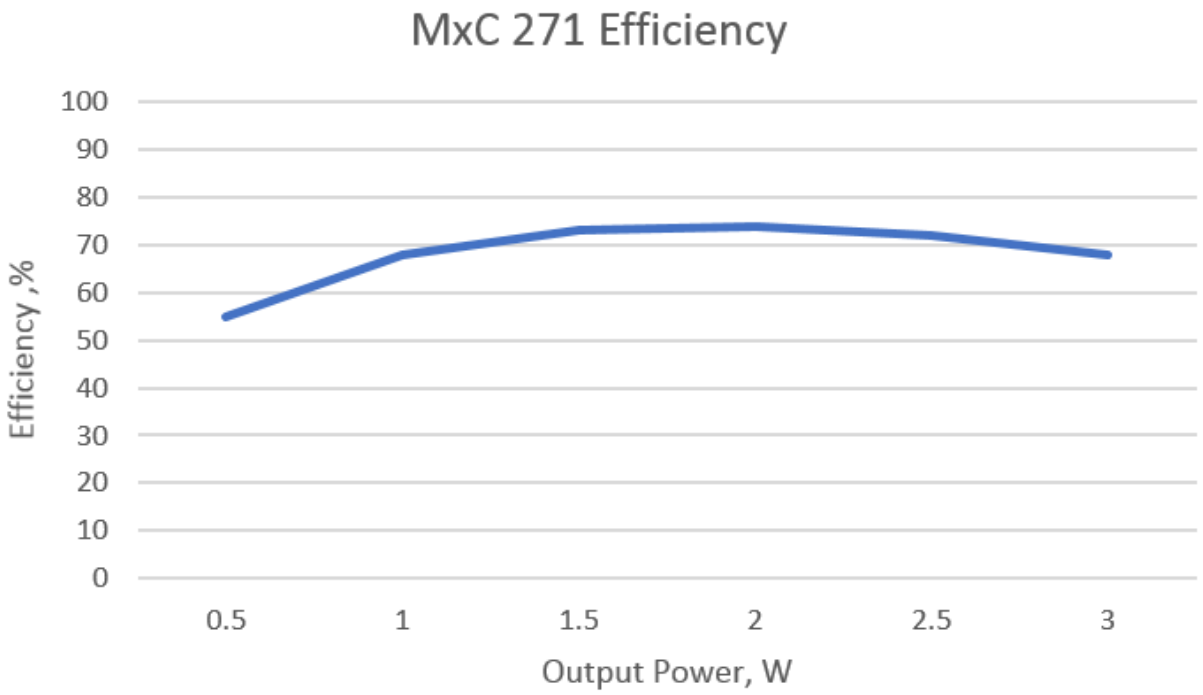

Figure 10: MxC 271 6V to 6V Output TL EVB Efficiency Curve

6. MxC 273 48V to ±12V & +5V Buck Reg. Output EVB

The MxC 273-EB-C 48V to unregulated ±12V & regulated +5V Output TL (Transformerless Isolation) EVB is a standalone isolated Divide-By-4 voltage reducer with a PoL regulator (Figure 12). The EVB's +12V and 5V outputs are configured for 5W operation combined. The -12V output is rated to 1W. A 10W power configuration can be constructed by combining the MxC 290 with the MxC 292.

Isolation is provided via the isolation barrier capacitors. Different types of capacitors are to be used depending on the required equipment safety classification. The 1.5KV capacitors used for 5W operation are not Y1/Y2 safety rated. Safety rated film capacitors can be substituted as required.

The MxC 273 48V to ±12V & regulated +5V Output TL EVB provides the highest power density for an isolated multi-output 12V & 5V configuration. Additionally, a low-profile module can be manufactured using all SMD components.

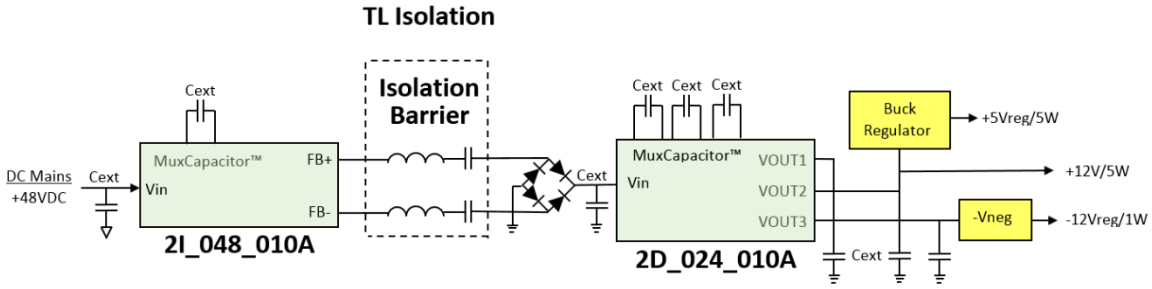

Figure 11: MxC 273 48V to ±12V & +5Vreg Output TL EVB Block Diagram

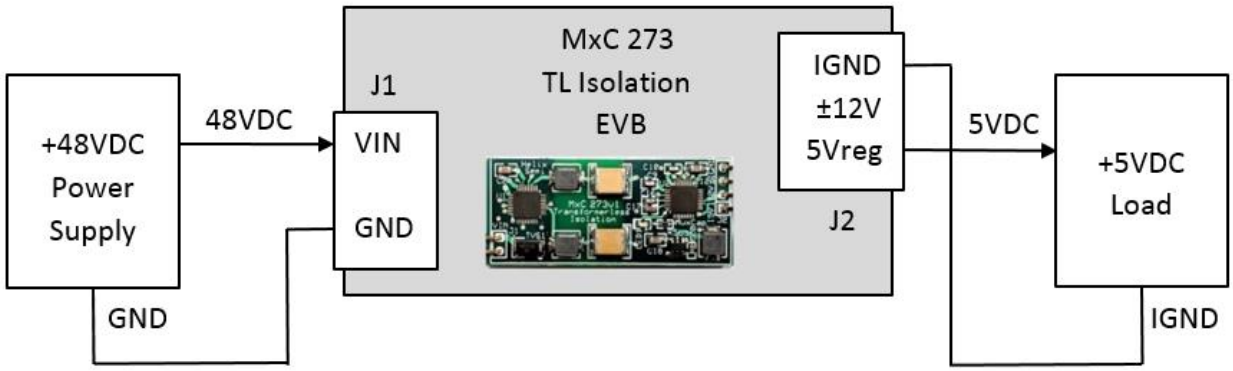

Figure 12: MxC 273 48V to ±12V & +5Vreg Output TL EVB Standalone Wiring Diagram

Warning: Do not “Hot-Plug” the power supply or electronic load.

Recommended start-up procedure:

1) With power supply off, attach power supply wires.
2) With electronic load disabled (monitor mode), attach electronic load wires.
3) Turn on power supply.
4) Enable electronic load with no load current, and then ramp up load current.

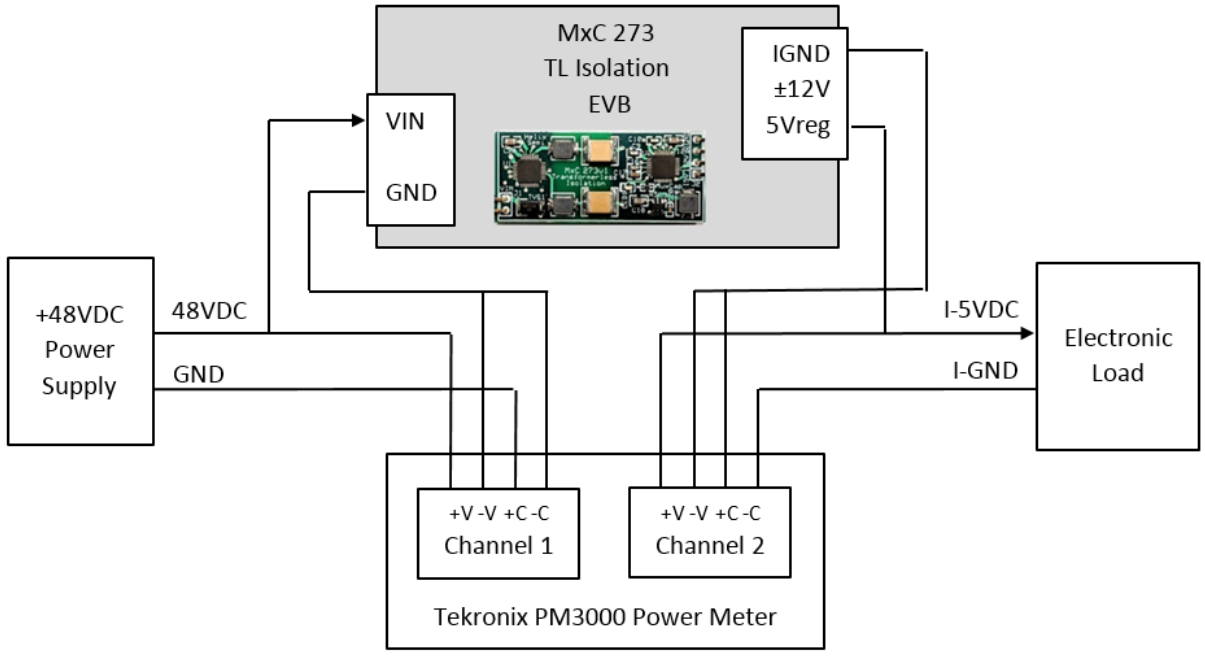

Figure 13: MxC 273 48V to ±12V & +5Vreg Output TL EVB Test Wiring Diagram

Table 5: MxC 273 48V to ±12V & +5Vreg Output TL EVB Connectors – J1 and J2

Pin No.	Name	Description
J1-1	VIN	+48VDC Input Power Pin
J1-2	GND	Power GND Pin
J2-1	I5VREG	Isolated regulated +5VDC Output Power Pin
J2-2	I+12V	Isolated unregulated +12VDC Output Power Pin
J2-3	I-12V	Isolated unregulated -12VDC Output Power Pin
J2-4	IGND	Isolated Power GND Pin

Note:

1) Due to board's small size, thermal dissipation is limited and may exceed the over-temperature shutdown threshold.
2) The MxC 273 can be powered from 24V delivering 6V to the buck regulator at reduced output power. The minimum VIN for the TPS565201 is 4.5V.
3) Other buck regulator output voltages are available by changing R8. Refer to the VOUT Table in Figure 14 schematic.

Table 6: MxC 273 48V to ±12V & +5Vreg Output TL EVB Bill of Materials (BOM)

Qty	Ref. No.	Description	Package	Manufacturer
3	C4, C16, C20	CAP, 0.1µF±10%, 50V	0603 1608 Metric	Wurth Elektronik WCAP-CSGP 885012206095
2	C5, C17	CAP, 4.7µF±10%, 35V	0603 1608 Metric	TDK C1608X5R1V475M080AC
5	C3A, C3B, C8, C11, C18	CAP, 4.7µF±10%, 50V	0805 2012 Metric	SAMSUNG CL21A4475KBQNNNE
5	C12A, C12B, C13, C14, C15	CAP, 10µF±10%, 35V	0805 2012 Metric	MURATA GRM21BCBYA106KE11L
2	C9, C10	CAP, 0.1µF±10%, 100V	0805 2012 Metric	TDK C2012X7S2A104K085AE
4	C1A, C1B, C2A, C2B	CAP, 1µF±10%, 100V	0805 2012 Metric	TDK C2012X7S2A105K125AE
1	R3	RES, 10KΩ±10%	0603 1608 Metric	Rohm ESR03EZPJ103
3	R1, R4, R6	RES, 100KΩ±10%	0603 1608 Metric	Rohm ESR03EZPJ104
1	R2	RES, 178KΩ±1%	0603 1608 Metric	Rohm MCR03ERTF1783
1	R5	RES, 402KΩ±1%	0603 1608 Metric	Rohm MCR03ERTF4023
4	D1, D2, D3, D4	DIODE, SCHOTTKY, 60V, 3A	SOD-123W	Taiwan Semiconductor TSSW3U60
1	U1	IC, 2I_048_010A, QFN5x5, 32P 0.5	QFN32	Helix Semiconductors 2I-048-010A-QFN32-C
1	U2	IC, 2D_024_010A, QFN5x5, 32P 0.5	QFN32	Helix Semiconductors 2D-024-010A-QFN32-C
1	J1	CONN, 2P, M, R/A, 0.100	SIP100P2	Wurth Elektronik WR-PHD 61300211021
1	J2	CONN, 4P, M, R/A, 0.100	SIP100P4	Wurth Elektronik WR-PHD 61300411021
2	L1, L2	IND, 10uH, 1.5A	4.45mm x 4.06mm	Wurth Electronik WE-LHMI 74437324100
1	L3	IND, 4.7uH, 2.2A	4.45mm x 4.06mm	Wurth Electronik WE-LHMI 74437324047
2	C6, C7	CAP, 0.1uF, 1.5KV	2220 5750 Metric	AVX 2220AC104KAT1A
1	C19	CAP, 1µF±10%, 16V	0603 1608 Metric	Wurth Elektronik WCAP-CSGP 885012106017
1	R8	RES, 59.0KΩ±1%	0603 1608 Metric	Rohm MCR03ERTF5903

1	R7	RES, 10.0KΩ±1%	0603 1608 Metric	Rohm MCR03ERTF1003
1	U3	IC, TPS565201	TSOP8	TI TPS565201D
1	D5	DIODE, SCHOTTKY, DUAL	SOT23	ST Microelectronics BAT54SFFILMY
1	TVS1	TVS, 54V, Uni-Polar	SMA	Wurth Elektronik 824500541
1	LED1	LED, Blue	0603 1608 Metric	VCC VROL-98SB4

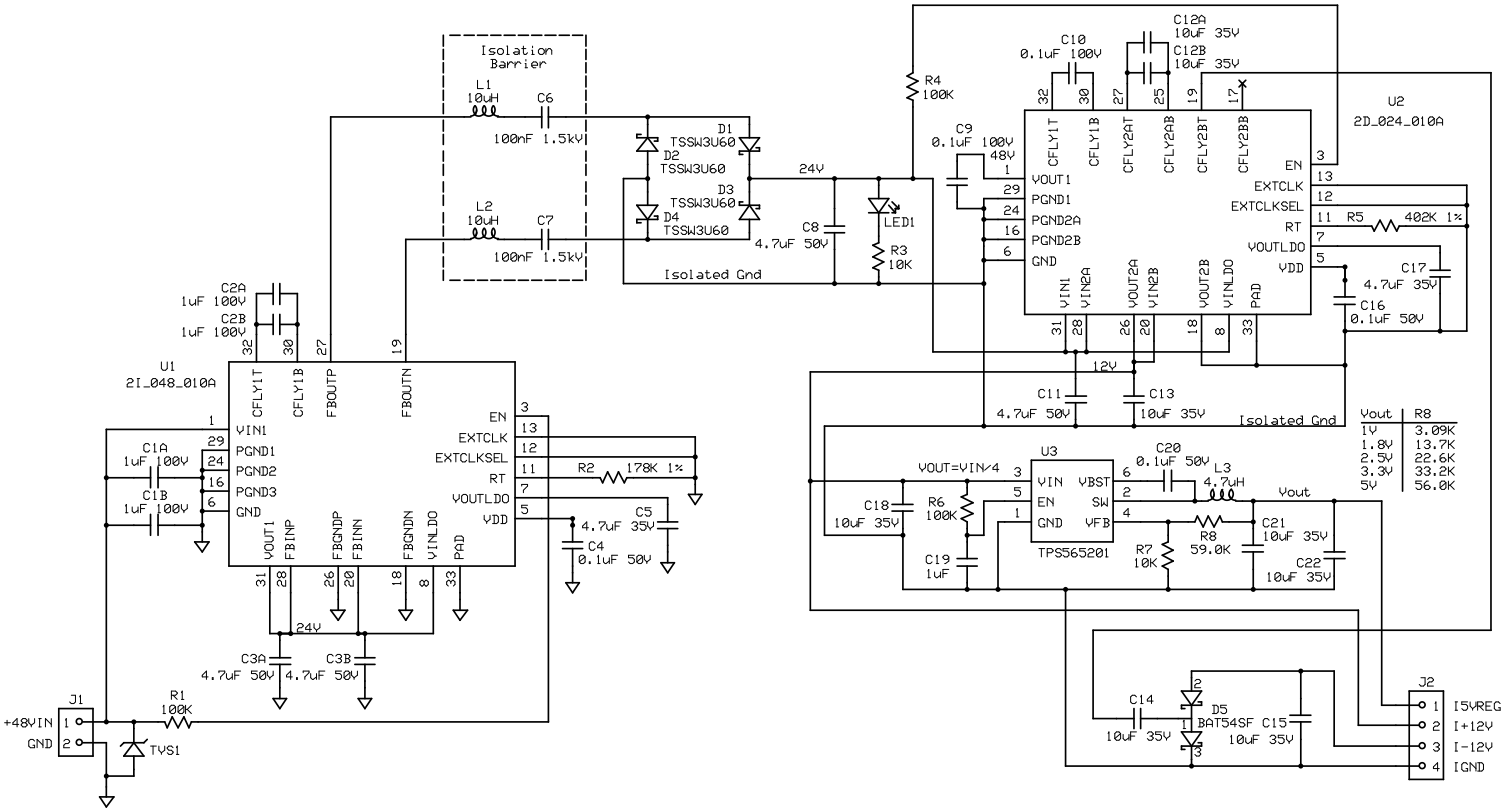

Figure 14: MxC 273 48V to ±12V & +5Vreg Output TL EVB Schematic

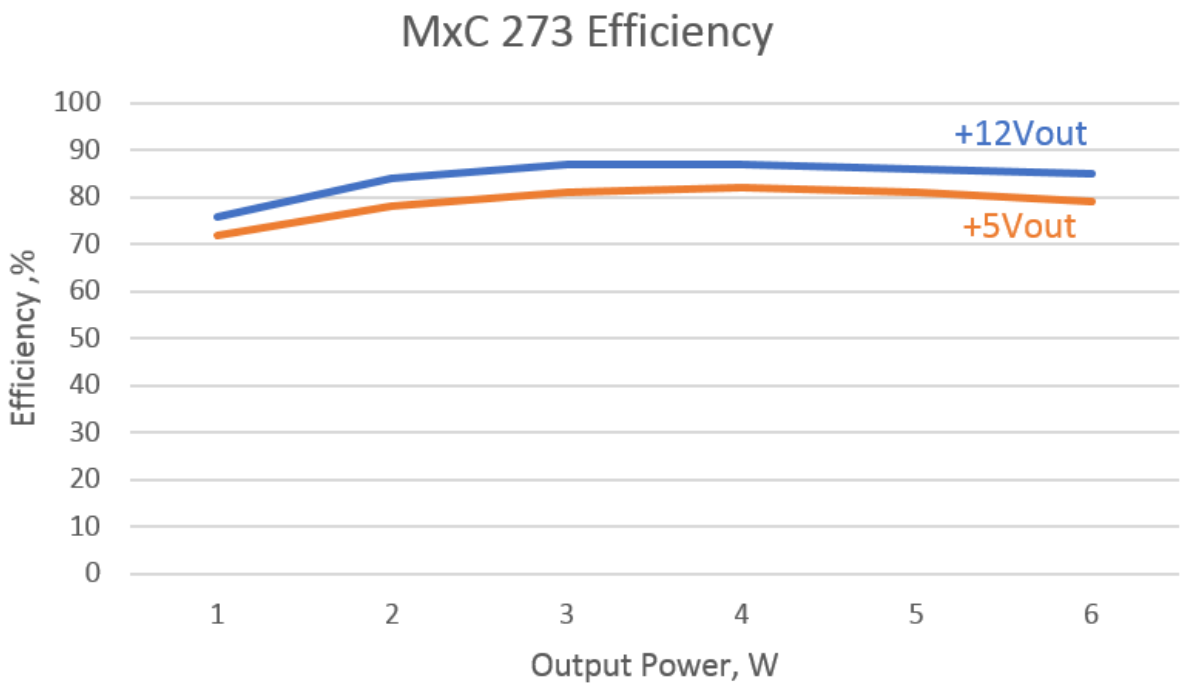

Figure 15: MxC 273 48V to ±12V & +5Vreg Output TL EVB Efficiency Curve

7. MxC 274 PoE Level 1 to USB-A +5V Buck Reg. Output EVB

The MxC 274-EB-C PoE Level 1 to USB-A regulated +5V Output TL (Transformerless Isolation) EVB is a standalone isolated Divide-By-4 voltage reducer with a PoL regulator (Figure 16). The On Semi NCP1090 PD Controller is configured to advertise a Level 1 power requirement. The EVB's 5V output is configured for 5W operation. A 10W power configuration can be constructed by combining the MxC 290 with the MxC 292.

Isolation is provided via the isolation barrier capacitors. Different types of capacitors are to be used depending on the required equipment safety classification. The 1.5KV capacitors used for 5W operation are not Y1/Y2 safety rated. Safety rated film capacitors can be substituted as required.

The MxC 274 PoE Level 1 to USB-A regulated +5V Output TL EVB provides the highest power density for an isolated 5V configuration. Additionally, a low-profile module can be manufactured using all SMD components.

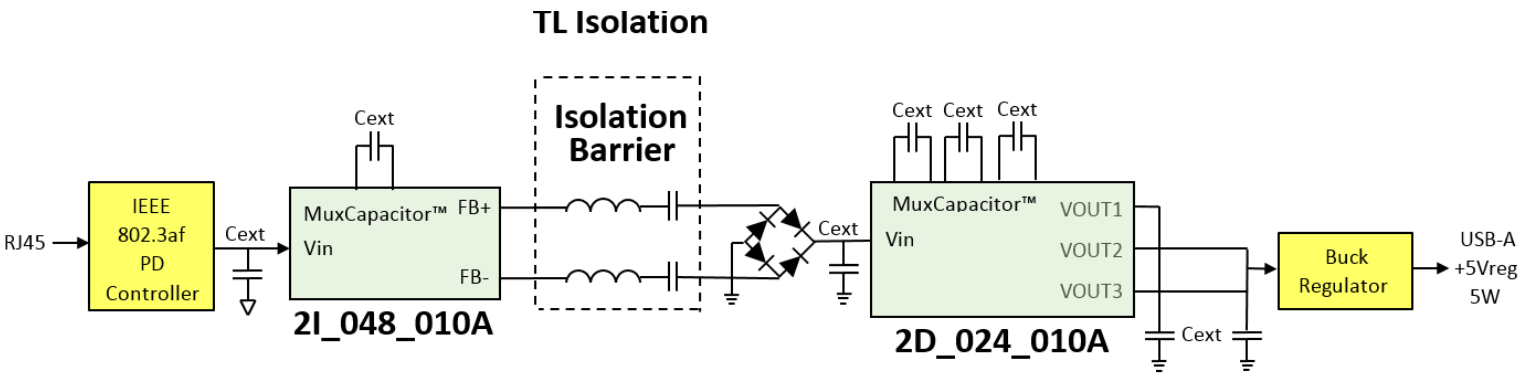

Figure 16: MxC 274 PoE Level 1 to USB-A +5Vreg Output TL EVB Block Diagram

Figure 17: MxC 274 PoE Level 1 to USB-A +5Vreg Output TL EVB Standalone Wiring Diagram

Warning: Do not “Hot-Plug” the electronic load.

Recommended start-up procedure:

1) Confirm which wire pairs power is delivered on. Board defaults to TP1/2 and TP5/6. Refer to Figure 19 for reconfiguring R13-R20 for alternate wire pair. Figure 20 provides a universal pass-through configuration.
2) With electronic load disabled (monitor mode), attach electronic load wires.
3) Attach CAT5 cable to RJ-45 and PoE switch.
4) Confirm switch and MxC 274 pair properly.
5) Enable electronic load with no load current, and then ramp up load current.

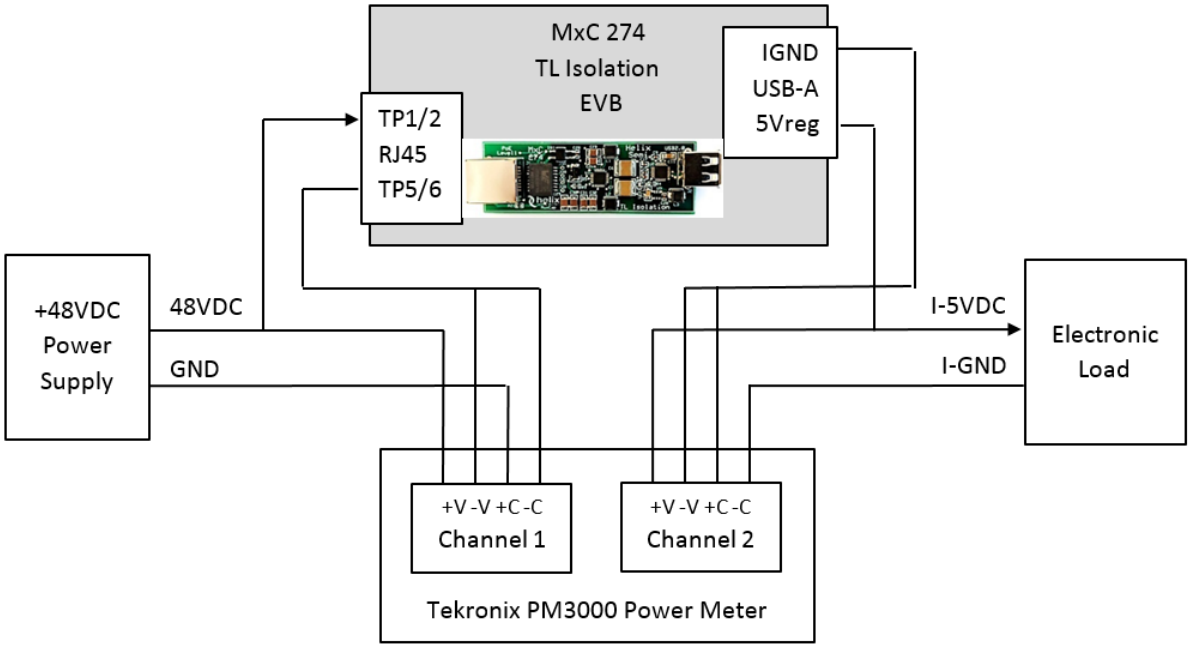

Figure 18: MxC 274 PoE Level 1 to USB-A +5Vreg Output TL EVB Test Wiring Diagram

Table 7: MxC 274 PoE Level 1 to USB-A +5Vreg Output TL EVB Connectors – J1 and J2

Pin No.	Name	Description
J1-1	TP1A	CAT5 twisted pair signal
J1-2	TP1B	CAT5 twisted pair signal
J1-3	TP2A	CAT5 twisted pair signal
J1-4	TP3A	CAT5 twisted pair signal
J1-5	TP3B	CAT5 twisted pair signal
J1-6	TP2B	CAT5 twisted pair signal
J1-7	TP4A	CAT5 twisted pair signal
J1-8	TP4B	CAT5 twisted pair signal
J2-1	I5VREG	USB-A Isolated regulated +5VDC Output Power Pin
J2-2	D+	Not Used
J2-3	D-	Not Used
J2-4	IGND	USB-A Isolated Power GND Pin

Note:

1) Due to board's small size, thermal dissipation is limited and may exceed the over-temperature shutdown threshold.
2) The MxC 274 can be powered from 24V delivering 6V to the buck regulator at reduced output power. The minimum VIN for the TPS565201 is 4.5V.
3) Other buck regulator output voltages are available by changing R7. Refer to the VOUT Table in Figure 14 schematic.

Table 8: MxC 274 PoE Level 1 to USB-A +5Vreg Output TL EVB Bill of Materials (BOM)

Qty	Ref. No.	Description	Package	Manufacturer
6	C4, C9, C15, C17, C20, C28	CAP, 0.1µF±10%, 100V	0603 1608 Metric	Samsung CL10B104KC8NNNC
2	C5, C16	CAP, 4.7µF±10%, 35V	0603 1608 Metric	TDK C1608X5R1V475M080AC
11	C3A, C3B, C8, C10, C11, C12, C13, C14, C18, C21, C22	CAP, 10µF±10%, 50V	1206 3216 Metric	Murata GRT31CR61H106ME01L
8	C1A, C1B, C2A, C2B, C29, C30, C31, C32	CAP, 4.7µF±10%, 100V	1210 3225 Metric	TDK C3225X7S2A475M200AB
2	R6, R8	RES, 10KΩ±10%	0603 1608 Metric	Rohm ESR03EZPJ103
3	R1, R3, R5	RES, 100KΩ±10%	0603 1608 Metric	Rohm ESR03EZPJ104
1	R2	RES, 178KΩ±1%	0603 1608 Metric	Rohm MCR03ERTF1783
1	R4	RES, 402KΩ±1%	0603 1608 Metric	Rohm MCR03ERTF4023
4	D1, D2, D3, D4	DIODE, SCHOTTKY, 60V, 3A	SOD-123W	Taiwan Semiconductor TSSW3U60
1	U1	IC, 2I_048_010A, QFN5x5, 32P 0.5	QFN32	Helix Semiconductors 2I-048-010A-QFN32-C
1	U2	IC, 2D_024_010A, QFN5x5, 32P 0.5	QFN32	Helix Semiconductors 2D-024-010A-QFN32-C
1	J1	CONN, RJ45, 8P, R/A	RJ-45	Wurth Elektronik 615008140121
1	J2	CONN, USB-A, 4P, R/A	USB-A	Wurth Elektronik 61400416021
2	L1, L2	IND, 4.7uH, 2.2A	4.45mm x 4.06mm	Wurth Electronik WE-LHMI 74437324047
1	L3	IND, 4.7uH, 3.8A	7.3mm x 6.60mm	Wurth Electronik WE-LHMI 74437346047
2	C6, C7	CAP, 0.15uF, 1.5KV	2220 5750 Metric	Kemet C225X154KDRACTU
1	C19	CAP, 1µF±10%, 16V	0603 1608 Metric	Wurth Elektronik WCAP-CSGP 885012106017

1	R7	RES, 59.0KΩ±1%	0603 1608 Metric	Rohm MCR03ERTF5903
1	U3	IC, TPS565201	TSOP8	TI TPS565201D
1	LED1	LED, Blue	0603 1608 Metric	VCC VAOL-S6SB4
1	T1	TRFMR, 10/100 BASE-T	SOW16	Wurth Elektronik 7490120110
1	U4	IC, 802.3AF PD CTRLR	8TSSOP	On Semi NCP1090DBRG
1	DB1	DIODE, BRIDGE, SCHOTTKY, 100V, 1A	MBS-1	MCC MB110S-TP
1	D5	TVS, 54V	DO214AC	Wurth Elektronik 824500541
	C24, C27	CAP, 1nF±10%, 50V	0603 1608 Metric	Murata GRM1885C2A102JA01D
	C25, C26	CAP,10nF±10%, 50V	0603 1608 Metric	AVX 06031C103JAT2A
6	R12, R13, R15, R17, R19, R21	RES, 0Ω±10%	0603 1608 Metric	Yageo RC0603JR-070RL
4	R22, R23, R24, R25	RES, 75KΩ±10%	0603 1608 Metric	Yageo RC0603FR-0775RL
1	R11	RES, 953Ω±1%	0603 1608 Metric	Yageo RC0603FR-07953RL
1	R9	RES, 24.9KΩ±1%	0603 1608 Metric	Yageo RC0603FR-0724K9L
1	R10	RES, 95.3KΩ±1%	0603 1608 Metric	Yageo RC0603FR-0795K3L
	C23, R14, R16, R18, R20, J3A, J3B, J3C, J3D	No component, Do not install		

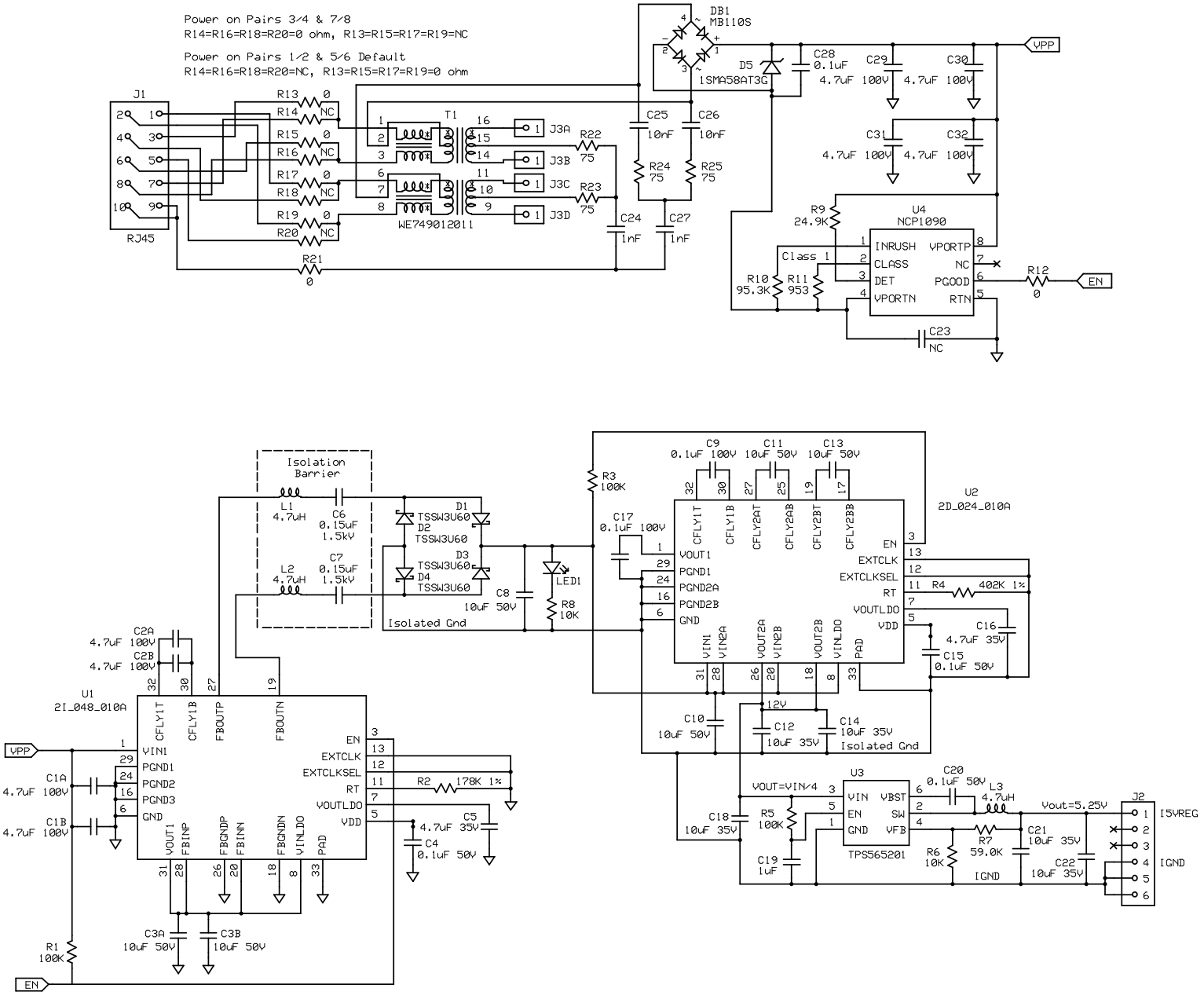

Figure 19: MxC 274 PoE Level 1 to USB-A +5Vreg Output TL EVB Schematic

The RJ-45 connection in Figure 19 assumes a known configuration for the assigned power wire pairs. Resistors R13-R20 must be properly configured for the appropriate power wire pairs. Also, test points are provided onboard for connection to the data signals. The following figure shows a universal power and data pass-through configuration

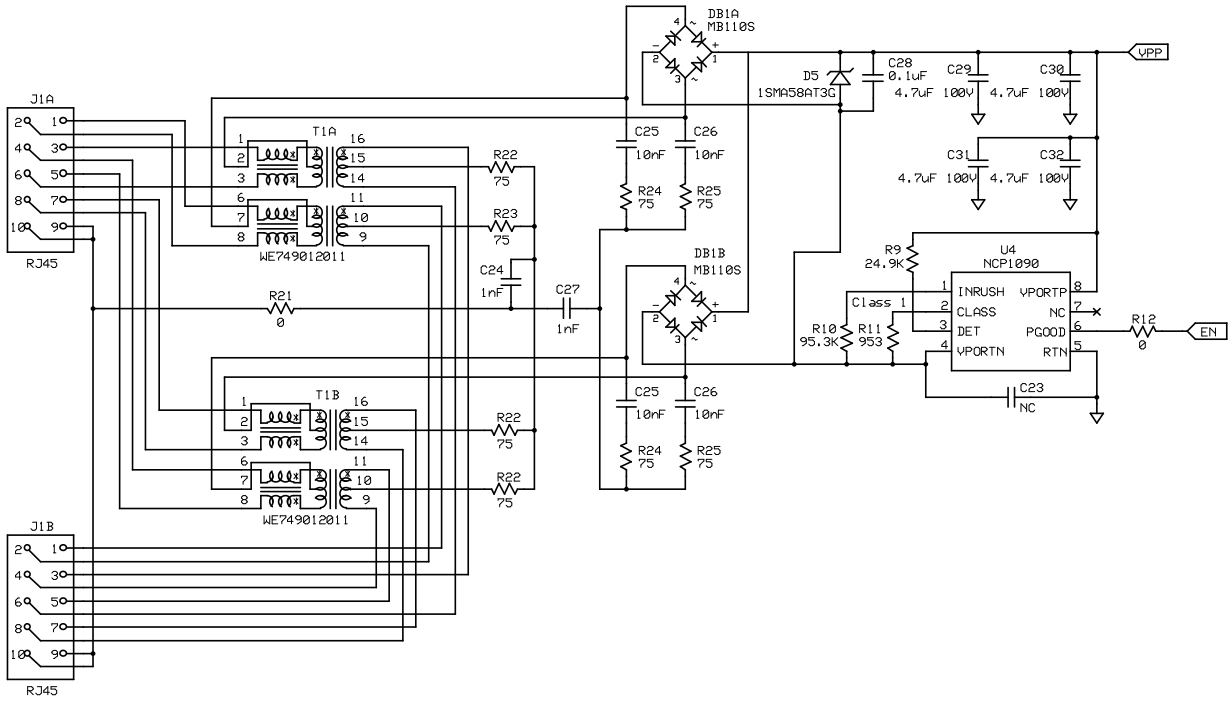

Figure 20: MxC 274 PoE Universal Pass-Through Schematic

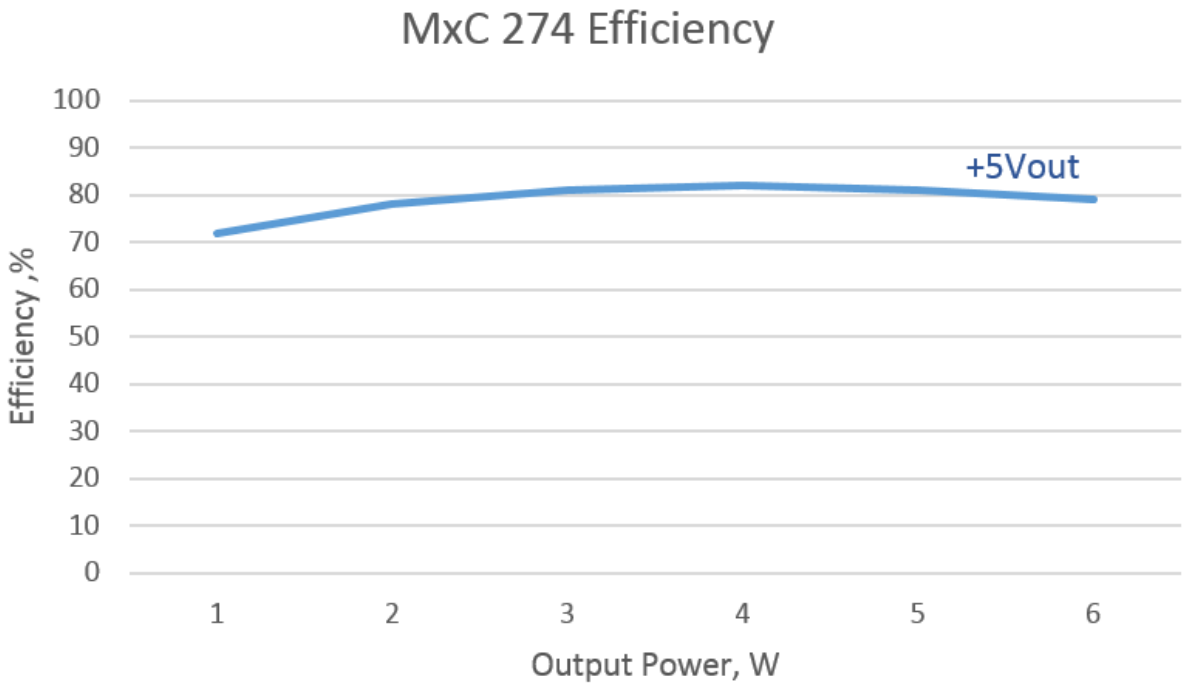

Figure 21: MxC 274 PoE Level 1 to USB-A +5Vreg Output TL EVB Efficiency Curve

8. Output Current Sharing

The MxC 200 MuxCapacitor outputs can be wire-OR'ed for higher output current capacity. No special synchronization is required. The following example uses the Single 12V Output MxC 270 EVB. Each individual MxC 200 cell can be connected in parallel with the corresponding cells of another identical board so all the VIN1 pins are connected together. Similarly, all respective GND pins, VOUT1, VOUT2, and VOUT3 pins are connected together in parallel as well for maximum efficiency. The individual flycap connections are still used separately.

Figure 22: MxC 270 Output Current Sharing 20W 48V-to-12V TL EVM

9. Performance Data

The previous MuxCapacitor efficiency data was measured using a Tektronix PM3000 power meter. The figure below shows the test equipment wiring diagram.

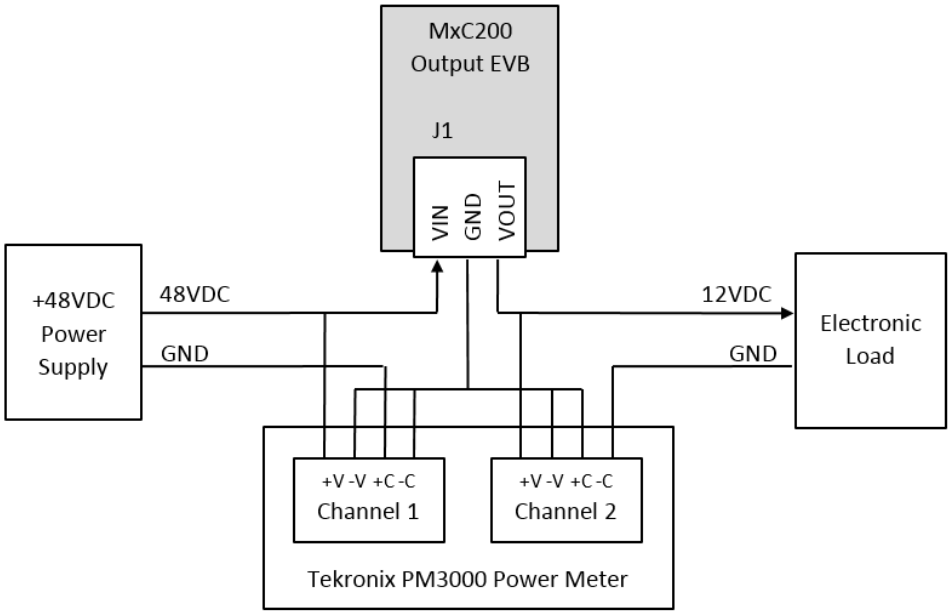

Figure 23: Efficiency Measurement Wiring Diagram

9.1. Operational Guidelines

It is recommended that the auto-ranging feature of current meters be disabled when performing efficiency measurements. The MxC 200 over current detector can trip when the current meter switches between ranges.

The startup waveform of VIN must be monotonic.

Depending on the startup load and VIN rise time, the startup over current detector can trip. A high startup load condition plus distributed filter capacitance could cause an over-current shutdown.

10. Flying Capacitor Value Verses Efficiency

The MxC 200 flying capacitors can be reduced in value for lower output power applications. Lower cost, smaller package size, etc. are tradeoffs that can affect the efficiency performance.

The Flying Capacitor's value is critical to the maximum load operating performance of the MuxCapacitor. If the flying capacitance is too small the efficiency of the MuxCapacitor decreases. Too little capacitance for the required output current effectively behaves as an increase in the impedance of the MuxCapacitor cell.

The effective operating capacitance of ceramic capacitors are subject to a DC Bias derating. As the DC voltage across the capacitor increases, the capacitor's capacitance value decreases. This DC Bias effect must be considered when operating the capacitor too close to its maximum rated voltage or selecting smaller case sizes.

There are other trade-offs that must be analyzed for reliable, efficient and safe capacitor operation.

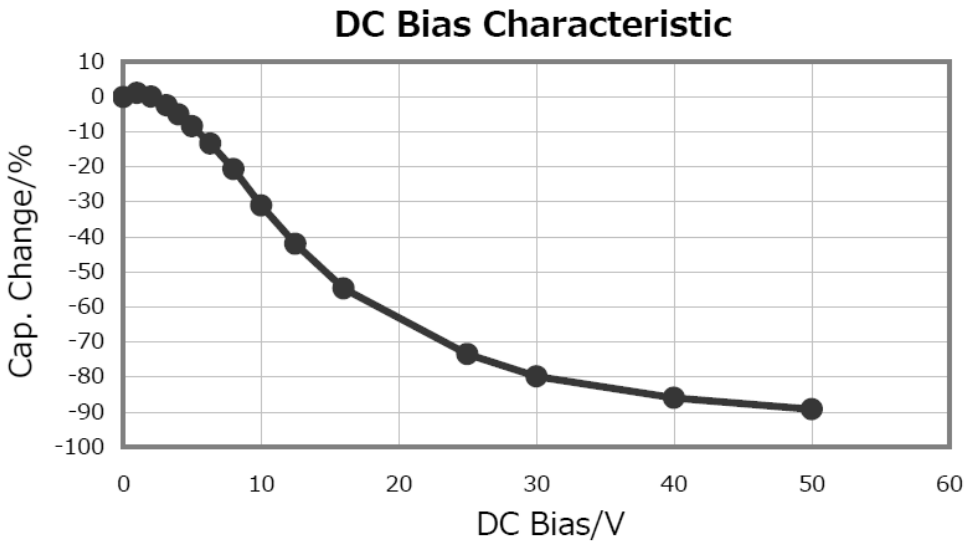

Figure 24: Typical Capacitance verses DC Bias, 50V Device

Table 9: Revision History

Date	Revision	Description
11.17.18	1	Initial release
1.30.19	2	Revised part numbers
2.26.19	3	Schematic updates
3.8.19	4	Add MxC 274 PoE
4.5.19	5	Updated PoE Schematic & BOM

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