User's Manual

ISL8274MEVAL1Z

User's Manual: Evaluation Board

Industrial Analog and Power

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1. Overview

The ISL8274M is a dual-channel, step-down DC/DC power supply module capable of delivering up to 30A per channel. With an integrated digital PWM controller, synchronous power switches, an inductor and passives, only input and output capacitors are needed to finish the design. A set of optional external resistors allows the user to easily configure the device for standard operation. For advanced configurations, a standard PMBus interface addresses tasks such as sequencing and fault management, as well as real-time full telemetry and point-of-load monitoring.

The ISL8274M uses ChargeMode™ control architecture, which responds to a transient load within a single switching cycle. Operating across an input voltage range from 4.5V to 14V, the ISL8274M offers adjustable output voltage from 0.6V to 5V.

The ISL8274MEVAL1Z evaluation board is a 4.0inx4.5in 8-layer FR4 board with 2oz. copper on top and bottom layer and 1oz. copper in buried layers. This evaluation board comes with a placeholder for pin-strap resistors to adjust output voltage, switching frequency, input Undervoltage Lockout (UVLO) protection threshold, device PMBus address, overcurrent limit, ASCR setting, and soft start setting. More configurations can be easily programmed or changed using a PMBus compliant serial bus interface.

The ZLUSBEVAL3Z (USB to PMBus adapter) is provided with this evaluation board, which connects the evaluation board to a PC to activate the PMBus communication interface. The PMBus command set is accessed by using the PowerNavigator™ evaluation software from a PC running Microsoft Windows. The ISL8274MEVAL1Z can operate in Pin-Strap mode without needing the ZLUSBEVAL3Z adapter or PMBus communication.

1.1 Key Features

- V_{IN} range of 4.5V to 14V, V_{OUT} adjustable from 0.6V to 5V. Up to 95.5% efficiency
- Programmable V_{OUT}, margining, UVP/OVP, OTP/UTP, I_{OUT} limit, soft-start/stop, sequencing, and external synchronization
- Monitor: V_{IN}, V_{OUT}, I_{OUT}, temperature, duty cycle, switching frequency, and faults
- ChargeMode control tunable with PMBus
- Mechanical switch for enable and power-good LED indicator

1.2 Specifications

This board has been configured and optimized for the following operating conditions:

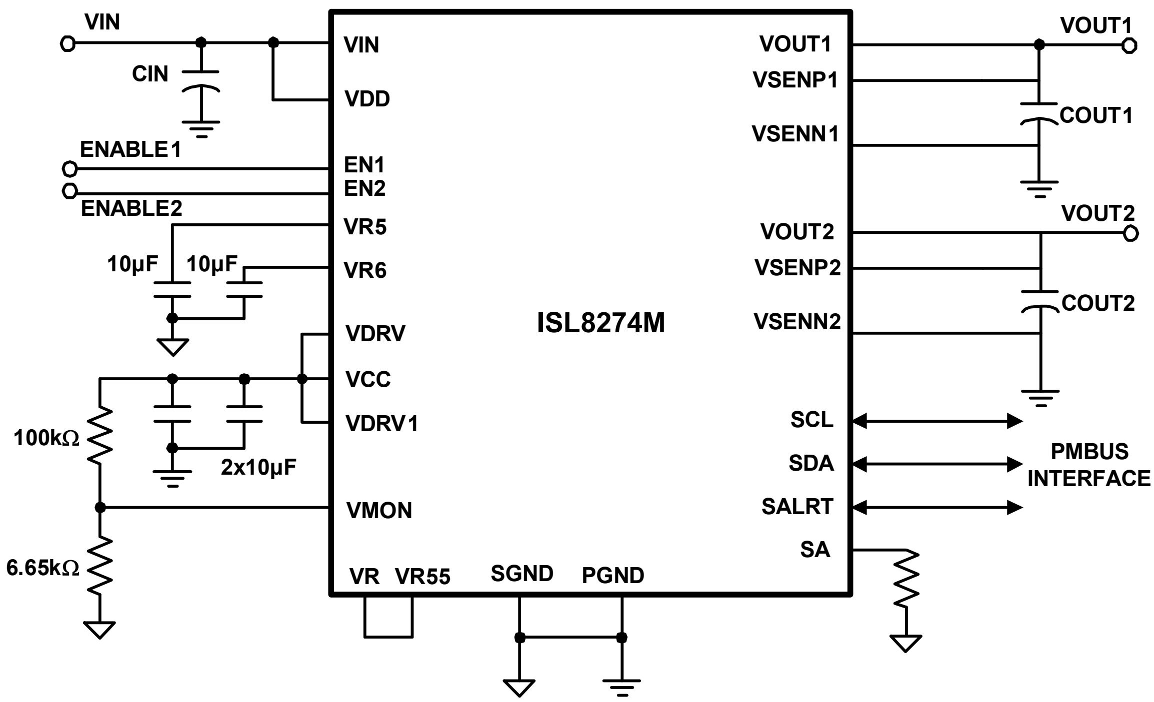
- V_{IN} = 5V to 12V
- V_{OUT} = 1.5V
- I_{MAX} = 30A per channel, IOUT_avg_OCP = 35A per channel
- f_{SW} = 889kHz
- ASCR gain = 525, ASCR residual = 90
- On/off delay = 5ms (Ch1), 5ms (Ch2), on/off ramp time = 2ms (Ch1), 5ms (Ch2)
- Input UVLO = 4.5V
- PMBus address = 0x28h

1.3 Ordering Information

Part Number	Description
ISL8274MEVAL1Z	ISL8274M evaluation board (ZLUSBEVAL3Z adapter and USB cable included)

1.4 Related Literature

- For a full list of related documents, visit our website
  - ISL8274M product page



Note: This figure represents a typical implementation of the ISL8274M. For PMBus operation, it is recommended to tie the enable pin (EN) to SGND.

Figure 1. ISL8274MEVAL1Z Block Diagram

2. Functional Description

The ISL8274MEVAL1Z provides all circuitry required to evaluate the features of the ISL8274M. A majority of the features of the ISL8274M, such as compensation-free ChargeMode control, soft-start delay and ramp times, supply sequencing, and voltage margining are available on this evaluation board. For sequencing evaluation, the board can be connected to any digital module evaluation board that supports the DDC bus. Figures 3 and 4 show the ISL8274MEVAL1Z evaluation board.

2.1 Recommended Equipment

- DC power supply with minimum 15V/40A sourcing capacity
- Electronic load capable of sinking current up to 30A per channel
- Digital Multimeters (DMMs)
- Oscilloscope with higher than 100MHz bandwidth

2.2 Quick Start Guide

2.2.1 Pin-Strap Option

The ISL8274MEVAL1Z can be configured in Pin-Strap mode with standard 1% resistors. The PMBus interface is not required to evaluate ISL8274M in Pin-Strap mode. Output voltages (V_{OUT}), switching frequency (f_{SW}), input Undervoltage Protection (UVLO) threshold, output average overcurrent threshold, tracking mode setting, ASCR setting, output delay/ramp setting and the device PMBus address can be changed by populating the recommended resistors at placeholders provided in the evaluation board.

By default, the evaluation board is programmed to regulate at the following:

- V_{OUT} = 1.5V
- f_{SW} = 889kHz
- UVLO = 4.5V
- OCP = 35A
- tracking disabled
- ASCR_gain = 525
- ASCR_residual = 90
- On/off delay = 5ms (Ch1), 5ms (Ch2)
- On/off ramp time = 2ms (Ch1), 5ms (Ch2)
- PMBus address = 28h.

Follow these steps to evaluate ISL8274M in Pin-Strap mode.

(1) Set the ENABLE switch to “DISABLE” for both channels (SW1 and SW2).

(2) Connect a load to the VOUT1/2 banana connectors (VOUT1/GND and VOUT2/GND).

(3) Connect a power supply to the V_{IN} connectors (VIN/GND). Make sure the power supply is not enabled when making the connection.

(4) Adjust the V_{IN} = 12V and turn the power supply on.

(5) Set the ENABLE switch to “ENABLE” for both channels (SW1 and SW2).

(6) Measure 1.5V V_{OUT} at probe jumpers, VOUT1/GND (J11) and VOUT2/GND (J17).

(7) Observe switching frequency of 889kHz at probe jumpers, PHASE1/GND (J27) and PHASE2/GND (J28). The two phases should be 180° phase shift.

(8) To change the V_{OUT}, disconnect the board from the setup and populate with a 1% standard 0603 resistor at the RVSET1/2 placeholder location on bottom layer. Refer to the “Output Voltage Resistor Settings” table in the ISL8274M datasheet for recommended values. By default, VOUT_MAX is set 110% of V_{OUT} set by the pin-strap resistor.

(9) To change the compensation, disconnect the board from the setup and populate with a 1% standard 0603 resistor at the R14/15 placeholder location on the bottom layer. Refer to the “ASCR Resistor Setting” table in the ISL8274M datasheet for recommended values.

(10) To change the soft-start/stop and tracking setting, disconnect the board from the set up and populate with a 1% standard 0603 resistor at the R6 placeholder location on the bottom layer. Refer to the “Soft-Start/Stop and Tracking Resistor Settings” table in the ISL8274M datasheet for recommended values.

(11) To change the switching frequency and the OCP limit, disconnect the board from the set up and populate with a 1% standard 0603 resistor at RFSET placeholder location on the bottom layer. Refer to the “Switching Frequency and OCP Limit Resistor Setting” table in the ISL8274M datasheet for recommended values.

(12) To change the input UVLO and address, disconnect the board from the set up and populate with a 1% standard 0603 resistor at the R4 placeholder location on the bottom layer. Refer to the “SMBus Address and UVLO Resistor Setting” table in the ISL8274M datasheet for recommended values.

2.2.2 PMBus Option

The ISL8274MEVAL1Z can be evaluated for all features using the provided ZLUSBEVAL3Z dongle and PowerNavigator evaluation software. Follow these steps to evaluate the ISL8274M with the PMBus option.

(1) Install the PowerNavigator software.

(2) Set the ENABLE switch to “DISABLE” for both channels (SW1 and SW2).

(3) Connect a load to the VOUT1/2 banana connectors (VOUT1/GND and VOUT2/GND).

(4) Connect a power supply to the V_{IN} connectors (VIN/GND). Make sure the power supply is not enabled when making the connection.

(5) Adjust the V_{IN} = 12V and turn the power supply on.

(6) Connect the ZLUSBEVAL3Z dongle (USB to PMBus adapter) to ISL8274MEVAL1Z board to the 6-pin male connector labeled as “PMBus DONGLE IN”.

(7) Connect the supplied USB cable from the computer through USB to the ZLUSBEVAL3Z dongle.

(8) Launch the PowerNavigator software.

(9) It is optional to load a predefined setup from a configuration file using the PowerNavigator software. The ISL8274M device on the board operates in Pin-Strap mode from factory default, but the user can modify the operating parameters through the evaluation software or by loading a predefined setup from a configuration file. A sample “Configuration File” on page 19 is provided and can be copied to a text editor to make desired changes. The default pin-strap configurations will be overwritten if a user-defined configuration file is loaded.

(10) Set the ENABLE switch to “ENABLE” for both channels (SW1 and SW2). Alternatively, the PMBus ON_OFF_CONFIG and OPERATION commands can be used from the PowerNavigator software to allow PMBus Enable.

(11) Monitor and configure the ISL8274MEVAL1Z board using the PMBus commands in the evaluation software. To store the configuration changes, disable the module and use the command STORE_USER_ALL. To restore factory default settings, disable the module and use the command RESTORE_FACTORY and STORE_USER_ALL.

(12) PowerNavigator tutorial videos are available on our website.

(13) For sequencing using a Digital-DC™ (DDC) Bus or to evaluate multiple digital power products using a single ZLUSBEVAL3Z dongle, the ISL8274M can be daisy chained with other digital power evaluation boards. The PMBus address can be changed by placing a 1% standard 0603 resistor at the R4 placeholder location on the bottom layer. Refer to the “SMBus Address and UVLO Resistor Setting” table in the ISL8274M datasheet for recommended values.

3. Evaluation Board Information

If the input voltage is less than 5.3V, tie the V_{CC} test point directly to VIN or to a separate 5V power supply for best efficiency. If an external synchronization is used, connect the SYNC test point to the external clock. Note that the external clock signal should be active before the module is enabled.

3.1 V_{OUT} Transient Response Check

The ISL8274MEVAL1Z board has a built-in transient load test circuit (see the schematic in Figure 2). A 100A N-Channel MOSFET (Manufacturer PN: BSC010NE2LSI) is connected across VOUT and PGND. A 10mΩ current-sense resistor R54/R68 is used for monitoring the drain-to-source current of the MOSFET. For a transient load test, inject the gate drive pulse signal at J33/J34. The load current can be monitored through J31/J32. Because the MOSFET will operate in the saturation region instead of the linear region when the gate turn-on signal is applied, the pulse width and duty cycle of the gate signal must be limited small enough to avoid MOSFET overheating (recommended duty cycle should be less than 2%). The amplitude of the gate driver pulse voltage can be adjusted to obtain a desired transient load current step size.

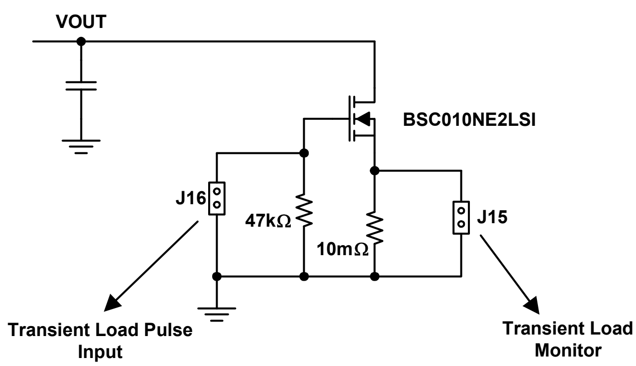


Figure 2. Schematic for Transient Load Measurement

3.2 Thermal Considerations and Current Derating

Board layout is very critical to make the module operate safely and deliver maximum allowable power. To work in the high temperature environments and carry large currents, the board layout needs to be carefully designed to maximize thermal performance. To achieve this, select enough trace width, copper weight, and the proper connectors. The ISL8274MEVAL1Z evaluation board is designed for running 30A per channel at room temperature without additional cooling systems needed. However, if the output voltage is increased or the board is operated at elevated temperatures, then the available current is derated. Refer to the derated current curves in the ISL8274M datasheet to determine the maximum output current the evaluation board can supply. θ_{JA} is measured by inserting a thermocouple inside the module to measure peak junction temperature.

4. PCB Layout Guidelines

To achieve stable operation, low losses, and good thermal performance, some layout considerations are necessary.

- Establish separate SGND plane and PGND planes, then connect SGND to PGND plane on a middle layer and underneath PAD6 with a single point connection. For SGND and PGND pin connections, such as small pins H16, J16, M5, and M17, use multiple vias for each pin to connect to inner SGND or PGND layers.
- Place enough ceramic capacitors between VIN and PGND, VOUT and PGND, and bypass capacitors between VDD, VDRV and the ground plane, as close to the module as possible to minimize high frequency noise. It is very critical to place the output ceramic capacitors close to the VOUT pads and in the direction of the load current path to create a low impedance path for the high frequency inductor ripple current.
- Use large copper areas for power path (VIN, PGND, VOUT) to minimize conduction loss and thermal stress. Also, use multiple vias to connect the power planes in different layers. It is recommended to enlarge PAD11 and 9 to also place more vias on them. The ceramic capacitors CIN can be placed on the bottom layer under these two pads.
- Connect remote sensing traces to the regulation point to achieve a tight output voltage regulation and place the two traces in parallel. Route a trace from VSEN1/2N and VSEN1/2P to the point of load where the tight output voltage is desired. Avoid routing any sensitive signal traces, such as the VSENN, VSENP sensing lines near the SW pins.
- PAD14 and 16 (SW1 and SW2) are noisy pads, but they are beneficial for thermal dissipation. If the noise issue is critical for the applications, it is recommended to use only the top layer for the SW pads. For better thermal performance, use multiple vias on these pads to connect into the SW inner and bottom layers. However, caution must be taken when placing a limited area of SW planes in any layer. The SW planes should avoid the sensing signals and should be surrounded by the PGND layer to avoid the noise coupling.
- For pins SWD1 (L3) and SWD2 (P10), it is recommended to connect to the related SW1 and SW2 pads with short loop traces. The trace width should be more than 20 mils.

4.1 Board Pictures

Figure 3. Bottom of Board

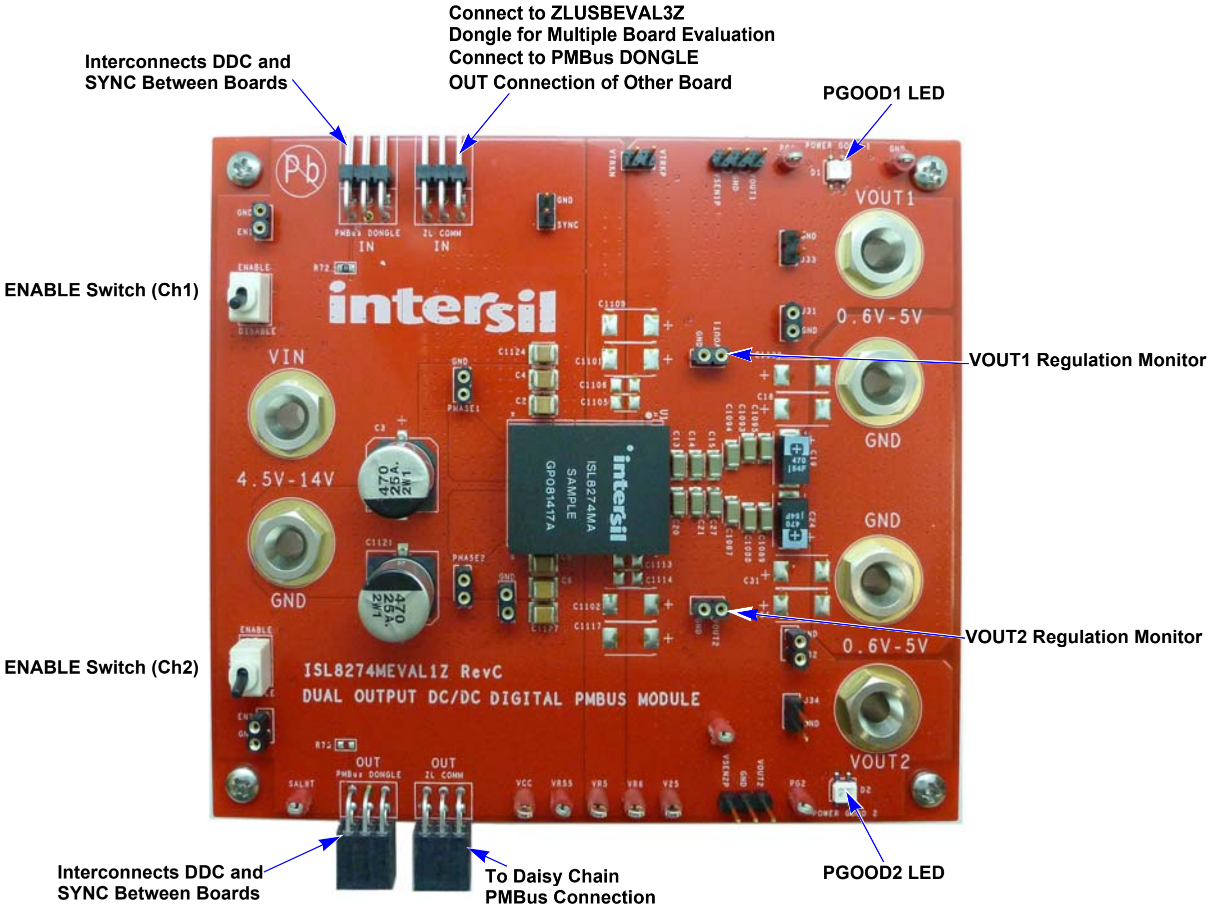


Figure 4. Top of Board

4.2 ISL8274MEVAL1Z Schematic

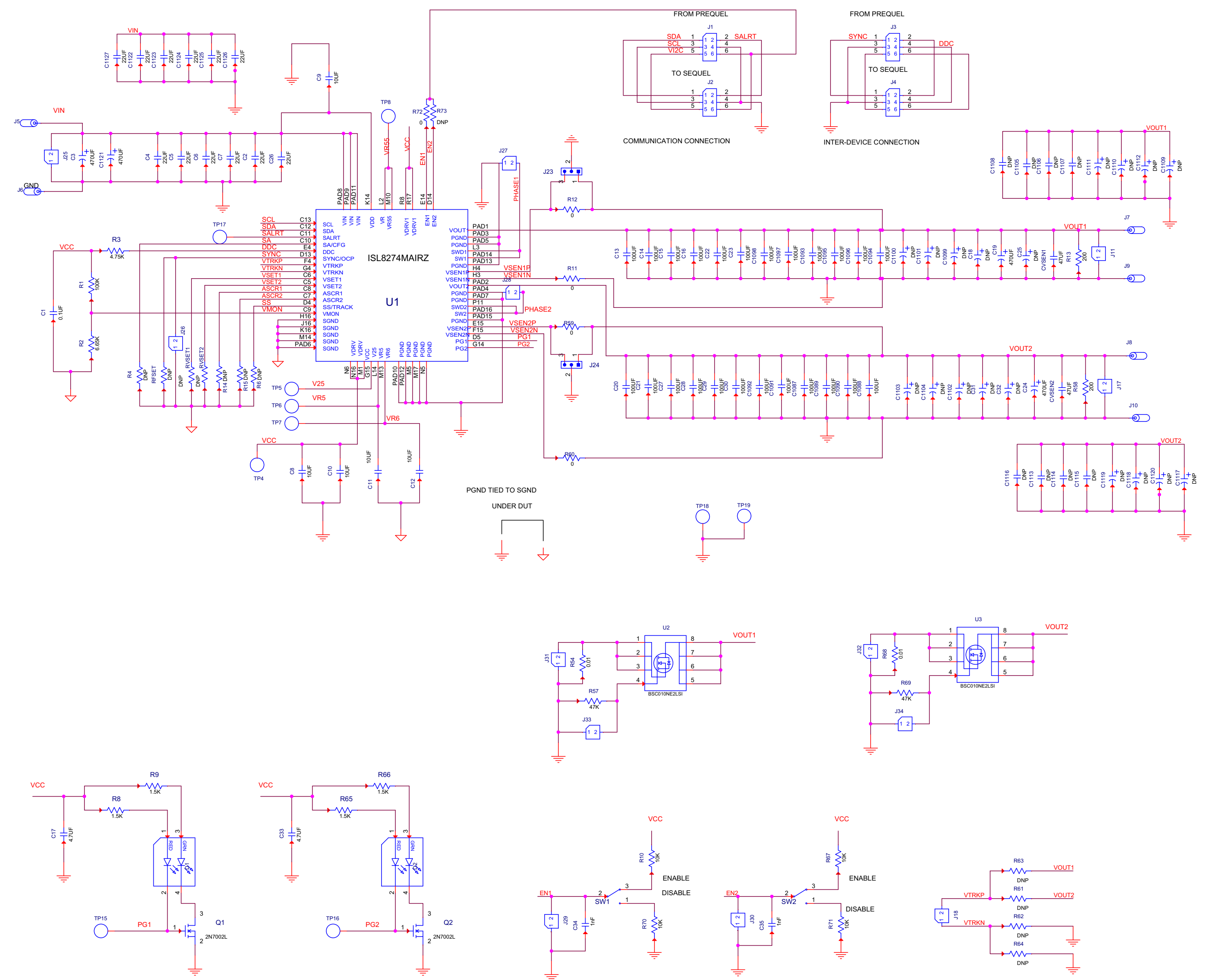


Figure 5. Schematic

4.3 Bill of Materials

Reference Designators	Qty	Manufacturer	Manufacturer Part	Description
CVSEN1, CVSEN2	2	Murata	GRM21BR61A476ME15L	CAP CER 47µF 10V X5R 0805, RoHS
C1	1	Murata	GRM21BR71E104KA01L	CAP CER 0.1µF 25V X7R 0805, RoHS
C2, C4-C7, C26, C1122-C1127	12	Murata	GRM32ER71E226KE15L	CAP, SMD 22µF 25volts X7R 10% 1210, RoHS
C3, C1121	2	Panasonic	EEE1EA471P	Aluminum Electrolytic Capacitors - SMD 470µF 25V, RoHS
C8, C10-C12	4	Murata	GRM31CR71A106KA01L	CAP, SMD 10µF 10volts X7R 10% 1206, RoHS
C9	1	Murata	GRM31CR71E106KA12L	CAP CER 10µF 25V X7R 1206, RoHS
C13-C16, C20-C23, C27-C30, C1087-C1098	24	Murata	GRM31CD80J107ME39L	CAP, SMD 100µF 6.3Volts X6T 20% 1206, RoHS
C18, C25, C31, C32, C1099-C1120	DNP			
C17, C33	2	Murata	GRM31CR71A475KA01L	CAP CER 4.7µF 10V X7R 1206, RoHS
C19, C24	2	Panasonic	6TPF470MAH	CAP TANT POLY 470µF 6.3V 2917, RoHS
C34, C35	2	Murata	GRM188R71H102KA01D	CAP CER 1000PF 50V X7R 0603, RoHS
D1, D2	2	Lumex Opto	SSL-LXA3025IGC	Green, Red LED Indication - Discrete 2.2V Green, 2V Red 4-SMD, RoHS
J1, J3	2	Samtec	TSW-103-08-T-D-RA	6 Positions Header, Unshrouded Connector 0.100" (2.54mm) Through Hole, Right Angle Tin, RoHS
J2, J4	2	Samtec	SSQ-103-02-T-D-RA	6 Position Receptacle Connector 0.100" (2.54mm) Through Hole, Right Angle Tin, RoHS
J5-J10	6	Clinch Connectivity	108-0740-001	Banana Jack Connector Standard Banana Threaded, External (Nut), RoHS
J11, J17, J25, J27-J32	9	Mill-Max	310-93-164-41-001000	2 Positions Receptacle Socket, Unshrouded Connector 0.100" (2.54mm) Through Hole Gold, RoHS
J18, J26, J33, J34	4	Amphenol	77311-118-02LF	2 Positions Header, Unshrouded Connector 0.100" (2.54mm) Through Hole Gold, RoHS
J23, J24	2	Amphenol	68000-103HLF	3 Positions Header, Unshrouded Connector 0.100" (2.54mm) Through Hole Gold, RoHS
Q1, Q2	2	ON Semi	2N7002LT1G	MOSFET N-CH 60V 0.115A SOT-23, RoHS
R1	1	Yageo	RC0603FR-07100KL	RES SMD 100kΩ 1% 1/10W 0603, RoHS
R2	1	Yageo	RC0603FR-076K65L	RES SMD 6.65kΩ 1% 1/10W 0603, RoHS
R3	1	Yageo	RC0603FR-074K75L	RES SMD 4.75kΩ 1% 1/10W 0603, RoHS
R4, R6, R14, R15, R61-R64, R73, RFSET, RVSET1, RVSET2	DNP			
R8, R9, R65, R66	4	Yageo	RC0603FR-071K5L	RES SMD 1.5kΩ 1% 1/10W 0603, RoHS
R10, R67, R70, R71	4	Yageo	RC0603FR-0710KL	RES SMD 10kΩ 1% 1/10W 0603, RoHS

Reference Designators	Qty	Manufacturer	Manufacturer Part	Description
R11, R12, R59, R60, R72	5	Yageo	RC0603JR-070RL	RES SMD 0.0Ω 1/10W 0603, RoHS
R13, R58	2	Yageo	RC0603FR-07200RL	RES SMD 200Ω 1% 1/10W 0603, RoHS
R54, R68	2	Vishay	WSL2512R0100FEA	RES SMD 0.01Ω 1% 1W 2512, RoHS
R57, R69	2	Yageo	RC0603FR-0747KL	RES SMD 47kΩ 1% 1/10W 0603, RoHS
SW1, SW2	2	C&K	GT13MCBE	Switch Toggle SPDT 0.4VA 20V, RoHS
TP4-TP8, TP15-TP19	10	Keystone	5005	Red PC Test Point, Compact Phosphor Bronze, Silver Plating 0.063" (1.60mm) Hole Diameter Mounting Type, RoHS
U1	1	Intersil	ISL8274MAIRZ	Digital 25A/25A dual channel DC/DC step down power supply module, HAD, RoHS
U2, U3	2	Infineon	BSC010NE2LSI	MOSFET N-CH 25V 38A TDSON-8, RoHS

4.4 Layout

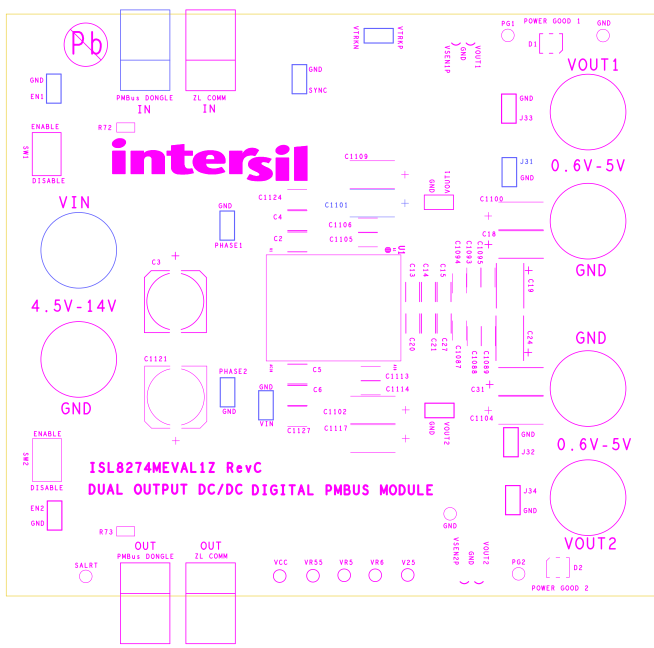


Figure 6. Silkscreen Top

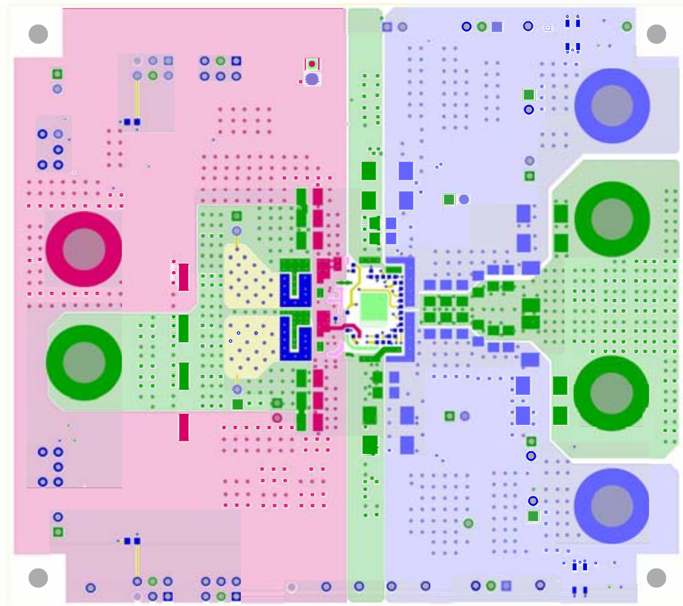


Figure 7. Top Layer

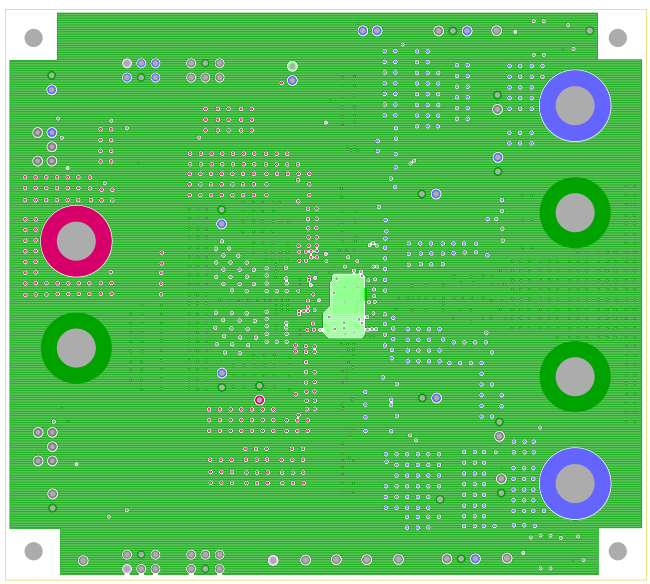


Figure 8. Layer 2

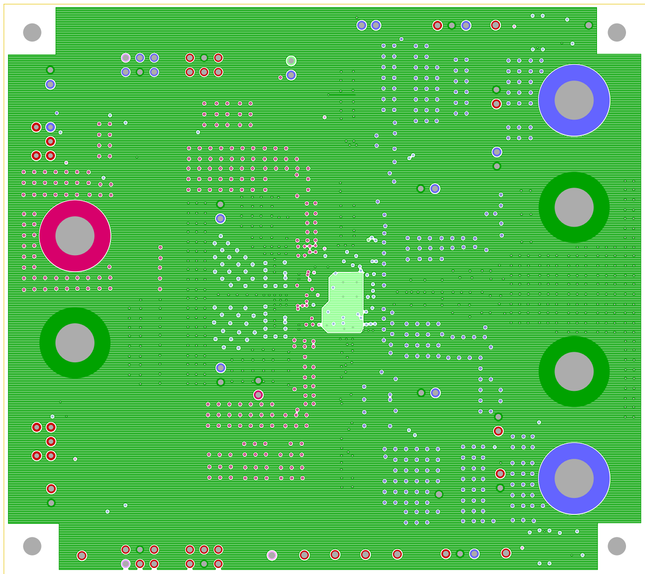


Figure 9. Layer 3

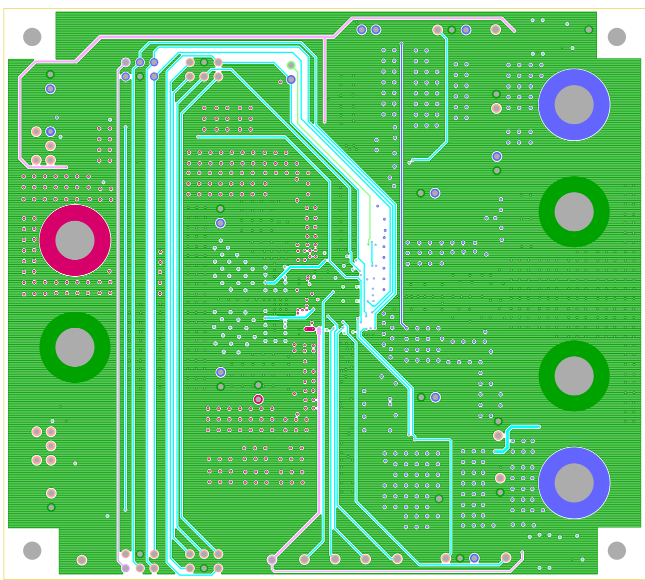


Figure 10. Layer 4

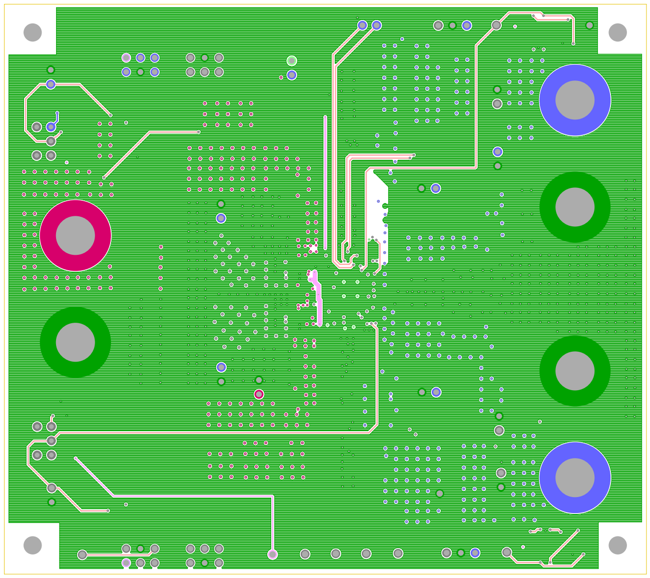


Figure 11. Layer 5

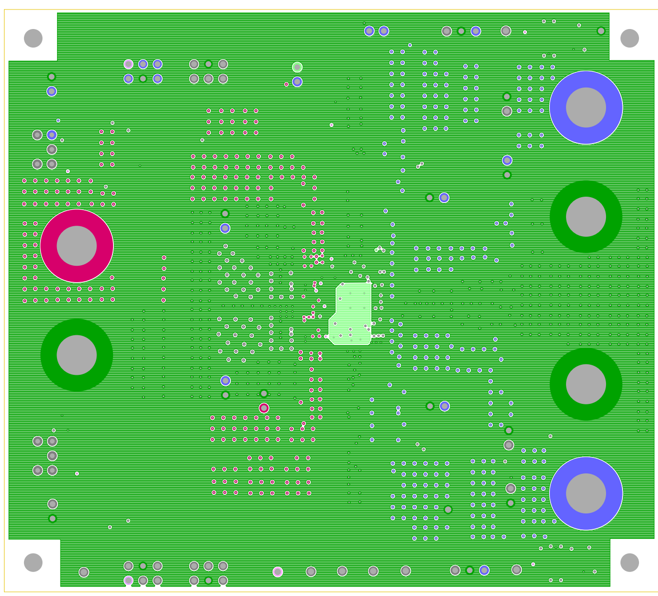


Figure 12. Layer 6

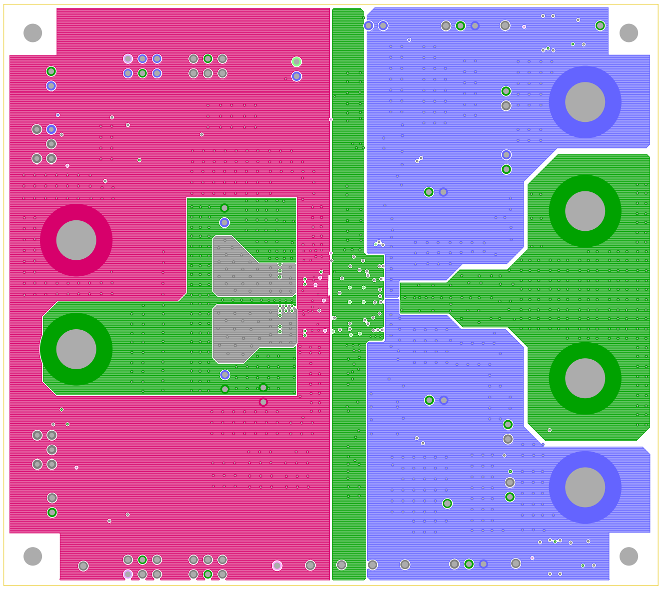


Figure 13. Layer 7

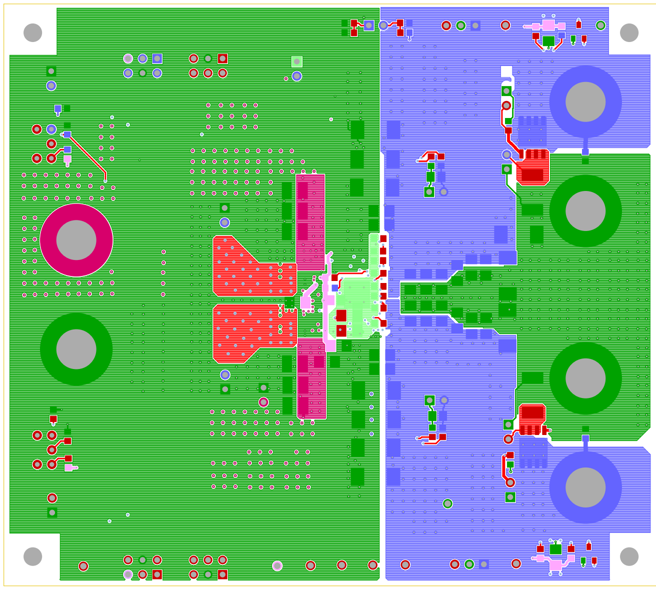


Figure 14. Bottom Layer

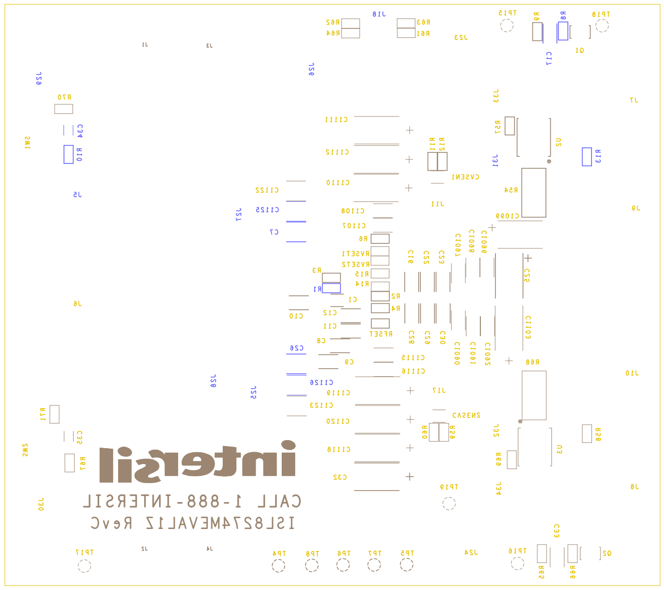


Figure 15. Silkscreen Bottom

5. Typical Performance Data

The following data was acquired using an ISL8274MEVAL1Z evaluation board. For test conditions, refer to the "ISL8274M Design Guide Matrix and Output Voltage Response" table in the ISL8274M datasheet.

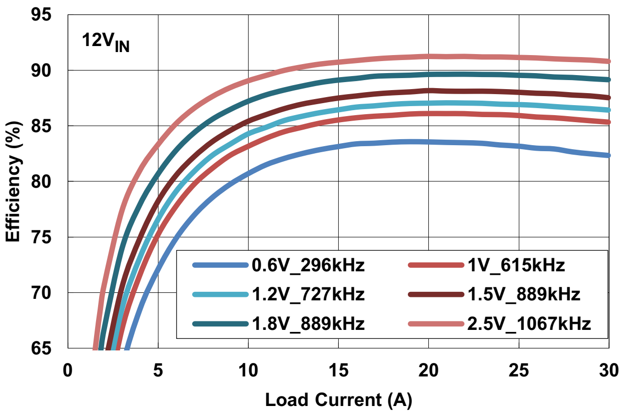


Figure 16. Single Channel Efficiency vs Output Current

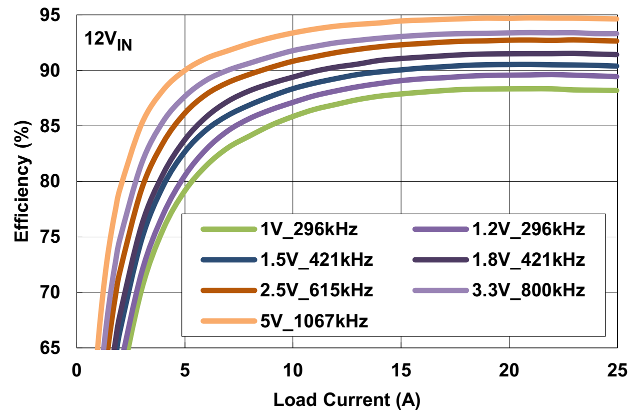


Figure 17. Single Channel Efficiency vs Output Current

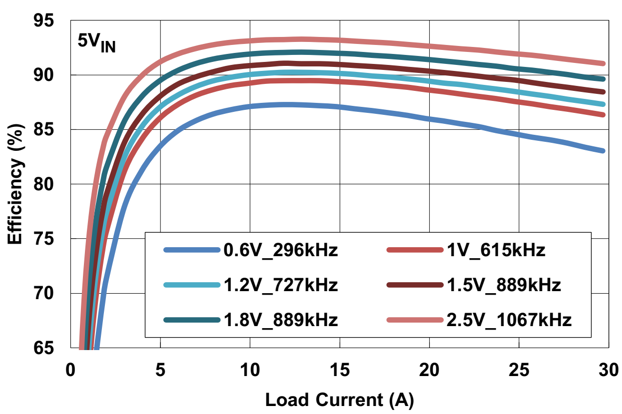


Figure 18. Single Channel Efficiency vs Output Current

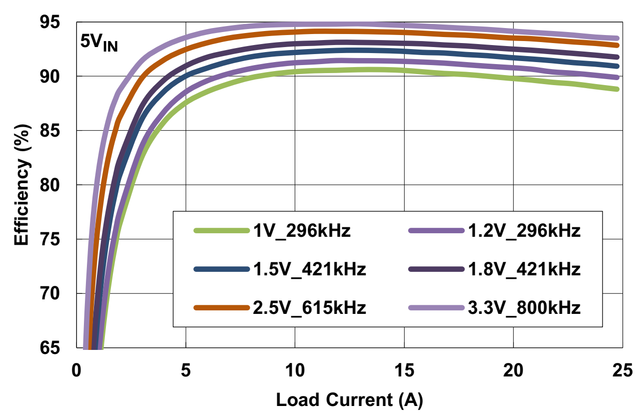


Figure 19. Single Channel Efficiency vs Output Current

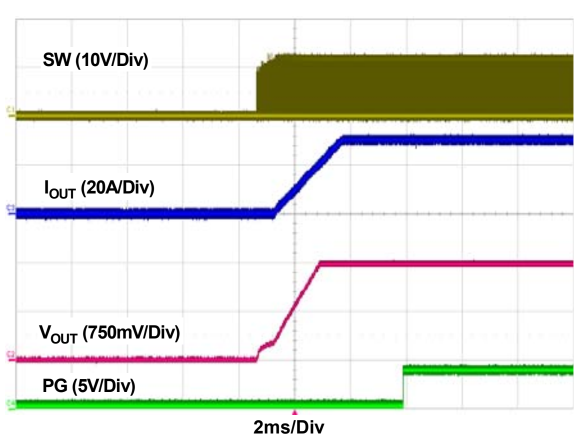


Figure 20. Single Channel Startup $12V_{IN}$, $1.5V_{OUT}$, 30A

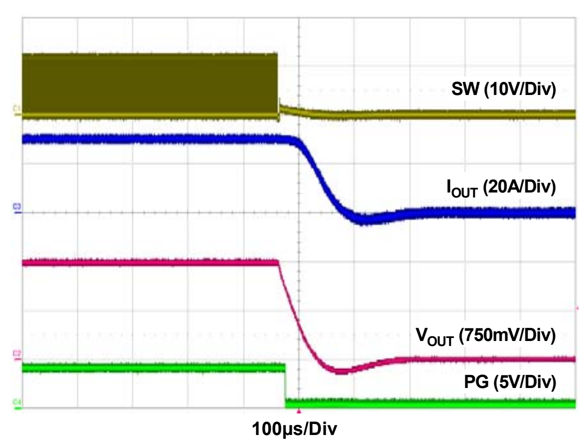


Figure 21. Single Channel Shutdown $12V_{IN}$, $1.5V_{OUT}$, 30A

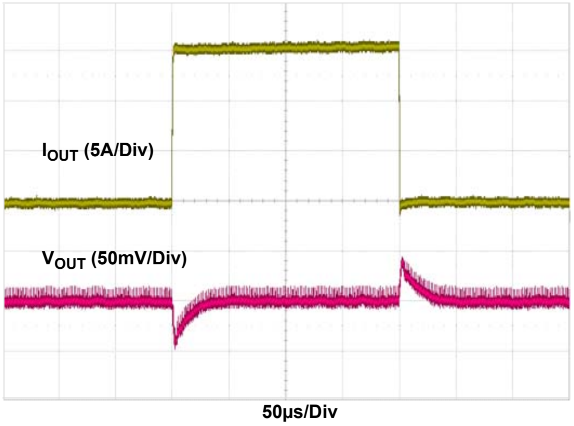


Figure 22. 0A-15A, >10A/µs, 12V_{IN}, 1V_{OUT}, 615kHz

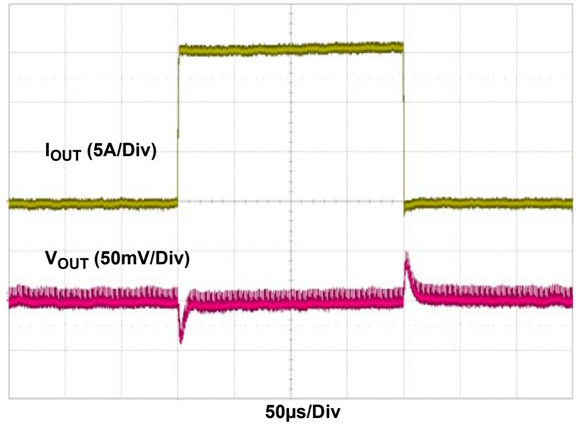


Figure 23. 0A-15A, >10A/µs, 12V_{IN}, 1.5V_{OUT}, 889kHz

6. Configuration File

Sample Configuration File for ISL8274M Module. Copy and paste (from RESTORE_FACTORY TO ### End User Store) to a text editor and save it as Confile_file_name.txt. The # symbol is used for comment lines. The following settings are already loaded to ISL8274M module as factory defaults.

```
RESTORE_FACTORY
STORE_USER_ALL
### Begin User Store
RESTORE_USER_ALL
PAGE                    0x00
FREQUENCY_SWITCH        0x0379      # 889 kHz
OT_FAULT_LIMIT          0xEB98      # 115 °C
OT_FAULT_RESPONSE       0x80
OT_WARN_LIMIT           0xEB48      # 105 °C
UT_WARN_LIMIT           0xDC40      # -30 °C
UT_FAULT_LIMIT          0xE530      # -45 °C
UT_FAULT_RESPONSE       0x80
VIN_OV_FAULT_LIMIT      0xD3A0      # 14.5 V
VIN_OV_FAULT_RESPONSE   0x80
VIN_OV_WARN_LIMIT       0xD353      # 13.297 V
VIN_UV_WARN_LIMIT       0xCA51      # 4.633 V
VIN_UV_FAULT_LIMIT      0xCA40      # 4.5 V
VIN_UV_FAULT_RESPONSE   0x80
MFR_ID
MFR_MODEL
MFR_REVISION
MFR_LOCATION
MFR_DATE
MFR_SERIAL
LEGACY_FAULT_GROUP      0x00000000
USER_DATA_00
SYNC_CONFIG             0x00
ON_OFF_CONFIG           0x17
VOUT_COMMAND            0x3000      # 1.5 V
VOUT_CAL_OFFSET         0x0000      # 0 V
VOUT_MAX                0x34CC      # 1.65 V
VOUT_MARGIN_HIGH        0x3266      # 1.575 V
VOUT_MARGIN_LOW         0x2D99      # 1.425 V
VOUT_TRANSITION_RATE    0xBA00      # 1 V/ms
VOUT_DROOP              0x0000      # 0 mV/A
INTERLEAVE              0x0021
IOUT_CAL_GAIN           0xB2C3      # 0.69 mV/A
IOUT_CAL_OFFSET         0xB529      # -0.71 A
VOUT_OV_FAULT_LIMIT     0x3733      # 1.725 V
VOUT_OV_FAULT_RESPONSE  0x80
VOUT_OV_WARN_LIMIT      0x34CC      # 1.65 V
VOUT_UV_WARN_LIMIT      0x2B33      # 1.35 V
VOUT_UV_FAULT_LIMIT     0x28CC      # 1.275 V
VOUT_UV_FAULT_RESPONSE  0x80
IOUT_OC_FAULT_LIMIT     0xE320      # 50 A
IOUT_OC_WARN_LIMIT      0xDBF0      # 31.5 A
IOUT_UC_FAULT_LIMIT     0xE4E0      # -50 A
POWER_GOOD_ON           0x2B33      # 1.35 V
TON_DELAY               0xCA80      # 5 ms
TON_RISE                0xC200      # 2 ms
TOFF_DELAY              0xCA80      # 5 ms
TOFF_FALL               0xC200      # 2 ms
ISENSE_CONFIG           0x06
USER_CONFIG             0x84
DDC_CONFIG              0x0800
POWER_GOOD_DELAY        0xC300      # 3 ms
TEMPCO_CONFIG           0x27
ASCR_CONFIG             0x015A020D
```

SEQUENCE	0x0000	
TRACK_CONFIG	0x00	
DDC_GROUP	0x00080808	
MFR_IOUT_OC_FAULT_RESPONSE	0x80	
MFR_IOUT_UC_FAULT_RESPONSE	0x80	
IOUT_AVG_OC_FAULT_LIMIT	0xE230	# 35 A
IOUT_AVG_UC_FAULT_LIMIT	0xDC40	# -30 A
PAGE	0x01	
FREQUENCY_SWITCH	0x0379	# 889 kHz
OT_FAULT_LIMIT	0xEB98	# 115 °C
OT_FAULT_RESPONSE	0x80	
OT_WARN_LIMIT	0xEB48	# 105 °C
UT_WARN_LIMIT	0xDC40	# -30 °C
UT_FAULT_LIMIT	0xE530	# -45 °C
UT_FAULT_RESPONSE	0x80	
VIN_OV_FAULT_LIMIT	0xD3A0	# 14.5 V
VIN_OV_FAULT_RESPONSE	0x80	
VIN_OV_WARN_LIMIT	0xD353	# 13.297 V
VIN_UV_WARN_LIMIT	0xCA51	# 4.633 V
VIN_UV_FAULT_LIMIT	0xCA40	# 4.5 V
VIN_UV_FAULT_RESPONSE	0x80	
MFR_ID		
MFR_MODEL		
MFR_REVISION		
MFR_LOCATION		
MFR_DATE		
MFR_SERIAL		
LEGACY_FAULT_GROUP	0x00000000	
USER_DATA_00		
SYNC_CONFIG	0x00	
ON_OFF_CONFIG	0x17	
VOUT_COMMAND	0x3000	# 1.5 V
VOUT_CAL_OFFSET	0x0000	# 0 V
VOUT_MAX	0x34CC	# 1.65 V
VOUT_MARGIN_HIGH	0x3266	# 1.575 V
VOUT_MARGIN_LOW	0x2D99	# 1.425 V
VOUT_TRANSITION_RATE	0xBA00	# 1 V/ms
VOUT_DROOP	0x0000	# 0 mV/A
INTERLEAVE	0x0022	
IOUT_CAL_GAIN	0xB2D7	# 0.71 mV/A
IOUT_CAL_OFFSET	0xBDDC	# -1.07 A
VOUT_OV_FAULT_LIMIT	0x3733	# 1.725 V
VOUT_OV_FAULT_RESPONSE	0x80	
VOUT_OV_WARN_LIMIT	0x34CC	# 1.65 V
VOUT_UV_WARN_LIMIT	0x2B33	# 1.35 V
VOUT_UV_FAULT_LIMIT	0x28CC	# 1.275 V
VOUT_UV_FAULT_RESPONSE	0x80	
IOUT_OC_FAULT_LIMIT	0xE320	# 50 A
IOUT_OC_WARN_LIMIT	0xDBF0	# 31.5 A
IOUT_UC_FAULT_LIMIT	0xE4E0	# -50 A
POWER_GOOD_ON	0x2B33	# 1.35 V
TON_DELAY	0xCA80	# 5 ms
TON_RISE	0xCA80	# 5 ms
TOFF_DELAY	0xCA80	# 5 ms
TOFF_FALL	0xCA80	# 5 ms
ISENSE_CONFIG	0x06	
USER_CONFIG	0x84	
DDC_CONFIG	0x0900	
POWER_GOOD_DELAY	0xC300	# 3 ms
TEMPCO_CONFIG	0x27	
ASCR_CONFIG	0x015A020D	
SEQUENCE	0x0000	
TRACK_CONFIG	0x00	
DDC_GROUP	0x00080808	

```
MFR_IOUT_OC_FAULT_RESPONSE          0x80
MFR_IOUT_UC_FAULT_RESPONSE          0x80
IOUT_AVG_OC_FAULT_LIMIT             0xE230      # 35 A
IOUT_AVG_UC_FAULT_LIMIT             0xDC40      # -30 A
STORE_USER_ALL
### End User Store
```

7. Revision History

Rev.	Date	Description
0.00	Jan 9, 2018	Initial release

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Refer to "http://www.renesas.com/" for the latest and detailed information.

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