ISLDDR4DEMO1Z

Radiation Tolerant DDR4 Power Management Reference Design

Description

The ISLDDR4DEMO1Z is a fully functional DDR4 power management solution. The design uses Renesas Radiation Tolerant (RT) Plastic Power Management devices to supply the required DDR4 VPP, VDDQ, VTT, and VREF rails. The ISL73007M RT 18V, 3A Point-of-Load (PoL) Regulator generates the VPP rail. The ISL71001M RT 6A Synchronous Buck Regulator generates the VDDQ rail. The ISL75055M RT 3A Source and Sink DDR Terminator generates the VTT and VREF rails. The board features necessary test points and connections to evaluate the multiple power solutions. On-board load transient circuits are also included to evaluate VDDQ and VTT transient response.

Features

- Complete plastic package solution
- Fully qualified radiation tolerant power solution
- All power management devices are qualified to Renesas Rad Tolerant Screening and QCI Flow (R34TB0004EU)
- Includes regulators for all DDR4 compliant power rails
- On-board load transient generator for VDDQ and VTT
- Total solution area: 3178mm^2

Specifications

- Input voltage supply (V_{IN}): 5V ±10%
- VPP power supply output: 2.5V/3A
- VDDQ power supply output: 1.2V/6A
- VTT power supply output: 0.6V/3A

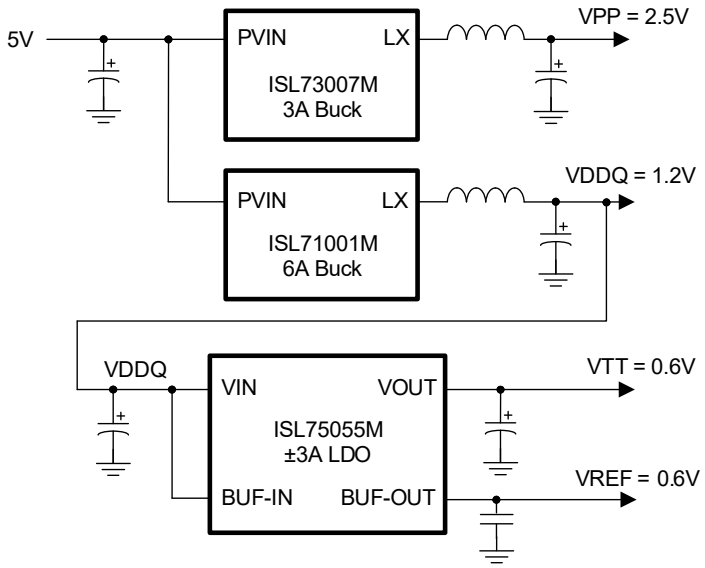

Figure 1. Block Diagram

Contents

1. Functional Description

The ISLDDR4DEMO1Z demonstration board evaluates a complete RT plastic power management solution for DDR4 memory. The 2.5V/3A VPP supply is generated by ISL73007M. The 1.2V/6A VDDQ supply is generated by ISL71001M. The 0.6V/±3A VTT supply is generated by the ISL75055M. The supplies meet DDR4 power supply requirements. The board includes test points to observe all DDR4 voltage rails. An on-board load transient generator circuit is included to evaluate the transient performance of VDDQ and VTT.

1.1 Operational Characteristics

The ISLDDR4DEMO1Z board requires an input voltage supply of 5V ±10%. An optional +5V supply is required to power the on-board load transient gate driver VDD bias supply.

Table 1 shows the power supply parameters for each of the DDR4 power supply rails.

Table 1. Power Supply Parameters

Parameter	Value	Unit
VPP		
Input Voltage	5	V
Output Voltage	2.5	V
Output Current	3	A
Switching Frequency	500	kHz
VDDQ		
Input Voltage	5	V
Output Voltage	1.2	V
Output Current	6	A
Switching Frequency	1000	kHz
VTT		
Input Voltage	1.2	V
Output Voltage	0.6	V
Output Current	±3	A
VREF		
Input Voltage	1.2	V
Output Voltage	0.6	V

1.2 Setup and Configuration

Figure 2 shows an overview of the demo board connections.

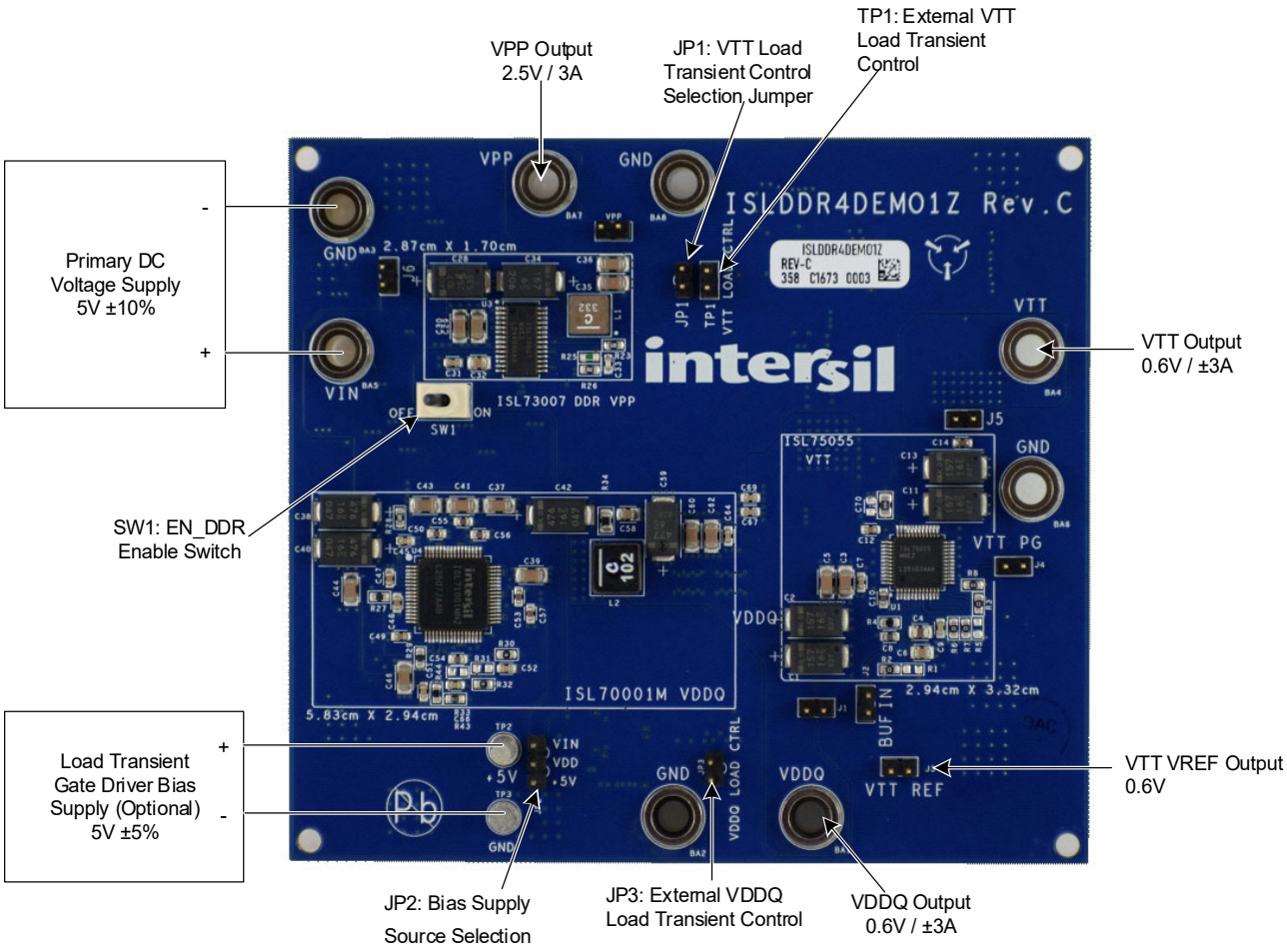

Figure 2. ISLDDR4DEMO1Z Board Overview

1.2.1 Test Points and Jumpers

Table 2. Test Point Descriptions

Name	Description
J1	VDDQ test point
J2	BUF-IN test point
J3	VTT_VREF test point
J4	VTT_PG test point
J5	VTT test point
J6	VIN test point
VPP	VPP test point

Table 3. Jumper Descriptions

Name	Description
TP1	VTT load transient control input: Connect 5V PWM signal from a function generator to control load transient on/off time.
JP1	VDDQ/VTT load transient PWM sync: Populate with jumper to tie VDDQ and VTT load transient PWM inputs together.
JP2	Load transient VDD supply selection header: Set jumper to tie U2 and U5 VDD to either +5V input or VIN input.
JP3	VDDQ load transient control input: Connect 5V PWM signal from a function generator to control load transient on/off time.
SW1	EN_DDR toggle switch: ON position sets EN_DDR high. OFF position sets EN_VDDR low. The switch power sequences the VPP, VDDQ, VREF and VTT rails up and down.

1.2.2 Power-On Sequencing

Default power sequencing for the ISLDDR4DEMO1Z output rails results in the following startup order:

1. VPP
2. VDDQ
3. VREF
4. VTT

VPP startup is dependent on both the VIN supply voltage above the ISL73007M PVIN UVLO threshold and the SW1 enable switch set to the ON position. VDDQ startup is initiated by the ISL73007M PG pin going high, driving the ISL71001M EN pin (EN_VDDQ net). Next, VREF and VTT startup is initiated by ISL71001M PGOOD pin going high, driving the ISL75055M EN pin (EN_VTT net).

Alternatively, the enable sequencing of VDDQ and VTT/VREF can be adjusted to rely on the SW1 enable switch, instead of VPP and VDDQ supply PG signals. For the VDDQ supply, DNP R30 and short R31. For the VTT/VREF supply, DNP R2 and short R1. Now, the EN_DDR net is tied to both EN pins of ISL71001M and ISL75055M, resulting in all power supplies starting up simultaneously when SW1 is toggled to the ON position.

1.2.3 Testing Procedure

The following test procedure outlines how to setup and evaluate the ISLDDR4DEMO1Z board.

1. Connect a DC voltage source capable of supporting up to 5V/5A to the VIN and GND banana jacks.
2. Set the VIN supply to 5V and turn on the power supply.
3. Flip the SW1 enable switch to the ON position to start up the power supplies.
4. Individual electronic or resistive loads can be connected to the outputs of the three power supplies. Banana jacks are labeled with the respective voltage rail names: VPP, VDDQ, and VTT.
5. Output voltage can be monitored with a multimeter or oscilloscope at the 2-pin header test points as described in Table 2.
6. See Load Transient Testing for details about load transient testing.

1.2.4 Load Transient Testing

The ISLDDR4DEMO1Z board features two on-board load transient generators for evaluating load transient response on both the VDDQ and VTT power supplies. The load transient circuit consists of an ISL71441M half-bridge FET driver driving a MOSFET in series with a load resistance.

The VDDQ on-board load transient generator is designed for a 0.4Ω (3A) load transient across resistors R45, R47, and R49. The load consists of three 1.2Ω, 2512 resistors.

The VTT on-board load transient generator is designed for a 0.2Ω (3A) sourcing and sinking load across load resistors R18 to R22. The load consists of five 1Ω, 2512 resistors. VDDQ provides the bias for VTT sinking and therefore will see a 3A load when VTT is sinking 3A.

A 5V VDD supply is required to power the ISL71441 gate driver ICs. This bias supply can be provided by an external DC voltage source applied to TP2/TP3 terminals or it can be provided by the VIN input supply if VIN can maintain ±5% regulation. The VDD supply source is selected by placing a jumper on JP2 to tie VDD to +5V or VIN.

Load transient testing procedure:

1. Select the VDD bias supply source using a jumper on JP2 to tie VDD to a 5V supply of either +5V or VIN.
   a. Ensure the VIN supply can support the ISL71441 typical UVLO rising threshold of 4.6V.
2. Power up the board to steady state operating point as described in the procedure in Testing Procedure.
3. Using a function generator, apply a 5V PWM signal to:
   a. JP3 two pin header to generate a 3A load transient on VDDQ.
   b. TP1 two pin header to generate a ±3A load transient on VTT.
4. Alternatively, control the VDDQ and VTT load transients from the same PWM source by populating JP1, which connects U2 and U5 PWM pins together.
5. Measure the output voltage transient response by connecting oscilloscope probes at J1 (VDDQ) and J5 (VTT).

Note: Keep the 5V PWM signal high time to less than 250µs for the VTT sinking transient load (U2 high side drive) to avoid discharging the bootstrap capacitor to the BOOT UVLO threshold and disabling the gate driver output. The PWM low time should be >10% of the high time used to ensure the boot capacitor is sufficiently recharged.

2. Board Design

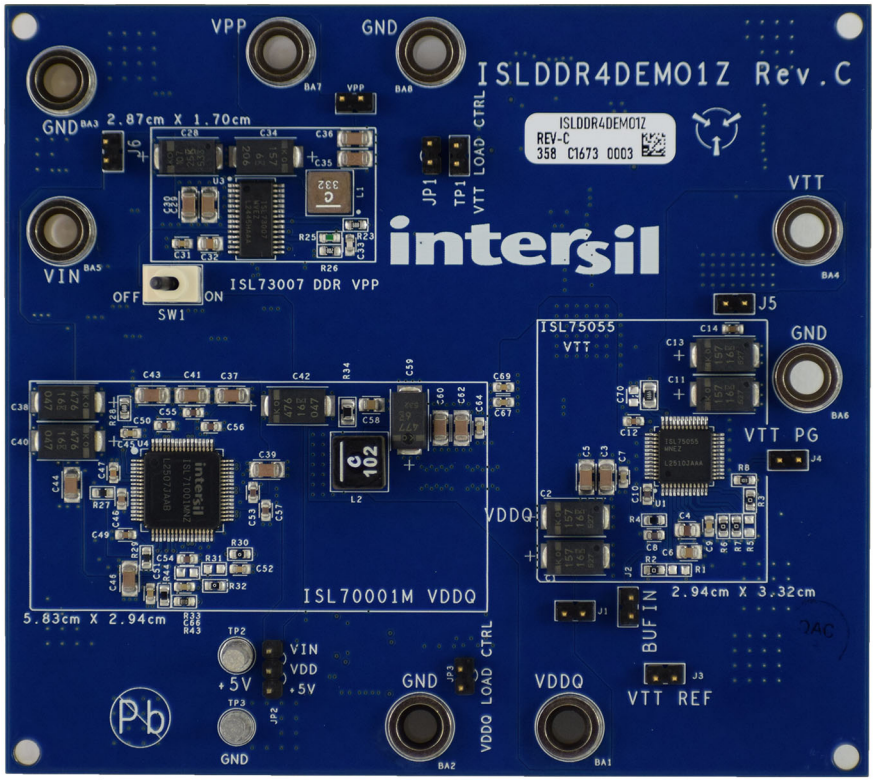

Figure 3. Demonstration Board (Top)

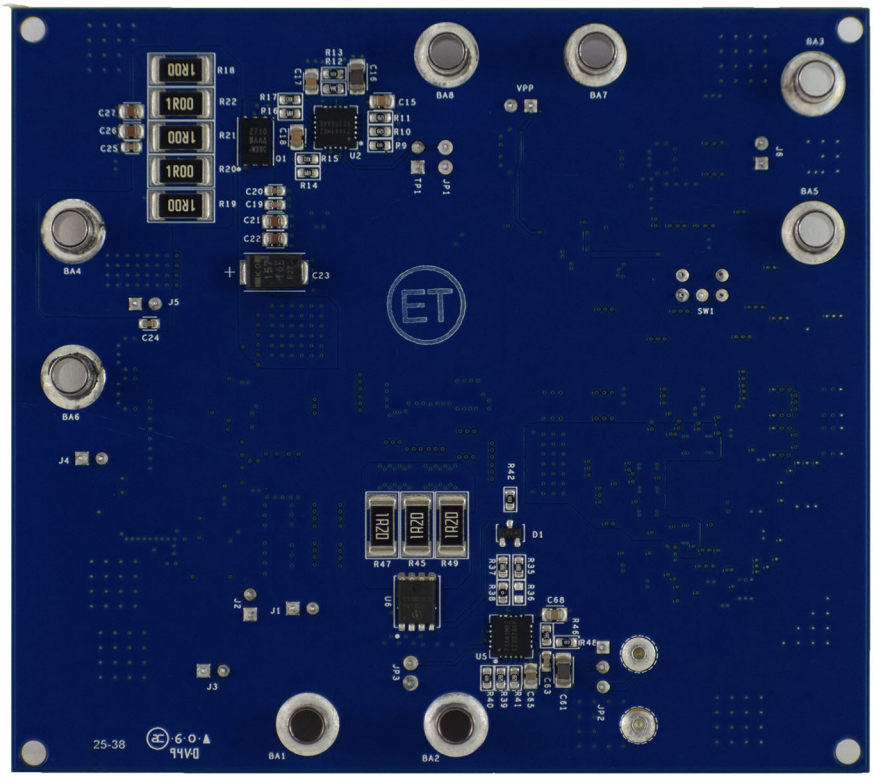

Figure 4. Demonstration Board (Bottom)

2.1 Layout Guidelines

A layout example is shown for the DDR4 power management solution in Board Layout.

For detailed information about layout guidelines, refer to the respective *ISL73007M, ISL71001M,* and *ISL75055M Datasheets*.

2.2 Schematic Diagrams

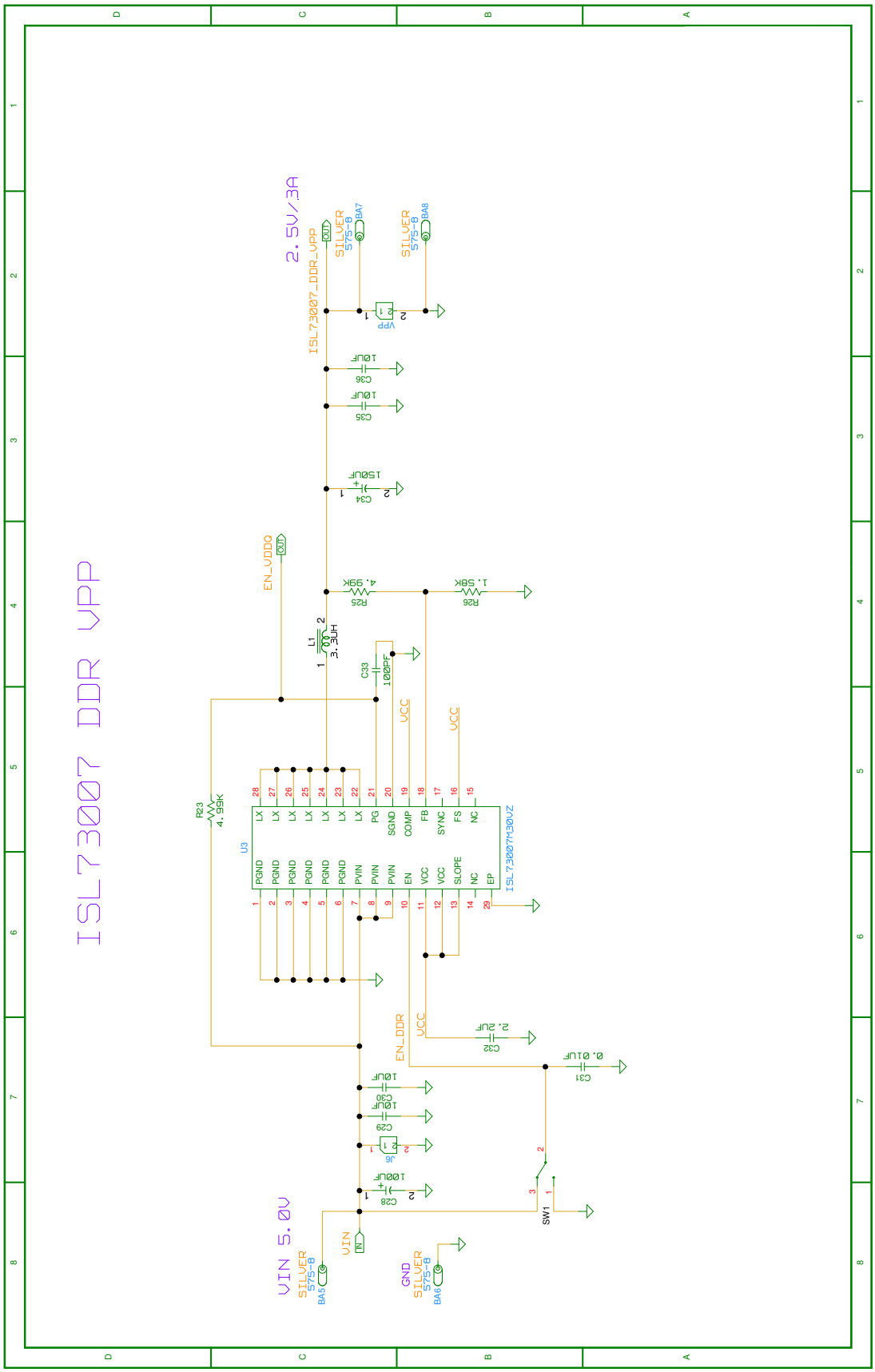

Figure 5. ISLDDR4DEMO1Z Schematic - ISL73007M VPP

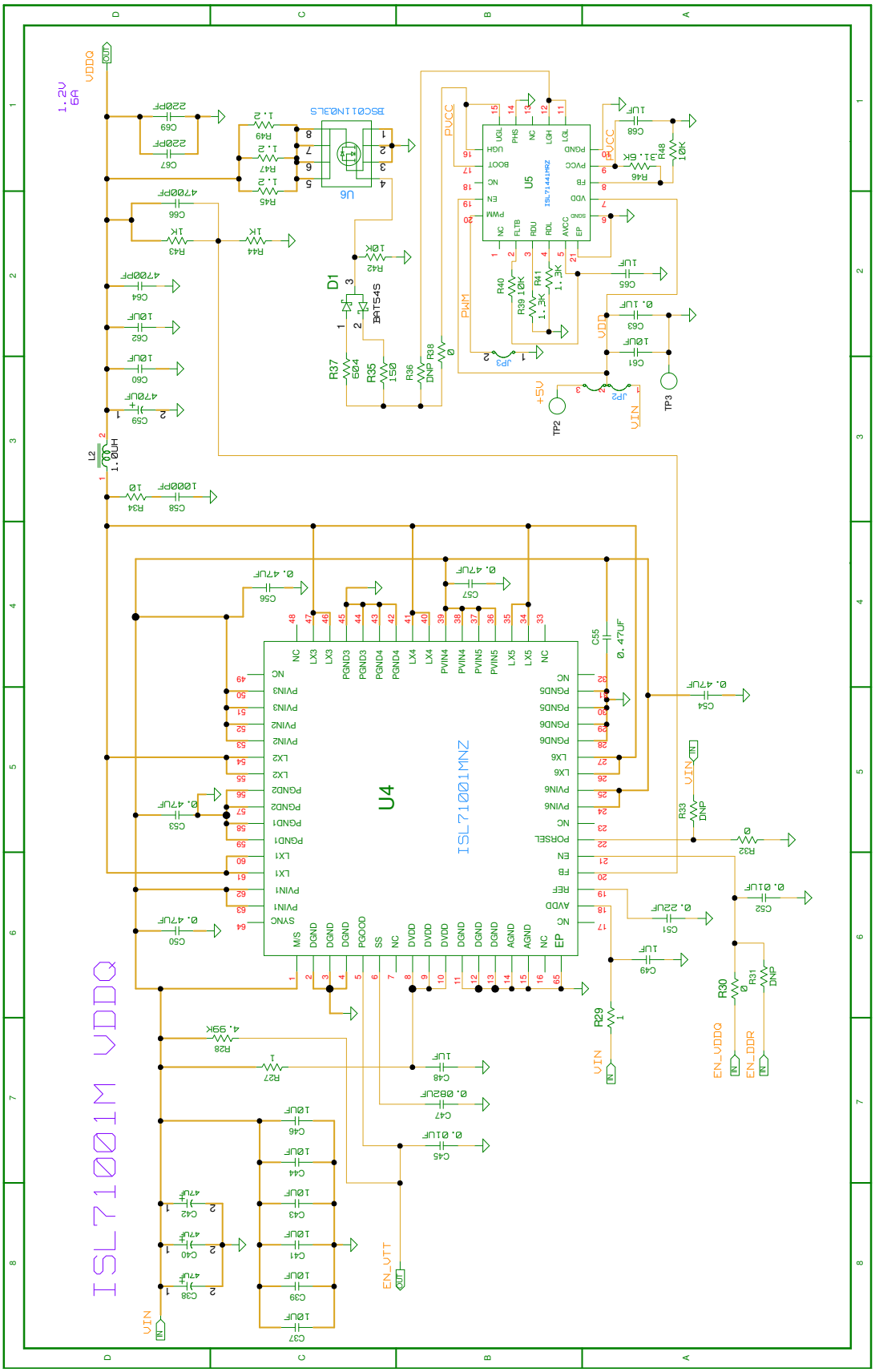

Figure 6. ISLDDR4DEMO1Z Schematic - ISL71001M VDDQ

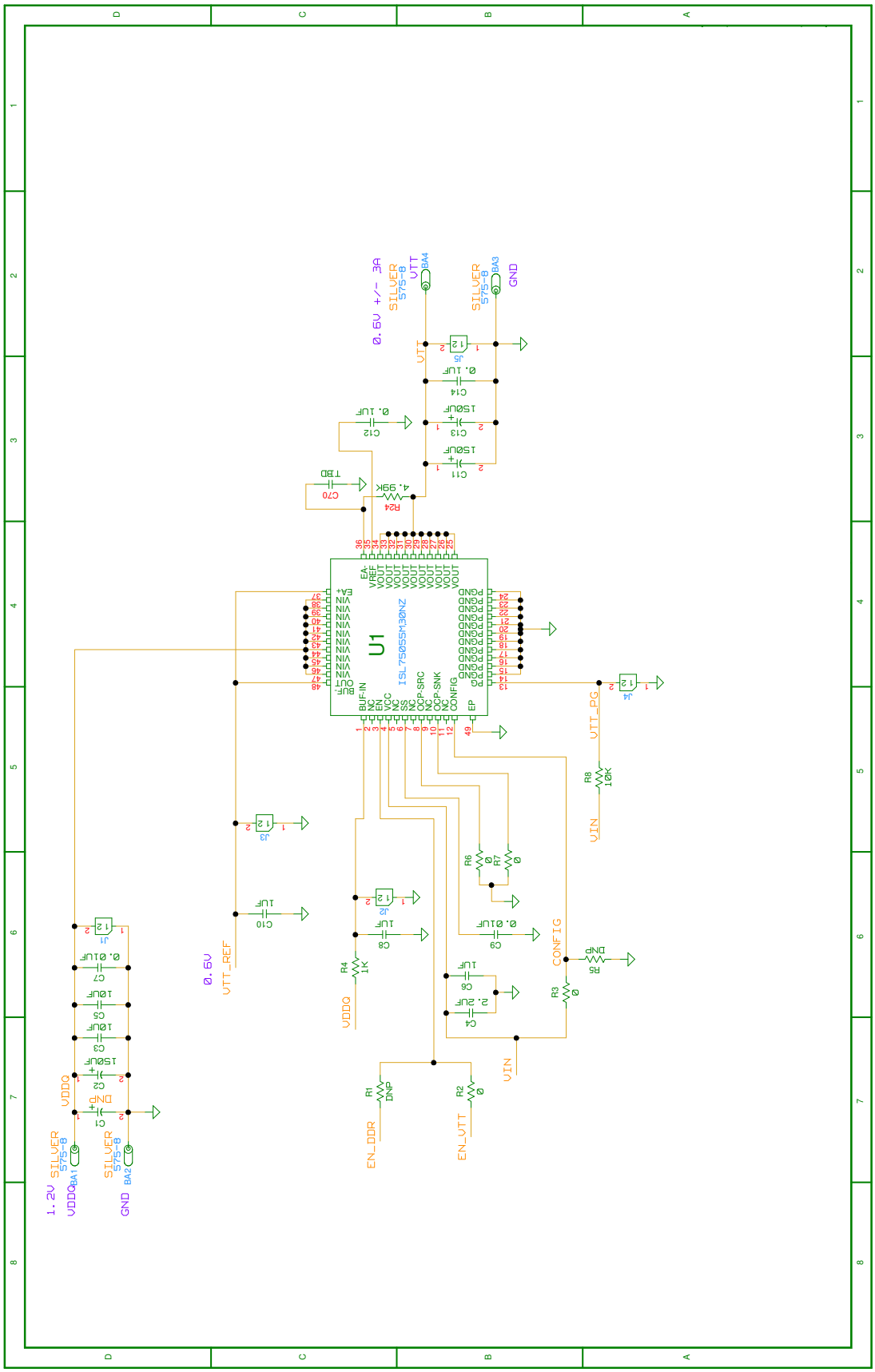

Figure 7. ISLDDR4DEMO1Z Schematic - ISL75055M VTT

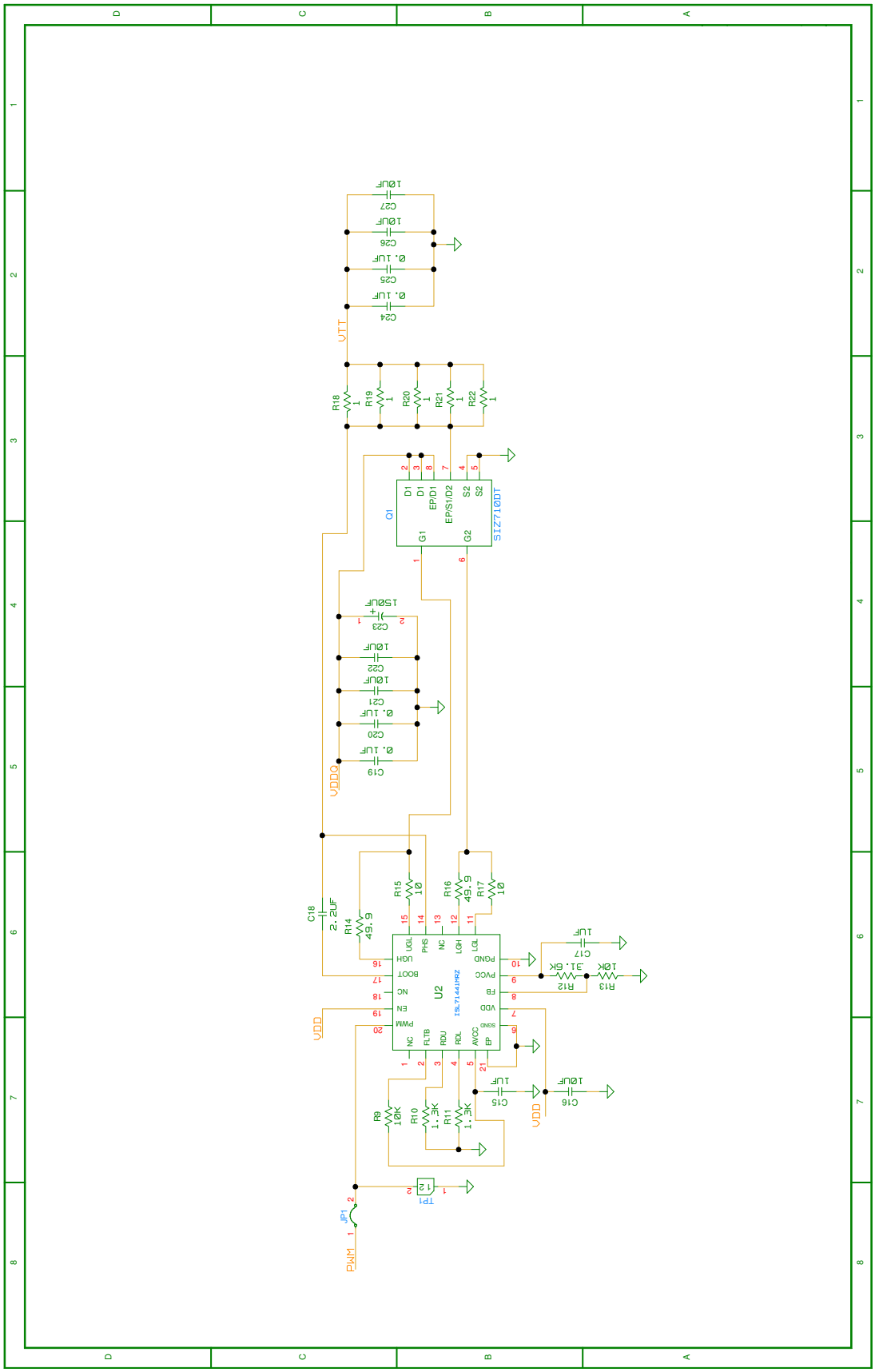

Figure 8. ISLDDR4DEMO1Z Schematic – VTT Transient

2.3 Bill of Materials

Qty	Ref Des	Description	Manufacturer	Part Number
2	TP2, TP3	Test Point Turret 0.150 Pad 0.100 Thole	Keystone	1514-2
8	BA1, BA2, BA3, BA4, BA5, BA6, BA7, BA8	L = 0.350in Solder Mount Banana Plug	Keystone	575-8
7	J1, J2, J3, J4, J5, J6, VPP	Male 2 Pin Header 2.54mm (0.100) Pitch	FCI	69190-202HLF
1	TP1	Test Point 2 Pin Header 2.54mm (0.100) Pitch	FCI	69190-202HLF
1	D1	30V 200mA Schottky Barrier Diode	Diodes	BAT54SLT1G
1	U6	OptiMOS Power-MOSFET	Infineon	BSC011N03LS
1	C47	CAP CER 0.082µF 25V X7R 0603	Kemet	C0603C823K3RACTU
6	C50, C53, C54, C55, C56, C57	CAP CER 0.47µF 16V X7R 0603	TDK	C1608X7R1C474K080AC
1	C4	CAP CER 2.2µF 16V X7R 0805	TDK	C2012X7R1C225K125AB
5	R18, R19, R20, R21, R22	High Power Current Sense Chip Resistor	Bourns	CRM2512-FX-1R00ELF
1	C14	Multilayer Cap (Automotive AEC-Q200)	Murata	GCJ188R71H104KA12D
4	C21, C22, C26, C27	Multilayer Cap (Automotive AEC-Q200)	MURATA	GCJ21BR71A106KE01L
2	C48, C49	Multilayer Cap	YAGEO	CC0603KRX7R6BB105
2	C8, C10	Ceramic Chip Cap	YAGEO	CC0603KRX7R8BB105
2	C18, C32	CAP CER 2.2µF 25V X7R 0805	YAGEO	CC0805KKX7R8BB225
1	SW1	SPDT On-None-On (2 Switch Positions) PTH Ultraminiature Toggle Switch	C&K	GT11MCBE
1	C33	CAP CER 100PF 25V X7R 0603	YAGEO	CC0603KRX7R8BB101
1	C52	CAP CER 10000PF 16V X7R 0603	YAGEO	CC0603KRX7R7BB103
4	C7, C9, C31, C45	Multilayer Cap	YAGEO	CC0603KRX7R7BB103
4	C19, C20, C24, C25	CAP CER 0.1µF 16V X7R 0603	YAGEO	CC0603KRX7R7BB104
2	C12, C63	Multilayer Cap	YAGEO	CC0603KRX7R7BB104
2	C67, C69	CAP CER 220PF 50V X7R 0603	YAGEO	CC0603MRX7R9BB221
1	C51	CAP CER 0.22µF 16V X7R 0603	YAGEO	CC0603KRX7R7BB224
2	C64, C66	CAP CER 4700PF 50V X7R 0603	YAGEO	CC0603KRX7R9BB472
1	C58	CAP CER 1000PF 50V X7R 0805	YAGEO	CC0805KRX7R9BB102
1	C6	Multilayer Cap	YAGEO	CL21B105KAFNNNE
4	C15, C17, C65, C68	CAP CER 1µF 25V X7R 0805	YAGEO	CC0805KKX7R8BB105
14	C3, C5, C29, C30, C35, C36, C37, C39, C41, C43, C44, C46, C60, C62	Multilayer Cap	Samsung Electro-Mechanics	CL31B106MOHNNNE
2	C16, C61	CAP 1206 25V 10µF X7R	YAGEO	CC1206KFX7R8BB106
1	R43	RES 1kΩ 0.1% 1/16W 0603	Stackpole Electronics Inc	RNCS0603BKE1K00
2	R15, R17	RES 10Ω 1% 1/10W 0603	YAGEO	RC0603FR-0710RL
4	R2, R3, R6, R7	RES 0Ω JUMPER 1/10W 0603	YAGEO	RC0603JR-070RL
1	R44	RES SMD 1kΩ 1% 1/10W 0603	Vishay Dale	CRCW06031K00FKEA

Qty	Ref Des	Description	Manufacturer	Part Number
6	R8, R9, R13, R40, R42, R48	RES 3.32kΩ 1% 1/10W 0603	Stackpole Electronics Inc	RMCF0603JT10K0
4	R10, R11, R39, R41	RES 1.3kΩ 1% 1/10W 0603	YAGEO	RC0603FR-101K3L
1	R35	RES 150Ω 1% 1/10W 0603	YAGEO	RC0603FR-10150RL
1	R26	RES 1.58kΩ 1% 1/10W 0603	YAGEO	RC0603FR-071K58L
2	R12, R46	RES 31.6kΩ 1% 1/10W 0603	YAGEO	RC0603FR-0731K6L
2	R23, R28	RES 4.99kΩ 1% 1/10W 0603	YAGEO	RC0603FR-104K99L
2	R14, R16	RES 49.9Ω 1% 1/10W 0603	YAGEO	RC0603FR-1049R9L
1	R37	RES 604Ω 1% 1/10W 0603	YAGEO	RC0603FR-13604RL
1	R34	RES SMD 10Ω 1% 1/2W 0805	Panasonic Electronic Components	ERJ-P6WF10R0V
1	U4	6A Synchronous Buck Rad Hard Regulator	Renesas Electronics America	ISL71001MNZ
2	U2, U5	Rad Tolerant 12V Half Bridge GaN FET Driver	Renesas Electronics America	ISL71441MRZ
1	U3	Radiation Tolerant 30krad Plastic 18V 3A Point-of-Load Regulator	Renesas Electronics America	ISL73007M30VZ
1	U1	5V 3A Source and Sink LDO	Renesas Electronics America	ISL75055M30NZ
1	JP2	Three Pin Jumper	Harwin Inc.	M20-9990345
2	JP1, JP3	100 mil Spacing Two Pin Jumper	Amphenol ICC (FCI)	69190-202HLF
1	R4	RES SMD 1kΩ 1% 1/10W 0603	Vishay Dale	CRCW06031K00FKEA
2	R27, R29	Thick Film Chip Resistor	Vishay	RCA06031R00FKEA
3	R45, R47, R49	Thick Film Chip Resistor	Stackpole	RC2512FK-7W1R2L
3	R30, R32, R38	Film Chip Resistor	Yageo	RMCF0603ZT0R00
1	R24	Thick Film Chip Resistor (Automotive QEC-Q200)	Stackpole	RMCF0805FT4K99
1	Q1	N-Channel 20V 16A/35A Power MOSFET	Vishay	SIZ710DT
1	C34	Low ESR 6mΩ Polymer Tantalum Capacitor	KEMET	T520D157M006ATE007
3	C38, C40, C42	ESR 40mΩ Conductive Polymer Capacitor	KEMET	T521D476M016ATE040
1	C28	ESR 30mΩ Conductive Polymer Capacitor	KEMET	T521X107M025ATE030
5	C1, C2, C11, C13, C23	High Capacitance Ultra-Low ESR Tantalum SMD Cap	KEMET	T530X157M016ATE015
1	C59	7300ma Low ESR 5mΩ Tantalum SMD Cap	KEMET	T530Y477M006ATE005
1	R25	Thin Film Resistor	Vishay	TNPW06034K99BEEA
1	L1	Shielded Power Inductor	Coilcraft	XAL5030-332MEC
1	L2	Shielded Power Inductor	Coilcraft	XEL6060-102MEC
5	R1, R5, R31, R33, R36	Metal Film Chip Resistor (Do Not Populate)	DNP	H2505-DNP-DNP-1
1	C70	Multilayer Cap	DNP	H1045-TBD-TBD

2.4 Board Layout

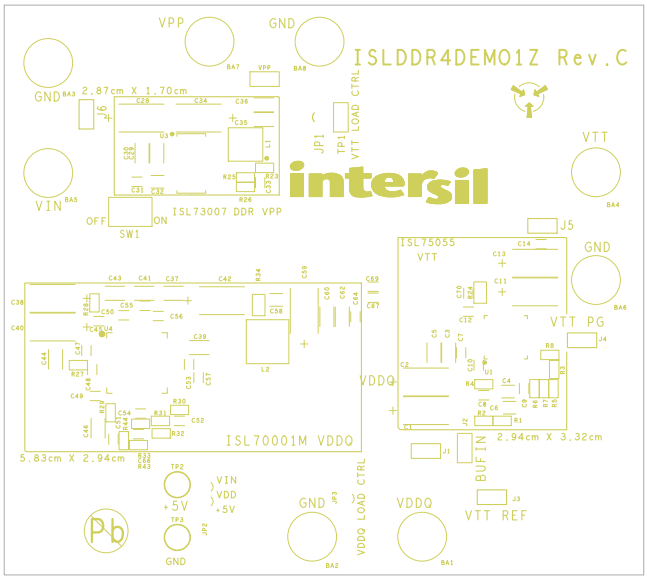

Figure 9. Silkscreen Top

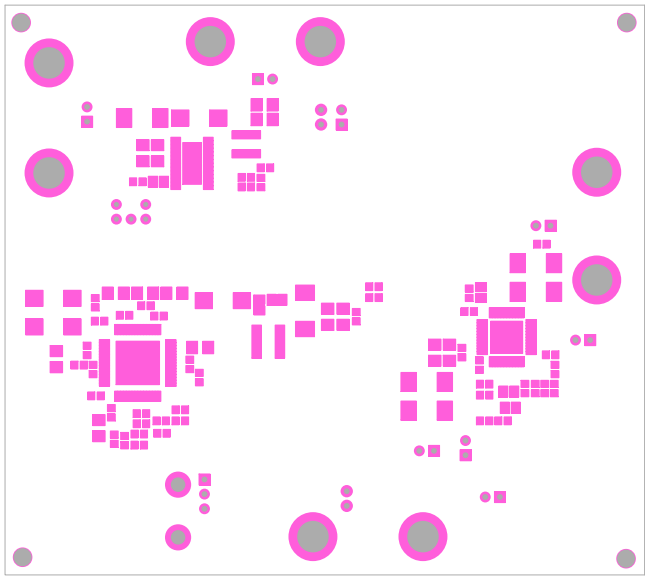

Figure 10. Solder Mask Top

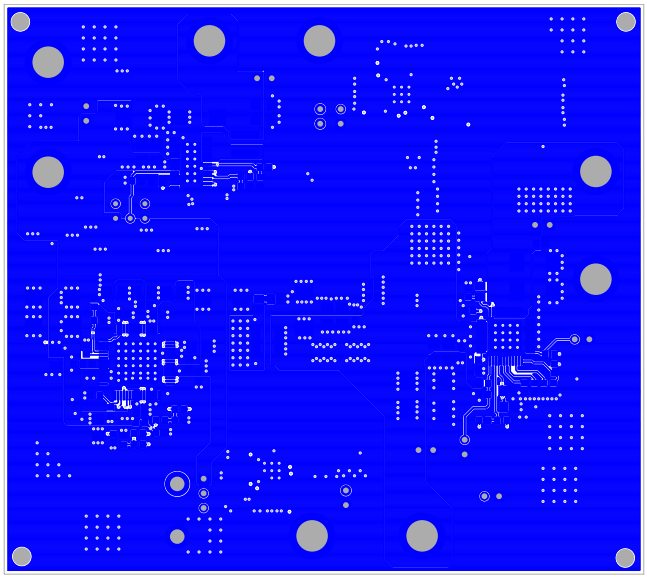

Figure 11. Top Layer

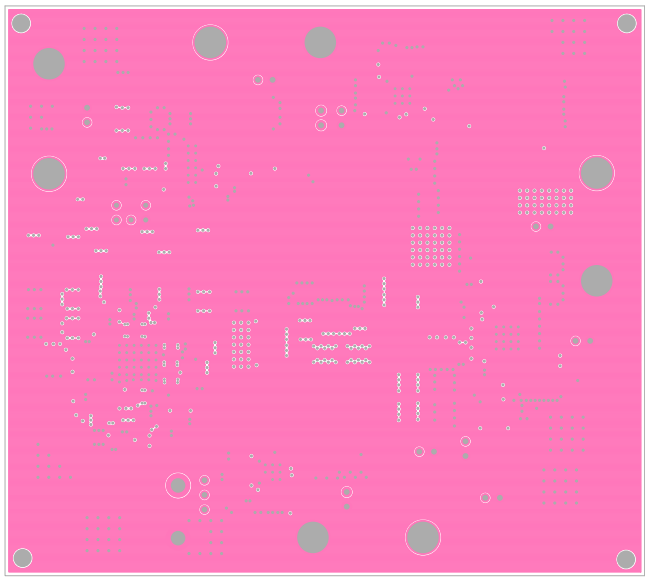

Figure 12. Layer 2

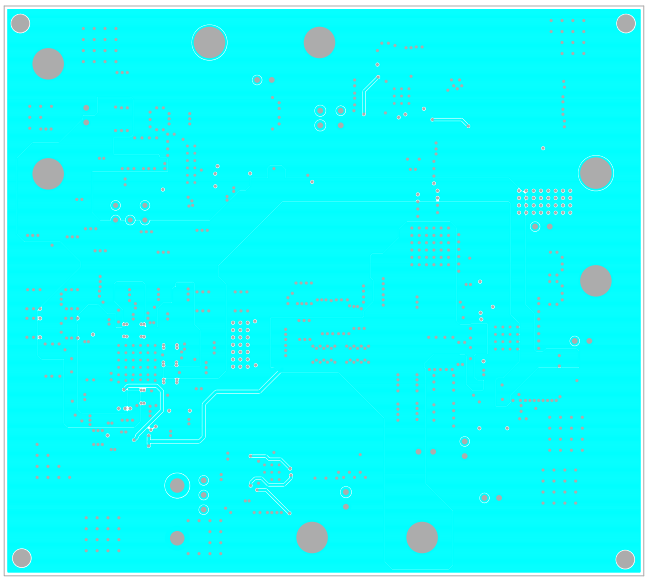

Figure 13. Layer 3

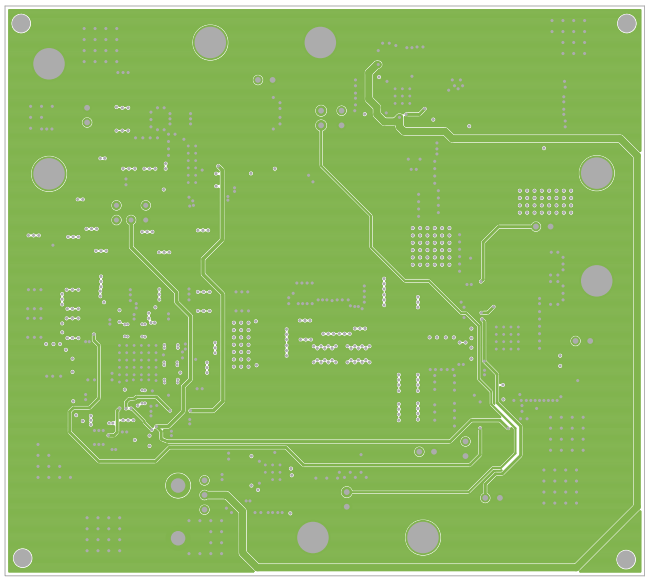

Figure 14. Layer 4

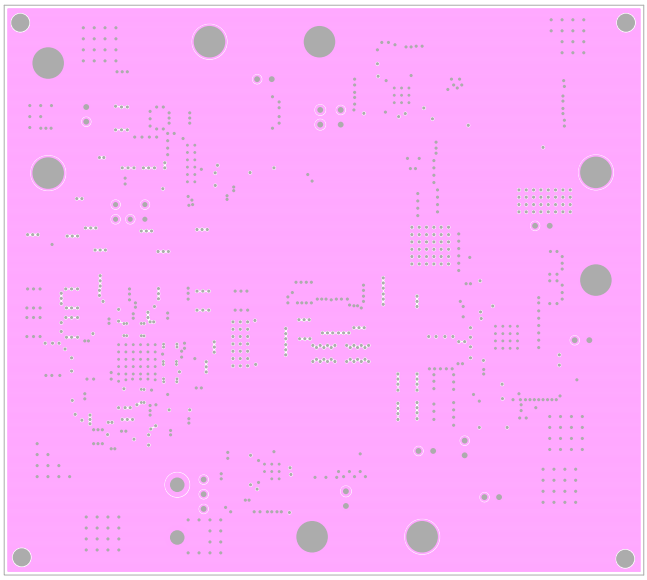

Figure 15. Layer 5

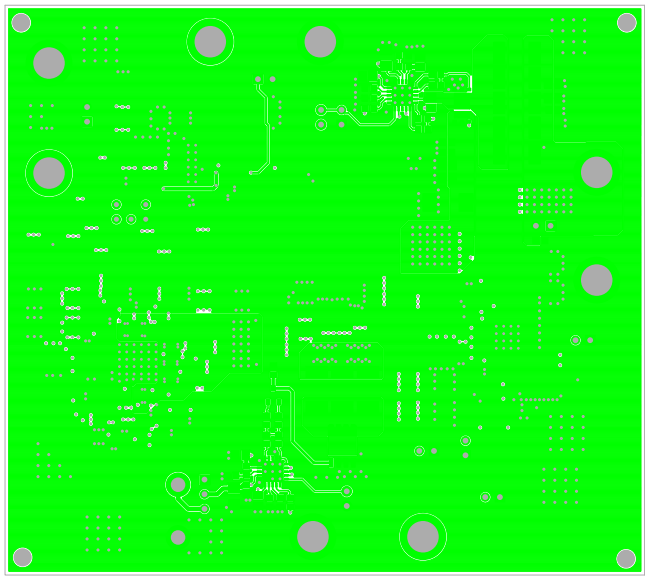

Figure 16. Bottom Layer

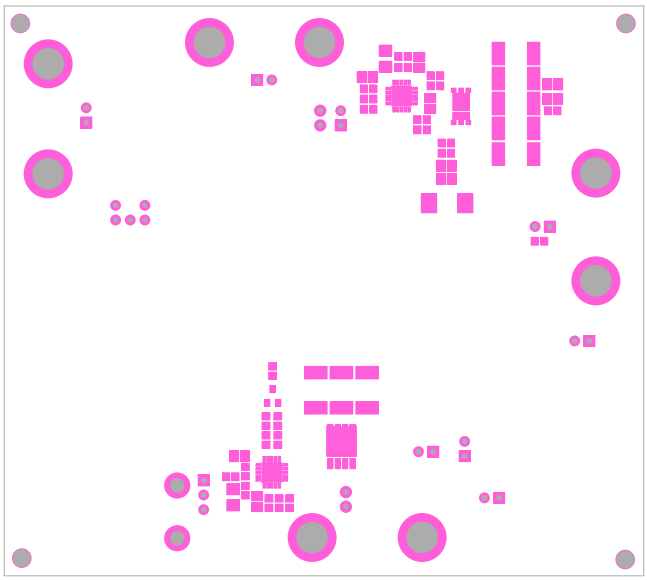

Figure 17. Solder Mask Bottom

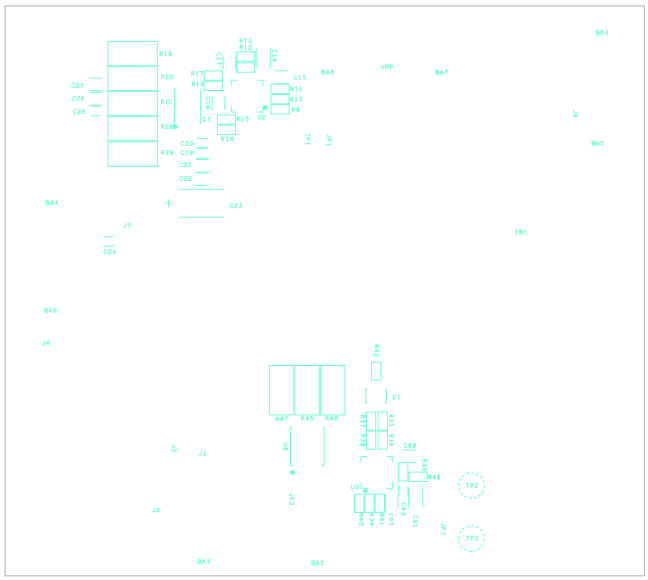

Figure 18. Silkscreen Bottom

3. Typical Performance Graphs

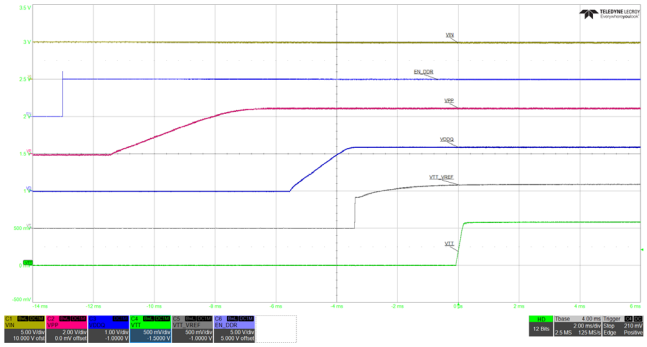

Figure 19. EN Startup, Resistive Load (V_{IN} = 5V, RLOAD_VPP = 1Ω, RLOAD_VDDQ = 0.75Ω, RLOAD_VTT = 0.3Ω)

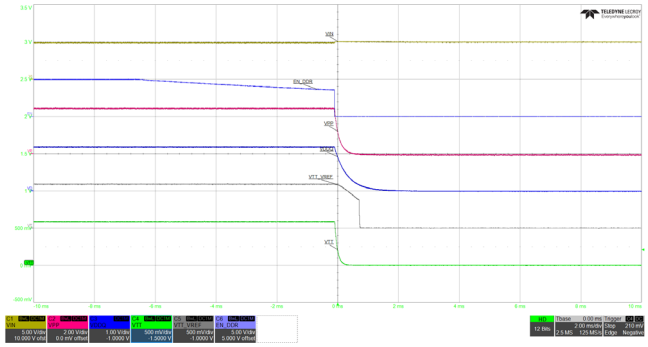

Figure 20. EN Shutdown, Resistive Load (V_{IN} = 5V, RLOAD_VPP = 1Ω, RLOAD_VDDQ = 0.75Ω, RLOAD_VTT = 0.3Ω)

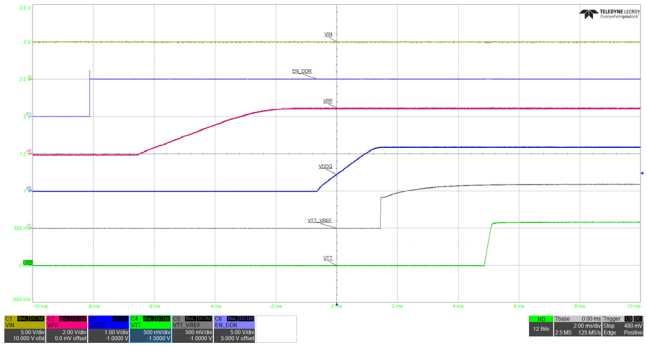

Figure 21. EN Startup, No Load (V_{IN} = 5V)

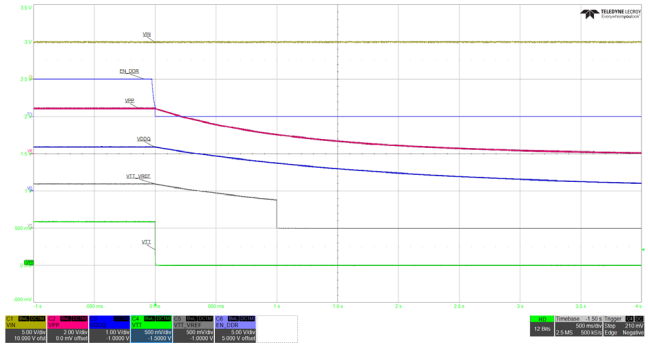

Figure 22. EN Shutdown, No Load (V_{IN} = 5V)

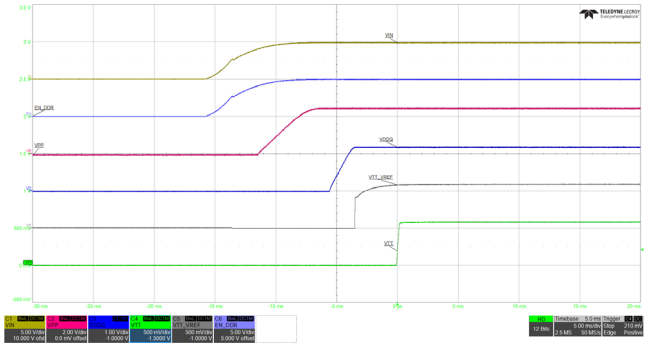

Figure 23. VIN Startup, Resistive Load (V_{IN} = 5V, RLOAD_VPP = 1Ω, RLOAD_VDDQ = 0.75Ω, RLOAD_VTT = 0.3Ω)

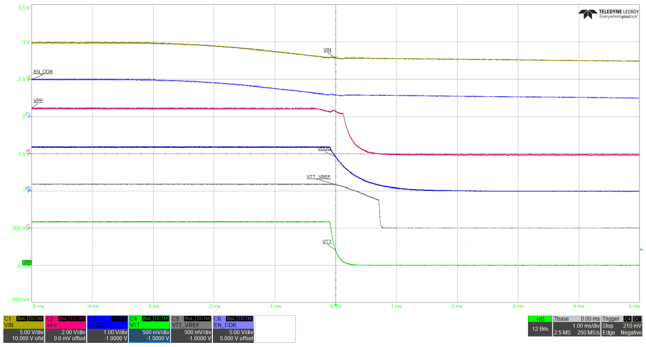

Figure 24. VIN Shutdown, Resistive Load (V_{IN} = 5V, RLOAD_VPP = 1Ω, RLOAD_VDDQ = 0.75Ω, RLOAD_VTT = 0.3Ω)

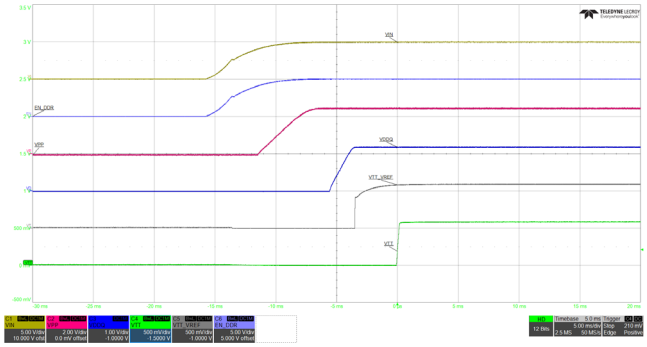

Figure 25. V_{IN} Startup, No Load (V_{IN} = 5V)

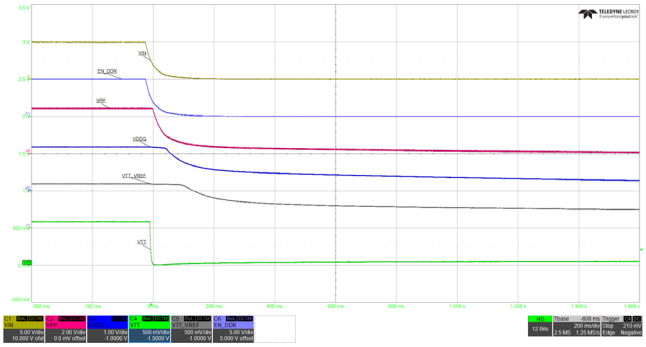

Figure 26. VIN Shutdown, No Load (V_{IN} = 5V)

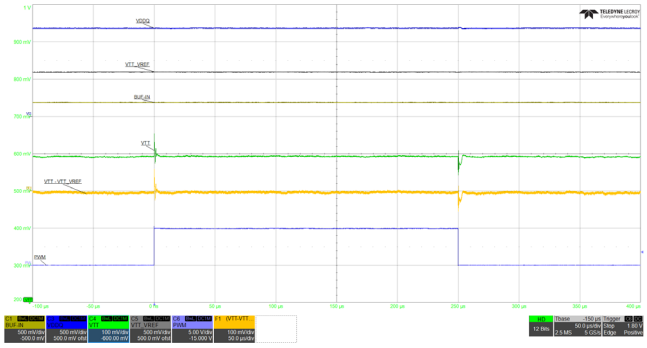

Figure 27. VTT Load Transient, -3A to 3A (V_{IN} = 5V, VDD(U2) = 5V, Slew rate = 42.5A/µs)

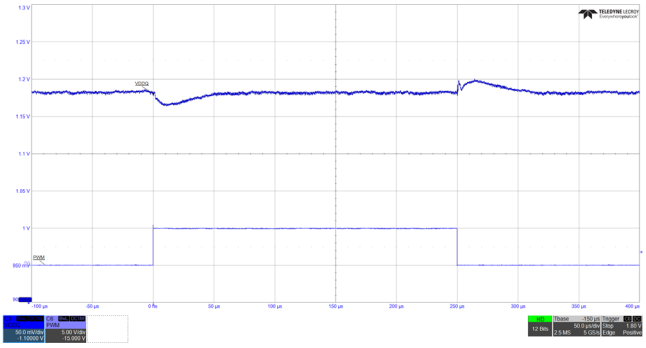

Figure 28. VDDQ Load Transient. 0A to 3A (V_{IN} = 5V, VDD(U2) = 5V, VDD(U5) = 5V, JP1 = Shorted, Slew rate = 3.6A/µs)

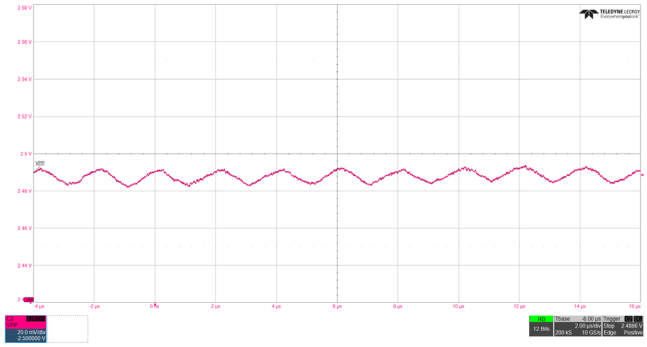

Figure 29. Output Voltage Ripple (V_{IN} = 5V, ILOAD_VPP = 3A)

4. Ordering Information

Part Number	Description
ISLDDR4DEMO1Z	Radiation Tolerant DDR4 Power Management Reference Design

5. Revision History

Revision	Date	Description
1.01	Jun 8, 2026	Updated Figure 8.
1.00	Nov 24, 2025	Initial release.

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers who are designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only to develop an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third-party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising from your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.01)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit www.renesas.com/contact-us/.

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.