

LTC7151S High Efficiency 15A Silent Switcher Buck Regulator

DESCRIPTION

Demonstration circuit 2615A features the **LTC®7151S** in a high efficiency 1.2V/15A step-down regulator with an input voltage range of 3.1V to 20V and a 1MHz switching frequency. The Silent Switcher®2 technology reduces the switching noise while the internal MOSFETs of the LTC7151S provide high efficiency over a wide input voltage range. No current sense resistor is required.

The LTC7151S employs a controlled on-time, valley current mode architecture. This architecture allows for a short minimum on-time which is ideal for high step-down ratios. In addition, the architecture provides a fast load step response by allowing the switch node pulses to compress after the load steps up – see Figure 6.

Other features of the DC2615A include:

- Selectable light load operating modes of continuous conduction mode (CCM) or discontinuous mode (DCM).
- SYNC pin to synchronize the regulator to an external clock.
- PGOOD pin and RUN pin

The LTC7151S data sheet provides a complete description of the IC operation and application information. The data sheet must be read in conjunction with the quick start guide.

[Design files for this circuit board are available.](#)

All registered trademarks and trademarks are the property of their respective owners.

PERFORMANCE SUMMARY

Specifications are at $T_A = 25^\circ\text{C}$, No Airflow

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		3.1V to 20V
Output Voltage	$V_{IN} = 3.1\text{V to } 20\text{V}$, $I_{OUT} = 0\text{A to } 15\text{A}$	$1.2\text{V} \pm 2\%$
Maximum Output Current	$V_{IN} = 3.1\text{V to } 20\text{V}$, $V_{OUT} = 1.2\text{V}$	15A
Nominal Switching Frequency		1MHz
Typical Efficiency See Figure 3	$V_{IN} = 12\text{V}$, $I_{OUT} = 15\text{A}$	87.6% Typical

DEMO MANUAL DC2615A

QUICK START PROCEDURE

The evaluation setup for demonstration circuit 2615A is straight forward. Refer to the diagram shown in Figure 1.

Next, follow the procedure below:

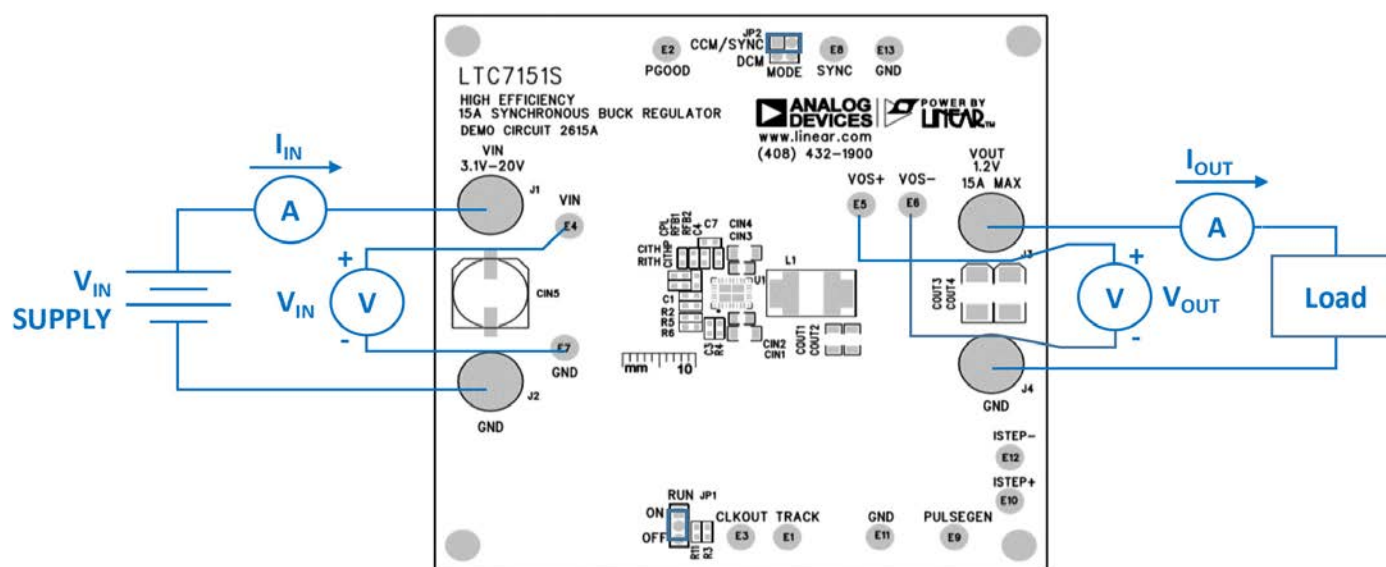
- 1) With power off, connect the input supply, load and meters as shown in Figure 1. Preset the load to 0A and the V_{IN} supply to 0V.
- 2) Place the RUN jumper in the ON position and the MODE jumper in the CCM/SYNC position.
- 3) Set the input voltage to 12V.
- 4) Check V_{OUT} . The output voltage should be within the regulation limits shown in the performance summary table.
- 5) Apply 15A load and re-measure V_{OUT} . It should be within the same regulation limits.

- 6) After the basic performance has been verified, the other aspects of performance can be measured and observed.

Note: To avoid large input voltage transients, do not hot plug the input supply to the DC2615A. Connect the input supply first and then turn it on.

Output Ripple Measurement

When measuring the output voltage or input voltage ripple, be sure to place the probe directly across an output or input capacitor. Figure 2 shows one example. Leads are soldered to both sides of the capacitor. The probe's ground ring makes contact with the return lead and the probe tip makes contact with the other lead.



NOTE: FOR ACCURATE EFFICIENCY MEASUREMENTS,
MONITOR V_{OUT} ACROSS COUT11

Figure 1. Proper Measurement Setup of the DC2615A

QUICK START PROCEDURE

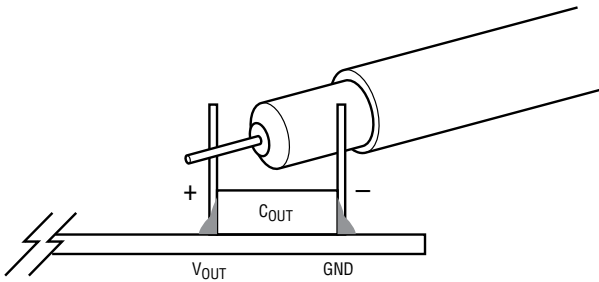
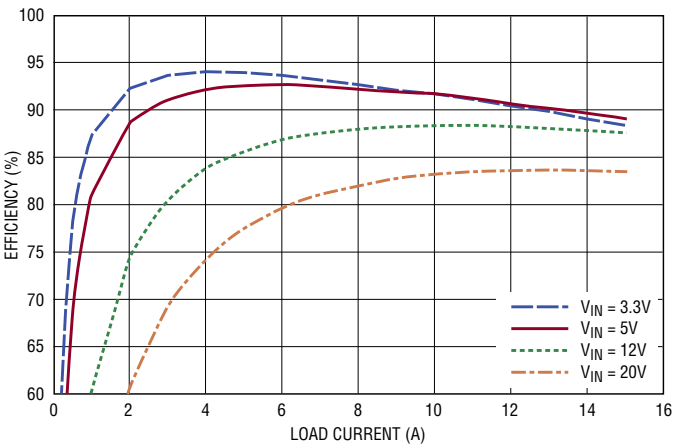
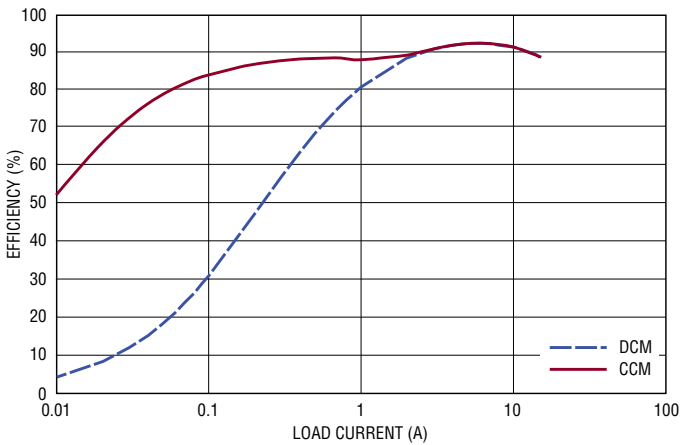


Figure 2. Measurement Output Voltage Ripple



f_{sw} : 1MHz
L: WURTH 744308020 (200nH, 0.37mΩ TYP)

Figure 3. Efficiency of the 1.2V/15A Regulator in CCM



f_{sw} : 1MHz
L: WURTH 744308020 (200nH, 0.37mΩ TYP)

Figure 4. Efficiency of the 1.2V/15A Regulator in CCM and DCM, $V_{IN} = 5V$

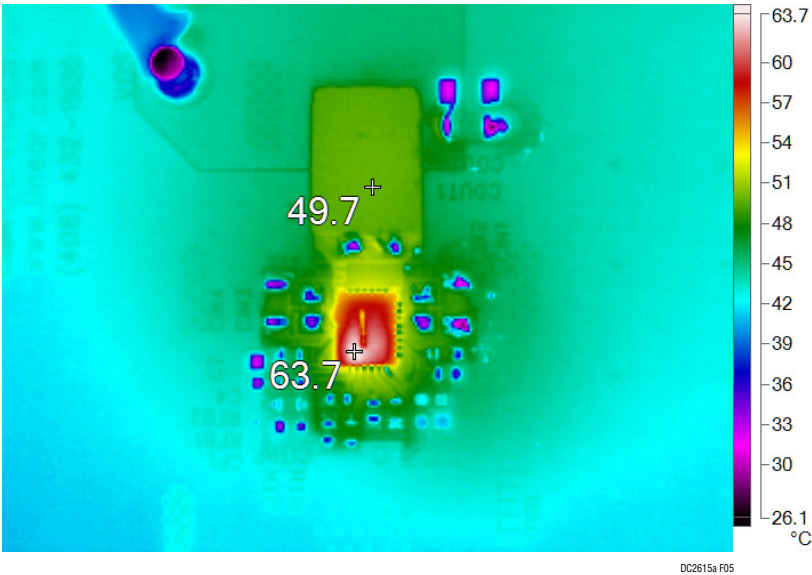
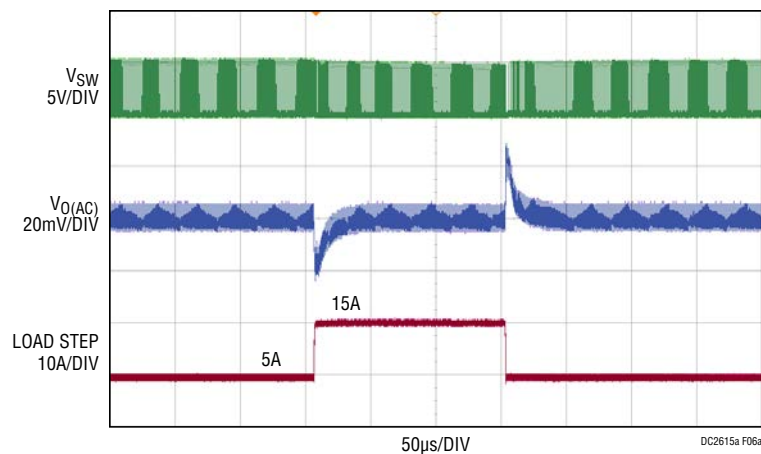
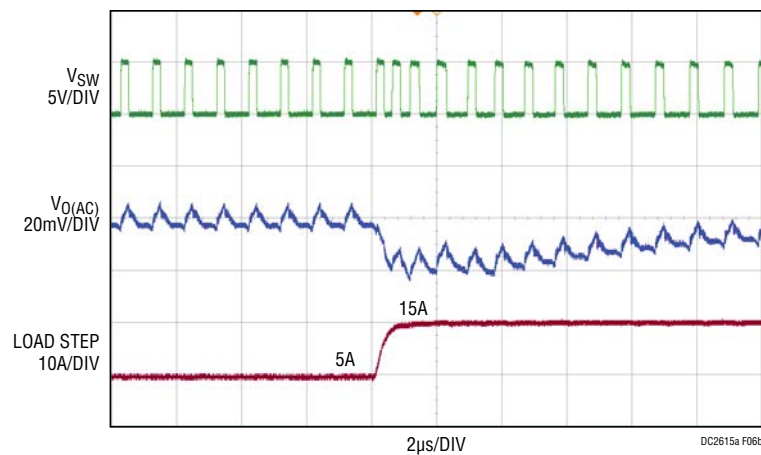


Figure 5. Thermal Image of the 1.2V/15A Regulator, $V_{IN} = 12V$, $f_{sw} = 1MHz$, L = Wurth 744308020 (200nH, 0.37mΩ Typ) 24°C Ambient, No Airflow

QUICK START PROCEDURE



(a) Load Step Pulse



(b) Rising Edge of Load Step

$C_{OUT} = 2 \times \text{Panasonic EEFSX0E331ER (330}\mu\text{F, 2.5V, 9m}\Omega\text{)} \parallel (100\mu\text{F, 6.3V, X5R, 1206})$,
 $L = \text{Würth 744308020 (200nH, 0.37m}\Omega\text{ Typ), } f_{SW} = 1\text{MHz}$

Figure 6. 5A to 15A Load Step, $V_{IN} = 5\text{V}$. The Controlled On-Time Valley Current Mode Architecture of the LTC7151S Allows the Switch Node Pulses to Compress During the 5A to 15A Load Step Transition. Approximately 1µs After the Start of the Rising Edge, the Output Voltage Starts Its Recovery.

PARTS LIST

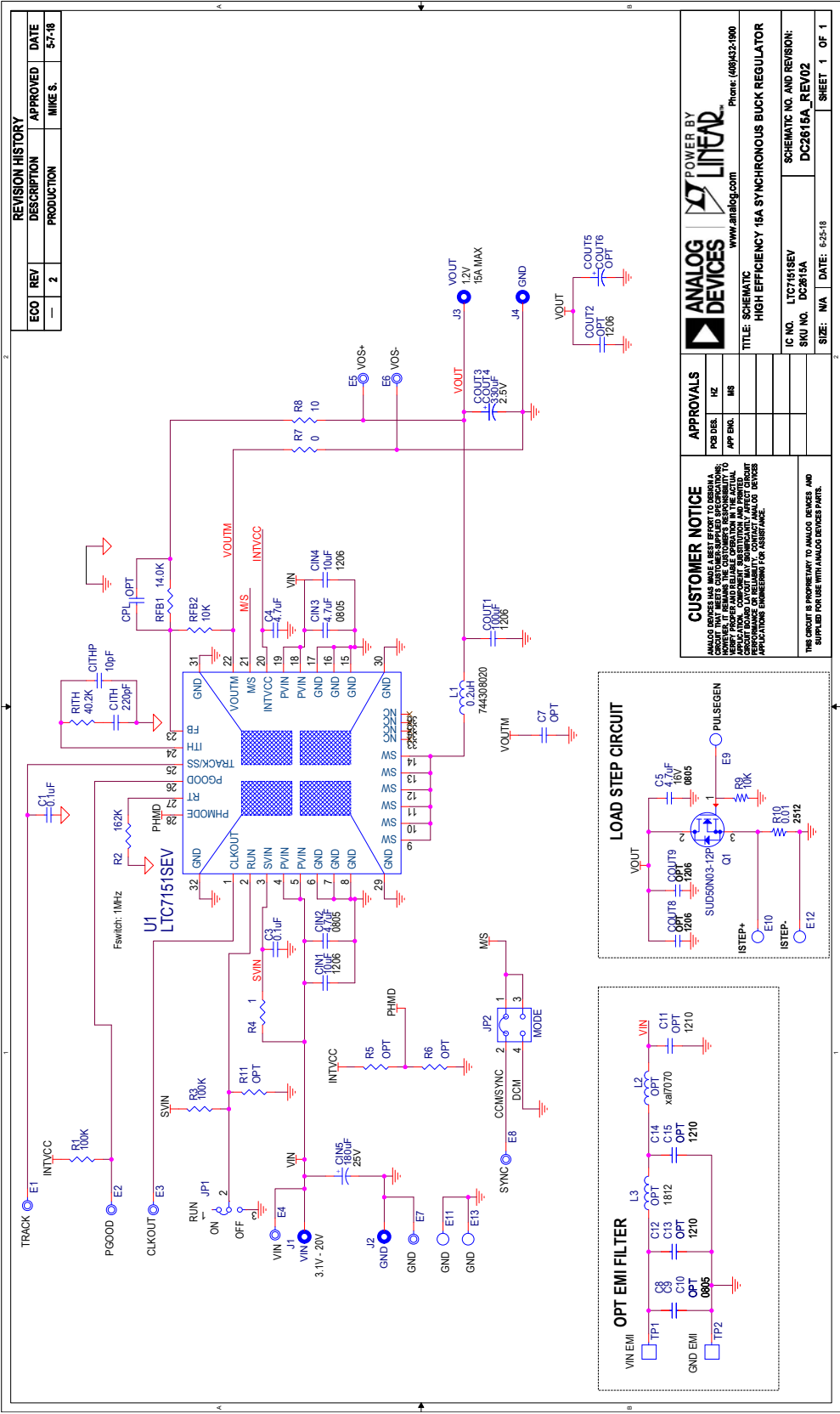
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C1, C3	CAP, 0.1 μ F, X5R, 25V, 10%, 0603	AVX, 06033D104KAT2A
2	1	C4	CAP, 4.7 μ F, X5R, 6.3V, 10%, 0603	AVX, 06036D475KAT2A MURATA, GRM188R60J475KE19D TDK, C1608X5R0J475K080AB
3	1	C5	CAP, 4.7 μ F, X5R, 6.3V, 10%, 0805	AVX, 08056D475KAT2A
4	2	CIN1, CIN4	CAP, 10 μ F, X5R, 25V, 10%, 1206	AVX, 12063D106KAT2A MURATA, GRM31CR61E106KA12L TDK, C3216X5R1E106K160AB
5	2	CIN2, CIN3	CAP, 4.7 μ F, X5R, 25V, 10%, 0805	MURATA, GRM219R61E475KA73D TDK, C2012X5R1E475K085AC
6	1	CIN5	CAP, 180 μ F, OS-CON, 25V, 20%, 8mm $\times$ 12mm SMD, E12	PANASONIC, 25SVPF180M
7	1	CITH	CAP, 220pF, C0G, 50V, 5%, 0603	AVX, 06035A221JAT2A
8	1	CITHP	CAP, 10pF, C0G, 25V, 5%, 0603	AVX, 06033A100JAT2A
9	1	COUT1	CAP, 100 μ F, X5R, 6.3V, 20%, 1206	MURATA, GRM31CR60J107ME39L TDK, C3216X5R0J107M160AB
10	2	COUT3, COUT4	CAP, 330 μ F, SP-CAP, 2.5V, 20%, 9m Ω , 6.3A, 7343	PANASONIC, EEFSX0E331ER
11	1	L1	IND, 0.2 μ H, HIGH CURRENT, 20%, 25A, SMD 1070	WURTH ELEKTRONIK, 744308020
12	2	R1, R3	RES, 100k Ω , 1%, 1/10W, 0603	NIC, NRC06F1003TRF PANASONIC, ERJ3EKF1003V VISHAY, CRCW0603100KFKEA
13	1	R2	RES, 162k Ω , 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF1623V ROHM, MCR03EZPFX1623 VISHAY, CRCW0603162KFKEA
14	1	R4	RES, 1 Ω , 5%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06031R00JNEA
15	1	R7	RES, 0 Ω , 1/10W, 0603	NIC, NRC06Z0TRF VISHAY, CRCW06030000Z0EA
16	1	R8	RES, 10 Ω , 5%, 1/10W, 0603	NIC, NRC06J100TRF VISHAY, CRCW060310R0JNEA
17	1	RFB1	RES, 14k Ω , 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060314K0FKEA
18	1	RFB2	RES, 10k Ω , 1%, 1/10W, 0603, AEC-Q200	KOA SPEER, RK73H1JTTD1002F PANASONIC, ERJ3EKF1002V VISHAY, CRCW060310K0FKEA
19	1	RITH	RES, 40.2k Ω , 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F4022TRF PANASONIC, ERJ3EKF4022V VISHAY, CRCW060340K2FKEA
20	1	U1	IC, SYNCHRONOUS BUCK CONVERTER, LGA-28 (5mm $\times$ 4mm), 20V, 14A	ANALOG DEVICES, LTC7151SEV#PBF
Load Step Circuit				
1	1	Q1	XSTR, MOSFET, N-CH, 40V, TO-252 (DPAK)	VISHAY, SUD50N04-8M8P-4GE3
2	1	R10	RES, 0.01 Ω , 1%, 1W, 2512, SENSE, AEC-Q200	VISHAY, WSL2512R0100FEA
3	1	R9	RES, 10k Ω , 1%, 1/10W, 0603, AEC-Q200	KOA SPEER, RK73H1JTTD1002F PANASONIC, ERJ3EKF1002V VISHAY, CRCW060310K0FKEA

DEMO MANUAL DC2615A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
1	0	COUT2, COUT8, COUT9	CAP, OPTION, 1206	
2	0	COUT5, COUT6	CAP, OPTION, 7343	
3	0	C7, CPL	CAP, OPTION, 0603	
4	0	R5, R6, R11	RES, OPTION, 0603	
Hardware: For Demo Board Only				
1	13	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13"	TEST POINT, TURRET, 0.094", MTG. HOLE	MILL-MAX, 2501-2-00-80-00-00-07-0
2	4	J1, J2, J3, J4	CONN, BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE	KEYSTONE, 575-4
3	3	JP1, JP2, JP3	CONN, SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421
4	2	JP1, JP3	CONN, HDR, MALE, 1×3, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000311121
5	1	JP2	CONN, HDR, MALE, 2×2, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000421121
6	4	MH1, MH2, MH3, MH4	STANDOFF, NYLON, SNAP-ON, 0.50"	WURTH ELEKTRONIK, 702935000

SCHEMATIC DIAGRAM



DEMO MANUAL DC2615A



ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.