

LT8640A

42V, 5A (8A Peak) Synchronous Step-Down Silent Switcher with 2.5μA Quiescent Current

DESCRIPTION

Demonstration circuit 3099A is a 42V, 5A synchronous step-down Silent Switcher® with spread spectrum frequency modulation featuring the [LT®8640A](#). The demo board is designed for 5V output from a 5.7V to 42V input. Meanwhile the LT8640A can operate down to 3.4V inputs. The wide input range allows a variety of input sources, such as automotive batteries and industrial supplies. The LT8640A is a compact, ultralow emission, high efficiency, and high speed synchronous monolithic step-down switching regulator. The integrated power switches and inclusion of all necessary circuitry reduce the components count and solution size. Special Silent Switcher architecture minimizes EMI emissions. Selectable spread spectrum mode can further improve EMI performance. Ultralow 2.5μA quiescent current in Burst Mode® operation achieves high efficiency at very light loads. Fast minimum on-time of 30ns enables high V_{IN} to low V_{OUT} conversion at high frequency.

The LT8640A switching frequency can be programmed either via oscillator resistor or external clock over a

200kHz to 3MHz range. The default frequency of demo circuit 3099A is 2MHz. The LT8640A SYNC/MODE pin on the demo board is grounded (JP1 at BURST position) by default for low ripple Burst Mode operation. Spread spectrum mode and forced continuous mode can be selected respectively by moving JP1 shunt. To synchronize to an external clock, move JP1 to FCM/SYNC and apply the external clock to the SYNC terminal.

The LT8640A data sheet gives a complete description of the part, operation, and application information. The data sheet must be read in conjunction with this demo manual for demo circuit 3099A. The LT8640A is assembled in a 3mm × 4mm plastic QFN package with exposed pad for low thermal resistance. The layout recommendations for low EMI operation and maximum thermal performance are available in the data sheet section Low EMI PCB Layout and Thermal Considerations and Peak Output Current.

[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 $T_A = 25^\circ\text{C}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range		5.7		42	V
V_{OUT}	Output Voltage	$R4 = 1\text{M}\Omega$, $R5 = 243\text{k}\Omega$	4.85	5	5.15	V
I_{OUT}	Maximum Continuous Output Current	Derating Is Necessary for Certain V_{IN} and Thermal Conditions	5			A
f_{SW}	Switching Frequency	$R2 = 17.8\text{k}\Omega$, JP1 = FCM/SYNC	1.85	2	2.15	MHz
EFF	Efficiency at DC	$V_{IN} = 12\text{V}$, $I_{OUT} = 3\text{A}$		94		%

QUICK START PROCEDURE

Demonstration circuit 3099A is easy to set up to evaluate the performance of the LT8640A. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Place JP1 on BURST position.
2. With power off, connect the input power supply to VEMI and GND. If the EMI performance is not important, the input EMI filter can be bypassed by connecting the input power supply to VIN and GND.
3. With power off, connect the load from VOUT to GND.
4. To read the input voltage and output voltage accurately, the voltage meters should be connected to VIN_SENSE and VOUT_SENSE turret pins.

5. Turn on the power at the input.

NOTE: Make sure that the input voltage does not exceed 42V.

6. Check for the proper output voltage ($V_{OUT} = 5V$).

NOTE: If there is no output, temporarily disconnect the load to make sure that the load is not set too high or is shorted.

7. Once the proper output voltage is established, adjust the load within the operating ranges and observe the output voltage regulation, ripple voltage, efficiency, and other parameters.

NOTE: When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip directly across the output capacitor. See Figure 2 for the proper scope technique.

8. JP1 can also set LT8640A in spread spectrum mode (JP1 on the SPREAD-SPECTRUM position) or forced continuous mode (JP1 on the FCM/SYNC position). An external clock can be added to the SYNC terminal when SYNC function is used (JP1 on the FCM/SYNC position). Please make sure that R2 should be chosen to set the LT8640A switching frequency equal to or below the lowest SYNC frequency.

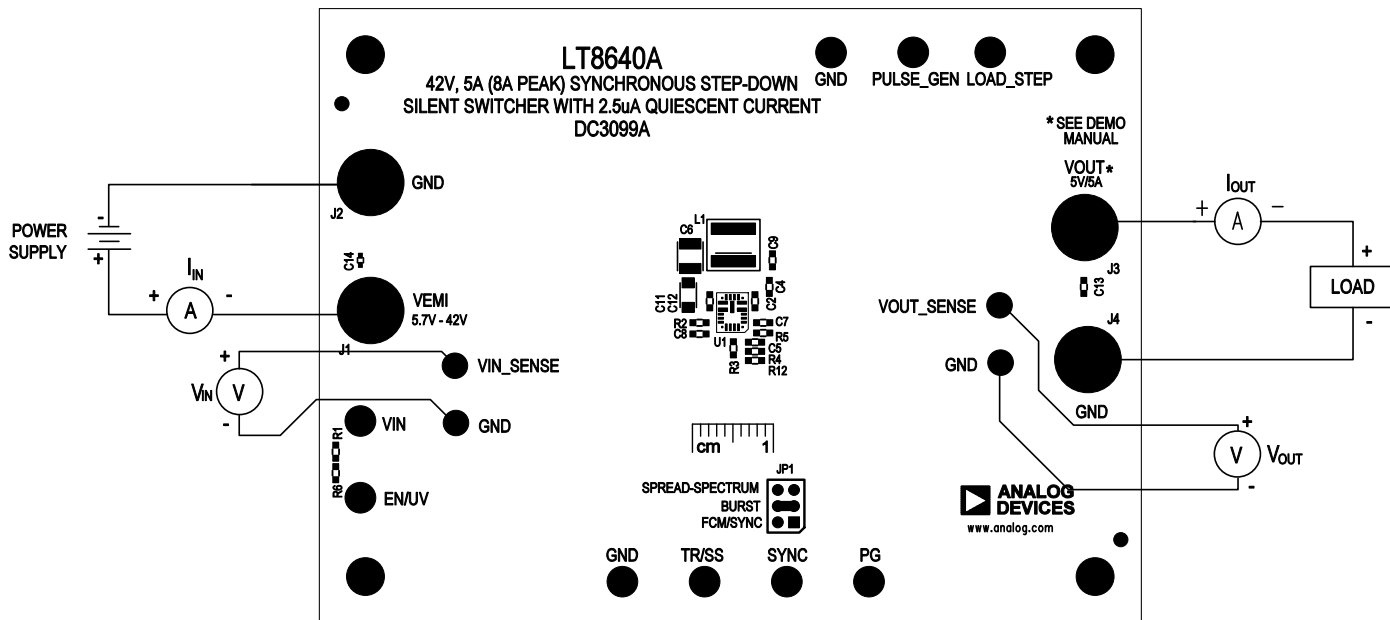


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

Figure 3 shows the efficiency of demo circuit 3099A at 12V input and 24V input in Burst Mode Operation (input from VIN terminal, JP1 = BURST).

The demo board has an EMI filter installed. The EMI performance of the board (with EMI filter) is shown on

Figure 4. The red line in Figure 4 is CISPR25 Class 5 peak limit. The figure shows that the circuit passes the test with a wide margin. To achieve EMI performance as shown in Figure 4, the input EMI filter is required, and the input voltage should be applied at VEMI.

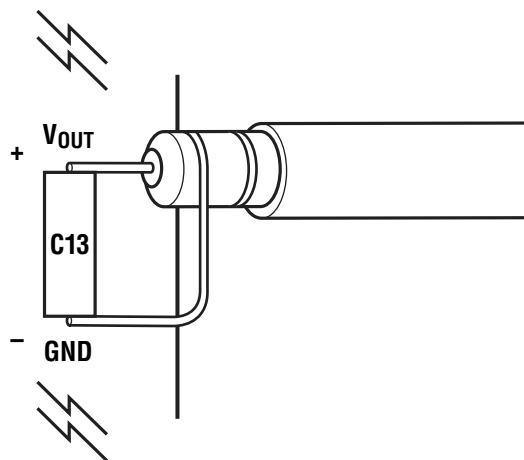


Figure 2. Measuring Output Ripple at Output Capacitor C13

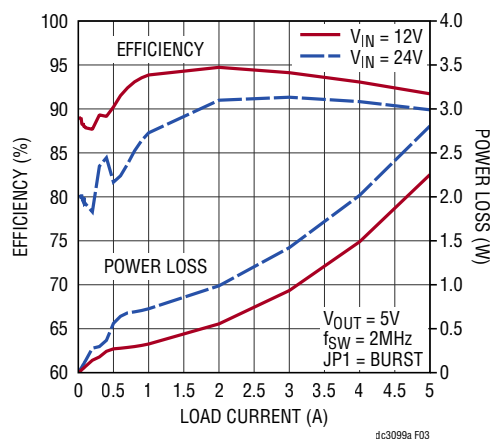
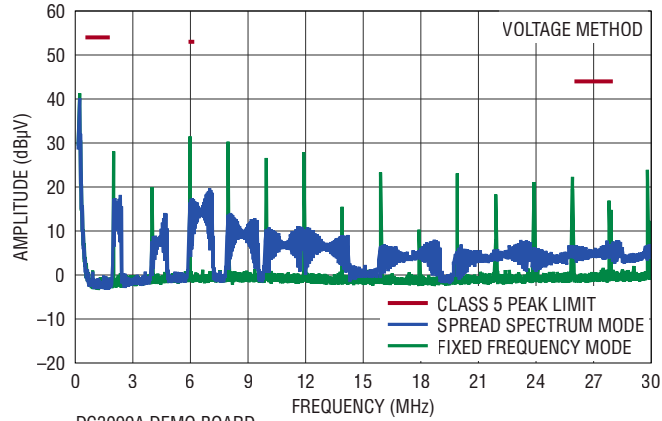


Figure 3. LT8640A Demo Circuit 3099A Efficiency vs Load Current (Input from V_{IN} Terminal)

QUICK START PROCEDURE

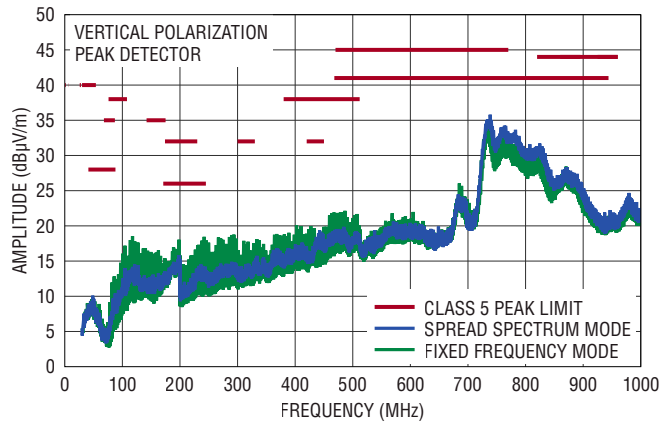
Conducted EMI Performance (CISPR25 Conducted Emission Test with Class 5 Peak Limits)



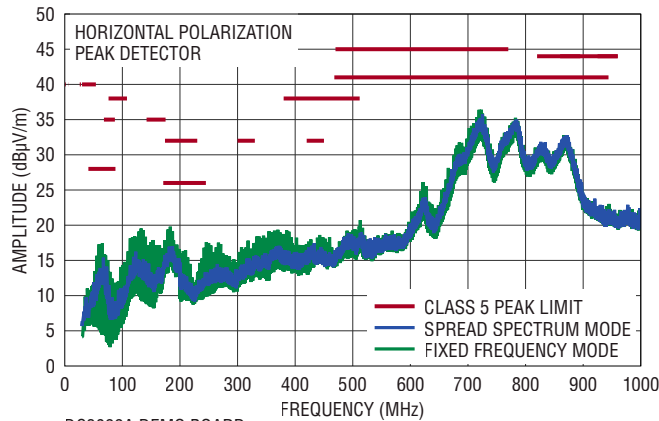
DC3099A DEMO BOARD
(WITH EMI FILTER INSTALLED)
12V INPUT TO 5V OUTPUT AT 5A, $f_{SW} = 2\text{MHz}$

dc3099a F04a

Radiated EMI Performance (CISPR25 Radiated Emission Test with Class 5 Peak Limits)



dc3099a F04b



dc3099a F04c

DC3099A DEMO BOARD
(WITH EMI FILTER INSTALLED)
12V INPUT TO 5V OUTPUT AT 5A, $f_{SW} = 2\text{MHz}$

Figure 4. LT8640A Demo Circuit 3099A EMI Performance (12V Input from VEMI, with EMI filter, $I_{OUT} = 5\text{A}$)

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C2, C12	CAP, X5R, 1 μ F, 50V, 10%, 0603	MURATA, GRT188R61H105KE13D
2	2	C4, C8	CAP, X7R, 0.1 μ F, 16V, 10%, 0603	MURATA, GRM188R71C104KA01D
3	1	C5	CAP, C0G, 10pF, 25V, \pm 0.25pF, 0603	AVX, 06033A100CAT2A
4	1	C6	CAP, X5R, 100 μ F, 10V, 20% 1210	MURATA, GRM32ER61A107ME20L
5	2	C7, C9	CAP, X7R, 1 μ F, 25V, 10%, 0603	MURATA, GRM188R71E105KA12D
6	1	C11	CAP, X5R, 10 μ F, 50V, 10%, 1206	TDK, C3216X5R1H106K160AB
7	1	C13	CAP, X5R, 4.7 μ F, 25V, 10%, 0603	MURATA, GRM188R61E475KE11D
8	1	L1	INDUCTOR, 1.5 μ H	COILCRAFT, XEL6030-152ME
9	2	R1, R3	RES., CHIP, 100k, 1/10W, 1% 0603	VISHAY, CRCW0603100KFKEA
10	1	R2	RES., CHIP, 17.8k, 1/10W, 1% 0603	VISHAY, CRCW060317K8FKEA
11	1	R4	RES., CHIP, 1M, 1/10W, 1%, 0603	VISHAY, CRCW06031M00FKEA
12	1	R5	RES., CHIP, 243k, 1/10W, 1%, 0603	VISHAY, CRCW0603243KFKEA
13	1	U1	I.C., STEP-DOWN SILENT SWITCHER, QFN-18	ANALOG DEVICES, LT8640AJUDCM#PBF
Additional Demo Board Circuit Components				
1	1	C1	CAP, ALUM 22 μ F, 63V	SUN ELECT., 63CE22BS
2	2	C3, C10	CAP, X7R, 10 μ F, 50V, 10%, 1210	MURATA, GRM32ER71H106KA12L
3	1	C14	CAP, X7R, 0.1 μ F, 50V, 10%, 0402	MURATA, GRM155R71H104KE14D
4	0	C19 (OPT)	CAP, OPTION, 0805	
5	1	FB1	BEAD, FERRITE, 100 Ω AT 100MHz, 8A, 1812	WURTH ELEKTRONIK, 74279226101
6	0	L2	IND., OPT, XAL60XX	
7	1	Q1	MOSFET, N-CH, 40V, 14A, DPAK (TO-252)	VISHAY, SUD50N04-8M8P-4GE3
8	0	R6 (OPT)	RES., OPTION, 0603	
9	2	R7, R12	RES., CHIP, 0 Ω , 1/10W, 1%, 0603	VISHAY, CRCW06030000Z0EA
10	1	R10	RES., CHIP, 10k, 1/10W, 1% 0603	VISHAY, CRCW060310K0FKEA
11	1	R11	RES., 0.1 Ω , 1%, 3W, 2512, SHORT-SIDE TERMINAL	SUSUMU, KRL3264E-C-R100-F-T1

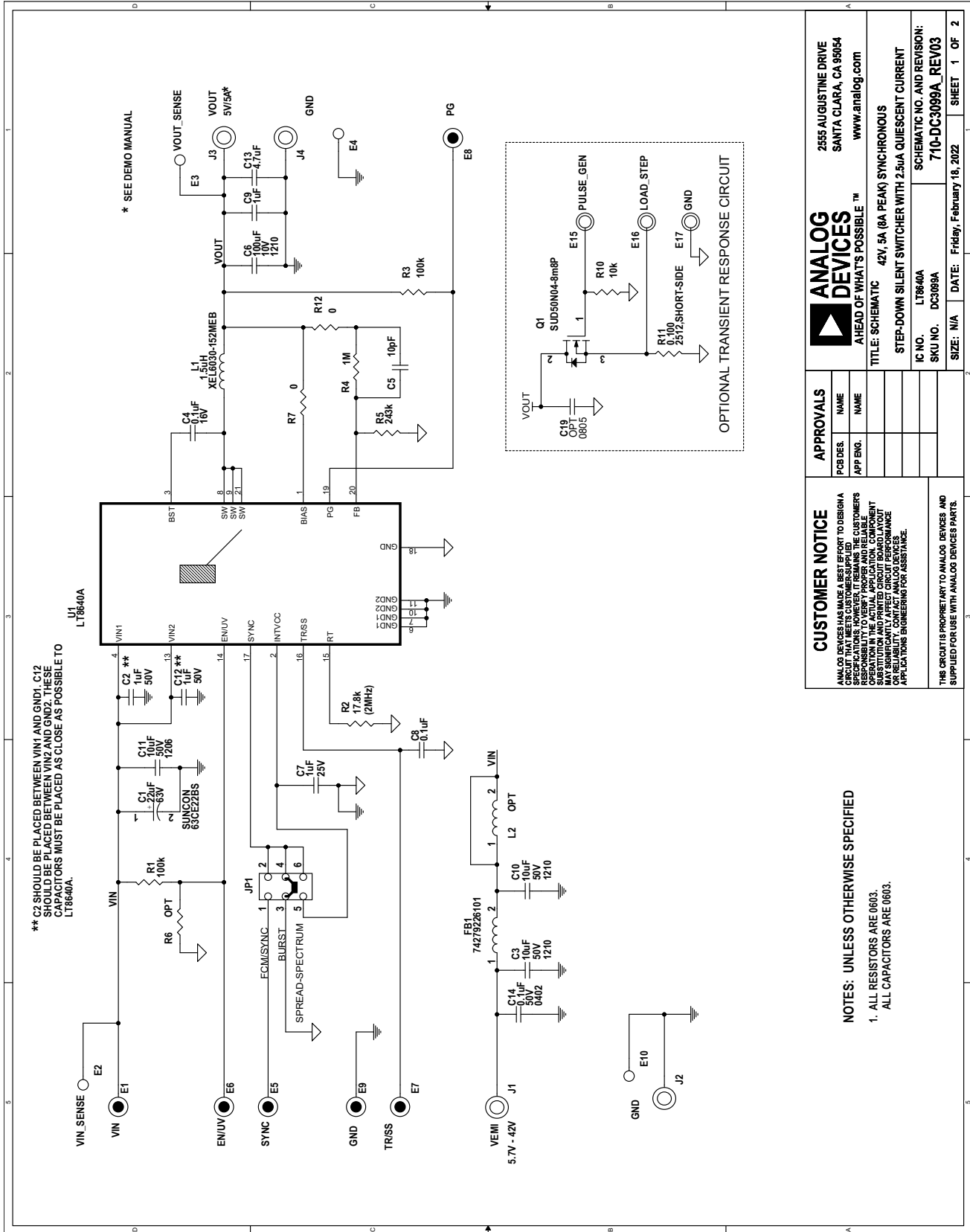
DEMO MANUAL DC3099A

PARTS LIST

Hardware: For Demo Board Only

1	9	E1, E5-E9, E15-E17	TESTPOINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	4	E2, E3, E4, E10	TESTPOINT, TURRET, 0.064"	MILL-MAX, 2308-2-00-80-00-00-07-0
3	4	J1-J4	JACK BANANA	KEYSTONE, 575-4
4	1	JP1	2X3, 0.079 DOUBLE ROW HEADER	WURTH ELEKTRONIK, 62000621121
5	4	MP1-MP4	STANDOFF, NYLON, SNAP-ON, 11.1mm	WURTH ELEKTRONIK, 702934000
6	1	XJP1	SHUNT, 0.079" CENTER	WURTH ELEKTRONIK, 60800213421

SCHEMATIC DIAGRAM





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.