

# LT8609A/09A-5/09A-3.3 42V, 3A Micropower Synchronous Step-Down Regulator

## DESCRIPTION

Demonstration circuit 2958A is a 42V, 3A micropower synchronous step-down regulator featuring the [LT®8609A/09A-5/09A-3.3](#). There are three assembly versions; DC2958A-A is for the LT8609A adjustable output, DC2958A-B is for the LT8609A-5 with a fixed 5V output voltage and DC2958A-C is for the LT8609A-3.3 with a fixed 3.3V output voltage.

The LT8609A/09A-5/09A-3.3 is a compact, high efficiency, high speed synchronous monolithic step-down switching regulator that consumes only 2.5µA of quiescent current. Top and bottom power switches, compensation components and other necessary circuits are inside of the IC to minimize external components and simplify design.

The SYNC pin on the demo board is grounded by default for low ripple Burst Mode operation. Moving JP1 to PULSE SKIPPING position changes the operation mode to pulse-skipping operation. Once JP1 is placed on SPREAD SPECTRUM position,  $V_{CC}$  is applied to the SYNC pin for low EMI spread spectrum operation. To synchronous to an external clock, move JP1 to SYNC and apply the external clock to the SYNC turret.

The demo board is designed for 5V or 3.3V output with up to 42V input. The wide input range allows a variety of input sources, such as automotive batteries and industrial supplies. The minimum input voltage can be as low as 3V

for drop out mode operation. Under this mode, the output voltage is below the regulation point and follow the input voltage. To maintain the output under regulation, input voltage should be above certain value. For DC2958A-A (adjustable) and DC2958A-B (5V), this value is 5.5V while 3.8V for DC2958A-C (3.3V). The rated maximum load current is 3A, while derating is necessary for certain input voltage and thermal conditions. Figure 1 shows the efficiency of the circuit. Figure 2 shows the IC top temperature rising on DC2958A demo board under different load conditions.

The demo board has an EMI filter installed. The radiated EMI performances of the board (with EMI filter) are shown in Figure 3 and Figure 4. The red lines in Figure 3 and Figure 4 are CISPR25 Class 5 peak limit. To use the EMI filter, the input should be tied to  $V_{EMI}$ , not  $V_{IN}$ . An inductor L2, which is shorted on the board by default, can be added in the EMI filter to further reduce the conducted emission.

The LT8609A/09A-5/09A-3.3 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 DC2958A.

**[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 Voltage Range				42	V
$V_{OUT}$	Output Voltage	DC2958A-A/DC2958A-B	4.8	5	5.2	V
		DC2958A-C	3.168	3.3	3.432	
$I_{OUT}$	Maximum Output Current		3			A
$f_{SW}$	Switching Frequency		1.85	2	2.15	MHz
EFF	Efficiency for DC2958A-A/DC2958A-B	$V_{IN} = 12\text{V}, I_{OUT} = 1\text{A}$		92.1		%
	Efficiency for DC2958A-C	$V_{IN} = 12\text{V}, I_{OUT} = 1\text{A}$		89.3		%

## QUICK START PROCEDURE

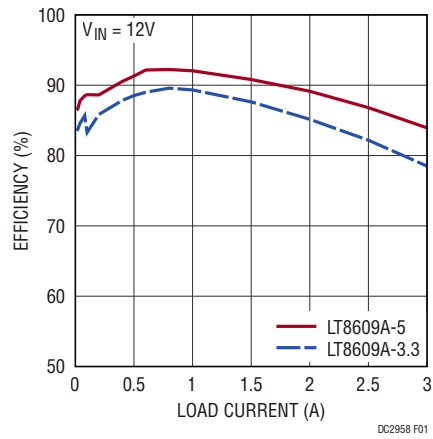


Figure 1. Efficiency vs Load Current at 12V Input 2MHz Switching Frequency

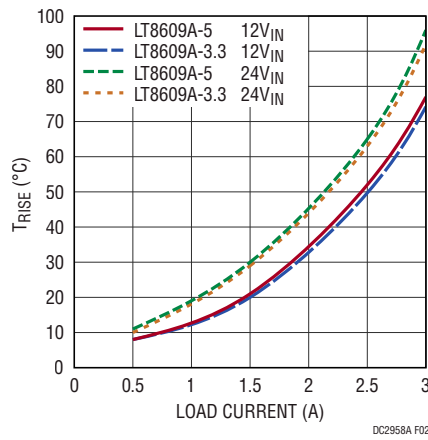
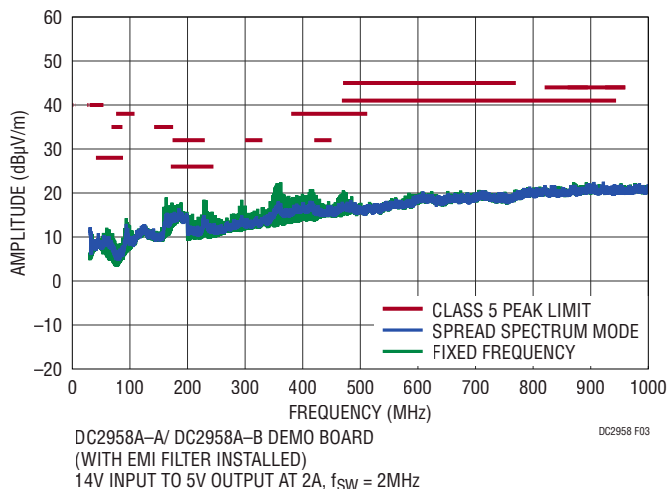
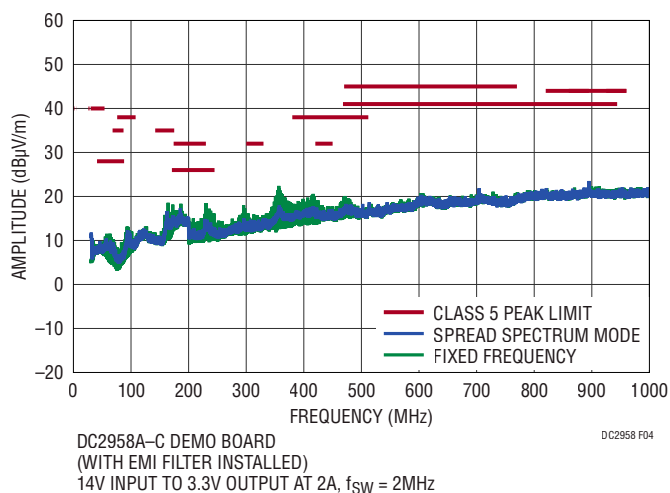


Figure 2. LT8609A Demo Circuit Case Temperature Rise

**QUICK START PROCEDURE**



**Figure 3. LT8609A-5 Demo Circuit EMI Performance in CISPR25 Radiated Emission Test, ( $V_{IN} = 14\text{V}$ ,  $V_{OUT} = 5\text{V}$ ,  $I_{OUT} = 2\text{A}$ , 2MHz Switching Frequency)**



**Figure 4. LT8609A-3.3 Demo Circuit EMI Performance in CISPR25 Radiated Emission Test, ( $V_{IN} = 14\text{V}$ ,  $V_{OUT} = 3.3\text{V}$ ,  $I_{OUT} = 2\text{A}$ , 2MHz Switching Frequency)**

## QUICK START PROCEDURE

DC2958A is easy to set up to evaluate the performance of the LT8609A/09A-5/LT8609A/09A-3.3. Refer to Figure 5 for proper measurement equipment setup and follow the procedure below.

**NOTE:** When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. See Figure 6 for the proper scope technique.

1. Set an input power supply that is capable of 42V/3A. Then turn off the supply.

2. With power off, connect the supply to the input terminals  $V_{IN}$  and GND.

3. Turn on the power at the input.

**NOTE:** Make sure that the input voltage never exceeds 42V.

4. Check for the proper output voltage. Turn off the power at the input.

5. Once the proper output voltage is established, connect a variable load capable of sinking 3A to the output terminals  $V_{OUT}$  and GND. Set the current for 0A.

a. If efficiency measurements are desired, an ammeter can be put in series with the output load in order to measure the DC2958A's output current.

b. A voltmeter can be placed across the output terminals in order to get an accurate output voltage measurement.

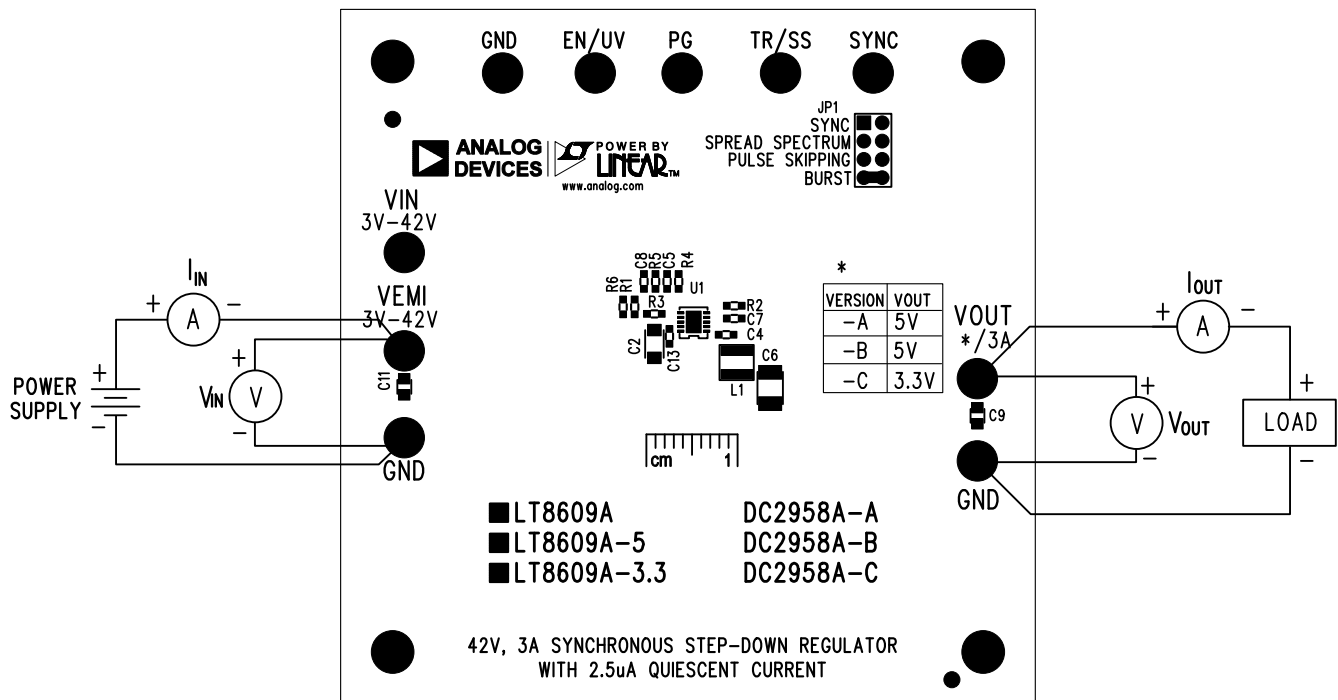
6. Turn on the power at the input.

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

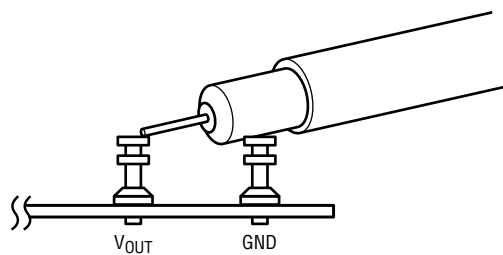
7. Once the proper output voltage is again established, adjust the load and/or input within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other desired parameters.

8. An external clock can be added to the SYNC terminal when SYNC function is used (JP1 on the SYNC position). Please ensure that the chosen RT sets the LT8609A/09A-5/09A-3.3 switching frequency to equal or below the lowest SYNC frequency. See the data sheet section, "Synchronization."

**QUICK START PROCEDURE**



**Figure 5. Proper Measurement Equipment Setup**



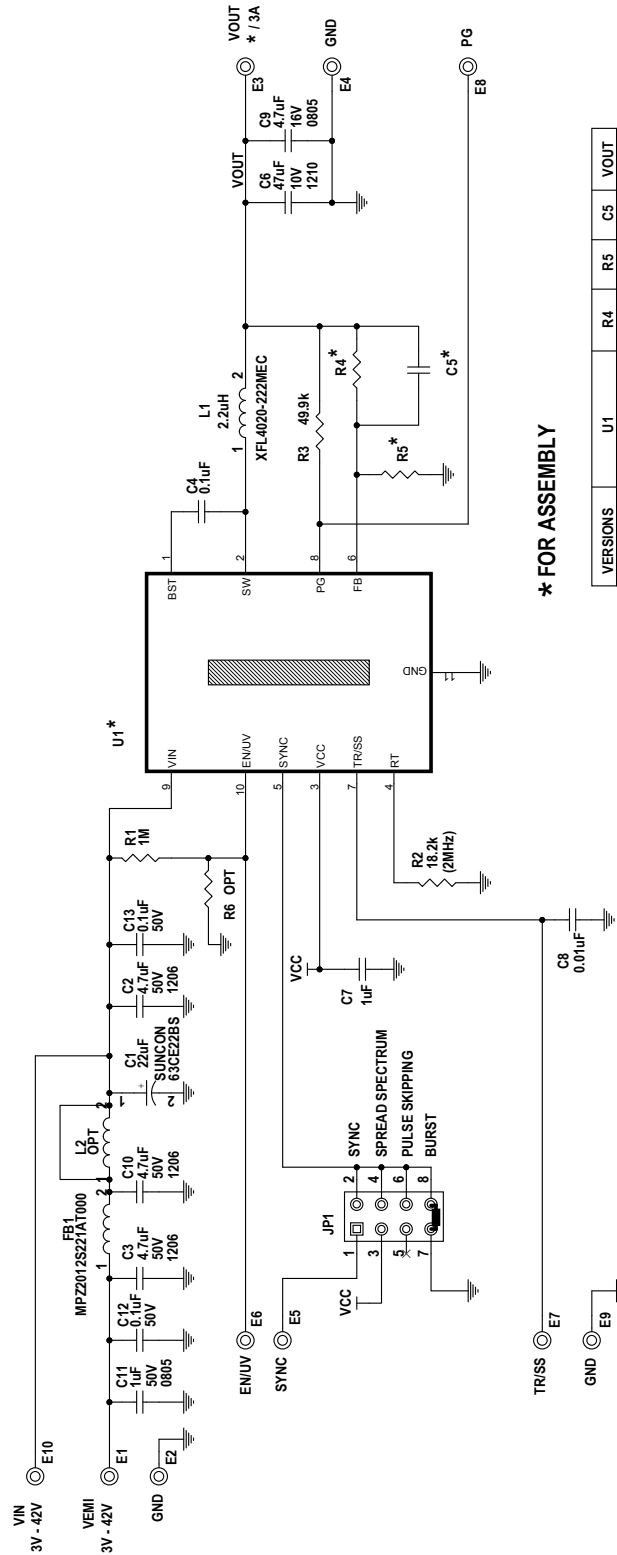
**Figure 6. Measuring Output Ripple**

# DEMO MANUAL DC2958A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	1	C2	CAP, X7R, 4.7 $\mu$ F, 50V, 10% 1206	MURATA, GRM31CR71H475K
2	1	C4	CAP, X7R, 0.1 $\mu$ F, 16V, 10%, 0603	MURATA, GRM188R71C104KA01D
4	1	C6	CAP, X7R, 47 $\mu$ F, 10V, 10%, 1210	MURATA, GRM32ER71A476KE20L
5	1	C7	CAP, X7R, 1.0 $\mu$ F, 25V, 10%, 0603	MURATA, GRM188R71E105KA12D
6	1	C8	CAP, X7R, 0.01 $\mu$ F, 16V, 10%, 0603	AVX, 0603YC103KAT2A
7	1	L1	IND., 2.2 $\mu$ H	COILCRAFT, XFL4020-222MEC
8	1	R2	RES., CHIP, 18.2k, 1/10W, 1%, 0603	VISHAY, CRCW060318K2FKEA
9	1	R3	RES., CHIP, 49.9k, 1/10W, 1%, 0603	VISHAY, CRCW060349K9FKEA
<b>DC2958A-A Version Specific Components</b>				
1	1	U1	IC, REGULATOR, DDM-10	ANALOG DEVICES, LT8609AEDDM#PBF
2	1	C5	CAP, COG, 10pF, 25V, 5%, 0603	AVX, 06033A100JAT2A
3	1	R4	RES., CHIP, 1M $\Omega$ , 1/10W, 1%, 0603	VISHAY, CRCW06031M00FKEA
4	1	R5	RES., CHIP, 187k, 1/10W, 1%, 0603	VISHAY, CRCW0603187KFKEA
<b>DC2958A-B Version Specific Components</b>				
1	1	U1	IC, REGULATOR, DDM-10	ANALOG DEVICES, LT8609AEDDM-5#PBF
2	0	C5 (OPT.)	CAP, 0603	
3	1	R4	RES., 0 $\Omega$ , 1/10W, 0603	VISHAY, CRCW06030000Z0EA
4	0	R5 (OPT.)	RES., 0603	
<b>DC2958A-C Version Specific Components</b>				
1	1	U1	IC, REGULATOR, DDM-10	ANALOG DEVICES, LT8609AEDDM-3.3#PBF
2	0	C5 (OPT.)	CAP, 0603	
3	1	R4	RES., 0 $\Omega$ , 1/10W, 0603	VISHAY, CRCW06030000Z0EA
4	0	R5 (OPT.)	RES., 0603	
<b>Additional Demo Board Circuit Components</b>				
1	1	C1	CAP, ALUM 22 $\mu$ F 63V	SUN ELECT, 63CE22BS
2	2	C3,C10	CAP, X7R, 4.7 $\mu$ F, 50V, 10% 1206	MURATA, GRM31CR71H475K
3	1	C9	CAP, X7R, 4.7 $\mu$ F, 16V, 10%, 0805	MURATA, GRM21BR71C475K73L
4	1	C11	CAP, X7R, 1 $\mu$ F, 50V, 10%, 0805	TDK, C2012X7R1H105K
5	2	C12, C13	CAP, X7R, 0.1 $\mu$ F, 50V, 10%, 0603	MURATA, GRM188R71H104KA93D
6	1	FB1	FERRITE BEAD 0805	TDK, MPZ2012S221A
7	1	L2	RES., CHIP, 0 $\Omega$ , 3/4W, 2010	VISHAY, CRCW20100000Z0EF
8	1	R1	RES., CHIP, 1M $\Omega$ , 1/10W, 1%, 0603	VISHAY, CRCW06031M00FKEA
9	0	R6 (OPT.)	RES., 0603	
<b>Hardware for Demo Board Only</b>				
1	9	E1 – E9	TESTPOINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	1	E10(OPT.)	TESTPOINT, TURRET, 0.094"	
3	1	JP1	DOUBLE ROW HEADER 2 x 4 0.079"	SULLINS NRPN042PAEN-RC
4	1	XJP1	SHUNT, 0.079" CENTER	SAMTEC 2SN-BK-G
5	4	MH1 – MH4	STAND-OFF, NYLON 0.50" TALL	KEYSTONE, 8833 (SNAP ON)

**SCHEMATIC DIAGRAM**



**\* FOR ASSEMBLY**

VERSIONS	U1	R4	R5	C5	VOUT
DC2958A-A	LT8609AEDDM	1M	187k	10pF	5V
DC2958A-B	LT8609AEDDM-5	0 OHM	OPT	OPT	5V
DC2958A-C	LT8609AEDDM-3.3	0 OHM	OPT	OPT	3.3V



## 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.