

## Evaluating the **EVAL-CN0369SDPZ**

### FEATURES

Self contained evaluation board including

[ADF4002](#) PLL frequency synthesizer

[AD8065](#) operational amplifier

[HMC512](#) VCO 9.6 GHz to 10.8 GHz, with  $f_{OUT}/2$

Ultralow noise voltage regulators: [ADP151](#) and [ADM7150](#)

USB interface

[ADF4002](#) Integer-N software allows control of synthesizer functions from PC

### ONLINE RESOURCES

Documents Needed

[ADF4002](#) data sheet

[AD8065](#) data sheet

[HMC512](#) data sheet

[ADL5801](#) data sheet

[ADF4355-2](#) data sheet

[EV-ADF4355-2SD1Z](#) user guide

Required Software

[ADF4002](#) Integer-N software

[EV-ADF4355-2SD1Z](#) evaluation software

Design and Integration Files

[Schematics](#), [Layout Files](#), [Bill of Materials](#)

### EQUIPMENT NEEDED

A standard PC running Windows® XP, Windows Vista (32-bit), or Windows 7 with a USB port

[EVAL-CN0369SDPZ](#) circuit evaluation board

[ADL5801-EVALZ](#) circuit evaluation board

[EV-ADF4355-2SD1Z](#) circuit evaluation board

2 [EVAL-SDP-CS1Z](#) evaluation boards

A 400 MHz low pass filter

A 100 MHz low pass filter

5.5 V, 5 V, and 12 V power supplies

A signal source, such as the R&S® SMA100A signal generator

A second signal source, such as the R&S SMA100A signal generator or a 100 MHz, low noise crystal

A spectrum analyzer, such as the R&S FSUP signal source analyzer

### GENERAL DESCRIPTION

The [EVAL-CN0369SDPZ](#) is the evaluation board described in [CN-0369](#) and is shown in Figure 1. It contains the [ADF4002](#) synthesizer, the [AD8065](#) operational amplifier, [HMC512](#) voltage controlled oscillator (VCO), and ultralow noise low dropout regulators (LDOs). Users can program the evaluation board using the [ADF4002](#) Integer-N software. A USB cable is included with the evaluation board to connect to a PC USB port.

**TABLE OF CONTENTS**

Features .....	1	Power Supplies.....	4
Online Resources.....	1	Jumpers.....	4
Equipment Needed.....	1	RF Outputs .....	4
General Description .....	1	Active Loop Filter and Charge Pump Current.....	4
Revision History .....	2	Reference Source and Fine Tuning .....	4
EVAL-CN0369SDPZ Evaluation Board Setup.....	3	RFIN and RF_MIXER and Course Tuning .....	4
Evaluation Board Hardware.....	4	Evaluation Board Software Quick Start Procedures.....	6
Transation Loop Synthesizer.....	4		

**REVISION HISTORY**

12/2016—Revision 0: Initial Version

## EVAL-CN0369SDPZ EVALUATION BOARD SETUP

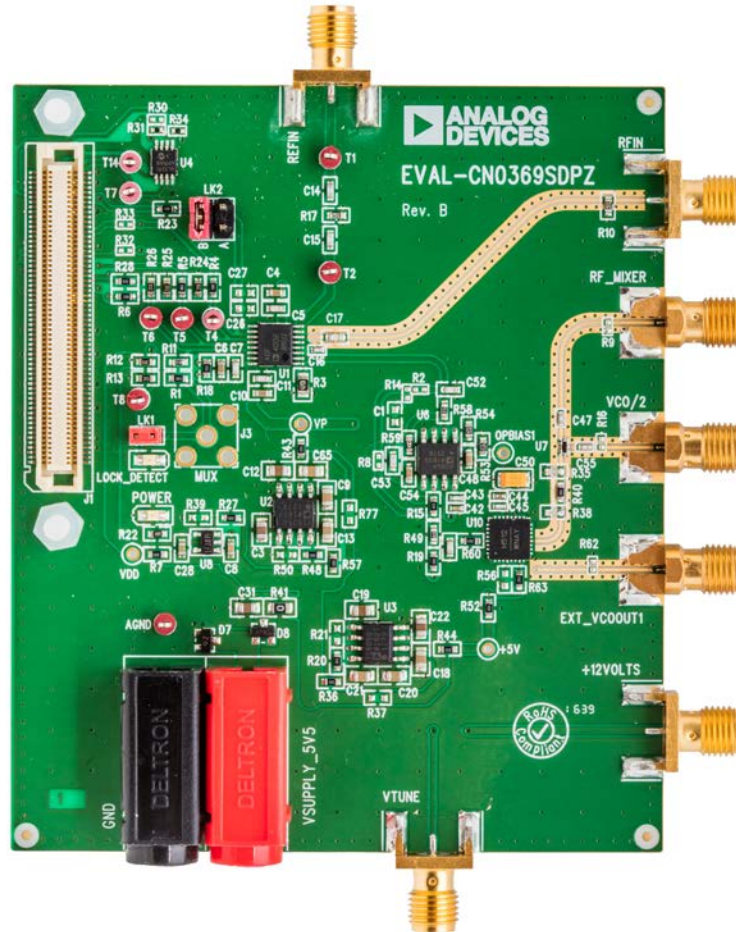


Figure 1.

12945-001

## EVALUATION BOARD HARDWARE

### TRANSLATION LOOP SYNTHESIZER

The translation loop synthesizer (also known as an offset loop) as the name implies, translates the lower 100 MHz reference frequency of the [ADF4002](#) phase locked loop (PLL) up to a higher frequency range of 5.0 GHz to 5.4 GHz, as determined by the frequency of the local oscillator (LO). Figure 2 shows a translation loop evaluation setup using the [EVAL-CN0369SDPZ](#).

### POWER SUPPLIES

The user must apply 5.5 V to the VSUPPLY\_5V5 power connectors (4 mm banana connectors) and +12 V to the SMA connector labeled +12VOLTS. The POWER on-board LED indicates when the [EVAL-CN0369SDPZ](#) is powered.

### JUMPERS

Table 1 shows the required positions for Jumper LK1 and Jumper LK2 for normal operation.

**Table 1. Jumper Positions**

Jumper	Position
LK1	Inserted
LK2	B—normal operation A—hardware power-down

Jumper LK1 inserted enables the LOCK DETECT on-board LED.

### RF OUTPUTS

The radio frequency (RF) output (VCO/2) and the fundamental VCO output (EXT\_VCOOUT1) are ac-coupled to VCO/2 and EXT\_VCOOUT1 SMA connectors, respectively. Set the RF output coupling to the spectrum analyzer must be set to 50  $\Omega$ .

### ACTIVE LOOP FILTER AND CHARGE PUMP CURRENT

The default active loop filter is set to 1.1 MHz. Using a charge pump setting of 5 mA is recommended.

### REFERENCE SOURCE AND FINE TUNING

An external reference using the REFIN SMA is the default reference source and fine tuning for the [EVAL-CN0369SDPZ](#), provided by the [ADF4355-2](#). To evaluate the [EVAL-CN0369SDPZ](#), initially program the [EV-ADF4355-2SD1Z](#) to generate 100 MHz RF output frequency. Achieve fine tuning of the translation loop by changing the [EV-ADF4355-2SD1Z](#) output frequency incrementally. A loop bandwidth of 100 kHz is recommended to allow the [ADF4355-2](#) to provide the fine tuning required. Insert a low pass filter between the RFOUTB+ SMA connector of the [EV-ADF4355-2SD1Z](#) and the REFIN SMA connector of the [EVAL-CN0369SDPZ](#) to filter the harmonics created by the output dividers. Terminate the unused RFOUTB– SMA connector on the [EV-ADF4355-2SD1Z](#) in 50  $\Omega$ .

The RFOUTBx SMA connector gives higher output power in comparison to RFOUTAx for lower output frequencies as it uses a higher value of pull-up inductor. Refer to the [EV-ADF4355-2SD1Z](#) user guide for details on evaluation board set-up and programming.

### RFIN AND RF\_MIXER AND COURSE TUNING

The [ADL5801-EVALZ](#) mixer evaluation board and a low noise signal generator provides the translation loop coarse tuning requirement.

Connect the low noise signal generator to the LO input of the [ADL5801-EVALZ](#). Connect the RF\_MIXER SMA connector from the [EVAL-CN0369SDPZ](#) to the RF input of the [ADL5801-EVALZ](#). Connect the intermediate frequency (IF) output of the [ADL5801-EVALZ](#) to the REFIN SMA connector of the [EVAL-CN0369SDPZ](#) via a 400 MHz low pass filter. Consult the [ADL5801](#) data sheet for details on using and connecting the [ADL5801-EVALZ](#) evaluation board.

Refer to the [CN-0369](#) for a block diagram of the test setup of the [EVAL-CN0369SDPZ](#), [EV-ADF4355-2SD1Z](#), and [ADL5801-EVALZ](#).

To evaluate the [EVAL-CN0369SDPZ](#), initially program the signal generator to output 5.2 GHz with a power level of 0 dBm. Achieve coarse tuning of the translation loop by changing the output of the signal generator in increments of 100 MHz from 5.3 GHz to 4.9 GHz.

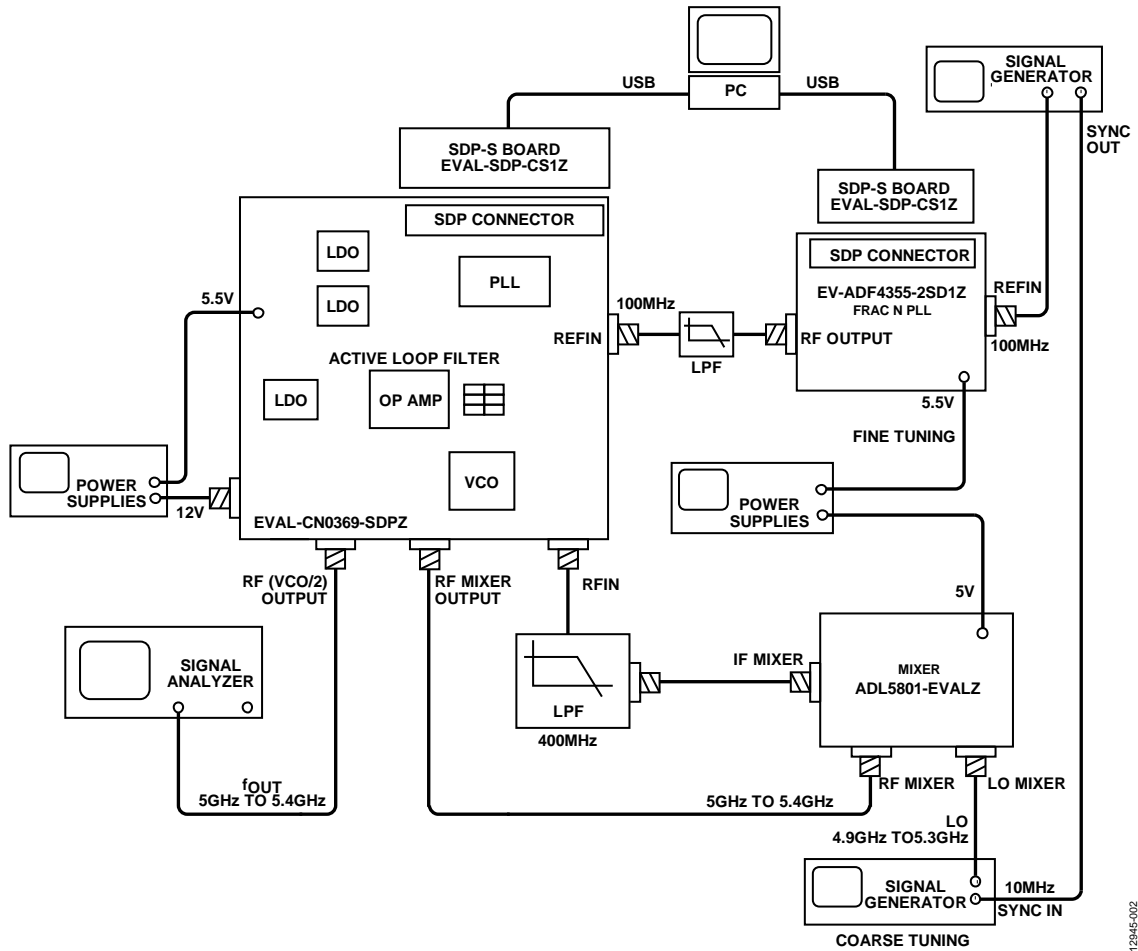


Figure 2. Translation Loop Evaluation Setup using the EVAL-CN0369SDPZ

12945-002

## EVALUATION BOARD SOFTWARE QUICK START PROCEDURES

The control software for [EVAL-CN0369SDPZ](#) uses the standard Integer-N programming software. For more details on the installation and use of the Integer-N programming software, consult the [UG-476](#) user guide and the [UG-161](#) user guide.

After installing the software, run the software by clicking the **Analog Devices Int-N PLL Software** file on the desktop or in the **Start** menu. The software main window opens (see Figure 3).

Confirm **SDP Board connected** displays in the bottom left corner of the window. Otherwise, the software has no connection to the evaluation board. In this case, check that the cable connection and USB drivers are correctly installed.

In the **Main Controls** tab (see Figure 4), program the **RF VCO Output Freq** to **100 MHz**, the **PFD Frequency** to **100 MHz**, the **Charge Pump Setting 1** and **Charge Pump Setting 2** to **5.0 mA**, and the **Phase Detector Polarity** to **Negative**.

Double-click on the **ANALOG DEVICES** logo to enable additional test modes. In the **Testmodes** drop down menu, select **Force Charge Pump Down** and update all registers (see Figure 4). Check that the VCO/2 output is free running at approximately 5.47 GHz.

Again, in the **Testmodes** drop down menu, select **Normal operation, 2.9 ns ABPW** and update all registers (see Figure 4). Check that the VCO/2 output is locked at 5.3 GHz. See Figure 5 for a phase noise plot at 5.3 GHz.

The translation loop cannot distinguish between the need for a  $\pm$ ve change in VCO output frequency, therefore it is necessary to tune the loop in one direction only, hence the need to manually force the VCO output frequency to 5.47 GHz (top of tuning range), before operating in normal operation. Coarse tuning of the translation loop can then be performed by the local oscillator input to the mixer, and finely tuned by the reference input to the [EVAL-CN0369SDPZ](#). Tuning must always be in one direction, for example, in this user guide, the VCO frequency is always tuned from the top of the VCO tuning range to the required frequency.

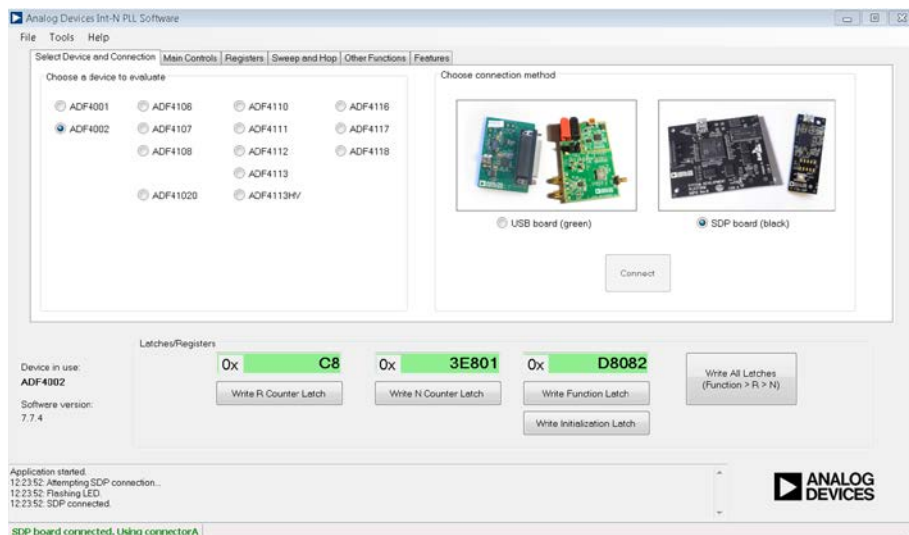


Figure 3. **Select Device and Connection Tab**

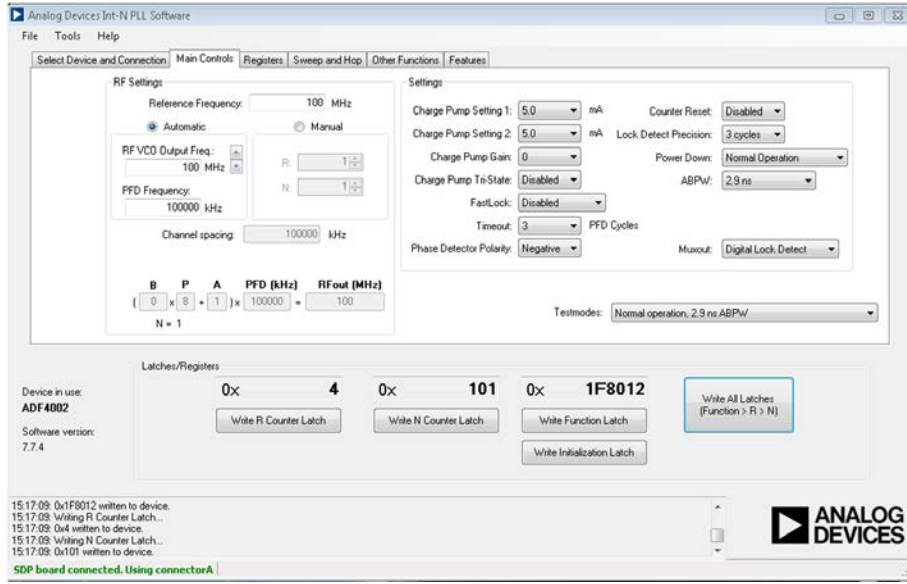


Figure 4. Main Controls Tab

R&S FSUP 26 Signal Source Analyzer				LOCKED			
Settings		Residual Noise [T1 w/o spurs]		Phase Detector +20 dB			
Signal Frequency:	5.300000 MHz	Int PHN (1.0 k .. 30.0 M)	-60.8 dBc				
Signal Level:	2.33 dBm	Residual PM	73.480 m°				
Cross Corr Mode	Harmonic 1	Residual FM	2.017 kHz				
Internal Ref Tuned	Internal Phase Det	RMS Jitter	0.0385 ps				

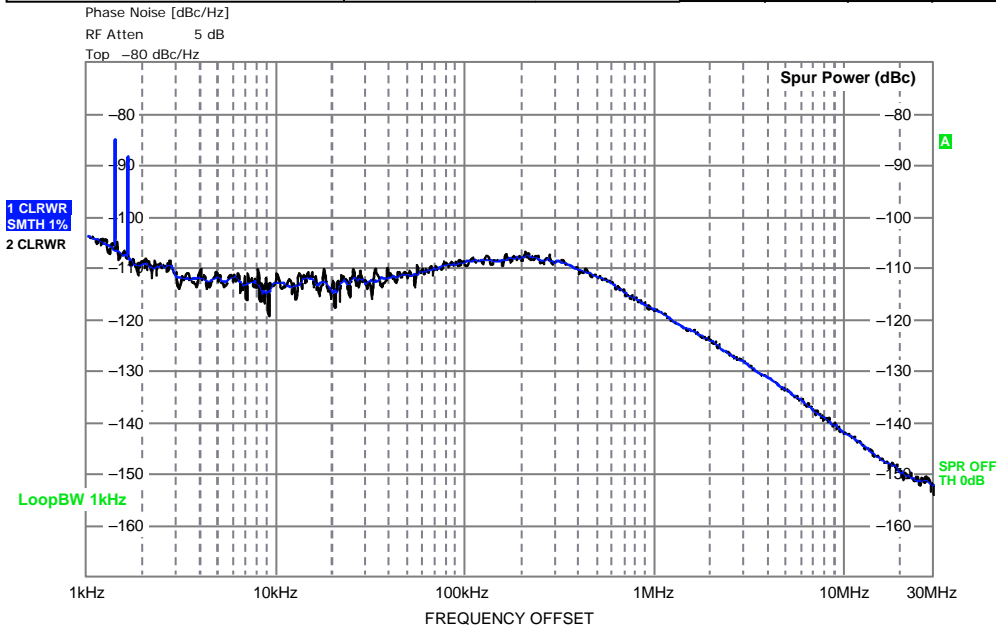


Figure 5. Translation Loop Output Frequency ( $f_{OUT}$ ) Phase Noise Plot

## NOTES

**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.