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Evaluation Board for the Integer-N PLL Frequency Synthesizer

FEATURES

General-purpose PLL evaluation board excluding VCO, loop filter, and TCXO Contains ADF4002 400 MHz frequency synthesizer IC

Accompanying software allows complete control of synthesizer functions from a PC

EVALUATION KIT CONTENTS

EV-ADF4002SD1Z board

CD that includes Self-installing software that allows users to control the board and exercise all functions of the device Electronic version of the ADF4002 data sheet Electronic version of the UG-108 user guide

ADDITIONAL EQUIPMENT

PC running Windows XP or more recent version SDP-S board (system demonstration platform, serial only) T-package VCO 0805 resistors and capacitors Spectrum analyzer Oscilloscope (optional)

DOCUMENTS NEEDED

ADF4002 data sheet

REQUIRED SOFTWARE Analog Devices Int-N software (Version 7 or higher) ADIsimPLL

GENERAL DESCRIPTION

This board is designed to allow the user to evaluate the performance of the ADF4002 frequency synthesizer for phase-locked loops (PLLs). Figure 1 shows the board, which contains the footprint for an ADF4002 synthesizer, an SMA connector for the reference input, power supplies, and an RF output. There is also a footprint for a loop filter and a VCO on board.

The evaluation kit also contains software that is compatible with Windows[®] XP and later versions to allow easy programming of the synthesizer.

This board requires an SDP-S (system demonstration platformserial) board (shown in Figure 1, but not supplied with the kit). The SDP-S allows software programming of the ADF4002 device.



EVALUATION BOARD

Figure 1. EV-ADF4002SD1Z with SDP-S

PLEASE SEE THE LAST PAGE FOR AN IMPORTANT WARNING AND LEGAL TERMS AND CONDITIONS.

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REVISION HISTORY

12/11-Rev. 0 to Rev. A

Changes to Features and General Description Sections and	
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Added Quick Start Guide Section	3
Deleted Figure 3; Renumbered Sequentially	3
Replaced Hardware Description Section with Evaluation Board	
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Changes to Power Supplies Section and Figure 2	1
Added Input Signals Section and Output Signals Section	1
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Section and System Demonstration Platform (SDP) Section 5	5
Added Table 1; Renumbered Sequentially	5
Added Evaluation Board Setup Procedure Section	5
Added Figure 3 and Figure 4; Renumbered Sequentially	5
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Added Figure 15 to Figure 16)

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Added Figure 18	11
Added Evaluation and Test Section, Figure 19, and	
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9/10—Revision 0: Initial Version

QUICK START GUIDE

Follow these steps to quickly evaluate the ADF4002 device:

- 1. Solder the VCO (T-package compatible).
- 2. Solder the loop filter components (design with ADIsimPLL^{**}).
- 3. Connect the reference frequency to J11.
- 4. Install the system development platform (SDP) drivers.
- 5. Install the Int-N software.
- 6. Connect the SDP-S motherboard to the PC and to the EV-ADF4002SD1Z.
- 7. Follow the hardware driver installation procedure.
- 8. Connect the power supplies to banana connectors (6 V to 12 V).
- 9. Run the Int-N software.
- 10. Select the SDP board and the ADF4002 device in the Select Device and Connection tab of the software front panel window.
- 11. Click the Main Controls tab. Update all registers.
- 12. Connect the spectrum analyzer to J2.
- 13. Measure the results.

EVALUATION BOARD HARDWARE

The evaluation board requires the use of an SDP-S motherboard to program the device. This is not included and must be purchased separately. The EV-ADF4002SD1Z schematics are shown in Figure 21, Figure 22, and Figure 23.

POWER SUPPLIES

The board is powered from external banana connectors. The voltage can vary between 6 V and 12 V. The power supply circuit provides 3.0 V to the ADF4002 V_{DD} and allows the user to choose either 3.0 V or 5 V for the ADF4002 V_P . The default settings are 3.0 V for the ADF4002 V_{DD} and 5 V for the ADF4002 V_P . Note that V_{DD} should never exceed 3.3 V. This can damage the device.

External power supplies can be used to directly drive the device. In this case, the user must insert SMA connectors as shown in Figure 2.

INPUT SIGNALS

The necessary reference input can be sourced from an external generator. A low noise, high slew rate reference source is best for achieving the stated performance of the ADF4002. This reference source can be connected to Connector J11. If preferred, the edge mount connector, J5, can be inserted and used instead. A third option is to solder a footprint-compatible TCXO to Footprint Y2. To use this option, connect 0 Ω links to R16 and R14.

Digital SPI signals are supplied through the SDP connector, J1. Using the SDP-S platform is recommended. The SDP_B can also be used, but Resistor R57 must be removed on the SDP-B board. Some additional spurious low frequencies may appear if the SDP-B connector is used.



Figure 2. Evaluation Board Silkscreen

OUTPUT SIGNALS

All components necessary for LO generation can be inserted on board. The PLL is made up of the ADF4002 synthesizer, a passive loop filter, and the VCO. The package containing the VCO must be a T-package (or similar). A low-pass filter must be inserted between the charge pump output and the VCO input. In this case, the user must insert the relevant parts as shown in Figure 2. The VCO output is available at RFOUT through a standard SMA connector, J2. The MUXOUT signal can be monitored at Test Point T8 or at SMA Connector J3.

DEFAULT OPERATION AND JUMPER SELECTION SETTINGS

This board is shipped without a TCXO, low-pass filter, or a VCO. Users must insert suitable components to complete a PLL. Link positions are outlined in Table 1.

Table 1. Link I ositions and I unction			
Link	Position	Options	Description
LK1	А	R1A	Not used
	В	RSET	Normal operation
LK2	А	GND	Hardware power-down
	В	VDD	Normal operation
LK3 (V _{DD})	А	5V	Not used
	В	3V	Normal operation
LK4 (V _{vco})	А	5V	VCO supply 5 V
	В	3V	VCO supply 3 V
LK5 (V _P)	А	5V	V _P supply 5 V
	В	3V	V _P supply 3 V

Table 1. Link Positions and Function

SYSTEM DEMONSTRATION PLATFORM (SDP)

The system demonstration platform (SDP) is a series of controller boards, interposer boards, and daughter boards that can be used for easy low cost evaluation of Analog Devices, Inc., components and reference circuits. It is a reusable platform whereby a single controller board can be reused in various daughter board evaluation systems.

Controller boards connect to the PC via USB 2.0 and provide a range of communication interfaces on a 120-pin connector. The pinout for this connector is strictly defined. This 120-pin connector's receptacle is on all SDP daughter boards, component evaluation boards, and Circuits from the Lab[™] reference circuit boards. There are two controller boards in the platform: the SDP-B, which is based on the Blackfin* ADSP-BF527, and the SDP-S, which is a serial interface only controller board. The SDP-S has a subset of the SDP-B functionality.

Interposer boards route signals between the SDP 120-pin connector and a second connector. When the second connector is also a 120-pin connector, the interposer can be used for signal monitoring of the 120-pin connector signals. Alternatively, the second connector allows SDP platform elements to be integrated into a second platform, for example, the BeMicro SDK. More information on the SDP can be found at www.analog.com/sdp.

EVALUATION BOARD SETUP PROCEDURE SOFTWARE INSTALLATION

Use the following steps to install the SDP drivers and Int-N software.

- 1. Install the SDP drivers by double-clicking **SDPDrivers.exe** and following the relevant installation instructions. See the UG-291 for further instructions on installation of the SDP-S platform or the UG-277 if the SDP-B platform is used.
- Install the Analog Devices Int-N software by doubleclicking ADI_Int-N_Setup.msi. If you are using Windows XP, follow the instructions in the

Windows XP Software Installation Guide section (see Figure 3 to Figure 7).

If you are using Windows Vista or Windows 7, follow the instructions in the Windows Vista and Windows 7 Software Installation Guide section (see Figure 8 to Figure 12). Note that the software requires Microsoft Windows Installer and Microsoft .NET Framework 3.5 (or higher). The installer connects to the Internet and downloads Microsoft .NET Framework automatically. Alternatively, before running the **ADI_Int-N_Setup.msi**, both the installer and .NET Framework can be installed from the CD provided.

3. Connect your SDP board (black) or USB adapter board (green) by USB. If you are using an SDP board, the drivers install automatically, and you are ready to run the software. If you are using a USB adapter board on Windows XP, follow the steps in the Windows XP Driver Installation Guide section (see Figure 13 to Figure 16). On Windows Vista or Windows 7, the drivers install automatically.

Windows XP Software Installation Guide



Figure 3. Windows XP Int-N Software Installation, Setup Wizard

1. Click Next.

률 ADI_Int-N	
Select Installation Folder	
The installer will install ADI_Int-N to the following folder.	
To install in this folder, click "Next". To install to a different folder, enter it be	elow or click "Browse".
Eolder:	
E: VProgram Files vanalog Devices VaDI_Inc-NV	BIowse
	Disk Cost
Install ADI_Int-N for yourself, or for anyone who uses this computer:	
⊙ Everyone	
◯ Just <u>m</u> e	
Cancel < Back	<u>N</u> ext >

Figure 4. Windows XP Int-N Software Installation, Select Installation Folder

2. Choose an installation directory and click Next.

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Figure 5. Windows XP Int-N Software Installation, Confirm Installation

3. Click Next.



Figure 6. Windows XP Int-N Software Installation, Logo Testing

4. Click Continue Anyway.

谩 ADI_Int-N	
Installation Complete	
ADI_Int-N has been successfully installed. Click "Close" to exit.	
Please use Windows Update to check for any critical updates to the .NET Framewo	tk.
Cancel < <u>B</u> ack	Close

Figure 7. Windows XP Int-N Software Installation, Installation Complete

5. Click Close.

Windows Vista and Windows 7 Software Installation Guide



Figure 8. Windows Vista/7 Int-N Software Installation, Setup Wizard

1. Click Next.

B ADI_Int-N
Select Installation Folder
The installer will install ADI_Int-N to the following folder.
To install in this folder, click "Next". To install to a different folder, enter it below or click "Browse".
Eolder: C:\Program Files (x86)\Analog Devices\ADI_Int-N\ Browse Disk Cost
Install ADI_Int-N for yourself, or for anyone who uses this computer:
<u>E</u> veryone
⊘ Just <u>m</u> e
Cancel < <u>B</u> ack Next>

Figure 9. Windows Vista/7 Int-N Software Installation, Select Installation Folder

2. Choose an installation directory and click Next.

谩 ADI_Int-N	
Confirm Installation	
The installer is ready to install ADI_Int-N on your computer.	
Click "Next" to start the installation.	
Cancel < <u>B</u> ack	Next >

Figure 10. Windows Vista/7 Int-N Software Installation, Confirm Installation

3. Click Next.



Figure 11. Windows Vista/7 Int-N Software Installation, Start Installation

4. Click Install.



Figure 12. Windows Vista/7 Int-N Software Installation, Installation Complete

5. Click Close.

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Windows XP Driver Installation Guide

Found New Hardware Wizard			
	Welcome to the Found New Hardware Wizard		
	Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission). <u>Read our privacy policy</u>		
	Can Windows connect to Windows Update to search for software?		
	Yes, this time only Yes, now and gvery time I connect a device No, not this time		
	Click Next to continue.		
	< <u>B</u> ack <u>N</u> ext> Cancel		

Figure 13. Windows XP USB Adapter Board Driver Installation, Found New Hardware Wizard

1. Choose Yes, this time only and click Next.

ound New Hardware Wizard	
This wizard helps you install software for: ADF4xxx USB Adapter Board Image: Software Comparison of the software Comparison (Advanced) Image: Software Comparison of the software Comparison of the software Comparison (Advanced) Image: Comparison of the software Comparison (Advanced) Click Next to continue.	4
< <u>Back</u> <u>N</u> ext > Cancel	DRRG6-014
	Ŭ

Figure 14. Windows XP USB Adapter Board Driver Installation, Installation Options

2. Click Next.

Note that Figure 14 may list **Analog Devices RFG.L Eval Board** instead of **ADF4xxx USB Adapter Board**.



Figure 15. Windows XP USB Adapter Board Driver Installation, Logo Testing

3. Click Continue Anyway.



Figure 16. Windows XP USB Adapter Board Driver Installation, Complete Installation

4. Click Finish.

EVALUATION BOARD SOFTWARE

The control software for the EV-ADF4002SD1Z accompanies the EV-ADF4002SD1Z on a CD. To install the software, see the Software Installation section.

To run the software, click the **ADI PLL Int-N** file on the desktop or in the **Start** menu.

On the **Select Device and Connection** tab, choose your device and your connection method, and click **Connect**.

Confirm that SDP board connected, ADF4xxx USB Adapter Board connected, or Analog Devices RFG.L Eval Board **connected** is displayed at the bottom left of the window (see Figure 17). Otherwise, the software has no connection to the evaluation board.

Note that, when connecting the board, it takes about 5 sec to 10 sec for the status label to change.

Under the **File** menu, the current settings can be saved to, and loaded from, a text file.

nalog Devices In Tools Help	t-N PLL Softwar	e		
Select Device and C	onnection Main Co	ontrols Registers Sweep	and Hop Other Fund	tions
Choose a device t	o evaluate			Choose connection method
O ADF4001	O ADF4106	O ADF4110	O ADF4116	
ADF4002	 ADF4107 ADF4108 	 ADF4111 ADF4112 ADF4113 	 ADF4117 ADF4118 	
	O ADF41020	O ADF4113HV		USB board (green)
	- Latches/Benist			Connect
ice in use: - 4002		0x C8 Write R Counter Latch	Ox 3	V Counter Latch Ox D8082 Write Function Latch Write Initialization Latch
17: 0xD8082 written 17: Writing R Counte 17: 0xC8 written to d 17: Writing N Counte 17: 0x3E801 written	to device. rr Latch evice. rr Latch to device.			
oard connected.	Using connector	A		

Figure 17. Software Front Panel Display—Select Device and Connection

08896-018

The Main Controls tab controls the PLL settings (see Figure 18).

Use the **Reference Frequency** text box to set the correct reference frequency and the reference frequency divider. The default reference on the software window is at 10 MHz.

Use the **RF Settings** section to control the output frequency. You can type the desired output frequency in the **RF VCO Output Frequency** text box (in megahertz).

In the **Registers** tab, you can manually input the desired value to be written to the registers.

In the **Sweep and Hop** tab, you can make the device sweep a range of frequencies or hop between two set frequencies.

In the Latches/Registers section at the bottom of the window, the values to be written to each register are displayed. If the background on the text box is green, the value displayed is different from the value actually on the device. Click Write R Counter Latch or Write N Counter Latch to write that value to the device.

	s Int-N PLL Software						
Select Device ar	nd Connection Main Contro	s Registers Sweep and Hop	Other Functions				
	RF Settings RF VCO Output Frequenc Reference Frequenc PFD Frequenc (125 x 8 + 0 N = 1000	y: 200 MHz y: 10 MHz y: 200 kHz PFD (kHz) RFout (MH)x 200 = 200	Settings Charge Pump Setting 1: Charge Pump Setting 2: Charge Pump Gain: Charge Pump Tri-State: FastLock: Timeout: Phase Detector Polarity:	2.5 V 2.5 V Disabled V Disabled 3 V Positive V	mA Counter Reset: mA Lock Detect Precision: Power Down: ABPW: PFD Cycles Muxout:	Disabled 3 cycles Normal Operation 2.9 ns 3-state output	
Device in use: ADF4002 7:37:17: 0xD8082 wrf 7:37:17: Writing R Co 7:37:17: 0xC8 wrften	Latches/Registers	Dx C8 Write R Counter Latch	0x 3E801 Write N Counter Latch	Ox D80 Write Functi Write Initializa	182 Ion Latch		NALOG
7:37:17: Writing N Co 7:37:17: 0x3E801 writ SDP board connect	tten to device. ted. Using connectorA						

Figure 18. Software Front Panel Display—Main Controls

EVALUATION AND TEST

To evaluate and test the performance of the ADF4002, use the following procedure:

- 1. Ensure that a VCO and loop filter are inserted on the board. Use ADIsimPLL to generate the loop filter component values.
- 2. Install the SDP-S software drivers. Connect the evaluation board to a PC using the supplied USB cable. Follow the hardware driver installation procedure that appears.
- 3. Connect the SDP-S connector to the EV-ADF4002SD1Z.
- 4. Connect a reference signal to J11 (or J5, if an edge mount connector is inserted).
- 5. Connect a spectrum analyzer to Connector J2.
- 6. Run the Int-N software.
- Select the SDP board and the ADF4002 device in the Select Device and Connection tab of the software front panel window.
- 8. In the software window, set the VCO center frequency (Figure 19 uses a 400 MHz VCO). Set the PFD frequency as defined in ADIsimPLL, and program the reference frequency to equal that supplied to Connector J11 (or the TCXO). See Figure 20 for the suggested setup.

9. Measure the output spectrum. Figure 19 shows a 400 MHz output.



Figure 19. Spectrum Analyzer Display



Figure 20. Typical Evaluation Setup

EVALUATION BOARD SCHEMATICS AND ARTWORK





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Figure 24. Layer 1 (Component Side)

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Figure 25. Layer 2 (Ground Plane)



Figure 26. Layer 3 (Power Plane)

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Figure 27. Layer 4 (Solder Side)

Table 2.

ORDERING INFORMATION

BILL OF MATERIALS

Reference Designator Part Description Manufacturer/Part No. C1, C2, C3 Capacitor, 0805 User supplied C4, C6, C10 Capacitor, 0402, 0.1 µF, 16 V AVX CM105X7R104K16AT C5, C7, C9, C11, C13 AVX 06035A100JAT2A Capacitor, 0603, 10 pF, 50 V, SMD C8, C12 Capacitor, Case A, 22 µF, 6.3 V AVX TAJA226K006R C14, C15 Capacitor, 0603, 1 nF, 50 V AVX 06035A102JAT2A C16, C17, C18, C19 Capacitor, 0603, 100 pF, 50 V AVX 06035A101JAT2A AVX TAJA105K016R C20, C23 Capacitor, Case A, 1 µF, 16 V C21, C24 Capacitor, 0603, 10 nF, 50 V AVX 06035C103JAT2A C22, C25 Capacitor, Case A, 4.7 µF, 10 V AVX TAJA475K010R C26, C27 Capacitor, 0603, 10 nF, 50 V Not inserted OSRAM LGR971-Z D1 LED, green D2 Diode, DO41, 1 A, 50 V Multicomp 1N4001 SD103C, 6.2 V ON Semiconductor MBR0520LT1G D3, D5 D4 LED, red Avago HSMS-C170 J1 120-way connector, 0.6 mm pitch Hirose FX8-120S-SV(21) Jack, SMA, SMA EDGE Johnson Components 142-0701-851 J2 J3, J4, J10 Jack, SMA, receptacle straight PCB Not inserted J5, J6, J7, J8, J9 Jack, SMA, SMA_EDGE Not inserted Jack, SMA, receptacle straight PCB Pomona 72963 J11 LK1, LK3, LK4, LK5 Jumper-2\SIP3, Link-3P Harwin M20-9990345 and M7566-05 Jumper-2 Harwin M20-9990245 and M7566-05 LK2 Black 4 mm banana socket GND Deltron 571-0100-01 VSUPPLY Red 4 mm banana socket Deltron 571-0500-01 R1A Resistor, 0805 User supplied R1 Resistor, 0805 User supplied R2 Resistor, 0805 User supplied Multicomp MC 0.1 0805 1% 5K1 R3 Resistor, 0805, 5.1 kΩ, ±1%, 0.1 W R4, R5, R6, R23, R29, R42 Resistor, 0603, 330 Ω Multicomp MC 0.063W 0603 1% 330R R7, R8, R9 Resistor, 0603, 18 Ω Multicomp MC 0.063W 0603 1% 18R R10, R17 Resistor, 0603, 51 Ω Multicomp MC 0.063W 0603 1% 51R R11 Resistor, 0603 100 Ω Multicomp MC 0.0625W 0402 1% 100R R12, R13, R24, R25, R26 Resistor, 0603, 10 kΩ Multicomp MC 0.063W 0603 1% 10K Multicomp MC 0.063W 0603 1% 0R R14, R16, R18, R28, R36 Resistor, 0603, 0 Ω R15, R22, R27, R32, R33, R37, R46 Resistor, 0603, 0 Ω Not inserted R19, R20 Resistor, 0603, 330 kΩ, ±1%, 0.063 W Multicomp MC 0.063W 0603 1% 330K R21 Resistor, 0603, 4.7 kΩ, ±1%, 0.063 W Multicomp MC 0.063W 0603 1% 4K7 R30 Resistor, 0402 Not inserted R31, R34 Resistor, RC31 0402 100 kΩ YAGEO (Phycomp) RC0402JR-07100KL Switch, PCB, SPDT, 20 V APEM TL36P0050 S1 T1 to T14 Test point, PCB, red PK_100 Vero 20-313137 U1 ADF4002, TSSOP-16 ADF4002BRUZ U3 ADP3300, SOT23-6 ADP3300ART-5 ADP3300, SOT23-6 ADP3300ART-3 U2 U4 32k I²C serial EEPROM, MSOP8 Microchip 24LC32A-I/MS Y1 VCO19V-XXXXT Not inserted Y2 Low profile/temperature compensated Not inserted crystal oscillator, OSC_TCXO, 10 W

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RELATED LINKS

Resource	Description	
ADF4002	Product Page, Phase Detector / PLL Frequency Synthesizer	
ADP3300	Product Page, High Accuracy any CAP [®] 50 mA Low Dropout Linear Regulator	

NOTES

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NOTES

I²C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).



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.

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