ONET1130EC-EVM 11.7-Gbps transceiver with dual CDRs and modulator driver

User's Guide

Literature Number: SNLU245
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ONET1130EC-EVM 11.7-Gbps transceiver with dual CDRs and modulator user's guide

This document describes the main features and functionality of the evaluation module (EVM) board for the part numbers ONET1130EC and ONET1130EP.

The ONET1130EC and ONET1130EP are 11.7-Gbps transceivers with integrated limiting amplifier and modulator driver. The ONET1130EC includes dual CDRs and the ONET1130EP does not.

The EVM can be used to evaluate the performance of the parts in conjunction with an electroabsorptive modulated laser (EML) transmit optical subassembly (TOSA) and a receive optical subassembly (ROSA) in standard XMD compliant packages.

The EVM is controlled with USB2ANY graphic user interface (GUI). This software can be downloaded at www.ti.com.

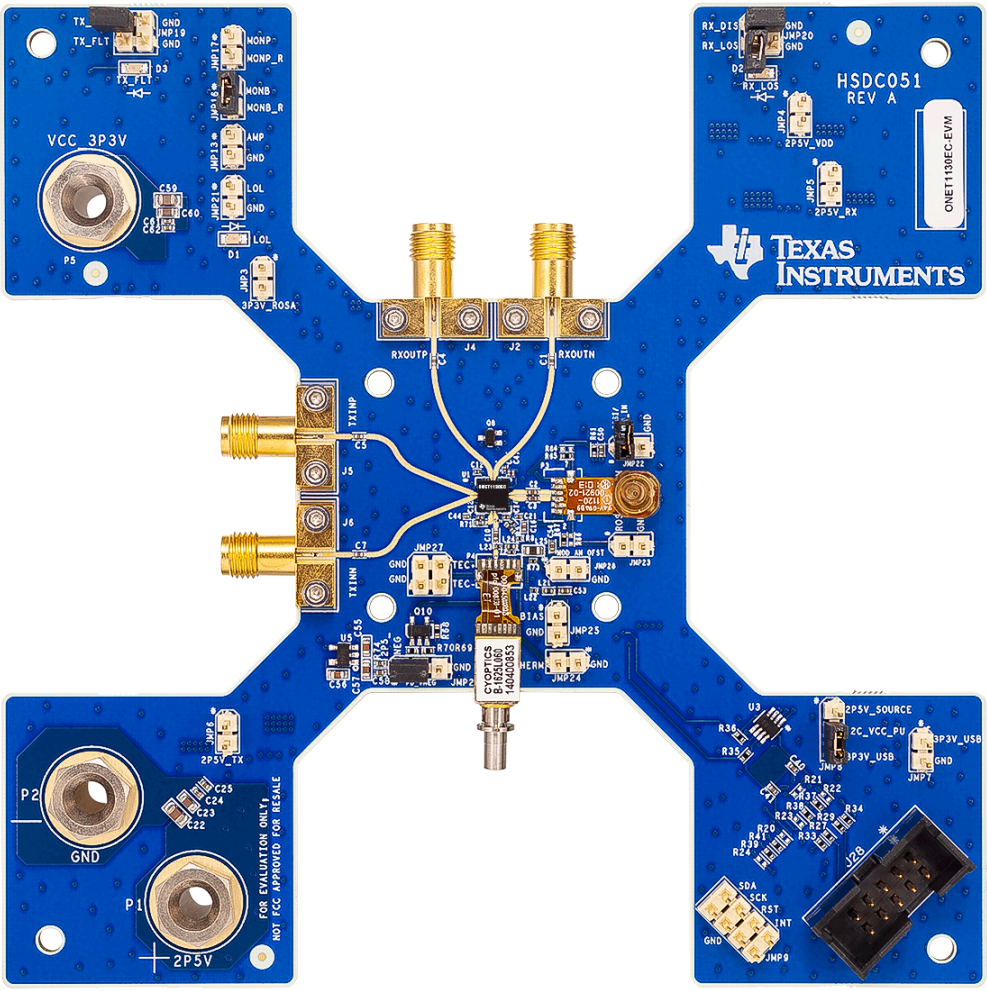


Figure 1. ONET1130EC-EVM

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1 Trademarks

All trademarks are the property of their respective owners.

2 Hardware and Equipment

The following hardware and equipment are required to evaluate the EVM:

- An ONET1130EC-EVM
- An XMD-compliant EML TOSA
- An XMD-compliant PIN or APD ROSA
- TI USB2ANY Interface Adaptor
- TI USB2ANY Explorer Software
- A USB cable with standard-A to Mini-B connector
- A PC with a USB A port
- RF cables with SMA connectors
- External thermoelectric controller
- Single-mode fiber patch cords
- Electrical cables with banana jack connections

3 EVM Block Diagram

Figure 2 represents the block diagram of the ONET1130EC-EVM. The board is designed to be powered from a 2.5-V supply using cables with banana jacks.

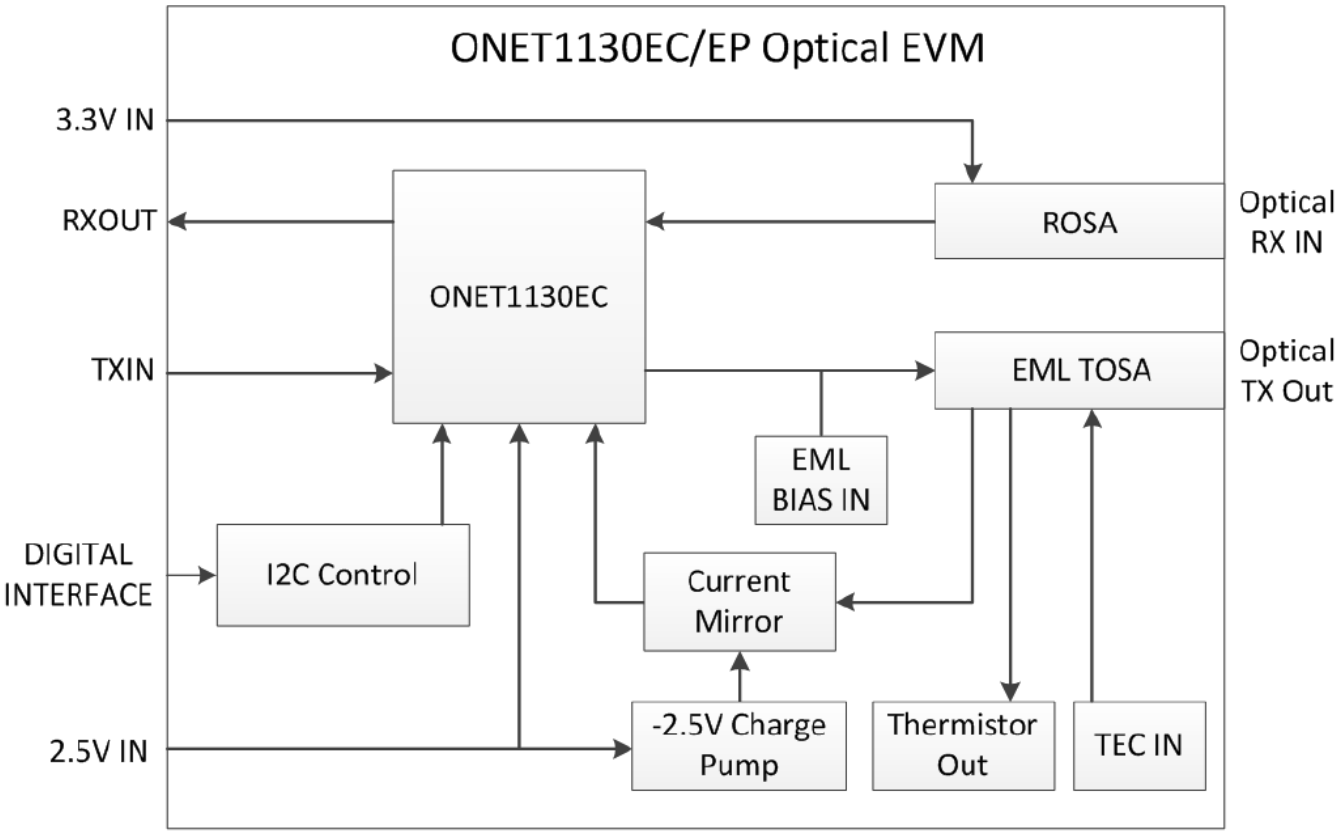


Figure 2. ONET1130EC-EVM Block Diagram

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4 EVM Connections

Figure 3 shows the location of the major inputs and outputs on the EVM board.

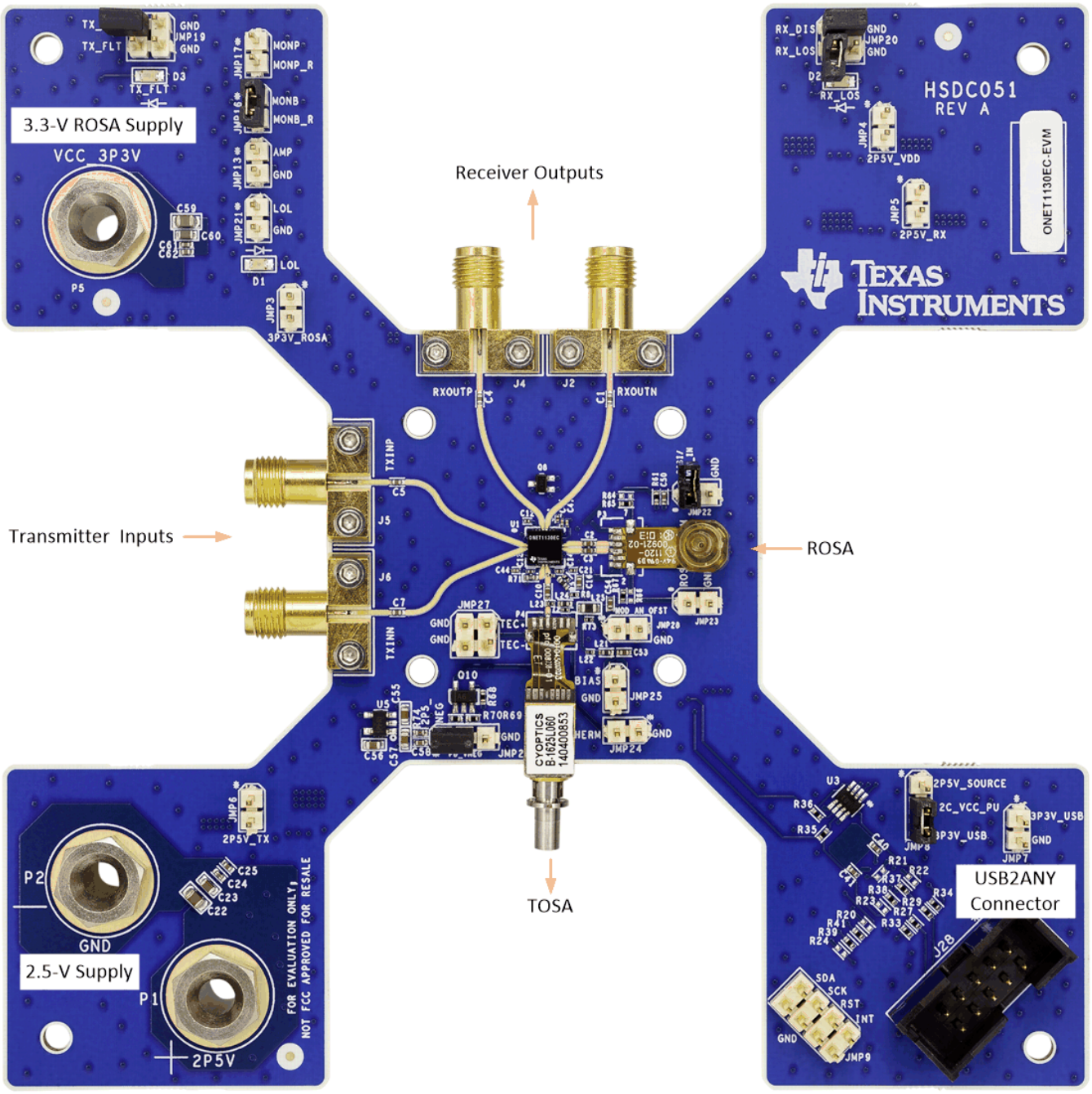


Figure 3. ONET1130EC-EVM Connections

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A ROSA and TOSA are to be supplied by the user. In addition, connections for the EML bias voltage and TEC controller are also required. Figure 4 shows the locations for the ROSA and TOSA, EML bias voltage, TOSA thermistor, and the TEC+ and TEC– connections to the TEC controller.

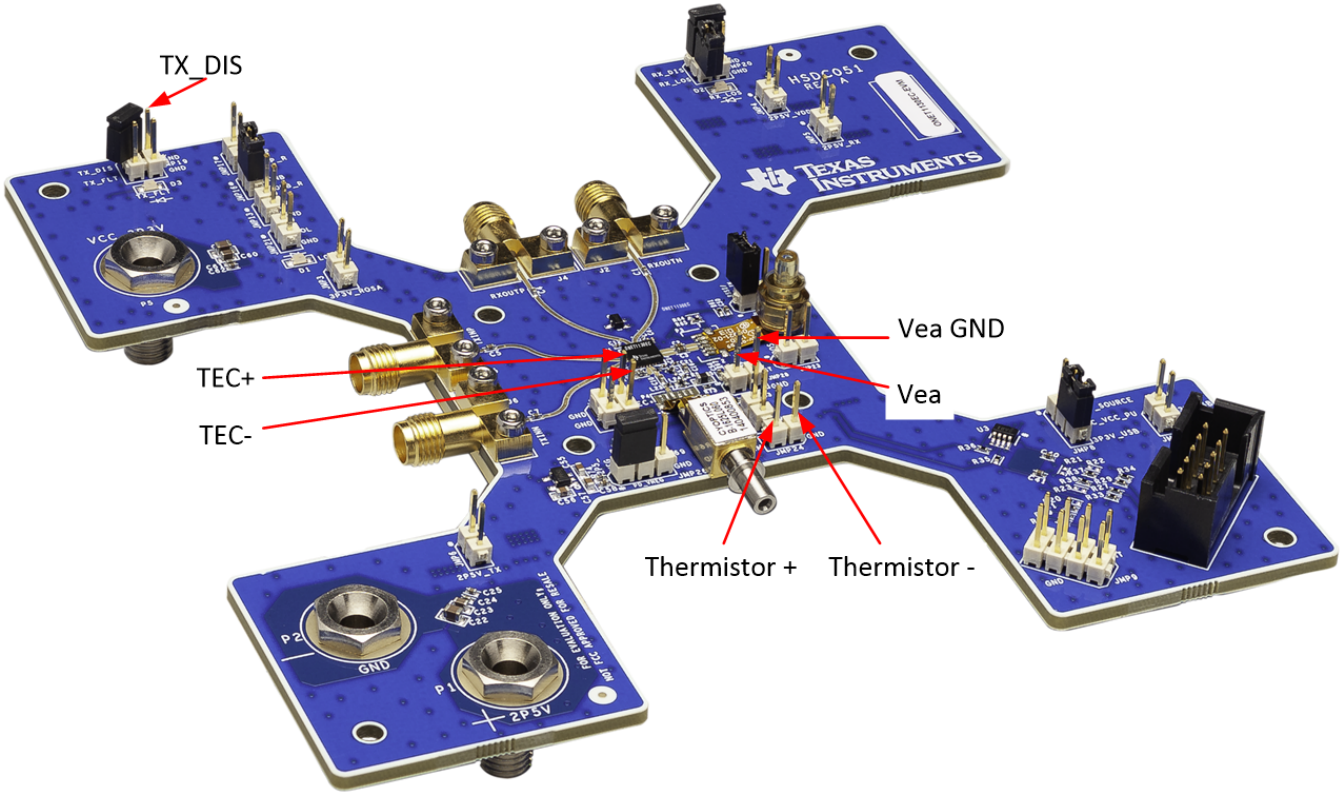


Figure 4. ONET1130EC-EVM Connections

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5 Measurement Setup

Follow this procedure to quickly setup for measurements.

5.1 USB2ANY GUI Installation

Follow the steps below to install the USB2ANY software and confirm the GUI to ONET1130EC-EVM communication.

1. Install the USB2ANY GUI onto the computer and follow the instructions to install this software.
2. Check the USB2ANY packaging for the box and cables necessary to set up the ONET1130EC-EVM. Figure 5 shows the required USB2ANY hardware.



Figure 5. USB2ANY Box and Cables

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3. Connect the USB2ANY 10-pin cable to the USB2ANY box as shown in Figure 6. Connect the other side of the 10-pin cable need to J28 on the ONET1130EC-EVM. Note that this cable is locked.

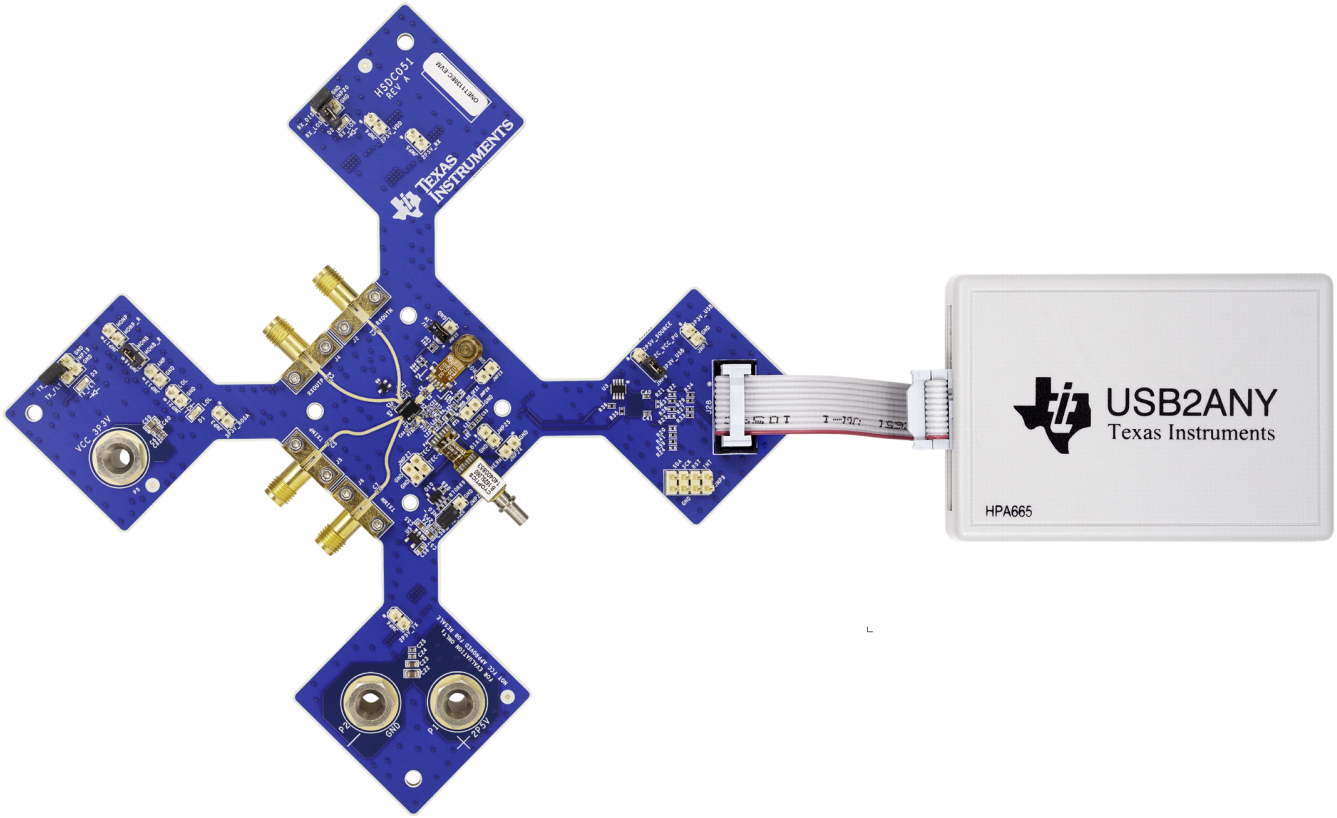


Figure 6. Cable Connected to USB2ANY

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4. Start the USB2ANY GUI and make sure the GUI authenticates the USB2ANY box. The GUI should show the serial number and firmware revision as shown in Figure 7.

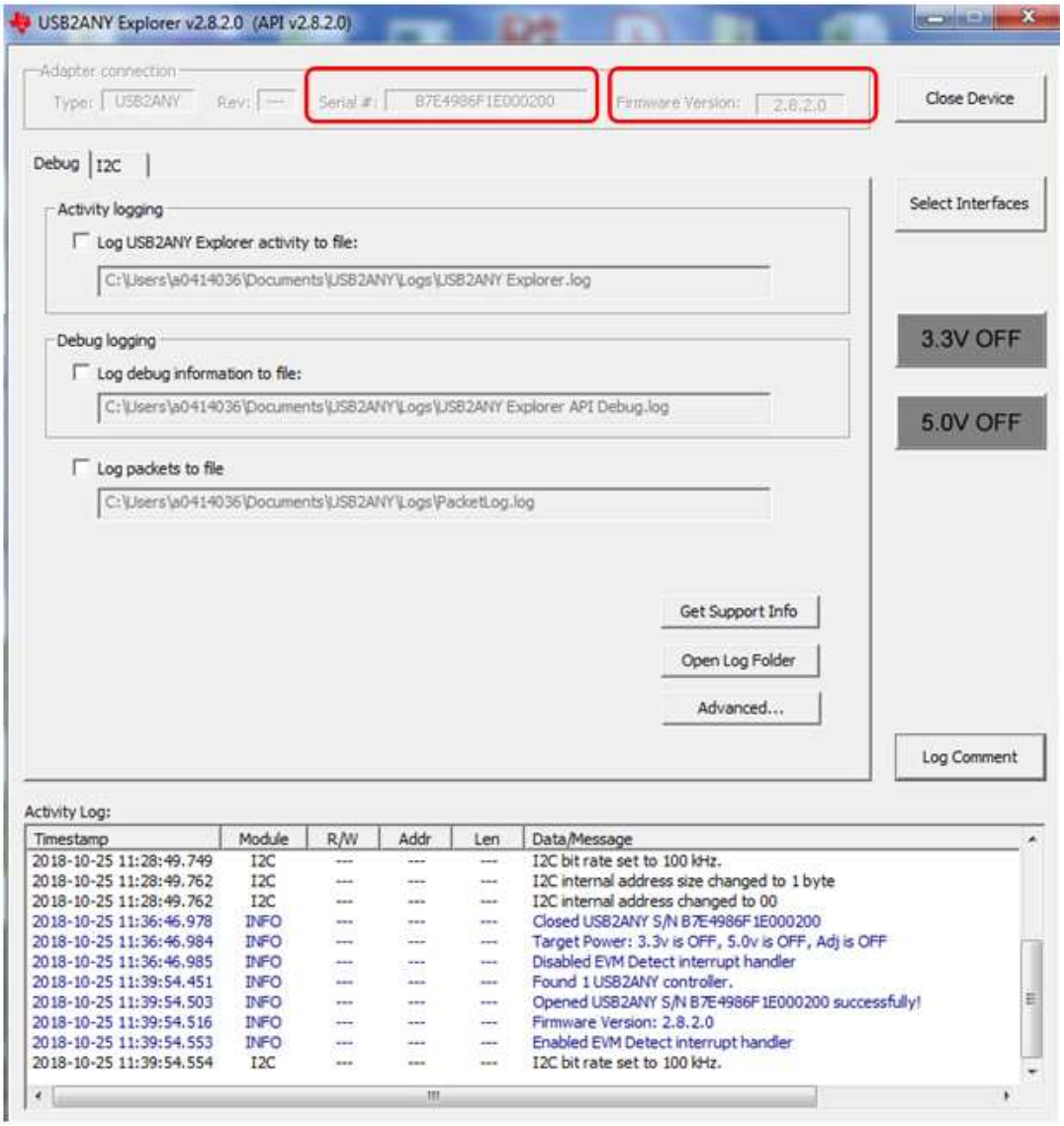


Figure 7. USB2ANY Box Serial Number and Firmware Revision

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5. Click on the USB2ANY tab and change the slave address to 0x08 and turn on 3.3-V supply as shown in Figure 8.

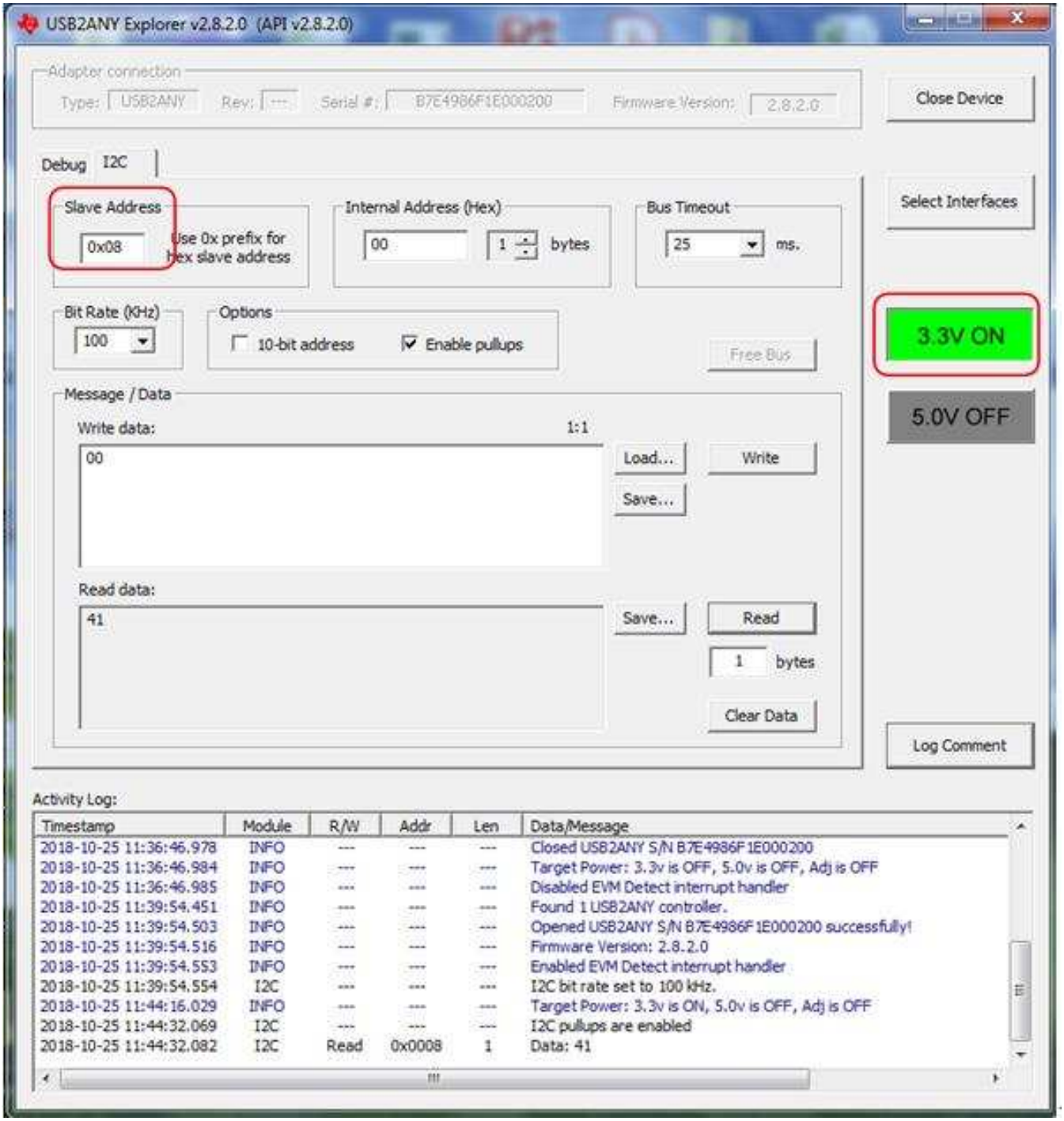


Figure 8. USB2ANY Slave Address

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6. Make sure the internal address is set to 00 and click the "Read" button. If the read data is "41," the GUI and ONET1130EC-EVM have reliable communication. See Figure 9

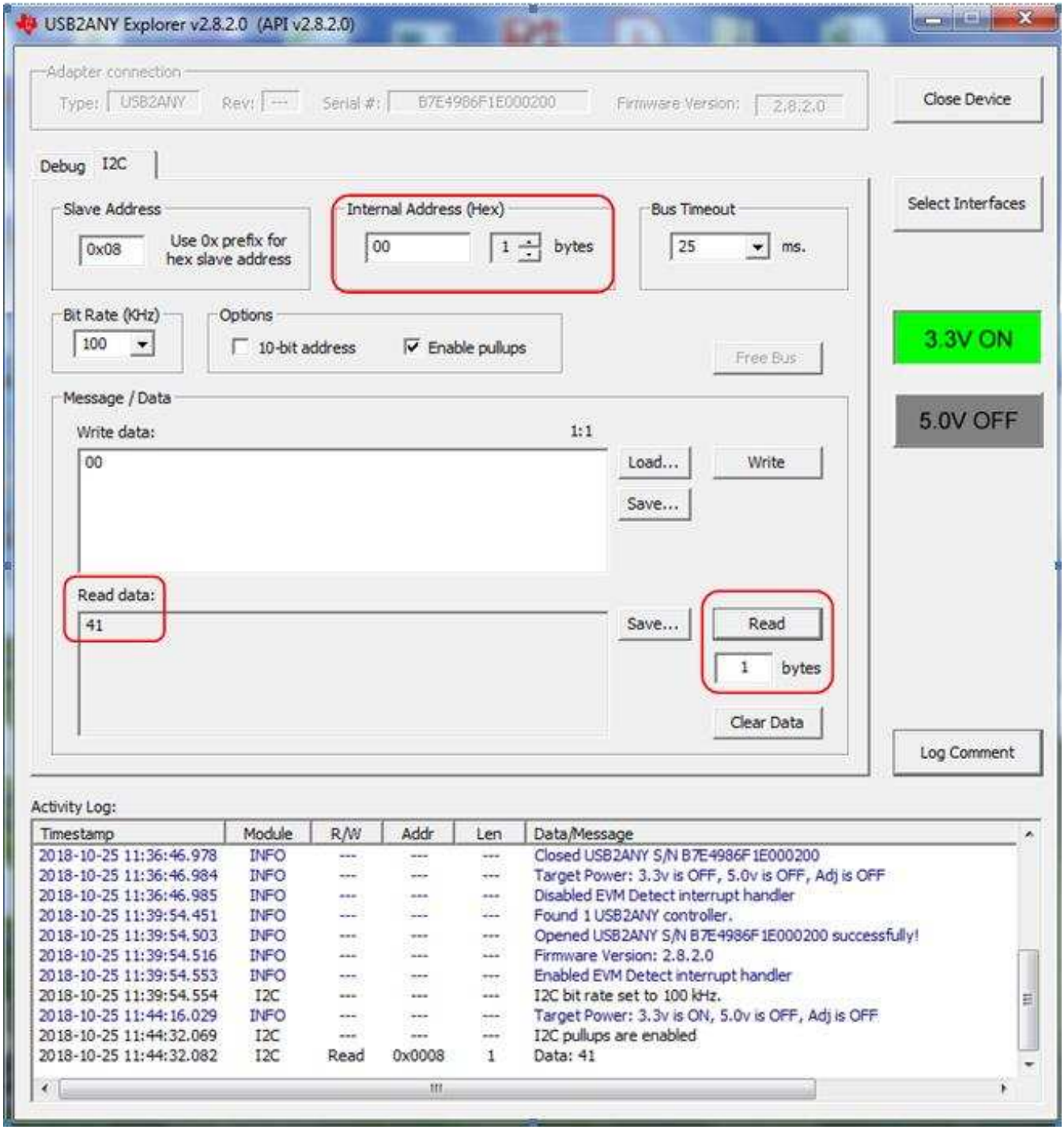


Figure 9. USB2ANY GUI to ONET1130EC-EVM Reliable Communication

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Follow these steps to gather ONET1130EC-EVM measurements:

1. Solder the ROSA and TOSA onto the EVM.
2. Connect a differential data input signal source to the SMA connectors TXINP/TXINN through 50-Ω matched impedance cables. Set the data rate between 9.8 Gbps and 11.7 Gbps. Set the amplitude between 100mVp-p differential and 1000mVp-p differential.
3. Connect the output SMA connectors RXOUP/RXOUTN through 50-Ω matched impedance cables to a digital communications analyzer (DCA).
4. Connect the USB dongle to the EVM and attach the interface cable from the USB port of the computer to the mini-B USB port of the dongle.
5. Apply a +2.5-V supply to the +2.5-V banana jack and connect the supply ground to the GND banana jack.
6. Apply a negative bias voltage in the range of –0.4 V to –1.5 V for the EML to JMP28. The required voltage is TOSA-dependent.
7. Connect the TOSA thermistor at JMP24 to the TEC controller.
8. Connect the TEC+ and TEC– at JMP27 to the TEC controller.
9. Connect the TOSA to the optical input of a DCA through a single-mode fiber patch cord.
10. Connect an optical input source to the ROSA through a single-mode fiber patch cord.

Figure 10 shows a typical setup.

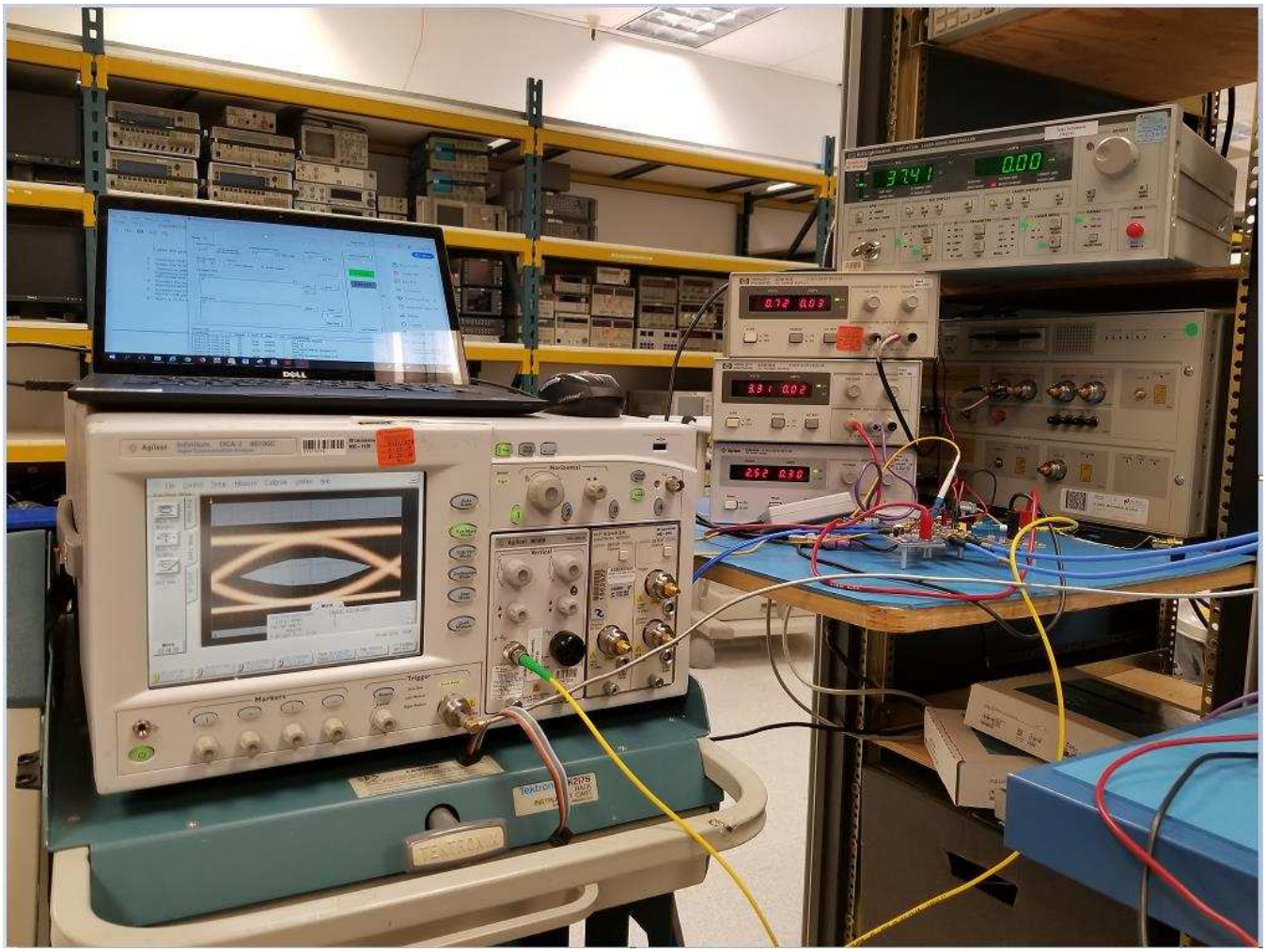


Figure 10. Typical ONET1130EC-EVM Setup

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5.2 Open-Loop Operation Without Fault Detection or Digital Monitoring

With the USB2ANY GUI, write the register settings as shown in the following steps. After each write sequence, perform a read operation to make sure the change has gone into effect

NOTE: TI recommends to initially operate the TOSA in open-loop mode, with fault detection disabled, and enable the Laser Bias Current: Reg 0x01 = 0x14.

1. Set TX Output Mode to Single Ended Mode (OUTP): Reg 0x0D = 0x40
2. Set the desired TX Laser Bias Current: For example, in setup for Figure 10 we have Reg 0x0F = 0x60
3. Set the desired Transmitter Modulation Current: Reg 0x0C = 0x050
4. Use Reg 0x0E to adjust the cross point. For this setup, use reg 0x0E = 0xAF

NOTE: If the transmitter modulation current is less than approximately 0xC0, TI recommends that the designer use the slow edge speed mode (Reg 0x0D[4] = 1'b}. The need for this mode, however, is TOSA-dependent.

5. Disable and bypass the TX-CDR for ONET1130EP evaluation: Reg 0x0A = 0x10
6. Set the Desired RX Output Amplitude: Reg 0x08[3:0]
7. Set the Desired De-Emphasis: Reg 0x08[6:5] = 10'b
8. Disable and bypass the RX-CDR for ONET1130EP evaluation: Reg 0x04 = 0x18

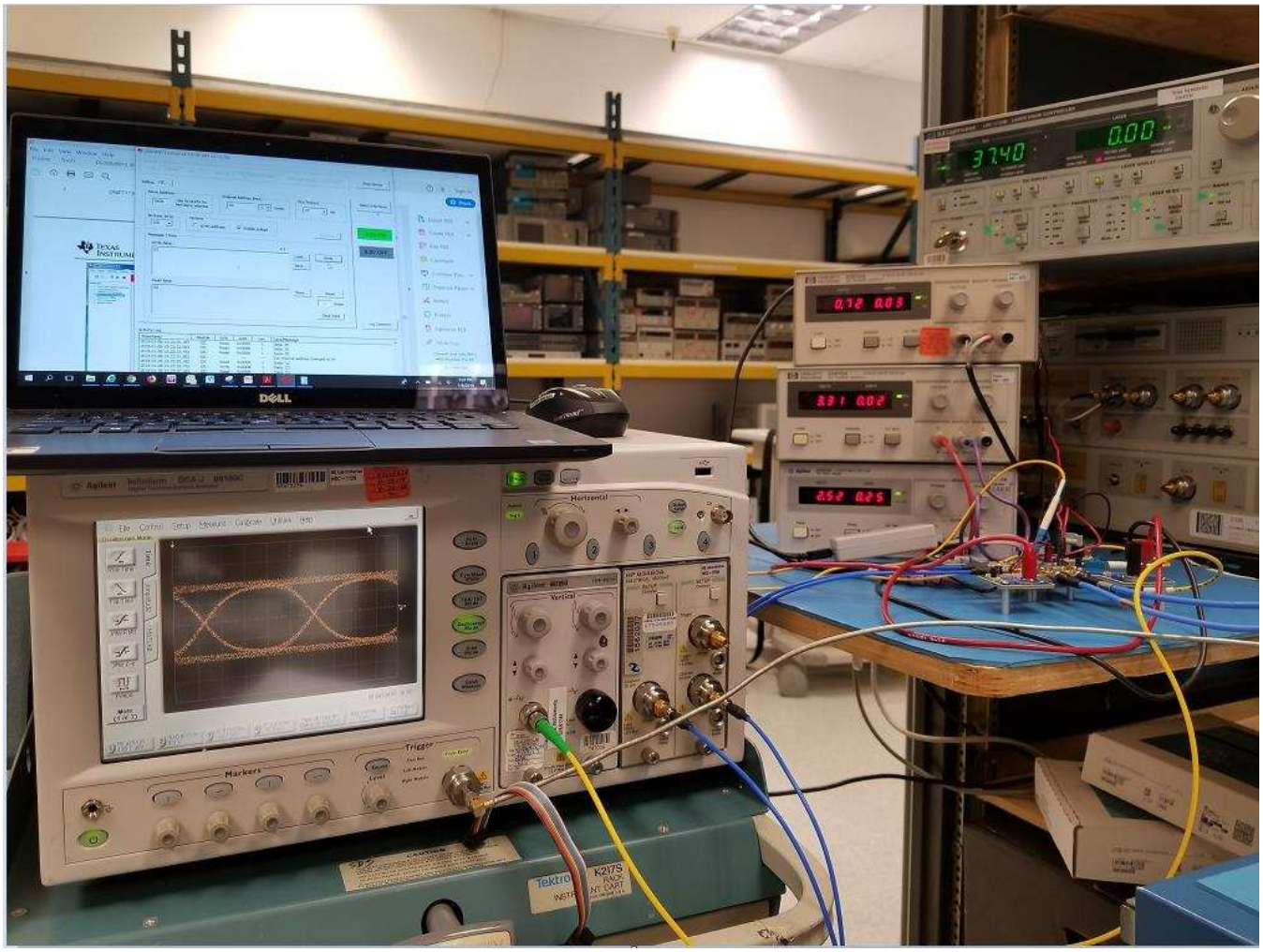


Figure 11. 10.3125-GBps Open-Loop RX Eye Diagram

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5.3 Closed-Loop Operation With Fault Detection and Digital Monitoring

1. Place a jumper between pins 1 and 2 of JMP26 to supply -2.5V to the photodiode current mirror to configure the part for automatic power control with digital monitoring and fault detection.
2. Go to the Core Configuration page.
3. Disable the laser bias current to prevent a fault from occurring when the Fault Detection is enabled: Reg 0x01[2] = 0'b
4. Enable the Fault Detection (Reg 0x01[3] = 1'b) and enable the Fault Trigger on MONP Pin (Reg 0x01[7] = 1'b).
5. Set the TX Bias Current Control to Closed Loop (Reg 0x01[4] = 0'b) and initially use the default 770uA photodiode current range (Reg 0x01[6:5] = 00'b).
6. Enable the laser bias current: Reg 0x01[2] = 1'b
7. Enable the ADC (Reg 0x03[7] = 1'b) and ADC oscillator (Reg 0x03[6] = 1'b) in the Analog to Digital Conversion box and select the desired parameter to be monitored using reg 0x03[2:0]).
8. Set the bias current monitor fault threshold and power monitor fault threshold to max: TXBMF[7:0] Reg 0x11 = TXPMF[7:0] Reg 0x12 = 0xFF. To enable fault detection for these two conditions, set Reg 0x10 [6:5] = 11'b.
9. Select Digital Bias Current and Digital Photodiode current: Reg 0x10 [6:5] = 11'b.
10. Set the TX Output Mode to Single-Ended (OUTP): Reg 0x0D[6] = 1'b.
11. Set the desired TX laser bias current, transmitter modulation current, and TX cross point: Reg 0x0F[7:0] = 0x60, 0x0C[7:0] = 0x50, 0x0E[7:0] = 0xAF
12. Reduce bias current monitor fault threshold TXBMF[7:0] Reg 0x11 until fault occurs. When the TX_FLT goes high, increase TXBMF[7:0] by at least 16 steps.
13. Toggle the enable laser bias current by setting Reg 0x01[2] = 0'b followed by Reg 0x01[2] = 1'b to clear the fault and restore the transmit output.
14. Reduce the power fault threshold TXPMF[7:0] Reg 0x12 until a fault occurs. Increase the power fault threshold level by at least 16 steps.
15. Toggle the enable laser bias current by setting Reg 0x01[2] = 0'b followed by Reg 0x01[2] = 1'b to clear the fault and restore the transmit output.
16. Read Reg 0x28[9:2] and Reg 0x29[1:0] content to read the value from the ADC source.

6 LED Indicators

Table 1 shows the meaning of the 2 LEDs on the EVM.

Table 1. LED Indicators

LED	LED Color	Default state	Indication when On
D1	Red	On	The transmit CDR or the receive CDR has indicated Loss of Lock (LOL).
D2	Red	On	The receiver input signal level is set below the Loss of Signal (LOS) threshold.

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7 Typical Performance Results

A typical set of conditions for operating the EVM are as follows:

- VCC = 2.5 V, ICC = 300 mA with ROSA
- 10.71 Gbps, PRBS31 Pattern
- Transmitter Single-Ended Mode of Operation
- TOSA Temperature = 37°C
- Vea = –0.65 V
- Laser Bias Current = 0xF0 (approximately 53m A)
- Transmitter Modulation Current = 0xB0
- Transmitter Cross Point = 0xB0
- TX and RX CDRs Enabled
- Receiver amplitude set to 600mVpp
- Receiver de-emphasis set to 0x02

Figure 12 shows a typical unfiltered eye diagram.

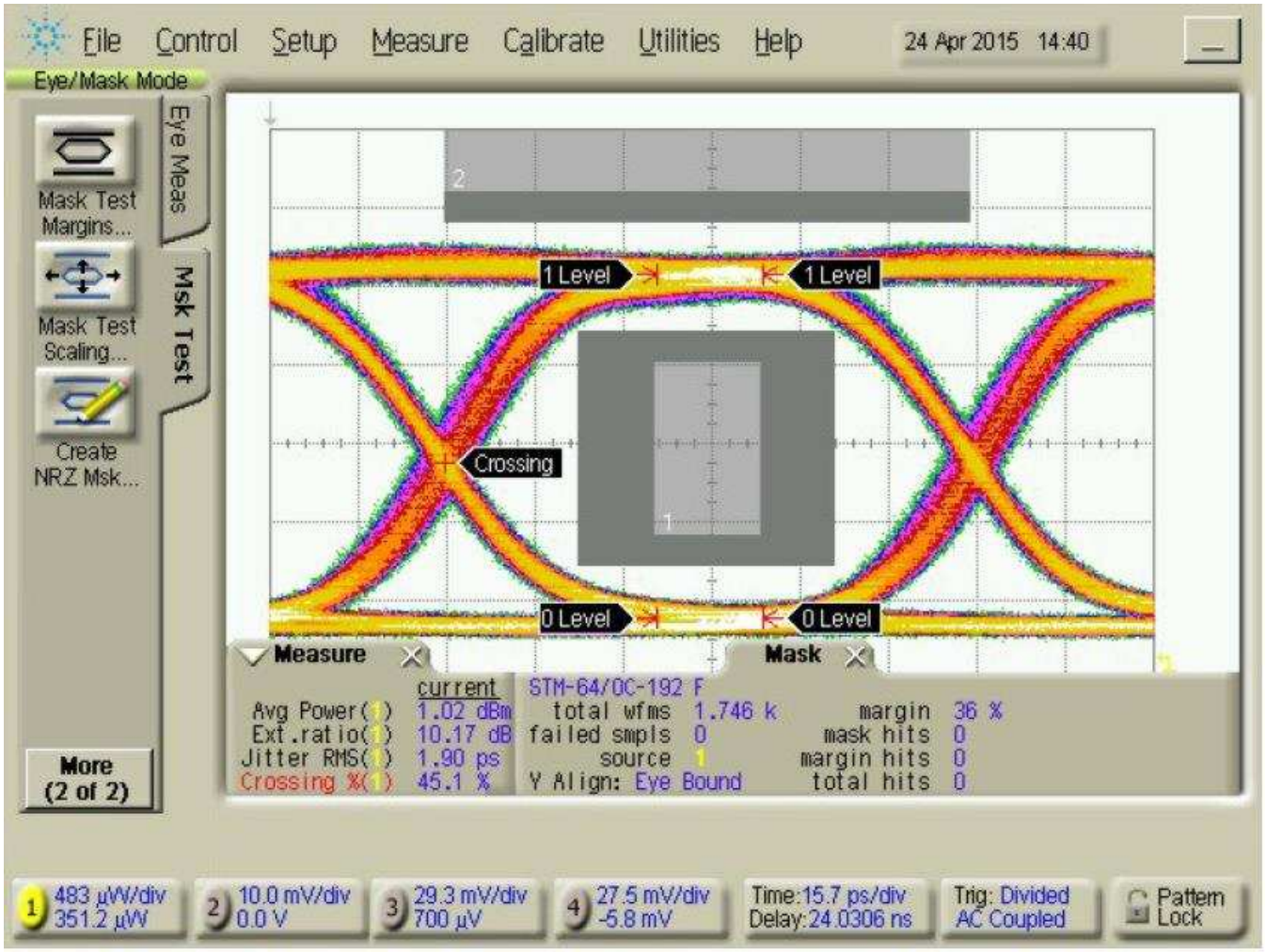


Figure 12. Unfiltered Transmitter Eye Diagram

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Figure 13 shows a typical filtered eye diagram.

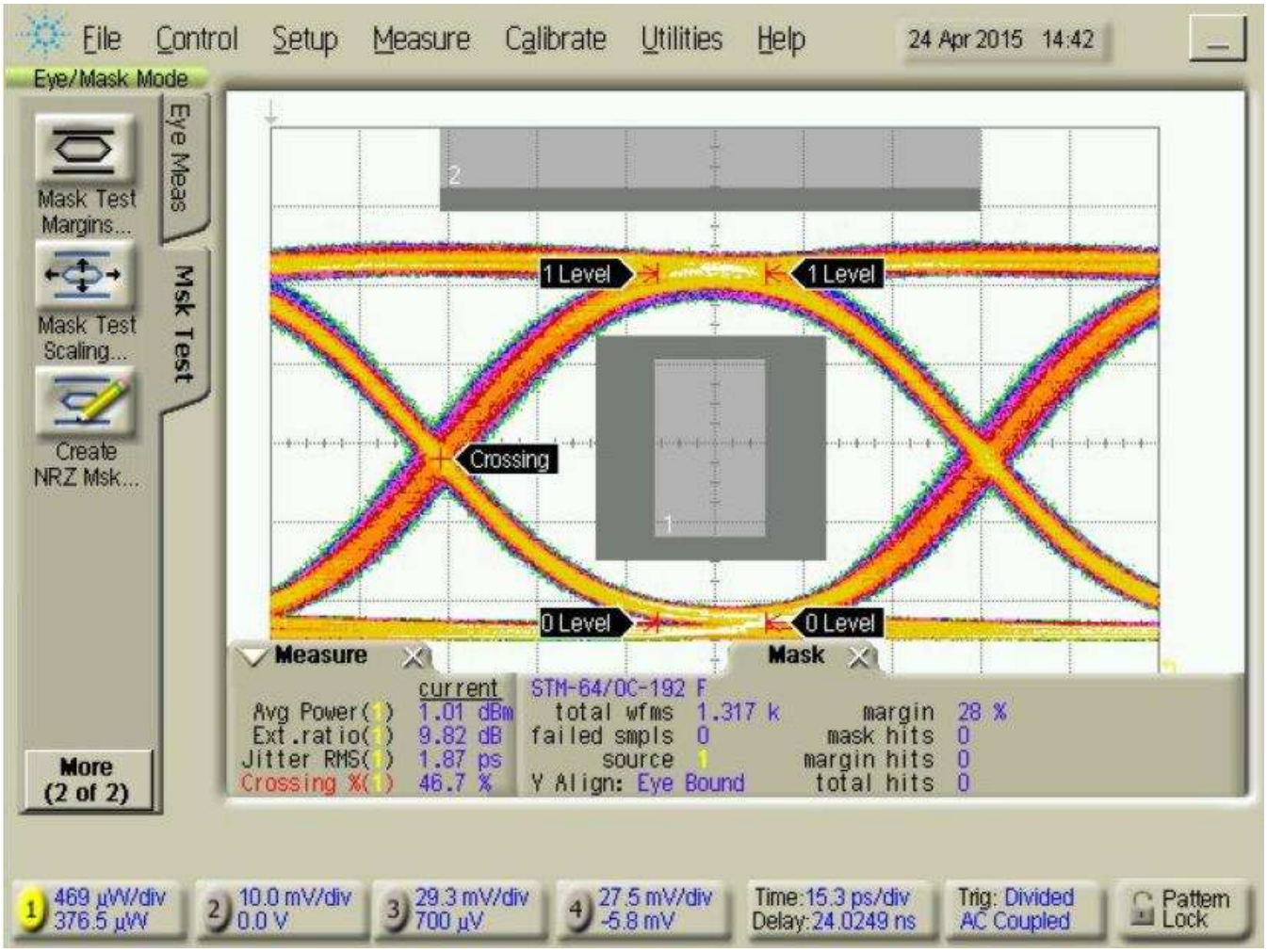


Figure 13. Filtered Transmitter Eye Diagram

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Figure 14 shows a typical receiver eye diagram with the CDR enabled and -20dBm average optical input power to a PIN ROSA.

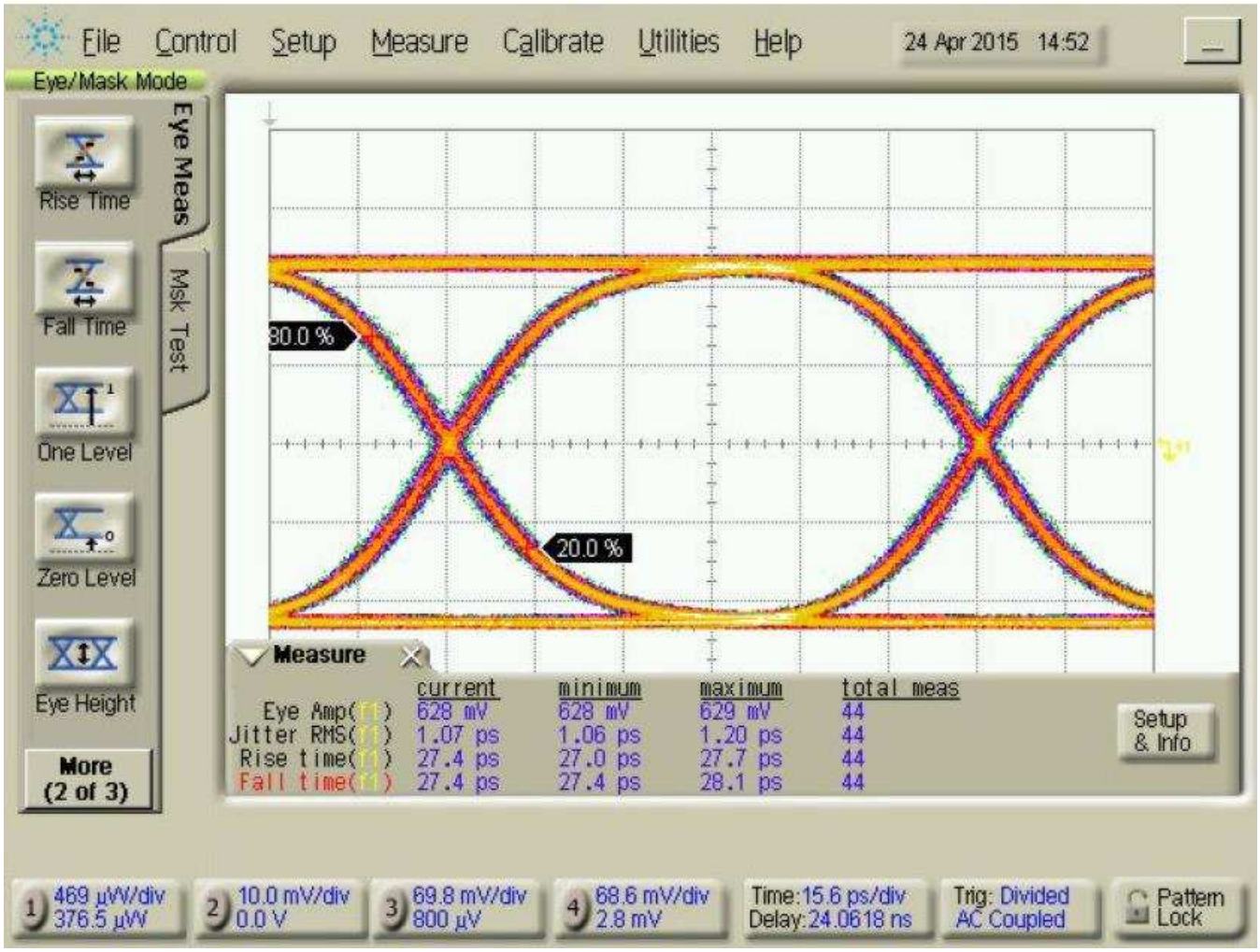


Figure 14. Receiver Eye Diagram With CDR Enabled

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Figure 15 shows a typical receiver eye diagram with the CDR disabled and -20dBm average optical input power to a PIN ROSA.

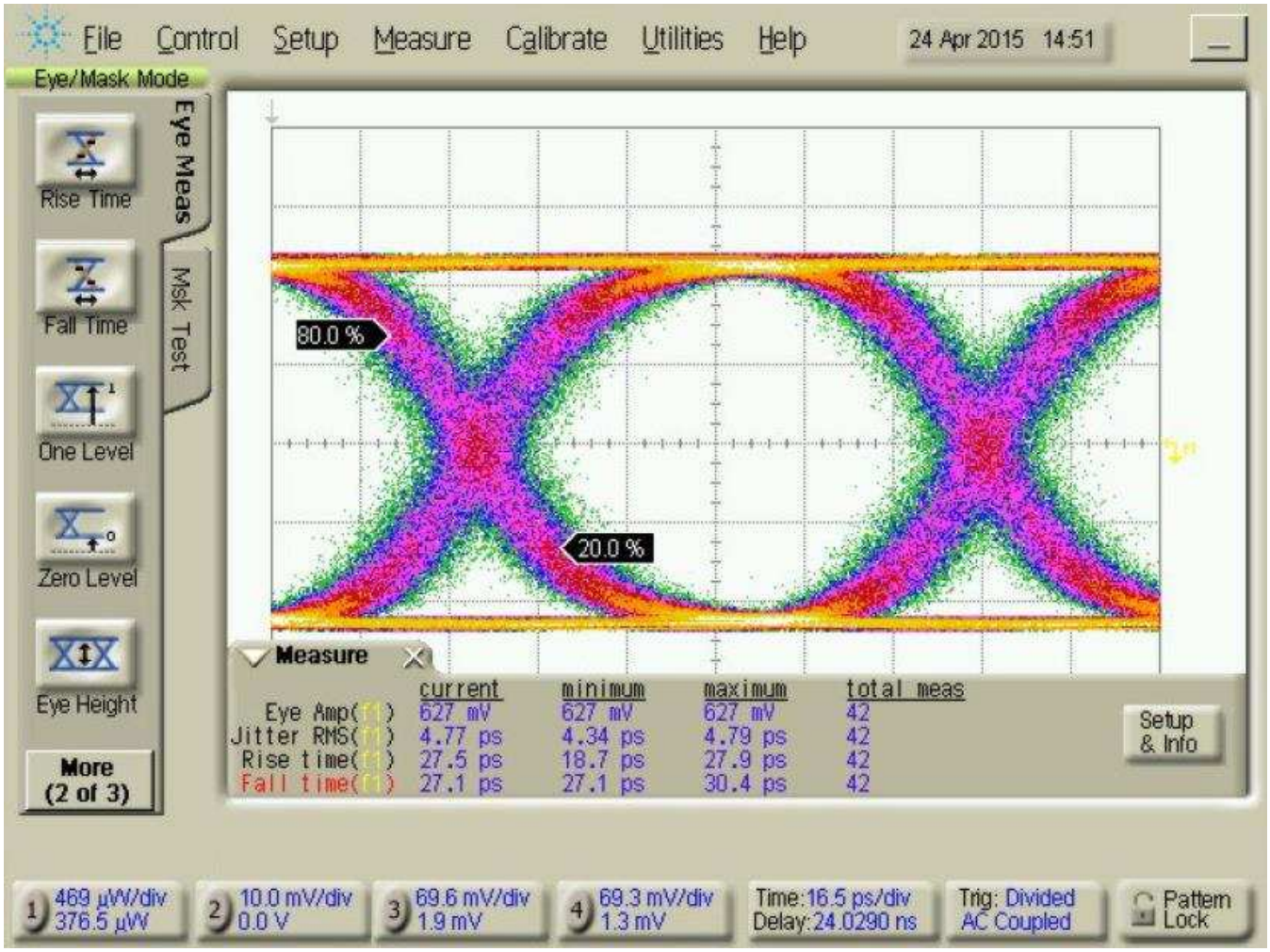


Figure 15. Receiver Eye Diagram With CDR Disabled

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8 Schematics

Figure 16, Figure 17, and Figure 18 show ONET1130EC-EVM schematic.

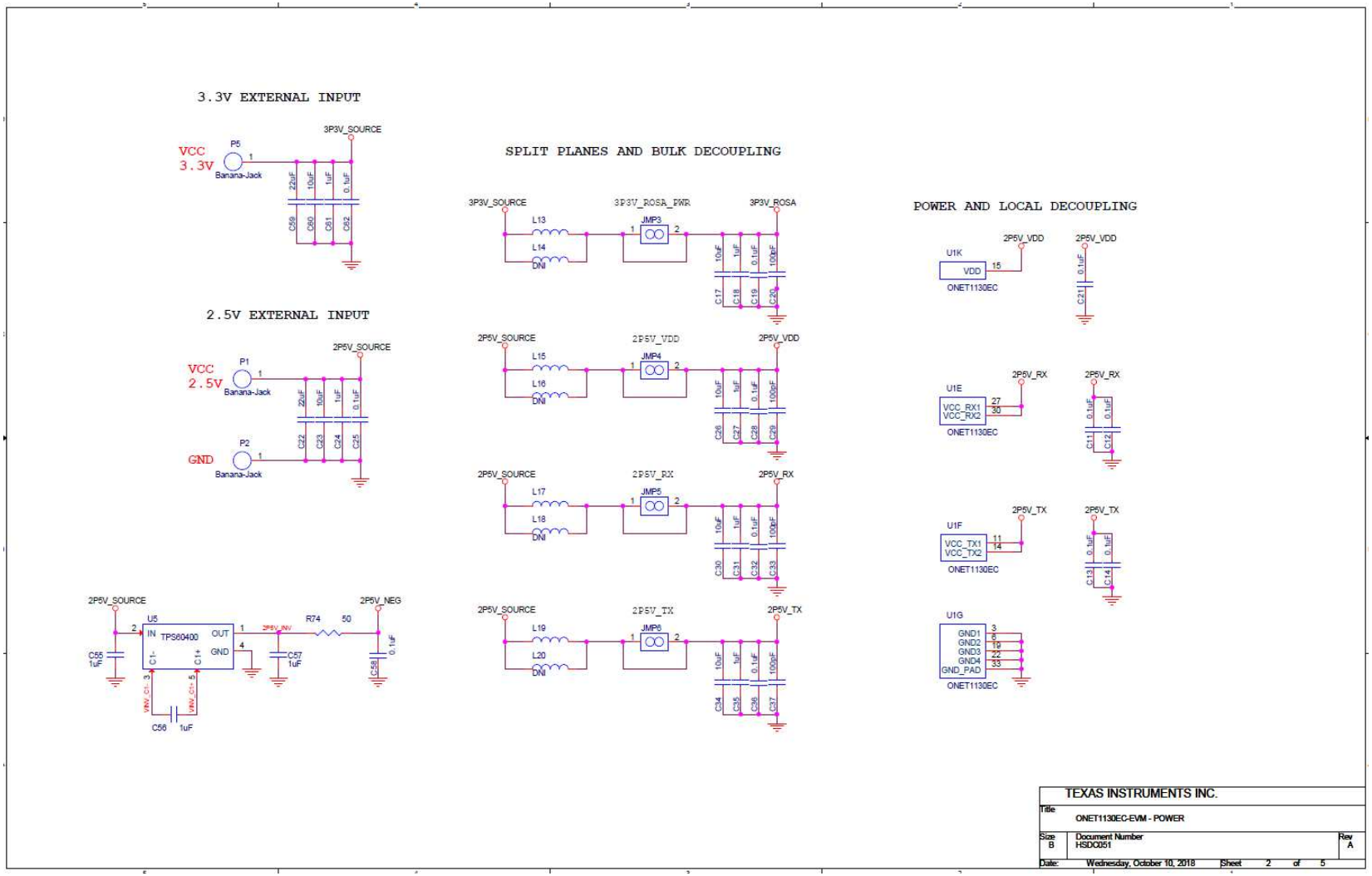


Figure 16. Schematic 1

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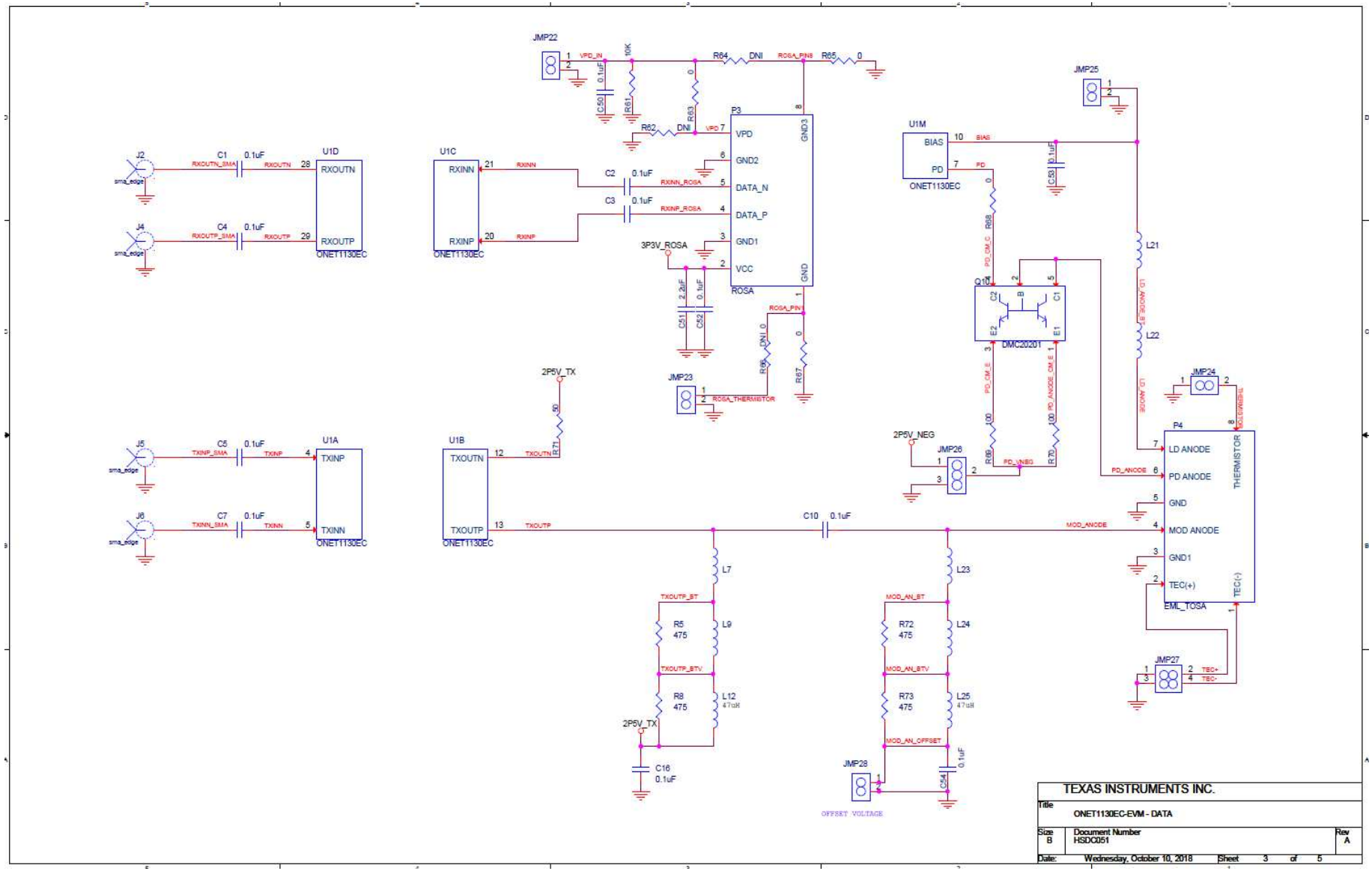


Figure 17. Schematic 2

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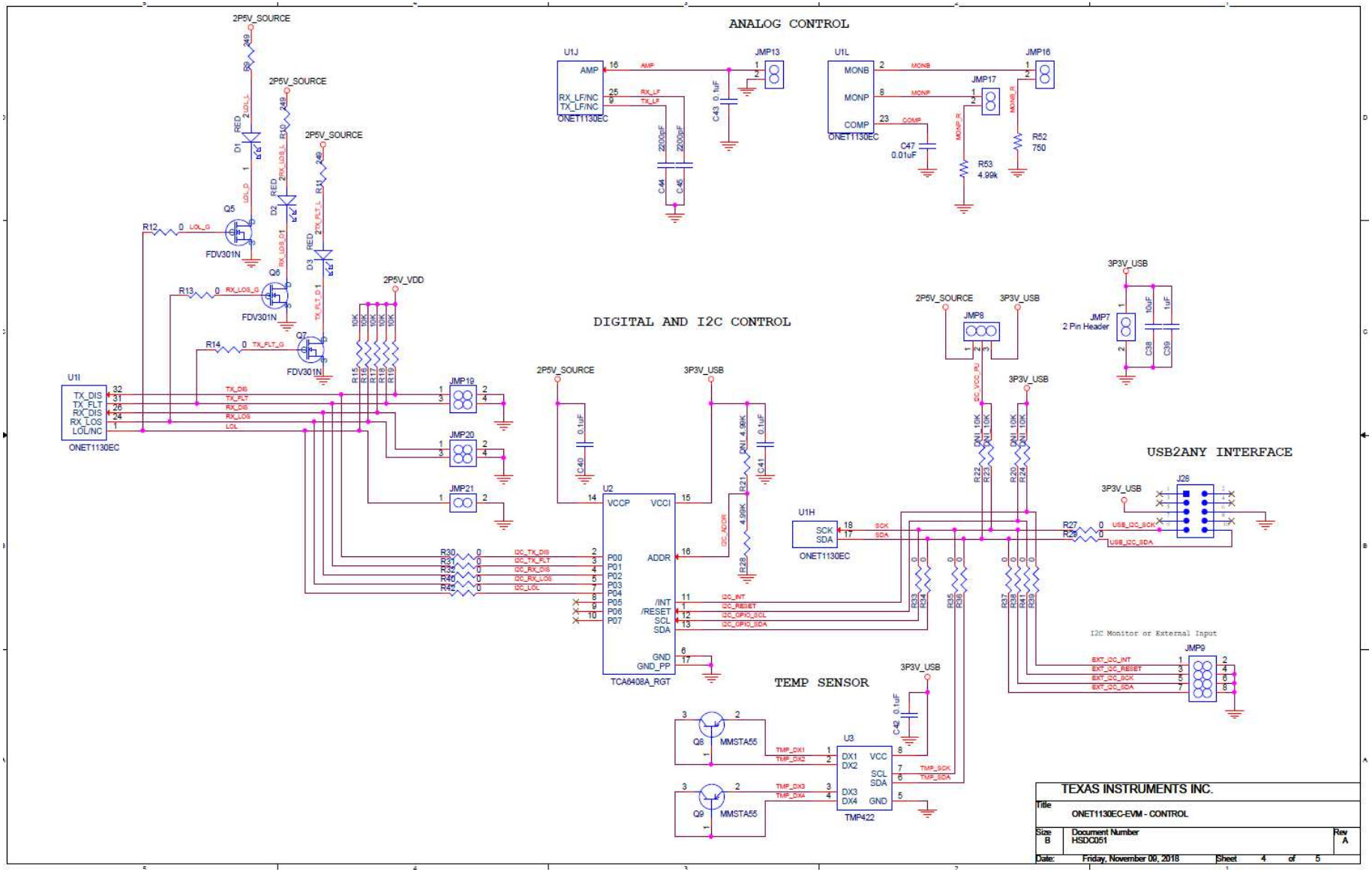


Figure 18. Schematic 3

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9 ONET1130EC-EVM PCB Layout

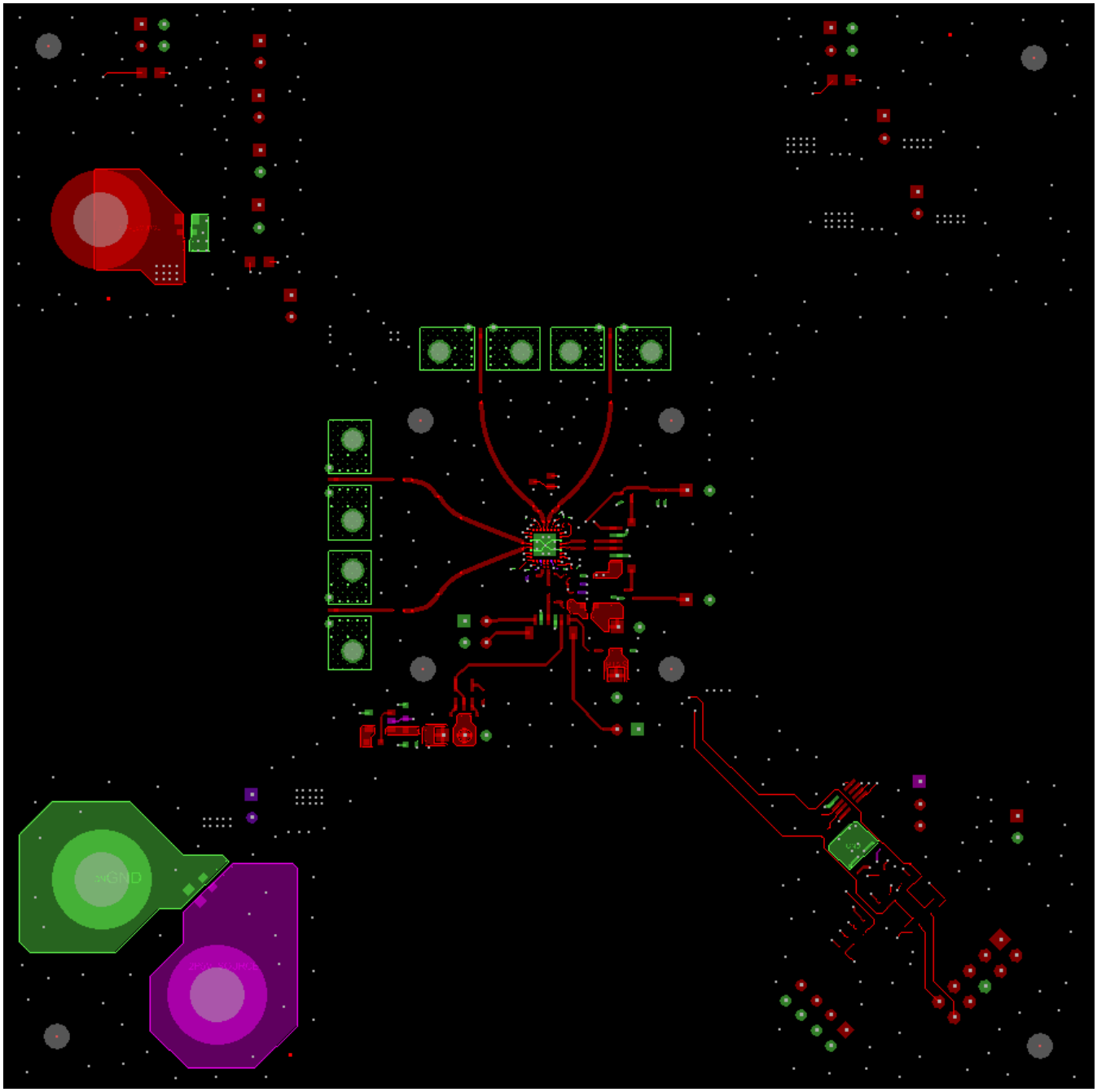


Figure 19. ONET1130EC-EVM Top Layer PCB Layout

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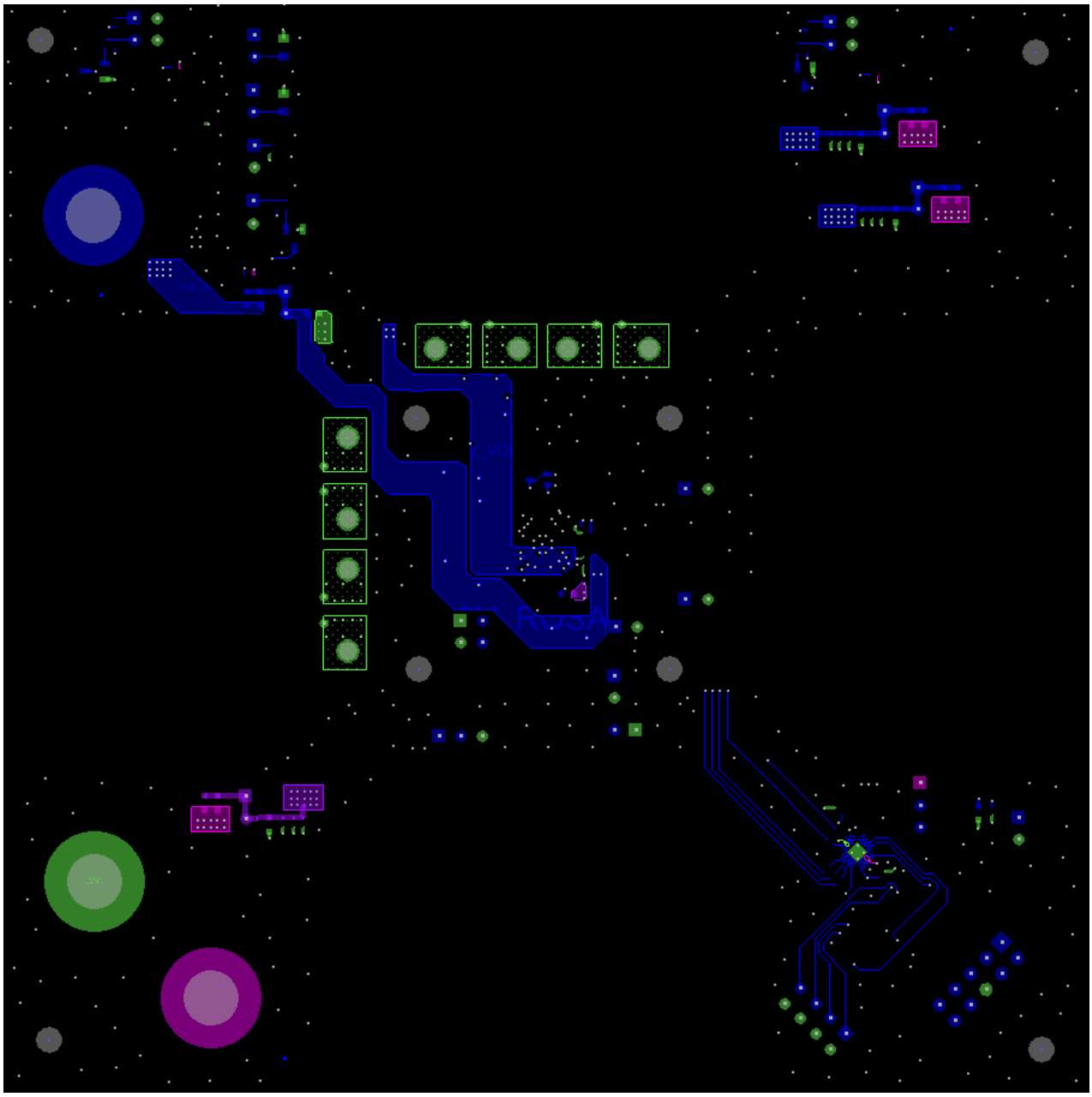


Figure 20. ONET1130EC-EVM Bottom Layer PCB Layout

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10 Bill of Material

Table 2. ONET1130EC-EVM BOM

Item	Quantity	Reference	Value	Manufacturer Part Number	Manufacturer	PCB Footprint
1	2	C44, C45	2200pF	GRM033R71C222KA88D	Murata Electronics North America	0201
2	1	C47	0.01uF	GRM033R71A103KA01D	Murata Electronics North America	0201
3	5	C11, C12, C13, C14, C21	0.1uF	GRM033C71C104KE14D	Murata Electronics North America	0201
4	4	C20, C29, C33, C37	100pF	C0402C101K4GACTU	KEMET	0402
5	7	C1, C2, C3, C4, C5, C7, C10	0.1uF	GCM155R71C104KA55D	Murata Electronics North America	0402
6	16	C16, C19, C25, C28, C32, C36, C40, C41, C42, C43, C50, C52, C53, C54, C58, C62	0.1uF	GCM155R71C104KA55D	Murata Electronics North America	0402
7	7	C18, C24, C27, C31, C35, C39, C61	1uF	GRM153R61A105ME95D	Murata Electronics North America	0402
8	1	C51	2.2uF	GRM155C81C225ME15D	Murata Electronics North America	0402
9	3	C55, C56, C57	1uF	GRM188R61A105KA61D	Murata Electronics North America	0603
10	7	C17, C23, C26, C30, C34, C38, C60	10uF	ZRB18AD71A106KE01L	Murata Electronics North America	0603
11	2	C22, C59	22uF	GRM219R61C226ME15L	Murata Electronics North America	0805
12	4	R5, R8, R72, R73	475	RC0201FR-07475RL	Yageo	0201
13	24	R12, R13, R14, R27, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R63, R65, R67, R68	0	RC0402JR-070RL	Yageo	0402
14	0	R62, R64, R66	DNI	RC0402JR-070RL	DNI	0402
15	2	R71, R74	50	504L50R0FTNCFT	American Technical Ceramics	0402
16	2	R69, R70	100	CRCW0402100RFKEDHP	Vishay Dale	0402
17	3	R9, R10, R11	249	ERJ-2RKF2490X	Panasonic Electronic Components	0402

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Table 2. ONET1130EC-EVM BOM (continued)

Item	Quantity	Reference	Value	Manufacturer Part Number	Manufacturer	PCB Footprint
18	1	R28	4.99K	CRCW04024K99FKEDHP	Vishay Dale	0402
19	0	R21	DNI	CRCW04024K99FKEDHP	Vishay Dale	0402
20	6	R15, R16, R17, R18, R19, R61	10K	ERJ-2RKF1002X	Panasonic Electronic Components	0402
21	0	R20, R22, R23, R24	DNI	ERJ-2RKF1002X	DNI	0402
22	1	R52	750	ERJ-6ENF7500V	Panasonic Electronic Components	0805
23	1	R53	4.99K	RC0805FR-074K99L	Yageo	0805
24	3	D1, D2, D3	RED	HSMS-C170	Avago Technologies Us Inc	LED_SM_HSMB_C170
25	14	JMP3, JMP4, JMP5, JMP6, JMP7, JMP13, JMP16, JMP17, JMP21, JMP22, JMP23, JMP24, JMP25, JMP28	0.1" Header (1x2)	961102-6404-AR	3M	HDR_THVT_1x2_100
26	2	JMP8, JMP26	0.1" Header (1x3)	961103-6404-AR	3M	HDR_THVT_1X3_100
27	3	JMP19, JMP20, JMP27	0.1x0.1" Header (2x2)	961204-6404-AR	3M	HDR_THVT_2x2_100
28	1	JMP9	0.1x0.1" Header (2x4)	961208-6404-AR	3M	HDR_THVT_2X4_100
29	4	J2, J4, J5, J6	Edge Launch SMA	32K243-40ML5	Rosenberger	CON_02K243-40M
30	1	J28	5103308-1	5103308-1	TE Connectivity	CON_SHRD_THVT_5103308-1
31	2	L12, L25	Inductor 47uH, 35mA	GLFR1608T470M-LR	Taiyo Yuden	0603
32	3	L9, L21, L24	Ferrite Bead 1.8kohm, 200mA	BLM15HD182SN1D	MuRata	0402_2020MIL
33	3	L7, L22, L23	Ferrite Bead 1000ohm, 125mA	BLM03HG102SN1D	MuRata	0201
34	4	L13, L15, L17, L19	BLM18PG330SN1D	BLM18PG330SN1D	MuRata	0603
35	0	L14, L16, L18, L20	DNI	BLM18PG330SN1D	DNI	0603
36	3	P1, P2, P5	Solderless Banana Jack	108-0740-001	Emerson Network Power	JACK_THVT_BANANA_500dia
37	0	P3	DNI	ROSA	DNI	MSA_XMD_ROSA_INV
38	0	P4	DNI	TOSA	DNI	162X_TOSA
39	3	Q5, Q6, Q7	FDV301N	FDV301N	Fairchild	SOT23_3
40	2	Q8, Q9	MMSTA55	MMSTA55-7-F	Diodes Inc.	SOT_323-3
41	1	Q10	DMC20201	DMC20201	Panasonic	SOT23_5
42	1	U1	ONET1130EC	ONET1130ECRSMT	Texas Instruments	ONET1130EC_QFN32

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Table 2. ONET1130EC-EVM BOM (continued)

Item	Quantity	Reference	Value	Manufacturer Part Number	Manufacturer	PCB Footprint
43	1	U2	TCA6408A_RGT	TCA6408ARGTR	Texas Instruments	QFN_16_3MSQ
44	1	U3	TMP422	TMP422AIDCNT	Texas Instruments	DCN_SOT23-8
45	1	U5	TPS60400	TPS60400DBVT	Texas Instruments	SOT23-5
50	8	Standoff	ROUND STANDOFF #4-40 ALUM 3/4"	2029	Keystone Electronics	
51	4	SHNT1,SHNT2, SHNT3,SHNT4	QPC02SXGN-RC	QPC02SXGN-RC	Sullins	0.1
52	8	Screws	Round 4-40/0.25"	PMSSS 440 0025 PH	B&F Fastener	
53	1	LB1	PCB Label 0.650"H x 0.200"W	THT-14-423-10	Brady	rectangle
54	1	Laser safety tag	PCB tag	MCH042	Any	rectangle
55	1	H1	HPA665-001; CDDS # 6542513	USB2ANY	TI	n/a
56	1	PCB1	HSDC051	HSDC051	Any	n/a

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STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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