Wireless Power Dual-Mode Charging Receiver with RX coil

Evaluation Board Manual

IDTP9023 CSP Dual-Mode EVALUATION KIT

Features

- IDTP9023 CSP Evaluation Design Module with Dual-Mode Rx coil
- 4-layer PCB with 1 oz. copper traces
- Fully assembled with test points and coil fixture
- Micro-A/B USB Input/ USB A Output
- USB to I²C hardware converter for PC connectivity
- EEPROM to store and load start-up script/firmware
- Software tool to monitor operation, settings control and R/W EEPROM
- LED status indicator
- 5W output power setting

Evaluation Kit Contents

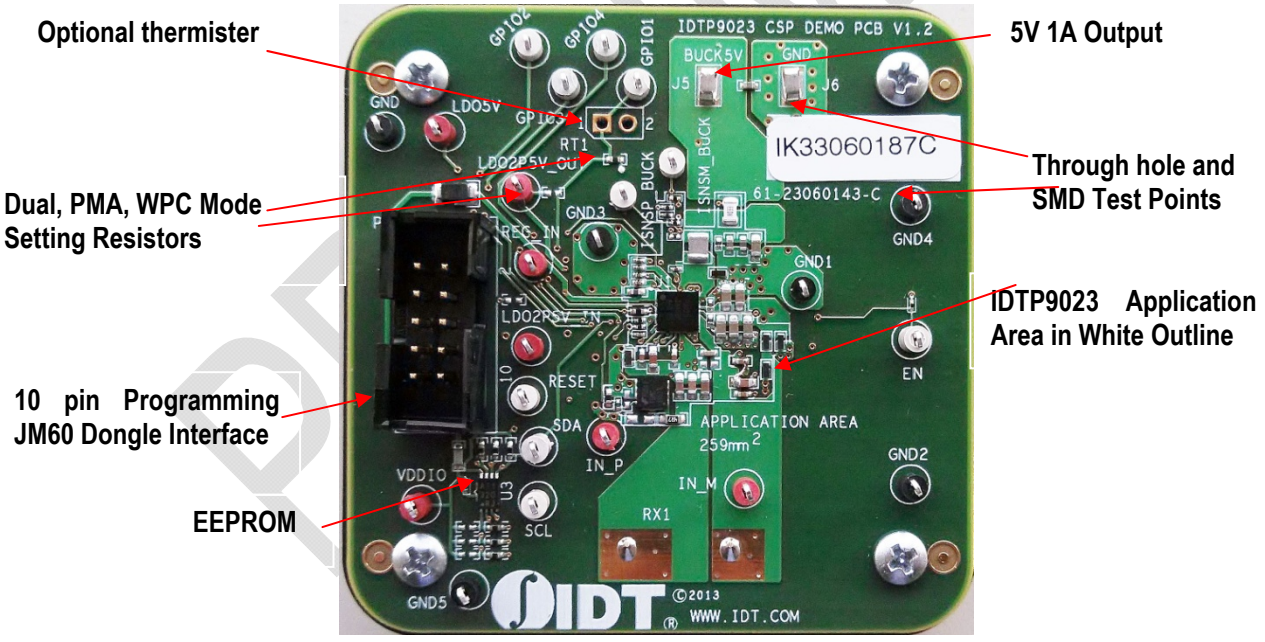
- IDTP9023 V1.2 EVAL Evaluation board
- JM60 Programming Dongle
- USB type A to micro-USB type B cable
- CD containing:
  - IDTP9023 control software tool
  - PC_USB Driver software
  - Reference layout Gerber Files
  - Reference layout Cadence Allegro board files
  - Electronic copy of IDTP9023 product datasheet
  - Electronic copy of IDTP9023-EVAL manual

Description

The IDTP9023 "CSP" evaluation board serves to demonstrate the features and performance of the IDTP9023 Dual-Mode Wireless Power Receiver solution for Mobile Devices. The intuitive top-level layout and control simplifies the user experience to emphasize the impressive level of integration and abundance of useful features that this device offers.

The device is powered by a Dual-Mode RX receiver coil attached to a 2mm thick plastic fixture. Dual-Mode receivers will operate with either a WPC or PMA transmitter (Tx). GUI (graphical user interface) software with a USB Type B cabled programmer board (JM60) is provided to program the on-board EEPROM. The evaluation board utilizes an external EEPROM which contains IDTP9023 firmware to enable functions and allow programmability. The external EEPROM memory chip is pre-programmed with a standard start-up program that is automatically loaded when the board is placed upon a PMA or WPC transmitter such as the IDTP9035A TX-A11 EVKIT. The EEPROM can be reprogrammed to suit the needs of specific applications using the IDTP9023 software tool. The core layout is a 4-layer Cadence Allegro reference design that can be copied and integrated into a larger system design.

Evaluation Board



USAGE GUIDE

The IDTP9023-EVAL demo board is designed to demonstrate the performance and functionality of the IDTP9023 dual-mode WPC/PMA wireless receiver in a lab bench test environment. In most cases, this board can be wired into an existing system for evaluation. For complex or electrically sensitive situations, it is recommended to use the reference layout to integrate this design into the final system to eliminate hardware limitations or signal degradation introduced by long leads.

With no computer interface, this evaluation board can function in its pre-programmed mode of operation using a WPC compatible TX transmitter such as the IDTP9030/35A/36A EVKIT. Optionally, to program the EEPROM a PC with USB output is required. Everything needed is included in this evaluation kit.

Quick-Start Guide

1. Place the IDTP9023 RX board onto the TX coil of a PMA or WPC compatible transmitter; note that 5V will appear across the SMD test pins BUCK5V and GND on the IDTP9023 board.
2. Connect up to a 1A load to the BUCK5V test point and GND.

SCHEMATIC

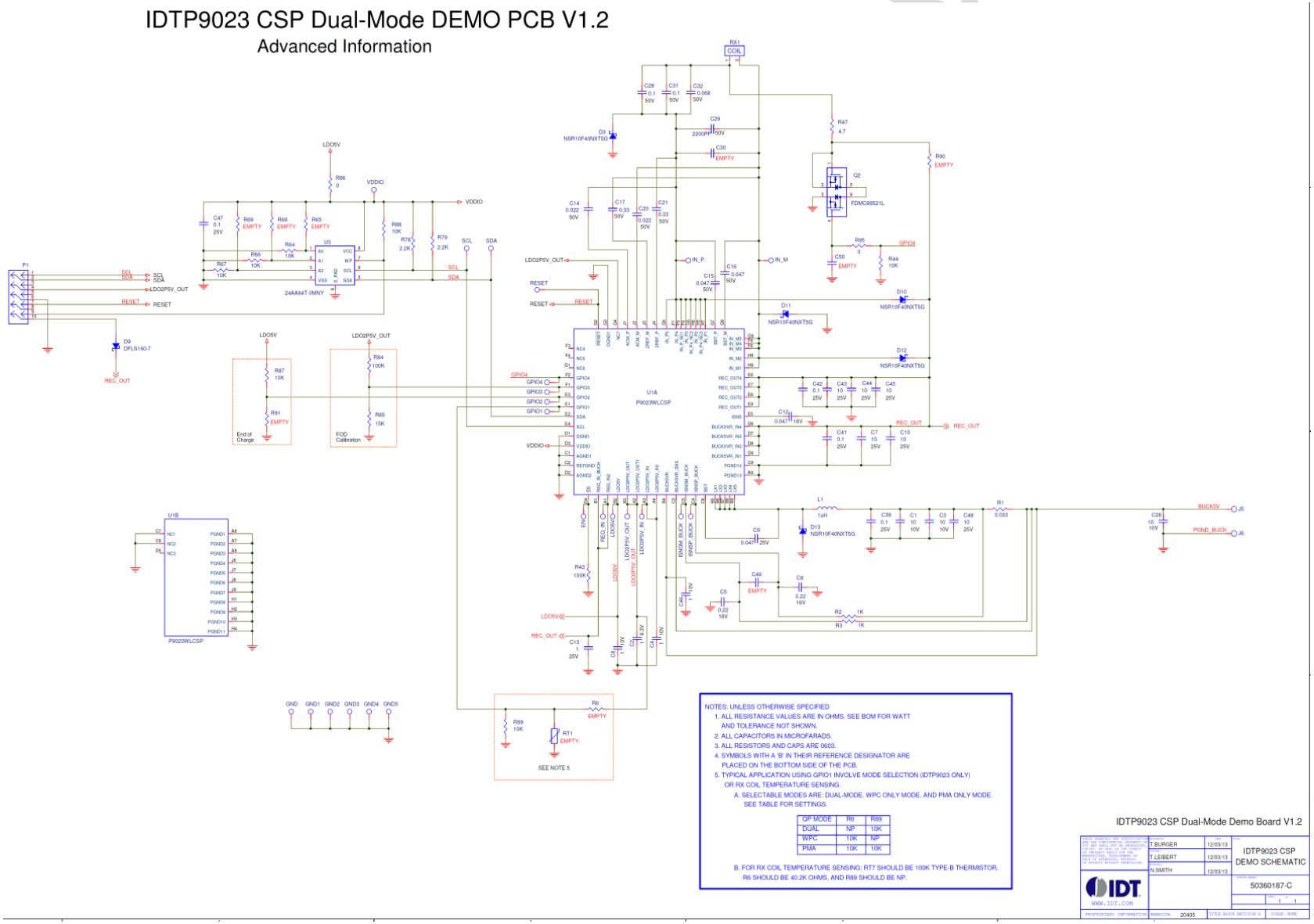


Figure 1. IDTP9023 V1.2 Eval Kit Board Schematic

Table 1. Bill of materials (IDTP9023 Dual-Mode Demo PCB V1.2)

Item Number	Description	Qty	Manufacturer	Mfr Part Number	Ref Designator
0010	CON 010 M ST HDR PC NLK DRW 100 9.86MM	1.000	TE CONNECTIVITY	5103308-1	P1
0020	TEST POINT 0.05ID LOOP WHT BASE	10	KEYSTONE	5002	EN,GPIO1,GPIO2,GPIO3,GPIO4,ISNSM_BUCK,ISNSP_BUCK,RESET,SCL,SDA
0030	TEST POINT 0.05ID LOOP RED BASE	7.000	KEYSTONE	5000	IN_M,IN_P,LDO2P5V_IN,LDO2P5V_OUT,LDO5V,REG_IN,VDDIO
0040	TEST POINT 0.05ID LOOP BLK BASE	6.000	KEYSTONE	5001	GND,GND1,GND2,GND3,GND4,GND5
0050	IND 10U0 8A00 50Q 37.0X37.0X1.80MM	1.000	WURTH ELECTRONIK	760308201	RX1
0051	IND 10U4 0R20 WIRELESS RX COIL 48X32MM	1.000	TDK	WR-483250-15M2-G	ALTERNATE FOR RX1
0060	CON 001 F ST OTH PC NLK SRW 000 TST PNT	2.000	HARWIN	S1751-46	J5,J6
0070	RES 0R00 MF 0W10 Z 0603 THNF JUMPER	1.000	VISHAY	MCT06030Z0000ZP500	R86
0080	RES 10K0 MF W063 J 0402 THKF 200PPM/C	7.000	KOA SPEER	RK73B1ETTP103J	R64,R66,R67,R88,R44,R87,R89
			PANASONIC	ERJ-2GEJ103X	
			VISHAY	CRCW040210K0JNED	
			YAGEO	RC0402JR-0710KL	
0090	RES 2K20 MF 0W10 J 0402 THKF 200PPM/C	2.000	PANASONIC	ERJ-2GEJ222X	R78,R79
0100	RES 4R70 0W10 J 0603 THKF 400PPM/C	1.000	IRC	WCR-WCR0603LF-4R70JELT	R47
			KOA SPEER	RK73B1JTTD4R7J	
			VISHAY	CRCW 0603-4R70J-KEA-E3	
			YAGEO	RC0603JR-074R7L	
0110	RES R033 0W33 J 0805 THKF -0/+250PPM/C	1.000	ROHM	UCR10EVHJSR033	R1
0120	RES 1K00 W050 F 0201 THKF 200PPM/C	2.000	KOA SPEER	RK73H1HTTC1001F	R2,R3
			VISHAY	CRCW02011K00FNED	
			YAGEO	RC0201FR-071KL	
			PANASONIC	ERJ-1GEF1001C	
0130	RES 0R00 W050 F 0201 THKF	1.000	KOA SPEER	RK73Z1HTTC	R95
			TT ELECTRONICS	WCR-WCR0201LF-R000JPLT	
			VISHAY	CRCW0201000Z0ED	
			YAGEO	RC0201JR-070RL	
			PANASONIC	ERJ-1GN0R00C	
0140	RES 100K MF 0W05 J 0201 THKF 200PPM/C	2.000	KOA SPEER	RK73B1HTTC104J	R43,R84
			PANASONIC	ERJ-1GEJ104C	
			VISHAY	CRCW0201100KJNED	
			YAGEO	RC0201JR-07100KL	
0150	RES 15K0 MF 0W05 F 0201 THKF 200PPM	1.000	PANASONIC	ERJ-1GEF1502C	R85
			VISHAY	CRCW0201115K0FNED	
0170	CAP 1U000 MLC X5R 25V0 M 0402 0.55MM	1.000	TAIYO YUDEN	TMK105BJ105MV-F	C13
			TDK	C1005X5R1E105M050BC	
0180	CAP 2200P MLC X7R 50V0 K 0402 0.56MM	1.000	AVX	04025C222KAT2A	C29
			KEMET	C0402C222K5RACTU	
			MURATA ERIE	GRM155R71H222KA01D	
			TDK	C1005X7R1H222K050BA	
			YAGEO	CC0402KRX7R9BB222	
0190	CAP 0U022 MLC X7R 50V0 K 0402 0.55MM	2.000	TDK	CGA2B3X7R1H223K050BB	C14,C20
			KEMET	C0402C223K5RACTU	
			MURATA ERIE	GRM155R71H223KA12D	

Note 1 - Recommended capacitor temperature/dielectric and voltage ratings. 50V capacitors are recommended for C14, C15, C16, C17, C20, C21 C28, C29, C31, C32. Furthermore, C0G/NPO-type capacitor values stay constant with voltage while X7R and X5R capacitor values derate over the working voltage range at 40% to over 80%. The decision to use lower voltage lower voltage rated capacitors or other type temperature/dielectric capacitors is left to the end user.

Table 1. Bill of materials Continued(IDTP9023 Dual-Mode Demo PCB V1.2)

Item Number	Description	Qty	Manufacturer	Mfr Part Number	Ref Designator
0190	CAP 0U022 MLC X7R 50V0 K 0402 0.55MM	2.000	TDK	CGA2B3X7R1H223K050BB	C14,C20
			KEMET	C0402C223K5RACTU	
			MURATA ERIE	GRM155R71H223KA12D	
			TAIYO YUDEN	UMK105B7222KV-F	
0200	CAP 0U047 MLC X7R 50V0 K 0402 0.55MM	2.000	TDK	C1005X7R1H473K050BB	C15,C16
0210	CAP 10U00 MLC X5R 10V0 M 0402 0.70MM	3.000	SAMSUNG	CL05A106MP5NUNC	C1,C26,C3
0220	CAP 0U068 MLC X7R 50V0 K 0603	1.000	KEMET	C0603C683K5RAC	C32
			TDK	C1608X7R1H683K	
0230	CAP 0U100 MLC X7R 50V0 K 0603	2.000	KEMET	C0603C104K5RAC	C28,C31
			TDK	C1608X7R1H104K	
			MURATA ERIE	GRM188R71H104KA93D	
			TDK	C1608X7R1H104K080AA	
0240	CAP 10U00 MLC X5R 25V0 M 0603 0.9MM	6.000	SAMSUNG	CL10A106MA8NRNC	C10,C43,C44,C45,C48,C7
			TDK	C1608X5R1E106M080AC	
0250	CAP 0U330 MLC X5R 50V0 K 0603 0.9MM	2.000	TDK	C1608X5R1H334K080AB	C17,C21
0260	CAP 0U100 MLC X5R 25V0 K 0201 0.3MM	4.000	SAMSUNG	CL03A104KA3NNNC	C39,C41,C42,C47
			TDK	C0603X5R1E104K030BB	
0270	CAP 0U047 MLC X5R 25V0 K 0201 0.3MM	1.000	TDK	C0603X5R1E473K030BB	C9
0280	CAP 1U000 MLC X5R 6V30 M 0201 0.35MM	1.000	AVX	02016D105MAT2A	C2
			MURATA ERIE	GRM033R60J105MEA2D	
			TDK	C0603X5R0J105M030BC	
0290	CAP 1U000 MLC X5R 10V0 M 0201 0.35MM	3.000	SAMSUNG	CL03A105MP3NSNC	C4,C46,C6
0300	CAP 0U220 MLC X5R 25V0 K 0201 0.35MM	2.000	TDK	C0603X5R1E224K030BC	C5,C8
0310	CAP 0U047 MLC X5R 16V0 K 0201 0.33MM	1.000	MURATA ERIE	GRM033R61C473KE84D	C12
			TAIYO YUDEN	EMK063BJ473KP-F	
0320	IND 1U00 2A50 R078 2.7X2.2X1.0MM	1.000	TOKO	1269AS-H-1R0M	L1
0330	DIO SKY 60V0 1A00 POWERDI123 DFLS160-7	1.000	DIODES INCORPORATED	DFLS160-7	D9
0331	DIO SKY 40V0 0A50 SOD123 B0540W-7-F	1.000	DIODES INCORPORATED	B0540W-7-F	ALTERNATE FOR D9
0340	DIO SKY 40V0 1A00 2DSN NSR10F40NXT5G	5.000	ON SEMICONDUCTOR	NSR10F40NXT5G	D10,D11,D12,D13,D3
0350	FET DNN 60V0 8A20 R017 POWER33 FDMC89521	1.000	FAIRCHILD	FDMC89521L	Q2
0360	IC MEM TDFN08 64KBYTE EEPROM 400KHZ I2C	1.000	MICROCHIP TECHNOLOGY	24AA64T-I/MNY	U3
0370	IC BGA-79 IDTP9023 DUAL MODE RX	1.000	IDT	P9023WLCSP	U1
0380	PCB IDTP9023 CSP DEMO	1.000	COASTAL CIRCUITS	61-23060143	
			VECTOR	61-23060143	
0390	BOX BLACK WIRELESS	1.000	POLYCASE	J-7674ABR1	
			UTHMANN MOLD & MACHINE INC	61-21500074 (MODIFIED FROM J-7674AB)	
0400	SCW 004 0038 PAN PHL STL ZNC	4.000	B&F FASTENERS	PSMS 004 0038 PH	
			OLANDER	4N37PPAZR	
0410	KAPTON TAPE 2 MIL 1.5IN X 36YD	.020	DUPONT	KPT2-1 1/2	
8000	DRW PCB IDTP9023 CSP DEMO	1.000			
8010	DRW SCH IDTP9023 CSP DEMO	1.000			
8020	ASSUME ANY REFERENCE DESIGNATOR NOT LISTED ON BOM IS NOT POPULATED	1.000			

Note 1 - Recommended capacitor temperature/dielectric and voltage ratings. 50V capacitors are recommended for C14, C15, C16, C17, C20, C21 C28, C29, C31, C32. Furthermore, C0G/NPO-type capacitor values stay constant with voltage while X7R and X5R capacitor values derate over the working voltage range at 40% to over 80%. The decision to use lower voltage lower voltage rated capacitors or other type temperature/dielectric capacitors is left to the end user.

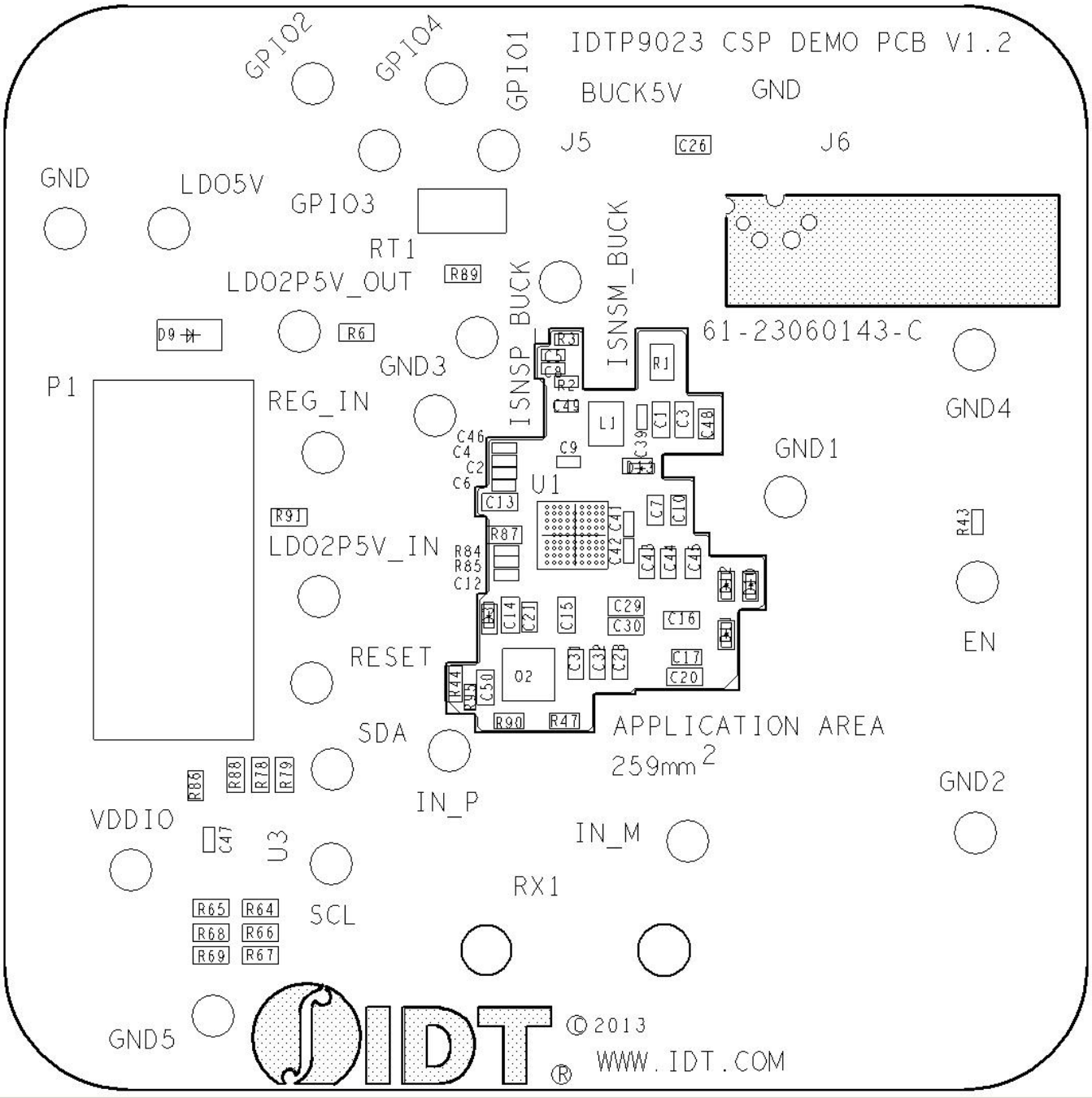


Figure 2. Assembly Placement Map

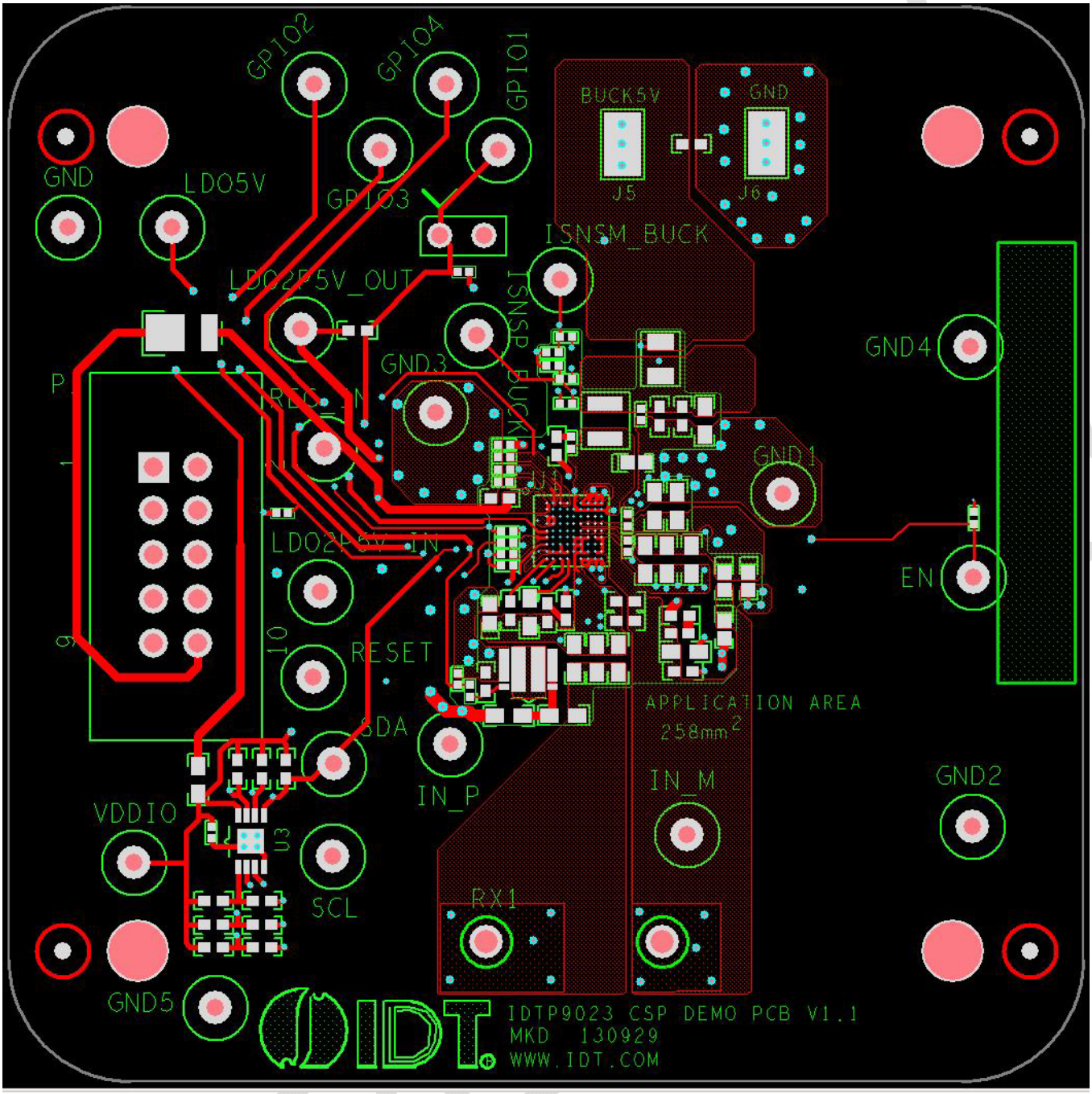


Figure 3. Top and Top Silkscreen Layer

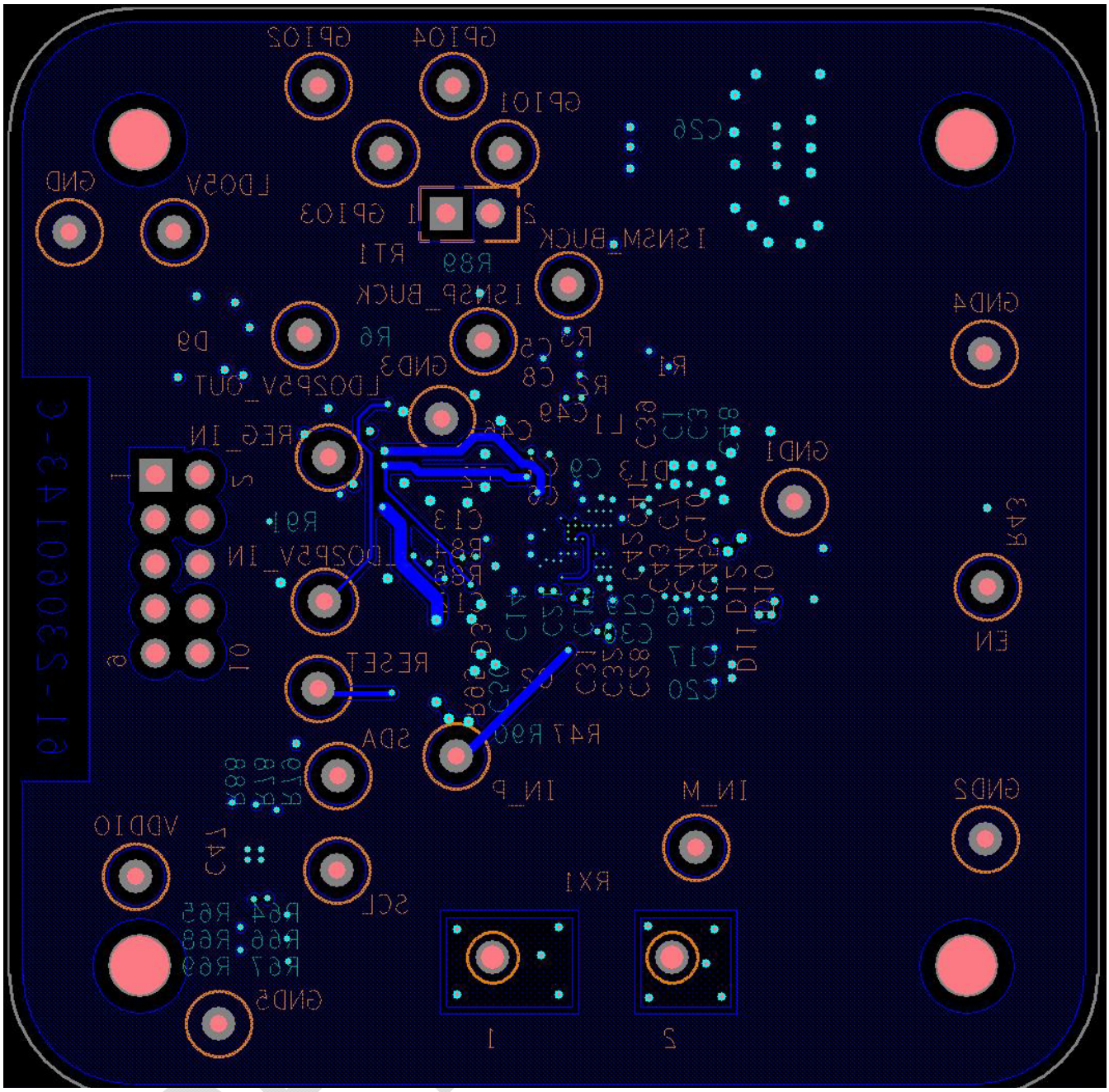


Figure 4. Bottom and Bottom Silkscreen Layer.

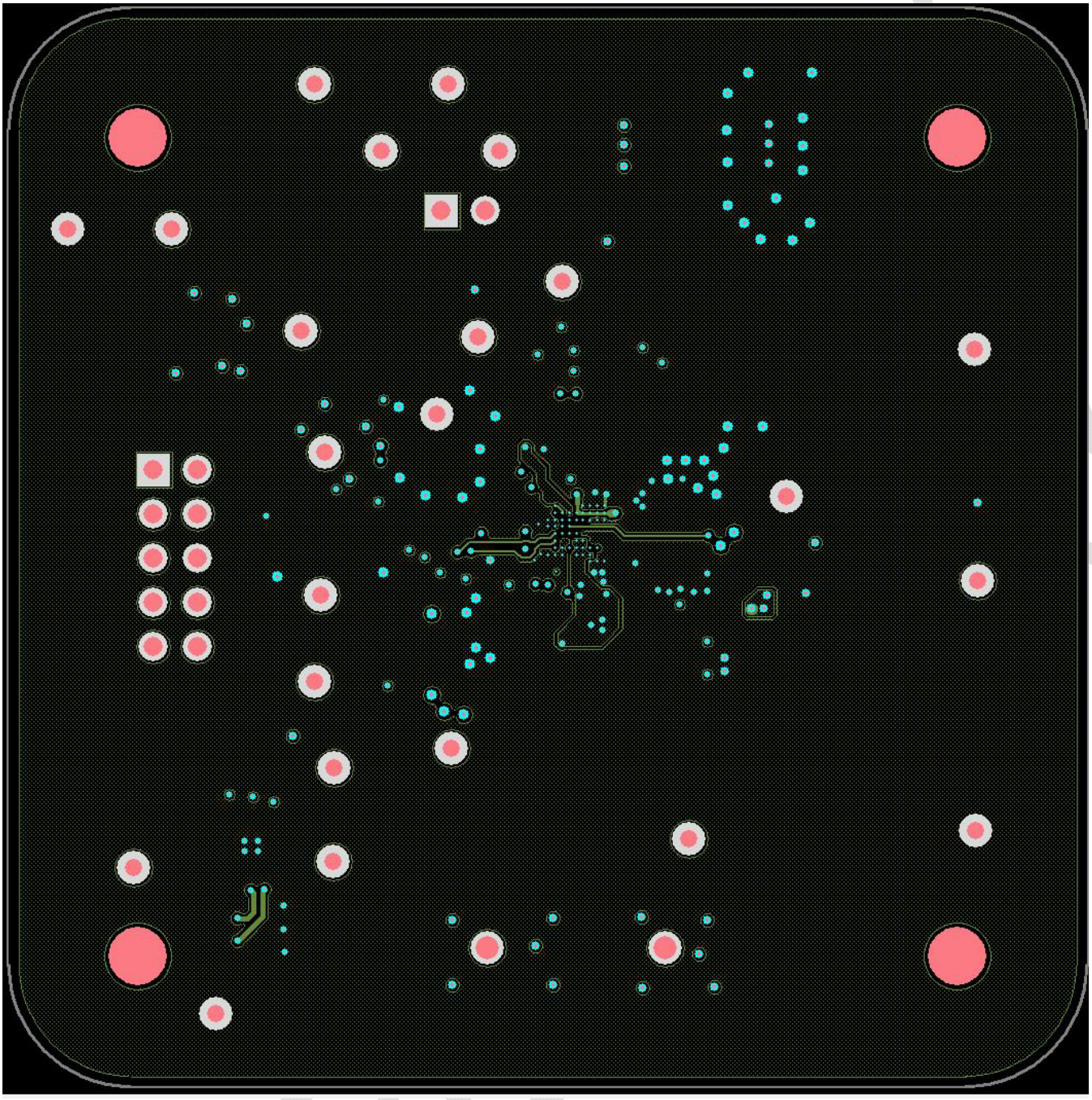


Figure 5. Mid 1 Layer

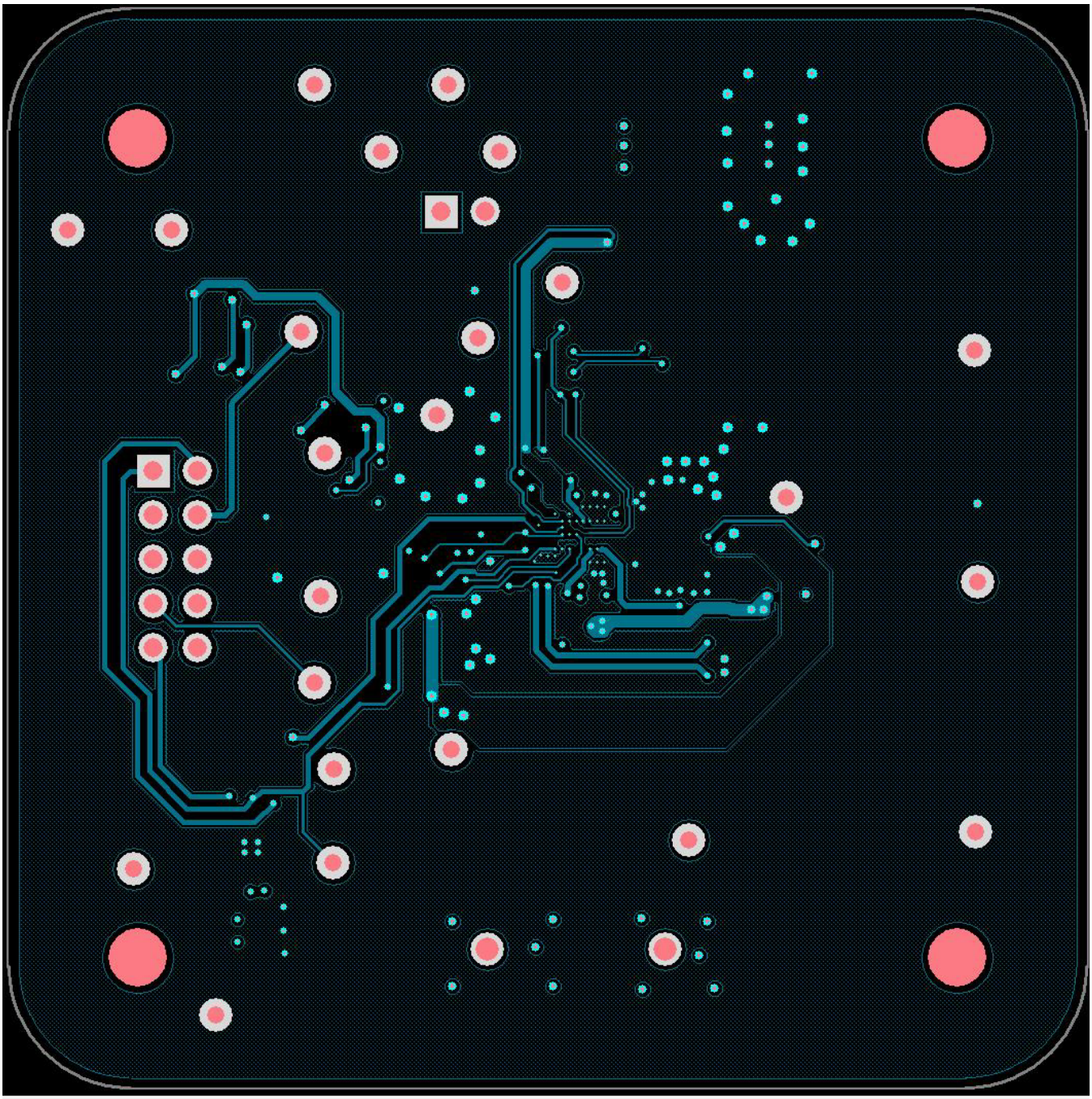


Figure 6. Mid 2 Layer

OPTIONAL WINDOWS GUI

The I²C USB adapter (JM60) is optional and the main purpose is to upload the IDTP9023 firmware into the EEPROM (U3). The I²C adapter may be used to interface the IDTP9023 and the PC GUI – see detailed description on "*Installing the Windows GUI*" section:

3. Install the Wireless Power Demo Windows GUI software by executing the Setup.exe file from the CDROM in the folder "9020Tool_final" (Figure 7).
4. Connect the USB cable from a PC to the 1" x 2" JM60 programming board. The JM60 board has already been programmed.
5. Connect the JM60 to the connector on the IDTP9023 CSP DEMO PCB board (J1 Fig 8).

6. Click Start >> All Programs >> Integrated Device Technology (Folder) >> Wireless Power Demo (Application Icon) to open the GUI software (Fig 9).

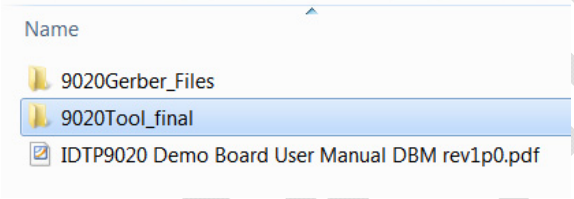


Figure 7. File folder structure on the CDROM.

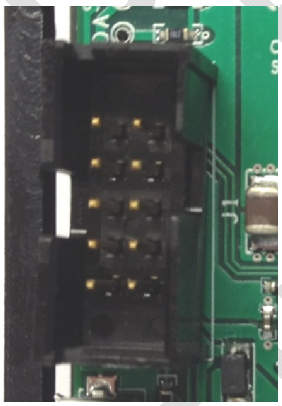


Figure 8. IDTP9023-EVAL JM60 Programmer input 10pin header.

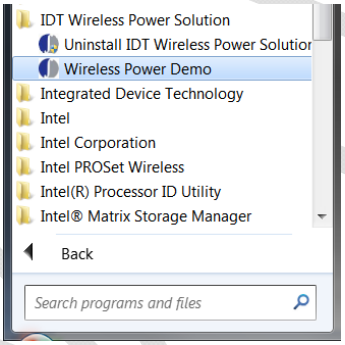


Figure 9. Starting the Graphical User Interface

Verifying Connectivity

You can verify that the IDTP9023 is properly connected to your computer and able to communicate to the evaluation board by looking at the lower left of Figure 10. It should state "USB Connected". Otherwise it will state in Red letters: "USB Disconnected – Check Connection".

If it states USB Disconnected, it might be that the driver was not properly installed on the PC. Check to see that a USB Connector icon appears and disappears, at the lower right of the Taskbar, as the Cable's USB Connector is plugged and unplugged from the USB port. If it does not appear, then proceed to Troubleshooting section.

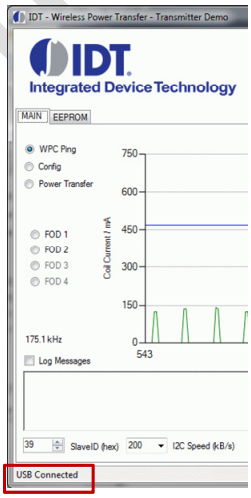


Figure 10. Windows GUI Main tab

OPTIONAL - Installing the Windows GUI

For the first time use of the IDTP9023-DEMO board or to write a new .bin file into the EEPROM, the Windows Drivers and GUI must be installed to communicate with the JM60 USB to I²C controller that is located on the JM60 Programmer Dongle board. The JM60 Dongle board is attached to the left side of the DEMO board, and is connected via a 10pin keyed header on the bottom side of the board. The purpose of this controller is to be able to write different .bin files into the EEPROM on the DEMO board, and to be able to acquire real time signals showing system operation. Different .bin files can be made available, for example, when a different output power setting test is desired.

Example installation of the Windows USB-to I²C-Drivers on a Win7 32-bit or 64-bit system is shown in the following steps:

To install the GUI, open the IDTP9023-DEMO CD and run the file: setup-1.0.0.11.exe within the 9020Tool_final folder. I.e. the path is 9020Tool_final/setup-1.0.0.11.exe shown in figure 11. Follow the Setup Wizard instruction shown in Figure 12. This will install the GUI and driver automatically. After the installation process is complete, you may connect the evaluation board to the computer with the USB cable, via the Dongle, and use the software tool. *At this point, a little USB icon should appear at the lower right of the desktop screen. If it does not, then the machine being used should be rebooted.* Now plug the USB cable into the dongle board, and plug the USB cable into the PC. *Then connect the JM60 dongle board into the evaluation board.*

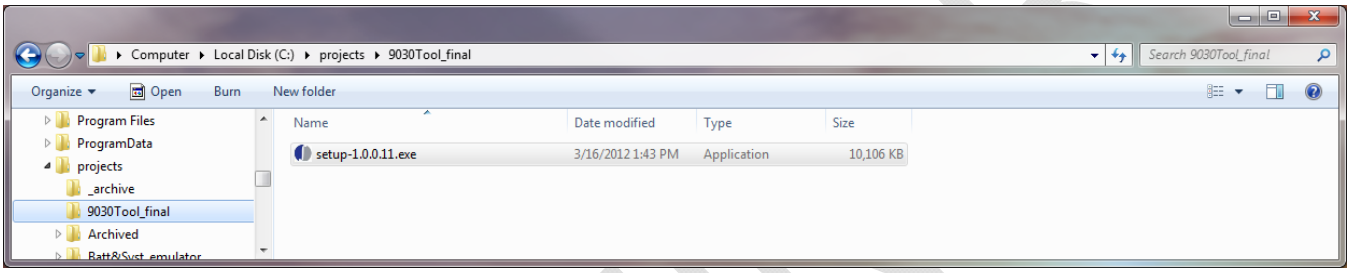


Figure 11. Path to driver setup.exe.

Figure 12. Setup Wizard.

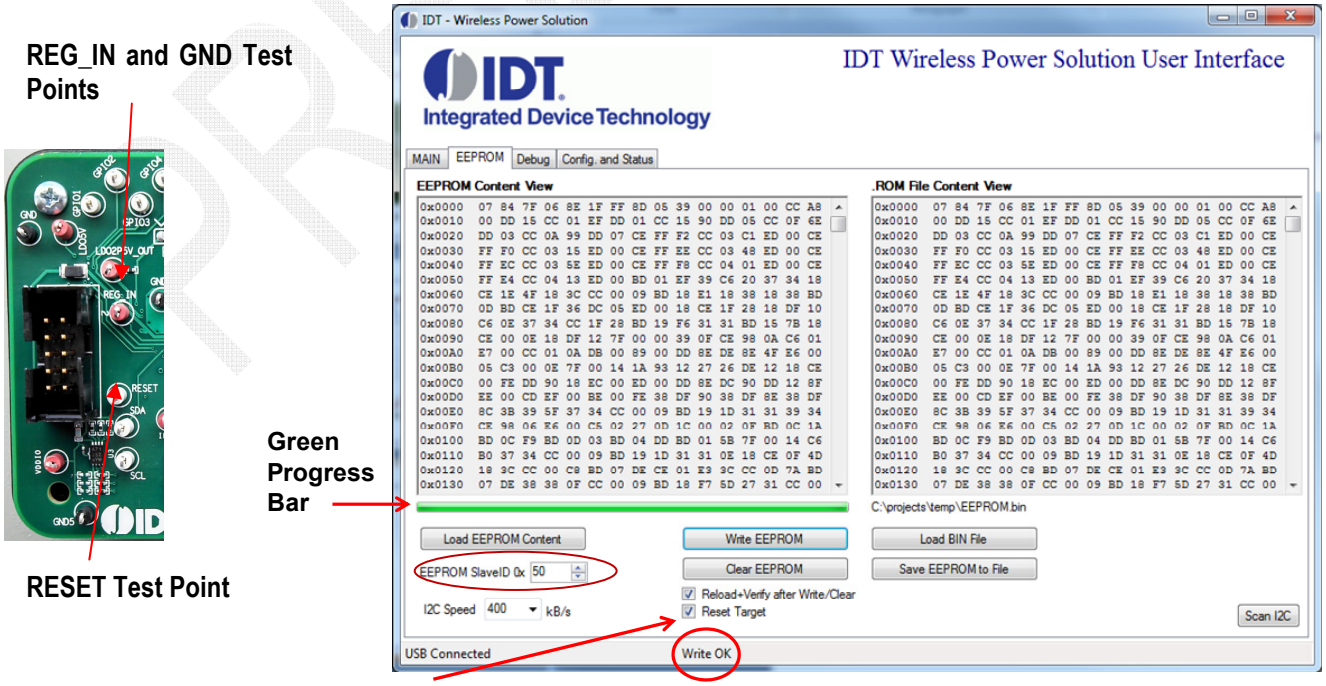
Writing to the EEPROM

Loading the XXXX.bin File

As mentioned, the EEPROM already comes with a standard BIN file programmed into it, which gets downloaded to the IDTP9023 upon power up. However, if another one has been provided by the factory, for instance, for perhaps a higher output power, the way to write it into the EEPROM is as follows:

1) Plug the USB cable from the computer to the dongles USB type B connector.
2) Plug the dongle into the IDTP9023 Demo board. Connect a 7.5V power supply to the REG_IN and GND test points on the IDTP9023 Demo Board (Fig 13 left). Alternately, place the demo board on a powered Tx transmitter.
3) Click Start >> All Programs >> Integrated Device Technology (Folder) >> Wireless Power Demo.
4) Choose "RECEIVER".
5) Click on the EEPROM tab directly right of the MAIN tab.
6) Click on the Load Bin file and browse to the path where the new bin file is located, for example, on the CD (type .bin).
7) Set the EEPROM Slave ID to 50 and select the Scan I²C button (Fig 13 lower right) and check that the slave address for the EEPROM appears as 0x50.
8) Click the Write EEPROM button, the green progress bar should increase in size from left to right and two **green passes** should be observed as the file is written to the EEPROM and then the Write OK should appear at the bottom of the screen. If not, click the Write EEPROM button again until Write OK appears.
9) Finally, to get the LEDs on the DEMO board to start flashing, the Reset Target check mark has to be unchecked. Uncheck it and the various LEDs will start flashing.

If a Write OK is not shown in step 8, then refer to the Troubleshooting section on page 13. "Error Writing" is shown in place of "Write OK", and it should be easily visible that FF's will be shown across the entire 0x0000 address row or simply that the EEPROM Content View doesn't match the .ROM File Content View. Note: The left Content view shows the current EEPROM contents and can be seen by clicking on the Load EEPROM Content. The Right side Content view is the Bin file that was loaded.



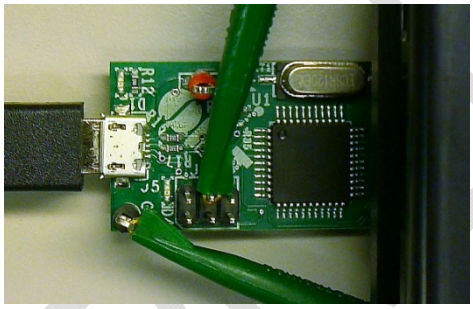
Reset Target field needs to be unchecked after Write OK! It also serves as a very convenient system reset tool if the I²C bus disconnects. Check the box and then uncheck it to reset the system.

Figure 13. Connection for external supply connected to REC_OUT and location of the RESET Switch. The GUI screen after Loading a BIN File and Writing to the EEPROM.

Troubleshooting

The IDTP9023 demo board was designed to quickly show the performance of the IDTP9023. However, if you are experiencing trouble getting started, here are some tips to help accelerate setup and connectivity.

1. Check to make sure that the PC shows it is connected to the demo board. USB connected should always show at the lower left of the Dongle GUI. If it doesn't it is always good practice to disconnect and reconnect the USB cable. Unplugging and plugging the USB cable should show an icon appearing and disappearing at the lower right of your computer screen.
2. Reset the JM60 by momentarily connecting a jumper wire from pin 4 on the J2 connector to ground. The USB will disconnect and reconnect on the GUI Screen (See Figure 10 left). When the wire is removed, program the EEPROM.
3. Select the Scan I²C button (Fig 13 lower right) and check that the slave address for the EEPROM appears as 0x50
4. Reload the .bin file and re-write it. Make sure WRITE OK shows at the middle of the display after a write takes place.
5. **Update the Driver.** If you have a previous version of the eval tool, the driver will probably need to be updated. The way to check on the version of the driver is to open up the Device Manager as shown in Figure 14. Expand the USB Bridge Devices and double click on it. Click on the Driver Tab, and be sure its' Driver Date is 7/5/2009 and Version is 7.0.0.0. See Figure 16. If it is not version 7.0.0.0 then go to directory C:\Program Files\IDT Wireless Power Solution\Drv as shown in Figure 17 and double click the DPInst.exe file. The system will then go through a driver update install. Be sure to reboot your machine once the install is complete.



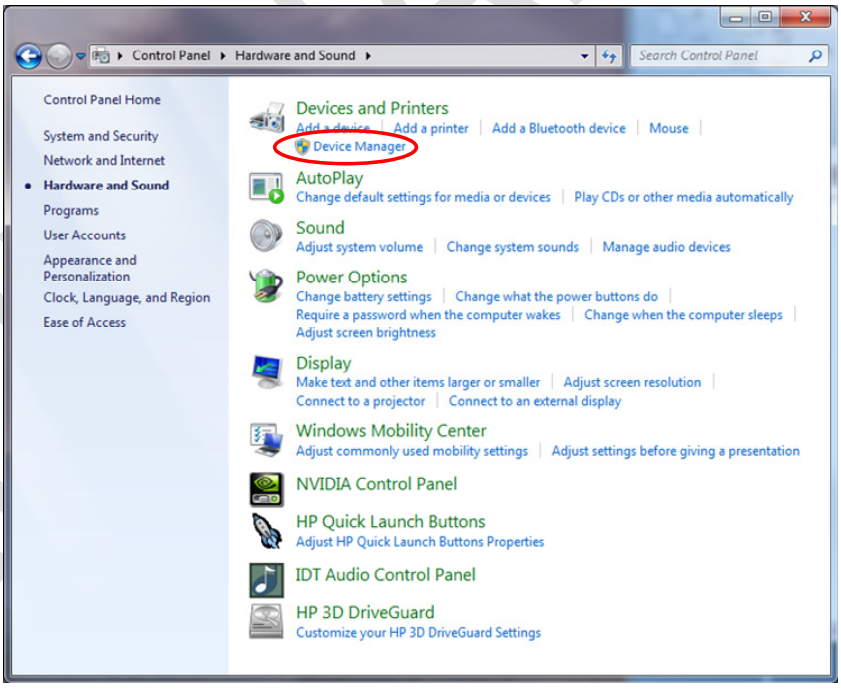


Figure 14. Resetting the JM60. *Checking the revision of the driver using Device Manager, shown is a Win7 PC.*

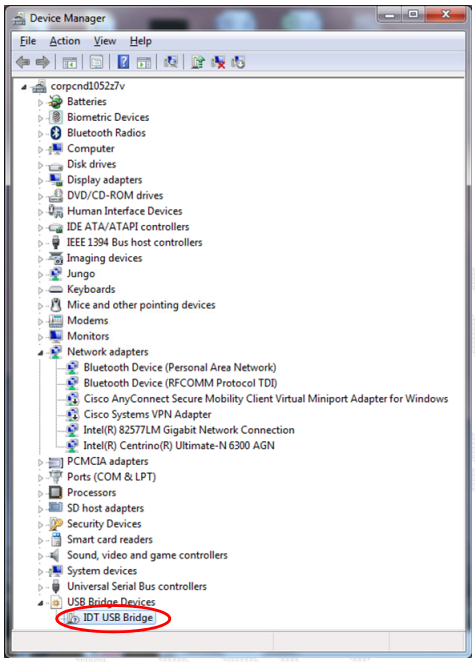


Figure 15. Checking the revision of the driver in Device Manager.

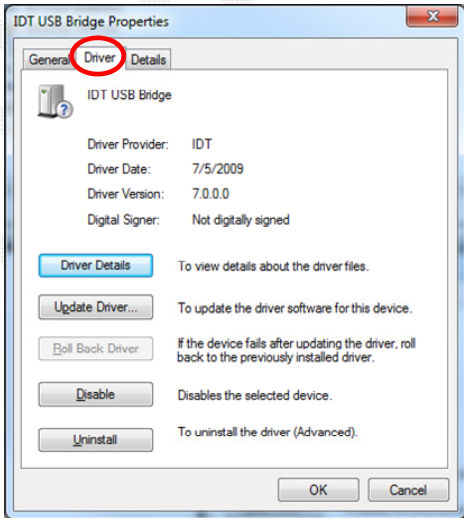


Figure 16. Checking that the revision of the driver is correct.

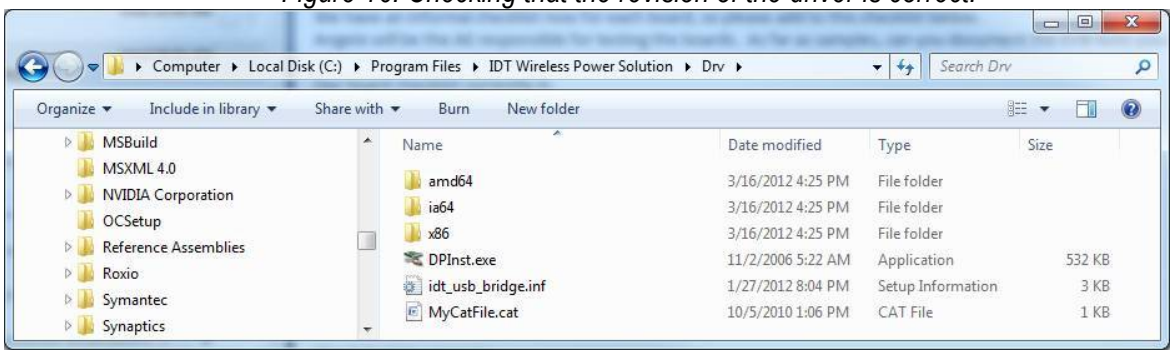


Figure 17. Installed Device Driver Directory.

ORDERING GUIDE

Table 2. Ordering Summary

PART NUMBER	MARKING	PRICE	AMBIENT TEMP. RANGE	SHIPPING CARRIER	QUANTITY
IDTP9023-EVAL	IDTP9023 CSP DEMO PCB V1.2	$149.00	0°C to +70°C	Box 14”x10”x2”	1

Revision History

September 27, 2013 Version 1.0 – Initial Release.

October 10, 2013 Version 1.1 – Update to the new board revision V1.1.

October 15, 2013 Version 1.2 – Update to a new diode NSR10F40NXT5G.

December 10, 2013 Version 1.3 – Update to a new board reversion PCB V1.2.

January 9, 2014 Version 1.4 – Update assembly drawing to include designators.

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