Wireless Power WPC “Qi” Charging Receiver with RX coil

Evaluation Board Manual

IDTP9022 CSP WPC “Qi” EVALUATION KIT

Features

- IDTP9022 CSP Evaluation Design Module with WPC “Qi” Rx coil
- 4-layer PCB with 1 oz. copper traces
- Fully assembled with test points and coil fixture
- 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

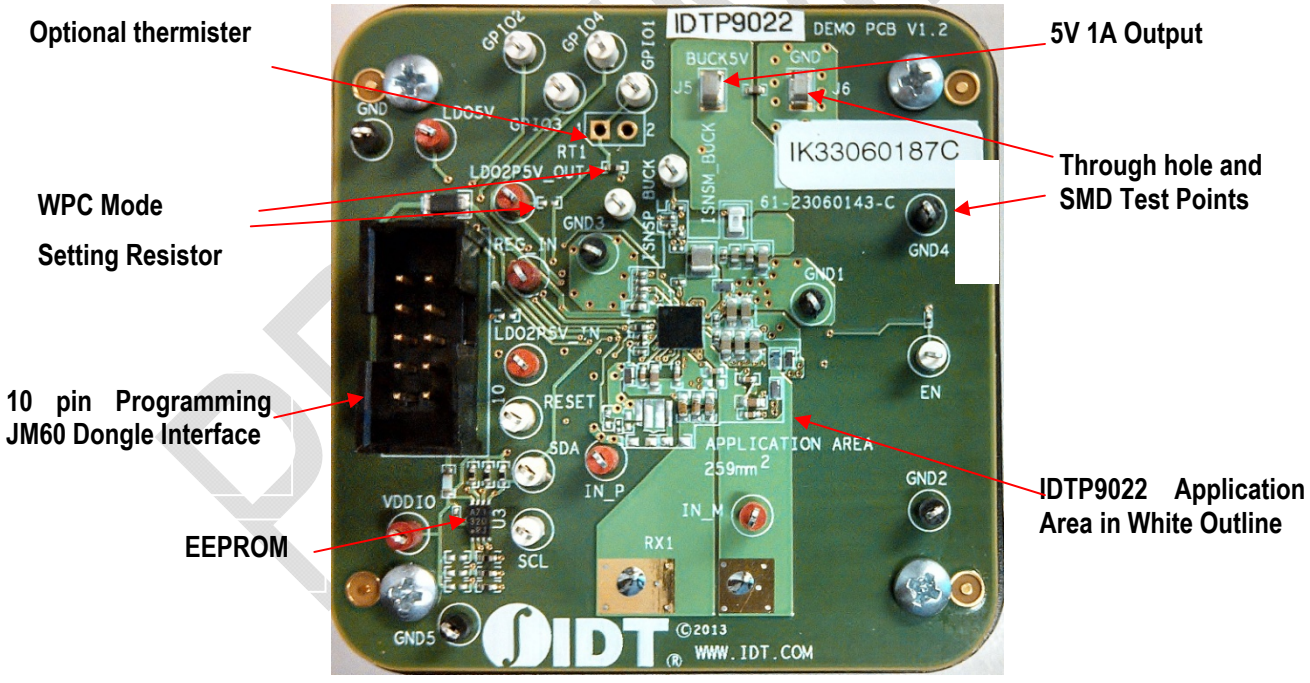
- IDTP9022 V1.1 EVAL Evaluation board
- JM60 Programming Dongle
- USB type A to micro-USB type B cable
- CD containing:
  - IDTP9022 control software tool
  - PC_USB Driver software
  - Reference layout Gerber Files
  - Reference layout Cadence Allegro board files
  - Electronic copy of IDTP9022 product datasheet
  - Electronic copy of IDTP9022-EVAL manual

Description

The IDTP9022 “CSP” evaluation board demonstrates the features and performance of the IDTP9022 WPC “Qi” 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 WPC “Qi” RX receiver coil attached to a 2mm thick plastic fixture. WPC “Qi” receivers will operate with a WPC “Qi” 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 IDTP9022 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 WPC transmitter such as the IDTP9035A TX-A11 EVKIT. The EEPROM can be reprogrammed to suit the needs of specific applications using the IDTP9022 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 IDTP9022-EVAL demo board is designed to demonstrate the performance and functionality of the IDTP9022 WPC "Qi" WPC 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 IDTP9022 RX board onto the TX coil of a WPC compatible transmitter; note that 5V will appear across the SMD test pins BUCK5V and GND on the IDTP9022 board.
2. Connect up to a 1A load to the BUCK5V test point and GND.

SCHEMATIC

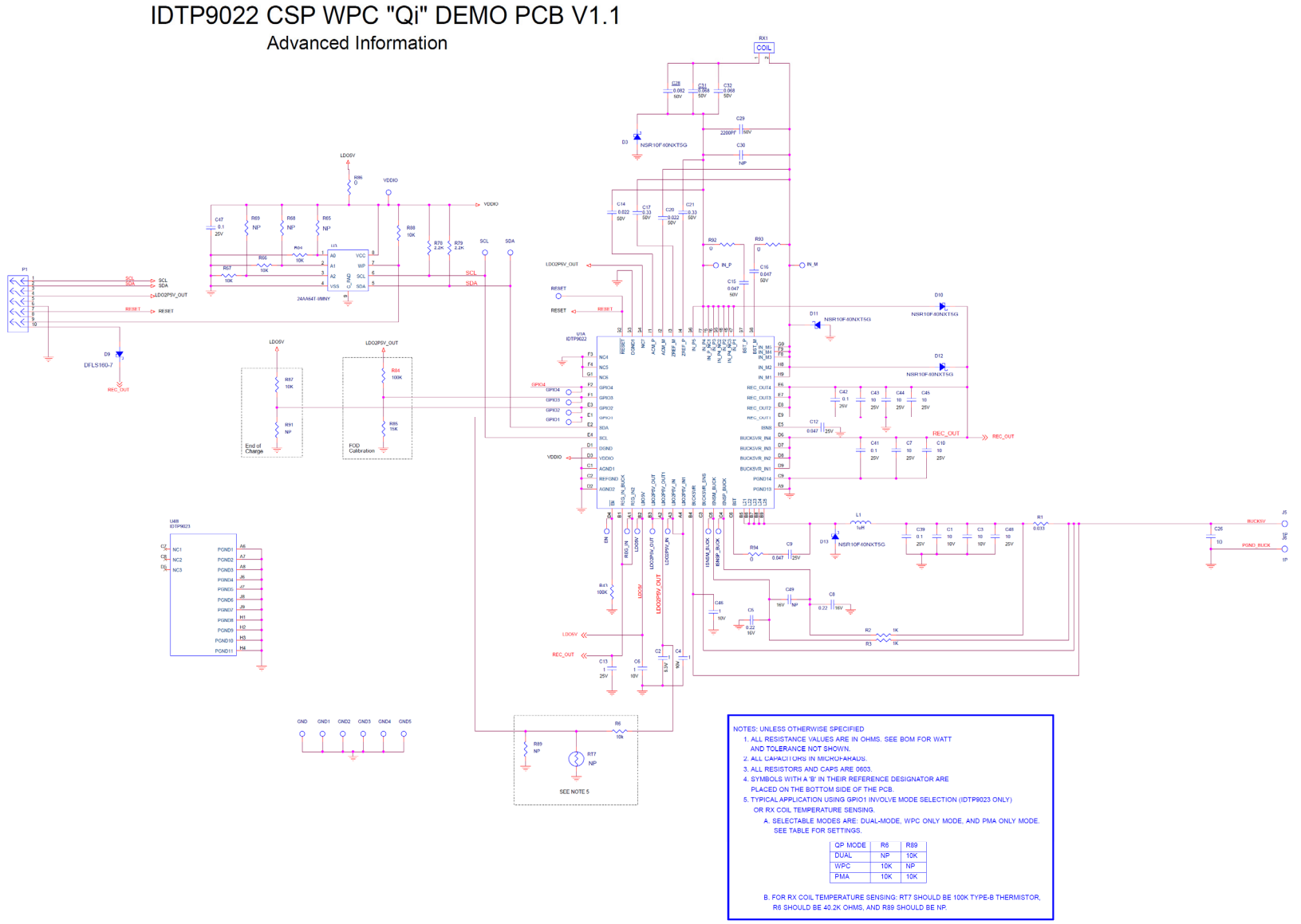


Figure 1. IDTP9022 V1.1 Eval Kit Board Schematic

Table 1. Bill of materials (IDTP9022 WPC "Qi" Demo PCB V1.1)

Item	Quantity	Description	Reference	Part Number	Value	Footprint
1	3	CAP 10U00 MLC X5R 10V0 M 0402	C1,C3,C26	CL05A106MP5NUNC	10	402
2	1	CAP 1U000 MLC 6V3 0201	C2	C0603X5R0J105M030BC	1	201
3	3	CAP 1U000 MLC X5R 10V0 0201	C4,C6,C46	CL03A105MP3NSNC	1	201
4	2	CAP 0U220 MLC X5R 16V0 K 0201	C5,C8	C0603X5R1E224K030BC	0.22	201
5	6	CAP 10U00 MLC X5R 25V0 M 0603 0.9MM	C7,C10,C43,C44,C45,C48	GRM188R61E106MA73	10	603
6	2	CAP 0U047 MLC X5R 25V0 0201	C9,C12	C0603X5R1E473K030BB	0.047	201
7	1	CAP 1U000 MLC 25V0 K 0402	C13	TMK105BJ105MV-F	1	402
8	2	CAP 0U022 MLC X7R 50V0 K 0402	C14,C20	CGJ2B3X7R1H223K050BB	0.022	402
9	2	CAP 0U047 MLC X7R 50V0 K 0402	C15,C16	CGA2B3X7R1H473K050BD	0.047	402
10	2	CAP 0U330 MLC X5R 50V0 K 0603	C17,C21	C1608X5R1H334K	0.33	603
11	2	CAP CER 0.082UF 50V 10% X7R 0603	C28	C0603C823K5RACTU	0.082	603
12	1	CAP 2200pF MLC X7R 50V0 K 0402	C29	C1005X7R1H222K050BA	2200PF	402
13	1	CAP 2200pF MLC X7R 50V0 K 0402	C30	C1005X7R1H222K050BA	NP	402
14	1	CAP 0U068 MLC X7R 50V0 K 0603	C31, C32	C1608X7R1H683K	0.068	603
15	4	CAP 0U100 MLC X5R 25V0 0201	C39,C41,C42,C47	C0603X5R1E104K030BB	0.1	201
16	1	CAP 0U220 MLC X5R 16V0 K 0201	C49	C0603X5R1E224K030BC	NP	201
17	1	CAP 0U047 MLC X7R 50V0 K 0402	C50	CGA2B3X7R1H473K050BD	NP	402
18	3	DIODE SCHOTTKY 40V 1A 2DSN	D3,D11,D13	NSR10F40NXT5G	NSR10F40	2-DSN (1.4x0.6)
19	1	DIO SKY 60V0 1A00 2-SMD	D9	DFLS160-7	DFLS160-7	DFLS160
20	2	DIODE SCHOTTKY 40V 1A 2DSN	D10,D12	NSR10F40NXT5G	NSR10F40	2-DSN (1.4x0.6)
21	10	TEST POINT, 0.05ID LOOP, WHT BASE	GPIO1,GPIO2,GPIO3,GPIO4,SDA, SCL,RESET,ISNSP_BUCK,ISNSM_B UCK,EN	5002	WHT	80-40pth
22	6	TEST POINT, 0.05ID LOOP, WHT BASE	GND1,GND2,GND3,GND4,GND5, GND	5001	WHT	80-40pth
23	7	TEST POINT, 0.05ID LOOP, WHT BASE	LDO5V,LDO2P5V_OUT,LDO2P5V_ IN,VDDIO,REG_IN,IN_P,IN_M	5000	WHT	80-40pth
24	2	CON 001 F ST OTH PC NLK SRW 000 TST PNT	J5,J6	S1751-46R	1P	SMT3-65X2-05
25	1	IND 1U00 2A70 0R06 2520 2.5X2.0X1.0MM	L1	DFE252010C-1R0M	1uH	IND_TOKO_2P5X2
26	1	CON 010 M ST HDR PC NLK DRW 100 9.86MM	P1	5103308-1	10P	HEADER10P2Rlatch
27	1	NP	Q2	NP	NP	NP
28	1	THM 100K 25C 0W63 K 0402 NTC 4308 K	RT7	91700011	NP	JUMPER2PIN01IN
29	1	760308201 WR-483250-15M2-G (with added FK2 Ferrite)	RX1	COIL_9022	10uH	COIL_9022
30	1	RES, .033 1/3W 5%	R1	UCR10EVHJSR033	0.033	805
31	2	RES 1K00 0W10 F 0201	R2,R3	ERJ-1GEF1001C	1K	201
32	1	RES 40K2 0W10 F 0402	R6	ERJ-1GEJ103C	10K	201
33	2	RES 100K 0W20 0201	R43,R84	ERJ-1GEJ104C	100K	201
34	2	RES 10K0 0W05 F 0201	R44, R89	NP	NP	NP
35	1	NP	R47	NP	NP	NP
36	4	RES 10K OHM 1/10W 5% 0402 SMD	R64,R66,R67,R88	ERJ-2GEJ103X	10K	402
37	3	RES 10K0 0W10 F 0402	R65,R68,R69	ERJ-2GEJ103X	NP	402
38	2	RES 2K2 0W10 F 0402	R78,R79	ERJ-2GEJ222X	2.2K	402
39	1	RES 15K0 0W20 F 0201 THKF 100PPM/C	R85	ERJ-1GEF1502C	15K	201
40	1	RES 0 0W10 F 0603	R86	MCT06030Z0000ZP500	0	603
41	1	RES 10K OHM 1/20W 5% 0201 SMD	R87	ERJ-1GEJ103C	10K	201
42	1	NP	R90	NP	NP	NP
43	1	RES 10K OHM 1/20W 5% 0201 SMD	R91	ERJ-1GEJ103C	NP	201
44	3	Short	R92,R93,R94	0	0	402
45	1	NP	R95	NP	NP	NP
46	1	IC CTR BGA-79 WIRELESS RCVR 8W IDTP9022	U1	P9023	IDTP9023	BGA_IDTP9022_CSP
47	1	IC MEM TDFN08 64KBYTE EEPROM 400KHZ I2C	U3	24AA64T-I/MNY	24AA64T-I/MNY	TDFN08
48	1		7		SCH_NOTES	

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.

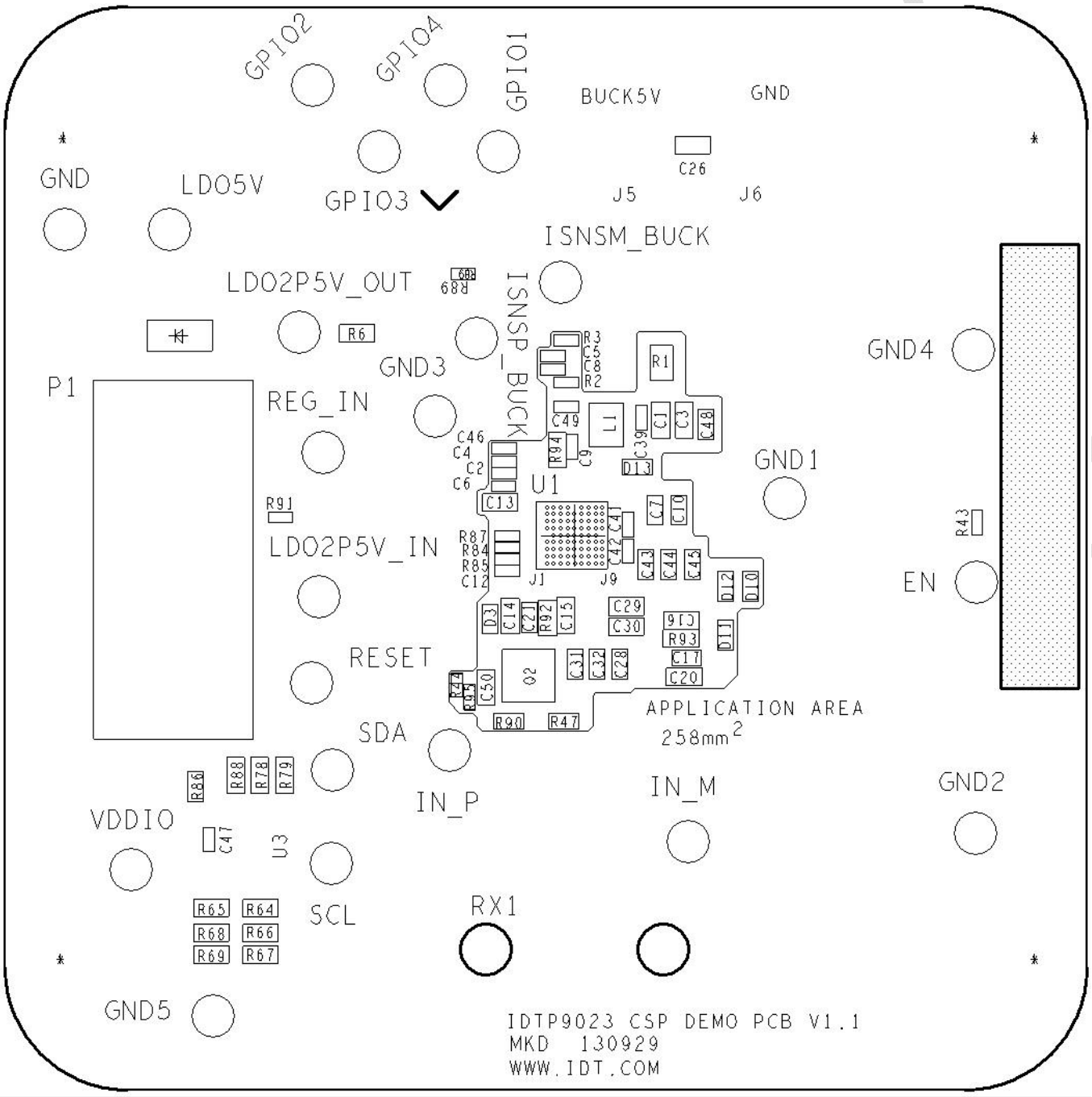


Figure 2. Assembly Placement Map

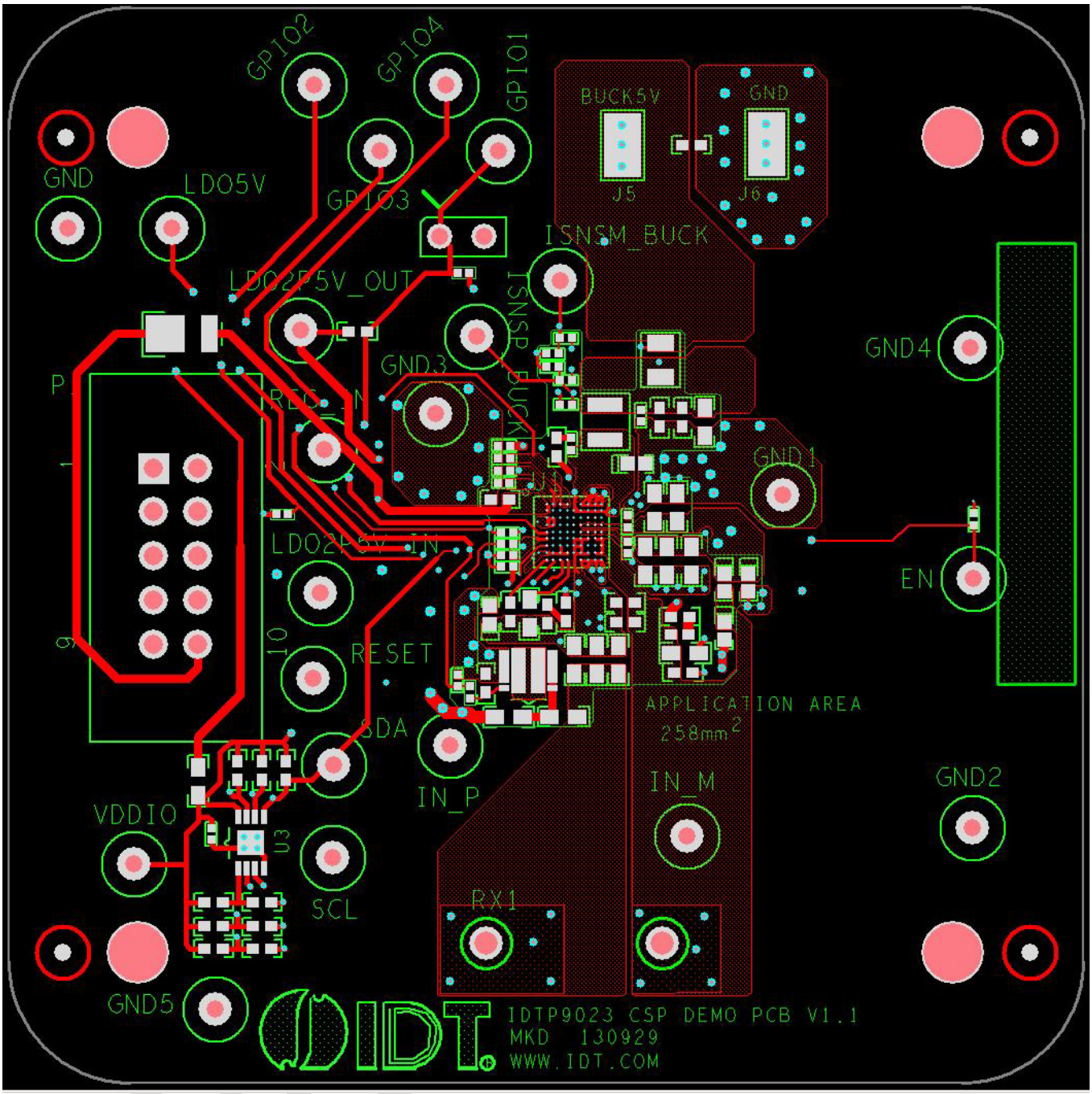


Figure 3. Top and Top Silkscreen Layer

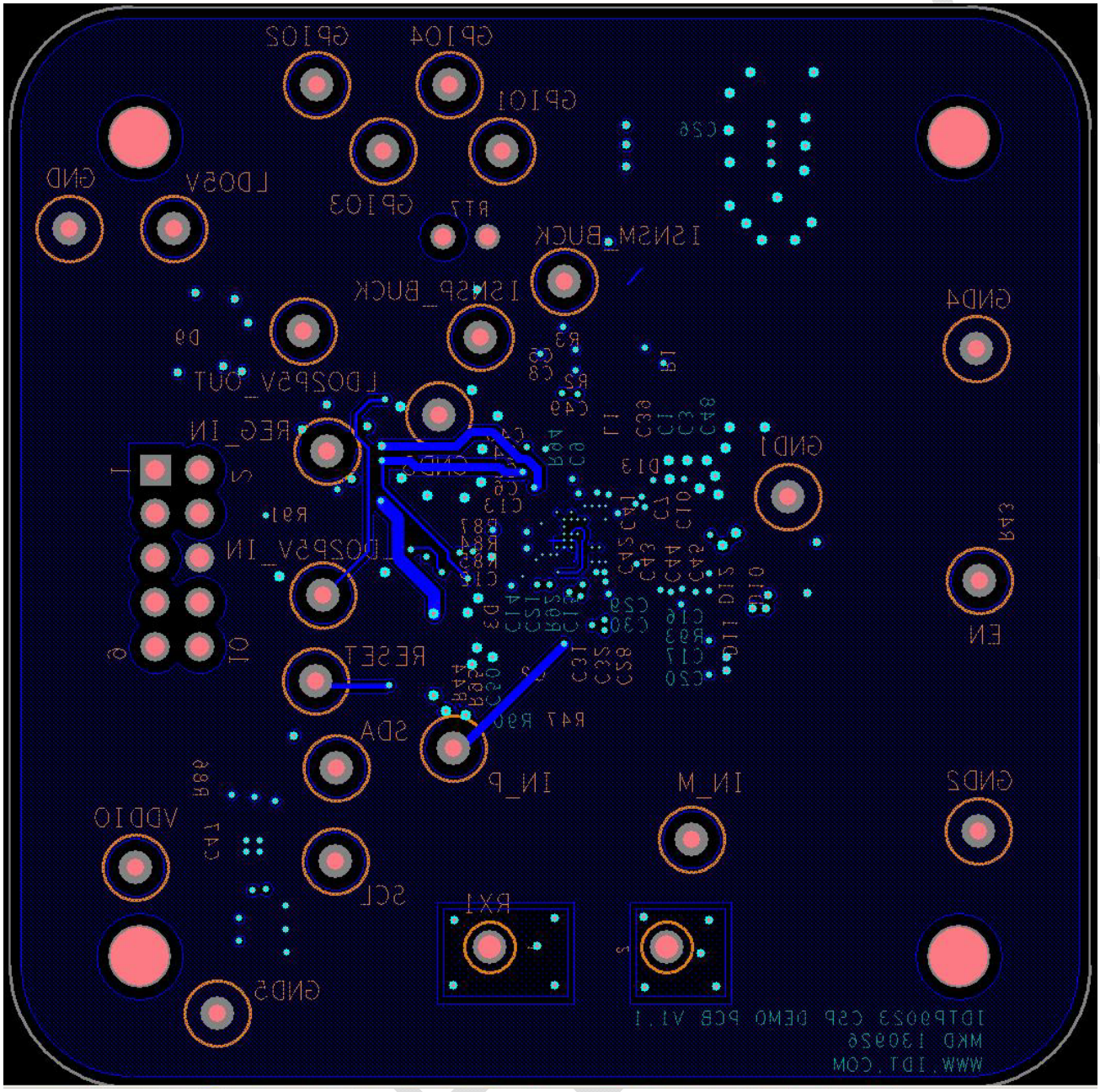


Figure 4. Bottom and Bottom Silkscreen Layer.

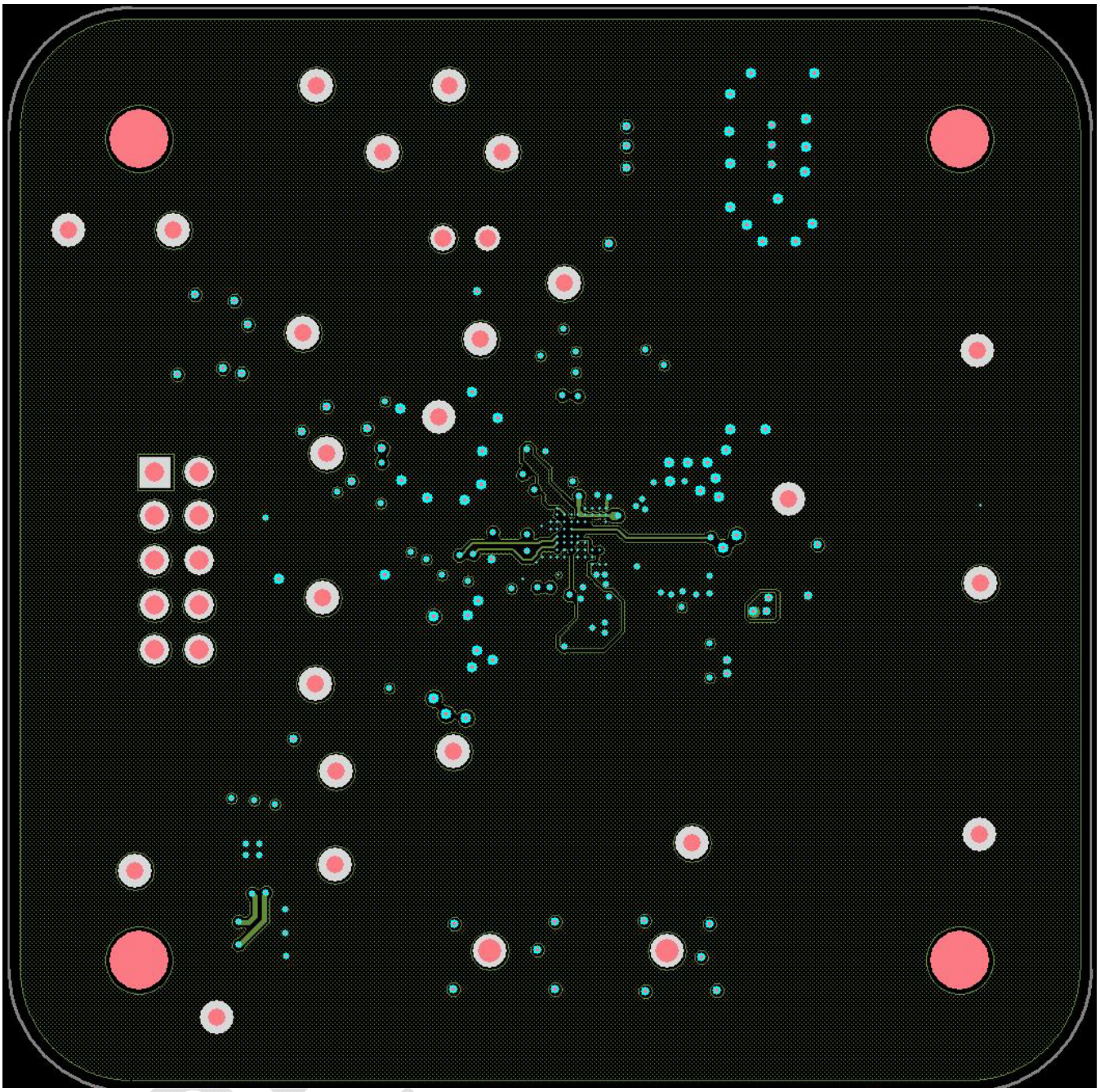


Figure 5. Mid 1 Layer

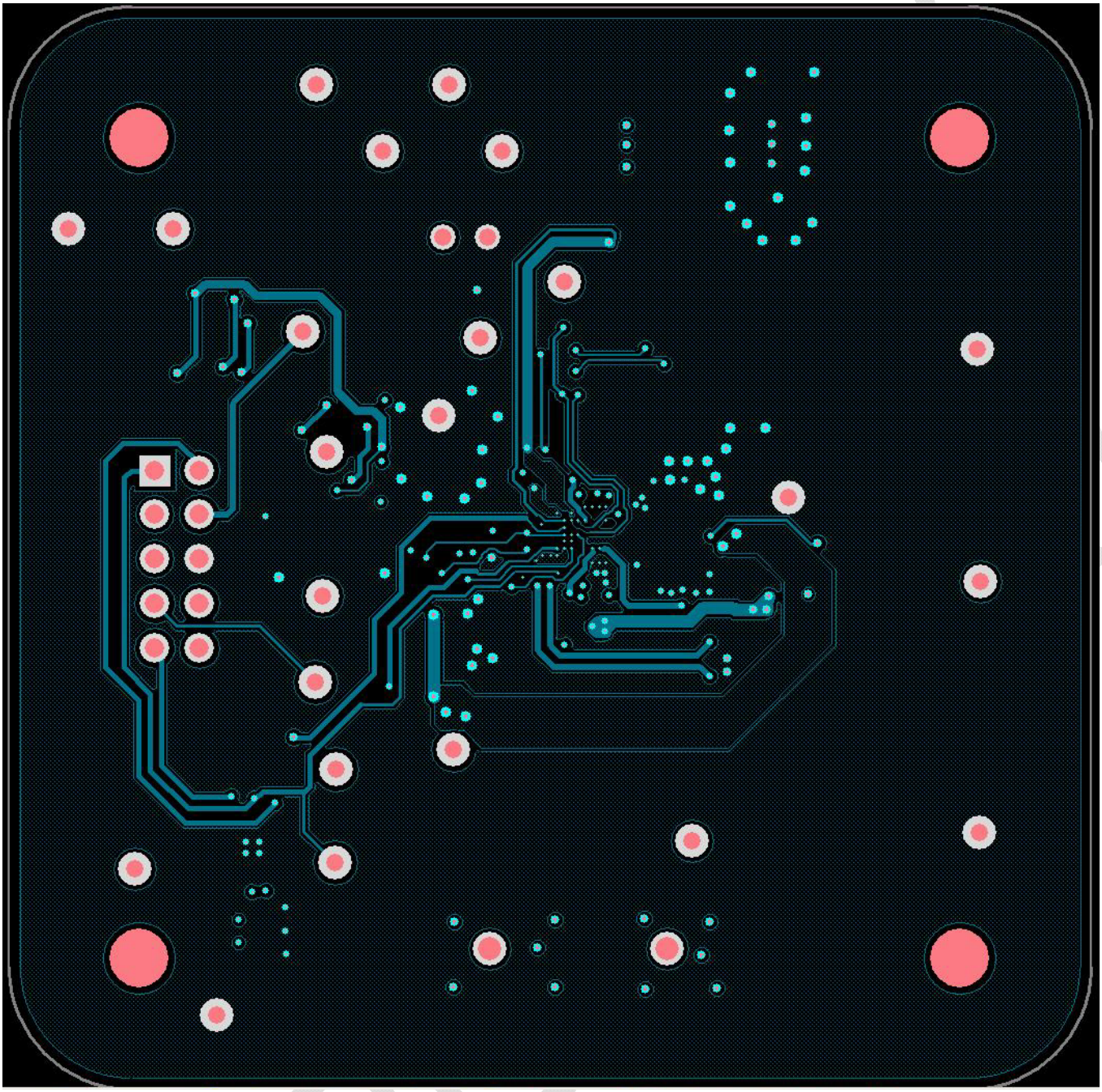


Figure 6. Mid 2 Layer

OPTIONAL WINDOWS GUI

The I²C USB adapter (JM60) is optional and the main purpose is to upload the IDTP9022 firmware into the EEPROM (U3). The I²C adapter may be used to interface the IDTP9022 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 IDTP9022 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).

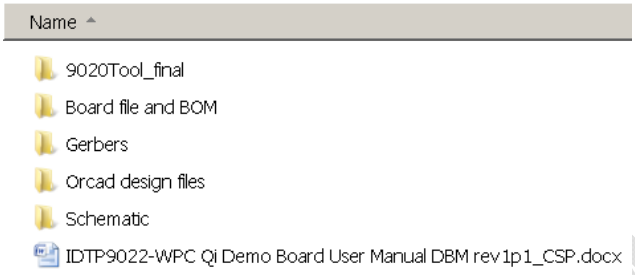


Figure 7. File folder structure on the CDROM.

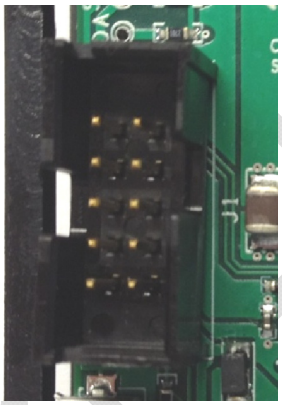


Figure 8. IDTP9022-EVAL JM60 Programmer input 10pin header.

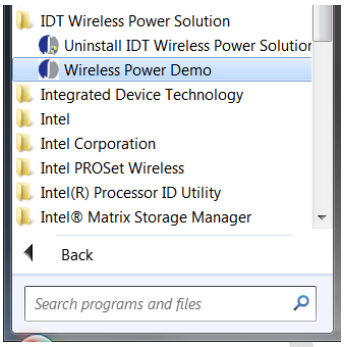


Figure 9. Starting the Graphical User Interface

Verifying Connectivity

You can verify that the IDTP9022 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.

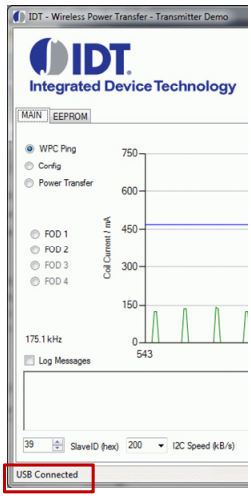


Figure 10. Windows GUI Main tab

OPTIONAL - Installing the Windows GUI

For the first time use of the IDTP9022-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. **The Waveforms and Notifications are Disabled in the IDTP9020 GUI, the GUI is only ised to read/write firmware into the EEPROM.**

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 IDTP9022-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.*

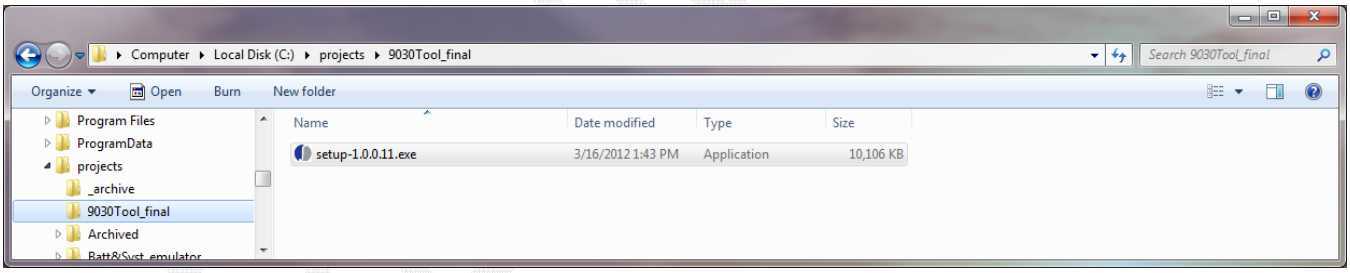


Figure 11. Path to driver setup.exe.

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 IDTP9022 upon power up. However, if a new version has been provided by the factory, for instance, the mrthod 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 IDTP9022 Demo board. Connect a 7.5V power supply to the REG_IN and GND test points on the IDTP9022 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.

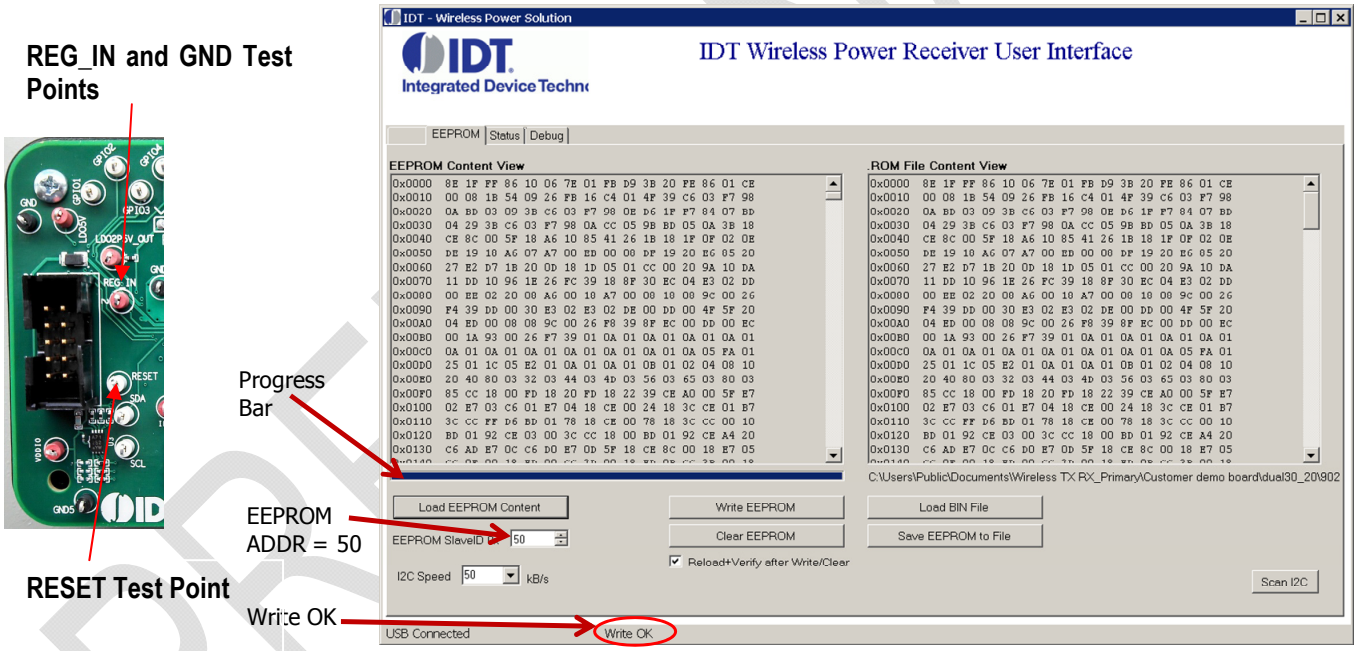
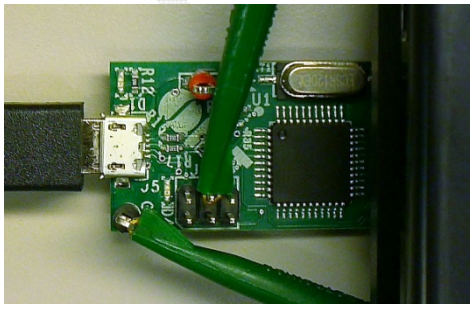


Figure 13. Connection for external supply connected to REC_OUT and location of the RESET Switch. The GUI screen after Loading a BIN File and Writing to the EEPROM.

Troubleshooting

The IDTP9022 demo board was designed to quickly show the performance of the IDTP9022. 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 I^2C 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.



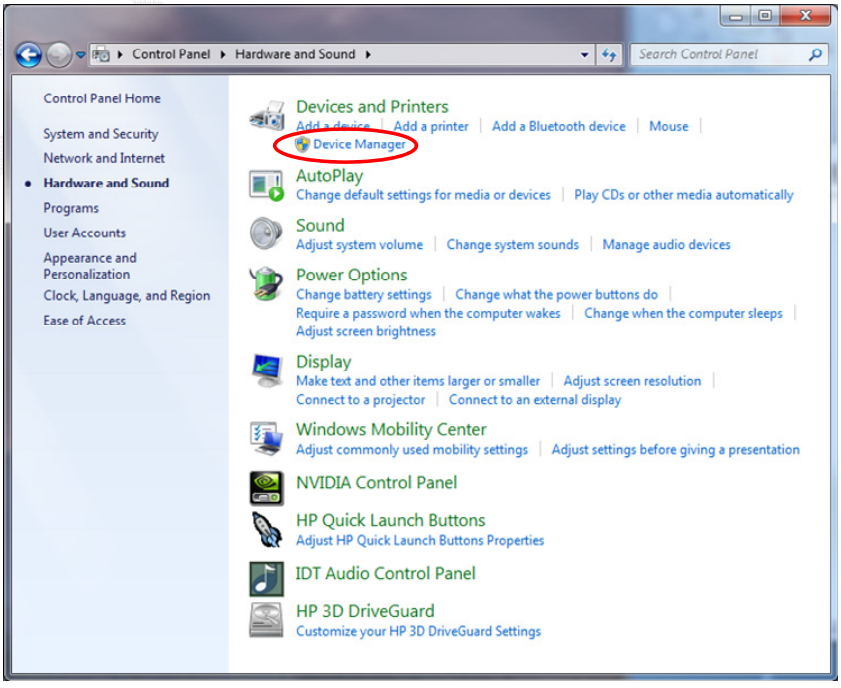


Figure 14. Resetting the JM60. *Checking the revision of the driver using Device Manager, shown is a Win7 PC.*

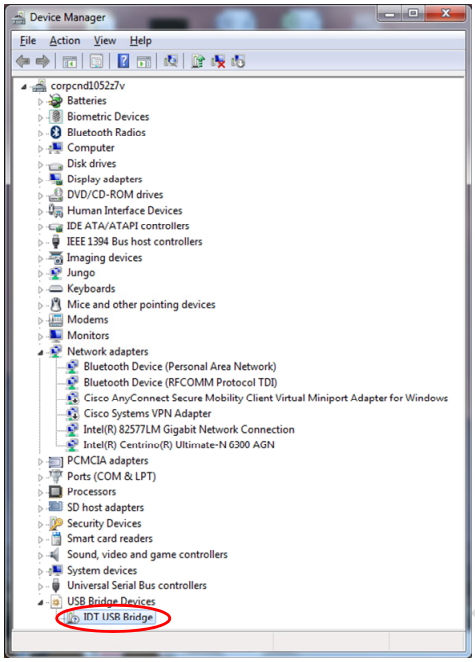


Figure 15. Checking the revision of the driver in Device Manager.

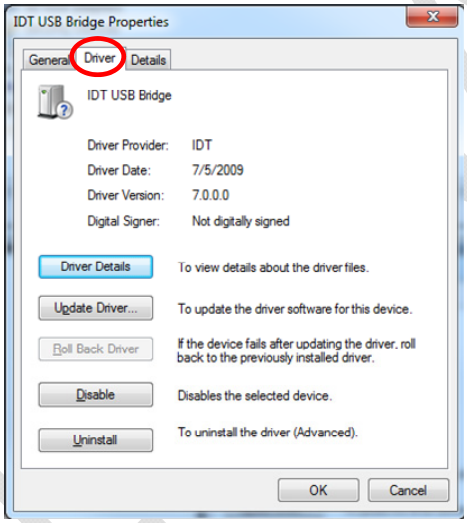


Figure 16. Checking that the revision of the driver is correct.

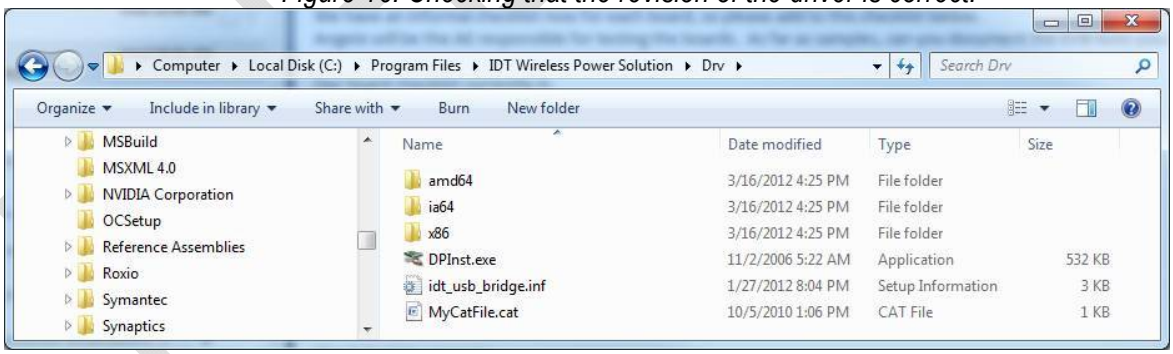


Figure 17. Installed Device Driver Directory.

ORDERING GUIDE

Table 2. Ordering Summary

PART NUMBER	MARKING	PRICE	AMBIENT TEMP. RANGE	SHIPPING CARRIER	QUANTITY
IDTP9022-EVAL	IDTP9022 CSP DEMO PCB V1.1	$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.

November 13, 2013 Version 1.3 – Update resonant capacitor values to 183nF total.

November 13, 2013 Version 1.4 – Update R6 and R89 positions.

February 10, 2014 Version 1.5 – Update C28 and C31 values.

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