EZ-PD CCG3
USB-C Power Delivery Manager Daughter Board

DESCRIPTION

Demonstration circuit 2654A features the EZ-PD™ CCG3 USB Type-C Port Controller IC designed by Cypress Semiconductor. This product is a daughter board meant to interface with some of Analog Devices' power product demonstration circuits in order to demonstrate their compatibility with the USB Type-C Power Delivery specification.

The default program for this board negotiates a USB Power Delivery profile and chooses the highest voltage advertised by the power adapter plugged into the board, then turns on the power switches to power the main PCB through the banana plugs for a low-impedance connection. Any required digital information is passed between boards through header J3.

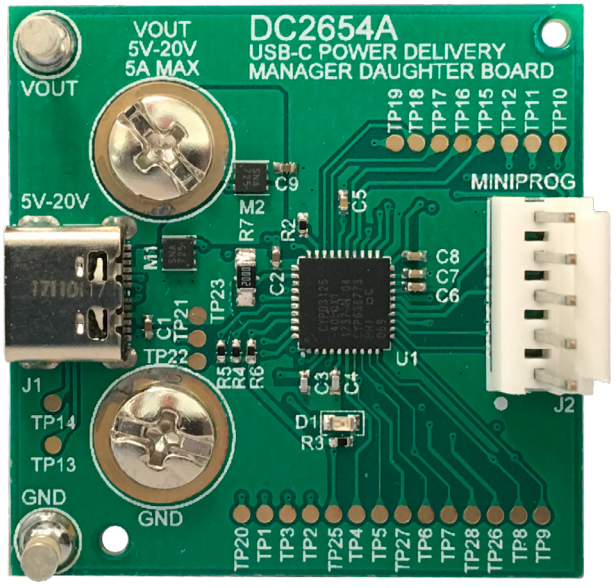
Design files for this circuit board are available.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	DC2654A Input Voltage Range		5		20	V
V_{OUT}	DC2654A Output Voltage Range		5		20	V
I_{OUT}	DC2654A Output Current				5	A

BOARD PHOTO



QUICK START PROCEDURE

Refer to Figure 1, Figure 2 and Figure 3 for the proper equipment setup. Follow the procedure below to familiarize yourself with the DC2654A.

STANDALONE PROCEDURE

1. Connect a voltmeter (VM1) across the V_{OUT} and GND turrets.
2. Plug your USB Type-C power adapter into J1 on the DC2654A.
3. Observe the voltage on VM1 go to 5V and then to the negotiated voltage (if there is one). The LED on the DC2654A will light as soon as power is delivered to the VM1 node.

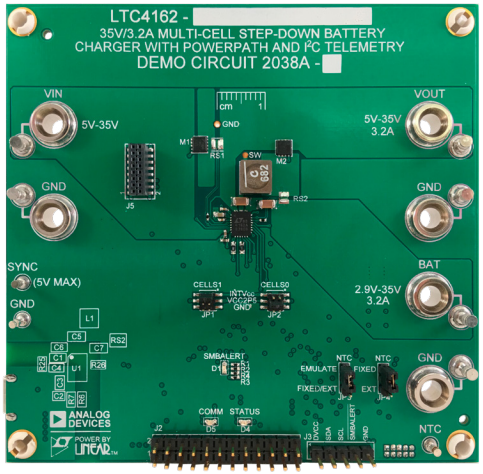


Figure 1. DC2038A is a Battery Charger Demo Board for the LTC4162 Designed to Interface with DC2654A.

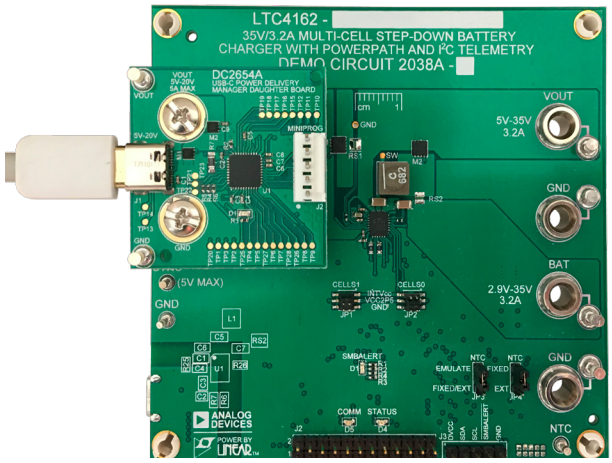


Figure 2. DC2654A Mounted Onto DC2038A

DEMO BOARD PROCEDURE

1. If the demo board is designed to interface with DC2654A, follow any instructions in that board's demo manual before continuing. If you need to program the DC2654A, refer to the Programming Instructions section in this manual.

   If the board is not designed to interface with DC2654A, you can continue, but be sure that the adapter used does not offer a higher profile than the board can withstand.
2. Connect a voltmeter (VM1) across the V_{OUT} and GND turrets. Connect DC2654A to the demo board under test.
4. Plug your USB Type-C power adapter into J1 on the DC2654A.
5. Observe the voltage on VM1 go to 5V and then to the negotiated voltage (if there is one). The LED on the DC2654A will light as soon as power is delivered to the VM1 node.

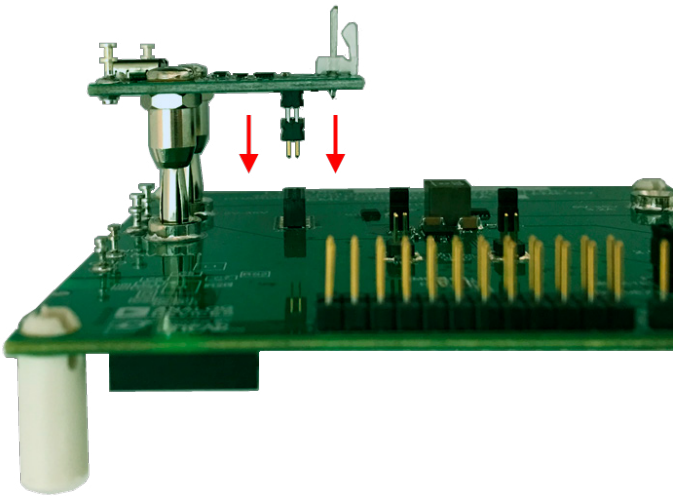


Figure 3. The Banana Plugs and Header on DC2654A Will Fit Snugly Into Compatible Demo Boards.

BOARD OPERATION

DEFAULT PROGRAM

The factory-default program on DC2654A is based on the CYPD3125-40LQXI_notebook example project that comes with the EZ-PD CCG3 SDK. The main differences are the addition of variable sink power profile and the operation of the on-board LED. The LED (D1) operates as shown in Table 1.

Table 1. LED (D1) Operation

LED STATE	BOARD STATUS
Off	Power Switches Off, Load Has No Power
On	Power Switches On, Load Has at Least 5V
Blinking	SMBAlert Is Asserted Low

SOURCE MOSFETs

Components M5, M6, R8, and R9 are left unpopulated by default, making DC2654A operate as a sink-only device. In order to operate as a source, these components can be purchased separately and installed to the relevant footprints. Table 2 shows the part numbers for these components.

Table 2. Part Number for Source Components

COMPONENT	MANUFACTURER	PART NUMBER
M5, M6	Toshiba	SSM6K513NU, LF
R8, R9	Any 10MΩ 0402 Resistor	

USE WITH CUSTOM DESIGNS

While in the early design phase, it may be helpful to simply use DC2654A as a simple breakout board for the EZ-PD CCG3. The banana plug outputs have an industry-standard spacing which can serve as an input to many boards with banana jacks. This may serve as a simple way to connect any board to a wall outlet using any USB-C adapter. This spacing as well as spacing for the header that mates with J3, can be copied from gerbers for any demo boards compatible with DC2654A (such as DC2038A).

PROGRAMMING INSTRUCTIONS

Software to interface with specific demo boards can be found on the DC2654A product page. Follow any instructions within those software downloads to program the DC2654A with application-specific firmware examples. The generic software, which just passes a USB-C adapter's highest available voltage to a sink, is also available from the DC2654A product page.

MiniProg3 PROGRAMMER/DEBUGGER

To program DC2654A, you will need a MiniProg3 Programmer/Debugger. This can be used for uploading a hex file as well as programming and debugging your own project. The MiniProg3 can be purchased through Cypress Semiconductor's website or third-party distributors. The 5-pin header on the MiniProg3 connects to J2 on DC2654A as shown below. The CCG3 can be reprogrammed in-circuit with or without USB power applied.

EZ-PD SOFTWARE DEVELOPMENT KIT

After acquiring a MiniProg3 debugger, download the EZ-PD SDK for CCG3. Be sure to consult the instructions in the firmware download for the demo board that you will be interfacing with to determine the version of the SDK that should be used.

Figure 4. MiniProg3 Connected to DC2654A for Programming and Debugging

PROGRAMMING INSTRUCTIONS

PSoC PROGRAMMER

The quickest way to upload an existing program to the DC2654A is to upload the HEX file using PSoC Programmer software from Cypress Semiconductor. The HEX file is included in the top-level directory of the DC2654A firmware package hosted on the product page of any compatible demo board. See Figure 5 for the proper programming configuration.

PSoC CREATOR

DC2654A source code can be also programmed and debugged using the PSoC Creator IDE. Firmware downloads include source code and a PSoC Creator project which can be easily uploaded to the DC2654A. From there, users can modify the code to fit their own requirements and program/debug as necessary.

To program DC2654A once a project has been downloaded, launch PSoC Creator and click the Program button (or Ctrl + F5). This will launch the Select Debug Target dialog as shown in Figure 6. Click the Port Setting button and verify that the settings match those shown in Figure 7.

Ensure that the computer is connected to the MiniProg3 and that the MiniProg3 is connected to the DC2654A. In the Select Debug Target dialog, click the Port Acquire button, and then the Connect button once acquired. Press OK to program the target board.

For further instructions, consult PSoC Creator documentation.

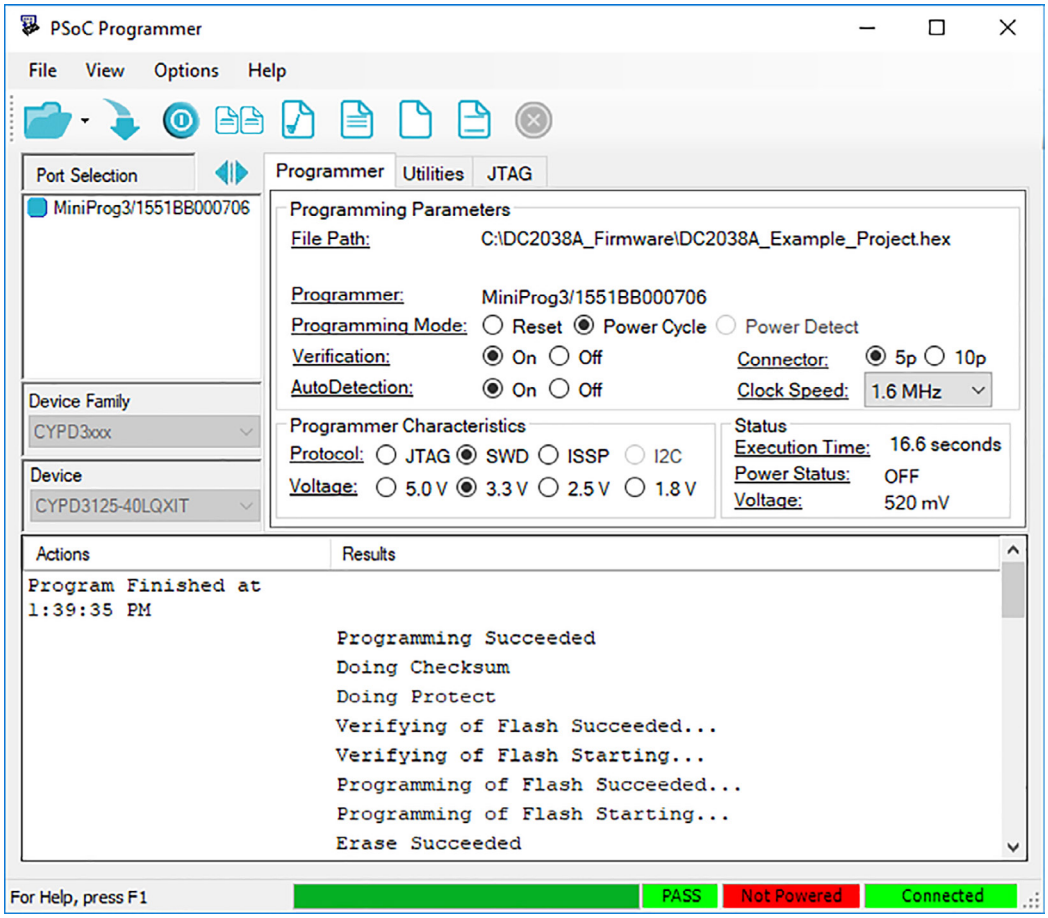


Figure 5. PSoC Programmer Settings

PROGRAMMING INSTRUCTIONS

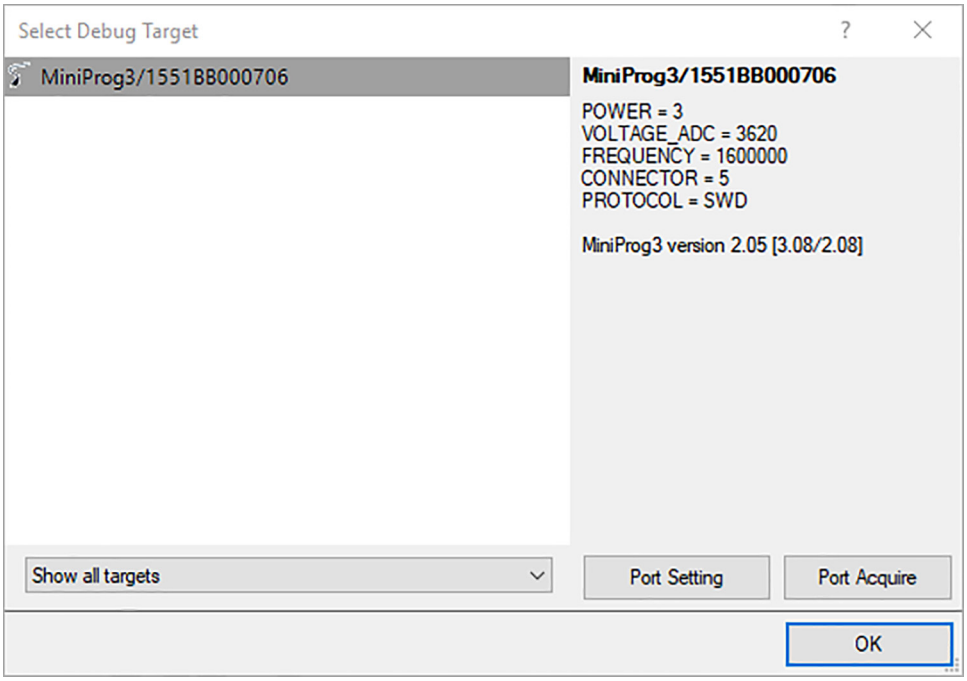


Figure 6. Select Debug Target Dialog

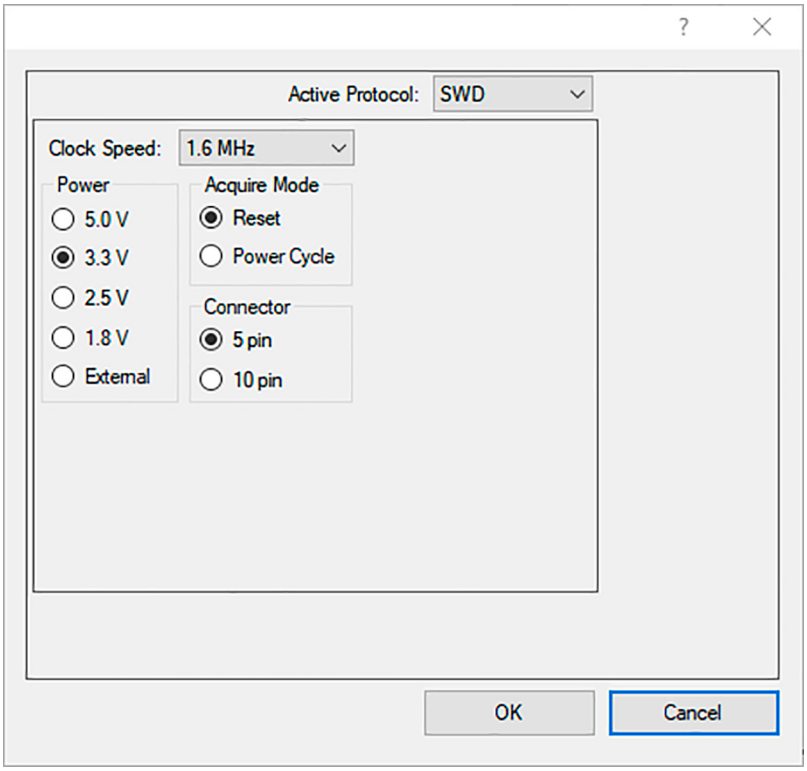


Figure 7. Port Setting Dialog

PROTOCOL ANALYZER

The CY4500 EZ-PD Protocol Analyzer from Cypress Semiconductor can be used to monitor the USB PD negotiation. This is useful for debugging and understanding the data that is being passed between the USB PD adapter and the board under test.

The adapter can be connected between the USB PD source providing power and the DC2654A as shown in Figure 8. The micro USB port is then connected to a computer to monitor the data through the supporting GUI from Cypress Semiconductor. Visit the CY4500 product page for more information.

Figure 9 shows the negotiation from a power supply offering 3 Power Data Objects (PDOs): 5V/3A, 9V/3A, and 12V/2.25A.

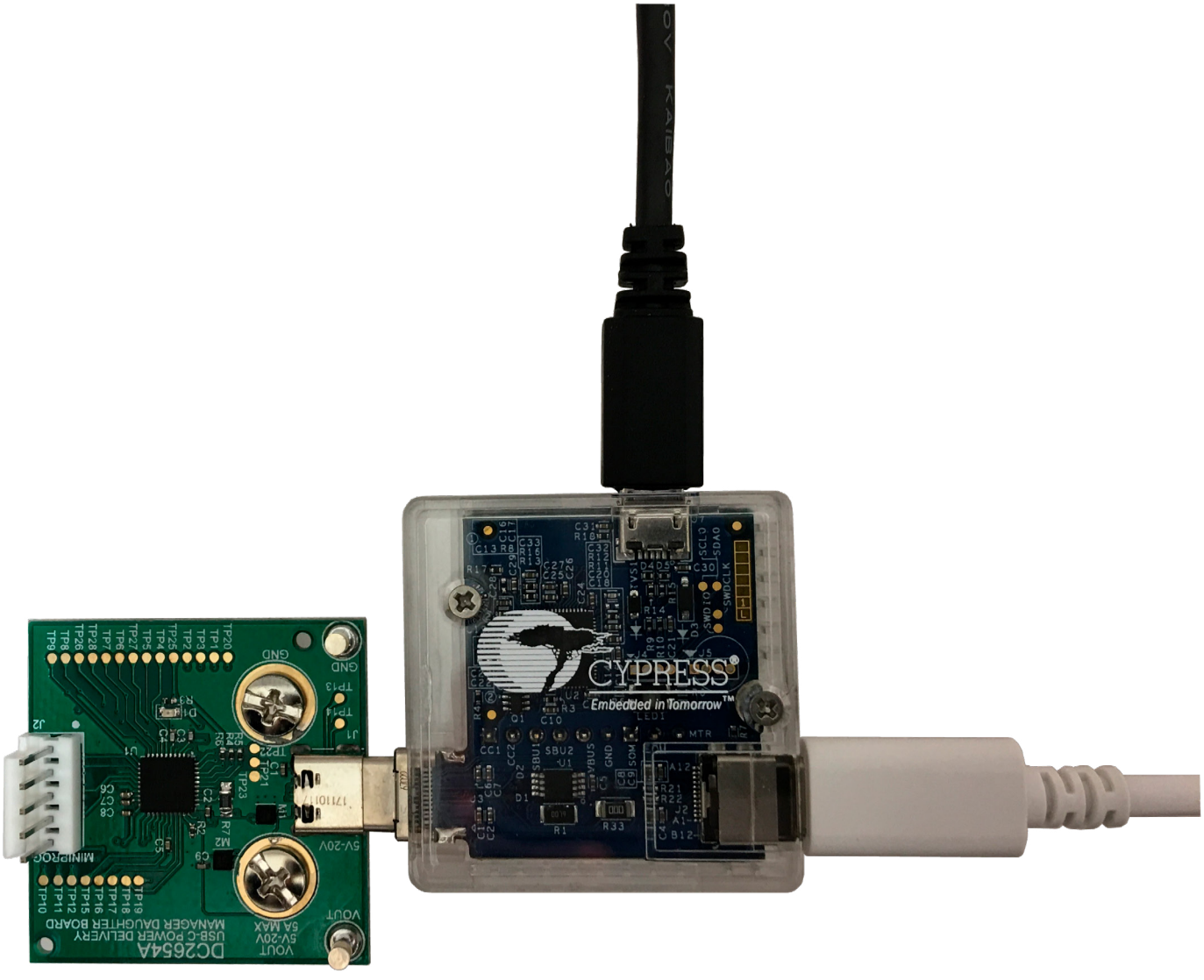


Figure 8. CY4500 EZ-PD Protocol Analyzer Connected Between the DC2654A and a USB PD Wall Adapter

PROTOCOL ANALYZER

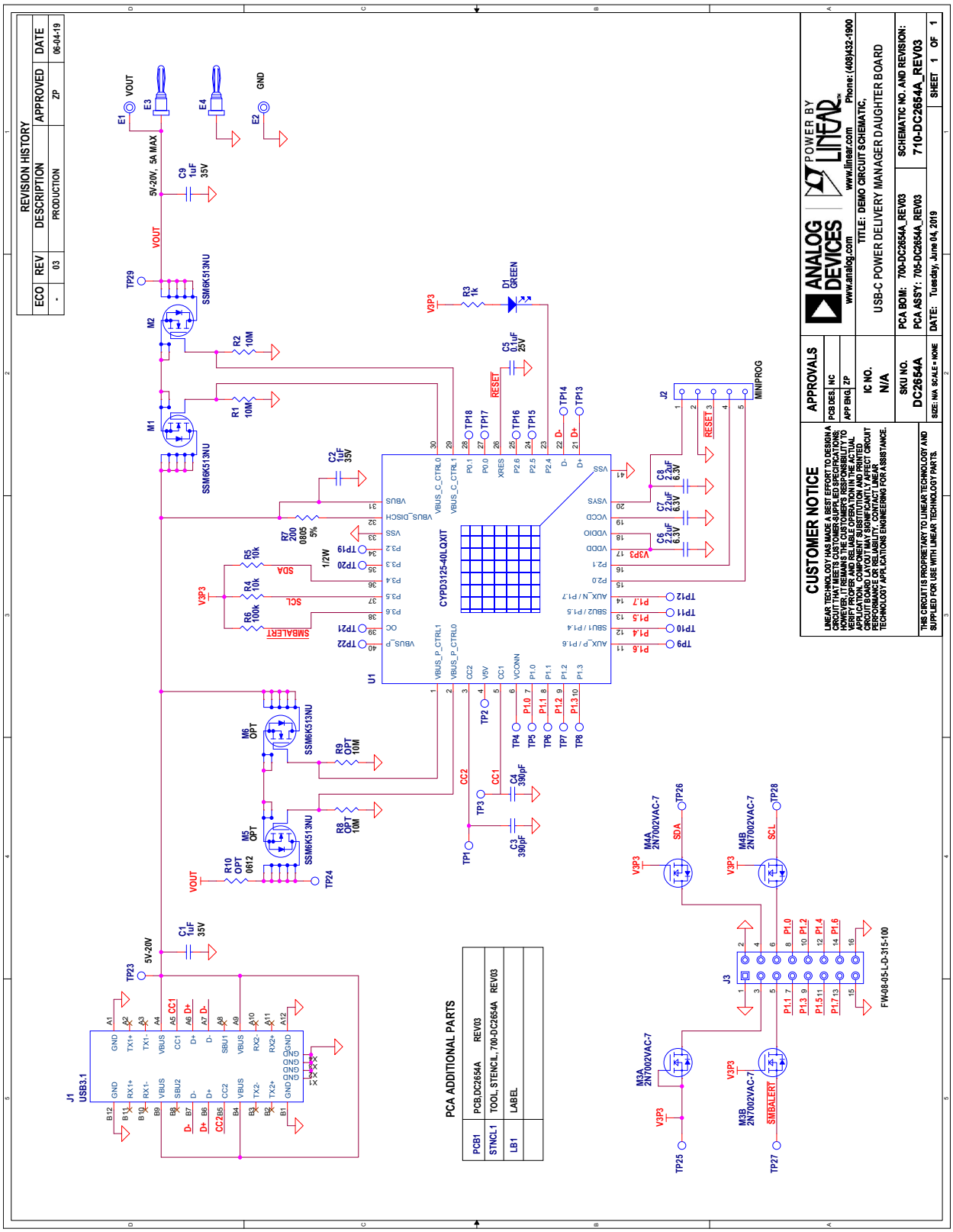
Description	Value
SOP Type	SOP
Header	**0x51A1**
Reserved (15)	0
Data Objs (14..12)	5
Message Id (11..9)	0
Port Power Role (8)	SOURCE (1)
Spec Rev (7..6)	Reserved(2)
Port Data Role (5)	DFP (1)
Reserved (4)	0
Msg Type (3..0)	Source Capabilities
Power Data Obj-Source 1	**0x801912C**
Type (31..30)	Fixed
Dual-Role Power (29)	No (0)
USB Suspend Supported (28)	No (0)
Externally Powered (27)	Yes (1)
USB Communications Capable (26)	No (0)
Data Role Swap (25)	No (0)
Reserved (24...22)	0
Peak Current (21...20)	IOC (default)
Volt in 50mV (19...10)	100(5V)
Max Current in 10mA (9...0)	300(3A)
Power Data Obj-Source 2	**0x2D12C**
Type (31..30)	Fixed
Dual-Role Power (29)	No (0)
USB Suspend Supported (28)	No (0)
Externally Powered (27)	No (0)
USB Communications Capable (26)	No (0)
Data Role Swap (25)	No (0)
Reserved (24...22)	0
Peak Current (21...20)	IOC (default)
Volt in 50mV (19...10)	180(9V)
Max Current in 10mA (9...0)	300(3A)
Power Data Obj-Source 3	**0x3C0E1**
Type (31..30)	Fixed
Dual-Role Power (29)	No (0)
USB Suspend Supported (28)	No (0)
Externally Powered (27)	No (0)
USB Communications Capable (26)	No (0)
Data Role Swap (25)	No (0)
Reserved (24...22)	0
Peak Current (21...20)	IOC (default)
Volt in 50mV (19...10)	240(12V)
Max Current in 10mA (9...0)	225(2.25A)
Power Data Obj-Source 4	**0xC076213C**
Power Data Obj-Source 5	**0xC8DC213C**

Figure 9. Decoded Data from the Protocol Analyzer GUI Showing the Power Data Objects (PDOs) Offered

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	3	C1, C2, C9	CAP., 1µF, X5R, 35V, 10%, 0402	MURATA, GRM155R6YA105KE11D
2	2	C3, C4	CAP., 390pF, COG, 50V, 5%, 0402	AVX, 04025A391JAT2A
3	1	C5	CAP., 0.1µF, X7R, 25V, 10%, 0402	AVX, 04023C104KAT2A
4	3	C6-C8	CAP., 2.2µF, X5R, 6.3V, 10%, 0402	AVX, 04026D225KAT2A
5	1	D1	LED,GREEN, WATER CLEAR, 0603	LITE-ON, LTST-C190KGKT
6	2	M1, M2	XSTR., MOSFET N-CH, 30V, 15A, UDFN-B EP	TOSHIBA, SSM6K513NU,LF
7	2	M3, M4	XSTR., MOSFET, DUAL N-CH, 0.28A, SOT-563	DIODES INC., 2N7002VAC-7
8	2	R1, R2	RES., 10MΩ, 5%, 1/16W ,0402	VISHAY, CRCW040210M0JNED
9	1	R3	RES., 1k, 1%, 1/16W, 0402, AEC-Q200	VISHAY, CRCW04021K00FKED
10	2	R4, R5	RES., 10k, 1%, 1/16W, 0402	SAMSUNG, RC1005F103CS
11	1	R6	RES., 100k, 1%, 1/10W, 0402, AEC-Q200	KOA SPEER, RK73H1ETTP1003F
12	1	R7	RES.,200Ω, 5%, 1/2W, 0805, AEC-Q200	PANASONIC, ERJP06J201V
13	1	U1	IC, USB TYPE-C PORT CONTROLLER, 40-PIN QFN	CYPRESS, CYPD3125-40LQXIT
Hardware				
1	2	E1, E2	TEST POINT, TURRET, 0.094" MTG. HOLE, PCB 0.062" THICK	MILL-MAX, 2501-2-00-80-00-00-07-0
2	2	E3, E4	CONN., PLUG BANANA, MALE,INTERNAL THREAD	KEYSTONE, 6072
3	1	J1	CONN., USB 3.1, RCPT, 24POS, 0.5mm, SMD RA	MOLEX, 1054500101
4	1	J2	CONN., HEADER, MALE PIN, 5 POS, 2.54mm, ST THT	TE CONNECTIVITY, 640456-5
5	1	J3	CONN., HEADER, MALE, 16 POS, 1.27mm, VERT TALL	SAMTEC, FW-08-05-L-D-315-100

SCHEMATIC DIAGRAM



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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