SN75DP130 EVM User's Manual

High Performance Analog / Interface Group

ABSTRACT

The SN75DP130 is a single port Dual-Mode DisplayPort (DP++) repeater that regenerates the DP high speed digital link. The device complies with the VESA Embedded DisplayPort Standard Version 1.2 supporting up to four lanes of 5.4 Gbps (HBR2) and DP++ dual-mode TMDS signaling for full HDMI 1.4a data rate support.

The device compensates for PCB related frequency loss and switching related loss to provide the optimum DP electrical performance from source to sink. The Main Link signal inputs feature configurable equalizers with selectable boost settings. At the Main Link output, four primary levels of differential output voltage swing (V_{OD}) and four primary levels of pre-emphasis are available, as well as a secondary level of boost adjustment, programmed through I^2C, for fine-tuning the Main Link output. The device can monitor the AUX channel and automatically adjust the output signaling levels and input equalizers in response to Link Training commands. Additionally, the SN75DP130 output signal conditioning and EQ parameters are fully programmable through the I^2C interface.

The SN75DP130 offers separate AUX and DDC source ports and an AUX sink port. This minimizes component count when implemented with a graphics processor (GPU) comprising separate DDC and AUX interfaces. For GPUs with combined DDC/AUX, the device can operate as a FET switch to short circuit the AUX channel AC coupling caps while connected to a TMDS sink device. Other sideband circuits such as Hot Plug Detect (HPD) are optimized to reduce external components, providing a seamless connection to Intel, AMD, and NVIDIA graphics processors.

The SN75DP130 is optimized for mobile applications, and contains activity detection circuitry on the Main Link input that transitions to a low-power Output Disable mode in the absence of a valid input signal. Other low power modes are supported, including a Standby mode with typical dissipation of ~2mW when no video sink (eg. monitor) is connected.

The device is characterized for an extended operational temperature range from 0ºC to 85ºC.

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Introduction

The SN75DP130 is a high-speed one-to-one redriver for Display Port signals. This guide describes the construction and usage of the EVM for the SN75DP130. The EVM is meant to serve as an evaluation tool for the SN75DP130, as well as a reference design for the device.

SN75DP130 Evaluation Module Configuration

SN75DP130 EVM Kit Contents

This EVM kit should contain the following items:

- SN75DP130 EVM board
- DC Power Supply
- This user's manual

Description of EVM Board

The SN75DP130 EVM is designed to provide easy evaluation of the SN75DP130 device. It is also meant to serve as a reference design to show a practical example of how to use the device in a mass-production system.

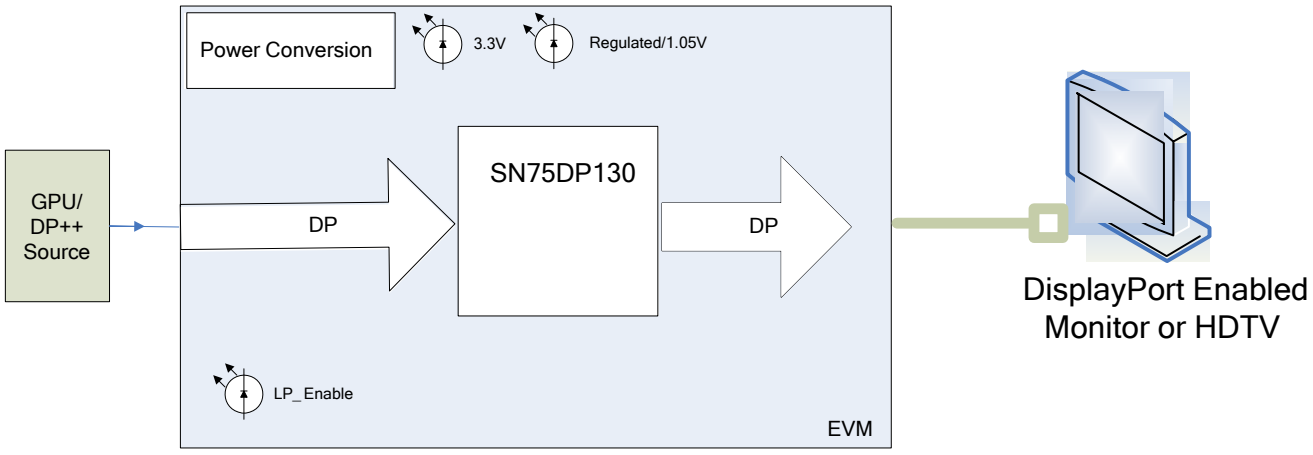

Figure 1. SN75DP130 EVM Block Diagram

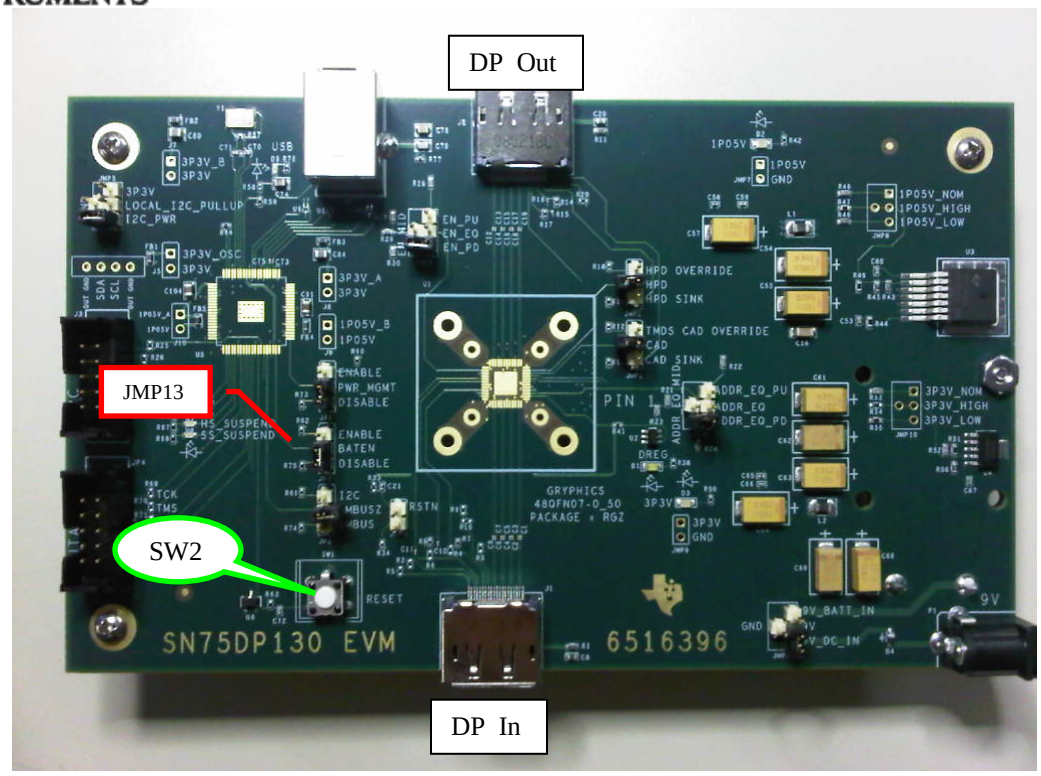

Figure 2. SN75DP130 EVM Switch and Jumper Location (Top)

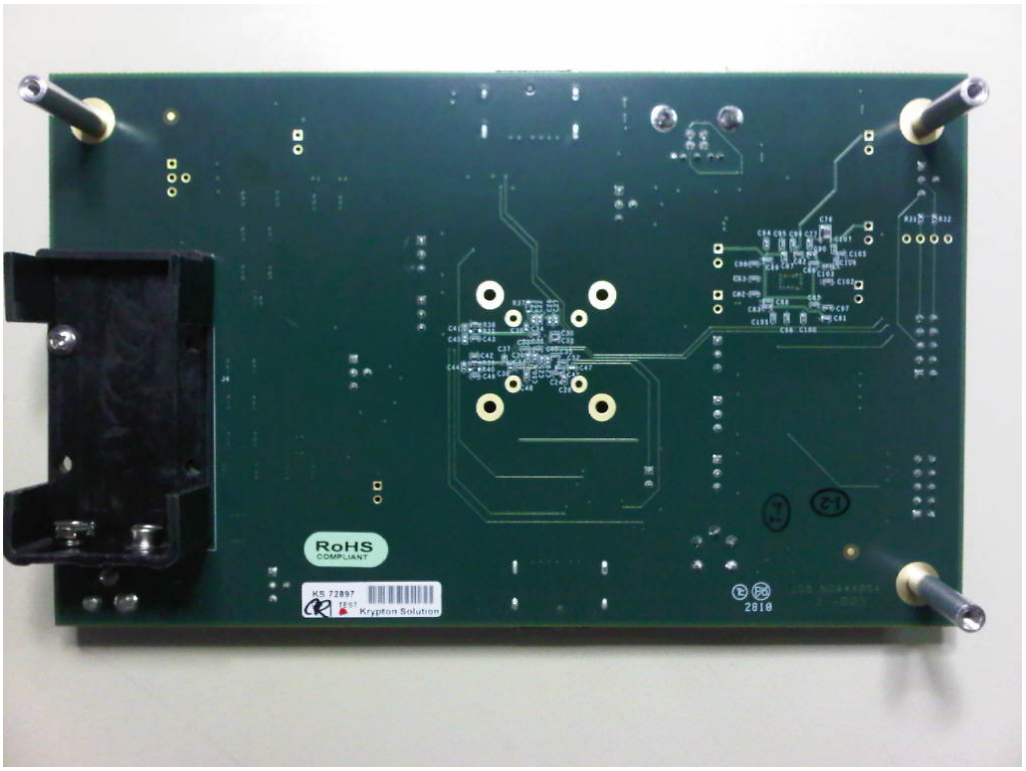

Figure 3. SN75DP130 EVM Switch and Jumper Location (Botom)

Jumper Number/ Switch	Functionality	Selection
JMP1	CAD Sink Over Ride (the CAD pin input from the sink is independently pulled high by a 2k pullup to allow the DP130 EVM to be in TMDS mode independent of the sink)	Normal CAD operation = JMP1:2-3 Over ride CAD = JMP1:2-1
JMP2	HPD Sink Over Ride (the HPD pin input from the sink is independently pulled high by a 2k pullup to allow the DP130 EVM to provide an indication of the sink presence)	Normal HPD operation = JMP2:2-3 Over ride HPD = JMP2:2-1
JMP3	Allows for the three settings of either Equalization (in GPIO	
JMP4 (not installed)	Aux channel pullup voltage (5 or 3.3V)	
JMP7 (not installed)	Allows for easy connect to the 5V rail for monitoring	
JMP8 (not installed)	Allows for easy connect to the 3.3V rail for monitoring	
JMP9	Allows for selection of EVM power from the wall or 9V battery Normal position would be "Wall" to "VIN"	
JMP10	HPD Override for port A (Only used to override or create an HPD)	
JMP11	HPD Override for port B (Only used to override or create an HPD)	
JMP12	CAD Override for port A (Only used to change CAD from 0 to 1)	
JMP13	CAD Override for port B (Only used to change CAD from 0 to 1)	
SW1	Priority Control (DP Out A/B)	
SW2	Low Power mode control (LP/Normal)	
SW3	Vdd* Voltage selection (Some EVM's will have this voltage fixed)	

s

Table 1. Jumper and Switch Functionality

The power supply provided with this EVM is a +5V DC power supply. Any ac-to-dc converter can be used as long as it has a 2.5mm plug with the positive terminal in the center. The output voltage of the power supply should be within the range of +2.5V to +10V (JMP9 = VIN_WALL).

For portability, a battery holder is also provided for use with a 9V battery (JMP9 = BATT_IN).

PCB Construction

This section discusses the construction of the EVM boards. It includes the board schematics and Gerber files to show how the board was built.

SN75DP130 EVM Board Layout

This EVM was designed to show the implementation of this device on a 6-layer board.

The pin assignments of the input ports of the SN75DP130 device are optimized for the PCB mount DP connector. This allows easy routing of the input traces without the need for vias. The output port of the SN75DP130 device is optimized for a direct connection to a TMDS receiver. On this EVM the output port is routed to a DP connector. In this case the pin assignment for the connector is exactly opposite of the device. Every effort was made to keep the routing as clean as possible to the DP connectors.

The board was designed to maintain 100 Ω differential impedance between each of the TMDS differential traces. For the material used in this design (FR4 – TurboClad 370), and with the stackup (shown below) this required the differential traces to be 12mil wide with an 11mil air gap between differential pairs. A minimum spacing of 3 times the trace width was maintained to all other components to prevent coupling.

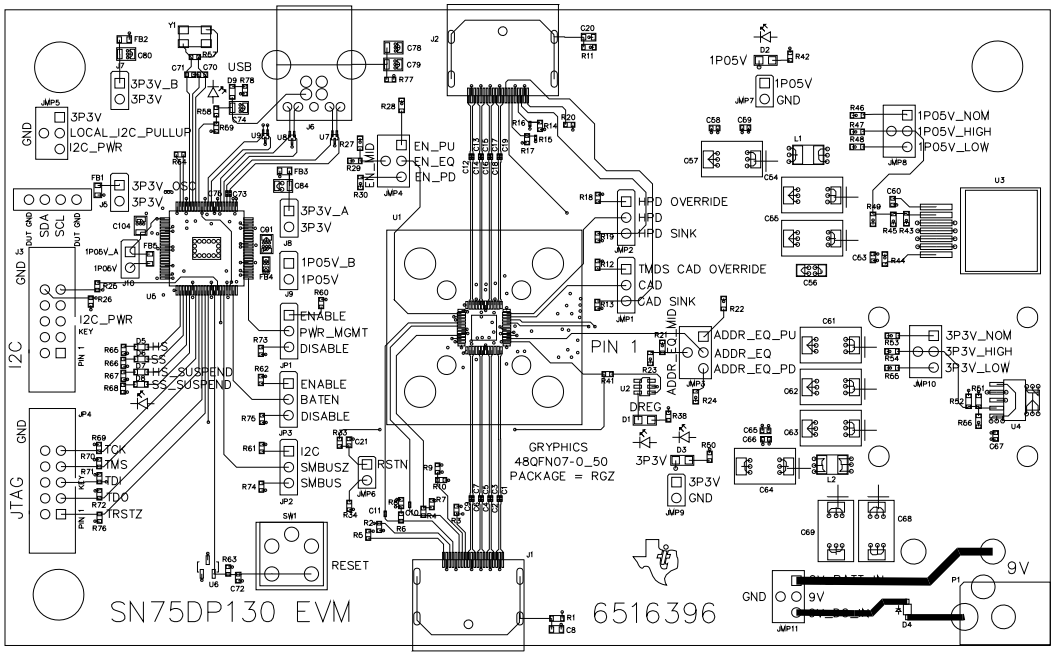

Figure 4. SN75DP130 EVM Top Layer 1

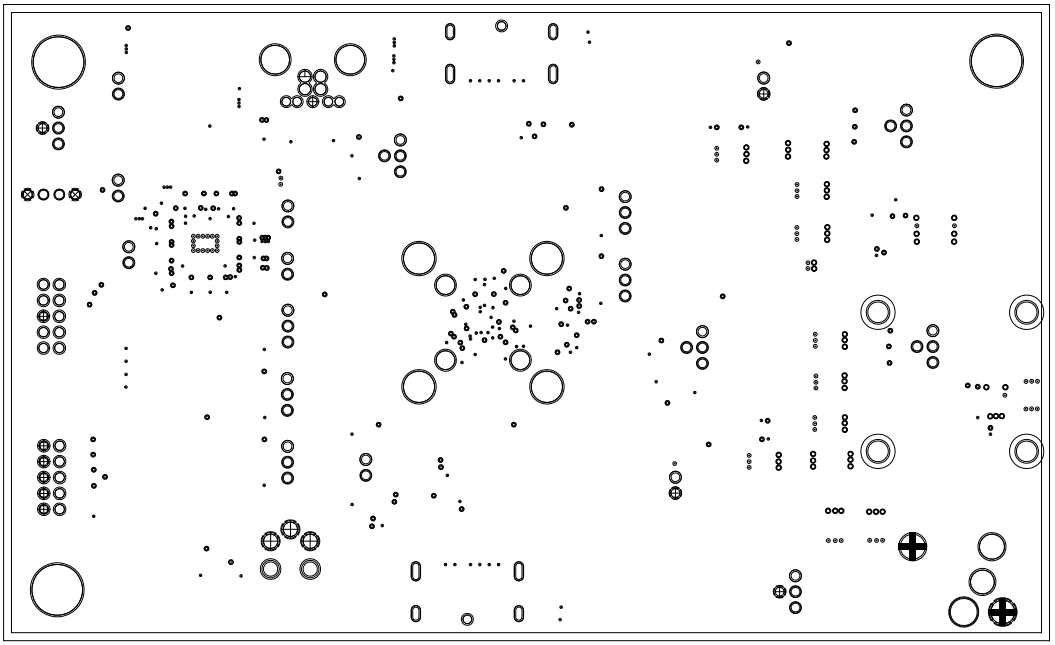

Figure 5. SN75DP130 EVM Ground Layer 2

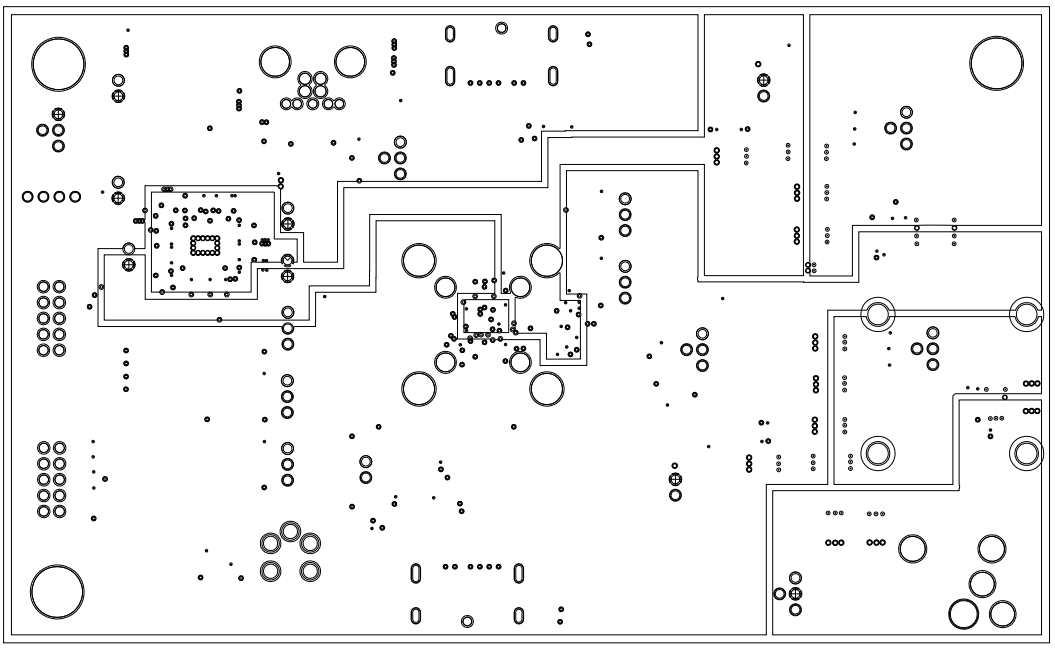

Figure 6. SN75DP130 EVM Power Layer 3

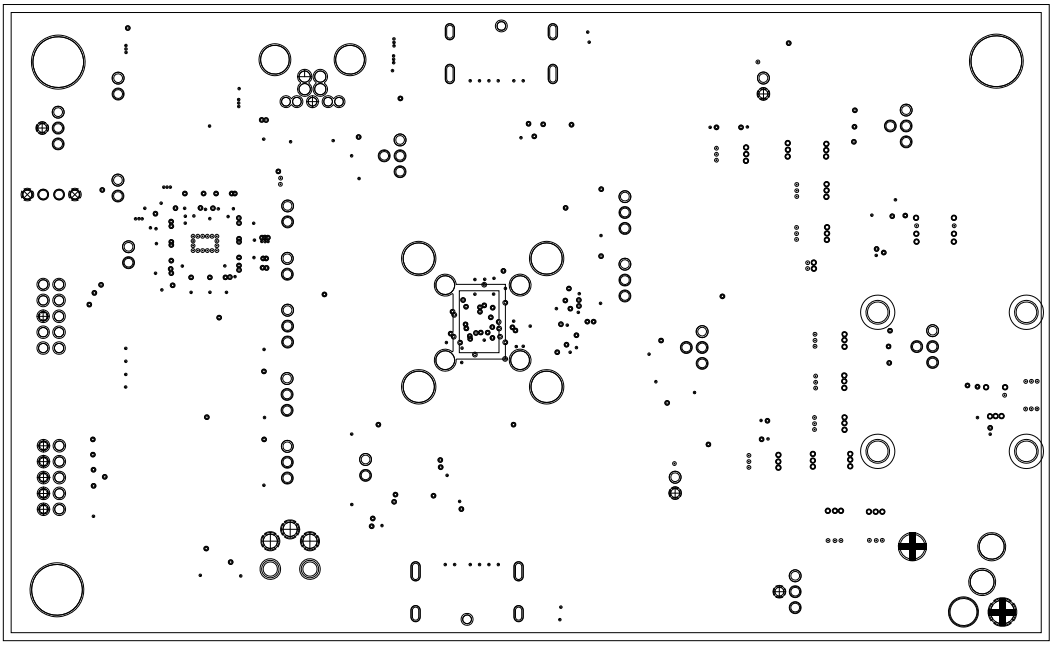

Figure 7. SN75DP130 EVM Power Layer 4

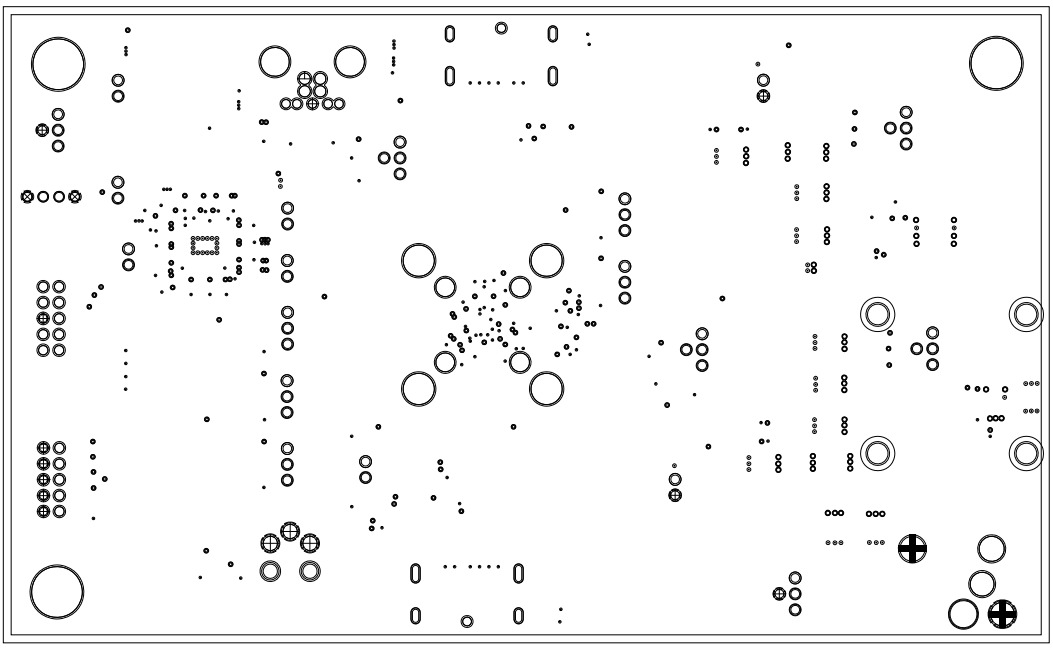

Figure 8. SN75DP130 EVM Ground Layer 5

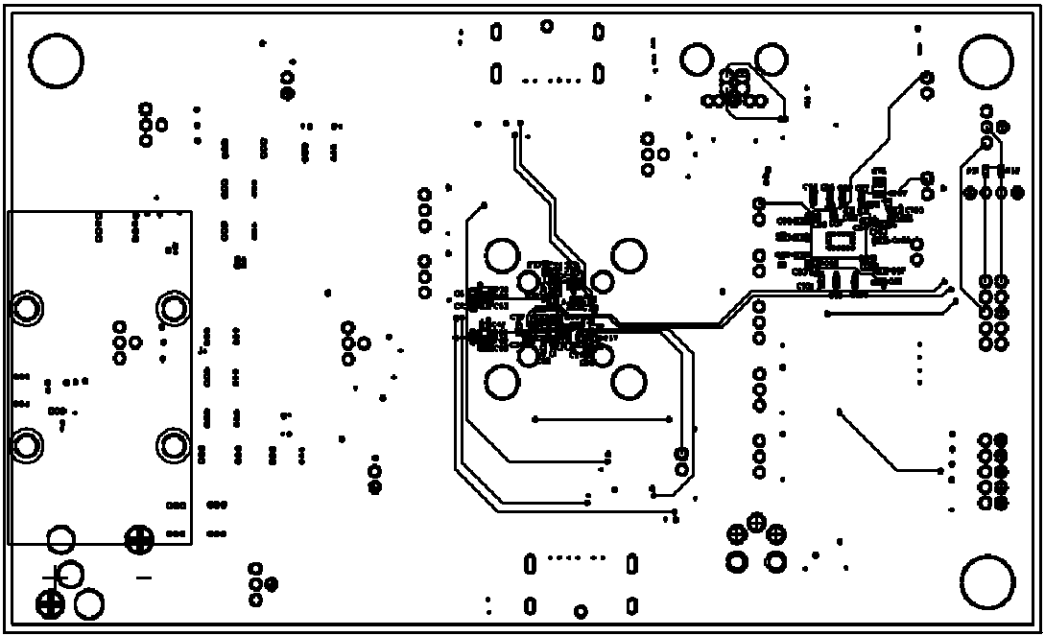

Figure 9. SN75DP130 EVM Bottom Layer 6 (Mirrored)

SN75DP130 EVM Board Construction

The EVM board is a 6-layer board constructed of FR4 – TurboClad 370 material. The board stackup consists of a signal layer on top, a ground layer, a power layer, power, ground, and a Signal layer on bottom.

Figure 10. EVM Layer Stack-up

SN75DP130 EVM Material Listing

The complete Bill of Material for the EVM is listed in Appendix A.

SN75DP130 EVM Board Schematics

The board schematic sheets for the EVM are shown at the end of this document.

Appendix A – Bill of Materials

The following table is the complete BOM for the EVM.

Item	Quantity	Reference	Value
1	16	C1,C2,C3,C4,C5,C6,C7,C8,C10,C11,C12, C13,C14,C15,C16,C17	0.1uF
2	2	C9,C18	0.01uF
3	3	C19,C31,C33	0.1uf
4	2	C20,C22	220u
5	1	C21	DNI
6	1	C23	22u
7	2	C24,C27	0.01u
8	1	C25	10u
9	1	C26	0.1u
10	6	C28,C29,C34,C35,C36,C37	0.01uF
11	2	C30,C32	1.0uf
12	2	D1,D3	LED
13	1	D2	40V 1A
14	5	JMP1,JMP2,JMP5,JMP6,JMP7	Header 2x1
15	3	JMP3,JMP4,JMP8	Header 3x1
16	1	JMP9	Header 2x1 DNI
17	1	JMP10	DNI
18	1	J1	Display_Port_Connector_Sink
19	1	J2	Display_Port_Connector_Source
20	1	J3	Battery Holder 9V
21	1	L1	HI1206N101R-00
22	1	P1	RAPC722
23	2	R1,R9	1M
24	7	R2,R4,R6,R7,R15,R21,R22	100k_DNI
25	2	R3,R12	0_DNI
26	1	R5	27k_DNI
27	1	R8	5M_DNI
28	2	R10,R11	1M_DNI
29	4	R13,R14,R19,R20	4.7k
30	1	R16	1M
31	1	R17	450
32	1	R18	100k
33	1	R23	250
34	1	R24	23.2k
35	2	R25,R26	150k
36	1	R27	DNI
37	1	R28	64.9k
38	1	R29	13k
39	1	U1	SN75DP130
40	1	U2	REG104-3.3

Table 2. DP130 EVM Bill of Materials

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/ kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

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Mailing Address: Texas Instruments Post Office Box 655303 Dallas, Texas 75265

REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this is strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). 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.

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.

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Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan!

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

(1) Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or

(3) Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product.

Also, please do not transfer this product, unless you give the same notice above to the transferee.

Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjukku-ku, Tokyo, Japan

http://www.tij.co.jp

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西新宿三井ビル
http://www.tij.co.jp

EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.

2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.

3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.

4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60^{o}C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

REVISIONS		
ECR	ECR NUMBER	DATE
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NOTES:

1. SILKSCREEN ALL JUMPERS AND HEADERS.
2. PLACE ALL PARTS ON A 0 OR 90 DEGREE ORIENTATION.
3. HIGH SPEED SERIAL DATA SHOULD BE ROUTED AS SINGLE-ENDED 50 OHM TRANSMISSION LINES. ROUTING DISTANCE SHOULD BE 3 INCHES OR LESS.
4. USE FR4-370 MATERIAL.
5. PLACE TI LOGO IN TOP SIDE METAL

DP130 DATA SHEET REVISION: 0.98
DATA SHEET LAST UPDATED ON: 03/30/10

ENGINEER	K SHAW
DATE	05/08/10
LAYOUT	Steve Gregory
DATE	05/09/10
RELEASED	
DATE	

TEXAS INSTRUMENTS

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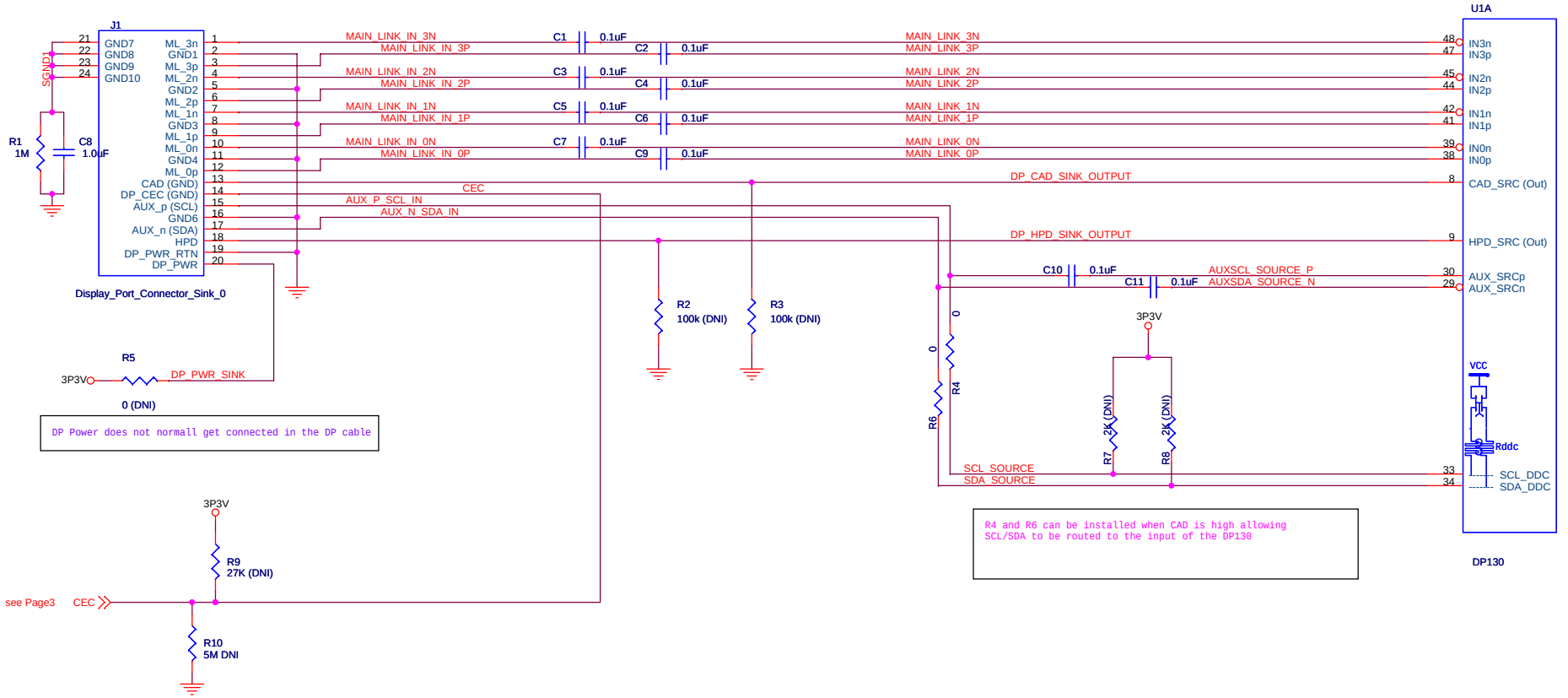

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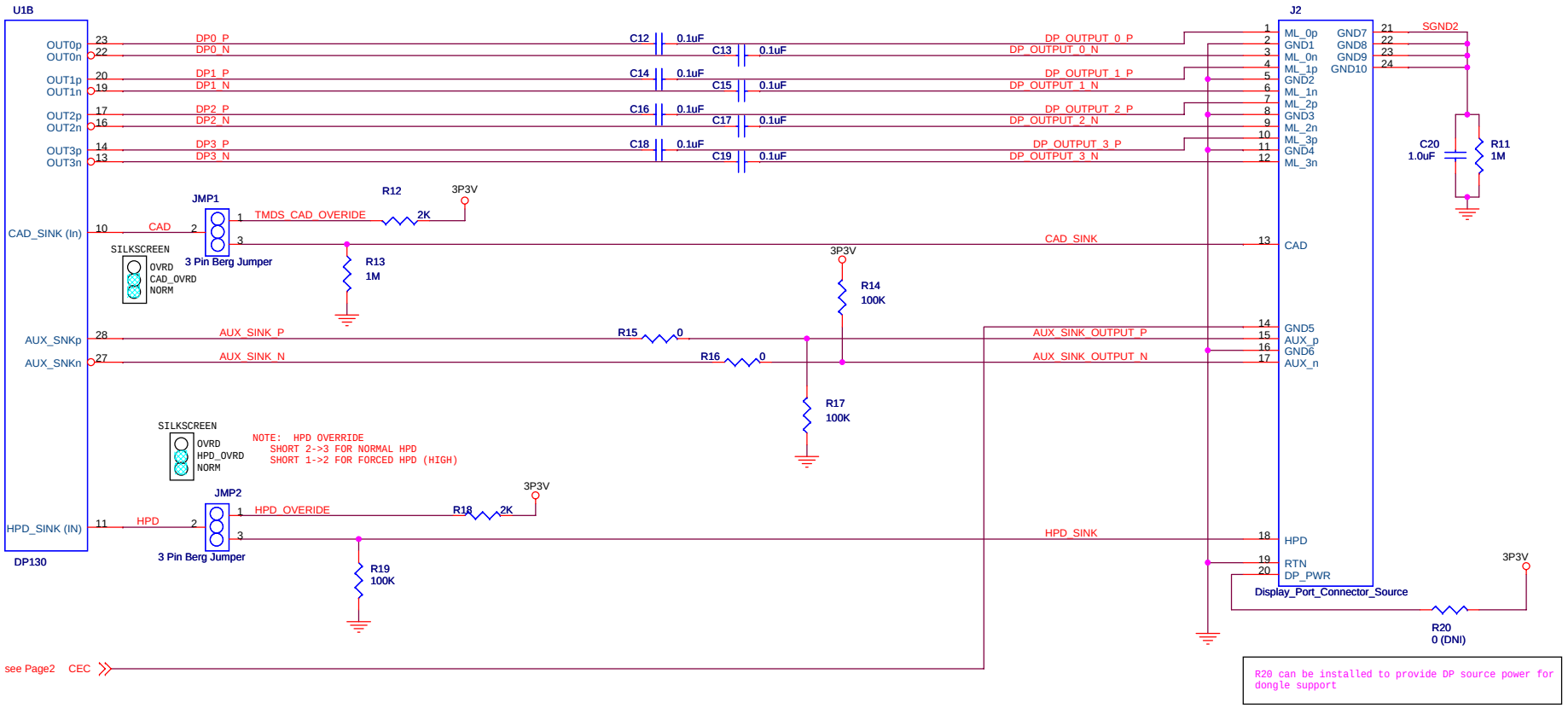

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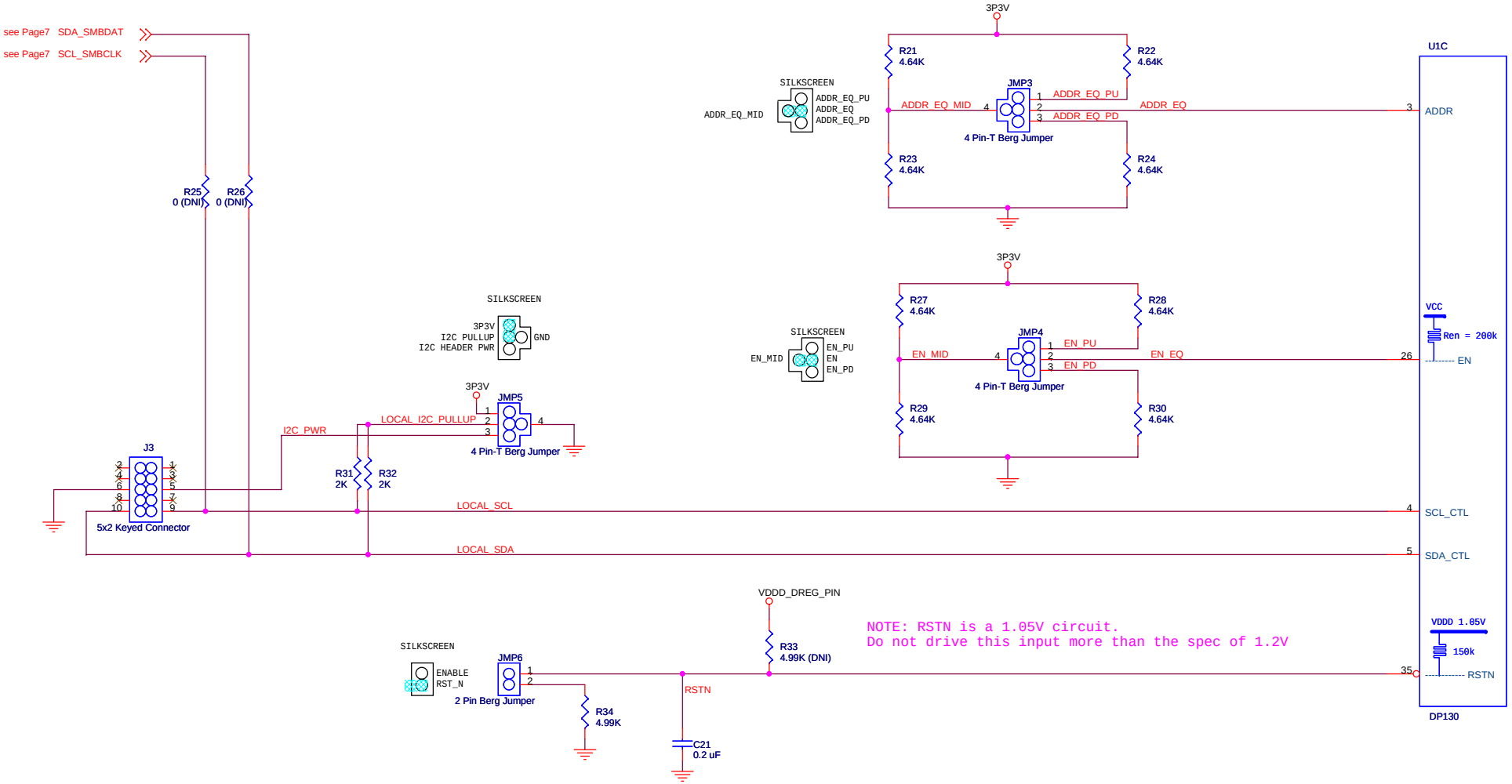

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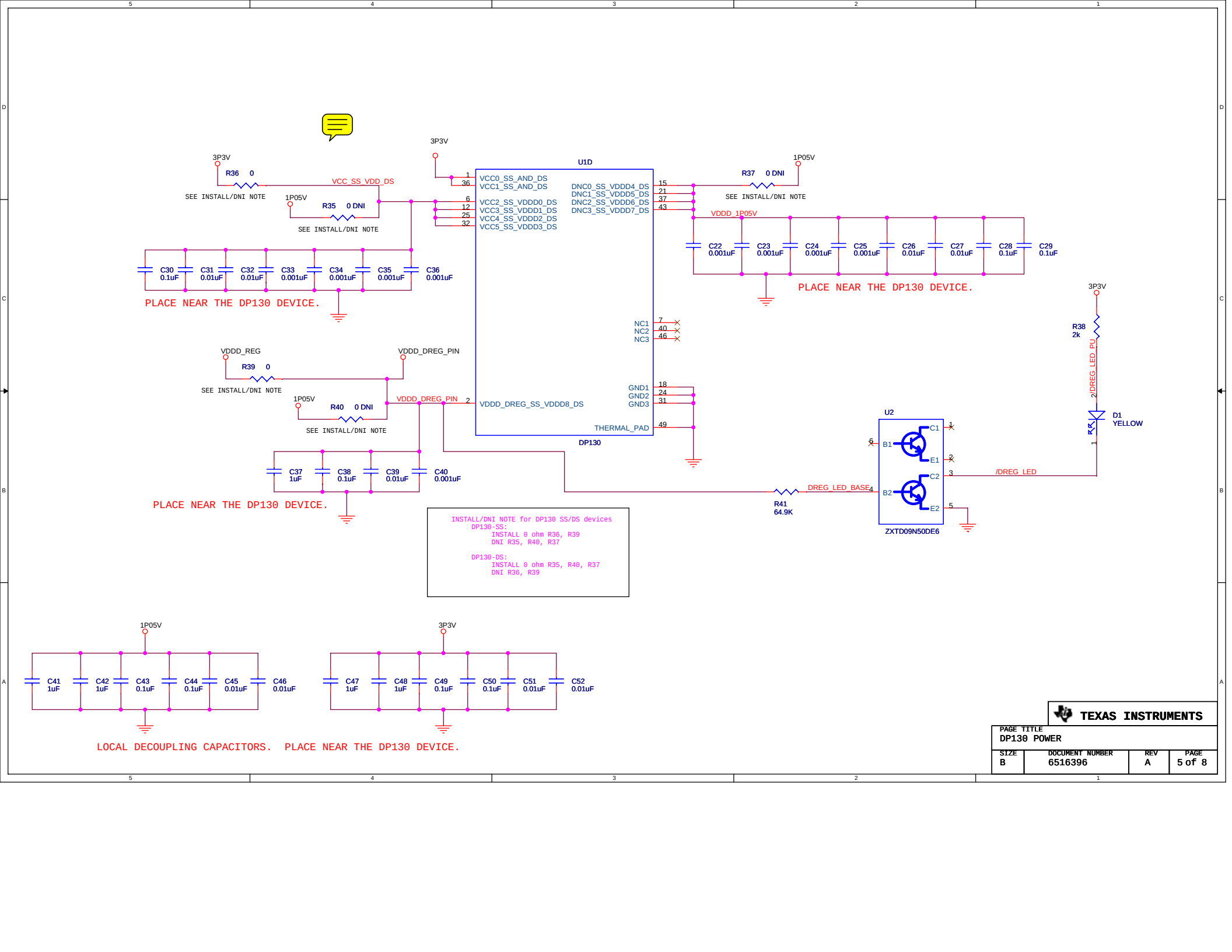
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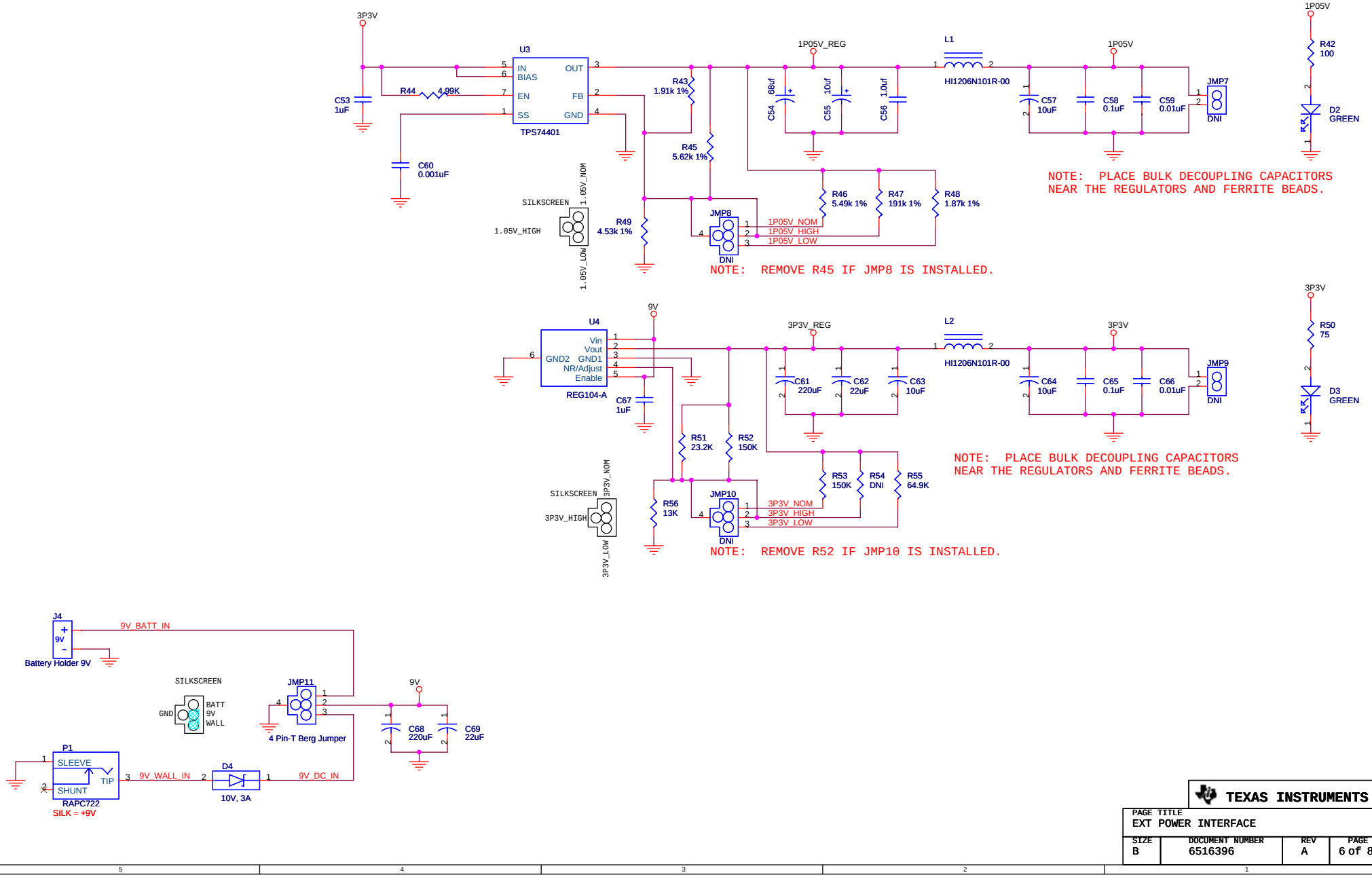
SEE INSTALL/DNI NOTE
VCC_SS_VDD_DS
1P05V
R35 0 DNI
SEE INSTALL/DNI NOTE
C30 0.1uF
C31 0.01uF
C32 0.01uF
C33 0.001uF
C34 0.001uF
C35 0.001uF
C36 0.001uF
PLACE NEAR THE DP130 DEVICE.
U1D
VCC0_SS_AND_DS
VCC1_SS_AND_DS
VCC2_SS_VDDD0_DS
VCC3_SS_VDDD1_DS
VCC4_SS_VDDD2_DS
VCC5_SS_VDDD3_DS
DNC0_SS_VDDD4_DS
DNC1_SS_VDDD5_DS
DNC2_SS_VDDD6_DS
DNC3_SS_VDDD7_DS
NC1
NC2
NC3
GND1
GND2
GND3
THERMAL_PAD
VDDD_DREG_SS_VDDD8_DS
DP130
R37 0 DNI
SEE INSTALL/DNI NOTE
VDDD_1P05V
C22 0.001uF
C23 0.001uF
C24 0.001uF
C25 0.001uF
C26 0.01uF
C27 0.01uF
C28 0.1uF
C29 0.1uF
PLACE NEAR THE DP130 DEVICE.
VDDD_REG
R39 0
SEE INSTALL/DNI NOTE
VDDD_DREG_PIN
R40 0 DNI
SEE INSTALL/DNI NOTE
C37 1uF
C38 0.1uF
C39 0.01uF
C40 0.001uF
PLACE NEAR THE DP130 DEVICE.
R41 64.9K
DREG_LED_BASE
U2
B1
E1
C1
B2
E2
C2
ZXTD09N50DE6
/DREG_LED
R38 2k
/DREG_LED_PU
D1 YELLOW
INSTALL/DNI NOTE for DP130 SS/DS devices
DP130-SS:
INSTALL 0 ohm R36, R39
DNI R35, R40, R37
DP130-DS:
INSTALL 0 ohm R35, R40, R37
DNI R36, R39
C41 1uF
C42 1uF
C43 0.1uF
C44 0.1uF
C45 0.01uF
C46 0.01uF
C47 1uF
C48 1uF
C49 0.1uF
C50 0.1uF
C51 0.01uF
C52 0.01uF
LOCAL DECOUPLING CAPACITORS. PLACE NEAR THE DP130 DEVICE.
TEXAS INSTRUMENTS
PAGE TITLE
DP130 POWER
SIZE
B
DOCUMENT NUMBER
6516396
REV
A
PAGE
5 of 8



TEXAS INSTRUMENTS

PAGE TITLE			
EXT POWER INTERFACE			
SIZE	DOCUMENT NUMBER	REV	PAGE
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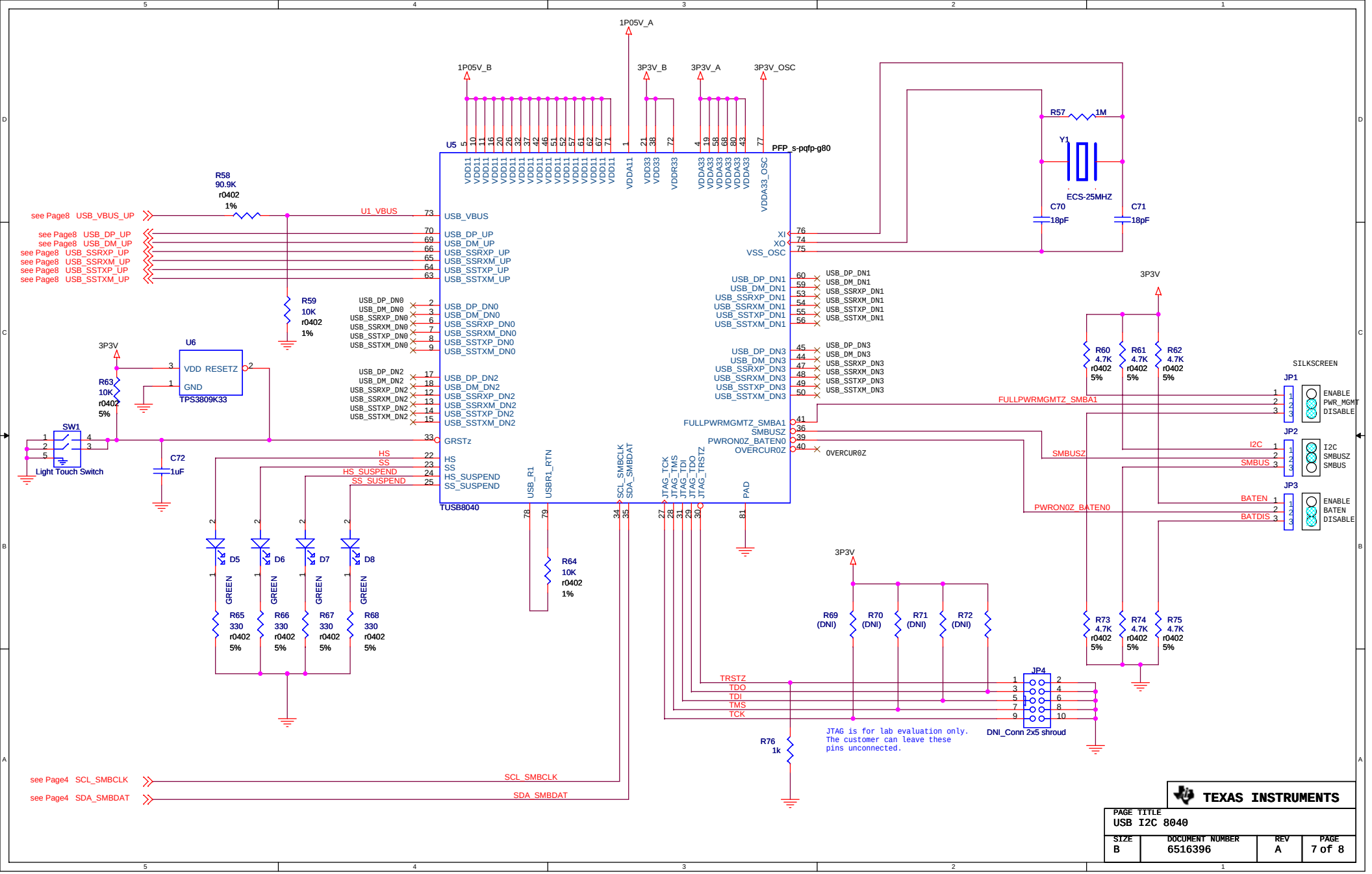

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USB I2C 8040			
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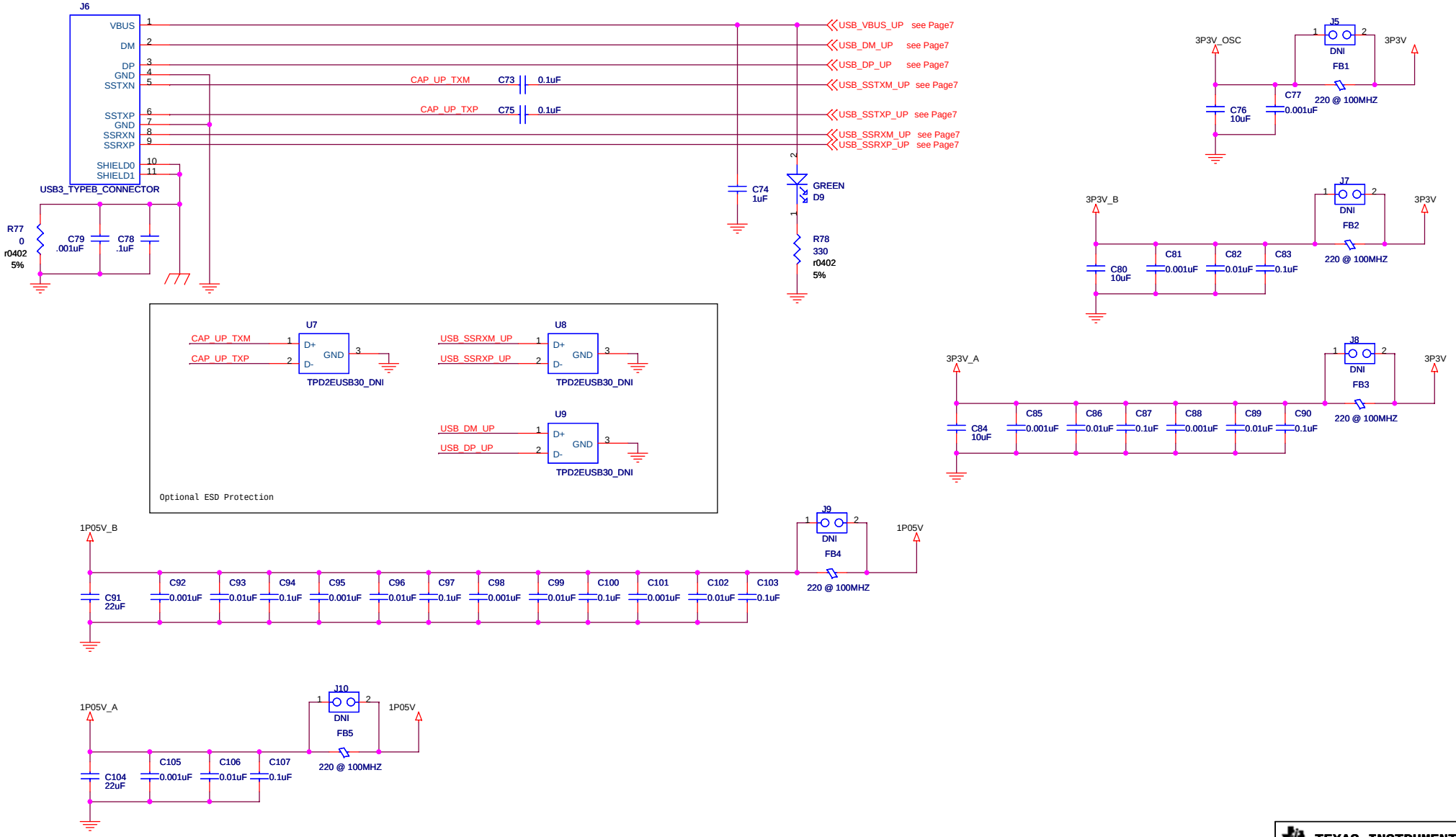

TEXAS INSTRUMENTS

PAGE TITLE			
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