User's Manual

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# V850E2/Px4 Application Board

## User's Manual: Hardware

RENESAS MCU
V850 P Series

AB-050-PX4 Rev.: 1.0



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# Table of Contents

# 1. Introduction

The AB-050-Px4 is designed as a simple and easy to use Starter Board to support users with the first steps when starting with the V850E2/Px4.

The Starter Board is prepared to hold a V850E2/Px4 device (uPD70350x),

With the Nexus Debug interface and the Flash Programming interface for the Renesas PG-FP5 Flash Programmer the standard Renesas programming interfaces are directly available.

To enable further application development the board features drivers for 2 high speed CAN interfaces, 3 RS-232 interfaces, 3 LIN bus interfaces and 2 FlexRay interfaces.

With on-board voltage regulator and reset generator a simple external DC power supply is sufficient to operate the board.

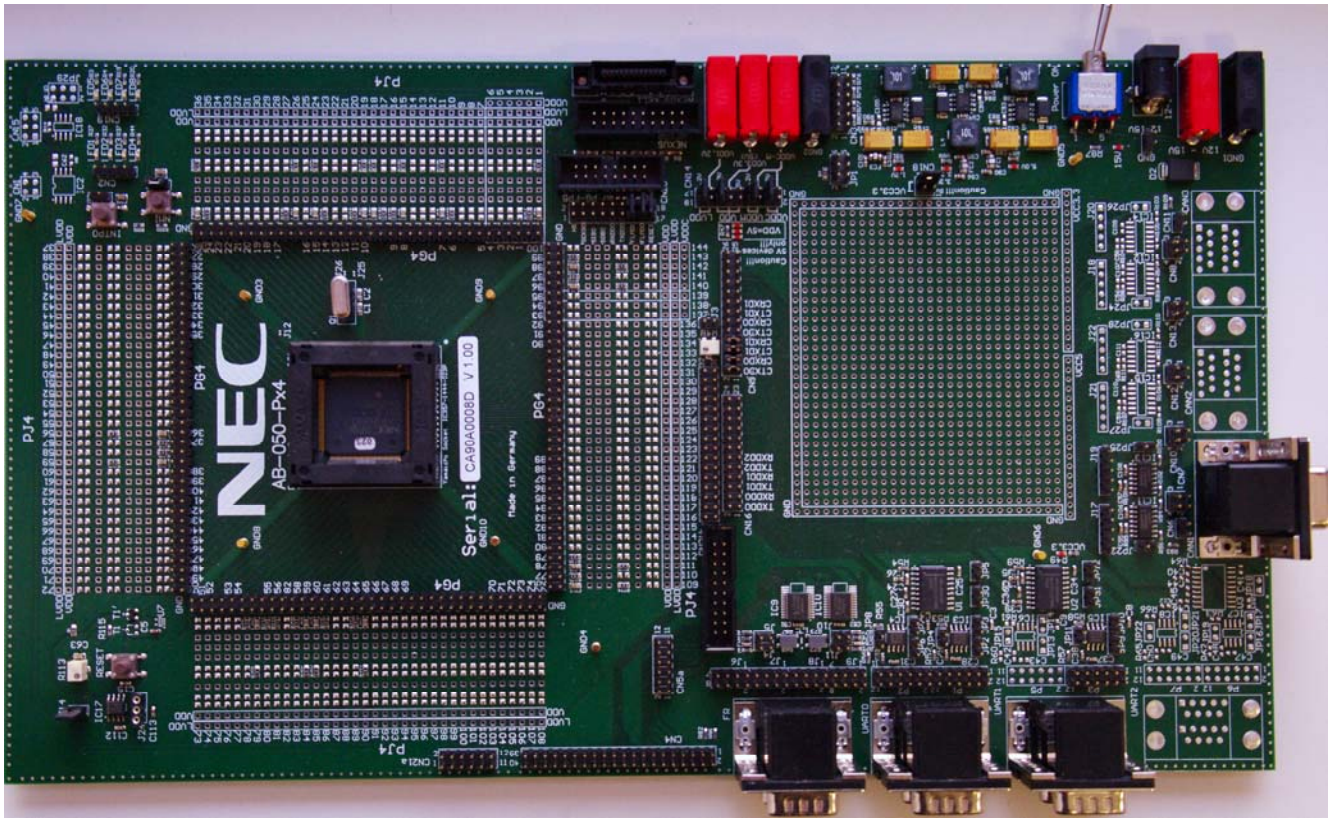


***Figure 1. AB-050-Px4***

# 2. Board description

## 2.1 Overview

Basically the board is divided into two areas, an ‘Electrical Area’ and a ‘Functional Area’.

In Figure 2 the Electrical Area is marked yellow and the Functional Area is marked blue.

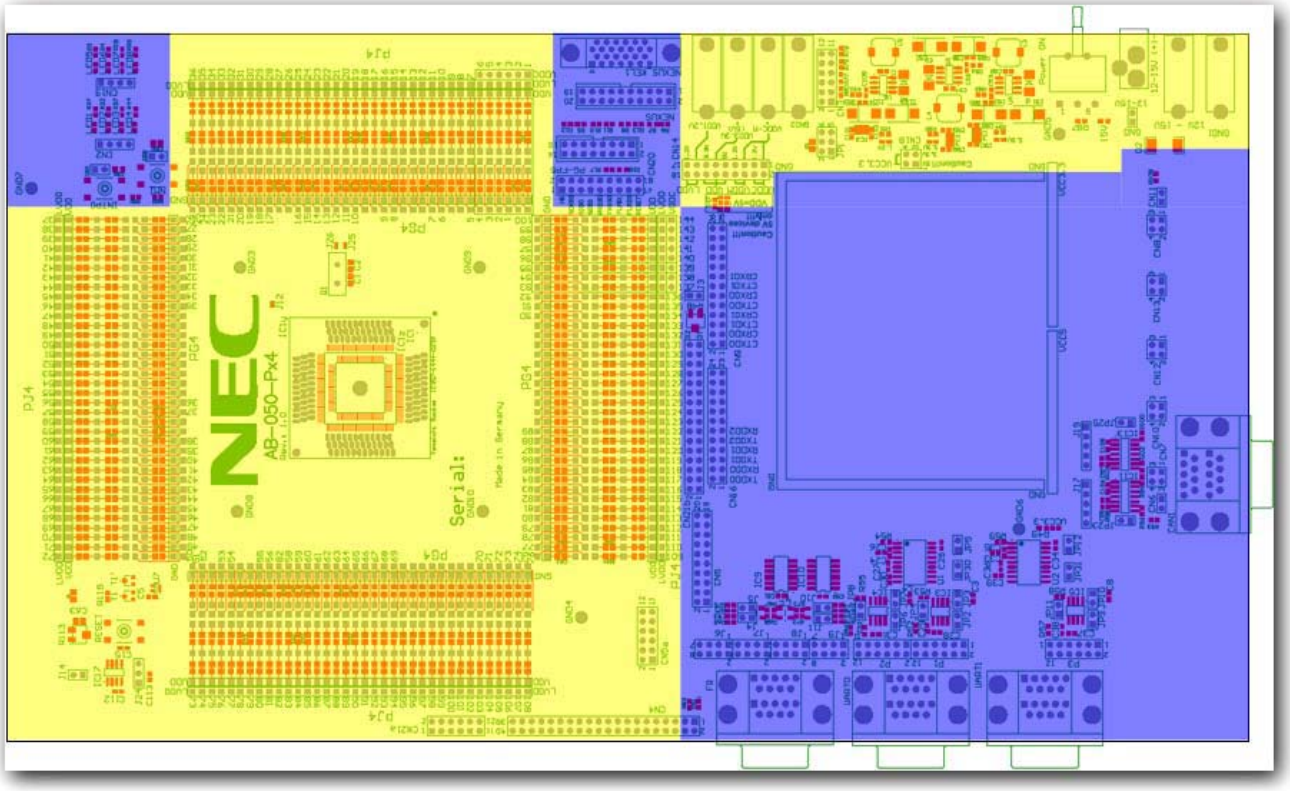


***Figure 2. Board overview***

### 2.1.1 Electrical Area

The yellow marked Electrical Area comprised the power supply, the reset circuit and the device socket with a surrounding Pin Patch Area. The core voltage supply is divided into a master and a checker domain, which is mandatory to fulfill the safety concept of the Px4 redundant core architecture.

In the centre of the Electrical Area the device socket is soldered either on a 100 pin or a 144 pin SMD pad field. On each side of the package/socket a “Pin Patch Area” is located.

In this patch area access is given to:

- each pin of the device (Note)
- VSS (GND)
- LVDD (1.2V)
- VDD (3.3V)

Further more SMD and through-hole components can directly be soldered onto the Pin Patch Area to allow simple networks to be easily built up.

**Note:**

The Board supports the 144pin PJ4 and the 100pin PG4 packaging. Inside pin labeling is for PG4, outside pin labeling for PJ4.

### 2.1.2 Functional Area

The blue marked Functional Area holds the drivers for RS-232, LIN bus, CAN and FlexRay. Additionally other patch areas are available as well to directly assembled LEDs, PowerDrivers and connectors to the board. Additional 2 EEPROM devices are available.

**Note:**

For detailed information about the operation of the used RS-232, LIN bus, CAN and FlexRay drivers refer to the related datasheets of those devices.

### 2.1.3 Connecting both areas

The Electrical and Functional Areas are not connected to each other except by a common VSS plane. Nevertheless by use of Jumpers a signal connection between the Electrical Area and the Functional Area is possible.

The following signals are available on the related jumper fields:

| Signal | Jumper |
|---|---|
| FlexRay | CN5+CN5a |
| UART - URTHn (n=0..2) | CN16 |
| CAN - FCNn (n=0..1) | CN9 |

***Table 1. Overview of functional signals***

#### 2.1.4 Minimal configuration for quick start

To run the device without the Functional Area the following minimal configuration has to be done.

- select with CN14 the used power supply and VDD voltage
- assemble an 8MHz or an 16MHz oscillator to Q1
- set the required jumper setting to CN20

### 2.2 Reset

The V850E2/Px4 can be reset by asserting RESETZ input pin.

#### 2.2.1 RESETZ input

The RESETZ input of the V850E2/Px4 is controlled via a pull-up resistor and transistor to GND. With J14 the connection to this circuit can be established.

### 2.3 Connecting the Power Supply

There are two different ways to supply the board with power:

a) Switching power supply

By supplying 12-15V to the 12-15V power connector jacket or to the 12-15V banana jacket. This will supply the on board voltage regulators for VCC5, VCC3.3 and VCC1.2 as well as directly supply VCC15.

b) Linear power supply

Optional the device voltages VDDC, VDDM, VDD and LVDD can be supplied separately by supplying the required voltages carefully to the corresponding banana jackets VDDC/M, VDD3.3V and VDD1.2V.

Use CN14 to select the device voltage supply source:

| Supply voltage | Supply Source | CN14 |
|---|---|---|
| VDDC | Extern | 1-2 |
| VDDC | Regulator | 3-4 |
| VDDM | Extern | 5-6 |
| VDDM | Regulator | 7-8 |
| VDD | Regulator 5V | 9-10 |
| VDD | Extern | 11-12 |
| LVDD | Extern | 15-16 |
| LVDD | Regulator | 17-18 |

***Table 2. Power Supply***

VDDC and VDDM are the separated core voltage. VDDM supplies the Master Core and VDDC the Checker Core.

The board supports a voltage supply of 5V VDD. If the device should run with 5V, the voltage of the Functional Area and the Electrical Area has to be changed separately.

- With CN18 the voltage for the components of the Functional Area can be set to 5V.
- To switch the voltage of the device to 5V pin 9-10 of CN14 has to be connected.

**Caution: Applying a voltage to the device outside the specified device operating voltage range may damage the device!**

## 2.4 Nexus connection

The Nexus debug cable from a Renesas Debug Tool (e.g. MiniCube) can be connected to the Nexus Connector on the board.

KEL connector (Nexus_KEL1) is not supported by the AB-050-Px4 evaluation board.

The following jumpers must be closed in order to physically connect some of the Nexus signals from the Nexus Connector to the corresponding pins of the V850E2/Px4 device:

| Jumper | Pin number |
|---|---|
| CN20 | 17-18 |
| CN20 | 15-16 |

***Table 3. Nexus***

## 2.5 PG-FP5 connection

The programming cable of the PG-FP5 Flash programmer can be connected to 'PG-FP5' Connector.

To program the device via the CSI interface the following jumpers must be closed:

| Connector | Pin number |
|---|---|
| CN20 | 3-4 |
| CN20 | 5-6 |
| CN20 | 7-8 |
| CN20 | 13-14 |
| CN20 | 15-16 |
| CN20 | 17-18 |

***Table 4. FP5 (CSI) Jumpers***

To program the device via the UART interface the following jumpers must be closed:

| Connector | Pin number |
|---|---|
| CN20 | 1-2 |
| CN20 | 9-10 |
| CN20 | 11-12 |
| CN20 | 13-14 |
| CN20 | 15-16 |
| CN20 | 17-18 |

***Table 5. FP5 (UART) Jumpers***

**Note:**

For Flash programming, using the PG-FP5 device, power must be supplied by the AB-050-Px4. Please make sure to switch of power monitoring in PG-FP5 setup.

For Flash programming, using the PG-FP5, clock supply is done by the AB-050-Px4. Please make sure to enter the right crystal value in PG-FP5 setup.

## 2.6 RS-232 / LIN

### 2.6.1 RS-232 Transmission

VBAT of the LIN bus driver is direct connected to the 12- 15V power supply jacket and the corresponding banana jackets. If the 12- 15V power supply is not used as power supply, a voltage in the range of 5V to 12V must be supplied to the jackets. For the exact specification refer to the Datasheet of the LIN Drivers.

Close the following jumpers on CN16 to physically connect the URTH signals from the Electrical Area to the Functional Area.

| Signal | | CN16 |
|---|---|---|
| URTH0 | TXD0 | 1-2 |
| | RXD0 | 3-4 |
| URTH1 | TXD1 | 5-6 |
| | RXD1 | 7-8 |
| URTH2 | TXD2 | 9-10 |
| | RXD2 | 11-12 |

***Table 6. URTHn signal jumpers***

To connect the RS-232 bus driver signals to the RS-232 / LIN bus connecters close the following jumpers:

| Signal | | Connector | Pin # |
|---|---|---|---|
| URTH0 | TXD0 | P1 | 1-2 |
| | RXD0 | | 3-4 |
| | GND | | 5-6 |
| URTH1 | TXD1 | P2 | 1-2 |
| | RXD1 | | 3-4 |
| | GND | | 5-6 |
| URTH2 | TXD2 | P3 | 1-2 |
| | RXD2 | | 3-4 |
| | GND | | 5-6 |

***Table 7. RS-232 signal jumpers***

To enable RS-232 transmission the disable Jumper must be removed from the corresponding RS232 transceiver. In addition the corresponding LIN-Transceiver must be send into SLEEP-Mode, otherwise it will disturb the transmission by limiting the level on RXD-Signal to 1,5V max. In most cases this high-level of 1,5V will not be recognized by the RS-232 controller.

To send LIN-Transceiver into SLEEP-Mode all 3 Jumpers must be removed from the LIN-Transceiver!

A falling edge must be generated on the NSLP-pin. This can either be done by setting and immediately removing the NSLP-Jumper after powering the board or by connecting both pins of the NSLP-Jumper via a 4,7nF capacity. By this the potential on the NSLP-Pin will follow the 5V power up and then it will be pulled down by the NSLP-Pin internal pull down resistor. This will generate the required falling edge.

### 2.6.2 LIN Transmission

To connect the LIN bus driver signals to the related RS-232/LIN bus connector close the following jumpers:

| Signal | | Connector | Pin # |
|---|---|---|---|
| LIN0 | 12V | P1 | 7-8 |
| | LIN | | 9-10 |
| | GND | | 11-12 |
| | | JP30 | 1-2 |
| LIN1 | 12V | P2 | 7-8 |
| | LIN | | 9-10 |
| | GND | | 11-12 |
| LIN2 | 12V | P3 | 7-8 |
| | LIN | | 9-10 |
| | GND | | 11-12 |
| | | JP31 | 1-2 |
| LIN3 | 12V | P5 | 7-8 |
| | LIN | | 9-10 |
| | GND | | 11-12 |
| LIN4 | 12V | P6 | 7-8 |
| | LIN | | 9-10 |
| | GND | | 11-12 |
| LIN5 | 12V | P7 | 7-8 |
| | LIN | | 9-10 |
| | GND | | 11-12 |

***Table 8. LIN bus signal jumpers***

To enable the LIN drivers (IC3, IC4, IC5, IC6, IC7, IC8) the NSLP pin of the drivers must be pulled high. To do so a Jumper is available to connect the pin to VDD.

| LIN channel | NLSP Jumper |
|---|---|
| 0 | JP3 |
| 1 | JP7 |
| 2 | JP10 |
| 3 | JP14 |
| 4 | JP17 |
| 5 | JP21 |

***Table 9. LIN NLSP Pin***

At same time the RS232 Transceiver RX Pin must be disabled for the LIN-enabled channel. This must be done by the Disable Jumper connected to the EN-Pin of RS232 Transceiver.

| LIN channel | RS232 Jumper |
|---|---|
| 0 | JP5 |
| 1 | JP5 |
| 2 | JP12 |
| 3 | JP12 |
| 4 | JP18 |
| 5 | JP18 |

***Table 10. LIN RS232 Jumper***

**Note:** The Disable Jumper will disable 2 channels at same time!

The RxD pin of the LIN driver (pin #1) is an open drain output. The necessary pull-up resistor in order to interface to the Px4 device is not assembled on the board. To enable operation of the RxD signal user has either

- To connect an appropriate pull up resister to the related RxD input pin of the LIN channel,

Or

- To enable the internal Pull-Up resistors available in the Px4 devices for each LIN input pin.

For additional information on the LIN driver refer to its User's Manual / Datasheet.

## 2.7 CAN

Power is permanently supplied to the CAN drivers by VCC5 and VCC3.3 and VCC15. These power lines are decoupled from Px4 power supply areas VDDC, VDDM, VDD, LVDD.

Close the following jumpers to physically connect the devices CAN signals to the CAN interface drivers located on the Functional Area of the board:

| Signal | | CN9 |
|---|---|---|
| FCN0 | CTXD0 | 1-2 |
| | CRXD0 | 3-4 |
| FCN1 | CTXD1 | 5-6 |
| | CRXD1 | 7-8 |
| FCN2 | CTXD2 | 9-10 |
| | CRXD2 | 11-12 |
| FCN3 | CTXD3 | 13-14 |
| | CRXD3 | 15-16 |
| FCN4 | CTXD4 | 17-18 |
| | CRXD4 | 19-20 |
| FCN5 | CTXD5 | 21-22 |
| | CRXD51 | 23-24 |
| FCN6 | | 25-26 |
| | CRXD6 | 27-28 Note |

***Table 11. FCNn signal jumpers***

**Note**: CAN6 of V850E2/Px4 is for diagnosis purpose and has only receive functionality. The physical interface on the Px4-Board is shared with the one for CAN5. Please make sure to jumper only one of them.

## 2.8 FlexRay

Power is permanently supplied to the FlexRay drivers by VCC5 and VCC3.3 and VCC15. These power lines are decoupled from Px4 power supply areas VDDC, VDDM, VDD, LVDD.

Close the following jumpers to physically connect the devices FlexRay signals to the FlexRay interface drivers located on the Functional Area of the board:

| Signal | | CN5a |
|---|---|---|
| FlexRay | FTXDA | 1-2 |
| | FRXDA | 3-4 |
| | FTXENA | 5-6 |
| | FTXDB | 7-8 |
| | FRXDB | 9-10 |
| | FTXENB | 11-12 |

***Table 12. FlexRay signal jumpers***

**Note**: To control the operating mode of FlexRay interface drivers, the following jumpers have to be closed:

| Signal | CN5 |
|---|---|
| FR_EN1 | 1-2 |
| FR_EN2 | 3-4 |
| FR_STBN1 | 5-6 |
| FR_STBN2 | 7-8 |
| FR_WAKE1 | 9-10 |
| FR_WAKE2 | 11-12 |
| FR_RXEN1 | 13-14 |
| FR_RXEN2 | 15-16 |
| FR_ERRN1 | 17-18 |
| FR_ERRN2 | 19-20 |

***Table 13. FlexRay control jumpers***

To connect the FlexRay bus driver signals to the related FlexRay bus connector close the following jumpers according to your requirements (refer to the AB-050-PJ4-Schematics for details):

| Signal | | Connector | Pin # |
|---|---|---|---|
| FlexRay | CH0_A | J6 | x-y |
| | CH0_B | J7 | x-y |
| | CH1_A | J8 | x-y |
| | CH1_B | J9 | x-y |

***Table 14. FlexRay bus jumpers***

To terminate the FlexRay bus close the following jumpers:

| Signal | | Connector | Pin # |
|---|---|---|---|
| FlexRay | CH0_A | J4 | 1-2 |
| | CH0_B | J5 | 1-2 |
| | CH1_A | J10 | 1-2 |
| | CH1_B | J11 | 1-2 |

***Table 15. FlexRay bus termination jumpers***

## 3. FlexRay / UART / LIN / CAN DSUB connectors

To physically connect the Starter Board to other UART / LIN / CAN devices DSUB type connectors are available.

### 3.1 UART / LIN connectors

To interface the AB-050-Px4 board to external to UART / LIN devices a 9 pin male D-SUB connector is supplied for each of the six available UART / LIN interfaces.

The signal layout of the UART/LIN DSUB connector can be seen in Table 16.

| Male D-SUB, 9pin | Function |
|---|---|
| 1 | n/c |
| 6 | n/c |
| 2 | RS-232 TxD |
| 7 | LIN |
| 3 | RS-232 RxD or GND |
| 8 | n/c |
| 4 | n/c |
| 9 | +12V |
| 5 | GND |

***Table 16. UART / LIN DSUB connectors***

### 3.2 FlexRay connectors

To interface the AB-050-Px4 board to external to FlexRay devices a 9 pin male D-SUB connector is supplied for each of the two available FlexRay interfaces.

The signal layout of the FlexRay D-SUB connector can be seen in Table 17.

| Male D-SUB, 9pin | Function |
|---|---|
| 1 | n/c |
| 6 | n/c |
| 2 | CH0_A or CH1_A |
| 7 | CH0_B or CH1_A |
| 4 | CH0_A or CH1_A |
| 8 | CH0_B or CH1_A |
| 3 | n/c |
| 9 | n/c |
| 5 | n/c |

***Table 17. FlexRay DSUB connectors***

Figure 3 displays the assignment of each DSUB connector to its related peripheral:

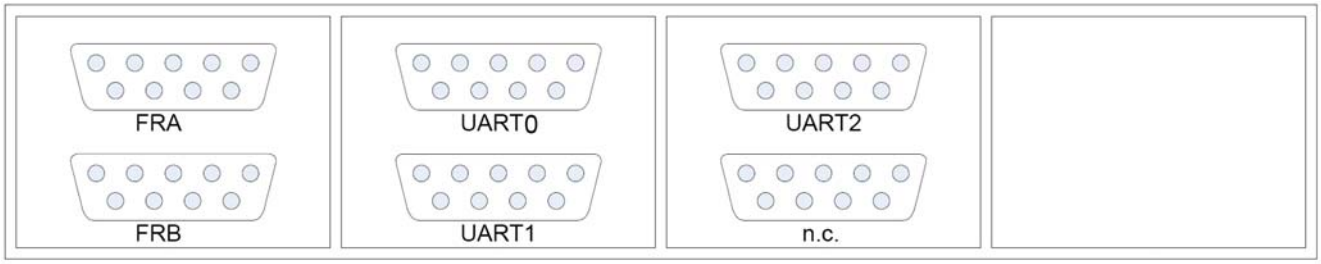


***Figure 3. FlexRay / UART / LIN DSUB connectors***

### 3.3 CAN connectors

To interface the AB-050-Px4 board to external CAN devices a 9 pin female D-SUB connector is supplied for each of the six available CAN interfaces.

The pin functions of the CAN DSUB connectors can be seen in Table 18.

| Male D-SUB, 9pin | Function |
|---|---|
| 1 | n/c |
| 6 | GND |
| 2 | CANL |
| 7 | CANH |
| 3 | GND (if jumpered) |
| 8 | n/c |
| 4 | n/c |
| 9 | n/c |
| 5 | n/c |

***Table 18. CAN DSUB connectors***

Figure 4displays the assignment of each DSUB connector to its related peripheral:


*Figure 4. CAN DSUB connectors*

## 3.4 Pin connection

The pin connection, which is described below, is already done on the board.

### 3.4.1 Power supply pins

Connect the devices power supply pins to the related power lines using the available SMD pads in the Pin Patch Areas.

Refer to the V850E2/Px4 User's Manual and Electrical Target Specification for the location of the VDD and VSS pins on the different devices.

Connect the VDD and VSS pins in the Pin Patch Areas like this:

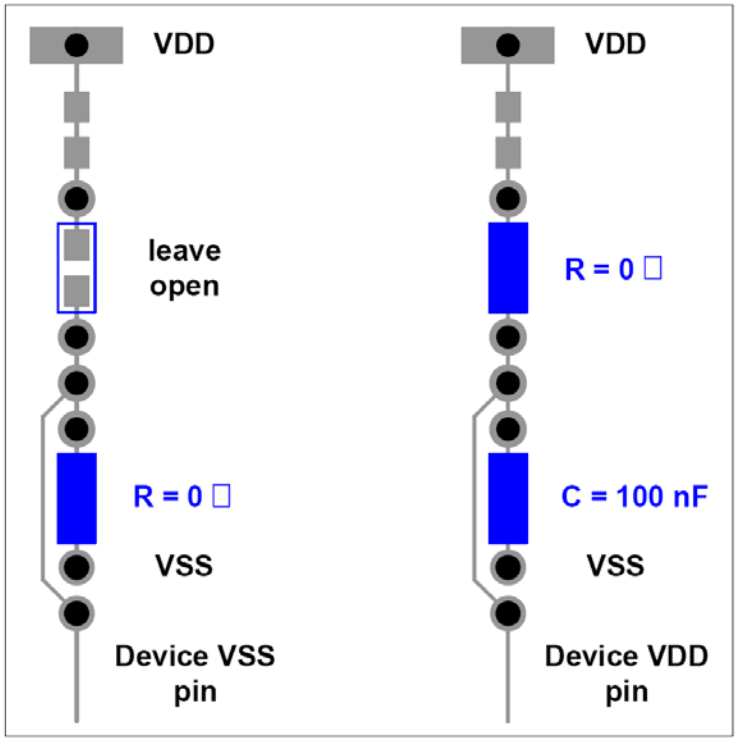


*Figure 5. Device power supply*

To connect the devices VSS pins to the VSS lane of the board place a 0 Ohm resistor on the SMD1 pad.

To connect the devices VDD pins to the VDD lane of the board place a 0 Ohm resistor on the SMD2 pad and place a 100 nF buffering capacitor on the SMD1 pad.

### 3.4.2 REGC pin

A buffering capacitor between the devices REGC pin(s) and VSS should be placed. Assemble the capacitor to the SMD1 pad field.

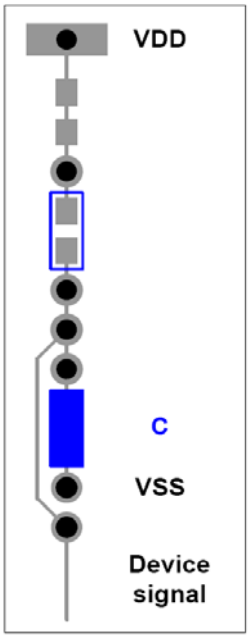


***Figure 6. REGC pin components***

Refer to the Px4 User's Manual and Electrical Target Specification for the location of the REGC pin on the different devices.

### 3.4.3 X1, X2 pins

The external crystal can be connected to the socket Q1. Alternatively An external oscillator can be connected to the X1 and X2 pins of the device. Connect the oscillator between the X1 and X2 pins and place a small capacitor on the SMD1 areas of those pins. For size of the capacitor refer to the oscillator manufacturer specification / recommendation.

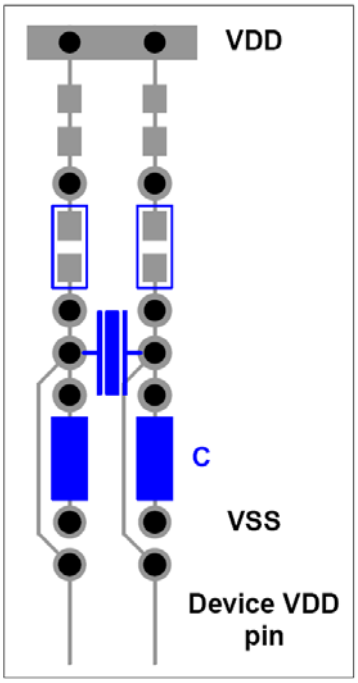


***Figure 7. X1, X2 pin components***

In this case you have to connect the J25 and J26 with solder.

Refer to the Px4 User's Manual and Electrical Target Specification for the location of the X1 and X2 pins on the different devices.

### 3.4.4 XT1, FLMD0

A pull-down resistor should be connected to input pin FLMD0.

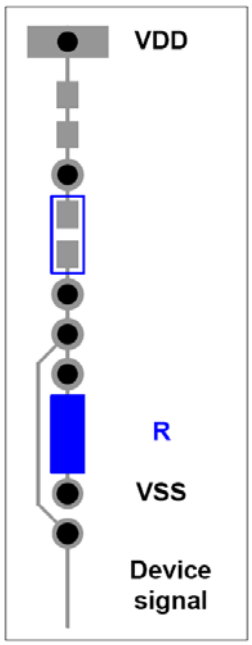


***Figure 8. Pins with Pull-Down***

Refer to the Px4 User's Manual and Electrical Target Specification for the location of the FLMD0 pins on the different devices.

## 3.5 Functional pin connection

As the routing of the functional signals (Reset, UARTHn, CANn, NWIRE and FP5) between the device SMD pad area and the Jumpers connecting the Electrical Area and Functional Area is based on the Px4 device, the routing of those signals for other Px4 devices must be place manually.

To do so, connect a wire between the device pin (e.g. from one of the through holes in the Pin Patch areas) and the functional side of the related signal jumper.

**Caution: Do not close the related Jumpers of any of the newly routed signals as this can lead to a direct connection between different device pins. Be aware that no further disconnection by the use of jumpers between the Electrical Area and Functional Area is possible after wiring the signals for other than Px4 devices.**

### 3.5.1 Jumper and connector overview

The location of all jumpers located on the board can be seen in the Figure 9.

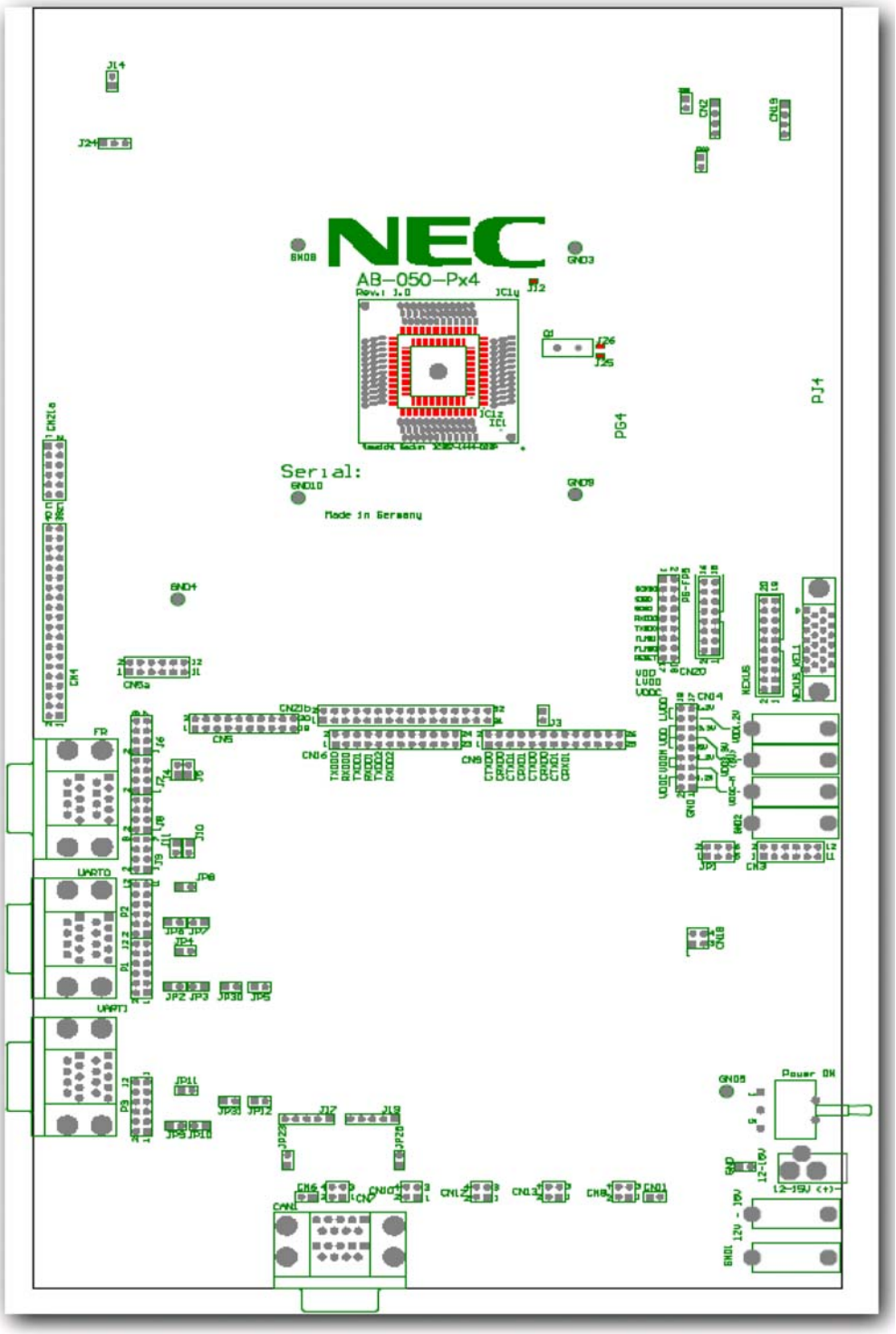


***Figure 9. Jumper and connector location***

# 4. Revision History

| Version | Chapter | Comment |
|---|---|---|
| 0.1-0.4 | | Initial releases incl. bug fixes |
| 0.5-0.6 | | Modification due to merger of<br>Renesas Technologies and NEC Electronics. |
| 0.7 | | Socket board schematics attached. |
| 0.8 | | Included information: KEL connector not supported. |
| 0.09 | | Modified document template and document numbering format. |

V850E2/Px4 Application Board User's Manual: Hardware

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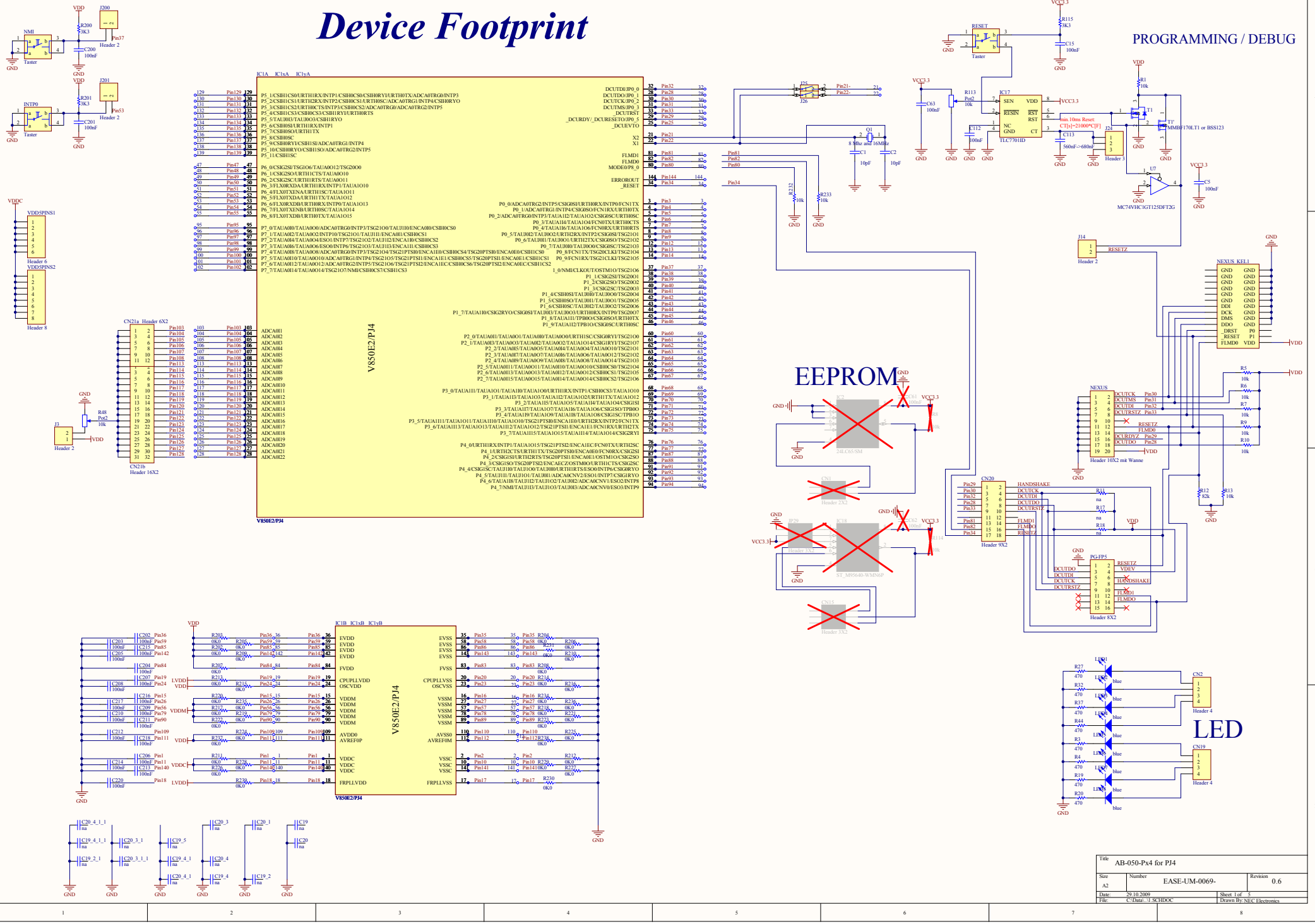
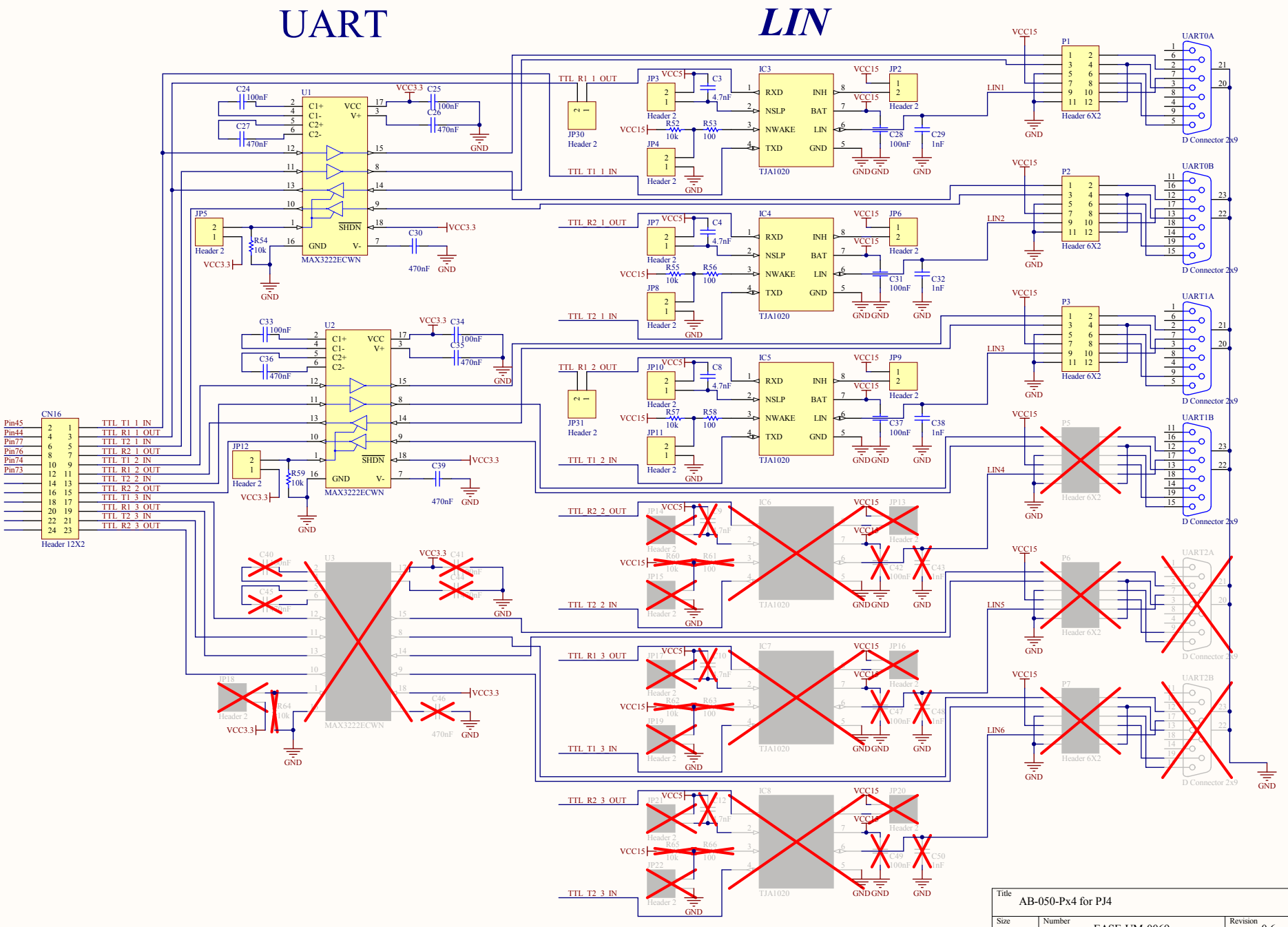
# V850E2/Px4 Application Board

# Device Footprint



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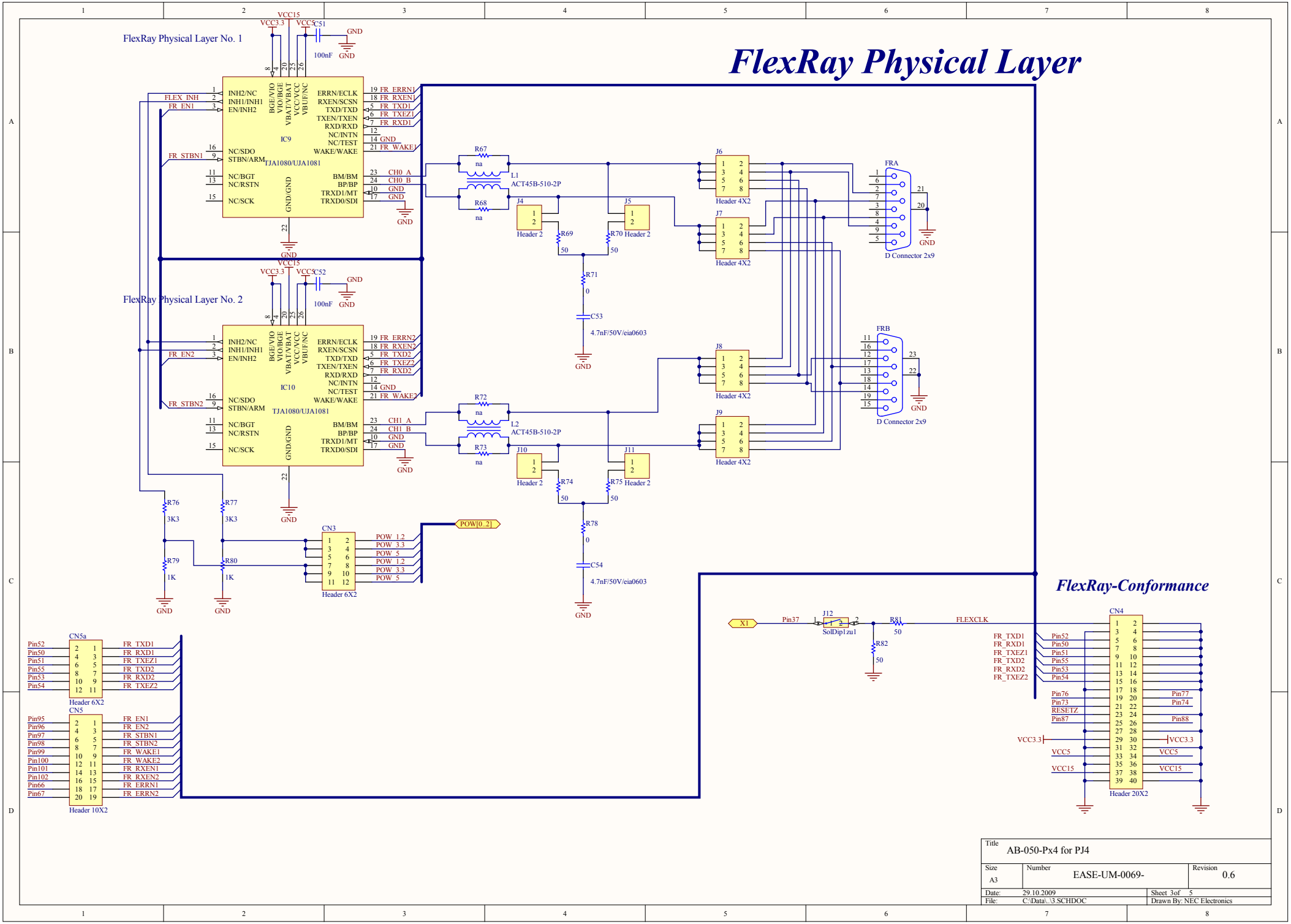
| Title | AB-050-Px4 for PJ4 | | |
| Size: A3 | Number: EASE-UM-0069- | | Revision: 0.6 |
| Date: 29.10.2009 | | Sheet 2 of 5 | |
| File: C:\Data\..\2.SCHDOC | | Drawn By: NEC Electronics | |

# FlexRay Physical Layer

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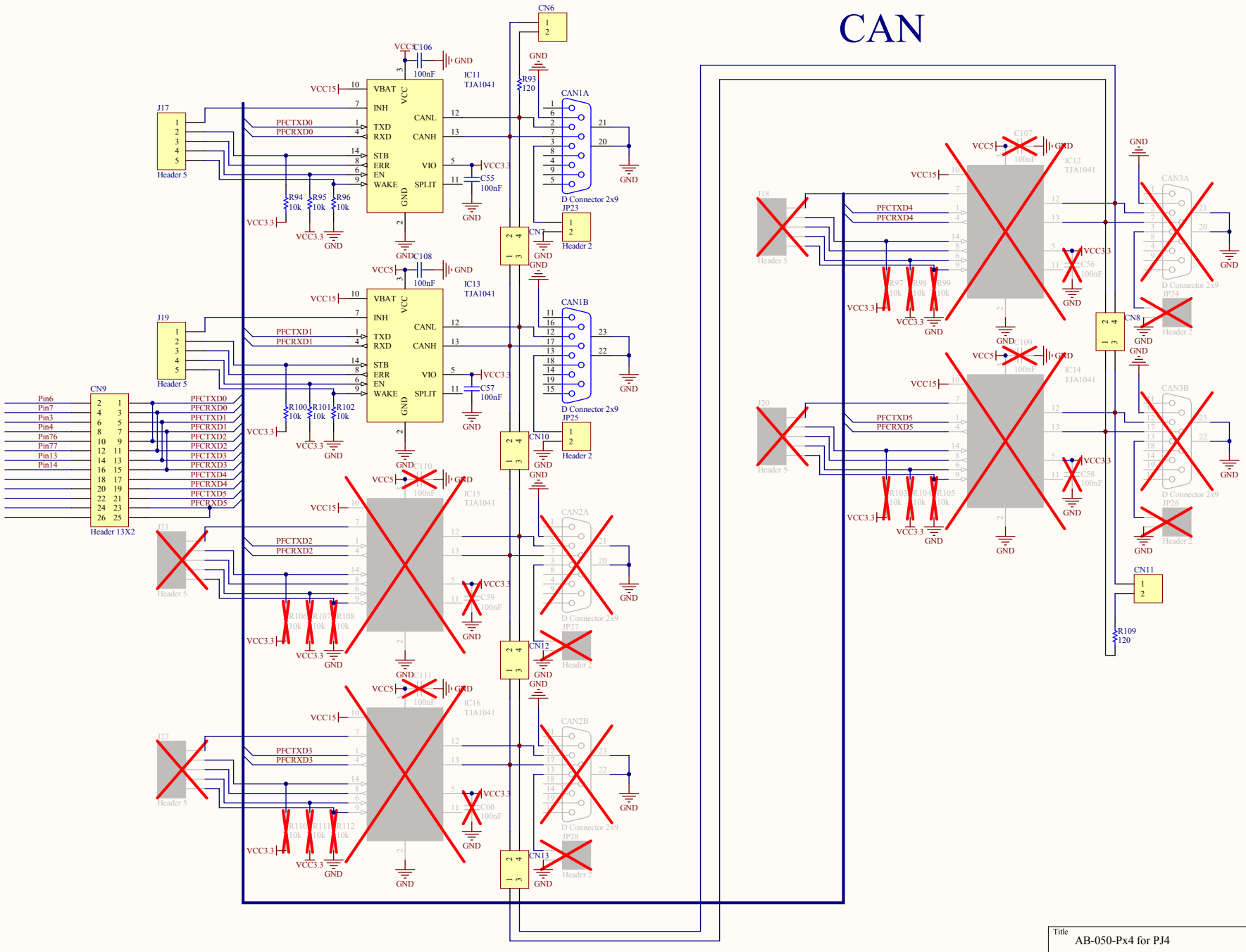
| File: C:\Data\..\3.SCHDOC | Drawn By: NEC Electronics | |

# CAN

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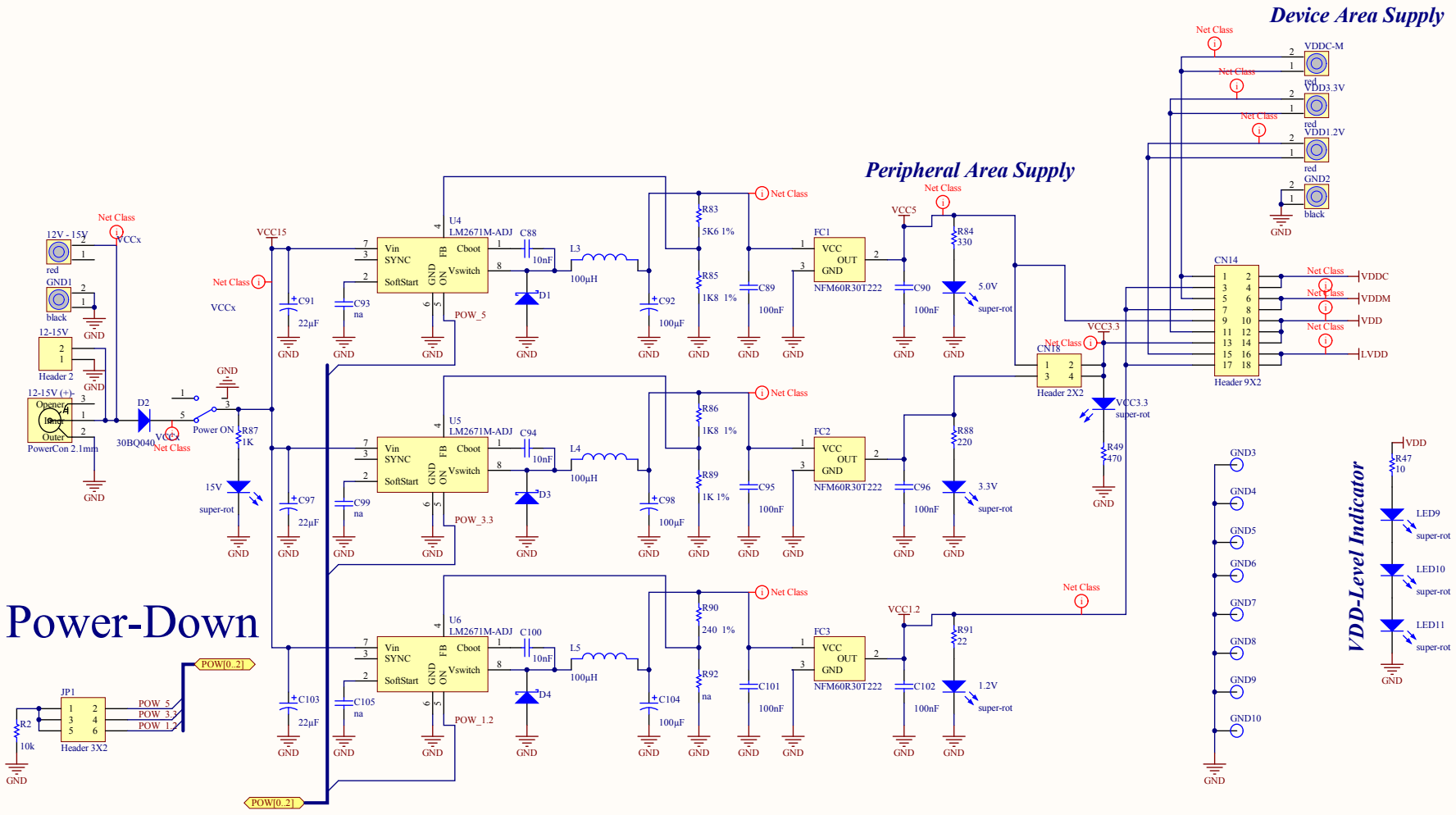
# Power Supply

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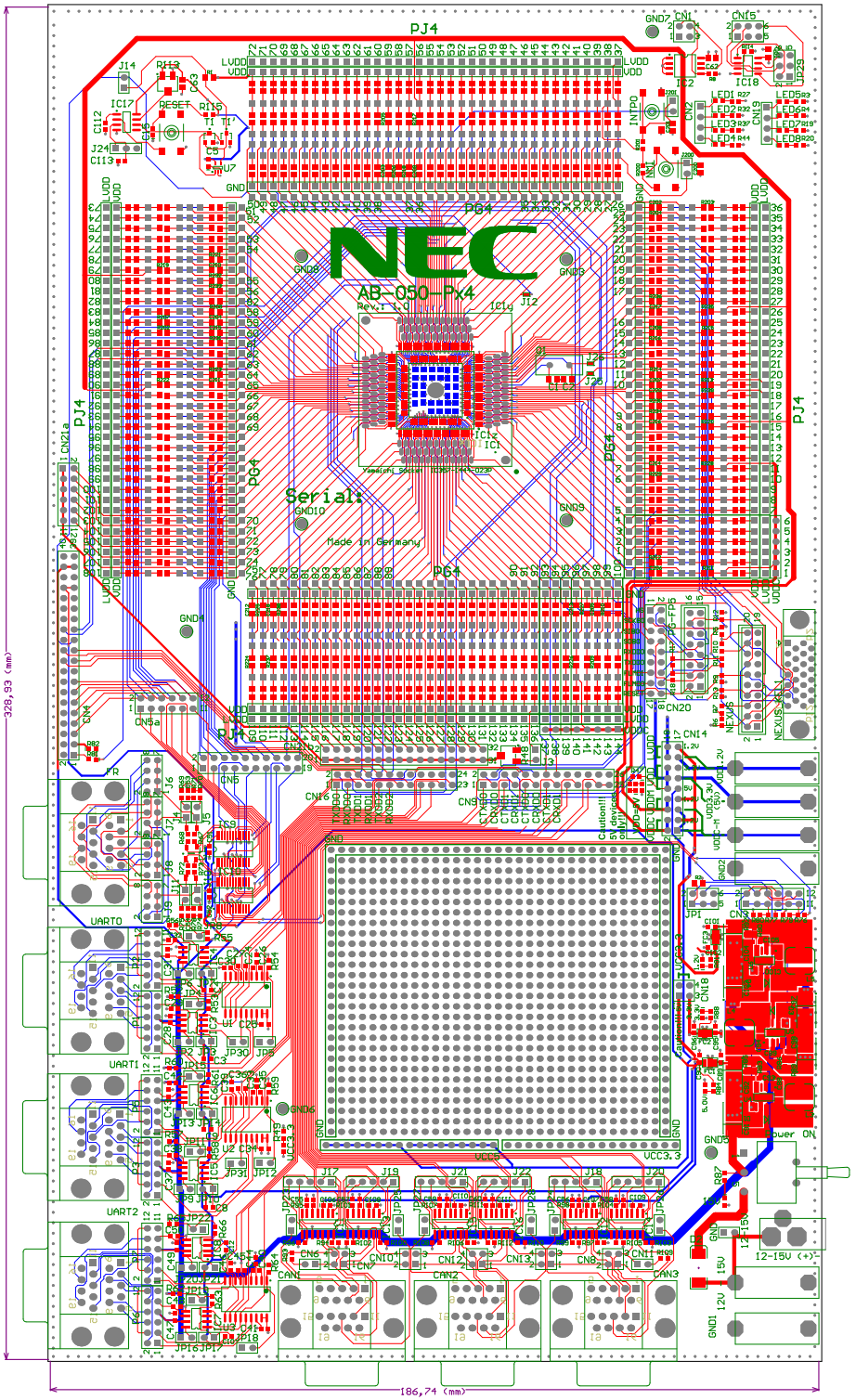
NEC
AB-050-Px4
Serial:
Made in Germany
328,93 (mm)
186,74 (mm)