

# V850E2/Px4 Starter Kit Board

## 32-bit Microcontroller Extension Hardware

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- Network requirements

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## Preface

**Readers** This manual is intended for users who want to understand the functions of the concerned hardware.

**Purpose** This manual presents the hardware manual for the concerned product.

**Legend** Symbols and notation are used as follows:

- Weight in data notation: Left is high order column, right is low order column
- Active low notation:  $\overline{\text{xxx}}$  (pin or signal name is over-scored) or /xxx (slash before signal name) or \_xxx
- Memory map address: High order at high stage and low order at low stage

**Note** Additional remark or tip

**Caution** Item deserving extra attention

**Numeric notation**

Binary:	xxxx or xxxB
Decimal:	xxxx
Hexadecimal	xxxxH or 0x xxxx

**Numeric prefixes** representing powers of 2 (address space, memory capacity):

K (kilo):	$2^{10} = 1024$
M (mega):	$2^{20} = 1024^2 = 1,048,576$
G (giga):	$2^{30} = 1024^3 = 1,073,741,824$

**Register contents** X, x = don't care

**Diagrams** Block diagrams do not necessarily show the exact wiring in hardware but the functional structure. Timing diagrams are for functional explanation purposes only, without any relevance to the real hardware implementation.

# How to Use This Manual

## (1) Purpose and Target Readers

This manual is designed to provide the user with an understanding of the hardware functions and electrical characteristics of the corresponding Hardware. A basic knowledge of electric circuits, logical circuits and MCUs is necessary in order to use this manual. The manual includes an overview of the product, describes the function and usage of the separate circuit and the connectors.

Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.

The following documents apply to the Automotive Group. Make sure to refer to the latest versions of these documents. The newest versions of the documents listed may be obtained from the Renesas Electronics Web site.

Document Type	Description	Document Title	Document No.
User manual for Hardware	Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and operation description. Note: Refer to the application notes for details on using peripheral functions.	xxx/xx User manual for Hardware	This User manual
Application Note	Information on using peripheral functions and application examples. Sample programs. Information on writing programs in assembly language and C.	Available from Renesas Electronics Web site.	
Renesas Technical Update	Product specifications, updates on documents, etc.		

## (2) List of Abbreviations and Acronyms

Abbreviation	Full Form
bps	bits per second
CRC	Cyclic Redundancy Check
DMA	Direct Memory Access
DMAC	Direct Memory Access Controller
GND	Ground
Hi-Z	High Impedance
I/O	Input/Output
LSB	Least Significant Bit
MCU	Microcontroller unit
MSB	Most Significant Bit
NC	Non-Connect
PLL	Phase Locked Loop
PWM	Pulse Width Modulation
SFR	Special Function Register
SIM	Subscriber Identity Module
UART	Universal Asynchronous Receiver/Transmitter
VCO	Voltage Controlled Oscillator

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## Chapter 1 Introduction

The V850E2/Px4 Starter Kit is Renesas' new evaluation platform for the latest 32-bit microcontroller V850E2/Px4.

The board is designed for engineers starting software development with the V850E2/Px4 device e.g. with the Renesas' AUTOSAR compliant MCAL.

A large number of connectors/interfaces provide full access to the functionality of the mounted microcontroller. With the versatile onboard equipment like the LCD, multiple LEDs, push-buttons and potentiometers, the board can be used for several application fields.

The mounted V850E2/Px4 with its redundant V850E2M CPU core permits also the usage in safety-critical automotive applications including braking, steering and suspension control up to high-end chassis servers.

**Overview** Below you find a short summary of all contained functionalities:

- V850E2/Px4 32-bit microcontroller
- Onboard circuit for supply voltage generation
- Nexus Debug interface
- Flash Programming interface for Renesas' PG-FP5 Flash Programmer
- Communication interfaces for almost all kinds of automotive networks
  - 2x CAN
  - 1x LIN
  - 1x UART
  - 2x FlexRay
  - CSIG/H - clocked serial interface (without or with FIFO)
  - SENT
- LCD display (2x12 characters)
- 4x push-buttons
- 2x potentiometers connected to A/D converter's inputs
- 2x motor control interfaces
- 8x LED at dedicated ports
- LED indication of the ERROROUT status

**Note** The name V850E2/Px4 describes a product family of several devices with different packages and memory sizes, but almost the same peripheral set and functionality.

The mounted device, V850E2/PJ4 (Order code:  $\mu$ PD703506), is very suitable to become familiar with the functionality of the whole product family.

Contact your local sales to get more information about the V850E2/Px4 family.

## Chapter 2 General information

### 2.1 Start-up

The board is delivered with the minimal configuration for the first startup.

- The I/O voltage is set to 3.3 V by jumper CN18
- A 16MHz Oscillator is mounted into socket Q1
- The potentiometer (R113) of reset circuit is adjusted
- The potentiometer (R48) for the LCD contrast is adjusted

If any communication or I/O interface will be used, additional jumper settings have to be made. For more information please take a look into the corresponding chapters.

### 2.2 Power supply

The onboard power supply needs 12 – 15 V input voltage. This voltage can be provided by the 12 – 15 V power connector jacket or the black and red banana jackets. With this supply voltage the onboard circuit generates all needed voltages (5 V, 3.3 V and 1.2 V). The current status of all voltages, also the supply voltage, can be checked very quickly by the corresponding LEDs.

**Note** The 1.2 V overvoltage LED is an indicator for overvoltage on the 1.2 V line, thus the non-glowing of this LED is not a malfunction.

The V850E2/Px4 is available for two different I/O voltages, 3.3 V or 5 V. As the Starter Kit Board supports both types, the I/O voltage can be chosen by CN18. The switchable I/O voltage signal is called “VCC3.3V/5V”. Three additional LEDs on the left side of the jumper CN18 indicate the 5 V operation.

**Table 2-1 Power supply**

I/O Voltage	CN18
5 V	1 – 2
3.3 V	3 – 4

**Caution** Applying a voltage to the device outside the specified device operating voltage range may damage the device! Please refer to the V850E2/Px4 Data Sheet for operating voltage specification.

## 2.3 Reset

On the left side of the board a reset button is mounted. To adjust the threshold voltage for the reset IC the potentiometer R113 is used. The delay between power up and reset up can be varied with an additional capacitor into J24.

For additional information please consult the Data Sheet of the reset controller (Texas Instruments, TLC7701ID).

## 2.4 Nexus connection

The 20-pin Nexus debug cable from Renesas' debug tool (e.g. MiniCube) can be connected to the Nexus Connector on the board.

## 2.5 E1 connector

The board is equipped with a 14-pin connector.

This connector can be used for the Renesas E1 Emulator and the flash programmer PG-FP5.

**Note** Make sure that your PG-FP5 connection cable provides the new 14-pin plug and not the old 16-pin plug.

For Flash programming, using the PG-FP5, power and clock must be supplied by the Starter Kit Board. Please make sure to switch off power monitoring and enter the right oscillator value in PG-FP5 setup.

## Chapter 3 Communication

The Starter Kit Board is equipped with five D-Sub connectors, mounted at the left and right side.

On the left side you can find the two female connectors for FlexRay and one shared male connector for UART and LIN. On the right side the two female connectors for CAN are located.

To use one of this communication functions some jumper settings have to be done. In the following you find the corresponding settings and connector pin outs for each communication.

**Note** All Jumper settings have to be finished before power on.

### 3.1 UART/LIN

#### 3.1.1 UART-Transmission

The D-sub connector is shared for UART and LIN communication. For UART connection jumper P1 must be set according to Table 3-1 to connect the RxD signal to pin 3 of the connector.

Table 3-1 UARTH signal jumpers

Signal		Connector	Pin #
UART	RxD	P1	2 – 3

To avoid any disturbance by the LIN-transceiver, it must be disconnected from the connector.

By removing all jumpers named in Table 3-2 the LIN-transceiver is fully disconnected.

Table 3-2 UARTH remove jumpers

Signal		Connector	Pin #
LIN	INH	JP2	1 – 2
LIN	NSLP	JP3	1 – 2
LIN	NWAKE	JP4	1 – 2
UART	Rx $\bar{E}N$	JP5	1 – 2
LIN	RxD	JP30	1 – 2

### 3.1.2 LIN-Transmission

For LIN transmission some jumper settings have to be done to disconnect the UART signals and connect the LIN signals to the microcontroller and the D-sub connector.

To set/clear all needed connections please use the jumper settings of Table 3-3.

Table 3-3 LIN bus signal jumpers

Signal		Connector	Pin #
LIN	GND	P1	1 – 2
LIN	RXD	JP30	1 – 2
UART	RX EN	JP5	1 – 2

In detail, the following three settings are done:

- P1 connects pin 3 (RxD signal for UART) of the D-sub connector with ground.
- JP30 connects the RxD signal of the LIN-transceiver to the microcontroller.
- JP5 set the RxD output of the UART-transceiver to Hi-Z to enable the LIN-transceiver to drive the signal path.

Table 3-4 LIN control signal

Signal		Connector	Pin #
LIN	NSLP	JP3	1 – 2

To enable the LIN transceiver (IC3) the NSLP pin of the transceiver must be pulled high. Closing jumper JP3 will connect the NSLP pin to VDD.

- Note** The RXD pin of the LIN transceiver (pin #1; IC3) 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
- connect an appropriate pull up resistor to the related RXD input pin of the LIN channel,
- or**
- enable the internal Pull-Up resistors available in the Px4 devices for the LIN input pin.

For additional information on the LIN transceiver, please have a look into its User Manual/Datasheet (Philips, TJA1020).

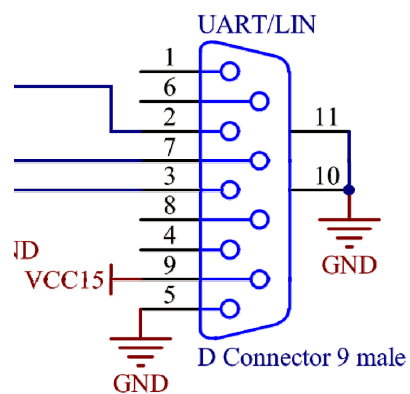
### 3.1.3 UART/LIN connectors

The signal layout of the UART/LIN D-Sub connector can be seen in Table 3-5.

Table 3-5 UART/LIN D-Sub layout

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	+12 V
5	GND

Figure 1 UART/LIN D-Sub connector



## 3.2 CAN

CAN transmission doesn't need any jumper settings. All signals are hard-wired. Power is permanently supplied to the CAN transceivers by VCC5 and VCC3.3V/5V and VCC15.

### 3.2.1 CAN connections

The signal layout of the female D-Sub connectors can be seen in the below table.

Table 3-6 CAN D-Sub connectors

Female D-SUB, 9pin	Function
1	GND
6	GND
2	CANL
7	CANH
3	GND
8	n/c
4	n/c
9	n/c
5	n/c

Table 3-7 shows the hard-wired interconnection between the V850E2/Px4 and the CAN transceivers.

Table 3-7 CAN transceiver connection

Channel	Function	Transceiver	PJ4 pin (port)
CAN0	TxD	1	Pin6 (P0_3)
	RxD	4	Pin7 (P0_4)
	ERR	8	Pin48 (P6_1)
	EN	6	Pin95 (P7_0)
	STB	14	Pin97 (P7_2)
	WAKE	9	Pin99 (P7_4)
CAN1	TxD	1	Pin13 (P0_8)
	RxD	4	Pin14 (P0_9)
	ERR	8	Pin49 (P6_2)
	EN	6	Pin96 (P7_1)
	STB	14	Pin98 (P7_2)
	WAKE	9	Pin100 (P7_5)

**Note** The CAN and FlexRay control signals (Error, Enable, Wake and STB) are shared. So, it is not possible to use the same CAN and FlexRay channel simultaneously.

### 3.3 FlexRay

FlexRay transmission does not need any jumper settings. All signals are hard-wired. Power is permanently supplied to the FR drivers by VCC5 and VCC3.3/5V and VCC15.

**Note** Bus Driver control signals (i.e. EN, STBN etc.) are also directly connected to the V850E2/Px4 port pins. For further information, please take a look into the schematics.

**Note** The two FlexRay channel names FRA and FRB are written as FR0 and FR1 in the schematics.

#### 3.3.1 Bus termination

According to the FlexRay Electrical Physical Layer Specification document the bus must be terminated or not depending on the bus topology.

The board gives you the possibility to terminate the bus or not. So it can be used with several bus topologies.

To terminate the bus set the depending jumper according to Table 3-8. To leave the bus open no jumper setting must be done.

Table 3-8 FlexRay bus termination

Signal		Connector	Pin #
FRA	CHA_BP	J4	1 – 2
	CHA_BM	J5	1 – 2
FRB	CHB_BP	J10	1 – 2
	CHB_BM	J11	1 – 2

#### 3.3.2 FlexRay connections

The signal layout of the female FlexRay D-Sub connectors can be seen in Table 3-9.

Table 3-9 FlexRay D-Sub connectors

Female D-SUB, 9pin	Function
1	n/c
6	n/c
2	CH0_A or CH1_A
7	CH0_B or CH1_B
4	n/c
8	n/c
3	n/c
9	n/c
5	n/c



Table 3-10 shows the interconnection between the V850E2/Px4 and the FlexRay transceivers.

Table 3-10 FlexRay transceiver connection

Channel	Function	Transceiver	PJ4 pin (port)
FRA	RXD	7	Pin50 (P6_3)
	TXEZ	6	Pin51 (P6_4)
	TXD	5	Pin52 (P6_5)
	ERR	13	Pin48 (P6_1)
	EN	3	Pin95 (P7_0)
	STBN	9	Pin97 (P7_2)
	WAKE	15	Pin99 (P7_4)
	RXEN	12	Pin101 (P7_6)
FRB	RXD	7	Pin53 (P6_6)
	TXEZ	6	Pin54 (P6_7)
	TXD	5	Pin55 (P6_8)
	ERR	13	Pin49 (P6_2)
	EN	3	Pin96 (P7_1)
	STBN	9	Pin98 (P7_3)
	WAKE	15	Pin100 (P7_5)
	RXEN	12	Pin102 (P7_7)

**Note** The CAN and FlexRay control signals (Error, Enable, Wake and STB) are shared. So, it is not possible to use the same CAN and FlexRay channel simultaneously.

### 3.3.3 FlexRay wake up

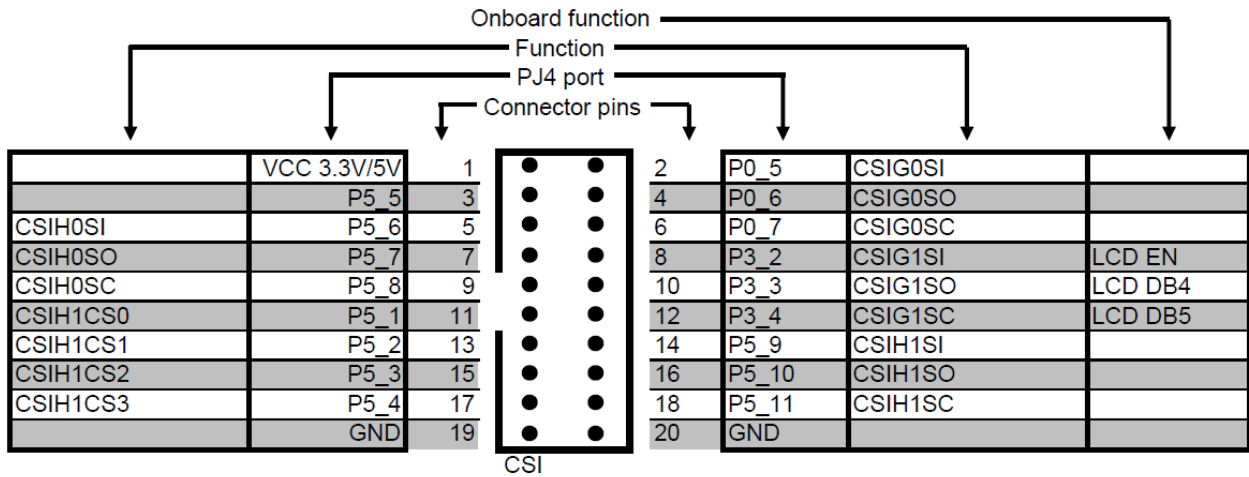
The Starter Kit offers the possibility to power on the three power supplies (1.2 V, 3.3 V, 5 V) by the FlexRay transceivers in case a FlexRay wake up procedure is executed. The connections between the FlexRay transceivers are made by CN1.

For further information, please take a look into the schematics.

### 3.4 CSI interface

The mounted CSI (SPI) interface provides access to two instances of each kind of CSI (CSIG and CSIH) and four chip select signals.

Figure 2 CSI 20-pin interface



**Note** The chip select signals of the two CSIH instances are multiplexed to the same port, so CSIH1CSx means also chip select signal for CSIH0.

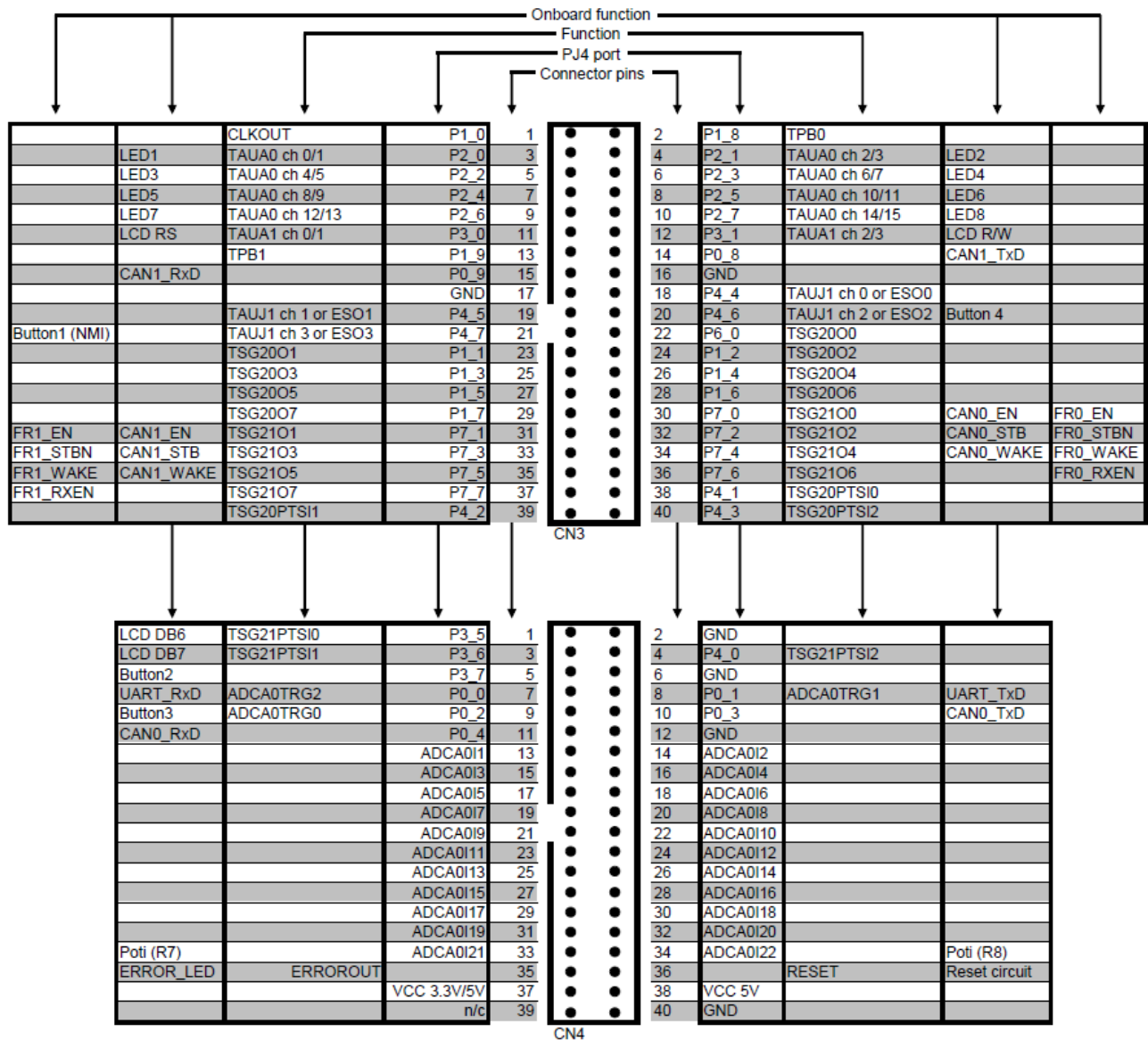
**Note** The signals for CSIG1 are shared with the LCD signals.

### 3.5 Motor control interfaces

The Starter Kit is equipped with two 40-pin interfaces to connect it with application hardware e.g. the forthcoming “motor control board” or a customer specific application boards.

Figure 3-2 shows a proposal of possible pin function configuration for a motor control application and it shows the shared onboard functions.

Figure 3 Motor control 40 pin interface



**Note** The outputs of the mounted V850E2/Px4 are multiplex with different functions. This port configuration is only a proposal.

## Chapter 4 Onboard functions

### 4.1 LCD

A 2x12 characters LCD is mounted on the board.

The display is connected for the 4-bit interface operation. Please consult the User Manual/Datasheet for additional information (Winstar, WH1202A-YYB-JP).

Table 4-1 LCD connections

LCD signal	PJ4 Pin	Shared with
RS	Pin68	CN3_11
R/W	Pin69	CN3_12
EN	Pin70	CSIG1SI
DB0	n/c	-
DB1	n/c	-
DB2	n/c	-
DB3	n/c	-
DB4	Pin71	CSIG1SO
DB5	Pin72	CSIG1SC
DB6	Pin73	CN4_1
DB7	Pin74	CN4_3

### 4.2 LEDs

The complete port 2 (P2\_0 to P2\_7) is connected to 8 LEDs. The LEDs are connected in active high mode.

Table 4-2 LED connections

LED	PJ4 Pin	Shared with
LED1	Pin60	CN3_3
LED2	Pin61	CN3_4
LED3	Pin62	CN3_5
LED4	Pin63	CN3_6
LED5	Pin64	CN3_7
LED6	Pin65	CN3_8
LED7	Pin66	CN3_9
LED8	Pin67	CN3_10

### 4.3 Push buttons

The Starter Kit provides five push buttons. One is reserved for the reset circuit, the other four can be connected to the V850E2/Px4 by jumpers.

All free push buttons can be used as I/O input or they can be used with the multiplexed alternative function. Table 4-3 shows the interconnection between the buttons and the microcontroller and one of the possible alternative functions.

Table 4-3 Button jumpers

Button	Jumper	PJ4 Pin	Function
1	J1	Pin94	NMI
2	J9	Pin75	-
3	J8	Pin5	ADCA0TRG0
4	J7	Pin93	ESO2

### 4.4 Potentiometers

Channel 21 and 22 of the V850E2/Px4 ADC can be connected to a potentiometer. The potentiometers are connected to the switchable VCC3.3V/5V signal, so every time the full voltage range is available.

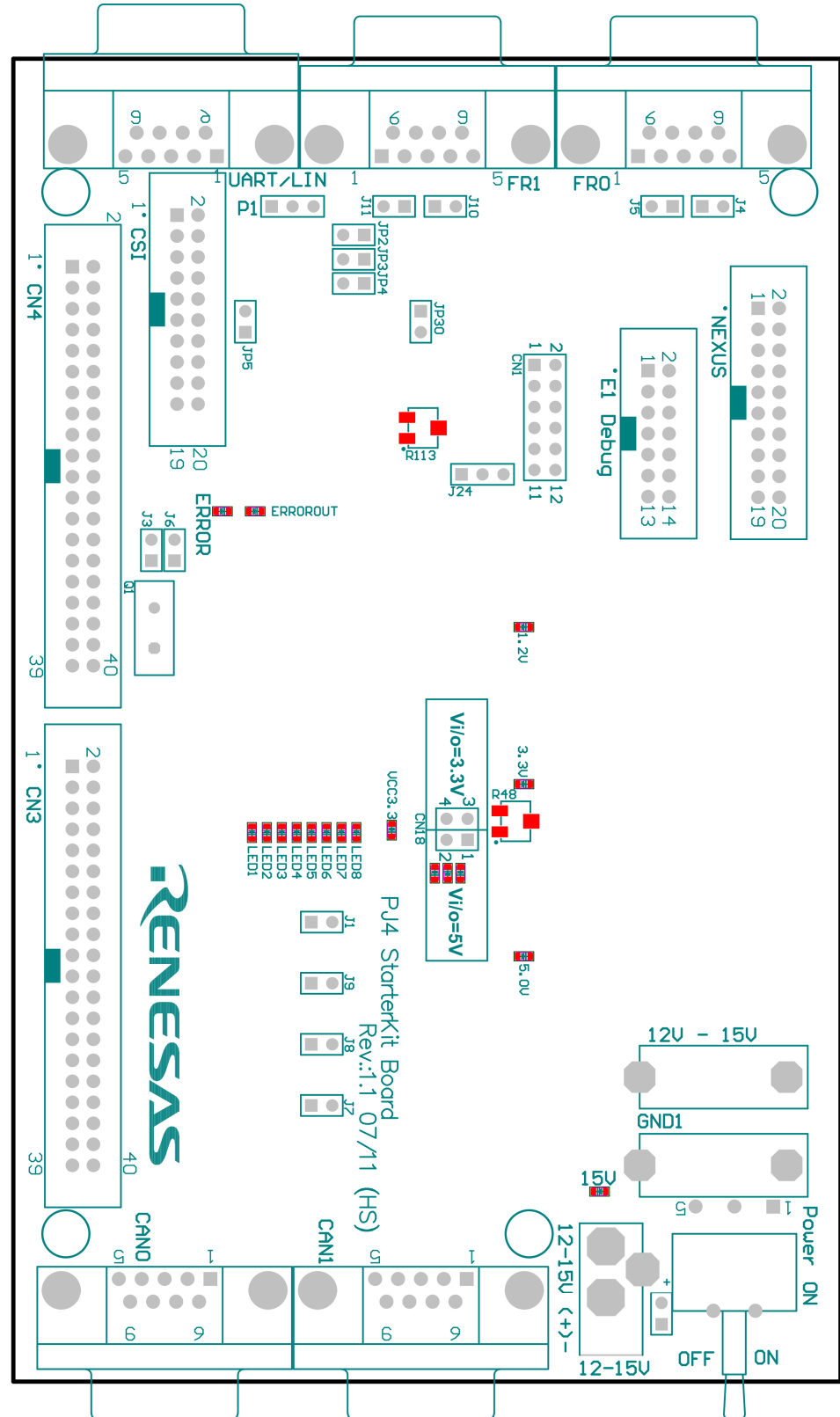
Table 4-4 Potentiometer jumpers

ADC	Jumper	Pot
Ch 21	J3	R7
Ch 22	J6	R8

### 4.4.1 Jumper and connector overview

The location of all jumpers and connectors on the board can be seen in the

Figure 4 Jumper and connector location



## Chapter 5 Revision History

Version	Date	Comment
1.00	17.10.2011	Initial release

# V850E2/Px4 Starter Kit Board



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