

RH850 Evaluation Platform

RH850/E2x-600BGA Emulation Adapter Board for E2M and E2L

Y-RH850-E2X-40NM-EMU-ADAPTER
Y-RH850-E2X-EA-373PIN
Y-RH850-E2X-EA-292PIN

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Chapter 1 Introduction

The RH850/E2x-600BGA emulation adapter board (Y-RH850-E2X-40NM-EMU-ADAPTER) is part of the RH850 Evaluation Platform and serves as a development platform for evaluating the features and performance of Renesas Electronics 32-bit RH850/E2M and E2L microcontrollers. Together with the available exchange adapter boards E2M and E2L devices in a BGA373 (Y-RH850-E2X-EA-373PIN) or BGA292 (Y-RH850-E2X-EA-292PIN) package can be emulated.

The RH850/E2x-600BGA emulation adapter board can be used as a standalone board. It is also possible to use this board to emulate the corresponding device on a target board. Thus, the emulation adapter board, together with the exchange adapter boards and the target PiggyBack boards (Y-RH850-E2X-373PIN-PB-T2-V2) can be mated with a mainboard (Y-RH850-X1X-MB-Tx-Vx) for extended functionality.

Main features:

- RH850/E2x-FCC1 device in BGA600 package
- Standalone operation of the board
- Direct supply of device voltage (typ. 5V) enabling single power supply
- Device programming capability
- Device debugging capability
- Pin headers for direct access to the majority of the functional device pins
- Reset switch
- MainOSC circuitry
- Connectors to exchange adapter boards
- Operating temperature from 0°C to +40°C

This document describes the functionality provided by the emulation adapter board and guides the user through its operation.

For details regarding the operation of the microcontroller, refer to the corresponding User's Manual.

1.1 Emulated devices

The emulation adapter board together with the exchange adapter boards is designed to emulate following devices:

- RH850/E2x-FCC1 for E2M in BGA373
- RH850/E2x-FCC1 for E2M in BGA292
- RH850/E2x-FCC1 for E2L in BGA292
- RH850/E2M in BGA373 or BGA292
- RH850/E2L in BGA292

Chapter 2 Overview

2.1 Overview of Y-RH850-E2X-40NM-EMU-ADAPTER

Figures 1 and 2 provide a schematic view of the Y-RH850-E2X-40NM-EMU-ADAPTER board.

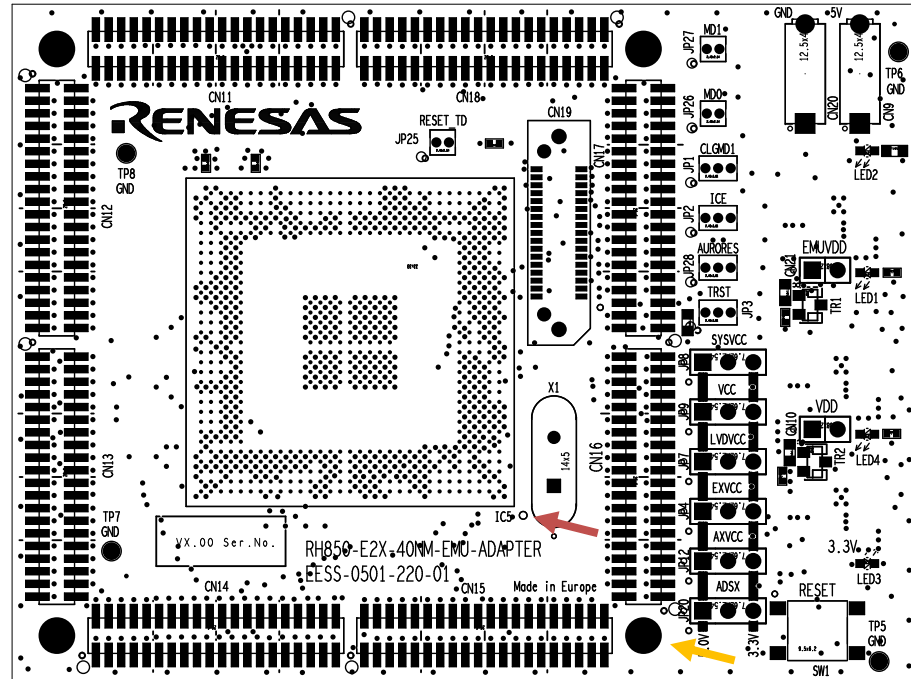


Figure 1 Emulation Adapter Board Top View

The red arrow denotes the position of socket pin #1.

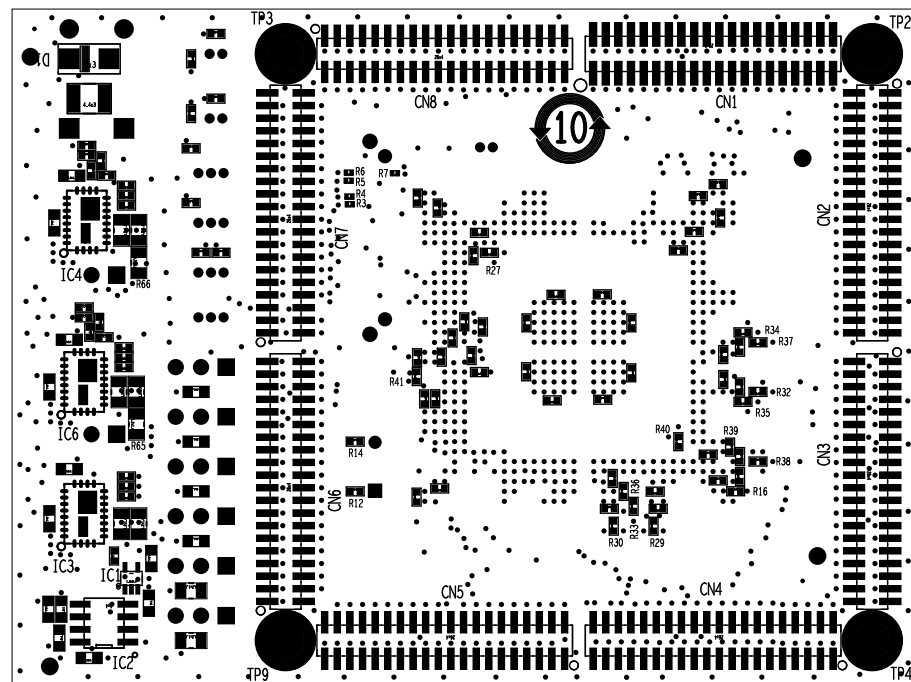


Figure 2 Emulation Adapter Board Bottom View

2.2 Alignment of the Emulation Adapter Board

The Y-RH850-E2X-40NM-EMU-ADAPTER board can be mated with a target board (e.g. Y-RH850-E2X-373PIN-PB-T2-V2). For this purpose, an Exchange Adapter board (Y-RH850-E2X-EA-xxxPIN) for the target BGA is available.

CAUTION: *Due to the symmetrical nature of the BGA package, there is no protection against erroneous polarity towards the target board. Therefore, special care is mandatory to not damage the boards and devices.*

The #1 pin of the emulation adapter board (see red arrow in **Figure 1**) must be aligned with the #1 pin of the target board.

2.3 Mating of the Emulation and Exchange Adapter Boards

The emulation adapter board can be mated with the exchange adapter board via CN1 to CN8.

The individual boards of Y-RH850-E2X-40NM-EMU-ADAPTER and Y-RH850-E2X-EA-xxxPIN do have an in-build protection against erroneous polarity.

In order to separate the boards more easily, 4 nylon screws are provided with the board. An orange arrow in Figure 1 depicts the position of the corresponding metric threads. Please note that in total four threads are available at the edges near the connectors. By evenly turning all four screws, the boards can be detracted easily.

CAUTION: *Please take special care when plugging and detracting the boards, otherwise they could be damaged.*

Chapter 3 Power supply

3.1 Board power connection

For operation of the device, a supply voltage must be connected to the board.

Within this document the following voltages are considered as 'typical' values:

Voltage1 = 5V

Voltage2 = 3.3V

Voltage3 = 1.25V

Direct voltage supply

The following connectors are available to supply the voltage directly:

- Two 2mm 'banana-type' connectors:
 - One red connector for voltage 5V (CN9).
 - A black connector for ground (GND) connection (CN20).

Note: The two connectors are supplied with the board but not assembled. For connection of the board to a power supply two cables with 2mm banana plugs and two adapters from 4mm to 2mm are provided with the board.

On-board voltage regulators generate the 3.3V (IC3) and 1.25V (IC4 and IC6 for EMUVDD and VDD, respectively) from the 5V power supply.

For details about voltage distribution, refer to **Chapter 3.2 'Voltage distribution'**.

For each of the voltages, 5V, 3.3V and two 1.25V green LEDs are available to signal that the related voltage is available on the PiggyBack board.

- LED2 -> 5.0V, beneath CN19
- LED3 -> 3.3V, in the vicinity of reset switch SW1
- LED1 -> 1.25V for EMUVDD, next to CN21
- LED4 -> 1.25V for VDD, next to CN10

3.2 Voltage distribution

The table shows the required device power supply pins and their function. For detailed explanation of their function and specification, please refer to the user documentation of the corresponding device:

Table 1 Available Power Domains for MCU

Device Supply Pin
SYSVCC
VCC
EnVCC (n = 0-2)
LVDVCC
EMUVCC
AnVCC (n = 0-3)
AnVREFH (n = 0-3)
ADSVCC
ADSVREFH
EMUVDD
VDD

The following figure shows the configurable voltage distribution on the emulation adapter board.

- Jumpers can interrupt all power supply lines. Thus, the voltage can be configured to either 3.3V or 5V power supply.
Note: Due to limited space available on the emulation adapter board, the power supply for all EnVCC can only be configured together to either 3.3V or 5V.
- The source for the on-board voltage regulator, as well as the source for all on-board devices (e.g. LEDs) is the 5V supplied via connector CN9.
- VDD and EMUVDD are powered from the on-board voltage regulators IC6 and IC4, respectively.

Note: Although nominally 1.25V is used even as name in the schematic the output of the voltage regulator IC19 is slightly increased to 1.28V (see **Chapter 10 'Schematic'**). With this sufficient high voltage is applied, even in case of any possible voltage drops.

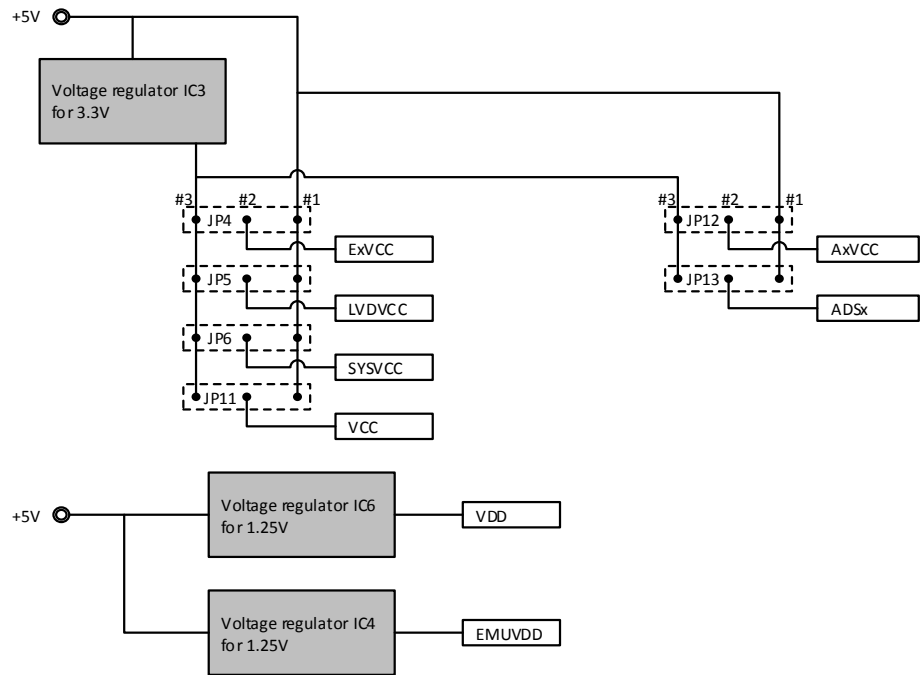


Figure 3 Voltage Distribution on the PiggyBack Board

For more details, please refer to **Chapter 10 ‘Schematic’**. For typical configuration of the jumpers, please refer to **Chapter 7 ‘Jumper Configuration’**.

Chapter 4 Clock sources

External crystal oscillators for the device clock supply are provided with the board.

4.1 MainOsc

A crystal or ceramic resonator can be mounted on socket X1.

A 20 MHz and 40MHz oscillator are supplied with the board.

The signals X1 and X2 are by default not connected to a pin header in order to minimize disturbance on the resonator signal and therefore are not connected to the exchange adapter boards, which are connecting the emulation adapter board to a target board. Thus, an oscillator available on the target board cannot be used for clock supply of the emulation adapter board.

Chapter 5 Debug and Programming interface

The signal 'EVTO' from below connectors is pulled up to 'E0VCC' via resistor R52. Please refer to the documentation of the used tool, whether this is needed. Otherwise R52 can be removed.

The signal 'TRST' from below connectors can be pulled up to 'SYSVCC' or to the 'TRST' line of the used tool via jumper JP3.

For typical configuration of the jumpers, please refer to **Chapter 7 'Jumper Configuration'**.

5.1 14 Pin Debug Connector

For connection of the microcontroller to debug and flash programming tools with a 14pin connector a debug adapter is provided with the board. This must be mounted on CN19.

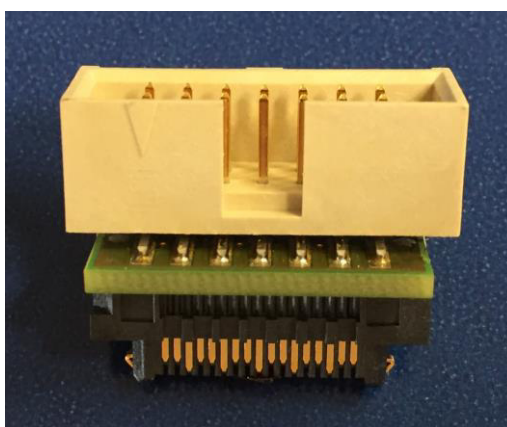


Figure 4 34pin to 14pin Debug Adapter

The signal connection of this connector is shown in the table below:

Table 2 Pin Assignment of 14 Pin Debug Connector

Debug Adapter Pin	Function
1	TCK
2	GND
3	TRST / Jumper JP3 #3
4	MD0
5	TDO
6	-
7	TDI
8	VCC
9	TMS
10	EVTO
11	DRDY
12	GND

13	RES_IN
14	GND

5.2 34 Pin Aurora Connector

For connection of the microcontroller to a trace tool CN19 is available.

The signal connection of the connector CN19 is shown in the table below:

Table 3 Pin Assignment of CN19

CN19 Pin	Function	CN19 Pin	Function
1	TODP0	2	VCC
3	TODN0	4	TCK
5	GND	6	TMS
7	TODP1	8	TDI
9	TODN1	10	TDO
11	GND	12	TRST / Jumper JP3 #3
13	TODP2	14	MD0
15	TODN2	16	EVTI
17	GND	18	EVTO
19	TODP3	20	MD1
21	TODN3	22	RES_IN
23	GND	24	GND
25	Reserved*1	26	CICREFP
27	Reserved*1	28	CICREFN
29	GND	30	GND
31	Reserved*1	32	DRDY
33	Reserved*1	34	RES_OUT*2

Access to the signal AURORES is possible via JP28. With this jumper AURORES can also be connected to TRST or pulled-down to GND

Note 1: These pins can be connected to RES_OUT via resistors (R3-6) if needed.

Note 2: This pin connects to RES_OUT via resistor R7. R7 can be removed in order to separate the pin from signal RES_OUT.

Chapter 6 Connectors for ports of device

Connection to most functional pins of the devices is possible via the connectors CN11 to CN18.

Some functions might not be available on the pin headers, e.g. high frequency signals, as this would disturb the integrity of such signals. For more details, please refer to **Chapter 10 'Schematic'**.

CAUTION: *The pin headers are directly connected to the pins of the device, therefore special care must be taken to avoid any electrostatic or other damage to the device.*

6.1 Push button for RESET

In order to issue a RESET to the device, the push-button SW1 is available.

6.2 Mode Selection

The emulation adapter board gives the possibility to configure the following mode pins

- MD0 via jumper JP26
- MD1 via jumper JP27

To apply "High" to the mode pins, the corresponding jumpers can be set.

CAUTION: *Be careful in configuration of mode related pins, as wrong configuration can cause irregular behavior of the devices. Be sure to check the corresponding User's Manual for details, which modes can be selected for the used device.*

6.3 Emulation Pins Selection

The emulation adapter board gives the possibility to configure the following emulation pins

- ICE via jumper JP2
- CLGMD via jumper JP1

To apply "High" to the mode pins, the corresponding jumpers can be set. Pin CLGMD0 is clamped to GND.

6.4 Connectors to the Exchange Adapter Board

Eight connectors (CN1 to CN8) are available on the bottom side to connect the emulation adapter board to the exchange adapter board and thus to a target board.

For details about the signal assignment to the connectors, please refer to **Chapter 10 'Schematic'**.

The following signals are not connected to a target board via the exchange adapter board:

- X1_C and X2_C
- MSYNZ
- TSRT

The JTAG / Debug related signals TCK, TMS, TDI, TDO and DRDY are by default not connected. If needed, they can be connected via 0Ohm resistors R1 to R5. For details, please refer to **Chapter 10 'Schematic'**.

Chapter 7 Jumper Configuration

Jumper are available to configure the function of the board. This chapter describes the standard configuration, i.e. jumper setting for the intended devices, to enable basic operation. For a detailed explanation of the supported function of the used device, please refer to the corresponding HW user's manual.

Table 4 Recommended Jumper Settings

Purpose	Jumper #	Setting
CLGMD1	1	#2-#3
ICE	2	#2-#3
TRST Config	3	#2-#3
ExVCC Config	4	#1-#2
LVDVCC Config	7	#1-#2
SYSVCC Config	8	#1-#2
VCC Config	9	#1-#2
AxVCC Config	12	#1-#2 only
ADSx Config	20	#1-#2 only
VCC Config	25	#1-#2
MD0 Pull-Up	26	- (opt)
MD1 Pull-Up	27	- (opt)
AUORES Config ^{*1)}	28	#1-#2

Note 1): Please refer to the user's documentation of the used tool for dedicated requirement.

The table has the following meaning:

- - (opt): Not mandatory to connect. Can be connected if necessary for use case
- #x-#y: Connect the pins #x and #y for the standard configuration. Possible to configure depending on the use case and on the allowed specification of the used device.
- #x-#y only: Only allowed to connect pins #x and #y.

A small circle near the jumper on the board identifies the #1 pin of the jumper.

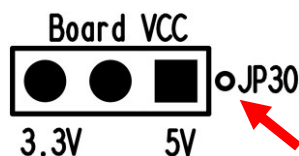


Figure 5 Identifying the Pin #1 at a Jumper (Example)

In this example, the pin #1 is on the right side. The red arrow highlights the marking circle.

Chapter 8 Precautions

8.1 Power-Off Sequence

A dedicated sequence needs to be applied, when the power supplied to the board is turned off.

Please follow below sequence:

1. At first press the reset push-button SW1 and keep the button pushed down (keep the Reset asserted)
2. Turn off the board power supply
3. After power supply is shut down, release the push-button SW1

Chapter 9 Mechanical dimensions

All dimensions given in mm.

9.1 Emulation Adapter Board Y-RH850-E2X-40NM-EMU-ADAPTER

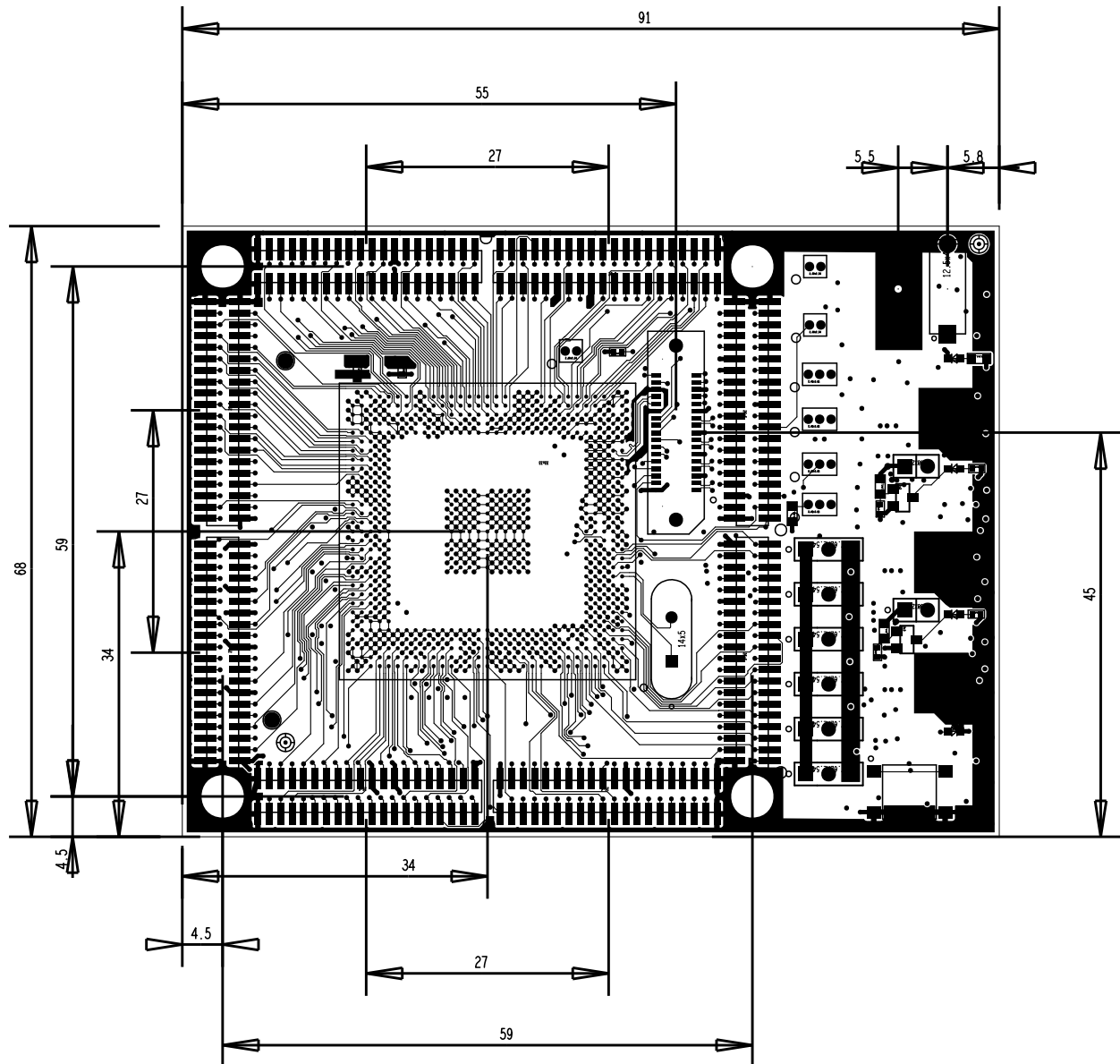


Figure 6 Dimensions of the Emulation Adapter Board

9.2 Exchange Adapter Board Y-RH850-E2X-EA-xxxPIN

The exchange adapter board (Y-RH850-E2X-EA-xxxPIN) consists of two boards. One common BGA exchange board (Y-RH850-E2X-EA-BGA) and a dedicated target adapter board for the corresponding package (Y-RH850-E2X-TA-373PIN and Y-RH850-E2X-TA-292PIN for BGA373 and BGA292, respectively).

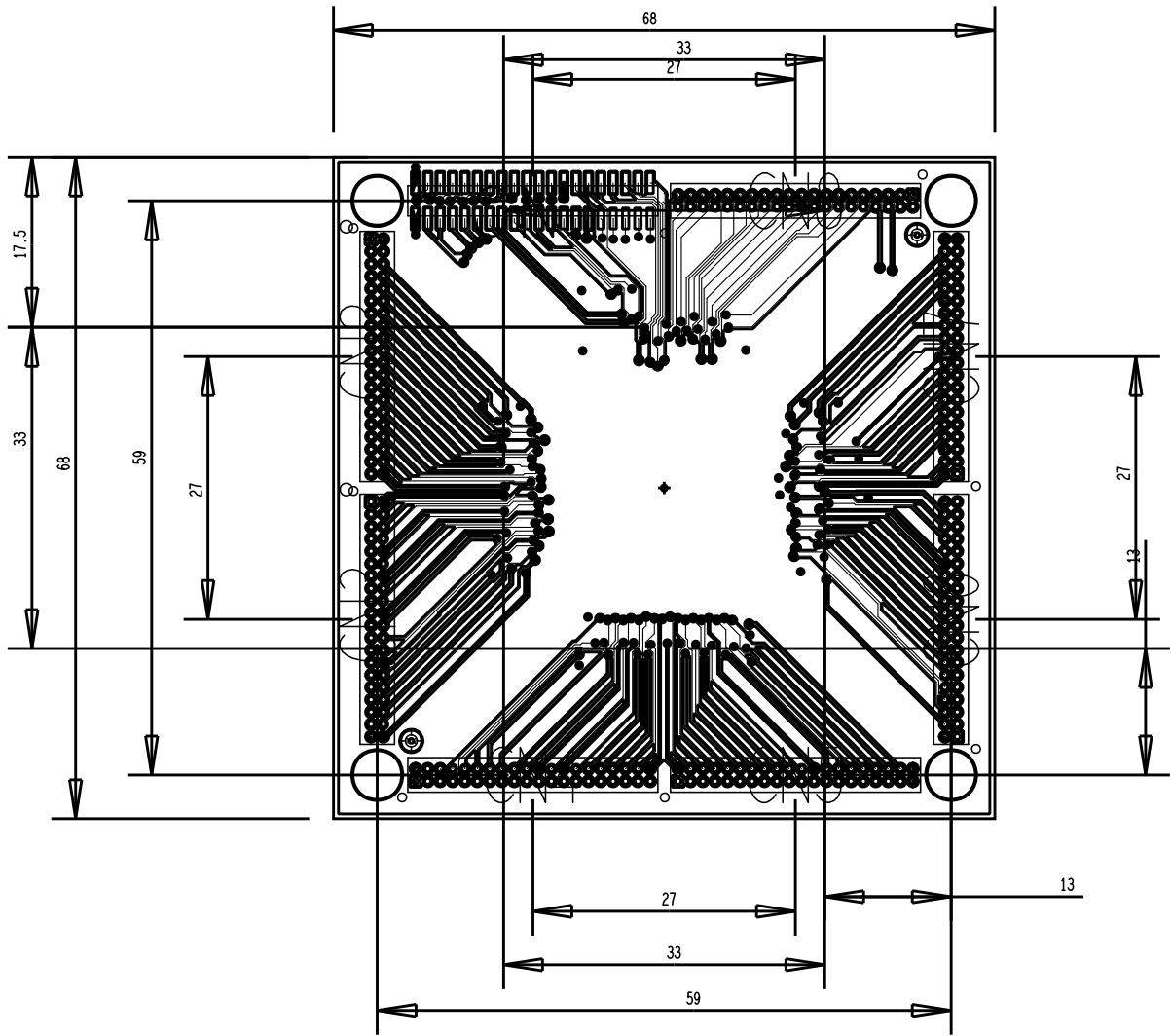


Figure 7 Dimension of Y-RH850-E2X-EA-BGA

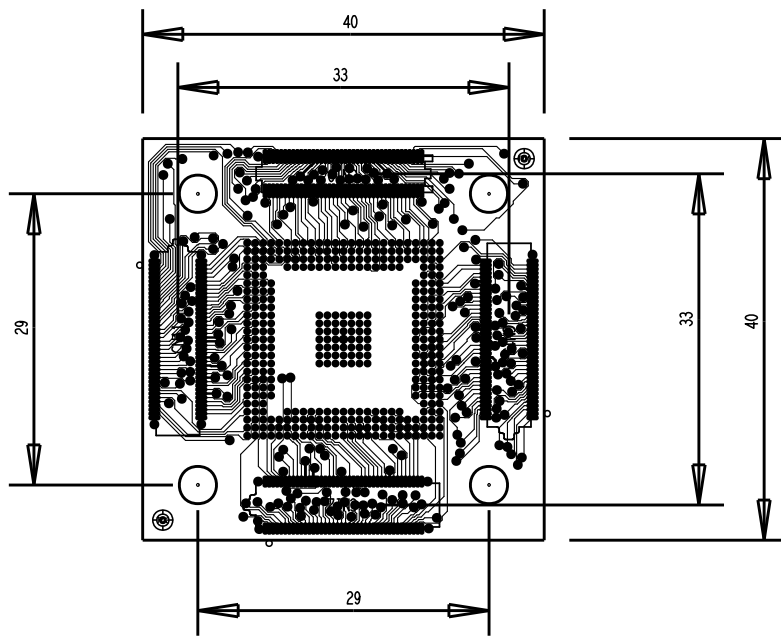


Figure 8 Dimension of Y-RH850-E2X-TA-373PIN

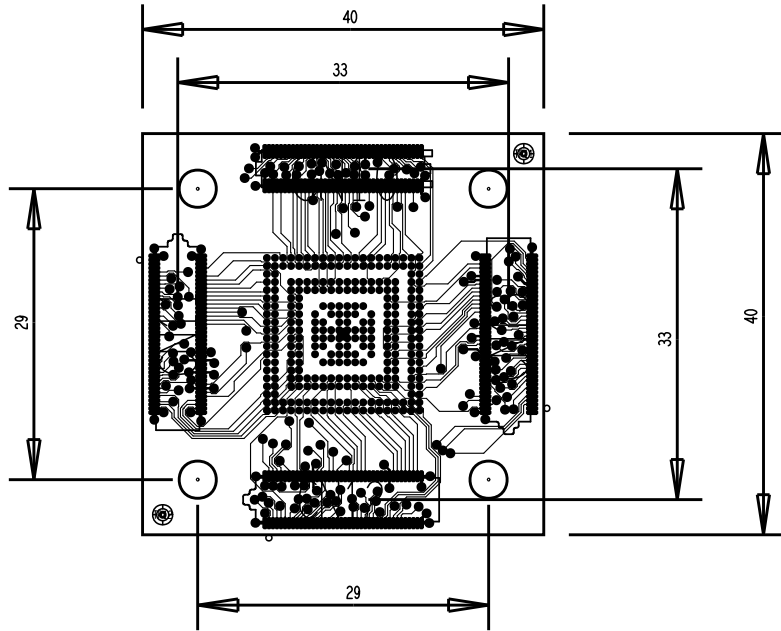


Figure 9 Dimension of Y-RH850-E2X-TA-292PIN

Chapter 10 Schematic

CAUTION: *The schematics shown in this document are not intended to be used as a reference for mass production. Any usage in an application design is in sole responsibility of the customer.*

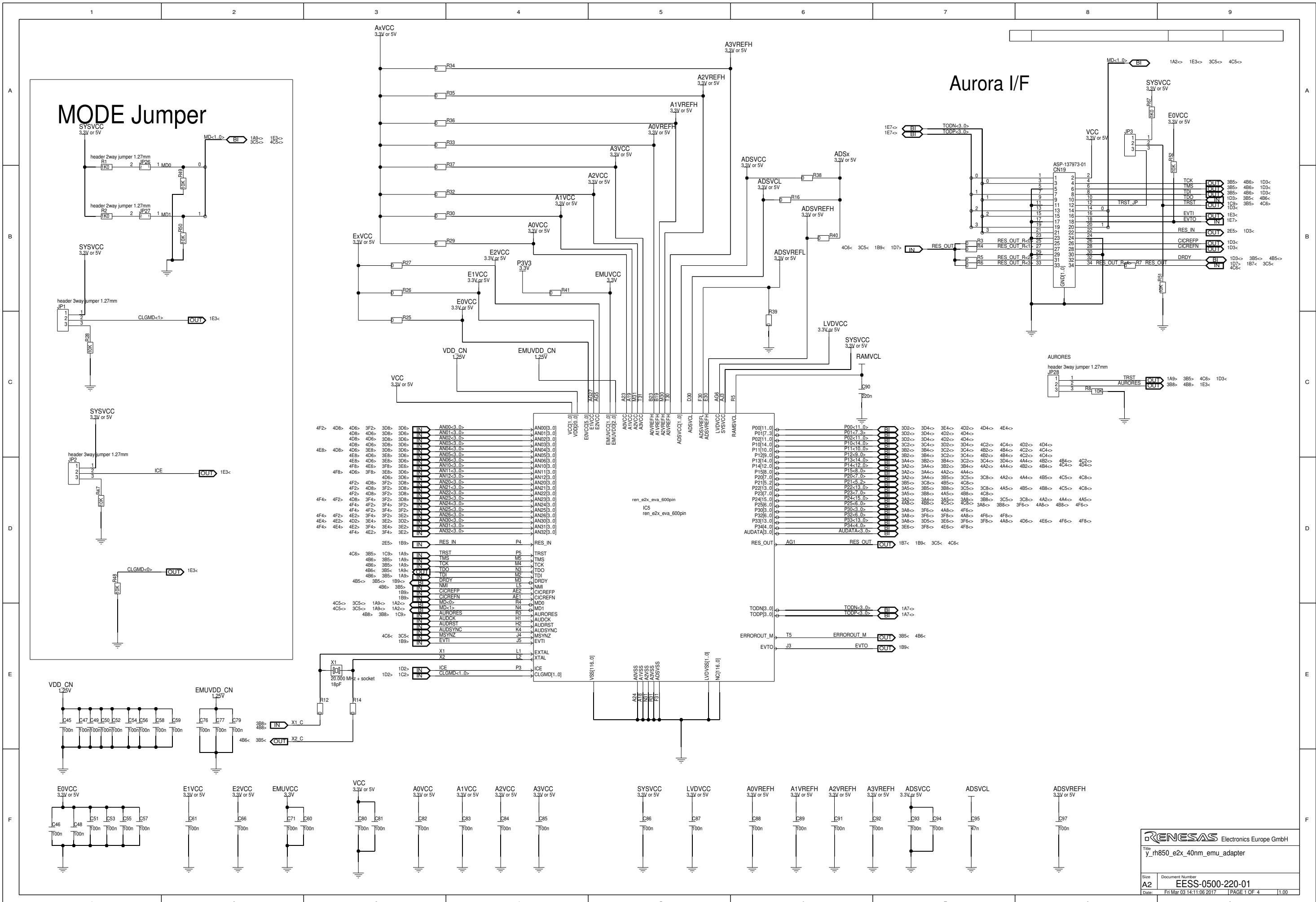
10.1 Emulation Adapter Board Y-RH850-E2X-40NM-EMU-ADAPTER

The following components described in the schematic are not provided with the board:

- Resistances
 - R3, R4, R5 and R6
 - R21, R22, R61 and R62

The following components described in the schematic are provided with but not mounted on the board:

- Standard 2mm power lab sockets
 - CN20
 - CN9



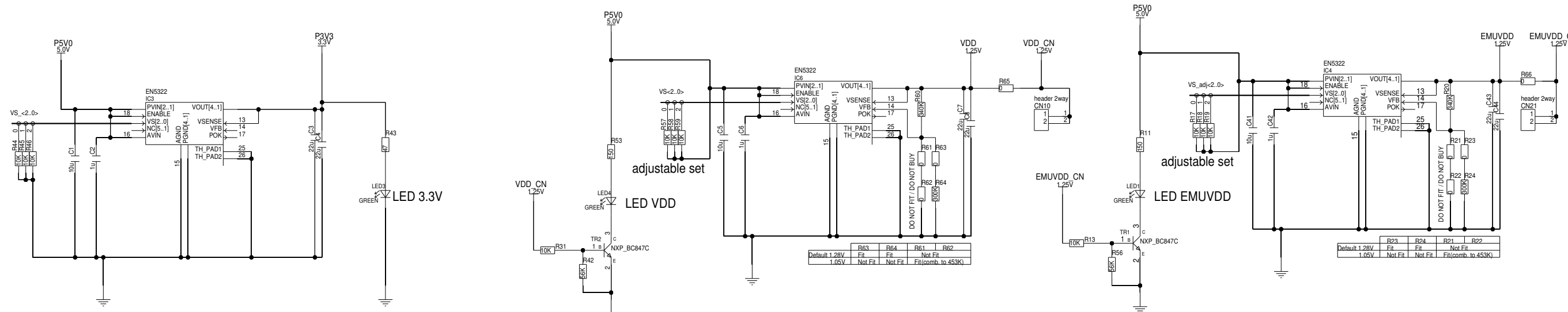
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VOLTAGE REGULATOR



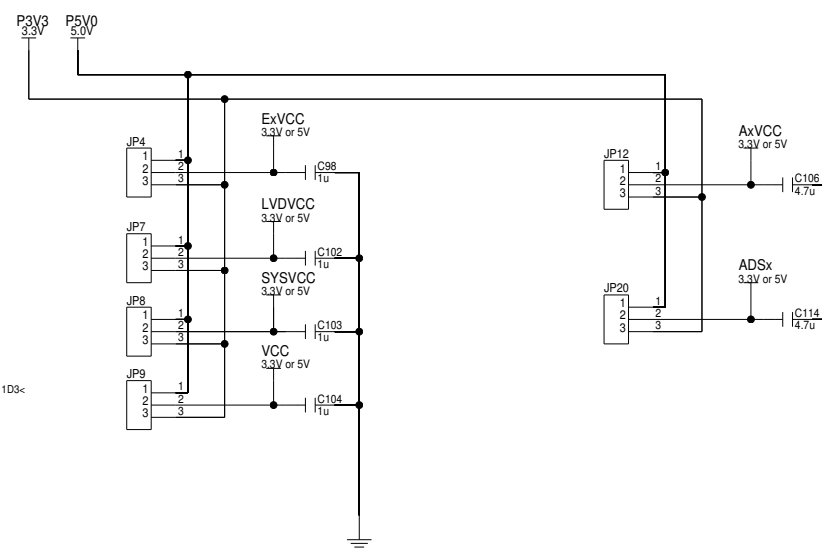
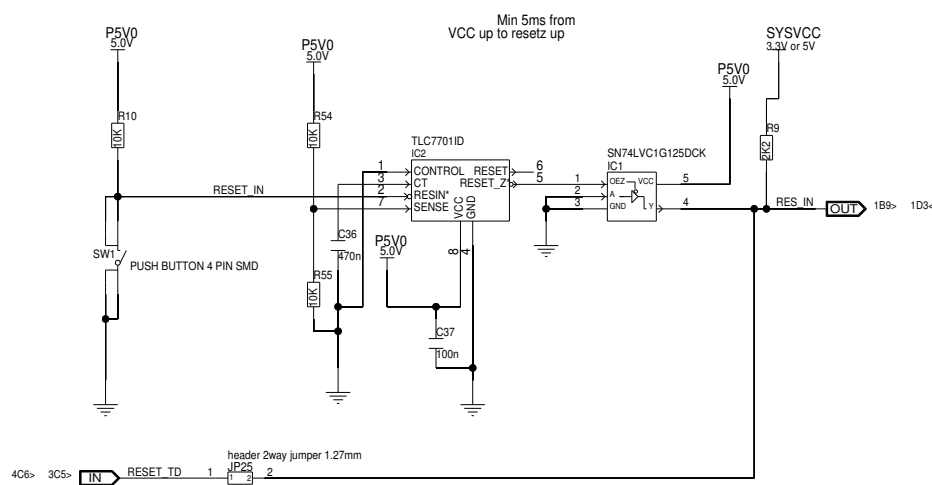
POWER SUPPLY

VOLTAGE DISTRIBUTION

TO BE PRINTED ON PCB
Std Power Lab socket 2mm black GND

DO NOT FIT / TO DELIVER WITH THE BOARD

PUSH BUTTON FOR RESET



FUDICIALS

TOP

1 TP11 FIDUCIAL_1MM

1 TP12 FIDUCIAL_1MM

BOTTOM

1 TP14 FIDUCIAL_1MM

1 TP15 FIDUCIAL_1MM

GND TEST POINT

- 1 TP5 Testpoint_small_b1
- 1 TP6 Testpoint_small_b1
- 1 TP7 Testpoint_small_b1
- 1 TP8 Testpoint_small_b1

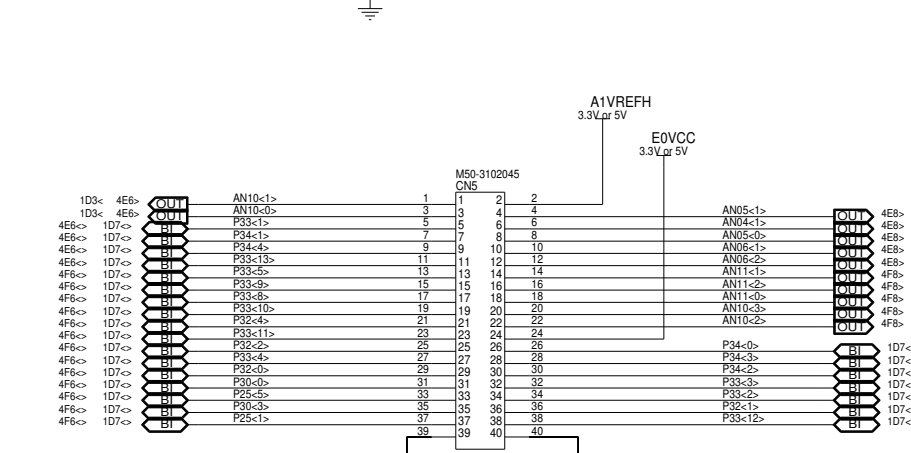
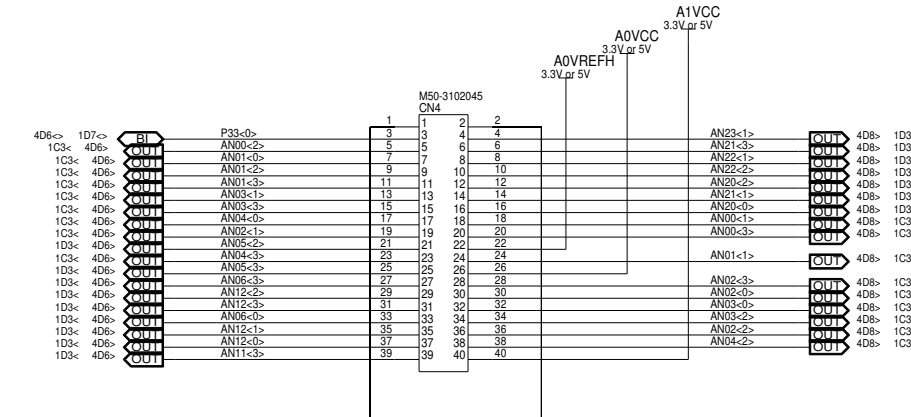
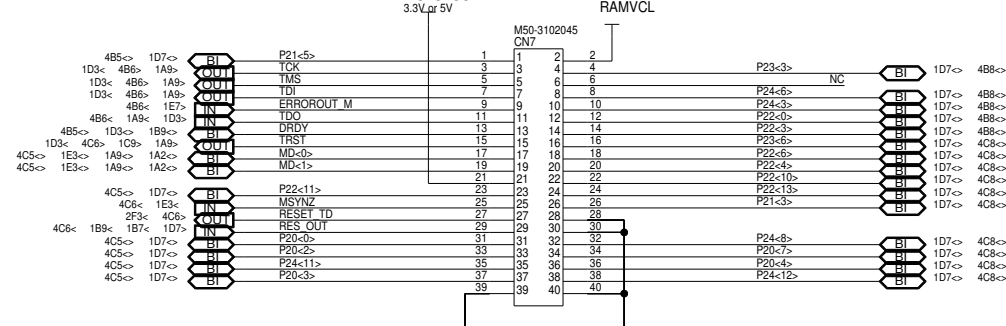
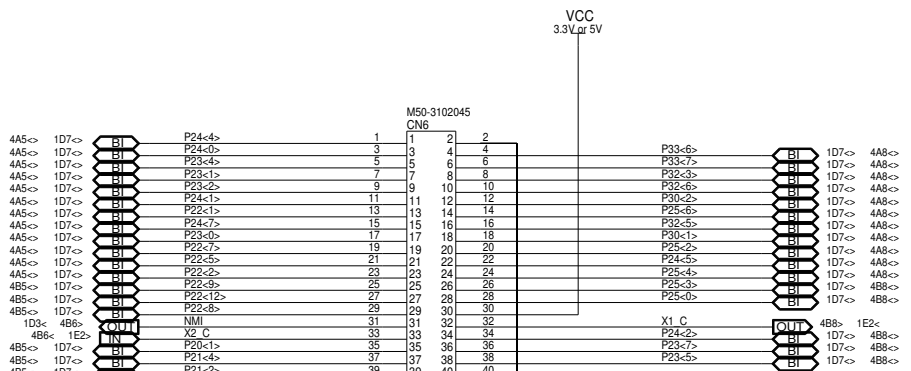
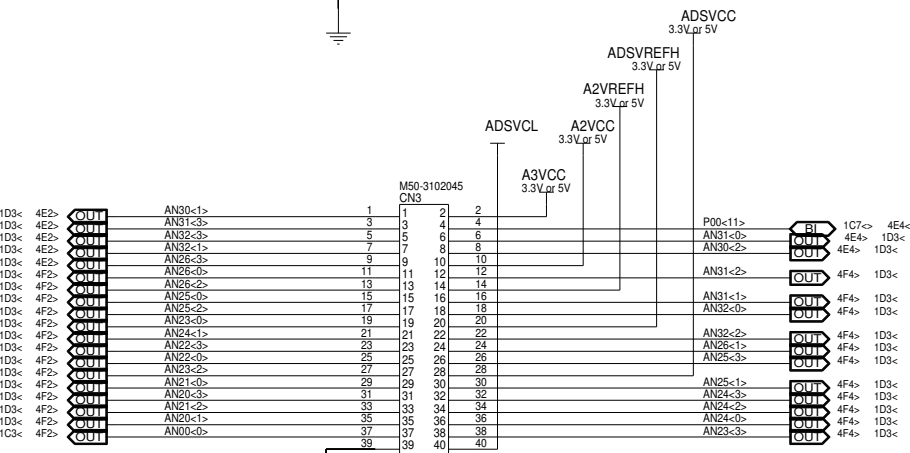
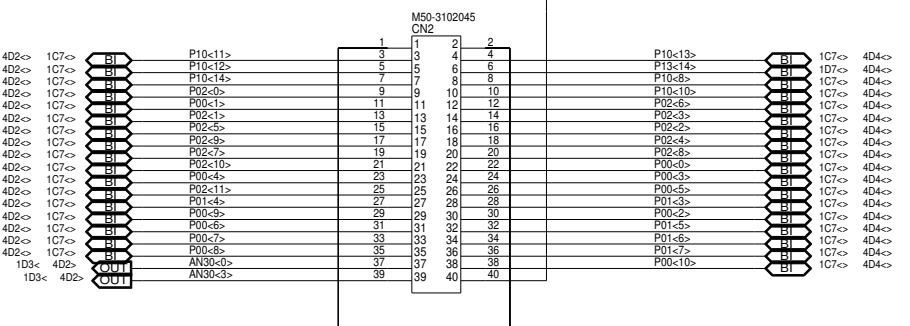
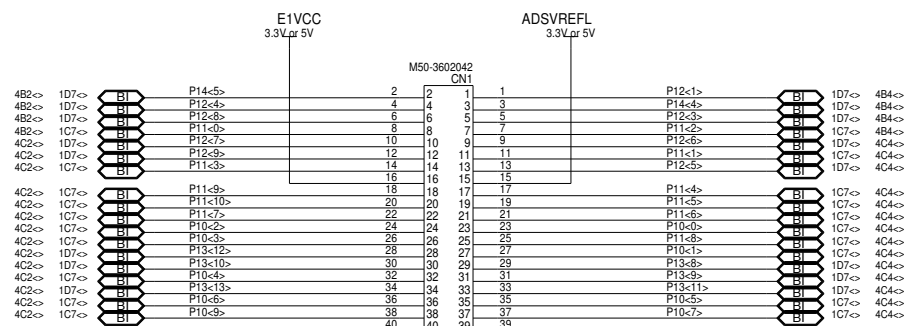
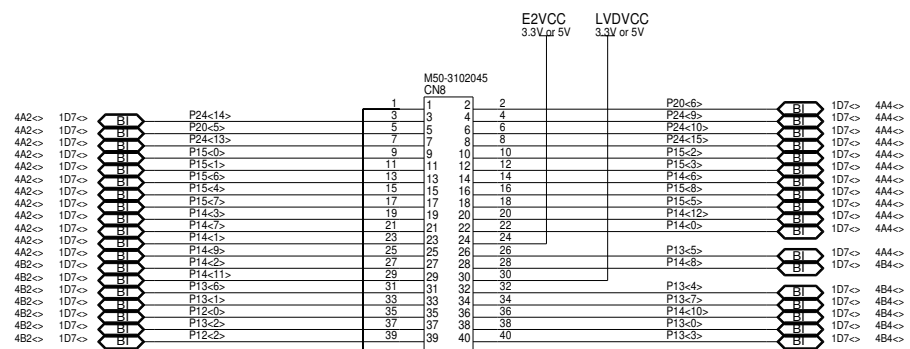
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- 1 steel_spacer_m2_5
- 1 TP3
- 1 steel_spacer_m2_5
- 1 TP4
- 1 steel_spacer_m2_5
- 1 TP9
- 1 steel_spacer_m2_5

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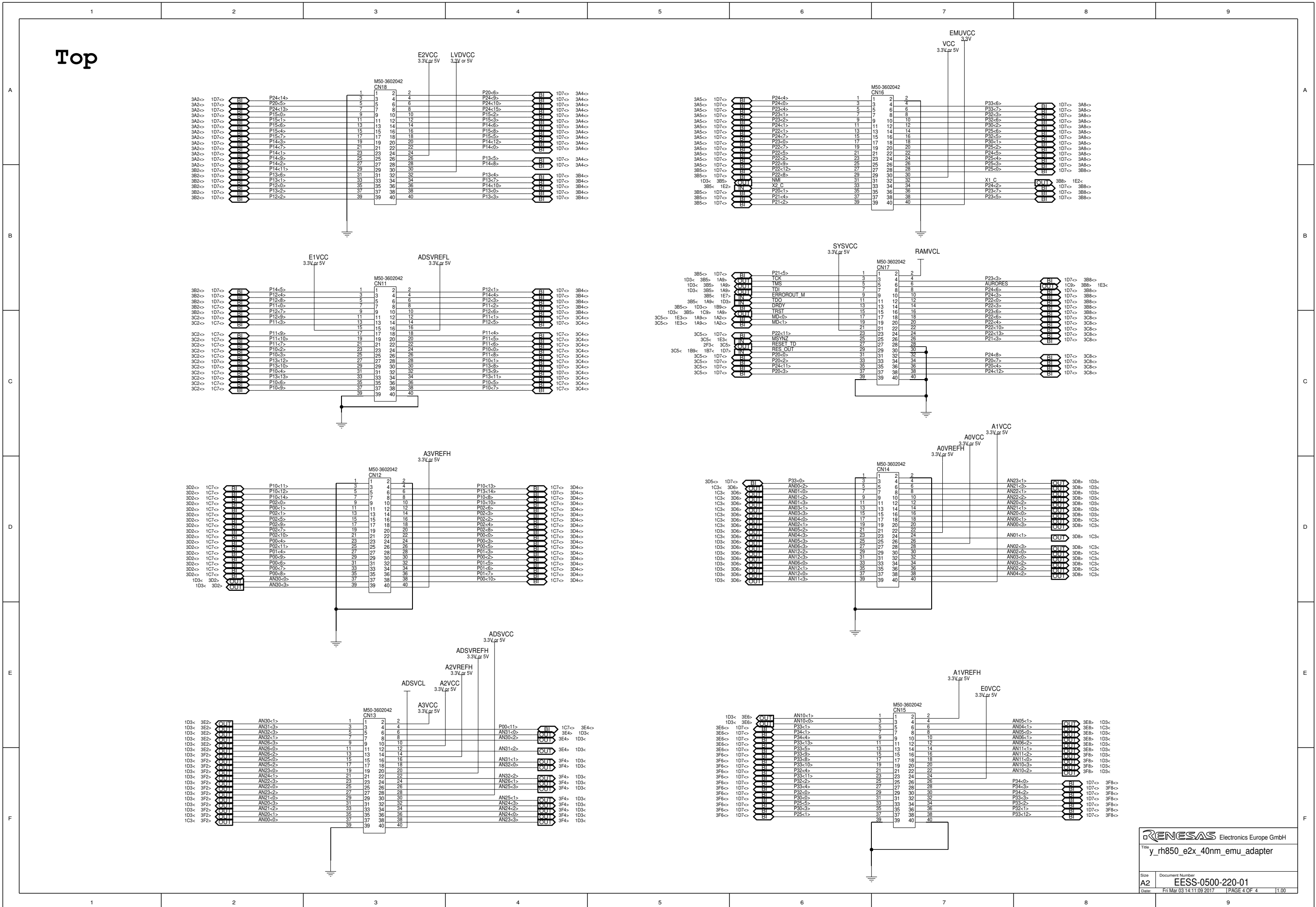
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Bottom



Top

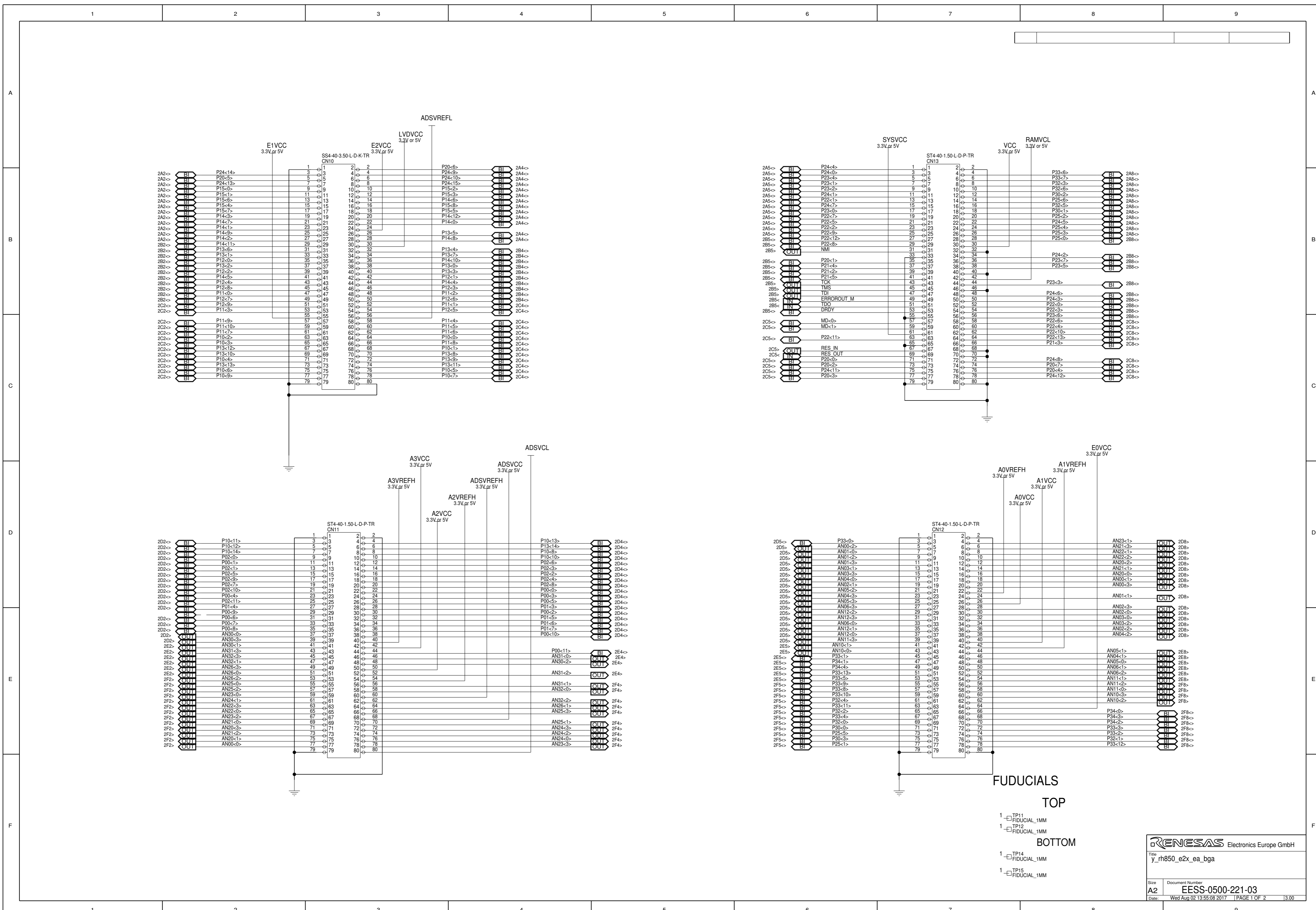


10.2 Exchange Adapter Board Y-RH850-E2X-EA-xxxPIN

10.2.1 BGA Exchange Board Y-RH850-E2X-EA-BGA

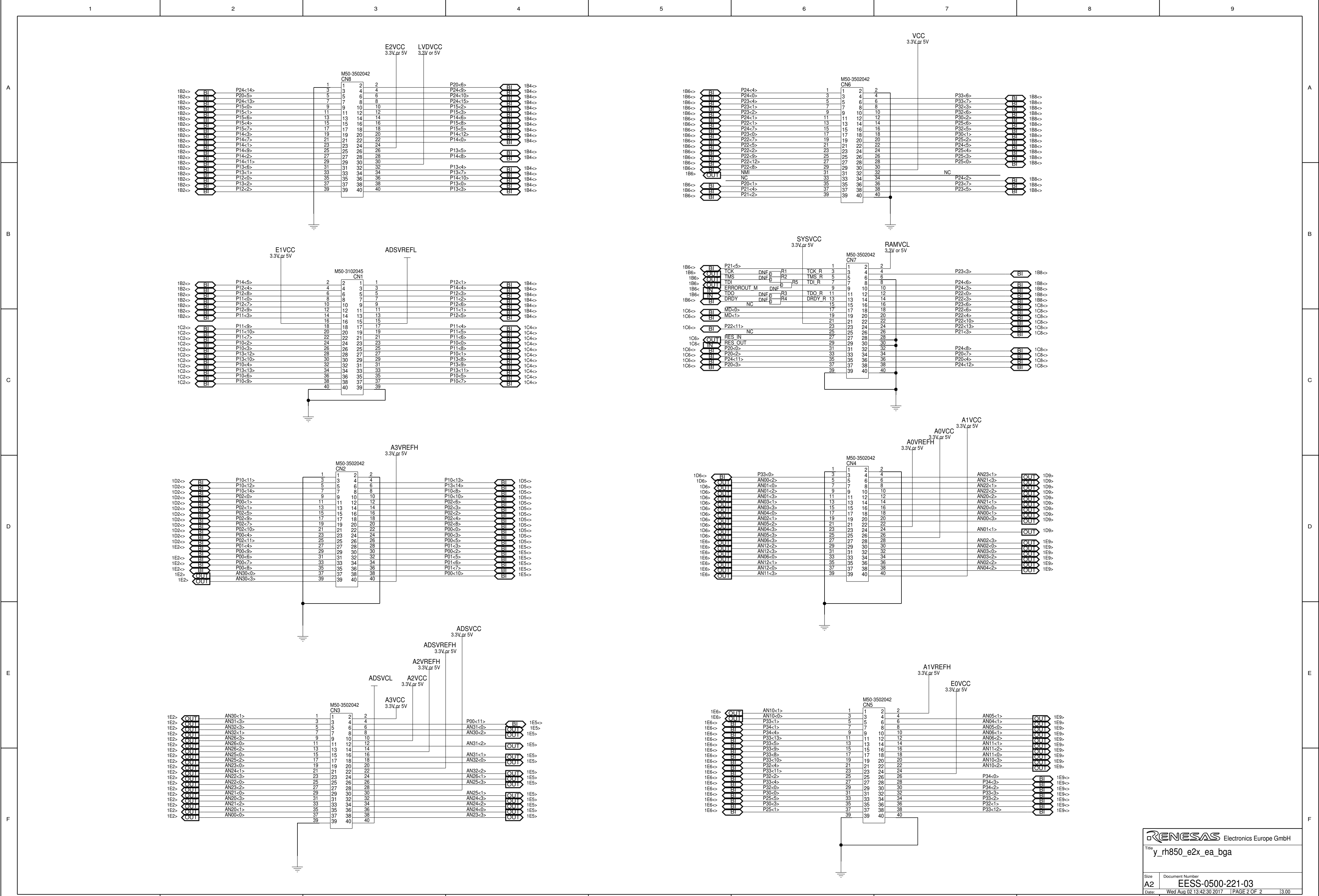
The following components described in the schematic are not provided with the board:

- Resistances R1 to R5



FUDUCIALS
TOP
 1 = TP11 FIDUCIAL_1MM
 1 = TP12 FIDUCIAL_1MM
BOTTOM
 1 = TP14 FIDUCIAL_1MM
 1 = TP15 FIDUCIAL_1MM

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10.2.2

Target Adapter Boards (Y-RH850-E2X-TA-xxxPIN)

The following pages depict the schematics of the target adapter boards.

The currently available boards are:

- Y-RH850-E2X-TA-373PIN for a BGA373 target package
- Y-RH850-E2X-TA-292PIN for a BGA292 target package



FUDUCIALS
TOP
BOTTOM

- steel_spacer_m2_5
- TP1
- 1 - []
- steel_spacer_m2_5
- TP2
- 1 - []
- steel_spacer_m2_5
- TP3
- 1 - []
- steel_spacer_m2_5
- TP4
- 1 - []

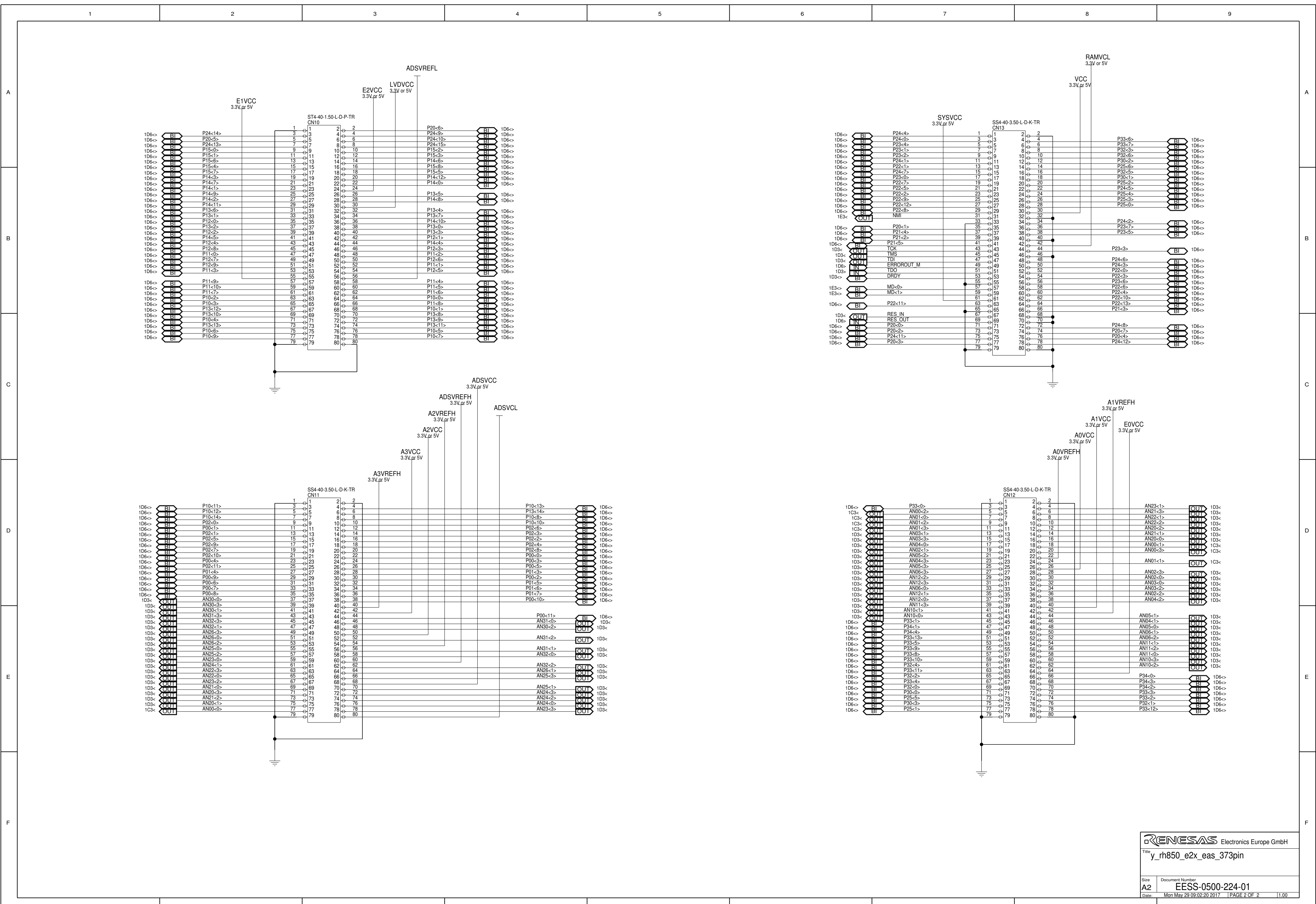
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- TP14
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- TP15
- 1 - [] FIDUCIAL_1MM

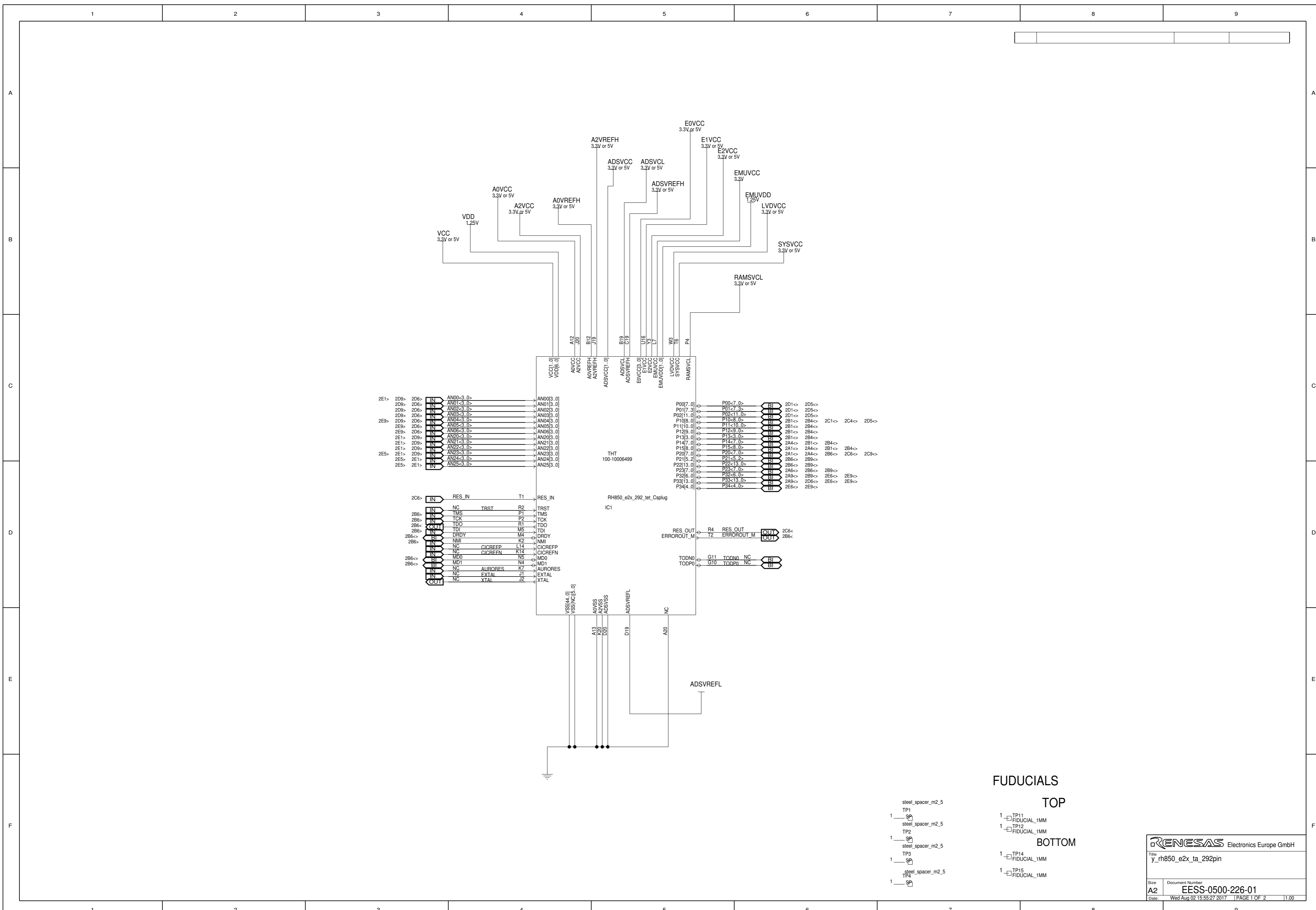
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Date: Mon May 29 09:02:19 2017 TPAGE 1 OF 2 1.00





FUDUCIALS
TOP
BOTTOM

- steel_spacer_m2_5
- TP1
- 1 FIDUCIAL_1MM
- steel_spacer_m2_5
- TP2
- 1 FIDUCIAL_1MM
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- TP3
- 1 FIDUCIAL_1MM
- steel_spacer_m2_5
- TP4
- 1 FIDUCIAL_1MM

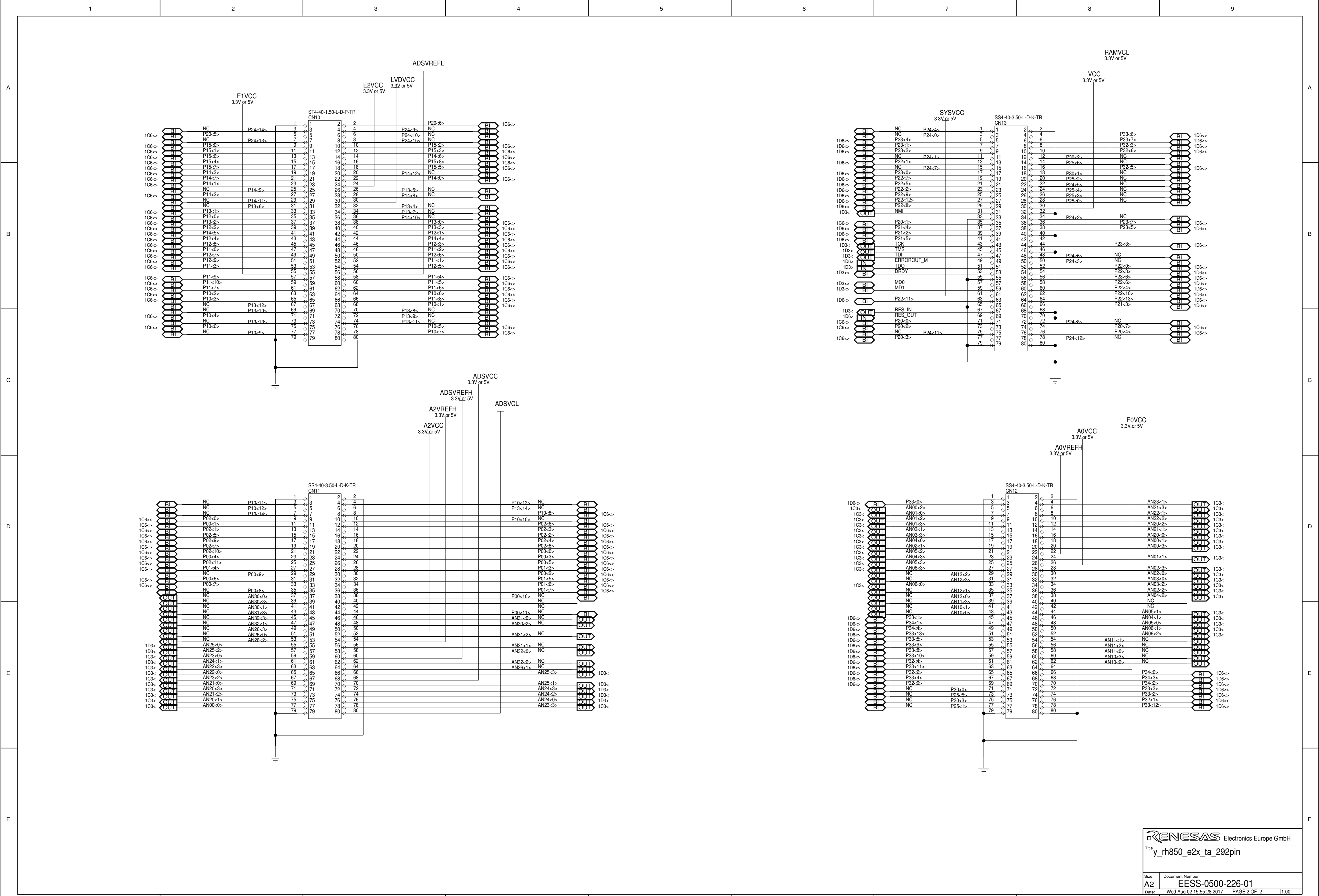
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- 1 TP12 FIDUCIAL_1MM
- 1 TP14 FIDUCIAL_1MM
- 1 TP15 FIDUCIAL_1MM

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Title: y_rh850_e2x_ta_292pin

Size: A2 Document Number: EESS-0500-226-01

Date: Wed Aug 02 15:55:27 2017 PAGE 1 OF 2 1.00



Chapter 11 Revision History

The table provides information about the major changes of the document versions.

Date	Version	Description
2017-09-20	1.0	Initial release

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