MSRZFive Hardware Manual

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Created by: Diana Korchmar

CONTENTS:

CHAPTER

ONE

ABOUT THIS MANUAL

1.1 Imprint

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1.5 Care and Maintenance

- Keep the device dry. Precipitation, humidity, and all types of liquids or moisture can contain minerals that will corrode electronic circuits. If your device does get wet, allow it to dry completely.
- Do not use or store the device in dusty, dirty areas. Its moving parts and electronic components can be damaged.
- Do not store the device in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.
- Do not store the device in cold areas. When the device returns to its normal temperature, moisture can form inside the device and damage electronic circuit boards.
- Do not attempt to open the device.
- Do not drop, knock, or shake the device. Rough handling can break internal circuit boards and fine mechanics.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the device.
- Do not paint the device. Paint can clog the moving parts and prevent proper operation.
- Unauthorized modifications or attachments could damage the device and may violate regulations governing radio devices.

1.6 Change Log

Revision	Date	Revised	Comment
1.0	13.09.2022	dk	Initial creation

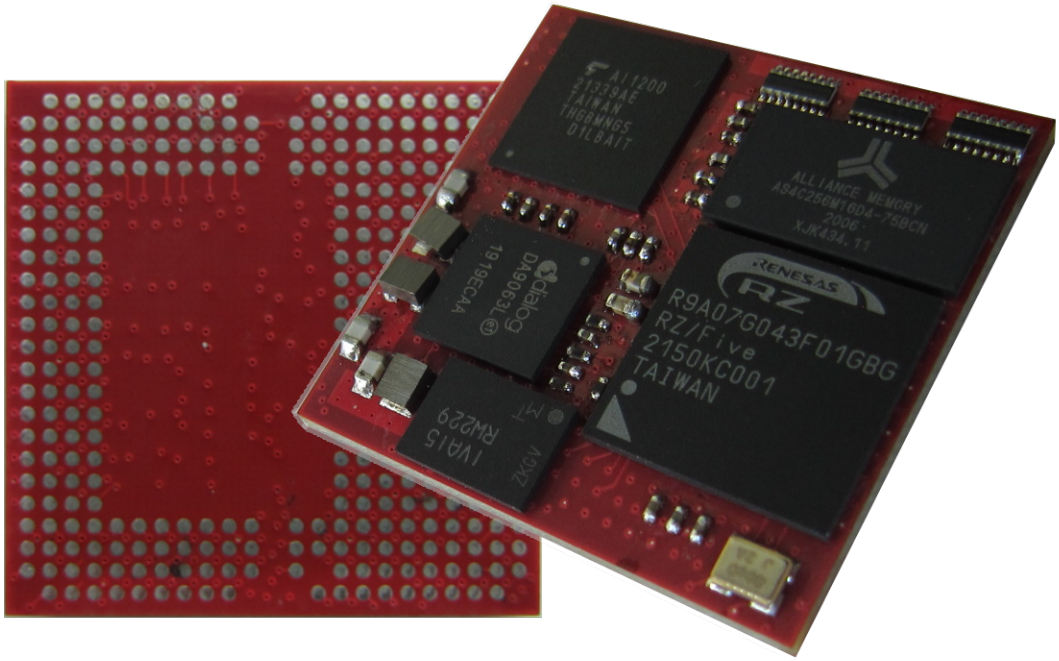
CHAPTER

TWO

OVERVIEW

2.1 MSRZFive Microprocessor SiP

The MSRZFive is the Open Standard Module compliant System-In-Package based on Renesas RZ Family architecture offering high-performance 64-bit RISC-V core. The MSRZFive combines compact design and a wide range of services, bringing low power consumption, thermal efficiency and low-cost to embedded systems.



2.2 Feature Set

- **RZ/Five general-purpose microprocessor unit**
  - Single core RISC-V, up to 1GHz
- 512MB – 4GB DDR4 RAM
- 4GB eMMC NAND Flash
- dual 10/100/1000MBit Ethernet
- USB2.0 Host/OTG
- 2x CAN
- UART, I2C, SPI
- ADC
- compliant to the SGET OSM standard
- size S, 30x30mm^2,
- pin count: 332
- 0°C..+70°C commercial temperature range
- -40°C..+85°C industrial temperature range

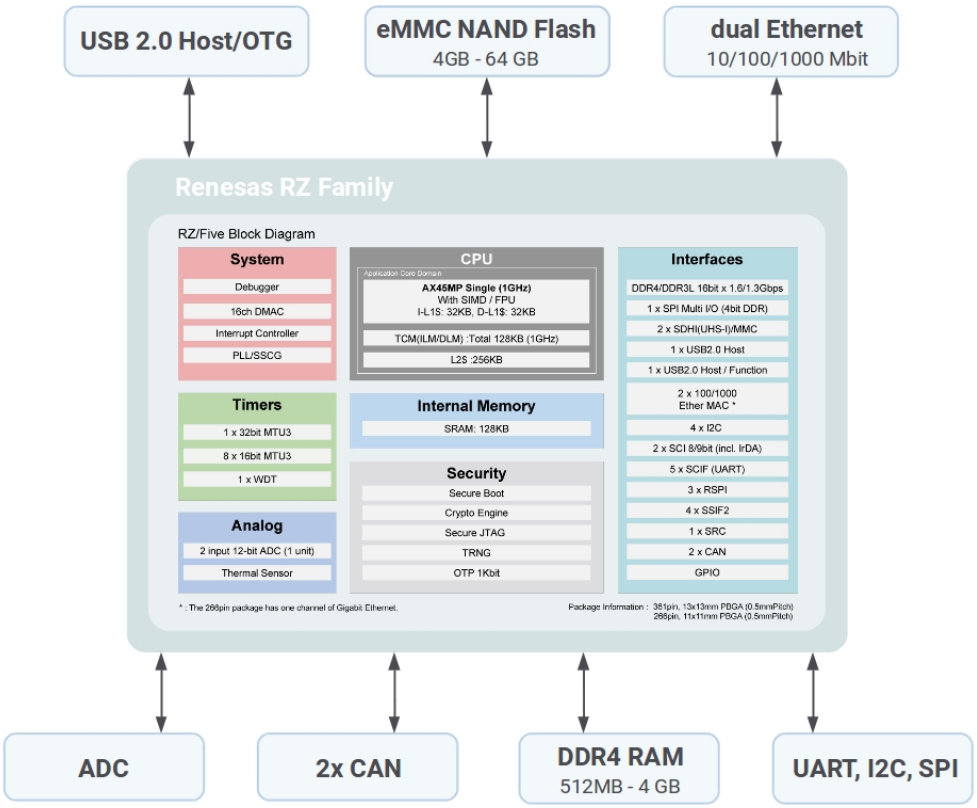
2.3 Order Codes

The MSRZFive SiP is available in the following standard configurations:

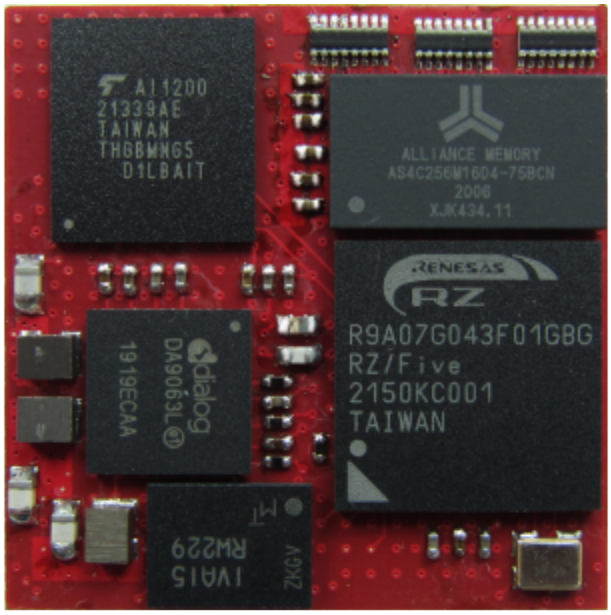
- **MSRZFive-AAE**
  - Single core RISC-V
  - 512MB DDR4 RAM
  - 4GB eMMC
  - -25...+85°C

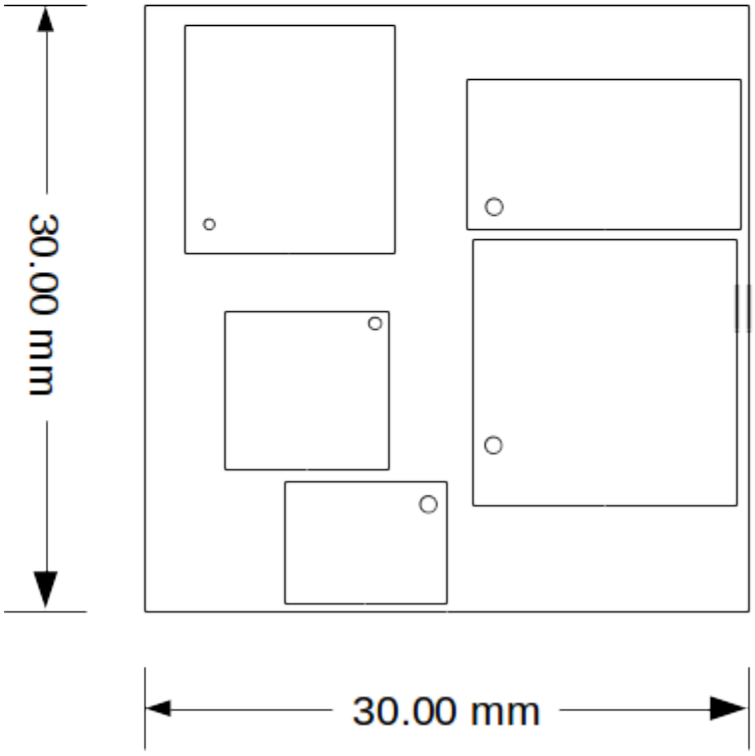
Please contact ARIES Embedded for more information about the availability of other standard products of MSRZFive or custom configurations.

2.4 Block Diagram



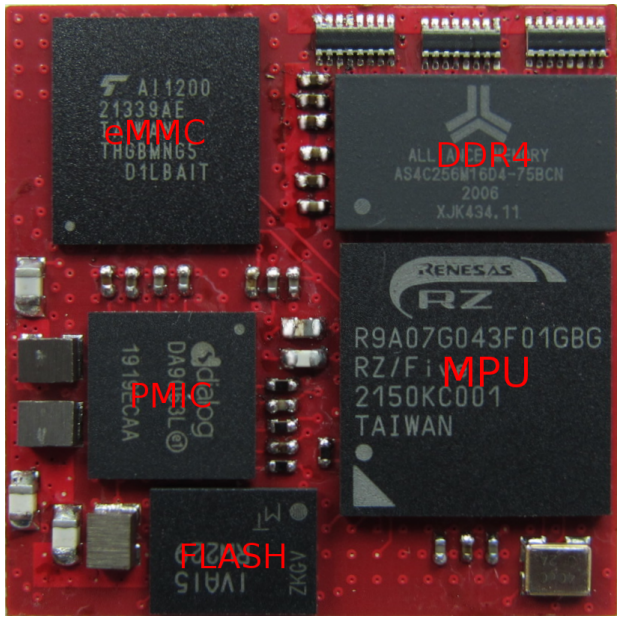
2.5 Dimensions



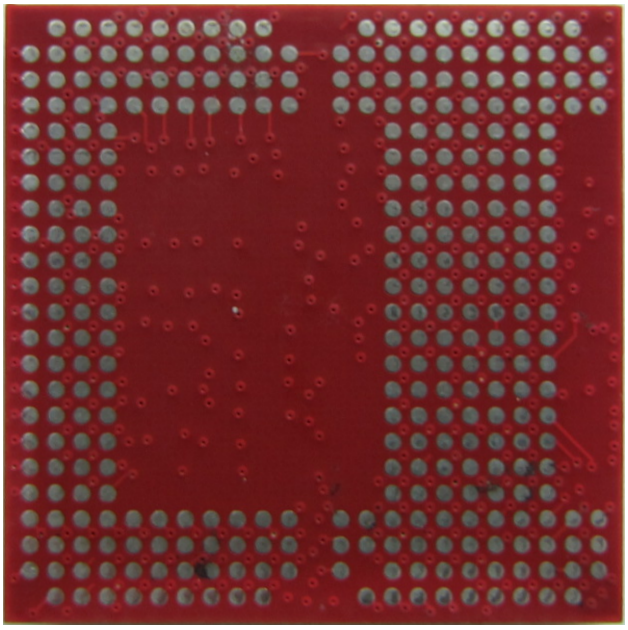


2.6 Part Overview

Assembly Top

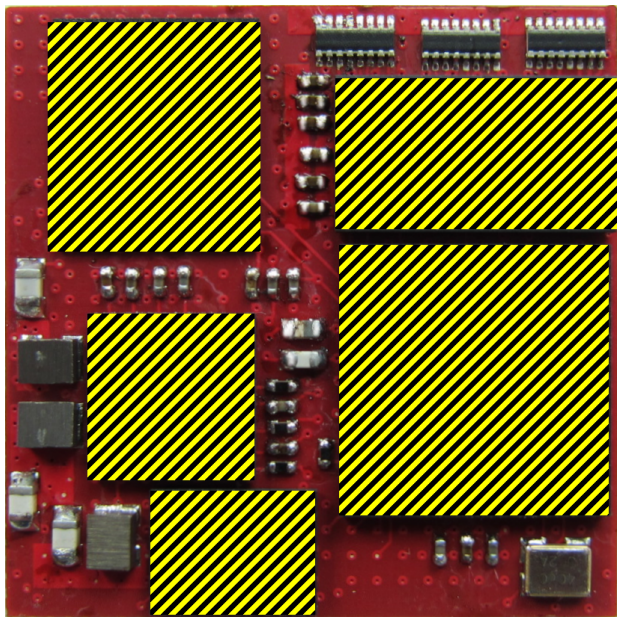


J1 Assembly Bottom



2.7 Handling Recommendations

To avoid mechanical damage to the components populated on MSRZFive it is strongly recommended not to apply mechanical force on the Ball Grid Array (BGA) components. The BGA components are marked as shaded in the figure below:



CHAPTER

THREE

RESOURCES

3.1 Components

3.1.1 MPU

The R9A07G043F01GBG microprocessor is based on the high-performance 64-bit RISC-V/AX45MP Single MPCore operating at up to 1.0 GHz. The AndesCore AX45MP single core processor includes a 32-Kbyte L1 instruction cache for CPU and a 256-Kbyte level2 cache.

Features	R9A07G043F01GBG
Package	BGA Package (13x13mm)
CPU	AndesCoreTM AX45MP Single core 1.0 GHz
On-chip RAM	128 Kbytes (ECC)
DDR4 Memory	512MB – 4GB

For more information about the R9A07G043F01GBG microprocessor please refer to the documentation which is available from Renesas.

3.1.2 DDR4 SDRAM

The MSRZFive is equipped with 1 block of Micron MT40A512M16LY-062E DDR4 SDRAM resulting in up to 8 GB of 16bit memory. Device is available in the commercial temperature range -40°C. . . +95°C. The memory interface is clocked at 1.6 GHz using the 1.2V/1.8V SDRAM standard interface.

3.1.2.1 MPU Signals for DDR4

MPU Pin	Function	DDR4 Pin		MPU Pin	Function	DDR4 Pin
G25	DDR_ADDR0	P3		U25	DDR_DQ0	G2
D25	DDR_ADDR1	P7		Y25	DDR_DQ1	F7
D23	DDR_ADDR2	R3		R25	DDR_DQ2	H3
K23	DDR_ADDR3	N7		T25	DDR_DQ3	H7
F23	DDR_ADDR4	N3		W24	DDR_DQ4	H2
E25	DDR_ADDR5	P8		T23	DDR_DQ5	H8
F25	DDR_ADDR6	P2		R24	DDR_DQ6	J3
C25	DDR_ADDR7	R8		T24	DDR_DQ7	J7
C24	DDR_ADDR8	R2		V25	DDR_DQSL_P	G3
B24	DDR_ADDR9	R7		V24	DDR_DQSL_N	F3
H25	DDR_ADDR10	M3		U23	DDR_DML	E7
B25	DDR_ADDR11	T2		AE24	DDR_DQ8	A3
H23	DDR_ADDR12	M7		AD24	DDR_DQ9	B8
A24	DDR_ADDR13	T8		AD25	DDR_DQ10	C3
K25	DDR_WE#	L2		AD23	DDR_DQ11	C7
L24	DDR_CAS#	M8		AA23	DDR_DQ12	C2
N23	DDR_RAS#	L8		AC24	DDR_DQ13	C8
E24	DDR_BA0	N2		W23	DDR_DQ14	D3
P23	DDR_BA1	N8		AA24	DDR_DQ15	D7
J25	DDR_BG0	M2		AB24	DDR_DQSU_P	T11
M24	DDR_ODT0	K3		AB25	DDR_DQSU_N	R8
P25	DDR_CLK_P	K7		Y24	DDR_DMU	R9
P24	DDR_CLK_N	K8		–	GND	F9
M25	DDR_CKE	K2		–	GND	E9
N24	DDR_CSO#	L7		–	–	T7
–	VCC_DDR4	P9		–	GND	M9
–	GND	T3		J24	DDR_ADDR14	L3
B23	DDR_RESET#	P1		–	GND	N9

3.1.3 eMMC Flash

The MSRZFive offers 4GB THGBMDG5D1LBAIL TOSHIBA eMMC Module housed in 153 ball BGA package.This unit is utilized advanced TOSHIBA NAND flash device(s) and controller chip assembled as Multi Chip Module. The eMMC provides a high-speed memory card interface compliant with JEDEC Version 5.0, eliminating the need for users to be concerned about directly controlling Flash Memories.

Function	eMMC Pin
EMMC_D0	M5
EMMC_D1	B6
EMMC_D2	B5
EMMC_D3	B4
EMMC_D4	B3
EMMC_D5	B2
EMMC_D6	A5
EMMC_D7	A4
EMMC_CMD	A3
EMMC_CLK	H5
EMMC_RST	M6

3.1.4 QSPI NOR FLASH

The W25Q128JWSIQ (128M-bit) Serial Flash memory provides a storage solution for systems with limited space, pins and power. The 25Q series offers flexibility and performance well beyond ordinary Serial Flash devices. The device operates on a single W25Q128JW power supply with current consumption as low as 1 mA active and 1 microA for power down.

Function	QSPI Pin
QSPI_IO0	C7
QSPI_IO1	A5
QSPI_IO2	B7
QSPI_IO3	C6
QSPI_SPCLK	B6
QSPI_SSL	B5

3.1.5 PMIC

Power on the MSRZFive is controlled by a DA9063L-00 Dialog Semiconductor fully integrated power management IC designed for productsbased on high integrated application processor designs requiring low power and highefficiency. The DA9063L follows a scalable approach of output currents and rails to supply the entire system and is capable of delivering a total of up to 12 A from its six DC-DC buck converters.

MPU Pin	Function	PMIC Pin	SiP Pads
–	PWR_BTN#	J7	AA9
–	PMIC_TP	D5	D6
–	PMIC_SDA	A7	P16
–	PMIC_SCL	A8	C16
W2	PRST#	D9	–
AA2	PMIC_IRQ#	B7	AA9
–	CARRIER _PWR_EN	D3	V17

3.2 I2C

MPU Pin	Function	SiP Pads
A19	I2C_B_SCL	AA20
A20	I2C_B_SDA	AA21
B19	I2C_A_SCL	AA15
B20	I2C_A_SDA	AA16

3.3 JTAG

MPU Pin	Function	SiP Pads
U2	JTAG_TCK/SWDCLK	N17
U1	JTAG_TMS/SWDIO	N19
W1	JTAG_TDI	P17
V2	JTAG_TDO	R17
V1	JTAG_TRST#	R19

3.4 UART

MPU Pin	Function	SiP Pads
AC1	UART_CONS_RX	D22
AC2	UART_CONS_TX	D23
B22	UART_A_RX	A14
A21	UART_A_TX	B13

3.5 Pin Out

3.5.1 Ethernet

MPU Pin	Function	SiP Pads		MPU Pin	Function	SiP Pads
M2	ET0_TXC	J15		AE18	ET1_TXC	H1
M1	ET0_TX_CTL	K16		AD17	ET1_TX_CTL	J2
K6	ET0_TX_ERR	K19		AE17	ET1_TX_ERR	K17
M3	ET0_CRS	E16		AC16	ET1_COL	E1
M6	ET0_COL	F15		AC15	ET1_CRS	D2
L1	ET0_TXD0	H15		AD16	ET1_TXD0	G1
L2	ET0_TXD1	G15		AE16	ET1_TXD1	F1
K1	ET0_TXD2	H16		AD15	ET1_TXD2	G2
K2	ET0_TXD3	G16		AE15	ET1_TXD3	F2
N3	ET0_RXC	R15		AC17	ET1_RXC	P1
N1	ET0_RX_CTL	M15		AC18	ET1_RX_CTL	L1
N2	ET0_RX_ERR	L16		AD18	ET1_RX_ERR	K2
P2	ET0_RXD0	K15		AE19	ET1_RXD0	J1
R3	ET0_RXD1	L15		AD19	ET1_RXD1	K1
R2	ET0_RXD2	N15		AE20	ET1_RXD2	M1
R1	ET0_RXD3	P15		AD20	ET1_RXD3	N1
T3	ET0_MDC	T16		AC20	ET1_MDC	C6
T2	ET0_MDIO	T15		AE21	ET1_MDIO	C7
P1	ET0_LINKSTA	D19		AC19	ET1_LINKSTA	E19

3.5.2 ADC

MPU Pin	Function	SiP Pads
B18	ADC0	M18
A18	ADC1	N18

3.5.3 SDIO

MPU Pin	Function	SiP Pads
H6	SDIO_A_CMD	E20
G2	SDIO_A_CLK	F21
H2	SDIO_A_D0	G20
J3	SDIO_A_D1	G21
J1	SDIO_A_D2	H20
J2	SDIO_A_D3	H21
D3	SDIO_A_CD#	J21
C3	SDIO_A_WP	D20

3.5.4 GPIO

MPU Pin	Function	SiP Pads
U2	GPIO_B_2	F19
U1	GPIO_B_3	G19
W1	GPIO_A_7	L17
V2	GPIO_B_5	J19
AB2	GPIO_B_4	H19

3.5.5 USB

MPU Pin	Function	SiP Pads
AD3	USB_A_EN	AC16
AE3	USB_A_OC#	AC15
AD2	USB_A_ID	AB14
AD1	USB_B_EN	AC20
AE2	USB_B_OC#	AC21
AD6	USB_A_D_P	AC14
AE6	USB_A_D_N	AB13
AD8	USB_A_VBUS_IN	AB16
AD5	USB_B_D_P	AC22
AE5	USB_B_D_N	AB23

3.5.6 MSRZFive SiP Pads

Connector J1

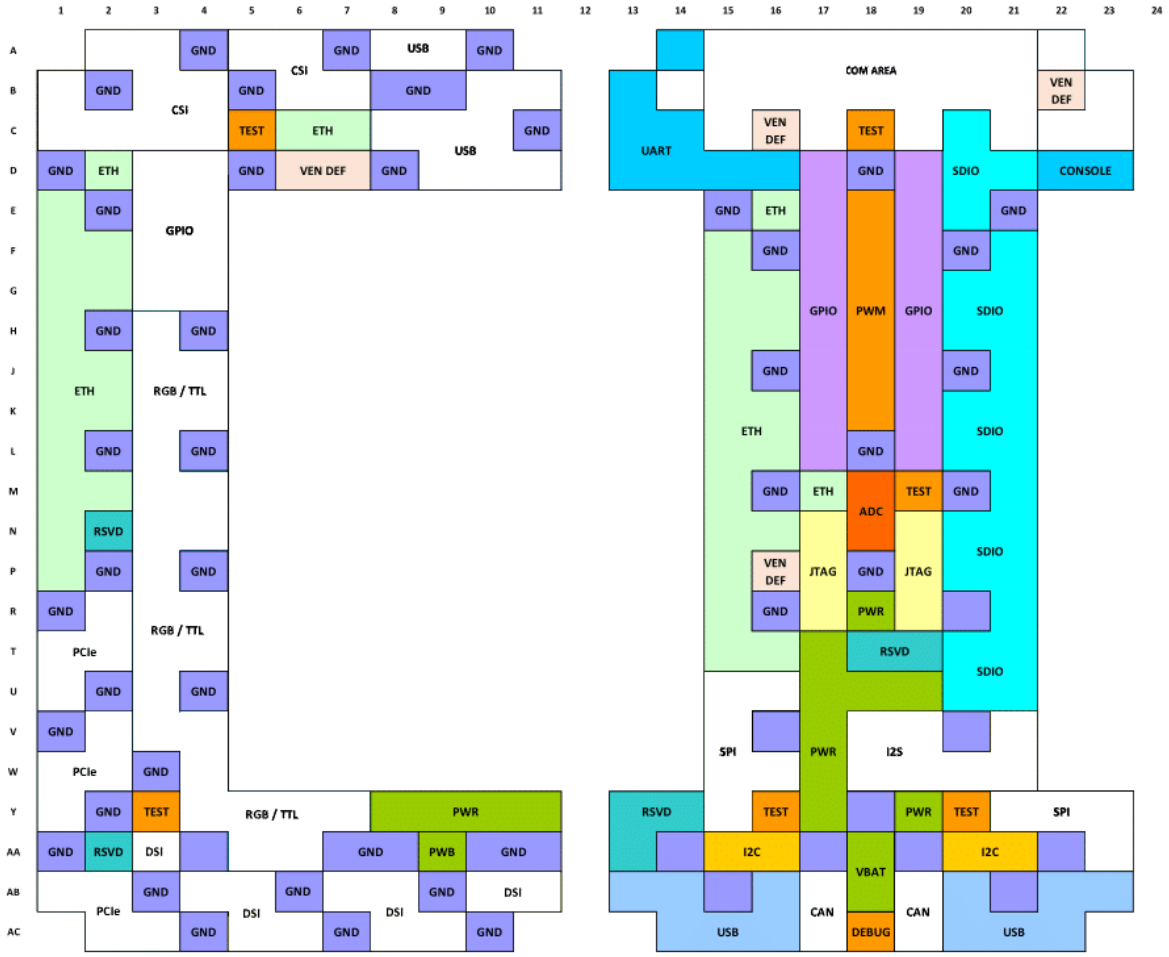


Fig. 1: Contact Overview

MPU Pin	Function	SiP Pads		MPU Pin	Function	SiP Pads
J1A						
–	–	M19		C4	MD_BOOT2	B22
–	–	Y16		–	PMIC_SCL	C16
–	–	Y20		–	PMIC_SDA	P16
–	3.3V	Y17		–	–	V21
–	3.3V	Y19		–	–	W21
–	–	AA18		–	–	V19
–	–	AB18		–	–	W19
–	OSM_SYS_RST#	U17		–	–	V18
–	CARRIER_PWR_EN	V17		–	–	W18
–	–	U18		–	–	W20

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Table 1 – continued from previous page

MPU Pin	Function	SiP Pads		MPU Pin	Function	SiP Pads
–	–	W17		AD6	USB_A_D_P	AC14
C5	MD_BOOT1	U19		AE6	USB_A_D_N	AB13
C4	MD_BOOT2	R18		AD2	USB_A_ID	AB14
–	–	T17		AE3	USB_A_OC#	AC15
–	–	U15		AD8	USB_A_VBUS_IN	AB16
–	–	V15		AD3	USB_A_EN	AC16
–	–	W16		AD5	USB_B_D_P	AC22
–	–	W15		AE5	USB_B_D_N	AB23
–	–	Y15		–	–	AB22
–	–	U16		AE2	USB_B_OC#	AC21
–	–	Y22		–	–	AB20
–	–	Y23		AD1	USB_B_EN	AC20
–	–	B19		B19	I2C_A_SCL	AA15
–	–	Y21		B20	I2C_A_SDA	AA16
H6	SDIO_A_CMD	E20		A19	I2C_B_SCL	AA20
G2	SDIO_A_CLK	F21		A20	I2C_B_SDA	AA21
H2	SDIO_A_D0	G20		–	–	AC17
J3	SDIO_A_D1	G21		–	–	AB17
J1	SDIO_A_D2	H20		–	–	AC19
J2	SDIO_A_D3	H21		–	–	AB19
D3	SDIO_A_CD#	J21		B18	ADC0	M18
C3	SDIO_A_WP	D20		A18	ADC1	N18
–	–	D21		–	–	E18
–	VCC_SD	C20		–	–	F18
–	–	K20		–	–	G18
–	–	K21		–	–	H18
–	–	L20		–	–	J18
–	–	L21		–	–	K18
–	–	M21		M3	ET0_CRS	E16
–	–	N20		M6	ET0_COL	F15
–	–	N21		L1	ET0_TXD0	H15
–	–	P20		L2	ET0_TXD1	G15
–	–	P21		K1	ET0_TXD2	H16
–	–	R21		K2	ET0_TXD3	G16
–	–	T21		M1	ET0_TX_CTL	K16
–	–	U20		M2	ET0_TXC	J15
–	–	U21		P2	ET0_RXD0	K15
–	–	T20		R3	ET0_RXD1	L15
AC1	UART_CONS_RX	D22		R2	ET0_RXD2	N15
AC2	UART_CONS_TX	D23		R1	ET0_RXD3	P15
–	–	C22		N2	ET0_RX_ERR	L16
–	–	C23		N1	ET0_RX_CTL	M15
–	–	A22		N3	ET0_RXC	R15
–	–	B23		–	–	N16
–	–	D14		T2	ET0_MDIO	T15
–	–	D13		T3	ET0_MDC	T16
–	–	D15		–	PVDD18	M17
–	–	D16		U2	JTAG_TCK/SWDCLK	N17
B22	UART_A_RX	A14		U1	JTAG_TMS/SWDIO	N19

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Table 1 – continued from previous page

MPU Pin	Function	SiP Pads		MPU Pin	Function	SiP Pads
A21	UART_A_TX	B13		W1	JTAG_TDI	P17
–	–	C13		–	–	P19
–	–	C14		V2	JTAG_TDO	R17
–	–	D17		V1	JTAG_TRST#	R19
–	–	E17		–	DEBUGEN	AC18
–	–	F17		–	–	C18
–	–	G17		–	GND	D18
–	–	H17		–	GND	E15
–	–	J17		–	GND	E21
AE17	ET1_TX_ERR	K17		–	GND	F16
AC3	GPIO_A_7	L17		–	GND	F20
P1	ET0_LINKSTA	D19		–	GND	J16
AC19	ET1_LINKSTA	E19		–	GND	J20
B1	GPIO_B_2	F19		–	GND	L18
C2	GPIO_B_3	G19		–	GND	M16
AB2	GPIO_B_4	H19		–	GND	M20
AB3	GPIO_B_5	J19		–	GND	P18
K6	ET0_TX_ERR	K19		–	GND	R16
–	–	L19		–	GND	R20
–	–	V16		–	GND	V20
–	GND	Y18		–	GND	AA14
–	GND	AA17		–	GND	AA19
–	GND	AA22		–	GND	AB15
–	GND	AB21		–	–	–
J1B						
–	–	A16		–	–	A20
–	–	C15		–	–	C17
–	–	C19		–	–	C21
–	–	A15		–	–	A17
–	–	A18		–	–	A19
–	–	A21		–	–	B15
–	–	B16		–	–	B17
–	–	B18		–	–	B19
–	–	B20		–	–	B21
J1C						
–	5V	Y8		–	PMIC_TP	D6
–	5V	Y9		–	AUDIO_CLK	D7
–	5V	Y10		–	–	AB1
–	5V	Y11		–	–	AB2
–	PWR_BTN#	AA9		–	–	AC2
–	–	Y3		–	–	AC3
–	–	C5		–	–	W2
AC15	ET1_CRS	D2		–	–	V2
AC16	ET1_COL	E1		–	–	W1
AD16	ET1_TXD0	G1		–	–	Y1
AE16	ET1_TXD1	F1		–	–	T2
AD15	ET1_TXD2	G2		–	–	U1
AE15	ET1_TXD3	F2		–	–	T1
AD17	ET1_TX_CTL	J2		–	–	R2

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Table 1 – continued from previous page

MPU Pin	Function	SiP Pads		MPU Pin	Function	SiP Pads
AE18	ET1_TXC	H1		–	–	D3
AE19	ET1_RXD0	J1		–	–	D4
AD19	ET1_RXD1	K1		–	–	E3
AE20	ET1_RXD2	M1		–	–	E4
AD20	ET1_RXD3	N1		–	–	F3
AD18	ET1_RX_ERR	K2		–	–	F4
AC18	ET1_RX_CTL	L1		–	–	G3
AC17	ET1_RXC	P1		–	–	G4
–	–	M2		–	–	AB10
AE21	ET1_MDIO	C7		–	–	AB11
AC20	ET1_MDC	C6		–	–	AC8
–	–	B1		–	–	AC9
–	–	C1		–	–	AC5
–	–	A3		–	–	AC6
–	–	A2		–	–	AB4
–	–	A6		–	–	AB5
–	–	A5		–	–	AB7
–	–	B7		–	–	AB8
–	–	B6		–	–	AA3
–	–	B4		–	–	Y7
–	–	B3		–	–	AA6
–	–	C2		–	–	Y6
–	–	C3		–	–	AA5
–	–	C4		–	–	Y5
–	GND	A4		–	–	Y4
–	GND	A7		–	–	W4
–	GND	A10		–	–	V3
–	GND	B2		–	–	V4
–	GND	B5		–	–	U3
–	GND	B8		–	–	T3
–	GND	B9		–	–	T4
–	GND	C11		–	–	R4
–	GND	D1		–	–	R3
–	GND	D5		–	–	P3
–	GND	D8		–	–	N3
–	GND	E2		–	–	N4
–	GND	H2		–	–	M3
–	GND	H4		–	–	M4
–	GND	L2		–	–	L3
–	GND	L4		–	–	K3
–	GND	P2		–	–	K4
–	GND	P4		–	–	J4
–	GND	R1		–	–	J3
–	GND	U2		–	–	H3
–	GND	U4		–	–	D10
–	GND	V1		–	–	D11
–	GND	W3		–	–	D9
–	GND	Y2		–	–	C8
–	GND	AA1		–	–	C10

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Table 1 – continued from previous page

MPU Pin	Function	SiP Pads		MPU Pin	Function	SiP Pads
–	GND	AA4		–	–	A9
–	GND	AA7		–	–	A8
–	GND	AA8		–	–	B11
–	GND	AA10		–	–	B10
–	GND	AA11		–	GND	AB3
–	GND	AB6		–	GND	AB9
–	GND	AC4		–	GND	AC7
–	GND	AC10		–	–	–

3.6 Schematics

Schematics for the MSRFive SiP may be obtained on request.