Application Report
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Compatibility Considerations: Migrating From RM48x or RM46x to RM44x Safety Microcontrollers

David Livingston

ABSTRACT

This application report provides a summary of the differences between the RM44x versus the RM48x and RM46x series of microcontrollers.

Contents

List of Tables

1 Introduction

The RM44x series incorporates a subset of the functionality incorporated on the RM48x and RM46x series. There are some enhancements implemented on the RM44x similar to the enhancements implemented on the RM46x series vs the overall superset RM48x series, while still maintaining application code compatibility to the overall superset series when the code is targeted to the subset functionality. An application written for the RM48x or RM46x series runs correctly on the RM44x series as long as only the common functions and features are exercised.

A product overview can be found in the Hercules Product Brochure that outlines content differences between all three series of devices.

2 Memory Configuration Differences

The memory configurations of each of the three series of microcontrollers are different. In each series, the memories are sized according to the targeted applications. Table 1 shows the primary memory spaces within each series of microcontrollers in order to highlight the differences.

Table 1. Memory Configuration Differences

Memory Type	RM48x	RM46x	RM44x
Flash: Program Memory	3MB/2MB	1.25MB/1MB	1MB/768MB
Flash: Boot Sector	1 X 32kB Sector	Up to 2 X 16kB Sectors	Up to 2 X 16kB Sectors
Flash: EEPROM Emulation	4 X 16kB Sectors	4 X 16kB Sectors	16 X 4kB Sectors
CPU Data RAM	Up to 256kB	Up to 192kB	Up to 128kB
MibADC1 RAM	64 Result Buffers	64 Result Buffers	64 Result Buffers
MibADC2 RAM	64 Result Buffers	64 Result Buffers	64 Result Buffers
N2HET1 RAM	160 Instruction RAM	160 Instruction RAM	160 Instruction RAM
N2HET RAM	160 Instruction RAM	160 Instruction RAM	160 Instruction RAM
DCAN1 RAM	64 Mailboxes	64 Mailboxes	64 Mailboxes
DCAN2 RAM	64 Mailboxes	64 Mailboxes	64 Mailboxes
DCAN3 RAM	64 Mailboxes	64 Mailboxes	64 Mailboxes
MibSPI1 RAM	128 Words	128 Words	128 Words
MibSPI3 RAM	128 Words	128 Words	128 Words
MibSPI5 RAM	128 Words	128 Words	128 Words
FlexRay RAM	8kB Message RAM	8kB Message RAM	N/A

3 Package Compatibility Considerations

Both the RM48x and RM46x series of microcontrollers are supported in either a 337 ball grid array (337 BGA) or a 144-pin quad flat pack (144 QFP) package. The RM44x series of devices is available in pin compatible versions of the previously listed packages as well as the 100-pin quad flat pack (100 QFP) package compatible with the RM42x series of devices.

3.1 Pin-Out Compatibility

Table 2 demonstrates how the default functional pins of the 100QFP package for the RM44x series map to the subset of default functional pins of the 144QFP on the RM48x and RM46x series of microcontrollers.

Table 2. Functional Pin Compatibility Mapping

RM44x 100PZ		RM48x and RM46x 144PGE		Comments
Pin Number	Pin Name/Function	Pin Number	Pin Name/Function	
1	GIOA[0]/INT[0]	2	GIOA[0]/INT[0]	
2	GIOA[1]/INT[1]	5	GIOA[1]/INT[1]	
3	FLTP1	7	FLTP1	
4	FLTP2	8	FLTP2	
5	GIOA[2]/INT[2]	9	GIOA[2]/INT[2]	
6	VCCIO	10	VCCIO	
7	VSS	11	VSS	
8	GIOA[3]/INT[3]	12	CAN3TX	GIOA[3:4]/INT[3:4] are not available in the 144PGE package of the superset devices. CAN3TX and CAN3RX used in GIO mode will allow functional compatibility.
9	GIOA[4]/INT[4]	13	CAN3RX	
10	GIOA[5]/INT[5]	14	GIOA[5]/INT[5]	
11	N2HET[22]	15	N2HET[22]	
12	GIOA[6]/INT[6]	16	GIOA[6]/INT[6]	
13	VCC	17	VCC	
14	OSCIN	18	OSCIN	
15	KELVIN_GND	19	KELVIN_GND	
16	OSCOUT	20	OSCOUT	
17	VSS	21	VSS	
18	GIOA[7]/INT[7]	22	GIOA[7]/INT[7]	
19	N2HET[0]	25	N2HET[0]	
20	VSS	27	VSS	
21	VCC	29	VCC	
22	N2HET[2]	30	N2HET[2]	
23	SPI2nCS[0]	32	MibSPI5nCS[0]	SPI2 is not available in the 144 PGE package for the superset devices. With an offset change and configuration of the MibSPI5 module in compatibility mode, pin functional compatibility can be realized.
24	TEST	34	TEST	
25	N2HET[4]	36	N2HET[4]	
26	N2HET[6]	38	N2HET[6]	
27	MibSPI1nCS[2]	40	MibSPI1nCS[2]	
28	VCCIO	42	VCCIO	
29	VSS	44	VSS	
30	VCC	45	VCC	
31	nPORRST	46	nPORRST	
32	VCC	49	VCC	
33	VSS	50	VSS	

Table 2. Functional Pin Compatibility Mapping (continued)

RM44x 100PZ		RM48x and RM46x 144PGE		Comments
Pin Number	Pin Name/Function	Pin Number	Pin Name/Function	
34	MibSPI3SOMI	51	MibSPI3SOMI	
35	MibSPI3SIMO	52	MibSPI3SIMO	
36	MibSPI3CLK	53	MibSPI3CLK	
37	MibSPI3nENA	54	MibSPI3nENA	
38	MibSPI3nCS[0]	55	MibSPI3nCS[0]	
39	MibSPI1nCS[3]	3	MibSPI1nCS[3]	
40	ADIN[16]	58	ADIN[16]	
41	ADIN[17]	59	ADIN[17]	
42	ADIN[0]	60	ADIN[0]	
43	ADIN[7]	61	ADIN[7]	
44	ADIN[20]	64	ADIN[20]	
45	ADIN[21]	65	ADIN[21]	
46	VCCAD/ADREFHI	66	ADREFHI	VCCAD and REFHI are combined on the subset package. REFHI limited to a range of 3-3.6V
		69	VCCAD	
47	VSSAD/ADREFLO	67	ADREFHI	VSSAD and REFLO are combined on the subset package. REFLO limited to GND.
		68	VSS	
48	ADIN[9]	70	ADIN[9]	
49	ADIN[1]	71	ADIN[1]	
50	ADIN[10]	72	ADIN[10]	
51	ADIN[2]	73	ADIN[2]	
52	ADIN[3]	74	ADIN[3]	
53	ADIN[11]	75	ADIN[11]	
54	ADIN[4]	76	ADIN[4]	
55	ADIN[5]	78	ADIN[5]	
56	ADIN[6]	80	ADIN[6]	
57	ADIN[8]	83	ADIN[8]	
58	ADEVT	86	ADEVT	
59	VSS	-	-	This subset pin has no direct matching pin in the 144QFE but can be connected directly to the common ground for the MCU
60	VCCIO	-	-	This subset pin has no direct matching pin in the 144QFE but can be connected directly to the common 3.3 V rail for the MCU.
61	VCC	87	VCC	
62	CAN1TX	89	CAN1TX	
63	CAN1RX	90	CAN1RX	
64	N2HET[24]	91	N2HET[24]	
65	MibSPI1SIMO	93	MibSPI1SIMO	
66	MibSPI1SOMI	94	MibSPI1SOMI	
67	MibSPI1CLK	95	MibSPI1CLK	
68	MibSPI1nENA	96	MibSPI1nENA	

Table 2. Functional Pin Compatibility Mapping (continued)

RM44x 100PZ		RM48x and RM46x 144PGE		Comments
Pin Number	Pin Name/Function	Pin Number	Pin Name/Function	
69	SPI2SOMI	98	MibSPI5SOMI	There is no SPI2 or MibSPI2 available in the 144QFP superset package; therefore, the subset pins map to the MibSPI5 functionally equivalent pins. The SPI2 module on the subset device is limited to non-buffered 4-pin mode only.
70	SPI2SIMO	99	MibSPI5SIMO	
71	SPI2CLK	100	MibSPI5CLK	
72	VSS	102	VSS	
73	MibSPI1nCS[0]	105	MibSPI1nCS[0]	
74	N2HET[8]	106	N2HET[8]	
75	TMS	108	TMS	
76	nTRST	109	nTRST	
77	TDI	110	TDI	
78	TDO	111	TDO	
79	TCK	112	TCK	
80	RTCK	113	RTCK	
81	nRST	116	nRST	
82	nERROR	117	nERROR	
83	N2HET[10]	118	N2HET[10]	
84	ECLK	119	ECLK	
85	VCCIO	120	VCCIO	
86	VSS	121	VSS	
87	VSS	122	VSS	
88	VCC	123	VCC	
89	N2HET[12]	124	N2HET[12]	
90	N2HET[14]	125	N2HET[14]	
91	CAN2TX	128	CAN2TX	
92	CAN2RX	129	CAN2RX	
93	MibSPI1nCS[1]	130	MibSPI1nCS[1]	
94	LINRX (UARTRX)	131	LINRX (UARTRX)	
95	LINTX (UARTTX)	132	LINTX (UARTTX)	
96	VCCP	134	VCCP	
97	N2HET[16]	139	N2HET[16]	
98	N2HET[18]	140	N2HET[18]	
99	VCC	143	VCC	
100	VSS	144	VSS	

4 Input/Output Considerations

There are some low-EMI differences for output signals between the RM44x series vs the RM48x and RM46x series of microcontrollers. These are listed in Table 3.

Table 3. Low-EMI Differences Between RM44x vs RM48x and RM46x

Low-EMI Name RM44x	Low-EMI Output Buffer Signal Hookup RM44x	Low-EMI Name RM48x and RM46x	Low-EMI Output Buffer Signal Hookup RM48x and RM46x
SPI2	N/A	SPI2	GPREG1.1
TDI	N/A	TDI	GPREG1.9
TEST	N/A	TEST	GPREG1.12
AD1EVT	N/A	AD1EVT	GPREG1.14

5 Module Compatibility Considerations

The RM44x series of microcontrollers are a subset of the features/functionality available on the RM46x and RM48x series of microcontrollers. As such, the majority of the software written for the superset devices, RM46x and RM48x, will be compatible with the RM44x series of microcontrollers. However, in some cases, features that are utilized in the superset devices need to be considered either during development of the software or during the porting process to the subset device. In addition, the RM44x series of microcontrollers has similar enhancements to key peripherals as the RM46x series of microcontrollers. Some key feature differences and brief description of the peripheral enhancements are listed below.

5.1 Feature differences on RM44x Series

The RM44x series of microcontrollers is a subset of the RM48x and RM46x series of microcontrollers. Some features are not included as a result of the simpler implementation.

5.1.1 Feature Implementation Differences for the RM44x Series

- Flash EEPROM emulation bank

  The module IP used for the Flash EEPROM emulation is the same as the RM42x series. This new bank is a 72-bit wide bank with slower access times than the bank used on super set series.

  – Wait States

  The EWAIT parameter within the Flash Wrapper register set will need to be programmed according to the waitstates defines in the data sheet for RM44x series of microcontrollers.

  – Flash Topology

  The number and size of each sector in bank 7 has changed from 4, 16kB sector to 16, 4kB, see the *OTP Memory* section in the*RM44x 16/32-Bit RISC Flash Microcontroller Technical Reference Manual* (SPNU608).

- Pin muxing/IOMM configuration

  The PINMMR register assignments are mostly the same as the RM48x and RM46x series although there are some differences where modules were removed.

  The following eight N2HET2 signals (only available in the 337pin) primary function EMIF was removed, however, the default behavior and mux options are still available.

Table 4. Output Multiplexing and Control

ZWT PIN	RM46xPrimary Functionailty	Alternate Function1	Pin MMR Selection Bit
D4	EMIF_ADDR[0]/	N2HET2[1]	22[1]
D5	EMIF_ADDR[1]/	N2HET2[3]	21[1]
D16	EMIF_BA[1]/	N2HET2[5]	14[25]
N17	EMIF_nCS[0]/	N2HET2[7]	10[18]
K17	EMIF_nCS[3]/	N2HET2[9]	11[2]
C4	EMIF_ADDR[6]/	N2HET2[11]	22[18]
C5	EMIF_ADDR[7]/	N2HET2[13]	22[10]
C6	EMIF_ADDR[8]/	N2HET2[15]	23[2]

- eQEP VIM interrupt mappings are different

  The default eQEP VIM interrupt request is 110 on RM44x devices and 84 on RM42x. Since the EQEP interrupt configuration is different, it results in software incompatibility. Also, in the RM44x devices, the eQEP module is present on SCR5 (similar to RM46x), whereas, in RM42x, it is present on the PCR. On RM42x, there is a peripheral select bit that needs to be enabled before the eQEP can be used.

- Power Domain States

  In the RM44x devices, the Off state is equivalent to the Idle state in terms of power saving. From a programmer model perspective, users can still put a power domain into the Off state as if the power domain can be physically turned off.

  NOTE: This device does not implement power switches to physically isolate the power domain from its power supply. Putting a power domain into the Off state has no effect to remove leakage power. For more details, see the *Power Domains* section in the *RM44x 16/32-Bit RISC Flash Microcontroller Technical Reference Manual* (SPNU608).

- Max Clock Speeds

  RM44x devices performance will be similar to the RM46x devices and faster than RM42x. When migrating between series, see the device-specific data sheets.

6 References

- *RM44x 16/32-Bit RISC Flash Microcontroller Technical Reference Manual* (SPNU608)
- *RM46L852 16- and 32-Bit RISC Flash Microcontroller Data Sheet* (SPNS185)
- *RM42L432 16- and 32-Bit RISC Flash Microcontroller Data Manual* (SPNS180)
- *RM44Lxx 16- and 32-Bit RISC Flash Microcontroller Data Manual* (SPNS229)

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