

QLS1046 - Configuration of the DDR4 memory controller

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1. DOCUMENT AMENDMENT RECORD

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2. INTRODUCTION

This application note applies to the Qormino® QLS1046 processing module, which features a LS1046 processor and a DDR4 memory. The purpose of this document is to describe the recommended configuration, and especially the timing parameters, to achieve a 2.1GT/s transfer rate on the DDR4 interface. These parameters have been optimized for the QLS1046 layout, and they correspond to the parameters that are applied in production for the testing of the device. The parameters should be setup in the configuration registers of the DDR4 controller of the LS1046 processor.

Warning: Other sets of parameters might be usable, but Teledyne e2v only guarantees operation when using the set of parameters described in this application note.

In Section 3, a focus is made on specific parameters that have a higher importance in the DDR4 controller configuration. In Section 4, the complete set of recommended parameters is provided as the reference configuration.

3. SPECIFIC PARAMETERS

The DDR4 controller configuration has a large number of parameters, with some of them having a greater importance in the behaviour of the interface. The critical parameters and their recommended values are summarized in the Table 3-1:

Parameter	DDR4 Controller Register Name	DDR4 Controller Register Offset	Register field(s)	Field value	Register Value (hex)
Write Leveling	DDR_WRLVL_CNTL	+0x174	WRLVL_START	0x06	c675f606
	DDR_WRLVL_CNTL_2	+0x190	WRLVL_START_[1/2/3/4]	0x06/0x06/0x07/0x07	06060707
	DDR_WRLVL_CNTL_3	+0x194	WRLVL_START_[5/6/7/8]	0x07/0x06/0x06/0x06	07060606
Clock Adjust	DDR_SDRAM_CLK_CNTL	+0x130	CLK_ADJUST	0x0A	02800000
Refresh Recovery	TIMING_CFG_3	+0x100	EXT_REFREC	0x16	02161100
DQ mapping register 0	DDR_DQ_MAP0	+0x400	DQ_0_3, DQ_4_7, DQ_8_11, DQ_12_15, DQ_16_19		475953a4
DQ mapping register 1	DDR_DQ_MAP1	+0x404	DQ_20_23, DQ_24_27, DQ_28_31, DQ_32_35, DQ_36_39		2d2c55bc
DQ mapping register 2	DDR_DQ_MAP2	+0x408	DQ_40_43, DQ_44_47, DQ_48_51, DQ_52_55, DQ_56_59		0f2bd460
DQ mapping	DDR_DQ_MAP3	+0x40C	DQ_60_63, ECC_0_3,		90ba8000

register 3			ECC_4_7, ORS		
------------	--	--	-----------------	--	--

Table 3-1 : Critical DDR4 parameters.

4. COMPLETE SET OF RECOMMENDED PARAMETERS

The complete set of recommended configuration parameters for the DDR4 controller of the LS1046 is given below. It corresponds to the dump of the memory content of the LS1046 for the DDR4 memory controller (base address: 108_0000h). Note that the register descriptions are given in Section 15.4 of the reference manual for the LS1046 processor.

```

01080000: 000000ff 00000000 00000000 00000000 .....
01080010: 00000000 00000000 00000000 00000000 .....
01080020: 00000000 00000000 00000000 00000000 .....
01080030: 00000000 00000000 00000000 00000000 .....
01080040: 00000000 00000000 00000000 00000000 .....
01080050: 00000000 00000000 00000000 00000000 .....
01080060: 00000000 00000000 00000000 00000000 .....
01080070: 00000000 00000000 00000000 00000000 .....
01080080: 80440412 00000000 00000000 00000000 .....
01080090: 00000000 00000000 00000000 00000000 .....
010800a0: 00000000 00000000 00000000 00000000 .....
010800b0: 00000000 00000000 00000000 00000000 .....
010800c0: 00000000 00000000 00000000 00000000 .....
010800d0: 00000000 00000000 00000000 00000000 .....
010800e0: 00000000 00000000 00000000 00000000 .....
010800f0: 00000000 00000000 00000000 00000000 .....
01080100: 02161100 d1770018 f2fc9265 005941a0 .....
01080110: e5000000 00401140 03010631 00100200 .....
01080120: 0600081f 0fff03ff deadbeef 00000000 .....
01080130: 02800000 00000000 00000000 00000000 .....
01080140: 00000000 00000000 00000000 00000000 .....
01080150: 00000000 00000000 00000000 00000000 .....
01080160: 00220002 05401400 00000000 26600000 .....
01080170: 8a090705 c675f606 00000000 00000000 .....
01080180: 00000000 00000000 00000000 00000000 .....
01080190: 06060707 07060606 00000000 00000000 .....
010801a0: 00000000 00000000 00000000 00000000 .....
010801b0: 00000000 00000000 00000000 00000000 .....
010801c0: 00000000 00000000 00000000 00000000 .....
010801d0: 00000000 00000000 00000000 00000000 .....
010801e0: 00000000 00000000 00000000 00000000 .....
010801f0: 00000000 00000000 00000000 00000000 .....
01080200: 00010631 00100200 00010631 00100200 .....
01080210: 00010631 00100200 00000000 00000000 .....
01080220: 00000500 08000000 00000400 08000000 .....
01080230: 00000400 08000000 00000400 08000000 .....
01080240: 00000000 00000000 00000000 00000000 .....
01080250: 05447a00 00000000 00000000 00000000 .....

```

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```

01080260: 00000000 00000000 00000000 00000000 .....
01080270: 0000ffff 00000000 00000000 00000000 .....
01080280: dd7bdded dd7edbe7 22842212 22812418 .....
01080290: 21de0001 00000000 00000000 00000000 .....
010802a0: 00000000 00000000 00000000 00000000 .....
010802b0: 00000000 00000000 00000000 00000000 .....
010802c0: 00000000 00000000 00000000 00000000 .....
010802d0: 00000000 00000000 00000000 00000000 .....
010802e0: 00000000 00000000 00000000 00000000 .....
010802f0: 00000000 00000000 00000000 00000000 .....
01080300: 00000000 00000000 00000000 00000000 .....
01080310: 00000000 00000000 00000000 00000000 .....
01080320: 00000000 00000000 00000000 00000000 .....
01080330: 00000000 00000000 00000000 00000000 .....
01080340: 00000000 00000000 00000000 00000000 .....
01080350: 00000000 00000000 00000000 00000000 .....
01080360: 00000000 00000000 00000000 00000000 .....
01080370: 00000000 00000000 00000000 00000000 .....
01080380: 00000000 00000000 00000000 00000000 .....
01080390: 00000000 00000000 00000000 00000000 .....
010803a0: 00000000 00000000 00000000 00000000 .....
010803b0: 00000000 00000000 00000000 00000000 .....
010803c0: 00000000 00000000 00000000 00000000 .....
010803d0: 00000000 00000000 00000000 00000000 .....
010803e0: 00000000 00000000 00000000 00000000 .....
010803f0: 00000000 00000000 00000000 00000000 .....
01080400: 475953a4 2d2c55bc 0f2bd460 90ba8000 .....
01080410: 00000000 00000000 00000000 00000000 .....
01080420: 00000000 00000000 00000000 00000000 .....
01080430: 00000000 00000000 00000000 00000000 .....
01080440: 00000000 00000000 00000000 00000000 .....
01080450: 00000000 00000000 00000000 00000000 .....
01080460: 00000000 00000000 00000000 00000000 .....
01080470: 00000000 00000000 00000000 00000000 .....
01080480: 00000000 00000000 00000000 00000000 .....
01080490: 00000000 00000000 00000000 00000000 .....
010804a0: 00000000 00000000 00000000 00000000 .....
010804b0: 00000000 00000000 00000000 00000000 .....
010804c0: 00000000 00000000 00000000 00000000 .....
010804d0: 00000000 00000000 00000000 00000000 .....
010804e0: 00000000 00000000 00000000 00000000 .....
010804f0: 00000000 00000000 00000000 00000000 .....
01080500: 00000000 00000000 00000000 00000000 .....
01080510: 00000000 00000000 00000000 00000000 .....
01080520: 00000000 00000000 00000000 00000000 .....
01080530: 00000000 00000000 00000000 00000000 .....
01080540: 00000000 00000000 00000000 00000000 .....
01080550: 00000000 00000000 00000000 00000000 .....
01080560: 00000000 00000000 00000000 00000000 .....
01080570: 00000000 00000000 00000000 00000000 .....

```

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01080580:	00000000	00000000	00000000	00000000
01080590:	00000000	00000000	00000000	00000000
010805a0:	00000000	00000000	00000000	00000000	.....
010805b0:	00000000	00000000	00000000	00000000	.....
010805c0:	00000000	00000000	00000000	00000000	.....
010805d0:	00000000	00000000	00000000	00000000	.....
010805e0:	00000000	00000000	00000000	00000000	.....
010805f0:	00000000	00000000	00000000	00000000	.....
01080600:	00000000	00000000	00000000	00000000	.....
01080610:	00000000	00000000	00000000	00000000	.....
01080620:	00000000	00000000	00000000	00000000	.....
01080630:	00000000	00000000	00000000	00000000	.....
01080640:	00000000	00000000	00000000	00000000	.....
01080650:	00000000	00000000	00000000	00000000	.....
01080660:	00000000	00000000	00000000	00000000	.....
01080670:	00000000	00000000	00000000	00000000	.....
01080680:	00000000	00000000	00000000	00000000	.....
01080690:	00000000	00000000	00000000	00000000	.....
010806a0:	00000000	00000000	00000000	00000000	.....
010806b0:	00000000	00000000	00000000	00000000	.....
010806c0:	00000000	00000000	00000000	00000000	.....
010806d0:	00000000	00000000	00000000	00000000	.....
010806e0:	00000000	00000000	00000000	00000000	.....
010806f0:	00000000	00000000	00000000	00000000	.....
01080700:	00000000	00000000	00000000	00000000	.....
01080710:	00000000	00000000	00000000	00000000	.....
01080720:	00000000	00000000	00000000	00000000	.....
01080730:	00000000	00000000	00000000	00000000	.....
01080740:	00000000	00000000	00000000	00000000	.....
01080750:	00000000	00000000	00000000	00000000	.....
01080760:	00000000	00000000	00000000	00000000	.....
01080770:	00000000	00000000	00000000	00000000	.....
01080780:	00000000	00000000	00000000	00000000	.....
01080790:	00000000	00000000	00000000	00000000	.....
010807a0:	00000000	00000000	00000000	00000000	.....
010807b0:	00000000	00000000	00000000	00000000	.....
010807c0:	00000000	00000000	00000000	00000000	.....
010807d0:	00000000	00000000	00000000	00000000	.....
010807e0:	00000000	00000000	00000000	00000000	.....
010807f0:	00000000	00000000	00000000	00000000	.....
01080800:	00000000	00000000	00000000	00000000	.....
01080810:	00000000	00000000	00000000	00000000	.....
01080820:	00000000	00000000	00000000	00000000	.....
01080830:	00000000	00000000	00000000	00000000	.....
01080840:	00000000	00000000	00000000	00000000	.....
01080850:	00000000	00000000	00000000	00000000	.....
01080860:	00000000	00000000	00000000	00000000	.....
01080870:	00000000	00000000	00000000	00000000	.....
01080880:	00000000	00000000	00000000	00000000
01080890:	00000000	00000000	00000000	00000000

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```

010808a0: 00000000 00000000 00000000 00000000 .....
010808b0: 00000000 00000000 00000000 00000000 .....
010808c0: 00000000 00000000 00000000 00000000 .....
010808d0: 00000000 00000000 00000000 00000000 .....
010808e0: 00000000 00000000 00000000 00000000 .....
010808f0: 00000000 00000000 00000000 00000000 .....
01080900: 00000000 00000000 00000000 00000000 .....
01080910: 00000000 00000000 00000000 00000000 .....
01080920: 00000000 00000000 00000000 00000000 .....
01080930: 00000000 00000000 00000000 00000000 .....
01080940: 00000000 00000000 00000000 00000000 .....
01080950: 00000000 00000000 00000000 00000000 .....
01080960: 00000000 00000000 00000000 00000000 .....
01080970: 00000000 00000000 00000000 00000000 .....
01080980: 00000000 00000000 00000000 00000000 .....
01080990: 00000000 00000000 00000000 00000000 .....
010809a0: 00000000 00000000 00000000 00000000 .....
010809b0: 00000000 00000000 00000000 00000000 .....
010809c0: 00000000 00000000 00000000 00000000 .....
010809d0: 00000000 00000000 00000000 00000000 .....
010809e0: 00000000 00000000 00000000 00000000 .....
010809f0: 00000000 00000000 00000000 00000000 .....
01080a00: 00000000 00000000 00000000 00000000 .....
01080a10: 00000000 00000000 00000000 00000000 .....
01080a20: 00000000 00000000 00000000 00000000 .....
01080a30: 00000000 00000000 00000000 00000000 .....
01080a40: 00000000 00000000 00000000 00000000 .....
01080a50: 00000000 00000000 00000000 00000000 .....
01080a60: 00000000 00000000 00000000 00000000 .....
01080a70: 00000000 00000000 00000000 00000000 .....
01080a80: 00000000 00000000 00000000 00000000 .....
01080a90: 00000000 00000000 00000000 00000000 .....
01080aa0: 00000000 00000000 00000000 00000000 .....
01080ab0: 00000000 00000000 00000000 00000000 .....
01080ac0: 00000000 00000000 00000000 00000000 .....
01080ad0: 00000000 00000000 00000000 00000000 .....
01080ae0: 00000000 00000000 00000000 00000000 .....
01080af0: 00000000 00000000 00000000 00000000 .....
01080b00: 00000000 00000000 00000000 00000000 .....
01080b10: 00000000 00000000 00000000 00000000 .....
01080b20: 00008080 80000000 80080000 0000a180 .....
01080b30: 00000000 00000000 00000000 00000000 .....
01080b40: 00000000 00000000 00000000 00000000 .....
01080b50: 00000000 00000000 00000000 00000000 .....
01080b60: 00000000 00000000 00000000 00000000 .....
01080b70: 00000000 00000000 00000000 00000000 .....
01080b80: 00000000 00000000 00000000 00000000 .....
01080b90: 00000000 00000000 00000000 00000000 .....
01080ba0: 00000000 00000000 00000000 00000000 .....
01080bb0: 00000000 00000000 00000000 00000000 .....

```


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```

01080bc0: 00000000 00000000 00000000 00000000 .....
01080bd0: 00000000 00000000 00000000 00000000 .....
01080be0: 00000000 00000000 00000000 00000000 .....
01080bf0: 00000000 00000000 00020502 00000100 .....
01080c00: 07100000 00000000 00000000 00000000 .....
01080c10: 00000000 00000000 00000000 00000000 .....
01080c20: 00000000 00000000 00000000 00000000 .....
01080c30: 00000000 00000000 00000000 00000000 .....
01080c40: 00000000 00000000 00000000 00000000 .....
01080c50: 00000000 00000000 00000000 00000000 .....
01080c60: 00000000 00000000 00000000 00000000 .....
01080c70: 00000000 00000000 00000000 00000000 .....
01080c80: 00000000 00000000 00000000 00000000 .....
01080c90: 00000000 00000000 00000000 00000000 .....
01080ca0: 00000000 00000000 00000000 00000000 .....
01080cb0: 00000000 00000000 00000000 00000000 .....
01080cc0: 00000000 00000000 00000000 00000000 .....
01080cd0: 00000000 00000000 00000000 00000000 .....
01080ce0: 00000000 00000000 00000000 00000000 .....
01080cf0: 00000000 00000000 00000000 00000000 .....
01080d00: 00000000 00000000 00000000 00000000 .....
01080d10: 00000000 00000000 00000000 00000000 .....
01080d20: 00000000 00000000 00000000 00000000 .....
01080d30: 00000000 00000000 00000000 00000000 .....
01080d40: 00000000 00000000 00000000 00000000 .....
01080d50: 00000000 00000000 00000000 00000000 .....
01080d60: 00000000 00000000 00000000 00000000 .....
01080d70: 00000000 00000000 00000000 00000000 .....
01080d80: 00000000 00000000 00000000 00000000 .....
01080d90: 00000000 00000000 00000000 00000000 .....
01080da0: 00000000 00000000 00000000 00000000 .....
01080db0: 00000000 00000000 00000000 00000000 .....
01080dc0: 00000000 00000000 00000000 00000000 .....
01080dd0: 00000000 00000000 00000000 00000000 .....
01080de0: 00000000 00000000 00000000 00000000 .....
01080df0: 00000000 00000000 00000000 00000000 .....
01080e00: 00000000 00000000 00000000 00000000 .....
01080e10: 00000000 00000000 00000000 00000000 .....
01080e20: 00000000 00000000 00000000 00000000 .....
01080e30: 00000000 00000000 00000000 00000000 .....
01080e40: 00000000 00000000 00000000 00000000 .....
01080e50: 00000000 00000000 00000000 00000000 .....
01080e60: 00000000 00000000 00000000 00000000 .....
01080e70: 00000000 00000000 00000000 00000000 .....
01080e80: 00000000 00000000 00000000 00000000 .....
01080e90: 00000000 00000000 00000000 00000000 .....
01080ea0: 00000000 00000000 00000000 00000000 .....
01080eb0: 00000000 00000000 00000000 00000000 .....
01080ec0: 00000000 00000000 00000000 00000000 .....
01080ed0: 00000000 00000000 00000000 00000000 .....

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```

01080ee0: 00000000 00000000 00000000 00000000 .....
01080ef0: 00000000 00000000 00000000 00000000 .....
01080f00: 00000000 00000002 0000000a 14000c20 .....
01080f10: 00000000 00000000 00000000 00000000 .....
01080f20: 00000000 25002400 23002200 24002300 .....
01080f30: 25002500 24005000 00000000 00000000 .....
01080f40: 00000000 00000000 00000001 94000000 .....
01080f50: 0d000d00 0e000f00 0e000f00 0d000e00 .....
01080f60: 0d000000 00009000 00000000 00000000 .....
01080f70: 006a004d 00000000 00000000 00000000 .....
01080f80: 00000000 00000000 00000000 00000000 .....
01080f90: 00000000 80000000 00000000 28002800 .....
01080fa0: 28002c00 28002a00 27002800 29000000 .....
01080fb0: 00000003 1f1e1b1f 1c1d1e1d 1f1c1b1e .....
01080fc0: 1d1b1d1c 1f1d1c1f 1d1d1f1d 1f201e20 .....
01080fd0: 1d1e1f1d 1f1d1b1d 1d1e1d1d 1f1d1c20 .....
01080fe0: 1d1e1e1c 1f1c1c1e 1e1d1d1b 1f1e1d1e .....
01080ff0: 1e1e1f1c 1f1e1b1e 1d201e1c 1f000000 .....

```