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M16C/62A Group

Clock Signals in used for the SIM Interface (UART)

1. Abstract

The following article introduces clock signals in used for the SIM Interface (UART).

2. Introduction

The explanation of this issue is M16C/62A Group.

3. Clock Signals in used for the SIM Interface (UART)

In conforming to the SIM interface, the UART clock signal within the SIM card needs to conform to the UART2 clock signal within the microprocessor. Two examples are given here as means of generating a UART2 clock signal within the microprocessor.

* In the case of setting a value equal to or less than (1/256 X 1/16) in the division rate of UART2 clock
  Choose f_1 for the UART's source clock signal and set an optional value in the bit rate generator.
* In the case of setting a value equal to or greater than (1/256 X 1/16) in the division rate of UART2 clock
  Set the bit rate generator to "0", turn the source clock signal to timer output and set an optional value in the timer. In order to maintain the synchronization, the serial I/O mode select bits must be reset to "000_2", then the UART2 transmit/receive mode register is set back to the original setting at every one byte transmission.

Let F be the clock signal within the SIM card and D be the bit rate adjustment factor, then the formula for the UART clock signal becomes as follows. Figure 1 shows an example of connection.

- In the case of setting a value equal to or less than (1/256 X 1/16) in the division rate of UART2 clock
  UART2 clock signal within microprocessor = UART clock within SIM card

$$f_1 \times \frac{1}{\text{Bit rate generator} + 1} \times \frac{1}{16} = f_1 \times \frac{1}{\text{Timer Ai counter} + 1} \times \text{flip-flop} \times \frac{1}{F/D}$$

Let X_{IN} = 16 MHz, timer Ai counter = 1, F = 372, and D = 1, then the value to be set in the bit rate generator becomes

$$16 \times \frac{1}{\text{Bit rate generator} + 1} \times \frac{1}{16} = 16 \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{372/1}$$

Bit rate generator = 92

Table 1 shows an example of setting in the UART2 bit rate generator.

- In the case of setting a value equal to or greater than (1/256 X 1/16) in the division rate of UART2 clock
  UART2 clock signal within microprocessor = UART clock within SIM card

$$f_1 \times \frac{1}{\text{Timer Aj counter} + 1} \times \text{flip-flop} \times \frac{1}{\text{Bit rate generator} + 1} \times \frac{1}{16}$$

$$= f_1 \times \frac{1}{\text{Bit rate generator} + 1} \times \text{flip-flop} \times \frac{1}{F/D}$$

Let X_{IN}= 16 MHz, timer Ai counter = 3, bit rate generator = 0, F = 1860, and D = 1, then the value to be set in the timer Aj counter becomes

$$16 \times \frac{1}{\text{Timer Aj counter} + 1} \times \frac{1}{2} \times \frac{1}{0 + 1} \times \frac{1}{16} = 16 \times \frac{1}{3 + 1} \times \frac{1}{2} \times \frac{1}{1860/1}$$

Timer Aj counter = 464

Table 2 shows an example of setting in the timer Aj counter.

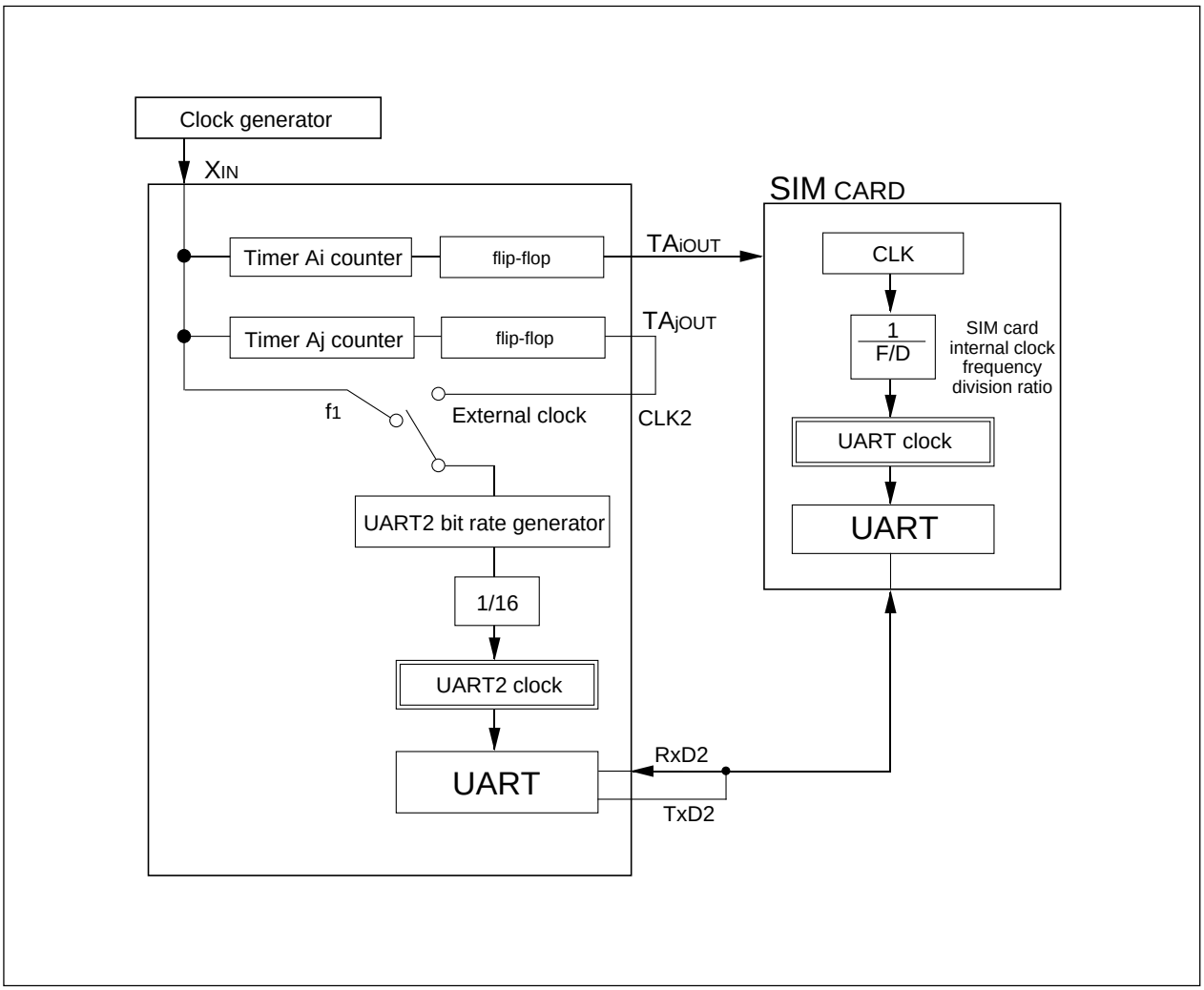

Figure 1. Example of connection

Table 1. UART2 bit rate adjustment factor

SIM card internal clock F(Hz)	Bit rate D	F/D	UART2 bit rate generator set value	SIM card internal clock F(Hz)	Bit rate D	F/D	UART2 bit rate generator set value
372	1	372	92	1116	1	1116	
	2	186			2	558	
	4	93			4	279	
	8				8		
	16				16		
	1/2	744	185		1/2	2232	
	1/4	1488			1/4	4464	
	1/8	2976			1/8	8928	
	1/16	5952			1/16	17856	
	1/32	11904			1/32	35712	
	1/64	23808			1/64	71424	
558	1	558		1488	1	1488	
	2	279			2	744	185
	4				4	372	92
	8				8	186	
	16				16	93	
	1/2	1116			1/2	2976	
	1/4	2232			1/4	5952	
	1/8	4464			1/8	11904	
	1/16	8928			1/16	23808	
	1/32	17856			1/32	47616	
	1/64	35712			1/64	95232	
744	1	744	185	1860	1	1860	
	2	372	92		2	930	
	4	186			4	465	
	8	93			8		
	16				16		
	1/2	1488			1/2	3720	
	1/4	2976			1/4	7440	
	1/8	5952			1/8	14880	
	1/16	11904			1/16	29760	
	1/32	23808			1/32	59520	
	1/64	47616			1/64	119040	

Combination impossible

Combination in which the F/D itself does not become an integer

Setting example under the following conditions.

f(XIN)=16MHz

Timer Ai counter set value = 1

Table 2. TimerAi register adjustment factor

SIM card internal clock F(Hz)	Bit rate D	F/D	Timer Ai value	SIM card internal clock F(Hz)	Bit rate D	F/D	Timer Aj value
372	1	372	92	1116	1	1116	278
	2	186			2	558	
	4	93			4	279	
	8				8		
	16				16		
	1/2	744	185		1/2	2232	557
	1/4	1488	371		1/4	4464	1115
	1/8	2976	743		1/8	8928	2231
	1/16	5952	1487		1/16	17856	4463
	1/32	11904	2975		1/32	35712	8927
	1/64	23808	5951		1/64	71424	17855
558	1	558		1488	1	1488	371
	2	279			2	744	185
	4				4	372	92
	8				8	186	
	16				16	93	
	1/2	1116	278		1/2	2976	743
	1/4	2232	557		1/4	5952	1487
	1/8	4464	1115		1/8	11904	2975
	1/16	8928	2231		1/16	23808	5951
	1/32	17856	4463		1/32	47616	11903
	1/64	35712	8927		1/64	95232	23807
744	1	744	185	1860	1	1860	464
	2	372	92		2	930	
	4	186			4	465	
	8	93			8		
	16				16		
	1/2	1488	371		1/2	3720	929
	1/4	2976	743		1/4	7440	1859
	1/8	5952	1487		1/8	14880	3719
	1/16	11904	2975		1/16	29760	7439
	1/32	23808	5951		1/32	59520	14879
	1/64	47616	11903		1/64	119040	29759

Combination impossible

Combination in which the F/D itself does not become an integer

Setting example under the following conditions.

f(XIN)=16MHz

Timer Ai counter set value = 3, UART2 bit rate generator set value = 0

REVISION HISTORY	M16C/62A Group Application Note Clock Signals in used for the SIM Interface (UART)

Rev.	Date	Description	
		Page	Summary
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