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Application Note

GDDR Dout Valid Window at DLL-Off Mode

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Introduction

The graphic industry keeps driving memory vendors to increase the memory frequency as fast as they can. Through a continuous efforts, now the conventional GDDR can achieve 800Mbps operation while GDDR2/3 hits over 1Gbps throughout the industry.

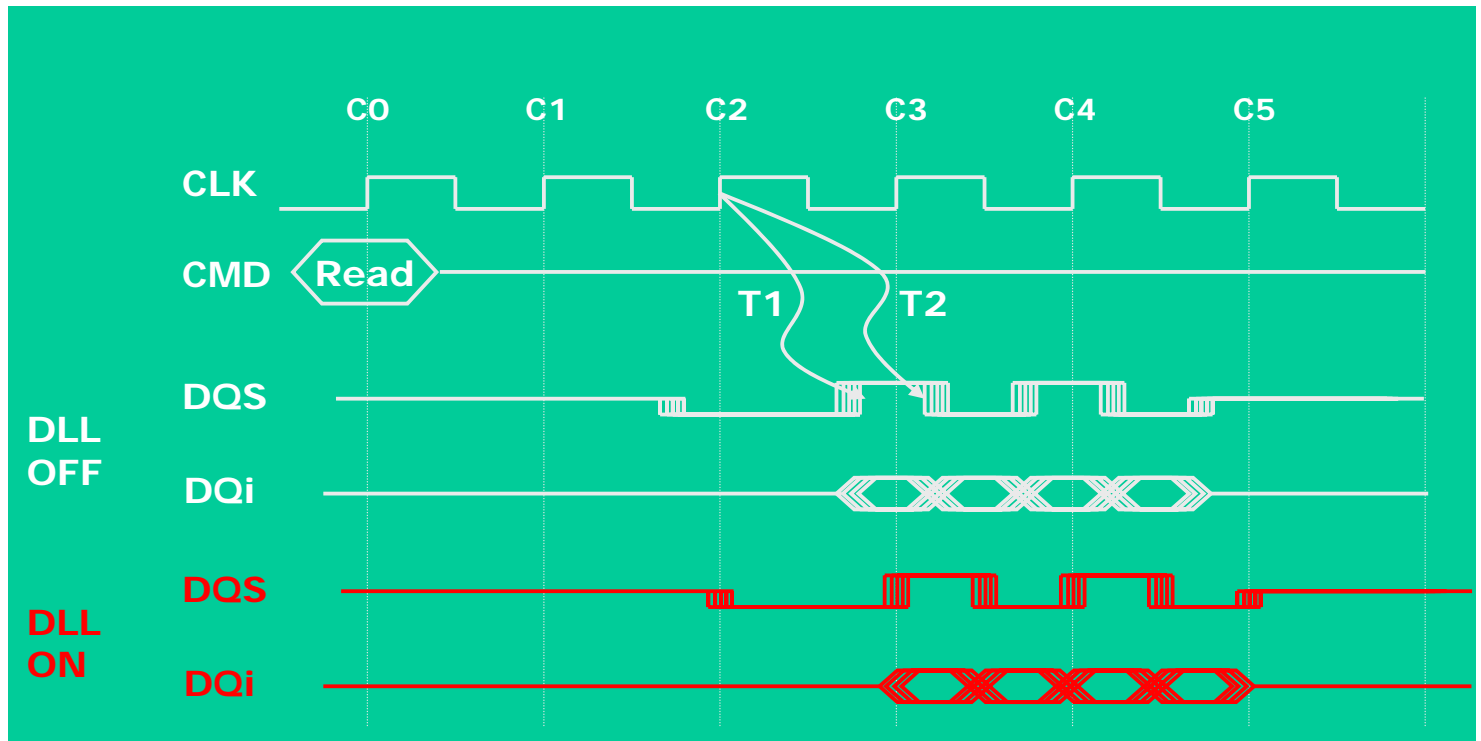
For the stable high frequency memory operation, the graphic DDR requires a fine tuned DLL and it limits the memory's DLL operating range narrow, however this causes concern among the customers who need to run GDDR below 100MHz. Especially, notebook graphic developers concern it because they need to vary memory frequency from high frequency to low frequency even below 100MHz depending on the application programs.

To overcome this concern, Samsung provides DLL-Off mode guideline for lower frequency and changed the format which represent tDV instead of tDQSK before. We list up each GDDR device's tDV at DLL-Off mode so that the user can refer to it in configuring its system properly.

GDDR tDV at DLL-Off Mode

□ Timing Diagram (Example)

- Assuming Operating Condition : **CL3** & BL4
- Dout Valid Window = T1 ~T2



Valid Data Window

□ tDV at DLL-Off mode

Density	Type	Generation	DLL-On Freq(min)	DLL-Off Freq(max)	DLL-Off Mode tDV			
					100MHz		166Mhz	
					T1	T2	T1	T2
512Mb	GDDR3	K4J52324QC-BC	300MHz	166MHz	5.0ns	8.6ns	5.0ns	6.4ns
256M	GDDR3	K4J55323QG-BC	300MHz	166MHz	5.4ns	9.0ns	5.4ns	7.0ns
	GDDR3	K4J55323QF-GC	300MHz	166MHz	6.5ns	9.8ns	6.5ns	7.8ns
	gDDR2	K4N56163QF-GC	100MHz	166MHz	5.4ns	8.6ns	5.4ns	6.6ns
	GDDR	K4D55323QF-GC	166MHz	166MHz	6.5ns	9.6ns	6.5ns	7.6ns
	GDDR	K4D553235F-GC	100MHz	166MHz	5.9ns	9.1ns	5.9ns	7.1ns
128M	GDDR	K4D26323QG-GC	100MHz	166MHz	6.1 ns	9.1ns	6.1 ns	7.1ns
	GDDR	K4D263238G-GC	100MHz	166MHz	4.8ns	8.4ns	4.8ns	6.4ns

How to extract valid data window at a certain frequency other than stated above

-T1 : Fixed regardless of frequency as shown on the table

-T2 : Related with operating frequency. (Assumed default tCC=10ns)

$$T2(\text{Required tCC}) = T2(\text{@default tCC}) + (\text{Required tCC} - \text{default tCC})/2$$

Example) 128Mb G-die $T2(\text{@166Mhz}) = 9.1\text{ns} + (6\text{ns} - 10\text{ns})/2 = 7.1\text{ns}$

Example) 128Mb G-die $T2(\text{@ 66Mhz}) = 9.1\text{ns} + (15.2\text{ns} - 10\text{ns})/2 = 11.7\text{ns}$