HDQ Compatibility Between OMAP™ and bq Products

Battery Management

TI's OMAP™ and battery management products are found in today's fast-paced developing market of handheld products that include cellular phones with integrated camera and video recorder features, PDAs with wireless capabilities, and advanced handheld gaming systems. In many of these systems, both OMAP and battery management products coexist. OMAP platforms have an HDQ engine that is used to communicate with TI's battery monitors. Due to the different clock speeds that are used among the different OMAP families and the minor differences between HDQ timings in selected battery monitors, certain combinations of OMAP and battery monitor may not be fully compatible for HDQ communication. The intent of this document is to provide a tool for battery pack and system developers in choosing the right match between an OMAP processor and an HDQ-compliant TI battery monitor.

1.1 HDQ Communication Protocol

Most battery monitor ICs from TI, including the bq26220 and bq26500, include a single-wire HDQ serial data interface. Host controllers, configured for either polled or interrupt processing, use the interface to access various IC registers.

The interface uses a command-based protocol, where the host processor sends a command byte to the battery monitor. The command directs the battery monitor either to store the next eight bits of data received to a register specified by the command byte or to output the eight bits of data from a register specified by the command byte. The communication protocol is asynchronous return-to-one and is referenced to Vss, which is typically tied to the battery pack's negative terminal.

The timing requirements for HDQ are shown in Figure 1-1. The timing references used in this figure are used throughout the rest of this document.

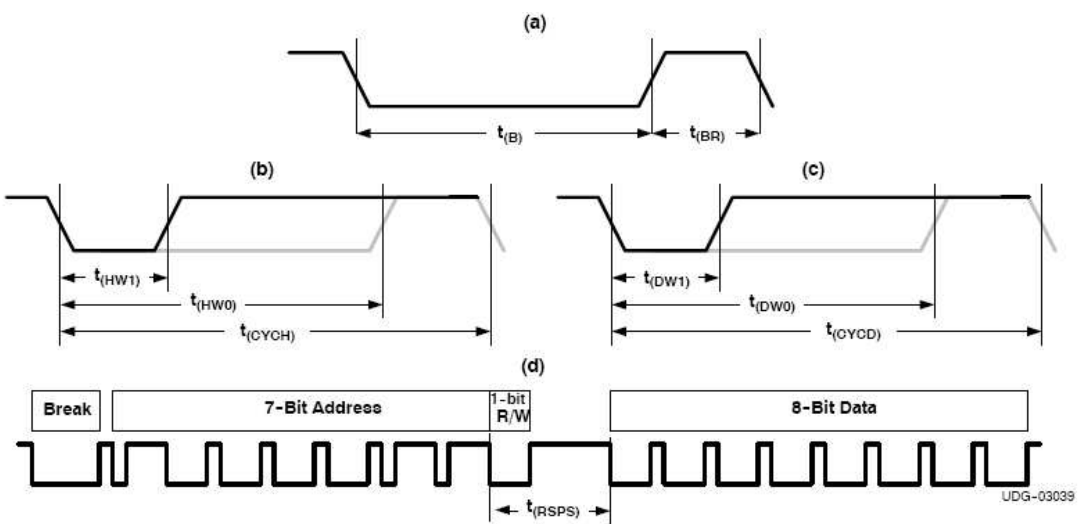

Figure 1-1. HDQ Timing Requirements

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1.2 OMAP™ and HDQ

Three clock speeds affect the timing specifications of the HDQ engine in OMAP. Some OMAP families can select any of the speeds. Table 1-1 summarizes the different clock speeds that each OMAP family works with.

Table 1-1. HDQ Clock Speeds in OMAP

	12 MHz	13 MHz	19.2 MHz
OMAP710	√		
OMAP73x		√	
OMAP750/850		√	
OMAP1510	√	√	
OMAP16xx	√	√	√
OMAP1710	√	√	√
OMAP24xx	√		

Depending on the clock speed that the HDQ engine of OMAP is using, the timing specifications for HDQ will vary. Table 1-2 shows the timing characteristics associated with the different clock speeds. Use Figure 1-1 to relate the values in Table 1-2.

Table 1-2. HDQ Timing Requirements and Characteristics Based on OMAP

PARAMETER	DESCRIPTION	12 MHz		13 MHz		19.2 MHz		UNIT
$t_{(B)}$	Break timing	192		178		120		µs
$t_{(BR)}$	Break recovery	63		58		39		µs
$t_{(CYCH)}$	OMAP bit window	232		214		145		µs
$t_{(HW1)}$	OMAP sends 1 (OMAP write)	1.3		1.2		0.81		µs
$t_{(HW0)}$	OMAP sends 0 (OMAP write)	101		93		63		µs
		MIN	MAX	MIN	MAX	MIN	MAX	µs
$t_{(CYCB)}$	OMAP bit window	253		234		158		µs
$t_{(DW1)}$	OMAP reads 1		68		63		42	µs
$t_{(DW0)}$	OMAP reads 0	180		166		112		µs

1.3 bq Monitors and HDQ

Most TI battery monitors use HDQ to communicate with hosts. Although the HDQ protocol is the same among these monitors, the timings may be different between product numbers. Table 1-3 summarizes the different timing requirements for HDQ depending on model of battery monitor. See the parameters to Figure 1-1.

Table 1-3. HDQ Timing Requirements in Different TI Battery Monitors

PARAMETER	bq2019, bq26200, bq26220		bq26500		bq26221		bq26501		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{(B)}$	190		190		190		190		µs
$t_{(BR)}$	40		40		40		40		
$t_{(CYCH)}$	190		190		190		190		
$t_{(HW1)}$	0.005 (1)	50	17	50	0.005 (1)	50	0.5	50	
$t_{(HW0)}$	100	145	100	145	92	145	86	145	
$t_{(RSPS)}$	190	320	190	320	190	320	190	320	
$t_{(CYCB)}$	190	250	190	260	190	250	190	260	
$t_{(DW1)}$	32	50	32	50	32	50	32	50	
$t_{(DW0)}$	80	145	80	145	80	145	80	145	

(1) The HDQ engine of these battery monitors interpret a 5-ns or longer glitch on HDQ as a bit start.

1.4 HDQ Comparison Between OMAP and bq Monitors

Based on Table 1-2 and Table 1-3, it can be determined that none of the TI battery monitors are compatible with the OMAPs that have the HDQ engine set with 19.2-MHz clock. Depending on the clock setting for OMAP, certain monitors must be used to be fully HDQ compatible. Because bq26221 and bq26501 do not have a *Break Timing* compatible with 13-MHz OMAPs, the actual HDQ break command cannot be used. Instead of using HDQ mode to send a break condition on the HDQ line, the break condition must be generated using 1-wire mode. In 1-wire mode, the initialization pulse timing is >400 µs, long enough for the bq26501 to properly synchronize with the OMAP HDQ module. The initialization pulse is used to generate the break condition. After the break condition has been met, the OMAP HDQ module must be reconfigured for HDQ mode and processing resumes as outlined in the OMAP Technical Reference Manuals (Both read and write work the same for 13-MHz and 12-MHz clocks. Only the break condition must be generated differently).

Table 1-4 can be used as a selection matrix to determine which handheld battery monitor to use depending on the OMAP platform selected for a given system design. The bq26221 and the bq26501 have HDQ compatibility with both 12-MHz and 13-MHz OMAP. They are also the most advanced battery monitor and gas gauge at the time of writing.

Table 1-4. Battery Monitor Selection

	12 MHz	13 MHz
bq2019	√	
bq26200	√	
bq26220	√	
bq26221	√	√
bq26500		
bq26501	√	√

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