

Gameboy Advance For Non-Gaming Applications

*Turning a fun toy
into a powerful tool*

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With more than 100-million units shipped since 1989, Nintendo's Gameboy is a hugely popular game console. The Gameboy Advance is powered by a 32-bit ARM processor and it sports a color LCD with 240x160 display resolution, stereo sound, headphone support, multiple input buttons, serial I/O, DC-power support, and a cartridge to change programs. Moreover, it operates for 10 to 15 hours on just two AA batteries. And all this for only about \$70.00.

As it turns out, the Gameboy Advance (GBA) can also be used for a variety of

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nongaming applications, ranging from real-time control and image processing to robotics and data collection, to name a few. What makes this possible is the GBA connector slot that game cartridges plug into. Figure 1 shows the pinout of this connector, which provides access



to internal ARM processor signals. The connector can be used to interface external memory through the cartridge connector, as well as I/O devices as memory-mapped ports. The ARM processor does not differentiate between memory or ports, and uses a single address map to access both types of devices.

The signals on the cartridge interface show a 24-bit address bus (the lower 16 addresses of the 24-bit address bus are multiplexed with the 16-bit data bus) as well as two chip select signals (CS* and CS2*). These signals can be used to address up to 32 MB of external memory addresses. The ARM processor supports random- and sequential-memory access. In random-memory access, the address of the memory location is placed on the address bus, followed by the data read/write. In sequential-memory access, the address is sent out once, then a burst of data read/write operations are performed. Table 1 presents the GBA memory map.

The GBA executes user programs via a multiboot cable or through memory cards plugged into the cartridge connector.

- With the multiboot method, you download programs from a PC through the GBA's serial port into the internal 256-KB RAM (referred to as "external work RAM" in Table 1). The advantage of this method is that, except for a PC-to-GBA serial cable, extra hardware is not required. (The serial communication protocol used by the GBA is a nonstandard, 16-bit asynchronous transfer.) The disadvantage is that the PC (or other host) that downloads the program is required every time the GBA is powered up. Figure 2 shows the GBA's serial port connections.

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