

Bit Angle Modulation

Bit Angle Modulation (BAM) is a new LED drive technique invented by Artistic Licence. It is a variation of Pulse Code Modulation.

The technique can be used with fixed or variable frequency modulation and is also applicable to multiplexed systems.

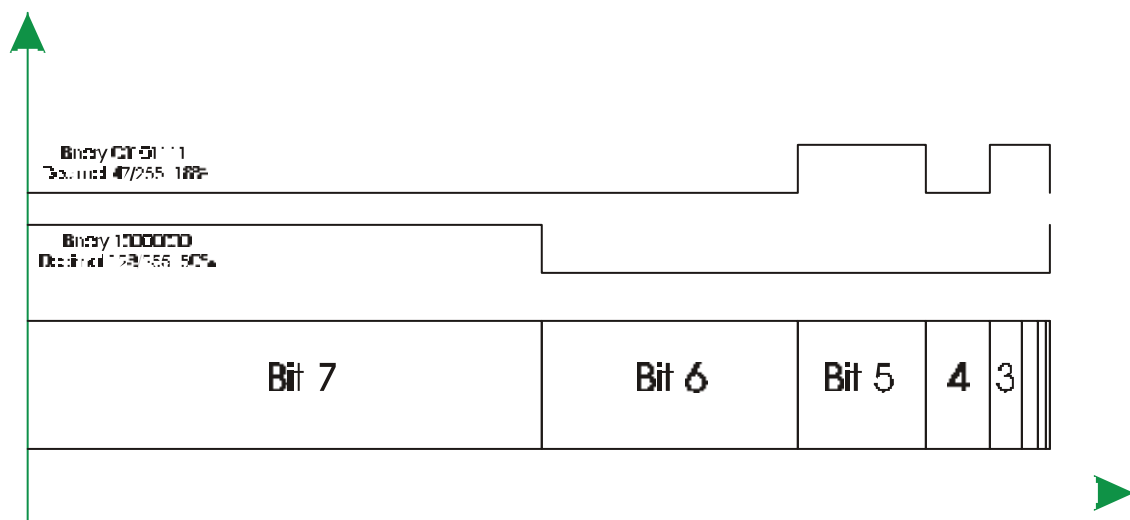
In essence, the LED is driven by a pulse train that is the binary word defining the value of required intensity. Each bit of the pulse train is stretched by a ratio defined by the binary significance of each bit.

Each bit of the binary word is effectively allocated a fixed range of phase angles within the drive cycle.

The following table shows the ratio by which each bit is stretched:

Bit Position	Stretched by:
7	128
6	64
5	32
4	16
3	8
2	4
1	2
0	1

The following diagram shows an example (not to scale):



Benefits:

1. Simple to implement in hardware or software.
2. The drive signal is a multiple of the modulation frequency, thus reducing potential flicker.
3. Required significantly less processing power compared to PWM. A microprocessor generating an eight bit resolution PWM signal at 100Hz will need to process the output every 39uS, a total of 256 times per output cycle. By comparison a microprocessor generating an eight bit resolution BFM signal at 100Hz will need to process the output only 8 times at 5000us, 2500us, 1250uS, 625uS, 312uS, 156uS, 78uS, 39uS intervals from the cycle start. This represents an 800% reduction in required processing power compared to PWM.
4. The LED drive signal contains a digital code of the intensity value allowing other devices to recover the data.

Drawbacks:

1. None - this is the most efficient drive technique developed thus far.

Bit Voltage Modulation

Bit Voltage Modulation is the AC version of Bit Angle Modulation. In this variant, the drive signal is used to switch a full wave rectified AC waveform.

The pulse stretching used in BAM is modified to allow for the varying peak voltage of the AC waveform in such a way as to ensure that the time averaged drive current represents the binary ratios of 128 : 64 : 32 etc.

Benefits:

1. Simple to implement in hardware or software.
2. The drive signal is a multiple of the modulation frequency, thus reducing potential flicker.
3. Reduced processing power

Drawbacks:

1. Can suffer from the same peak current limitations of standard AC drive.