SPREAD SPECTRUM CLOCK OSCILLATORS – REDUCING EMI AT SOURCE

Andy Treble, Euroquartz's sales and marketing director, gets to grips with the black arts of spread spectrum technology (SST) clock oscillators, a modulation technique that results in significant reductions in EMI emissions.

Why use low EMI clock oscillators? Both the European EMI Directive and the United States' FCC Regulations stipulate maximum standards of ***Electromagnetic Interference (EMI)*** that can be tolerated in electrical equipment.

In electronic systems a principal cause of EMI is the system clock oscillator and traditional "patching-up" methods of combatting interference – ferrite beads, ground planes, metal shielding and similar – are frequently costly and awkward to implement and most often applied after a system has failed EMI testing.

Often, engineers are forced into drastic redesign of equipment following failure of equipment submitted for testing to either of these standards. Usually this is just before the commercial launch of the equipment and the resultant "fixes" are often costly.

To avoid this problem **Euroquartz** produces ***low EMI clock oscillators*** utilizing SST that provide an efficient and economic method of reducing EMI at its source, the clock oscillator.

Among traditional methods of dealing with EMI problems include the use of EMI filters, ferrite beads and chokes, adding power layers and ground planes to PCBs, adding metal shielding, special coatings or RF gaskets. A spread spectrum clock oscillator will obviate the need for any other EMI reduction methods. The most efficient method to reduce EMI is to suppress it at source and Euroquartz's EQHM22 does exactly that. Compared with conventional clock oscillators, spread spectrum (dithered) oscillators can reduce EMI by up to 12dB and the parts are drop-in replacements for standard components so there is no requirement to redesign existing PCBs.

What are spread spectrum clock oscillators? Spread spectrum clock oscillators spread out the concentrated mode energy on one particular frequency to a broader bandwidth and controlled frequency range (for example: centre frequency ±1%) with a controlled modulation rate. The total mode energy remains the same but the peak energy is spread out to nearby frequencies. Euroquartz's range of low EMI oscillators is outwardly identical to standard clock oscillators and, as such, provides a "drop in" replacement for standard clocks.

What are the principal causes of EMI? The principal sources of EMI come from system clocks including frequency timing generators, crystal oscillators, VCOs and PLLs. Instead of patching a system by using filtering and shielding, use of a SST clock oscillator at the design stage will obviate expensive EMI reduction techniques, usually incurred after a system has failed to meet EMI/EMC regulations at test laboratories.

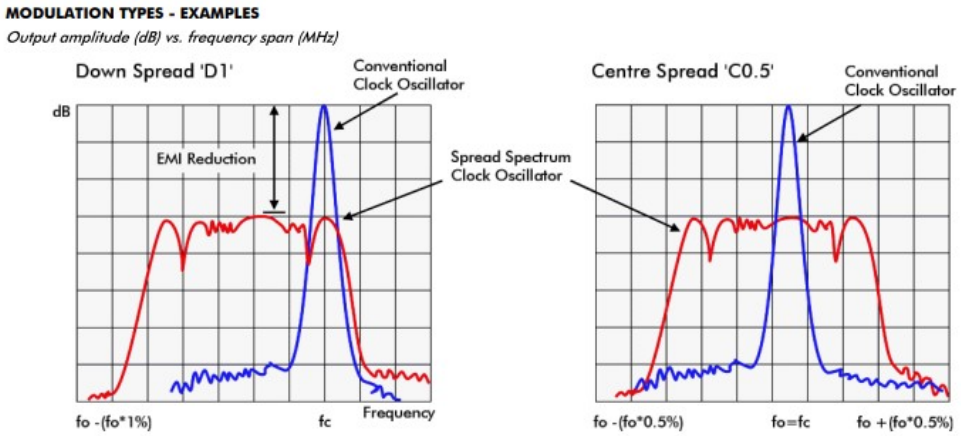
Euroquartz HM series low EMI crystal oscillators provide a drop-in replacement solution for these situations, one major cost-saving advantage being that re-working a PCB will not be necessary.

How much EMI reduction can I expect? By using a SST oscillator a reduction of 10dB or more of EMI can be expected. The modulation carrier frequency is usually in the range of 6 to 55kHz (model and frequency dependent), which makes the modulation process transparent to the oscillator frequency. Consequently, electronic devices have lower EMI emissions but are not affected by the resultant instantaneous frequencies.

Centre spread or down spread? The controlled modulation process of SST oscillators can be on one side of the nominal frequency (down spread) or modulated either side of nominal frequency (centre spread). If we were to assume a 100MHz SSC (Spread Spectrum Clock) for example, its nominal frequency is modulated between 99.500 and 100.500MHz with a centre spread of 0.5%.

If a down spread oscillator is used then a 0.5% spread gives frequencies between 99.500 and 100.00MHz. By moving the centre frequency a down spread of 0.5% modulation can be considered a process equivalent to a centre spread of 0.25%.

To explain differently, modulation between 99.500 and 100.00MHz (down 0.5%) is equivalent to a centre spread of 0.25% with centre frequency at 99.750MHz.



Notes on choice of spread Down spread is preferred if a system cannot tolerate over-clocking (operation at higher than nominal frequency). In the above 100MHz example, centre spread 0.5%, there is a period of time that the system will be running between 100 and 100.5MHz; these instantaneous frequencies are higher than the system clock and may erode the system timing margin. Using down spread will avoid this problem with the small sacrifice of a slightly slower clock rate.

Modulation carrier frequency The modulation carrier frequency (sweep rate) is in the kHz region, considerably slower than the clock frequency in the MHz range. As shown in the examples, the output frequency is slowly swept within the pseudo triangular wave shape envelope. The resultant instantaneous frequencies are always between f(max) and f(min). The modulation percentage determines the bandwidth of the span while the modulation carrier frequency determines the spacing of the spectrum.

EMI reduction on harmonics Higher order harmonic frequencies receive a stronger EMI reduction. This also shows that the greater modulation percentage further reduces EMI emission. It is worth noting that as well as the fundamental frequency, every harmonic also has EMI reduced by employing SST techniques.

So SST clock oscillators can significantly reduce a system's EMI emissions at the design stage and can save the considerable time, money and effort that go into trying to fix a system after it has failed testing. In short, a little extra for the SST clock oscillator can avoid a lot of problems later on.a drop-in replacement for standard clock oscillators with a reduction in electromagnetic interference (EMI) by as much as 12dB. Offering a choice of modulation rates and spreads, these devices offer frequencies from 16 to 40MHz in a miniature surface mount package measuring 2.5 x 2.0 x 0.9mm. Frequency stability is available as low as ±25ppm in both commercial (0 to 70°C) and industrial (-40 to +85°C) grades with input voltages of 1.8, 2.5 and 3.3V DC available, all ±10%. Output logic is CMOS with load capability of 15pF.

Additional specifications include current consumption of 4, 5 or 6mA depending on voltage model, rise/fall times from 7ns to 10ns, start-up time of 1ms typical, 5ms maximum, output enable/disable function and duty cycle of 50% ±10%. Ageing is ±5ppm/year maximum at 25°C ambient temperature.

Euroquartz's EQHM22C low EMI oscillators are ideal for use in a wide range of applications including printers and multifunction printers, digital copiers, PDAs, networking LAN/WAN and routers, storage systems such as CD-ROM, DVD and HDD, scanners, modems, projectors, embedded systems, automotive GPS navigation systems, LCD PC monitors and TVs, ADSL, PCMCIA devices and digital cameras.

Euroquartz provides major OEMs with a global manufacturing and supply facility for all types of quartz crystals, oscillators, filters and frequency control products. They are available through their USA distributor Saelig Co. Inc.