Active EMI Management and the Challenge in Using It

Active EMI management is the use of "Active Components" which are commonly referred to as "Spread Spectrum" Integrated Circuits (ICs) to solve the EMI / RFI problems of electronic systems. These are typically used in conjunction with passive components such as capacitors, resistors, inductors, shielding etc..

The dominant architecture used in current (1st-Gen) Active EMI ICs is based on Phase Locked Loops (PLLs), which are used to Frequency Modulate the offending periodic signal.

These techniques, though effective in certain cases suffer from the following inherent limitations:

(1) Intrinsic jitter caused by the PLL, which impacts the modulation efficiency.
(2) High power consumption due to the significant amount of analog circuitry.
(3) Large part-to-part variations due to the typical shifts in the IC manufacturing process.
(4) Performance changes due to in-system operating voltage and temperature excursions.

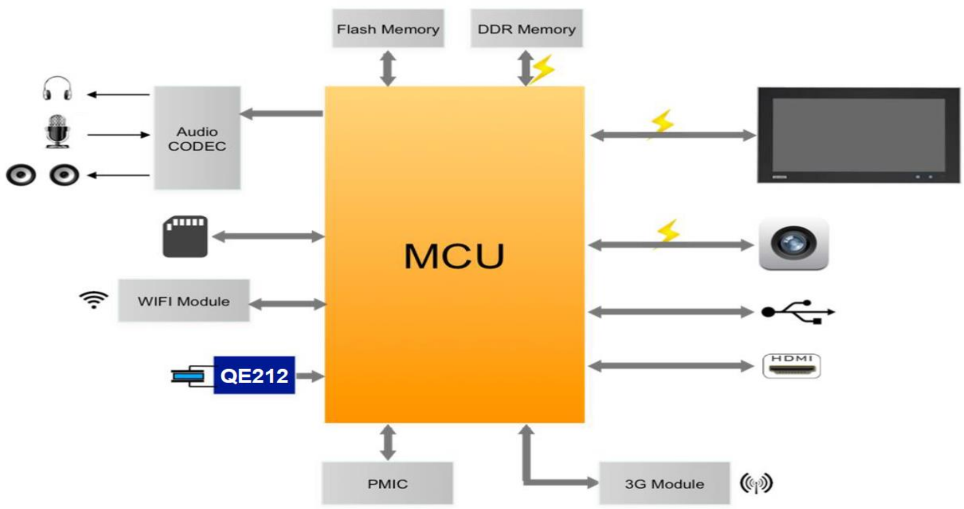
These issues have prohibited widespread adoption of this technology especially in timing and power sensitive applications. This is becoming increasingly evident in today's ever-growing world of high speed interconnected mobile devices.

Compliance at Every Level

Electronic systems today are highly integrated and support numerous interfaces such as USB, HDMI, and Ethernet to name a few. These systems must secure compliance both from an EMI / RFI point as well as from a functional level (system interoperability). This functional compliance requires certification that the system meets the strict timing requirements of the interface.

To illustrate this, a case study is presented in this article to compare the current 1st-Gen technology with QST's proprietary technology.

Case Study: EMC and USB Compliance in a Tablet PC



The block diagram above shows a very typical application (Tablet PC), which supports numerous interfaces. The EMI / RFI compliance while also staying in compliance with the USB 2.0 specification is addressed by the usage of a QST Active EMI reduction IC (QE212) at the clock source of the ASIC (MCU). This IC is subsequently replaced by a 1st-Gen Active EMI reduction IC from a competitor, configured to achieve comparable EMI / RFI benefits and the comparative results of

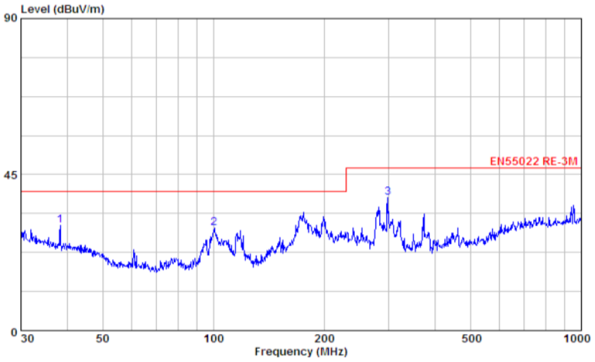
(1) EMI compliance testing
(2) USB compliance testing

are presented below.

QE212 Settings

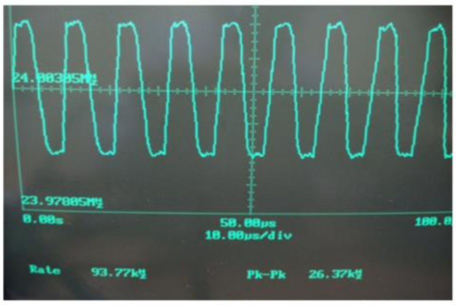
Vdd	Input Frequency	Deviation	Modulation Rate	Dynamic Current
3.3 V	24 MHz	26.4 kHz	93.77 kHz	4.35 mA

EMC Chamber Scan

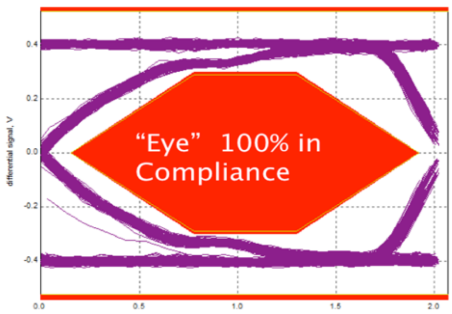


Condition : EN55022 RE-3M 3m HORIZONTAL
: RBW:120.000KHz VBW:300.000KHz SWT:Auto

	Freq (MHz)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Remark	Pol/Phase
1	38.35	30.46	40.00	-9.54	Peak	HORIZONTAL
2	100.58	29.70	40.00	-10.30	Peak	HORIZONTAL
3 max	298.27	38.35	47.00	-8.65	Peak	HORIZONTAL



QE212 Modulation Profile

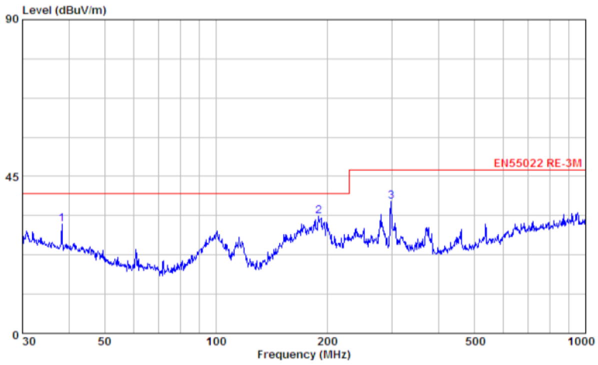


QE212 Eye Diagram

1st Generation IC Settings

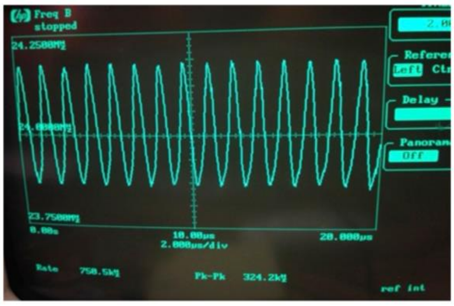
Vdd	Input Frequency	Deviation	Modulation Rate	Dynamic Current
3.3 V	24 MHz	OFF	OFF	5.6 mA
3.3 V	24 MHz	324 kHz	750 kHz	8.0 mA

1st Generation Device with Active EMI Suppression Enable

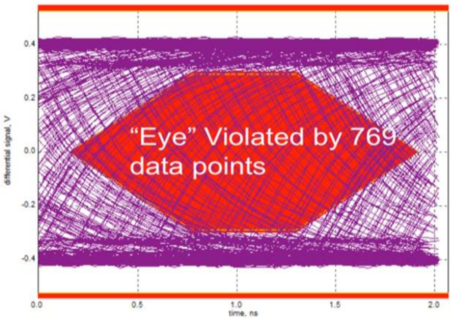


Condition : EN55022 RE-3M 3m HORIZONTAL
: RBW:120.000KHz VBW:300.000KHz SWT:Auto

	Freq (MHz)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Remark	Pol/Phase
1	38.35	31.27	40.00	-8.73	Peak	HORIZONTAL
2 max	189.74	33.70	40.00	-6.30	Peak	HORIZONTAL
3	298.27	37.98	47.00	-9.02	Peak	HORIZONTAL



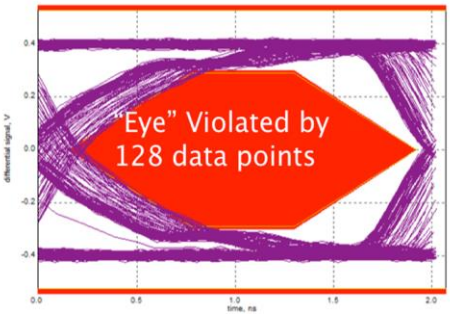
1st-Gen. Device Modulation Profile



1st-Gen. Device Eye Diagram

What is clearly evident is that to achieve the same level of EMI reduction, the 1st-Gen device grossly violates the USB 2.0 specification. In contrast the QE212 allows the system to secure both EMC and USB 2.0 compliance. Moreover the dynamic current drawn by the QE212 is almost 50% less than that drawn by the competing 1st-Gen device.

An interesting observation is that even with the Active EMI reduction disabled this 1st-Gen device still fails to pass the USB "Eye" requirement (refer to figure below). This can be attributed to the inherent jitter induced into the system due to the PLL based architecture.



1st-Gen. Device Eye Diagram

In conclusion, the QST technology now allows systems designers to exploit the tremendous benefits of Active EMI management without having to compromise on the performance and reliability of the system.