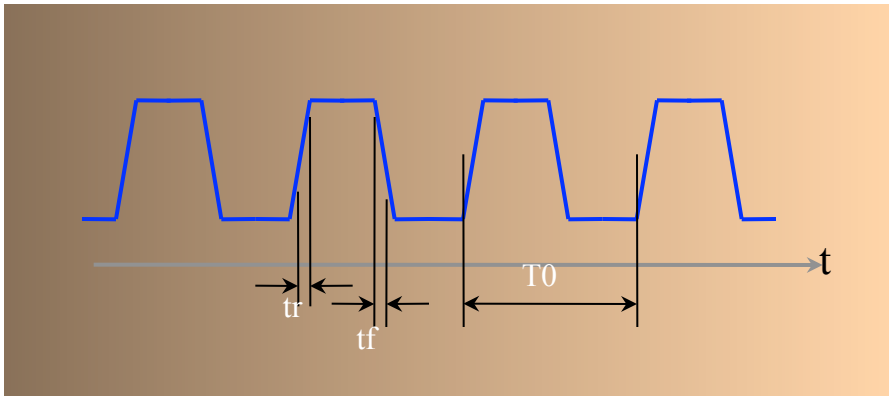
What is EMI

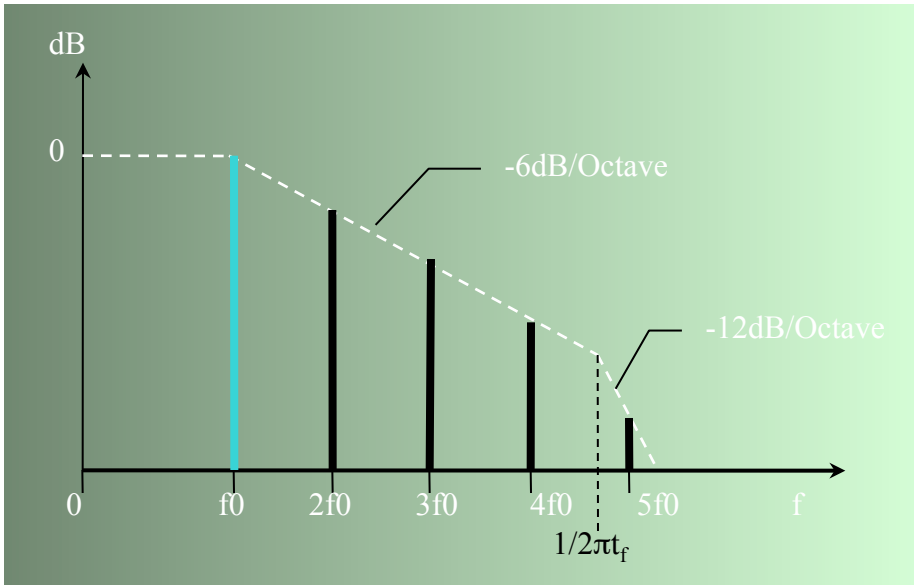
- Radiation of unwanted radio frequencies
- Electromagnetic Interference is everywhere
- Highly unpredictable
- EMI compliance is required by law

10+ billion electronics products either require or could benefit from EMI reduction solutions in 2014

Real World Signals and Spectrum



A real world signal with finite Rise and Fall times t_r and t_f and Period T_0

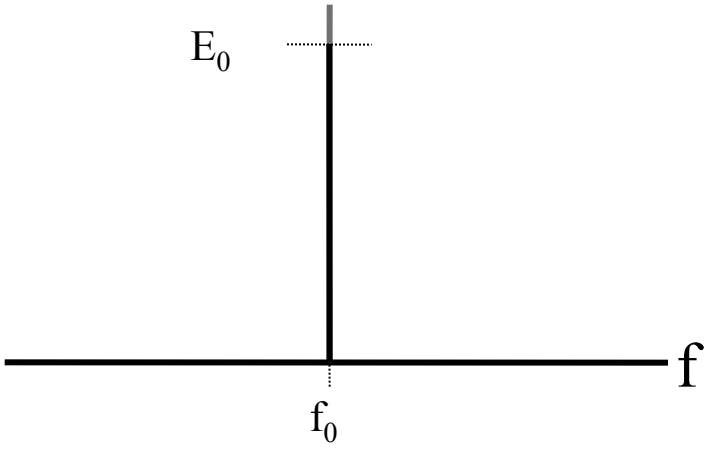


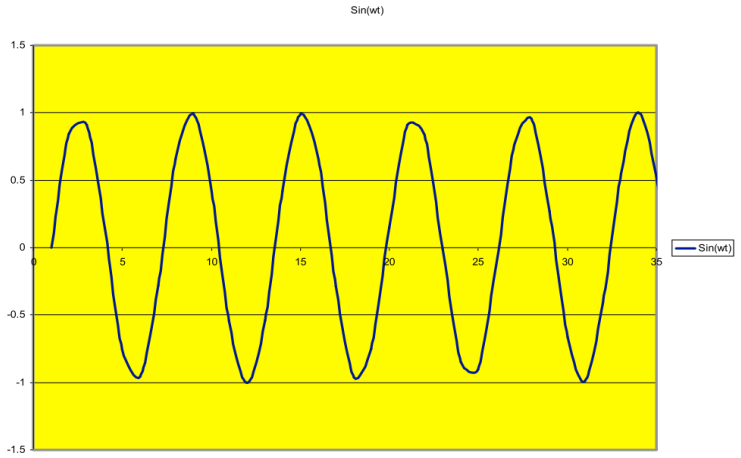
The Fourier Series for a periodic signal f(t) can be expressed as

$$f(t) = \frac{a_0}{2} + \sum_{n=1}^{n=\infty} (a_n \cos n\omega_0 t + b_n \sin n\omega_0 t)$$

Spread Spectrum Modulation Basics

Unmodulated Sine wave of frequency f_0

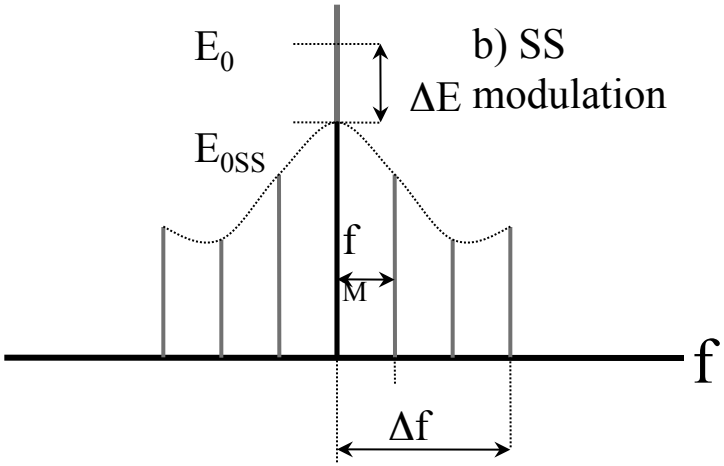


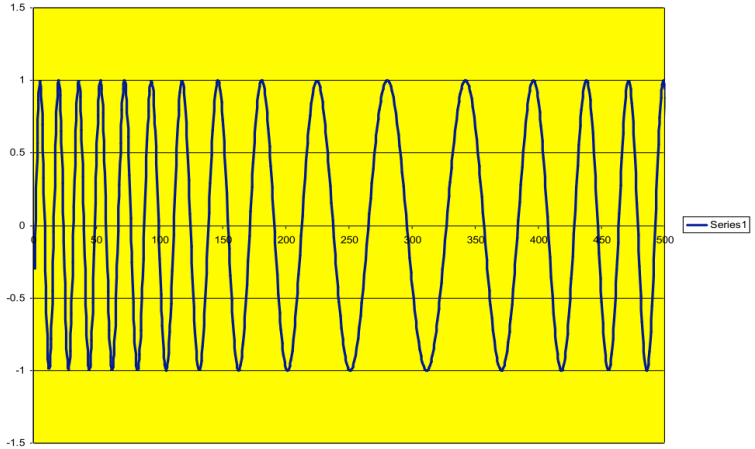


Spread Spectrum Modulation Basics

Modulated Sine Wave

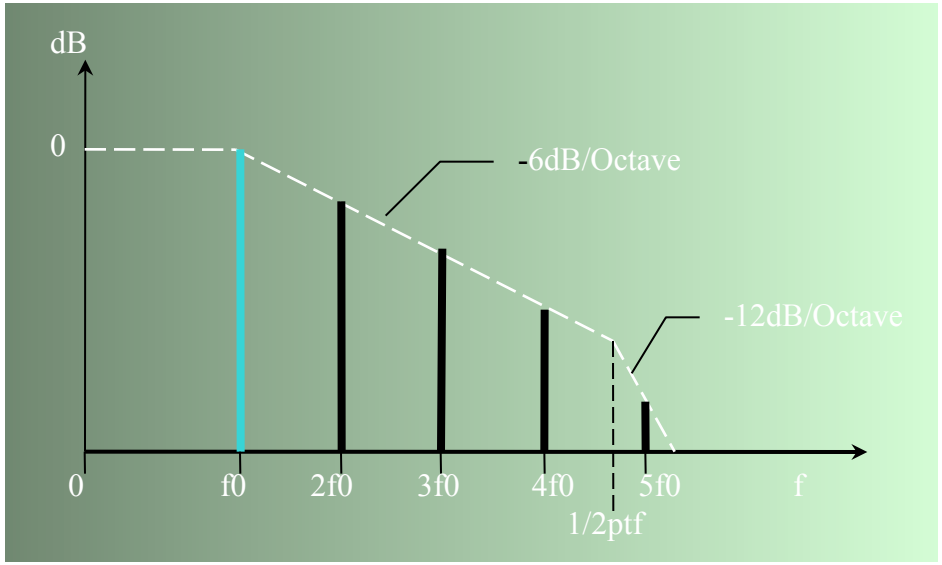
f_0 = center frequency
Δf = modulation spread
f_M = modulation rate



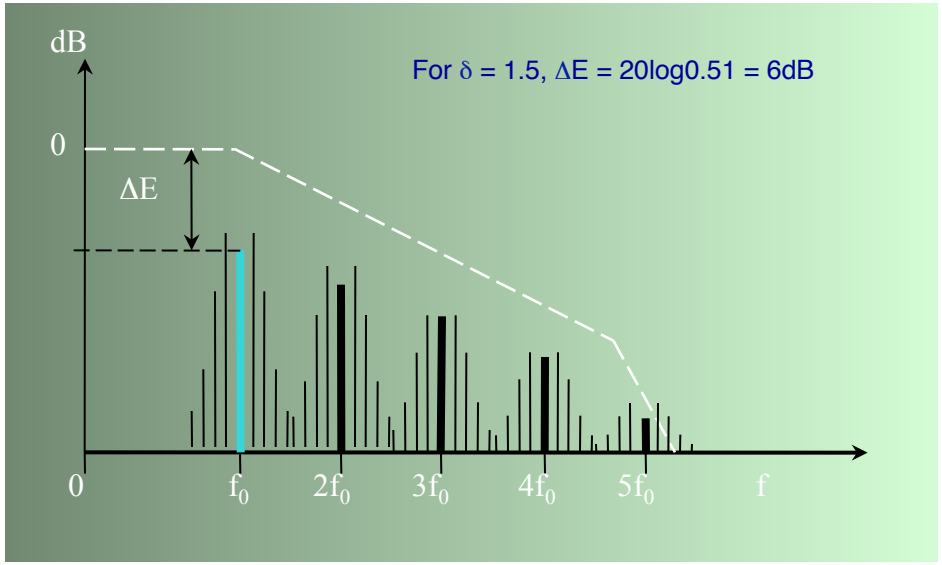


- Spectrum of an un-modulated Real World Clock

No Modulation; Normalized to 0dB

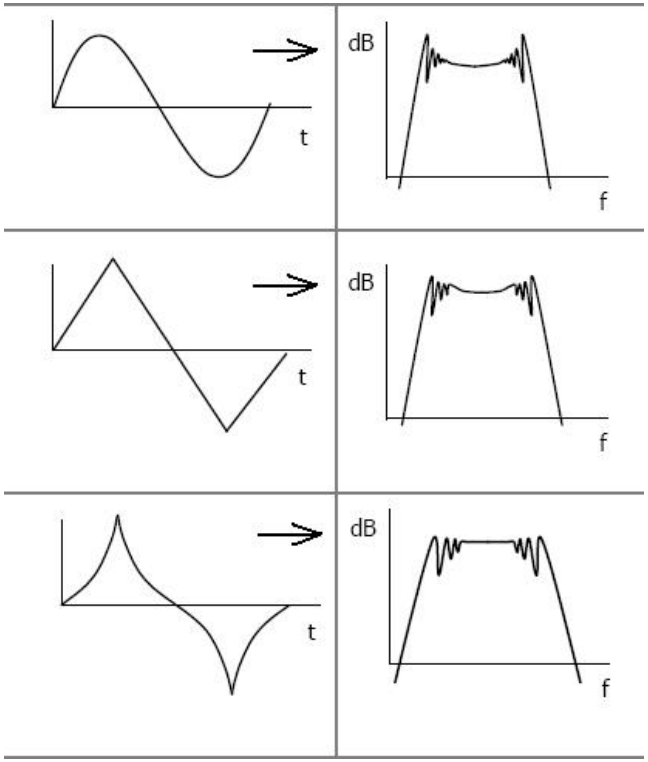


- Sine wave modulation on a Real World Clock
  - The Peak amplitude of the harmonics are suppressed
    - ΔE dB suppression at the fundamental

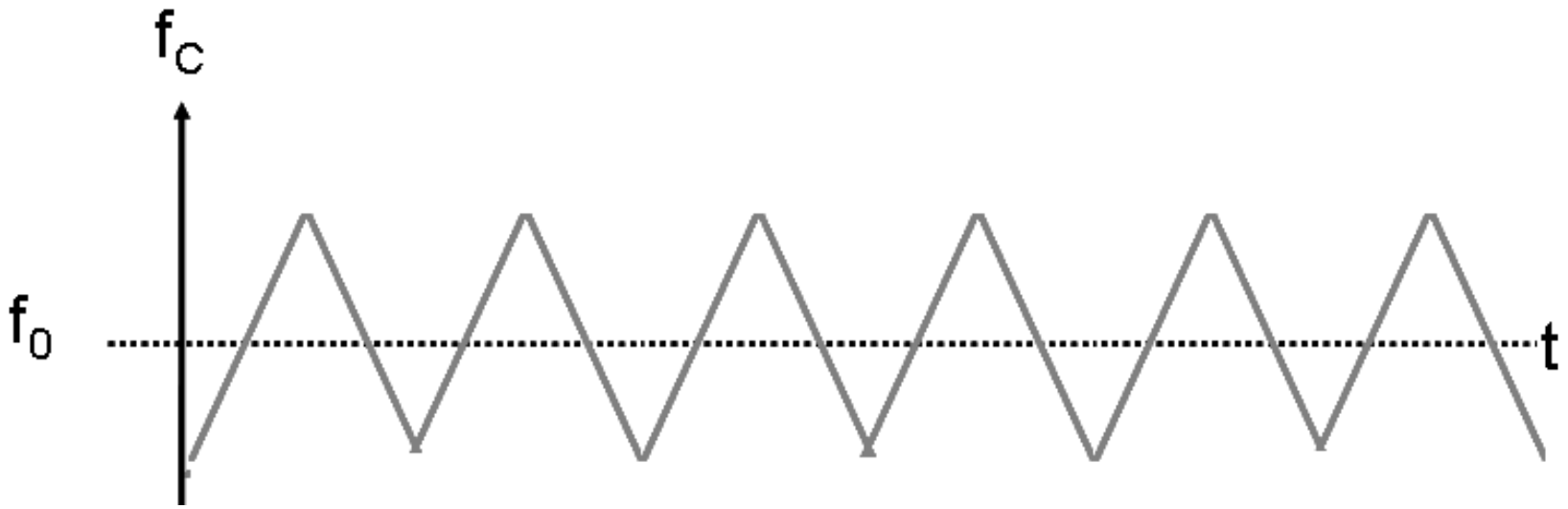


Modulation Profiles

- The shape of the profile can determine the energy peaks of the modulated wave
- Energy tends to accumulate where there is a slow change in the frequency



Frequency Deviation Calculation

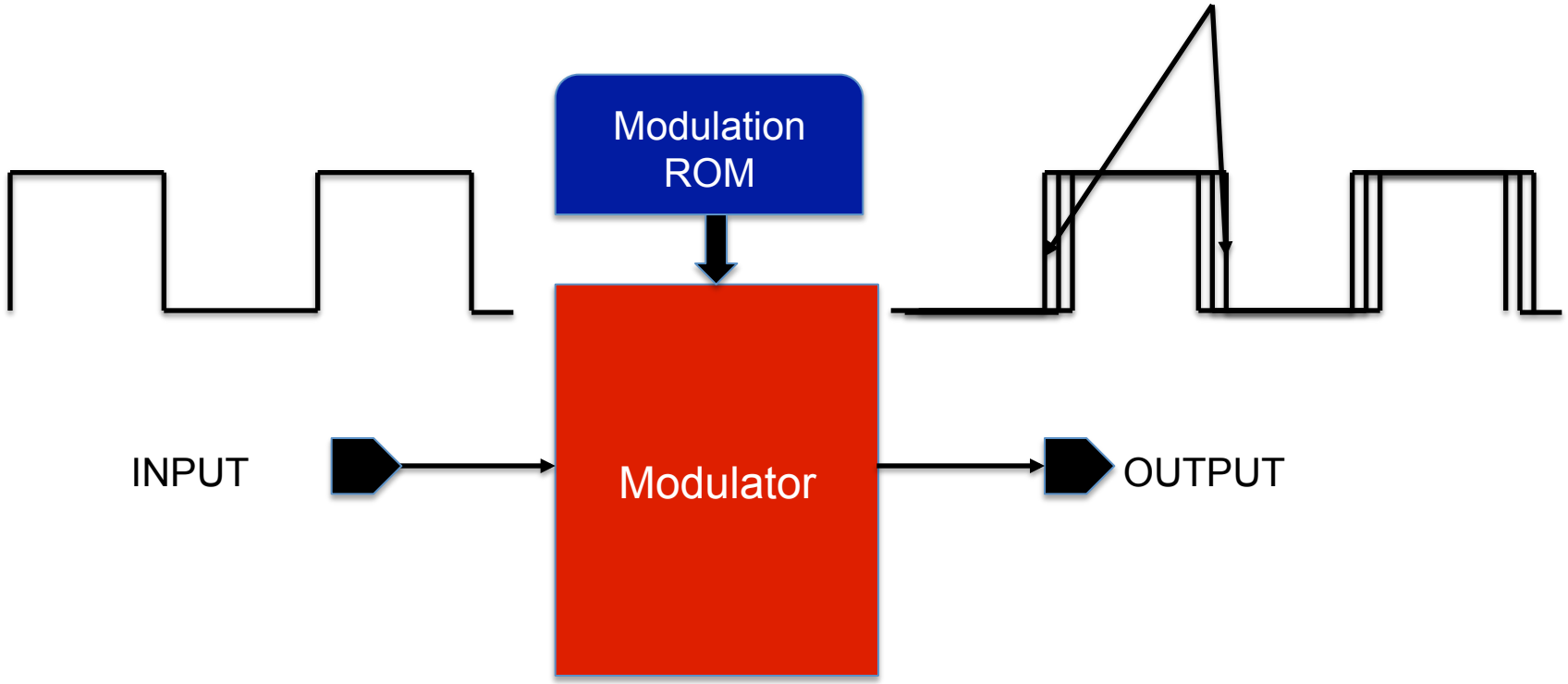


f_o = center frequency
Δf = modulation spread
f_M = modulation rate

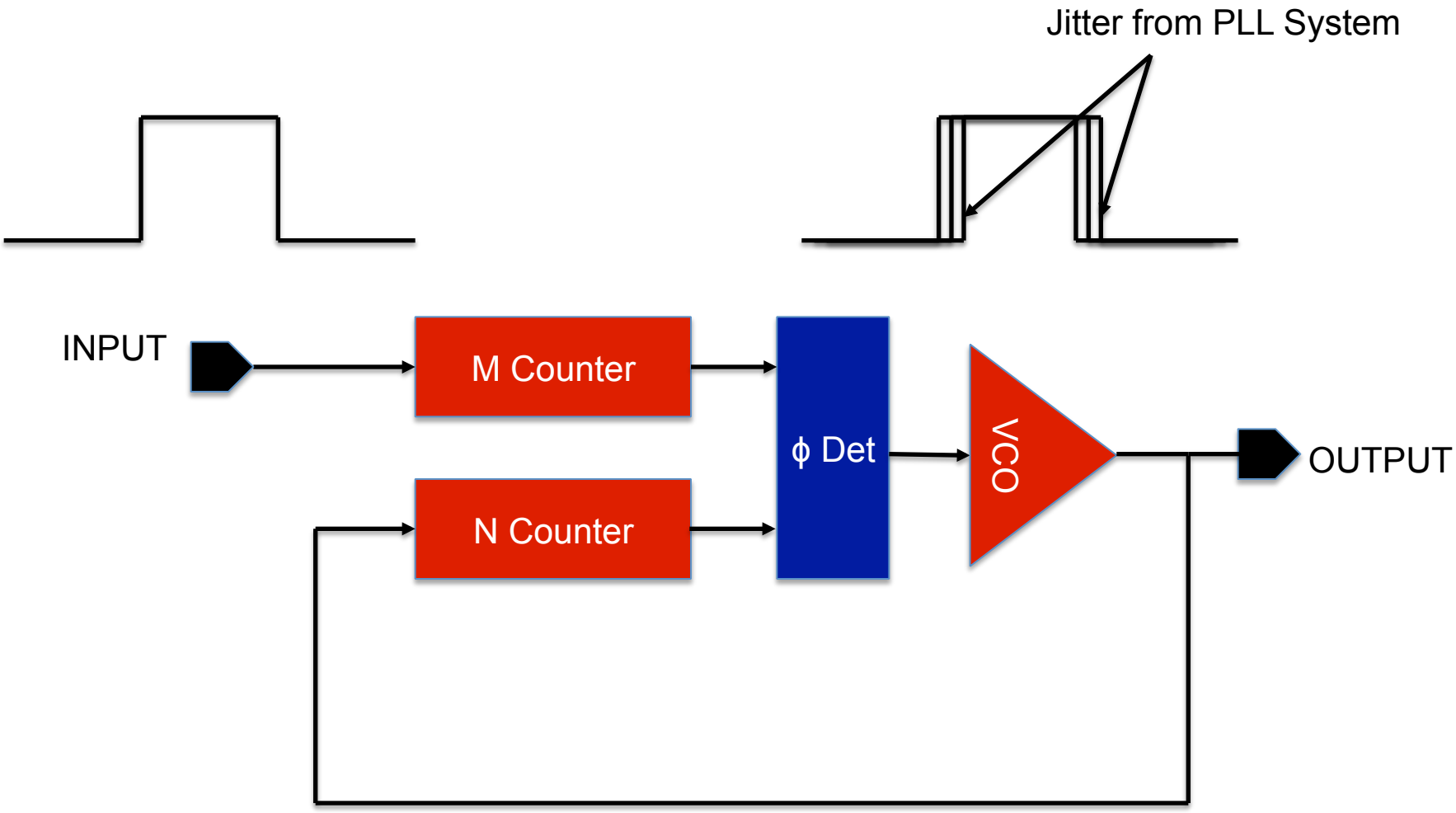
Deviation%=+/- $\Delta f/f_o$ *1/2*100

Ideal SS Implementation

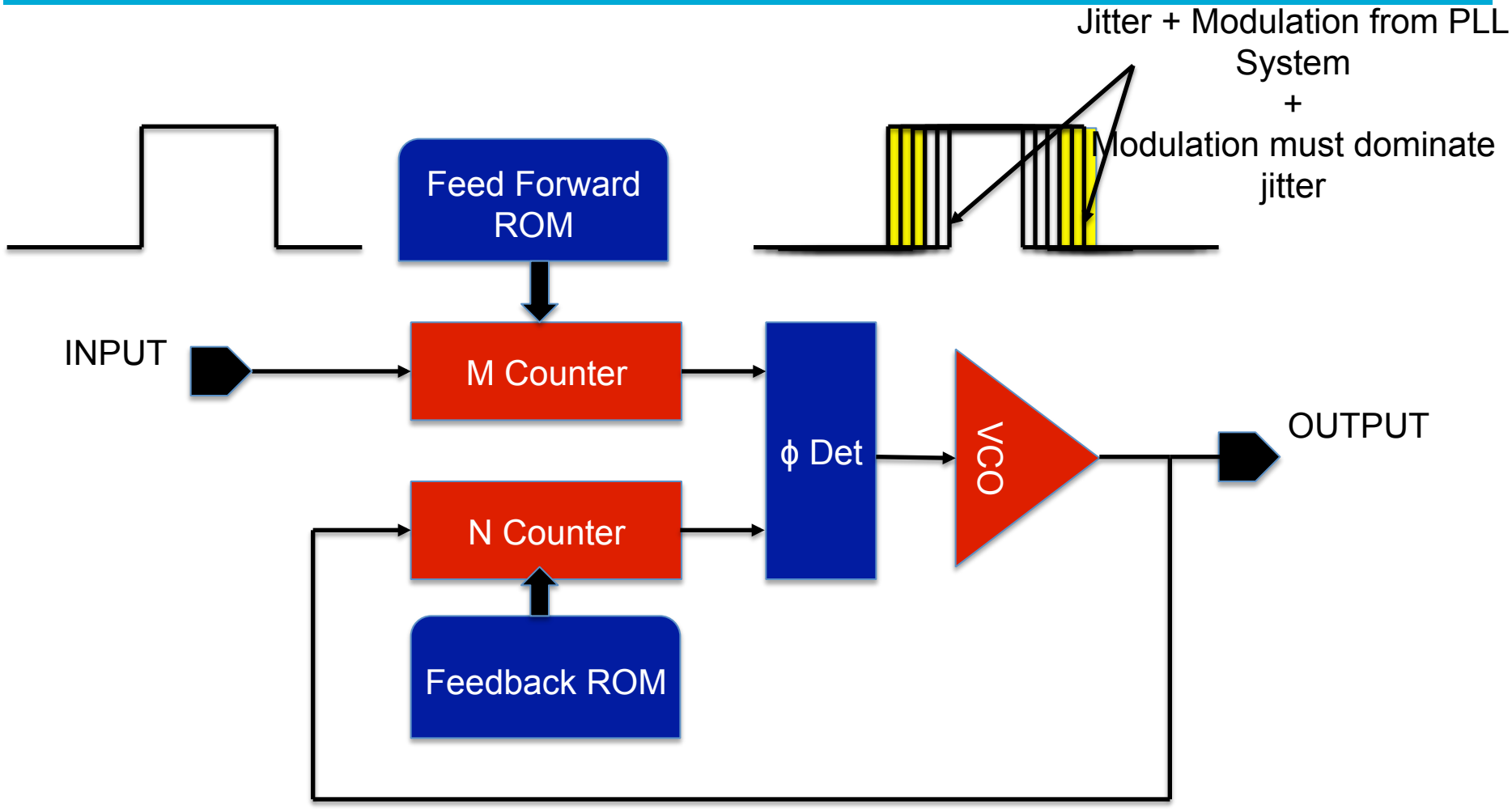
Ideal Modulated output with precise edge placement

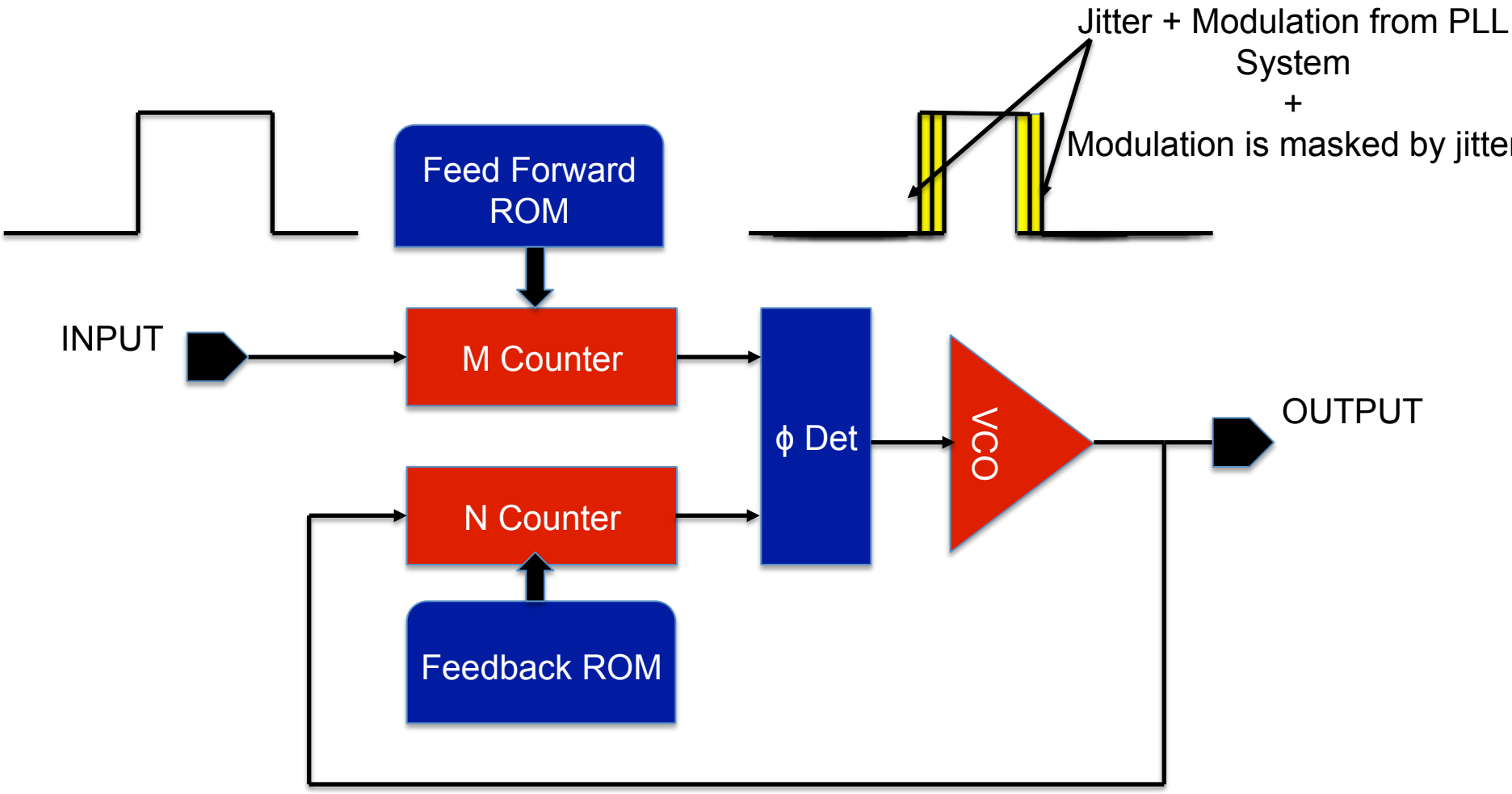


Real World SS Implementation 1



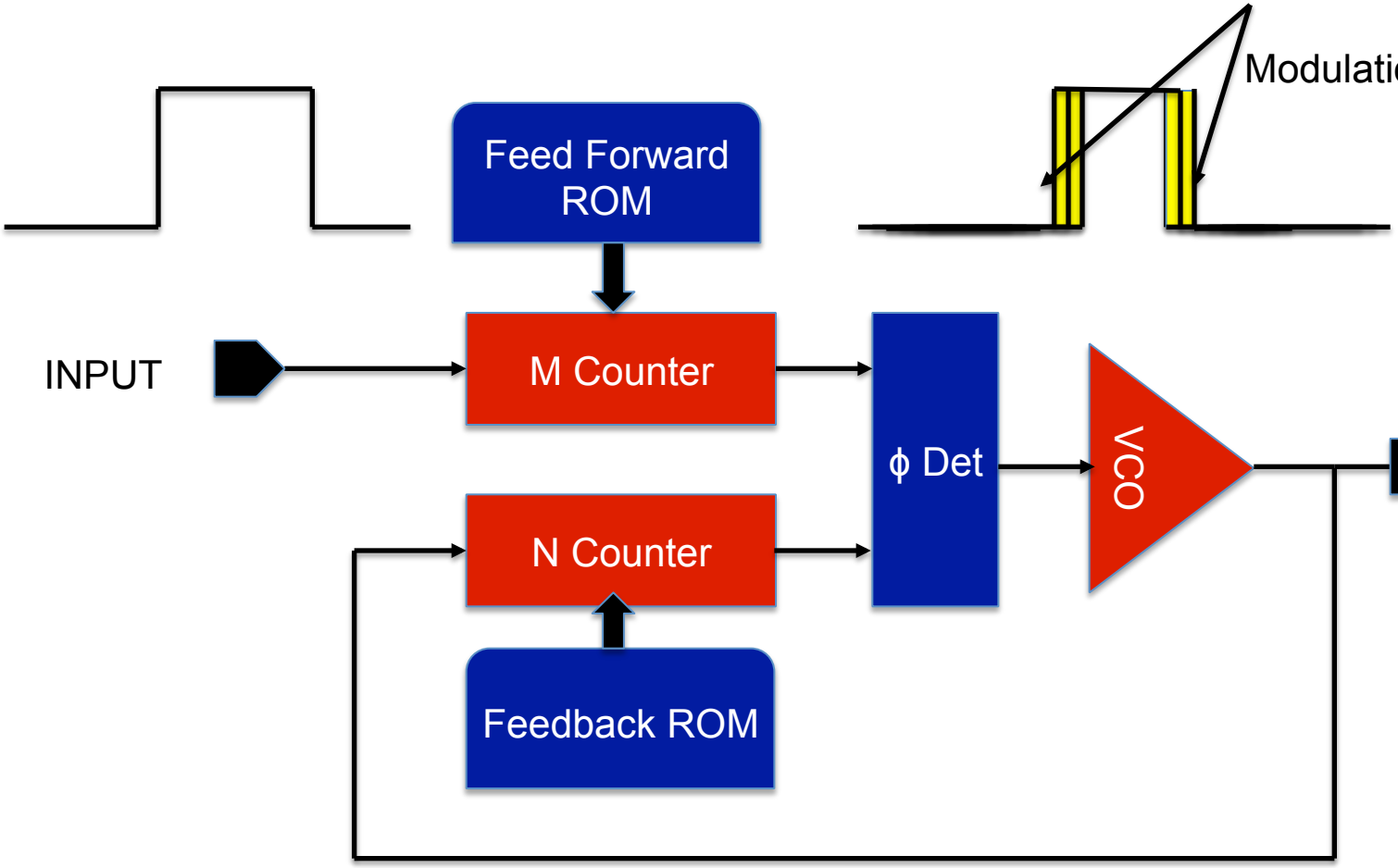
Real World SS Implementation – Large Devia




Jitter + Modulation from PLL System
+
Modulation is masked by jitter
Feed Forward ROM
INPUT
M Counter
ϕ Det
VCO
OUTPUT
N Counter
Feedback ROM

Real World SS Implementation – Small Deviation

Jitter + Modulation from PLL System
+
Modulation is masked by jitte

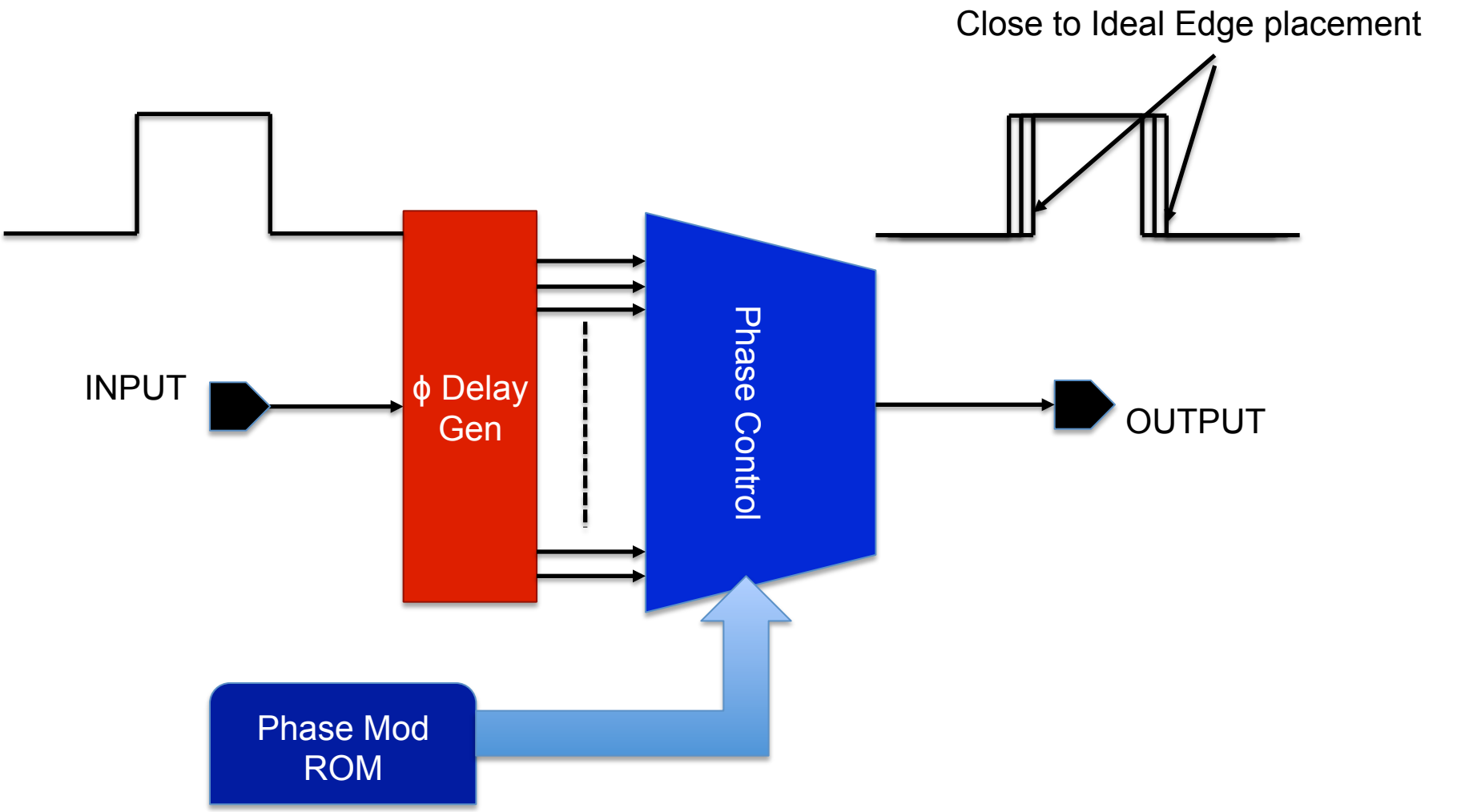


- **Limitation**

- Can only be used on periodic signals (Clock line)
- Narrow frequency range.
- Difficult to implement very small deviations as are required to ensure compliance in applications with USB and HDMI.
- High current consumption can limit applications to mobile markets.

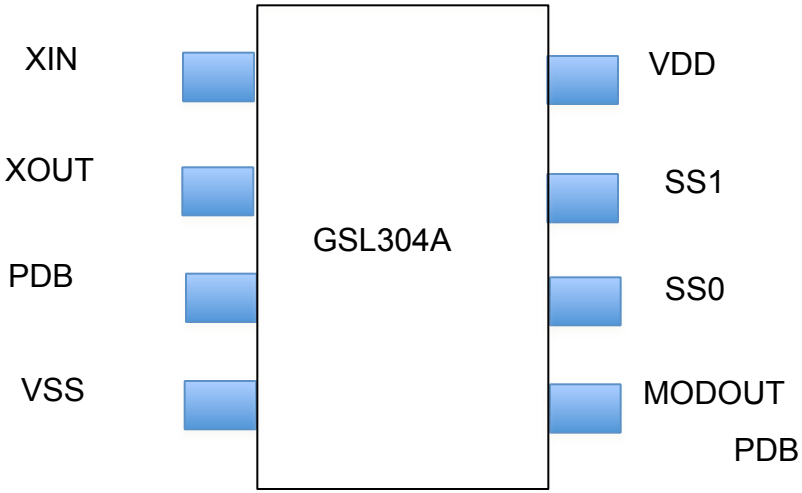
Issues

- JITTER
  - PLL jitter
  - Power supply noise
- A significant portion of the total modulation is wasted due to the inherent jitter of the system.
- Huge part to part variations can also limit the maximum deviation the system can tolerate.

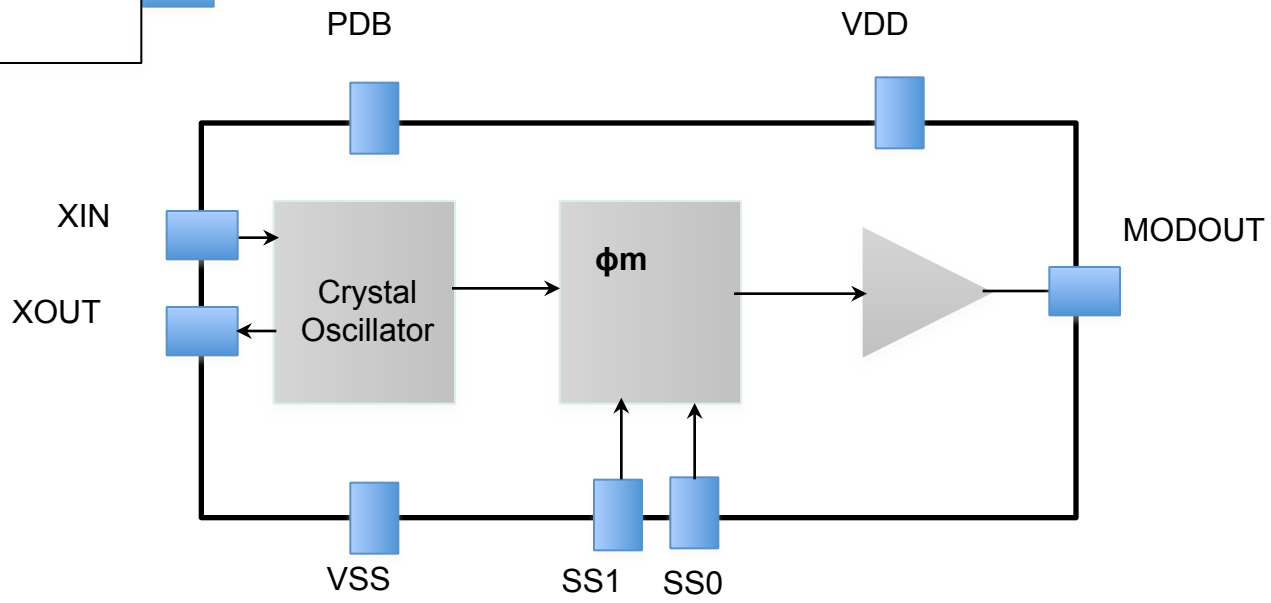

Close to Ideal Edge placement
INPUT
ϕ Delay Gen
Phase Control
OUTPUT
Phase Mod ROM

- NO PLL
  - Eliminates jitter from PLL and other factors like power supply noise
  - Lower noise floor
  - Less power consumption
  - Low part to part variations.

- Precise edge placement through digital control.
  - Maximizes modulation applied to system to allow huge EMI benefits with minimal system timing impact
  - Allows either full compliance or eye pattern compliance to various standards like USB and HDMI



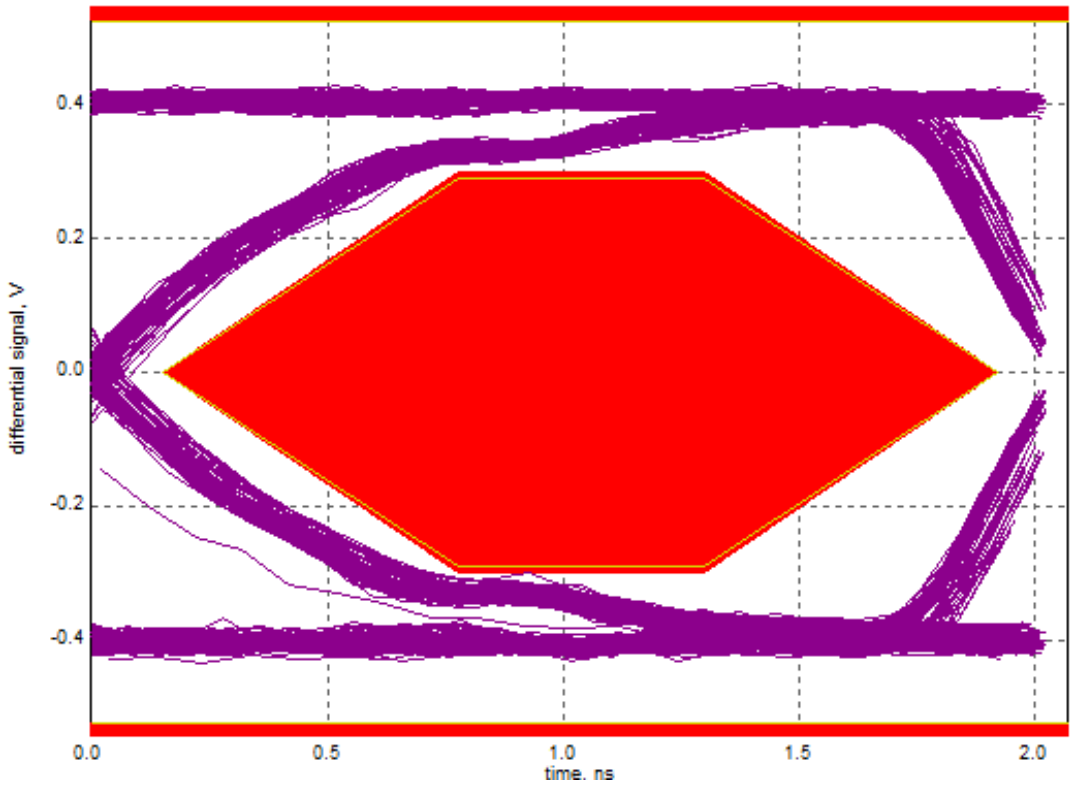
BLOCK DIAGRAM



GSL304 Product Specifications

- 4th Generation EMI Suppression IC
- 1.8V to 3.3V operation
- DC to 100 MHz operation.
- 2mm x 2mm DFN
- Phase Modulation
- Low Jitter
- Ultra Low Power
- Minimal Part to Part Variation
- HDMI and USB Compliance Options

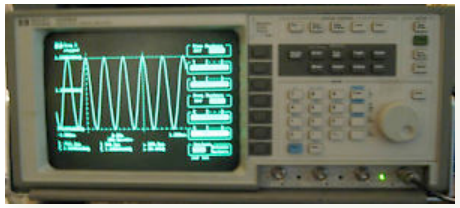
Tablet PC Case
Compliance in EMI and USB



System and Equipment

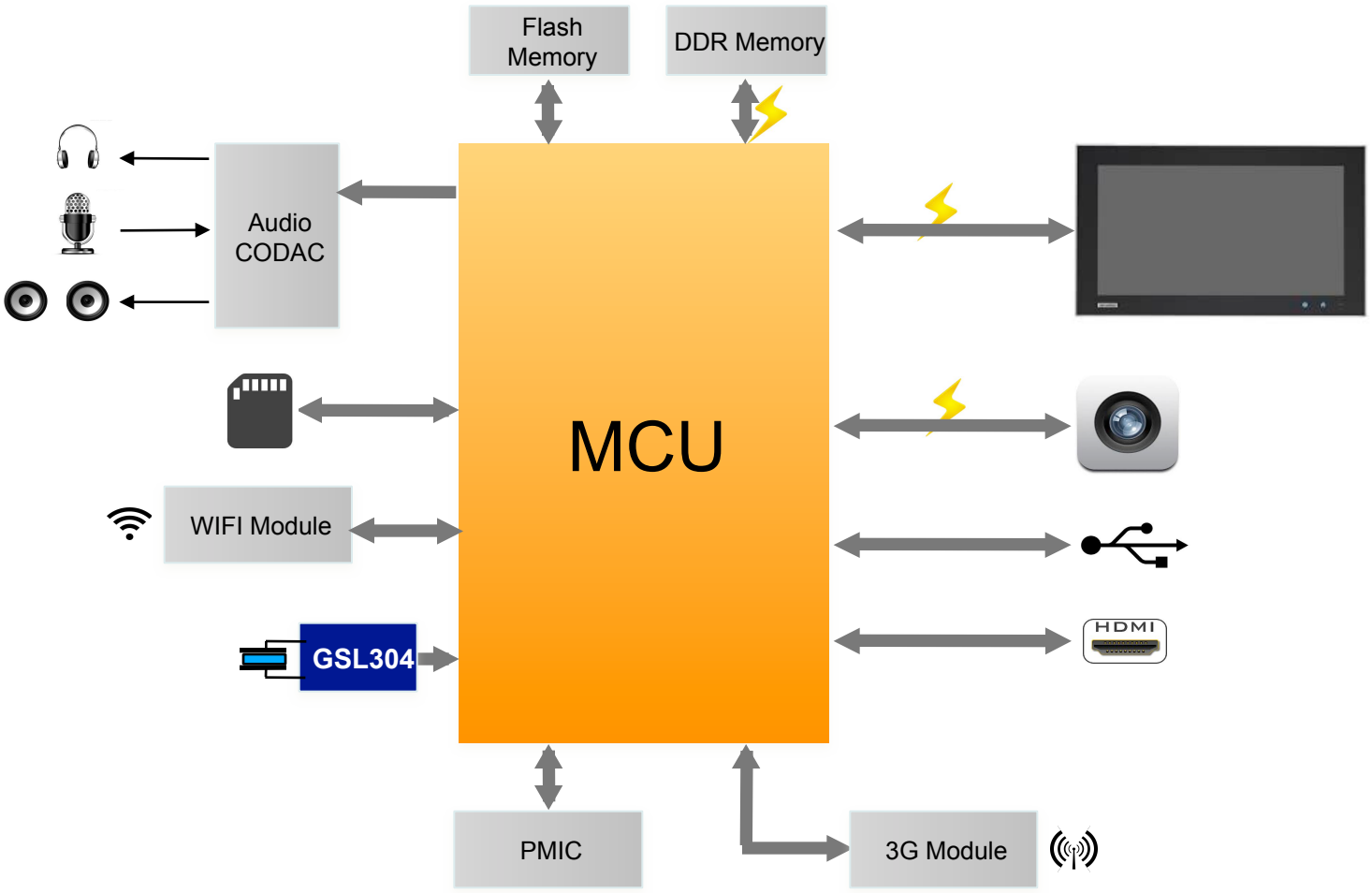
LC584AL : Oscillloscope
AP0202 : Active Probe

HP53310A : MDA



BK PRECISION 2650 : SA

Active EMI Management



LCD Clock EMI Peaks Comparison

49.5 MHz Harmonics

Unit : dBm

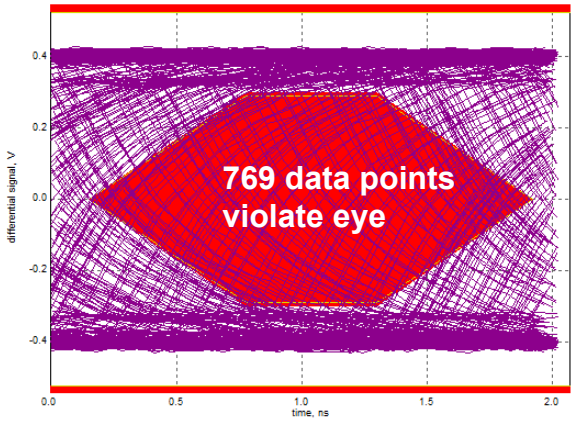
Device / Setting	49.5	148.5	247.5	298	346.5	445.5
NO SSCG	-11.6	-26.4	-40.0	-34.0	-49.2	-41.2
SS1=0,SS1=0	-12.0	-30.8	-45.6	-40.8	-54.5	-47.2
SS1=0,SS0=1	-12.8	-31.6	-45.6	-41.2	-56.0	-47.6
SS1=1,SS0=0	-16.4	-32.8	-46.4	-43.2	-56.0	-48.4
SS1=1,SS0=1	-17.2	-32.8	-47.6	-43.6	-56.4	-51.2

(MHz)

Active EMI Management

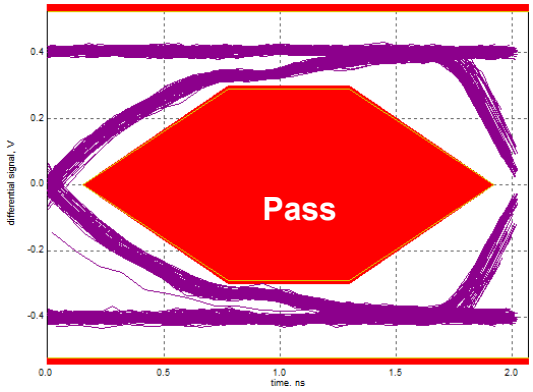
Non Compliant IC

USB2.0 Test Condition :
Device mode, High Speed,
Up Stream Port, Near End

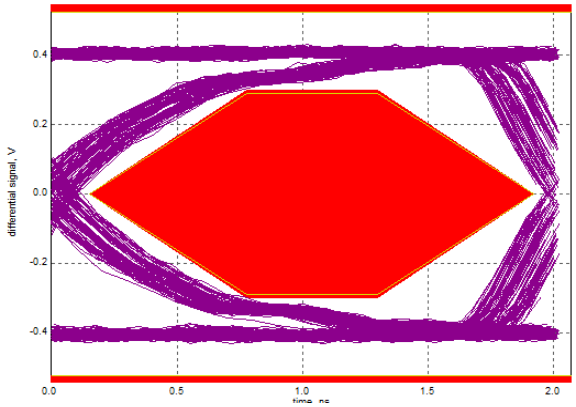


Measured signaling rate: 481.7605 MHz

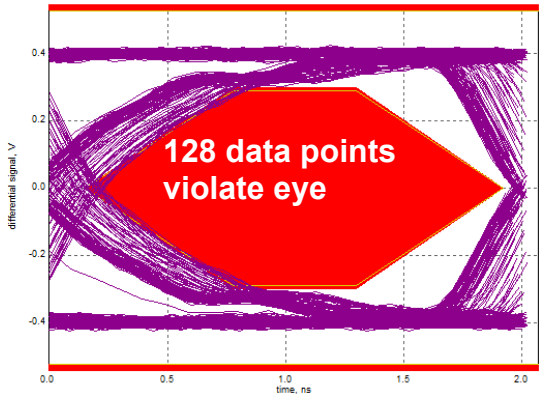
No EMI IC



GSL304 : SS1=0,SS0=0



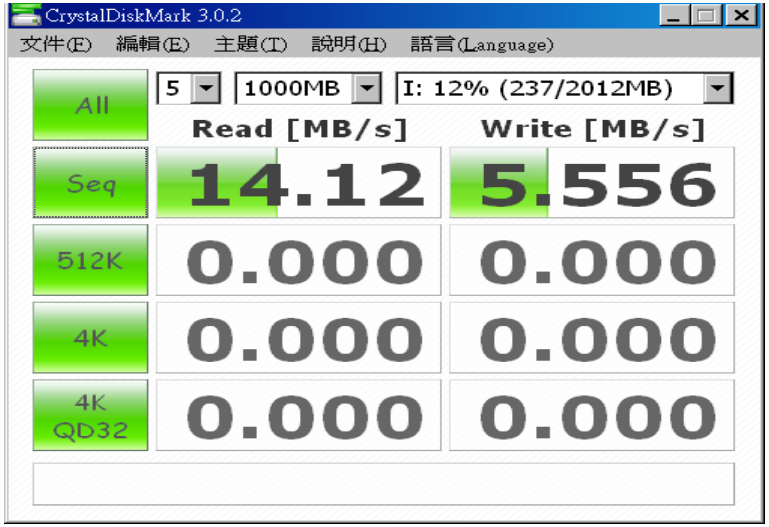
Measured signaling rate: 480.7112MHz



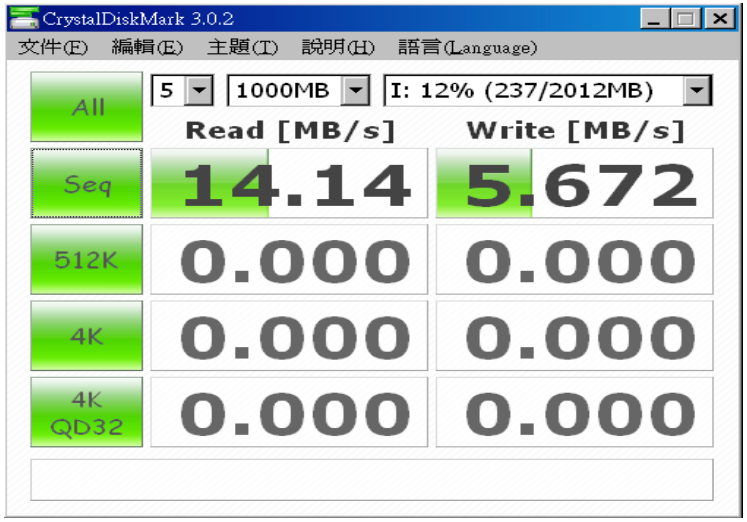
Measured signaling rate: 480.1274 MHz

USB Transmission - CrystalDiskMark

No EMI IC

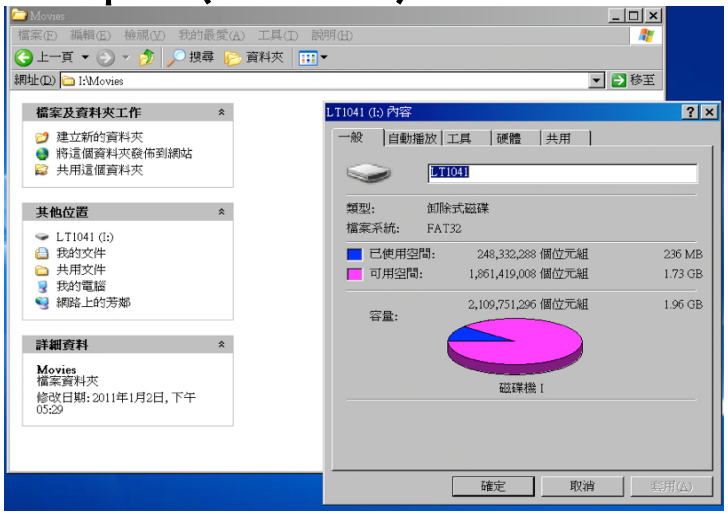


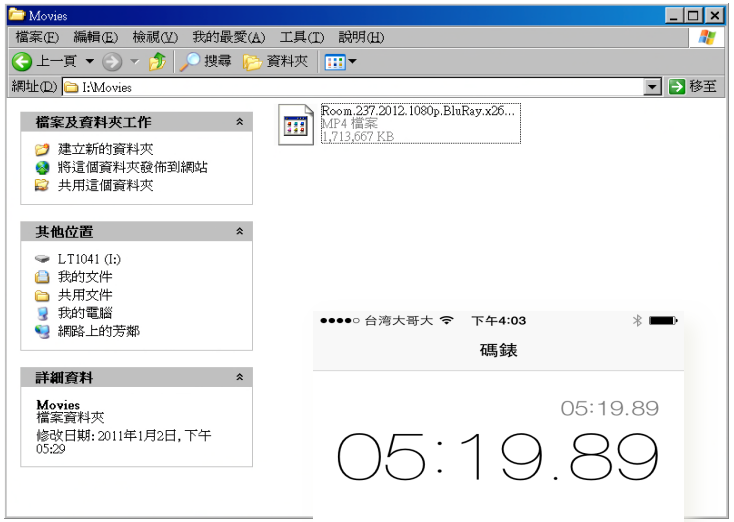
GSL304 : SS1=0,SS0=0



Write File Test (GSL304) 1.7GB

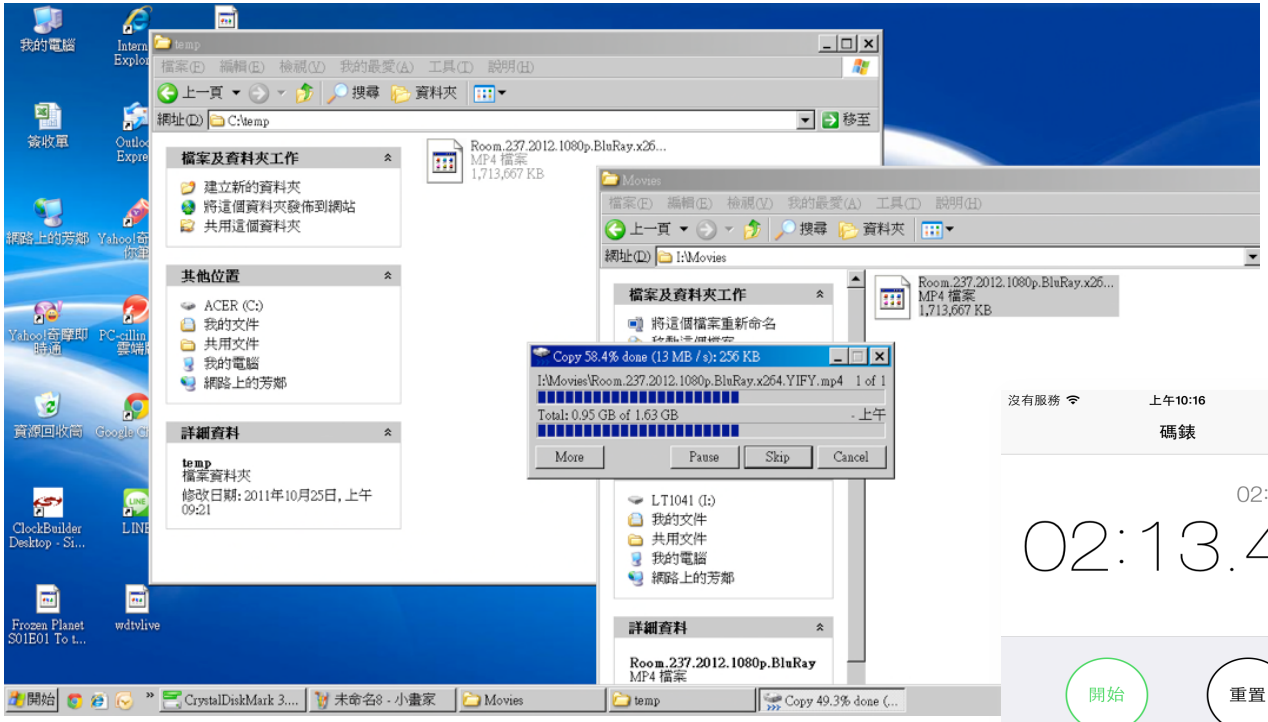
MID Space (1.73G free)





The Transfer Rate = 1713.667 MB ÷ 320 sec
= 5.35 MB/s

ReadFile Test (GSL304) 1.7GB FILE



The Transfer Rate = 1713.667 MB ÷ 134 sec
= 12.79 MB/s

	GSL304	Non Compliant Device
USB Compliance	EYE	NOT COMPLIANT
Average Power Consumption (3.3V)	5mA	9mA
Period Variance	.0837	.1186
SAMPLES	NOW	x
MP	NOW	X

- **Features of GS EMI IC devices**
  - **Low Jitter. Optimized EMI reduction with minimal deviation**
  - **USB “Eye Pattern” compliant (GSL304)**
  - **100% USB compliant – GS400 (Q2 2014)**
  - **Wide Operational Voltage (1.8V to 3.3V)**
  - **Low power consumption**

GLOBALTECH SEMICONDUCTOR

Active EMI Management

HDMI and USB COMPLIANT GP Active EMI Suppression IC *GSL306* 3.3/1.8V, DC ~ 100 MHz

GP Active EMI Suppression IC *GSL304* 3.3/1.8V, DC ~ 100 MHz

EMI Compliance and RF Sensitivity Improvement

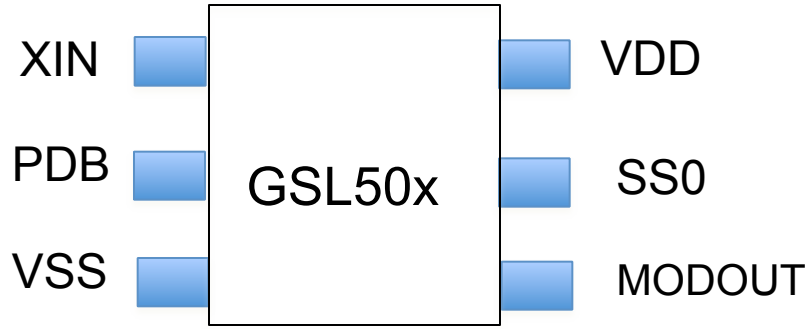
Ultra Low Power GP Active ESIC 3.3V/1.2V Dc to 100 MHz 1mmx1mm

LED MODULE Power Supply EMI IC

GP PWM Controller EMI IC

Q1 2014 | Q2 2014 | Q3 2014 | Q4 2014

Active EMI Management



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- Phase Modulation
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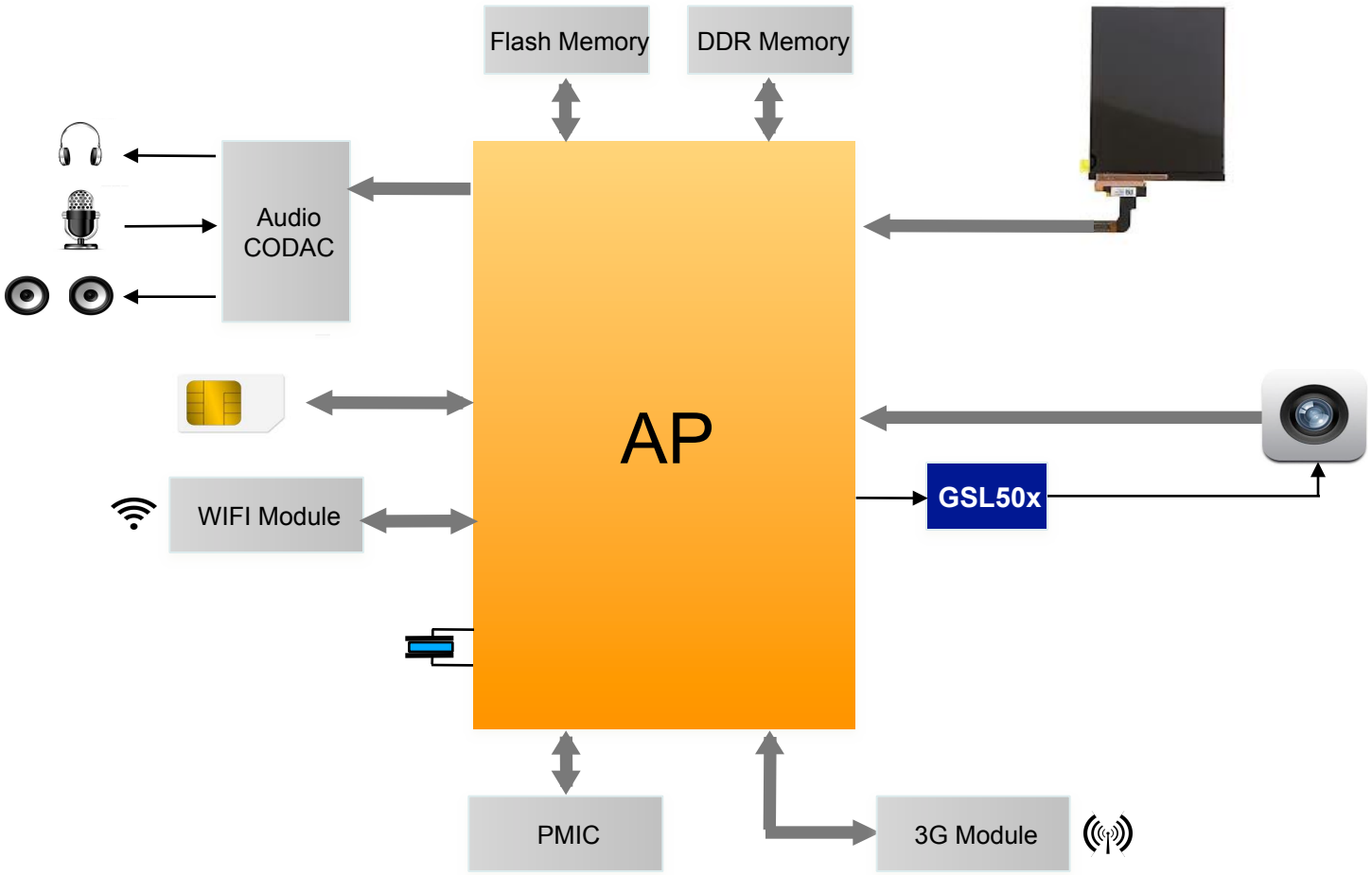
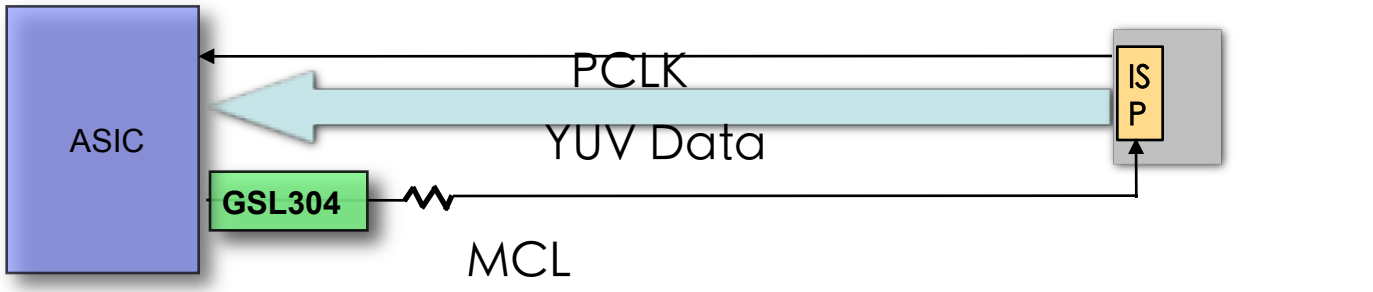
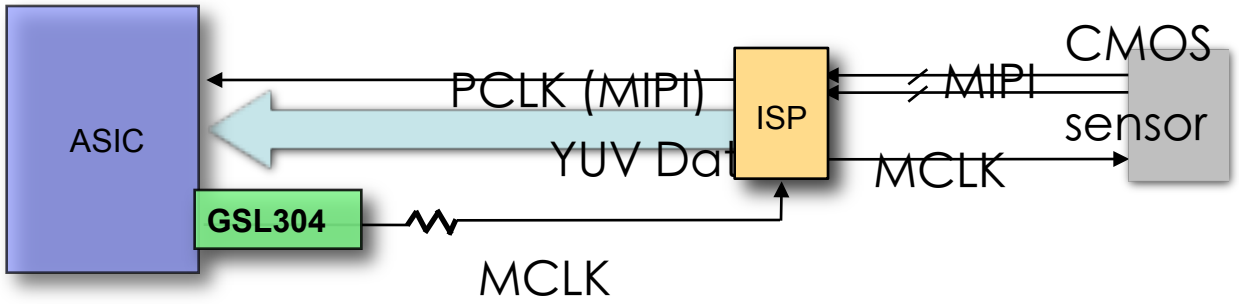
- Minimal Part to Part Variation
- HDMI and USB Compliance Options
- ES Q2 2014

Active EMI Management

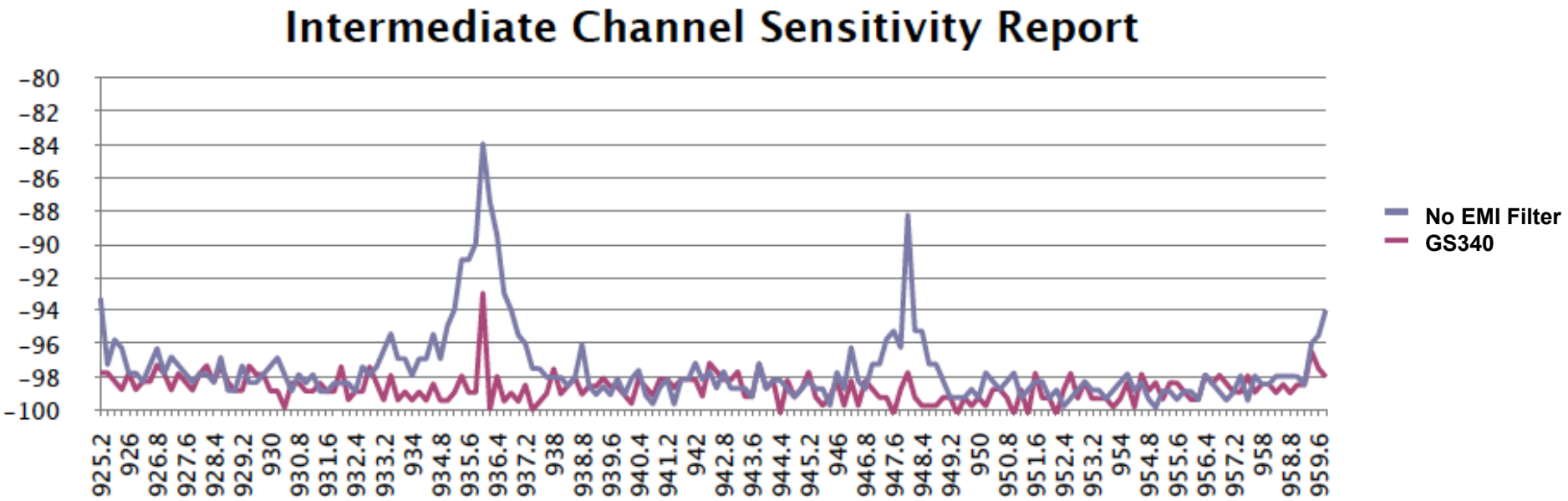



ASIC
PCLK
YUV Data
ISP
GSL304
MCLK


ASIC
PCLK (MIPI)
YUV Data
ISP
MIPI
CMOS sensor
MCLK
GSL304
MCLK


ISP
ASIC
MIPI
PCLK
CMOS sensor
GSL304
MCLK

Reduction in Peaks
in GSM 900 Band



GLOBALTECH SEMICONDUCTOR

Active EMI Management

- **New 4th Gen Active EMI Suppression Ics based on Phase Modulation.**
- **Superior EMI management along with the ability to meet compliance standards for USB and HDMI interfaces.**
- **Currently shipping GSL304**
- **New GSL50x series for Mobile phones - ES Q2 2014**
- **Product roadmap to extend technology to multiple applications and markets.**
- **Proven track record of delivering high quality products to Tier 1 customers.**
- **Focus on customer requirements and commitment to providing the highest level of care and support.**