SiTime University Turbo Webinar Series

SiT15xx 32kHz NanoDrive™ Output

June 17-18, 2013

The Smart Timing Choice™
Agenda

• SiT153x XO Status

• MCU Interface

• NanoDrive™ Benefits

• Summary
### SiT15xx 32 kHz XO Family

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Preliminary Datasheets Available on the Web
NanoDrive Output Designed to Interface to MCU XTAL Input

- Interfaces Directly into XTAL Input
- NanoDrive™ Output Optimizes Swing for Lowest Power
- Factory Programmable from 200mV to Full-Swing LVCMOS

Standard XO LVCMOS Swing Consumes too Much Power And Package is too Large!

3215 is smallest XO package (4.8mm² Area)
NanoDrive 800mV Output Voltage

SiT1533AI-H4-D14-32.768

$V_{OH} = 1.1\text{V}$, $V_{OL} = 0.4\text{V}$

$V_{OUT\ swing} = V_{OH} - V_{OL} = 700\text{mV}$
LVCMOS Full-Swing Output

SiT1533AI-H4-DCC-32.768
SiT1532/42 CSP for Smallest Footprint and No External Components

SiTime’s MEMS Solution in Chip-Scale (CSP)

- Internal Vdd Filtering Eliminates Bypass Cap
- SiT1532
- MCU or Mobile Chipset PMIC
- Osc I/O
- 200mV

Quartz XTAL Solution

- MCU or Mobile Chipset PMIC
- Osc I/O
- 200mV

1.2 mm² Footprint with CSP

8 mm² Footprint with 2012 SMD
SiT15xx 2.0x1.2 (2012) Package is Pin Compatible with Quartz Resonator

- SiT15xx is footprint compatible with a crystal resonator
  - Use SiTime’s Solder Pad Layout (SPL) → pin-compatible with quartz XTALs
  - Acceptable for mobile and portable design manufacturing (DFM) guidelines
  - Validated by customers

![Package Drawing](image1)
![Solder Pad Layout](image2)
SiT1533/43 Replaces 32 kHz XTALs in 2012 Pkg

SiTime MEMS Solution in 2012 SMD

SiT15xx pin 1 does not care what it sees. Can be NC or connected to XOut

CLK Out (pin 3) Connects to XIN

200mV to 800mV

SiTime MEMS Solution in 2012 SMD

Quartz XTAL Solution

MCU or Mobile Chipset PMIC

Osc I/O

200mV
Identifying the Correct Output Configuration

Example 1: Chipset Vdd ≤ 1.8V, Oscillator Enabled or Disabled, Unknown Min/Max XIN Input Requirements

- Chipset/MCU Oscillator is Enabled or Disabled
- If the customer does not know the chipset/MCU min/max input voltage requirements.
- SiT153x voltage setting: DC-Coupled, $V_{OH}$: 1.1V, $V_{OL}$: 0.4V → 700mV
- Note: may overdrive XIN Osc. Then select “AA2” Setting (Ex. 2)
- Part Number: SiT1533AI-H4-D14-32.768
Identifying the Correct Output Configuration

Example 2: XTAL Compatible, Oscillator Enabled

- Chipset/MCU Oscillator is Enabled
- Chipset and SiT153x Vdd = Don’t Care
- SiT153x output voltage setting: AC-Coupled, 250mV Swing
- Part Number: SiT1533Al-H4-**AA2**-32.768
Identifying the Correct Output Configuration

Example 3: Chipset Vdd > 1.8V, Oscillator Disabled (power saving)
- Chipset/MCU Oscillator is Disabled
- Any application with chipset Vdd > 1.8V
- SiT153x Voh must be able to reach chipset/MCU Vih requirements
- SiT153x output voltage setting: LVCMOS
- Part Number: **SiT1533AI-H4-DCC-32.768**
NanoDrive™ Benefit—Ultra Low Power

Total Supply Current (no load) = \( I_{dd \text{ Core}} + I_{dd \text{ Output Driver}} \)

**Example 1: Full-swing LVCMOS**
- \( V_{dd} = 1.8V \)
- \( I_{dd \text{ Core}} = 800nA \text{ (typ)} \)
- \( V_{out_{p}} = 1.8V \)
- \( I_{dd \text{ Output Driver}} = (C_{out})(V_{out})(F_{out}) = (3.5pF)(1.8V)(32768Hz) = 206nA \)
- No Load Current = 800nA + 206nA = 1006nA

**Example 2: NanoDrive™ Reduced Swing**
- \( V_{dd} = 1.8V \)
- \( I_{dd \text{ Core}} = 800nA \text{ (typ)} \)
- \( V_{out(\text{Programmable})} = 250mV \)
- \( I_{dd \text{ Output Driver}} = (C_{out})(V_{out})(F_{out}) = (3.5pF)(0.25V)(32768Hz) = 29nA \)
- No Load Current = 800nA + 29nA = 829nA

20% Lower Power with NanoDrive
NanoDrive™ Benefit—Ultra Low Power

Total Current = Idd Core + Idd Output Drive + Load Current

Common Conditions: Vdd = 1.8 V, Load Cap = 10 pF

Example 1: Full-swing LVCMOS
- Idd Core = 800nA
- Idd Output Driver = (Cout)(Vout)(Fout) = (3.5pF)(1.8V)(32768Hz) = 206nA
- Load Current: (CLoad)(Vout)(Fout) = (10pF)(1.8V)(32768Hz) = 590nA
  Total Current with Load = 2.643µA

Example 2: NanoDrive™ Reduced Swing
- Idd Core = 800nA
- Vout (Programmable): 250mV
- Idd Output Driver = (Cout)(Vout)(Fout) = (3.5pF)(0.25V)(32768Hz) = 29nA
- Load Current: (CLoad)(Vout)(Fout) = (10pF)(0.25V)(32768Hz) = 82nA
  Total Current with Load = 911nA

65% Lower Power with NanoDrive
Summary: SiT15xx Offers Unique Benefits

• First oscillator to target crystal replacement
  • 2.0 x 1.2mm (2012) SMD Package

• Unique power saving features enable XTAL replacement
  • NanoDrive™ output reduces swing to minimize power & eliminate load caps
  • Integrated supply filter eliminates bypass capacitors

• Focus on applications that need the smallest footprint
  • Do not target large 32 kHz Can or molded SMD XTALs
  • Push 3.2mm x 1.5mm (3215) XTAL customers over to SiTime’s 2012 package
Contact Information

• For Questions, contact SiTime Technical Support
  Technicalsupport@sitime.com

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