ON Semiconductor

Compte Rendu de la réunion du Comité d’Entreprise du 27 mai 2013

La composition de l’assemblée était la suivante :

Représentants de la Direction	
Yolande De Busschop, Présidente	Sophie Baquié, Administration Ressources Humaines
Carolina De Landsheer, Directrice des Ressources Humaines EMEA	Pascal Aigouy, Collaborateur de la Présidente
Bertrand Clou, Responsable activité design	
Représentants du Personnel	
Titulaires	**Suppléants**
Olivier Martinez, Secrétaire	Myriam Combes
Bernard Clarysse, Trésorier (excusé)	André Saillart (excusé)
Julie Athanassiadis, Trésorier adjoint	Olivier Causse
Carl Van Baelen (excusé)	Géraldine Saint-Upéry
Thierry Viard (excusé)	Aurore Weiss

Ordre du jour :

1) Approbation du compte-rendu du CE du 29 avril 2013.

2) Politique de recherche et développement technologique de l’entreprise – Information & consultation

3) Evolution générale des commandes et de la situation financière – Information.

Il n’y a pas de question(s) DP.

Questions Diverses.

Approbation du compte-rendu du CE du 29 avril 2013 :

Le compte-rendu de la réunion du CE du 29 avril 2013 est approuvé.

Evolution générale des commandes et de la situation de l'entreprise

Pascal A. présente l'état des commandes et la situation financière de l'entreprise. En préambule Pascal A. souhaite la bienvenue aux nouveaux membres du CE et rappelle les règles de confidentialités.

La présentation est disponible sur le site du CE.

Q1 2013 s'est terminé avec un chiffre d'affaire de 661 M$. L'EBITDA (96.8 M$) et la marge sont toujours positifs. L'entreprise a en cash 614.3 M$, et a 2 importantes échéances de remboursement de la dette en 2013 et 2016.
L'inventaire moyen est de 12 semaines, avec des allocations sur certains produits.

Les investissements ont été de 259 M$ en 2012 et devraient être de 160-170 M$ en 2013. Gresham devrait augmenter sa capacité, ON manque de capacité notamment pour les produits wireless et white goods. Un taux d'utilisation > à 90% pour une fab est considéré comme anormal et « ingérable », le taux d'utilisation en Q2 et Q3 2013 pour Gresham est prévu ≈ 100%.

Les ventes de la division Sanyo en Q1 2013 ont baissé à 151 M$ en partie du à la baisse du Yen.

Les ventes consumer / computing souffrent essentiellement du à la baisse des ventes en computing qui embarquent beaucoup d'électronique, et ce n'est pas compensé par l'augmentation des ventes de tablette qui sont plus intégrées. Les ventes de smartphone se portent toujours bien. Les ventes automotive se portent bien grâce aux ventes de voitures haut / très haut de gamme. Il est à noter que l'activité Automotive ASIC a à nouveau des « design wins » après 3 ans d'échec à cause principalement de problème technologique et d'un manque d'investissement. Les ventes « Industrial / Medical / Mil-Aero » sont stables.

Les crawl-chart à jour seront présentés lors du CE du mois de juin.

Politique de recherche et développement technologique de l’entreprise

Bertrand C. commence par présenter les activités de la BU PG sur Toulouse à la place de Christophe B en déplacement professionnel. Il est à noter que ce service travaillait principalement pour Delta, mais les ventes ont baissé du à des problèmes ESD suite au transfert de Aizu vers Gresham. L’activité de cette division augmente par contre chez Huawei. L’activité de ce service est tirée par l’intitiative « green power » qui vise à réduire le plus possible la consommation d’énergie en veille des équipements.

Bertrand C. présente ensuite les activités de la BU PI. Les produits développés pour la BU PY sont transférés vers le centre de design en Roumanie.

Les activités PI se concentrent sur les produits suivant :

- PMIC.
- Flash IC.
- Arm core DCDC.
- DCDC pour PA.
- Boost converter.
- Chargeur de batterie.
- Load switch.

20% du parc de station de travail / calculateur sera renouvelé d’ici la fin de l’année.

Bertrand C. nous présente « l’organization chart » avec la répartition approximative des personnes par famille de produits. En ce début d’année l’essentiel de l’équipe design travaille sur le NVDC, qui est un chargeur de batterie nouvelle génération pour les ultrabook répondant à la dernière norme d’Intel. Toute la bande passante de l’équipe layout pendant 2 mois est prise par ce produit.

Pour les équipes dépendant de Bertrand C, il y a en priorité un besoin de ressources pour les équipes layout et caractérisation en rapport avec le nombre de produits développés.

Les 2 présentations sont disponibles sur le site du CE.

Toulouse le 27 mai 2013,

Yolande De Busschop	Olivier Martinez
Présidente	Secrétaire

ON Semiconductor®

Tlse Design Team
2013 Goals

Content

- PI Executive Summary
- 2013 NPD Calendar
- Design Team Goals
  - ✓ Power Management ICs
  - ✓ Buck DCDCs
  - ✓ Boost DCDCs
  - ✓ Power Interface
  - ✓ Load Switch & Protections
  - ✓ Audio
- Continuous Improvement

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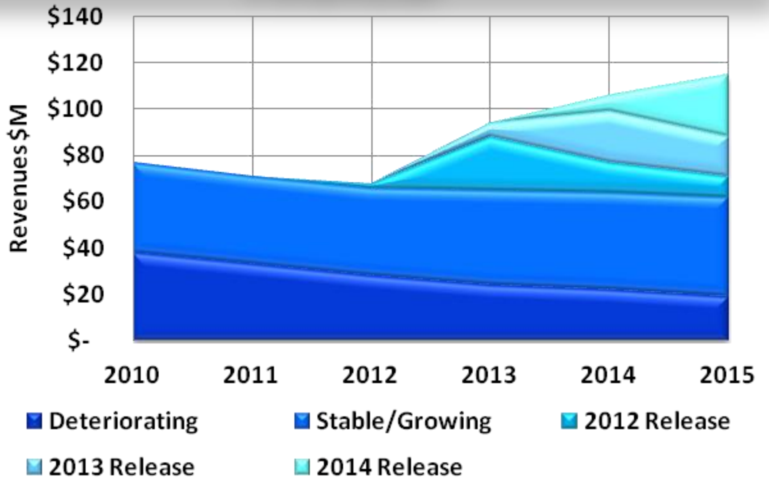
PI Executive Summary

Strategy

- Focus investment in smartphone targeting high power conversion sockets around ARM Vcore, PA DCDC, Camera PMIC, Switching Charger and Load Switches. Win with market makers: **Qualcomm and Samsung**.
- Leverage power IP in vertical markets: Infotainment, Computing.
- Expand share in legacy A/S, Audio and OVP to minimize revenue decline in a contracting market.
- In a nutshell: Continue to win Samsung & Qualcomm; grow **Huawei & MTK**; plug holes elsewhere.

Financial



Key Takeaways – Why Invest

- **Doubled Samsung** revenue in 2012 to $16M, 2013 forecast > $30M
- **New product revenues up 49%** in 2H12 vs. 1H12.
- More than **$20M in new product design wins** at Samsung, Qualcomm, Microsoft, Seagate, and Huawei ramping in 2013.

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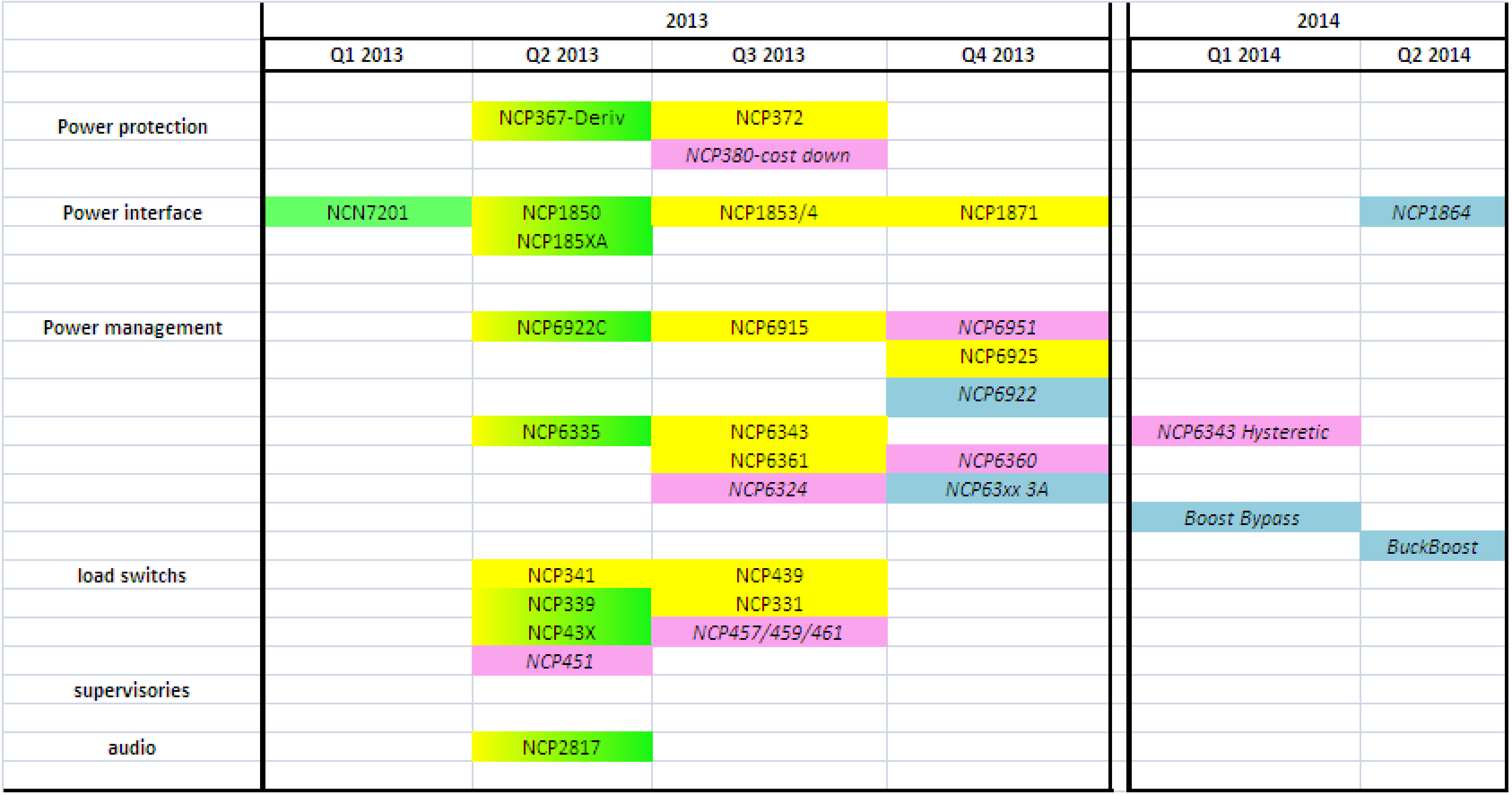
2013 NPD calendar

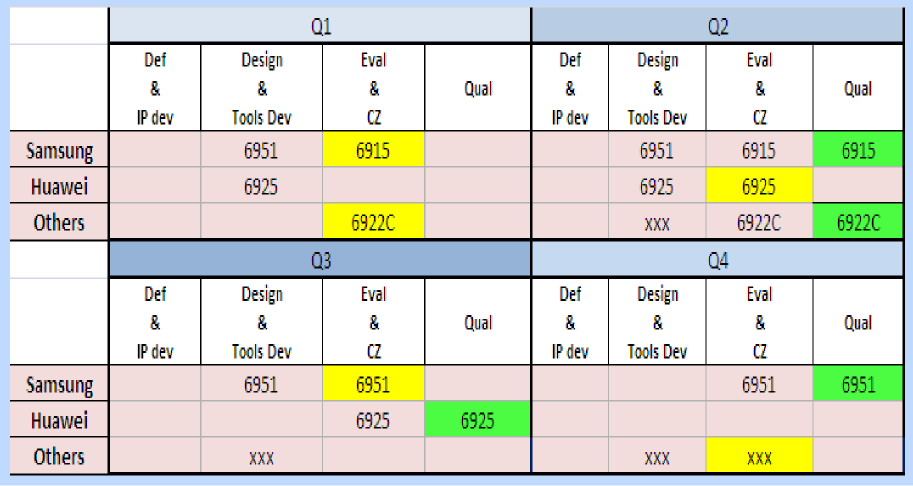


	2013				2014	
	Q1 2013	Q2 2013	Q3 2013	Q4 2013	Q1 2014	Q2 2014
Power protection		▨ NCP367-Deriv	🟨 NCP372			
			🟪 *NCP380-cost down*			
Power interface	🟩 NCN7201	▨ NCP1850	🟨 NCP1853/4	🟨 NCP1871		🟦 *NCP1864*
		▨ NCP185XA				
Power management		▨ NCP6922C	🟨 NCP6915	🟪 *NCP6951*		
				🟨 NCP6925		
				🟦 *NCP6922*		
		▨ NCP6335	🟨 NCP6343		🟪 *NCP6343 Hysteretic*	
			🟨 NCP6361	🟪 *NCP6360*		
			🟪 *NCP6324*	🟦 *NCP63xx 3A*		
					🟦 *Boost Bypass*	
						🟦 *BuckBoost*
load switchs		🟨 NCP341	🟨 NCP439			
		▨ NCP339	🟨 NCP331			
		▨ NCP43X	🟪 *NCP457/459/461*			
		🟪 *NCP451*				
supervisories						
audio		▨ NCP2817				

🟩	RTM
▨	Close to RTM
🟨	In execution with PSG approval
🟪	In execution but PSG not passed yet
🟦	Roadmap or Opportunity not yet in execution

Power Management IC Summary

NPI: +4RTM, +5NP Samples



	Q1				Q2			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
Samsung		6951	6915			6951	6915	6915
Huawei		6925				6925	6925	
Others			6922C			xxx	6922C	6922C

	Q3				Q4			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
Samsung		6951	6951				6951	6951
Huawei			6925	6925				
Others		xxx				xxx	xxx	

NPI Challenges

- Develop camera modules value proposition & diversify customers:
  - ✓ 6925 with integrated 10 Bit ADC for Huawei.
  - ✓ 6951 with integrated Flash for Samsung.
- Propose new quick product derivatives to gain new sockets & customers:
  - ✓ 6922C (Msft), 6922 (Phison), 6914 (Leap Motion)

Technical Highlights

- Target low cost technical solution
  - ✓ System/features simplification
  - ✓Continue optimize building blocks
  - ✓Optimize use of metal layers: trend is RDL/Met4
  - ✓Prepare transition to SGO 5V process option
  - ✓Close work with test on DFT to optimize test time.
- Develop tools & test system to support characterization of new critical IPs: ADC, Flash
- Keep improve key IPs for PMICs:
  - ✓Leverage all new standalone Buck enhancements
  - ✓LDO: min input voltage, in rush current.
  - ✓Explore new high resolution ADC architecture
- Benchmark of the competition to understand competitor strength and identify IP gap or new opportunities for improvement.

Develop PMIC Value proposition

Core & IC Control

2010-2011-2012:

Analog CORE
- Vin 2.3 V to 5.5 V
- Band-gap
- Oscillator
- Biasing
- sub uA Core supply

Digital Control
- OTP control
- Customizable power up & down sequence
- DVS, Power Good

2013:
- Flat Bandgap over temp for ADC precision or other parameter accuracy

. Enhance DFT for multi site

LDOs

2010-2011-2012:
- Vin 1.7 V to 5.5 V
- Vout Fixed, Prog
- From 0.8 V to 3.3 V
- Up to 300 mA / channel

- Die size optimization
- Higher PSRR
- Lower Noise
- Fast turn on

2013:
- Vin down to 1.5V/1.2V
- Vout down to 0.6V
- Soft start
- 1A LDO

BUCK & BOOST DCDCs

2010-2011-2012:

BUCK
- Vin 2.3 V to 5.5 V
- Vout Fixed, Prog
- From 0.6 V to 3.3 V
- Up to 2 A / channel

BOOST
- Vin 2.5 V to 5.5 V
- Vout Fixed, Prog
- From 3.3 to 5.5V
- up to 1.5A

2013:

BUCK
- Implement SGO 5V IP
- Improve transient load

BOOST
- Eco Mode
- Auto Pass through Mode
- Adaptive for Flash LED

Other Key Functions

2010-2011-2012:

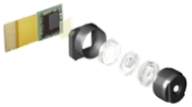
GPADC
- Vin 2.5V to 5.5 V
- FS=2.5V
- 10us conversion time (1mA max)
- Scalable/Diff input support
- Target true 10 bits

2013:

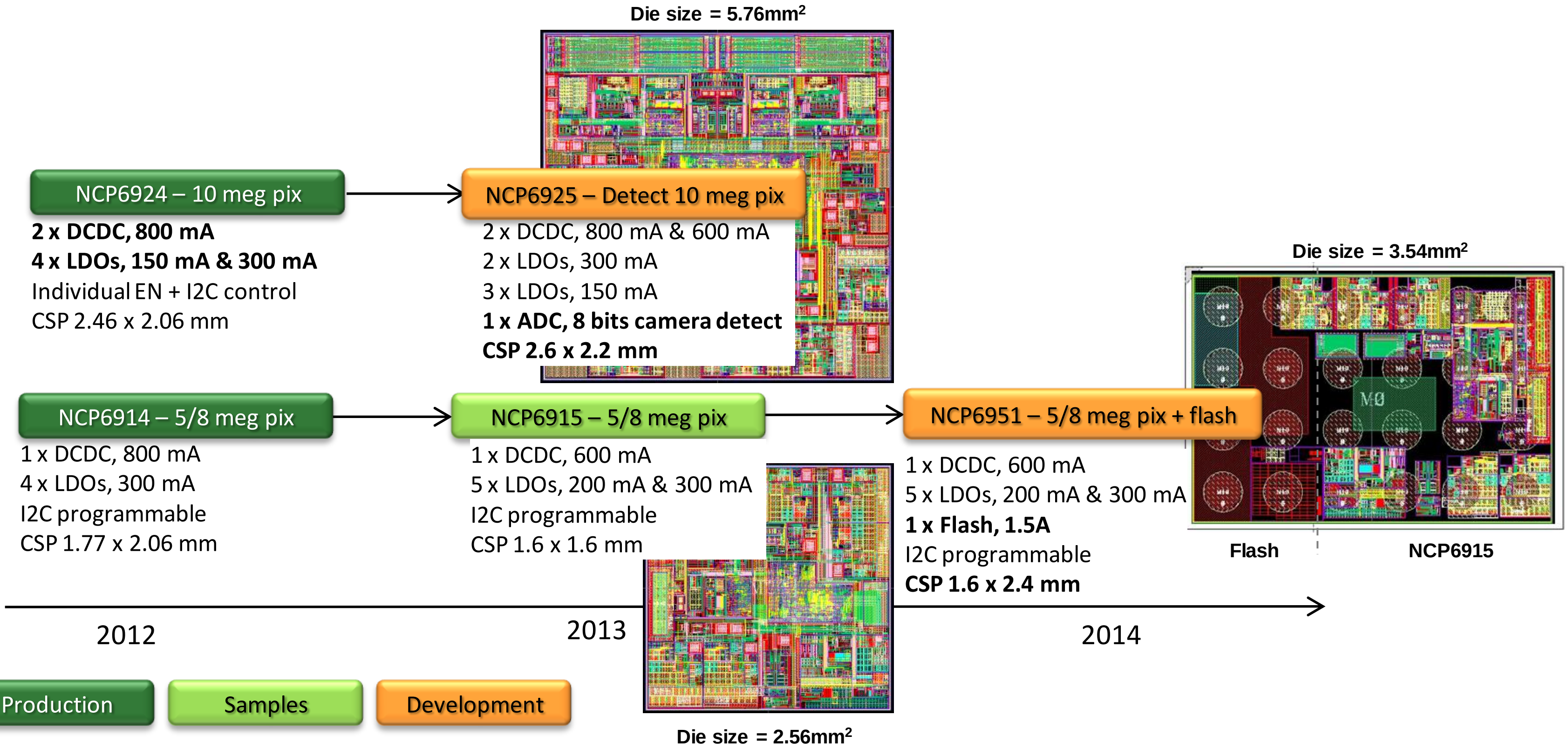
Flash LED driver
- high side current driver
- 100mA to 1.5A
- 250mV headroom
- 5% accuracy
- Torch mode

2010-2011-2012

2013



PMIC integration



Die size = 5.76mm^2

NCP6924 – 10 meg pix

2 x DCDC, 800 mA
4 x LDOs, 150 mA & 300 mA
Individual EN + I2C control
CSP 2.46 x 2.06 mm

NCP6925 – Detect 10 meg pix

2 x DCDC, 800 mA & 600 mA
2 x LDOs, 300 mA
3 x LDOs, 150 mA
1 x ADC, 8 bits camera detect
CSP 2.6 x 2.2 mm

Die size = 3.54mm^2

NCP6914 – 5/8 meg pix

1 x DCDC, 800 mA
4 x LDOs, 300 mA
I2C programmable
CSP 1.77 x 2.06 mm

NCP6915 – 5/8 meg pix

1 x DCDC, 600 mA
5 x LDOs, 200 mA & 300 mA
I2C programmable
CSP 1.6 x 1.6 mm

NCP6951 – 5/8 meg pix + flash

1 x DCDC, 600 mA
5 x LDOs, 200 mA & 300 mA
1 x Flash, 1.5A
I2C programmable
CSP 1.6 x 2.4 mm

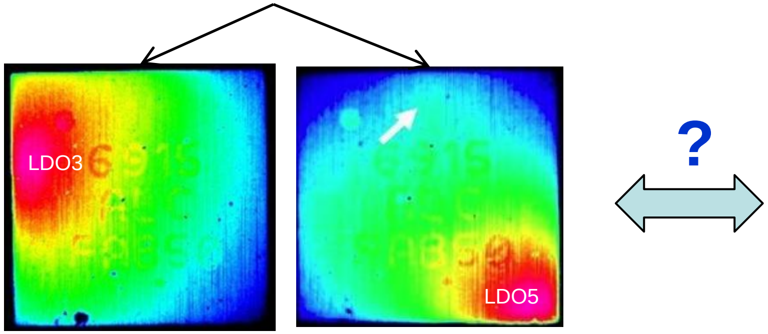
Flash NCP6915

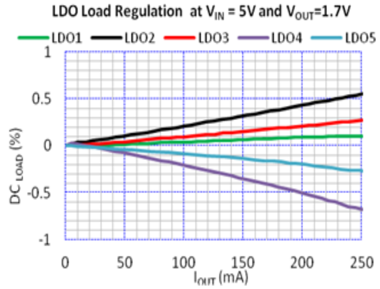
2012 2013 2014

Die size = 2.56mm^2

🟩 Production 🟩 Samples 🟧 Development

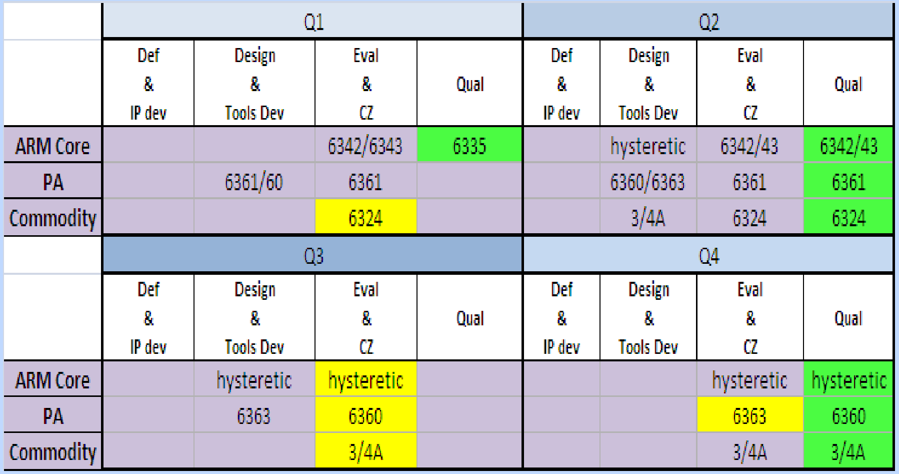
- **Continue Develop Integration Expertise**
  - New IPs integration
  - Besides knowhow on coupling/isolation concerns, understand IC blocks self heating constraints.





Buck Summary

NPI: +8RTM, +5NP Samples



	Q1				Q2			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
ARM Core			6342/6343	6335		hysteretic	6342/43	6342/43
PA		6361/60	6361			6360/6363	6361	6361
Commodity			6324			3/4A	6324	6324

	Q3				Q4			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
ARM Core		hysteretic	hysteretic				hysteretic	hysteretic
PA		6363	6360				6363	6360
Commodity			3/4A				3/4A	3/4A

NPI Challenges

- Complete products qualification, support production ramp-up & customer applications:
  - ✓6335, 6342, 6343, 6361
- Validate & Qualify 6324 (SGO 5V Buck IP).
- Develop new quick derivatives while targeting solution cost down.
  - ✓6360, new commodity devices, 6341?
  - ✓Re-use SGO 5V Buck IP; Balance metal options

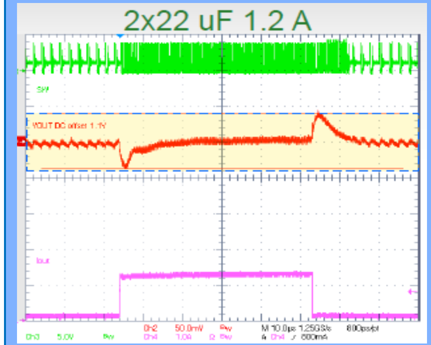
Technical Highlights

- Keep Buck IP aligned through the different products lines: ARM, PA, Commodity.
- Develop new architecture based on hysteretic mode control, for best in class load transient.
  - ✓ Keep system likely a fixed frequency one.
  - ✓ Use 6343 as test vehicle to validate the IP.
- Improve device robustness especially for consumer market
  - ✓ Extend Vin operating range up to 6V?
  - ✓ Support high output cap value ~ 200uF
- Explore new package & benchmark to identify smallest & cheapest powerful solution.
- Awareness on dual phase architecture.
- Grow expertise in EMI, spread spectrum.
- Develop active bypass mode for PA control
- Develop Mathcad models so they can be reused by Apps team for customers support.

ARM DCDC

- Baseline: NCP6338, NCP6335
- 1A to 10A, I²C & DVS, WLCSP, C=10uF, L=0.33uH
- Key customer focus: Solution size, Transient Load, Efficiency
- Competition: FAN53540, TPS62380

F_{SW}, L & C_{OUT} TRADE OFF FOR BEST EFFICIENCY, INDUCTOR SIZE & TRANSIENT LOAD

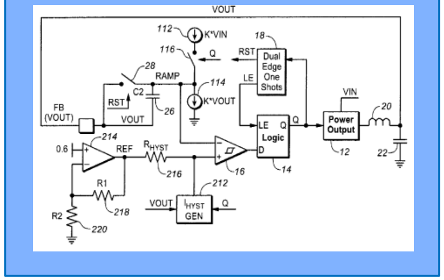


2012

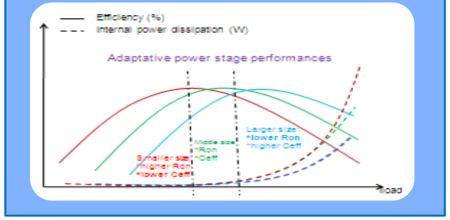
Load transient

Efficiency

HYSTERETIC CONTROL FOR BEST IN CLASS LOAD TRANSIENT



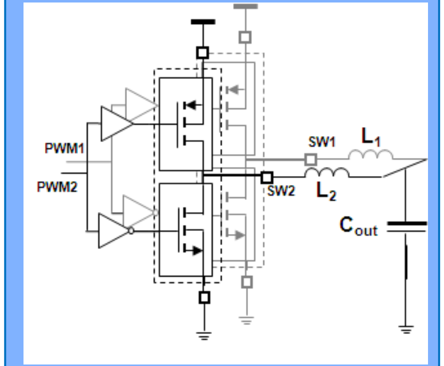
POWER STAGE BENCHMARK -DIE AREA - ADAPTIVE DEAD TIME - MODULAR POWER STAGE



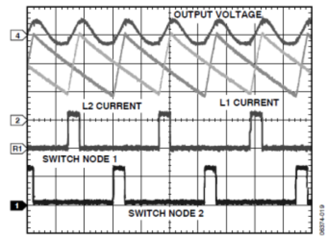
2013

Efficiency & Load transient

DUAL PHASE CONTROL FOR BEST EFFICIENCY



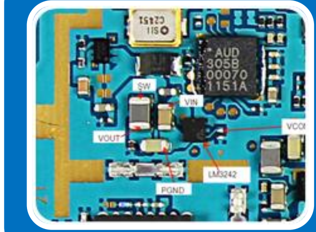
DYNAMIC LOSSES / 2 AT SAME APPARENT F_{SW}



INPUT CURRENT RIPPLE/2

2014

Buck PA Control



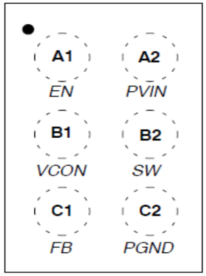
- Baseline: NCP6361
- NCP6360 (6Mhz,0.8A), NCP6363 (3A)
- Key customer focus: Solution cost
- Competition: LM3242, LM3241, FAN5903

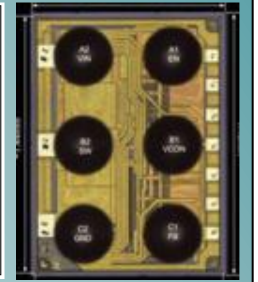
NCP6360

3G & LTE
Up to 0.8A pk
No Bypass
CSP6

LM3241 SECOND SOURCE

- CSP PITCH 0.5 (1.04X1.54)
-REMOVE BYPASS MODE
- REUSE SGO 5V BUCK IP
-NO RDL, 4ML





FURTHER COST DOWN

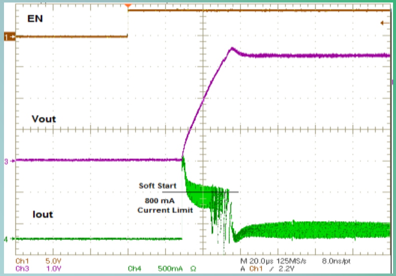
- CSP PITCH 0.4 (0.89X1.29)
- RDL? 4ML

NCP6361

3G & LTE
Up to 1A pk
Bypass
CSP9

IMPROVEMENTS:

- BYPASS MODE ENTRY/EXIT ACCURACY
- CONCILIATE INRUSH CURRENT & FAST TURN ON



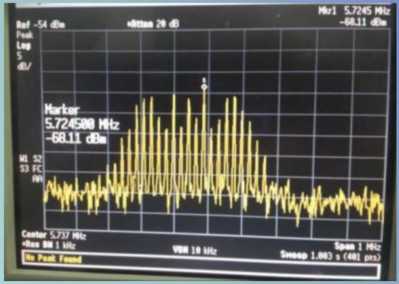
- 100% DUTY CYCLE OPERATION

NCP6363

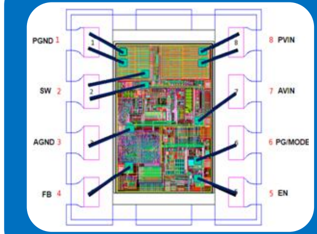
2G, 3G & LTE
Up to 3A pk
Active Bypass/Spread Spectrum
CSP 16

HIGH END SOLUTION

-ACTIVE BYPASS MODE (LDO MODE)
-ENHANCED SPREAD FREQUENCY SPECTRUM?



- PROGRAMMABLE F_{SW}
- EMI CONTROL



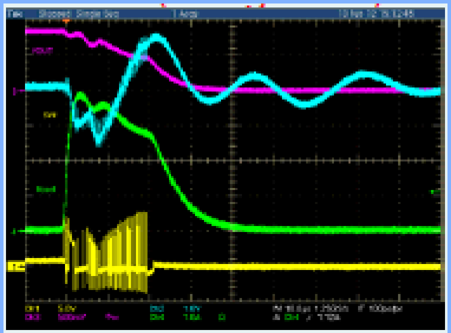
Commodity Buck

- Baseline: NCP6324
- > 2A Buck solutions, no I2C
- Key customer focus: Solution cost, Solution robustness
- Competition:

ENHANCE DEVICE ROBUSTNESS

-EXTEND VIN RANGE TO 6V OPERATING?

IIMPROVE ROBUSTNESS AGAINST EOS STRESS ON INPUT (SUPPLY RINGING / HOT PLUG)



GATHER ALL EXPERIENCES IDENTIFY WEAK POINTS IN DESIGN

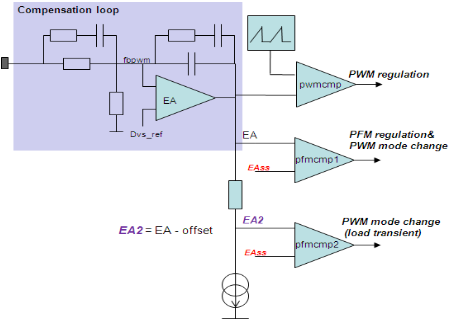
- SUPPORT LARGE OUTPUT CAP

VALIDATE & QUALIFY NEG PK CURRENT LIMIT

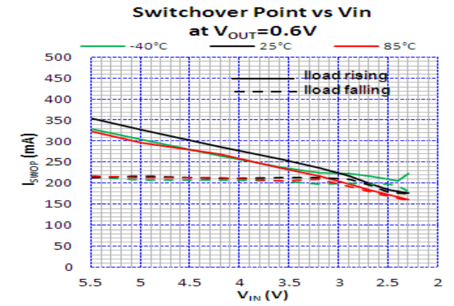
ONE LOOP IP ENHANCEMENT?

-PFM/PWM TRANSIENT LOAD

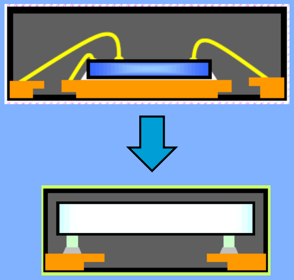
EA OUTPUT CLAMP



-PFM/PWM HYSTERESYS

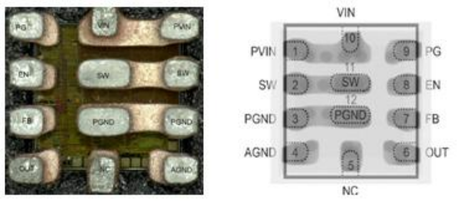


EXPLORE NEW PACKAGE FOR HIGHEST POWER DENSITY



- BETTER RON FOR SAME DIE SIZE

- BETTER PACKAGE Rθ?

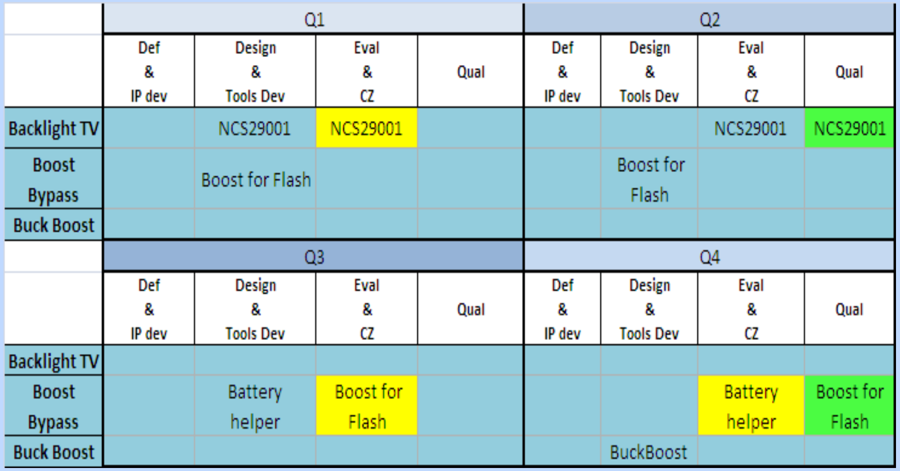


BENCHMARK ALL PACKAGES ON COST & Rθ:

- DFN (BONDING, PILLAR), CSP

Boost Summary

NPI: +2RTM, +2NP Samples



	Q1				Q2			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
Backlight TV		NCS29001	NCS29001				NCS29001	NCS29001
Boost Bypass		Boost for Flash				Boost for Flash		
Buck Boost								

	Q3				Q4			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
Backlight TV								
Boost Bypass		Battery helper	Boost for Flash				Battery helper	Boost for Flash
Buck Boost						BuckBoost		

NPI Challenges

- Validate, Characterize & Qualify NCS29001 Boost Backlight for TV.
- Design & qualify adaptive boost IP for Flash LED driver.
  - ✓ Design freeze end of April
- Target a Boost Bypass solution like FAN48630
  - ✓Engineering Samples in Q4

Technical Highlights

- Define & Start development of Standalone Boost with Eco and Pass through modes.
  - ✓ Develop simple & efficient low power mode
  - ✓ Boost bypass or Fsw increase underline the need for smaller Ton or new techniques as Toff / Valley Current control methods.
- As for Buck, develop tools for boost top down system analysis:
  - ✓ Generic efficiency worksheet
  - ✓ NCS29001 BOM worksheet for DCM operation.
  - ✓ Mathcad models (CCM, DCM)
  - ✓ Simplis models: adaptive boost, boost bypass
  - ✓ Check possibility of Cadence PAC models
  - ✓ AC models including LED string & LED Idriver
- Prepare the road for Buck-Boost IP
  - ✓ Internship to investigate & benchmark all Buck boost architectures.

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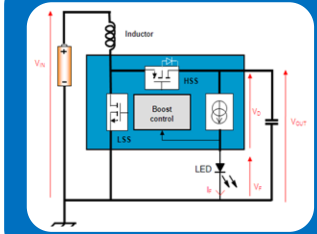
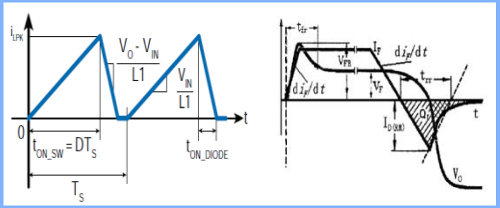
Boost DCDC



- Baseline: Adaptive boost IP
- Solution like FAN4863 (1.5A, 2.5Mhz, CSP16)
- Key customer focus: Bypass Mode, Efficiency, Output Ripple
- Eco mode, True cut off, Pass through mode, ACM

BACKLIGHTING APPLICATIONS

- DCM MODE CONTROL
TO AVOID PENALTY OF DIODE T_{RR}



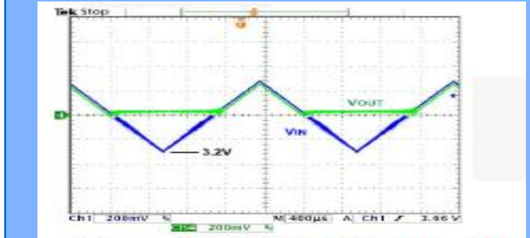
-BOOST STABILITY ANALYSIS

- CCM/DCM OPERATION
- LED STRING IMPEDANCE
-LED CURRENT DRIVER IMPEDANCE
- SIMPLIS, PAC MODELS

- ADAPTIVE BOOST
- HIGH SIDE LED DRIVER
HEADROOM REGULATION

BYPASS MODE

AUTOMATIC PASS THROUGH OR BYPASS MODE:
- BYPASS MODE ENTRY/EXIT CONDITIONS TO ACHIEVE BEST EFFICIENCY & OUTPUT REGULATION



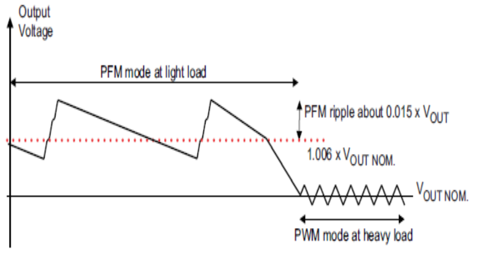
ure. 27 Bypass Entry / Exit, Slow V_{IN} Ramp 1 ms Edge, 500 mA Load, V_{OUT}=3.5 V, 3.2 - 3.8 V_{IN}

MIN TON ENABLING BOOST TO OPERATE WITH MIN (VOUT-VIN) DROP
- REDUCE T_{ON} DOWN TO ~ 20ns

NEXT STEP: TOFF / VALLEY CURRENT" CONTROL METHOD
MODULATE T_{OFF} INSTEAD OF T_{ON}

POWER SAVING MODES

- AUTOMATIC ECO MODE



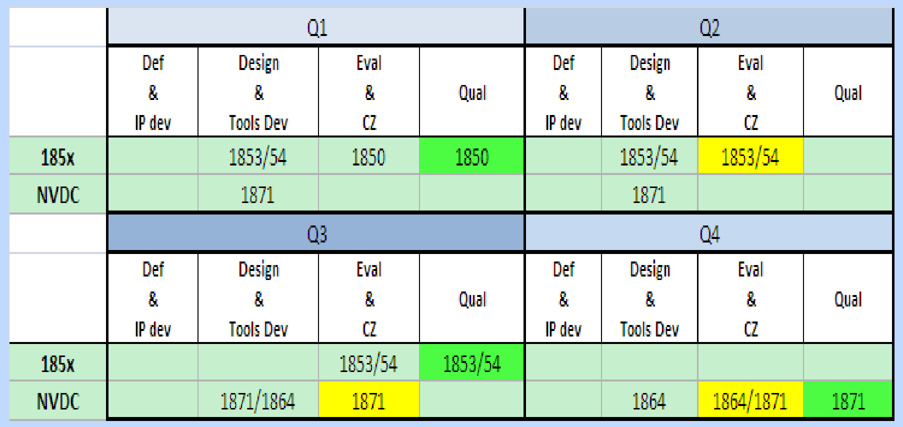
PFM, PULSE SKIP OR BURST MODE?

-TRANSIENT LOAD PERFORMANCE
-AUTOMATIC MODE CHANGE HYSTERESYS
- EFFICIENCY OR IQ GAIN
- OUTPUT RIPPLE

- LOAD DISCONNECT & REVERSE VOLTAGE PROTECTION

Power Interface Summary

NPI: +3RTM, +3NP Samples



	Q1				Q2			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
185x		1853/54	1850	1850		1853/54	1853/54	
NVDC		1871				1871		
	Q3				Q4			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
185x			1853/54	1853/54				
NVDC		1871/1864	1871			1864	1864/1871	1871

NPI Challenges

- 1871 NVDC charger development
  - ✓ Tape out by end of June (Design freeze W21)
  - ✓ Target fully functional first samples
  - ✓ Target die size ~ 1.9x1.84mm (NCP3800)
  - ✓ Enable quick development of one cell solutions
- Extend SBC1 portfolio: Apollo (1853/1854)
  - ✓ Target first pass success
  - ✓ Target same die size as 1851: 2.2x2.55mm^2

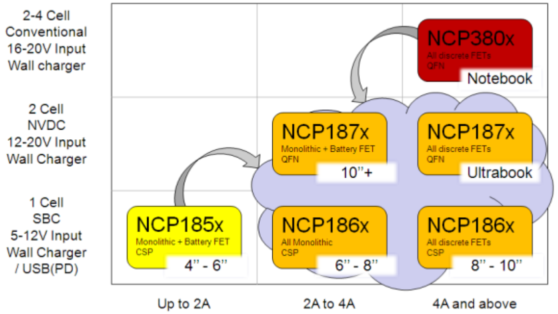
Technical Highlights

- Improve product line GM
  - ✓ Design new products in ONC25 30V
  - ✓ Take best benefit of RDL (Rdson, ESD ring)
- Continue improve some key performances
  - ✓ Transient load response of Buck to supply system
  - ✓ Tight system accuracy (auto zeroing, auto cal).
- Develop flexible Buck & Boost topologies
  - ✓ Adaptive to any power path mgt system.
  - ✓ Adaptive to external components selection.
  - ✓ Core supply tree adaptive to support also multiple inputs
- Anticipate roadmap developments
  - ✓ Think reuse for 1 cell only solutions
  - ✓ Technology: re-launch NMOS 30V separated bulk
- Adapt MCU tools to SMBUS protocol

4/3/2&1 Cells Charger NVDC

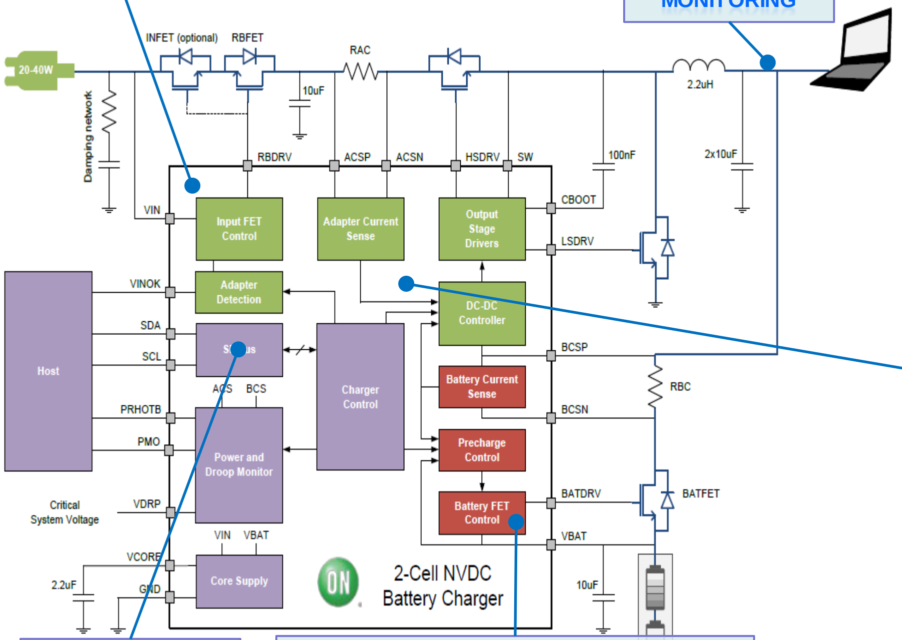
NCP1871
> 4A NVDC
12V/20V Input
2/3/4 cells - Controller
QFN

Anticipate Reuse for 1Cell SBC
NCP1864
3.5A SBC
4V/16V Input
1 cell - Monolithic
CSP-36



NEGATIVE INPUT SUPPORT

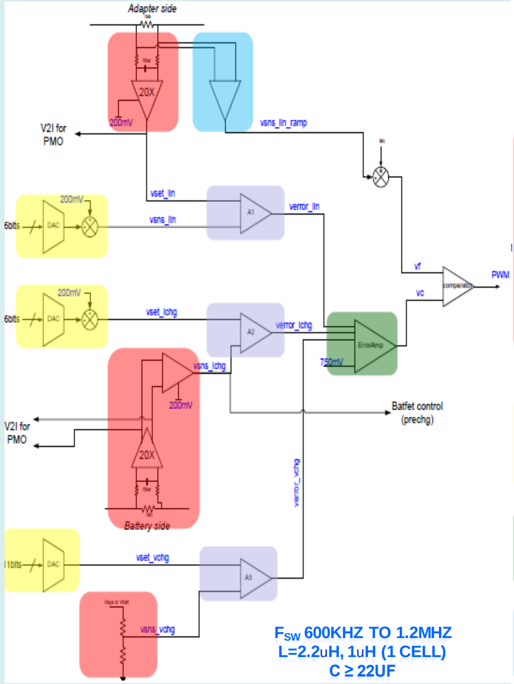
SYSTEM POWER MONITORING



SMBUS OR I2C INTERFACE

BATFET (NMOS) CONTROL
FAST TURN ON
LINEAR PRECHARGE & ADAPTIVE MODE

BUCK CONTROL LOOPS



- **Transconductor preamplifiers:**
  - balanced around 750mV
  - trimmed

- **Adapter current sensing :**
  - autozeoring with interleaving
  - single ended
  - 200mV shifted ground
  - filter to allow full linear operation
- **Battery current sensing :**
  - autozeoring with interleaving
  - differential for PMO
  - diff to single conversion for buck
  - 200mV shifted ground
  - anti-alisiasing filter

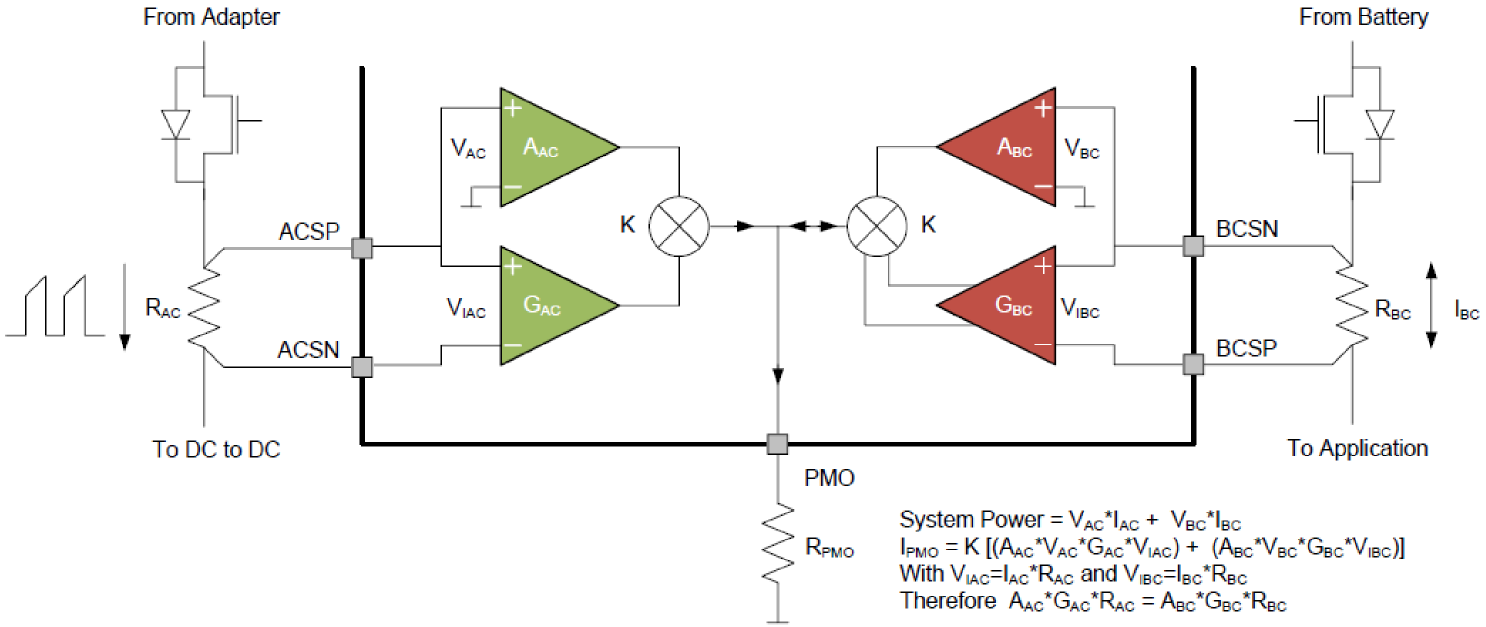
- **voltage references :**
  - R-2R dacs
  - 200mV shifted gnd for vset_iin and vset_ichg
  - Input buffer trimmed

- **Error amplifier**
  - type II compensator
  - trimmed

- **peak current mode current sense:**
  - BW : 15MHz
  - offset not critical

F_{SW} 600KHZ TO 1.2MHZ
L=2.2uH, 1uH (1 CELL)
C ≥ 22UF

Power Monitoring IP



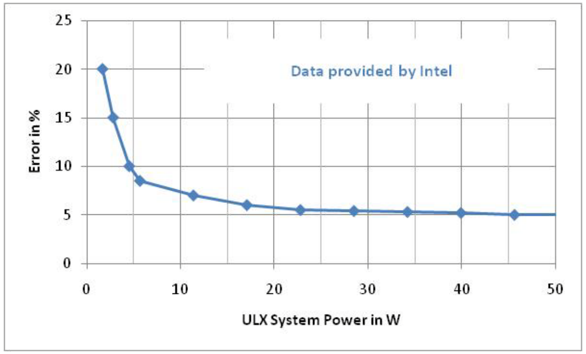
System Power = $V_{AC}*I_{AC} + V_{BC}*I_{BC}$

$I_{PMO} = K [(A_{AC}*V_{AC}*G_{AC}*V_{IAC}) + (A_{BC}*V_{BC}*G_{BC}*V_{IBC})]$

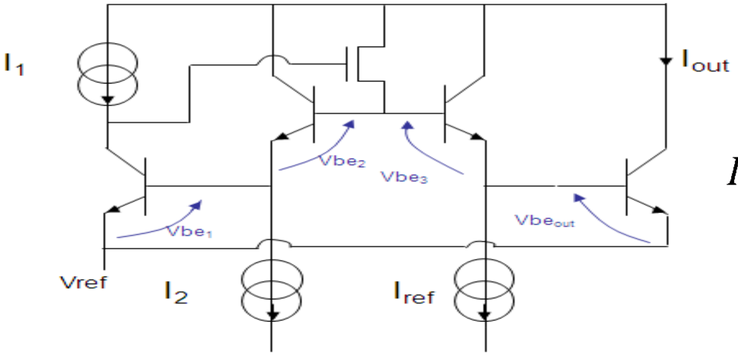
With $V_{IAC}=I_{AC}*R_{AC}$ and $V_{IBC}=I_{BC}*R_{BC}$

Therefore $A_{AC}*G_{AC}*R_{AC} = A_{BC}*G_{BC}*R_{BC}$

Intel Requirement



Gilbert Cell



$$I_{Out}\Big|_{\beta\to\infty} = \frac{I_1 . I_2}{I_{ref}}$$

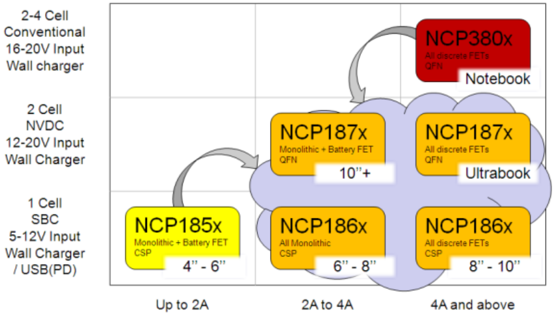
Extend SBC1 portfolio

NCP1850
1.5A SBC
+22V OVP
CSP 2.06x2.06

NCP1851
1.6A SBC
+28V OVP
CSP 2.55x2.2

NCP1852
1.8A SBC
+/-28V OVP
CSP 2.55x2.2

NCP1853/ NCP1854
2.0/2.5A SBC
+28V OVP
CSP 2.55x2.2



INPUT CURRENT LIMIT
UP TO 2A FOR TA

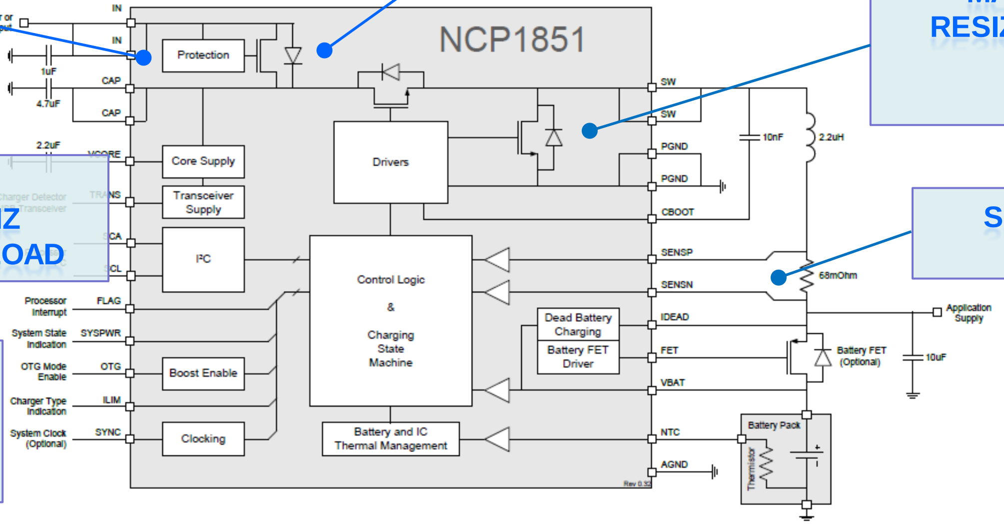
USB OTG
-1A CAPABILITY
- HOT PLUG SUPPORT

BUCK
- FSW: 3MHZ → 1.5MHZ
- IMPROVE TRANSIENT LOAD

NO NTC FUNCTION
NEW FACTORY MODE
SAFE CHARGE = 40mA
PRECHARGE = 450mA

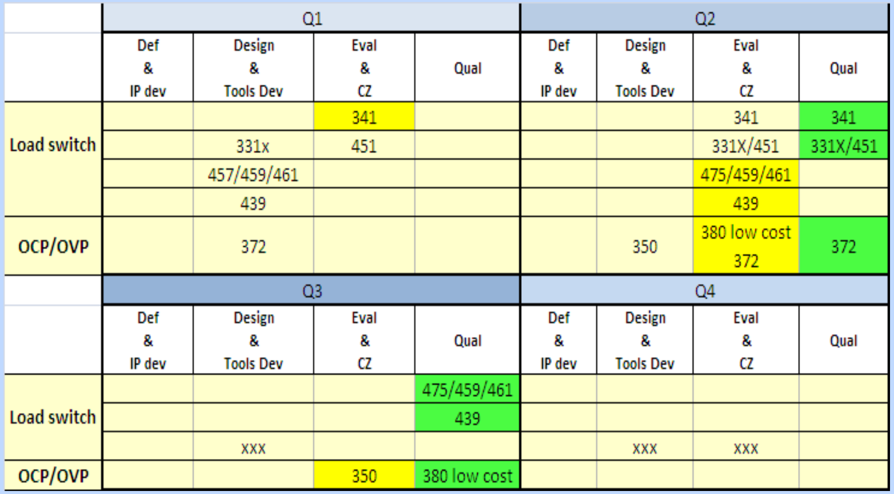
MAX ICHG = 2.0/2.5A
RESIZE POWER DEVICES
RBFET/HS/LS
45, 55, 70 mΩ

SENSE RESISTOR
66mΩ → 33mΩ



Load Switch& Protection Summary

NPI: : +7RTM, +7NP Samples



	Q1				Q2			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
Load switch			341				341	341
		331x	451				331X/451	331X/451
		457/459/461					475/459/461	
		439					439	
OCP/OVP		372				350	380 low cost 372	372

	Q3				Q4			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
Load switch				475/459/461				
				439				
		xxx				xxx	xxx	
OCP/OVP			350	380 low cost				

Technical Highlights

- Load switch robustness: Negative voltage support, EOS on input while targeting IEC standard.
- Bring new features to align or even differentiate from competition: Adjustable slew rate , Vbias supply rail, NMOS versions with very low Iq close to PMOS versions, modulate Vt with bulk effect …
- Optimize integration for Dual versions
- Update Design check list for load switch to gather all uses cases & lessons learned.

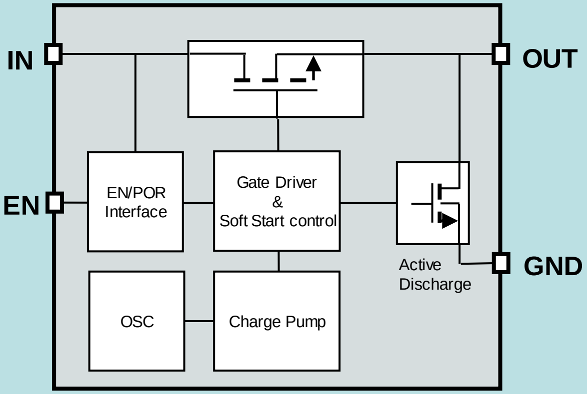
NPI Challenges

- Keep Load switch & OVP: less than 6 months from opportunities to revenues!
- Leverage Load Switch IPs in Computing Market: NCP457, NCP459, Dual LS: 461
- Quickly answer all new opportunities at Samsung around factory mode test application:
  - ✓ Finalize on going projects to secure high volume position at Samsung: 330, 341.
  - ✓ Opportunistically develop new devices to answer customer concerns
- Opportunistically develop new OVP/OCP versions:
  - ✓ Support legacy products versioning by proposing quick metal tweak options (367, 370, 380 …).

New Load Switch Developments

NMOS TYPE

BEST RDSON X AREA
LOW IQ<3UA
CHARGE PUMP X3 OR 4
(ADAPTIVE FREQ FOR MIN IQ)
LOW RDSON AT LOW VIN



NCP451 ○
20mΩ CSP
0.9x1.4mm

NCP457 ○ ▲ ★
25mΩ CSP
0.8*1.2mm

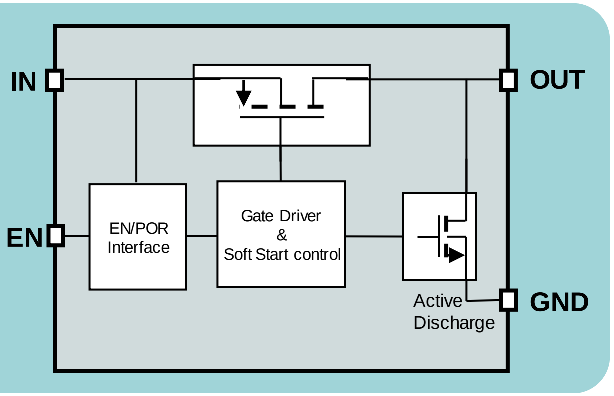
NCP461 ○ ▲ ★
Dual 40mΩ
CSP 1x2mm

NCP331X ○ ▲
26mΩ
TSOP6

NCP459 ○ ▲ ★
15mΩ CSP
1.0x2.0mm

PMOS TYPE

VERY LOW IQ<1UA
FAST TON
SIMPLE TOFF CONTROL
COMPETITIVE RDSON
(MODULATE VT WITH BULK EFFECT)



NCP439 ○ ▲
33mΩ CSP
0.96x0.96mm

NCP341 ✦
26mΩ DFN
1.2x1.6mm

PRODUCT OPTIONS

INPUT VOLTAGE: 5.5 OR 3.3V DOWN TO 0.75V

-AUTO DISCHARGE ○
- REVERSE BLOCKING PROTECTION ▲
-SLEW RATE CONTROL ★
-NEGATIVE INPUT VOLTAGE ✦

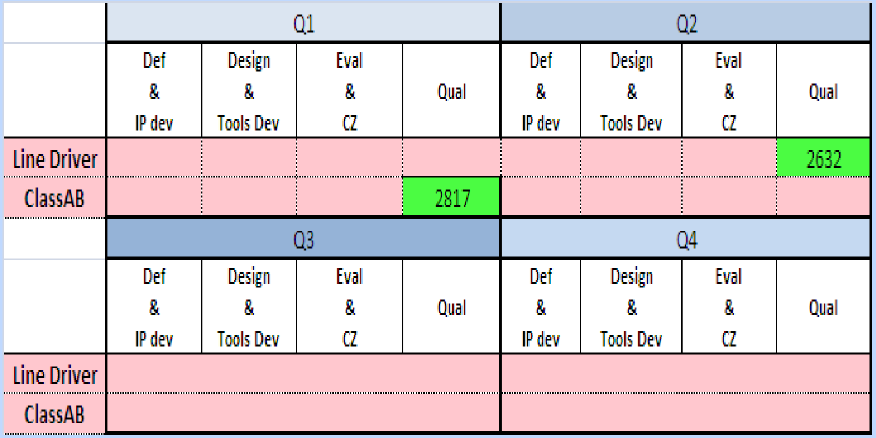
NEW OPTIONS?
(ADVANCE DEVELOPMENT)

- CURRENT LIMIT
-CURRENT MODE CONTROL @STARTUP
- ULTRA LOW IQ TSD

2013

Audio Summary

NPI: +2RTM 🟩, +0NP Samples 🟨 .



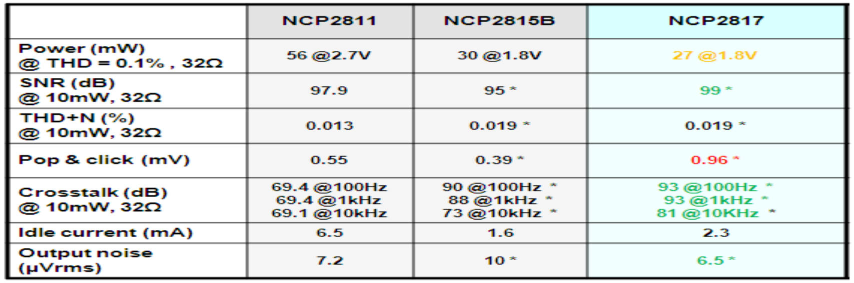
	Q1				Q2			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
Line Driver								2632
ClassAB				2817				
	Q3				Q4			
	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual	Def & IP dev	Design & Tools Dev	Eval & CZ	Qual
Line Driver								
ClassAB								

Technical Highlights

- Fix all reliability issues on 2632
  - ✓ Antenna diodes: offset drift captured during HTOL.
  - ✓ SOA of devices: pending HCI issues.
  - ✓ Oscillator locked at min operating voltage.
- Amplifier with IOD devices to meet IEC standard
- Version with offset auto calibration for test time reduction

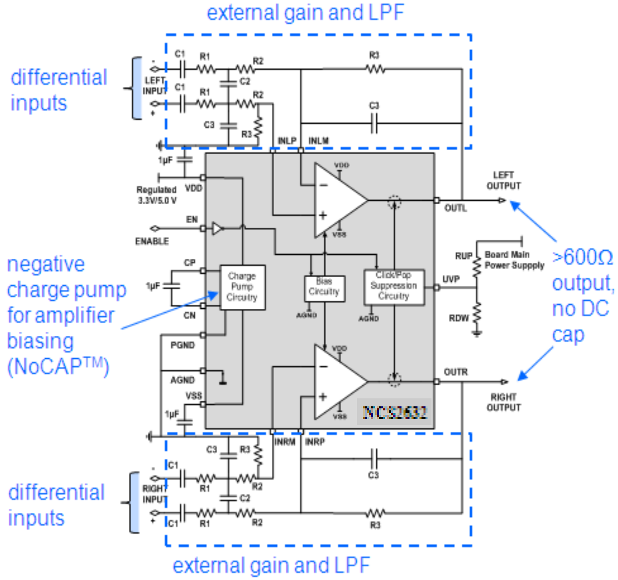
NPI Challenges

- Support Application on legacy products.
- Complete Qual. of 2817 for 2811 replacement.



	NCP2811	NCP2815B	NCP2817
Power (mW) @ THD = 0.1% , 32Ω	56 @2.7V	30 @1.8V	27 @1.8V
SNR (dB) @ 10mW, 32Ω	97.9	95 *	99 *
THD+N (%) @ 10mW, 32Ω	0.013	0.019 *	0.019 *
Pop & click (mV)	0.55	0.39 *	0.96 *
Crosstalk (dB) @ 10mW, 32Ω	69.4 @100Hz 69.4 @1kHz 69.1 @10kHz	90 @100Hz * 88 @1kHz * 73 @10kHz *	93 @100Hz * 93 @1kHz * 81 @10KHz *
Idle current (mA)	6.5	1.6	2.3
Output noise (μVrms)	7.2	10 *	6.5 *

- Complete NCS2632 project (Qual. for end of Q2).



Continuous Improvement

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2012 Lessons Learned

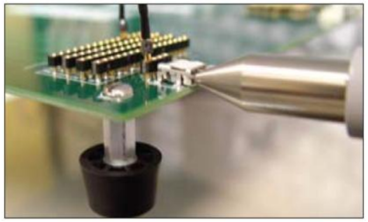
DESIGN & VERIFICATION 2012 LESSONS LEARNED

- **Antenna diode guide lines** for ONC25(BCD) (Julien C.)
- Carefully review devices isolation, substrate routing … to avoid latch-up.
- Develop formal verification method to **guarantee alignment** between last **RTL code** & **Cadence schematic** just before TO.

DFT FOCUSED ON TEST TIME REDUCTION

- Deploy **auto zeroing** or **self calibration** to optimize performance & test time.
- Optimize digital control to reduce OTP fuse time.
- Digital Team should be Key contact for Scan.
  - ✓ Evaluate coverage benefit of Scan for simple projects
- Identify other opportunities for test time reduction.

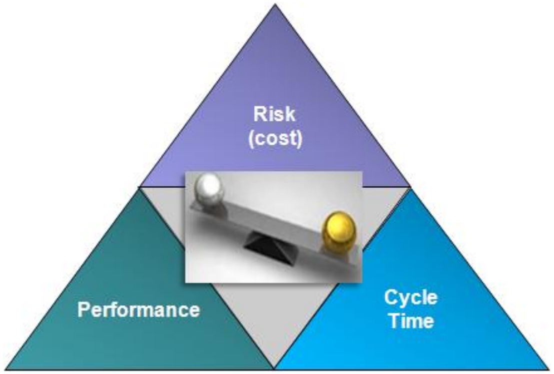
BUILDING ON ESD EXPERIENCE



- **ESD guidelines & lessons learned** for ONC25(BCD) (Geraldine S.)
- Start gather & synthesize IEC experience from Audio or LS products.

Design Cycle Time

SMART APPROACH FOR IP REUSE & INNOVATION

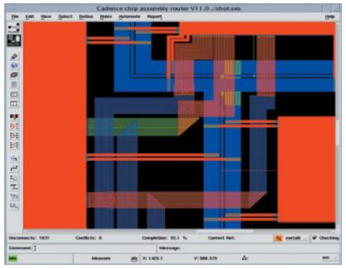


- **Balance risks versus benefits**
  - ✓ Keep IP aligned through projects.
  - ✓ Make change only if necessary: "The perfect is the enemy of the good.“
  - ✓ Make best usage of Mask set to secure critical design changes.
- **Continue enhance our technical solutions**
  - ✓ Keep record of all improvement opportunities for next gen IPs.
  - ✓ Gather customer feedbacks and competitors strengths.
  - ✓ Anticipate roadmap evolutions or product derivatives.

OPTIMIZE SIMULATION COMPUTING TIME

- Deploy best practices for switching power supplies simulations.
- Define with TD a consistent method for connect module.
- Refresh on best usage of RTDA.
- 20% renewal of computing farm & park machine planned by Q4.

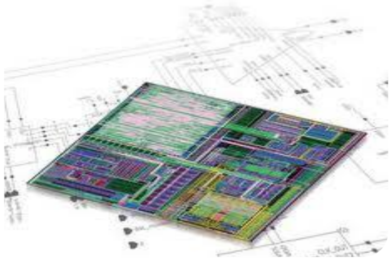
PHYSICAL DESIGN



- Grow Layout team leadership to drive external resources.
- **Test & deploy Virtuoso Chip Assembly Router** (top-cell, blocks).
  - ✓ Measure time gain benefit and check routing quality.
  - ✓ Deploy tool usage over team if proven it can maximize productivity.
  - ✓ Automatic routing rules with design constraints set in schematic.

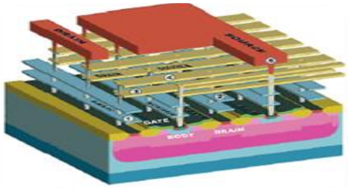
Pre Silicon Verification Coverage

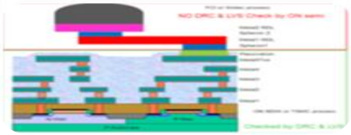
CONTINUE RUN RELEVANT SIMULATIONS



- **Define scenarios to emulate use cases, even unlikely ones** (En bouncing, digital inputs >Vin, turn on supply while output not discharged …).
- **Design to be simulated in real silicon environment** (customer hardware components, package parasitic, board parasitic, on chip routing …).

MEASURE PHYSICAL DESIGN PERFORMANCE





- Keep **run back-annotated simulations** especially for high current design (parasitic resistance) or low quiescent & low noise (on chip coupling).
- **Modeling & Analysis of Metal Interconnect Resistance of Power MOSFETs**
  - ✓ Complete Benchmark of Calibre & Magwell tools.
  - ✓ Enhance tools by taking into account RDL layers, bump or wire bonding.
- **Work with TD to enhance Design Kits rules for DFM.**

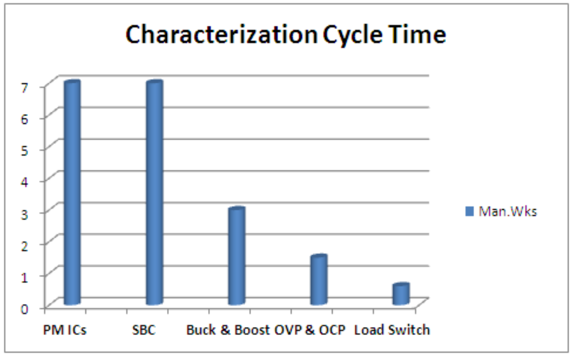
RE-ENFORCE SOME KEY SAFE OPERATING CHECKS

- Improve **floating node detection** method.
- **Check** all **devices** are operating in their **SOA.**
- **Simulate** circuitry sensitivity to **ESD & IEC stress.**

IC CZ Cycle Time & Coverage

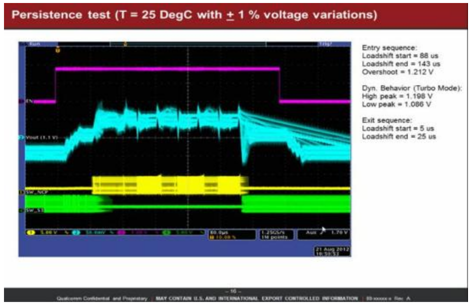
IC CHARACTERIZATION CYCLE TIME

- Continue **grow automatic tests portfolio**
  - ✓ Finalize the Load Transient test
  - ✓ Automate AC measurements (Peak Current, switchover point, PSRR, noise).
- **Develop new features for the test sequencer** " Xtest"
  - ✓ Characteristic viewer during the test execution.
  - ✓ Test editor to ease test duplication, Hw setup reuse, register map change.



IC CHARACTERIZATION COVERAGE

- Adapt bench setup to support new coming products.
- Develop test system to characterize **SMBUS protocol**.
- **Develop MCU tools** to support new complex ICs (INL/DNL test, SMBUS protocol, digital signal generation and capture)


Persistence test (T = 25 DegC with ± 1 % voltage variations)

Entry sequence:
Loadshift start = 88 us
Loadshift end = 143 us
Overshoot = 1.212 V

Dyn. Behavior (Turbo Mode):
High peak = 1.198 V
Low peak = 1.086 V

Exit sequence:
Loadshift start = 5 us
Loadshift end = 25 us

- 16 -
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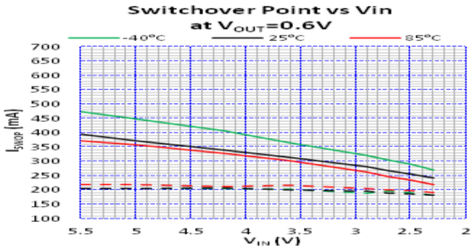
IC EVALUATION & DEBUG SUPPORT

- Involve much CZ team in Design reviews, so they can provide best in class support for IC debug.
- Continue to deploy CZ tools across Application & Design teams



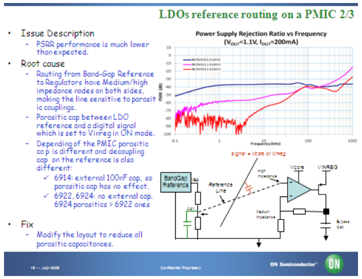
Organize ourselves for Quality Standards

DESIGN REVIEWS

- **Refresh Checklists** (design, layout) based on recent lessons learned.
- Besides design, maintain **layout reviews** with support of **layout memo**.
- Write **smart Design Review meeting minutes**
  - ✓ Should systematically make reference to date, specification release & list of attendees.
  - ✓ Should ever note actions identified and make follow-up with owners.
  - ✓ Attache to the summary all useful documentation.

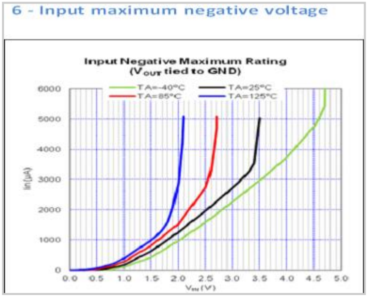
KEY WORKING DOCUMENTS FOR NEW PRODUCT DEVELOPMENT

- **Product Technical Specification**: design leader is responsible to raise any discrepancies to the attention of application engineer.
- Set a pre-silicon Bug tracking List to guide focus of top level verifications.
- Build a **Verification & CZ Plan**, be able provide progress status indicating coverage.
- Maintain a **« Changes Tracking List »** to track modifications from pass to pass.
- Write **One pager** for critical issues including description, root cause & fix.
- **Documentation** of **CZ boards** (schematic, BOM, layout) to ease large usage.
- Design Leader to provide **Design For Test document** to enable IC test/ evaluation.
- IC & System level ESD documents
  - ✓ Work with Apps team to write an internal **IEC test procedure** based on IEC standard.
  - ✓ Set **ESD metrics** to measure reliability & cycle time of ESD tests.
  - ✓ Install a tracking sheet to improve follow-up of ESD tests & Failures analysis.
- Continue provide clear **Characterization report** and highlight issues or concerns.



LDOs reference routing on a PMIC 2/3

- Issue Description
  - PSRR performance is much lower than expected.
- Root cause
  - Routing from Band-Gap Reference to Regulators have Medium/high impedance nodes on both sides, making the line sensitive to parasitic couplings.
  - Parasitic cap between LDO reference and a digital signal which is set to Vinreg in ON mode.
  - Depending of the PMIC parasitic cap is different and decoupling cap on the reference is also different:
    - ✓ 6914: external 100nF cap, so parasitic cap has no effect.
    - ✓ 6922, 6924: no external cap. 6924 parasitics > 6922 ones
- Fix
  - Modify the layout to reduce all parasitic capacitances.



6 - Input maximum negative voltage

Technical Presentation & Mutual Training

DOCUMENTATION PURPOSE

- Keep trace of architecture choice
- Ease reuse within and beyond Toulouse Design Team
- Support for Technical sharing and Team development

POWER MANAGEMENT TOPICS

- Boost converter in DCM mode (Laurent B.)
- Automatic bypass or pass through mode for boost converter (Berengere L.)
- 3 regulation loops Buck converter & transient load performance(Loic C.)
- Hysteretic mode control for Buck converter (Henrique F.)
- PMIC building blocks & integration challenges (Vincent T.)

GENERAL TOPICS

- DAC architectures benchmark & NVDC application (Pascal T.)
- Digital Control architecture overview (Franck D.)
- Flat Band-gap over temp for 10bits ADC (Anissa K.)
- Verification Methodology for medium complexity circuits (Hassan C.)
- Power device Rdson optimization with ,Met, RDL layers (Alexandre A.)
- Automatic test bench (Mathieu G.)
- Auto zeroing & auto offset calibration techniques (Marc R.)
- Power Monitoring function (Paolo)
- High Side Flash LED driver (Christophe P.)
- Periodic large & small signal analysis (PAC) applied to SMPS (Stephane C.)
- ADC Control & Built In Self Test (Stephanie C.)
- New bench setup to support high current ICs (Maxime L., Serge L.)

Confidential Proprietary

ON Semiconductor®

Ac-dc Toulouse Application Team

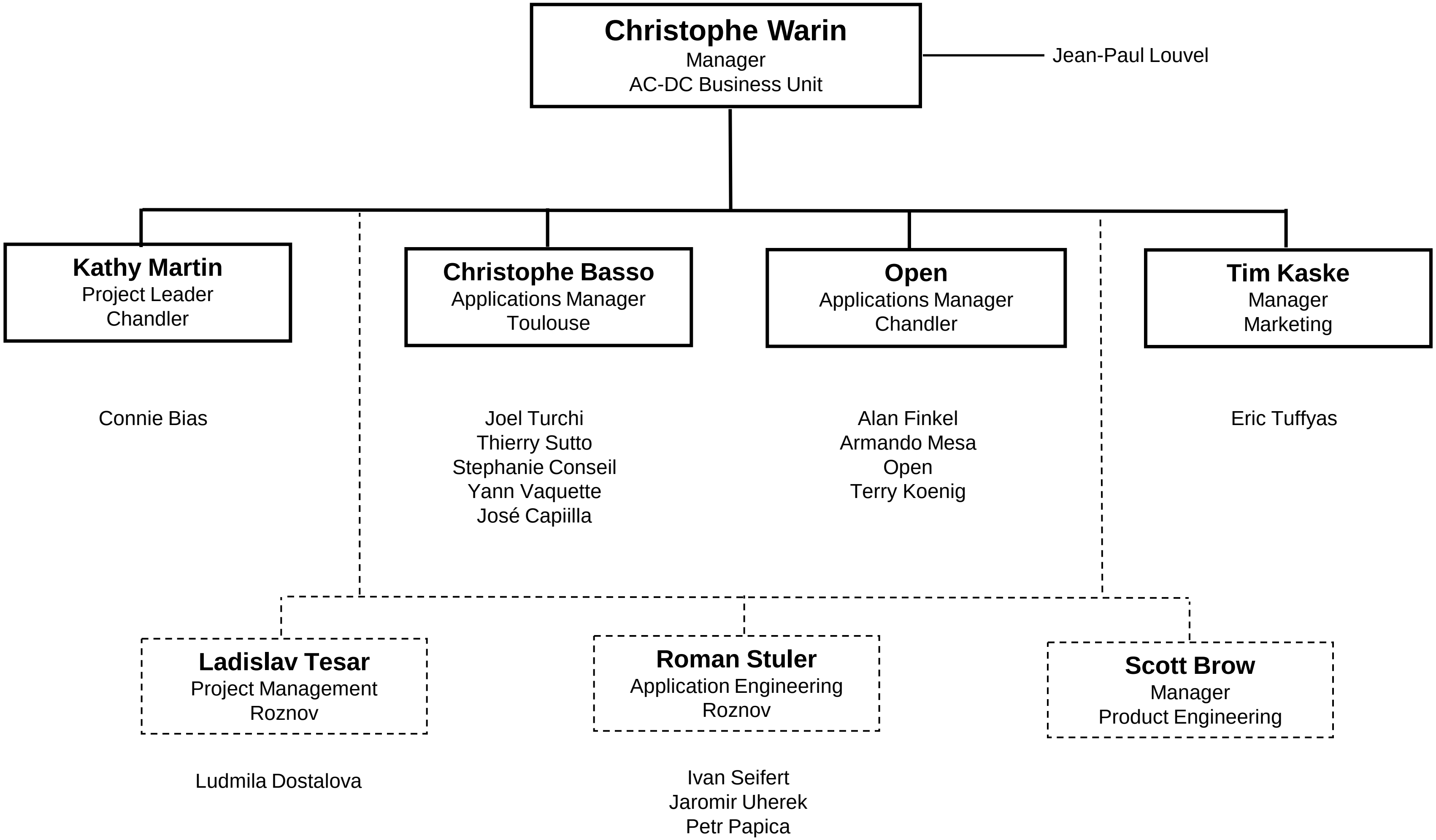
Christophe Basso

Director, Product Applications Engineering

Ac-dc Team Members

- ❑ Joël Turchi – app. eng. PFCs, analytical studies
- ❑ Thierry Sutto – app. eng. half-bridges, forward
- ❑ Stéphanie Cannenterre – app. eng. modeling, analytical studies
- ❑ José Capilla – app. eng. stability, analytical studies
- ❑ Yann Vaquette – app. eng. switching concerters
- ❑ Jean-Paul Louvel – system architect TV (Chris Warin)
- ❑ Christophe Basso – manager

Ac-dc Organization Chart



Christophe Warin
Manager
AC-DC Business Unit

Jean-Paul Louvel

Kathy Martin
Project Leader
Chandler

Connie Bias

Christophe Basso
Applications Manager
Toulouse

Joel Turchi
Thierry Sutto
Stephanie Conseil
Yann Vaquette
José Capiilla

Open
Applications Manager
Chandler

Alan Finkel
Armando Mesa
Open
Terry Koenig

Tim Kaske
Manager
Marketing

Eric Tuffyas

Ladislav Tesar
Project Management
Roznov

Ludmila Dostalova

Roman Stuler
Application Engineering
Roznov

Ivan Seifert
Jaromir Uherek
Petr Papica

Scott Brow
Manager
Product Engineering

Skills

❑ **New product concepts:**

✓ Power supply control: PFC control laws, resonance, quasi-resonance etc.

✓ Analytical analysis of problems, equations-based studies

✓ Design-aids software in Visual Basic and operated from Excel

✓ IP generation, numerous patents from 2008 to 2013

❑ **Customer support**:

✓ small-signal, average modeling, SPICE model generation

✓ articles and papers presentations (PET-US, APEC/IEEE, PCIM…)

❑ **Seminar organization**:

✓ lot of training sessions, internal and external (1 hour to 8 hours sessions). IEEE-related conferences, APEC 2009/10/11/12/13 in the US

❑ **Copernican approach!** ⟶

✓ specifications are written here, dispatched worldwide (US, Czech R.)

Patents

☐ **2008-2013**

✓ ONS01196, C. Basso, J-P. Louvel: “TL431 bias current suppression”

✓ ONS01525, J. Turchi, "6-pin PFC without aux winding"

✓ ONS01444, S. Cannenterre, J. Turchi: "Primary CC PFC"

✓ ONS01320, J-P. Louvel: "High voltage Pre-Regulator"

✓ ONS013884, J. Turchi: "Optoless CC flyback conv."

✓ ONS01449, S. Cannenterre: "Automatic prop. delay compensation"

✓ ONS01383, J-P. Louvel: "OFF mode & Feedback combined SMPS"

✓ ONS01383, J-P. Louvel: "High Efficiency DSS"

✓ ONS01430, J-P. Louvel: "Automatic Eco mode detector"

✓ ONS01158, J. Turchi: "Interleaved clock"

✓ ONS01194, J. Turchi: "Brown-Out solution"

✓ ONS01220, J. Turchi: "Current Limit for Interleaved Converter"

✓ ONS01333, J. Turchi: "CCFF Modulation Strategy for PFC"

Recent Circuit Introductions

- ☐ NCP1565: hi performance active clamp dc-dc for Huawei
- ☐ DAP029: new QR controller for Delta
- ☐ NCP1255 and DAP versions, peak power controllers
- ☐ NCL30080/81/82/83: Constant current controllers for SSL
- ☐ DAP013 CA/H, 7 different successful versions
- ☐ NCP1910: combo CCM PFC+LLC
- ☐ NCP1379/80: Quasi-resonant controller for ac-dc adapters
- ☐ NCP1611/12: Novel control scheme PFC circuits for open market
- ☐ Kraken, NCP1250 and DAP022 for Delta Electronics and open market

Products Sales (2011)

	Lifetime Billings	Backlog
NCP1200	$51M	$1.17M
NCP1203	$32.6M	$1M
NCP101X, monolithic switcher family	$29.4M	$3M
Maximus (SCY99008) for Delta	$28.1M	$2.7M
NCP1207	$22.8M	$1.9M
NCP1230	$18M	$1.5M
Speedking I (SCY99056) for Delta	$10M	$1.1M
NCP1396	$9.3M	$600k
NCP1653	$6.9M	$2.1M
NCP1377	$6M	$1M
NCP1308	$5.1M	$19K
DAP017x (SCY99058) for Delta	$1.6M	$500K
Chrono14 (SCY99082/88) for Delta	$1M	$3.8M
Speedking II (SCY99079) for Delta	$480K	$1.8M

Involvement in Green Power Initiative

- Power consumption reduction necessity is present at design stage.
- Communication of ON Semiconductor performance via articles, papers.
- Involved in international conferences (APEC in the US, PCIM Germany)
- Companies like Apple challenge us to reduce the consumption further
- From 70 mW a few years back, they now want 10 mW

$P_{noload} = 10$ mW

- Toulouse members have worked on original solutions to meet 10 mW
- Several patents have been filed

Involvement in Solid-State Lighting

- LEDs-based lighting solutions are flooding the market
- Solutions still use an optocoupler to maintain the output current constant
- ON Semiconductor Toulouse has patented a novel optoless solution
- Solution addresses mass market production for CC applications

- Several patents have been filed for this project
- Power Factor correction is now being added

Analytical Analysis, Trainings

❑ Analytical analysis of complex circuits

❖ Problems solving for customers

❖ Equation-based small-signal compensation

❖ Power stage transfer function derivations

$$\frac{V_{out}(s)}{D(s)} = F_0 \frac{1+\frac{s}{s_{\mathrm{zF}}}}{1+\frac{s}{\omega_{0\mathrm{F}} Q_{\mathrm{F}}}+\left(\frac{s}{\omega_{0\mathrm{F}}}\right)^2} N \left(V_{in} - D_0 r_{on1} M_0 \frac{sC_{clp}}{1+\frac{s}{\omega_{0\mathrm{M}} Q_{\mathrm{M}}}+\left(\frac{s}{\omega_{0\mathrm{M}}}\right)^2} \right)$$

Active-clamp forward converter transfer function

❑ Cross-fertilization meetings involving Phoenix, Roznov and TLS

❑ Internation trainings to ON locations, Brno, Phoenix, Piestany etc.

On-Going Activity

❑ Delta Electronics is one of our technology driver:

✓ design-in support

✓ intensive production support, ramp-up and mass production

✓ new idea discussions with different BUs (adapter, ATX, TVs, printers…)

✓ four ASICs in development for 2012-13

❖ Eris: power supply controller with peak power capabilities

❖ DAP028: fixed switching controller for low standby power applications

❖ DAP029: high-power adapter for notebook

❖ DAP030: power supply controller for low standy power applications

❑ BU committed annual dedicated slots for Delta adapter BU

❑ cycle-time with Chrono: 6 months from spec definition to samples!

ON Semiconductor®

CE update May 27th, 2013

Welcome Géraldine, Aurore & Olivier

- R&R's within Toulouse site
  - Christophe Basso : building management (facilities, reception, maintenance), Technical expert for audit, "credit impot recherche"
  - Sophie Penent : finance/expenses goal keeper : phone contracts, travel approval, …
  - Didier Ribas : WW business data support, network improvement
  - Michel Pradille : EMEA business data support
  - Bertrand Clou : Technical expert for audit, "credit impot recherche", BU "PI" management inputs
  - Pascal Aigouy : Work Council/CHSCT/Staff interface, HR facilitator, travel approval
  - All : RPS plan support
- Confidentiality

Q1’13 Highlights / Lowlights

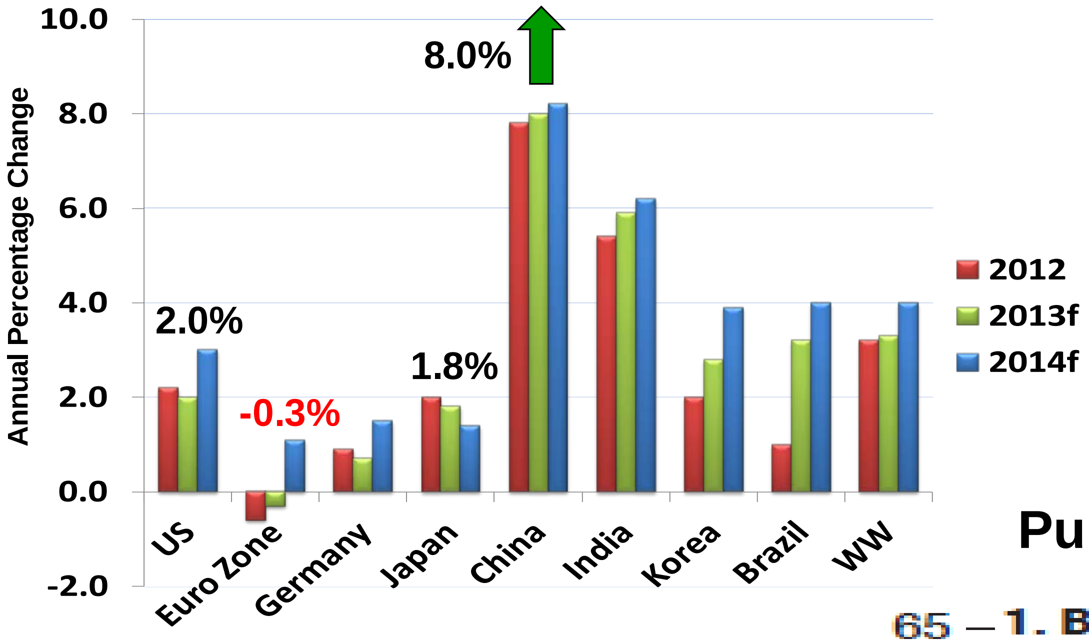
Highlights:

- Sequentially increased non-GAAP earnings by 21% on 3% lower revenues
- Maintained strong cash flow on trough sales and retired $73.4M in debt
- Reduced Sanyo revenue break-even point on a non-GAAP net income basis to $170M and remain on track to achieve break-even in Q3’13
- Increased design wins at focus customers in automotive and wireless applications
- Commenced first OIS production shipments for smartphone camera modules (Nokia) and ramped RF tuning shipments to lead customers (Blackberry, HTC)
- Recorded 43% sequential growth in white goods sales and increased design wins
- Strong control on OPEX across the company

Lowlights:

- Sanyo sales declined to $151M on weaker Yen and seasonal decline in consumer market
- No evidence that Japanese electronics OEM sales are improving on weaker Yen
- Expected moderate global economic growth in 2013 appears to be slowing (China)
- Unable to fulfill some demand in wireless and white goods due to supply constraints

Leading Indicators

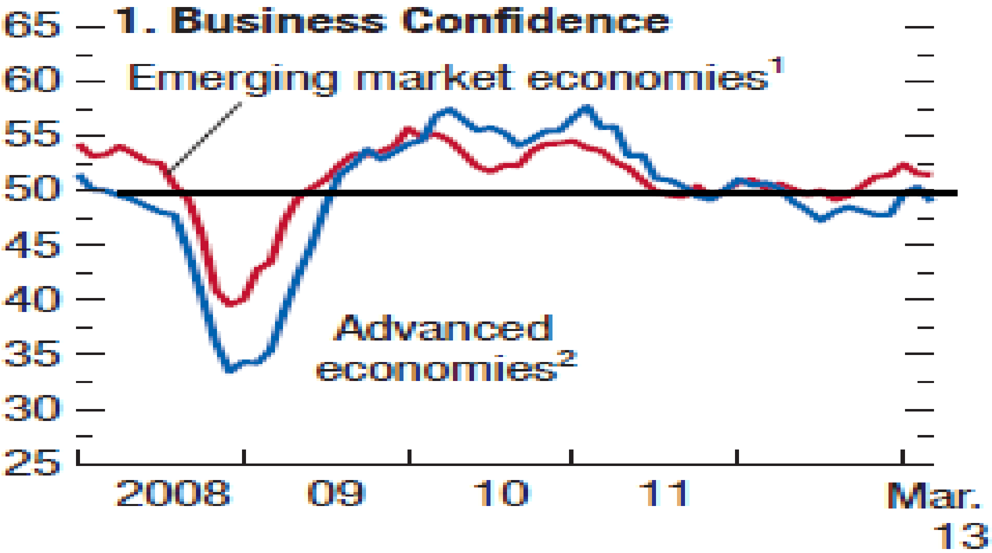


Global Real GDP

2013 = 3.3%

2014 = 4.0%

Purchasing Managers Index (PMI)

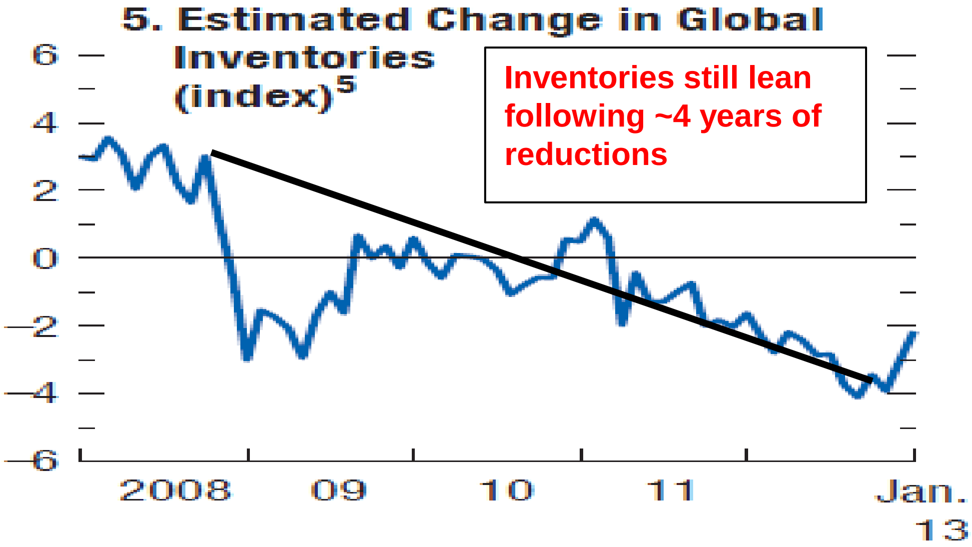


Slowing growth in emerging countries and EU recession drag on global growth. A demand increase will drive short cycle orders due to lean inventories.

Source: IMF WEO Apr'13, Caris & Company Apr'13

[5] Based on deviations from an estimated (cointegral) relationship between global industrial production and retail sales.

Leading Indicators: Inventory

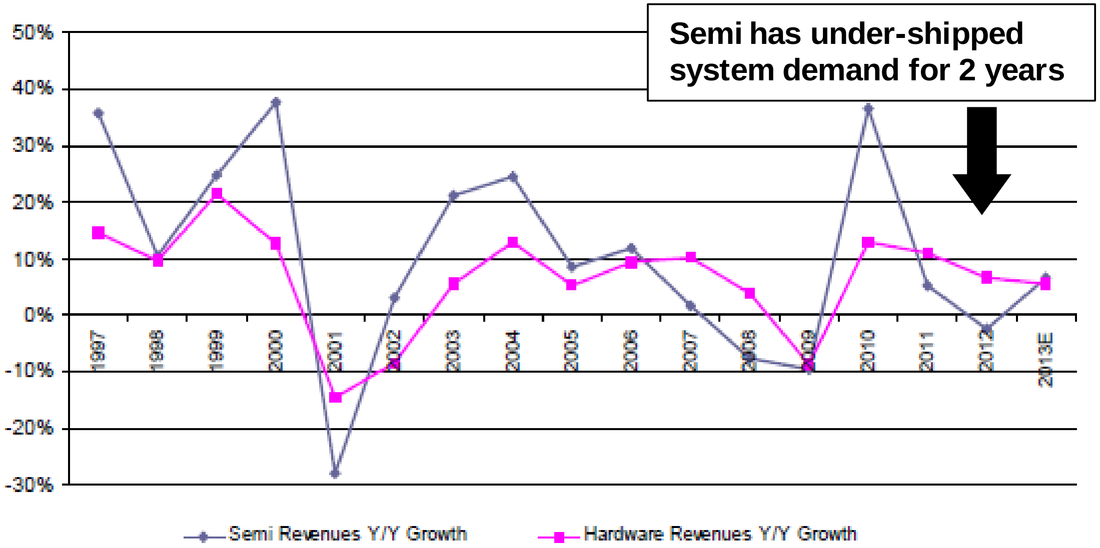


5. Estimated Change in Global Inventories (index)[5]

Inventories still lean following ~4 years of reductions

Slowing growth in emerging countries and EU recession drag on global growth. A demand increase will drive short cycle orders due to lean inventories.

Annual Semiconductor Revenue Versus Hardware Revenue



Semi has under-shipped system demand for 2 years

Source: IMF WEO Apr’13, Caris & Company Apr’13

[5] Based on deviations from an estimated (cointegral) relationship between global industrial production and retail sales.

Application and Unit Forecast

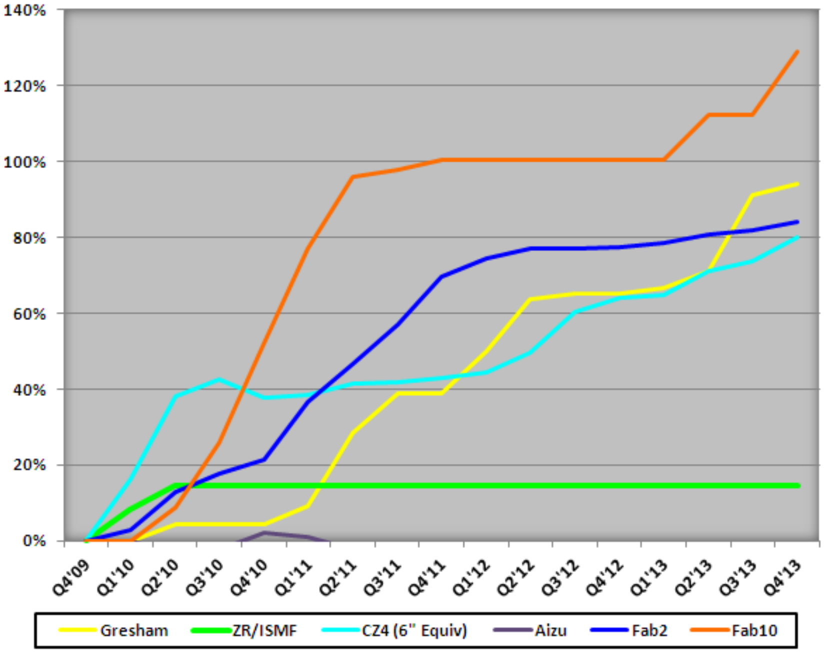
- **Consumer** – Expect continued decline in most consumer electronics shipments. Improving US / China housing markets drive moderate white goods growth. R
- **Computing** – 1Q'13 PC shipments fell ~13% yoy. Expect ~4% decline in PC and HDD shipments in 2013. More touch display PCs / convertibles at <$700 and Windows 8 improvements should drive increased sales. R
- **Automotive** – Light vehicle production forecast to grow ~2.5% to 82M units in 2013. Semi growth forecast at ~6%. G
- **Tablets** – Apple dominates with Samsung, Amazon and China OEMs challenging. Expect ~52% growth to 165Mu in 2013. G
- **Smartphones** – Growth led by low-cost smartphones. China is the largest market. Apple, Samsung and China OEMs dominate. Chipset reference designs drive device proliferation. Expect 25% growth to 870Mu in 2013. G
- **Industrial / Medical / Mil-Aero** – Expect flat market supported by low inventories. Strong growth in LED general lighting. Y

Sources: IHS-iSuppli AMFT Apr'13, Gartner Apr'13, Corporate Marketing

G **Indicates end-market health**

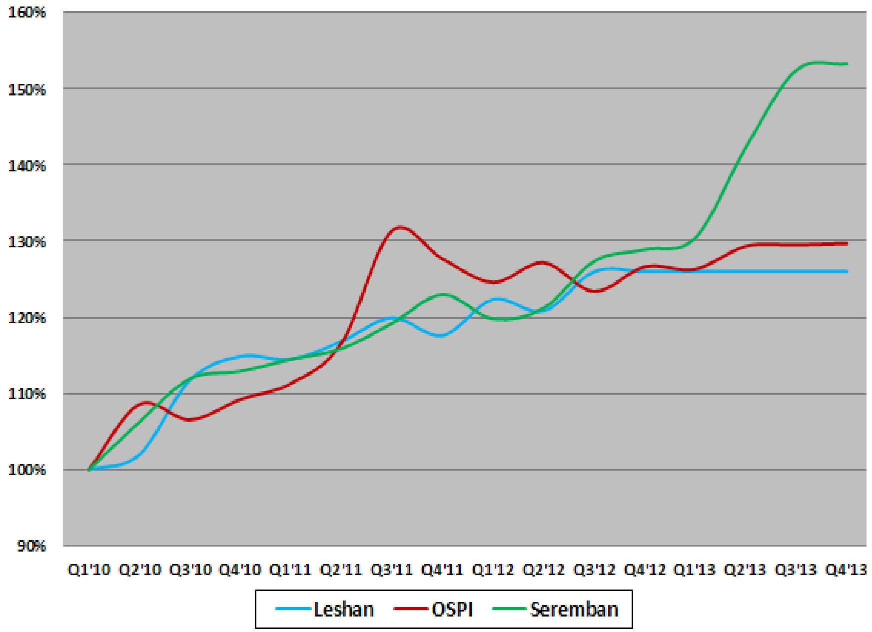
Capacity Investment Status

Wafer Fab Increases



- Gresham (8in) is adding capacity to support the wireless and computing market, and to enable the Aizu transfer ramp
- Fab10 (8in) is adding equipment capability to 2nd source I2T100 from Fab2, and capacity to support discrete growth
- CZ4 (6in) is adding capacity through 2012 & 2013 for Aizu transfers and Trench IGBT parts
- Fab2 (6in); by transferring out various parts and adding I3Txx equipment, automotive ASIC / ASSP capacity will continue to expand through 2013

ATO Capacity Increases



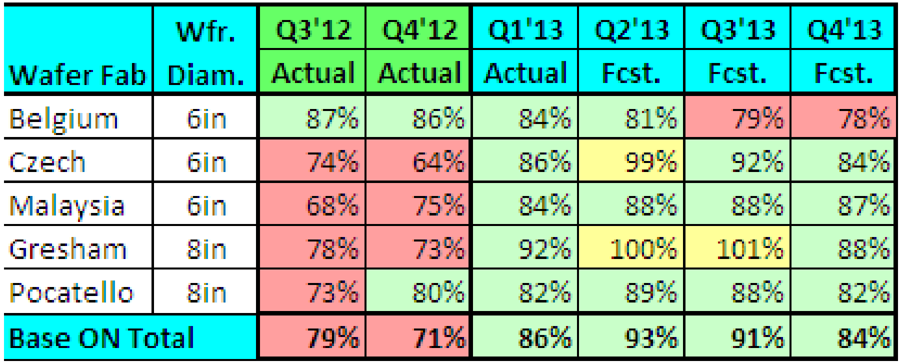
<u>Expansions:</u>

- Seremban: BUMP, X3DFN, WFN/CMF, SO8-FL & Sanyo SOSM packages
- OSPI: SSOP AMIS & SOIC Sanyo in-sourcing, SOIC WB expansion

ON Wafer Fab Capacity Utilization

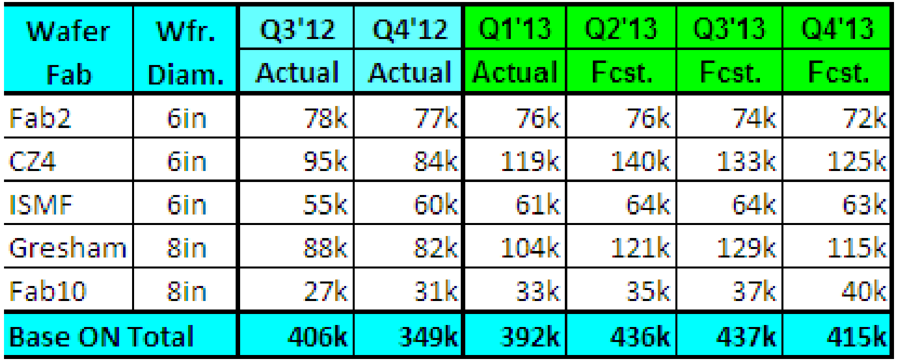
> 93%	🟨
80-93%	🟩
< 80%	🟥

Wafer Fab Equipment Utilization



Wafer Fab	Wfr. Diam.	Q3'12 Actual	Q4'12 Actual	Q1'13 Actual	Q2'13 Fcst.	Q3'13 Fcst.	Q4'13 Fcst.
Belgium	6in	87%	86%	84%	81%	79%	78%
Czech	6in	74%	64%	86%	99%	92%	84%
Malaysia	6in	68%	75%	84%	88%	88%	87%
Gresham	8in	78%	73%	92%	100%	101%	88%
Pocatello	8in	73%	80%	82%	89%	88%	82%
Base ON Total		79%	71%	86%	93%	91%	84%

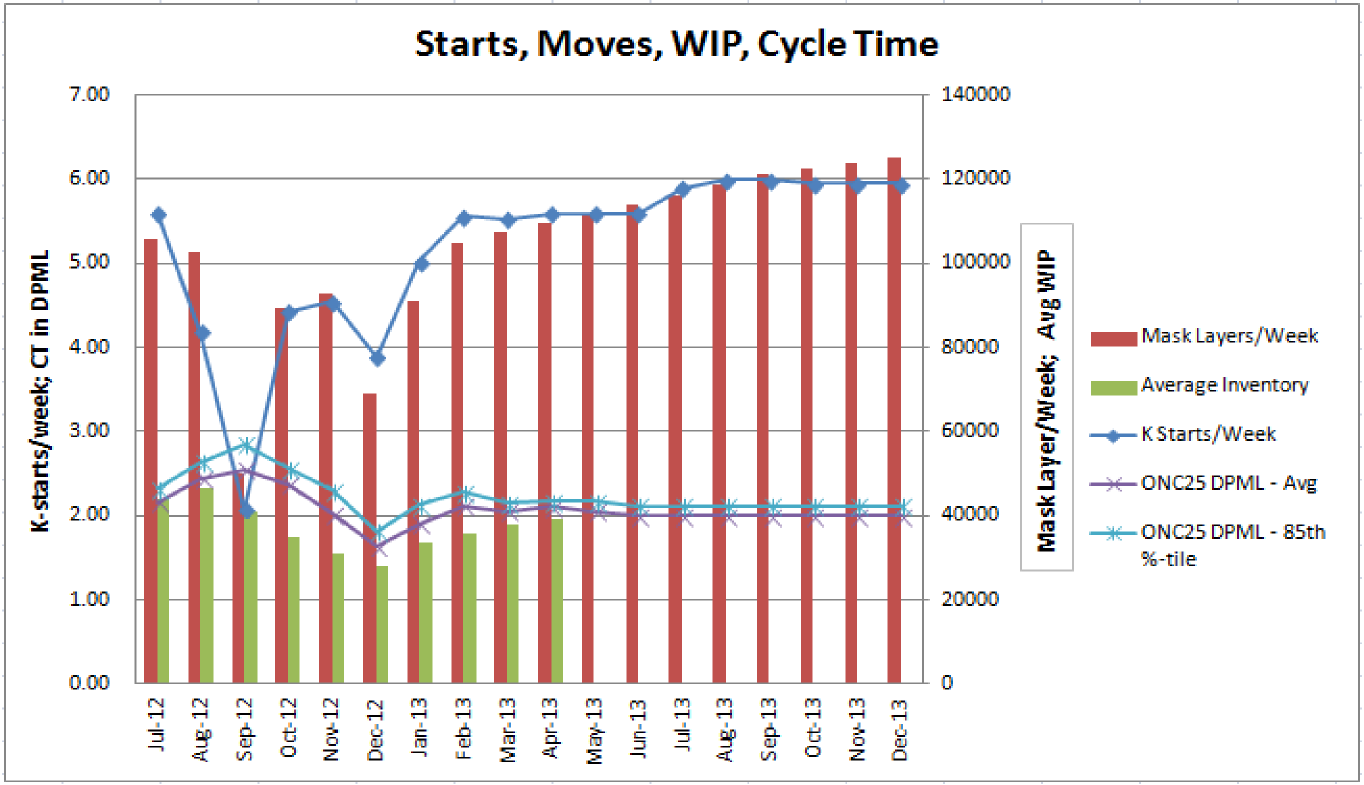
Mask Layers / Week



Wafer Fab	Wfr. Diam.	Q3'12 Actual	Q4'12 Actual	Q1'13 Actual	Q2'13 Fcst.	Q3'13 Fcst.	Q4'13 Fcst.
Fab2	6in	78k	77k	76k	76k	74k	72k
CZ4	6in	95k	84k	119k	140k	133k	125k
ISMF	6in	55k	60k	61k	64k	64k	63k
Gresham	8in	88k	82k	104k	121k	129k	115k
Fab10	8in	27k	31k	33k	35k	37k	40k
Base ON Total		406k	349k	392k	436k	437k	415k

- CZ4 ramp continues. Aizu discrete demand higher than planned, adding in capacity
- Gresham at maximum loading. Will run for 6wks above modeled capacity, monitor WIP, capacity being added.
- ISMF plagued by power interruptions, focus is on wafer output

Gresham Ramp and Cycle Time

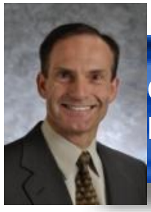


- Currently achieving record activity
  - Cycle time is much faster than when prior record was set in Jul12
- Adding capacity to achieve 14% additional activity by Dec13

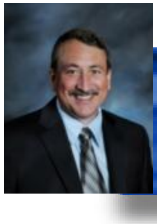
Corporate Leadership Team

CEO Direct Reports

Manufacturing Operations
Mark Goranson



Chief Technical Officer
Hans Stork



Operating Systems & Technology
Bill Schromm

Sales & Marketing
Bob Mahoney

SANYO Semiconductor
Mamoon Rashid

President and Chief Executive Officer
Keith Jackson

General Counsel
Sonny Cave

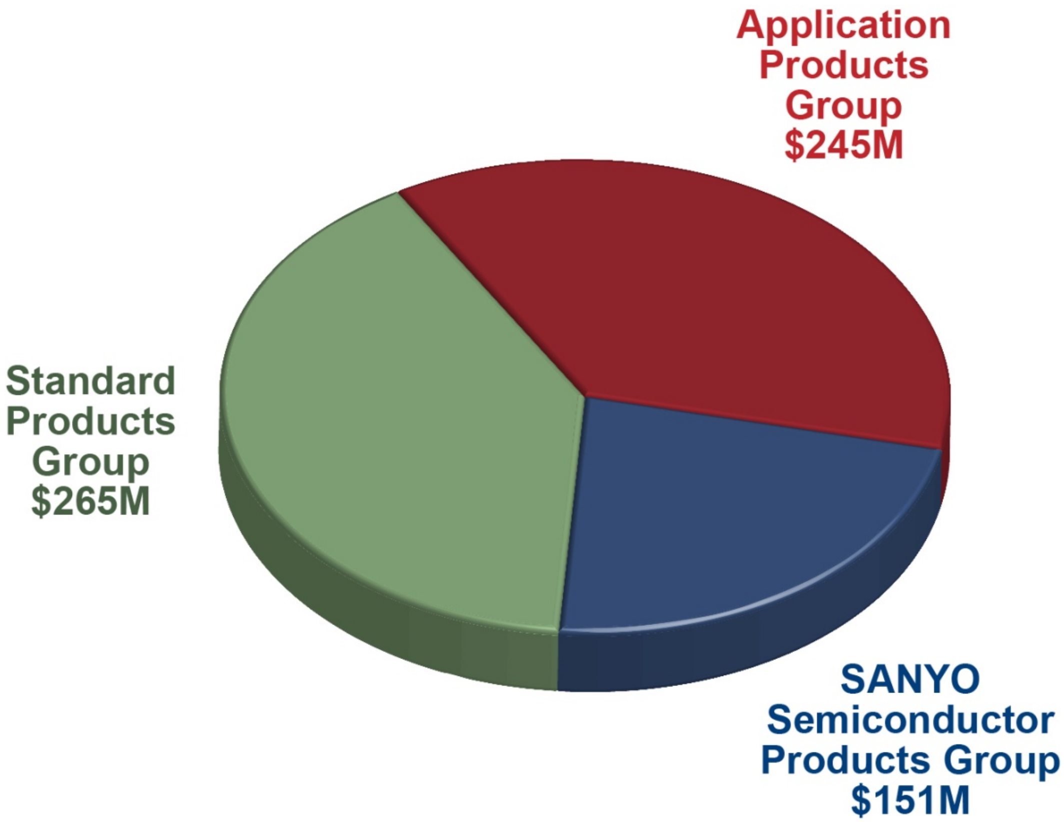
Chief Financial Officer
Bernard Gutmann

Human Resources
Tobin Cookman

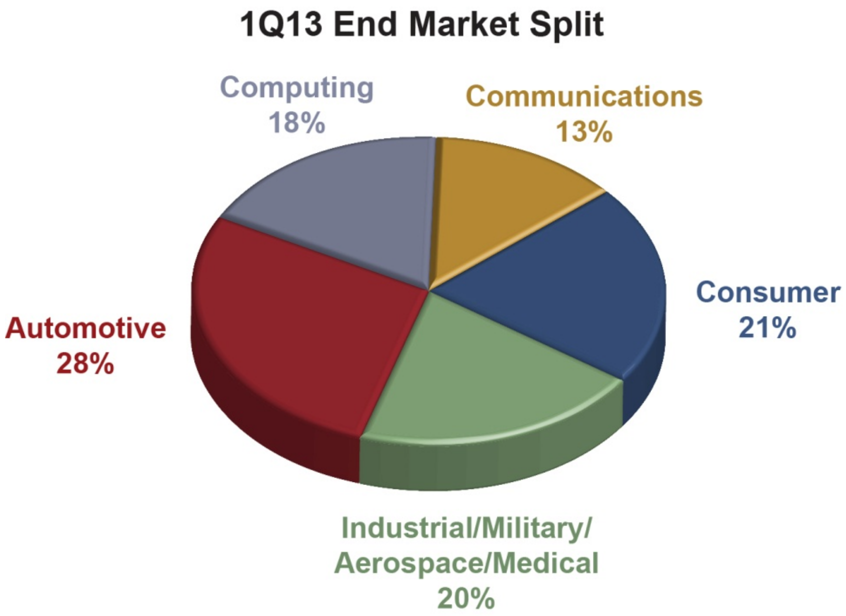
Application Products Group
Bob Klosterboer

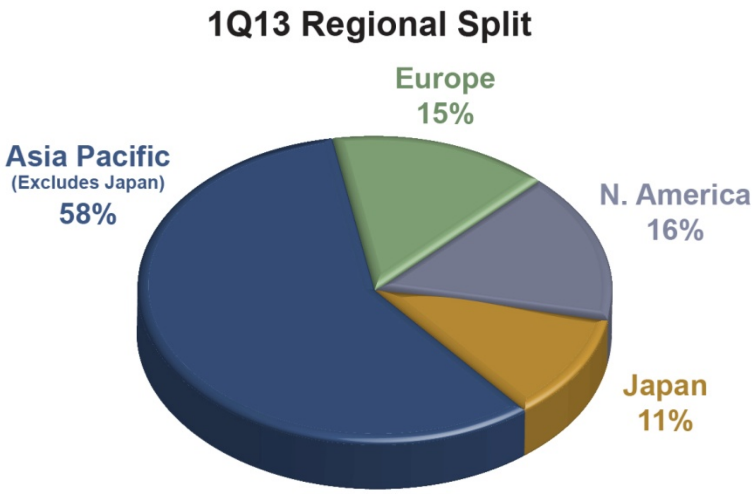
Standard Products Group
Bill Hall

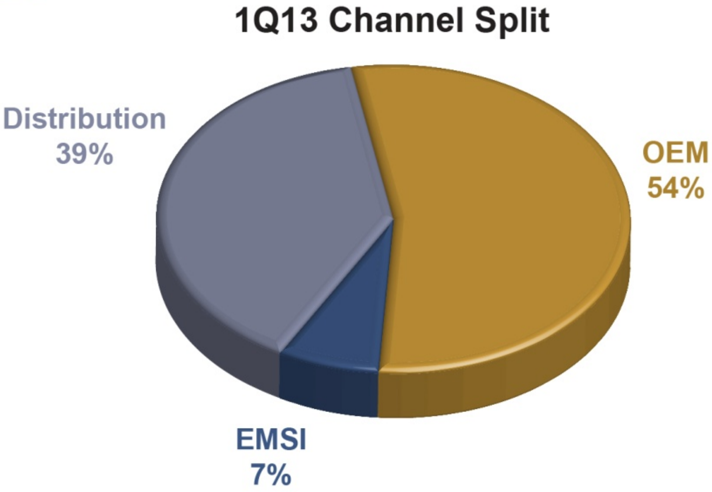
1Q13 Revenues: $661 Million



Diverse Segment and Regional Profile

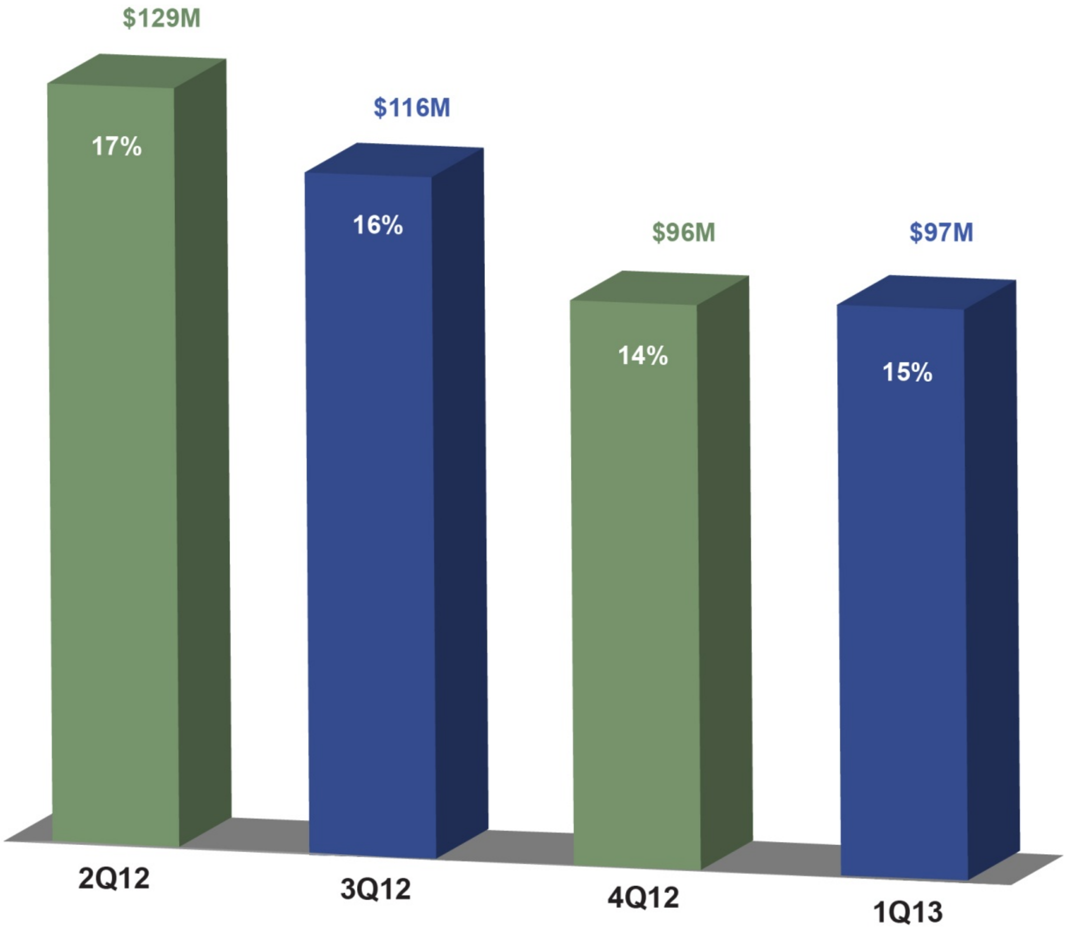






Adjusted EBITDA Position

(Includes Stock-Based Compensation Expense)

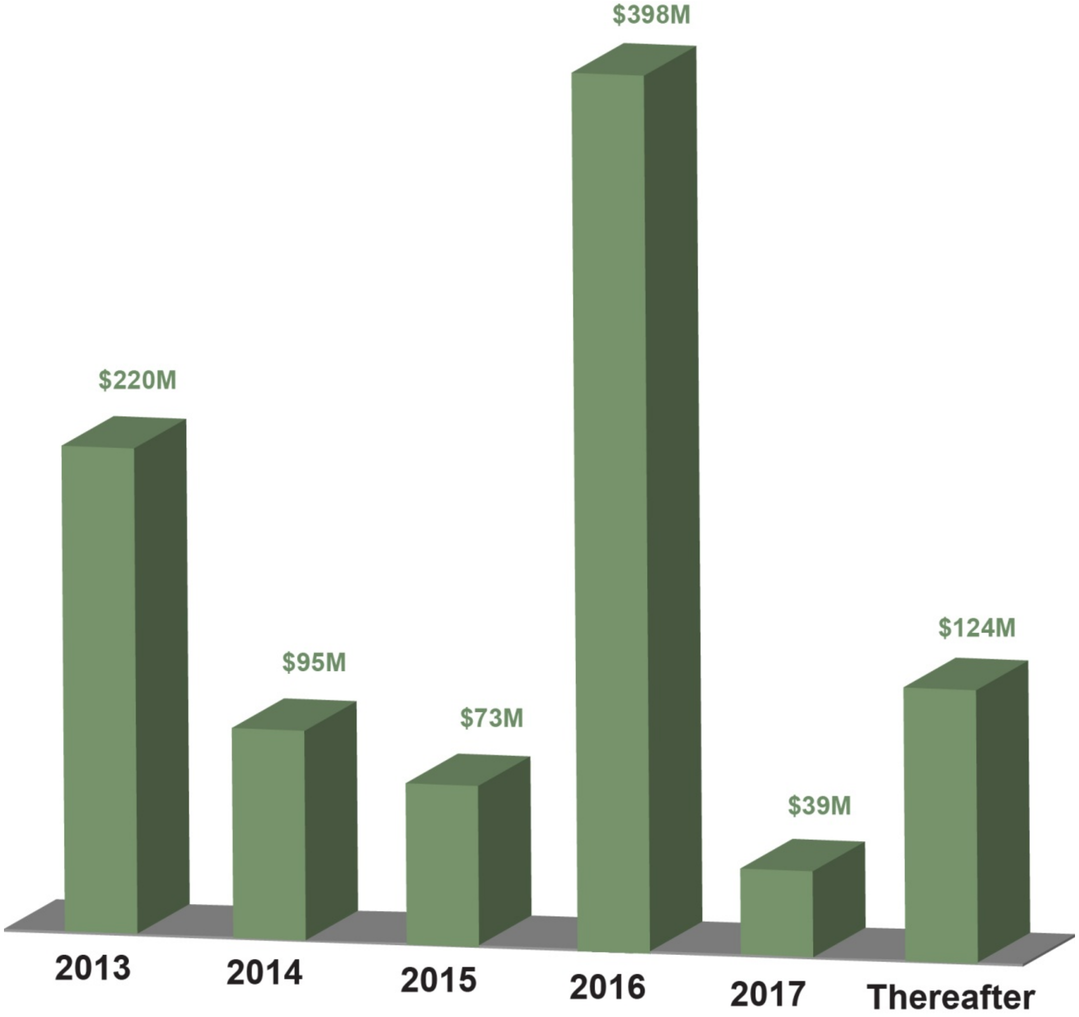


TTM EBITDA

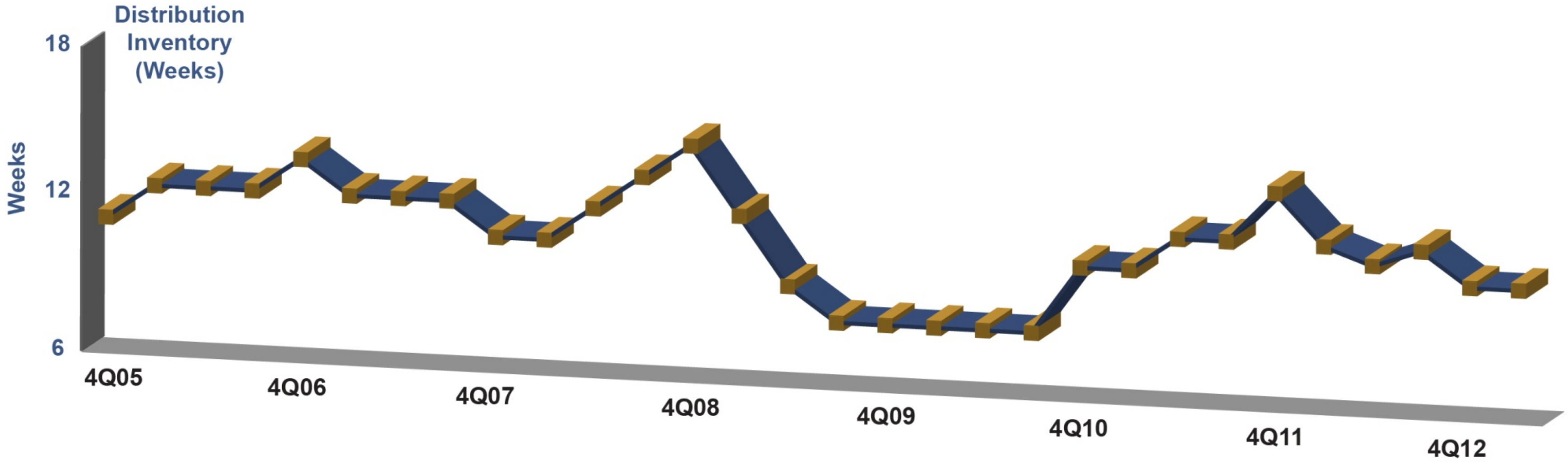
$438M

Current GAAP Debt Amortization Schedule

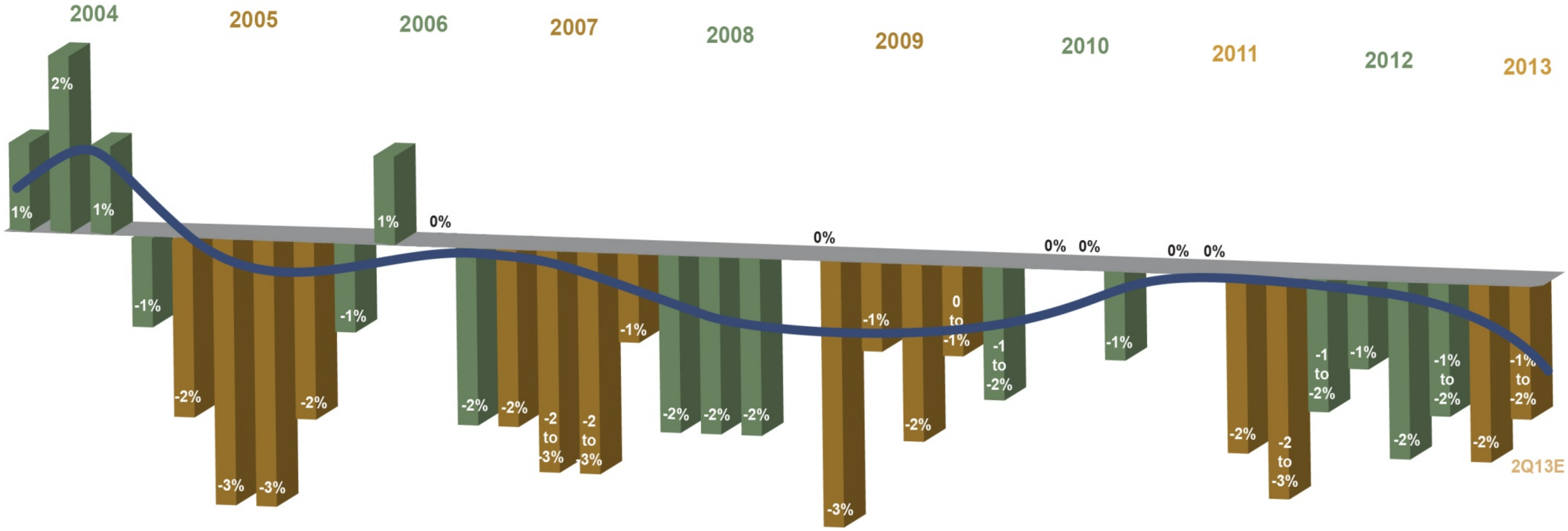
(Convertible Notes Net of Discount (FSP APB 14-1))



1Q13 Inventory Levels

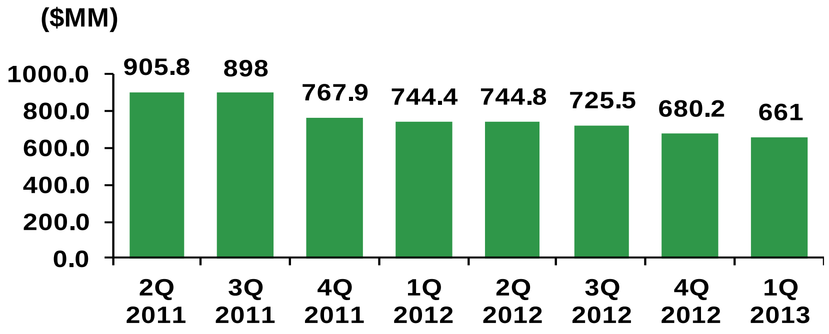


Historical ASP Trends



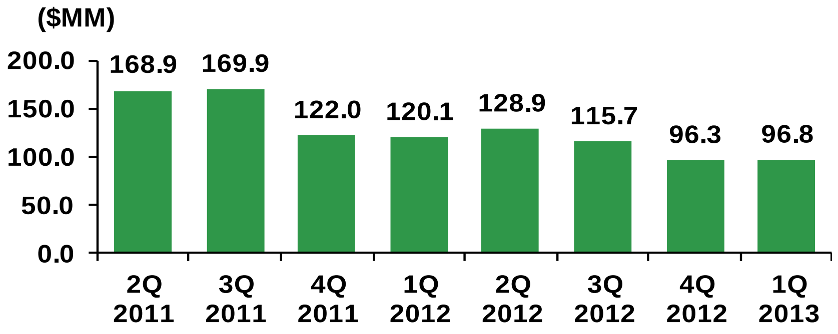
Financial Overview

Revenue



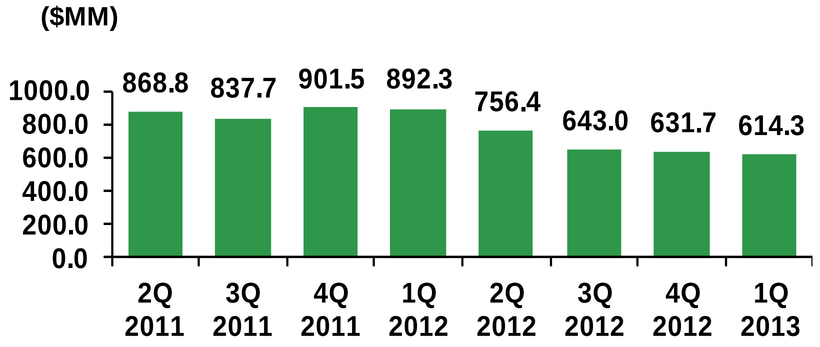
Y-o-Y Growth (%): 55.3	49.5	32.6	-14.5	-17.8	-19.2	-11.4	-11.2

Adjusted EBITDA [1]

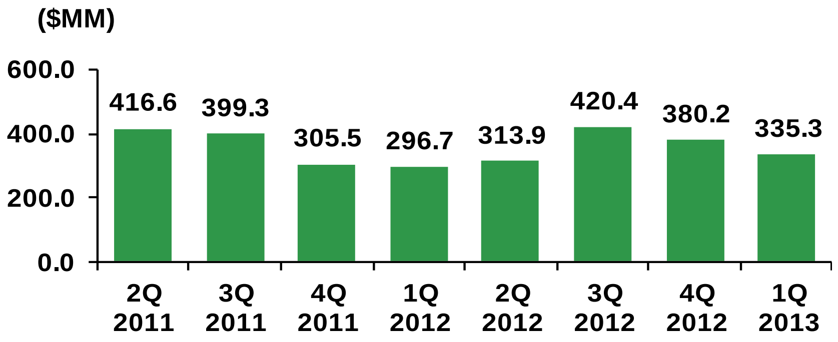


EBITDA Margin (%): 18.7	18.9	15.9	16.1	17.3	15.9	14.2	14.6

Cash, Equivalents & ST Investments Balance



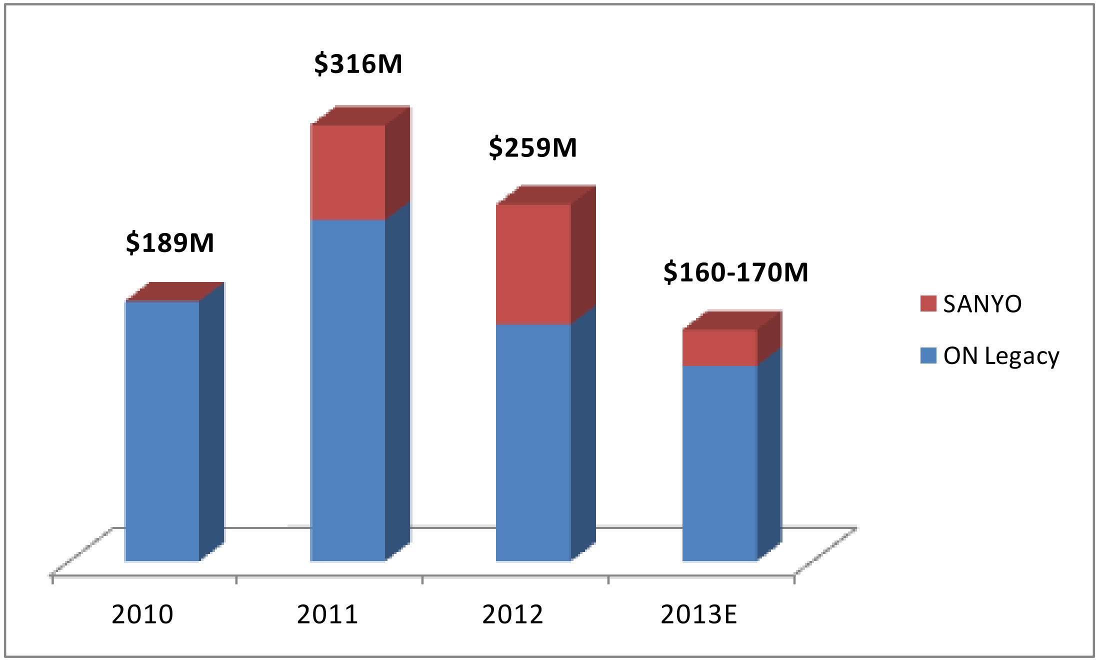
Net Debt Balance [2]



(1) See Appendix for GAAP Net Income to Adjusted EBITDA reconciliation. Adjusted EBITDA includes the impact of stock-based compensation.

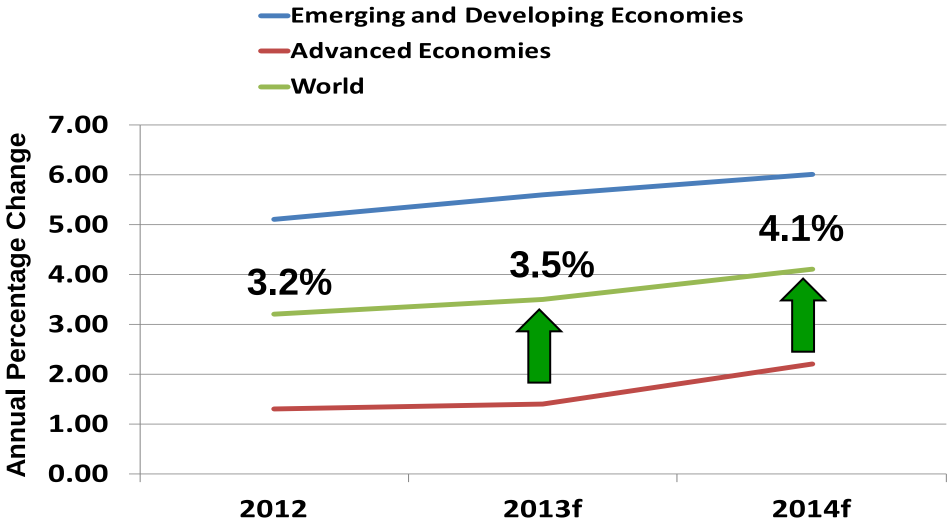
(2) See Appendix for Reconciliation of Non-GAAP Net Debt.

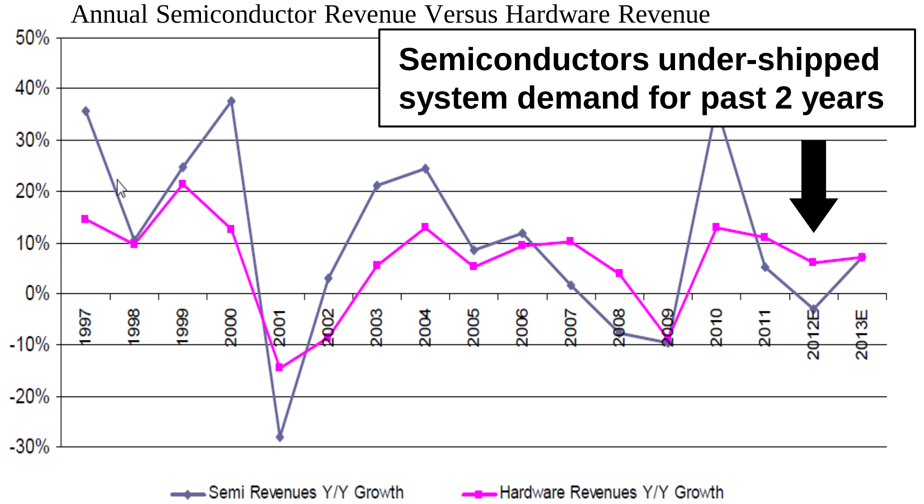
Capital Expenditures



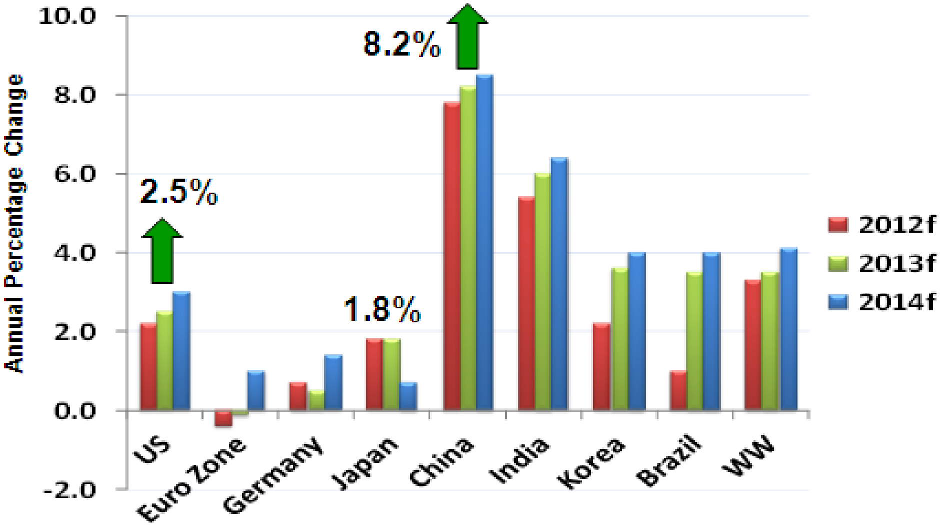
2013 capital spend will be down due to better utilization of 2011 and 2012 capital investments

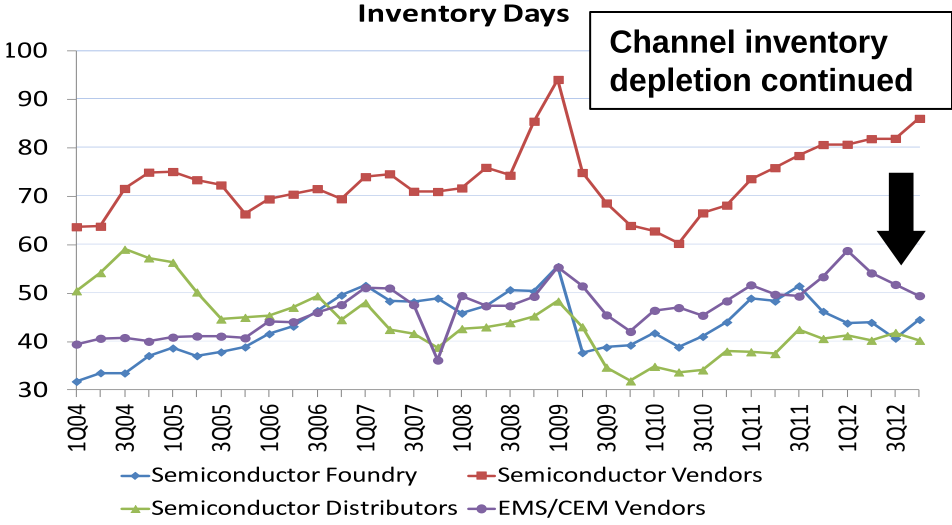
Macroeconomic and Industry Outlook





Semiconductors under-shipped system demand for past 2 years



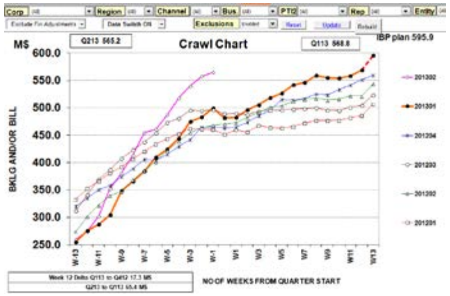


Channel inventory depletion continued

Expected 2013 growth catalysts: Global GDP improvement, distributor / OEM inventory restocking, automotive, smartphones / tablets and China / US housing recoveries

Sources: IMF WEO Jan'13, Caris & Company Nov'12, Gartner Jan'13

Crawl chart


Corp
Region
Channel
Bus
PTI2
Rep
Entity
Exclusions
Q213 565.2
Crawl Chart
Q113 568.8
IBP plan 595.9
M$
600.0
550.0
500.0
450.0
400.0
350.0
300.0
250.0
BKLG AND/OR BILL
W-13
W-11
W-9
W-7
W-5
W-3
W-1
W1
W3
W5
W7
W9
W11
W13
201302
201301
201204
201203
201202
201201
NO OF WEEKS FROM QUARTER START

Corporate Strategy

Focus to Outperform the Market

- **Aggressively investing to grow in Automotive applications**
  - Products and technology, manufacturing capacity, sales, FAEs, SECs
- **Expanding portfolio of high power products, packages and manufacturing processes**
  - Launched new leadership products in high voltage IGBTs, rectifiers and MOSFETs
- **Investing to broaden power module product portfolio for SAM and ASP expansion**
  - Supports growth in automotive, consumer white goods and industrial HPPC end-markets
- **Positioning to grow in LED general lighting**
  - SEC expansion and new FAEs to drive key customer penetration; product portfolio expansion
- **Aggressively grow at leading wireless customers**
  - Winning in camera modules, tunable antennae components, analog power, battery protection, ESD protection, EMI filters and switches
- **Get SANYO Semiconductor growing and profitable from lower revenue base**
  - Reduce break-even point to $190M per quarter
  - Accelerate SANYO Semiconductor cross-sell outside of Japan and post-flood market share recovery

Global Macroeconomic Environment

Expect the global economy to have moderate growth of ~3.3% in 2013

- The IMF forecasts global GDP growth of 3.3%, up from 3.2% in 2012
- China's economy forecast to grow 8.0% versus 7.8% in 2012
- Mild Euro zone recession expected to continue into 2013 with GDP outlook slightly better than 2012
- US economy anticipated to be flat at 2% owing to government spending cuts and tax increases
- Japan returned to growth in 4Q12 and project moderate recovery in 2013 driven by depreciation of yen, aggressive stimulus package and monetary easing

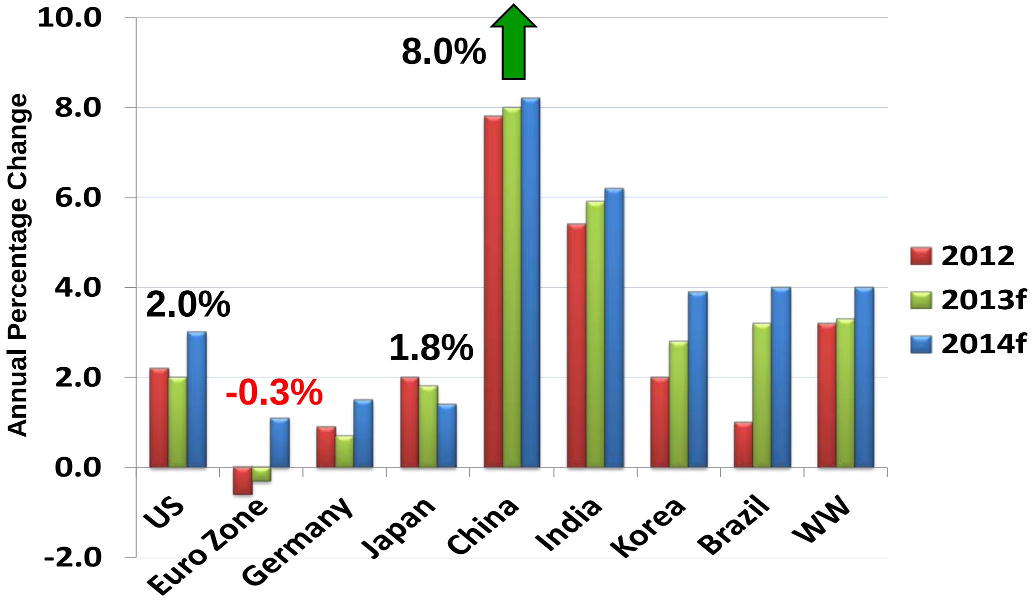
Global electronics and semiconductor industry outlook

- Japanese consumer OEMs are suffering a precipitous decline in their traditional business and attempting to transition into auto, industrial, medical and renewable energy to reinvigorate growth
- Commercial building construction showing signs of improvement which may increase future sales in the industrial market
- Signs of moderate growth in Telecom carrier capex spending to deploy LTE wireless infrastructure
- PC and HDD unit shipments declined in 2012, expect shipments down mid single digits in 2013
- Vehicle sales expected to increase by ~2.5% in 2013 with semiconductors up ~6%
- US and China housing markets gaining momentum which should lift sales of white goods and other household electronics
- Growth drivers for 2013 include smartphones, tablets, automotive, mobile payment ecosystem (NFC) and channel inventory restocking

Expect moderate global GDP growth during 2013 led by China, others stabilizing

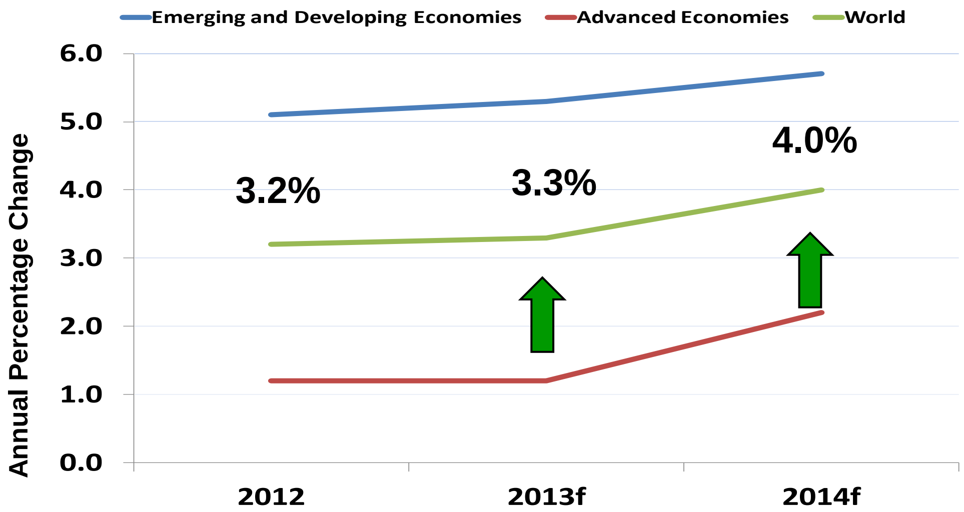
Source: The Economist Apr'13, IMF WEO Apr'13, Corporate Marketing

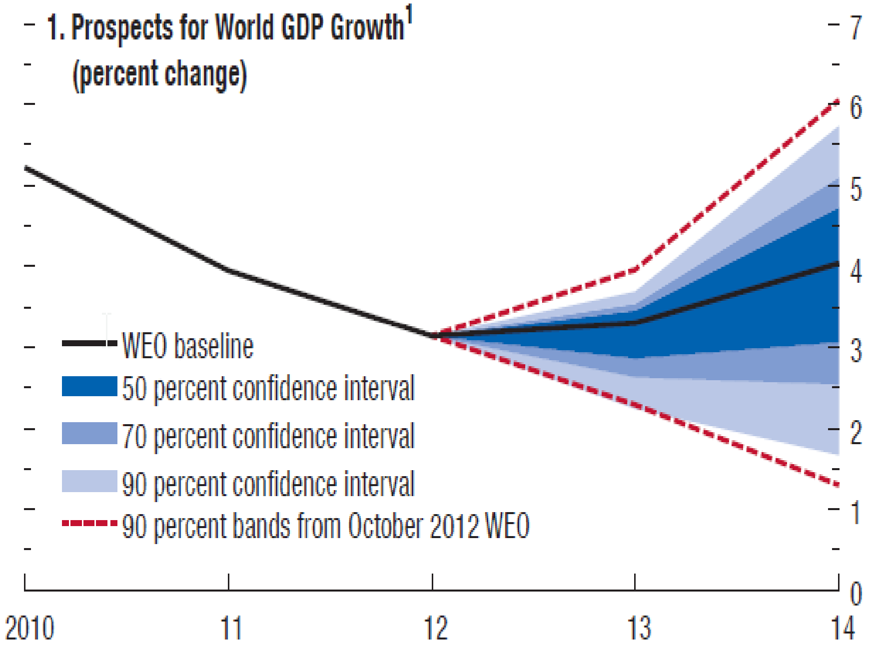
Global Real GDP Outlook



GDP Update			Qtr Trend (bps)
➢ China:	Q1 = 7.7%	2013f = 8.0%	↓ -20
➢ Germany:	Q4 = -2.4%	2013f = 0.7%	↓ -330
➢ US:	Q1 = 2.5%	2013f = 2.0%	↑ +210
➢ Japan:	Q4 = 0.2%	2013f = 1.8%	↑ +390

Note: US, Germany and Japan quarterly GDPs are annualized rates; China quarterly GDP is year-over-year growth rate





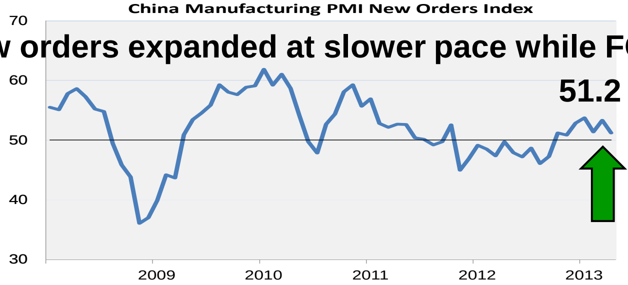
Expect moderate global GDP growth during 2013 led by China, others stabilizing

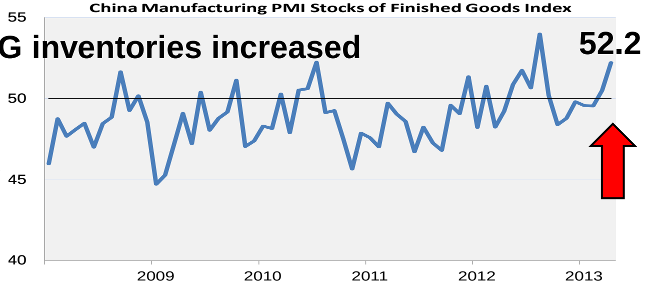
Sources: IMF WEO Apr'13, The Economist Apr'13, National Bureau of Statistics China Apr'13, Japan Center for Economic Research, Japan Cabinet Office, The Federal Statistical Office (Destatis), Bureau of Economic Analysis (U.S Department of Commerce)

Global Manufacturing Activity (Apr'13 PMI)

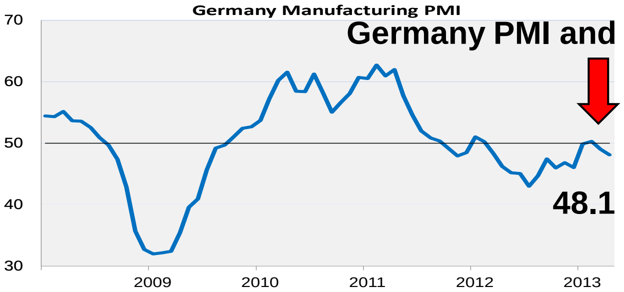
China PMI and new orders expanded at slower pace while FG inventories increased

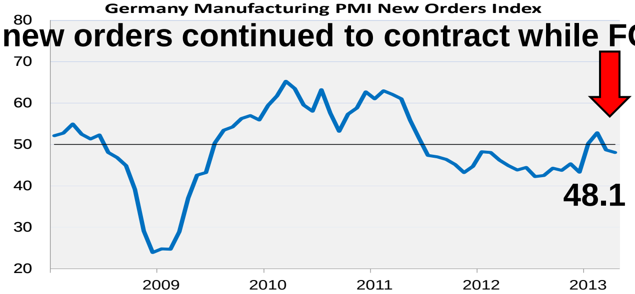

China Manufacturing PMI

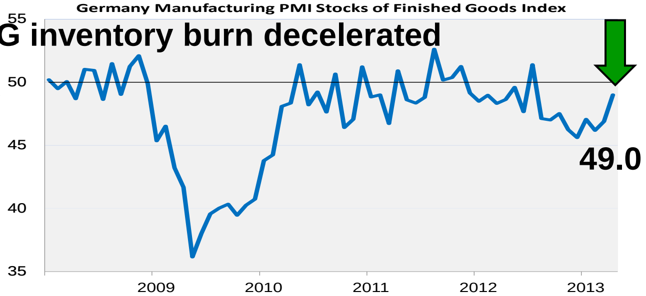

China Manufacturing PMI New Orders Index


China Manufacturing PMI Stocks of Finished Goods Index

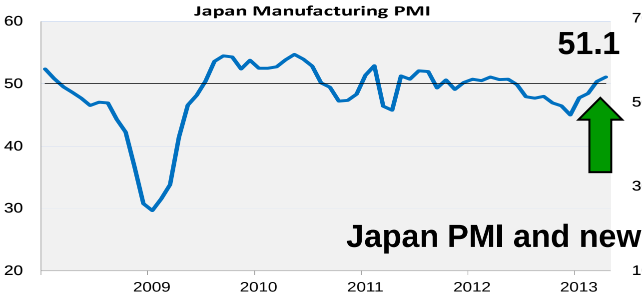
Germany PMI and new orders continued to contract while FG inventory burn decelerated

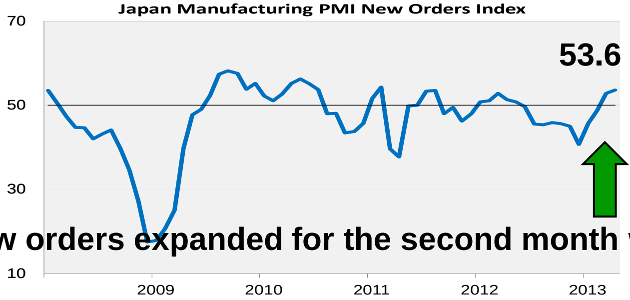

Germany Manufacturing PMI

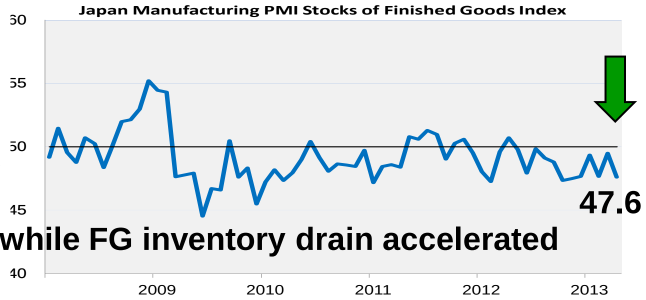

Germany Manufacturing PMI New Orders Index


Germany Manufacturing PMI Stocks of Finished Goods Index

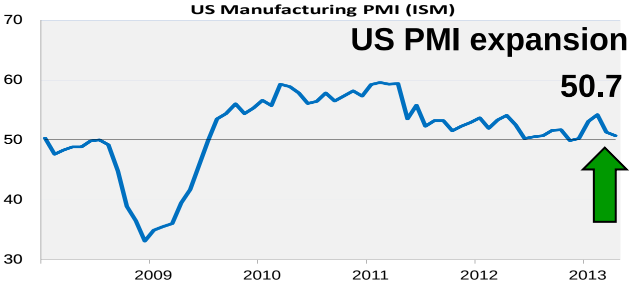
Japan PMI and new orders expanded for the second month while FG inventory drain accelerated


Japan Manufacturing PMI

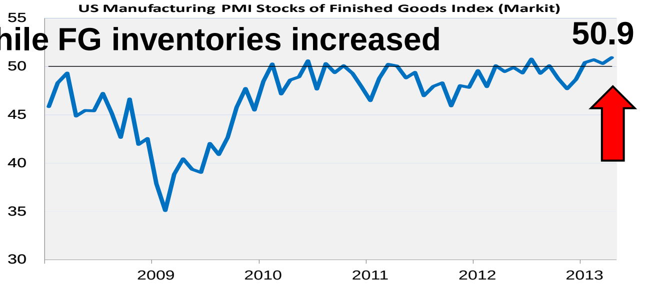

Japan Manufacturing PMI New Orders Index


Japan Manufacturing PMI Stocks of Finished Goods Index

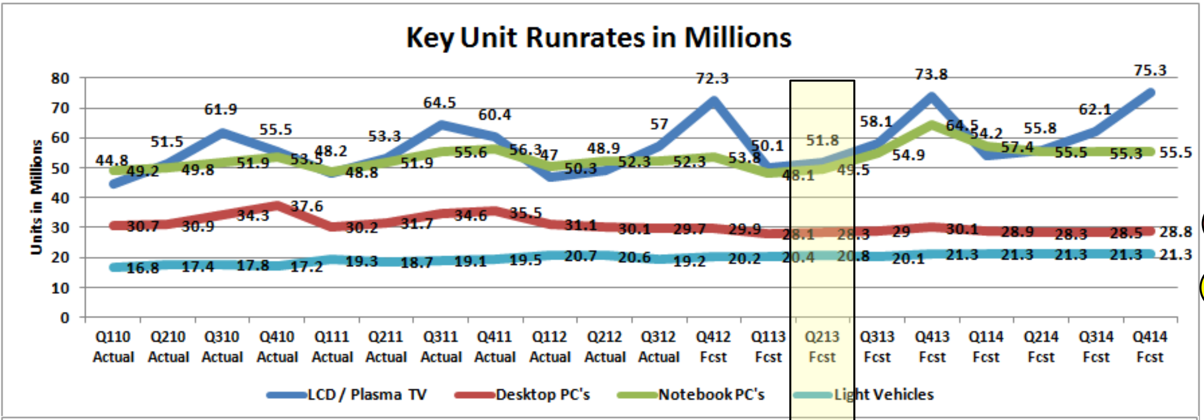
US PMI expansion decelerated and new orders expanded while FG inventories increased


US Manufacturing PMI (ISM)

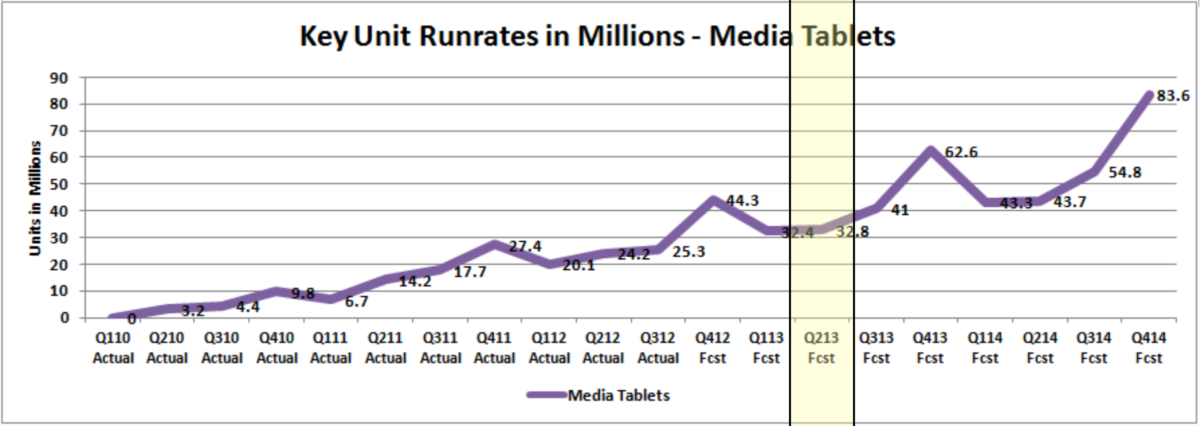

US Manufacturing PMI New Orders Index (ISM)


US Manufacturing PMI Stocks of Finished Goods Index (Markit)

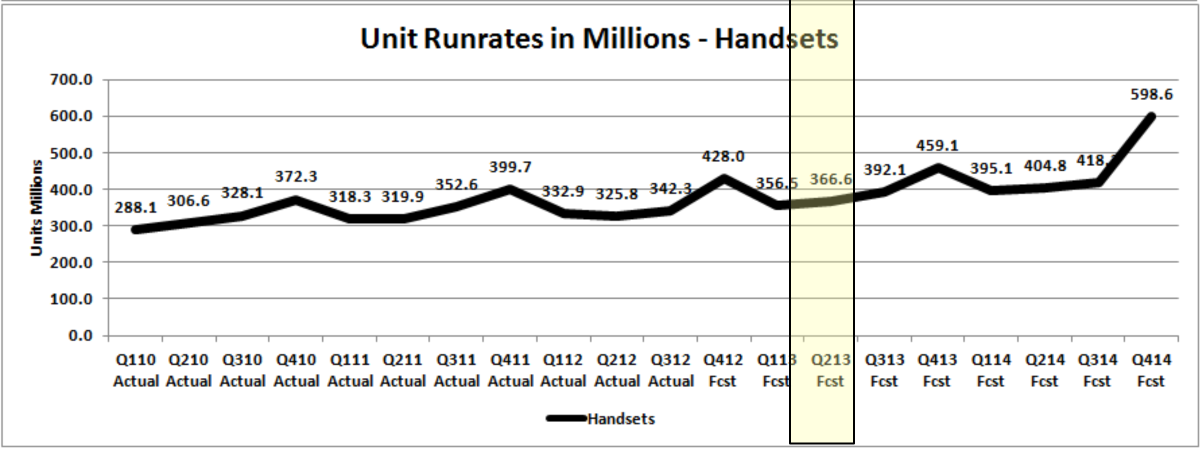
Source: ISM, Markit May'13 (>50 = expansion, <50 = contraction)



Key Unit Runrates in Millions



Key Unit Runrates in Millions - Media Tablets



Unit Runrates in Millions - Handsets

Application and Unit Forecast

- R **Consumer** – Expect continued decline in consumer electronics shipments.
  Y Improving US / China housing markets drive moderate white goods growth.

- R **Computing** – 1Q'13 PC shipments fell ~13% yoy. Expect ~4% decline in PC and HDD shipments in 2013. More touch display PCs / convertibles at <$700 and Windows 8 improvements should drive increased sales.

- G **Automotive** – Light vehicle production forecast to grow ~2.5% to 83M units in 2013. Semi growth forecast at ~6%.

- G **Tablets** – Apple dominates with Samsung, Amazon and China OEMs challenging. Expect ~52% growth to 165Mu in 2013.

- G **Smartphones** – Growth led by low-cost smartphones. China is the largest market. Apple, Samsung and China OEMs dominate. Chipset reference designs drive device proliferation. Expect 25% growth to 870Mu in 2013.

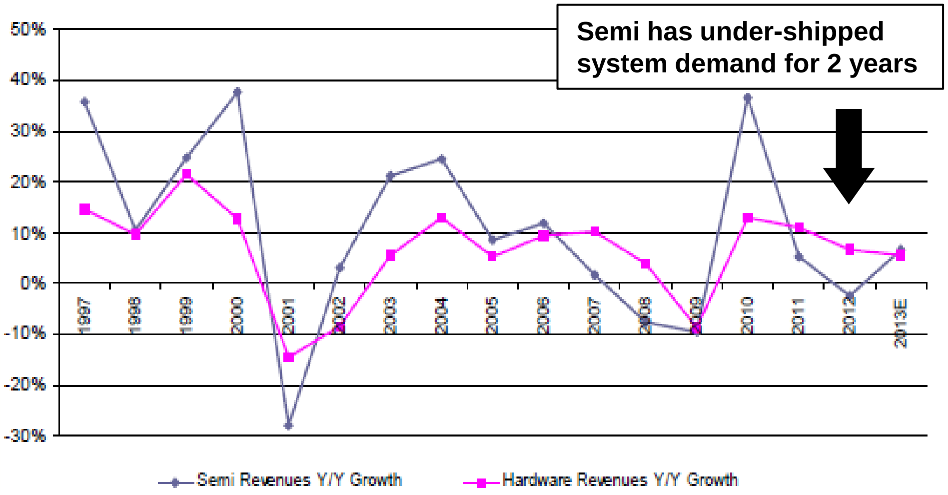
- Y **Industrial / Medical / Mil-Aero** – Expect flat market supported by low inventories. High growth in LED general lighting.

Sources: IHS-iSuppli AMFT Apr'13, Gartner Apr'13, Corporate Marketing

G **Indicates end-market health**

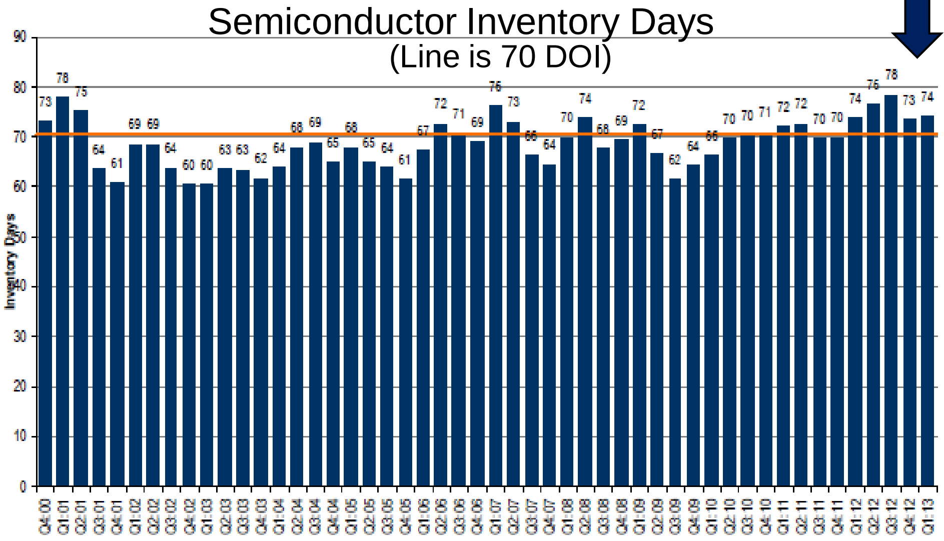
Semiconductor Market Indicators

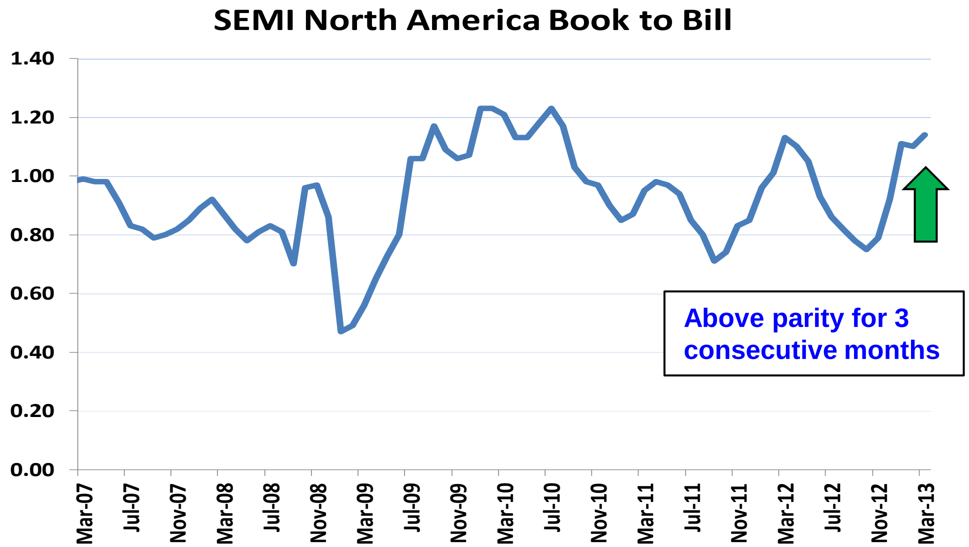
Annual Semiconductor Revenue Versus Hardware Revenue



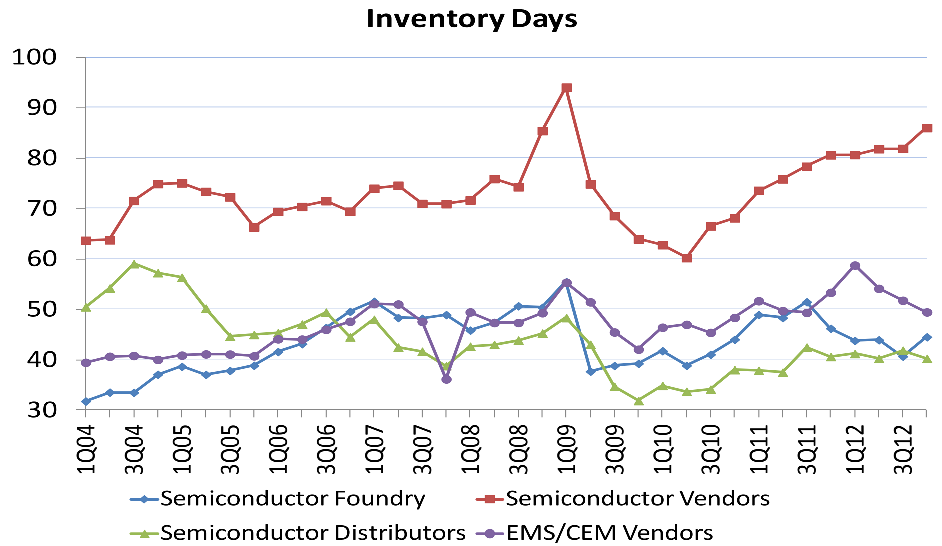
Semi has under-shipped system demand for 2 years

74 DOI





Above parity for 3 consecutive months

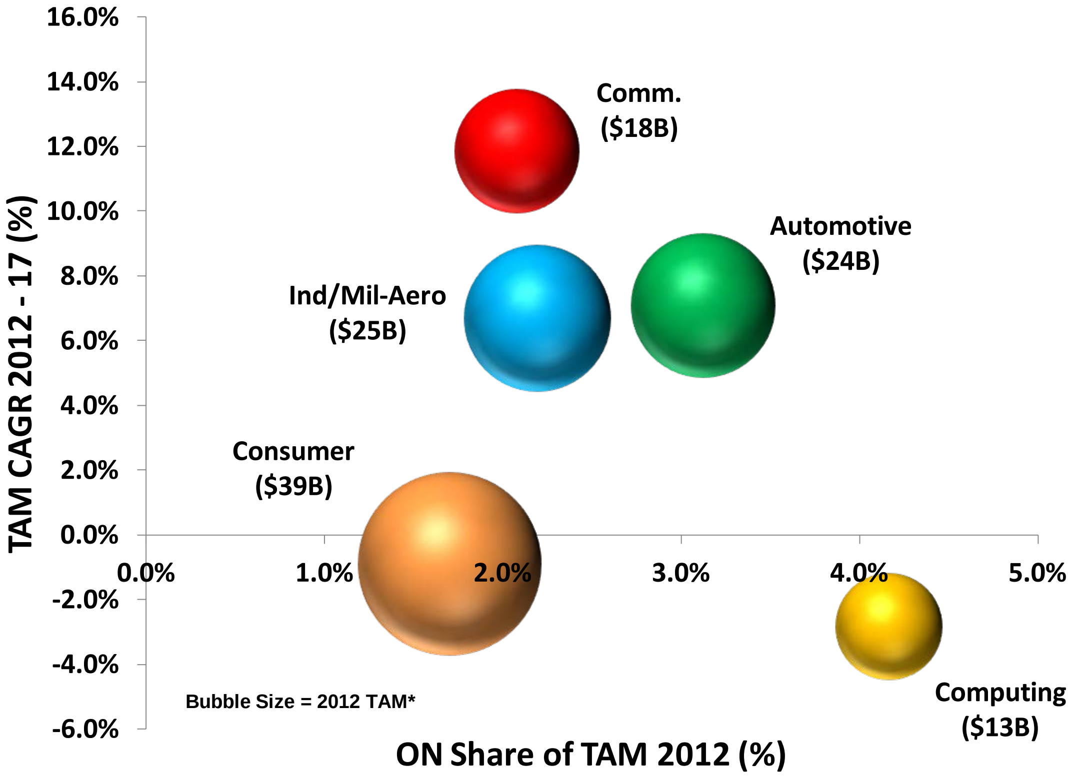


Book-to-Bill increased to 1.14. Lean inventories expected to drive short cycle orders.

Source: SEMI Mar’13 (North America), Caris & Company Apr’13, Gartner Nov’12 / Jan‘13

Semiconductor Outlook by Market Segment

Global Semiconductors



- Smartphones and tablets drive communications segment growth. Expect a 12X increase in mobile data by 2015 to drive telecom and networking investment.
- Increasing electronics content for fuel economy, safety and convenience features expected to drive high single-digit semiconductor growth.
- Global energy legislation drives growth in high-efficiency industrial motors, power supplies and LED general lighting.
- Computing sees modest decline on flattening units and ASP erosion.
- Adoption of high-efficiency variable speed motors and US / China housing recoveries drive growth in consumer white goods.

Source: iSuppli AMFT Apr'13, Ericsson Dec'12 Briefing, ON Semi 2012 financial results, Corporate Marketing
*TAM excludes MPU, memory and baseband products; Industrial includes Mil-Aero and Medical; Tablets are in Communications

Key Takeaways

- The IMF forecasts moderate global GDP growth of 3.3% in 2013, up from 3.2% in 2012
  - China and emerging economies expected to support moderate global GDP growth
  - Japan returned to growth in 4Q12 with 2013 GDP expected to be about flat to last year
  - Mild Euro Zone recession continues in 2013 but expect 2H to show modest improvement over 1H

- Global governments and central banks providing economic stimulus to spur growth
  - Significant China and Japan growth stimulus and accommodative monetary policies
  - ECB committed to preserving the Euro through monetary support
  - US Federal Reserve maintaining aggressive monetary policy

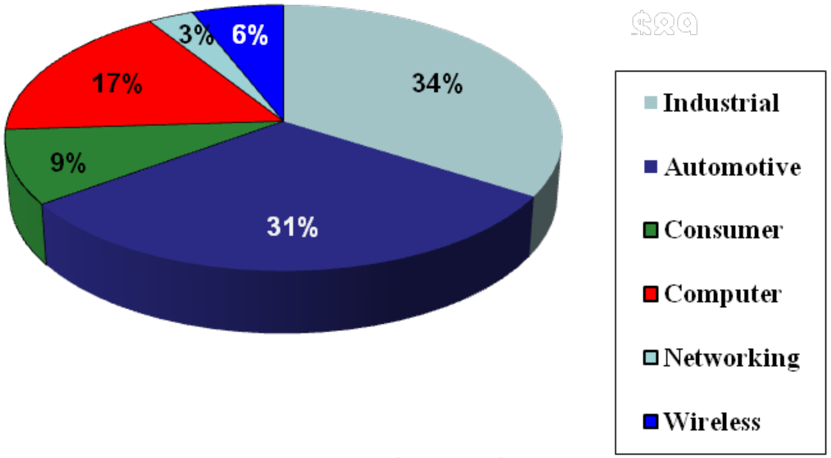
- Expect global semiconductor sales to see modest recovery in 2013
  - Moderate GDP growth and China / US housing recoveries
  - Channel inventory restocking
  - Smartphones / tablets, automotive and consumer white goods are leading growth catalysts

Expect 1Q13 to be the bottom of the current industry cycle with gradual growth resuming from 2Q13

Application Products Group (APG)

2012 Financial Review

- ***APG 2012 Revenue $ 1019M***
- ***Gross Margin 45.1%***
- ***EBITDA 21.7%***



APG 2012 Revenue by Market

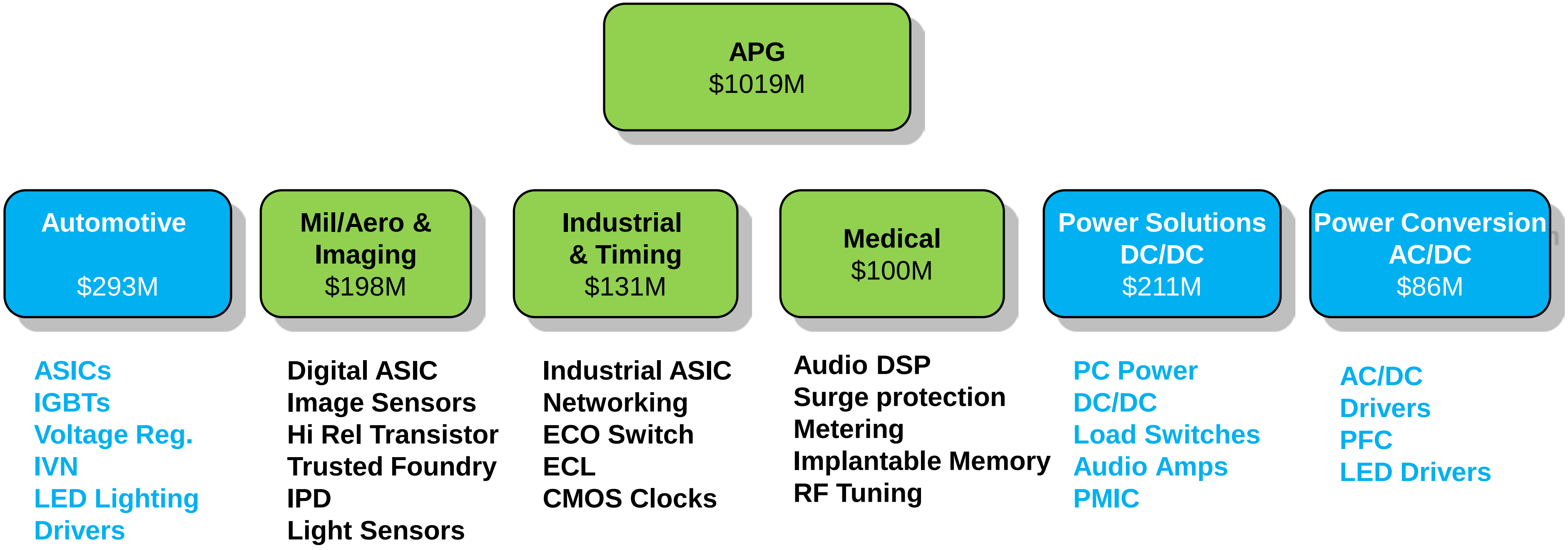
Key 2012 Milestones

- ***Completed organizational alignment***
- ***Licensed RF tuning IP from RIM (Blackberry)***
- ***Success in Qualcomm reference designs***
- ***Released 286 new products into production***
- ***Record new ASIC wins at strategic customers***
  - ***Continental Automotive, Hella, Valeo, Seagate, Huawei, Boston Scientific, FLIR, Delta***
- ***Secured “trusted foundry” status***

Value Proposition

“We help our customers develop world class products by providing high quality, innovative, solutions that solve demanding power and signal management challenges.”

APG Structure



APG
$1019M

Automotive
$293M

- ASICs
- IGBTs
- Voltage Reg.
- IVN
- LED Lighting
- Drivers

Mil/Aero & Imaging
$198M

- Digital ASIC
- Image Sensors
- Hi Rel Transistor
- Trusted Foundry
- IPD
- Light Sensors

Industrial & Timing
$131M

- Industrial ASIC
- Networking
- ECO Switch
- ECL
- CMOS Clocks

Medical
$100M

- Audio DSP
- Surge protection
- Metering
- Implantable Memory
- RF Tuning

Power Solutions DC/DC
$211M

- PC Power
- DC/DC
- Load Switches
- Audio Amps
- PMIC

Power Conversion AC/DC
$86M

- AC/DC
- Drivers
- PFC
- LED Drivers

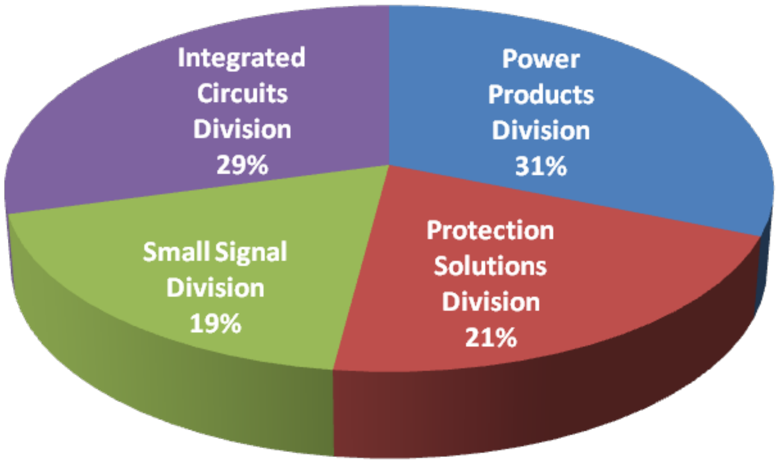
- Consolidated all Application defined products
  - Technology roadmap simplification
  - Product overlap eliminated
  - IP reuse across multiple applications and product lines
- Margins above corporate average
- Focus markets Are Mobile, Automotive, Medical, Telecom, and Industrial

🟦 Divisions and products added to APG since the 2010 Analyst day

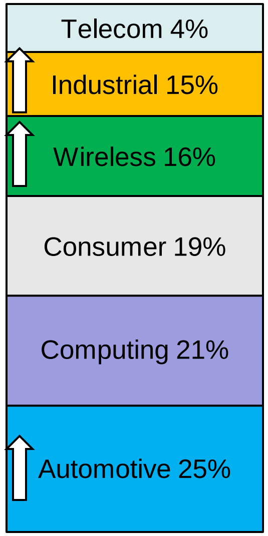
Standard Products Group (SPG)

% Rev by Division 2011

$1.2B Total

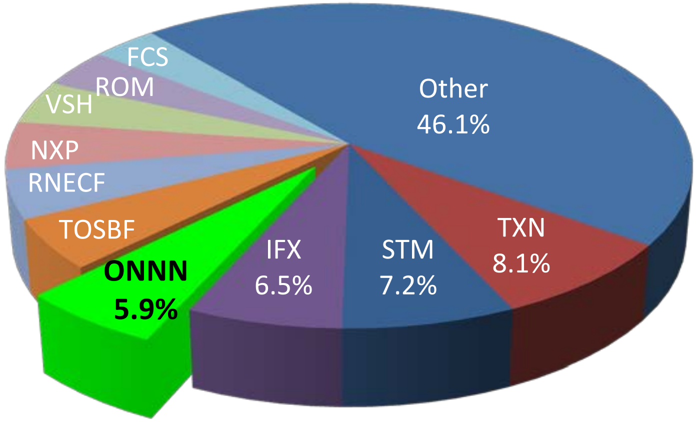


% Rev by Mkt Segment



% SPG Market Share 2011

$20.3B TAM*



* 2012 market data not available yet. Sources: iSupply, IMS Research, WSTS, Databeans, Web-Feet Research, Prismark, Paumanok, Annual Reports and 10-Ks

Positioned to Win

- 4 Divisions, 70 families, 20K part numbers, ship 36BU (2013).
- Asia is 68% of total business. China ~ 50% total SPG revenue.
- Top 10 customers (26% of revenue): Bosch, CAS, Delphi, Apple, Huawei (wireless & energy), Motorola, Samsung, Delta, Kinpo, Seagate.
- Market Rank: #1 Si Protection, #1 Translators, #1 SS FETs, #1 Vregs, #2 SOSM Packaging, #2 CSP, #2 GP Op Amps, #3 Discretes, #3 LVFET.

SPG Structure

Allowing for Faster Than Market Growth

	2009	2012
TAM addressed:	$9B	$17.7B*
SPG Revenue:	$500M	$1.1B

SPG
$1105M

Power Discrete
$344M

MOSFETs
IGBTs
Rectifiers
Triacs
Relays

Protection Solutions
$231M

Zeners
TVS
TSPDs
ESD (LC)
EMI Filters (CMF)
eFuse

Small Signal
$207M

Small Signal Diodes & Trans
Schottky Diodes
Pwr Bipolar
LowVce (Sat) Transistors
JFETs
CCR
0201 µPkg

IC Division
$323M

Logic
Interface
Translators
LDO's, V Regs
Linear: OA, Comparators
E2PROMs

2010 Focus
Cell Phones
Digital Consumer
White Goods

- All standard products now in SPG. Can run to standard products model.
- Major platforms developed/introduced:
  - 600V/1200V FS1 IGBT's, SJ MOSFET, Gen6 LV/MV MOSFETs, world's smallest MOSFET, industry's 1st Si Common Mode Filter (CMF), lowest capacitance ESD solutions for HS interfaces, DFN/DSN 0201 µpkg, automotive SMT.

2013 Focus
Smartphones & Tablets
Automotive
HPPC

🟦 Blue represents divisions and products added to SPG since the 2010 Analyst day

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* 2012 market data not available. TAM constructed from annual reports and segment data.

SPG Strategy

Focus investment in markets that are large, growing, utilize SPG technical competencies, support high margins, and where ON Semiconductor has a significant presence.

Smart Phones & Tablets

- $20B TAM @ 12% CAGR
- ON Semi focus segment, 3 SECs, Qualcomm ref., Samsung, Apple, Microsoft, Huawei, ZTE.
- Leveraged competencies: µpkg, lowest cap best surge rating ESD devices, best noise rejection/highest signal integrity EMI filters (1st to market), world's smallest MOSFET, quick turn specialized translators.
- Key investments: CSP, LC-ESD, Common Mode Filters, µMOSFETs.

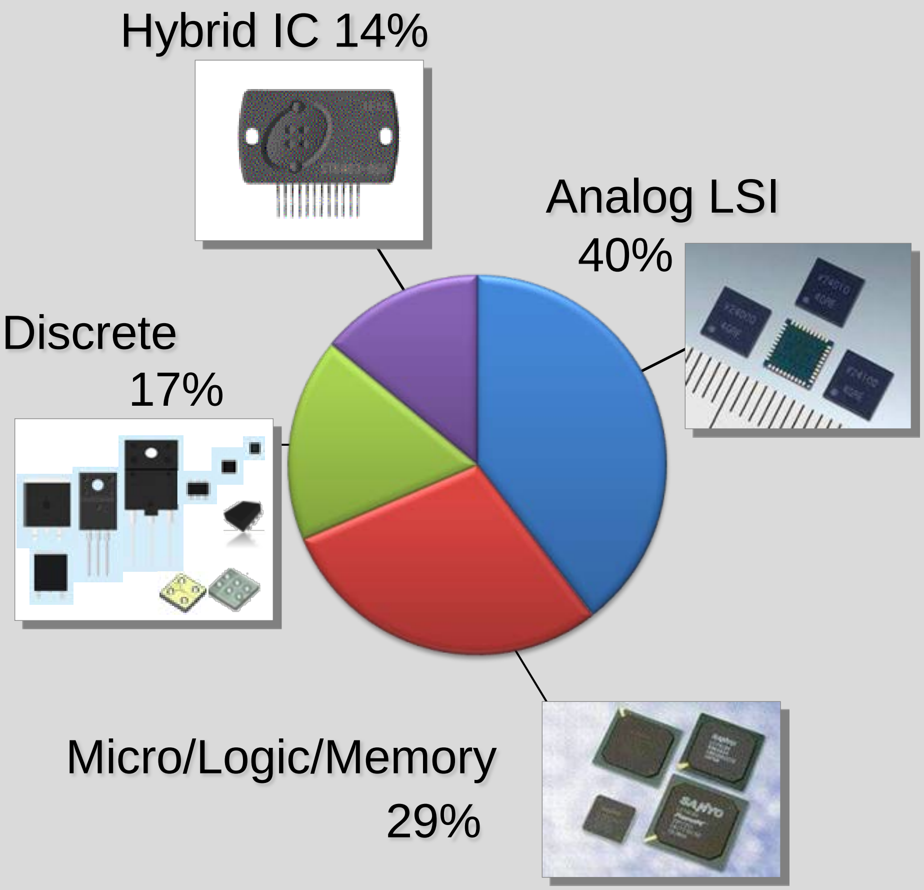
Automotive

- $28B TAM @ 7% CAGR
- ON Semi's largest segment (25% of total revenue), 3 SECs, CAS, BOSCH, Delphi, Valeo.
- Leveraged competencies: SMT automotive packages, back side wafer processing & thinning for power technologies, CCR low cost LED driver, MG Logic (12V), >3000 AEC qual'd devices, automotive infrastructure, module technologies (IPMs).
- Key investments: specialized MV MOSFETs, FS IGBTs, GAN, PIMs, Relays, protection for infotainment, IVN, & load dump, CCR, more AEC quals.

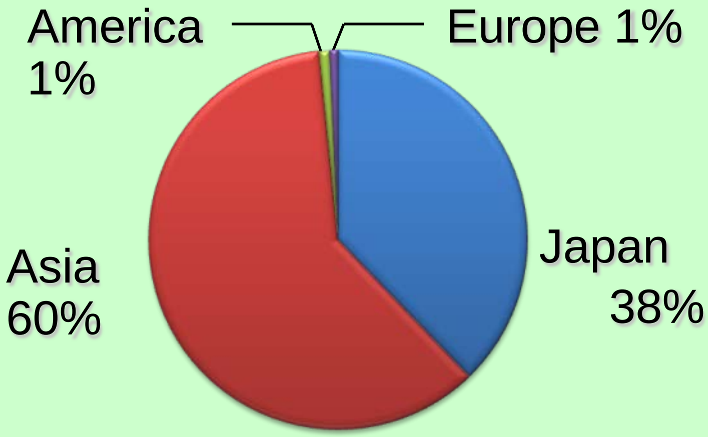
High Performance Power Conversion (HPPC)

- $25B TAM @ 10% CAGR
- Includes UPS, server & telecom PS, industrial motor control, alternative energy.
- Leveraged competencies: backside wafer processing, power dense packages, relationships with leading high performance power technology customers, power module technologies.
- Key investments: HE MOSFETs, SJ MOSFETs, FS IGBTs, GAN, PIMs, Precision OP Amps.

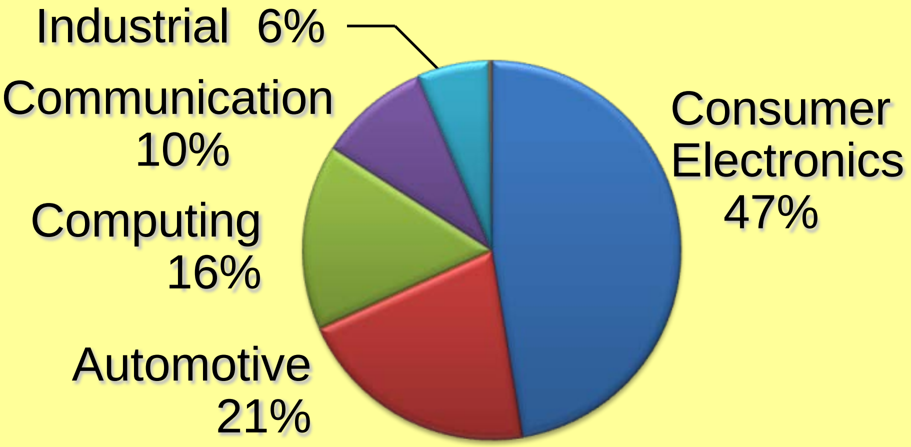
SANYO Semiconductor Products Group



by Products



by Regions



by End Use

SANYO Growth Drivers

Smartphone / Tablet

AF/OIS ICs for Camera Module

- Best in class lens positioning accuracy (1um) for greater than 8M pixel cameras

MOSFET for Li-ion Battery

- Low on-resistance (below 5mΩ)
- Improved battery life

Back Light Driver

- Thin & Small package: AMOLED
- Low power consumption.

White Goods

Inverter Module for White Goods

- High efficiency: 27% lower loss than competitor
- New 2-in-1 IPM allows 40% smaller area than competitor

NPT IGBT

- Low power consumption : 10% lower loss than competitor
- 10% lower saturation high speed switching

Fan Motor Driver

- Low consumption

Automotive

Infotainment (Audio)

- Image processer for small size LCD
- Radio tuner

LCD Drivers for Instrument Panel

- 30% BOM cost reduction with combined (LED + LCD) driver
- Chinese character display

Igniter Module

- Leading high energy igniters for fuel efficient engines

Industrial

Printer Driver

- High efficiency (70% improvement)
- Reduced BOM solution

MOSFET for Storage Battery

- MV-SJ (split gate type super junction)
- Industry-lowest Ron A in 100V products (45mΩmm2).

Power Inverter Module

- Low power loss
- High reliability