The POWER Behind Your Designs

MP3/PMP

- Single Alkaline Powered
- Li+ Powered

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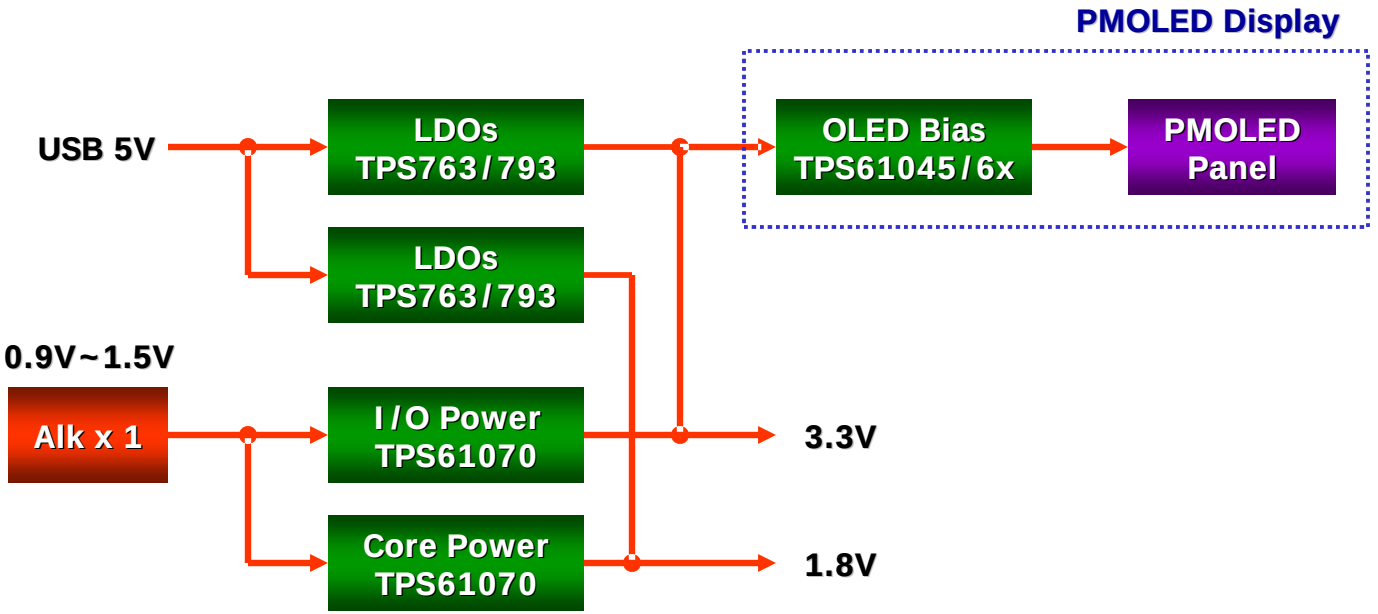
The POWER Behind Your Designs

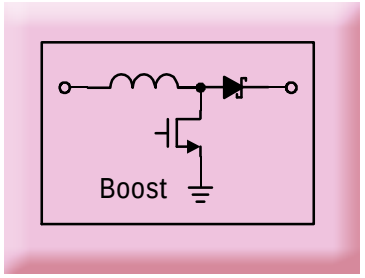
Single Alkaline Powered Device Block Diagram & Solution

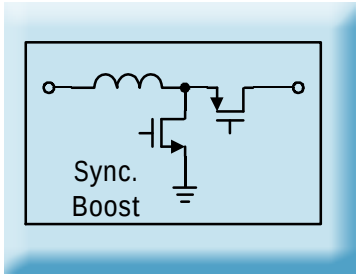
Block Diagram - Single Alkaline/Flash MP3



Efficiency & Battery Run Time

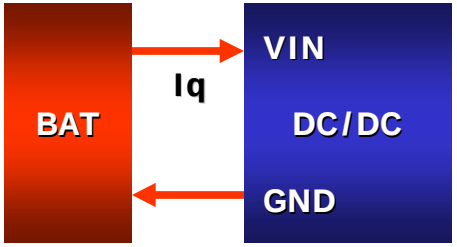
- **Power Loss**
  - Conduction Loss + Switching Loss
- **Reduce Diode Loss**
  - Lower VF, Schottky Diode
  - Fast Recovery
  - Sync. Switch
- **Benefit of Synchronous**
  - Increase efficiency
  - True Shutdown for Boost Converter





- **Example of calculation**
  - Loss of Diode = VF ´ I = 0.4 ´ 0.1 = 40mW
  - Loss of FET = Rds ´ I^2 = 0.03 ´ 0.1^2 = 0.3mW
  - Advantage when (Rds ´ I) < VF@0.4V

- **Quiescent Current**
  - Usually been ignored in regulator selection
  - Depends on different operation condition
  - Depends on design technique and process



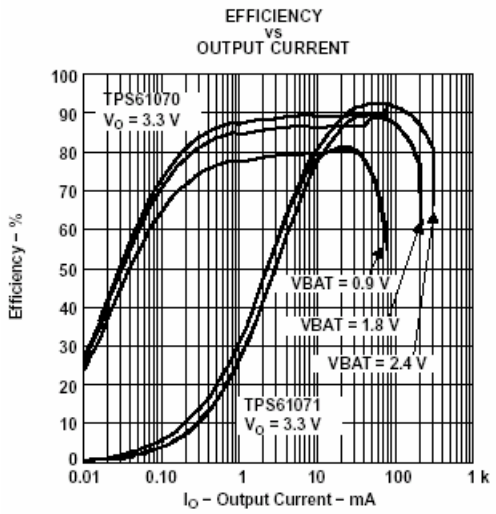
TPS61070 – Single Cell, Sync. Boost Converter

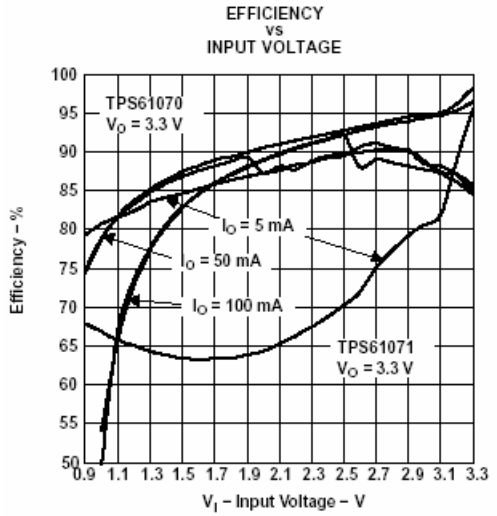
Features

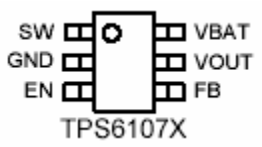
- Synchronous Boost Topology
- Load disconnect during shutdown
- 1.2MHz switching frequency
- TSOT23 package

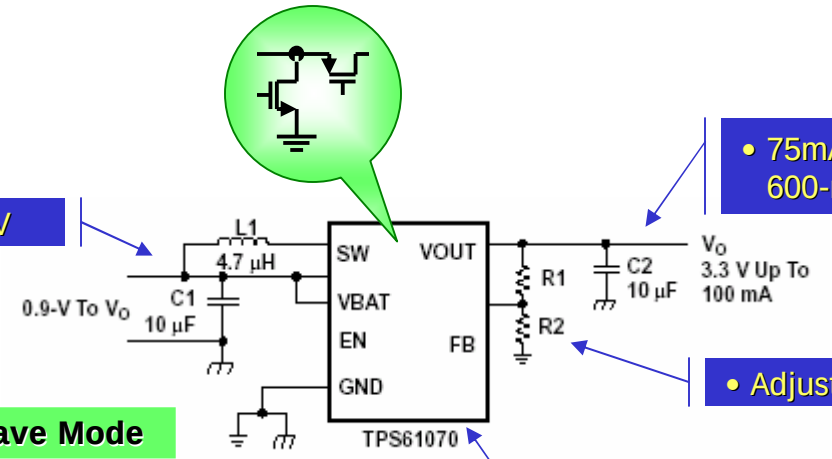
Focus

- Single Alkaline powered apps. Eg, MP3
- Backup up battery supply





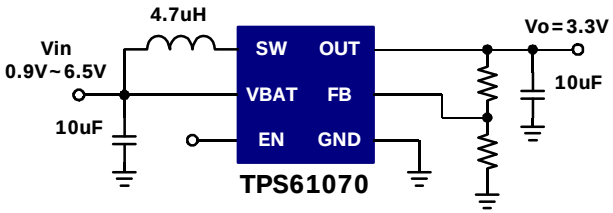


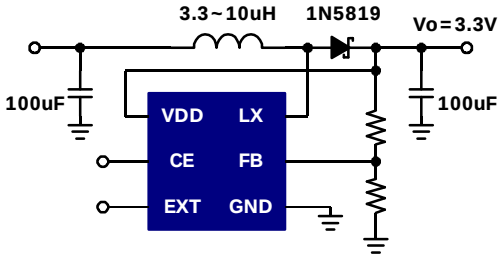


- 1V start up, down to 0.9V
- 75mA @ 3.3V Vout and 0.9V Vin, 600-mA switch current limit
- Adjustable, up to 5.5V
- 19µA Quiescent Current

TPS61070	**Power Save Mode**
TPS61071	**PWM Mode Only**

Solution Comparison





	TPS61070	Competition	TPS61070 Advantage
Package	TSOT23-5	SOT23-6	--
Topology	Sync. Boost	Boost	Smaller start up inrush current
True Shutdown	Yes	No	High Eff & save ext Diode
Switching Frequency	1.2MHz	500kHz	Allow Smaller Inductor
Low Side Switch Rds (on)	0.54W ± 20%	1.1W	Reduce Conduction Loss Loss = $I^2 \cdot R \cdot D$
High Side Switch Rds(on)	0.66W ± 20%	0.4V (Schottky Diode)	Reduce Conduction Loss Loss = $I^2 \cdot R \cdot D$ vs $I \cdot VF \cdot D$
Iq	VBAT/VO 1mA/30mA	75mA/550mA	Extend Battery Life
Input Cap	10mF	100mF	Smaller & Cheap
Output Cap	10mF	100mF	Smaller & Cheap

- USD$0.1~0.15 external component save
- Smaller solution size
- Higher efficiency

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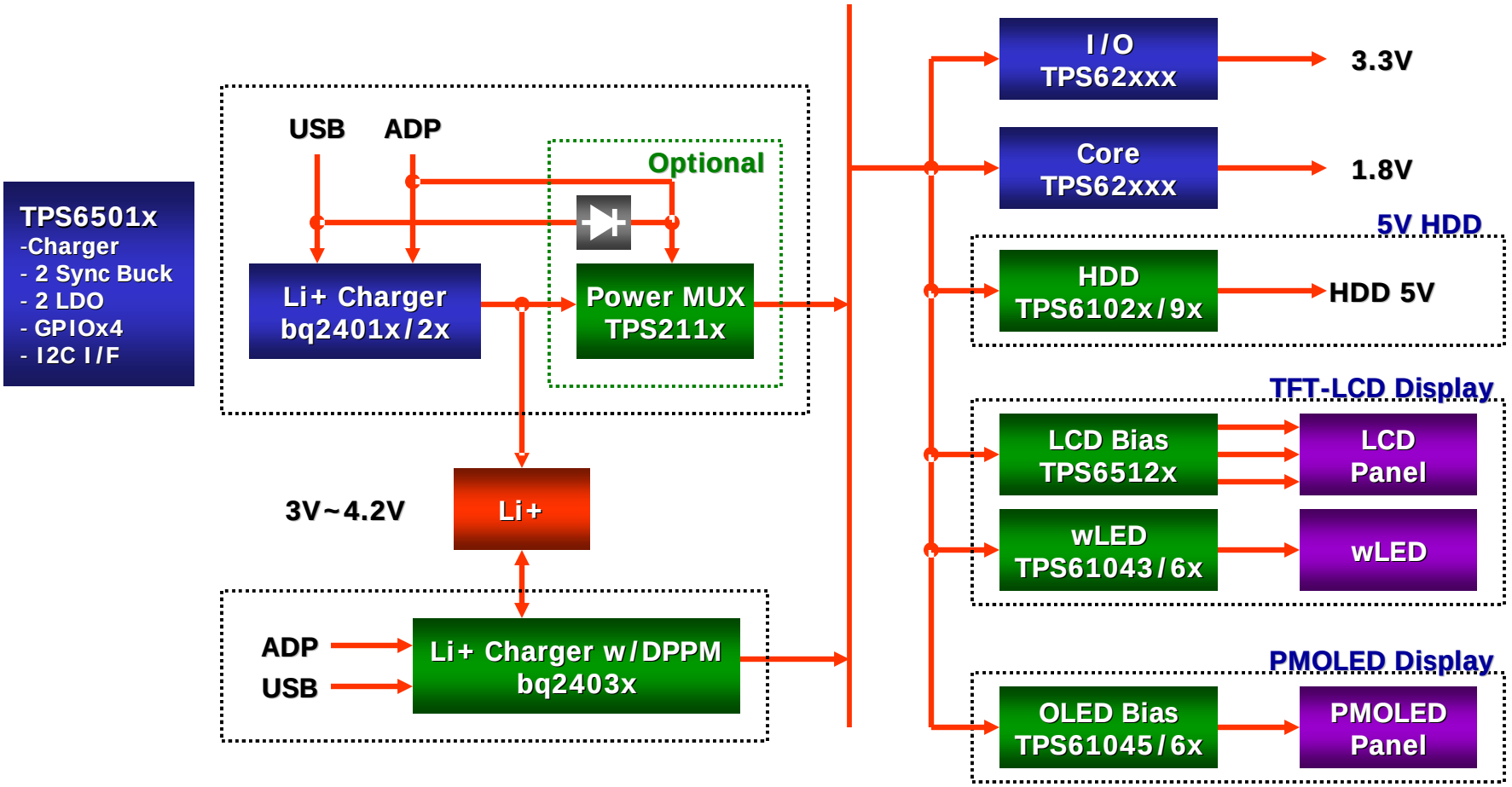
Li+ Powered Device Block Diagram & Solution

Block Diagram - Li+ Battery/Flash, HDD MP3



Solution List

Device	Description
Charger	**Li+ /Li poly charger**
bq2401x	1A adaptor input Li+ Charger, 3x3QFN10
bq2402x	Adaptor/USB dual input Li+ Charger, 3x3QFN10
bq2403x	Adaptor/USB dual input Li+ charger with DPPM, 3.5x4.5QFN20
Sync Buck	**Vcore, 3.3V I/O, 3.3V HDD**
TPS6220x	300mA, 1MHz, SOT23
TPS6222x	400mA, 1.25MHz TSOT23
TPS6230x	500mA, 3MHz, QFN/CSP
TPS6202x	600mA, 1.25MHz, MSOP10
TPS6204x	1200mA, 1.25MHz, MSOP10
Sync Boost	**5V HDD apps**
TPS61020	500mA@(Li→5V), 1.5A Iswitch, Sync Boost topology, 3x3QFN10
TPS61090	1.2A@(Li→5V), 2.2A Iswitch, Sync Boost topology, 4x4QFN16
Display Power	**LCD bias, wLED driver, PMOLED driver**
TPS6512x	Single inductor, 4ch output for VGH, VGL, Vs and Vlogic, programable sequence, 3x3QFN16
TPS61043	Series wLED driver, internal OVP, 3x3QFN8
TPS61045	PMOLED driver, True shutdown, 3x3QFN8
TPS61060	Sync. Boost, can be series wLED driver or PMOLED driver
PMU	**Integrated Solution**
TPS6501x	Charger, dual Sync. Buck, dual LDO, GPIO & I2C I/F, 7x7QFN48
Power Switch	**Power Path Management**
TPS211xA	Power Multiplexer, TSSOP8

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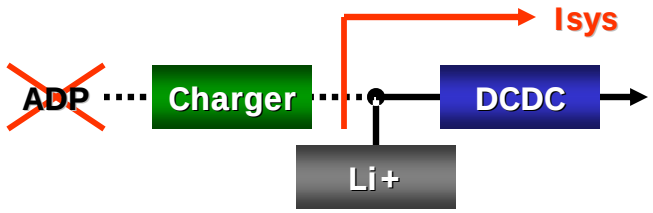
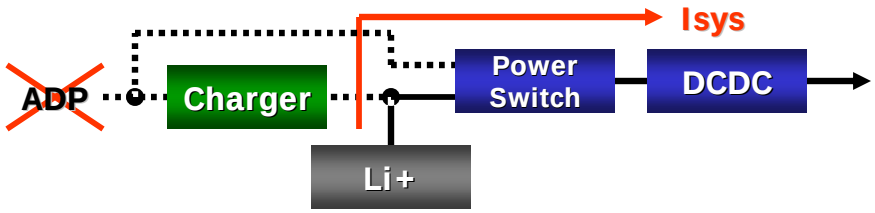
Li+ Powered Device
Charger & Power Path Management

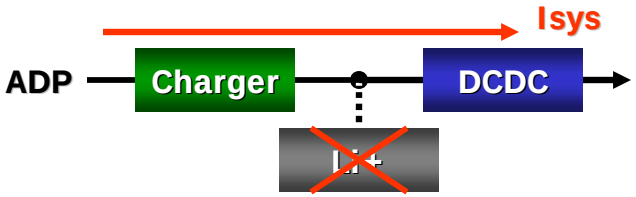
Power Path Management – Issue of Charger Design



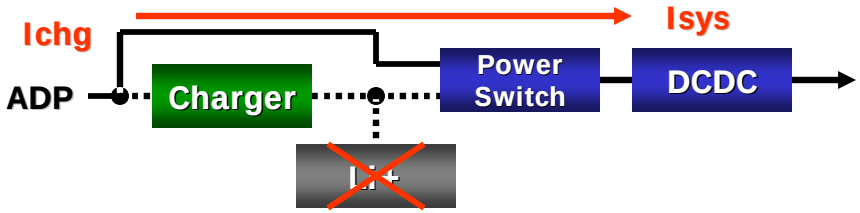
- DCDC supply all from battery
- Charger Suspend due to ADP absent



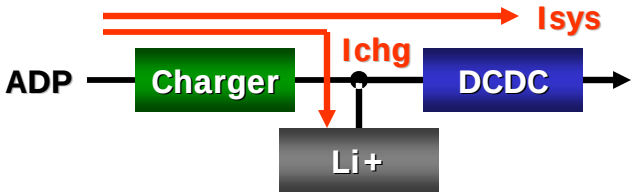
- Battery power via power switch
- Charger suspend



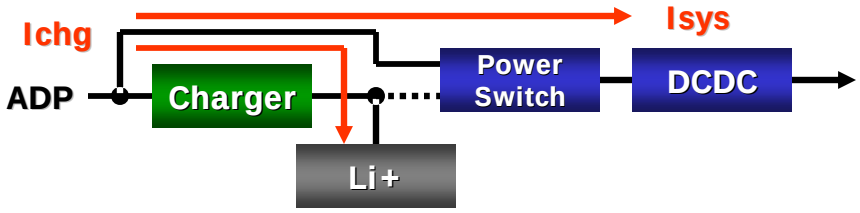
- Removable battery design
- DCDC supply from charger
- Charger behave as a switch or LDO



- Removable battery design
- Charger suspend
- DCDC input supply from Adaptor



- Adaptor supply power to DCDC & Charger
- Higher charger current rating required



- Battery to DCDC input path cut off
- Different power path for charge & DCDC supply

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Li+ Powered Device
Key Device

bqTiny III – bq24030, Charger w/ DPPM

Features

- Li+ Charger with Dynamic Power Path Management (DPPM)
- 3.5x4.5 QFN20 package

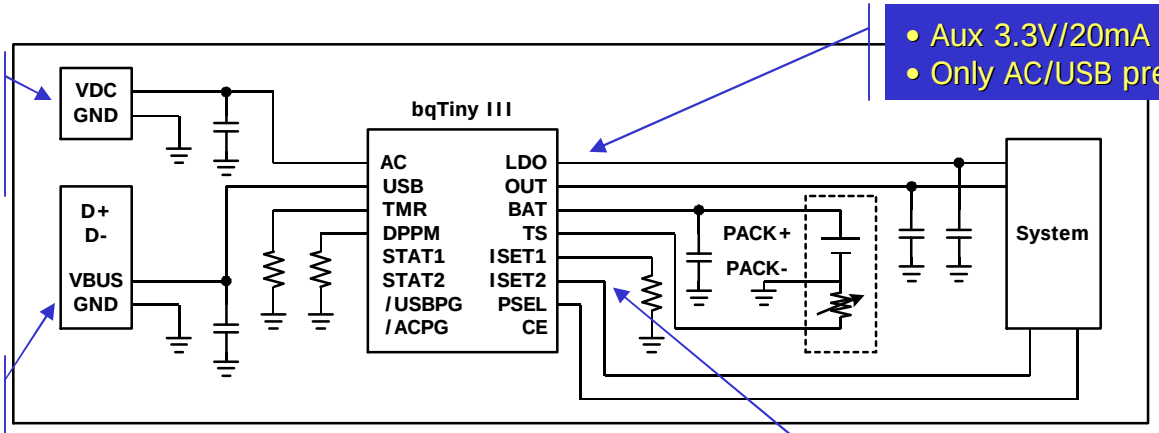
Focus

- Smartphone
- MP3/Media player

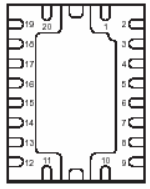
Device	CHG Reg Voltage	Option
bq24030	4.2V	AC input regulated above 6V
bq24032	4.2V	AC input regulated above 4.4V
bq24035	4.2V	AC input cut off above 6V

- Charge from Adaptor
- 4.5V~6.5V Input Range
- Ichg : 500mA max

- Charge from USB
- 4.35v~6.5V Input Range
- Ichg : 100/500mA

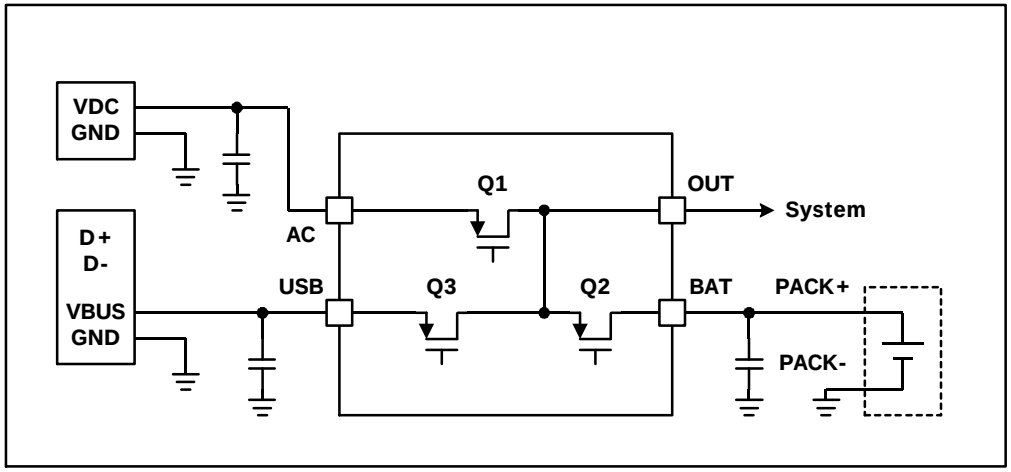


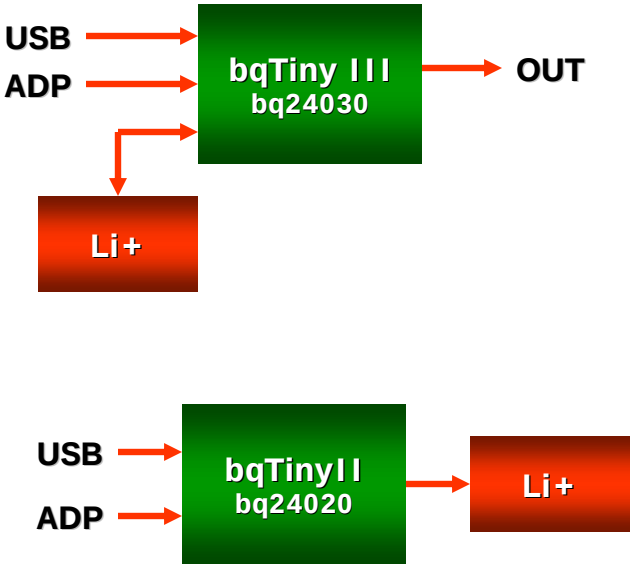
- Aux 3.3V/20mA LDO output
- Only AC/USB present



- ISET1 : Adpt/Prechg/Taper Current
- ISET2 : USB Chg selection

bqTiny III – Dynamic Power Path Management

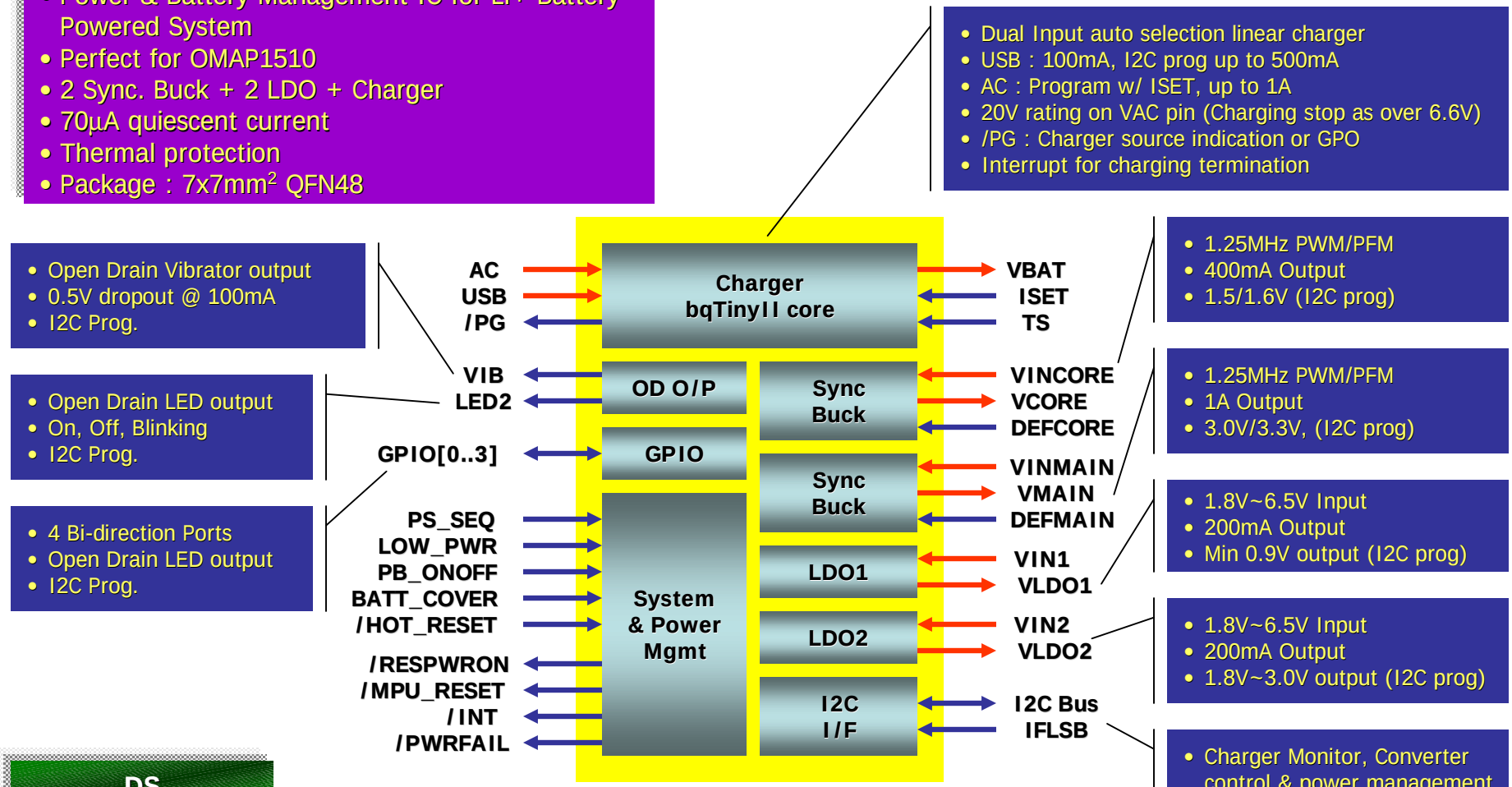




Scenario	VOUT	Charge Control	DPPM
AC (PSEL=High)	- Q1 full ON as AC < Vreg - Q1 as a LDO as AC > Vreg	- Via Q2 - Charge rate by ISET1 setting	- Reduce Q2 charge current as VOUT < V_{DPPM} - V_{DPPM} =I_{DPPM} x R_{DPPM}
USB (PSEL=Low)	- Q3 on, Q1 off	- Via Q2 - Charge rate by ISET2 setting	- Reduce Q2 charge current as VOUT < V_{DPPM} - V_{DPPM} =I_{DPPM} x R_{DPPM}
Battery (/xPG=Off)	- Powered by Battery via Q2 - Q1 & Q3 off (SLEEP Mode)	- Charge circuit turned off	- Disable

TPS65010 - Overview

General
- Power & Battery Management IC for Li+ Battery Powered System
- Perfect for OMAP1510
- 2 Sync. Buck + 2 LDO + Charger
- 70µA quiescent current
- Thermal protection
- Package : 7x7mm^2 QFN48



DS

Software User Guide

TPS6501x Family Comparison

	TPS65010	TPS65012	TPS65011	TPS65013
Wait state (software programmable power down of Vmain and Vcore)	NO	YES	YES	YES
Wait state at device power-up, implement Push-Button power-on function	NO	NO	YES	YES
Default core voltage, Vcore (V) DEFCORE=1/0	1.6/1.5	1.6/1.5	1.8/1.5	1.6/1.3
Default Vmain voltage, Vmain (V) DEFMAIN=1/0	3.3/3.0	3.3/3.0	3.3/3.0	3.3/1.8
Available Vmain voltages (V)	2.5/2.75/3.0/3.3	2.5/2.75/3.0/3.3	2.5/2.75/3.0/3.3	1.8/2.75/3.0/3.3
Default Core voltage in low power mode (V)	1.1	1.1	1.1	1.05
UVLO default voltage (V)	3.25	3.25	2.75	2.75
Typical UVLO hysteresis (mV)	175	175	400	400
default delay time for RESPWRON	1s	1s	100ms or 1s by pin 27 (TPOR)	100ms or 1s by pin 27 (TPOR)
Charger Power up time (ms)	375	375	< 60ms (23ms typ)	< 60ms (23ms typ)
LDO2 output voltage (V) Default at Startup are all 1.8V	1.8/2.5/2.75/3.0	1.8/2.5/2.75/3.0	1.8/2.5/3.0/3.3	1.8/2.5V/3.0/3.3
RESPWRON source	LDO1	LDO1	Vmain	Vmain
Auto turn on if USB or AC voltage is applied	NO	NO	Yes	Yes
SCLK, SDAT and low_pwr pin 1.8V compliant	NO	NO	NO	Yes

Changes compared to TPS65010 are shown in red

TPS65010: original device for OMAP1510 / 1610

TPS65012: WAIT mode

TPS65011: WAIT mode at power up mainly needed for smartphones.

TPS65013: the device is intended to be used with OMAP1710. Vcore =1.3V (1.05V in low power mode), Vmain =1.8V

TPS6501x Comparison

Auto-Switching Power MUX - TPS211x/A

p Features

- ü Input Voltage 2.7V to 5.5V
- ü Low Supply Current 55 μA
- ü Adjustable Current Limit
- ü Manual and Auto-switching Modes
- ü Thermal Shutdown
- ü CMOS and TTL Compatible Logic
- ü Controlled Transition Times to Limit Inrush Current, Minimize Output Voltage Holding Cap
- ü Small/Thin TSSOP-8 Package

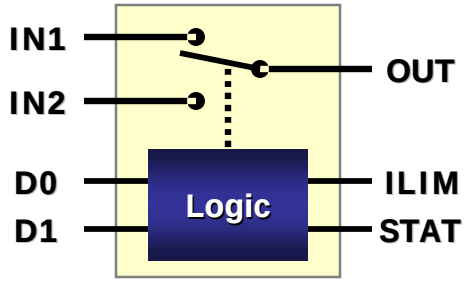
p Auto Switching Mode (D0=1, D1=0)

- ü OUT = Max (IN1, IN2)

p Manual Switching Mode (D0=0, D1=x)

- ü D1=1, OUT=IN1
- ü D1=0, OUT=IN2

p Off Mode (D0=1, D1=1)



Device	$I_{IN1,2}$	$R_{DS,ON1/2}$	Package
TPS2110A	312~750 mA	120mΩ/120mΩ	TSSOP-8
TPS2111A	625~1250 mA	84mΩ/84mΩ	TSSOP-8
TPS2112A	312~750 mA	120mΩ/120mΩ	TSSOP-8
TPS2113A	625~1250 mA	84mΩ/84 mΩ	TSSOP-8
TPS2114A	312~750 mA	120mΩ/120mΩ	TSSOP-8
TPS2115A	625~1250 mA	84mΩ/84 mΩ	TSSOP-8

DS Available

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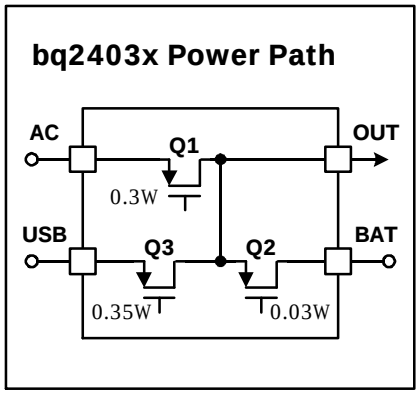
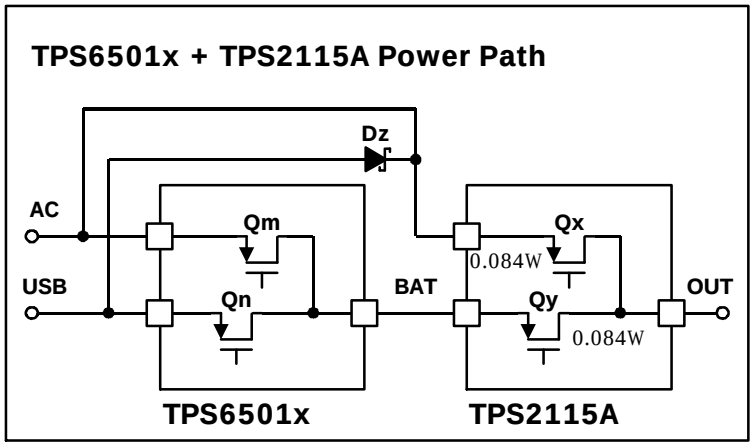
Li+ Powered Device Solution Comparison

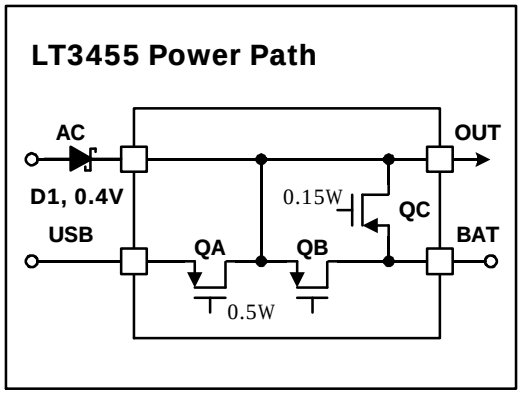
Solution Comparison – LT3455, RT9901/2

	TPS6501x	LT3455	RT9901/02	
Package	**7x7 QFN48**	**4x4 QFN24**	**5x5 QFN32**	
Charger	**Yes**	**Yes**	**No**	
Vin(max)	20V	6V	--	Can use cheap adaptor
Charging rate	1A	500mA	--	Fast Charging rate
Sync Buck 1 (Core)	**400mA**	**400mA**	**?**	
1.8V Eff (%) @3.6Vin	92%	91%	87%	Highest efficiency
Sync Buck 2 (I/O)	**1000mA**	**600mA**	**?**	
3.3V Eff (%) @3.6Vin	96%	97%	?	
PowerSave Mode	**Yes**	**Yes**	**No**	High efficiency at lightload
Boost Converter	**No**	**No**	**Yes**	
LDOs	**200mA x2**	**No**	**Controller**	
GPIO	**x4**	**No**	**No**	
I2C I/F	**Yes**	**No**	**No**	
Iq	**70μA**	**500μA**	**1100μA**	Extend battery life

Solution Comparison for Power Path management







Scenario	Device/Loss	bq2403x	TPS6501x + TPS2115A	LT3455	Bq2403x Benefits
AC to OUT	Device	Q1 (0.3Ω)	Qx (0.084Ω)	D1 (0.4V)	Internal FET, Save cost & Space
	Loss @0.5A/1A	75mW/300mW	21mW/84mW	200mW/400mW	Less power consumption
USB to OUT	Device	Q3 (0.35Ω)	Dz (0.4V)+ Qx(0.084Ω)	QA (0.5Ω)	
	Loss @0.5A	87.5mW	221mW	125mW	Less power consumption
BAT to OUT	Device	Q2 (0.03Ω)	Qy (0.084Ω)	QC (0.15Ω)	
	Loss @0.5A/1A	7.5mW/30mW	21mW/84mW	37.5mW/150mW	20%/56% power consumption only
Charging	Device	Q2	Qm or Qn	QB	

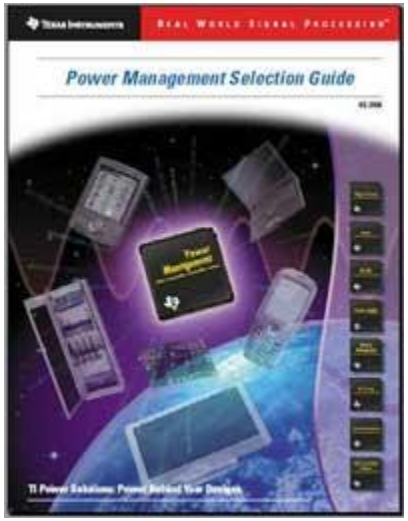
• Key for Battery Operation time

The POWER Behind Your Designs

Li+ Powered Device
Display & wLED driver

Link

New PMP Selection Guide - 2004Q4



http://www-s.ti.com/sc/techlit/slvt145.pdf

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