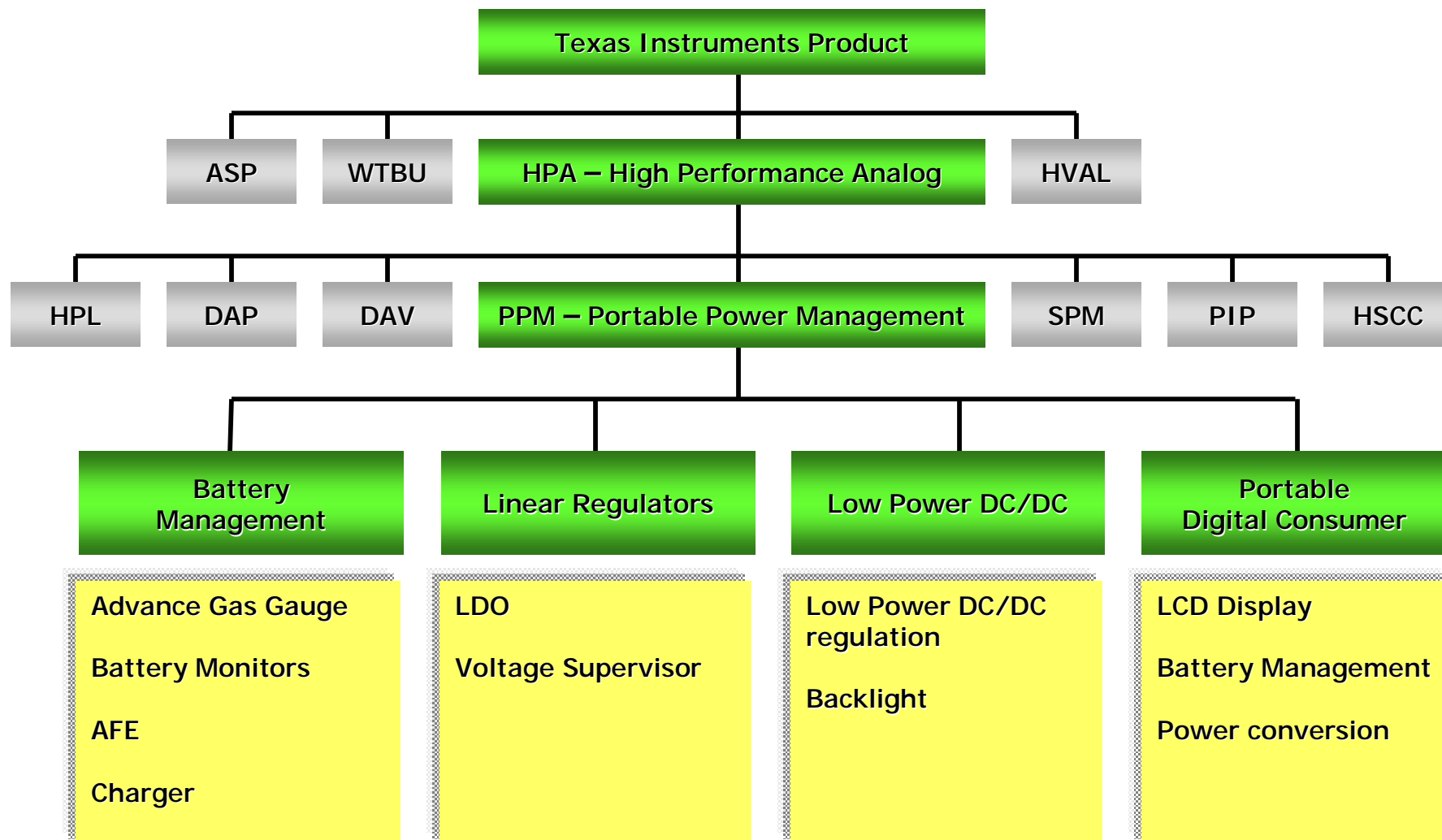


# *HPA Solution for LFF TFT-LCD Panel*

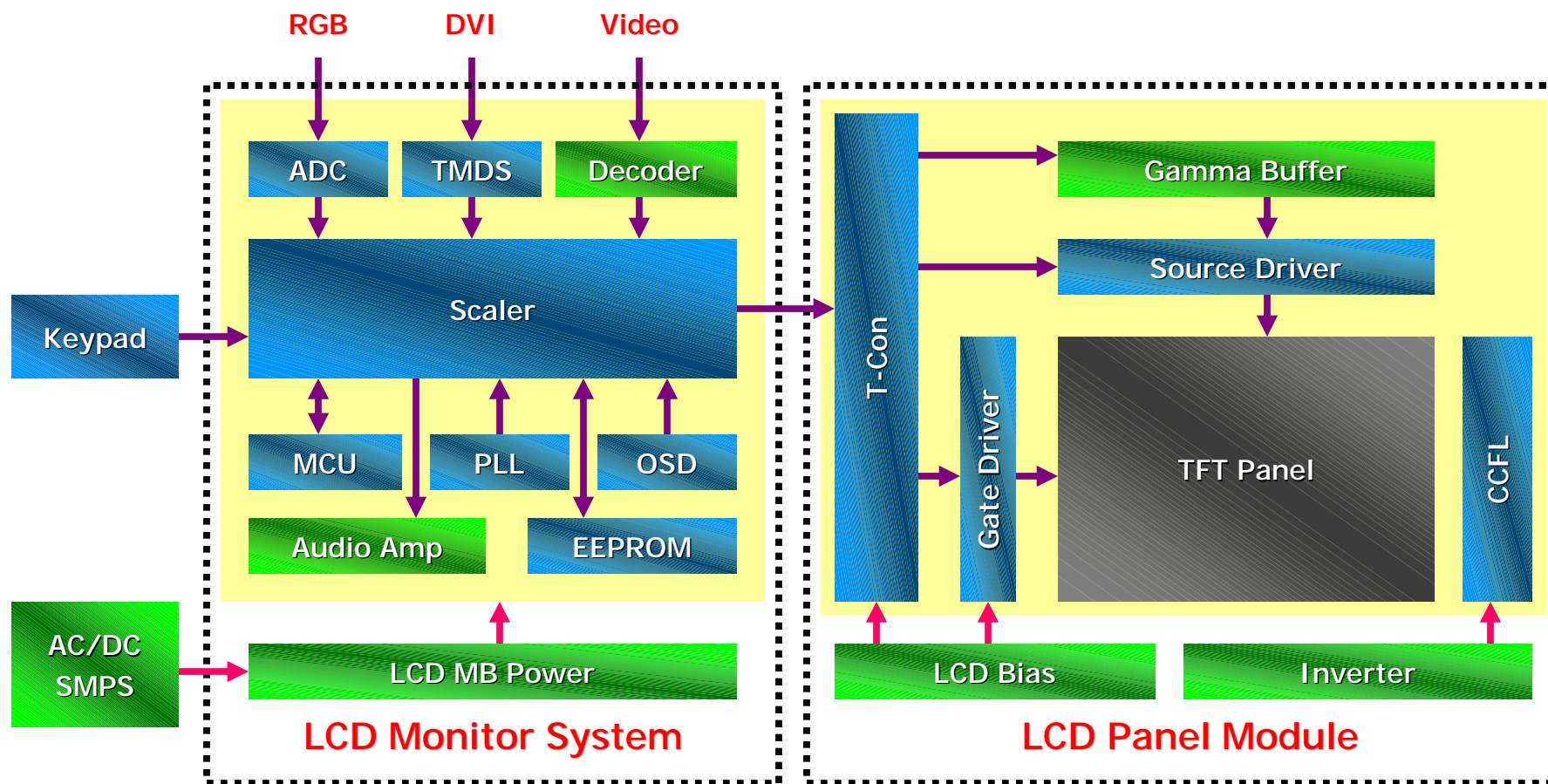


Silvan Ho  
HPA/APR Mkt Dev  
[silvan\\_ho@ti.com](mailto:silvan_ho@ti.com)  
Dec 9, 2004

## Organization Summary - Portable Power



## LCD Monitor Block Diagram

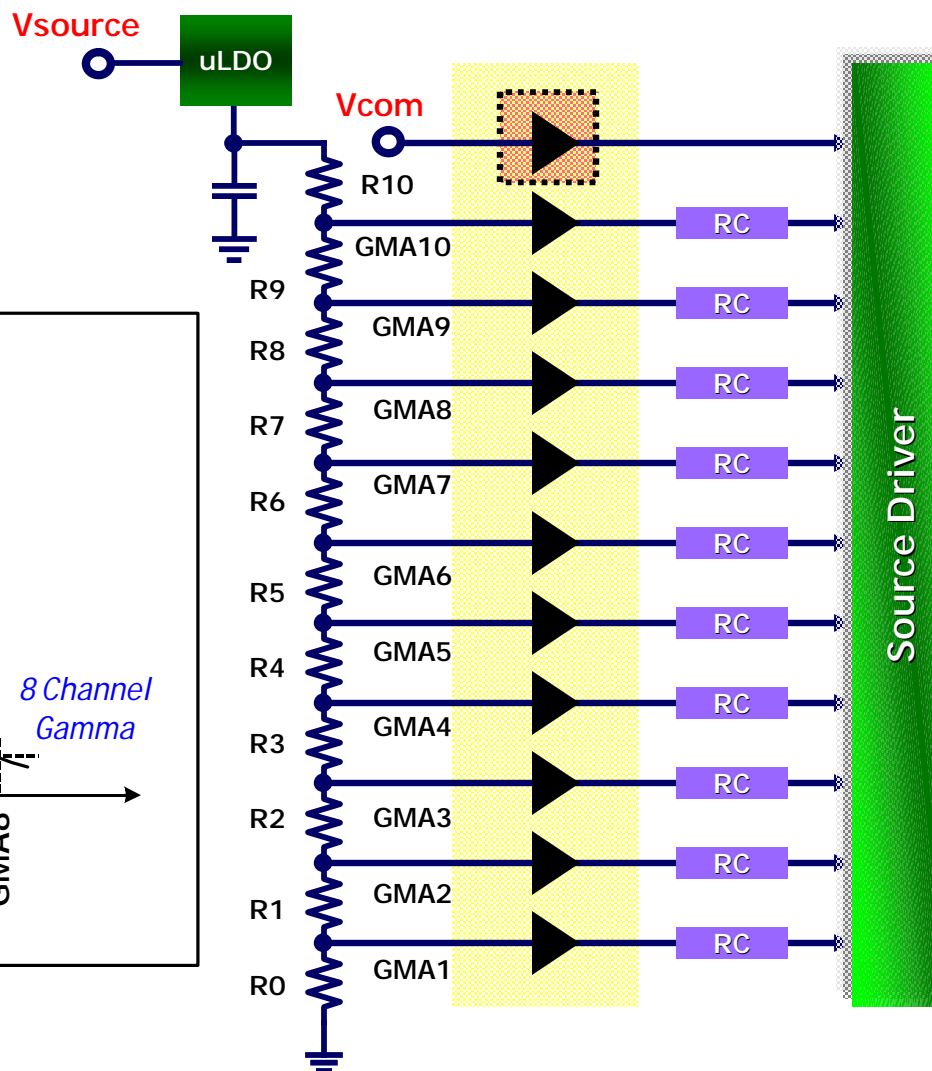
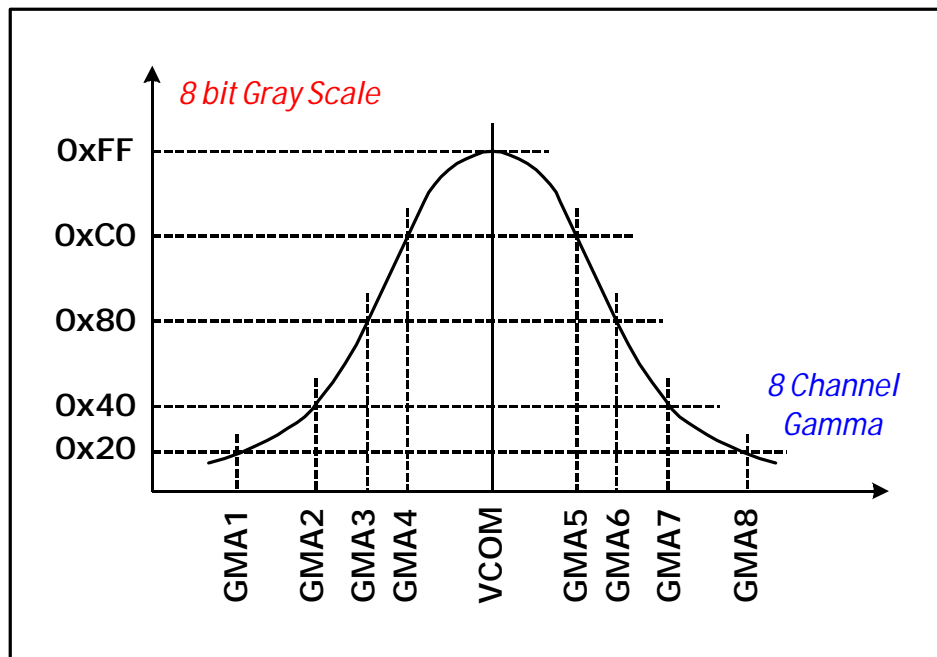


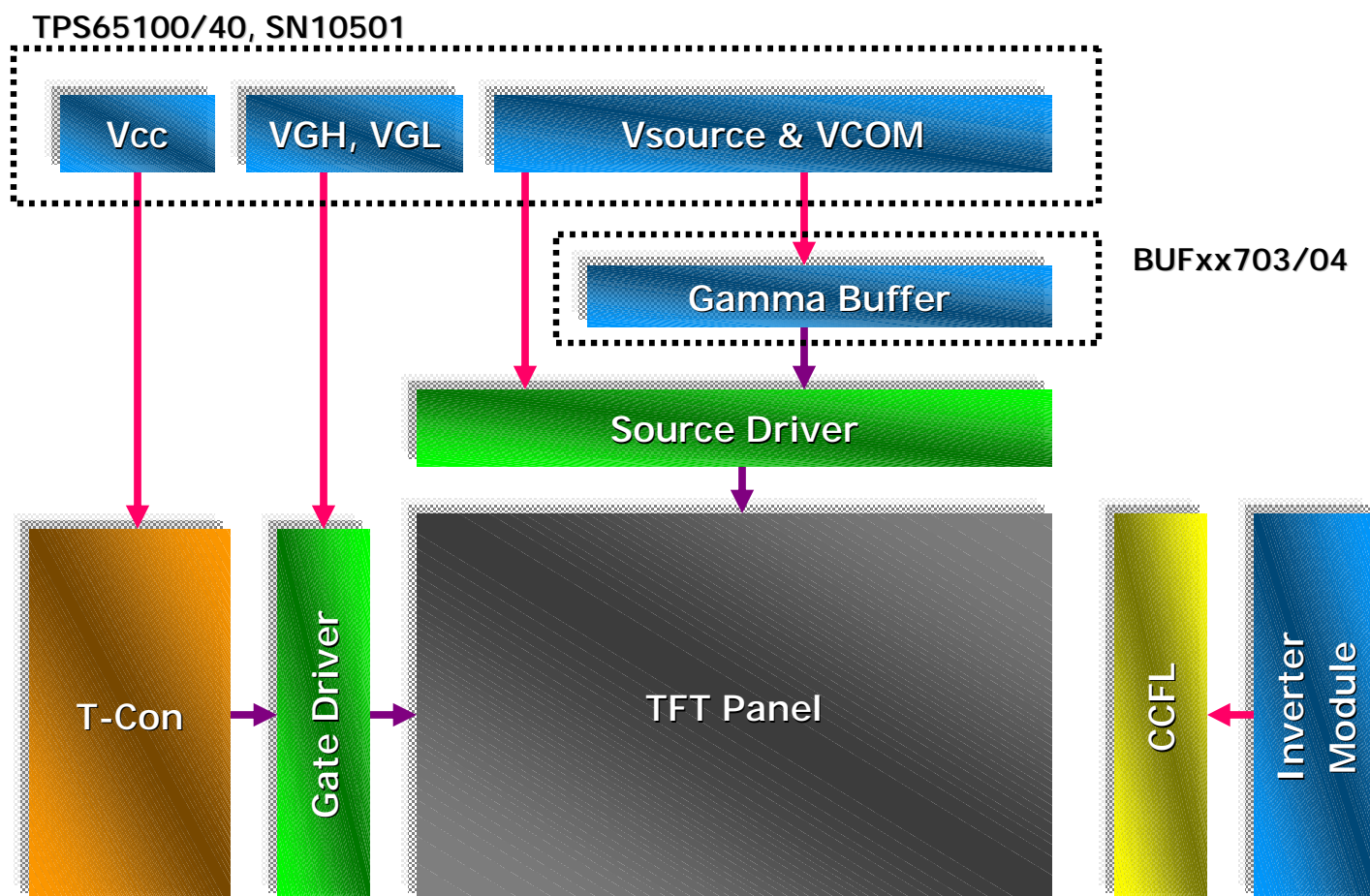
Ti HPA solution available

## Gamma Reference

### Gamma Reference

- ü Data Voltage to Gray Scale Mapping
- ü Source driver dependent
- ü Precise Voltage required

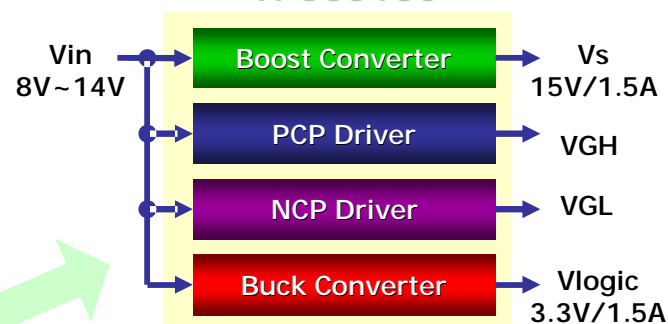




## TFT-LCD Bias Family

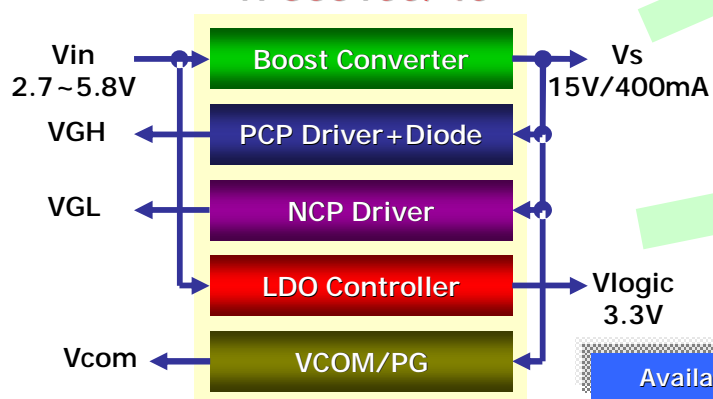
Feature	TPS65100/40	TPS65150	TPS65160
Output Channel	5/4	3	4
Regulated PCP/NCP	ü	ü	ü
VGH Gate Shaping ckt	x	ü	x
Power On Seq.	Int Fixed	Prog.	Prog.
Adjustable Delay Time	x	ü	ü
Input Rail	3.3/5	2.5/3.3/5	12
Package	TSSOP24 QFN24	TSSOP24 QFN24	TSSOP28

### TPS65160



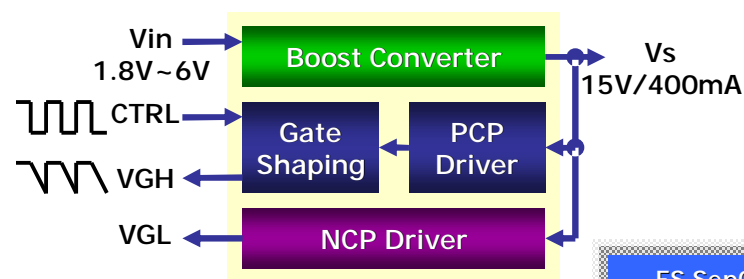
ES Oct04  
RTP Aug05

### TPS65100/40



Available

### TPS65150



ES Sep04  
RTP Feb05



*TFT-LCD Bias Solution*  
*TPS65100/40*

## TPS65100/40 - Overview

TPS65100

TPS65140

Available

### General

- Integrated TFT-LCD Bias Supply
- Boost + PCP + NCP + VCOM + Linear Controller
- Internal Power on Sequencing : Vmain → NCP → PCP → Vcom
- Small Capacitance Required
- Fault Protection for All Output
- TSSOP24 & 4x4mm<sup>2</sup> QFN24 package with PowerPAD
- Thermal Shutdown

- 2.7V~5.5V Input Range
- 1.6MHz Switching Frequency
- 0.96A/1.6A Switch Current Limit
- 20V on SW pin
- 12V/500mA @4.5V input

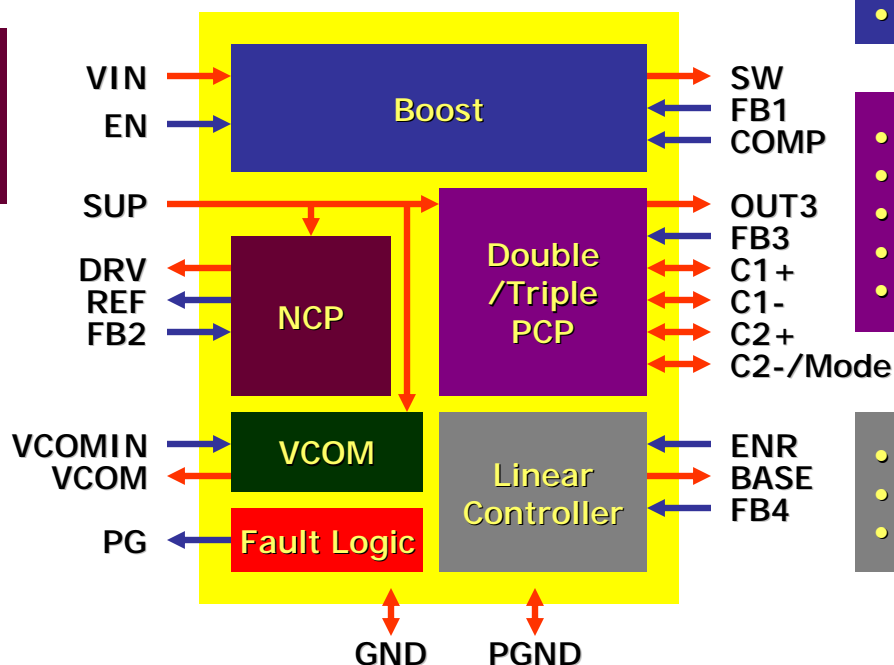
- Regulated Output
- Output down to -12V
- 40mA Output
- 1.6MHz Switching Frequency

- TPS65100 only
- Adjustable Output
- ±200mA Source & Sink
- 1.2A Peak Current @ 15V supply

- TPS65140 only
- Monitor Vo1, Vo2 & Vo3
- Open Drain Output

- Regulated Output
- Output up to 30V/20mA
- 1.6MHz Switching Frequency
- Tripler or Doubler Mode
- Integrate Schottky Diode

- Tcon Logic Supply
- Drive External NPN
- 3.3V output



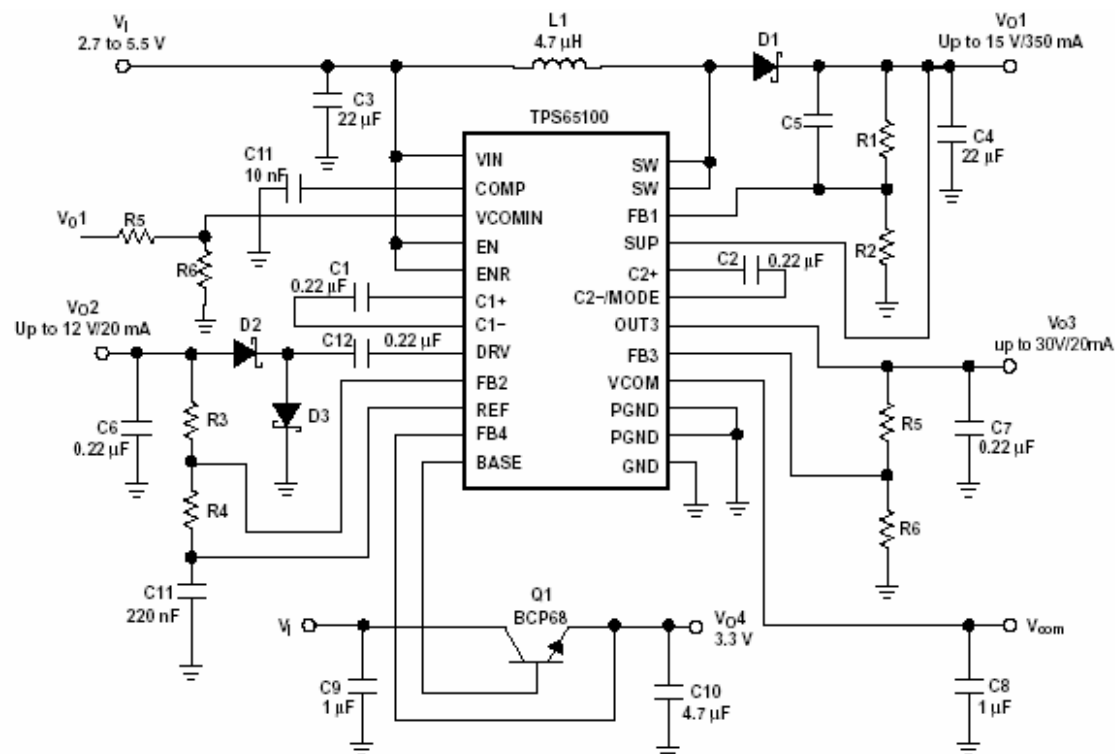


## TPS65100/40 - Typical Application

### Simple & Easy Design with Flexibility

- ü Only 26 external component counts (TPS65100)
- ü Adjustable Output
- ü 5 Regulated Outputs
- ü Short Circuit protection
- ü Integrate Power On Sequence Control
- ü Softstart Control

Component	Count
Inductor	1
Schottky Diode	3
Transistor	1
Resistor	8
Ceramic Capacitor	13
Total	26



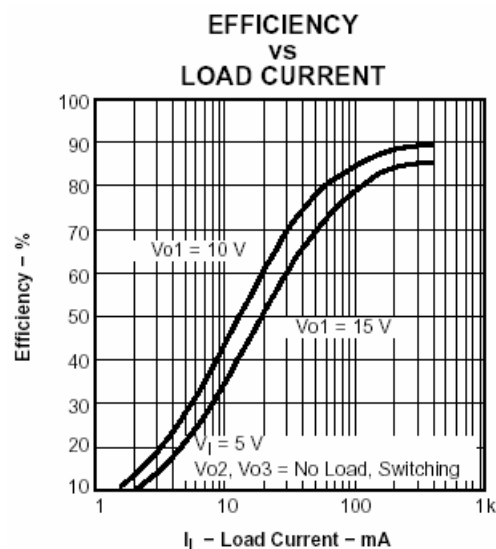
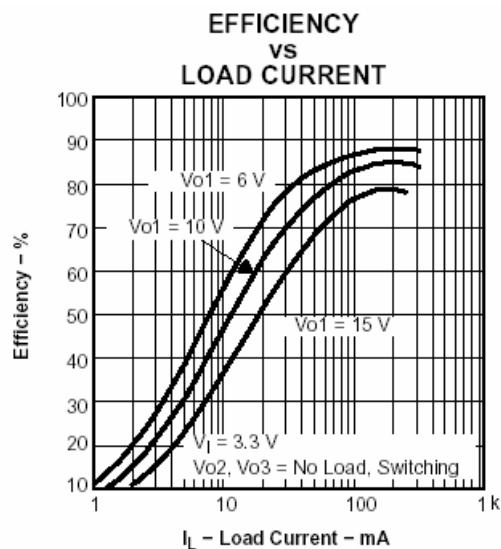
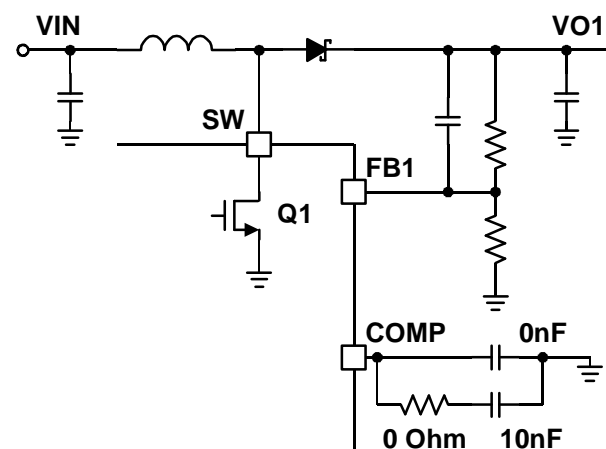
## TPS65100/40 - Boost Converter

### Boost Converter

- 1.5MHz Fixed Switching frequency
- Internal Switch with 1.6A/0.96A current limit
- External Compensation Network

### Output Capacity

- $I_o @ V_{in} \sim 1.6A \cdot 80\% / V_o$
- Eg.  $V_{in}=4.5V$ ,  $V_o=12V$ ,  $L=6.2mH$  @  $I_o=500mA$



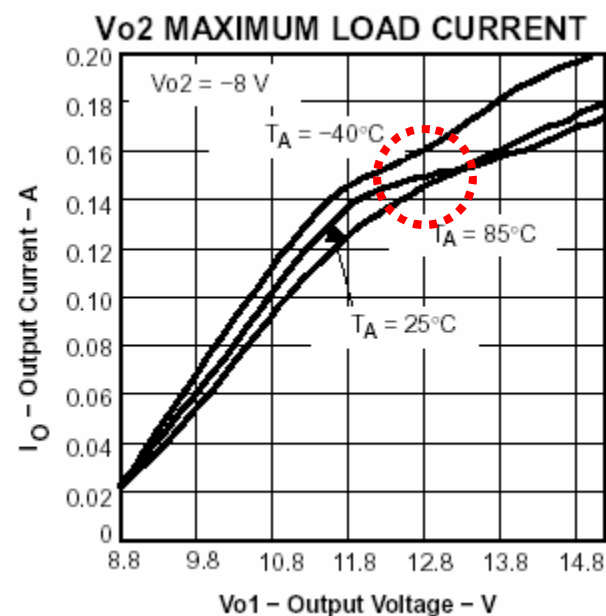
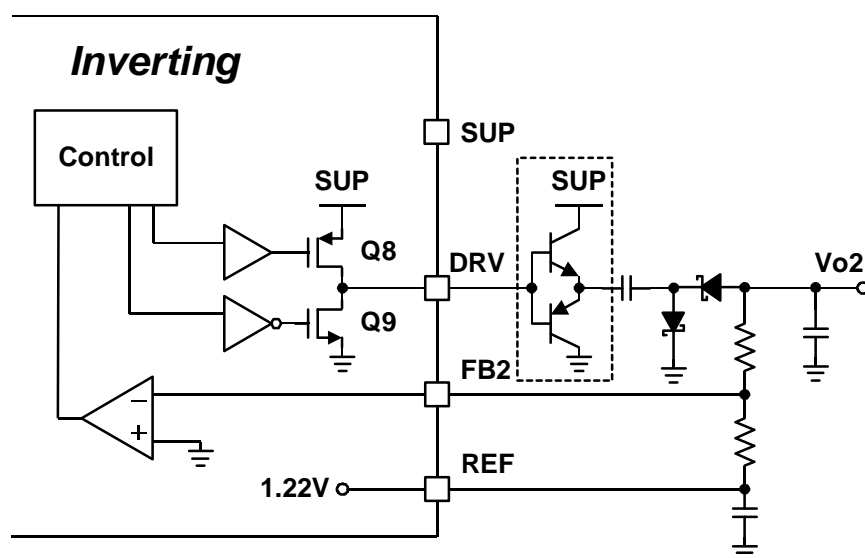
## TPS65100/40 - Negative Charge Pump

### ρ Negative Charge Pump

- ü Output Current Depends on Supply voltage (140mA @ 11.8V supply)
- ü Add external push-pull driver for larger output current

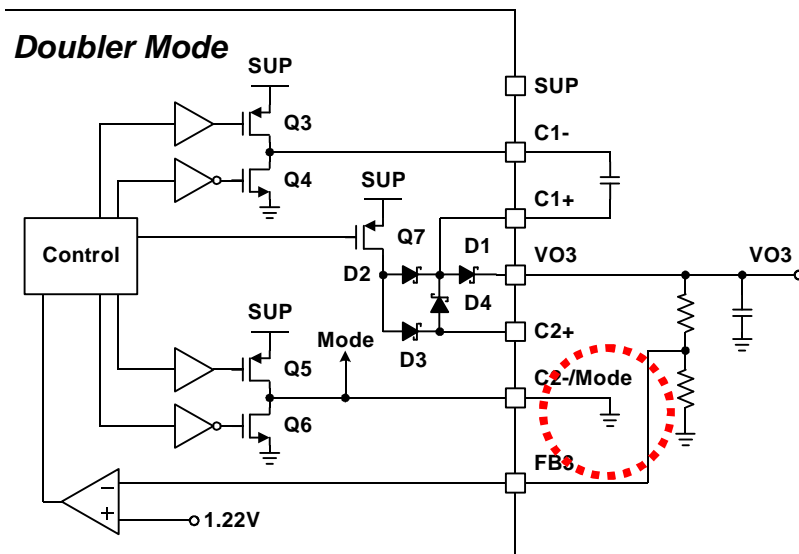
### ρ Advantage to Traditional Approach

- ü Regulated Output
- ü Short Circuit Protection
- ü Integrate Power On Sequence Control

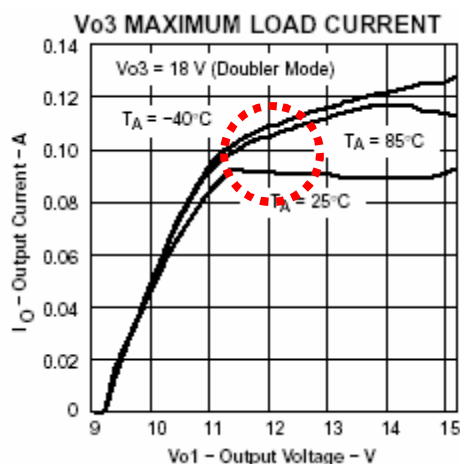
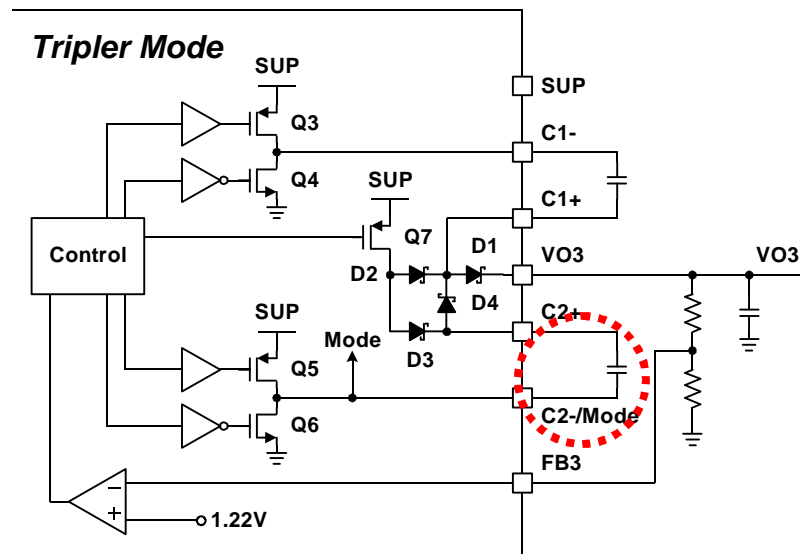


## TPS65100/40 - Positive Charge Pump

**Doubler Mode**

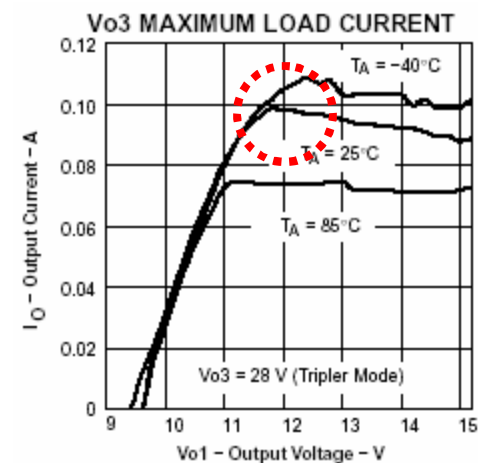


**Tripler Mode**



### Advantage to Traditional Approach

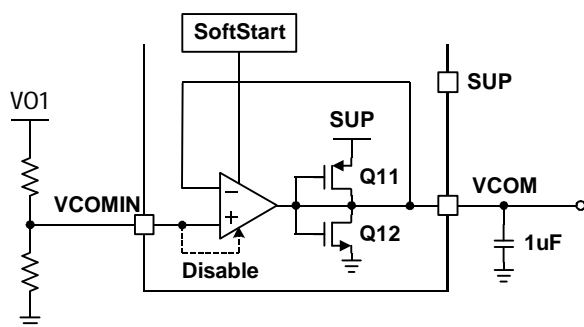
- ü Integrate all schottky diodes
- ü Regulated Output
- ü Short Circuit Protection
- ü One component difference between Doubler and Tripler Mode
- ü Integrate Power On Sequence Control



## TPS65100/40 - VCOM/PG & LDO

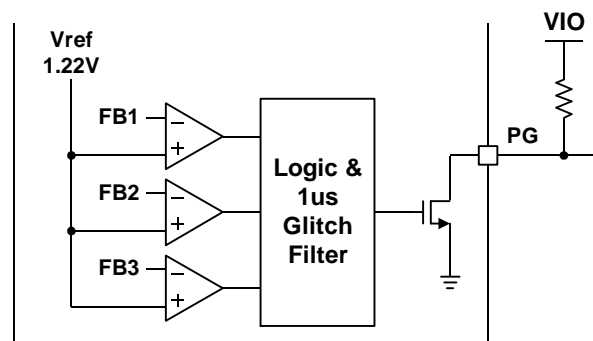
### ⌚ Vcom - TPS65100

- ü Adjustable Output
- ü  $\pm 1.2A$  Peak Current



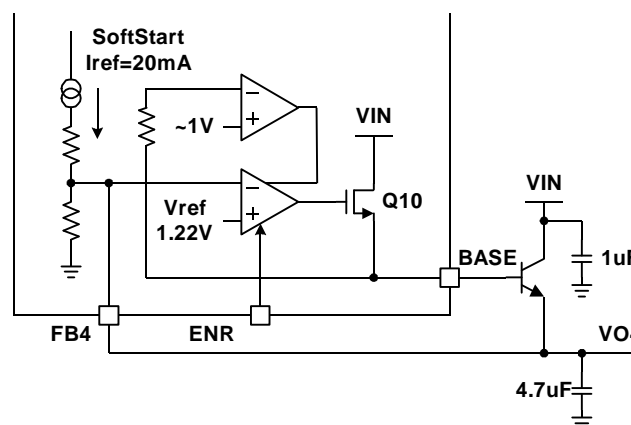
### ⌚ PG - TPS65140

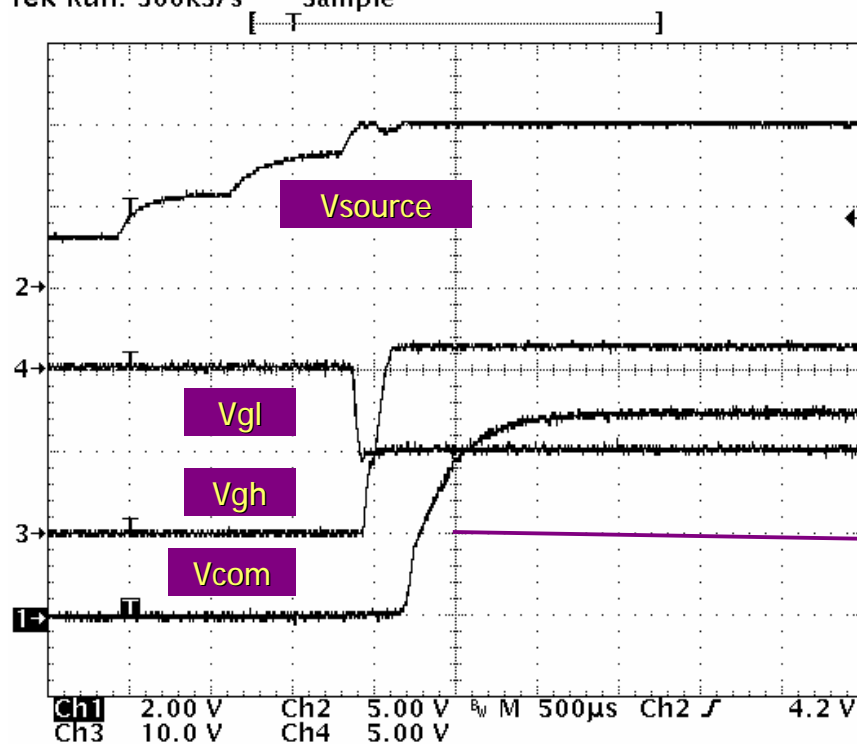
- ü Open Drain/Active High Output
- ü 500mA Sink Current
- ü Monitor Vo1/Vo2/Vo3



### ⌚ Linear Controller

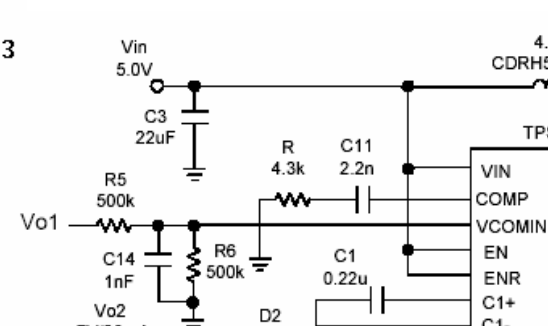
- ü T-con Supply
- ü 3.3V fixed output
- ü Driver external NPN
- ü Up to 20mA base current





VCOM buffer Softstart,  
Adjustable by external filter capacitor

21 Aug 2003  
17:27:34





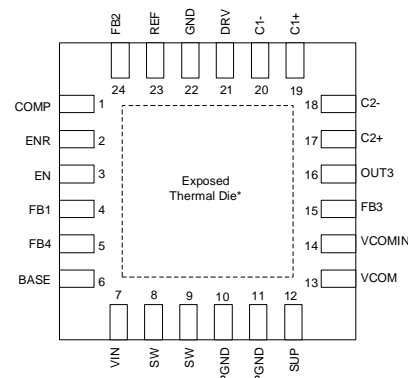
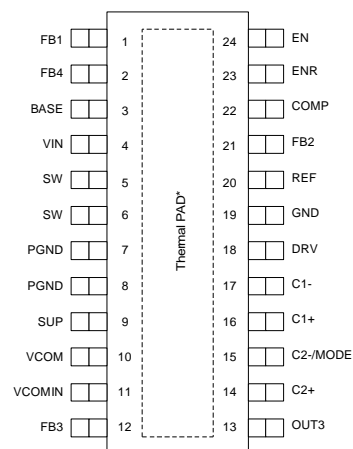
## TPS65100/40- Package

### Available Device

ü TPS65100	Switch current: 1.6Amin	VCOM
ü TPS65105	Switch current: 0.96Amin	VCOM
ü TPS65140	Switch current: 1.6Amin	Power Good
ü TPS65145	Switch current: 0.96Amin	Power Good

### Package

- ü All device are available in TSSOP and QFN package
- ü TSSOP24 : 5´6.4mm2/1.2mm max
- ü QFN24 : 4´4 mm2/1.0mm max
- ü PowerPAD for thermal Enhancement (Connect to PGND)



BOM Comparison

## *Gamma & Vcom Buffer*

*Simple Buffer : BUFxx702/03/04*

*Programmable Buffer : BUFxx801*

*PAL Buffer : BUFxx820*

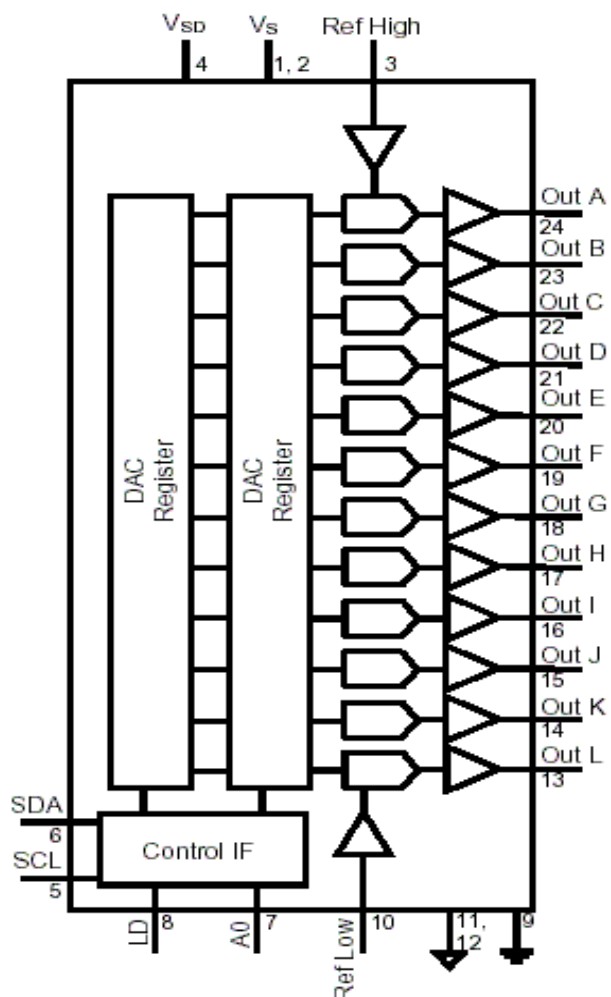
*Programmable Vcom :*

## Simple Gamma Buffer Family

- ρ Wide Selection of Gamma Correction Buffers
- ρ High level of Integration
  - ü Integrated high-current Vcom Driver
  - ü programmability of Reference Voltages
- ρ Enhanced ESD Protection
  - ü Increased Manufacturability
  - ü Higher Reliability
- ρ Increased Supply Voltage
  - ü Increased Reliability

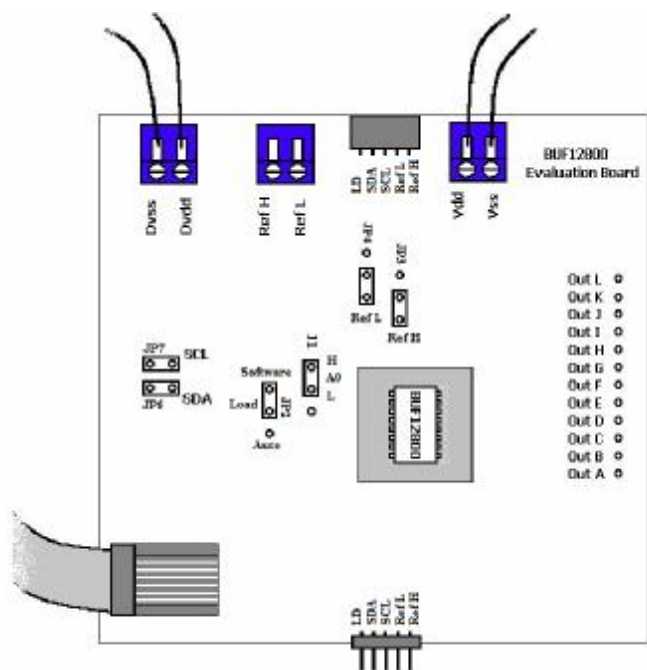
Part Number	Gma Buffer	Vcom Buffer	Input	Package
BUF11702	10	Ö	4.5 ~ 16V	HTSSOP28
BUF07703	6	Ö	4.5 ~ 16V	HTSSOP20
BUF06703	6		4.5 ~ 16V	TSSOP16
BUF05703	4	Ö	4.5 ~ 16V	TSSOP14
BUF11704	10	Ö	4.5 ~ 18V	HTSSOP28
BUF07704	6	Ö	4.5 ~ 18V	HTSSOP20
BUF06704	6		4.5 ~ 18V	HTSSOP16
BUF05704	4	Ö	4.5 ~ 18V	HTSSOP14
BUF07710	6	HS OP	4.5 ~ 16V	TSSOP
SN10501		Ö	3 ~ 15V	SOT23-5

## BUFxx800 – Programmable



- p 2-Wire Industry-Standard Interface
- p 10 Bit Resolution
- p 1 DAC / Channel
  - ü Double Buffered DAC Registers
  - ü Fast Programming
- p 12 or 20 Programmable Gamma Ch.
- p Rail-to-rail Output
- p Integrated Reference Buffer
- p Supply Voltage: 8-18V, 19V max
- p Digital Supply: 2.5V to 5V
- p Thin package: TSSOP-24
  
- p Use as “traditional” Buffer instead of BUFxx702/3/4
  - ü Programming accelerates Design (Prototyping) Phase
  - ü No time consuming resistor “tweaking” for best gamma curve
  - ü Use with external EEPROM
  
- p Use for “Dynamic Gamma Control”
  - ü 1 DAC / channel architecture allows quick update
  - ü Double Buffer Structure allows for programming during Frame
  - ü Fast I2C allows fast programming
  
- p Use as programmable Vcom solution
  - ü 10 channels for programmable gamma
  - ü Up to 2 channels programmable Vcom

# Demoboard BUF12800

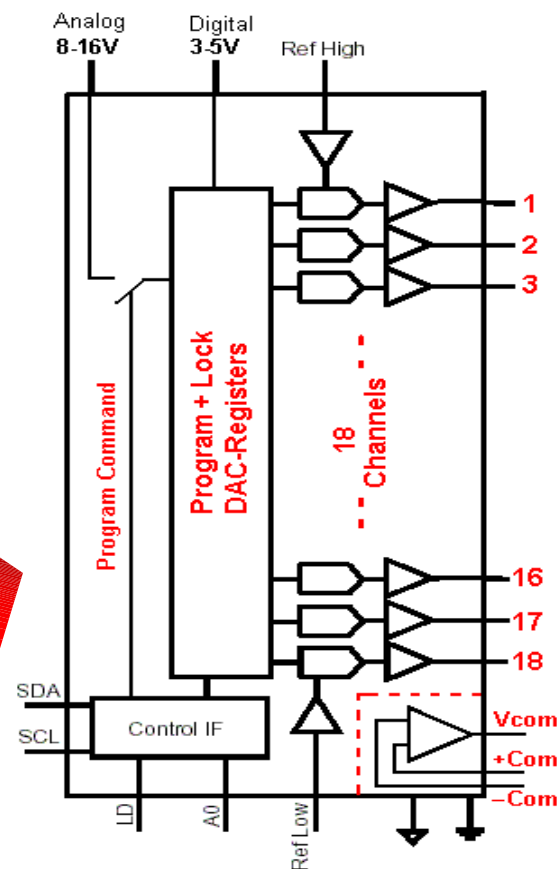
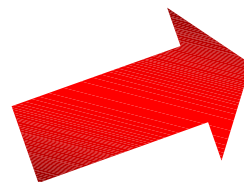
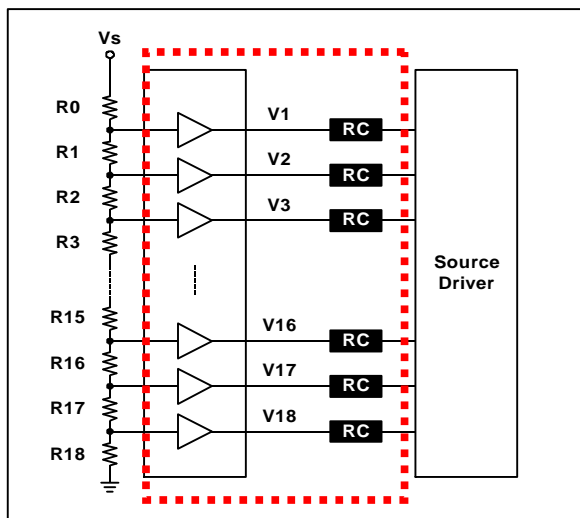


- Software Features
  - Easy Communication with PC
  - Automatic Update or Software Mode
  - Batch Running
    - Ideal for Dynamic Gamma Demo
- Supports Parallel Operation of Demoboards
  - Ideal to generate 20+ Gamma Channels



## BUF20820 – Programmable Gamma Buffer w/ Memory

- p Voltages can be Reprogrammed until "Burned-in"
 
  - ü Saves 2-4 Weeks Development Time
  - ü Good for Design and Production
  - ü Use "Socket" for Prototyping
- p 2-Wire Industry Standard Interface
 
  - ü Each can be used as Vcom
  - ü 100mA Output Drive on all buffers
  - ü Individual Programming
- p 20 gamma channels
 
  - ü Each can be used as Vcom
  - ü 100mA Output Drive on all buffers
  - ü Individual Programming
- p Memory Cell is small
 
  - ü Cost effective for Production
- p Digital Supply: 2.0 to 5V
 
  - ü Cost effective for Production
- p TI can "Preprogram" Buffers
 
  - ü Cost effective for Production

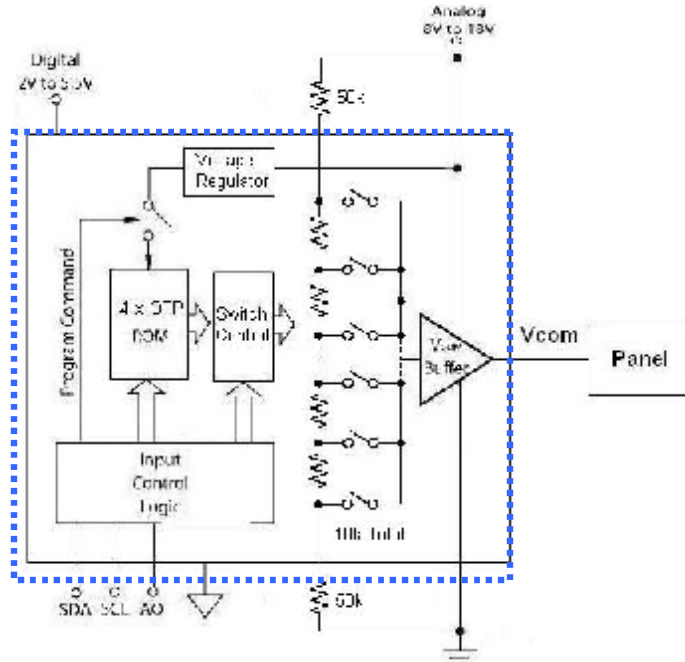




- ⌘ Use as programmable alternative to resistor string
  - ü Up to 20 channels programmable gamma control
- ⌘ Use for Dynamic Gamma control
  - ü Do not use Memory Option
- ⌘ Independently programmable RGB gamma
  - ü 3x6 channels Gamma
  - ü 2 extra channels for programmable Vcom
  - ü Channels can be programmed at different times
- ⌘ Combine Gamma and Vcom channels as needed:
  - ü 18 channel gamma + 2 Vcom
  - ü 16 channel gamma + 4 Vcom
  - ü Channels can be programmed at different times

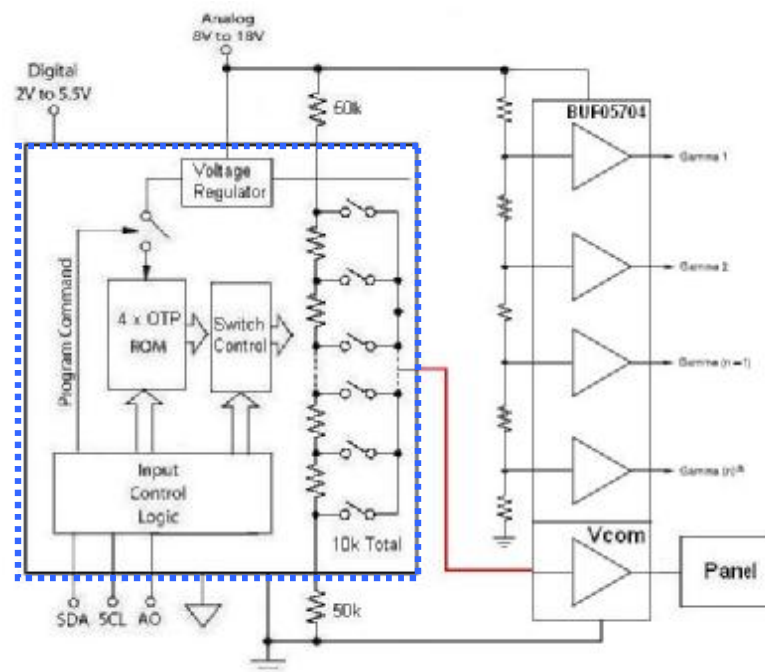
## BUF0190x Applications

### BUF01900: Internal Buffer



- Automating Final Production**
  - ü Eliminates variable resistor
  - ü Saves Trimming Time
- 2-Wire Interface**
- Reprogramming Possible**
  - ü Up to 4 times

### BUF01901: External Buffer



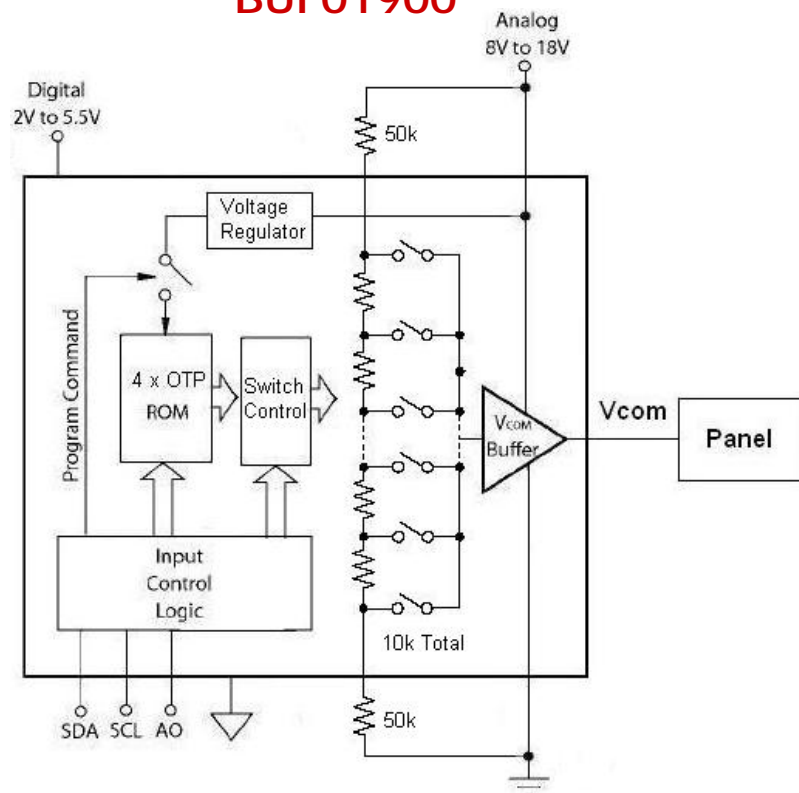
- 256 Trim Steps**
- Integrated Vcom Buffer**
  - ü 100mA output current
  - ü Optional
- Low Power: 1mA**
- Power Supply: 8V to 20V**
- Thin Package:**
  - ü QFN-10, MSOP-10

DS

ES/Jan 05

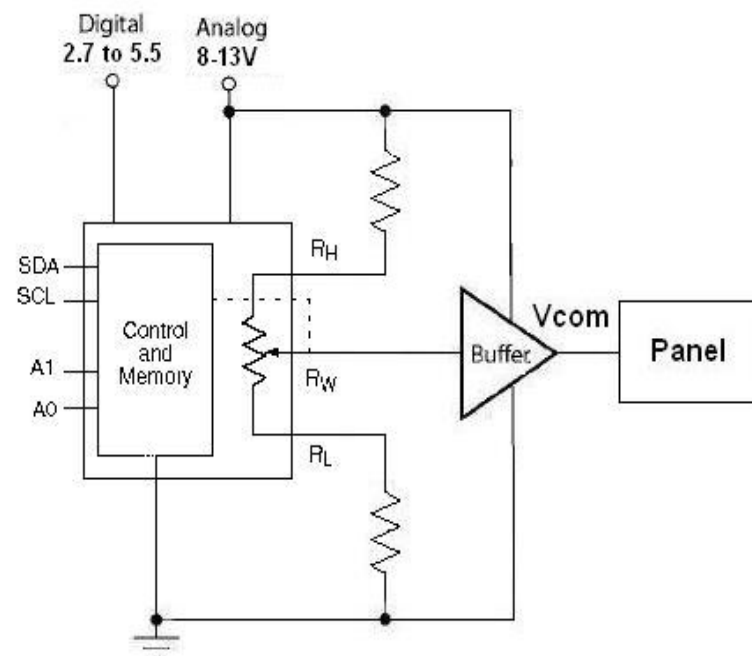
## Competitive Comparison

### BUF01900



- p Integrated Buffer: 100mA I<sub>out</sub>
- p High Resolution: 256 Steps
- p Wide Supply: 8-20V
- p Low Digital Supply: 2.0V

### Competition



- p Needs External Buffer
- p Low Resolution: 128 Steps
- p Narrow Supply Range: 8-13V
- p High Digital Supply: 2.7



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