

电视/电视机顶盒的电源设计解析

2017.11

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TV & Monitor Display Solutions

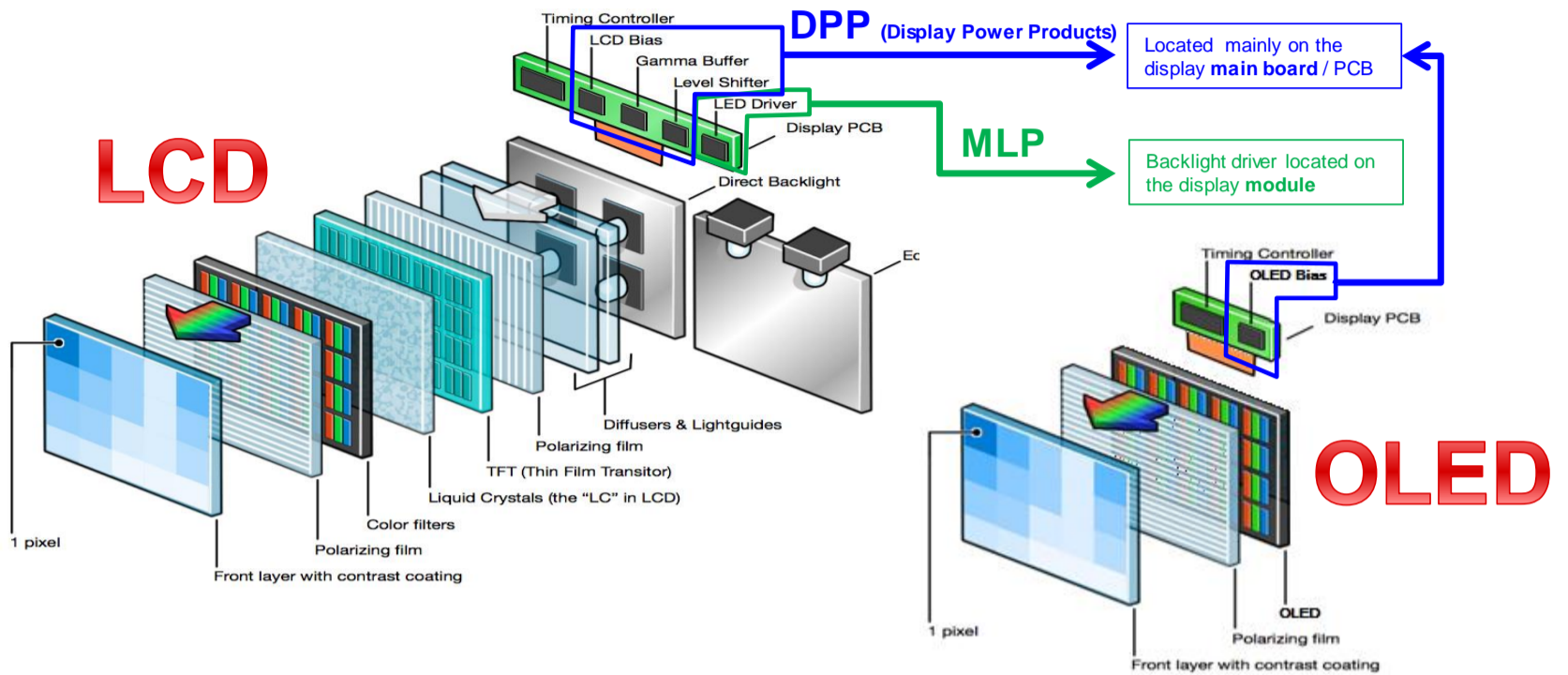
- LCD Bias, Level Shifters, Gamma Buffers

Nov 2017

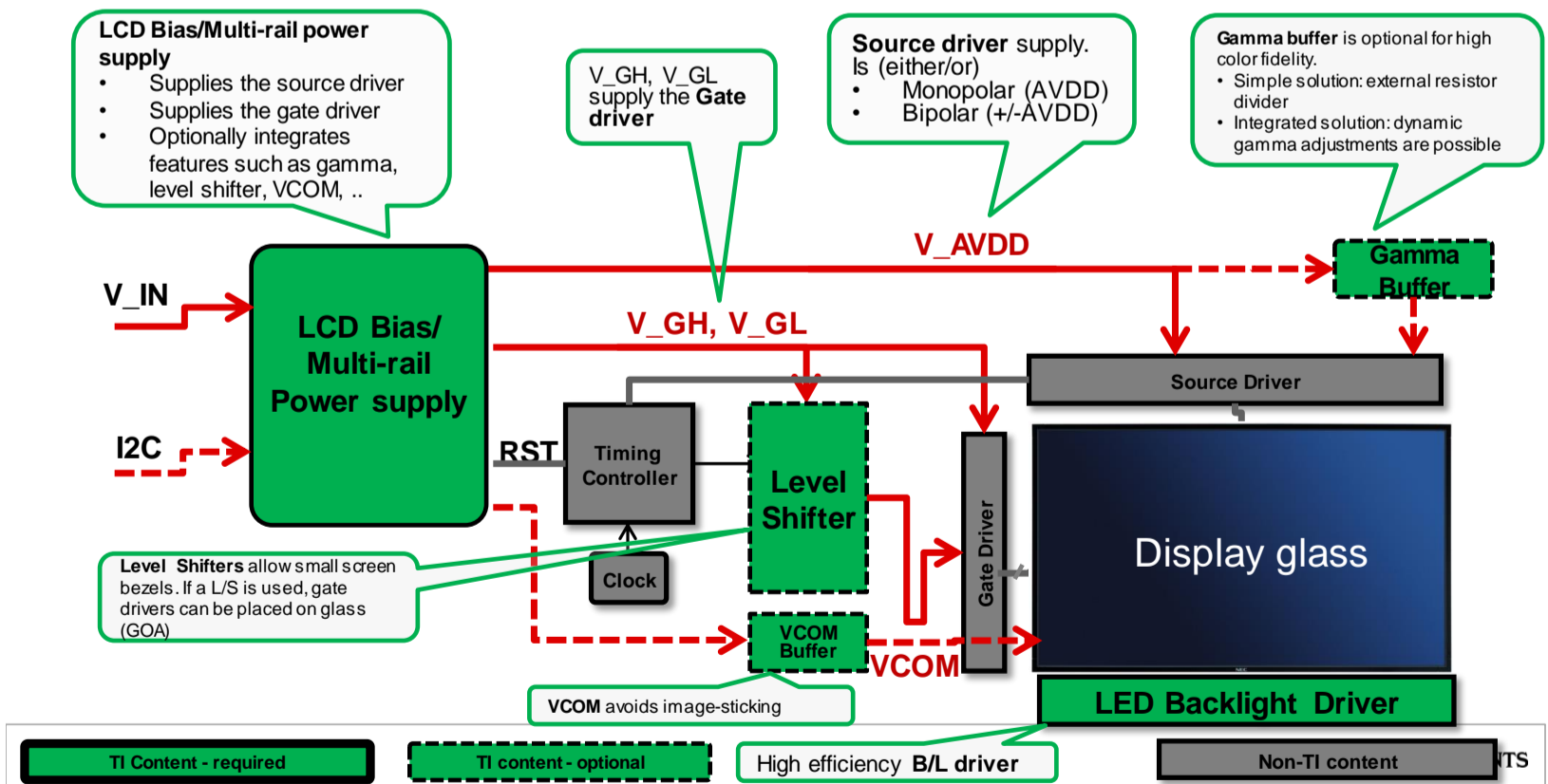
Max Han

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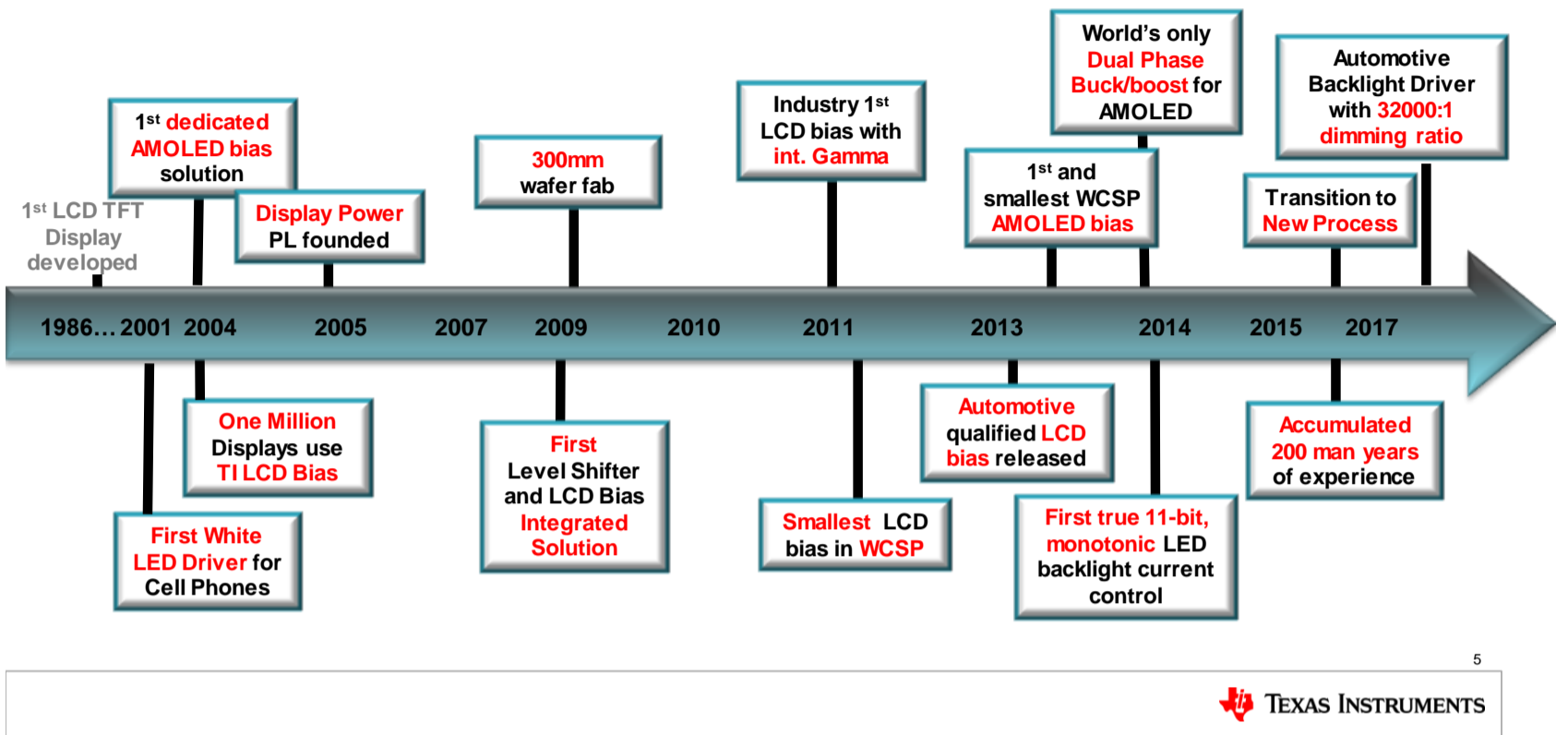
DPP AMOLED and LCD Display Solutions



Typical LCD Display Subsystem



TI Milestones of Display Expertise



LCD TV – why choose TI?

LCD Bias PMIC

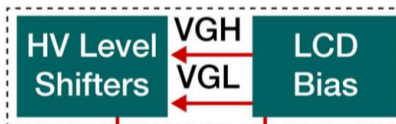
TPS6517x, TPS6516x

Power supply rails for Gate & Source drivers
50% market share in China & Korea
 Covering all WW TV panel makers & OEMs
~HALF BILLION units shipped!

Stand alone Level Shifters

TPS6519x

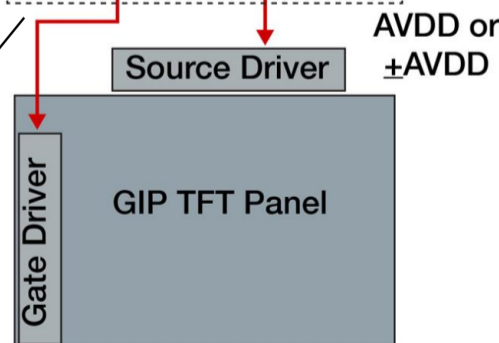
Support for Gate-in-panel (GIP) displays to enable narrow bezels
 Detailed timing knowledge used to match LS to specific panel/source driver.
>157Mu shipped & growing....



LCD Bias PMIC with integrated Level Shifter

TPS65175, TPS65163

Perceived as WW technology leader
 Complex PMICs with integrated Level shifters & Gamma buffers enable small solution size
>77Mu shipped to WW #1 panel maker



- ✓ Complete solution for LCD (Bias + LS + Gamma)
- ✓ Proven in production
- ✓ Technical support
- ✓ Competitive price

TPS65177 + TPS65197 on top panel maker reference design

TPS65175C: Fully Programmable LCD Bias IC for GIP TV with Integrated 12-Ch Level Shifters and 6-Ch Gamma Buffers

Features

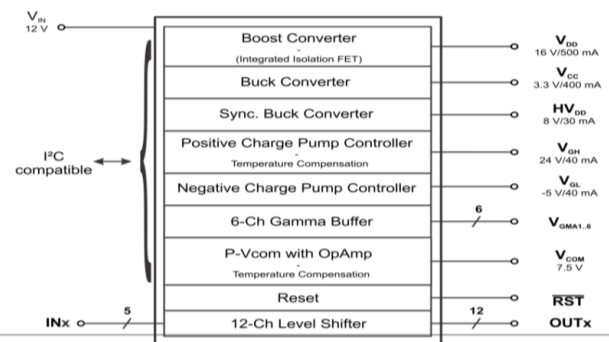
- 8.6V to 14.7V Input Voltage Range
- Boost Converter VDD: 12.7V...19V (6-Bit)
- Integrated Input-to-Output Isolation Switch
- Buck Converter HVDD: VDD Tracking
- Buck Converter VCC: 1.6V...2.0V & 3.0V...3.6V (4-Bit), 1.8V dft
- Positive Charge Pump VGH:
 - 19V...34V for Low Temperature (4-Bit)
 - 17V...32V for High Temperature (4-Bit)
- Negative Charge Pump VGL: -1.8V...-8.1V (6-Bit)
- 6-Ch Gamma Buffer:
 - 3-Ch: VDD...HVDD (9-Bit)
 - 3-Ch: HVDD...GND (9-Bit)
- 9-Bit VCOM Reference
- 3-Bit VCOM Gain
- VCOM_DAC Output for External Operational Amplifier Reference (TPS65175C specific)
- Temperature Compensation for VGH and VCOM
- Reset Signal with Programmable Delay Time
- Programmable Sequencing Delays (4 x 3-Bit)
- Thermal Shutdown
- 12-Channel Level Shifters:
 - Supports Forward and Reverse Operation
 - Abnormal Operation Detection
- 56-Pin 7-mm x 7-mm QFN Package

Applications

- LCD GIP/GOA TVs
- LCD GIP/GOA Monitors

Benefits

- 1st TI device integrating the LCD bias, the 12ch level shifters and the gamma buffer, combining TPS65178 & TPS65198, saving the 4x4mm² package of TPS65198 + routing
- Very small device that use 3 high frequency converters which can be used with chip inductors (cheaper & smaller than wire wounded inductors)
- Better control of startup of the boost and short circuit & reduces the BOM
- I2C Programmability allows for :
 - Easy PCB layout (no resistor divider to set output voltages)
 - Flexible solution (1 BOM for all panels)



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TPS65177: Fully I2C programmable 6-Ch LCD Bias IC for all size TVs including Gate Pulse Modulation

Can be used in conjunction with the TPS65197 level shifter

Features

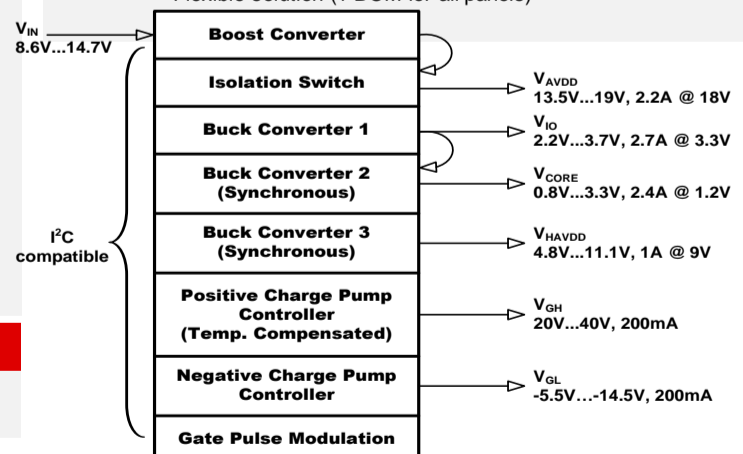
- Gate Pulse Modulation (GPM)
- Temperature Compensation for VGH
- 40-Pin 6x6 mm QFN Package
- I2C compatible Interface
- Input Voltage 8.6V...14.7V
- Integrated VAVDD Isolation Switch
- 6-bit Boost Converter VAVDD: 13.5V...19.8V
 - 3-bit prog. Switch Current Limit up to 4.25A
 - 4-bit prog. High Voltage Stress Mode
 - 1-bit prog. Soft-start
- 6-bit Sync. Buck VHAVDD: 4.8V...11.1V
 - 1.7A Switch Current Limit
 - 4-bit prog. High Voltage Stress Mode
- 4-bit Buck Converter VIO: 2.2V...3.7V
 - 3A Switch Current Limit
- 5-bit Sync. Buck VCORE: 0.8V...3.3V
 - 2.5A Switch Current Limit
- 4-bit Charge Pump Controller VGH: 20V...40V
 - 4-bit temp. Compensation Offset 0V...15V
- 4-bit Charge Pump Contr. VGL: -5.5V...-14.5V
- Thermal Shutdown

Applications

- GIP (Gate-in-Panel) LCD TVs
- Non-GIP LCD TVs

Benefits

- Enables non GIP TVs
- Enables GIP TVs
 - Polyvalent LCD bias enabling all TVs independently of the panel technology used
- Very small device that use 3 high frequency converters which can be used with chip inductors (cheaper & smaller than wire wounded inductors)
- I2C Programmability allows for :
 - Easy PCB layout (no resistor divider to set output voltages)
 - Flexible solution (1 BOM for all panels)



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TPS65178:

Fully programmable LCD Bias IC for TV with 6-Ch Gamma Buffers, Vcom and Dynamic Gain

Can be used in conjunction with the TPS65198 level shifter

Features

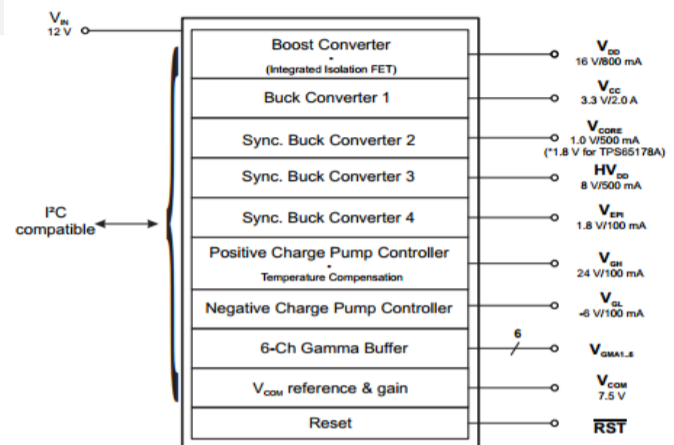
- 6-Ch Gamma Buffer
- 48-Pin 6x6 mm QFN Package
- Integrated isolation FET
- I2C Programmable sequencing delays (3 x 3 bits)
- 9-bit VCOM reference
- 2-bit VCOM gain
- 8.6 to 14.7V Input voltage range
- Integrated input-to-output isolation switch
- Rails:
 - Boost converter VDD: 12.8V...19V (6-Bit)
 - Buck converter HVDD: VDD tracking
 - Buck converter VCC: 3.0V...3.7V (3-Bit)
 - Buck converter Vcore: 0.9V...2.4V (4-Bit)
 - Buck converter VEPI: 0.9V...2.4V (4-Bit)
 - Positive charge pump controller VGH with temperature compensation: 19V...34V (4-Bit)
 - Negative charge pump controller VGL: -1.8V...-8.1V (6-Bit)
- Selectable dynamic gain feature
- Reset signal with programmable delay time
- Thermal Shutdown

Applications

- LCD TVs
- LCD monitor

Benefits

- 1st TI device integrating the LCD bias and the gamma buffer, combining TPS65168 & BUF08630, saving the 5x5mm² package of BUF08630 + routing
- Very small device that use 3 high frequency converters which can be used with chip inductors (cheaper & smaller than wire wounded inductors)
- Better control of startup of the boost and short circuit & reduces the BOM
- I2C Programmability allows for :
 - Easy PCB layout (no resistor divider to set output voltages)
 - Flexible solution (1 BOM for all panels)



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TPS65197 / 97B:

8-Channel Level-Shifter supporting 2- & 3-Channel Charge-Sharing & Panel Discharge

Works perfectly with the TPS65177 bias power solution

Features

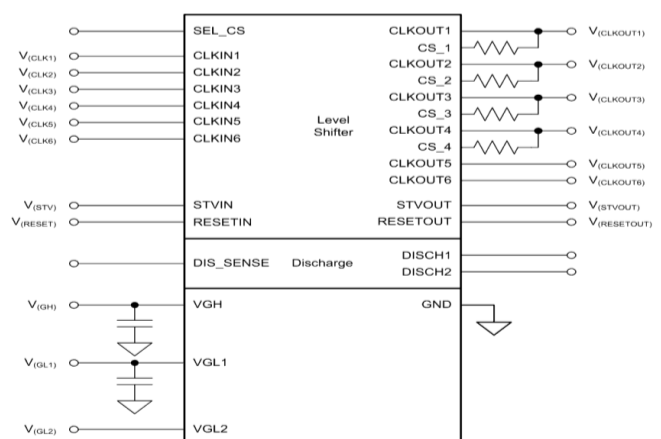
- 8- Channel Level-Shifter Supporting 6 x CLK, STV, RESET
- Supply Voltage Range: 16.5 to 45 V
- VGH Range (High Output-Voltage Level): 16.5 to 45 V
- VGL Range (Low Output-Voltage Level): -20 to 0 V
- Selectable Charge-Sharing Options
 - No Charge-Sharing
 - 2-channel Charge-Sharing
 - 3-channel Charge-Sharing
- 2-Channel Panel Discharge
- T-CON Failure Detection
 - TPS65197 (Failure Recovery: Reset Every Frame)
 - TPS65197B (no Reset)
- Shut-down Detection (Latched)
- Supports 100 kHz Clock Operating Frequency
- 28-pin 4x4 mm QFN package

Applications

- PC/Notebooks
- TV
- General Gate-in-Panel (GIP) TFT-LCD Applications

Benefits

- Charge-Sharing for Power Savings
- Improved Picture Quality by Charge-Sharing
- Active Panel Discharge Avoids Panel Flash at Shutdown
- Flexibility by three Charge-Sharing Options
- Latched Shut-down Detection Results in Proper Discharge



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TPS65198: 13-Channel Level Shifter with Op-Amp for LCD TVs and Monitors

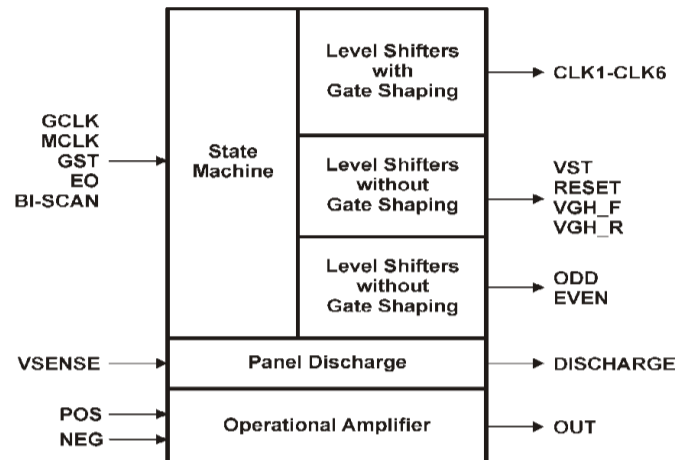
Can be used in conjunction with the TPS65178 bias

Features

- Built-in state machine
- **Six CLK outputs with Gate Shaping**
- VST and RESET outputs
- ODD and EVEN outputs
- VGH_F and VGH_R outputs
- 28-Pin **4x4 mm** QFN Package
- **Panel DISCHARGE output**
- **Supports forward and reverse operation**
- Abnormal operation detection
- Supports all display resolutions
- High-speed operational amplifier for **buffering the VCOM voltage**
 - **high slew rate**
 - **high output current**
 - **wide bandwidth**

Benefits

- **Integrated state machine reduces the number of connections between T-CON and level shifter from 12 to 5**
- Package is 36% smaller than existing devices (4x4 mm vs. 5x5 mm) and it includes additional VCOM buffer function



Applications

- LCD TVs and monitors using GIP technology

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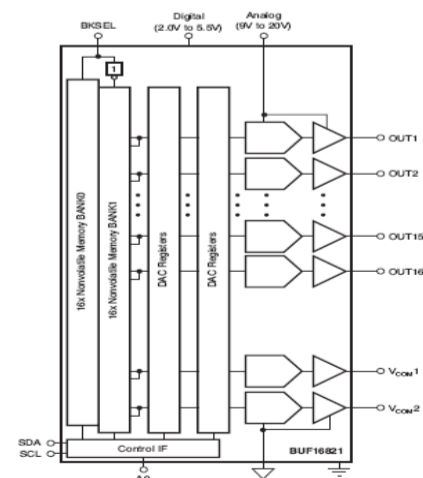
BUF16821: Multi-Channel 10-Bit Multi-Time Programmable Voltage Source

Features

- **10-Bit DACs**
- 16x MTP Memory
- Double Buffered Registers
- **2 Banks with Bank Select**
- Excellent Output Current Drive:
 - **16 Gamma Channels:** 30mA
 - **2 VCOM:** 100mA
- **Rail-to-Rail: Output**
- Analog Supply: 9V to 20V
- Digital Supply: 2.0V to 5.5V
- **I2C Interface**
- Packages
 - TSSOP-28 (PowerPad)

Benefits

- Non-Volatile Memory allows for system calibration
- **Bank Select allows for switching output bias levels on the fly**
- **Double buffering allows time for programming each channel, then loading simultaneously**



Applications

- LCD Panel
 - VCOM Calibration
 - Gamma Correction
- Potentiometer Replacement

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Thank you

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