

Maxim Automotive product update

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Agenda

1 Automotive power

2 LED lighting

3 Display Power

4 Q & A

AVNET[®]

Reach Further[™]

1 Automotive power

2 LED lighting

3 Display Power

4 Q & A

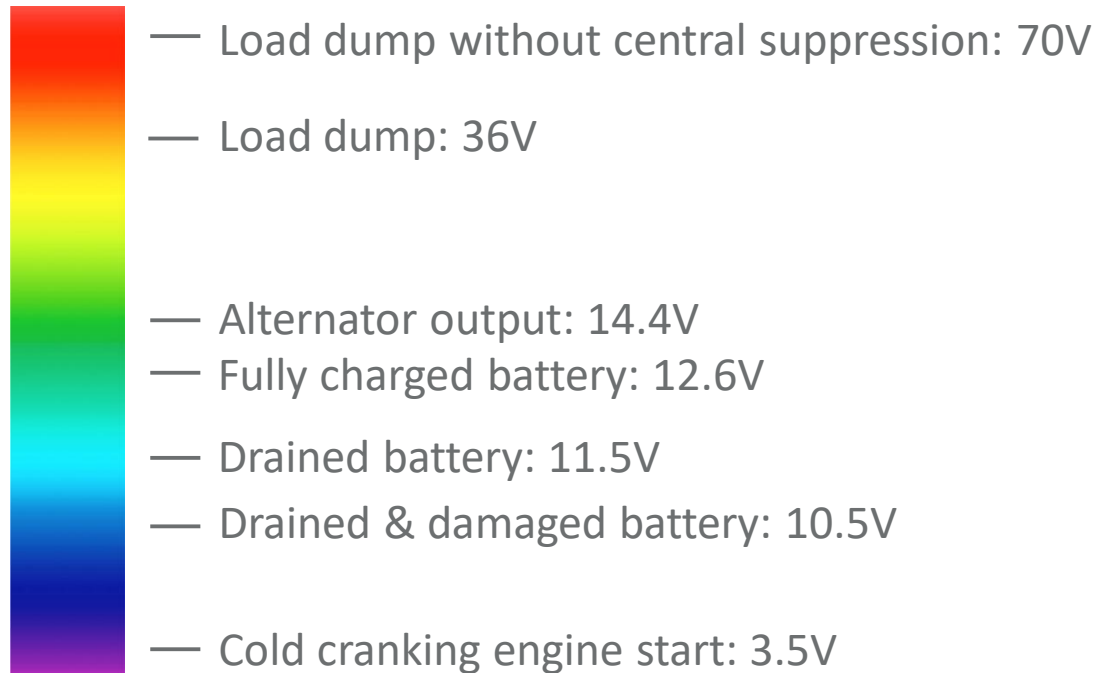
AVNET[®]

Reach Further[™]

Why is Automotive Power Different?

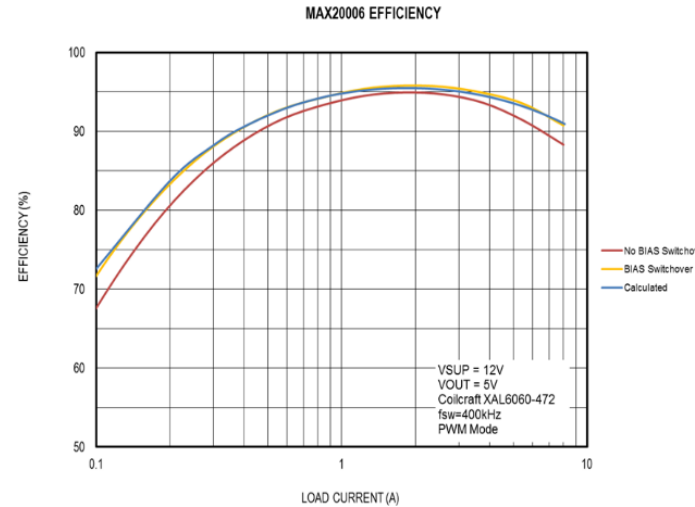
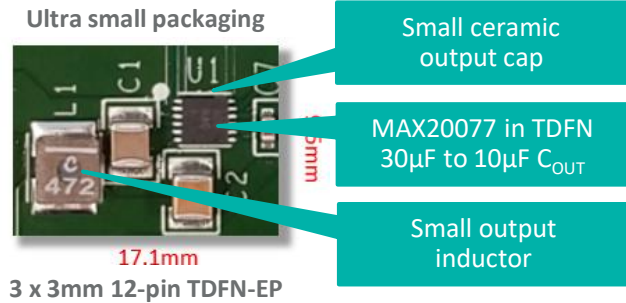
The problem with car battery

- What do you think of when you hear “car battery”?
 - > Hint: it’s not a 12V battery
- The actual car battery voltage range:

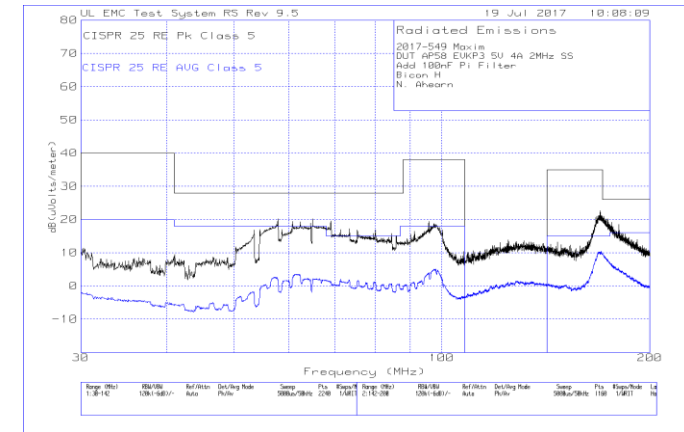


Maxim Automotive Power Solutions

Improve performance & reduce solution cost



Radiated emissions: MAX20006 SS=ON



Cost effective & small size

- 2MHz Fsw reduces inductor & capacitor sizes
 - > 60% smaller footprint typical
 - > Avoids AM radio interference
 - > Faster load transient response
- Internal compensation simplifies design & reduces footprint

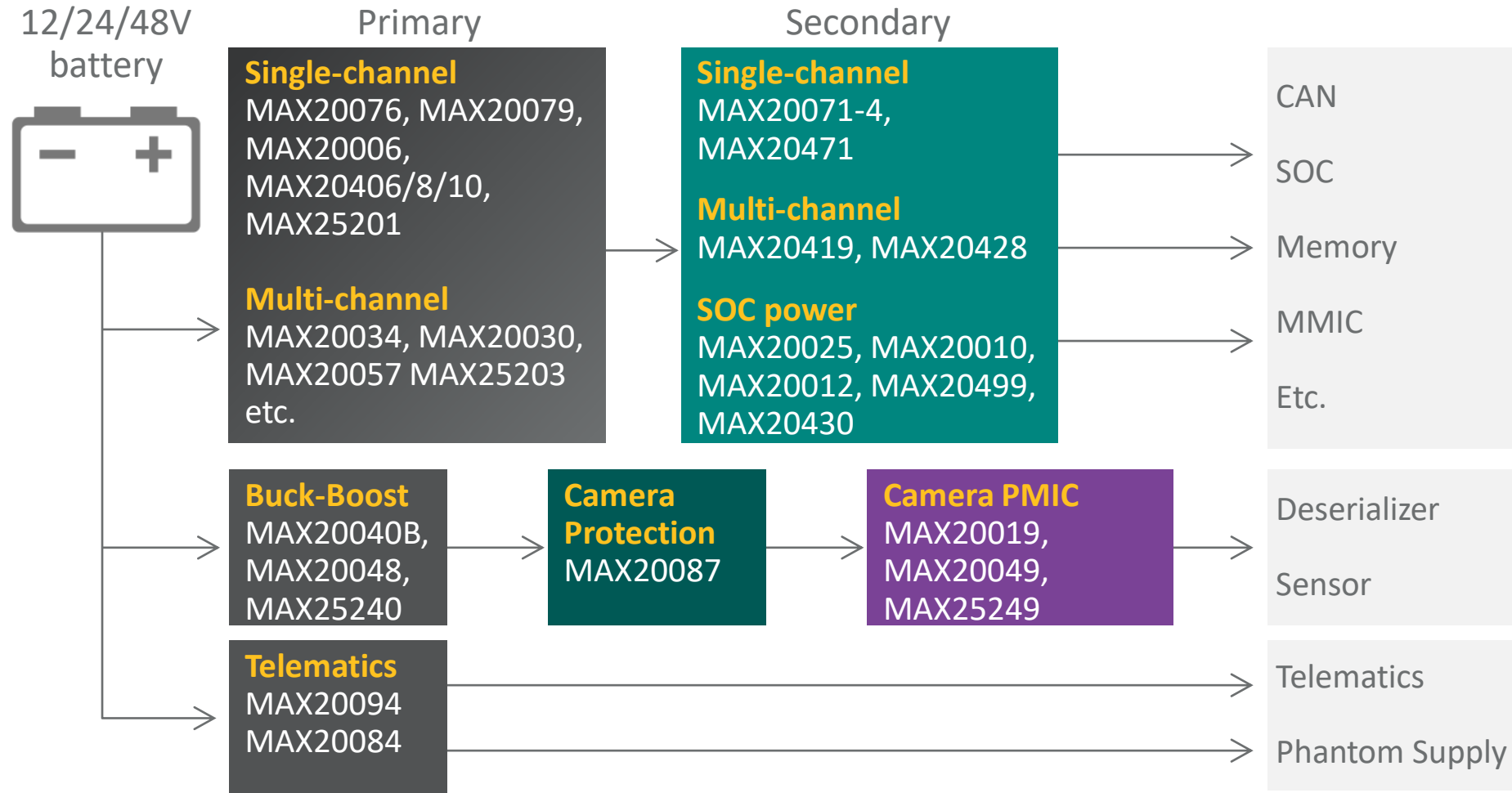
High efficiency & power

- Family of high-voltage DC/DC converters up to 8A
 - > Up to 95% efficient @ 5V_{OUT}
- Low quiescent current
 - > MAX20075: 3.5µA I_Q
- Integrated power FETs reduce solution size & cost

EMI reduction

- Features that lower and mitigate EMI emissions
- Spread Spectrum
- PWM for constant frequency
- Slow gate LX transition speed
- 2MHz Operation
- Forced PWM and external sync

Maxim Automotive Infotainment Power Portfolio



MAX20057: Dual Sync Buck Converter + ASync Boost Controller

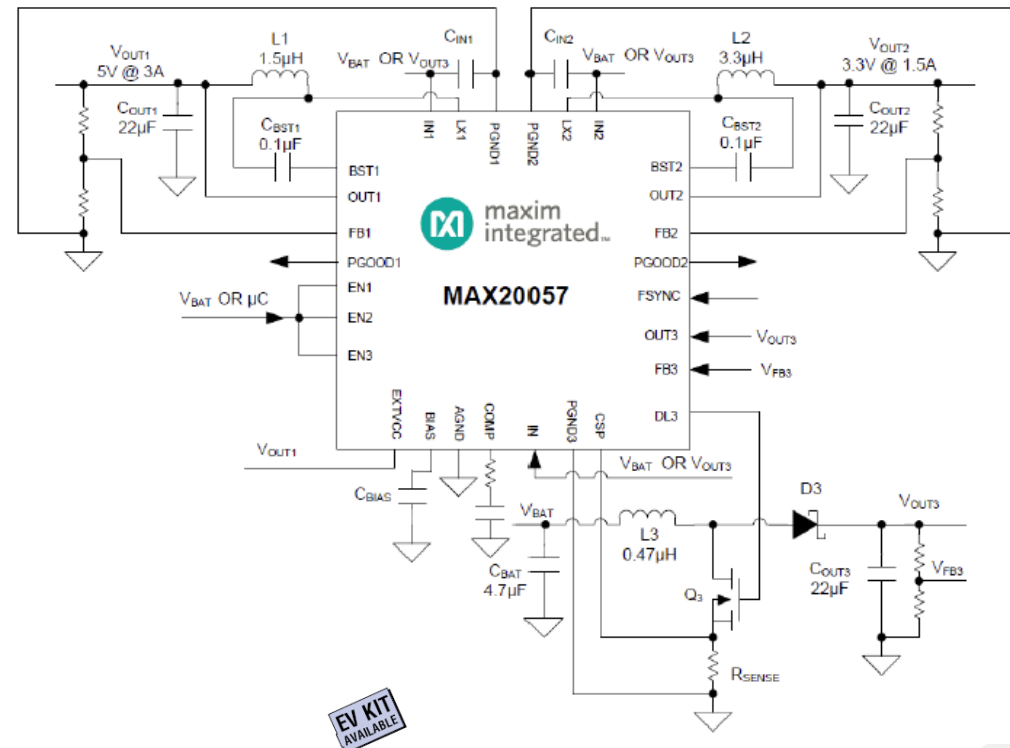
40V, 5uA Iq

Benefits/Features

- **Small Solution**
 - 2V to 40V Supply Voltage (40V tolerant)
 - Fixed output 3.3V/5V and 1% ref on FB pin
 - Adjustable Vo 1V to 10V
 - Non-Sync Boost controllers and sync Buck converters
 - 400kHz and 2.1MHz Fsw option
 - Low 20ns minimum on time
 - **PGOOD Output (94% ± 2%)**
 - SYNC Input
 - Buck1 3.5A & Buck2 2A
 - Small 5x5mm 28-SWTQFN-EP Package
- **Efficient**
 - **Low IQ of 5µA @ Vout 5V no load**
 - <10uA Shutdown current
- **Quiet-Low Noise**
 - 2.1MHz switching frequency above AM band
 - Forced PWM and Skip Mode Operation
 - Spread Spectrum Oscillator
- **AEC-Q100, Temp Range: -40°C to +125°C**

End Applications

- Instrument Clusters – PMIC for Mid-low power clusters
- Infotainment systems
- Telematics



MAX20049: Ultra Small Mid Voltage Dual Output Buck Converters

17V 2.2MHz, 500mA/1.2A Buck + 400mA LDO +150mA LDO

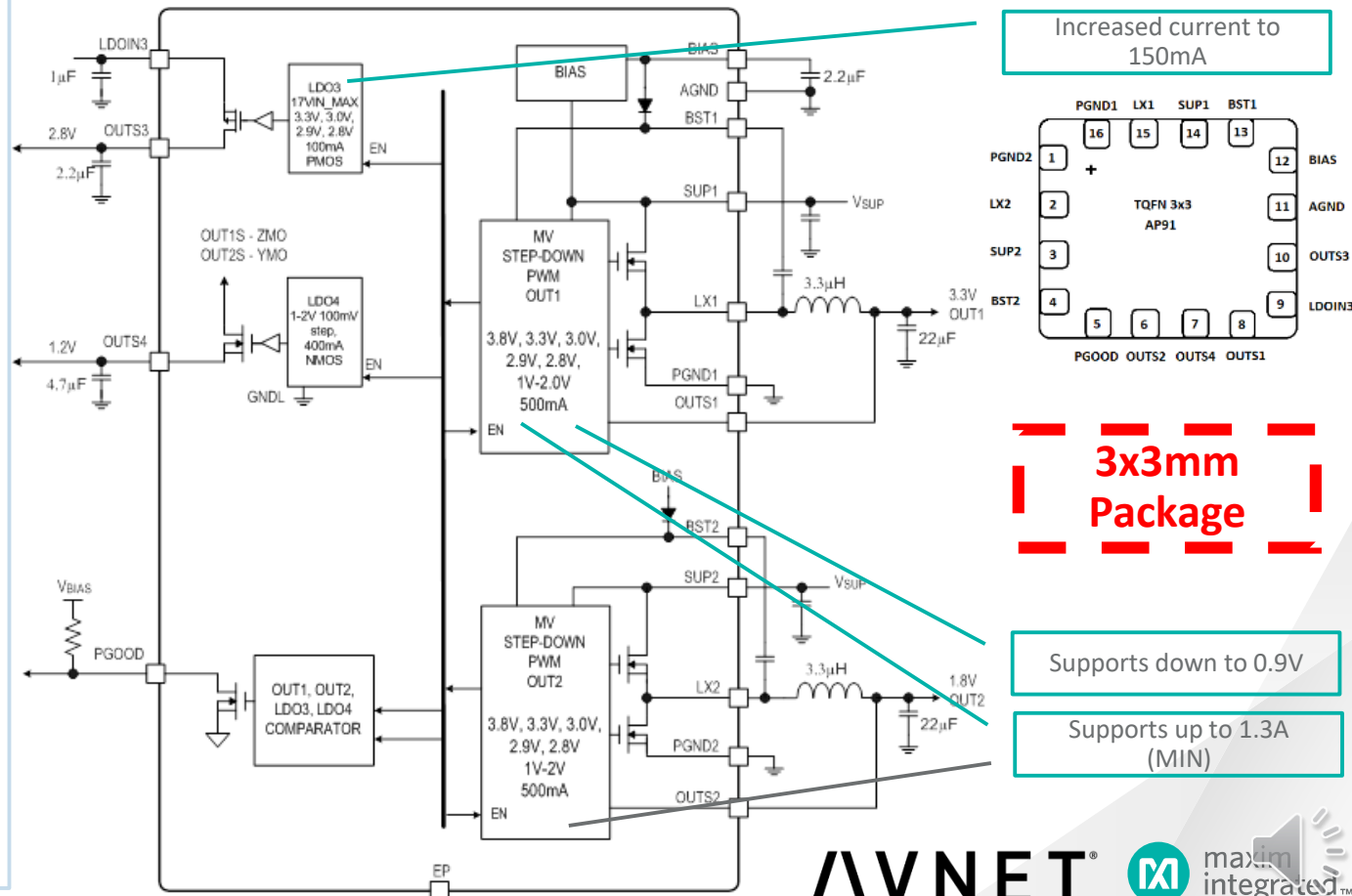
Benefits/Features

- **Small Solution**
 - Vin 5V to 17V [ABS MAX 18V]- MAX20049
 - Vin 4V to 17V [ABS MAX 18V] – MAX20049D
 - SW TQFN 16pin 3mm x 3mm
 - 17V LDO1 3.3V, 3.0V, 2.8V, 2.9V, 2.7V
 - 5V 400mA Low Noise LDO
 - LDO3 (150mA) input for reduced power loss
 - Buck1 and Buck2 output current
 - – 500mA – MAX20049
 - – 500mA & 1.2A – MAX20049D
 - +/-3% over full load and temp
 - Soft Start Time to Reduce Inrush in Coax 1msec
 - OV/UV Protection on Buck1, Buck2, and LDOs
 - PGOOD output for LDO and Buck rails
- **Efficient**
 - OUT1 & 2 ~ 90% efficiency
 - OUT1 and OUT2 operates 180 degrees out of phase
- **Quiet-Low Noise**
 - High PSRR Low Noise LDO
 - Fixed 2.2MHz Switching Frequency
 - Spread Spectrum Option
- **AEC-Q100, Temp Range: -40°C to +125°C**

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End Applications

- Remote camera module
- Forward/rear/side-view camera



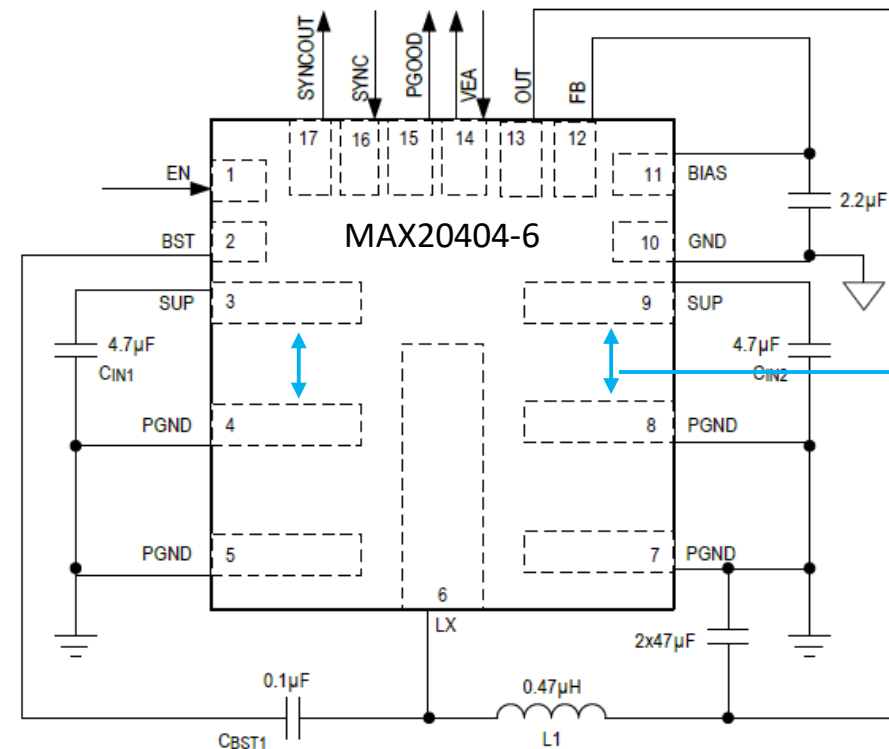
MAX20404/MAX20405/MAX20406 –Synchronous HV Step-Down Converter - 36V, 4A/5A/6A, 400kHz/2.1MHz/3.1MHz

Benefits/Features

- **Small Solution**
 - Operating Vin range: 3.5V to 36V (40V tolerant)
 - Iout = 4A/5A/6A
 - Integrated internal high- and low-side switches
 - 99% maximum duty-cycle with low dropout
 - VOUT: 3.3V and 5.0V (Fixed)
 - Contact factory for other output voltages
 - 3.1MHz, 2.1MHz and 400kHz fixed frequency operation
 - Low 40ns minimum on-time
 - Power-good output, current limit, thermal shutdown, and overvoltage protection
 - Adjustable Vout: 0.7V to 10V, +/- 2% Vout accuracy
 - 17 Pin FC2QFN package
- **Efficient**
 - Less than 1uA (typ.) in shutdown
 - Low 7µA (typ.) operating current in skip mode at 3.3Vout
- **Quiet**
 - 2.1MHz operation prevents AM band interference and minimizes external component size
 - Optional spread spectrum frequency modulation
- **AEC-Q100, Temp range: -40°C to +125°C**

End Applications

- Instrument Clusters
- Point-of-Load
- Distributed DC Power Systems



1mm
isolation
between
SUP and
PGND

MAX20408-MAX20410 –Synchronous HV Step-Down Converter

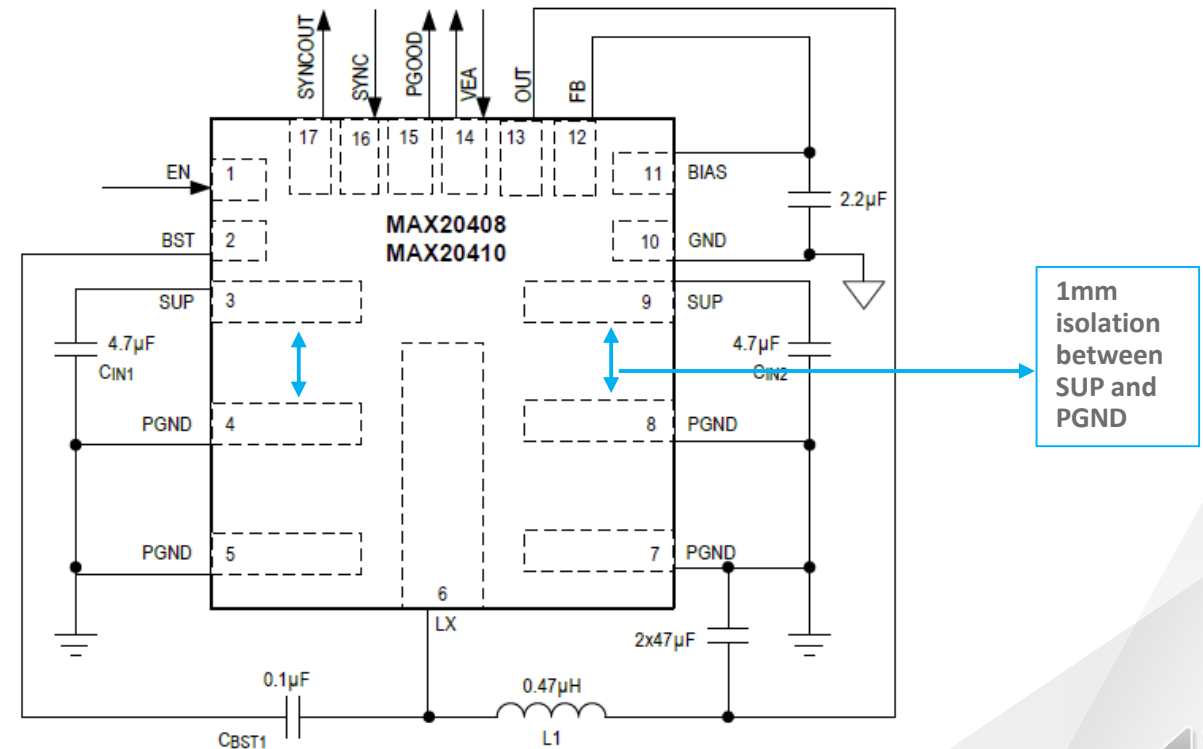
36V, 8A/10A, 400kHz/2.1MHz

Benefits/Features

- **Small Solution**
 - Operating Vin range: 3.5V to 36V (40V tolerant)
 - Iout = 10A
 - Integrated internal high- and low-side switches
 - 99% maximum duty-cycle with low dropout
 - VOUT: 3.3V and 5.0V (Fixed)
 - Contact factory for other output voltages
 - 2.1MHz and 400kHz fixed frequency operation
 - Low 40ns minimum on-time
 - Power-good output, current limit, thermal shutdown, and overvoltage protection
 - Adjustable Vout: 0.7V to 10V, +/- 2% Vout accuracy
 - 17 Pin FC2QFN package 3.5x3.75mm
- **Efficient**
 - Less than 1uA (typ.) in shutdown
 - Low 7µA (typ.) operating current in skip mode at 3.3Vout
- **Quiet**
 - 2.1MHz operation prevents AM band interference and minimizes external component size
 - Optional spread spectrum frequency modulation
- **AEC-Q100, Temp range: -40°C to +125°C**

End Applications

- Instrument Clusters
- Point-of-Load
- Distributed DC Power Systems



MAX20029: Quad Low-Voltage Step-Down Converters

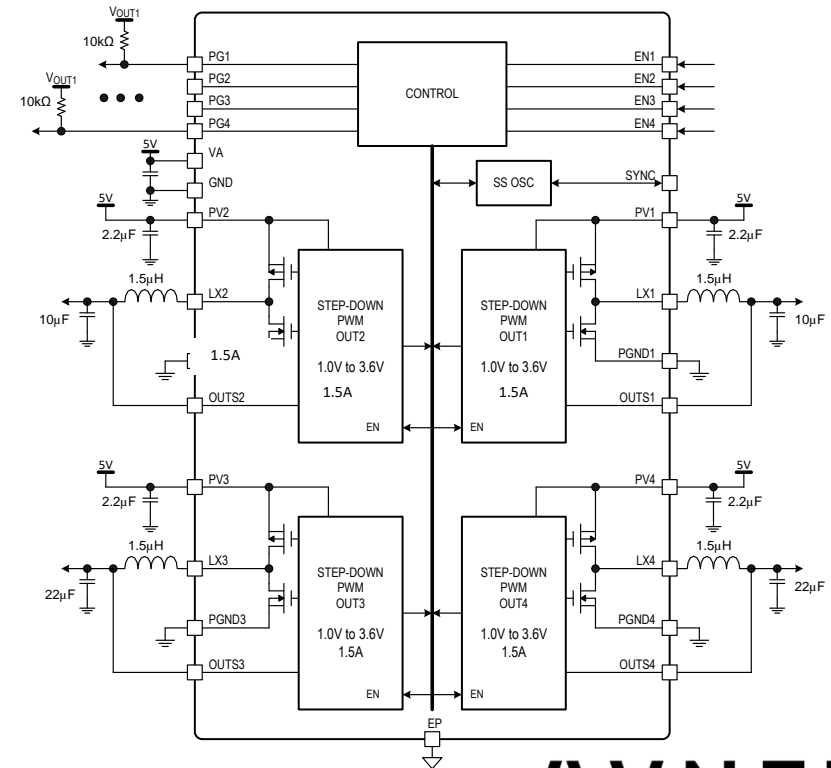
5.5Vin 4x 1.5A Quad Output

Benefits/Features

- **Small Solution**
 - Vin 3.0V to 5.5V
 - Vout 1.0V to 4.0V
 - Four-channel step-down converters
 - Outputs 1 & 2: 1.5A each
 - Outputs 3 & 4: 1.5A each
 - Each channel has an independent enable pin
 - All FETs integrated
 - 66ns (max) minimum on-time
 - Factory-preset or adjustable output voltages
 - 28pin 5mm x 5mm TQFN package
- **Quiet-Low Noise**
 - 2.2MHz switching frequency
 - Forced PWM
 - Spread-spectrum option
 - Reduced gate speed to minimize noise emissions
- **AEC-Q100, Temp Range: -40°C to +125°C**

End Applications

- Automotive infotainment systems
- Multi-channel point-of-load regulation



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Driver Monitoring System Trends

Increasing peak power

Up to 5A LED current,
2-4 LEDs, 1+ LED strings

Tiny camera modules and ECU boards allow for unobstructed camera views

Placement of camera in steering wheel column, A-pillar, CID

Migration from rolling shutter to global shutter sensors

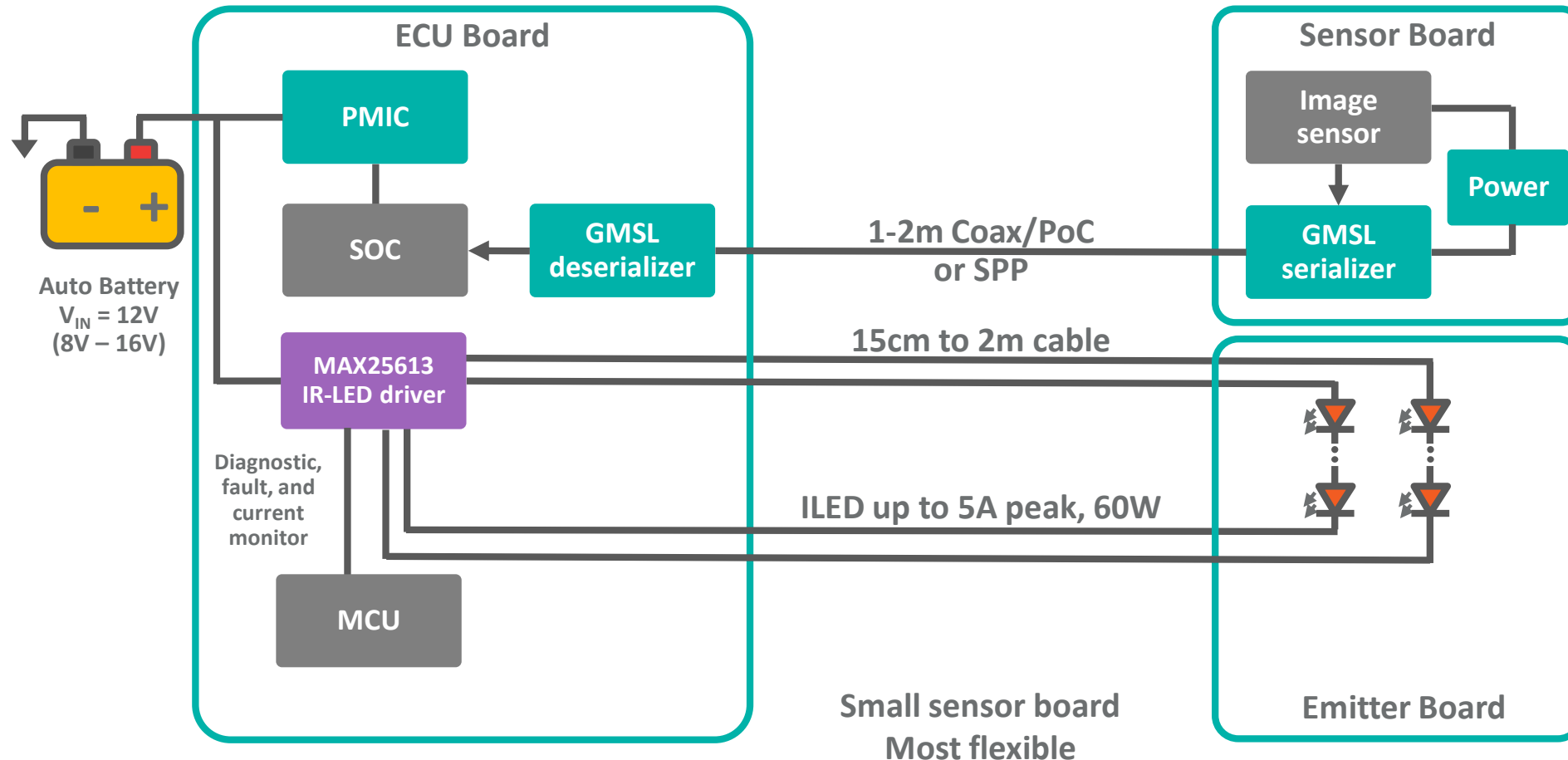
For optimum system efficiency and FPS

Higher resolution functions

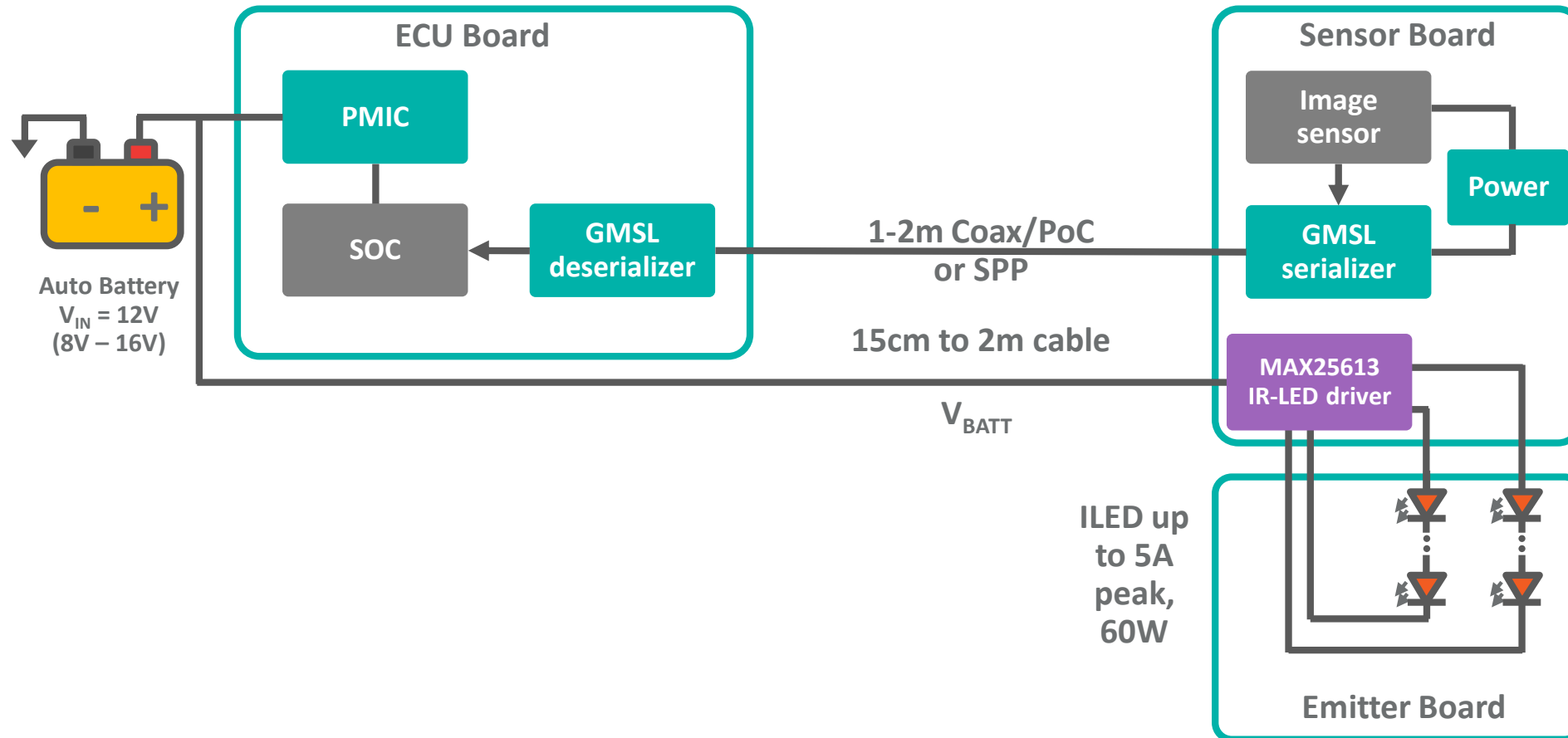
Multiple driver states
Higher accuracy
Lower number of false faults

DMS System Block Diagram Example

MAX25613 Solves voltage drop due to high input currents in this topology

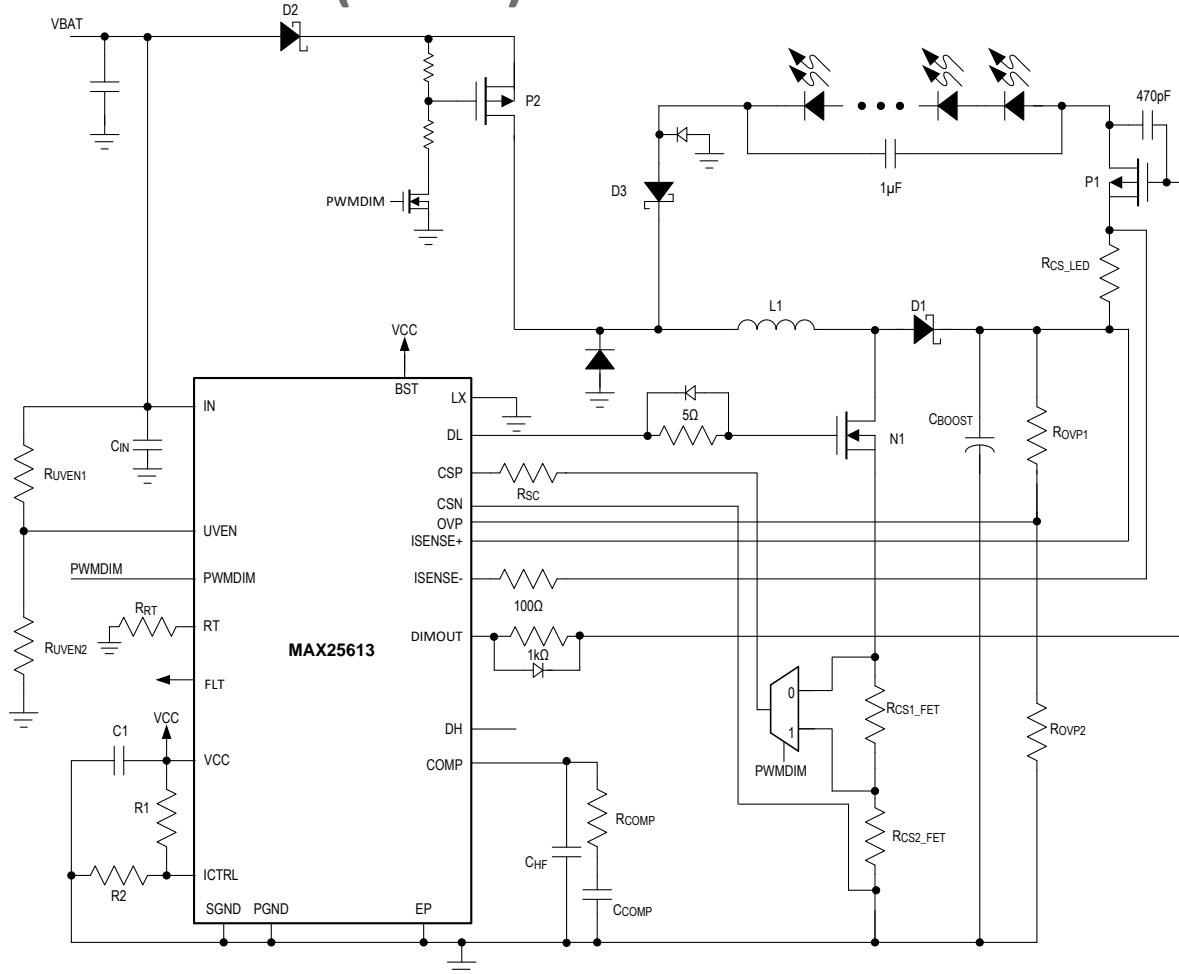


DMS System Block Diagram Alternative



Automotive IR-LED Controller for Driver Monitoring Systems

MAX25613 (Gen 1)



Status: Production Q4 2019
Samples Available

Benefits

- **Reduced BOM:**
 - Integrates boost DC/DC converter and buck LED driver
 - Shared external MOSFET & inductor between boost and buck stages
 - Programmable switching frequency 200kHz to 2.2MHz
 - Compact SW-TQFN20 4x4 package
- **EMI reduction:** Integrated spread spectrum

Features

- Wide Vin: 5V to 48V, Vout: 65V boost output
- Integrated PMOS dimming FET gate driver (allows single wire connection to the LED string)
- Full scale high side current sense voltage of 200mV
- Analog, PWM Dimming
- Fault flag, LED terminal short to battery and short to ground protection, overvoltage and thermal protection

1 Automotive power

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3 **Display Power**

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Display Power for Display Applications

Bigger Higher Res



Applications Needs

- Higher luminance
- Higher Current
- More Channels

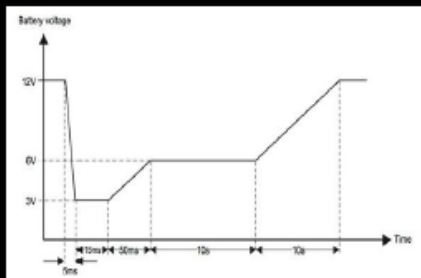
Top Parts

- MAX20446
- MAX20056
- MAX20067
- **MAX25221**

Upcoming Parts

- **MAX25501**

Lower Vin



Applications Needs

- Start-Stop
- Cold Crank

Top Parts

- MAX25014/24 (2.5V)

Upcoming Parts

- **MAX25510/1/2 (3V)**

Functional Safety



Applications Needs

- ASIL A/B
- Complete Diagnostics

Top Parts

- MAX25024
- **MAX25222**

Upcoming Parts

- **MAX25501**

Local Dimming Low EMI/EMC



Applications Needs

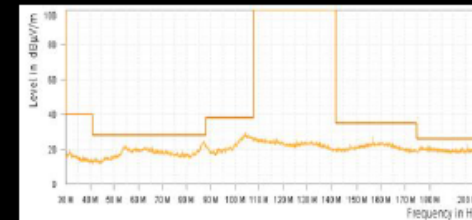
- High Contrast
- Less Fatigue
- Power Reduction

Top Parts

- MAX21610

Upcoming Parts

- **MAX25500/1**



Applications Needs

- Spread Spectrum
- Phase Shift
- 2.2MHz
- Hybrid Dimming

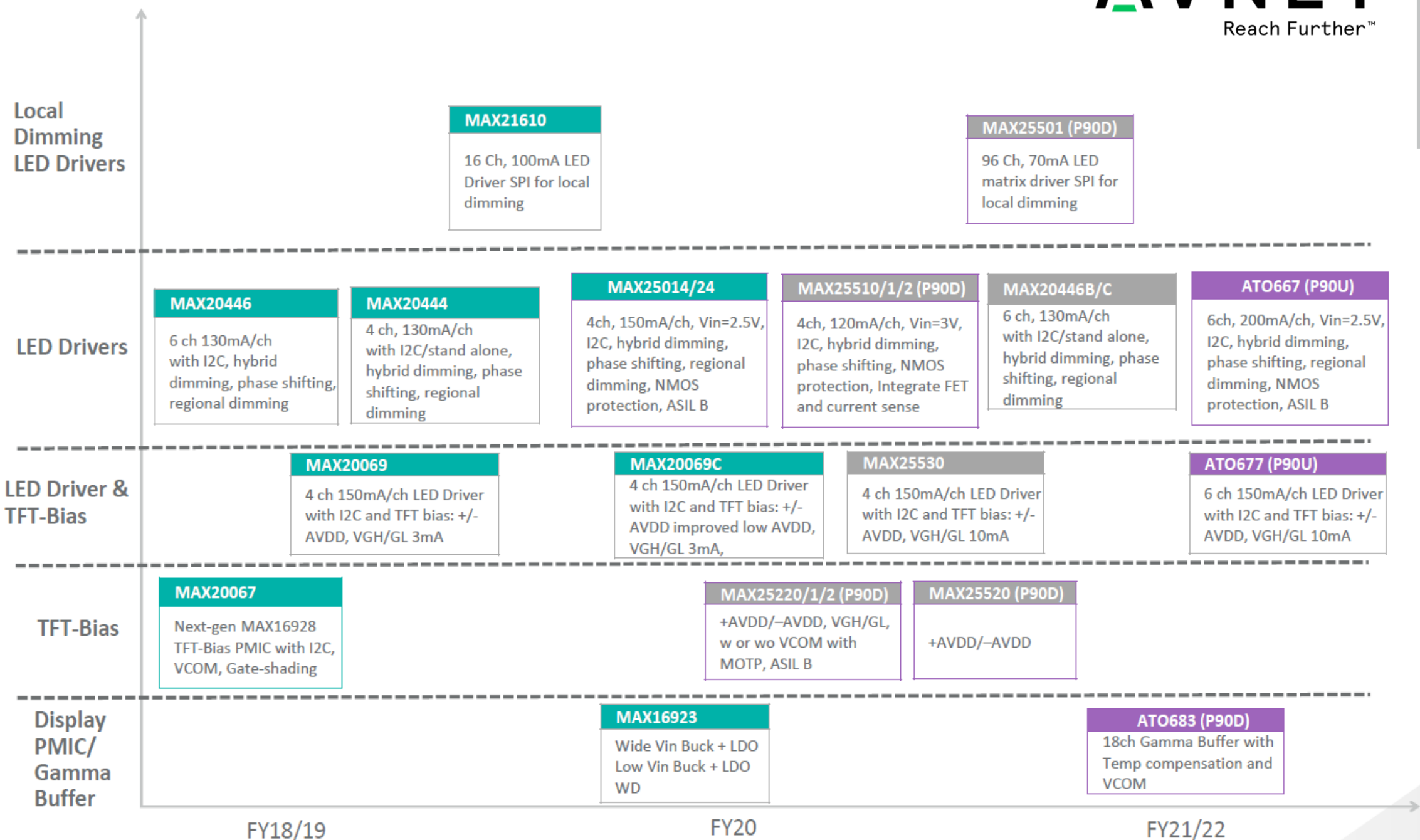
Top Parts

- MAX20444/6
- MAX20067
- **MAX25220/1/2**

Automotive Display Roadmap

Legend

- Production
- Development
- Concept



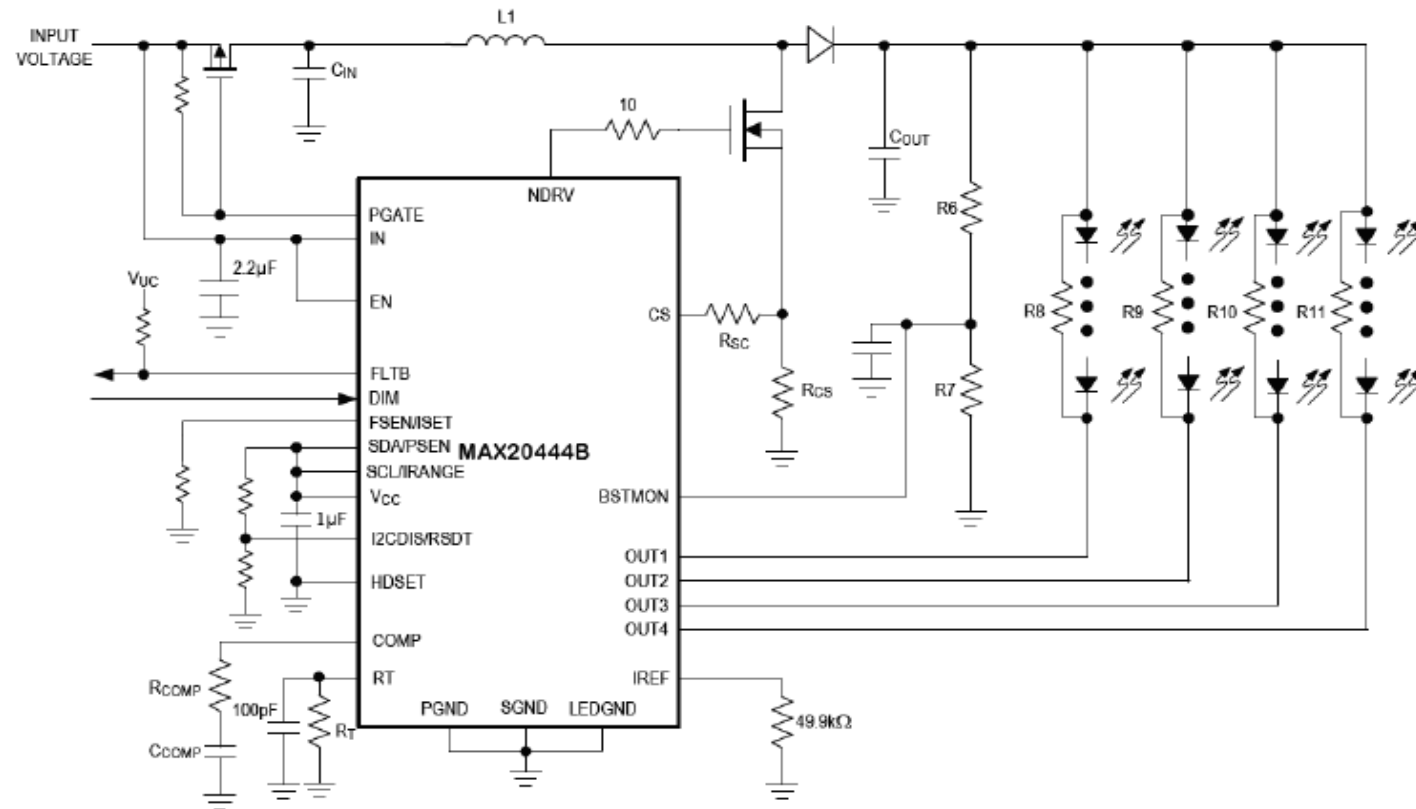
MAX20444: 4x 130mA LED Driver w/ Boost/SEPIC Cntlr, I2C, Hybrid Dimming

Benefits

- Minimum number of external components
- SEPIC and Boost Configurations Possible
- Fixed switching frequency with Spread-Spectrum

Benefits & Features

- Complete 4 channel Solution including Boost Controller, p2p compatible I2C control for minimum parts count
- Robust and low EMI
- Spread spectrum Oscillator
- Phase Shifting
- 400kHz to 2.2MHz Switching Frequency Range
- Fail-safe Operation Mode Using FSEN Pin
- Versatile Dimming Scheme allows Hybrid or PWM-Only Dimming using DIM input or I²C
- Dimming Ratio >10000:1 using Hybrid Dimming
- Complete Diagnostics:
 - LED Open/Short Detection & Protection
 - Boost Output Undervoltage & Overvoltage
 - Boost voltage
 - LED Current
- Thermal Shutdown
- Compact TQFN24 4mm x 4mm Package



Applications

- Automotive Instrument Clusters
- Automotive Displays

MAX25014/24: 4ch 150mA LED Driver with I2C, Hybrid Dimming

MAX25024

Features

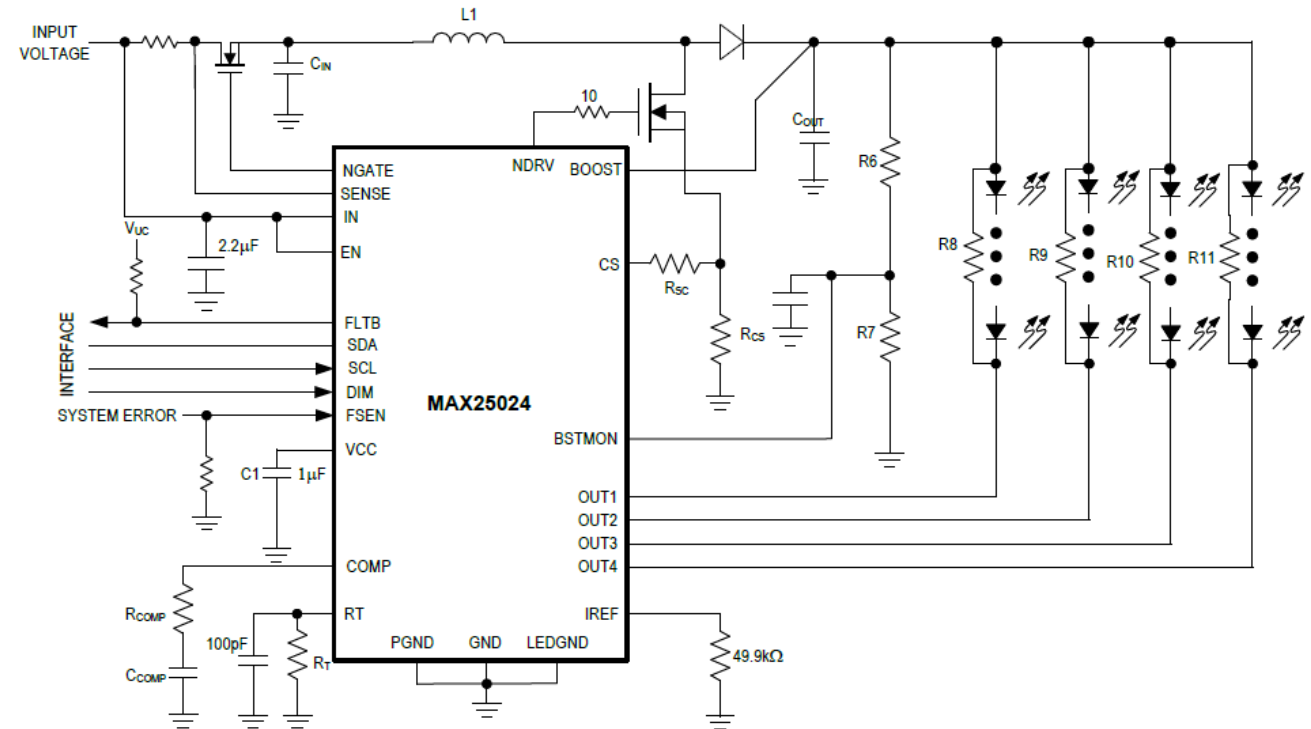
- Supports down to $2.5V_{BATT}$ after start up
- 2.5V to 36V Supply Voltage (40V Tolerant)
- 4 channel, 150mA current to drive LED
- NMOS input current protection
- Input current sense
- Hybrid dimming, spread spectrum and phase shifting
- Settings and complete diagnostics thru I²C
- 4 x 4mm package
- ASIL B certified

Benefits

- Simple to use with I²C
- Save BOM cost and board area with NMOS protection
- EMI mitigation
- Complete diagnostics to enable ASIL B
- Hybrid dimming to reduce EMI and increase dimming
- Small solution size

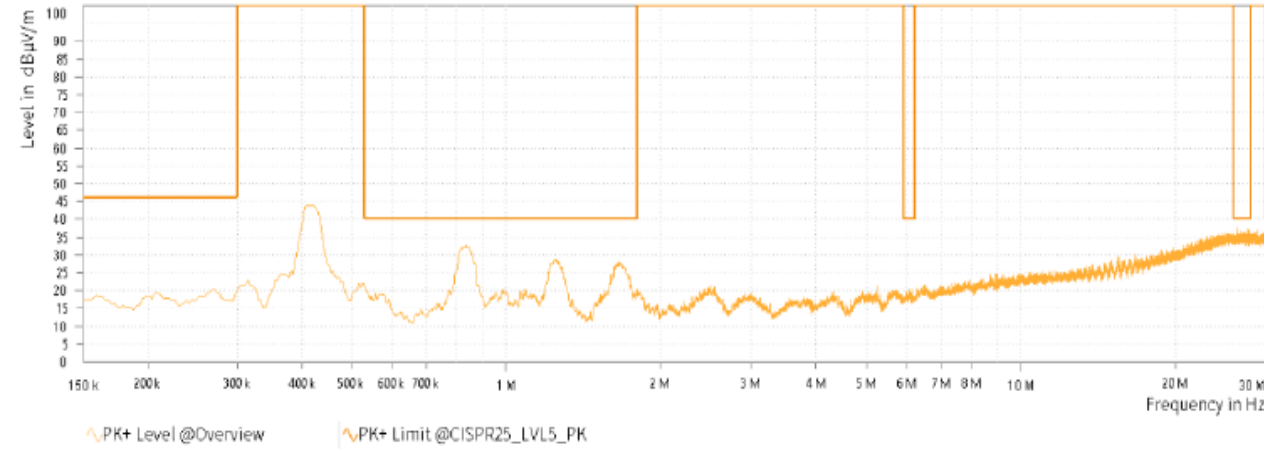
Applications

- Automotive display
- HUD



MAX25014 EMI results

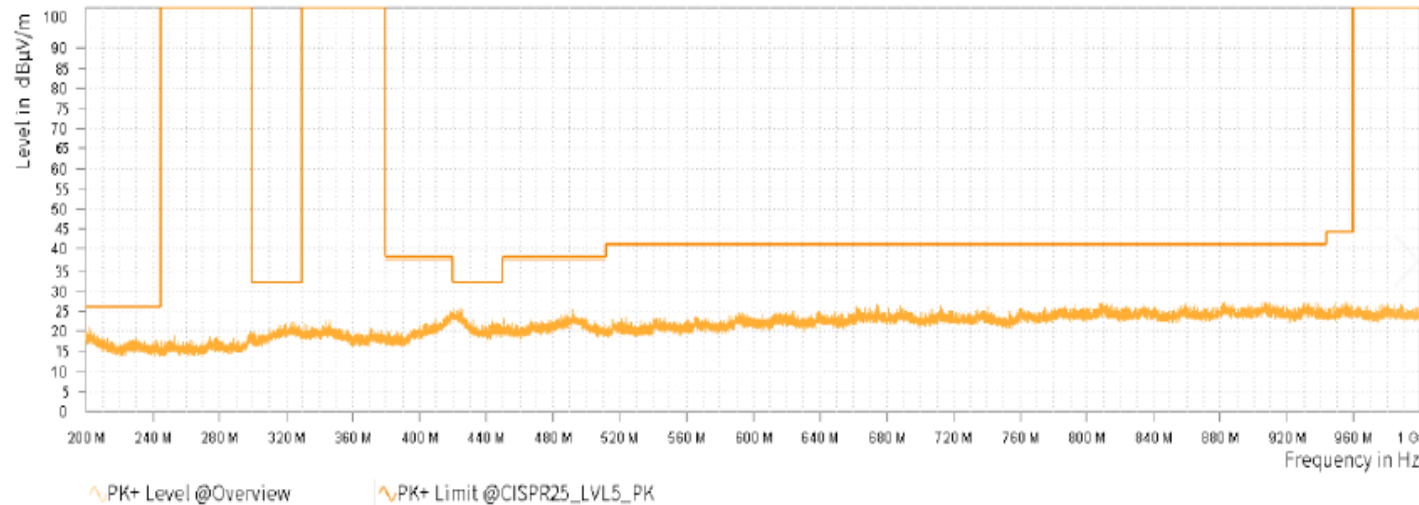
Monopole_400kHz



Bicon_400kHz



Longpole_400kHz



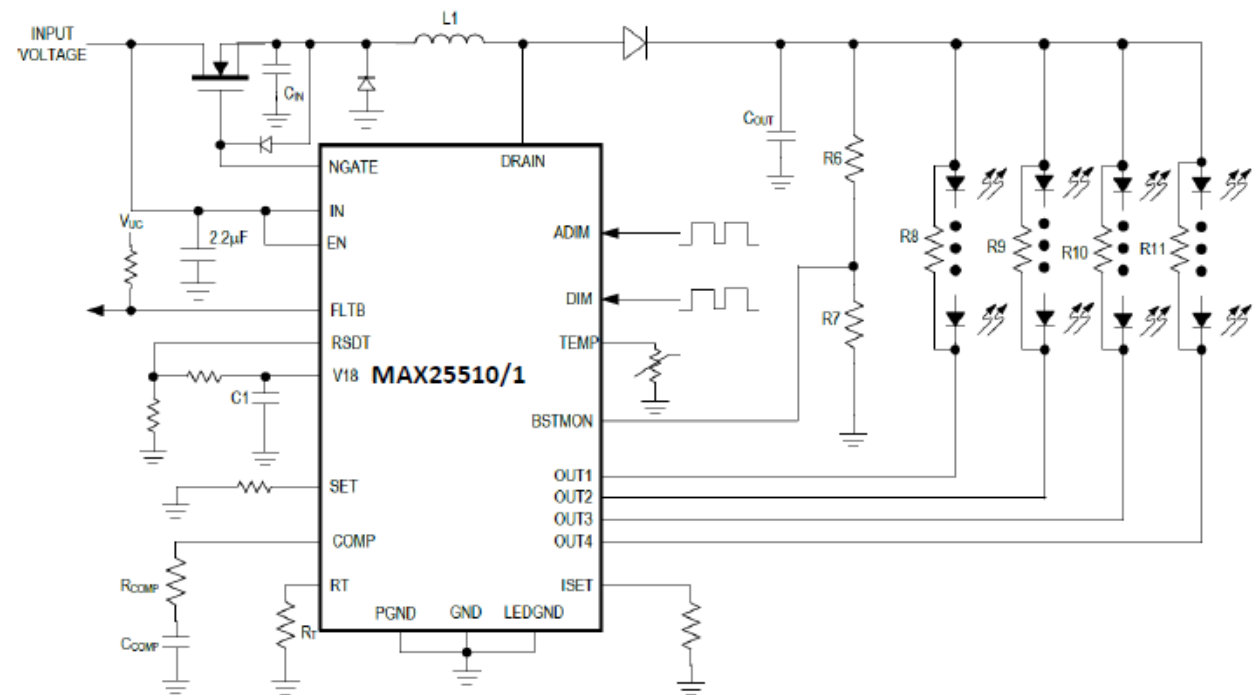
MAX25510/1/2: Highly Integrated 4ch 120mA LED Driver

Benefits/Features

- **Small Solution/High Integration**
 - 3V to 36V Supply Voltage (52V tolerant)
 - 4ch 120mA/ch
 - Boost FET Integrated to enable 15W Output Power
 - Current Sense Resistor Integrated
 - NMOS input protection
 - Small 4x4mm 24-TQFN and SW Package
- **Very High Dimming Ratio**
 - 15,000:1 at PWM=200Hz
 - >15,000:1 with Hybrid Dimming
- **Complete Diagnostics**
 - LED Open/Short on each string
 - Boost Output voltage and OV/UV
 - Interface with NTC for LED current derating
- **Quiet-Low Noise**
 - 400kHz to 2.2MHz switching frequency/Ext Sync
 - Phase Shift
 - Spread Spectrum
- **I2C (MAX25512)**
- Stand alone (MAX25510: 3.5A, MAX25511: 4.5A)
- AEC-Q100, Temp Range: -40°C to +125°C

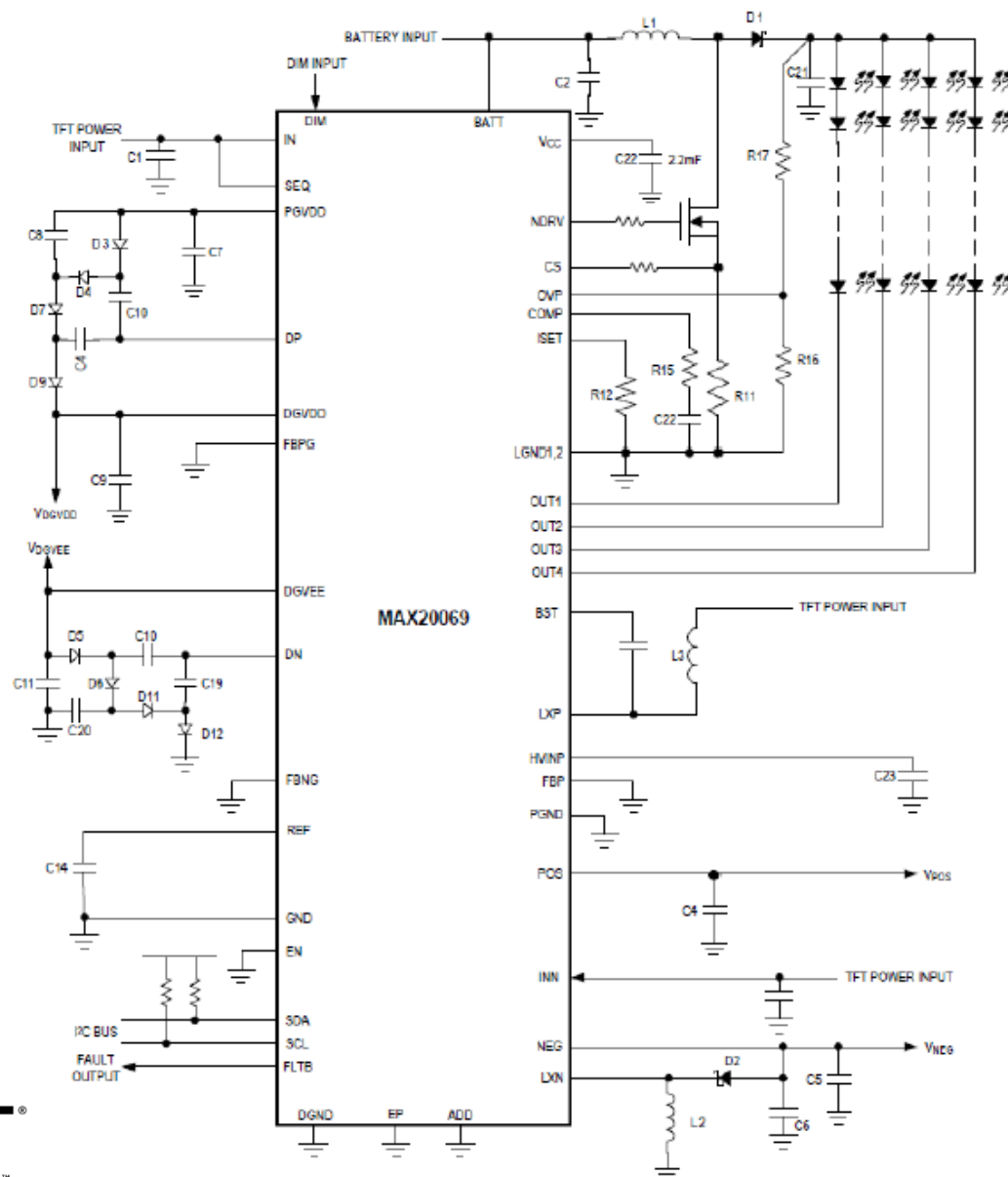
End Applications

- Instrument Clusters
- Center Infotainment Display



STATUS: SAMPLING

MAX20069: Automotive 4-Channel TFT-LCD Power Supply with 4-String LED Driver



Key Features

- Four LED Current Sinks at up to 150mA each
- Boost/SEPIC Backlight Controller (external NMOS switch)
- I²C Control/Diagnostic Interface
- 40-lead 6x6mm TQFN Package
- LED Phase-Shift Dimming

Diagnostics/Control via I²C

- Individual String Current Adjustment
- POS, NEG, GVDD, GVEE Voltage Adjustment
- Flexible Sequencing
- Overtemperature Indication & Pre-warming at 125°C
- LED Boost OV & UV, UV on other Outputs
- Open and Shorted LED Diagnostics
- Select switching frequency (420kHz or 2.1MHz & Enable/Disable Spread Spectrum)

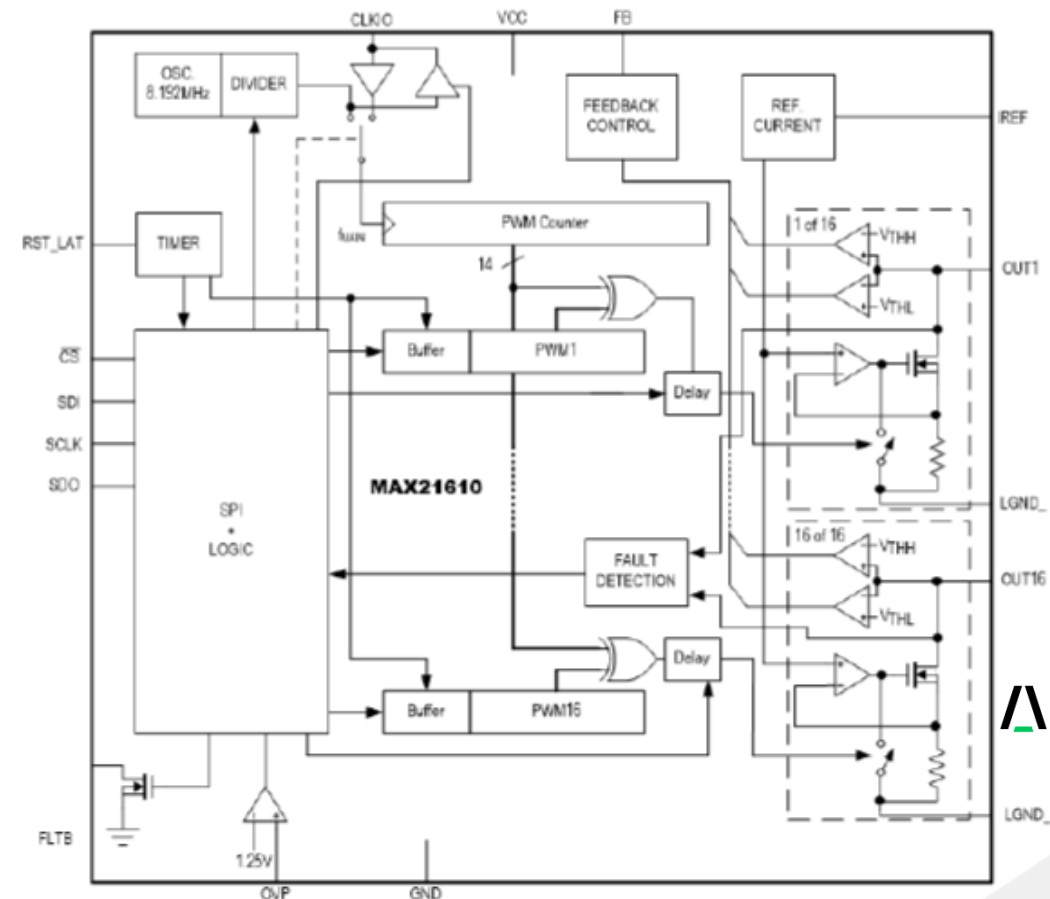
MAX21610: Local Dimming LED Driver for Automotive Display

Benefits/Features

- 16x 100mA Channels with Independent SPI control
- 10 Devices can be “Daisy-chained” on one SPI
- 17V Rating on OUT1-OUT16
- Robust and low EMI
 - Programmable Spread Spectrum on PWM Outputs
 - Programmable Output Delays
- Relative Dimming Ratio Between Strings Up to 32,768:1 @ PWM=100Hz
- Complete Diagnostics: LED Open/Short Detection & Protection
- Over-voltage Protection for External Converter
- Thermal Warning
- Thermal Shutdown
- Compact TQFN32 5x5mm Package
- AEC-Q100, Temp Range: -40°C to +125°C

End Applications

- Instrument Clusters
- Center Infotainment Display





Thank you