



ROHM Product Overview

LED Drivers for General Lighting

July 2014

LED Drivers for General Lighting

	BD550FH	BM2Pxxx	BM520Q1/2x	BD554FL	BM1050F	BD555BK
Feature	Low BOM solution	Internal HV start-up & MOSFET	Internal MOSFET Quasi resonant Current dimming with temperature	Low ripple current & quasi resonant current control	High Power PFC controller (> 0.9)	High Efficiency AC/DC buck Converter Fixed frequency
Isolated / Non-Isolated	Yes / Yes	Yes / Yes	no/ Yes	Yes / Yes	Yes / Yes	No / Yes
Power Factor Correction	No	No	Q1 no / Q2 yes	No	2 stage	No
TRIAC dimming	No	No	No	No	No	Yes
PWM dimming	No	No	No	Yes	Yes	Yes
Topology	Buck / Fly-back	Buck / Fly-back	Buck / Fly-back	Fly-back	Fly-back	Buck / Fly-back
LED current ripple	Low	Low	Low	Very Low	Low	Very Low
Input voltage*	8.5 – 25V	8.9 – 26V	8.9 – 26V	16 – 39V	8.5 – 24V	16 – 39V
Operating Frequency	65kHz	65kHz	150kHz	40~400kHz	120kHz	40~400kHz
Package Type	SSOP-6	DIP-7/SOP-8	DIP-7/SOP-8	SOP-10	SOP-24	SSOP-B14

* IC supply voltage

BD550FHG Specification Overview

AC/DC controller for non-dimmable LED lighting

- ❑ AC/DC controller IC to be used in a wide range of low-cost non-dimmable LED lighting driver applications up to 25W
- ❑ Main target application is retrofit LED lighting (E27, E14, GU10, T8)
- ❑ Samples available



Features

- Fixed 65kHz DC/DC switching frequency
- Frequency hopping function to reduce EMI
- Fly-back topology for isolated or non-isolated system
- Accurate feedback (also for isolated)
- Peak current regulation with leading-edge blanking
- Optional NTC controlled thermal protection
- Thermal Shutdown protection (TSD)
- Over Voltage Protection (OVP) for IC supply
- Under Voltage Lock Out (UVLO)

Key Specifications

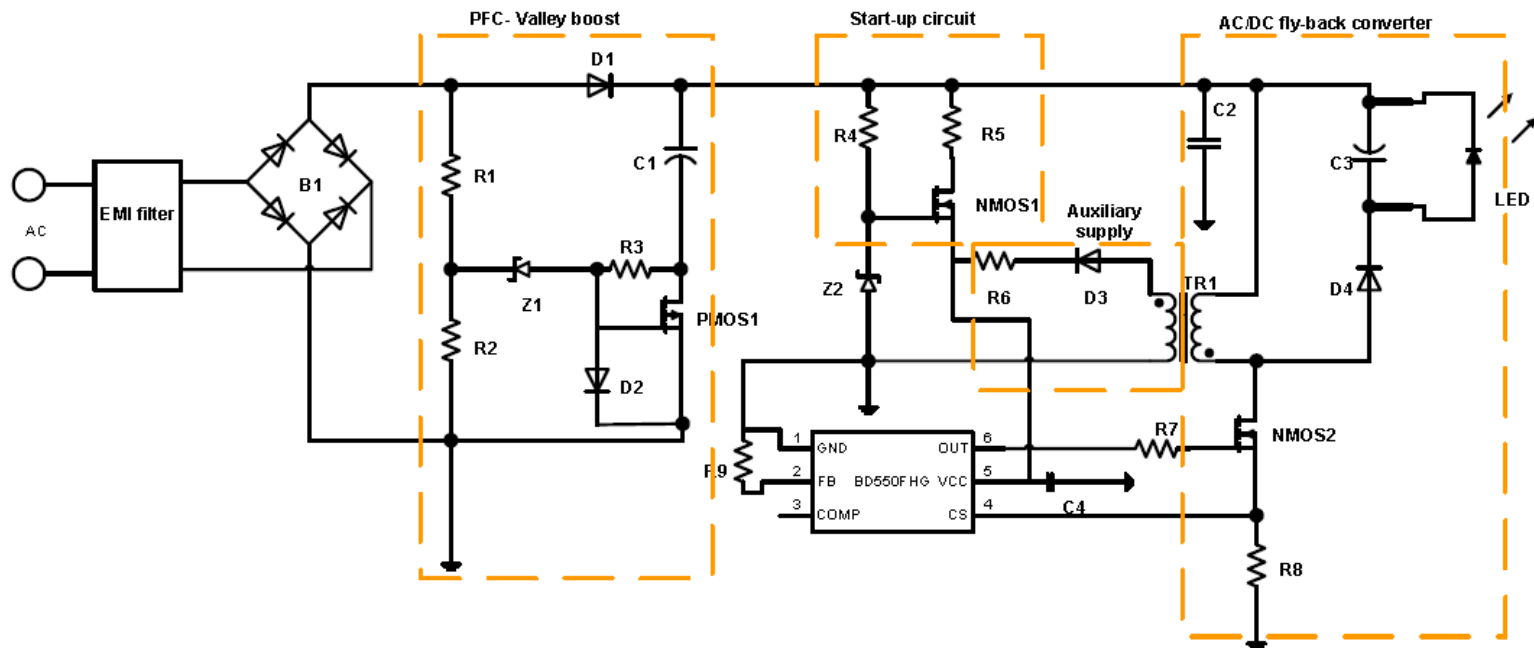
- Input voltage range: 8.5 ~25V
- Operating frequency: 65kHz
- Frequency hopping range: +/- 4kHz
- Typical current consumption: 600μA
- Under Voltage Lock Out detection: 7.5V
- Operating temperature range: -40~+110° C
- Package: SSOP-6

BD550FHG – Application Schematic

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❑ The application based on the BD550FHG has the following functional blocks:

- EMI filter – topology and type at customer's discretion.
- Valley boost circuit – ensures the input voltage does not drop below the minimum limit within one operation cycle and corrects the PF by reshaping the input current.
- Start-up circuit – provides the initial supply voltage for starting the IC.
- Auxiliary supply - provides the IC supply while the converter is running for boosting application efficiency.
- AC/DC converter – controls the LED voltage and current and provides cycle by cycle current limiting.



BM2Pxx Specification Overview

Low-cost AC/DC controller for non-dimmable LED lighting

- ❑ AC/DC controller IC to be used in a wide range of low-cost non-dimmable LED lighting driver applications up to 25W
- ❑ Main target application is retrofit LED lighting (E27, E14, GU10, T8)
- ❑ Samples available



Features

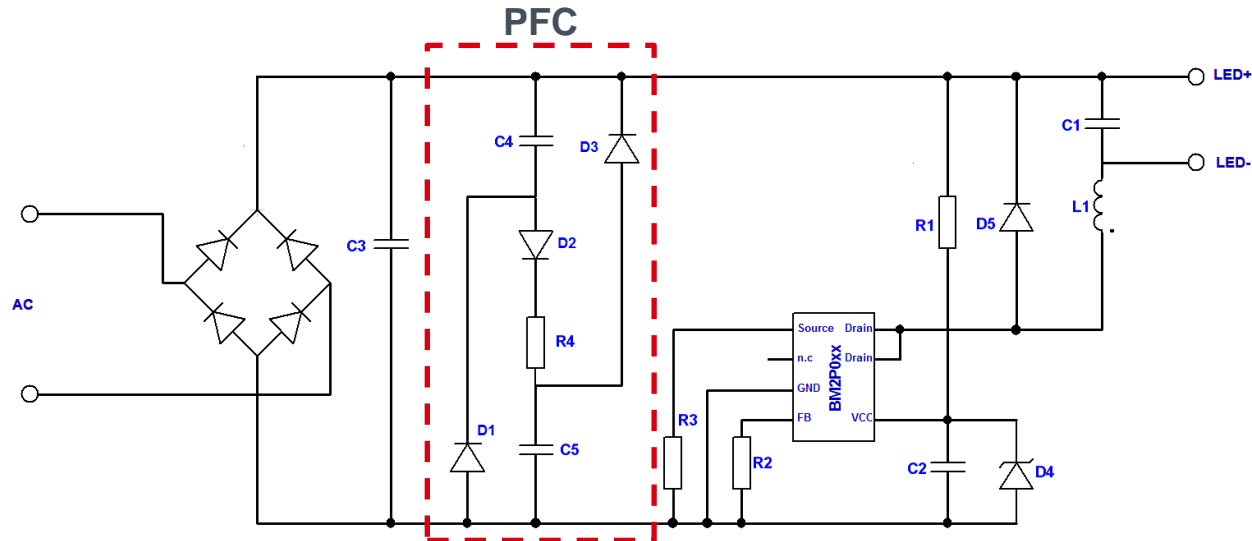
- Integrated 650V MOSFET
- Fixed 65kHz DC/DC switching frequency
- Frequency hopping function to reduce EMI
- Fly-back topology for isolated or non-isolated system
- Optional accurate feedback (also for isolated)
- Peak current regulation with leading-edge blanking
- Thermal Shutdown protection (TSD)
- Over Voltage Protection (OVP) for IC supply
- Under Voltage Lock Out (UVLO)

Key Specifications

- | | |
|-------------------------------------|-------------|
| ▪ VCC voltage range: | 8.9 ~26V |
| ▪ Drain voltage range: | 650V |
| ▪ Operating frequency: | 65kHz |
| ▪ Frequency hopping range: | +/- 4kHz |
| ▪ Typical current consumption: | 790μA |
| ▪ Under Voltage Lock Out detection: | 8.2V |
| ▪ Operating temperature range: | -40~+105° C |
| ▪ Package: | SOP-8 |

□ The simplest application based on the BM2P0xx is presented below:

- Non-isolated buck topology.
- The BM2Pxx products have 650V MOSFET integrated with different RdsON characteristic .
- Due to integrated MOSFET a small size application can be achieved with the output power limited by the MOSFET specification.
- The circuit includes PFC passive valley-fill circuit



BM520Q1xF Specification Overview

AC/DC controller IC for non-dimmable LED lighting

- ❑ AC/DC controller IC to be used in a wide range of low-cost non-dimmable LED lighting driver applications
- ❑ Main target application is retrofit LED lighting (E27, E14, GU10, T8)
- ❑ Samples available



Features

- Max 150kHz switching frequency (quasi-resonant)
- Buck topology for non isolated system
- Integrated 650V MOSFET (with different RdsON)
- Peak current regulation with leading-edge blanking
- Optional NTC controlled thermal protection
- Thermal Shutdown protection (TSD)
- Over Voltage Protection (OVP)
- Under Voltage Lock Out (UVLO)

Key Specifications

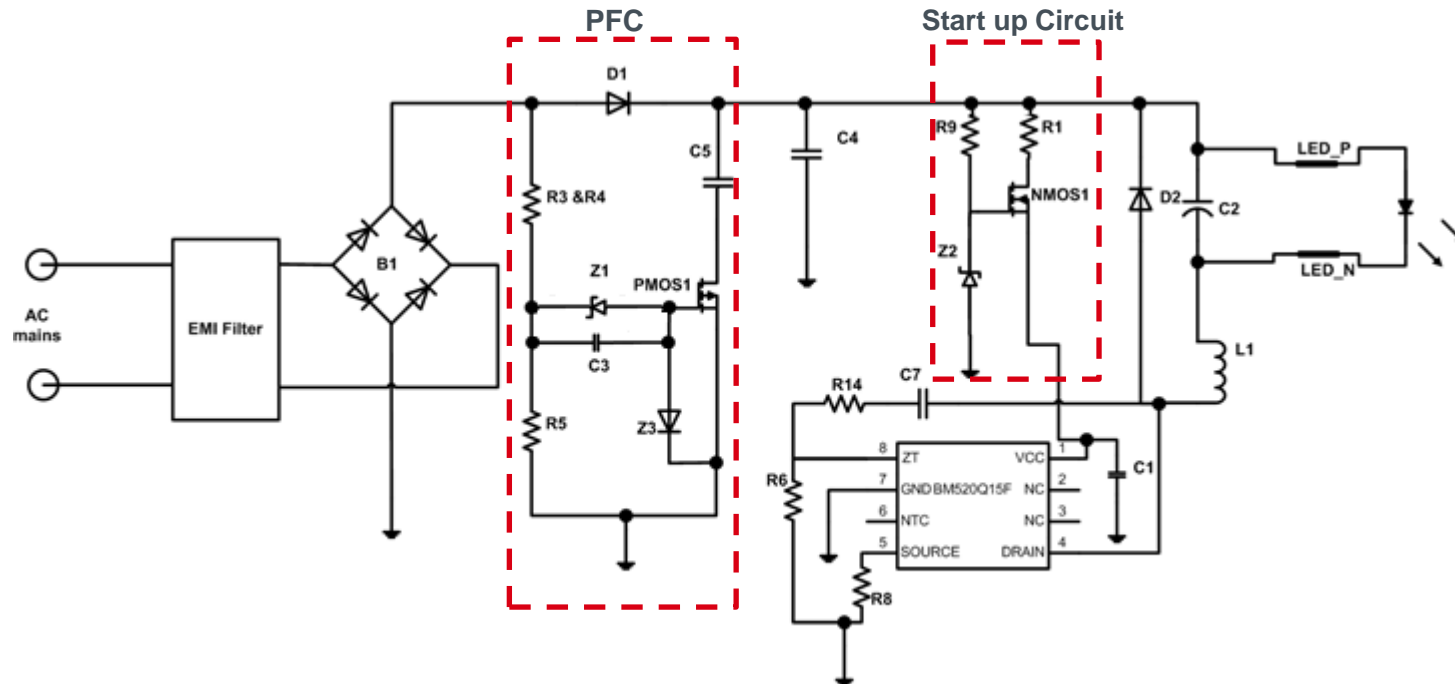
- Input voltage range: 8.9 ~26V
- Operating frequency: 150kHz
- Typical current consumption: 600μA
- Under Voltage Lock Out detection: 8.2V
- Operating temperature range: -40~+105° C
- Package: SOP-8/ DIP -8

BM520Q1xF – Schematic PCC

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❑ The application based on the BM520Q1xF has the following functional blocks:

- EMI filter – topology and type at customer's discretion.
- Valley boost circuit – ensures the input voltage does not drop below the minimum limit within one operation cycle and corrects the PF by reshaping the input current.
- Supply circuit - ensures stable supply voltage at the VCC pin.
- AC/DC converter – controls the LED current and provides cycle by cycle current limiting.
- Application works in quasi-resonant mode boosting efficiency and improving EMI behavior.



BM1050F Specification Overview

AC/DC controller for PWM-dimmable LED lighting

- ❑ AC/DC controller IC to be used in high power applications that require active PFC stage.
- ❑ Main target application is retrofit LED lighting (T8 tubes and ballast) and street lighting
- ❑ Samples available



Features

- Integrated 650V start-up circuit
- Quasi-resonant circuit (max 120kHz) DC/DC controller; fixed 65kHz PFC circuit
- PFC controller incorporates freq. hopping
- Burst mode at light loads to improve efficiency
- Boost and Fly-back topology system
- Peak current regulation with leading-edge blanking
- Overload and overvoltage protections
- Under Voltage Lock Out (UVLO)
- Protections are LATCH or AUTO-Recovery (externally selectable)
- External STOP function based on NTC
- Brownout function
- Thermal Shutdown protection (TSD)

Key Specifications

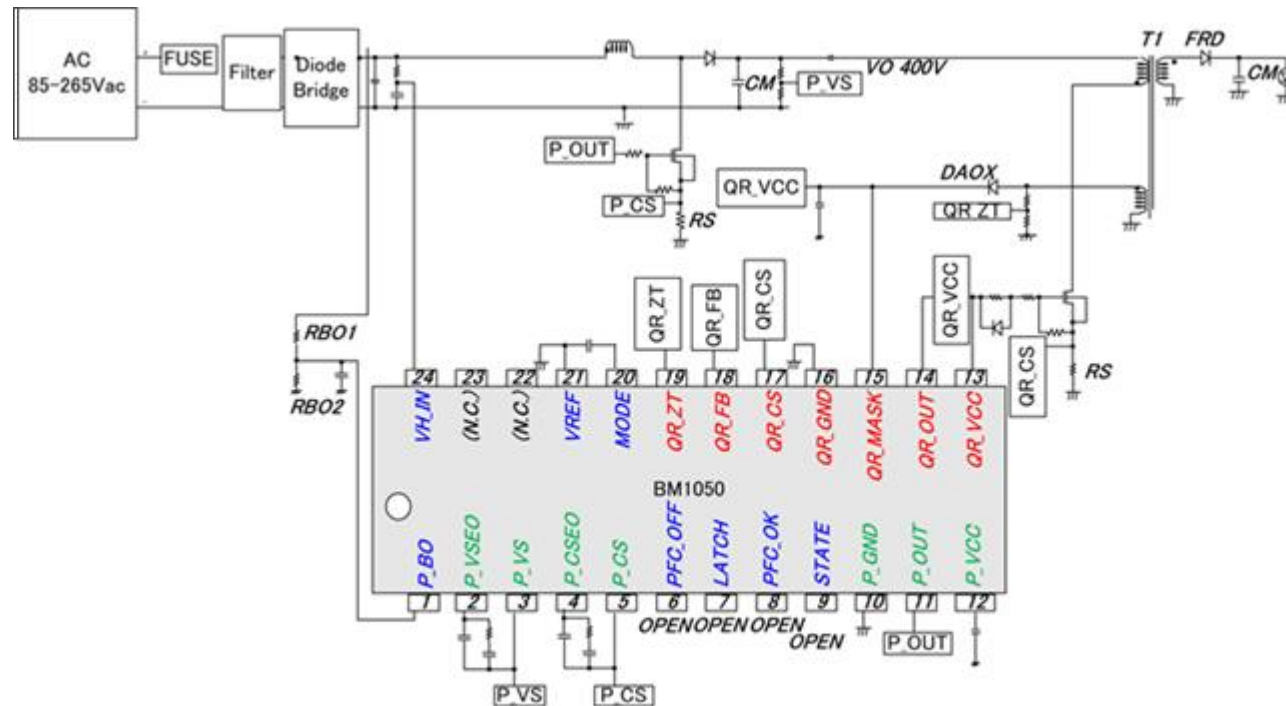
- VCC voltage range: 8.5 ~24V
- VH_IN voltage range: 80 ~ 600V
- Operating frequency DC/DC: 120kHz
- Operating frequency PFC: 65kHz
- Frequency hopping range: +/- 4kHz
- Typical current consumption: 1800μA
- Under Voltage Lock Out detection: 7.0V
- Operating temperature range: -40~+85° C
- Package: SOP-24

BM1050F – schematic PWM dimmable

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□ The application based on the BM1050F is presented below:

- The BM1050F is a dual stage converter with a boost stage and a flyback stage.
- The application can be dimmed by PWM using the FB pin.
- Protection functions are realized based on the auxiliary winding providing the supply of the IC.



BD554FLFV Specification Overview

In Development

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❑ AC/DC controller IC for PWM / Linear dimmable LED lighting

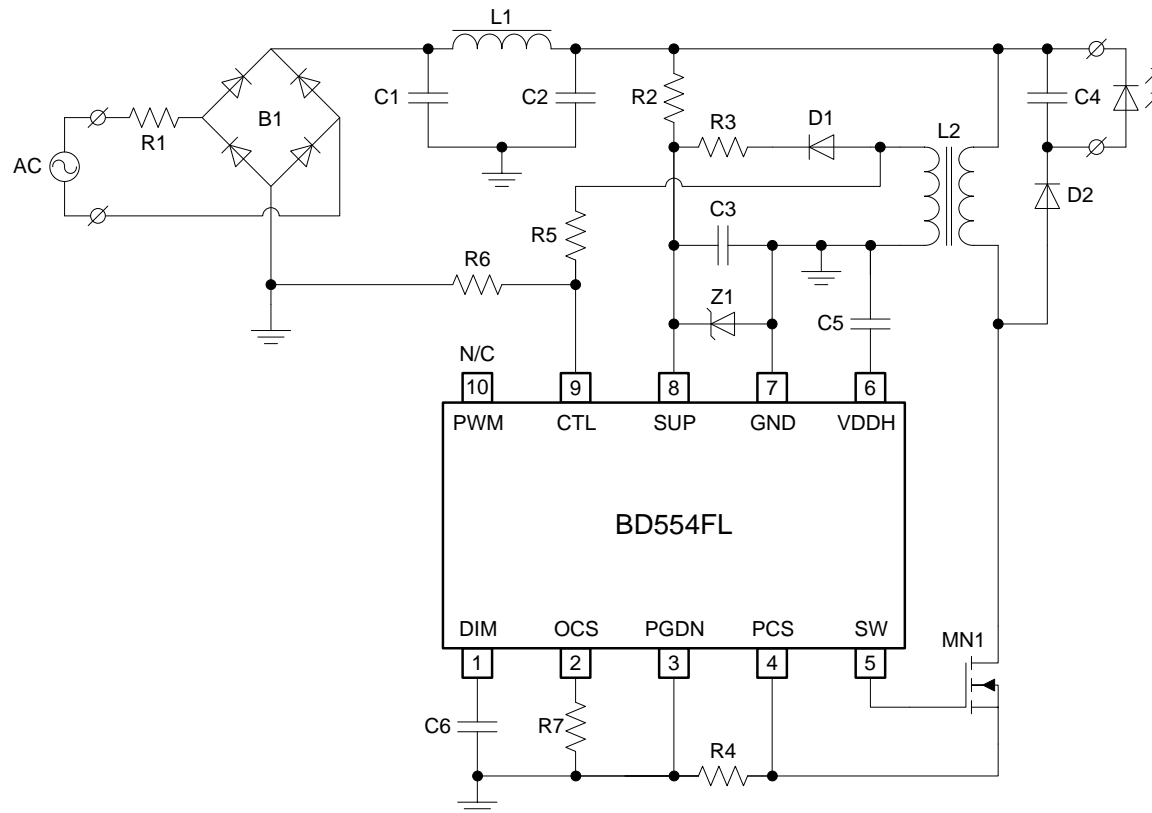
Parameter	BD554FLFV
Package	SSOP14
Application range	Consumer luminaires, intelligent office lighting, user-controlled ambience lighting <25W
Topology	Flyback / buck-boost LED drivers
Quasi-resonant switching*	Yes (within user-defined frequency window)
Valley switching*	Yes
LED current control	Primary-side sensing (no opto-coupler) with auto-correction algorithm
Dimming**	Linear and PWM (constant LED current)
Dimming range	5% - 100%
ON/OFF control	Yes
PFC controller	No
LED open/short protection	Yes
NTC thermal fold-back	Optional via DIM terminal
Universal mains	Optional (application dependent)
Thermal Shut Down	Yes

*non-dimmable operation

** fixed frequency DCM mode

□ The application based on the BD554FLF is presented below:

- The topology is a non-isolated flyback.
- The LED open and short protections are implemented based on the voltage at CTL.
- Zero Coil current is also detected based on CTL pin.



AC/DC driver for TRIAC, PWM or linear dimmed LED lighting

❑ LED lighting application

- AC voltage range 80...270VAC
- <10% LED current ripple
- Average and/or peak current regulation in buck / fly-back topology
- Fixed frequency DC/DC 40...400kHz

❑ Dimming compatibility

- Accurate 'true phase-cut' detector allows wide dimming range (<5%)
- Dynamic Load Current Controller (DLCC) function for stable operation with leading/trailing edge dimmers
- False LED activation prevention for mains-powered dimmers that require standby current
- Natural 'linear' dimming through logarithmic compensation
- Dimmer detector improves efficiency by turning off DLCC current if dimmer is not present
- Supports PWM and linear dimming (for non-retrofit LED lighting)

❑ Internal IC supply voltage regulator

- Wide input supply voltage range 15~40V
- Low current consumption 2mA in operation

❑ Safety & Protection

- Over Current Protection (OCP)
- Thermal Shut Down Protection (TSD)
- Under Voltage Lock Out detection (UVLO)

❑ Package

- Small & thin package (SSOP14) 5.0 × 4.5 × 1.15mm

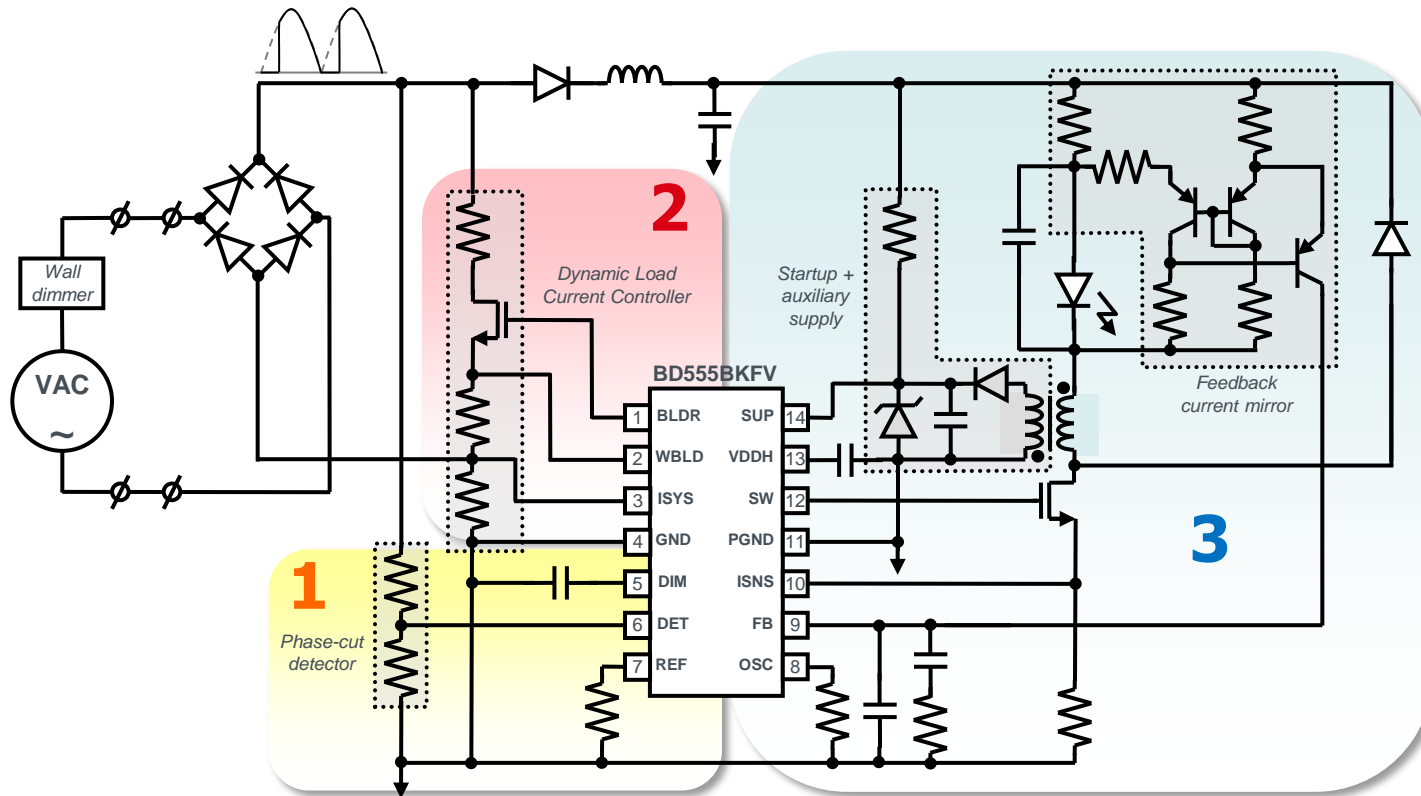


BD555BKFV - Application (typical)

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❑ For optimal performance with TRIAC / electronic dimmers, the BD555BKFV has three main individual functions:

1. 'True' phase-cut detector
2. Dynamic Load Current Controller (DLCC)
3. DC/DC controller for average current and/or peak current feedback



Key Strengths of BD555BKFV Solution

❑ True phase cut detector:

- Detects dimmer 'phase-cut' (45...135 degrees) from AC signal transient
- Detection independent from AC input RMS voltage level (as compared to detection via 'average' value of rectified AC)
- Logarithmic 'natural' dimming curve

❑ Dynamic Load Current Controller (DLCC):

- Allows for robust, flicker-free operation with TRIAC dimmers
- Dynamic load current automatically OFF at high LED power or if no dimmer present
- Prevents LED startup in case of leakage current
- DLCC stabilizing function for TRIAC dimmers independent of LED power

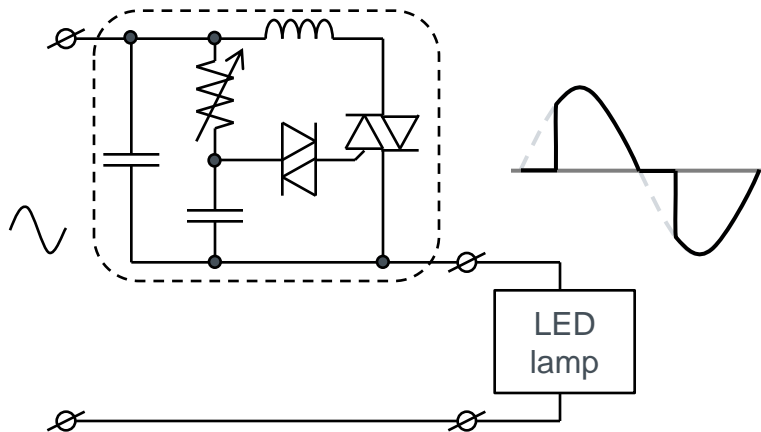
❑ LED current regulation

- Average and/or peak current feedback for dimmable solutions (buck & fly-back)
- Accurate for full dimming/input voltage range
- Equal dimming for multiple LED lamps attached to a single dimmer
- Low LED current ripple

Dimming: Adjusting LED Current to 'phase-cut'

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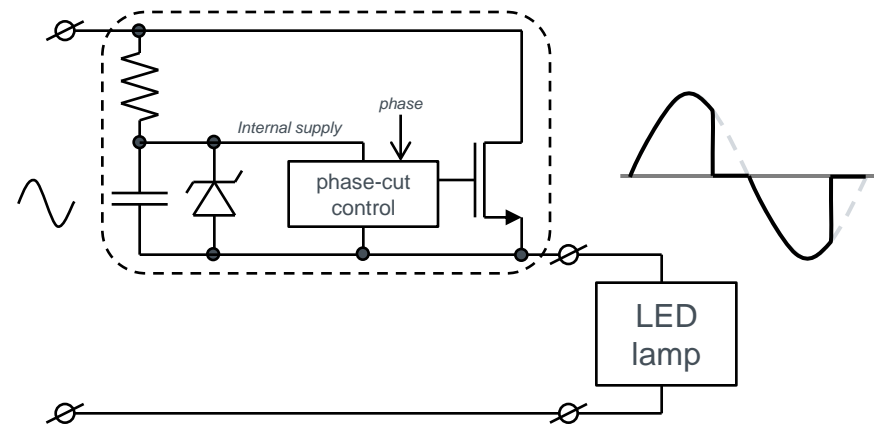
❑ TRIAC-dimmer (leading edge)



Features:

- Cuts AC sine on the leading edge
- RC time constant determines phase-cut
- TRIAC needs minimum 'hold current' to stay ON (~10-20mA)

❑ Transistor-dimmer (trailing edge)



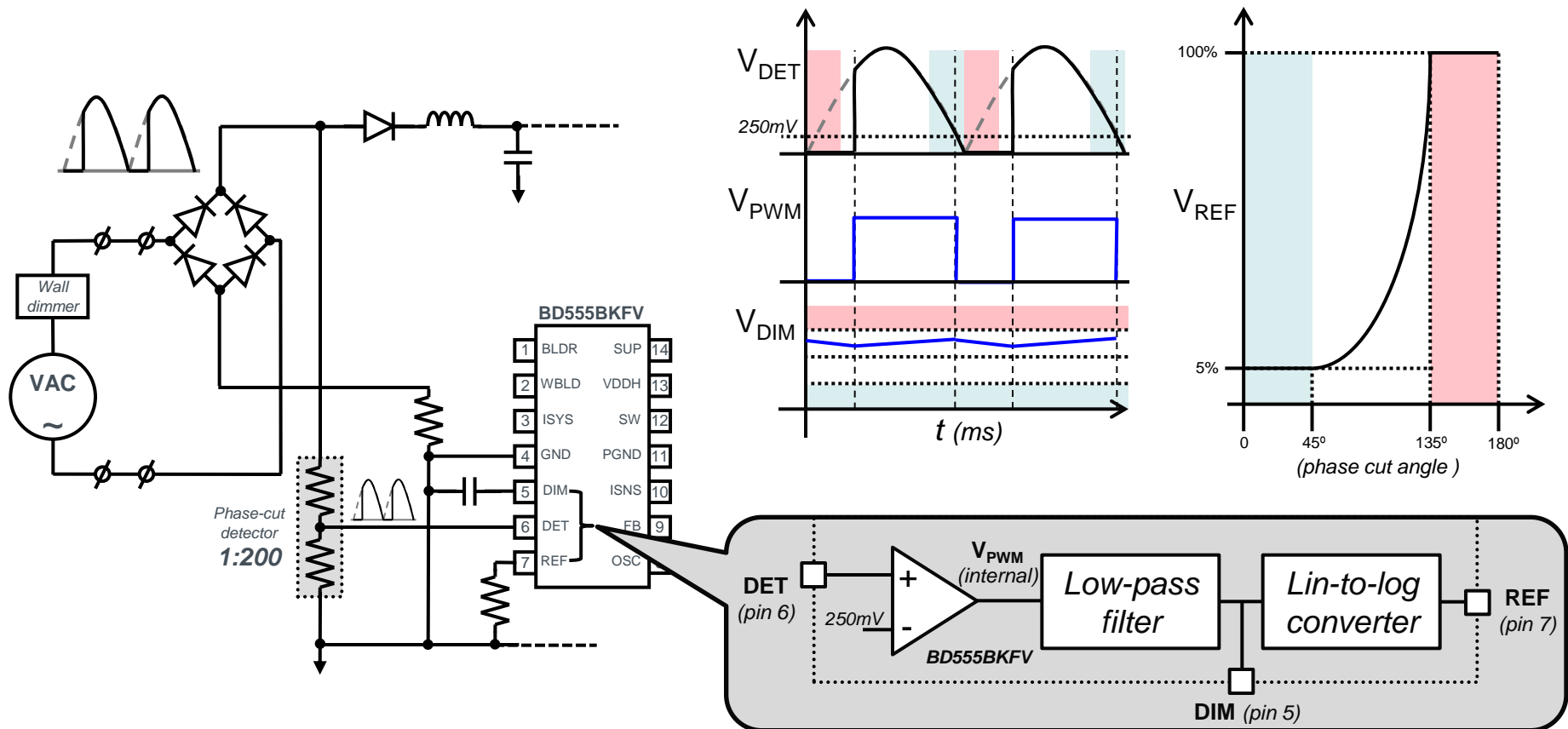
Features:

- Cuts AC sine on the trailing edge
- Transistor control by internal 'supply'
- Load needs to 'pull down' dimmer output to charge internal supply capacitor (~20mA)

BD555BK FV – ‘True’ phase cut detection

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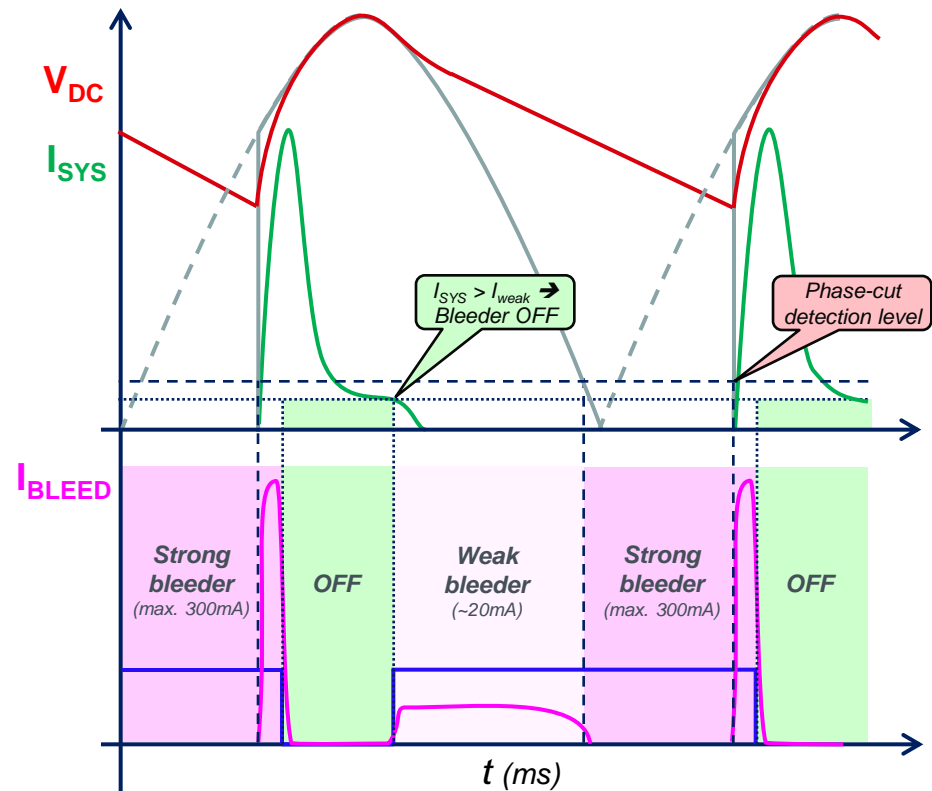
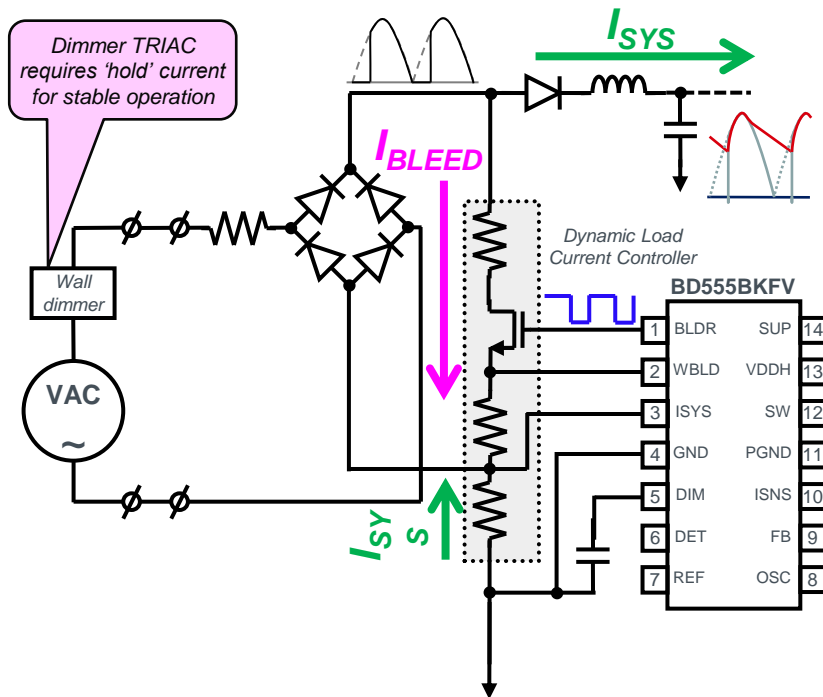
- ❑ Natural dimming of LED light intensity is achieved by detection of ‘true’ phase-cut (V_{DET}), low-pass averaging and conversion of linear (V_{DIM}) to logarithmic (V_{REF}) reference for LED current.



BD555BK FV – Dynamic load current controller

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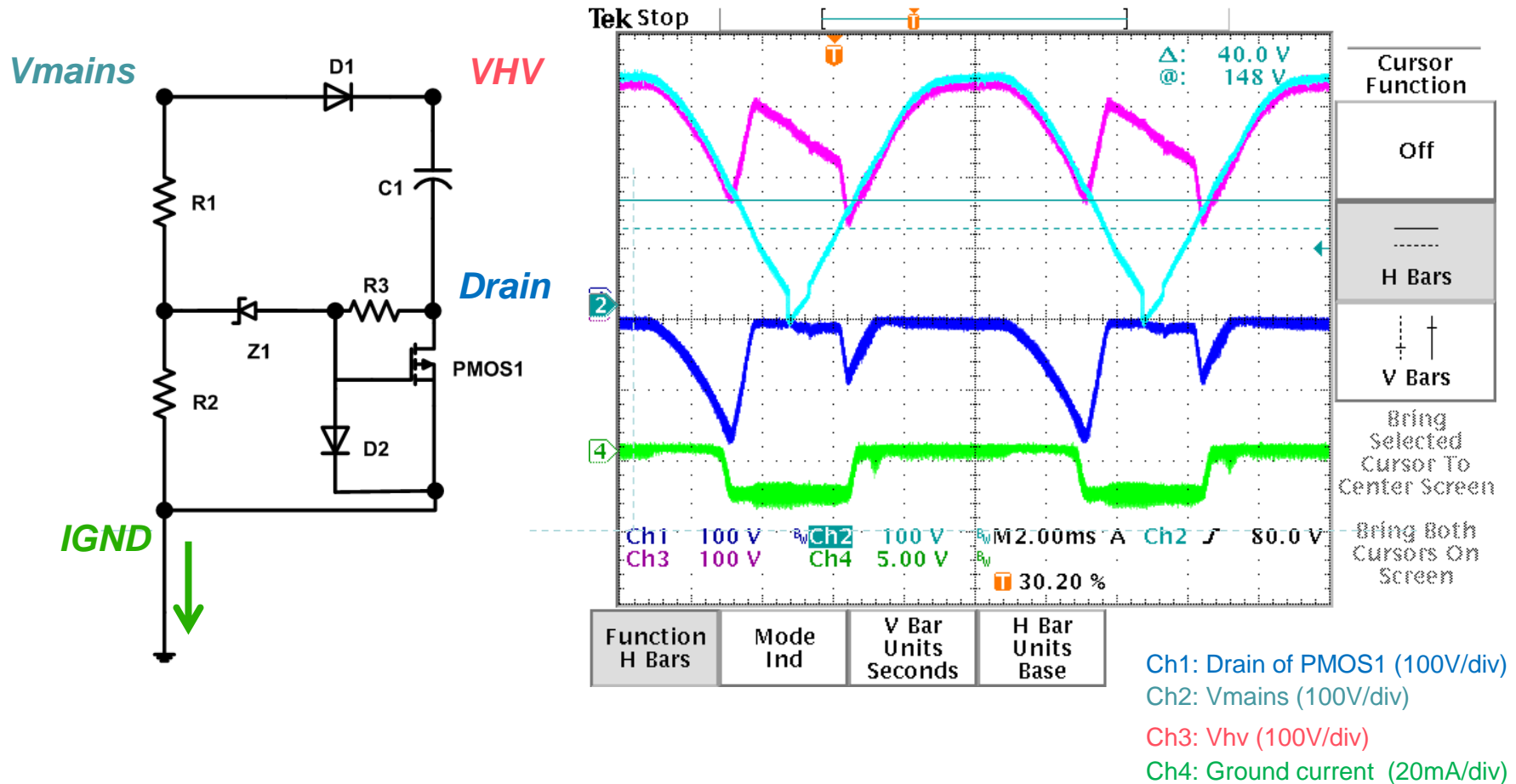
- ❑ The dynamic load current controller 'DLCC' (or 'bleeder') has two functions:
 1. Application load current will be matched to the required TRIAC 'ON' hold current (stabilizing)
 2. For (electronic) dimmers requiring a standby current (<10mA), the DLCC prevents false LED activation



ROHM 'valley boost' PFC circuit – waveforms

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- ❑ The load current is sustained as much as possible from the mains voltage

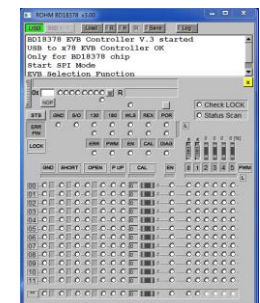
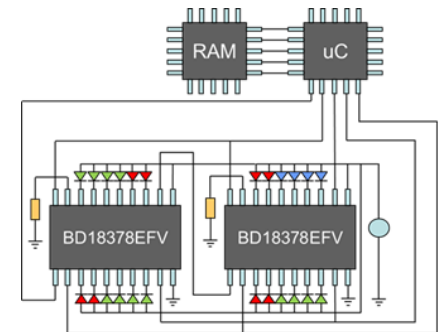
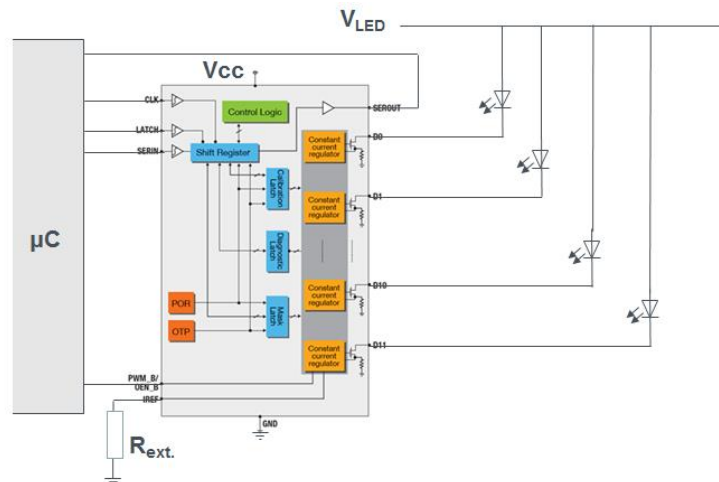
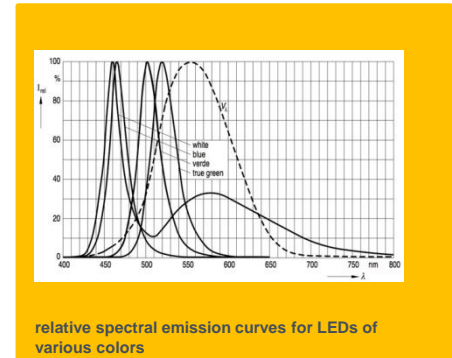


❑ ROHM 'active valley boost' circuit

- Uses larger part of system power (DC/DC+LED) to stabilize dimmers
- Power Factor 0.7 - 0.8 (dimmable) and >0.9 (non-dimmable)
- HV ceramic capacitors can replace electrolytic for better lifetime (for low output powers)
- Dimmer compatibility much improved
- AVB circuit improves performance for low power LED applications, but has even more effect for higher power applications

Advanced 12 Channel Constant Current LED Driver IC

- 12 channels up to 50mA / 10V accuracy +/- 3.5%
- 6 Bit calibration with 6 PWM inputs to compensate spectral emission curves
- Open / Short diagnostics on every channel
- UVLO and TSD, Rext SHORT/OPEN protection
- SPI interface with read back of all registers
- Daisy chain multi-board connection available
- Open drain fault indicator
- Automotive qualified
- GUI for customer evaluation



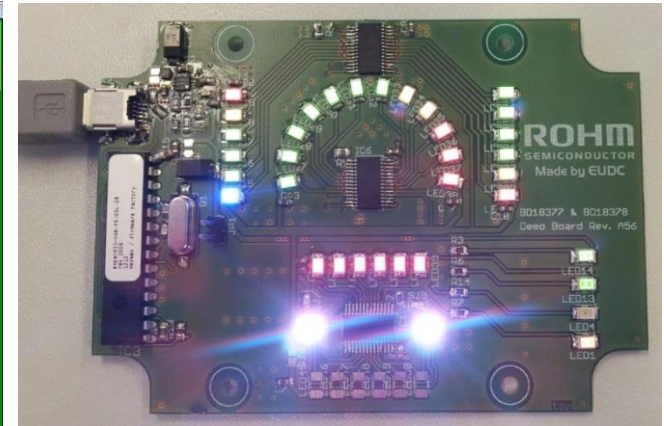
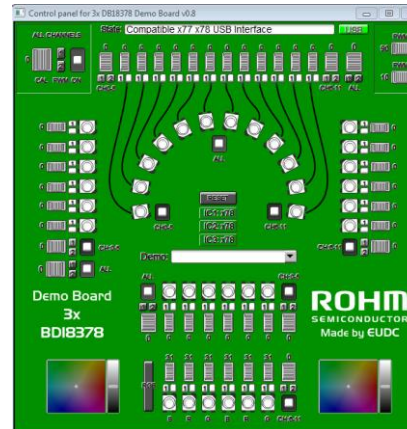
BD18378 applications and software

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2 different boards and software available

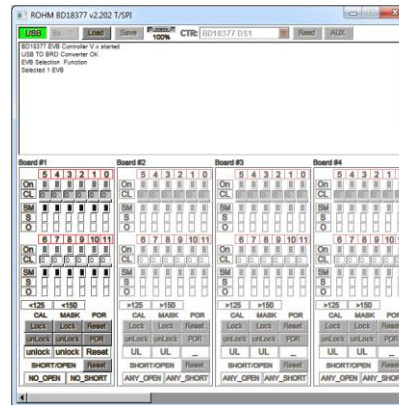
□ Functionality demo:

- Full control of BD18378
- Simple and direct to use
- Software oriented on application
- Daisy chain application



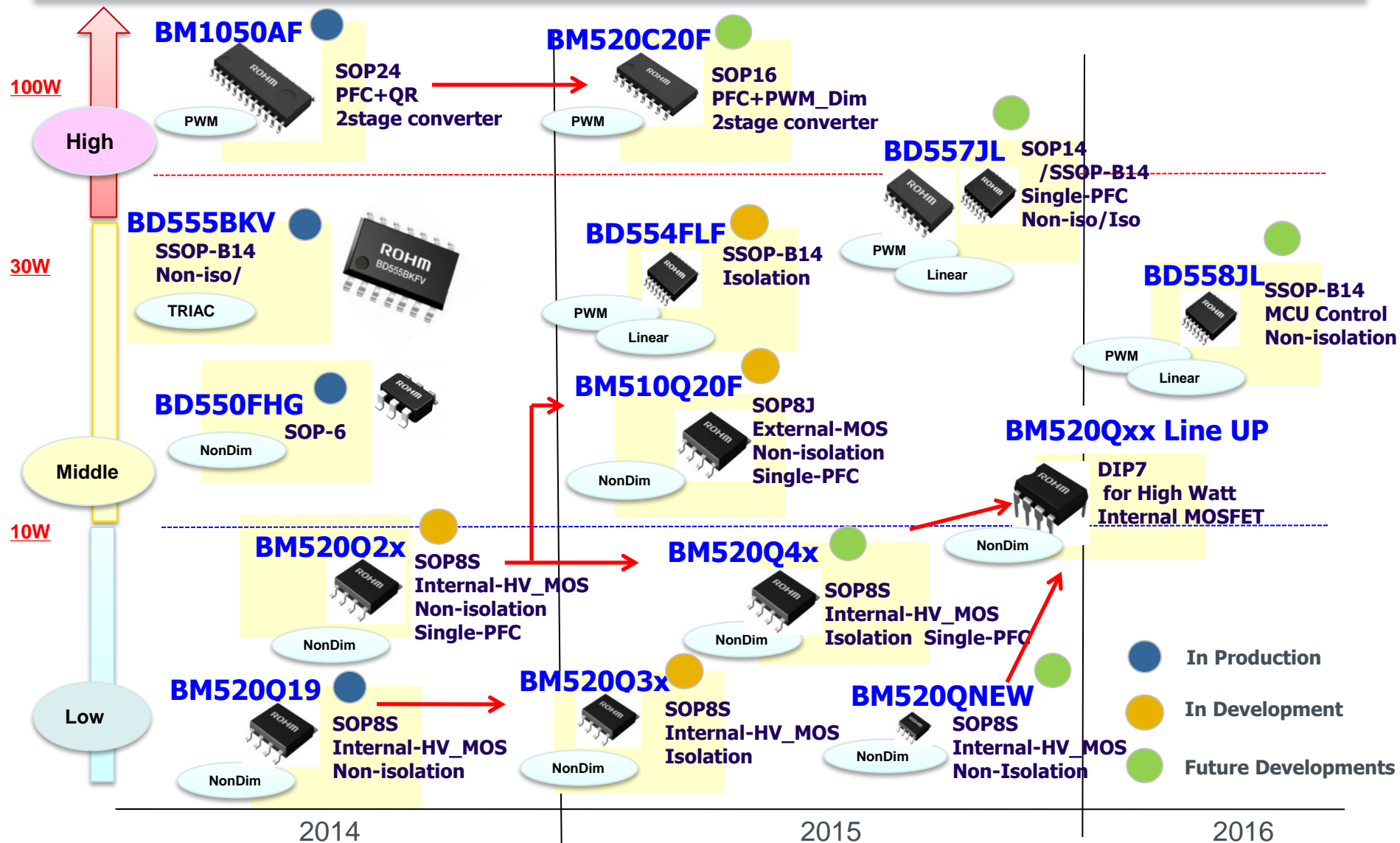
□ BD18378 demo:

- Full access to IC registers
- Writing and reading of all values
- Fully configurable
- Diagnostic management



Rohm Lighting: LED Driver Line-up

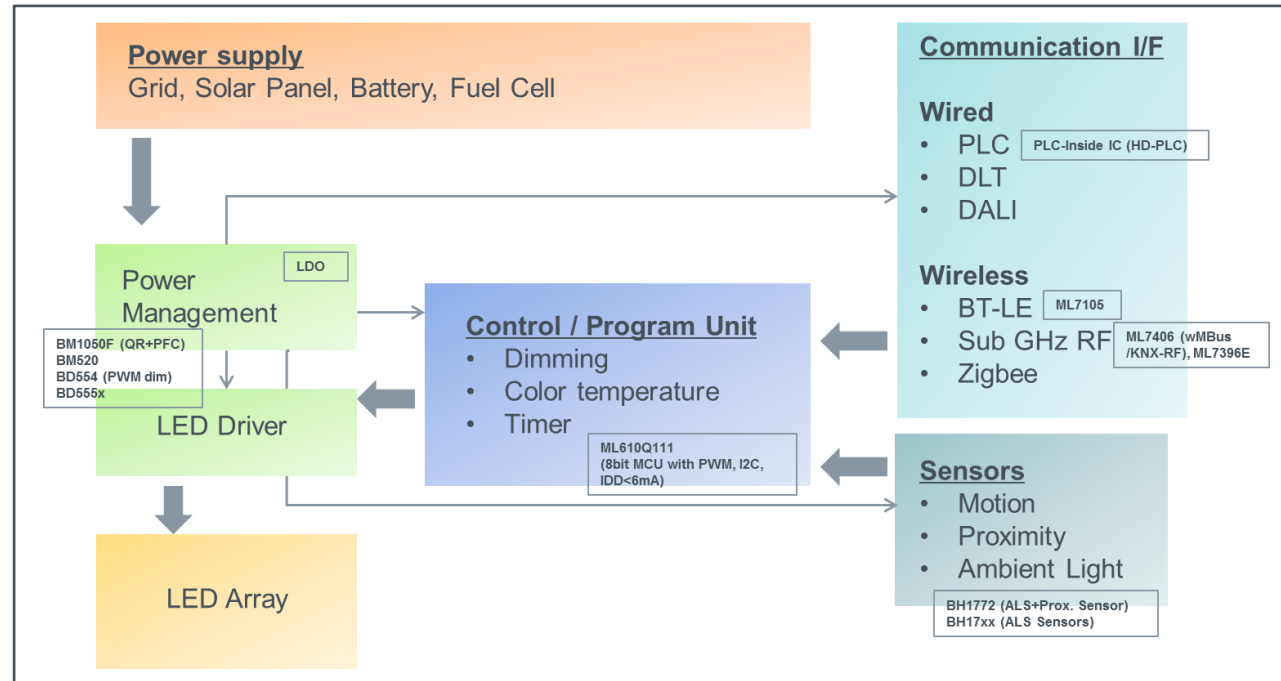
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Intelligent Lighting Platform

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Connectivity
Energy Management
Sensing
LED Lighting



Target Applications:

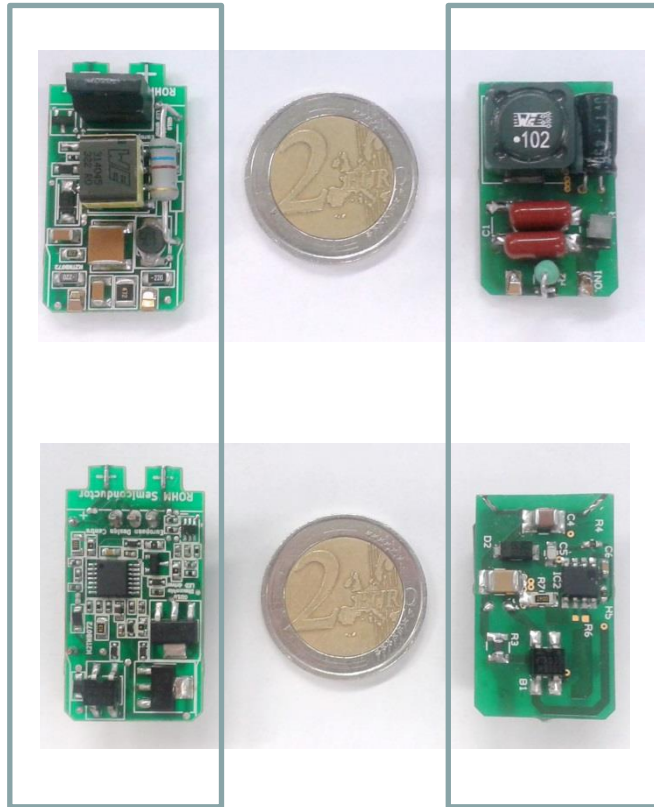
- Street Lighting
- Smart Home
- Building Automation



GU 10 Example Boards

Triac Dimmable

Non-Triac Dimmable



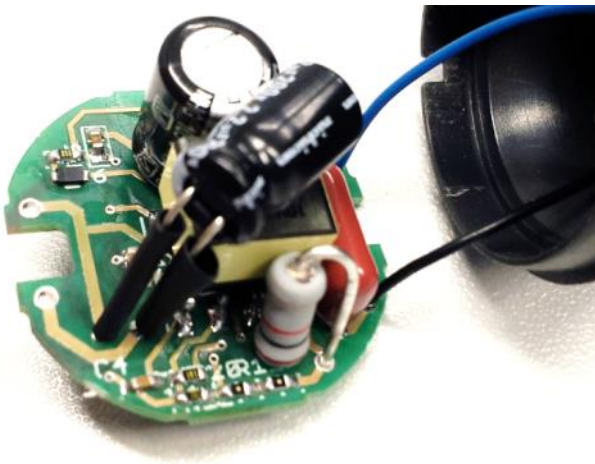
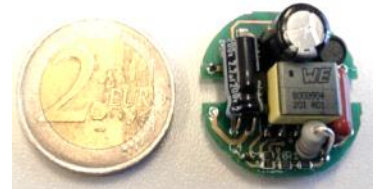
Several application examples for retrofit lamps; for GU10 Lamps Rohm developed solution for triac dimmable (left) and non-dimmable lamps (right) with dimensions compatible with lamp housing.

The boards can be available on request at European Design Centre.

Example 2 – GU10 socket 4W

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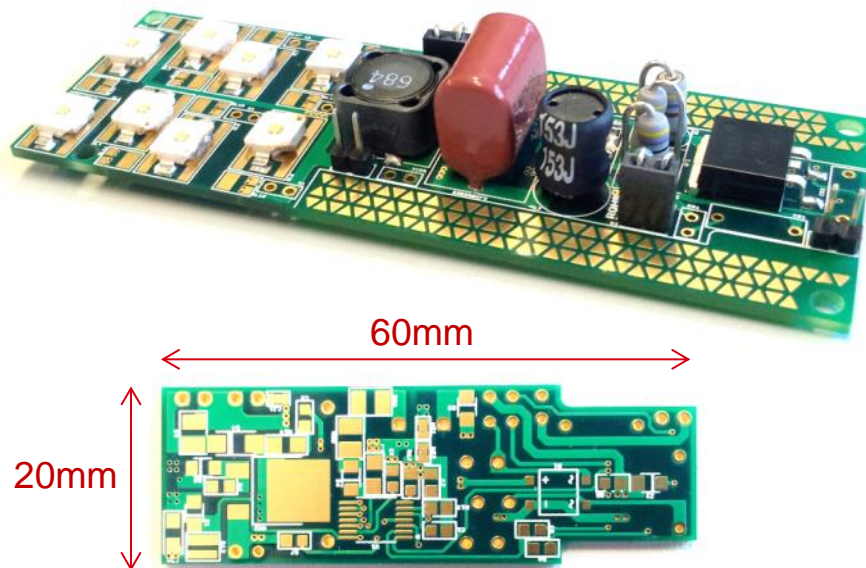
- Accurate ACC (average current control)
- Efficiency >85%
- Excellent line regulation
- Equal dimming among multiple LED spot lights
- Configurable 'dynamic load current controller' supports wide range of dimmers (leading/trailing edge & electronic feature dimmers)



Example 3 – E27 socket retrofit 5W

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- Low-cost buck or fly-back topology
- Fully configurable dimmer stabilization circuit
- Fits in existing E27 form-factor
- Supports HB-LED and multi-junction (high V_f) LED arrays



Dimmable System – E27 Lamp

Design 1 starting point:

- Output voltage 13,2V
- Output current 830mA
- Output power 11W



Design 2 starting point:

- Output voltage 36V
- Output current 375mA
- Output power 13W

PWM Dimmable Lamp

Design starting point:

- Output voltage 80V
- Output current 200mA
- Output power 16W



Dimmable System – High Bay Lamp

Design starting point:

- Output voltage 60V
- Output current 2,5A
- Output power 150W



Dimmable System – Isolated Lamp

Design starting point:

- Output voltage 60V
- Output current 200mA
- Output power 5W

