FSC LCD Backlight Inverter IC Solution

Lighting Product Line
Power Conversion

www.fairchildsemi.com

FSC Product Line - up

Generation	Products	Description	Features								Status
			Vcc (V)	Dimming	Soft Start	OLP	OLR(=OVP)	SCP	Vout(Max)	Iout(Max)	
0 G	FAN7547A	1Ch. Buck-Royer	6 ~ 30	Analog, Burst	O	O	O	X	Vcc	0.2A	S
	FAN7548	2Ch. Buck-Royer	9 ~ 30	Analog, Burst	O	O	O	X	13.5V	0.2A	S
1st G	FAN7311/A/B	P-N Full Bridge	5 ~ 25.5	Analog, Burst	O	O	O	X	8.5V	0.2A	S
	FAN7314/A	P-N Half Bridge	5 ~ 25.5	Analog, Burst	O	O	O	X	8.5V	0.2A	S
2nd G	FAN7313	Push-Pull	4.5 ~ 25.5	Analog, Burst	O	Internal (4)	O	O	6V	0.5A	S
	FAN7316	N-N Half Bridge	4.5 ~ 24	Analog, Burst	O	Internal (4)	O	O	6V	0.5A	S
	FAN7317	P-N Full Bridge	6 ~ 24	Burst	O	Internal (4)	Internal (4)	SLP	6V	0.2/0.3A	S
	FAN7318	P-N Half Bridge	6 ~ 30	Analog, Burst	O	Internal (4)	Internal (4)	SLP	8V	0.3/0.4A	D (P12)
3rd G	FAN7320	H/B Switch Integration	9 ~ 25.5	Analog, Burst	O	Internal (4)	Internal (4)	SLP	Ron=30mΩ		S

Product Introduction

- FAN7313 (Push-pull) / FAN7316 (N-N Half-Bridge)
- FAN7317 (Full-Bridge)

New Product

- FAN7318

FAN7313/6 Key Features

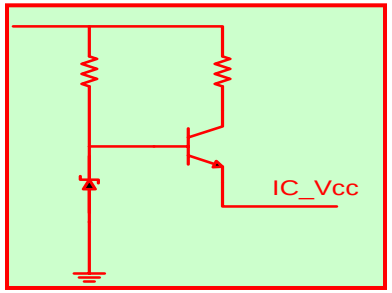
- **Reduce external components**
  → Wide Input Voltage Range : 4.5 ~ 25.5V (FAN7313),4.5 ~ 24V(FAN7316)
  → Integrated OLP circuit

- **Various Protection**
  → OLP, OLR, SCP, TSD, Soft-start, Arc Protection

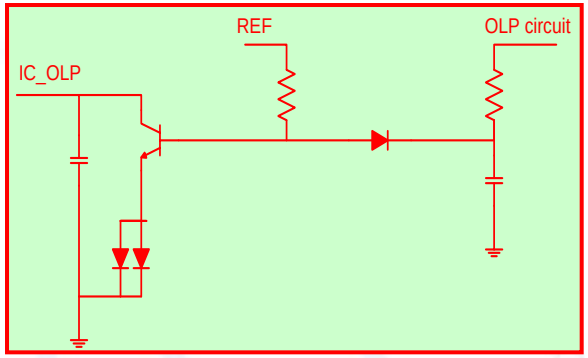
- **Design flexibility**
  → Selectable Dimming Polarity
  → N-N Half-bridge & Push-pull topology
  → Analog & Burst dimming
  → PWM dimming by external pulse signal
  → Wide input voltage range : 4.5 ~ 24V

Reduce External Components

- **Wide Input Voltage Range : 4.5 ~ 24V**
  - → Can use common Vcc with IC input voltage
  - → 1 TR, 1 Zenor D, 2 Resister

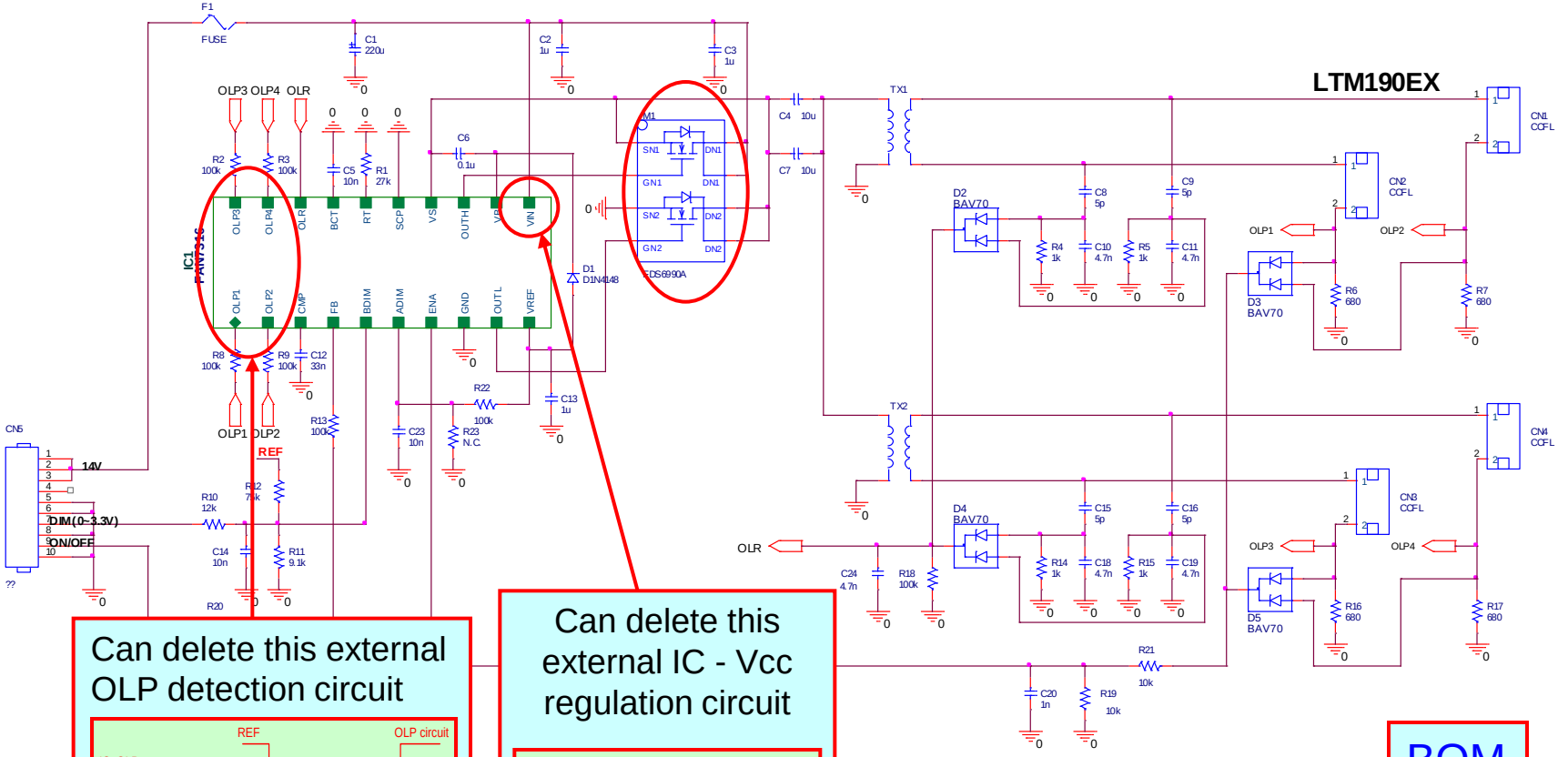


- **Integrated OLP Circuit**
  - → No need open lamp detection circuit
  - → Reduce Feedback rectifier diode
  - → 1 TR, 5 Diode (3 BAV55,2 BAV70)
    5 Capacitor, 1 Resister (@ 4Lamp)

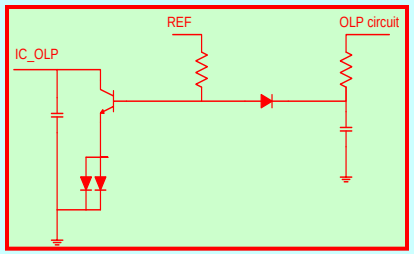


Reduce External Components

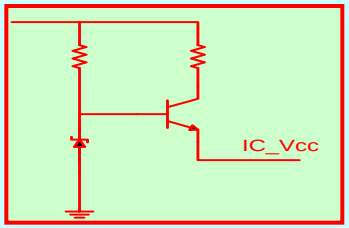
FAN7316 – N-N Half-Bridge



Can delete this external OLP detection circuit



Can delete this external IC - Vcc regulation circuit

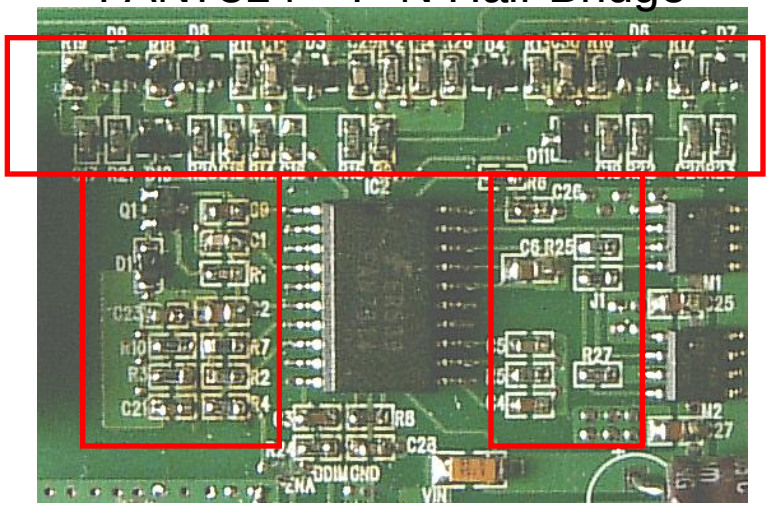


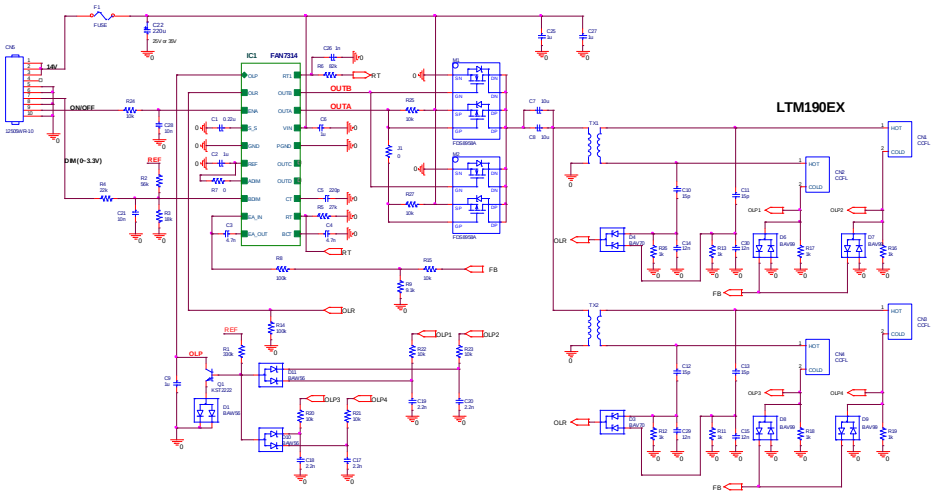
BOM

Dual N MOS	1
Control IC	1

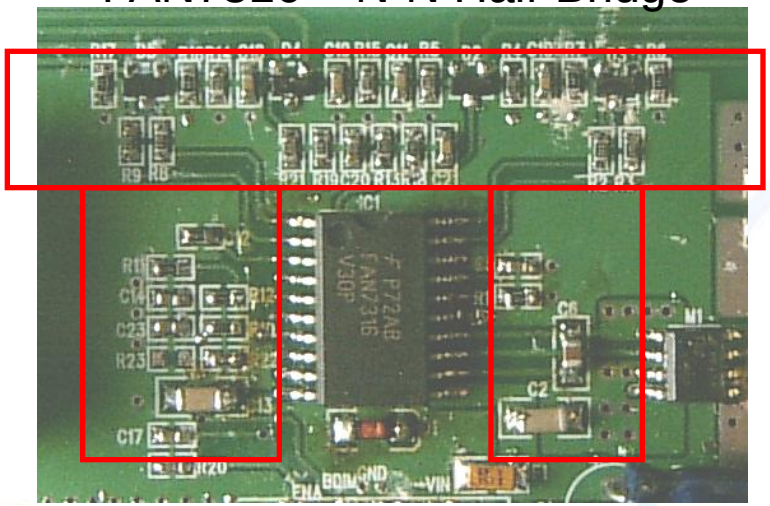
Reduce External Components

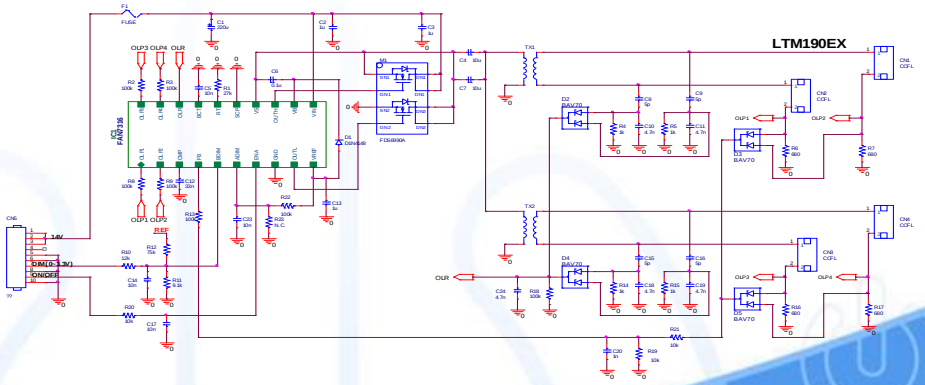
FAN7314 – P-N Half-Bridge





FAN7316 – N-N Half-Bridge





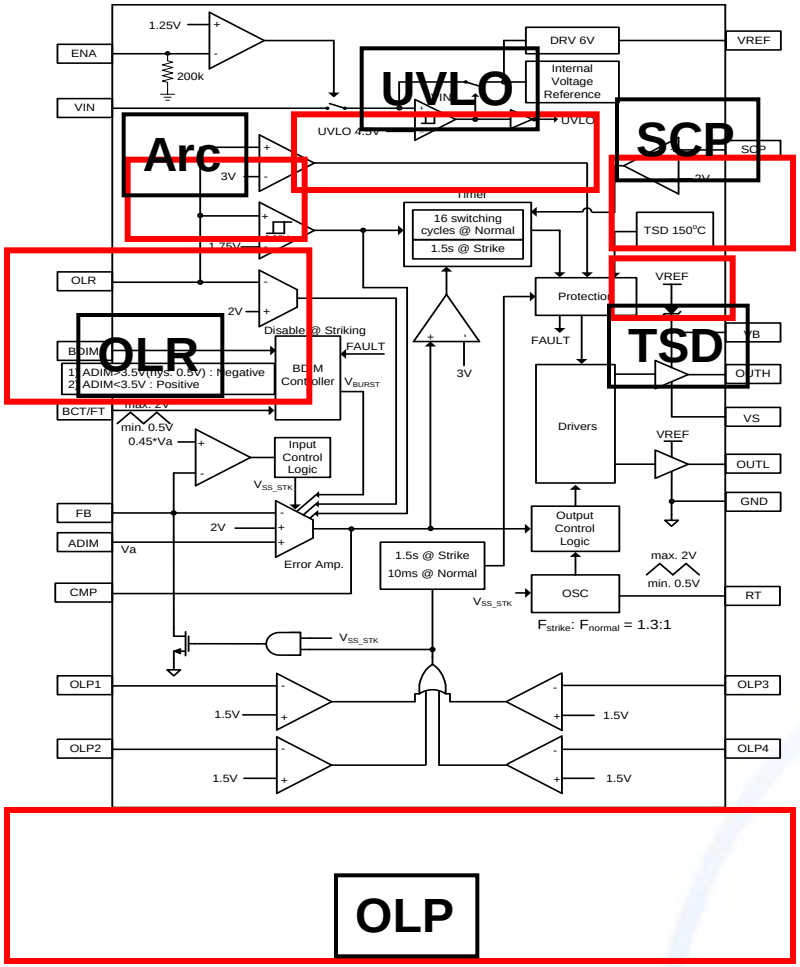
Key Features

- **Reduce external components**
  → Wide Input Voltage Range : 4.5 ~ 24V
  → Integrated OLP circuit

- **Various Protection**
  → OLP, OLR, SCP, TSD, Soft-start, Arc Protection

- **Design flexibility**
  → Selectable Dimming Polarity
  → N-N Half-bridge & Push-pull topology
  → Analog & Burst dimming
  → PWM dimming by external pulse signal
  → Wide input voltage range : 4.5 ~ 24V

Various Protection



Protection Item	Description	Protection Condition
SCP	Short Circuit Protection	> 2V (@ SCP)
OLR	Open Lamp Regulation	> 1.75V (@ OLR)
Arc	Arc Protection	> 3V (@ OLR)
OLP	Open Lamp Protection	< 1.5V (@ OLP)
TSD	Thermal Shut Down	150°C (@ Tj)

Key Features

- **Reduce external components**
  → Wide Input Voltage Range : 4.5 ~ 24V
  → Integrated OLP circuit

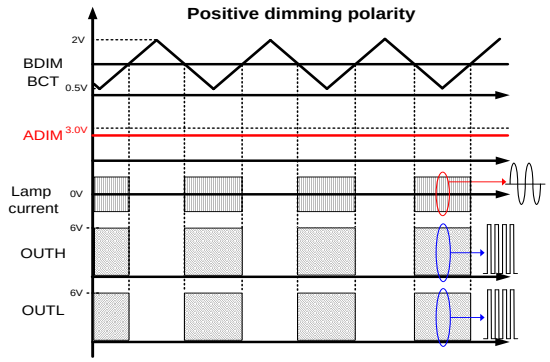
- **Various Protection**
  → OLP, OLR, SCP, TSD, Soft-start, Arc Protection

- **Design flexibility**
  → Selectable Dimming Polarity
  → N-N Half-bridge, Push-pull topology, P-N Half-bridge, P-N Full-bridge
  → Analog & Burst dimming
  → PWM dimming by external pulse signal
  → Wide input voltage range : 4.5 ~ 24V

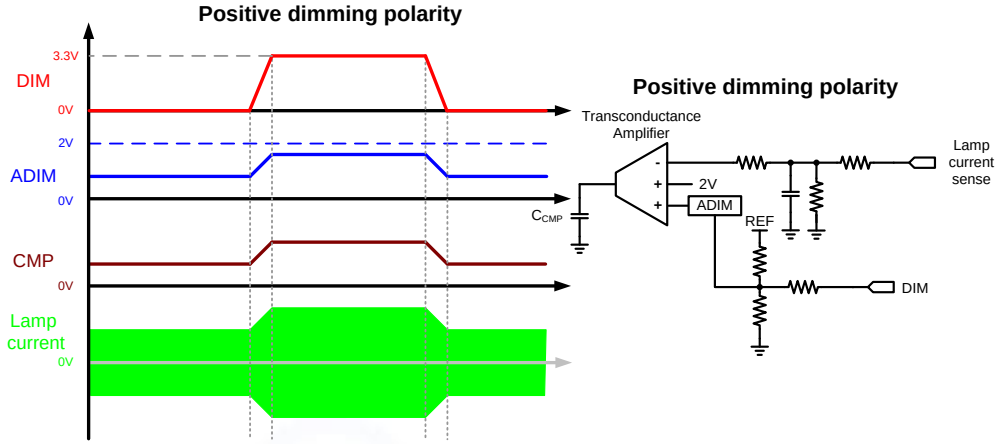
Design Flexibility

Selectable Dimming Polarity

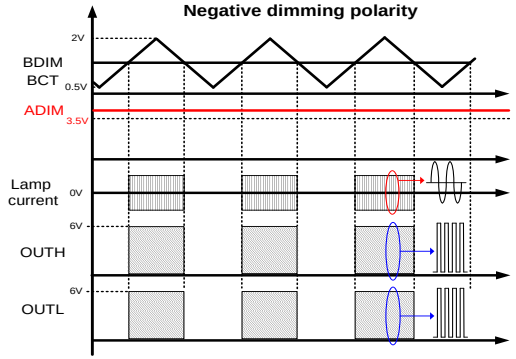
1) Positive burst dimming polarity @ ADIM < 3.0V



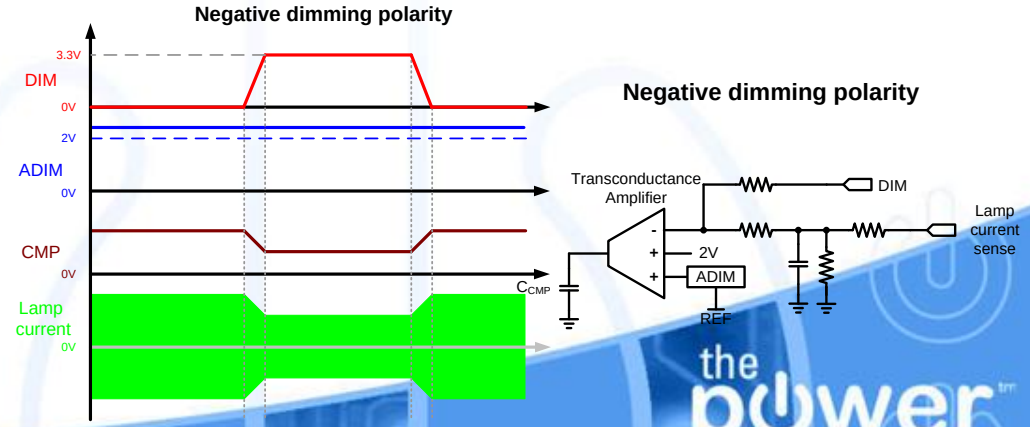
1) Positive burst dimming polarity



2) Negative burst dimming polarity @ ADIM > 3.5V

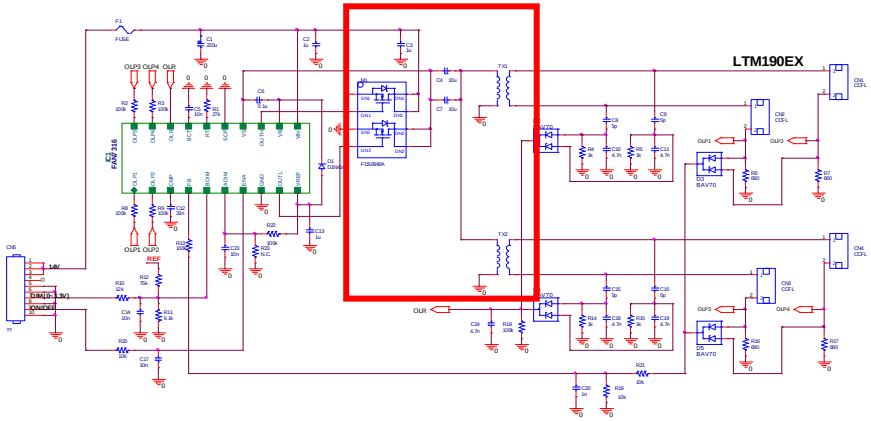


2) Negative burst dimming polarity

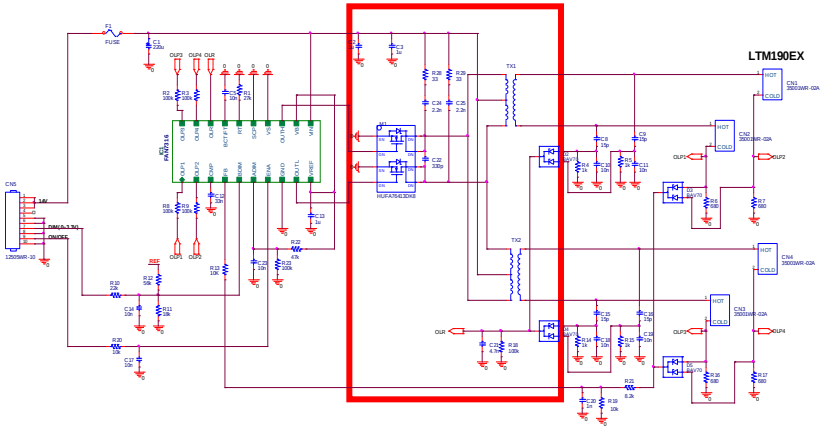


Design Flexibility

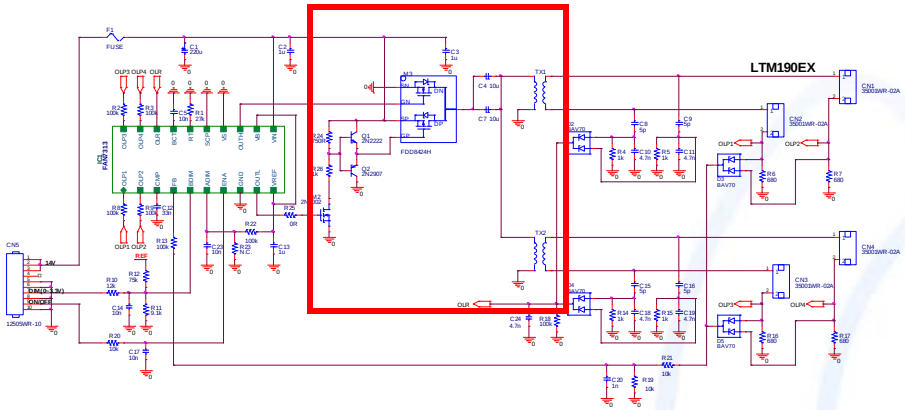
N-N Half-bridge Application



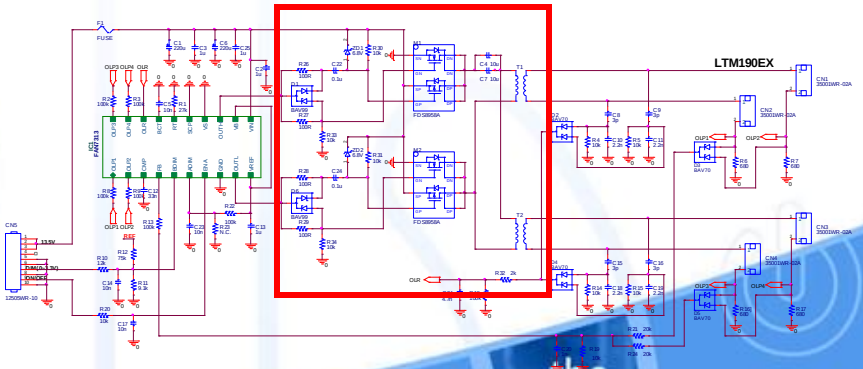
Push-pull Application



P-N Half-bridge Application

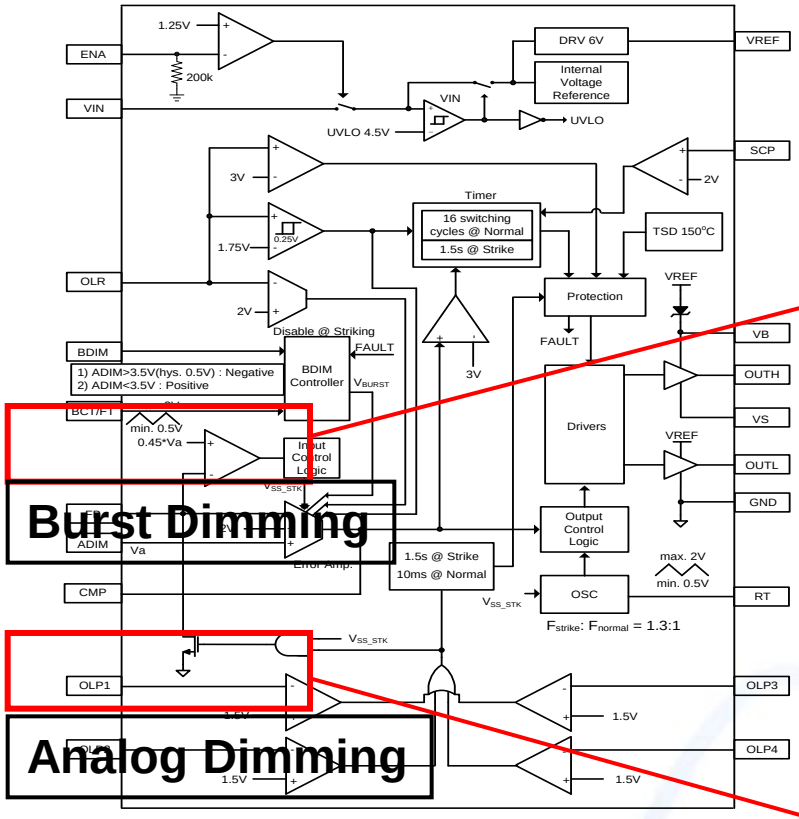


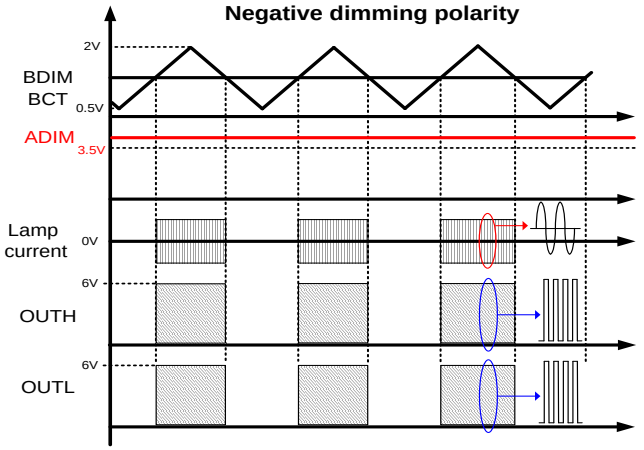
P-N Full-bridge Application

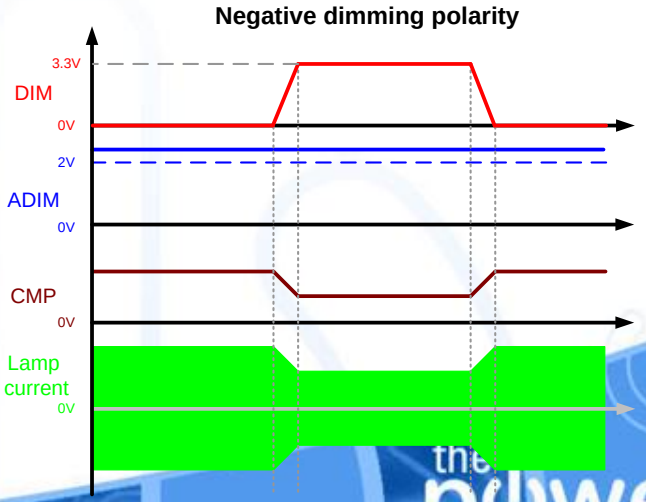


Design Flexibility

Analog & Burst Dimming



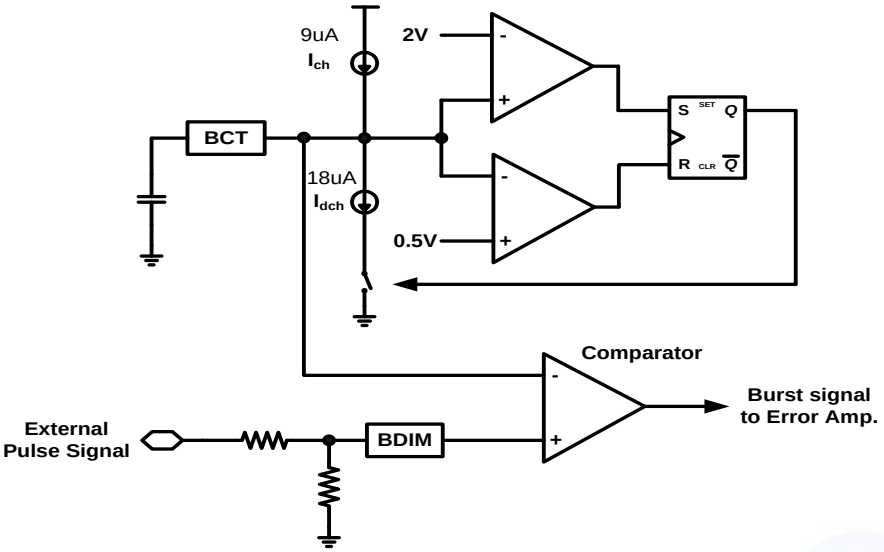


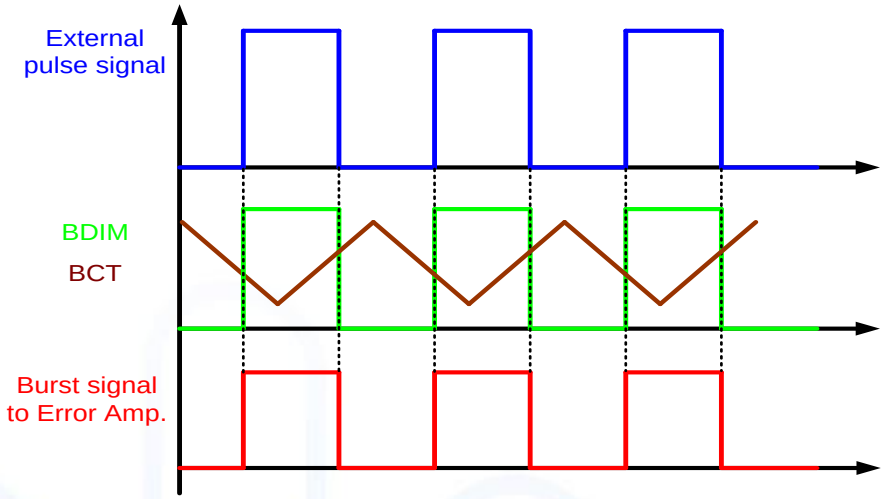


Design Flexibility

PWM dimming by external pulse signal

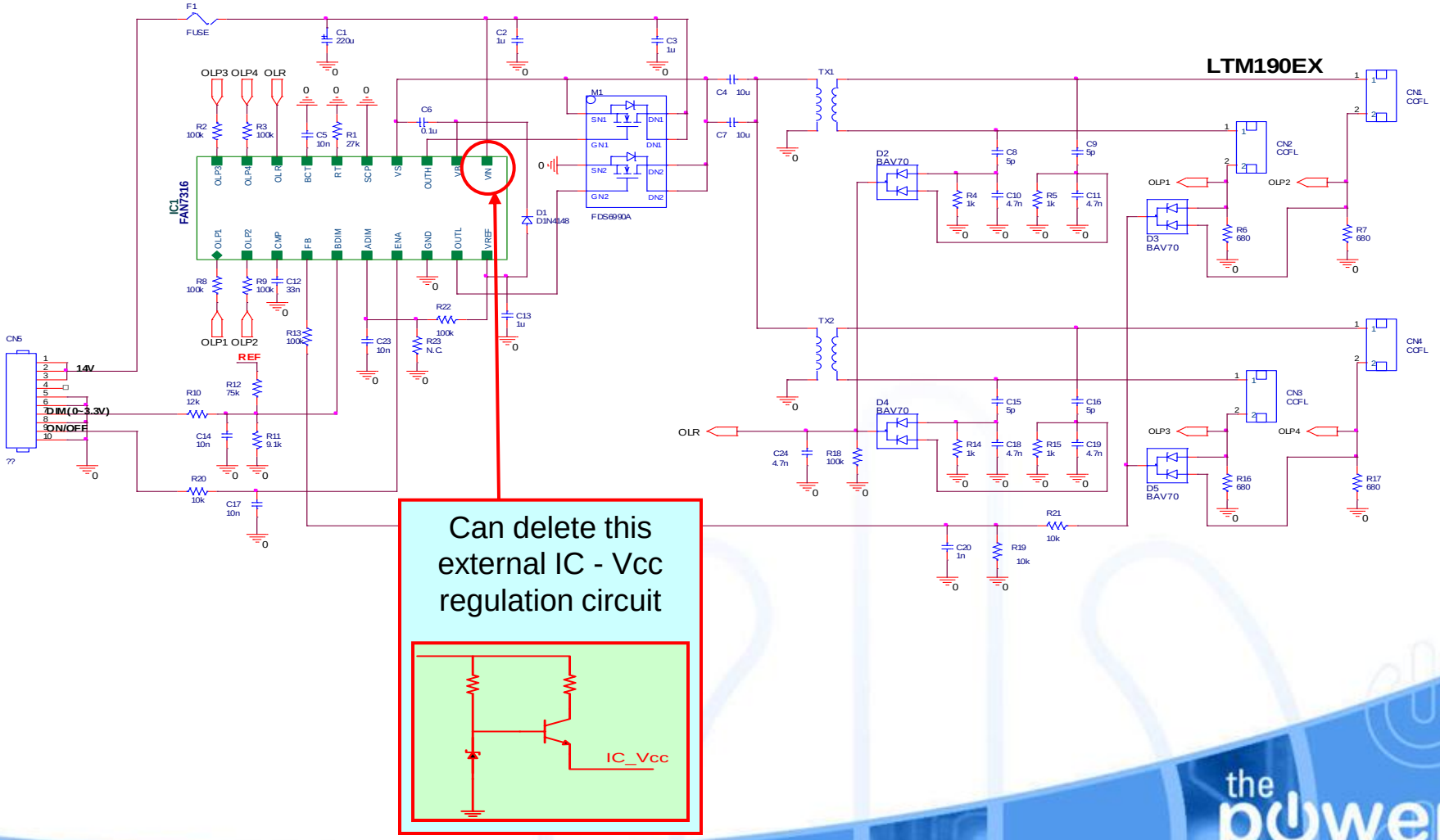
This method can be applied to FAN7313, FAN7316 application





Design Flexibility

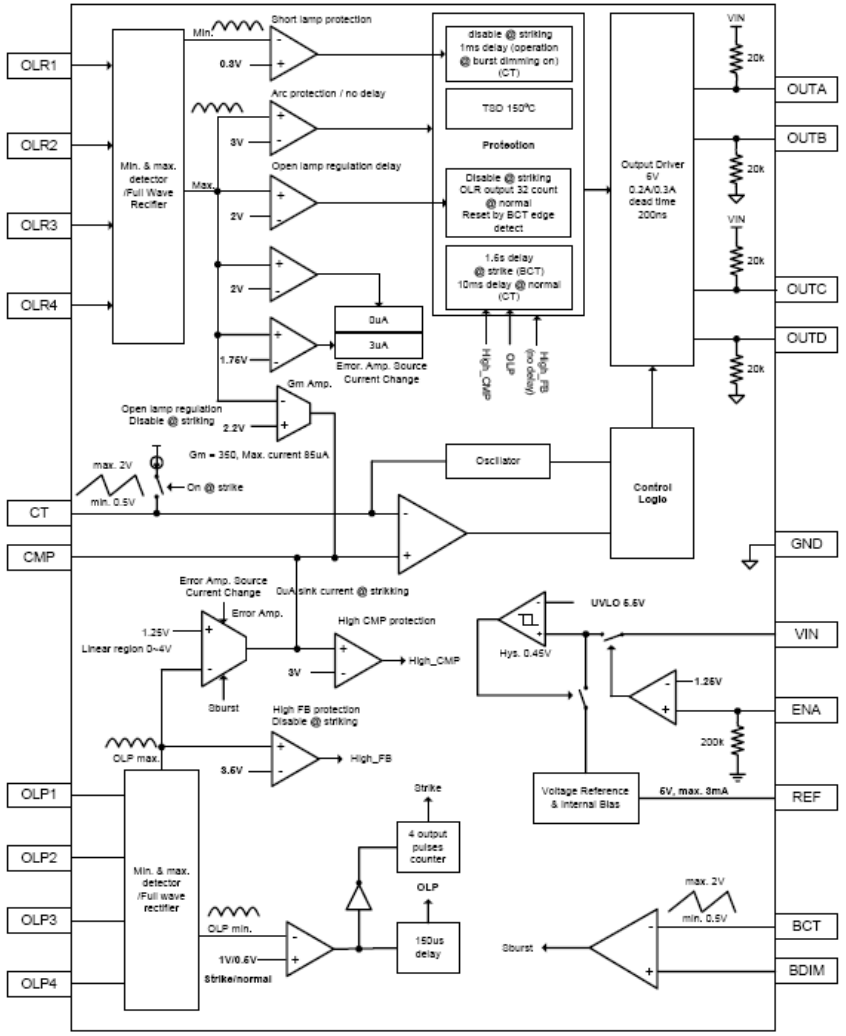
Wide Input Voltage Range : 4.5 ~ 24/25.5V



FAN7317 Key Features

- **Reduce external components**
  - → Wide Input Voltage Range : 6.0 ~ 24V
  - → Integrated OLP circuit
  - → Integrated OLR circuit
  - → Integrated P-MOS driving circuit

- **Various Protection**
  - → OLP, OLR, SLP, CMP-high, FB-high, TSD, Soft-start, Arc Protection



FAN7317 Key Features

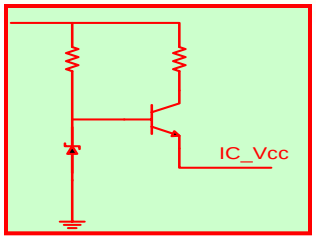
- **Reduce external components**
  - → Wide Input Voltage Range : 6.0 ~ 24V
  - → Integrated OLP circuit
  - → Integrated OLR circuit
  - → Integrated P-MOS driving circuit

- **Various Protection**
  - → OLP, OLR, SLP, CMP-high, FB-high, TSD, Soft-start, Arc Protection

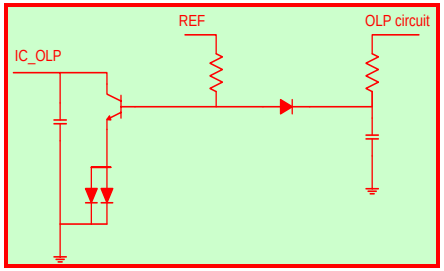
- **Design flexibility**
  - → Selectable Dimming Polarity
  - → N-N Half-bridge & Push-pull topology
  - → Analog & Burst dimming
  - → PWM dimming by external pulse signal
  - → Wide input voltage range : 4.5 ~ 24V

Reduce External Components

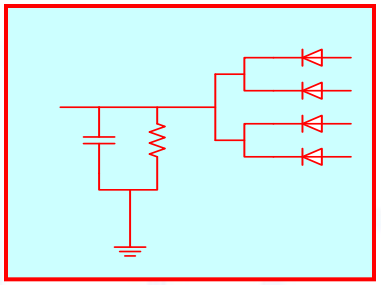
- **Wide Input Voltage Range : 6.0 ~ 24V**
  → Can use common Vcc with IC input voltage
  → 1 TR, 1 Zenor D, 2 Resister



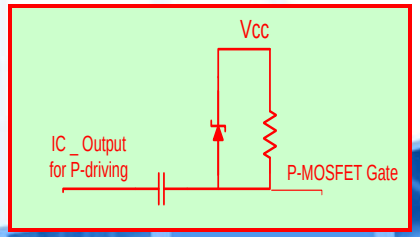
- **Integrated OLP Circuit**
  → No need open lamp detection circuit
  → Reduce Feedback rectifier diode
  → 1 TR, 5 Diode (3 BAV55,2 BAV70)
  5 Capacitor, 1 Resister (@ 4Lamp)



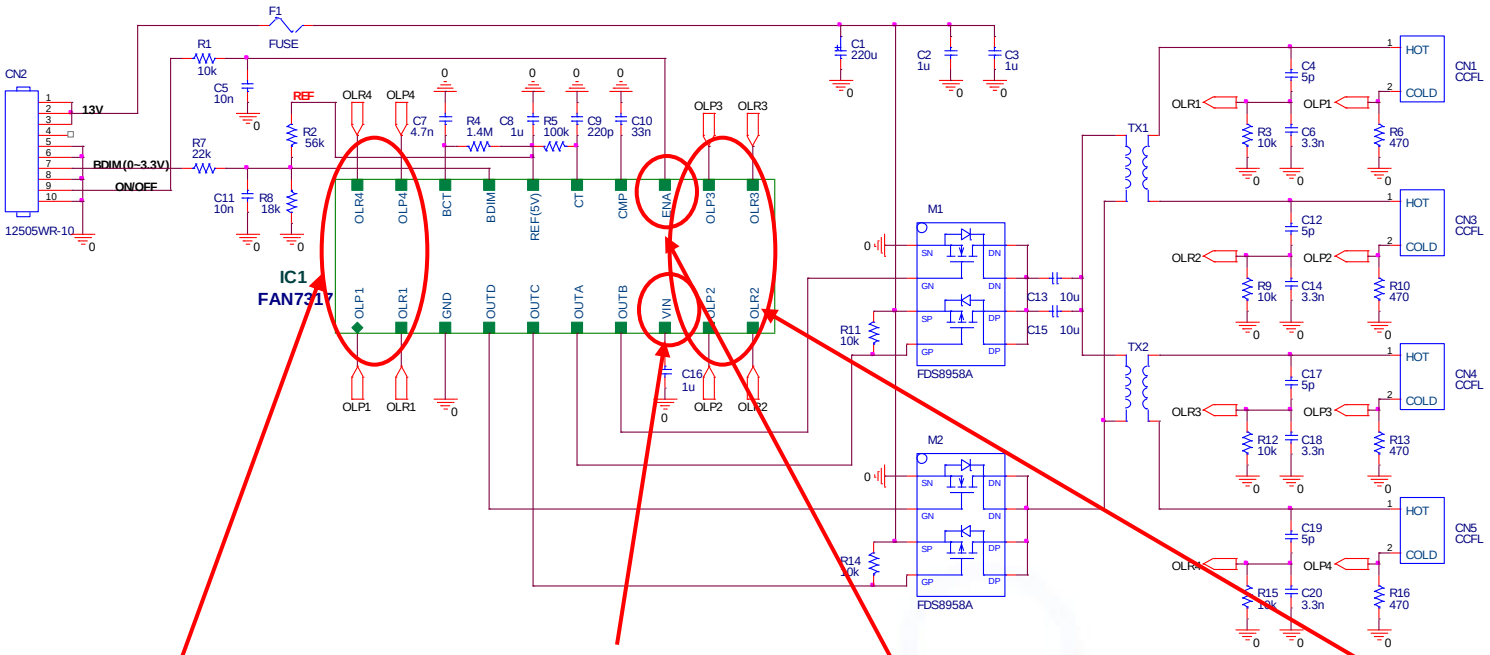
- **Integrated OLR Circuit**
  → No need open lamp regulation circuit
  → No need feedback diode
  → 2 Capacitor, 4 Diode (BAV70)
  3 Resister (@ 4Lamp)



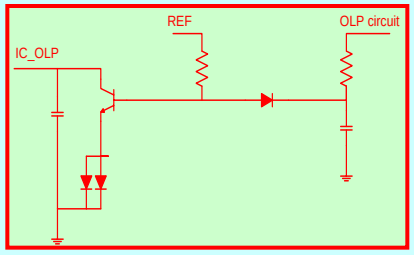
- **P-MOS Driving Circuit**
  → 2 Zenor D, 2 Capacitor, 2 Resistor



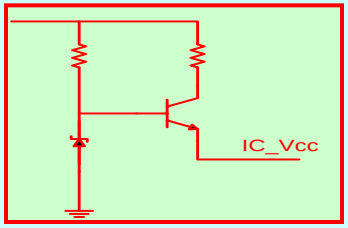
Reduce External Components



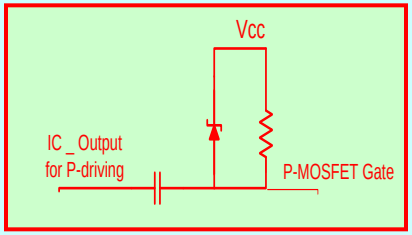
Can delete this external OLP detection circuit



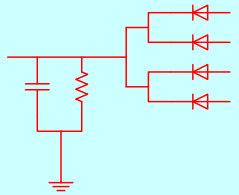
Can delete this external IC - Vcc regulation circuit



Can delete this external P-MOSFET driving circuit



Can delete this OLR circuit



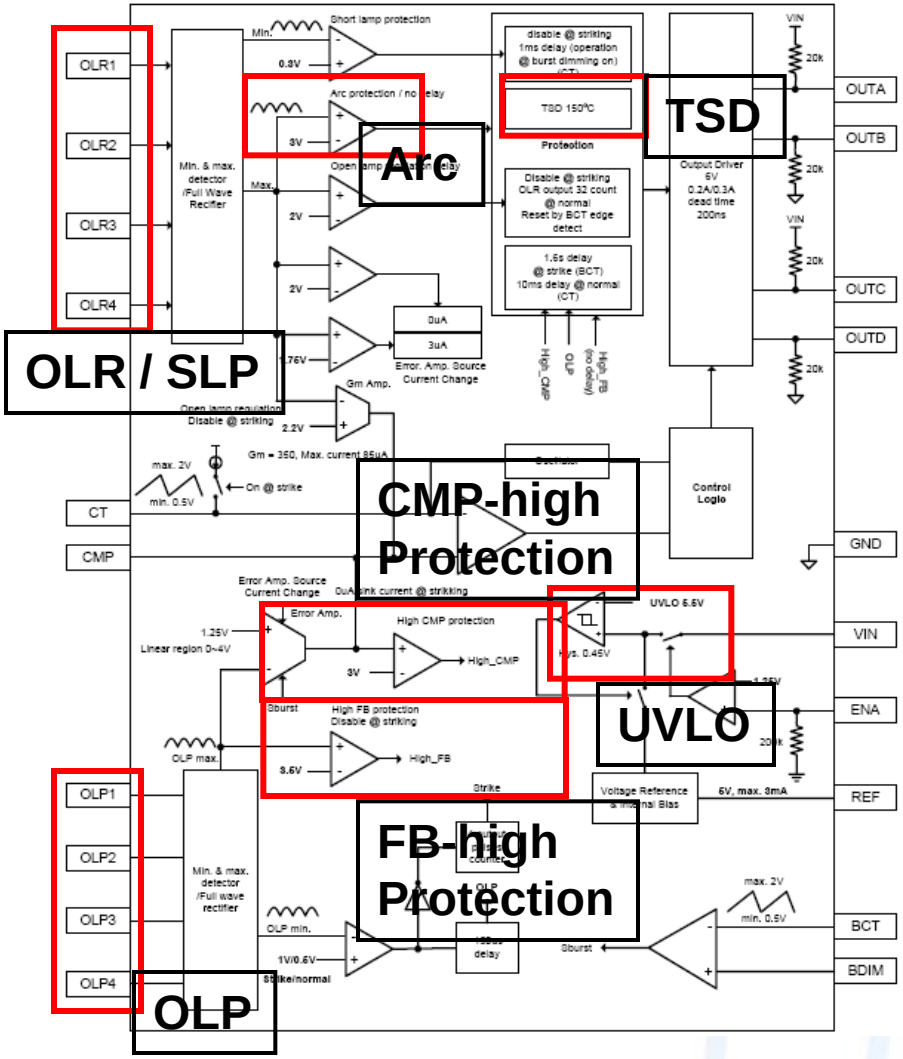
Key Features

- **Reduce external components**
  → Wide Input Voltage Range : 4.5 ~ 24V
  → Integrated OLP circuit

- **System Reliability with Various Protection**
  → OLP, OLR, SLP, CMP-high, FB-high, TSD, Soft-start, Arc Protection

- **Design flexibility**
  → Selectable Dimming Polarity
  → N-N Half-bridge & Push-pull topology
  → Analog & Burst dimming
  → PWM dimming by external pulse signal
  → Wide input voltage range : 4.5 ~ 24V

Various Protection



Protection Item	Description	Protection Condition
SLP	Short Lamp Protection	< 0.3V (@ OLR)
OLR	Open Lamp Regulation	> 2.0V (@ OLR)
Arc	Arc Protection	> 3V (@ OLR)
CMP-High	Comparator high protection	> 3V (@ CMP)
FB-High	Feedback high protection	> 3.5V (@OLP)
OLP	Open Lamp Protection	< 1/0.5V (@ OLP)
TSD	Thermal Shut Down	150°C (@ Tj)

Key Features

- **Reduce external components**
  → Wide Input Voltage Range : 4.5 ~ 24V
  → Integrated OLP circuit

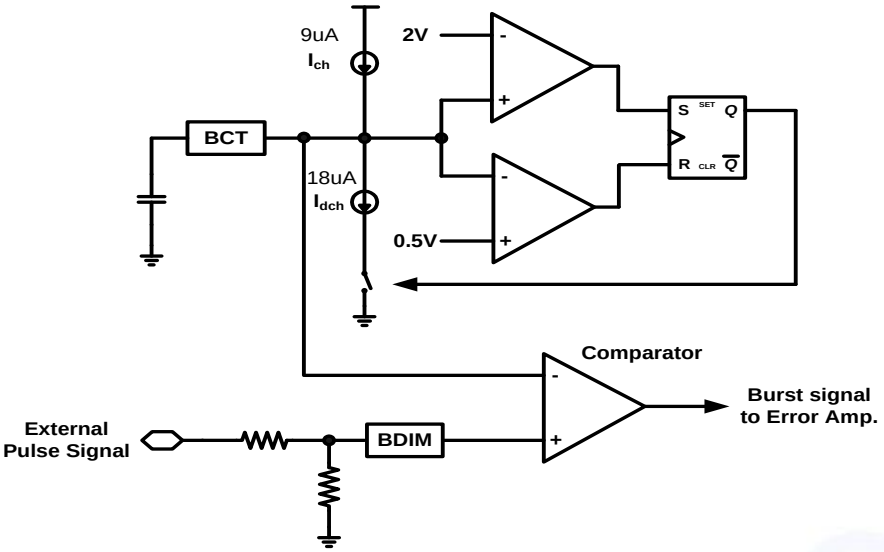
- **Various Protection**
  → OLP, OLR, SLP, CMP-high, FB-high, TSD, Soft-start, Arc Protection

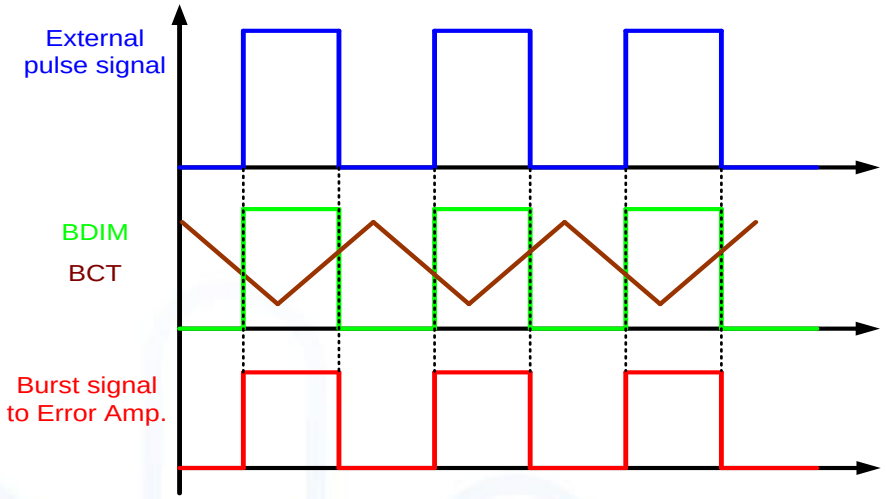
- **Design flexibility**
  → P-N Half-bridge, P-N Full-bridge
  → PWM dimming by external pulse signal
  → Wide input voltage range : 6.0 ~ 24V

Design Flexibility

PWM dimming by external pulse signal

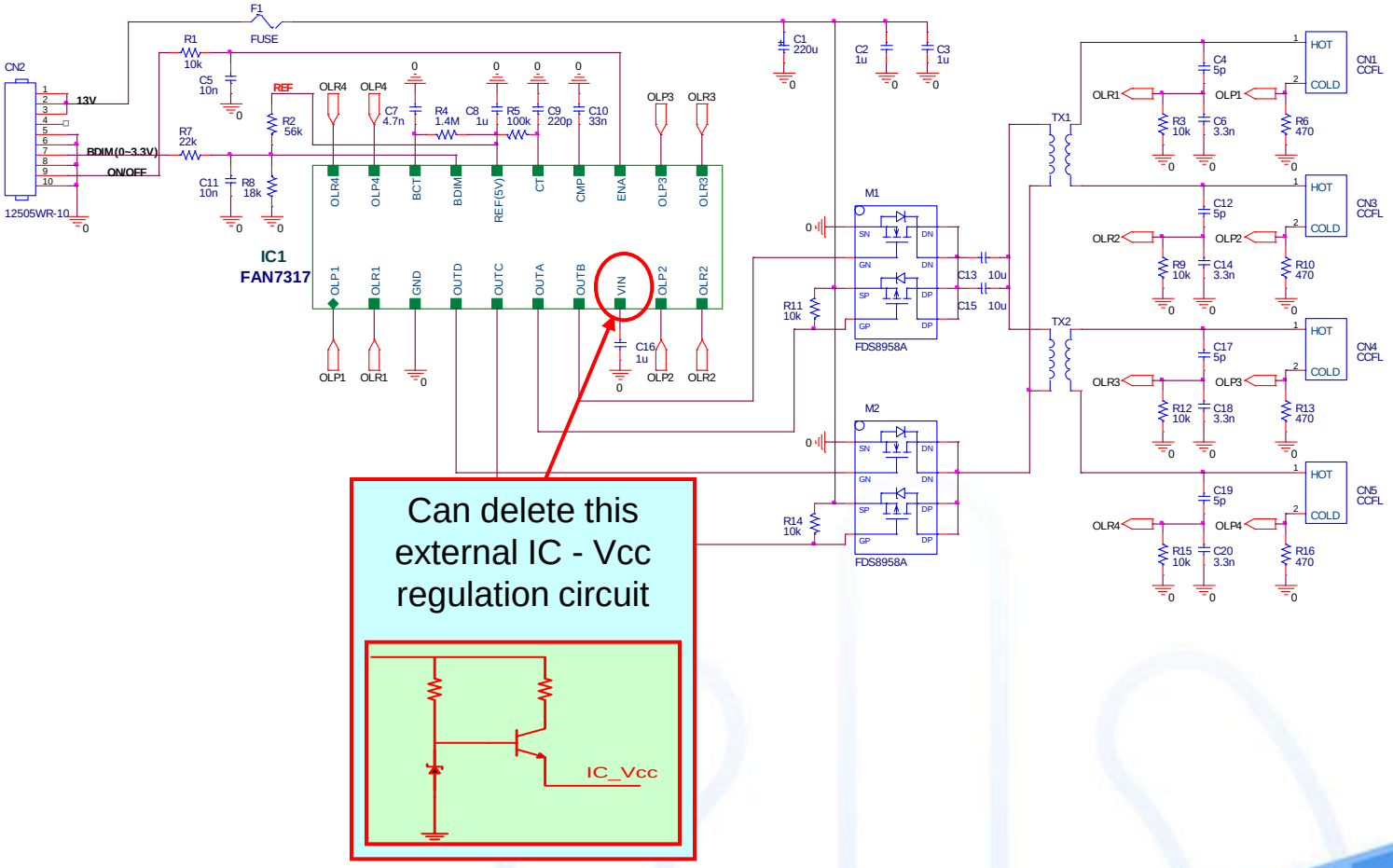
This method can be applied to FAN7313, FAN7316 application





Design Flexibility

Wide input voltage range 6 ~ 24V



New Product Introduction

- FAN7318 P-N Half Bridge Solution

FAN7318 Key Features

- **Reduce external components**
  - → Wide Input Voltage Range : 6.0 ~ 30.0 V
  - → Integrated OLP circuit
  - → Internal OLR circuit
  - → Internal feedback circuit
  - → Internal P-MOS driving circuit

- **Various Protection**
  - → OLP, OLR, SLP, OVP, COMP-Hi, Feedback-Hi, TSD, Soft-start

- **Design flexibility**
  - → Adjustable Striking & Protection delay time
  - → DCR mode operation
  - → Analog & Burst dimming
  - → PWM dimming by external pulse signal
  - → Wide input voltage range : 6.0 ~ 30V

Reduce External Components

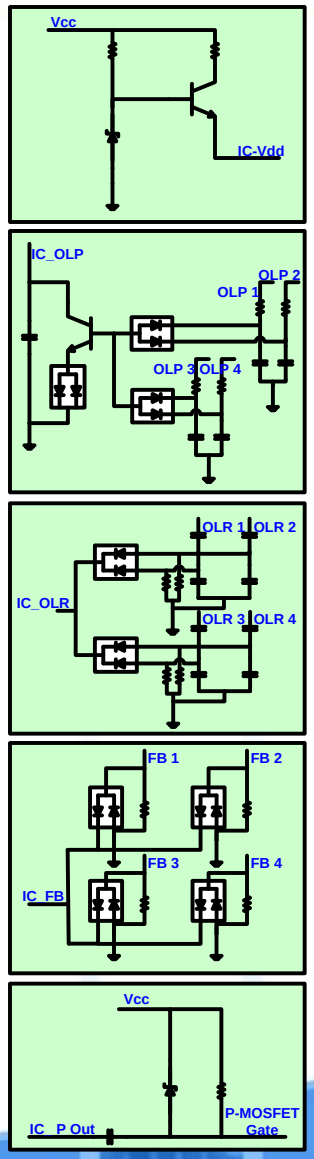
- **Wide Input Voltage Range : 6.0 ~ 30V**
  → Can use common Vcc with IC input voltage
  → 1 TR, 1 Zenor D, 2 Resister

- **Integrated OLP Circuit**
  → No need open lamp detection circuit
  → 1 TR, 3 Diode (BAW56)
  5 Capacitor, 5 Resister (@ 4Lamp)

- **Integrated OLR Circuit**
  → No need open lamp regulation circuit
  → 2 Capacitor, 2 Diode (BAV70)
  4 Resister (@ 4Lamp)

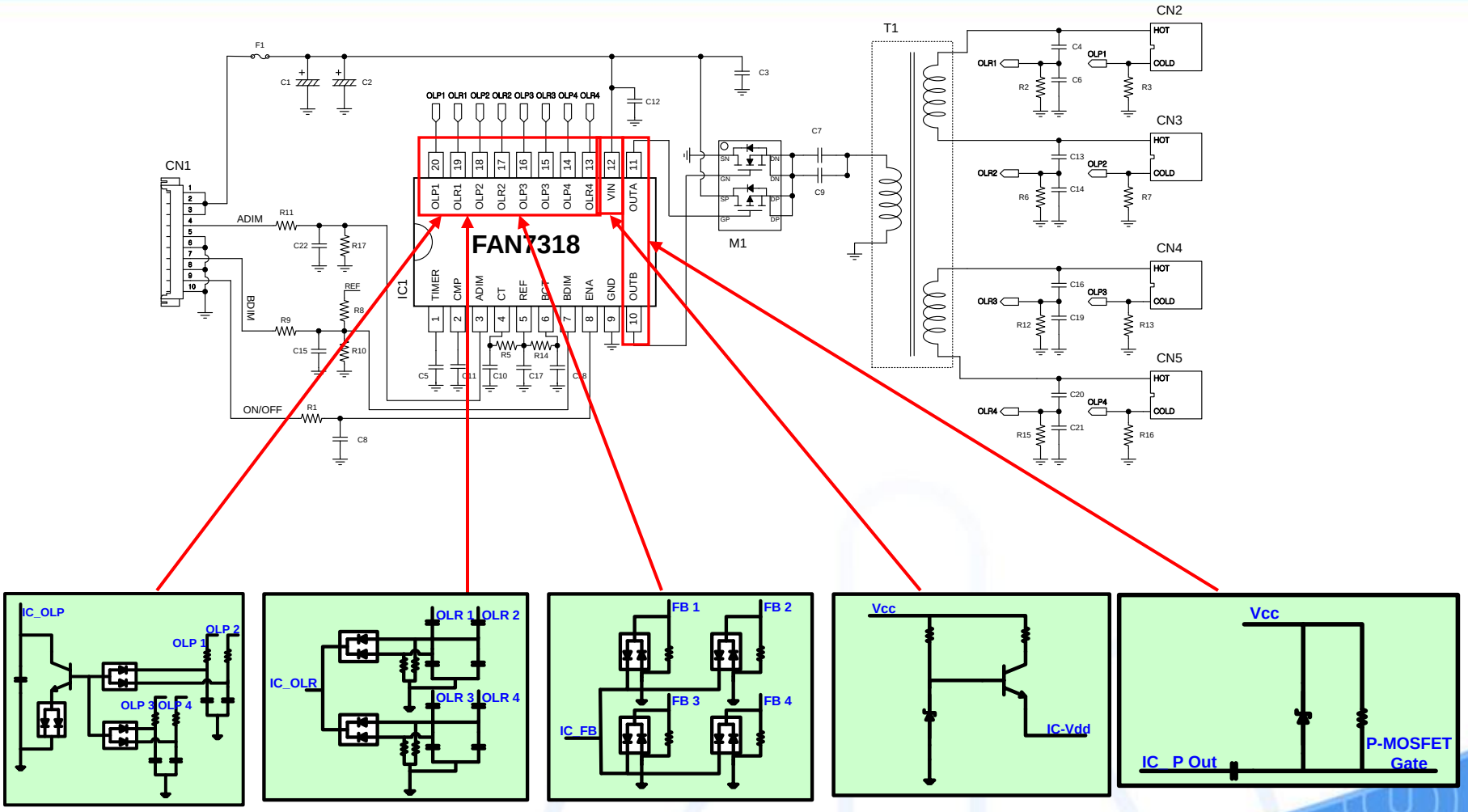
- **Integrated Feedback rectifier diode**
  → 4 Diode (BAV99) (@4Lamp)

- **P-MOS Driving Circuit**
  → 1 Zenor D, 1 Capacitor, 1 Resistor



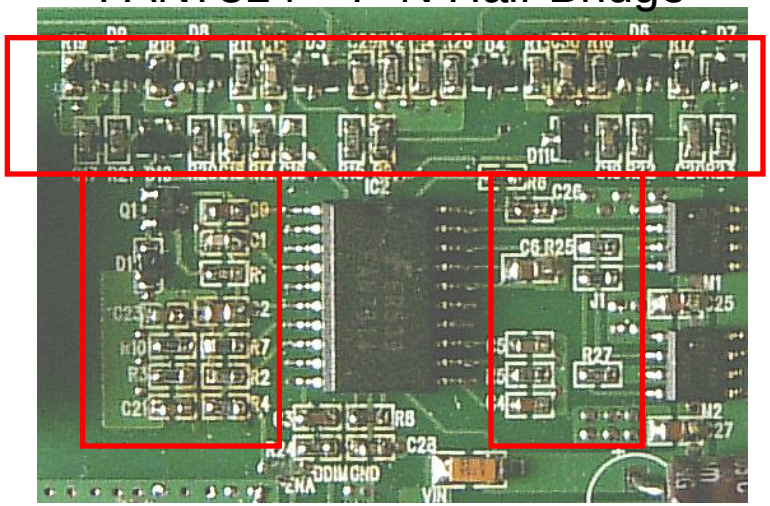
Device	Unit	Price
TR	2	$0.014
ZD	1	$0.007
BAV D	9	$0.063
Capacitor	6	$0.012
Resistor	12	$0.005
Total	30	$0.101

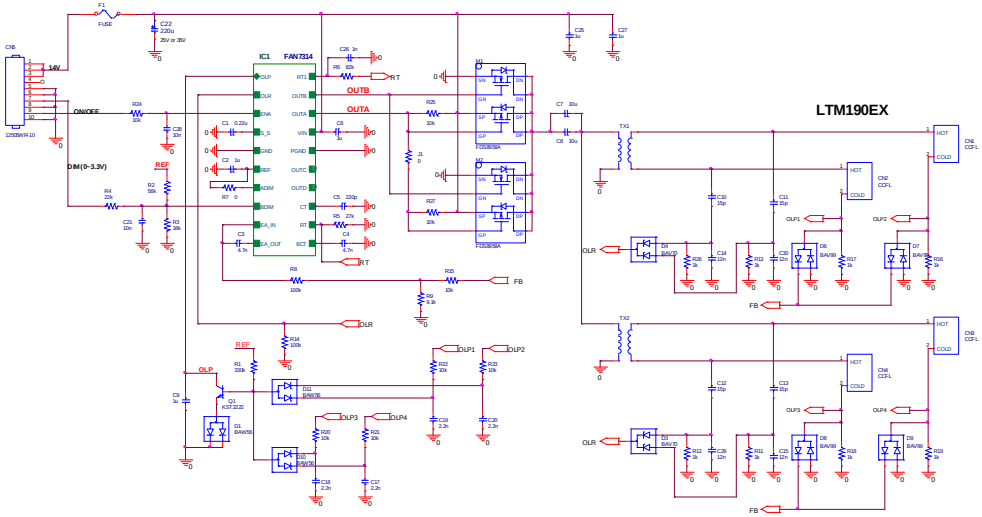
Reduce External Components



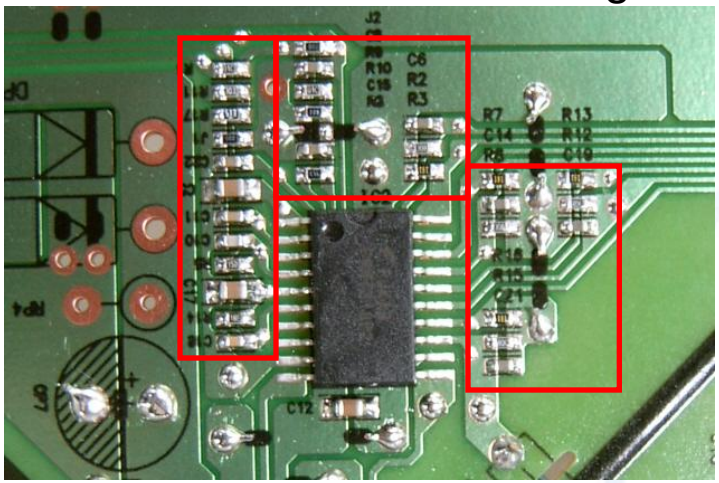
Reduce External Components

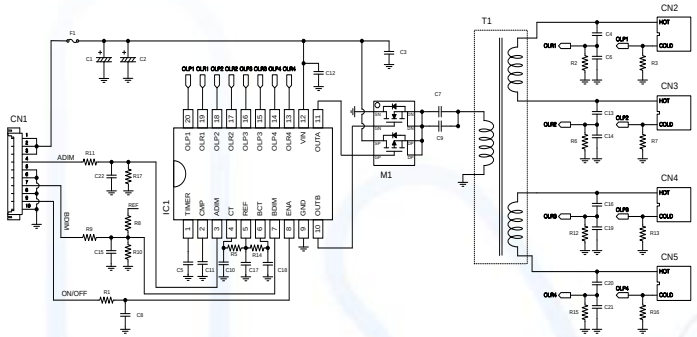
FAN7314 – P-N Half-Bridge





FAN7318 – P-N Half-Bridge





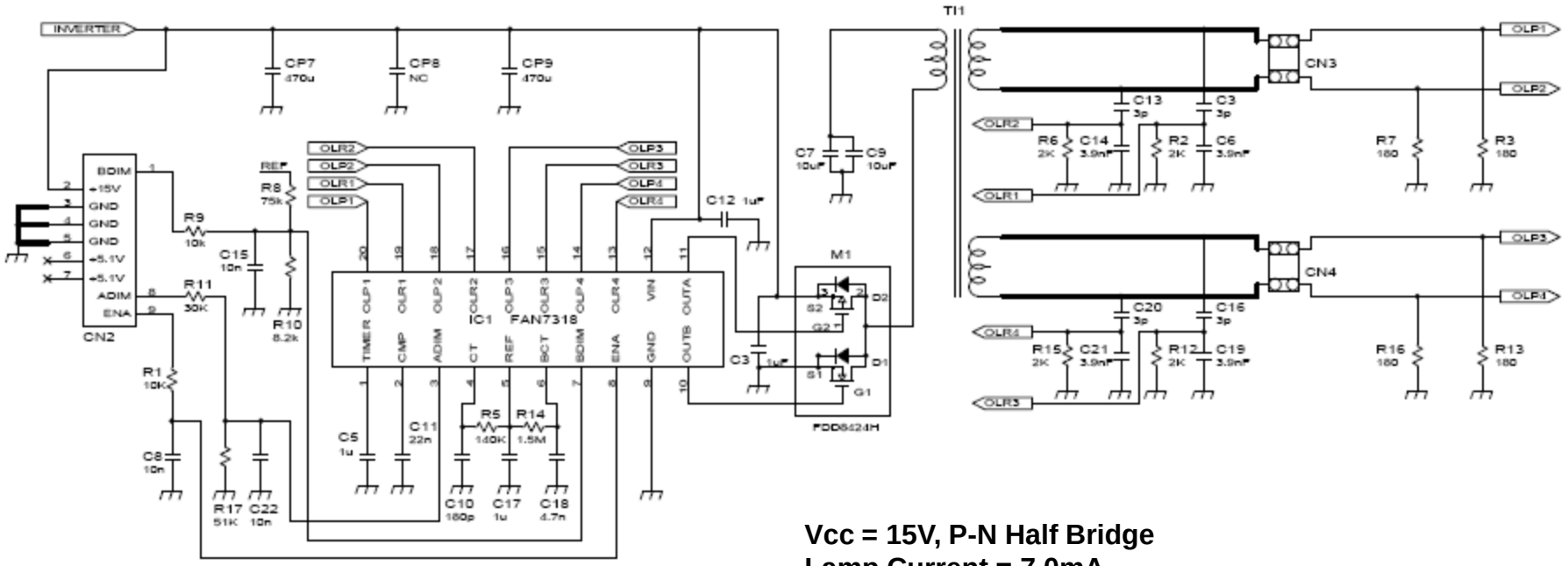
FAN7318 Key Features

- **Reduce external components**
  - → Wide Input Voltage Range : 6.0 ~ 30.0 V
  - → Integrated OLP circuit
  - → Internal OLR circuit
  - → Internal feedback circuit
  - → Internal P-MOS driving circuit

- **Various Protection**
  - → OLP, OLR, SLP, OVP, COMP-Hi, Feedback-Hi, TSD, Soft-start

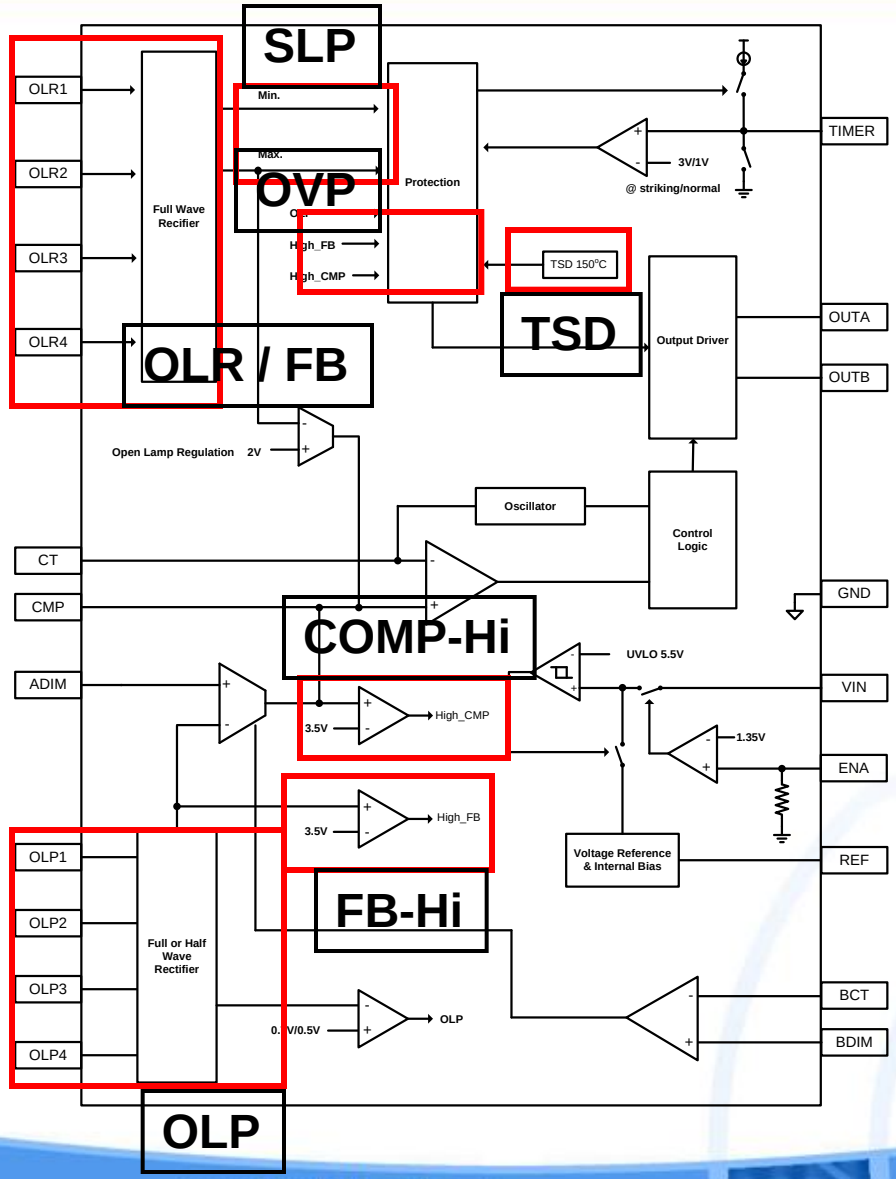
- **Design flexibility**
  - → Adjustable Striking & Protection delay time
  - → DCR mode operation
  - → Analog & Burst dimming
  - → PWM dimming by external pulse signal
  - → Wide input voltage range : 6.0 ~ 30V

FAN7318 Application Circuit



Vcc = 15V, P-N Half Bridge
Lamp Current = 7.0mA
Fm : 46.5KHz
Fstr : 65KHz
Fbus: 320Hz
Vstr : Over 1700V
Panel : M220EW01 (AUO 22”)

Various Protection



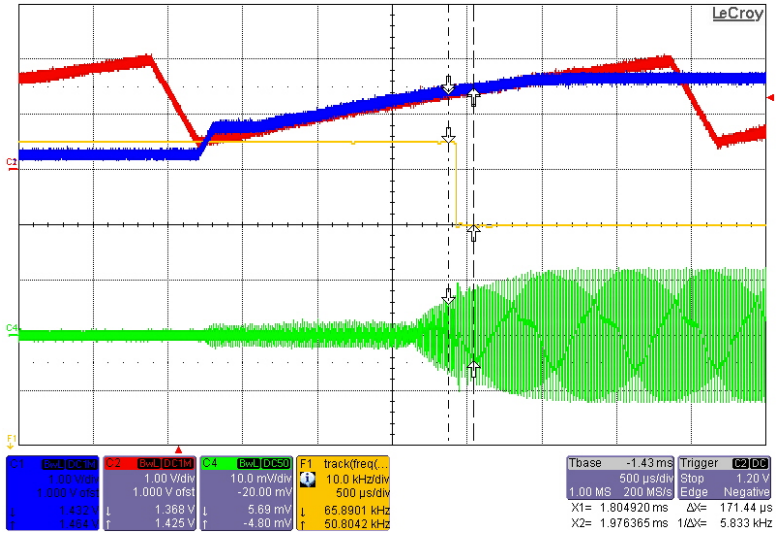
O **: Over /** ***U*** **: Under**

Protection	Description	Protection Condition	Delay Time @ 1uF
SLP	Short Lamp Protection	*U* 0.3V @ OLR (min.)	20mS
OLR	Open Lamp Regulation	*U* 2V (@ OLR)	
OVP	Over Voltage Protection	*O* 1.4V (@ OLR)	20mS
OLP	Open Lamp Protection	*U* 0.7/0.5V (@ OLP)	1.5/0.5S
CHP	Comparator High Protection	*O* 3.5V (@ CMP)	1.5/0.5S
FHP	Feedback High protection	*O* 3.5V (@ OLP)	80uS @50KHz
TSD	Thermal Shut Down	*O* 150°C (@ Tj)	

Soft Start

- Soft start operated by BCT waveform

Normal Mode



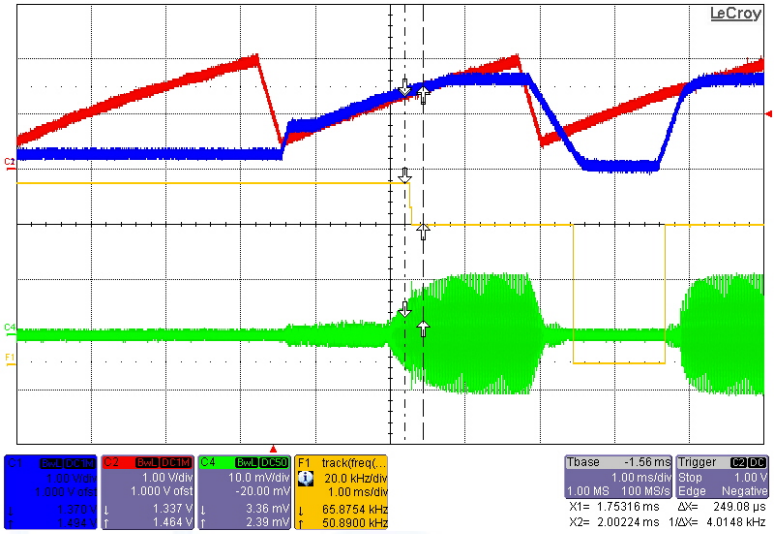
CMP

BCT

Frequency

I Lamp

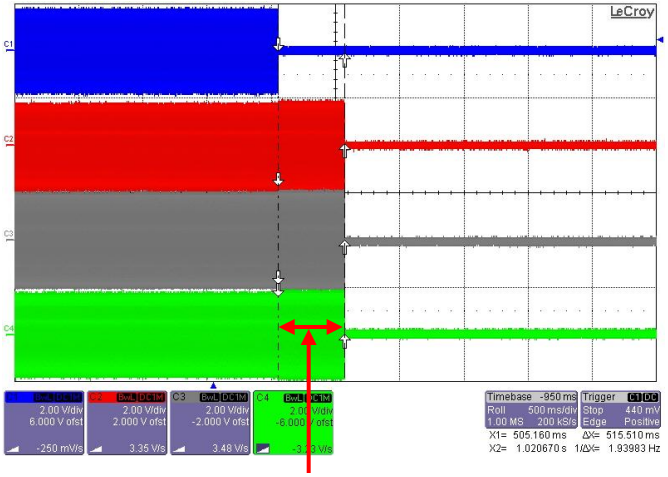
Burst Dimming Mode



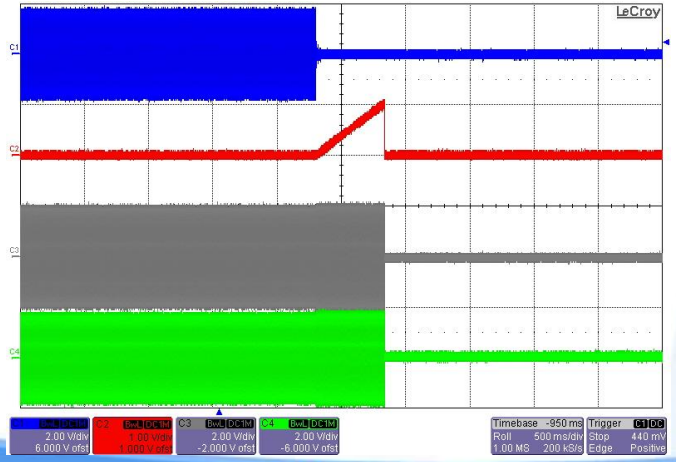
Open Lamp Protection

- Open Lamp Protection delay time is adjusted by C timer (@1uF)
- Open Lamp Protection disable for DCR Mode by ENA voltage

Normal Operation (ENA < 2.1V)



OLP delay time ≈ 500mS



OLP1
OLP2
OLP3
OLP4

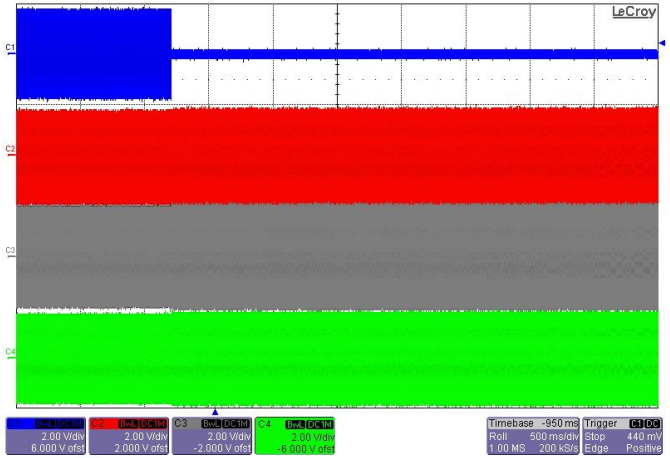
Lamp 1 Open

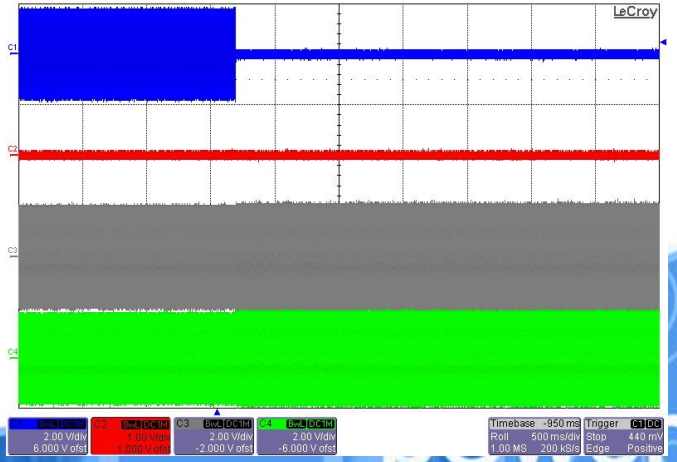
Protection Condition
OLP <0.7/0.5V

OLP1
Timer
OLP3
OLP4

Lamp 1 Open

OLP Disable (ENA > 2.5V)

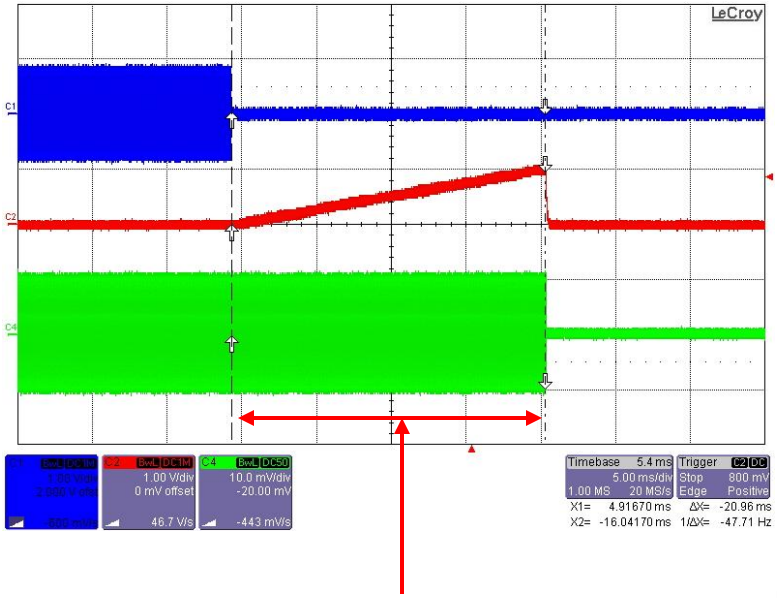




Short Lamp Protection

- Short Lamp Protection delay time is adjusted by C timer (@ 1uF)
- Short Lamp Protection disable for DCR Mode by ENA voltage

Normal Mode (ENA < 2.1V)



SLP delay time ≈ 20mS

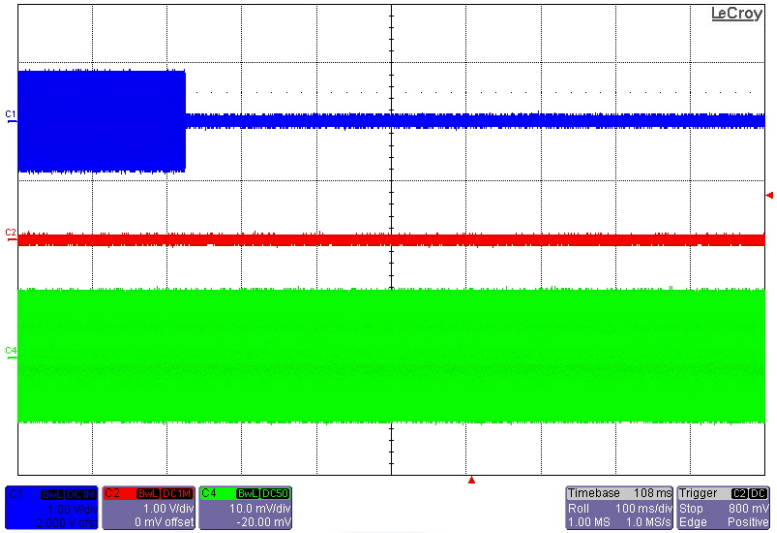
OLR

Timer

Lamp Current

Protection Condition
OLR <0.3V

SLP Disable ENA > 2.5V



Open Lamp Regulation & OVP

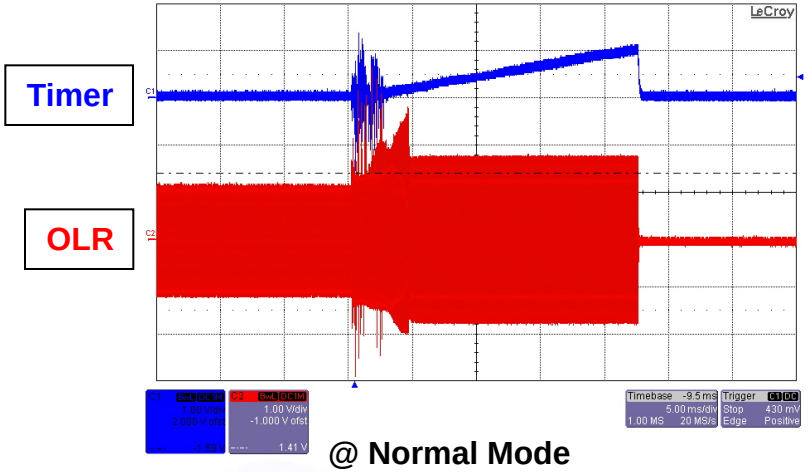
- OLR Voltage regulated at 2V
- Over Voltage Protection delay time is adjusted by C timer (@1uF)

Error Amp Source Current Change to protect overshoot

→ 22uA OLR<1.4V

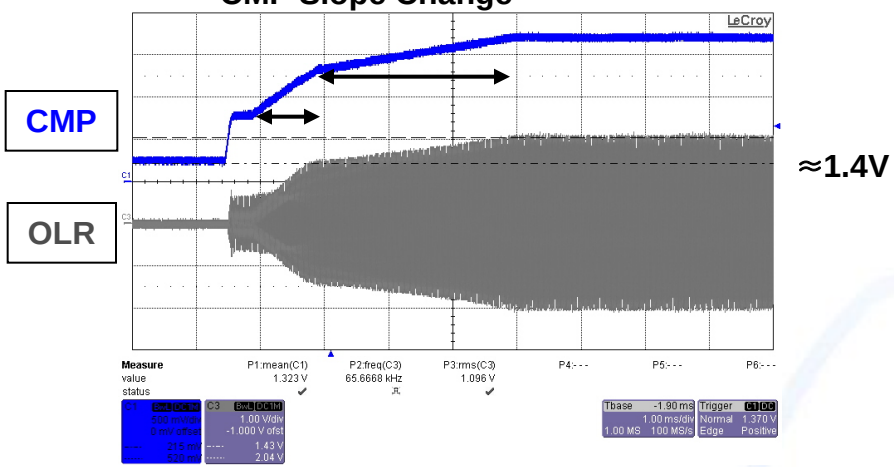
→ 3.2uA OLR>1.4V

→ 0uA OLR>2.0V

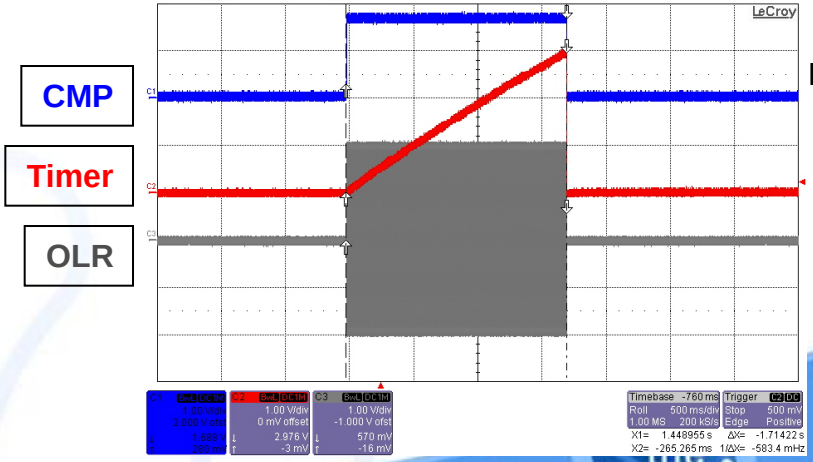


@ Normal Mode

CMP Slope Change



@ Striking Mode

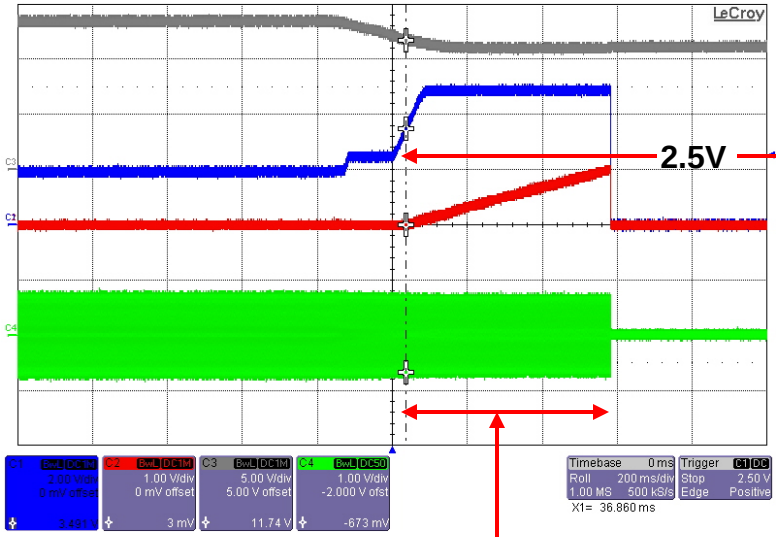


@ Striking Mode

CMP (Error Amp. Output) High Protection

- CMP High Protection operated over 3V
- CMP High Protection delay time is adjusted by C timer (@1uF)
- CMP source current decreases from 22uA to 3.2uA for CMP high protection disable

Normal Mode



CMP Hi P delay time ≈ 500mS

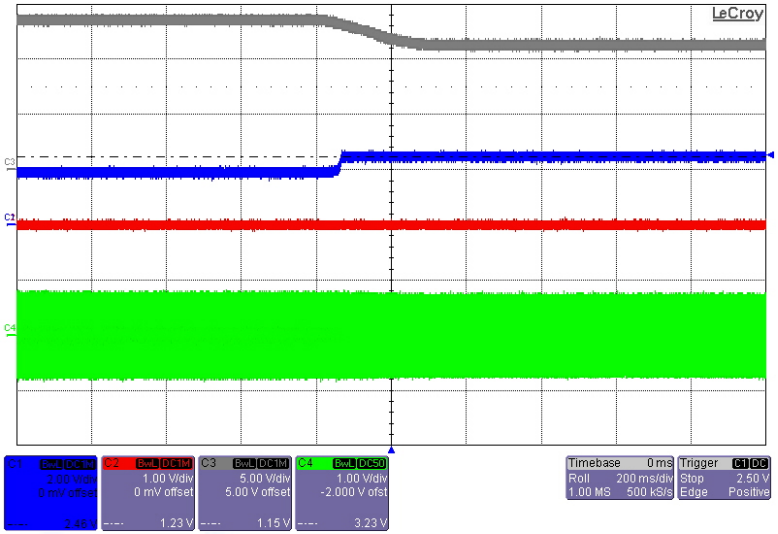
VIN

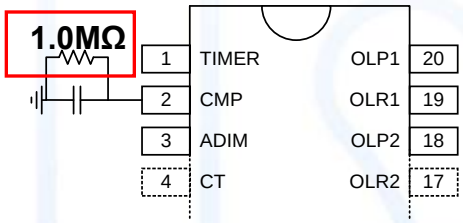
CMP

Timer

Primary Current

CMP-Hi P Disable

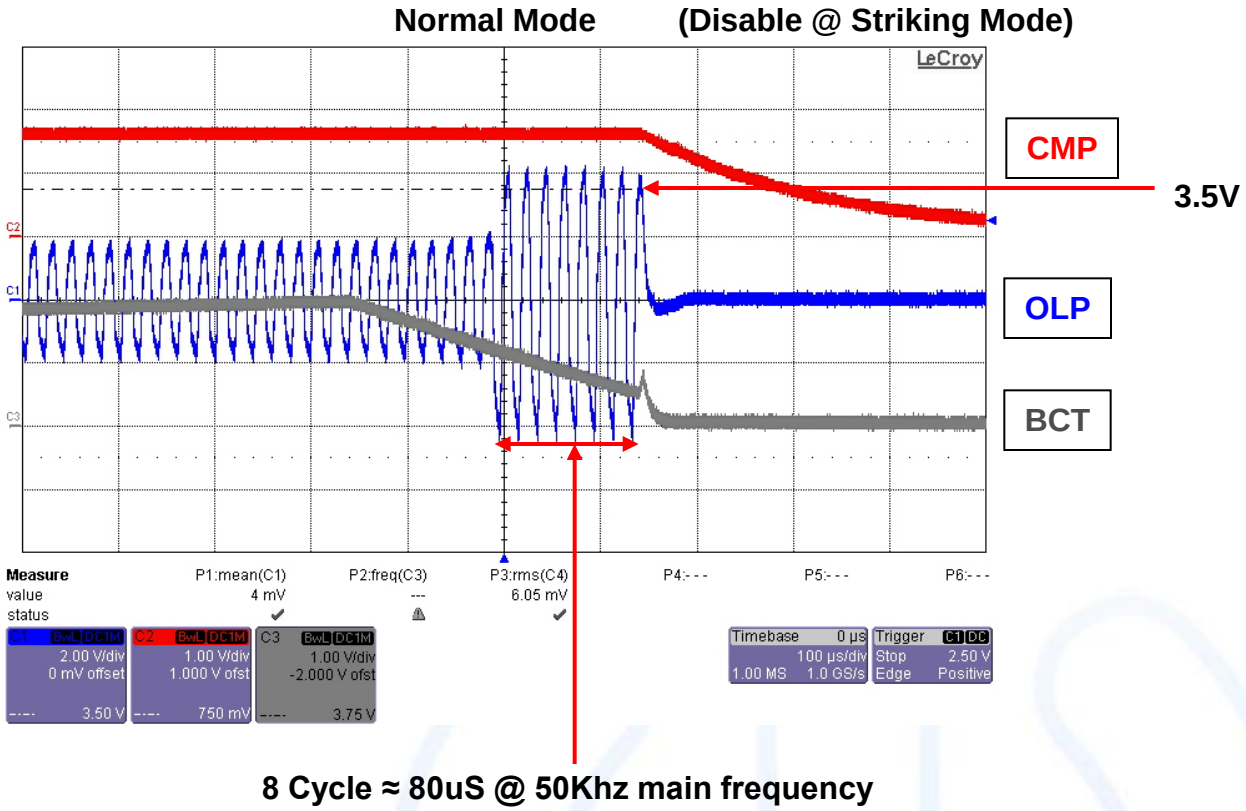




CMP-Hi Protection Disable Method

Feedback High Protection

- Feedback High Protection operated over OLP 3.5V
- Feedback High Protection delay time is decided by 8 cycle 3.5V OLP Voltage



Key Features

- **Reduce external components**
  - → Wide Input Voltage Range : 6.0 ~ 30.0 V
  - → Integrated OLP circuit
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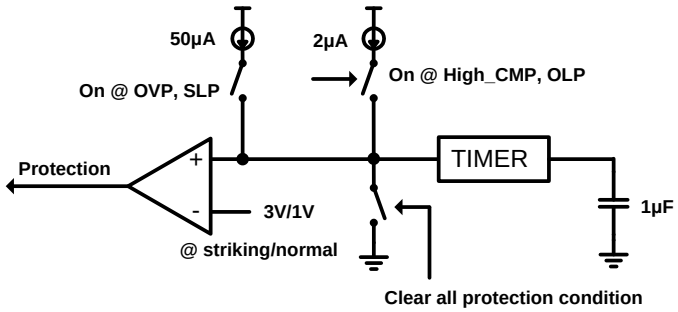
- **Various Protection**
  - → OLP, OLR, SLP, OVP, COMP-Hi, Feedback-Hi, TSD, Soft-start

- **Design flexibility**
  - → Adjustable Striking & Protection delay time
  - → DCR mode operation
  - → Analog & Burst dimming
  - → PWM dimming by external pulse signal
  - → Wide input voltage range : 6.0 ~ 30V

Adjustable Protection Delay & Striking Time

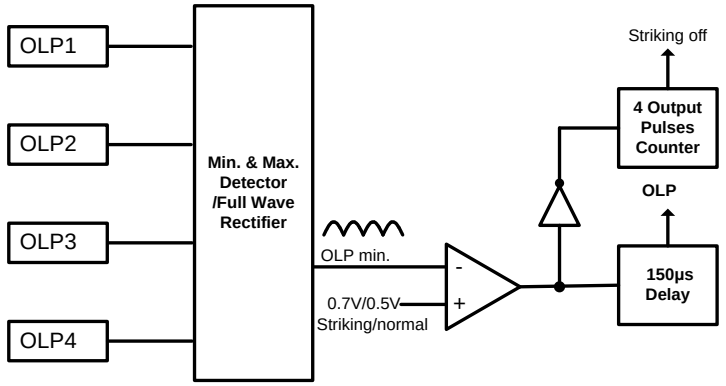
◆ Protection Delay Time



dt = Cdv/I

OVP, SLP dt = 1u / 50u = 20mS
OLP, High_CMP dt = 1u / 2u = 0.5S (Normal)
dt = 1u X 3 / 2u = 1.5S (Striking)

◆ Striking Time



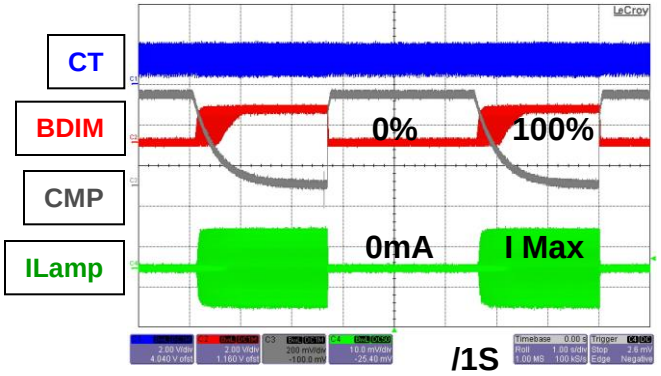
dt = Cdv/I

OLP dt = 1u X 3 / 2u = 1.5S (Striking)
T strike off = t OLP + 4 OLP out
= 1.5 + 40u (@ fmain = 50KHz)
≈ 1.5S

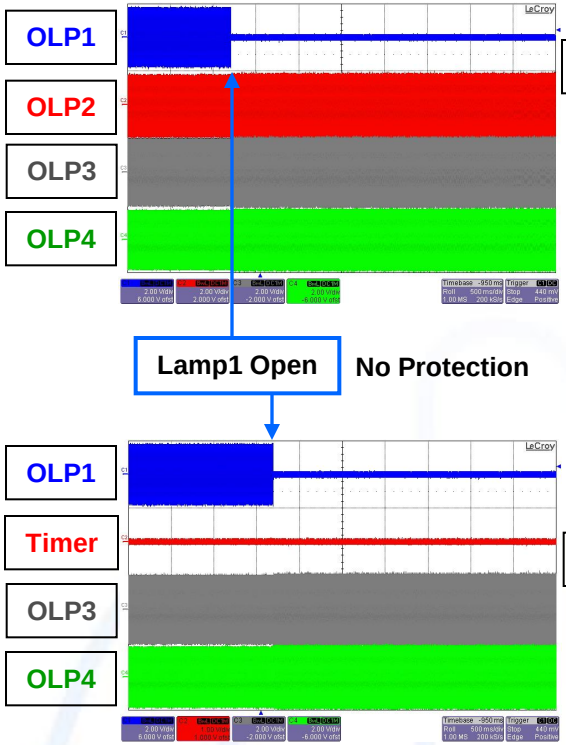
DCR Mode Operation

- DCR Mode Operated by ENA voltage (> 2.5V)
- Minimum lamp current = 0mA (Open lamp protection disabled)
- Open lamp protection operated by Over Voltage Protection (OLRv>1.4V, Tdelay = 20mS @ 1uF Ctimer)

DCR Mode Operation



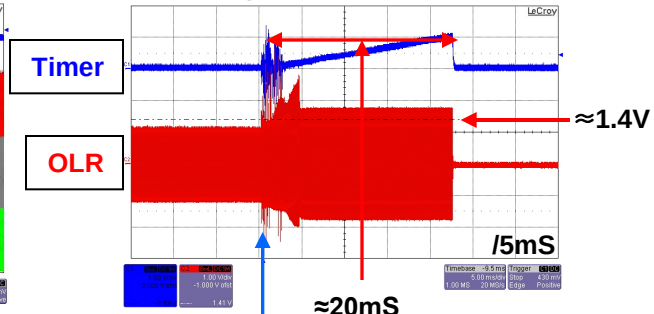
OLP Disable @ OLP condition



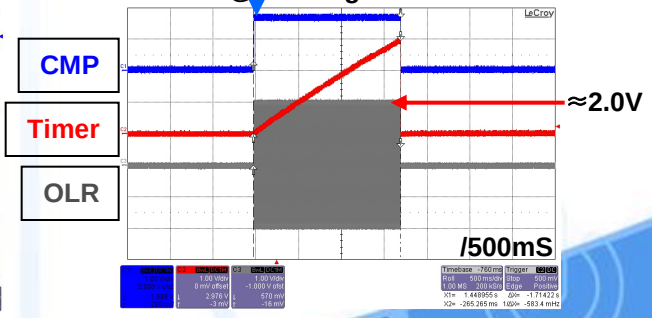
(Test condition : OVP disable)

Over Voltage Protection @ OLP condition

@ Normal Mode



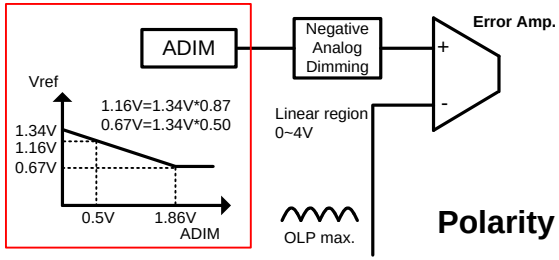
@ Striking Mode



Disabled

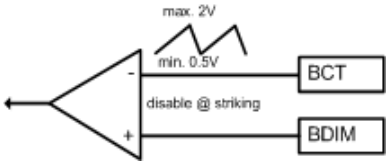
Analog & Burst Dimming

◆ Analog Dimming

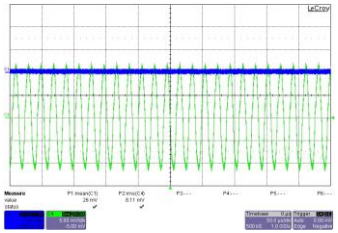


Polarity : Negative

◆ Burst Dimming

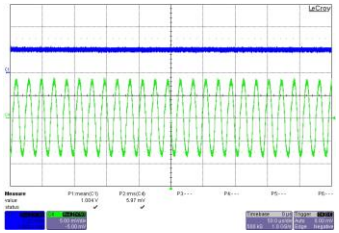


Polarity : Negative



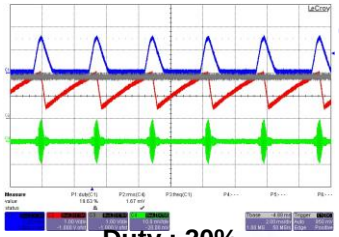
ADIM=0V

ILamp = 12mA



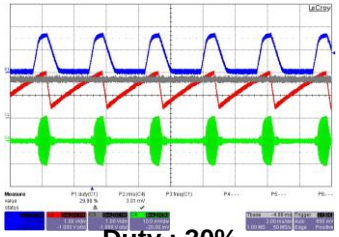
ADIM=1V

ILamp = 9mA



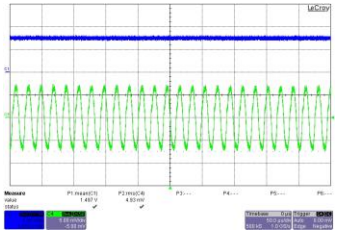
CMP
BCT
BDIM =1.8V
Ilamp =1.67mA

Duty : 20%



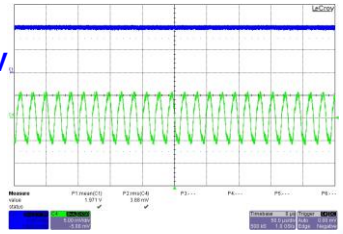
CMP
BCT
BDIM =1.7V
Ilamp =3.01mA

Duty : 30%



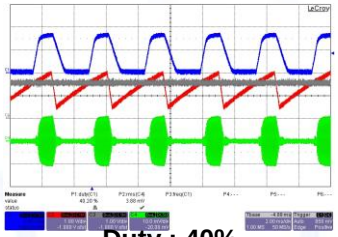
ADIM=1.5V

ILamp = 6mA



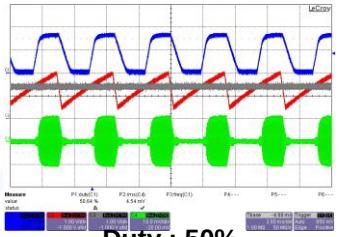
ADIM=2V

ILamp = 5mA



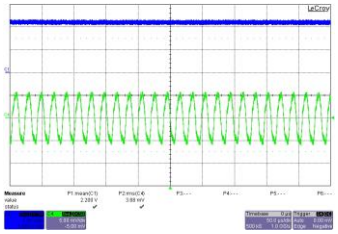
CMP
BCT
BDIM =1.6V
Ilamp =3.88mA

Duty : 40%



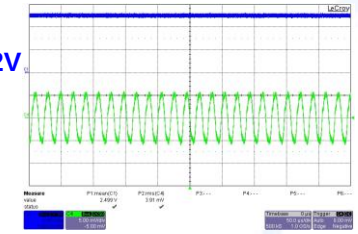
CMP
BCT
BDIM =1.5V
Ilamp =4.54mA

Duty : 50%



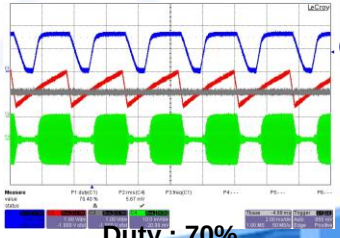
ADIM=2.2V

ILamp = 5mA



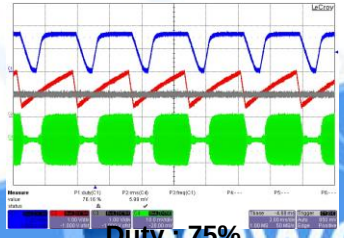
ADIM=2.5V

ILamp = 5mA



CMP
BCT
BDIM =1.0V
Ilamp =5.67mA

Duty : 70%



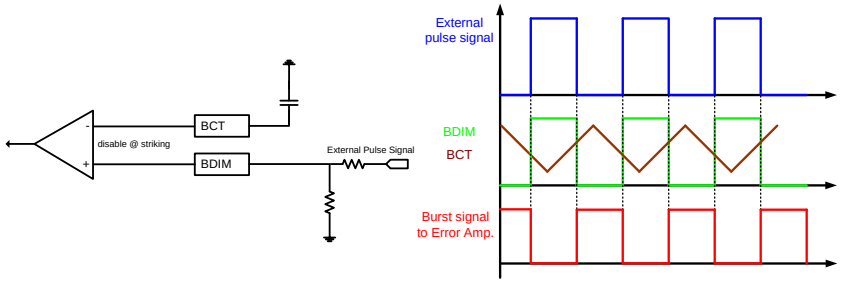
CMP
BCT
BDIM =0.95V
Ilamp =5.99mA

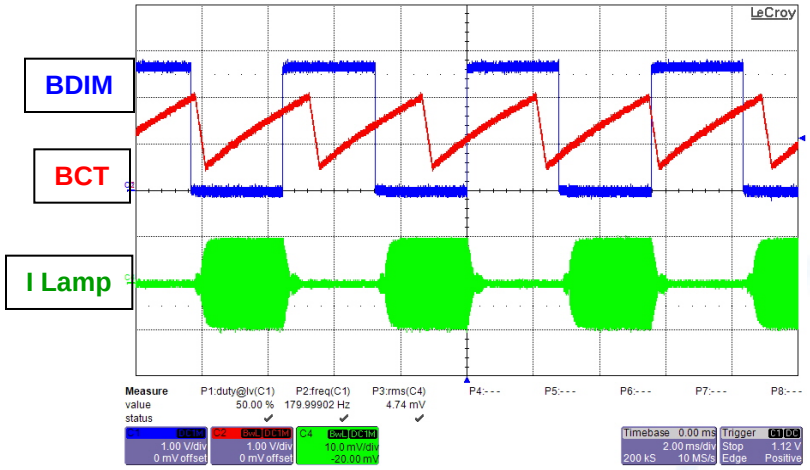
Duty : 75%

Burst Dimming by external Pulse signal

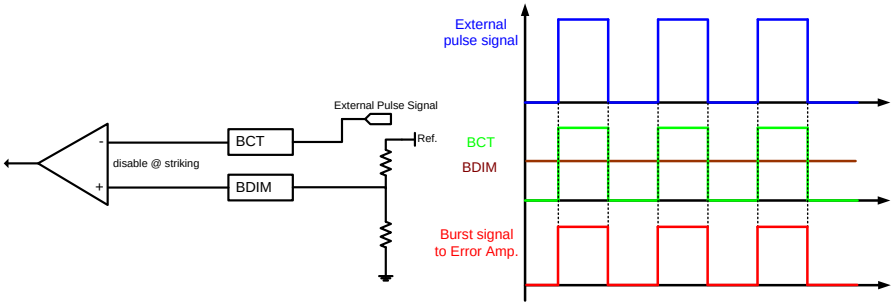
◆ **Burst Dimming implemented by external Pulse signal**

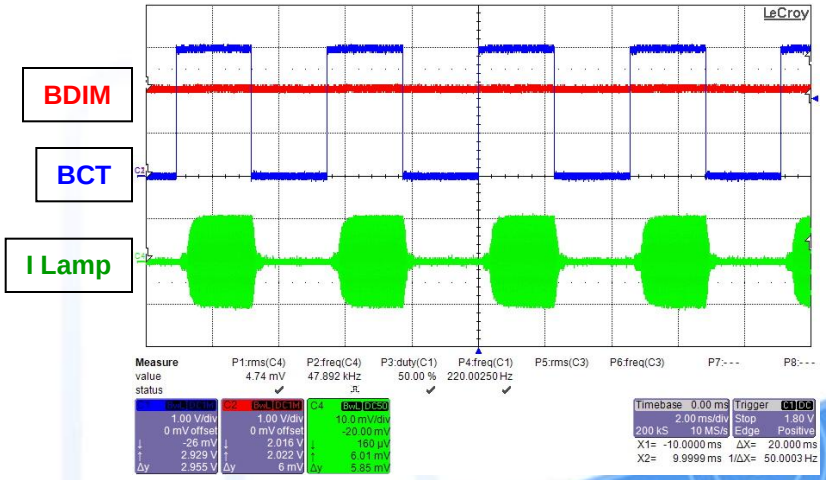
Polarity : Negative





Polarity : Positive





Product Roadmap - Backlight

2007 2008 2009 2010 2011

LED

RGB 3Ch. FAN7344 → RGB LED FAN7344X

8Ch WLED FAN7342 → WLED FAN7342X

• Channel Optimization
• High efficiency

8Ch WLED FAN7343 → WLED FAN7343X

CCFL

P.P. FAN7313

Super IP Solution

P.P FAN7319 → P.P. FAN733X

MOS Integrated (4Lamp)

N-N HB FAN7320

MOS Integrated

N-N HB FAN732X → N-N HB FAN732X

Customer optimized

P.P. FAN7313A → P.P. FAN733X

Low Cost (2 Lamp)

P-N HB FAN7318A

Protection Integrated

P-N HB FAN7318

P-N FB FAN7317

N-N HB FAN7316