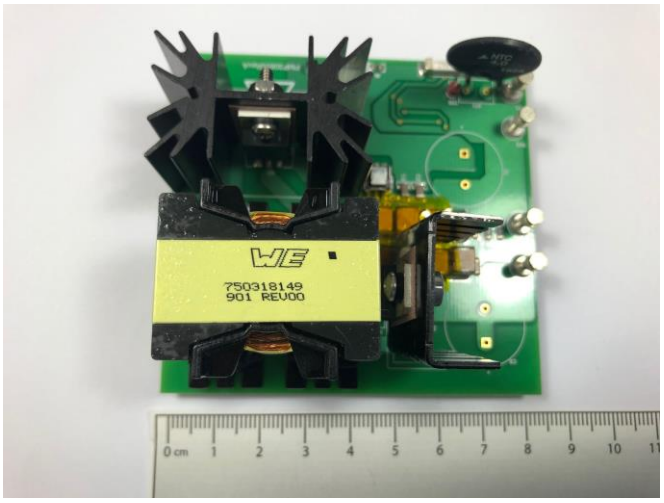
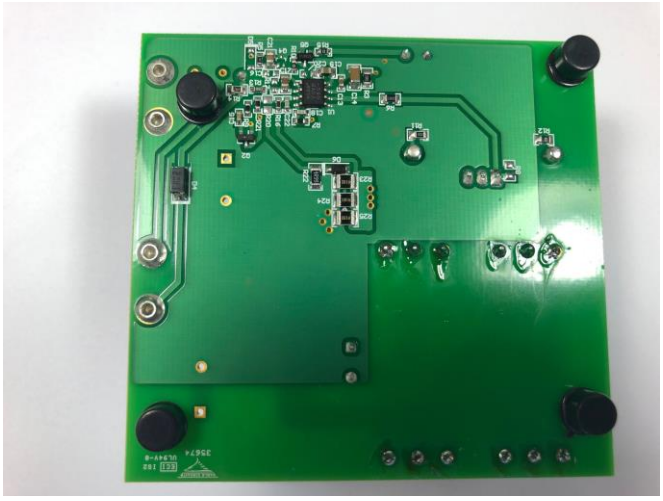
Test Report: PMP30653
200 V at 400 mA LED Lighting From a 24-V Input Reference Design

Description

This boost LED reference design uses the UCC28C42 controller to generate a non-isolated output (200 V at 400 mA) from a DC input (20 V - 28 V). The UCC28C42 provides a cost effective and precise constant-current regulation and is able to drive a 400 mA LED string up to a LED voltage of 200 V. An open LED protector circuitry provides overvoltage protection.





*1.1 Considerations**

General Texas Instruments High Voltage Evaluation (TI HV EVM) User Safety Guidelines

WARNING:

Always follow TI's set-up and application instructions, including use of all interface components within their recommended electrical rated voltage and power limits. Always use electrical safety precautions to help ensure your personal safety and those working around you. Contact TI's Product Information Center http://support/ti./com for further information.

Save all warnings and instructions for future reference.

Failure to follow warnings and instructions may result in personal injury, property damage or death due to electrical shock and burn hazards.

The term TI HV EVM refers to an electronic device typically provided as an open framed, unenclosed printed circuit board assembly. It is intended strictly for use in development laboratory environments, solely for qualified professional users having training, expertise and knowledge of electrical safety risks in development and application of high voltage electrical circuits. Any other use and/or application are strictly prohibited by Texas Instruments. If you are not suitable qualified, you should immediately stop from further use of the HV EVM.

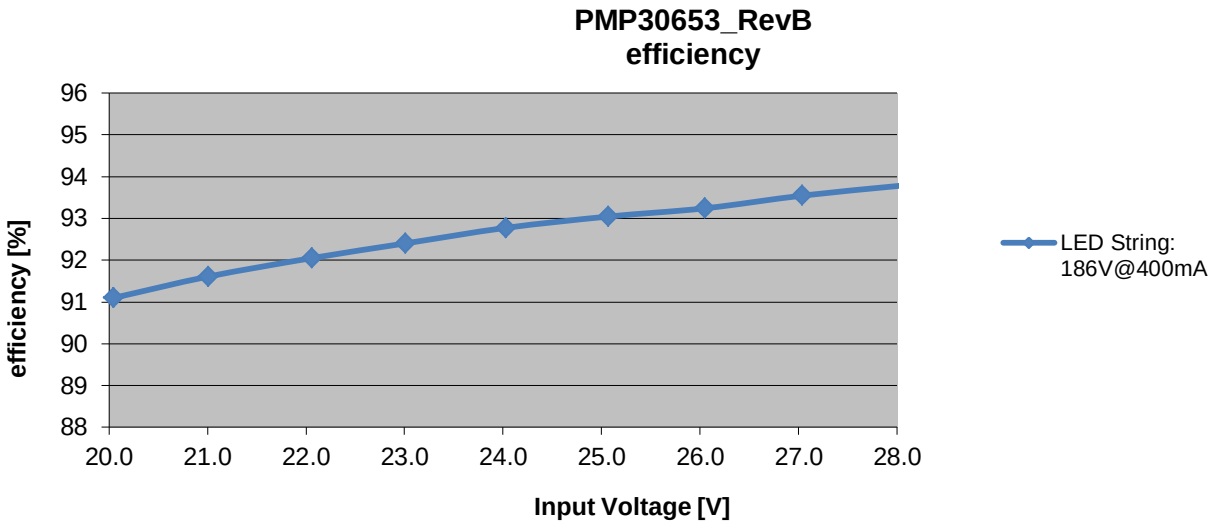
1. Work Area Safety:
a. Keep work area clean and orderly.
b. Qualified observer(s) must be present anytime circuits are energized.
c. Effective barriers and signage must be present in the area where the TI HV EVM and its interface electronics are energized, indicating operation of accessible high voltages may be present, for the purpose of protecting inadvertent access i
d. All interface circuits, power supplies, evaluation modules, instruments, meters, scopes and other related apparatus used in a development environment exceeding
50Vrms/75VDC must be electrically located within a protected Emergency Power Off
EPO protected power strip.
e. Use stable and non conductive work surface.
f. Use adequately insulated clamps and wires to attach measurement probes and instruments. No freehand testing whenever possible.

2. Electrical safety:
As a precautionary measure, it is always a good engineering practice to assume that the entire EVM may have fully accessible and active high voltages.
a. De-energize the TI HV EVM and all its inputs, outputs and electrical loads before performing any electrical or other diagnostic measurements. Revalidate that TI HV EVM
power has been safely de-energized.
b. With the EVM confirmed de-energized, proceed with required electrical circuit configurations, wiring, measurement equipment hook-ups and other application needs, while still assuming the EVM circuit and measuring instruments are electrically live.
c. Once EVM readiness is complete, energize the EVM as intended.

WARNING: WHILE THE EVM IS ENERGIZED, NEVER TOUCH THE EVM OR ITS ELECTRICAL CIRCUITS AS THEY COULD BE AT HIGH VOLTAGES CAPABLE OF CAUSING ELECTRICAL SHOCK HAZARD.

3. Personal Safety
a. Wear personal protective equipment e.g. latex gloves or safety glasses with side shields or protect EVM in an adequate lucent plastic box with interlocks from accidental touch.
Limitation for safe use:
EVMs are not to be used as all or part of a production unit.

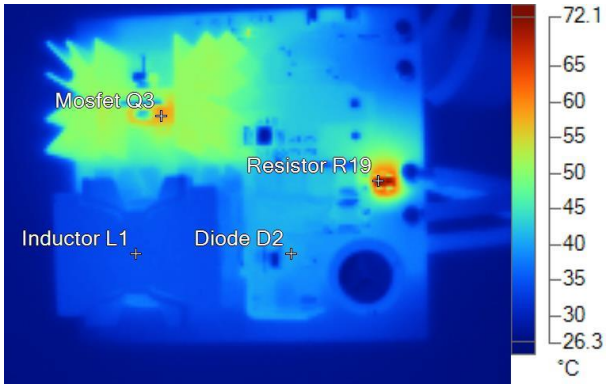
1.2 Efficiency Graphs



1.3 Thermal Images

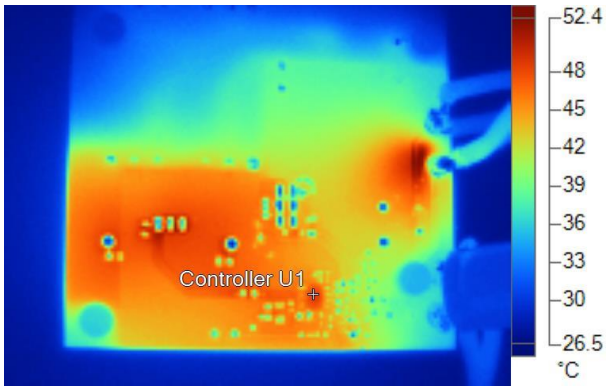
The images below show the infrared images taken from the FlexCam after 15min at full load output power with a LED load (188V@400mA).

1.3.1 Input Voltage = 24VDC



Vin=24VDC LED String = 188V@400mA

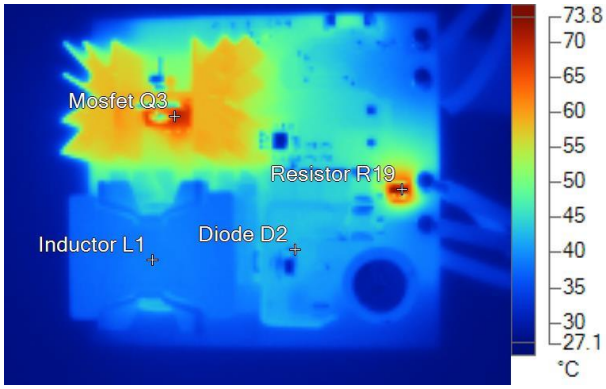
Name	Temperature	
Mosfet Q3	58.5°C	
Inductor L1	34.6°C	
Diode D2	40.4°C	
Resistor R19	72.1°C	



Vin=24VDC LED String = 188V@400mA Bottom

Name	Temperature	
Controller U1	49.0°C	

1.3.2 Input Voltage = 20VDC



Name	Temperature	
Mosfet Q3	70.5°C	
Resistor R19	73.8°C	
Inductor L1	39.1°C	
Diode D2	42.2°C	

Vin=20VDC LED String = 188V@400mA Top

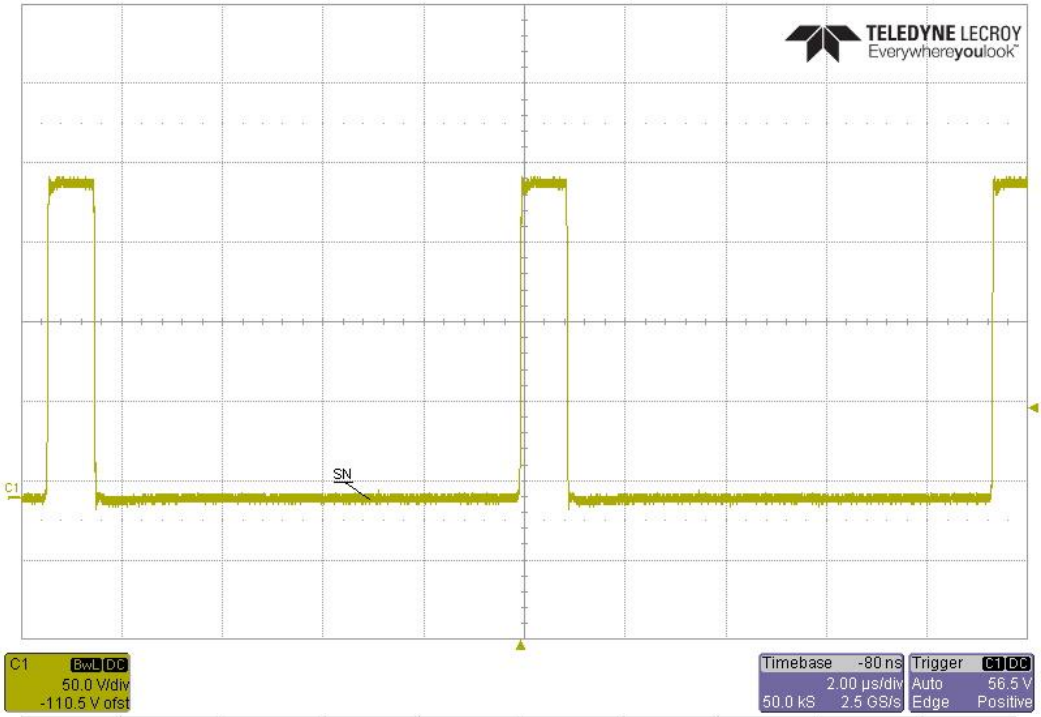
1.4 Dimensions

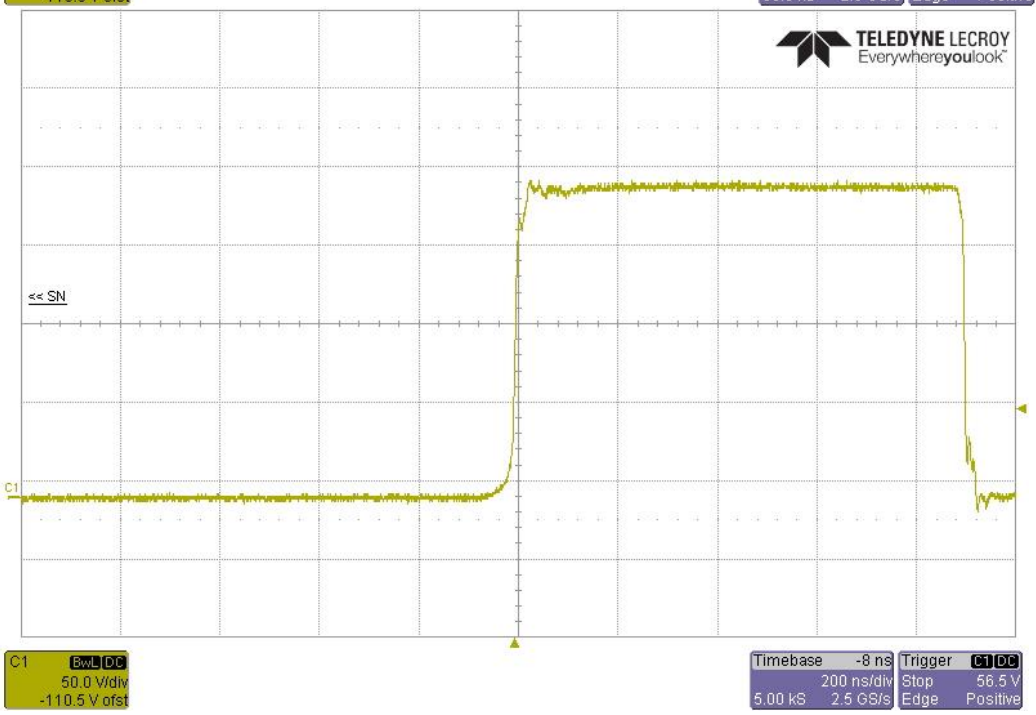
83mm x 78mm

2 Waveforms

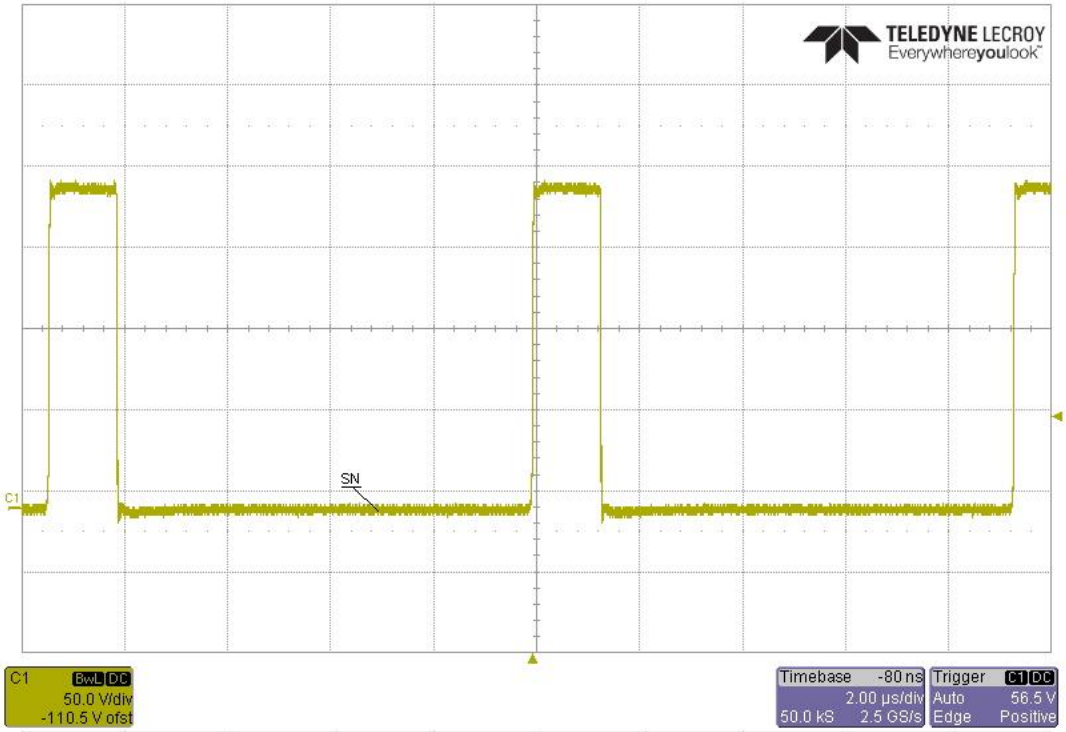
2.1 Switching

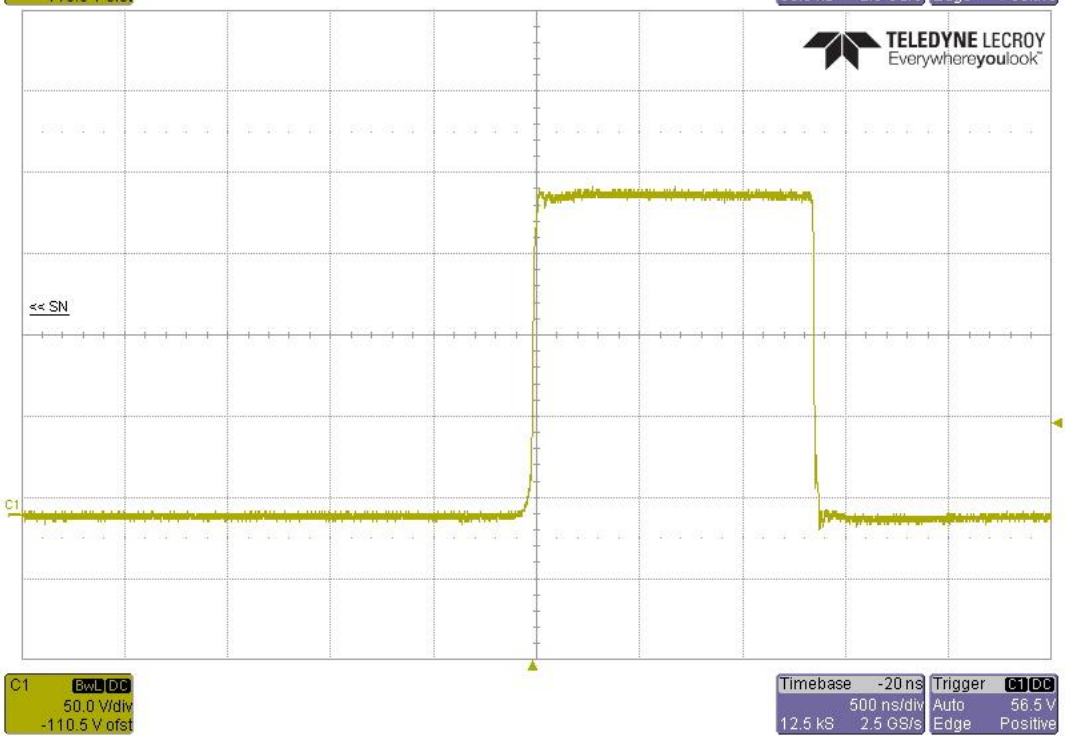
Input Voltage = 20VDC
Load = LED String (190V@400mA)





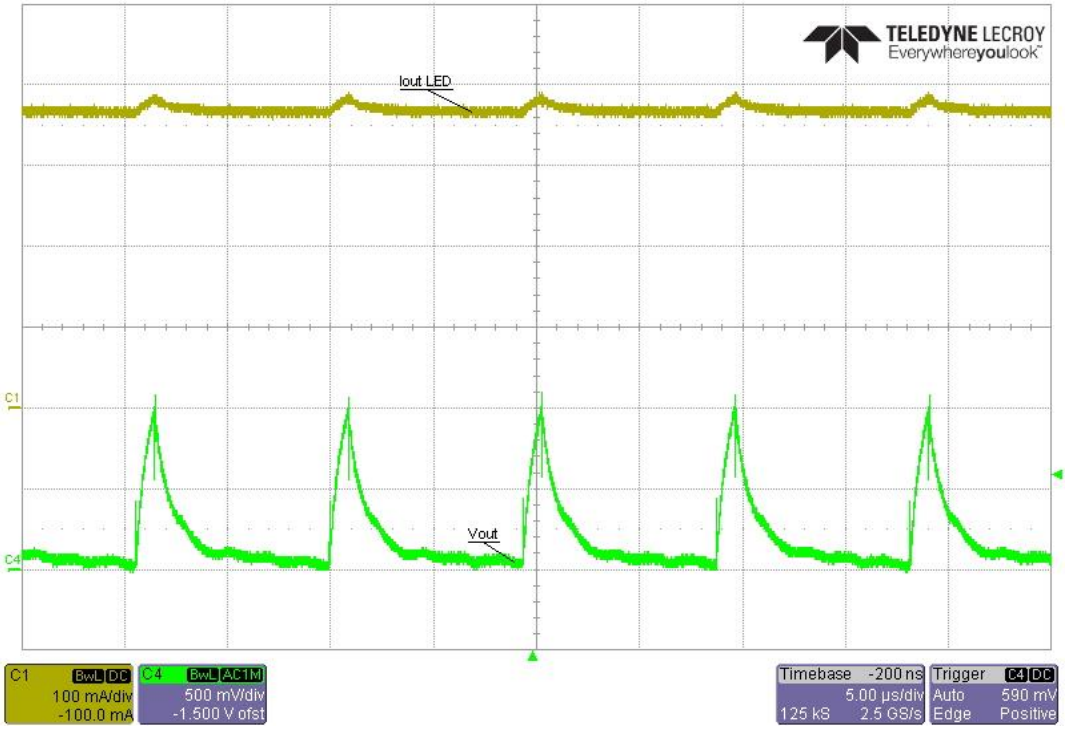
Input Voltage = 28VDC
Load = LED String (190V@400mA)



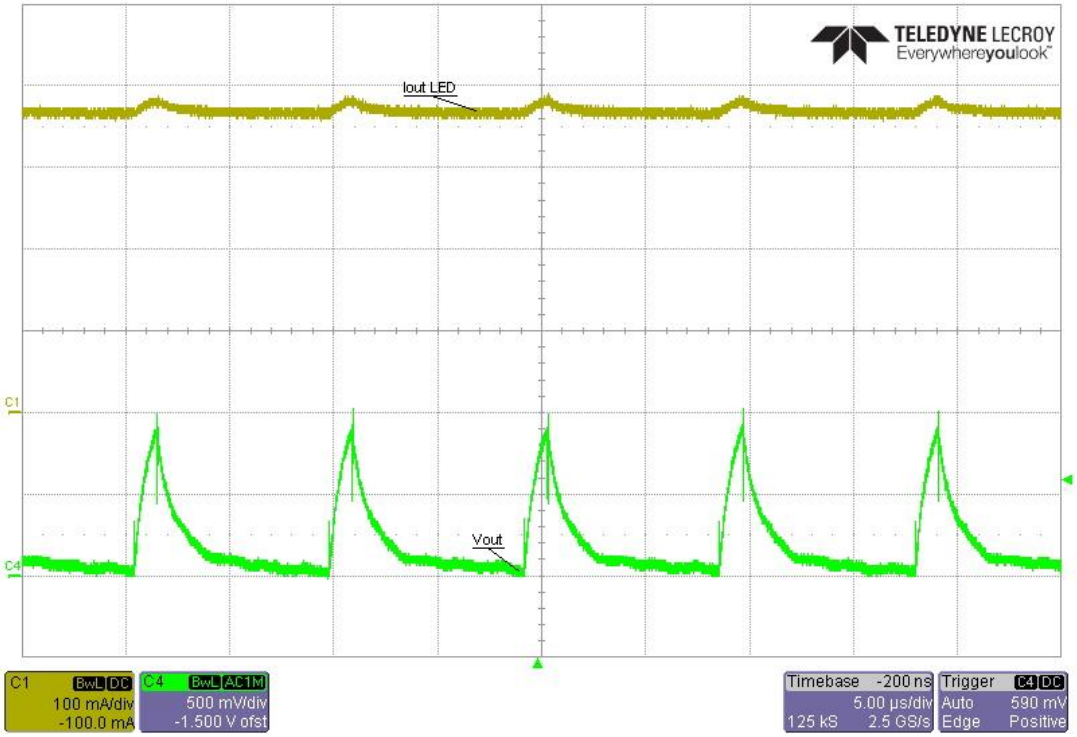


2.2 Output Voltage Ripple and LED current

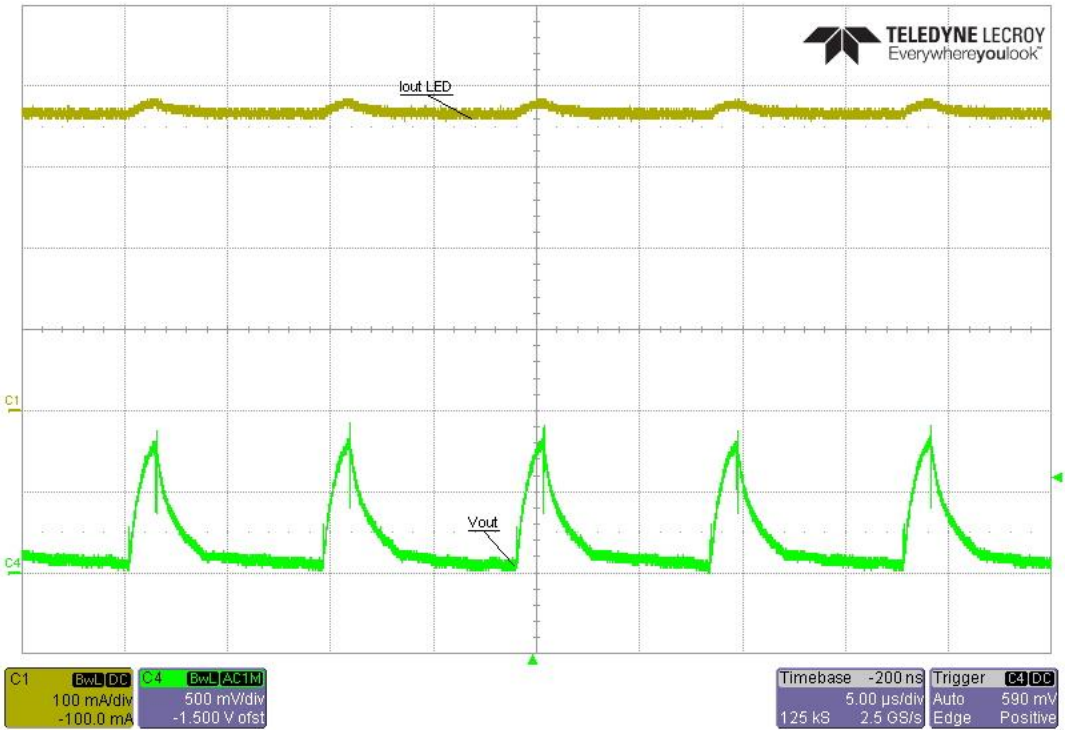
Input Voltage = 20VDC
Load = LED String (190V@400mA)



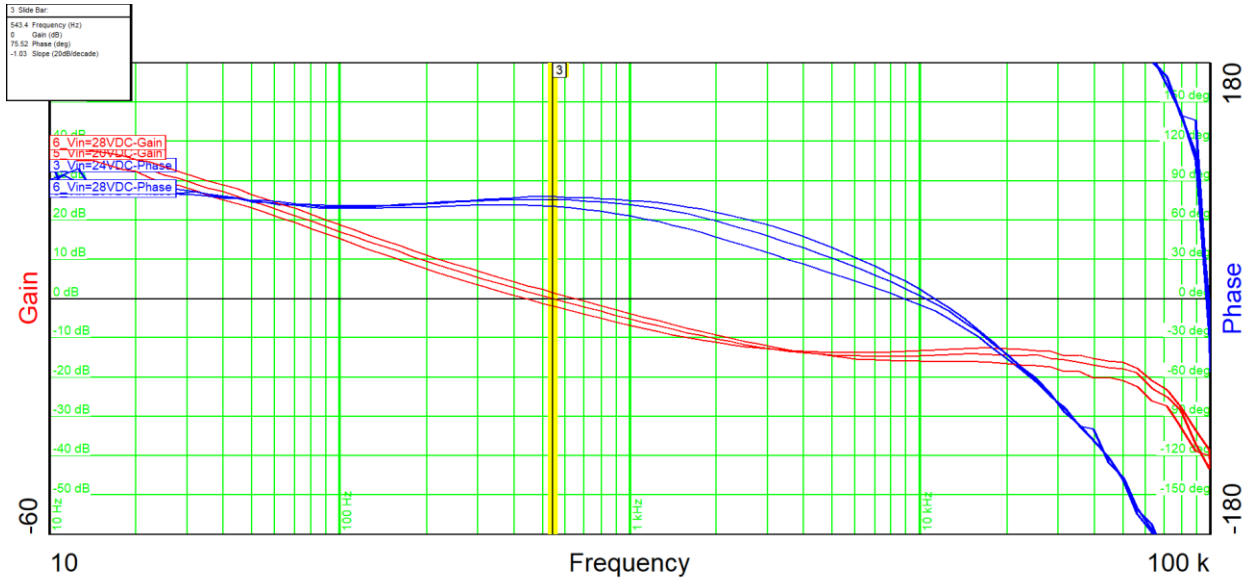
Input Voltage = 24VDC
Load = LED String (190V@400mA)



Input Voltage = 28VDC
Load = LED String (190V@400mA)



2.3 Bode Plot



Input Voltage = 20VDC
Load = LED String (190V@400mA)
Bandwidth = 0.4kHz
Phase Margin = 71°

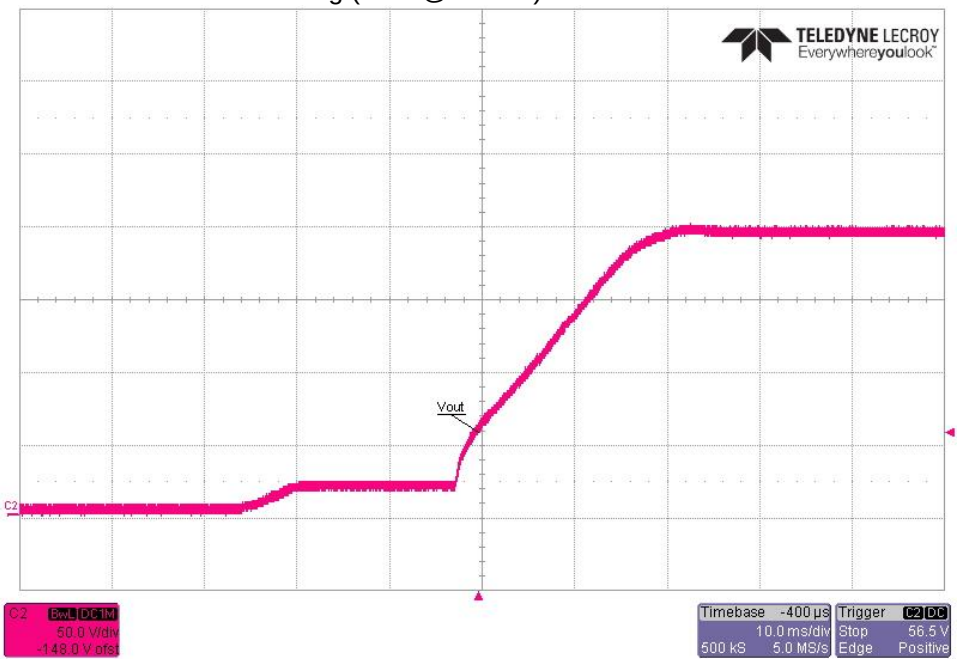
Input Voltage = 24VDC
Load = LED String (190V@400mA)
Bandwidth = 0.5kHz
Phase Margin = 76°

Input Voltage = 28VDC
Load = LED String (190V@400mA)
Bandwidth = 0.6kHz
Phase Margin = 77°

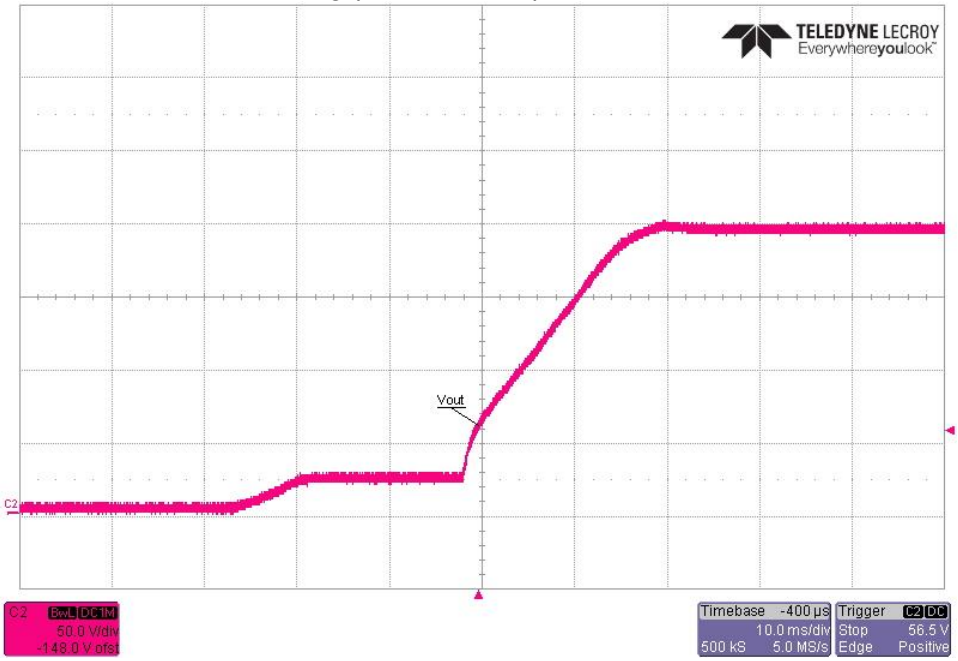
2.4 Start-up

2.4.1 Start-up Full Load

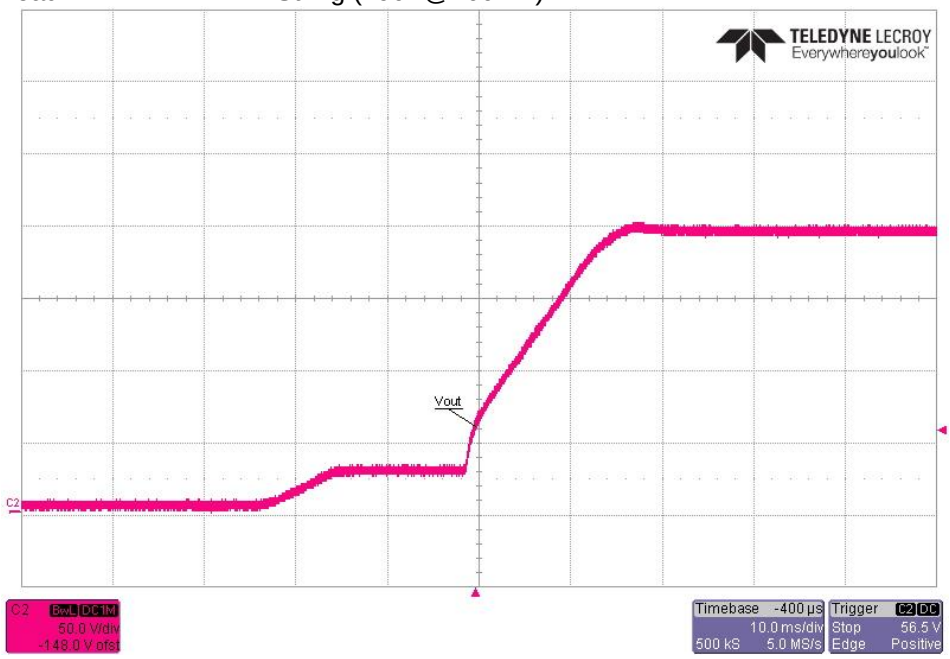
Input Voltage = 20VDC
Load = LED String (190V@400mA)



Input Voltage = 24VDC
Load = LED String (190V@400mA)

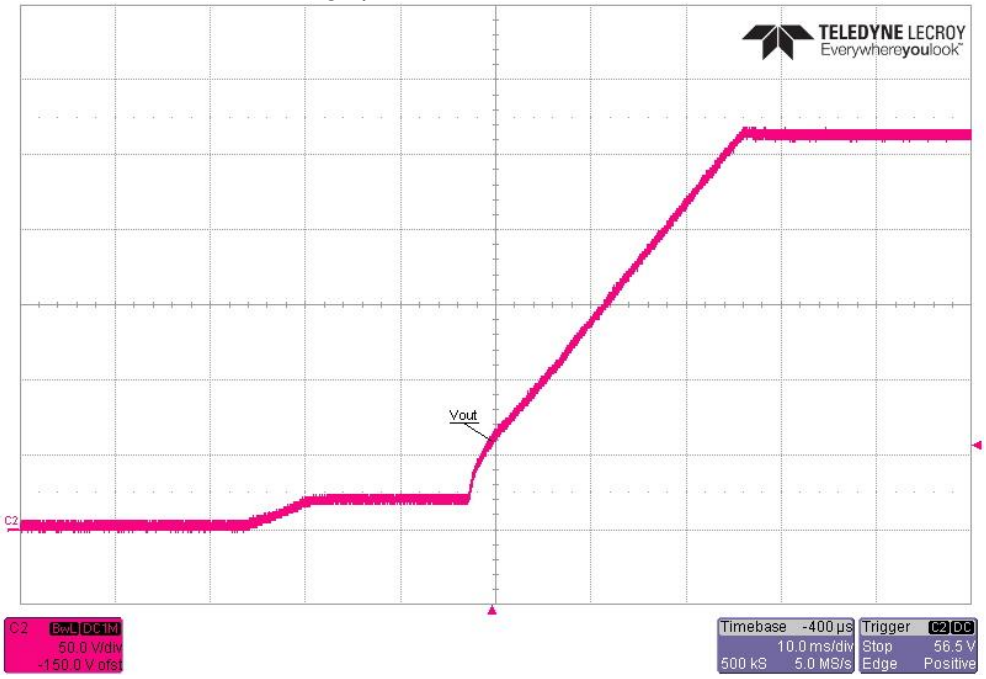


Input Voltage = 28VDC
Load = LED String (190V@400mA)

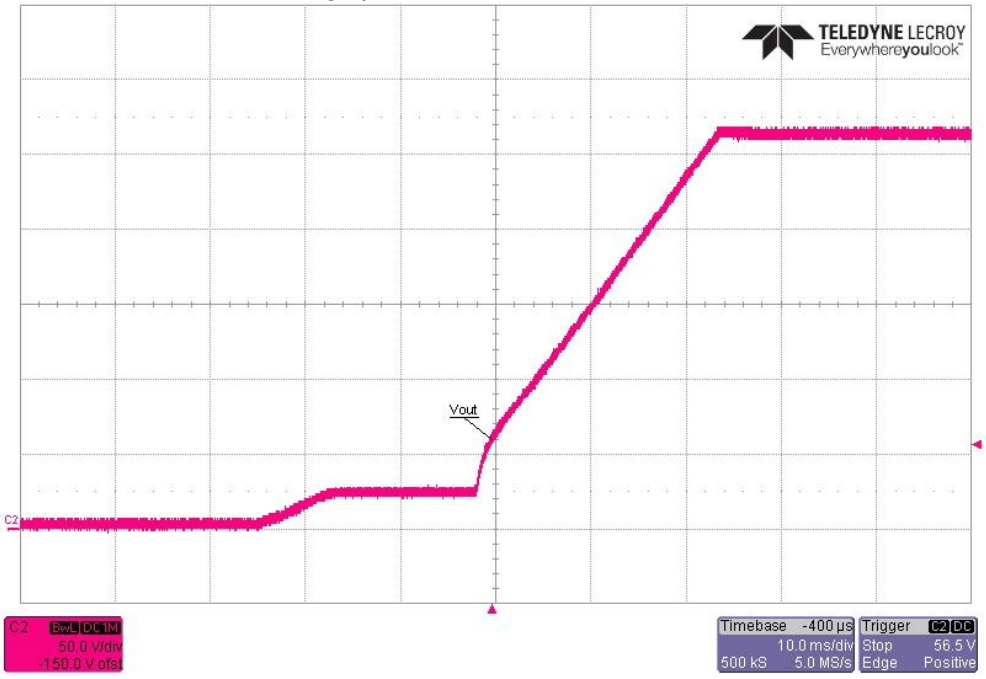


2.4.2 Start-up No Load

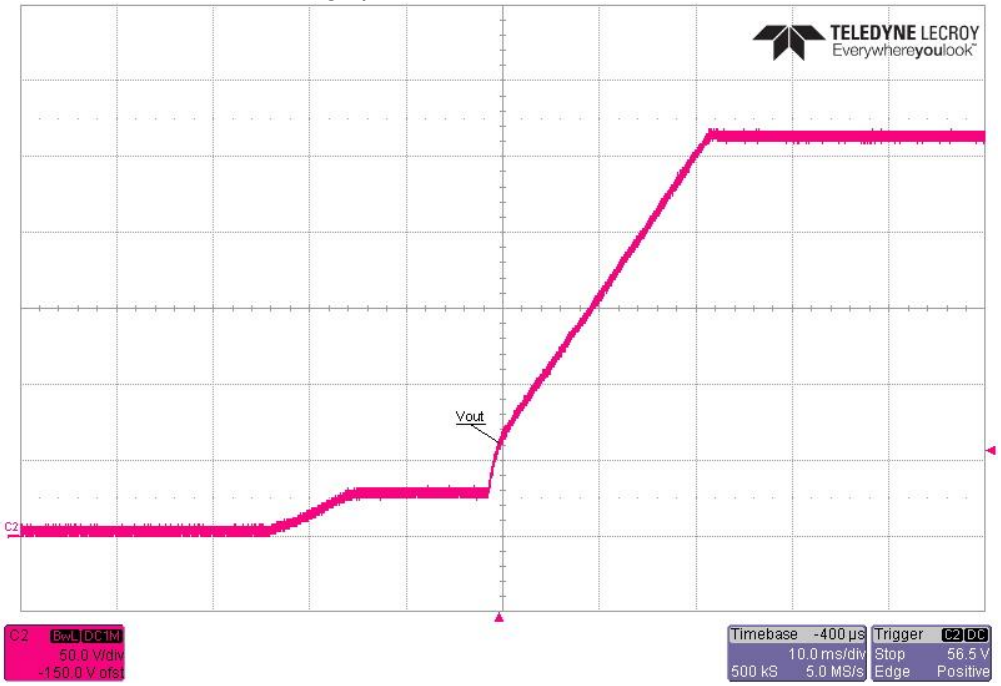
Input Voltage = 20VDC
Load = LED string open



Input Voltage = 24VDC
Load = LED string open



Input Voltage = 28VDC
Load = LED string open



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