Increased transient response in a vehicle enabling removal of the 12V Battery

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Eliminating the 12V battery with the use of a Sine Amplitude Converter

to create a 12V power from the high voltage vehicle battery

The 12V lead-acid battery will be banned!

- The 12V lead-acid battery in countries like Norway and Netherlands have expressed bans for ICE vehicles from 2025, even Germany vowing to wean itself off its ICE addiction by 2030
- The battery is a warranty issue
- The lead-acid battery is heavy and has no intelligence on its cycle time or health

The 12V battery benefits

- Alternate reservoir of energy not dependent on upstream electronics status
- Not dependent on the High Voltage Battery

Why not replace the Battery with a Sine Amplitude Converter?

Important perimeters

- Dynamic response
- Redundancy
- Vibration
- Feedback or communication to component

BCM under test

Outputs and Type	1, Isolated
Voltage - Output	47.5V
Current - Output	25.7A
Voltage - Input	260V ~ 410V
Regulator Topology	Buck
Frequency - Switching	1.18MHz
Board Type	Fully Populated
Supplied Contents	Board(s)
Utilized IC / Part	BCM380y475x1K2A30
Power - Output	1.2 kW

https://www.digikey.com/en/products/detail/vicorcorporation/BCD380P475T1K2A30/4740999

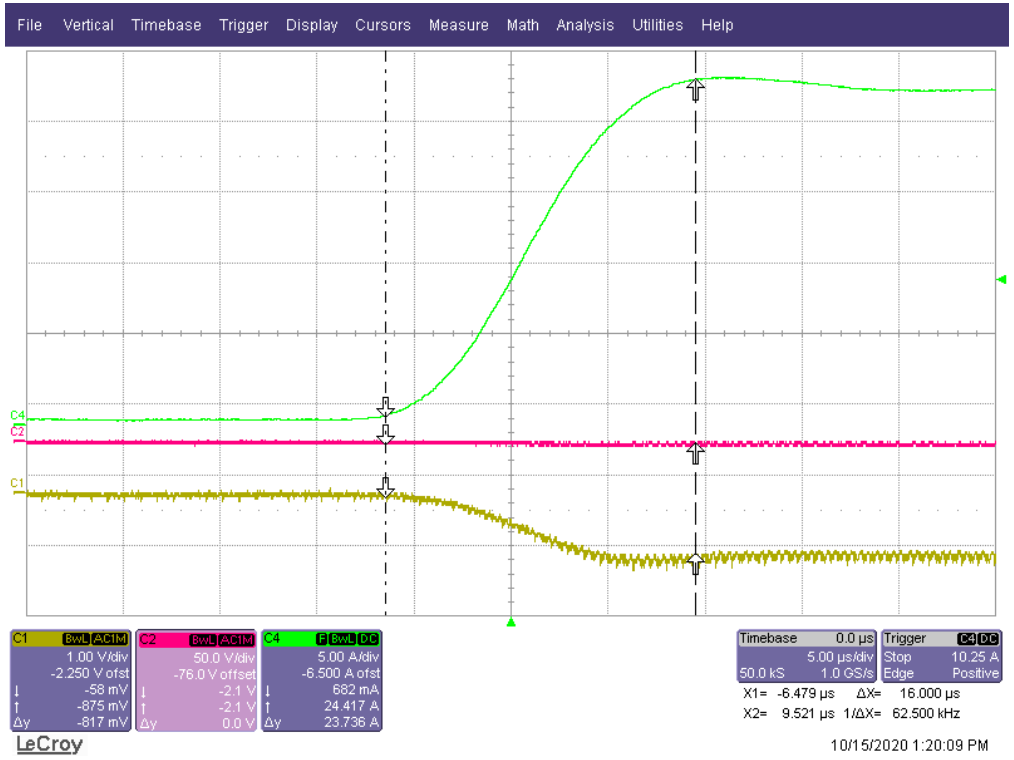
BCM6123 transient response

Load Bank limits the di/dt

$\Delta I_{OUT} = 24.4A - 0.68A = 23.72A$

Δ Time = 16µsec = 0.016msec

di/dt = 1,482.5A/msec



V_{IN} at 50V/div and V_{OUT} at 1V/div

BCM6123 with load switching 0.68A to 24.4A

Load bank limits the di/dt

$\Delta V_{IN} = 1.063V$

$\Delta V_{OUT} = 0.843V$

$K = 1/8$

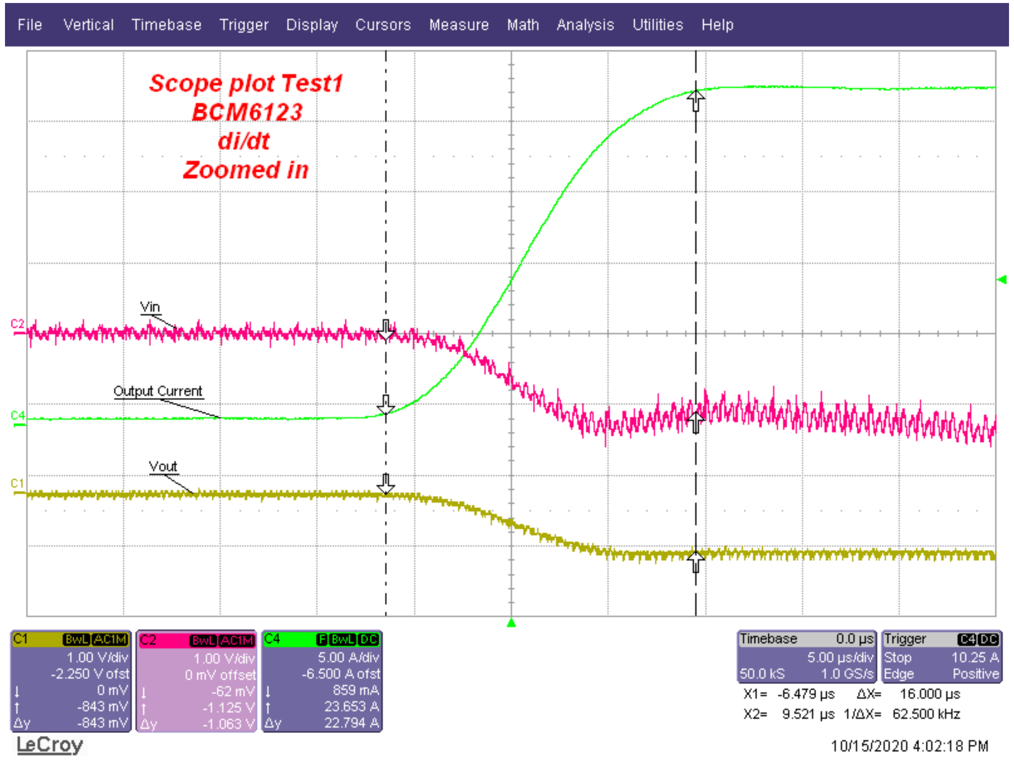
Input reflected to V_{OUT}

$1.063V/8 = 0.133V$

Voltage drop

$0.843V – 0.133V =$ 0.710V

Voltage drop is the BCM + cables



V_{IN} and V_{OUT} at same scale of 1V/div

NBM2317
48V to 12V bus converter at 1kW

NBM2317 in boost mode 12V → 48V

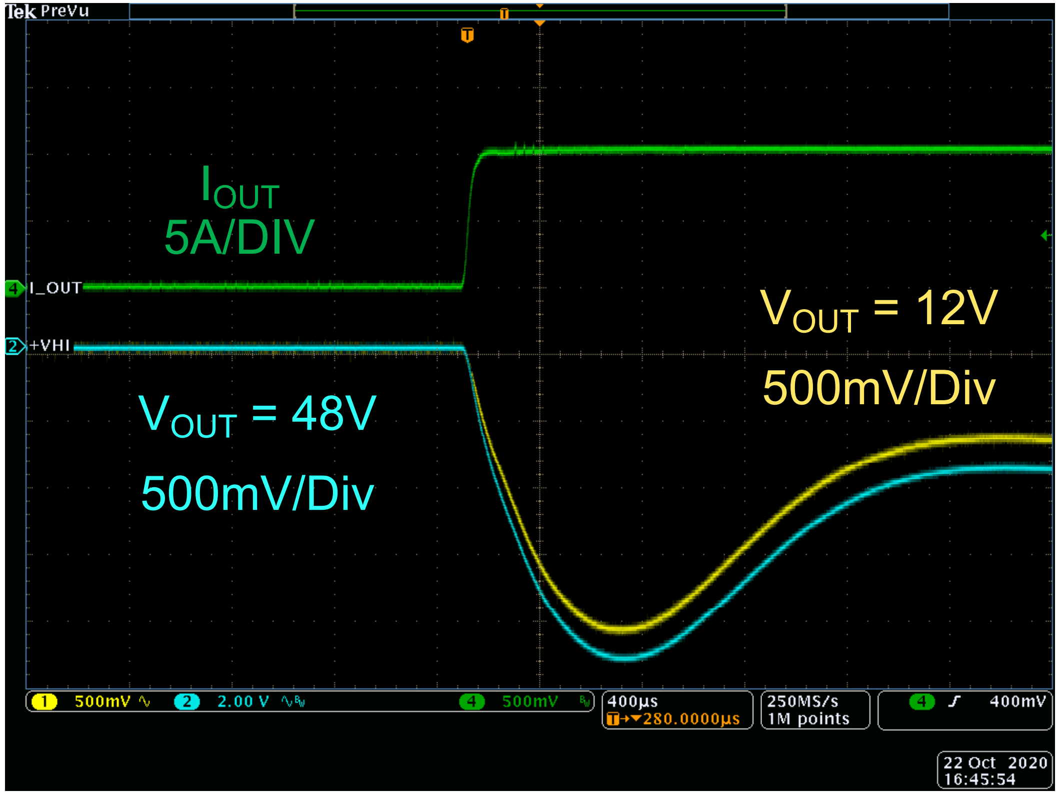
V_{IN} =12V

V_{OUT} = 48V

V_{IN} and V_{OUT} is superimposed

Load step 0 to 12A

Voltage is AC coupled to see the dip



The next slides are

V_{IN} = 48V
V_{OUT} = 12V
48V → 12V

Step down/buck

Transient testing with electronic load bank

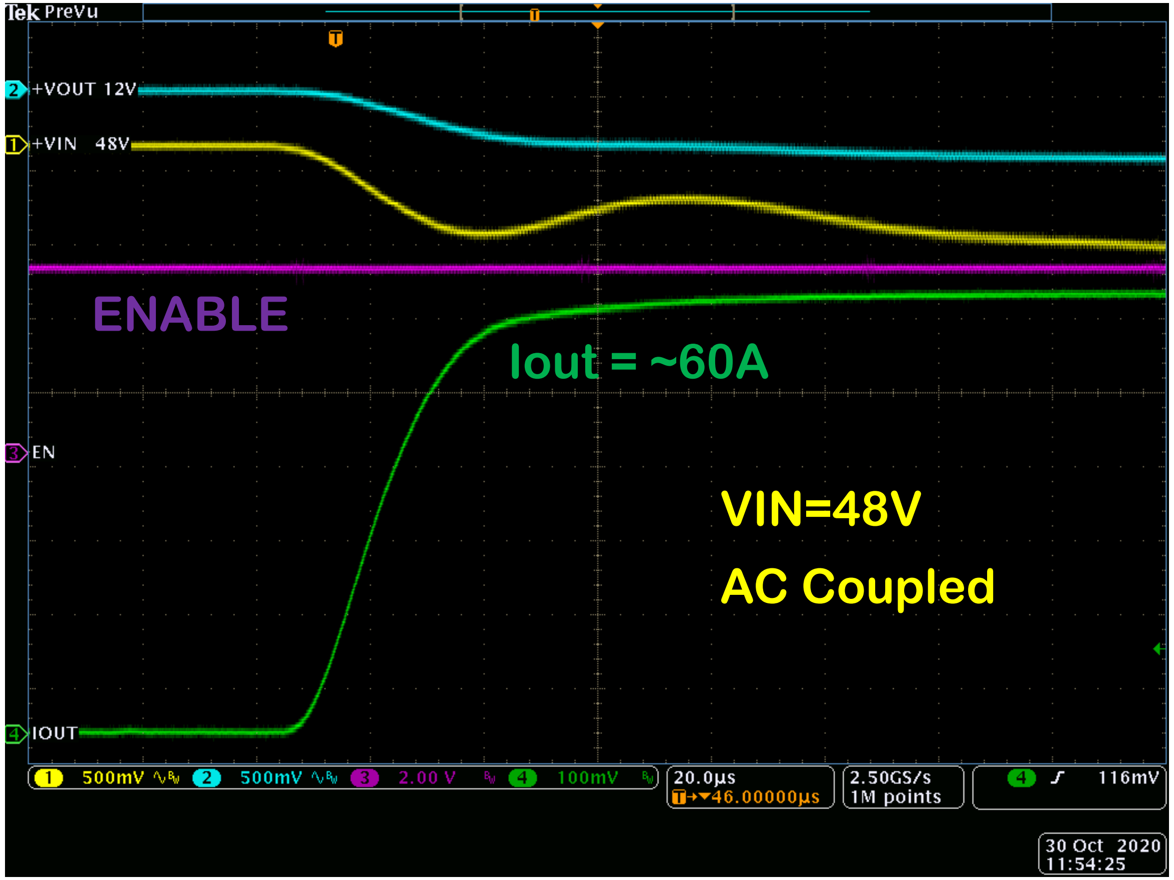
NBM2317 in buck mode 48V →12V

Vin is 48V

Vout is 12V

Load 0 to 60A

Electronic Load



Yellow = 48V = Vin

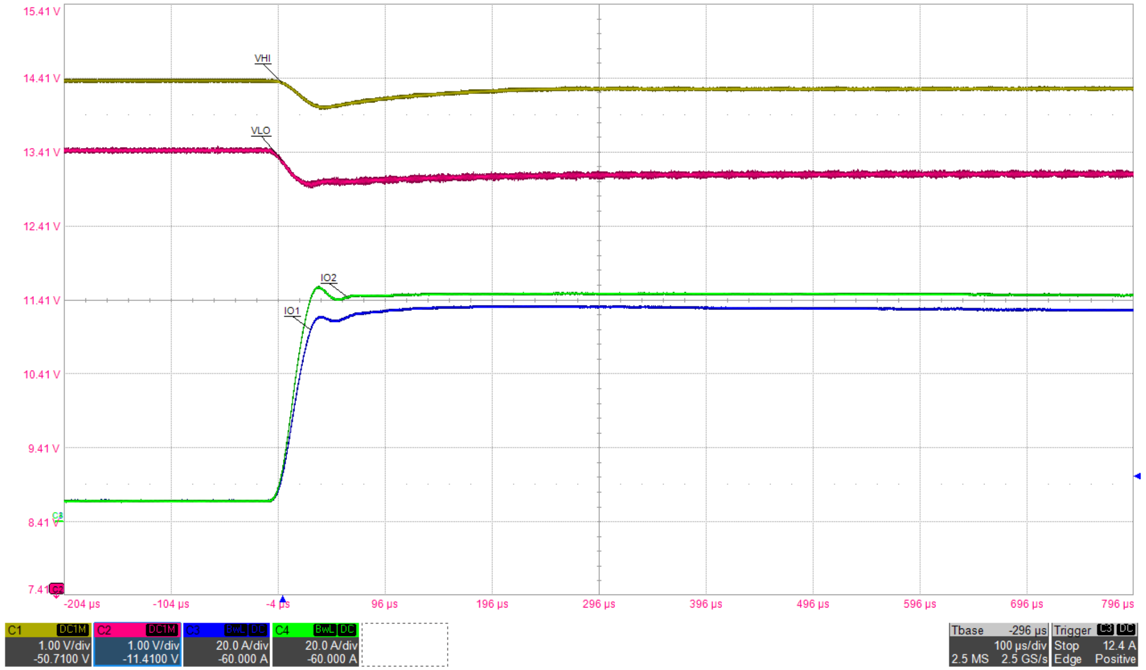
Blue = 12V = Vout

Purple = Enable

Green = Iout at 10A/div.

Load transient test 12A to 120A
54V bus load applied

- Slew rate ≈ 3A/us
- NBM2317
- V_{IN} = 12V
- V_{OUT} = 54V
- 2up array step transient test
- (DC coupled voltage probes)



CH1 – V_{HI}: 1V/div (DC)
CH2 – V_{LO}: 1V/div (DC)

CH3 – I_{O1}: 20A/div (DC)
CH4 – I_{O2}: 20A/div (DC)

Timebase
100µs/div

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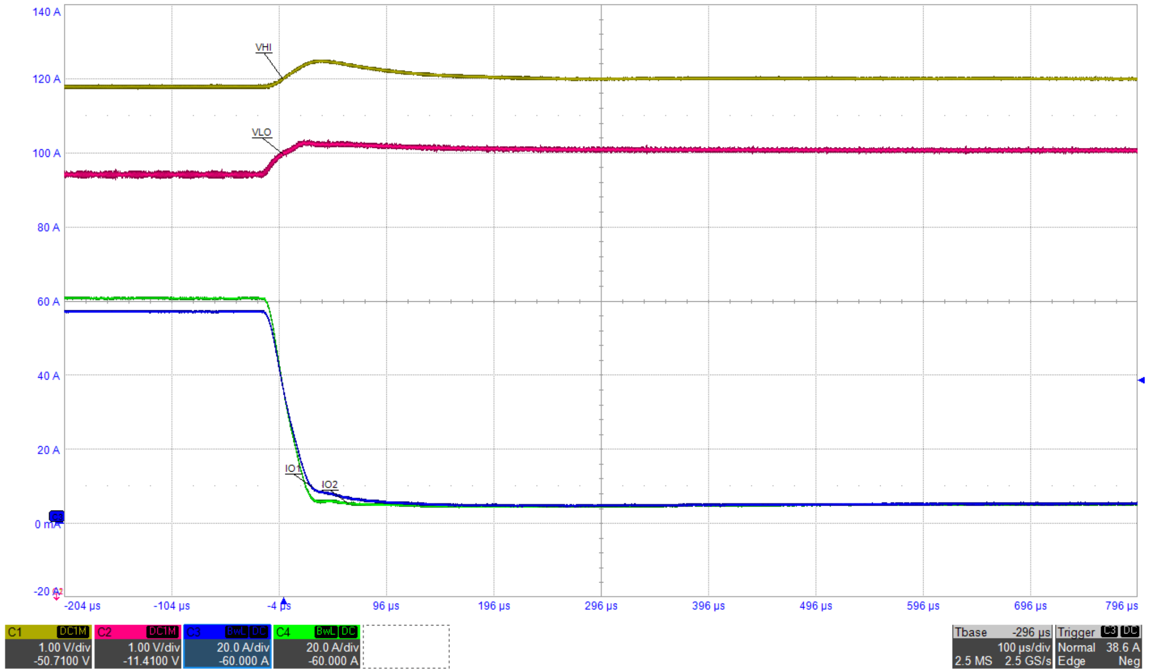
Load transient test 12A to 120A 54V bus load removed

- Slew rate ≈ 3A/us
- NBM2317
- V_{IN} = 12V
- V_{OUT} = 54V
- 2up array step transient test
- (DC coupled voltage probes)



CH1 – V_{HI}: 1V/div (DC)
CH2 – V_{LO}: 1V/div (DC)
CH3 – I_{O1}: 20A/div (DC)
CH4 – I_{O2}: 20A/div (DC)
Timebase 100µs/div

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Redundancy

Provide three separate channels of power from the high-voltage battery

1. Power for the typical non-critical loads that can be turned off during an accident
2. Steering and braking – always are on
3. Can bus and communication – always are on

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Scan and download the presentation

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Thank you