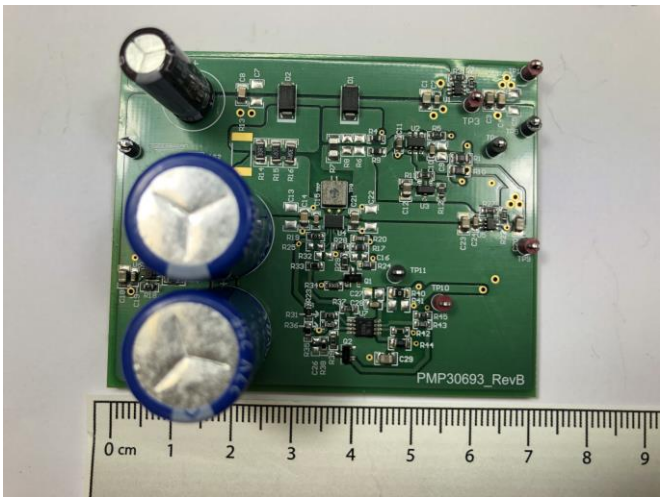
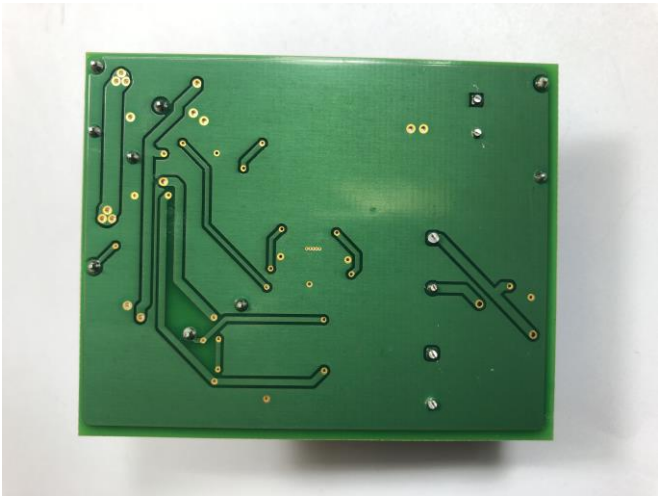
*Test Report: PMP30693*

# *Supercapacitor Backup Power Supply With Current Limit and Active Cell Balancing Reference Design*

## Description

This reference design automatically provides a back-up voltage during a power interruption. It manages the charging of supercaps and provides reverse blocking protection. The maximum supercap charging current and voltage can be adjusted. When the input voltage fails a buck-boost converter (TPS63802) takes over and generates a constant backup voltage. The supercap capacitance and voltage define the energy which is available for the backup. The PMP30693 provides a stable backup output of 3.7 V at 300 mA for more than 100 s until the output voltage drops.



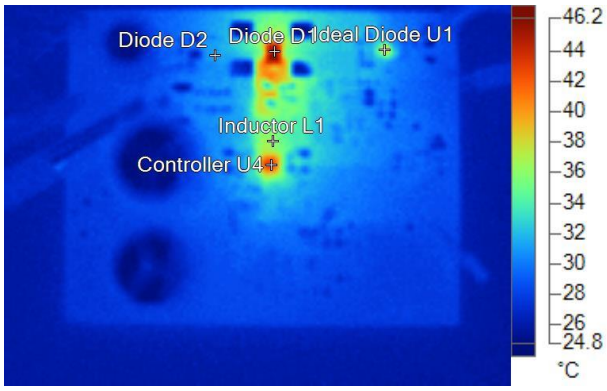



## 1.1 Thermal Images

The images below show the infrared images taken from the FlexCam

### 1.1.1 Supercap Charge; no input current limit (R7 = 0, R5 not populated)

MAIN Voltage = 3.6V
SYS Current = 1A

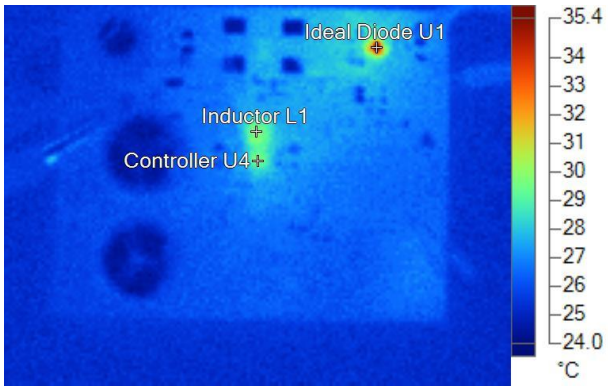



| Name | Temperature |
|---|---|
| Diode D2 | 31.2°C |
| Diode D1 | 46.0°C |
| Controller U4 | 43.3°C |
| Inductor L1 | 36.2°C |
| Ideal Diode U1 | 37.2°C |

**1714 Vin=3.6V SC CHARGE (no current limit) ILoad=1A.is2**

### 1.1.2 Supercap Charge; Input current limit Variant 1 (R7 = 68mohm, R5 = 0, R14 = R15 = R16 = 30.1ohm); Maximal charge current: 100mA , maximal precharge current = 300mA

MAIN Voltage = 3.6V
SYS Current = 1A

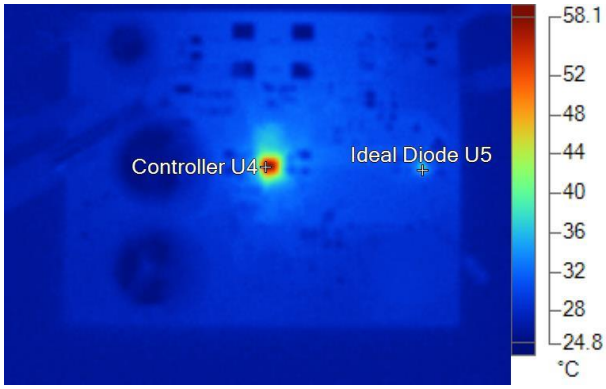



| Name | Temperature |
|---|---|
| Controller U4 | 29.5°C |
| Inductor L1 | 30.0°C |
| Ideal Diode U1 | 35.4°C |

1711_Vin=3.6V SC CHARGE 1 (300mA100mA) Iload=1A.is2

### 1.1.3 Supercap Discharge (Backup Mode)

SYS Current = 1A




1713 Vin=0V SC DISCHARGE (Backup) Iload=1A.is2

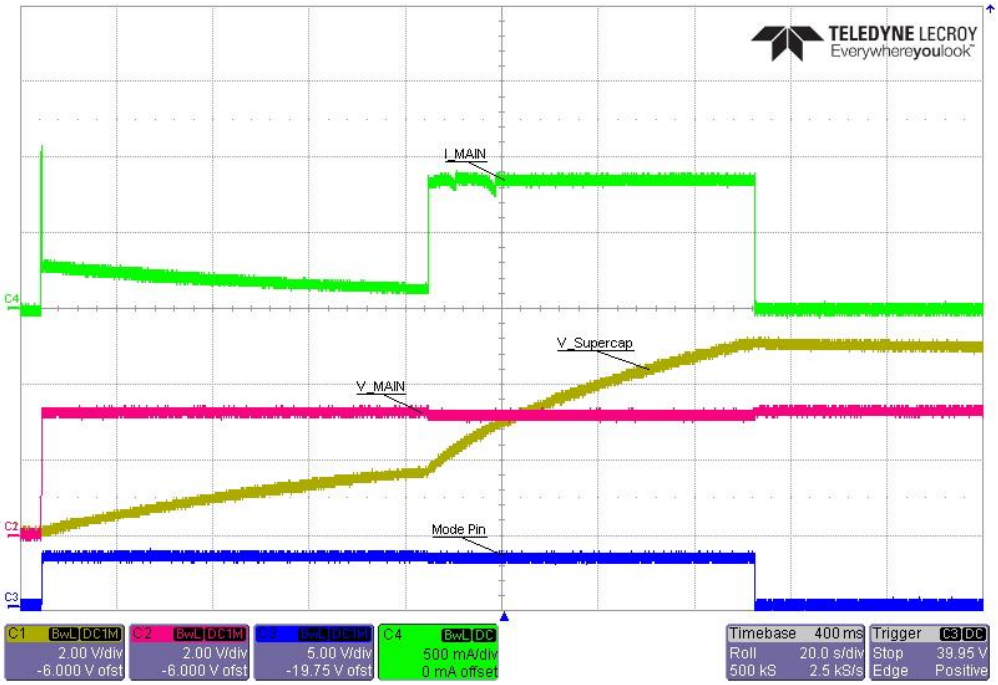
| Name | Temperature |
|---|---|
| Controller U4 | 58.1°C |
| Ideal Diode U5 | 36.9°C |

# 2 Waveforms

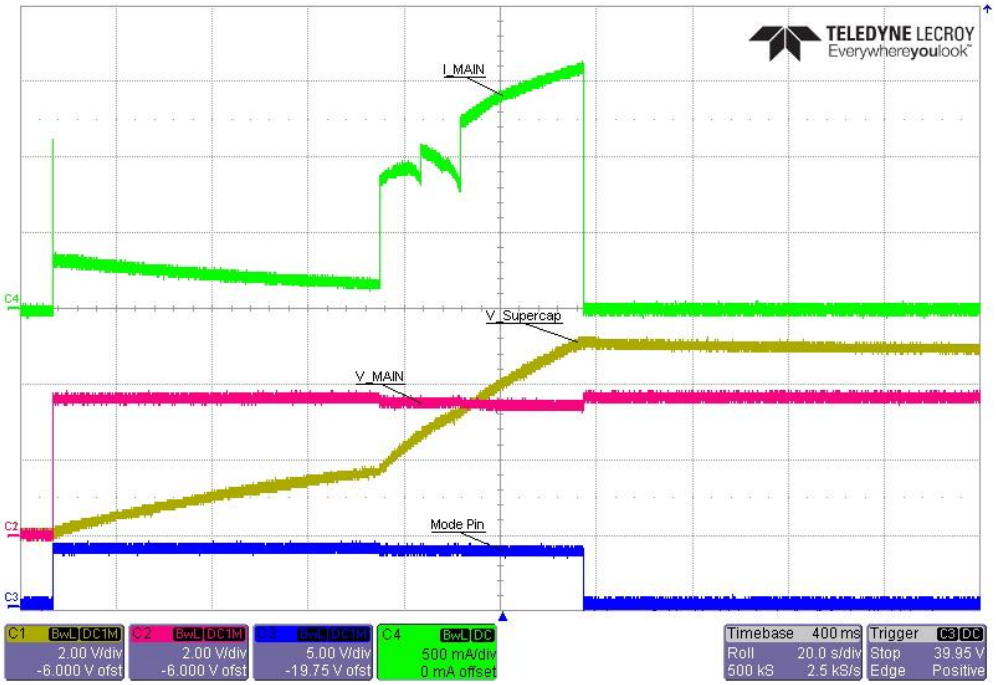
## 2.1 Supercap Charging

### 2.1.1 Supercap Charge; no input current limit (R7 = 0, R5 not populated)

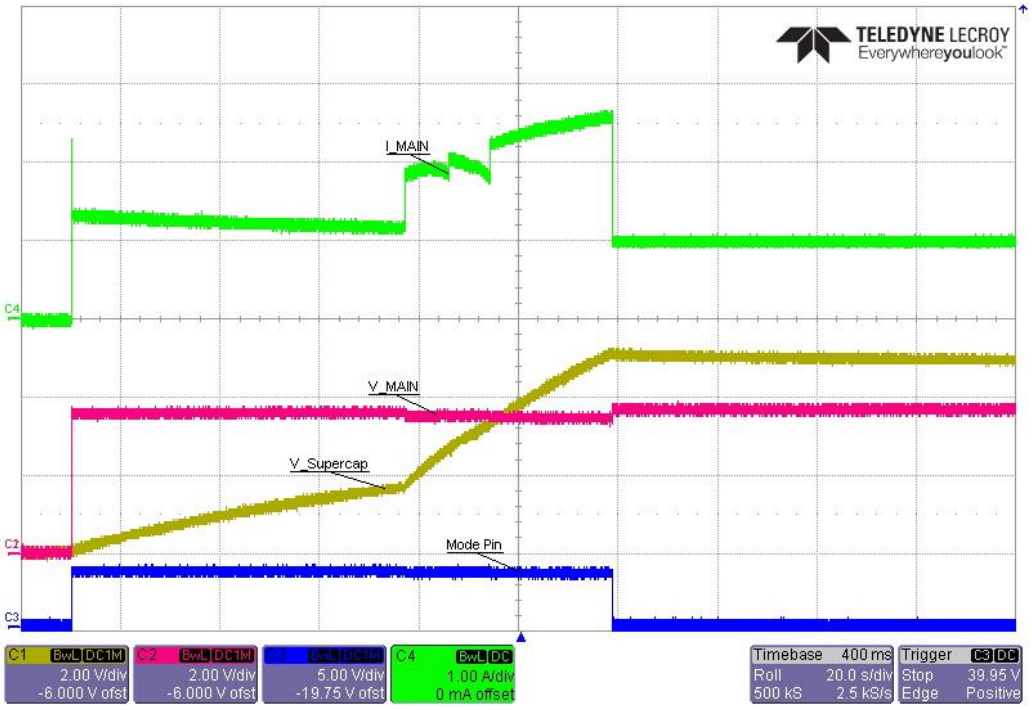
MAIN Voltage = 3.3V
SYS Current = 0A



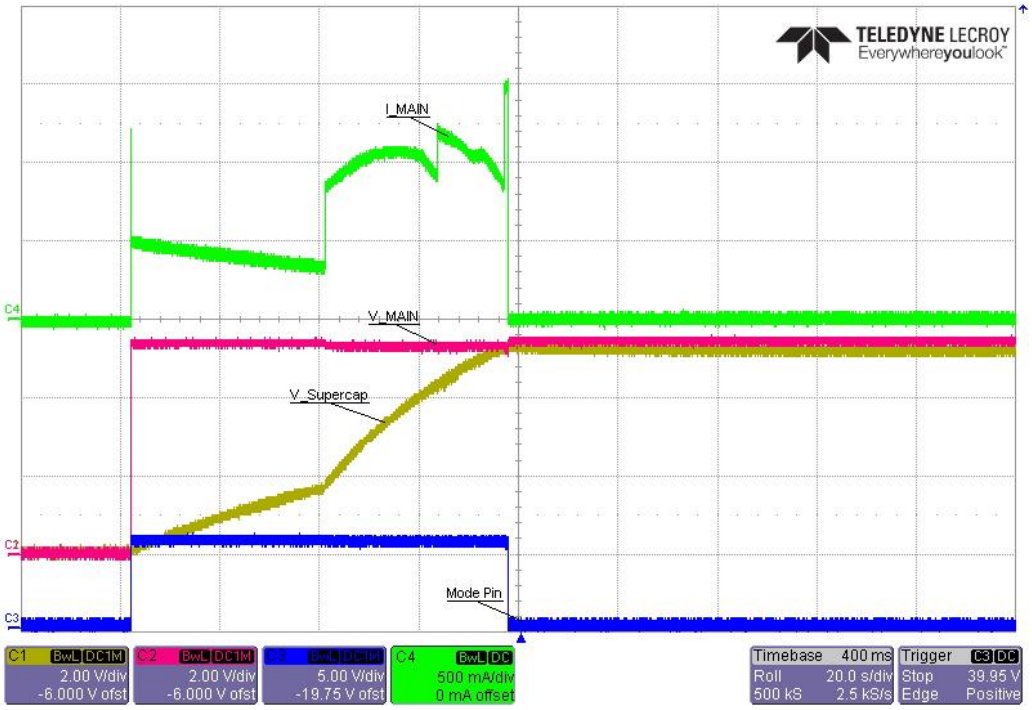

MAIN Voltage = 3.6V
SYS Current = 0A



MAIN Voltage = 3.6V
SYS Current = 1A

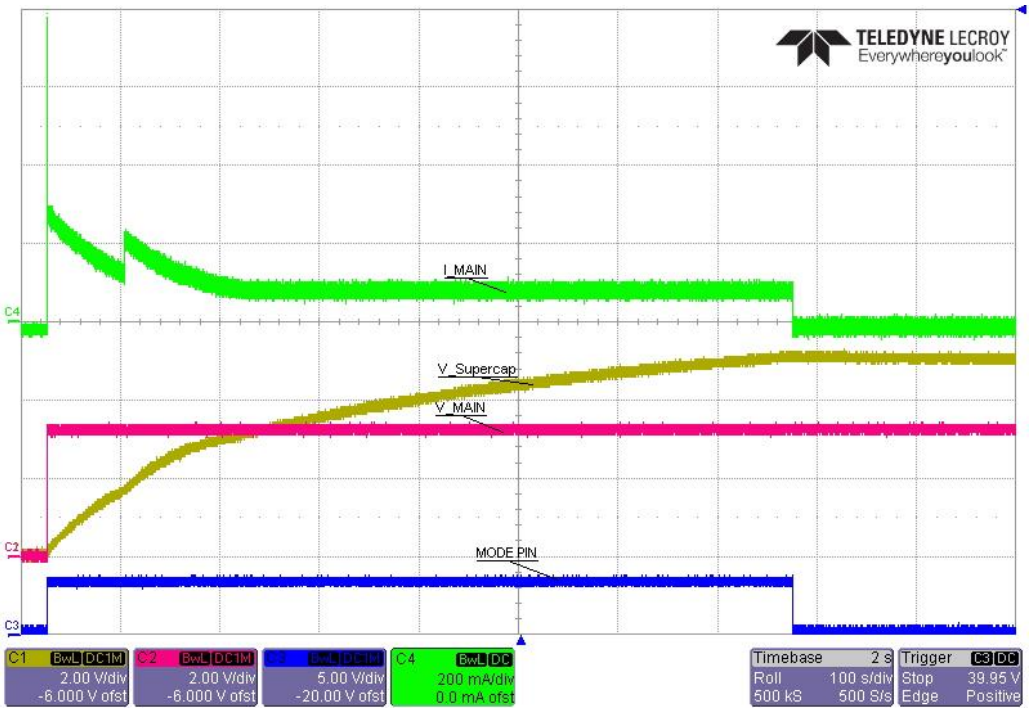



MAIN Voltage = 5.4V
SYS Current = 0A

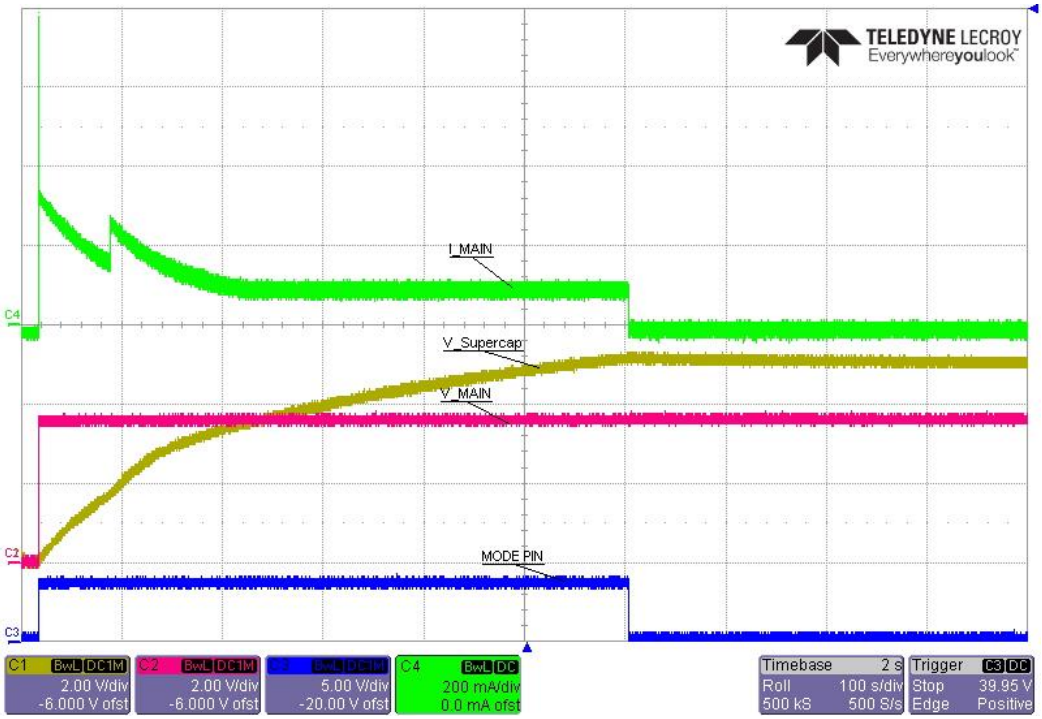


### 2.1.2 Supercap Charge; Input current limit Variant 1 (R7 = 68mohm, R5 = 0, R14 = R15 = R16 = 30.1ohm); Maximal charge current: 100mA , maximal precharge current = 300mA

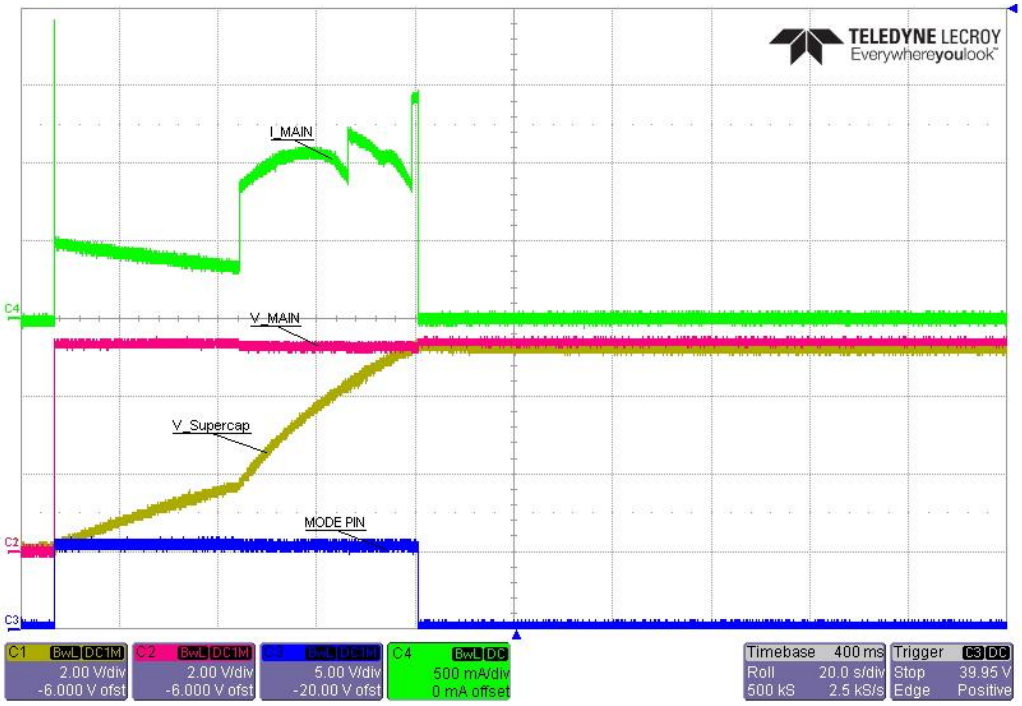
MAIN Voltage = 3.3V
SYS Current = 0A




MAIN Voltage = 3.6V
SYS Current = 0A

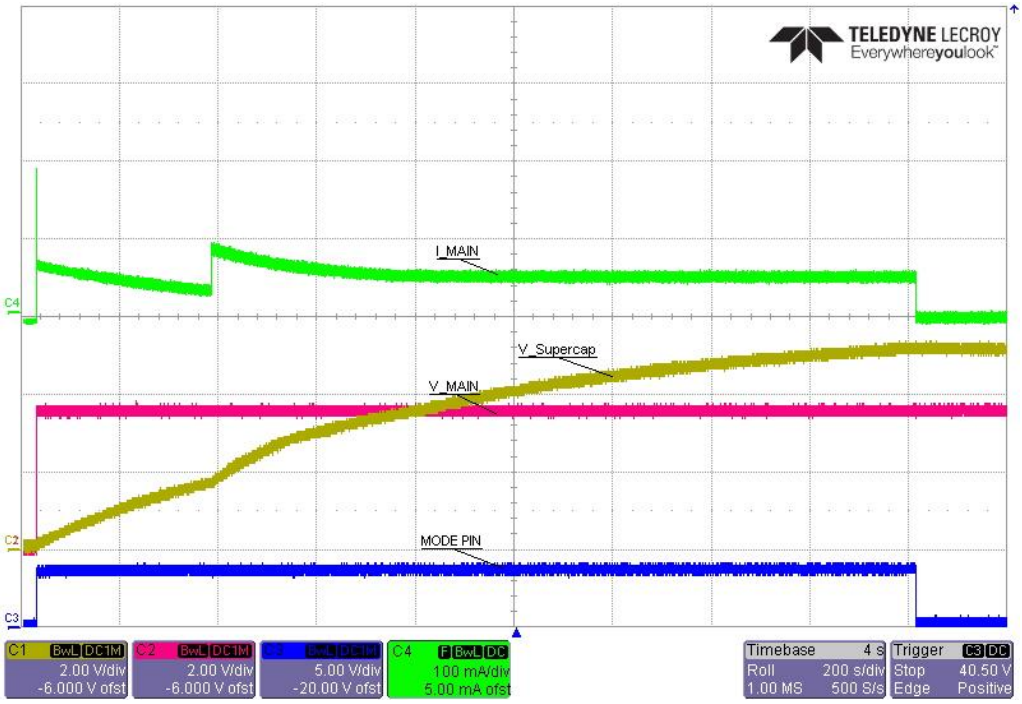


MAIN Voltage = 5.4V
SYS Current = 0A




### 2.1.3 Supercap Charge; Input current limit Variant 2 (R7 = 130mohm, R5 = 0, R13 = R14 = R15 = DNP, R16=49.9ohm); Maximal charge current: 50mA , maximal precharge current = 50mA

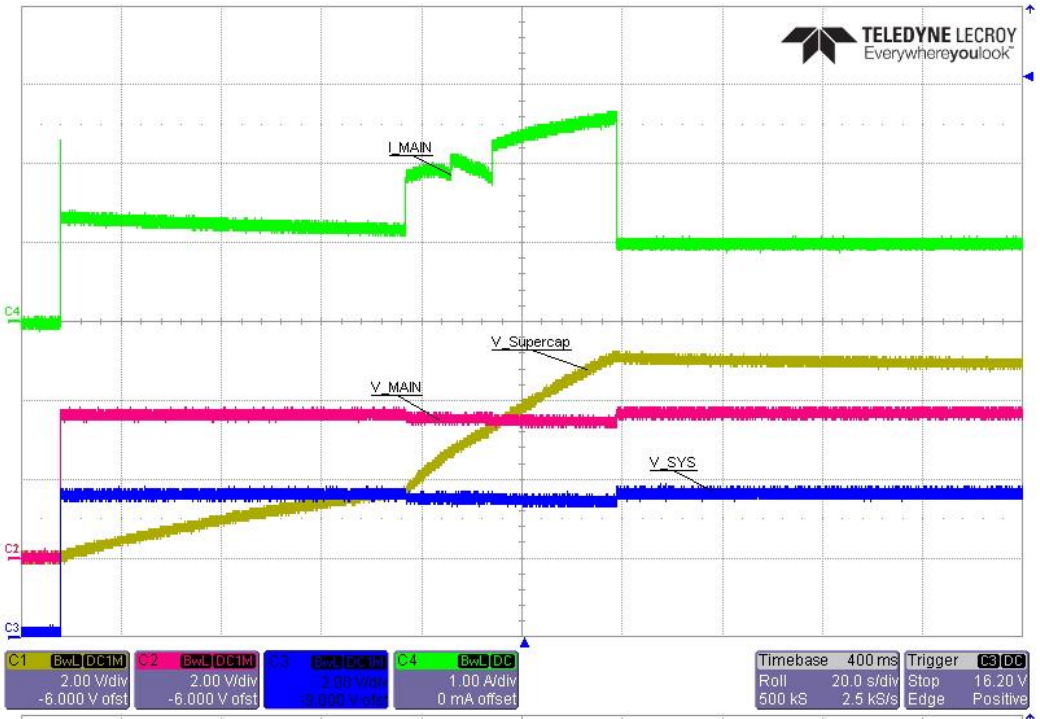
MAIN Voltage = 3.6V
SYS Current = 0A

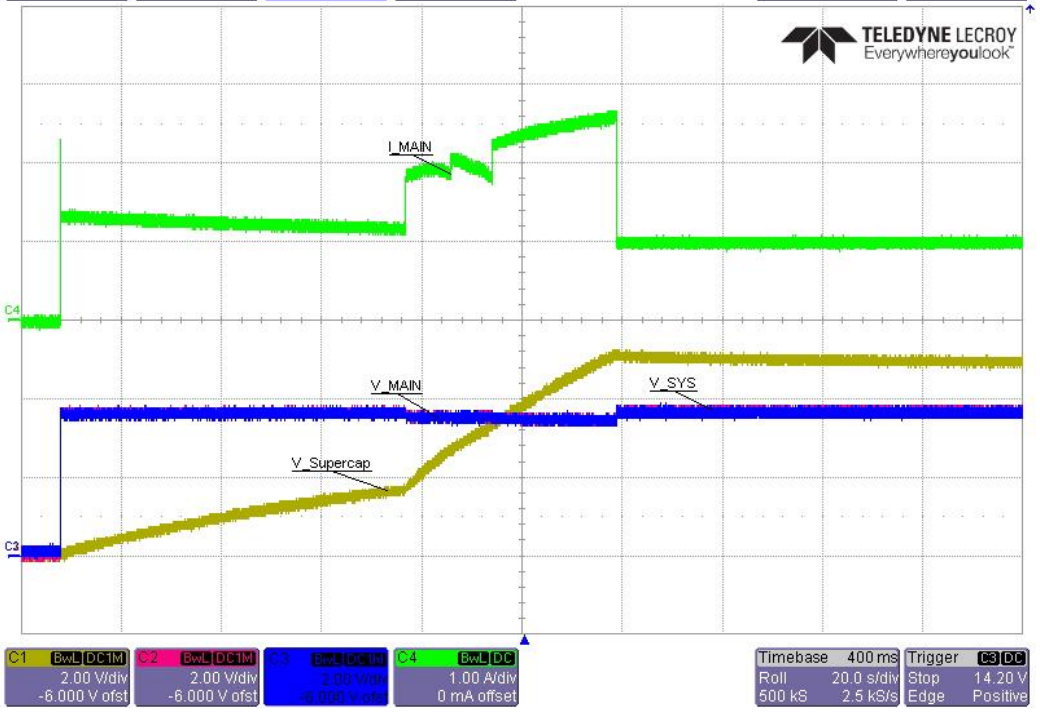


## 2.2 Voltage Drop input vs. output

### 2.2.1 Supercap Charge; no input current limit (R7 = 0, R5 not populated)

MAIN Voltage = 3.6V
SYS Current = 1A



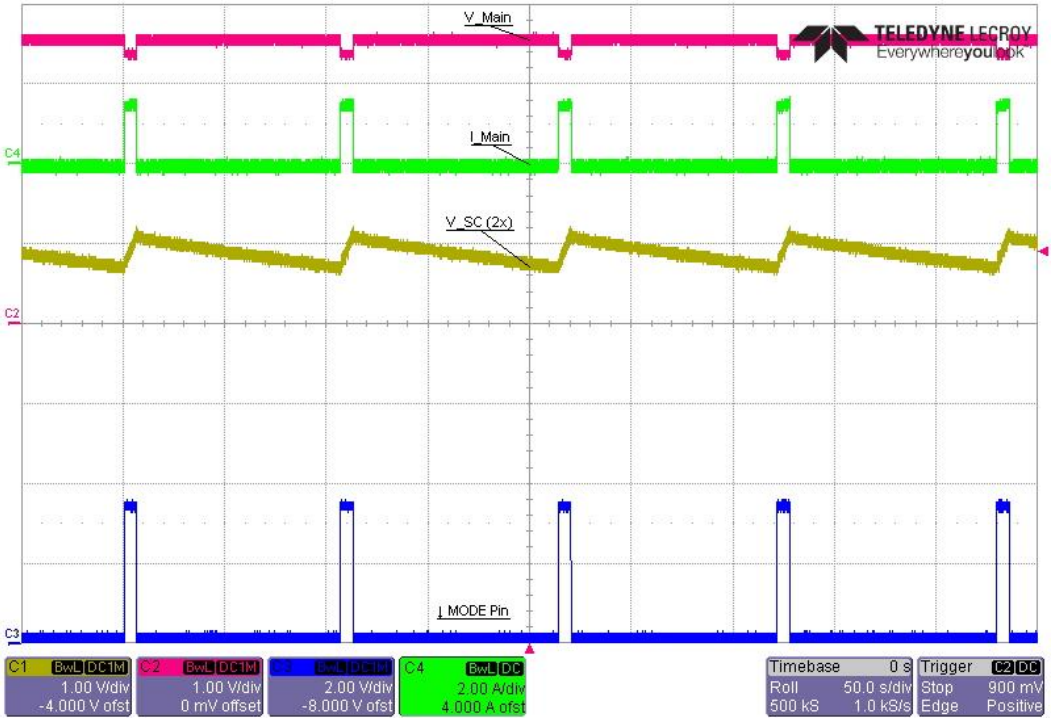



## 2.3 Supercap recharge cycle

### 2.3.1 no input current limit (R7 = 0, R5 not populated)

A supercap discharge resistor R_discharge was assembled for this measurement. The resistor was connected between the supercap voltage (V_SC (2x) and ground. It forces a discharge of the supercaps.

MAIN Voltage = 3.6V
SYS Current = 0A
R_discharge = 100ohm

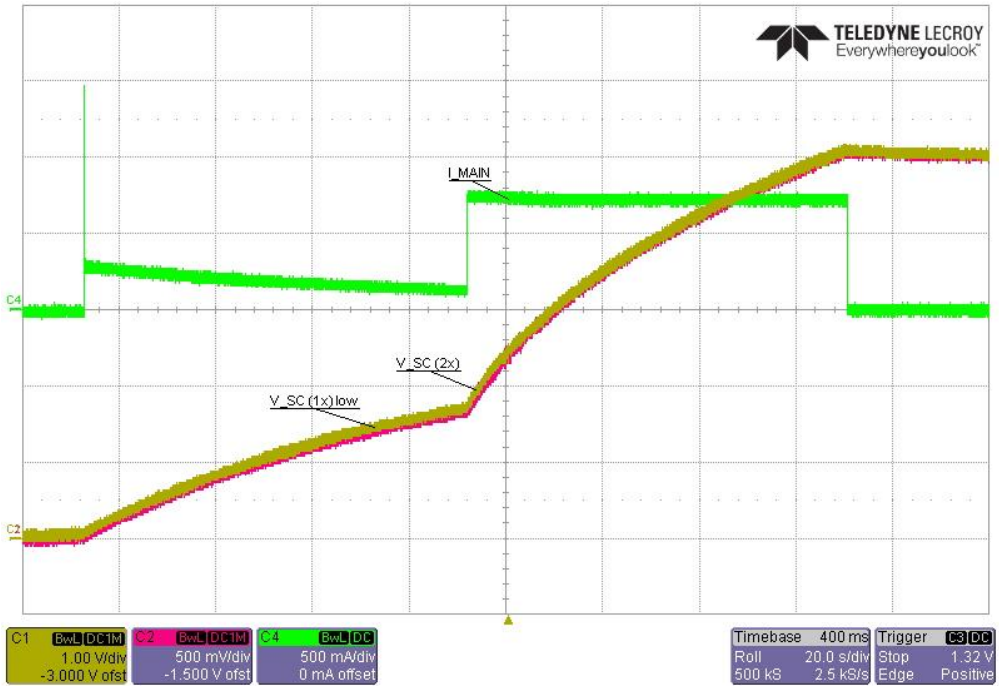


## 2.4 Supercap balancing

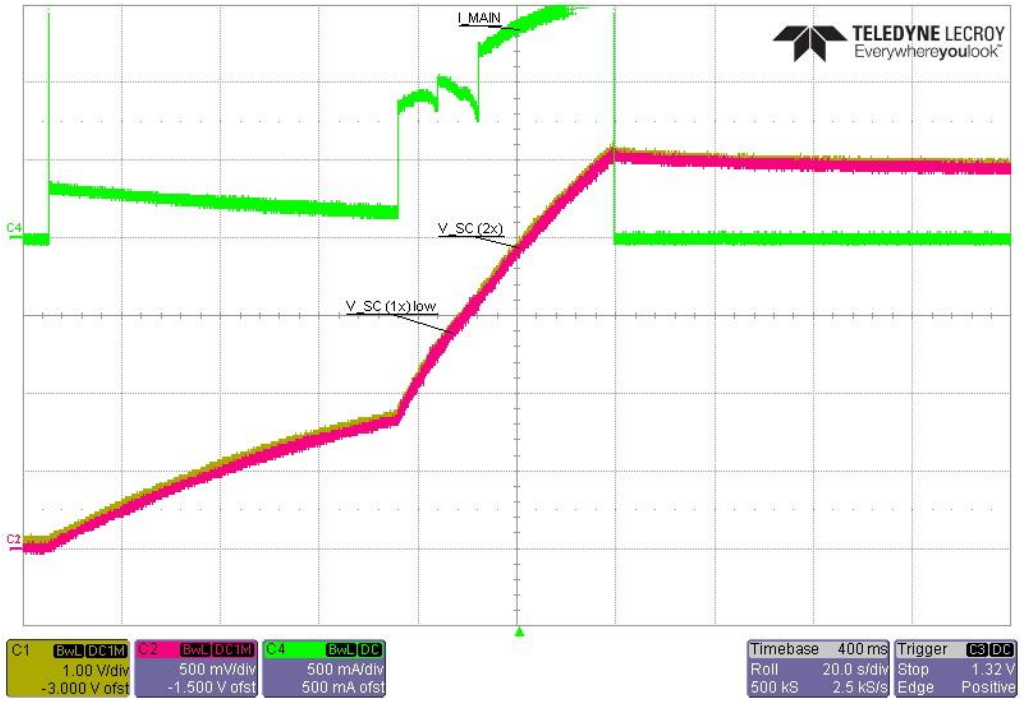
### 2.4.1 no input current limit (R7 = 0, R5 not populated)

C1 = voltage across capacitors C25+C17
C2 = voltage across capacitor C25

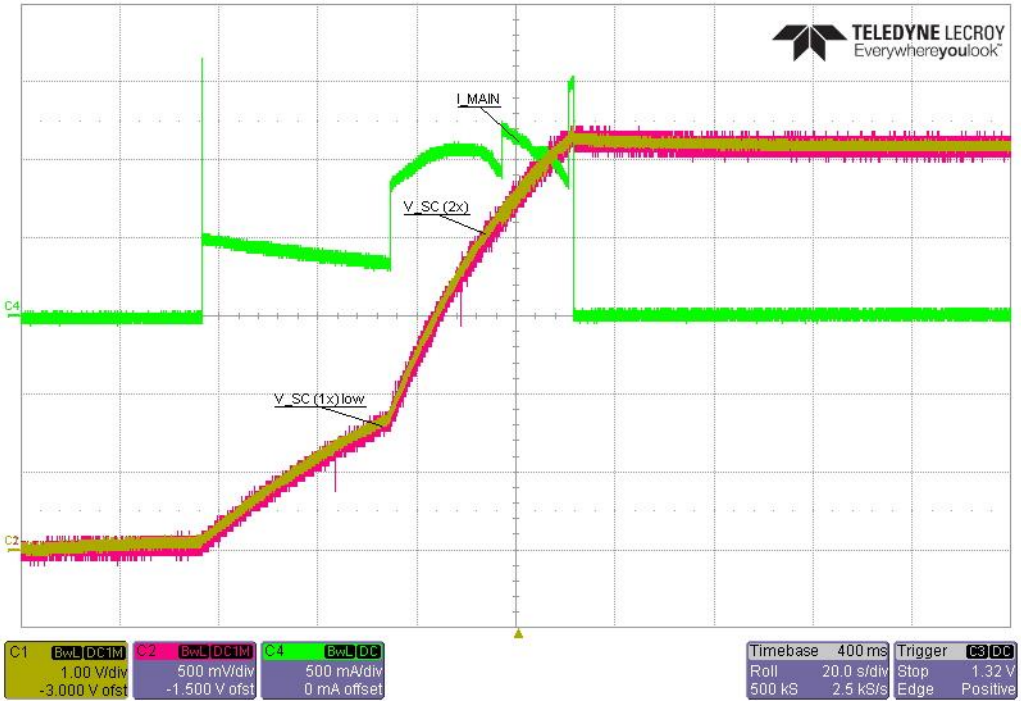
MAIN Voltage = 3.2V
SYS Current = 0A




MAIN Voltage = 3.6V
SYS Current = 0A

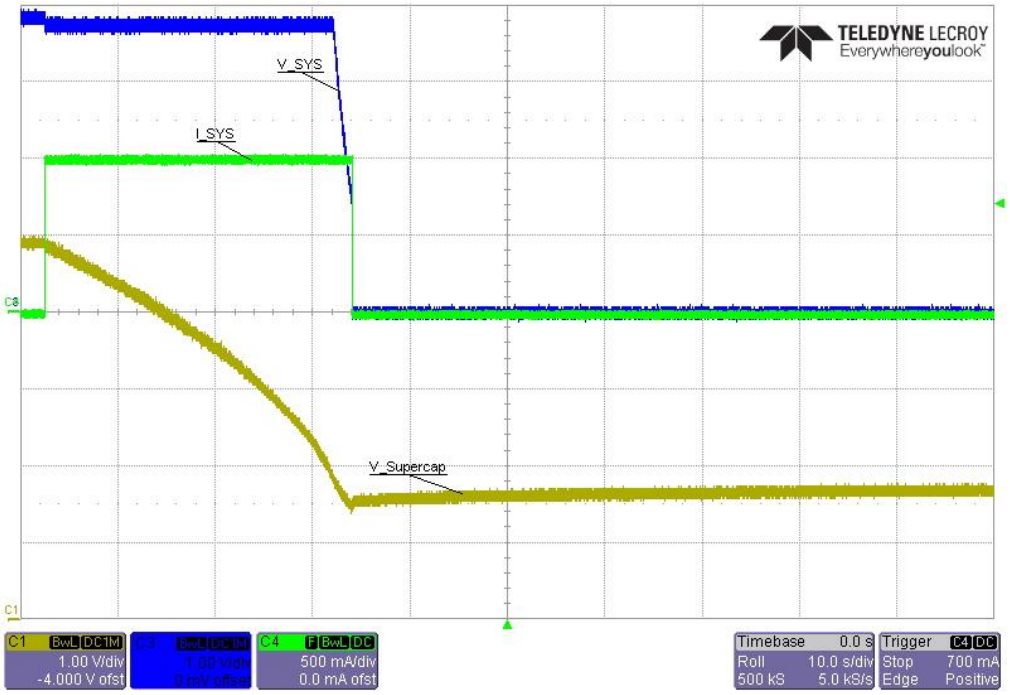


MAIN Voltage = 5.4V
SYS Current = 0A

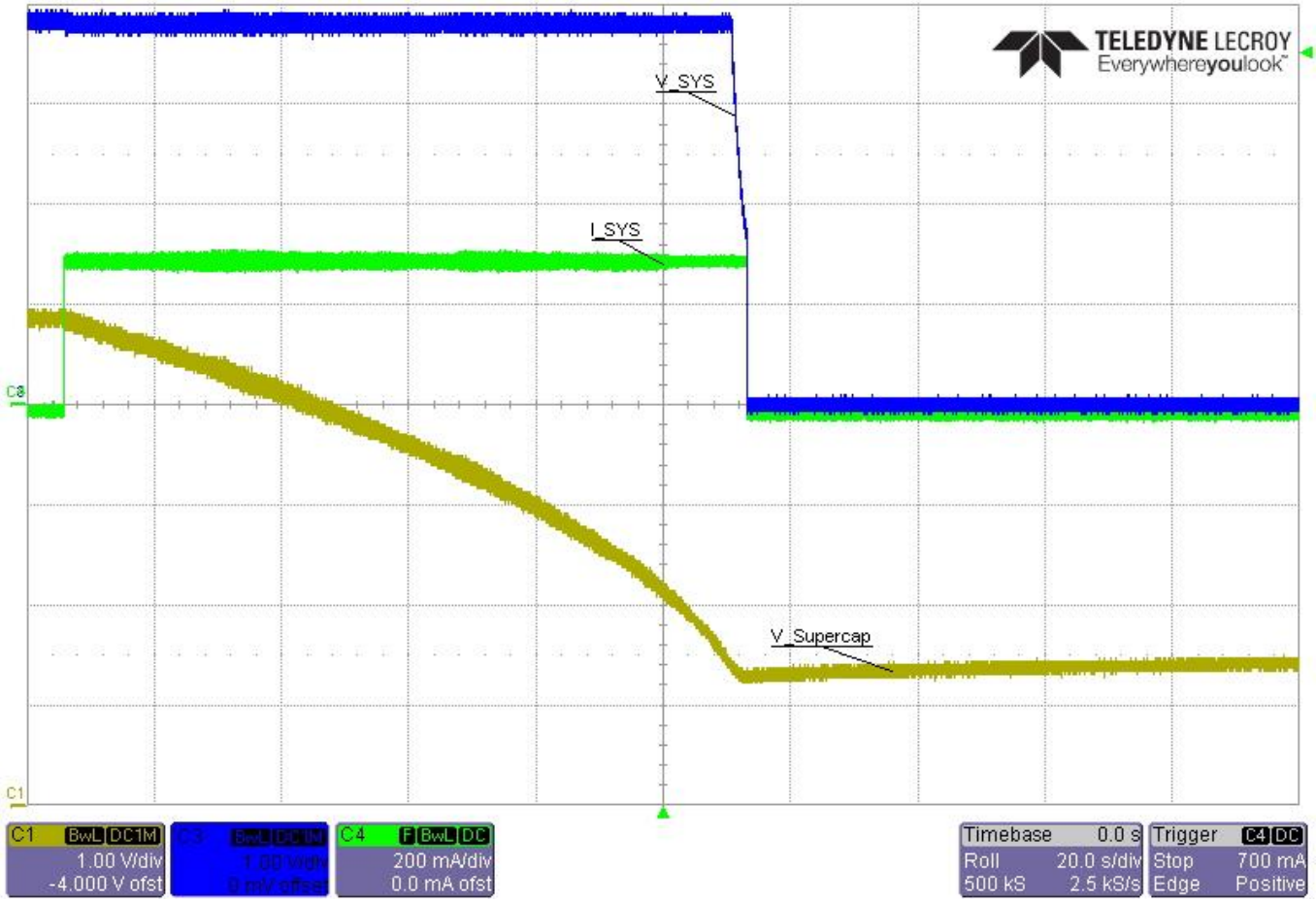


## 2.5 Supercap discharge time (Backup Mode)

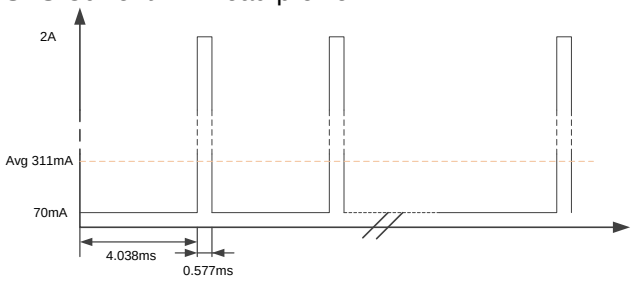
SYS Current = 1A

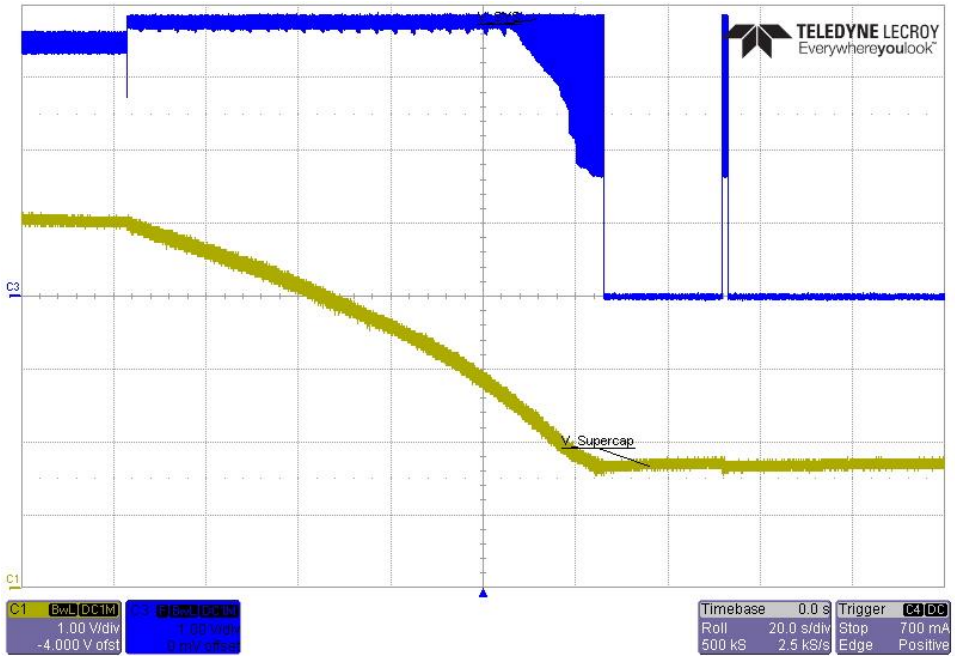



SYS Current = 0.3A



SYS Current = load profile:

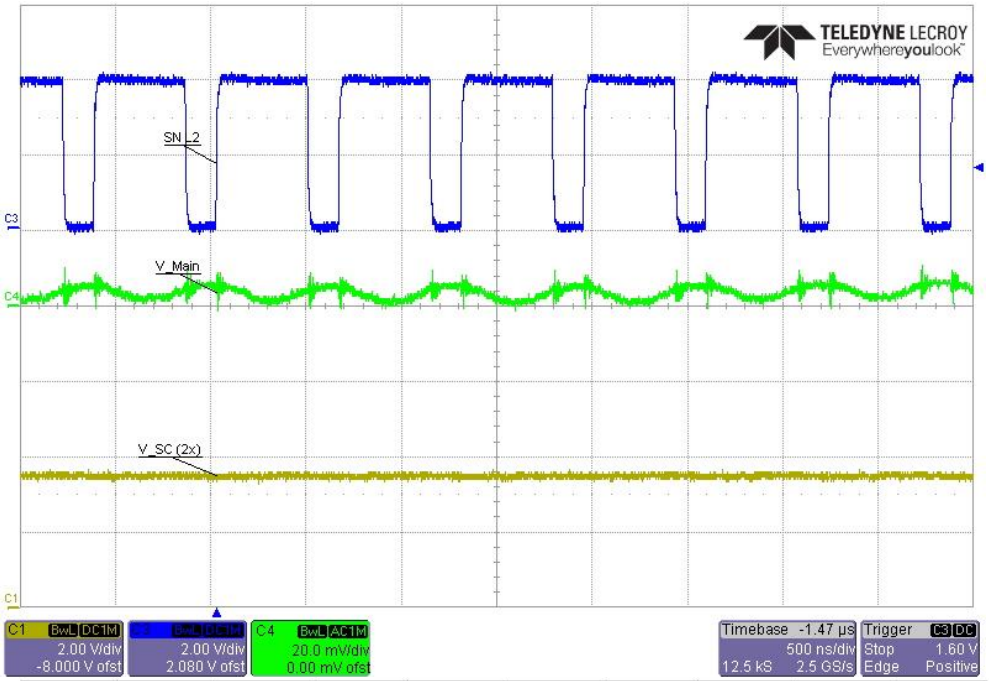


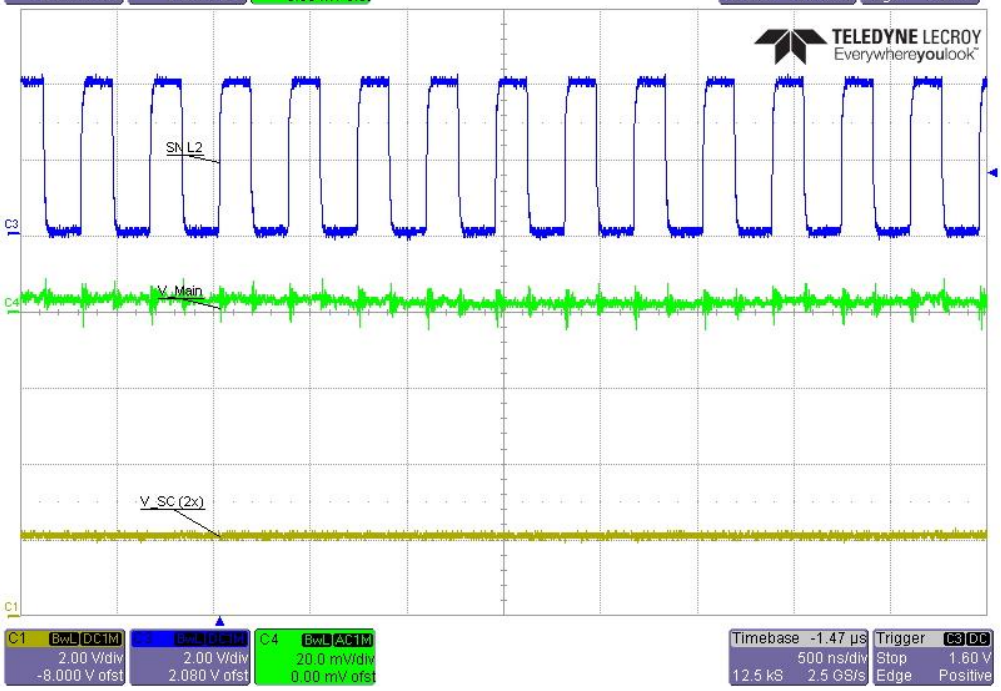



## 2.6 Output Voltage Ripple

### 2.6.1 Backup Mode (Supercap discharge)

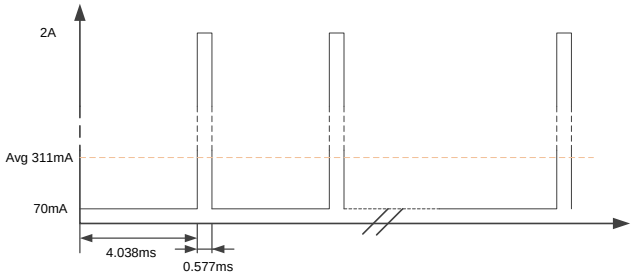
SYS Current = 1A



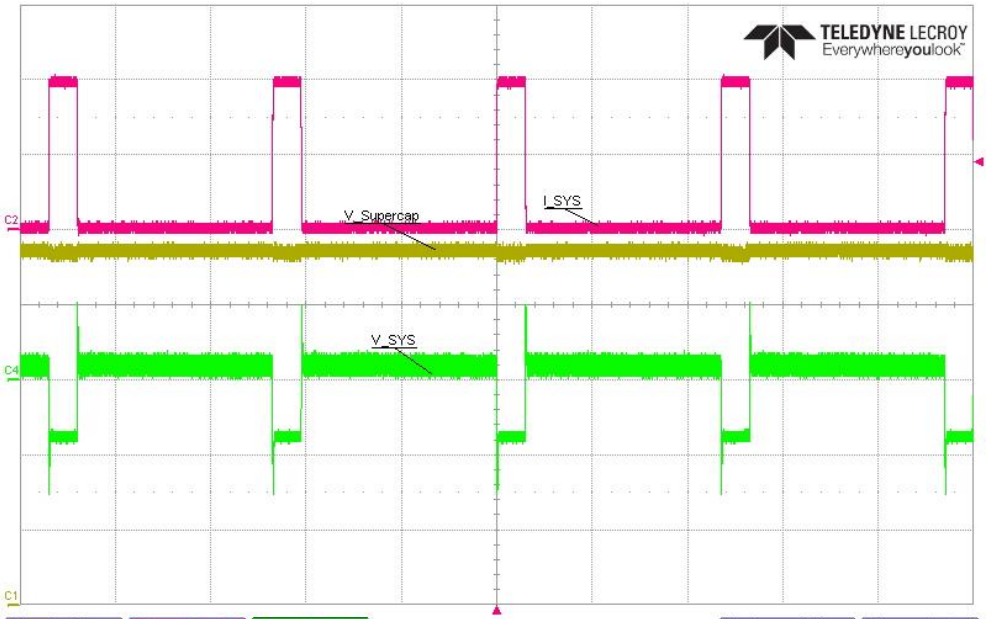



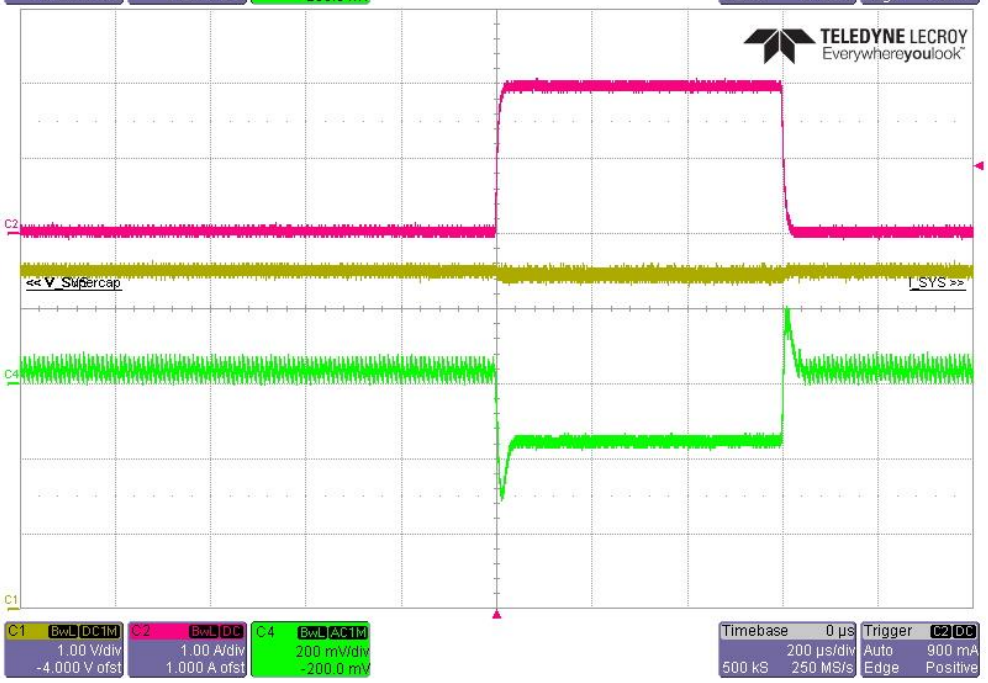
## 2.7 Load Transient Response

Load Profile:

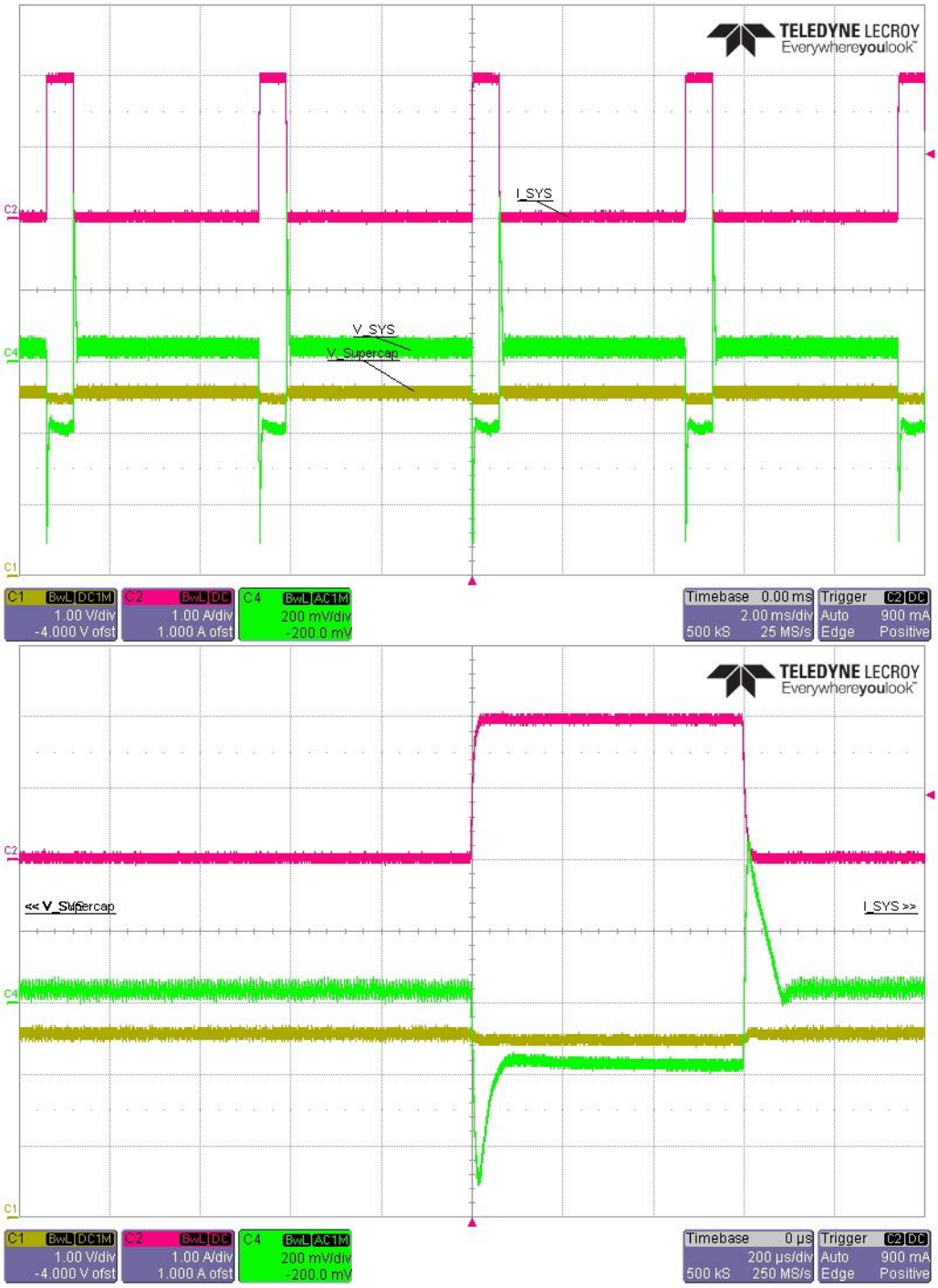



### 2.7.1 Buck Backup Mode (Supercap Discharge)



### 2.7.2 Boost Backup Mode (Supercap Discharge)



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