EV1406-0600-A
EVALUATION BOARD
USER GUIDE

Introduction

This user guide describes the evaluation board provided for the FS1406-0600 µPOL™ product.

The board generates an output voltage (V_{OUT}) of 1.8V* for loads of 0–6A from an input voltage (PV_{IN}) of 12V.

Specifications

- Input voltage (PV_{IN}) = +12V
- Output voltage (V_{OUT}) = +1.8V
- Output load (I_O) = 0–6A
- Switching frequency (F_{SW}) = 2.2MHz
- Output capacitance (C_O) = 2x22µF (MLCC)
- Input capacitance (C_{IN}) = 2x22µF (MLCC)
- Dimensions (width x length x thickness) = 63 x 84 x 1.5mm

Connections

Name	Identifier	Description
PV_{IN}	J1	Input voltage (+12V)
Gnd	J2	Ground for input voltage
V_{OUT}	J8	Output voltage (+1.8V)
Gnd	J7	Ground for output voltage
V_{CC}	TP2	Internal supply (V_{CC}) – output of an LDO regulator
Gnd	TP3	Ground for internal supply
En	TP11	Enable
PG	TP12	Power Good

The board is configured for a single input supply. An internal low drop-out regulator generates the internal supply (V_{CC}) from PV_{IN}. The Enable (En) input is connected to PV_{IN} through a resistor divider, so that no Enable signal is needed.

Operation

To use the evaluation board:

1. Connect a well-regulated +12V input supply to PV_{IN} (J1) and Gnd (J2).
2. Connect a load of 0–6A to V_{OUT} (J8) and Gnd (J7).

NOTE – Output Voltages from 0.6V to 1.8V can be obtained by changing the values of Resistor Divider Components. Refer Page 5.

Description

The evaluation board consists of a 4-layer PCB made from FR4 glass-reinforced epoxy laminate material. All layers use 2oz copper (equating to a thickness of 0.0694mm). The major power components, including the FS1406, are mounted on the top side of the board.

Part reference	Quantity	Type	Description
FS1406 µPOL	1	–	Main IC
C8	1	47pF	0805, 50V, COG
C9	1	2.2µF	0402, 10V, X7S
C10, C21	2	22µF	0805, 16V, X5R
C12	1	0.1µF	0402, 16V, X7R
C13	1	68µF	25V
C14, C15	2	22µF	0805, 6.3V, X5R
C26	1	1µF	0603, 25V, X5R
J1	1	Red	Banana connector
J2, J7	2	Black	Banana connector
J8	1	Green	Banana connector
J10, J11	2	–	3-pin header
R1	1	2.7Ω	10%, 1/8W, 0805 case size
R3, R7	2	49.9kΩ	10%, 1/8W, 0805 case size
R4	1	40.2kΩ	10%, 1/8W, 0805 case size
R5	1	19.1kΩ	10%, 1/8W, 0805 case size
R6	1	12.7kΩ	10%, 1/8W, 0805 case size
R9, R13	2	0Ω	0805 case size
R11, R17	2	0Ω	0402 case size
R18, R19	2	4.99kΩ	0402 case size
TP1-TP12, SW/NC15, VBUS, VEXTBUS, SCL, SDA	17	–	Test points

Figure 1 shows the layout of the board and Figure 2 shows a schematic of the electrical circuit.

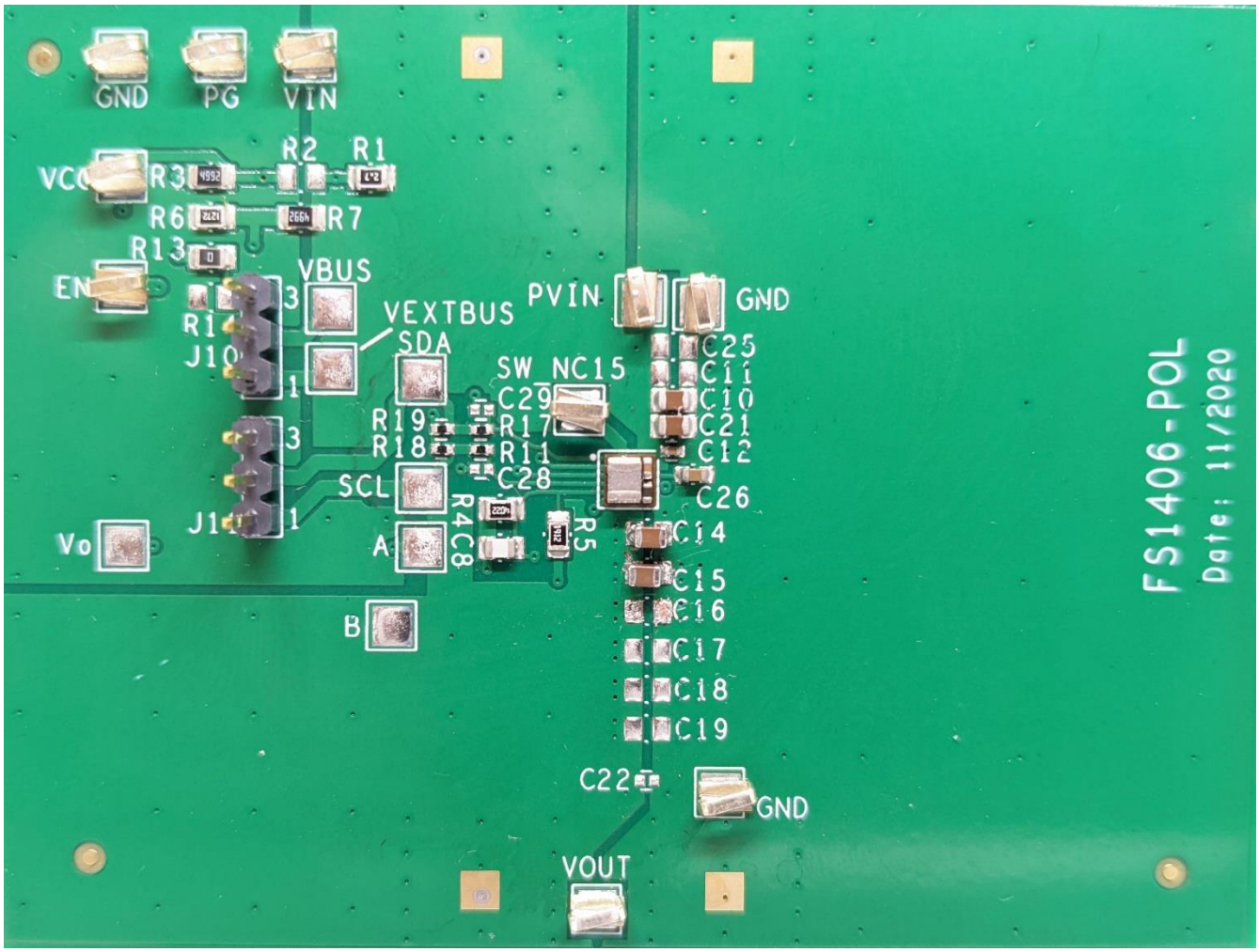
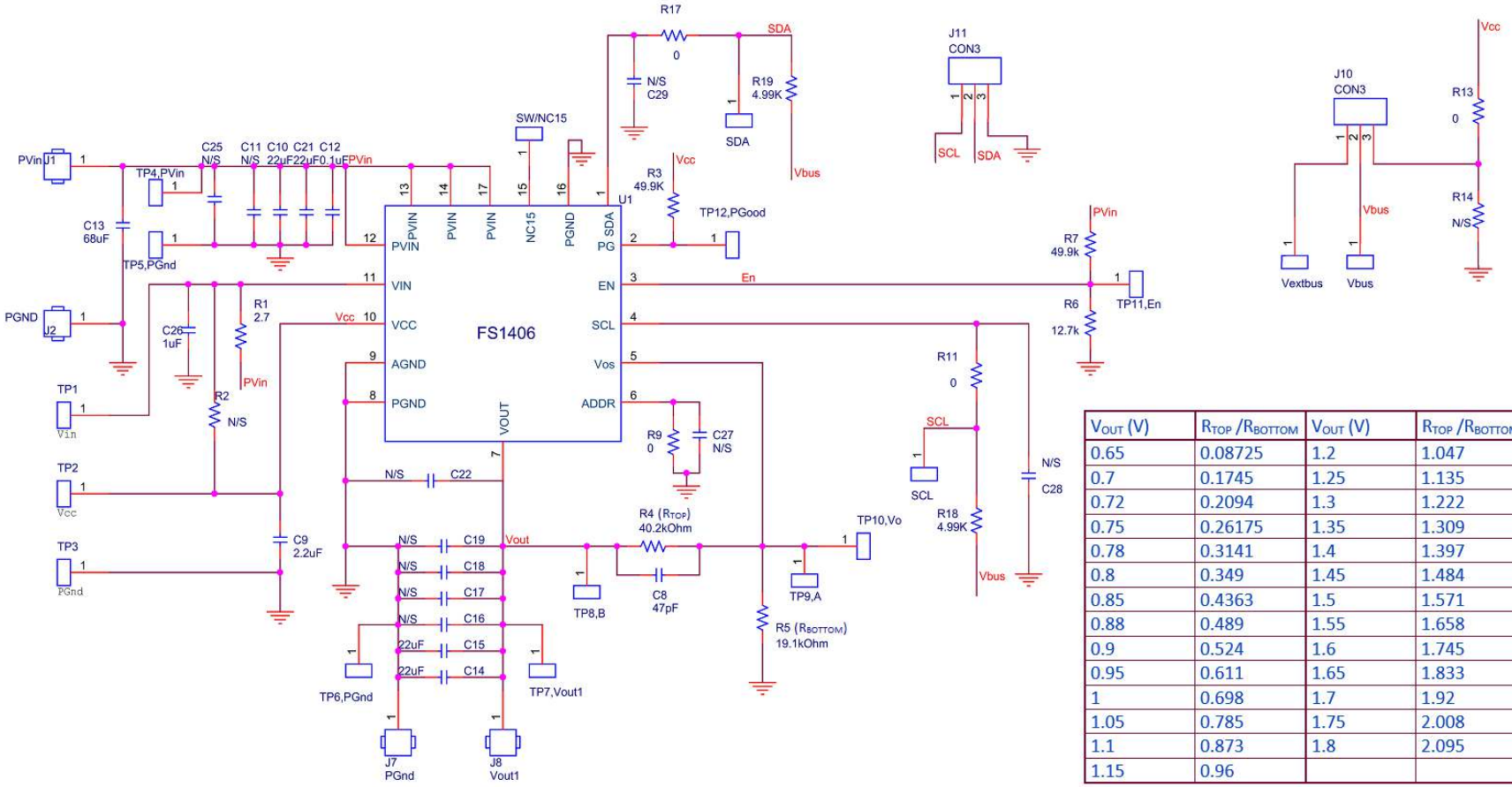


Figure 1 Board layout



V_{OUT} (V)	R_{TOP} /R_{BOTTOM}	V_{OUT} (V)	R_{TOP} /R_{BOTTOM}
0.65	0.08725	1.2	1.047
0.7	0.1745	1.25	1.135
0.72	0.2094	1.3	1.222
0.75	0.26175	1.35	1.309
0.78	0.3141	1.4	1.397
0.8	0.349	1.45	1.484
0.85	0.4363	1.5	1.571
0.88	0.489	1.55	1.658
0.9	0.524	1.6	1.745
0.95	0.611	1.65	1.833
1	0.698	1.7	1.92
1.05	0.785	1.75	2.008
1.1	0.873	1.8	2.095
1.15	0.96		

Figure 2 Schematic*

NOTE – Modify R5 (R_{BOTTOM}) for different V_{OUT} as per the included table. For V_{OUT} < 1V; R4 (R_{TOP}) = 4.02 kΩ, C8 = 470pF is recommended. For V_{OUT} =0.6V; R4 = 0Ω, C8 = DNP.

Typical performance

Figure 3 to Figure 17 show typical operating waveforms for the evaluation board, while Figure 18 shows a thermal image of the board in operation. In all cases, the board is operating at room temperature with no airflow; PV_{IN} is 12V, V_{OUT} is 1.8V and I_O is 0–6A.

Figure 3 ***Startup with no load (Ch1 :PV_{IN}, Ch2: V_{OUT}, Ch3: PG, Ch4:V_{CC}, Ch5: Enable)***

Figure 4 ***Startup with 6A load (Ch1:PV_{IN}, Ch2: V_{OUT}, Ch3: PG, Ch4:V_{CC}, Ch5: Enable)***

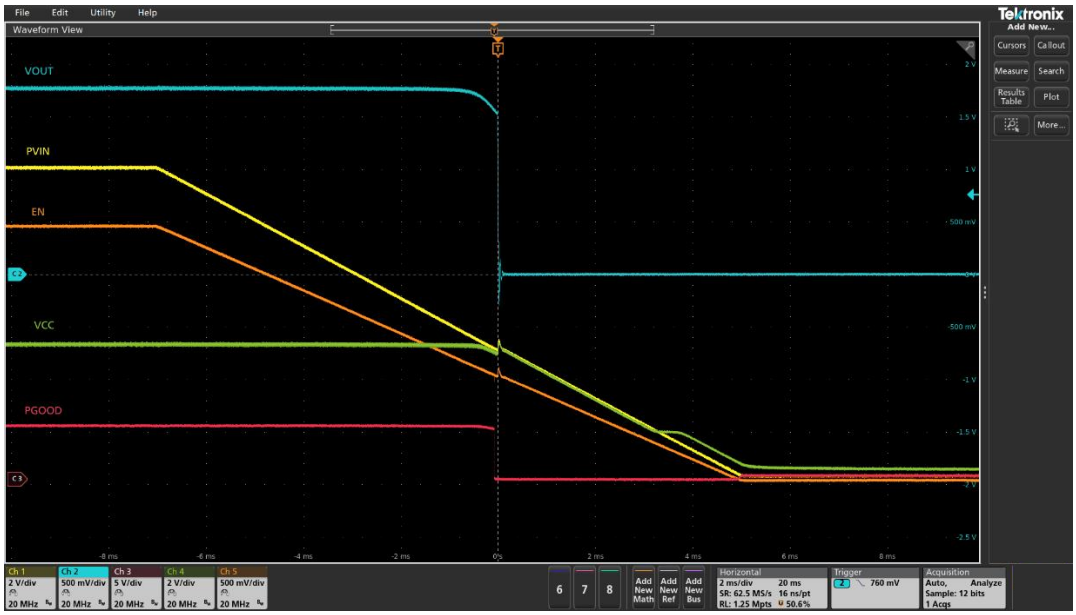


Figure 5 ***Shutdown with Enable de-assertion at 6A load (Ch1:PV_{IN}, Ch2: V_{OUT}, Ch3: PG, Ch4:V_{CC}, Ch5: Enable)***

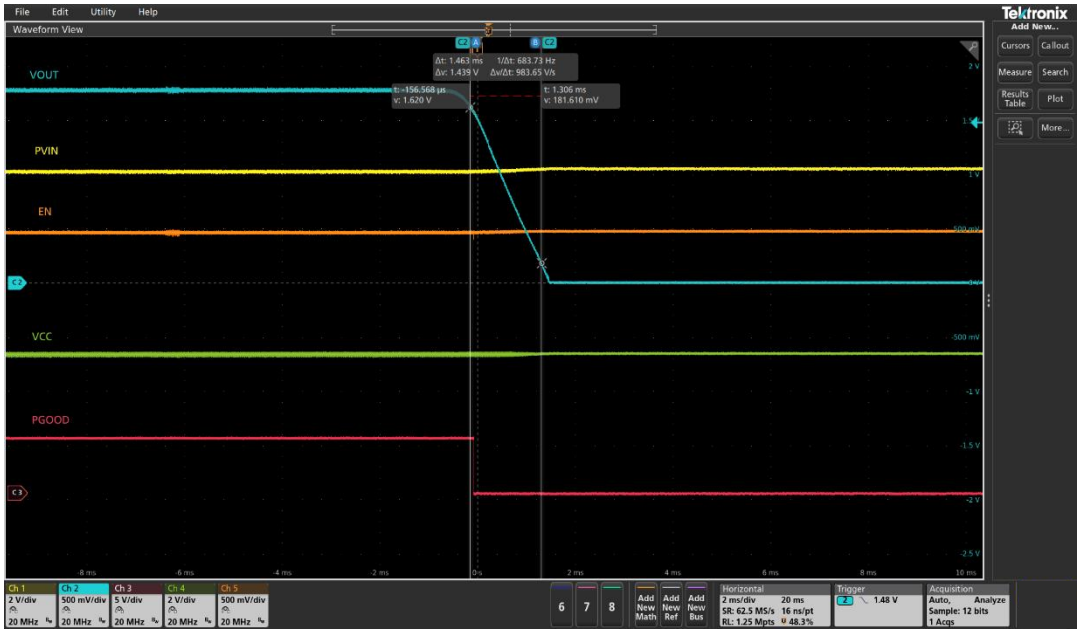


Figure 6 ***Soft turn off at 6A (Ch1:PV_{IN}, Ch2: V_{OUT}, Ch3: PG, Ch4:V_{CC}, Ch5: Enable)***

Figure 7 ***Startup into pre-bias***
(Ch1:PV_{IN}, Ch2: V_{OUT}, Ch3: PG, Ch4:V_{CC}, Ch5: Enable)

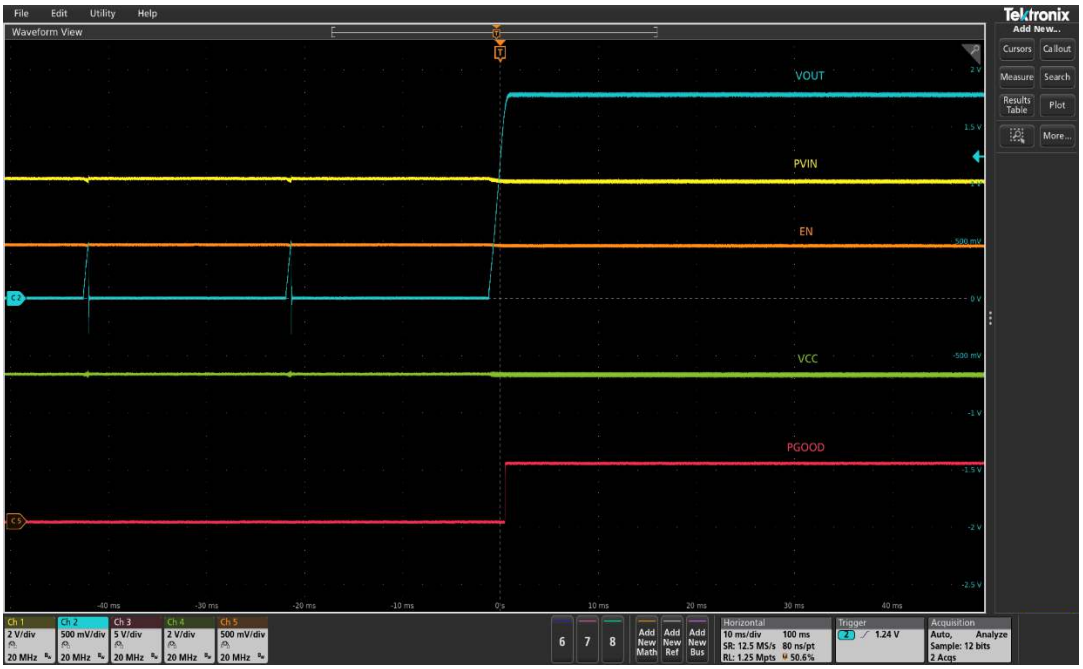


Figure 8 ***Over-current protection and auto-recover to 6A***
(Ch1:PV_{IN}, Ch2: V_{OUT}, Ch3: PG, Ch4:V_{CC}, Ch5: Enable)

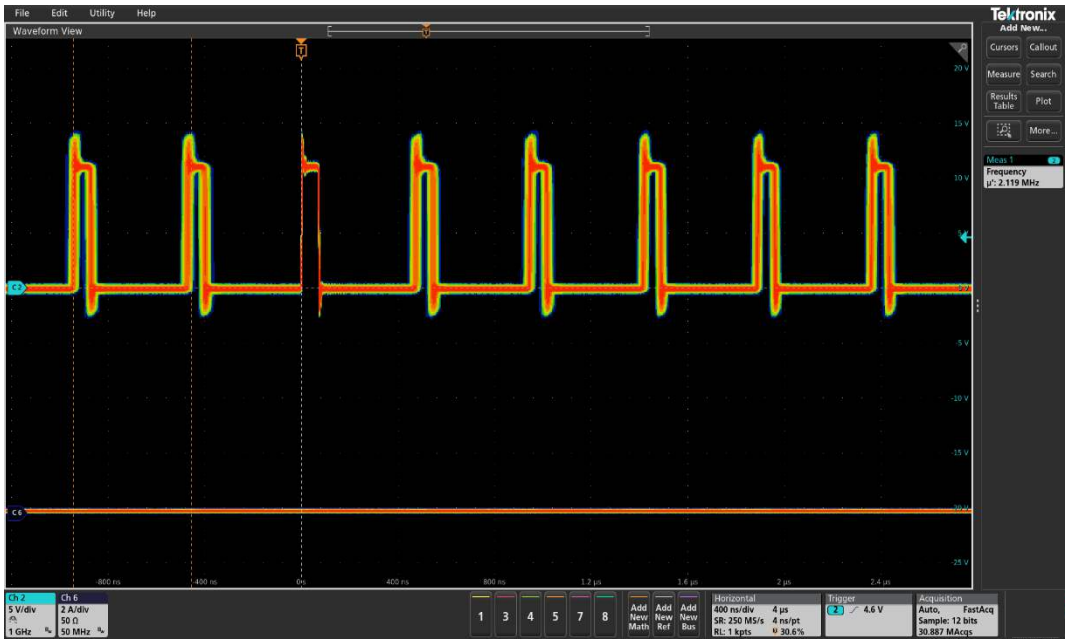


Figure 9 ***Sw at 0A (Ch2: Sw, Ch6: I_O)***

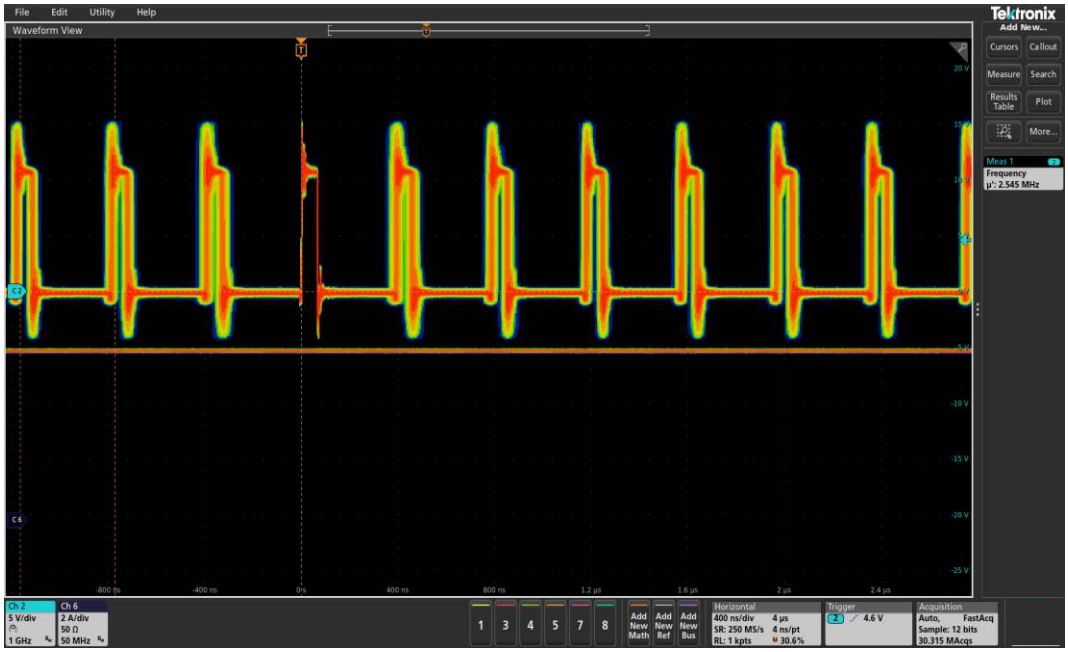


Figure 10 ***Sw at 6A (Ch2: Sw, Ch6: I_O)***

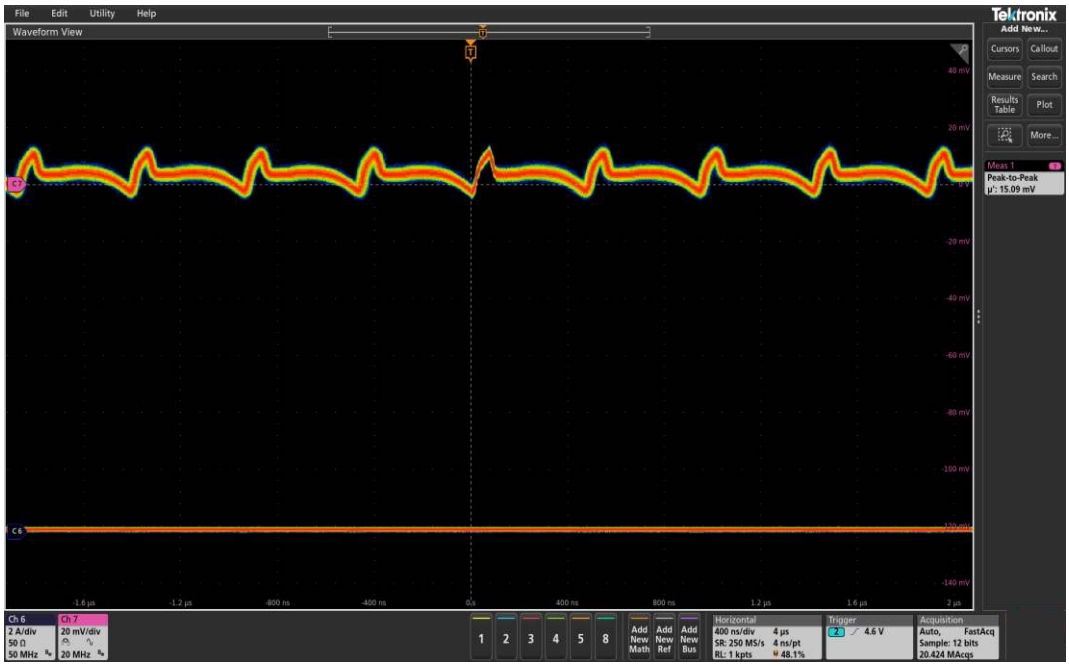


Figure 11 *V_{OUT} ripple at 0A (Ch6:I_O , Ch7:V_{OUT}), Peak-Peak V_{OUT} ripple = 15.1mV*

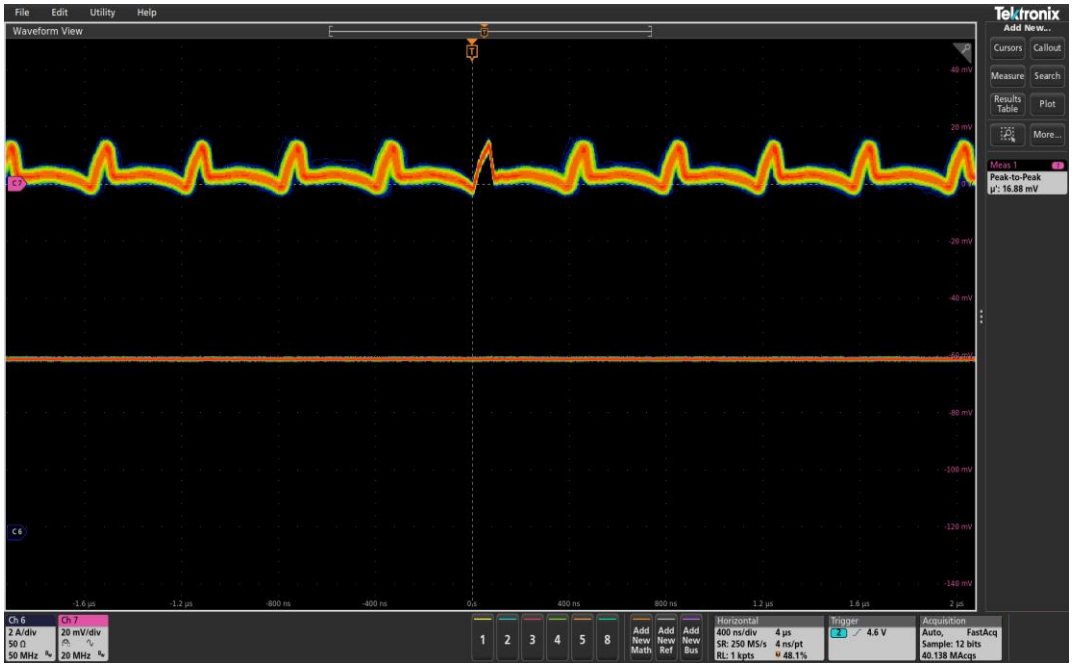


Figure 12 *V_{OUT} ripple at 6A (Ch6:I_O , Ch7:V_{OUT}), Peak-Peak V_{OUT} ripple = 16.9mV*

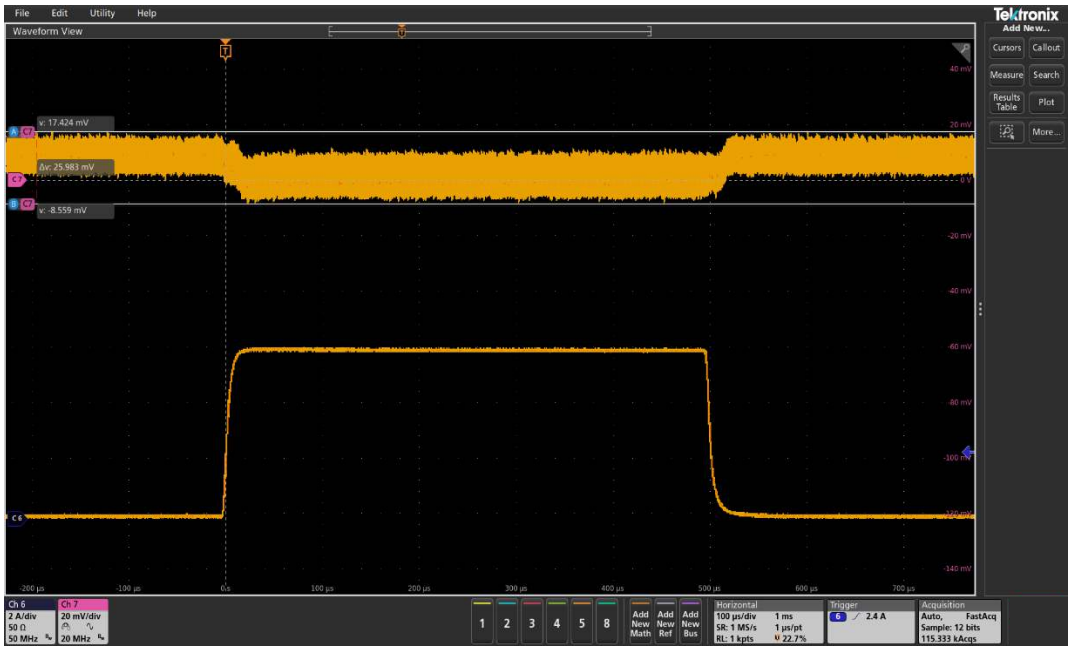


Figure 13 ***Transient response 0A to 6A (Ch6:I_O, Ch7: V_{OUT}), peak-peak deviation = 26mV***

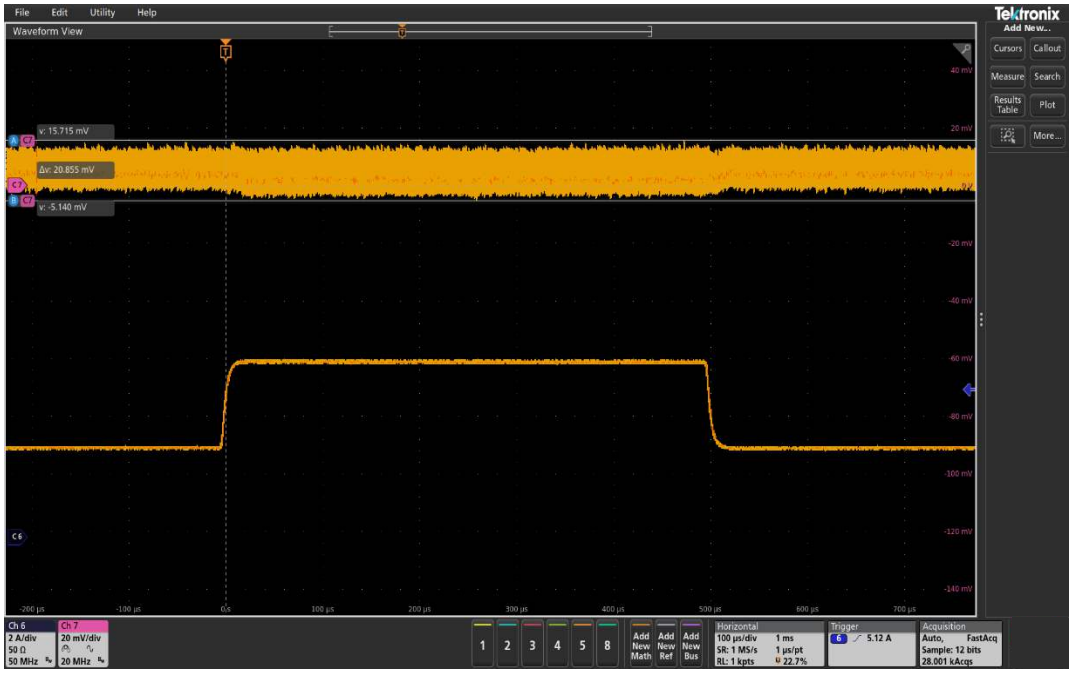


Figure 14 ***Transient response 3A to 6A (Ch6:I_O, Ch7: V_{OUT}), peak-peak deviation = 20.9mV***

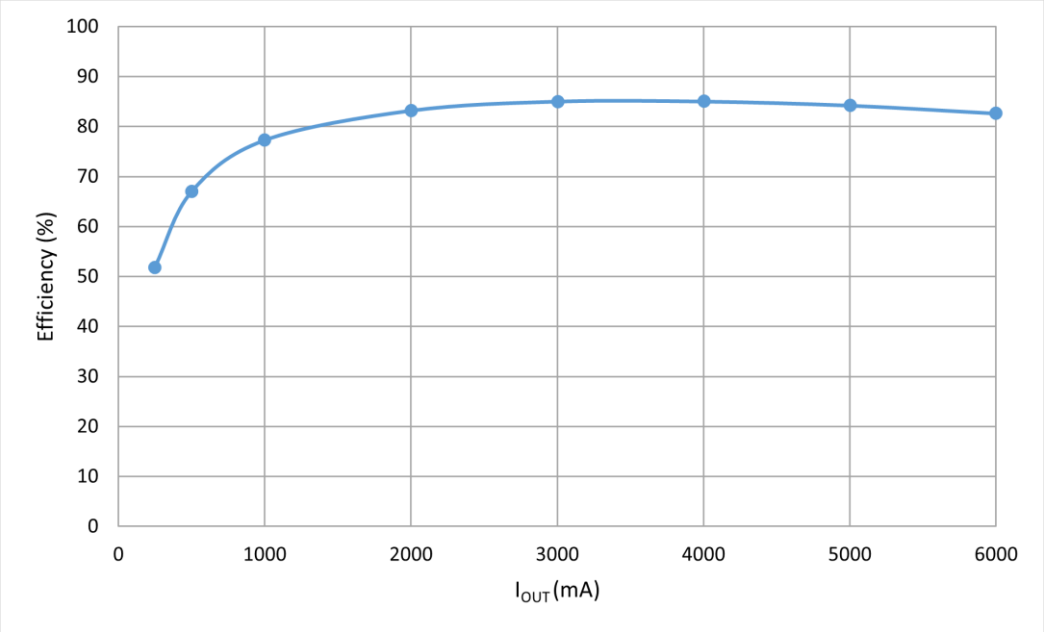


Figure 15 ***Efficiency***

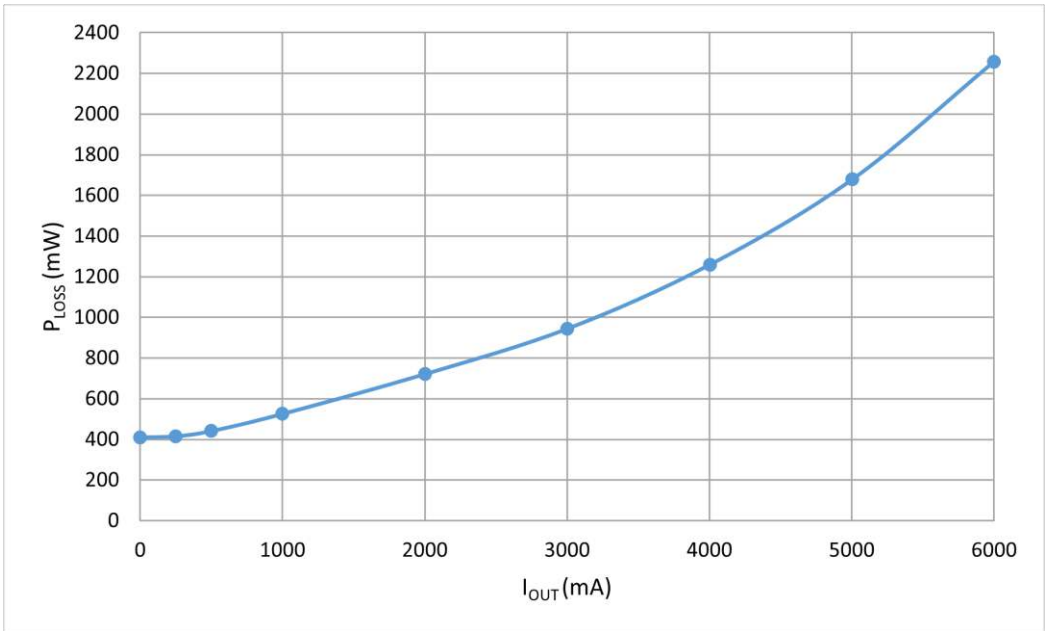


Figure 16 ***Power loss***

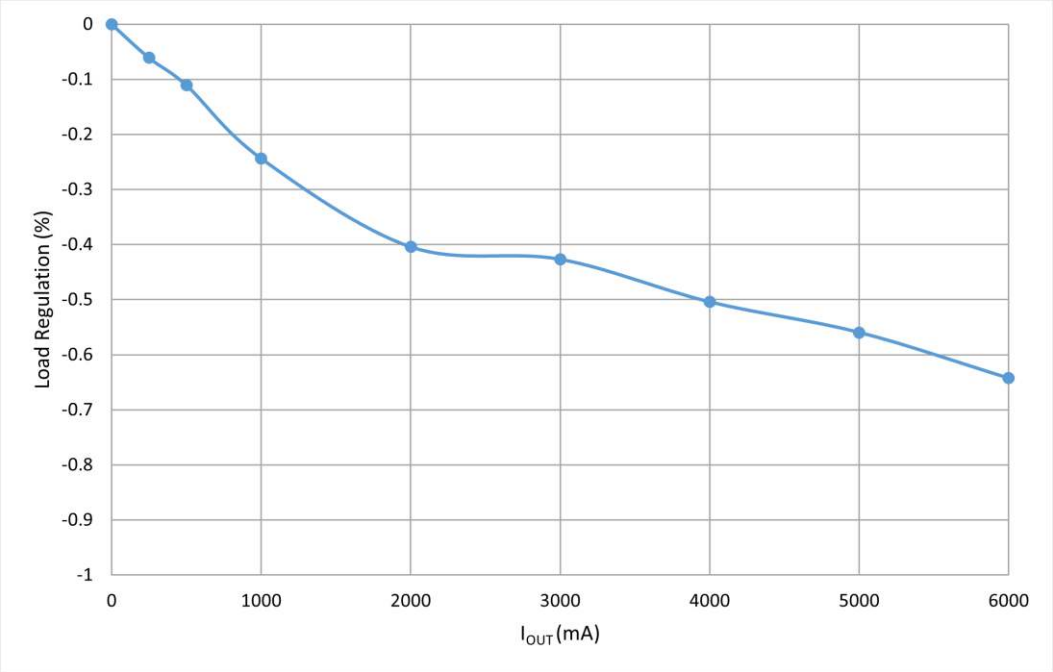


Figure 17 ***Load regulation (I_{O} = 0–6A)***

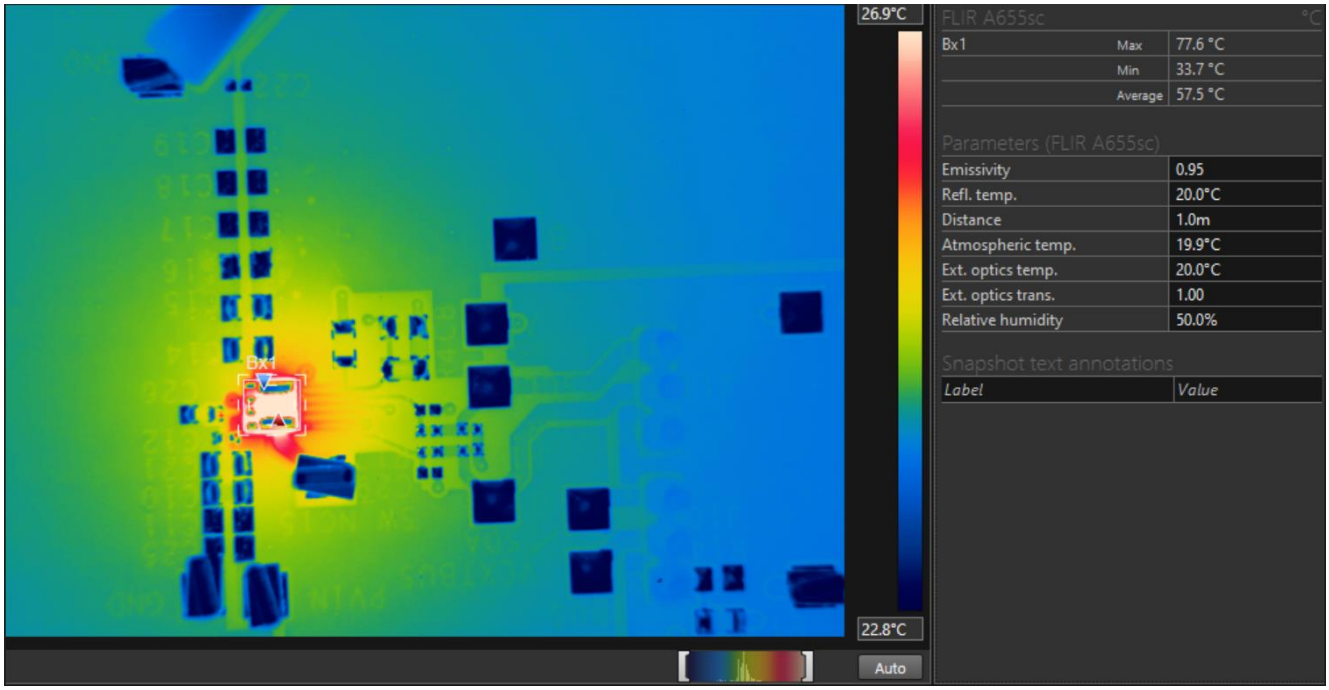


Figure 18 ***Thermal image(PVIN=12V, I_{OUT}=6A) – maximum temperature reached by FS1406= 77.6°C***

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