BD9P205EFV SEE TEST REPORT

Rohm Semiconductor, BD9P205EFV-C Nano Pulse Control, 3.5V to 40V Input, 2 A Single 2.2 MHz Buck DC/DC Converter for Automotive

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2. INTRODUCTION

The aim of this Single Event Effect test campaign was to evaluate the SEE radiation hardness level of the BD9P205EFV buck converter component from Rohm Semiconductor, especially regarding destructive single event effects, Single Event Functional Interrupts (SEFI), and Single Event Transients (SET), as well as their dependence on bias voltage and load. Tests were performed at room temperature and at LET of 46 MeV · cm^2/mg and 62 MeV · cm^2/mg. The component is selected from an ESA internal list of Commercial Of-The-Shelf (COTS) components, which contains components of high importance for ESA projects. The reported data can be used to derive information of a Safe-Operating-Area (SOA) for this device.

The test was carried out on 20-21 March and on the 8-9 June 2023 at UC-Louvain in Belgium.

3. ACRONYMS

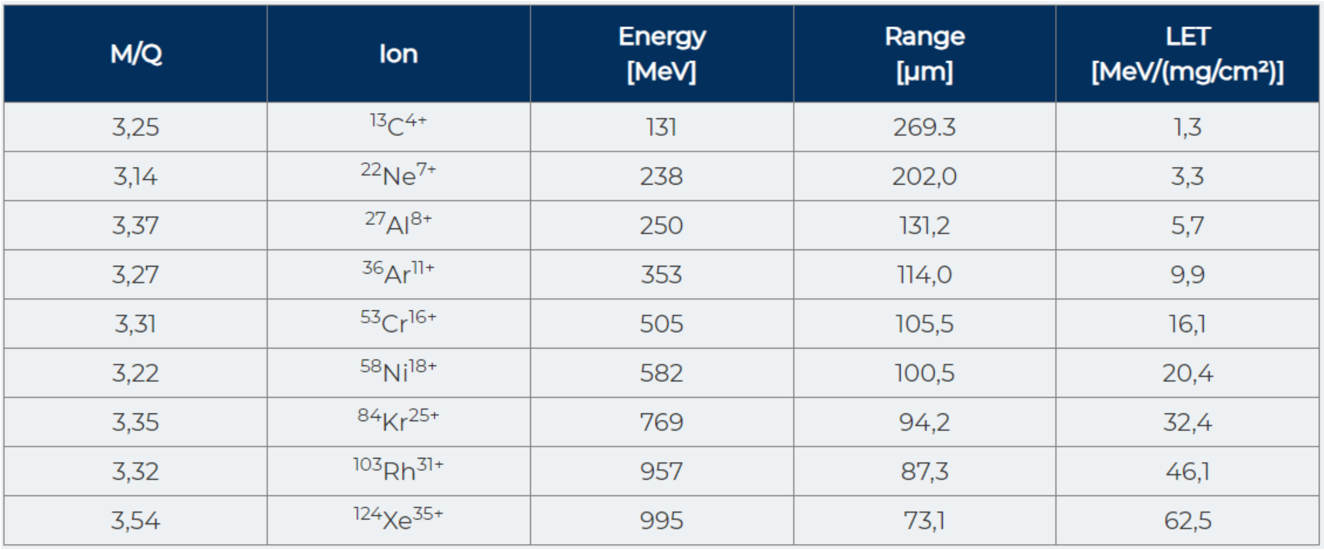
HIF	Heavy Ion Facility
COTS	Commercial-Off-The-Shelf
DSEE	Destructive Single Event Effect
DUT	Devices Under Test
HIF	Heavy Ion Facility
LDMOS	Lateral-Diffused Metal-Oxide Semiconductor
LET	Linear Energy Transfer
MIP	Microwaved Induced Plasma
MOSFET	Metal-Oxide-Semiconductor-Field-Effect Transistor
NDSEE	Non-Destructive Single Event Effect
PC	Power Cycle
SEB	Single Event Burnout
SEE	Single Event Effect
SEFI	Single Event Functional Interrupt
SEGR	Single Event Gate Rupture
SEL	Single Event Latchup
SET	Single Event Transient

SOA	Safe Operating Area

4. HEAVY ION IRRADIATION FACILITY

The heavy ion facility used for this test campaign is the Heavy Ion Facility (HIF) of UC-Louvain in Belgium [1]. The facility offers a cocktail of 9 ions including Xe-ions and Rh-ions which are used during this campaign. In the following table the available particles inside the cocktail are displayed. In this study Xe and Rh-ions where used.

Table 1: Available Ions at UCL (from [1])



M/Q	Ion	Energy [MeV]	Range [µm]	LET [MeV/(mg/cm²)]
3,25	$^{13}C^{4+}$	131	269.3	1,3
3,14	$^{22}Ne^{7+}$	238	202,0	3,3
3,37	$^{27}Al^{8+}$	250	131,2	5,7
3,27	$^{36}Ar^{11+}$	353	114,0	9,9
3,31	$^{53}Cr^{16+}$	505	105,5	16,1
3,22	$^{58}Ni^{18+}$	582	100,5	20,4
3,35	$^{84}Kr^{25+}$	769	94,2	32,4
3,32	$^{103}Rh^{31+}$	957	87,3	46,1
3,54	$^{124}Xe^{35+}$	995	73,1	62,5

5. DEVICES UNDER TEST

In Table 2 the parameters of the Device under Test (DUT), the BD9P205EFV, is given.

Table 2: Description of the DUT

Manufacturer	Datecode	Product	Uin,max (V)	Uout,max (V)	Uout,min (V)	Id,cont,max (A)	frequency (MHz)
Rohm	1133	BD9P205EFV	40	8.5	0.8	2	2.2

This device is a synchronous buck converter with a half bridge configuration which is used to step down a voltage with a switching application. For the device a specific application close to the usual application as presented in the datasheet, was developed. In Figure 1, a usual application for this synchronous buck converter with the internal MOSFETs (LDMOS) is given.

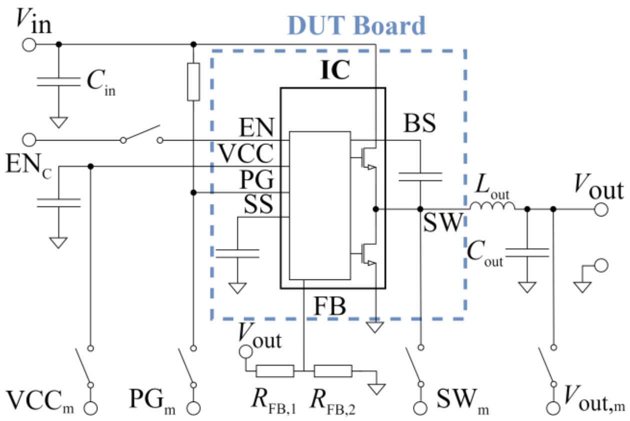


Figure 1: Typical application synchronous buck converter

In Figure 2 the Block diagram of the device is shown and in Figure 3 the decapsulated die can be seen.

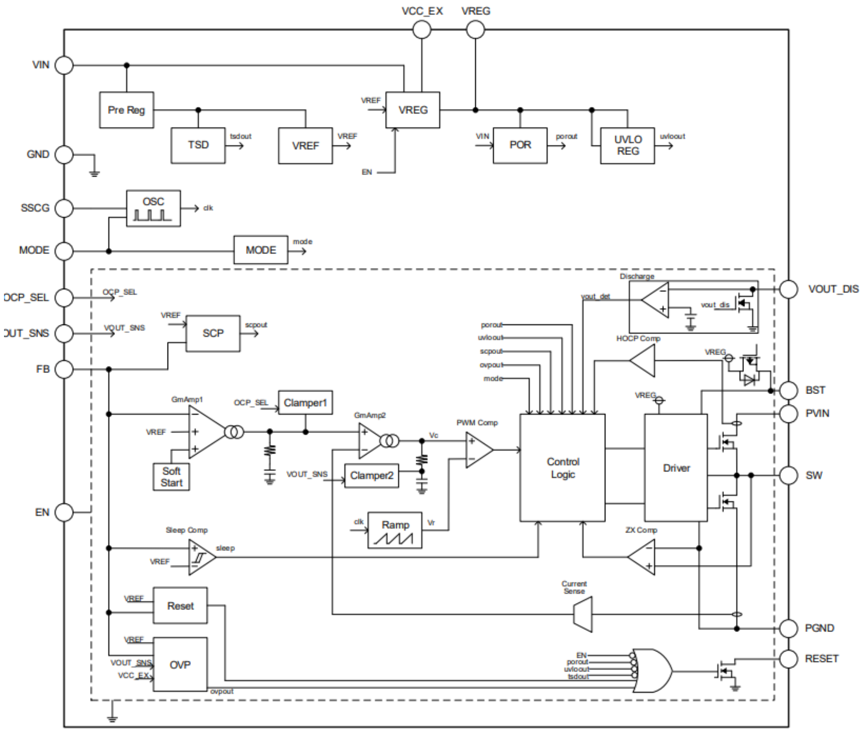


Figure 2: Block Diagram of the BD9P205EFV

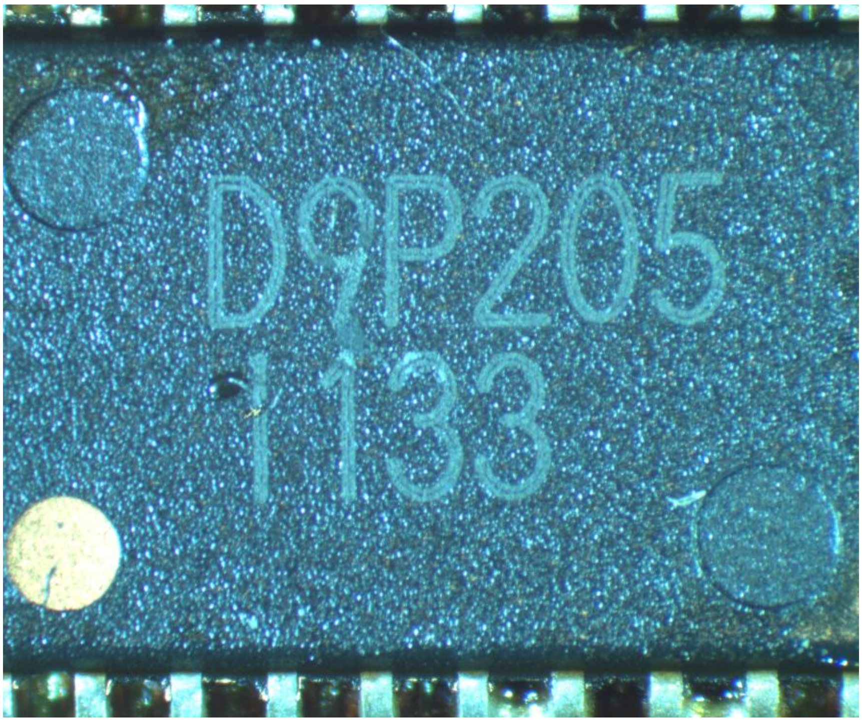


Figure 3: Microscope Picture of a BD9P205EFV package

6. TEST PREPARATION

6.1. Sample preparation

Due to the limited penetration depth of Xe-ions (75 µm in silicon), it is necessary to decapsulate the component to directly irradiate the die of the device. For the decapsulation procedure ESA internal equipment was used, including a laser to thin down the plastic capsulation and the use of a Microwave Induced Plasma (MIP) etcher, that etches down organic material and do not modify any inorganic material like silicon or metals. With these two tools a safe decapsulation was possible and in total 9 BD9P205EFV devices have been decapsulated for the heavy ion test. After each procedure a full functionality test was performed to validate the nominal operation.

6.2. Test set-up

The test was performed with heavy ion irradiation at UC-Louvain. The irradiation was performed in vacuum. The test was done in different application conditions. For the test, the following equipment, Table 3, was used:

Table 3: Test Equipment

Equipment	Name	Description
2x Source meter	Keithley 2612A	Providing the bias voltage/current and the Relay supply current
1 x Voltage source	Keysight N6705C	Used to test voltages above 35 V (if no DSEE happened at lower voltage)
1x 4 channel oscilloscope	Keysight DSOS804A	To observe all the parameters mentioned in Table 4
1x Laptop		To acquire data and to set the test setup

In Figure 4 the basic test setup with the equipment and the test boards inside the vacuum chamber is visualized. Multiple different buck converters have been tested during the campaign. one of the test boards consist of the BD9P205EFV.

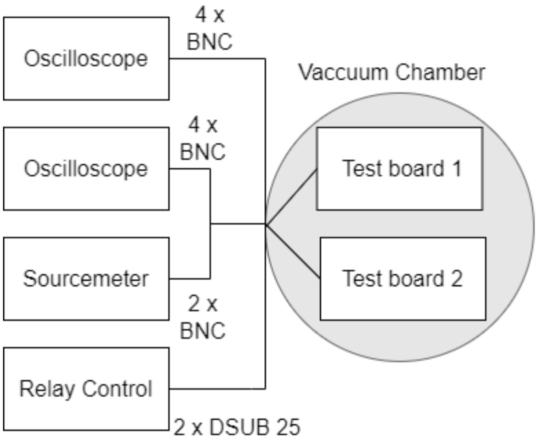


Figure 4: Test setup

For fast DUT sample exchange, a DUT board was designed and used for every different device type. This DUT board is mounted via pin headers on a second board, named “radiation-test-board” with the application circuitry and measurement and control connections to the outside. In the following a basic overview of the setup is given.

In Figure 5 the DUT board can be seen. This board is then mounted on the radiation-test-board in Figure 6. Specific values for the capacitances and inductances were calculated for each board to ensure a worst-case electrical stress while maintaining stability of the device. The biasing can flexibly be adjusted by jumpers and relays. The relays can be used to switch between the DUTs. In addition, the parameters of the device can be measured individually, and the device can be enabled and disabled. The relays are controlled outside the chamber with a specific designed relay-control-board.

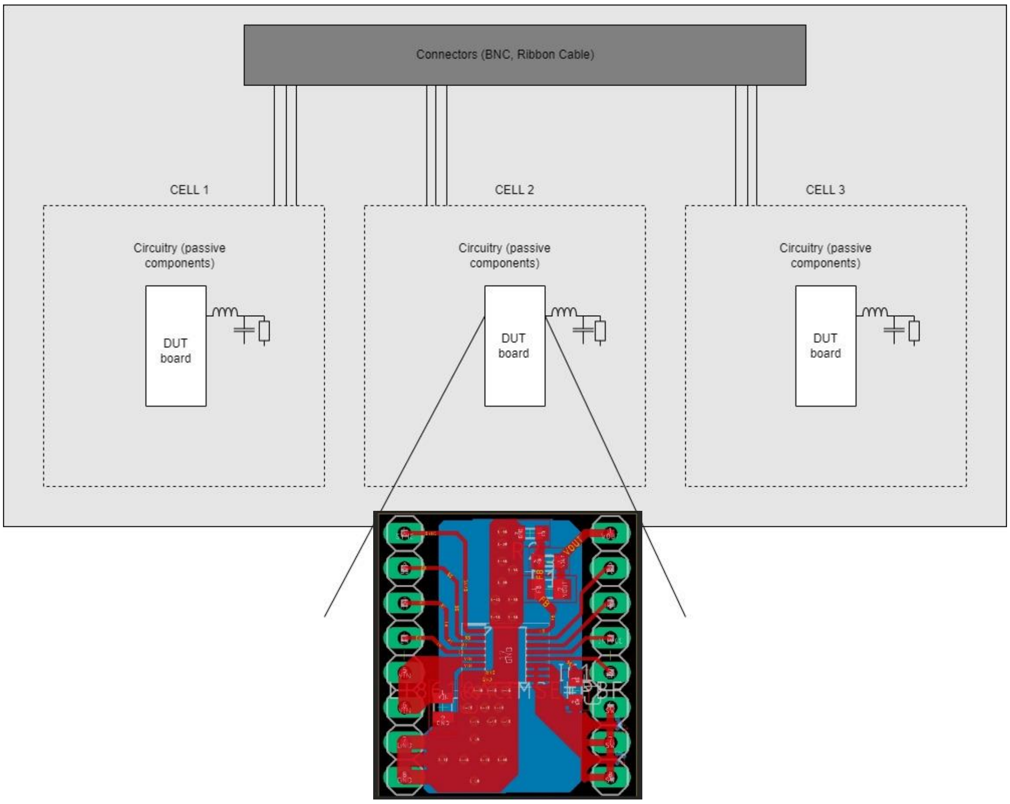


Figure 5: Visualization of the radiation-test-boards

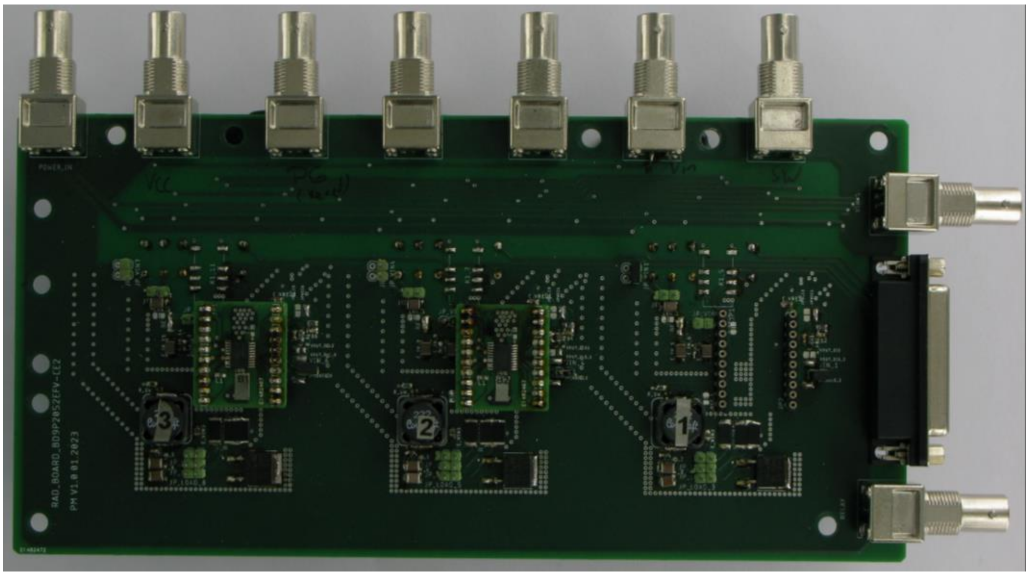


Figure 6: Top-side (left) and bottom-side (right) of the BD9P205EFV test board

In *Figure 7* an overview with the important capacitances is given. The value of the output capacitance is calculated to Cout = 80 µF, the input capacitance is Cin = 30 µF the output Inductance is Lout = 22 µH. The input & output conditions are summarised together with the results in Table 8.

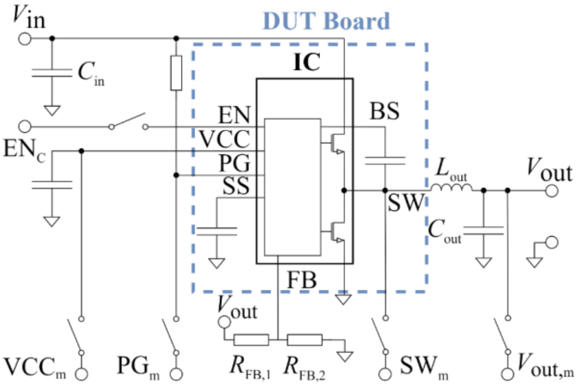


Figure 7: Simplified test setup with Cout = 80 µF, Cin = 30 µF, Lout = 22 µH with varying input and output conditions described in Table 8.

6.3. Measurement

As stated above, the use of relays allows an individual measurement for each DUT on the radiation-test-boards. All-important measurable device parameters are provided in Table 4.

Table 4: Measurement Parameters

PIN/Parameter	Description	I/O	Measured	Type of Measurement
EN	Enable input pin	I	no	-
Vin	Supply input	I	yes	Input Voltage & Current
PVin	Power input	I	yes	Voltage & Current
SW	Switching node	O	yes	SW Voltage & (Frequency)
BST	Bootstrap pin	I	no	-
OCP_SEL	OCP select (here GND for 3 A)	I	no	-
MODE	Auto selected (PWM, LLM) left open	I	no	-
SSCG	Spread Spectrum (deactivated)	I	no	-

RESET	Reset	I	yes	Voltage
Vout_dis	Discharges Vout	O	no	-
VOUT_SNS	Used for OVP, SCP	I	no	-
FB	Feedback pin	I	no	-
VREG	Output internal LDO	O	no	-
VCC	input internal LDO	I/O	no	-
Vout	Filtered output voltage		yes	Voltage

6.4. Data acquisition

The most important parameter of the DUT is the output voltage. Therefore, a trigger of the oscilloscope is set to the output voltage to observe whether the parameters are within the operating range. Also triggers on the PG have been set. As soon as the output voltage or PG voltage leaves the operating range, the oscilloscope acquires the data of SW pin, Vcc pin, Pgood pin and the output voltage. During the acquisition, the flux of the beam was adapted to not oversaturate the scope. That meaning, the saving time of the acquisition lead to the adjustment of the flux in such a way, that a safe acquisition of every SET was possible without the danger of losing the acquisition of other SETs. In addition, current measurements have been carried out to observe overcurrent situations, and, in the event of an overcurrent event, an internal designed delatching system was used to power off the device quickly to prevent a destruction in the event of a Single Event Latch up.

7. SINGLE EVENT EFFECTS RESULTS

7.1. Non-destructive Single Event Effects Results

In Table 5 an overview of the kind and number of the non-destructive SEEs is given. All changes in the output voltage are due to functional interrupts of the switching of the BD9P205EFV.

NDSEE were solely captured during irradiation under Rhodium and not under Xenon.

There are different kinds of SEFIs measured and presented in Table 5. Each SEFI type was grouped based on the different behaviours of the device. In Table 6 the number and kind of observed SETs is visualized. The number of events achieved was a trade-off between having enough statistical data & overall beamtime schedule. Many overvoltage situations have been observed and are displayed in Figure 8. The observed SEFIs are dependent on the chosen Soft Start (SS) time. As can be seen in Figure 9, this takes the longest for the device to be operational again. This time can be set by the user of the device. A cross section and an upper bound cross section, calculated with the Upper-N_{events} is presented in Table 5 and 6 and is calculated as follows [3]:

$$UpperN_{\text{events}} = 0.5 * CHISQ.INV.RT((1 - CL)/2{,}2x(N_{\text{events}} + 1)$$

With:

- $UpperN_{\text{events}}$, the upper limit of the confidence interval N_{events} *of* observed.
- $CHISQ.INV.RT$, returns the inverse of the right-tailed probability of the chi-squared distribution.
- CL, Confidence Limits, here the 95% confidence limit shall be used.
- N_{events}, the number of observed events.

Table 5: Description of the measured non-destructive SEFIs captured under Rh-ion irradiation and an Input voltage of 12 V and output current of 0.06 A

SEFIS with effect on Vout	Reference Figure	Cross section cm^2	Upper-bound cross-section cm^2	Fluence in ions/cm^2	Maximum duration of SEFI in s	Number (#) of Events	Description
Shutdown SEFI	Fig. 9.	$1.34 \cdot 10^{-5}$	$1.59 \cdot 10^{-5}$	$1 \cdot 10^{7}$	Up to $3 \cdot 10^{-2}$	134	decrease to 0.5 V of nominal Vout = 3.3 V
Reset SEFI	-	$>7 \cdot 10^{-7}$	$>14.42 \cdot 10^{-7}$	$1 \cdot 10^{7}$	Until reset	7+	Shut down of the device, reset over enable pin necessary
Power Cycle SEFI	-	$2 \cdot 10^{-7}$	$7.23 \cdot 10^{-7}$	$1 \cdot 10^{7}$	Until PC	2	Shut down of the device, full power cycle necessary

Table 6: Description of the measured non-destructive SETs captured under Rh-ion irradiation and an Input voltage of 12 V and output current of 0.06 A

SETs with effect on Vout	Reference Figure	Cross section cm^2	Upper-bound cross-section cm^2	Fluence in ions/cm^2	Maximum duration of SET in s	Number (#) of Events	Description
Undervoltage SET	Fig. 9.	$3.2 \cdot 10^{-5}$	$45.17 \cdot 10^{-5}$	$1 \cdot 10^{7}$	Up to $1 \cdot 10^{-4}$	32	decrease to 2.9 V of nominal Vout = 3.3 V
Overvoltage SET	Fig. 8.	$1.34 \cdot 10^{-4}$	$1.59 \cdot 10^{-4}$	$1 \cdot 10^{7}$	Up to $7 \cdot 10^{-4}$	134	Increase of up to 5.3 V of nominal Vout = 3.3 V

Different kind of SETs can be observed on all devices. The undervoltage SET is a decrease of up to 2.9 V of the nominal 3.3 V. An example is visible in Figure 8.

Auto-SEFIs, reset- SEFIs and PC-SEFIs can be observed on all DUTs. All SEFIs that lead to a shutdown are similar on the negative edges. This effect is due to a shutdown of the devices. As an example, typical SEFIs are shown in Figure 9. The figure shows an overlay of all SEFIs during a run. Once triggered, the auto-SEFI causes the device to shut down until a low voltage, about 0.3 V, is reached. The device then resumes back to normal operations automatically. The reset- SEFI can be observed as well and leads to a complete shutdown. After a reset or power cycle, the device restarts normally with the set soft start time, that was set via external capacitors. As soon as the output voltage leaves the nominal operating range, the PG pin triggers.

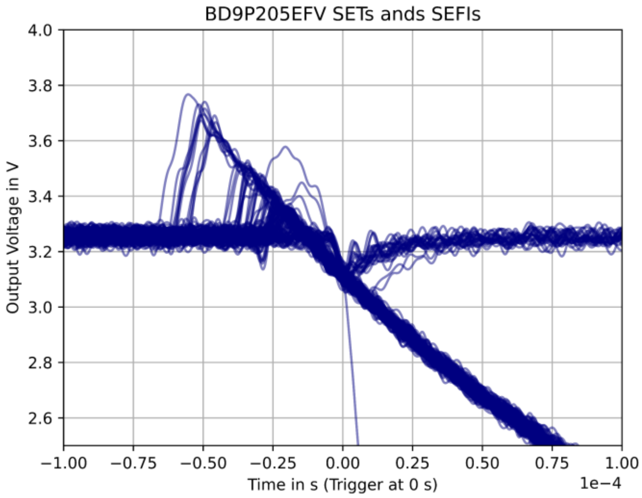


Figure 8: Vout overvoltage situations of the BD9P205EFV with small SETs visible

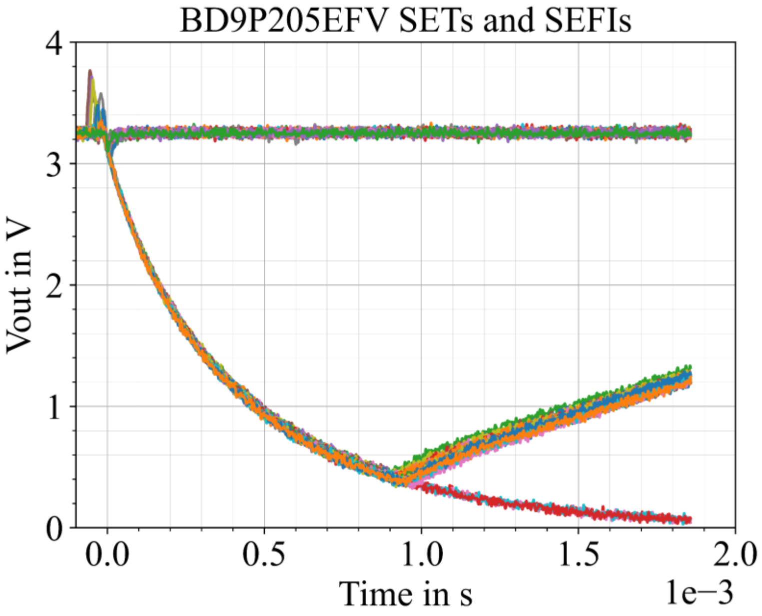


Figure 9: SEFI that lead to an undervoltage condition on the load with one small SEFI (left) and 41 shutdown SEFIs (right) during Rh-ion irradiation at Vin = 10 V, Rload = 50 Ohm and incident angle of 0°

7.1.1. Worst Case Condition for non-destructive SEE

The previously presented results for non-destructive SEEs can be considered as the worst-case condition. In fact, not only the safe operation of the device regarding DSEE is dependent on their bias condition but also the non-destructive SEEs. It has been observed, that at the maximum output current tested (0.6 A) 169 event for a Fluence of 1 $\cdot 10^7$ ions/cm^2 have been observed, while at 0.06 A output current the number of events has been over 60 % higher. The number of events is shown in Table 7. This test was carried out under Rh-ion irradiation. This test was not performed under Xe-ion irradiation.

Table 7: Total number of Events at different Load conditions under Rh-ion irradiation

Load condition	**Cross section cm^2**	**Upper-bound cross-section cm^2**	**Fluence in ions/cm^2**	**Number (#) of Events**	**Description**
Vin= 12 V, Iout = 0.06 Aout	$1.75 \cdot 10^{-4}$	$2.02 \cdot 10^{-4}$	Up to $1 \cdot 10^7$	175	Effects as shown above, here combined: SEFI & undervoltage SET
Vin = 12 V Iout = 0.6 A	$1.69 \cdot 10^{-4}$	$1.96 \cdot 10^{-4}$	Up to $1 \cdot 10^7$	169	Effects as shown above, here combined: SEFI & undervoltage SET

7.2. DSEE Results

The device was tested against DSEE during Rh-ion irradiation at a normal incidence angle of 0°. In Table 8 and Table 9 a SOA is given.

The success criteria for validating a given test conditions (electrical, angle & LET) was to have 3 different DUT tested & fully functional after the same test conditions at a fluence of $F = 1 \cdot 10^7$ cm^{-2}. In Figure 12, a device is given with Roll and Pitch direction and in Table 8 and Table 9 the angle in the shown direction is given.

At an input voltage of 19 V and a low load the device survived the Rh-ion irradiation. The device survived 12 V and Rh-ion irradiation at a high load and also 12 V at Xe-ion irradiation at every load tested.

No SEL occurred during any of the test runs & test conditions.

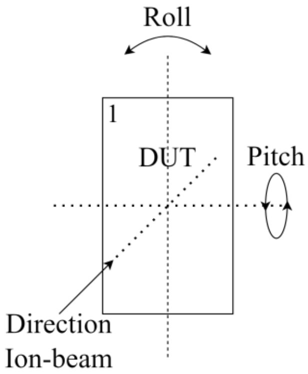


Figure 10: Display of the Roll and Pitch during tilting of the DUT. The DUT is irradiated with the first pin on the upper right and then tilted to the direction of the Ion-beam in the given directions.

Table 8: Safe Operating Area with red (unsafe), green (safe), blue (tilting)

Vin (LET 46 $\mathrm{MeV} \cdot \mathrm{cm}^2/\mathrm{mg}$)	Incident Angle @ 0°		Incident Angle @ pitch 0° & tilt 45°	Incident Angle @ pitch 90° & tilt 45°
	Low load (0.06 A)	High Load (0.6 A)	High Load (0.6 A)	Very High Load (0.6 A)
10V	🟩	🟩	🟦	🟦
12V	🟩	🟩 S2, S3, S4	🟦 S5	🟦 S5
15V	🟩			
19V	🟩 S1, S2, S3	🟥 ~~S4~~	🟥	🟥 ~~S5~~
24V	🟥 ~~S1~~	🟥 -	🟥 -	🟥 -
29V	🟥	🟥	🟥	🟥
42V	🟥	🟥	🟥	🟥

Vin (LET 62 MeV · cm^2/ mg)	Incident Angle @ 0°		Incident Angle @ pitch 0° & tilt 45°	Incident Angle @ pitch 90° & tilt 45°
	Low load (0.06 A)	High Load (0.6 A)	High Load (0.6 A)	Very High Load (0.6 A)
10V	🟩	🟩	🟦	🟦
12V	🟩	🟩 S6, S7	🟦 S8	🟦 S8
15V				
19V	🟥	🟥 ~~S6~~	🟥	🟥 ~~S8~~
24V	🟥	🟥	🟥	🟥
29V	🟥	🟥	🟥	🟥
42V	🟥	🟥	🟥	🟥

In Figure 11 a visualization of the SOA is given. The red area is the unsafe area where a destructive event has been observed. The yellow area is an area usable for high-risk missions when a LET of 46 MeV · cm²/mg or below is acceptable. The green area is characterized in terms of DSEE at nominal incidence at LET of 63 MeV · cm²/mg. The Figure is displayed at normal incident. Tilting is not included as the success criteria of three devices per condition is not met. However, in the Tables above the information regarding the tilting can be observed.

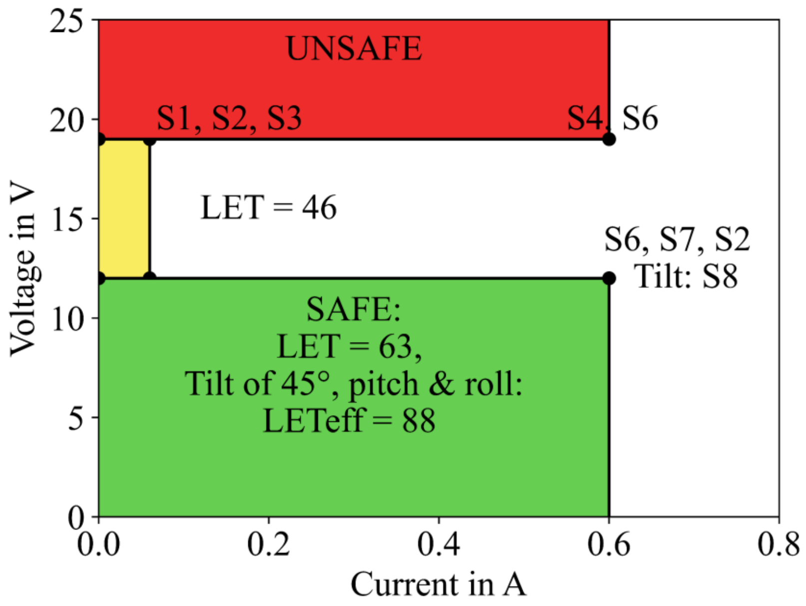


Figure 11. Safe Operating Area of the BD9P205EFV with the Unsafe are (red), safe for high risk missions (yellow), and safe area with tilting (green)

8. CONCLUSION

The aim of this test campaign is to evaluate the radiation hardness of the COTS BD9P205EFV buck converter component (date code HY29) tested at 2 LET and room temperature against NDSEE and DSEE. The BD9P205EFV showed DSEE outside of the safe operating area. The SOA can be defined as follows:

- 12 V and up to 0.6 A for an LET of 62 $\mathrm{MeV \cdot cm^2/mg}$, and up to 0.6 A for an LET of 46 $\mathrm{MeV \cdot cm^2/mg}$ including partial results at tilting angles.
- 19 V and 0.06 A for an LET of 46 $\mathrm{MeV \cdot cm^2/mg}$

The component showed not only DSEE but also a variety of non-destructive effects all of which need consideration in assessing the use of this part. The devices exhibit overvoltage situations that could potentially damage the load. During the test no Single Event Latchup has been observed. In Table 10 a SEE summary is given.

The data provided in the report should be handled with caution considering traceability challenges in the use of COTS. However, the data gives an overview of different kinds of SEE and allows preparation for validation test campaigns and be able to identify possible mitigation techniques.

Table 9: SEE Summary

Item	Description
Aim	SEE sensitivity evaluation of different synchronous buck converter devices for destructive SEE and SET/SEFI
Biasing Conditions	1. various input voltages and output currents 2. steady output voltage (<3.3 V) and steady output switching frequency
Sample size	3 devices to be tested for each final biasing condition for result confirmation
LET	$46\ \mathrm{MeV} \cdot \frac{\mathrm{cm^2}}{\mathrm{mg}}$, $60\ \mathrm{MeV \cdot cm^2/mg}$ and higher LET$_{\mathrm{eff}}$ with tilting
Fluence	1. $10^7\ \mathrm{ions/cm^{-2}}$ for DSEE 2. various for SET and SEFI characterization
Environmental condition	Room temperature condition
Results	Safe Operating Area for DSEE: 1. high load and 12 Vin, 2. Low load and 19 Vin @ $46\ \mathrm{MeV} \cdot \frac{\mathrm{cm^2}}{\mathrm{mg}}$.

	3. high load and 12 Vin@ 62 $\mathrm{MeV} \cdot \frac{\mathrm{cm}^2}{\mathrm{mg}}$ Soft-error & non-destructive SEL sensitivity (Rh irradiation): 1. Shutdown-SEFI, Reset-SEFI and power cycle SEFI 2. Undervoltage SET, Overvoltage SET 3. No SEL observed

9. REFERENCES

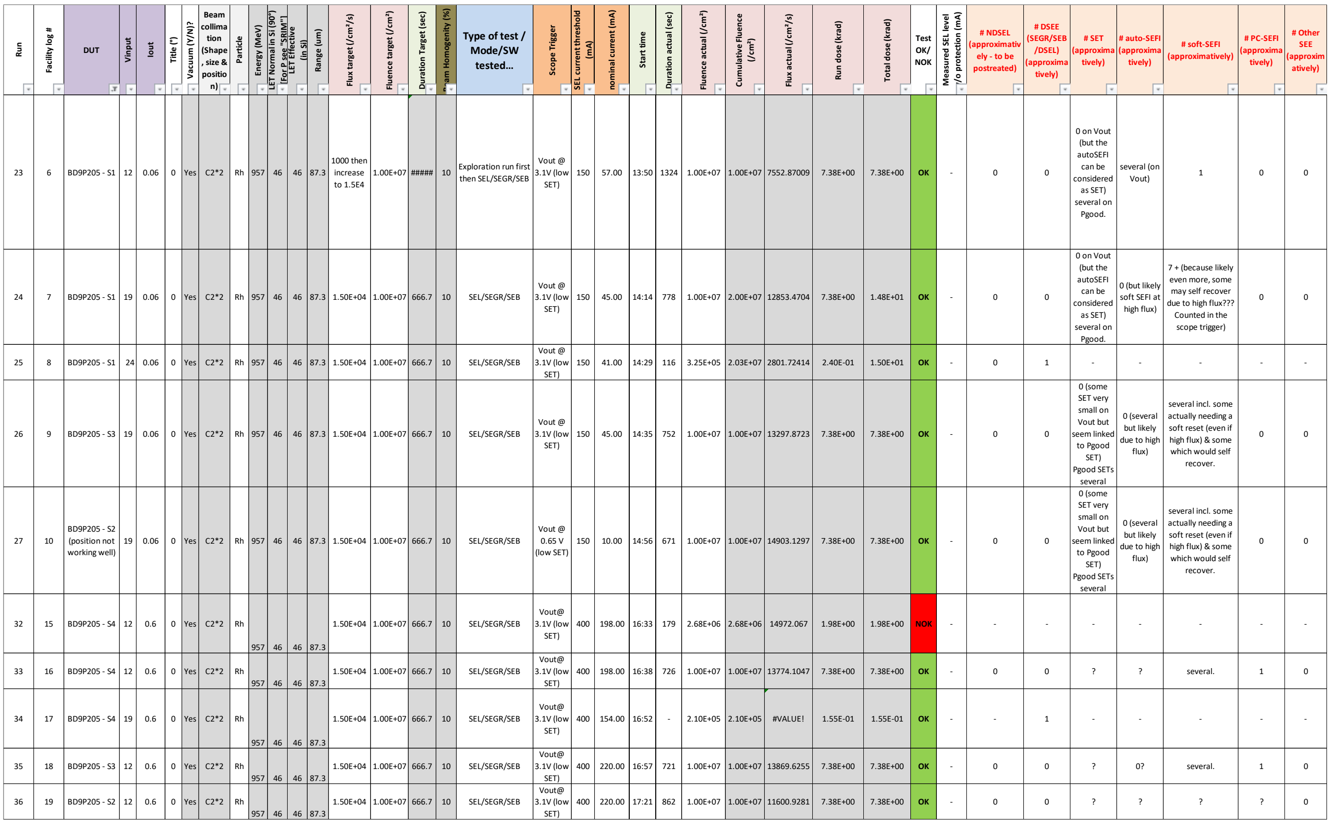
[1] UC-Louvain, Heavy Ion Facility, Heavy Ion Facility (HIF) | UCLouvain\

[2] Rohm Semiconductor, BD9P205EFV-C
Nano Pulse Control™, 3.5V to 40V Input, 2A Single 2.2MHz Buck DC/DC Converter For Automotive, BD9P2x5EFV-C Series : Power Management (rohm.com)

[3] ESCC, Single Event Effect Test Method and Guidelines, ESCC Basic specification No. 25100

10. ANNEX

In the following tables the whole test campaign including different COTS devices is given.



Run	Facility log #	DUT	Vinput	Iout	Title (°)	Vacuum (Y/N)?	Beam collimation (Shape, size & position)	Particle	Energy (MeV)	LET Normal in Si (90°) [For P see "SRIM"]	LET Effective (in Si)	Range (um)	Flux target ($/cm^2/s$)	Fluence target ($/cm^2$)	Duration Target (sec)	eam Homogenity (%)	Type of test / Mode/SW tested…	Scope Trigger	SEL current threshold (mA)	nominal current (mA)	Start time	Duration actual (sec)	Fluence actual ($/cm^2$)	Cumulative Fluence ($/cm^2$)	Flux actual ($/cm^2/s$)	Run dose (krad)	Total dose (krad)	Test OK/ NOK	Measured SEL level /o protection (mA)	# NDSEL (approximatively - to be postreated)	# DSEE (SEGR/SEB /DSEL) (approximatively)	# SET (approximatively)	# auto-SEFI (approximatively)	# soft-SEFI (approximatively)	# PC-SEFI (approximatively)	# Other SEE (approximatively)
23	6	BD9P205 - S1	12	0.06	0	Yes	C2*2	Rh	957	46	46	87.3	1000 then increase to 1.5E4	1.00E+07	#####	10	Exploration run first then SEL/SEGR/SEB	Vout @ 3.1V (low SET)	150	57.00	13:50	1324	1.00E+07	1.00E+07	7552.87009	7.38E+00	7.38E+00	OK	-	0	0	0 on Vout (but the autoSEFI can be considered as SET) several on Pgood.	several (on Vout)	1	0	0
24	7	BD9P205 - S1	19	0.06	0	Yes	C2*2	Rh	957	46	46	87.3	1.50E+04	1.00E+07	666.7	10	SEL/SEGR/SEB	Vout @ 3.1V (low SET)	150	45.00	14:14	778	1.00E+07	2.00E+07	12853.4704	7.38E+00	1.48E+01	OK	-	0	0	0 on Vout (but the autoSEFI can be considered as SET) several on Pgood.	0 (but likely soft SEFI at high flux)	7 + (because likely even more, some may self recover due to high flux??? Counted in the scope trigger)	0	0
25	8	BD9P205 - S1	24	0.06	0	Yes	C2*2	Rh	957	46	46	87.3	1.50E+04	1.00E+07	666.7	10	SEL/SEGR/SEB	Vout @ 3.1V (low SET)	150	41.00	14:29	116	3.25E+05	2.03E+07	2801.72414	2.40E-01	1.50E+01	OK	-	0	1	-	-	-	-	-
26	9	BD9P205 - S3	19	0.06	0	Yes	C2*2	Rh	957	46	46	87.3	1.50E+04	1.00E+07	666.7	10	SEL/SEGR/SEB	Vout @ 3.1V (low SET)	150	45.00	14:35	752	1.00E+07	1.00E+07	13297.8723	7.38E+00	7.38E+00	OK	-	0	0	0 (some SET very small on Vout but seem linked to Pgood SET) Pgood SETs several	0 (several but likely due to high flux)	several incl. some actually needing a soft reset (even if high flux) & some which would self recover.	0	0
27	10	BD9P205 - S2 (position not working well)	19	0.06	0	Yes	C2*2	Rh	957	46	46	87.3	1.50E+04	1.00E+07	666.7	10	SEL/SEGR/SEB	Vout @ 0.65 V (low SET)	150	10.00	14:56	671	1.00E+07	1.00E+07	14903.1297	7.38E+00	7.38E+00	OK	-	0	0	0 (some SET very small on Vout but seem linked to Pgood SET) Pgood SETs several	0 (several but likely due to high flux)	several incl. some actually needing a soft reset (even if high flux) & some which would self recover.	0	0
32	15	BD9P205 - S4	12	0.6	0	Yes	C2*2	Rh	957	46	46	87.3	1.50E+04	1.00E+07	666.7	10	SEL/SEGR/SEB	Vout@ 3.1V (low SET)	400	198.00	16:33	179	2.68E+06	2.68E+06	14972.067	1.98E+00	1.98E+00	NOK	-	-	-	-	-	-	-	-
33	16	BD9P205 - S4	12	0.6	0	Yes	C2*2	Rh	957	46	46	87.3	1.50E+04	1.00E+07	666.7	10	SEL/SEGR/SEB	Vout@ 3.1V (low SET)	400	198.00	16:38	726	1.00E+07	1.00E+07	13774.1047	7.38E+00	7.38E+00	OK	-	0	0	?	?	several.	1	0
34	17	BD9P205 - S4	19	0.6	0	Yes	C2*2	Rh	957	46	46	87.3	1.50E+04	1.00E+07	666.7	10	SEL/SEGR/SEB	Vout@ 3.1V (low SET)	400	154.00	16:52	-	2.10E+05	2.10E+05	#VALUE!	1.55E-01	1.55E-01	OK	-	-	1	-	-	-	-	-
35	18	BD9P205 - S3	12	0.6	0	Yes	C2*2	Rh	957	46	46	87.3	1.50E+04	1.00E+07	666.7	10	SEL/SEGR/SEB	Vout@ 3.1V (low SET)	400	220.00	16:57	721	1.00E+07	1.00E+07	13869.6255	7.38E+00	7.38E+00	OK	-	0	0	?	0?	several.	1	0
36	19	BD9P205 - S2	12	0.6	0	Yes	C2*2	Rh	957	46	46	87.3	1.50E+04	1.00E+07	666.7	10	SEL/SEGR/SEB	Vout@ 3.1V (low SET)	400	220.00	17:21	862	1.00E+07	1.00E+07	11600.9281	7.38E+00	7.38E+00	OK	-	0	0	?	?	?	?	0

Run	Facility log #	Reminder Philipp file name	DUT	Vinput	Rout (Ohm)	Pitch (°)	Title (°)	Vacuum (Y/N)?	Beam collimation (Shape, size & position)	Particle	Energy (MeV)	LET Normal in Si (90°) [For P see "SRIM"]	LET Effective (in Si)	Range (um)	Flux target (/cm^2/s)	Fluence target (/cm^2)	Duration Target (sec)	am Homogenity (%)	Type of test / Mode/SW tested…	Scope Trigger	SEL current threshold (mA)	nominal current (mA)	Start time	Duration actual (sec)	Fluence actual (/cm^2)	Cumulative Fluence (/cm^2)	Flux actual (/cm^2/s)	Run dose (krad)	Total dose (krad)	Test OK/ NOK	Measured SEL level /o protection (mA)	# NDSEL (approximatively - to be postreated)	# DSEE (SEGR/SEB/DSEL) (approximatively)	# SET (approximatively)	# auto-SEFI (approximatively)	# soft-SEFI (approximatively)	# PC-SEFI (approximatively)	# Other SEE (approximatively)
49	11	ok	BD9P205-S1	12	0.6A	0	0	Yes	C2*2	Xe	995	63	63	73	1.50E+04	1.00E+07	666.7	10	confirmation run	Vout pos. @ 3.32V then @V out neg 2.9V	400	220.00	14:52	702	1.00E+07	1.00E+07	14245.014	1.00E+01	1.00E+01	**OK**								
50	12	ok	BD9P205-S1	19	0.6A	0	0	Yes	C2*2	Xe	995	63	63	73	1.50E+04	1.00E+07	666.7	10	DSEE SoA	Vout pos. @ 3.32V then @V out neg 2.9V	400	155.00	15:06	??	9.25E+06	9.25E+06	#VALUE!	9.25E+00	9.25E+00	**OK**						1		
51	13	ok	BD9P205-S4	12	0.6A	0	0	Yes	C2*2	Xe	995	63	63	73	1.50E+04	1.00E+07	666.7	10	Confirmation run	Vout pos. @ 3.5V, Vout neg. @ 3.00V.	400	220.00	15:12	904	1.00E+07	1.00E+07	11061.947	1.00E+01	1.00E+01	**OK**							Several not counted.	
52	14	OK	BD9P205-S4	10 then 12, then 19	0.6A	0	45	Yes	C2*2	Xe	995	63	88	73	1.50E+04	1.00E+07	666.7	10	Testing with tilt 45°	Vout pos. @ 3.5V	400	250.00	15:42	837	5.15E+06	5.15E+06	6152.9271	5.15E+00	5.15E+00	**OK**			SEL: 2					
55	17	ok	BD9P205-S5	10	0.6A	90	45	Yes	C2*2	Xe	995	63	88	73	1.50E+04	1.00E+07	666.7	10	Testing with tilt 45 and pitch 90	Vout negs. @ 2.7V	400	250.00	16:43	658	5.00E+06	5.00E+06	7598.7842	5.00E+00	5.00E+00	**OK**								
69	31	-	BD9P205-S5*	12V, then 15V	0.6A	0	45	Yes	C2*2	Rh	957	46	65	87	1.50E+04	1.00E+07	666.7	10	Testing with tilt 45 and pitch 0°	Vout pos. @ 3.5V	400	190.00	21:48	584	4.80E+06	4.80E+06	8.22E+03	3.54E+00	3.54E+00	OK							1	
72	34	-	BD9P205-S2*	12V	0.6A	0	60	Yes	C2*2	Rh	957	46	92	87	1.50E+04	1.00E+07	666.7	10	Testing with tilt 60 and pitch 0°	Vout neg. @ 0.4V	400	270.00	22:20	406	2.22E+06	2.22E+06	5467.9803	1.64E+00	1.64E+00	OK			1DSEE					
74	36	-	BD9P205-S5*	12V, then 19V	0.6A	90	45	Yes	C2*2	Rh	957	46	65	87	1.50E+04	1.00E+07	666.7	10	Testing with tilt 45 and pitch 90°	Vout neg. @ 0.4V	400	210.00	22:54	558	4.39E+06	#REF!	7867.3835	3.24E+00	#REF!	OK			1DSEE					