

Charging Powency SSC Devices

Version 2.10 – November 2025

ITEN Solid State Ceramic (SSC) Power Devices can be used in different applications as power assist, power back or in an always-on design. One key feature of ITEN Powency is its ability to charge quickly in a few minutes. To achieve such quick charging, several types of architecture are available and described in this document.

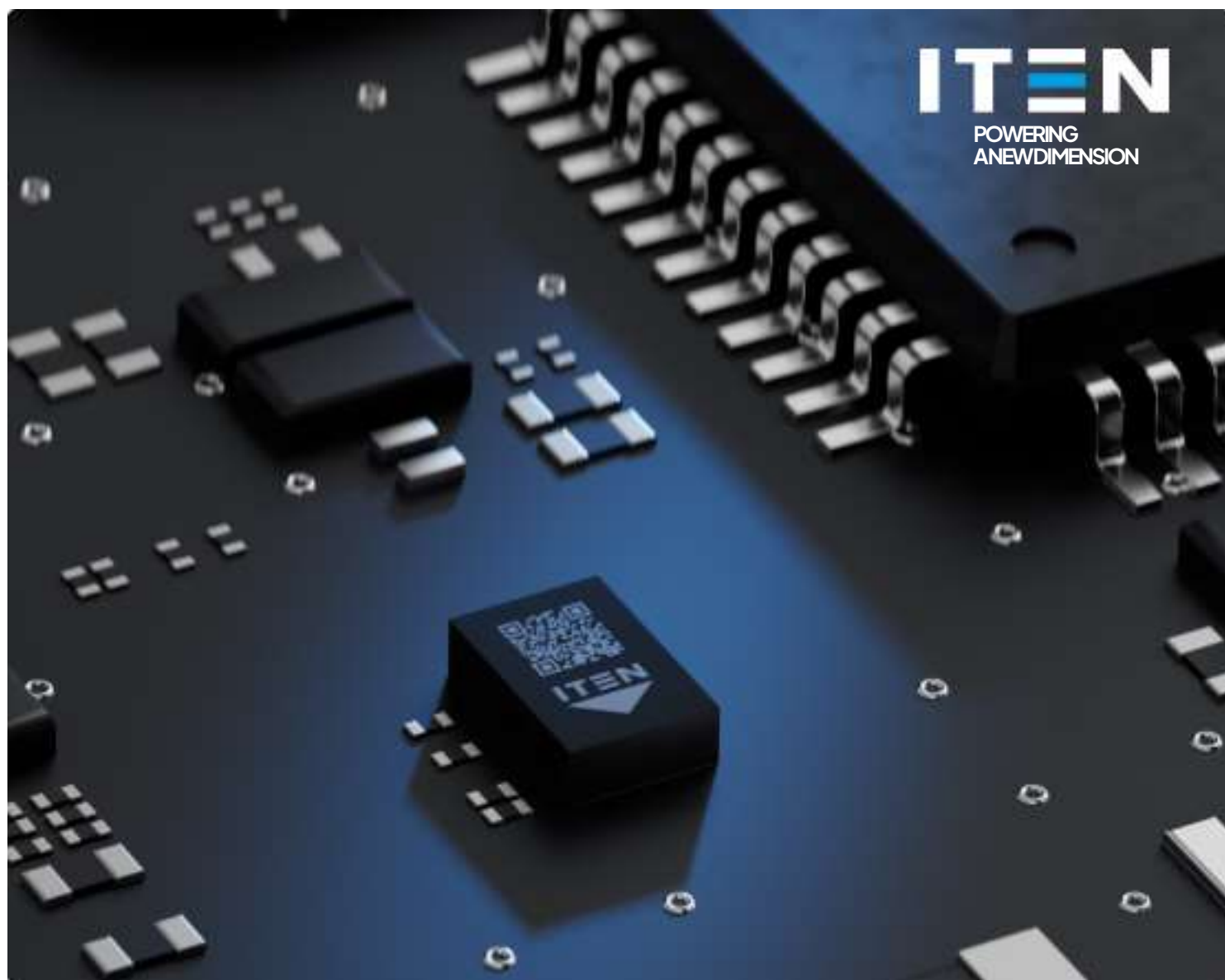


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Overview

To achieve quick charging, several types of architecture are available as shown in the below figure.

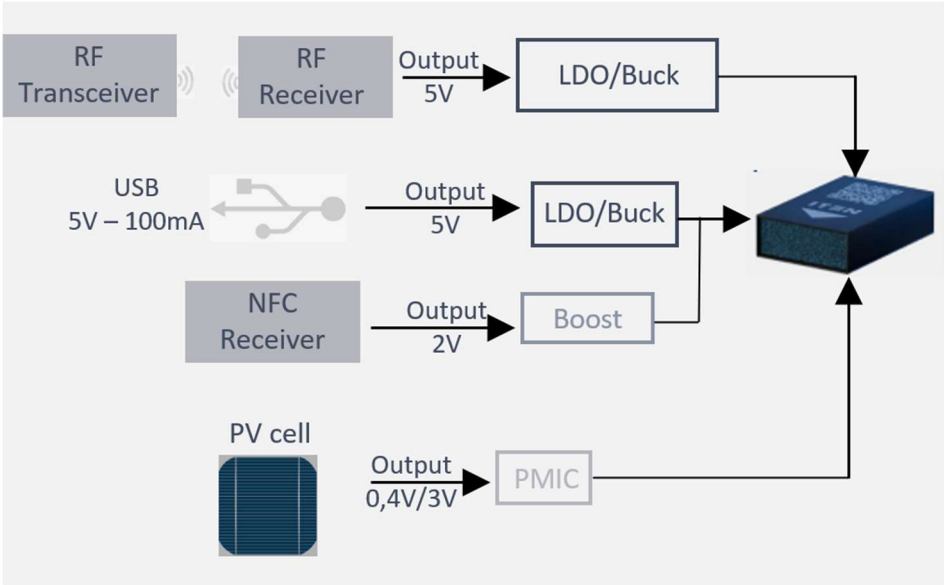


Figure 1: Different ways to charge ITEN Powency

Current ITEN Powency such as PWY0150S model uses 2.7V voltage as charging voltage. Depending the voltage level available on the system, several charging options are available:

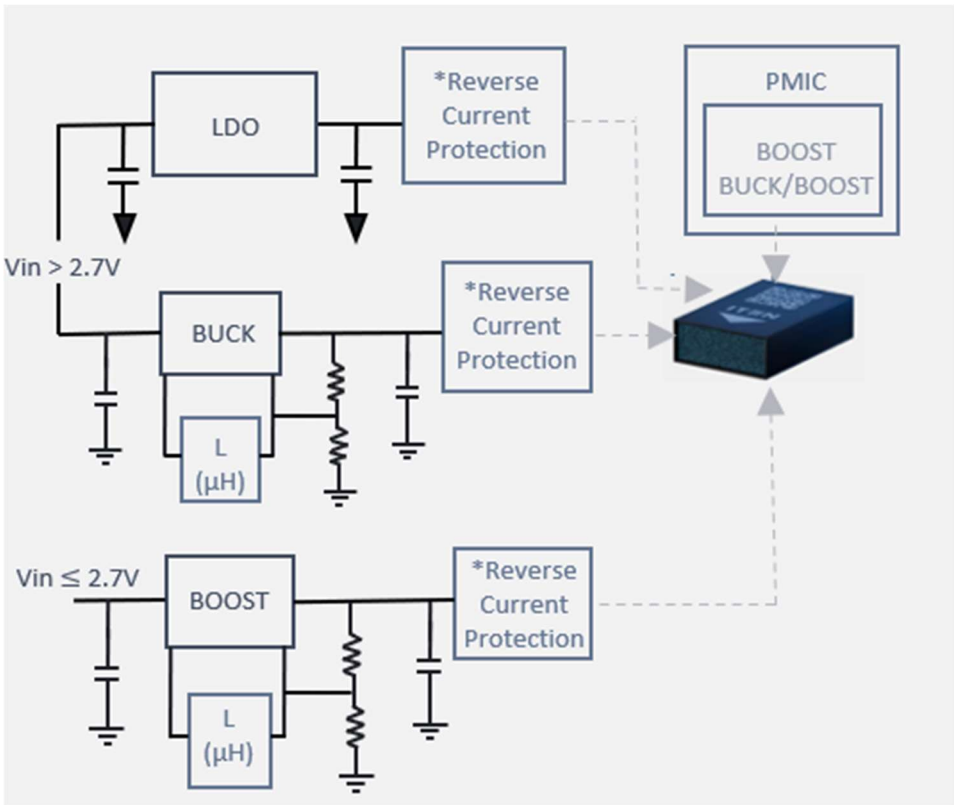


Figure 2: Component selection to charge ITEN Powency

There are numerous methodologies on how to charge SSC power devices. ITEN POWENCY devices can be charged from a stable fixed voltage of 2.7 V. The device’s current falls as the component is charging, it is considered fully charged once the current reaches a rate of C/10. This application note presents very simple and low-cost systems for a constant voltage charging. Users must select the preferable design for their aspect of use.

LDO Voltage Regulator

Low-dropout regulators (LDO) are a simple way to regulate an output voltage powered from a higher input voltage. Typical implementation of LDO voltage regulator with ITEN Powency :

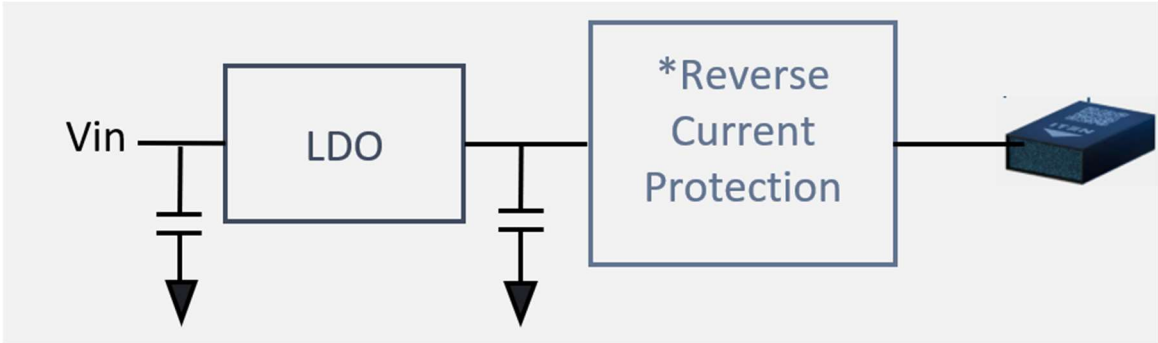


Figure 3: Typical implementation of LDO voltage regulator with ITEN Powency

01 Component Selection

Part Number	Manufacturer	Output	Footprint	RP* required
TPS70927	Texas Instruments	Fixed (2.7V)	SOT23 WSON	Yes (diode/NMOS/PMOS)
TPS78227	Texas Instruments	Fixed (2.7V)	SOT23 WSON	Yes (diode/NMOS/PMOS)
XC6240A263XR-G	Torex	Fixed (2.7V)	SSOT-24 USPN-4 USP-6B06	Yes (diode/NMOS/PMOS)
RT9073/N-27	Richtek	Fixed (2,7V)	SC-70-5 SOT-25	

02 Schematic



Figure 4: Schematic of TPS70927 (TI) Fixed 2.7V output voltage, LDO voltage regulator

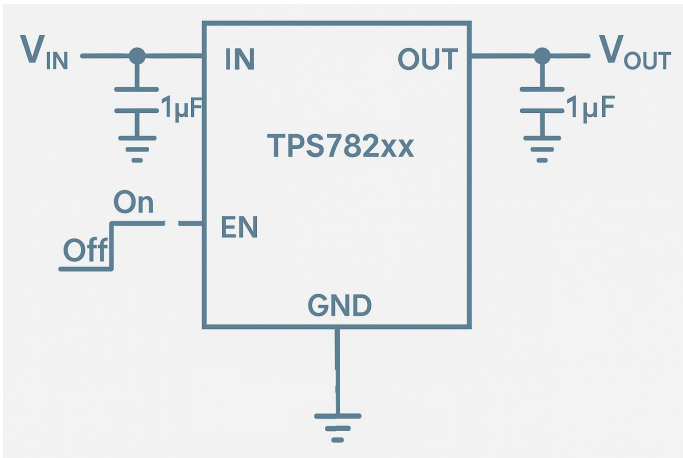


Figure 5: Schematic of TPS782 (TI) Fixed 2.7V output voltage, LDO voltage regulator

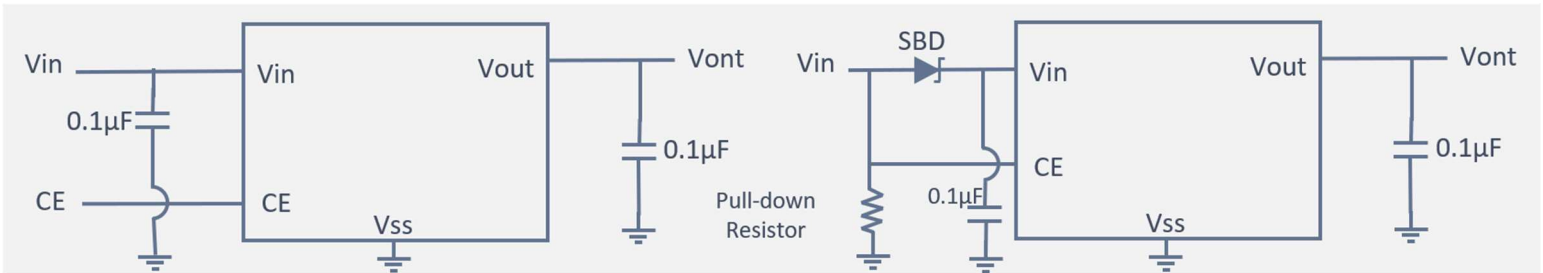


Figure 6: Schematic of XC6240A263XR-G LDO voltage regulator
(Left Standard regulator circuit Right With reverse current prevention)

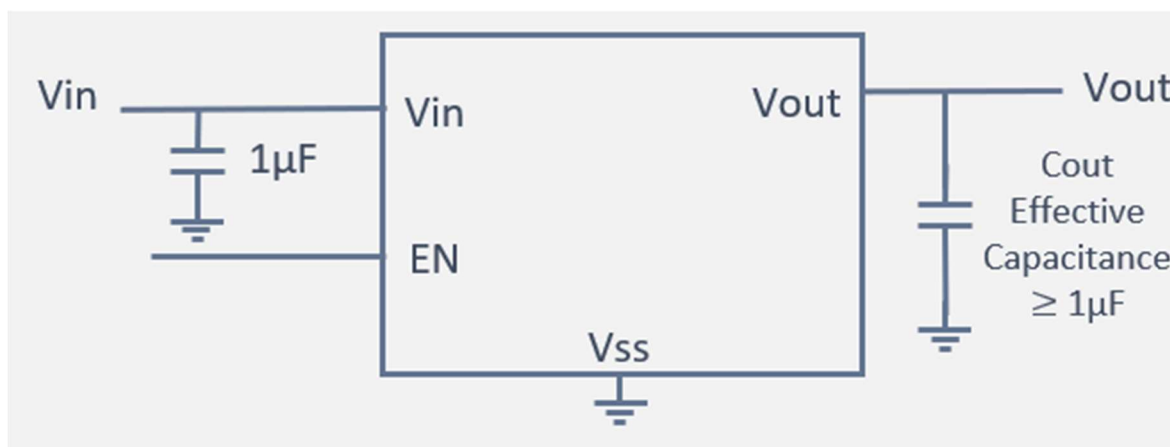


Figure 7: Schematic of RT9073 (Richtek) LDO voltage regulator

Recommendation: A reverse current protection circuit is required between the LDO and ITEN POWENCY device except for the right side of Figure 6.(cf section 8 solution A).

Buck Charge Circuit

The buck converter is a very simple type of DC-DC converter that produces an output voltage that is less than its input. The buck converter is so named because the inductor always “bucks” or acts against the input voltage. The output voltage of an ideal buck converter is equal to the product of the switching duty cycle and the supply voltage.

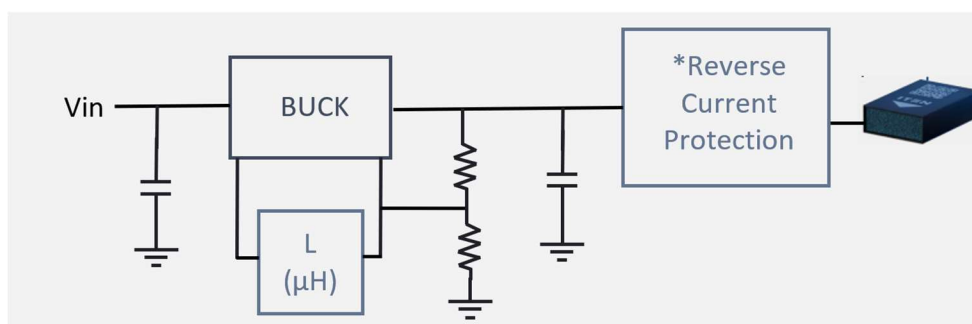


Figure 8: Typical implementation of buck circuit with ITEN Powency

01 Component Selection

Part Number	Manufacturer	Output	Footprint	Efficiency* @5V input	RP* required
TPS62745	Texas Instruments	Fixed	WSO ^N	90%	Yes (diode/NMOS/PMOS)
ST1PS02C1	ST Microelectronics	Fixed (2.7V)	TQFN12	82%	Yes (diode/NMOS/PMOS)
LTC3103	Analog Devices	Adjustable	DFN-10 MSOP-10	85%	Yes (diode)

* Based on the datasheet over a 10mA –10uA current range

02 Schematic

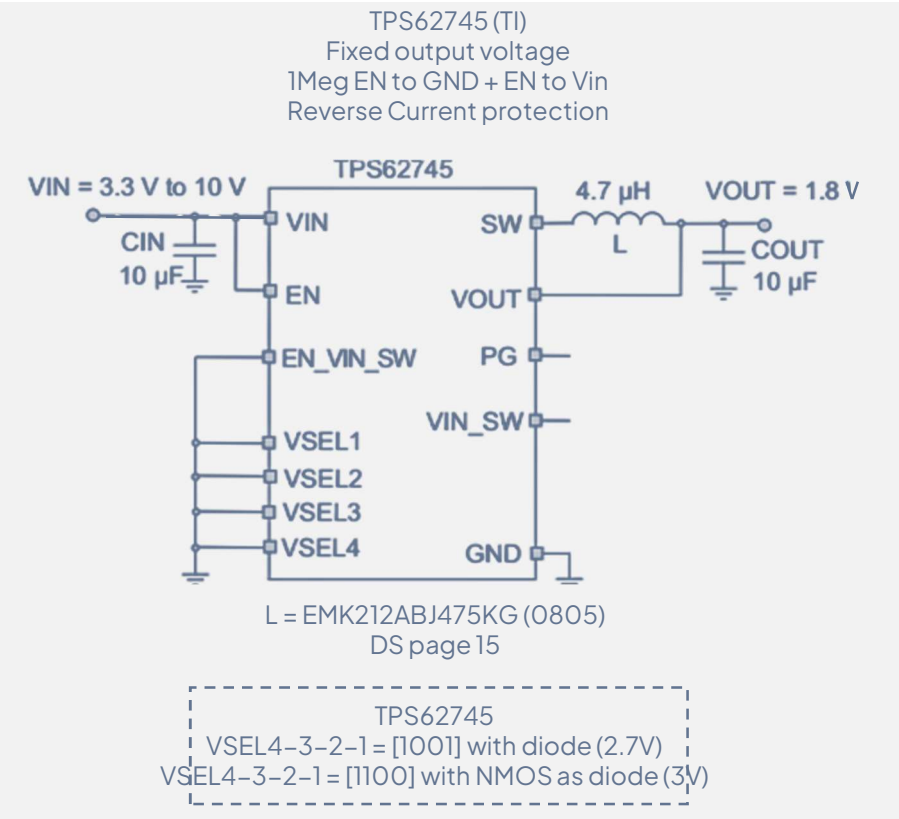


Figure 9: Schematic of TPS62745 buck converter

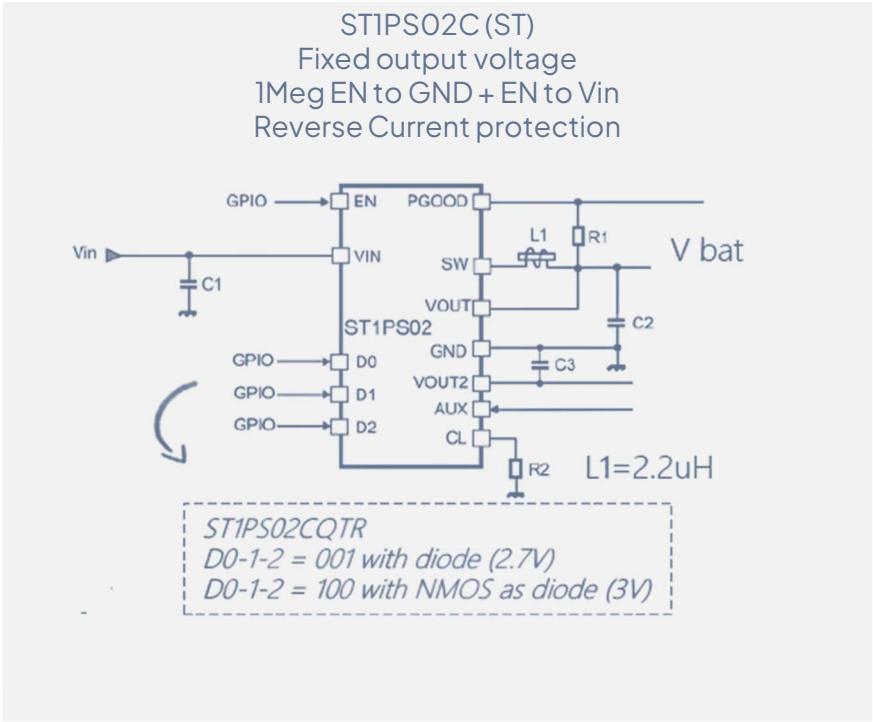


Figure 10: Schematic of ST1PS02C buck converter

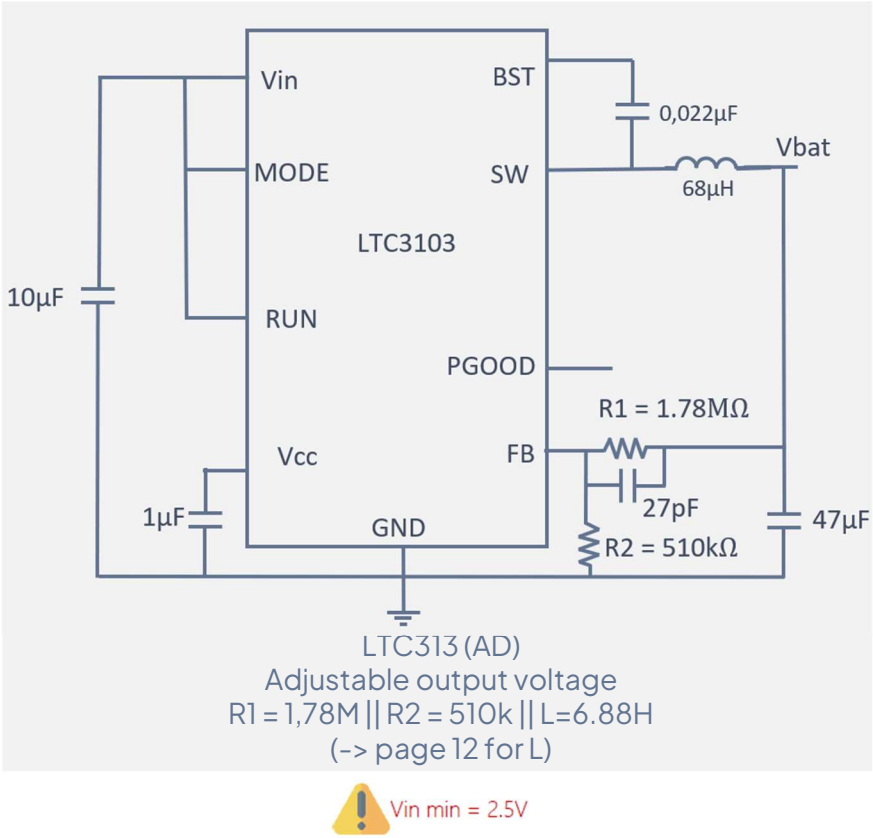


Figure 11: Schematic of LTC3103 buck converter

Boost Converter

It is a step-up converter that increases the input voltage to a stable output voltage; therefore, it can only be used for systems with a power supply lower than 2.7 V. Beware of the lower limit of the input voltage that can be used depending on the converter chosen.

In this case, the N-MOS is not used, as it needs a minimum V_{gs} voltage usually higher than 2.7 V. Consequently, there is a leakage current that can't be blocked.

Output voltage is often regulated by a resistor divider, as is indicated in the datasheet of the converter. Next figure shows a typical implementation of boost converter with ITEN Powency

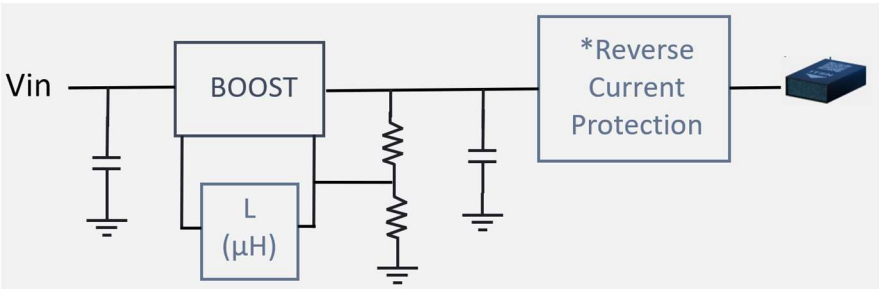


Figure 12: Typical implementation of boost converter with ITEN Powency

01 Component Selection

Part Number	Manufacturer	Output	Footprint	Efficiency* @1.5V input	RP* required
TPS61099	Texas Instruments	Adjustable	YFF-6 DRV-6P	82%	Yes (diode) Enable = Vin
MAX1724EZK27	Analog Devices	Fixed	uDFN	78%	Yes (diode/NMOS as diode)

02 Schematic

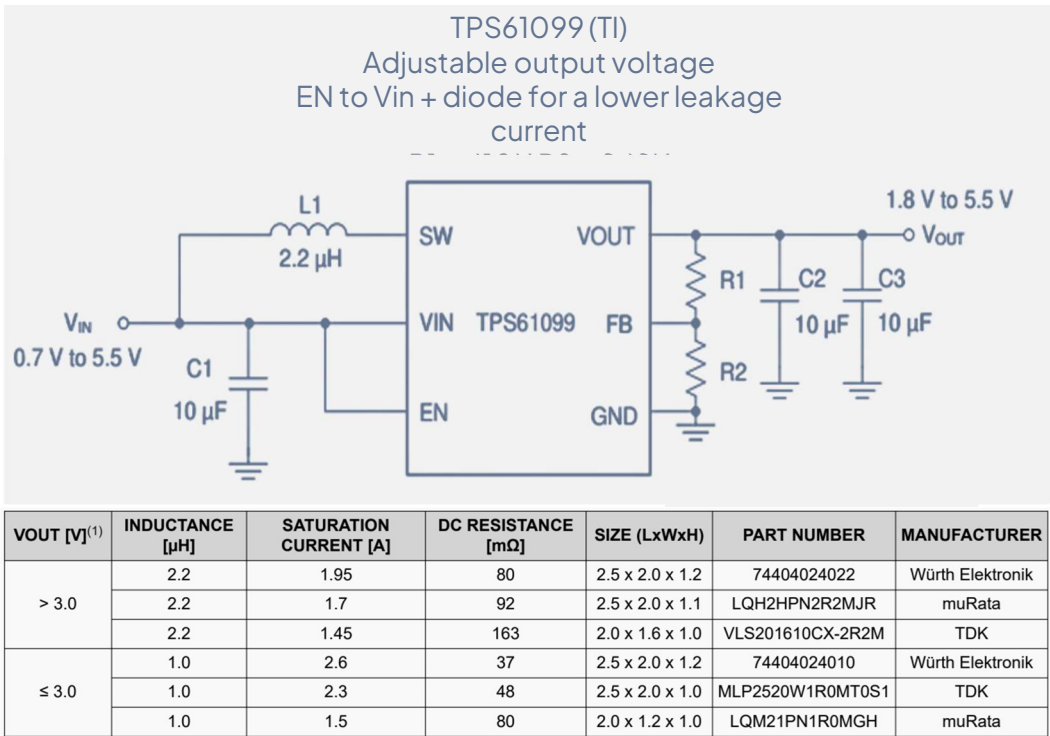


Figure 13: Schematic of TPS61099 boost converter

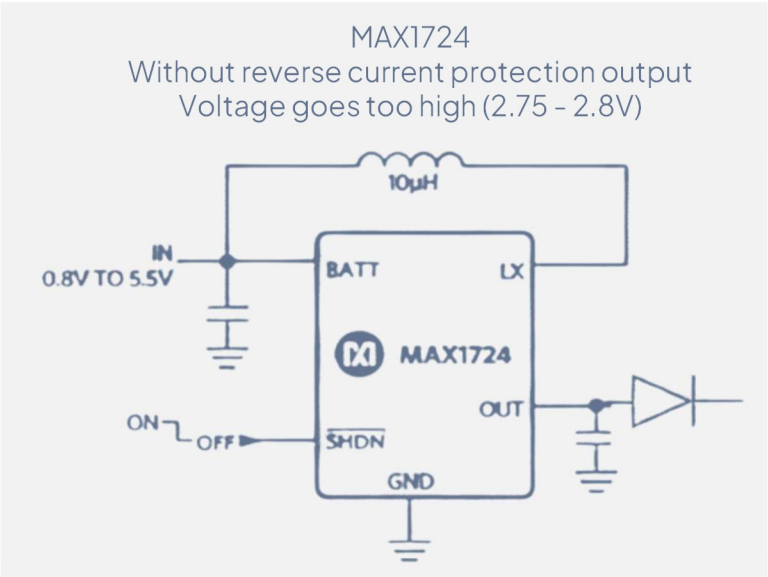


Figure 14: Schematic of MAX1724 boost converter

Energy Harvesting Charge Circuit

The Energy harvesting PMICs are specialized units designed to collect energy from ambient energy sources. They significantly improve energy conversion efficiency by reducing energy losses to improve device performance.

3 PMICs have been tested with the following configurations:

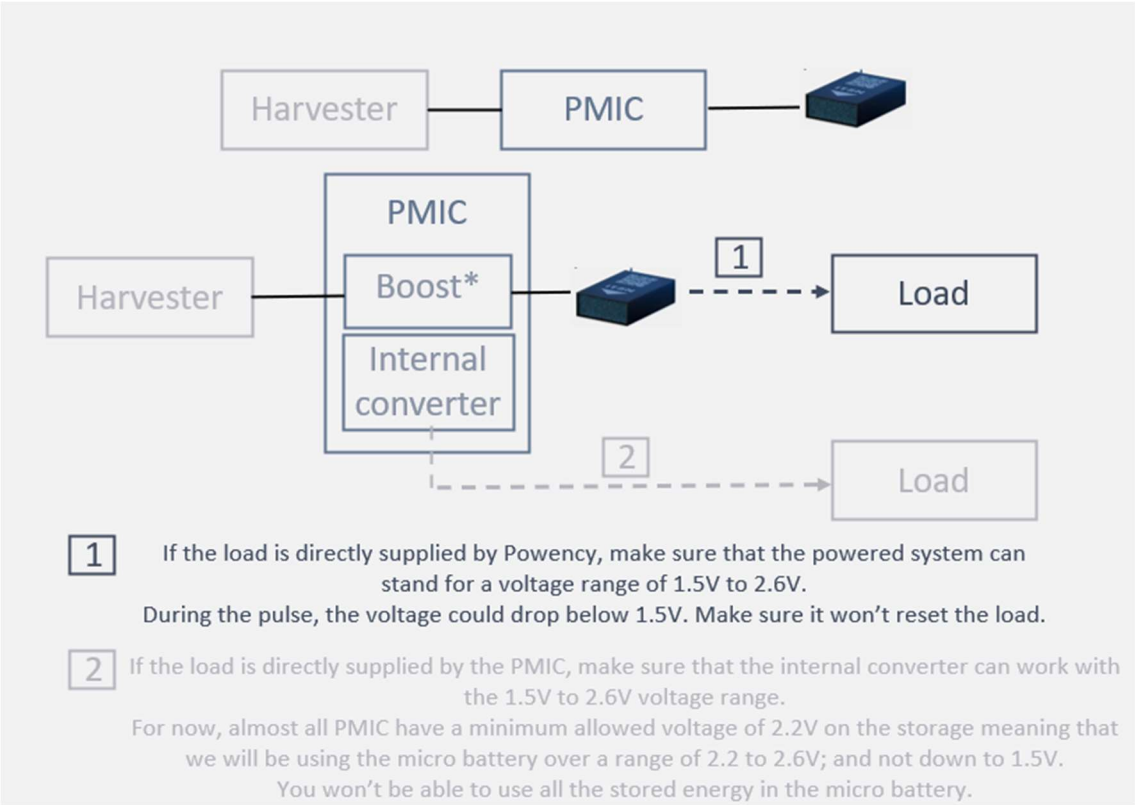


Figure 15: Typical implementation of energy harvester PMIC with ITEN Powency

01 Component Selection

Part Number	Manufacturer	Voltage configuration		Other parameters
TPS61099	Texas Instruments	VBIAS = 1.21V VBAT_OK = 2.5V VBAT_OV = 2.7V VBAT_UV = 2.2V VBAT_OK_HYST = 2.6V	ROK1 = 4.64M ROK2 = 5.34M ROK3 = 10k ROV1 = 6.65M ROV2 = 3.16M	Rout1 = 3.48M Rout2 = 1.6M => for 1.8V output voltage ROC1 & ROC2 to be chosen according to the harvester MPP ratio International converter = BUCK Vmin = 2.2V RVID = R2 = 14k to select 1.8V as output voltage Remove R9 on EVK R7 = 0R Internal converter = LDO
ADP5092	Analog Devices	V_INT REF = 1.02 V VBAT_TERM = 2.73 V VSETSD = 2,06 V VSETPG_FALLING = 2.18V VSETPG_RISING = 2.22 V VSETBK = 2,06 V	RBK1=5M49=R4 RBK2=5M36=R11 RTERM1=4.95M=R5 RTERM2=6.49M=R12 RSD1=5M49=R3 RSD2=5M36=R10 Rhyst=100k=R8 RPG1=5.49M=R6 RPG2=4.64M=R13	
AEM10941	e-peas	Vovch = 2.7V Vchrdy = 2.3V Vovdis = 2.2 V	Vovch = 2.7V CFG2-1-0 = H-L-L Custom mode available For Vchrdy level >2.3V Internal converter = LDO Vmin = 2.2V	BAL = GND ENHV = H to enable the HVOUTLDO ENLV = H to enable the LVOUTLDO SELMPP0&1 to select according to the harvester used

Zener Diode

Low-cost solution to consider when the energy transfer does not have to be efficient, and in a stable thermal environment. The Zener diode is highly dependent on the temperature.

01 Component Selection

Part Number	Manufacture	Characteristics
BZX84-A2V7	Nexperia	Zener Diode 2.7V 250 mW
BZX55C2V7	Vishay Semiconductor	Zener Diode 2.7V 500 mW
MTZJ2V7SA	Vishay Semiconductor	Zener Diode 2.65V 500 mW

02 Schematic

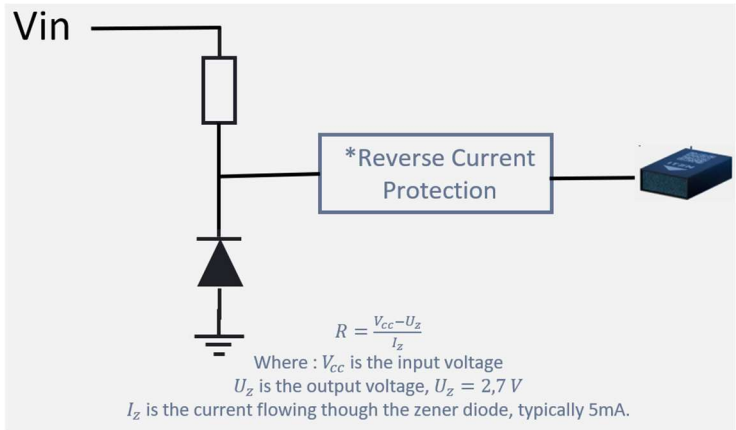


Figure 16: Charging circuit with Zener diode

Solution comparison

Charging System	Efficiency	Cost	Leakage current	Thermal stability	EMC compatibility	Charging Time
LDO Converter	✓	✓	✓	✓	✓	✓
Buck Converter	✓	✓	✓	✓	✗	✗
Boost Converter	✓	✓	✗ ✗	✓	✗	✓
Energy Harvesting PMIC	✓	✗	✓	✓	✓	✓
Zener Diode	✗ ✗	✓ ✓	✓ ✓	✗ ✗	✓	✓

Reverse Current Protection

If the DCDC converter does not include any reverse current protection, one should be added to avoid discharging ITEN SSC power devices when the source goes missing.



Be careful that an enable pin might not be quick enough according to the converter behavior. A 1M Ohm resistor could help between the enable and the ground to force the converter when the source goes missing. ITEN recommends testing the behavior of the system if you don't follow ITEN recommendations.

If a leakage occurs in the DCDC converter, several options exist:

- An NMOS transistor with the gate connected to the source after the DCDC converter as shown in figure 17. Be careful that the source might need to be at a certain level to enable the complete charge to 2.7V according to the V_{gs} threshold.
- An NMOS transistor connected as a diode as shown in figure 18.

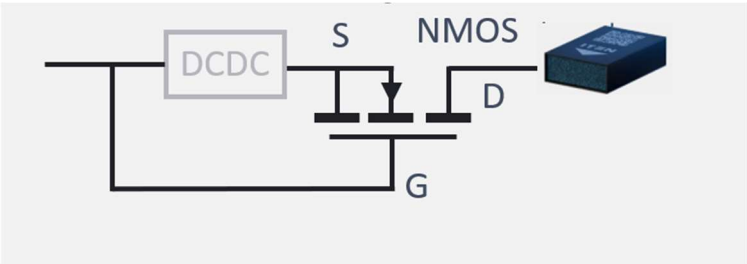


Figure 17: Reverse current protection with NMOS

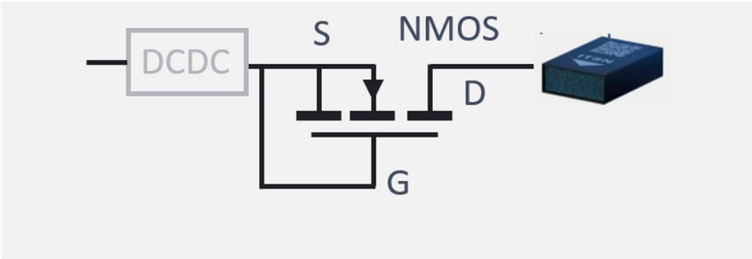


Figure 18: Reverse current protection with NMOS

- An PMOS transistor after the converter with the gate to the GND and the source connected to the converter output as shown in figure 19.
- A Schottky diode as shown in figure 20.
- An ideal diode as shown in figure 21.

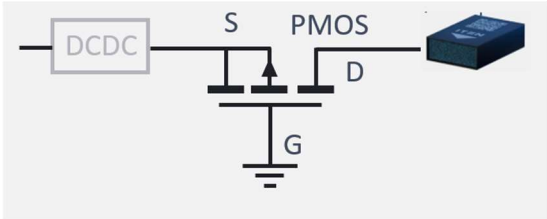


Figure 19: Reverse current protection with PMOS



Figure 20: Reverse current protection with Schottky diode

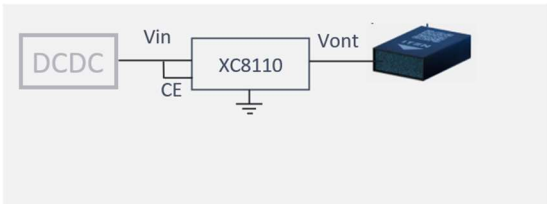


Figure 21: Reverse current protection with ideal diode

01 NMOS transistor

For the figure 22, according to the source voltage, the V_{gs} should be small enough to allow a voltage up to 2.7V on ITEN POWENCY. For the figure B, the V_{gs} should be as small as possible, and the converter output should be defined as $(2.7V + V_{gs} \text{ min})$.

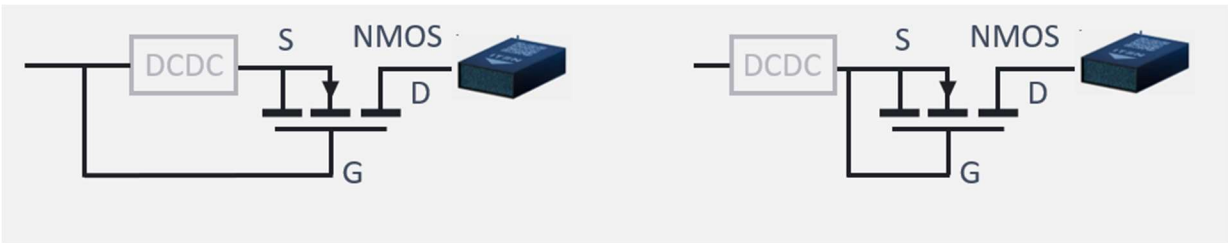


Figure 22: NMOS transistor selection for reverse current protection

Part Number	V_{gsTh}	$V_{source} \text{ Minimum}$
DMT6010LSS	0,8V	3,4V
SSM37K3	0,7V	3,3V

02 PMOS transistor

Please be careful at the converter behaviour when the source goes off. If the output of the output converter node remains charged, the transistor won't be opened quick enough, and the SSC power devices will be discharged.

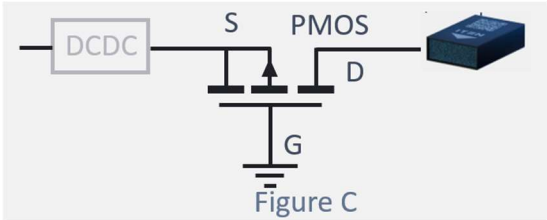


Figure 23: Reverse current protection with PMOS

Part Number	Vgs Th
IRF9393PBF	-1,8V

03 Schottky diode



Figure 24: Reverse current protection with Schottky diode

Part Number	Voltage Forward	Voltage Forward @1A	Package
Schottky AT60AE6327HTSA1	120mV	300mV	SOD323
SchottkyRB161MM		310V	SOD123

04 Ideal diode load switch

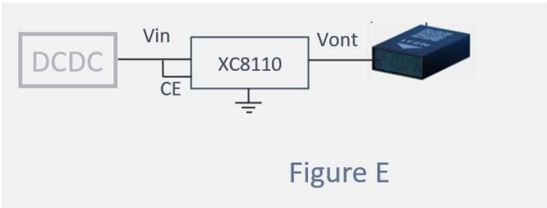
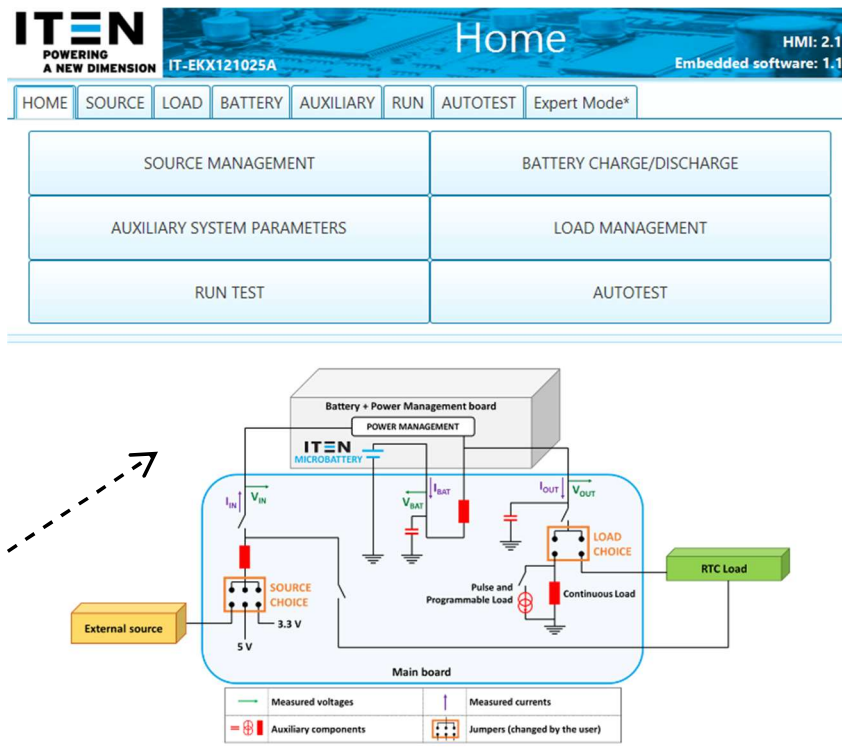


Figure 25: Reverse current protection with ideal diode

Part Number	Voltage Forward @10mA
XC8110AA01	20mW

Charging Systems Evaluation

Customer willing to test and measure performances of ITEN Powency can use ITEN Evaluation kit, which provide a customizable platform for both source and load. Next figure shows Iten evaluation kit :



- ITEN POWENCY
- Software provided

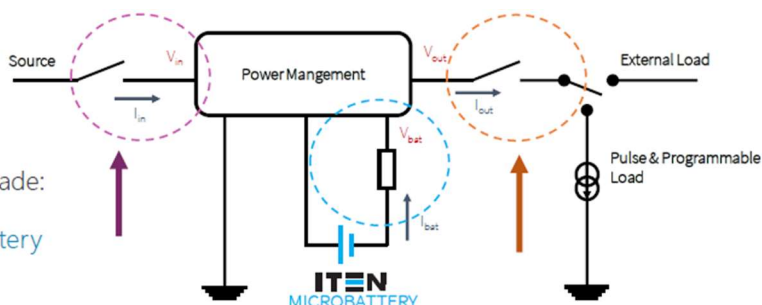
- Working with NUCLEO F767ZI

- Current and voltage measurement

Evaluation Kit Behavior :

Voltages and Current measurement are made:

- Before the charging IC
- After the charging IC to the micro battery
- On the way to the load



ITEN evaluation kit could be used in association with ITEN dev board which offers multiple charging systems.

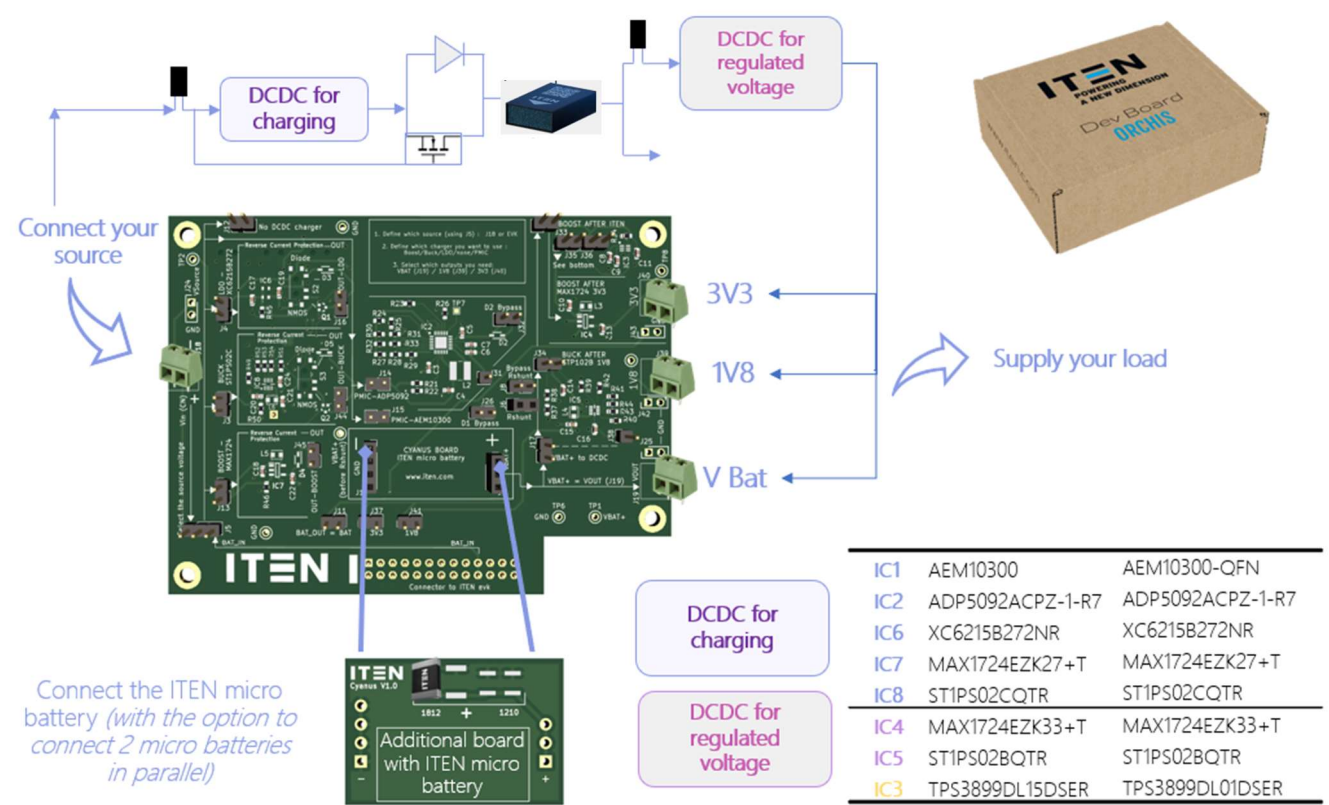


Figure 26: Development board overview with charging IC references

Revision History

Date	Revision	Change
13 November 2025	V2.10	Minor wording adjustments; No change in meaning
22 Avril 2025	V2.9	Changing the template Add <u>Richtek</u> LDO
30 September 2024	V2.8	Remove efficiency column in table 1 Update figure 6 with and without reverse current Add ideal diode for reverse current solution
03 June 2024	V2.7	Fixed TOREX LDO reference in table 1
17 May 2024	V2.6	Fixed SBD placement with XC6240 (section 2.2) Update corporate application note template
21 June 2023	V2.5	Add Figure 2 : Component selection to charge ITEN Powency
15 May 2022	V2.4	Add EVK overview

Contact

For any technical questions or Charging IC recommendations, please send us an email to:

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For any commercial requests, please send us an email to:

sales@iten.com

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About Us

I-TEN SA is a French industrial gem, leader in the development and production of solid-state technologies with unrivalled power density. It is one of the few global players with the capacity for industrial production of this technology, mastering the entire design and production chain. These revolutionary components meet the power and miniaturization needs of electronic systems used in connected objects, autonomous sensors and wearables. At the heart of the French DeepTech ecosystem, ITEN holds over 200 patents. ITEN is the two-time winner of the global innovation competition in 2015 and 2017, the French Tech 120 winner in 2023 and 2024 and won the CES 2024 Best of Innovation Awards in Las Vegas for its Powency 250µAh component (the second French company to be honoured since CES was founded in 1967).