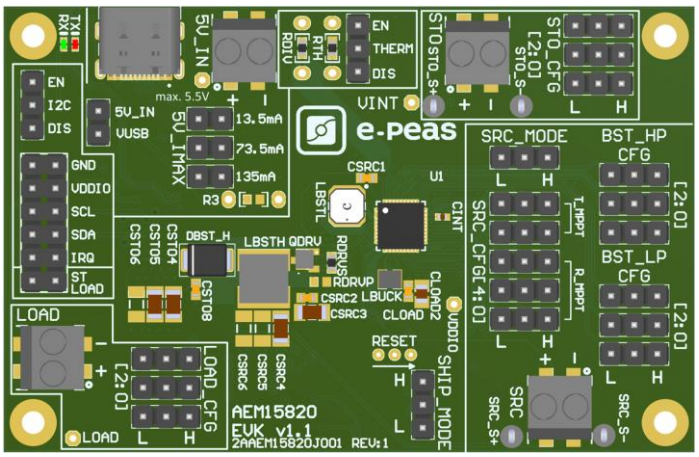
# AEM15820
# Quick Start Guide EVK


## FEATURES

### Connectors

- 1 screw connector for the source
- 1 screw connector for the storage element
- 1 screw connector for the application circuit
- 1 screw connector for 5 V DC power input
- 1 USB connector for alternative 5 V DC power input / USB to I²C converter

### Configuration

- 1 header SRC_MODE to configure the source voltage regulation mode
- 5 headers SRC_CFG[4:0] to configure the source regulation voltage
- 3 headers BST_LP_CFG[2:0] to configure the low-power boost converter timings
- 3 headers BST_HP_CFG[2:0] to configure the high-power boost converter timings
- 3 headers STO_CFG[2:0] to configure the storage element protection thresholds
- 3 headers LOAD_CFG[2:0] to configure the LOAD output regulation voltage
- 1 header THERM to enable/disable the thermal monitoring
- 1 header to enable/disable the I²C functionalities
- 1 header (6 pins) to connect the I²C communication related pins and the ST_LOAD signal
- 3 headers to configure the 5 V charge current
- 1 header to enable/disable the shipping mode

### Size

- 76 mm x 49 mm.
- 4 x M2.5 mounting holes.

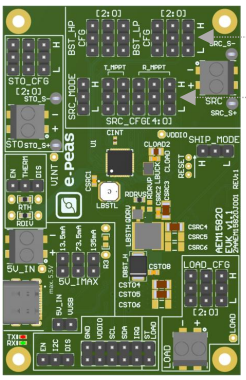
## SUPPORT PCB

### BOM around the AEM15820

| Designator | Description | Quantity | Manufacturer | Part Number |
|---|---|---|---|---|
| U1 | AEM15820 QFN40 | 1 | e-peas | Order at sales@e-peas.com |
| CINT | Ceramic Cap 10 µF, 6.3 V, 20 %, X5R, 0402 | 1 | Murata | GRM155R60J106ME44D |
| CSTO | Ceramic Cap 47 µF, 6.3 V, 20 %, X5R, 0603 | 1 | Murata | GRM188R60J476ME15D |
| CSTO2 | Ceramic Cap 220 µF, 6.3 V, 20 %, X5R, 1206 | 1 | Murata | GRM31CR60J227ME11L |
| CSTOHP1 | Ceramic Cap 47 µF, 6.3 V, 20 %, X5R, 0603 | 1 | Murata | GRM188R60J476ME15D |
| CSRC1 | Ceramic Cap 22 µF, 10 V, 20 %, X5R, 0603 | 1 | Murata | GRM188R61A226ME15D |
| CSRC2 to CSRC9 | Ceramic Cap 220 µF, 6.3 V, 20 %, X5R, 1206 | 1 | Murata | GRM31CR60J227ME11L |
| LBOOST_LP | Power inductor 33 µH, 0.68 A, LPS4018 | 1 | Coilcraft | LPS4018-333MRB |
| LBOOST_HP | Power inductor 3.3 µH, 10 A, MAPI-5030 | 1 | Wurth | 74438367033 |
| DBOOST_HP | Schottky Diode 1A | 1 | Vishay | VS-10BQ015HM3/5BT |
| QDRV | N-MOS Transistor, 25 V, 100 A, 2 mΩ | 1 | Infineon | ISK024NE2LM5 |
| QP_PG | P-MOS Transistor, 20 V, 70 A, 6.5 mΩ | 1 | Diodes Inc. | DMP2005UFG |
| QN_PG | N-MOS Transistor, 60 V, 230 mA, 3.5 Ω | 1 | Infineon | BSS138NH6327XTSA2 |
| RPG_PU | Resistor 330 kΩ | 1 | Yageo | RC0603FR-07330KL |
| RDRV_PD | Resistor 330 kΩ | 1 | Yageo | RC0603FR-07330KL |
| CLOAD | Ceramic Cap 22 µF, 10 V, 20 %, X5R, 0603 | 1 | Murata | GRM188R61A226ME15D |
| LBUCK | Power inductor 10 µH | 1 | TDK | VLS252012CX-100M-1 |
| C5 | Ceramic Cap 47 µF, 25 V, 20 %, X5R 1206 | 1 | TDK | C3216X5R1E476M160AC |
| R1 | Resistor 2.2 Ω | 1 | TE | CRGCQ2512J2R2 |
| D5 | Zener diode 5.1V | 1 | ON Semi | 1SMB5918BT3G |
| RSCL | Resistor 1 kΩ | 1 | Multicomp | MCWR06X1001FTL |
| RSDA | Resistor 1 kΩ | 1 | Multicomp | MCWR06X1001FTL |
| RDIV | Resistor 22 kΩ | 1 | Yageo | RC0402FR-0722KL |
| RTH | 10 kΩ NTC thermistor | 1 | Murata | NCP15XH103J03RC |

**Footprint & Symbol:** Information available on the datasheet

# STEP 1: Configure the AEM15820



- **SRC voltage regulation:**
  SRC_MODE and SRC_CFG[4:0] (seen as HIGH if left floating)

If SRC_MODE = L (constant voltage):

| Configuration pins | | | | | Voltage [V] |
|---|---|---|---|---|---|
| SRC_CFG[4:0] | | | | | $V_{SRC,REG}$ |
| L | L | L | L | L | Reserved[1] |
| L | L | L | L | H | 0.30 |
| L | L | L | H | L | 0.35 |
| L | L | L | H | H | 0.41 |
| L | L | H | L | L | 0.45 |
| L | L | H | L | H | 0.50 |
| L | L | H | H | L | 0.56 |
| L | L | H | H | H | 0.60 |
| L | H | L | L | L | 0.65 |
| L | H | L | L | H | 0.71 |
| L | H | L | H | L | 0.75 |
| L | H | L | H | H | 0.80 |
| L | H | H | L | L | 0.86 |
| L | H | H | L | H | 0.90 |
| L | H | H | H | L | 0.95 |
| L | H | H | H | H | 1.01 |

| Configuration pins | | | | | Voltage [V] |
|---|---|---|---|---|---|
| SRC_CFG[4:0] | | | | | $V_{SRC,REG}$ |
| H | L | L | L | L | 1.10 |
| H | L | L | L | H | 1.20 |
| H | L | L | H | L | 1.31 |
| H | L | L | H | H | 1.40 |
| H | L | H | L | L | 1.50 |
| H | L | H | L | H | 1.59 |
| H | L | H | H | L | 1.70 |
| H | L | H | H | H | 1.79 |
| H | H | L | L | L | 1.90 |
| H | H | L | L | H | 1.99 |
| H | H | L | H | L | 2.19 |
| H | H | L | H | H | 2.41 |
| H | H | H | L | L | 2.59 |
| H | H | H | L | H | 2.82 |
| H | H | H | H | L | 3.00 |
| H | H | H | H | H | 3.18 |

*1. This reserved configuration must not be used*

If SRC_MODE = H (MPPT ratio):

| Configuration pins | | | MPPT Ratio |
|---|---|---|---|
| SRC_CFG[2:0] | | | $R_{MPPT}$ |
| L | L | L | Reserved |
| L | L | H | 50 % |
| L | H | L | 65 % |
| L | H | H | 70 % |
| H | L | L | 75 % |
| H | L | H | 80 % |
| H | H | L | 85 % |
| H | H | H | Reserved |

| Configuration pins | | MPPT wait time [ms] | MPPT Period [ms] |
|---|---|---|---|
| SRC_CFG[4:3] | | $T_{MPPT,WAIT}$[1] | $T_{MPPT,PERIOD}$ |
| L | L | 1.8 | 116 |
| L | H | 7.3 | 465 |
| H | L | 29 | 1862 |
| H | H | 233 | 14895 |

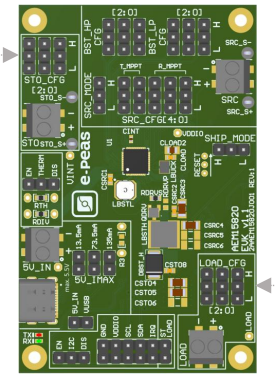
*1. The total time in open-circuit is the sum of $T_{MPP,WAIT}$ (see table above) plus $T_{MPP,MEASURE}$ (fixed to 1.36ms).*

- **LP and HP boost timing multipliers:** BST_LP_CFG[2:0] and BST_HP_CFG[2:0] (seen as HIGH if left floating)

| Configuration pins | | | Boost timing multiplier |
|---|---|---|---|
| BST_LP_CFG[2:0] BST_HP_CFG[2:0] | | | $T_{MULT}$ |
| L | L | L | x1 |
| L | L | H | x2 |
| L | H | L | x3 |
| L | H | H | x4 |
| H | L | L | x6 |
| H | L | H | x8 |
| H | H | L | x12 |
| H | H | H | x16 |

- **Storage element protection thresholds:** STO_CFG[2:0] (seen as HIGH if left floating)

| Configuration pins | | | Overdischarge voltage [V] | Charge ready voltage [V] | Overcharge voltage [V] | Storage element type |
|---|---|---|---|---|---|---|
| STO_CFG[2:0] | | | $V_{OVDIS}$ | $V_{CHRDY}$ | $V_{OVCH}$ | |
| L | L | L | 2.51 | 2.61 | 3.79 | Lithium-ion Super Capacitor (LiC) |
| L | L | H | 2.51 | 2.61 | 3.49 | Lithium-ion Super Capacitor 85 °C (LiC) |
| L | H | L | 3.00 | 3.21 | 4.13 | Lithium-ion |
| L | H | H | 3.00 | 3.21 | 3.90 | Lithium-ion (long life) |
| H | L | L | 3.51 | 3.60 | 3.90 | Lithium-ion (super long life) |
| H | L | H | 3.00 | 3.60 | 4.35 | Lithium Polymer (LiPo), NiMH |
| H | H | L | 2.81 | 3.11 | 3.62 | Lithium Iron Phosphate (LiFePO4) |
| H | H | H | 2.61 | 2.70 | 3.90 | Tadiran HLC1020 |



If the LOAD output is used and configured with the headers (not by I²C), the $V_{CHRDY, BUCK}$ threshold will be configured automatically in function of the STO_CFG[2:0] and $V_{LOAD}$ settings:

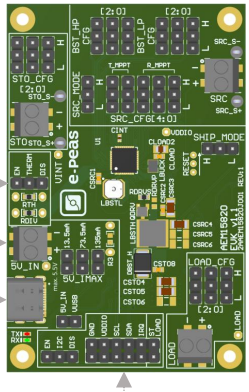
| Configuration pins | | | Buck charge ready voltage [V] | | | | Storage element type |
|---|---|---|---|---|---|---|---|
| STO_CFG[2:0] | | | $V_{CHRDY,BUCK}$ for $V_{LOAD} \leq 2.5$ V | $V_{CHRDY,BUCK}$ for $V_{LOAD}$ = 2.8 V | $V_{CHRDY,BUCK}$ for $V_{LOAD}$ = 3.0 V | $V_{CHRDY,BUCK}$ for $V_{LOAD}$ = 3.3 V | |
| L | L | L | 2.61 | 2.91 | 3.11 | 3.41 | Lithium-ion Super Capacitor (LiC) |
| L | L | H | 2.61 | 2.91 | 3.11 | 3.41 | Lithium-ion Super Capacitor 85 °C (LiC) |
| L | H | L | 3.21 | 3.21 | 3.21 | 3.51 | Lithium-ion |
| L | H | H | 3.21 | 3.21 | 3.21 | 3.51 | Lithium-ion (long life) |
| H | L | L | 3.60 | 3.60 | 3.60 | 3.60 | Lithium-ion (super long life) |
| H | L | H | 3.60 | 3.60 | 3.60 | 3.60 | Lithium Polymer (LiPo), NiMH |
| H | H | L | 3.11 | 3.11 | 3.21 | 3.41 | Lithium Iron Phosphate (LiFePO4) |
| H | H | H | 2.70 | 2.91 | 3.11 | 3.41 | Tadiran HLC1020 |

- **Load voltage regulation:** LOAD_CFG[2:0] (seen as HIGH if left floating)

| Configuration pins | | | LOAD voltage [V] |
|---|---|---|---|
| LOAD_CFG[2:0] | | | $V_{LOAD}$ |
| L | L | L | Buck disabled |
| L | L | H | 1.5 |
| L | H | L | 1.8 |
| L | H | H | 2.2 |
| H | L | L | 2.5 |
| H | L | H | 2.8 |
| H | H | L | 3.0 |
| H | H | H | 3.3 |

- **5 V charger maximum current:** the maximum charging current can be configured with a jumper (135 mA, 73.5 mA and 13.5 mA) or by mounting R3 resistor (e.g., 1.5 kΩ resistor for 33.3 mA).

| Resistor [Ω] | Maximum Charging Current [mA] |
|---|---|
| $R_{5V\_IMAX}$ | $I_{5V,CC}$ |
| 370 | 135.0 |
| 680 | 73.5 |
| 1500 | 33.3 |
| 3700 | 13.5 |



- **Thermal monitoring:** connect the jumper THERM to EN/DIS to enable/disable the thermal monitoring feature.
  For preconfigured temperature thresholds, see *"Storage Element Thresholds"* section in the datasheet.

- **I²C communication:** all the configurations of the AEM, as well as various information, are available through I²C communication. See the datasheet for more details.
  Please note that, while ST_LOAD shares the same header as the I²C interface, its power domain is not VDDIO but $V_{LOAD}$.

- **USB to I²C converter:** to use the "I²C Configuration Tool" for easy configuration of all I²C functionalities, install jumpers on VDDIO, SDA, SCL and IRQ on the I²C communication header and connect the EVK to a computer through the USB connector.
  The USB connector can also be used as an alternative power source for the 5 V charger. To do so, install a jumper on the "5V_IN-VUSB" header.

**STEP 2:** Connect the storage element with a voltage higher than 2.4 V.

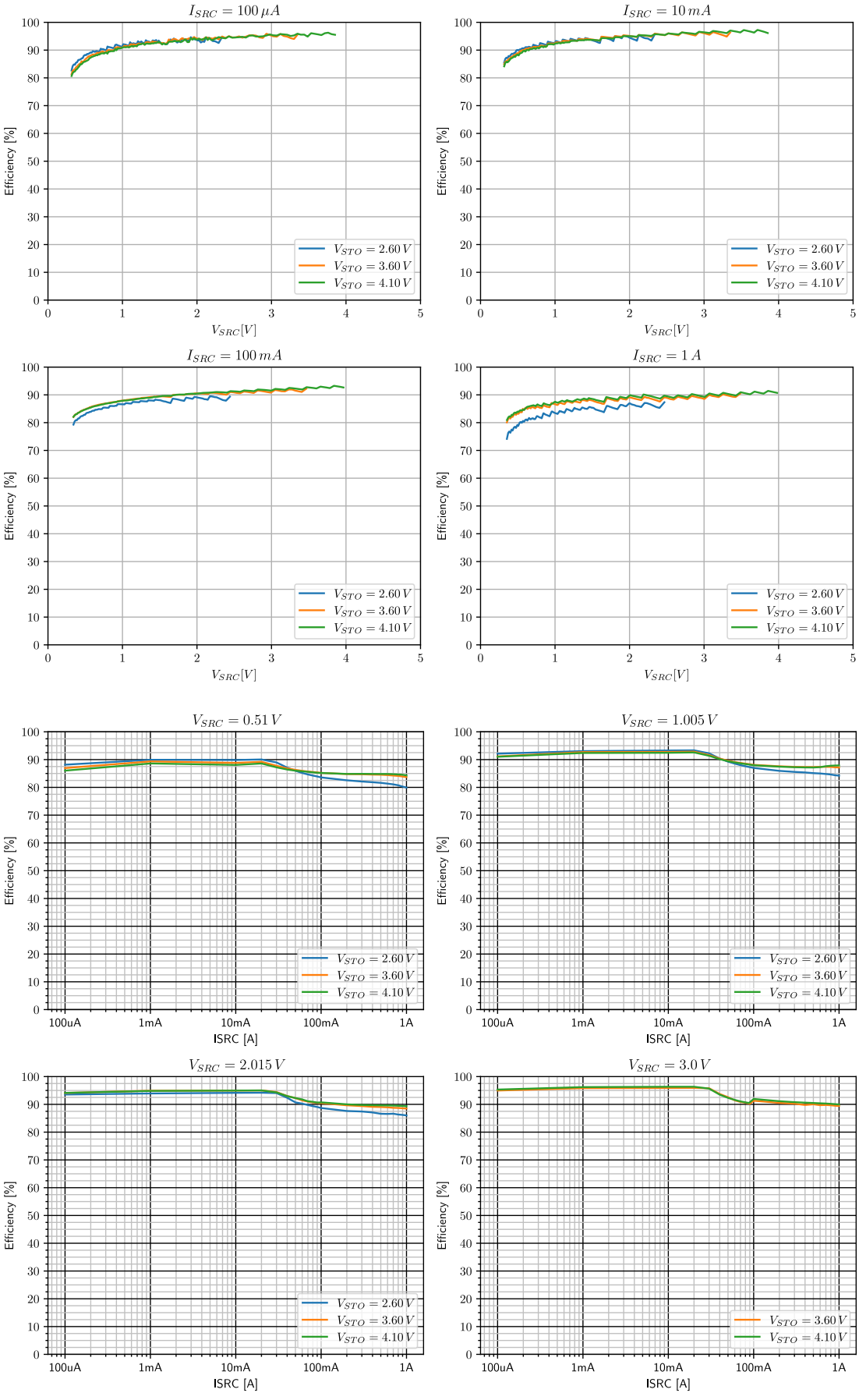
**STEP 3:** Connect the application circuit.

**STEP 4:** Connect the source or the 5 V power input.

## Boost efficiency:

$L_{BOOSTLP}$ = 33 µH Coilcraft LPS4018-333MRB, timing x3

$L_{BOOSTHP}$ = 3.3 µH Wurth 74438367033, timing x6



## Buck efficiency:

$L_{BUCK}$ = 10 µH TDK VLS252012CX-100M-1, timing x2