Getting started with the AEK-POW-LDOV01J and AEK-POW-LDOV01S automotive-grade LDOs with configurable output voltage

Introduction

The AEK-POW-LDOV01J and AEK-POW-LDOV01S evaluation boards host, respectively, the L99VR01JTR and L99VR01STR voltage regulator ICs, which are two different versions of the L99VR01.

Figure 1. AEK-POW-LDOV01J evaluation board

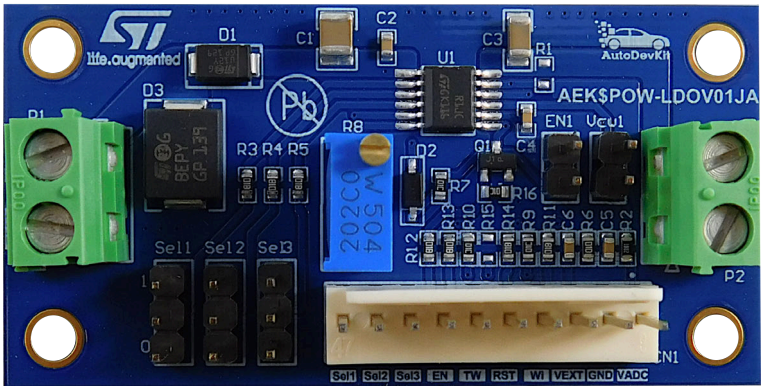
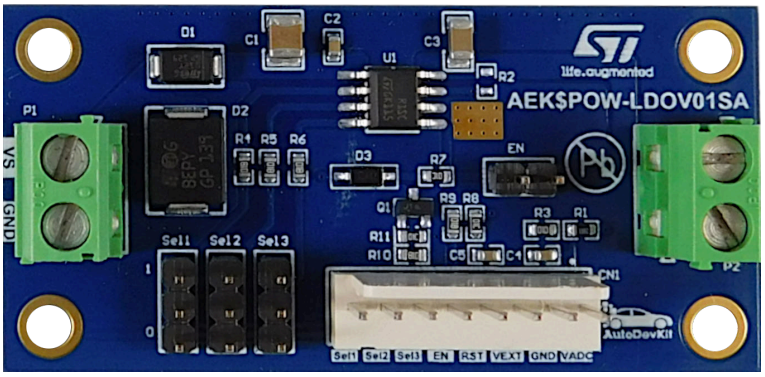


Figure 2. AEK-POW-LDOV01S evaluation board



The L99VR01 is a DC-DC voltage regulator designed for automotive applications (AEC-Q100 qualified). It can deliver up to 200 mA of load current and consumes around 1 µA when the regulator is disabled.

The operating input voltage is between 2.15 and 28 V, while a fixed selectable output voltage (0.8 V, 1.2 V, 1.5 V, 1.8 V, 2.5 V, 2.8 V, 3.3 V, or 5 V) is configurable.

Figure 3. **L99VR01JTR functional block**

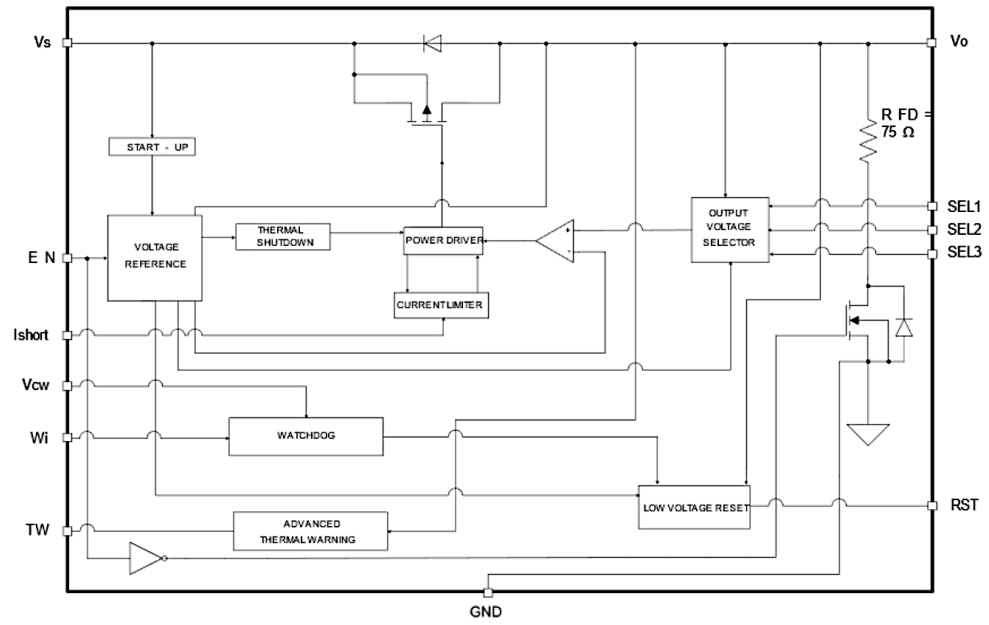
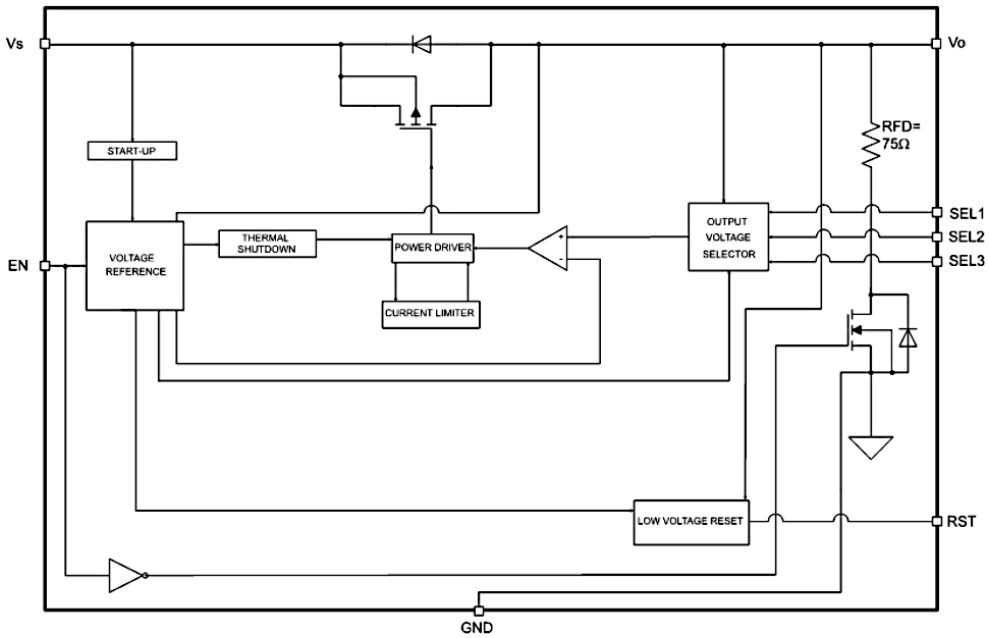


Figure 4. **L99VR01STR functional block**



The AEK-POW-LDOV01J and AEK-POW-LDOV01S boards can be used in a standalone configuration or with an external microcontroller. In the latter case, the MCU provides a watchdog signal to the regulator to monitor the active connection.

These boards are included in the AutoDevKit ecosystem to enable a quick and easy prototyping for automotive and transportation applications.

Warning: *The AEK-POW-LDOV01J and AEK-POW-LDOV01S are evaluation tools for R&D laboratory use only. They are not intended to be used inside a vehicle.*

1 Getting started

1.1 Safety and protection mechanisms

The AEK-POW-LDOV01J evaluation board implements the following automotive safety mechanisms:

- **Output voltage monitoring**

  It supervises the generated output voltage (V_O). If the V_O output voltage falls below the V_{OTH} threshold (equal to V_O-10% V_O), the RST pin is pulled low.

- **Active connection monitoring (MCU connected configuration only)**

  For a continuous monitoring of the connection between the LDO and the MCU, a watchdog is used. The watchdog signal (generated by the MCU and applied to the AEK-POW-LDOV01J WI pin) is a square wave with a duty cycle equal to 50%. The frequency value depends on both the output voltage and the chosen C4 capacitor value (see the L99VR01JTR schematics). The LDO device monitors the watchdog signal provided by the MCU. If the signal frequency is outside the range described above, the RST pin is pulled low. You can disable the watchdog through a jumper on the AEK-POW-LDOV01J Vcw1 pin.

- **Regulator enabling and disabling**

  The L99VR01JTR voltage regulator is enabled/disabled through the EN signal input.

- **Overcurrent monitoring and lost ground protection**

  The overcurrent limit is set by regulating a current on the Ishort through an external potentiometer available on the AEK-POW-LDOV01J. If the overcurrent limit is reached, the RST pin is pulled low.

- **Thermal warning detection**

  To warn the microcontroller about a severe temperature increase of the LDO, a thermal warning output has been implemented. If the device detects a junction temperature above 150°C, the thermal warning (TW) output pin is pulled low, while the voltage regulator and all its features remain active.

- **Overvoltage warning detection**

  The TW pin also provides diagnostics about the output overvoltage. To distinguish between a thermal and an overvoltage warning event, two different signals are generated on the same TW output pin. A thermal warning event detection sets the TW pin to low, whereas an output overvoltage event generates a square wave (duty cycle 50% and period 300 microseconds) on the TW pin.

The AEK-POW-LDOV01S does not support safety features like watchdog, Ishort control, thermal and overvoltage warning detections.

1.2 MCU connected configuration

In this configuration, the external MCU performs the following actions:

- generates signals (3.3 or 5 V) to control the output voltage selection thought the SELx pin;
- generates a signal to control the EN input pin (3 or 5 V);
- generates a square wave (3.3 or 5 V) to control the watchdog logic (for the AEK-POW-LDOV01J only)
- reads the TW pin to detect the thermal warning or overvoltage events (for the AEK-POW-LDOV01J only)
- reads the RST pin to detect if the V_O output voltage is below a given threshold or to detect a wrong watchdog frequency (for the AEK-POW-LDOV01J only)
- uses an ADC to monitor the voltage generated by the LDO
- generates a fixed voltage reference (V_{EXT} - 3.3 or 5 V) to read the LDO signals properly.

Note: If the AEK-POW-LDV01x is connected to an external MCU, remove all the on-board jumpers.

1.3 Standalone configuration

In the standalone configuration:

- select the output voltage by using the Sel1, Sel2, or Sel3 jumpers;
- insert the EN1 jumper to enable the L99VR01 and remove it right after the power-up sequence;
- insert the Vcw1 jumper to disable the watchdog requirement (for the AEK-POW-LDOV01J only).

2 Hardware architecture

The AEK-POW-LDOV01J and AEK-POW-LDOV01S evaluation boards are equipped with:

- CN1 connector: used only if the board is connected to an external microcontroller.

Table 1. CN1 pin description

Pin	Description
Sel1 Sel2, Sel3	Output voltage selectors
EN	Enable input
TW (for the AEK-POW-LDOV01J only)	Thermal warning output and overvoltage warning output
WI (for the AEK-POW-LDOV01J only)	Watchdog input
RST	Reset output
VEXT	Input external voltage reference (3.3 or 5 V)
GND	Ground reference
VADC	Output voltage. This pin can be used to read the output voltage via a configured external ADC peripheral that belongs to the MCU.

- Jumpers: to be used in standalone working mode only.

Table 2. Jumper pin description

Pin	Description
Sel1 Sel2, Sel3	Output voltage selectors. To set SELx to high, put a jumper between the central position and ‘1’ position. To set SELx to low, put a jumper between the central position and ‘0’ position.
EN1	Enable jumper. To enable the board, mount the jumper and remove it right after.
Vcw1 (for the AEK-POW-LDOV01J only)	Watchdog disable jumper. In standalone mode, disable the watchdog by applying a jumper on Vcw1.

- Voltage connectors

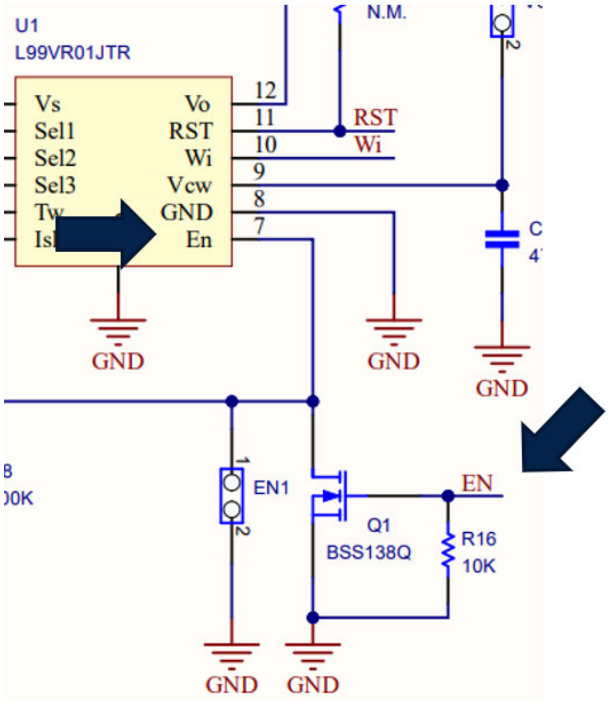
Table 3. Voltage connector details

Connector	Description
VS	Operating DC power supply voltage range from 2.15 to 28 V
V_O	LDO output voltage

2.1 Enable pin

The enable input (EN) enables/disables the L99VR01. A high-voltage signal switches the regulator on. When the enable pin is set to low, the output is switched off. Then, the current consumption of the device is about 1 µA.

Figure 5. Enable and disable signals

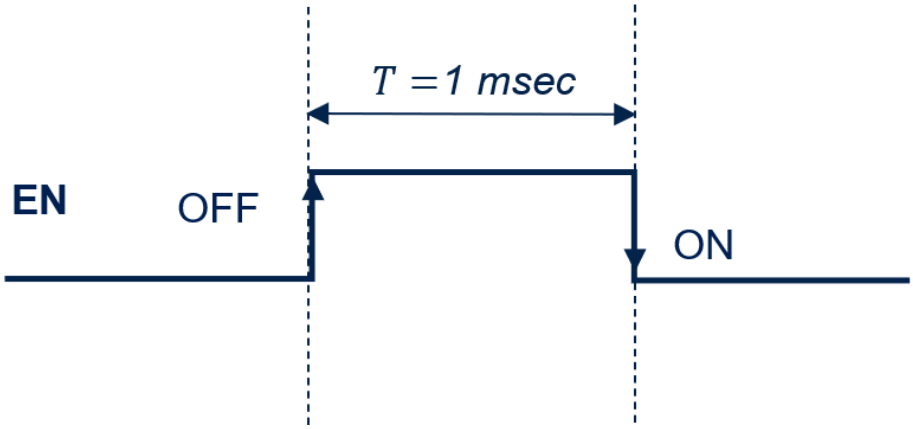


The EN input pin or the EN1 jumper enable/disable the AEK-POW-LDOV01J/AEK-POW-LDOV01S, as follows:

- when the EN pin is set to high, it is forced to low and the output is switched off;
- when the EN pin is set to low, it is forced to high and the output is switched on;
- when the EN1 jumper is applied, the EN pin is forced to low and the output is switched off.

To change the output voltage while the regulator is on, apply a pulse signal to the EN input pin after the SELx pin setting.

Figure 6. Pulse signal in case of output voltage changing



2.2 Output voltage selection

The L99VR01 provides up to eight different output voltage options. The combination of its three digital input selectors (SELx) determines the output voltage according to the following truth table.

Table 4. SELx pins: truth table

V_O (volt)	SEL1	SEL2	SEL3
5	1	1	1
3.3	1	1	0
2.8	1	0	1
2.5	1	0	0
1.8	0	1	1
1.5	0	1	0
1.2	0	0	1
0.8 (default)	0	0	0

The SELx pin configuration is acquired at the device startup (about 500 microseconds). Once the configuration is set, the output voltage cannot be changed until the next EN pin transition. If all SELx pins are left unconnected, the default configuration is selected.

2.3 Watchdog (for the AEK-POW-LDO01J only)

The watchdog is an automotive safety mechanism used to monitor a continuous connection with an external MCU.

The watchdog signal (generated by the MCU and applied to the AEK-POW-LDOV01J WI pin) is a square wave with a duty cycle equal to 50%. Its frequency value depends on both the output voltage and the chosen C4 capacitor value (see the L99VR01JTR schematics).

The table below lists the watchdog frequencies (Hz) related to the selectable output voltage.

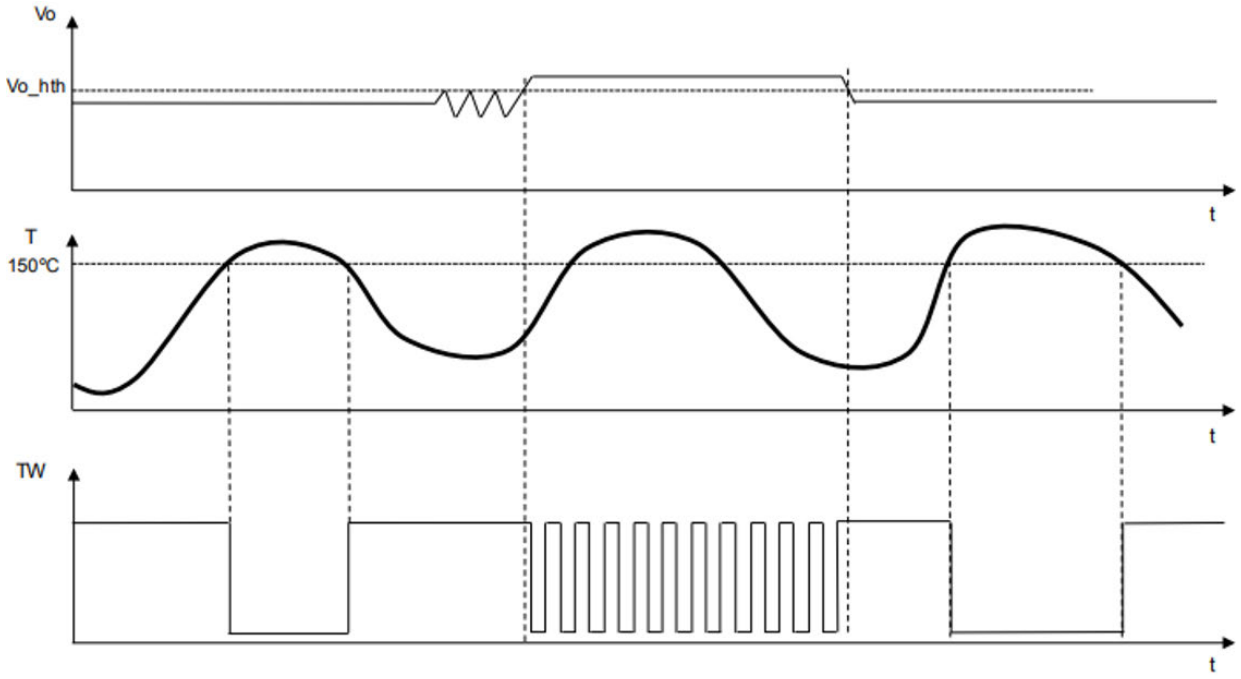
Table 5. WI frequencies in Hz

V_O (volt)	WI frequency (Hz)
5	172
3.3	114
2.8	94
2.5	76
1.8	55
1.5	49
1.2	42
0.8 (default)	28

2.4 Overvoltage warning (for the AEK-POW-LDO01J only)

The TW pin provides the output overvoltage (OV) diagnostic. To distinguish between a thermal warning and an output overvoltage event, two different signals are generated on the same TW output pin. A thermal warning event detection sets the TW pin low. An output overvoltage event generates a square wave on the TW pin. The overvoltage detection has a higher priority than the thermal warning detection. Therefore, if both protections are triggered, the generated signal is a square wave.

Figure 7. Overvoltage warning



3 Software architecture

According to the AutoDevKit paradigm, several MCU boards can be connected to the AEK-POW-LDOV01J/AEK-POW-LDOV01S evaluation board. The smallest available MCU is the SPC582B Chorus 1M.

The AutoDevKit ecosystem fully supports the hardware. This ecosystem consists of:

- the SPC5-STUDIO development environment;
- the SPC5-UDESTK debug and firmware download tool;
- the STSW-AUTODEVKIT Eclipse plugin.

The AutoDevKit software includes a dedicated driver for the AEK-POW-LDOV01J/AEK-POW-LDOV01S as well as demo codes.

3.1 SPC5-STUDIO

SPC5-STUDIO is an integrated development environment (IDE) based on Eclipse designed to assist the development of embedded applications based on SPC5 Power Architecture 32-bit microcontrollers.

The package includes an application wizard to initiate projects with all the relevant components and key elements required to generate the final application source code. It also contains straightforward software examples for each MCU peripheral.

SPC5-STUDIO also features:

- the possibility of integrating other software products from the standard Eclipse marketplace
- free license GCC GNU C Compiler component
- support for industry-standard compilers
- support for multi-core microcontrollers
- PinMap editor to facilitate MCU pin configuration

Download the SPC5-UDESTK software to run and debug applications created with SPC5-STUDIO.

3.2 STSW-AUTODEVKIT

The STSW-AUTODEVKIT plug-in for Eclipse extends SPC5-STUDIO for automotive and transportation applications.

STSW-AUTODEVKIT features:

- integrated hardware and software components, component compatibility checking, and MCU and peripheral configuration tools
- the possibility of creating new system solutions from existing ones by adding or removing compatible function boards
- new code can be generated immediately for any compatible MCU
- high-level application APIs to control each functional component, including the ones for the AEK-POW-LDOV01J and AEK-POW-LDOV01S boards

The GUI helps configure interfaces, including SPI, and can automatically manage all relevant pin allocation and deallocation operations.

3.3 AEK-POW-LDOV01x software library architecture

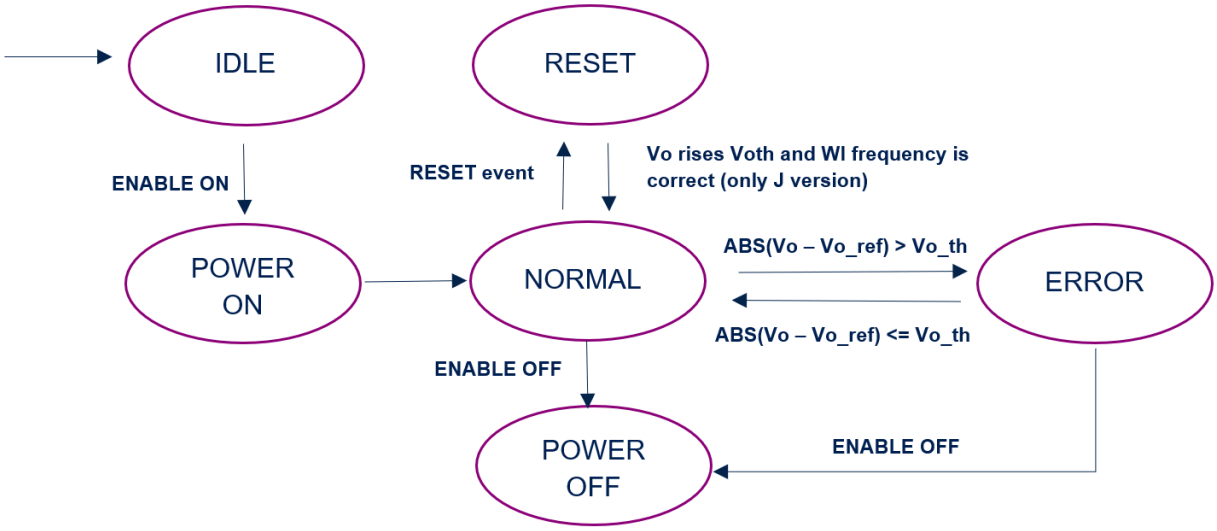
The drivers related to the AEK-POW-LDOV01x are included in a component belonging to the AutoDevKit software (STSW-AUTODEVKIT) version 1.7.0 (or higher). The library is written in C and the target software is generated automatically according to the code generation and pin allocation paradigm included in the AutoDevKit design flow.

The AEK-POW-LDOV01x software library is based on a finite state machine (AEK-POWLDOV01x_fsm) called by a timer (PIT peripheral on SPC58 microcontrollers). The minimum value selectable for the FSM frequency is equal to 10 kHz, which ensures the correct detection of thermal and overvoltage warnings (for the AEK-POW-LDOV01J only).

The AEK-POW-LDOV01x software library supports a multiple board allocation configured inside the dedicated AutoDevKit GUI.

To simplify the management of multiple boards, a unique FSM is used in the driver and for each board allocated. The current state is recorded.

Figure 8. LDO driver finite state machine



The AEK-POW-LDOV01x states are:

- **IDLE**: initial state at power-up
- **POWER ON**: this state is reached when the AEK-POW-LDOV01x is enabled (through the pulse signal applied to the EN pin)
- **POWER OFF**: this state is reached when the AEK-POW-LDOV01x is disabled (through the high signal applied to the EN pin)
- **RESET**: this state detects a falling reset signal. It returns to the normal state when the V_O output voltage rises above V_{OTH} and the watchdog frequency value is correct (for the AEK-POW-LDOV01J only)
- **ERROR**: the FSM enters this state when the absolute value of the difference between the V_O voltage output (read by the SARADC-12 bit) and the voltage output reference (selected by the SELx pin) is greater than a voltage threshold equal to 5% of the voltage reference. In this state, the system is in a dangerous condition and the LDO should be disabled
- **NORMAL**: this is the state of normal operating conditions. In this state, the AEK-POW-LDOV01x software library is able to detect the thermal and overvoltage warning events (for the AEK-POW-LDOV01J only).When the normal state is active, the AEK-POW-LDOV01x software library generates a WI (watchdog) signal by using the E-MIOS peripheral with a fixed frequency whose value depends on the SELx configuration pin (for the AEK-POW-LDOV01J only)

Note: The AEK-POW-LDOV01x software library supports both AEK-POW-LDOV01J and AEK-POW-LDOV01S evaluation boards. If the user selects the AEK-POW-LDOV01S, the watchdog signal generation (WI), thermal, and overvoltage detection events are disabled.

3.3.1 Init device

At power-up, the AEK-POW-LDOV01x initializes the E-MIOS peripheral in the microcontroller to generate the WI signal (for the AEK-POW-LDOV01J only). The second step consists in initializing the ADC (SARADC-12bit) used to read and monitor the V_O output voltage provided by the voltage regulator.

The AEK-POW-LDOV01x software library includes a unique `Init` instruction with the following prototype:

`void AEK_POW_LDOV01x_init(uint8_t AEK_POW_LDOV01x_n_device);` where the `AEK_POW_LDOV01x_n_device` represents the allocated AEK-POW-LDOV01x board.

Note: You can invoke `void AEK_POW_LDOV01x_initAll()` to initiate all the boards allocated.

3.3.2 Power on

The AEK-POW-LDOV01x activation requires an enable on transaction of the FSM (see Section 2.2).

The AEK-POW-LDOV01x software library includes the following power on instruction:

`void AEK_POW_LDOV01x_power_on(uint8_t AEK_POW_LDOV01x_n_device);`, where the `AEK_POW_LDOV01x_n_device` represents the allocated AEK-POW-LDOV01x board.

Note: Before proceeding with the power on, set the output voltage by using the SELx pins.

3.3.3 Power off

To turn the AEK-POW-LDOV01x off, an enable off transaction is required.

The AEK-POW-LDOV01x software library includes the following power off instruction:

`void AEK_POW_LDOV01x_power_off (uint8_t AEK_POW_LDOV01x_n_device);`, where the `AEK_POW_LDOV01x_n_device` represents the allocated AEK-POW-LDOV01x board.

3.3.4 Setting the output voltage

To set the AEK-POW-LDOV01x output voltage, configure the SELx pins.

The AEK-POW-LDOV01x software library includes an instruction for the output voltage setting:

`void AEK_POW_LDOV01x_setOperationMode(AEK_POW_LDOV01x_op_mode_t op_mode, uint8_t AEK_POW_LDOV01x_n_device);`, where:

- `AEK_POW_LDOV01x_n_device` represents the allocated AEK-POW-LDOV01x board;
- `AEK_POW_LDOV01x_op_mode_t` is an `enum typedef` structure (_0_8V, _1_2V, _1_5V, _1_8V, _2_5V, _2_8_V, _3_3V, and _5_0V) used for the output voltage selection.

Note: Before proceeding with the power on, set the operating voltage by using the SELx pins.

3.3.5 Get device status

The AEK-POW-LDOV01x software library includes a `get FSM status` instruction:

`AEK_POW_LDOV01x_sts_t AEK_POW_LDOV01x_getDeviceSts (uint8_t AEK_POW_LDOV01x_n_device);`, where:

- `AEK_POW_LDOV01x_n_device` represents the allocated AEK-POW-LDOV01x board;
- `AEK_POW_LDOV01x_sts_t` is an `enum typedef` structure (`IDLE, POWER_OFF, POWER_ON, RESET, ERROR, NORMAL`).

3.3.6 Get warning status

The AEK-POW-LDOV01x software library includes a `get warning status` instruction to detect the warning events while the FSM is in the normal status:

`AEK_POW_LDOV01x_warning_sts_t AEK_POW_LDOV01x_getWarningStatus (uint8_t AEK_POW_LDOV01x_n_device);`, where:

- `AEK_POW_LDOV01x_n_device` represents the allocated AEK-POW-LDOV01x board;
- `AEK_POW_LDOV01x_warning_sts_t` is an `enum typedef` structure (`THERMAL_WARNING, OVERVOLTAGE_WARNING, NO_WARNING`).

3.3.7 Get output voltage

The AEK-POW-LDOV01x software library includes an instruction to get the output voltage value read from the SARADC:

`float AEK_POW_LDOV01x_getVout (uint8_t AEK_POW_LDOV01x_n_device);`, where:

- `AEK_POW_LDOV01x_n_device` represents the allocated AEK-POW-LDOV01x board;

4 Demo in the AutoDevKit

4.1 How to create a sample application for the AEK-POW-LDOV01x

This example explains how to create an application for the AEK-POW-LDOV01J/AEK-POW-LDOV01S. The microcontroller board used is the AEK-MCU-C1MLIT1.

Step 1. Create a new SPC5-STUDIO application for the SPC582B series microcontroller and add the following components:

- SPC582Bxx Init Package Component RLA
- SPC582Bxx Low Level Drivers Component RLA

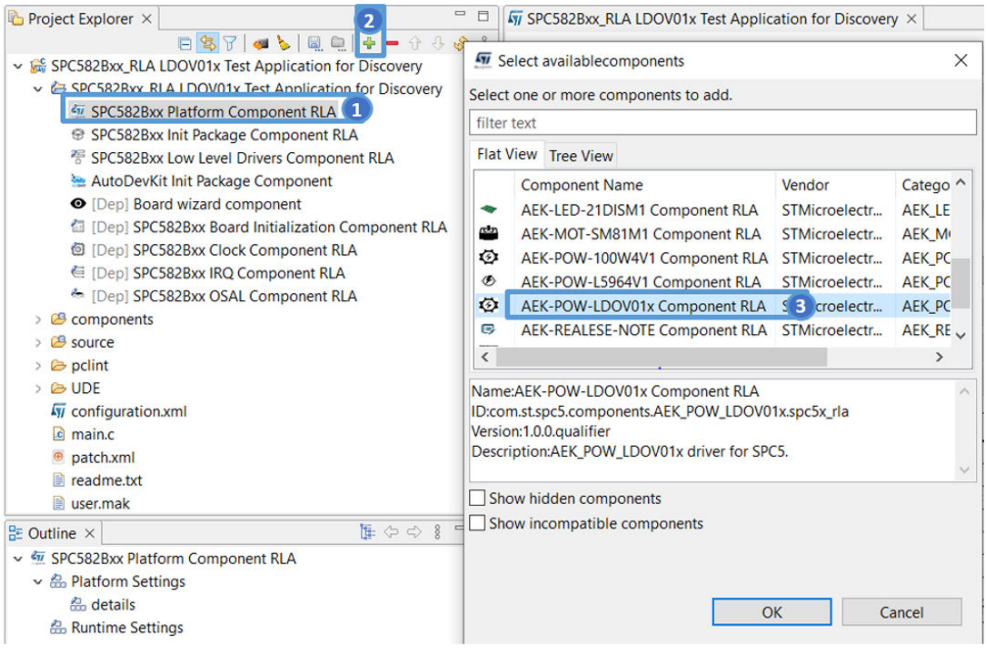
Important: Add these components immediately. Otherwise, the other components are not visible.

Step 2. Add the following additional components:

- AutoDevKit Init Package Component
- SPC582Bxx Platform Component RLA
- AEK-POW-LDOV01X Component RLA

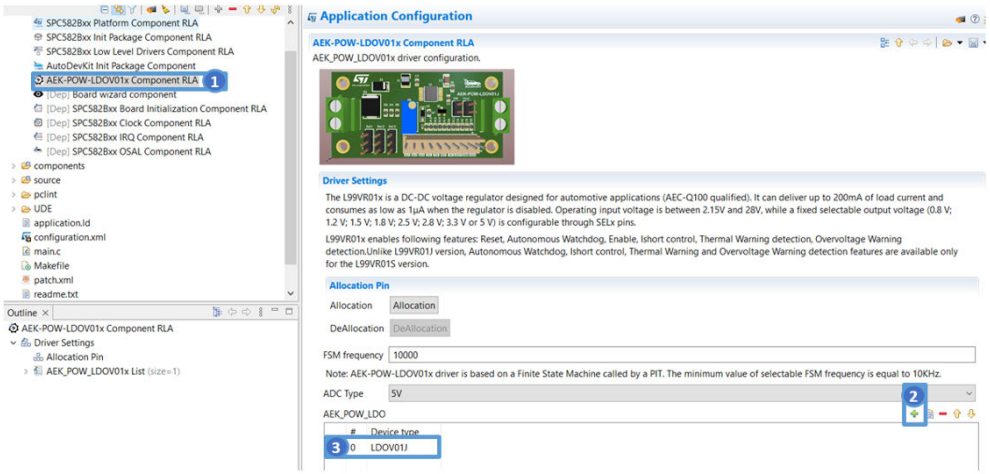
Step 3. Select [**AEK-POW-LDOV01x Component RLA**] to open the [**Application Configuration**] window.

Figure 9. [AEK-POW-LDOV01x Component RLA] selection



Step 4. Click on [**+**] to add a new element to the board list.

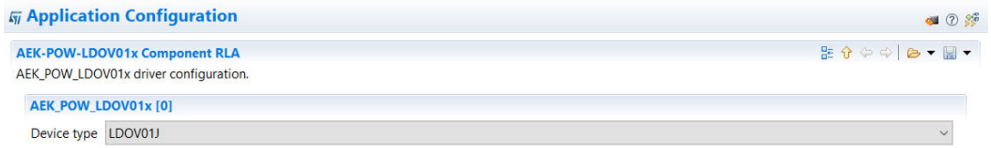
Figure 10. Adding a new element



Step 5. Double-click on the newly added element to configure the board.

Step 6. Select the voltage regulator part number.

Figure 11. Voltage regulator selection



Step 7. Select the FSM frequency (the default value is 10 kHz).

Step 8. Select the ADC voltage reference (the default value is 5 V).

Step 9. Click the [**Allocation**] button below the AEK-POW-LDOV01x list and click [**OK**] in the confirmation window.

This operation delegates the automatic pin allocation to the AutoDevKit.

Step 10. Generate and build the application using the appropriate icons in SPC5-STUDIO.

The project folder is then populated with new files, including the main.c and the component folder with the AEK-POW-LDOV01x drivers.

Step 11. Open the main.c file and include the AEK_POW_LDOV01x.h file.

Step 12. Save, generate, and compile the application.

Step 13. Open the [**Board View Editor**] provided by the AutoDevKit.

This editor offers a graphical point-to-point guide on how to wire the boards.

Step 14. Connect the AEK-MCU-C1MLIT1 to a USB port on your PC using a mini-USB to USB cable.

Step 15. Launch SPC5-UDESTK-SW and open the debug.wsx file in the chosen application name UDE folder.

Step 16. Run and debug your code.

4.2 Available demos for the AEK-POW-LDOV01x

The AutoDevKit includes some voltage regulator demos available for the SPC58EC Chorus 4M (SPC58ECxx_RLA AEK-POW-LDOV01x – DC – DC Voltage Regulator - Test Application) and SPC582B Chorus 1M (SPC582Bxx_RLA AEK-POW-LDOV01x – DC – DC Voltage Regulator - Test Application). The demos are identical, but they are controlled by different MCUs.

The AEK-POW-LDOV01J board demo goal is to generate a fixed output voltage (5 V). If an overvoltage warning or thermal warning event occurs, the regulator is switched off.

Figure 12. Demo code

```
#include "components.h"
#include "AEK_POW_LDOV01x.h"
/*
 * Application entry point.
 */
int main(void) {

  /* Initialization of all the imported components in the order specified in
     the application wizard. The function is generated automatically.*/
  componentsInit();

  irqIsrEnable();

  /*
   * Init AEK_POW_LDOV01x_DEV0
   */
  AEK_POW_LDOV01x_init(AEK_POW_LDOV01x_DEV0);
  AEK_POW_LDOV01x_setOperationMode(_5_0_V,AEK_POW_LDOV01x_DEV0);
  AEK_POW_LDOV01x_power_on(AEK_POW_LDOV01x_DEV0);

  /* Application main loop.*/
  for ( ; ; ) {
      if(AEK_POW_LDOV01x_getWarningStatus(AEK_POW_LDOV01x_DEV0)!=NO_WARNING){
          AEK_POW_LDOV01x_power_off(AEK_POW_LDOV01x_DEV0);
      }
  }

  /*
   * DeInit AEK_POW_LDOV01x_DEV0
   */
  AEK_POW_LDOV01x_Deinit(AEK_POW_LDOV01x_DEV0);
}
```

Note: If the AEK-POW-LDOV01J is connected to the load, set the correct V_O output voltage by using the `AEK_POW_LDOV01x_setOperationMode` API.

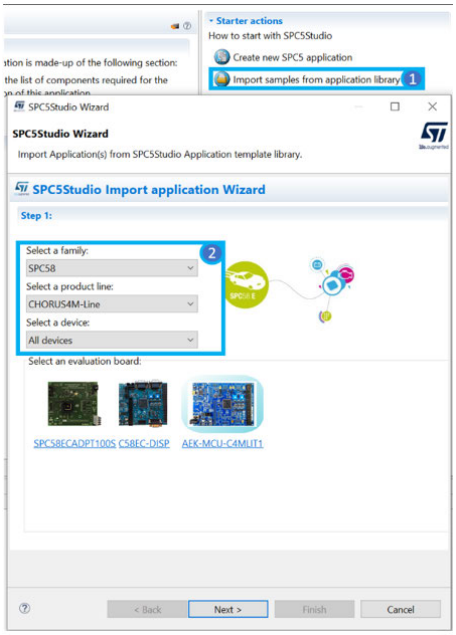
4.2.1 How to upload the demos

Follow the procedure below to import the demos into SPC5-STUDIO.

Step 1. Select [**Import samples from application library**] from the [**Common tasks**] panel.
An [**Import application Wizard**] appears.

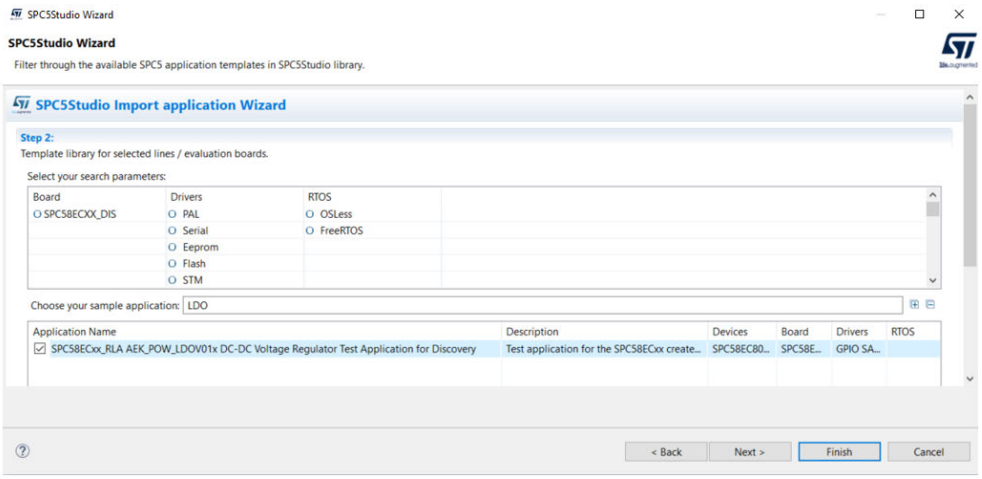
Step 2. Insert the appropriate MCU family details.

Figure 13. MCU family selection



Step 3. Select the desired application from the library.

Figure 14. Application selection



Step 4. Click the [**Finish**] button.

5 APIs

void AEK_POW_LDOV01x_init(uint8_t AEK_POW_LDOV01x_n_device);

This function initializes the AEL_POW_LDOV01x.

void AEK_POW_LDOV01x_initAll();

This function initializes all the AEL_POW_LDOV01x.

void AEK_POW_LDOV01x_power_on(uint8_t AEK_POW_LDOV01x_n_device);

This function turns on the AEK_POW_LDOV01x.

void AEK_POW_LDOV01x_power_off(uint8_t AEK_POW_LDOV01x_n_device);

This function turns off the AEK_POW_LDOV01x.

void AEK_POW_LDOV01x_setOperationMode(AEK_POW_LDOV01x_op_mode_t op_mode, uint8_t AEK_POW_LDOV01x_n_device);

This function sets the output voltage (0.8 V, 1.2 V, 1.5 V, 1.8 V, 2.5 V, 2.8 V, 3.3 V, or 5 V) for the AEK_POW_LDOV01x.

AEK_POW_LDOV01x_sts_t AEK_POW_LDOV01x_getDeviceSts(uint8_t AEK_POW_LDOV01x_n_device);

This function gets the AEK_POW_LDOV01x status (`IDLE, POWER_OFF, POWER_ON, RESET, ERROR, NORMAL`)

AEK_POW_LDOV01x_warning_sts_t AEK_POW_LDOV01x_getWarningStatus(uint8_t AEK_POW_LDOV01x_n_device);

This function gets the AEK_POW_LDV01x warning status (`THERMAL_WARNING, OVERVOLTAGE_WARNING, NO_WARNING`).

float AEK_POW_LDOV01x_getVout(uint8_t AEK_POW_LDOV01x_n_device);

This function gets the output voltage read from SARADC when the AEK_POW_LDOV01x is connected to an external MCU.

6 Test results

Figure 15. **Enable pulse signal waveform generated by an external MCU connected to the AEK-POW-LDOV01J**

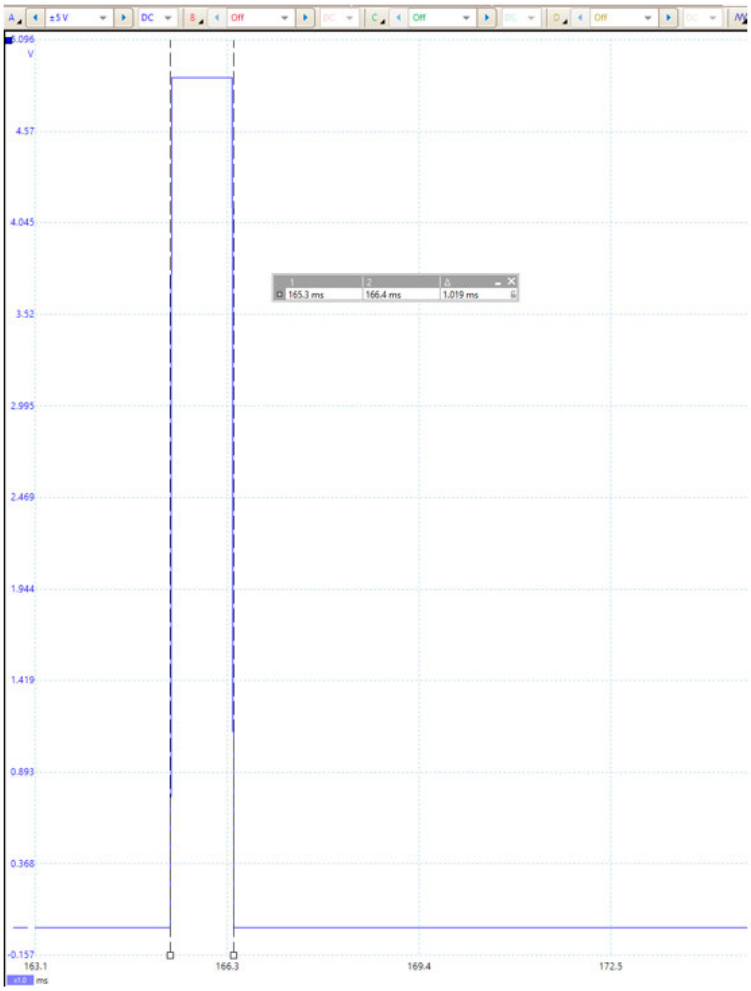


Figure 16. **Watchdog signal waveform generated by an external MCU connected to the AEK-POW-LDOV01J (operating voltage selected = 5 V)**

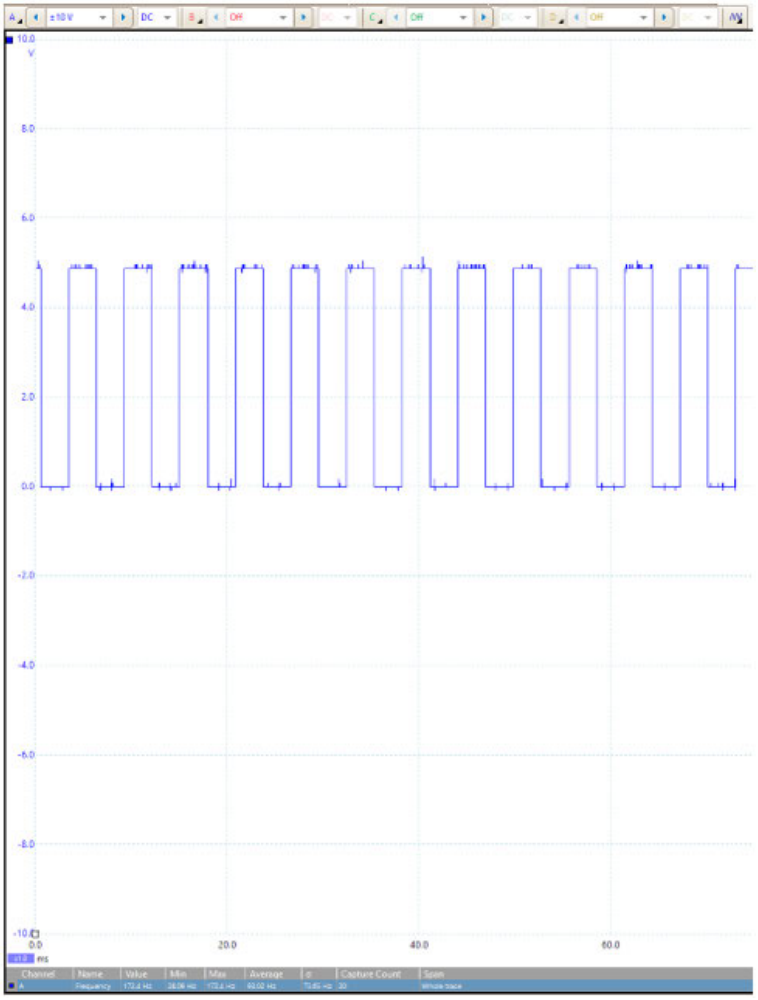


Figure 17. Output voltage waveform generated by the AEK-POW-LDOV01J after power on (operating voltage selected = 5 V)

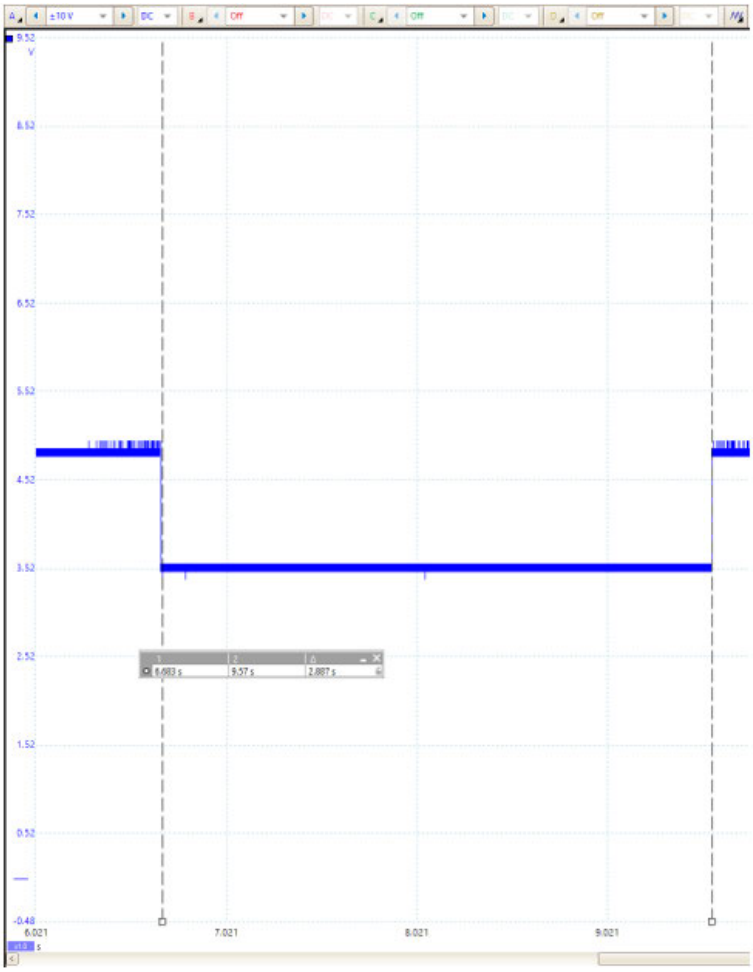


Figure 18. **Thermal warning waveform generated by the AEK-POW-LDOV01J after power on (operating voltage selected = 5 V)**

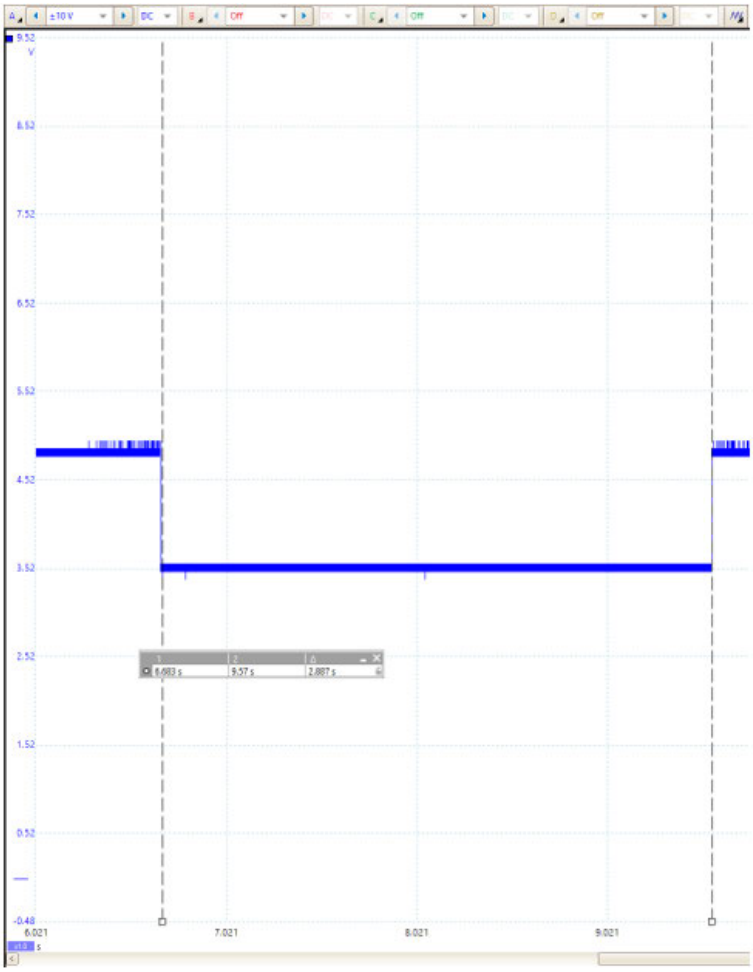


Figure 19. Overvoltage warning waveform generated by the AEK-POW-LDOV01J (operating voltage selected = 5 V)

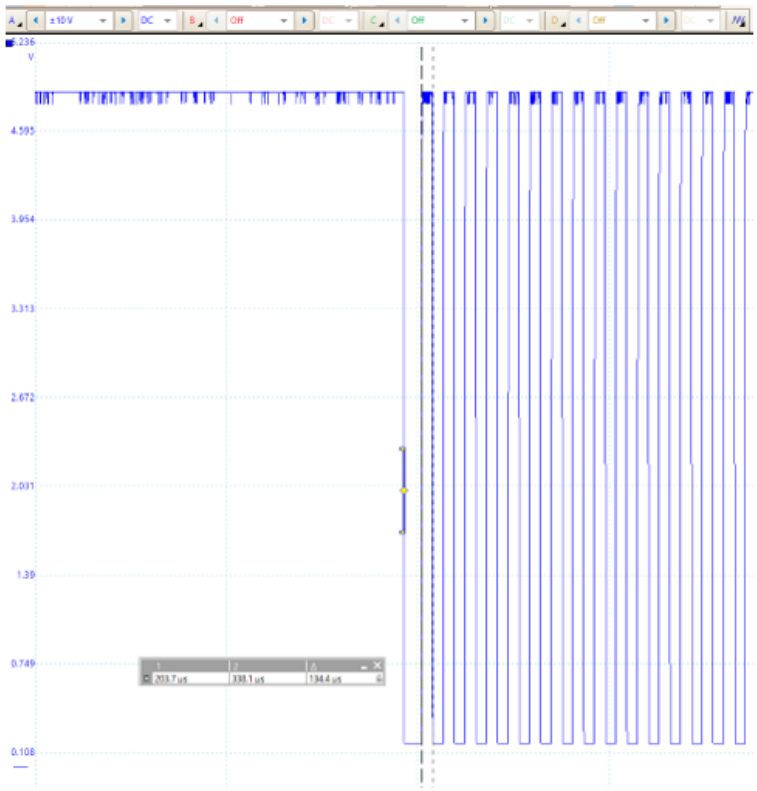
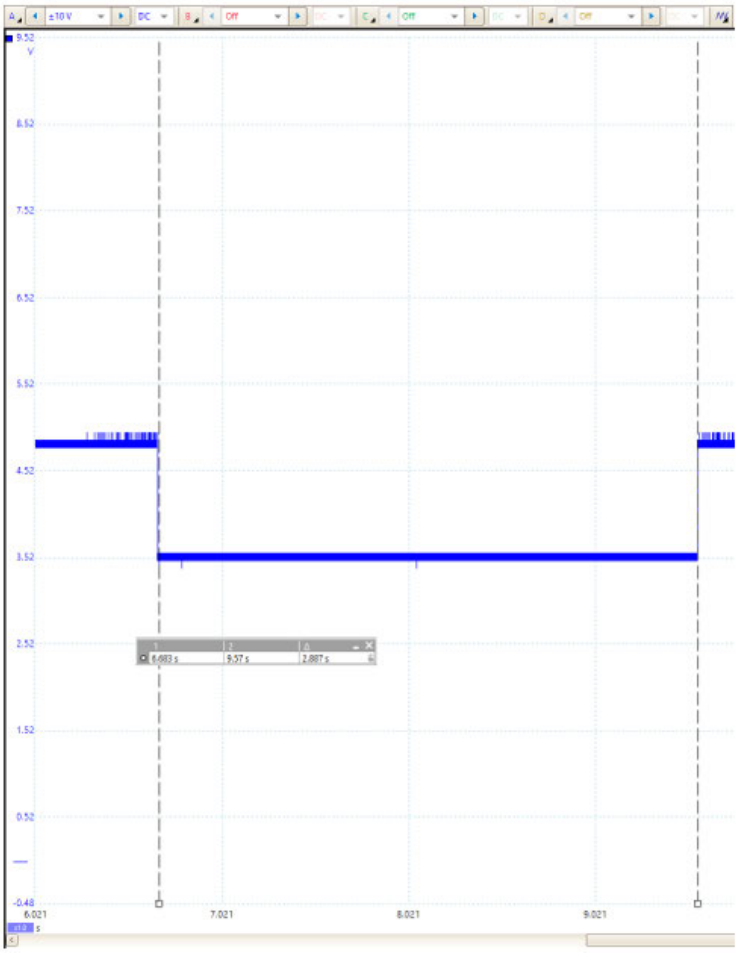
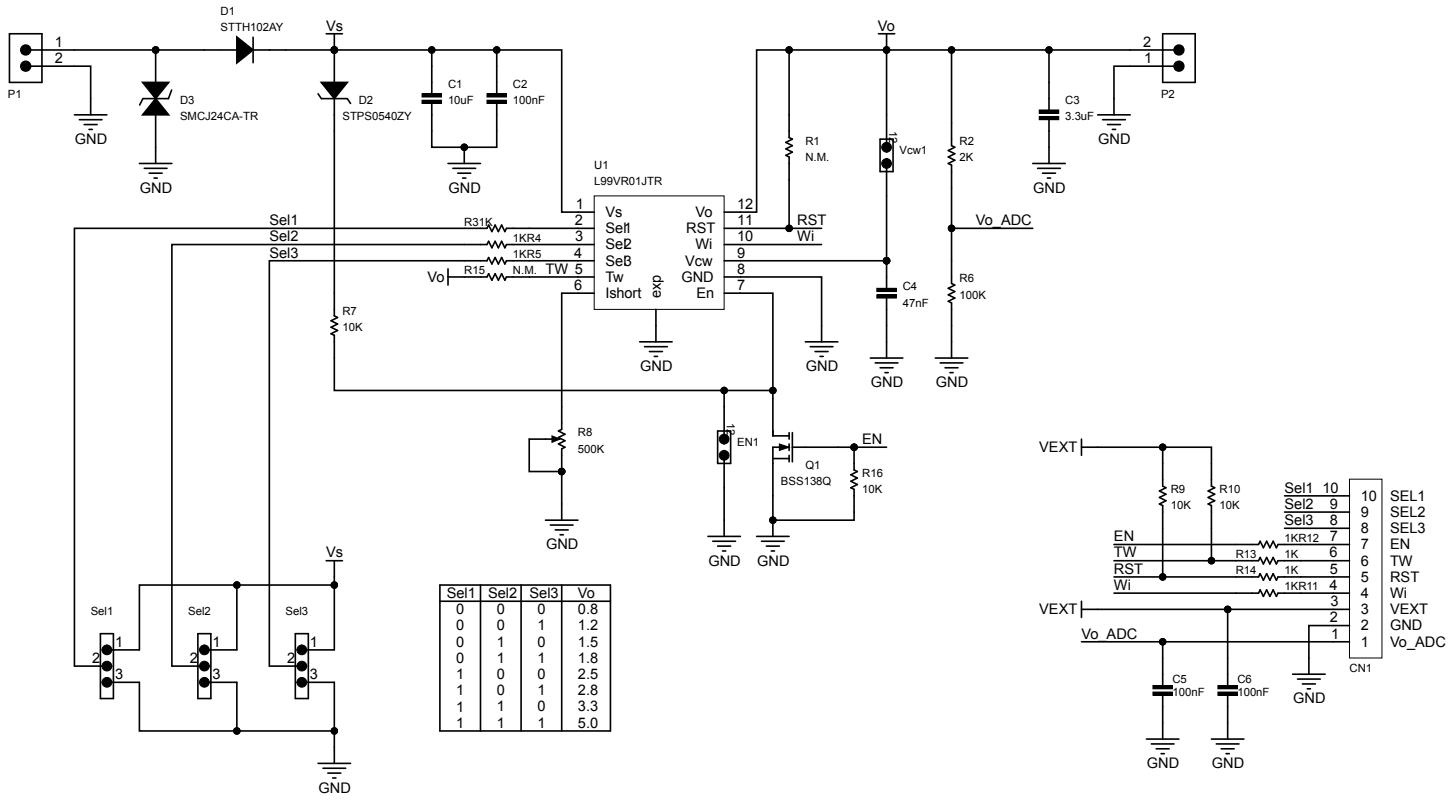


Figure 20. **Reset signal waveform generated by the AEK-POW-LDOV01J if the V_O output voltage is lower than the V_{th} threshold**



7 AEK-POW-LDOV01J schematic diagrams

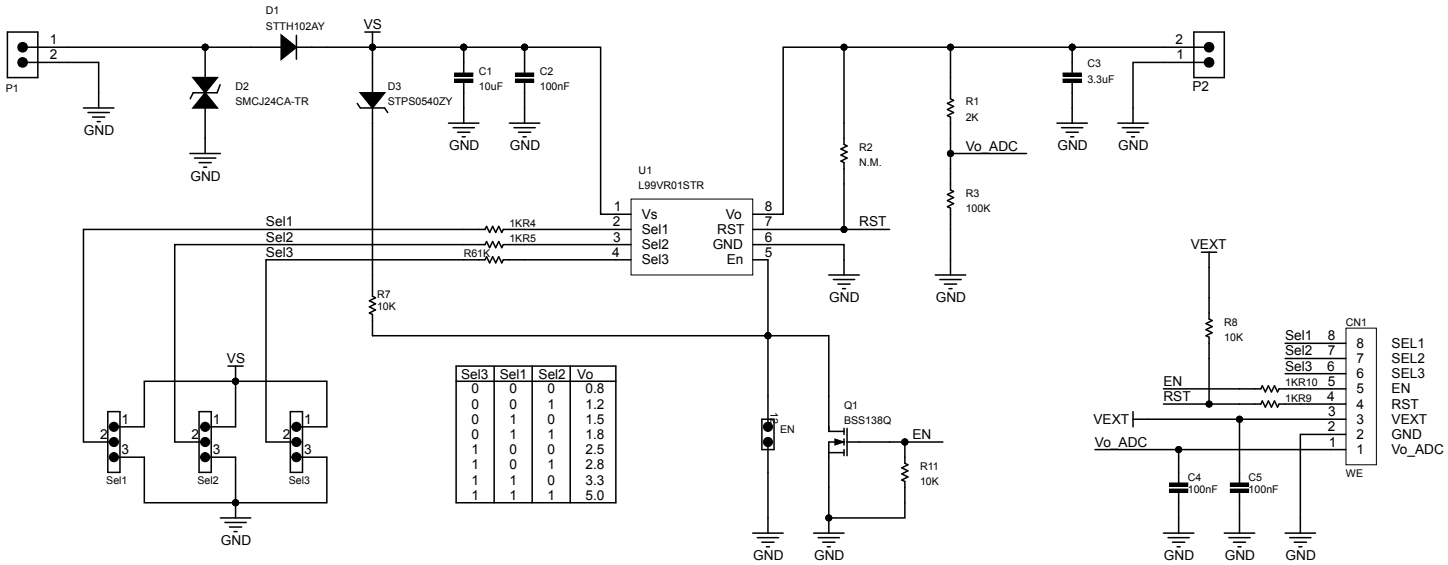
Figure 21. **AEK-POW-LDOV01J circuit schematic**



Sel1	Sel2	Sel3	Vo
0	0	0	0.8
0	0	1	1.2
0	1	0	1.5
0	1	1	1.8
1	0	0	2.5
1	0	1	2.8
1	1	0	3.3
1	1	1	5.0

8 AEK-POW-LDOV01S schematic diagrams

Figure 22. **AEK-POW-LDOV01S circuit schematic**



Sel3	Sel1	Sel2	Vo
0	0	0	0.8
0	0	1	1.2
0	1	0	1.5
0	1	1	1.8
1	0	0	2.5
1	0	1	2.8
1	1	0	3.3
1	1	1	5.0

9 AEK-POW-LDOV01J bill of materials

Table 6. AEK-POW-LDOV01J bill of materials

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
1	1	C1	10uF, 1210C, 50V, ±10%	1210 capacitor - X7R Class II	Wurth Elektronik	885012209073
2	3	C2, C5, C6	100nF, 0603C, 50V, ±10%	0603 capacitor - X7R Class II	Wurth Elektronik	885012206095
3	1	C3	3.3uF, 1206C, 25V, ±10%	1206 capacitor - X7R Class II	Wurth Elektronik	885012208067
4	1	C4	47nF, 0603C, 50V, ±10%	0603 capacitor - X7R Class II	Wurth Elektronik	885012206093
5	1	CN1	Connector M KK254	Conn, header, 10-pos, 1 row, 2.54 mm	Wurth Elektronik	61901011121
6	1	D1	STTH102AY, SMA	Automotive 200 V, 1 A ultrafast diode	ST	STTH102AY
7	1	D2	STPS0540ZY, SOD-123	Automotive 40 V, 0.5 A power Schottky rectifier	ST	STPS0540ZY
8	1	D3	SMCJ24CA-TR, SMC	1500 W, 24 V TVS in SMC	ST	SMCJ24CA-TR
9	2	EN1, Vcw1	Jumper, SIP2	Header, 2-Pin, Single row	Wurth Elektronik	61300211121
10	2	P1, P2	691213510002, RisingCageClamp - 2p-5.08mm	WR-TBL series 2135 - 5.08 mm horizontal entry modular w. rising cage clamp	Wurth Elektronik	691213510002
11	1	Q1	BSS138Q, SOT23	N-channel enhancement mode automotive vertical DMOS FET	Diodes	BSS138Q-7-F
12	2	R1, R15	N.M., 0603R	0603 Resistor - ±1%	Any	Any
13	1	R2	2K, 0603R, 0.2W, +/-1%	0603 Resistor - ±1%	Panasonic	ERJP03F2001V
14	7	R3, R4, R5, R11, R12, R13, R14	1K, 0603R, 0.2W, +/-1%	0603 Resistor - ±1% -	Panasonic	ERJPA3F1001V
15	1	R6	100K, 0603R, 0.2W, +/-1%	0603 Resistor - ±1%	Panasonic	ERJP03F1003V
16	4	R7, R9, R10, R16	10K, 0603R, 0.2W, +/-1%	0603 Resistor - ±1%	Panasonic	ERJP03F1002V
17	1	R8	500K, 3296W Trimmer THT, 0.5W, +/-10%	Trimmer - ±10%	Bourns	3296W-1-504LF
18	3	Sel1, Sel2, Sel3	Jumper SIP3	Header, 3-pin, single row	Wurth Elektronik	61300311121

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
19	1	U1	L99VR01JTR, PowerSSO-12	Automotive linear voltage regulator with configurable output voltage and 200 mA current capability	ST	L99VR01JTR
20	4		60900213421	Jumper 2.54 mm	Wurth Elektronik	60900213421
21	4		970100365	Nylon spacer M3x10mmF/F	Wurth Elektronik	970100365
22	4		97790603111	Nylon screw M3x6mm	Wurth Elektronik	97790603111
23	1		61901011621	2.54 mm female terminal housing	Wurth Elektronik	61901011621
24	10		61900113722DEC	WR-WTB 2.54 mm female crimp contact	Wurth Elektronik	61900113722DEC

10 AEK-POW-LDOV01S bill of materials

Table 7. AEK-POW-LDOV01S bill of materials

Item	Q.ty	Ref.	Value	Description	Manufacturer	Order code
1	1	C1	10µF, 1210C, 50 V, ±10 %	1210 capacitor - X7R class II	WE	885012209073
2	3	C2, C4, C5	100nF, 0603C, 50 V, ±10 %	0603 capacitor - X7R class II	WE	885012206095
3	1	C3	3.3uF, 1206C, 25 V, ±10 %,	1206 capacitor - X7R class II	Wurth Elektronik	885012208067
4	1	CN1	Connector, KK254, pitch 2.54 mm, 1 row, 8 ways	Connector	Wurth Elektronik	61900811121
5	1	D1	STTH102AY, SMA	Automotive 200 V, 1 A ultrafast diode	ST	STTH102AY
6	1	D3	STPS0540ZY, SOD-123	Automotive 40 V, 0.5 A power Schottky rectifier	ST	STPS0540ZY
7	1	D2	SMCJ24CA-TR, SMC	1500 W, 24 V TVS in SMC	ST	SMCJ24CA-TR
8	1	EN1	Jumper, SIP2	Header, 2-Pin, Single row	Wurth Elektronik	61300211121
9	2	P1, P2	691213510002, RisingCageClamp - 2p- 5.08 mm	WR-TBL series 2135 - 5.08 mm horizontal entry modular with rising cage clamp	Wurth Elektronik	691213510002
10	1	Q1	BSS138Q, SOT23	N-channel enhancement mode automotive vertical DMOS FET	Diodes	BSS138Q-7-F
11	0	R2	N.M., 0603R ±1%	0603 resistor (not mounted)	-	-
12	1	R1	2K, 0603R, 0.2 W, ±1%	0603 resistor	Panasonic	ERJP03F2001V
13	5	R4, R5, R6, R9, R10	1K, 0603R, 0.2 W, ±1%	0603 resistor	Panasonic	ERJPA3F1001V
14	1	R3	100K, 0603R, 0.2 W, ±1%	0603 resistor	Panasonic	ERJP03F1003V
15	3	R7, R8, R11	10K, 0603R, 0.2 W, ±1%	0603 resistor	Panasonic	ERJP03F1002V
16	3	Sel1, Sel2, Sel3	Jumper, SIP3	Header, 3-pin, single row	Wurth Elektronik	61300311121

Item	Q.ty	Ref.	Value	Description	Manufacturer	Order code
17	1	U1	L99VR01STR, SO-8	Automotive linear voltage regulator with configurable output voltage and 200 mA current capability	ST	L99VR01STR
20	5		60900213421	Jumper 2.54 mm	Wurth Elektronik	60900213421
21	4		970100365	Nylon spacer M3x10 mmF/F	Wurth Elektronik	970100365
22	4		97790603111	Nylon screw M3x6 mm	Wurth Elektronik	97790603111
23	1		61900811621	2.54 mm female terminal housing	Wurth Elektronik	61900811621
24	8		61900113722DEC	WR-WTB 2.54 mm female crimp contact	Wurth Elektronik	61900113722DEC

11 AEK-POW-LDOV01J versions

Table 8. AEK-POW-LDOV01J versions

PCB version	Schematic diagrams	Bill of materials
AEK$POW-LDOV01JA (1)	AEK$POW-LDOV01JA schematic diagrams	AEK$POW-LDOV01JA bill of materials

1. *This code identifies the AEK-POW-LDOV01J evaluation board first version. It is printed on the board PCB.*

12 AEK-POW-LDOV01S versions

Table 9. AEK-POW-LDOV01S versions

PCB version	Schematic diagrams	Bill of materials
AEK$POW-LDOV01SA (1)	AEK$POW-LDOV01SA schematic diagrams	AEK$POW-LDOV01SA bill of materials

1. *This code identifies the AEK-POW-LDOV01S evaluation board first version. It is printed on the board PCB.*

13 AEK-POW-LDOV01J regulatory compliance information

Formal Notice Required by the U.S. Federal Communications Commission

For evaluation only; not FCC approved for resale

FCC NOTICE

This kit is designed to allow:

(1) Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and

(2) Software developers to write software applications for use with the end product.

This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter 3.1.2.

Formal Product Notice Required by Industry Canada Innovation, Science and Economic Development

Canada compliance:

For evaluation purposes only. This kit generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to Industry Canada (IC) rules.

À des fins d'évaluation uniquement. Ce kit génère, utilise et peut émettre de l'énergie radiofréquence et n'a pas été testé pour sa conformité aux limites des appareils informatiques conformément aux règles d'Industrie Canada (IC).

Formal product notice required by EU

This device is in conformity with the essential requirements of the Directive 2014/30/EU (EMC) and of the Directive 2015/863/EU (RoHS).

14 AEK-POW-LDOV01S regulatory compliance information

Formal Notice Required by the U.S. Federal Communications Commission

For evaluation only; not FCC approved for resale

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This kit is designed to allow:

(1) Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and

(2) Software developers to write software applications for use with the end product.

This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter 3.1.2.

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Formal product notice required by EU

This device is in conformity with the essential requirements of the Directive 2014/30/EU (EMC) and of the Directive 2015/863/EU (RoHS).

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
26-Jul-2022	1	Initial release.

Contents

List of tables

List of figures