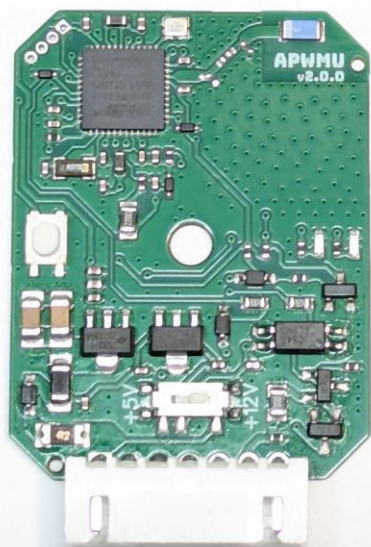


APWMU 2.0

UNIVERSAL PWM FAN ADAPTER
NEW GENERATION WITH **BLUETOOTH** SUPPORT
AND THE **APWMU BLE** MOBILE APP



 **USER MANUAL**

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DEVICE PURPOSE:

ApwmU 2.0 is a universal PWM adapter for cooling fan control with Bluetooth and a mobile app. The device is intended for automotive fans with an electronic power control unit.

The controller generates a control PWM signal with the required parameters: frequency, polarity, amplitude and duty cycle. The main setup method is through the **ApwmU BLE** mobile app via **Bluetooth Low Energy**. The device also retains setup via the on-board button and LED indication, as in the previous version.

ApwmU 2.0 can operate in two main modes:

- from a separate NTC temperature sensor - the controller measures engine temperature itself and calculates fan speed;
- from the stock ECU PWM signal - the controller receives the stock signal and converts it into PWM with parameters suitable for the installed fan.

Setup methods

The most convenient way to configure ApwmU 2.0 BLE is through the mobile app. The button and LED on the board remain an additional service setup method when the app is unavailable (see the end of the document).

IMPORTANT BEFORE INSTALLATION:

ApwmU 2.0 is not original vehicle equipment and is not factory-certified for any specific vehicle!!! Installation is performed at the responsibility of the owner or installer!!!

Before installation, study the manual carefully and make sure you understand the purpose of each pin and each setting.

The device is intended for use in a 12 V vehicle electrical system. Controller power must be supplied from the ignition circuit so that the device turns on only when the ignition is on.

Before connection, be sure to check:

- the purpose of the fan wires;
- the type of the fan control signal;
- the required PWM signal amplitude: +5 V or +12 V;
- the required PWM signal frequency;
- whether inversion and/or an idle PWM signal must be enabled;
- correct connection of power, ground and fuses.

Incorrect connection may cause improper fan operation, engine overheating, damage to the fan, wiring, or the controller itself!!!

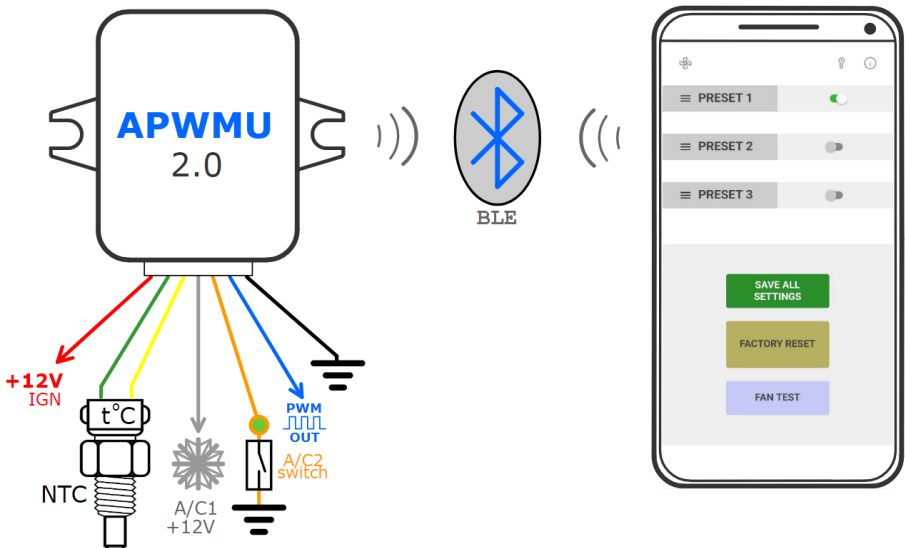
TECHNICAL SPECIFICATIONS:

Case dimensions	40x50x20 mm
Case type	standard (not sealed)
Case material	ABS plastic
Connector	standard 7-pin x 2.54 mm
PCB dimensions	30.5 x 40.5 mm
Supply voltage	+12 V (max. +16 V)
Continuous current consumption	< 50 mA
Number of signal/power ports	5/2
Control signals	- NTC temperature sensor - PWM input (10...1000 Hz)
PWM output frequencies	10/25/50/100/250/500/1000 Hz
Maximum PWM output load capacity	200 mA
PWM output amplitude	+5 V/+12 V (switch on the board)
PWM input frequencies	from 10 to 1000 Hz
PWM input amplitude	+3 V...+24 V
Adapter interaction	- mobile app - on-board button
Fan operation indication	- mobile app - green LED on the board
Bluetooth connection indication	- blue LED on the board

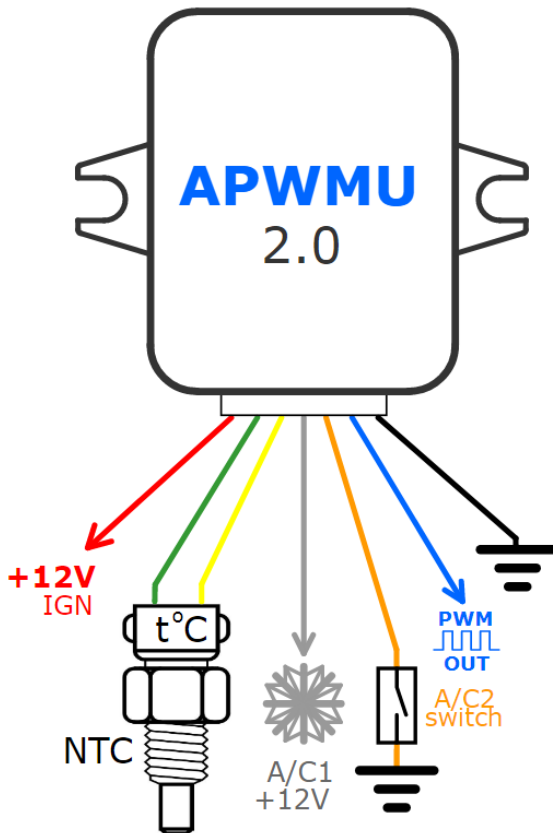
Pinout:

PIN	COLOR	PURPOSE
+12V	red	controller power from ignition circuit
NTC	green	connection of a separate NTC temperature sensor
	yellow	
AC1	white	+12 V input, usually from the air conditioning system
AC2	orange	ground-switch input, for example from a pressure sensor or manual switch
PWM	blue	output PWM signal to the fan control unit
GND	black	vehicle ground

Depending on the selected operating mode, not all inputs are used at the same time. When operating from an NTC sensor, the controller measures temperature and controls the fan according to the selected cooling strategy. When operating from the stock PWM signal of the engine ECU, the controller temperature sensor is not used and ApwmU works as a PWM signal converter.



Connection with a separate NTC sensor:



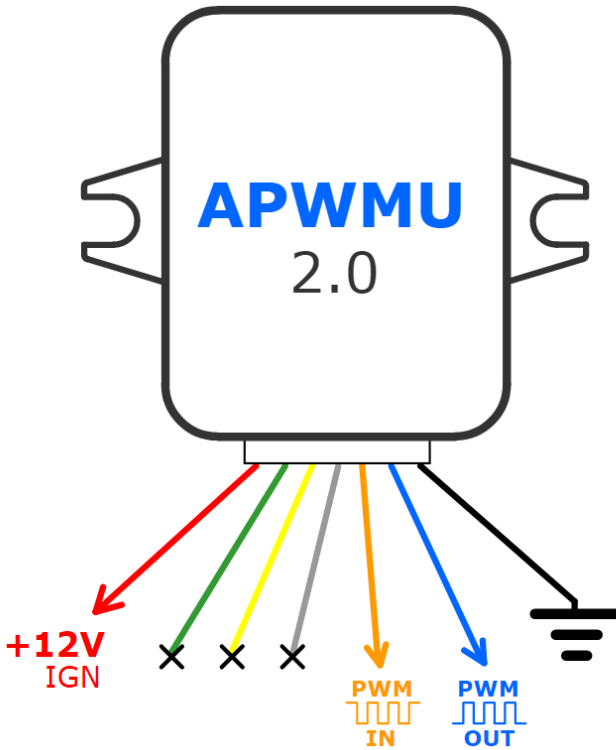
Connection diagram with a separate NTC sensor

This option is used when the fan must be controlled by engine temperature, and the stock engine ECU does not provide a suitable PWM signal for the installed fan.

In this mode, the controller measures temperature using a separate NTC sensor, compares it with the configured thresholds and smoothly changes fan speed. AC1 and AC2 inputs may also be used.

It is recommended to install the NTC sensor as close as possible to the coolant outlet from the engine. Do not install the sensor in the lower radiator hose or in a place where temperature strongly depends on airflow and thermostat opening!!!

Connection from the stock ECU PWM signal:



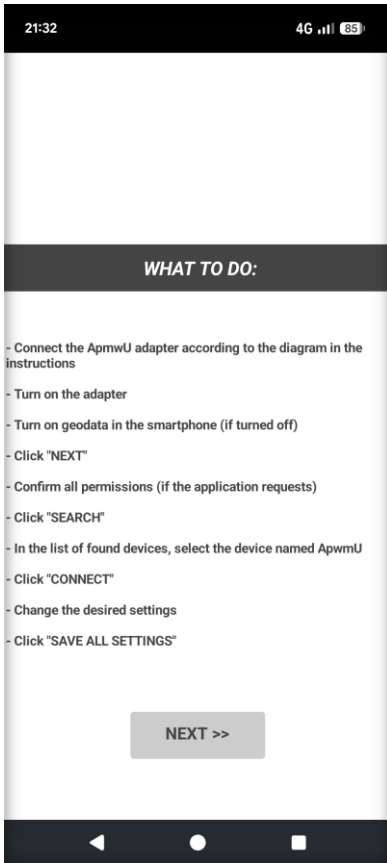
Connection diagram in ECU PWM input mode

This option is used when the stock engine control unit already outputs a PWM fan control signal, but this signal is not directly suitable for the installed fan.

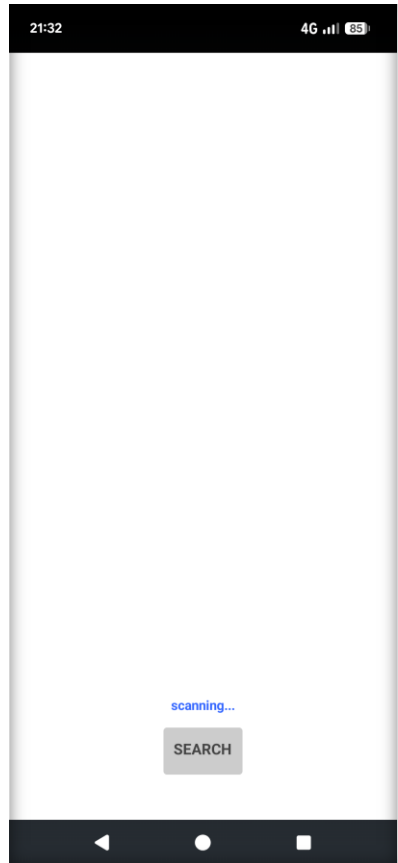
ApwmU 2.0 receives the PWM signal from the ECU and generates a new output PWM signal for the fan. The controller can change the frequency, duty range, polarity, speed-change smoothness and idle PWM availability.

For this mode, select the "External PWM" or "External PWM (inversion)" strategy in the app. Temperature thresholds are not used in PWM adaptation mode, and AC1/AC2 ports are not used either.

Quick start:



Quick start



Device search

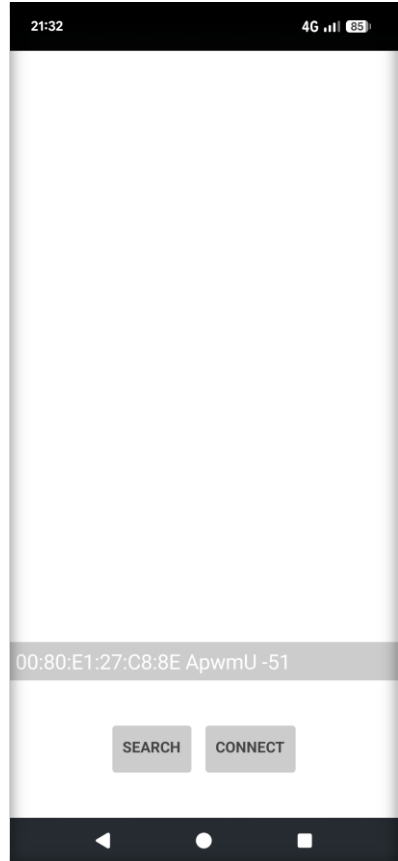
1. Connect ApwmU 2.0 according to the selected diagram.
2. Install the ApwmU BLE app on your smartphone.
3. Enable Bluetooth and location services on your smartphone.
4. Apply power to the controller.
5. Open the app and tap SEARCH.
6. Select the found ApwmU device and tap CONNECT.
7. Open the required preset and, if necessary, set the PWM frequency, min/max speed, idle PWM, inversion and other parameters. If the app is unavailable, setup is also possible using the button and LED on the board.

9. For NTC sensor mode, save the lower and upper temperature thresholds.
10. Tap the SAVE ALL SETTINGS button.
11. Before setting temperature thresholds, check fan operation by tapping the FAN TEST button.

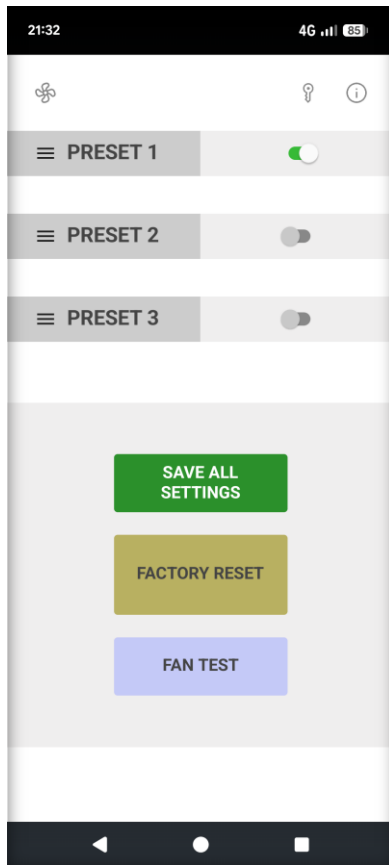
Connecting to the app:



Device found



Connection

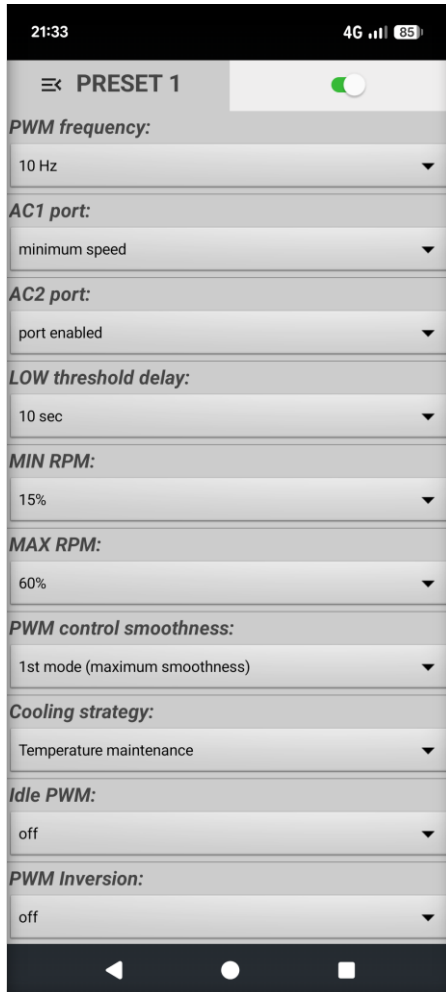


Main screen after connection

After launching the app, tap SEARCH. When the controller is found, a device named ApwmU will appear in the list. Select it and tap CONNECT.

After successful Bluetooth connection, the main settings screen opens in the mobile app. If the device is not found, check controller power, Bluetooth status and distance to the device, then restart the app or controller power.

Main screen, presets and setup methods:



Expanded preset with settings

The main screen contains three independent presets. Each preset stores its own set of settings. This is convenient for different fan operation variants: summer mode, winter mode, test mode or a mode for another fan.

One preset can be active. The active preset settings are used by the controller during operation.

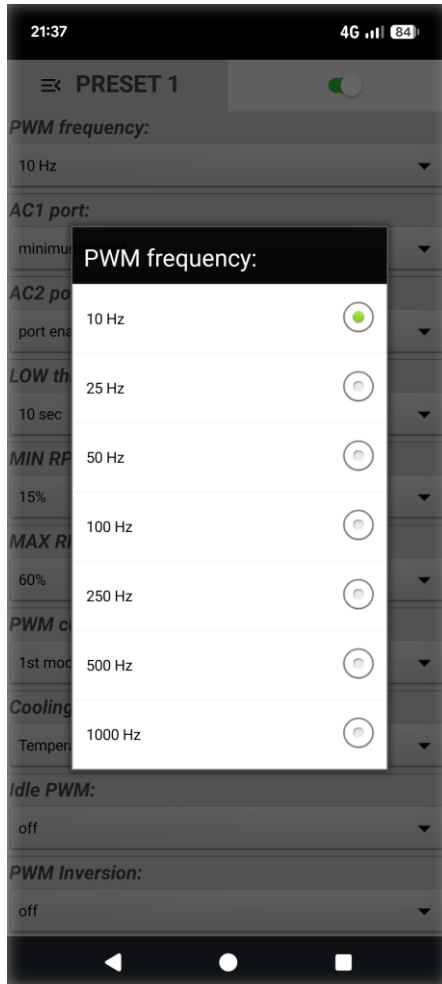
- SAVE ALL SETTINGS - writes the current settings to controller memory.
- FACTORY RESET - returns settings to factory values.

- FAN TEST - starts a fan test to check the connection and PWM parameters.

After changing parameters in the app, be sure to tap SAVE ALL SETTINGS. If parameters are changed but not saved, after power restart the controller will restore the previously saved values.

Additionally, ApwmU 2.0 can be configured using the on-board button and LED indication, as in the previous version. This method is convenient for service setup or restoring basic parameters without a smartphone. The main and more visual setup method is the mobile app.

PWM frequency:



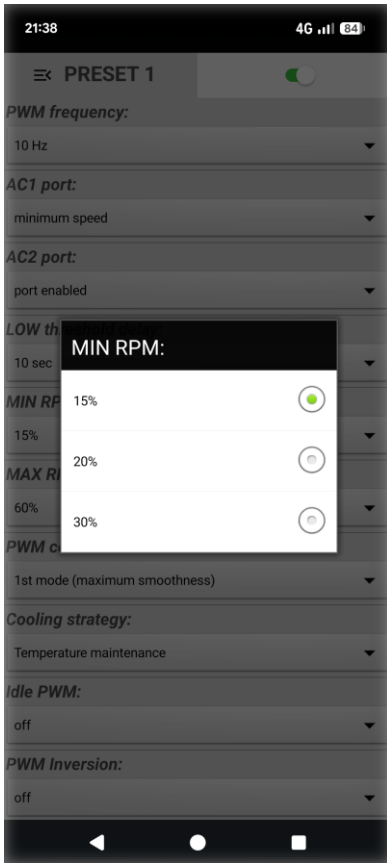
PWM frequency setting

PWM frequency determines how often the controller generates the fan control signal. Available frequencies: **10, 25, 50, 100, 250, 500** and **1000** Hz.

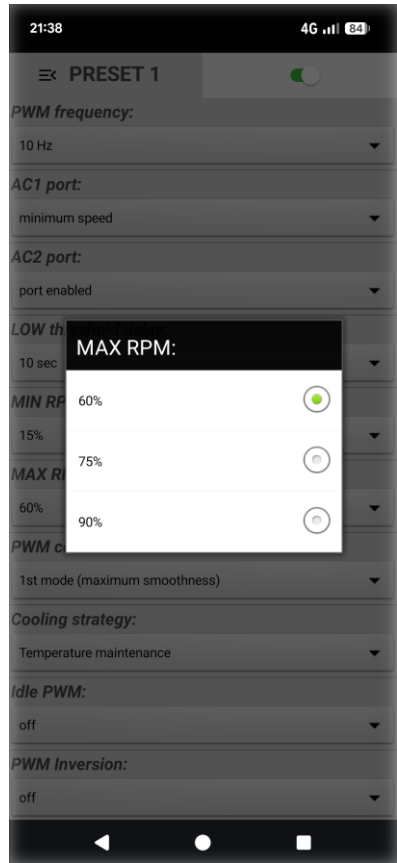
Different fans may require different PWM frequencies. If the frequency is selected incorrectly, the fan may fail to start, run in jerks, immediately go to maximum, hold speed unstably, or not respond to duty changes.

After changing the frequency, it is recommended to run the fan test.

Minimum and maximum speed:



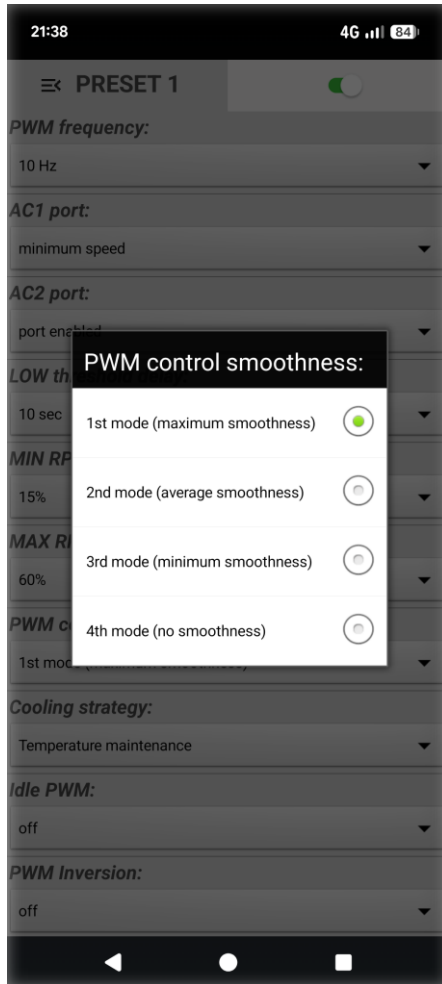
Minimum speed



Maximum speed

Minimum speed is the duty value from which the fan must start reliably and rotate stably. Maximum speed is the upper duty limit to which the controller will accelerate the fan at high temperature, active AC2, or other maximum cooling conditions.

PWM smoothness adjustment:



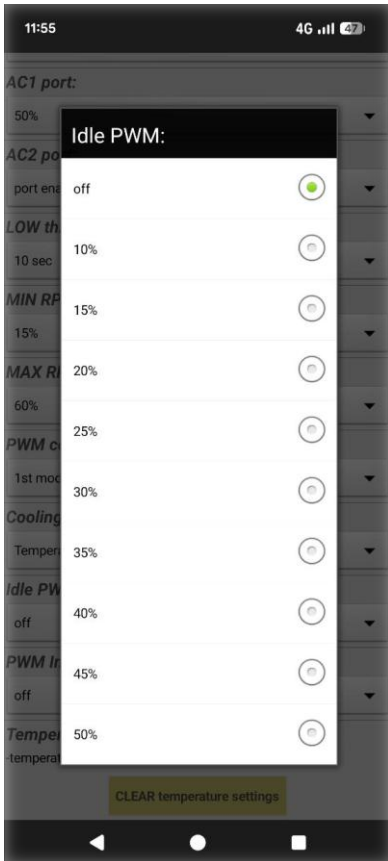
PWM smoothness setting

Smoothness adjustment determines how quickly the controller changes fan speed when temperature or the control signal changes.

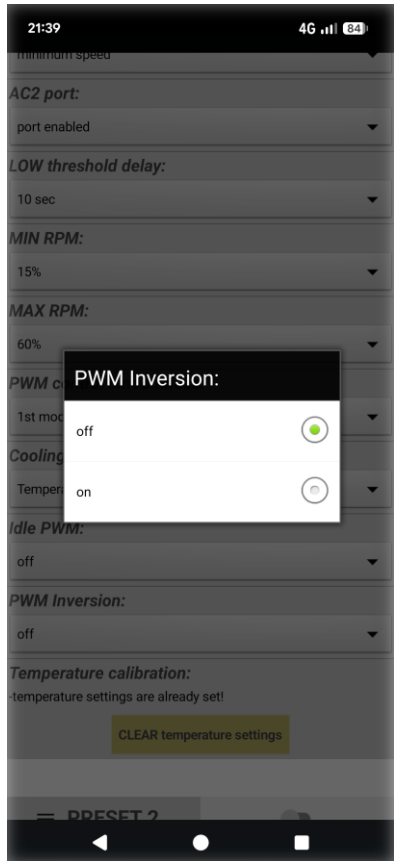
Lower smoothness means faster fan response.

Higher smoothness makes speed changes softer.

Idle PWM and inversion:



Idle PWM



PWM inversion

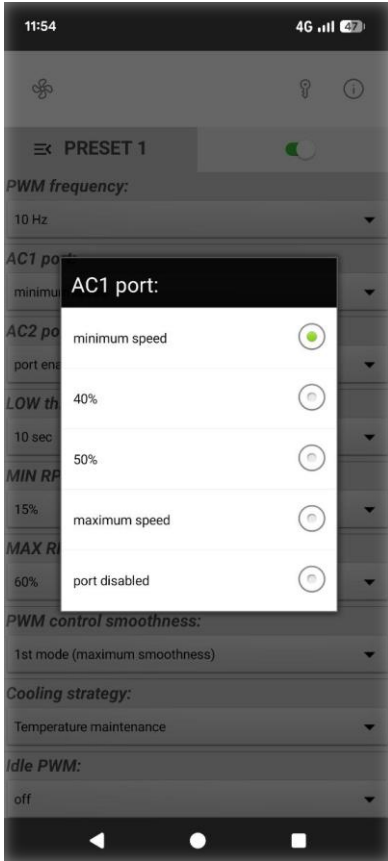
Some fan control units require a constant PWM signal even when the fan should be stopped or in standby mode.

(for example Mercedes-Benz, BMW).

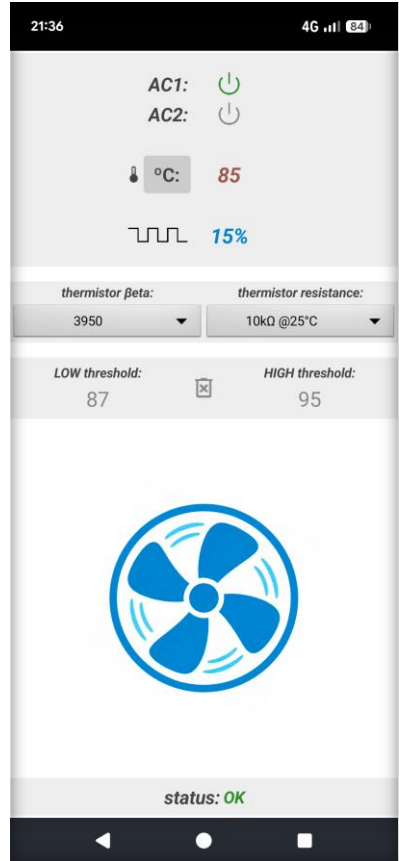
For such fans, the Idle PWM function is used.

Inversion changes the logical direction of the PWM signal. If the fan works opposite to what is expected, starts at maximum with low duty, or slows down instead of speeding up, enable or disable PWM inversion and repeat the test.

AC1 input:



AC1 setup

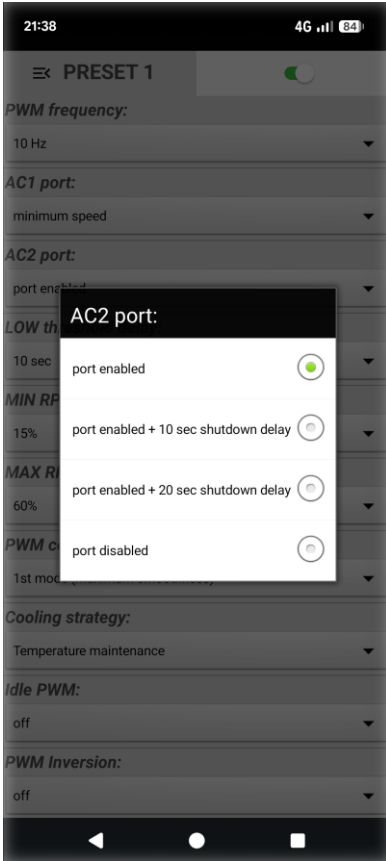


AC1 activation

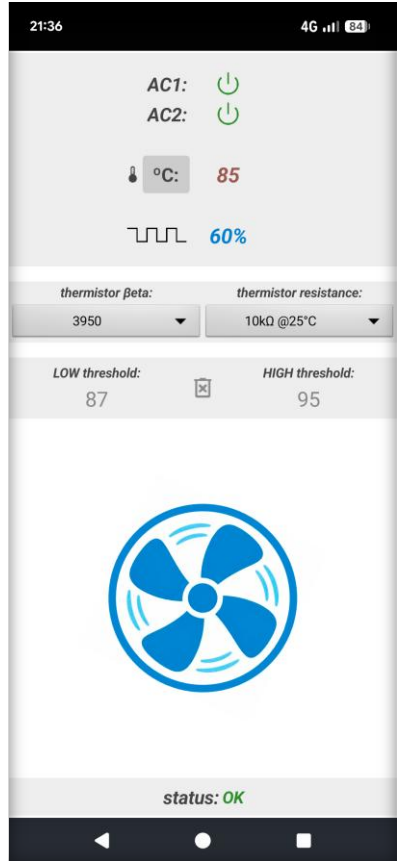
The AC1 input is intended for connecting a +12 V signal from the air conditioning or climate system. When +12 V is present on AC1, the controller can turn on the fan in advance or increase its speed to improve A/C condenser cooling.

In the settings, you can select the response to AC1: minimum speed, 40%, 50%, maximum speed, or no response to this input.

AC2 input:



AC2 setup

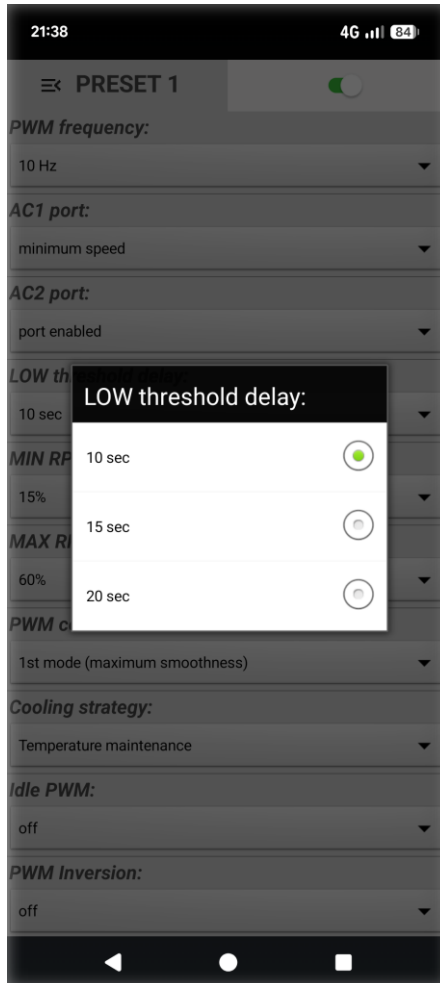


AC1 and AC2 activation

The AC2 input is used as an additional control input. In the NTC sensor option, it is convenient for a refrigerant pressure sensor, a manual forced-on button, or an external signal that should enable enhanced cooling.

When AC2 is activated, the controller can turn on the fan regardless of current temperature if this is provided by the selected settings.

LOW threshold delay:

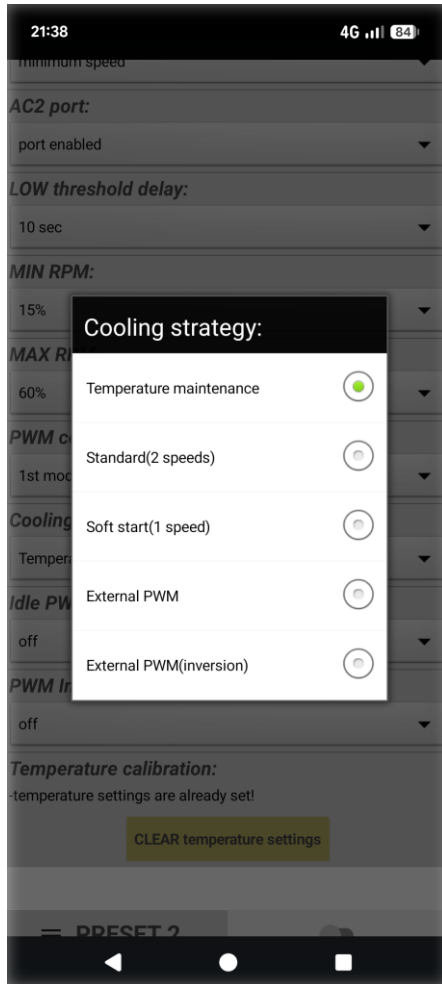


Lower threshold delay setting

The LOW threshold delay is needed so the fan does not turn on and off too often during small temperature fluctuations near the LOW threshold.

Too long a delay can slow the response to temperature rise.

Cooling strategies:



Cooling strategy selection

The cooling strategy defines the algorithm used by the controller to calculate fan speed. ApwmU 2.0 provides strategies for operation from an NTC sensor and from an external ECU PWM signal.

Before setting temperature thresholds, select the required cooling strategy.

Strategy 1 - Temperature holding

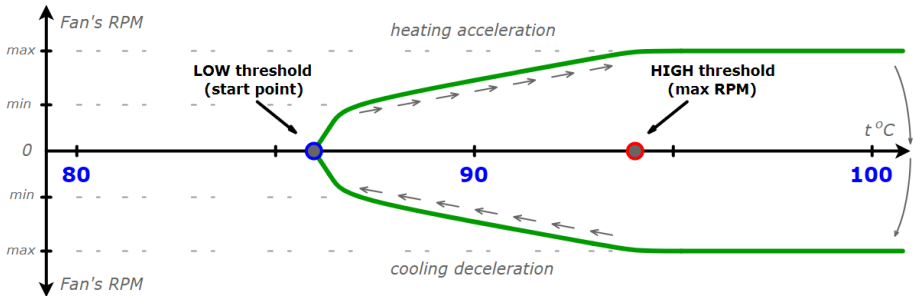
The Temperature holding strategy is intended to smoothly keep engine operating temperature within the set range.

The user sets two thresholds: the LOW threshold is the temperature where smooth fan activation begins; the HIGH threshold is the temperature where the fan reaches the configured maximum speed.

When temperature is below the LOW threshold, the fan is off. When temperature rises above the LOW threshold, the controller begins to smoothly increase PWM duty. The closer the temperature is to the HIGH threshold, the higher the fan speed.

When the HIGH threshold is reached, the fan runs at the configured maximum speed. As temperature decreases, the controller smoothly reduces fan speed. After temperature drops below the LOW threshold, the fan can be turned off (if AC1/AC2 ports are not active).

This strategy is the most universal and usually works best for smooth engine temperature control.



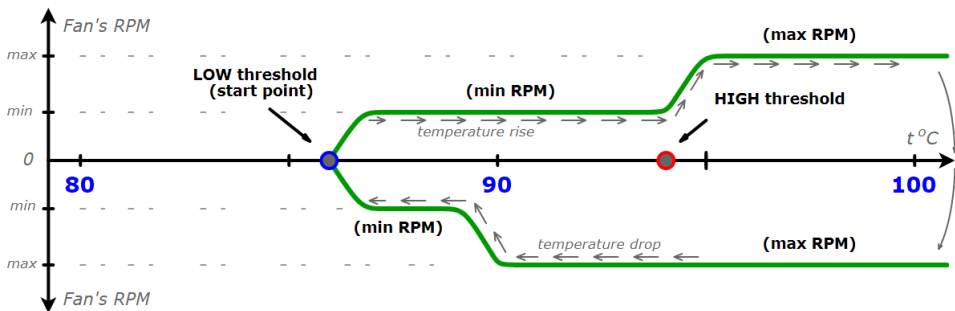
Strategy 2 - Standard mode, 2 speeds

The Standard mode, 2 speeds strategy imitates classic two-speed fan operation.

The user sets two temperature thresholds: the LOW threshold enables minimum speed, the HIGH threshold enables maximum speed.

After the LOW threshold is reached, the fan starts smoothly and runs at the configured minimum speed. After the HIGH threshold is reached, the fan smoothly transitions to the configured maximum speed.

This strategy is suitable when simple logic is needed: first speed for normal heating and second speed for high temperature.



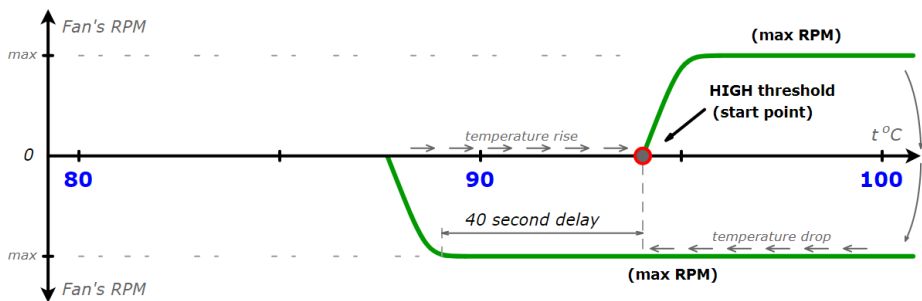
Strategy 3 - Smooth start to maximum speed

The Smooth start to maximum speed strategy is used when the fan should turn on only after the set temperature is reached, but then immediately go to maximum mode.

In this mode, one main temperature threshold is used - the upper threshold. When temperature reaches the set value, the fan smoothly accelerates to the configured maximum speed.

After temperature drops below the set value, the fan does not turn off immediately, but continues running for some time to remove residual heat from the radiator and engine.

This strategy is suitable for systems where continuous smooth regulation is not required, but a soft fan start without a sharp jerk is needed.



Strategy 4 - External PWM

The External PWM strategy is used when operating from the stock ECU PWM signal.

In this mode, ApwmU does not calculate fan speed by temperature. The controller receives an external PWM signal and converts it into an output PWM signal for the installed fan.

The controller can change the output PWM frequency, minimum and maximum duty range, speed-change smoothness, idle PWM availability, amplitude and output signal polarity.

This mode is needed if the ECU and fan are not directly compatible, for example when installing a fan from another vehicle.

Strategy 5 - External PWM, inversion

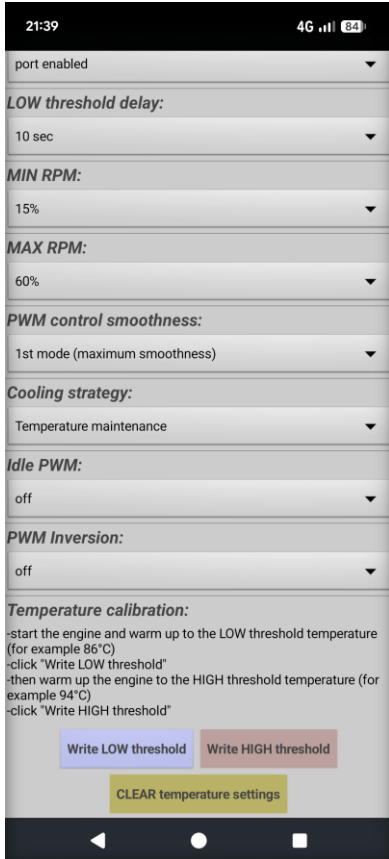
The External PWM, inversion strategy is similar to the previous one, but is used when the input PWM signal from the ECU has inverted logic.

If fan response in normal mode is opposite to what is expected, try the strategy with inversion.

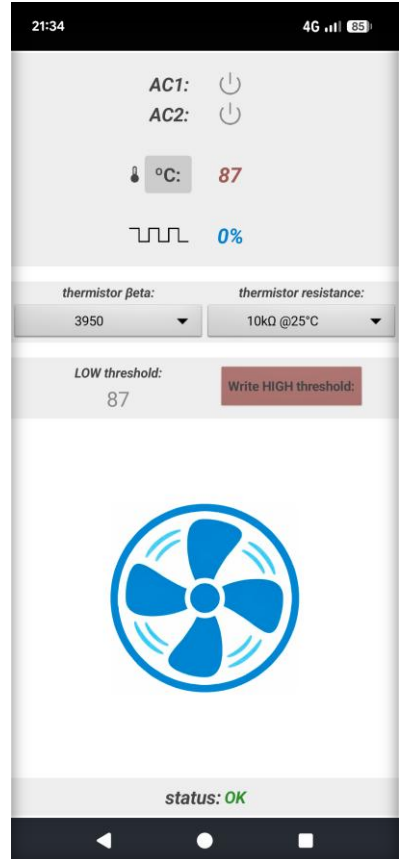
Signs of incorrect input or output PWM polarity: the fan runs at maximum with a low control signal, slows down instead of speeding up, reacts opposite to duty changes, or behaves as if a command is active when there is no command from the ECU.

After selecting this strategy, be sure to check fan operation in different engine and air conditioner modes.

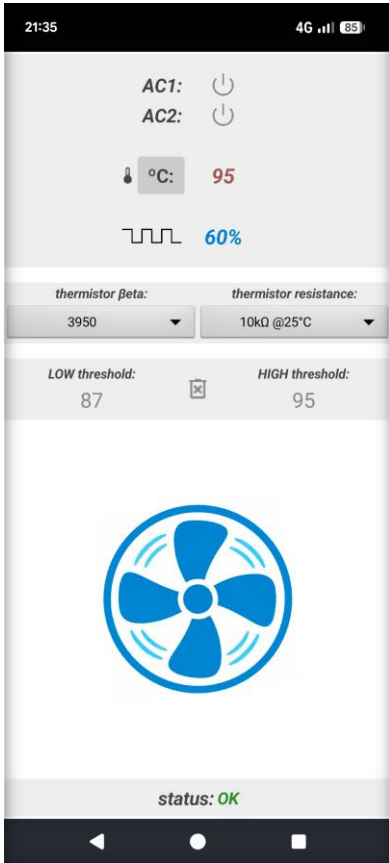
Temperature thresholds:



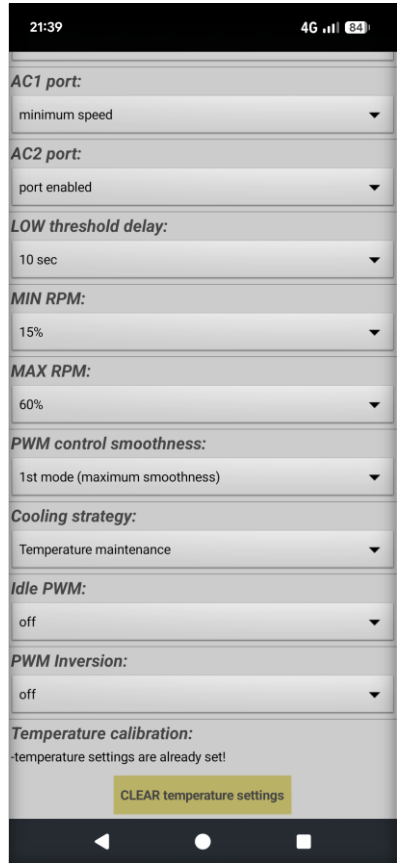
Threshold setting



Lower threshold saving



Upper threshold saving



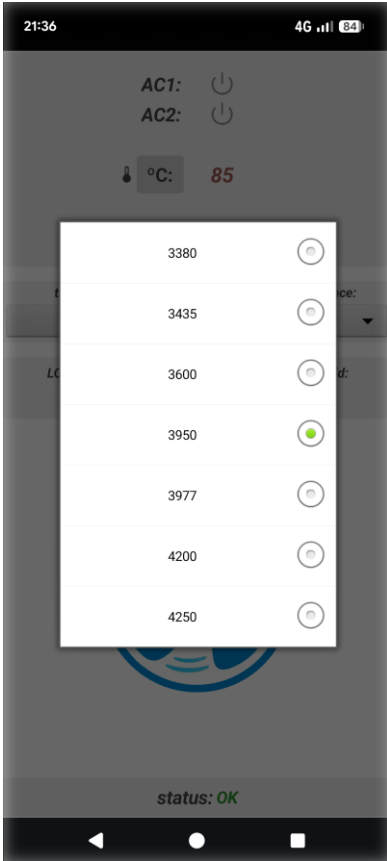
Deleting temperature settings

For strategies operating from an NTC sensor, temperature thresholds must be configured. The LOW threshold is the temperature for starting or switching to minimum speed. The HIGH threshold is the temperature for reaching the configured maximum speed.

Thresholds can be saved while the engine is warming up, when the actual temperature has reached the required value. It is recommended to select thresholds taking into account thermostat opening temperature, engine thermal inertia and operating conditions.

If thresholds were saved incorrectly, they can be deleted from the current preset and saved again.

NTC sensor setup:



BETA coefficient



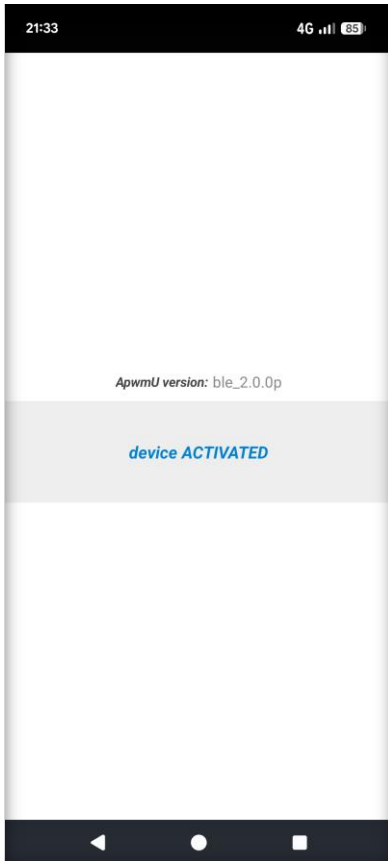
Sensor resistance

ApwmU 2.0 allows setting NTC temperature sensor parameters: BETA coefficient and nominal resistance.

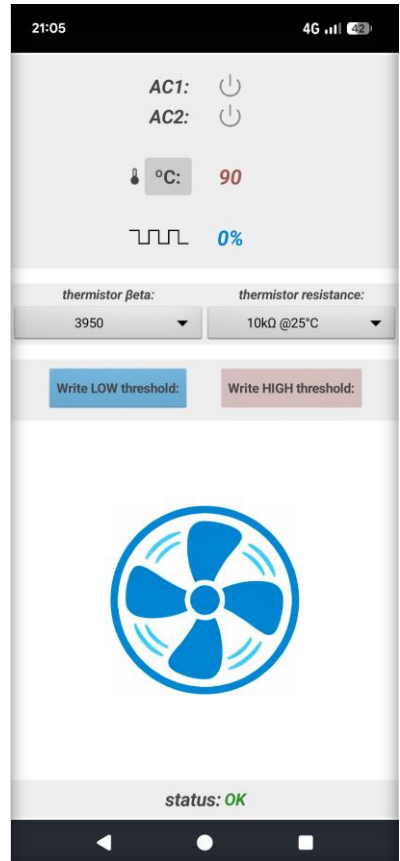
These parameters are needed to correctly calculate temperature from NTC sensor resistance. If the supplied sensor is used, the parameters usually do not need to be changed. If another NTC sensor is installed, specify its characteristics from the sensor documentation.

Incorrect NTC parameters will cause incorrect temperature display and incorrect fan operation. After changing the parameters, check readings on a cold and warmed-up engine.

Monitoring and controller information:




Status and version



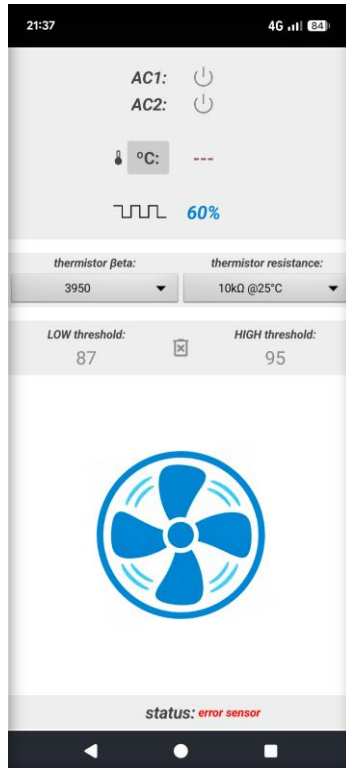
Monitoring screen

On the monitoring screen, you can check the controller version, current temperature, current PWM level, AC1 state, AC2 state, current device status and errors.

During initial setup, it is recommended to watch temperature, PWM duty and AC1/AC2 input states. This makes it easy to understand whether the controller correctly sees external signals and reacts to them properly.

To go to the monitoring screen, tap the  icon on the main page.

Temperature sensor error:



Temperature sensor error message

If the controller detects a temperature sensor error, the corresponding status is displayed in the app.

Possible causes: sensor not connected, broken wire, short circuit, incorrect connection, damaged sensor, wrong operating mode selected, or incorrect NTC sensor parameters set.

1. Turn off controller power.
2. Check the sensor connector and wires.
3. Check NTC sensor resistance with a multimeter.
4. Turn power on and check the status again.

Fan test:

The FAN TEST function is used to check correct fan connection and the selected PWM parameters.

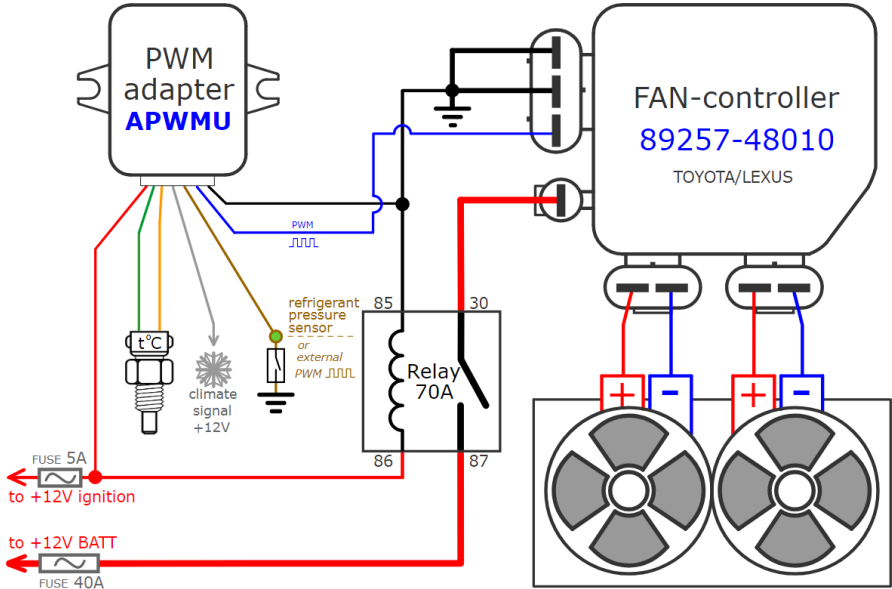
Before the test, make sure the fan is connected correctly, fan power is connected through the appropriate fuse, ground is reliable, the PWM wire is connected to the correct pin, and the selected PWM amplitude matches the fan.

If the fan does not start during the test, check PWM frequency, PWM inversion, idle PWM, minimum speed, fan pinout and fan power control unit supply.

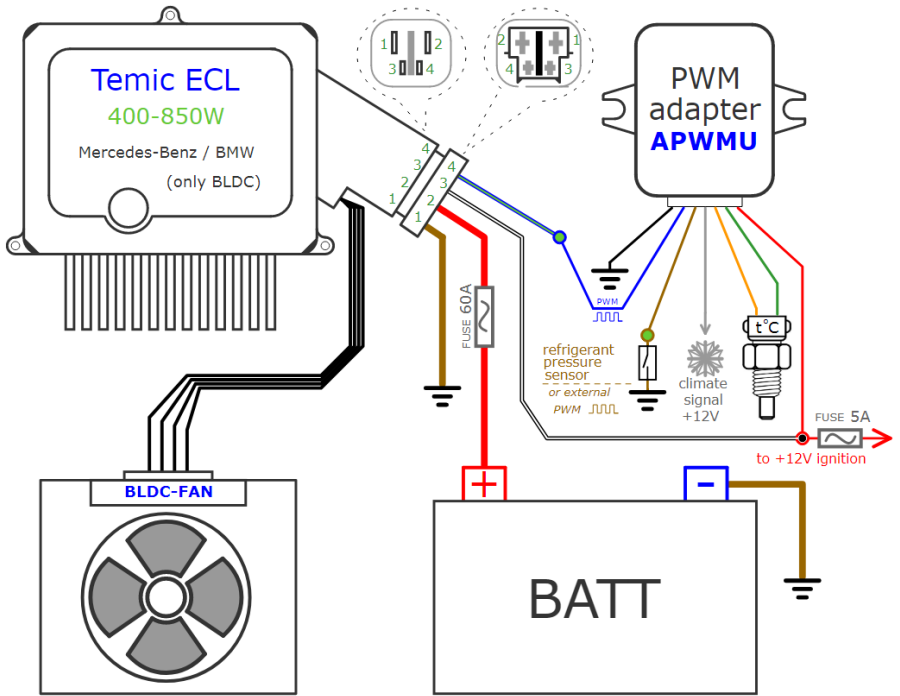
If the fan immediately goes to maximum, polarity, frequency, amplitude, idle PWM or the fan connection diagram is probably selected incorrectly.

Fan connection examples:

The diagrams below are examples of connection to common types of PWM fans and control units. Before installation, always verify the pinout for the specific fan and vehicle model.



Connection example for DENSO / Toyota / Lexus fan controller



Connection example for Temic ECL 400-850 W, Mercedes-Benz / BMW

Typical issues:

Device does not appear in search:

Check controller power, Bluetooth on the smartphone and distance to the device. In the app properties, check that all permissions are enabled (Bluetooth, location). Try restarting the app and controller power.

Device found but does not connect:

Move the smartphone closer to the controller. Make sure another smartphone is not connected to the device. Restart the app.

Fan does not start:

Check fan power supply, ground, PWM wire, PWM frequency, minimum speed, inversion and idle PWM.

Fan immediately runs at maximum:

Check correct connection of the fan PWM input.

Check idle PWM

Check PWM inversion

Fan runs in jerks:

Try another PWM frequency.

Temperature is displayed incorrectly in the app:

Check the BETA coefficient and nominal resistance of the NTC sensor. Check sensor connection and installation location.

No response to air conditioner:

Check whether +12 V appears on AC1 when the air conditioner is switched on. Check AC1 port settings.

AC2 does not work:

Check whether the AC2 input is actually shorted to ground. Check AC2 port settings in the app.

First setup recommendations:

- set a PWM frequency suitable for the fan;
- set minimum speed so that the fan starts reliably;
- set maximum speed with cooling reserve;
- enable inversion if required;
- enable idle PWM only if the fan requires a constant signal;
- save temperature thresholds after the engine is fully warmed up;
- check operation with the air conditioner on;
- check operation in traffic or during long idling.

It is not recommended to set temperature thresholds too high at first. It is better to start with earlier fan activation, make sure operation is stable, and then adjust the settings if necessary.

Temperature thresholds must be matched to thermostat opening temperature; otherwise fan operation efficiency will be very low!

Quick reminder:

- ApwmU 2.0 operates from a separate NTC temperature sensor or from the stock ECU PWM signal.
- The most convenient setup method is through the ApwmU BLE app; setup using the button and LED is also available.
- After changing parameters, tap SAVE ALL SETTINGS.
- Before operation, be sure to run FAN TEST.
- If the fan works incorrectly, first check PWM frequency, inversion, idle PWM and minimum speed.
- If a sensor error is displayed, check the NTC sensor, wiring and sensor parameters in the app.