

Dear FSE Team

We are pleased that you are using our AMK RACING KIT in your formula student electric racing car to make it even faster and more efficient. In this difficult time we cannot offer personal training, but we would like to continue to look after our customers as best we can.

That is why we have made the training documents available to you as a download.

This document guides you step by step through the FSE training.

The training consists theory and practical parts and is designed for participants with an electrical background.

If you have any questions or suggestions, we are still available for you. Please contact by email application@amk-group.com with the subject: FSE TRAINING

We wish you and your colleagues every success in working through the documents and good health!

Yours sincerely

The AMK training team

Training targets:

You get to know the components and functionality of the RACING KIT.

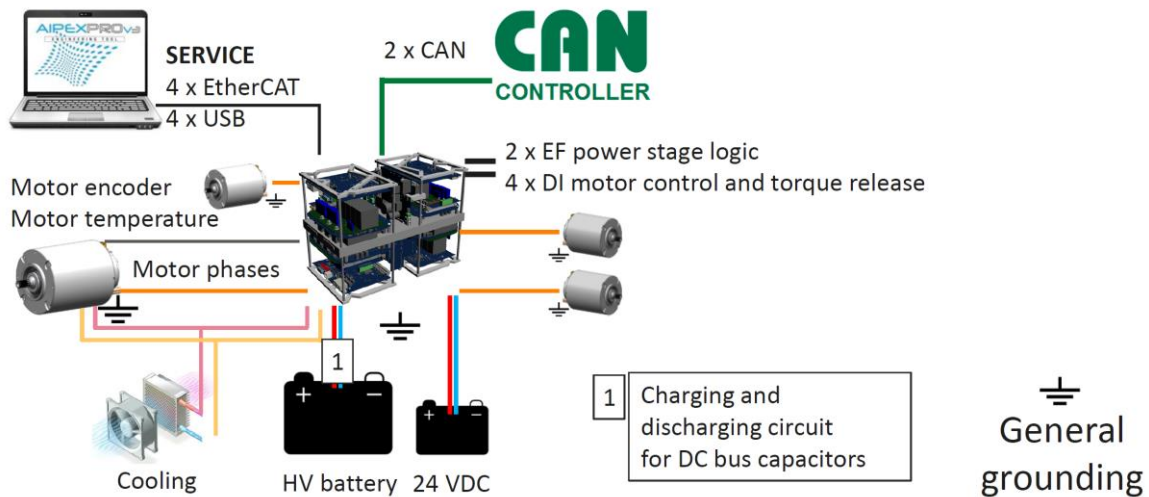
You can operate the commissioning software AIPEX PRO.

You can commission an inverter with FSE functionality.

You can control the inverter with your CAN controller.

Structure of the RACING KIT

A connected FSE drive is required for the practical training part. Also observe all safety instructions for temporary structures.



Theory part

Get to know the components and functionality of the RACING KIT.

See: Training package → Folder: Power Point

Power Point file: MORE_DRIVE_Geraeteschulung_FormulaStudent_2020_05_V2_en

The presentation contains all important information about the FSE RACING KIT. You can find detailed descriptions of the topics covered in the device description PDK_205481_KW26-S5-FSE-4Q_en.

You can find the current version of the device description in the FSE download area:

<https://amk-group.com/amk-dokucd/dokucd/FSE/start.htm>

Practical training part:

AMK Software AIPEX PRO and set up of inverters (practical work on the RACING KIT)

Display conventions

Calling up a function in the AIPEX PRO menu bar e. g. the documentation	Menu → ? → AIPEX Software description
Detailed information in the AIPEX PRO documentation (chapter)	Software description: AIPEX PRO > Communication PC - AMK device > Testing the communication

AIPEX PRO

Get to know the commissioning software AIPEX PRO.

Installation:

Topic	INFORMATION
Install AIPEX PRO	Administrator rights are required
	The following components must be installed: AIPEX ATF V3 Drivers - USB Driver - WinPcap
	Enter serial number. You can find it on the cover of the installation CD
	Reboot PC after installation

Basic settings:

Topic	INFORMATION
Execute AIPEX PRO	
Choose a language	Menu → Extras → Options → Base Settings Software description: AIPEX PRO > Menus > Extras > Base Settings
Activate communication between PC and drive	Menu → Extras → Options → PC Communication CANclient → Inactive EtherCAT → Active Supply voltage 24 VDC FSE RACING KIT. Restart AIPEX PRO after selection. Check that the status communication icon is green.

	Software description: AIPEX PRO > Communication PC - AMK device > Testing the communication
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Function "Direct mode"

The "Direct mode" function is used for quick access to the drive in order to change parameter values or read out diagnostic messages.

Familiarize yourself with the functions of "Direct mode".

Software description:

AIPEX PRO> Menus > Direct mode

Topic	INFORMATION
Activate "Direct mode"	<p>Supply voltage 24 VDC FSE RACING KIT. Start the "Direct mode".</p> <p>Communication</p> <ul style="list-style-type: none"> • Select interface • Wait for status "GREEN" • Select drive <p>FSE relevant functions</p> <p>(Remanent) parameters Parameter value that is loaded at system start. The acceptance of a change in value depends on the parameter property (system start, positive edge controller enable) Actual values are only updated when you login. Online help: Select parameters, then F1 key.</p> <p>Temporary parameters A change in value is immediately active. The remanent value is activated when the drive is restarted or there is a positive edge at controller enable.</p> <p>Diagnosis A detailed diagnostic message is obtained by evaluating the additional information.</p> <p>Communication (EtherCAT Slave address) Address 0: Automatic addressing, address depending on the bus position. Assign different addresses if all controller cards are connected to each other via EtherCAT.</p>

	<p>Special functions (read parameters from encoder) Manual function for uploading the motor parameters to the controller card.</p> <p>Systeminfo "Event trace" function. Automatic error memory for subsequent reading. "Save Parameter Set" function. Do not use this function. Create an AIPEX project to save the drive parameters.</p> <p>Function monitor Display of actual values.</p>
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AMK software AIPEX PRO and commissioning inverter (practical work on the RACING KIT)

The following steps describe the basic procedure for commissioning.

Topic	INFORMATION
Initial program loading	<p>The AMK factory setting can be restored again and again with the function "Initial program loading"</p> <p>The password for the "Initial program loading" function is 500591. Restart the drive after initial loading.</p>
Create a project that can be saved	<p>(Close the "Direct mode")</p> <p>Tab → Configuration</p> <p>Create an AIPEX data record Menu → Online → Logon → Accept to the project complete</p> <p>Menu → Project → Save as ...</p>
Commissioning	<p>Click on the icon → Device (drive 1)</p> <p>Properties → Customize the station name (e.g. front_left) Click on the icon → Motor</p> <p>The controller card automatically reads the motor parameters from the motor encoder. Motor properties: Check the part number motor is shown. Part no. available = motor parameters ok Part no. not available = motor parameters not available</p>
Activate motor overload protection	<p>Tab → Parameters</p> <p>ID32773 Service bits - bit 14 → Activate I2t monitoring motor</p>

Scope function

With the Scope you can record cyclical measurements and display them graphically. Up to 8 channels can be freely configured (signal, trigger type, trigger position, trigger combination and sampling time).

AIPEX PRO (PC) does not have to be connected to the drive for recording.

Configure your measurement signals. Start the scope and wait for status <Init...>. As soon as the status <started> is reached, you can disconnect the PC from the drive. Now move your car. After the measurement is finished, you can connect the PC to the drive again. Confirm the diagnostic message that appears and wait until the connection is initialized again. The measurement data are then automatically transferred and displayed.

Software description:

AIPEX PRO> tabs> Scope

AIPEX PRO> Functions> Configuring oscilloscope

Topic	INFORMATION
Oscilloscope	<p>Tab → Scope</p> <p>Functions relevant to FSE</p> <ul style="list-style-type: none"> • Sampling time • Trigger position • Trigger combination • Second cursor • Zoom • Commissioning menu → Open / Save oscilloscope • ID34284 OSC container length <p>Get to know the scope through various sample measurements.</p> <p>Example: Click the Configuration button Channel 1</p> <ul style="list-style-type: none"> • ID40 Velocity feedback value • Trigger Type: Positive edge • Level 10 <p>Close the window with the OK button Click the Start button Turn the motor shaft by hand to start the measurement</p> <p>Channel 2: ID34299 Velocity setpoint in control ID36 not possible!</p>

Test generator

Various setpoints can be generated with the test generator to support commissioning.
A detailed description of how to use the test generator can be found in the device description.
Startup > Tuning the speed controller > AIPEX PRO settings

Topic	INFORMATION
Test generator	<p>Menu Startup → Test generator (PW 500591)</p> <p>Only operate the drive system with active liquid cooling. Observe all safety instructions.</p> <p>Practical tests - Generate target values and record them with the scope.</p>
Optimization of the speed controller with the help of the test generator	<p>Device description: Startup > Tuning the speed controller</p> <p>Practical tests - Generate setpoint values and measure them with the scope. After optimizing the speed controller, you must save the changed values remanent.</p>

Parameterization

The inverter has numerous parameters for a wide variety of applications. The FSE-relevant parameters and their settings can be found in the device description PDK_205481_KW26-S5-FSE-4Q_en.

Device description:

Projecting > Configuration

Topic	INFORMATION
Commissioning	<p>A preselection of the parameters relevant to FSE can be found in the text file FSE_Parameter.</p> <p>See: Training package → Folder Parameter selection – own list</p> <p>Copy the line FSE_R25 into the AIPEX PRO window → Parameter selection → Own list</p> <p>Apply the FSE settings to the parameters relevant for FSE. ID32798 "User List 1" ID32800 "AMK main operating mode" ID32796 "Source RF" ID32901 "Global service bits" ID32773 "Service bits" bit 14 + bit 16 ID113 "Maximum speed" ID38 "Positive velocity limit"</p>

	<p>ID39 "Negative velocity limit"</p> <p>ID32837 "DC bus voltage monitoring"</p> <p>ID32865 "Port 3 bit 0"</p> <p>ID32978 "Port 3 bit 1"</p> <p>ID32866 "Port 3 bit 2"</p> <p>ID32979 "Port 3 bit 0"</p> <p>ID32867 "Port 3 bit 1"</p> <p>ID32980 "Port 3 bit 2"</p> <p>ID34091 User List 3 (Use fixed CAN configuration)</p> <p>Restart drive system</p> <p>Function test: Check whether your CAN controller receives the AMK Actual Values 1 and AMK Actual Values 2 data telegrams. Goal: Switch motor control on and off, send setpoints (positive / negative torque limit and speed setpoint) and receive actual values (DI1, DI2 and EF must be available)</p> <p>Device description: Functionality > CAN bus > CAN bus communication > Mode Fixed CAN message configuration</p>
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Free CAN message configuration

In the Free CAN message configuration mode, you can freely configure the content of the data telegram.

You will find examples and a configuration template (Excel file) in the training package.

See: Training package → Folder: Examples FREE CAN Configuration

Topic	INFORMATION
Free CAN Configuration	<p>Device description: Functionality > CAN bus > CAN bus communication > Mode Free CAN message configuration</p> <p>Practical exercise: Transfer the sample project FSE_R25_FreeCanConfig_Velocity_en to the drive.</p> <p>Practical exercise (torque control) Change the setpoint speed to a torque setpoint ID34091-76 Index 6 (speed) -> Index 17 (torque) ID32800 Operating mode -> torque control</p>

	<p>Goal: Switch motor control on and off, send setpoints (pos./neg. torque limit and torque setpoint) and receive actual values. (DI1, DI2 and EF must be available)</p>
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