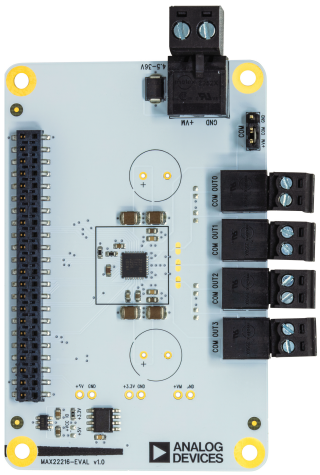
MAX22216-EVAL Evaluation Board

319-101029, Rev 1: 03/24

The MAX22216-EVAL allows evaluation of the MAX22216 in combination with the TRINAMIC evaluation board system or as stand-alone-board. It uses the standard schematic and offers several options to test different modes of operation. The MAX22216-EVAL can also be used in the evaluation of the MAX22217 by setting SNSF[1:0] = "10" for all channels while in use.

⚠ WARNING **DO NOT CONNECT/DISCONNECT LOAD WHILE POWER IS CONNECTED.**



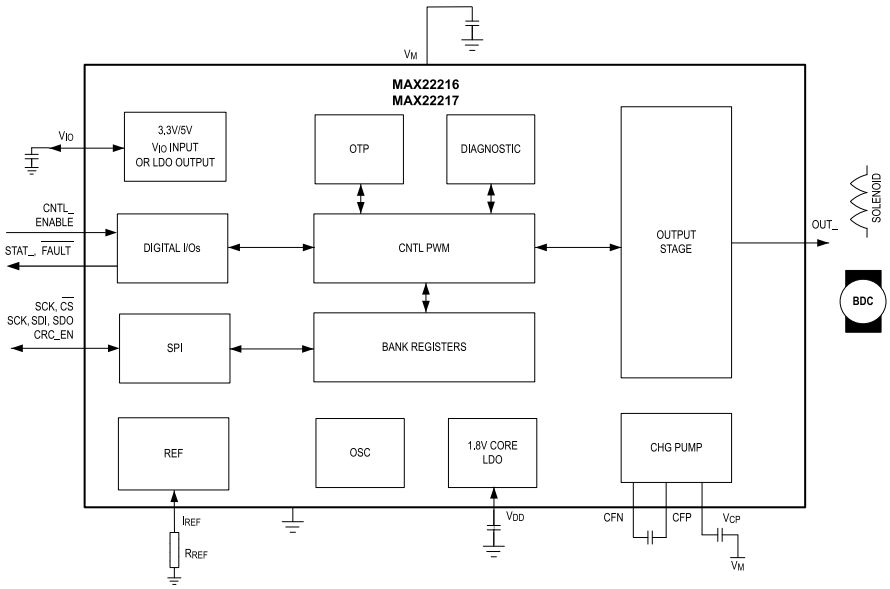
Features

- **Quad** smart serial-controlled 36V half bridges up to 1.7A/3.2A full scale
- **Supply voltage** 4.5V to 36V DC
- **SPI** and **OTP** registers
- Highly flexible control methods (e.g. **Bridge-Tied Load**)
- Two-level current/voltage sequencer
- Detection of plunger movement
- Power-saving features
- Advanced diagnostics
- Full set of protections

Applications

- Solenoid Valves and Relays
- Real-Time Current Measurement
- Proportional Valves
- DC Motors
- Digital-Output Interface
- Bi-stable Latching Solenoid Valves

Simplified Block Diagram



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Contents

1 Order Codes

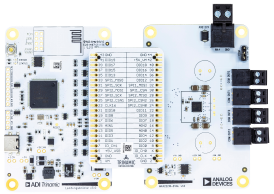
Order Code	Description	Size
MAX22216-EVAL-KIT	The kit includes: MAX22216 evaluation board Landungsbruecke (interface board to a PC) Eselsbruecke (bridge connector board) 	140mm x 85mm

Table 1: MAX22216-EVAL Order Codes

2 Getting Started

Required Equipment

- MAX22216-EVAL evaluation board
- Landungsbruecke with latest firmware
- Eselsbruecke bridge board
- Load (e.g. Solenoid)
- USB interface
- Power supply
- Latest TMCL-IDE and PC
- Cables for interface, load, and power

Precautions

- Do not mix up connections or short-circuit pins.
- Avoid bundling I/O wires with load wires.
- Do not exceed the maximum rated supply voltage!
- Do not connect or disconnect the load while powered!
- START WITH POWER SUPPLY OFF!
- Set the COM jumper correctly.
  Use +VM for COM as default.

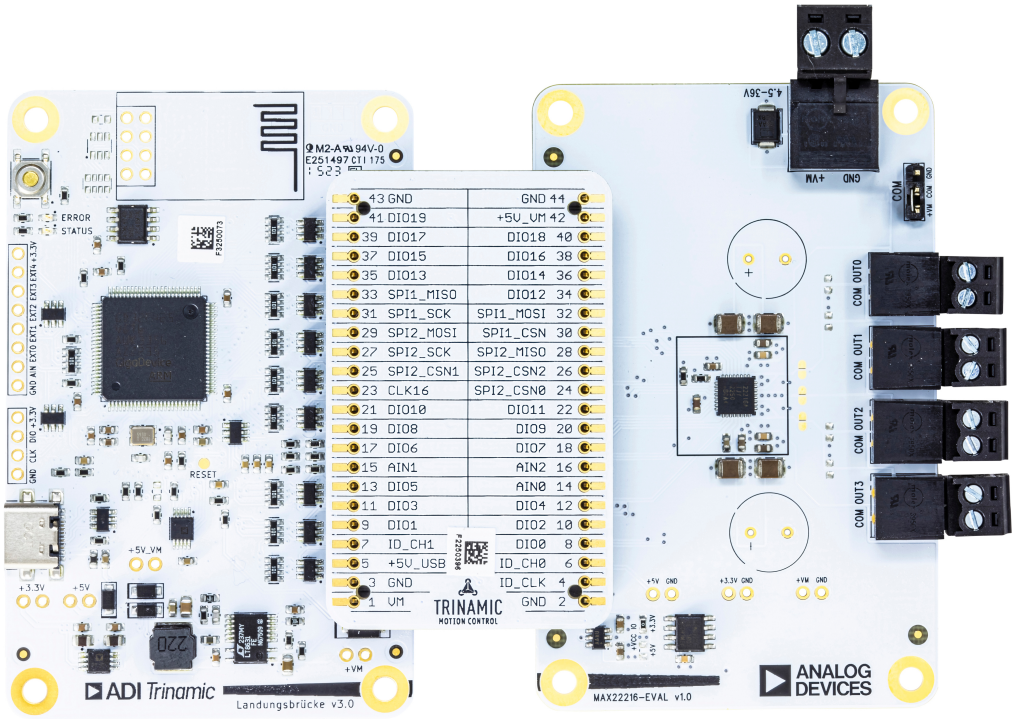


Figure 1: Getting Started

2.1 First Start-Up

1. Make sure that the latest version of the TMCL-IDE is installed. TMCL-IDE can be downloaded from www.analog.com TMCL-IDE.
2. Open TMCL-IDE and connect the Landungsbruecke with the attached MAX22216-EVAL by USB to the computer. For Windows® 8 and higher, no driver is needed. For Windows 7, TMCL-IDE installs the driver automatically.
3. Verify that the Landungsbruecke is using the latest firmware version. The firmware version is shown in the connected device tree. The newest firmware can be downloaded from www.trinamic.com/support/eval-kits/details/landungsbruecke/.

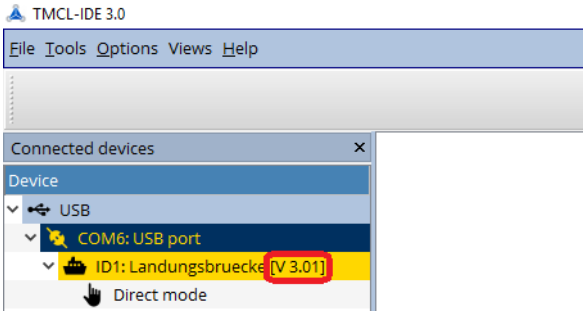


Figure 2: Firmware Version

4. TMCL-IDE needs space to display all important information and to provide a good overview. Therefore, arrange the main window as needed. Using full-screen mode is recommended. For evaluation boards, it is essential to have access to the registers. Therefore, open up the register browser (left side). For a better view, click the top right on the normal icon to get a maximized register browser window.
5. TMCL-IDE includes a dialog box for diagnostic tasks. The dialog box provides an overview of the connected motion controller and driver chips. A window pops up immediately after connecting the Landungsbruecke the first time. The Board Assignment tab shows the actual status of the connections. The Settings tab allows the user to choose basic settings or to reset the module to the factory default settings.

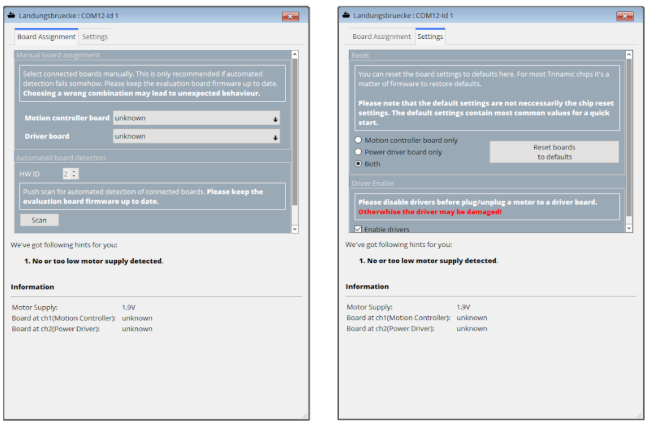


Figure 3: Landungsbruecke Dialog Box

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3 Hardware Information

All design files for TRINAMIC evaluation boards are available for free. The original ECAD files, Gerber data, the BOM, and PDF copies are available. Typically, the ECAD files are in KiCAD format. Some (older) evaluation boards may only be available in Eagle, Altium, or PADS format.
Check schematics for jumper settings and input/output connector descriptions.

The files can be downloaded from the TRINAMIC evaluation boards home page.

NOTE For help locating files or other concerns, contact Customer Service.

3.1 On-Board Jumper

The MAX22216-EVAL evaluation board has one jumper (Figure 4) to change COM of all of the four outputs between +VM and GND. This setting is needed if the outputs are used in half-bridge mode.

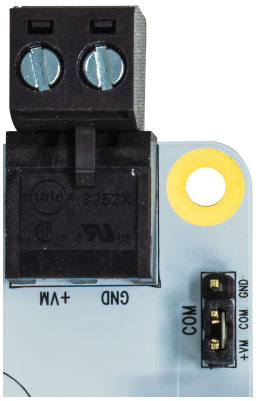

Figure 4: Jumper for COM Signal Next to the Supply Plug

Adapt the *HSnLS* (high side not low side) setting for each used half-bridge accordingly. The default jumper setting is *+VM* and matches the MAX22216 *HSnLS* = false default.

NOTE To control the *HSnLS* of a MAX22216 half-bridge individually, the load needs to be wired externally. For example, to use one output in *HSnLS* = true mode, connect one terminal of the load to the OUT_ pin and the other terminal to GND of the supply.

3.2 Onboard Options

3.2.1 Solder Bridges

There are three solder bridges (SB301, SB302, and SB303) near the MAX22216. They can be used to bridge outputs for bridge-tied load (BTL) operation without the need of external wiring. Make sure to use the correct CHS within the general settings tool. Change CHS first and activate the part afterwards.

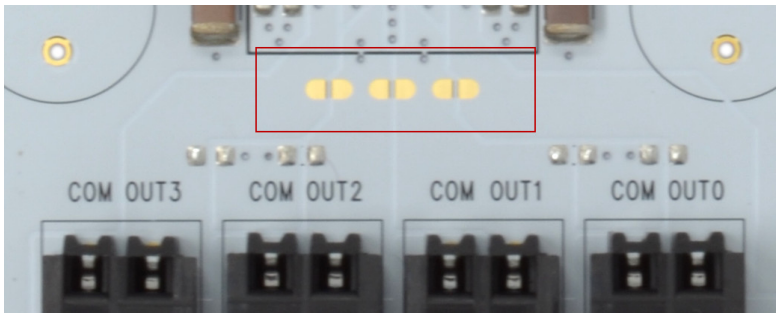

Figure 5: Three Solder Bridges (Red Rectangle) and Four Optional SMD Capacitors Near the Outputs

3.2.2 Capacitors

As shown in Figure 5, there are four positions next to the outputs for optional 0603 SMD capacitors (C203, C204, C205, and C206). Two THT EL100 electrolytic capacitors are also optional next to the MAX22216.

3.2.3 Voltage Selection

If the MAX22216 V_{IO} (+VCC_IO on this evaluation board) is used with +5V instead of +3.3V, there is a solder selection near the EEPROM. The selection should be changed if an external electronic with 5V levels is connected.

NOTE

Do not bridge both selections at the same time. This can disturb the onboard voltage regulator.

In the rare case of the OTP output voltage being used, neither selection should be present. This happens when the MAX22216-EVAL is started after the V_{IO} output has been configured by the OTP setting.

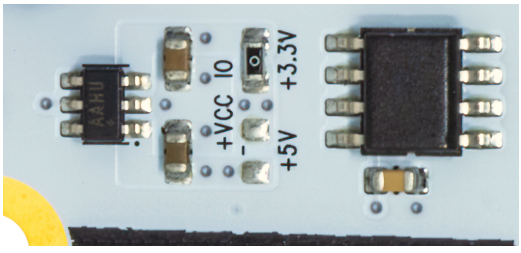

Figure 6: +VCC_IO Selection Near the EEPROM

3.3 Onboard Connectors

The MAX22216-EVAL has seven onboard connectors. The following table contains information on the connector type and mating connectors.
The connector pinning and signal names can be derived from the board design and schematic files available here: Landungsbruecke Eval System

#	Connects to...	Connector Type	Description
1	Power Supply	MOLEX 0395221002	Connects a battery or power supply to the evaluation board. An example of a mating connector is MOLEX 0395200002.
2	4x Load	MOLEX 0395021002	Connects the loads to the MAX22216 outputs. An example of a mating connector is MOLEX 0395000002.
3	Landungsbruecke	46-3492-44-3-00-10-PPTR from W+P Series 3492	Main I/O and digital supply connector to connect to the Landungsbruecke controller board through the Eselsbruecke connector or to connect to an own controller board.
4	COM	Standard 2.54mm header	Use to connect COM to +VM or GND through a jumper.

Table 3: MAX22216-EVAL Connectors

3.3.1 Landungsbruecke Connector

NOTE All signals are connected to the MAX22216 directly without any additional protection. Refer to the MAX22216 data sheet for electrical ratings.

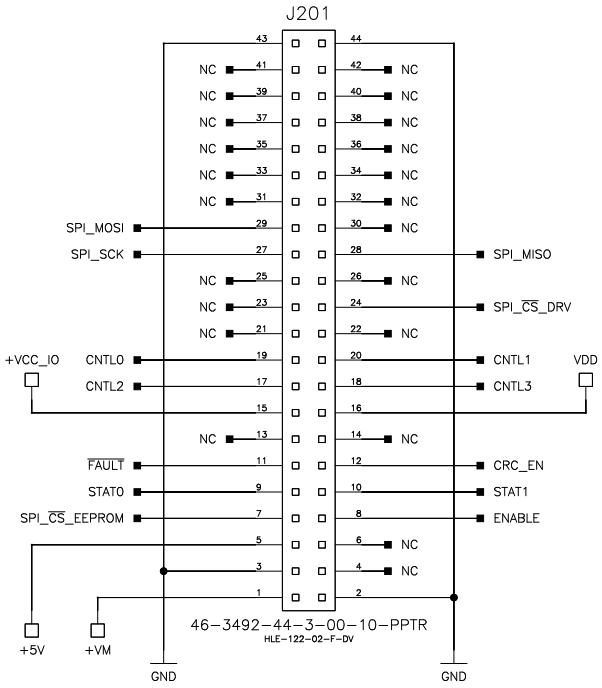

Figure 7: Pin Assignment on Landungsbruecke Connector

3.3.2 Load Connector

The MAX22216-EVAL consists of four plugs to attach loads (see Figure 5). Each of the four plugs has one COM and one OUT_ connection. All COM pins are connected to the selection jumper (see the On-Board Jumper section) and each OUT_ is connected to the MAX22216 directly. Check the currently selected channel hardware settings (CHS) via General Settings or the register browser.

3.3.2.1 Half-Bridge Usage

IHB shows individual half-bridges. *PHB* shows parallel half-bridges. Connect the load to the output terminals COM and OUT_. COM is set globally by the jumper for all outputs. If a parallel half-bridge configuration is set, connect the corresponding OUT_ together externally or use the Solder Bridges.

3.3.2.2 Full-Bridge Usage

IFB shows individual full-bridges. *PFB* shows parallel full-bridges. Connect the load to the output terminals which form the full-bridge (e.g. OUT0 and OUT1 at CHS = 0x05). COM has no influence and is therefore not used. If a parallel full-bridge configuration (CHS = 0x08) is set, connect OUT0 to OUT1 and OUT2 to OUT3 externally or use the Solder Bridges. The load is then connected between OUT0 to OUT1 and OUT2 to OUT3.

3.3.2.3 Load Connector Example

In this example, assume CHS = 0x07, which is *1IFB_2PHB* and translates to 1x full-bridge at OUT0 and OUT1 with 1x parallel half-bridge at OUT2 and OUT3. Connect the first load to OUT0 and OUT1. Connect OUT2 and OUT3 to each other and the second load between this OUT2 to OUT3 connection and COM. The low-side and high-side behavior of OUT2 to OUT3 is controlled by the On-Board Jumper and the *HSnLS* register-field of OUT2.

4 TMCL-IDE Evaluation Features

This section gives tips on using TMCL-IDE.

NOTE

To achieve optimal settings, refer to the descriptions and flow charts in the MAX22216 data sheet. The register browser of the TMCL-IDE provides helpful information about any currently selected parameter. Beyond that, the data sheet explains concepts and ideas which are essential for understanding how the registers are linked together and which settings are suitable for the application. At first, to get more familiar with the evaluation board, drive the load using the solenoid sequencer.

4.1 General Settings

To configure general settings for the MAX22216-EVAL, open the MAX22216 General Settings tool by clicking the appropriate entry in the tool tree. This tool usually includes settings to control the IC globally e.g. to turn it on or set special modes.

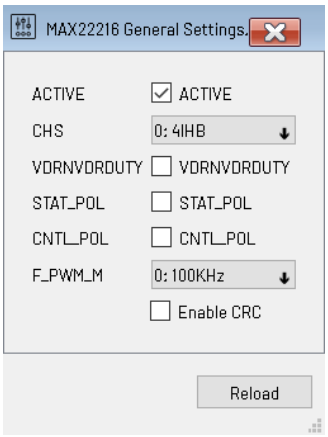

Figure 8: Configuring MAX22216 General Settings

To get the MAX22216-EVAL started, set the part to *ACTIVE*, clear the flags within the EvalBoard Flags Tool, and select the desired output configuration through *CHS*. For a more stable SPI communication, *CRC* can be enabled. This automatically sets the needed CRC-ENABLE pin of the MAX22216 and appends the CRC checksum to the communication.
The voltage control is *VDRDUTY* by default but *VDRnVDRDUTY* can change it to *VDR*. In *VDRDUTY*, a fixed duty cycle is given to the output and the voltage changes with input-voltage changes. In *VDR*, the set output voltage is fixed and adapted to input-voltage changes.

4.2 ChipClick

To configure the control pins for the MAX22216-EVAL, open the Chip Click tool by clicking the appropriate entry in the tool tree. By hovering the mouse over a pin in the graphical view, a description of the pin's possible configurations is shown. To change the pin state, click on the small boxes next to the pin name. There are three possible states that tie to GND, to VCC_IO and to OPEN (tri-stated). Landungsbruecke then controls the pin directly through the Eselsbruecke interface. Signals read by Landungsbruecke are read only and their status is displayed within the small boxes.

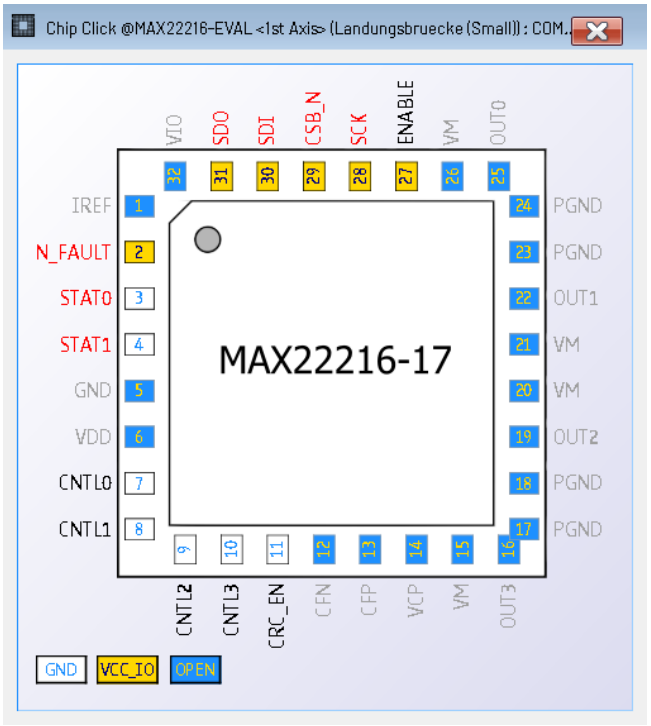

Figure 9: MAX22216 Graphical Pin Control Within the Chip Click Tool

4.3 Solenoid Sequencer

To control a specific channel of MAX22216-EVAL, open the Solenoid Sequencer by clicking the appropriate entry in the tool tree. This tool shows the most common controls for a solenoid. It provides all transformed values for the two-level sequencer and its ramps into real-world units. The resulting internal register values can be found within the Register Browser. Changing *CTRL_MODE* adapts the units according to the selected mode. Note that the undershoot shown in the graph is only possible if the global demagetization is used and the channel is configured in full-bridge mode.

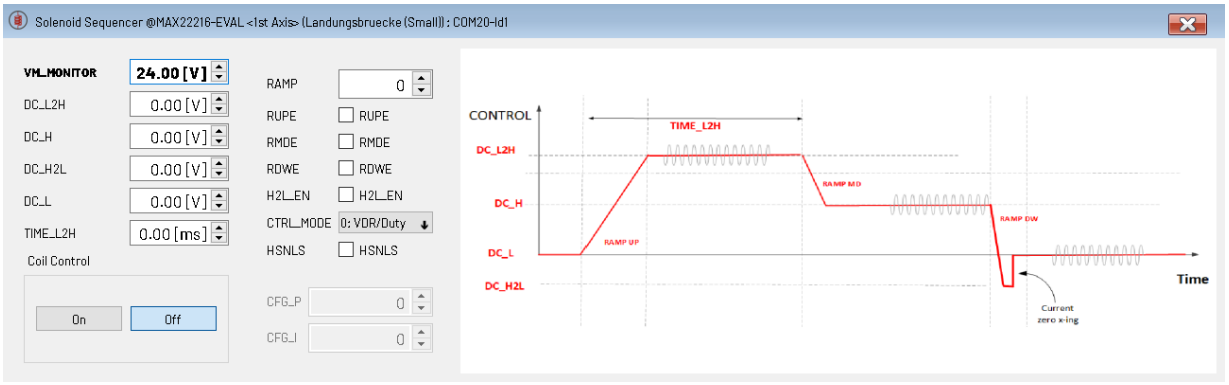

Figure 10: Sequencer Configuration of One MAX22216 Channel

4.4 Solenoid Inductance

To measure a specific channel of the MAX22216-EVAL, open the Solenoid Inductance by clicking the appropriate entry in the tool tree. This tool shows the required settings for dithering or inductance/resistance measurement. The graph shows the measured current and inductance.

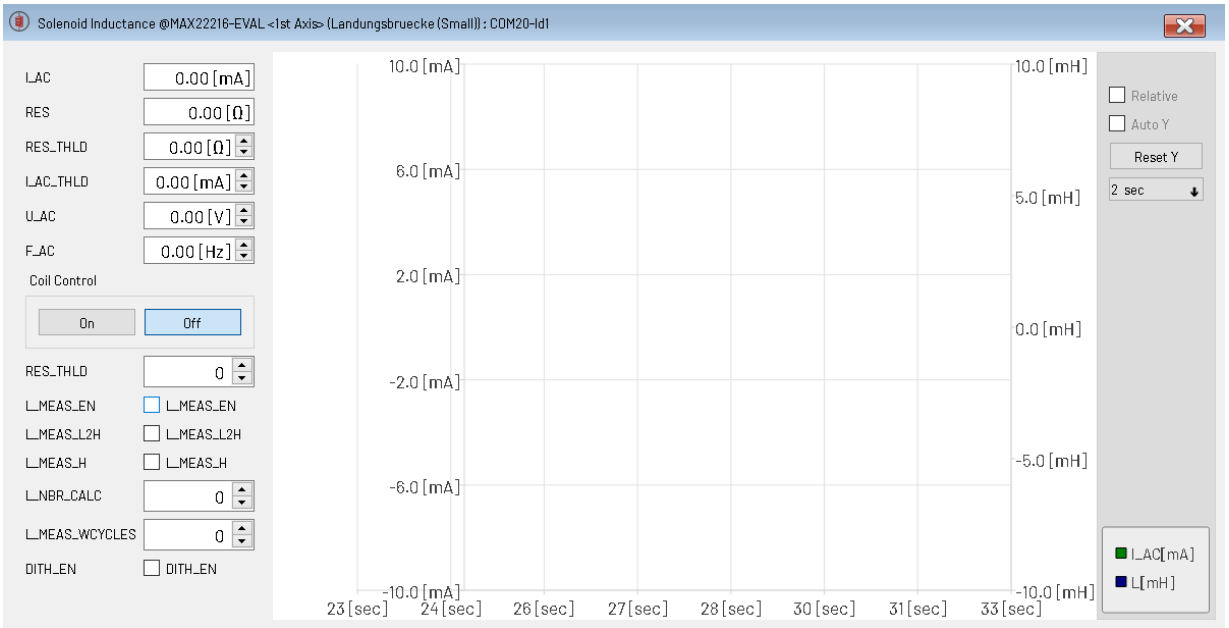

Figure 11: MAX22216 Inductance Settings and Graph

4.5 BEMF/DPM Tuning

To tune a specific channel of the MAX22216-EVAL, open the BEMF/DPM Tuning tool by clicking the appropriate entry in the tool tree. A prerequirement for this tool is a working actuation within the Solenoid Sequencer. After activating the coil, the Landungsbruecke buffers the real-time current from the MAX22216 and downloads the data to the tool afterward. The graph on the right side shows the current profile of the attached solenoid. If a BEMF dip is visible within the L2H phase, the DPM slider values can define the search area for the dip. Enable *DPM_EN* to enable the DPM functionality. After a successful setup, solenoid actuations that follow show changing measurements. Enabling *END_HIT_AUTO* activates the power saving by shortening the fixed predefined *TIME_L2H* directly after a plunger movement is detected.

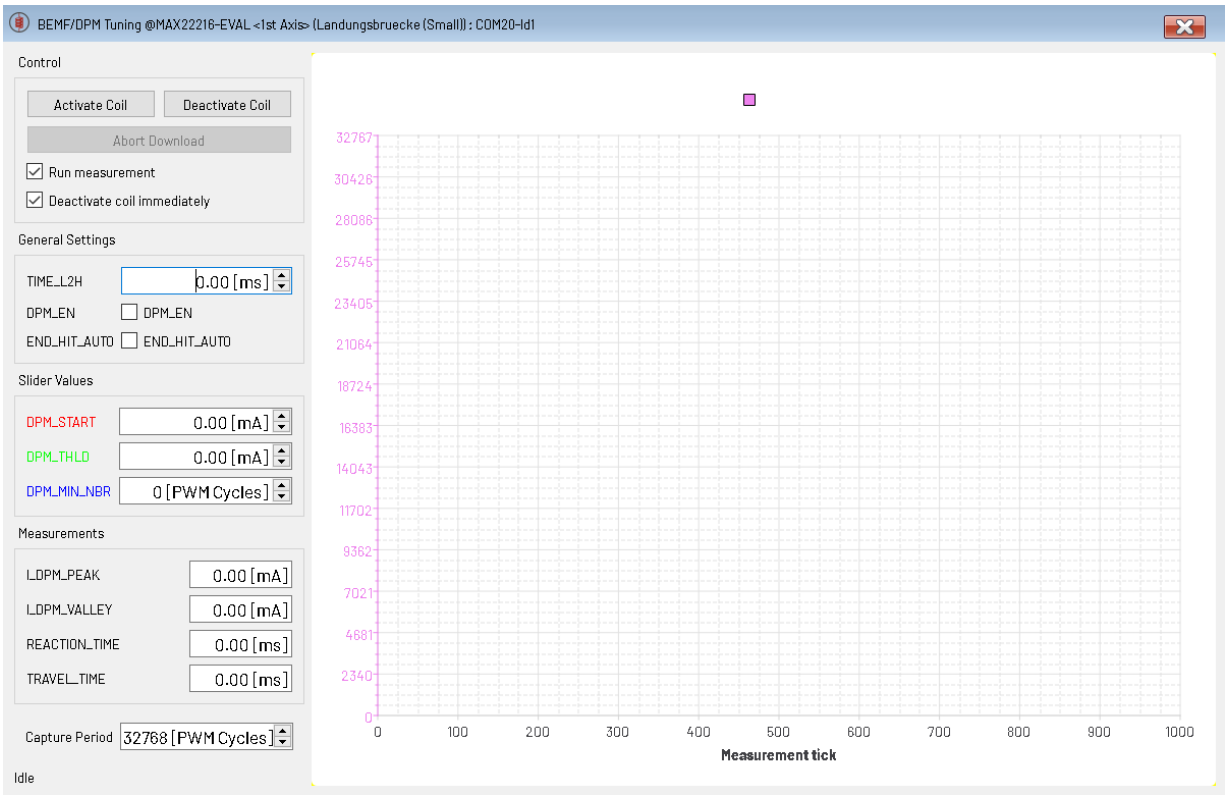

Figure 12: MAX22216 Actuation Current in BEMF Configuration

4.6 Rapid Fire Tool

To turn on or off a specific channel repetitvely, open the Rapid Fire tool by clicking the appropriate entry in the tool tree. This tool controls the on and off time for the selected channel. The Rapid Fire tool requires a working actuation within the Solenoid Sequencer.

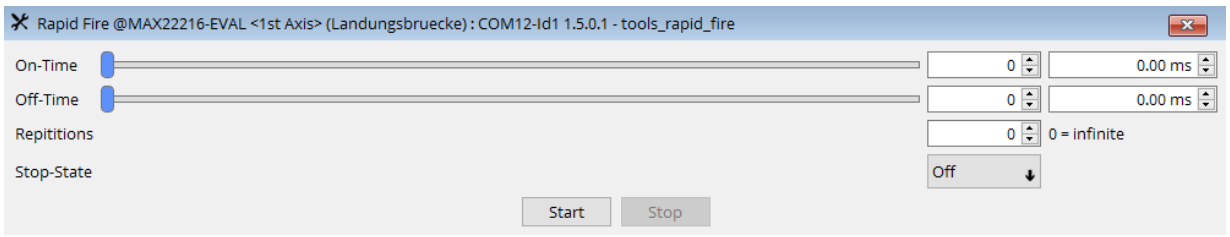

Figure 13: MAX22216 On/Off Slider Control for One Channel

4.7 Linear Positioning Tool

The Linear Positioning tool is intended to use with proportional valves/solenoids. To control the *DC_H* with a selected value, a minimum and maximum value can be set. Activate the coil so the slider selects the value between minimum and maximum.

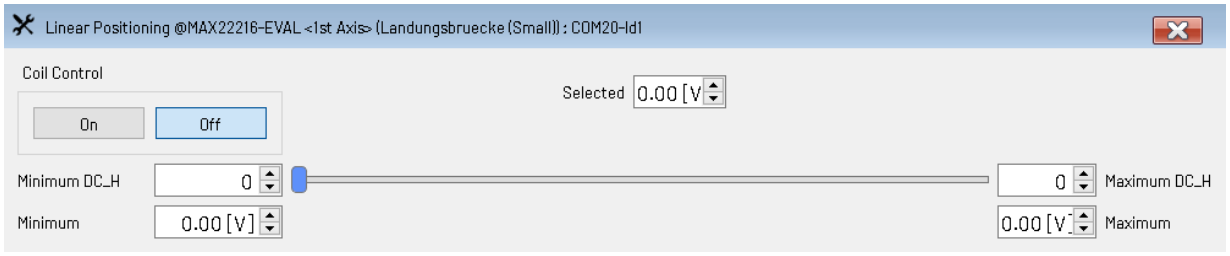

Figure 14: MAX22216 Value Slider for One Channel

4.8 Parameter and Register Scope

The MAX22216-EVAL is capable of using the Parameter & Register Scope. To collect the data, the Landungsbruecke buffers the desired values in real time to send them through the slower USB connection to the connected IDE. Depending on the selected sample count and number of measurement channels, this process can take some time.

To get started, select the parameter/register for the measurement and press *Start*. In the Condition dropdown, select the trigger mode e.g. Immediately or Rising edge. The *Value* number input defines the value for the trigger, which is applied on the selected measurement *Channel*.

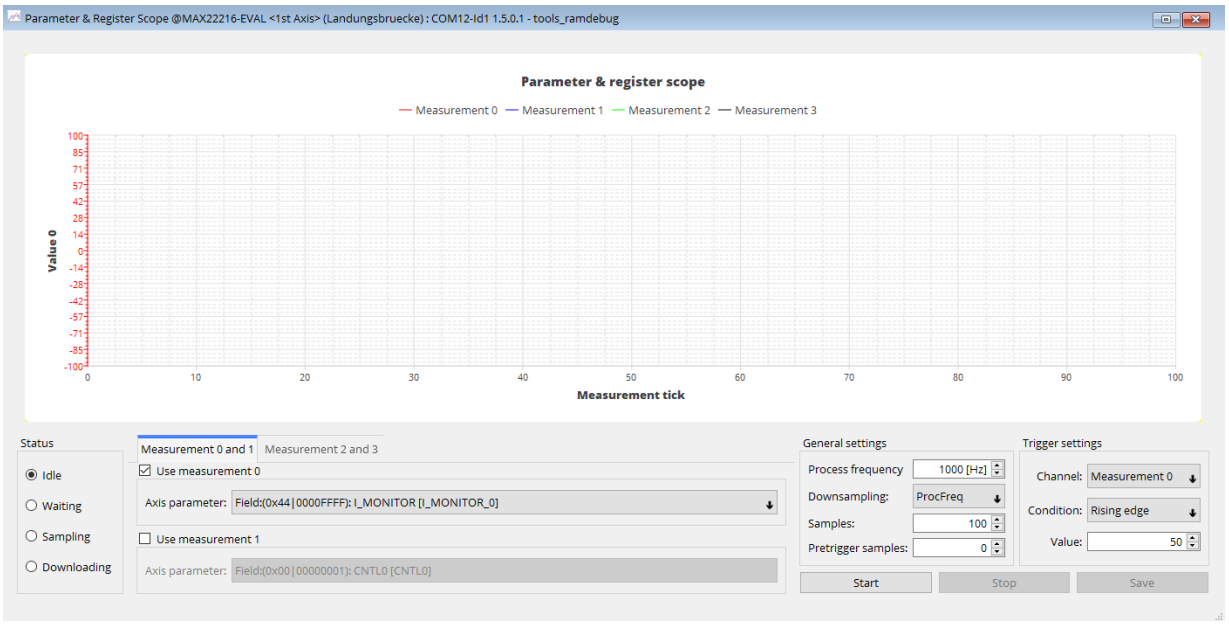

Figure 15: View of the Scope for the MAX22216

NOTE

Make sure the newest Landungsbruecke firmware is used for this feature.
To improve the performance of this tool, close all unnecessary graphs and tools within the IDE.

4.9 OTP Programming

To configure the one-time programmable (OTP) registers for the MAX22216-EVAL, open the OTP Programmer tool by clicking the appropriate entry in the tool tree. By pressing Refresh, currently set registers within the Registry Browser can be applied to this tool. There is a short waiting period while the register values are loaded. Registers that can be programmed via by the OTP tool are displayed within the Register Browser with an identifier *P* in column *ACS*. Some registers can only be set by OTP programming (e.g. *RP* registers).

Info	Refer to the MAX22216 data sheet for additional information about OTP programming as preconditions are required in certain cases.

⚠ CAUTION	Exercise caution when using the OTP tool. OTP registers cannot be reset. To avoid creating an unusable device, check all settings before programming the device.

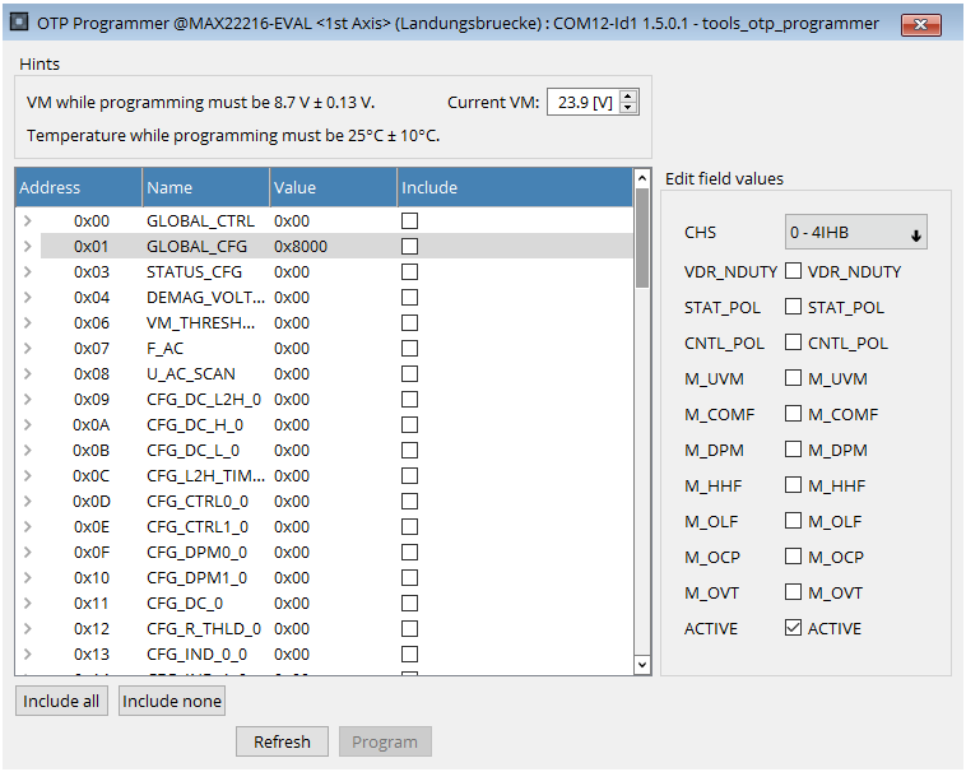

Figure 16: Configuring the MAX22216 OTP Registers

5 Revision History

5.1 Document Revision

Version	Date	Description
Rev 0	10/23	Initial release
Rev 1	03/24	Added MAX22217 support explanation

Table 4: Document Revision