SIMULATION & VIRTUALIZATION

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Digital twin at the press of a button



The machinery construction domain has always been subject to continuous change. For a long time now it has experienced changes as a result of the ever-increasing use of software-based solutions. With a new virtualization solution, Siemens is now providing additional (function) blocks, specifically for drive technology. Based on these blocks, drive-related solutions can already be simulated in the engineering and configuring phases close to reality – under the motto designing virtually for the future.

For decades now, the advantages of the digital factory and completely digitalized workflows have been discussed, starting with the planning of new systems and machines up to their deployment in the production environment. In this regard, companies such as Siemens are continually working on practical solutions – thereby underscoring and demonstrating their power of innovation. "Totally Integrated Automation", "Internet of Things" (IoT), "Cloud" or "Edge Computing" as well as additional achievements prove day in, day out that state-of-the-art automation relies heavily on software-based solutions. The significant added value for industry – contrary to pure hardwarebased solutions – is that these solutions can be more quickly optimized and flexibly adapted to address specific requirements.

Drive technology also profits from this to a high degree. In recent years, users in the widest range of sectors have followed the trend to systematically utilize drive-related parameters in higherlevel cloud systems, such as "Mindsphere" from Siemens. In a nutshell: Today, digitalization strategies and the use of software are shaping state-ofthe-art drive and automation technology more than ever, and increasing the demand for even more functionality.



Drives are integrated in the simulation program by importing the appropriate FMU file.

Parameter	Value	Unit	Description
🗄 Parameters			
✓ E Param			
✓			
R p0922_IF1_PZD_tel	4		Parameters.Param.PROFIdrive.p0922_IF1_PZD_tel: IF1 PROFIdrive PZD telegram selection
✓			
R p1082_n_max	1500		Parameters.Param.SetpointChannel.p1082_n_max: Maximum speed
R p1120_RFG_ramp_up_time	10		Parameters.Param.SetpointChannel.p1120_RFG_ramp_up_time: Ramp-function generator ramp-up time
R p1121_RFG_ramp_down_time	10		Parameters.Param.SetpointChannel.p1121_RFG_ramp_down_time: Ramp-function generator ramp-down time
R p1148_RFG_tol_HL_RL_act	0.2		Parameters.Param.SetpointChannel.p1148_RFG_tol_HL_RL_act: Hochlaufgeber Toleranz für Hochlauf und RücRamp-
✓ I Reference Values			
R p2000_n_ref	3000		Parameters.Param.ReferenceValues.p2000_n_ref: Reference speed reference frequency
> 🖪 Communication			
> EncoderEvaluation			

The new SINAMICS DriveSim Basic library includes the FMU files with the relevant parameters of the SINAMICS drives, which can be simply integrated in commercially available simulation programs.

Digitalization is more than just the "Internet of Things"

This "more" focuses on virtualization and simulation, as digitalization is far more than just the Internet of Things. Anyone striving for seamless digitalization requires functioning solutions for planning or virtualizing machines and systems right at the beginning of the engineering workflow. This is why Siemens is providing the device information required for virtualization – especially when it comes to drive technology. The name of the new Siemens solution is SINAMICS DriveSim Basic, with which individual drives are emulated as autonomous function blocks for the first time ever.

The four main elements when developing SINAMICS DriveSim Basic were compatibility, validity, user friendliness and speed of simulation – elements that are clearly reflected in this solution. The bottom line is that end users can significantly shorten their development phase using this solution. The virtual drive is available as standardized FMU model (Functional Mockup Unit), which has the great advantage of being compatible with many simulation programs currently available on the market. Many time-based simulation tools "understand" this FMU, irrespective of whether the user is simulating with Siemens solutions, for example SIMIT, Simcenter Amesim, NX Motion – or any other generally encountered tool (e.g. Matlab Simulink). Together with other virtual Siemens solutions (for example SIMATIC S7-PLCSIM Advanced or NX Mechatronics Concept Designer) a seamless, model-based development process can be implemented.

Users directly benefit from the drive and control-related experience-based knowledge, which is directly incorporated into the model from the SINAMICS device development environment. The essential difference to solutions already existing on the market is the fact that the models have been validated in-house in the Siemens test field based on real SINAMICS drive configurations. The virtual and real instances are aligned using the same test vectors, which are also created at the real devices as part of the release process. In a nutshell: With these function blocks, users obtain verified and validated digital twins of the drive technology hardware that they are using at the press of a button.



The advantage of the new SINAMICS DriveSim Basic software solution is that users can obtain validated emulations of SINAMICS drives. This facilitates simpler simulation of reality and simultaneously saves a lot of time.

The main focus is always ease-of-use. While users of simulation programs are used to generating the models required for the simulation task themselves from the information provided by the device manufacturer, with SINAMICS DriveSim Basic you now receive autonomous and tested entities. The real highlight is that the models accurately comply with the existing drive documentation, i.e. the function diagrams, with which users are already familiar with. Contrary to the real product, customers only have to configure the part of the drive that they actually require for their simulation. Users themselves can decide just how accurate the model should be. The drive no longer has to be completely commissioned - which would be a costly and time-consuming process – especially since the necessary information is frequently not available in the customer's design phase. A significant amount of time can be saved by focusing on the real essentials. This accelerates the complete planning phase of the drive environment, and also increases the guality of the information obtained and in turn, the planning quality.

The time saving for users can be significant: The manufacturer estimates that it takes about a week for customers to manually emulate drives in simulation programs – assuming of course that the customer has the appropriate know-how when it comes to simulating drives. Tests and validations with respect to the real drive would take up most of the time, especially since the drive may not yet have been precisely defined at such an early design stage in which the simulation is used – and certainly not yet purchased. This means that with the new simulation solution, the customer's application can be designed with the drive still undecided, without having to commit to a specific drive configuration too early in the design process.

Faster engineering using SINAMICS DriveSim Basic

The handling couldn't be simpler: SINAMICS DriveSim Basic offers one and the same FMU file for every Siemens drive; for instance the SINAMICS S120 or G120, including the motors. This FMU file can be directly imported into the simulation program being used. The drive parameters required for simulation are then available, along with the interfaces that are used for the real physical drive. This means that drive constellations can be specifically simulated, adapted and optimized in systems and machines before an actual product has been selected. And moreover, before a design engineer has made the first keystroke. The simulation should focus on the drive environment, i.e. supporting the specific customer application, and not on the virtual commissioning of all the fine details of the drive. Whether virtually commissioning the PLC control with the known PROFIdrive telegrams or a complex mechanical system at the virtual drive shaft - for both scenarios, SINAMICS DriveSim Basic dependably emulates the drive system. This provides the necessary degree of detail without requiring that users get involved with the complex drive configuration. This reduces the number of resources involved at all levels, and makes the complete development process transparent.

Based on virtualization solutions such as these, the future of automation and drive technology will develop to involve seamless digital engineering processes, therefore supplementing the frequently used approach of "copying & pasting existing solutions." This means: The design of new systems and machines today – along with their (driverelated) detailed solutions – is often based on projects that have already been implemented. Using the new possibilities offered through virtualization and simulation, as described here, validated drive solutions can be designed without incurring a high overhead. In conjunction with this, the advantages of distributed personnel or teams working on the same model must not be forgotten. This could also mean that a test field is no longer required, for example. In addition to a shorter time, high logistical costs can be eliminated to some extent. For example, if new drive solutions are available in a fully digital form, then they do not have to be shipped half way around the globe for testing.

As a consequence, simulation and virtualization of systems or machines play a significant role when re-evaluating known and established approaches and create new strategies both quickly and reliably. Therefore, it makes sense that users first simulate the required hardware, including the associated software control, and virtually test the associated topology. Using a "digital twin" like this means that time to market and customizing cycles can also be significantly accelerated – employing the easy-to-use SINAMICS DriveSim library described above.

Virtualization increases the cost effectiveness

Manufacturers of systems and machines are faced with the challenge that customers order solutions and products, but they do not want to get financially involved in the planning and development to the same extent. Seamlessly digitalized complete solutions are an absolute must if you wish to improve your cost effectiveness and in turn competitiveness. Increasingly, test setups and complex and costly prototypes known from the past can be eliminated. These advantages are becoming increasing more significant as simulation models evolve and mature.

With this as background information, Siemens is working flat out to further expand the virtualization solution described. Put simply, users of simulation programs only have to connect the signal cables and the application model to the drives that they selected, and then these can be immediately commissioned virtually. Ultimately, this digitalization strategy has the objective of virtually commissioning the drive.

Software as highway to the future

With SINAMICS DriveSim Basic Siemens provides a drive-related response to the increasing demands and requirements relating to the topic of virtualization and simulation – more precisely independent of any particular tool. And the next steps have already been defined. The software-related possibilities are becoming increasingly more complex and with them, the advantages when it comes to developing innovative systems and machines. Together with industry partners, Siemens intends to actively expand its leadership role, and take software solutions to a successful future. And more precisely, not just from the development laboratory, but also "live" from the field.

You can accompany Siemens on this journey if you wish to be part of this innovation process. This means that users, together with drive suppliers, can define certain features from the real drive portfolio, and influence the increase in the level of model detail provided in the direction that they want. One thing is for sure: Virtualization provides completely new product development strategies for the whole machinery construction domain. Software solutions such as SINAMICS DriveSim Basic provide a solid basis, therefore helping shape the future of automation and drive technology.

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With the new SINAMICS DriveSim Basic software solution, we provide users with a knowledge-based simulation library of our drives with which they can virtualize systems and machines even faster, more easily and in even more detail. You only have to import the relevant FMU file of the required SINAMICS drive into the simulation program you are using. Compared to when they model drives themselves, customers can save a significant amount of time and noticeably improve emulation of reality at the same time.



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