Crane drive and control systems: Part 2

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Abstract

The container transportation industry has witnessed a remarkable growth over the last decade. Control system wise, the programmable logic controller (PLC) was the preferred solution for motion control and general interlocking. As technology evolved over the years, so have the cranes, which are now bigger, faster and more complex electrically. Siemens as the leading supplier for container crane drive systems now introduces an innovative drive and control system solution that offers crane builders, system integrators and end-users for the first time standardised yet flexible hardware and software solutions.

Crane controller standardisation

On the power electronic side, several developments have been seen through the years. However, on the programmable controller side, there has not been a major revolution in the philosophy of the control since the introduction of programmable logic controllers and field-bus systems as substitute for relay logic.

Siemens’ powerful centralised motion controller SIMOTION D completely relieves the crane PLC from any technological crane drive task. This new approach (with internet connectivity) paves the way for a more effective approach to engineering, commissioning and troubleshooting. Key drive functions that are similar on any crane can be standardised and are available as tested and documented modules.

Crane builders and system integrators can now minimise the resources they require for development and maintenance of their own software blocks. End users gain the advantage that the core function modules are standard, independent of the crane manufacturer and the respective project team and also independent of the crane type, be it ship-to-shore, rail-mounted gantry, grab ship unloader, goliath or ladle crane, and ultimately the core function modules are standard.

Drive and control system availability is improved not only by the powerful internet-based diagnostic features of the new controller but also due to the quality of documentation and level of testing the standardised software functions.

Siemens’ DC thyristor converters (SIMOREG DC-MASTER) and AC drives (SIMOVERT MASTERDRIVES) with their crane-specific technology boards (T300 and T400) were widely accepted in the market. These technology boards provided crane-specific function blocks such as:

- Master-slave torque control
- Load-dependent field weakening
- Position sensing with synchronisation
- Limit switch handling
- Heavy load handling
- Slack rope control

![Figure 1. Typical control configuration tandem lift STS with SIMOTION D controller.](image-url)
These proven technology blocks and more are now available on a SIMOTION D controller and are marketed under the trademark ‘SIMOCRANE Basic Technology’. The resulting control configuration features the central SIMOTION D that directly controls the different inverters. The SIMOTION D is connected via PROFIBUS to the crane PLC and via ETHERNET to the crane management PC.

Although other control tasks, e.g. lighting control, which are specific to either the crane type or the crane builder, can be controlled by SIMOCRANE, these tasks are still to be handled in a PLC (e.g. SIMATIC S7-300).

With the use of the standard Basic Technology blocks, standard drive functions have been created to precisely control crane axis:

- **Hoist**
- **Trolley**
- **Gantry**
- **Boom hoist/luffing gear**
- **Holding and close gear**
- **Slewing gear**

The standard SIMOCRANE technology blocks and drive functions have been developed to facilitate the integration into any type of crane. Different applications have been created to suit users with different requirements and knowledge levels:

**a) Ready to run**

Designed for the crane builder or system integrator who only wants to spend a minimum amount of time developing the crane control software with the security of using tested and standardised blocks. For instance, standard applications for different crane types are pre-configured and the necessary function blocks are pre-connected. They only need to be appropriately parameterised. These applications include:

- Ship-to-shore single lift (rope propelled or self propelled trolley)
- Ship-to-shore tandem lift
- Grab ship unloader
- Rail-mounted gantry
- Overhead bridge crane

**b) Ready to apply**

Designed for situations where the crane builder or system integrator only partially uses the standard technology function blocks in conjunction with their own software or intends to create a completely new application with their own configuration. A ready to apply solution allows all levels of flexibility for the user to customise and protect their own technological algorithms.

**Integration of automatic crane operation functions**

A further advantage of a powerful central motion controller is the ability to integrate the crane motion control with automation.
functions. Siemens’ previous HIPAC TOUCHMATIC sway-control system, which was running on separate controller hardware, has been migrated onto SIMOTION. The product family SIMOCRANE offers a modular architecture, which can be expanded as required. The modularity of the system allows the user to decide when and how the application will be enhanced.

**Improved diagnostic functions**

The SIMOTION D motion control system allows a JAVA-script based browser tool to be run to support commissioning and diagnostics. No specific software other than a standard web browser is needed. The graphic screens provided by the tool, guides the user through crane commissioning which structures and simplifies the commissioning process. System diagnostics are supported by the powerful trace function that shows critical variables of different motion (e.g. hoist1 and hoist2) along the same time axis. This major benefit has been achieved by using a central controller.

**Conclusion**

Furthermore, standardised and pre-tested control function modules keep technical risk and integration time to a minimum. For the end user, system transparency and ultimately crane availability has been substantially improved. Siemens’ new crane drive and control solutions based on SIMOCRANE, SIMOTION D and SINAMICS will set a new trend in the crane drive and control system market.

**ABOUT THE COMPANY**

Siemens is one of the world’s largest electrical engineering companies. Siemens is committed to delivering state of the art solutions, which minimise the impact on the environment. With over a century of experience in supplying electrical traction equipment a revolutionary new drive system has evolved in the crane market.

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