

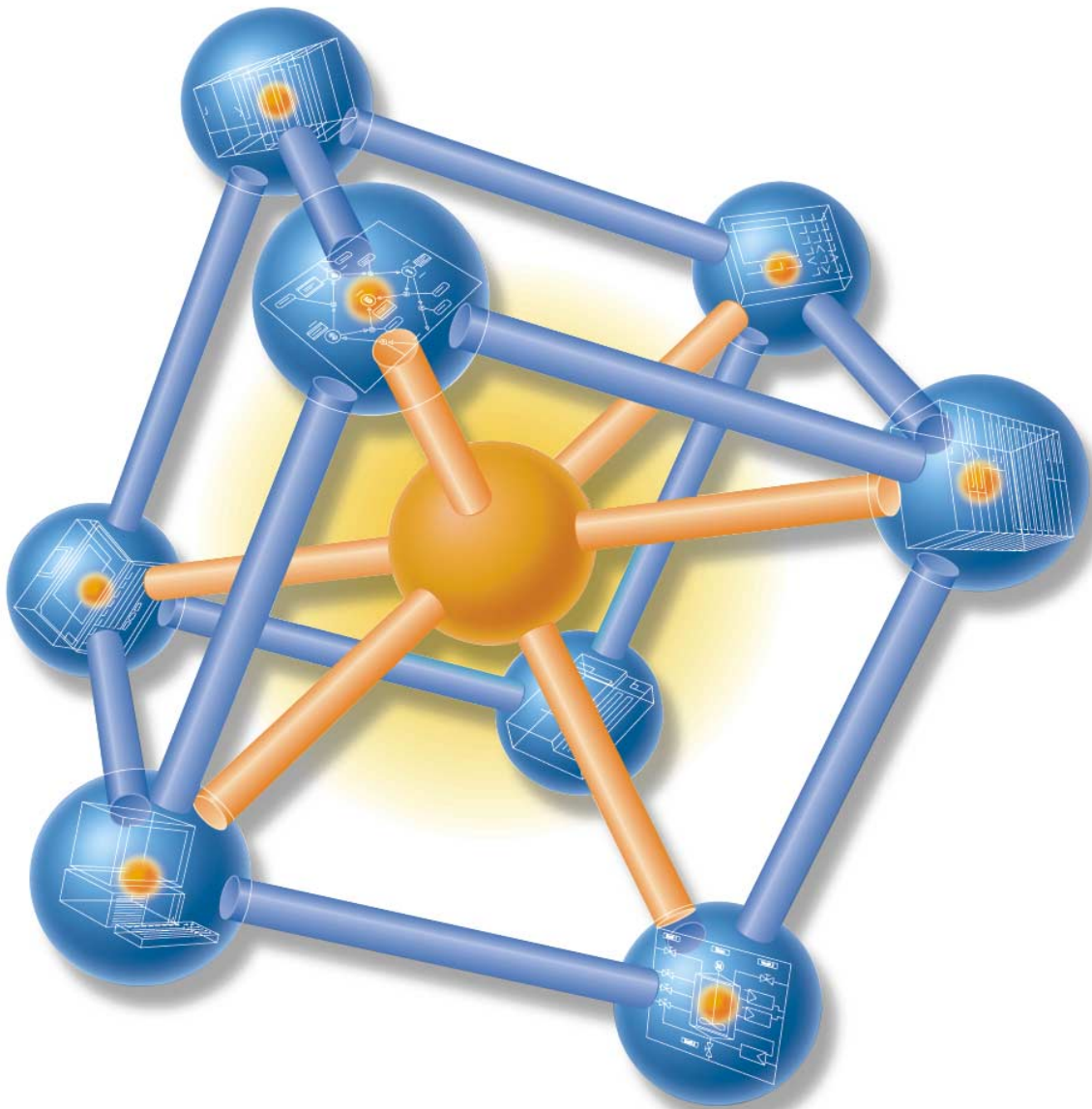
SIEMENS

SIMATIC FM 355 S

Getting Started

Edition 03/2000

First Steps in Commissioning



This manual guides you through the various steps in commissioning up to a fully functional application with the help of a concrete example. You will be acquainted with the basic functions of your FM 355 S hardware and software and learn how to check them. The references to the user guide serve to give you an initial overview of the information contained there.

The time effort depends on experience and takes up one to two hours plus the time needed for wiring and controller tuning.

Prerequisites

The prerequisites are:

- You have an S7-300, consisting of a power supply module and a CPU.
- STEP 7 ($\geq V4.02$) is correctly installed on your programming device.
- You have created a project for the S7-300 station.
- The programming device is connected to the CPU.
- You have a FM 355 S interface, the configuration package belonging to the FM 355 S and the required accessories, for example bus connectors (part of the FM 355 S scope of delivery), front connectors, sensors, switches, control elements (actuators) and the wiring material.

Installing the Project Package on the Programming Device

The project package contains a configuration tool for the FM 355 S, and the required function blocks (FBs) for linking the FM 355 S to your user program on the CPU and program examples.

In order to install the software insert the CD in your drive and start the installation program SETUP.EXE from this CD.

Follow the instructions of the installation program (refer to the manual of the controller module FM 355, Chapter 6).

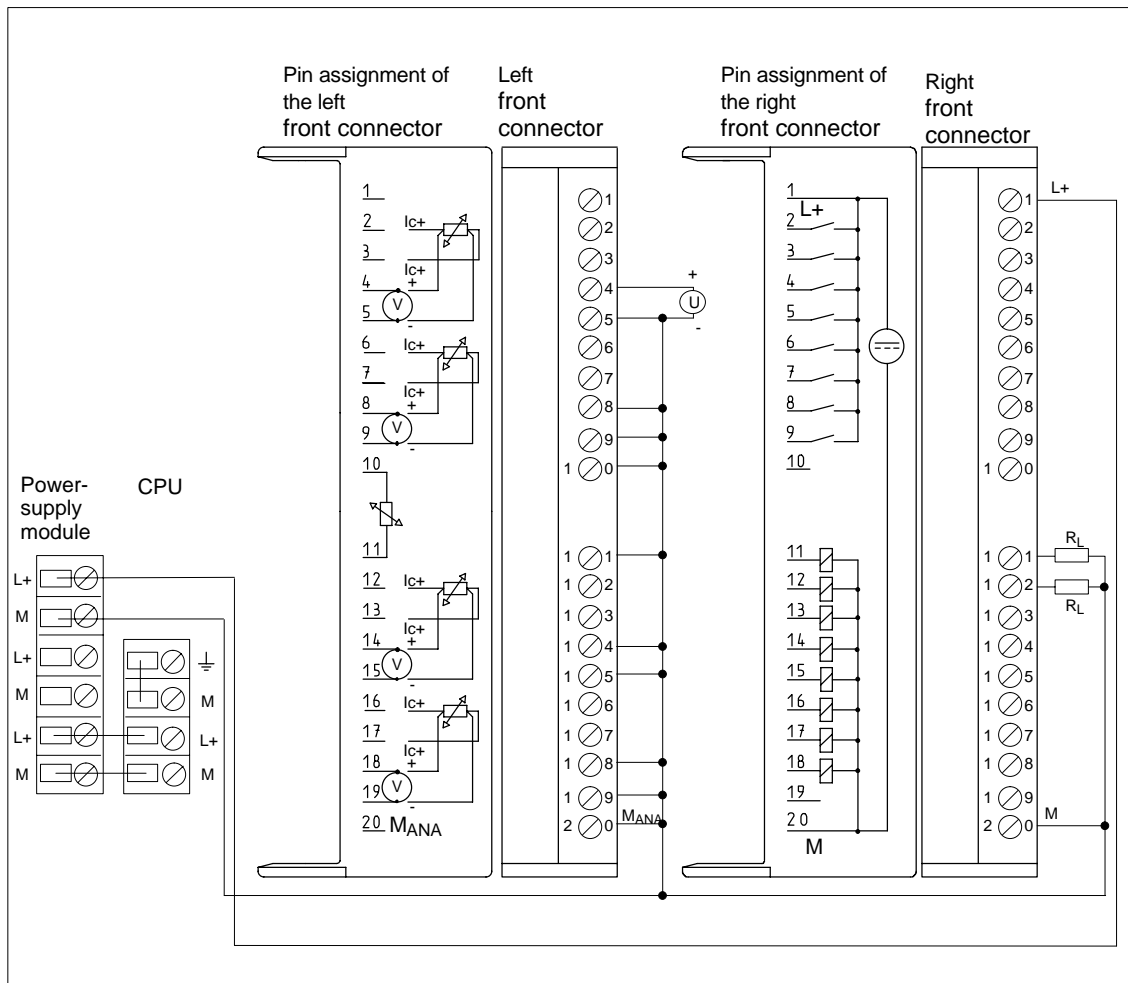
Installing and Wiring Up the FM 355 S

Connect the bus connector which is supplied with the FM 355 S to the bus connector of the CPU. Hang the FM 355 S into the DIN rail, swivel it down and screw it on to fasten it (refer to the manual of the controller module FM 355, Chapter 4).

The figure below shows the wiring of the front connector for a controller channel with voltage input and voltage output. The wiring of the other sensors and actuators is described in Chapters 5 and 10 of the manual for the controller module FM 355.

All unused analog inputs, including the reference junction, are always to be short-circuited to ground and to be connected to M_{ANA} and M, even if those inputs are not configured in the user interface.

For a closed-loop control it is not necessarily required to wire up the digital inputs. The wiring of the digital inputs is also explained in Chapters 5 and 10 of the manual for the controller module FM 355. The possible fields of application of the digital inputs are explained in Section 3.3.2 of this user guide.



After wiring up the front connectors, plug them into the FM 355 S and engage them.

Configuring the FM 355 S Parameters

Also refer to the manual for the function module FM 355, Chapter 6.

Open your project in the SIMATIC Manager.

In your project, call up the configuration table HW Config.

Select the FM 355 S - order number 6ES7 355-1VH10-0AE0 - from the hardware catalog and drag and drop it on the desired expansion slot (in the example: Slot 4).

Double-click on this FM 355 S to call up the "Properties - FM 355 S PID Control" window.

Note down the module address (in the example 256 = 100 Hex) which is shown in the addresses tab control. You need this address in the next step in order to integrate the FM 355 S into the user program.


Have a look at the "Basic parameters":

- Interrupt Generation: NO
- Interrupt Selection: None

This setting prevents the FM from sending a diagnostic interrupt to the CPU, for example when a disruption of the measuring transducer occurs (refer to the manual of the function module FM 355, Chapter 12).

Click on the [Parameter...](#) command button to open the parameter input screen. In the following section you are guided only through the parameter configuration which is required for this example. Not all parameter windows are followed up and explained.

Configuring the Analog Input Parameters

First you need to select a sensor type to be able to process an analog input and the corresponding controller with the module. Click on the button  of the analog input 1. Click on the button [Sensor](#). Configure the sensor type parameter "Voltage 0 ... 10 V" and enter the setting by clicking on the button [OK](#). The window is closed by this operation.

Click on the button [Normalize](#) and enter the desired physical values for the operating range between setpoint value and process variable. For "high", specify a value which corresponds to a 10 V input level. For "low", enter a value which has to correspond to 0 V input level and enter this setting with [OK](#).

Close the window "Analog input 1" by clicking on the button [Close](#).

You can find additional information regarding this subject in the online help.

Configuring the Error Signal Parameters

For the controller type leave the default "Fixed setpoint or cascade controller" and "Step controller without position feedback".

Click on the button [Error signal](#). With a click on the buttons [Setpoint](#) and [Actual variable A](#) you can see which source has been selected for the setpoint value and the process variable respectively. Do not alter the default value of "Setpoint value: by function block" and "Actual variable A: conditioned analog input 1". Close both windows by clicking on the button [Cancel](#).

Also observe the window [Switch Safety Setpoint](#). Here you see how the reaction of the module during a CPU failure or startup is specified.

In the window [Limit](#) enter the permissible range of value for limiting your setpoint value. Confirm the setting with [OK](#).

Close the error signal window.

You can find additional information regarding this subject in the online help.

Configuring the Controller Parameters

Click on the button [Control algorithm](#) - only to view the possible settings. You can choose a temperature controller or a PID controller. Do not modify the default setting of the PID controller and close the window "Controller 1" without having made any changes. Optimizing the parameters for this controller is explained at a later point.

You can find additional information regarding this subject in the online help.

Configuring the Controller Output Parameters

Here you can specify which signals or operating states lead to a changeover of the controller output - for example to safety manipulated value, tracking input or external preset manipulated value. It is not required to modify the parameters here.

Also note the window [Switch Safety Manipulated Value](#). Here you can determine the reaction of the module when it starts up or when the measuring transducer is disrupted. For stepping control without position feedback you can close the control valve completely if you configure the safety manipulated value parameter to 0% (refer to the manual for the controller module FM 355, Section 3.4)

Open the window [Pulse shaper](#) by clicking on the respective button. Here you can enter the parameters for the motor operating time of the control valve and the desired minimum pulse and minimum pause periods. Here you can also specify the source for the limit stop signals if it is not permissible that your control valve is driven permanently to the mechanical stop. These signals are preferably wired to a digital input of the FM 355 S. The digital outputs "Open" and "Close" are set to zero when the respective limit stop signal is high.

Close the window "Controller output".

The binary outputs of the FM 355 S are allocated fixed to the controller channels. Controller 1 is allocated to the outputs 1 and 2, controller 2 is allocated to the outputs 3 and 4, etc.

You can find additional information regarding this subject in the online help.

Saving the Parameters and Transferring Them to the FM 355 S

Now you are done with the parameter configuration. Save your settings with [File > Save](#) and close the parameter configuration with [File > Exit](#) .

Close the window "Properties - FM355 S PID Control" by clicking on the button [OK](#) .

Save the configuration you have created with [Station > Save](#) to your project.

Transfer the configuration to the CPU while it is in STOP mode with [PLC > Download to Module....](#)

The data are now transferred directly to the CPU and into the FM 355 S. As long as the configuration is buffered in the CPU, the data are always transferred to the FM 355 S with every CPU transition from STOP to RUN.

Test: *Switch the power supply of the CPU and of the FM 355 S off and on again. If the parameters and the wiring are correct, the red LED SF is actuated for a short period and switched off again when the internal module test has been proven successful. The yellow Backup LED lights up when the CPU is in STOP mode. It is switched off with the CPU transition to RUN mode.*

Integrating the FM 355 S into the User Program

In the SIMATIC Manager, open the library FM_PID with [File > Open... > Libraries](#) .

Copy the function block FB 31 PID_FM from the container FM 355, 455 PID Control / Blocks of the FM_PID library into your project container "Blocks".

You can use the function module FB 31 PID_FM to

- Modify operating parameters, for example specifying a setpoint value or changing the operating mode from manual to automatic,
- Read out process values from the FM, from example the current process variable, the manipulated variable or the current operating states and
- Modify controller parameters depending on the process status.

Insert a watchdog interrupt OB in your project, for example the OB 35. Open this OB 35. In OB 35, call FB 31 PID_FM. Assign an instance DB to this FB call, for example:

```
CALL "PID_FM", DB 50
```

In the parameter MOD_ADDR, enter the module address which you have noted down before (see above, "Configuring FM 355 S Parameters").

In the CHANNEL parameter, enter the channel number of the controller whose parameters you wish to read and write with this call.

In the parameter SP_RE you can specify the setpoint value. Changing over between manual and automatic mode and the manual value specification is possible via the parameters LMN_REON and LMN_RE. For stepping control without position feedback you can close the control valve completely if you enter a manual value LMN_RE 0%. You can open it completely by entering a manual value LMN_RE 100% (refer to the manual for the function module FM 355, Section 3.4)

Save the OB 35 with [File > Save](#) .

Assign a symbolic name to the thus created instance DB, for example DB_cont1, by using the symbol editor.

For further information on this subject refer to Section 7.1 of the manual for the controller module FM 355.

Modifying Controller Parameters by Means of the User Program

If you want to modify individual parameters during operation, the FB PID_FM at first needs to read out the parameters from the FM 355 during start-up, since not only the modified parameters are transmitted to the FM but always all parameters. In OB 100 set the parameter COM_RST of the FB 31 PID_FM to carry out this operation:

SET

= "DB_cont1".COM_RST

The FB 31 PID_FM reads out the controller parameters from the FM 355 and stores them to its instance DB during the first call of the OB 35. You can now modify individual values, for example the controller gain GAIN. Now, if you have set the parameter LOAD_PAR to TRUE in OB 35, the parameters are transferred from the instance DB to the FM 355 S. The successful action is indicated by the reset of COM_RST or LOAD_PAR (refer to the manual for the controller module FM 355, Section 7.1 and 11).

Downloading the Example Program

For the following tests we recommend you use the example "SIMATIC 300 Station2 (S)" from the project FM_PIDEx. You can use this to test the FM 355 S in a simulated control system, without a real process (see the manual for the controller module FM 355, Section 13.2).

In the HW Config, replace your FM 355 S with the FM 355 S of the example.

Save, compile and download this configuration.

With the exception of system data and the SFCs 58 and 59, copy all the blocks into the block container of your user program.

Download these blocks to the CPU.

Check the module address in parameter MOD_ADDR of the DB 31. It needs to agree with the FM 355 S address which is entered in HW Config.

In HW Config check the cyclic interrupt clock cycle of OB 35. The execution time must be set to 100 ms.

Testing the Controller by Means of the Loop Display and the Curve Recorder

You can access the loop display by opening the instance DB 31 of the example program in the parameter input window of the FM 355 S with [Test > Loop Monitor](#). You can use the loop monitor to specify setpoint values and manual manipulated variables for testing the controller.

You can access the curve recorder by opening the instance DB 31 of the example program in the parameter input window of the FM 355 S with [Test > Curve Recorder](#). You can use the curve recorder, for example, to record the curve of a setpoint step.

Also observe the online help (button [Help](#) in the respective window) regarding the loop display and the curve recorder.

Note: Changing over to the programming-device setpoint value and programming-device manipulated value is carried out via the variables SP_OP_ON, SP_OP, LMNOP_OP and LMN_OP of the FB 31 PID_FM. These variables are reserved for this function and should therefore not be used in the user program.

Tuning the PID Controller

For the step controller you first need to measure the motor actuating time. In the parameter interface carry out this operation by opening the instance DB 31 of the example program with [Test > Measure Motor Actuating Time](#).

If you do not use any limit stop signals of the actuator or if your process can not handle opening or closing of the control valve, you need to enter parameters for the actuating time and then click on the [OK](#) button.

If you use the [Actuator Limit Signals](#) and have interconnected them to the FM 355 S and if you want to measure the actuating time, select to use the signals "Actuator Limit Signals". Now follow the instructions for "Measuring motor actuating time" displayed and set the actuating signal to programming device. Then press the "send" button. In the window "Measuring motor actuating time", start measuring by clicking on the [Start](#) button and in the following screen "Measuring motor actuating time" click on [OK](#). The opening and closing run time of the control valve is now measured. As soon as the result is shown, click on the [OK](#) button in the windows "Measuring motor actuating time" and "Close loop monitor".

In the subsequent window "Measuring motor actuating time" you can also modify the minimum pulse and minimum pause periods. Transfer these values with [PLC > Download](#) to the instance DB of the FB 31 PID_FM and from there to the FM 355 S.

In the parameter input window, use [Test > Controller Optimization](#) to open the instance DB 31 of the example program.

Follow the instructions in the "Controller optimization" information window:

Switch to the programming device at "Setpoint value" and click on the command button [Send](#).

In the subsequent window "Controller optimization: preparing for data recording" accept the default settings with [OK](#).

In the message window you are now prompted to set the manipulated value to the operating point. By using the button [Send](#), for example, you set a manipulated value of 0% as the operating point. When the process value has settled you can also click on the command button [OK](#) in the "Controller optimization" command button.

In the loop monitor, enter 30% as the setpoint value and click on the button [Send](#). Data acquisition is now in operation. Now you need to wait for the program to detect whether the process variable has settled. The time which the program needs to recognize settling seems to be somewhat long. However, quite often a measuring value noise is superimposed over the process variable. In order to achieve a good controller setting in spite of this measuring value noise and to be on the safe side the time for completing the data acquisition period was extended slightly.

When the information "Reverse excitation" is displayed on the "Controller optimization" window, close the loop monitor with [Close](#) and also close the message window "Close loop monitor" with [OK](#).

The subsequent window displays the determined process and controller parameters and offers a PI controller.

Select the [Load PI](#) command button and click on the [Yes](#) command button in the "Write parameters for controller optimization" window which now opens. The determined controller parameters are now stored in the offline data pool of your project and in the instance DB of the 31 PID_FM. Also, by setting the parameters LOAD_PAR in this instance DB, they have already been transferred to the FM 355 S.

Do not forget to transfer the modified parameters from the off-line data pool of your project to the system data of the CPU. You can only carry out this operation via the HW Config configuration table. Should you forget to carry out this operation, the old controller parameters are again loaded into the FM 355 S with the next CPU transition from STOP to RUN.

At this point we also draw your attention to the SIMATIC product "PID Self Tuner" (Order number 6ES7 860-4AA02-0YX0). This is a function block used to tune PID controllers. It is especially suitable for temperature processes. Please also refer to the information on the Internet under <http://www3.ad.siemens.de/ca01online/index.asp?nodeID=5000523&lang=en>.

Optimizing the Temperature Controller

You can obtain information on this subject in Section 3.8 of the manual for the controller module FM 355 and in the online help.

Diagnosis

Wrong parameter configuration, wiring or measuring transducer disruption can result in errors which are displayed in the FM 355 S via the group error message LED.

Chapter 12 of the manual for the controller module FM 355 explains how to debug those errors.

Examples

FM_PIDEx contains further examples which are a source of orientation to you and which can adapt to your application.