

56F805

BLDC Motor Control Application with
Quadrature Encoder using Processor Expert™
Targeting Document

56F800
16-bit Digital Signal Controllers

805BLDCQETD
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BLDC Motor Control Application with Quadrature Encoder

This application exercises simple control of the BLDC motor with the Quadrature Encoder on the 56F805EVM board and the EVM Motor Kit.

1. Specifications

This application performs simple control of the BLDC motor with the Quadrature Encoder and closed-loop speed control on the 56F805 processor. In the application, the PWM module is set to complementary mode with a 16kHz switching frequency. The masking and swapping of PWM channels is controlled by the PWM Channel Control Register. The content of this register is derived from Quadrature Encoder signals. The required voltage is set independently on the commutation by the speed PI controller. The speed is measured by the Quadrature Timer. The RUN/STOP switch enables/disables motor spinning. The allowable range of speed is from 50rpm to 1000rpm in both directions.

The application can run on:

- External RAM or Flash

The BLDC Motor Control Application with Quadrature Encoder can operate in two modes:

1. Manual Operating Mode

The drive is controlled by the RUN/STOP switch (S6). The motor speed is set by the UP (S2-IRQB) and DOWN (S1-IRQA) push buttons; [Figure 1-1](#). If the application runs and motor spinning is disabled (i.e., the system is ready), the USER LED (LED3, shown in [Figure 1-2](#)) will blink. When motor spinning is enabled, the USER LED is on. Refer to [Table 1-1](#) for application states.

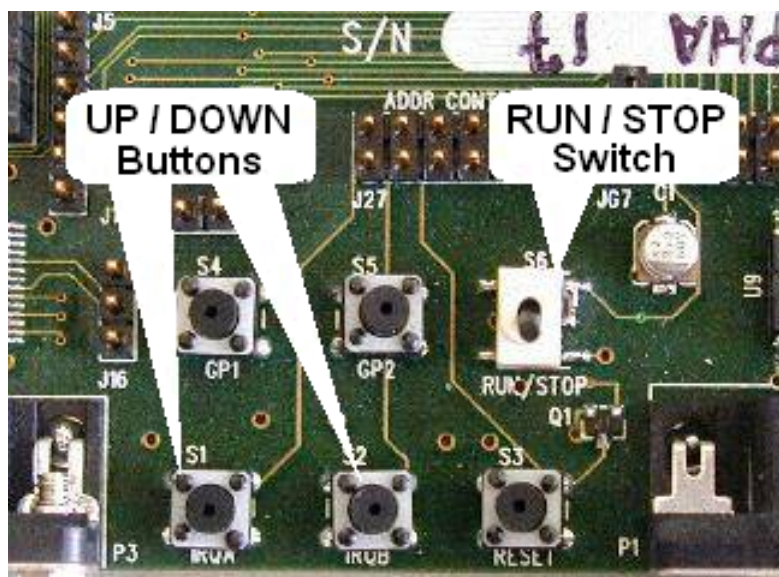


Figure 1-1 RUN/STOP Switch and UP/DOWN Buttons

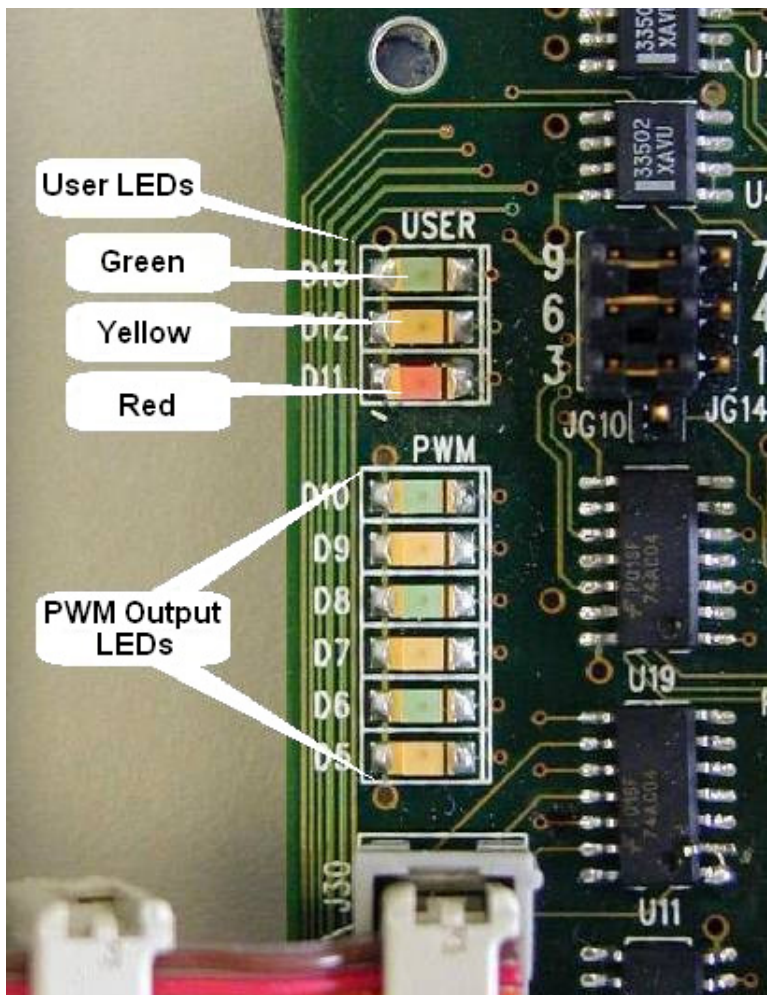


Figure 1-2 USER and PWM LEDs

Table 1-1 Motor Application States

Application State	Motor State	Green LED State
Stopped	Stopped	Blinking at a frequency of 2Hz
Running	Spinning	On
Fault	Stopped	Blinking at a frequency of 8Hz

2. PC master software (Remote) Operating Mode

The drive is controlled remotely from a PC through the SCI communication channel of the device via an RS-232 physical interface. The drive is enabled by the RUN/STOP switch, which can be used to safely stop the application at any time.

The following control actions are supported:

- Set the Required Speed of the motor

PC master software displays the following information:

- Required Speed
- Actual Speed
- Applied Voltage
- DCBus Voltage
- RUN/STOP Switch Status

Application Mode Project files for the PC master software are located in:

..\PC_Master\external memory.pmp, uses Map file to run in the external memory

..\PC_Master\internal pROM-xRAM.pmp uses Map file to run in the internal memory

..\PC_Master\internal xROM-xRAM.pmp uses Mapvfile to run in the internal memory

Start the PC master software window's application, *external memory.pmp*. **Figure 1-3** illustrates the PC master software control window after this project has been launched.

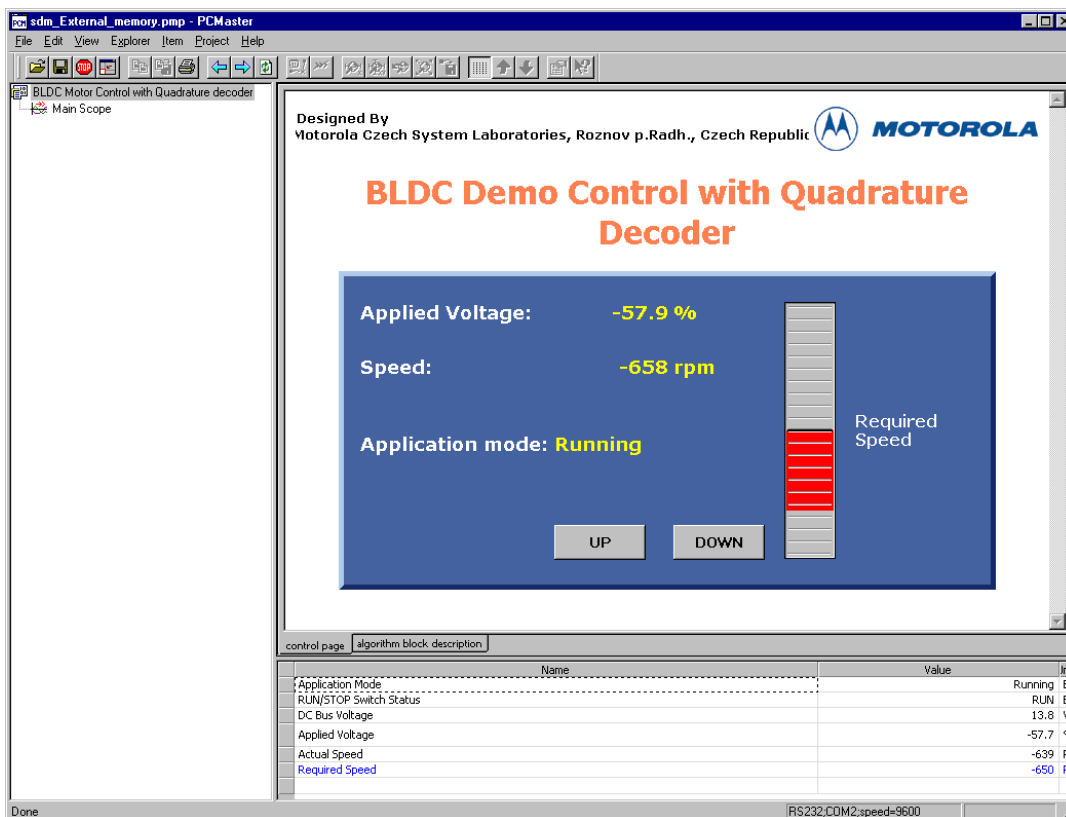


Figure 1-3 PC Master Software Control Window

2. Hardware Set-up

2.1 The Motor

The default hardware and software configuration is set up to support a BLDC motor with one wiring hole. Since there are two motor types that are in the field, please **check to see if your BLDC motor has a single wiring hole in the motor housing** from which the power stage and Hall Sensor connections are located (See motor photos in [Figure 2-1](#)). When using a BLDC motor with two wiring holes, **it is necessary to turn over the yellow power stage connector from the position shown in [Figure 2-2](#) (left picture) to inverted connection** (right picture in [Figure 2-2](#)).



Figure 2-1 Possible Motor Types

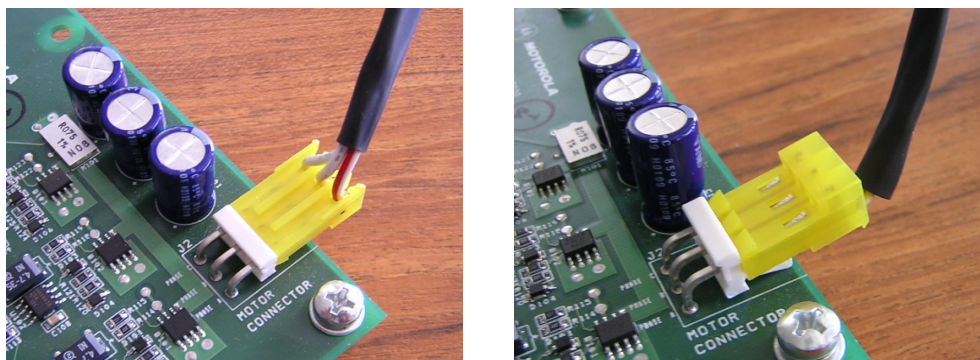


Figure 2-2 Default (left picture) and Inverted Connections of the Motor Cable

2.2 Application Hardware Set-up

Figure 2-1 illustrates the hardware set-up for the BLDC Motor Control Application with Quadrature Encoder.

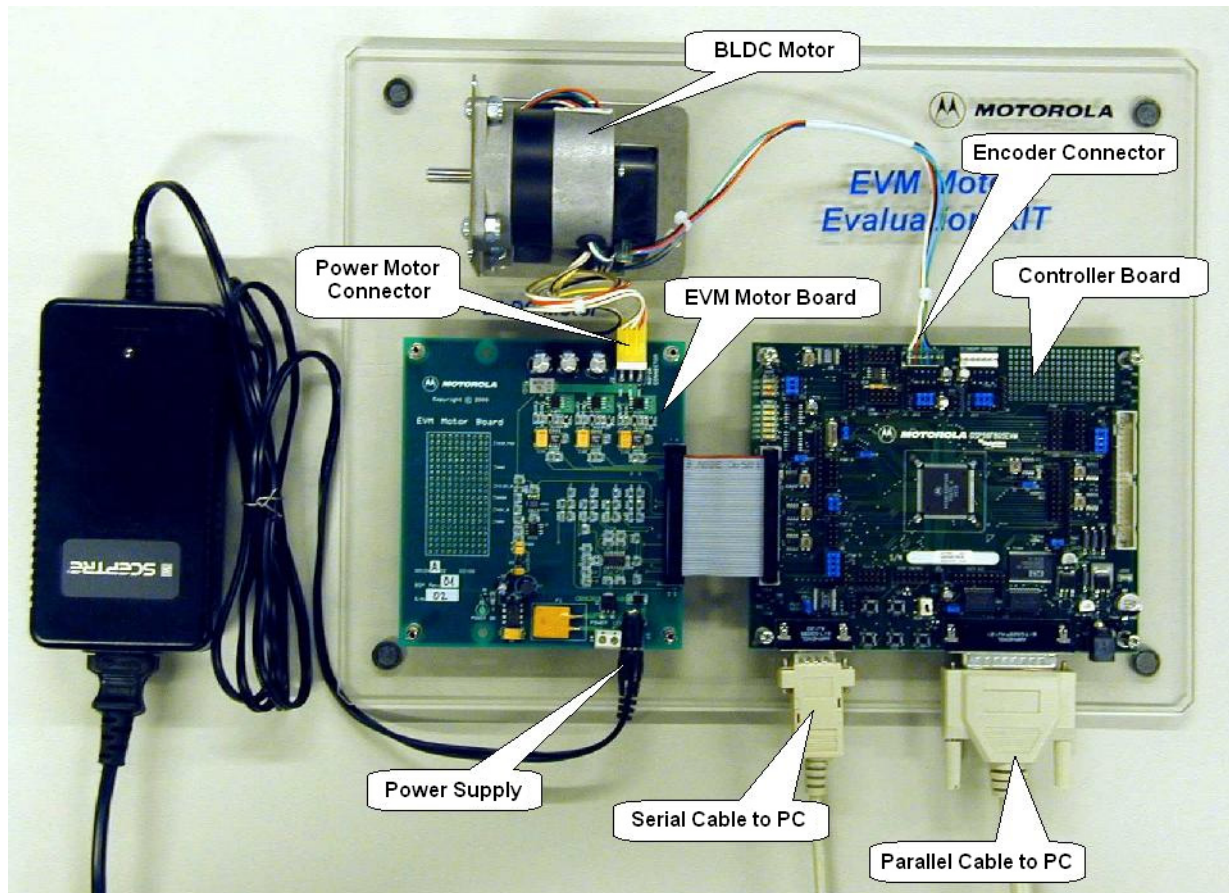


Figure 2-3 Set-up of the BLDC Motor Control Application

For detailed information, see the **56F805 Evaluation Module Hardware Reference Manual**. The serial cable is needed for the PC master software debugging tool only.

2.3 EVM Jumper Settings

To Execute the BLDC Motor Control Application with Quadrature Encoder, the 56F805 board requires the strap settings shown in [Figure 2-4](#) and [Table 2-1](#).

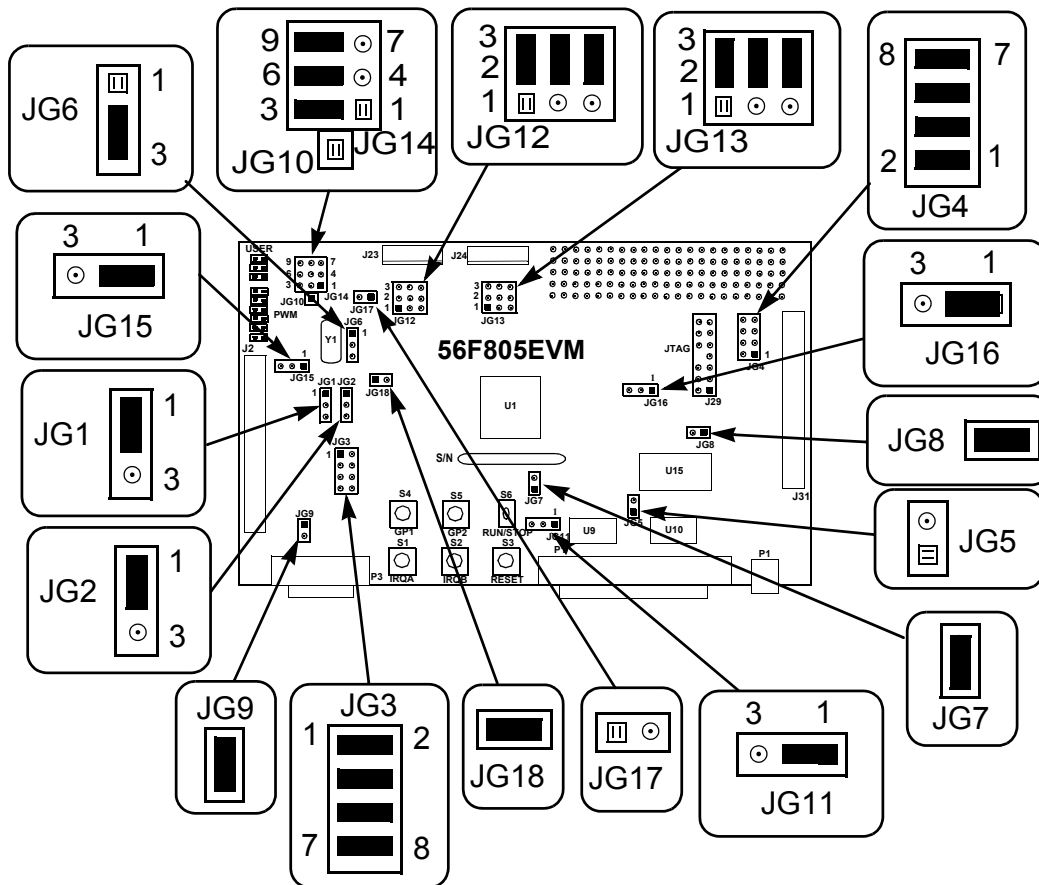


Figure 2-4 56F805EVM Jumper Reference

Table 2-1 56F805EVM Jumper Settings

Jumper Group	Comment	Connections
JG1	PD0 input selected as a high	1-2
JG2	PD1 input selected as a high	1-2
JG3	Primary UNI-3 serial selected	1-2, 3-4, 5-6, 7-8
JG4	Secondary UNI-3 serial selected	1-2, 3-4, 5-6, 7-8
JG5	Enable on-board parallel JTAG Command Converter Interface	NC
JG6	Use on-board crystal for oscillator input	2-3
JG7	Select controller's Mode 0 operation upon exit from reset	1-2
JG8	Enable on-board SRAM	1-2
JG9	Enable RS-232 output	1-2
JG10	Secondary UNI-3 Analog temperature input unused	NC
JG11	Use Host power for Host target interface	1-2
JG12	Primary Encoder input selected for Quadrature Encoder signals	2-3, 5-6, 8-9
JG13	Secondary Encoder input selected	2-3, 5-6, 8-9
JG14	Primary UNI-3 3-Phase Current Sense selected as Analog Inputs	2-3, 5-6, 8-9
JG15	Secondary UNI-3 Phase A Overcurrent selected for FAULTA1	1-2
JG16	Secondary UNI-3 Phase B Overcurrent selected for FAULTB1	1-2
JG17	CAN termination unselected	NC
JG18	Use on-board crystal for controller oscillator input	1-2

3. Build

When building the BLDC Motor Control Application with Quadrature Encoder, the user can create an application that runs from internal Flash or External RAM. To select the type of application to build, open the *bldc_encoder.mcp* project and choose the target build type; see [Figure 3-1](#). Selecting *Build All* will build all application build types. A definition of the projects associated with these target build types may be viewed under the *Targets* tab of the project window.

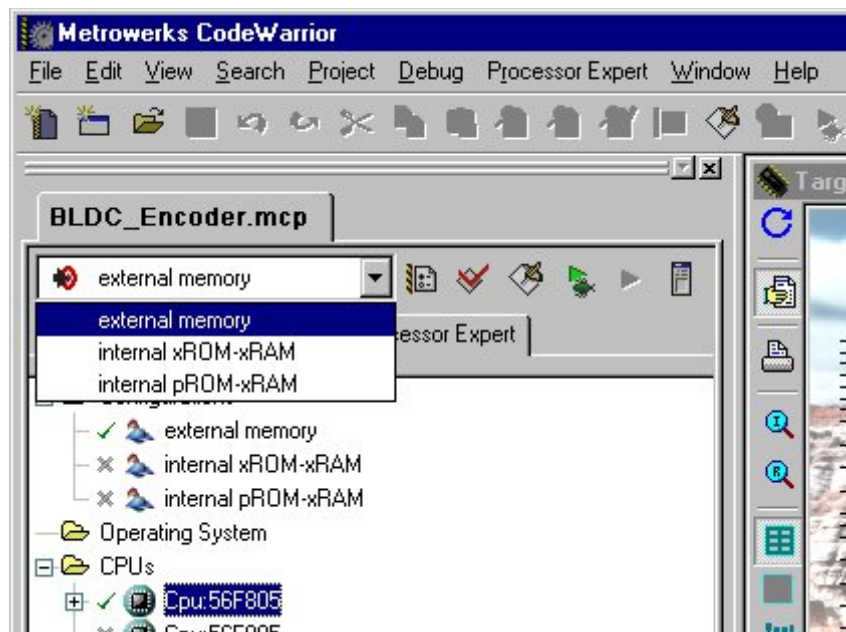


Figure 3-1 Target Build Selection

The project may now be built by executing the *Make* command, as shown in [Figure 3-2](#). This will build and link the BLDC Motor Control Application with Quadrature Encoder and all needed CodeWarrior and Processor Expert libraries.

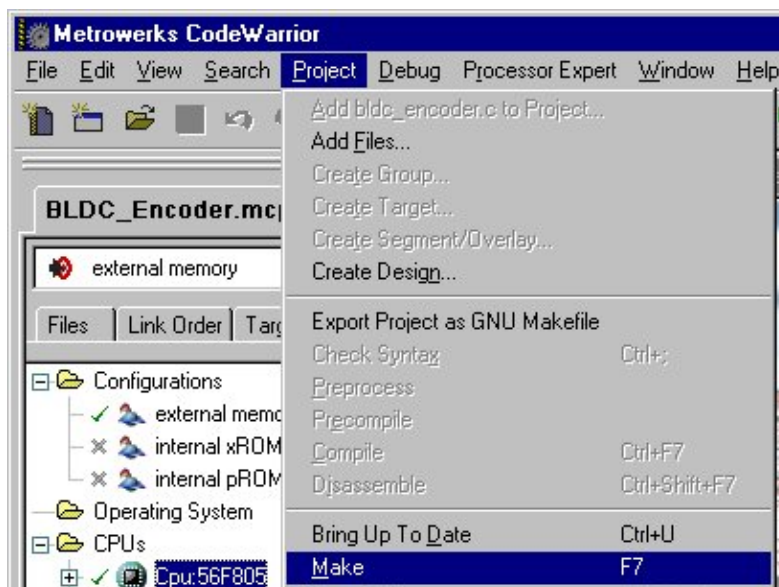


Figure 3-2 Execute *Make* Command

For more information about these commands, see:

<...>\CodeWarrior Manuals\PDF\Targeting_56800.pdf

4. Execute

To execute the BLDC Motor Control Application with Quadrature Encoder, select the *Project\Debug* command in the CodeWarrior IDE, followed by the *Run* command. For more help with these commands, refer to the CodeWarrior tutorial documentation in the following file, located in the CodeWarrior installation directory:

<...>\CodeWarrior Manuals\PDF\Targeting_56800.pdf

If the Flash target is selected, CodeWarrior will automatically program the device's internal Flash with the executable generated during Build. If the External RAM target is selected, the executable will be loaded to off-chip RAM.

Once Flash has been programmed with the executable, the EVM target system may be run in a stand-alone mode from Flash. To do this, set the JG5 jumper in the 1-2 configuration to disable the parallel port, and press the RESET button.

Once the application is running, move the RUN/STOP switch to the RUN position, and set the required speed with the UP/DOWN push buttons. Pressing the UP/DOWN buttons should incrementally increase the motor speed until it reaches maximum speed. If successful, the BLDC motor will be spinning.

Note: If the RUN/STOP switch is set to the RUN position when the application starts, toggle the RUN/STOP switch between the STOP and RUN positions to enable motor spinning. This is a protection feature that prevents the motor from starting when the application is executed from CodeWarrior.

You should also see a lighted green LED, which indicates that the application is running. If the application is stopped, the green LED will blink with a 2Hz frequency. If an Undervoltage fault occurs, the green LED will blink at a frequency of 8Hz.

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