

Control Word Sequences in ABB Drives Profile Communication

Ready to operate & Ready to switch on behavior

When controlling all compatible ABB AC drives via fieldbus communications using the ABB Drives Profile, users often employ simplified control word sequences to start and stop the drive. A common approach is:

- Send control word 1150 (decimal) = 047Eh (hex) to enable the drive = 0100 0111 **1110** (binary)
- Send control word 1151 (decimal) = 047Fh (hex) to start the drive = 0100 0111 **1111** (binary)
- Send control word 1150 (decimal) = 047Eh (hex) to stop the drive = 0100 0111 **1110** (binary)

We can see that Bit 0 is being cycled from low to high and back to low again. Bit 0 of the fieldbus control word is defined below as Off1 control. When the bit is high we receive the Ready to Operate and 1151 is acting as a start command so the ready to operate is not received prior to starting the motor.

Note: 1150 to be used when a ramp stop is needed, 1149 to be used when a coast stop is needed.

■ Contents of the fieldbus Control word (ABB Drives profile)

The upper case boldface text refers to the states shown in the state diagram (page 575).

Bit	Name	Value	STATE/Description
0	Off1 control	1	Proceed to READY TO OPERATE .
		0	Stop along currently active deceleration ramp. Proceed to OFF1 ACTIVE ; proceed to READY TO SWITCH ON unless other interlocks (OFF2, OFF3) are active.

While this simplified sequence successfully starts and stops the drive there can be some behaviors that are overlooked. One example is that Relay Output 1 (RO1) by default is setup as Ready Run and it will not energize in this situation until after the motor is started. RO1 is activated when set to Ready Run based on 6.11 Status Word Bit 1, which indicates the drive has reached the "READY TO OPERATE" state in the ABB Drives Profile state machine control word. This state is only achieved by following the proper state machine transition sequence. When using a simplified control word sequence (1150 → 1151 → 1150) critical state machine transitions are skipped. Specifically, it does not properly transition through the "READY TO SWITCH ON" state before attempting to reach "READY TO OPERATE". This could lead to a problem if a ready light is available on the cabinet door because the light will not actually illuminate until the start is commanded. Another scenario could be using this ready signal as a permissive connected to a PLC input. If the logic is set to receive this prior to allowing a start command to be sent to the drive, this acknowledgment will never be made. Care should be taken to understand the sequence of operation to ensure the desired results.

Following the State Machine

Using the correct control word sequence that follows the ABB Drives Profile state machine:

The drive requires control word 1143 (0477h) to be sent FIRST to properly establish the "READY TO SWITCH ON" state, which is a prerequisite for the "READY TO OPERATE" state that activates the Ready Run bit.

Step	Control Word (Decimal)	Control Word (Hex)	Drive State
1	1142	0476h	After power-on, fault, or emergency stop (NOT READY TO SWITCH ON)
2	1143	0477h	READY TO SWITCH ON (stopped) Ready Run bit = 0
3	1151	047Fh	READY TO OPERATE → OPERATING (running) Ready Run bit = 1
4	1143	0477h	Stop and return to READY TO SWITCH ON Ready Run bit = 0

Control Word Bit Definitions (ABB Drives Profile):

- Bit 0: OFF1 control (1 = proceed to READY TO OPERATE)
- Bit 1: OFF2 control (1 = continue operation)
- Bit 2: OFF3 control (1 = continue operation)
- Bit 3: Run command (1 = proceed to OPERATION ENABLED)

Status Word Bit 1 (Ready Run):

- Value = 1: Drive is in "READY TO OPERATE" state
- Value = 0: Drive is in "OFF1 ACTIVE" state or earlier

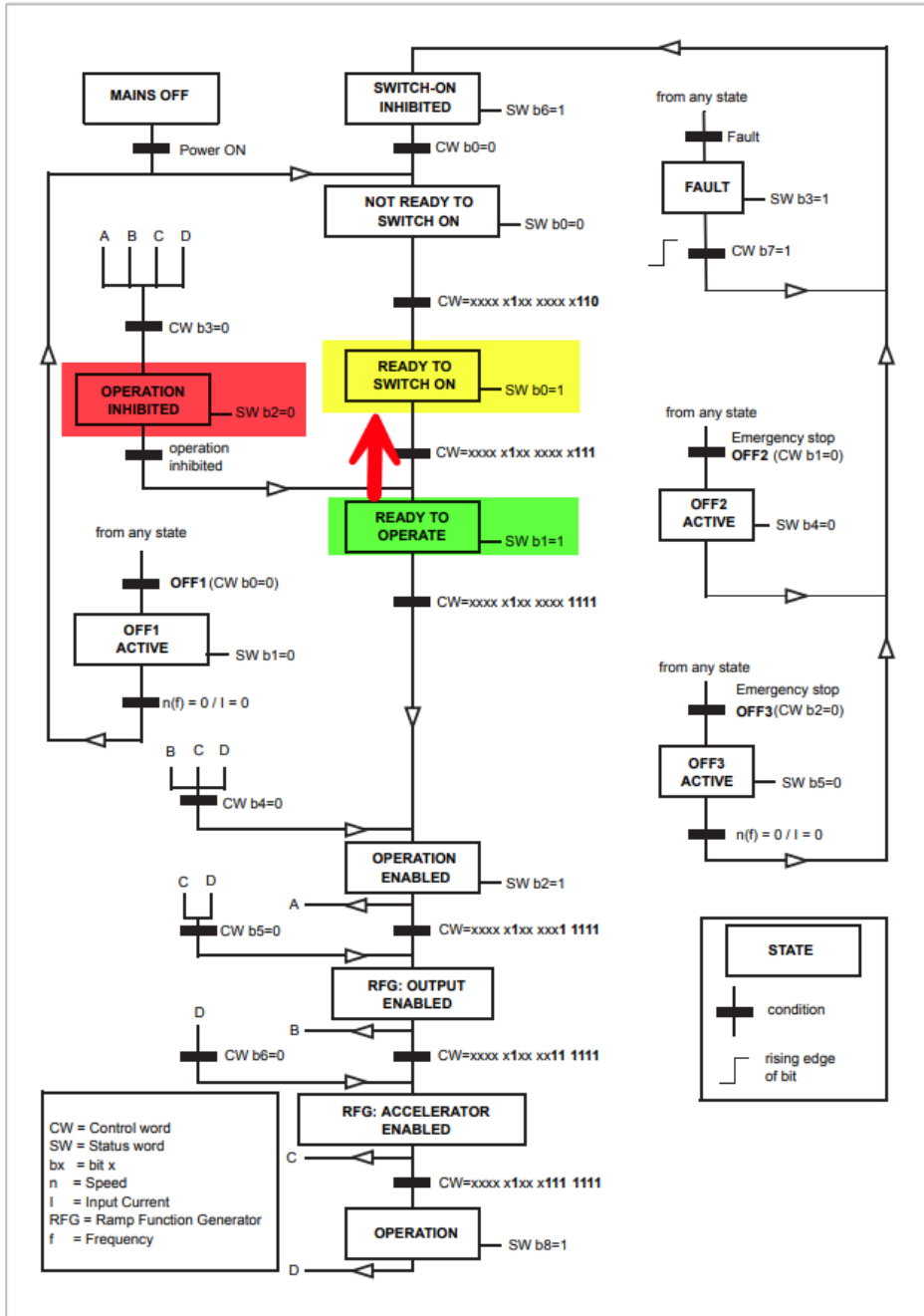
Work around solution without changing control logic in PLC

Configure the relay output to activate based on a different status bit, one option would be:

- Parameter 10.24 (RO1 source) = "Other" (select parameter 6.11 Main status word, bit 0)

This maps Status Word Bit 0 to the relay output, which is one step before ready to run step in the state machine as seen in the following figure. A word of caution, when using this workaround, the status word bit is also prior to the operation inhibited step. This means if the operation is inhibited it will still inhibit the operation but the visibility to this occurring is not letting the drive move forward in the state machine.

- The state diagram (ABB Drives profile)



Additional Notes:

1. The state machine transitions are defined in IEC 61800-7 and implemented in the ABB Drives Profile. Skipping states can result in unpredictable behavior of status-dependent outputs.
2. When implementing PLC/SCADA control, ensure the control logic includes all necessary state transitions rather than using shortcuts.

References:

- ACS880 Primary Control Program Firmware Manual
- Section: Fieldbus control through a fieldbus adapter, pages 656-665
- Parameter Group 6: Control and status words
- Parameter Group 10: Digital and relay inputs and outputs
- IEC 61800-7: Adjustable speed electrical power drive systems