



Bulletin 1395

Drive Module 9.xx

1395–5.40 Manual Supplement

General

The primary reason for this firmware enhancement is to provide additional application flexibility when the Bulletin 1395 is applied to loads with higher than normal armature circuit inductance. The purpose of this publication is to provide an explanation of the software enhancements.

Background

When an armature regenerative DC drive is asked to switch between bridges, it must wait for the current in the presently active bridge to decay to zero before the opposite bridge can be fired. With SCR bridges, the devices remain in conduction until current flow falls below a “holding level”. If the drive does not wait for the device to turn off, then a possible short circuit condition exists where both bridges would be in conduction at the same time.

Because of the inherent electrical noise found in the armature circuit of a DC motor, a DC drive current transducer would never be able to measure an absolute zero value to know that the devices in the active bridge have stopped conducting. Therefore, once the decaying armature current reaches the “noise range” the drive must try to “estimate” (based on decaying time constant) when current reaches zero and the last device turned off. The time constant used for this estimation is based on that of a typical industrial duty DC motor. A load with a higher than normal inductance could mean that an undesirable level of current still exists when the drive attempts to change bridges.

Description

The 9.xx firmware update adds the following changes to the Bulletin 1395 Drive:

The maximum user values for rated AC Line Voltage, Parameter 617, was increased to a max value of 690 volts and Rated Motor Voltage, Parameter 610 was increased to a max value of 850 volts.

The CP and SP software was changed to add a new parameter, P744, "Bridge Switch Delay". This parameter allows the user to set up a programmable delay which would begin after the drive's Zero Current Detector tells the drive to switch between bridges. This is true for both a forward to reverse bridge change and for a reverse to forward bridge change. This delay would help to insure that the armature circuit current has additional time to reach zero before the bridge change occurs.

The units used for Parameter 744 will be a number "n" ranging from 0 to 75. Where "n" represents the number of "time increments" to delay the bridge change. The length of these time increments will vary for 60Hz or 50Hz systems.

For a 60Hz system:

Time Delay in seconds = $n (2.78 \times 10^{-3}) + 1.1 \times 10^{-3}$ where 2.78 ms is the conduction time @ 60 Hz.

For a 50Hz system:

Time Delay in seconds = $n (3.33 \times 10^{-3}) + 1.1 \times 10^{-3}$ where 3.33 ms is the conduction time @ 50 Hz.

The 1.1 ms in the above formula is the standard time delay used for normal armature inductance. As you can see in the above formula, the number programmed into Parameter 744 is the integer number of conduction periods added to the normal 1.1 ms delay. The default value for n is set at 2. See Table 8.H for additional Set-up information.

Application

NOTE: For DC motor armature time constants in the range of 1 to 100 milliseconds, parameter 744 may be left at zero. (Zero is the default)

Ideally, before one of the above equations is applied, it is advisable that some additional application information be acquired and the following equation solved.

$$t_d = 0.03 (I_o) (L_a) / V_d \quad \text{Time delay in seconds}$$

where:

I_o = Rated armature bridge amps of the 1395.

L_a = Inductance of the load in Henrys, when load current is .03 (I_o)

$V_d = 1.169 (V_{ll})$ where:

V_{ll} = the lowest average line to line voltage input to the 1395 at a particular installation.

Example

Assume a load with a 10 Henry inductance, a drive rated at 75 amps, and a 460 VAC line that could dip to 90% of nominal.

$t_d = .03 (75) (10) / 1.169 (414) = .04649$ would be the desired delay for this application. Using this value in the equation for calculating the time delay for Parameter 744 @ 60 Hz:

$$.04649 = n (2.78 \times 10^{-3}) + 1.1 \times 10^{-3}$$

and rearranging to solve for **n**:

$n = .04649 / (2.78 \times 10^{-3}) + (1.1 \times 10^{-3}) = 16.72$. Rounding to the next highest integer, 17 would be the value programmed into Parameter 744. If additional safety margin is desired, the number 20 might be suitable for this application.

Start-Up

Basic Parameter Set-Up – The Following information is an addition to Table 8.H on page 8.9 in the Start-Up chapter of the 1395–5.40 manual.

Table 8.H (Supplement)
Basic Parameters

Parameter	Parameter Name	Description
744	Bridge Switch Delay	<p>Normal Applications – (For armature time constants in the range of 1 to 100mS) Value should be set to 0. Non-zero values will effect the bandwidth of the drive.</p> <p>High Inductance Applications – (Armature time constants greater than 100 mS) Value needs to be adjusted according to the parameter description explained previously in this document.</p>