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Application Note

DECS-250 Setup Guide: Using the Automatic Synchronizer

As digital voltage regulators continue to evolve, their functional capabilities increase in both quantity and complexity. The DECS-250 has the ability to act as an automatic synchronizer, which once required external controls. Integrating the automatic synchronizer into the DECS-250 was logical because it directly controls the voltage of a generator. For the DECS-250 to successfully synchronize, it needs to be able to meter the generator and the bus, as well as to bias the governor through output contacts. This Application Note lays out the ground work needed to program the DECS-250 for automatic synchronization.

> **NOTE**
>
> Settings provided in this document are intended only as examples and should not be construed as suitable for use in a given application. Settings should be thoroughly evaluated prior to use in an application. These settings augment the settings required for basic regulation. This guide was written with the assumption that the DECS-250 has already had the basic settings programmed and has been properly tuned.

The first step toward setting up the DECS-250 for automatic synchronization is ensuring that it has the Auto Sync option. This can be verified through the style number which can be found on the DECS-250 ratings label, its HMI display, or through BESTCOMSPlus® as illustrated in Figure 1. A DECS-250 equipped with the automatic synchronizer function has an "A" in the fifth digit of its style number.

After the DECS-250's style number has been verified, the next step is to configure the Bus Condition Detection. The Bus Condition Detection settings establish how the DECS-250 determines if the generator and bus are stable, failed, or dead. These criteria are important because it would be detrimental to have a generator synchronize to a bus that is not stable and incapable of supporting load properly. The first of the criteria is shown in Figure 2 and includes dead-voltage thresholds for the generator and bus. These thresholds establish the levels below which the generator and bus voltage must decrease in order to be considered "dead". Next are the overvoltage

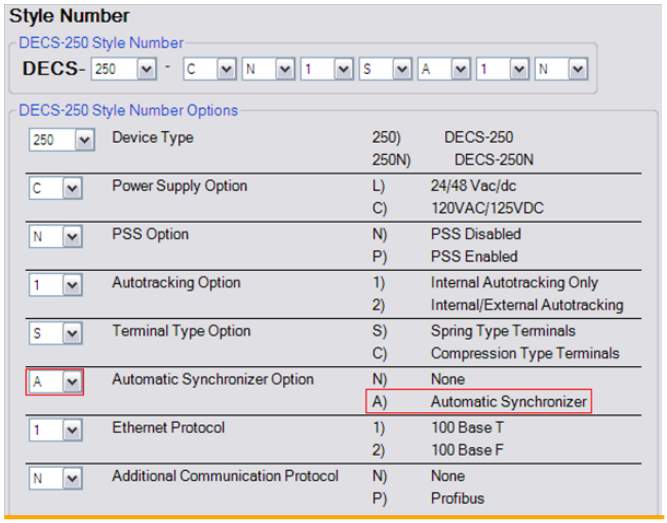

Figure 1 - DECS-250 Style Number
(Settings Explorer>DECS-250>General Settings>Style Number)

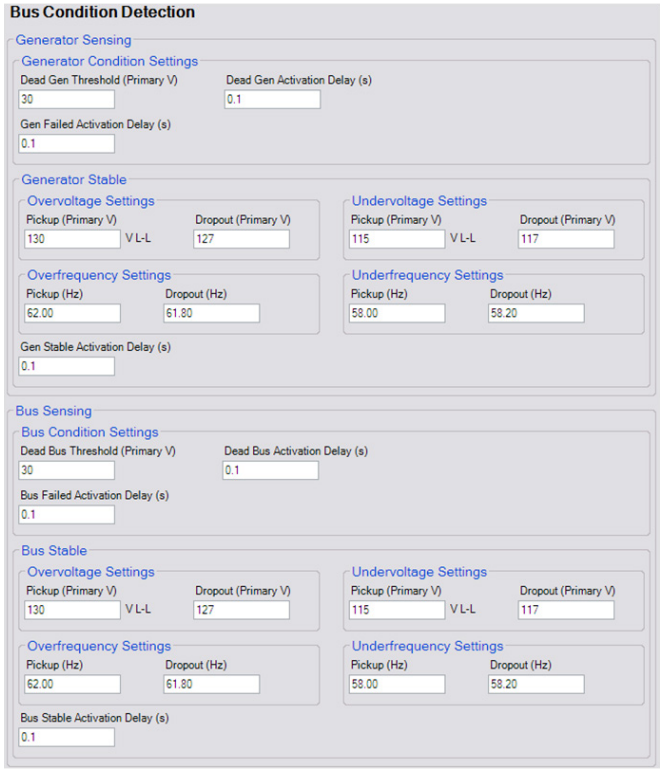

Figure 2 - Bus Condition Detection
(Settings Explorer>DECS-250>Synchronizer/Voltage Matching>Bus Condition Detection)

and undervoltage thresholds, which set the upper and lower boundaries for what the DECS-250 considers to be a stable region. Each setting has a pickup threshold for when the unit detects a failed generator or bus and a dropout threshold for when the generator or bus has safely returned to a stable condition. Likewise, overfrequency and underfrequency settings for both the generator and bus carry the same functionality as the overvoltage and undervoltage, except in regard to frequency. The settings also contain activation delays, which are used to verify the buses are in the stated condition and not simply the result of some transient.

Next, the Breaker Hardware settings of Figure 3 should be adjusted for compatibility with the generator breaker characteristics. These settings configure the DECS-250 for dead bus or dead field paralleling and continuous- or pulsed- contact breaker closure commands.

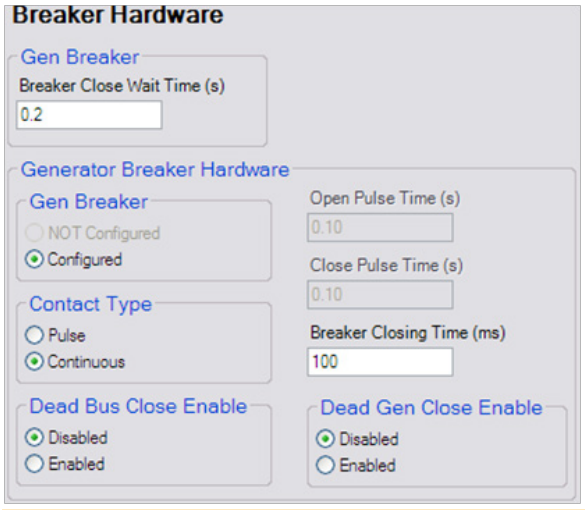

Figure 3 - Breaker Hardware (Settings Explorer>DECS-250>Synchronizer/ Voltage Matching>Breaker Hardware)

There are two timers that need to be set. The Breaker Closing Time establishes the approximate time needed for the breaker to close after receiving a close command. Establishing an accurate Breaker Closing Time is important if Anticipatory synchronization will be used. More information about Anticipatory synchronization is provided later in this guide. The second timer is the Breaker Close Wait Time which determines the length of time between issuing a breaker close command, the DECS-250 waiting for the Breaker Closing Time, and then recognizing and annunciating an alarm if the breaker fails to close.

After the breaker has been configured, the next step is configuring the DECS-250 to bias the governor controls (Figure 4). The governor is biased by raise and lower contact inputs received from the DECS-250. Assignment of the DECS-250 raise and lower output contacts is covered in the logic discussion later in this guide. There are only a few selections to cover for the Bias Control Contact Type setting. The primary one is whether the governor controller can accept a continuous pulse or a proportional pulse. If a continuous pulse type is selected, no other governor bias control settings need to be made. If a proportional pulse type is selected, the correction pulse width and interval time must be set. For more information on those two settings, please refer to the DECS-250 instruction manual.

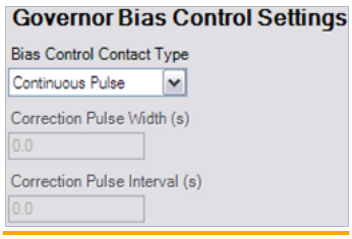

Figure 4 - Governor Bias Control Settings (Settings Explorer>DECS-250>Synchronizer/ Voltage Matching>Governor Bias Control Settings)

Next is configuring the synchronizer's functionality. As seen in Figure 5, there are several settings that need to be established. The synchronizer is enabled by selecting the Enable check box and establishing the Sync Type. The two types of synchronization are Phase Lock Loop and Anticipatory. Phase Lock Loop synchronization utilizes the slip frequency, which tells the DECS-250 the maximum allowable deviation of the generator frequency from the bus frequency. The DECS-250 also utilizes the minimum and maximum slip limits in this mode, which are used in the slip frequency error. If the slip error falls outside the limits, the error is set to the maximum error in the opposite direction. If it is within the slip limits, the DECS-250 is allowed to continually calculate the error. This allows the DECS-250 to drive the controlled frequency to be within the breaker closing angle setting range in the fastest possible way. Anticipatory synchronization adjusts the slip error at a constant rate so the DECS-250, with the Breaker Closing Time setting, can calculate when the unit should issue the breaker close command to synchronize at the twelve o'clock (zero degrees of error) position.

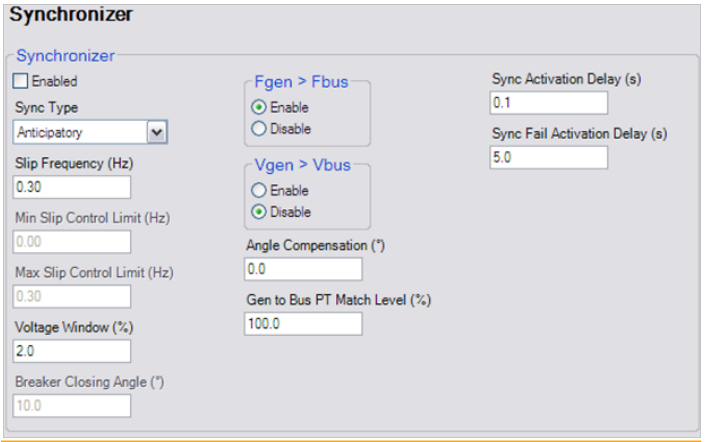

Figure 5 - Synchronizer Settings (Settings Explorer>DECS-250>Synchronizer/Voltage Matching>Synchronizer)

Additional settings are relevant to synchronization no matter which type of synchronization is selected. The Voltage Window setting establishes the acceptable difference between the generator voltage and bus voltage during synchronization. Enabling the Fgen > Fbus setting requires that the generator frequency be greater than the bus frequency for synchronization to occur. Likewise, enabling the Vgen > Vbus setting requires that the generator voltage be greater than the bus voltage for synchronization to occur.

For systems with step-up transformers, two settings are provided. The Angle Compensation setting compensates for any transformer phase shift and the Gen to Bus PT Match Level setting accounts for differences in the sensing PT ratios.

The last settings of the synchronizer are the timers. The Sync Activation Delay establishes the length of time that the slip rate must remain within its limits before permitting synchronization. A Sync Fail Activation Delay determines the length of active synchronizing time before synchronizing is aborted and a failure is annunciated.

Finally, the last step in setting up the automatic synchronizer is establishing its logic. Three primary tasks need to be accomplished in BESTlogic™*Plus*. The first task is to provide indication to the DECS-250 when it is operating online. This function is provided through the PARALLEL_ENABLE_LM block of the default logic which monitors for the presence of a 52a auxiliary output contact from the generator breaker. If that same input is used, we already have the necessary status input for the generator breaker logic block, which is the second task. In addition to seeing the status, the DECS-250 needs inputs to "control" the generator breaker so it knows when it should or should not synchronize.

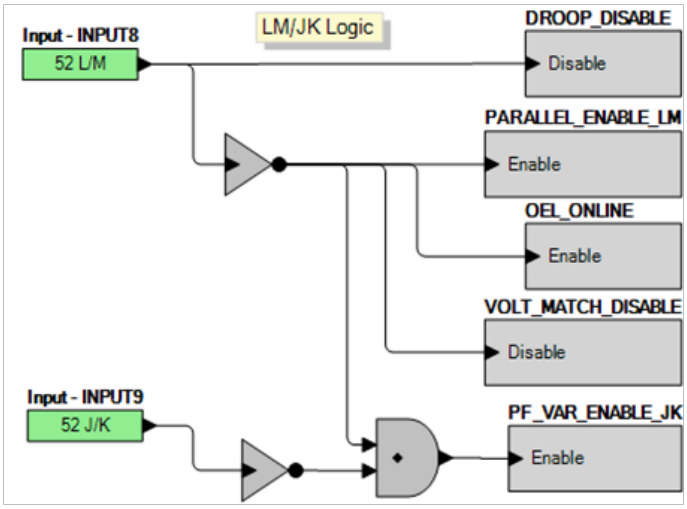

Figure 6 - 52LM and 52JK Logic

This leads to a decision that must be made for the system, and that is whether the DECS-250 should have breaker control. Many designers apply a sync-check relay which issues a close signal to the generator breaker once it verifies that the synchronizer has operated correctly and the generator is within the closing parameters. Other designers control the breaker with the DECS-250, but require a supervisory input from a sync-check relay. Other variations of breaker control are possible. The synchronizer activates any time the DECS-250 considers both the generator and the bus to be stable and sees a generator close request. Some systems are configured for automatic synchronization and only certain status conditions will trigger a breaker closure. In addition, others look for a Synchronizer Activation input, in which a switch is used to close a contact input. Figure 7 shows the DECS-250 using only statuses for synchronization with no breaker control, while Figure 8 shows the DECS-250 using a Synchronizer Activation input with breaker control and a sync-check

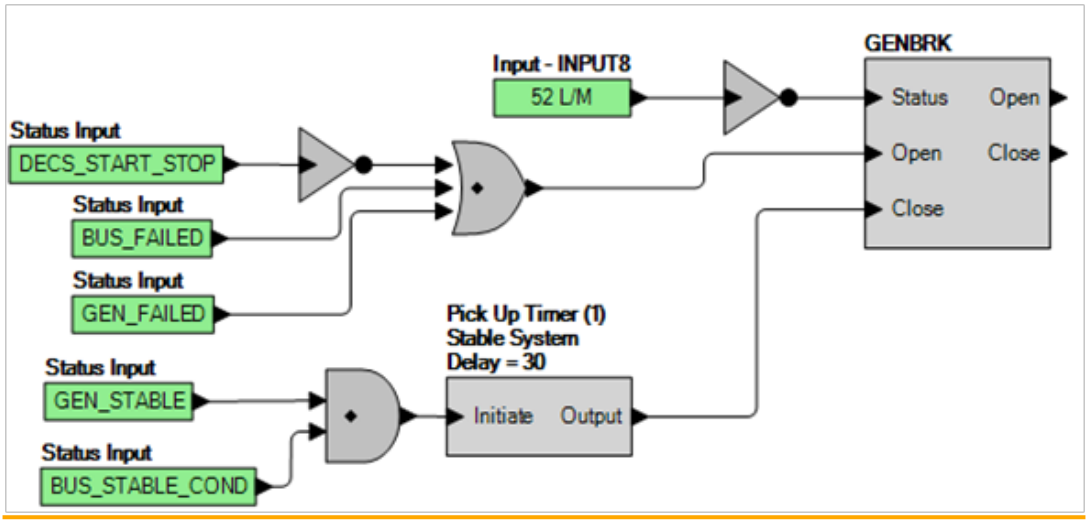

Figure 7 - Status Controlled Synchronizer, No Breaker Control

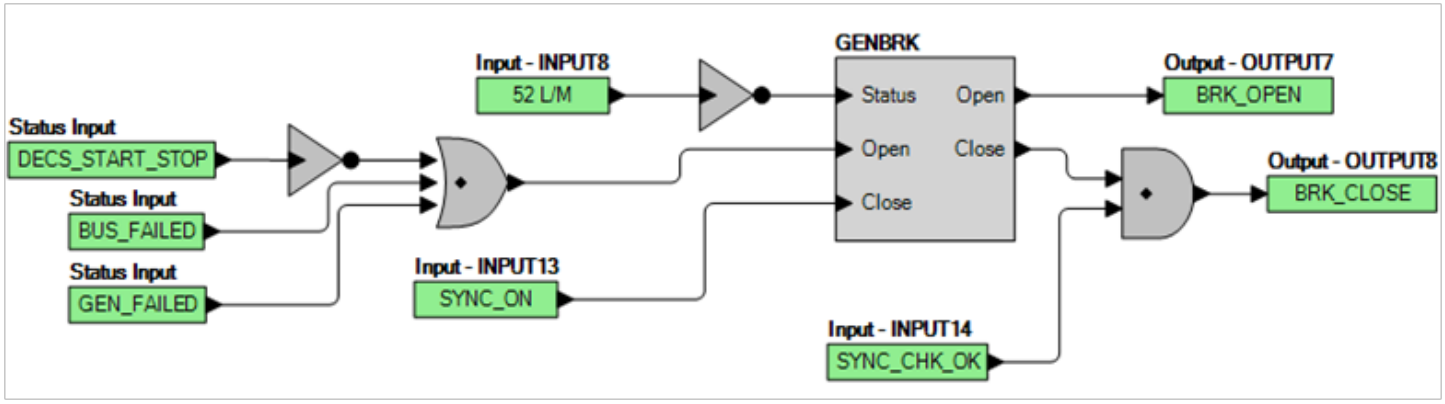

Figure 8 - Input Controlled Synchronizer with Breaker Control

input.

The last of the three sections of logic is the governor raise and lower contact outputs. These logic outputs are sent directly to physical outputs, shown in Figure 9.

As this guide has shown, the synchronizer can be configured for compatibility with many applications. Having a synchronizer integrated with the voltage regulator can be useful for saving space and possibly reducing cost by not requiring control or bias lines to be run. This shows how the DECS-250 is a powerful and versatile voltage regulator.

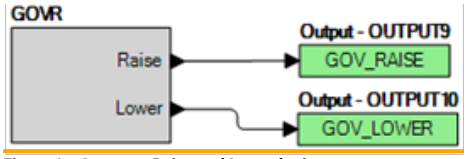

Figure 9 - Governor Raise and Lower logic

For more information

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