8.2 DSE 4 STEPS TO SUCCESSFUL SYNCHRONISING

Synchronising and load sharing is often considered to be a complex subject. In fact, it is very simple when broken down into smaller steps.

After following the *Commissioning* section of this manual, the *DSE 4 Steps* **must** be followed before any parallel operation is attempted.

The following information covers the *DSE 4 Steps to Successful Synchronising* in full detail and must be completed on all generators in the system before they are placed in parallel with each other.

Once in parallel, further commissioning may be required to fine tune the Gain (P), Stability (I) and Derivative (D) of the governor/AVR and DSE module.

8.2.1 CONTROL

CAUTION!: Failure to perform the *Control* steps results in poor control over the engine and alternator. This causes long and unstable synchronising as well as unstable kW and kvar load sharing.

NOTE: For further details of module configuration, refer to DSE Publication: 057-238 *DSE8610 MKII Configuration Suite PC Software Manual.*

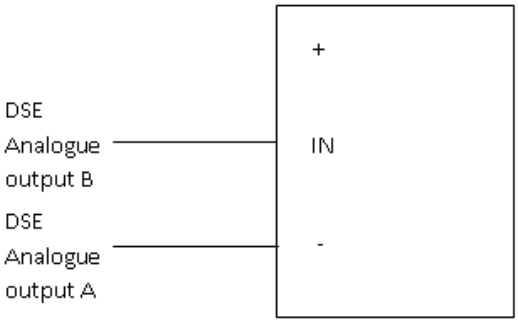
Continued overleaf…

8.2.1.1 DETERMINING CONNECTIONS AND SETTINGS FOR GOVERNORS

Setting up the Governor (Adjustment of SW1 and SW2)

Before You Start

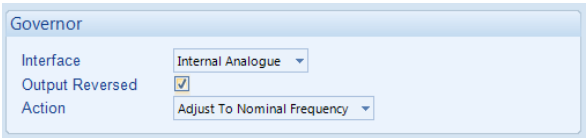
1. Ensure that generator bus is not live, has no load connected, the other generator's breakers are open, and the *Frequency Droop* function and *Mains Parallel Mode* digital input within the module are disabled.
2. With the generator breaker open, set the generator to run at the **Nominal Frequency** without the DSE module connected to the Governor. To achieve this, you will have to adjust the settings on the governor.
3. Stop the generator and connect the DSE module to the Governor. The DSE controller connects only to the "-" and "IN" terminals and provides the varying DC voltage to simulate the turning of a potentiometer. The Analogue output terminals of the DSE controller are connected as follows. Note that the "+" terminal of the governor is left unconnected.



4. With the generator stationary, adjust the Governor SW1 setting to 10 and measure the voltage across the "-" and "IN" governor terminals. Assuming the sensing probes had the correct polarity, the voltage across the "-" and "IN" governor terminals should be roughly +5 V. If this is not the case, check the polarity of the wiring and sensing probes.
5. Once successful, reset the Governor SW1 setting back to 0.

Adjustment of Governor SW1

6. Start the generator and ensure that the breaker is left open.
7. Check the direction of drive by increasing and decreasing SW1. If the frequency increases whilst SW1 is being decreased, enable the option 'Output Reversed'. If moving SW1 does not change the frequency, check the wiring to the governor for faults or, ensure the *Enhanced J1939* option is enabled and the *CAN Source Address* is correct within the module when connected to an ECU.

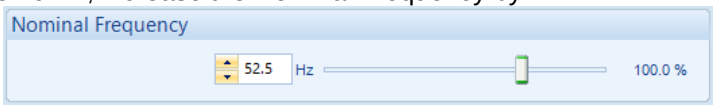


8. Adjust the SW1 setting for the Governor until the generator runs at **Nominal Frequency (50 Hz or 60 Hz)**
9. Stop the generator. SW1 is now complete and must not be adjusted further.

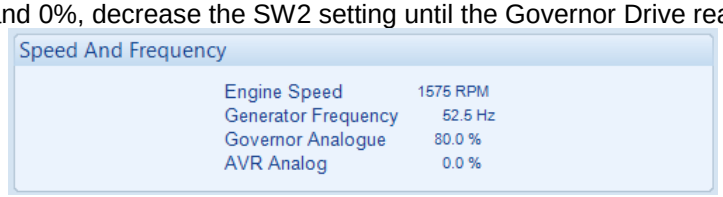
Adjustment of Governor SW2

NOTE: If it is not possible to achieve ±2.5 Hz adjustment with the governor, contact DSE Technical Support for further advice: support@deepseaelectronics.com

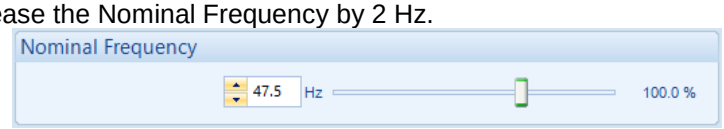
10. Increase the setting of the Nominal Frequency by **2.5 Hz** (52.5 Hz or 62.5 Hz).
    If *Frequency Droop* is enabled, increase the Nominal Frequency by the **Maximum Frequency Difference From Nominal** (Max Hz Up) within the *Droop Curve*. For example, if the *Droop Curve* is 52 Hz down to 49 Hz, increase the Nominal Frequency by 2 Hz.



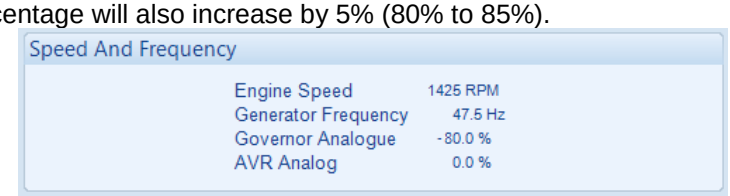
11. Start the generator. With the breaker open the generator will run at setting of SW1 (50 Hz or 60 Hz).
12. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator frequency shall start to increase towards the new Nominal Frequency setting (52.5 Hz or 62.5 Hz or Max Hz Up), however it may not achieve this.
13. Adjust SW2 until the frequency increases to the new Nominal Frequency (52.5 Hz or 62.5 Hz or Max Hz Up).
14. Keep adjusting SW2 further to ensure Governor Drive reads between **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the Governor Drive is between 100% and 85%, increase the SW2 setting until the Governor Drive reads ideally 80%. If the Governor Drive is between 75% and 0%, decrease the SW2 setting until the Governor Drive reads ideally 80%.



15. Open the generator breaker and stop the generator.
16. Decrease the setting of the Nominal Frequency by **2.5 Hz** (47.5 Hz or 57.5 Hz). If *Frequency Droop* is enabled, decrease the Nominal Frequency by the **Maximum Frequency Difference From Nominal** (Max Hz Down) within the *Droop Curve*. For example, if the *Droop Curve* is 52 Hz down to 49 Hz, decrease the Nominal Frequency by 2 Hz.



17. Start the generator. With the breaker open the generator will run at setting of SW1 (50 Hz or 60 Hz).
18. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator frequency shall start to decrease towards the new Nominal Frequency (47.5 Hz or 57.5 Hz or Max Hz Down).
19. SW2 is then adjusted further to ensure Governor Drive reads within **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the Governor Drive is between 100% and 85%, increase the SW2 setting until the Governor Drive reads ideally 80%. If the Governor Drive is between 75% and 0%, decrease the SW2 setting until the Governor Drive reads ideally 80%.
    NOTE: Any change made to the driving down percentage will be made to the driving up percentage. For example, if the driving down percentage is increased by 5% (70% to 75%), the driving up percentage will also increase by 5% (80% to 85%).



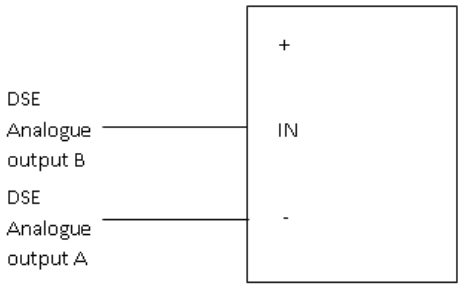
20. Change the setting of the Nominal Frequency back to the actual Nominal Frequency (50 Hz or 60 Hz).

8.2.1.2 DETERMINING CONNECTIONS AND SETTINGS FOR AVRS

NOTE: Determining the settings of SW1 and SW2 for the AVR MUST only be done once the setup for SW1 and SW2 for the governor has been complete. Changing engine speed affects the level of voltage produced.

Before You Start

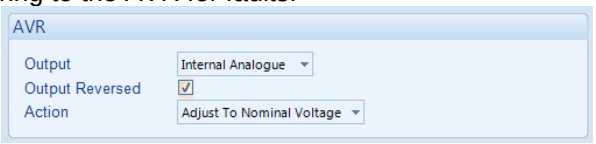
1. Ensure that generator bus is not live, has no load connected, the other generator's breakers are open, and the *Voltage Droop* function and *Mains Parallel Mode* digital input within the module are disabled.
2. With the generator breaker open, set the generator to run at the **Nominal Voltage** without the DSE module connected to the AVR. To achieve this, you will have to adjust the settings on the AVR.
3. Stop the generator and connect the DSE module to the AVR. The DSE controller connects only to the "-" and "IN" terminals and provides the varying DC voltage to simulate the turning of a potentiometer. The Analogue output terminals of the DSE controller are connected as follows. Note that the "+" terminal of the AVR is left unconnected.



4. With the generator stationary, adjust the AVR SW1 setting to 10 and measure the voltage across the "-" and "IN" AVR terminals. Assuming the sensing probes had the correct polarity, the voltage across the "-" and "IN" AVR terminals should be roughly +5 V. If this is not the case, check the polarity of the wiring and sensing probes.
5. Once successful, reset the AVR SW1 setting back to 0.

Adjustment of AVR SW1

6. Start the generator and ensure that the breaker is left open.
7. Check the direction of drive by increasing and decreasing SW1. If the voltage increases whilst SW1 is being decreased tick the option 'Output Reversed'. If moving SW1 does not change the voltage, check the wiring to the AVR for faults.

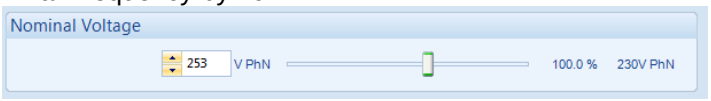


8. Adjust the SW1 setting for the AVR until the generator runs at **Nominal Voltage (230V for example).**
9. Stop the generator. SW1 is now complete and must not be adjusted further.

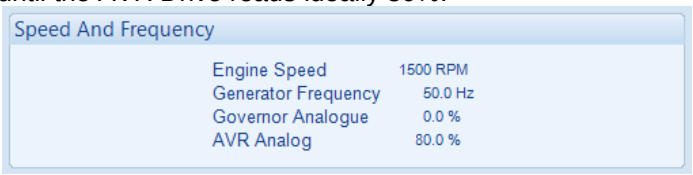
Adjustment of AVR SW2

NOTE: If it is not possible to achieve ±10 % voltage adjustment with the AVR, contact DSE Technical Support for further advice: support@deepseaelectronics.com

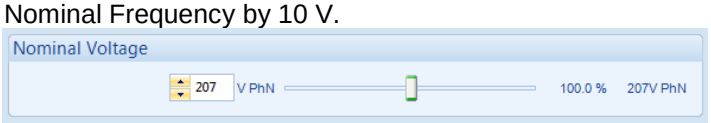
10. Increase the setting of the Nominal Voltage by 10% (230 V to 253 V for example). If Voltage Droop is enabled, increase the Nominal Voltage by the **Maximum Voltage Difference From Nominal** (Max Volt Up) within the Droop Curve. For example, if the *Droop Curve* is 240 V down to 225 V, increase the Nominal Frequency by 10 V.



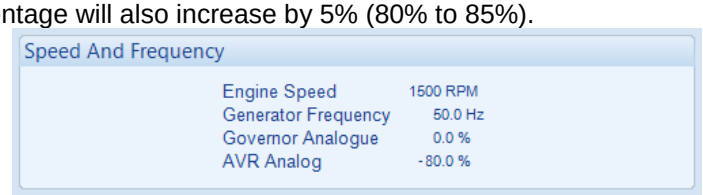
11. Start the generator. With the breaker open the generator will run at setting of SW1 (230 V for example).
12. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator voltage shall start to increase towards the new Nominal Voltage setting (+10% [253 V for example] or Max Volt Up), however it may not achieve this.
13. Adjust SW2 to until the voltage increases to the new Nominal Frequency ((+10% [253 V for example] or Max Volt Up).
14. Keep adjusting SW2 further to ensure AVR Drive reads between **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the AVR Drive is between 100% and 85%, increase the SW2 setting until the AVR Drive reads ideally 80%. If the AVR Drive is between 75% and 0%, decrease the SW2 setting until the AVR Drive reads ideally 80%.



15. Open the generator breaker and stop the generator.
16. Decrease the setting of the Nominal Voltage by **10%** (230 V to 207 V for example). If *Voltage Droop* is enabled, decrease the Nominal Voltage by the **Maximum Voltage Difference From Nominal** (Max Volt Down) within the *Droop Curve*. For example, if the *Droop Curve* is 240 V down to 225 V, decrease the Nominal Frequency by 10 V.



17. Start the generator. With the breaker open the generator will run at setting of SW1 (230V for example).
18. Once the generator is detected as available, close the generator breaker onto a **DEAD BUS BAR WITH NO LOADS** connected. The generator voltage shall start to decrease towards the new Nominal Voltage ((-10% [207 V for example] or Max Volt Down)
19. SW2 is then adjusted further to ensure AVR Drive reads within **75% to 85%**, the sign of the drive (+ or - percentage) does not matter. If the AVR Drive is between 100% and 85%, increase the SW2 setting until the AVR Drive reads ideally 80%. If the AVR Drive is between 75% and 0%, decrease the SW2 setting until the AVR Drive reads ideally 80%.
    NOTE: Any change made to the driving down percentage will be made to the driving up percentage. For example, if the driving down percentage is increased by 5% (70% to 75%), the driving up percentage will also increase by 5% (80% to 85%).



20. Change the setting of the Nominal Voltage back to the actual Nominal Voltage (230 V for example).

8.2.2 METERING

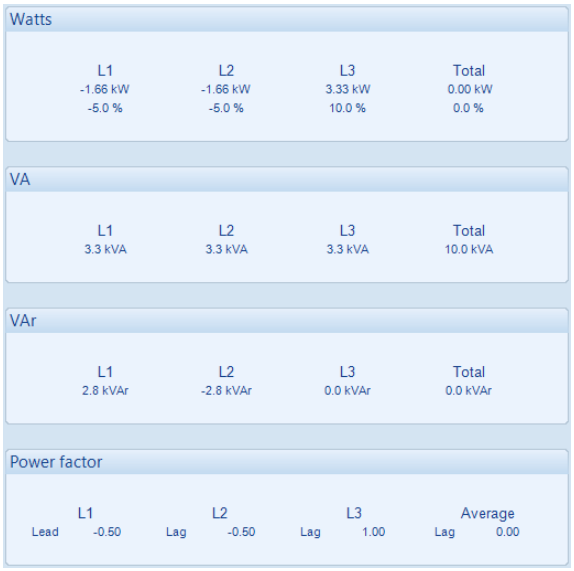
WARNING!: Do not disconnect the CT wires from the DSE module when the CTs are carrying current. Disconnection open circuits the secondary of the CT's and dangerous voltages may then develop. Always ensure the CTs are not carrying current and the CTs are short circuit connected before making or breaking connections to the module.

CAUTION!: Failure to perform the Metering steps results in incorrect power factor and kW calculations leading to problems with kW and kvar load sharing if not corrected.

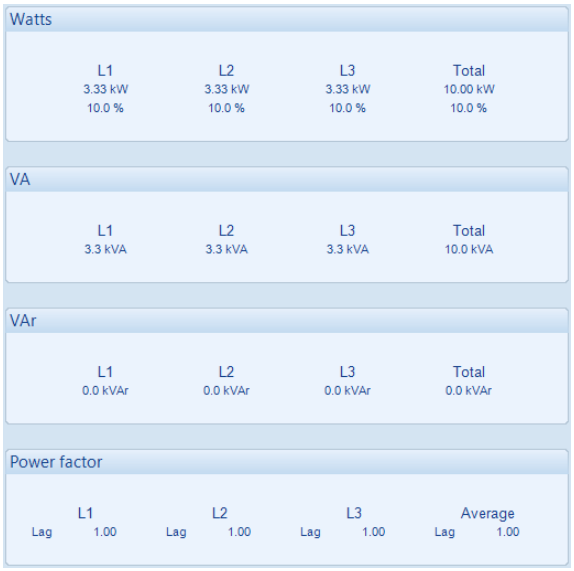
8.2.2.1 CTS ON THE RIGHT PHASE

Check to ensure that the CTs on L1, L2 & L3 are connected to their respective connection on the DSE module.

1. Ensure that generator bus is not live and the other generator's breakers are open.
2. Start the generator and once available, close the generator breaker.
3. Apply purely resistive load (around 10% of the generator's size) across the three phases.
4. If the CTs on L1, L2 & L3 are wired to the correct terminals on the module, it displays unity power factor (1.0 pf) across all three phases. If unity power factor (1.0 pf) is not displayed across all three phases, the CTs have been wired to the wrong phases on the module.



Cables from the CTs on L1 and L2 are swapped over at the module's terminals.

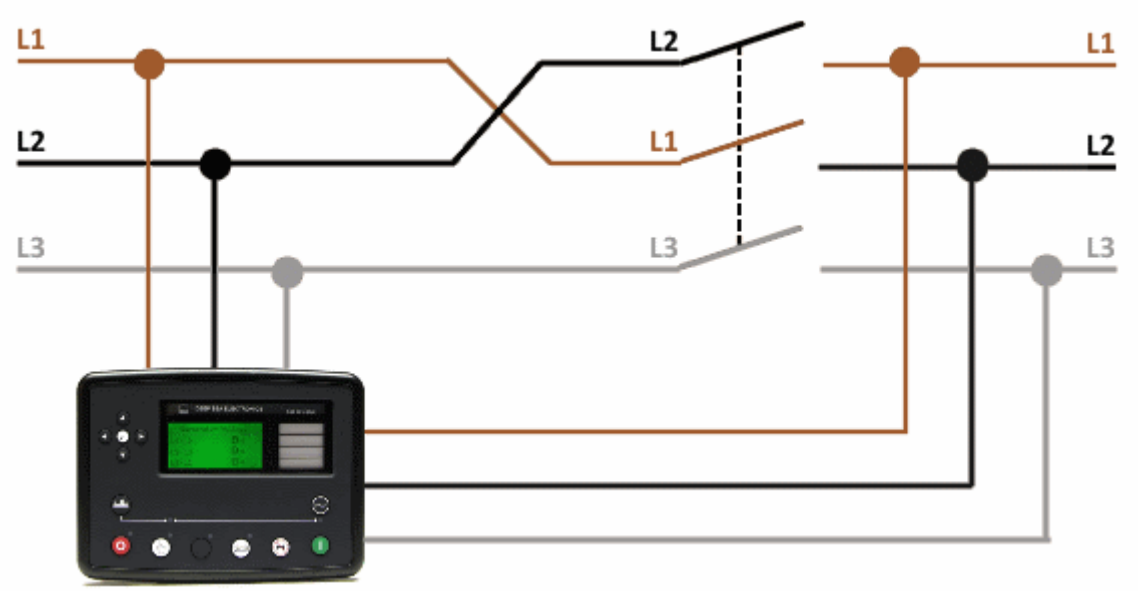


Cables from the CTs on L1 and L2 are connected correctly to module's terminals.

8.2.4 SYNC CHECKS

CAUTION!: Failure to perform the Sync Check steps results in in serious damage to the system (breakers, bus bars, alternators, engines etc) caused by out of sync closures.

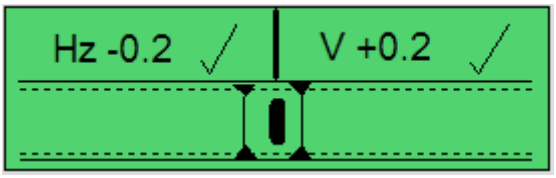
Check to ensure that all the module's sensing cables have been connected to the correct phases and that the generator's load switch has been correctly connected. Failing to perform such tests may lead to the DSE module sensing both sides of the breaker as in sync

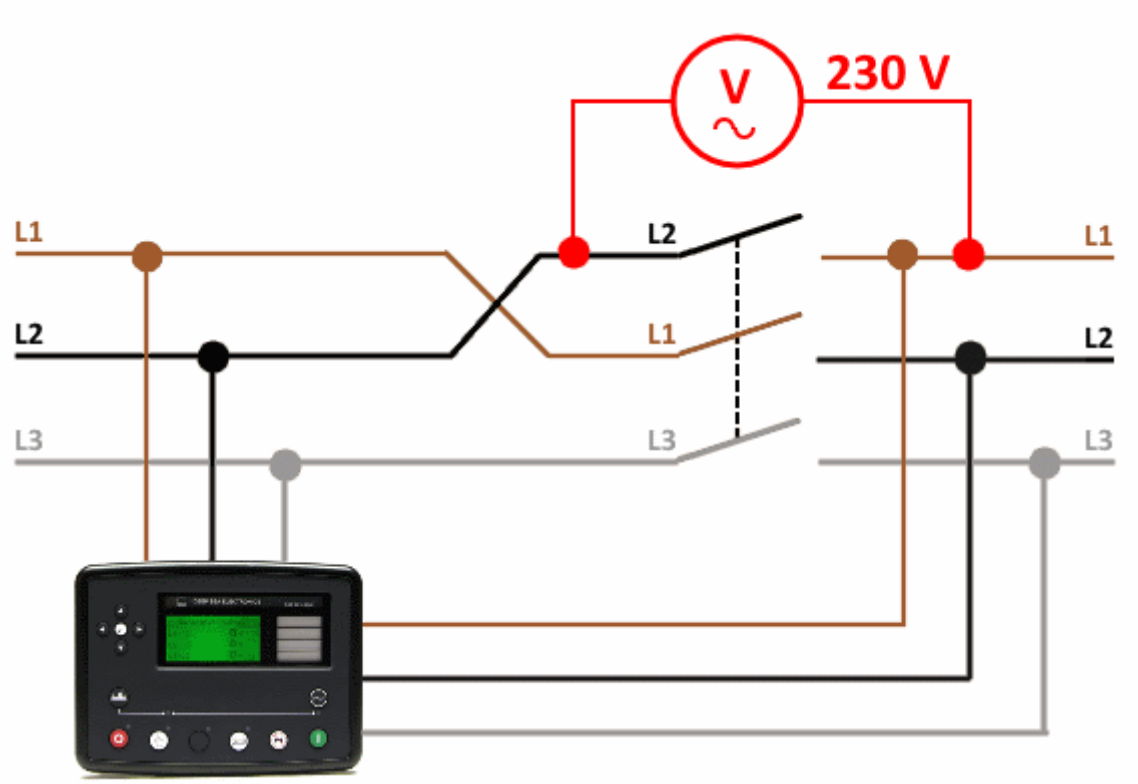


This is tested by starting the generator with the DSE module and ensuring the generator load switch is left open (activate an input configured for *Generator Load Inhibit*). Then the generator common bus is to be made live, this is achieved by starting another generator and closing its load switch. Across the open load switch, connect a voltage meter to measure the AC voltage when the DSE module shows the two supplies in sync.

8.2.4.1 INCORRECTLY WIRED BREAKER

When the DSE module's synchroscope shows the two supplies in sync, if the voltage meter shows a voltage difference the breaker is wired incorrectly. This is shown in the example below.





8.2.4.2 CORRECTLY WIRED BREAKER

When the DSE module's synchroscope shows the two supplies in sync, if the voltage meter shows no voltage difference the breaker is wired correctly. This is shown in the example below.