



	1 – Fundamental - No previous experience necessary 2 – Basic – Some Basic drives knowledge recommended 3 – Advanced – Some Basic drives knowledge required 4 – Expert – Good experience in topic of subject matter recommended

A special version of Optidrive E2 drive is available intended for control of Single Phase Permanent Split Capacitor (PSC) or Shaded Pole type motors. This application notes provides an overview of the key differences between the single phase output drives compared to the three phase output drives, and describes a simplified means of commissioning the drives to ensure reliable motor starting.

Note that only Optidrive E2 units with model code ending in “-01” are intended for use with single phase motors. All other Optidrive E2 units are designed for three phase motor operation.

As with all drive selection, it is essential that the drive is selected based on the motor current, and not the kW or HP. This becomes even more important with single phase motors, where efficiency and performance vary greatly between motors.

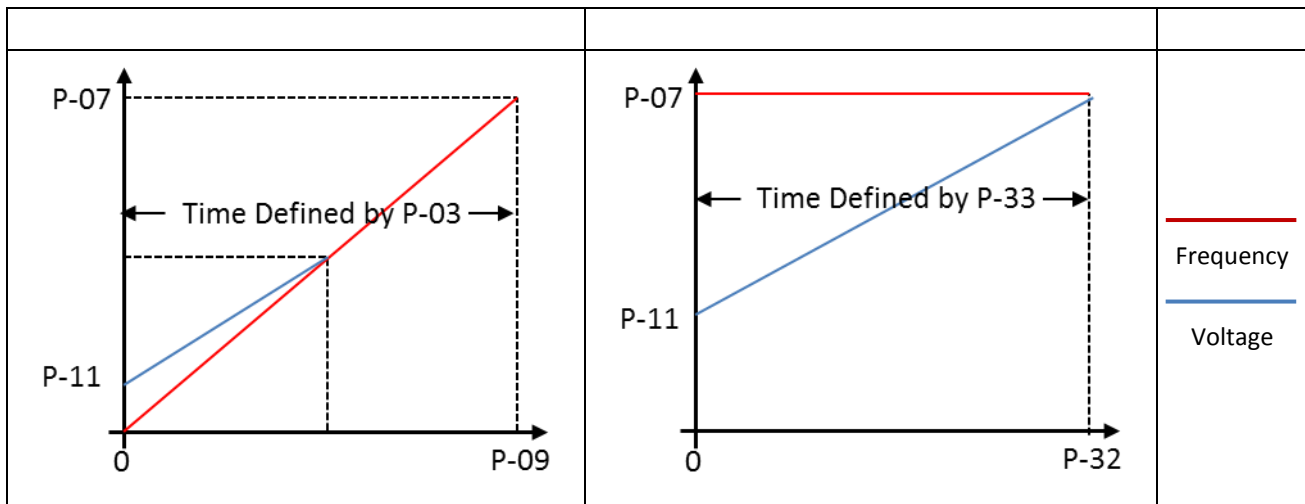
Single phase motors have inherently lower starting torque compared to three phase motors, and in some cases, it may be necessary to oversize the drive compared to the motor to ensure sufficient starting torque is generated, or the required starting duty cycle can be achieved.

In addition, low speed performance of single phase motors is reduced, hence in general, it is not advised to reduce the speed below 50% of the rated motor speed, unless the load reduces at lower speeds (for example is centrifugal fan applications) or the motor manufacturer deems it is safe to do so.

Many single phase motors have two capacitors fitted, one for starting and one for normal running. These capacitors are switched in circuit using a centrifugal switch on the motor shaft. Whilst it may be possible to operate these motors from the drive, operation is not guaranteed, and operating at low frequency may cause damage to the motor or capacitors. Again, the motor manufacturer’s advice should be sort before using the Optidrive E2 with these motors.

Essentially, speed control of single phase motors operates in the same manner as speed control of three phase motors, where the drive outputs a variable frequency and voltage to control the motor. The key difference in the single phase output drives is in the starting of the motor.

- With a three phase output drive, the output frequency starts from zero, and is ramped up to the setpoint frequency at a rate defined by the Acceleration Ramp Time P-03. At the same time, the output voltage is also gradually increased, from a point defined by the Boost voltage parameter (P-11) up to the appropriate motor voltage defined by the V/F characteristic
- Single phase output drives start immediately at the 'Motor Start Frequency' set in P-32 (usually the motor rated frequency), and the voltage is ramped up from the 'Boost Start Voltage' set in P-11 to the 'Motor Rated Voltage' set in P-07 at a rate defined by the 'Boost Period Duration' set in P-33



It is important to understand this alternative approach to motor starting in order to correctly commission the drive. Note that once the motor is started, a linear V/F characteristic is used during control, from 0 Volts, 0 Hz to Rated Volts, Rated Frequency. It is also important to remember that single phase motors can be operated in one direction only. Any applications which require bidirectional operation should use a three phase motor and three phase output drive.

In order to quickly achieve good starting performance, it is important to follow the procedure outlined below; this will generally enable the correct starting parameters to be determined for a given motor relatively quickly and easily.

The first step is to determine the motor continuously rated current from the motor nameplate and enter this into parameter P-08. This ensures that the motor is correctly protected against overload conditions.

The easiest method to determine the correct boost start voltage for a given motor is as follows.

- Ensure the motor is correctly connected to the drive, and that the normal starting load is in place. Do not disconnect the load.
- Enable Full parameter access by setting P-14 = 101.
- Set the Boost Period Duration in P-33 to the maximum allowed 150 seconds. This provides the slowest possible ramp up of motor voltage, hence allowing the start voltage to be adjusted, and the performance checked easily.
- Start the drive, and read the current on the drive display – press the navigate key if necessary until the display shows “A x.x”
- The current should rise quickly, then stabilise after a few seconds, rising very slowly from this point onwards. The value which should be noted is the stabilised current reading a few seconds after the drive starts.
  - If the current reading is  $>$  than  $1.2 \times$  of the motor rated current,
    - Stop the drive
    - Reduce the value of P-11
    - Repeat the test
  - If the current is  $<$  than  $0.8 \times$  of the motor rated current
    - Stop the drive
    - Increase the value of P-11
    - Repeat the test
  - The aim is to achieve a voltage setting whereby the motor draws 80 – 90% of the rated continuous current shortly after starting the drive. This is the correct boost voltage for the motor
  - Note that the motor may not turn during this test, this is not important, it is only a procedure to determine the correct Boost Starting Voltage.

Once the correct boost voltage has been determined, the ‘Boost Period Duration’ P-33 should be adjusted. Initially, this can be adjusted in large steps, until the ideal value is found, e.g. starting from 150 seconds, the time can be reduced in steps of as much as 50% until it is close to the required value.

The correct Boost Period Duration will be very slightly longer (e.g. 1 – 2 seconds) than the time required to start the motor to full speed. This can be determined using the following procedure:-

- Ensure the correct Boost Start Voltage has been set according to the procedure described above
- Ensure that the frequency setpoint to the drive is below the motor rated frequency, e.g. minimum speed can be used. This ensures that when the boost period ends, the motor will slow to this speed; hence it is easy to observe when the Boost Duration Period has elapsed.
- Start the drive, and read the current on the drive display – press the navigate key if necessary until the display shows “A x.x”
- Check that the motor starts to rotate as the voltage increases. As the motor starts to turn, the output current will increase, however once the motor reaches full speed, the current should reduce very quickly. If the Boost Period Duration is too long, however, the applied motor voltage will still be low at this point, so the motor will rotate with high current.
  - Approximately measure the time required from starting the drive until the motor reaches full speed
  - Reduce the Boost Duration Period to this time, and repeat the test
  - If the motor reaches full speed before the end of the boost period, reduce the boost period again and repeat the test
  - O-I and It.trp faults are common during the testing phase. If the drive trips, allow at least 30 seconds before restarting.
  - If the Boost Duration Period is too long, this can result in the motor running with reduced voltage, and hence high current for a timer period after starting, in this case, reduce the Boost Period.

Revision History			
Issue	Comments	Author	Date
01	First release	KB	23/4/13
02	Revised to new format	KB	24/04/14