Installation:

NuStart must be installed by qualified/licensed technician. Record date of installation on device.

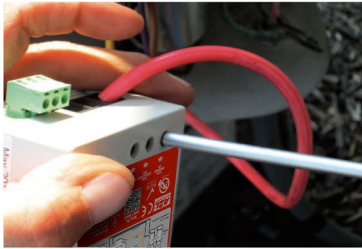1. Turn off all power to the HVAC unit at the circuit breaker.

2. Secure the mounting bracket for the NuStart inside the control

3. Remove the compressor <u>Run wire</u> from the contactor or <u>Run Capacitor terminal</u>, as applicable.
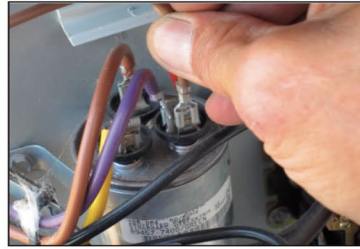
4. Strip the compressor <u>Run wire</u> at least 1/2 in* Crimp appropriate size <u>Ferrule</u> (supplied) onto it.
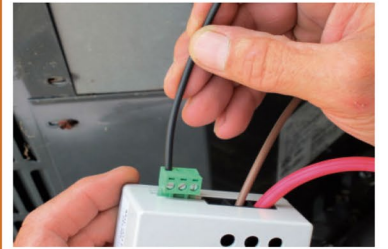
5. Attach the compressor <u>Run wire</u> to the NuStart <u>Run Winding</u> terminal.
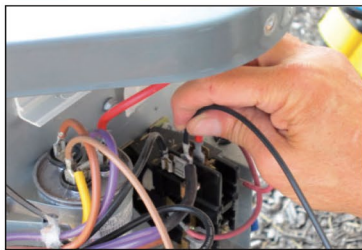
6. Attach the <u>brown wire</u> supplied with the NuStart to the <u>Run Capacitor terminal</u> of NuStart.

7. Identify the cable connecting the contactor and the <u>Run Cap</u>. Remove this connection to the <u>Run Cap</u> Attach the flagged end of the <u>brown wire</u> to the same terminal of the <u>Run Cap</u>[#1].
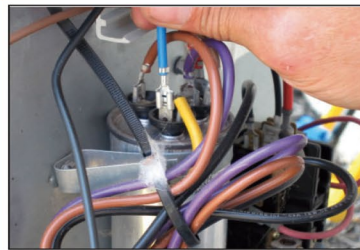
8. Attach the <u>black wire</u> (supplied) to <u>Compressor Common</u> on the NuStart <u>green terminal connector</u>.

9. Attach the flagged end of the <u>black wire</u> to the <u>Compressor Common</u> on the <u>"T"</u> side of the contactor.

10. Attach the <u>blue wire</u> (supplied) to the <u>Start Winding</u> on the NuStart <u>green terminal connector</u>.

11. Attach the flagged end of the <u>blue wire</u> to the other terminal[#2] of the <u>Run Capacitor</u>. Ensure that this terminal on the capacitor also joins to the <u>Start Winding</u> of the compressor.

12. Attach the <u>red wire</u> (supplied) to the <u>Active Terminal</u> on the NuStart.

13. Remove the loose wire (from Step 7) from the <u>active</u> input of the contactor and attach the stripped end of the <u>Active wire</u> in its place.

14. Apply power to the equipment and cycle[#3] to ensure proper operation.

⚠ Caution

NuStart must be installed in a location that ensures that the external heat from a hot gas line, compressor discharge piping, or similar heat source will not cause damage. Minimum 3˝ (76 mm) clearance is recommended.

Sample schematic is not a reflection of all HVACR units in the field. If the wiring differs from the base schematic or if it needs to be wired through a control board, please contact us: info@nucalgon.com

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Suitable for use on a circuit capable of delivering no more than 5000rms symmetrical amperes, 240 volts maximum, when protected by a non-time delay RK5 fuse or circuit breaker rated 80A, or a time delay fuse rated 70A. NuStart does not provide current limiting control or equivalent.

NuStart is NOT an overcurrent protection device and must NOT be used as a replacement for any primary circuit overcurrent protection. NuStart does not provide surge protection.
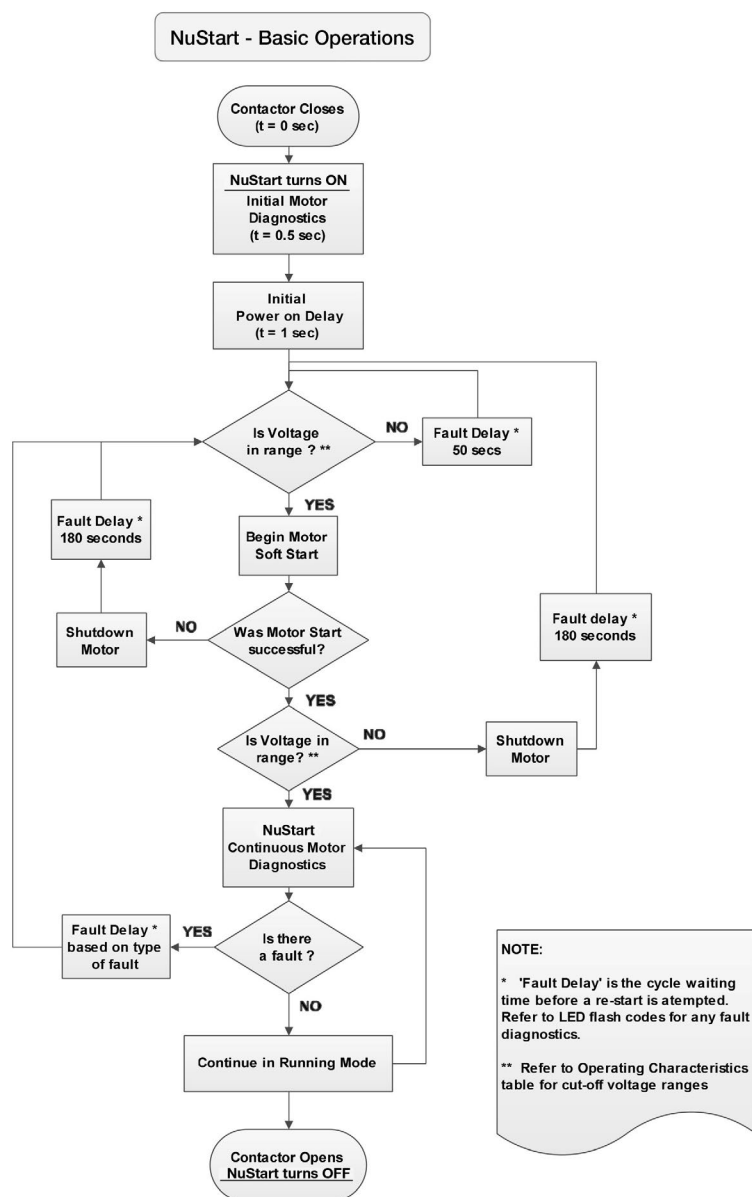
NOTES:
#1 This is the Common (C) terminal for Dual Compressor/Fan Capacitors.
#2 This is the Herm (H) terminal for Dual Compressor/Fan Capacitors.
#3 NuStart device could take up to six (6) starts to optimize.

Mode of Operation:

NuStart - Basic Operations

Contactor Closes
(t = 0 sec)
↓
NuStart turns ON
Initial Motor
Diagnostics
(t = 0.5 sec)
↓
Initial
Power on Delay
(t = 1 sec)
↓
Is Voltage in range ? ** —NO→ Fault Delay * 50 secs
↓ YES
Begin Motor Soft Start
↓
Was Motor Start successful? —NO→ Shutdown Motor → Fault Delay * 180 seconds → (back to Is Voltage in range?)
↓ YES
Is Voltage in range? ** —NO→ Shutdown Motor → Fault delay * 180 seconds
↓ YES
NuStart Continuous Motor Diagnostics
↓
Is there a fault ? —YES→ Fault Delay * based on type of fault
↓ NO
Continue in Running Mode
↓
Contactor Opens NuStart turns OFF

NOTE:

* 'Fault Delay' is the cycle waiting time before a re-start is attempted. Refer to LED flash codes for any fault diagnostics.

** Refer to Operating Characteristics table for cut-off voltage ranges

LED Flash Codes

Flash Code	Definition	Time to Re-start Attempt
Rapid Flash 10 LED Flashes per second	Low Voltage	3 min
Triple Flash 3 LED Flashes per every 3 seconds	Lockout on 3 Failed Starts	50 min
Slow Flash 1 LED Flash every 3 seconds	Lockout on Overcurrent	10 min
Steady Flash 1 LED Flash every second	Cycle Delay/Faults	3 min

NOTE: LED fault indicator remains off in normal running mode.

Flash Code - Rapid Flash (10 LED flashes every second):
Low Voltage
- Displayed for "Low supply voltage" before or after a soft start.
- If low voltage is detected before a start, a re-start is attempted after 50 seconds.
- If low voltage is detected after a start, a re-start is attempted after 3 minutes.

Flash Code - Triple Flash (Triple LED flash every 3 seconds):
Lockout on Three Failed Starts
- Displayed after failure to start on "three consecutive start attempts".
- Re-start is attempted after 50 minutes.
- Standard lockout period is revised to 3 minutes after a successful start.

In circumstances where the compressor may have seized or is unable to startup due to failure of other components in the HVAC system, the software will check for three consecutive failed starts. On the third sequential failed start, the program goes into Lockout for 50 mins. On failing to get a good start even after 50 mins, it will re-attempt start again after duration of 50 mins. Once a good start is eventually achieved, it will reset the hard start counter and will require 3 failed starts again to force it back into Lockout mode. Lockout can be cleared anytime through a power reset of NuStart.

Flash Code - Slow Flash (One LED flash every 3 seconds):
Lockout on Over current
- Displayed for "overcurrent" in running mode of the compressor motor.
- Overcurrent limit is "25A for 08-16A version" and "50A for 16-32A rated version".
- Also displayed, if internal Klixon of the compressor trips out on overheat.
- Re-start is attempted after 10 minutes.

To limit the current in compressors from extending abnormally beyond its stated capacities, NuStart is also equipped with Overcurrent limit protection. For models rated from 16-32A, NuStart is designed to trip out in overload conditions exceeding 50A. In smaller models, it is designed to cutoff power to the compressor if the current drawn exceeds 25A. On overcurrent lockout, NuStart attempts a re-start automatically after 10 minutes. Both failed start lockout and overcurrent limit protection have been designed to prevent the compressor from drawing abnormal currents in conditions not feasible for the compressor operation.

Flash Code - Slow Steady Flash (One LED flash every second): *Cycle Delay / Fault Mode*
- Displayed for "cycle delay" between two consecutive soft starts or other faults mentioned below.
- Re-start is attempted after a default period of 3 minutes.
- Other possible reasons for this fault mode indicator can be due to:
  - Incorrect wiring during installation
  - Failed soft start attempt
  - Intermittent power loss (duration longer than 100ms)
  - Frequency out of range
  - Failed run capacitor

1. What is different between a hard start kit and NuStart?

Hard start kits are more preferred in applications where the system design requires high starting torque. In small sized applications reciprocating and rotary compressors that must start against a pressure head and may require a device to increase the starting torque. If the HVAC unit utilizes a scroll compressor, hard start kits are not normally required.

NuStart is a sophisticated and intelligent device designed to reduce the starting current of the compressor by actively controlling the current in both the run and start windings. They actively (phase control) limit the current through run winding while a balanced value of start capacitor is connected in situ to provide the optimal torque required to start a compressor at any operating voltage. Along with soft starting, electronic soft starters also provide a substantial number of built-in features to pre-emptively protect the compressor under abnormal circumstances.

2. How do I select a NuStart?

Determine voltage input, phase type (single or three), compressor RLA and LRA to make sure it falls between specified range of appliable NuStart model. For residential a/c systems if the RLA is between 14-16 amps but LRA over 85, go with model 5010-21. If LRA is under 85, go with model 5010-20.

3. What compressors is NuStart suitable for?

Single stage, dual stage, and digital scroll type compressors. Do not use NuStart on inverter type scroll compressors.

4. Why can't I use NuStart on a reciprocating compressor?

It is extremely important that NuStart starts a compressor when system pressures are equalized so not to shorten NuStart's service life. By design, scroll compressors equalize very quickly at shut-off. Reciprocating and other compressors don't necessarily equalize quickly at system shut-down and NuStart is not to be used with non-scroll compressor designs without some system design provision to allow quick pressure equalization at shut-down.

5. Can I use NuStart with Emerson CoreSense and Comfort Diagnostics?

Yes. NuStart is a current control based controller – its methodology and timing allows its compatibility the device sampling rate.

6. Do I need to do anything different with a condensing fan using a ECM motor?

No, NuStart is wired independently of the condensing fan motor.

7. What is unique with NuStart vs. other market options?

Most compact soft starter in the market for easiest installation inside the condensing unit. NuStart is available in single and three phase models and provides a suite of protection features for the scroll compressor: reverse scroll protection, low voltage, hard start lock-out feature, plus overcurrent protection (single phase types) and over voltage/integrated phase protection (three phase types).

8. What is reverse scroll protection?

If there is a brief interruption in power, it is possible for a scroll compressor to suddenly operate in reverse direction caused by pressure differential in the system – this is very detrimental to the compressor. NuStart will de-energize the compressor and restart the compressor after a few minutes.

9. What is low voltage protection?

During a low voltage (brownout) event, if the voltage is below the specified minimum voltage input during start-up or during running, NuStart will de-energize the compressor and try a restart three minutes later. Low voltage conditions can cause compressor stall resulting in LRA current draw which is damaging to the compressor after an extended period of time.

10. How does NuStart protect the compressor from rapid cycling damage?

After three failed attempts, the NuStart will go automatically into a 50 minute lockout before attempting another start. This prevents the compressor from overheating due to rapid cycling which leads to a bigger issue versus what is preventing the compressor from starting successfully.

11. Is NuStart transferable to another system?

Yes, as long as it is for another single, dual or digital scroll compressor system. Not to be to be used in an inverter type scroll compressor equipped system.

12. What is automatic optimization of motor start-up?

NuStart requires 6 to 8 starts to learn what is required to optimize the start-up of the compressor. NuStart continues to automatically optimize the compressor start-up during its service life.

13. Do I need a circuit breaker with installing NuStart?

Yes, a circuit breaker is electrical circuit protection is required with installation of NuStart.

14. Is NuStart a surge protection from electrical storms?

No. NuStart does not provide this level of protection to protect the refrigerant system. This requires a standalone protection device for the system or house.

15. Does the capacitor stay in the system with the installation of NuStart?

For a single phase scroll compressor systems equipped with a run capacitor, this device remains in the system with NuStart installation. If there is a hard start kit installed in a single phase system, this must be removed before installing NuStart. Start and run capacitors are not applicable with three phase NuStart installations.