
**Rack Refrigeration With VFD's Application Note
APP-027****THEORY**

This application uses the special CR-110 Rack software.

This system application note is for a rack system with three compressors. Compressor C1 is 7hp, Compressor C2 is 25hp and Compressor C3 is 50hp. Each of the three compressors is equipped with a VFD on the compressor that is being driven from a CR-110 card. All three compressors are connected in parallel. Each compressor will run its own PID loop with some conditions. The three CR cards are supervised by a Micrologix's 1100 PLC. Each of the CR card has two relay outputs that are adjustable. One comes on when the VFD is running at max freq and the other is closed when the VFD is running at minimum percentage. Each of the two outputs of the CR cards are tied to the PLC. When any of the XT panels are running in refrigeration a dry contact is used to tell the PLC to go to a refrigeration mode. If there is no call for refrigeration, then the PLC sets the mode to zero and compressor one will pump down. This same contact on CR 1 is used on input 5 to force pump down. The PLC controls each of the CR cards using a dry contact output that goes on input 6 of each of the cards. C1 is the only compressor that is set to pump down, C2 and C3 are set as parallel compressors. Compressor C1 has a address of 01, compressor C2 is 11 and compressor C3 is 21. The reason for the individual networks is so each one will run independently. The PLC determines the over all mode of operation. The different modes are as follows:

Mode 0	Standby
Mode 1	Compressor C1 running, C2 & C3 off
Mode 2	Compressor C2 running, C1 & C3 off
Mode 3	Compressor C1 & C2 running, C3 off
Mode 4	Compressor C3 running, C1 & C2 off
Mode 5	Compressor C3 & C1 running, C2 off
Mode 6	Compressor C3 & C2 running, C1 off
Mode 7	Compressor C3 & C2 & C1 running

Each of the CR cards when in Refrig will adjust it output to the VFD to maintain the Suction Setpoint. If any of the compressors alarm, the PLC will skip modes that require that compressor to run.

Each of the individual evaporators will have a ER-110 card that will drive both a EEV and EPR valve. The card will get a 0-20ma signal from a XT-70 control panel. The ER-110 will then calculate the ideal suction pressure range for the given Setpoint. It will then modulate the EPR valve to control to this pressure. The Rack system needs a suction Setpoint that will be low enough for the coldest evaporator.

OPERATION

When using a VFD on a compressor, typically 30% is the lowest you should run the compres-

sor. Using 30% as a minimum you can get the range as follows:

C1 30% = 4.5hp 100% = 15hp

C2 30% = 12hp 100% = 40hp

C3 30% = 22hp 100% = 75hp

C1 is the only compressor that will pump down. C2 and C3 will start only when there start contact applied to input 6 and the suction pressure is above the compressor start setting. The controls panels for each of the bins has a dry contact output when calling for refrigeration. This controls a relay, that when de-energized will force C1 to pump down. Input 5 on C1 is used for pump down. A closed contact on input 5 will cause C1 to ignore the parallel check box. All compressors will be checked as parallel.

Each compressor will run its own suction pid loop and make adjustments to the VFD on its compressor. To program each compressor to run independently each one has to have its own network number and be compressor 01. So for three compressors, they would be numbered C01, C11 and C21.

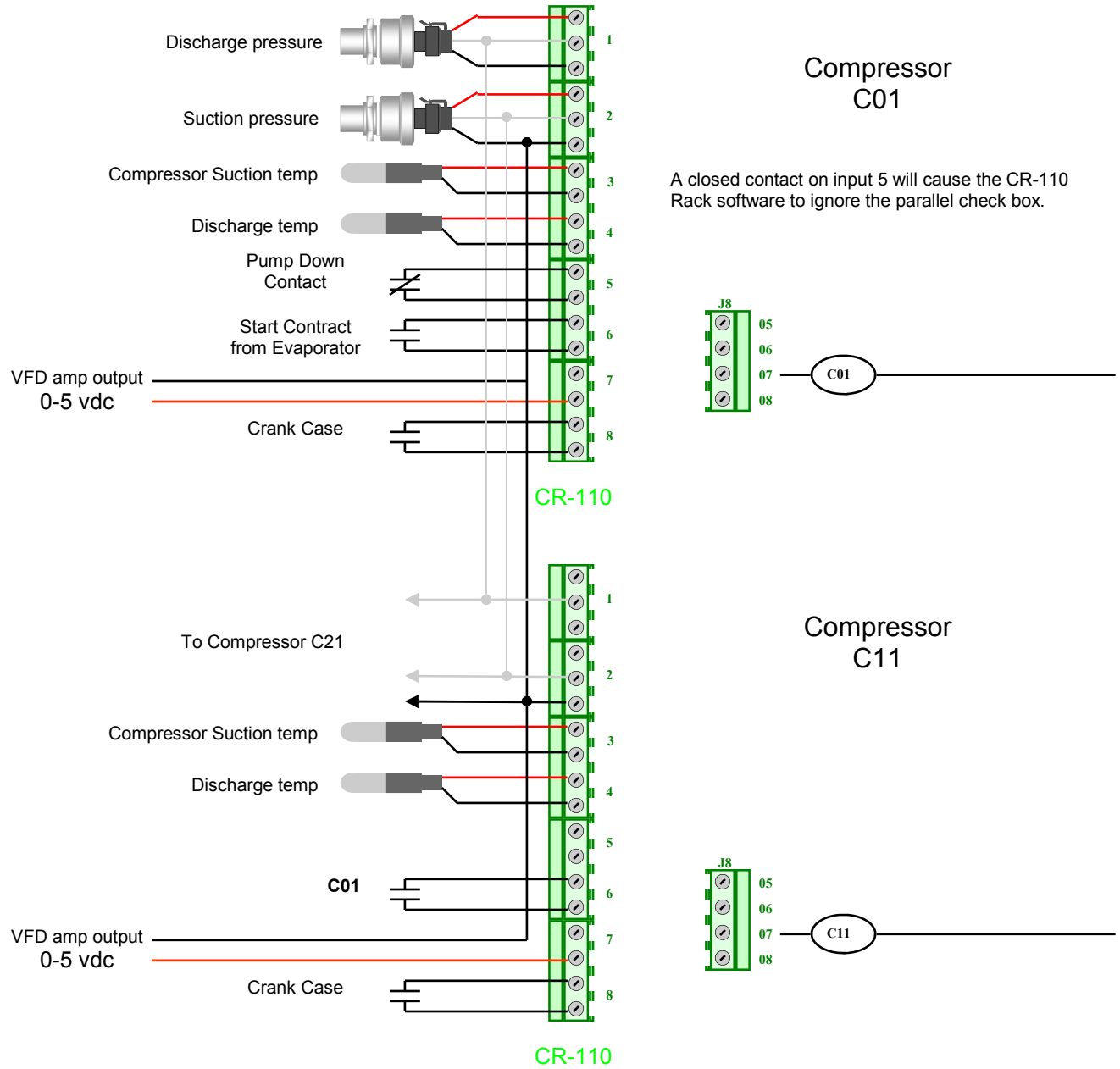
Typical setting for the compressors are:

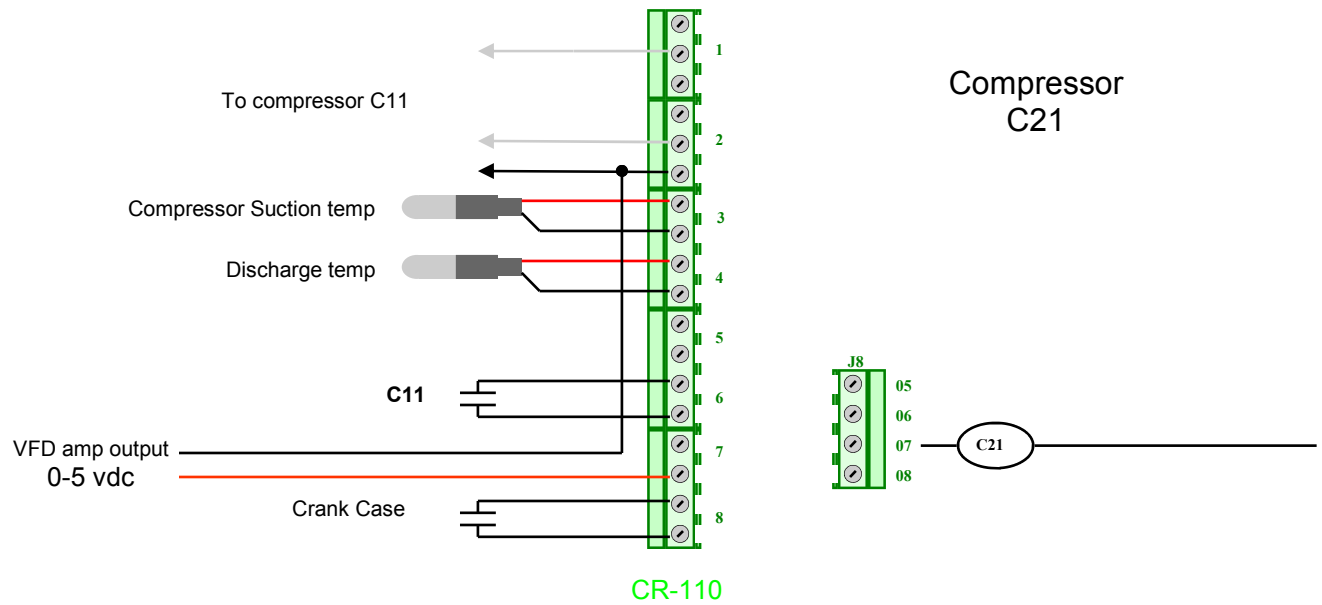
C01 runs all the time there is demand and a start contract.

C11 runs when C01 is above 90% loaded and will shut off when C01 is at 30%.

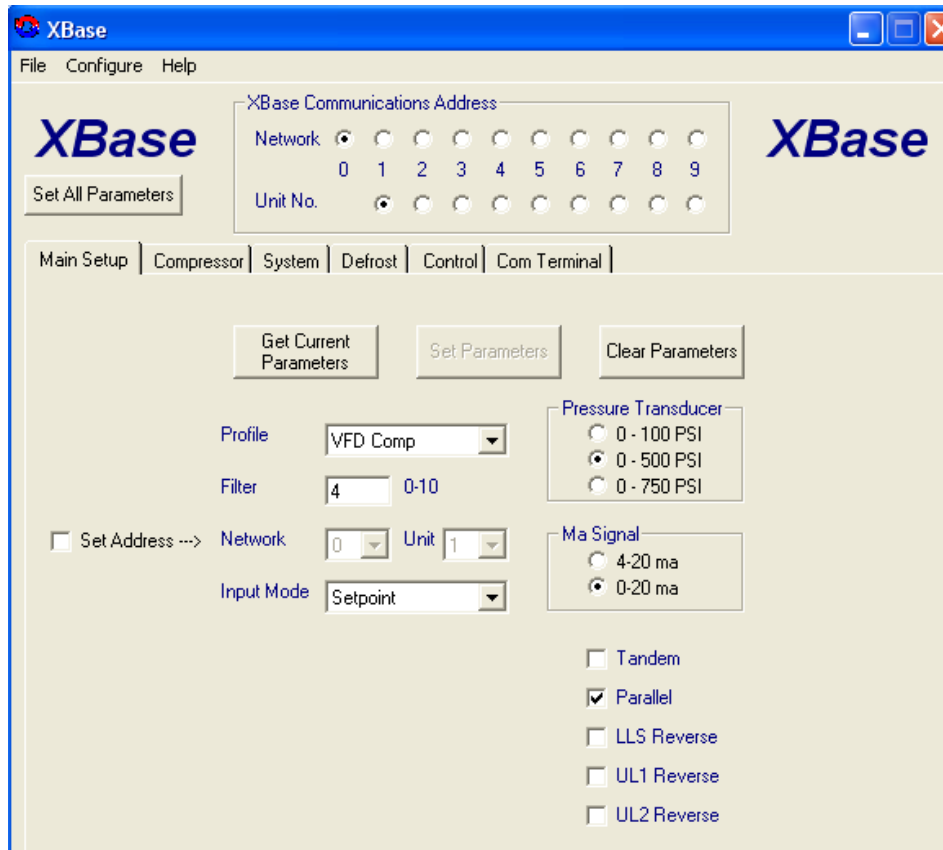
C21 runs when C11 is above 90% loaded and will shut off when C11 is at 30%.

WIRING





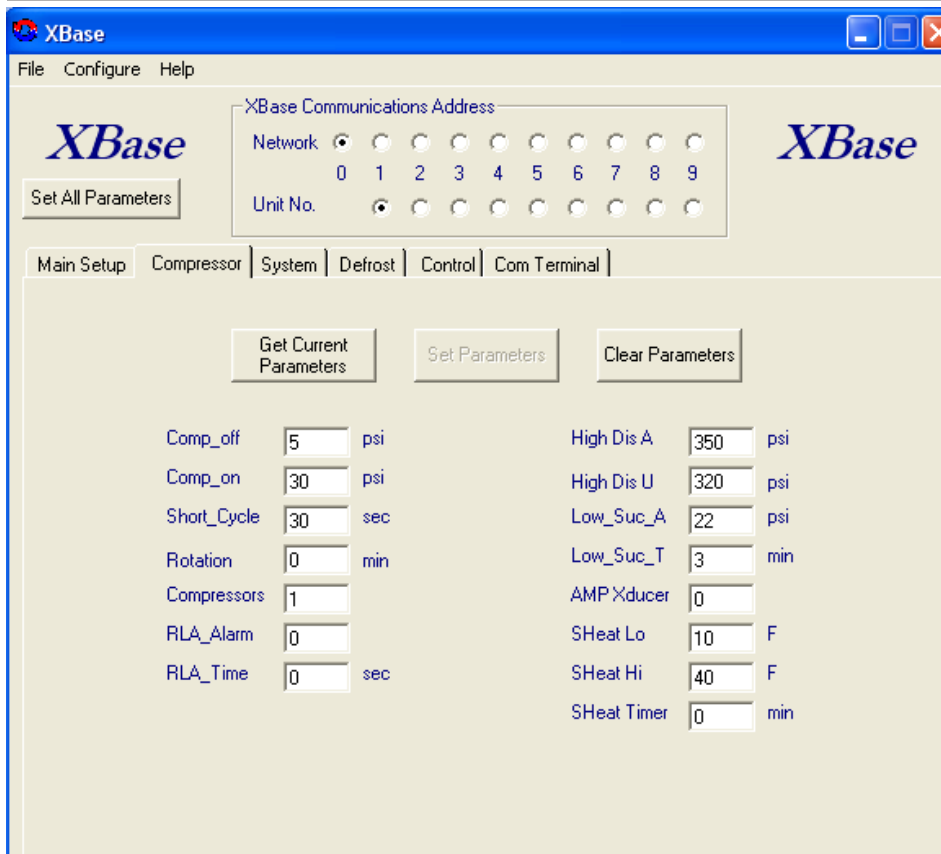
PROGRAMMING & SETUP



For the Profile, select VFD Compressor. This will set the CR-110 to output a 0-10vdc or 0-20ma signal to the VFD on the Compressor.

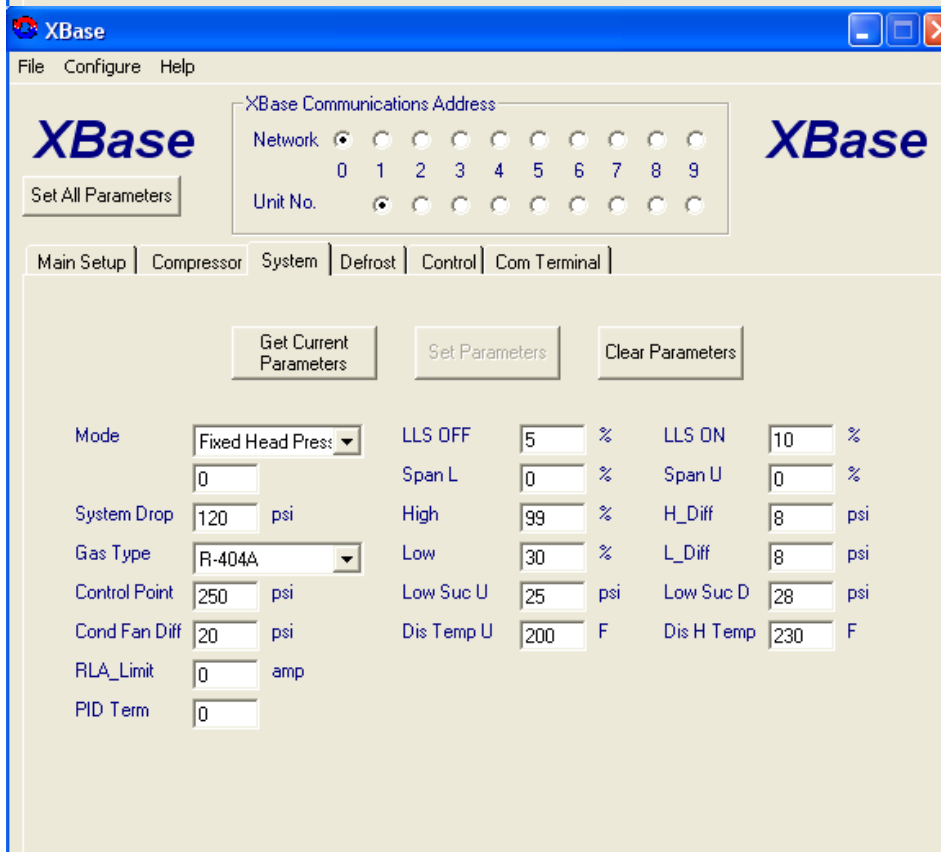
The Input Mode needs to be set to Setpoint. This will force the system to run off of a Suction Setpoint instead of a signal from a panel or temperature controller.

For all Compressors you need to check the Parallel box. If this box is checked the compressor will not pump down. C01 will be the only compressor to pump down. It has a contact on input 5 that when closed will cause the parallel box to be ignored.



For this application, the Rotation should be set to zero and the Compressors set to 1.

The High Dis A will shut the system down with an alarm. The High Dis U will unload the system when the discharge pressure is greater than this value.



The LLS Off and LLS On setting are not used in this application.

Span L and Span U are not used on this application.

The High setting is percentage and works off of the PID output that controls the VFD. Output 7 will turn on when the PID output gets above the High setting and the suction pressure goes above the Suc SP plus the H_Diff. There is a -3 psi differential that will shut off output 7.

Output 8 will turn on if the PID output drops below the Low setting and the suction pressure drops the L_Diff setting below Suc SP. There is a 3 psi differential that will shut off output 8.

Once started, each compressor will run its own PID loop and adjust the compressor VFD.



Each compressor must have the PID adjusted for that unit. The Suc SP is the value the rack will try and maintain for suction pressure. Each compressor must have the same Suc SP value.

The PID Mode must be set to Comp Freq for each of the compressors.

The Min Output is the lowest value for the compressor VFD. Most compressors should not be run below 30%.

The Man Output is used for scaling and should be set for 100% on each compressor.