Techsys Corporation

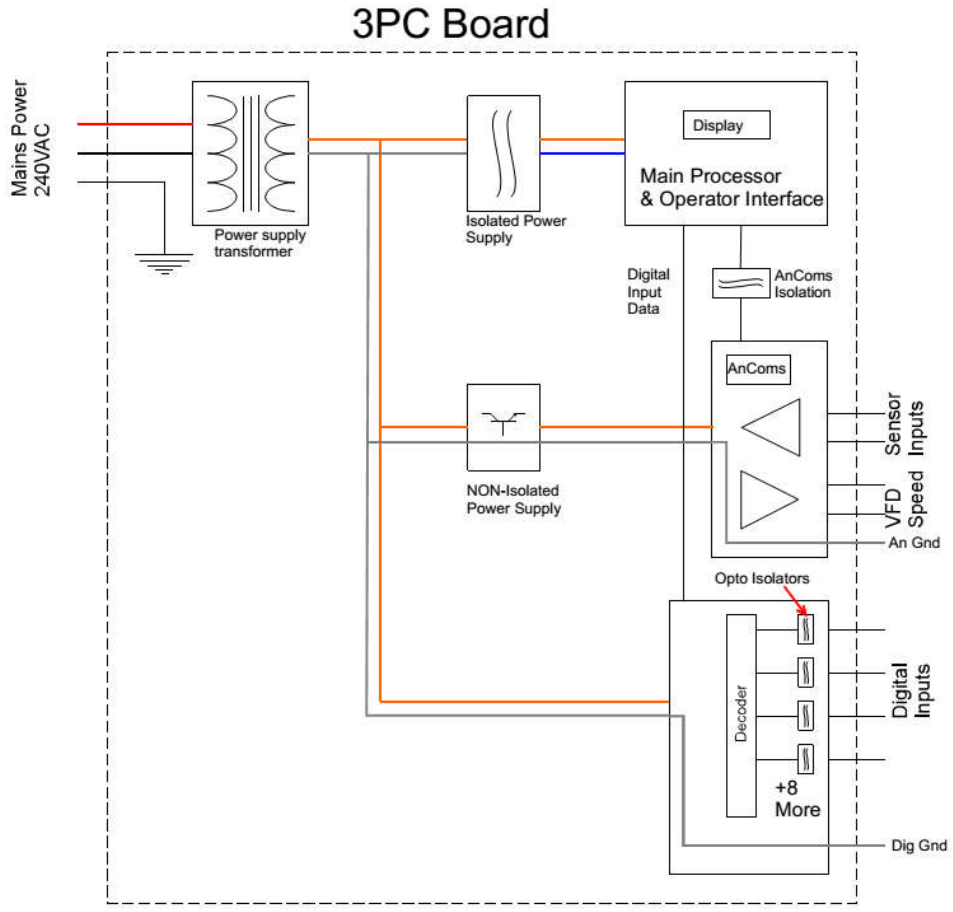
TECHNICAL BULLETIN

Rectifying AnComs Faults, AutoReboot & System/Power Supply Shutdowns.

Mains Electrical Power is heavily regulated and by definition should be "clean". Unfortunately this is not always the case and there are many devices used in new systems that can cause interference. Systems that have been working for many years sometimes start to exhibit strange errors or faults. These are often attributed to a fault in the control system, whereas in reality it may be another piece of equipment or many additions over time that are creating "noise" on the mains supply. Ideally the noise source should be rectified but in many cases it is difficult to identify where the problem is coming from without installing expensive test equipment.

The 3PC board as used in the ORCA, MINKE & Swordfish+ products was designed to minimize this as much as possible but other objectives limited the level noise attenuation (reduction) capability. Without going into too much detail the 3PC board has isolated supplies which will accommodate short term inadvertent connections to LV supplies (240VAC) without any damage, this however limits the opportunity to de-couple the noise.

By studying the block diagram below it can be seen that the inputs are isolated from the main processing section but there are some common connections.



The word "noise" is fairly broad and in this case we can just focus on two types of noise, directly induced or close coupled.
In the case of the pump controller, directly induced noise tends to come via the mains supply power, induced noise will come via the inputs.

Close Coupled noise.
This is an example of what can happen. If the Analogue (An) or Digital (Dig) input wires are run too close to a 400V power cable for an extended distance, then voltage can be transferred into the digital input or analogue input/output wires. The magnitude of the voltage will depend on a number of factors but for the most part a limited level of voltage will not cause a problem, as it tends to be common to the GND & Power and the whole circuit voltage will float up and down. Problems tend to only arise when the voltage is extremely high and the rise time is very rapid. This is called high dv/dt.

The first thing to check and change if possible, is the location of these wires in relation to power or motor cables. VFDs with no Sine Wave output filters are one of the biggest problems and it is one which we are unable to avoid, as most panels with a 3PC board will probably have a VFD fitted. ANY Extra Low Voltage cables should not be run parallel to VFD cables. Running cable across at right angles will typically be okay.

Directly Induced noise.
This will typically come from the mains power supply where there are inductive devices being switched on and off without any dv/dt mitigation. Contactors, solenoids, relays etc are inductive devices.

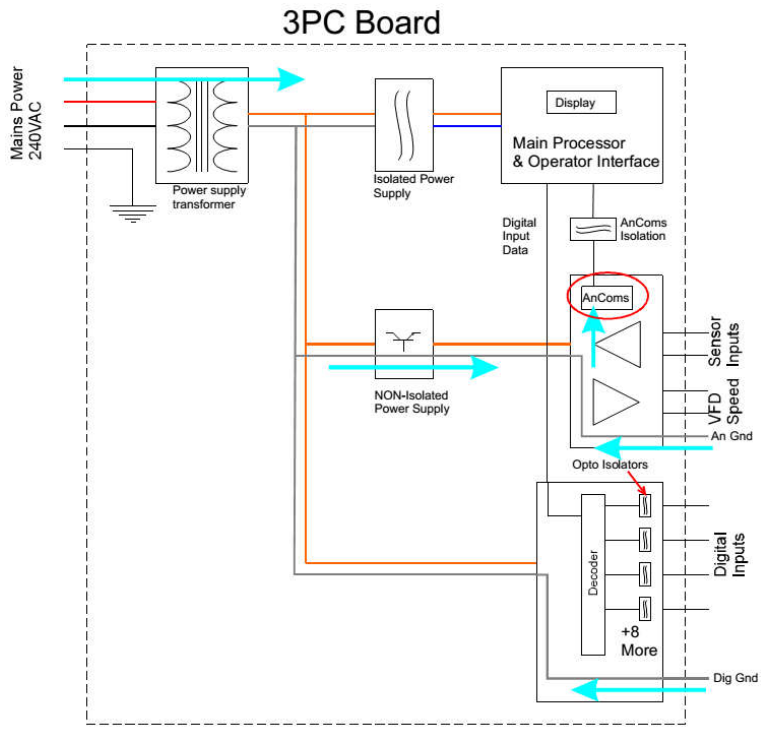
AnComs Faults.
There are two possible sources of interference for an AnComs fault but the outcome is the same.

- The transient voltage can be coupled through the transformer.

OR

- Via the common on either of the inputs.

The noise spike will typically latch-up the AnComs module and prevent it from working. The main controller will attempt to reset the AnComs module, and is successful most times. In some instances only a power cycle will fix the fault and with extreme dv/dt occurrences, it can damage the AnComs module permanently.



AutoReboot Faults.

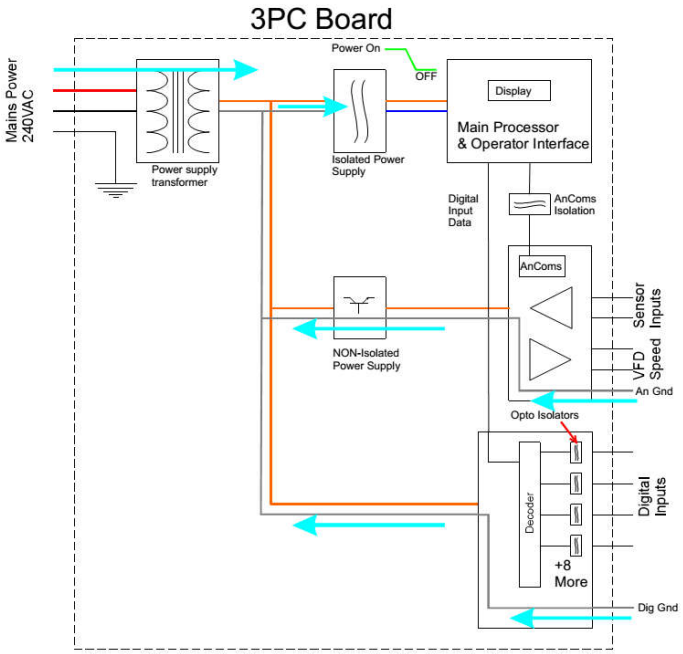
There are two possible sources of interference for an AutoReboot fault, but the outcome is the same.

- The transient voltage can be coupled through the transformer.

OR

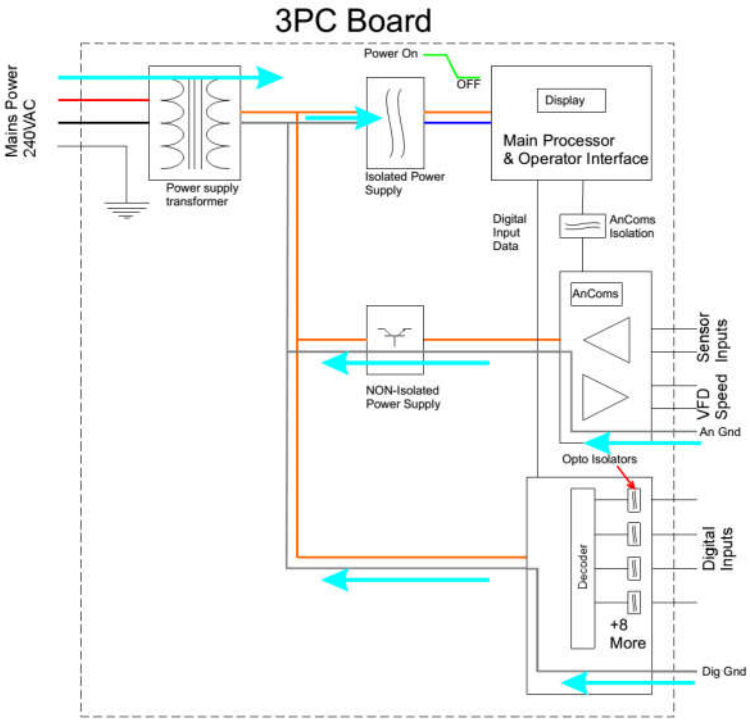
- Via the common on either of the inputs.

This noise spike will interrupt the electronic control inside the Isolated Power Supply, causing the power output to the Main Processor to turn off for a short period of time. When power is restored, the main controller identifies that it was not shut down via the power being turned off as per normal and therefore logs an AutoReboot occurrence.

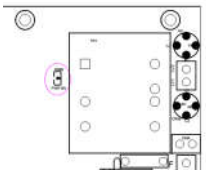


In some cases the "Glitch" or power cycle is not long enough to cause an AutoReboot but can affect the Digital Input Decoder and cause the main processor to falsely read inputs. This will not cause too many issues but could occasionally turn pumps off.

Main Processor Shutdown.



There are two possible sources of interference for a Shutdown fault. This can be identified by checking to see if the Power LED DS39 is on but the LCD display is blank and no beeps can be heard when a button is pressed. This fault appears with extreme dv/dt occurrences and the electronics inside the isolated power supply latch-up.



- The transient voltage can be coupled through the transformer.

OR

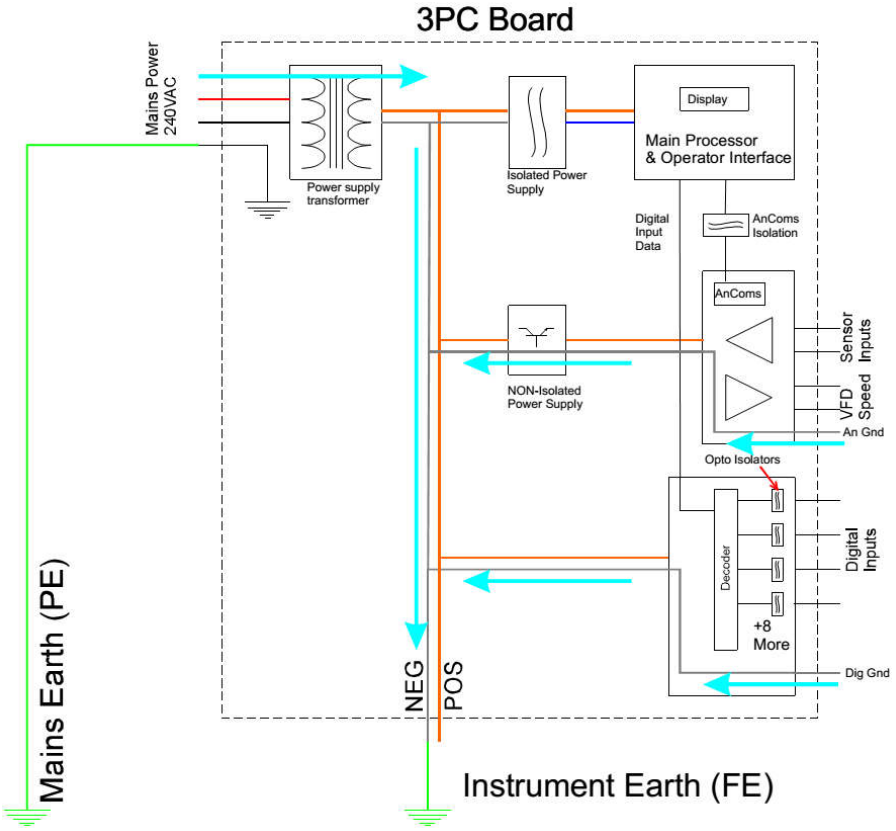
- Via the common on either of the inputs.

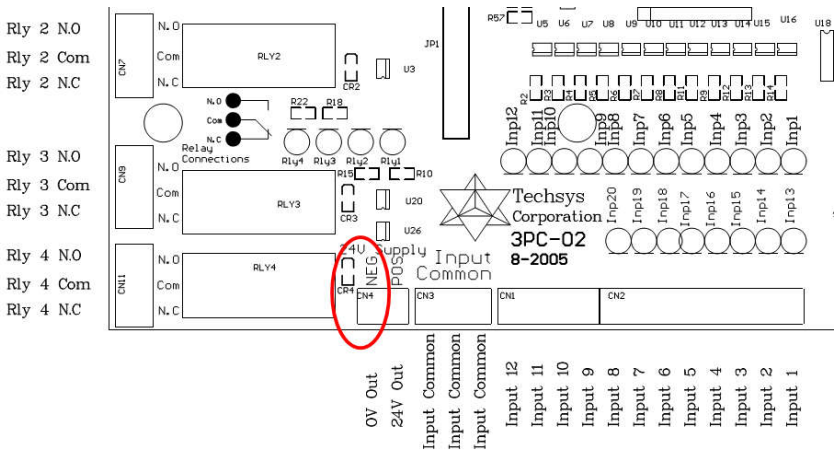
NOTE- Only a power cycle will rectify the fault.

Solutions.

There are three options.

Option 1 is to install an Instrument/Functional Earth (FE) and connect it to the NEG terminal of the power supply output connector. This is by far the best option but not always easy to achieve.



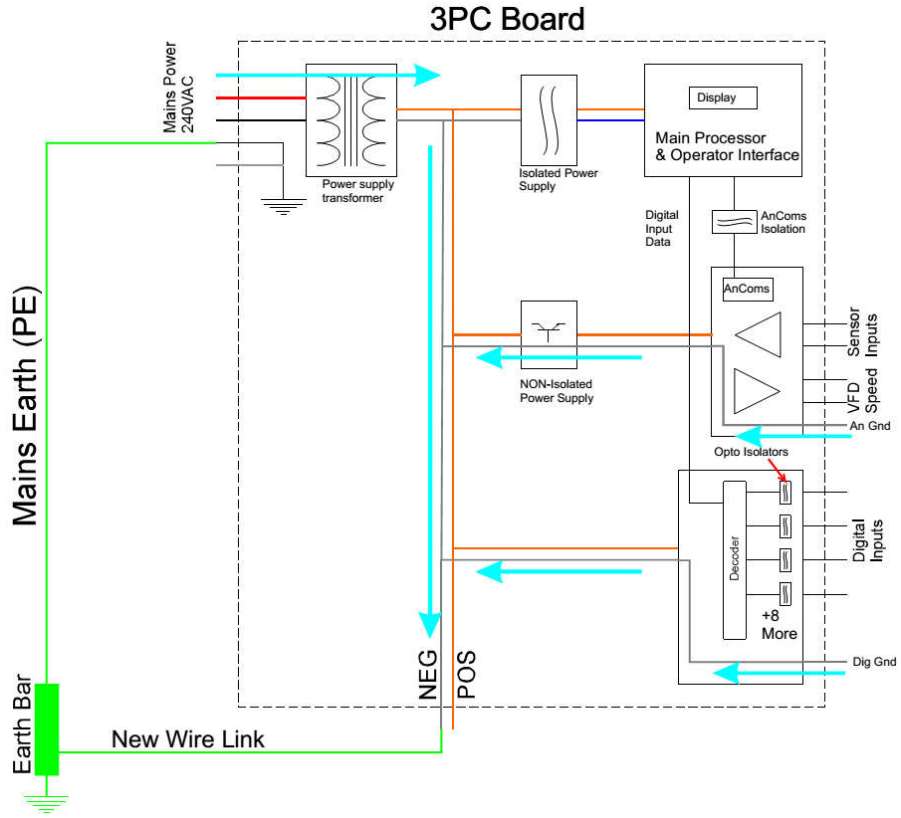


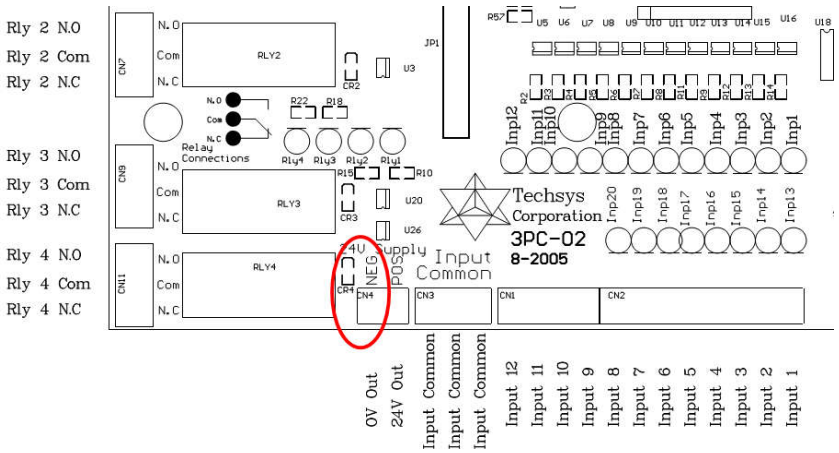
This requires a completely separate "clean" instrument/functional earth wire to a separate Earth Stake at or near the control panel.

Option 2 is to fit a link from the internal power supply NEG terminal to the Earth bar in the switchboard/panel.

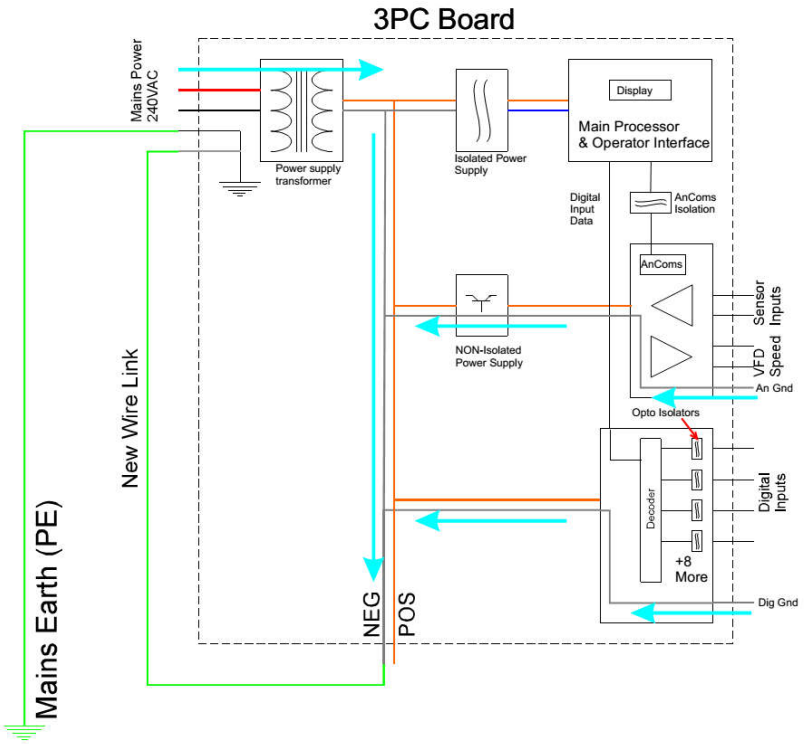
This is not as good as option 1. It will however connect the new wire to the earth where the cable size is larger and there is potentially less noise.

Note – avoid running this cable near all 240/415 power wires.



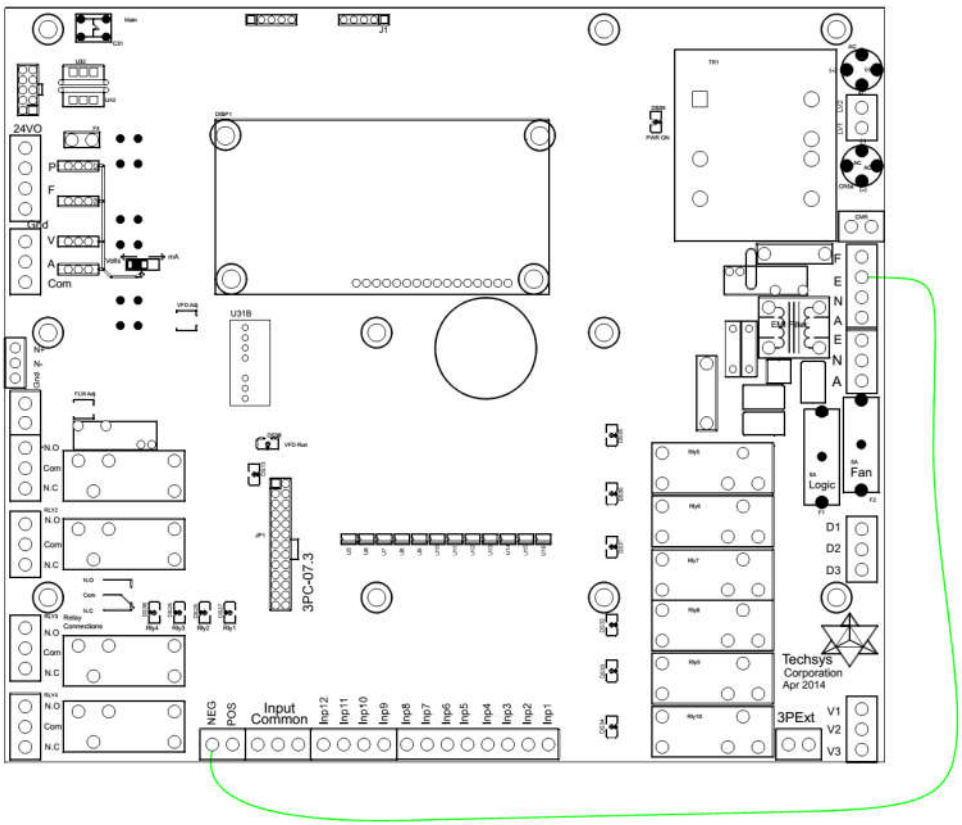


Option 3 is to fit a link from the internal power supply NEG terminal to the Earth terminal on the board.
This option is the easiest but not as good as Options 1 or 2.



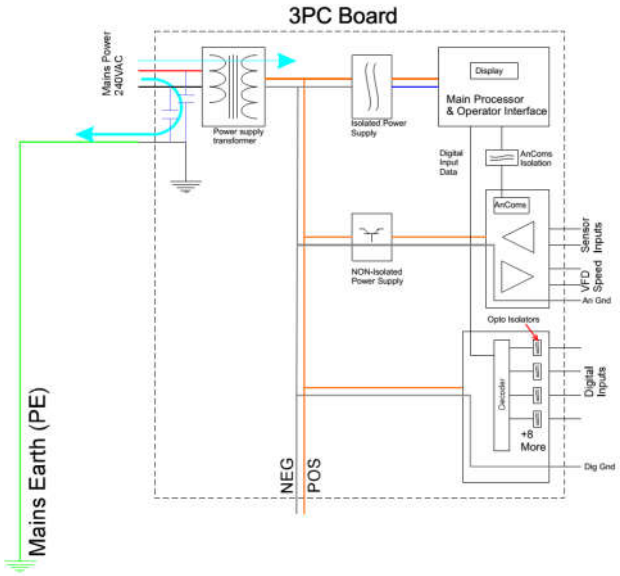
Connection details

- Turn the power OFF.
- Insert a wire from the Earth Output Terminal to Power Supply NEG as shown in the drawing below.

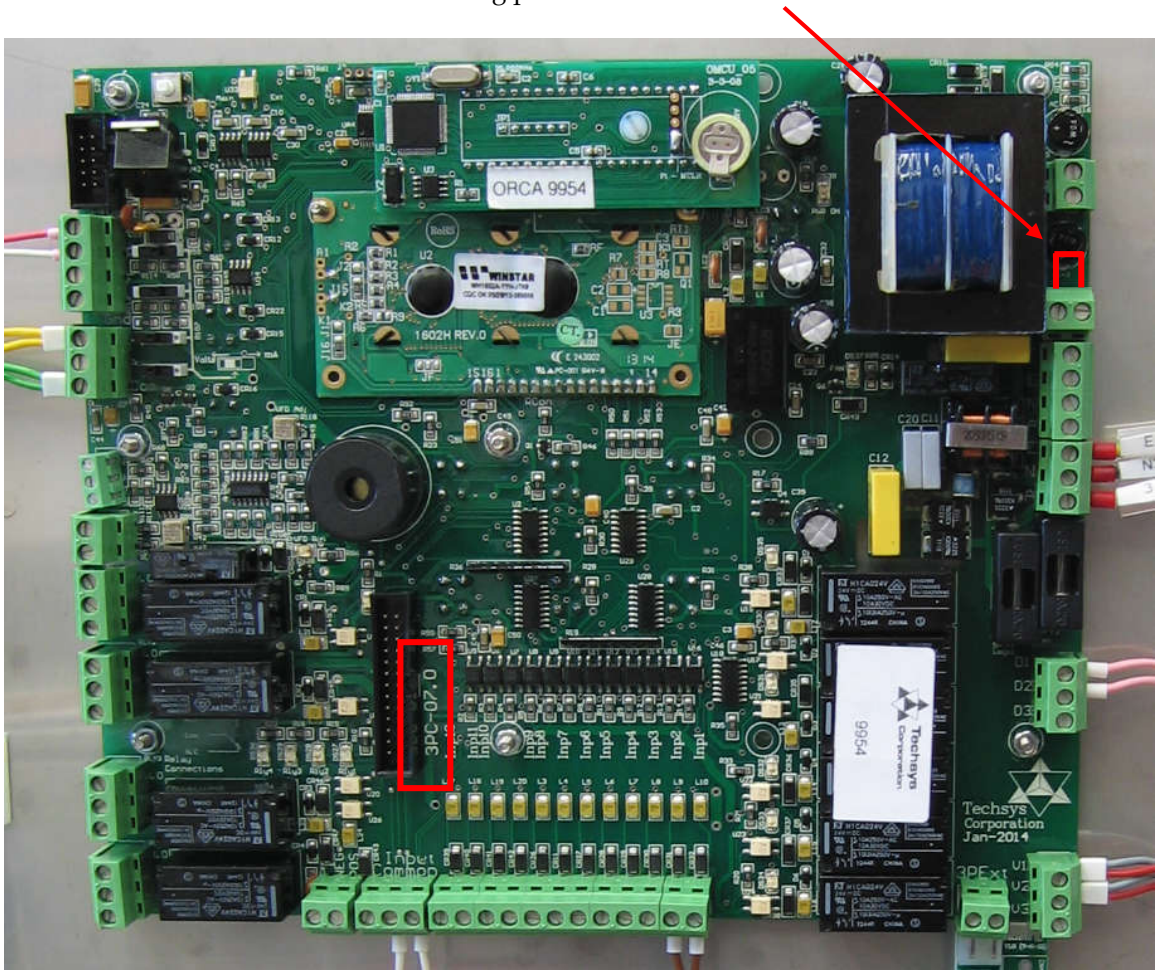


Mains Power Filtering

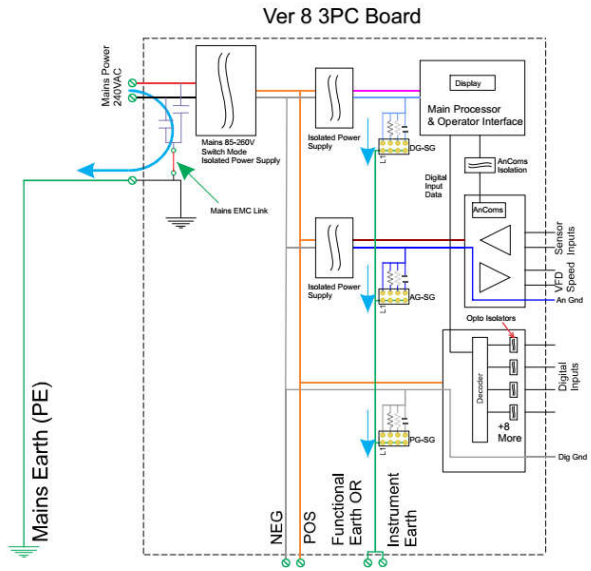
Version- 7 3PC boards also have an option to turn on some extra mains power filtering. This is typically done by coupling noise to the supply Earth. Be mindful that if the Earth is already full of noise, then it can make things worse.



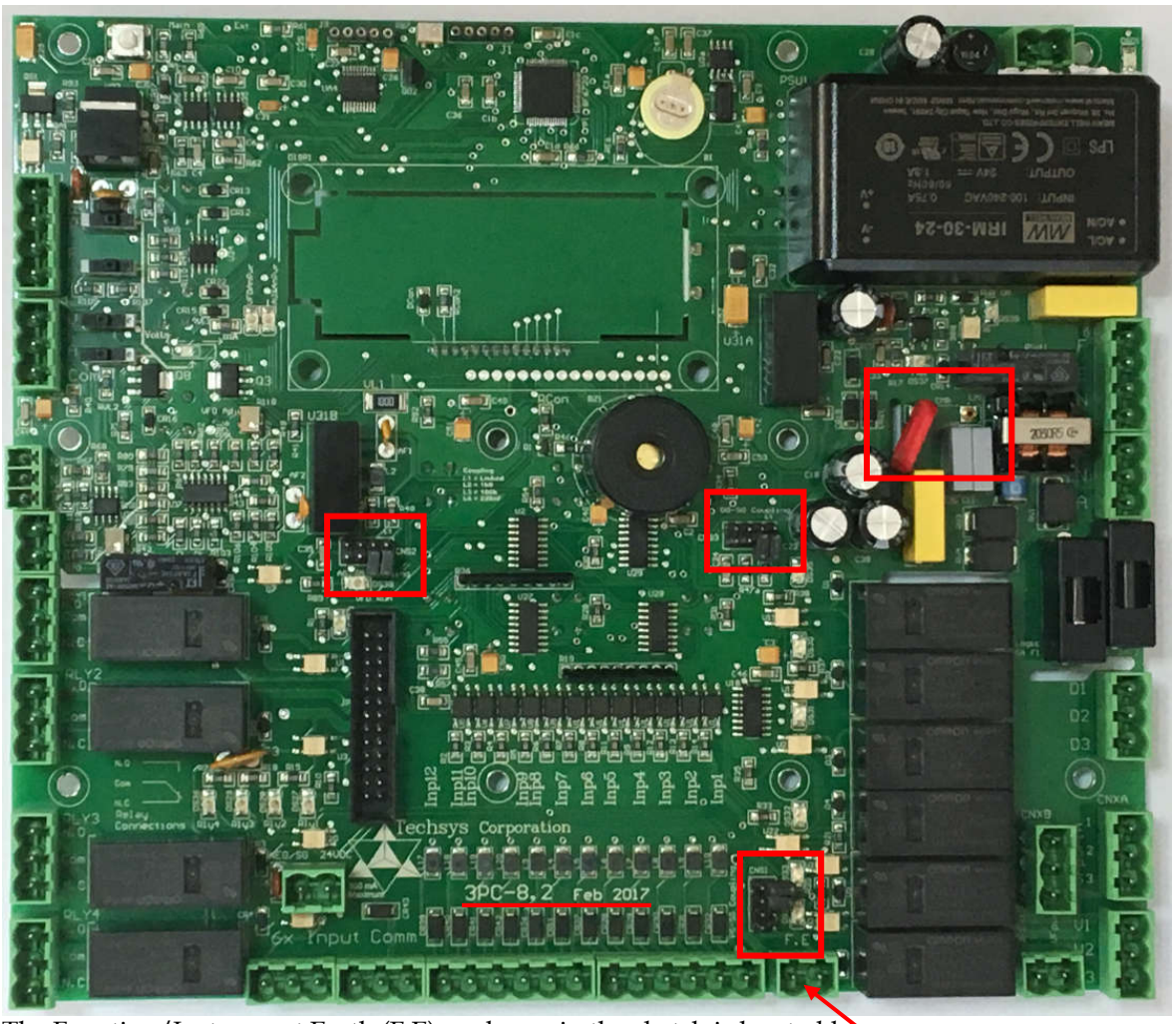
The Version Number can be found near the expansion connector as highlighted below.
Insert a link on the terminal near incoming power as shown below.



Version- 8 3PC boards also have an option to turn on some extra mains power filtering. This is typically done by coupling electrical noise to the supply Earth. A plug in LINK is provided to achieve this – see below for instruction.
Again be mindful that if the Earth is already full of noise, then it can make things worse.
The 3PC-V8 also has some extra filtering on each of the power supplies that can be turned on or off depending on the where the electrical noise is emanating from.

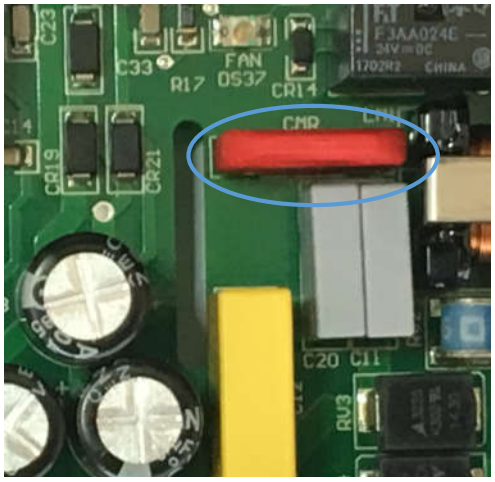


The image below shows the location of all of the links.



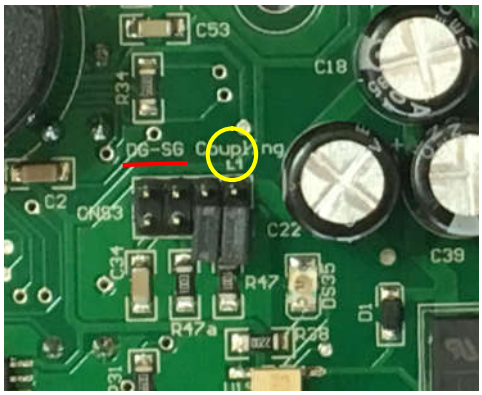
The Function/Instrument Earth (F.E) as shown in the sketch is located here.

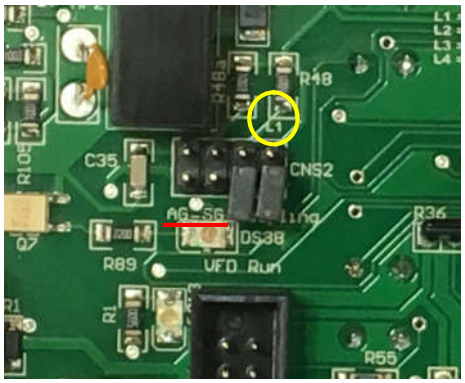
The EMC link as show above is in the disconnected position, to connect the EMC filtering, make sure the power is turned off, pull the link away from the board and plug it in as shown below.



These are the indivual power supply filter links.

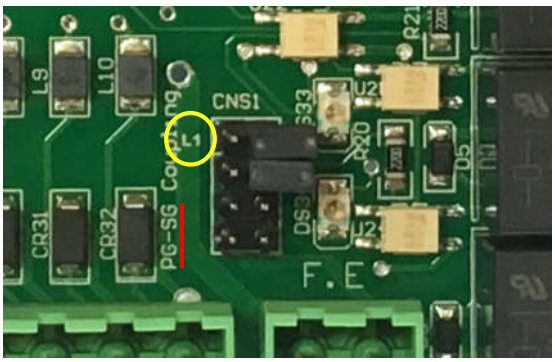
DG-SG Links





AG-SG Links

PG-SG Links



Each has L1 (Link 1) marked as shown in the scetch, L2 is the next, then L3 & L4 (these are not marked). L1 is also marked on the board.

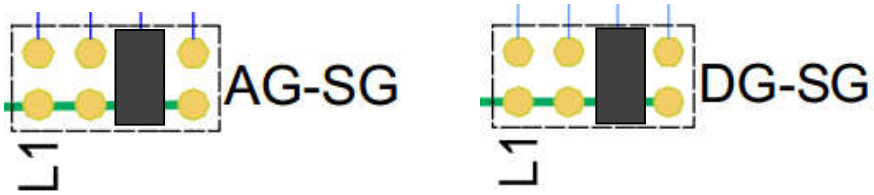
- L1 connects the relevant power ground to the Instrument/FE connector.
    - Do not do this unless instructed to do so.
- L2 connects the relevant power ground to the Instrument/FE connector with some moderate impeadance.
- L3 connects the relevant power ground to the Instrument/FE connector with some soft impeadance.
- L4 connects the relevant power ground to the Instrument/FE connector via some capacitance.

There are so many options with all of these links it will be difficult to explain all of the possible reason for connecting each of the links. In most cases it is best to Consult Techsys for any possible solutions.

Here are some basic guidelines.

If still experiencing AnComms messages after connecting the EMC link, try the following:

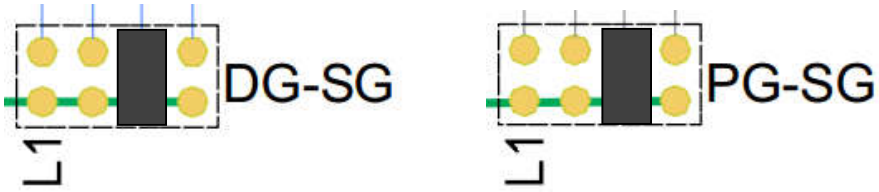
- Place one of the jumper blocks provided over both L3 pins of the AG-SG connector & also on the L3 of the DG-SG connector.



- If the problem has not been eliminated after running for some time, remove the EMC and operate the system again.
- If this fails, then a F.E stake may need to be installed. Remove the link on the DS-SG.

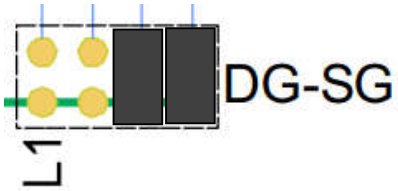
If still experiencing Auto Reboot messages after connecting the EMC link, try the following:

- Place one of the jumper blocks provided over both L3 pins of the DG-SG connector & also on the L3 of the PG-SG connector.



If still experiencing Auto Reboot messages after trying the above, try the following:

- Place one of the jumper blocks provided over both the L3 & L4 pins of the DG-SG connector and then install an F.E stake. (Remove the jumper from PG-SG)



- Test with and without the EMC link connected.

To determine the cause and a possible solution, it might take some time inspecting and testing whilst the system is running through a number over cycles to understand when the problem occurs, this information should be passed on as it will assist in making the correct actions to eliminate the problem.

Earthing Systems Explained

Protective Earthing (PE)

The resistance to earth from protective earthed parts in Class 1 equipment must be low enough to permit adequate fault current to flow to earth, thereby ensuring that the over-current protection device in the final sub-circuit (fixed wiring) opens quickly in the event of insulation failure.

The protective earthing conductor also ensures that any leakage current from the live parts within Class 1 equipment flows harmlessly, via a low resistance path, to earth.

All Class 1 equipment shall have the integrity and resistance value of its earthing conductor checked at regular intervals during its service life to ensure that connections have not been loosened, transposed or corroded.

Protective bonding or Equipotential bonding

Earth bonding helps to protect people and equipment from electric faults, power surges, and other surges and transients. Earth grounding also helps reduce noise and other forms of interference.

Proper bonding helps to ensure that people are not exposed to voltage potentials between two metal surfaces, such as bathroom taps or electrical control cabinets. Accessible conductive parts shall be bonded to the protective conductor terminal, if they could become hazardous live in case of a single fault of the primary protective means specified in 6.4.

Alternatively, such accessible parts shall be separated from parts which are hazardous live by a conductive protective screen or barrier bonded to the protective conductor terminal.

This protective bonding is known as equipotential bonding.

Instrument/Functional Earth terminal (FE)

A functional earth is provided for a purpose other than safety, usually for surge suppression, lightning protection or as a "quiet" communications earth for telecommunications systems such as computers and telephone systems [AS/NZS 60950.1:2003]. There will be a separate earth stake for the functional earth. There are other types of technical earths that have different names that perform the same function as a functional earth.

There will always be a protective earth supplied in addition to the functional earth.

A functional earth terminal may be provided on equipment such as laboratory power supplies, by which electrical connection is made direct to a point of a measuring or control circuit or to a screening part and which is intended to be earthed for any functional purpose other than safety.

Industrial equipment manufacturers may provide a functional earth terminal for reduction in EMC with high-frequency equipment. The functional earth conductor for this type of equipment is typically flat copper bar or hollow copper pipe.