PRODUCT ADVICE SHEET

Universal Power / VSD Controllers

Fantech AVA series





FANTECH

RoHS compliant

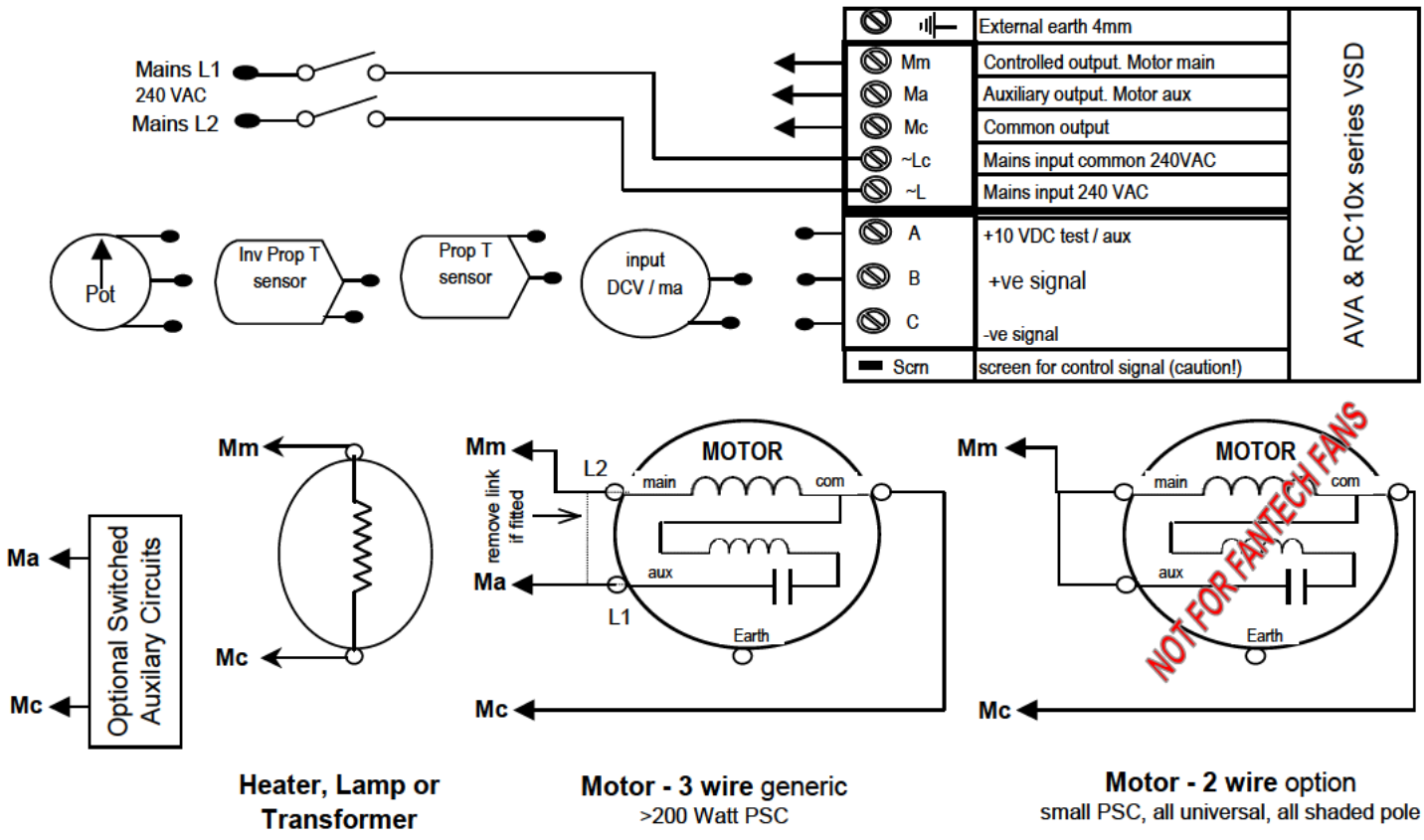
FEATURES

- **VSD** Remote electronic speed control in fan, blower, pump or applications where the torque varies with speed. Load independent speed control of universal & shaded pole motors.
- **Energy efficient 3-wire PSC** motor configuration. 2 separate outputs for main / auxiliary windings. Can also be connected as simple 2-wire system.
- **Power Control.** Remote stepless electronic power control of resistive loads eg - lamps & heaters.
- **Multiple & dissimilar loads** accommodated.
- **EMI Filters built in. Ctick approved** – no external filters required.
- **Selectable input** 0–10 VDC or 2 – 20ma control signal with adjustable min / max levels.
- **Factory calibrated** for most fans or pumps.
- **Easy custom calibration** internal test source & simple range (span & offset) adjustments.
- **Auto OFF at low signal levels** <0.8V / 1.5ma
- **Double isolation** of control signal and mains circuitry via transformer and opto-isolation.
- **Range of power ratings** 1200 VA - 7200 VA.
- **Custom applications. Specific** control parameters, interfaces, environmental probes.
- **RoHS** compliant and Ctick approved.
- **IP65 version available** with removable base that can be separately drilled / mounted

SPECIFICATIONS	**Fantech Model AVA Universal Power / VSD Controllers**
APPLICATIONS	Speed control of most single phase PSC motors with mechanical loads such as fans, centrifugal pumps or those applications where the torque of the load varies with speed. Can also control shaded pole and universal motors with any type of mechanical load. Remote stepless power control of all general resistive and inductive loads such as lamp, heating elements or transformers. Multiple & dissimilar loads can be accommodated simply by connecting in parallel.
TECHNICAL BASIS	Phase angle control of AC mains. **B version** – single output for small PSC motors connected as 2-wire, universal and shaded pole motors, lamps, heaters and transformers. **D version** – dual outputs for small, medium and large PSC motors and all other types of loads that require main & auxiliary control outputs. Standard proportional control via 0–10 V or 2-20ma DC control signal.
RATINGS RMS continuous	Single phase 240 V AC (+10/- 20%) 50 Hz. Also available for 110V 60 Hz. **AVA5.0** – 1200 VA 5A **AVA8.0** – 2000 VA 8A **AVA10.0** – 2400 VA 10A. (other sizes also available) Main variable output rated to full rated power and can be varied between ~20 and 100%. Auxiliary output is zero voltage solid state switched and can be rated up to 100% rated power. Total controlled plus auxiliary output power should not exceed 100% of maximum controller rated power. Environmental: up to 50°C in free air for AVA5.0 & AVA8.0 (no de-rating required). For AVA10.0 to AVA20.0 de-rate (max VA) 1.6% x "max VA rating" per °C above 30°C. Max case temp all models 70 °C.
PROTECTION	Surge protection network incorporated on board for over voltage / noise spikes. Control circuit for remote control signal operates at 12 volts DC and is totally isolated from the supply mains / load power circuit by a double insulated fully encapsulated BS415 rated transformer and a 5000V opto coupler between control input & power output. Generous power design parameters – controller designed for PSC motor starting and reasonable short term overload conditions. On-board replaceable fuse in **~L** line. External DB MCB overload / isolation protection recommended for motor load is usually adequate to protect controller.
CONTROL INPUTS	0-10 volts terminals **B** (+ve) & **C** with input resistance 1 Mohm. 2-20ma on terminals **B** (+ve) & **C** with sink resistance = 500 ohm. An internal 10V DC source (max 50 ma) is provided between terminals **A**(+) & **C** which can be used for custom remote control applications, a remote or local potentiometer or testing.
AUTO TURN-OFF	At low control levels, the controller is designed to shut down the main control and auxiliary outputs. Normal operation resumes at higher control levels. Auto turnoff occurs at < 0.8 VDC for voltage input, ~<5% for a potentiometer, < 1.5 ma for 2 - 20 ma.
COMPLIANCE	Fitted with internal Electromagnetic Interference suppression network, and complies with AS/NZS CISPR 14.1:2003 when correctly installed. ACA C-Tick lev 2 **N29529.** ROHS compliant.

MOUNTING & CASE	Extruded aluminium. IP30. 174L x 114W x 74D fixing width 111mm wt 0.8 – 1.1Kg. Anodised and wall mountable extreme environment diecast IP65 options available. Removable aluminium end plates held in place with cs self tap screws. One end plate cover for terminal access & cable entry whilst the other is for setting potentiometers.
SETTING & ADJUSTMENT	A user selectable 2-20ma control input can be selected on the PCB via a miniature link plug. Span and Offset – two preset potentiometers permit the user to custom calibrate maximum and minimum motor speeds over a range of control inputs. A switchable internal calibration source with a 3rd preset potentiometer can be used to set up and test the installation without needing an external control signal. Two test pins are provided to monitor the control signal during set-up or testing using an external DC voltmeter. Factory calibration is 1VDC for an output of ~120 VAC (RMS) which is ~ 32% of power or ~38% of most motors maximum speed and 9.2 VDC for an output ~238 (234 for 2-wire) VAC (RMS) which is ~ 98% of power / maximum speed. Control input protected for voltages >10 VDC.
OPTIONS Specify at the time of ordering	**Higher Power:** ***AVA15.0*** – 3600 VA 15A ***AVA20.0*** – 5000 VA 20A ***AVA30.0*** – 7200VA 30A **B version** only 1 auto-off control output **Low Power cut-down version** (small footprint): ***AVA3.0*** – 600VA 2.5A **Input:** * Other current or voltages **Sensors:** Proportional or inverse proportional temperature thermistor. Specify T°C range & lead length **Auto off level:** * no auto off level * adjustable auto off level (approx. 2 – 35% of max) **Input modules:** * PID module for pressure, air velocity , temperature, humidity or other control parameters. **Enclosures:** * IP65 powder coated diecast enclosure.
RELIABILITY	Fantech controllers are built for long service life and have been proudly designed & manufactured in Australia for Fantech using pragmatic design criteria and high grade components. Appropriate quality control is ensured throughout their manufacture. Fantech has a commitment to on-going research and development of its products.
CONNECTION	Internal 300 VAC 30A UL95V0 5-way terminal strip with screw wire protection terminals able to take up to 2 x 2.5mm² or a 1 x 4mm² conductors. Control input has smaller 300 VAC 5A UL95V0 3-way terminals. Cable entry plate has 2x10 & 1x4mm neoprene grommets or can be specified as blank for customer specific gland / entry requirements. **CONTROL SIGNAL** **B** = +ve signal **C** = -ve or ground **A** = +10 volts constant voltage source (max 50ma) **INPUT/OUTPUT:** terminal block mounted inside enclosure end plate marked ***Mm*** ***Ma*** ***Mc*** ***˜L*** ***˜Lc***. ***Mm*** Controlled Output. (Motor main) Up to 100% of total load. NB controlled + aux not to exceed 100% rated VA ***Ma*** Auxiliary Switched Output (Motor aux for 3-wire control). Up to 100% of total load ***Mc*** Common output Note: Mc & Lc are internally connected. Connection of Mc optional if external common used. **˜L** – Mains input **˜Lc** – Mains common input **Scrn** – miniature control signal screen earth terminal provided

WIRING DIAGRAM



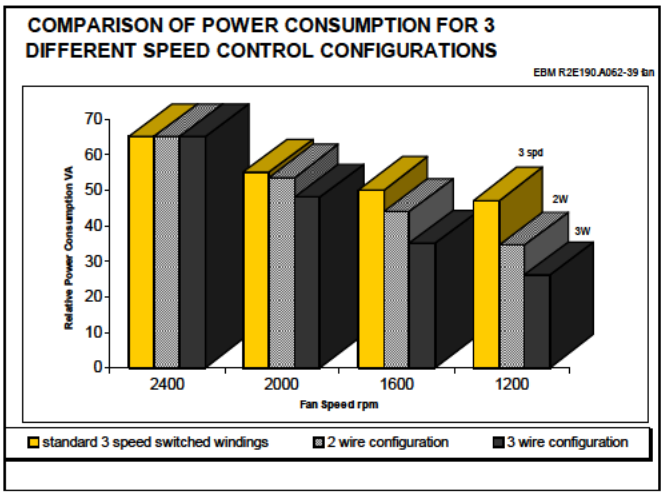
GUIDELINES FOR INSTALLING the AVA series of VSD controllers

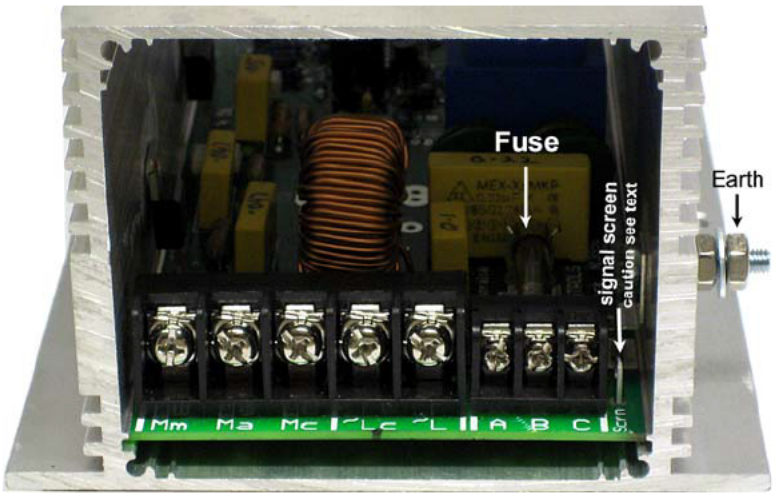
How does the controller work? Fantech single phase controllers vary available power to the load using phase angle conduction control. As the conduction angle is reduced, the power to the load is reduced. This reduction is accompanied by a reduction in the AC voltage across the load and can be used as an indicator of the power change or calibration reference. In resistive, transformer, universal motor and shaded pole motor applications, the main output is used. For PSC motors, either 2 or 3 wire control can be used. 3 wire has separate outputs for the main and aux windings of the motor from the controller.

How effective and efficient? There is much to be said for keeping things simple! It is in this spirit that Fantech single phase controllers have been designed. There are no micro controllers or sensitive electronic components – just simple rugged commercially designed circuitry and industrially rated power components that can be protected using standard MCB's and fuses. There are many ways to vary power to AC loads. For resistive and transformer type inductive loads, Fantech Controllers are highly effective and very efficient (~95%) . For universal brush type motors they are also efficient but for some motors minor "cogging" can occur at very low speed settings due to AC waveform and brush / commutator being out of sync. For induction type capacitor run PSC motors using a permanent aux/ run capacitor, phase angle control is highly effective for loads where the torque requirements changes with speed – eg fans and pumps. Efficiency is ~70% for the 2-wire method and can be >90% for 3-wire configurations & comparable to the more complex 3-phase variable frequency V/F or inverter drives. The graph below shows typical power efficiencies for a single phase fan using std 3-speed windings, 2-wire and 3-wire control.

Motor considerations Phase angle conduction control is suitable for all types loads connected to universal (brush) or shaded pole motors. For PSC capacitor run motors there are some criteria essential for successful speed control. If a reasonably linear change in speed is required, the motor must be suitable for speed control, it must be optimally sized for the load and the load torque characteristics must change (increase) with speed. Fans and centrifugal pumps are ideal but high starting torque loads such as compressors or loads whose torque does not change with speed, are not. Split phase and capacitor start capacitor run motors cannot be used with a speed control due to the start circuit which is usually motor speed dependant. Inefficient & poorly matched motor / load combinations are more difficult to speed control particularly where the motor is sized much larger than the load requires.

Output Configurations The AVA can be connected in two different configurations. For transformer, resistive loads, shaded pole motors or universal (brush) motors, the output is between **Mm** and **Mc**. For PSC motors there are two ways in which the motor may be wired. Generally the *2-wire* is simplest and can be used for smaller motors <150W output power. The *3-wire configuration* involves connecting the main and auxiliary windings of the motor to different parts of the AVA controller. Three wires are thus involved – input, main output and auxiliary output. The *3-wire* is slightly more complex but for most motors offers better speed control over the range, higher efficiency, lower motor noise and lower motor temperature. **NB:** For all Fantech fans, CMG motors and motors >200w, the 3-wire configuration MUST be used. The AVA series of VSD's can individually control more than one motor (similar or dissimilar) provided the maximum current of all motors does not exceed the maximum controller current.





Wiring For resistive loads and shaded pole / universal (brush) AC/DC motors use terminals ***Mm*** and ***Mc*** for the output. This is termed simple 2-wire control. Terminal ***Ma*** (ver D) is a solid state 240 VAC output, uses zero voltage switching & cuts in slightly after the main output. This minimises switching surges and EMI. Terminal ***Ma*** in ver D controllers can also be used for switching auxiliary loads ON/OFF - eg pilot lamps, shutters, contactor, aux motor windings – NB max total power of main and aux outputs must not exceed 100% of total controller rated power.
For PSC (capacitor run) motors, there are 2 ways in which the motor may be wired to the controller. The 3-wire configuration requires disconnection of one side of the capacitor from the main motor terminal & route this as the 3rd wire from the motor to the controller aux output – ***Ma***. Fantech fan motors make this easy by removing the link between L1 & L2. L1 goes to Ma and L2 to Mm. On some motors the main, auxiliary and capacitor are wired in the neutral side with the common windings going to active. The mains input to the controller may be connected either way around in terms of whether the active goes to ***~L*** or ***~Lc***. It is also acceptable to change the motor wiring to a common neutral – there is no difference.

CAUTION: Always isolate the controller / motor OFF via the feed MCB or isolator before working on any wiring. Be careful connecting cables to terminals. Make sure the opposite end plate (adjusting potentiometers end), is in place and secure as it provides a mechanical end stop for the PCB. Divide individual cable cores evenly across each terminal spade. Tighten terminals securely. Support back of connector with finger whilst tightening & pushing with a screwdriver. A slot screwdriver may provide better grip than a star or Phillips type.

Electromagnetic Compliance No additional snubbers or external suppressors are required. When properly installed, the AVA series of Fantech controllers meet the Electromagnetic Compliance (EMC) requirements of Australia & New Zealand. Correct installation requires the Mm conductor between the controller and the load, be screened (shielded), and that the screen be earthed at one point. Screening may be accomplished by enclosing all the cables between the controller and motor in an earthed screen or metal conduit. If the motor and controller are installed within a common earthed metal chassis or are close together, then cable screening may not be necessary.

Earthing. The controller must be installed in accordance with AS3000:2000. The case of the controller is earthed through the separate external earth lug provided. Caution - Screened output cable – the cross-sectional area of screening on a single screened cable may not be sufficient for it to act as an earth conductor.

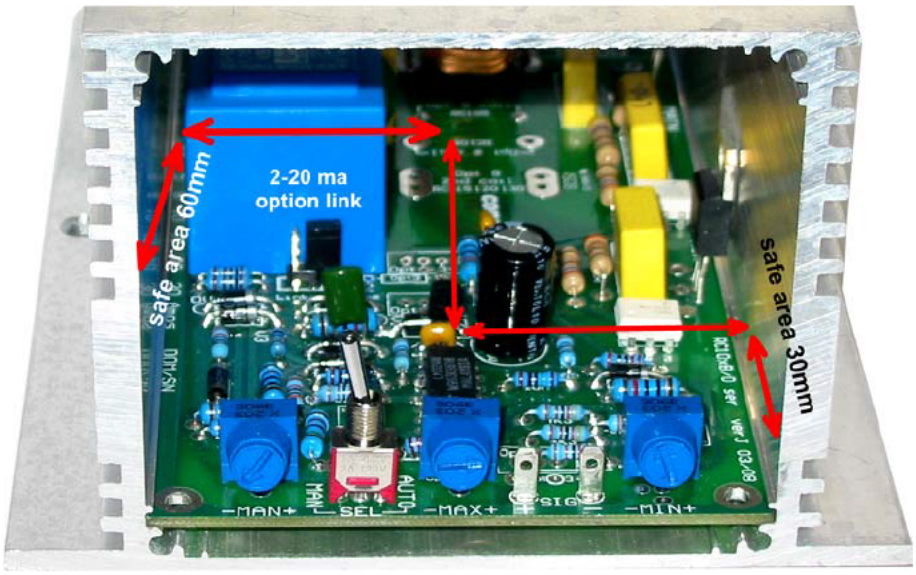
Overload Protection. The AVA range is adequately rated for motor starting and a generous short term overload margin is provided for in its design. It is recommended that both the load and controller are protected by a thermo-magnetic circuit breaker rated according to the motor or appliance manufacturer recommendations and/or local wiring regulations. As a guide fit circuit breakers: AVA5.0 – 5 or 6 amp AVA8.0 – 8 amp AVA10.0 – 10 amp AVA15.0 – 15 amp AVA120 – 20 amp AVA130 – 30 amp.
Controller Fuse: The controller is fitted with a replaceable fuse just behind terminals **A B C**. If it blows, something is wrong with your wiring, installation or motor! To check, isolate OFF then carefully prise out the fuse with a small screwdriver or long nose pliers. Only the following fuses should be used.
AVA5.0 6A slow blow (SB) / 7A fast blow (FB) **AVA8.0** 10A SB / 12A FB **AVA10.0** 12A SB / 15A FB **AVA15.0** 20A SB **AVA120** 25A SB **AVA130** 35A SB
When replacing the fuse make sure that the clips are a tight grasp onto the fuse. If not, gently squeeze them together to effect a firm grip on the fuse when it is inserted. Each clip has an end stop and the fuse should be located centrally between the two opposite end stops. If a fuse blows, there is usually a serious problem that must be investigated & resolved.

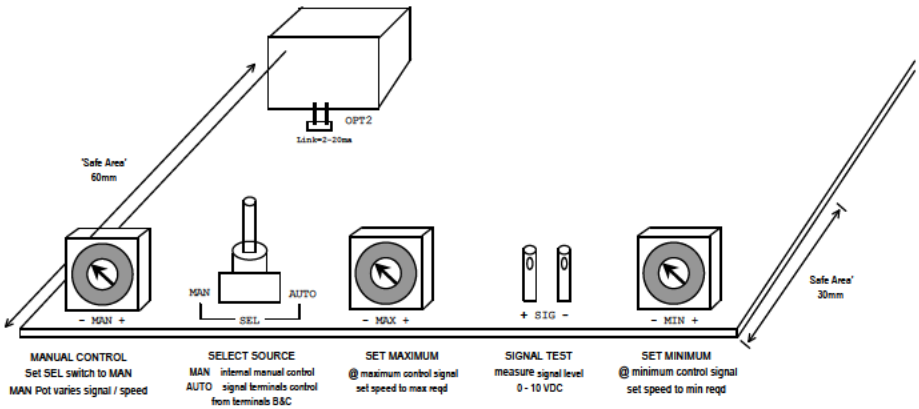
Control Signal Screen. A control cable screen earthing point is provided near the terminals. This should be used with caution. Best practice is to earth the screen at one end only and this ideally should be the source end. Do not earth both ends of a screened control cable as earth loops could result causing erratic control signal problems.

GUIDELINES FOR SETTING UP & OPERATING the AVA series of controllers

Operation. When terminal ***B*** is at 10 VDC (20ma), the load / motor speed will be at maximum. Reducing the control voltage at terminal ***B*** will reduce the power / motor speed until the minimum level is reached when the voltage at terminal ***B*** is 1 volt (2ma). Ensure that at the minimum speed of the control signal, there is sufficient air flow across the motor to prevent it from overheating. When the voltage at terminal ***B*** is reduced below ~0.8 volts (~1.25 ma), the controller will shut down power electronically to terminals ***Mm*** and ***Ma***. **CAUTION** – this is an electronic switched STANDBY STATE and should not be used for permanent shutdown or relied upon to switch off / isolate the load for servicing. A separate mechanical safety isolator switch should be included in the wiring for safe isolation. Dependant on motor type, mechanical load, 2 or 3 wire configuration and efficiency of the motor, the maximum output of the controller will be achieved from 8.5-9.5 VDC (~15-19 ma) control input.

Manual Control: If manual control is required at any time for testing an installation during commissioning, remove the blank end plate, switch the **SEL** switch to **MAN** (left). This disconnects the control input on terminal B and selects the internal 0 – 10 VDC reference. The **MAN** pot will now be available for varying the internal control signal between OFF and 100% (0-10 VDC). When finished, remember to switch the **SEL** switch back to AUTO to reconnect the signal source. Monitor the control signal on the "SIG" pins (0 – 10 VDC)





Calibration adjustment: The standard factory settings are optimal for most loads and usually adequate for most fans. Most BMS controllers can easily take account of different loads. If custom calibration is necessary, set-up potentiometers (pots) are provided behind the blank panel opposite the terminal end. These pots may be horizontal or vertical adjusting. The adjusting end of the PCB is free of mains potential voltages within the "safe area" shown 30-60mm. If the installation requires fine tuning for the particular motor or if the controller is required to operate over a narrow region of speeds, then two simple adjusting pots are provided – **MAX** and **MIN**. These adjust the span and offset. Please note that the factory calibration is marked on the pots with a black line so its easy to get back to this calibration. An internal variable control signal is provided via the **SEL** switch and adjustable via the **MAN** pot and its operation is described above.

CALIBRATION PROCEDURE

Controller to be connected to motor with normal load. Remove end faceplate. DC & AC voltmeters required.

1. Connect DC voltmeter (0-10VDC) to **SIG** test pins. Connect AC voltmeter (300 VAC) to **Mm / Mc** terminals.
2. Set **SEL** switch to **MAN**. This disconnects the control signal and connects the internal 0-10 VDC source.
3. What are your control voltages for desired maximum and minimum motor speeds? You will need to know these!
4. Advance **MAN** pot until maximum control voltage required is shown on DC voltmeter – eg say ~9V.
5. Adjust **MAX** speed pot for desired maximum motor speed eg AC voltmeter across Mm and Mc – eg say 220 – 235V AC
6. Decrease **MAN** pot setting to minimum control voltage on DC voltmeter – eg say ~1V.
7. Adjust **MIN** speed pot for desired minimum motor speed eg AC voltmeter across Mm and Mc – eg say 120V.
8. Set **SEL** switch to AUTO. Remove voltmeters.
9. Replace end plate. The controller is ready for operation.
11. For current control input (2 - 20 ma) fit **OPT 2 LINK**. Please note that the voltage on the SIG pins will still be 0-10 VDC which is directly proportional to 0 - 20 ma. The sink between terminals B & C is 500 ohms. It is an easy calculation to determine what voltage represents a particular current.

CAUTION: Do not attempt to adjust the other potentiometers marked SC, SH, SL if fitted. They are used for temp probes and other interfaces and are factory set.

How does one know if the controller is wired up correctly and the motor is suitable for speed control? Generally for resistive and transformer loads, the current draw should decrease linearly with decreasing output. For PSC motors, the current should drop with decreasing speed. A simple test of whether a PSC motor is suitable for speed control is to wire it up in a 3-wire configuration. The current draw at any speed setting (50 – 100%) should never exceed the nameplate maximum current for the motor. If it does, the motor should not be speed controlled. In general, whether 2 or 3-wire, the current draw should decrease with decreasing speed. What's better – 2-wire or 3-wire? Generally, for smaller PSC motors <100 watt, the difference may be small. However, usually for motors >150 watt the 3-wire is optimal. For all Fantech fans > 100W the 3-wire configuration is mandatory. For smaller fans <100W, the cut-down model VA3.0 (up to 600 VA), which operates in a 2-wire configuration, can be considered.

Problem Oops – the fuse blows. Something is wrong! Check your wiring. Check the motor insulation resistance by meggering. You should be checking everything before switching ON! The likelihood of an error is very high if you don't check! The internal wiring of PSC motors can be confusing, particularly with a plethora of wire colours that don't conform to any common standard. The common winding can be in the active or neutral lines and for some motors rotation direction can be changed by reversing certain connections. Check the current draw and don't ignore or compromise on a slightly abnormal reading – find a reason.

SAFETY Always isolate the controller / motor OFF via the feed MCB or isolator before working on any wiring. NEVER rely on the auto OFF standby for isolation.

Confused / Need Help? Please contact Fantech or your agent for advice & assistance if you are unsure of any aspect of installation, wiring or operation.

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GOODS AND WARRANTY

1. When supplying goods to a consumer, the following mandated statement applies:
   "Our goods come with guarantees that cannot be excluded under the Australian Consumer Law. You are entitled to a replacement or refund for a major failure and for compensation for any other reasonably foreseeable loss or damage. You are also entitled to have the goods repaired or replaced if the goods fail to be of acceptable quality and the failure does not amount to a major failure."

2. The benefits of this warranty are in addition to any rights and remedies imposed by Australian State and Federal legislation that cannot be excluded. Nothing in this warranty is to be interpreted as excluding, restricting or modifying any State or Federal legislation applicable to the supply of goods and services which cannot be excluded, restricted or modified.

3. Subject to the conditions and limitation below, the Company warrants products of its manufacture to be free of defects in workmanship and/or materials at the time of delivery to the Buyer.

4. Any part, assembly or portion thereof found to be defective within one year from the date of commissioning or eighteen (18) months from date of shipment from our factory, whichever is the sooner, unless expressly stated otherwise in the Company's Publications or Literature, will be repaired or exchanged F.O.B factory.

5. The Company reserves the right to replace defective parts of the goods with parts and components of similar quality, grade and composition where an identical component is not available.

6. Goods presented for repair may be replaced by refurbished goods of the same type rather than being repaired. Refurbished parts may be used to repair the goods.

7. Goods or parts that have been returned for repair (except where the repair is as a result of the Company's failure to comply with the statutory guarantees in the ACL) or warranty assessment are deemed to have been abandoned by the Buyer if not collected within 30 days after the Company has notified the Buyer in writing of the warranty assessment outcome or the completed repair.

8. The Company reserves the right to dispose or otherwise deal with an abandoned product or part at its discretion.

9. This warranty does not apply if:
   (i) the goods have not been paid for by the Buyer as per the credit terms provided; or
   (ii) the goods have not been installed in accordance with AS NZS 3000/2000 Australian/New Zealand Wiring rules; or
   (iii) the goods have been misused or neglected.

10. The Company assumes no responsibility under this warranty for the labour costs involved in the removal of defective parts, installation of new parts or service charges related thereto.

11. If a fault covered by this warranty occurs, the Buyer must first contact the Company at the contact address listed below.

12. Any warranty claim must be accompanied by:
    (i) proof of purchase;
    (ii) written details of the alleged defect; and
    (iii) appropriate documentation (such as installation and maintenance records etc).

13. The Company shall have the option of requiring the return of the defective part (transportation prepaid by the Buyer) to establish the claim.

14. The Company makes no warranties or representations other than set out in this clause 7.

15. The repair or exchange of the goods or part of the goods, is the absolute limit of the Company's liability under this express warranty.

FANTECH
Intelligent Ventilation

Fantech Contacts

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