



CONTROL PANEL - 50Hz





## GENERAL DATA

### TORMAC CONTROL PANELS > TM - SERIES

Tormac Control panels are widely used to start, monitor, control & protect the Pumpsets which are used to pump the water from underground & surface. During start up motors develop currents of up to approximately 6-8 times the rated current and high torque linked to this. The high starting currents often lead to voltage drop in the supply network and high starting torque put the mechanical elements under considerable strain. Therefore it is must to limiting values for the motor starting currents in relation to the rated operational currents. The permissible values vary from network to network and depend on its load bearing capacity. With regards to mechanics, methods are required which reduce starting high currents. At the same time motor functioning to be monitored & protected against supply faults and application failures. Considering above criteria Tormac control panels are specially designed to facilitate complete protection for pumpsets against faulty current & voltage. Our Panels are designed to monitor and protect motors against,

- Overloading
- Under current
- Over voltage / Under voltage
- Phase failure / Phase unbalance / Phase Reversal
- Dry Running
- Short circuit
- Surge current

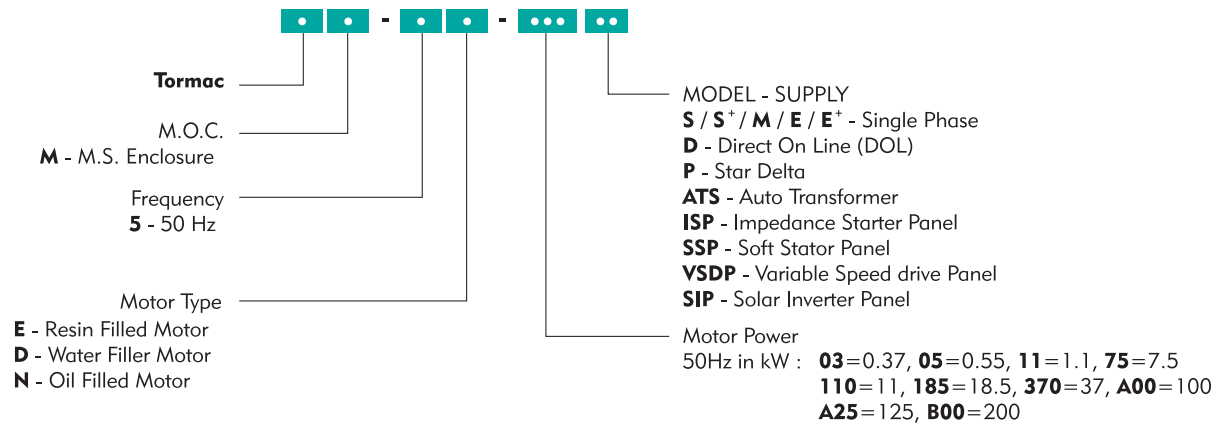
Various types of control panels are designed by Tormac as below based on the motor design and application requirements;

1. Direct On Line starter panel (**DOL**)
  - 1-Phase (220 / 230 V)
  - 3- Phase (380 - 415 V)
2. Star Delta starter panel (**SD**)
3. Auto Transformer starter Panel (**ATS**) / Impedance Starter Panel (**ISP**)
4. Electronic Soft starter Panel (**SSP**)
5. Variable Speed Drive starter Panel (**VSDP**)

In addition to the above control panels Tormac is supporting solar control panel which operates the Ac pumpsets on solar power.

6. Solar Inverter Control panels (**SIP**)

## Model Designation > CONTROL PANEL



## Single Phase Control Box (220 / 230 V)

### S – Type



### S+ – Type



### M – Type



\* Company reserve the rights to modify the technical specifications & Illustrations without notice.

\* Schematics are just for models only. Company may change the designs without notice at any part of time.

## Single Phase Control Box (220 / 230 V)

### S – Type

S - Type of control box are designed to support starting of 1 Phase Oil filled submersible motors (3 wire) provided with Capacitor Start Run (CSR) type. It is designed with Overload protection, ON/OFF switch in a sheet steel enclosure / Plastic enclosure.

kW	HP	PANEL MODEL	MATERIAL DESCRIPTION
0.37	0.50	TM-5N-03S	S - Type control box consists of Start Run capacitor, Over load protector, PVC connector, ON / OFF switch, in a powder coated sheet steel enclosure / Plastic enclosure
0.55	0.75	TM-5N-05S	
0.75	1.00	TM-5N-07S	
1.10	1.50	TM-5N-11S	
1.50	2.00	TM-5N-15S	

\* Suitable for 1 Phase Oil filled motors.

### S<sup>+</sup> – Type

S<sup>+</sup> - Type control box are designed to support starting of 1 Phase Oil filled / Water filled / Resin filled submersible motors (3 wire) provided with Capacitor Start Capacitor Run (CSCR) type. It is designed with Overload protection, Quick Disconnect or (QD) relay for starting-capacitor switching in a sheet steel enclosure / Plastic enclosure.

kW	HP	PANEL MODEL	MATERIAL DESCRIPTION
0.37	0.50	TM-5D-03S <sup>+</sup>	S <sup>+</sup> - Type control box consists of start capacitor, Run capacitor, QD relay, Over load protector, PVC connector in a powder coated sheet steel enclosure/ Plastic enclosure.
0.55	0.75	TM-5D-05S <sup>+</sup>	
0.75	1.00	TM-5D-07S <sup>+</sup>	
1.10	1.50	TM-5D-11S <sup>+</sup>	
1.50	2.00	TM-5D-15S <sup>+</sup>	

\* Suitable for 1 Phase Oil Filled / Water Filled / Resin Filled Motors

### M – Type

M - Type of control box are designed to support starting of 1 Phase Oil filled / Water filled / Resin filled submersible motors (3 wire) provided with Capacitor Start Capacitor Run (CSCR) type. It is designed with MCB incomer, ON / OFF selector switch, Quick Disconnect (QD) relay for starting-capacitor switching in a sheet steel enclosure / Plastic enclosure.

kW	HP	PANEL MODEL	MATERIAL DESCRIPTION
0.37	0.50	TM-5D-03M	M - Type control box consists of main incomer MCB, start capacitor, Run capacitor, QD relay, ON / OFF switch, PVC connector, Fitted in a powder coated sheet steel enclosure / Plastic enclosure.
0.55	0.75	TM-5D-05M	
0.75	1.00	TM-5D-07M	
1.10	1.50	TM-5D-11M	
1.50	2.00	TM-5D-15M	

\*Suitable for 1 Phase Oil Filled / Water Filled / Resin Filled Motors

## Single Phase Control Panel (220 / 230 V)

### E – Type

E - Type of control panels are designed to support starting of 1 phase Oil filled / Water panel monitoring indications & Trip indications. It is a manual starting type in a sheet filled / Resin filled submersible motors / Electrical Induction motors (3 wire) provided with Capacitor Start Capacitor Run (CSCR) type. It is designed with MCB Incomer, ON / OFF Push buttons, power contactors, Electronic pump protection relays with steel enclosure with lock & key.



kW	HP	PANEL MODEL	MATERIAL DESCRIPTION
0.37	0.50	TM-5D-03E	E - Type control panel consists of Start capacitor, Run capacitor, Main incomer MCB, Power Contactor, Electronic Pump protection relay for overload & Dry run protection, Current transformer, ON / OFF push button, Fault indication lamp, PVC connector, Voltmeter & Ammeter in a powder coated sheet steel enclosure with lock & key.
0.50	0.75	TM-5D-05E	
0.75	1.00	TM-5D-07E	
1.10	1.50	TM-5D-11E	
1.50	2.00	TM-5D-15E	
2.20	3.00	TM-5D-22E	

\*Suitable for Oil Filled / Water Filled / Resin Filled Motors

### E<sup>+</sup> - Type (Fully Automatic)

Fully Automatic E<sup>+</sup> - Type of control panels are designed to support starting of 1 phase - 3 wire Oil filled / Water filled / Resin filled submersible motors / Electrical Induction motors provided with Capacitor Start Capacitor Run (CSCR) type. It is a Fully Automatic operation design with MCB incomer, ON / OFF Push buttons, power contactor, ON delay timer, Thermal Overload relays with panel monitoring indications & Trip Indications in a sheet steel enclosure with lock & key.

It supports both manual and automatic operations. When connected with float switch, in Manual mode pump switching off will happens automatic in connection with float operation. In Auto mode pump switching ON and OFF will happens automatic in connection with the float operation.



kW	HP	PANEL MODEL	MATERIAL DESCRIPTION
0.37	0.50	TM-5D-03E+	Fully automatic E <sup>+</sup> - Type control panel consists of incomer MCB, Start capacitor, Run capacitor, Power Contactor, Thermal overload relay, ON delay Timer, ON / OFF push button, AUTO / MANUAL Selector Switch, Provision for float switch connection, fault indication lamp, PVC connector, Volt meter & Ammeter in a powder coated sheet steel enclosure with lock & key.
0.50	0.75	TM-5D-05E+	
0.75	1.00	TM-5D-07E+	
1.10	1.50	TM-5D-11E+	
1.50	2.00	TM-5D-15E+	
2.20	3.00	TM-5D-22E+	

\*Suitable for Oil Filled / Water Filled / Resin Filled Motors.

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## Direct Online Control panel (DOL) > 3 Phase Panels (380 / 415 V)

### D - Type (Fully Automatic)



D - Type of control panels are designed to support starting of 3 phase-3 wire Oil Filled / Water Filled / Resin filled submersible motors / Electrical Induction motors. It's an Auto / manual operation design with MCB incomer, ON / OFF Push buttons, power contactor, Electronic pump protection relay, ON delay timer, Surge protectors, trip indication and panel monitoring indications in a sheet steel enclosure with lock & key.

#### Features of DOL panels:

- It supports both manual and automatic operations. When connected with float switch, in Manual mode pump switching off will happen automatic in connection with float operation. In Auto mode both pump switching ON and OFF will happen automatic in connection with the float operation.
- It's provided with ON delay timer which functions in Auto mode to make delay start during power failure & fault Tripping, this prevents the system from high voltage fluctuations.
- All panel components are of leading brands, assembled in a detachable base plate & most of them are rail mounting type for easy maintenance and component portability.
- It's provided with surge protectors which protects the panel from high surge & faulty supply.
- It's provided with dedicated power, control & Earth terminals for easy cable connections.
- Panels are provided with proper earthing terminals.
- All control wirings carry numbering ferules for easy tracking during faults and servicing.
- Enough space provided on all sides inside the panel for easy accessing the components & doing the connections; gap between individual components make sure proper cooling.
- All panel doors come with Foaming gasket for dust protections. Doors are wide opening atleast 120°angle.

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## Star Delta Control panel (SD) > 3 Phase Panels (380 / 415 V)

### P- Type (Fully Automatic)



P - Type of control panels are designed to support starting of 3 phase-6 wire submersible / Electrical Induction motors. It's an Auto / manual operation design with MCB/ MCCB incomer, ON / OFF Push buttons, power contactors, Electronic pump protection relay, ON delay timer, Surge protectors, phase-phase voltage and current monitoring provision, trip indication and panel monitoring indications in a sheet steel enclosure with lock & key.

#### Features of SD Panels:

- It supports both manual and automatic operations. When connected with float switch, in Manual mode pump switching off will happen automatic in connection with float operation. In Auto mode both pump switching ON and OFF will happen automatic in connection with the float operation.
- It's provided with ON delay timer which functions in Auto mode to make delay start during power failure & Tripping, this prevents the system from high voltage fluctuations.
- All panel components are of leading brands, assembled in a detachable base plate & most of them are rail mounting type for easy maintenance and component portability.
- It's provided with surge protectors which protect the panel from high surge & faulty supply.
- It's provided with dedicated power, control & Earth terminals for easy cable connections.
- Panels are provided with proper earthing terminal.
- All control wirings carry numbering ferules for easy tracking during faults and servicing.
- Enough space provided on all sides inside the panel for easy accessing the components & doing the connections; gap between individual components make sure proper cooling.
- All panel doors come with Foaming gasket for dust protections. Doors are wide opening at least 120° angle.
- All panels upto 30 kW ratings are with Analog Voltmeter & Ammeter, above ratings are with digital meters.

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## Electrical Data > D - Type & P - Type

kW	HP	PANEL MODEL*		MATERIAL DESCRIPTION
		D - Type (DOL)	P - Type (DOL)	
0.37	0.50	TM-5D-03D	-	<p><b>D - Type - (DOL)</b> Fully Automatic D-Type control panel consists of main incomer (MCB / MCCB), Power contactor, Electronic Pump protection relay, (Over load, Under load, Over voltage, Under voltage, Dry run, Phase failure, Phase unbalance, Phase reversal protections) Current Transformer, Surge protection, Short circuit protection, Fault Indication lamp, ON / OFF push button, Auto / Manual selector switch, ON Delay timer, Voltmeter, Ammeter, Provision for water level controller, External terminals, all mounted in a powder coated sheet steel enclosure with lock &amp; key.</p> <p><b>P - Type - (SD)</b> Fully Automatic P-Type control panel consists of main incomer (MCB / MCCB), Power contactor, Pump protection relay, (Over load, Under load, Over voltage, Under voltage, Dry run, Phase failure, Phase unbalance, Phase reversal protections) Current Transformer, Surge protection, Short circuit protection, Fault Indication lamp, ON / OFF push button, Auto / Manual selector switch, ON Delay timer, Voltmeter, Ammeter, Provision for water level controller, External terminals, all mounted in a powder coated sheet steel enclosure with lock &amp; key.</p>
0.50	0.75	TM-5D-05D	-	
0.75	1.00	TM-5D-07D	-	
1.10	1.50	TM-5D-11D	-	
1.50	2.00	TM-5D-15D	-	
2.20	3.00	TM-5D-22D	-	
3.30	4.00	TM-5D-30D	-	
3.70	5.00	TM-5D-37D	-	
4.00	5.50	TM-5D-40D	-	
5.50	7.50	TM-5D-55D	TM-5D-55P	
7.50	10.00	TM-5D-75D	TM-5D-75P	
9.30	12.50	TM-5D-93D	TM-5D-93P	
11.00	15.00	TM-5D-110D	TM-5D-110P	
13.00	17.50	TM-5D-130D	TM-5D-130P	
15.00	20.00	TM-5D-150D	TM-5D-150P	
18.50	25.00	TM-5D-185D	TM-5D-185P	
22.00	30.00	TM-5D-220D	TM-5D-220P	
26.00	35.00	TM-5D-260D	TM-5D-260P	
30.33	40.00	TM-5D-300D	TM-5D-300P	
37.00	50.00	TM-5D-370D	TM-5D-370P	
45.00	60.00	TM-5D-450D	TM-5D-450P	
55.00	75.00	TM-5D-550D	TM-5D-550P	
63.00	85.00	TM-5D-630D	TM-5D-630P	
75.00	100.00	TM-5D-750D	TM-5D-750P	
93.00	125.00	TM-5D-930D	TM-5D-930P	
110.00	150.00	-	TM-5D-A10P	
130.00	175.00	-	TM-5D-A30P	
150.00	200.00	-	TM-5D-A50P	
165.00	225.00	-	TM-5D-A65P	
185.00	250.00	-	TM-5D-A85P	

\* Higher rating panels are supported on specifications.

\* Panel customisation can be done on request.

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\* All the components used are as per the submersible electrical motor standards only.

## **Auto Transformer Starter panels (ATS) / Impedance Starter Panels (ISP):**

This type of control panels are designed to support starting of higher rating 3 phase-3 wire submersible / Electrical Induction motors with a reduced starting currents & Voltages.



### **Auto Transformer Starter panels (ATS):**

It's an Auto / Manual operation design panel with MCB/ MCCB incomer, Auto transformer with tapings, ON / OFF Push buttons, power contactors, Electronic pump protection relay, ON delay timer, phase-phase voltage and current monitoring provision, trip indication and panel monitoring indications in a sheet steel enclosure with lock & key.

During start up the motor is connected to the auto transformer's tapings. This means the motor start up with the reduced voltage and correspondingly low current. The auto transformer reduces the current in the mains supply line further and in accordance with its ratio. Like the star delta connection, the auto transformer starter has a favourable torque-current take up ratio.

In order to adapt the motor start characteristics to the torque requirement, auto transformers are usually equipped with three selectable tapings (50%, 65%, 80%).

When the motor has almost reached its rated torque, the star connection on the transformer is opened. The transformer's partial windings act as chokes in series to the motor windings and therefore like an uninterrupted star delta connection, the motor speed does not drop during switch over. After the main contactor has been switched in, the motor windings are applied to the full mains voltage. Finally the transformer is disconnected from the mains.

### **Impedance Starter Panels (ISP)**

Impedance starter panel employs Harmonic free series reactors in place of transformers, which supports motor start up with the reduced voltage and correspondingly low current. The reactors are selected based on the motor ratings so as to provide enough starting torque with reduced starting currents.

It's an Auto / Manual operation design with MCB/ MCCB incomer, Harmonic free series reactors, ON / OFF Push buttons, power contactors, Electronic pump protection relay, ON delay timer, phase-phase voltage and current monitoring provision, trip indication and panel monitoring indications in a sheet steel enclosure with lock & key.

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## Electrical Data > ATS / ISP

kW	HP	PANEL MODEL		MATERIAL DESCRIPTION
		ATS	ISP	
5.50	7.50	TM-5D-55ATS	TM-5D-55ISP	<b>ATS / ISP</b> Fully automatic ATS / ISP panel consists of 3 step starting Auto transformer / Reactor, Main incomer (MCCB), Power contactors, Electronic pump protection relay (Over load, Under load, Over voltage, Under voltage, Dry run, Phase failure, Phase Unbalance, Phase reversal protectors). Short circuit protection, Fault indication lamp, ON / OFF push button, AUTO/MANUAL selector switch, ON delay timers, Provision for water level controller, Voltmeter with 3 phase volt selector Ammeter with 3 Phase current selector switch, External power terminals mounted in a powder coated sheet steel enclosure with lock & key.
7.50	10.00	TM-5D-75ATS	TM-5D-75ISP	
9.30	12.50	TM-5D-93ATS	TM-5D-93ISP	
11.00	15.00	TM-5D-110ATS	TM-5D-110ISP	
13.00	17.50	TM-5D-130ATS	TM-5D-130ISP	
15.00	20.00	TM-5D-150ATS	TM-5D-150ISP	
18.50	25.00	TM-5D-185ATS	TM-5D-185ISP	
22.00	30.00	TM-5D-220ATS	TM-5D-220ISP	
26.00	35.00	TM-5D-260ATS	TM-5D-260ISP	
30.33	40.00	TM-5D-300ATS	TM-5D-300ISP	
37.00	50.00	TM-5D-370ATS	TM-5D-370ISP	
45.00	60.00	TM-5D-450ATS	TM-5D-450ISP	
55.00	75.00	TM-5D-550ATS	TM-5D-550ISP	
63.00	85.00	TM-5D-630ATS	TM-5D-630ISP	
75.00	100.00	TM-5D-750ATS	TM-5D-750ISP	
93.00	125.00	TM-5D-930ATS	TM-5D-930ISP	
110.00	150.00	TM-5D-A10ATS	TM-5D-A10ISP	
130.00	175.00	TM-5D-A30ATS	TM-5D-A30ISP	
150.00	200.00	TM-5D-A50ATS	TM-5D-A50ISP	
166.00	225.00	TM-5D-A66ATS	TM-5D-A66ISP	
185.00	250.00	TM-5D-A85ATS	TM-5D-A85ISP	
220.00	300.00	TM-5D-B20ATS	TM-5D-B20ISP	

\* Higher rating panels are supported on specifications

\* Panel customisation can be done on request

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\* All the components used are as per the submersible electrical motor standards only.

### Features of ATS / ISP Panels :

- It supports high starting torques at reduced voltage and starting currents.
- It supports both manual and automatic operations. When connected with float switch, in Manual mode pump switching off will happens automatic in connection with float operation. In Auto mode both pump switching ON and OFF will happens automatic in connection with the float operation.
- Transformers are of copper wound heavy duty type with 3 selectable tapings.
- All panel components are of leading brands, assembled in a detachable base plate & most of them are rail mounting type for easy maintenance and component portability.
- It's provided with dedicated power, control & Earth terminals for easy cable connections.
- Panels are provided with proper earthing.
- All control wirings carry numbering ferules for easy tracking during faults and servicing.
- Enough space provided on all sides inside the panel for easy accessing the components & doing the connections; gap between individual components make sure proper cooling.
- All panel doors come with Foaming gasket for dust protections. Doors are wide opening atleast 120° angle.

## Soft Starter Panels (SSP)



This type of control panels are designed to support starting 3 phase - 3 wire submersible / Electrical Induction motors with a smooth starting curve with reduced starting currents & Voltages.

A soft starter is an electronic device that regulates the supply voltage to the motor and this provides smooth transition from standstill to full speed operation. Soft starter starts a motor by modifying the voltage waveform. Waveforms refer to the shape and form of a wave generated by voltage, or the electrical force that drives a current between two points. Soft starters gradually increase the level of voltage transmitted to the motor until the motor reaches full voltage capacity and speed.

### Features of Soft Starter Control Panels

- Tormac soft starter panels are designed with ABB / Equivalent brand soft starters with latest technologies and are fitted with Filters to reduce the harmonics and to minimise the output supply voltage drop to the pumpsets.
- Smooth starting by torque control for gradual acceleration of the drive system thus preventing jerks and extending the life of mechanical components.
- Reduction in starting current to achieve break-away and to hold back the current during acceleration, to prevent mechanical, electrical, thermal weakening of the electrical equipment such as motors, cables, transformers & switch gears.
- Enhancement of motor starting duty, by reducing the temperature rise in stator windings and supply transformer.
- The power factor improvement is a self monitoring in built feature. When the motor is running at less than full load, the comparative reactive component of current drawn by the motor is unnecessarily high due to magnetizing and associated losses. Hence the voltage dependent losses are minimized with the load proportional active current component and as a result the power factor also improves simultaneously
- All components are equipped in a powder coated sheet steel enclosures with proper cooling arrangements.

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## Variable Speed Drive Panels (VSDP)



This type of control panels are designed to support starting 3 phase -3 wire submersible / Electrical Induction motors with a smooth starting curve with reduced starting currents & Voltages. It works on the principle of varying the frequency and voltage supplied to the electric motor.

Frequency (hertz) is directly related to the motor's speed (RPMs). In other words, the faster the frequency, the faster the RPMs go. If an application does not require an electric motor to run at full speed, the VFD can be used to ramp down the frequency and voltage to meet the requirements of the electric motor's load. As the application's motor speed requirements change, the VFD can simply turn up or down the motor speed to meet the speed requirement.

### Features of VSD Control Panels :

- Tormac VSD control panels are designed with ABB / Equivalent brand VSD with latest technologies
- Saves energy based on the RPM settings and therefore reduces energy costs
- No output transformer necessary. High input power factor, low harmonic current, no power factor correction capacitors and harmonic filters required.
- Modular design of the power circuits for simpler maintenance routines.
- Support for standard communication protocols (Modbus, Profibus, DeviceNet, TCP/ IP etc.)
- All components are equipped in a powder coated sheet steel enclosures with proper cooling arrangements.

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## Electrical Data > Soft Starter & VSD Panels

kW	HP	PANEL MODEL		MATERIAL DESCRIPTION
		SS	VSD	
0.37	0.50	TM-5D-03SS	TM-5D-03VSD	<p><b>Fully automatic Soft Starter panel</b></p> <p>Fully automatic Soft Starter panel consists of ABB/Equivalent make soft starter. Main incomer MCCB, Bye pass contactor, Pump protection relay (OL, UL, OV, UV, DR, PF, PU, PR Protections), ON/OFF push button, AUTO/MANUAL Selector switch fault indications, voltmeter with 3 phase volt selector switch, Ammeter with 3 phase current selector switch, PVC terminals in a powder coated sheet steel enclosure with lock &amp; key.</p> <p><b>Variable speed drive panel</b></p> <p>Variable frequency drive consists of ABB/Equivalent make VFD. Main incomer MCCB, Bye pass contactor, Pump protection relay (OL, UL, OV, UV, DR, PF, PU, PR Protections), ON/OFF push button, AUTO/MANUAL Selector switch fault indications, Voltmeter with 3 phase volt selector switch, Ammeter with 3 phase current selector switch, PVC terminals in a powder coated sheet steel enclosure with lock &amp; key.</p>
0.50	0.75	TM-5D-05SS	TM-5D-05VSD	
0.75	1.00	TM-5D-07SS	TM-5D-07VSD	
1.10	1.50	TM-5D-11SS	TM-5D-11VSD	
1.50	2.00	TM-5D-15SS	TM-5D-15VSD	
2.20	3.00	TM-5D-22SS	TM-5D-22VSD	
3.30	4.00	TM-5D-30SS	TM-5D-30VSD	
3.70	5.00	TM-5D-37SS	TM-5D-37VSD	
4.00	5.50	TM-5D-40SS	TM-5D-40VSD	
5.50	7.50	TM-5D-55SS	TM-5D-55VSD	
7.50	10.00	TM-5D-75SS	TM-5D-75VSD	
9.30	12.50	TM-5D-93SS	TM-5D-93VSD	
11.00	15.00	TM-5D-110SS	TM-5D-110VSD	
13.00	17.50	TM-5D-130SS	TM-5D-130VSD	
15.00	20.00	TM-5D-150SS	TM-5D-150VSD	
18.50	25.00	TM-5D-185SS	TM-5D-185VSD	
22.00	30.00	TM-5D-220SS	TM-5D-220VSD	
26.00	35.00	TM-5D-260SS	TM-5D-260VSD	
30.33	40.00	TM-5D-300SS	TM-5D-300VSD	
37.00	50.00	TM-5D-370SS	TM-5D-370VSD	
45.00	60.00	TM-5D-450SS	TM-5D-450VSD	
55.00	75.00	TM-5D-550SS	TM-5D-550VSD	
63.00	85.00	TM-5D-630SS	TM-5D-630VSD	
75.00	100.00	TM-5D-750SS	TM-5D-750VSD	
93.00	125.00	TM-5D-930SS	TM-5D-930VSD	

\* Higher rating panels are supported on specifications.

\* Panel customisation can be done on request.

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\* All the components used are as per the submersible electrical motor standards only.



## Solar Inverter Control Panels (SIP) :



This type of control panels are designed to operate motors with energy drawn from photovoltaic cells (PV). The inverter is customized to operate in dual supply mode, so the grid connected supply is used in the absence of energy from PV cells. A four-pole changeover switch enables switching between the two supply modes.

It's a fully electronic type of control panel fitted with ABB / Equivalent make inverter which starts automatically if current DC bus voltage is more than the start DC voltage set in parameter. The inverter functions with the latest in technology maximum power point tracking (MPPT) algorithm to derive maximum power from the PV cells at any instant. The working principle is closely related with the VSD panels.

### Features of Solar Inverter Control Panels:

- It's an automatic design functions based on the DC input voltage from the solar modules.
- Customised to operate in dual power mode, Solar / Grid supply.
- Complete motor protections in both the modes against supply faults.
- Modular design of the power circuits for simpler maintenance routines.
- Support for standard communication protocols (Modbus, Profibus, Device Net, TCP/ IP etc.)
- All components are equipped in a powder coated sheet steel enclosures with proper cooling arrangements.

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## Comparison: Soft starter and Auto Transformer starter

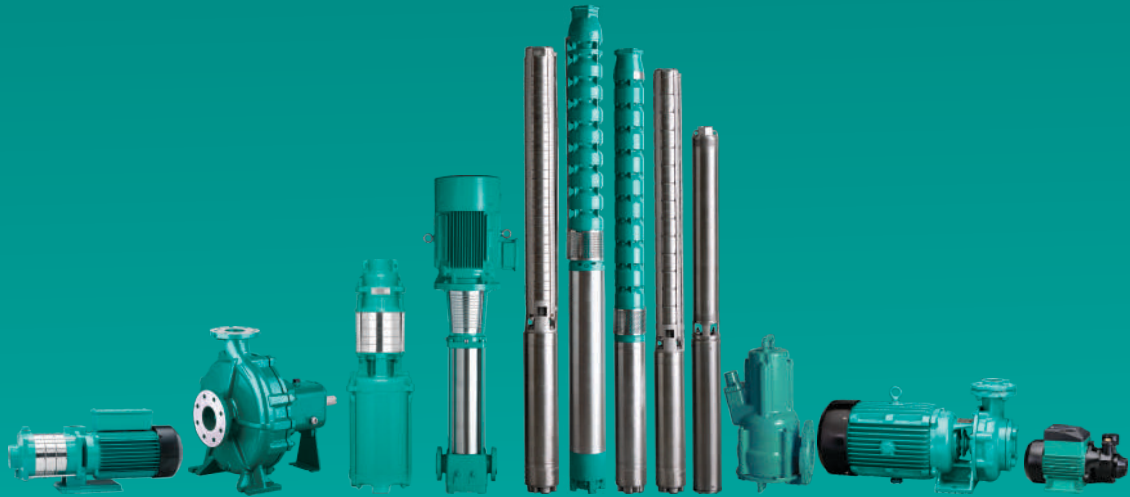
Soft starter	Auto Transformer starter
<p>Soft Starter Voltage applied to the motor terminal is in a smooth curve and continuous, hence there won't be any mechanical jerks during starting.</p>	<p>Voltage applied to the motor terminals is in step manner and not continuous. Hence, voltage flickers and mechanical jerks are a part of auto transformer starting.</p>
<p>As the starting curve is smooth, there won't be any chances for spikes.</p>	<p>A very dangerous spike is experienced by the system during starting.</p>
<p>Soft starting and soft stopping avoids back thrust on the NRV or the pipe line which is therefore protected against the back thrust during switching OFF.</p>	<p>Such a protection is not provided and therefore, proper operation of the valves is absolutely essential.</p>
<p>No electrical moving contacts and no oil hence no sparking and hazards.</p>	<p>Circuitry consists of several moving parts and hence sparking is unavoidable.</p>
<p>No limitations on the No. of starts and No. of stops per hour.</p>	<p>Limited No of starts and stops per hour because of: motor windings getting heated.</p>
<p>Acceleration time for motor to speed up from rest to rated full speed can be adjustable from 2 secs to 90 secs. This will facilitate selection of appropriate ramp times to suit the desired load/ torque requirements.</p>	<p>Such a facility is not available with conventional timers used in this method of starting.</p>
<p>Inrush (starting) current restricted to 200% of rated full load current (FLC).</p>	<p>Inrush current restricted to maximum of 400% of the FLC.</p>
<p>Phase reversal, single phasing, overload, over voltage, under voltage and short circuit protections are inbuilt.</p>	<p>Phase reversal, single phasing, overload, over voltage, under voltage and short circuit protections are to be done with additional devices.</p>
<p>Current limit facility is available which limits the current drawn by the motor plus the load to a desired safe value.</p>	<p>This facility is not available.</p>

## Comparison: Soft Starter and Variable Speed Drive

Soft starter	Variable Speed Drive
<p>Soft Starters A Soft Starter works on the principle of RVSS (Reduced Voltage Soft Start).</p>	<p>A Variable Speed Drive (VSD) works on vector control method by controlling starting voltage as well as starting frequency through V/F control.</p>
<p>Soft starters are extremely useful in applications like Pumps, Screw Compressors where low starting torque is desired.</p>	<p>VSD can be used for variable torque applications (VT) like Pumps, Fans and Screw compressors as well as constant torque applications like Conveyors.</p>
<p>Though a soft starter is able to provide soft start, the acceleration time is dependent on the load as soft starter shall have low starting torque.</p>	<p>VSD can provide smooth ramp-up as it can maintain a constant starting torque.</p>
<p>A Soft Starter can be suitable only for constant speed applications.</p>	<p>In applications like Pumps and Fans, running them at speeds lower than rated speeds has its potential for energy saving.</p>
<p>Ramp Down Operation - Soft starters also have the facility for Soft stop wherein we can control deceleration time for Motors. This is useful in cases Pumps to avoid water hammer.</p>	<p>Ramp Down Operation - VSD also have the facility for Soft stop wherein we can control deceleration time for Motors. This is useful in cases Pumps to avoid water hammer.</p>
<p>Soft Starters are less expensive than VFD &amp; is small in size which reduces the panel cost.</p>	<p>VSDs are more expensive and are big in size.</p>







## T H E P O W E R B E H I N D T H E F O R C E

Naargo Industries Private Limited, one of the leading manufacturers of latest state of art, large range of pumps and motors, is managed by veterans who are in the pump industry for almost half a century. The products are employed in various applications like irrigation, domestic, civil construction, de-watering etc; The Company has a strong distribution network in India for sales & service and a strong global presence.

Quality is the key factor in Naargo's products. The expansive infrastructure and environment accredited with ISO 9001 quality certification, latest engineering softwares, high-tech machinery, futuristic pumping technology and high caliber workforce facilitate the production of flawless and efficient products on par with international standards under the brand name of "Tormac". The well equipped R & D wing stays alive to the changing global trends and comes out with viable solutions for innovative product development and upgradation.

The Products currently available include Stainless Steel Submersible Pumps, 4" Thermoplastic Submersible Pumps, 6" & 8" Cast Iron Submersible Pumps, Submersible Motors and Controls, Centrifugal Pumps, Inline Booster Pumps, Jet Self-priming Pumps and Peripheral Pumps.

The power, performance and endurance of the products backed by the uncompromising teamwork and value systems will certainly propel the company's growth towards new horizons in the pump industry.

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