

# I-Pump System Book

Refer I-Pump System Schematic.

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## **I-Pump System**

I-Pump from Autonomous Well is a flexible and complete gauge system for ESP wells. Available as component parts for third party gauge manufacture or on-site repair, as well as complete systems I-Pump is unmatched in practicality, cost of use and its diversity of measurements.

There are some choices to make when ordering I-Pump, and we do appreciate that there are more choices than just a 'Type'. We don't apologise for that - we don't apologise for supplying fit for purpose products that are upgradeable and serviceable for a long lifetime of active use.

Hopefully the information in this booklet will be enough to choose your system. If not, please contact us directly at [reception@a-well.com](mailto:reception@a-well.com) (full contact information on the back page).

## **Autonomous Well**

With a strong background in ESP projects and ESP control product design, Autonomous Well was founded by it's employees in 1998 to develop unique sensor and automation solutions for ESPs.

I-Pump was launched in mid-2002 using a PocketPC based display system, with the first units installed in September 2002. In late 2003 the Artificial Lift Controller replaced the PocketPC display. With the I-Pump product line we at Autonomous Well have driven down the cost of ESP monitoring whilst raising the benchmark of what should be expected by you, the Customer, from the surface unit. We are proud of that. But we are more proud of the track record of I-Pump.

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## Differences

You may be familiar with our competitor equipment and sometimes this creates a bit of confusion when upgrading to I-Pump, so we have listed out some of the frequently asked questions about our system versus others':

**One Coupler** - we have two couplers, one of which is always required and one which is an upgrade. This is different to Phoenix although ESPi have followed our lead in their products.

**Portable Data Collector** - we don't need these. All of our data is stored in Excel format onto Windows formatted compactFLASH cards which can simply be retrieved from the well (swapped out for a blank one) and read in your PC. For routine data gathering one compactFLASH card can be used to gather from multiple wells (upto 400 on one card).

**Specialist viewing software** - we don't need it as all of our data and event log files are CSV type and open in Excel.

**Cable Pack** - we don't need these as standard terminals and cabling is used throughout. We do supply boxes of 8kV wire for coupler hookup.

**Type 0 , 1, 2** - we don't have multiple models, instead having a base I-Pump that may be upgraded with discharge pressure and flow options. These options can be field or factory fitted.

**ISP vs. ISU** - basically these are the same product from our competitor, with a different screen and some parts removed in the ISU to sell to you as options. We have a different architecture where all sensor communications are handled by the Transceiver and one Transceiver is required per sensor. If you want to use your own logging and display unit this is all you require (It is a compact DIN mount unit). Our ALC is not really comparable to the ISP: we have compactFLASH and onboard logging, time/ level based alarms and trips, direct Excel logging, graphical display, automated pump flow and thrust determination, analog channels as standard, multiple SCADA ports.

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**Calibration Data** - there is no calibration key or data to be loaded, lost or confused from well to well. All I-Pump store and recalibrate their data before transmitting to surface. It is just simpler.

**Safe fusing** - we supply inline 5kV fuses so that all cable runs can be fused at the supply end. All our competitors fuse at the load end, a strange and incorrect practice.

**Metal shielded medium voltage components** - all our couplers are metal shielded. We do not use low voltage, plastic enclosures.

**Small, easily handled sensor** - at 635mm and 26kg it's almost half the length and weight of our competitor's equipment.

**Field serviceable** - sensor may be stripped and rebuilt in the field. We have designed out the need for return-to-base servicing.

**Choice of metallurgy and sealing** - all parts comes as 316SS/ Viton Sealing as standard.

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## Surface Systems

Although there are many choices to make with the surface hook-up:

- SCADA arrangement (if any),
- alarm and trip arrangement (if used),
- speed control (4-20mA or 0-10V, if used)
- compactFLASH logging regime (long term archive in ALC or regular gather),
- whether to use Autonomous Well HV wire or standard customer stock,
- whether to use the fuseCARTRIDGE or use existing switchboard or VSD HV fuses
- use ALC for automated pump flow and thrust calculations

the key initial purchasing choices are simple: Is a balanceCOUPLER Required?, Do I Need/ Want a Coupler Enclosure, and Do I Want an ALC?

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## Base System

A basic system comprises a starCOUPLER to connect to a system neutral and a Transceiver (the device that communicates with the sensor). There is no display and a 3rd party SCADA solution (or upgrade with an Artificial Lift Controller) is required.

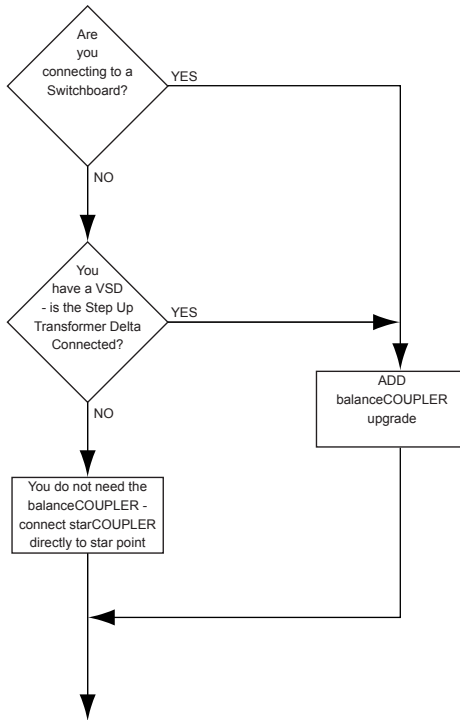
Part Number	Part Name	Multiple
PAW-0256	fuseCARTRIDGE	1
PAW-0277	8kV Instrument Wire	20m
PAW-0266	starCOUPLER	1
PAW-0155	I-Pump Transceiver	1

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## Add System Neutral

Where the system neutral is not available (e.g. switchboard and delta connected secondaries) you need to add a few high voltage parts to safely create one. If you already have enough 8kV wire then you won't need any more, and if your switchboard has fuses (<1A) on the downhole side (outgoing terminals) then you won't need the fuseCARTIDGES. An enclosure is optional (we recommend the coupler goes into the transformer terminal box or the switchboard HV area).



Part Number	Part Name	Multiple
PAW-0256	fuseCARTRIDGE	3
PAW-0277	8kV Instrument Wire	20m
PAW-0250	balanceCOUPLER	1
PAW-0297	Coupler Enclosure	1

**Note:** some customers use 3rd party supplied inductors rather than our balanceCOUPLER. This keeps cost down when they have stock of other gauge suppliers 3 phase chokes when replacing failed 3rd party units with I-Pump. You still need the starCOUPLER, but the 3 phase choke can be reused.

Do we recommend using 3rd party? Yes, and No! Yes, because you have stock and they obviously pass your safety criteria, and, to date, we have had no problem with these 3rd party units. No, because the balanceCOUPLER is the safest design of all available units, coming with grounding cover plates, and is manufactured and

tested to higher safety standards.

**Do I Want/Need a Coupler Enclosure?**

All our couplers are designed to mount inside the switchboard or step-up transformer high voltage area. It's the best place for them, reducing HV cabling and keeping all HV rated equipment in the same enclosure.

There are some instances where an enclosure is required (you just don't have enough room) and we can supply one. Alternatively, you can use a locally procured enclosure (we have some customers who mount the equipment in a wellhead junction box with the insulators removed).

Again this option just keeps costs down.

Do we recommend it? No, we recommend doing everything possible to fit the couplers into the enclosure that everyone knows is high voltage - the switchboard HV section or step-up transformer.

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## Upgrade to Artificial Lift Controller

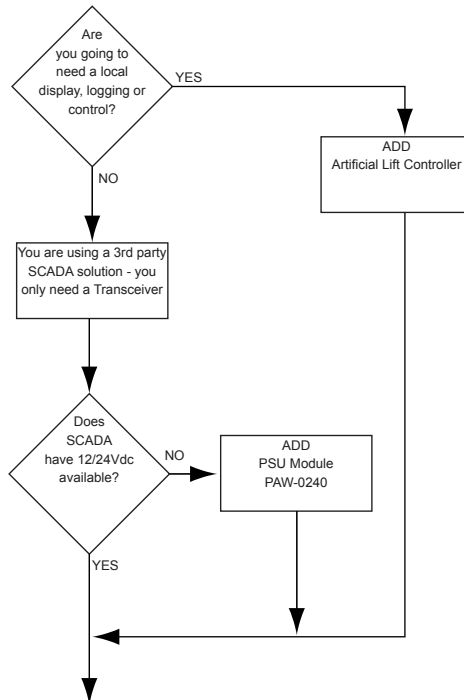
Artificial Lift Controller (ALC) is the Autonomous Well display, logging unit, and controller with alarm, trip, speed and choke control. It is not essential - it is the Transceiver Module which in fact talks to the sensor. The ALC simply gathers data from the Transceiver and uses it in a control scheme.

By adding the ALC (with a link cable and memory cards) you have a standalone solution with data logging, display, alarm/trip, speed control and a host of other functions. The ALC is supplied in a mild steel enclosure. Flash card readers (for PCMCIA/ laptop, and USB) are available although you won't need one per well.

For multi-well situations a single ALC can display, log and control multiple wells, although additional parts may be required (for example additional relay or analog modules). Discuss this with Autonomous Well if you think a multiwell solution would be better.

Some customers have excellent SCADA systems and do not see the need for the ALC. They gather all data from the Transceiver using Modbus RS485 protocol and display it via the field SCADA system. By not using the ALC the initial capital cost is reduced.

Remember, if an ALC is not supplied then you (the customer) require to provide a 12/24Vdc supply and SCADA hook up (RS485/ 232 Modbus RTU). Typically this is available from SCADA although modules are available from Autonomous Well.



Part Number	Part Name	Multiple
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<b>PAW-0288</b>	busLINK Cable	1
<b>PAW-0057</b>	Artificial Lift Controller [Rittal 1033.600]	1
<b>PAW-0285</b>	compactFLASH Card (recommend 2 per ALC)	1
<b>PAW-0299</b>	compactFLASH Reader [PCMCIA]	1
<b>PAW-0310</b>	compactFLASH Reader [USB]	1

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Do we recommend this solution? Yes, if you do not need local (well site) data access and your SCADA can provide adequate historical logging (a lot of SCADA systems have very poor logging capabilities).

**PN: Surface**

Part Number	Part Name	Specification
PAW-0256	<b>fuseCARTRIDGE</b> Inline 5kV fuse holder for protective fusing of supply (phase A, B, C) to balanceCOUPLER and wye point to starCOUPLER. Can be used with wire upto 2.5mm wire diameter or 10mm insulation diameter.	<b>Connection</b> Brass, M2.5 Hole with M2 Grub Screw <b>Fuse</b> Bussmann HVJ 1/8 <b>Voltage</b> 5kV <b>Construction</b> Nylon 66 <b>Environment</b> IP43
PAW-0277	<b>8kV Instrument Wire</b> Suitable for fuseCARTRIDGE and balanceCOUPLER or starCOUPLER hookup	<b>Type</b> PTFE <b>Voltage</b> 8kV <b>Conductor</b> 18AWG <b>Manufacturer</b> Axon <b>Part Number</b> 1819 SPC
PAW-0250	<b>balanceCOUPLER</b> Inductor package to create a system neutral/ star point for connection of I-Pump starCOUPLER. This part must be fused (available seperately or customer supply). Fuse at supply end, not load end. HV wire available seperately for connecting coupler to supply phases.	<b>Connection</b> to star/ neutral <b>Fuse</b> 1/8 A (Bussman HVJ 1/8) <b>Voltage</b> 3 kV rms max <b>Enclosure</b> not enclosed <b>Dimensions</b> 595 mmw x 380 mmh x 365 mmd <b>Weight</b> 10 kg <b>Temperature</b> -40 to 85 C
PAW-0266	<b>starCOUPLER</b> Coupling unit to connect the I-Pump Transceiver to the 3-phase supply to the ESP. This part must be fused (available seperately). Fuse at supply end, not load end. HV wire available seperately (required to connect to wye/ star point or balanceCOUPLER, both via inline 5kV fuse).	<b>Connection</b> to star/ neutral <b>Fuse</b> 1/8 A (Bussman HVJ 1/8) <b>Voltage</b> 3 kV rms max <b>Enclosure</b> not enclosed <b>Dimensions</b> 150 mmw x 335 mmh x 197 mmd <b>Weight</b> 10 kg <b>Temperature</b> -40 to 85 C
PAW-0155	<b>I-Pump Transceiver</b> Talks to the I-Pump gauge. Can be used on it's own (12/ 24 Vdc supply, RS485/RS232 Modbus RTU) or connected to an ALC in a complete solution.	<b>Power</b> 12/24 Vdc 0.5 A <b>Port</b> Modbus RTU Slave RS485 <b>Mechanical</b> 35 mm DIN Enclosure <b>Temperature</b> -40 to 85 C
PAW-0288	<b>busLINK Cable</b> Connects Transceiver to ALC, carries RS485 and 24Vdc/ Gnd power supply.	<b>Connection</b> ALC 10 Way SCADA C [a-well] <b>Length</b> 600mm
PAW-0057	<b>Artificial Lift Controller [Rittal 1033.600]</b> Modbus Master Controller with programmable logic, compactFLASH card slot for set-up and data files, graphic display, remote access Modbus Slave RTU ports.	<b>Power</b> 100/240 Vdc <b>Port</b> CompactFLASH, RS232 <b>Dimensions</b> 95 mmw x 130 mmh x 17 mmd <b>Weight</b> 200 g <b>Temperature</b> -40 to 85 C
PAW-0285	<b>compactFLASH Card</b> Used for expanded data logging (upto 2 GB), log recovery (in Windows format, Excel readable) and upload of new setup file.	<b>Type</b> compactFLASH Type II
PAW-0310	<b>compactFLASH Reader</b> To read the compactFLASH card in a Windows PC.	<b>Type</b> USB - compactFLASH Type II
PAW-0290	<b>ALC SCADA A NULL Modem Cable</b> RS232 Cable for use with SCADA A hookup or as engineer cable.	<b>Type</b> 9 Way D Null Modem Cable

PAW-0297	<b>Coupler Enclosure</b> Mild steel Rittal enclosure with back plate drilled, tapped and with fixings mounted ready to accept starCOUPLER and balanceCOUPLER. Enclosure has gland plate. No glands are supplied.	<b>Type</b> <b>Dimensions</b> <b>Weight</b>	Rittall 1045.600 400mmw x 500mmh x 210mmd 13.0kg (no couplers)
PAW-0299	<b>compactFLASH Reader</b> To read the compactFLASH card in a Windows PC.	<b>Type</b>	PCMCIA - compactFLASH Type II



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## Downhole Systems

Although we do supply different mechanical configurations and metallurgy for the sensor we supply these as and when required by you (the Customer) and keep the purchasing options on the downhole unit to only two issues: discharge pressure, and motor adapter.

Other issues you do need to consider with I-Pump are the same for all installations:

- is well temperature <125.0C (unit self protects, shuts down, above 125.0 C),
- is 316SS with Viton sealing suitable,
- do I need to hook up a motor J-Type thermocouple (boots are included in the install kit),
- how many spare install kits should I buy (1 recommended per install),
- do I need to field splice the motor I-wire to a suitable wire for the sensor (500mm wire supplied in kit)

If you want more advice, just contact Autonomous Well. To review purchasing options:

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## Base System

A basic system comprises the sensor and an installation kit.

Part Number	Part Name	Multiple
PAW-0173	I-Pump ESP Sensor	1
PAW-0157	I-Pump Installation Kit	1

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## Add Discharge Pressure

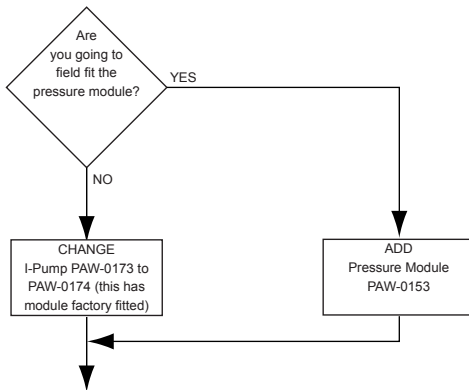
You have two options when adding discharge pressure measurement: factory fitted, field fitted. If you have it factory fitted then you should order an I-Pump with the Pd module fitted, which is PAW-0174.

Part Number	Part Name	Multiple
PAW-0174	I-Pump ESP Sensor with Pd Fitted	1

For the pressure module on it's own order PAW-0153 (which you can retrofit to stock I-Pump in the field). We recommend having a Full Redress Kit on hand if you are going to open the sensor (just incase you damage a seal)

Doing the upgrade is easy and we recommend that if you are a large user of I-Pump that you purchase a few Pressure Modules enabling you to upgrade any I-Pump if you want/ need discharge monitoring but don't have the time to order another sensor (or don't see the point in having to order a new 'Type').

Do we recommend this? Yes. It is a pump and we see no reason not to monitor Pi and Pd. It is not a huge cost addition.



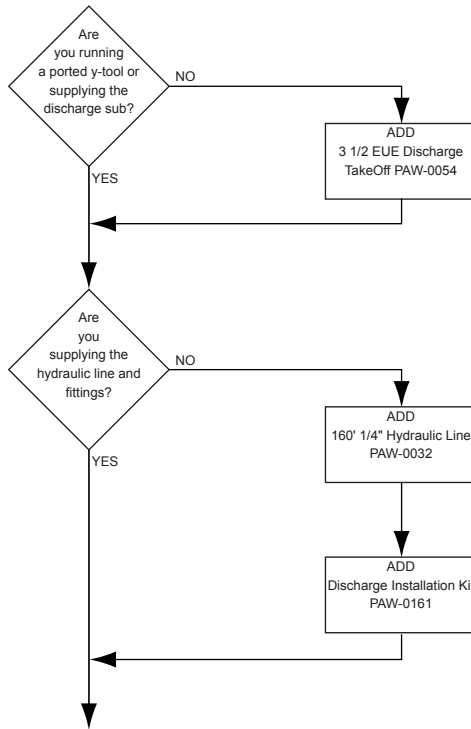
Part Number	Part Name	Multiple
PAW-0165	I-Pump Full Redress Kit	1
PAW-0153	I-Pump Pressure Module	1

This just upgrades the sensor - you also need to decide how you want to connect the sensor to the pump discharge - using your own sub-assembly or our standard 3 1/2 EUE one. If you decide to do it yourself then all you need to remember is that the sensor has a 1/4" NPT port that you must connect to.

Part Number	Part Name	Multiple
PAW-0054	Universal Discharge Pressure TakeOff	1

PAW-0032	1/4" Discharge Pressure Transfer Line	160ft
PAW-0161	Discharge Installation Kit	1

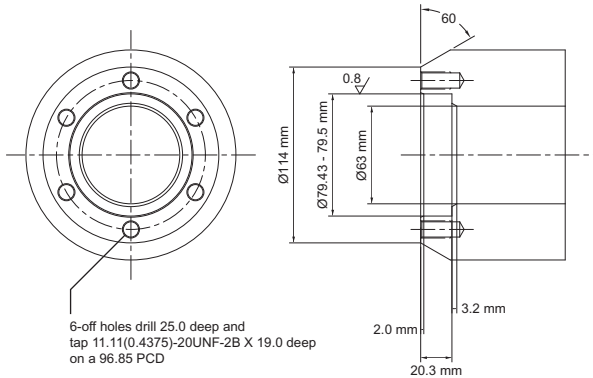
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## Motor Base Crossovers

I-Pump uses the 6-bolt flange that has become the standard for esp sensors (it is used by the PHD and MultiSensor). Check the interface details to ensure your motor will connect to I-Pump - if not then you need to purchase a crossover (if your crossover is not shown just contact us)

Part Number	Part Name	Multiple
PAW-0175	540 Motor Base [REDA Style]	1
PAW-0317	456 Motor Base [REDA Style]	1



We supply 540 and 456 series motor base adapters suitable for REDA and WG-ESPI motors. Each comes with a shorting ring, modified and including an I-wire lead with pre-fitted boot connector for I-Pump. We do supply modification drawings and motor I-wire assemblies for field/ customer modification of stock shorting rings, whether for 540, 456, 562 or other motors, independent of supplier.

Do we recommend this? Well, if you need an adapter there is not choice!

**PN: Downhole**

Part Number	Part Name	Specification
PAW-0173	<b>I-Pump ESP Sensor</b> Basic ESP Monitoring Gauge with Intake Temperature and Pressure, Motor Winding Temperature, Dual Vibration and Current Leakage.	<b>Length</b> 25.787 " (655 mm) <b>Diameter</b> 4.375 " (111 mm) <b>Weight</b> 25 kg <b>Material</b> 316SS <b>Seals</b> Viton <b>Temperature</b> 125 C Max 0.1 C resolution 1 C accuracy <b>MWT</b> J-Type 0.1 C resolution 1 C accuracy <b>Pressure</b> 5000 psi Max 1 psi resolution 0.1% accuracy <b>Vibration</b> 10 g 13 - 180 Hz Filtered 0.001 g resolution 1% accuracy
PAW-0174	<b>I-Pump ESP Sensor with Pd Fitted</b> As above part with additional pressure module internally fitted.	<b>Pressure</b> 5000 psi Max 1 psi resolution 0.1% accuracy
PAW-0157	<b>I-Pump Installation Kit</b> Kit of parts for installation (basic redress) of I-Pump (with/ without Pd fitted). I-Pump does not require opening.	<b>Contents</b> Thermocouple Probe 2" Thermocouple Boots HV I-Wire Boot 500mm HV Wire 2"BS232VIT O Ring
PAW-0165	<b>I-Pump Full Redress Kit</b> Kit of parts for full strip and rebuild of I-Pump (with/ without Pd fitted) with replacement of all O rings, seals and high voltage/ fragile parts [Contents subject to change]	<b>Contents</b> 2"BS 239 VIT 75 O Ring BS 239 PTFE Back Up Ring 2"1/4" BSP Viton 75 Dowty Washer 1/4" BSP Blanking Plug 3"Peek Insulators 3"BS18 Internal Circlip 2"LV Brass Rods HV Brass Rod HV Feed Thru with Peek Insulator 2"LV Feed Thru's 3"BS08 VIT 75 O Ring Brass Stud Brass Stud with Earth Wire 2"M6 Brass Nut 2"M6 Plain Washer 2"M6 Gromet 3/8" AF Box Spanner 1/4" AF Box Spanner
PAW-0153	<b>I-Pump Pressure Module</b> Add to the I-Pump to add discharge pressure to the monitored parameters.	<b>Pressure</b> 5000 psi Max 1 psi resolution 0.1% accuracy <b>Additional</b> Must be fitted by trained personnel.
PAW-0054	<b>3 1/2 EUE Discharge Pressure TakeOff</b> A simple pressure sub which is mounted above the pump, torqued to a standard discharge head.  Not required if supplied by 3rd party or if y-tool has port.	<b>Length</b> 12 " (304.8 mm) standalone, 20 " (508 mm) with crossover <b>Diameter</b> 5.375 " (136 mm) <b>Weight</b> 10 kg <b>Material</b> 316SS <b>Seals</b> none supplied <b>Additional</b> Port is 1/4 " NPT
PAW-0032	<b>1/4" Discharge Pressure Transfer Line</b> Standard Hydraulic Control Line connecting the Discharge Pressure Spool to the I-Pump.  Both I-Pump and Discharge Pressure Spool accept 1/4 " NPT fittings.	<b>Length</b> ESP length + 10 ' <b>Diameter</b> 1/4 " <b>Weight</b> varies <b>Additional</b> Ports to 1/4 " NPT

<b>PAW-0161</b>	<b>Discharge Installation Kit</b>	<b>Contents</b>	2" 1/4" NPT - 1/4" Line Compression Filing BS 235 VIT 75 O Ring PTFE Tape
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<b>PAW-0175</b>	<b>540 Motor Base</b> Motor base crossovers to connect I-Pump to 540 REDA/ ESPI motors. Includes Shorting Ring.	<b>Length</b>	5.875 " (149 mm)
		<b>Diameter</b>	5.375 " (136 mm)
		<b>Weight</b>	10 kg
		<b>Material</b>	410SS
		<b>Seals</b>	none supplied
		<b>Additional</b>	Bus bar with I-Wire and drain/fill valve included.

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## Service, Support and Spare Parts/ Consumables

We recommend you have some spare fuses, some 8kV wire and various of the installation kits. If you intend connecting to the star point of the transformer we do recommend having at least one balanceCOUPLER upgrade on site - just incase you need to run in Delta (see the relevant section for parts required).

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PN: Service

Part Number	Part Name	Specification
PAW-0038	<b>Replacement Fuse</b> For the HV fuseCARTRIDGE	<b>Type</b> Bussmann HVJ 1/8
PAW-0277	<b>8kV Instrument Wire</b> Suitable for fuseCARTRIDGE and balance/starCOUPLER hookup.	<b>Type</b> PTFE <b>Voltage</b> 8kV <b>Conductor</b> 18AWG <b>Manufacturer</b> Axon <b>Part Number</b> 1819 SPC
PAW-0285	<b>compactFLASH Card</b> Used for expanded data logging (upto 2 GB), log recovery (in Windows format, Excel readable) and upload of new setup file.	<b>Type</b> compactFLASH Type II
PAW-0310	<b>compactFLASH Reader</b> To read the compactFLASH card in a Windows PC.	<b>Type</b> USB - compactFLASH Type II
PAW-0287	<b>Replacement ALC Connector Pack</b> Pack of all connectors for the ALC.	<b>Contents</b> ALC 2 Way: Vdc In ALC 2 Way: Analog+ ALC 2 Way: Analog- ALC 3 Way: Power ALC 3 Way: Alarm ALC 3 Way: Trip ALC 4 Way: SCADA B ALC 10 Way: SCADA C [a-well]
PAW-0289	<b>Replacement ALC Fuse, T1.6A</b> Pack of replacement fuses for the ALC.	<b>Type</b> T1.6A
PAW-0290	<b>ALC SCADA A NULL Modem Cable</b> RS232 Cable for use with SCADA A hookup or as engineer cable.	<b>Type</b> 9 Way D Null Modem Cable
PAW-0117	<b>Engineer Toolbox</b> Everything required to carry out the installation of the I-Pump System [Contents subject to change]	<b>Contents</b> Portable Test Box Test Leads US 3 Pin Charging Lead  Tool Wrap Kemlon Crimp Tool 2*9/16" Wrenches 1/8" Terminal Driver Pipe Cutters Wire Strippers 3/8" AF Box Spanner 1/4" AF Box Spanner 10mm Nut Spinner 5/16 Ball Head Hex key  Tool Box Manual 128Mb compactFLASH Card Type II 9 Way D Null Modem Cable USB compactFLASH Reader PCMA compactFLASH Reader  10*Fuse Bussmann HVJ 1/8 10*1.6AT 20mm Fuse 10*10AT 20mm Fuse 20m 8kV Instrument Wire 10 replacement Crimps for HV Boot Kits

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<b>PAW-0073</b>	<b>Portable Surface Unit [Battery Powered]</b> Test box to be run where there is no permanent or available power; whether it is fault finding, RIH testing or just pre-shipping workshop tests.	<b>Connection</b>	Gauge, Ground, Power
		<b>Fuse</b>	not user serviceable
		<b>Voltage</b>	110/240 Vac 12 Vdc Battery
		<b>Enclosure</b>	Pelican Case
		<b>Dimensions</b>	270 mmw x 173 mmh x 245 mmd
		<b>Weight</b>	5 kg
		<b>Temperature</b>	-40 to 85 C

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# Specification

**Document** PAW-0298-00-FILE [Copy only]

**Product** I-Pump System Book

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