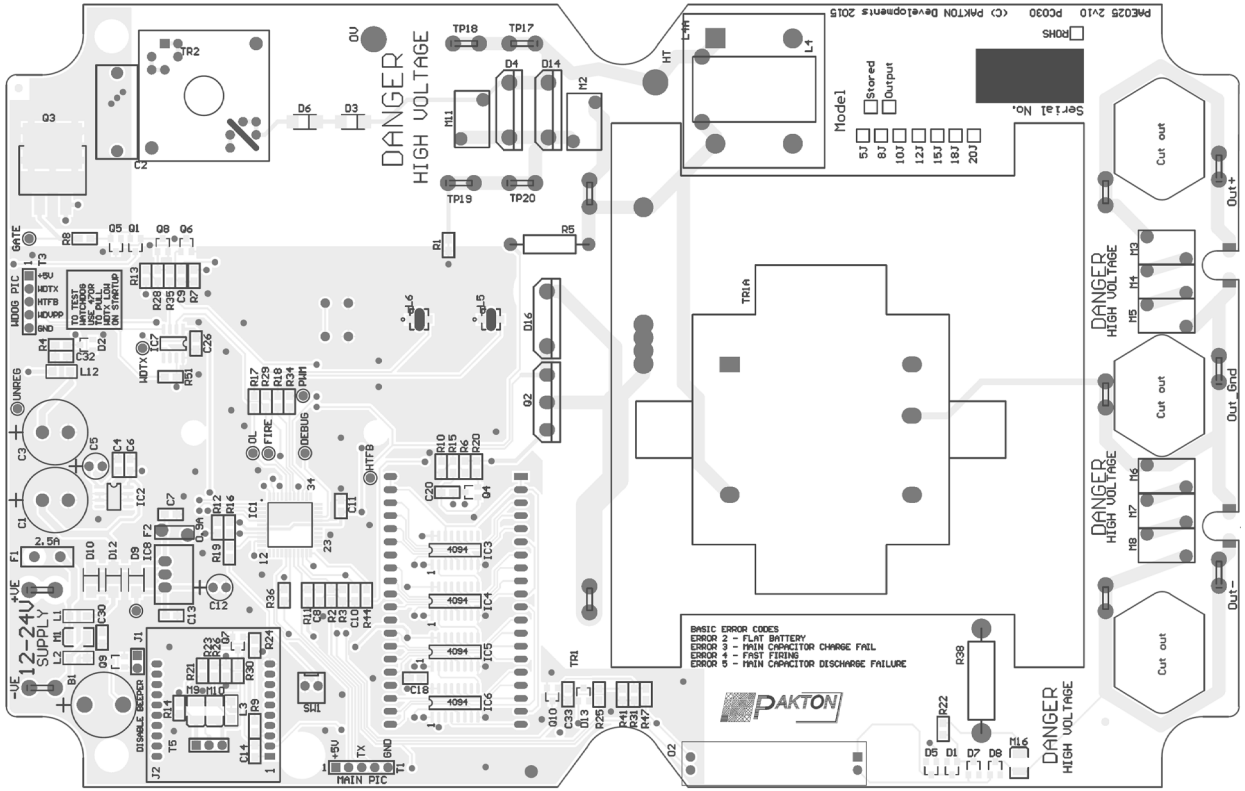
Repair Chart

PAE025c PCB 2v10+ MBXL Large DC Energiser



Notes

Electrical Appliance Repairs can be dangerous and should only be carried out by suitably qualified persons. If in doubt consult your local electrical safety authority.
This is a BASIC level repair chart; it covers repairs which can be done without Schematics or an Oscilloscope. It is designed to allow the repair of 80% of expected faults.
There is a minimum set of tools and equipment required, see the list at the end of the document.
Schematics etc are available from sales@pakton.com.au
For other support documents please see http://www.pakton.com.au/support.php
For explanations of the test methods used herein, see the Pakton document “Technical resources for repairs”.

Preliminary checks before power on

Check the power lead for breaks or shorts
Check the case is not wet inside or full of ants
Check for lightning damage, burn marks etc. If found start by doing a Diode test of every semiconductor
Inspect the PCB both sides for any signs of moisture or physical damage

Known Issues with this design

M2/M11 can fail, this usually causes them to look burnt and cause Error 3

Symptom Table

Start with the **symptom**. Then work through the **tests**.
On, means turn the power on. **Off**, means turn it off. All tests are done with a 24V power supply.
A test method in *italics* is described in the Technical resource document.

Symptom	Line	Theory	Tests	Possible Results
No Pulse, no LEDs or drawing too much current.	1	MOSFET failure	**Off.** *Continuity Test* from the UNREG test point near C3 to Bat-	a) Continuity – Go to 101 b) No continuity – Go to 2
	2	External Power Supply failure	**On.** *Measure DC voltage* at the DC input terminal Bat+. Expect 24V.	a) No voltage – Go to 3 b) Voltage – Go to 4
	3		Disconnect the power supply at the SAE connector. **On.** *Measure DC voltage* at the SAE connector from the external power supply. Expect 24V.	a) No voltage – Go to 108 b) Voltage OK – Go to 117
	4	Blown fuse on PCB	**On.** *Measure DC voltage* at the join between L1, C30, D10 and D12. Expect 24V.	a) No voltage – Go to 112 b) Voltage OK – Go to 5
	5	Blown D10 and D12	**On.** *Measure DC voltage* at the UNREG test point near C3. Expect 24V.	a) No voltage – Go to 105 b) Voltage OK – Go to 6
	6	+5V rail faulty	**On.** *Measure DC voltage* at Pin 1 of T1. Expect 5V.	a) Low voltage – Go to 106 b) 4.8 to 5.2V OK – Go to 109
No Pulse. Energiser OK LED flashes the stops. LCD shows Er 3	8	Main capacitor not charging	**On.** *Measure Maximum DC voltage* on the main capacitor at TP18. See table below for expected voltage under 'Capacitor V'. It should achieve the maximum in approx 1 second. DANGER! Turn off and discharge capacitor after test.	a) Voltage Low – Go to 10 b) Voltage OK – Go to 21
	9	Discharge circuit failure	**Off.** Check or Replace Q4.	a) Was bad – Go to 102 b) OK – Go to 10

	10	Charging circuit failure	**Off.** *Diode Test Mosfet* Q3.	a) Bad – Go to 101 b) OK – Go to 11
	11	Charging circuit failure	**Off.** *Diode Test* D3, D6, D4, D14.	a) Bad - Go to 107 b) OK – Go to 12
	12	Discharge circuit failure	**Off.** Remove D16. *Diode Test* D16 (note 2)	a) Bad - Go to 107 b) OK – Go to 14
	13	Charging circuit failure	**Off**. Remove or *Lift one end* of M2 and M11. **On.** *Measure Maximum DC voltage* on the main capacitor at TP18. See the table below for expected voltage. It should achieve the minimum in approx 1 second. DANGER! Discharge capacitor after test.	a) Voltage still low - Go to 118 b) Voltage now OK – Go to 111
Output Voltage is lower than normal (note 3). Overload/Status LED flashing every cycle.	14	Capacitors not charged correctly	**On.** *Measure Maximum DC voltage* on the main capacitor at TP18. See the table below for expected voltage. It should achieve the minimum in approx 1 second. Danger! Discharge Capacitor after test.	a) Voltage Low – Go to 15 b) OK – Go to 17
	15	Charging circuit faulty	**Off.** *Diode Test* diodes D3, D6, D4, D14, D16. Also check for poor solder joints and “head on pillow”.	a) Bad – Go to 107 b) OK – Go to 16
	16	Mosfet or Mosfet Driver failure	**Off.** Replace Q3. Can optionally replace Q1, Q5, Q6 although less likely.	a) Was bad – Go to 101 b) OK – Go to 118
	17	Main capacitor failure	**Off.** DANGER! Discharge capacitors. Disconnect main pulse capacitors and *Measure Capacitance*. Expect 30uF +/- 10% each.	a) Low - Go to 104 b) OK – Go to 18
	18	Transformer failure	**Off.** DANGER! Discharge capacitors.	Go to 103

More than 1 pulse per second. Overload/Status LED flashes Error 4.	19	Fast firing	Assume it is caused by a dying SCR.	Go to 102
No pulse. Energiser OK LED flashes then stops. Overload/Status LED flashes Error 5.	20	Not firing, firing circuit failure	**Off**. DANGER! Discharge Capacitor before test. *Measure Resistance In-circuit* of R20. Expect 12 Ohms.	a) Bad – Go to 115 b) OK – Go to 21
	21	Firing circuit failure	**Off**. DANGER! Discharge Capacitor before test. *Diode Test a NPN type Bipolar transistor* Q4.	a) Bad – Go to 116 b) OK – Go to 118

Notes

1. After lifting a leg or removing a component to test it, replace it before proceeding to the next test step.
2. D16 will fail a diode test if Q2 has failed “short circuit”. If replacing D16 does not help, you may have to replace Q2 as well.
3. Test Output Voltage using an Electric Fence voltmeter with a 500 Ω load across the output.

Faults table

If you find a fault which is not covered in the list below, and it is likely to occur again, please inform Pakton.

No.	Fault(s)	Repair Action / Notes
101	Q3 or associated drivers failed.	Replace Q3. Check D10/D12, also check beads L1/L2, and check for burnt track work leading to Q3.
102	SCR Q2 failed.	Replace Q2. You may need to snip two leads off at SCR body to remove it.
103	Output Transformer TR1A failed.	Replace TR1A. You can check the secondary resistance using a DMM – blue to red output leads should read ~8Ω. However, even if secondary reads correctly, primary (black to yellow) may still be faulty.
104	Main capacitor(s) failed.	Replace main discharge capacitor(s). Use a pulse grade capacitor of the same specifications, available from Pakton.
105	D10/D12 failed.	Replace the diode. Also check bead L1, and check for burnt track work leading to Q3. Check Q3.
106	IC2 failed.	Replace IC2.
107	A diode failed.	Replace it with the same type.
108	Power supply failure.	Replace the external power supply with one of the same type, available from Pakton.
109	IC1 (main processor) failed.	Replace IC1. Requires SMD rework tools and must be purchased pre-programmed from Pakton.
110	Shorted 5V rail.	One of IC1, IC2 or Q3 may be dead. Further diagnosis is beyond basic level.
111	M2 or M11 failed.	Replace M2 and/or M11.
112	F1 failed.	Replace F1. Also check bead L1 and L2 for continuity. Do a diode test on Q3.
115	R20 failed.	Replace R20. Also check Q4 and Q2.
116	Q4 failed.	Replace Q4, check Q2.
117	Break in input lead.	Replace the input lead, available from Pakton (COX032)
118	Unknown.	Repair is beyond basic level.

Table of Expected Output Voltage (kV) on Load per Model

Model	Module Part Number	Joules	Main Cap	Capacitor V (no load)	Capacitor V (200R load)	kV (500R)	kV (100R)
PTE2140 JVA MB8 AU PTE2150 JVA MB8 EU	PAE083	8	30uF	520	830	7.0	3.5
PTE2140 JVA MB8 AU PTE2150 JVA MB8 EU PTE2154 Artex LIMB80	PAE089 PAE089c	8	60uF	495	595	7.0	3.2
PTE2141 JVA MB12 AU PTE2151 JVA MB12 EU PTE2154 Artex LIMB120	PAE089 PAE089c	12	60uF	515	740	7.0	4.0
PTE2152 MBXL – JVA MB16 PTE2154 Artex LIMB160	PAE089c	16	60uF	520	875	7.0	4.8

Minimum Tools Required for Basic level repair charts

If you do not have any of these basic tools, stop now.

- Electric fence kilo-voltmeter and 500 Ohm load Or Electric Fence Impulse Energy Meter
- Digital Multi-Meter with Diode check, Capacitance measurement to 30uF, Voltage range to 1000Vdc and maximum hold function.
- Temperature controlled Soldering Iron
- Desoldering suction tool for through hole re-work and or Solder wick (desoldering braid)
- Capacitor discharge resistor (500 Ohm 10W)
- Small hand tools such as screw drivers and side cutters etc
- Mains Isolation transformer (for 110/240Vac designs)
- A clean and tidy work area with an insulated surface

Good repair procedure

The basis of good electronics repair is the scientific method.

- Observe the symptoms (gather facts)
- Form a theory (based on the known facts)
- Test the theory
- Continue around this loop until you prove a theory and repair the appliance.

It’s a poor repair procedure to randomly replace components in the hope of finding a bad one.