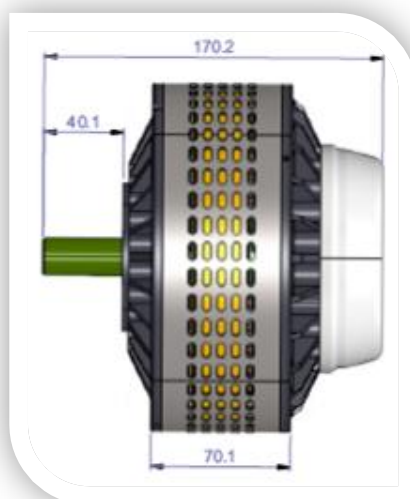


# Operation & Maintenance Manual

for

## LEM-130, LEM-170 & LEM-200 Series Motors



[www.lmcltd.net](http://www.lmcltd.net)

## Safety

### SAFETY WARNING:

This motor contains powerful magnets generating very large forces which can cause serious injury. Before carrying out any servicing or repair please ensure you have read the service manual and have the correct tools and safety wear available to you. Do not attempt to open the motor casing if you are at all unsure about completing the service / repair.

We recommend approved service agents to assist you.

LMC Ltd accepts no liability for any injury caused.

## Warranty

All motors produced by LMC have a 12 month warranty against defects in materials or manufacture.

In the event of a warranty claim the motor needs to be returned to LMC for inspection and verification.

Your LMC warranty is subject to the conditions set out below:

The warranty is invalid if:

- (a) If the motor is damaged by running above its rated current or RPM, or with the brush holder in the wrong position.\*
- (b) If the motor is opened or serviced by anyone other than an approved service agent except for replacement of the brushes or brush holder.
- (c) If the serial number label and other particulars are removed or altered.
- (d) If the motor is installed in an enclosed space without sufficient ventilation.

*\*This will particularly apply if the drive system used is designed with a very low reduction gear ratio so that the motor runs at a very low speed and / or at high current e.g. used in hill climbing.*

## Maximum Current

The motor has a low resistance and is capable of drawing very high currents. It should therefore either be operated through a controller set at, or below, the motor's continuous current limit or be attached, through suitable gearing if necessary, to a system incapable of taking more than the current limit at full voltage. E.g. in a scooter or a boat. The controller also provides overload protection.

If peak current is to be drawn above the continuous rating, the the controller should limit this to 5 seconds before reverting back to the continuous rating. All applications need a soft start if the motor is to be connected direct on line without a controller.

Vehicles should be designed to cope with the steepest gradient or the greatest acceleration they will encounter. Vehicles over 250Kg will almost certainly need a gearbox or other change of ratio, unless their top speed is low.

For continuous running in boats we find the true continuous rating of most proprietary controllers is about 25% of peak.

## Operating Speed

The continuous rating is based on the assumption that the motor is running at or near full speed – i.e. at full voltage. If the motor is to run for more than a few seconds at reduced speed and voltage, or above 300 metres (1000ft) altitude, then the continuous current should be down-rated.

130 Table

Motor	No Load Current A	Torque Constant Nm/A	Speed Constant Rpm/V	Armature Resistance DC mΩ	Armature Inductance @ 15kHz μH	Armature Inertia Kg/m <sup>2</sup>	Peak Power kW	Peak Efficiency %	Peak Current A	Rated Power kW	Rated Speed Rpm	Rated Voltage V	Rated Current A	Rated Torque Nm
95	5	0.0831	138	32.5	14	0.0116	3	82	100	2.27	4668	35	75	4.35
95S	6	0.0631	138	32.5	14	0.0117	4	87	100	3.02	5524	45	75	4.35

170 Table

Motor	No Load Current A	Torque Constant Nm/A	Speed Constant Rpm/V	Armature Resistance DC mΩ	Armature Inductance @ 15kHz μH	Armature Inertia Kg/m <sup>2</sup>	Peak Power kW	Peak Efficiency %	Peak Current A	Rated Power kW	Rated Speed Rpm	Rated Voltage V	Rated Current A	Rated Torque Nm
125	18	0.055	140			0.0234	7	76	400	4.30	3360	24	240	12.2
127	5	0.12	88	880	20	0.0236	16	88	400	5.54	3254	45	140	16.2
D127	4	0.134	82	480	18	0.0236	21	88	400	7.10	3720	60	140	18.2

200 Table

Motor	No Load Current A	Torque Constant Nm/A	Speed Constant Rpm/V	Armature Resistance DC mΩ	Armature Inductance @ 15kHz μH	Armature Inertia Kg/m <sup>2</sup>	Peak Power kW	Peak Efficiency %	Peak Current A	Rated Power kW	Rated Speed Rpm	Rated Voltage V	Rated Current A	Rated Torque Nm
85	6	0.113	75	21.5	22	0.0238	18	89	400	5	3200	48	175	19
125	10	0.0737	105	175	6	0.0234	7.89	83	400	5.05	2520	24	270	19.2
127	5	0.15	84	22.5	23	0.0238	18.08	88	400	8.55	2992	48	215	31.5
D85	6	0.14	85	20.5	11	0.0238	28.50	91	400	15.00	6000	72	200	30.0
D125	5	0.0748	100	138	5	0.0234	11.14	81	400	6.91	3600	36	250	18.3
D127	4	0.17	59	17.5	13	0.0238	25.38	90	400	12.99	3600	72	200	33.3
D135	3.5	0.185	45	16.75	15	0.0238	29.04	90	400	14.39	3780	84	200	36.4
D135PAG	7.36	0.207	42	16.95	16	0.0238	34.32	91	400	18.84	4032	96	200	38.68
D135RAGS	7.45	0.21	40	16.95	16	0.0238	36.00	91	400	18.00	4400	110	200	42.00

Torque Output of Motor:  $J [Nm] = Kt [Nm/A] * (Current [A] - No Load Current [A])$

## Use of Gearbox

It should be noted that if excessive current is drawn, the current is not reduced by dropping the voltage and thus the speed of the motor, eg on a steep hill.

The solution is to design the drive with a mechanical ratio such that the motor is rotating at full speed when maximum torque is required. To meet this requirement it is likely that a change of ratio will be needed, a vehicle above 250kg will require a gearbox or other variable speed drive unless it has a very low top speed, eg as a golf buggy (less than 15mph)

Do not lower the speed to resolve this issue. Reducing the speed (and thus the voltage) by means of an electronic controller because this will not necessarily reduce the current, instead it will usually make the problem worse by reducing the motors cooling through less ventilation due to lower speed of rotation.

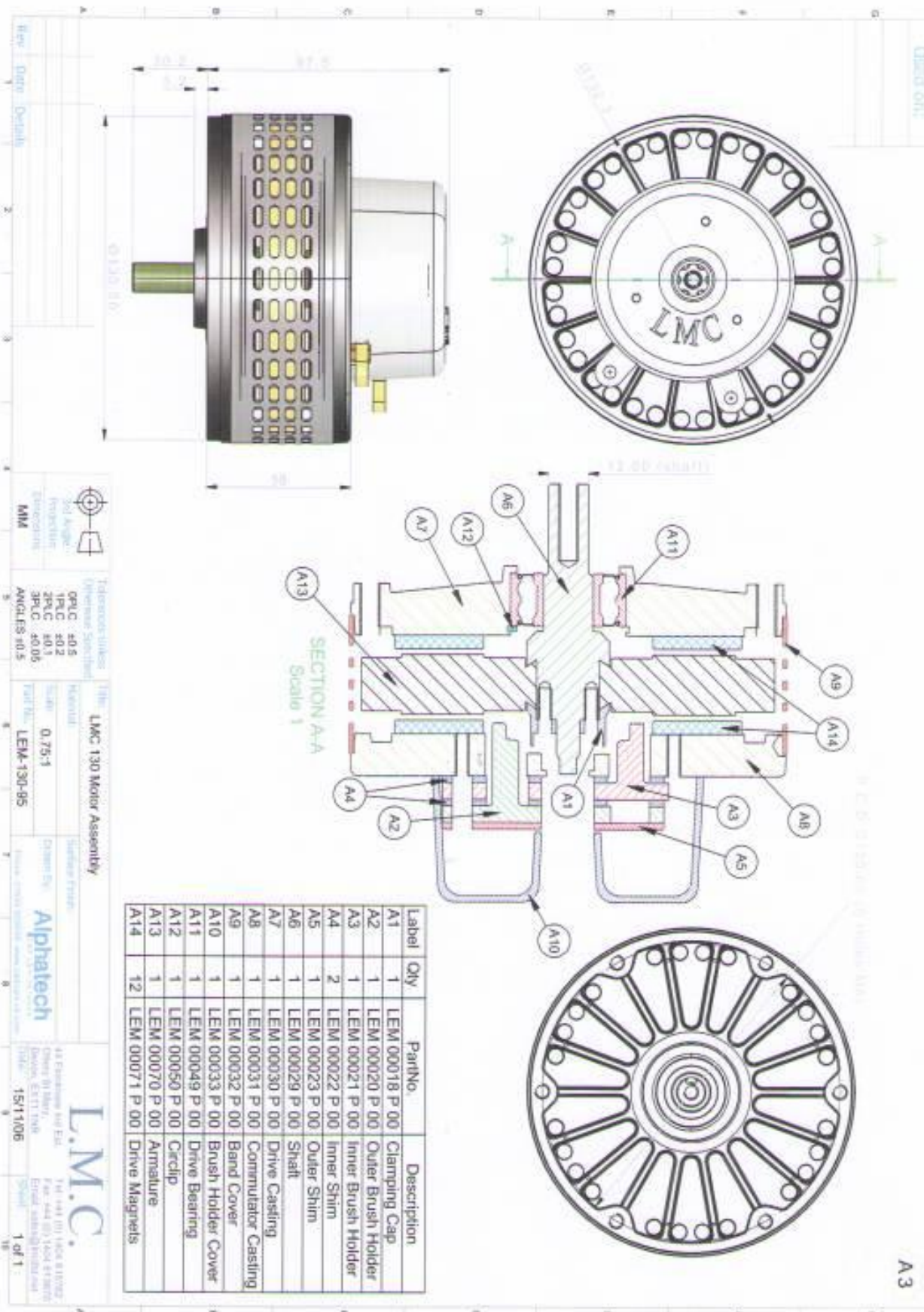
Lower speed means less cooling; unlike a petrol engine, an electric motor should be run at full speed most of the time; even at low load it will not over-speed.

## Cleaning

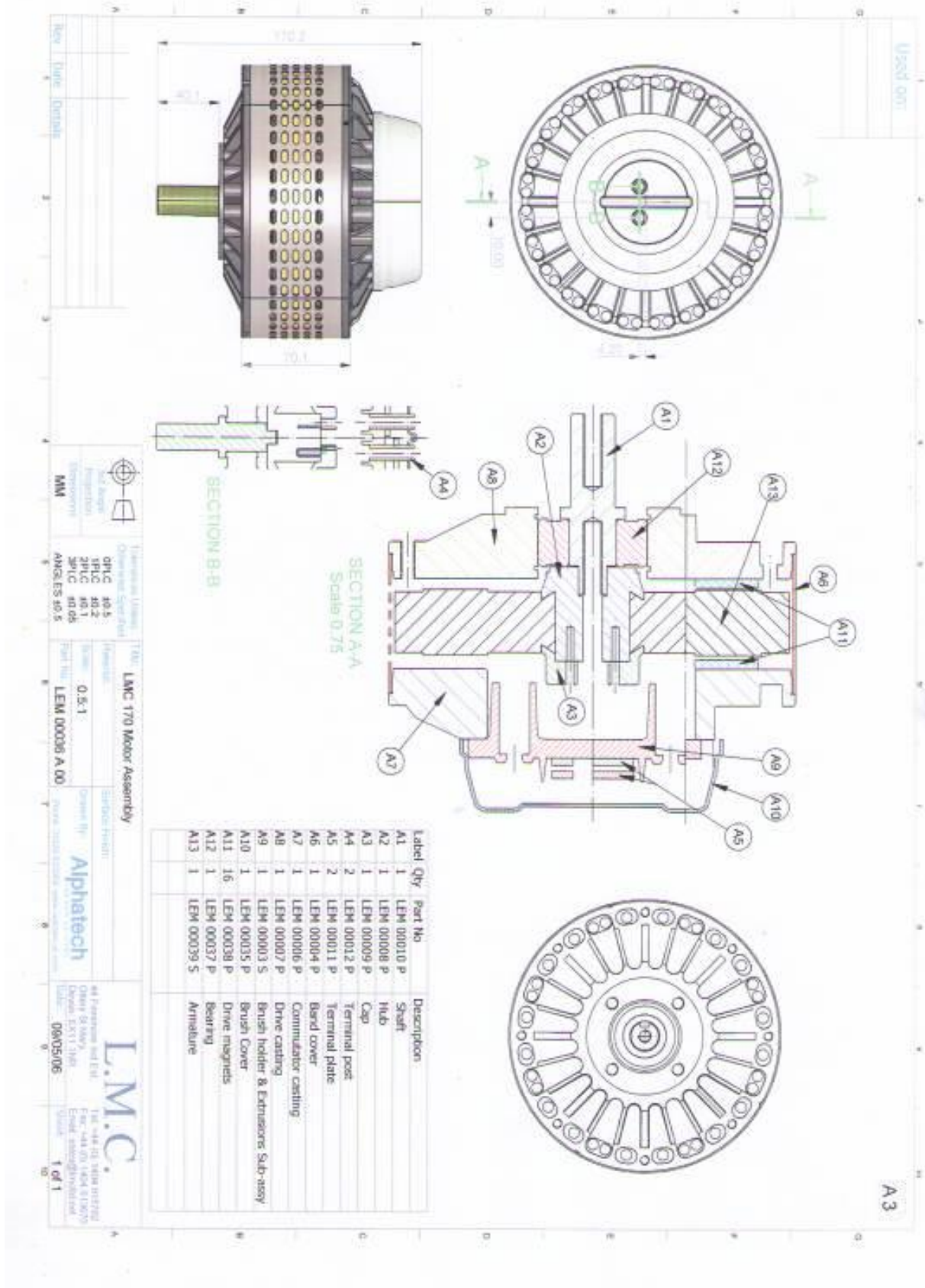
The outside of the motor can be cleaned using a damp cloth or stiff brush. You can also use an aerosol cleaning products to clean the outside of the motor, however only apply the cleaning solution to a cloth/rage do not apply directly to the motor. Do not clean with water.



## Installation Drawings: LEM-130

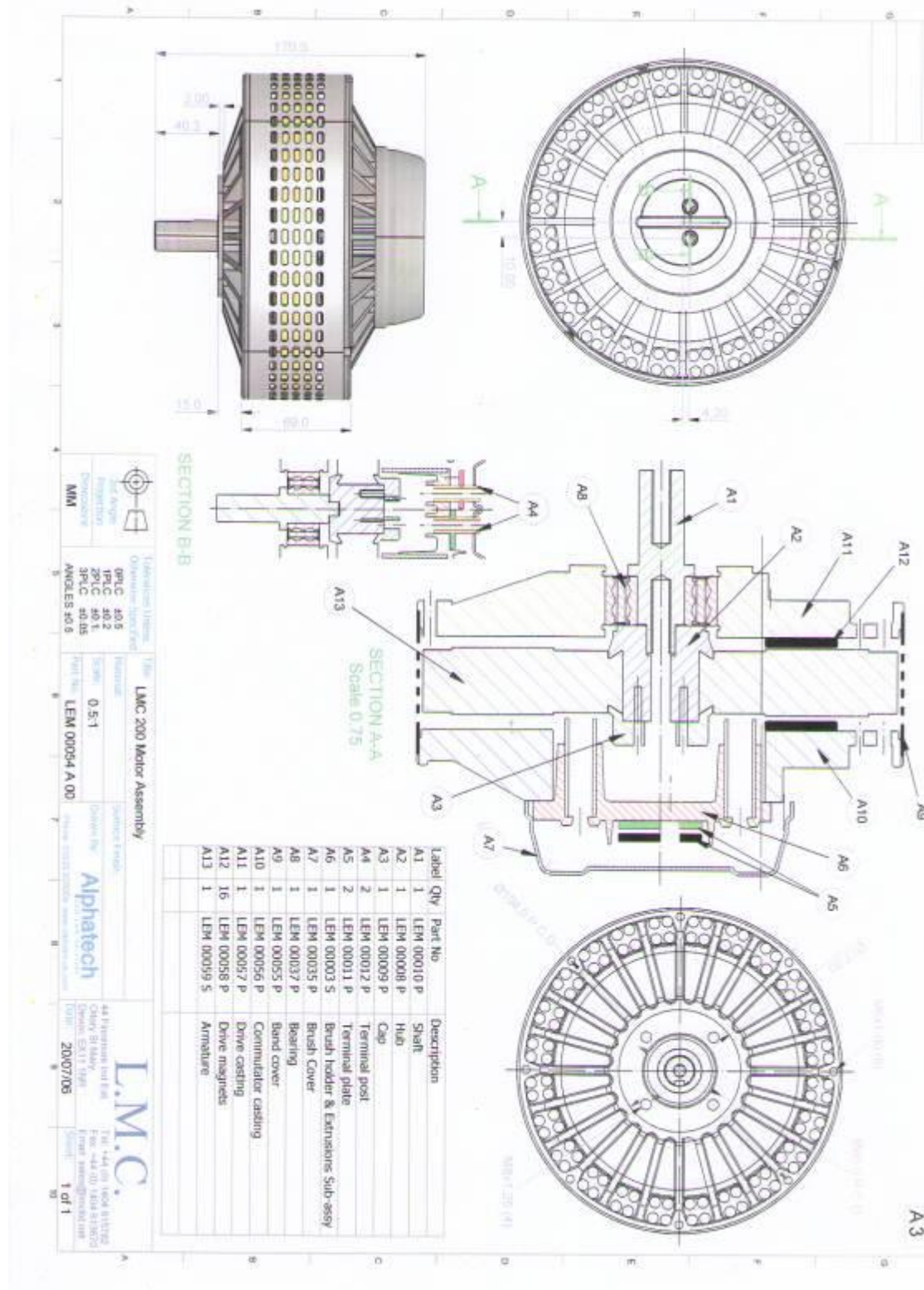


## Installation Drawings: LEM-170





## Installation Drawings: LEM-200







## Routine Maintenance

Depending on the frequency of use the routine maintenance will vary. High usage applications or where air conditions are dusty, the motor may need checking after use e.g. racing.

If the motor is used at low current in an application involving little or no dust or other contamination the motor may only need servicing every thousand hours. Some displays provided with controllers can be programmed to give a maintenance reminder.

**External checks** – When you turn the motor very slowly there should be a faint, smooth hissing sound from the brushes. Any unusual noises like rasping or clicking could indicate a problem. Also shake the motor shaft to see if there is any significant movement in the shaft or if there are any unusual noises when the motor is running. To repair these faults please see the section on “Dismantling and reassembly of the motor”.

Take off the terminal cap and check that the flexible leads to the brush holder are slack and are being pulled tight between the terminals and where they pass in between the individual brush channels. You should pull each lead to see the brushes are free to move in there channels. If you feel the motor has accumulated very many hours of running remove the brush holder and blow dust out of the armature using compressed air. Complete this in a well ventilated area and ensure you are wearing a suitable mask so that you do not breathe in the dust.

Further information about removing can be found below in the section “removing the terminals from the brush holder”.

## Maintenance of main Parts

**Belts or Chains** – These must not be over tightened as this will cause rapid wear on the motor bearings and will greatly reduce their life. When replacing follow belt and chain manufacturers instructions for tightness required and do not exceed this.

Remember that if regenerative braking is used the large vehicle pulley is driving the small motor pulley. In this case the belt will need to wrap further round the small pulley to engage a sufficient number of teeth to avoid the belt jumping over the teeth. This should be avoided as it will rapidly destroy the belt.

**Enclosure** – The motor relies on an unrestricted supply of ambient air for cooling; air temperature not to exceed 40 degrees C. If the motor is installed in an enclosure, then this should be provided with an ample supply of ambient air, by means of suitable ventilation or a fan if necessary. Installation of the motor in a closed space without ventilation will invalidate the warranty. To ensure the motor does not overheat please check the enclosure area of debris and check movement of ventilation fans regularly.

**Replacement Bearings** – If replacing bearings, use only high quality branded product such as RHP etc; cheap alternatives could have only a third the life of original manufacturer’s product. Please note, we make this suggestion as a result of more than 20 years practical experience; we have no commercial relationship with any bearing manufacturer.

**Brushes** – Brushes should be checked once a year and after periods when not in use, it is possible under some circumstances for carbon brushes to absorb moisture – e.g. if the motor is left in the cold, damp environment such as garage or boat house over winter. When restarting a motor that has been left standing for some time, it should be run for a minimum of 15 minutes at low current e.g. 30 -40amps, to dry the brushes. The current should be gradually increased over the next hour of running. If you are leaving for long periods then its possible to remove the brush holder assembly and store separately.

Under these circumstances or once a year, it would be advisable to check the brushes to make sure they have not expanded and that they are completely free in the brush tubes. If there is any sign of sticking,



the rubbing parts of the brush should be filed so that a 0.25mm feeler gauge can be inserted on one side of the brush guide-ways in the retaining tubes.

## LMC130 and 2X2 Models

It is recommended that the above versions are returned to the factory if the motors are required to be stripped down due to special tooling needed however if the customer wishes to dismantle these for whatever reason then please email [engineering@lmcltd.net](mailto:engineering@lmcltd.net) for specific details relating to make and model.

## Replacing Brush holders

To replace a brush holder in your motor you need to fit the new holder with the 4 M4 cap screws but do not lock down leave then slack so that the holder can be rotated within its slot by hand.

Connect a power source 12v or similar to the motor terminals ensuring that the motor is fixed down switch the power supply on and by means of a volt meter measure the volts that is being feed to the motor, you need to find the highest voltage reading to locate the neutral position once found lock the brush holder by means of the 4 cap screws and mark.

## Dismantling and Reassembly

*LMC170 and 200 frame models*

### Tools Required

- A bench vice with soft jaws (to prevent damage to the motor shaft)
- LMC assembly jig
- 3mm Allen key
- 6mm Allen key
- Internal circlip Pliers
- Small hammer
- Short M8x1,25 screw
- Bearing fit Loctite

**Picture of the motor mounted in a bench vice  
and basic tools required to strip down**



**LMC assembly tool, 3mm Allen key and 6mm Allen key**







## 1

Secure the motor by the shaft in the soft jaws of the bench vice.

Using the 3mm Allen key undo the 3 of Cap screws that hold the brush holder cover in place.

Store in a safe place whilst dismantling the motor.



## 2

Once the cap is removed this gives access to the brush holder, this again is secured to the motor by 4 of Cap screws, using the same 3mm Allen key undo and remove from the motor.

Mark the holder to the casting so that you put it back in the same position.

Again store in a safe place until



### 3

Using the LMC assembly tool fix to the commutator casting via 2 of M4x25 cap screws (1 at each end of the bar) and secure with the 3mm Allen key.





**4**

Once the LMC tool is fixed in position then turn the bar clockwise which will lower the threaded bar until it reaches the top of the armature.



**5**

Continue to turn the bar until you create a gap of approx 20 to 25mm between the casting and the band cover.

Taking note of the indentation in the band cover, which there are 3 these must go back in the same position or you will destroy the motor.

Lift of the top half and store in a safe place free from metallic objects.



**6**

Using the 6mm Allen key, unscrew the centre cap screw as shown.

**DO NOT UNDO THE 6 5MM CAP SCREWS.**

Once completely undone the armature will tilt to one side allowing you to lift off, you will feel the force of the magnet strength which will ease as the armature comes away from the drive casting.



**7**

Once the armature is stored this then gives access to the drive casting as shown take a note to see if there are any shims fitted between the armature and shaft. If so lift off and store with the armature, these are required to centralise the armature within the motor case.





## 8

Using the circlip pliers remove the top circlip, then remove the casting from the bench vice turn over this then allows for the shaft and bearing to be pushed out by means of the small M8 bolt fitted in the end of the shaft and hammer to knock out.

**DO NOT HIT SHAFT DIRECTLY.**