EMU/MEMU Con.
TRACTION MOTOR
TYPE 4601BY/BX

N.D.Turkar/PL/PSTC/IRIEEN/NK

Parameters	4601 AZ	4601 BZ
Rating (KW)	167 KW	187 KW
Rating (HP)	224 HP	250 HP
Current	340 Amps	380 Amps
Voltage	535 V	535 V
Speed (RPM)	1200	1182
Gear Ratio	20/91	20/91

TECHNICAL DATA

TECHNICAL DATA

Rating

	Continuous	One hour
Voltage	535 V	535 V
Current	340 A	380 A
RPM	1260 rpm	1182 rpm
Power	167 KW	187 KW

Resistance Values (Average at 25 deg. C in ohms)

Armature winding	0.0186
Series field winding	0.0103
Commutating field winding	0.009

TECHNICAL DATA

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Armature winding	0.0186
Series field winding	0.0103
Commutating field winding	0.009

Armature

Core Diameter	457.2 mm
Core length	260.50 mm
Distance between bearing end faces	575.35 mm
Overall length of armature	975.00 mm

TECHNICAL DATA

Armature Permanent Banding Res-I-Glass

Material	0.33t k x 20mm wide Res-I-glas Tape
Turns on PE winding	100
Turns on CE winding	105
Banding tension	190 – 205 Kg

Commutator

Length of working face	99mm
Diameter – New	324/325.5 mm
Diameter-min. permissible	305 mm
Mica thickness	1.14mm
Depth of Mica undercut	0.8 to 1.3mm
Permissible ovality	0.03 mm

TECHNICAL DATA

Brush Gear

No. of brush arms	4
Brush holders per arm	1
No. of brushes per arm	2
Type of brush	Half width, split Rubber top.
Brush grade	EG 14D (I) ACPL (Morgan), E88 x (I) ELCA (S&E), EG 7097 Lecarbone
Brush length	60 mm New
Width	44.45 mm
Thickness over two halves	25.4 mm
Minimum scrapping length (condemn size)	32.0 mm
Clearance between brush holder and commutator	1.6 to 3.2 mm
Brush holder spring tension	2.7 – 3.65 kg

TECHNICAL DATA

Armature Bearings

Armature bearings	Pinion end	Commutator end
Manufacturer	SKF/FAG/NSK/NTN	SKF/FAG/NSK/NTN
Type	NU 326M/C4 VA 301	NUP 318 VA 301
Diametrical clearance of free bearing when new	0.145 to 0.190 mm	0.105 to 0.140 mm
Diametrical clearance after assembling	0.03 to 0.13 mm	0.03 to 0.10 mm
Fit between inner race and shaft	0.035 to 0.08 mm interference	0.025 to 0.06 mm interference
Fit between outer race and bearing housing	0.025 mm interference to 0.35 mm clearance	0.020 mm interference to 0.030 mm clearance
Main permissible radial clearance when assembled	0.03 to 0.13 mm	0.03 to 0.10 mm
Housing dimensions	279.97 – 279.99 mm	189.98 – 190.00 mm

TECHNICAL DATA

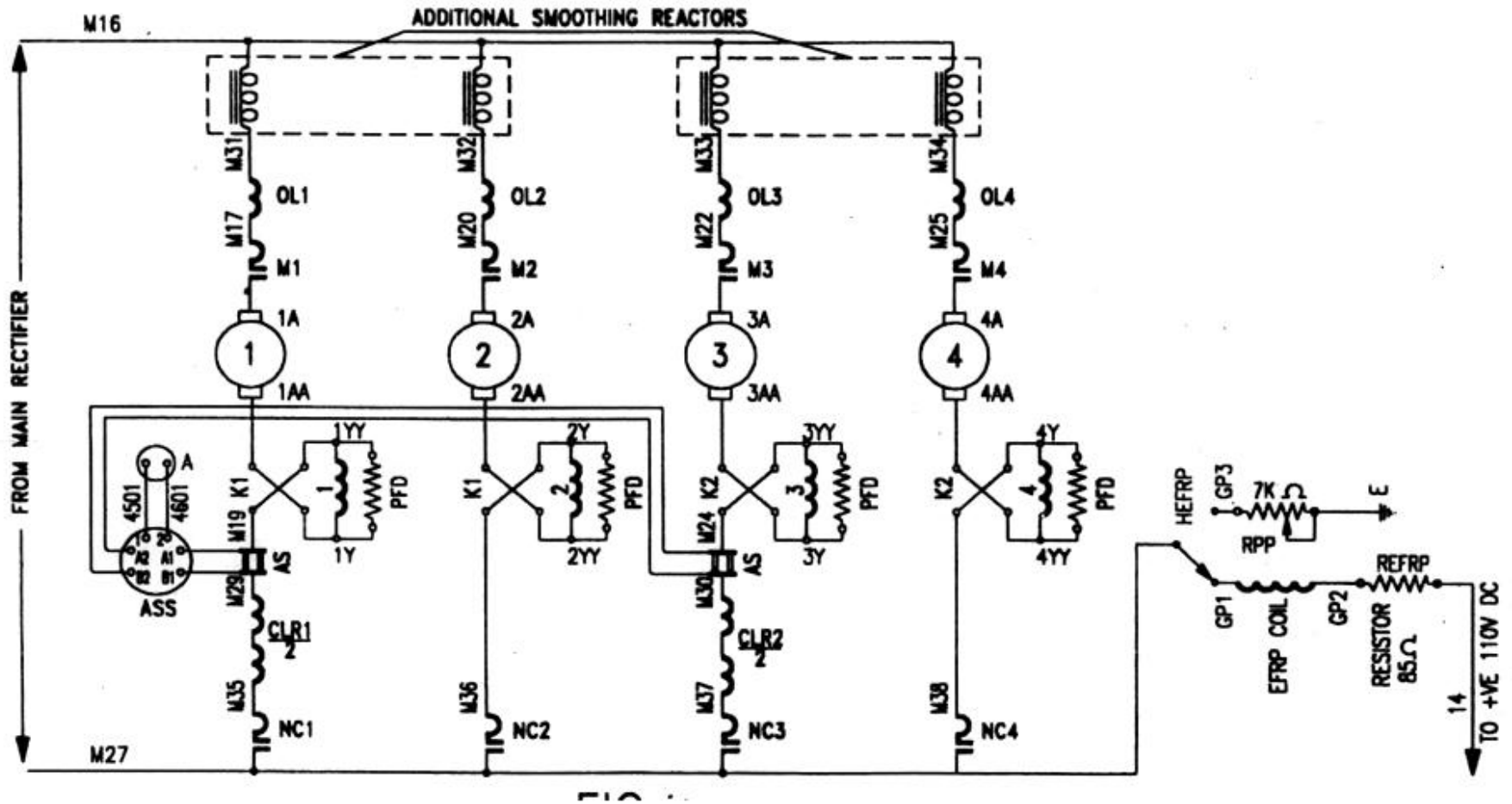
Earth Return Brushes

Brush grade	BE 14Z1 (ELCA) CM1S (Morgan OEM)
Size	New – 53.5 mm Condemn – 34.4 mm

Weights (Approximate)

Motor complete with gear & gear case	2035 Kg
Motor complete including axle caps, axle bearings & pinion but without gear wheel gear case	1812 Kg
Armature	520 Kg
Gearcase	85 Kg
Pinion	9 Kg

TM CIRCUIT


M16
ADDITIONAL SMOOTHING REACTORS
FROM MAIN RECTIFIER
M31
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M34
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OL4
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M4
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RESISTOR
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TO +VE 110V DC

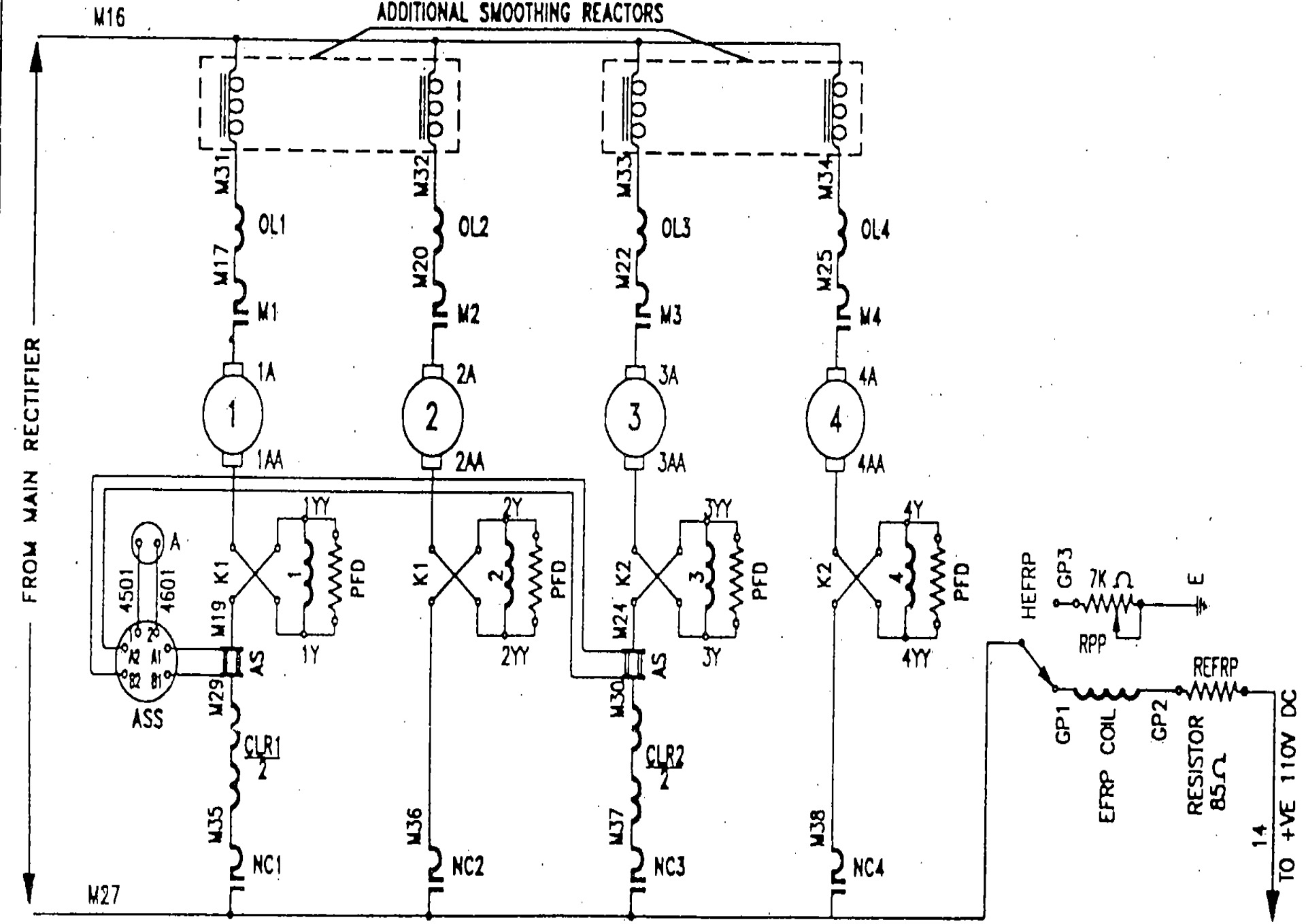
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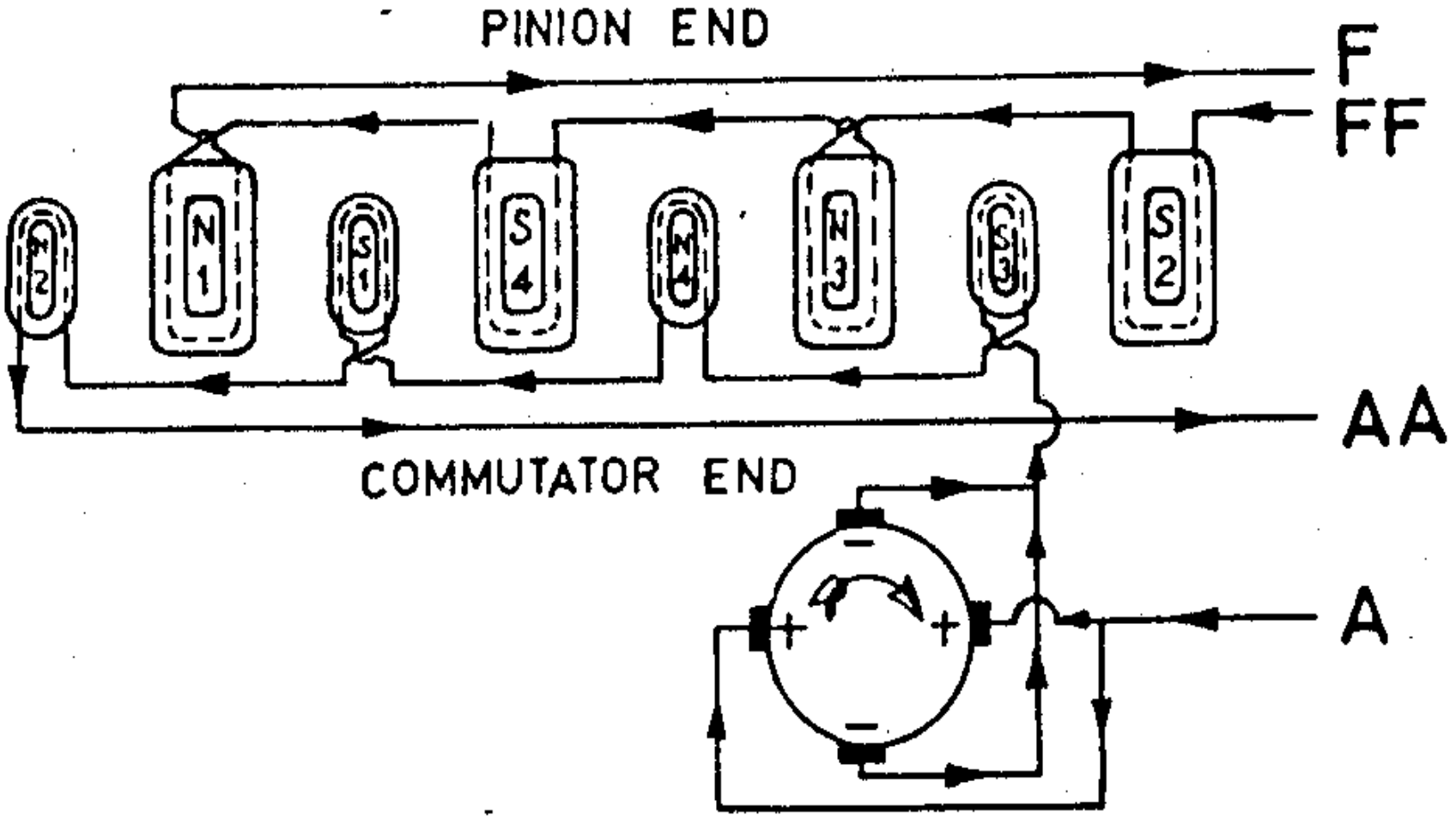
FIG. 4



DEVELOPED VIEW LOOKING ON POLE FACES

TM COMMUTATOR RUBBED

COMMUTATOR

- The commutator is of arch bound construction built up with hard drawn silver bearing copper segments which are insulated with micanite segments and are assembled with moulded mica insulation between between steel V-rings.
- After assembly, the commuator is statically and dynamically seasoned to ensure stability.
- The complete armature is dynamically balanced. The commutator outer mica V-ring is protected with anti-creepage PTFE tape/ring

COMMUTATOR CHAMFERING

ARMATURE

- It is the rotating part of the motor, consisting of a number of copper conductors suitably placed and connected so as to form a closed winding.
- Armature core is built up from electrical quality varnished sheet steel laminations assembled on the shaft with interference fit and consolidated under pressure.
- The armature has a 40% (80% from traction motor s.no. 4514981, Sept.99 onwards, modified by BHEL) equalization. The armature coils are kapton covered.

ARMATURE

- The armature and equalizer coil leads are TIG welded to commutator risers.
- The armature coils are held down in the core slots by Epoxy glass wedges and the end windings are secured by Res-I-glass bands. The vacuum pressure impregnated with solventless polyster resin insulating varnish.

COMMUTATION

- The function of the commutator in d.c. motor is to reverse the direction of current in each conductor as it passes from one pole to another, it helps to develop a continuous and unidirectional torque.
- The current in a particular conductor is in one direction when the conductor is moving under the North pole and in the opposite direction, when it is moving under South pole.
- This reversal of current in a coil will take place when the two commutator segments to which the coil is connected are being short circuited by a brush. This process of reversal of current in coil is termed as commutation.

COMMUTATION

- The period which coil remains short circuited is very small. If the current reversal is completed by the end of short circuit then the commutation is ideal. If reversal is not completed by that time, then sparking is produced between the brush and the commutator which results in progressive damage to both.
- The rapid reversal of current in the armature core sets up a self induced emf, generally called reactance voltage, which hinders the reversal of current and tends to decay the current reversal in the coil. As a result, the current in the short circuit coil does not attain its full value in the reversed direction by the end of short circuit. This is the basic cause of sparing at commutator.

METHOD OF IMPROVING COMMUTATION

- Arrangement is made to neutralize the reactance voltage by producing a reversing e.m.f. in the short circuited under commutation. For this purpose, special commutating poles (inter poles) are placed mid way between the main poles and wound with comparatively few heavy gaugeCu wire turns, and are connected in series with the armature so that they carry full armature current. The polarity should be opposite to the next main pole in the direction of rotation. The field produced by the interpole winding opposes the armature field.

METHOD OF IMPROVING COMMUTATION

- The mmf developed by the interpole must be stronger than the armature mmf in the neutral zone, because this mmf has to cancel the armature mmf and in addition induce an emf in short circuit coil which opposes reactance voltage and the voltage drop at the brushes.

STATOR (MAGNET FRAME)

- The high permeability cast steel of fabricated magnet frame is machined to ensure alignment of the end shields, pole bores and axle way bores. It consists of main poles and interpoles fixed to it which are built from steel laminations riveted together.
- Mainpole and compole coils are epoxy insulated and bonded to pole bodies using epoxy resin. This improves heat dissipation.

MAGNET FRAME OF TM

BRUSH HOLDER

- There are four brush holders per motor, each carrying two split carbon brushes. The brush holder is an internal casting having a single adjustable spring for each brush to provide the correct brush pressure. The brush holders are secured to the magnet frame by FRP moulded insulated pins. The rubber top carbon brushes are split type to ensure better contact with the commutator.

ARCING HORNS

- Arcing horns are provided near the brush holders to minimise the damage in an event of a flash.

ARMATURE BEARINGS

- The armature is supported on two grease lubricated roller bearings. Bearing assemblies are sealed type, thereby lubrication is only required during o/H (18 months). The armature is located axially by the commutator end bearing, while the pinion end bearing is capable of taking care of any axial play between armature and frame.

SUSPENSION BEARING

- The axle suspension bearing is high leaded bronze shell type. One half of the bearing is keyed to axle cap to prevent rotation and to again the oiling window. The oil lubrication is provided by spring loaded wick assembly of the axle lubricator.

PINION

- The pinion which is shrunk fitted on the armature shaft, drives the EMU/MEMU axle through a spur gearwheel which is pressed onto the axle, it is made of high speed carbon ateel and having 20 teeth.

GEAR CASE

- The gearcase is of welded steel construction and is in two halves, which are bolted together. The complete gearcase is supported on the motor frame and end shield PE. The joints between the gearcase halves are baffled and grooved to carry felt sealing rings so as to prevent ingress of dust and any other foreign material and the escape of the gear lubricant.

COOLING SYSTEM

- The motor is self ventilated and the fan is mounted on C.E. shaft extension.
- Air enters the motor through a duct system connected to an opening provided in fan chamber and assembled on the motor frame at the commutator end.
- The cooling air then sucked by fan flows in two parallel paths, one under the commutator through the armature core ducts and the other along the outside of the armature and between the field coils and is discharged through the opening provided at the pinion end of the frame.

Traction Motor

Type

4601 AZ/BZ/BX/BY for existing EMU

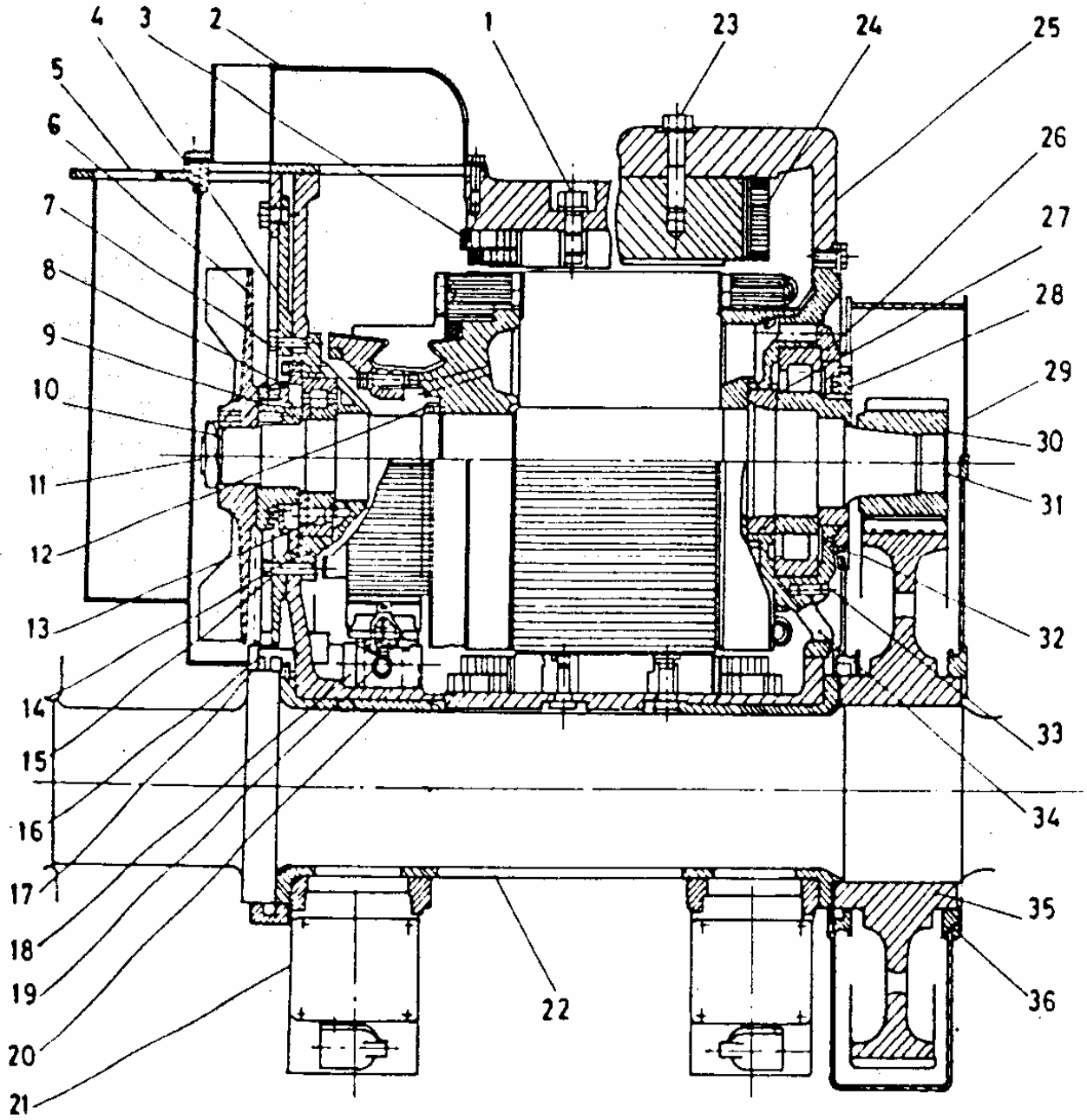
535 V, 340 A (cont.), 167 KW,1260 RPM.

4303 BY of BHEL for tube suspension type.

557 V, 415 A r(cont.), 212 kW 1160 RPM

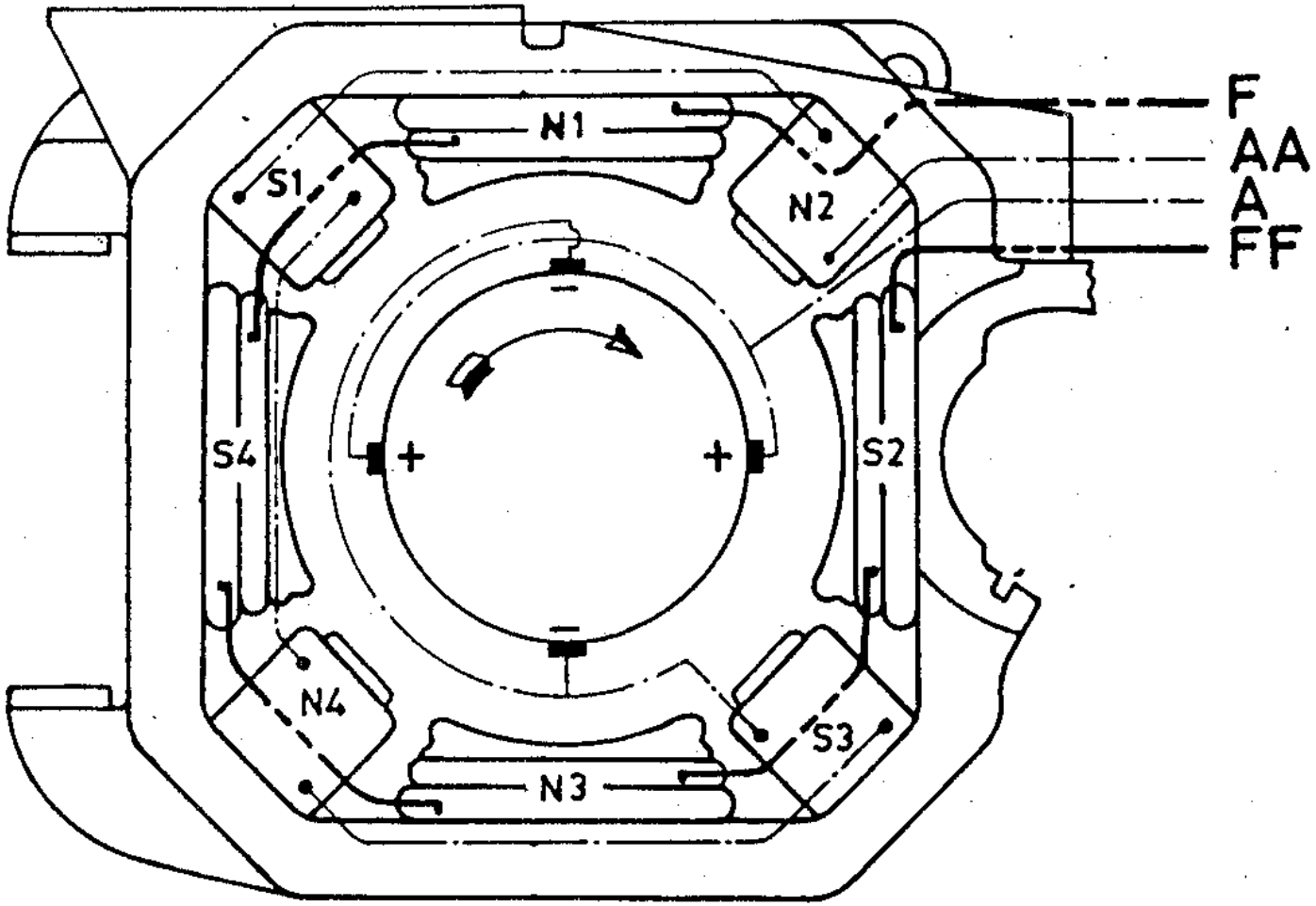
3005 of CGL for tube suspension type.

557 V, 415 A r(cont.), 208 kW 1160 RPM



1. MAIN POLE BOLT & WASHER
2. AIR DUCT
3. MAIN FIELD COIL & COIL ASSY.
4. ADAPTER PLATE
5. FAN CHAMBER
6. ARMATURE FAN
7. CE OUTER BRG. CAP BOLT & WASHER
8. OUTER BRG. CAP CE
9. BEARING WIPER C.E.
10. FAN NUT
11. FAN NUT LOCKING WASHER
12. ARMATURE NUT
13. ARMATURE BRG.C.E.
14. BRG CARTRIDGE C.E.
15. BRG. CARTRIDGE BOLT & WASHER
16. AXLE FLANGE DUST GUARD
17. WIPER FELT SEAL
18. BRUSH HOLDER CLAMP
19. B/H CLAMP BOLT & WASHER
20. AXLE SUSPENSION BRG.
21. AXLE CAP
22. AXLE SHIELD
23. COMPOLE BOLT & LOCK WASHER
24. COMPOLE COIL & COMPOLE ASSY.
25. MAGNET FRAME
26. P.E BRG.CAP
27. P.E INNER BRG. SLEEVE
28. P.E BRG. WIPE
29. GEAR CASE
30. PINION
31. SHAFT
32. ARMATURE BRG. P.E.
33. P.E BRG. CAP SOCKET SCREW
34. END SHIELD P.E.
35. GEAR WHEEL
36. GEAR CASE FELT SEAL

LONG SECTION OF TM 4601



DENOTES MAIN FIELD CONNECTIONS AT PINION END.

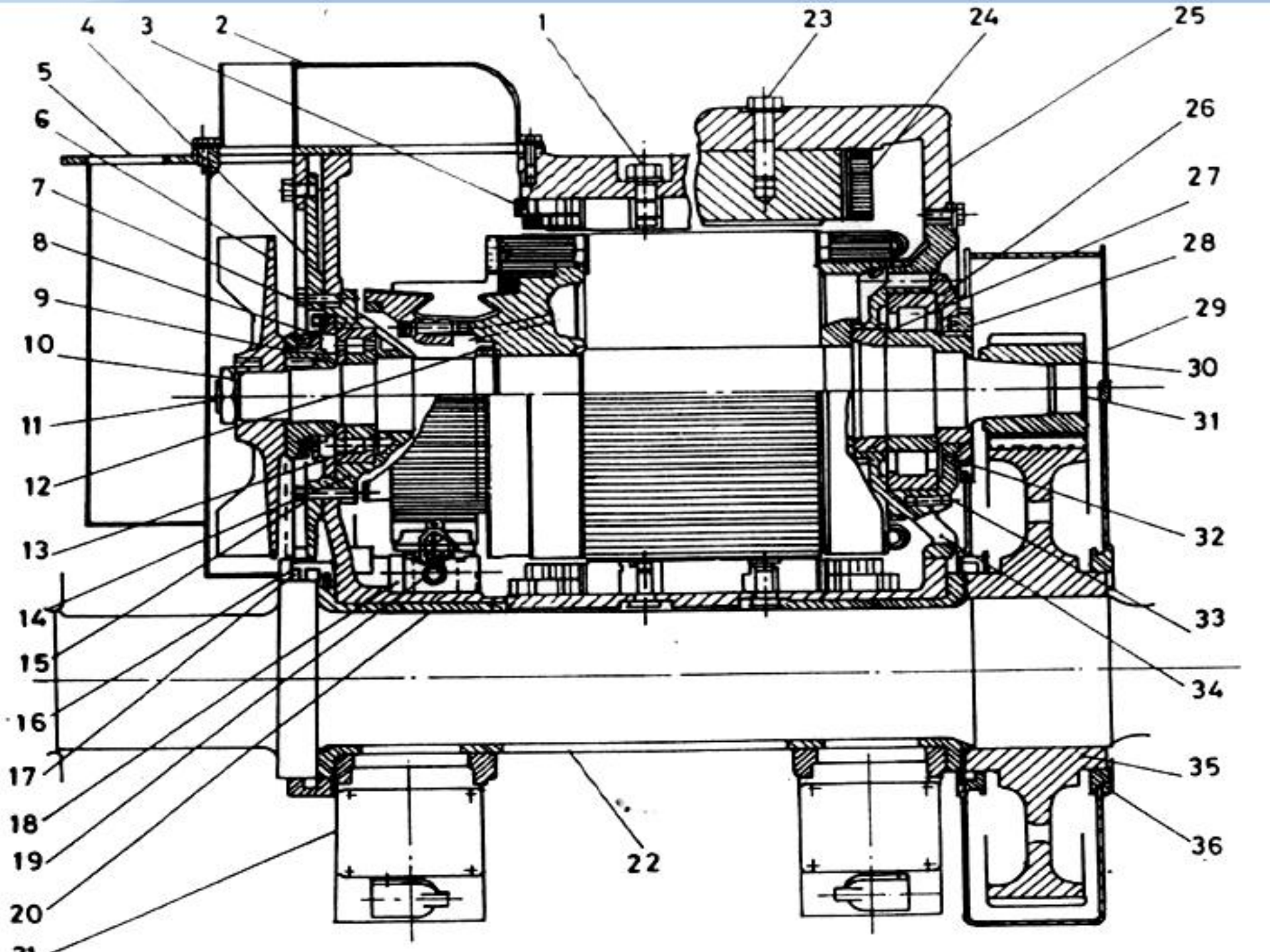
DENOTES COMPOLE FIELD AND BRUSHGEAR CONNECTIONS AT COMMUTATOR END.

VIEW LOOKING ON COMMUTATOR END

FIELD CONNECTIONS

OVERHAULING PROCEDURE

- Pre-Inspection
- **Run test**
- Before dismantling the motor, connect variable d.c. supply to its terminals (connecting armature and field in series) and run the motor at 1500 – 2000 rpm to check the bearings noise and vibrations.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1.	Main pole bolt	19	Brush holder clamp bolt
2	Air duct	20	Axle suspension bearing
3	Main field coil	21	Axle cap
4	Adapter plate	22	Axle shield
5	Fan chamber	23	Compole bolt
6	Armature fan	24	Compole coil
7	CE outer bearing cap bolt	25	Magnet frame
8	Outer bearing cap CE	26	PE bearing cap
9	Bearing wiper CE	27	PE inner bearing sleeve
10	Fan nut	28	PE bearing wiper
11	Fan nut locking washer	29	Gear case
12	Armature nut	30	Pinion
13	Armature bearing CE	31	Shaft
14	Bearing cartridge CE	32	Armature bearing PE
15	Bearing cartridge bolt	33	PE bearing cap socket screw
16	Axle flange dust guard	34	End shield PE
17	Wiper felt seal	35	Gear wheel
18	Brush holder clamp	36	Gear case felt seal

Test the Motor on No-load As Follows:

- Run the motor at a speed of 1500 RPM. After the motor has been running for a few minutes, check whether the run is smooth. If so, continue to run the motor and record the temperature of the bearing, the steady state temperature rise should not exceed 35 to 40 deg C above ambient.

Figure 3.33 RUN TEST OF TRACTION MOTOR ON NO LOAD

- Increase the speed to about 2000 rpm. After 15 minutes, increase the speed to 2725 rpm for short period. During this test, the peak temperature rise should not exceed 50 to 60 deg C above ambient.

Thanking You All