RS

Data Sheet

Synchronous motor and gearboxes

Synchronous motor (**RS** stock no. 332-802)

A synchronous motor having two separately wound phases red to grey and blue to grey, which depending on the way they are connected (Figure 1), will allow the motor to be operated from either 240Vac or 110Vac. The phases are wound symmetrically around 12 pairs of poles in the motor such that given a constant supply frequency 50Hz or 60Hz, a rotating magnetic field will be developed which will drive the central permanent magnet rotor (mounted on the output spindle) at a speed which is directly proportional to the frequency.

The motor is supplied with two capacitors of specific value and voltage rating which when connected as shown in Figure 1 will determine the direction and phasing of the current through the windings such that the resultant rotating magnetic field will change direction at the flick of a switch S. If only one direction is required then the appropriate capacitor should be permanently connected.

Figure 2 gives the motor dimensional details.

Features

- ● Accurate output shaft speeds
- ● High torque with small physical size
- ● Smooth running
- ● Dual voltage input
- ● Forward and reverse output drive
- ● Quiet operation.

Note: It is important that these capacitor values are adhered to as they are chosen for correct current phasing. Deviation of greater than ±10% of these values may result in motor instability.

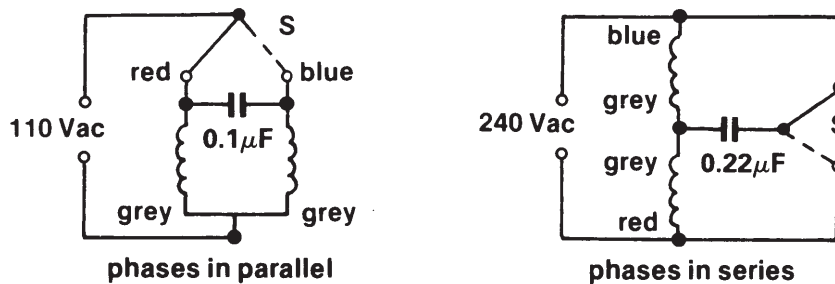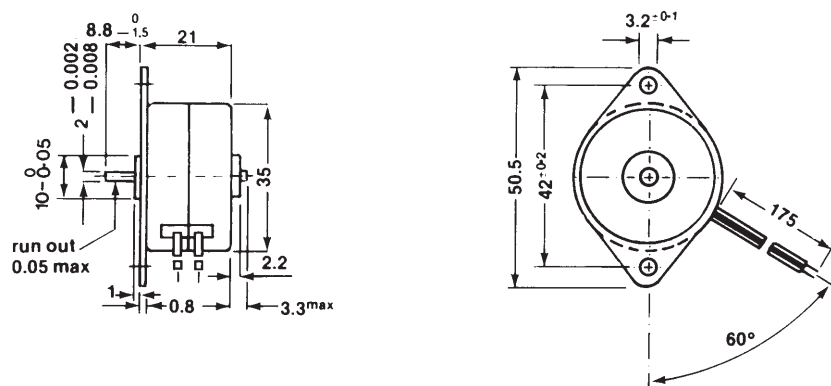
Figure 1 **Rate contacts of a switch S at 250 Vac minimum**

Figure 2 **Dimensions**

Motor characteristics figures are typical at T_{amb} = 25°C unless otherwise stated

| Parameter	Phases in parallel	Phases in series	Unit
Nominal input voltage	110	240	V(ac)
Input voltage tolerance	±10	±10	%
Frequency	50/60	50/60	Hz
Output speed	250/300	250/300	rpm
Running current	8	8	mA
Input power	0.8	1.7	W
Starting torque (max.)	4	7	mNm
Working torque (max.)	4	7	mNm
Torque derating	0.4*	0.4*	% per °C
Temperature increase of motor	30	50	°C
Required phasing capacitor	0.1	0.22	µF
Ambient temperature range	- 20 to +60		°C
Insulation test voltage	1500		V
Radial force (max)	2.5		N
Axial force (max)	0.75		N
Mass	80		g
Moment of inertia	2.6		gm cm2
Case	Zinc plated pressed steel		
Bearings	Sintered bronze (slide)		

* Derate torque by 0.4% per °C ambient temperature rise above 25°C, eg. maximum derating at T_{amb} = 60°C is (60 - 25) X 0.4 = 14%

Gearboxes

A range of ovoid shaped gearboxes, for use with RS synchronous motor 9 **RS** stock no. 332-802). Gears are fixed (reversible) ie. output shaft will not slip in either direction. Their rugged construction consists of cogs mounted between passivated steel side plates with beryllium copper intermediate support bearings and a self-lubricating bronze output bearing. The output shaft is stainless steel and incorporates a flat for ease of load coupling. The high material and constructional quality provides for a very efficient transmission of torque with speed reduction.

These advantages coupled with a gearhead fixture which is based on commonly-used ovoid standards renders this range suitable for reliable, long life performance in many industrial and instrument applications. Figure 3 gives dimensional detail including a motor/gearbox assembly profile.

Assembly detail

Figure 3 **Dimensions**
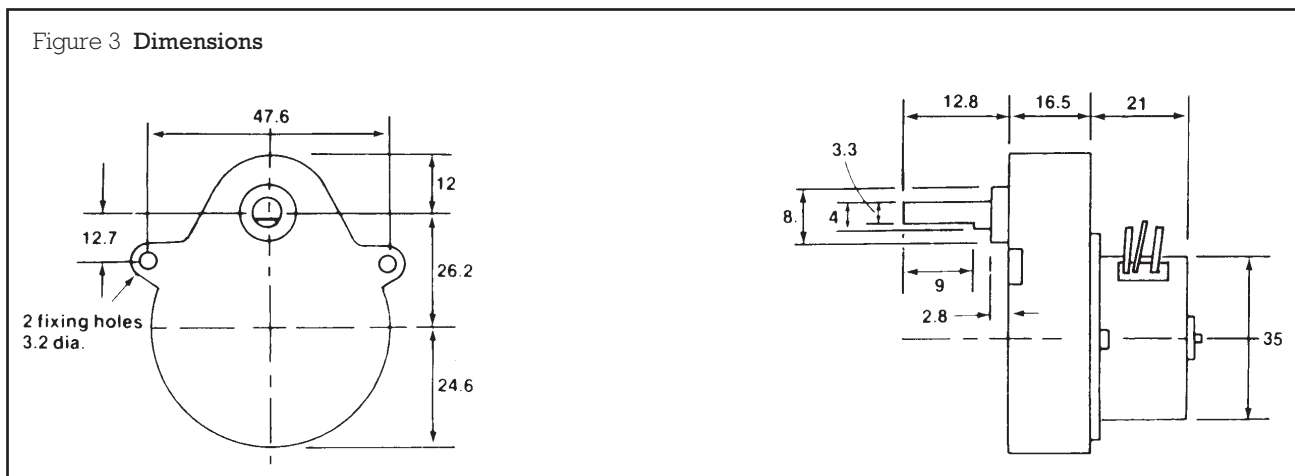
Gearbox parameters coupled with synchronous motor (RS stock no. 332-802) at 50 Hz

RS stock no.	332-868	336-450	336-444	336-438	336-422	336-416	336-400†
Synchronous output speed (50Hz)	60rpm	20rpm	10rpm	5rpm	2rpm	1rpm	1rph
Gear ratio	25 : 6	25 : 2	25 : 1	50 : 1	125 : 1	250 : 1	15,000 : 1
Maximum output torque *240V i/p	21mNm	62mNm	121mNm	233mNm	560mNm	800mNm**	80mNm**
110V i/p	12mNm	35mNm	69mNm	133mNm	320mNm	576mNm	800mNm**
Maximum radial load	40N (8 mm from mtg. face)						
Maximum axial load	20N						
Maximum shaft run out	±0.13 mm						
Maximum backlash	± 1°						

* @ T amb = 25°C   ** Absolute maximum torque for any gearbox

† Direction of rotation of output shaft is clockwise when the motor rotation is anticlockwise looking in the same direction.

Each gearbox is provided with a pinion which is the appropriate link between the motor and the first cog of the gearbox. With the aid of a spacer tool (also provided) and a little RS high strength adhesive retainer (RS stock no. 851-016), the pinion may be securely fitted to the motor spindle. Detail assembly instructions are supplied with each gearbox.

Load considerations

Torque

The gearbox should not be subjected to load torques in excess of the maximum output values stated. Should a mechanical stop be applied or the load system is inadvertently jammed, the motor is stall proof and will run with the output shaft locked. (Do not apply a stop to gearbox (RS stock no. 336-400) as the mechanical advantage of the gear ratio far exceeds the maximum torque of 800mNm.) As with any gearbox these conditions are not recommended

and where necessary loads should be controlled by overtravel cut out mechanisms linked to the motor supply or reversing switch S (Figure 1).

Care should also be taken when increasing the output shaft synchronous speed, by means of additional pulleys and gears, as the maximum available output torque will be proportionally reduced by the ratio of the increased speed and the efficiency of the additional pulley/gear system.

Example

Using gearbox (RS stock no. 336-444) at 240 V i/p with required final output speed of 15 rpm and an additional gear efficiency of 80%.

Final available output torque:

$$= 121 \times \frac{10}{15} \times 0.8 = 64.5 \text{mNm}$$

It will also follow that available output torque will increase proportionally with a required reduction in output speed. But in all cases, available torque will decrease with gear efficiency.

Figure 4 **Load torque and moment of inertia**

Torque = RF   Inertia = WR²
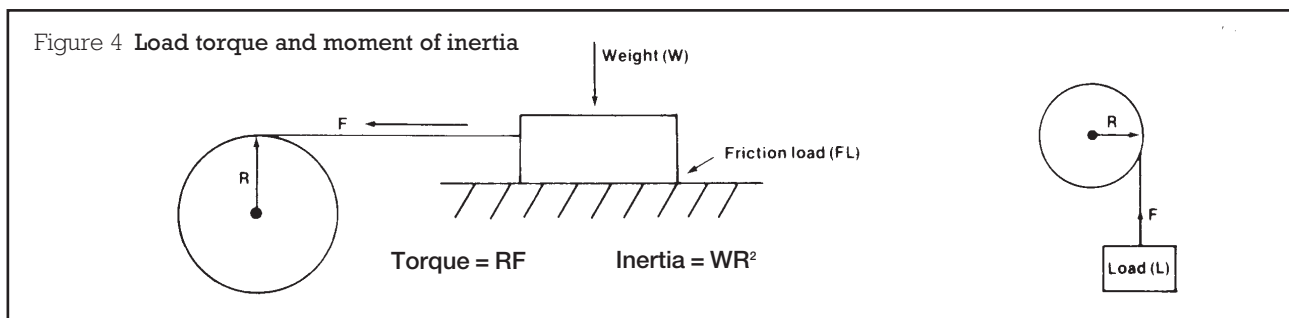
Torque is the force (F) applied at a radius (R) to lift a Load (L) or overcome Friction (FL). Inertia is the tendency of a body weight (W) to preserve its state of rest or uniform motion in a straight line.

In the case of RS synchronous motors and gearboxes, the motor equivalent moment of inertia (J) at the gearbox output should be equal to or greater than the equivalent load inertia at the same point.

This will ensure that load starting and stopping will not override the positional and timing control of the motor. A table of (J) is given for each gearbox fitted with motor (RS stock no. 332-802).

Gearbox RS stock no.	332-868	336-450	336-444	336-438	336-422	336-416	336-400
J (kg cm2)	0.022	0.2	0.8	3.2	20	80	144 x 10³

Depending on the state of the motor at rest (ie. the relative position between the rotor and the initiated magnetic field), under adverse conditions a starting time of up to 80mS should be allowed before synchronous speed is reached.

Torque conversion factors   Read down

Units to be converted	Imperial			Metric			International system - S.I.		
	0zf-in	lbf-in	lbf-ft	gf.cm	kgf.cm	kgf.m	mN.m	cN.m	N.m
1 oz·in =	1	0.0625	0.005	72	0.072	0.0007	7.062	0.706	0.007
1 lbf·in =	16	1	0.083	1152.1	1.152	0.0115	113	11.3	0.113
1 lbf·ft =	192	12	1	13825	13.825	0.13825	1356	135.6	1.356
1 gf·cm =	0.014	0.009	0.000 07	1	0.001	0.0000 01	0.098	0.01	0.001
1 kgf·cm =	13.89	0.868	0.072	1000	1	0.01	98.07	9.807	0.098
1 kgf·m =	1389	86.8	7.233	100 000	100	1	9807	980.7	9.807
1 mN·m =	0.1416	0.009	0.0007	10.2	0.01	0.0001	1	0.1	0.001
1 cN·m =	1.416	0.088	0.007	102	0.102	0.00102	10	1	0.01
1 N·m =	141.6	8.851	0.738	10.197	10.197	0.10197	1000	100	1

Example 1

Convert 10 lbf·ft into cN·m

cN·m

lbf·ft
10 × 135.6 = 1356 cN·m   135.6

Example 2

Convert 14 kgf·m into lbf·ft

lbf·ft

kgf·m
14 × 7.233 = 101.26 lbf·ft   7.233