

# HFSR

**H**ARMONIC **F**REE  
**S**ERIES **R**EACTOR\*

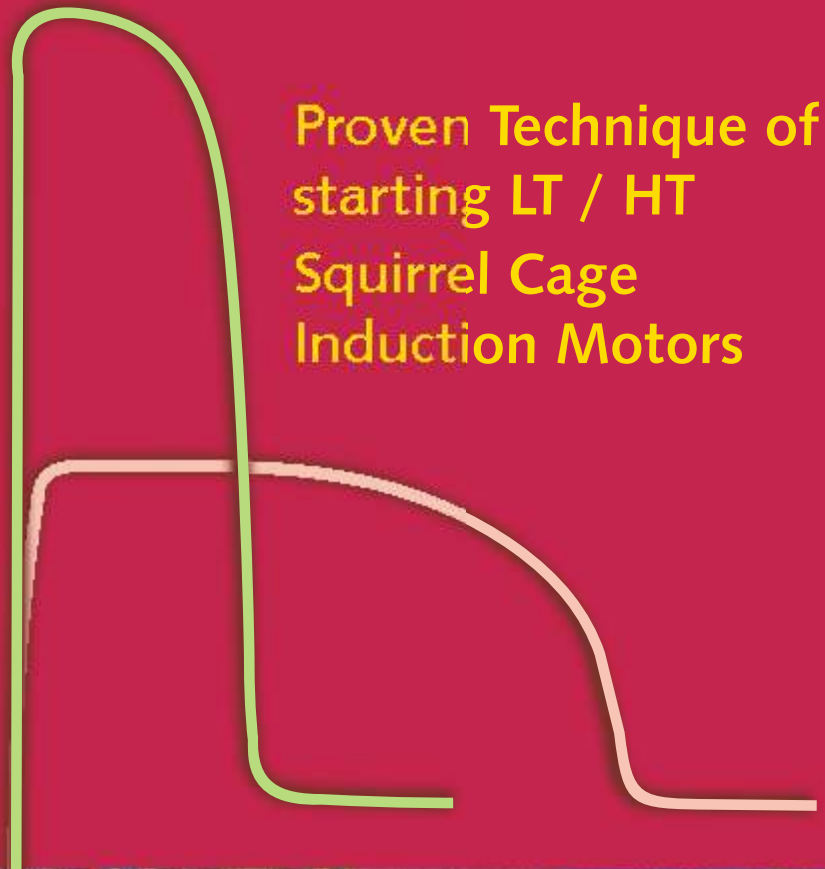
*\* Validated by recognized test house*

# Soft Starter

Series HFSR - 201



Proven Technique of  
starting LT / HT  
Squirrel Cage  
Induction Motors



Cement Plant

Chemical Industries

Pharma Industries

Irrigation & Water Supply

# HFSR HARMONIC FREE SERIES REACTOR\*

\* Validated by recognized test house

## Soft Starter

Series HFSR - 201

### INTRODUCTION:

Squirrel Cage Induction Motor is the most preferred drive in industry. However, starting of this motor has always been an intricate affair. The starting techniques that are universally employed fall into two basic categories.

#### 1) FULL VOLTAGE (DOL) STARTING:

Direct On Line (DOL) starting is the simplest and the cheapest method for starting induction motor but suffers from the effect of high starting current & associated torque jerk.

#### 2) REDUCED VOLTAGE STARTING:

Reduced Voltage starting is achieved by Star-Delta / Autotransformer / Series Impedance starting.

- A Start Delta method requires three power contactors and is always open transition, causing a surge during Changeover. This start Delta starting method can not be applied to H.T. Motors since their windings are generally connected in star.
- Autotransformer starting provides a better solution. However, the open transition from the tap to full voltage causes severe current surges during changeover. Closed transition from tap to full voltage overcomes this defect but the costs involved are abnormally high.
- The series impedance method consists of introducing either a resistance or a reactance of appropriate value in series with the motor winding during starting and then bypassing it when the motor reaches full speed. For a minimum energy loss the series reactance type arrangement is always recommended.

For low voltage (415 V) the Reactance can be introduced in line side of motor winding as against for HT motors, the reactance can be introduced into the line side or neutral side of motor winding.

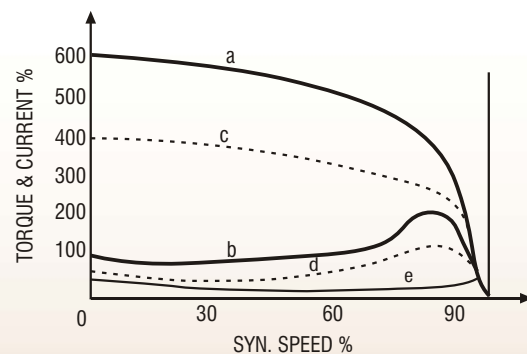
The air cored Reactor eliminates iron losses and saturation effect caused by magnetic core and gives perfect linear characteristics, totally free from harmonics. The Series reactance is designed to withstand surges & fault levels prevailing on the line side as well as neutral side of motor winding.



### HFSR SOFT STARTER:

The Jayashree HFSR soft starter falls in the category of series impedance type of starters & provides an optimum solution by reducing the starting current & ensuring gradual increase in the motor terminal voltage from the initial lower value to the line voltage in a smooth steps manner.

The simple and elegant construction of HFSR makes it the most reliable, economical and convenient device for starting of cage induction motors, particularly for drives such as centrifugal pumps and compressors whose load characteristics are parabolic, permitting low starting torque and involve moderate inertia.



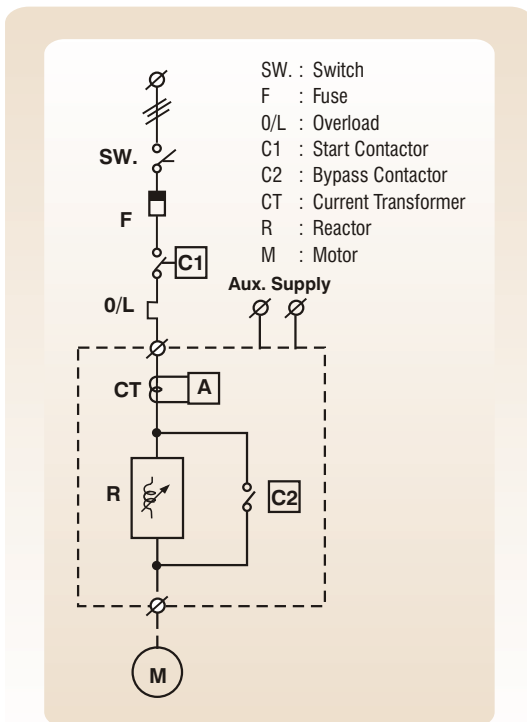
- |                        |                       |
|------------------------|-----------------------|
| a - Motor Current DOL  | d - Motor Torque HFSR |
| b - Motor Torque DOL   | e - Load Torque       |
| c - Motor Current HFSR |                       |

Fig. 1



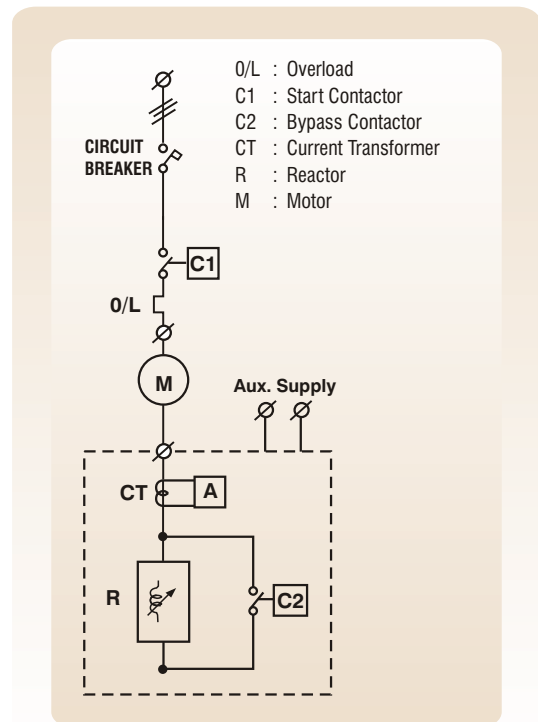
## PRINCIPLE OF OPERATION :

The HFSR acts as impedance in series with motor winding and allows only a part of the line voltage to be applied at the motor terminals at the time of starting. This results in reduced starting current coupled with reduced starting torque as compared with the DOL values. The reactor parameters are so chosen so as to allow the motor to generate adequate starting torque to overcome the load torque and friction to ensure smooth acceleration.



**HFSR - LS**

Fig. 2



**HFSR - NS**

Fig. 3

The starting current reduces well below DOL value, the actual permissible value depends upon the starting torque and starting current parameters of the motor and torque speed characteristics of the driven load. Please refer to Fig. 1.

As the motor accelerates the current drawn by motor goes on reducing as a result of generation of counter EMF in the motor winding. This in turn causes less drop across the Reactor and allows more voltage across the motor terminals thereby increasing the torque gradually. The Reactors are bypassed after a set time delay near motor full speed by appropriate rated Contactor. This entire process of reduction in current, with gradual increase in motor voltage, takes place in a steples manner from zero to full speed. This achieves very soft and smooth starting of the loads such as pumps & compressors.

The current and voltages fully retain their sinusoidal form and harmonic disturbances are totally absent. This starting duty is achieved as a result of natural behaviour of squirrel cage induction motor & the Reactor as a combination. HFSR does not incorporate any electronic controls which are likely to cause apprehension in the minds of the operating staff at remote locations. HFSR has found wide acceptance in countries like Canada, USA, Middle East. The IS 3914 also has taken cognizance of this method of starting.

## REACTOR DESIGN :

The Jayashree HFSR uses specially designed air cored reactors. The air cored reactors are superior in performance compared to Iron cored Reactors. They do not produce any humming sound during operation. The Iron cored reactors can get saturated and generate harmonics. The air core design also minimises the losses which can occur with Iron core design.

## STANDARD MODELS OF HFSR FOR MOTORS UPTO 10000 KW

Motor KW	MODEL	
	Line Side	Neutral Side
Up to 90 KW	HFSR 2011 LS	---
150 - 300 KW	HFSR 2012 LS	HFSR 2012 NS
400 - 750 KW	HFSR 2013 LS	HFSR 2013 NS
800 - 1200 KW	HFSR 2014 LS	HFSR 2014 NS
1300 - 2000 KW	HFSR 2015 LS	HFSR 2015 NS
2200 - 3000 KW	HFSR 2016 LS	HFSR 2016 NS
3000 - 4400 KW	HFSR 2017 LS	HFSR 2017 NS
4500 - 6000 KW	HFSR 2018 LS	HFSR 2018 NS
6500 - 8000 KW	HFSR 2019 LS	HFSR 2019 NS
8500 - 10000 KW	HFSR 2020 LS	HFSR 2020 NS

**Supply Voltage :** Add suffix 'L' for 415 V AC  
Add suffix 'M' for 3.3 KV/6.6 KV  
Add suffix 'H' for 11 KV

\* Note: Models for motor KW above 10000, please refer our works.

### CONSTRUCTION :

The HFSR consists of:

- A Reactance module in the form of a set of insulated air cored coils, held on a rigid steel frame, duly insulated for the rated voltage and with suitable taps. The coils are suitable to insulation grade class "H" / "F" and are vacuum impregnated to withstand the rated voltage. Coils are built from heavy copper section to circulate the current involved in starting duty without overheating.
- Shorting / Bypassing contactor suitable for the rated current and voltage of the motor.
- A strong sheet metal floor standing cubicle which houses, the reactor module, the shorting contactor, cable boxes, and control elements such as timer, auxiliary contactor, space heater etc. to meet all application requirements.
- Suitable arrangement for termination of required cable size.  
The reactor is provided with suitable taps for making finer adjustments at site to provide optimum starting solutions. The coils are natural air cooled and do not require any maintenance in services.

### STANDARD SPECIFICATIONS :

- Operating Voltage : 415V/3300V/6600V/11000V
- Control Voltage : 110VDC/240VAC.50Hz
- Auxiliary supply : 240 VAC
- Insulation : Class H/F
- Duty Cycle : 2 starts from cold and 1 hot start or 4 equispaced start / hour. For more duty cycles, please refer our works.
- Method of Cooling : Natural air cooled.
- Operating Condition: 55° C Max + altitude up to 1000m
- Space Heater : Provided on aux supply.
- Enclosure : 2/3 mm sheet steel floor mounting cubicle with bottom / side cable entry in IP32 grade of protection suitable for indoor installation.
- Finish : Epoxy powder coated

### ORDERING INFORMATION :

- The motor output in Kw, rated voltage, full load current, speed, power factor and resistance per phase.
- Control supply voltage, Auxiliary supply voltage.
- The motor torque speed characteristic at rated voltage and starting current with DOL starting.
- The load torque speed characteristic.
- The inertia of motor rotor as well as machine rotating parts.
- The number of starts from cold and in hot conditions.
- Any other relevant data.

## JAYASHREE ELECTRON PVT. LTD.

**Works :** EL-34, 'J' Block, M.I.D.C. Bhosari, Pune - 411 026. **Tel :** 020 - 30681343. **Fax :** 020 - 27120640.  
**E-mail :** sales@jayashree.co.in **Website :** www.jayashree.co.in