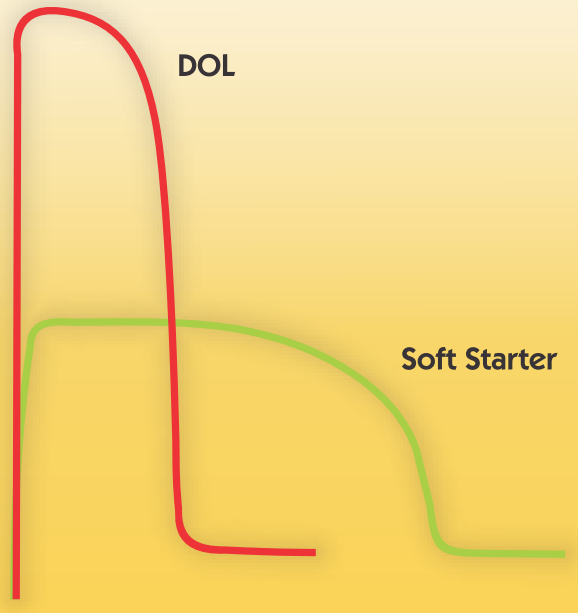
JAYASHREE ELECTRON

HFSR
HARMONICS FREE SERIES REACTOR ™

Soft Starters

Proven Technique of Starting LT / HT Squirrel Cage Induction Motors Up to 35 MW / 13.8 KV



Pumps

Crushers

Compressors

HFSR

HARMONICS FREE SERIES REACTOR (TM)

Soft Starters

Series HFSR - 201

INTRODUCTION :

'JAYASHREE' an ISO 9001 2008 company, established in **1972**, is engaged in Designing and Manufacturing of Electrical and Electronics Control and Safety products, like **LT/HT Soft starters, Electronic Non Contact Speed Switches, Proximity Switches** etc.

Jayashree is manufacturing Soft Starters of HFSR, Digital Type for more than 30 years. We have more than 5000 Installations throughout India.

MOTOR STARTING :

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 three basic categories as below:

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) A **Start Delta** method requires three power contactors and is always an open transision operation, causing a surge during changeover. This starting method can not be applied to H.T. Motors since their windings are generally connected in star.

b) **Autotransformer** starting provides a better solution. However, the open transition from a tap to full voltage causes severe current surges during changeover .

c) 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.

3) **V/F AC DRIVE :**

This technology is very useful for Staring LT Motors but is very expensive for HT Motors.

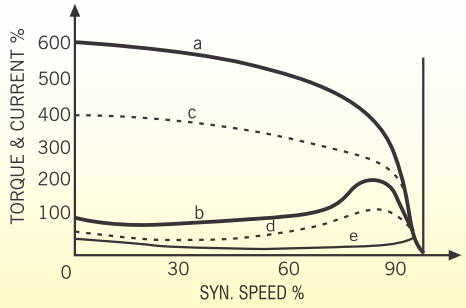
HFSR SOFT STARTER:

The complex process of Starting an Induction Motor is intelligently controlled by JAYASHREE make, **Harmonics Free Series Reactor (HFSR)** Soft Starters, which fall in the category of series impedance type of starters.

The HFSR modules in the Soft Starter, acts as impendence in series with motor winding and allows only a part of the line voltage to be applied at the motor terminals at the starting and finally gets bypassed after starting process is complete. This results in a reduced starting current coupled with reduced starting torque as compared with the DOL starters.

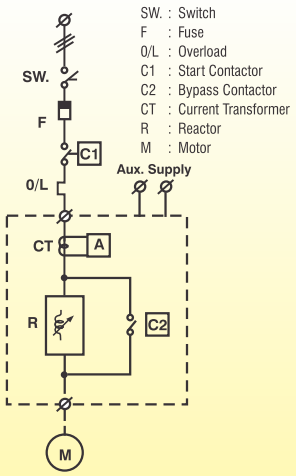
PRINCIPLE OF OPERATION:

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.

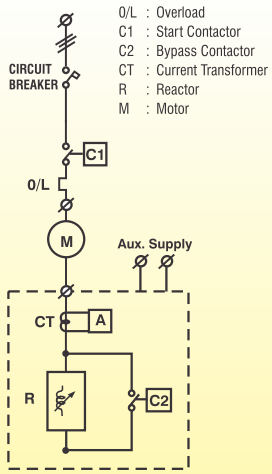


a - Motor Current DOL
b - Motor Torque DOL
c - Motor Current HFSR
d - Motor Torque HFSR
e - Load Torque

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.



HFSR - LS Fig. 2



HFSR - NS Fig. 3

Total control at a tip of finger with New advance HMI /PLC System :

The HFSR Series Soft – Starters are now available with use of advance, rugged HMI /PLC control System.

- Big display – 5.7" LCD
- Display of Starting current/Voltage/KVA
- Multiple preset sets of starting parameters for instant selection
- Auto self check
- Complete protection against failure
- Password protected
- Memory of faults
- Data logging of operations for 5 years.

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 starting event is closely monitors by PLC control with a close loop control system which provides a smooth trouble free starting and ensures the bypass is achieved below FLC. This entire process of reduction in current, with gradual increase in motor voltage, takes place in a step less manner from zero to full speed. This achieves very soft and smooth starting of the loads, such as pumps & compressors. all the working parameters/warnings/faults/errors are communicated with HMI, all the site programming is done through HMI.

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 has found wide acceptance in countries like Canada, USA, Middle East Europe, entire Asia and African continent, the HFSR soft starter installations are available all over the world.

The IS 5553 (part 3) confirm the use of Air Core Type Reactors for Soft Starting application.

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. The reactors are manufactured strictly according to IS & IEC standards.

STANDARD MODELS OF HFSR FOR MOTORS UP TO 35 000 KW

Motor KW Range	Model No.	Suffix Details
Up to 90	HFSR 2011	LS= Line Side Soft Starter NS= Neutral Soft Starter L = 220 To 690 VAC M = 3 KV To 6.6 KVAC H= 11 KV To 13.8 KVAC C = HFSR with dynamic compensator F= HFSR with line contactor /feeder VCB S= complete start station with HFSR
91 TO 300	HFSR 2012	
301 TO 750	HFSR 2013	
751 TO 1200	HFSR 2014	
1201 TO 2000	HFSR 2015	
2001 TO 3000	HFSR 2016	
3001 TO 4500	HFSR 2017	
4501 TO 6000	HFSR 2018	
6001 TO 8000	HFSR 2019	
8001 TO 10000	HFSR 2020	
10000 TO 35000	HFSR 2030	

Example : 800 KW 11KV neutral HFSR soft starter with dynamic compensator model number = HFSR 2014 – NS – H – C

CONSTRUCTION :

The HFSR consists of:

a) 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 copper section to circulate the current involved in starting duty without overheating. The Reactors are designed as per IS 5553 guide lines.

b) Shorting / Bypassing contactor suitable for the rated current and voltage of the motor.

c) A strong sheet metal floor standing cubicle, fabricated on CNC Machine 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.

d) 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.

STARTING CURRENT :

Our standard models are designed to limit starting current between 3*FLC to 3.5*FLC. Special models with use of additional DCC (Dynamic Compensator Capacitor) Panels are available upon request. The starting current can be brought down to 1.2*FLC by using DCC Panels.

STANDARD SPECIFICATIONS :

- Operating Voltage : 415V/3300V/6600V/11000/ 13800V, 50/60Hz
- Control Voltage : 110VDC/240VAC.50Hz
- Auxiliary supply : 240 V AC
- Insulation : Class H / F
- Duty Cycle : 2 starts from cold and 1 hot start or 4 equal spaced 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 IP42 grade of protection suitable for indoor installation.
- Finish : Epoxy powder coated

ORDERING INFORMATION :

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

APPROVALS :

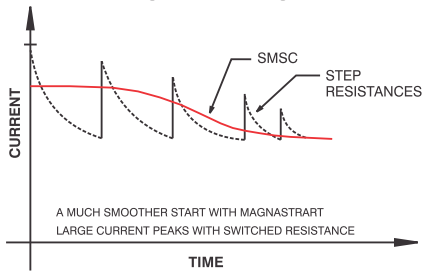
- Tested at CPRI up to 10MW / 12KV
- Design Appreciated by Institute of Engineering India.
- Major Infrastructures & water supply projects.

SLIP RING MOTOR SOFT STARTERS :

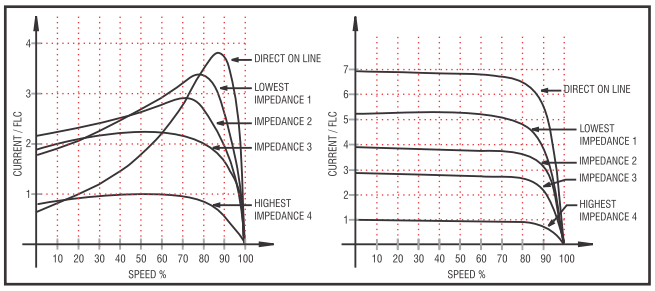
Jayashree 'SMSC' is a unique Impedance system for starting asynchronous Slip ring Induction Motors offering considerable improvements in maintenance, reliability and cost-effectiveness.

The SMSC product line consists of a range of steel cored Inductors, each individual model suitable for a variety of motor sizes. When used with rotor starter systems,the SMSC acts as a auto adjusting rotor impedance during run-up, and is bypassed by a shorting contactor when near full speed is reached.

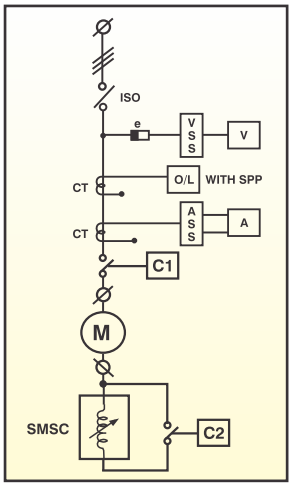
To start a system driven by motor, an amount of electrical energy, approximately equal to the mechanical starting effort, has to be dissipated by the rotor circuit. With a squirrel cage motor, this would appear in the rotor itself. A slipring rotor enables this energy to be absorbed in external equipment, thus avoiding overheating of the rotor.



The Impedance of SMSC is maximum at the supply ON instant and it reduces automatically as the motor accelerates. The energy of the Rotor is dissipated in SMSC modules. The change in impedance is directly proportional to speed. The design ensures that the Stator current remains almost constant up to approximately 75% of rated speed and then reduces.



Typical torque and current to speed characteristics are given in the charts above to illustrate the benefits of using a 'SMSC' as a rotor starter, compared to direct on line starting. (The impedance values 1- 4are nominal, and only reflect the typical range of impedances achievable from a 'SMSC', not any particular tapping). Fig. 5 shows the variation in starting torque as a proportion of Full Load Torque (FLT) with impedance.



STANDARD MODELS OF SMSC FOR MOTORS UP TO 2000 KW:

Motor KW Range	Model No.	Suffix Details
Up to 45	SMSC 2011	SR = Stator + Rotor Side RS = Rotor Side L = 415 V AC M = 3.3 KV To 6.6 KV H = 11 KV
Up to 55	SMSC 2012	
Up to 95	SMSC 2013	
Up to 150	SMSC 2014	
Up to 220	SMSC 2015	
Up to 500	SMSC 2016	
Up to 1000	SMSC 2017	
Up to 2000	SMSC 2018	

ORDERING INFORMATION :

a) Motor kW / Voltage.
b) Motor RV / RA Values.
c) The number of starts from cold and in hot conditions.
d) Any other relevant data.

ASK THE EXPERT:

Please contact us for any of your motor starting problem. We can give you a complete solution. We can supply all types of panels (MCC's, PCC's, APFC) associated with Soft Starter for more details call or write to

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