

Presentation on Products / technologies

S. K. Dynamics Pvt. Ltd.

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Ether mechanics Pvt. Ltd.

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About S K Dynamics Pvt. Ltd.



◆ S K Dynamics Pvt. Ltd. (SKD) was established in 1992 with sole purpose of pursuing R&D projects in the area of Electromechanical Engineering, Digital Signal processing, Power Electronics and System engineering.

◆ Since 1995 SKD is recognized by Department of Scientific and Industrial Research (DSIR), India as in-house R&D unit and now approved as **Commercial R&D Company** (TU/IV- R&D.Com /37/ 2002-03).

◆ SKD has worked with Analog Devices, Inc. USA in the area of Motor Control, and has launched ADMC326-SKD-1F Universal Embedded Processor.

◆ Around **2 Million** Household appliances in the USA, Japan, Europe and China are working using SKD Embedded (Motor) Control Technology.

◆ Recently developed high performance Motors with power to weight ratio of 1 hp / Kg for Aerospace application.



About SKD

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Present & past Clients

- ◆ Indian Space Research Organization
- ◆ Indian Defense Labs
- ◆ Indian Automotive Industry
- ◆ ACC / SOLE Italy
- ◆ Analog Devices Inc. USA
- ◆ Sharp Japan, (Embedded Control for Refrigerator)
 - ◆ Frigidaire USA, (Embedded Control for Washing Machine)
 - ◆ Huening China, (Embedded Control for Air-Con.)

Core Competence

- Motors and Motor controls
- Digital signal processing & processors
- Embedded software
- Microprocessors & Micro controllers
- Power Electronics
- Electromechanical Engineering
- FPGA, Analog and Digital Electronics
- System Engineering /System Integration
- Product manufacturing capabilities & Prototype Manufacturing



- ◆ DSIR National Award 2000 for Technology Export of Motor control.
- ◆ EEPC Award 2000 and 2001 for Services Export.
- ◆ ESC Award for Services Export in the years 1998, 1999 and 2001.
- ◆ NSIC Award for Electric Bicycle Technology
- ◆ ADI Award for world's first Washing Machine using DSP Control
- ◆ VNMM award by IIT – Roorkee to Mr. Rakesh Goel (CEO)



About Ether mechanics Pvt. Ltd.

- ◆ Floated in 2006 in Roorkee (India)
- ◆ Main objective is to establish small volume production of motors and DSP controls
- ◆ Technology available from partner company S K Dynamics Pvt. Ltd.
- ◆ Present focus is to produce high efficiency products in the area of motors & controls
- ◆ Willing to start production of small wind generators
- ◆ Promoter Directors Rakesh Goel and Ankur Goel are also Directors in the partner company S K Dynamics Pvt Ltd

Awards & Achievements



Products recently developed by SKD



BLDC motor (12KW) with Integrated Control

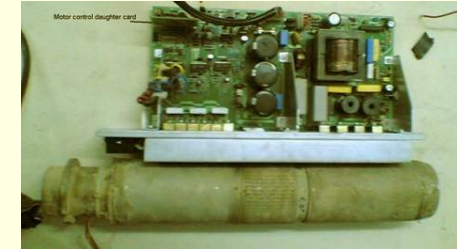


350W & 750W BLDC Motor With Integrated control

800W Transformerless Sine Wave Inverter



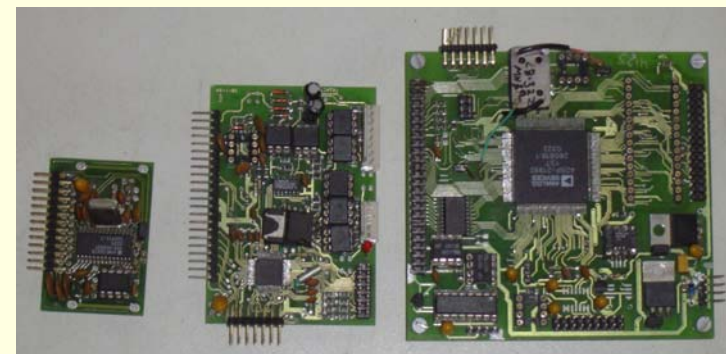
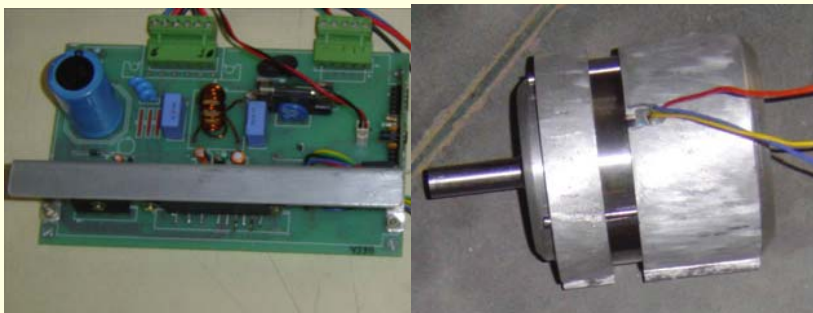
SMPS based Battery Charger with PFC



Submersible Pump



High Efficiency Washing Machine Solution



Various control card based on different DSP's for different applications

Breakthrough Prototype / Technology

Torque and thrust generation in Space Without using reaction mass

[worldwide Patent Pending Application PCT/IN2010/000223]

Apparatus name & model: Gravity Motor **D10P4**
Weight: 19 kg
Power consumption: 350 W
Torque Output: 0.03 Nm (300 gram-cm)



Renewable Energy Wind Turbine

Introducing the indigenously developed Wind Turbine for harnessing the Renewable Energy provided by the winds. Following Technical advancements are present:

- The Alternator is **Permanent Magnet Synchronous (PMS)** thus providing maximum efficiency & highest power output in least frame size possible
- DSP based alternator controller results in increased performance & improved battery charging capability
- Controller allows for peak-power tracking of the wind by optimizing the alternator's output on all points of the cubic curve and then efficiently delivers the energy to the battery
- Blades of the turbine are mounted on a gear driven rotating fixture which automatically alters blade angle based on wind speed c

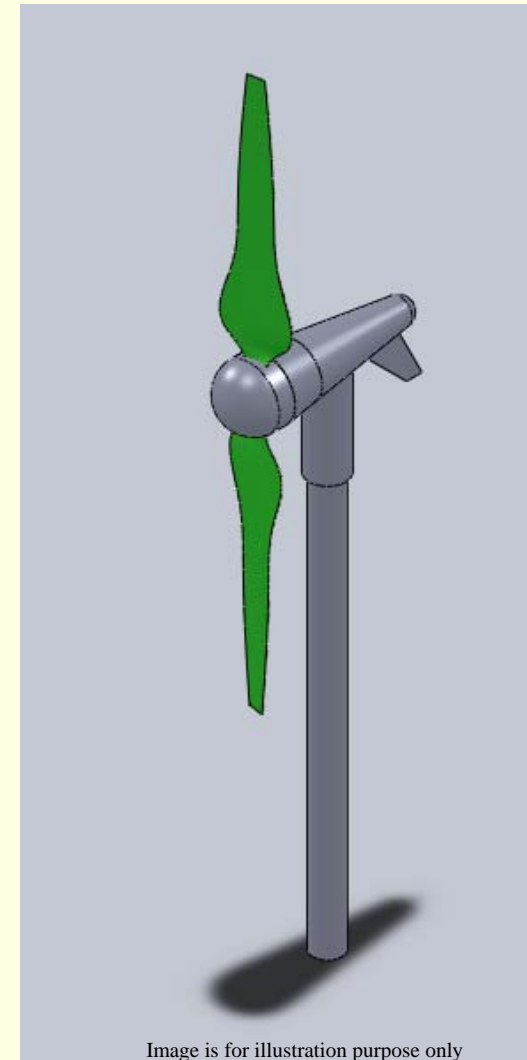


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Renewable Energy Wind Turbine

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Features:

- Simple rooftop installation; no tower necessary
- Brushless type Alternator for less replacement parts
- Sophisticated internal battery charge regulator
- Maintenance-free – very few moving parts
- High Wind Safe Mode - Automatically slows turbine in potentially damaging winds and reduces noise.

S.No.	Technical Details	Unit	Specification
1	Model No.		WT-100
2	Rotor Diameter	M	1.3
3	Weight	Kg	8
4	Start-up Wind Speed	m/s	2.8
5	Voltage	V	24
6	Output	W	400 at 12m/s
7	No. of Blades		2

Submersible Pumps

Presenting the new era of Submersible Pumps with following Technical advancements:

- Based on **Permanent Magnet Synchronous Motor (PMSM)** technology for lower power consumption operating in **sensorless mode**
- PMSM operates at **higher speed** and has **higher motor efficiency**
- Higher motor speed has enabled us to reduce the number of impeller stages to achieve required water head and delivery which has in-turn has **increased pump efficiency**
- Soft-start technology based controller enables the Pump motor to increase speed gradually with controlled current allowing the **submersible to start and run even on 1KW Inverter**

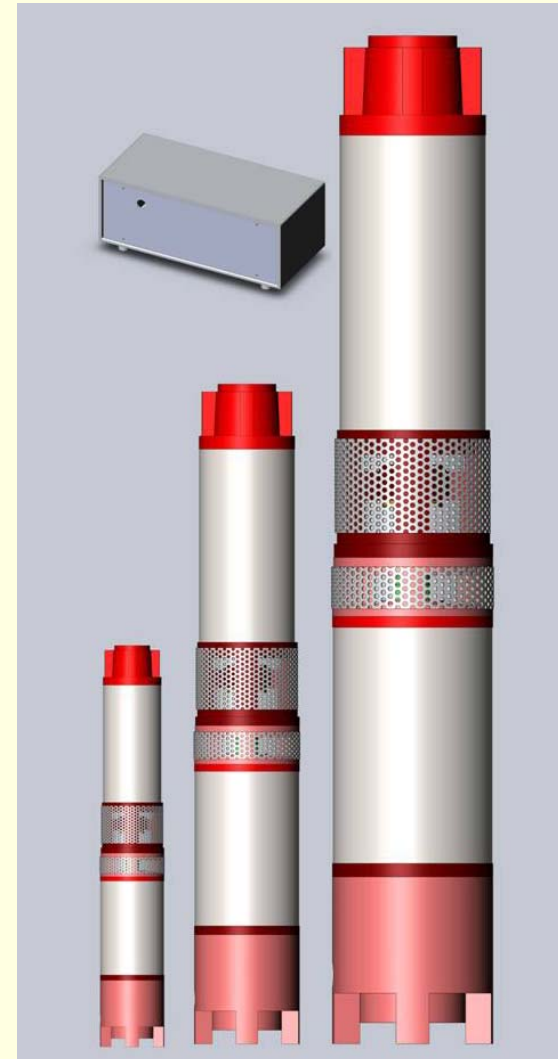


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Submersible Pumps

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S.No.	Technical Details	Unit	4" Bore	3" Bore	2" Bore
Motor					
1	Model No.		V-4	V-3	V-2
2	Outer Diameter	mm	94	68	42
3	Speed	rpm	5800	7500	10000
4	Power	W	800	750	500
5	No. of Poles		8	6	4
6	No. of Slots		12	9	6
Pump					
7	Maximum Pressure	Bar	5		4
8	Maximum Flow	LPM	80		60
9	Maximum Power		60 LPM @ 3 Bar		30 LPM @ 3 Bar
10	Number of Stages		3		4
Control VSD					
11	Input Voltage (Nominal)	V, AC	220 +/- 10%		
12	Minimum Voltage	V, AC	160		
13	Maximum Voltage	V, AC	260		
14	Protections		Under / Over Voltage, Wire Break, Overload, Over Temperature		

Heritage

- We have developed more than 50 products / technologies in past 32 years
- We have made DC shunt motors from 1977 and PMSM / BLDC from 1994
- We cover wide range of BLDC motors from 10 W to 18 KW

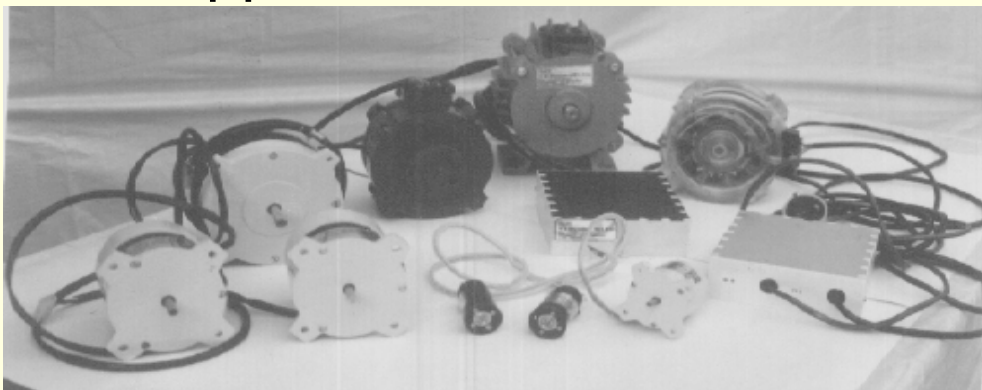
About Motors & Controls

Types of Motors

- DC Brush Motor
- Induction Motor
- Permanent Magnet Synchronous Motor (PMSM)
- Brushless DC Motor (BLDC)
- Switched Reluctance Motor (SRM)
- Stepper Motor

Motor Configurations

- Conventional Configuration
- (Outer Stator)
- Outer Rotor Configuration
- Pancake / HUB Motor
- Linear Motor
- Low Inertia / Coreless Motor
- High Inertia / Gyro Motor
- Motor with Internal Planetary Gear Assembly



Performance of our BLDC Motor

Motor performance is described as power to weight ratio. A typical value is 1 hp/kg achievable for high performance motors above 1 hp.

Higher number of poles and operation at 1 KHz electrical frequency is the main factor for high performance BLDC motors. However, there are certain limitations while increasing # of poles

BLDC Motor design is a complicated process, but a shortcut is

Power = $.03 \times f \times D^2 \times L$ Watt , Speed = $f \times 120 / (\text{No of poles})$ rpm

Where f= frequency (Hz), D = air gap diameter (cm), L= stack length (cm)

Example: Poles=12, f=1 KHz, Dimensions= 8 cm dia x 8 cm length,
D=4 cm, L=5.5 cm, speed=10000 rpm, power= 2.5KW, Weight= 3 Kg

Advanced Techniques used in DSP based control

1. Third Harmonic Injection and Space Vector Modulation was used in induction motor control for washing machine.
2. Single Point Discrete Fourier Transform was used in sensorless Vector Control of induction motor based compressor control
3. Digital Angular Filter with Phase advance was used in BLDC control.
4. Nonlinear controls were used in speed and servo controls.
5. Maxima of cross-correlation/ Auto-correlation for rotor position estimation was used in PMSM sensorless control of refrigerator compressor and submersible pump.

SKD

EM

Typical Induction Motor Control (for Washing Machine)

- Optimized processor for motor control application
- Wide range Speed Control 200 to 16000 rpm of a 4 pole motor to give efficient washing control during Tumble/ Spin
- Timer Motor Control
- Data Recovery during Power Failure
- Weight unbalance detection and re- distribution
- **Over 2 Million washing machines are sold in US market, based on this design**

Typical PMSM Sensorless Control (for Refrigerators)

- The control Solution for a Sensorless PMSM was developed in the year 1996 which was modified and tuned for a refrigerator compressor control by 1998.
- The Sensorless PMSM control technique is implemented, in which only two windings are excited at a time and third phase is used to measure back EMF for Rotor position detection.
- This solution was transferred and used by Sharp - Japan for their refrigerator compressor control.
- Over **0.5 Million** refrigerators were sold in Japanese market based on this technology, which is protected by **US Patent 5,635,810**.

Bofors Gun Control Project-

- Bofors Gun control unit was developed by SKD, for its sister concern Saraswati Dynamics Pvt. Ltd. working for the Indian Army under a financial commitment.
- It was a challenging project as the control unit was the only electronic part in the complete Gun unit, while rest of the Gun contains electromechanical and hydraulic equipments.
- Original unit was developed by Philips Holland.
- SKD used DSP and FPGA technology to design more efficient and reliable control unit. We developed and our associate company Saraswati Dynamics supplied 28 control units to Indian Military.
- Joint National award was received from DSIR, Government of India for the same.



About Key Person

- Name** : Rakesh Goel
- Present Designation** : Managing Director & CEO of S.K. Dynamics Pvt. Ltd.
- Qualification** : Bachelor of Engineering in Electronics & Communication [Gold Medalist] from IIT Roorkee, (Formerly known as University of Roorkee), India in 1977.
- Industrial Experience** : Worked as a Technical Director and Partner in an Engineering Firm from 1978 to 1992 where I completed various projects and developed many Test Equipments and Control Systems.
Established full fledged R&D Organization S.K. Dynamics Pvt. Ltd. in 1992 after acquiring experience of about 15 years in Engineering Industry. SKD worked as strategic Partner of ADI from 1994 till 2005 and developed Motor and Control Solution for ADI and their customers.
SKD continues to receive *Royalty from ADI for its Motor Control Technology.*
- Specialization** : Motors and Motion Control, Electromechanical Engineering, Digital Signal Processing & Processors, Embedded Software, Power Electronics, Analog and Digital Electronics, System Engineering, Prototype manufacturing capability and Product Engineering.



About Key Person [contd.....]

Patents

[Granted / pending]

- : 1. Control System for PMSM US Patent 5,635,810 [Granted]
- 2. Improved Gate Driver Circuit and Hysteresis Circuit Therefore US Patent 5,675,276 [Granted]
- 3 Geared Permanent Magnet Synchronous Motor (India, Application No. 1884/CAL/96) .
- 4. Electronic Compass (India, Application No. 1011/CAL/98) .
- 5. Electrical Transmission Based Flying Car India (October 19, 2000)
- 6. Dedicated Permanent Magnet Synchronous Motor for Washing Machine, (October 12, 2007)
- 7. Low Cost Tacho Generator (Nov 14, 2008) [Pending].
- 8. Thrust and Torque Generation in space without reaction mass (April 2009) [Pending].

Paper & Thesis

- : i) Flexible Speech Audio Coding published in Signal Processing & Communication, January 18-20, 1993 IISC, Bangalore, India.
- ii) Generation of Gravitational Force (ICGA-5) October-2001, Russian Gravitational Society.
- iii) A method to calculate the value of Pi, The Mathematics Students Vol.72, Nos. -4 (2003), 227 – 232.
- iv) Universal Embedded Controller ADMC326-YR-SD-1F for various Motor Control and Power Electronics Applications, GSPx2003.
- v) Intelligent Tracking Camera System, GSPx2004.

Membership

- : i) Member IEEE
- ii) American Physical Society

Thank You

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