



YASKAWA

# Varispeed F7

ADVANCED FLUX VECTOR CONTROL  
GENERAL-PURPOSE INVERTER



Powerful, Compact, Energy Efficient



EBG-Control & Automation Business Unit  
**LARSEN & TOUBRO LIMITED**

# Enhanced Value at Maximum Performance-Cost

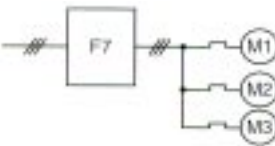
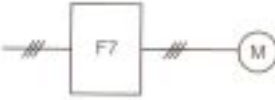
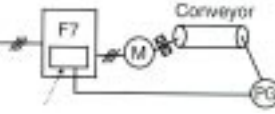
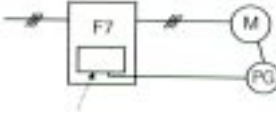
The F7 drive is the most versatile drive in the market with an exceptional variety of design features and options applicable in an incredibly wide variety of installations to provide the optimum control method. The F7 can operate in conventional V/f, V/f with encoder feedback, open loop vector, or Flux vector mode. It can handle every conventional application found within a typical industrial plant from simple variable torque pumping to sophisticated networked Material Handling, Metal, Paper Process Lines, etc. All of this is possible with the smart and flexible design platform of the F7, providing both Normal and Heavy Duty ratings, four modes of control, network communication options, application-specific drive software, and an array of standard and optional input/output choices.

For Variable Torque (VT)

For Constant Torque (CT)



## New Equipped with 4 Control Modes

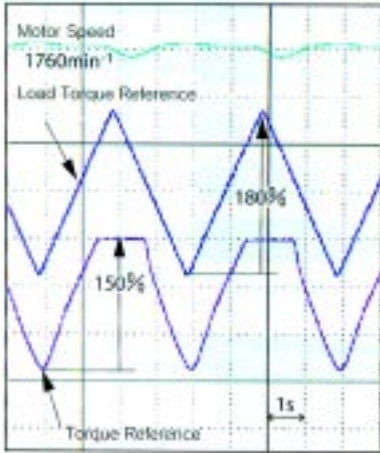
<p><b>V/f control</b></p> <hr/> <p>Drive for multiple motors</p> <p>A single inverter drives multiple motors</p> 	<p><b>Open-loop vector control</b></p> <hr/> <p>High-performance drive without speed detector</p> <p>No need of PG wiring</p> 	<p><b>V/f control with PG feedback</b></p> <hr/> <p>Accurate control on a line speed</p> <p>Speed control using the machine axis speed feedback</p>  <p>PG speed control card (PG-A2 or PG-D2)</p>	<p><b>Flux vector control</b></p> <hr/> <p>High-precision drive using PG feedback</p> <p>High-precision positioning, zero-speed control, and torque control</p>  <p>PG speed control card (PG-B2 or PG-X2)</p>
--	---	--	---

# Advanced Control Features for Outstanding Performance

## Torque Limit

The precision torque limit function allows accurate control of the output torque, protecting your machines from sudden load fluctuations.

- ◆ **Torque Control** (Torque limit set at 150%)



## Torque Control (with Flux Vector Control)

The motor torque can be controlled freely using external references. This function is effective for winding and rewinding motions of winders.

Configuration	Winding Operation		Rewinding Operation	
	Forward	Reverse	Forward	Reverse
Item Rate Detector	Forward	Reverse	Forward	Reverse
Torque Reference Polarity (TRCP)	(+)	(-)	(-)	(+)
Speed Limit Polarity (SLMP)	(+)	(-)	(+)	(-)
Generated Torque				

## Zero-servo Control (with Flux Vector Control)

No matter if an external force is applied or an offset is set for an analog reference input, this function stops a motor electrically and forcibly when the frequency (speed) reference drops to the zero-speed level.

- ◆ **Zero-servo Signal Timing Chart**

Setting the zero-servo command to one of the multi-function contact inputs S3 to S8 enables the zero-servo function.

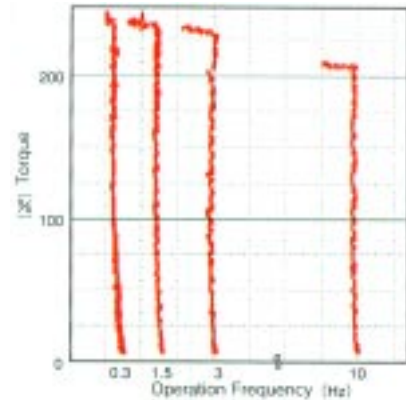


If the frequency (speed) reference decreases to the zero-speed level while the zero-servo command is ON, the motor stops in zero-servo status.

## High starting torque

With flux-vector control, a high-torque operation of 150% or more is possible from zero speed.

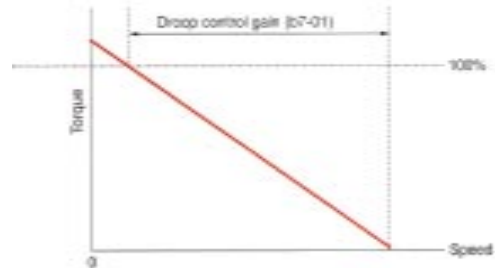
With open-loop, vector control, a high-torque operation of 150% at 0.5 Hz is possible from a low speed of 1/100.



## Droop Control (with Flux Vector Control)

This feature converts low slip motor behaviour to high slip motor. Very useful for the application requiring single load to be driven by two motors in current sharing mode.

- ◆ **Droop Control Gain**



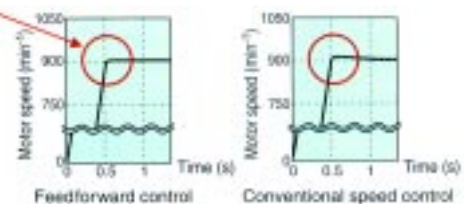
Set the droop control gain as the speed reduction at a 100% motor torque, as a percentage of the maximum output frequency

## Feedforward Control (with Flux Vector Control)

An accel/decel torque is applied by the feedforward control device, which enables a quick response. Therefore, it is not necessary to increase the gain forcibly. This function is effective to improve response to accel/decel for a load with high moment of inertia or machine with low rigidity.

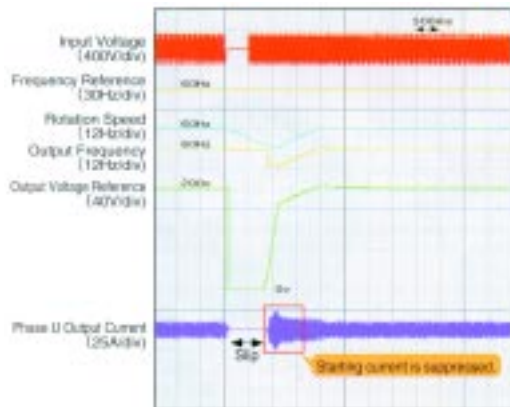
- ◆ **Overshoot Control Effects**

Overshooting is suppressed when the acceleration completes.



- **High-speed search (patent pending)**

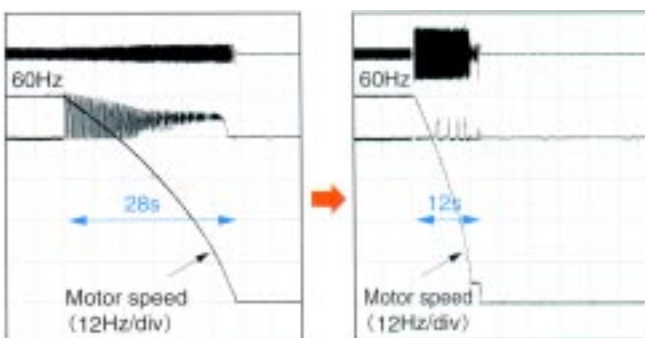
- The high-speed search function reduces the recovery time after momentary power loss (halved in in-house comparison)
- Recovery is possible regardless of direction of rotation without speed detector.
  - ◆ **Quick, Shockless Start**  
(Continued operation after momentary power loss)



- **Quick stop without using braking resistor**

The newly developed high-slip braking function reduces deceleration time to 50% without using a braking resistor even for a load with high moment of inertia. This function is effective for emergency stop of machines with high moment of inertia such as press machines, centrifuges, and blowers.

- ◆ Deceleration to stop without using a braking resistor
- ◆ High-slip braking stop without using a braking resistor



- **Built-in Memobus (Modbus) Communication (RS-485/422, 19.2kbps)**

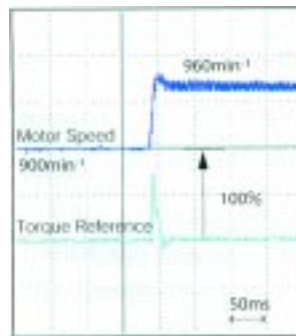
- **Certified by UL/cUL and CE marking**



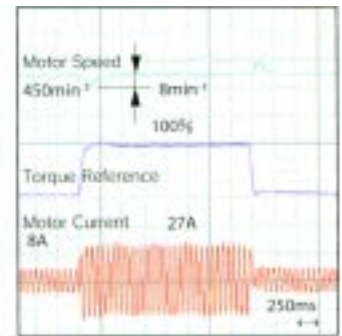
- **High-speed response**

Open-loop vector control: Speed response 5Hz  
Flux vector control: Speed response 40 Hz/motor unit  
With a PG, our unique high-speed current vector control enables your machine to respond more rapidly to speed-reference changes. The speed remains constant even if the load fluctuates.

- ◆ **Quick Response to Reference Changes**  
(Speed reference step response)



- ◆ **Handles Sudden Load Fluctuations**  
(Flux vector control with a machine connected)



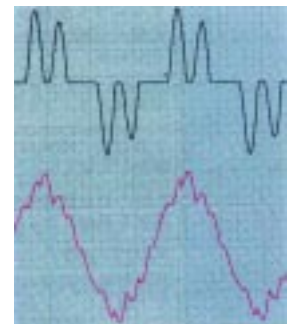
- **Countermeasures to minimize harmonics current**

- Models of 22kW or more come equipped with a built-in DC reactor to minimize harmonics current (option for models of 18.5kW or less). They also have 12-pulse input to prevent current distortion.

6-pulse input without reactor (conventional model) Current distortion factor: 88%

12-pulse input with optical transformer with a dual stardelta secondary Current distortion factor: 12%

Note: For 12-pulse input, a transformer with a star-delta secondary is required for the input power supply.



Input Current Waveforms

- **Easy maintenance and inspection**

- Detachable terminals make it easy to exchange units fully wired.
- Detachable cooling fan. Extended life with the on/off control function.
- The accumulated operation time and the cooling fan operation time can be recorded and displayed.



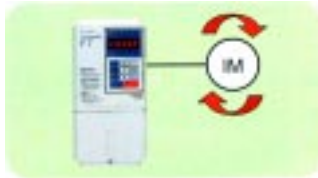
## Advanced Autotuning

Three autotuning modes are provided to use the best of motor capacity

### 1 Rotational autotuning

(Open-loop vector control, flux control)

The conventional autotuning mode. Use this mode for the applications where high-starting torque and high-speed control accuracy are required.



### 2 Stationary autotuning

(Open-loop vector control, flux control)

Use this mode to perform autotuning for a motor connected to a load such as material handling machine.



### 3 Stationary autotuning for line-to-line resistance only (V/f control)

If the motor cable length changes or the motor capacity is different from the inverter capacity in the application using V/f control, perform this autotuning to improve the control accuracy.



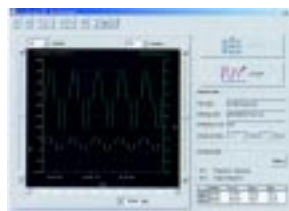
## DriveWizard - Software Tool

All constants of each inverter can be managed by a personal computer, which simplifies the adjustment and maintenance.



### ◆ Oscilloscopic Display

Monitor data during operation online



### ◆ Parameter Editing

Display or edit inverter constants.



### ◆ Troubleshooting

Confirm faults occurred. Display fault trace, causes, and corrective actions.



## Options

### ● Communications option card

- The F7 supports the industry's open architecture and open connectivity requirements, with network communication choices including:

- ◆ MECHATROLINK
- ◆ DeviceNet
- ◆ CC-Link
- ◆ Profibus-DP
- ◆ LONWORKS
- ◆ InterBus-S
- ◆ CANopen

### ● Multi-line Alphanumeric LCD Display



- Regenerative Active Front End
- Dynamic Braking Unit (for rating above 22kW)

### ● I/O interfaces

- The Varispeed F7 supports various I/O interfaces shown in the figure aside.



### ■ Speed reference card

- ◆ Analog reference card - AI-14U
- ◆ Analog reference card - AI-14B
- ◆ Digital reference card - DI-08
- ◆ Digital reference card - DI-16H2

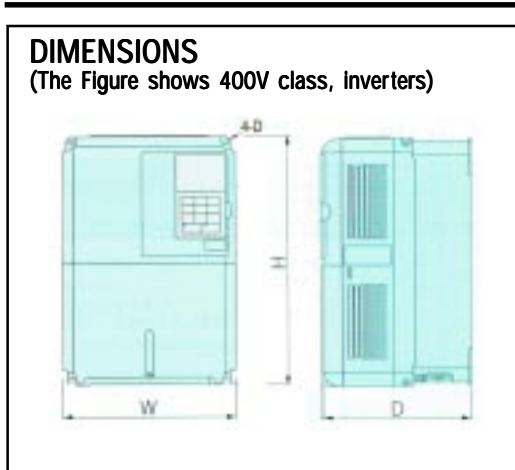
### ■ Monitor option card

- ◆ Analog monitor card - AO-08
- ◆ Analog monitor card - AO-12
- ◆ Digital output card - DO-08
- ◆ 2C-relay output card - DO-02C

# STANDARD SPECIFICATIONS

400 V Class	Model CIMR-F7A□		40P4	40P7	41P5	42P2	43P7	45P5	47P5	4011	4015	4018	4022	4030	4037	4045	4055	4075	4090	4110	4132	4160	4185	4220	4300		
	Inverter Capacity kVA		1.4	1.6	2.8	4.0	5.8	9.5	13	18	24	30	34	46	57	69	85	110	140	160	200	230	280	390	510		
Output Characteristics	Continuous Current *1*2		2.0	2.3	4.0	5.8	8.3	13.6	18.5	26.2	33.8	42.5	49.1	65.4	81.8	99.2	122.1	163.5	196.2	235.4	283.4	331.4	403.3	551.5	735.8		
	Variable Torque Current *1		1.9	2.2	3.9	5.5	7.9	13.1	17.7	25.1	32.4	40.7	47.0	62.6	78.3	95.0	116.9	156.6	187.9	225.5	271.4	317.4	386.3	528.3	704.7		
Power Supply	Constant Torque Current *1		1.8	2.1	3.7	5.3	7.6	12.5	17.0	24.0	31.0	39.0	45.0	60.0	75.0	91.0	112.0	150.0	180.0	216.0	260.0	304.0	370.0	404.8	540.0		
	Max. Voltage		3-phase, 380/400/415/440/460/480 V (Proportional to input voltage)																								
Max. Frequency		300Hz for Constant Torque: 400Hz for Variable Torque																									
Rated input voltage and Frequency		3-phase, 380/400/415/440/460/480V, 50/60Hz																									
Allowable Voltage Fluctuation		+10%, -15%																									
Allowable Frequency Fluctuation		±5%																									
Control Characteristics	Harmonic Wave Prevention		DC Reactor										Option										Provided				
	12-Pulse input		Not available										Available (3-winding transformer required at 12-pulse input)														
	Control Method		Sine wave PWM [V/f, Open-loop vector, V/f with PG control, Flux vector (Software selectable)]																								
	Starting Torque		150% at 0.5Hz (Open-loop vector control), 150% at 0Hz (Flux vector control)																								
	Speed Control Range		1:100 (Open-loop vector control), 1:1000 (Flux vector control)																								
	Speed Control Accuracy		±0.2% (Open-loop vector control), ±0.02% (Flux vector control)																								
	Speed Response		5Hz (Open-loop vector control), 40Hz (Flux vector control)																								
	Torque Limit		Can be set by parameter: 4 steps available (in vector control)																								
	Frequency Control Range		CT Mode: 0.01 to 300Hz, VT Mode: 0.01 to 400Hz																								
	Frequency Accuracy		Digital reference: ±0.01%, Analog reference: ±0.1%																								
	Frequency Setting Resolution		Digital reference: ±0.01Hz; Analog reference: 0.03 Hz / 60Hz (11-bit, + sign)																								
	Output Freq. Resolution		0.001Hz																								
	Overload Capacity		CT Mode: 150% of Constant Torque Current for 60 seconds VT Mode: 110% of Variable Torque Current for 60 seconds																								
	Frequency Setting Signal		-10 to +10V, 0 to 10V, 4 to 20mA, pulse train																								
	Accel/Decel Time		0.01 to 6000.0 sec. (Accel/Decel time setting independently, 4 steps available)																								
Braking Torque		Approx. 20% (Approx. 125% when using braking resistor), Built-in braking transistor provided for inverters of 18.5kW or less																									
Main Control Functions		Torque control, droop control, speed/torque control switching, feedforward control, zero-servo control, momentary power loss restart, Speed search, Over torque detection, Torque limit, 17-step speed operation (max.), Accel/decel time changeover, S-curve accel/decel, 3-wire sequence, Auto-tuning (dynamic, static), DWELL, Cooling fan ON/OFF, Slip compensation, Torque compensation, Jump frequency, Frequency upper/lower limit settings, DC injection braking at start/stop, High slip braking, PID control (with sleep function), Energy-saving control, MEMOBUS communication (RS-485/422 max. 19.2 kbps), Fault retry, Constant copy, etc.																									
Protective Functions		Motor overload protection, Inverter overload, Fuse protection, Instantaneous overcurrent, Open phase, Undervoltage, Overvoltage, Ground fault, Fin overheat, Stall prevention, etc.																									
Enclosures		Enclosed wall-mounted type [NEMA 1]: 18.5 kW or less, Open chassis type (IP00): 22 kW or more																									

Notes: 1. Current rating at 45°C. Deration of 1.33% per degree rise above 45°C (upto 60°C) • 2. Current considering No overload.



For more details, please contact:



**EBG - Control & Automation Business Unit**  
**LARSEN & TOUBRO LIMITED**

Automation Systems Centre,  
TTC Electronic Zone, Shil Mahape Road,  
Navi Mumbai - 400 710  
Tel: 91-22-5590 1401/2768 3511 • Fax: 91-22-2761 1590  
www.automation4me.com

Voltage Output	Motor kW	Open Chassis Type (IP00) mm <sup>1*2</sup>			Enclosed Type [NEMA1 (Type1)] mm <sup>2</sup>			Mass kg	DC Reactor*3
		W	H	D	Mass kg	W	H		
400 V Class	0.4								Option
	0.75	140	280	160	3	140	280	160	
	1.5								
	2.2								
	3.7	140	280	180	4	140	280	180	
	5.5								
	7.5	200	300	200	6	200	300	200	
	11								
	15	240	350	210	10	240	350	210	
	18.5								
	22	275	450	260	21	279	535	260	
	30								
	37								
	45	325	550	285	36	329	635	285	
	55						715		
	75	450	725	350	88	455	1100	350	
	90				89				
	110	500	850	360	102	505	1245	360	
	132				120				
160	575	916	378	160	579	1324	378		
185				260					
220	710	1305	413	280	Not available				
300	916	1475	413	405	Not available				

Notes: 1. To use open chassis type inverter models 18.5 kW or less, remove the top and bottom covers. 2. An attachment is required when installing external cooling fin in a cabinet for 18.5 kW or less inverters. Contact our L&T representative. 3. Mounting hole and DC reactor are common for both open chassis type and enclosed type.

## Sales Sections

**Mumbai**  
Tel: 022-55051191 • Fax: 022-55051463  
**Baroda**  
Tel: 0265-5513619 • Fax: 0265-2336184  
**Pune**  
Tel: 020-4033409 • Fax: 020-26124910

**New Delhi**  
Tel: 011-5141 9521 • Fax: 011-51419600  
**Bangalore**  
Tel: 080-25020342 • Fax: 080-25583613  
**Kolkata**  
Tel: 033-22828418 • Fax: 033-22827587

**Chennai**  
Tel: 044-28462050 • Fax: 044-28462102  
**Hyderabad**  
Tel: 040-55720319 • Fax: 040-23242356  
**Coimbatore**  
Tel: 0422-2311872 • Fax: 0422-2313881

**Abu Dhabi**  
Tel: +971504422097  
**Bahrain**  
Tel: +97339601427