YASKAWA

1500 Hz High Frequency F7 Drive Software Technical Manual

Software Number: VSF11001X, Drive Models: CIMR-F7UXXXXXX-056
Document Number: TM.F7SW.056, Date: 05/05/05, Rev: 05-05

This document is intended to provide proper installation and use of the Yaskawa drive with custom software. This document is a supplement to the standard drive technical manual. It describes the effects on the drive parameters and functions with the software installed. Read and understand this document and the standard drive technical manuals before attempting to install, adjust, operate, inspect or maintain the drive. ***Observe all cautions and warnings in this document and the standard drive technical manuals.*** *Custom software is written to add functionality to a standard AC drive to enhance or enable use in a specific application. The software is loaded to the flash ROM area of the control board, and replaces the standard drive software. Custom software can add new functions, modify standard functions, or even inhibit standard functions. It can be used to modify display text or parameter names. Custom software is usually loaded to the drive before delivery. The control board and drive nameplate are assigned unique part numbers and the software is registered, archived, and retrievable.*

When seeking support for a drive with custom software, it is imperative to provide the unique part number shown on the drive nameplate. The software has been flashed to the control board memory and the operation of parameters, functions, and monitors are different than the standard drive software, as described herein.

1.0 Overview

This custom software is designed for high frequency motor (spindle) applications. The drive's maximum output frequency can be set to either 1000Hz or 1500Hz, depending upon C6-11. C6-11 is a factory level parameter that can be accessed by setting A1-04 = 0616 (Password) and then setting A1-01 = 616 (Access Level). *Do not change any other factory parameters.* Non-applicable drive functions have been deleted in order to optimize CPU processing time for this software.

1.1 Basic Specifications

Item	Specification
Maximum Output Frequency	1000Hz (1500Hz when C6-11 = 1)
Control Mode	V/f without encoder feedback only (A1-02 = 0)
Drive Duty Rating	Normal Duty 1 only (C6-01 = 1). See section 6.3
Drive Overload	120% for 1 minute only
Drive Current Rating	See section 6.3
Carrier Frequency	10.0kHz maximum and default
Applicable Inverter Models	230V Class, 20P4 – 2090, 480V Class, 40P4 - 4160

2.0 Changes from Standard Product

a. The drive's output current has been de-rated to allow for a higher carrier frequency.
b. Many of the drive's standard features have been deleted.

3.0 Limitations

See section1.1.

4.0 Related Parameters and Functions

4.1 New Parameters

Parameter Number	Modbus Address	Parameter Name ***Digital Operator Display***	Description	Range	Default	Change During Run	Control Mode *1			
							V/f	V/f w/ PG	Open Loop Vector	Flux Vector
C6-11	22DH	Frequency Reference Limit ***Unbal Det Sel***	Sets the upper limit of the maximum output frequency (E1-04). 0: 1000Hz 1: 1500Hz	0 ~ 1	0	No	F	-	-	-

*1: Access Level (A1-01): Q = "Quick Start", A = "Advanced", F = "Factory".

4.2 Deleted Parameters and Functions

Parameter Number	Description
B1-05	Zero-speed Operation
B2-08	Magnetic Field Forcing
B3-10	Speed Search Detection Gain
B7 Group	Droop Control
B8 Group	Energy Savings
B9 Group	Zero Servo Control
C3-05	Field Weakening Method
C4-03	Torque Compensation - Forward Start
C4-04	Torque Compensation - Reverse Start
C4-05	Torque Compensation Time Constant
C5 Group	ASR Tuning
C6-01	Drive Duty Selection (Internally fixed to setting 1: Normal Duty 1)
C6-02	V/F Pattern Selection (Internally fixed to setting F: Program)
D5 Group	Torque Control
E2-04	Motor 1 Motor Poles
E2-06	Motor 1 Leakage Inductance
E2-07	Motor 1 Saturation Comp 1
E2-08	Motor 1 Saturation Comp 2
E2-09	Motor 1 Mechanical Loss
E4-04	Motor 2 Motor Poles
E4-06	Motor 2 Leakage Inductance
F1 Group	Encoder Feedback Option Card
H1 Group	Digital Inputs: Deleted Functions D, E, 65, 66, 68, 71, 72, 77, and 78
H2 Group	Digital Outputs: Deleted Functions 1D, 30, 31, 32, and 33
H3 Group	Analog Inputs: Deleted Functions 10, 11, 12, 13, 14, and 15
H4 Group	Analog Outputs: Deleted Functions 5, 9, 19, 21, 22, 26, 27, 32, 33, and 44
L2-06	KEB Decel Time
L2-07	KEB Recovery Time
L2-08	KEB Start Gain
L7 Group	Torque Limit
N2 Group	AFR Tuning
N3 Group	High Slip Braking
N5 Group	Feed Forward Control
O1-04	V/F Pattern Scaling
T1 Group	Auto-tuning

4.3 Modified Parameters and Functions

Parameter Number	Description
A1-02	Motor 1 Control Method: Setting fixed to ‘0’ (Open Loop V/F)
B3-01	Speed Search Selection: Range changed to 2 ~ 3
B5-15	PID Sleep Level: 1000.0Hz maximum
B6-01	Dwell Frequency at Start: 1000.0Hz maximum *1
B6-03	Dwell Frequency at Stop: 1000.0Hz maximum *1
C1-11	Acc/Dec Switch Frequency: 1000.0Hz maximum *1
C4-01	Torque Compensation Gain: Default changed to 0.0
C6-03	Carrier Frequency Upper Limit: 10.0kHz maximum and default
C6-04	Carrier Frequency Lower Limit: 10.0kHz maximum and default
D1 Group	Frequency References: 1000.0Hz maximum *1
D3-01	Jump Frequency 1: 1000.0Hz maximum *1
D3-02	Jump Frequency 2: 1000.0Hz maximum *1
D3-03	Jump Frequency 3: 1000.0Hz maximum *1
D6-02	Field Weakening Frequency: 1000.0Hz maximum *1
E1-04	Motor 1Maximum Output Frequency: 1000.0Hz maximum *1
E1-06	Motor 1 Base Frequency: 1000.0Hz maximum *1
E1-07	Motor 1 Midpoint Frequency A: 1000.0Hz maximum *1
E1-09	Motor 1 Minimum Frequency: 1000.0Hz maximum *1
E1-11	Motor 1 Midpoint Frequency B: 1000.0Hz maximum *1
E3-01	Motor 2 Control Method: Range fixed to 0 (Open Loop V/F)
E3-02	Motor 2 Maximum Output Frequency: 1000.0Hz maximum *1
E3-04	Motor 2 Base Frequency: 1000.0Hz maximum *1
E3-05	Motor 2 Midpoint Frequency A: 1000.0Hz maximum *1
E3-07	Motor 2 Minimum Frequency: 1000.0Hz maximum *1
F3-01	DI-08 / DI-16H2 Selection: Range changed to 0 ~ 4, 7
L4-01	Speed Agree Level: 1000.0Hz max *1
L4-03	Speed Agree Level +/-: -1000 to 1000Hz max *1
N1-01	Hunting Prevention Selection: Default changed to 0 (Disabled)
O1-03	Keypad Display Scaling: Setting ‘0’ resolution changed to 0.1Hz

*1: 1500Hz when C6-11 = 1 (Frequency Reference Limit).

4.4 Deleted Monitors (U1-XX)

Monitor Number	Description
U1-05	Motor Speed
U1-09	Torque Reference
U1-19	Motor Excitation Current (Id)
U1-21	ASR Input
U1-22	ASR Output
U1-26	Voltage Reference (Vq)
U1-27	Voltage Reference (Vd)
U1-32	ACR (q) Output
U1-33	ACR (d) Output
U1-35	Zero Servo Pulses
U1-44	ASR Output (w/o filter)
U2-06	Fault Trace Motor Speed
U2-10	Fault Trace Torque Reference

4.5 Modified Monitors (U1-XX)

Monitor Number	Description
U1-01	Frequency Reference: Resolution changed to 0.1Hz
U1-02	Output Frequency: Resolution changed to 0.1Hz
U1-20	Soft Starter Output: Resolution changed to 0.1Hz
U2-03	Fault Trace Frequency Reference: Resolution changed to 0.1Hz
U2-04	Fault Trace Output Frequency: Resolution changed to 0.1Hz

5.0 <u>Function Description</u>

See sections 1.0 and 6.0.

6.0 Application Notes

6.1 Carrier Frequency

The carrier frequency should be left at 10kHz whenever possible. This is because at high output frequencies, the number of output PWM pulses per AC sine wave cycle is low. At an output frequency of 1000Hz and a carrier frequency of 10kHz, there are only 10 output pulses per cycle. The fewer the number of pulses, the less sinusoidal the current waveform will be. If the starting torque for the application is insufficient with the default carrier frequency parameter settings, then use the following settings:

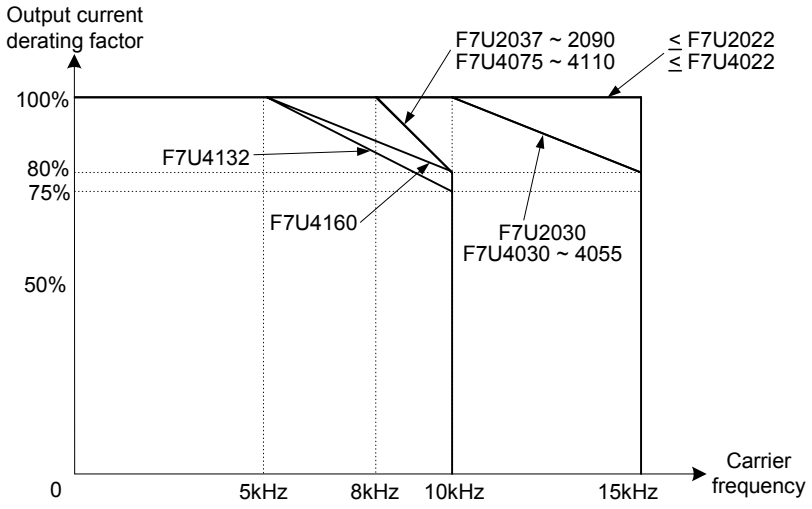
C6-03 = 10.0kHz	Carrier Frequency Upper Limit
C6-04 = 1.0kHz	Carrier Frequency Lower Limit
C6-05 = 24	Carrier Frequency Gain

6.2 Applying an Output Reactor

High-speed motors typically have very low impedance. This can result in excessive motor current, increased motor temperature, low speed cogging, and increased torque ripple. The use of an output reactor may be required to add impedance to the system. The output current should be measured using an oscilloscope or chart recorder with a clamp-on amp meter to check for a sinusoidal waveform. If a reactor is needed (based on the above mentioned conditions), be sure to account for the high output frequencies. The reactor impedance is directly proportional to the output frequency and is usually given at 60Hz. The same reactor operating at 1200Hz would have 20 times the impedance, which would result in 20 times the voltage drop at rated load! Therefore, a reactor must be chosen that will smooth out the current waveform, but not result in too large of a voltage drop. Unfortunately, there are no golden rules as to when a reactor is needed or the correct amount of impedance of the reactor.

6.3 Current / Overload Ratings

In order to achieve a high carrier frequency across the entire model range, the F7 is operated in Normal Duty 1. Normal Duty 1 is an unpublished operating mode that utilizes high carrier frequency, reduced current ratings (same as Heavy Duty 1 ratings in TM.F7.01), and reduced overload (120% for 1 minute). This software defaults the carrier frequency to 10.0kHz for all ratings to achieve the best possible current waveform. In order to run the larger drives at 10.0kHz (models 2037 / 4075 and larger), the rated current is automatically de-rated. The graph below details the de-rating of each model. The drive's rated current for 10.0kHz operation is listed below in the table, which shows the de-rated values of the larger models. The drive overload function (120% for 1 minute) uses the values listed in the table below as the 100% level. The drive must be correctly sized for the application using the correct overload and current ratings.



De-rating of Rated Current Based on Carrier Frequency

6.3.1 Rated Output Current for High Frequency Operation

Model	Rated Output Current	Model	Rated Output Current
F7U20P4	3.2 A	F7U40P4	1.8 A
F7U20P7	4.1 A	F7U40P7	2.1 A
F7U21P5	7.0 A	F7U41P5	3.7 A
F7U22P2	9.6 A	F7U42P2	5.3 A
F7U23P7	15.0 A	F7U43P7	7.6 A
F7U25P5	23.0 A	F7U44P0	8.7 A
F7U27P5	31.0 A	F7U45P5	12.5 A
F7U2011	45.0 A	F7U47P5	17.0 A
F7U2015	58.0 A	F7U4011	24.0 A
F7U2018	71.0 A	F7U4015	31.0 A
F7U2022	85.0 A	F7U4018	39.0 A
F7U2030	115.0 A	F7U4022	45.0 A
F7U2037	116.0 A *2	F7U4030	60.0 A
F7U2045	144.0 A *2	F7U4037	75.0 A
F7U2055	172.0 A *2	F7U4045	91.0 A
F7U2075	226.4 A *2	F7U4055	112.0 A
F7U2090	276.8 A *2	F7U4075	120.0 A *2
-	-	F7U4090	144.0 A *2
-	-	F7U4110	172.8 A *2
-	-	F7U4132	195.0 A *2
-	-	F7U4160	243.2 A *2

*2: Denotes current ratings that have been de-rated from Heavy Duty 1 ratings to achieve 10.0kHz carrier frequency.