YASKAWA

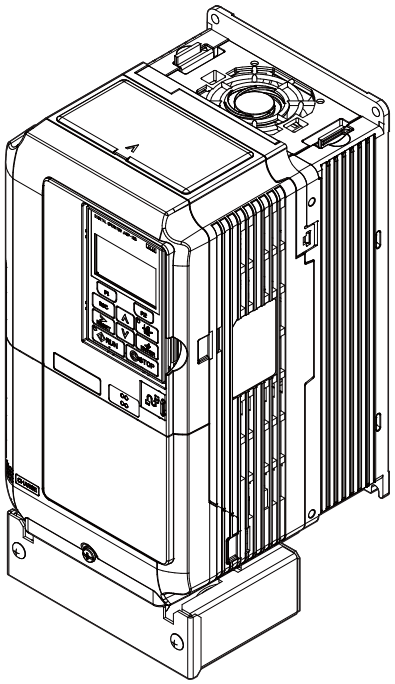
YASKAWA AC Drive - A1000

# High Frequency
## Custom Software Supplement

Software No. VSA90511□

Models: 200 V Class, CIMR-AU2A0004□A□ to CIMR-AU2A0415□A□
400 V Class, CIMR-AU4A0002□A□ to CIMR-AU4A0250□A□

To properly use the product, read this manual thoroughly and retain for easy reference, inspection, and maintenance. Ensure the end user receives this manual.



MANUAL NO. TM.A1000SW.056

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Refer to the A1000 Technical Manual for content not described in this document.

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# 1 Preface and Safety

Yaskawa manufactures products used as components in a wide variety of industrial systems and equipment. The selection and application of Yaskawa products remain the responsibility of the equipment manufacturer or end user. Yaskawa accepts no responsibility for the way its products are incorporated into the final system design. Under no circumstances should any Yaskawa product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and fail safely under all circumstances. All systems or equipment designed to incorporate a product manufactured by Yaskawa must be supplied to the end user with appropriate warnings and instructions as to the safe use and operation of that part. Any warnings provided by Yaskawa must be promptly provided to the end user. Yaskawa offers an express warranty only as to the quality of its products in conforming to standards and specifications published in the Yaskawa manual. NO OTHER WARRANTY, EXPRESSED OR IMPLIED, IS OFFERED. Yaskawa assumes no liability for any personal injury, property damage, losses, or claims arising from misapplication of its products.

## ◆ Applicable Documentation

The following manuals are available for the A1000 High Frequency Drive:

**Option Supplement**

| | |
|---|---|
|  | **Yaskawa AC Drive -A1000 High Frequency Custom Software Supplement**<br>**Manual No: TM.A1000SW.056 (This document)** |
| | Read this manual first.This supplement is an addendum to A1000 Quick Start Guide and Technical Manual. It lists the effect of this custom software on the parameters in the drive and function descriptions in the manual. To obtain the supplement access this site:<br>U.S.: http://www.yaskawa.com |

**Yaskawa Drive**

| | | |
|---|---|---|
|  | **Yaskawa AC Drive-A1000 Quick Start Guide** | To obtain instruction manuals for Yaskawa products access these sites:<br>U.S.: http://www.yaskawa.com<br><br>For questions, contact the local Yaskawa sales office or the nearest Yaskawa representative. |
| | **Yaskawa AC Drive-A1000 Technical Manual** | |

## ◆ Supplemental Safety Information

Read and understand this manual and the A1000 Quick Start Guide before installing, operating, or servicing this option unit. The drive must be installed according to the A1000 Quick Start Guide and local codes. Observe all cautions and warnings in this document and the standard drive technical manuals.

Refer to the A1000 Quick Start Guide and the A1000 Technical Manual for safety information and installation and start-up instructions.

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.

- Custom software adds 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.

## ◆ Obtaining Support

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 is flashed to the control board memory and the operation of parameters, functions, and monitors are different than the standard drive software, as described herein.

Refer to Yaskawa office locations listed on the back cover of this supplement.

# 2 Product Overview

## ◆ About This Product

This custom software is designed for high frequency motor applications. The drive's maximum output frequency can be set up to 1000 Hz. Non-applicable drive functions are deleted in order to optimize CPU processing time for this software.

## ◆ Applicable Models

The 1000 Hz Option is available in these drive models in ***Table 1***.

**Table 1 Applicable Models**

| Voltage Class | Drive | Software Version <1> |
|---|---|---|
| 200 V | CIMR-AU2A0004☐A☐-056 to CIMR-AU2A0415☐A☐-056 | VSA90511☐ |
| 400 V | CIMR-AU4A0002☐A☐-056 to CIMR-AU4A0250☐A☐-056 | |

<1> See “PRG” on the drive nameplate for the software version number.

# 3 Summary of Modifications from Standard Software

| Changed Item | High Frequency Software | Standard Software |
|---|---|---|
| Maximum Output Frequency | 1000 Hz | 400 Hz |
| Carrier Frequency | Max: 12.5 kHz<br>• V/f Control: 1.1 kHz to 12.5 kHz<br>• Open Loop Vector Control for PM: 1.1 kHz to 10.0 kHz | Max: 15 kHz<br>C6-02: 1 ~ A, F |
| Drive Duty Rating | Fixed at Heavy Duty (HD) ratings | Depends on C6-01 |
| Drive Overload Rating | Fixed at 150 %/1 min. (C6-01 fixed) | Depends on C6-01 |
| Control Mode | 0: V/F Control<br>5: Open Loop Vector Control for PM | 0: V/f Control<br>1: V/f Control with PG<br>2: Open Loop Vector Control<br>3: Closed Loop Vector Control<br>5: Open Loop Vector Control for PM<br>6: Advanced Open Loop Vector Control for PM<br>7: Closed Loop Vector Control for PM |
| DriveWorksEZ (DWEZ) | No | Available |
| Option Kits | Motor encoder card (PG) not available.<br>**Note:** r/min units (8E2H) cannot be used when an option card is supplying the frequency reference. | Available |
| Frequency Setting Resolution | Fixed at 0.1 Hz | 0.01 Hz (less than 100 Hz) |
| Frequency reference and output frequency display units. | o1-03 parameter (same as b5-20)<br>0: 0.1 Hz<br>1: 0.01 (Max frequency 100 %)<br>2: Deleted<br>3: User Defined (o1-10: It is possible to set it within the range of 1..60000)<br>**Note:** The setting for o1-04 is fixed at 0 and access is restricted so that units are always displayed in Hz. | o1-03 parameter (same as b5-20)<br>0: 0.1 Hz<br>1: 0.01 (Max frequency 100%)<br>2: RPM<br>3: User Defined (o1-10: It is possible to set it within the range of 1..60000)<br><br>o1-04 parameter<br>0: Hz<br>1: r/min<br>Units depend on the setting of A1-02.<br>Set as a percentage of the maximum output frequency when using Advanced OLV for PM. |
| Torque Compensation | Enabled only at low speeds.<br>**Note:** Torque compensation derating function is added.<br>***Refer to Details for New and Modified Software Functions on page 13***. | Constant throughout the entire frequency range. |
| On-Delay Compensation | Enabled only at low speeds. Addition of On-Delay Compensation Selection parameter S1-01<br>***Refer to Details for New and Modified Software Functions on page 13***. | Enabled throughout the entire frequency range. |
| Stall Prevention Level During Acceleration (L3-02) | Maximum setting: 170% | Maximum setting: 150% |

| Changed Item | High Frequency Software | Standard Software |
|---|---|---|
| PM Motor Settings | Number of digits past the decimal point are as follows:<br>E5-05 (Motor Stator Resistance): 4 digits<br>E5-06 (Motor d-Axis Inductance): 3 digits<br>E5-07 (Motor q-Axis Inductance): 3 digits<br>E5-08 (Motor q-Axis inductance for Extended Observer): 3 digits<br>E5-09 (Motor Induction Voltage Constant 1): 2 digits<br>E5-24 (Motor Induction Voltage Constant 2): 2 digits | Number of digits past the decimal point are as follows:<br>E5-05 (Motor Stator Resistance): 3 digits<br>E5-06 (Motor d-Axis Inductance): 2 digits<br>E5-07 (Motor q-Axis Inductance): 2 digits<br>E5-08 (Motor q-Axis inductance for Extended Observer): 2 digits<br>E5-09 (Motor Induction Voltage Constant 1): 1 digit<br>E5-24 (Motor Induction Voltage Constant 2): 1 digit |
| Deleted Functions | • Estimation type Speed Search<br>• High Slip Braking (HSB)<br>• Energy Saving Control<br>• KEB<br>• Overexcitation Deceleration<br>*Refer to Modified Parameters on page 9*. | - |

## ◆ General Precautions

1. The drive should generally be at least two model/capacity sizes larger than the motor.
2. Use only devices designed specifically for operation with a PWM drive.
3. For operation in Open Loop Vector Control for PM motors, contact Yaskawa.
4. When operating a PM motor at high frequency, an AC reactor should be installed between the motor and drive to reduce drive and motor heating.

# 4 Modified Parameters

**Table 2 Added Parameters and Monitors**

| Parameter | Name | Setting Range | Default |
|---|---|---|---|
| L6-07 | Torque Detection Delay Time Constant | 0~1000 ms | 0 ms |
| n8-84 | Polarity Current Level | 0-150 % | 100 % |
| S1-01 | On-Delay Compensation Selection | 0: Disabled, 1: Enabled | 1 |
| S1-02 <1> | Polarity Level Disable | 0: Disabled, 1: Enabled | 1 |
| S1-03 <1> | Switching Scan Frequency per Cycle | 0: Disabled, 1: Enabled | 1 |
| U6-31 | Torque Output Monitor for Torque Detection | 0.1 % | - |

**Table 3 Modified Parameter Setting Ranges**

| Parameter | Name | Setting Range |
|---|---|---|
| A1-02 | Selection of control mode | 0, 5 |
| b5-20 | PID Setpoint Scaling | 0,1,3 |
| C6-02 | Carrier Frequency Selection | F |
| C6-03 | Carrier Frequency Upper Limit | 1.1 ~12.5 kHz |
| C6-04 | Carrier Frequency Lower Limit | 1.1 ~12.5 kHz |
| C6-06 | PWM Method Selection | 0,2 |
| E1-03 | V/f Pattern Selection | F,FF |
| E5-01 | Motor Code Selection (PM) | FFFF |
| E5-05 | Motor Stator Resistance | 0.000~6.5000 |
| E5-06 | Motor d-Axis Inductance | 0.00~65.000 |
| E5-07 | Motor q-Axis Inductance | 0.00~65.000 |
| E5-08 | Motor q-Axis inductance for Extended Observer (PM motors) | 0.00~65.000 |
| E5-09 | Motor Induction Voltage Constant 1 | 0.0~650.00 |
| E5-24 | Motor Induction Voltage Constant 2 | 0.0~650.00 |
| H6-01 | Pulse Train Input Terminal RP Function Selection | 0,1,2 |
| L2-01 | Momentary Power Loss Operation Selection | 0~2 |
| L3-02 | Stall Prevention Level during Acceleration | 0~170 |
| L3-04 | Stall Prevention Selection during Deceleration | 0~3 |
| L3-06 | Stall Prevention Level during Run | 0~170 |
| o1-03 | Digital Operator Display Selection | 0,1,3 |
| o1-04 | V/f Pattern Display Unit | 0 |
| T1-01 | Auto-Tuning Mode Selection | 2 |
| T2-01 | PM Motor Auto-Tuning Mode Selection | 0,1,2 |
| T2-02 | PM Motor Code Selection | FFFF-FFFF |
| T2-07 | PM Motor Base Frequency | 0.0~1000.0 |
| T2-09 | PM Motor Base Speed | 0.0~1000.0 |
| T2-10 | PM Motor Stator Resistance | 0.0000~6.5000 |
| T2-11 | PM Motor d-Axis Inductance | 0.000~65.000 |
| T2-12 | PM Motor q-Axis Inductance | 0.000~65.000 |
| T2-14 | PM Motor Induced Voltage Constant | 0.000~650.00 |

**Table 4 Parameters with Modified Defaults**

| Parameter | Name | Setting Range | Unit | Default | Note |
|---|---|---|---|---|---|
| b2-04 | DC Injection Braking Time at Stop | 0~10.0 | sec | 0 | Before change: Initial value (0.5sec) |
| b8-01 | Energy Saving Control Selection | 0 | - | 0 | Before change: Determined by A1-02 |
| C6-01 | Drive Duty Selection | 0 | - | 0 | Before change: Determined by o2-09 |
| E1-03 | V/f Pattern Selection | F,FF | - | F | Before change: Initial value (1or7) |
| E5-01 | Motor Code Selection (PM) | FFFF | - | F | Before change: Determined by A1-02 and drive capacity |
| n1-01 | Hunting Prevention Selection | 0,1 | - | 0 | Before change: Initial value (1) |

**Table 5 Parameters with Modified Upper Limits**

| Parameter | Name | Setting Range | Default |
|---|---|---|---|
| C1-11 | Accel/Decel Switch Frequency | 0~1000.0 | 0.0 Hz |
| C5-07 | ASR Gain Switching Frequency | 0~1000.0 | 0.0Hz |
| d1-01 | Frequency Reference 1 | 0~1000.0 | 0.0 Hz |
| d1-02 | Frequency Reference 2 | 0~1000.0 | 0.0 Hz |
| d1-03 | Frequency Reference 3 | 0~1000.0 | 0.0 Hz |
| d1-04 | Frequency Reference 4 | 0~1000.0 | 0.0 Hz |
| d1-05 | Frequency Reference 5 | 0~1000.0 | 0.0 Hz |
| d1-06 | Frequency Reference 6 | 0~1000.0 | 0.0 Hz |
| d1-07 | Frequency Reference 7 | 0~1000.0 | 0.0 Hz |
| d1-08 | Frequency Reference 8 | 0~1000.0 | 0.0 Hz |
| d1-09 | Frequency Reference 9 | 0~1000.0 | 0.0 Hz |
| d1-10 | Frequency Reference 10 | 0~1000.0 | 0.0 Hz |
| d1-11 | Frequency Reference 11 | 0~1000.0 | 0.0 Hz |
| d1-12 | Frequency Reference 12 | 0~1000.0 | 0.0 Hz |
| d1-13 | Frequency Reference 13 | 0~1000.0 | 0.0 Hz |
| d1-14 | Frequency Reference 14 | 0~1000.0 | 0.0 Hz |
| d1-15 | Frequency Reference 15 | 0~1000.0 | 0.0 Hz |
| d1-16 | Frequency Reference 16 | 0~1000.0 | 0.0 Hz |
| d1-17 | Jog Frequency Reference | 0~1000.0 | 6.0 Hz |
| d3-01 | Jump Frequency 1 | 0~1000.0 | 0.0 Hz |
| d3-02 | Jump Frequency 2 | 0~1000.0 | 0.0 Hz |
| d3-03 | Jump Frequency 3 | 0~1000.0 | 0.0 Hz |
| d3-04 | Jump Frequency Width | 0~1000.0 | 0.0Hz |
| d6-02 | Field Weakening Frequency Limit | 0~1000.0 | 0.0Hz |
| E1-04 | Max Output Frequency | 40.0. 1000.0 | 60.0 Hz |
| E1-06 | Base Frequency | 0~1000.0 | 60.0 Hz |
| E1-07 | Mid Output Frequency | 0~1000.0 | 3.0 Hz |
| E1-09 | Minimum Frequency | 0~1000.0 | 1.5 Hz |
| E1-11 | Mid Output Frequency 2 | 0~1000.0 | 0.0 Hz |
| L4-01 | Speed Agreement Detection Level | 0~1000.0 | 0.0 Hz |
| L4-03 | Speed Agreement Detection Level (+/-) | -999.9.~999.0 | 0.0 Hz |

**Table 6 Modified Monitors**

| Parameter | Name | Setting Range |
|---|---|---|
| U1-01 | Frequency Reference | 0-1000.0 Hz |
| U1-02 | Output Frequency | 0-1000.0 Hz |
| U1-05 | Motor Speed | 0-1000.0Hz |
| U1-16 | Output Frequency after Soft Start | 0-1000.0 Hz |
| U2-03 | Frequency Reference at Previous Fault | 0-1000.0 Hz |
| U2-04 | Output Frequency at Previous Fault | 0-1000.0 Hz |
| U2-06 | Motor Speed at Previous Fault | 0-1000.0Hz |
| U2-15 | Soft Starter Speed Reference at Previous Fault | 0-1000.0Hz |
| U2-22 | Peak Hold Frequency at Previous Fault | 0-1000.0Hz |
| U4-14 | Peak Hold Output Frequency | 0-1000.0 Hz |

**Table 7 MEMOBUS/Modbus Communication Data**

| Register | Name | Revised Content |
|---|---|---|
| 0010H | Frequency Reference RPM | Deleted |
| 003EH | Output Frequency RPM | Deleted |
| 00ACH | Motor Speed RPM | Deleted |
| 00B5H | Frequency Reference After Soft-starter RPM | Deleted |
| 00B7H | Frequency Reference RPM | Deleted |

**Table 8 Deleted Parameters from Standard Software**

| Parameter | Name |
|---|---|
| A1-06 | Application Preset |
| b1-05 | Action Selection below Minimum Output Frequency |
| b2-08 | Magnetic Flux Compensation Value |
| b3-06~12 | Estimation Type Speed Search |
| b3-24 | Speed Search Method Selection |
| b8-01~03 | Energy Saving Control (OLV) |
| b8-01,04~14 | Energy Saving Control (V/f) |
| b8-01,16~18 | Energy Saving Control (PM) |
| b9-01,02 | Zero Servo |
| C3-05 | Output Voltage Limit Operation Selection |
| C3-06 | Flux Characteristics Selection |
| C3-15 | Lower Limit Frequency for Slip Compensation during Regen |
| C3-21 | Motor 2 Slip Compensation Gain |
| C3-22 | Motor 2 Slip Compensation Primary Delay Time |
| C3-23 | Motor 2 Slip Compensation Limit |
| C3-24 | Motor 2 Slip Compensation Selection during Regeneration |
| C3-25 | Motor 2 Lower Limit Frequency for Slip Compensation during Regen |
| C4-03 | Torque Compensation at Forward Start |
| C4-04 | Torque Compensation at Reverse Start |
| C4-05 | Torque Compensation Time Constant |
| C4-06 | Torque Compensation Primary Delay Time 2 |
| C4-07 | Motor 2 Torque Compensation Gain |
| C5-05,11,12, 21~35 | ASR |
| C5-17,18, 37,38 | Load Inertia |
| C6-14,15,16 | Swing-PWM |
| D4-11 | Bi-Directional Function Selection |
| D4-12 | Simple Positioning Gain |
| D5-01~06,08 | Torque Control |
| D6-03,06 | Field Forcing |
| E2-07 | Motor Iron-Core Saturation Coefficient 1 |
| E2-08 | Motor Iron-Core Saturation Coefficient 2 |
| E2-09 | Motor Mechanical Loss |
| E2-12 | Motor Iron-Core Saturation Coefficient 3 |
| E2-13 | Leakage Inductance Current Saturation Characteristics |
| E3-01~13 | V/f Characteristics for Motor 2 |
| E4-01~16 | Motor Parameters for Motor 2 |
| F1-01,31 | PG 1/2 Pulses Per Revolution |
| F1-02,14 | PG Open Circuit Detection |
| F1-05,32 | PG 1/2 Rotation Selection |
| F1-06,35 | PG 1/2 Division Rate for PG Pulse Monitor |
| F1-12,13,33,34 | PG 1/2 Gear Teeth |

| Parameter | Name |
|---|---|
| F1-15 | Speed Detection Filter Selection |
| F1-21,37 | PG 1/2 Signal Selection |
| F1-16~19 | zdv Detection |
| F1-20,36 | PG Option Card Disconnect Detection |
| L2-06~10 | KEB Function |
| L2-11 | DC Bus Voltage Setpoint during KEB (Power KEB) |
| L2-29~L2-31 | KEB Method Selection |
| L3-11,17,19~21,24~26 | Overvoltage Suppression Function |
| L7-06~07 | Torque Limit Control |
| N2-01~04 | Speed Feedback Detection Control (AFR) |
| N3-01~12 | High Slip Braking |
| N3-14~18 | Overexcitation Deceleration (High Frequency Injection) |
| N3-13,21,22,23 | Overexcitation Deceleration |
| N6-01~N6-04 | Online Tuning |
| N6-05~10 | Regenerative Operation Control with Motor Feedback (for CLV) |
| T1-01~T1-11 | Auto-Tuning for IM |
| T3-01~T3-04 | Auto-Tuning for PG Motor Encoder |
| U6-13 | Flux Position Detection (sensor) |
| U6-22 | Zero Servo Pulse Movement |
| U6-25 | Feedback Control Output |
| U6-26 | Feed Forward Control Output |
| U6-27 | Control Estimation Speed |
| U6-30 | Flux Reference |
| U6-41 | d-Axis Compensation Voltage |
| U6-42 | q-Axis Compensation Voltage |
| U6-43 | d-Axis Estimated Flux |
| U6-44 | q-Axis Estimated Flux |
| U6-45 | Slip Temperature Compensation |

**Table 9 Deleted Multi-function Digital Inputs (H1 Group) and Digital Outputs (H2 Group)**

| Setting | Function |
|---|---|
| H0-XX=D | No Speed Control during V/f with PG Control. Closed: Speed feedback disabled<br>(i.e., normal V/f Control without PG) |
| H1-XX=16 | Motor 2 Selection |
| H1-XX=65 | KEB Ride-Thru 1 (N.C.) |
| H1-XX=66 | KEB Ride-Thru 1 (N.O.) |
| H1-XX=68 | High Slip Braking |
| H1-XX=71 | Speed/Torque Control Switch |
| H1-XX=72 | Zero Servo |
| H1-XX=78 | External Torque Reference Polarity Inversion |
| H1-XX=7A | KEB Ride-Thru 2 (N.C.) |
| H1-XX=7B | KEB Ride-Thru 2 (N.O.) |
| H2-XX=1D | During Regeneration |
| H2-XX=23 | Frequency (Speed) Agree 3<br>Closed: Frequency (Speed) Agree 3 is enabled<br>(Enabled as defined by L4-02, but disabled during deceleration while the torque limit is active) |
| H2-XX=31 | During Speed Limit |
| H2-XX=32 | During Speed Limit in Torque Control |
| H2-XX=33 | Zero Servo Complete |
| H2-XX=4A | During KEB Ride-Thru |
| H3-XX=13 | Torque Reference/Torque Limit |
| H6-01=3 | V/f Control with Simple PG Feedback |

# 5 Details for New and Modified Software Functions

## ◆ Carrier Frequency

- The upper limit for the carrier frequency is 12.5 kHz for V/f Control, but changes to 10.0 kHz when using a PM motor.
- Carrier Frequency Upper limit will vary according to drive capacity.
- The lower limit for the Carrier Frequency is changed to 1.1.
- Parameter C6-02 Carrier Frequency is fixed to setting F.

**Table 10 Carrier Frequency Selection Parameter (C6-02) Settings**

| C6-02 Carrier Frequency Selection | C6-03 Carrier Frequency Upper Limit | C6-04 Carrier Frequency Lower Limit | C6-05 Carrier Frequency Proportional Gain | Note |
|---|---|---|---|---|
| F | 10.0 | 1.1 | 24 | Parameter table changes according to setting value of C6-02. |

## ◆ Torque Compensation

High speed motors typically have very low impedance compared to standard 60/120 Hz motors. These high speed/low impedance motors saturate easily and may cause hunting and oscillation when a high V/f pattern is applied, especially at high frequencies. Therefore, consider decreasing torque compensation gain according to the output frequency as shown in ***Figure 1***.

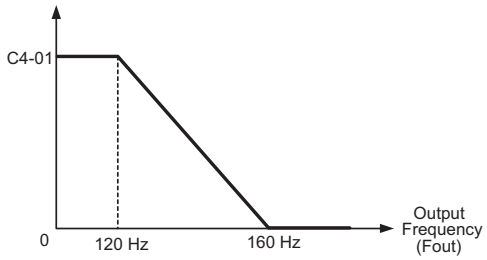



**Figure 1 Torque Compensation Gain**

## ◆ On-Delay Compensation

High speed motors typically operate at low V/f ratios compared to standard 60/120 Hz motors, and On-Delay Compensation settings may adversely affect the motor voltage and cause hunting and oscillation. By reducing voltage level for On Delay Compensation according to the output frequency, the user can have On Delay Compensation be active only during low frequencies as shown in ***Figure 2***.

***Figure 2*** shows the gain added to On Delay Compensation voltage. Parameter S1-01 is used to enable and disable On Delay Compensation.

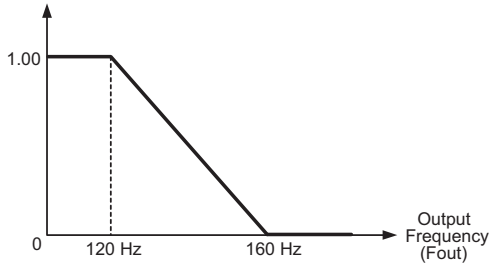



**Figure 2 On-Delay Compensation Gain**

# 6 Application Notes

## ◆ Using an Output Reactor

If drive **oL2** faults occur and a typical drive overload is not suspected, an output reactor or a larger drive may be required to eliminate oL2 faults. High-speed motors typically have very low impedance, which may result in excessive peak motor current, increased motor temperature, low speed cogging, or increased torque ripple.

It may be necessary to use an output reactor to add impedance to the system and reduce the peak ripple current and eliminate nuisance oL2 faults. To confirm that excessive peak current caused by low motor impedance is causing the oL2 fault, measure the output current using an oscilloscope or chart recorder with a clamp-on amp meter.

Generally, the peak of the motor current waveform should not exceed **100% continuous drive HD nameplate x 2.5**. This value may vary slightly by drive model. Refer to ***Figure 3*** for an example of peak current measurement.

When using a reactor to reduce peak current, consult with the reactor manufacturer to select a reactor that will smooth out the current waveform and also prevent a large voltage drop.

Proper reactor selection is critical in high speed applications because the reactor impedance is directly proportional to the output frequency, which is usually given at 60 Hz. Example; a reactor operating at 600 Hz will have 10 times the impedance and result in 10 times the voltage drop when compared to the same reactor operating at 60 Hz.

Using a larger capacity drive to allow for the additional peak current may also solve the oL2 overload trip problem. The decision to employ an output reactor or increase drive capacity is made on a case-by-case basis.

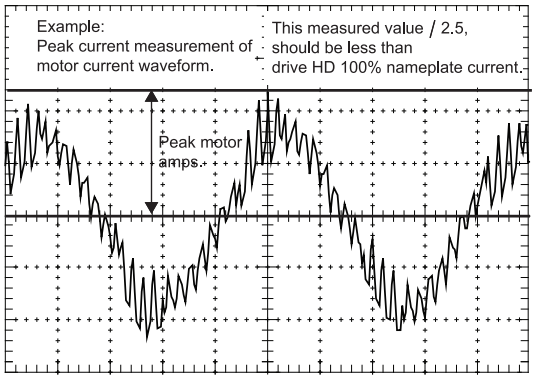



**Figure 3 Measuring Peak Current**

## ◆ Fine Tuning the Carrier Frequency

It is important to optimize the carrier frequency to improve the motor current waveform. This will improve motor speed stability and torque performance and also limit hunting and oscillation at higher speeds.

Use one of the following setting recommendations to fine tune the carrier frequency for optimum motor performance:

1. **For a flat 7.0 kHz across the speed range:** Set C6-02 = “F” with C6-03 = “7.0”, C6-04 = “7.0”, and C6-05 = “0”. The 7.0 kHz across the output frequency range keeps the carrier frequency as high as possible.
2. **To create a ramped carrier frequency pattern to keep the output frequency and carrier frequency at a constant ratio:**

- Set C6-02 = “F” to build a custom pattern.
- Set C6-03 = “7.0 kHz” so the motor will run at 7.0 kHz at top speed.
- Set C6-04 = “1.0 kHz” so the carrier frequency will be ramped for the greatest output frequency range.
- Solve the following formula for C6-05:

C6-05 = [7000 Hz / (2 x E1-04)]

The C6-05 setting range is 7 ~ 99, however a setting lower than 7 disables the ramp function and C6-03 is used across the output frequency range. For motors with output frequencies greater than 500 Hz, use C6-05 = 7.

- Solve for corner output frequencies A and B

A Hz = [1000 Hz / (2 x C6-05)]
B Hz = [7000 Hz / (2 x C6-05)]

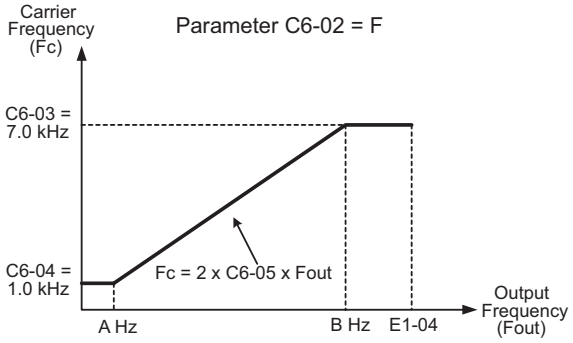



**Figure 4 Carrier Frequency**

## ◆ Precautions for High Frequency/Low Impedance Motors

High frequency motors exhibit different characteristics than standard 60/120 Hz maximum frequency motors. The low impedance associated with these high frequency motors often requires manually programming a custom V/f pattern into the E1 parameter group to obtain proper performance and rated power from the drive-motor combination.

The low impedance may also cause excessive motor current. In addition to considering the use of an output reactor, it may be advantageous to oversize the drive to accommodate the high peak current that may result from the low impedance motor. Using a drive that is at least one or two models larger than the motor FLA may also help eliminate the oL2 faults.

Compatibility between the drive, motor, and the reactor is best accomplished via testing and observation of the motor current waveform with an oscilloscope. *Refer to Using an Output Reactor on page 14*.

## ◆ Precautions for Auto-Tuning Open Loop vector for PM motors

For SPM motors with a small difference in d-axis inductance (E5-06) and q-axis (E5-07) inductance, parameter S1-02 should be disabled* (S1-02 = 0, default = 1) prior to performing Auto-Tuning. In motors where there is some difference in d-axis inductance (E5-06) and q-axis inductance (E5-07), reduce the setting of n8-84 prior to Auto-Tuning if there is a relatively lower amount of motor armature resistance (E5-05).

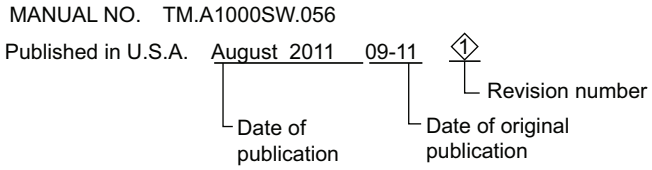
* If S1-02 = 0 (disabled), the drive will use saliency during Auto-Tuning and not estimate motor polarity.
**Note:** Because a high frequency motor has a unique design, Auto-Tuning may not be sufficient for the drive to achieve proper motor performance. Motor parameters (E5-XX) should be set manually accordingly the information on the motor nameplate.

## ◆ Switching the Scan Frequency per Cycle (S1-03)

Normally there is no need to change S1-03 from the default setting.I f there is a problem with output voltage weakening when attempting to compensate for output current distortion as the motor reaches 1000 Hz, with the load decoupled from the motor, then try setting S1-03 = 1. If this fails to solve the problem, then install an AC reactor designed specifically for AC drive high frequency applications.

## ◆ Revision History

The revision dates and the numbers of the revised manuals appear on the bottom of the back cover.

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YASKAWA AC Drive - A1000

# High Frequency
## Custom Software Supplement


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