IMPORTANT PRODUCT INFORMATION

READ THIS INFORMATION FIRST

Product: **IC693DSM302 Module ("DSM302")**
IC693DSM302-AD
Firmware Version 1.30

Purpose of this Document

Some of the information in this document is not available elsewhere, so we recommend you save it for future reference. This document covers the following subjects:

1. Basic features of the DSM302 module.

2. Special Operational Notes

3. Features of the module's latest firmware release, version 1.30.

4. Features of the module's two previous firmware releases, Versions 1.20 and 1.10.

Basic Features of the DSM302

Product Description

The DSM302 Module is a two-axis motion control module, which is highly integrated with the logic solving and communications functions of the IC693 PLC. Two primary control loop configurations are provided: Standard mode and Follower mode. The basic capabilities of the DSM302 are described below:

Performance

- Digital Signal Processor (DSP) provides vector control of GE Fanuc AC servos
- Servo loop update: 250 μsec (torque), 1 mSec (velocity), 2 mSec (position)
- Block processing time under 5 mSec
- Velocity Feed Forward and Position Error Integrator to enhance tracking accuracy
- High resolution of programming units
  - ♦ Position: –8,388,608 . . . +8,388,607 User Units
  - ♦ Velocity: 1 . . . 8,388,607 User Units / sec
  - ♦ Acceleration: 1 . . . 134,217,727 User Units / sec / sec

Ease of Use

- Simple and powerful instruction set
- One-axis or two-axis motion programs with synchronized block start
- Program support for a short motion program (called Program Zero) which can be created in the MS-DOS® programming software configuration function
- Nonvolatile (flash) storage for 10 programs and 40 subroutines
- User scaling of programming units (in Standard mode only)
- Generic programming using command parameters as operands for Acceleration, Velocity, Move and Dwell commands
- Configured with MS-DOS configuration software

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- Automatic data transfer between PLC tables and the DSM302 without user programming
- Ease of I/O connection with factory cables and terminal blocks as well as a serial port for connecting programming devices

Versatile I/O

- Control of GE Fanuc digital AC servos
- Home and overtravel switch inputs for each servo axis
- Two position capture strobe inputs for each position feedback input
- 5v, 24v and analog I/O for use by the PLC
- Incremental quadrature encoder input for Follower mode master axis
- 13-bit analog output for each auxiliary axis can be controlled by PLC or used as servo tuning monitor

Product ID

IC693DSM302-AD

Hardware ID:	AP3B1 (44A737294-G01R03 or later)	
Software ID:	Firmware version 1.30	Boot: 44P725986-408B
		App: 44S750607-G01R04

Firmware Update Kit

44A732298–G03 (firmware version 1.30)

Applicable Documents

GFK-1464A, *DSM302 for IC693 PLCs User's Manual*
GFK-0664A, *IC693 PLC Axis Positioning Module (APM) Programmer's Manual*

Special Operational Notes

IC693 CPU Firmware

Use of DSM302 firmware version 1.30 requires that version 6.50 or higher of the IC693 CPU firmware be installed in the CPU module.

IC693 MS-DOS Programming Software

Use of DSM302 firmware version 1.30 requires that version 8.02 or higher of the MS-DOS Programming Software be used to configure the DSM302 module. Version 9.00 or higher of the MS-DOS Programming Software is required to fully configure the expanded A/B ratio (see the "Expanded Follower A/B Ratio" section of the "Features and Functionality Introduced in Release 1.20" heading below).

Motion Programmer

Motion programs 1-10 must be created/edited with separate Motion Programmer software. DSM302 firmware version 1.30 requires that version 1.50 or higher of the APM300 MS-DOS Motion Programmer software be used.

Essential Configuration Parameters

MS-DOS Programming Software version 8.02 or higher must be used to configure the DSM302 module. The following configuration parameters will <u>not</u> default to the settings required for many applications and must be changed by the user.

> ### Caution
>
> *Fdback Type* and *Ctl Loop* **MUST be changed first. Any change to either** *Fdback Type* **or** *Ctl Loop* **resets all other parameters to default values.**

AI/AQ Len:	Set according to the minimum requirements of your application. Setting <u>40/6</u> can be used for Standard mode. Follower mode requires at least setting <u>50/9</u> if Master Axis position and velocity are to be monitored by the PLC. Setting <u>64/12</u> provides the maximum amount of analog I/O references.
Fdback Type:	Must be changed to <u>DIGITAL</u>. Feedback types <u>ENCODER</u>, <u>LINEAR</u>, <u>RESOLVR</u>, <u>CUSTOM1</u> and <u>CUSTOM2</u> are not supported in this release of the firmware.
Ctl Loop:	Select <u>STANDARD</u> for Standard control loop mode or <u>FOLLOWER</u> for Follower control loop mode. <u>CCL2</u> is reserved for special applications. <u>CCL1</u> is not supported in this release.
Servo Cmd:	Must be changed to <u>DIGITAL</u>. <u>ANALOG</u> and <u>DUAL</u> are not supported in this release.
Motor1 Type, *Motor2 Type:*	Must be changed to the correct GE Fanuc motor type. Select type 0 only if no servo is used.
Pos Err Lim:	Change from default setting of 4096 to a typical value of 15000 – 30000.
Pos Loop TC:	Change from default setting of 1000 ms to a typical value of 30 – 50 mSec.
Vel at 10v:	Must be changed to : 139,820 (User Units / Counts)

Configuration NOTEQ (Not Equal)

When a rack configuration containing a DSM302 module is stored (downloaded) to an IC693 PLC CPU with a firmware revision earlier than 8.10, the MS-DOS-based programmer status area will still show CONFIG NOTEQ even though the store operation completes successfully. If the configuration is immediately loaded back into the MS-DOS programming software, the status area will now show the expected CONFIG EQUAL. The status area will continue to show the correct CONFIG EQUAL setting until a new configuration is again stored to the PLC CPU.

PLC %Q Bits

PLC %Q bits are, by design, RETENTIVE in nature. These bits ONLY become NON-RETENTIVE after the location is used (programmed) in a PLC program. All motion-causing %Q bits such as *Drive Enable*, *Start Motion program*, *Jog*, etc. must be controlled from a "programmed" PLC coil reference for safe operation.

Grounding Bars and Clamps

The *DSM302 for IC693 PLCs User's Manual* describes the I/O cable grounding requirements necessary for a system to meet CE Mark installation guidelines. These guidelines include the use of grounding bars and clamps, both of which are available from GE Fanuc. The Grounding Bar may be ordered as part number 44B295864001R02, and the Ground Clamp as part number A99L-0035-0001.

Cables

Five different cables are available for use with the DSM302, as described below. Consult the factory regarding custom length cables.

- IC693CBL324: 1 meter terminal board connection I/O cable
- IC693CBL325: 3 meter terminal board connection I/O cable
- IC800CBL001: 1 meter servo command cable
- IC800CBL002: 3 meter servo command cable
- IC693CBL316: Motion programmer communications cable

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Caution

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The I/O and command cables listed above are custom manufactured with special shielding and internal construction. Substituting non-approved cables may adversely affect the servo system.

Terminal Boards

Two terminal boards for user I/O connections are available for use with the DSM302, as described below.

IC693ACC335:   Servo terminal board

• IC693ACC336: Auxiliary terminal board

These terminal boards provide screw terminal connections for I/O signals such as Position Strobes, Home Switches, Limit Switches, Analog Inputs and Analog Outputs. For additional information, refer to Chapter 3 and Appendix E of GFK-1464, *DSM302 for IC693 PLCs User's Manual.*

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Caution

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The terminal blocks contain Metal Oxide Varistor (MOV) circuit protectors, which prevent excessive electrical energy from affecting the DSM302. The maximum recommended input voltage for any of the 24v I/O circuits is 30 VDC with respect to earth ground ("S" terminal) or circuit common.

Problems Resolved by Firmware Release 1.30

AQ Command 30h Causes Module to "Crash"

Issuing an AQ command of 30h (Set Internal Master Velocity in Follower), to a value larger that 32,767,999 generated a fatal error (NMI generated/watchdog timeout). This is fixed in Firmware Version 1.30. Error checking is added to generate a warning when values outside the valid range (-1,000,000 … +1,000,000 counts/sec) are entered. If values outside the valid range are entered, the command is ignored and error code 01E9 (for Axis 1) or 02E9 (for Axis 2) is reported.

Turn off "CONFIG LED" when Flashing Error Code

A fatal error does not turn off the "CONFIG LED" when a fatal error code occurs. The firmware has been updated to turn off the "CONFIG LED" when a fatal error code is issued.

Jog Vel-User Units-Counts Configuration Value Causes Module to Crash

Configuring the module for User Units to Counts ratio of greater than 1:3, and Jog Vel = 8,388,607 causes a fatal error (NMI generated/watchdog timeout). The firmware has been enhanced to internally limit the Jog Velocity to 1,000,000 (count/sec). If the module is configured to a number greater than 1,000,000 (counts/sec), the module uses the maximum jog velocity of 1,000,000 (count/sec).

Follower Deceleration Ramp Reentry after Drive off/on

In follower mode, if follower is disabled and then the drive is disabled, motion will stop. However, the module continues to calculate the deceleration ramp while the follower is disabled. If the deceleration ramp has not reached zero prior to the drive being re-enabled, the module will issue a velocity command corresponding to the current deceleration ramp value and complete the deceleration ramp. This has been corrected in firmware version 1.30, such that the deceleration ramp is not re-entered.

Problems Resolved by the Previous Firmware Release (1.20)

Input IN4_C Does Not Function As Described

The on/off state of the IN4_C input (see GFK-1464, *DSM302 for IC693 PLCs User's Manual*, chapter 5, "DSM302 to PLC Interface," for details) was inverted from what was documented. This has been corrected in firmware version 1.20, such that the on/off state of the input matches the documentation.

Firmware Reports D6 Error Sporadically during Normal Operation

Previous firmware contains an error that causes a D6 error to be reported incorrectly during normal operation. The nature of the firmware error also causes errors D3-D9 to be reported incorrectly. These firmware errors were fixed in version 1.20.

Documentation Issues in GFK-1464, *DSM302 for IC693 PLCs User's Manual*, Resolved by Revision A (May 1998) Release

The following table outlines the previously identified documentation issues that have been resolved by the revision A release of GFK-1464, *DSM302 for IC693 PLCs User's Manual:*

Issues Resolved by Revision A of GFK-1464 (May 1998 Release)

Documentation Issue	Location	Description/Resolution
PCR Connectors Mislabeled in Pin Configuration Diagrams	Chapter 2	Two different connector pin configurations for the emergency stop JX5 connector on the β Series servo amplifier were shown with the labels (HIROSE and HONDA) incorrectly reversed. The labels were switched.
Grounding Bars and Clamps Need to Be Documented	Chapter 3	The "I/O Cable Grounding" section did not specify the part numbers for the grounding bars and clamps needed for proper installation. These have been added to the manual.
Quadrature Specifications Not Documented	Chapter 3	The technical specifications for quadrature devices used as a follower master axis were not documented. These have been added to the manual.
Incorrect Part Numbers Listed for Terminal Block Connection Cables	Chapter 3	The incorrect part numbers were given for the Terminal Board Connection cables. The incorrect part numbers listed were IC800CBL324 and IC800CBL325. These part numbers should have been IC693CBL324 and IC693CBL325, respectively, and have been corrected.
Input IN4_C Wiring Not Described	Chapter 3	The appropriate wiring for input IN4_C was not described. The description has been added.
Final Home Velocity Valid Command Range Incorrectly Specified	Chapter 4	The "Configuring the DSM302" section incorrectly specified the valid range as 1..8,388,607. The range is actually 1..65535 and has been corrected in the manual.
Select Return Data Command Incorrectly Described	Chapter 5	Section incorrectly stated that information is returned in the *Commanded Position* %AI word for each axis. Data is actually returned via the *User Selected Data* %AI word for each axis. Text has been corrected.
Wrong Graphic Used for Velocity Profile	Chapter 7, Figure 7-6	Figure showed an expected velocity profile for a program example describing "hanging" the DSM302 when distance runs out. The incorrect graphic that was included has been replaced with the correct one.
Error Code 35 Not Documented	Appendix B	Axis status error code 35 was not documented. This error is now correctly described as a "find home while follower enabled" error.
Wire Size, Screw Torque and MOVs for Terminal Blocks Not Specified	Appendix E	The wire size, screw torque and MOV descriptions for terminal block assemblies IC693ACC335 and IC693ACC336 were not specified. These descriptions have been added.

Problems Resolved by Firmware Release 1.10

Encoder 3 Home Position

During a *Find Home* cycle on the Aux 3 axis, the Encoder 3 home position was not registered correctly in firmware version 1.00 when the encoder marker pulse was sensed. This was corrected in firmware version 1.10. Note that this problem only pertained to Follower mode operation.

Module Sometimes Hangs Responding to COMMREQ Commands

When the DSM module was receiving a high rate of COMMREQ commands from the PLC CPU and was simultaneously executing a series of short move commands, the module would sometimes halt execution and flash a 6-count/ 7-count error code on its STAT LED (see Appendix B of GFK-1464, *DSM302 for IC693 PLCs User's Manual,* for details). This timing problem was corrected in firmware version 1.10.

Features and Functionality Introduced in this Release (1.30)

Enhanced %AI and %I Processing

The internal DSM update rate for %I data and %AI data (except for the *Actual Velocity* data) has been increased from once every 10 milliseconds to once every 2 milliseconds. *Actual Velocity* data is updated every 128 milliseconds.

Enhanced Follower Axis Ramp Control

The Follower Axis Ramp Control Function is enhanced in DSM firmware release 1.30. The enhancement improves motion smoothness. Prior to this release, when the follower was active and the master in motion, the acceleration/deceleration control during the make-up correction phase was not controlled by a velocity profile. This could cause unwanted machine shock. The enhanced method uses a trapezoidal velocity profile to address this problem. During the entire make-up correction phase, the acceleration/deceleration is limited to the jog acceleration value. Also during the correction, the velocity is not allowed to exceed the maximum. Appropriate warning/error codes notify the user about abnormal operation (see error table below).

Error Number (Hexadecimal)	Response	Description	Error Type
EA	Status Only	Master velocity greater than 0.8*velocity limit-no distance compensation	Axis
EB	Fast Stop	Error in calculation during ramp-up	Axis
EC	Status Only	Programmed makeup time is not long enough for trapezoidal correction of the makeup distance	Axis
ED	Status Only	Velocity limit violation during ramp	Axis
EE	Status Only	Time limit violation during acceleration sector of the distance correction	Axis

The figure below shows the velocity profile during the follower ramp cycle. *Note: The enhanced follower make-up may affect existing applications that use the old follower make-up feature.*
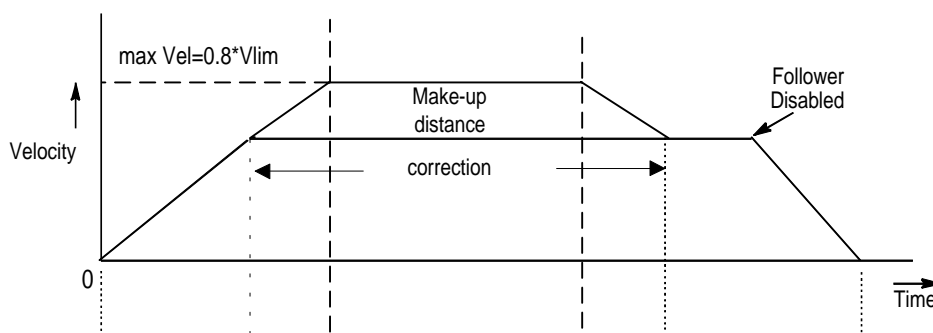
Features and Functionality Introduced in Previous Release (1.20)

Expanded Follower A/B Ratio

The A/B slave/master follower ratio has been expanded from the original range of 32:1 to 1:32 to a range that supports 32:1 to 1:10,000. Existing AQ command 2Dh can be used to specify an expanded range at runtime. Specifying the expanded range (ratio greater than 1:32) at configuration time requires release 9.0 or higher of the MS-DOS Programming Software, or Windows-based Programming Software release 2.11 or higher.